

# RAINWATER<sup>TM</sup> RESOURCES

Rainwater Harvesting for Stormwater Management

## Top 3 Learning Objectives

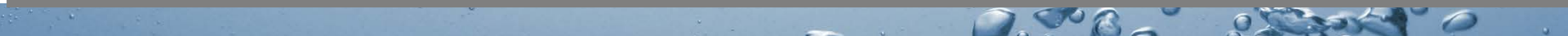
1. Rainwater harvesting basics. Design and components.
2. Importance of supply and demand basis for determining storage capacity.
3. Understand cost recovery factors for a rainwater harvesting investment



# Rainwater Harvesting

*-Definition-*

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



# Rainwater Harvesting Is Not

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





## 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?



# 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



# Users

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



# Uses

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



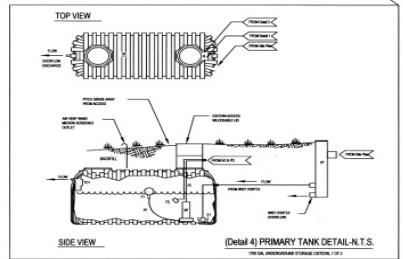
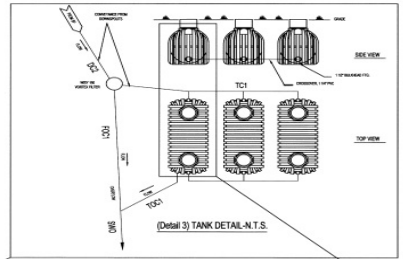
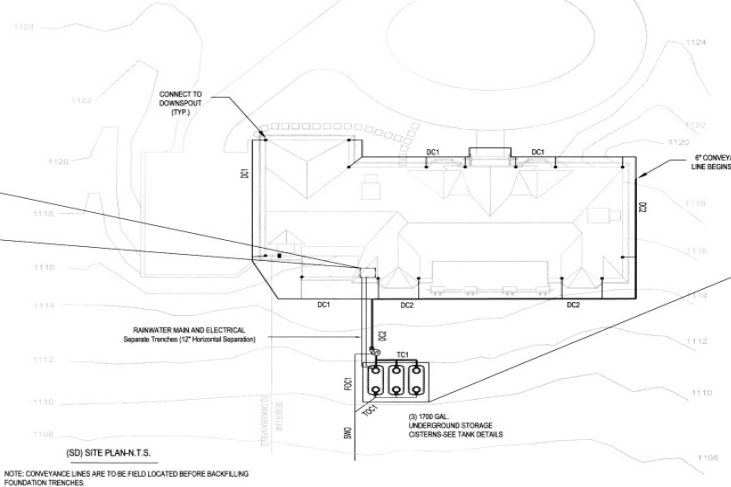
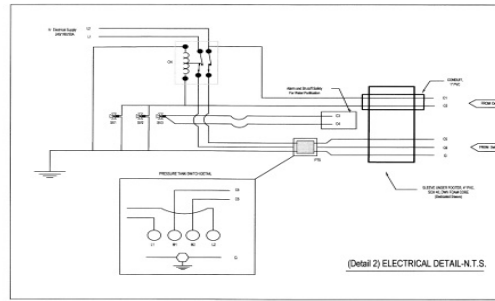
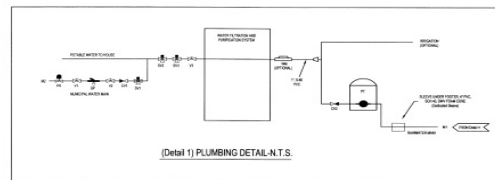
# The Process

