Floating Treatment Wetlands

A pilot-study of the stormwater treatment potential in urban catchments in a subtropical environment

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Stormwater Runoff – "Pollutant Soup"

- One of the leading causes of water pollution (National Research Council, 2009)
- Generated from precipitation that flows over land or impervious surfaces
- Can pick up & transport harmful pollutants
- Often transported into
  - Streams/Rivers
  - Lakes/Ponds
  - Groundwater
- Difficult to remove all pollutants with current drainage & storage methods

Image source DrDrainageMedia

Stormwater ponds

Common problems:

- Extreme water level fluctuations
- Nutrients such as N & P can accumulate without proper maintenance
  - Can lead to degraded conditions
  - Released into receiving surface waters

Wetlands – "kidneys of the landscape"

- Wetlands treat stormwater using natural processes such as
  - sedimentation
  - photo-oxidation
  - microbial degradation
  - nutrient uptake
- Erosion control
- Flood abatement
- Habitat enhancement

Image courtesy of EIH

Created wetlands – pros and cons

Images courtesy of Biomatrix Water

What are floating treatment wetlands (FTWs)?

Photo source: Salix®

Artificial islands that utilize plants to reduce pollutants in water

Buoyant mats anchored to the bottom or shore

Rise and fall with fluctuating water levels

Native wetland plant species

Roots suspended in water column

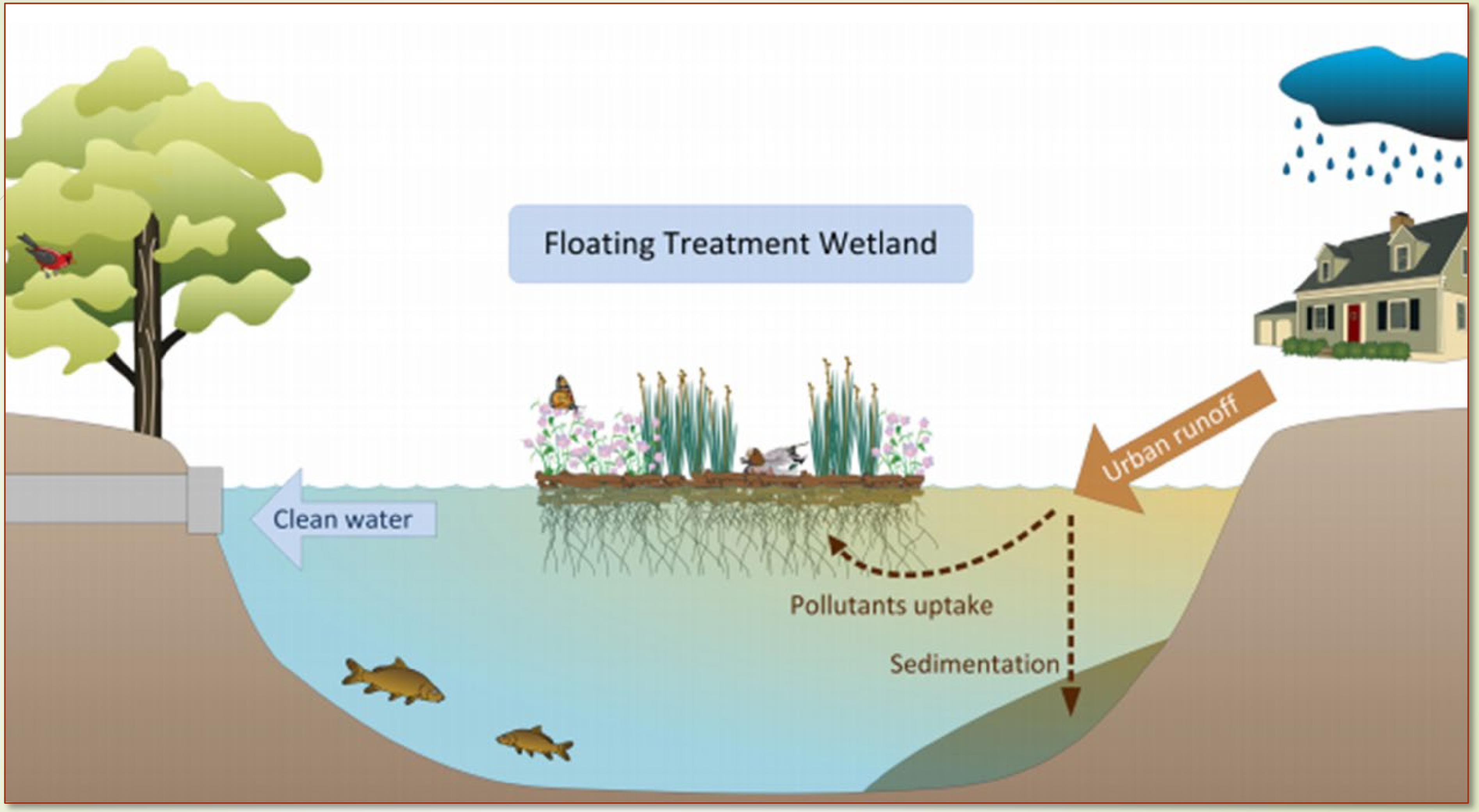


Figure 1. Diagram of a floating treatment wetland receiving urban runoff. Icons courtesy of the Integration and Application Network, University of Maryland Center for Environmental Science.

