Rainwater Harvesting with Cisterns

for Landscape Irrigation

Workshop/Presentation Manual

florida
Rainwater Harvesting Initiative

First Edition
October 2009

Acknowledgements

The Rainwater Harvesting Initiative would like to thank everyone that cooperated in assisting with this effort:

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First Edition
October 2009
Clearwater, FL

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1 Project Background and Definition

Defining the need

In early 2009, Tampa Bay Water, a regional water supply Authority, began work developing a Standardized Cistern Program Agenda, workshop structure and presentation materials. The overarching goal of this effort is to eliminate barriers to successful promotion of cistern systems for irrigation use in Florida and to link public and private efforts.

The Tampa Bay region endured water supply shortage conditions over the three year 2006-2009 period. As a funding agency of the Florida Yards and Neighborhoods (FYN) program in their tri-county area since 1994, they have witnessed the public's interest in installation of rain barrels and FYN's rain barrel workshop program success. This is also occurring through the 48 counties in Florida where the FYN programs are instituted.

Parties involved through initiative

Tampa Bay Water provided funding to University of Florida and the University South Florida to address these barriers and create a program that links the public to public agencies and private industry. They also worked with Florida Irrigation Society staff on this project.

What elements were being developed by whom

As part of Tampa Bay Water's effort to conserve water, the agency worked with the University of Florida, University of South Florida, the Florida Irrigation Society and various cistern manufacturers and installers to develop a standard workshop for citizens to promote installation and use of cisterns in the Tampa Bay region and across the state so stored water can be used for irrigation, thus saving potable water.

The University of Florida was specifically tasked to determine what legal and code analysis is required to adequately preclude program presenters from being liable for all

or portions of the workshop output. Local health departments were contacted throughout the state in order to gage their reaction to the installation outdoor cisterns for irrigation use. State and local ordinances were reviewed that may/may not deal with cisterns.

The University of South Florida was tasked with helping to analyze technical and engineering aspects of rainwater harvesting with cisterns. These included:

- Water quality considerations and issues associated with rainwater harvesting with cisterns
- Engineering designs on sizing, storage and treatment to enable the appropriate and reliable use of cistern water for intended applications
- Relevant operation and maintenance considerations for successful cistern use
- How rainwater harvesting with cisterns can be successfully integrated into an existing water supply infrastructure
- Economic considerations for cistern strategies

The Florida Irrigation Society (FIS) assisted in the development of water use requirements and sizing of cistern systems, while manufacturers and installers were a part of the process of including a full-scale workshop with presentations, sponsors, and links to actual product.

Drafting of materials

The University of South Florida coordinated with the University of Florida IFAS, FIS and Tampa Bay Water in the elaboration of workshop materials that were to be used. Specific issues and topics were identified as the most appropriate to present to the public. Once a draft presentation was completed, dry-run workshops with members from local governments, FYN (local and statewide), water management districts and experienced cistern installers (invited) took place to collect further feedback on content of presentation and workshop length.

Review mechanisms

Once the final workshop presentation is issued, further review, update and edit may be necessary. Errata and modifications may to be submitted to the presentation steward (Dave Bracciano, Tampa Bay Water) by email (dbracciano@tampabaywater.org) or in writing.

How the program can be used

The workshop will be delivered as a package to the Florida Yards and Neighborhoods (FYN) program throughout the region and state and would be part of FYN's workshop on rain barrels or a stand-alone workshop. In addition to educating citizens about cisterns, the program would seek to connect interested parties with contractors and businesses that can assist in designing and installing cistern systems.

2 How to Put on a Workshop

Florida Rainwater Harvest Initiative Linkage

The Florida Rainwater Harvest Initiative (FRHI) initial goal is to add private industry groups/associations that can use the workshop format to promote their industry and to help insure that expertise is funneled back and forth between educators and workshop attendees. It is not designed to circumvent training programs, continuing education unit development, or modify standards developed by others.

This will allow individual workshop developers to contact these entities for potential sponsors and potential business opportunities. It provides value to these private entities by linking the public with association membership at workshops.

About a month before the workshop is to occur, the workshop developer should contact either or both organizations to determine if they have members that would be interested in sponsoring the upcoming rainwater harvest workshop.
Current representative organizations and contacts are;

American Rainwater Catchment Systems Association

Florida Representative: John Hammerstrom
johnhammer@bellsouth.net
Phone Number: (305)852-8722
http://www.arcsa.org
919 Congress Ave., Ste. 460
Austin, TX 78701

Florida Irrigation Society

www.fisstate.org
Jennifer Amarosa, Executive Administrator
administration@fisstate.org
Phone Number: (800) 441-5341/(813) 839-4601 Fax Number: (813) 839-4759
Address: P.O. Box 13502, Tampa, FL 33681

Sponsor levels and charges

Since it is anticipated workshops will be put on by Florida yards and Neighborhoods, along with the potential for other government entity use, creating a sponsorhip process that is consistent between FRHI entities is important Although public entities have specific funding constraints through budgeting and oversight processes, monies are generally needed to continue and expand programs.

Having workshop sponsors is a legitimate means to promote workshops and also recoup costs for establishing them. In some instances, workshops may be located at facilities that require cost recovery.

Workshop implementers have two means of sponsorship; funding provided directly the entity in the way of a check or sponsoring a giveaway between all the sponsors at the event (no exchange of funds with the government entity). It is generally recommended that sponsorship levels be at least in the $50 range for 25-50 participants and at least $100 for over 50 participants. Sponsorship should be based on available space for sponsors to advertise along the side and/or back of the workshop location.

Workshop developers should decide which process works well for their entity before sending out request for sponsors.

What do the Sponsors receive in return for Sponsorship

Sponsors get recognized during the workshop and thanked for their efforts.
During breaks and at the end of the workshop, the public will directly interact with sponsors to determine if there is additional interest in pursuing installation of rainwater harvesting systems. Materials provided during the workshop will give participants a general checklist of items that are required for successful rainwater harvesting system installation and linkage to irrigation systems.

Identifying a Minimum Number of participants

Based on discussion with Florida Yards and Neighborhoods coordinators in the Tampa Bay region, it is expected that at least 25 participants should be signed up for the workshop so sponsor levels can be secured as identified above. If less than 25 participants are expected, sponsors should be alerted prior to securing funding to insure good will between the sponsors and workshop promoters.

In some cases, rain barrel workshops have had in excess of 100 people in attendance. It's generally recommended that workshops be kept to less than 100 people, unless workshop presenters have experience dealing with large groups.

Workshop Agenda

A standardized agenda has been developed for the workshop. Modifications to the agenda can be made but note the presentation is locked in presentation mode to insure material and content integrity. Modifications to the agenda will generally not coincide with material presented.

To suggest modifications to the agenda or presentation materials see *Revising Presentation Materials* below.

Use of Workshop Presentation

The workshop presentation, located at http://reservoir.tampabaywater.org/sites/frhi/default.aspx is locked in the presentation mode. The cover slide is not locked so it can be modified to coincide with the presentation date and location. Additionally, a slide with the workshop sponsors should be provided. If entities have a logo, it is suggested you request an electronic version, and use it in your presentation.

Obtaining the Workshop Powerpoint Presentation

The entire document will also be distributed through members of the Florida Rainwater Harvest Initiative and can be requested by emailing Dave Bracciano, Tampa Bay Water,

at dbracciano@tampabaywater.org. All organizations that are distributing this document are required to provide a master list of requesting entities, along with pertinent contact information. This information will be used to determine actual penetration rates for program implementation on an annual basis.

Revising Presentation Materials

On a quarterly basis, materials will be reviewed for modifications based on feedback to dbracciano@tampabaywater.org. All comments specific to the presentation will be addressed by the next quarter.

3 The Florida Rainwater Harvesting Initiative

4 Additional Future Coordination/Development Efforts

Standard Cistern Presentations for Other Water Use Opportunities

Identifying Technical Research Needs

Identifying Legal and Code-related Research and Development Needs

Other

APPENDIX A


Rainwater Harvesting
with Cisterns
for Landscape Irrigation
October 2009
Presented by:
florida
Rainwater Harvesting Initiative


florida
Rainwater Harvesting Initiative
ARCSA
American Rainwater Catchment Systems Association
TAMPA BAY WATER
Supplying Water To The Region
USF
UNIVERSITY OF SOUTH FLORIDA
UF
UNIVERSITY of FLORIDA
IFAS Extension
Florida Yards & Neighborhoods
fis
MANAGING EVERY DROP
2

Contributors

- Dave Bracciano, Tampa Bay Water
- Pacia Hernandez, University of South Florida
- Thomas Ruppert, University of Florida
- Skip Wright, Florida Irrigation Society
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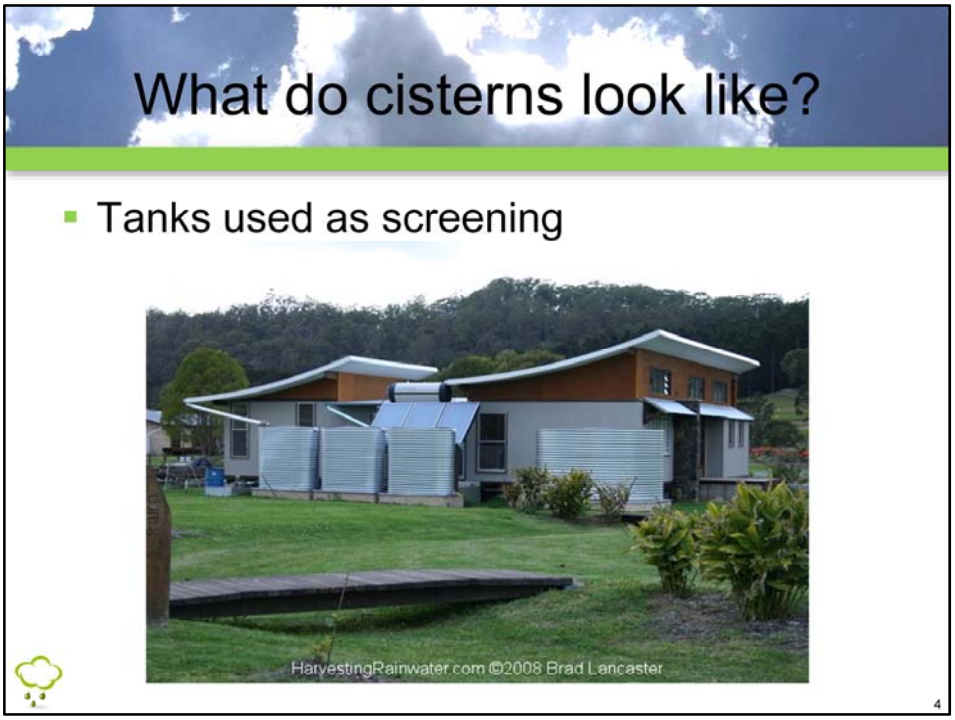

Corrugated metal tanks in oblong shapes.

The Beaconing Cistern

- Artwork – Cistern in the shape of a hand

King County, Washington
A faucet enables neighborhood gardeners to utilize the cistern water to irrigate the adjoining plantings.

www.GrowingVineStreet.org

5

Where's the cistern here?

- Cistern patio

Cistern (below table and chairs) doubling as a patio. Harvested water is directed to citrus trees below on south-facing side of the cistern's mass.

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Learning Gate Community School
Lutz, FL

http://www.learninggate.org/

7

Twin Lakes Park – Office Complex
Sarasota, FL

Project Owner:	Sarasota County
Owner Type:	Government
Project Type:	Commercial Office
Gross Sq. Ft.:	27,592

CISTERN INFO

Size:	28,000 gallons
Water Source:	Rainwater
Use:	Flushing in water closets, irrigation

Photo courtesy of Dickinson Studios at http://www.myfloridagreenbuilding.info/Profiles/TwinLakes.html

8

Residential Home, St. Petersburg, FL

CISTERN INFO

Size: 1,000 gallons

Water Source: Rainwater

Use: Irrigation

http://www.usgbc.org/ShowFile.aspx?DocumentID=5109

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Rinker Hall, University of Florida
Gainesville, FL

CISTERN INFO

Size: 8,000 gallons

Water Source: Rainwater

Use: Toilet flushing

Photo credit: Timothy Hursley http://eere.buildinggreen.com/site.cfm?ProjectID=286

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Florida House Learning Center
Sarasota, FL

CISTERN INFO

Qty/Size:	Two 2,500 gallon cisterns
Water Source:	Rainwater
Use:	Flushing in water closets, Irrigation, clothes washing
Type:	•East cistern constructed of sprayed lightweight concrete (similar to swimming pools) with a fiberglass-coated liner and a metal roof. • West cistern constructed of concrete block reinforced with poured cores with a liner of flexible, waterproof, acrylic coating and a metal roof.

http://sarasota.extension.ufl.edu/fhlc/flahousehome.shtml

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Smart Home, Duke University Durham, NC

CISTERN INFO	
Quantity:	Two
Size:	1,000 gallon
Water Source:	Rainwater
Use:	Landscape Irrigation, Toilet flushing, Clothes washing

http://www.jetsongreen.com/2008/07/duke-smart-home.html

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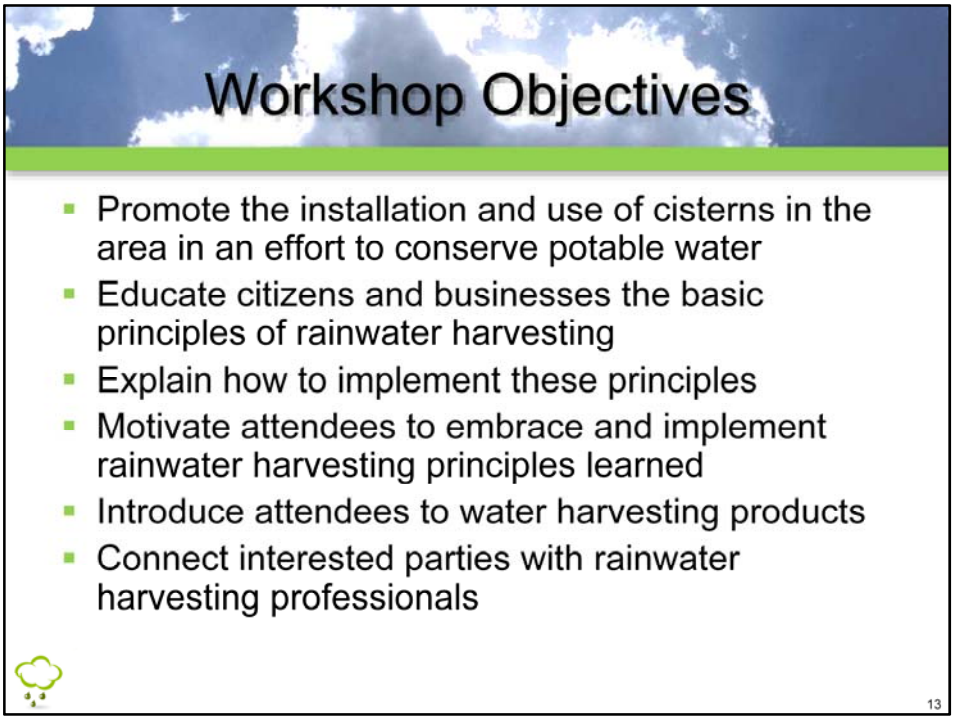
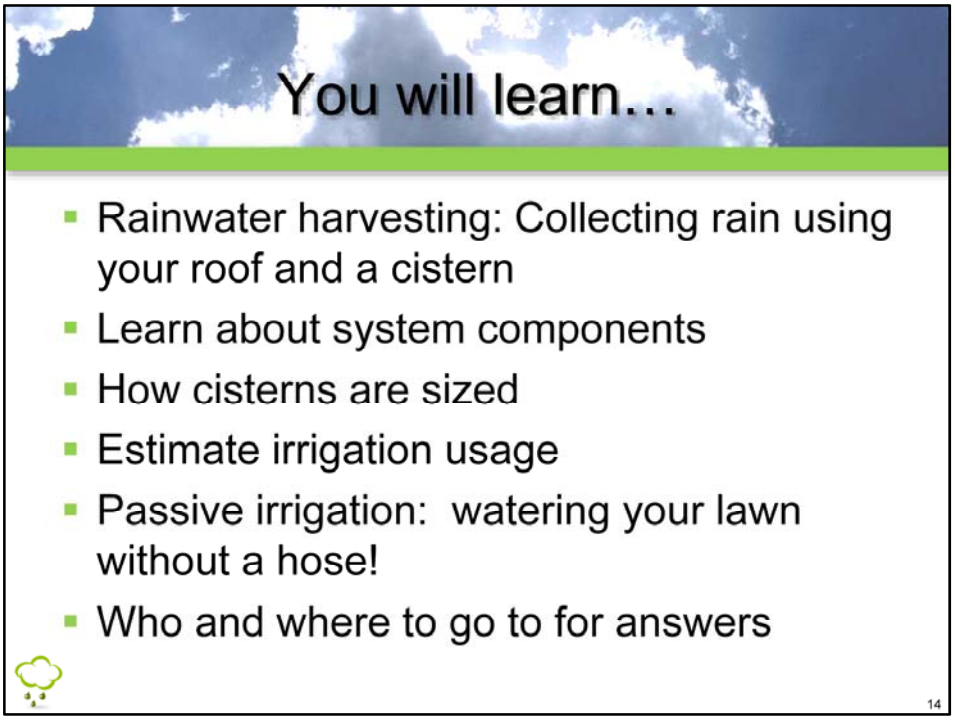


Our purpose in presenting this workshop…
Emphasis should be given that (1) these are basics – not comprehensive – of rainwater harvesting and (2) focus will be only on irrigation as end use.


You will learn…
Rainwater harvesting: Collecting rain using your roof and a cistern
Learn about system components
How cisterns are sized
Estimate irrigation usage
Passive irrigation: watering your lawn without a hose!
Who and where to go to for answers
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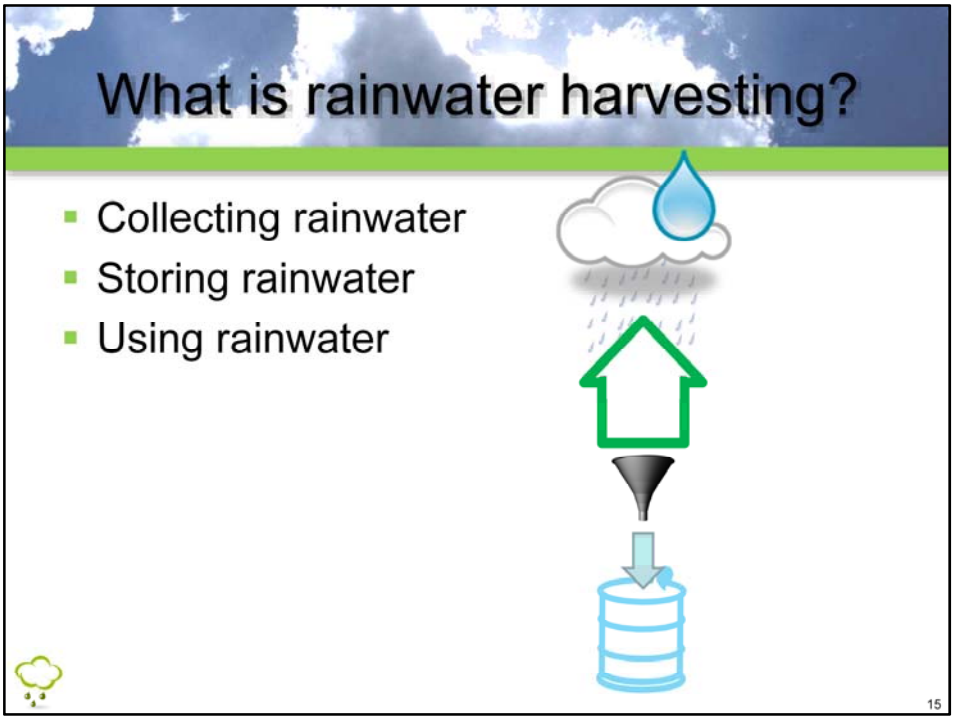
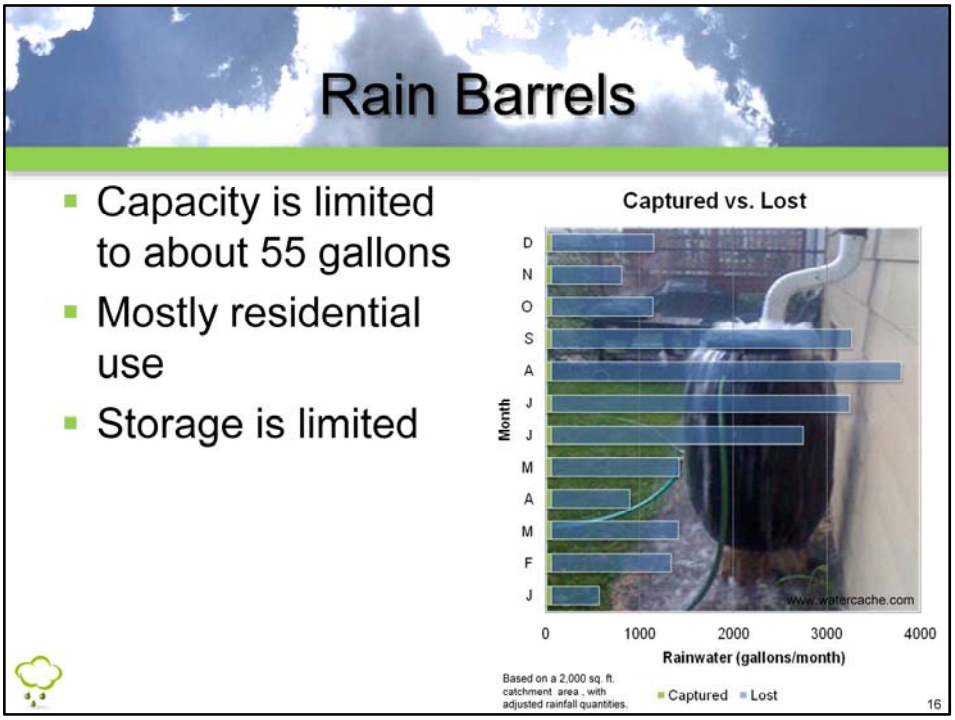
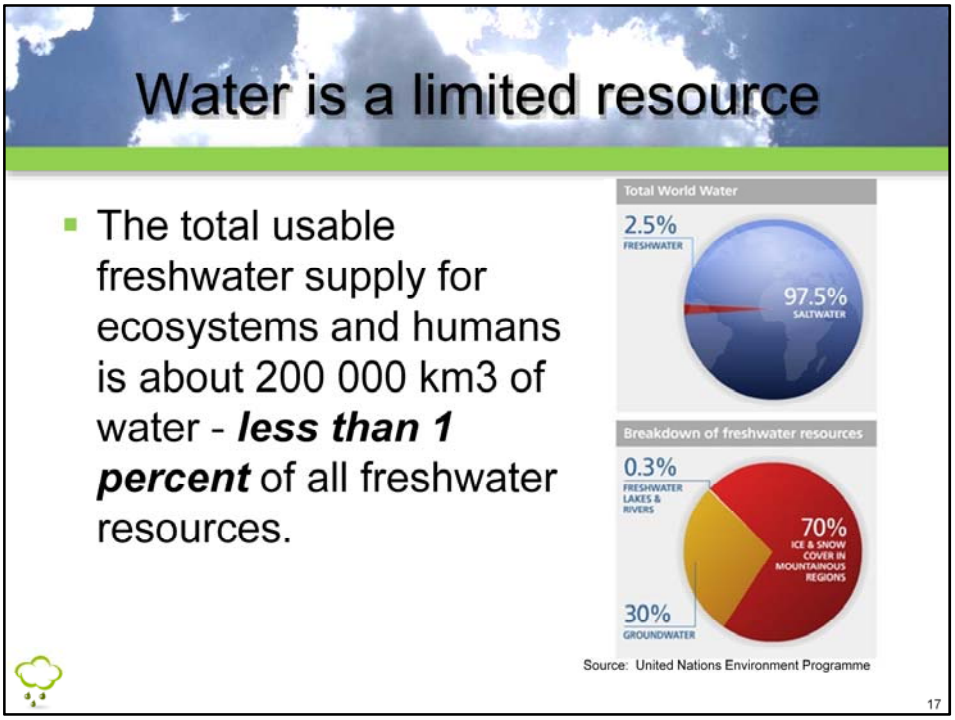


Rainwater harvesting is the collecting and storing of rainwater. Collection is usually from a roof, and storage is in a catchment tank.

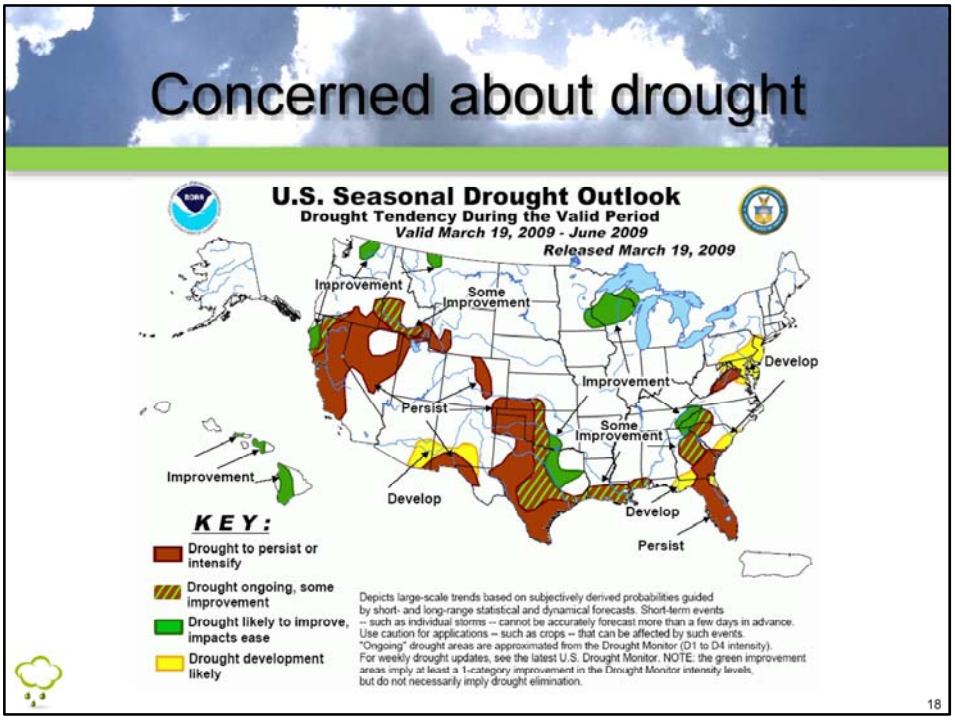


Some of you may be rain barrel users. How many of you do that already? Good! Rain barrels are a good start. That means that you are already doing your part in limiting potable use for irrigation. You are also more careful of how you use the rainwater that you collect.

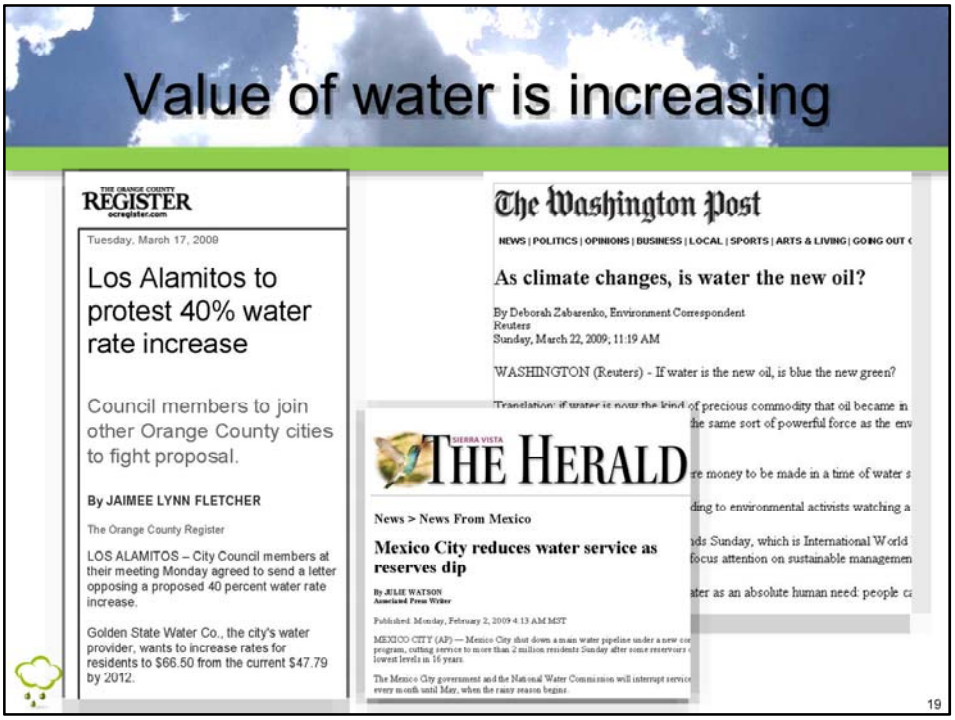
However, you may have noticed that a rain barrel's capacity is limited. It can only capture the first 55 gallons of water captured from any roof. The rest is lost. With a 2000 sq ft roof, it is possible to collect over 22000 gallons of rainwater, yet only 660 gallons can be captured by a single rain barrel. That's only 3% of available rainwater. 97% is lost!



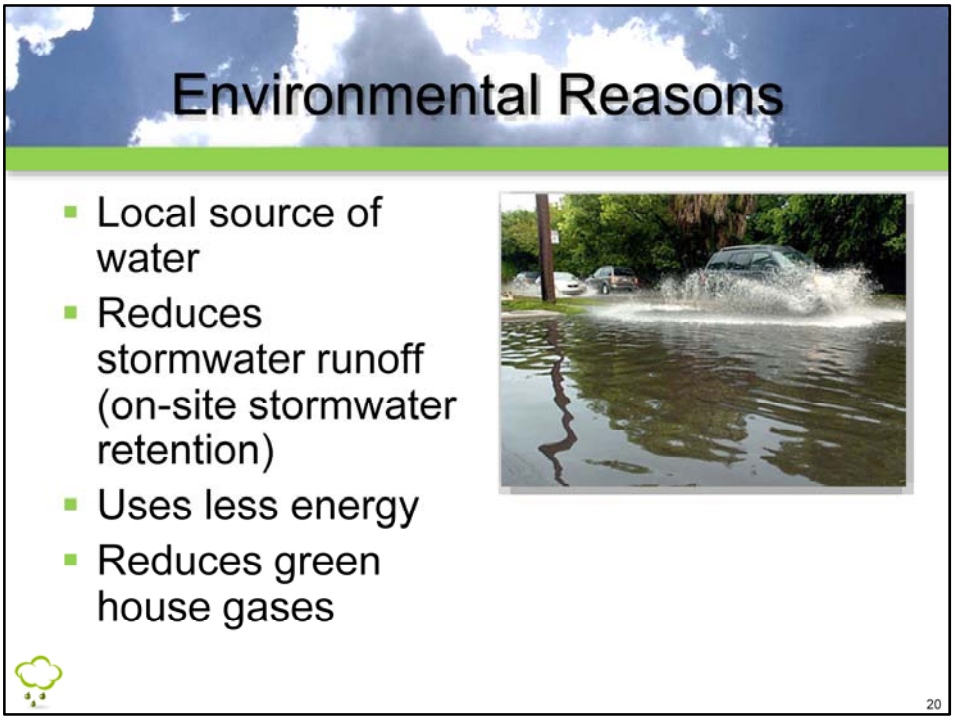
Why harvest rain? Water is a finite resource. There is a very limited amount of freshwater available for use. Most of it is trapped in ice and snow, 30% is underground while less than 1 percent is in our lakes and rivers.



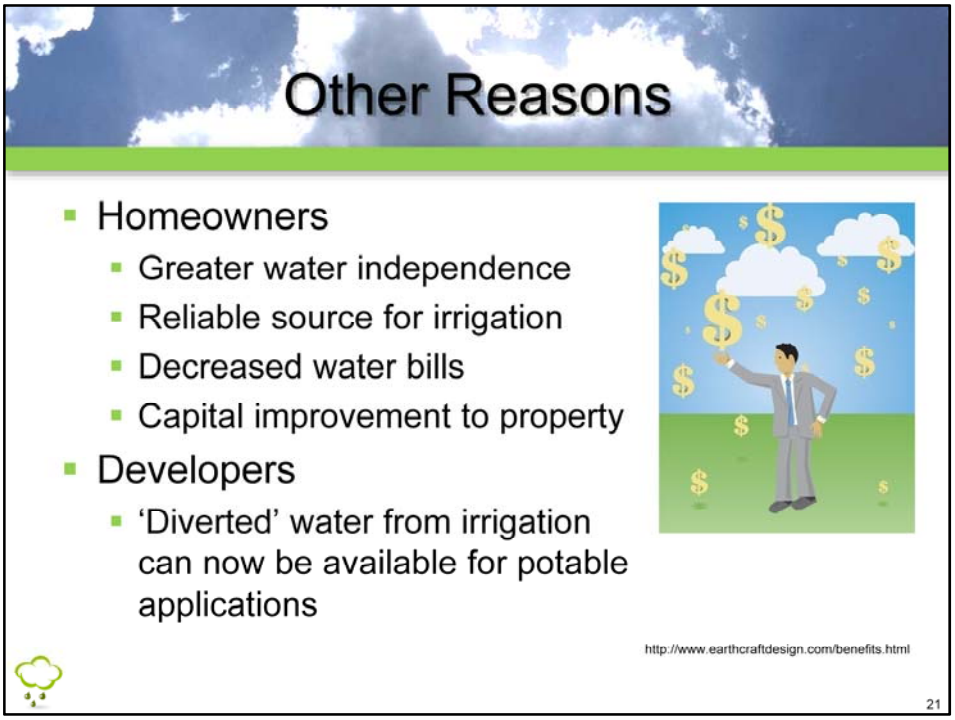
Others may be worried about current drought conditions and how this is affecting the availability of water.



We read about limited water supplies every day. The impending rise of the cost of potable water may be a result of limited supply.



There are environmental reasons to harvest rainwater. One reason is that it reduces the amount of stormwater runoff that occurs. This could reduce flooding issues during intense rain events. By collecting rain, we reduce the amount of water that is piped through our storm sewers to wastewater treatment facilities.



