FSA Winter Conference

December 6, 2024

Innovative Media-based Treatment Solutions for Meeting Nutrient Removal Targets

SWIG

SUSTAINABLE WATER INFRASTRUCTURE GROUP, LLC

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Director of Operations

Company Overview

- Working Florida since 2017
- Design, build, finance and operate innovative nutrient removal systems

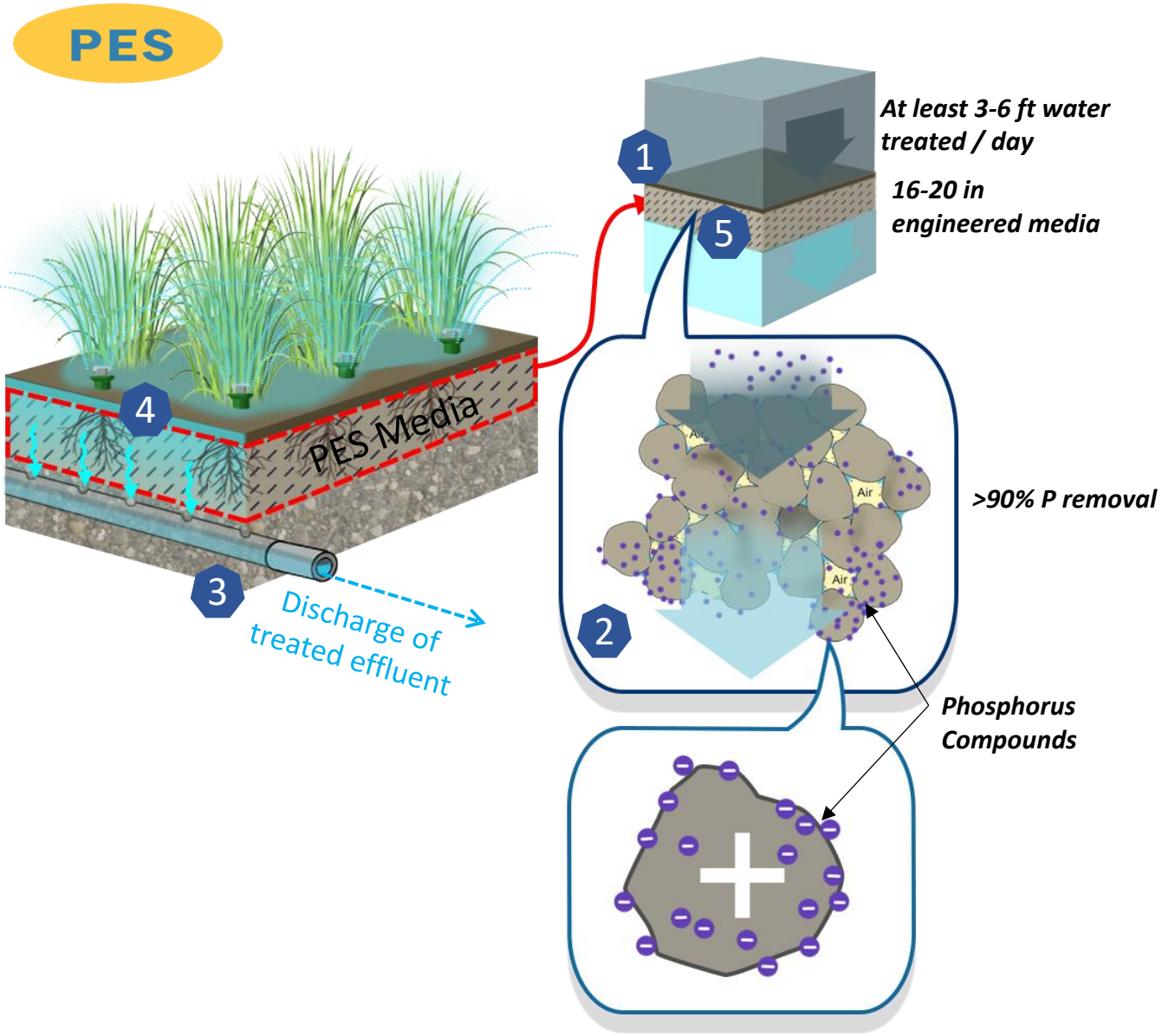
- Unique features of system:
  - Flexible deployment (point and non-point)
  - Speed of project delivery (<1 year)
  - Passive, easy to operate systems, no chemicals
  - Reliably remove:
    - P – Phosphorus Elimination System (PES) 

    - P + N – PES+N 

    - Color – PES+C 

  - Monitored systems, verified removal results
  - Alternative delivery, “pay for performance”
  - Spent media to be recycled for AG applications

Technology – Phosphorus Elimination System (PES) - Overview



1. Water is distributed onto and passes vertically through a layer of patented media (think "Brita" filter)
2. Patented media has an exceptionally high capacity to adsorb and irreversibly bind phosphorus (P)
3. Treated effluent is collected via underdrain pipe(s) and discharged into receiving waters
4. Robust plant growth assist in P removal and creates dense wildlife habitat
5. The media is designed for a specific lifetime (10 to 20 years) and can be replaced to extend project lifetime. Spent media is an excellent soil amendment