The benefits of Floating Treatment Wetlands

Image courtesy of EIH

- Expanded wetland surface with no additional land requirements
- Low maintenance = long-term cost savings
- Surface and root systems provide valuable wildlife habitat
- Unaffected by fluctuations in water level
- Adds aesthetic benefits to any system

Purpose of study

- Partnered with Harris County Flood Control District (HCFCD)
  - Phase 1 MS4 co-permittee
  - Responsible for reducing pollutant loads
- HCFCD interested in building and evaluating FTWs for use in flood control basins
  - Monitoring & assessing the performance at enhancing targeted pollutant reductions

Baseline Data Collection

- Flow pattern & residence time
- Ambient conditions and water level
- Water quality
  - Rain events
  - Ambient conditions

Figure 2 shows UHCL watersheds

Image courtesy of EIH

Monitoring Station 1 (MS1)

Figure 3. Diagram of MS1 showing SSA at the inflow, SSE in the control area, SSB behind row 1, SSC behind row 2, & SSD behind row 3 at the outflow.

- Sampled 6 rain events & 3 ambient condition events with FTWs installed
- Deployed "first-flush" samplers, noted environmental conditions and measured flow at the inflow
- Grab samples and water quality measurements at each sampling station (SS)
- Samples analyzed for
  - Bacteria
  - TSS
  - Nutrients

Timeline of Events

- **April 2020** – Began collecting MS1 baseline data
- **Sept. 2020** – Planted & installed FTWs
- **Oct. 2020 – May 2021** – Acclimation period for plants
- **June – Oct. 2021** – Ambient & storm event data collection with FTWs present
- **Nov. – Dec. 2021** – MS2 baseline data collection

Harvesting plants

Volunteers from both EIH and HCFCD collected over a THOUSAND wetland plants for this project in one day!

Planting

The very next day, volunteers met at the UHCL campus to plant the collected wetland plants on the floating mats.