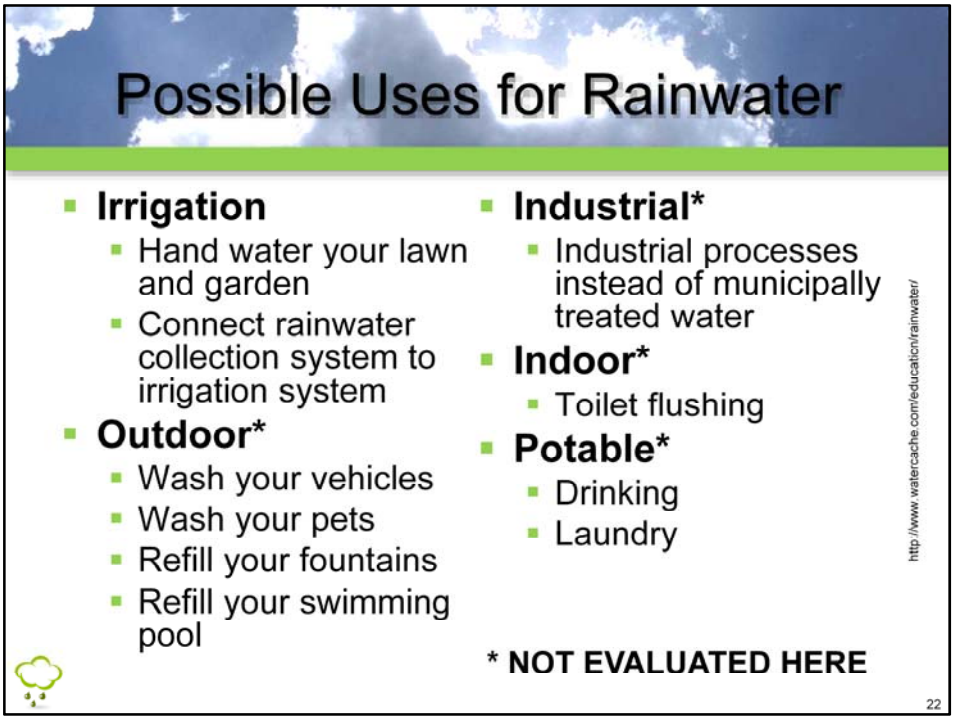
Presenter: Interject reasons for capturing rain. Otherwise, here are some reasons.

Irrigation for landscape. Plants love rainwater and it is the ideal source for irrigation when stored for summer usage. Rain naturally fertilizes plants (with nitrogen and sulfur) while at the same time flushing out harmful salts from the soil. Rainwater does not contain potential toxins and chemicals from water treatment plants or municipal underground pipes.

Stored rainwater is available for irrigation when water restrictions for irrigation are enforced and for emergency situations when municipal supplies may not be available or sufficient (in the case of fire or hurricanes).

Rainwater harvesting systems are considered a valuable capital improvement to property. The return on investment varies from project to project but our clients have found the independence gained from owning their own systems is priceless. For new construction, the cost of the initial rainwater system is minimal when added to the overall project loan.

At times, lack of available potable water supply has limited development. Conserving potable water supply can facilitate development.



There are many uses for rainwater. Irrigation would be the application requiring the least amount of treatment before use.

Where can we use harvested rainwater best?

Since irrigation consumes most of our potable water use, let's start here.
****
Irrigation remained the largest use of freshwater in the United States and totaled 137 Billion gallons/day for 2000.

Since 1950, irrigation has accounted for about 65 percent of total water withdrawals, excluding those for thermoelectric power.

The above info came from http://pubs.usgs.gov/circ/2004/circ1268/index.html

A good strategy would be to, not only conserve water, but also to use an alternative water source (rainwater) for irrigation, and save our precious potable drinking water for drinking and other indoor uses.

So today, we will be focusing on rainwater harvesting for LANDSCAPE irrigation.


Rainwater Harvesting with Cisterns
for Landscape Irrigation
PART 1
ANATOMY OF A RAINWATER HARVESTING SYSTEM
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Objectives

- Identify major parts of a rainwater harvesting system
- Become familiar with the function of each
- Understand what components may be necessary for irrigation purposes

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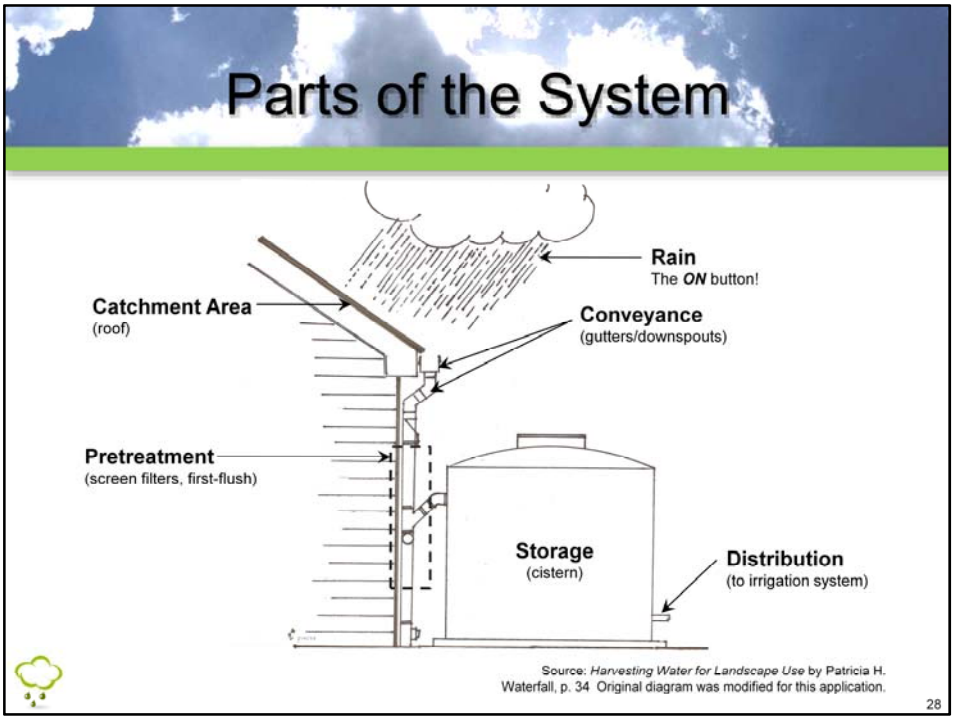
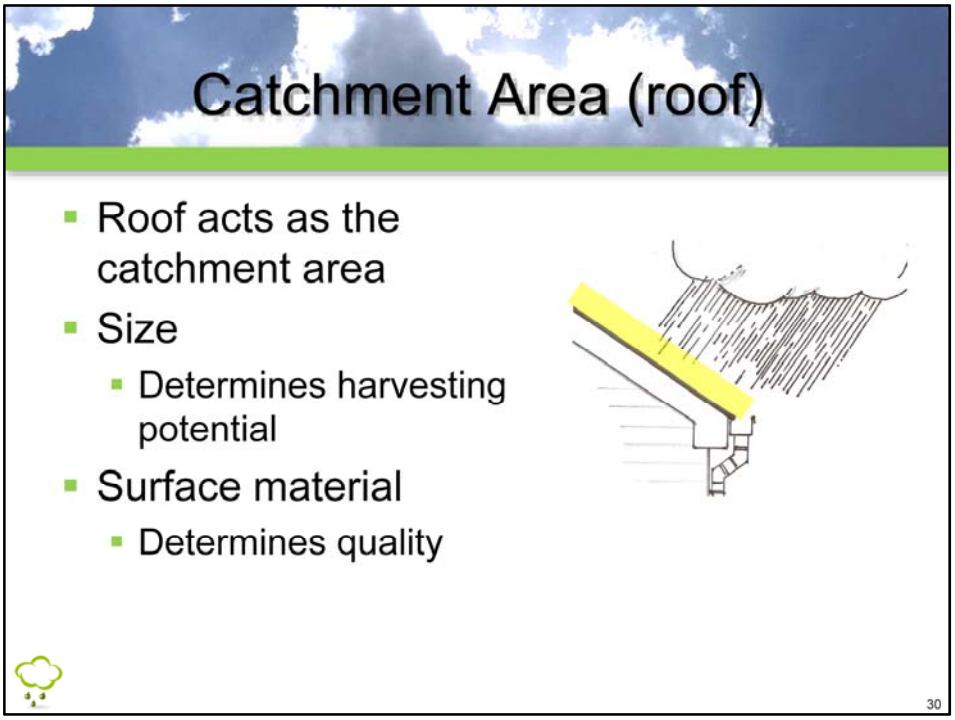


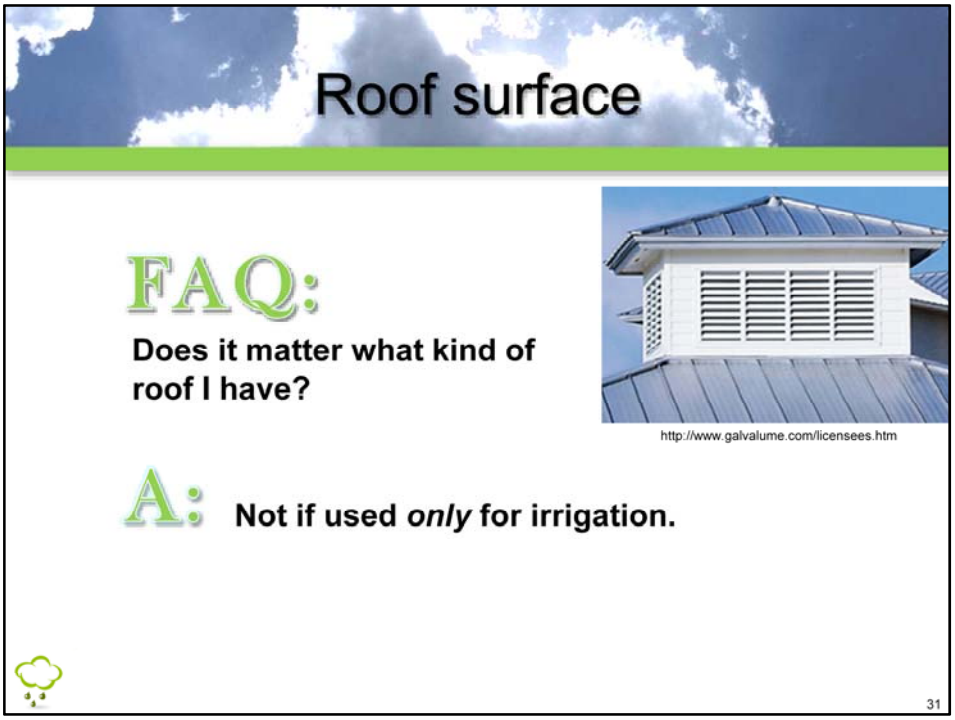
Big or small, residential or commercial, the harvesting system will have these components.

Trainer should mention each of these aspects and give a brief description of each. Each part will be covered in more detail, including rain and its reliability.


Catchment Area
29



The roof (highlighted in yellow) is what is used as the catchment area. Its size dictates how much rainwater can be captured.



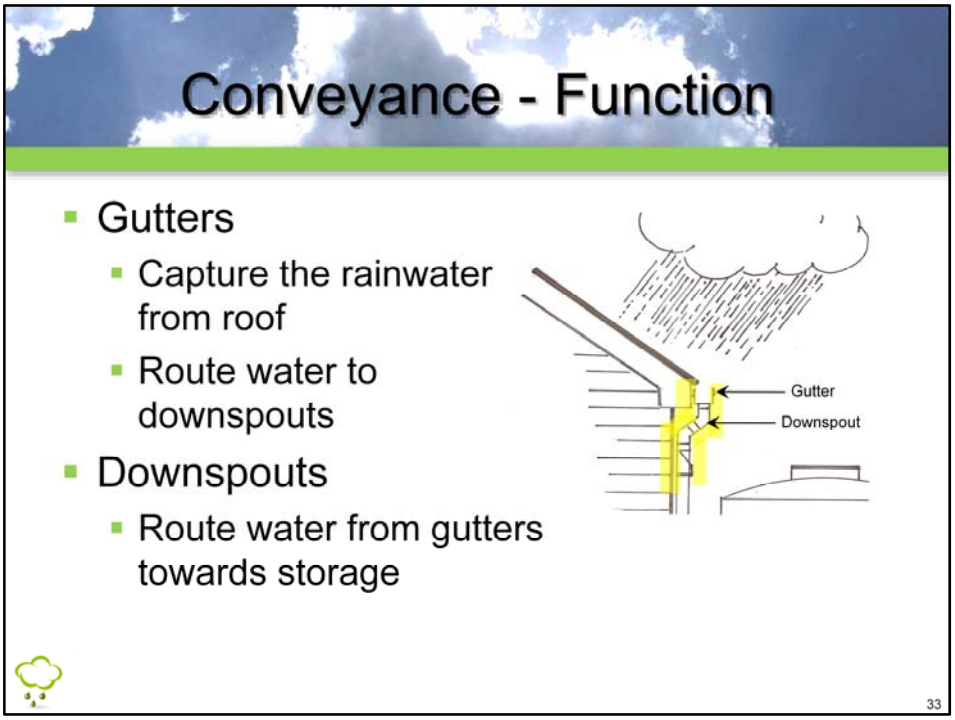
Q: Does it matter what kind of roof I have?

A: No.

For irrigation purposes, roof surface is not an issue. For potable applications, this becomes more of an issue. However, we aren't addressing potable applications in this workshop, …only irrigation applications.

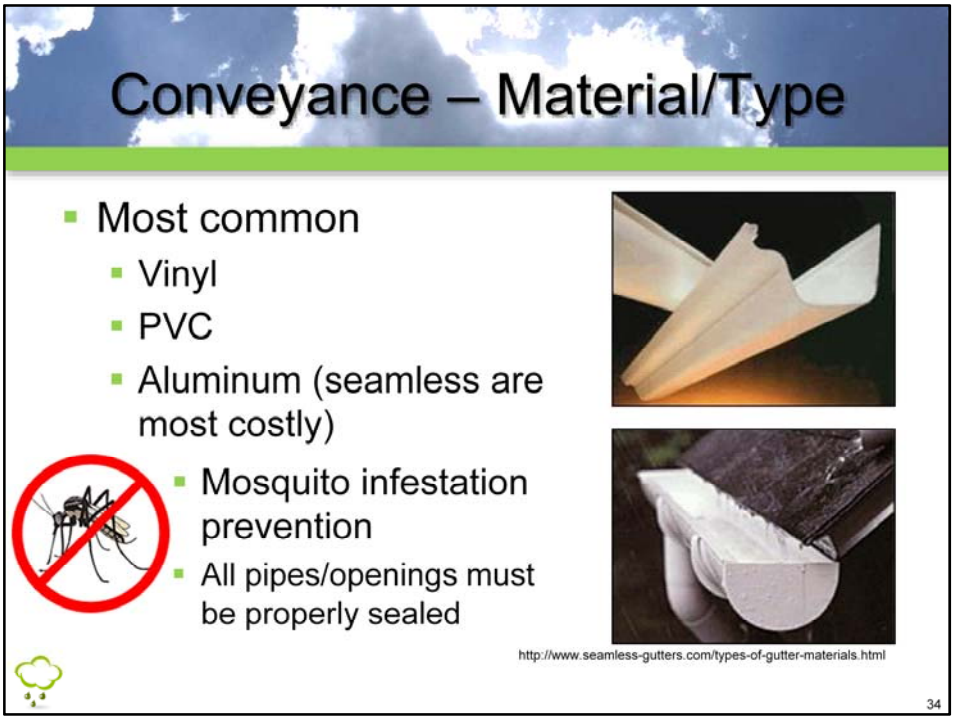
However, the smoother the surface, the better for collection. For example, rain runs off quicker and thus, 'washes' off any unwanted particles with less rain than other roof types. Also, roof slopes affect how quickly roof surfaces get washed: steeper slopes are 'washed' quicker.

The next part of a rain harvesting system is conveyance.

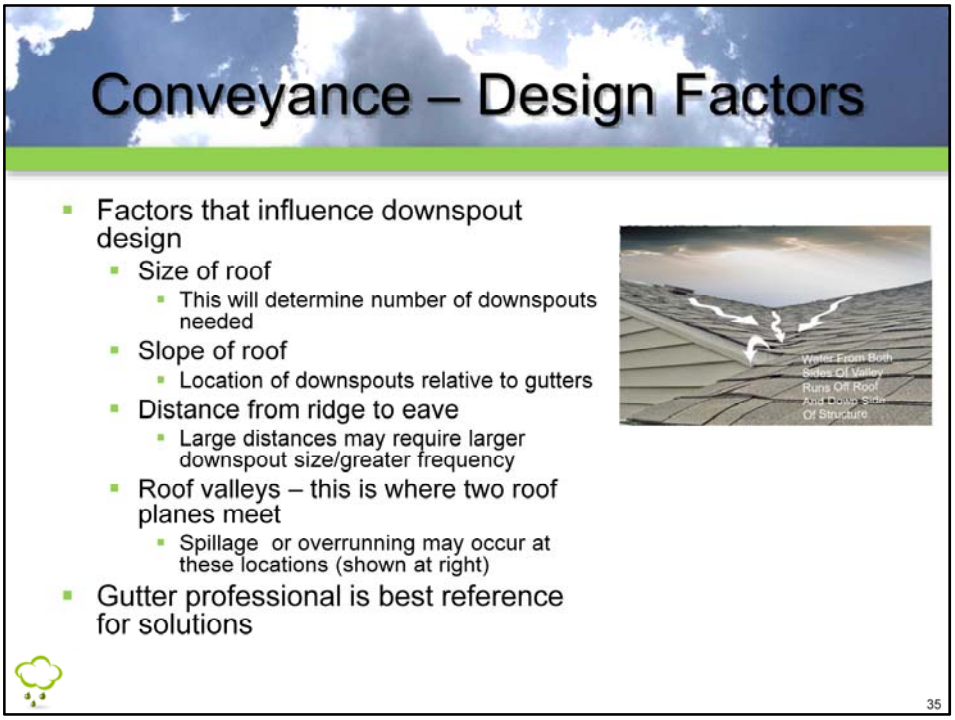


Highlighted area shows location of the conveyance system: gutters and downspouts.

These move the captured water along to the cistern.



Something to keep in mind is that, if we are installing gutters to collect water that will ultimately be stored, these need to be installed as a sealed system in order to keep mosquitoes from entering. This is **very** important, because, if overlooked, it can become a nuisance.



There are many factors that will affect the design of your home's gutter system. Your gutter professional will be best suited to address each of these. However, know that the dimensions and shape of your roof will determine the size of your gutters, the number of downspouts needed and where you will install proper hardware so that spillage can be minimized and every possible drop of rain is captured.

Keeping limbs and leaves away from catchment area and from clogging conveyance is important in keeping cistern water quality pure.

These products reduce maintenance needs while preventing debris from entering the cistern.

Pollen pods can be filtered out as well.


Pretreatment
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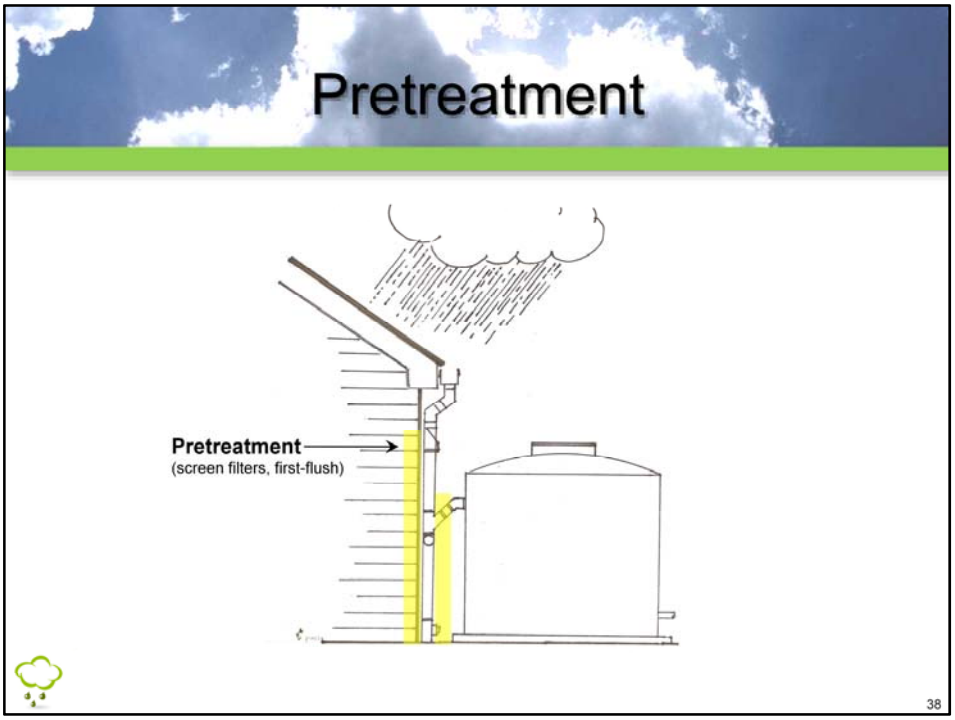

Filtration should occur between the downspout and the tank. The ultimate goal is to remove impurities before they reach the tank. What impurities? (Go to the next slide)

Purpose of Pretreatment

- Roof surface debris
  - Twigs and leaves
  - Dust
  - Bird droppings
  - Particle release (asphalt shingles)

Courtesy: ARCSA

http://www.brighteredge.com/wp-content/uploads/2009/03/asphalt-shingle-roofing.jpg

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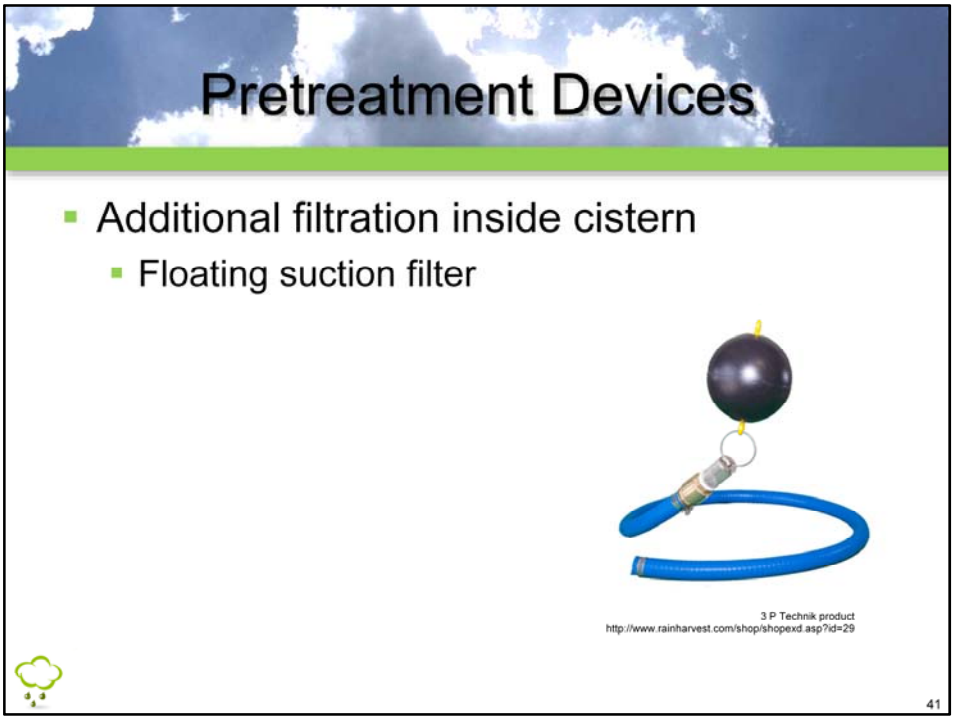
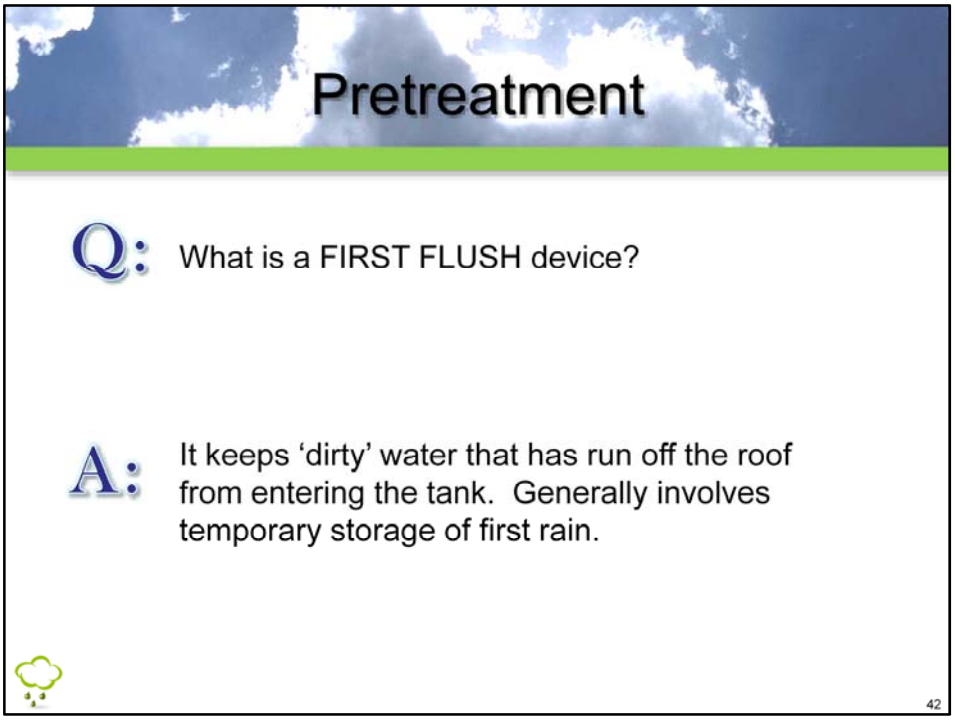
There are several kinds depending on your budget-but you need to have this!

There is the downspout filter, (extreme left) which has a fine filter screen. The next filter is a strainer type filter. Both of these require regular cleaning (like lint basket in your dryer!) in order for it to function efficiently.

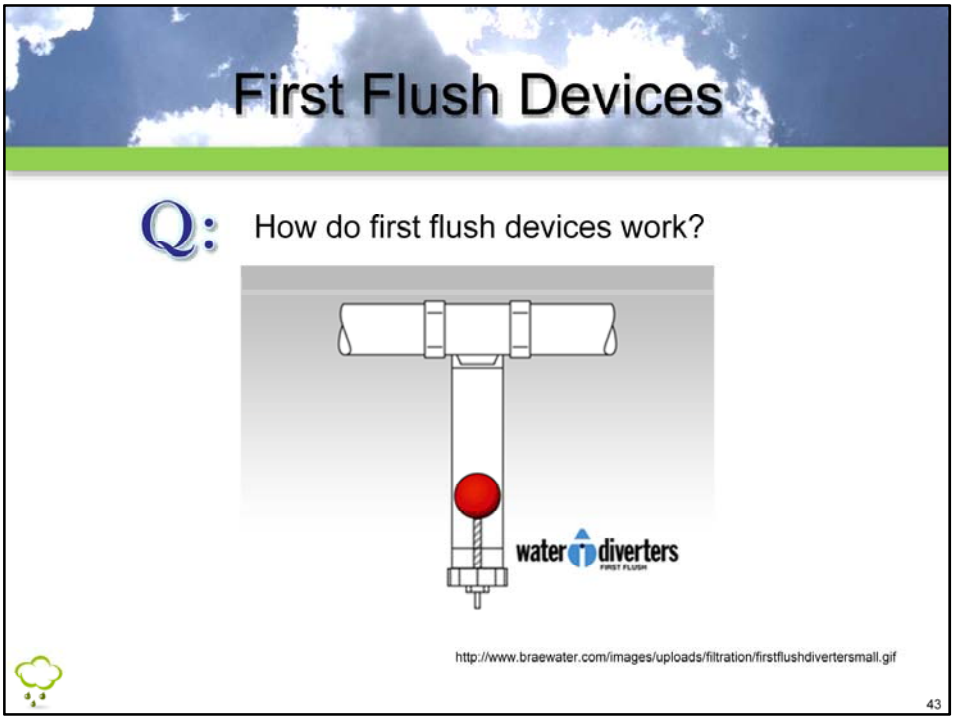
The next two shown are examples of the 'self cleaning type'. The benefit here is that less maintenance is required. The downside is that you lose some water in the process and…they are more expensive.



This is used so that (a) water can be extracted from the top of the cistern and (b) any floating particles can be filtered. Are they filtered or just precluded from being withdrawn till you get to the end?



This involves smaller contaminants that weren't filtered previously, like bird dropping residue.



Slide is animated!

First Flush Devices

- More first flush devices
  - Drains out through small hose at bottom
  - These can also be located underground

http://saferain.com.au/vertical_valve.html

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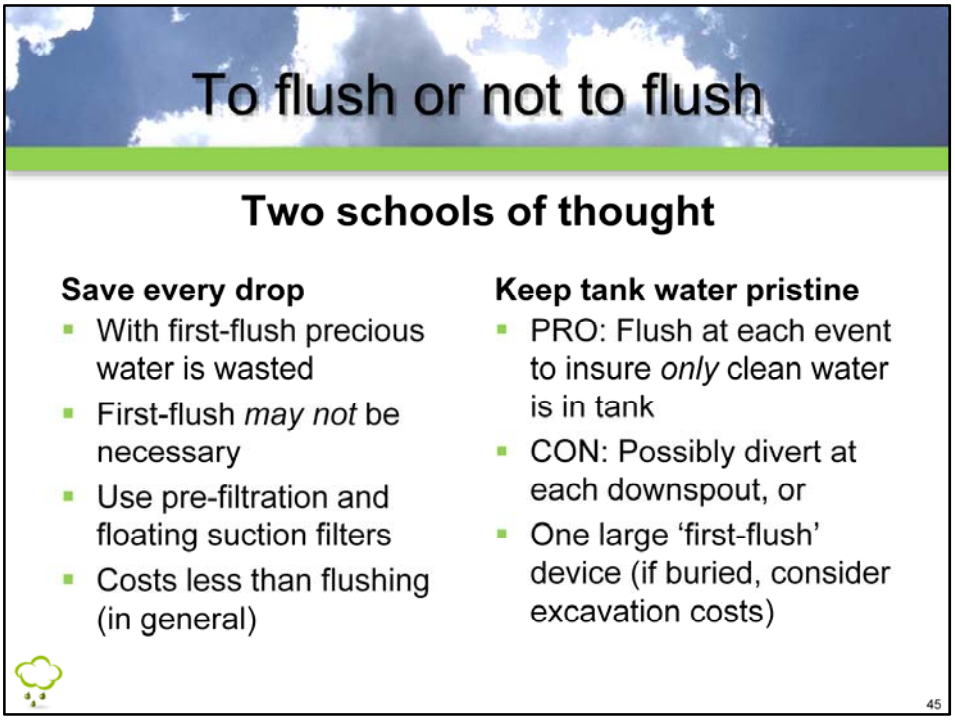
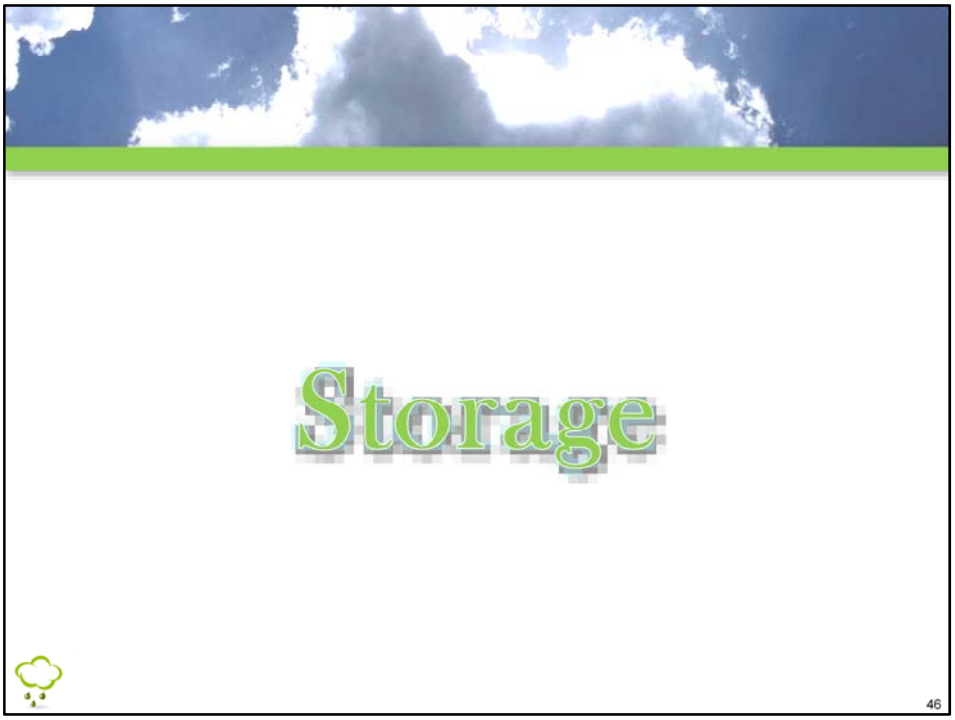
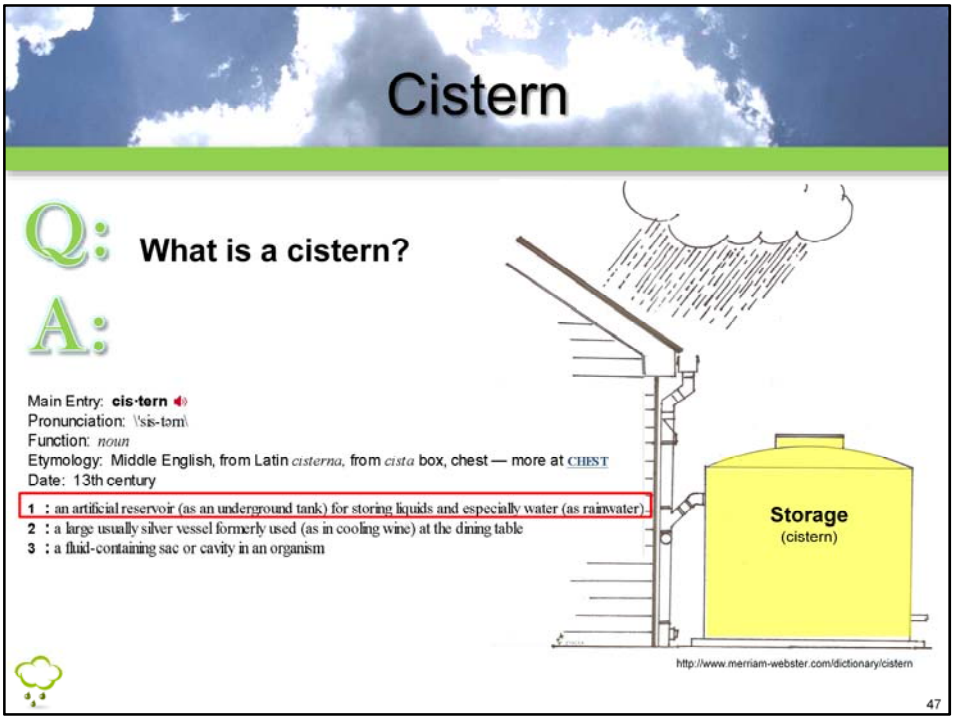


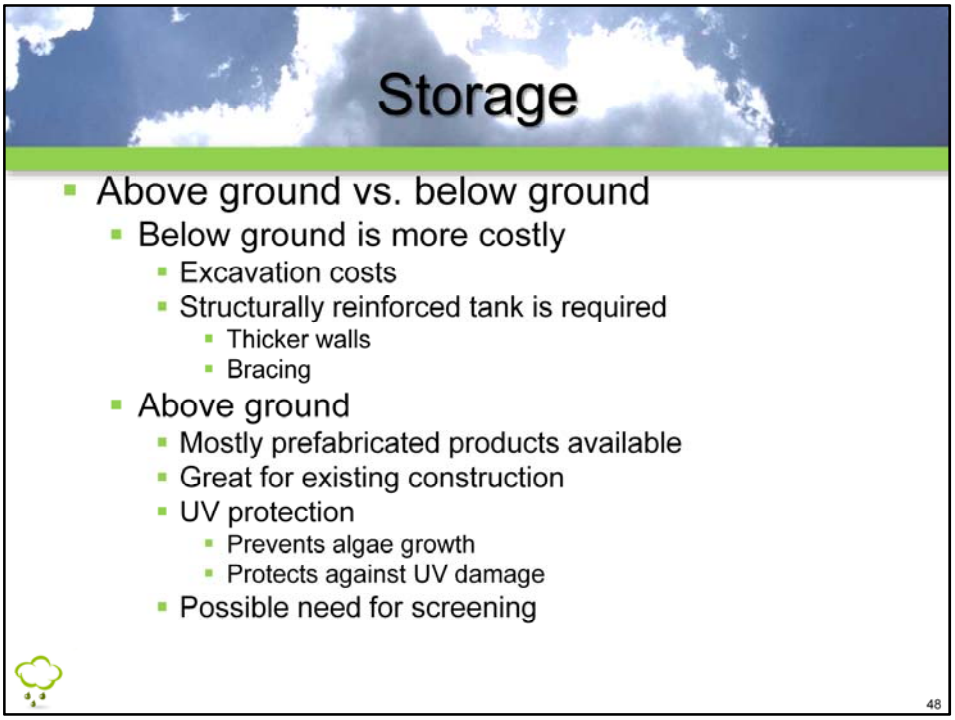
If we are serious about having only the cleanest water in the cistern, then, in essence, we need to have a first flush device at each collection point (picture this in your mind: as you collect water at each downspout, a 'first-flush' device needs to be at the end of each downspout) OR, all the collected water needs to be flushed - bigger volume - prior to entering cistern. Depending on the size of catchment area, this volume can be considerable, and burying the 'first-flush' tank may be a consideration.


