

Emory University

College Water Efficiency Group November Case Study



Jonathan Lanciani & Bob Salvatelli
Sustainable Water
November 24, 2015

Who we are...

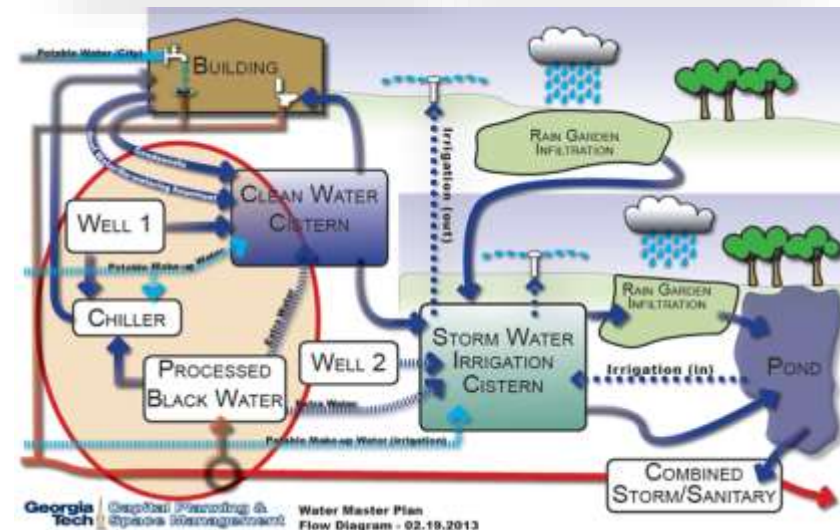
Water Management Consultants

- Water Balances & Footprint
- Water Reuse Feasibility
- Risk Management
- Flow Monitoring/Metering
- Water Management Plans



Turn-Key Developer

- Technology Integrator
- Planning/Design/Build
- Financing
- Operations



Helping Clients Utilize Water Resources More Efficiently

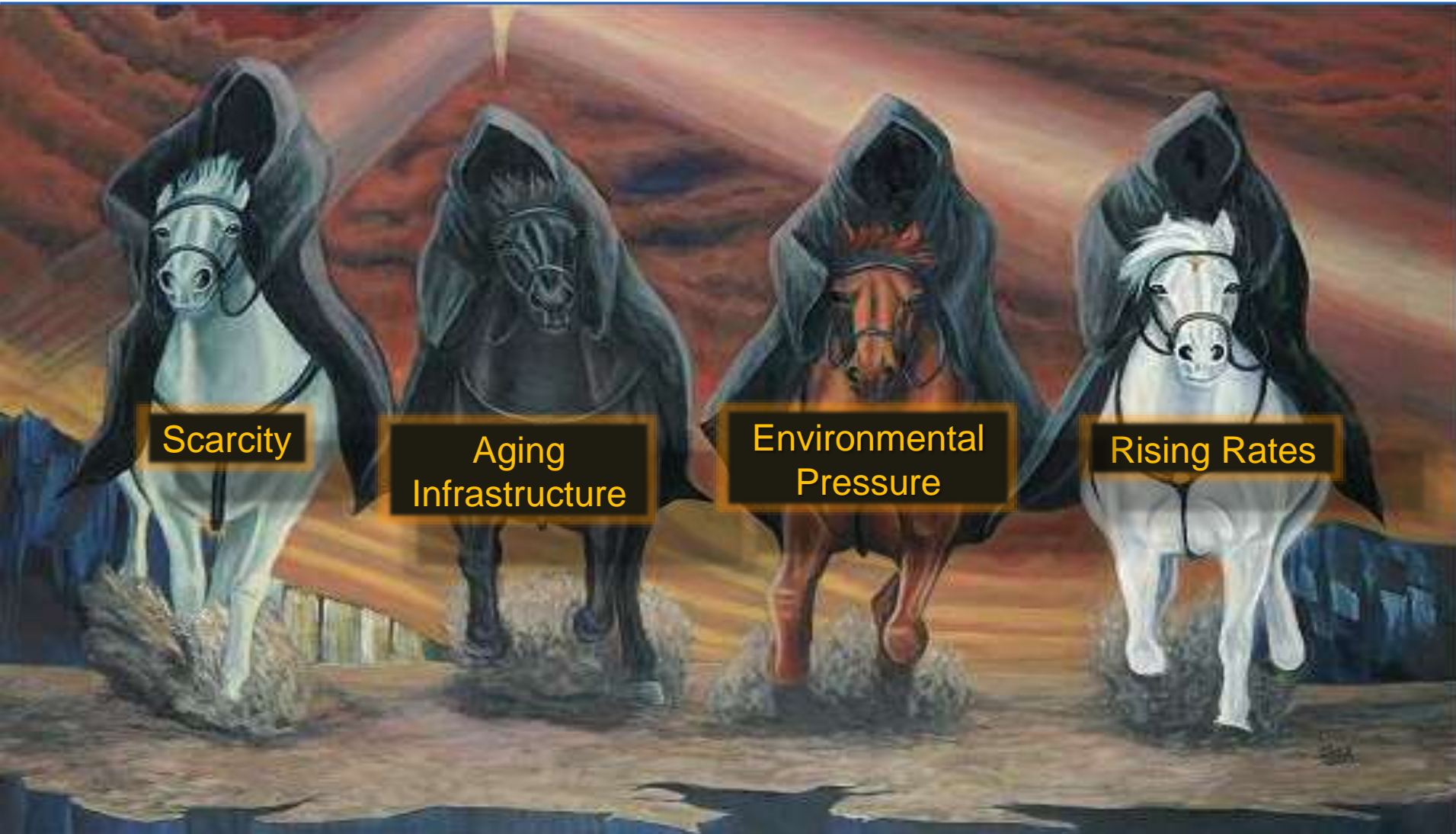


Portfolio of Clients



Diverse Clientele with Similar Goals to Preserve Precious Resource

The Water Apocalypse



Together These Factors Will Completely Change Water Management



Water Scarcity and Drought



Water Supply in the U.S.

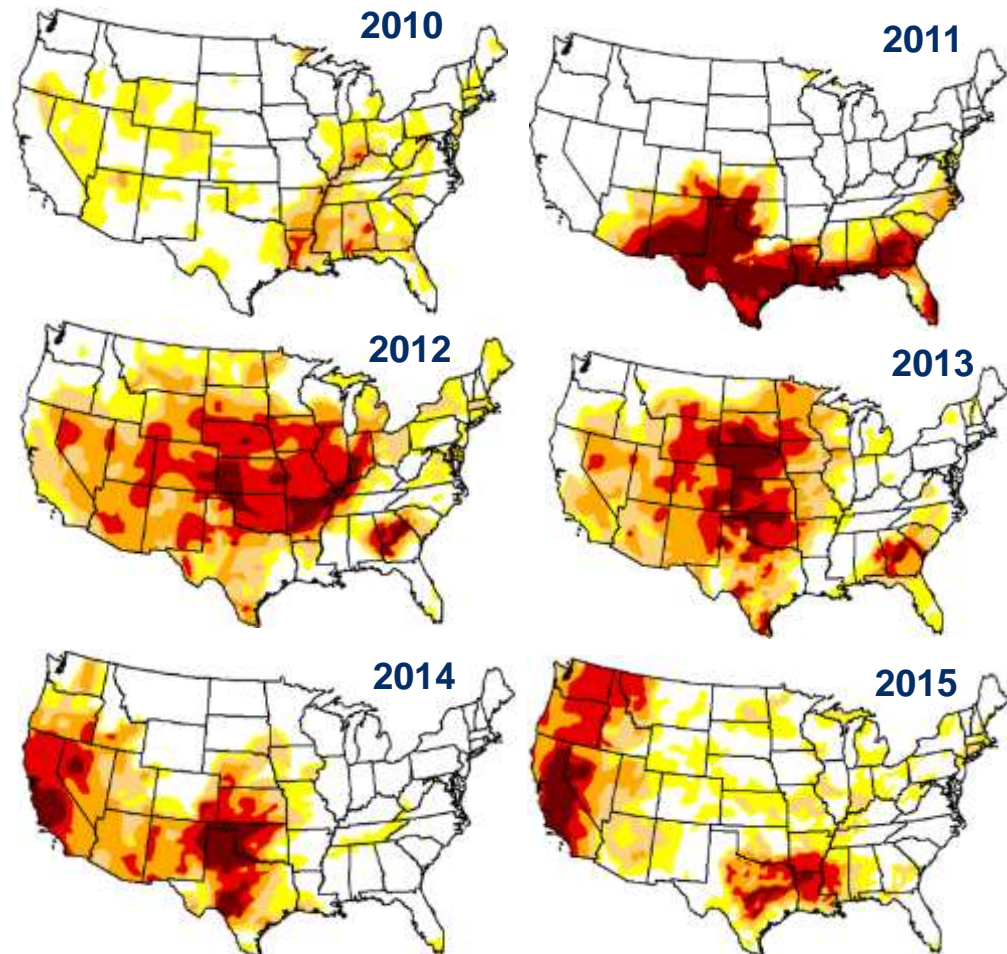
“Water Managers in 40 states expect water shortages in some part of their state **within the next 10 years.**”

- US Government Accountability Office

“**Nearly one in ten watersheds are stressed.** By midcentury, we expect to see less reliable surface water supplies in the United States. This is likely to create growing challenges for agriculture, electrical suppliers, and municipalities.”

- NOAA

How do we prepare for recurring droughts?



