

Water Harvesting



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What is Water Harvesting?

- Water harvesting is the activity of direct collection of rainwater.
- Water harvesting means to understand the value of rain, and to make optimum use of the rainwater at the place where it falls.
- Water harvesting means capturing, storing and utilizing rainwater for water consumption activities, thereby reducing reliance on potable water sources



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Why A Cistern

- ❑ Cisterns store rain water
- ❑ Rain water can be used for any non-potable use such as irrigation, vehicle washing, toilet flushing
- ❑ Saves money on drinking water
- ❑ Stored water does not contribute to runoff



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How Cisterns Work:

- ❑ First flush diverter diverts pollen/leaves, etc. so clean water enters cistern
- ❑ Cistern is sized to match roof size and intended use
- ❑ A pump is needed for pressure
- ❑ May need protection from freezing



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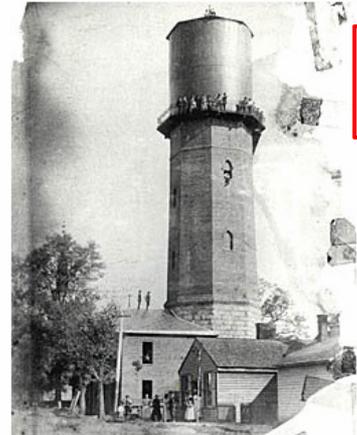
State Capitol building, completed in 1840
Photo courtesy of North Carolina Division of Archives and History

Although there was Union sentiment in Raleigh, a celebration occurred when the State convention voted to secede from the United States on May 20, 1861. The State Capitol served as the meeting place for the state's wartime legislatures, and the city became a concentration point for Confederate troops. General William T. Sherman's army entered Raleigh on April 13, 1865, beginning the occupation of the city by the Federal army. Troops were encamped around the city and Gen. Sherman established headquarters in the Governor's Palace. After war's end, the difficult period of Reconstruction began.

An 1872 birdseye view of the City of Raleigh (right) shows the arrangement of the community shortly after the Civil War. The commercial section emerged along Fayetteville Street, just south of the State Capitol. Foundries, factories and warehouses were located near the tracks on the north and west sides of town. The remaining spaces inside the city limits were occupied with boarding houses, private residences and three hotels inhabited by poor and wealthy, black and white, young and old. In the final quarter of the 19th century, Raleigh's public and private sector leaders were determined to improve the cityscape to their advantage. Proximity to surface transportation spelled success for merchants in the form of shops and warehouses, stables and hotels. City alderman established streetcar lines and community leaders enlarged churches. Businessmen endeavored to make Raleigh a prosperous city before the turn of the 20th century.



1872 birdseye view of the City of Raleigh. View high resolution map by clicking here. Photo courtesy of Library of Congress, Geography and Map Division, digital id g3904r pm006660



Raleigh Water Tower
Photo from National Register of Historic Places

A critical element to Raleigh's future growth was the provision of a stable, potable water supply. From its founding in 1792, until the municipal water works went into operation, Raleigh depended on springs, wells and cisterns for its water supply. The Raleigh Water Works complex, built in 1887 at the 1800 block of Fayetteville Street, was designed by civil engineer Arthur Winslow. Filtered water was fed to the 2,500,000 gallon holding reservoir. A 14-inch main carried water to the city and elevated storage was provided by a water tower. By the early 1900s, the water supply system had expanded to cover the entire city.

Besides the provision of water another amenity which was lauded by Raleigh's public and private sectors was transportation. The electrified streetcar in the capital city did not materialize until 1891, but for five years before this, mule-drawn, open-sided vehicles ran short routes

From its founding in 1792, until the municipal water works went into operation, Raleigh depended on springs, wells and cisterns for its water supply.

Cisterns



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History

Lighthouse Compound
 Lighthouse Facts
 Climb to the Top



THE CURRITUCK BEACH LIGHT STATION

On December 1, 1875 the beacon of the Currituck Beach Lighthouse filled the remaining "dark spot" on the North Carolina coast between the Cape Henry light to the north and Bodie Island to the south. To distinguish the Currituck Beach Lighthouse from other regional lighthouses, its exterior was left unpainted and gives today's visitor a sense of the multitude of bricks used to form the structure. The lighthouse was automated in 1939 when the United States Coast Guard assumed the duties of the Bureau of Lighthouses. At a height of 158 feet, the night beacon still flashes at 20-second intervals to warn ships hugging the chain of barrier islands along the coast.

The Lighthouse Keepers' House, a Victorian "stick style" dwelling, was constructed from pre-cut and labeled materials which were shipped by the U.S. Lighthouse Board on a barge and then assembled on site. In 1876, when the Keepers' House was completed, two keepers and their families shared the duplex in the isolated seaside setting. The keepers were removed after the Lighthouse was automated and attendants were no longer needed to clean the lenses, trim the wicks, fuel the lamp, and wind the clockwork mechanism which rotated the beacon.



By the late 1970s, the Lighthouse Keepers' House stood open to the elements with no windows or doors; porches had decayed and vines invaded the north side. Much of the interior millwork had been vandalized. Concerned about the preservation of the historic property, Outer Banks Conservationists, Inc., a private non-profit organization dedicated to the conservation of the character of the Outer Banks of North Carolina, signed a lease with the State of North Carolina in 1980 to begin a phased restoration of the property. The lease charged the group with the responsibility of restoring the Keepers' House and improving the historic compound.



