

2025 NATIONAL CONFERENCE | SAVANNAH, GEORGIA

# **Exploring AI: High-Level Insights and Innovations from University of Florida's Groundbreaking Efforts**

Michael D. Dukes, Ph.D., P.E.



# What is A.I.?

- Narrow AI– Voice Assistants (e.g. Siri, Alexa), self-driving cars
- General AI– Hypothetical, understand, learn, adapt like humans
- Super AI– Surpasses human intelligence



# ChatGPT(Chat Generative Pretrained Transformer)

- Released Nov. 30, 2022



# ChatGPT(Chat Generative Pretrained Transformer)

- Released Nov. 30, 2022

**AI is Coming for Our Jobs—But It's Also Creating New Ones**



<https://www.wsj.com/tech/ai/the-new-jobs-for-humans-in-the-ai-era-db7d8acd?mod=djemfoe>



# ChatGPT(Chat Generative Pretrained Transformer)

- Released Nov. 30, 2022
- Conversational usage
- Being used to write code
- Some “plausible but nonsensical answers”
- Will commoditize many work functions
- A series of prompts → ½ L of water



# ChatGPT

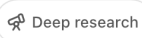
ChatGPT 4o ▾

Temporary



What can I help with?

Ask anything





# ChatGPT...

Make a presentation of how AI can be used in the irrigation industry

That's a great topic! AI is transforming the irrigation industry through smart automation, precision farming, and resource optimization.

Here's a proposed outline for the presentation:

## 1. **Introduction**

- Overview of AI in agriculture
- Importance of irrigation in farming



# Refine...

Refine for the landscape irrigation industry

Great! AI is revolutionizing **landscape irrigation** by optimizing water usage, reducing waste, and ensuring healthier green spaces. Here's a refined outline tailored specifically to the landscape irrigation industry:



# Refine some more...

Would you like me to research recent developments and case studies to provide the latest insights for your slides? Let me know, and I'll start generating the first slides with images and detailed content.



Yes please proceed with the research and slides creation. I need presentation that is 50 min long

Understood! For a **50-minute presentation**, we'll need around **15–20 slides**, each covering key aspects in detail. I will:

1. **Conduct research** to include up-to-date case studies, statistics, and real-world applications.
2. **Find relevant images** for each slide.
3. **Generate slides** with PhD-level content, ensuring depth and clarity.



# Agenda

- 1 Introduction to AI and Its Evolution
- 2 Key Trends Shaping the Future of AI
- 3 AI in Various Industries
- 4 Ethical Considerations in AI Development
- 5 The Role of AI in Society
- 6 Challenges Facing AI Adoption
- 7 Opportunities for Innovation with AI
- 8 The Future Workforce: Humans and AI Collaboration
- 9 Global AI Policies and Regulations
- 10 Case Studies: Successful AI Implementations
- 11 Predictions for AI in the Next Decade
- 12 Conclusion: Embracing the Future of AI



# Introduction to AI in Landscape Irrigation

## Revolutionizing Water Management with AI



### The Role of AI in Irrigation

AI optimizes water usage by analyzing environmental data, reducing waste and improving efficiency.



### Smart Irrigation Systems

AI-powered controllers and sensors automate watering schedules based on real-time data.



### Sustainability and Water Conservation

AI-driven irrigation enhances resource efficiency, mitigating the effects of climate change.



# AI-Powered Soil Moisture Monitoring

## Optimizing Irrigation Through RealTime Data



### RealTime Data Collection

AI-driven sensors analyze soil moisture levels and weather conditions for precise irrigation.



### Optimized Water Usage

Reduces water waste by irrigating only when necessary, improving plant health and conservation.



### Integration with Smart Controllers

AI integrates with irrigation systems to adjust water flow based on predictive analytics.



# AI-Driven Smart Irrigation Controllers

Automating Water Management with AI



## Automated Watering Schedules

AI adjusts irrigation based on weather forecasts, soil moisture, and plant needs.



## Water Conservation & Cost Savings

Reduces water waste and lowers operational costs by optimizing irrigation schedules.



## Remote Monitoring & Control

Users can manage irrigation remotely via mobile apps, ensuring flexibility and efficiency.



# AI's Role in Water Conservation

## Maximizing Efficiency in Irrigation

- **Precision Irrigation** AI ensures the right amount of water is applied at the right time, reducing waste.
- **Leak Detection & Prevention** AI-powered sensors detect leaks early, preventing water loss and damage.
- **Data-Driven Water Usage** AI analyzes usage patterns to optimize water allocation and improve conservation efforts.



Photo by noga fp on Unsplash



# AI in Predictive Analytics for Irrigation

## Enhancing Water Management Through Forecasting

- **Weather-Based Forecasting** AI analyzes historical and real-time weather data to optimize irrigation schedules.
- **Crop & Soil Data Analysis** AI-driven models predict soil moisture and plant water needs for precise irrigation.
- **Proactive Water Management** Prevents water shortages and overuse by anticipating future conditions.



Photo by Methi SOMÇAĞ on Unsplash



# AI in Autonomous Irrigation Systems

## Self-Operating Smart Irrigation

- **Fully Automated Watering** AI enables irrigation systems to function independently based on ~~real~~ <sup>real</sup> data.
- **Self-Learning Algorithms** Machine learning adapts to environmental changes for improved water efficiency.
- **Integration with IoT** AI-driven irrigation works with IoT sensors to enhance decision making and automation.



Photo by noga fp on Unsplash



# IoT and AI Integration in Irrigation

## Smart Sensors and AI-Driven Water Systems



### Connected Sensor Networks

IoT-enabled sensors collect data on soil moisture, temperature, and humidity in real time.



### AI-Powered Decision Making

Machine learning analyzes sensor data to optimize irrigation schedules dynamically.



### Remote Monitoring & Automation

Farmers and landscapers can manage irrigation remotely via AI-driven cloud platforms.



# AI-Powered Drones for Irrigation

## Aerial Monitoring and Precision Watering

- **Aerial Crop Monitoring** AI-driven drones analyze plant health, soil moisture, and irrigation coverage from above.
- **Targeted Water Delivery** Drones equipped with precision watering systems optimize irrigation for specific areas.
- **Data Collection & AI Insights** Drones gather high resolution data to refine irrigation strategies using machine learning.



Photo by Knoell Marketing on Unsplash



# AI's Role in Mitigating Climate Change Effects on Irrigation

## Adapting Water Management to Environmental Challenges



### ClimateResponsive Irrigation

AI adapts irrigation strategies to changing weather patterns and extreme conditions.



### Water Scarcity Solutions

AI optimizes water distribution in drought-prone regions to maximize efficiency.



### Carbon Footprint Reduction

AI-powered irrigation reduces energy and water waste, promoting sustainability.



# Emerging AI Irrigation Startups and Innovations

## Pioneering the Future of Smart Water Management

- **AI-Driven Irrigation Platforms** Startups are developing AI-powered software to optimize water use in real time.
- **Smart Irrigation Hardware** Innovative companies are introducing advanced sensors and autonomous irrigation systems.
- **Sustainable Water Solutions** New AI technologies focus on improving water conservation and climate resilience.



Photo by Methi SOMÇAĞ on Unsplash



# Challenges in AI Adoption for Irrigation

## Barriers to Implementing Smart Water Management

- **High Initial Costs** AI-powered irrigation systems require significant upfront investment, limiting adoption.
- **Technical Complexity** Farmers and landscapers may face challenges in operating and maintaining AI systems.
- **Data Privacy Concerns** The use of AI and IoT in irrigation raises concerns about data security and ownership.



Photo by Nicole Geri on Unsplash



# AI Regulations and Policies in Irrigation

## Governance for Smart Water Management



### Data Protection Laws

Governments are implementing regulations to protect AI-driven irrigation data.



### Sustainability Policies

Regulatory frameworks promote AI adoption for water conservation and efficiency.



### Ethical AI Implementation

Policies ensure AI systems in irrigation are fair, transparent, and accountable.



# Future Trends in AI for Irrigation

## Advancing Smart Water Management



### AI-Powered Sustainability

Future AI models will enhance precision irrigation, reducing water waste globally.



### Advanced Machine Learning

Next-generation AI will self-optimize, learning from environmental patterns and usage trends.



### Integration with Renewable Energy

AI-driven irrigation will increasingly be powered by solar and other renewable sources.



# Conclusion: AI's LongTerm Impact on Irrigation

## Transforming Water Management for a Sustainable Future

- **Revolutionizing Efficiency** AI-driven irrigation optimizes water usage, minimizing waste and maximizing productivity.
- **Sustainable Water Management** AI enables smarter resource allocation, crucial for combating water scarcity.
- **Ongoing Innovation** The future will bring even more advanced AI solutions for precision irrigation.



Photo by Methi SOMÇAĞ on Unsplash



# Case Study: AI-Driven Irrigation in California Vineyards

## Maximizing Efficiency in Agricultural Water Management

- **Precision Irrigation** AI sensors optimized water distribution, reducing usage by 25%.
- **Machine Learning Forecasting** AI analyzed weather patterns to prevent overwatering and crop stress.
- **Economic & Environmental Benefits** Farmers saved on water costs while improving grape yield and quality.



Photo by Methi SOMÇAĞ on Unsplash



# Global AI Irrigation Adoption

## Regional Trends in Smart Water Management



### North America

AI-driven irrigation is growing rapidly, especially in drought-prone regions like California and Texas.



### Europe

EU policies promote AI irrigation for sustainable agriculture and water conservation.



### Asia & Emerging Markets

Countries like India and China are investing in AI to optimize water use in large-scale farming.



# Economic Impact of AI in Irrigation

## Cost Savings and Efficiency Gains

- **Reduced Water Waste** AI optimizes water use, cutting waste by up to 30%, reducing costs for farmers and businesses.
- **Increased Crop Yields** Precision irrigation leads to healthier plants, improving agricultural output and profitability.
- **Lower Operational Costs** Automation reduces labor costs and energy consumption, improving overall efficiency.



Photo by philip junior mail on Unsplash



# AI Adoption in Public vs. Private Sector Irrigation

Comparing Government and Commercial Applications



## Government-Led Initiatives

Public sector investments focus on large-scale water conservation and policy-driven AI adoption.



## Private Sector Innovation

Businesses and farms adopt AI for cost savings, efficiency, and competitive advantage.



## Collaboration & Partnerships

Public-private partnerships accelerate AI adoption in sustainable irrigation projects.



# Emerging AI Technologies in Irrigation

## Next-Gen Innovations in Smart Water Management

- **AI-Integrated Drones** Advanced drones with AI analyze crop health and optimize precision irrigation.
- **Self-Learning Irrigation Systems** Machine learning models adapt to environmental changes, improving efficiency.
- **AI-Powered Soil Sensors** Next-gen sensors provide real time soil health insights for optimal watering.



Photo by Methi SOMÇAĞ on Unsplash



# AI's Role in Water Sustainability

## Smart Irrigation for Conservation and Efficiency

- **Optimizing Water Use** AI-driven irrigation systems minimize waste and ensure sustainable water distribution.
- **Reducing Environmental Impact** AI helps mitigate over extraction of water resources, preserving ecosystems.
- **Long-Term Conservation Strategies** AI models predict future water needs, improving long-term resource planning.



Photo by Methi SOMÇAĞ on Unsplash



# University of Florida AI Investment

**#1**

---

## **Supercomputer**

HiPerGator is the most powerful university-owned and operated supercomputer in the nation

**230+**

---

## **AI-Related Courses**

Across the curriculum and in every college

**1**

---

## **AI Fundamentals Certificate**

University-wide and open to all students, regardless of major



UF's AI Vision: Becoming a global leader in AI research and applications.



```
graph TD; A[UF's AI Vision: Becoming a global leader in AI research and applications.] --> B["$100M AI Initiative with HiPerGator AI supercomputer."]; B --> C["AI integrated across disciplines: agriculture, engineering, medicine."];
```

\$100M AI Initiative with HiPerGator AI supercomputer.

AI integrated across disciplines: agriculture, engineering, medicine.



# UF/IFAS AI Investment in Agriculture

Mission: Leverage AI  
for agricultural  
productivity and  
sustainability.

16+ AI faculty hires  
in precision ag,  
robotics, phenomics,  
plant breeding.

AI Workforce  
Development:  
Integrated into UF's  
curriculum.

<https://ifas.ufl.edu/artificial-intelligence/meet-the-experts/>



# Key AI Research Areas in Agriculture

1. Precision Agriculture & Robotics



2. Computer Vision & Machine Learning



3. Digital Twins & Synthetic Data



4. AI in Controlled Environment Agriculture  
(CEA)



# UF/IFAS AI in Action – Example Projects



Autonomous Field Operations



AI for Disease Detection and  
Prediction



AI-Driven Plant Breeding



AI-Powered Animal Agriculture



# Using artificial intelligence to detect plant diseases

## Strawberry Diagnosis

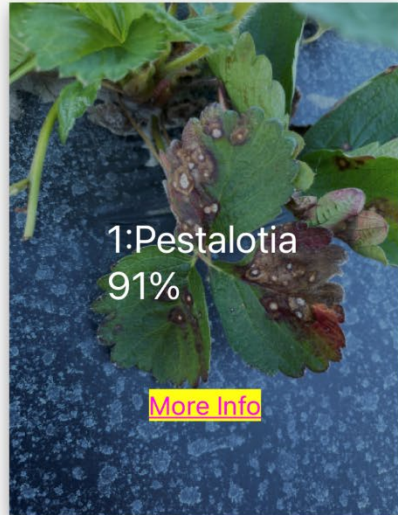
Welcome, fredflint



Submit

Clear

About



AA Not Secure — sgreatagain.com



## Strawberry Diagnosis

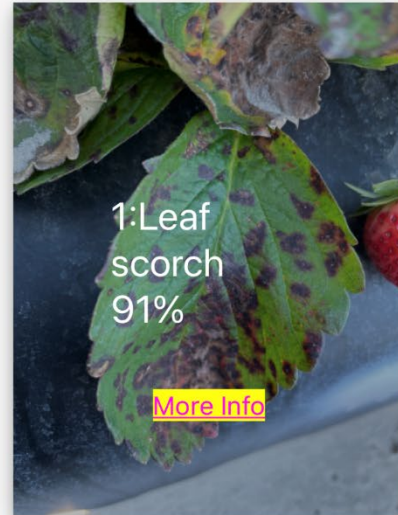
Welcome, fredflint



Submit

Clear

About



AA Not Secure — sgreatagain.com



Arnold Schumann



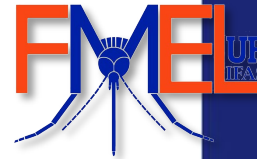
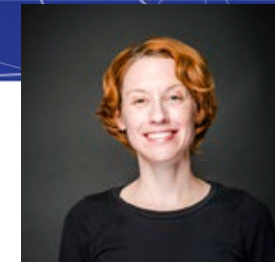
Natalia Peres



Marcus Marin



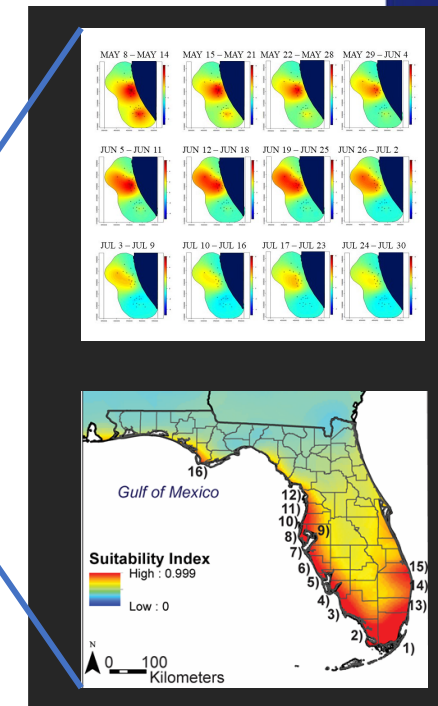
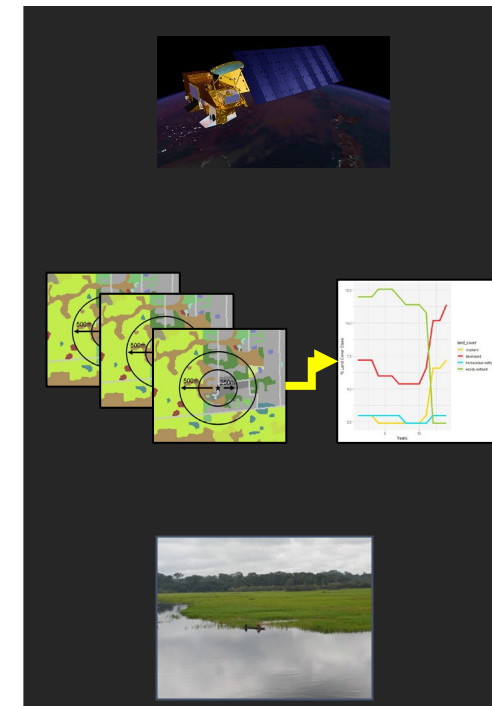
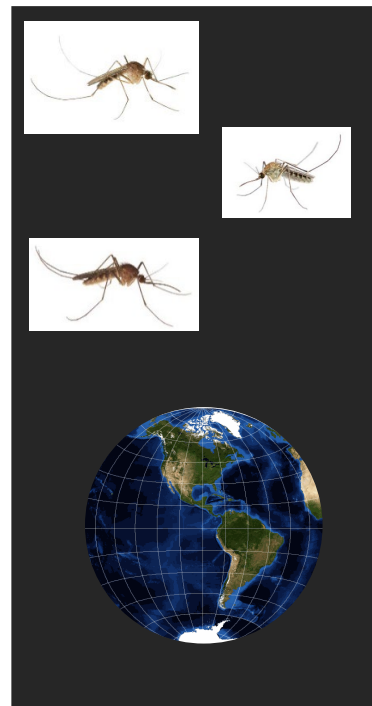
# Lindsay Campbell, Assistant Professor



Research: Modeling environmental correlations with vector borne disease systems to inform prevention and control

## Examples:

- Spatiotemporal ecology of Florida sentinel chicken program
- Predicting potential distribution of invasive *Aedes scapularis*
- LiDAR applications for precision larval control
- Spatiotemporal ecology of mosquito abundances