National Water Challenges Demand Immediate Action

Aging Infrastructure: A Local Concern



Water Main Break Closes School in Dekalb County



Atlanta Water Main Break Causes Travel Delays



Water Main Break Floods Downtown Athens



Water Main Break Floods Downtown Savannah Business

Atlanta's Water System Designed in 1875, Built Piecemeal Ever Since



Tightening Governmental Regulations

The federal & state regulatory environment is constricting to eliminate ground and surface water pollution as well as provide greater control over critical water resource management. A few regulatory issues driving water reuse:

- A move toward water withdrawal limitations
- Federal mandates to resolve CSO & SSO issues
- Stricter nitrogen & phosphorus discharge standards
- Stricter drinking water testing parameters



Water Withdrawal Limits



Combined Sewer Overflows



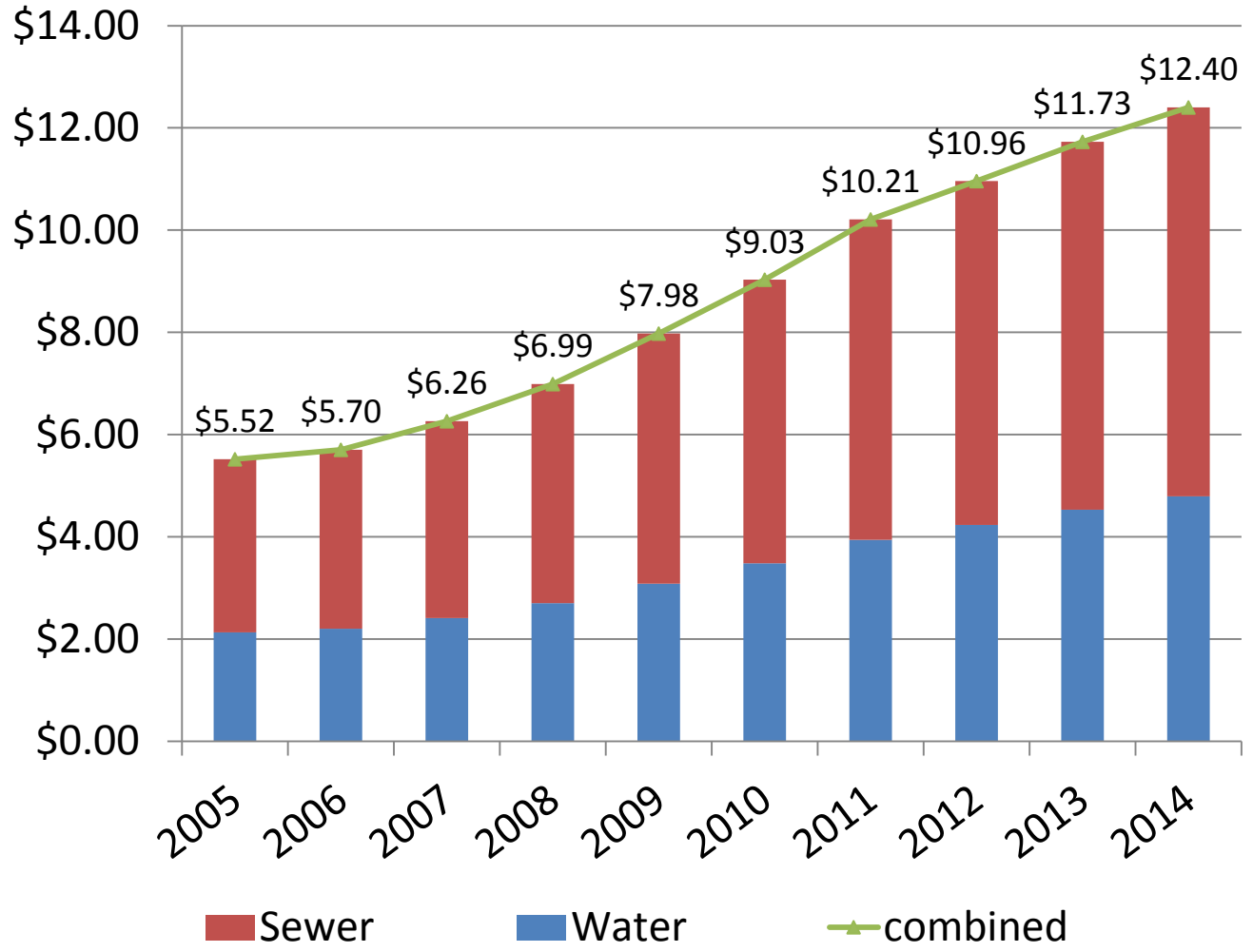
Point Source Pollution Control



Unfunded Mandates Drive Rate Increases

Major Metros-Rising Water & Sewer Rates

SUSTAINABLEWATER

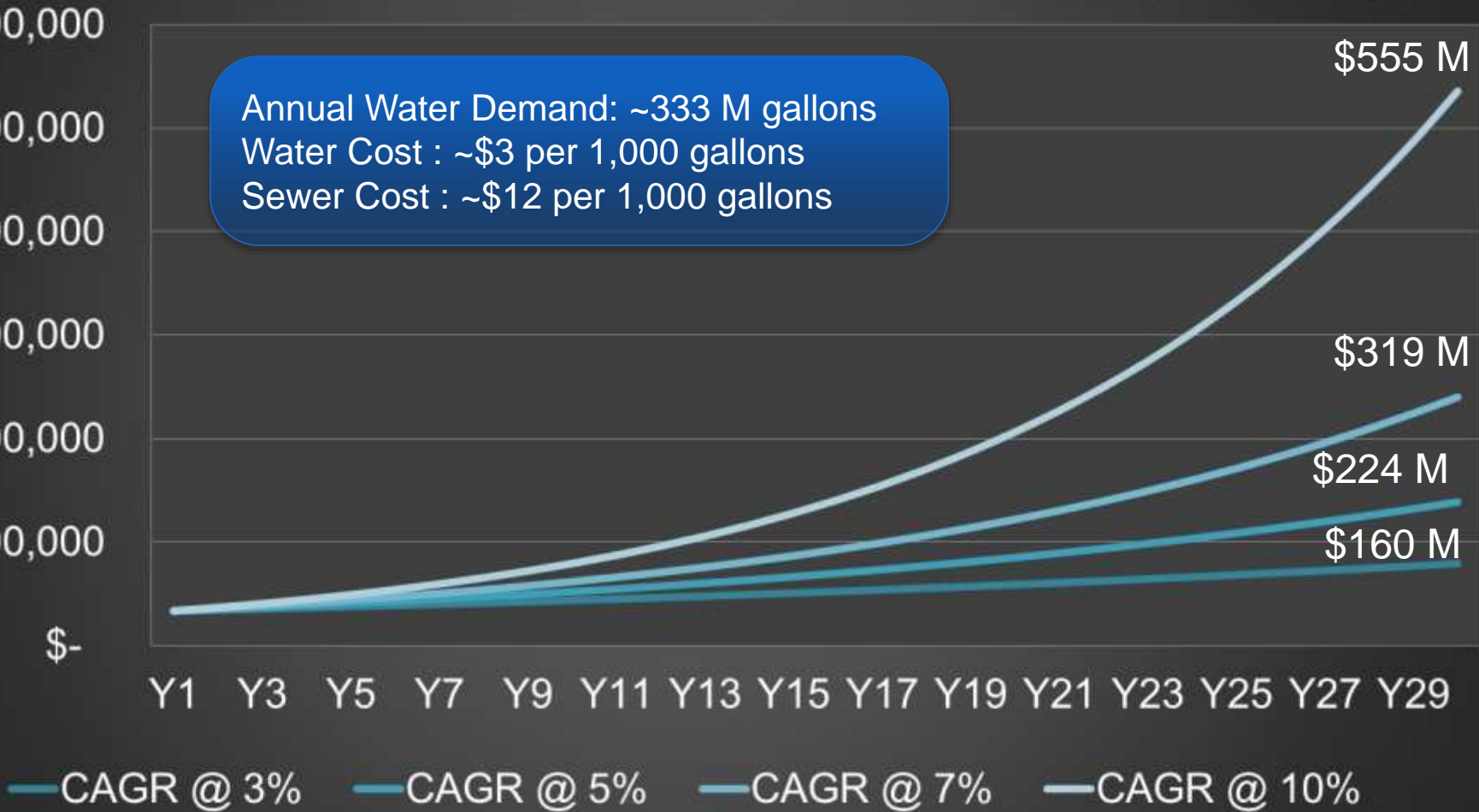


Water & Sewer Rates Averaging 10% CAGR

Projected Cost of Campus Water Services

Annual Water & Sewer Costs Over 30 Years , Emory University

Annual Water Demand: ~333 M gallons
 Water Cost : ~\$3 per 1,000 gallons
 Sewer Cost : ~\$12 per 1,000 gallons



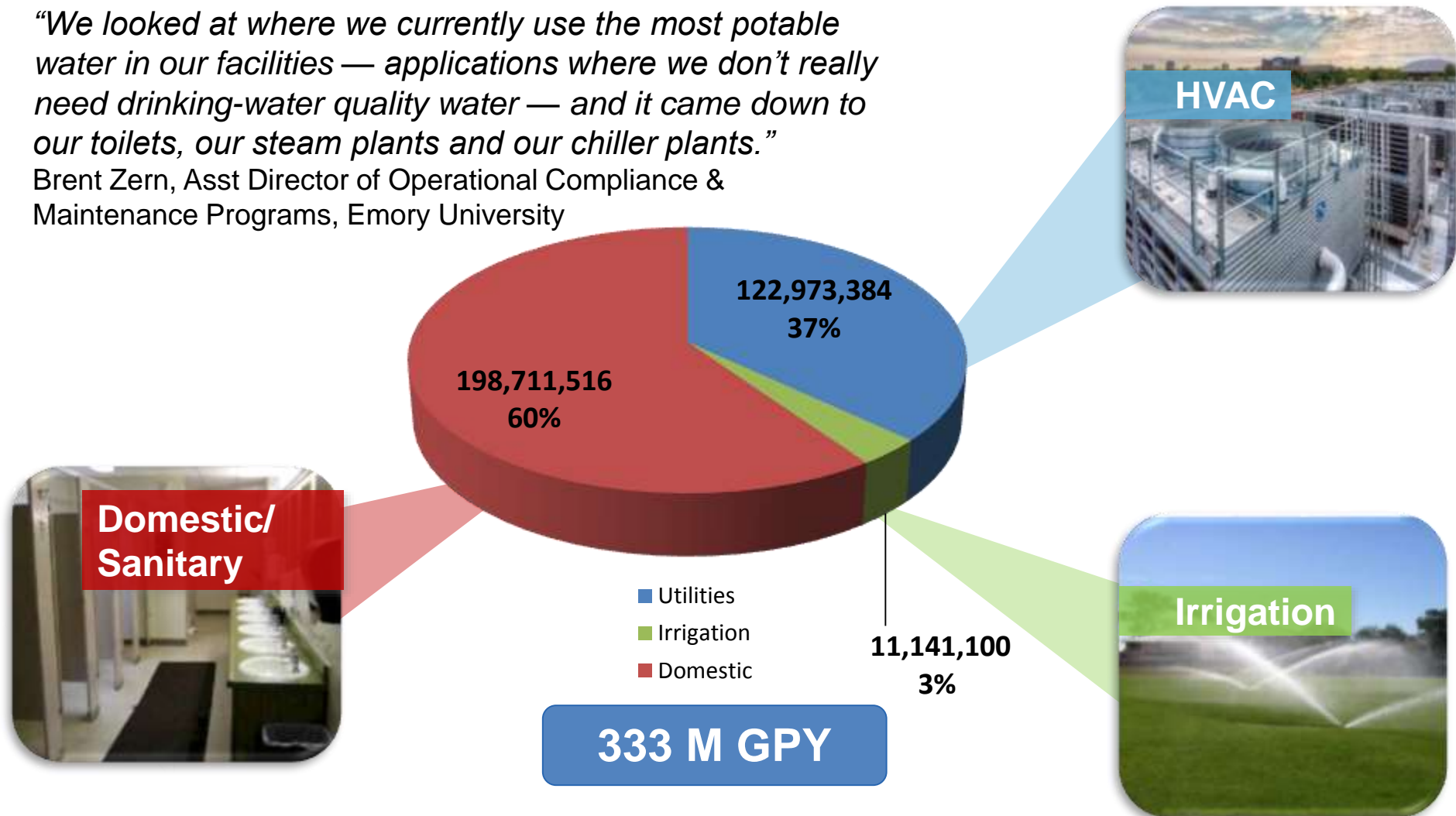
Hundreds of Millions of Dollars Demands Executive Attention