PES Phosphorus Elimination System Media

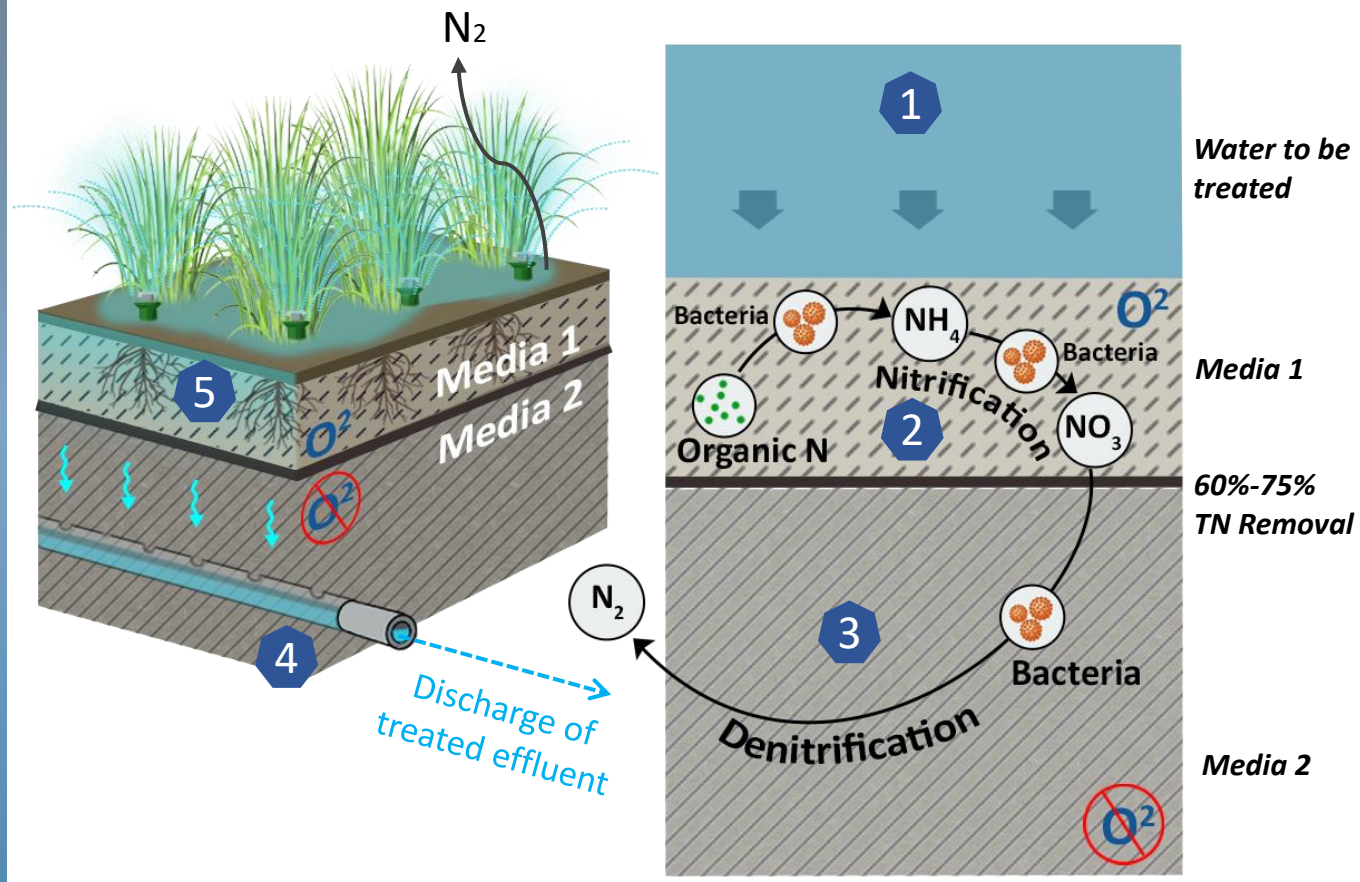
- Treats high influent TP concentrations up to 1.5 mg/l, while maintaining effluent concentrations <0.1 mg/l over 5 years.
- Treats low influent TP concentrations ~0.3 mg/l, while maintaining lower effluent concentrations of 0.05 mg/l or less over 25 years.
- Effectively removes suspended sediments, pathogens, metals, PAHs, PCBs, and EDCs, providing a comprehensive solution for water treatment.

Industry-leading Removal Rates

- Total Phosphorus: > 80%
- Total Nitrogen: > 20-30%
- TSS: 95%
- Metals: 80%
- Based on 25-year project lifetime removal

PES + Nitrogen System- Overview

PES + N



1. Water is distributed onto and passes vertically through two layers of patented media (think "Brita" filter)

2. The first media layer is aerobic and transforms organic nitrogen and ammonia into nitrate. This layer can be modified to include a phosphorus removal (PES) option.

3. The second media layer is anoxic and transforms nitrate into harmless nitrogen gas which is released to the atmosphere

4. Treated effluent is collected via underdrain pipe(s) and discharged into receiving waters

5. Robust plant growth with deep roots maintains media porosity and creates dense wildlife habitat

6. No media replacement required for ONE. Combined PES/ONE systems require replacement of first media layer

PES + N Phosphorus Elimination System Media + Enhanced Nitrogen Removal

- **Uses the PES media layer to efficiently convert Organic Nitrogen and Ammonium into Nitrate.**
- **Denitrification in lower media layer supplemented with organic amendments.**

Industry-leading Removal Rates

- **Total Nitrogen: > 60-75%**
- **Based on 25-year project lifetime removal**

PES + C Phosphorus Elimination System Media + Enhanced Color Removal

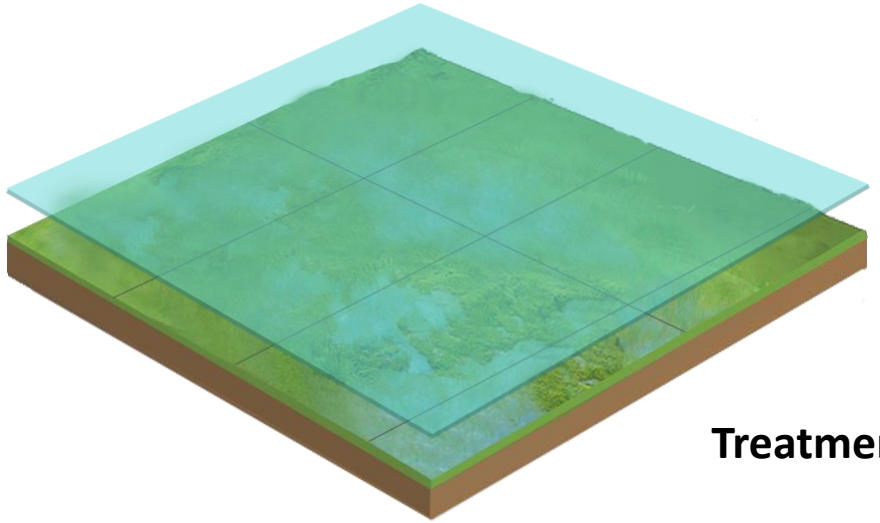
- **Only proven passive media technology to effectively remove tannins from water.**
- **Can support aquifer storage and recovery (ASR) and water resource development projects.**

Industry-leading Removal Rates

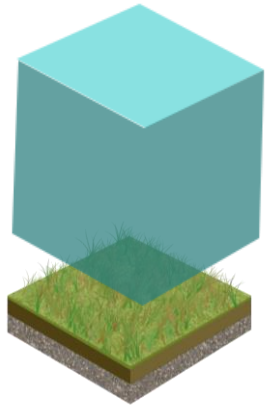
- **Total Color: 80% PCU**
- **Based on 10-year project lifetime removal**

How is it different from treatment wetlands?