**Jeongim Kim, (jkim6@ufl.edu) (hos.ifas.ufl.edu/kimlab)**

Assistant Professor of Horticultural Sciences

Plant biochemist



UF

- Plant natural products (anthocyanins, flavonols, and auxins)
- Control of plant growth and defense through metabolic engineering
- Identification of regulatory networks using multi-omics approaches



## AI-related research interest

- AI-LIFT: Genetic Control of Plant Architecture using AI (Haipeng Yu, Thomas Colquhoun, Kevin Wang)
- Prediction of metabolic pathways, regulation networks, protein structures
- Protein engineering
- Prediction of plant health through monitoring metabolite changes

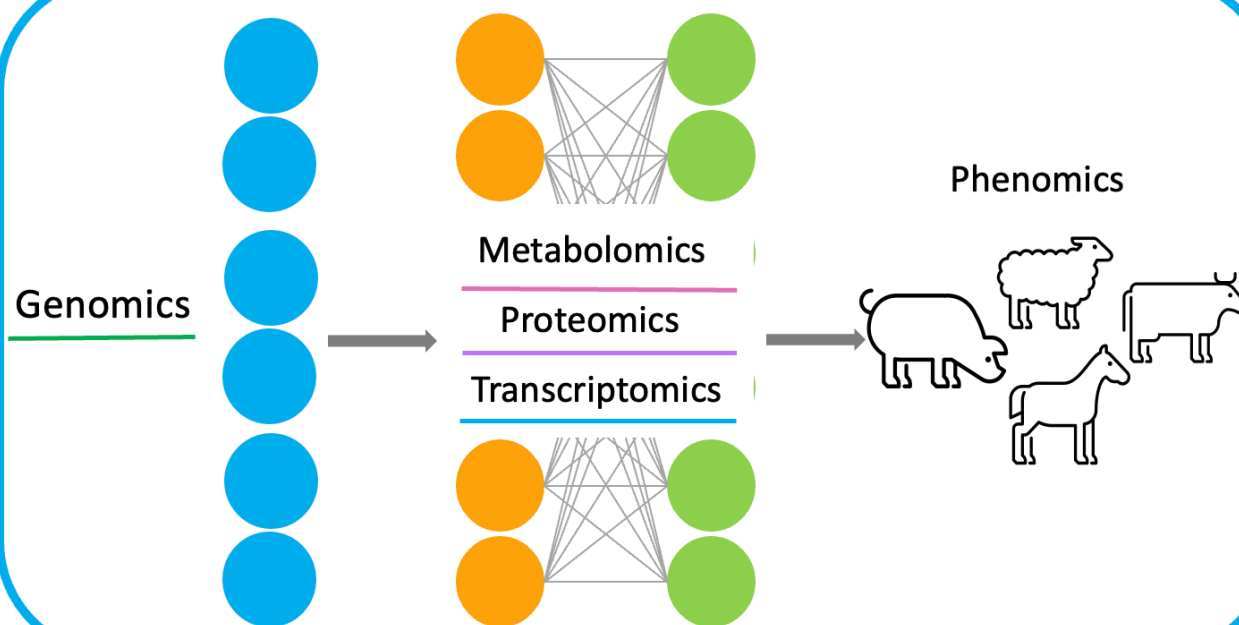


**Research:** Optimizing livestock farming systems using artificial intelligence to improve animal health and welfare

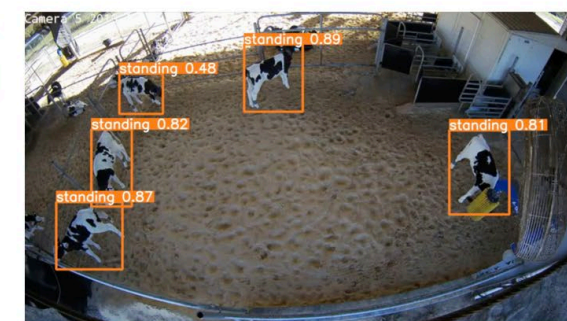
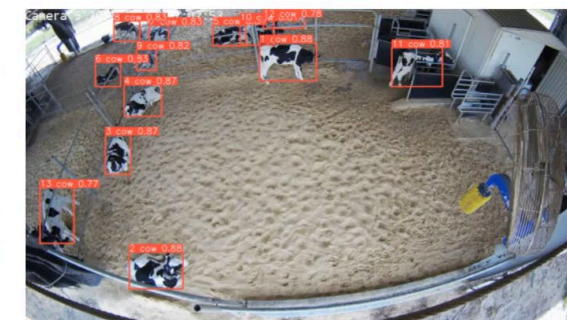
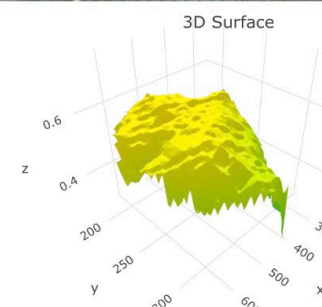
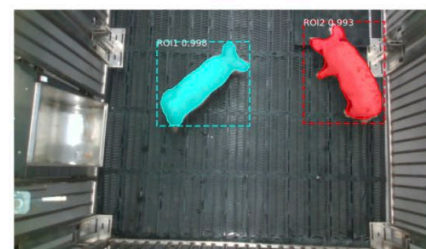


## Examples:

### Integration of High-dimensional Heterogeneous Omics Data



### Computer Vision for Precision Livestock Farming



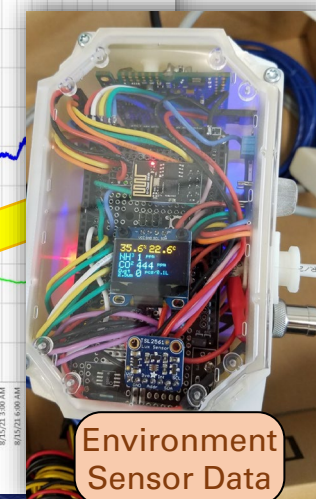
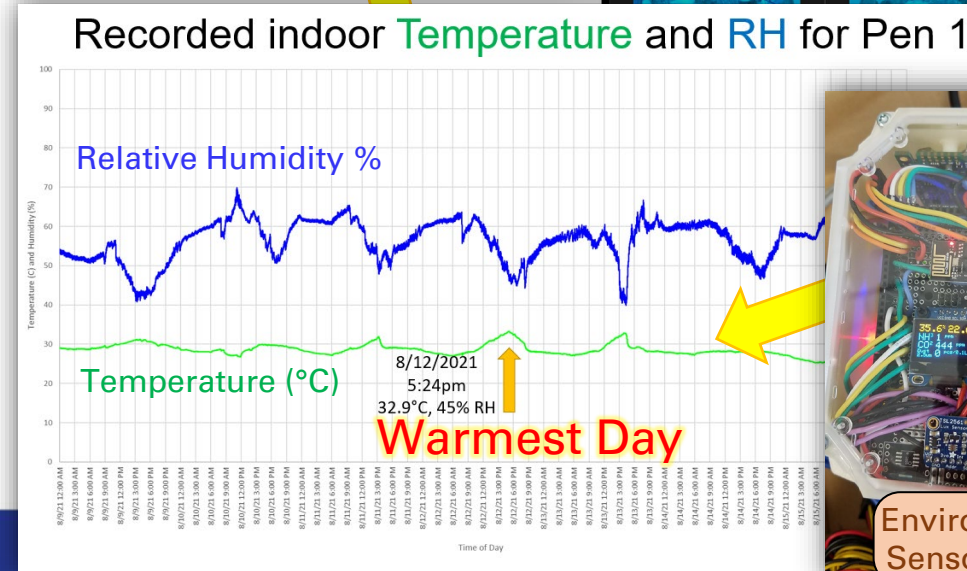
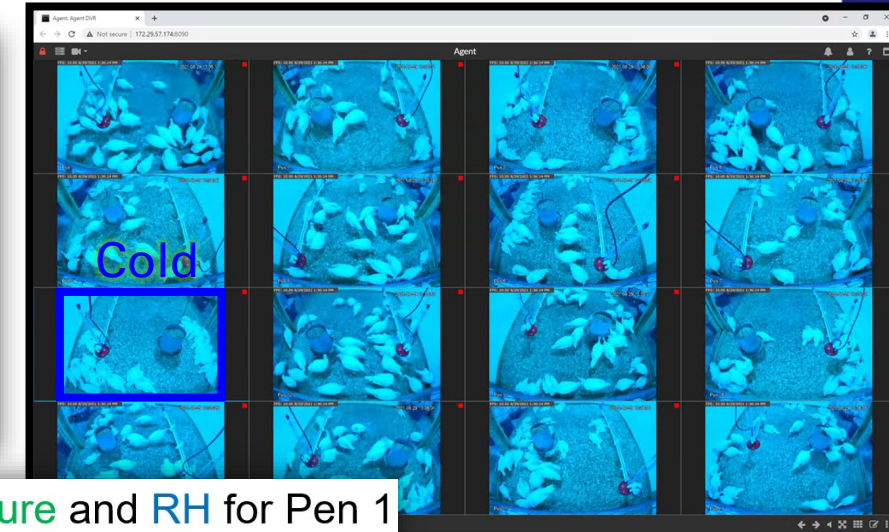


# Dan Hofstetter, ABE

**Research:** Information technology, sensors, and control systems applied to plant and animal facilities



- **Project:** AI-based animal behavior analysis using computer vision and environmental sensors
  - **Co-PI:** Henry Medeiros, ABE
- **Tools:** AI, computer vision, indoor/outdoor sensors and controls, weather forecast data
- **Purpose:** detect stress/injury, autonomous control over indoor environment for optimal conditions, sustainable production
- **Outputs:** Improved ag facility construction or ventilation methods in challenging climates like Florida





# Challenges in AI Adoption for Agriculture

Technical: AI models for variable farm environments, data scarcity.

Economic: High costs of AI adoption, need for incentives.

Social: Training agricultural workforce, equitable AI access.



# Center for Applied Artificial Intelligence

Need-based Research Process

**Ag Industry**



**UF** | UNIVERSITY of  
**FLORIDA**

Grower Focused Research Priorities

Grower Input on Tech Design

Grower Evaluation of Novel Technologies

Grower Selection of Desirable Attributes

Grower Adoption



# CAAI - Farming for the Future Program

- Bridge AI development with realworld agricultural applications.
- Industry Collaboration: AI startups & corporations.
- Field Testing: AIdriven autonomous systems for FL Ag Industries such as strawberries, tomatoes, watermelon.
- Ground breaking— 2025 FL Ag Expo
- Completion of the bldg- 2027



# The Future of AI at UF/IFAS



**Autonomous Robotics & Smart Equipment:** Design next-gen AI-driven harvesters, weed control bots, and smart irrigation systems.



**Expansion of AI Infrastructure:** Develop a fully automated research farm at GCREC to test AI driven precision agriculture and robotics.



**Next-Generation AI-Biotechnology Integration:** CRISPR & synthetic biology powered by AI to improve **crop resistance, yield, and nutrition.**



**Enhancing Workforce Development:** AI training programs for farmers, students, and extension agents.



**Industry Partnerships:** Align AI research with real-world agricultural challenges by actively engaging farmers in shaping research priorities, AI-Ag startup incubator



# Agroview



## **From problem to on-farm solution: The journey of one UF/IFAS AI technology**

Hurricane Irma served as a turning point for UF's Yiannis Ampatzidis, highlighting the urgent need to find innovative solutions to address challenges in agriculture.

## **AGROVIEW** **THE MOST ACCURATE PERENNIAL CROP INVENTORY PLATFORM**



**Agroview is a turn-key solution that is transforming perennial crop agriculture with proven deep learning systems that provide best-in-class data analytics, including:**

- ✓ Tree Counts
- ✓ Missing Tree Count ("Gaps")
- ✓ Revenue Recovery/Replant Maps
- ✓ Height
- ✓ Canopy Size
- ✓ Leaf Density Index (Per Tree NDVI)
- ✓ NPK Nutrient Analysis
- ✓ Full Block Nutrient Report



# Extension Bot



[NEWS](#) [ABOUT](#) [MEMBER SERVICES](#) [NATIONAL PROGRAMS AND SERVICES](#) [TOOLS](#) [PUBLICATIONS](#) [CONTACT](#)

## ExtensionBot



## How can I help?

### Lawn and Garden

What is the best fertilizer to use on my lawn?

### Local Extension Office

How do I contact my local extension office?

### Crop Management

What are some effective ways to manage my crops?

### Pest Management

I use *Bacillus thuringiensis* and spinosad together in a non-chemical form?

Type your question...



[Terms of Use](#) [Privacy policy](#) [About](#)



+ New Chat

Copy Chat

Hi! My name is ExtensionBot. I can help you with your extension-related questions. I am still under development so my responses might not always be reliable. What can I help you with today?

What is the best fertilizer to use on my lawn?

Choosing the best fertilizer for your lawn depends on several factors, including your lawn's needs and soil conditions. Most commercial lawn fertilizers will effectively nourish your grass. Look for a fertilizer with a balanced ratio of nitrogen, phosphorus, and potassium, usually represented as three numbers on the package. A common recommendation is a fertilizer with a 3:1:2 ratio, such as 15-5-10, or other similar analyses like 16-4-8 or 12-4-8 [1, 3].

It is also beneficial that about one-third to one-half of the nitrogen in the fertilizer is slow-release to provide extended feeding [1, 3]. Ensure that you apply the fertilizer after mowing to allow the granules to penetrate the soil effectively. Applying it evenly with a drop spreader can help avoid burning the grass [1, 3, 4].

Before fertilizing, consider your specific goals:

1. Do you want a lush, green lawn that requires intensive maintenance?
2. Are you looking for a maintenance-friendly lawn?
3. Is it primarily for erosion control?

Understanding your objectives will guide you in selecting the appropriate fertilizer [2]. If you have further specific conditions or regional needs in mind, please share!

Learn More: 1. [www.lsuagcenter.com](http://www.lsuagcenter.com), 2. [www.udel.edu](http://www.udel.edu), 3. [www.lsuagcenter.com](http://www.lsuagcenter.com), 4. [www.lsuagcenter.com](http://www.lsuagcenter.com)

Type your question...





What is the best fertilizer to use on my lawn in Florida?

For your lawn in Florida, the best fertilizer is typically one that contains a high proportion of slow-release nitrogen and low or no phosphorus. A suitable analysis to look for would be in the range of 16-0-8 or similar formulations [1, 4]. Make sure it is labeled for urban turf and compliant with local regulations due to restrictions that may exist during the rainy season [5, 6].

Florida lawns often benefit from a schedule of multiple applications throughout the year, with recommendations generally being around 1 pound of nitrogen per 1,000 square feet per application [1, 2]. It's important to avoid over-fertilizing, as this can lead to environmental runoff issues. Following the label instructions is crucial to achieving the best results while protecting local waterways [5, 6].

If your lawn has specific needs or if there have been signs of nutrient deficiencies, consider conducting a soil test to tailor the fertilization to your lawn's requirements [3]. If you have more detailed preferences or conditions for your lawn, please let me know!

**Learn More:** 1. edis.ifas.ufl.edu , 2. edis.ifas.ufl.edu , 3. edis.ifas.ufl.edu , 4. blogs.ifas.ufl.edu , 5. edis.ifas.ufl.edu , 6. blogs.ifas.ufl.edu

What are some signs of nutrient deficiencies in my lawn?

Type your question...



[Terms of Use](#) [Privacy policy](#) [About](#)