Water Use at Emory, FY 13-14

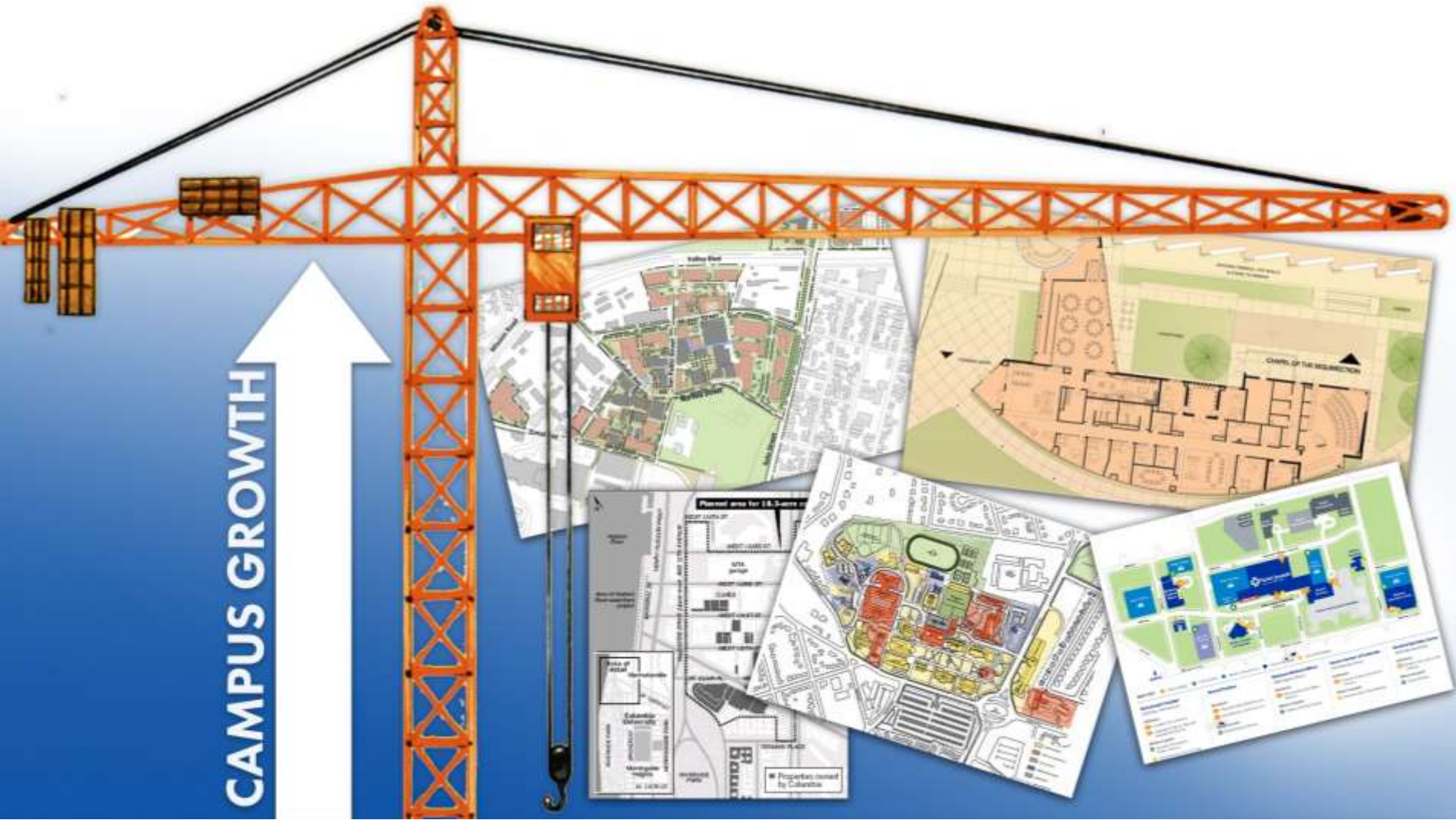
"We looked at where we currently use the most potable water in our facilities — applications where we don't really need drinking-water quality water — and it came down to our toilets, our steam plants and our chiller plants."

Brent Zern, Asst Director of Operational Compliance & Maintenance Programs, Emory University



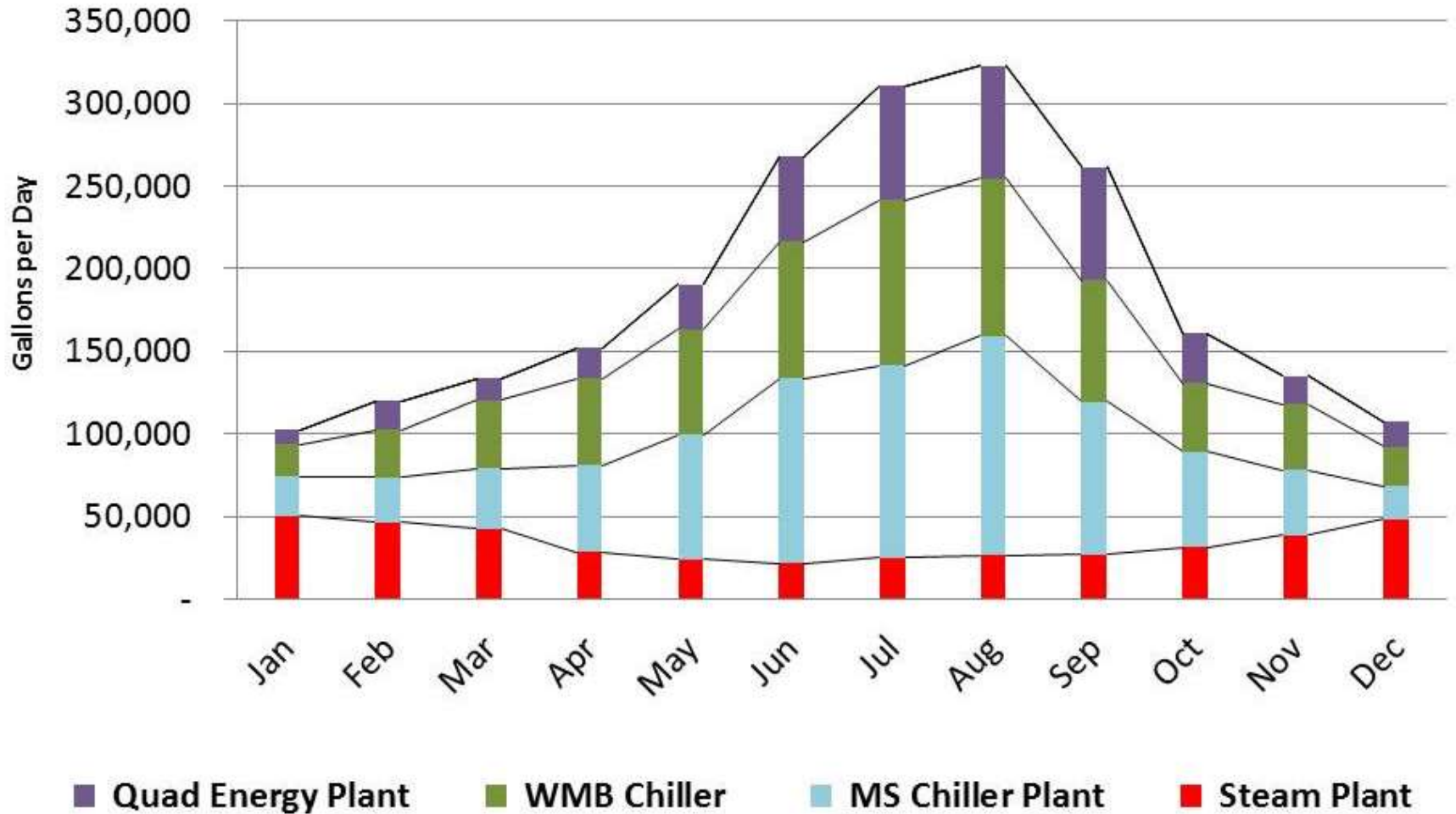
Significant Non Potable Demand Can Be Replaced by Reclaimed Water