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

# Residential Case Study

## Potable Water





ELECTRICAL DETAIL SCHEDULE		
LABEL	NAME	DESCRIPTION
CA	RELAY	DEFINITE PURPOSE CONTACTOR 200V, 5A
SV1	WELCHING WATER MAIN SOUNDED VALVE	110V, 25A, SQUARE D 600V-1P-200 ON EQUAL
SV2	WELCHING WATER MAIN SOUNDED VALVE	110V, 25A, ALSO EX-25000 (OR EQUIVALENT)
SV3	17" LAMP OUT SOUNDED VALVE	110V, 25A, SQUARE D 600V-1P-200 ON EQUAL
L1	LINE 1	110V, 30A, FANMA
L2	LINE 2	110V, 30A, FANMA
L3	GROUND	110V, 30A, FANMA
PT3	PRESSURE TRIP SWITCH	SQUARE D, 150V
C1	CABLE 1	5 GAUGE, STRANDED CABLE
C2	CABLE 2	5 GAUGE, STRANDED CABLE
C3	CABLE 3	5 GAUGE, STRANDED CABLE
C4	CABLE 4	5 GAUGE, STRANDED CABLE
C5	CABLE 5	110V, 30A, FANMA
G	GROUND	110V, 30A, FANMA

[illegible]

CONVEYANCE & PREFILTER SCHEDULE		
LABEL	NAME	DESCRIPTION
DC1	DOWNPOUT CONVEYANCE	SCH 4E, PWC, DNV, FORM CORN, 0"
DC2	DOWNPOUT CONVEYANCE	SCH 4E, PWC, DNV, FORM CORN, 0"
DC3	FILTER CONVEYANCE	SCH 4E, PWC, DNV, FORM CORN, 0"
TC1	TANK CONVEYANCE	SCH 4E, PWC, DNV, FORM CORN, 0"
TC2	TANK CONVEYANCE	SCH 4E, PWC, DNV, FORM CORN, 0"
TC3	TANK CONVEYANCE	SCH 4E, PWC, DNV, FORM CORN, 0"
S&O	STORMWATER CHOPFLOW	SCH 4E, PWC, DNV, FORM CORN, 0"
SAO	CROSSFLOW P&W	SCH 4E, PWC, DNV, 1.5"
VT	VORTEX FILTER	FIRST FLUSH AND PRE-STORAGE FILTER, WFT, 40/311 OR EQUIV.

TANK DETAIL SCHEDULE		
LABEL	NAME	DESCRIPTION
T01	TANK OVERFLOW	MULTIPHON BACKFLOW PREVENTER AND VERMIN INSECT PROTECTOR, W/ST. 1/2" I.D.
S1	SMOOTHING INLET	4" STAIN SS STEEL, 18"X 6" BORE OR EQUIVANT
F1	FLOATING FRET INTAKE	1" X 1/4" FLAT BAR FILTERED, ROUND MOUNTION AND SLUCTION HOSE, FOOD GRADE
SP	SUBMERSIBLE PUMP	1/4HP, STAINLESS STEEL BASE PLATE 1/4" X 1/4" INTAKE PTG., GOLD-CL. 1/2" SST 1/4" OR EQUAL
F2	FLOAT SWITCH	NOM MERCURY, PUMP CONTROL BRACKET, SEE RICHMOND SPINCOZ
B1	BUTTON HOZE	1 1/4" FOOD GRADE
H1	HIGH PRESS HOSE	1 1/4" FOOD GRADE
AIR	AIR VENT	1 1/2" SCH 40 WELDING, ABS REC. SCREEN

## NOTES

## BACKFLOW PREVENTION

**Backflow Prevention Device.** The backflow preventer shall be installed on the municipal water supply line to prevent back-siphoning and backpressure of hazardous materials into the potable water supply. The assembly shall consist of a pressure differential relief valve located in a zone between two positive venting check valves. Backsiphonage protection shall include provision to admit air directly into the reduced pressure via a separate channel from the water discharge channel, or directly into the supply pipe via a separate vent. The assembly shall include two tightly closing shutoff valves before and after the assembly, test cocks and a protective strainer upstream of the No. 1 shutoff valve. The backflow preventer shall 1", manufactured by Watts, Model 909-QT or equivalent. An air gap device shall be installed, manufactured by Watts, model 909-AG-C, or equivalent.