Same Volume at much higher HLR

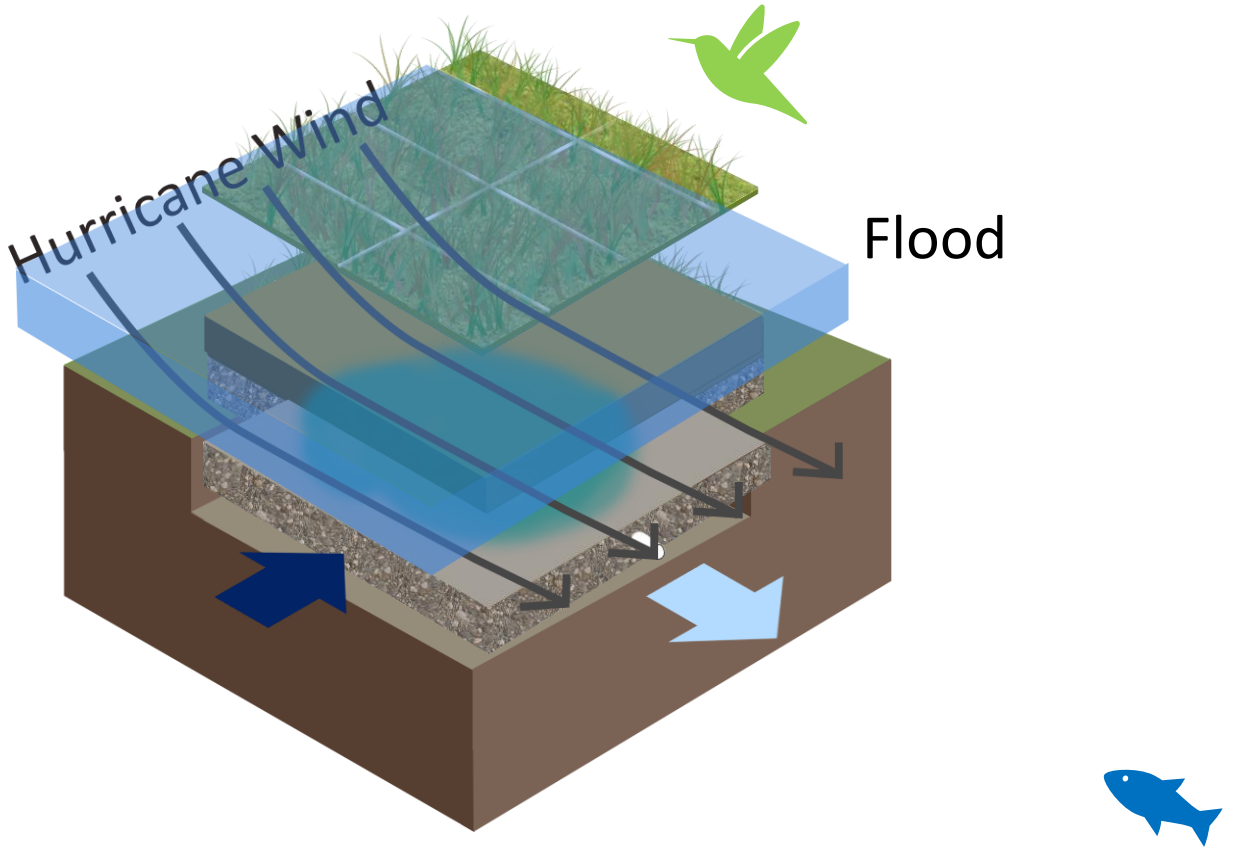


Treatment Wetlands



Compressed Treatment Footprint (95% reduction)

- **Passive Media**
- **Nature-based**
- **Resilient**

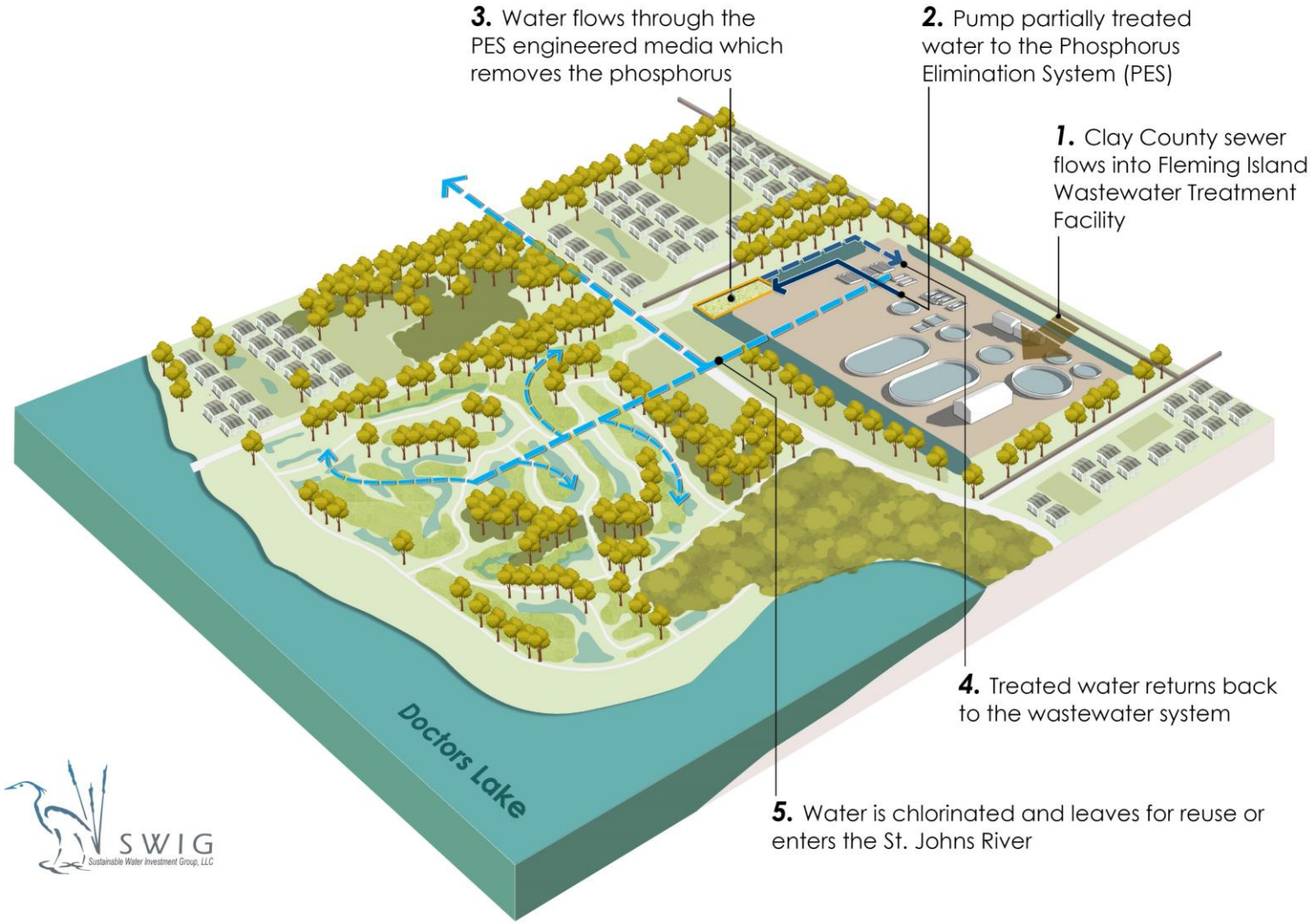


Bolt-on Regional System

PES

- 1.1-acre footprint
- ~1.4 mgd treated
- 6,500 lbs. of P removed
- Direct monitoring