Today, the grounds and walkways are rejuvenated and the exterior of the Keepers' House is nearly complete, but the phased restoration of the interior remains a considerable undertaking. Although plaster walls and pine floors have been repaired, vandalized wainscoting replaced, and the mahogany balustrades replicated, reproduction doors and hardware must be made and installed and interior finishes applied.

OBC worked with the N.C. Department of Cultural Resources to restore the smaller (and possibly older) dwelling on the north side of the complex. This house was probably moved to the site around 1920 as a residence for a third keeper and his family. The structure is now open from Easter through Thanksgiving as a Museum Shop offering models of Outer Banks lighthouses, books and other lighthouse and wild horse-related items.

Other historic structures located within the lighthouse compound include an outhouse and a storage building. The two-hole privy has been repaired and the storage building with its four sharp finials has been restored and now serves as the lighthouse staff office. The two louvered structures flanking the Keepers' House are cisterns which store rain water.



OBC has broad-based support from donations and sponsorships. An annual sponsorship is \$25 for an individual and \$50 for a family. Each sponsorship includes a number of free visits and an annual Newsletter. Donations are fully tax-deductible and sponsorships are deductible to the extent allowable by the IRS. Funds are used for historic preservation and conservation projects, including the restoration and maintenance of the Currituck Beach Light Station. For further information, contact the OBC site manager, at 252-453-8152.

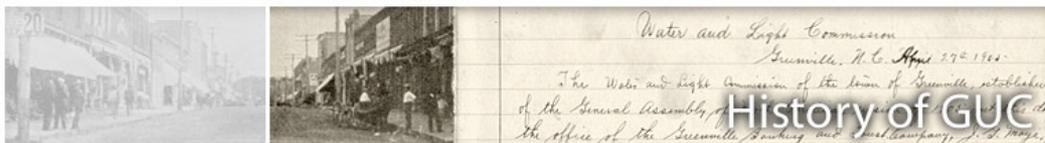
LIGHTHOUSE FACTS

- Number of steps: 214
- Height to focal plane of lens: 158 feet
- Height to top of roof: 162 feet
- Number of bricks: approximately one million
- Thickness of wall at base: 5 feet 8 inches
- Thickness of wall at parapet: 3 feet

On December 1, 1875...the two louvered structures flanking the Keepers' House are cisterns which store rain water.



Position: 34 miles south of the Cape Henry (Virginia) Lighthouse 32 1/2 miles north-northwest of Bodie Island Lighthouse



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A Brief History of Greenville Utilities

In 1903, Greenville was a town of just 2,565, governed by a Board of Alderman. Homes were dimly lit by kerosene lamps and the town's street lamp lighter, Henry Duff, had a secure job. The town's water supply consisted of cisterns, the town pump, and surface wells kept on back porches.

The "sewer system" was just a series of open pits in backyards--sometimes located within arm's reach of drinking wells, a perfect breeding ground for typhoid fever and malaria.

With an eye toward progress, on April 7, 1903, a \$65,000 bond referendum for water, sewer, and electric system was passed by a vote of 187 to 11. Two years later, on March 20, Greenville's new generator was cranked up and lights illuminated the downtown for the first time. The curious crowd, which had gathered for the occasion, shouted its delight. All, we assume, except for Henry Duff, who surely sensed that his lamp lighting days were numbered.

And so, the Water & Light Commission was established in 1905 with about 72 electric and 30 water customers. The gas system came a few years later, in 1925.

Since 1905, Greenville Utilities has grown to become a vital part of the community. There have been many changes, but one thing has remained constant--our dedication to personal service at the lowest reasonable cost. We are and always have been a public power utility, owned by the people we serve.

Electric System

April 1884 First known, serious talk of electricity surfaced at a citizen meeting at the Pitt County Courthouse when the Houston Electric Light Company presented a proposition to furnish lights.

In 1903... The town's water supply consisted of cisterns, the town pump, and surface wells kept on back porches.

Cisterns...shall be screened or oiled whenever in the opinion of Board of Health, such screening or oiling is necessary to prevent the breeding of mosquitoes. Every entity...shall be subject to a penalty of \$5.00 dollars for each and every offense, and each day's continuance...

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Ordinances of the town of Greenville, North Carolina: April 1st, 1928
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shall fail to place all excrement from typhoid cases in boiling water for at least twenty minutes before burying the same, shall, upon conviction, be fined five (\$5.00) dollars for each offense.

Back Matter

Section 13. No person shall butcher any cattle, hog or sheep within the corporate limits of the town under a penalty of five dollars for each and every offense: Provided, however, that the mayor may grant special permission for it to be done at some place that will not be offensive to the citizens of the town. Any person violating this section shall be fined ten (\$10.00) dollars.

Stagnant Water, Drainage, Oiling, etc.

Section 14. It shall be unlawful for any owner, lessee, tenant, or occupant of any building or premises within the town of Greenville to keep or permit thereon any standing water or matter or substance injurious to health or offensively odorous. All cellars, excavations, ditches, or open spaces therein in which water at any time stagnates or arises, or which are damp, and in which foul and unwholesome gasses are generated, and all premises therein on which water shall pond, shall upon written notification by or through the county health officer, be provided with proper drainage by the owner thereof, or be filled up with sand, gravel, or some other imperishable material, but not in such manner as to obstruct proper drainage of water. Upon the establishment of grades by said town of Greenville for a drainage system, it shall be the duty of all property owners to conform thereon and provide at their respective premises so as to abate and prevent nuisances. That all property owners when required so to do shall provide under ground drainage for water passing over their premises. **Cisterns**, tanks, vats, fire buckets, and other receptacles used to contain water, shall be screened or oiled whenever in the opinion the board of health, such screening or oiling is necessary to prevent the breeding of mosquitos. Every person, firm or corporation violating this section or failing to comply with any of its provisions, after five days written notification and requirement by or through the said county health officer, shall be subject to a penalty of five (\$5.00) dollars for each and every offense, and each day's continuance, after said five days notification shall constitute a separate and distinct offense.