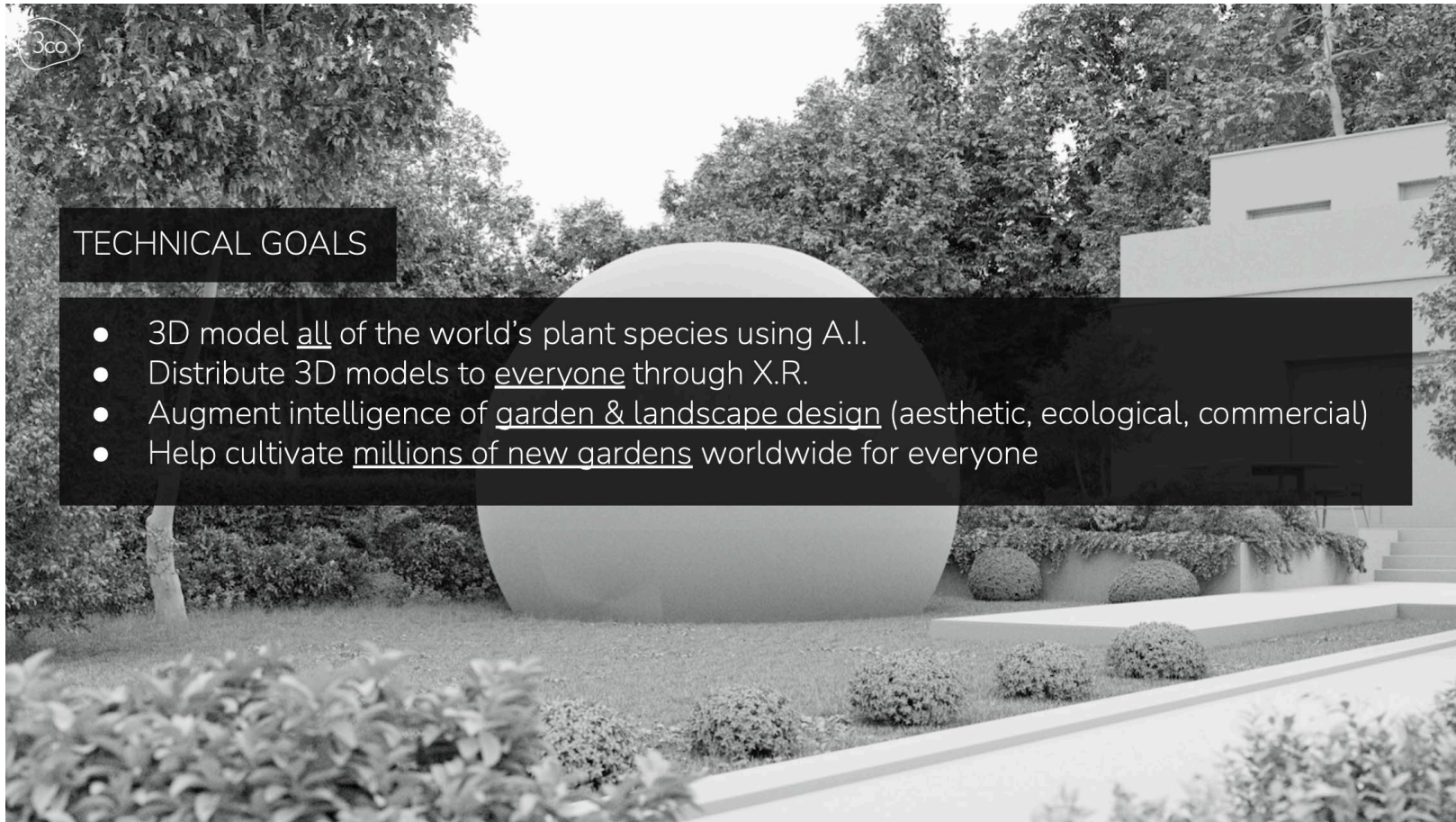


# Intelligent Cultivation of Urban Ecosystems:

## *A.I. + X. R. for Gardens Workshop*

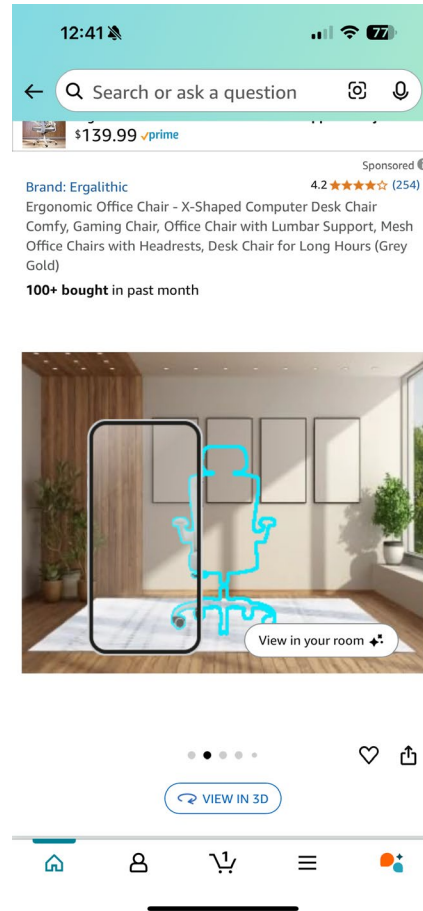


# AI Landscape Design Goals





# How Does This Look in Your Room?





# AI Based Landscape Design

## Sponsored



Neighborbrite

<https://www.neighborbrite.com>

### Neighborbrite - Free Ai Landscape Design

Explore a Variety of Garden Styles and Customize the Details to Match Your Vision.

#### People also search for

[ai landscape generator from photo](#)

[free ai landscape generator from photo](#)

[ai landscape design free reddit](#)

[free online landscape design tool](#)

[ai landscape design app](#)

[best ai landscape generator free](#)

[best ai landscape design](#)

[free landscape design app](#)

## Sponsored



ShrubHub

<https://www.shrubhub.com>

### ShrubHub 3D Landscape

30 Day Money Back Guarantee — Trusted by Homeowners Everywhere. ShrubHub Experts Are Waiting to Build Your Dream Yard! Professional 3D Designs, 1-on-1 Expert Consultations, Custom Shopping Lists, and...

[How It Works](#) · [Design Packages](#) · [Design Service](#) · [Contact Us](#) · [About Us](#) · [Design Portfolio](#)

## Sponsored



HomeDesignsAI

<https://www.homedesigns.ai> · [landscape-ai](#)

### Redesign Landscapes with AI

HomeDesignsAI for **Landscape** — Instant **Landscape** with **ai**. Generate new **landscape** designs in less then 30 seconds.



Neighborbrite

<https://neighborbrite.com>

### Neighborbrite - Free Ai Landscape Design

**AI-powered inspiration for your yard.** Just tap the area to landscape and get design inspiration!



# Select Property...

Your yard image

OPTION 1

Upload image

Upload image

By uploading an image, you agree to our [Terms of Use](#) and [Privacy Policy](#).

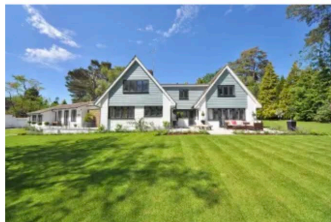
OPTION 2

Use an address

 To pull photo from Street View

OPTION 3

Use sample image



Use sample image



# Select Areas...

Tag yard



Next >

① Tap the areas of the yard to re-imagine

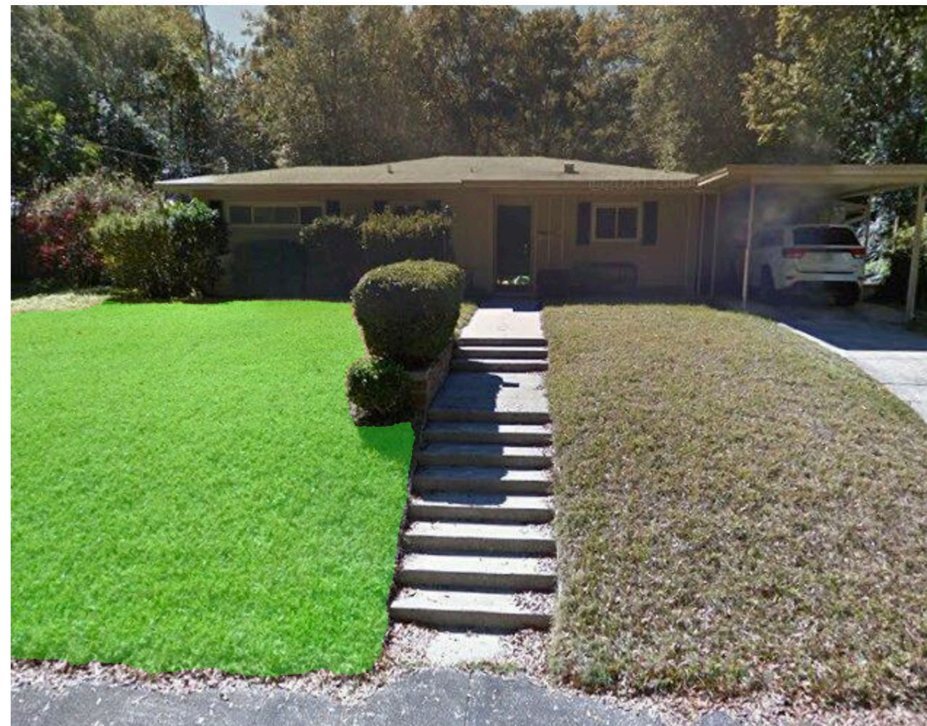


Tag yard



Next >

① Tap the areas of the yard to re-imagine





# Identify Plants...

Select plants



Next >

i Tap to select plants to identify



Unlock Pro Features to Bring  
Your Vision to Life

This feature is available exclusively for Pro and Business subscribers. Upgrade now to access advanced tools and customization options.



PRO

For homeowners and DIYers who want advanced customization.

**\$14.99/mo**

- ✓ Everything in Starter Plan
- ✓ Unlimited design creations
- ✓ Customize style using text
- ✓ Unlimited plant lists
- ✓ 50+ landscape elements to choose from
- ✓ Choose exact location and size of elements
- ✓ Add elements using free form text
- ✓ Personal use license

Subscribe

Cancel anytime

We'll remind you 3 days before your subscription renews

BUSINESS

For businesses needing commercial use with no watermarks.

**\$29.99/mo**

- ✓ Everything in Pro Plan
- ✓ Personal & Commercial use license
- ✓ Remove Neighborbrite watermark
- ✓ Optional "Virtually Enhanced" label

Subscribe

Cancel anytime

We'll remind you 3 days before your subscription renews



# AI Based Irrigation Design Tool

## Sponsored



Vectorworks

<https://www.vectorworks.net>

### Irrigation Layout Software | CAD With AI Image Generation

See why Vectorworks is a highly rated **design software** used by professionals just like you.

Why AutoCAD® users and more are moving...

#### AI Visualizer

Combine the strength of Vectorworks with the speed of AI image creation

#### Buy Vectorworks Now

Flexible pricing options for all of your design needs

## Sponsored



rainbird

<https://www.rainbird.com>

### Rain Bird Irrigation Tools | Optimize Your Watering

Efficient, targeted and cost-effective **watering tools** for every landscape with Rain Bird.

## Sponsored



Irrigreen

<https://www.irrigreen.com>

### Design Your System - Irrigreen Design Tool

DIY **irrigation** made smarter. Experience the next level of **watering** technology. Learn more. Say goodbye to overwatering & overpaying. Embrace precision with smart **irrigation**. See how. Digital Map Of Your Lawn. Smart **Sprinkler System**.

[Get a Quote](#) · [Simplifying Irrigation](#) · [Customer Review](#) · [Saving Water](#) · [Product](#) · [Pros](#)





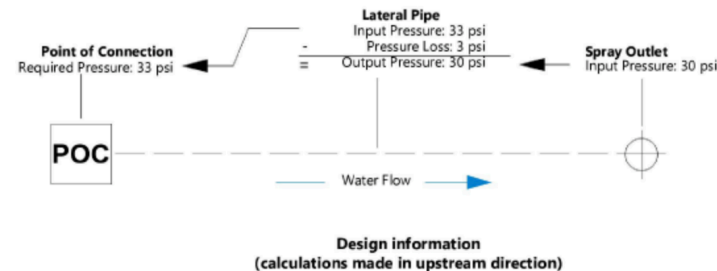
# AI Based Irrigation Design?

## Concept: Design and calculation parameters for irrigation

The Vectorworks program provides two sets of information for most irrigation objects: design information and calculated information. Design information tells you which values are required for the system to function as designed, while calculated information estimates what values can be expected based on the system's real-world point of connection (POC) water source. Design information can be thought of as what is needed, while calculated information can be thought of as what will be provided.

Design information tells you what the ideal pressure, flow rate, and other values are for a component. The calculations start with the system's outlets and the values that are necessary for them to operate as designed. Moving upstream, values are calculated for each component, ending with the point of connection.

The following example shows a simplified irrigation system and demonstrates how the pressure is determined for design information. The first known value is the outlet's input pressure. For the outlet to operate with the designed radius and arc, the input pressure must be 30 psi, based on the performance data associated with the selected outlet. The outlet is fed by the pipe, so the pipe must therefore have an output pressure of 30 psi. Since the pipe has a pressure loss value of 3 psi, its input pressure must be 33 psi. Lastly, the point of connection feeds the pipe, so it has a required pressure of 33 psi.



### In this Topic

- Irrigation
- Workflow: Irrigation design
- Landscape architects and designers
- Landscaping and irrigation design professionals
- Concept: Design and calculation parameters for irrigation



# AI-Powered Design Optimization

- **Automated System Layouts:** AI can generate optimized irrigation layouts based on terrain, crop type, and water availability.
- **Pipe Sizing & Pressure Calculations** AI tools can instantly calculate optimal pipe sizes and pressure zones, ensuring uniform water distribution.
- **Smart Zoning:** AI can create dynamic irrigation zones that adjust to soil moisture levels and plant needs.



# What products in this image are commercially available?

What products in this image are commercially available?

Several products depicted in the image are commercially available, integrating AI and advanced technologies to enhance irrigation and agricultural practices:

## 1. Automated Sprinkler Systems with AI Integration:

- **Aiper's IrriSense Smart Irrigation Sprinkler:** This device allows users to customize spray patterns and schedules via a mobile app, adjusting based on weather conditions and soil moisture to prevent overwatering. [theverge.com](https://theverge.com)

## 2. Soil Moisture Sensors:

- **Nano Ganesh:** An irrigation automation system enabling farmers to remotely control water pumps using mobile phones, effectively managing water usage based on soil moisture levels. [en.wikipedia.org](https://en.wikipedia.org)

## 3. Drones for Plant Health Monitoring:

- **Gamaya:** Offers drones equipped with hyperspectral cameras to monitor crop health, detect diseases, and optimize soil treatment and fertilization. [en.wikipedia.org](https://en.wikipedia.org)

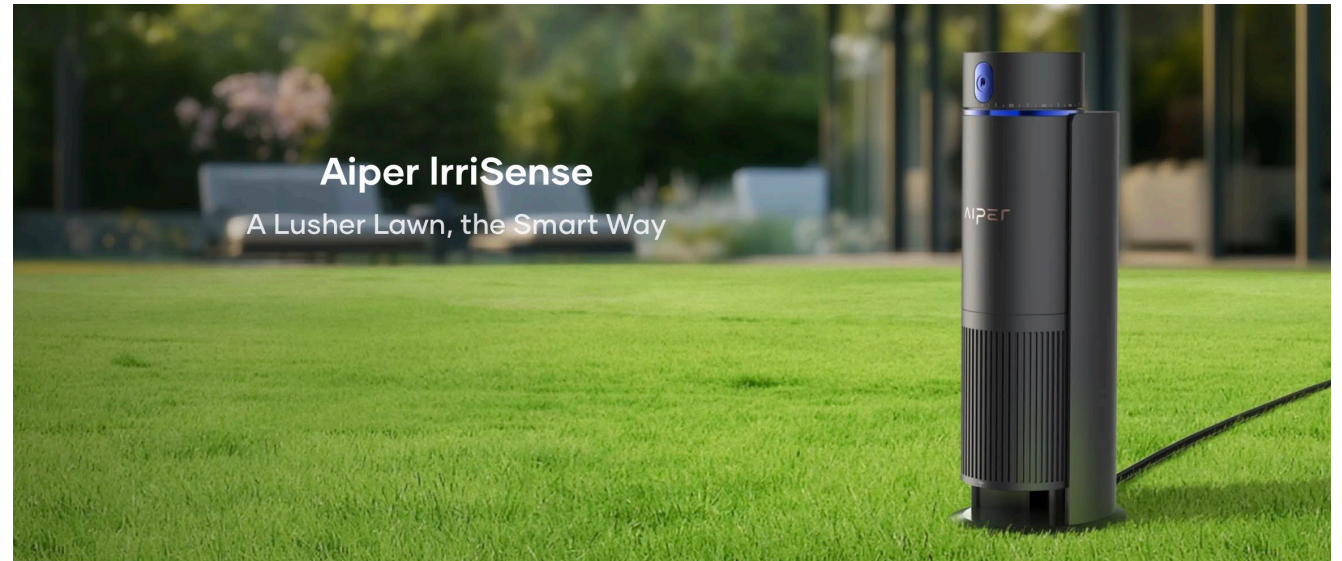
## 4. Central AI Control Systems:

- **Solinftec's Solix Ag Robotics:** An autonomous robot that analyzes plant health, assesses nutritional content, detects weeds, and monitors field ecosystems, providing real-time data to farmers. [en.wikipedia.org](https://en.wikipedia.org)

These technologies collectively contribute to precision agriculture by utilizing AI to optimize irrigation, monitor crop health, and enhance overall farming efficiency.



# Aiper's IrriSense Smart Sprinkler



## Worry Less with the Aiper IrriSense

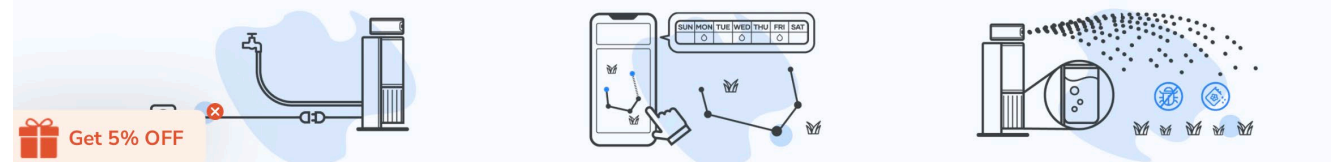
Revolutionizing Lawn Care With Intelligent,  
Water-Efficient Irrigation Solutions

**40%**  
Less Water Usage

**80%**  
Less Maintenance  
Needed

**95%**  
Less Piping


## The Easiest **Sprinkler** Set-up







# Nano Ganesh Automated Irrigation


[Home](#) [About Us](#) [Our Product](#) [Product Support](#) [View Our Video](#) [Our News](#) [Any Query?](#) [Contact Us](#)


 [Related Search . . .](#)


[Welcome To Our Website . . .](#)


 [Nano Ganesh Awards](#)

 [Nano Ganesh Articles](#)

 [Across The Web](#)


 [Photo Gallery](#)

 [View Our Video](#)

 [Special Cases](#)

New Products

- Nano Ganesh GSM
- Nano Ganesh M2M
- Nano Ganesh CM




Launching the **Real Digital Dream** of **Indian Farmers...!**

A **Low cost-easy to use** Mobile Remote Control  
for Water Pumps

**NANO GANESH - CM**

Available at  
**amazon**

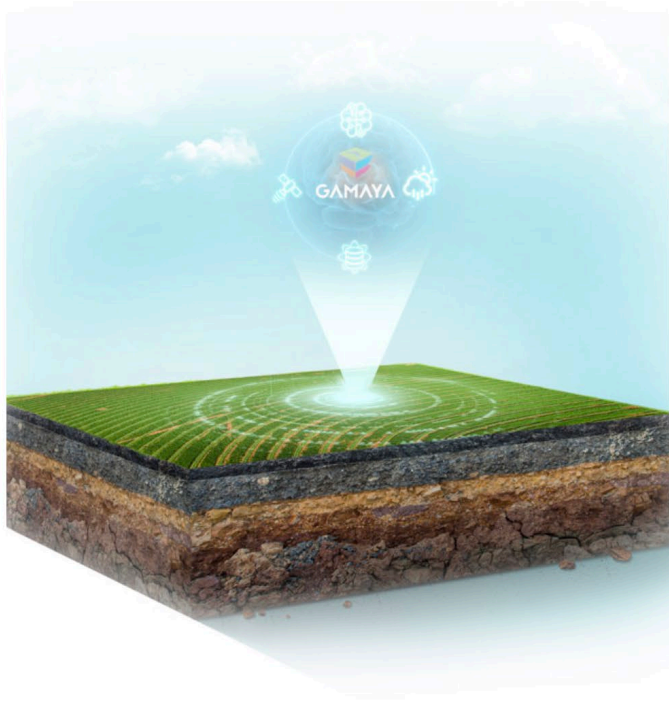
 **BUY NOW**

" Nano Ganesh "- A revolutionary electronic device manufactured by Ossian Agro Automation, a company working in the field of rural automation, since last 15 years.