Doctors Lake Phosphorus Removal Process Diagram



ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

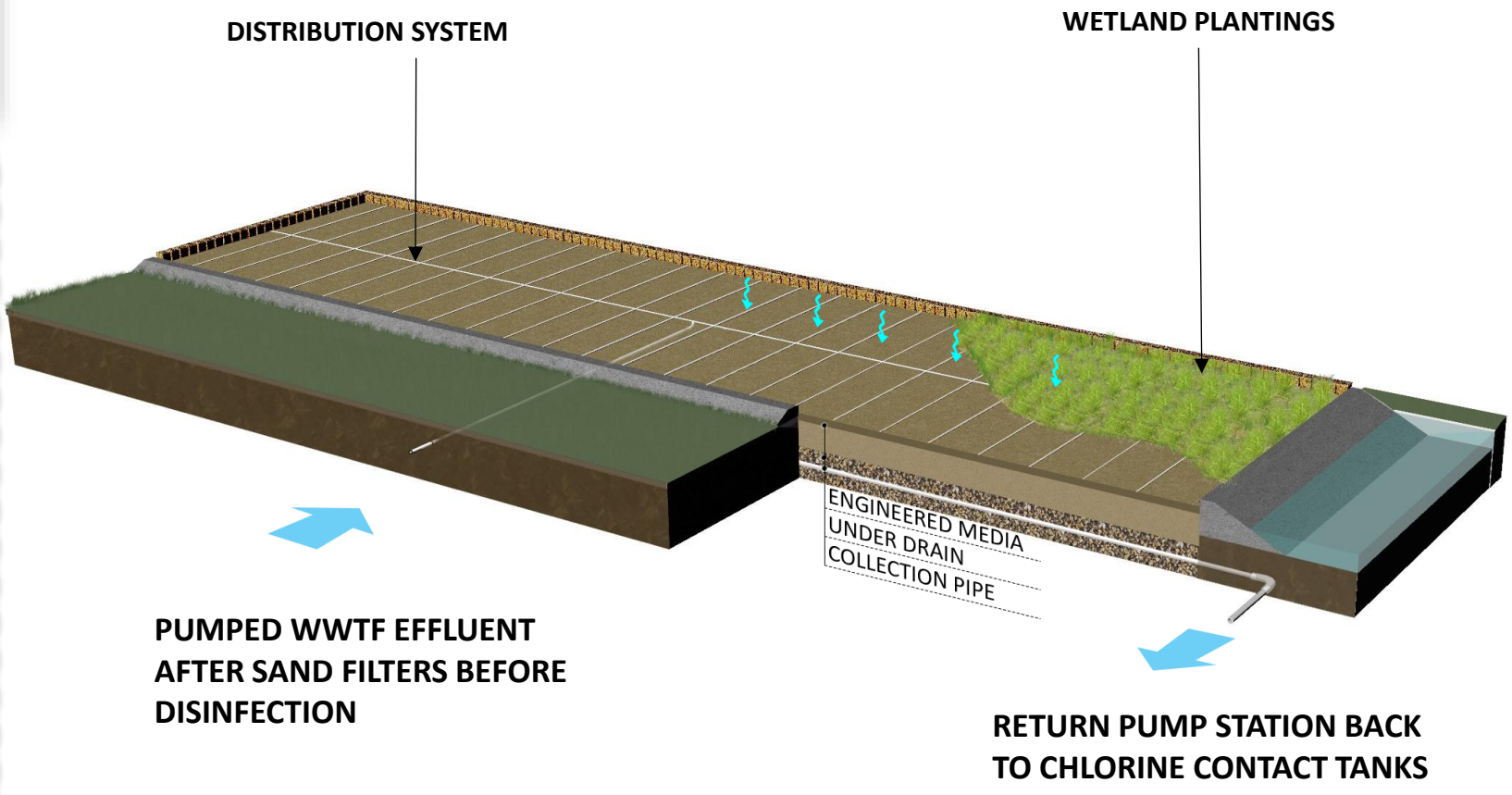
Doctors Lake Advanced Phosphorus Removal

PES

Cells are dosed in sequence, allowing flow regime to cycle between saturated and drained.

Wetland plantings facilitate TP removal and improve media infiltration rates.

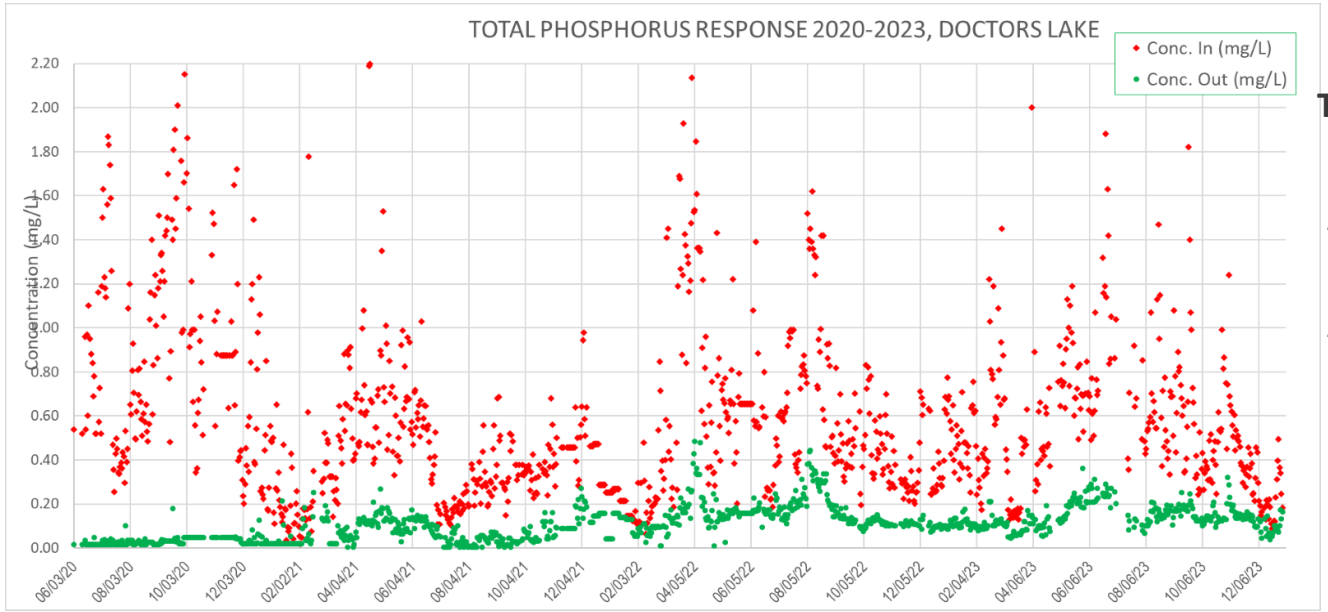
Treated PES effluent collected in under drain is then pumped back into WWTP.



