



> Offline Bioreactors For Nutrient Reduction In Fluvial Systems

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> Outline

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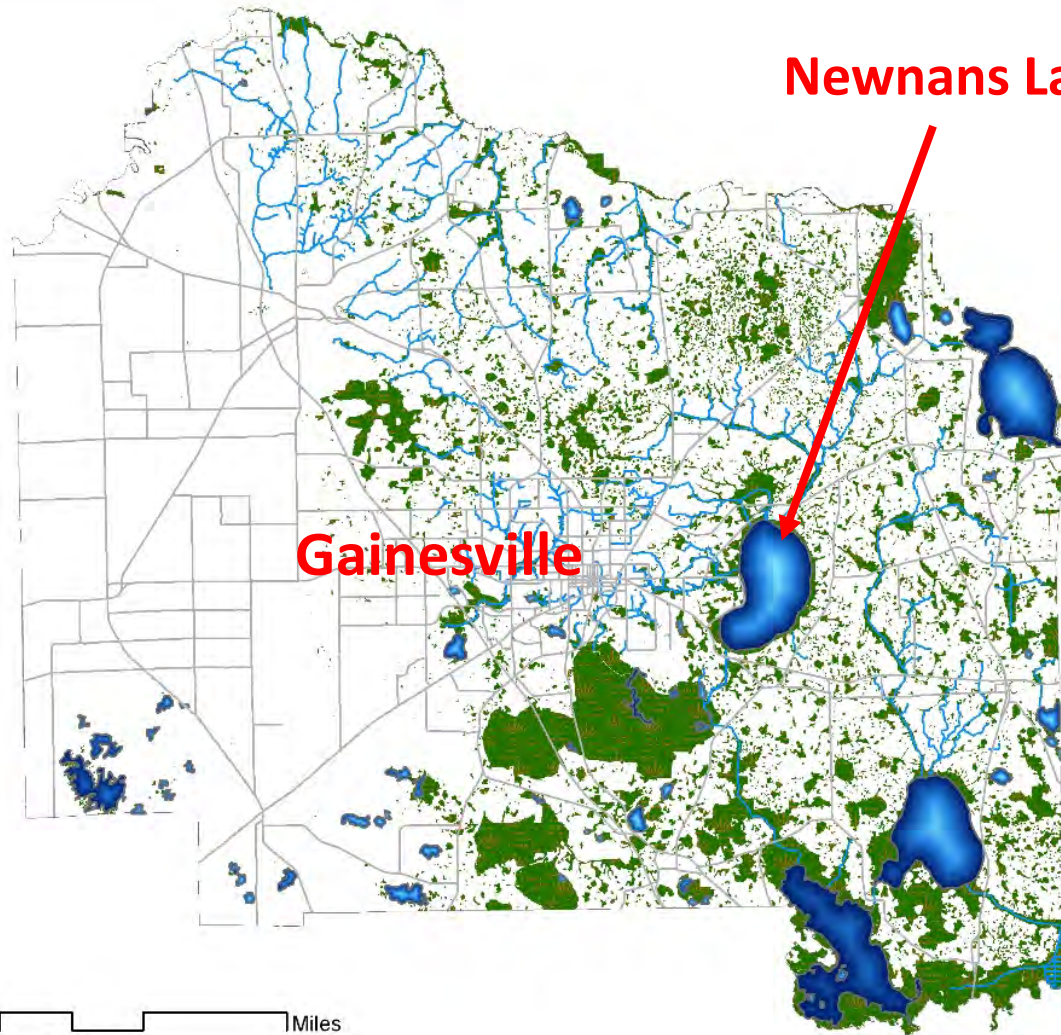
> Watershed Background

Newnans Lake

- Shallow naturally eutrophic lake.
- One of the four large lakes in eastern Alachua County.
- Water quality is declining. Lake is impaired for TN and TP. The lake is dominated by cyanobacteria and has become turbid and green.
- Tributaries to the lake include Hatchet Creek and Little Hatchet Creek, which enter the lake through Gum Root Swamp.
- Part of the Orange Creek BMAP.





Newnans Lake from East



Alachua County Water Bodies and Wetlands

Legend

- Major Roads
-  Lakes
-  Creeks
-  Wetlands

DISCLAIMER: This map and the spatial data it contains are made available as a public service, to be used for reference purposes only. The Alachua County Environmental Protection Department provides this information AS IS without warranty of any kind, implied or expressed, regarding accuracy, completeness, or fitness of use. The quality of the data is dependent on the various sources from which each data layer is obtained.