## CONVEYANCE

**STORAGE TANKS**  
The rawwater storage tank shall consist of three (3), 1700 gal underground, ribbed, tanks manufactured by Snyder Industries, Model, 512000097/401, or equivalent. Each tank will include a ribbed riser, 18" R x 24" S, manufactured by Snyder Industries, Model 34000010, or equivalent. A cistern lid will be installed on each riser, manufactured by Snyder Industries, Model 514163, or equivalent.

Tank elevation shall be made such that a minimum 1/8" per foot of fall is maintained between the Vortex Filter and the tank connection inlet. Further, the manhole cover should be placed such that a 5" build up in grade can be landscaped to direct runoff away from tank. Tanks shall be placed on a flat surface, with all tanks at the same elevation. Tank installation and backfill shall be made per manufacturer specifications. Conveyance penetration shall be made at the highest, manufacturer approved, flat surface possible, using a watertight connection. Crossover pipes shall be installed using bulkhead fittings for tank penetration. Connecting pipes shall be installed at a maximum distance of 6" from tank and shall be fully supported using #57 sized gravel.

**VORTEX FILTER**

Vortex filter elevation shall be such that a 5" minimum buildup in grade can be landscaped to direct runoff away from filter. Filter shall be placed level on a hard surface such as patio stone.

**OVERFLOW**  
Overflow pipe shall be installed with a minimum 1/4" per foot of fall and shall be fully supported by #57 smooth gravel. Overflow shall be directed to a natural storm-runoff area.

**TRAP COMPONENTS**  
A. Straining interst shall be placed flat, on tank bottom, at a location above 12" from tank wall below pump installation point. Pump outlet shall be placed flat on tank bottom, below manhole cover. A. Smoothing interst shall be placed flat, on tank bottom, at a location above 12" from tank wall below pump installation point. Pump outlet shall be connected to the penetration (inside the manhole enclosure with 1/2" rubber tubing (food grade) rated to a minimum of 200 PSI, for pump removal). The Floating Filter Intake shall be installed with the appropriate length of, food grade, section tubing to allow a full range of undisturbed vertical movement. The Multiphase overflow device shall be placed such that a maximum distance of 2" is maintained between the top of the skimming surface and the bottom of the overflow penetration.

**RAINWATER MAIN AND ELECTRICAL**  
The rainwater main from tank to house shall enter the house through a sleeve placed under the footer. The sleeve shall be a separate from the electrical lines.  
The electrical lines (pump and switch cable) from tank to house, shall enter the house through a sleeve placed under the footer. The sleeve shall be a separate from the rainwater main.

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Job	Date	Drawn by	Designed by	Scale
Cooper	4/11/12	KDR	DAR	NTS

**Rainwater Harvesting System**

System is the primary household, potable, water supply. Roof catchment through pre-storage filtration to three 1,200 gal underground storage tanks (3,600 gals). A submersible pump re-pressurizes water to the rainwater main. An automated, rainwater valve, drought proof, backup system is included. Pre-storage filtration and water storage management by Wray® Systems.