Location: **Clay County, FL**
Client: **St. Johns River WMD**

Technology Performance

PES



Period: 06/11/2020 - 12/31/2023

Total P removed:	**6,558 lbs.**
Average Daily Flow:	**1.4 MGD**
Average Daily Influent P:	**0.64 (mg/L)**
Average Daily Effluent P:	**0.142 (mg/L)**

Lifetime removal rate of 82.3%

Annual Vegetation Harvest and Plant Response

PES

October 2023

March 2024

May 2024
(regeneration from existing roots stock)

Technology PES + C

Regional Case Study

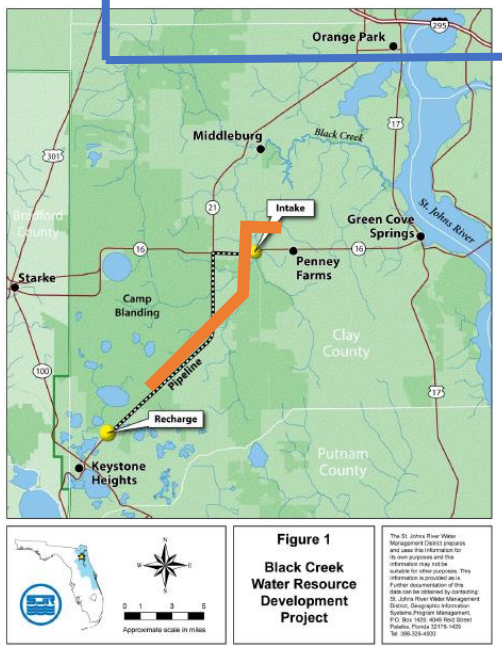
SJRWMD Black Creek Water Resource Development

Project:

- Recharge the Upper Floridian Aquifer with up to 10 MGD of water transported 17 miles from Black Creek.
- Secondary benefit is restoration of historic lake water levels.

Treatment:

- Color (tannins) and nutrients removal from water prior to discharge into Lake Brooklyn, a clear lake system.
- Both tannins and nutrients are negatively charged and adsorbed by the PES+C media.