Storage
46



Read definition #1

The cistern or storage tank is generally the most expensive aspect of the system.

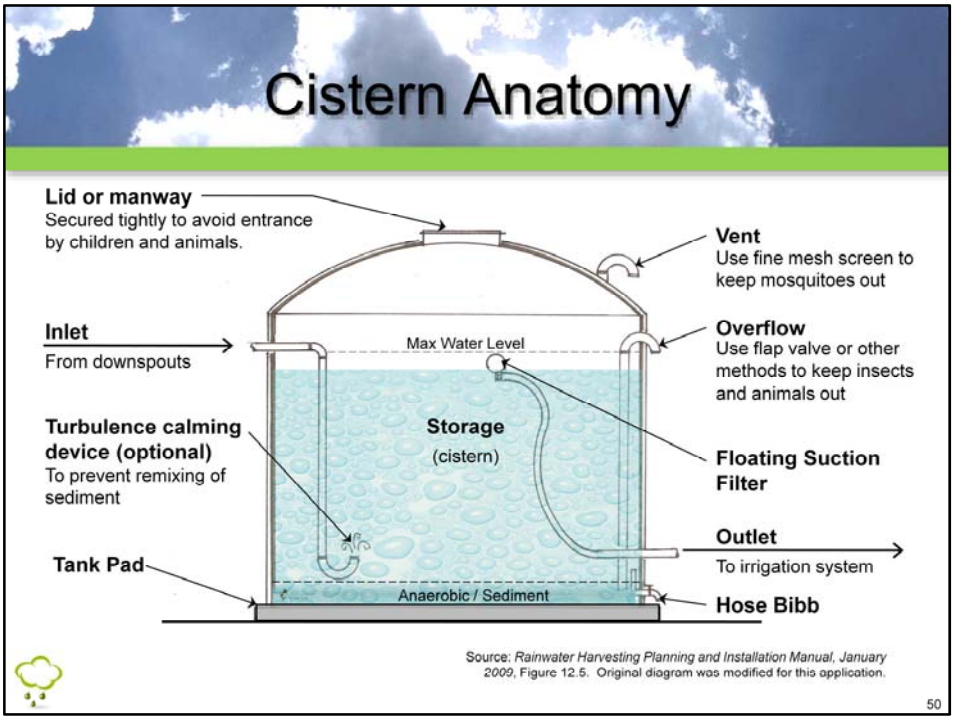


UV protection refers to not allowing any sunlight into tank. Sunlight is creates desirable conditions for algae growth. Therefore, black tanks are recommended.

Tank life are subject to conditions they are exposed to, but can last 30 year or more. Manufacturer's can provide a more accurate lifespan for tanks.

Both above and below ground tanks require stabilization and/or tank pad. Consult with tank installer or engineer regarding structural requirements. This may also include hurricane straps/bracing.

Cisterns are by no means 'one size fits all'. There are different shapes and materials for different needs and applications. They can also be custom made.
This is a good place to show the 5 minute video on how metal tanks are put together. The link is located on the last slide of this section.



You will notice that cisterns have a lot pipes going in and out of them. This configuration can vary, but generally there will be an inlet, an outlet, an overflow and drain valve.

A **manway** is also necessary for maintenance/cleaning. Never go inside alone or without a plan on how to get out.

Inlet, outlet and overflow are self explanatory. Trainer should call these out.

Overflow: ***Engineering drainage design may need to come into play here.*** Common sense dictates for overflow to be directed away from tank/buildings where volume of water won't cause erosion, flooding, carry organic material (especially if animals are present) into wells or water sources, cause standing water for long periods (mosquito breeding), etc. Over flow can be directed towards in place drainage system or can also be allowed to percolate into the ground via french drain, etc.

Overflow outlets can be configured in different ways. If the overflow outlet draws from the bottom, it should be **vent**ed to prevent siphoning. Overflow outlets and vents should be equipped with a fine mesh screen to prevent mosquito entry.

Anaerobic/Sediment zone is located in the bottom 6" or so of the tank. Here is where the 'dirtier' water and sediment tends to collect. Avoid drawing water from this portion of the tank.

A **hose bibb** or drain valve is needed in order to drain the tank if needed. Bibb should be elevated 6" or so. Solids tend to accumulate at the bottom so elevating will help avoid clogging.

The floating suction filter will allow water to be extracted in the cleaner area of the tank. Particles either settle at the bottom of the tank or float on top. Thus, the filter on the end of the hose will filter the remainder of the particles before sending the water to the irrigation system.

Important to make sure all openings are sealed properly to avoid (1) mosquito infestation (2) animal intrusion and (3) children from entering the cistern.

Tank should be placed on a level, stable foundation. This may consist of gravel or concrete pad.
FACT: Water weighs 8.34 pounds per gallon. A 1000 gallon cistern can weigh up to 8340 gallons when full. Imagine what would happen if an unstable tank tips over.


Distribution
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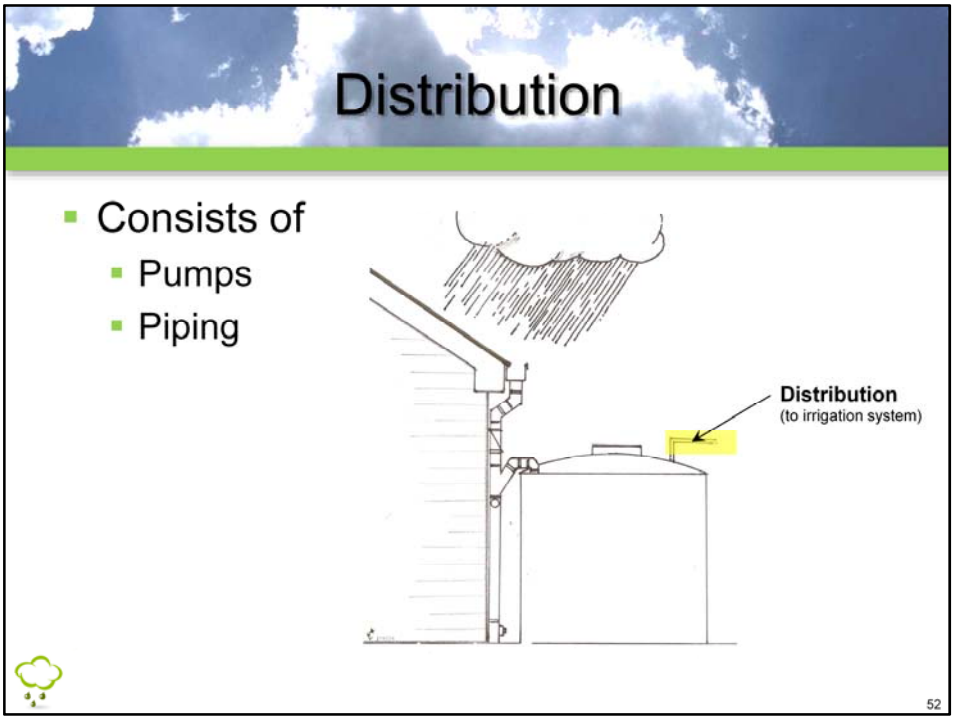
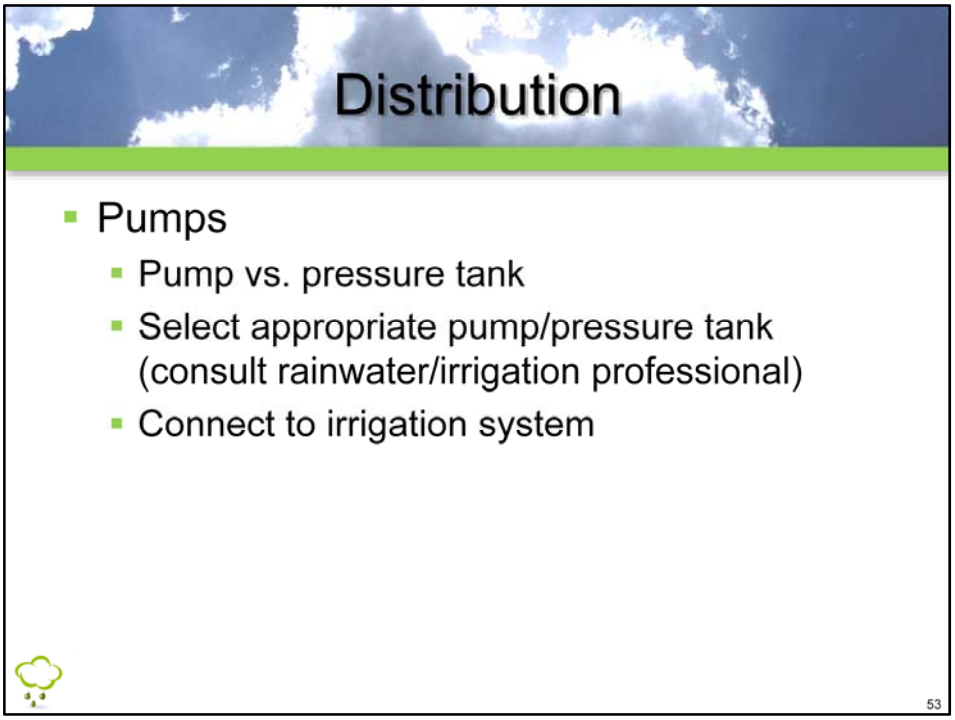


Pumps are necessary to pump water from cistern through irrigation system. Some drip irrigation systems may not require a pump.

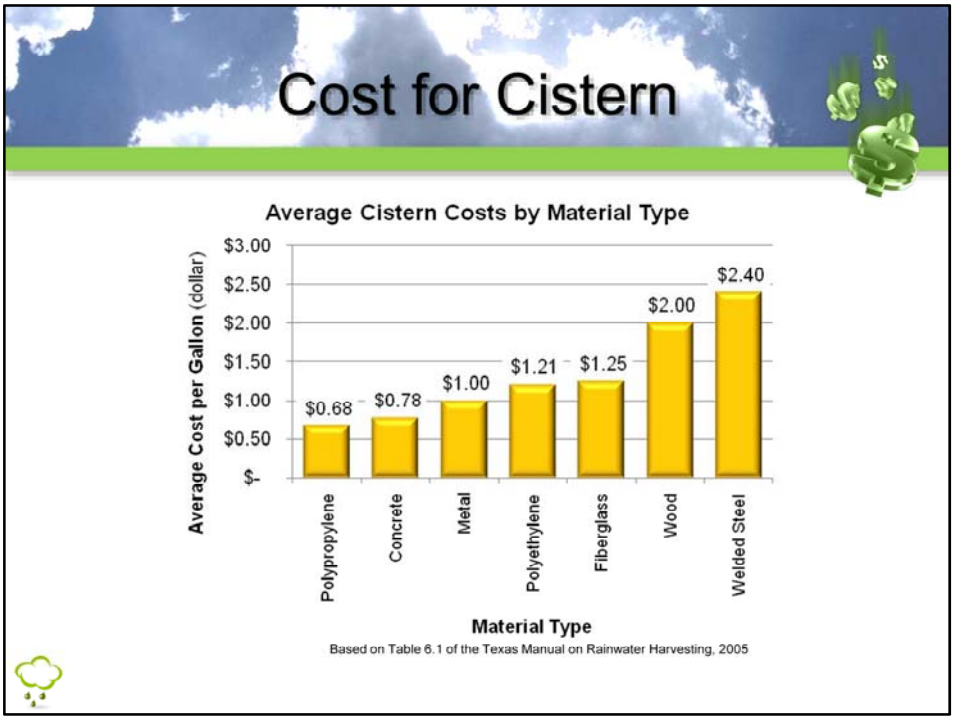


What a pressure tank does:
Protects and prolongs the life of the pump by preventing rapid cycling of the pump motor
Provides water under pressure for delivery between pump cycles; and
Provides additional water storage under pressure to assist the pump in meeting the total demands of a system if the pump is incapable of supplying the required capacity.

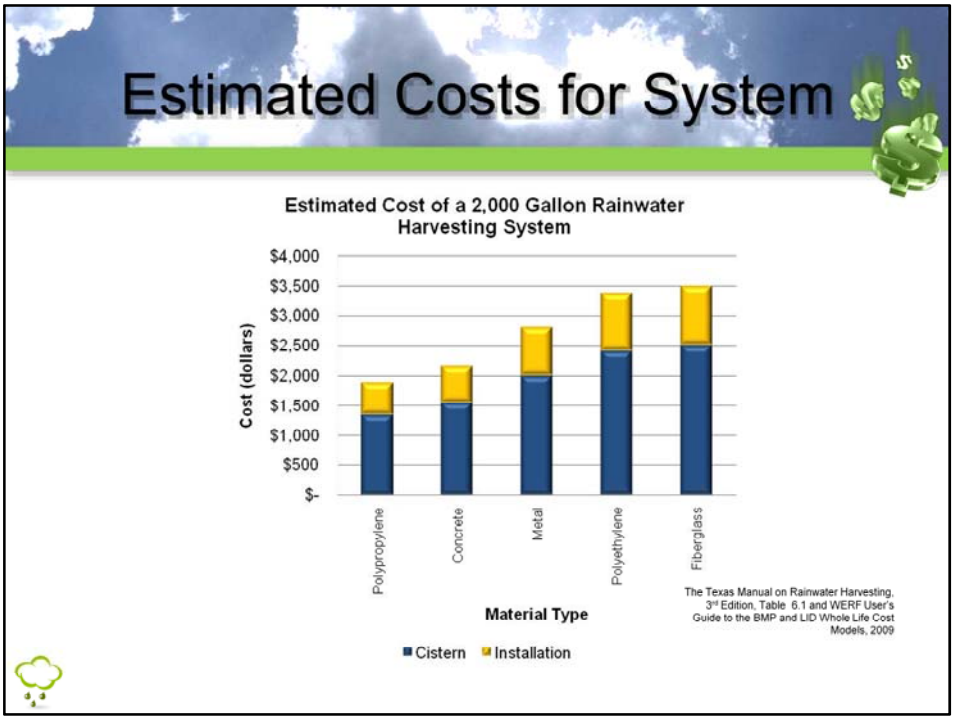
Pump sizing is best left to the experts. It is best to seek professional help in this department.

So, What does all this cost?

Cost for Cistern



Estimated Costs for System



Maintenance Costs

- Minimal costs for non-potable use system
  - Maintenance by owner keeps costs down

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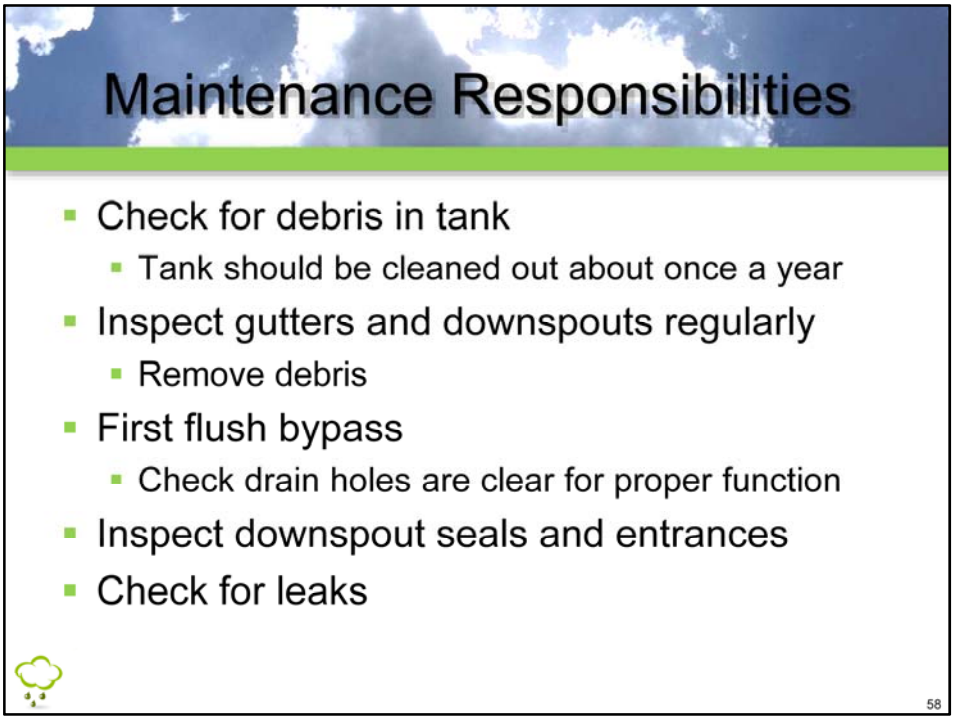

Very simple, but regular, maintenance is required.

Advice

- Questions regarding first flush, pumps or any other component/system design?
  - Consult with rain harvesting/irrigation professional
  - Each application is different

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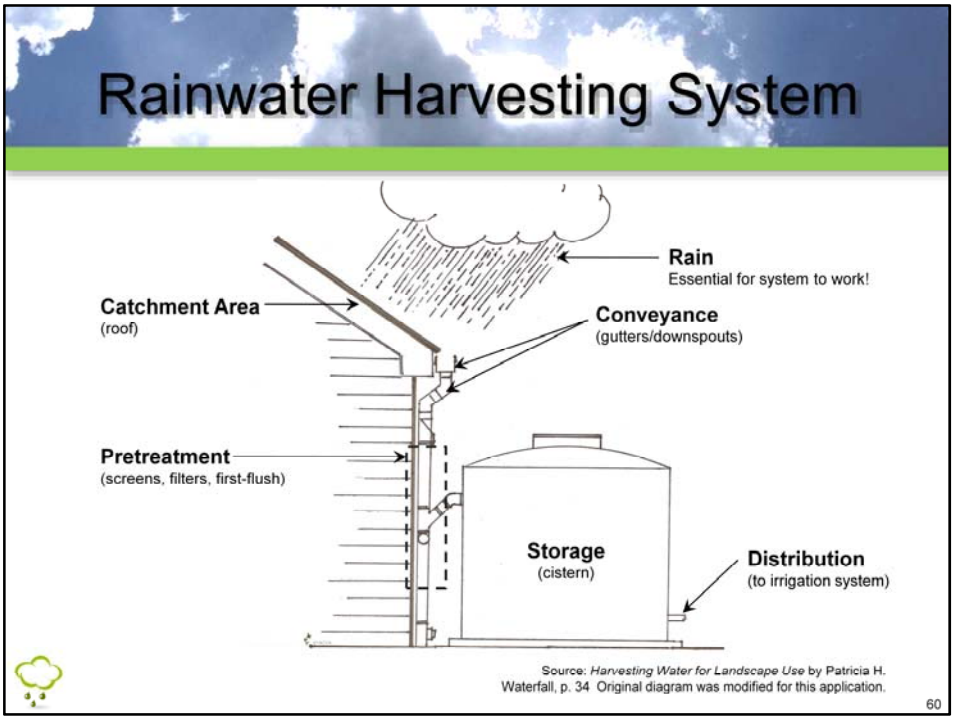
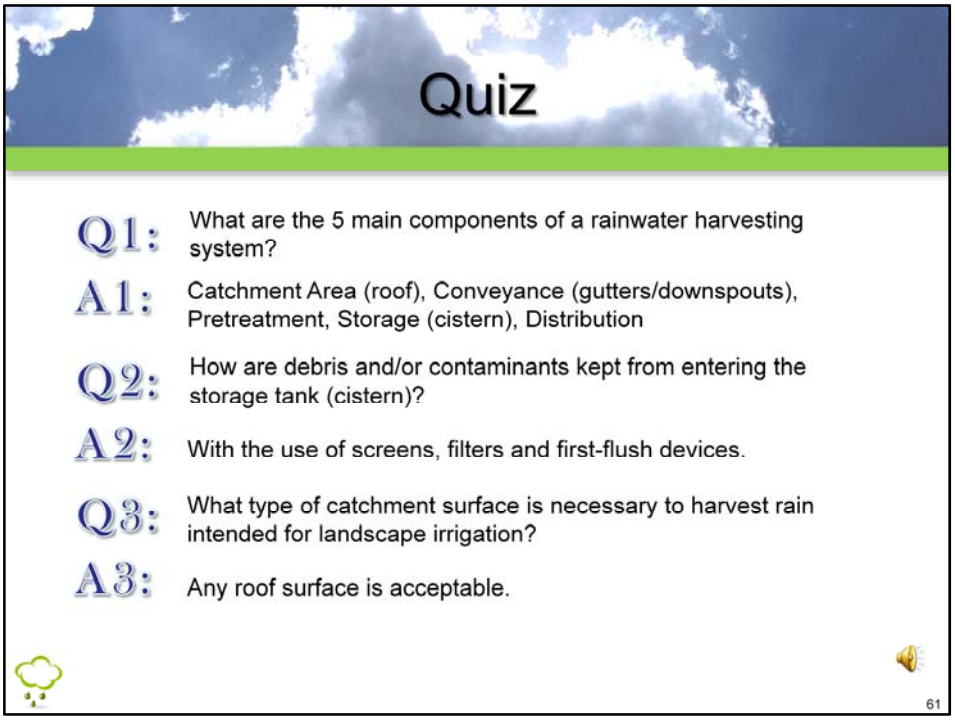
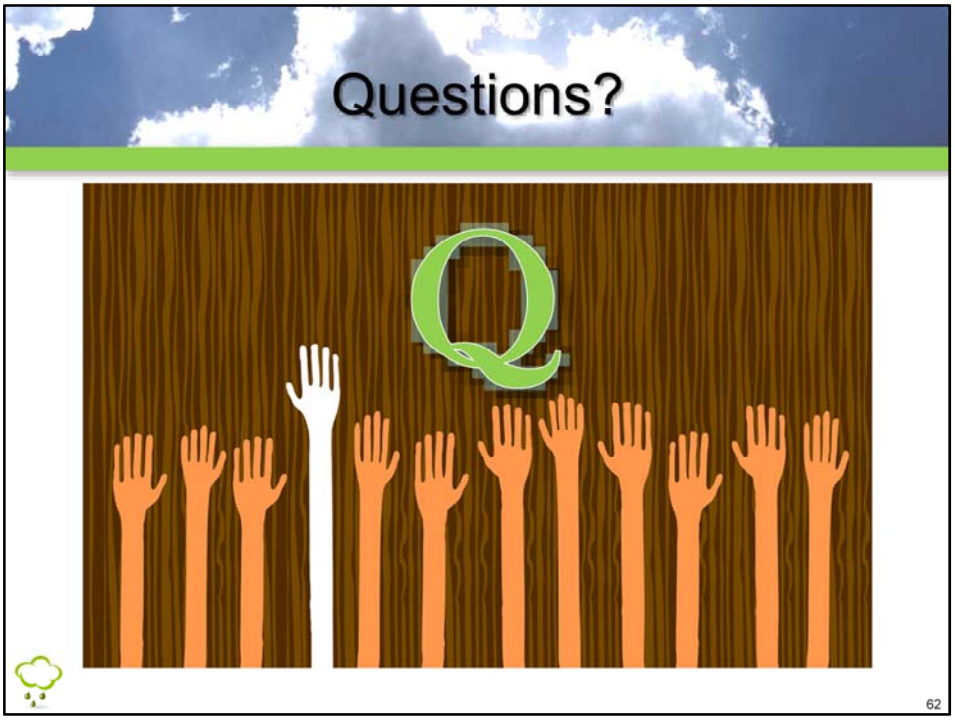


We have covered the basics of a rainwater harvesting system. Ready for a quiz?



Each question/answer comes up after mouse click. After question appears, optional 'jeopardy' music can be played (to avoid uncomfortable silence) by clicking 'speaker' icon at bottom right of slide.


Questions?
Q
62

Training Resources

- Construction of metal cistern
  - http://www.youtube.com/watch?v=besl1h6t6FA

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BREAK

- We will meet back in 20 minutes.
- Bring your calculators!

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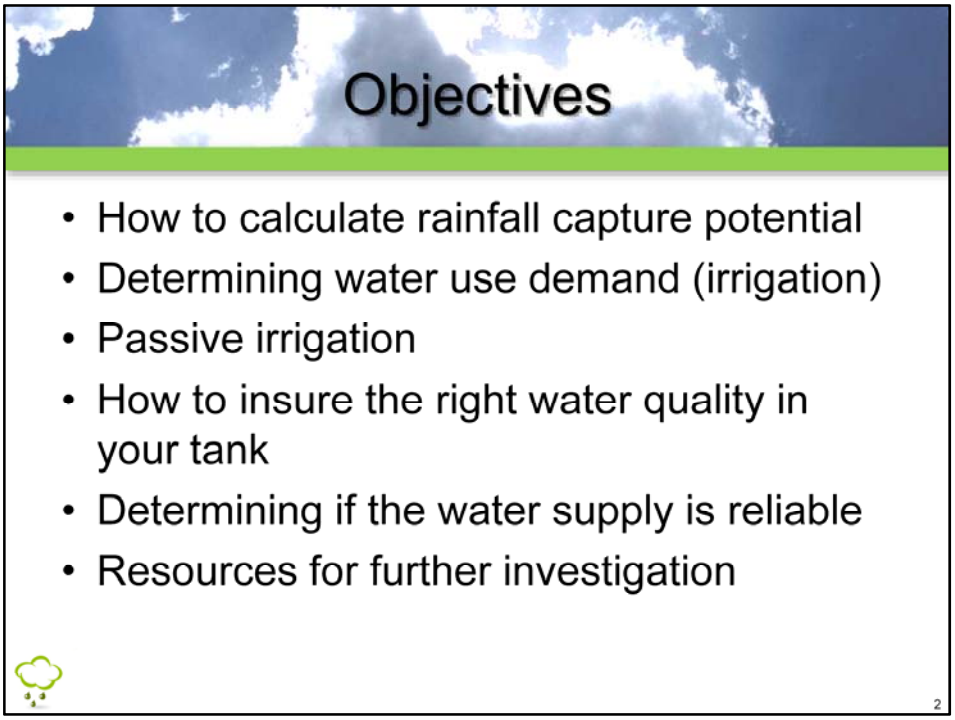
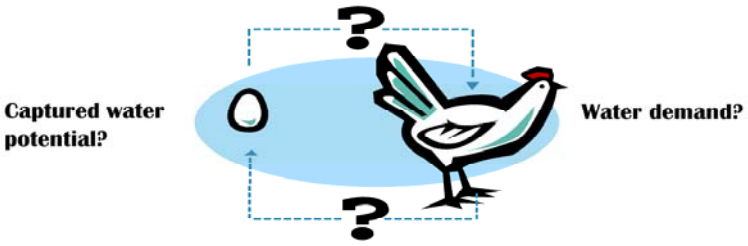
Rainwater Harvesting with Cisterns
for Landscape Irrigation
PART 2
SIZING & RELIABILITY
October 2009
florida
Rainwater Harvesting Initiative



Passive irrigation – what it is, how it conserves water, and how it can work for you!

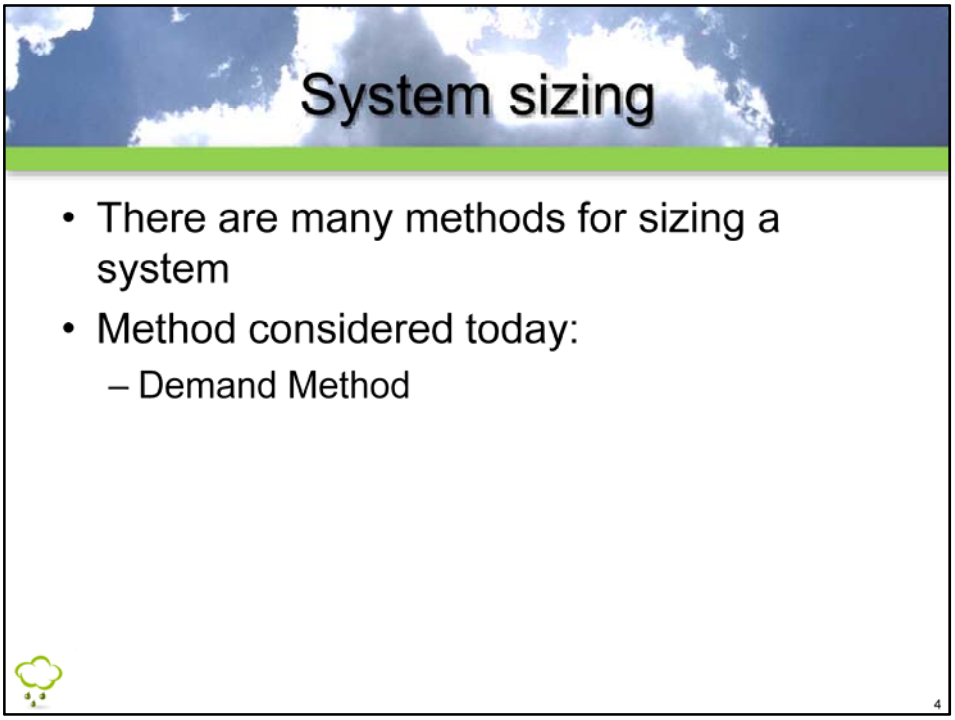
System Sizing

Q: What dictates size of storage?



A: In this case, demand dictates storage capacity

3



Demand Method - Based purely on anticipated water needs

****

Water balance method – (1) Maintain a monthly balance, (2) Start with an assumed volume (3) Add volume captured (4) Subtract monthly demand (5) Evaluate size and affordability of storage capacity.

Major storm method – This method is used in order to capture every drop available at a major storm event (or every available drop during wettest month).

Provides

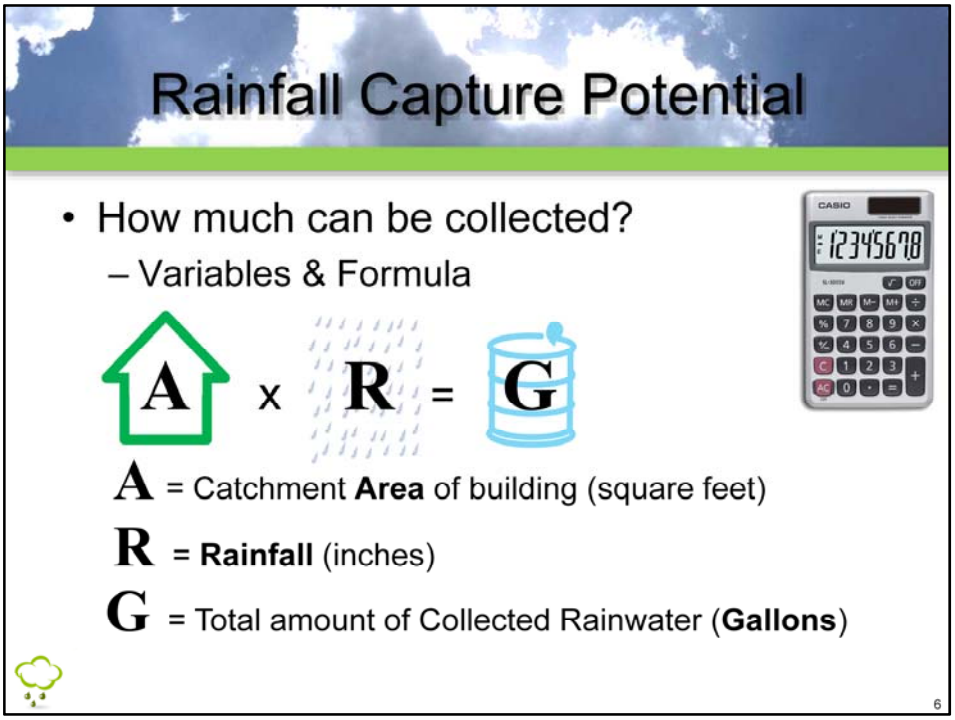
Pro- Minimum cistern volume needed to capture rainfall for this size storm

Con- Not based on water usage

What is the quick calculation method? A 'quick and dirty' way of calculating water quantities.