## Cooper Job – Conveyance



Residential

## Cooper Job – Storage



Residential



## Cooper Job – Pre-filtration



Residential

- 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

## Holwald Job Franklin, TN



### Sole Source

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

#### Application:

3000 Sq Ft roof area  
5100 gallons storage

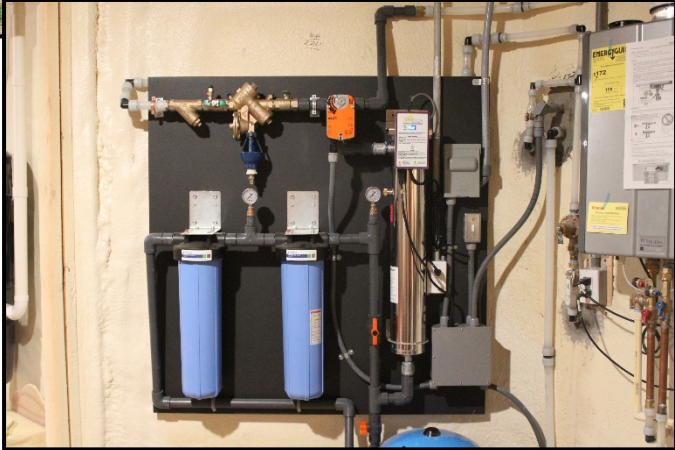
#### Benefits:

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

Commercial



## 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

## 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

## 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

Commercial



# Commercial Case Studies



# University Of Tennessee

## Project Case Study



Commercial





**RAINWATER HARVESTING SYSTEM**

**FOR**

**WEST CAMPUS REDEVELOPMENT**

**(Housing Site)**

**Phase III – Building 3 and 6**

**University of Tennessee**

**Knoxville Campus**

University Of Tennessee

**JN 1705-05-2**

**SP-100**

**System Design Description**

**Revision 0**

**March 15, 2017**

***Rainwater Resources  
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Commercial



## 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.

University Of Tennessee



### 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.

## 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



## 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



Commercial

Graystone Quarry  
Franklin, TN



Used for **fire protection**

Application:  
8000 gallons storage

Benefits:  
Fire code compliance

Commercial

# Western Regional Jail

Roanoke, VA

This is **the first LEED certified jail**. The jail is situated 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

Commercial





## 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** than a conventional facility.

Saves about 400,000 gallons per year.

LED's show water level in tanks.



Commercial

# 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.

Commercial

# 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**

Commercial

# 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



Commercial



## 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.



## 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.



# 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



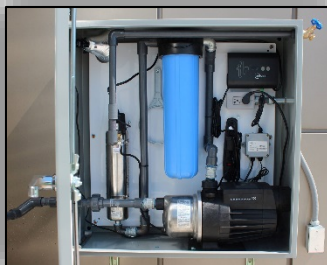
## Benefits:

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

» **Prevent stormwater runoff.**

Commercial

## 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

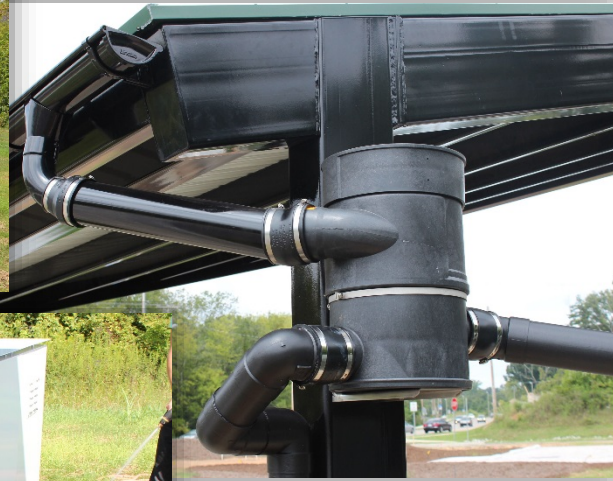
### **Benefits:**

- » Educate in environmental stewardship.
- » Provide water for outdoor class room.