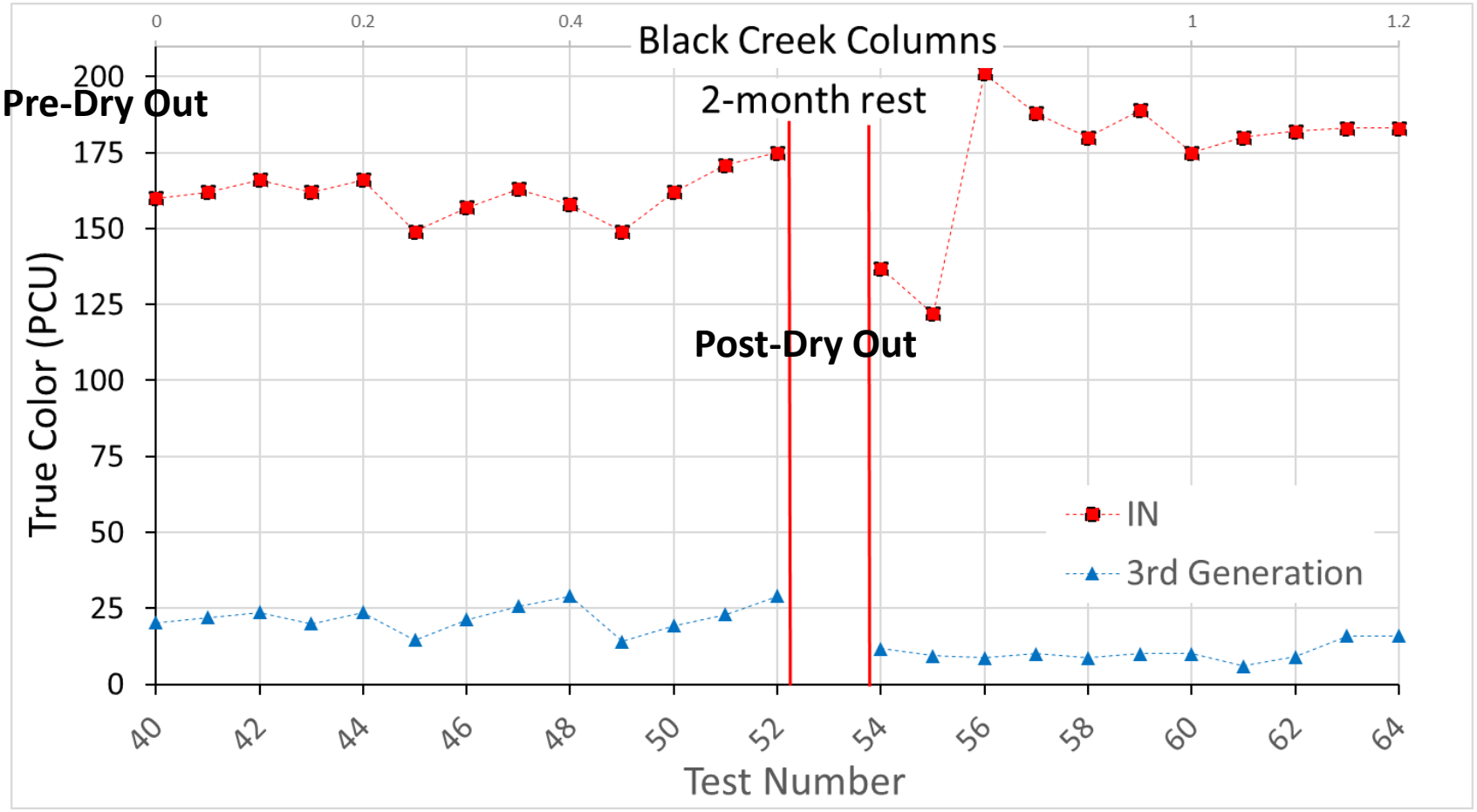


Technology- PES + C

PES + Color System- Black Creek Results

April 2024

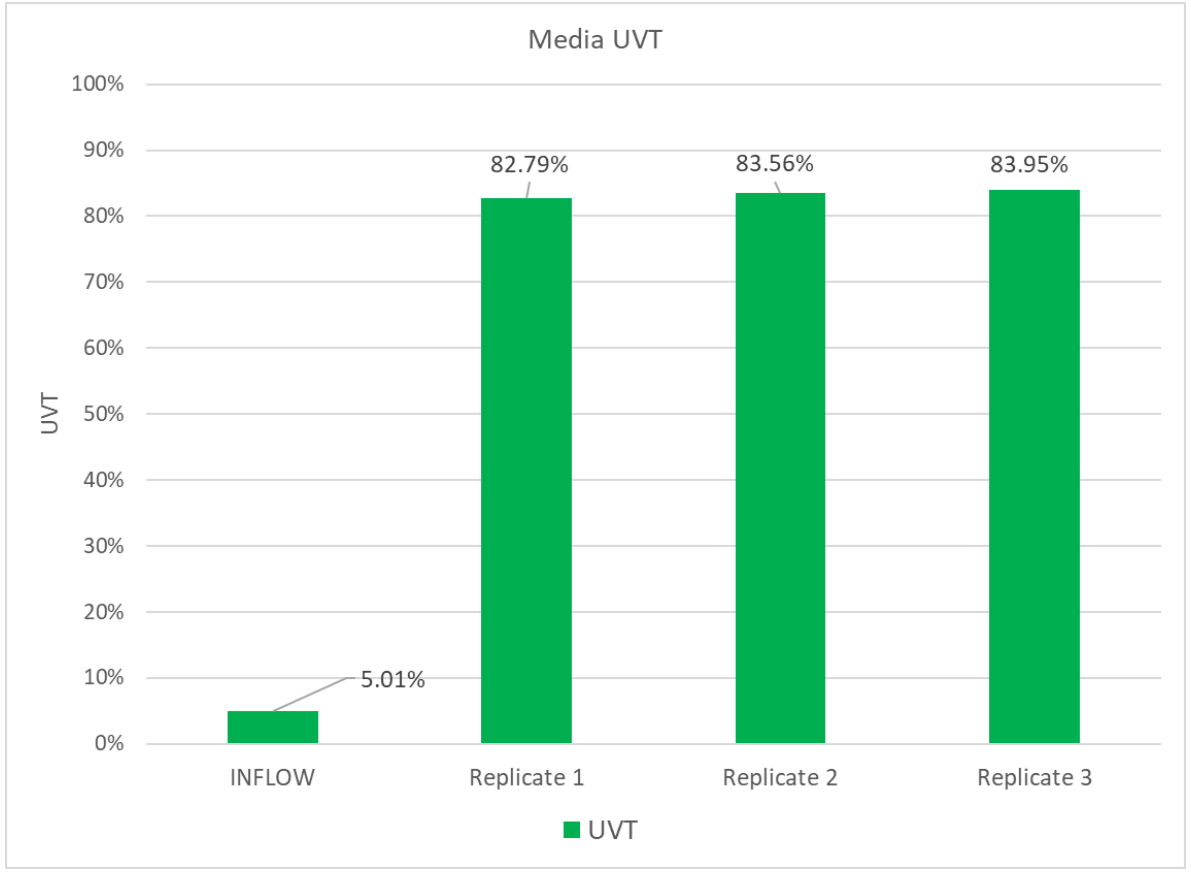
August 2024

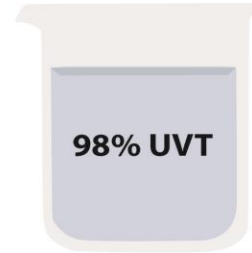


- **Pre-Dry Out:** Discharging at 23 -26 PCU; 84 to 86% removal
- **Post 2-month Dry-Out:** Average color declining to 10-12.5 PCU, 93-94%, removal

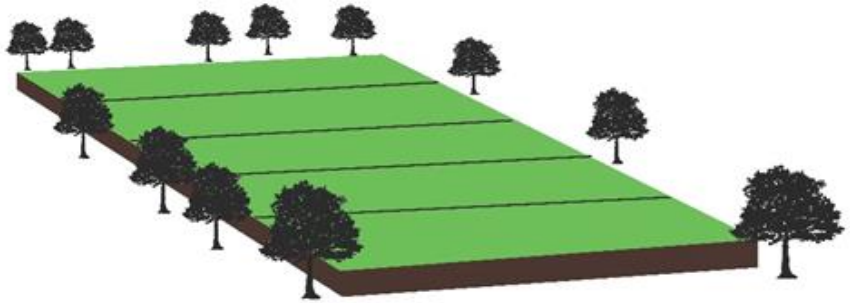
Ultraviolet Transmittance (UVT) Improvements attained through SWIG Passive Media

- **UVT is an important measurement for the <u>UV disinfection process</u>**
- **Minimum UVT of 70% to 75% is needed for disinfection**
- **Passive media treatment capable of achieving high UVT**



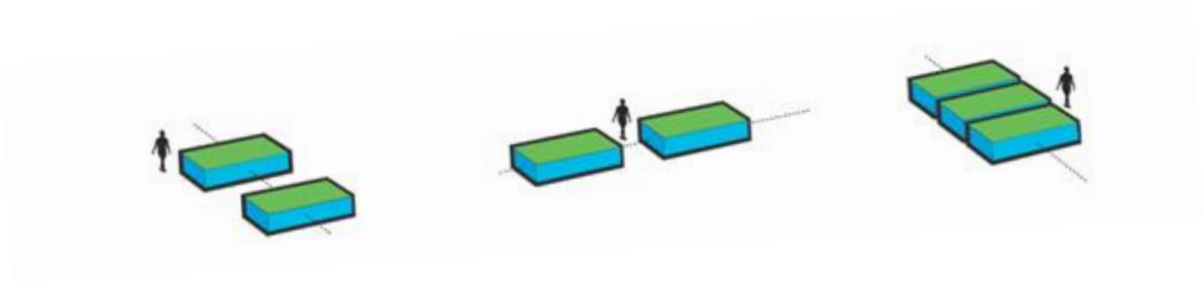


Media technology can be wrapped in different envelopes



Regional Systems
(Acres)

Low Impact
Development
(Linear Feet to Miles)



Modular
(Square Feet)


SWIG
Sustainable Water Infrastructure Group, LLC
SWIG
Floating System

Applications Summary

Point-source

Wastewater Treatment

Non-point source

Agriculture: Crops

Agriculture: Animals

Stormwater: Urban

Stormwater: Suburban

Power Plants

Roadways

Applications

Wastewater

Bolt-on to existing WWTP

Agriculture

Agricultural run-off from multi-property drainage area (i.e. creek, river, canal, etc.)

Agriculture

Agricultural run-off from individual farm (i.e. tile drainage system, etc.)