Ossian Agro Automation has developed various types wireless automation systems for the rural areas especially for irrigation purpose. By using Ossian's devices, one can save enormous amount of electricity, water, fuel, time and labor. This helps world to conserve the valuable stocks of energy.



# GamayaDrones in Agriculture

[Home](#)[About Us](#)[Our Technology](#) ▾[Blog](#)[Contact](#)[Login](#)

## Remote Sensing

We collect and analyze all sorts of imagery – from simple RGB to advanced hyperspectral imaging – in order to provide assessments and recommendations related to things like crop health, nutrient levels, and presence of weeds and invasive species. This information becomes the basis for our predictive analytics models.



## Crop Modeling

Our crop-specific models are based on the multiple years of sugarcane research and experience by the Gamaya team and our partners. Tested in the various environments and situations, our crop models enhance data-science based approaches in order to reach the highest levels of precision and accuracy.



## Artificial Intelligence

Our AI model stands out for its unique approach to crop prediction and management. Unlike other models that rely solely on satellite imagery, our model takes into account a diverse range of agronomic data such as soil type, crop varieties, and agronomic cycles.



# Solinftec's Solix Ag. Robotics



Solutions

Sustainability

Solix

Governance

About Us

Contact



- Complete agronomic field analysis;
- Early-stage weed control;
- Up to 95% reduction in herbicide application;
- Reduced soil compaction and carbon footprint;
- Potential productivity increase;
- Autonomous and sustainable, powered by solar energy;
- Low-impact, high-productivity agriculture.



# What AI products are available for landscape irrigation?

You're giving feedback on a new version of ChatGPT.

Which response do you prefer? Responses may take a moment to load.



## Response 1

Artificial intelligence (AI) is increasingly being integrated into landscape irrigation to enhance efficiency and sustainability. Here are some AI-driven products available in this field:

### Aiper IrriSense Smart Irrigation Sprinkler

This smart sprinkler allows users to customize spray patterns and schedules via a mobile app, adjusting based on weather conditions and soil moisture to prevent overwatering. [theverge.com](https://theverge.com)



### ETwater Smart Irrigation System

Acquired by Husqvarna Group, ETwater offers AI-powered solutions that analyze weather forecasts and plant types to optimize watering schedules, promoting water conservation. [en.wikipedia.org](https://en.wikipedia.org)



### Plantaform Fogponics System

Utilizing NASA-inspired fogponics technology, this system employs AI to monitor plant conditions, delivering nutrient-rich mist to optimize growth while conserving water. [thetimes.co.uk](https://thetimes.co.uk)



## Response 2

Several AI-powered products are available for **landscape irrigation**, helping improve water efficiency and automate irrigation processes. Here are some notable options:

### 1. Smart Irrigation Controllers with AI

- **Rachio 3** – Uses AI and real-time weather data to adjust watering schedules automatically.
- **RainMachine** – AI-powered controller that integrates with weather forecasts and sensors to optimize water use.
- **Hydrawise by Hunter** – Smart irrigation system with AI-driven adjustments based on predictive weather analysis.
- **Orbit B-hyve** – AI-enabled smart irrigation controller that adapts to weather, soil conditions, and plant types.

### 2. AI-Driven Soil & Moisture Sensors

- **Teralytic Soil Sensor** – Uses AI to analyze soil moisture, temperature, and nutrient levels for precise irrigation control.
- **GroGuru** – AI-based wireless soil moisture monitoring system for smart watering.



What AI products are available for landscape irrigation

#### 4. AI-Integrated Sprinkler Systems

- **Hunter Solar Sync** – AI-based climate sensor that adjusts irrigation based on solar radiation and temperature.
- **Weathermatic SmartLine** – AI-powered irrigation controller that fine-tunes watering based on landscape conditions.



# Hunter Solar Sync

The **Hunter Solar Sync** does not use AI in the same way as advanced machine-learning-driven systems, but it incorporates **smart technology** to optimize irrigation schedules based on environmental conditions. Here's how it works:

## How Hunter Solar Sync Works

### 1. Weather-Based Adjustments

- The Solar Sync sensor measures **solar radiation** and **temperature** throughout the day.
- It calculates an **ET (evapotranspiration) value**, which indicates how much water plants lose due to heat and sunlight.
- Based on this data, it **automatically adjusts irrigation schedules** on compatible Hunter controllers.



# Weathermatic Smart Line

How does Weathermatic SmartLine use AI?

The **Weathermatic SmartLine** irrigation system incorporates **AI-driven Smart Watering Technology** to optimize irrigation schedules based on real-time environmental data. Here's how it leverages AI:

## 1. Smart ET (Evapotranspiration) Watering

- The **SmartLine controller** uses AI to calculate the **exact water needs** of landscapes based on:
  - Temperature
  - Humidity
  - Wind speed
  - Solar radiation
- This prevents **overwatering or underwatering**, ensuring plants receive just the right amount of water.



# Really AI?

Is this really AI or just conventional algorithms

The Weathermatic SmartLine system primarily uses **conventional algorithms** rather than true **AI (Artificial Intelligence)**. Here's the distinction:

## What SmartLine Uses: Conventional Algorithms

- **ET-Based Adjustments:** It follows pre-programmed formulas to calculate water needs using evapotranspiration (ET) data.
- **Fixed Weather Responses:** It adjusts watering schedules based on **real-time weather data** but does not **learn or predict future trends**.
- **Rule-Based Flow Monitoring:** It detects leaks using **threshold-based alerts** rather than adaptive AI learning.

## What True AI Would Do

- **Machine Learning & Adaptation:** AI would **continuously learn from past irrigation cycles** and improve future scheduling.
- **Predictive Analytics:** AI would **forecast** watering needs based on weather **patterns and soil trends**, not just react in real-time.
- **Self-Optimizing System:** AI could detect **patterns of inefficiency** and adjust watering schedules **without user input**.



# Really AI?

Is this really AI or just conventional algorithms

The Weathermatic SmartLine system primarily uses **conventional algorithms** rather than true **AI** (Artificial Intelligence). Here's the distinction:

## What SmartLine Uses: Conventional Algorithms

- **ET-Based Adjustments:** It follows pre-programmed formulas to calculate water needs using evapotranspiration (ET) data.

## Conclusion: Smart Automation, Not AI

While SmartLine is an **advanced irrigation controller**, it **does not use AI** in the way that **machine learning-based** systems do. It relies on **pre-set weather-based algorithms**, making it a **smart automation system**, not a true AI-driven platform.

For true AI irrigation, systems like Jain Logic, HydroPoint WeatherTRAK, or Rachio 3 incorporate **machine learning, predictive analytics, and adaptive learning** to improve over time.

trends, not just react in real-time.

- **Self-Optimizing System:** AI could detect **patterns of inefficiency** and adjust watering schedules without user input.



# Jain Logic and AI

How does the Jain Logic use AI?

Jain Logic uses AI to enhance **precision irrigation management**, helping growers and landscape managers optimize water use through **real-time data analysis** and **automated decision-making**. Here's how Jain Logic leverages AI:

## 1. AI-Powered Data Analysis

- Jain Logic collects data from **soil moisture sensors, weather stations, and satellite imagery**.
- AI processes this data to **predict crop water needs and recommend irrigation schedules**.
- It analyzes **historical trends and real-time conditions** to adjust watering dynamically.

## 2. Predictive Irrigation Optimization

- AI in Jain Logic **forecasts plant water requirements** by analyzing:
  - Soil moisture levels
  - Weather conditions (humidity, temperature, wind, precipitation)
  - Crop evapotranspiration (ET) rates
- The system **automatically adjusts irrigation plans** to prevent overwatering or underwatering.



# Now/Future of Jobs in Agriculture

- Drone Technologist
- Aerial Applicator/Agricultural Pilot
- Hydrologist
- Agriculture Communicator
- Food Scientist
- Precision Ag. Technologist
- Agricultural Data Analyst





# Future Jobs in Agriculture

- Prompt Engineer
- Biostatistician
- Drone pilot
- Robotic engineer



# Future Future Jobs in Agriculture

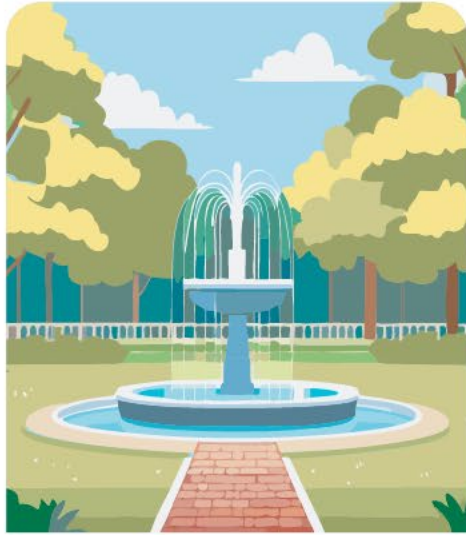
- AI Psychotherapist
- Reskiller
- Agroecological Farmer
- Bio-jacker
- Cricket Farmer
- Farm Safety Advisor



# Thank You!

- Michael D. Dukes, Ph.D., P.E.
- [mddukes@ufl.edu](mailto:mddukes@ufl.edu)
- [clue.ifas.ufl.edu](http://clue.ifas.ufl.edu)





2025 NATIONAL CONFERENCE | SAVANNAH, GEORGIA

# Rain Harvesting for Irrigation

## Considerations and Lessons Learned

Jeff Bowman

Irrigation Consulting, Inc.



# Speaker Background/Perspective



- ASIC Professional Member
- Agricultural Engineer
- Practicing Irrigation Consultant for 28 years
- Over 100 RWH Systems Installed
  - Mostly Northeastern United States
- A Contemporary of the Audience
- Not a Subject Matter “Expert”



# Topics

- Why?
- Design Considerations
- Collaborations/Collaborators
- Cost
- Installations Challenges
- Operation and Maintenance Challenges





# Why Employ a Rain Harvesting System?



- Part of a Broader Sustainability Objective/Requirement
  - LEED
  - SITES
  - Living Building Challenge
- Idealistic Principals/Mission
- Makes Sense Based on Site Conditions
- No Other Options
  - Domestic/Potable Water is Not Allowable or Available





# Sustainability Certification



- LEED Review (WEp1/WEc1) – v4 BD+C:NC
  - 30% Reduction in Outdoor Water Use – Prerequisite
    - Regardless of the Source of Water
  - 50% Reduction in Potable Water Use – 1 Point
    - With Drip Irrigation and “Smart” Controls, Can Typically be Achieved without employing a RWH/Reclaimed Water Sources.
  - 100% Reduction in Potable Water – 2 Points
    - Alternative Sources of Water Required if Site is Irrigated
      - RWH
      - Condensate Recovery
      - Treated Effluent
      - No Permanent Irrigation (2 Points)



# LEED Peak Watering Month



- RWH System *Should* Provide Enough Water to Support Landscape Irrigation When Average Rainfall is Received
- What About Droughts?
  - Focus on the Contribution (the good), not the Droughts
  - LEED Has Allowed Having a Potable Back-up to Support Irrigation During Times of Insufficient Precipitation
- Typical Cistern Size Based on Runoff From Average Rainfall for the Design (Peak) Month (July in New England)



# Living Building Challenge



- NO POTABLE WATER FOR IRRIGATION AFTER PLANT ESTABLISHMENT – NO EXCEPTIONS
- Condensate Recovery or Treated Effluent Recommended
  - More of a “Sure Thing”
  - Less Exposure to Climate Variability
- Deficit Irrigation
  - PET to PWP
  - Will the Landscape Recover?
- Cistern Sizing Feasibility (Budget and Site Constraints)



# RWH Design Considerations



- Cost (Previously was a Footnote, Elevated to the #1 Spot)
- Operation and Maintenance
- Site Constraints (Buildings, Utilities and Topography)
- Catchment/Drainage Conveyance to Storage
- Pre-Storage Filtration (Can't be an Afterthought)
- Landscape Typology (Subsurface Drip Versus Overhead)
- Public Exposure (Health and Safety)
- Pump, Controls and Treatment



# RWH Cost



- Storage is Approximately \$5.00-\$10.00 (+) per Gallon
- Cost Does Not Include Piping from Building to Cistern (Civil/MEP)
- Pump and Treatment \$15,000 to \$300,000 (+) (Excuse Me?)
- Cost Drivers
  - Volume of Storage (Goals/Purpose of RWH System)
  - Required Water Quality, Treatment (Pathogens or TDS Considerations)
  - Conveyance and Pretreatment
- Conceivable to Invest \$500,000 in a Commercial RWH System



# How Large *Should* the Cistern Be?



- LEED
  - Run a Quick Calculation Based on Catchment Area and Average Precipitation (Use a Trusted, Recognized and Reliable Data Source)
    - Rational Runoff Equation ( $Q = CiA$ )
    - $Q$  = Volume
    - $C$  = Runoff Coefficient (0.9 for most hardscapes)
    - $i$  = Rainfall Depth in the Design Month
    - $A$  = Catchment Area
  - Calculate Monthly Irrigation Demand (EPA Water Sense Water Budget)
  - Compare the two
  - If Supply is Greater Than Demand – Move to Step 2, Otherwise, Have a nice Day (Landscape Design Changes Could be Necessary)



# If Harvesting Potential is There...

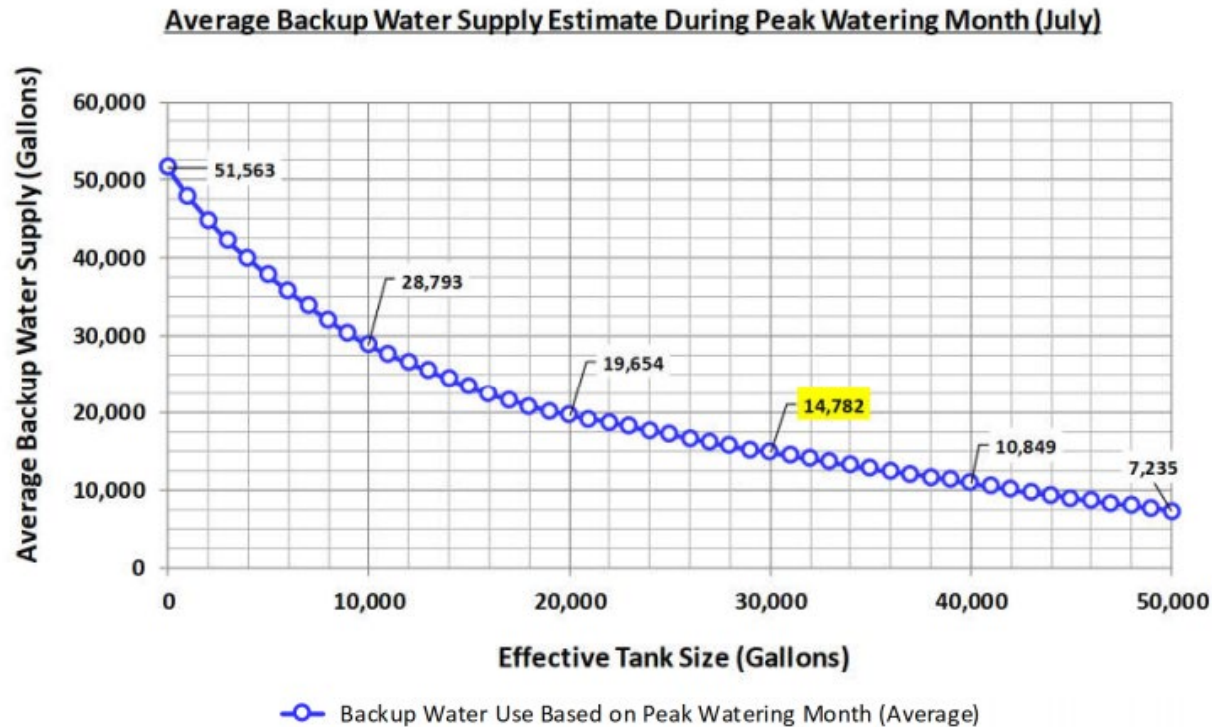


- If Budget and Site Conditions Allow, Consider Sizing the Cistern to Capture an Entire Month's Supply (This Provides Storage for Three to Four Weeks)
- Size the Cistern to be as Small as Possible, While Achieving the Goal - OPTIMIZATION
  - Run a Daily Simulation Over the Past +/- 20 years
  - Graph the Results
  - Provide a Statistical Assessment of the Results
  - Typically, This is Approximately Two Weeks of Storage for the Northeast



PROJECT:

LOCATION: Boston, MA



\* Actual tank size is 10% larger than the effective tank size due to dead storage which cannot be used by the pump.