Screening of Dwellings

Section 15. It shall be unlawful for any property owner or his authorized agent to construct, maintain or permit to exist on

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\$55.10 using the Consumer Price Index

Ordinance for Greenville, NC; April 1, 1928

Water Harvesting



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Water Harvesting-Benefits



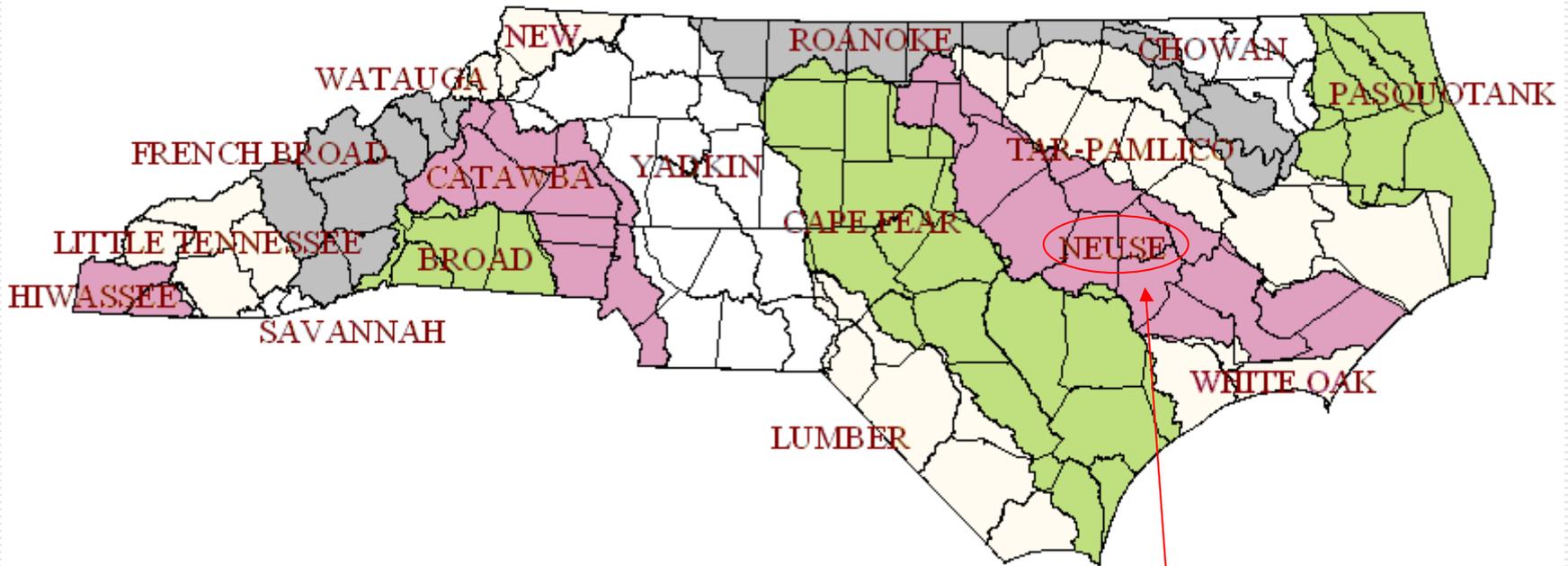
- Peak stormwater flow control
- Stormwater runoff volume reduction
- Reduce demands on groundwater resources
- Promote water conservation