How to calculate rainfall capture potential

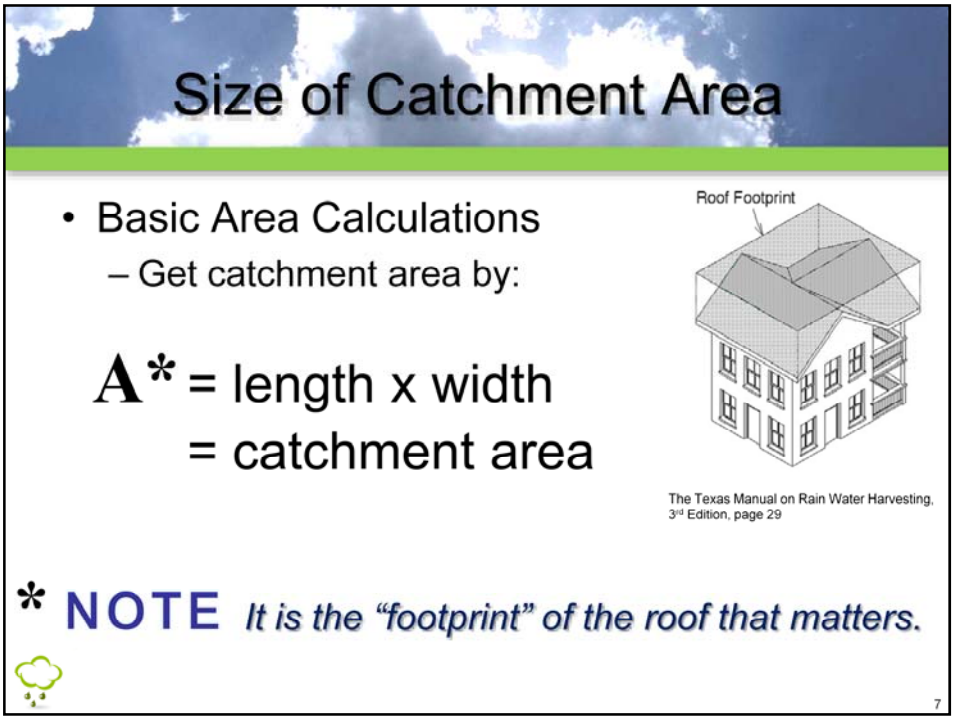
This means, how much rain can be collected on the roof that you have.



To calculate how many gallons of water that can be collected, use this basic formula:

Area of Roof (generally in square feet)
Rainfall (inches)

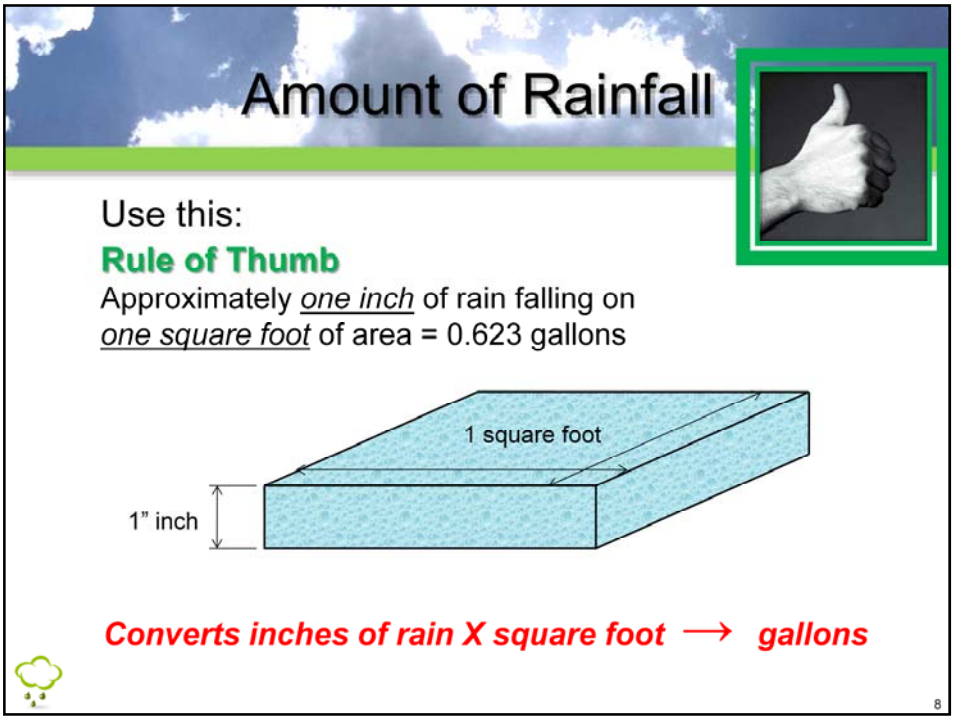
Then multiply to obtain amount in gallons.



The area of catchment surface is only as big as the footprint of your house. Think of how a raindrop sees your roof as it makes its way down. Whether it is slanted or flat, it will fall within this area. *That* is the area we are concerned about. So, you can multiply the length and width of roof area, or use the square footage of building.

****

For more information see http://www.harvestingrainwater.com/rainwater-harvesting-inforesources/water-harvesting-calculations/



One 'chunk' of rain….

One inch deep x 1 square foot = 0.623 gallons of rainwater collected

Remember this number:

0.623

This number is the conversion factor from:

inch X square foot → gallons

It can also be used for calculating irrigation water use.

9

Rainfall Data

- Use rainfall data by month

R = inches of rainfall (by month)

Month	"Normal" Rainfall (in)
J	2.27
F	2.67
M	2.84
A	1.80
M	2.85
J	5.50
J	6.49
A	7.60
S	6.54
O	2.29
N	1.62
D	2.30
Total	44.77

Sources for rainfall data:

http://www.ncdc.noaa.gov/oa/climate/online/ccd/nrmlprcp.html

http://www.swfwmd.state.fl.us/data/wmdbweb/rainfall_data_summaries.php

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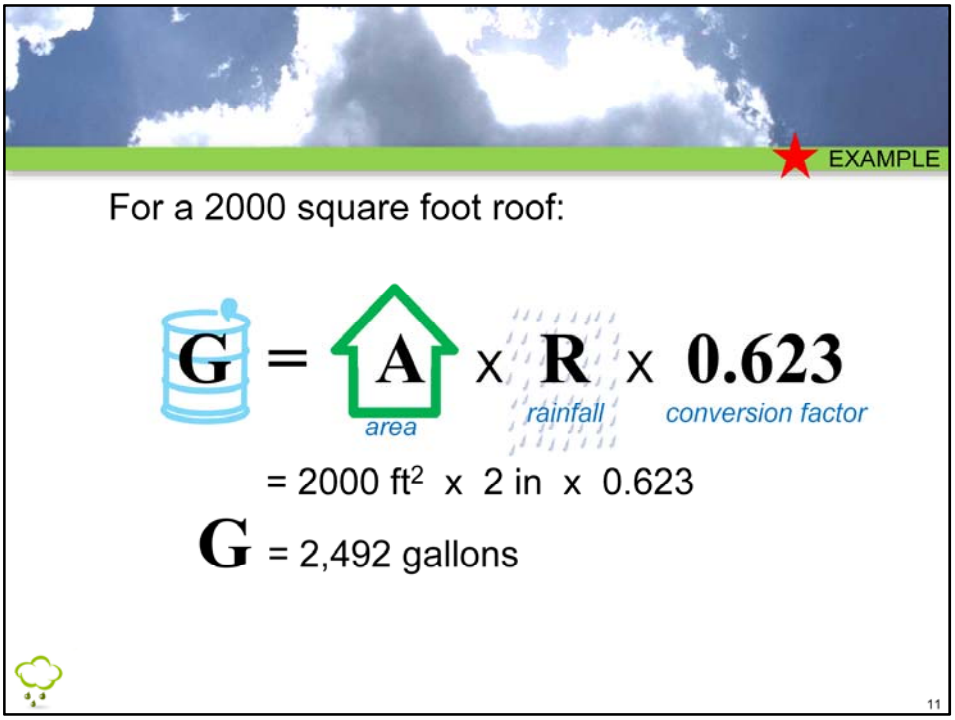
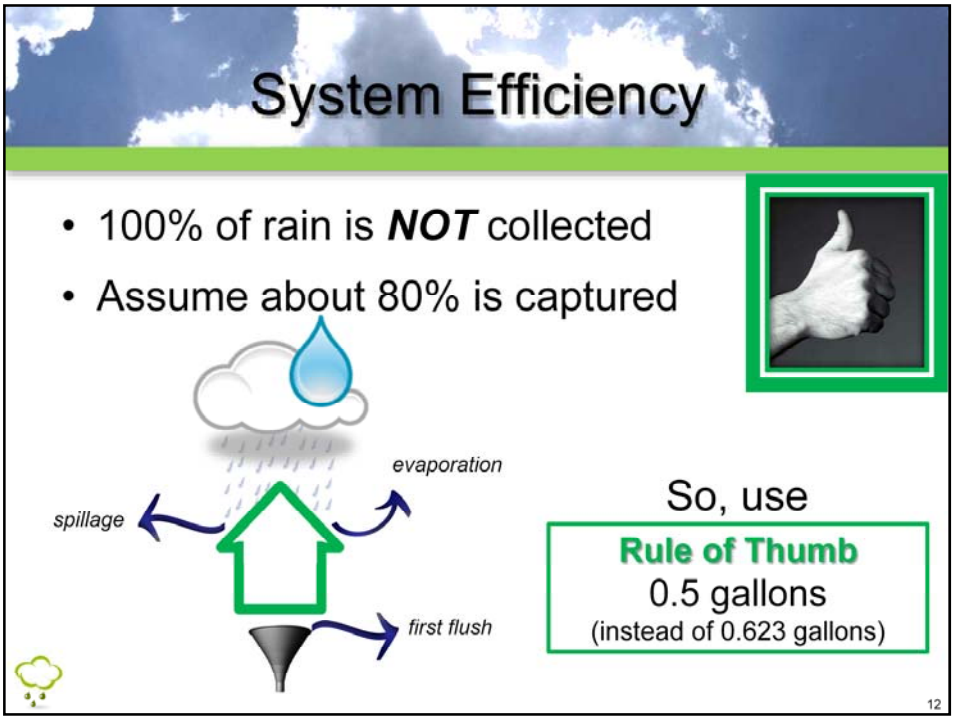

EXAMPLE
For a 2000 square foot roof:
G = A x R x 0.623
area
rainfall
conversion factor
= 2000 ft² x 2 in x 0.623
G = 2,492 gallons
11



Ever bake a batch of cookies? Even though the recipe states that you can bake a dozen, it's never exactly that much, right?

Well, try as you may, you will probably not collect every drop of water from your roof. You will lose water due to evaporation from your hot roof, spillage or overrunning of your gutters, or other factors. So, to compensate, lower factor down to .5 gallons/square foot per inch of rain.

******

In case someone asks: Why remember .623 when you tell them to use 0.500 ?

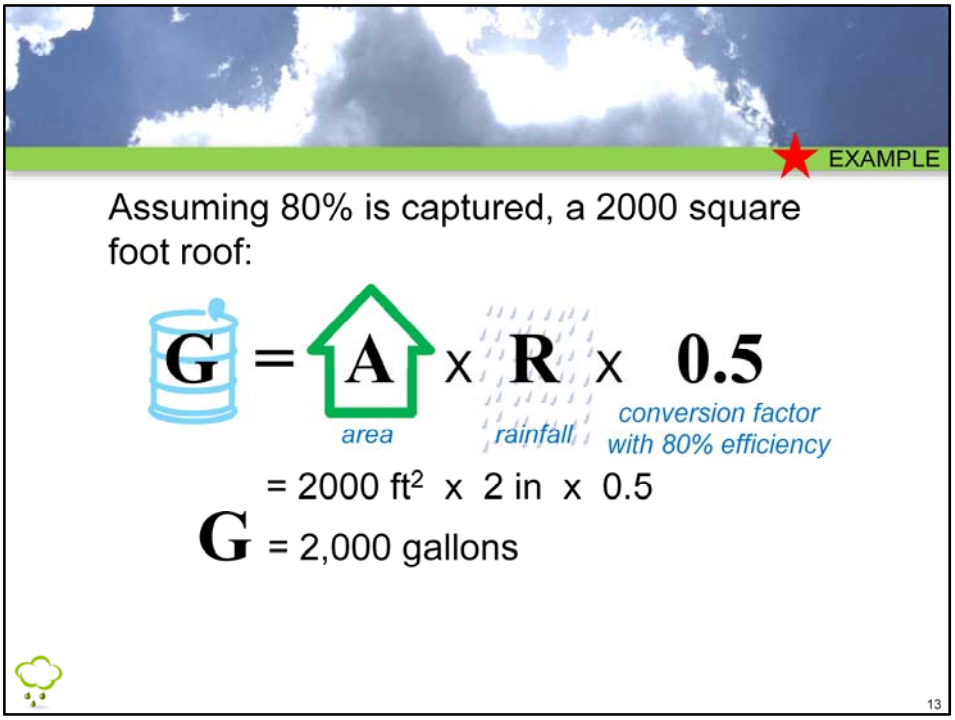
0.623 is the CONVERSION FACTOR. 0.5 is not.

0.5 takes into account water losses in the system.

0.5 = 0.623 (conversion factor) * 0.8 (runoff coefficient)

****

Runoff coefficient of 0.80 is a conservative number from *Civil Engineering Reference Manual for the PE Exam, Eighth Edition*, by Michael R. Lindeburg, PE, page A-43.



In case someone asks: Why remember .623 when you are using 0.500 ?

0.623 is the CONVERSION FACTOR. 0.5 is not.

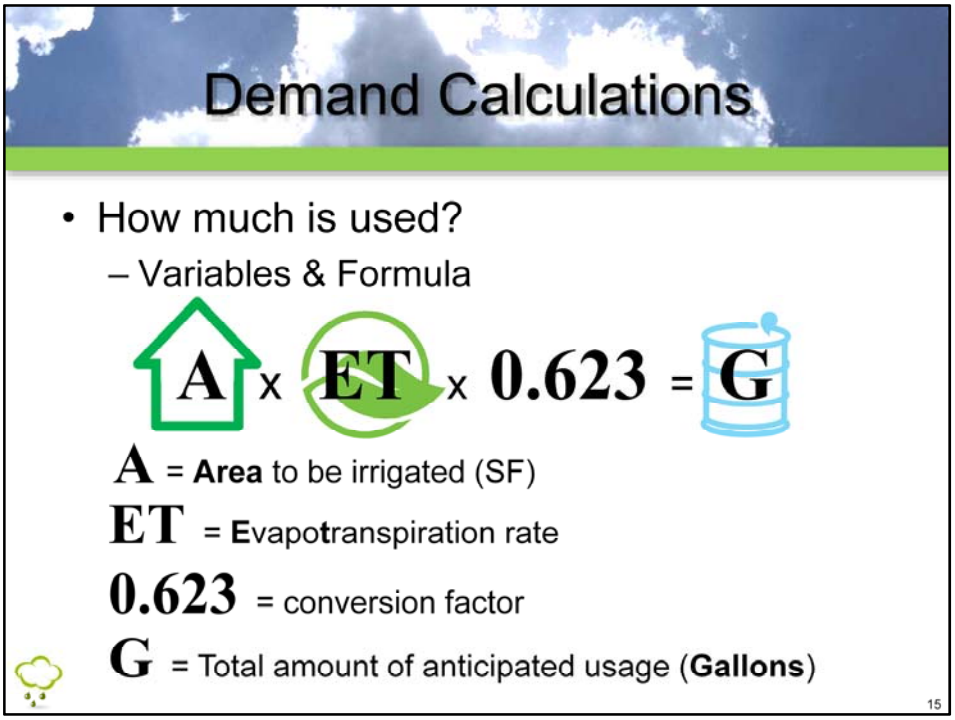
0.5 takes into account water losses in the system.

0.5 = 0.623 (conversion factor) * 0.8 (runoff coefficient)

****

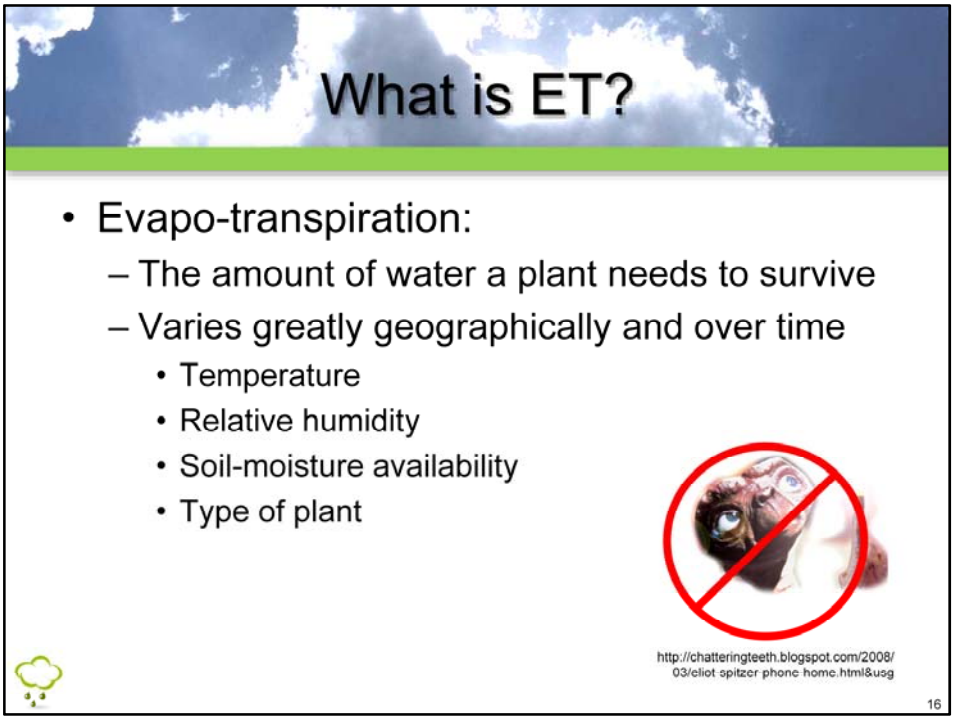
Instructions to Presenter: Arrow takes you to slide where conversion factor with water losses is broken down by units for those who require further explanation.

This is where we calculate how much water is used in irrigation.



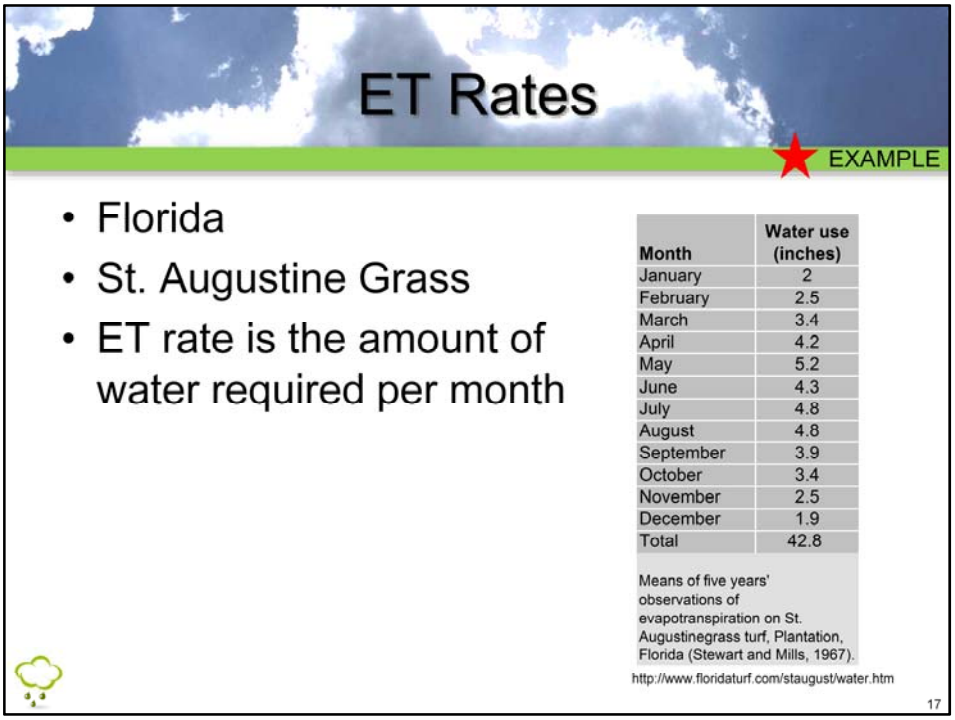
The formula for calculating water demand, in this case: how much water will be used for irrigation, is very similar to our first formula for calculating water collection potential.

We consider the area to be irrigated (in square feet), the conversion factor of 0.623. The only difference is that, instead of inches of rain, we use something called ET rate.

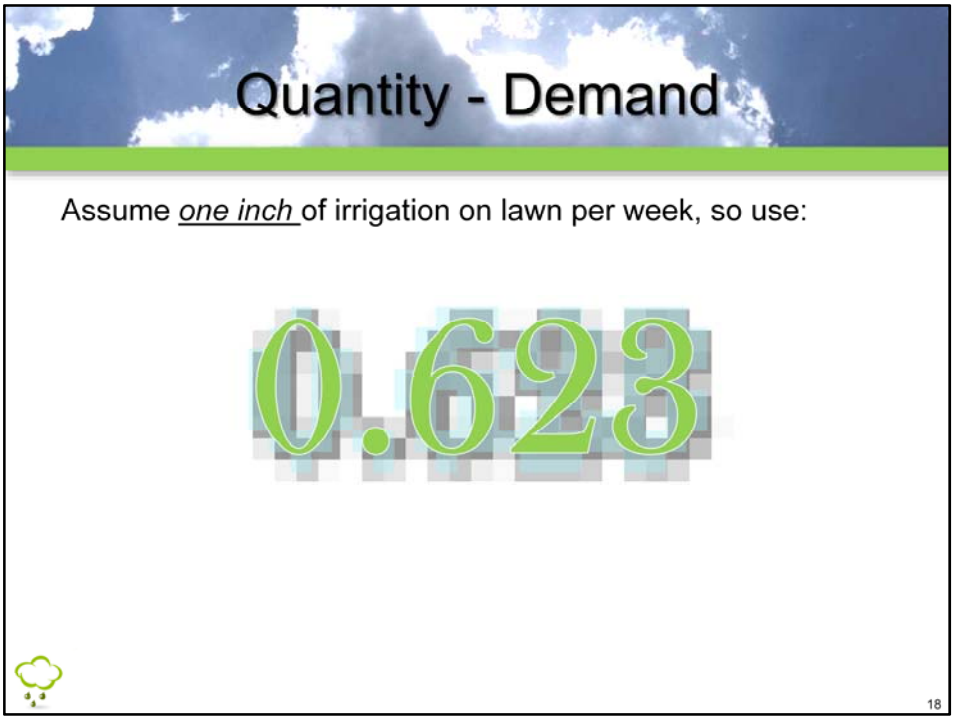


Check out the definition- Evapotranspiration (ET), defined as the evaporation from the soil surface and the transpiration through plant canopies (Allen et al., 1998), is the exchange of energy for outgoing water at the surface of the plant (Allen et al., 2005).

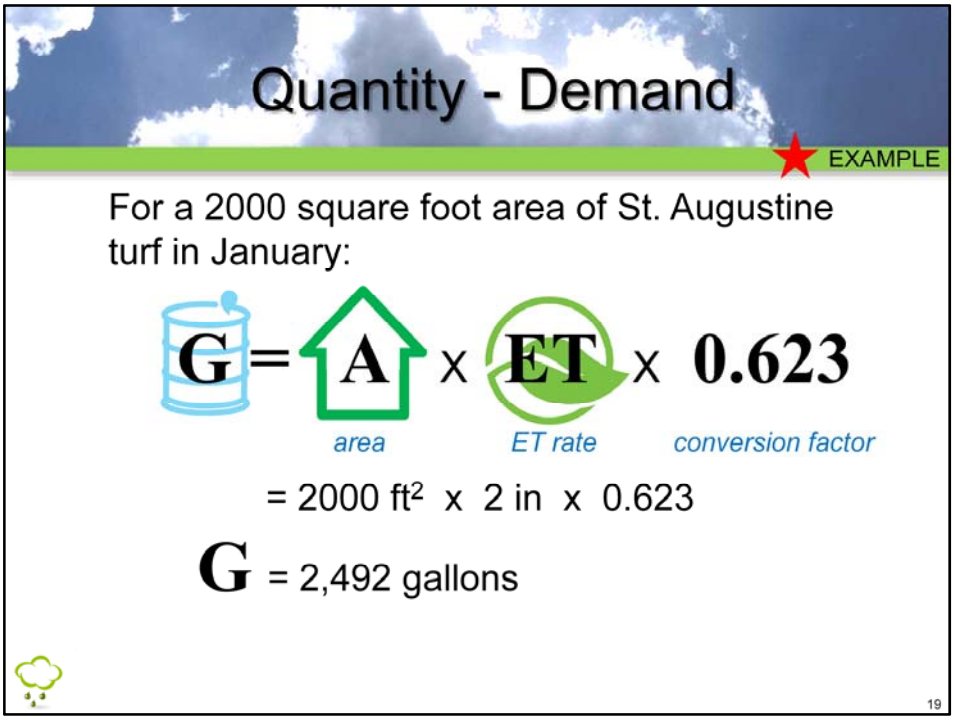
The above definition may be too 'high tech' for the layman, so simplifying it – as in slide – may be best.



So, as an example, let's calculate how much water is needed to irrigated 2000 square feet of St. Augustine sod in Florida. Let's calculate it for the month of January using 2" of water needed for that month.



Remember this number? Use this here.



Voila! This is how much water is necessary to irrigate 2000 square feet of St. Augustine in Florida for the month of January.

Quantity – Web resources

- Online calculators
  - www.arcsa.org
  - http://www.rainxchange.com/calculator.php

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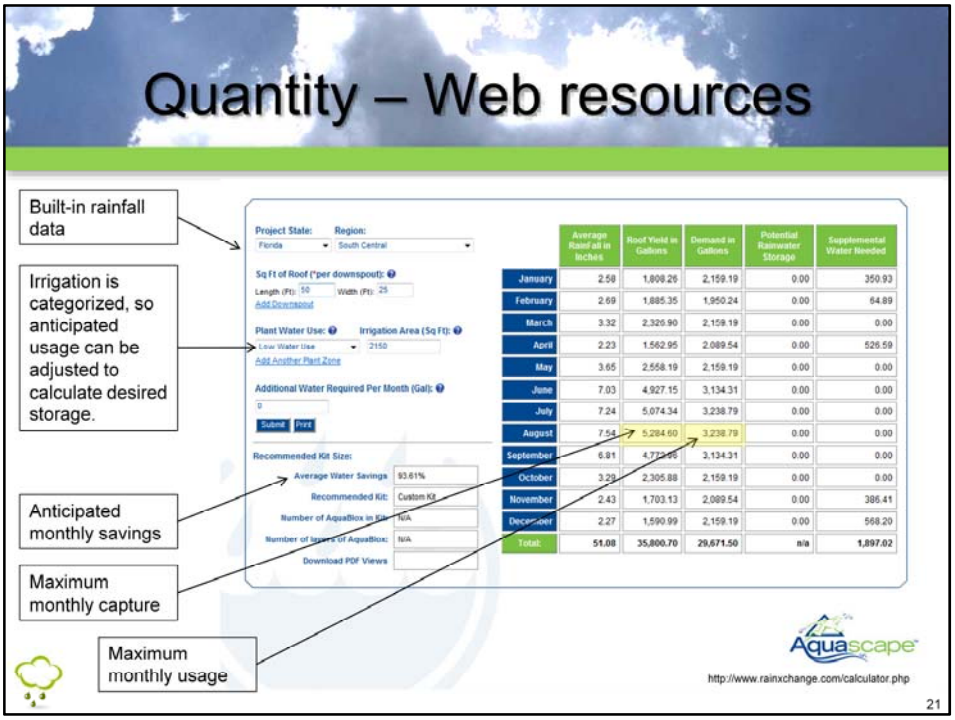
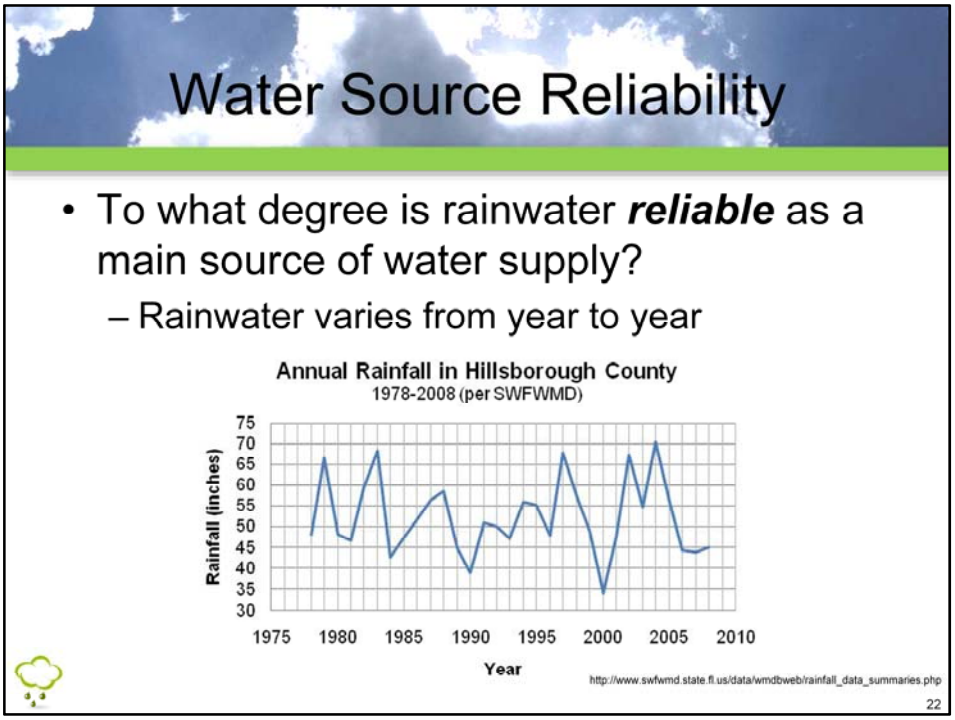


Vendors have websites that simplify the computation of rainfall potential and water use demand, as shown above. Note maximum monthly capture is approx. 5200 gallons; while maximum monthly usage at 3200 gallons. Owner must decide if they want to purchase enough that will be used, or a little bigger to capture max roof yield. Max roof yield option will allow to store that left over amount for drier months.

This is a good recommendation:

We need to size this based on warm dry season irrigation needs and mention drought conditions. Assume 50% of normal rainfall for dry period (say April and May).

Sizing should be captured at 50% of normal rainfall versus demand required. Deficit will require supplemental supply, reductions in use or modification to landscapes.



To what degree is rainwater reliable as a main source of water supply?

