

Hydro-Informatics Driven Onsite Water Reuse: Advancing the One Water Concepts to Increase Water Availability and Climate Resiliency

WEBINAR

One Basin, One Water

Integrating Basin-Scale and Onsite Water Systems

Two nations. One Mission. Water security for a changing climate.

May 20, 2026, 7:30PM CST

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Professor and Extension Specialist
Biological and Agricultural Engineering Department
Texas A&M AgriLife Extension & Research

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Presentation Outline

- Introduction of TAMUS and One Water Team
- BAEN 489: Special Topic - One Water Engineering Class
- Water Security in Changing Climatic Conditions
- Texas Water Demands v. Supplies, TWDB Water Plan
- Onsite Water Model Concepts Evaluation @ TAMU



HOWDY!

Texas A&M University (College Station, TX)
Texas A&M International University
Prairie View A&M University
East Texas A&M University
West Texas A&M University
Tarleton State University
Texas A&M University – Corpus Christi
Texas A&M University – San Antonio
Texas A&M University – Kingsville
Texas A&M University – Central Texas
Texas A&M University – Texarkana
Texas A&M University - Victoria

Texas A&M University System

- Twelve (12) Universities
- Eight (8) State Agencies

Texas A&M AgriLife Research

Texas A&M AgriLife Extension Service

Texas A&M Forest Service

Texas A&M Engineering Station

Texas A&M Engineering Extension Service

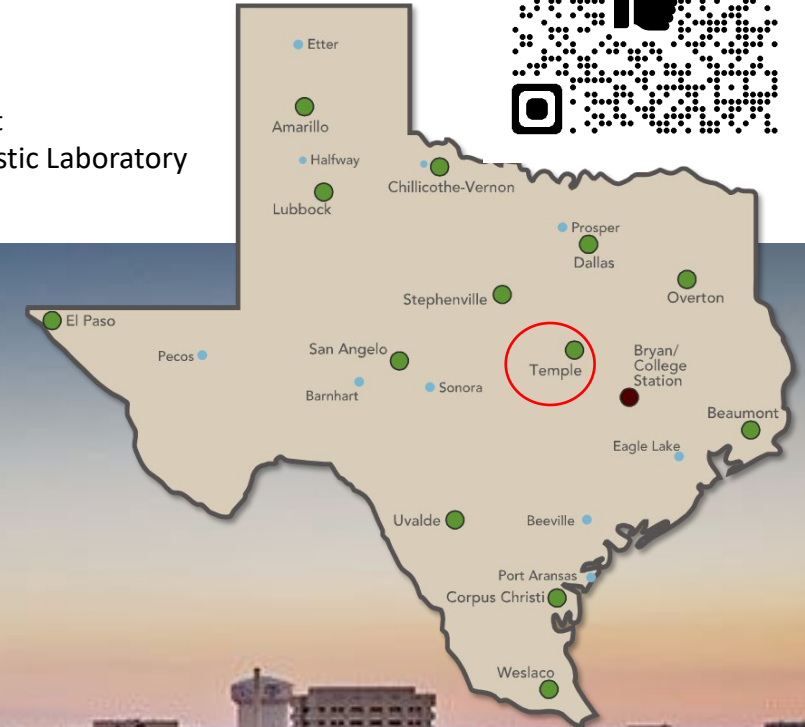
Texas A&M Transportation Institute

Texas Division of Emergency Management

Texas A&M Veterinary Medical Diagnostic Laboratory

Facts On-Line

<https://www.tamu.edu/about/facts.html>



Introduction

Myself... <https://baen.tamu.edu/people/jantrania-anish/>

Work Experience:

Onsite Industry since 1989

1. WVU/NSFC 1989-1993
2. Gloucester 1993-1996
3. Virginia DH 1996-2008
4. NSC/NWC 2008-2014
5. TAMU/AgriLife 2014-???



Education:

B.E., University of Udaipur, Agricultural Engineering, 1982
M.S., Ohio State University, Agricultural Engineering, 1985
Ph.D., Clemson University, Agricultural Engineering, 1989
M.B.A., West Virginia University, 1994
Registered Professional Engineer in TX and VA

Research Objective: Evaluate and demonstrate cost-effective and sustainable **onsite** water and wastewater infrastructure options.

Research Interests:

- Sustainable and integrated water infrastructure;
- Wastewater treatment and reuse;
- Desalination – groundwater and seawater;
- Cost analysis, pricing, and water economics;
- Regulatory framework for water quality and supply.

TAMU Onsite Team...



Dr. June Wolfe, III
Research Scientist
BREC-Research



Dr. Gabriele Bonaiti
Extension Program Specialist
BAEN-Extension

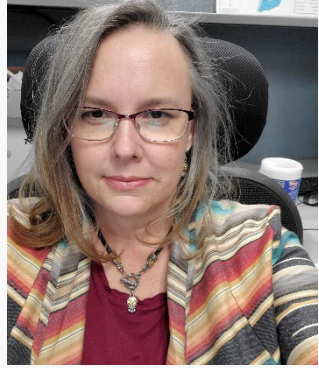


Lisa Prcin
Senior Research Associate
BREC-Research



Joshua Segura
Extension Assistant
BAEN-Extension

TAMU Onsite Team...



Tanya Mitchell
Extension Assistant
BAEN-Extension



William (Bill) Hyder
BAEN Graduate Student



Jakob Davis
Research Assistant
BAEN-Extension



Dr. Rajiv Srivastav
Post Doctoral Fellow
BAEN/BREC

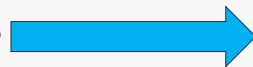
BAEN 489: One Water Class Students

- Total Number of Students = 7

Name	Major	Class
Carson Davis Deal	BAEN	U4
David Geltser	BAEN	G7
Michel Kordahi	COSC	G7
Rene Ramirez	BAEN	U3
Shima Nikkhouyemokamel	COSC	G8
Cole Louis Klauss	AREN	U4
Josiah I Lee	BAEN	U4

- Students Present in Webinar, introduce yourself...