Cisterns



Water Harvesting

North Carolina's River Basins



Kinston, Lenoir
County November 1998

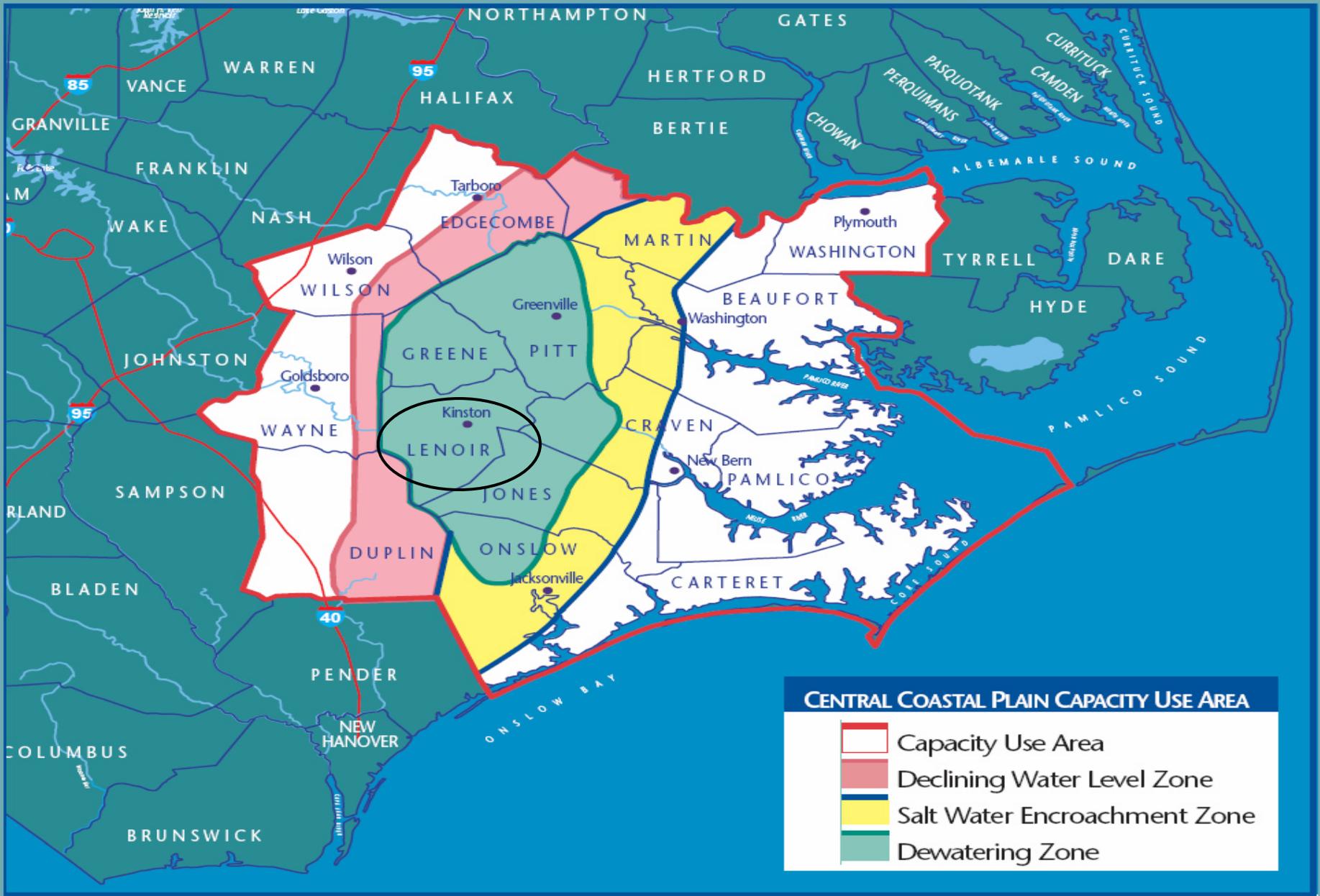


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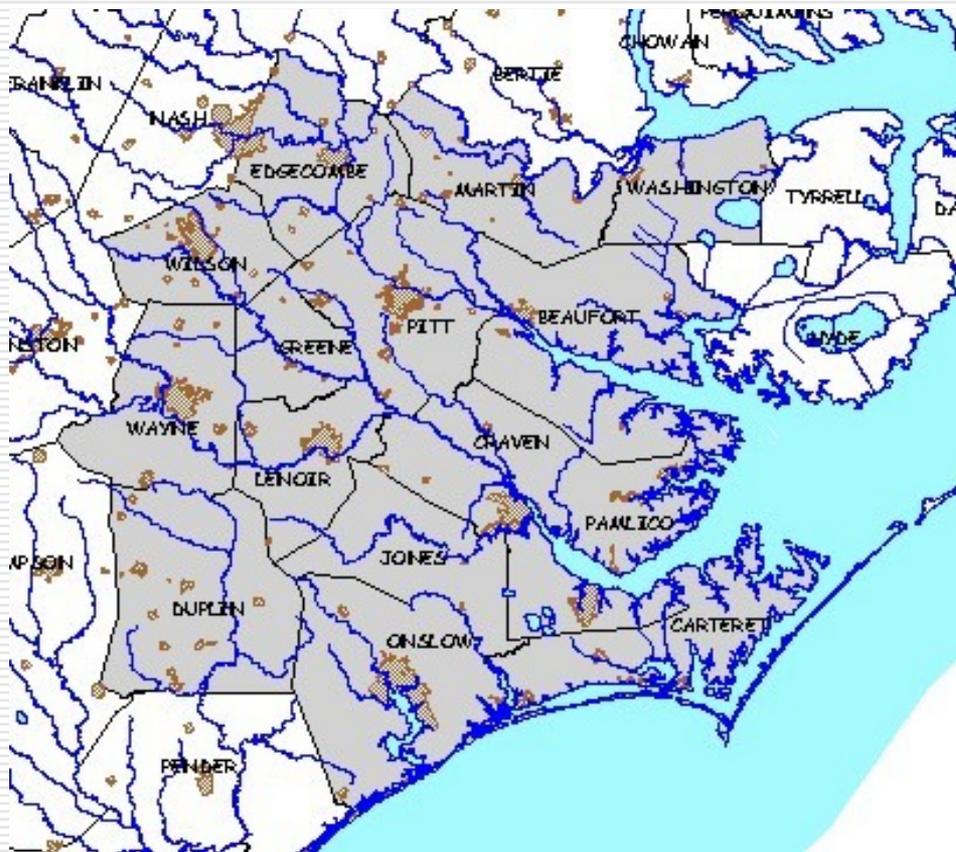
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Central Capacity Use Area



-Mandated by State to reduce consumption from aquifer by 25% by 2008 and 50% by 2013.