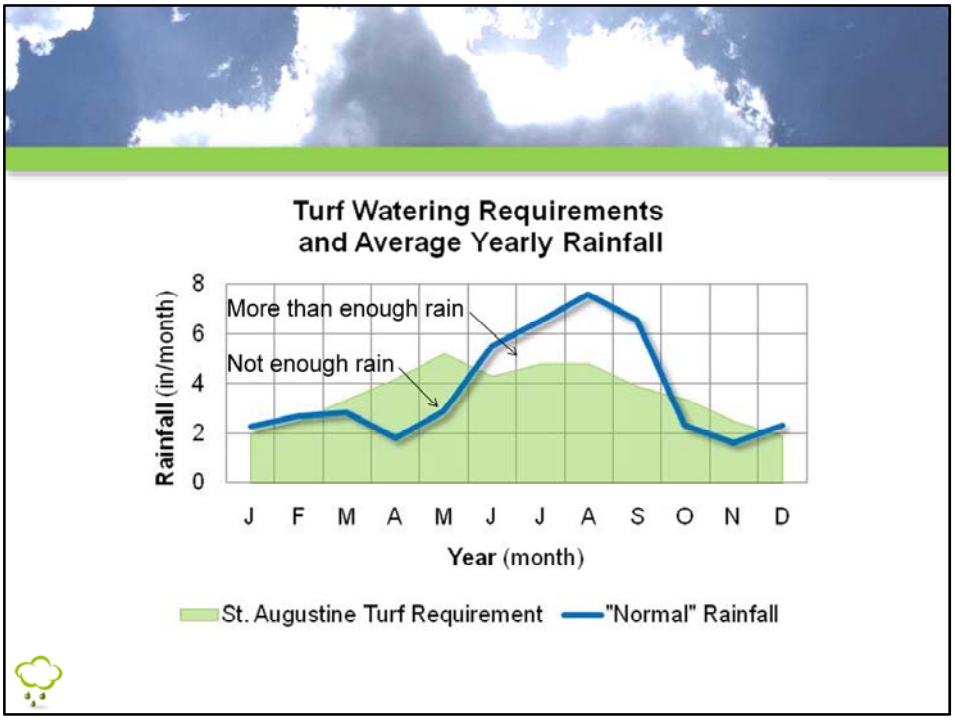
Rainwater varies from year to year

May need alternative source- BUILD YOUR SYSTEM TO MEET YOUR LANDSCAPE NEEDS IN A FLORIDA DROUGHT

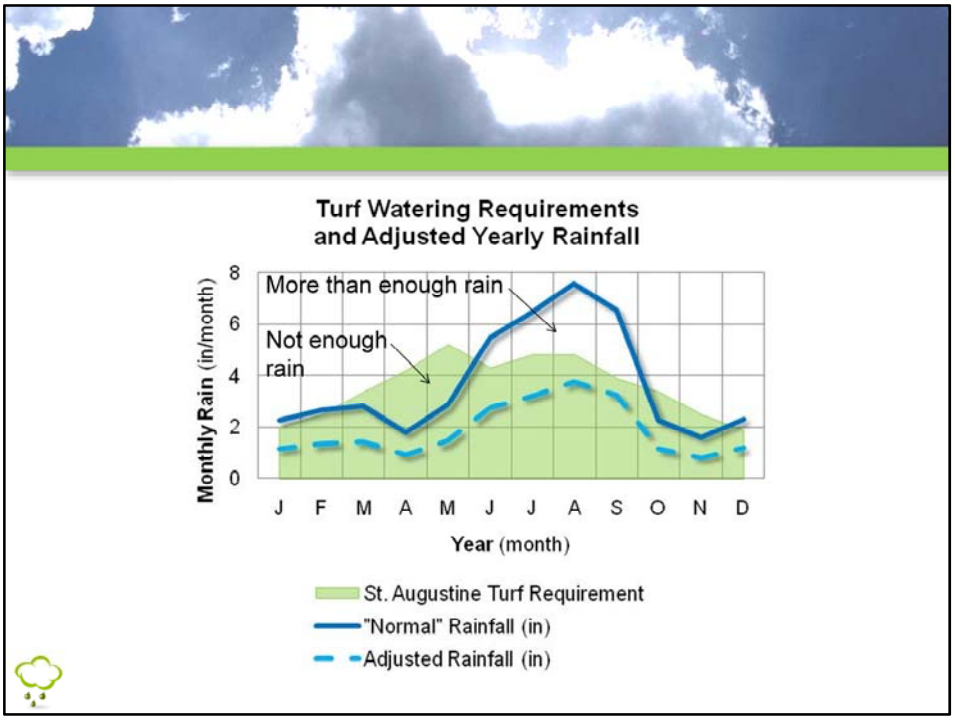
Alternative Water sources

AC Condensate

Shallow Wells

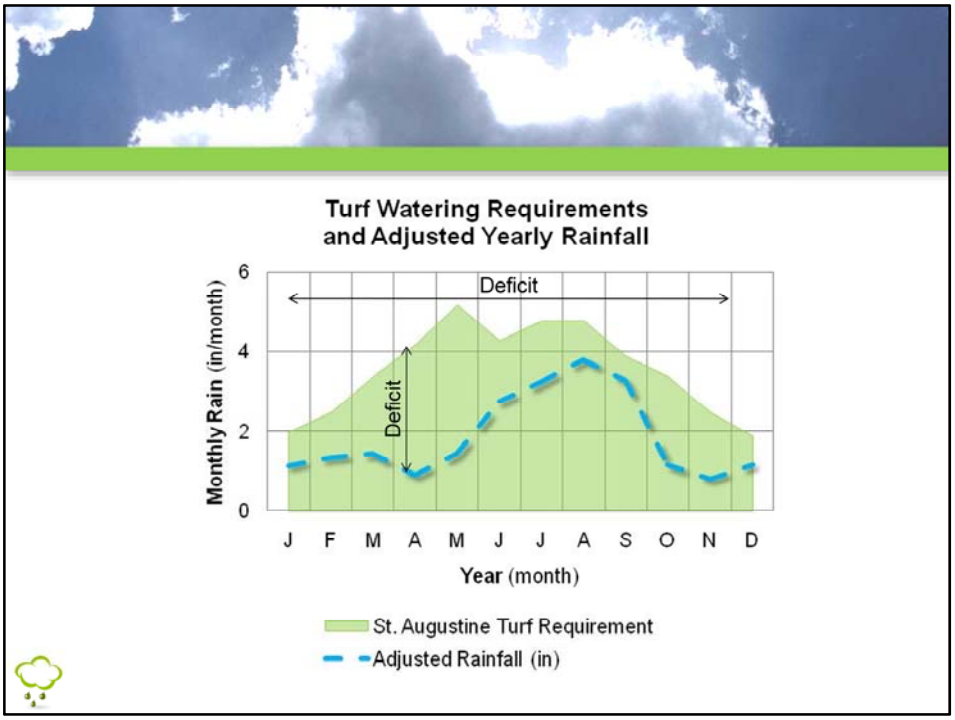


This graph shows the amount of water (in inches) for irrigation for a St. Augustine lawn per month (shown in green) and the average rainfall for our area (the blue line). As can be seen, there are times during the year that there is more than sufficient rainfall for our lawns (white space between blue line and green shading), but other times there isn't enough rain (shown where blue line dips into green shading).



During the last 3 years, we've been experiencing less than average rainfall.

In order to show this, the average yearly rainfall has been adjusted by 50%. The dashed blue line shows this as the 'adjusted' yearly rainfall. This is just a conservative number (factor of safety of 2), assuming we only receive half of the average rainfall.

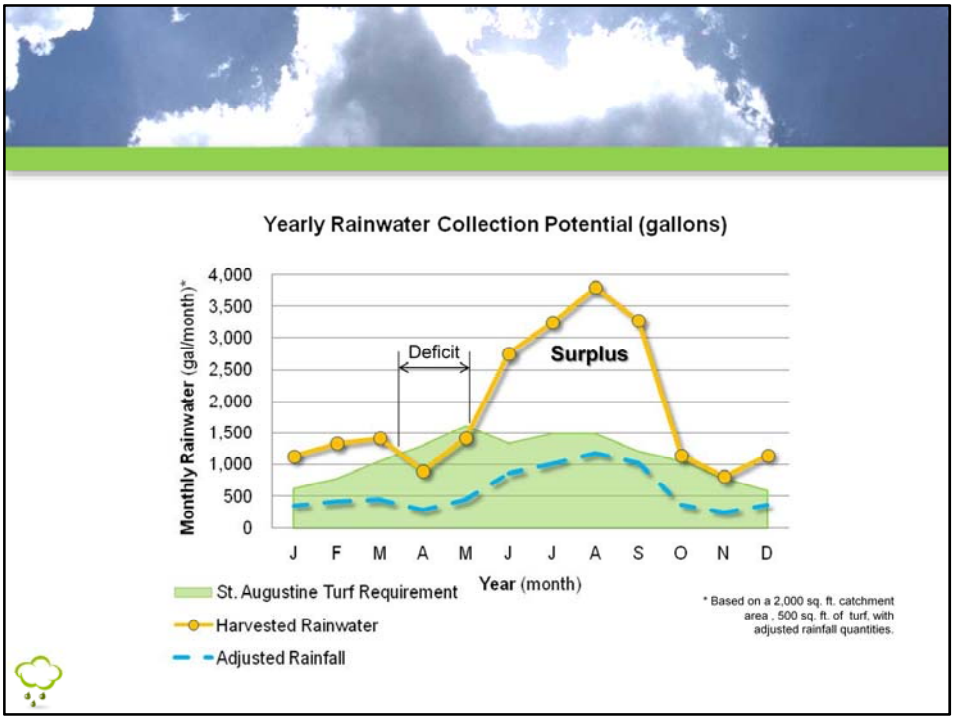


At this point, it may seem that it is impossible to irrigate using rainwater exclusively.

If we were to consider the required amount of water to irrigate St. Augustine turfgrass and contrast that with the adjusted rainfall, it would look something like this.

Click – It would seem that we now have a monthly rainfall deficit, every single month. Relying totally on the rain for irrigation would not be sufficient.

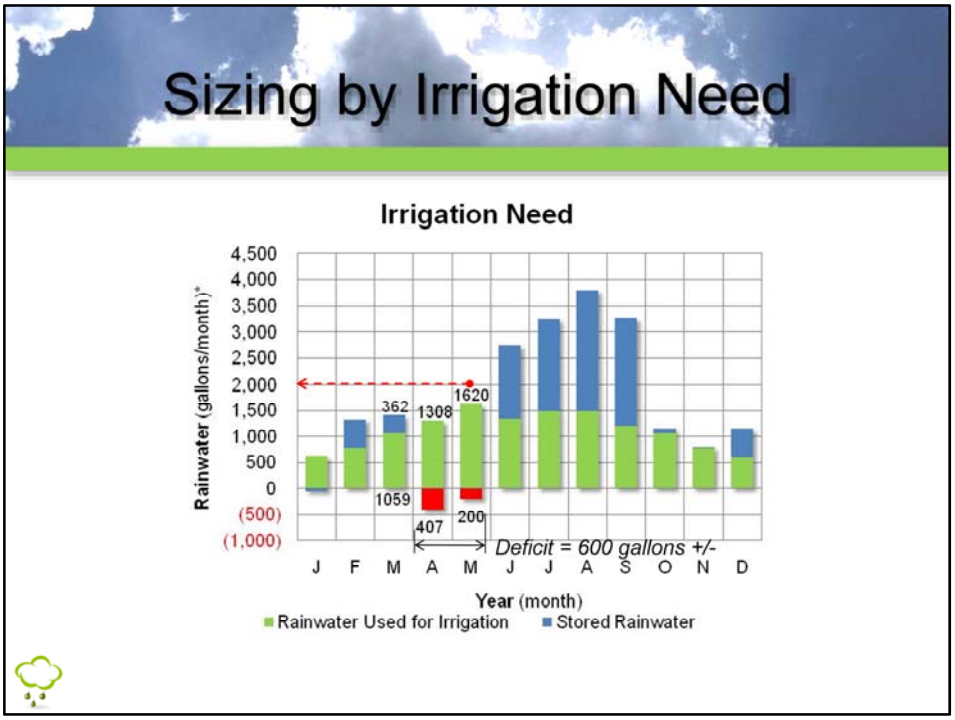
However, what if we captured the same amount of inches of rainfall on our roofs using a cistern? What would happen then?



What would happen is that we could actually capture the same number of inches of rain…and store it until we needed it?

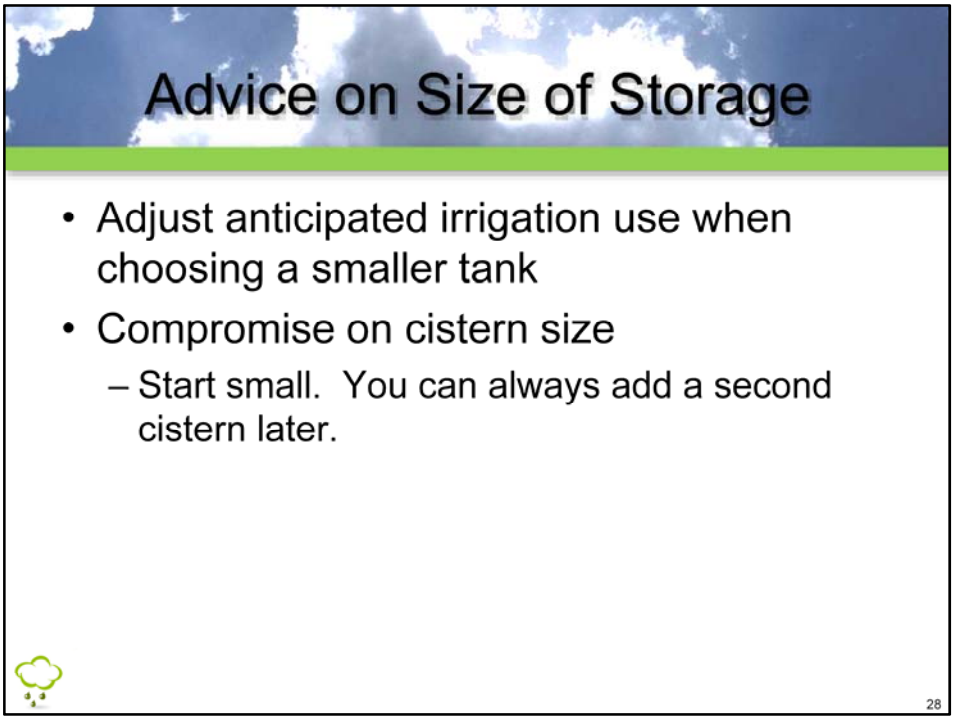
Suppose we had a 2000 sq. ft. catchment area and 500 sq. feet of St. Augustine turf to irrigate. This graph shows how many gallons of rainwater can be collected and how much is needed for irrigation.

Now we can clearly see parts of the year where there is a surplus and others where there is a deficit – or need – of irrigation water. In this particular instance, a **surplus** occurs between June and late September. A small **Deficit** occurs in March through late May.

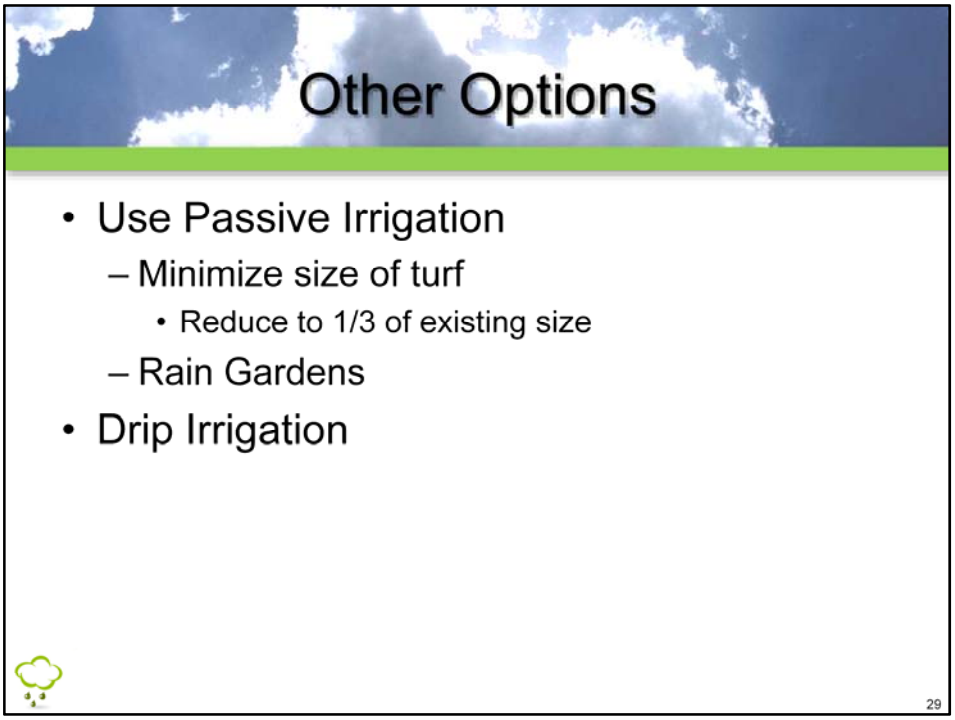


What size cistern is needed?

Here, green represents the harvested rainwater used for irrigation and the blue, the rainwater that is stored in the cistern.
The deficit that occurs in April and May, which accounts for about 600 gallons, should be added to total amount needed in April. The minimum capacity required during April is 1,915 gallons (1,308 + 407 + 200) to make it through the 'dry period' of April and May. This happens to be the maximum amount of volume stored throughout the year, as no other month requires this much volume. For this particular case, an adequately sized cistern is one whose capacity is approximately 2,000 gallons.

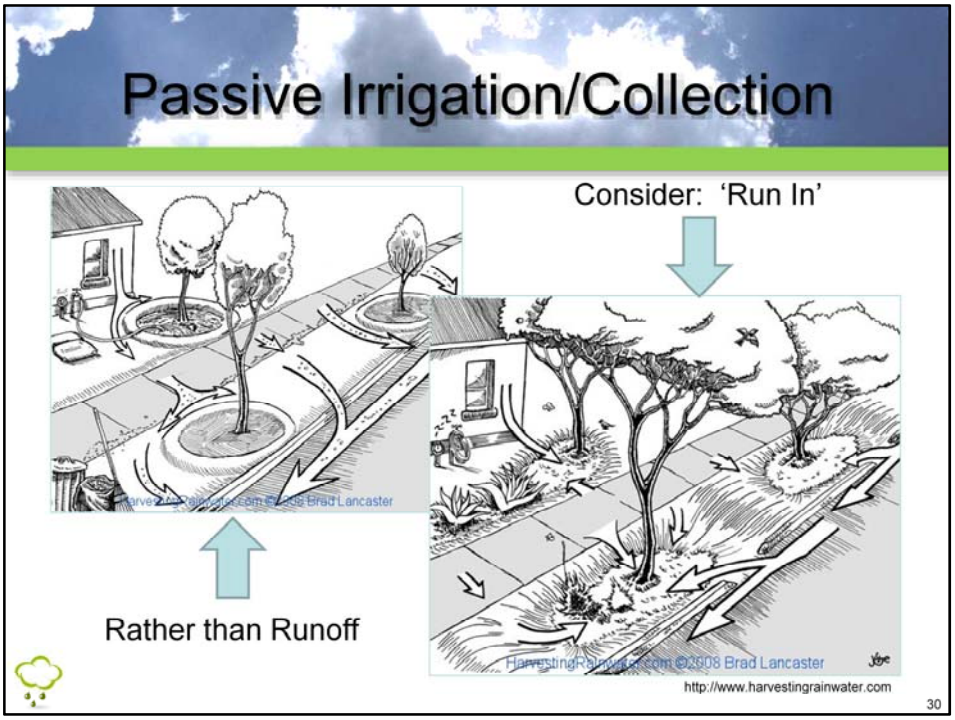


Adjust how much you intend to water. Maybe just water front yard and flower bed. Let the back go.



Conservation can be a big part of your overall plan in using rainwater for irrigation.

One good method for irrigation can be passive irrigation. What is that?
Should we build in FYN concepts here? Yes!



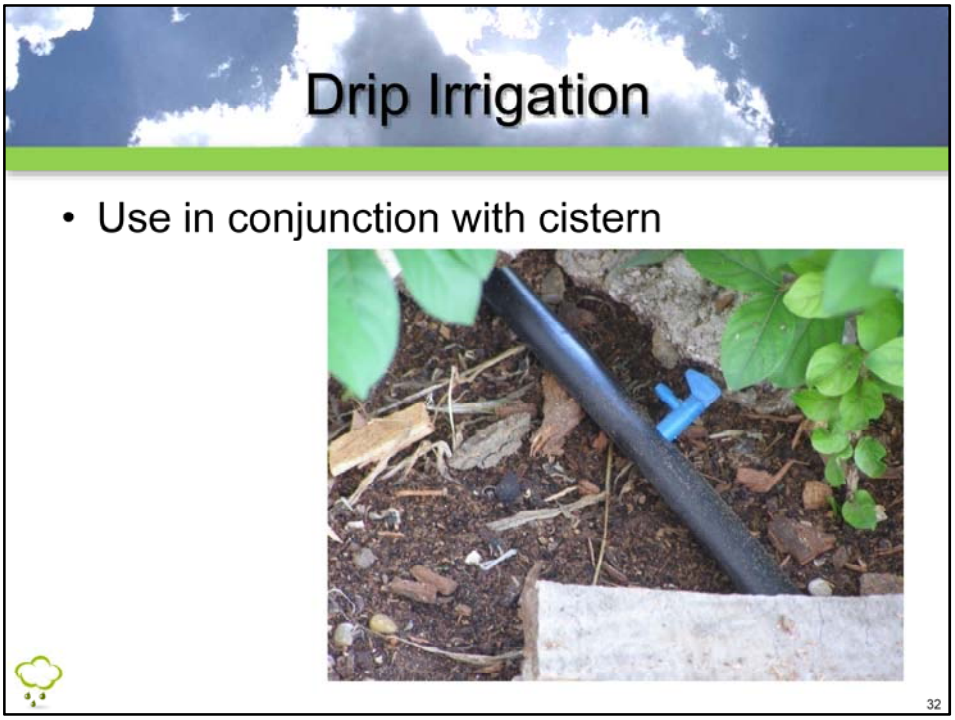
Presenter to explain the difference between these to diagrams. Rather than letting water drain to street to storm drains, capture water by grading yard to automatically capture some rain in beds and where trees are planted. Mulch these areas so that water isn't quickly evaporated.

These are recommended for new development. In attempting to incorporate this method in existing development, danger lies in (1) flooding your neighbor and (2) disturbing or damaging buried utilities (cable, telephone, water, sewer) or existing swales. Therefore it is discouraged.

**********Good time to show Movie by Brad Lancaster on Passive Irrigation**********

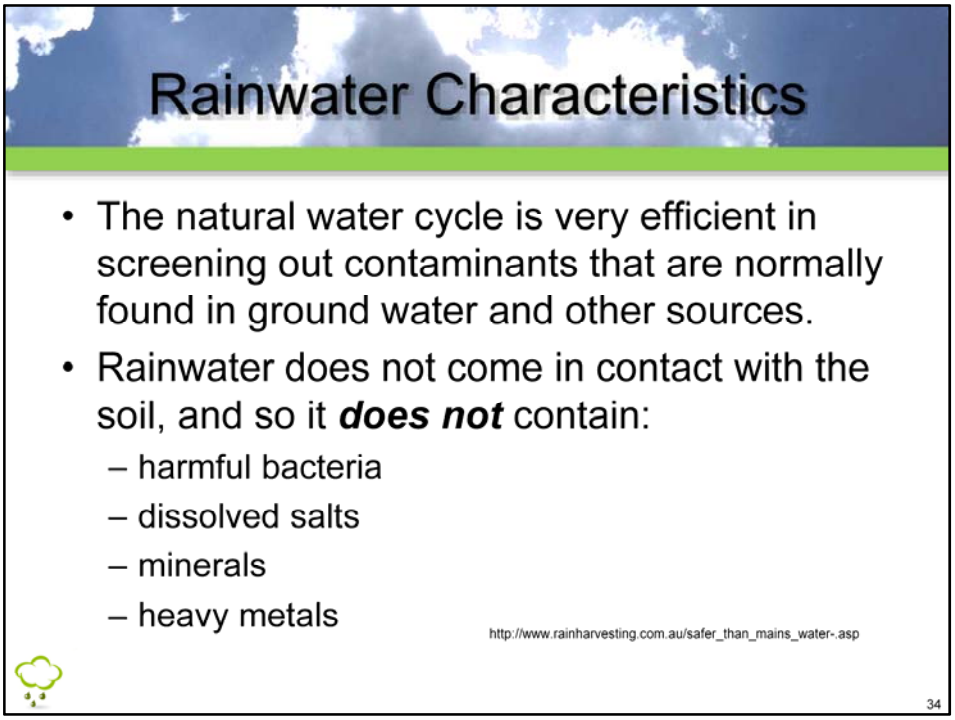
http://www.youtube.com/watch?v=k9Ku_xpyLK4&feature=related

Rain garden allows runoff to re-enter the soil, and is a place where drought-tolerant plants are used to provide an aesthetically pleasing landscape. Work with your FYN program to help determine how to do this.



Switch to drip irrigation. This allows water to be delivered directly to roots and avoids water to be lost to evaporation as in spray irrigation. In many cases pressure requirements can also be low!

There is no need to be afraid of the quality of rainwater.

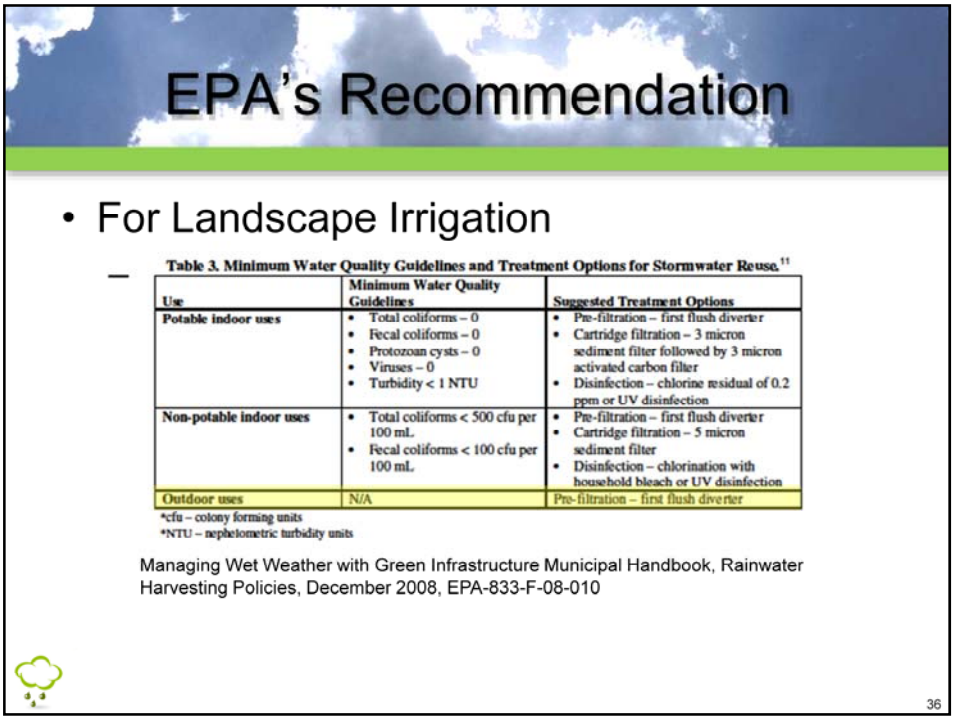


Rainwater is very clean.

Reliability of Quality

- Quality changes with surfaces it comes in contact with:
  - Catchment surface
  - Level of sanitary care in collection
    - Separation of first-flush improves quality
    - Effective filtration
  - Cistern material
    - NSF certified (for potable systems)
    - UV protected tanks (prevents algae growth)
  - Seasonal contaminants
    - Pollen

35



How much treatment is needed?

Non-potable uses

Minimal treatment

Filter – remove sediments, etc. runoff from roof (as mentioned earlier)

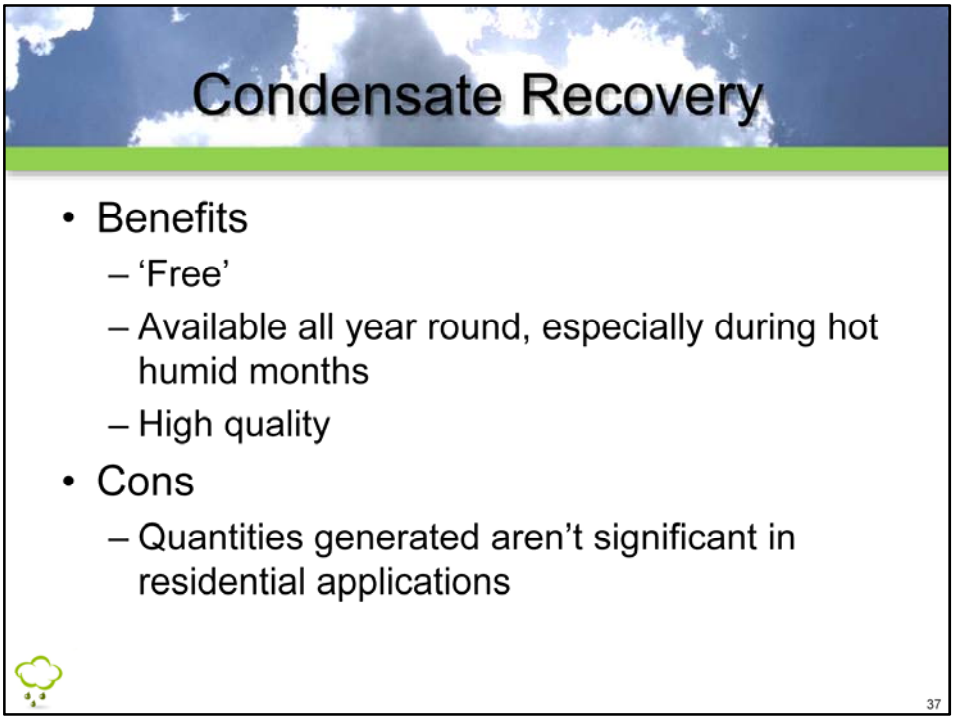
Potable (not addressed here)

Significant treatment

Filtering

****

When the water is to be used just for landscape irrigation, only sediment filtration is typically required. – Sustainable Construction – Green Building Design and Delivery – Charles J. Kibert



Condensate recovered from residential applications can vary between 3-5 gallons per day. Factors that influence condensate recovered is load size, load efficiency, interior relative humidity,

Shallow Wells

- Quality/quantity may not be as reliable as rainwater
- Permitting required by WMD

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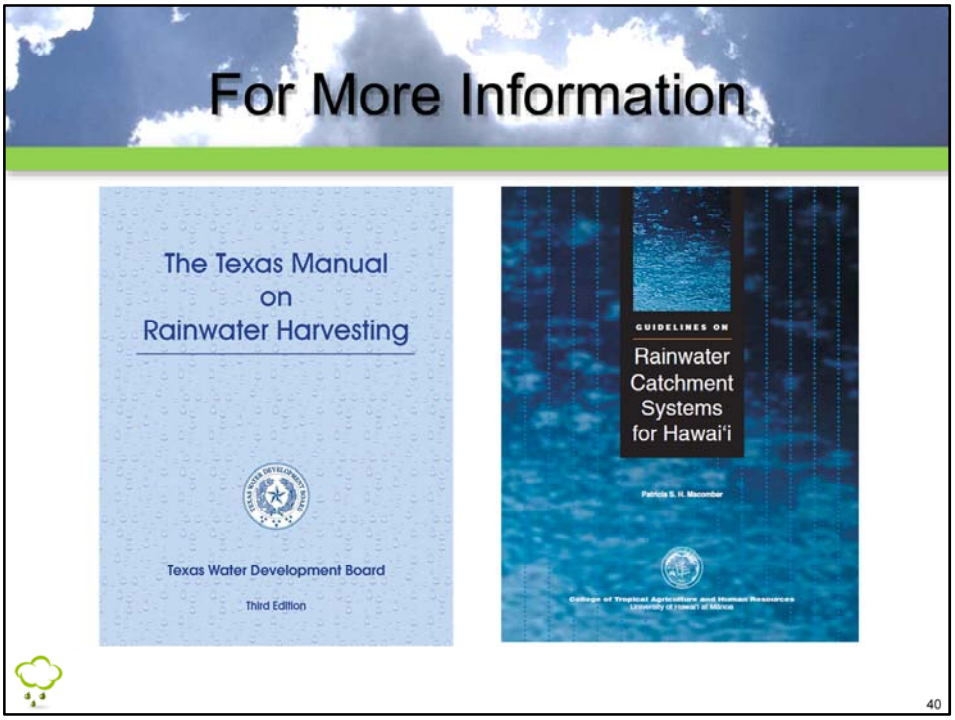
System Components Reliability

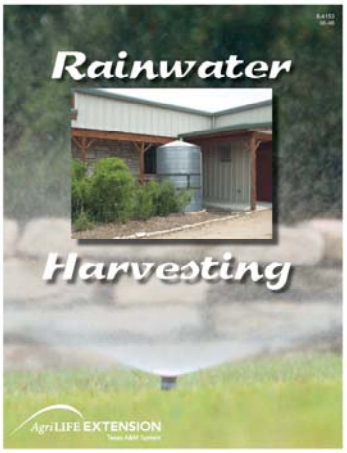
- Depend mostly on *regular inspections and maintenance*
- Look to manufacturers for information
- Life of equipment
  - Filters
    - for potable systems: 3 to 6 months
    - roof washing type, much longer.
  - Pumps
    - about 3 years
    - With a pressure vessel, much longer.
  - Tanks - about 20 to 30 years, depending on material and environmental conditions

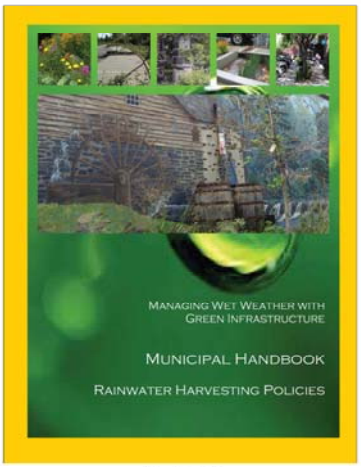
39



These guides are very useful and available online.

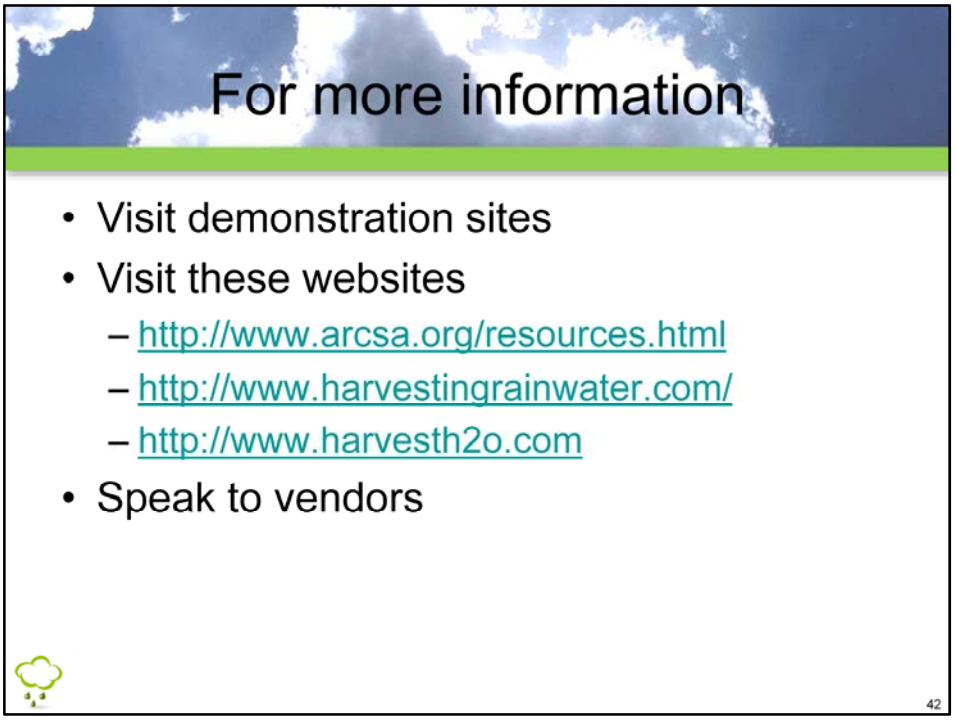
For more information





By EPA

41



Tell us why these sites are good to view?

ARCSA (American Rainwater Catchment Systems Association) website has a wealth of information.

Harvesting Rainwater.com is easy to read information

Harvest H2O has many articles on rainwater harvesting

There are others too. Surf around!

