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An Innovative "Smart" Stormwater Harvesting Treatment Train System

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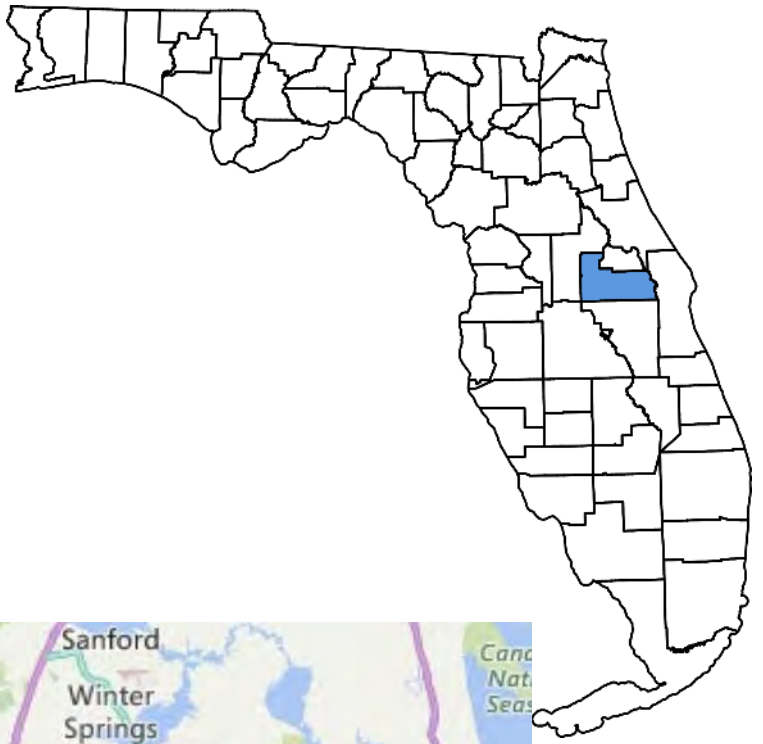
ORANGE COUNTY GOVERNMENT FLORIDA

Presentation Outline

- Introduction
- Project Objectives
- Project Team
- Design
- Construction
- Monitoring
- Results
  - Hydrologic
  - Water Quality
- Summary
  - Challenges
  - Successes

Introduction

- Orange County located in Central Florida
  - Services a diverse population
    - Permanent residents – Over 1.3 million people (2020)
    - Visitors - Over 75 million visitors in 2018 (Globe Newswire, 2019)
  - Protect infrastructure to ensure LOS
  - Protect water quality to ensure quality of life



Introduction

- Orange County Stormwater Management Division
  - Division of OC Public Works Department
  - Responsibilities – Primary drainage systems within unincorporated Orange County
    - Planning
    - Engineering Design
    - Operation
    - Maintenance
  - Administrators for FEMA programs
    - National Flood Insurance (NFIP)
    - Community Rating System (CRS)

Introduction

- Orange County Mission Statement

  Our mission is **to serve the citizens of Orange County and our guests** with integrity, honesty, fairness and professionalism. We are committed to engaging our citizens in the decision making process in order to earn their trust and **improve our quality of life**

- Orange County interested in innovative ways to manage stormwater while protecting water quality
- Stormwater harvesting demonstration project particularly attractive
  - Several benefits

Introduction - Benefits

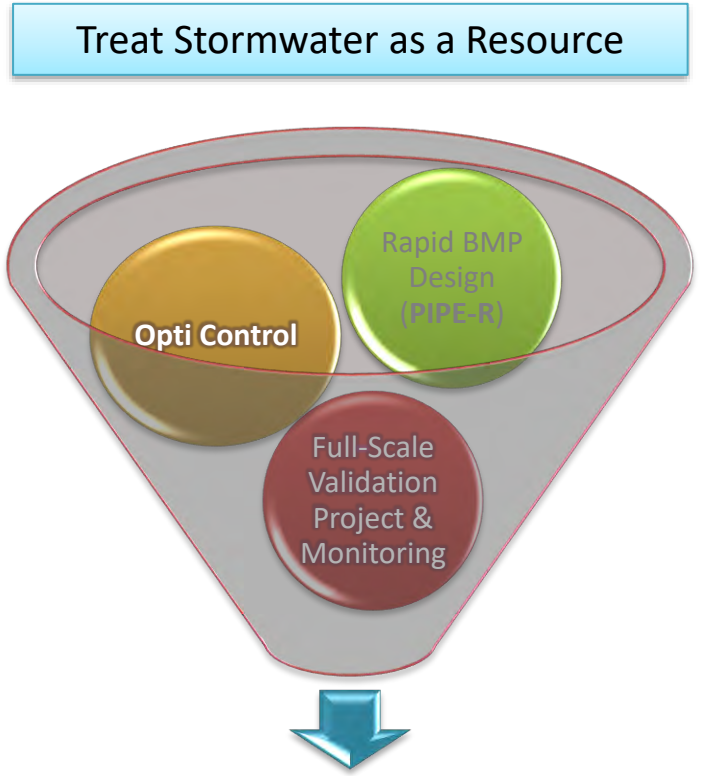
- Reduce stress on downstream stormwater system and reduces the mass of pollutants discharged
  - Reduce volume of stormwater leaving site
    - Harvest stormwater for non-potable applications
      - Irrigation
      - Equipment washing
      - Toilet flushing
    - System overflow preferentially goes to exfiltration component
  - Opti controls release excess stormwater from system prior to the arrival of storm event
    - Allows more water to infiltrate in drainfield overflow (increased time)
    - Increases downstream pond capacity

Introduction - Benefits

- Replace potable water use with stormwater
  - Reduce cost for user – lower water bill
  - Reduce stress on potable water system
    - Municipalities have significant water demand for non-potable applications
    - As aquifers continue to experience stress due to overuse the cost of potable will continue to increase further necessitating the use of stormwater and grey water for non-potable applications
- Introduce a new stormwater BMP to the Florida market
  - Give consultants a new tool to help clients address stormwater needs
  - Give regulators a new tool to help protect waters of the state

Project Objectives

- Objectives:
  - Design and construct full-scale, operational stormwater harvesting and exfiltration BMP. Project elements include:
    - Design and construction of a full-scale stormwater harvesting and exfiltration demonstration system at a Central Florida facility.
    - Implementation of real-time monitoring and control of the stormwater harvesting system by integration of Opti technology.
    - Monitor system for 1 year to determine water quality and quantity benefit of the integrated system.



Integrated Stormwater Management Solution

Project Team

- Project team
  - Project Funding
    - Orange County Public Works (provided location)
    - ECS, LLC
    - Opti RTC
    - Geosyntec Consultants, Inc.
  - Design Engineer
    - Geosyntec Consultants, Inc.
  - Construction Contractor
    - Scarborough Construction (general contractor)
    - Dan-Bar (electrical contractor)
  - Monitoring Equipment
    - Opti RTC
    - Geosyntec Consultants, Inc.

Design

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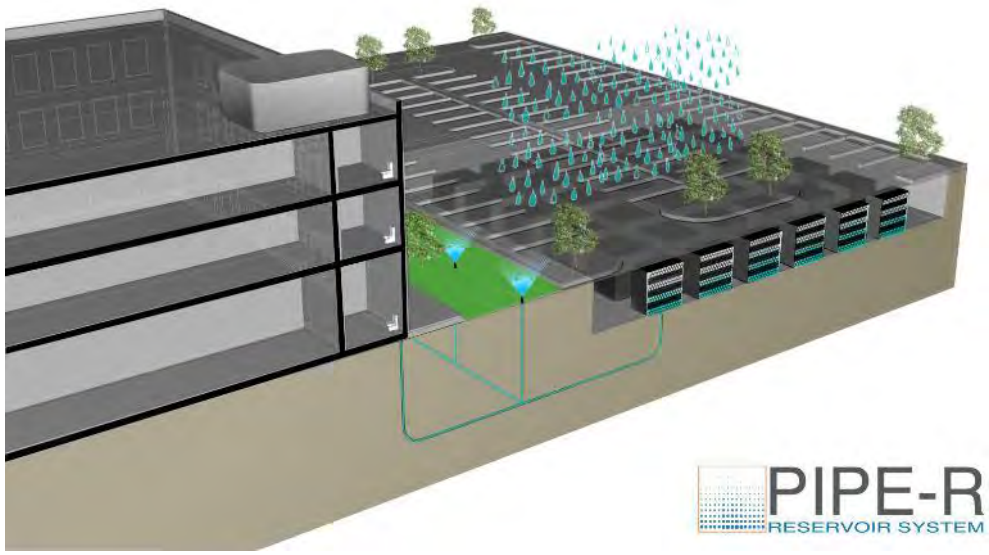
Design

- Design goals
  - Reduce stormwater discharges by >80%
  - Supply >70,000 gallons of reuse water per year
  - Increase groundwater recharge by >40,000 gallons per year
  - Demonstrate alternative stormwater harvesting application
    - Typically irrigation
      - When you have water you don't need to irrigate
      - When you don't have water, you need to irrigate
  - Demonstrate the benefit of real-time controls

Design Concept – PIPE R

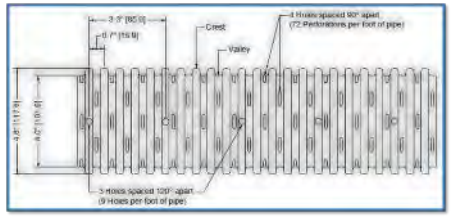
- Underground exfiltration
- Stormwater/graywater Harvesting
  - Under parking lots
    - Traditional
    - Pervious
  - Under landscaping
- Real-time control technology



Design Concept – PIPE R

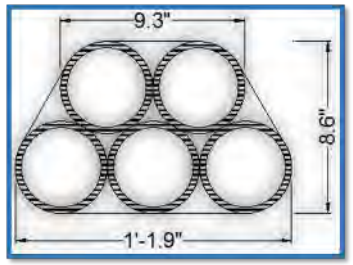
PIPE-R™ Reservoir System

4” corrugated HDPE pipe. Made in the USA from 100% recycled material.