Campus Growth is Contagious



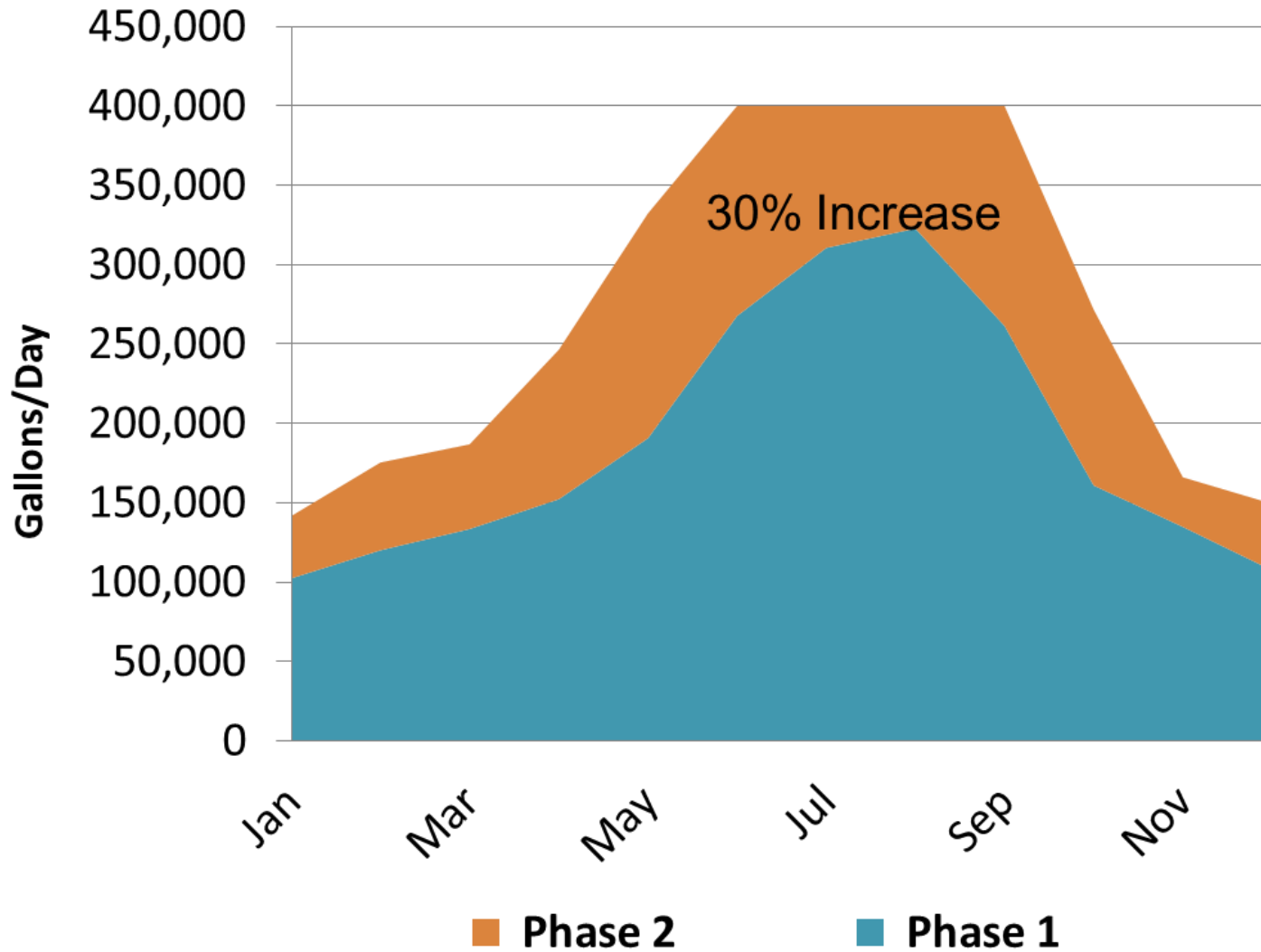
Careful Planning for Population and Square Foot Growth Necessary

Phase 1 Reclaimed Water Distribution



Additional Reclaimed Supply will Address Future Demand

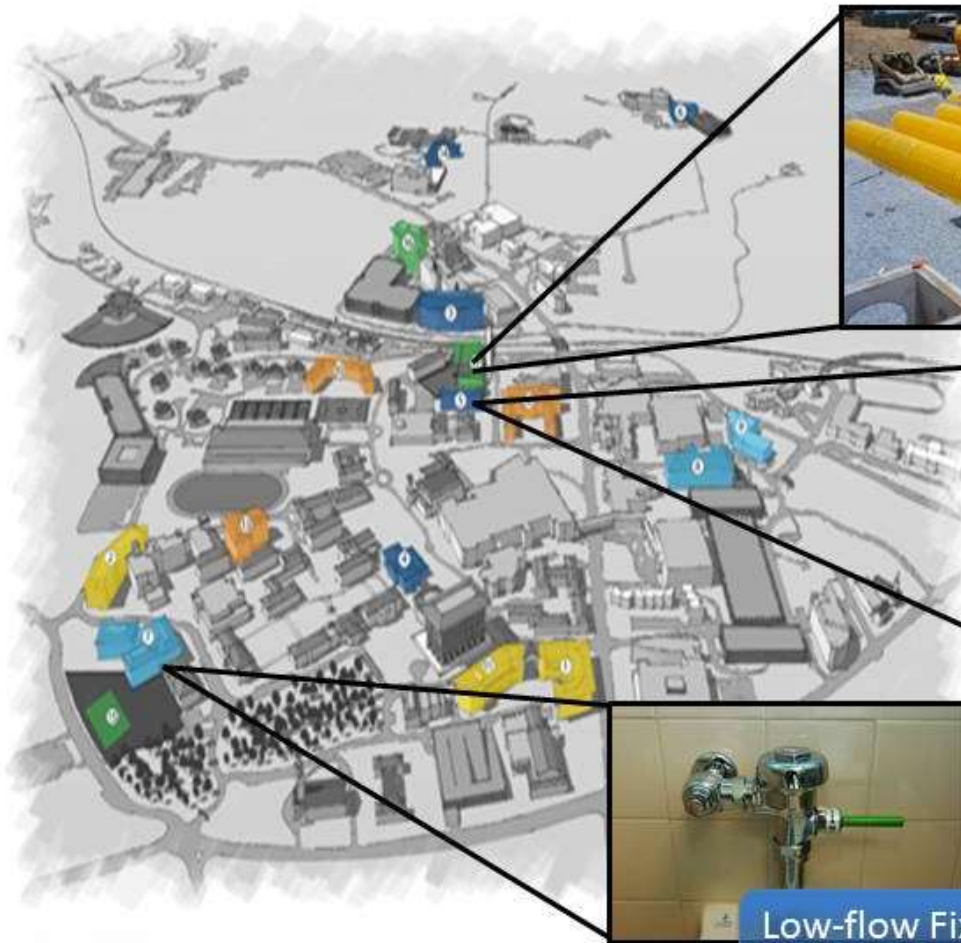
Phase II Reclaimed Water Distribution Expansion



Additional Reclaimed Supply will Address Future Demand



Emory Campus Water Conservation Initiatives



Stormwater Reuse
Saves 800,000 GPY



Graywater Reuse
Saves 750,000 GPY



Low-flow Fixtures

Signage & Advertising



Water Strategic Imperatives Drives Project Execution for Small Yields

The Evolution of Water Conservation



The Most Impactful Solution That Does Not Require Behavioral Change

A Sustainable Water Cycle...

Decentralized Reclamation and Reuse

Before

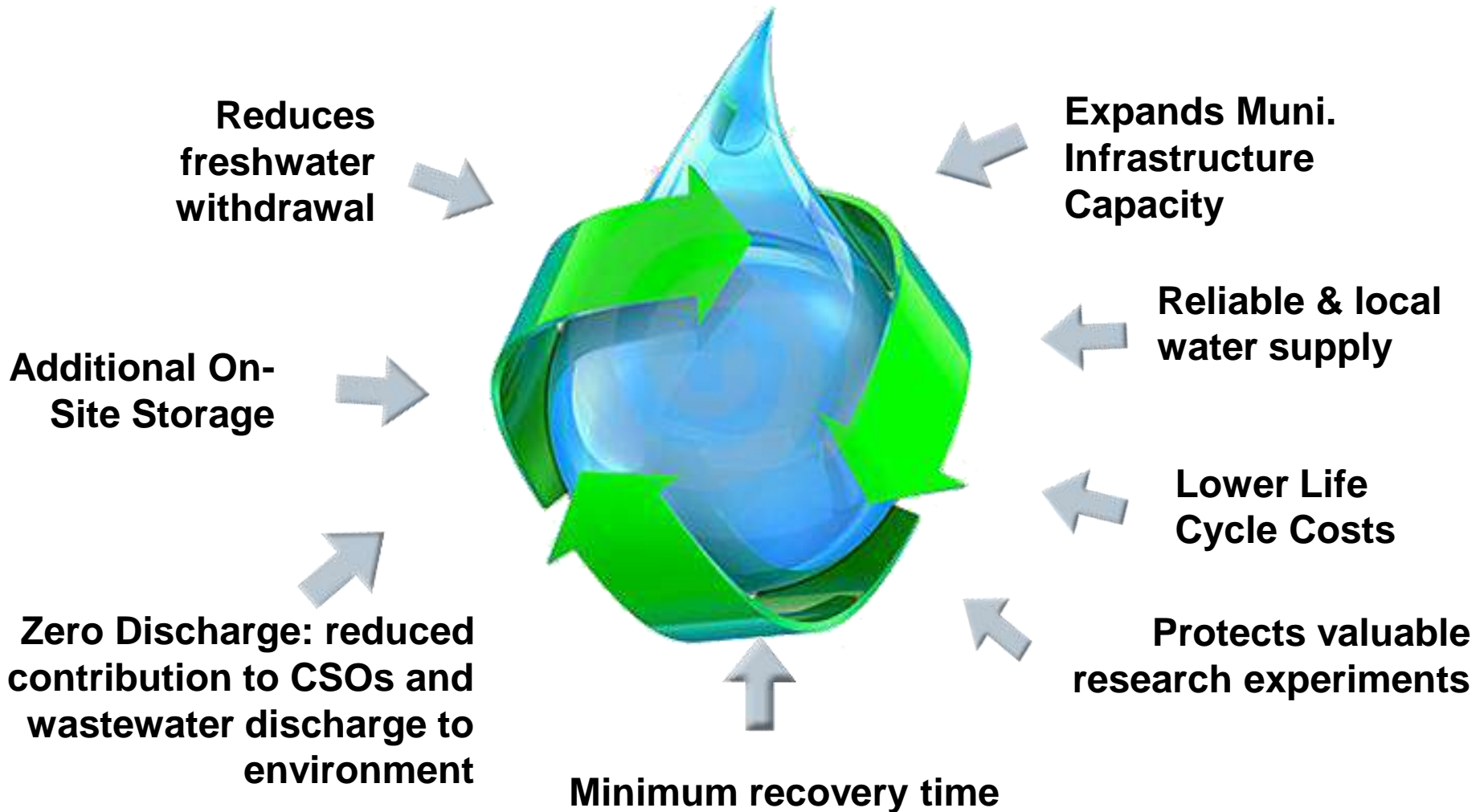


After



~Risk Management ~Cost Savings ~Environmental Responsibility

Flexibility: Independence and Resilience



Multiple Benefits Allow for Cross Facility Collaboration

State Support for Water Reuse



“Using reclaimed water conserves high quality water for drinking and other essential uses, reducing stress on water resources throughout the Commonwealth.”