Stormwater

Urban/suburban run-off from multi-property drainage area

Stormwater

Urban/suburban run-off from roadway / transportation

Stormwater

Urban/suburban run-off from individual property

Applications

Point-source

Wastewater Treatment

Non-point source

Agriculture: Crops

Agriculture: Animals

Stormwater: Urban

Stormwater: Suburban

Fossil-fuel combustion

Roadways

Enhanced Stormwater Treatment

Standard Stormwater Treatment

Enhanced Stormwater Treatment

POND AND PES+N SIZING FOR 16.6 ACRE URBAN DEVELOPMENT									
DEVELOPMENT SCENARIO		POND SIZING				PES+N SIZING			
		WQ Volume	@ Maximum	Minimized w/ PES+N		PES+N		@ Maximum	@ Small
		Runoff Depth	% Site	% Site	Reduction	Area (sf)	% Site	% Pond	% Pond
25% Impervious	LD	1" from Site	20.3%	10.3%	49.3%	2,100	0.47%	2.33%	4.60%
46% impervious	MD	1" from Site	20.3%	10.3%	49.3%	2,100	0.47%	2.33%	4.60%
75% Impervious	HD	2.5" Impervious	20.3%	16.0%	21.2%	2,700	0.60%	2.92%	3.70%

Pond Sizing Assumptions:

1) Small Pond areas are sized to contain WQV with no more than a 1.1-foot increase in stage over normal.
2) Small Pond areas are sized to manage all peak flows with less than 1.5-foot increase in stage over WQV.
3) Small Ponds are 3.5 feet deep to minimize the cut volume to be removed.
4) Maximum Pond is sized for 200-day HRT to maximize pond reductions.
5) Small Pond size reduction compared to sizing ponds increased for maximum HRT of 200 days.
6) All Pond reductions are based upon having no other BMPs to attain current criteria of 80% TP and 55% TN Removal.

SWIG TECHNOLOGY PERFORMANCE - PES+N SIZED FOR 16.6 ACRE URBAN DEVELOPMENT											
PERFORMANCE COMPARISON		PHOSPHORUS (PES or PES+N)					NITROGEN REMOVAL (PES+N)				
		Pond OUT (mg/L)	Pond Removal	PES OUT (mg/L)	PES Removal	System Removal	Pond OUT (mg/L)	Pond Removal	PES OUT (mg/L)	PES Removal	System Removal
SMALL POND	LD	0.109	66.7%	0.010	90.8%	96.9%	1.25	39.6%	0.41	67.2%	80.2%
	MD	0.110	66.4%	0.011	90.0%	96.6%	1.25	39.6%	0.39	69.0%	81.3%
	HD	0.109	66.7%	0.009	91.7%	97.2%	1.25	39.6%	0.41	67.5%	80.4%
MAXIMUM POND	LD	0.067	79.5%	0.007	89.6%	97.9%	1.18	43.0%	0.41	65.3%	80.2%
	MD	0.066	79.8%	0.007	89.4%	97.9%	1.18	43.0%	0.40	66.1%	80.7%
	HD	0.067	79.5%	0.007	89.6%	97.9%	1.18	43.0%	0.39	66.9%	81.2%

PES+N Sizing Assumptions:

1) PES+N is sized to treat the WQV over 72 hours of constant flow.
2) Peak HLR of 9.0 ft/day determines the PES+N size needed to discharge the WQV in 72 hours.
3) PES+N N removal calculations are based on WQV HLR and HRT, since N removal is HRT dependent.
4) PES+N P removal calculations are based on annual HLR, since P removal is load dependent.
5) PES P removal based on 25-year lifetime average discharge.
6) Between runoff events, the PES+N recycles the pond water at an HLR of 3.0 ft/day.
7) This recycle flow exceeds the entire annual runoff volume.
8) Since average annual HLR is less than 4.0 feet/day, recycling would increase N removal.
9) The effect of recycling is not accounted for in these peak flow responses.

Manufactured In Florida

Custom Media Formulation

SWIG Production Facility
(July 2024)

Applications

Point-source

Non-point source

Wastewater Treatment

Agriculture: Crops

Agriculture: Animals

Stormwater: Urban

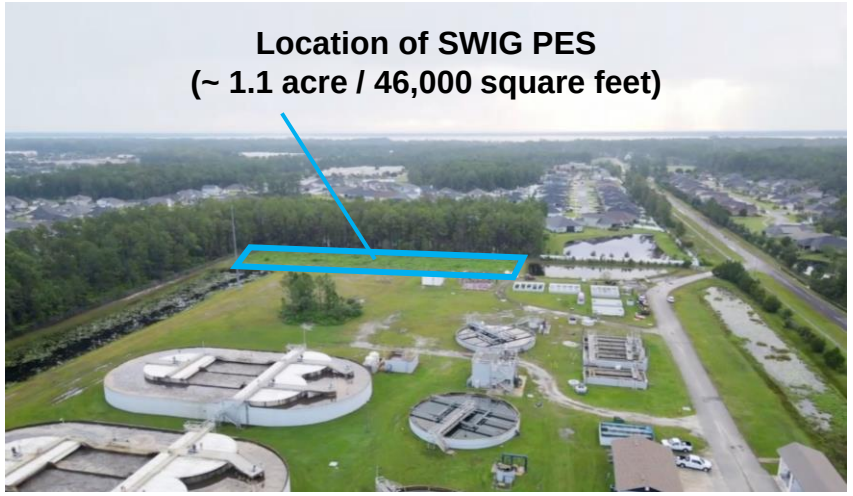
Stormwater: Suburban

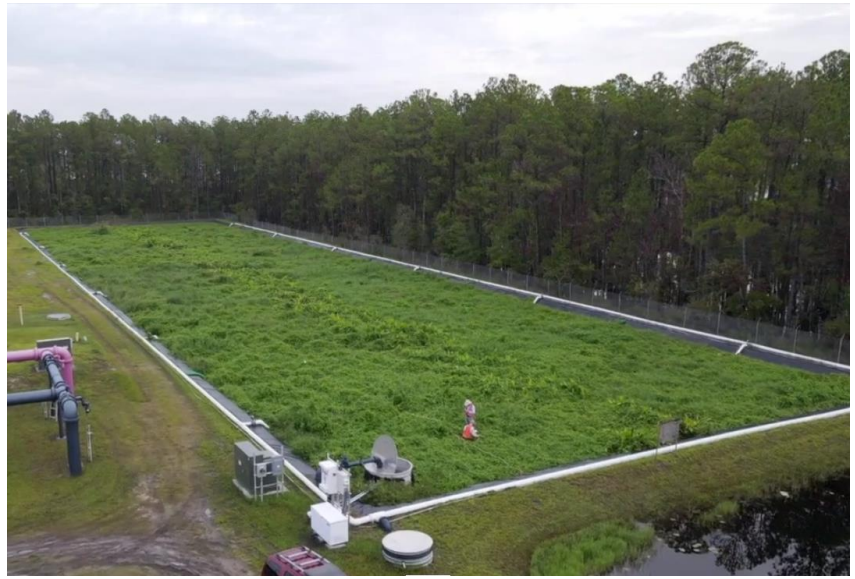
Fossil-fuel combustion

Roadways

- **Bolt-on PES/ONE system to end of WWTP**
- **Incremental P and/or N removal for:**
  - **permit compliance**
  - **nutrient credits**
- **Possible to modify existing Rapid Infiltration Basin (RIB) with PES/ONE layer**
- **Passive, easy to operate systems, no chemicals**
- **Delivery in < 1 year**