96% Void Space

Bundled into units of 5 (BPUs) - range from 8 1/2” to 86” to fit into very tight areas.

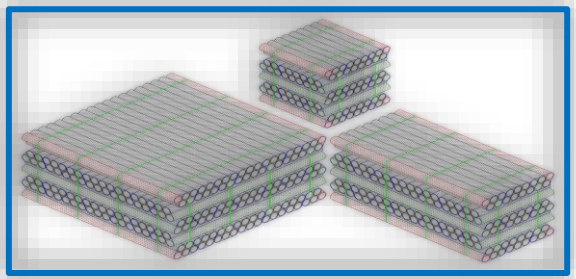


Interlocked, stacked, and banded into cubes. 3 standard sizes:

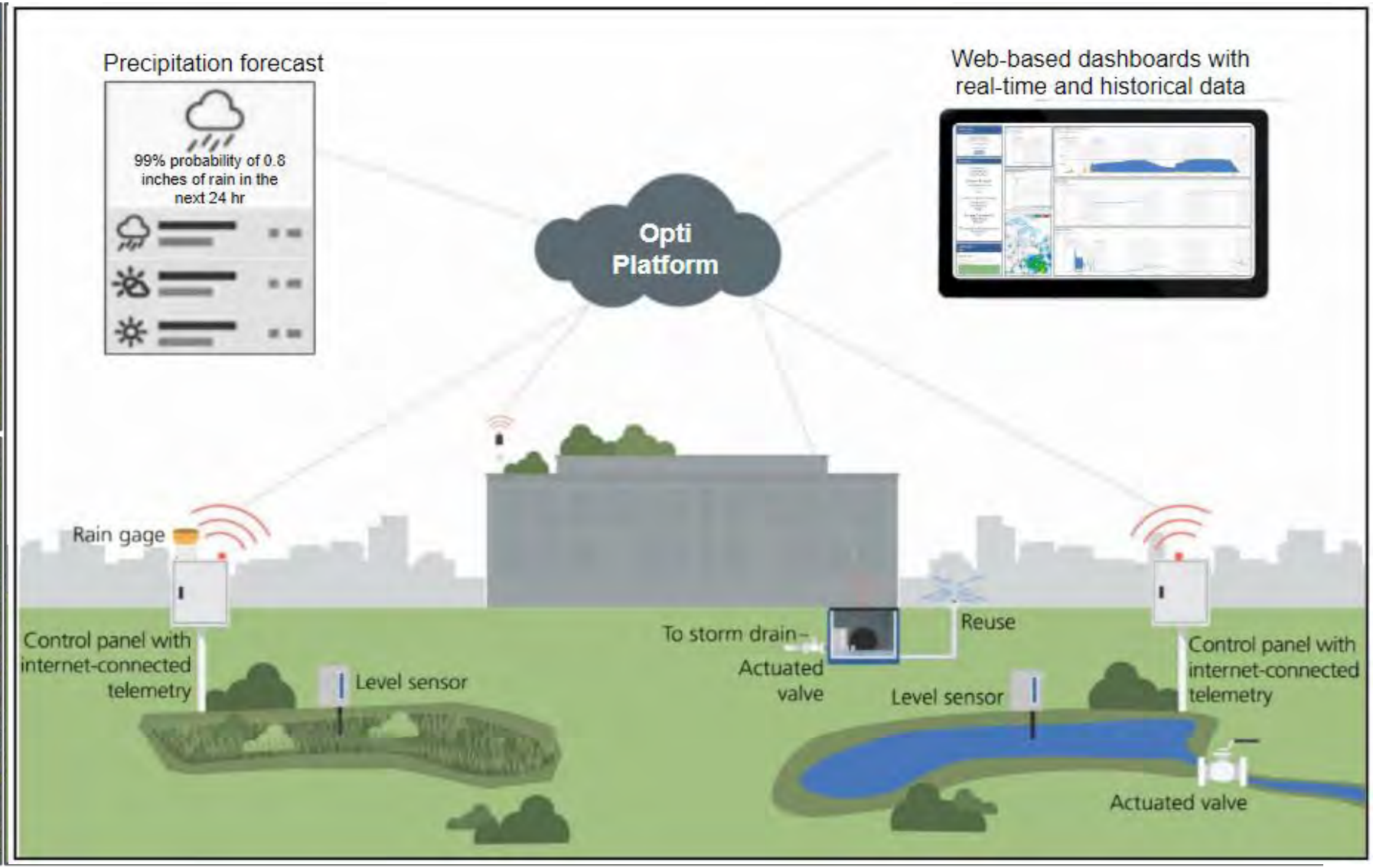
7 1/2’ x 7 1/2’

7 1/2’ x 3 1/2’

3 1/2’x 3 1/2’