RWH SIMULATION  
20 YEARS OF DATA  
FOR JULY – LEED MONTH

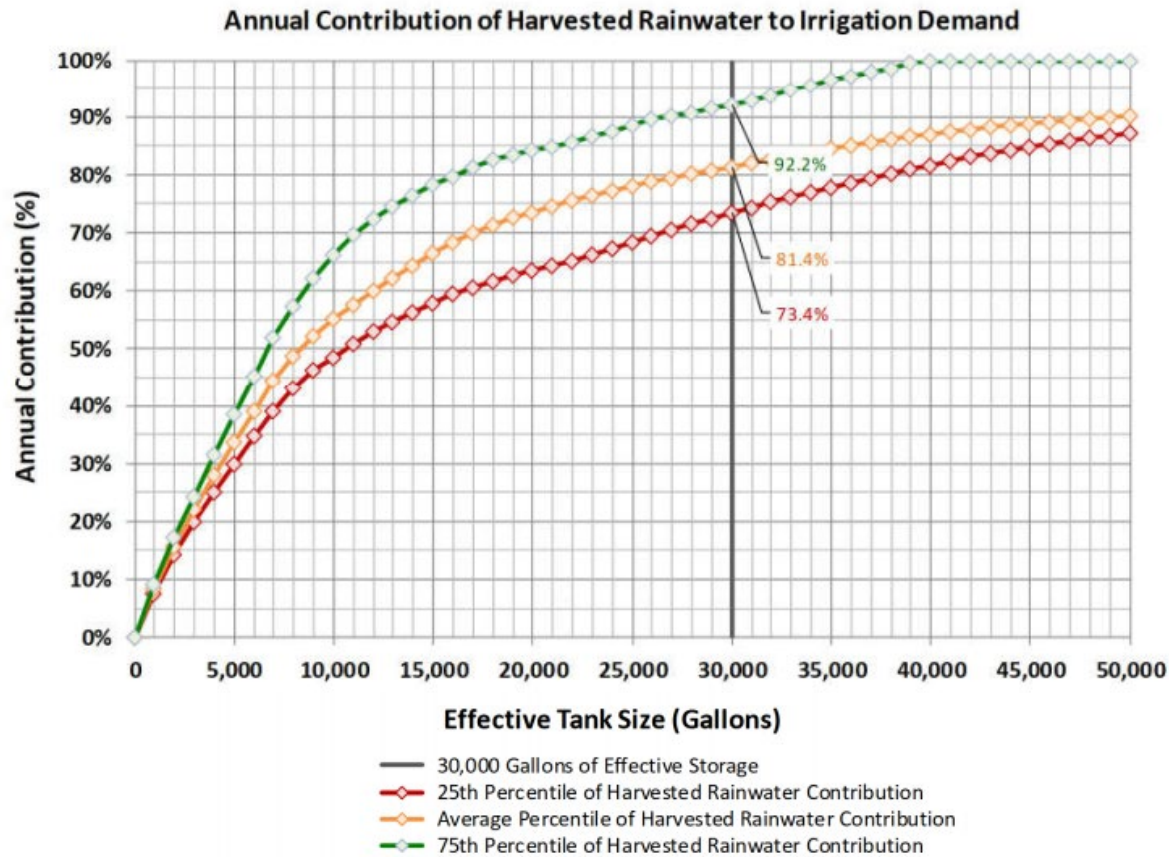
Graph 1: Average Water Use from a Backup Water Supply vs Effective Tank Size (July)



GRAPH 2: OUTPUT FOR RAINWATER HARVESTING EXPECTED PERFORMANCE

PROJECT

LOCATION Boston, MA



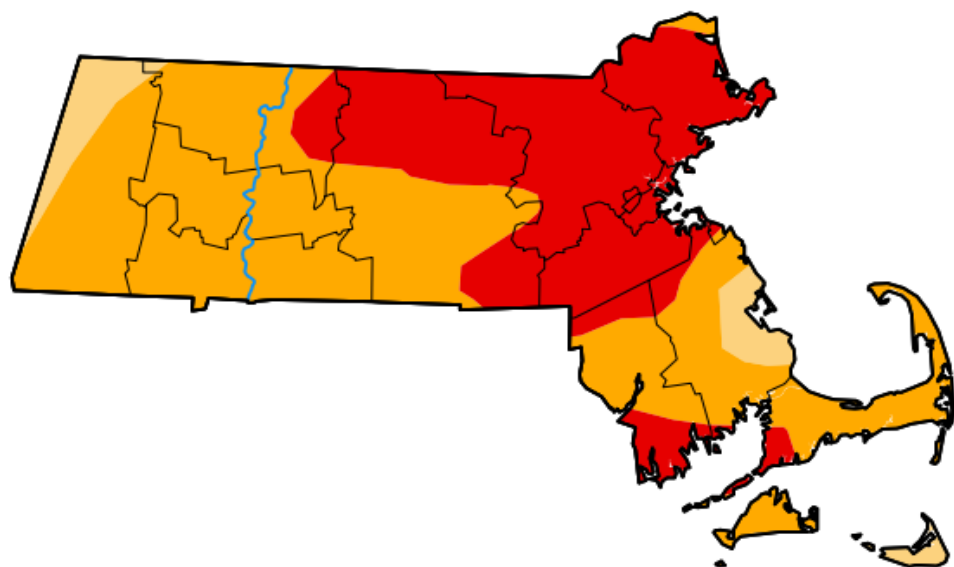
\* Actual tank size is 10% larger than the effective tank size due to dead storage which cannot be used by the pump.

RWH SIMULATION  
20 YEARS OF DATA  
ANNUAL EVALUATION

Graph 2: Annual Percentage Contribution of Rainwater to Overall Irrigation Demand



# U.S. Drought Monitor Massachusetts



**August 30, 2022**

(Released Thursday, Sep. 1, 2022)

Valid 8 a.m. EDT

*Drought Conditions (Percent Area)*

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
<b>Current</b>	0.00	100.00	100.00	93.98	38.35	0.00
<b>Last Week</b> 08-23-2022	0.00	100.00	100.00	96.08	39.48	0.00
<b>3 Months Ago</b> 05-31-2022	26.14	73.86	29.72	0.00	0.00	0.00
<b>Start of Calendar Year</b> 01-04-2022	100.00	0.00	0.00	0.00	0.00	0.00
<b>Start of Water Year</b> 09-28-2021	99.71	0.29	0.00	0.00	0.00	0.00
<b>One Year Ago</b> 08-31-2021	94.00	6.00	2.59	1.00	0.00	0.00

Intensity:

None	D2 Severe Drought
D0 Abnormally Dry	D3 Extreme Drought
D1 Moderate Drought	D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. For more information on the Drought Monitor, go to <https://droughtmonitor.unl.edu/About.aspx>

Author:

Deborah Bathke  
National Drought Mitigation Center



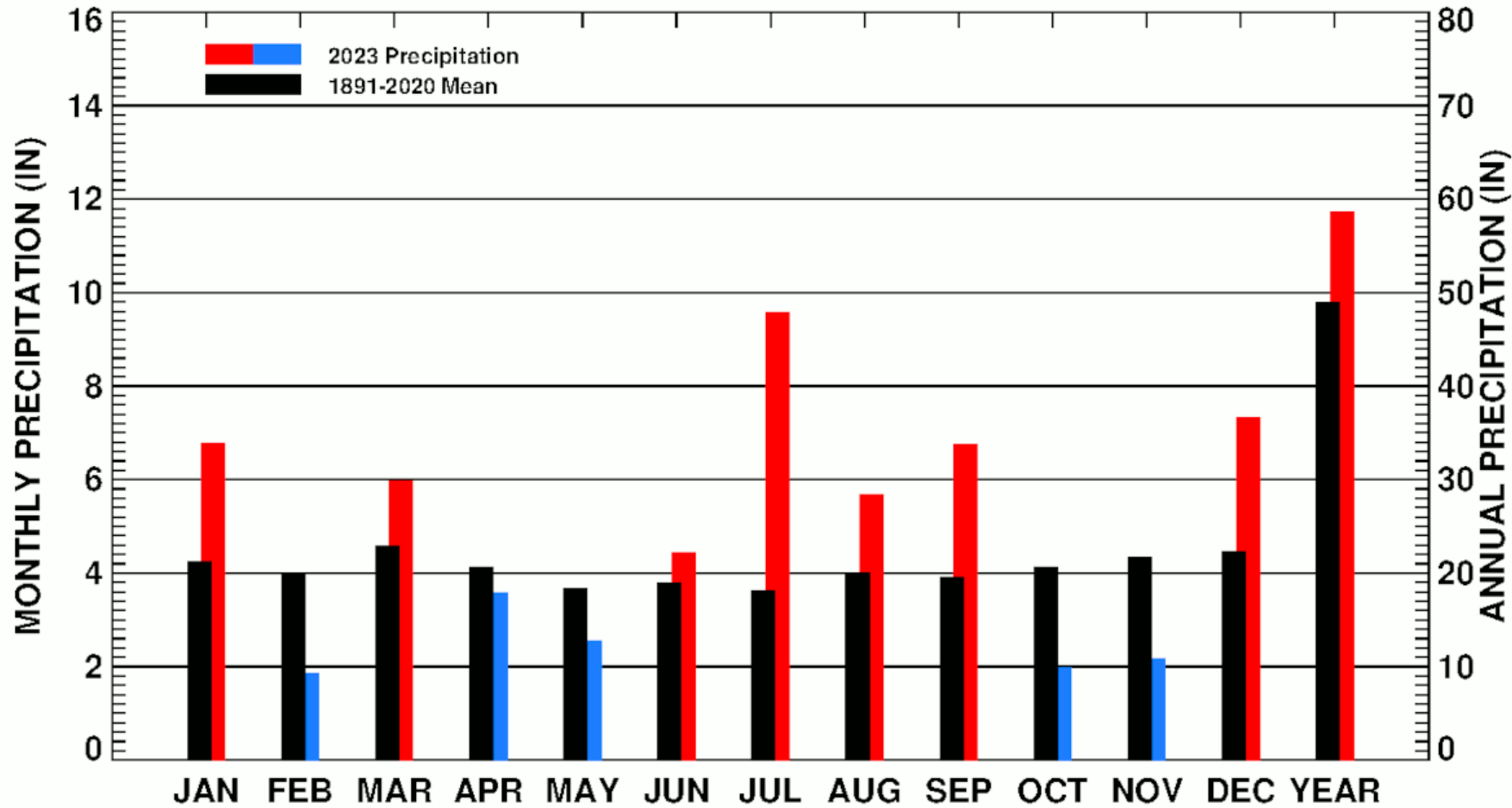
[droughtmonitor.unl.edu](https://droughtmonitor.unl.edu)

2025 NATIONAL CONFERENCE | SAVANNAH, GEORGIA





# BLUE HILL OBSERVATORY 2023 PRECIPITATION



\* Fifth wettest July, and seventh wettest summer (Jun-Aug) on record.

Michael J. Iacono, Atmospheric and Environmental Research / Blue Hill Observatory



# For LBC/Potable Water Independence:



- Size the Cistern to Maximize Capture
- Consider (Encourage) HVAC Condensate Capture
- Have a Water Reduction Strategy, Where Water is Reserved for Higher Priority (Water Intensive) Plantings
- Active Water Management
  - Informed and Invested Landscape Irrigation Managers



# Rain Water Harvesting Regulations



- Organizations Continuing to Fight for “Turf”(\$\$)
- International Code Council (ICC) and the CSA have published codes specific to rain water harvesting and reuse.
- Some differences between grade level collection and non-vegetative roofs
- Tier 1 End Use Versus Tier 3 End Use
  - Sprinkler irrigation on restricted areas versus non-restricted areas.
  - If Tier 3, Disinfection Required
  - The Water Supply Plan (WSP) shall establish whether a given application has restricted or unrestricted access or exposure.





# ICC 805, Storm Water Versus Roof Runoff

*(Check Current Standard!)*



- For Non-Residential Applications, Tier 3 (Unrestricted Sprinkler Irrigation) from Roof Harvesting Only:
  - Water from roof surfaces must be disinfected. If UV is the method, water shall be disinfected to  $30\text{mJ}/\text{cm}^2$  (UV Dosage) with at least  $0.5\text{ mg/L}$  chlorine residual.
  - UV Lights shall have pre-filtration at 5 micron.





# ICC 805, Storm Water Versus Roof Runoff

*(Check Current Standard!)*



- For Non-Residential Applications, Tier 3 (Unrestricted Sprinkler Irrigation) from at Grade Storm Water Runoff:
  - Water from at grade surfaces must be disinfected. If UV is the method, water shall be disinfected to 40mj/cm<sup>2</sup> (UV Dosage) with at least 0.5 mg/L chlorine residual.
  - UV lights shall have pre-filtration at 5 micron
  - Treatment shall also be third-party certified to Class A or NSF/ANSI 55 or Validated to U.S. EPA UVDGM





# Sources of Information



- American Rainwater Catchment Systems Association (ARCSA)
  - <http://www.arcsa.org>
- U.S. Department of Energy (Rainwater Harvesting Tool)
  - <https://www.energy.gov/femp/rainwater-harvesting-tool>
- Keep Track of Current Codes Governing Rain Water Harvesting Throughout the Country
- Employ Good, Responsible (and Feasible) Practices Regardless





# Catchment Considerations



- Stormwater: Collection From Grade-Level Areas
  - Sidewalks
  - Tennis/basketball Courts
  - Parking Lots
  - Landscape
- Roofs
  - Non-vegetative Roofs, Not Actively Used by the Public
  - Generally, Naturally Free of Dissolved Minerals
  - Higher Water Quality



# Catchment Considerations



- Recommend Harvesting from Impervious Roofs
  - Green Roofs Will Add TSS and Turbidity to Water
  - Asphalt Shingles Will Shed Granular Material
- Site Drainage with Vehicular Access Not Ideal
  - Oils
  - Deicing Agents (TDS, Salt)
  - TSS
  - Pathogens
  - Additional Code Constraints Where Adopted





2025 NATIONAL CONFERENCE | SAVANNAH, GEORGIA



# Pre-Storage Treatment

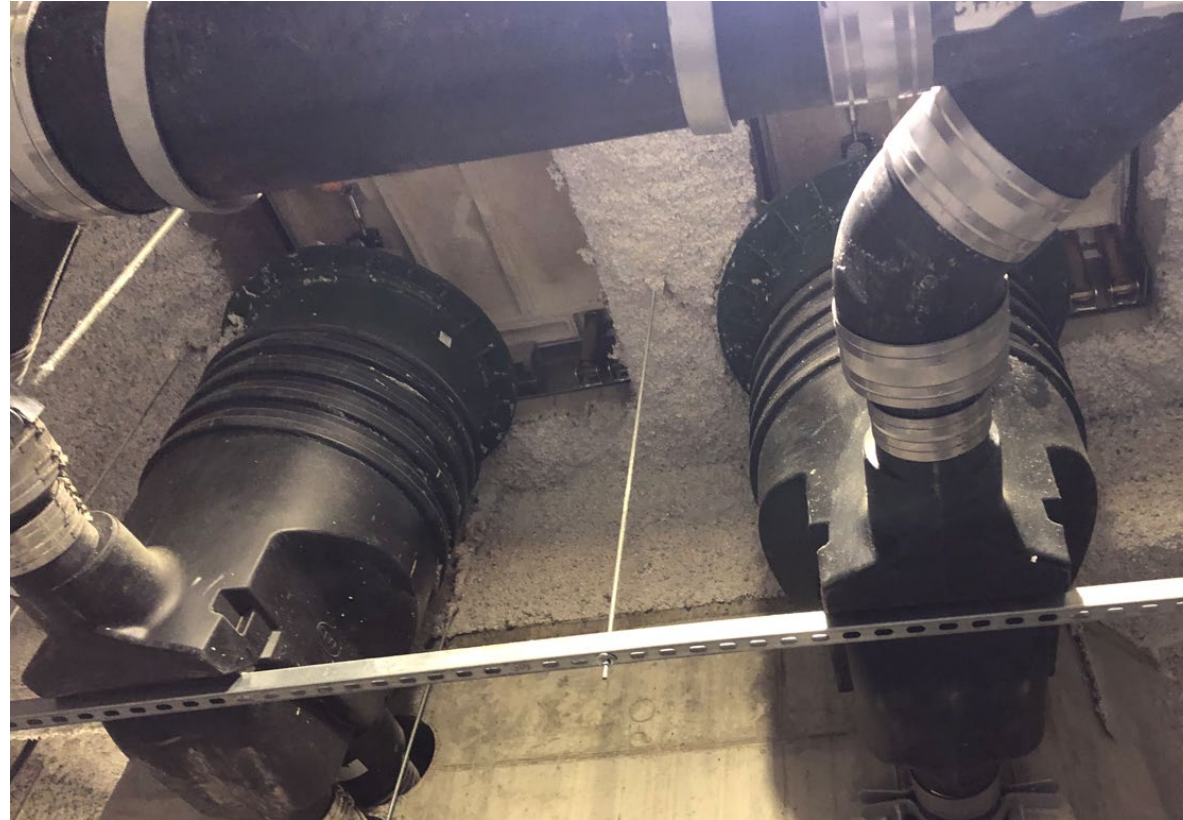


- First Flush
- Screens/Filters
  - Collaborate with MEP or Civil
- Hydrodynamic Separator (Stormceptor or equal)
  - Collaborate with Civil Engineer



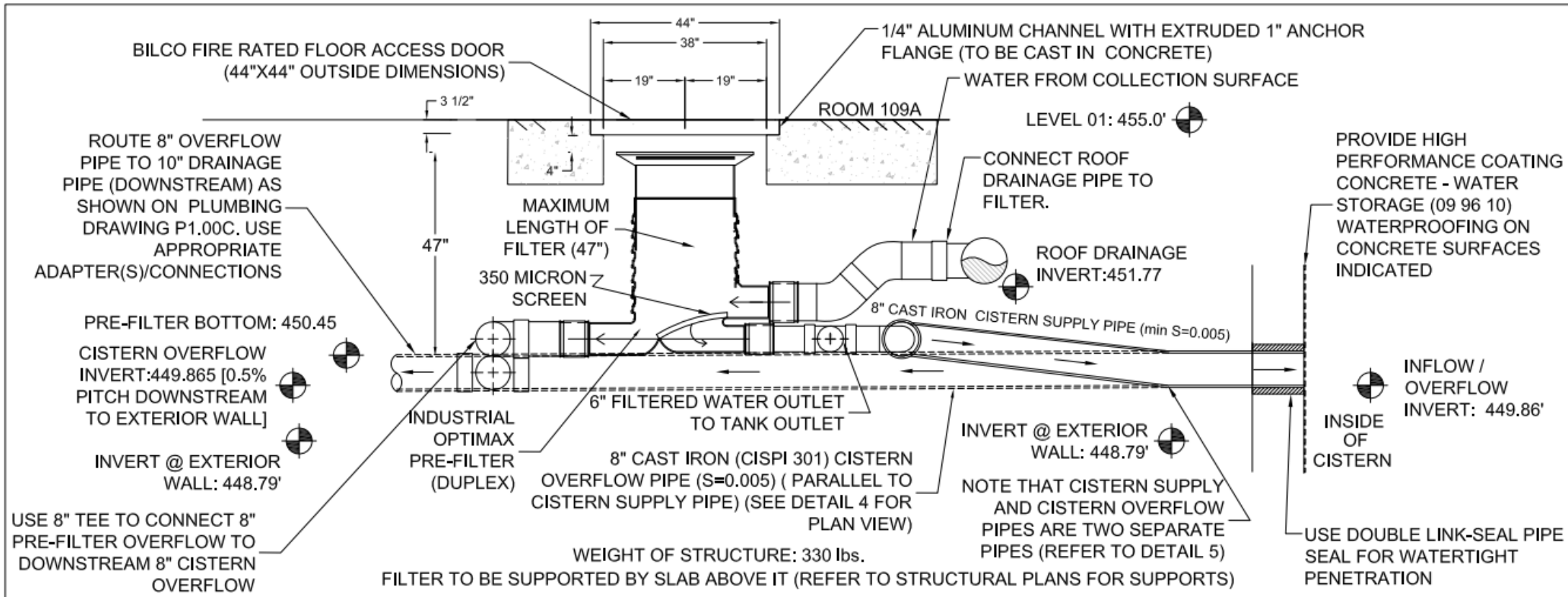


# Pre-Storage Filter/Treatment Examples





# Pre-Filter Section Detail Example (Close Coordination with Civil/MEP)





# Pump, Treatment and Control



- Keep it as Simple as Code Allows
- Employ Best Management Practices
- Drip Irrigation from Roof = Simplest (Least Public Exposure)
- Sprinkler Irrigation From Site/Stormwater = Most Complex
- Interior Irrigation Adds Complexity