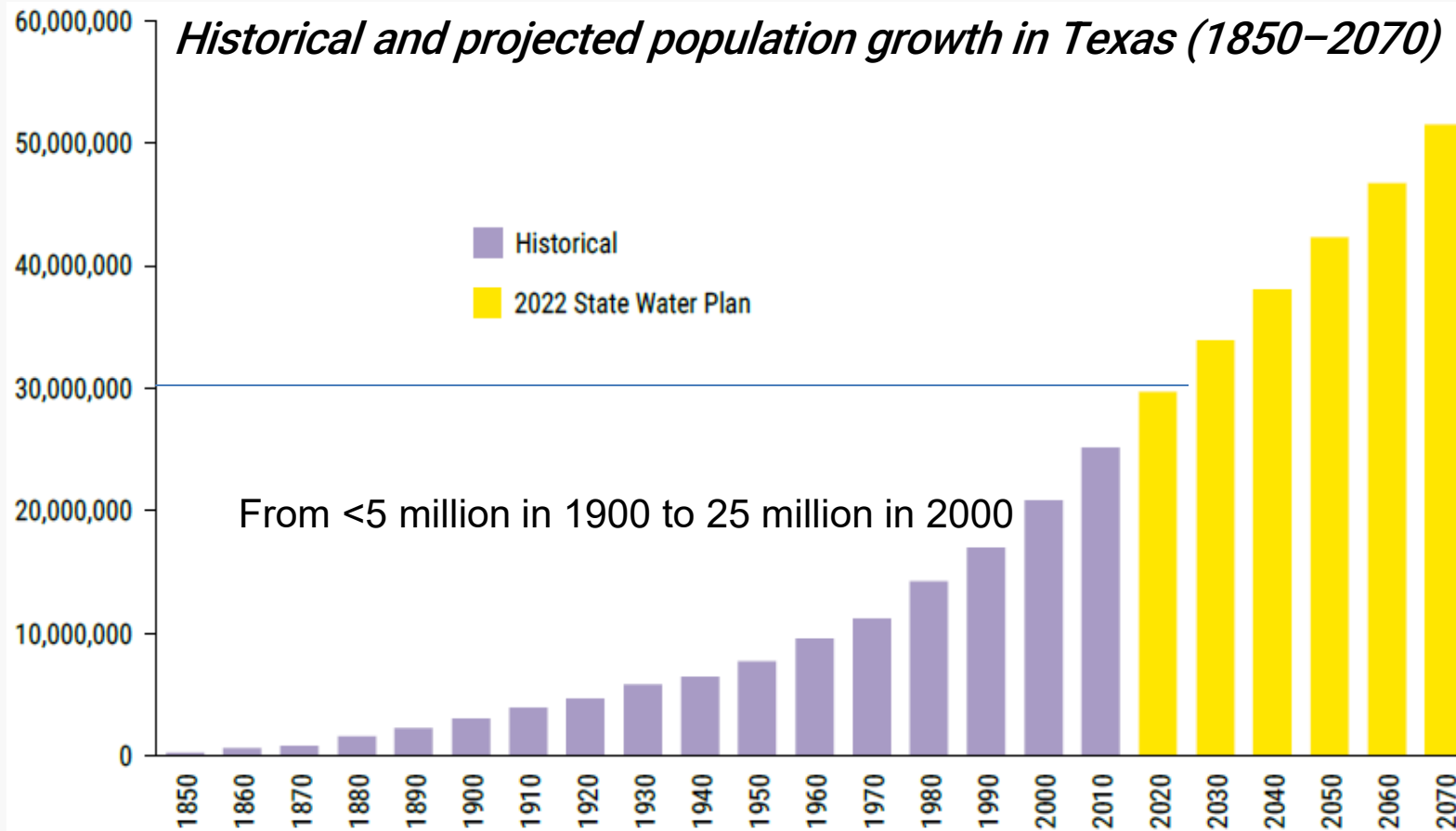
Water Security....

- *Water is Life* [....](#) **And more!**
- Think of one thing that you could do in a day WITHOUT Water, and without Running Water....
Last year example of my home in Virginia, 1st time in 28 years; my daughter spent 48 hours without Running Water [....](#)
- Main Water Risks at the Global Scale are 
- + One more risk for USA – Aging Water Infrastructure [....](#)
- D+ for Wastewater and C- for Water [....](#)



Water Security....

- Let's look at the two factors...
 - Population Growth (<https://2022.texasstatewaterplan.org/>)



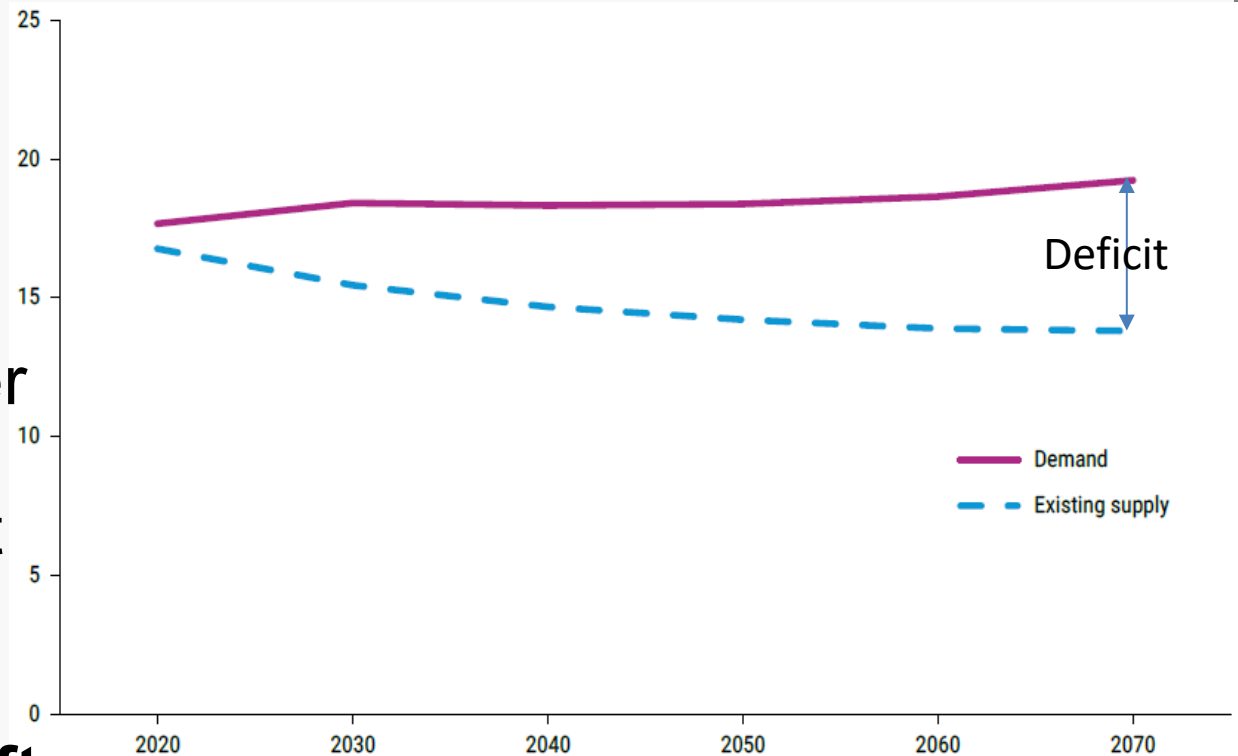
30.5 million (2023)

So, we are planning for 50 million Texans by 2070!

~**20%** of Texans are NOT on Public Infrastructure..... i.e., **depends on Onsite Industry**....

Growth: Population v. Water Demand

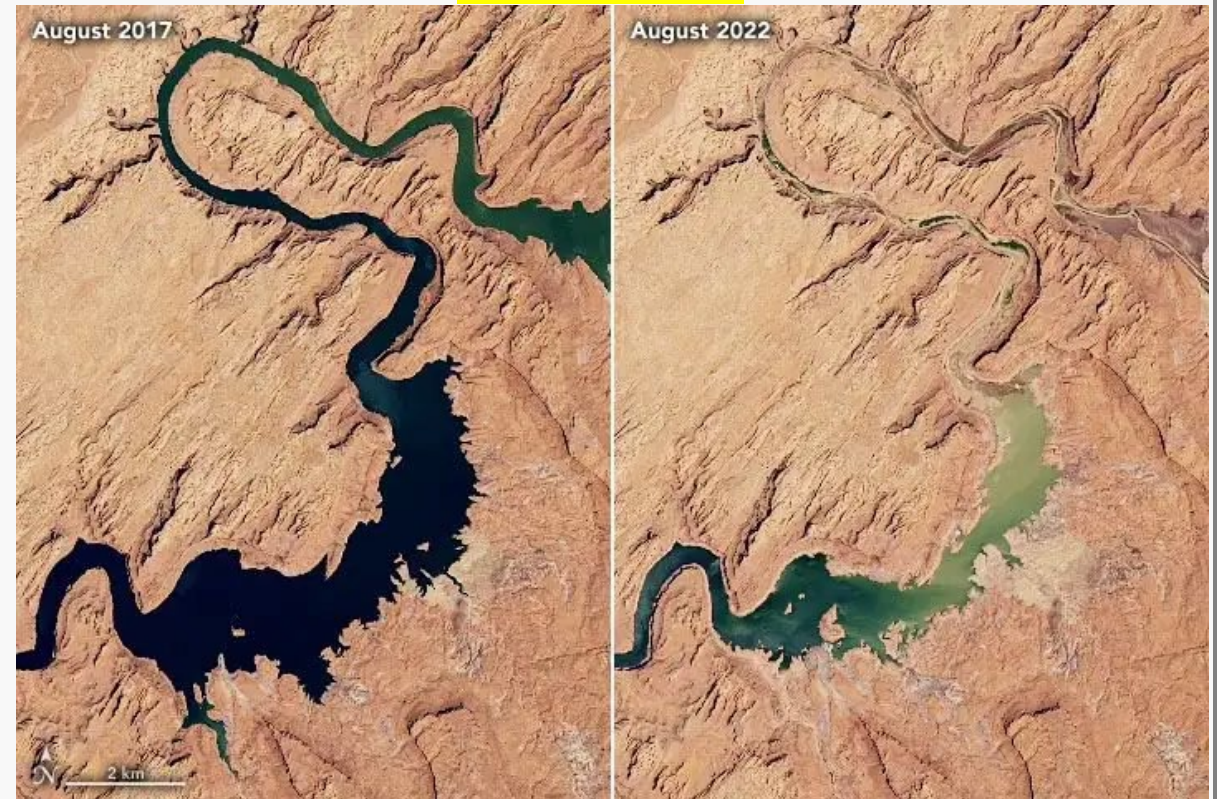
- Due to success in Water Conservation and Water Efficient Devices.....
- In Texas: While population is projected to increase 73 percent over the next 50 years, total water demand in Texas is projected to increase by only 9 percent.... But we are expecting WATER SHORTAGE, state-wide!
- Projected Deficit ~ **7,000,000 ac-ft**
- *1 ac-ft = 325,851 gallons*; thus, Texas needs additional **2.3 trillion gallons** water by 2070