Speak to vendors that are here sponsoring , and use our presentation as a starting point on purchasing your system.

Quiz

Q1: What is passive collection/irrigation?

A1: Contouring yard to create depressions where plants can naturally be irrigated.

Q2: How is a cistern sized?

A2: Based on landscape irrigation demand.

Q3: What is 0.623?

A3: Approximately how many gallons one inch of rain falling on one square foot of area is equal to.

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Questions?
Q
44

Training Resources

- Brad Lancaster Passive Irrigation/Cisterns
  - http://www.youtube.com/watch?v=k9Ku_xpyLK4&feature=related

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For more information
florida
Rainwater Harvesting Initiative
http://mbr.eng.usf.edu/rainwater/ or email to Florida RHI@gmail.com
ARCSA
American Rainwater Catchment Systems Association
TAMPA BAY WATER
Supplying Water To The Region
USF
UNIVERSITY OF SOUTH FLORIDA
UF
UNIVERSITY of FLORIDA
IFAS Extension
Florida Yards & Neighborhoods
fis
MANAGING EVERY DROP
46

Thank you to our sponsors

47

florida

Rainwater Harvesting Initiative

thanks you for attending!

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Short Cut

Why does this work?

0.8	x	1 ft /12 in	x	7.48gal/ft^3	= **0.5** = **G**
80% efficiency		Convert rainfall inches to feet		Convert cubic feet to gallons	

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APPENDIX B

Rainwater Harvesting With Cisterns for Landscape Irrigation

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ABSTRACT
The purpose of this paper is to present the technical content and sources reviewed in the development of the Florida Rainwater Harvesting Initiative's public training workshops. Said workshops are to be presented by FYN (Florida Yards and Neighborhoods) program either as a substitute or in conjunction with the Rain Barrel Workshops throughout Florida.

This paper describes the major parts of a rainwater harvesting system, the function of each, and what components may be necessary specifically for landscape irrigation use. Estimating irrigation demand and calculating cistern sizing based on demand are also considered.

INTRODUCTION
An ample water supply meant the survival of many ancient civilizations. The inhabitants of the ancient middle- eastern city of Petra were able to control their water supply by the use of dams, cisterns and water conduits. They developed the ability to store water during prolonged droughts. Their plentiful supply of water put them on the map as a hub for the east-west trade route.[1] For the ancient Mayans living in the city of Sayil, water was quite scarce. The water table lay 200 feet below ground which motivated them to discover how to collect and store rainwater. Archaeologists have discovered that each household had at least one underground cistern.[2] Even below the streets of the famous ancient city of Alexandria lies a system of cisterns.[3]

Today, water's scarcity is also making it a very valuable resource. Only 2.5% of the world's water is freshwater. Of that 2.5%, 0.3% can be found in our lakes and rivers. The rest is either frozen as ice and snow, or below ground.[4] Not only are fresh water sources limited, but drought conditions, together with increasing population and the lack of availability of potable water make it even more valuable. Several regions in the United States, including the Tampa Bay area, are currently experiencing drought conditions that are expected to persist.

In some parts of Florida, irrigation can account for over 50% of a single family's water use. Therefore, a logical first step in solving the water shortage problem is mitigating potable water use for irrigation. This can be accomplished by educating citizens and businesses to reduce their use of potable water for irrigation and substituting an alternative water source, such as rainwater. This strategy is gaining popularity in the Tampa Bay region. For instance, local citizens are on a waiting list in order to benefit from Hillsborough County's Extension Office free Rain Barrel Workshops.[5]
An important lesson that rain barrel users learn in harvesting their own water is that the typical 55 gallon rain barrel captures only a fraction of

[1] (The Jordan Tourism Board, 2008)
[2] (NOVA, 2008)
[3] (Dunn)
[4] (United Nations Environment Programme (UNEP))
[5] (University of Florida, 2008)

the available rainwater that falls on their roof. For example, (see Figure 1) a 2,000 square foot roof can capture almost 23,000 gallons per year, while a mere 700 is captured by rain barrel. That is only 3% of the available rainwater; nearly 97% is lost. This is a motivating factor in moving towards larger storage medium, such as cisterns.

Another indicator of the public's acceptance of rainwater harvesting is the growing number of buildings that use cisterns. Rinker Hall at the University of Florida in Gainesville has an 8,000 gallon cistern to collect rainwater for toilet flushing. Similarly, Learning Gate Community School in Lutz has a 10,000 gallon system for toilet flushing. Cisterns are not only for schools, or for toilet flushing. A residential home in St. Petersburg, Florida stores 1,000 gallons of rainwater by cistern for landscape irrigation.

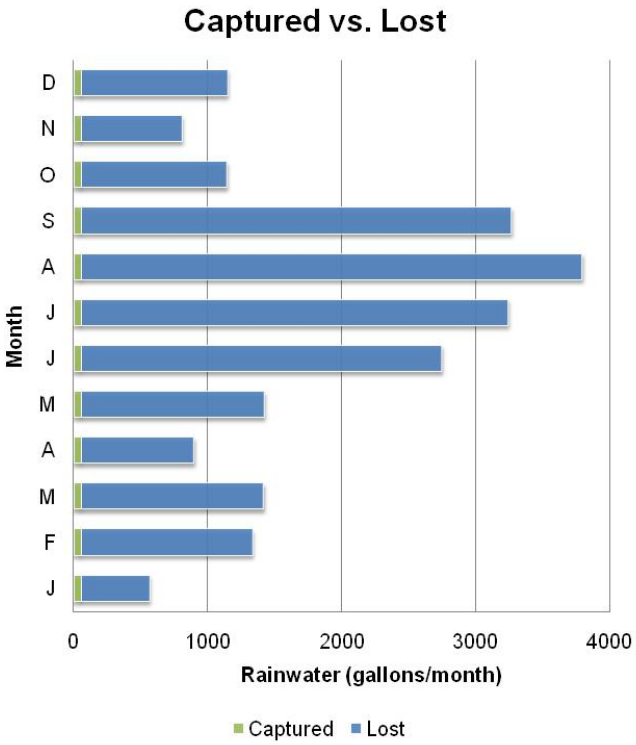


Figure 1 – Rainwater Capture by Rain Barrel

BENEFITS AND USES OF RAINWATER

There are many benefits to harvesting rainwater:

- Environmental reasons include reducing stormwater runoff (by creating on-site stormwater retention)
- Using less energy and reducing green house gases from reduced potable water system demand
- Homeowners have greater water independence, a reliable source for irrigation, decreased water bills, a capital improvement to their property
- Developers can count on 'diverted' water from irrigation to be available for new residential or commercial development

Though the focus of this research is for the application of landscape irrigation (non-potable), there are also many other uses for rainwater: outdoor applications, such as washing cars, replenishing pools and fountains, indoor uses such as toilet flushing, clothes washing and showering, industrial processes, and, with proper filtration and treatment, even for drinking. Different design criteria, regulations, costs and health concerns will apply for systems other than those intended strictly for landscape irrigation.

THE RAINWATER HARVESTING SYSTEM

There are five main parts to a rainwater harvesting system (see Figure 2):

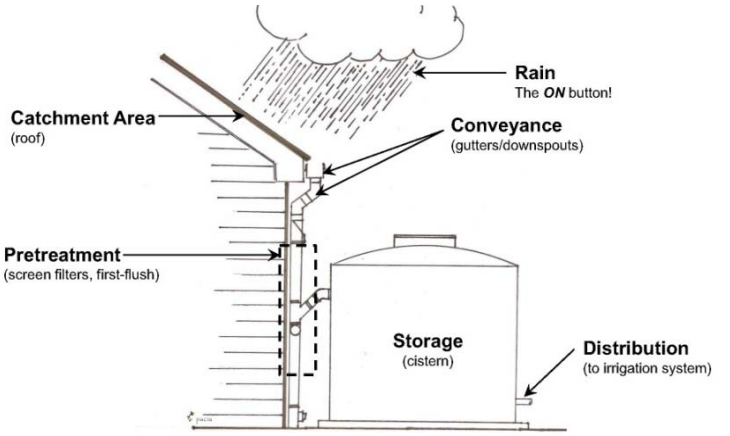
- Catchment Area (roof)
- Conveyance (gutters/downspouts)
- Pretreatment (filters, first-flush)
- Storage (cistern)
- Distribution (to irrigation system)

Catchment Area

The catchment area can consist of mostly anything. Island dwellers use tarps attached to trees to capture rainwater. However, if harvesting rainwater for use relative to a building, using the existing roof surface makes more sense.

Catchment surface material is not of primary importance when the intended use is irrigation. For potable applications, however, this becomes more of an issue because of the possible leaching of contaminants into the water that is collected (such as from asphalt shingles). Material is also an issue when considering how much is to be captured (system efficiency), as well as how quickly any given rain event 'washes' particles from the roof's surface. In other words, the slicker the material is, the quicker debris is washed off and the greater the quantity of clean water that can be captured.

The size of the catchment area determines the harvesting potential for the intended application. This aspect is addressed under the topic of System Sizing.



Source: *Harvesting Water for Landscape Use* by Patricia H. Waterfall, p. 34 Original diagram was modified for this application.

Figure 2 – Anatomy of the System

Conveyance

Conveyance consists of gutters and downspouts. This part of the system moves the captured water from the roof, through gutters and downspouts, down to the storage tank or cistern. Various materials are used with the most desirable being the aluminum seamless type. Seamless is desirable for two reasons (1) less water is lost if it is water tight and (2) less opportunity of mosquitoes to penetrate the system and infest the stored rainwater. As with standard gutter system design, the size and slope of the catchment surface determines the number of downspouts required and the location of downspouts relative to the gutters. The distance from ridge to eave also determines the size of the required downspouts and the frequency a downspout is needed.

A common issue with gutters is that leaves and twigs interrupt the flow of water, requiring frequent cleaning. Gutter accessories minimize the frequency of maintenance, with the ultimate goal being the collection of the cleanest water possible for storage.

Pretreatment

Pretreatment (or filtration) usually occurs between the downspout and the storage tank, removing impurities before they reach the tank. Debris and contaminants can consist of leaves, twigs, dust or particles (from shingles or pollution), and possibly bird droppings.

Pre-filtration screens are screened baskets that hold back larger debris (such as leaves, twigs, and pollen pods). Some must be cleaned regularly (like the filter in a clothes dryer - after every cycle); others are virtually self-cleaning, and require minimal maintenance. The self-cleaning types have two drawbacks: they (1) tend to lose water in the process and (2) are more expensive.

Another level of filtration that is commonly used is the 'roof-washer' or a first-flush device. Its purpose is to capture the first part of a rain event, with the intent of diverting the dirty or contaminated water (e.g. bird dropping residue) from entering the tank. In doing so, the stored water will remain relatively free from contamination and will minimize the frequency of cleaning the interior of the tank. Since there are many variables that can affect how quickly a roof is 'washed' with a rain event (e.g. intensity and time since previous rain event, slope and porosity of catchment surface), there are disagreements on how much should be flushed. Some sources say 10 gallons for 1000 square feet of catchment surface[6]. Others say more. Another school of thought subscribes to no flushing at all. This method may be used where rain is scarce and collecting every possible drop is more important than how clean the water is. Water quality is improved post-storage, by adding a filtration system (a combination of a series of filter cartridges with ultraviolet light or other treatment as needed and required by local agencies) prior to use.

One final level of filtration that is commonly used with cisterns for irrigation is one that is within the tank itself: the floating suction filter. This filter is attached at the end of a hose which floats on the water surface and collects the water near the top of the tank. With very few particles floating on the surface (most of the particles accumulate at the bottom of the tank), suctioning water from the top of the tank would provide the cleanest water possible.

Storage

The cistern is the storage component of the rainwater harvesting system. It is available in an infinite amount of colors, sizes, shapes and types of materials. If a pre-fabricated tank is selected, it should be black, a dark color, or UV resistant, such that no light can penetrate it (sunlight penetration encourages algae growth within the tank). Both above and below ground

[6] (Texas Water Development Board, Third Edition, 2005, p. 8)

type cisterns are available. Underground tanks require excavation costs and more structurally sound walls, which may be more expensive than installing a tank above ground. As far as costs are concerned, the cistern is usually the most expensive component of the rainwater harvesting system.

Any given cistern (above or below ground) will require an inlet, an outlet, an overflow and a manway (see Figure 3). The overflow will be positioned close to the top of the tank in case collected rainwater exceeds the cistern's capacity. Overflow should be routed away from the tank (either by piping or site grading) to a location that can accommodate the overflow volume and will not cause erosion or flooding. A flap valve (or similar device) should be used at this opening to keep out unwanted animals or insects. The manway is essential to allow access to the inside for cleaning/servicing the tank. It should be safely secured at all times to keep out animals and children. The cistern is considered a confined space; appropriate safety procedures should be followed.

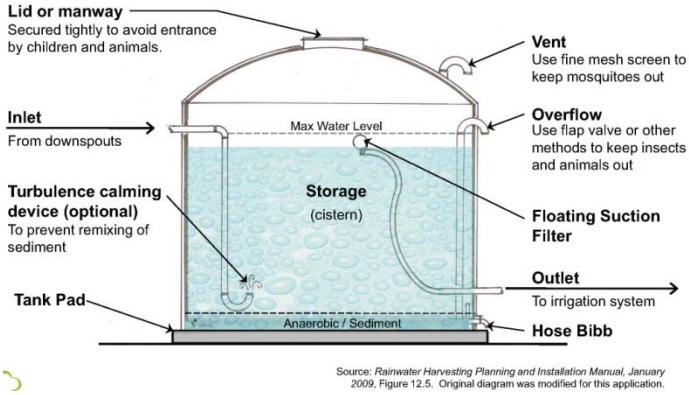


Figure 3 – Anatomy of a Cistern

Some recommended options for the tank could include a:

- Hose bibb - for ease in emptying the tank
- Turbulence calming device - since particles and debris tends to settle at the bottom of the tank, this would minimize mixing when water enters the tank.

Distribution

Ultimately, the system will need to be connected to the irrigation system. A pump is needed in order to provide sufficient head for water to be distributed to the desired location. The down side to a regular pump is that water is not 'ready-to-go' at a moment's notice, but rather pump needs to kick on and build up pressure in the system for use. For the pump, this would mean short on-off cycles until demand is met, and thus shortening the pump's life. A pressure tank system would provide water (under pressure) between cycles, eliminating both the constant cycling and wait times between cycles. Consulting a plumbing professional is highly recommended in selecting the best equipment for each application.

SYSTEM SIZING

There are several methods for sizing a cistern:

- Water Balance Method
- Major Storm Event Method
- Demand Method

The water balance method is similar to balancing a checkbook. Using the size of the catchment area, the amount of potential rainwater capture would be calculated and added as the amount coming 'in' to the system, subtracting monthly demand (amount needed for irrigation as amount coming 'out'), and evaluating the size and affordability of storage capacity.

The major storm event method sizes the cistern by assuming to collect all available rainwater during the heaviest storm event. For example, if the largest storm event has been measured to be approximately 4 inches, then the catchment area is multiplied by the conversion factor and runoff coefficient. Said volume would be the cistern size.

Since the Tampa Bay region does not experience long periods of drought (it rains most months), the most appropriate method is the demand method. It would determine tank size according to the amount of anticipated water demand. Rainfall capture potential is calculated by a simple formula:

Equation 1: $A \times R = G$

Where
A = Catchment area of building (in square feet)
R = Inches of Rainfall (inches)
G = Gallons of Rainwater collected (gallons)

Size of Catchment Area

Step one would be to calculated the rainfall potential for the catchment area available. Calculating the area is as simple as multiplying

the length times the width of the roof. The key is in calculating the *roof footprint*, regardless of how the roof is sloped.

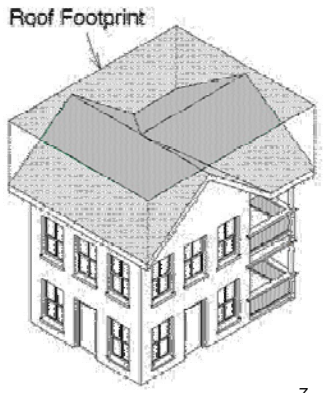


Figure 3 – Roof Footprint [7]

Amount of Rainfall
There is a rule of thumb that is used to quickly calculate rainfall potential:

> ***Rule of Thumb***
>
> *One inch of rain falling on one square foot of catchment area = 0.623 gallons of rainwater collected.*

We can think of a 'slice' or 'chunk' of rain that is one inch thick and one square foot in area equaling 0.623 gallons. Basically, this number is a conversion factor that converts inches per square foot to gallons. The equation now becomes

Equation 2: A x R x 0.623 = G

For a 2,000 square foot catchment area and 2 inches of rain,

2000 sq. ft. x 2 in x 0.623 = ***2,492 gallons***

However, 100% of the rain is not generally captured. There are factors, such as evaporation, the over-running of gutters, water loss due to filtration and/or first-flush, which reduces the captured amount. The runoff coefficients (C-Coefficients) for roof surfaces can vary from 0.7 – 0.95[8]. Because of this, another rule of thumb is used:

> ***Rule of Thumb***
> *(which includes runoff coefficient for losses)*
>
> *One inch of rain falling on one square foot of catchment area = 0.5 gallons of rainwater collected.*

The above rule of thumb reflects a C-Coefficient of 0.8. A more accurate estimate for capture potential would be:

Equation 3: A x R x 0.5 = G

2000 sq. ft. x 2 in x 0.5 = ***2,000 gallons***

Water Use Demand
The same general equation applies with regards to water demand, with only one difference: instead of rainfall, ET (evapotranspiration factor) is used.

Equation 4: A x ET x 0.623 = G

ET is the sum of evaporation and transpiration, which is basically the amount of water a plant needs. Each plant type requires different amounts of water in order to survive. ET rates also vary geographically and over time.
A good source for ET rates for the Tampa Bay region is http://www.floridaturf.com/ , which are based on the Steward and Mills, 1967 study. The ET rates for the coveted St. Augustine turf grass is shown in Figure 4.

Reliability of Rainwater
The reliability of rainwater for irrigation use depends on several factors: sufficient quantity of rainfall, efficiency of the system, and meticulousness of the harvester. The amount of rain that falls on any given region varies from year to year[9]. Even though predictability is not entirely possible, estimates can provide a good sense of how much rainwater to expect to capture.

[7] (Texas Water Development Board, Third Edition, 2005)

[8] (Michael R. Lindeburg, 2001, pp. A-43)
[9] (NCDC, 2007)

Month	Water use (inches)
January	2
February	2.5
March	3.4
April	4.2
May	5.2
June	4.3
July	4.8
August	4.8
September	3.9
October	3.4
November	2.5
December	1.9
Total	42.8

Means of five years' observations of evapotranspiration on St. Augustinegrass turf, Plantation, Florida (Stewart and Mills, 1967).

Figure 4 – ET Rates

Immediately following is an analysis of rainwater harvesting potential paired with irrigation demand for a small plot of St. Augustine turf.

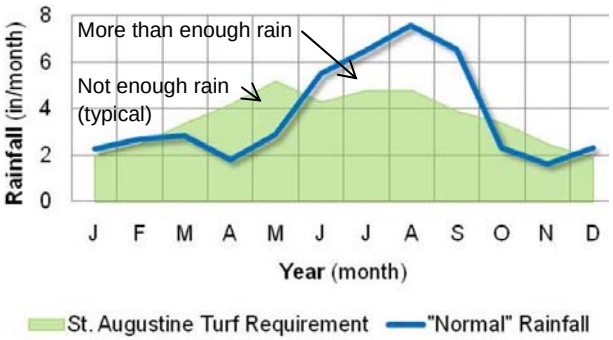


Figure 5 – Turf Water Requirements and Average Yearly Rainfall

Figure 5 shows the amount of water that is required to irrigate a St. Augustine lawn per month and the average rainfall for the Tampa area[10] . It is apparent that there are times during the year that there is ample rainfall for a typical St. Augustine lawn, while at other times there is not. Deficits generally occur during March through late May, and again during October and November. It seems that the timing of rainfall only rainwater could be captured (or harvested) during the rainy season (June through September), there would be sufficient rainwater for irrigating the St. Augustine turf. With the use of a cistern, captured rainwater could facilitate the use of rainwater whenever needed, especially during periods when rain is scarce.

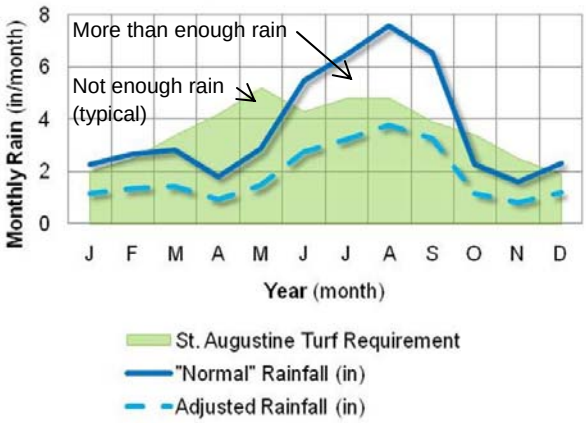


Figure 6 – Turf Water Requirements and Adjusted Yearly Rainfall

During a drought period, the amount of rainfall can be significantly reduced. To illustrate, an 'average' rainfall year can be reduced by 50%. This would produce a conservative 'adjusted' rainfall rate for calculating the anticipated rainfall amount (see Figure 6). Deficits would now exist throughout the year.

Consider a 2,000 square foot catchment area that is to be used to irrigate 500 square feet of St. Augustine turf (in Florida). Rainwater is to be collected during a drought year in a cistern. What is the minimum sized cistern that can accommodate the required demand?

Figure 7 shows the irrigation demand and collection potential relationship volumes. It clearly depicts which times during the year yields a surplus and where there is a deficit – or need – for additional water. In this particular instance, a surplus occurs between June and late September. A small deficit occurs in April through May.

[10] (NOAA Satelite and Information Service, 2008)

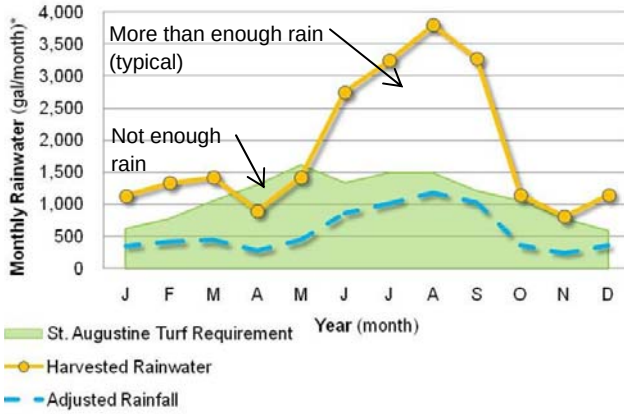


Figure 7 – Yearly Rainwater Collection Potential

In viewing how water is used and stored in the cistern, the method for sizing a cistern becomes more obvious. Figure 8 depicts the same data shown in Figure 7 only shown as water levels within the cistern. The deficit that occurs in April and May, which accounts for about 600 gallons, should be added to total amount needed in April. The minimum capacity required during April is 1,915 gallons (1,308 + 407 + 200) to make it through the 'dry period' of April and May. This happens to be the maximum amount of volume stored throughout the year, as no other month requires this much volume. For this particular case, an adequately sized cistern is one whose capacity is approximately 2,000 gallons.

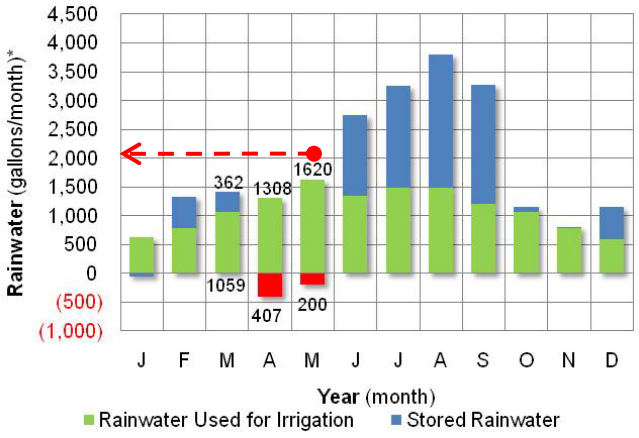


Figure 8 – Cistern Rainwater Levels

As a side note, most months show a surplus that is stored in the cistern for the following month. A larger cistern or adding additional cisterns could yield greater rainwater potential.

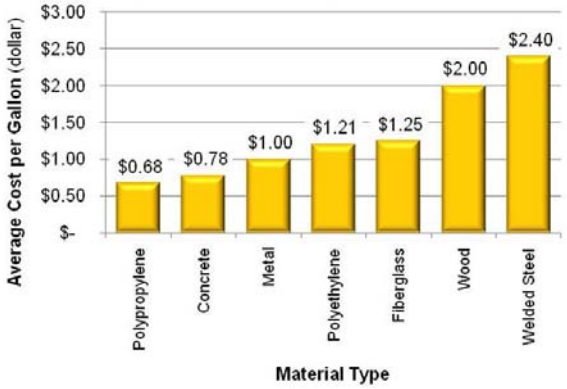


Figure 9 – Average Cistern Costs by Material Type [11]

Economic Considerations

The most costly portion of the initial investment (including design, components and installation) is the cost of the cistern. Costs for the cistern can vary depending on material type, above or below ground (needs to be more structurally sound) and relative distance between site and manufacturer (shipping). The cistern: installation cost ratio is approximately 60:40 [12]. Therefore, a complete 2,000 rainwater harvesting system (that would serve the example considered earlier) could cost between $2,000 to $3,500 (see Figure 10). Costs can be reduced by taking other water conservation measures. Consider the size of tank and material selection.

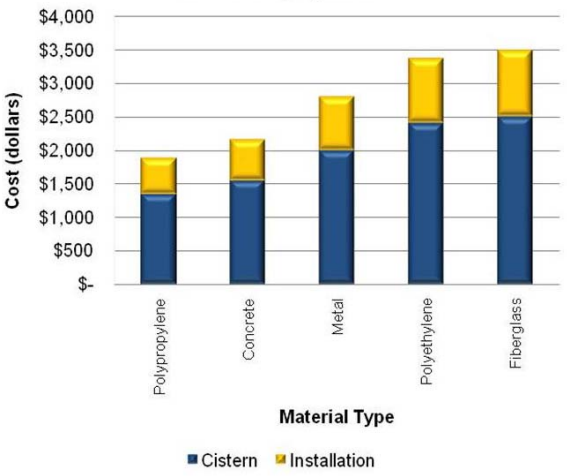


Figure 10 – Estimated Costs for a 2,000 Gallon Rainwater Harvesting System [13] [14]

[11] (Texas Water Development Board, Third Edition, 2005, p. Table 6.1)
[12] (Water Environment Research Foundation, 2009)
[13] (Texas Water Development Board, Third Edition, 2005, p. Table 6.1)

Irrigation Options

There are other methods for irrigating that are efficient. Passive Irrigation/Collection is a rainwater collection technique that involves contouring the landscape in a manner in which water is collected in depressions where trees or flower beds are located, eliminating the need for manual or mechanical irrigation. Brad Lancaster, a well known rainwater harvester who lives in the Sonoran Desert, is an avid promoter of this rainwater collection technique. A very informative video on this topic can be viewed at http://www.youtube.com/watch?v=k9Ku_xpyLK4&feature=related.

Retrofitting irrigation system to be of drip type can also be a water saving option. The amount of water used is minimized and precious water is applied at the roots rather than being sprayed into the air using traditional lawn sprinklers.

The application of Florida Friendly Landscaping techniques can be most beneficial. Drought tolerant plants can reduce the amount of turf and irrigation required in order to keep a beautiful landscape. Information can be found at http://www.swfwmd.state.fl.us/yards/ .

Water Quality

The quality of collected rainwater has always been a concern, as is how it would change over time. Generally, rainwater is the 'cleanest' source of water. It does not come in contact with the soil (as groundwater does), therefore it does not contain harmful bacteria, dissolved salts or heavy metals that would need to be treated or removed. The quality of harvested rainwater would rely mostly on the level of care and meticulousness that the harvester maintains in the system.

The end use of the water would determine the applicable level of treatment that is required. EPA's "*Managing Wet Weather with Green Infrastructure Municipal Handbook, Rainwater Harvesting Policies*" (Table 3) suggests pre-filtration and first-flush diverters as minimum water quality treatment options for outdoor uses.

An additional source of high quality water that is readily available during hot, humid summer months is AC condensate. This water source is of sufficiently high quality that it can be stored in the cistern along with rainwater. Production rates have not been officially established and therefore anticipating collection potential is difficult. An approximate amount of condensate that can be collected can vary between 3-5 gallons per day for every 1000 square feet. This amount alone is not significant enough in residential applications to be an alternative source.

Component Reliability

The reliability of the equipment or components of the system depend mostly on regular inspections and maintenance. Manufacturers provide general information on average life and recommended maintenance. Anticipated replacement life for some system parts:

Filters

- Cartridges for potable systems: 3 to 6 months
- Roof washing types: (see manufacturer's specifications)

Pumps

- Approximately 3 years (see manufacturer's specifications)
- With a pressure vessel: generally longer than pump alone (see manufacturer's specifications)

Tanks

- Approximately 20 to 30 years, depending on material and environmental conditions (see manufacturer's specifications)

Operation and Maintenance

Maintenance costs for a non-potable use system can be kept low, if the owner performs the required maintenance.

Some maintenance responsibilities include:

- Check for debris in tank (tank should be cleaned out about once a year)
- Inspect gutters and downspouts regularly (remove debris)
- First flush bypass (check drain holes are clear for proper function)
- Inspect downspout seals and entrances (check for leaks)

[14] (Water Environment Research Foundation, 2009)

Barriers and Incentives

There are no rules currently in place that would prohibit the installation rainwater harvesting systems in the Tampa Bay area. Non-potable rainwater applications have fewer code requirements and associated costs than potable ones.

Public agencies and organizations in the Tampa Bay area do not currently offer any monetary incentives for those wanting to install rainwater harvesting systems in their homes. There are places in Florida where incentives are offered. For instance, the Florida Keys Aqueduct Authority is currently offering monetary incentive to residents who convert their decommissioned septic tanks into cisterns for rainwater harvesting. [15]

CONCLUSION

Using rainwater as an alternative water source for irrigation is a very logical first step in conserving potable water. In educating the public about harvesting rainwater, a second lesson is learned in practice: Rainwater users learn to be more cautious with water usage.

Putting together a rainwater harvesting system for irrigating landscapes is not rocket science. The components are simple enough for homeowners to put together on their own with some education on the topic.

Systems can become complex depending on system size, intended use, and location. An excellent source of technical and professional help in building or developing said systems is ARCSA. ARCSA (the American Rainwater Catchment Systems Association) provides informal publications and networking for rainwater users. Their website is at www.arcsa.org.

Since the issue of conserving potable water and using alternative water sources (such as rainwater) is gaining momentum throughout the country in recent months, there is ample information at their reach: online sources, irrigation/rainwater harvesting professionals, and demonstration sites.

Some suggestions would be to:

- Research the topic. Educate yourself on the subject.
- Visit demonstration sites.
- Speak to vendors, irrigation/rainwater harvesting professionals.
- Start small. Improvements and additions could always be made at a later time.

SUGGESTED READING

Texas Manual on Rainwater Harvesting

EPA's *Managing Wet Weather with Green Infrastructure Municipal Handbook Rainwater Harvesting Policies*

Rainwater Harvesting for Drylands and Beyond by Brad Lancaster

Rainwater Collection for the Mechanically Challenged by Suzy Banks

[15] (United Press International, Inc., 2009)

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APPENDIX C

Levin College of Law
Conservation Clinic

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352-273-0835
352-392-1457 Fax

DATE: 3.11.09

MEMORANDUM

TO: Dave Bracciano, Tampa Bay Water
FROM: Thomas Ruppert, UF Levin College of Law

RE: Analysis of Potential Legal Liability for Recommending Cisterns

Context:

Tampa Bay Water seeks to develop a program to promote the installation and use of cisterns as a way to address the severe water shortages faced by the region Tampa Bay Water serves. Cisterns can conserve potable water by serving as a source of irrigation water for landscapes. Tampa Bay Water initially seeks to promote the use of cisterns only for connection to irrigation systems, not indoor water systems. Tampa Bay Water seeks to support development of program materials that will be incorporated into water conservation programs given by the Florida Yards and Neighborhoods® program.

Question Presented:

May Tampa Bay Water, the Florida Yards and Neighborhoods® program, or local governments in Florida that promote the use of cisterns be held liable for damages or injuries that may result from the installation or use of cistern-irrigation systems constructed as recommended by the proposed program and materials?

Short Answer:

Very likely not. Tort law theories that might allow for recovery against Tampa Bay Water, the Florida Yards and Neighborhoods® program, or local governments contain several hurdles any one of which a plaintiff would likely be unable to overcome. Taken together, these barriers make it very unlikely that a party that has suffered injury due to installation or use of a cistern-irrigation system could hold Tampa Bay Water, the Florida Yards and Neighborhoods® program, or local governments liable.

Analysis:

Most likely any attempt to hold Tampa Bay Water, the Florida Yards and Neighborhoods program or a local government (TBW/FYN/LG) liable for damages or injuries sustained due to installation or use of a cistern system based on the recommendations of TBW/FYN/LG would need to be pleaded as a tort (civil wrong) or as breach of an implied warranty. This analysis first considers tort law as a basis for liability, then implied warranty, and finally examines whether sovereign immunity would protect TBW/FYN/LG were a case somehow move forward.

Tort Law Liability

To prove a tort, the plaintiff must demonstrate: 1) that the defendant owed plaintiff a duty of care, 2) that the defendant breached this duty of care, 3) that this breach was the proximate cause of the damage or harm to plaintiff, and 4) that plaintiff suffered harm.

First, it appears that TBW/FYN/LG would likely not be the appropriate parties to sue. Liability for damages resulting from use of a cistern system as recommended by TBW/FYN/LG would likely be brought under products liability theories of strict liability or negligence. Both of these legal theories would require that the plaintiff sue the correct party as a defendant. The proper defendant in a products liability suit is a manufacturer, distributor, retailer, or anyone else involved in the production and distribution of a product.[1] TBW/FYN/LG do not intend to manufacture, distribute, or sell cisterns; rather, TBW/FYN/LG will simply supply information to those that will undertake these activities and the public. It would also likely not be possible to claim that TBW/FYN/LG were responsible for the actions of a contractor, distributor, or designer on the basis that TBW/FYN/LG developed the standards to which the contractor, distributor, or designer adhered in designing and installing the cistern.[2] Thus, according to the law, a proper defendant in an action for improper design or installation of a cistern-irrigation system is the contractor, developer, or seller.[3] Therefore, TBW/FYN/LG would likely be held not to be an appropriate defendant.