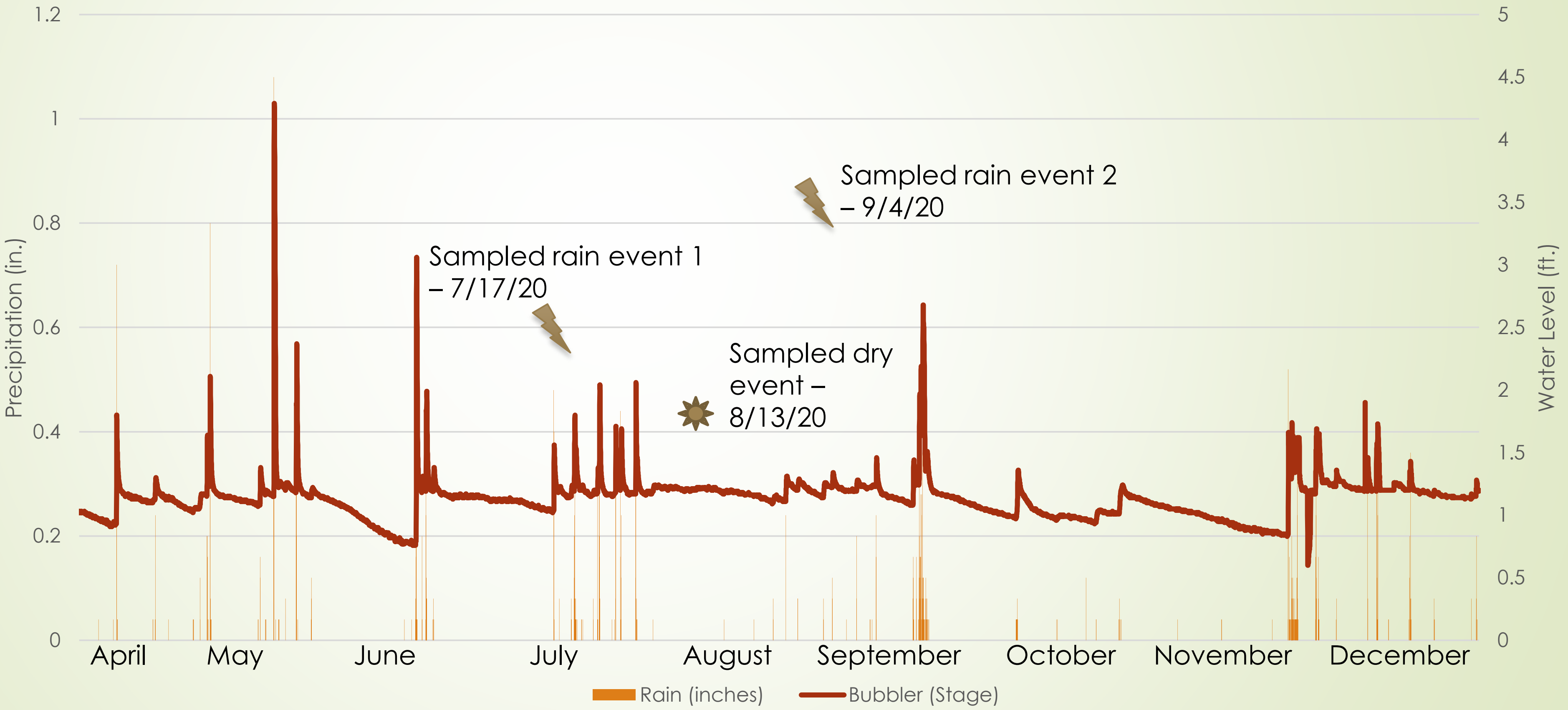
Root establishment

Long, thick, fibrous roots have shown to be the most adept at trapping suspended sediments and taking up pollutants. This photo was taken in March 2021. As you can see, the roots are getting to where we want them to be, but weren’t quite ready yet.

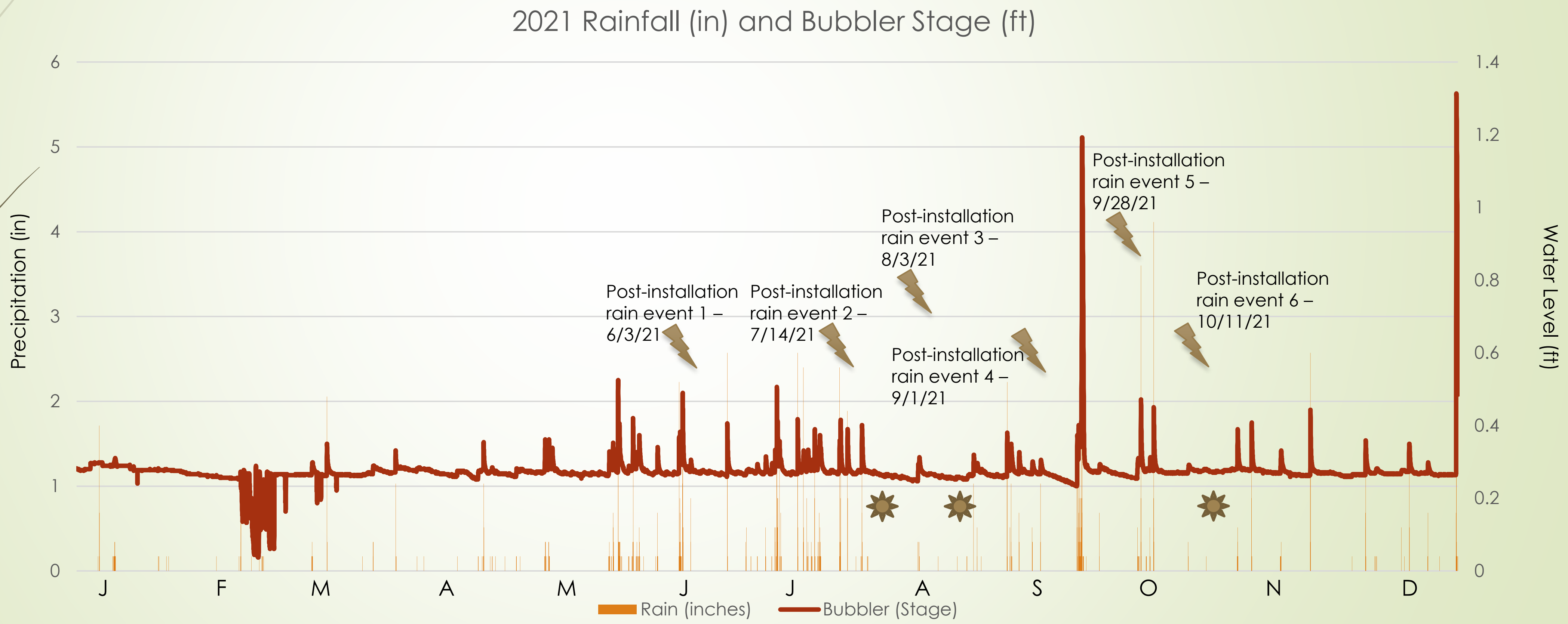
Root Establishment

Here we have a photo taken on July 26th of 2021 where the roots have been fully established.