Effects of Changing Climate on “free” water supply from **Natural Hydrologic Cycle (NHC)**

Colorado River

- “free” water = desalinated water we get in the form of Rain that feeds rivers, lakes, and wells on which our municipal and onsite water supplies **depend on** as their “source water”

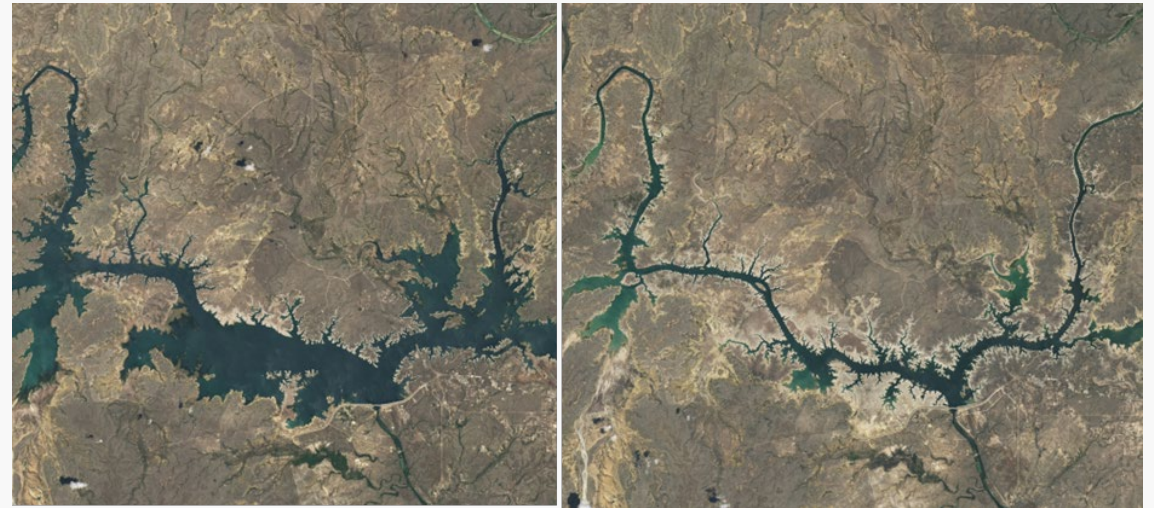


Source: [Eos....](#) Published by [AGU.ORG](#)

Effects of Changing Climate on “free” water supply from **Natural Hydrologic Cycle (NHC)**

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Rio Grande Basin

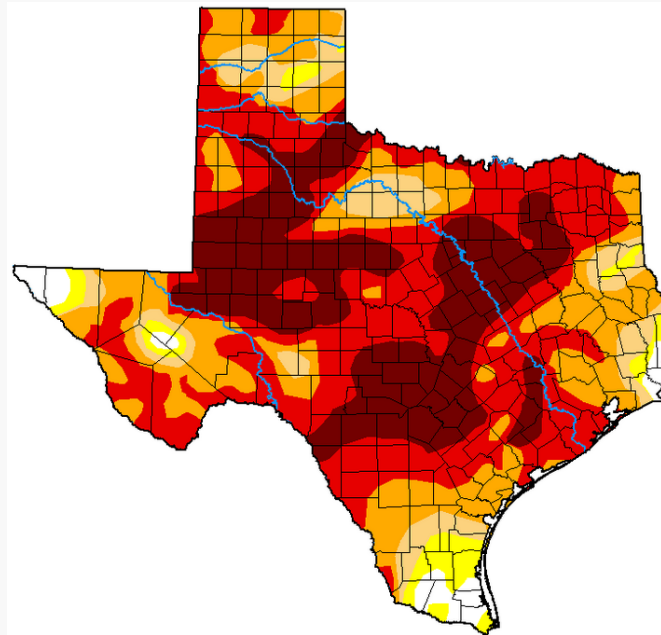


Source: [NASA Earth Observatory...](#)

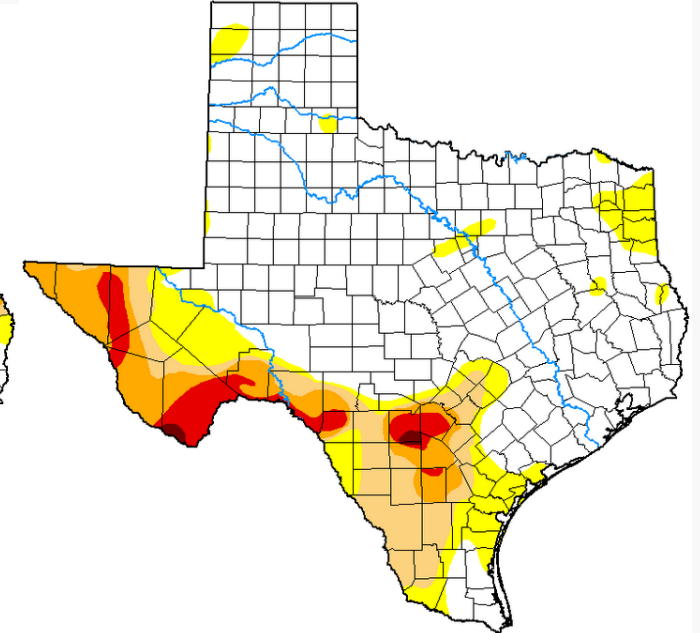
Water Crisis in Texas...

- Ask Google, “*water crisis in Texas*”
- AI Overview “*Texas faces a growing water crisis driven by a booming population, prolonged droughts, and aging infrastructure, leading to reduced water supplies and increased demand.*”

August 16, 2022



August 26, 2025



Ref: <https://droughtmonitor.unl.edu/CurrentMap.aspx>

Q: When is the next drought arriving in Texas?

And then, **Hurricane Harvey** in 2017...

- During Hurricane Harvey, some parts of Houston experienced over 50 inches of rainfall, a North American record. **The storm dumped more than 27 trillion gallons of rain over Texas.**
- Remember, projected deficit ~ 7,000,000 ac-ft by 2070? How many gallons is that???



2.3 trillion gallons, which is <10% of the Harvey dump!

Source: click2houston.com/weather/

Harris County (including Houston) Water Crisis... Aging Infrastructure....