-Will utilize other sources, but conservation is necessary

-Daily water use during summer months is over 400,000 gallons greater than winter.

Site Considerations and Restraints



Gutters and
downspouts!

AKA:
"Catchment
System"

Site Considerations and Restraints



Gutters and
downspouts!

Are they
fully
functional?

Vehicle Washing

- ◊ What is the demand or intended use for the system?
- ◊ What is the average annual rainfall?
- ◊ What is the catchment area of the rooftop?



City of Kinston Rainwater Management Demo Site

- ◆ >4000 (+) sf of Roof
- ◆ Gutter Rework & Trenching Required
- ◆ Demand: 33,000 gal/month
- ◆ Design Volume: 5000 gal (provides enough h₂o for 1.5 days washing/week)
- ◆ Designed by BAE Sr. Design Students

Demand: Vehicle Wash

- Number of Vehicles
- Size of Vehicles
- Type of Washer Used
 - Power Wash?
- Wash time per sf of vehicle
- Frequency of Washing



Kinston – 33,000 gal/month



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Choosing a Cistern Type

Cistern Type	Advantages	Disadvantages
fiberglass tanks	prevents algae growth and evaporation, rust resistant, durable	higher initial costs, degradable, requires exterior coating
polyethylene tanks	various sizes, shapes, alterable, inexpensive, movable	can deteriorate over time if not treated for UV radiation
plastic garbage can	available, inexpensive	use only new cans
barrels	attractive, alterable, great for small systems	hard to find, small
55 gallon steel drums	available, durable, great for small systems, moveable	prone to corrosion, rust and/or toxins
galvanized tanks	inexpensive, attractive, moveable, alterable	can rust, higher long term costs
plaster cisterns	low profile, inexpensive, can alter color	large footprint, unalterable, immovable
concrete tank-ferrocement, stone, or concrete block	durable, permanent	potential to crack, difficult to maintain