2020 Rainfall and MS1 Water Level at Inflow



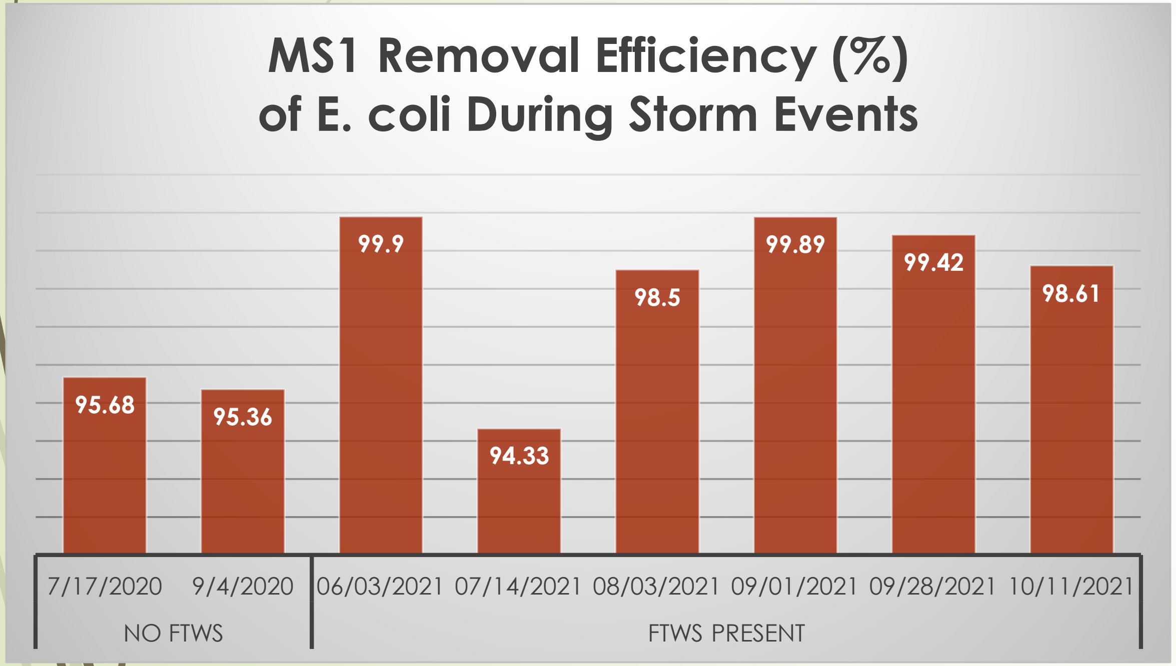
2021 Rainfall and MS1 Bubbler Stage at Inflow

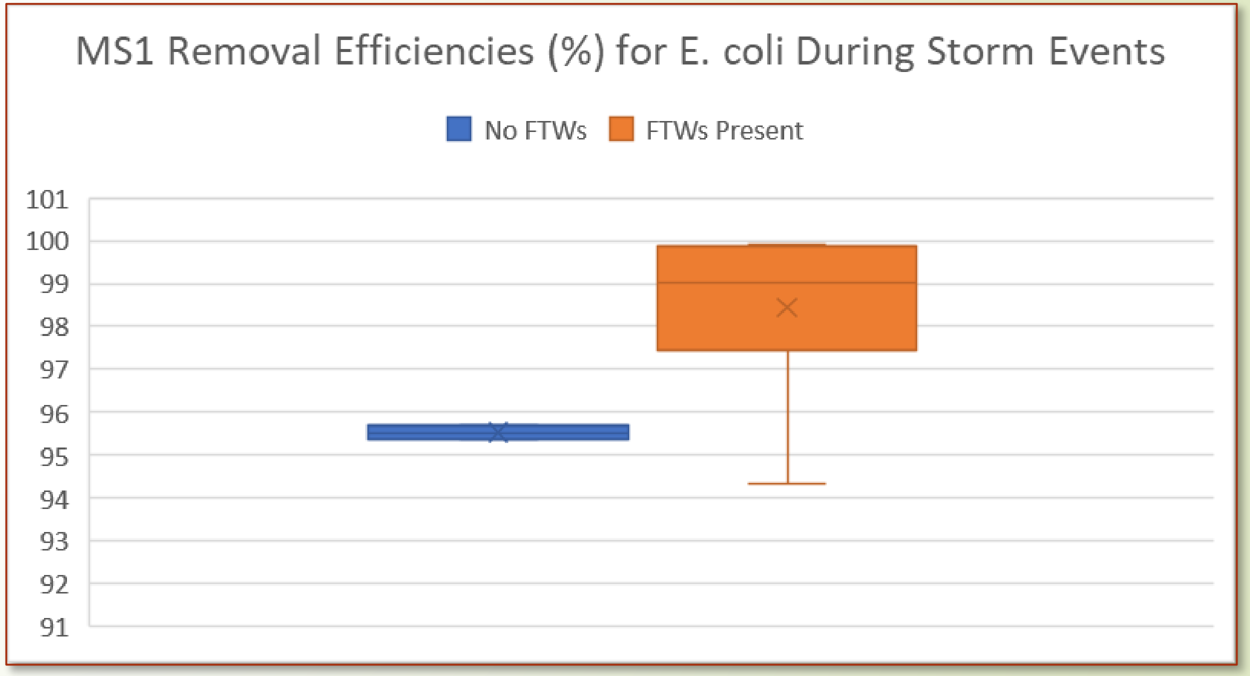


Pollutant Removal Efficiency

$$\% \text{ Removal Efficiency} = \frac{\text{(Influent concentration – Effluent concentration)}}{\text{Influent concentration}} \times 100$$