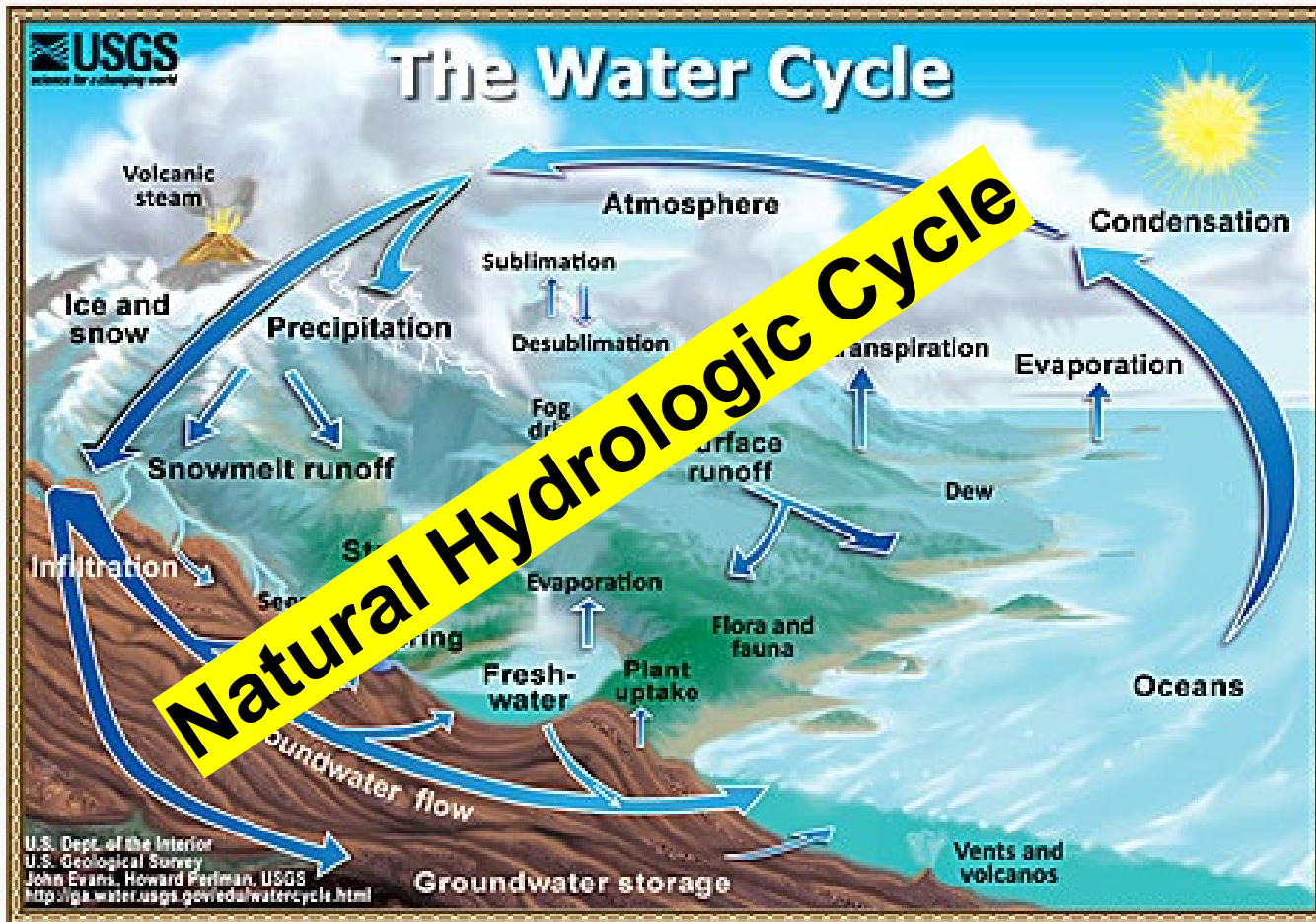
- Ask Google, “water crisis in Harris county Texas” ...
- AI Overview “Harris County, including the City of Houston, faces a significant water crisis due **to aging infrastructure and increasing water demands**. This results in substantial water loss from leaks, with the City of Houston experiencing losses of over 30 billion gallons annually. Furthermore, the city's *East Water Purification Plant*, a major source of drinking water, is also aging and facing operational challenges..”



One of the most significant incidents occurred in February 2020, when a 96-inch water main ruptured.... The break flooded roadways, caused widespread water outages, and prompted a citywide boil water notice.....

Source: [WestHouston.org](https://www.westhouston.org)

Changing Climate = Changing Water Supplies, i.e., Changing Water Availability from NHC

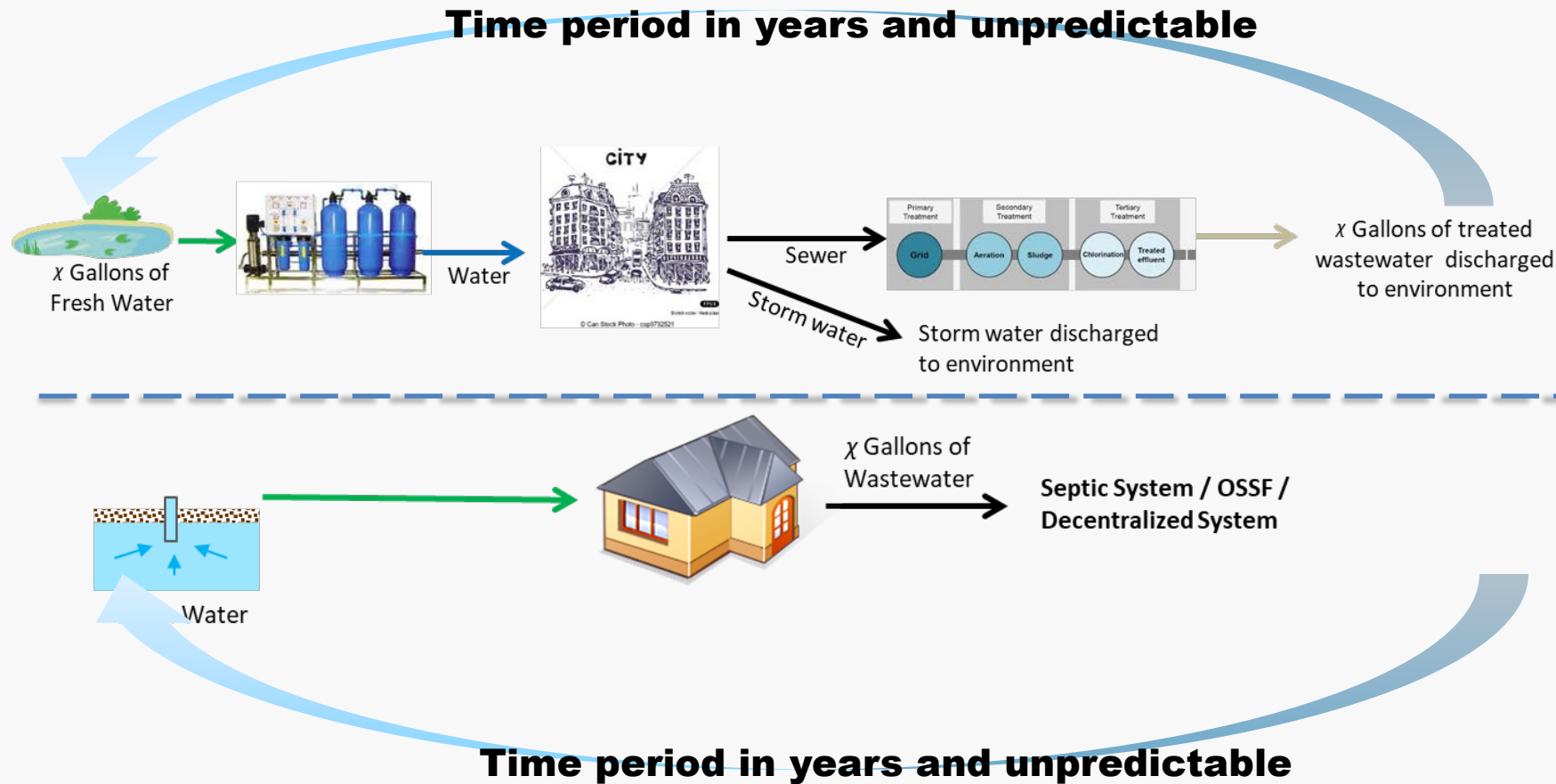


Problem is not that we are running out of Water, we still have same amount of water as we had before start of the human civilization.... About 366×10^{18} Gallons!