- David Paylor, Director of the Virginia DEQ

“Reuse is key to the State’s water future. Currently, Florida is leading the nation – reusing 660 million gallons of reclaimed water each day to conserve freshwater supplies and replenish our rivers, streams, lakes, and the aquifers.

- Florida Department of Environmental Protection



“The Georgia Environmental Protection Division (EPD) encourages the use of reclaimed water as a substitute for potable water for the purposes identified.”

- Georgia Department of Natural Resources, *Guidelines for Water Reclamation and Urban Water Reuse*

Decentralized Water Treatment and Reuse is Becoming Nationally Accepted



Federal Support for Water Reuse

“U.S. water and wastewater utilities are putting more of an emphasis on water reuse and improving energy and water efficiency, which will benefit both water and energy conservation. In recent years, some states have started to promote decentralized systems that require much less energy for delivery and much lower infrastructure costs.”

- US Department of Energy



“Water recycling is a critical element for managing our water resources. Through water conservation and water recycling, we can meet environmental needs and still have a sustainable development and a viable economy.”

- Environmental Protection Agency

“Water reuse is the reclamation of water from wastewater plants for beneficial non-potable and potable uses. As freshwater supplies are approaching or have reached full allocation, water reuse is becoming a critical part of community water supplies.”

- US Department of Interior, Bureau of Reclamation



Decentralized Water Treatment and Reuse is Becoming Nationally Accepted



The Future: Decentralized Urban Reuse



Boilers



Cooling Towers



Irrigation

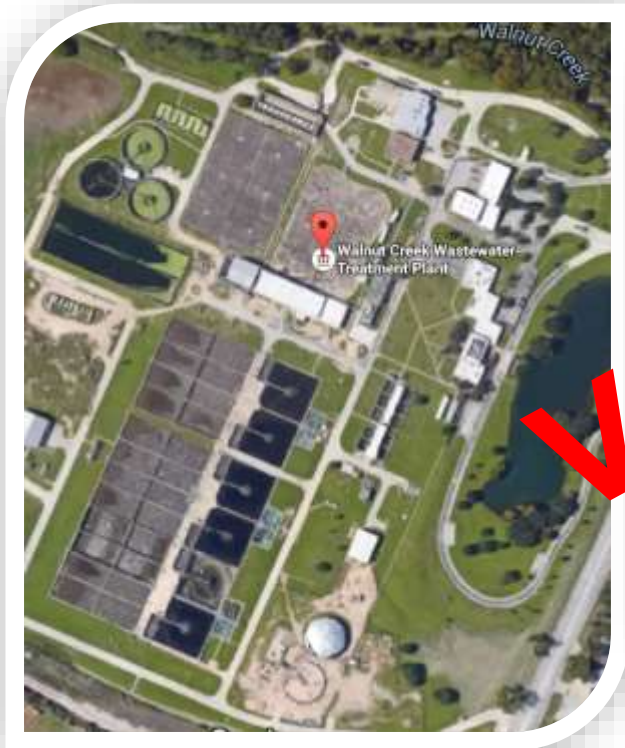


**Reciprocating
Wetlands**



**Fixed-film
Hydroponics**

Integrating Water Reuse into Urban Areas



VS



The SW Approach

Innovative Technology Enables Thoughtful Urban Deployment


Approval Process for Major Capital Projects

- **Step 1:** Project Idea Inception
- **Step 2:** Feasibility Study
- **Step 3:** Feasibility Study Review
- **Step 4:** Program Document
- **Step 5:** Consultant Selection
- **Step 6:** Schematic Design
- **Step 7:** Design Development
- **Step 8:** Construction Documents
- **Step 9:** Construction

Similar Terminology to Typical Construction Projects



Ecological Water Treatment Technologies

	 ReCip® Tidal Wetlands	 Hydroponic & Fixed Media	 Moving Bed Bioreactor (MBBR)	 Membrane Bioreactor (MBR)	 Conventional Activated Sludge
 CAPITAL EXPENSE					
 OPERATING EXPENSE					
 ENERGY EFFICIENCY					
 EFFLUENT QUALITY					
 FOOTPRINT					
 AESTHETICS					

Innovative Technology Increases Biodiversity & Reduces Energy Requirements

Rostrifera



Collotheca



Philodina



Aquatic Worm



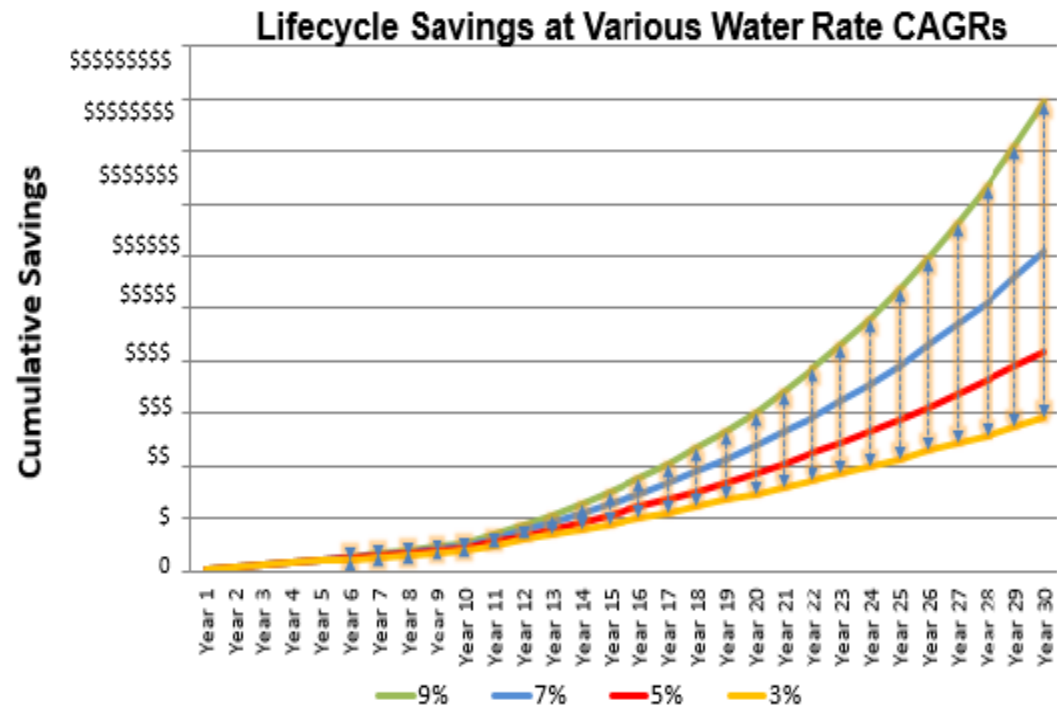
Unique Development Approach

Water Purchase Agreement

~ Shared Savings Agreement ~ Operating Lease ~ DBO Agreement ~ Performance Contract

Benefits

- **No up-front capital**
- Innovative Technologies
- Leverages superior credit rating
- Lifecycle Savings
- Long Term Pricing Stability
- **No O&M Responsibilities**
- SW bears majority of risk



Flexible, Innovative Vehicle that Yields Guaranteed Savings



Operating Agreement O & M

- Highly Automated Operations
- Remote Monitoring Capabilities
- State Certified Operator On-Site
- Compliance Testing
- Preventative & Predictive Maintenance
- Includes All Operating Expenses

- Labor
- Energy
- Permit Fees
- Compliance Testing
- Taxes
- Insurance
- Chemicals
- Discharge Fees
- Maintenance



Operations Performed in Accordance to State Standards/Protocols



SUSTAINABLE WATER

The WaterHub at Emory University

400K GPD and up to 140M GPY Displaced
 Up to 40% of Total Campus Demand
 90% of Utility Water Demand
 3 Chiller Plants/1 Power Plant (phase 1)



Permitted for Use in Utility Operations, Irrigation, and Toilet Flushing

Emory WaterHub - Aerial View



Small Physical Footprint, Sited in the Middle of Campus



WaterHub Process Design

How the WaterHub Works

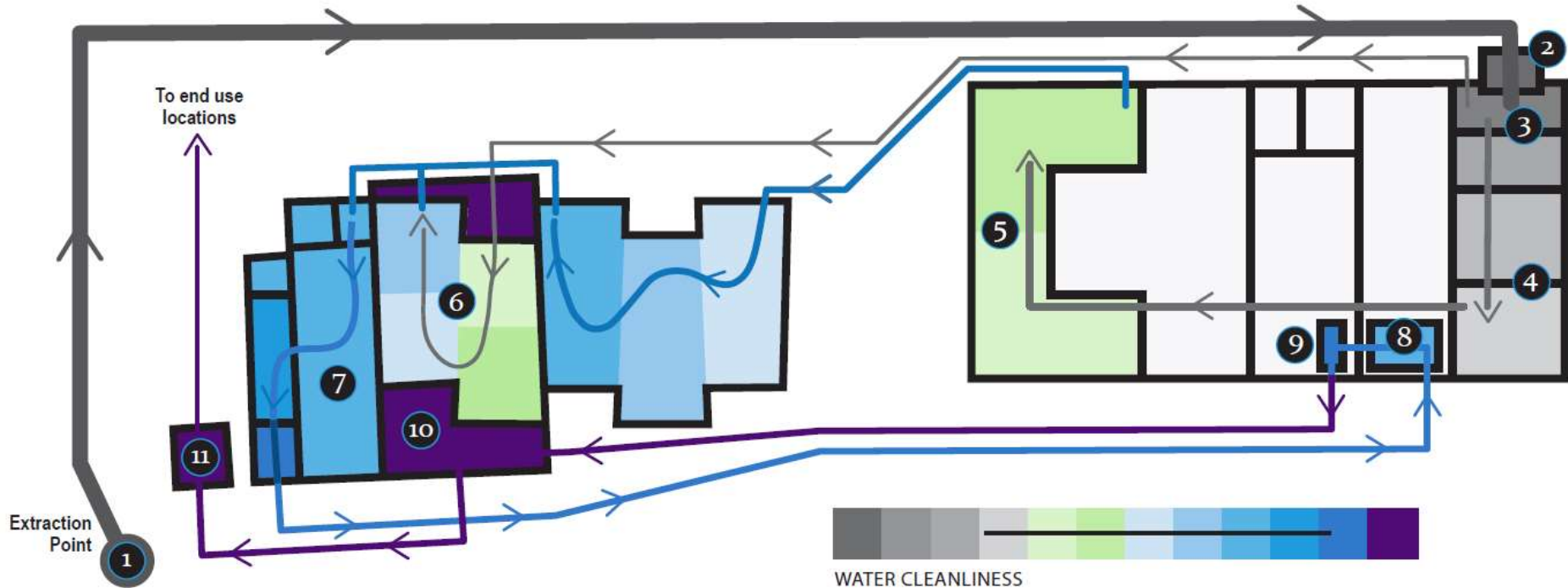
- 1** **2** **Extraction Point & Rotary Screen**
Wastewater is diverted from the sewer system and sent through a screen to remove debris.