Second, even were TBW/FYN/LG found to be appropriate defendants, tort liability for TBW/FYN/LG may only arise if there is a common law or statutory duty of care with

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[1] Mahl v. Dade Pipe and Plumbing Supply Co., Inc., 546 So.2d 740 (3d DCA 1989) (dismissing action where plaintiff presented no evidence that defendants either manufactured or distributed the allegedly faulty product); Restatement (3d) of Products Liability, § 1:7. *See also* 51 A.L.R.3d 1344, § 2(a) (1973) ("The term 'products liability' . . . is now almost universally applied to the liability of a *manufacturer, processor, or nonmanufacturing seller* for injury to the person or property of a buyer or third party caused by a product which has been sold." (emphasis added). "It is obvious that to hold a producer, manufacturer, or seller liable for injury caused by a particular product, there must first be proof that the defendant produced, manufactured, sold, or was in some way responsible for the product.")

[2] Such vicarious liability is called *respondeat superior*. This theory is only applicable where TBY/FYN/LG hired a contractor and then maintained control over the work of the contractor. TBY/FYN/LG has no intention of such a scenario arising.

[3] Trianon Park Cond. Assoc. v. City of Hialeah, 468 So. 2d 912, 923 (Fla. 1985)

respect to the allegedly negligent conduct.[4] However, it is unlikely that a court would find that TBW/FYN/LG owe a duty of care to a specific plaintiff since TBW/FYN/LG issuance of guidelines for construction of a cistern-irrigation system is a discretional governmental function that does not give rise to a specific duty of care to individuals.[5] This is so because TBW/FYN/LG do not actually give a specific service to any individual in issuance of recommendations and guidelines, but are only furthering the policy of TBW/FYN/LG to conserve water resources for the benefit of the public. In this case, any cistern-irrigation system recommendations or even adopted guidelines could be compared to establishment of a building code. Case law clearly states that adoption of a building code does not create a specific duty of care to any particular individual.[6] Furthermore, there is no duty of TBW/FYN/LG to prevent the misconduct of a third party in the design or installation of a specific system.[7] In the absence of a duty of care to a specific individual, a claim of liability against TBW/FYN/LG would fail.

While legislative enactments for the benefit of the general public do not create an independent duty of care to individuals, another common law duty may apply. Case law establishes that if a governmental body creates a dangerous situation that is not obvious, the government has a duty to warn the public.[8] While difficult, it might be possible to argue that promoting cisterns could create a dangerous situation if the system is installed in such a way as to create a danger that one could fall into the cistern and drown. TBW/FYN/LG can avoid any minimal risk of liability under this theory by warning of potential dangers in the cistern materials. In addition, the common indicates that when a person undertakes to warn the public about a danger and creates reliance in the public on this warning, the party warning must exercise care in the warning.[9] Thus, as long as the guidelines or recommendations of TBW/FYN/LG do not create hidden dangerous conditions for the public or clearly warn of such dangers if they do exist, TBW/FYN/LG owe no duty of care to specific individuals that might choose to install cisterns.

Despite the likelihood that TBW/FYN/LG would not likely be found to be appropriate defendants and that TBW/FYN/LG do not owe a duty of care to would-be plaintiffs, design and use recommendations should contain the following disclaimers or something substantially similar:

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[4] The question of immunity does not even arise until it is determined that a defendant otherwise owes a duty of care to the plaintiff and thus would be liable in the absence of such immunity. Wilson v. Miami-Dade County, 370 F.Supp.2d 1250, 1253 (2005) (citing Kaisner v. Kolb, 543 So.2d 732, 734 (Fla.1989)) ; Trianon Park Cond. Assoc. v. City of Hialeah, 468 So. 2d 912, 917 (Fla. 1985).

[5] Trianon Park Cond. Assoc. v. City of Hialeah, 468 So. 2d 912, 917, 919 (Fla. 1985).

[6] Trianon Park Cond. Assoc. v. City of Hialeah, 468 So. 2d 912, 915 (Fla. 1985).

[7] Trianon Park Cond. Assoc. v. City of Hialeah, 468 So. 2d 912, 917 (Fla. 1985).

[8] Orlando v. Broward County, Florida, 920 So.2d 54, 58 (4th DCA 2005).

[9] *See, e.g.* Indian Towing Co. v. United States, 350 U.S. 61, 64-65 (1955).

"FYN and ___[name of local government]___ recommend the use of cisterns as a source of outdoor irrigation water in order to conserve potable water resources. The design recommendations here are provided to property owners and contractors as minimum recommendations. Due to variations in rainfall, soil type, and water requirements of landscapes, FYN and ___[name of local government]___ make no specific claims or warranty that systems built to the minimum recommendations here will be appropriate for a particular landscape or environment. It remains the responsibility of the contractor and/or property owner to ensure that the cistern-irrigation system design and installation complies with applicable state and local laws and that the system is designed and maintained to avoid any nuisance or safety hazards. For example, local laws often require that cisterns or other standing water not be allowed to serve as a mosquito-breeding area. Safety also requires that cistern access be securely limited to prevent children or adults from accessing and falling into the cistern. Furthermore, many residential and commercial structures in Florida are subject to private restrictions based on homeowners' associations, condominium associations, property owners' associations, or similar associations. Such associations often have architectural standards requiring that ancillary services and structures—such as a cistern—must be screened from site from adjacent lots or public areas. It is the responsibility of the property owner to ensure that construction of a system complies with any private restrictions to which the property in question is subject."

Breach of Implied Warranty Claim

In addition to a tort claim, a claim could arise under a breach of warranty claim that a system designed according to recommendations of TBW/FYN/LG does not perform as the purchaser was led to believe, leading to damages. Under Florida's implied warranty law, all goods that are sold must be generally fit for their intended purpose.[10] If a product is not generally fit for its intended purpose or if it does not meet the terms of its express warranty and a person is injured by the product, that person may sue the manufacturer for breach of warranty. In this case, an attempt to hold TBW/FYN/LG liable would likely be based on the theory that TBW/FYN/LG is somehow responsible for a cistern/irrigation system due to TBW/FYN/LG design recommendations. Such a theory suffers from two fatal flaws. First, similar to the situation in general tort law of products liability, TBW/FYN/LG are not appropriate defendants because they do not manufacture, sell, or distribute the products that a plaintiff might claim breached an implied warranty but only created guidelines and information to assist private contractors and the public.[11] Second, TBW/FYN/LG have no contractual relationship with a potential plaintiff as TBW/FYN/LG are not the parties that sell the

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[10] FLA. STAT. §§ 672.315, 672.314 (2008).

[11] *See supra* note 1 and accompanying text. Breach of implied warranty is typically not available as part of a services contract. However, design and installation of a cistern-irrigation system might be considered a "hybrid" transaction including both goods and services that might qualify. If so, liability would still be limited to those with whom the plaintiff had a contractual relationship.

cistern/irrigation system; a contractual relationship (privity of contract) is a requisite for a breach of implied warranty claim in Florida.[12] Thus, the contractor or product manufacturer would be a proper defendant but not TBW/FYN/LG

Sovereign Immunity

In the unlikely event a plaintiff were able to develop a legal theory that would overcome the outlined hurdles to a suit against TBW/FYN/LG, sovereign immunity to the suit would very likely apply and protect TBW/FYN/LG from suit.[13] Despite the fact that Florida has waived sovereign immunity in statute, this waiver only applies in cases in which an individual in the same situation would be exposed to liability.[14] In this case, no private individual would be exposed to liability for recommending someone take an action, particularly if the party recommending the action did not contract to assist in the action and receives no direct remuneration for the recommendation and supply of information. Furthermore, courts have determined that despite the limited statutory waiver of immunity, governmental actors still enjoy immunity for "planning-level" discretionary actions as opposed to "operational" or implementation decisions.[15] A decision by TBW/FYN/LG to develop materials and presentations promoting the use of cisterns for irrigation very likely falls in a category of governmental activities that are "basic governmental functions performed by the legislative or executive branches of government."[16] This being the case, existing doctrine on sovereign immunity indicates that the judicial branch should not seek to second guess a legislative decision to entrust to experts the government service of protecting potable water resources.[17]

Sovereign immunity for planning-level actions may be overcome if a plaintiff can show that the defendant created a hidden danger and failed to warn of the danger.[18] This conclusion leads to the recommendations above for certain safety warnings regarding the design of cisterns and their covers.

Potential Property Owner Liability

Although there exists virtually no possibility that TBW/FYN/LG could be held liable for damages associated with installation or use of a cistern/irrigation system, property owners may be liable for damages to guests or trespassers that suffer harm due to improperly constructed or covered cisterns. For example, one court held that a trespassing boy who drowned in a well covered by a concrete slab with an eighteen

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[12] FLA. STAT. §§ 672.315, 672.314 (2008).

[13] Sovereign immunity would apply to TBW/FYN/LG as each of them is an agency or subdivision of the state.

[14] FLA. STAT. § 768.28 (2008).

[15] Trianon Park Cond. Assoc. v. City of Hialeah, 468 So. 2d 912, 919 (Fla. 1985).

[16] Trianon Park Cond. Assoc. v. City of Hialeah, 468 So. 2d 912, 919 (Fla. 1985).

[17] *Cf.* Trianon Park Cond. Assoc. v. City of Hialeah, 468 So. 2d 912, 919 (Fla. 1985); Commercial Carrier Corp. v. Indian River Cty, 371 So.2d 1010, 1018 (1979) (citing Weiss v. Fote, 167 N.E.2d 63 (1960)).

[18] Orlando v. Broward County, Florida, 920 So.2d 54, 58 (Fla.App. 4 Dist.,2005).

inch square opening in the top that was covered by a car trunk was liable for the boy's death since the trap-like nature of the opening in the middle of the slab constituted an ultra-hazardous condition.[19] Thus, it is recommended that TBW/FYN/LG materials note that liability of property owners for harm is negligible if a cistern is securely covered and protected to ensure the cistern is not an attractive nuisance or danger to anyone on the property, even trespassing children. This can be accomplished by installing tightly-closed access to the cistern, a lock, and permanently installing ladders or other means of escape inside the cistern.

Conclusion

TBW/FYN/LG subject themselves to virtually no risk of liability for developing a program and materials to promote the use of cisterns as part of irrigation systems that conserve potable water supplies. Tort law of products liability is inapplicable because TBW/FYN/LG are not appropriate defendants as they are not directly engaged in the manufacture, sale, or distribution of the products or services that could be faulty. TBW/FYN/LG also do not have the requisite duty of care to individuals that would be necessary for a plaintiff to succeed in a products liability case. TBW/FYN/LG are also not liable for a breach of implied warranty if a cistern-irrigation system fails to perform or causes damages. A breach of implied warranty claim requires a contractual relationship between the plaintiff and defendant. This cannot exist since TBW/FYN/LG do not sell their services. In addition, as with other tort law, TBW/FYN/LG are not appropriate parties to sue for breach of implied warranty as they are not manufacturers, sellers, or distributors of the products used.

Even were a plaintiff to somehow overcome all the previous impediments to suing TBW/FYN/LG, the decision of TBW/FYN/LG to promote the use of cisterns for irrigation would very likely be protected from suit by the doctrine of sovereign immunity.

[19] Bichsel v. Blumhost, 429 S.W.2d 301 (Mo.App. 1968).

CISTERN CODE REFERENCES- University of Florida

A search of Florida Statutes revealed no uses of the word "cistern" in Florida's statutes. A search for "cistern" in the Florida Administrative Code revealed only two current uses of the word, neither particularly relevant to the particular aim of Tampa Bay Water to promote use of cisterns for outdoor irrigation. These two uses, cited below, could impact homeowners using a cistern as a source of household (greywater) or potable water. In addition, a current draft rule of the Florida Department of Health would set standards for use of old septic tanks as cisterns for irrigation purposes.

A search of the codes of ordinances of 336 of Florida's local governments revealed 124 instances of codes referring to cisterns. Many of these references discuss matters not related to Tampa Bay Water's interest in cisterns for outdoor irrigation or only indirectly related. For example, the code of ordinances of Bunnell in Flagler County (cited below) refers to cisterns in its code when it prohibits obstructions near fire hydrants, cisterns, and other sources of water for fire fighting.

Many of the code references deal with issues tangentially related to Tampa Bay Water's initiative to encourage installation of cisterns for irrigation purposes. For example, the code of ordinances of Wilton Manors, Florida requires that wells, cisterns, pools, etc. be either fenced or securely covered. Many of the code references require that cisterns or other water not be allowed to become nuisances or sites that breed mosquitos (see, e.g. Ormond Beach, Volusia County, cited below).

In the Florida Keys, use of cisterns is common due to the lack of available groundwater. Cisterns there are used for both irrigation and for potable water supplies. In fact, cisterns are so common that codes such as Key West's specify how to calculate waste water flows for units that have a cistern for water supply.

A few of the code references explicitly encourage use of cisterns to conserve potable water resources as Tampa Bay Water wishes to encourage (see, e.g. Marathon and others). Some codes also view cisterns as a potential tool for stormwater management (see, e.g. Dunnellon, Marion County and Sarasota County, cited below).

Florida Statutory References:

None

Florida Administrative Code References:

64E-64.005(7)(c): tangential mention of cisterns as a possible type of water supply and how this affects calculations for septic drain field infiltration rates
28-20.100(11): allows for points to be awarded to proposed dwelling units under Monroe County's comprehensive plan if the dwelling unit has a minimum size of cistern for its primary or secondary water supply.

In addition, there is currently a proposed new sub-section (4) Florida Administrative Code section 64E-6.011. The Florida Department of Health is receiving comments on this proposed rule from March 6, 2009 until March 27, 2009. For more information, please see information available at https://www.flrules.org/notice/QuickResult.asp?P0=Stat_Comm_Chpt&P1=5795&P2=90
The text of the proposed rule is as follows:

64E-6.011 Abandonment of Systems.

(1) through (3) No change.

(4) A septic tank serving a single family residence may, at the owner's discretion, be converted into a cistern pursuant to the following procedures:

(a) The applicant shall obtain a system abandonment permit from the county health department.

(b) The permit application shall specify the intended use of the abandoned septic tank.

(c) The activities related to abandoning the onsite sewage treatment and disposal system shall not create a sanitary nuisance.

(d) The septic tank shall be disconnected from the drainfield and from the building sewer pipe.

(e) All work to disconnect, clean and sanitize the septic tank shall be conducted by a registered septic tank contractor or a state-licensed plumber or by the owner of the owner-occupied single family residence being served by the septic tank.

(f) All septage, wash water, and other liquids removed from the tank shall be removed and handled as septage (Rule 64E-6.010, F.A.C.) by a DOH-licensed septage disposal service and disposed of at a DEP-regulated wastewater treatment facility.

(g) The health department shall inspect the tank once it is disconnected, emptied, cleaned, disinfected and filled with water. The inspection shall determine whether all of the following conditions have been met:

1. The tank has been disconnected from the drainfield and the building sewer.

2. The tank is full of water within 12 inches of the top of the tank.

3. The clarity of the water is such that a Secchi disk is visible at the bottom of the tank.

4. The pH of the water in the tank is between 6.0 and 8.0.

5. The free chlorine residual of the water in the tank is ≤1.0 ppm.

6. The total coliform count is ≤ 1000 per 100 ml.

7. The fecal coliform count is ≤ 200 per 100 ml.

8. No sanitary nuisance condition exists on the property related to the abandonment activities.

(h) One inspection is included in the abandonment permit fee. The applicant shall pay a reinspection fee for any additional inspection visits necessary until all of the criteria in subparagraphs 64E-6.011(4)(g)1. through 8., F.A.C., are met and final approval of the abandonment is granted by the county health department.

(i) The applicant shall be responsible for all required laboratory fees. All sampling shall be conducted by county health department staff during the final inspection.

(j) The septic tank shall be converted and inspected within 90 days after connection of the building plumbing to the sanitary sewer.

(k) The tank shall not be connected to any irrigation components nor shall the water used for irrigation purposes until final approval of the abandonment has been granted by the county health department.

(l) Upon final approval of the abandonment, use of the tank or the drainfield for sewage storage, treatment or disposal is prohibited and constitutes a nuisance injurious to health as defined by Section 386.041, F.S.

(m) Upon final approval of the abandonment, the water collected in the tank shall be utilized for non-potable, irrigation purposes only.

(n) Persons contemplating this work are advised that working in and around an open septic tank can be dangerous. Activities related to the cleaning and disinfection of the septic tank could expose workers to hazards related to confined workspaces, methane gas, aerosolized pathogens, collapsing tanks and other hazards. The applicant and workers are advised to seek advice from OSHA or experts in occupational safety before undertaking this work.

(o) The applicant is advised to have the tank inspected by a civil engineer or other person qualified to evaluate the condition of the tank and its suitability for the intended use.

Local Ordinance References in Florida:

Below appear some of the results of a search through local codes for references to cisterns. Some are included here because they are directly relevant. Some that are less directly relevant have nonetheless been added as examples of the many sections similar to them in other codes that have been left out of this list.

BONITA SPRINGS (Lee Cty.)
Table V-I (Southwest Florida Best Management Practices): Building and home rooftops which direct fifty percent (50%) of their runoff into cisterns for storage and reuse shall receive credit for one (1) BMP.

BUNNELL (Flagler Cty.)
ARTICLE I. IN GENERAL

Sec. 34-1. Placement of obstructions near fire stations, fire apparatus or fire hydrants or cisterns.
No person shall cause any obstruction to be placed within 25 feet of the entrance of any fire station or any place where a fire apparatus is stored, or within ten feet of any fire hydrant or cistern.
(Ord. No. 1983-12, § 10(2), 1-17-84)

CASSELBERRY (Seminole Cty.)
Section 3-11.11. Conservation of potable water supply.
The City shall assist in regulating development for purposes of complying with policies of the St. Johns River Water Management District directed toward conservation of potable water supply and to achieve a reduction in the current rates of water consumption. Therefore, site plans shall be required to comply with the following potable water supply performance criteria:
1. Where nonpotable alternative sources of irrigation water are available, potable water supplies shall not be used to meet irrigation needs.
2. All new development shall be required to use water-saving plumbing fixtures.
3. In order to reduce demand for irrigation water (which in turn often places greater demand upon potable water sources), at least 70 percent of all landscaping material obtained from offsite sources for use on any site should be native plant material adapted to soil and climatic conditions existing on the subject site. Further, at least 50 percent of all trees used in landscaping shall be drought-tolerant native species adapted to soil and climatic conditions existing onsite in order to lessen water demand.
4. The City shall require, to the extent lawful, reuse of water, including use of cisterns for collecting rainwater for use in spray irrigation. In addition, the City may require mandatory hookup to systems distributing reclaimed water within 500 feet of the site.

CRYSTAL RIVER
Sec. 6-63. Exterior maintenance standards.

The owner of a structure shall maintain the structure and premises in a safe and sanitary condition in accordance with the following standards:
. . . . (4) All open, uncovered or insecurely covered cisterns, cellars, wells, pits, excavations or vaults situated on any premises shall be properly secured or filled to grade with appropriate fill material.

DUNNELLON (Marion Cty.) (Ord. 2008-01, River Corridor Protection)
(3) Stormwater run-off on the developed portion of the lot shall be treated in accordance with the following standards to minimize pollution of the water.

a. The runoff to open spaces containing natural vegetation shall be sheet flow, not channelized flow, in order to prevent erosion.

b. One (1) of the following stormwater treatment methods shall be used to minimize the amount of stormwater flowing directly into the waterway.

i. A berm and swale shall be constructed within the river corridor buffer area to capture stormwater flow and eliminate direct run-off into the water; or,

ii. Runoff from parking lots, driveways, paved courtyards, and other paved surfaces, roof drains or downspouts shall be directed to a vegetated area of sufficient size for absorption of the runoff. The vegetated area shall be designed as one (1) or more slightly depressed planting beds with drought tolerant ground covers or native plants; or,

iii. Runoff from roof drains or downspouts shall be directed to a rain barrel or cistern designed to allow reuse of the water. These facilities may be freestanding, designed as an integral part of the buildings, or directed to underground storage. The reuse system shall be shown on the proposed plan for development, and may include irrigation, or other uses that do not require potable water.

c. All stormwater treatment shall meet the Outstanding Florida Water standards.

d. No stormwater retention facilities are permissible within the buffer

FORT WALTON BEACH
Sec. 5.04.02. Nuisance Conditions.
A public nuisance includes, but is not limited to, the following actions or omissions:
. . . . (7) The pollution of any public well, cistern, stream, lake, canal, or body of water by sewage, dead animals, industrial wastes or other noxious substances;

ISLAMORADA (Monroe Cty.)
Sec. 34-36. Exemptions.
The following activities shall be exempt from the provisions of this article:
(1) Landscape irrigation by hand watering using a self-canceling nozzle;

(2) Landscape irrigation by systems from which the sole source is treated wastewater effluent;
(3) The operation of irrigation systems for system repair and maintenance;
(4) Flushing of water mains required for normal water main clearance and maintenance and for maintenance of water quality; provided that, where practical, flushed water shall be directed into pervious areas and flushed at the minimum rate necessary for cleaning and dispersing the water in such a manner to benefit local vegetation;
(5) Landscape irrigation, by a licensed pest control operator, for purposes of watering in fungicides, insecticides and herbicides as required by the manufacturer or by federal or state laws;
(6) Landscape irrigation for the purpose of watering in newly planted grass and foliage for the first 45 days after initial installation;
(7) Irrigation activity for dust emissions required by court order or administrative action;
(8) Agricultural irrigation where the use of water is permitted by a consumptive or water use permit issued by the South Florida Water Management District;
(9) Landscape irrigation from which the sole source is a cistern; and
(10) Any irrigation approved by the village manager or his designee under section 34-38.

Sec. 30-304. Levels of service for concurrency facilities.
All development or development of land shall be served by adequate public facilities in accordance with the following standards:
(1) *Roads.* Sufficient capacity shall be available on affected roadways to accommodate all existing and approved development at the following level of service:
a. U.S. 1 shall have sufficient available capacity to operate at or within five percent of LOS C as measured on an annual average daily traffic (AADT) basis at all intersections and roadway segments.
b. All other roadways for which the village is responsible shall have sufficient available capacity to operate at or within five percent of LOS D as measured on an annual average daily traffic (AADT) basis at all intersections and roadway segments.
(2) *Solid waste.* Sufficient capacity shall be available at a solid waste disposal site to accommodate all existing and approved development for a period of at least three years from the projected date of completion of the proposed development or use, at the following levels of service:
a. Residential disposal quantity: 5.44 pounds per capita per day, or 12.2 pounds per day, equivalent residential unit.
b. Nonresidential disposal quantity: 6.37 pounds per acre per day.
c. Residential collection frequency: Minimum, one time per two weeks for domestic refuse and for yard trash.
(3) *Potable water.* Sufficient potable water from an approved and permitted source shall be available to satisfy the projected water needs of the proposed development or use at the levels of service listed below. Approved and permitted sources shall include cisterns, wells, FKAA distribution systems, individual water condensation systems, and any other system which complies with state standards for potable water.

(12) *Structural integrity of construction.* The following points are intended to encourage high standards of structural integrity.
TABLE INSET:

Point assignment and criteria:	+1 per application which proposes a dwelling unit designed to meet a minimum peak wind speed of 160 miles per hour as certified by a qualified engineer or architect.
	+1 additional point per application which proposes a dwelling unit designed to meet a minimum peak wind speed of 175 miles per hour as certified by a qualified engineer or architect.
	+1 per application which proposes a dwelling unit with a concrete cistern with a capacity of no less than 2,500 gallons, gutters along the entire roof channeling into the cistern, and a pump-out system for recovery of the water.

Sec. 14-98. Exemptions.
(a) The following activities shall be exempt from the provisions of this article:
(1) Landscape irrigation by hand watering using a self-canceling nozzle;
(2) Landscape irrigation by systems from which the sole source is treated wastewater effluent;
(3) The operation of irrigation systems for system repair and maintenance;
(4) Flushing of water mains required for normal water main clearance and maintenance and for maintenance of water quality; provided that, where practical, flushed water shall be directed into pervious areas, and flushed at the minimum rate necessary for cleaning and dispersing the water in such a manner as to benefit local vegetation;
(5) Landscape irrigation, by a licensed pest control operator, for purposes of watering in fungicides, insecticides and herbicides as required by the manufacturer or by Federal or State laws;
(6) Landscape irrigation for the purpose of watering in newly planted grass and foliage for the first 45 days after initial installation;
(7) Irrigation activity for dust emissions required by court order or administrative action;
(8) Agricultural irrigation where the use of water is permitted by a consumptive or water use permit issued by the District;
(9) Landscape irrigation from which the sole source is a cistern;
(10) Slow drip irrigation systems; and
(11) Any irrigation approved by the City Manager or his designee under Section 14-99.
(b) In the event that any regulations promulgated by the District conflict with these exemptions, the District's restrictions shall supercede these exemptions.

KEY WEST (Monroe Cty.)
Sec. 14-35. Amendments to building code.
The Florida Building Code adopted by the provisions of section 14-31 is amended in the following respects:
Section 107.4 Schedule of permit fees is amended to read as follows:

The office of the building official of the City of Key West, Florida, shall charge and collect for building permits at the rates set forth below:
(1) New buildings (including balconies, porches, additions, garages and accessory buildings):
(a) For each $1,000.00 of value, or fractional part thereof, of enclosed space . . . $18.00
(b) Minimum fee . . . 60.00
(2) New structures other than buildings (including water towers, radio towers, water plants, bridges, cisterns, seawalls, docks and boat davits):
(a) For each $1,000.00 of cost or fractional part thereof . . . 24.00
(b) Minimum fee . . . 60.00

ARTICLE IV. WELLS AND CISTERNS
Sec. 74-336. Definitions.
The following words, terms and phrases, when used in this article, shall have the meanings ascribed to them in this section, except where the context clearly indicates a different meaning:
Abandoned well or cistern means a well or cistern which is in a state of disrepair such that it is mechanically not capable of use for its intended purpose.
Aquifer means a geological formation, group of formations, or part of a formation that is capable of yielding water to a well.
Cistern means a structure or device, the intended use of which is the storage of rainwater for household or commercial purposes.
Groundwater means water contained in or derived from an aquifer.
Owner means the person with legal title to the property on which a well exists.
Well means any excavation that is drilled, cored, bored, washed, driven, dug, jetted, or otherwise constructed which extends into or above an aquifer and the intended use of which is the location, acquisition, or development of groundwater for household or commercial purposes, but such term does not include temporary dewatering of subsurface formations for construction purposes.
(Code 1986, § 77.09)
Cross references: Definitions generally, § 1-2.

Sec. 74-337. Registration required.
Every owner of real property located within the city limits shall register any well and cistern located on his property, excluding abandoned wells and cisterns, with the city building department. Registration of new wells and cisterns shall be completed prior to the start of excavation. Owners shall provide the city building department with information regarding location on the property, diameter, depth, height, extraction or storage capacity, current status as active or inactive, and current extraction or usage rate if any.
(Code 1986, § 77.10)

Sec. 74-204. Meters required for commercial property with well or cistern discharging to sewer system.
(a) Every owner of commercial licensed property upon which any well or cistern is located and which well or cistern discharges to the sewer system shall install, at an

accessible location upon the property, a meter measuring water flow. Installation and purchase of equipment shall be at the owner's expense to conform to the city's specifications. If any owner fails to perform such installation, the city may do so and shall, in that event, bill the owner's sewer account for such installation charges. Meters shall be considered city property. City employees or agents may enter upon the premises during business hours for such purposes and shall notify the owner prior to entry.

(b) City employees or agents shall maintain, repair, and read the meters referred to in subsection (a) of this section, and the city shall bill the owner's sewer account for such charges. City employees or agents may enter upon the premises during business hours for such purposes. City employees or agents may remove meters from the property for purposes of maintenance and repair. The city manager shall determine approved meter types, frequency of maintenance and testing, criteria for meter location, and requirements for meter replacement.

(Code 1986, § 74.451)

Sec. 74-205. Billing for well- and cistern-generated flows.

Monthly charges for the use of the city sewer system for flows from wells and cisterns referred to in section 74-204 shall be based upon (i) the monthly water consumption for each customer, derived from meter readings, or, where such information is unavailable, (ii) estimated sewage flow. The city manager shall establish a schedule of estimated flows for use in estimating flows where no meter readings or other accurate data are available. The schedule shall be presented to the city commission, which may adopt and amend it by resolution. If no schedule is adopted by the city commission, the city manager shall set an interim schedule of estimated flow. The schedule or interim schedule shall be used to determine monthly charges where meter reading or other accurate data are not available.

(Code 1986, § 74.452)

Sec. 74-238. Estimates of flow, extranormal strength and base charge units.

(a) *Sewage flow.* Sewage flow shall be estimated by obtaining monthly water consumption data for each sewer system user and multiplying by a factor representing the assumed percentage of water being contributed to the sewer system. Monthly wastewater contribution shall be estimated for each account by the city from FKAA water meter reading data or from water meters installed on privately owned wells and cisterns.

If water furnished by the FKAA or any other water supply source or system shall be used exclusively for irrigation purposes or for any other application from which the water does not enter the city's sanitary sewer facilities, the user may, at the user's own expense, install a deduct meter to separately meter such water. The city manager shall determine approved meter types, frequency of maintenance and testing, criteria for meter location, and requirements for meter replacement. After the city is notified by the user of the installation of such a meter, the city shall maintain, repair, and read the meter and may bill the owner's sewer account for such charge. The water measured by such meter will be excluded from the calculation of chargeable sewer flow. Meters shall be considered city property. City employees or agents may enter upon the premises during business hours for purposes of maintenance, repair, and reading and may remove meters from the property for purposes of maintenance and repair.

For any residential living space using unmetered wells or cisterns as the sole source of water supply, a base charge shall be assessed for each such living space. The monthly wastewater flow (proportional use) component of the user charge for such residential wells and/or cisterns shall be based on an amount of water equal to the average monthly flow for residential system users. In addition to the proportional use component, a flat monthly well surcharge shall be assessed for each residential living space served by the unmetered wells and/or cisterns. The well surcharge shall be assessed to account for the exposure of the wastewater system to unmetered flows and the likelihood that wells are contributing more than the average monthly flow for residential system users.

For any residential system user having a metered water connection to the FKAA water system and owning wells and/or cisterns currently in use and connected to the wastewater system, a base charge shall be assessed for the FKAA water system connection, but no base charge shall be assessed for the wells and/or cisterns. However, a minimum flow charge based on the estimated average monthly residential wastewater flow shall be assessed, if the FKAA meter reading is less than the average. In addition, regardless of the amount of metered FKAA water consumption, the flat monthly well surcharge to be established by the city manager shall be assessed for each residential living space served by an unmetered well or cistern connected to the city's wastewater system. Owners of single-family residences and duplexes, including mobile homes, may but shall not be required to install water meters on their private water supplies.

Wells and cisterns used by all nonresidential users and that are connected to the city's wastewater system shall be metered at the user's expense in accordance with section 74-204. The city shall bill monthly sewer service charges to such users in accordance with section 74-205.

All wells and cisterns of all residential and nonresidential users within the city limits shall be assumed to be active wells and cisterns connected to the city's sanitary sewer system. The holder of record title to the property may demonstrate otherwise by filing with the city a notarized affidavit, supported by available documentation, declaring that the well or cistern is not active or connected and does not discharge water before or after use into the city sanitary sewer system.

(b) *Extranormal strength.* The extranormal strengths of wastes shall be estimated by the city by periodically monitoring wastes contributed to the system by users deemed as frequently or consistently having waste discharges of strengths in excess of those defined as being of domestic or normal strength. The monitoring of wastes shall be performed in accordance with current industry standards and procedures for waste flow sampling and laboratory testing. The amounts of extranormal strength waste components, expressed in pounds of biochemical oxygen demand (BOD) and total suspended solids (TSS), to which the extranormal strength surcharge shall be applied shall be calculated from monitoring data. The estimated amount of such waste component shall be applicable for 12 billing periods or until an adjustment is made resulting from a user's request for adjustment in accordance with the appeals and adjustment sections of this subdivision.

(c) *Base charge units.* For purposes of determining the number of base charge units chargeable to each sewer system user, the average monthly water consumption shall be calculated annually for residential users on the basis of a three-year rolling average. The average monthly water consumption per residential dwelling unit shall be calculated from FKAA water billing records, from city sewer department data files, and from the

city's water well and cistern meter readings data for all residential users of the sewer system owning such wells and cisterns, currently in use, who have elected to install, at their own expense, water meters. The water consumption records and meter reading data shall be adjusted prior to calculation of the monthly average residential consumptions, to account for nonuse, meter errors, customers' misclassifications and other data errors. Each residential dwelling unit shall be defined as one base charge unit regardless of the source of water for that dwelling unit.

The total annual water consumption from FKAA and city meter reading data, adjusted, for each nonresidential user of the sewer system shall be divided by the number of water bills rendered to such FKAA water customer, and the quotient of that division shall be divided by the monthly average water consumption for residential users of the sewer system, calculated as prescribed in this section. The quotient of the second division will show the number of base charge units and fractions thereof that such sewer system user shall be assessed; provided, however, that the number of the base charge units shall not be less than one. The resulting number of base charge units, including fractions thereof, shall be billed to such nonresidential users for the 12 billing periods following such determination.

(Code 1986, § 74.42(b))

Sec. 108-957. Conservation of potable water supply.

The city shall assist in regulating development for purposes of complying with policies of the South Florida Water Management District directed toward conservation of potable water supply and to achieve a reduction in the current rates of water consumption. Therefore, development plans shall be required to comply with the following potable water supply performance criteria:

(1) Where nonpotable alternative sources of irrigation water are available, potable water supplies shall not be used to meet irrigation needs.

(2) All new development shall be required to use water-saving plumbing fixtures.

(3) In order to reduce demand for irrigation water, which in turn often places greater demand upon potable water sources, at least 70 percent of all landscaping material obtained from off-site sources for use on any site should be native plant material adapted to soil and climatic conditions existing on the subject site. Further, at least 50 percent of all trees used in landscaping shall be drought tolerant native species adapted to soil and climatic conditions existing on site in order to lessen water demand. Refer to section 108-518 for recommended plant material.