> Watershed Background

Newnans Lake Required TP Reductions and Credits (lbs-TP/yr) by Jurisdiction

Jurisdiction	Total Developed Land Use Reduction	First 5-Year 50 % Developed Land Use Reduction	Education Credit	Project Credits	Remaining Developed Land Use Reduction with a Target Date of 2023	Second 5-Year 50 % Developed Land Use Reduction	Total Septic System Reduction with a Target Date of 2028	Total Reduction to be Achieved with a Target Date of 2028*
Alachua County	465	233	33	42	158	232	198	588
FDOT, District 2	93	47	4	525	-483	46	0	0
Gainesville	461	231	33	259	49	230	16	185
Waldo	27	14	1	0	13	13	0	26
Total	1,046	525	71	826		521	214	799

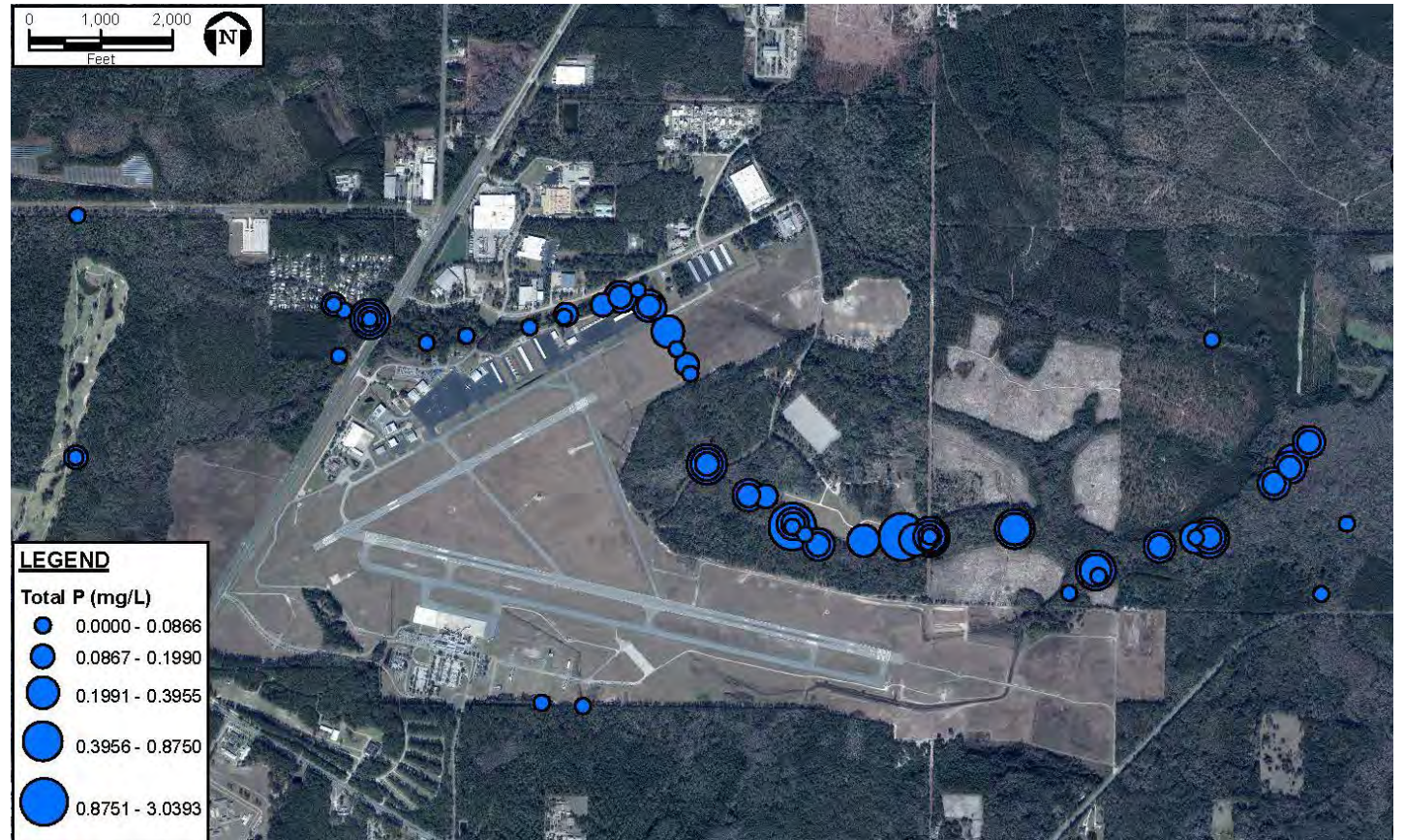
From: Orange Creek BMAP Amendment

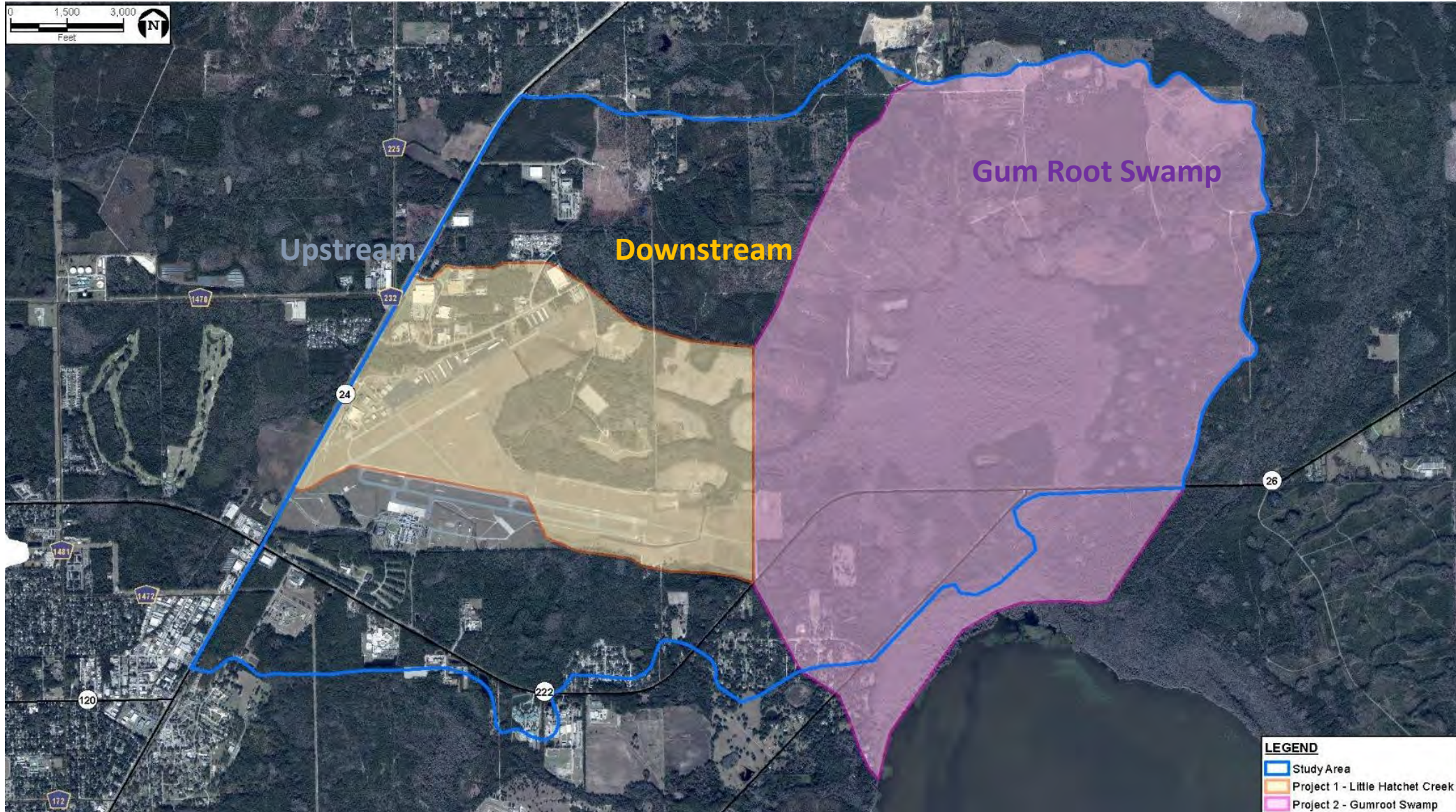


> Watershed Background

Water Quality in Little Hatchet Creek (LHC)

- TP concentration in LHC averaged 0.25 mg/L, mostly SRP.
- Criteria for Peninsula Nutrient Region streams is 0.12 mg/L.