Design Concept – Opti Real-time Control

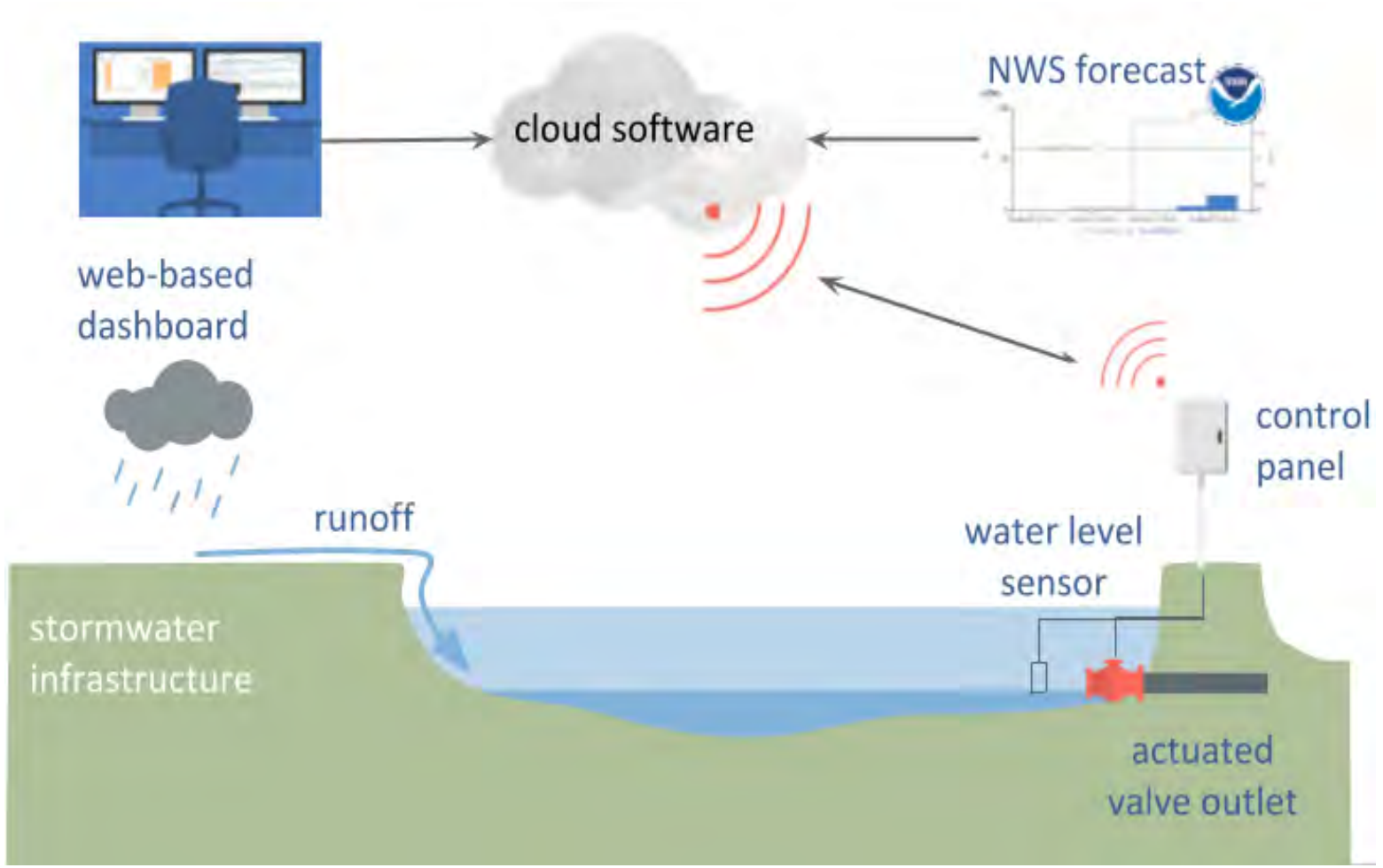


Design Concept – Opti Real-time Control

Lakes

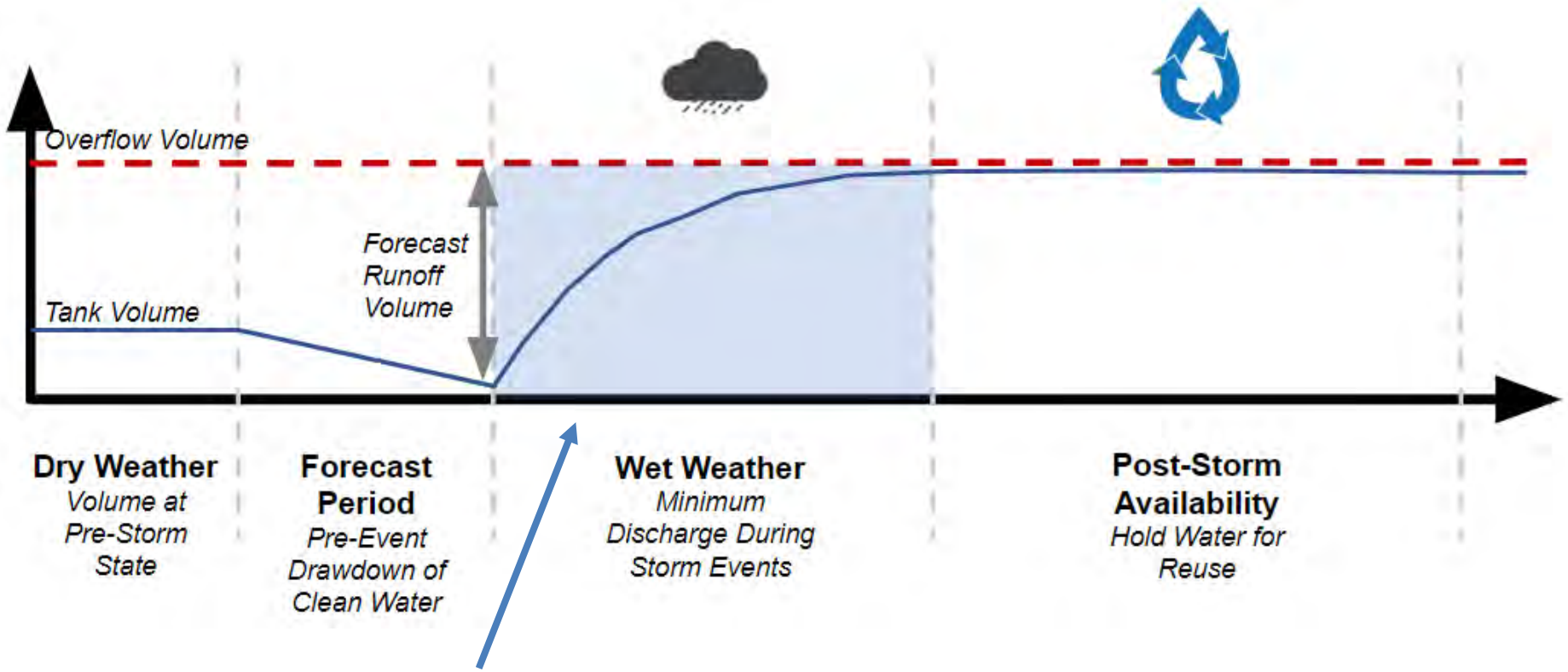
Ponds and Wetlands

Detention Structures



Design Concept – Opti Real-time Control

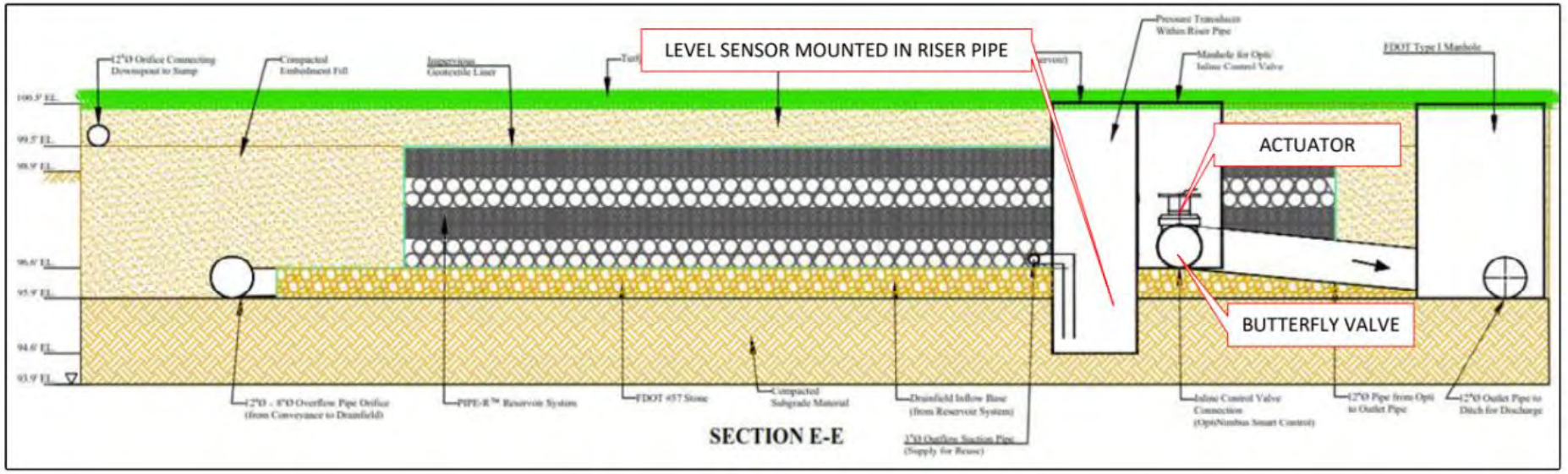
Allows system draw down before the storm event arrives