The problem is that water availability from the **NHC** is changing due to changing climate, resulting unpredictable drought and flooding....

Existing Centralized and Decentralized Water Infrastructure Model, one use & one source

NHC



Research and Extension Questions we are working on...

- Is there a way “we” can make Water availability more predictable and reliable, while meeting growing demand for water in Texas?
- Can we “Engineer” the Hydrologic Cycle?
- Engineered Hydrologic Cycle (**EHC**) that keeps water in the loop closer to where it’s needed, reusing wastewater and harvesting rainwater?

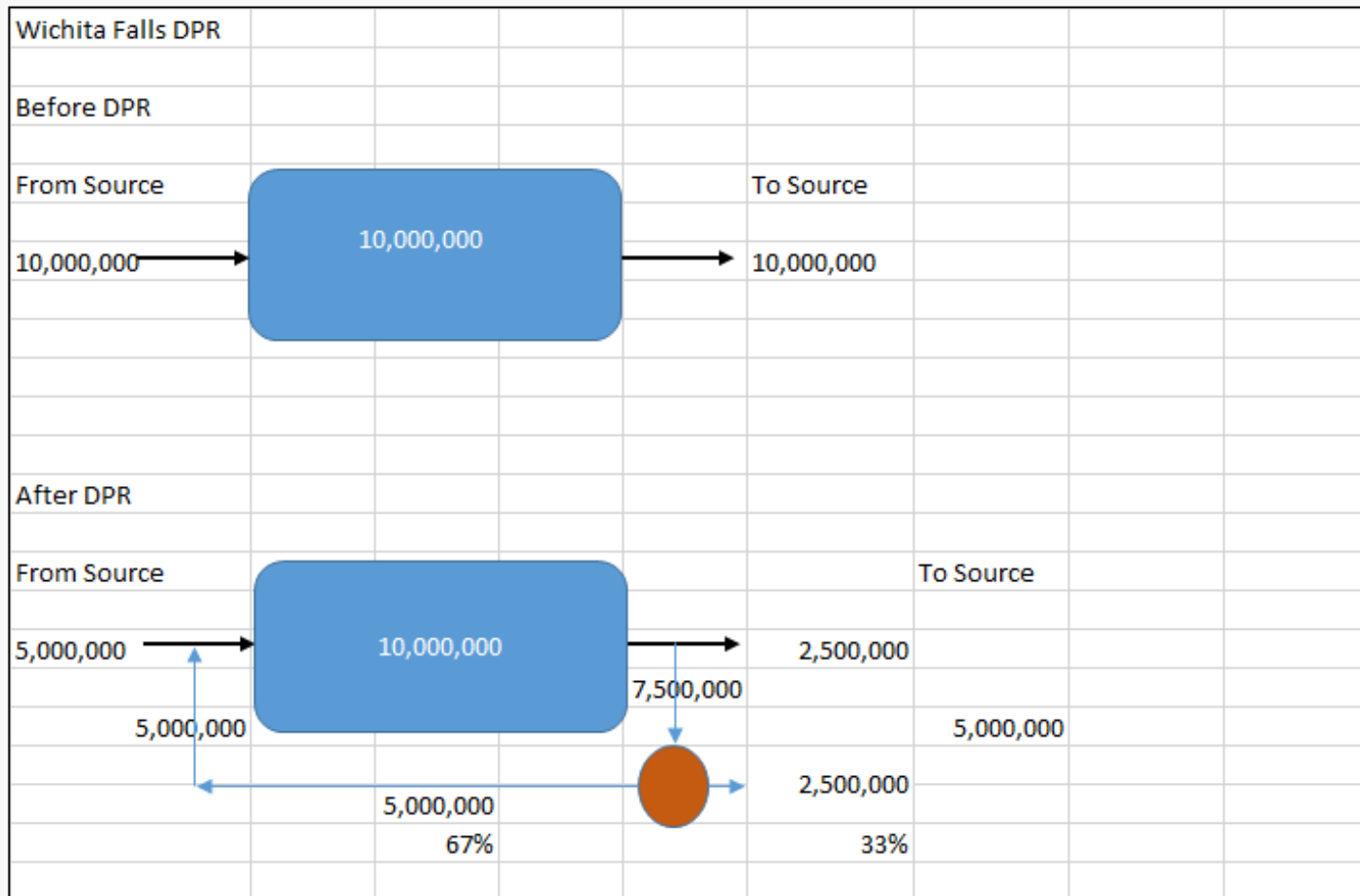
City Scale Direct Potable Reuse (Centralized)

- Wichita Falls, TX DPR Project (2014 site visit...)



- 6 ½ minute video presentation?

City Scale Direct Potable Reuse (Centralized)



By **mid-2015**, annual rainfall back to normal, and no drought conditions since then.... So, the city converted their DPR system to **IPR** system...

In January 2018, the City completed a \$35 million Indirect Potable Reuse project which takes **all our wastewater effluents to Lake Arrowhead for storage and ultimate use.** This project will **recycle up to 16 million gallons per day**....

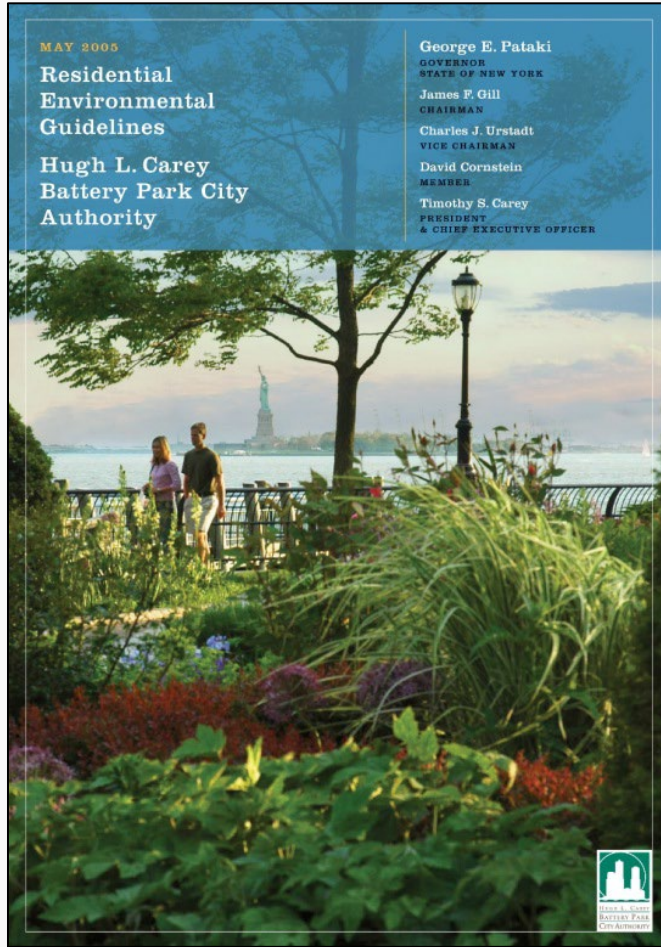
What about Building Scale Reuse?



What about Building Scale Reuse?



