RAINWATER™ RESOURCES

Rainwater Harvesting for Stormwater Management

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Top 3 Learning Objectives

1. Rainwater harvesting basics. Design and components.

2. Importance of supply and demand basis for determining storage capacity.

3. Understand cost recovery factors for a rainwater harvesting investment

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Rainwater Harvesting

-Definition-

The capture and storage of rooftop rainwater for retention for future use and/or detention for stormwater runoff compliance

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Rainwater Harvesting Is Not

- Reclaimed Water
- Reuse Water
- Recycled Water
- Gray Water

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Rainwater is an asset of the homeowner or property/building owner.

How much is it worth now? In the future?
Other Cost Savings?
Other Non-Monetary Benefits?

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Benefits

- Stormwater Management
- Reduced cost of site plan
- Reduced cost of water
- Reduced cost of irrigation
- LEED Points
- Availability of water
- Superior water quality
- Mitigation credits
- Stewardship
    - Protect groundwater resources
    - Carbon footprint of centralized water

RAINWATER RESOURCES

Users

- Commercial
- Industrial
- Institutional
- Government (Federal, State, County, Municipal)
- Military Installations
- Agricultural (Poultry, Veal, Cattle, Swine, Horses)
- National, State, Local Parks
- Residential

RAINWATER RESOURCES

Uses

- Toilet flushes
- Irrigation
- Cooling tower makeup
- Fire suppression
- Mfg processes
- Car / truck washes
- Laundries
- Pool fills
- Stormwater management
- Household general and potable use

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The Process

1. Capture | Convey
2. Pre-Filtration
3. Containment
    a) Calming Inlet
    b) Floating Extraction
    c) Overflow
    d) Capacity Regulator
4. Output (Supply)
    a) Pressurization
    b) Backup Supply
    c) Filtration and Purification
    d) Controls

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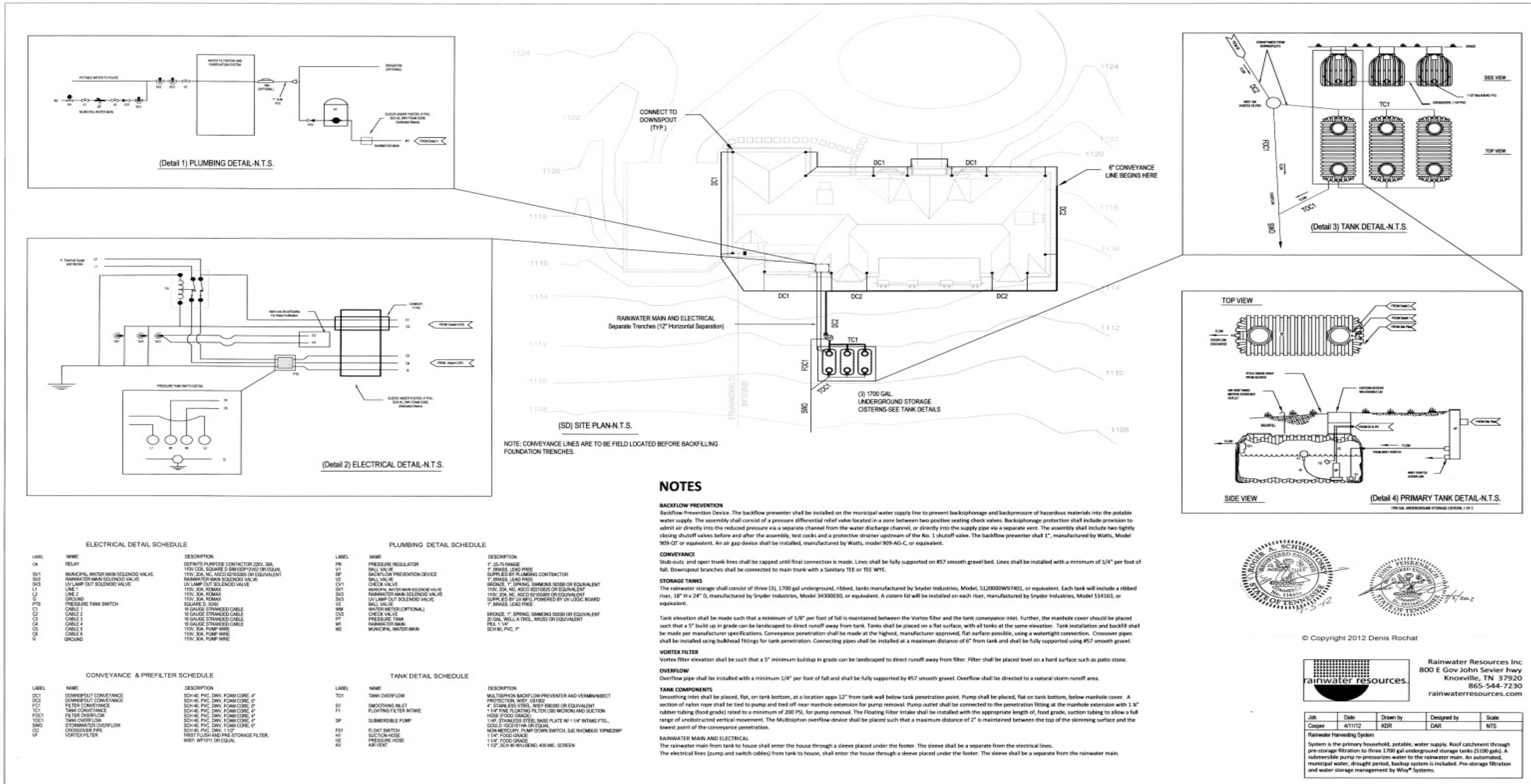
Residential Case Study
Potable Water