Capture full rainfall volume

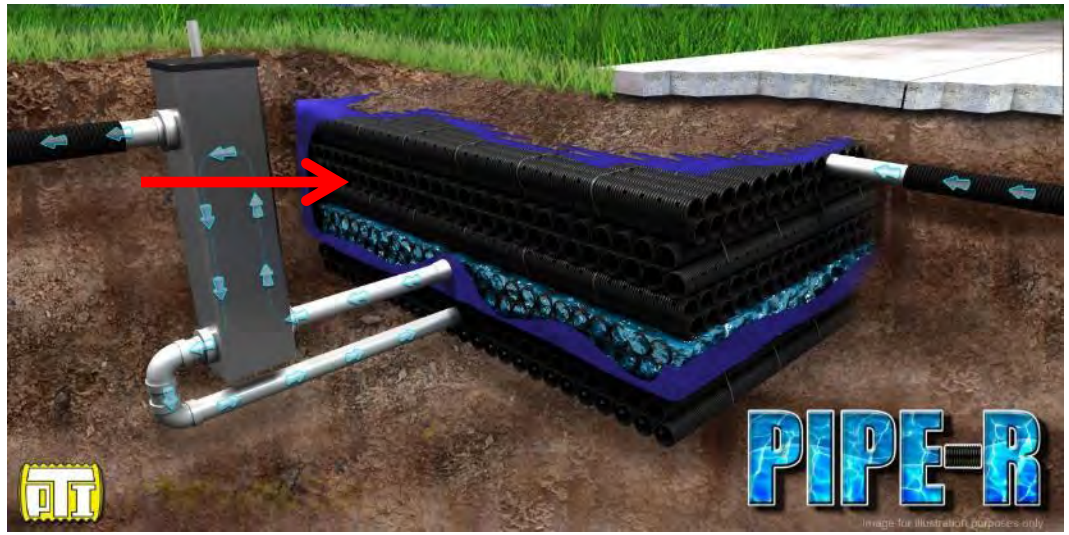
Design Concept – Opti Real-time Control

Maximize water availability and water quality



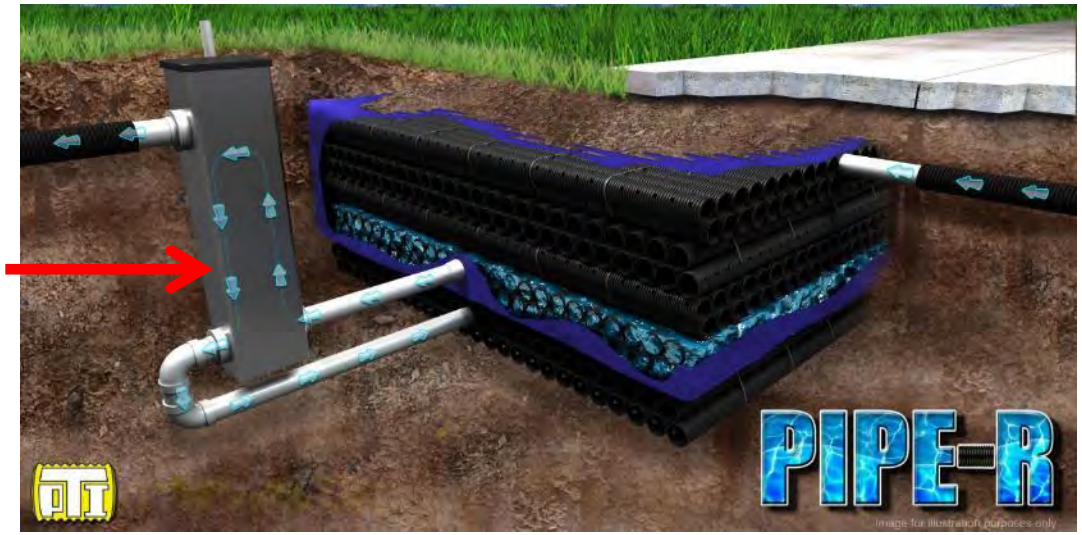
Design Concept

- Main Components
  - Reservoir storage layer
    - Storage of harvested water
    - Exfiltration if installed without liner



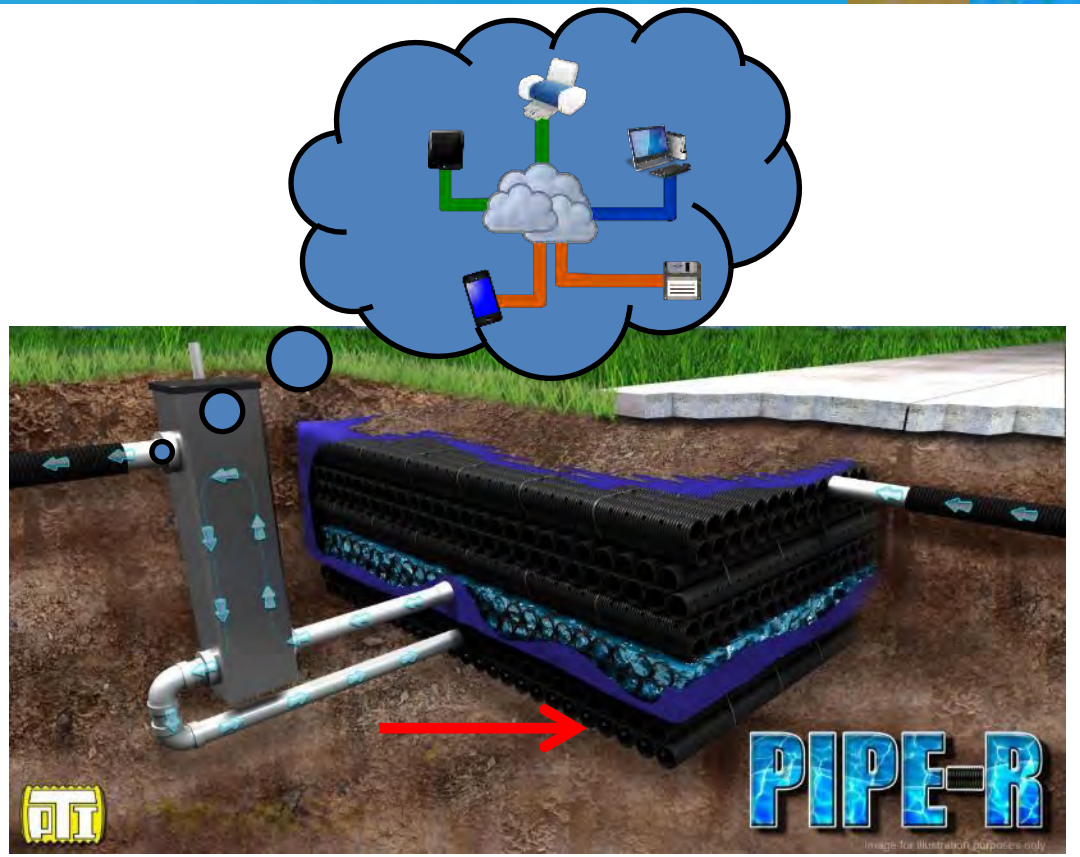
Design Concept

- Main Components
  - Control box
    - Controls the water level in the reservoir layer
    - Not required for exfiltration system
    - Location of pump



Design Concept

- Main Components
  - Drainfield overflow
    - Allows water to infiltrate prior to discharge to drainage infrastructure
    - Not required for exfiltration systems



Design – Underground Storage

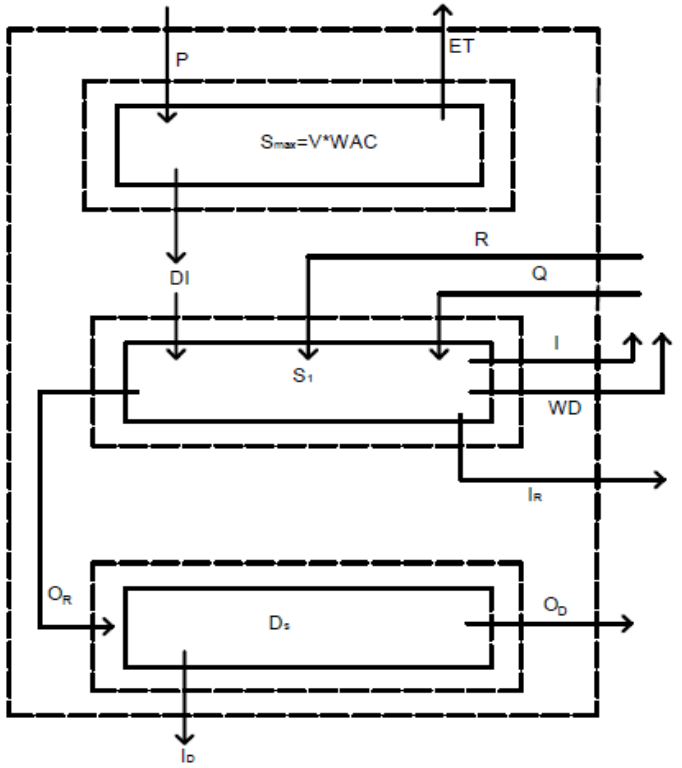
- The **PIPE-R** numerical model was used to design the system and predict long-term performance
  - 10-year hourly continuous simulations
  - Less likely to under- or over-design stormwater BMP
  - Ability to achieve similar volume reduction with smaller and thus more economical system
- Incorporation of Opti real-time control technology to increase stormwater harvesting efficiency of the BMP
- System size to meet project goals was 10,000 gallons