Metal 5,000 gallon cistern



Location of Cistern









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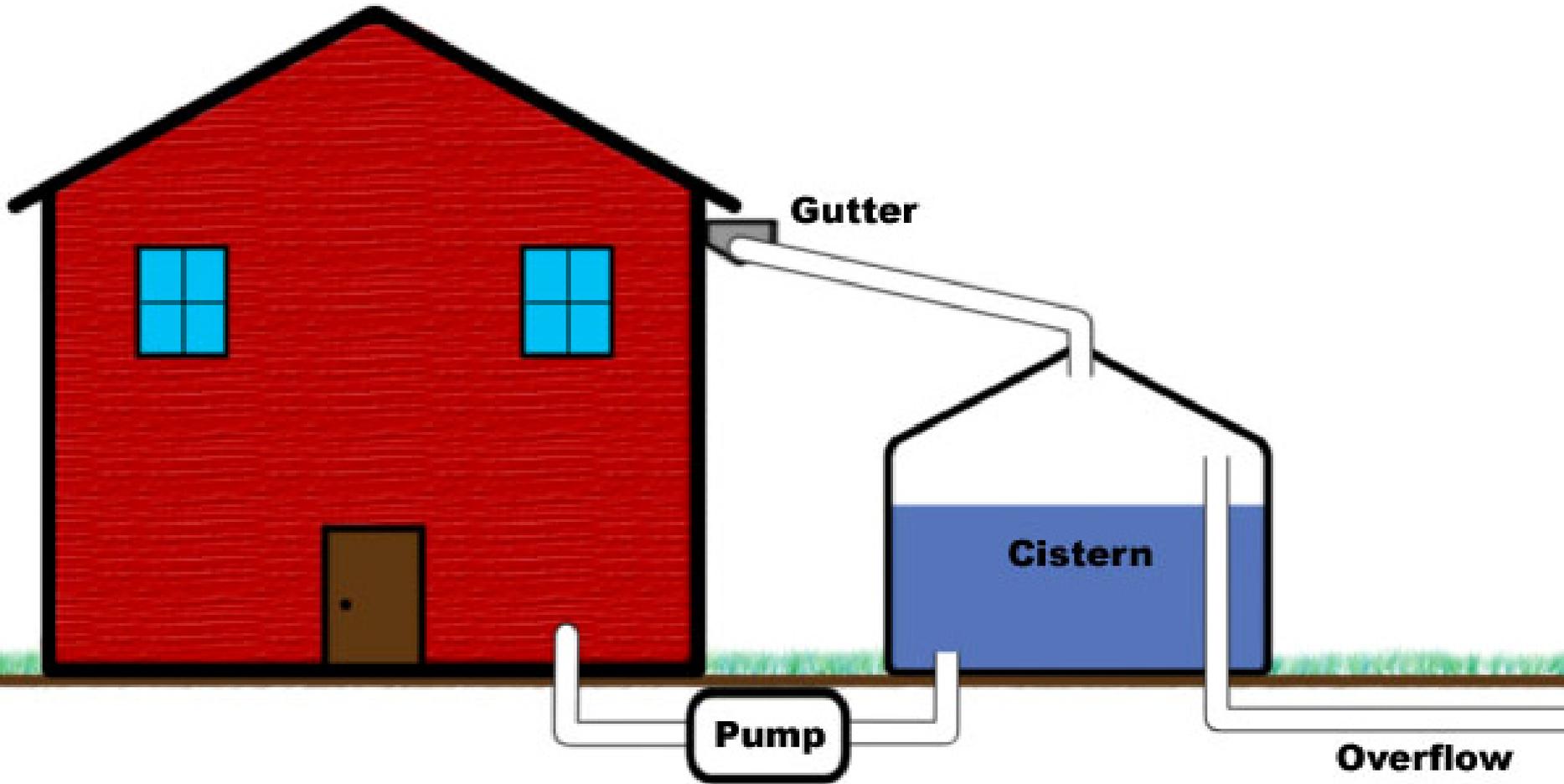
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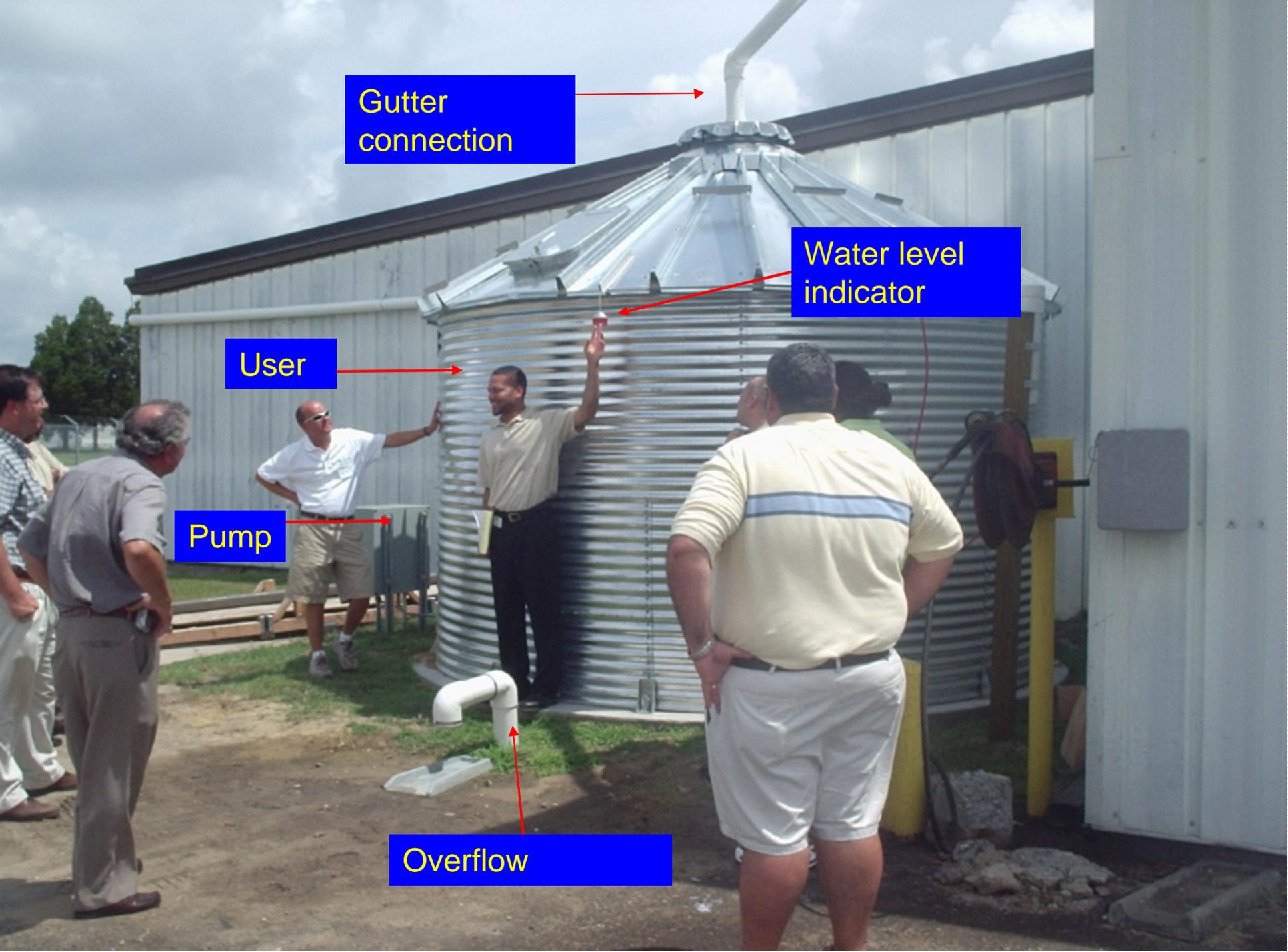






Water Harvesting Layout





Gutter connection

Water level indicator

User

Pump

Overflow





Cistern Usage





Maintenance

Water Harvesting



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Kinston Project Conclusions



- Peak stormwater flow control
- Stormwater runoff volume reduction
- Reduce demands on groundwater resources
- Promote water conservation



Quiz, #1

1. As cited in this presentation, what is water harvesting?

a. Water harvesting is the process by which ditches collect stormwater in eastern NC.

b. Water harvesting means to understand the value of rain, and to make optimum use of the rainwater at the place where it falls.

c. Water harvesting is using water from a water provider in contrast to using it from a groundwater well.