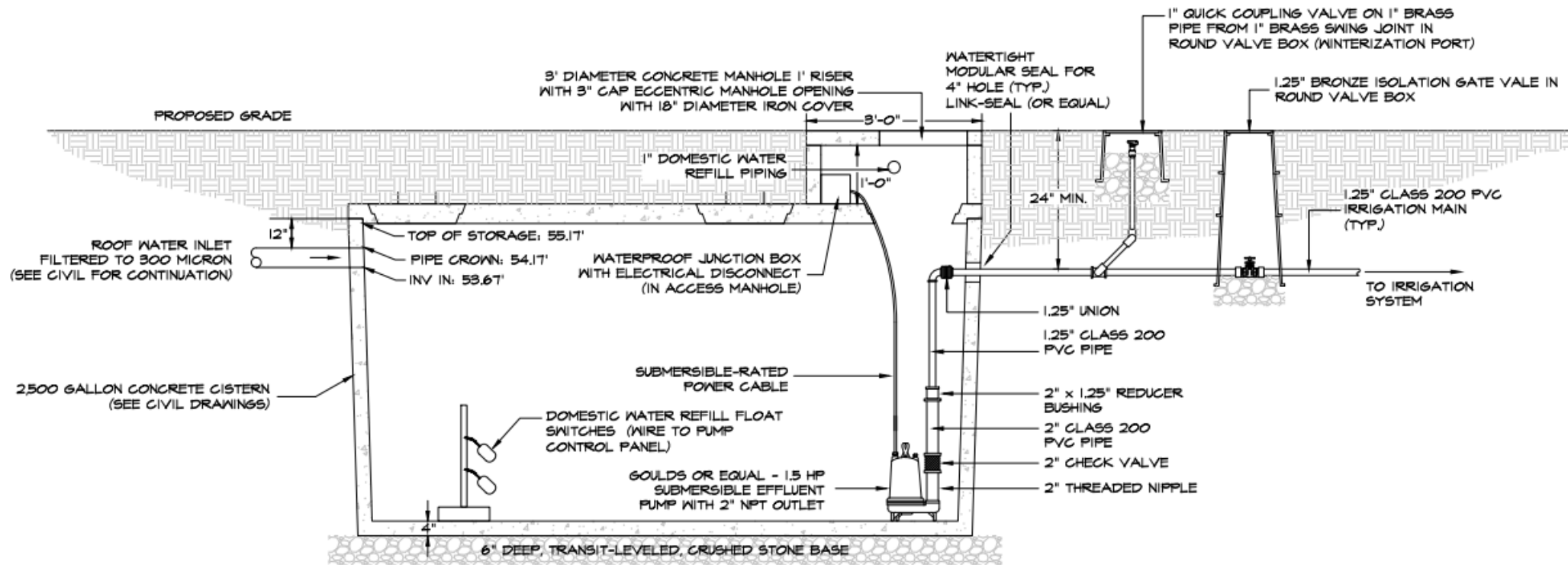
# Simple Drip System



- Low Pressure
- Submersible Pump (High Head Trash Pump)
- Float Switch/Safety
  - Low Level Light
- Pump Start Relay
- Fixed Speed
- Similar to a Septic System with a Leach Field



# Simple RWH System



SECTION VIEW

29 IRRIGATION CISTERN AND PUMP DETAIL  
NO SCALE



# RWH System for Drip Irrigation Only



2025 NATIONAL CONFERENCE | SAVANNAH, GEORGIA



# Commercial Site with Sprinkler Irrigation



- High Head Submersible Pump (Typical)
  - Horizontal or Vertical Pump Installation
- Domestic Back-Up
  - To Cistern or to Break Tank (With Secondary Pump)
  - Air Gap Recommended (and Sometimes Required)
  - **Caution: Three-Way Valves Illegal in Some States**
- Primary Filter w/Auto Backflushing
  - Problematic with Screens Finer Than 20 Micron
- Potential Secondary Cartridge Filter (5 Micron)
- Sterilization (See Governing Codes/Regulations)
  - UV
  - Ozone
  - Chlorine
- Level Controls, PLC, VFD, Remote Telemetry (Cloud)





# Commercial Site with Sprinkler Irrigation



2025 NATIONAL CONFERENCE | SAVANNAH, GEORGIA





# Commercial Site with Sprinkler Irrigation



2025 NATIONAL CONFERENCE | SAVANNAH, GEORGIA





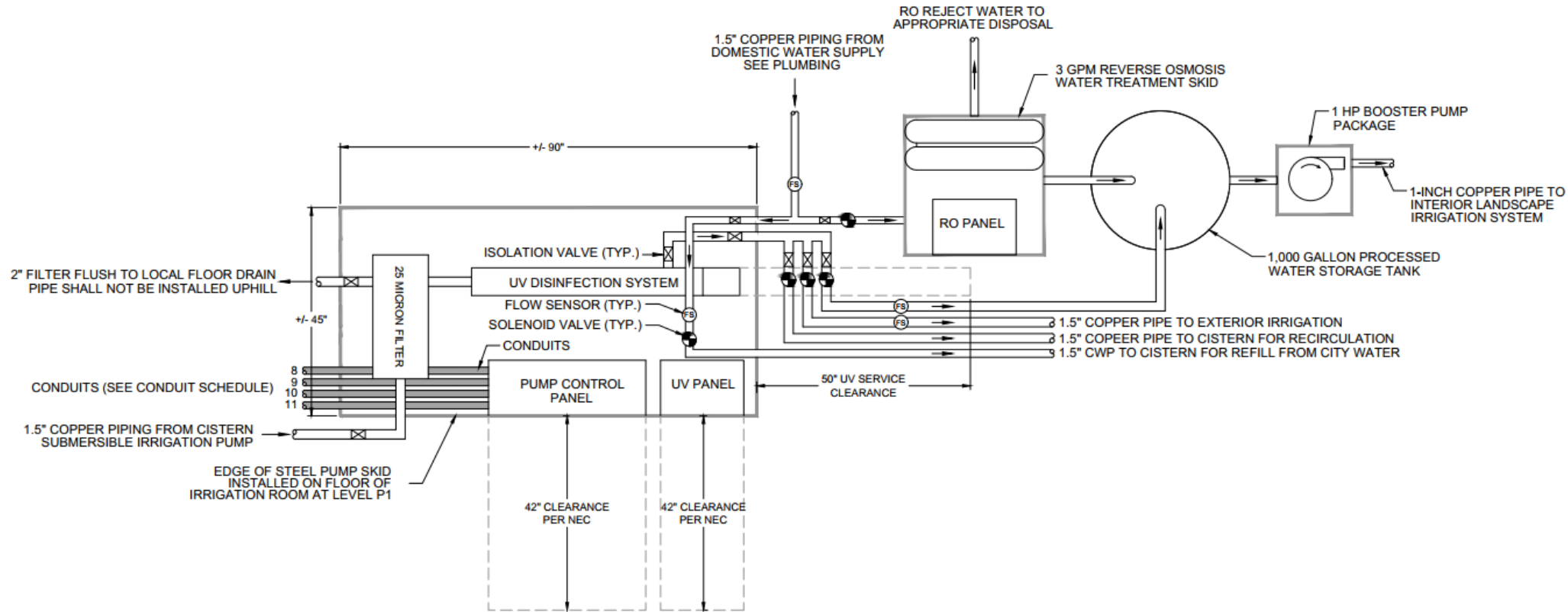
# Special Considerations



- Exterior and Interior Irrigation – Boston Area
- Interior Atrium Requires Irrigation 12 Months
- LEED with RWH
- Exterior Catchment and Pump System is Winterized
- Domestic Back-up High in TDS (Polluted With Salt, Urban Runoff)
- In Addition to All Standard Features, System Requires Reverse Osmosis to Remove Salts in Public Water Supply so Atrium Soils Don't Harden and Plants Receive More Natural, Soft Water