> Watershed Background

Phosphorus Source: Exposed Hawthorn Group

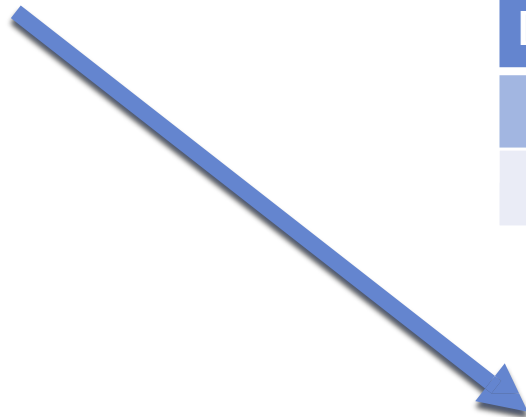


> Watershed Background

TN and TP Loads

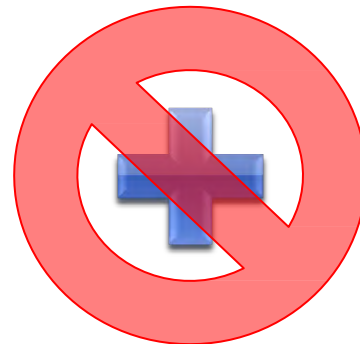
Upstream	
TN (lbs/yr)	TP (lbs/yr)
6,518	453

Before Impacted Segment



Downstream	
TN (lbs/yr)	TP (lbs/yr)
8,825	2,570

After Impacted Segment



Swamp	
TN (lbs/yr)	TP (lbs/yr)
14,390	1,226

> Project Background

- Newnans Lake Initiative, Phase 1 investigated nutrient sources and evaluated projects.
- The concept of a reactive weir pilot project on LHC was one of the top-ranked recommendations.
- Originally proposed as either a single weir pilot project or three weirs.



Alachua County Environmental Protection Department
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Complex Challenges . . . PRACTICAL SOLUTIONS