- 3** **Anoxic Moving Bed Bioreactors**
Wastewater enters a low-oxygen environment where microorganisms living on honeycombed plastic pellets (mid-density housing for microbes) begin to metabolize carbon and nitrogen.

- 4** **Aerobic Moving Bed Bioreactors**
Wastewater enters an oxygen containing environment with a different community of microbes that continue the treatment process. Diffusers add air bubbles to assist treatment. Odorous gasses are removed with charcoal filters.

- 5** **Hydroponic Reactors**
Water clarity increases as water is treated in tanks with suspended plant roots. Water is cleaned by microbes living on the plant roots and on the specially engineered bio fabric (high-density housing for microbes) located below the plant roots.

- 6** **Demonstration Reciprocating Wetlands**
An alternate treatment system, this area demonstrates a highly energy efficient treatment process applicable for rural areas and developing countries. Screened wastewater is pumped to four 8' deep cells. Cells are alternately filled-and-drained 8 to 18 times a day. The system mimics the behavior of natural tidal wetland areas and uses gravel and plant roots to provide microbial habitat.



- 7** **Clarifier Tank**
In a still-water tank, Phosphorus and any remaining solids are removed as the particles hit interior baffles and slide to the bottom.

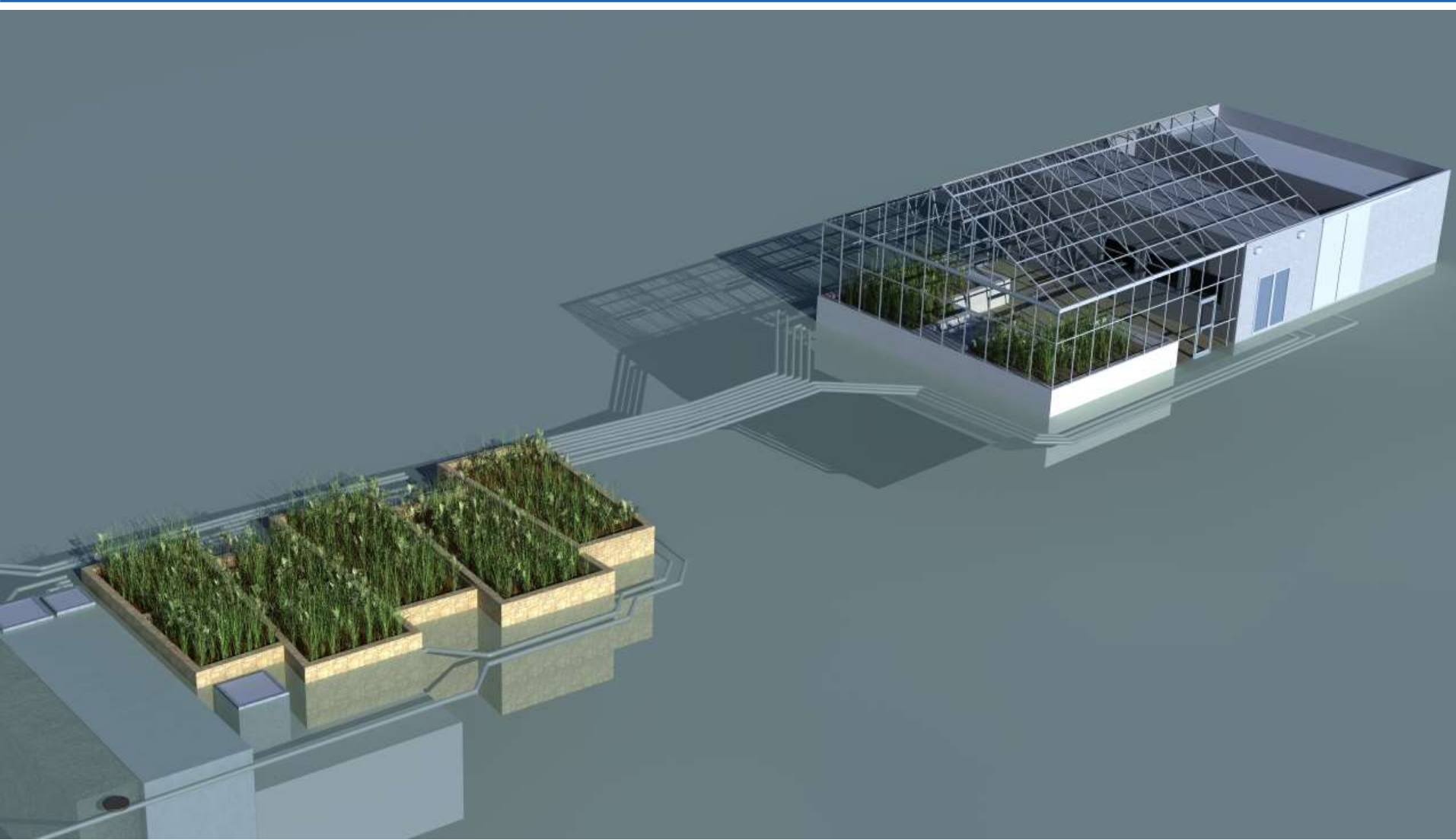
- 8** **Disk Filter**
Very clean water is sent through a felt filter to remove any remaining particulate material.

- 9** **Ultraviolet Disinfection**
Water is treated with ultraviolet light that provides extensive disinfection, producing water that complies with state and local health requirements.

- 10** **50,000 Gallon Storage Tank**
Fully treated water is stored underground as a reserve supply.

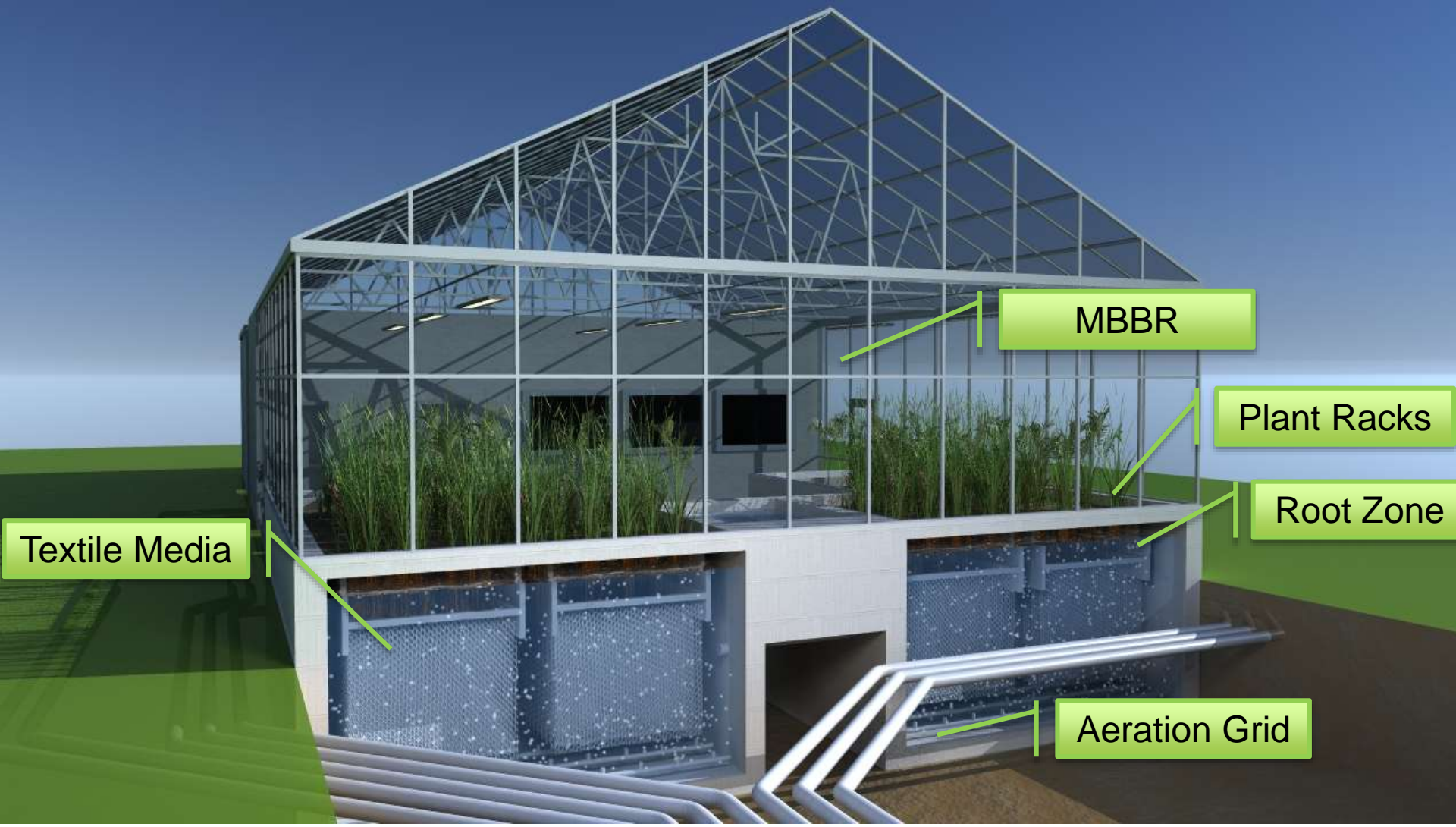
- 11** **Campus Distribution**
Water is distributed to the steam and chiller plants for use as process make-up water. In the future, water will be sent to residence halls for toilet flushing.