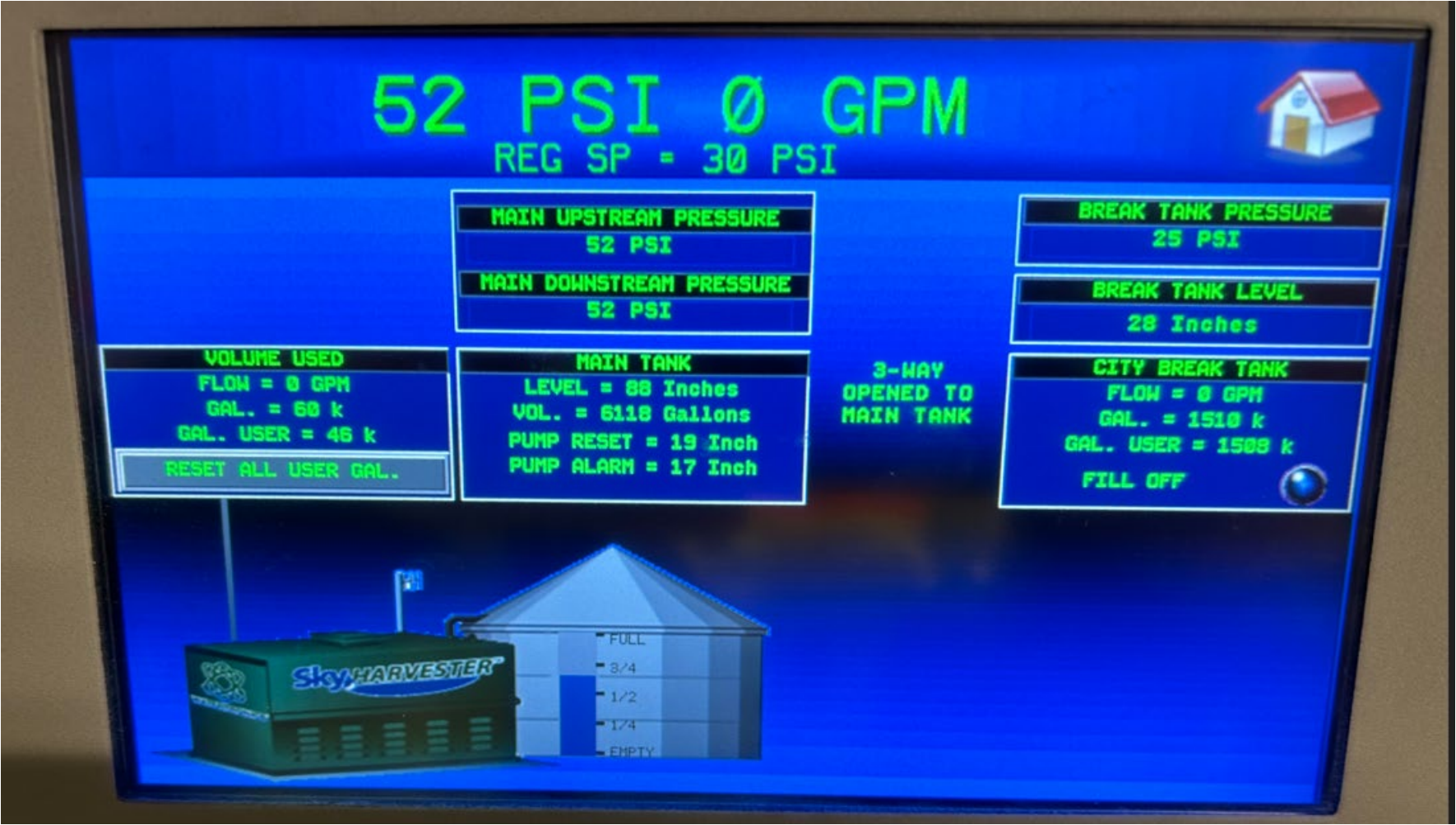
# Special Circumstances



OVERALL PUMP SYSTEM  
SCHEMATIC PLAN VIEW

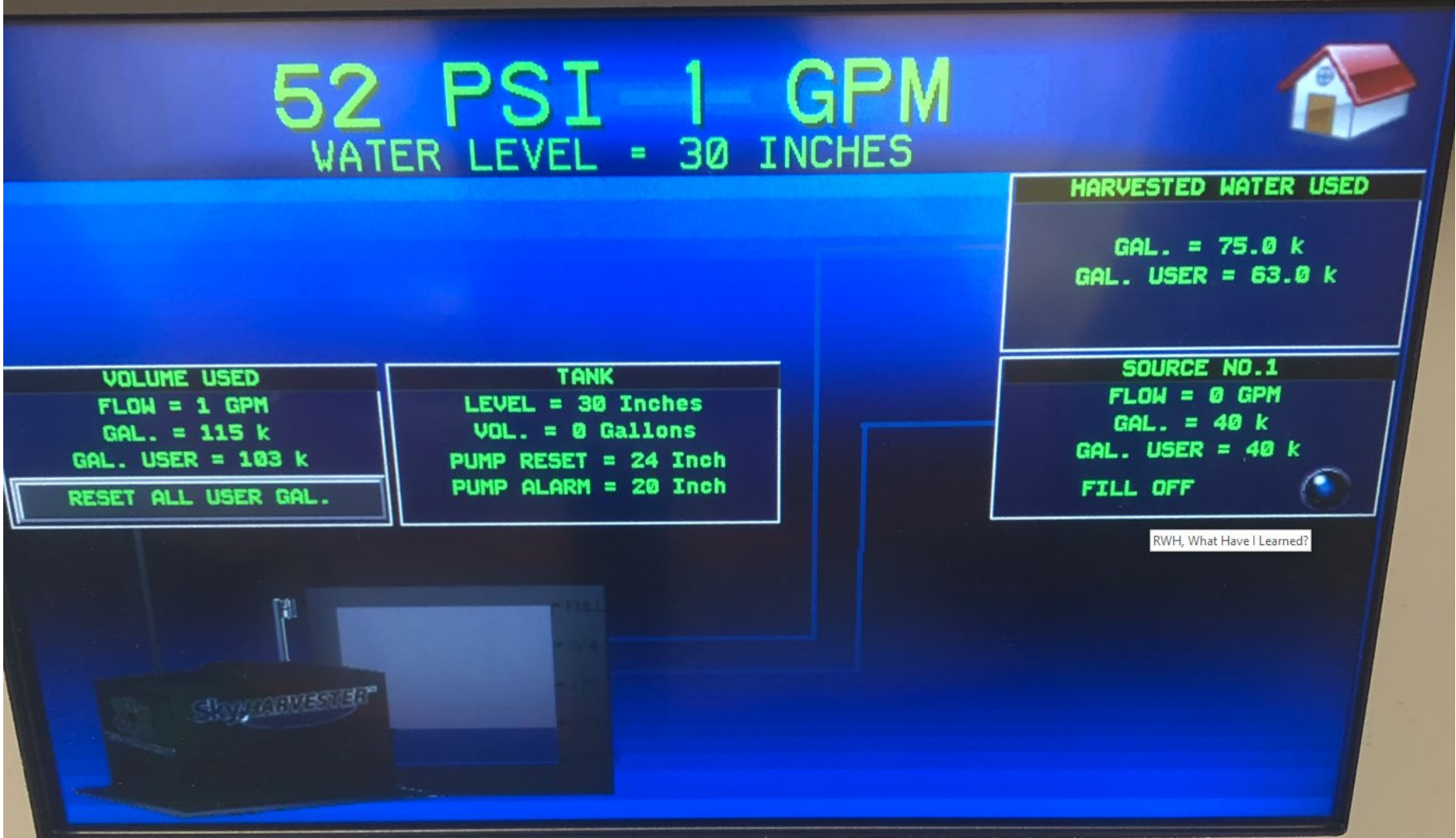


# Periodically Review Performance

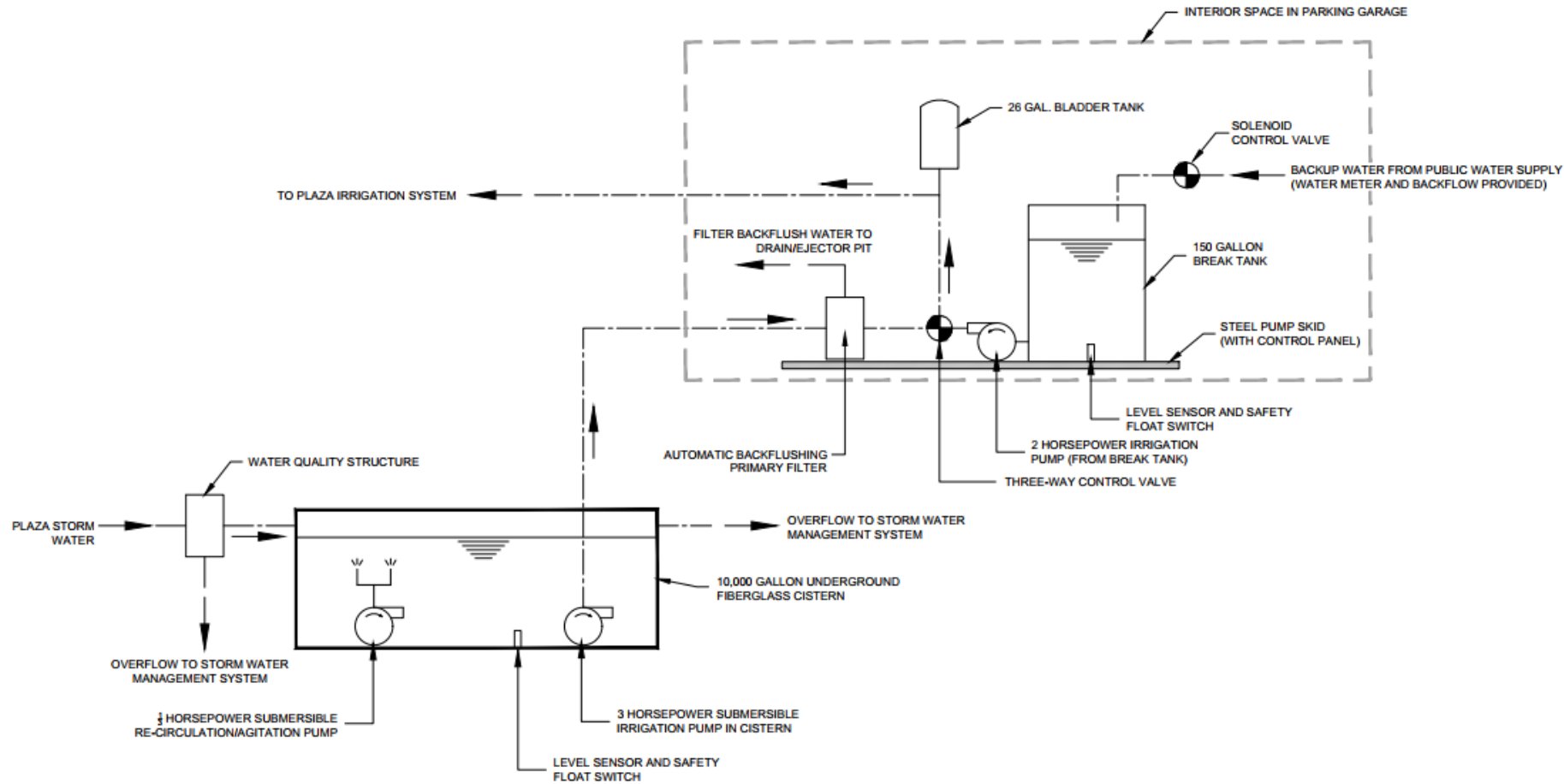




# Performance Review







BOSTON CITY HALL PLAZA  
RAIN HARVESTING IRRIGATION REUSE SYSTEM  
FLOW DIAGRAM

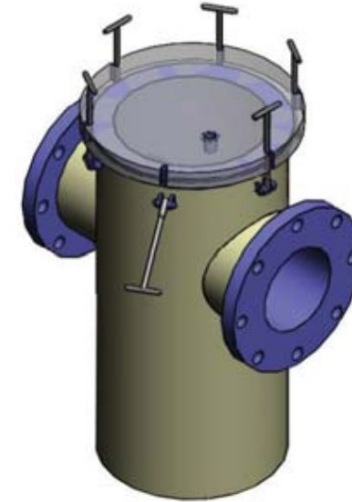
CITY of **BOSTON**



# New RWH From Tennis Courts



- No Vehicular Traffic on Courts
- Catchment Completely Fenced In
- No Deicing Agents or Sanding
- 1/16" Pool Filters on Incoming Lines
- Irrigation Consultant Participated in Training and Producing a Training Video for Maintenance Personnel
- System Was Underperforming
- Why?





# Picture Of Pool Filter



2025 NATIONAL CONFERENCE | SAVANNAH, GEORGIA



# In Year 2, Operators Didn't Know Filter Maintenance/Cleaning was Required



- What training video?
- Let the Domestic Back-Up Kick-On
  - Clean Water
- RWH System is Poorly Designed
- Tennis Balls Have Fuzz





# RWH, What Have I Learned?

- Wisdom = Collection of Failures
- You Don't Know What you Don't Know
- COLLABORATE
- Be Fortright With Your Consultation
  - Expensive
  - Who Will Manage the System?
  - Budget Regular Service
  - Managers Need to Understand the “Greater Good”
  - Understand the Data and Performance
  - Easy to Walk Away if there isn't “buy-in”
- IT HAS TO BE MORE THAN A “LEED THING”







2025 NATIONAL CONFERENCE SAVANNAH, GEORGIA

# IRRIGATION IN THE GULF STATES

Fawzi Melhem



- Work Experience

- *Founder & Managing Director* – *RADIUS & RADIUS ACADEMY*
- *Water Management Consultant* – *GCC Private & Public Sectors*
- *Water Sustainability Consultant* – *GCC Smart & Sustainable Cities*

- Education & Certification

- *M.Sc. in Irrigation* – *American University of Beirut (AUB)*
- *B.E. Agriculture & B.Sc. Agriculture (AUB)*
- *IA Certified* - *CLIA & EPA WaterSense® Partner*
- *Certified Irrigation Trainer* – *Dubai Municipality*
- *Program Developer* – *The GCC Sustainable Irrigation Training Workshop*

- Awards and Honors

- *Penrose Award & Thomas Sutherland Prize Winner for Academic & Leadership Excellence* – *AUB*
- *Trustee, American University of Beirut* – *2010*
- *Vice President of AUB for University Faculty & Student Committee* – *2001*



Fawzi Melhem



# IRRIGATION IN THE GULF STATES (GCC)

## Outline

### 1. Introduction to GCC

- *Geography, Population, and Economic Overview (GDP)*

### 2. Water Resources in the GCC

- *Primary Water Sources (Desalination & Treated Sewage Effluent -TSE)*
- *GCC Sustainability & Economic Roadmaps*
- *Sustainable Water Management Approaches*

### 3. Irrigation System Guidelines

- *GCC Practices for Irrigation Design, Installation, and Maintenance*

### 4. Sustainable Irrigation Solutions - Live Topics

- *Water Budgeting, Water Quality, Maintenance, Integrated Water Strategies*





# GULF STATES

## Geography

Europe

Asia

Africa

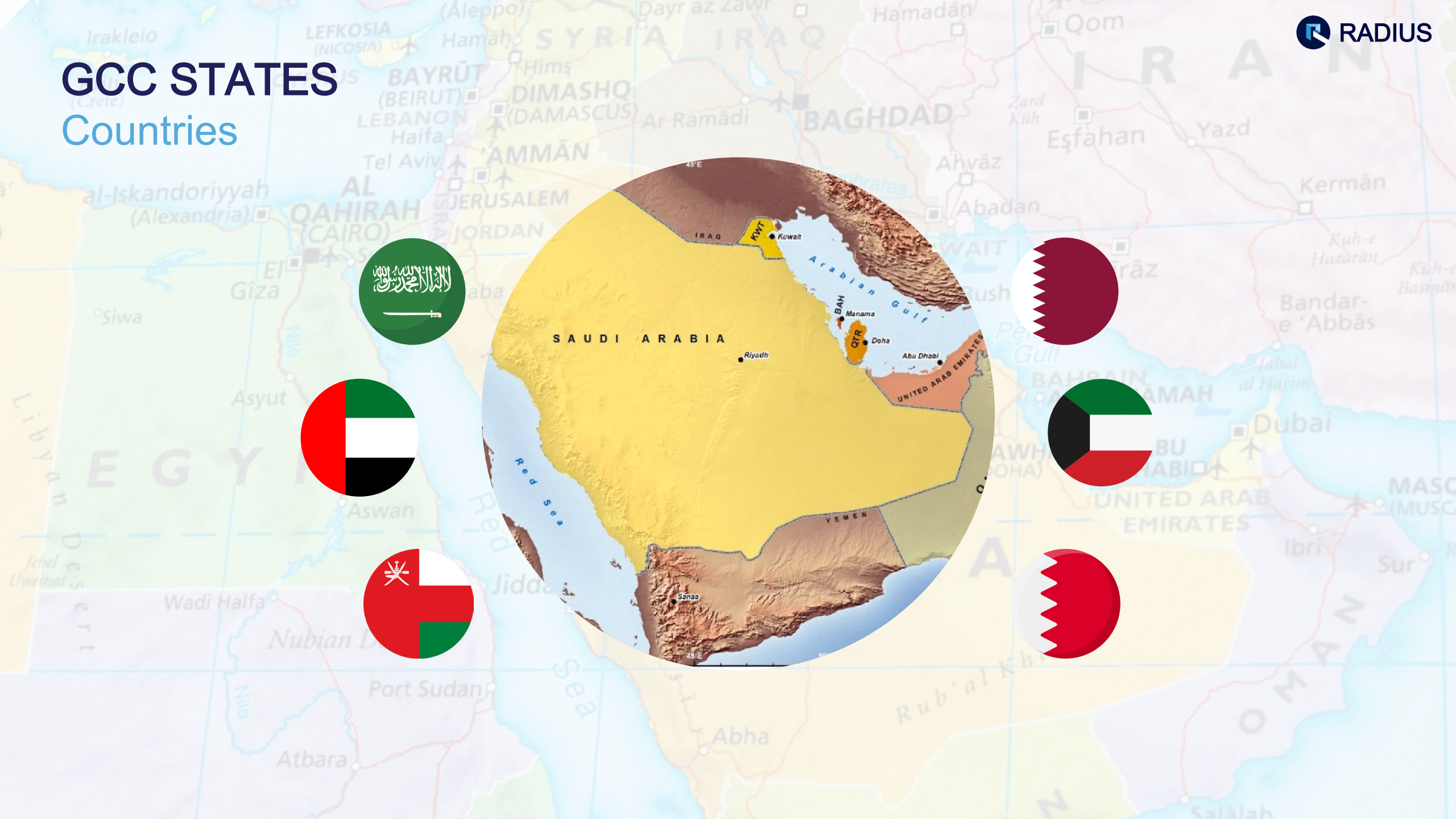
India





# GCC STATES

## Countries





# GCC STATES

## Main Cities



**DUBAI**



**ABU DHABI**



**RIYADH**



**JEDDAH**



**DOHA**



**MUSCAT**



**KUWAIT**



**DAMMAM**



# GCC STATES

## Population and GDP

Country	Population Millions	Expats %	Growth Rate %	GDP Billions	GDP Growth %	HDI
KSA	40	40%	1.6%	1,100	1.8%	0.85
UAE	11.5	90%	1.5%	510	1.7%	0.85
Oman	5.5	40%	2%	120	1.2%	0.8
Qatar	3	90%	1.6%	240	1.6%	0.86
Kuwait	4.5	70%	1.3%	180	1.3%	0.8
Bahrain	1.5	60%	2%	50	2%	0.82
TOTAL	66 M	60%	1.6%	2,200	1.8%	0.85
USA	340 M	15%	0.9%	27,500	2.2%	0.95



# WATER RESOURCE

## Water Sources - Desalination

- Water Desalination Applications
  - *Essential for municipal, industrial, and tourism sectors*
- Global Leadership in Desalination
  - *The GCC accounts for 50% of the world's desalination capacity*
- Production Capacity
  - *Total output: 55 million m<sup>3</sup>/day*
- Primary Desalination Technologies
  - *Multi-Stage Flash (MSF): Thermal High energy consumption*
  - *Multi-Effect Distillation (MED): Low energy demand*
  - *Reverse Osmosis (RO): Membrane -based, energy -efficient solution*





# WATER RESOURCE

## Water Sources - Desalination & the Environment

- By-Products & Environmental Concerns
  - *Brine Discharge* → *Increases seawater salinity, harming marine ecosystems*
  - *Greenhouse Gas (GHG) Emissions* → *High energy demand contributes to climate change*
  - *High Chlorine Levels* → *Leads to high toxicity risks for marine life and coastal plants*
  - *Trace Element Accumulation* → *Degrades soil and water quality over time*
- Hybrid (Thermal & Membrane) Desalination Plants
  - *KSA: Ras Al Khair, Al Jubail & Yanbu Cogeneration Plants*
  - *UAE: Fujairah 2 Desalination Plant*
  - *Qatar: Umm Al Houl Plant*
- Sustainable Solutions: Solar-Powered & RO Desalination
  - *UAE: Masdar Renewable Energy Desalination Pilot Program*
  - *Abu Dhabi: Taweelah (1M m<sup>3</sup>/day)*      – *World's largest RO desalination plant*
  - *KSA: King Abdullah Economic City*      – *Solar -powered (30,000 m<sup>3</sup>/day), aligns with Vision 2030*

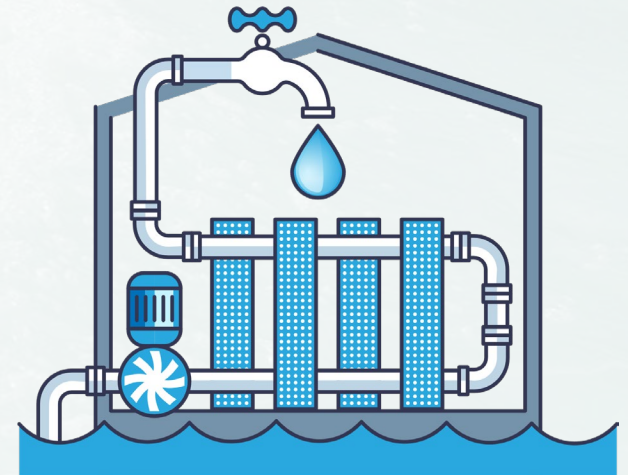




# WATER RESOURCE

## Water Sources - TSE

- TSE Applications
  - *Landscape, agriculture, and for refilling aquifers*
- Production Capacity
  - *Total output: 16 million m<sup>3</sup>/day*
- Key Factors Affecting Production
  - *Daily Flow Variations → Seasonal and consumption*
  - *weather-based fluctuations*
- Tip for Irrigation Designers 
  - *Water Usage Patterns → Manage water production expectations*





# WATER RESOURCE

## Water Sources - TSE & The Environment

- By-Products & Environmental Concerns
  - *Heavy Metals* → *Potential soil and water contamination*
  - *Bacteria & Pathogens* → *Can cause methane production and health risks*
- Challenges & Solutions
  - *Social Acceptance* → *Public perception remains a challenge*
  - *Disposal Challenges* → *Large wastewater volumes discharged into the sea*
  - *High Water Table* → *A major issue in Dubai & Riyadh*
  - *Purification Methods* → *UV treatment & Reverse Osmosis (RO)*
  - *Reuse Potential* → *Treated water can support other applications*
- Tips for Irrigation Designers
  - *Irrigation Windows* → *Optimize spray zones timing*





# WATER RESOURCE

## Water Demand & Sustainability in the GCC

- Water Consumption

- *Population Growth* → Fueled by the oil industry & economic expansion
- *Rising Living Standards* → Increased demand for water & energy
- *High Water Consumption* → 560 L/capita/day (vs. 180 L global average)

- Water Scarcity & Resource Depletion

- *Desertification Effect* → Threatening arid regions
- *Urban Expansion* → Rapid city growth
- *Aquifer Depletion* → Overuse of non-renewable groundwater
- *Seawater Intrusion* → Salinization of coastal aquifers

- Environmental & Energy Impact


- *Climate Change* → Rising temperatures & extreme weather
- *Desalination Dependency* > *Treated Sewage Effluent (TSE)* → High reliance on fossil fuels





# WATER RESOURCE

## Water Cost - Forecast

- Desalination & Treated Water Costs
  - *Desalination Costs* → \$0.5 – \$2 per m<sup>3</sup> (Lowered costs due to improved efficiency)
  - *Treated Water Costs* → \$0.1 – \$0.5 per m<sup>3</sup> (More affordable alternative)
- Government Subsidies & Market Trends
  - *GCC Water Prices* → Still heavily subsidized by governments
  - *Expected Price Increase* → Water costs are projected to rise in the near future
- Tip for Irrigation Designers 
  - *Rising Water Prices* → Adopt efficient irrigation technologies

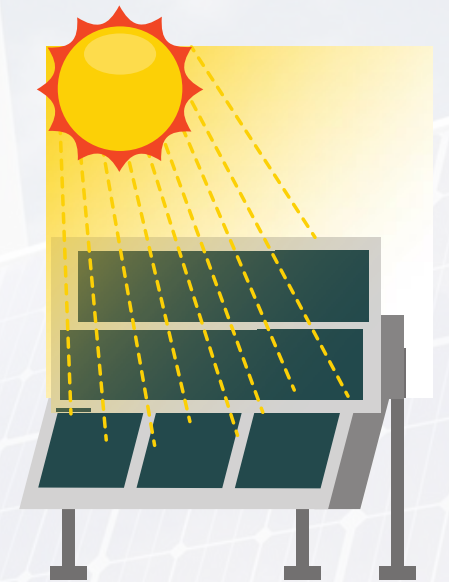




# WATER RESOURCE

## GCC Sustainability & Economic Roadmaps

- Economic Diversification
  - *Boosting non -oil sectors (e.g., tourism, manufacturing, and technology)*
- Sustainability & Green Communities
  - *Prioritizing green energy, resource conservation, and sustainable growth*
- Human Development Improvement
  - *Improving education, healthcare, and workforce competitiveness*
- Technical Innovation
  - *Investing in technology and infrastructure to drive economic growth*
- ***GCC Governmental Visions***
  - *UAE Vision 2021 & 2071 / Qatar National Vision 2030*
  - *Saudi Arabia Vision 2030 / Oman Vision 2040*
  - *Bahrain Economic Vision 2030 / Kuwait Vision 2035*





# WATER RESOURCE

## Sustainable Water Management Approaches

- Economic Measures

- *Rising Water Prices & Tariffs* → *Encouraging conservation & efficient use*

- Enhancing Irrigation Efficiency

- *Smart Irrigation Systems* → *Use of advanced emitters & automation*

- *Agricultural Water Control* → *Avoid high water consumption crops*

- Water Treatment & Reuse

- *Advanced Desalination & Treatment* → *Investing in energy*                      -*efficient technologies*

- *Expanding Wastewater Reuse* → *Increasing the use of TSE for non*                      -*potable applications*