Water Quality – E.coli





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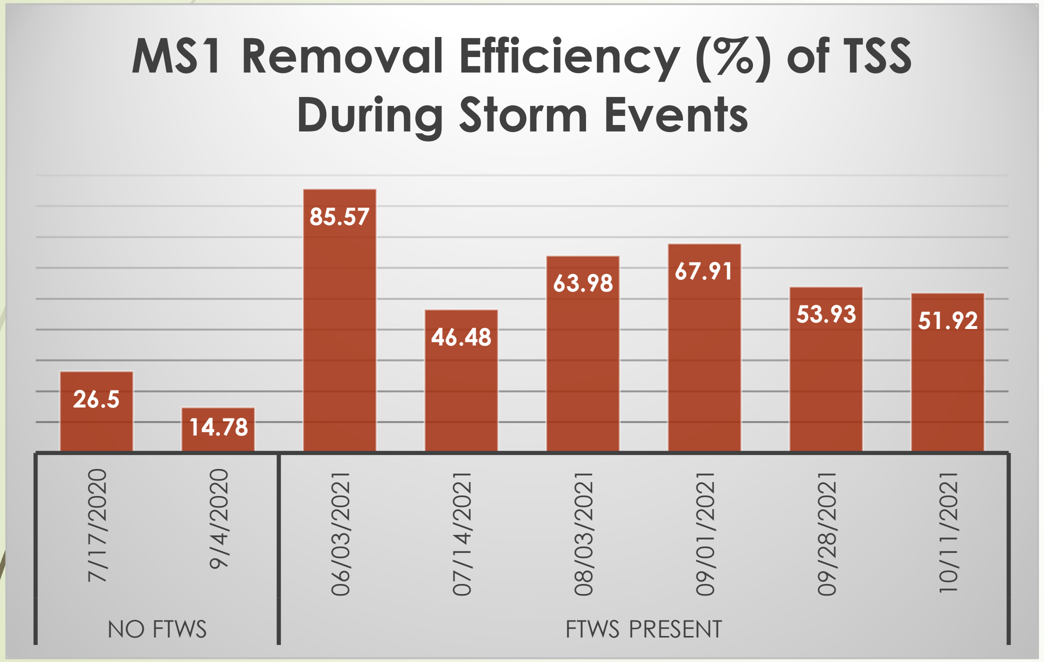
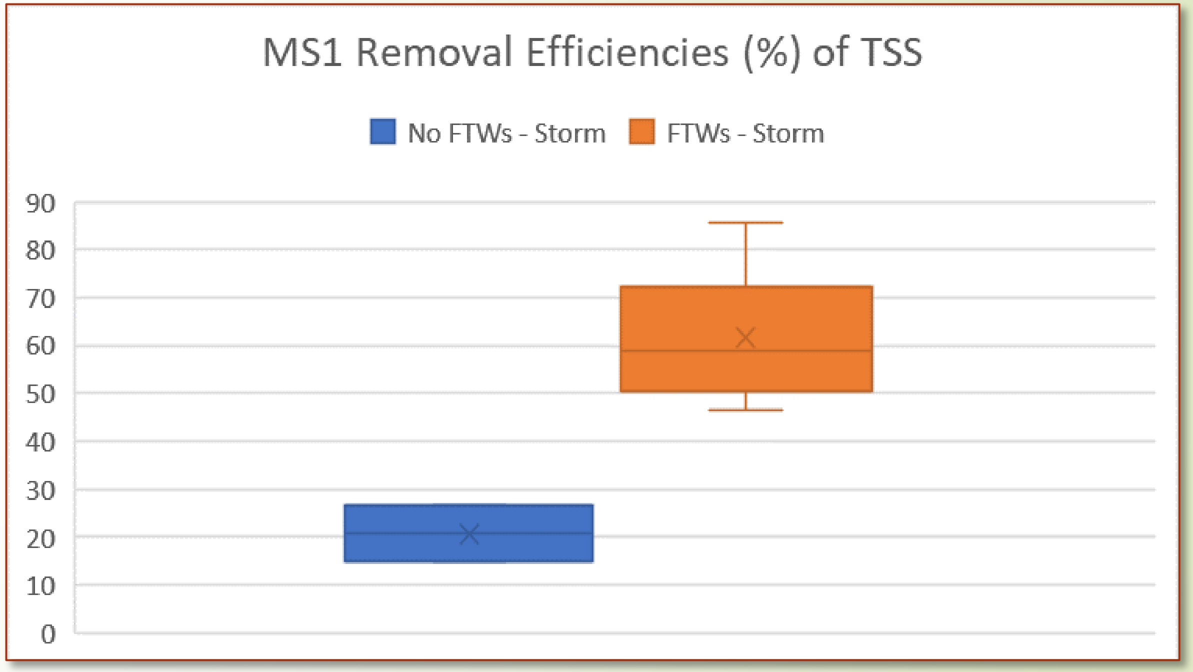
Water Quality - TSS