Cooper Job – City of Knoxville



Residential

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Cooper Job – City of Knoxville

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Cooper Job – Conveyance

Residential

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Cooper Job – Storage

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Cooper Job – Pre-filtration

Residential

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Cooper Job – Data

- 4000 Sq Ft Roof
- Avg Annual Yield – 120,000 gal
- Appx Annual Indoor Use – 82,000 gal
- Available for Irrigation and Pool Makeup – 38,000 gal

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Holwald Job
Franklin, TN

Sole Source

Used for **potable and general household use**

Application:
3000 Sq Ft roof area
5100 gallons storage

Benefits:
Well construction cost avoidance
Water availability
Superior Water Quality
Off-grid capability

Commercial

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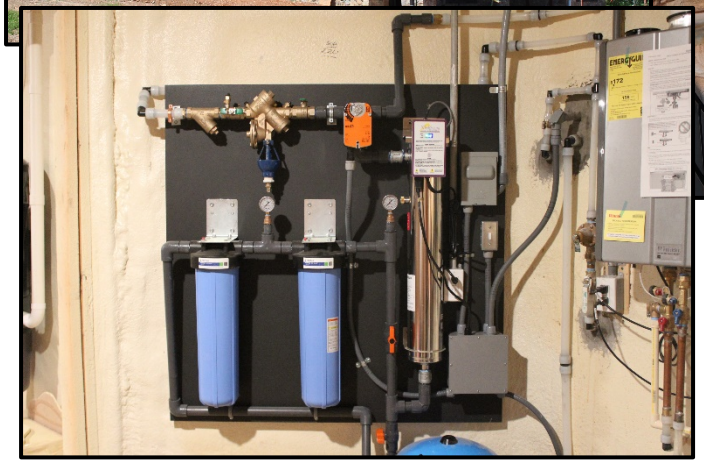
Lowrance Job

Lenoir City, TN



Used for **potable and general household use, irrigation**

Application:

4000 Sq Ft roof area

8500 gallons storage

Benefits:

Well construction cost avoidance

Superior Water Quality

Off-grid capability

Commercial

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Hester Job

Knoxville, TN

Used for **potable and general household use.**

Application:

3000 Sq Ft roof area

5100 gallons storage

Benefits:

Superior Water Quality

Off-grid capability

Cost reduction

Commercial

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Reyes Job
Franklin, TN

Used for **potable and general household use.**

Application:

2800 Sq Ft roof area

5000 gallons storage

Benefits:

Superior Water Quality

Off-grid capability

Cost reduction

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Commercial Case Studies

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University Of Tennessee

Project Case Study

Commercial

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University Of Tennessee

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RAINWATER HARVESTING SYSTEM

FOR

WEST CAMPUS REDEVELOPMENT
(Housing Site)
Phase III – Building 3 and 6
University of Tennessee
Knoxville Campus

JN 1705-05-2

SP-100
System Design Description

Revision 0

March 15, 2017

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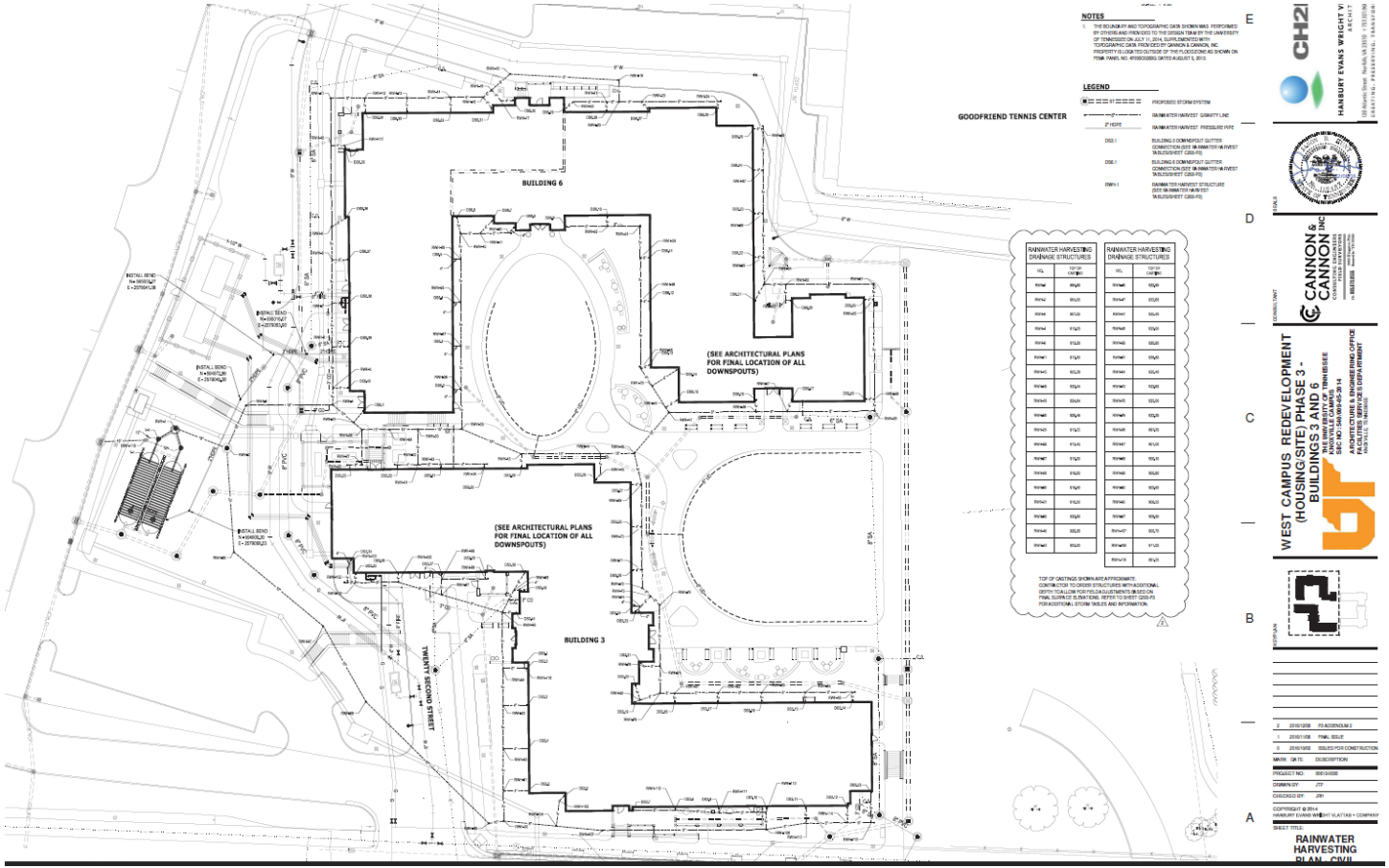