Model Schematic

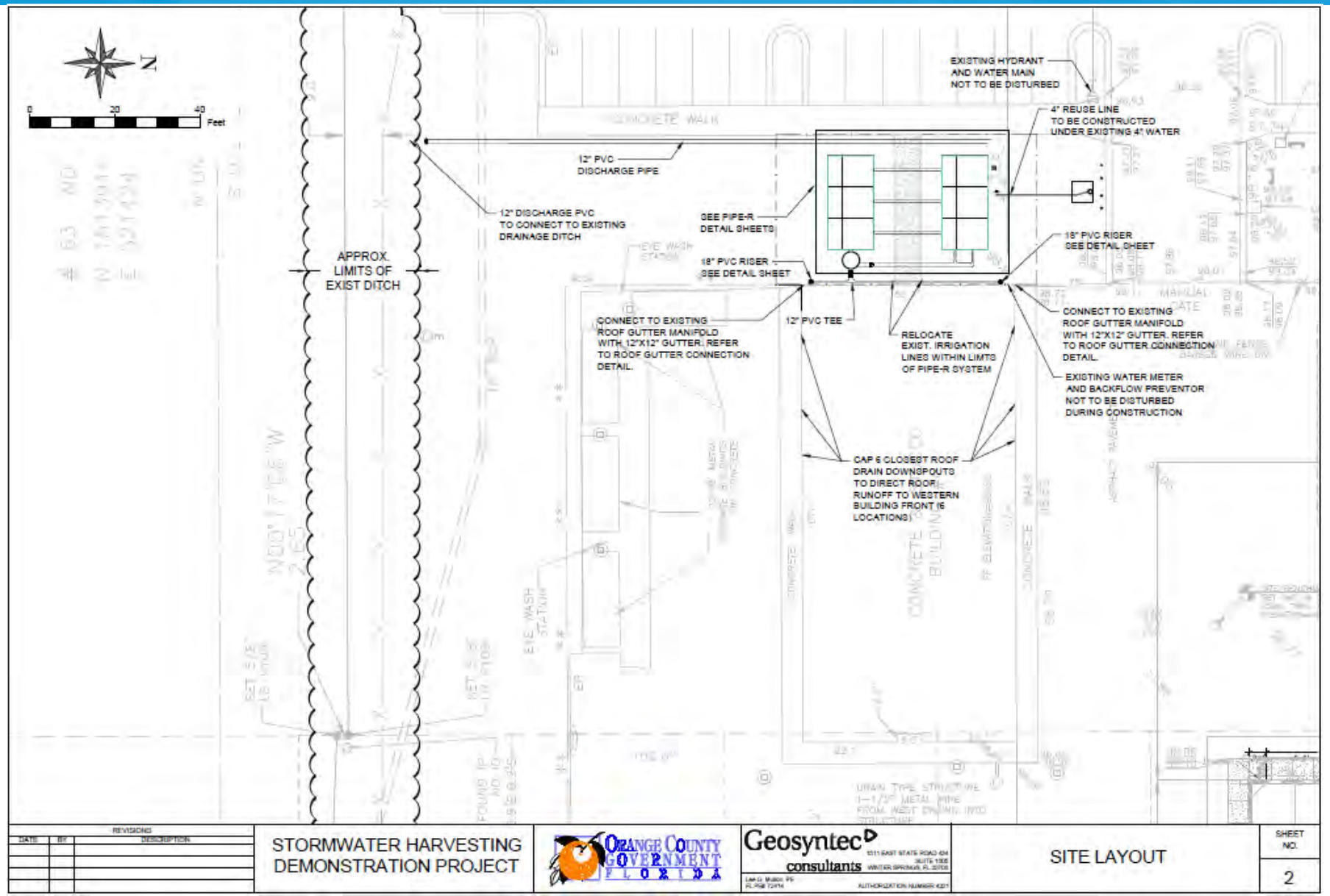
Top surface layer

Reservoir

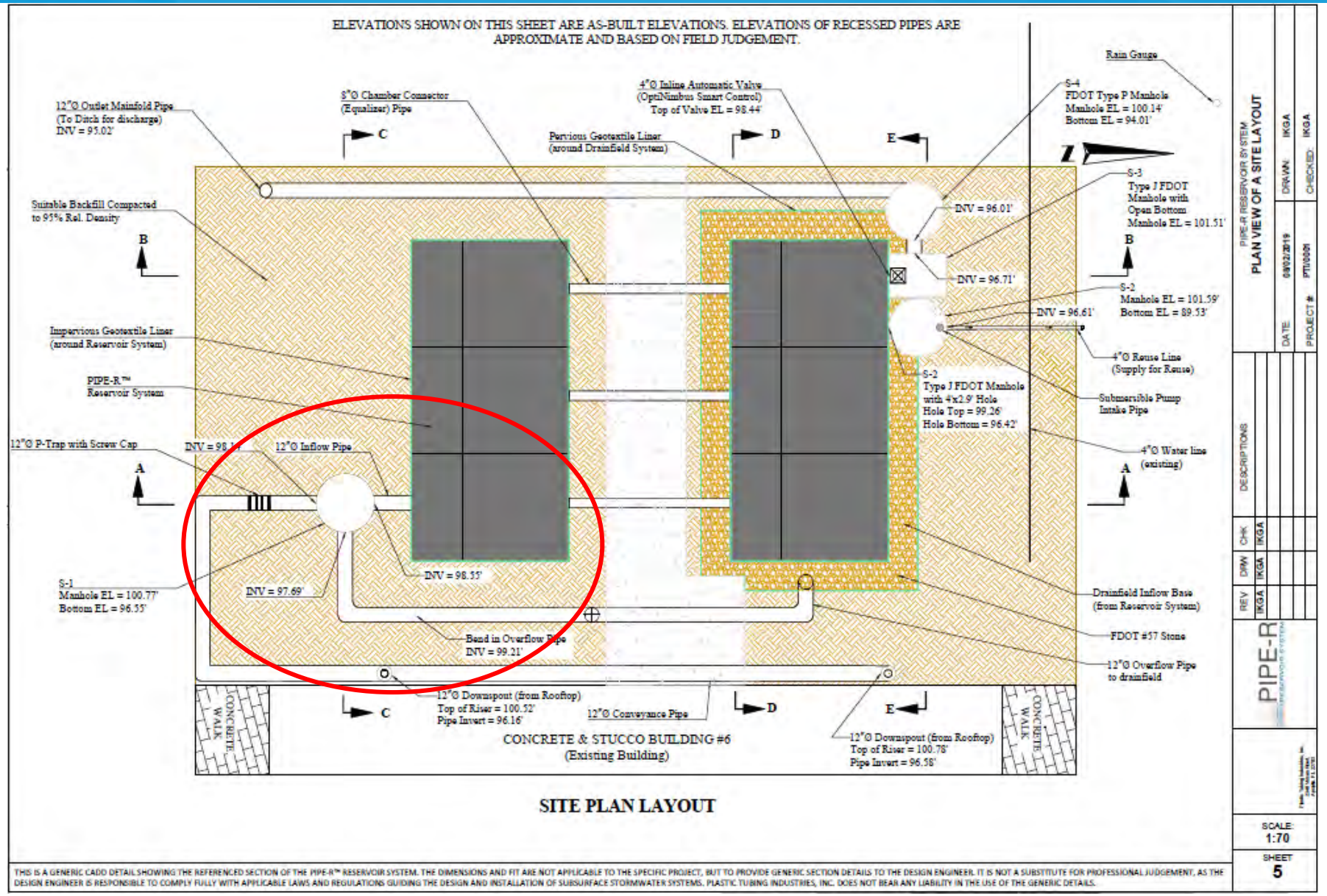
Drainfield



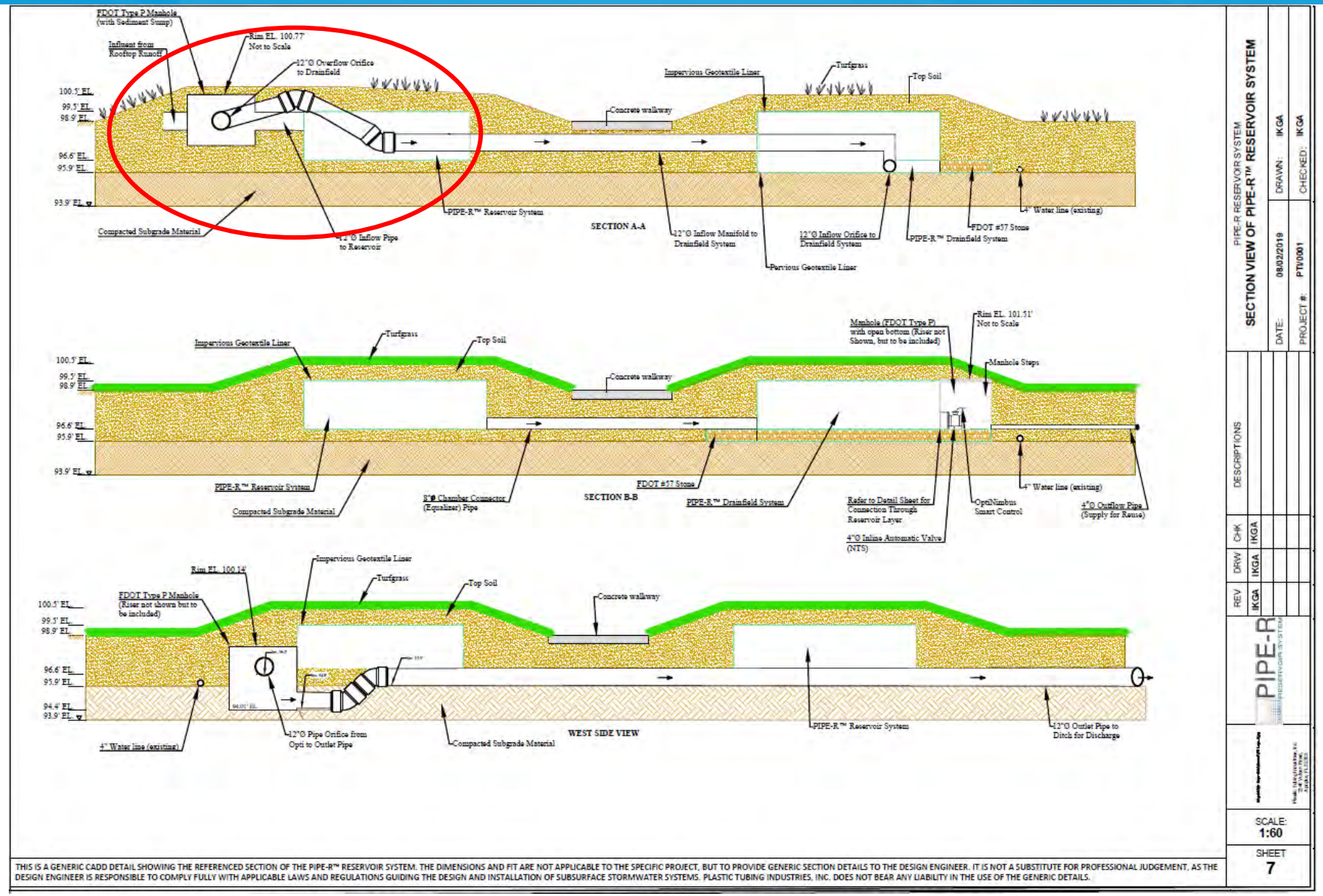
Design – Selected Plan Sheets: Site Layout