Doctors Lake PES, Clay County, FL





Applications

Point-source

Wastewater Treatment

Non-point source

Agriculture: Crops

Agriculture: Animals

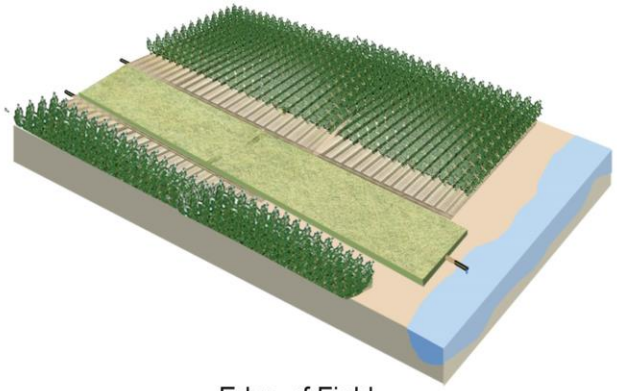
Stormwater: Urban

Stormwater: Suburba

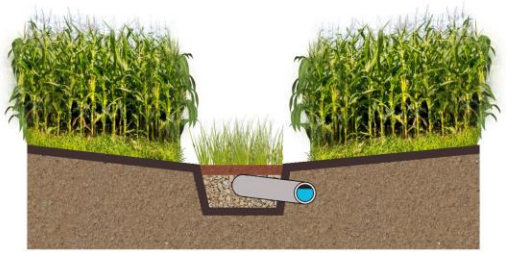
Fossil-fuel combustion

Roadways

Agricultural run-off



Edge of Field



Edge of Field Section

Applications

Point-source

Wastewater Treatment

Non-point source

Agriculture: Crops

Agriculture: Animals

Stormwater: Urban

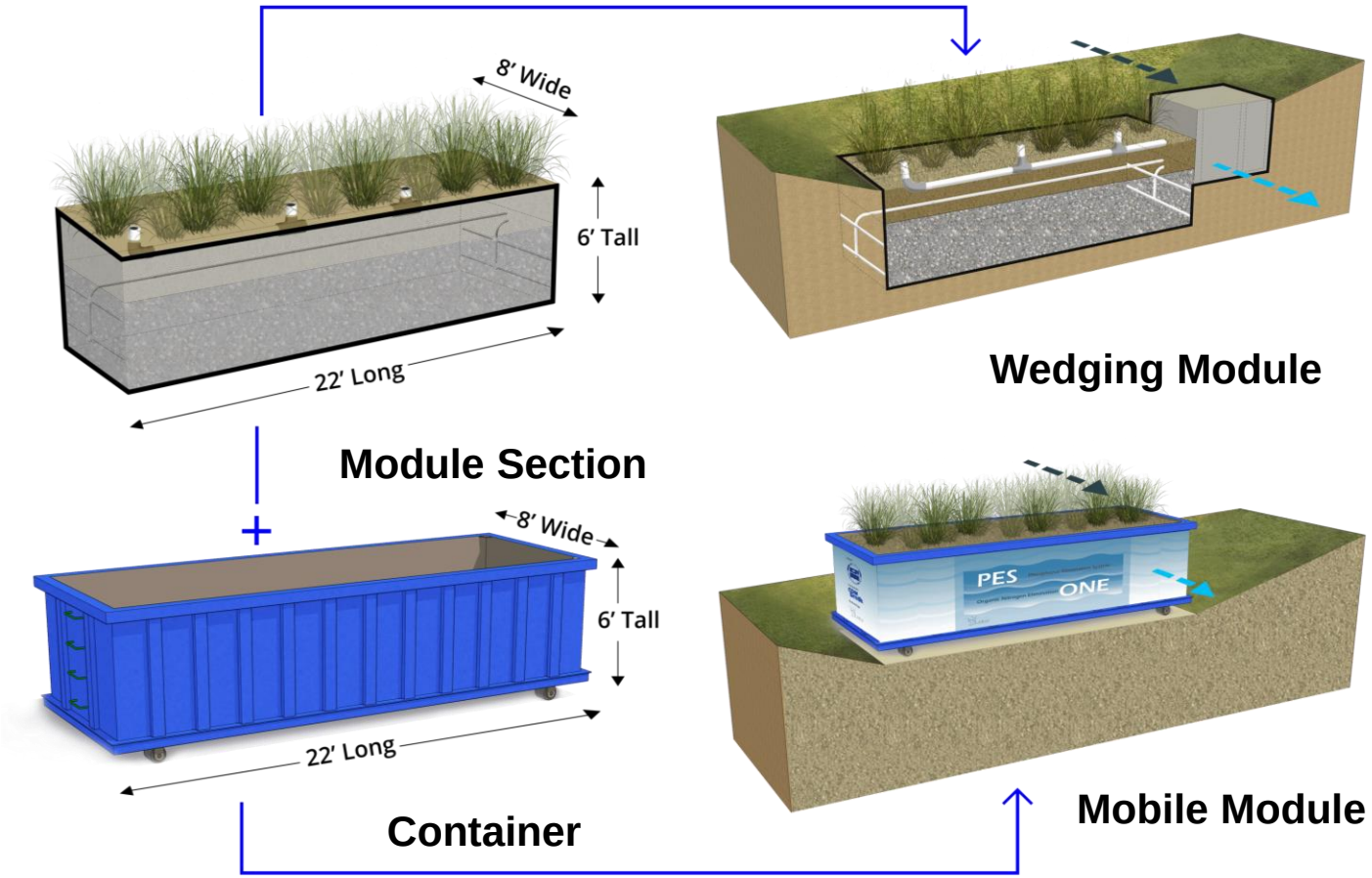
Stormwater: Suburban

Fossil-fuel combustion

Roadways

Urban Module

- **Small/compact footprint for tight urban spaces.**
- **Technology can be containerized for mobile solution.**



Takeaways

SWIG technologies can clean large volumes of water below non-detect for many of the world's worst water pollutants:

- Removes Phosphorus, Nitrogen, Tannins, Fecals, Metal, Flouride, PFAS and E.Coli
- Cost efficient – lower cost than competitors (including O&M)
- Scalable – any size from small drainage boxes to 10's of acres
- Sustainable / non-toxic /no chemicals – Storm and Drought proof
- Uses recycled materials and spent material is reused
- Carbon sequestration through wetland plant harvesting
- Short Permit / Construction Time – minimal permitting and simple construction
- Flexible in application – can be used as bolt on or solo
- Fully Monitored (no guessing)
- Designed for longevity (can last 10 – 25 years as wanted)

SWIG
SUSTAINABLE WATER INFRASTRUCTURE GROUP, LLC

QUESTIONS?

SWIG
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