Ecological Treatment Design



Flexible Integration into the Built Environment

GlassHouse (Upper Site)



GlassHouse Footprint Compact and Efficient at 2,100 SF

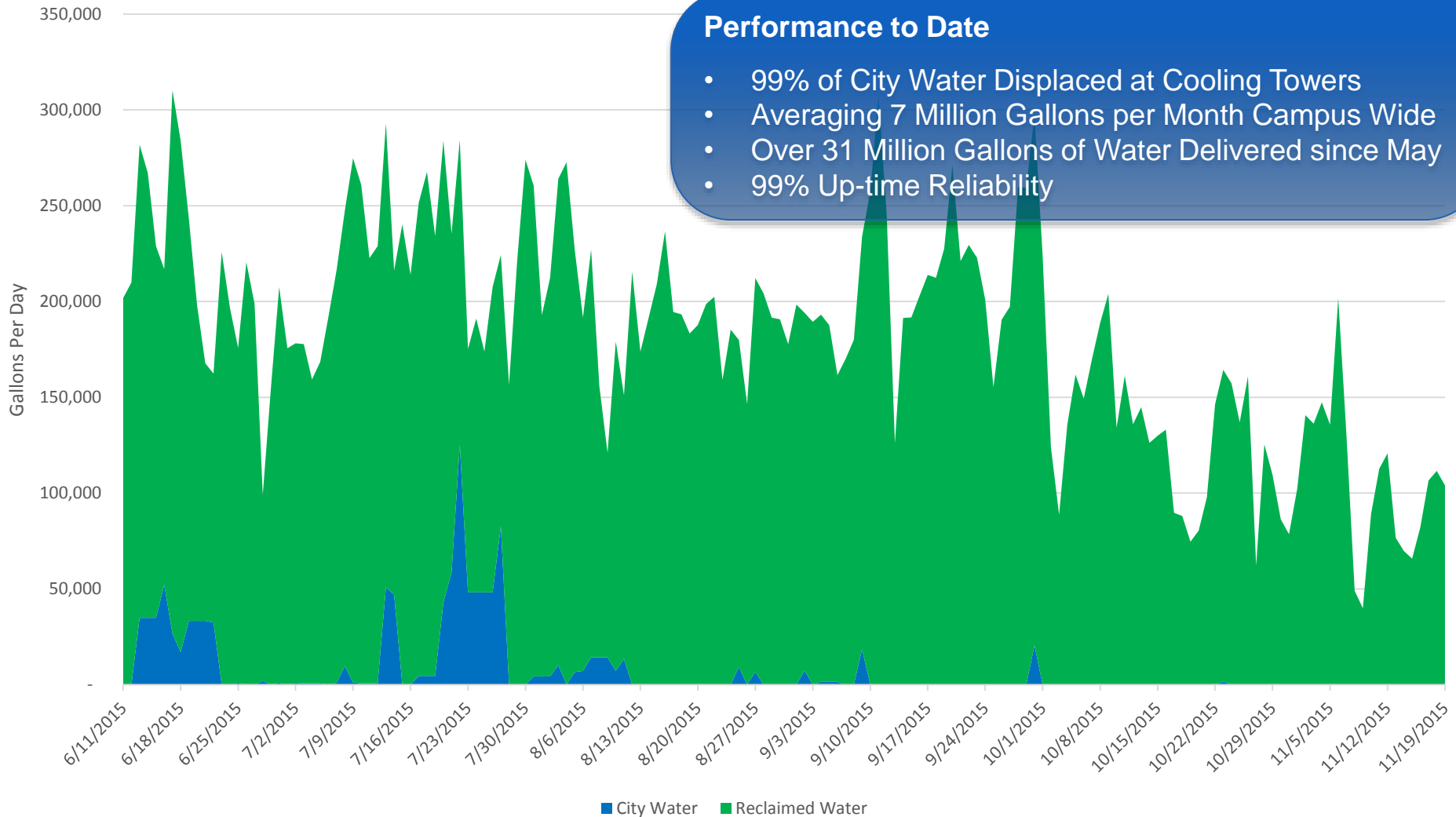
Outdoor System (Lower Site)



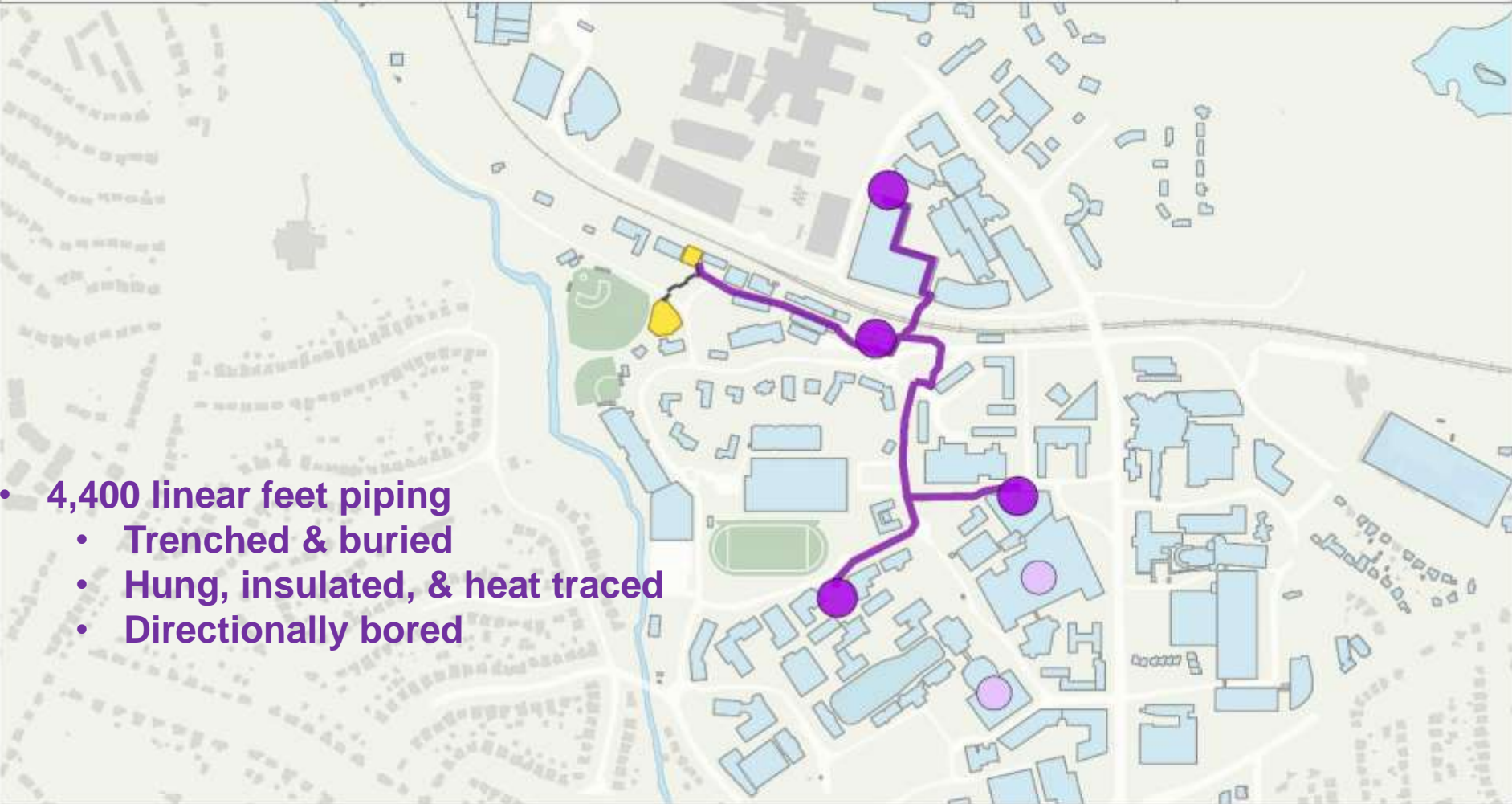
Convergence of Multiple Ecological Treatment Technologies



Historical Cooling Tower Water Use (Michael St and Quad)



Reliable Supply of Reclaimed Water with Proven Results



- 4,400 linear feet piping
 - Trenched & buried
 - Hung, insulated, & heat traced
 - Directionally bored

	Phase 1 Water Displacement		WaterHub
	Future Water Displacement		Emory Buildings
	Reclaimed Water Distribution Piping		Fields
	Connection Piping		Other Buildings
			railroads

Revised 12/15/2014

0 500 1,000 Feet

Scale 1:8,000

Coordinate System: NAD 1983 StatePlane Georgia West FIPS 1002 Feet

Utility features portrayed on this map may not be survey verified.

SUSTAINABLE WATER

Sustainable Water Consultants LLC
Glen Allen, VA



The WaterHub at Emory University

“The WaterHub will shine as a model for other universities, governments, and commercial campuses to replicate. The benefits of this project are not theoretical or abstract. They’re very real, very measurable, and they’re very immediate, leaving no doubt of the direct beneficial impact that sustainable practices can have on our water systems. The WaterHub is emblematic of the kind of leadership this region needs.”

- Douglas Hooker, Executive Director of Atlanta Regional Commission



Showcase Solution for Sustainable Water Management and Leadership

Sustainability 101



Educational Awareness Imperative to Complete Sustainability Messaging

Living, Learning Laboratory



“The WaterHub was vital to our coursework. It is much more than a beautiful facility, it’s an opportunity for students, it’s a tool for them to make those applied connections to their coursework.”