Design – Selected Plan Sheets: Site Plan Layout



Design – Selected Plan Sheets: Section View



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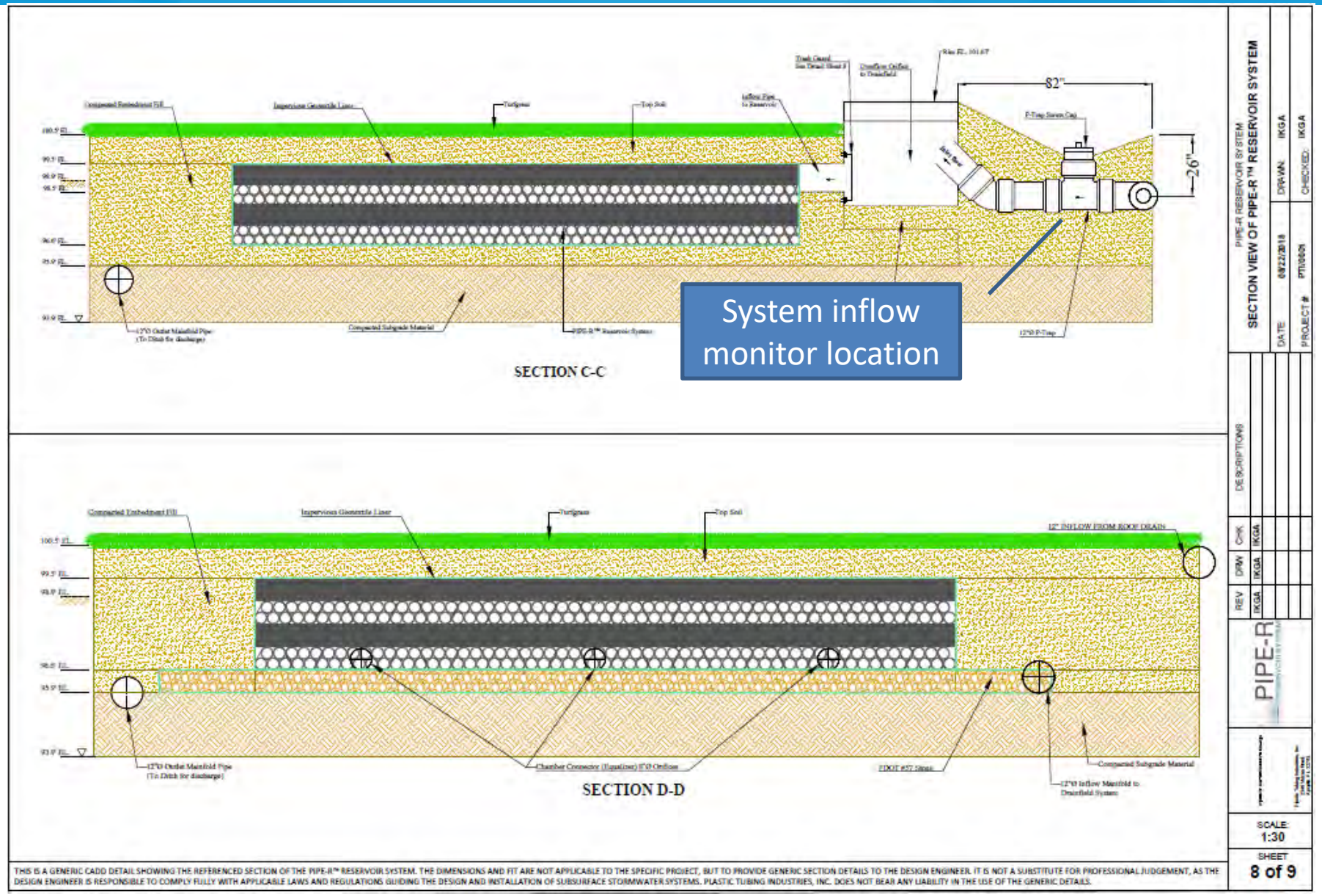

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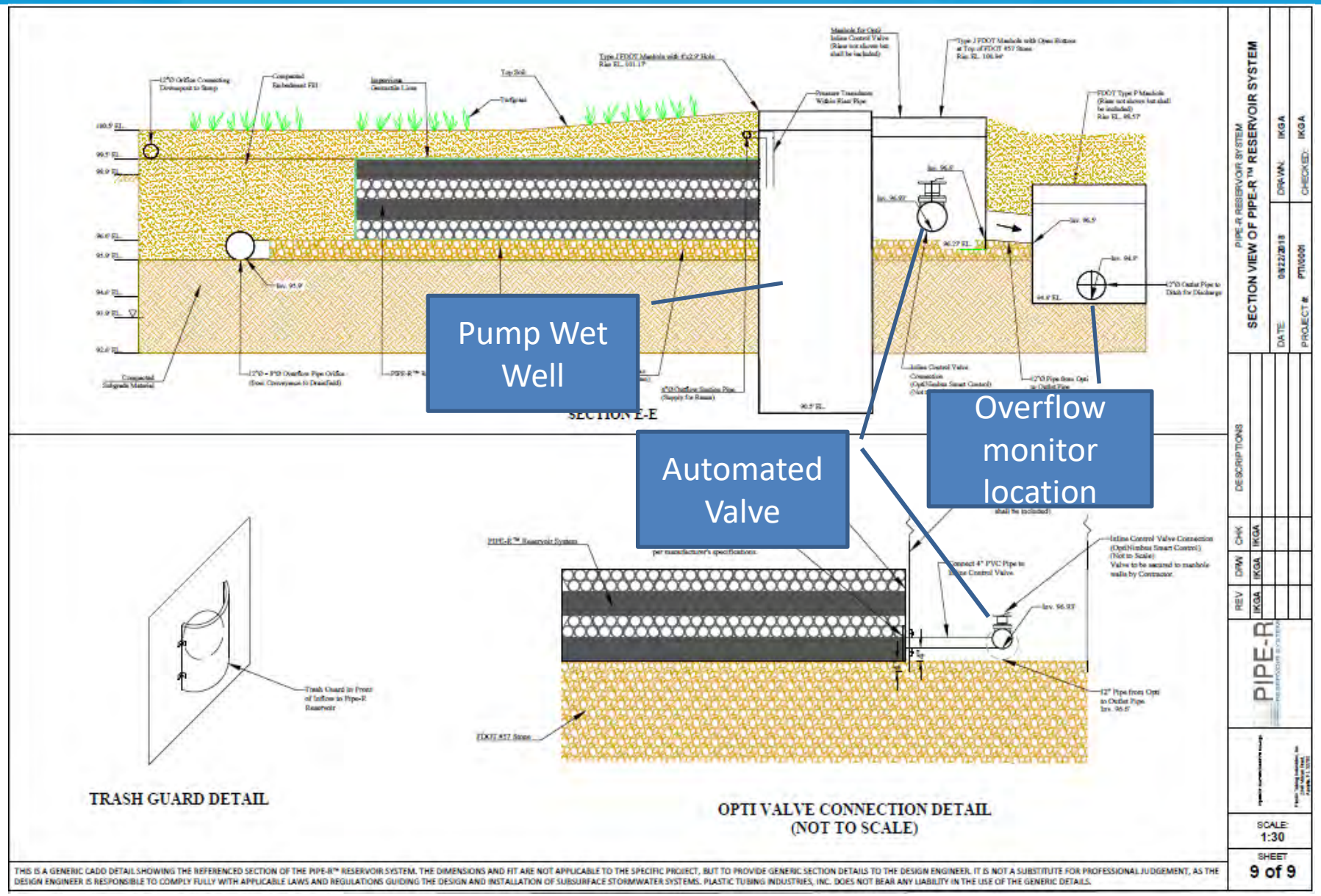