- Water Collection & Distribution

- *Stormwater & Drainage Harvesting* → *Lessons from Dubai 2024 flooding incident*

- *Infrastructure Upgrades* → *Pipes, sensors, and smart leak detectors to reduce water losses*





# IRRIGATION SYSTEM GUIDELINES

## Design Guidelines

Plant	Daily Requirement	Zone Type	Irrigation Time
Palm Trees	120-150 L/plant/day <del>32</del> -40 Gal/plant/day	Bubbler	15 mn
Ornamental Trees	60-80 L/plant/day $\approx$ 15-21 Gal/plant/day	TSH	120 mn
Shrubs & hedges	15 L/plant/day $\approx$ 4 Gal/plant/day	TSH	120 mn
Shrubs ( Mass)	18 L/m <sup>2</sup> /day $\approx$ 0.44 gal/ft <sup>2</sup> /day	TSH	120 mn
Ground Covers & Succulents	12 L/m <sup>2</sup> /day $\approx$ 0.29 gal/ft <sup>2</sup> /day	GC	50 mn
Succulents	7 L/m <sup>2</sup> /day $\approx$ 0.17 gal/ft <sup>2</sup> /day	GC	50 mn
Seasonal Flowers & creepers	12 L/m <sup>2</sup> /day $\approx$ 0.29 gal/ft <sup>2</sup> /day	SF	24 mn
Lawn	10 L/m <sup>2</sup> /day $\approx$ 0.25 gal/ft <sup>2</sup> /day	SPR / SP	60 mn / 14 mn

▶ Daily Operation Time for irrigation system shall not exceed 10 hours



# IRRIGATION SYSTEM GUIDELINES

## Design Guidelines

Plant	1 riser per every of plant beds	Row Distance
All Palm Trees/Trees in grass/gravel area	1 riser per tree	
Trees in open area in planting beds	1 riser per 6 trees 3 on either side or 40m one side drip line from riser	
Shrubs (1 nos/Sqm)	1 riser per row of shrub planting	100 cm $\approx$ 3.2 ft
Shrubs (2 nos/Sq .m)	25 m <sup>2</sup> $\approx$ 270 ft <sup>2</sup>	50 cm $\approx$ 1.6 ft
Mass Shrubs (3-4 nos./sqm)	35 m <sup>2</sup> $\approx$ 375 ft <sup>2</sup>	50 cm $\approx$ 1.6 ft
Ground Covers & Succulents	25 m <sup>2</sup> $\approx$ 270 ft <sup>2</sup>	50 cm $\approx$ 1.6 ft
Seasonal Flowers & creepers	15 m <sup>2</sup> $\approx$ 160 ft <sup>2</sup>	30 cm $\approx$ 1 ft

- ▶ Distance between riser headers (Group of risers arranged in-line over the lateral pipe) shall not exceed of 50m 164' (25m 82' on either side)
- ▶ All riser assemblies shall consist of a ½" (20mm) PE riser pipe with a ½" x ¾" (Poly x Male) PE compression fitting and a ¾" x 16mm x 16mm poly compression swivel tee, suitable for dripline connection



# IRRIGATION SYSTEM GUIDELINES

## Design Guidelines

- Allowed Water Velocities
  - Lateral Lines (up to 2") → 0.9 m/s (3 fps)
  - Lateral Lines (3" & 4") → 1.05 m/s (3.5 fps)
  - Mainlines (4" & above) → 1.2 m/s (4 fps)
- Allowed Hydrodynamic Losses
  - Mainline Pressure Loss → Not to exceed 4.0 m (5.8 psi)
  - Total Friction Loss (Lateral End to Solenoid Valve) → Max 2.5 m (3.63 psi)
  - Solenoid Valve Assembly Head Loss → Max 3.0 m (4.3 psi)
  - Pump/Filtration Complex Head Loss → Max 5.0 m (7.25 psi)
- Pipe Materials in Pump Room
  - Filtration Station Manifolds → Epoxy      -coated steel (Schedule 80)



# IRRIGATION SYSTEM GUIDELINES

## Design Guidelines

SV Size (inch)	Inlet/Outlet Pipe Size	SV Flow (lps)	uPVC Pipe Size (inch)	uPVC Pipes Flow (lps)
			1"	0.55
1"	1"1/2	1.25	1"1/2	1.25
1"1/2	2"	1.97	2"	1.97
2"	3"	5.03	3"	5.03
3"	4"	8.33	4"	8.33
			6"	20.50
			8"	35.9
			10"	55.8
			12"	78.6



# IRRIGATION SYSTEM GUIDELINES

## Design Guidelines

SV Size (inch)	Inlet/Outlet Pipe Size	SV Flow (gpm)	uPVC Pipe Size (inch)	uPVC Pipes Flow (gpm)
			1"	8.72 gpm
1"	1.5"	19.81 gpm	1"1/2	19.81 gpm
1"1/2	2"	31.22 gpm	2"	31.22 gpm
2"	3"	79.73 gpm	3"	79.73 gpm
3"	4"	132 gpm	4"	132 gpm
			6"	325 gpm
			8"	569 gpm
			10"	885 gpm
			12"	1,246 gpm



# IRRIGATION SYSTEM GUIDELINES

## Design Guidelines

- Seasonal Adjustment

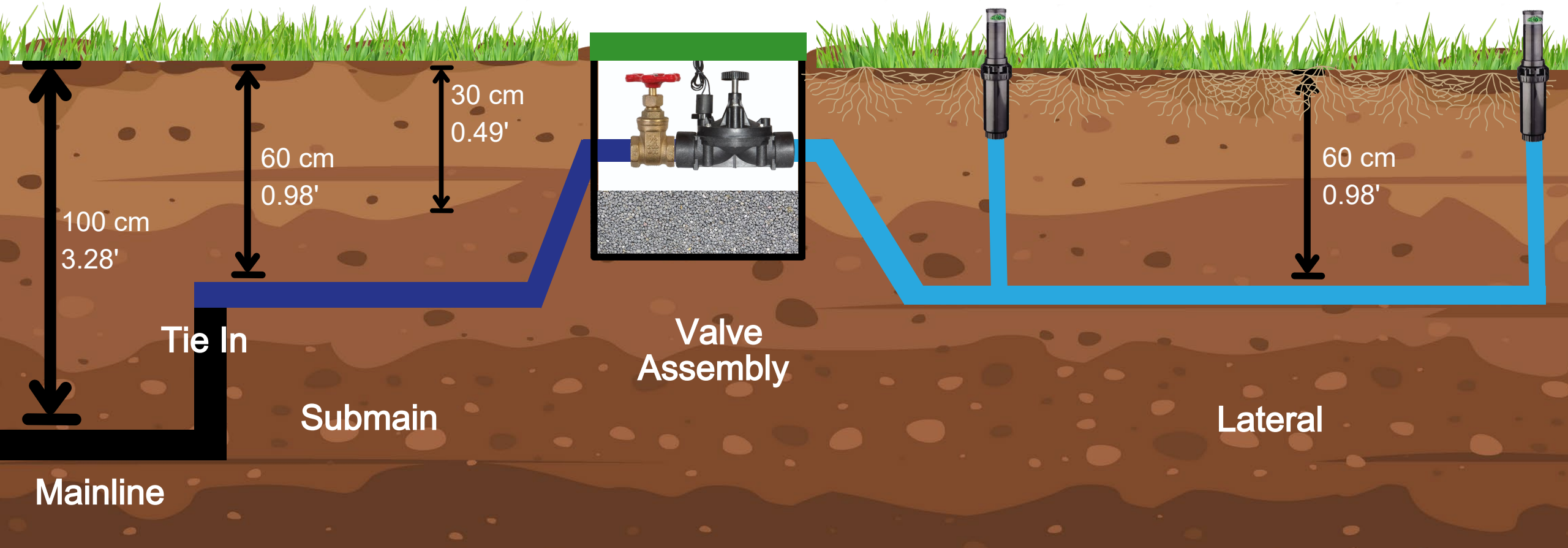
- *Summer (June – August) → 100%*
- *Autumn (September – November) → 75%*
- *Winter (December – February) → 50%*
- *Spring (March – May) → 75%*





# IRRIGATION SYSTEM GUIDELINES

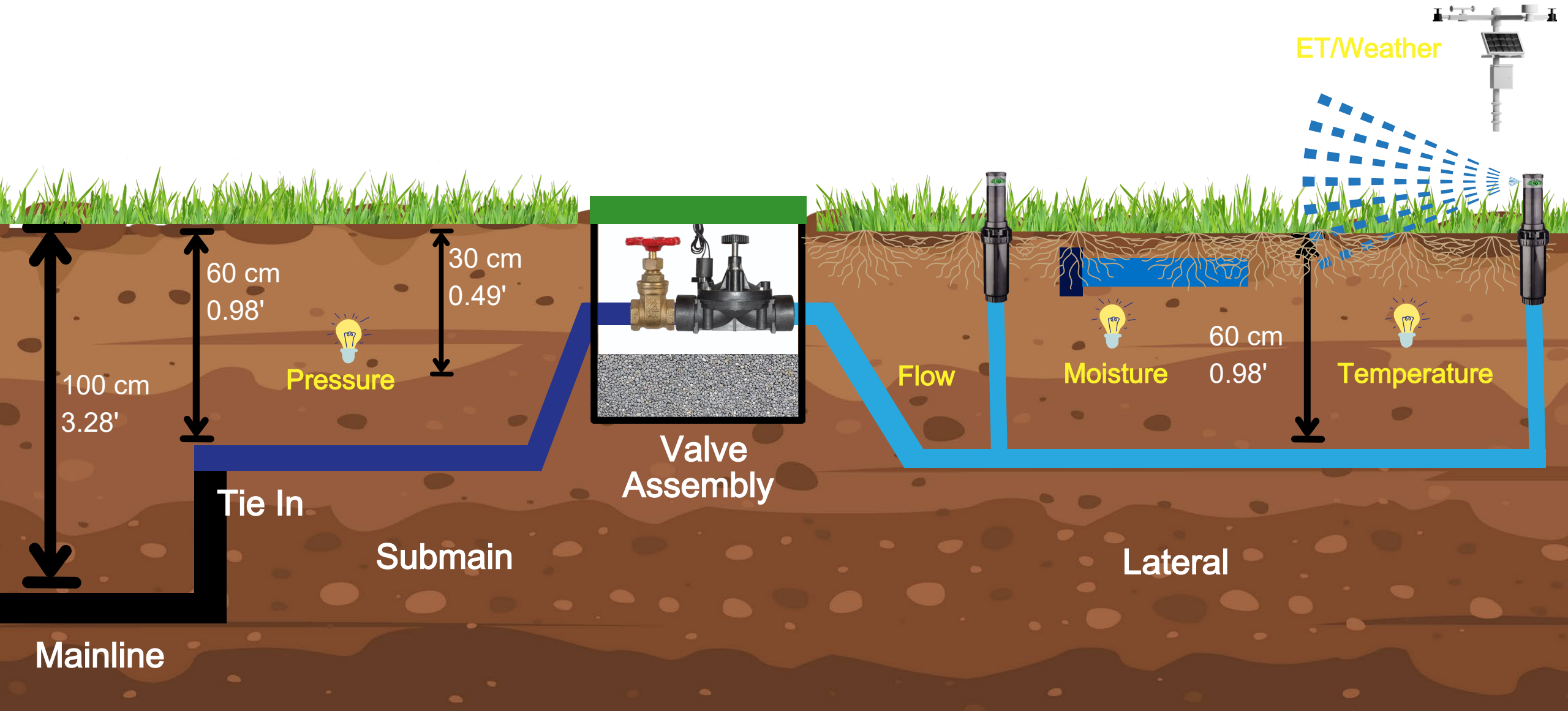
## Installation - Hydraulic Components





# IRRIGATION SYSTEM COMPONENTS

## Installation - Smart Sensing





# IRRIGATION SYSTEM GUIDELINES

## Maintenance Practices

- Daily Maintenance

- *Check and adjust all sprayers for proper coverage*
- *Check and adjust all emitters and bubblers for proper discharge*
- *Replace any clogged or shooting emitters*
- *Avoid watering over palm tree trunks*
- *Avoid watering over footpaths, jogging tracks*

- Weekly Maintenance

- *Inspect all valves in valve box and chambers and rectify any defect immediately*
- *Check all poly pipes and connections*



# IRRIGATION SYSTEM GUIDELINES

## Maintenance Practices

- Monthly Maintenance

- *Operate the irrigation system to check for broken, plugged or misaligned equipment*
- *Check all sprayers/sprinklers for popping up and down, replace leaking and broken heads*
- *Remove any grass or weeds that may affect the operation of the sprayers*
- *Trim grass and plants around valve boxes and pull boxes to keep them visible always*
- *Check for broken valve boxes and pull boxes and replace them*
- *Check and clean inside the valve boxes and pull boxes and place new gravel if intruded by soil*
- *Check waterproof wire connectors for coils and decoders and replace them if required*
- *Check conduit ends and seal properly if ends are open*
- *Check the location of the emitters and their location next to the plants*



# IRRIGATION SYSTEM GUIDELINES

## Maintenance Practices

- Half Yearly Maintenance
  - *Flush complete automatic system main line*
  - *Flush all uPVC lateral pipelines & poly pipes*
  - *Clean filters of all sprayers and bubblers*
  - *Check sprayer wiper seals and replace and necessary*



# SUSTAINABLE IRRIGATION SOLUTIONS

## GCC TOPICS - Water Budget


- Cities Exponential Growth
  - *NEOM in KSA: \$500 Billion High Tech Megacity of a 26,500 Km<sup>2</sup> (10,232 square miles)*
  - *MASDAR City in UAE: Sustainable Urban Community*
  - *LUSAIL in Qatar: 200,000 Resident City*
  - *DUBAI SOUTH in UAE: Multi -purpose city with Al Maktoum International Airport*
- Tips for Irrigation Designers 
  - *Water Budgets → To be planned properly*
  - *Infrastructure Capacity → To meet long -term demand*
  - *IoT in Irrigation → Implement Smart Technologies at a City Scale*

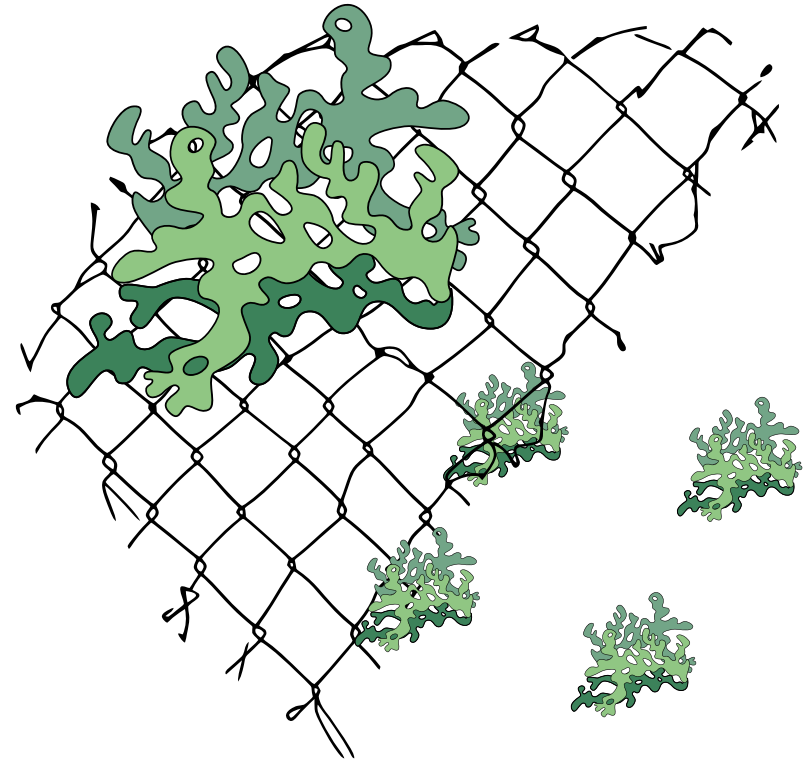




# SUSTAINABLE IRRIGATION SOLUTIONS

## GCC Topics - Water Quality

- Key Concern
  - *Predominantly Organic & Microbial Contamination*
- Tips for Irrigation Designers 
  - *Water Source → Address contamination*
  - *Appropriate Filtration → 3D filtration*
  - *Proper Emitters → Use emitters resistant to clogging*



**7 psi threshold!**



# SUSTAINABLE IRRIGATION SOLUTIONS

## GCC Topics - Operation & Maintenance

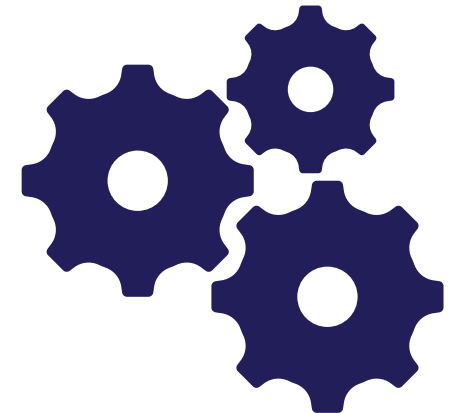
- Key Factors

- *Contractors' Expertise → Skilled workforce availability varies*
- *Maintenance Budget → Cost constraints impact system upkeep*
- *Hot Weather Conditions → From uPVC to polyethylene*
- *Extrme Weather Events → Heavy rain & heat storms*

- Tips for Irrigation Designers



- *Specify low -maintenance irrigation Systems*
- *Adapt to site specific conditions for optimal performance*
- *Use smart technologies to protect infrastructure assets*
- *Use landscape for Drainage purpose*





# SUSTAINABLE IRRIGATION SOLUTIONS

## GCC Topics - Integrated Water Strategy

- Water Resource
  - *A Challenge Across All Scales* – *Extends beyond just landscape irrigation*
- Tips for Irrigation Designers 
  - *View water management as an opportunity for integrated indoor & outdoor solutions*





# SUSTAINABLE IRRIGATION SOLUTIONS

## GCC Topics - Market Orientation



*"A daily commitment to driving transformative change in the GCC region by integrating smart, sustainable, and scalable water strategies —empowering the market through education on cutting -edge designs and technologies, while focusing on local GCC conditions and requirements."*