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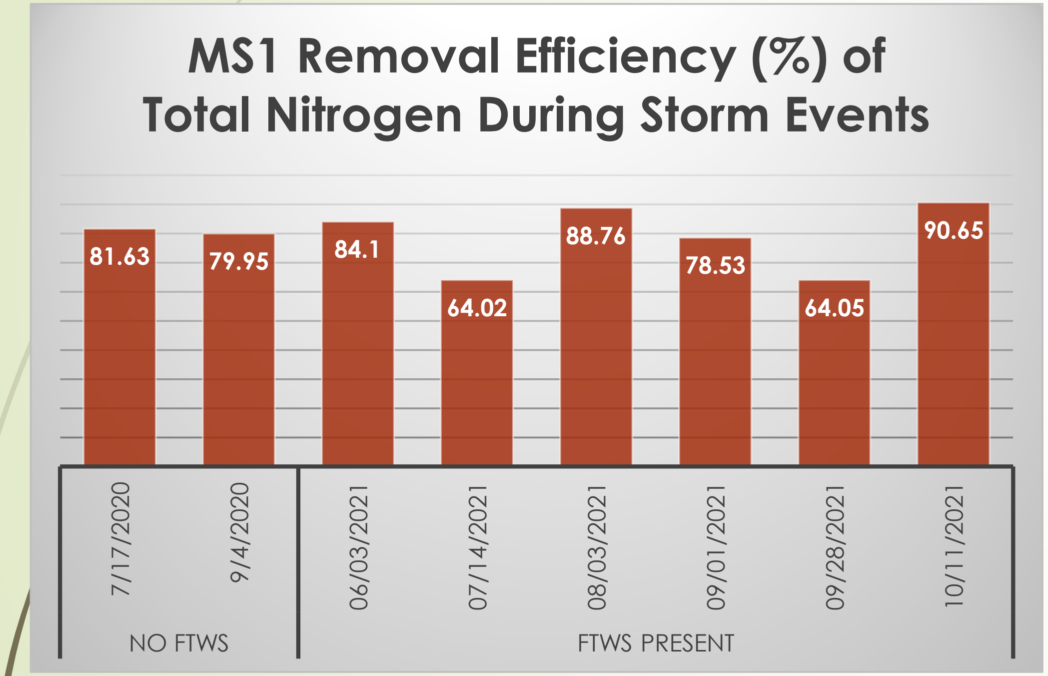
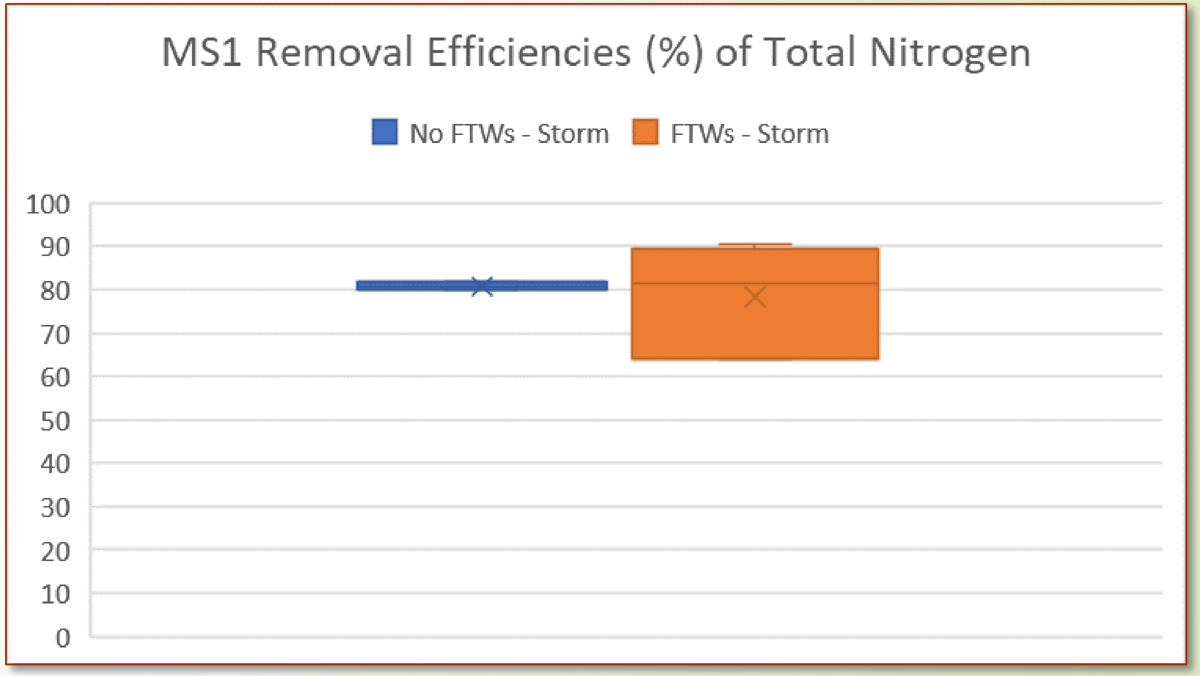
Water Quality – Total Nitrogen