Construction

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Construction

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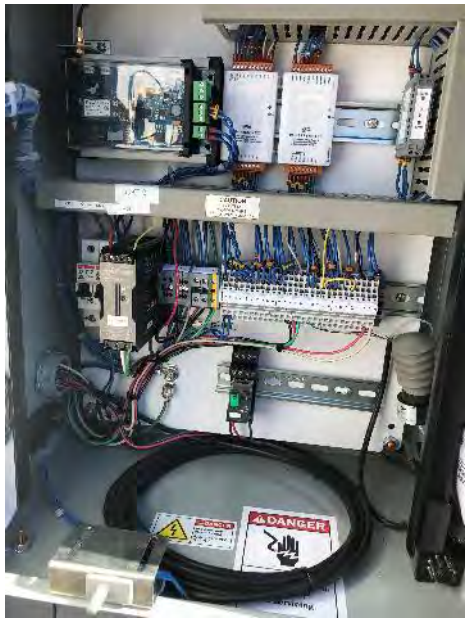

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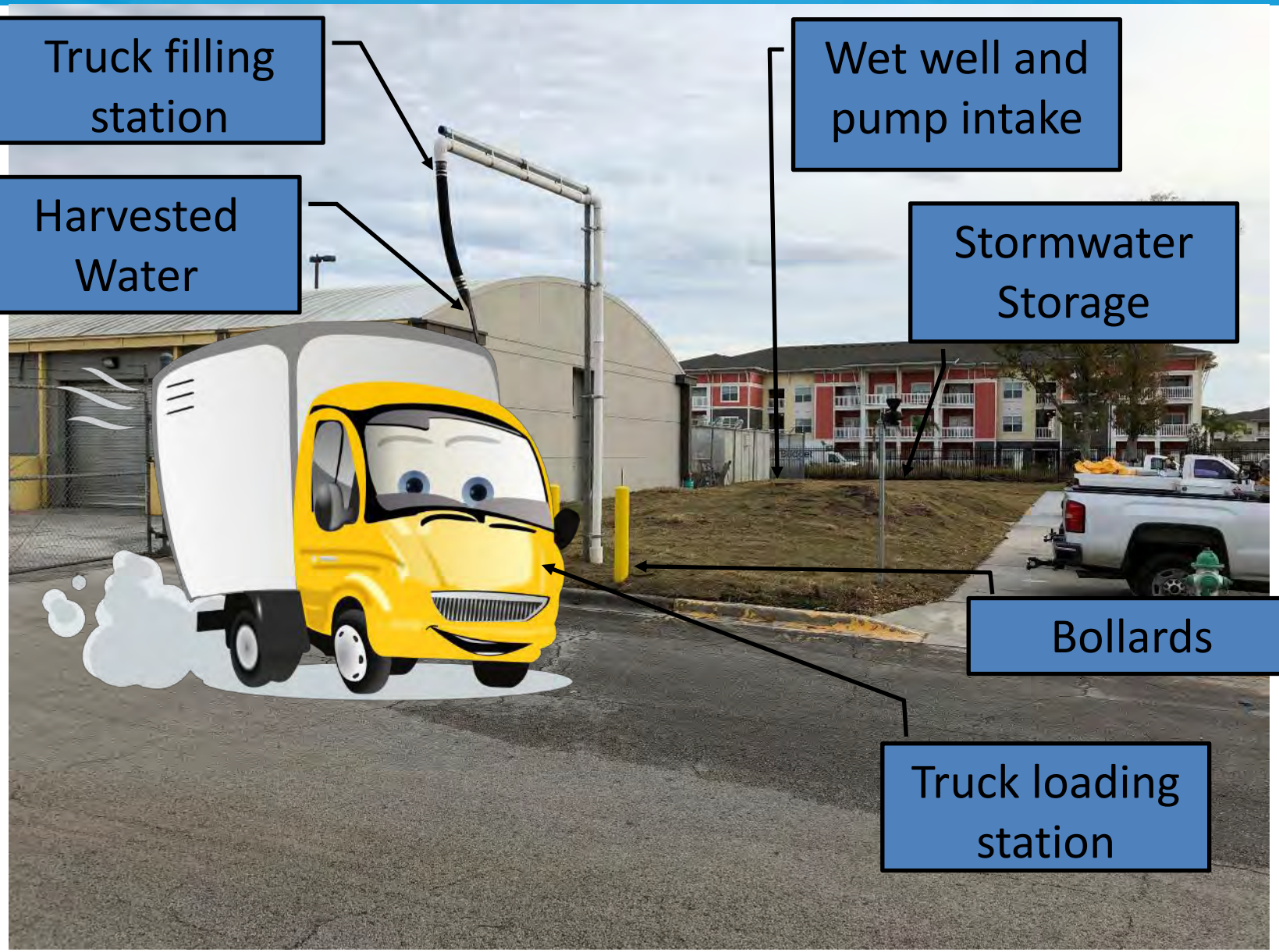

Results

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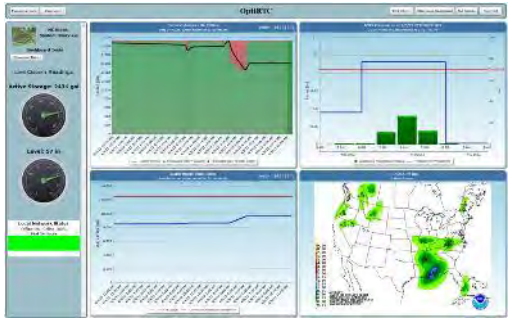
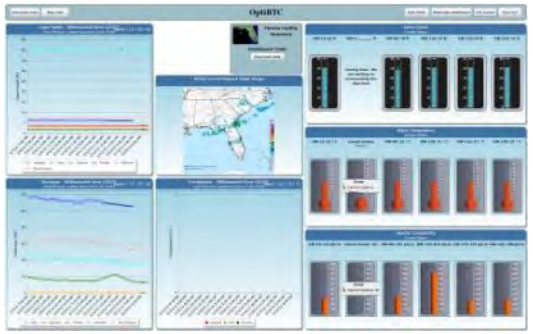
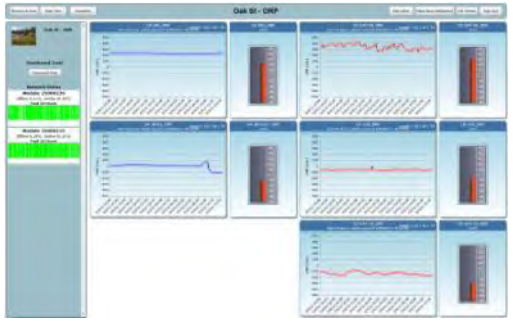
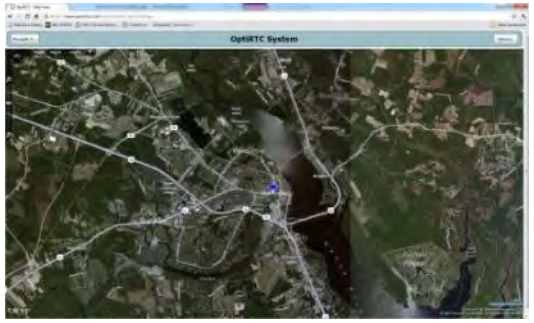
Results

- Monitoring for this project included
  - Rainfall Monitoring
  - Inflow Monitoring
  - Overflow Monitoring
    - Drainfield
    - Bypass
  - Harvested Water (calculated)
  - Water Quality
    - NOx
    - TKN
    - TN
    - TP
    - TSS
    - Fecal Coliform
    - pH