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RAINWATER HARVESTING SYSTEM
UT West Campus Redevelopment Housing Site
Phase III – Building 3 and 6

System Design Description

INTRODUCTION

The University of Tennessee, Knoxville (UTK) is in the process of redeveloping student housing on its West Campus Site. Building 3 and 6 are under construction. The project plan is to collect the rainwater from the roof areas of both buildings and make it available for laundry, toilet and irrigation uses. The harvesting and use of rainwater not only provides for these uses but also minimizes the impact of storm water on the site. Satisfying these needs through Rainwater Harvesting is the purpose of this system.

In response to the needs of this UTK Project, Rainwater Resources of Knoxville, Tennessee, has developed a Rainwater Harvesting System that will meet the need.

The Rainwater Harvesting System for the UTK West Campus Redevelopment Phase III, Buildings 3 and 6, will provide necessary water for the required uses, and will facilitate the maximum use of the natural resource of rainwater.

Rainwater that falls on the roofs of these two buildings will be collected from the roof drains and transferred through a system of conveyance piping through a filter that eliminates the first rainwater that washes off the building roofs. The filter then eliminates particulates and adds oxygen to the water that is then discharged to the cistern tanks for storage and treatment. When the water is required for its intended use, it is pumped through the water treatment and control skid where it is again filtered and treated where all particulates, and bacteria are removed. It is then discharged to the water distribution system that feeds all selected uses of the complex.

This system and its components are further described in this document.

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III. DESIGN GOALS

The required Rainwater Harvesting System must be capable of meeting the requirements of ARCSA/ASPE/ANSI Standard 63, "Plumbing, Engineering, and Design Standards." Deviations and variations may be implemented as needed for adaption to site conditions:

- Collect water from roof drains with minimal water loss.
- Maximize gravity flow conveyance from down comer to storage and treatment system achieving minimum holdup in conveyance between rain events.
- Provide a "first flush" diverting the initial runoff from entering storage.
- Maintain high quality stored water.
- Maintain stored water near ambient temperature in summer and warmer than ambient during freezing and below temperatures.
- Size storage containment to balance supply and demand achieving minimal "dry days."
- Supply uses with microbiologically safe water.
- Provide automated crossover to backup water supply
- Provide components requiring minimal maintenance
- Meet applicable local building code requirements.

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Project Profile:

Catchment Area – 55,000 Sq Ft

Annual Yield (25 Yr Rainfall basis) - 1,572,764 Gal (10% loss)

1” Rooftop Runoff – 30,838 gal (10% loss)

Application:

Storage – 44,000 gal

Prefiltration

365 GPM Capacity pump, filtration, and Purification Skid

Purified to Potable Water Quality (Not Potable Water)

Automated Municipal Water Backup

Safeties for instant crossover in the event of system failure or power outage

Investment Considerations

- Capture and storage was required to build otherwise reduced cost of site plan
- Based upon local commercial water rates the additional cost for use = 12.2 yr cost recovery
- Reduced maintenance and replacement cost of commercial grade laundry and hot water equipment due to naturally soft water
- Increasing water costs

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Tennessee Aquarium Conservation Institute
Chattanooga, TN

Harvesting rainwater from roof to use for **toilets and irrigation**

Application:

7000 Sq Ft catchment area

9000 gallons storage

Benefits:

- NPDES permit compliance
- Cost reduction
- Environmental stewardship

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Graystone Quarry

Franklin, TN

Used for **fire protection**

Application:

8000 gallons storage

Benefits:

Fire code compliance

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Western Regional Jail

Roanoke, VA

This is **the first LEED certified jail**. The jail is situation next to the Roanoke River. The rainwater harvesting system:

- reduces stormwater runoff
- protects the nearby stream
- allows for water use in the building.
- laundry

Catchment Area:
250,000 sq. ft. roof

Application:
WFF300 Wisy® Filters
(4) 30,000 gallons storage tanks

Benefits:
» Reduce municipal supply demand
» Provided solution for stormwater control
» Promotes environmental stewardship

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Center For Urban Water

Tacoma, WA

The combination of rainwater harvesting and efficient plumbing fixtures mean the Center For Urban Water uses **46% less municipal water** then a conventional facility.

Saves about 400,000 gallons per year.

LED's show water level in tanks.

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Port Of Gray's Harbor

Aberdeen, Washington

Harvesting water from incubator facility to supply water for onsite irrigation.

Application:

WFF150 Wisy® Filter

(2) 8,700 gallons storage

Benefits:

» Promote environmental stewardship.

» Provide water for irrigation.

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Federal Way Public School Service Center

Federal Way, WA

This public school's service center captured the rainwater from the roof and put it to good use for **washing public vehicles**.

Application:

(8) WFF150 Wisy® Filters
(8) 1,400 gallons above ground storage tanks
2" Floating Filter Intake
(8) Smoothing Inlets

Benefits:

» Harvested rainwater used to wash vehicles
» Promote green infrastructure for schools
» Prevent stormwater runoff

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Oscar Smith Middle School

Virginia Beach, VA

This school is situated in the sensitive Chesapeake watershed.

The goals were to:

- Reduce the use of municipal water for non-potable water needs.
- Reduce storm water runoff from the site to protect the environment.
- Educate students on water stewardship and conservation

Application:

(9) WFF300 Wisy® Filters

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Burton Elementary and Middle School

Grand Rapids, MI

An 82-year old building was renovated to bring in modern technologies while incorporating some of the historical features.

Application:

11,000 sq.ft. roof collection area

10,000 gallons of storage

Wisy WFF 300 vortex filter

Benefits:

Harvested rainwater used to flush toilets.

LEED Certification

Prevent stormwater runoff.

Promote green infrastructure for schools.

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Carilion New River Valley Medical Center

Christiansburg, VA

Challenge:
Reduce or eliminate the rate and quantity of storm water run-off to neighboring properties.

Reduce the use of municipal water in the **cooling plant's evaporative cooling towers.**

Reconstruct the storm discharge swale into a detention pond to act as a supply for the evaporative cooling towers and site irrigation systems.

Application:

A Reverse Osmosis system and pre-filter were used to **clean and recycle the cooling tower condenser water** loop to reduce system blow-down.

Benefits:
Reduction of 15,000 gallons of blow-down water and municipal water makeup per day.
Reduction in the cost of municipal water of $10.00 per 1000 gallons of water and sewer provided.
The return on the system investment is less than two years.

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Williamson Road Fire-EMS Station

Roanoke, VA

The construction of the Williamson Road Fire Station was completed in 2009.

Application:

9000 sq. ft. roof collection area.

10,000 gallons of below ground storage

(2) Wisy® WFF150 Vortex Filters

Filtration and UV purification system

Benefits:

» Harvested rainwater is used to **wash vehicles and flush toilets.**

» **Prevent stormwater runoff.**

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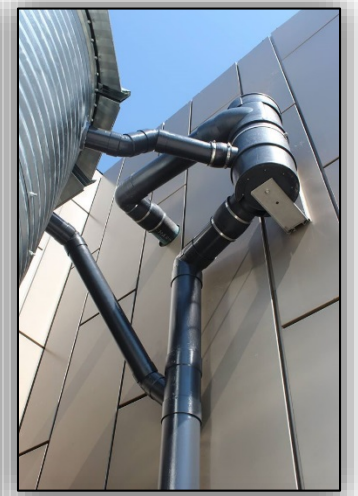
Charleston County School District

Career and Technology Academy – Charleston, SC



Harvesting rainwater from third story roof.