# 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.

Commercial



# Freebird Farms



Commercial

# Freebird Farms



Commercial

# Freebird Farms



Commercial



# Freebird Farms



Commercial



# Design



# 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



# Sizing

Supply



Demand

Storage



Design

## 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
<b>Total</b>	<b>48.1</b>	<b>432,990</b>

\*10,000 Sq Ft Roof, 90% Yield

Design



## Storage / Aesthetics



Design

## Storage / Aesthetics



Design

# Storage / Aesthetics

Lady Bird Johnson  
Wildlife Resource Center



Design

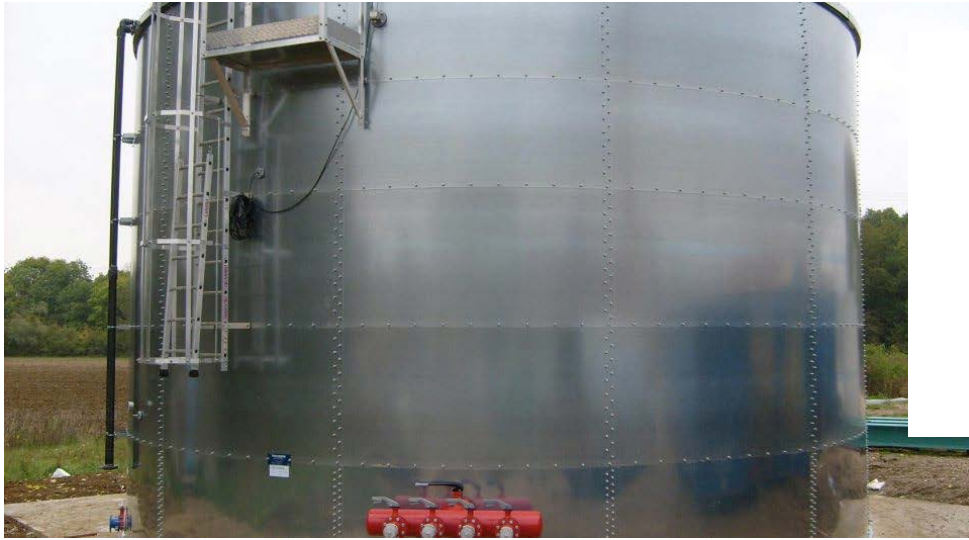


# Storage / Aesthetics





# Storage / Aesthetics



Design

# Storage / Aesthetics



Design

## Collection Surface – Non Potable

Commercial Membrane Roofing Material

Galvanized

Asphalt Shingle (Must not contain algaecide)

Cedar Shake

Tile

Enameled Steel



# 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





# Containment

## **Above Grade**

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

## **Below Grade**

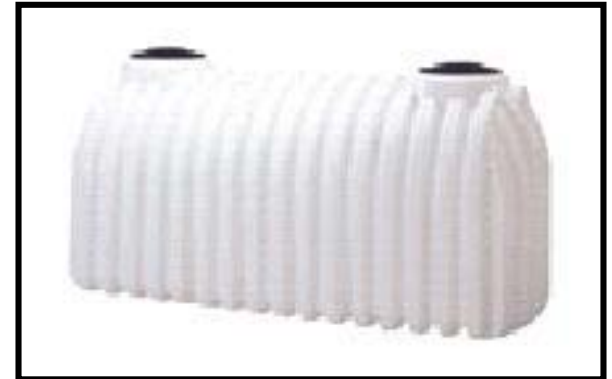
- Fiberglass
- Matrix



# Containment - Polyethylene

## Manufacturers

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



# Containment - Fiberglass

## Manufacturers

- Xerxes
- Containment Solutions



Design

# Containment - Corrugated Bolted Steel

## Manufacturers

- Contain Water Systems
- CorGal™
- Quality Control Steel



Design



## Containment - Corrugated Bolted Steel

Manufacturer

- Contain Water Systems



# Containment – Smooth Wall Bolted Steel

Manufacturer

- Climate Inc

Available in 26 Colors



Design

# Containment - Modular

Brands

- ACF



Design

# Containment - Bladder

## Brands

- Ready Containment



Design



## Cost Recovery



# 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



# Intangible Returns

Consider your impact on the collective freshwater supply in  
your community

Positive community environmental perceptions



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





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# RAINWATER<sup>TM</sup> RESOURCES

Knoxville, TN

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*Q & A*