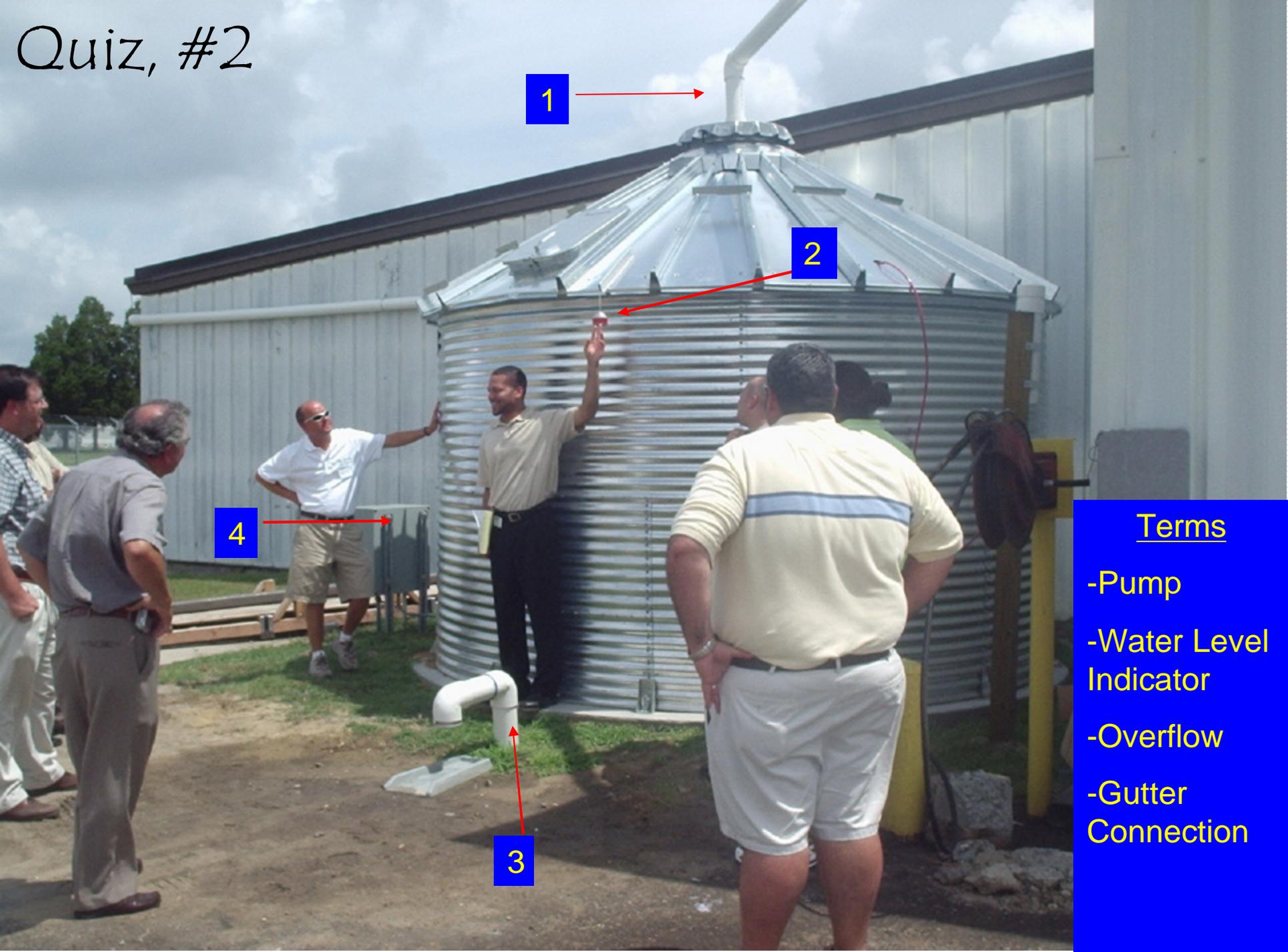
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Quiz, #2