Battery Park City Urban Reuse Project, New York City, NY. <https://nsuwater.com/portfolio-item/battery-park/>



1 Bligh St Sydney, Australia

Project Status: Completed

Project Size: 460,000 Square Feet

Alternate Water Sources:

- Blackwater

End Uses:

- Toilet Flushing
- Irrigation
- Cooling Towers

Treatment System Size: 26,500 Gallons/Day

Potable Water Use Reduction: 90%

Drivers: 6 Star Green Star

System Cost: \$780,000

Annual O&M Cost: \$65,000

Owner: Cbus Property, Dexus Property, and the Dexus Wholesale Fund

Project Description:

Completed in 2011, 1 Bligh Street was the first commercial high-rise building in Sydney to incorporate onsite blackwater recycling. The project was awarded the first combined private network and retailer's water recycling license in New South Wales, allowing Aquacell, the technology/system provider, to install a sewer mining system to supplement the building's blackwater supply. The sewer mining arrangement ensures that 100% of the non-potable demand within 1 Bligh Street can be met with recycled blackwater.

Drivers for Onsite Water Reuse:

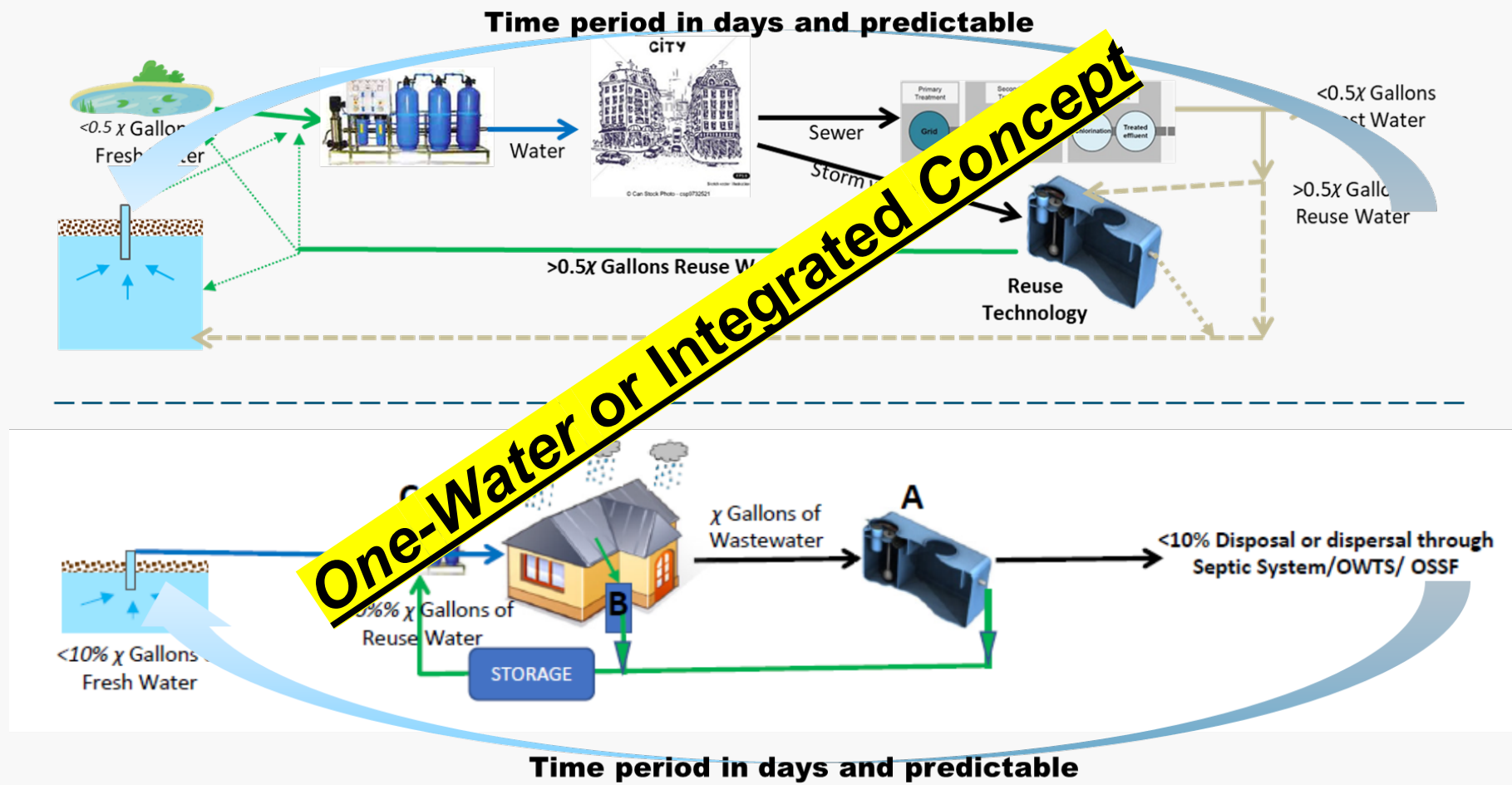
The primary driver for onsite water reuse was achieving a 6-star Green Star rating for the building, the highest level for Australia's sustainability rating system for buildings. A cost benefit is achieved from operating the plant when compared to the 'business as usual' model.



Reference: Onsite Water Recycling, An Innovative Approach to Solving Old Problems. SF Utility.

<https://aquacell.com.au/>

Futuristic Centralized and Decentralized Water Infrastructure Model, reuse use & multiple sources



EHC

One-Water or Integrated Concept

One-Water *aka* Integrated Water Concept

- Managing all available Water Onsite to maximize Water Availability and minimize adverse impacts of Changing Climate, (drought and flooding conditions)....
- National movement organized and lead by the **National Blue Ribbon Commission** for Onsite Water Systems ([NBRC](#))....
- At building scale, we have Rainwater Harvesting (RWH) and Onsite Wastewater Reuse (OWR)...
- Texas model for meeting Onsite Water Demand **combining RWH and OWR**.... i.e., One-Water Hydrology Model...

RWH in Texas

A home in Texas where Rainwater is the only source of water



Rainwater as the only source of water for this home in Menard, TX...

Historical Rainfall Data		
Maximum	39	in/year
Minimum	9	in/year
Average	23	in/year

Roof Area for RWH	2,500	sqft
Collection efficiency	75%	

Rainwater Supply		
Maximum	45,593	Gal/year
Minimum	10,986	Gal/year
Average	26,459	Gal/year

Rainwater Supply Avg GPD	
Maximum	125
Minimum	30
Average	72

Fun facts from TX
 Average Rainfall ranges from ~50 inches/year in East to ~5 inches/year in West....

Can we get Avg. 150 GPD by adding OWR?

Can Onsite Water Reuse Increase the supply of available water from RWH?

Table 2: Effects of on-site reuse when implemented with rainwater harvesting (RWH) to meet the annual water demand as measured by the number of days/year demand met.

RWH and On-Site Reuse Calculations				
Average daily water demand	150	Gal/day		
	54,750	Gal/year		
Roof Area for RWH	2,500	sqft		
Historical Rainfall Data				
Maximum	39	in/year		
Minimum	9	in/year		
Average	23	in/year		
Collection efficiency	75%			
Rainwater Supply				
Maximum	45,593	Gal/year		
Minimum	10,986	Gal/year		
Average	26,459	Gal/year		
Will I have enough water during the year?				
On-site Wastewater Reuse	0%	33%	50%	80%
Rainwater Supply	# of days/year daily water demand is met			
Maximum	304	>365	>365	>365
Minimum	73	110	146	>365
Average	176	265	353	>365

Amount of Available Water (GPD) by combining OWR with RWH...