Application:

WFF150 Wisy® Filter

2,200 gallons above ground storage

Benefits:

» Educate in environmental stewardship.

» Provide water for outdoor class room.

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Town of Farragut

Outdoor Classroom

Harvesting rainwater from 700’ Shed Roof

Application:

WFF100 Wisy® Filter

1.500 gallons above ground storage

Benefits:

» Educate in environmental stewardship.

» Provide water for outdoor class room.

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Freebird Farms

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Freebird Farms

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Design

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Site Considerations

- Available Space
- Site Topography
- Water Table
- Soils
- Proximity Of Underground Utilities
- Contributing Drainage Area
- Water Quality Of Rainwater
- Setbacks from Buildings
- Vehicle Loading

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Sizing

Supply

Demand

Storage

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Supply

Roof Sq Ft x .623 x Inches Rainfall x Loss (Evaporation + Leakage) = Yield (Gallons)

Nashville, TN Annual Precipitation		
Month	Monthly Rainfall (Inches)	Gal/Mo Yield*
January	3.97	35,730
February	3.69	33,210
March	4.87	43,830
April	3.93	35,370
May	5.07	45,630
June	4.08	36,720
July	3.77	33,930
August	3.28	29,520
September	3.59	32,310
October	2.87	25,830
November	4.45	40,050
December	4.54	40,860
Total	48.1	432,990

*10,000 Sq Ft Roof, 90% Yield

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Storage / Aesthetics

Design

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Storage / Aesthetics

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Storage / Aesthetics

Lady Bird Johnson
Wildlife Resource Center

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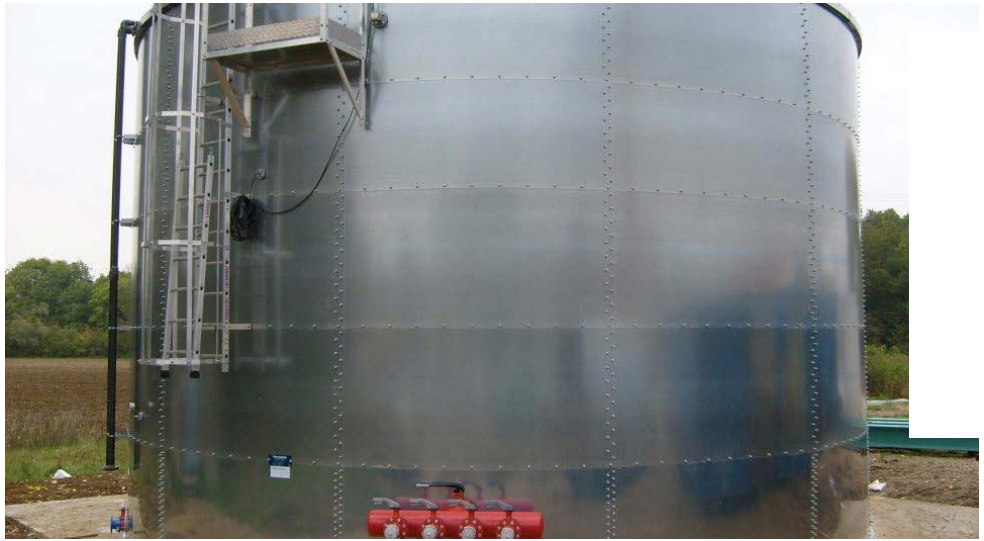
Storage / Aesthetics



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Storage / Aesthetics

Design

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Collection Surface – Non Potable

Commercial Membrane Roofing Material
Galvanized
Asphalt Shingle (Must not contain algaecide)
Cedar Shake
Tile
Enameled Steel