1

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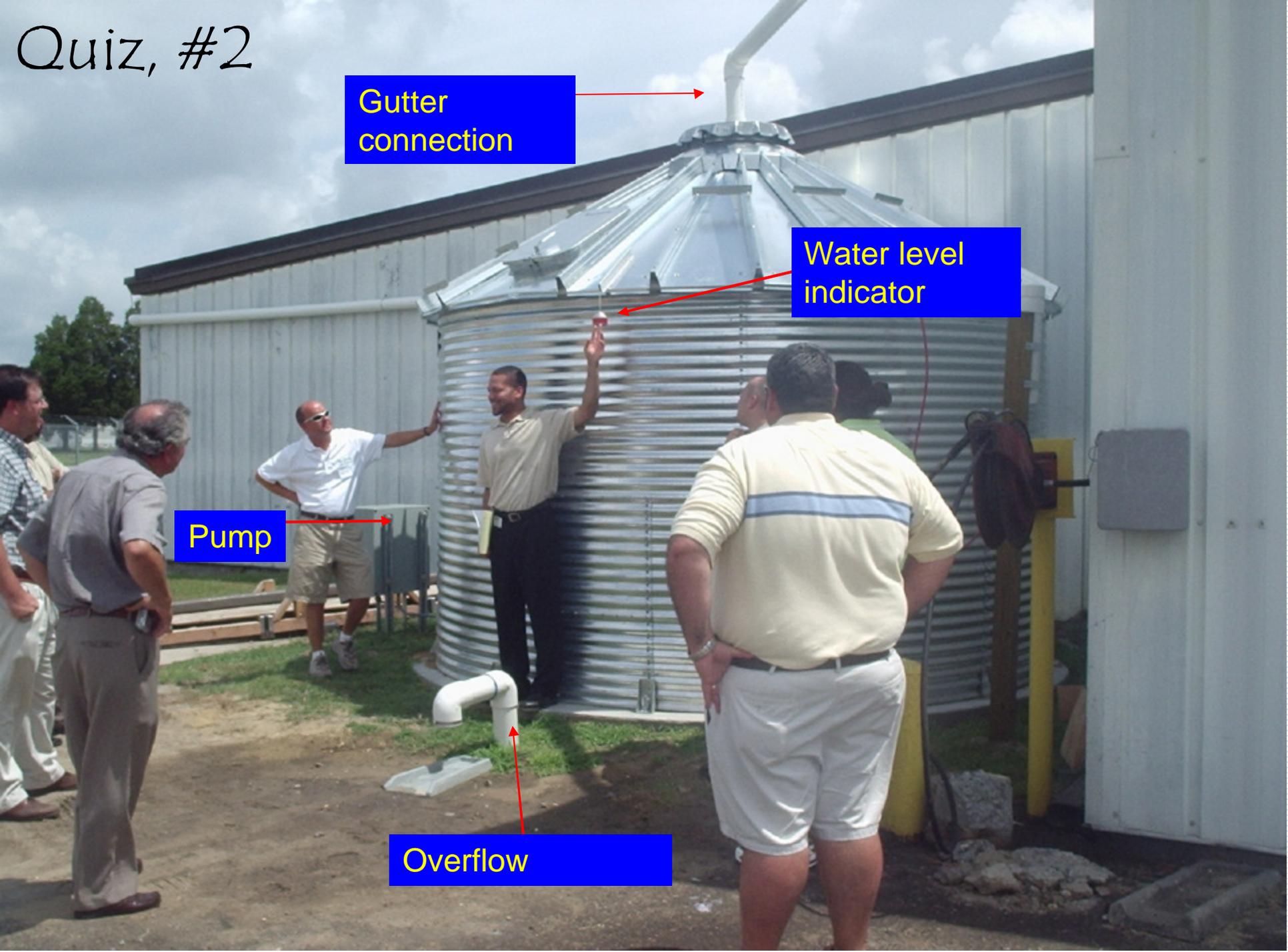
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Terms

- Pump
- Water Level Indicator
- Overflow
- Gutter Connection

Quiz, #2



Gutter connection

Water level indicator

Pump

Overflow

Quiz, #3

What are three considerations when planning to install a water harvesting system?

- a. What is the demand or intended use for the system?
- b. What is the average annual rainfall ?
- c. What is the catchment area of the rooftop?



Rainwater Management System Applicability



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Water Uses

Irrigation, washing vehicles



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2000 ft²

Reducing Stormwater Runoff

Education and Outreach



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Education and Outreach

Sun Journal

New Bern, North Carolina



Byron Holland/Sun Journal

From left, Megan Toler, 7, Taylor Bryan, 6, Andrew Register, 6, and Jordan Hill, 10, try to break a water balloon during the games portion of a 4-H Club water conservation program. The club members spent Wednesday at the Agriculture Center in New Bern learning about ways to conserve water.

Wacky Water Day a cool relief

Record heat provides backdrop for learning about conservation as area students participate

By Sue Book
Sun Journal Staff

Katie White was one of 20 area children keeping cool with water in Wednesday's record heat while learning about ways to conserve the precious resource.

A rising fifth-grader at James W. Smith Elementary School, White and students from Cove City, Vanceboro,

Trenton and Ernal, spent the day at the Craven Cooperative Extension Service office taking hits from cold water balloons and playing other cool-down games as part of Wacky Water Day.

Hosted by Craven County 4-H Agent Tammy Boyd, with Joan Hobbes providing instruction, the kids brought beach bags, coolers and lunch and went in and out regularly to keep away from too much exposure to the blistering heat.

"People can use rain for water," said White, who was introduced to the Craven Cooperative Extension Service

INSIDE

For more on the heat wave gripping North Carolina and the eastern third of the nation, see **A4** and **D2**.

rain barrels that environmental agent Charlie Humphries worked with North Carolina State University to install.

Revitalizing one of the most ancient man-made water collection systems, the cistern, the 3,000-gallon container collects rainwater for use in outdoor uses like watering gardens and washing

cars and cooling off on a hot summer day.

"The rain harvesting system we have catches water from a 2,000-square-foot roof," said Hobbes. "One inch of rain produces 1,200 gallons of water."

Screens over gutters keep insect breeding down and the water is then filtered before use. The event is part of a county-wide water conservation education program that will be taken into area schools next year.

Sue Book can be reached at (252)635-5666 or sbook@free-domeinc.com.



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Maintenance Activities

- ❑ Conduct a walk through inspection of the entire system (screens, plumbing connections, pump, hose, etc.,) on a routine basis and after every significant storm event

- ❑ Keep gutters open and debris-free
 - Cleaning frequency will depend on site characteristics and storm event intensity and frequency

- ❑ Clean/remove any debris from inlet screens as needed

- ❑ Wash inside and outside of cistern



Maintenance Activities

- ❑ Flush/drain cisterns regularly to prevent build up
- ❑ Check pipe connections and valves to look for any leaks
- ❑ Make sure cistern manhole is accessible, operational and secure
- ❑ If your system has a water level indicator, check its accuracy
- ❑ If your system has a pump, follow maintenance guidelines provided with pump



Maintenance Activities

- Winter-proof system
 - Insulate supply lines, pumps and fixtures if they are not sheltered
- Check to insure that the cistern is secured with tie downs and/or has a water level in cistern that will prevent it from becoming dislodged



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