Table 2: Effects of on-site reuse when implemented with rainwater harvesting (RWH) to meet the annual water demand as measured by the number of days/year demand met

RWH and On-Site Reuse Calculations				
Average daily water demand	150	Gal/day		
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Historical Rainfall Data				
Maximum				
Minimum				
Average				
Collection efficiency				
Rainwater Supply				
	45,593	Gal/year		
Minimum	10,986	Gal/year		
Average	26,459	Gal/year		
Available water supply				
Wastewater Reuse	0%	33%	50%	80%
Water Supply	Average GPD available			
Maximum	125	187	250	625
Minimum	30	45	60	150
Average	72	109	145	362

Question – can this be done in real world?

On-Site Water Reuse Research Capacity @ TAMU-RELLIS campus



OSSF



OWR?????

<https://ossf.tamu.edu/togp-research/>



On-Site Water Reuse Research Capacity @ RELLIS campus

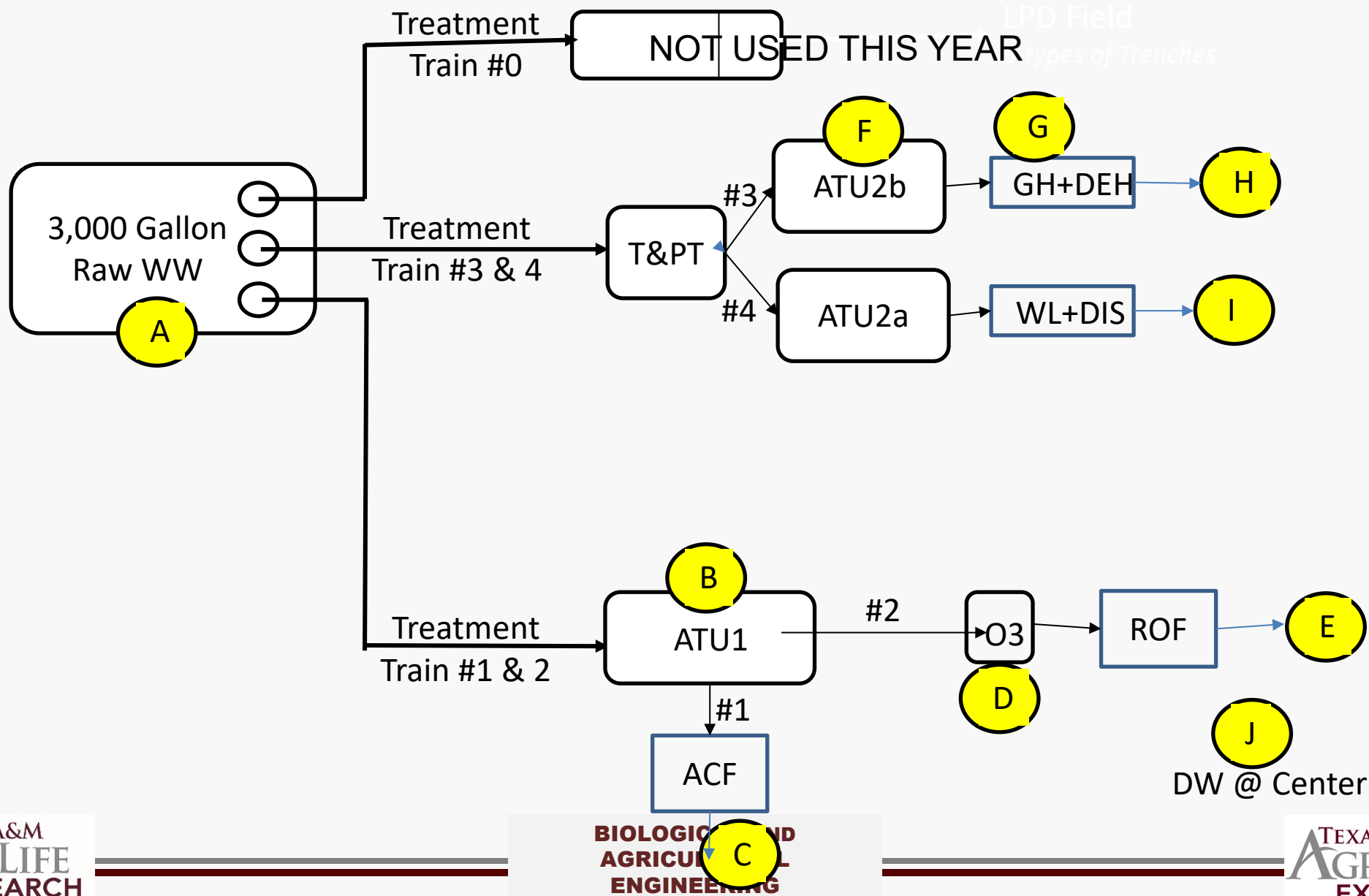
- Focusing on Onsite Direct Potable Reuse....
- Following well water treatment technologies are *getting* installed to treat MBR effluent:
 - Reverse Osmosis (RO)
 - UV Disinfection (UV)
 - Ozone Disinfection (OZ)
 - Chlorine Disinfection (Cl)
 - Activated Carbon Filter (AC)
 - Capacitive Deionization (CapDI)
 - High-Efficiency Distillation
- Also, meeting with TCEQ Wastewater Reuse & Drinking Water Supply teams to understand current rules and regulations.

2023 RWQ-REEU Group



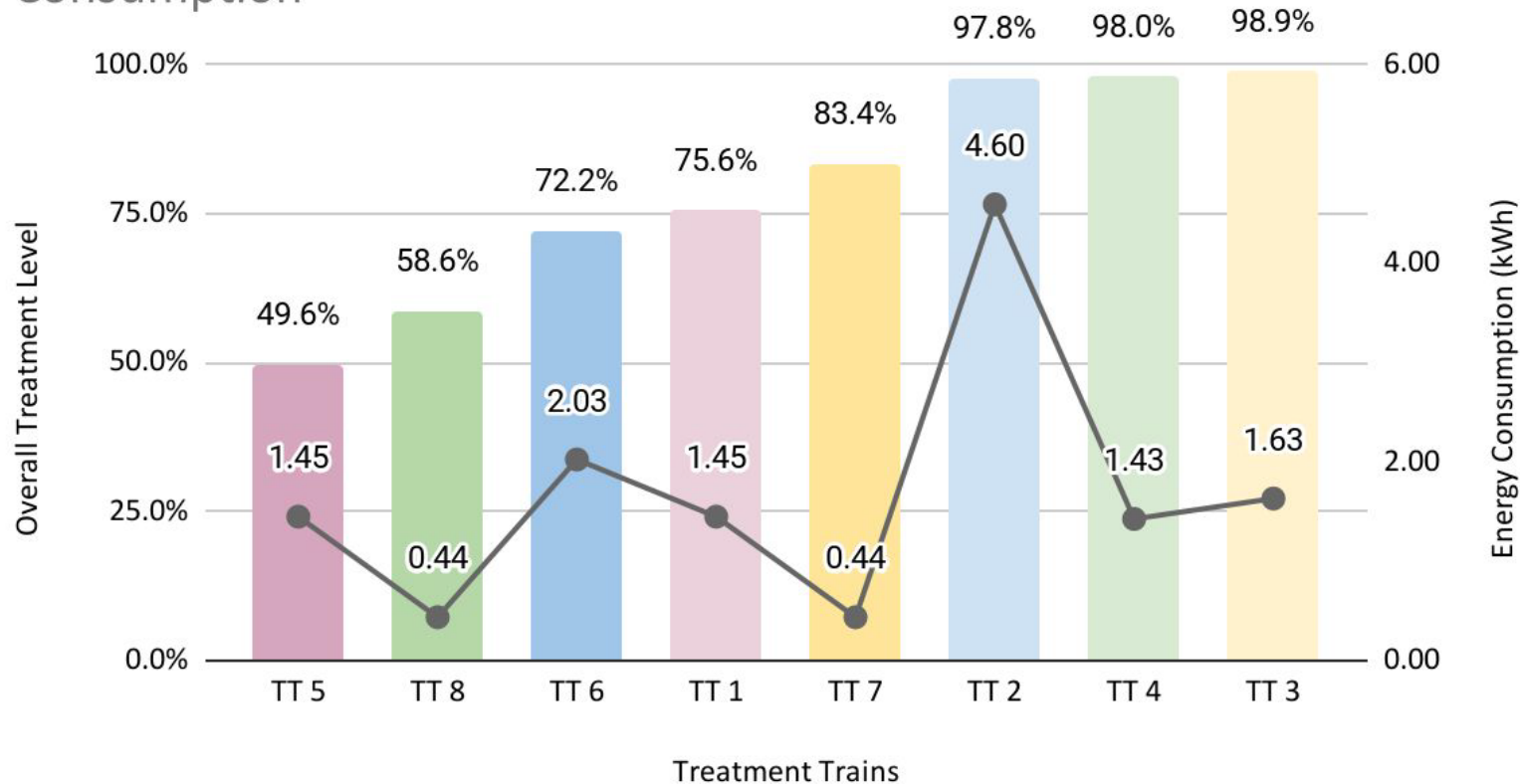
For more information, visit our website <https://reeu.baen.tamu.edu/>