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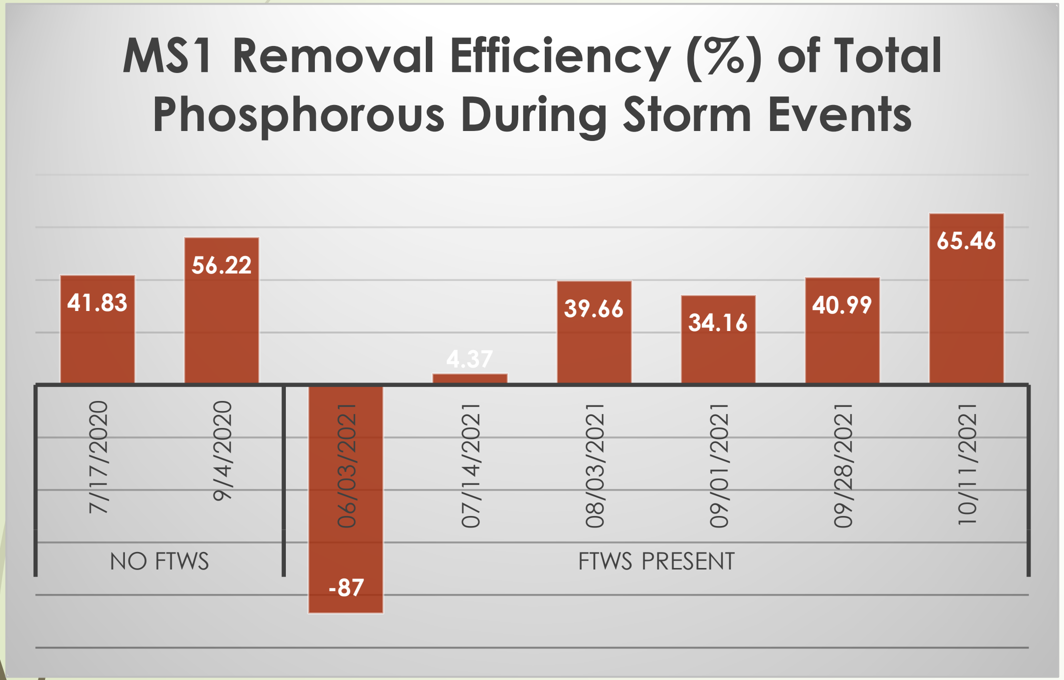
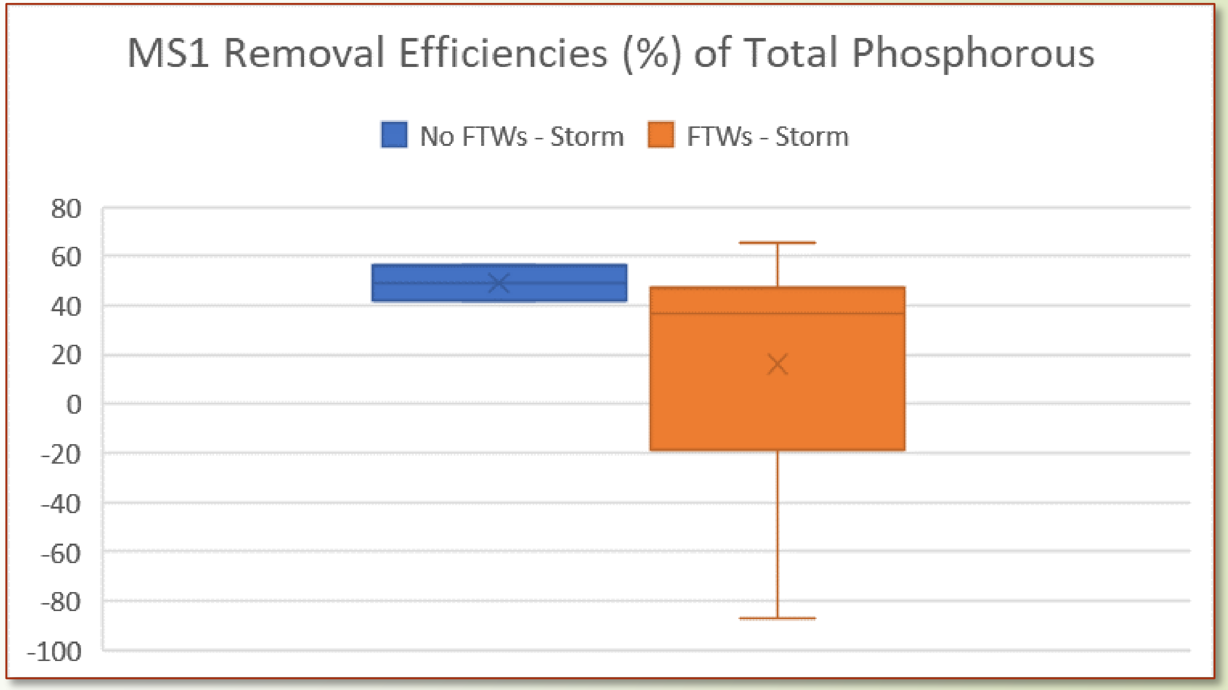
Water Quality – Total Phosphorous