RAINWATER RESOURCES

Collection Surface - Potable

Commercial Membrane Roofing Material
Galvanized
Asphalt Shingle (Must not contain algaecide)
Tile
Enameled Steel

Note: Painted Surfaces – NSF P151

No copper roofing, flashings, guttering

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Containment

Above Grade

- Bolted smooth wall steel
- Corrugated Steel
- Stainless Steel
- Polyethlyene (UV Resistant)

Below Grade

- Fiberglass
- Matrix

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Containment - Polyethlyene

Manufacturers

- Norwesco
- Snyder
- Den-Hertog (Ace)
- Roth (Fralo)

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Containment - Fiberglass

Manufacturers

- Xerxes
- Containment Solutions

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Containment - Corrugated Bolted Steel

Manufacturers

- Contain Water Systems
- CorGal™
- Quality Control Steel

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Containment - Corrugated Bolted Steel

Manufacturer

- Contain Water Systems

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Containment – Smooth Wall Bolted Steel

Manufacturer

- Climate Inc

Available in 26 Colors

Design

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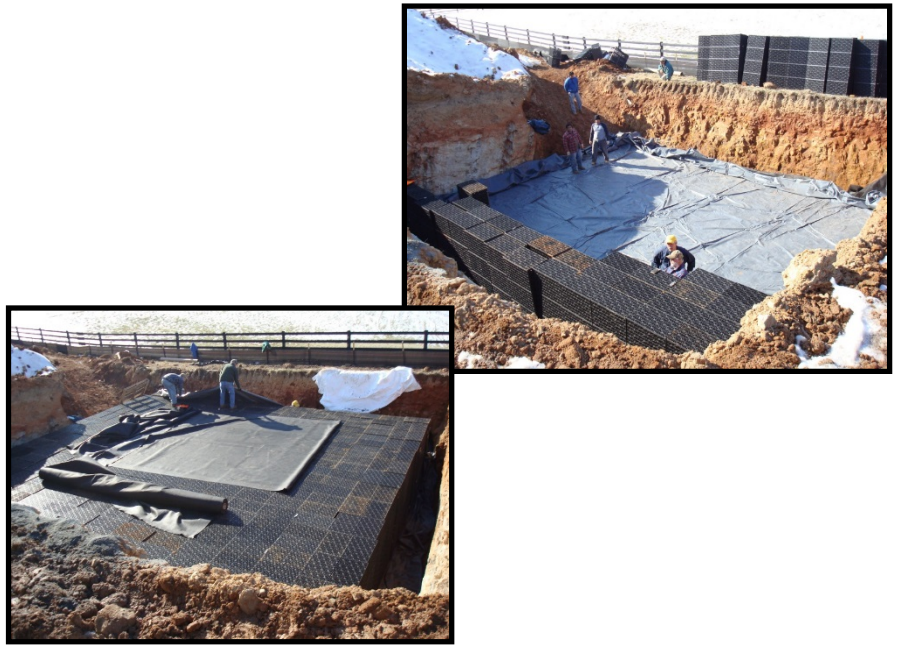
Containment - Modular

Brands

- ACF



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Containment - Bladder

Brands

- Ready Containment

Design

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Cost Recovery

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Cost Recovery

- Determining Bottom Line Returns (ROI)
  - Substantial LEED Points
  - Rainwater system capital cost can be depreciated to reduce taxes
  - Project future water rate increases
  - Factor in costs of storm water detention/retention requirements
  - Factor in costs of site plan development
  - Include any applicable tax incentives
  - Determine the value of your landscaping and include what it would cost to replace plants. (No Water Bans).
  - Factor in the cost of softening systems when treated process water is required (Naturally Soft
  - Reduced cost of stormwater mitigation fees

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Intangible Returns

Consider your impact on the collective freshwater supply in your community

Positive community environmental perceptions

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RESOURCES

- Turn Key - Complete System Supplier
- Engineered Systems
- Design Consultation
- Skid Fabrication
- Installation
- Maintenance Agreements

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Q & A