Treatment Trains and Sampling Points



Water Quality and Energy Demand

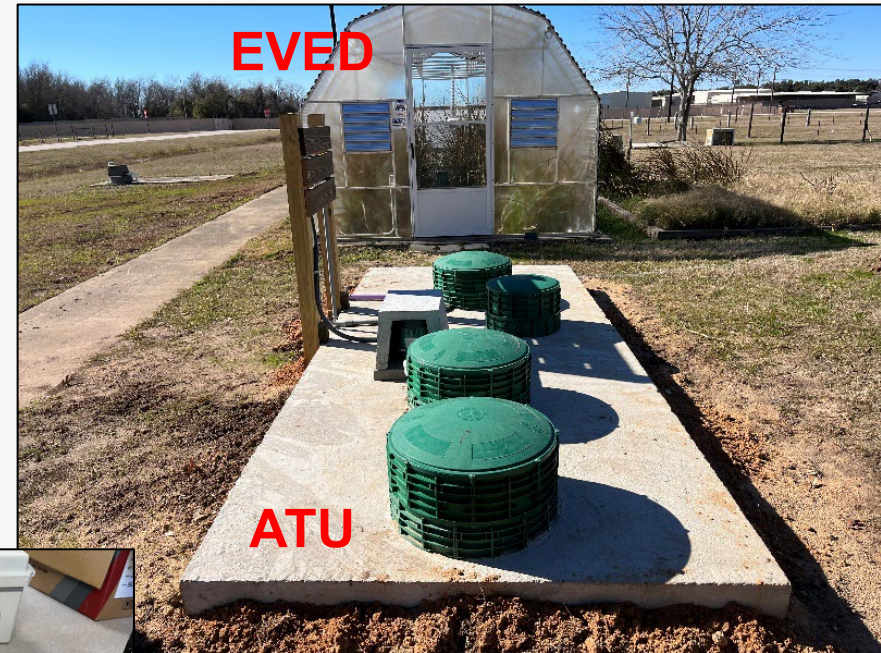
Overall Treatment Level of Treatment Trains with Energy Consumption



- 90% Treatment
- ~2 to 5 kWh per Gal...

$$\text{Overall Treatment Level (\%)} = \frac{\sum_{n=1}^i \text{Treatment Level}}{i}$$

RELLIS Experimental Reuse Facility



New OSSF Design EVED + Reuse

Data collection to start soon to study water quality and discharge quantity reduction....

REAL WORLD



Rainwater Harvesting

RELLIS Sewer Line

Lift Station

Raw Wastewater
3000 Gallons
Tank

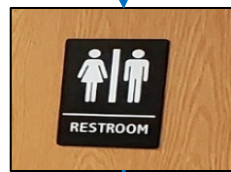
Passed through Dosing tank
~150 gpd or less



Advanced Onsite
Wastewater
Treatment for Reuse

BOPR
Buffer

Polish



Real time monitoring

IoT

Water Quality monitoring sensors
Temperature, Humidity, Rainfall sensors
Water quantity monitoring sensors

DIGITAL TWIN

3D modelling

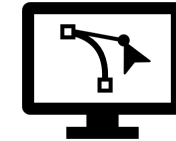


Machine Learning

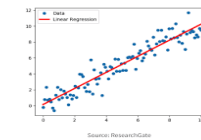


Machine Learning

Visualization



Prediction



Optimization



Decisions

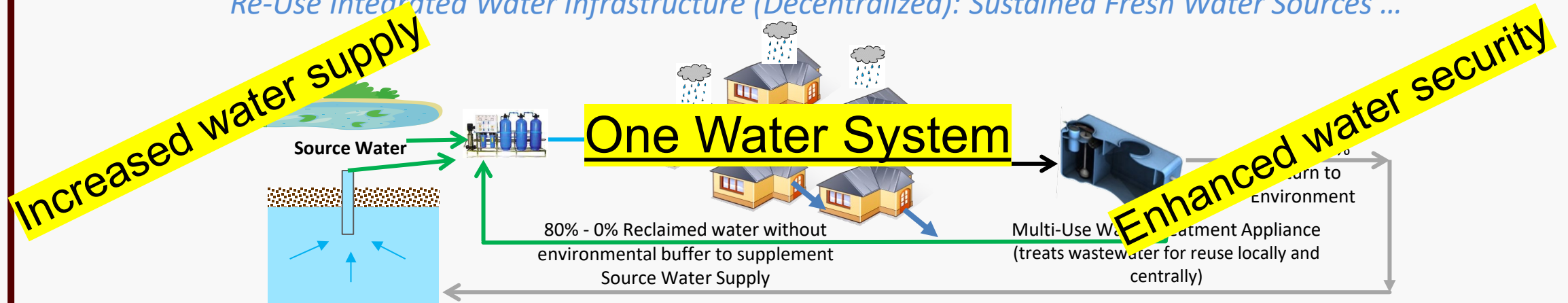
Feedback

Future of Onsite Systems When Engineered Hydrologic Cycle (EHC) becomes a reality...

Single-Use Water Infrastructure (Decentralized): Depleting Fresh Water Sources ...



Re-Use Integrated Water Infrastructure (Decentralized): Sustained Fresh Water Sources ...



Four main pillars necessary to have an **EHC** driven One Water infrastructure in Texas and elsewhere

1. **Conservation** – use only as much water as you need and avoid any environmental losses of the water you have.
2. **Capture all water** available onsite, this includes Rainwater, Condensate water, available ground and surface water, and have a “fit-for-purpose” treatment and distribution infrastructure, i.e., *One Water Infrastructure*.
3. **Reuse or Multiuse** – use the water available onsite more than one time, as *many times as the available reuse technology allows economically*.
4. **Have a reliable access** to necessary amount of **“seed” water**. This is the weakest pillar of our current onsite and centralized water infrastructure!

BAEN 489: One Water Engineering, 3 credit class

- Learning Objectives as planned...
 1. Identify challenges associated with growing water demands due to population growth and climate change.
 2. Describe various source waters that are part of the One Water Approach.
 3. Describe technical options available for designing One Water Infrastructure.
 4. Understand water quantity calculations and water quality parameters and monitoring.
 5. Analyze federal, state, and local regulations governing water infrastructure design.
 6. Design a One Water System for three types of residential dwelling, Class Project.
 7. Prepare an engineering report to include design and O&M specifications, 30-year life-cycle cost analysis, regulatory/permitting requirements, and other client specific information.
 8. Prepare a multi-media presentation of your design proposal to present to your client.

Thank you.

ajantrania@tamu.edu

Questions / Comments???