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Conclusions & Future Work

Goals other than water quality improvement

Potter Pond (MS1)

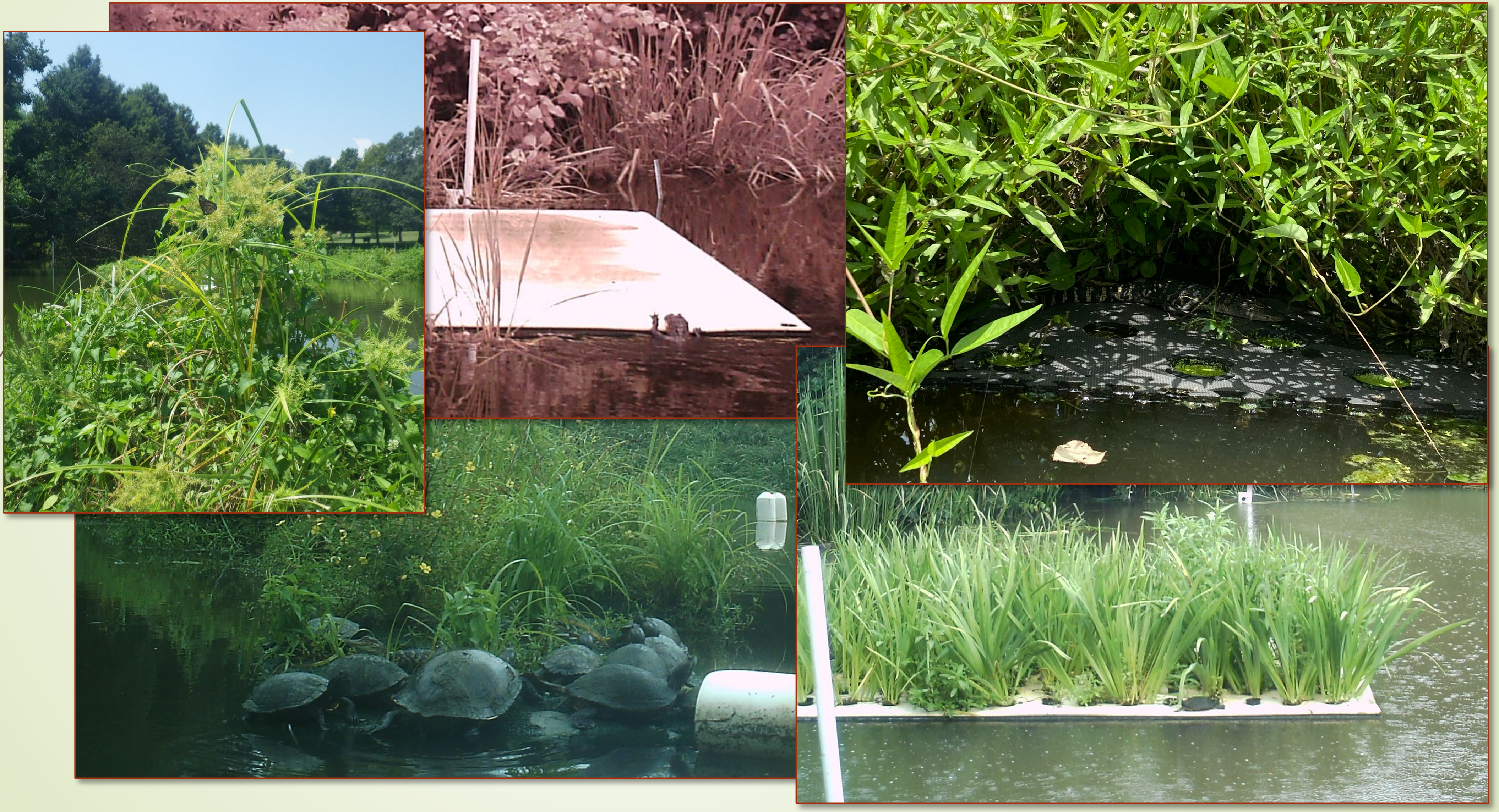
- Evaluated 3 commercially-available mats
  - Durability/longevity
  - Cost-effectiveness
  - Plant success
  - Wildlife use
- Assess plant growth and success of 7 native wetland plant species grown together
- Make maintenance recommendations

Alligator Pond (MS2)

- Evaluate DIY mats
  - Durability/longevity
  - Cost-effectiveness
  - Plant success
  - Wildlife use
- Evaluate pollutant removal efficiency of individual plant species:
  - (1) Swamp Lily
  - (2) Virginia Iris
  - (3) control mat with no vegetation

Wildlife Sightings

And more…



Questions?

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