Results

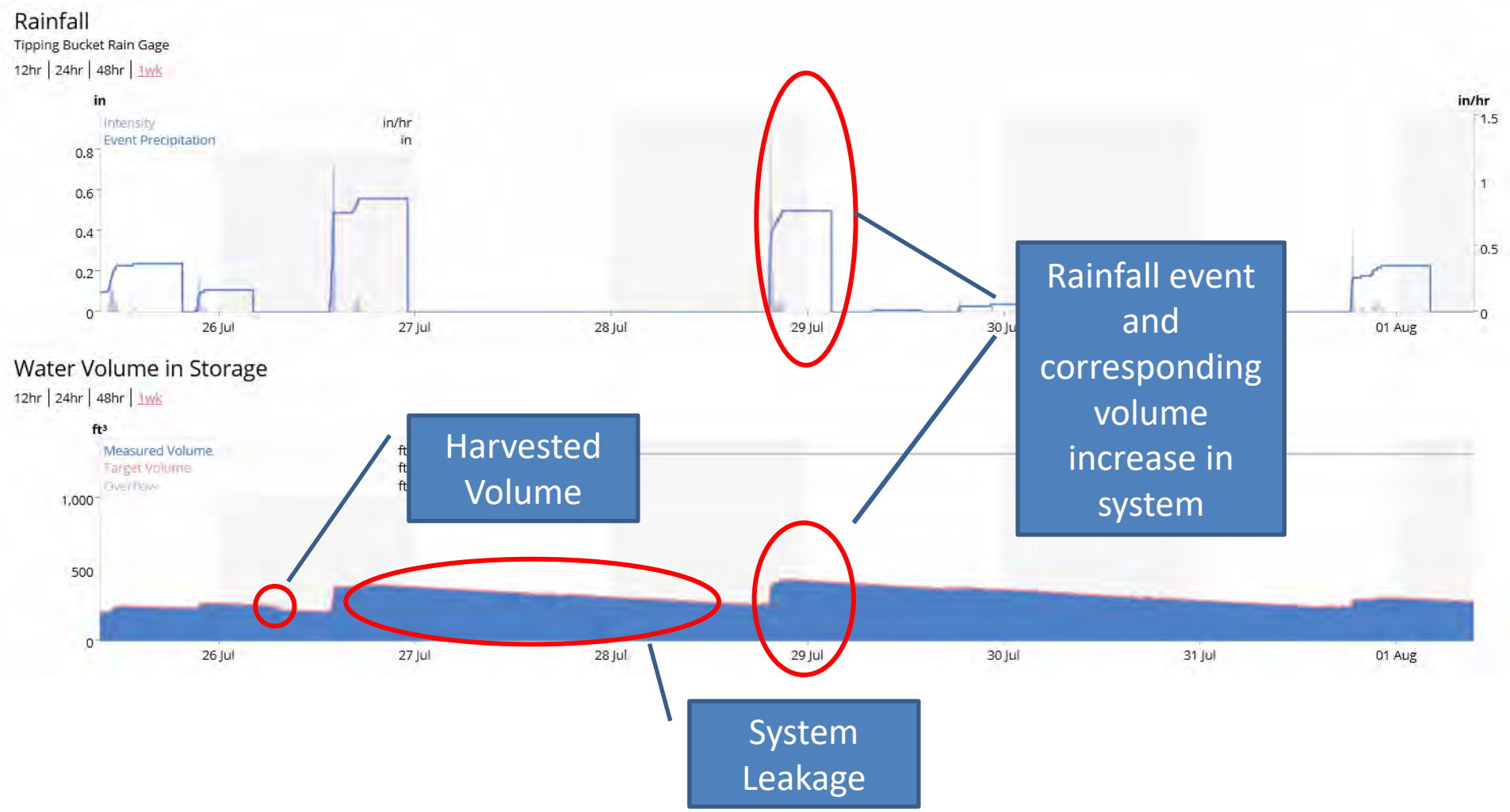
- Opti Dashboard
  - Allowed for real-time assessment of current conditions of system
  - Helped diagnose leaking issue
  - Helped track and identify when water was used for harvesting



Results

Opti Dashboard



Results – Water Budget

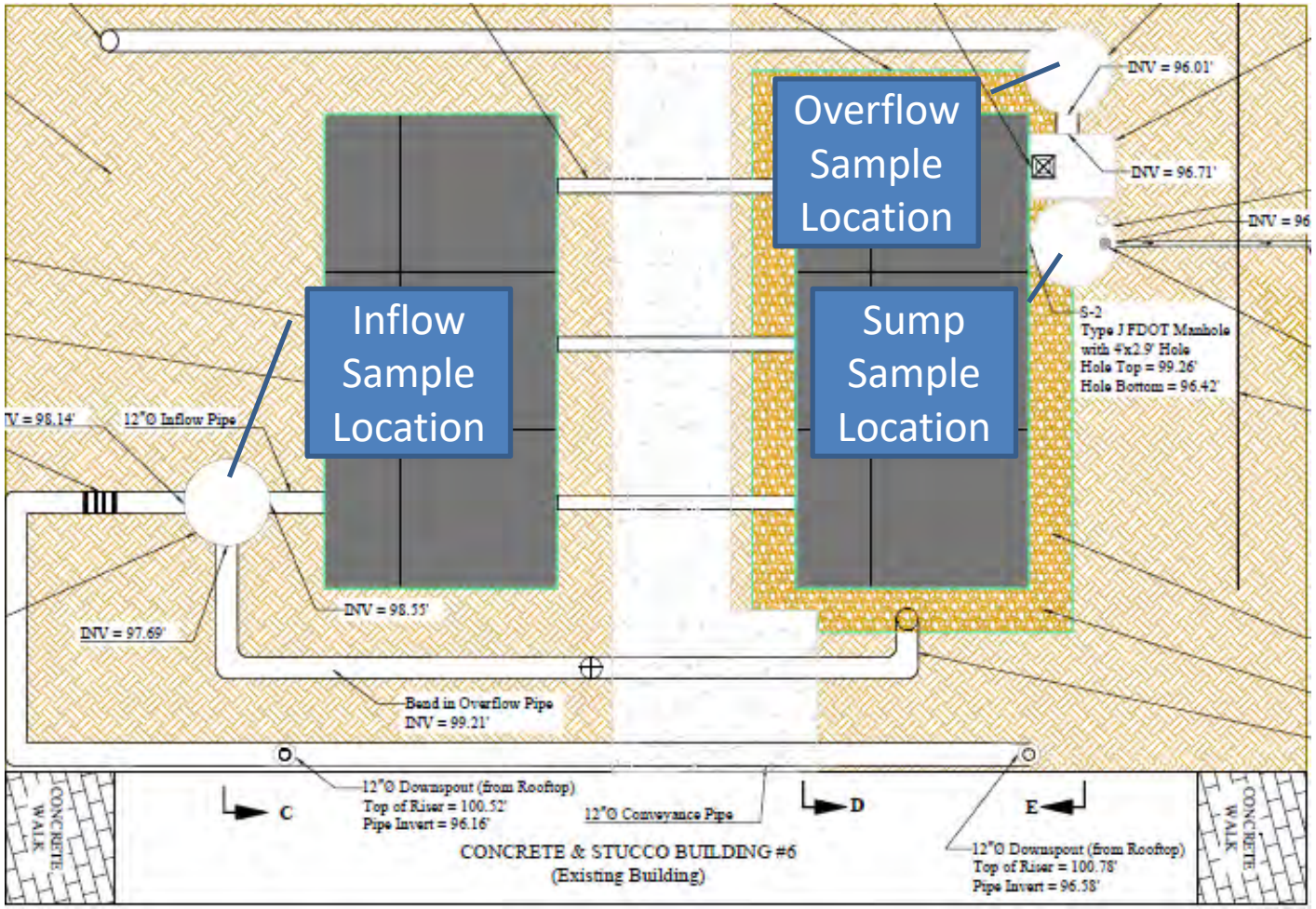
- The following parameters were monitored for approximately 1 year
  - Precipitation = 43.47 inches
  - Runoff Volume = 143,186 gallons
  - Harvested Volume = 7,000 gallons = 5%
  - Leakage = 55,000 gallons = 38%
  - Infiltration (maintenance discharges are included in this total) = 81,000 gallons = 57%
  - Overflow = Negligible ~ 0%

Results – Water Budget

- Was able to prevent nearly all stormwater runoff from discharging downstream
- County harvested approximately 5% of the total runoff generated, or 7,000 gallons
- Infiltrated almost all the rest of the water
- Leakage resulted in the following
  - Minimized the amount of water available for harvesting
  - Significantly increased the infiltrated water >95% of total

Results – Water Quality

- Have collected 3 water quality samples from three locations in the system



Results – Water Quality

Sample Results	Inflow	Sump	Overflow
– NOx [mg/L]	0.183	0.055	1.435
– TKN [mg/L]	0.283	0.119	0.67
– TN [mg/L]	0.463	0.17	2.1
– TP [mg/L]	0.036	0.015	0.135
– TSS [mg/L]	9.57	3.07	3
– Fecal Coliform	4	<1	<1
– pH	7.17	7.69	8.26

- Note that the sump had the best water quality – This is where water is taken from for use
- No bacterial issues
- Overflow had worst water quality except TSS

Summary

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Summary - Challenges

- Had to deal with high seasonal high groundwater conditions
  - Resulted in a raised system
- Maintaining water tight conditions with a liner and curved surface a challenge
  - Use pipe connections, more common
- You never know what you will find when you start to dig, even if you do utility locates
  - Had to move system on the fly due to unknown utility conflict
- Designing without survey
  - Didn’t have the space we thought, had to make design changes on the fly

Summary - Successes

- Successfully built and monitored stormwater harvesting treatment train system
- Prevented almost 150,000 gallons of water from flowing downstream, along with associated pollutants
- Significantly increased groundwater recharge
  - >130,000 gallons
- Demonstrated good water quality for harvested water
  - Overflow had lowest quality, which was likely impacted from the ditch it discharged to
- Demonstrated the benefit of Opti real-time monitoring
  - Were not able to observe benefit of real-time forecasting and control, but being able to monitor system real-time was very helpful (identified leak)

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Thank You!

Questions?

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