(4) The city shall require, to the extent lawful, reuse of water, including use of cisterns for collecting rainwater, for use in spray irrigation. In addition, the city may require mandatory hookup to systems distributing reclaimed water within 500 feet of the site.

LAKE COUNTY

9.01.03 General Requirements

. . . . .

F. *Irrigation.*

1. For all required Landscaped Areas irrigation Shall be used in order to establish and maintain optimal growth of plant material.

2. In order to conserve Groundwater, Brightwater, Reclaimed Water and Rainwater from cistern collection are recommended as primary irrigation sources.

LEON COUNTY

Sec. 10-4.301(5)(a)(i):

Systems utilizing on-line dry retention only. A volume of runoff calculated as four inches times the total impervious area that will be situated on the site shall be retained on the site or in an approved master stormwater facility. This calculation can exclude the wetted area of the pond/stormwater facility. This volume of runoff shall be collected from the entire developed portion of the site and directed to on-line dry retention storage. Retention can occur in cisterns, ponds, shallow swales, landscaped areas, or natural areas.

Sec. 10-4.382(a)(1): same as previous in that allows use of cistern for on-line dry retention

MARATHON (Monroe Cty.)

107.69.D(6)(d): *Rain Water Collection:* The City encourages the installation of rainwater catchment systems such as cisterns or rain barrels to reduce dependency on the use of potable water for outdoor irrigation.

MONROE COUNTY

9.5-122.3.a(16): [table with credit criteria for points for water conservation] *An application includes either: A primary water source consisting of a cistern (twelve thousand five hundred (12,500) gallon minimum) or a reverse osmosis (RO) facility (two hundred (200) gallon per day minimum); or a secondary water source consisting of a cistern (two thousand five hundred (2,500) gallon minimum) or a reverse osmosis facility (fifty (50) gallon per day minimum).*

Sec. 9.5-292. Adequate facilities and development review procedures.

(a) *Adequate Facilities:* After February 28, 1988, all development or land shall be served by adequate public facilities in accordance with the following standards:

(1) *Roads:*

a. County Road 905 within three (3) miles of a parcel proposed for development shall have sufficient available capacity to operate at level of service D as measured on an annual average daily traffic (AADT) basis at all intersections and/or roadway segments. U.S. 1 shall have sufficient available capacity to operate at level of service C on an overall basis as measured by the U.S. 1 Level of Service Task Force Methodology. In addition, the segment or segments of U.S. 1, as identified in the U.S. 1 Level of Service Task Force Methodology, which would be directly impacted by a proposed development's access to U.S. 1, shall have sufficient available capacity to operate at level of service C as measured by the U.S. 1 Level of Service Task Force Methodology.

b. All secondary roads to which traffic entering or leaving the development or use will have direct access shall have sufficient available capacity to operate at level of service D as measured on an annual average daily traffic (AADT) basis.

c. In areas which are served by inadequate transportation facilities on U.S. 1, development may be approved provided that the development in combination with all other permitted development will not decrease travel speed by more than five (5) percent below level of service C, as measured by the U.S. 1 Level of Service Task Force Methodology.
d. Within thirty (30) days of the receipt of the official 1989 FDOT traffic counts of U.S. Highway 1 the county shall publish a notice informing the public of the available transportation capacity for each road segment of U.S. 1 as described in the county's annual public facilities capacity report. The available capacity shall be expressed in terms of number of trips remaining until the adequate transportation facilities standard is exceeded. The notice shall be published in the nonlegal section of the local newspapers of greatest general circulation in the Lower, Middle and Upper Keys.
(2) *Solid waste:* Sufficient capacity shall be available at a solid waste disposal site to accommodate all existing and approved development for a period of at least three (3) years from the projected date of completion of the proposed development or use. The Monroe County Solid Waste and Resource Recovery Authority may enter into agreements, including agreements under Florida Statutes section 163.01, to dispose of solid waste outside of Monroe County.
(3) *Potable water:* Sufficient potable water from an approved and permitted source shall be available to satisfy the projected water needs of the proposed development or use. Approved and permitted sources shall include cisterns, wells, FKAA distribution systems, individual water condensation systems, and any other system which complies with Florida standards for potable water.

Sec. 9.5-327. Potable water conservation standards.
All development shall make adequate provision for water conservation in accordance with the following standards:
(a) Installation of toilets with a maximum flush of three and five-tenths (3.5) gallons;
(b) Showerheads and faucets with a maximum flow rate of three (3.0) gallons per minute at sixty (60) pounds of pressure per square inch as specified in the Water Conservation Act, section 553.14, Florida Statutes.
(c) Independent water systems shall be encouraged whenever permitted.
(Ord. No. 33-1986, § 9-703; Ord. No. 40-1987, § 97)
Annotation--The intent of amendment 97, adding subsection (c), was to allow development that relies on cisterns and desalinization plants. It was not intended to allow the use of wells, which is prohibited by vol. II of the comprehensive plan.
Secs. 9.5-328--9.5-334. Reserved.

Sec. 2.4-45. Exemptions.
The following activities shall be exempt from the provisions of this article:
(1) Landscape irrigation by hand watering using a self-canceling nozzle.
(2) Landscape irrigation by systems from which the sole source is treated wastewater effluent, cistern water, or desalinated water.
(3) The operation of irrigation systems for system repair and maintenance.
(4) Flushing of water mains required for normal water main clearance and maintenance and for maintenance of water quality; however, where practical, contractors shall direct

flushed water into pervious areas, flush at the minimum rate necessary for cleaning and disperse the water in such a manner to benefit local vegetation.
(5) Landscape irrigation for purposes of watering in fungicides, insecticides and herbicides as required by the manufacturer or by federal or state laws; however, this exemption applies only to licensed pest control operators and shall be limited to manufacturer's recommendations.
(6) Landscape irrigation for the purpose of watering in newly planted grass and foliage for the first forty-five (45) days after initial installation.
(7) Irrigation activity for dust emissions required by court or administrative action.
(8) Agricultural irrigation where the use of water is permitted by a consumptive or water use permit issued by the SFWMD.

ORMOND BEACH (Volusia Cty.) [many jxs have the same/similar ordinances]
Sec. 11-3. Conditions breeding mosquitoes.
(a) *Prohibited.* It shall be unlawful for any person to have, keep, maintain, cause or permit within the corporate limits of the city any collection of standing or flowing water in which mosquitoes are breeding or are likely to breed, unless such collections of water are treated so as to effectually prevent such breeding.
(b) *Defined.* Collections of water in which mosquitoes breed or are likely to breed within the meaning of this section are those contained in ditches, ponds, pools, excavations, holes, depressions, open cesspools, privy vaults, fountains, cisterns, tanks, shallow wells, barrels, troughs, urns, cans, boxes, bottles, tubs, buckets, defective roof gutters, outdoor tanks of flush closets or other similar water containers.

PORT ORANGE (Volusia Cty.)
Sec. 42-57. Same--Enumerated.
Collections of water in which mosquitoes breed or are likely to breed are those contained in ditches, ponds, pools, excavations, holes, depressions, open cesspools, privy vaults, septic tanks, fountains, cisterns, tanks, shallow wells, barrels, troughs, urns, cans, boxes, bottles, tubs, buckets, defective house roof gutters, tanks or flush closets, or other similar water containers or depressions in lots where water is allowed to remain. The natural presence of mosquito larvae in standing or running water shall be evidence that mosquitoes are breeding there.

SARASOTA COUNTY
Sec. 126-58(d)(1)b.2.:
At his/her own expense, the property owner shall, within 90 calendar days of connection to the Utility, either:
1. Properly Abandon any existing OSTDS in accordance with applicable County and state laws and codes, or
2. Obtain approval from the DOH to use the abandoned septic tank as an irrigation cistern.

Sec. 126-58(e)(1)c.: (similar to previous)

District Development Standards, Art. 6, Sec. 6.10.5.l.2.: Innovative stormwater management designs and techniques including but not limited to porous pavement, infiltration trenches, treatment inlet boxes, cisterns, underground vaults, etc. and stormwater treatment mitigation may be considered for addressing stormwater treatment. All stormwater management designs and techniques shall be certified by a Florida registered professional engineer.

SURFSIDE (Miami-Dade Cty.) (Plumbing—Jon Lindgren 305-331-4621; building inspector—Steve Yuman)
90-88(13)(c)3: Encourage the use of rainwater cisterns to help save water, one of our greatest natural resources. Also, rainwater cisterns will help on reducing watering costs and the impacts of water restrictions on the landscaping. Cisterns shall be provided below grade and are permitted in all zoning districts.

WAKULLA COUNTY COMP. PLAN
Policy 13.1. Development shall meet the following design standards:
a. Except as otherwise provided, development shall be buffered from the following karst features as shown below.
TABLE INSET:

Feature	Minimum buffer (feet)
•1 st & 2 nd Magnitude Springs	300
•Spring runs	150
•Smaller springs	100
•Sinkholes, with a direct connection to the aquifer	100
•Other karst features with a direct connection to the aquifer (swallet or stream to sink)	100

b. The buffer shall be measured from the rim of the sinkhole or karst feature; ordinary high water line for fresh water springs and spring runs; or mean high water line for tidally controlled springs and spring runs;
c. The buffer required in (b) above shall retain natural vegetation within the buffer area, except for minimal removal to allow uses such as docks or boardwalks for which mitigation is required;
d. Non-residential development shall use joint or shared access and shared parking to the maximum extent feasible in order to minimize impervious surfaces. Any parking lots with more than 50 spaces shall be designed with a minimum of twenty (20) percent of the parking spaces in pervious area;

e. Design of parking lots, sidewalks, buildings, and other impervious surfaces shall minimize connections between impervious surfaces, through techniques such as:
Directing flows from roof drains to vegetated areas or rain barrels or cisterns for reuse;
Directing flows from paved areas to vegetated areas;
Locating impervious surfaces so that they drain to vegetated buffers or natural areas; and
Breaking up flow directions from large paved surfaces.

WILDWOOD (Sumter Cty.)
Sec. 19-366. Definitions.
As used in this division the following words and terms shall have the following meanings:
Available means:
(1) The water supply system and sewer systems are not under a moratorium from an appropriate federal, state or local authority.
(2) A water supply and sewer distribution and collection line exists in a public or private easement or right-of-way or utility easement which abuts the property.
(3) The water supply system and sewer system shall meet all current requirements of state, federal and local regulations.
(4) The sewage system has gravity fed lines as opposed to force main lines available to the parcel; provided, however, that the sewer system shall be deemed available to any non-single-family residential parcel regardless of the type of main available to the parcel.
Domestic water means water for drinking, culinary, bathing, sanitary, and other domestic purposes.
Individual water supply means a well, spring, cistern or other similar source of water and appurtenance of piped water for human consumption and other domestic purpose excluding irrigation.

Conclusion

The law regarding use of cisterns for irrigation or for potable water systems in Florida is still in its infancy. The area of the state in which this law has most developed is in Monroe County, which encompasses the Florida Keys. Monroe County has ordinances which specifically allow and encourage use of cistern systems for potable water and for irrigation purposes. However, in these cases, the property typically has no access to any other water, thus making moot the significant concerns about connections between a cistern and public water supply systems.

Most county health departments interviewed had little knowledge of cisterns. Indeed, some did not even know what a cistern is. When they had any idea, county health departments typically asserted that if the system was only for irrigation, they would have nothing to do with it as their charge is to regulate certain types of public water supplies and wells. In more than one case, county department of health officials recommended speaking with the building department of the county.

At the same time, some local governments in Florida see the potential for cisterns for potable water conservation and stormwater management. These efforts have so far not resulted in comprehensive plans for regulation or oversight of cistern systems.

The State of Florida's Department of Health is moving forward on one aspect of cisterns for irrigation: conversion of old septic tanks into cisterns for irrigation purposes. The current draft rule on this topic, however, is limited to considering the potential health impacts of disconnecting, cleaning and disinfecting the old septic tank.

In summary, both the State of Florida and its local jurisdictions will greatly benefit from additional information on the use of cisterns for irrigation systems. They will also benefit from examples of regulatory/oversight approaches from other jurisdictions, particularly in instances in which local governments might consider giving some sort of legal recognition to use of a cistern system in a permitting or regulatory field as, for example, by allowing exemptions from watering restrictions for irrigation systems fed by a cistern.

Examples of Code References and Topics for Cisterns in Florida Local Governments

Topic Area	Jurisdiction	Code Section(s)	
Drinking Water (may be used for)	Monroe County	9.5-292(a)(3)	
Cisterns as basis for exemptions from watering restrictions	Monroe County	2.4-45(2)	(305) 289-2810 Code Enforcement (3/10/09: need to speak with Rhonda Norman)
	Islamorada	34-36(9)	305-664-6400 Left message for code officer Delgado 3/10/09 [#3->#5->#2]
Water Conservation (cisterns encouraged for this purpose)	Bonita Springs (Lee Cty.)	Comp plan Goal 9, Table V-1	
	Casselberry (Seminole Cty.)	3-11.11	
	Lake County	9.01.03	
	Marathon (Monroe Cty.)	107.69.D(6)(d)	305-743-0033 building department
	Surfside (Miami-Dade Cty.)	90-88(13)(c)3	(305) 861-4863 Lily S. (left message 3/10/09)
Stormwater (cisterns may be part of system)	Dunnellon	Ord. 2008-01, River Corridor Protection	
	Leon County	10-4.301(5)(a)(i)	
	Sarasota County	6.10.5.I.2.	
	Wakulla County	comp plan policy 13.1(e)	
Mosquitos or nuisance (must not be a nuisance or breeding place for mosquitos)	Ormond Beach	11-3(b)	
	Port Orange	42-57	
Registration required for new cisterns	Key West	74-337	
Permit fee required for construction	Key West	14-35	

Safety concerns (requirements to cover or fill)	Crystal River	6--63
Pollution concerns (prohibitions on polluting a cistern or other water body)	Ft. Walton Beach	5.04.02(7)
Abandonment of septic tanks	State Dept. of Health	64E-6.011(1)

FKAA person: Colleen Tagle 305-747-0466

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DATE: 3.12.09

MEMORANDUM

TO: Dave Bracciano, Tampa Bay Water
FROM: Thomas Ruppert, UF Levin College of Law and IFAS

Review of White Paper "A Review of Applicable Policies and Permitting Requirements for Non-Potable Use of Cisterns" (dated Dec. 14, 2007)

Much of the information and assertions in the paper "A Review of Applicable Policies and Permitting Requirements for Non-Potable Use of Cisterns" is still current and accurate. A few exceptions are first noted before moving on to consideration of additional materials from other states not encompassed in the paper.

While it is technically true that Florida, at the state level, still does not have any official policy or regulation on the use of cisterns for non-potable use, that is about to change. The change, however, will affect very few cistern systems as the change applies only to those that wish to convert a septic tank to use as a cistern for irrigation purposes. For additional information, see the section below on Florida.

The white paper states on page 2 that "[r]esearch completed indicates rainwater harvesting for non-potable use (irrigation) does not appear to require policies or permitting to regulate their water use." This assertion is not very clear and may need qualification. While rainwater harvesting may not "need" policies, adequate policies could certainly remove confusion and provide direction. For example, interviews with local departments of health and building officials made clear that many are unsure how to treat cisterns for irrigation. This confusion sometimes results in directives to comply with standards that might be more stringent than required. In other words, a complete lack of policy and guidance can lead to confusion and uncertainty as the need for or extent of regulatory review and proper design of systems to comply with the review required. Such uncertainty may not be fatal to the project of an individual who wants "to do the right thing," but such confusion will almost certainly mean that developers will shun cisterns if they increase permitting uncertainty. Thus, an excellent way to promote cisterns for irrigation in Florida is to ensure clarity as to the presence or absence of regulatory requirements and set a clear policy promoting cisterns.

Review of Ordinances and Laws in States Other Than Florida[1]

Arizona

Tuscon has established its own ordinance that requires all commercial development plans in 2010 to include a landscape water budget, separate metering for irrigation, and an approved rainwater harvesting system.[2] A failure of such a site to supply at least 50% of its landscape water through the rainwater catchment system each year will constitute a violation.

Colorado

As a western state that applies the "prior-appropriation doctrine" of water rights, water in Colorado, including rainwater falling on roofs, must be allowed to flow downstream to those with a pre-existing right to use the water.

Hawai'i

An estimated 30,000 to 60,000 people in Hawai'i depend on cisterns for water, and yet Hawai'i does not regulate these private water supplies.[3]

North Carolina

While North Carolina does not appear to have any statutes or regulations referring directly to cisterns, the North Carolina Division of Water Quality in September of 2008 issued the document "Technical Guidance: Stormwater Treatment Credit for Rainwater Harvesting Systems"[4] that indicates that captured rainwater can receive credit as part of stormwater treatment system and that the water can be used for landscape irrigation, among other purposes.

Ohio

Ohio has extensive, detailed administrative code provisions detailing the construction of cistern systems to be used as potable water[5] The code specifies minimum tank sizes,

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[1] Information for this section on other states comes primarily from the "Harvest H2O" website at http://www.harvesth2o.com/statues_regulations.shtml.

[2] Ordinance 10597, Tuscon, Arizona, passed October 14, 2008.

[3] *See*, GUIDELINES ON RAINWATER CATCHMENT SYSTEMS FOR HAWAI'I 1 (2004), available at http://www.ctahr.hawaii.edu/oc/freepubs/pdf/RM-12.pdf.

[4] Document available at http://h2o.enr.state.nc.us/su/documents/RainwaterHarvesting_Approved.pdf.

[5] *See, e.g.* Ohio Administrative Code § 3701-28-13, available at http://www.odh.ohio.gov/ASSETS/691262E5B7AA44838CED85C47AD8B5AC/FR28_13.pdf. It appears that these regulations only apply to potable water systems. *See* Ohio Revised Statute § 6103.01 (2008).

materials standards, and other design specifications, even including "roof washers" and "first-flush" diverters. Ohio also has a website for information on private [potable] water systems.[6]

Texas

The State of Texas and many of its municipalities are actively promoting rainwater harvesting as a source of water for landscape irrigation.

For example, Texas requires that efficiency and conservation building standards include procedural standards for rainwater harvesting[7] and has required development of health and safety standards for rainwater harvesting.[8] Effective September 2009, new state buildings over 10,000 sq. ft. will be required to have on-site reclaimed water facilities such as cisterns for indoor non-potable use and irrigation.[9]

In addition to these state laws, Texas law indicates its policy to encourage all institutions of higher learning to develop curriculums and instruction for on-site reclaimed water facilities such as cisterns.[10] Texas also grants a sales tax exemption to equipment, supplies, and services for rainwater harvesting systems.[11]

Texas law does not allow homeowners' association covenants, conditions, and restrictions to prohibit cisterns or rain barrels although the law does allow the association to regulate the size, location, appearance, and shielding.[12]

http://rainwaterharvesting.tamu.edu

Austin: The City of Austin provides a "Texas Guide to Rainwater Harvesting" on their website at www.cityofaustin.org/watercon/rainwaterharvesting.htm. Austin also offers financial incentives ranging from $45 to $500 towards the cost of installation of cisterns to supply an irrigation system. The program requires Note that the Austin, Texas "Rainwater Harvesting Incentive Program" application contains language specifying that "The City of Austin makes no claims as to the safety or reliability of installed equipment or resulting water. The participant agrees that the water is to be for non-potable uses only."

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[6] Available at http://www.odh.ohio.gov/odhprograms/eh/water/water1.aspx.

[7] Texas Government Code § 447.004(c)(8) (2008).

[8] Texas Health & Safety Code § 341.042 (2008).

[9] Texas Government Code § 447.004(c)(1) (2009).

[10] Texas Education Code § 51.969 (2008).

[11] Texas Tax Code § 151.355 (2008).

[12] Texas Property Code § 202.007 (2008).

Utah

As a "prior-appropriation" water law state, Utah concluded that rainwater catchment without a permit was illegal.[13] A proposed state law would change this by allowing catchment of up to 2,500 gallons without a permit.[14]

Virginia

While it has no laws or regulations on cisterns, Virginia has established a manual on rainwater harvesting and views this as a tool to help deal with stormwater runoff problems.[15]

Washington State:

Washington, like other western states, follows the western water law rule of prior appropriation. Under this law, the state may not permit water uses that will impair the availability of water to those with pre-existing rights to water use. Allowing capture of rainwater, because it can reduce surface water runoff flows, may impair the rights of existing water rights holders.[16] To address this, Washington is currently working on a stormwater rule that will create a limited exemption from the need for a water rights permit to harvest rainwater at the same time that they develop an expedited permitting process for rainwater harvesting systems that do not qualify for the exemption.[17] San Juan County is looking at regulating rainwater harvesting for irrigation systems.[18]

Washington has also passed a state law mandating a reduction in stormwater fees for commercial buildings that install properly-sized rainwater harvesting systems.[19]

Florida

Florida does not have a comprehensive policy on cisterns with clear laws indicating regulation or lack thereof. This lack of laws and regulations at the state level in Florida has in some instances created confusion. For example, when Sarasota County, Florida sought to construct a building in its Twin Lakes Park facility that incorporates a cistern

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[13] Catching rain water is against the law, available at http://www.ksl.com/?nid=148&sid=4001252.

[14] Utah S.B. 128 Rainwater Harvesting, available at http://le.utah.gov/%7E2009/htmdoc/sbillhtm/sb0128.htm.

[15] Virginia Rainwater Harvesting Manual, available at http://www.harvesth2o.com/www/www/Virginia%20Rainwater%20Harvesting%20Manual.pdf.

[16] *See* Rainwater Collection in Washington State, available at http://www.ecy.wa.gov/programs/wr/hq/rwh.html.

[17] Department of Ecology, State of Washington, Focus on the Proposed Stormwater Rule 2 (2008), available at http://www.ecy.wa.gov/pubs/0811023.pdf.

[18] See information at http://www.ecy.wa.gov/programs/wr/nwro/sjc_rwc.html.

[19] Revised Washington Code 36.89.080 (2008).

system whose water would be used to flush toilets, Florida's Department of Environmental Protection (DEP) only had one rule applicable to non-potable water piped into a building. Rule 62-610.468 of Florida's Administrative Code is supposed to apply only to reuse water, but DEP applied the rule because it had no other rules for non-potable water.[20] This rule requires notification to the public of reuse water and posting a sign that states "Do Not Drink" where reuse water is used. Thus, when one visits the LEED-Gold-certified building in Sarasota County, above each toilet is sign that says "Do Not Drink."

While many jurisdictions have no express permitting process for cisterns used for irrigation purposes, some review the plans for the cistern-irrigation system as part of the building plans while others do not. Should a person want to install a cistern and use the water to flush toilets, some jurisdictions are applying Appendix C of Florida's Plumbing Code, which is titled "Gray Water Recycling Systems."[21] Since rainwater from a cistern is not gray water, this appendix is not appropriate. In fact, the definitions section of Appendix C of Florida's plumbing code defines "cistern." In addition, "Appendix F - Proposed Construction Building Codes for Turf and Landscape Irrigation Systems" also fails to mention cisterns although a cistern can supply water that meets the requirements of "water supply" listed in Part II.B.1. of Appendix F.

Recommendations Moving Forward

The State of Florida should establish statutory guidance in Florida Statutes section 373.228 that it is the policy of the state to seek to conserve potable water resources and protect surface water quality by encouraging the capture of roof runoff into properly-designed cistern-irrigation systems. In addition, it might be advisable to also consider adding to the general water policy statements in Florida Statutes section 373.016(2) that it is the policy of the state to encourage the lowest-quality appropriate source of water for each use and mention cisterns, reclaimed water, and stormwater reuse. In addition, the

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[20] The problem of applying the wrong rule has been noted by proponents of rainwater harvesting.

> Harvested Rainwater is storm water that is conveyed from a building roof, stored in a cistern and disinfected and filtered before being used for toilet flushing. It can also be used for landscape irrigation.
>
> Appendix J of the UPC deals with reclaimed water, but according to the above definition, rainwater harvesting is not reclaimed water. Plumbing officials that do not know how to classify rainwater harvesting systems consider it reclaimed water systems and therefore require plumbing engineers to design systems that conform to Appendix J of the UPC. This is due to the lack of guidance in the code. As rainwater catchment systems are becoming more prevalent in the United States, both the UPC and the IPC need a section dedicated to rainwater harvesting.
>
> From website http://www.harvesth2o.com/statues_regulations.shtml

[21] Florida's Building Code, of which the Plumbing Code is a part, may be found at http://www2.iccsafe.org/states/florida%5Fcodes/.

"definitions" in section 373.203 should include definition of a cistern to ensure that there is no confusion between a cistern system that uses roof runoff and reclaimed water or stormwater. Other desireable policies to promote cisterns could be gleaned from the examples in Texas and further research could develop additional examples.

Florida's Plumbing Code should be modified to directly address cisterns in their three possible uses: outdoor irrigation, indoor non-potable uses, and potable use.

In addition to these recommended changes, the Uniform Plumbing Code (UPC) and the International Plumbing Code also still represent challenges. Currently Appendix J of the UPC sets out design standards for reclaimed water. Many local government regulators do not fully appreciate that harvested rainwater is *not* the same as reclaimed water. Thus, regulators may insist on compliance with Appendix J.

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MEMORANDUM

TO: Dave Bracciano, Tampa Bay Water
FROM: Thomas Ruppert, UF Levin College of Law

RE: Sponsorship and Advertising Supporting Outreach Activities

Tampa Bay Water and The Florida Yards and Neighborhoods Program seek to promote conservation of potable water resources by promoting use of cisterns as a source of irrigation water for landscapes. To this end, Tampa Bay Water and The Florida Yards and Neighborhoods Program are developing a workshop and materials on cisterns and their design and use as part of an irrigation system. This effort includes involvement by private companies and contractors that offer related services. In addition, these companies will likely advertise their products and services as part of the sponsorship of educational programs hosted by Tampa Bay Water, The Florida Yards and Neighborhood Programs, and local governments. The question has arisen as to how private vendors may be involved in presentations and advertising of their products in these workshops.

Research revealed extensive materials on sponsorship of conferences by private parties. These arrangements involve allowing vendors certain advertising opportunities in exchange for cash, merchandise, or services that support the organizer's conference. However, none of the material reviewed addressed whether the conference organizer could be assumed to be responsible for a product or held to be directly advertising a specific product or service. All the materials located for this review were directed to conference organizers and focused exclusively on the topic of maximizing the gross amount of revenue of sponsorship. The only cautionary note encountered was an admonition to avoid giving so many advertising opportunities to sponsors that the conference would appear to be nothing more than marketing; the example was that conference publications and sites should not be solidly plastered with logos as a car on the NASCAR circuit as this can negatively affect the image of the conference/presentation and it can dilute the effectiveness of the advertising opportunity afforded each sponsor.

Examples of reviewed materials on sponsorship:

1. Article "Innovative Ideas for Successful Planners: Sponsorships Done Right!" giving advice on how to secure sponsorships: http://www.mpiweb.org/CMS/mpiweb/mpicontent.aspx?id=14018
2. Article "Sponsorship and Sales: Sales Strategies and Techniques for the Exhibition Manager" http://www.mpiweb.org/CMS/MPIweb/mpicontent.aspx?id=16938
3. Article "Build the Relationship. Reap the Rewards" about growing sponsorships https://www.mpiweb.org/CMS/mpiweb/mpicontent.aspx?id=14010&printview=1
4. Detailed listing of sponsorship opportunities and prices for a European conference: http://www.mpiweb.org/cms/uploadedFiles/EMEC%202009%20Sponsorship%20Opportunities.pdf
5. Sponsorship advice for sponsorship advertising directed at women: http://www.mpiweb.org/CMS/mpiweb/mpicontent.aspx?id=5839

The ubiquity of materials on sponsorship, absence of materials discussing potential liability, and the common practice of doing sponsorships indicates little to no likelihood of adverse liability for Tampa Bay Water, the Florida Yards and Neighborhoods Program, or cooperating local governments in allowing sponsorship and advertising of private vendors during presentations to promote installation and use of cisterns.

Nonetheless, some basic best practices and policies should be observed. For example, Tampa Bay Water, the Florida Yards and Neighborhoods Program, and the involved local government should never endorse specific products or service providers. The proper role of Tampa Bay Water, the Florida Yards and Neighborhoods Program, and the involved local government is to promote the installation and use of cistern systems through providing informational resources. These informational resources may include various products or service providers that can help, but it should be clear that they are not guaranteed or specially endorsed by Tampa Bay Water, the Florida Yards and Neighborhoods Program, or the local government. Thus, no advertising allowed at the venue or in printed materials should be allowed to state that Tampa Bay Water, the Florida Yards and Neighborhoods Program, or the local government endorses/recommends a specific product or service.

To also avoid problems, representatives of event sponsors may be allowed as speakers/presenters/panelists. However, such participants must receive notice that their roles shall be limited to explanations of technical materials, descriptions of types of services or products/processes available and that specific references or promotion of specific brand products or services are prohibited.

APPENDIX D

florida Rainwater Harvesting Initiative

ARCSA
American Rainwater Catchment Systems Association

TAMPA BAY WATER
Supplying Water To The Region

USF
University of South Florida

UF University of Florida IFAS Extension

Florida Yards & Neighborhoods

fis
Managing Every Drop

Rainwater Harvesting with Cisterns

for Landscape Irrigation

Brought to you by:

florida Rainwater Harvesting Initiative

Workshop Agenda

Part I	**9:00am – 10:00am**

Anatomy of a Rainwater Harvesting System
- System components and their function

Break	**10:00am – 10:20am**
Part II	**10:20am – 11:20am**

Sizing and Reliability

- How cisterns are sized
- Estimate irrigation demand
- Reliability
- Resources

Q & A/Vendors	**11:20am – 12:00 noon**

Equations to Remember

Rainfall Potential: ***A x R x 0.5 = G***

Irrigation Demand: ***A x ET x 0.623 = G***

A=Area R=Rainfall

G=Gallons ET=Evapotranspiration

NOTES:

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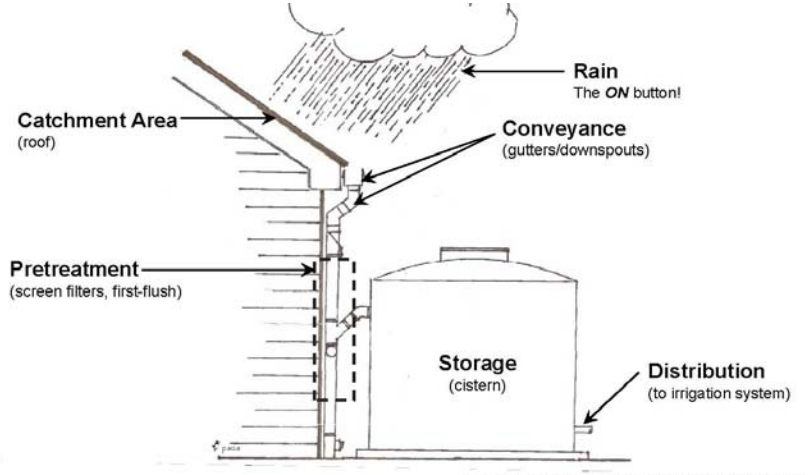
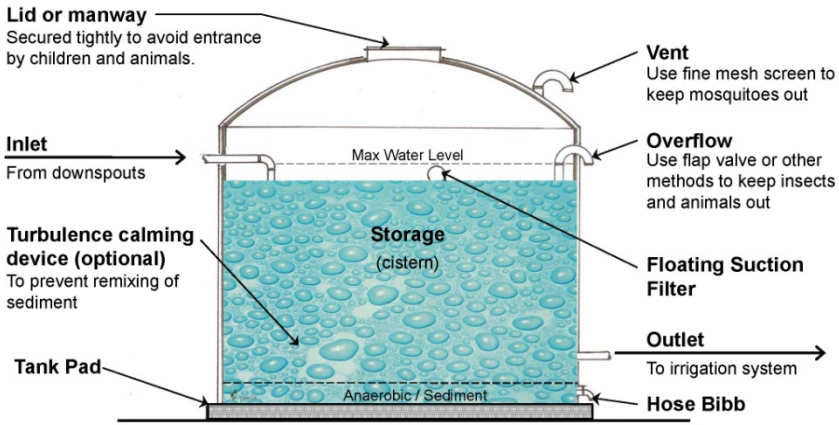
Recommended System Parts



Source: *Harvesting Water for Landscape Use* by Patricia H. Waterfall, p. 34 Original diagram was modified for this application.

Cistern Anatomy



Source: *Rainwater Harvesting Planning and Installation Manual, January 2009*, Figure 12.5. Original diagram was modified for this application.

Rainfall/ET Data

Month	"Normal" Rainfall (in)
J	2.27
F	2.67
M	2.84
A	1.80
M	2.85
J	5.50
J	6.49
A	7.60
S	6.54
O	2.29
N	1.62
D	2.30
Total	44.77

Month	Water use (inches)
January	2
February	2.5
March	3.4
April	4.2
May	5.2
June	4.3
July	4.8
August	4.8
September	3.9
October	3.4
November	2.5
December	1.9
Total	42.8

Source for rainfall data:

http://www.ncdc.noaa.gov/oa/climate/online/ccd/nrmlprcp.html

Source for ET rates:

http://www.floridaturf.com/staugust/water.htm

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Questions to ask…

Are you an accredited professional?

Are there codes/permits required for this application? If so, how much will this cost and it is part of the estimate?

What provisions have been made for overflow or excess water?

Do you offer a maintenance agreement? What does it include?

What is the warranty period on cistern components and installation?

Maintenance Requirements

- Check for debris in tank
  Tank should be cleaned out about once a year. It is a confined space and should not be entered alone!
- Inspect gutters and downspouts regularly
  Remove debris
- First flush bypass
  Check drain holes are clear for proper function
- Inspect downspout seals and entrances
- Check for leaks

Cistern System Checklist

Catchment Area
_____ Size determines collection potential
_____ Roof Size: [ ] sq. ft.

Conveyance
_____ Need gutters/downspouts?
_____ Do existing gutters collect ALL roof runoff?
_____ Are gutters properly sloped/sealed?
_____ Need leaf guards?

Pretreatment
_____ First flush device needed?
Above or below ground?
_____ Filters

Cistern
_____ Size recommended: [ ] gal.
_____ Material type: [ ]
_____ Above or below ground?
_____ Stable/level foundation?
_____ Strapped down (if above ground)?

Distribution
_____ Pump? Or pressure tank?

Miscellaneous
_____ Tank Level Indicator
_____ Other _____

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