– Gloria Scar, Graduate Student Rollins School of Public Health

Academics

Outreach

WaterHub

Passive Study

Active R&D

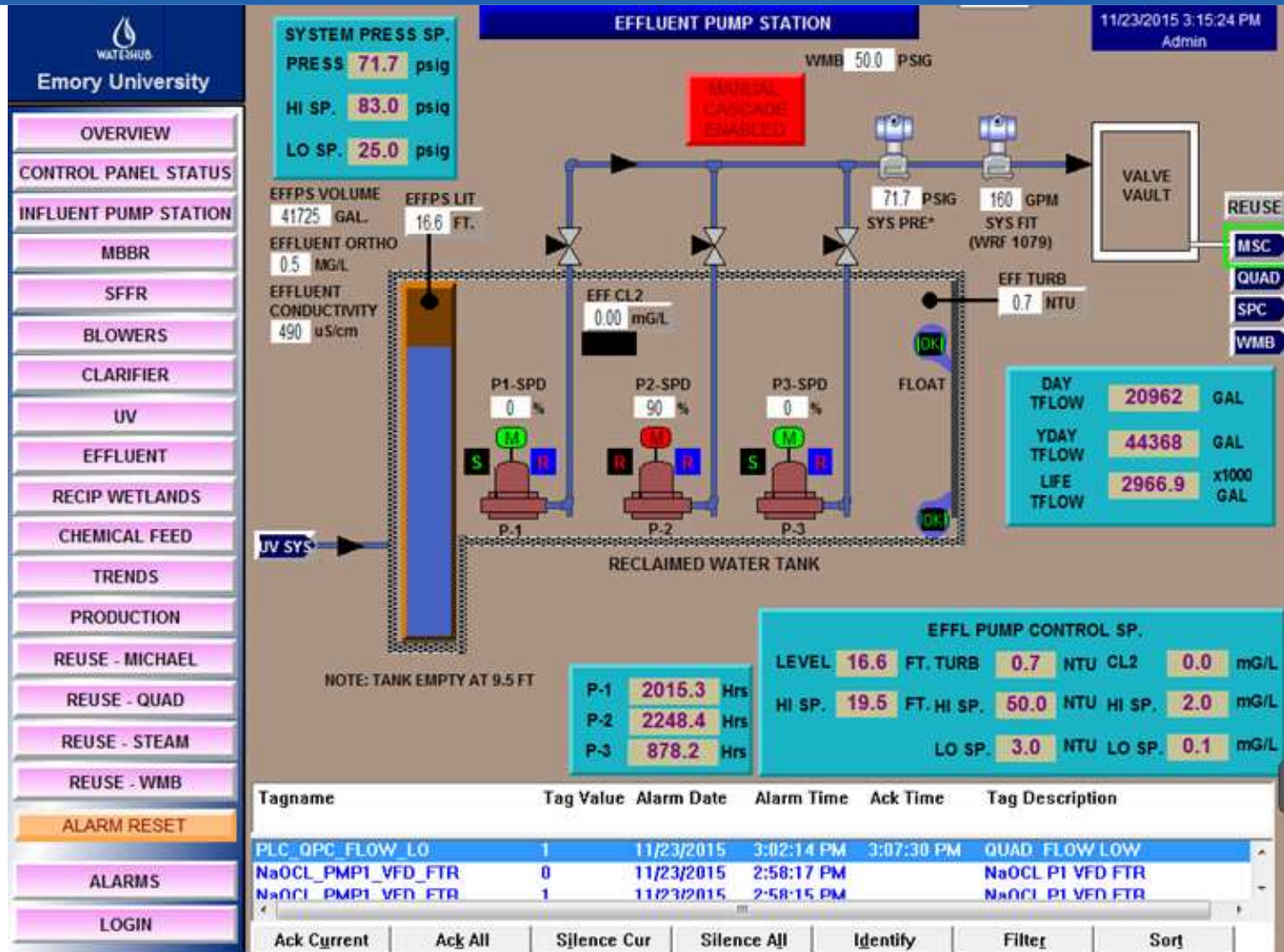


Hands On Learning for Multiple Academic Disciplines

State of the Art Controls

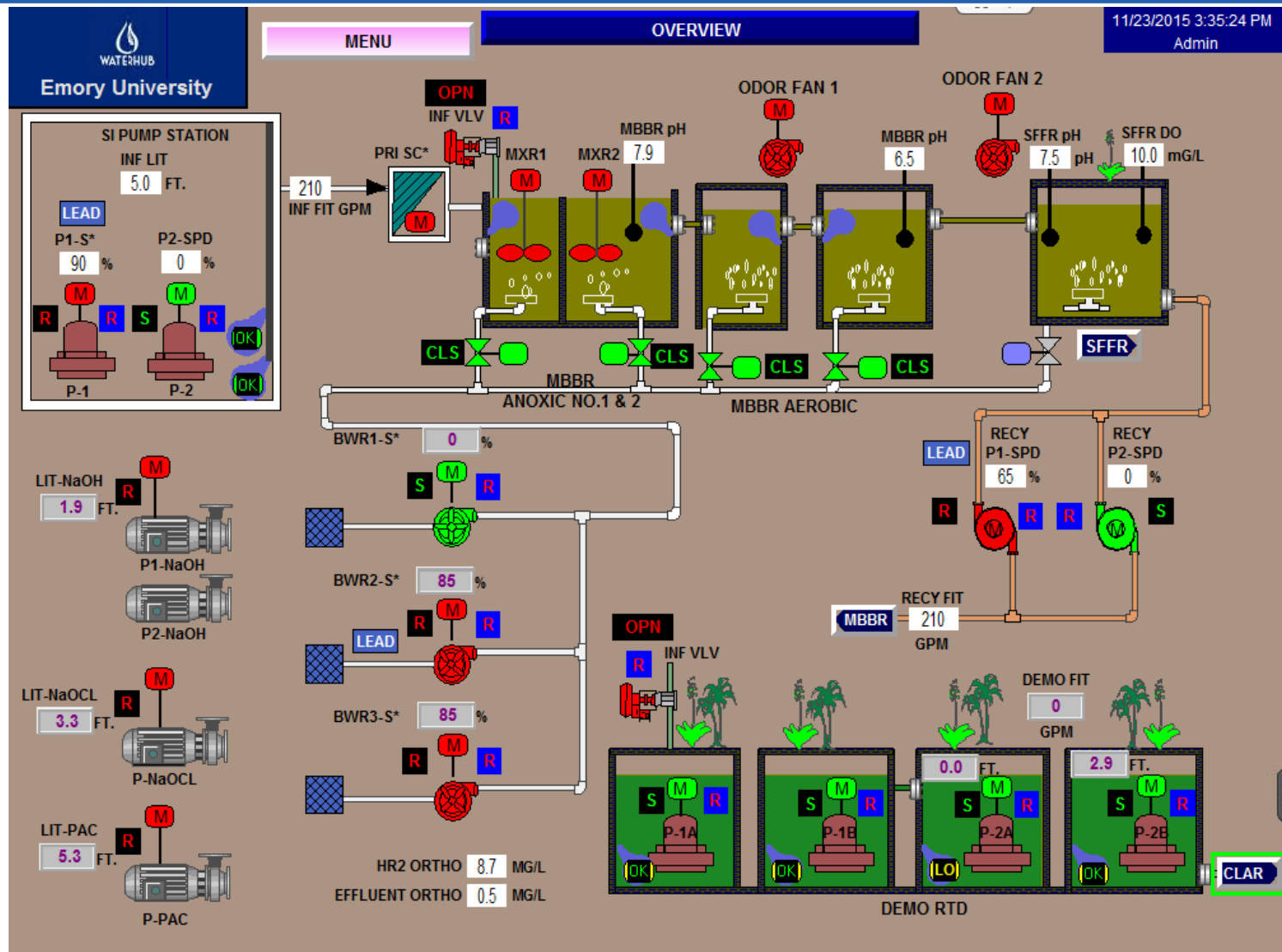


SUSTAINABLE WATER



Real Time Remote Access Allows for Proper Oversight

State of the Art Controls



Real Time Remote Access Allows for Proper Oversight



Water Supply Risks to Campus

“This recent issue could have caused life threatening injuries.”

– John Shelton, CEO DeKalb Medical Center




- 48" Potable Water Main Break
- Severe Loss of Pressure
- CDC & DeKalb Medical Center Shut-down
- 700k residences – 3 day Boil Advisory

WaterHub Maintains Water Supply for Critical Heating & Cooling Needs



EPA Administrator Gina McCarthy Tours Emory University's WaterHub



 **The Administrator**
Washington, D.C. 20460

FEB 27 2015

Ms. Ciannat Howett
Director of Sustainability Initiatives
Emory University
201 Dowman Drive
Atlanta, Georgia 30322


Dear Ms. Howett:

The tour of the WaterHub was a highlight of my recent visit to Emory University, and I want to thank you and your colleagues again for all the hard work you devoted to making it so interesting and informative.

I enjoyed learning more about Emory's commitment to best practices in water stewardship and its conservation. You offered a great overview of the operations there, and everyone I met was so eager to share their knowledge and to answer my questions.

Given the U.S. Environmental Protection Agency's ongoing focus on protecting and improving the quality of America's waters, I was impressed to learn the new facility will make it possible for Emory to save tens of millions of gallons of potable water every year. That is a real achievement.

I applaud Emory's leadership in sustainability and wish you continued success in your exciting initiatives.

Sincerely,

Gina McCarthy

EPA Head Administrator, Gina McCarthy, toured the WaterHub at Emory University in February 2015.

 **Gina McCarthy @GinaEPA** 10m
 .@EmoryUniversity cut water use by ~35% w/new WaterHub, saving the school big on utility costs. A model for us all! pic.twitter.com/FQUVPOJoBt

 **Gina McCarthy @GinaEPA** 12m
 .@EmoryUniversity WaterHub isn't a typical treatment facility. It filters wastewater thru plant roots & microbes clean out organic material.

Federal Validation for an Ecological Solution to Wastewater Management

WaterHub Concepts



Seamless Integration with Diverse Design Options



Ecological Treatment Technology in Place

Marines Corps Recruit Depot, San Diego, CA



San Francisco Public Utilities Commission, CA



Port of Portland, Portland, WA



Wastewater Management Tool Serves as the Centerpiece of the Institutions



EXTENDING THE LIFECYCLE OF WATER.

Nature's Idea. Our Science.

QUESTIONS?

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