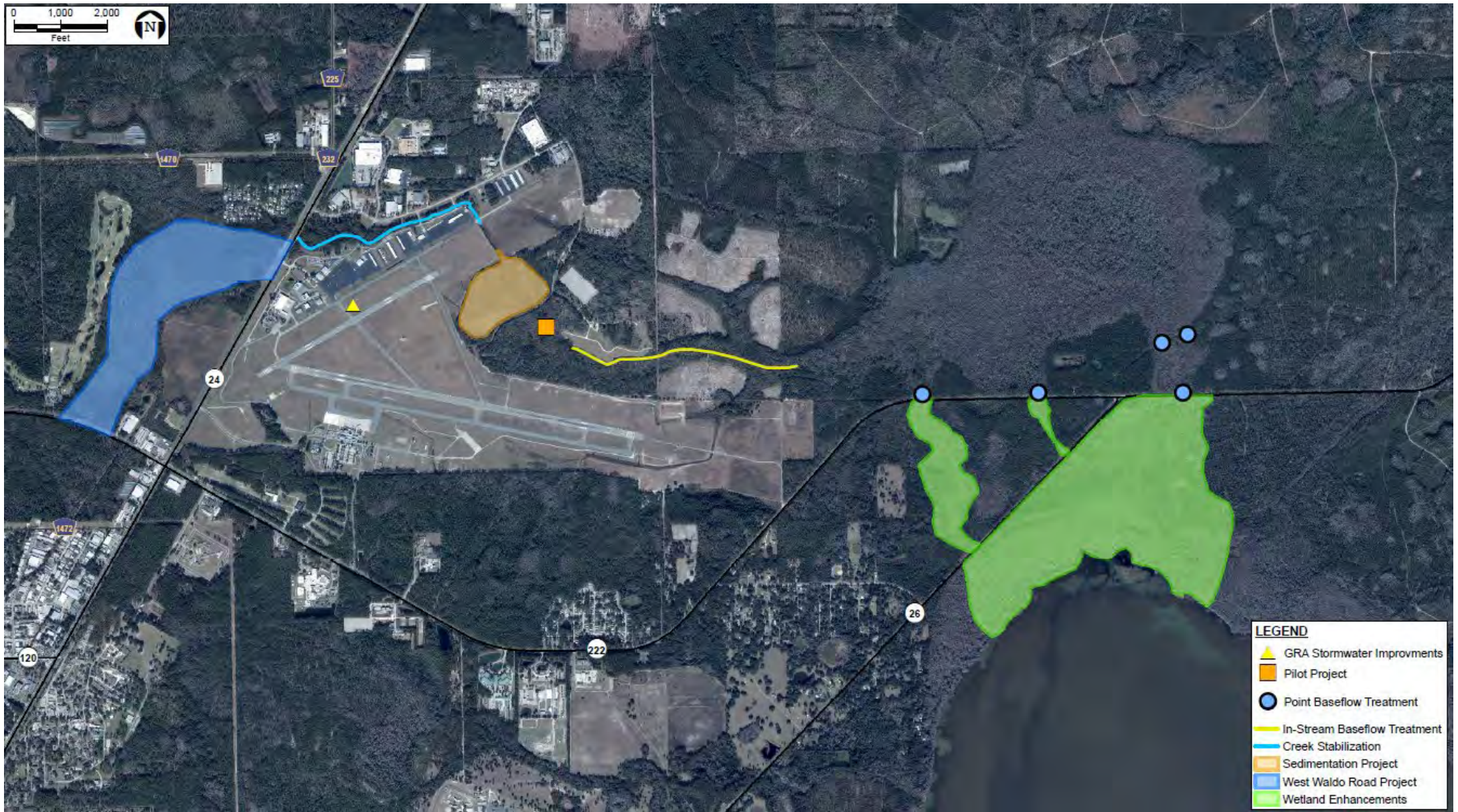


> Project Background

Newnans Lake Improvement Initiative –Phase I

Project categories:

- Water quality improvement projects
 - Sedimentation basins
 - Offline bioreactor
 - Treatment wetland
- Restoration Projects
 - Restore stream cross-section
 - Armor stream channel



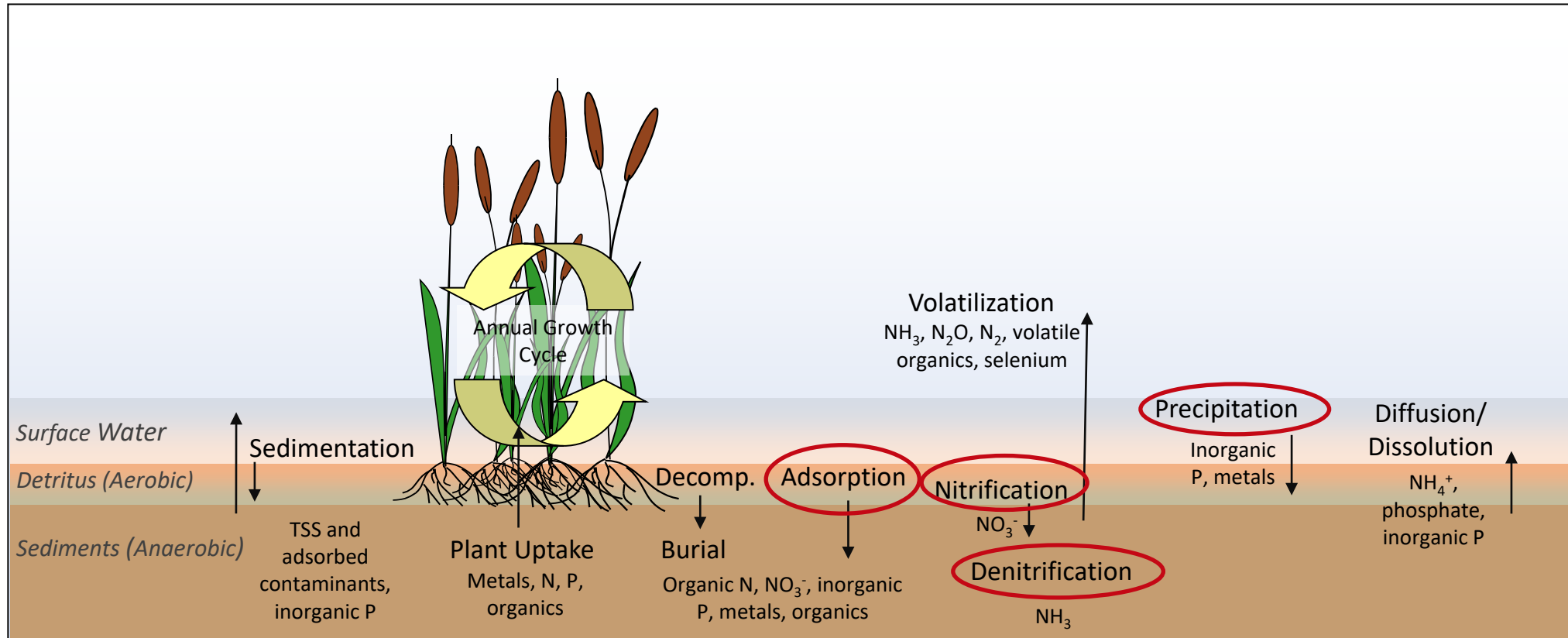
> Project Funding

- \$250,000 from Florida Department of Environmental Protection
 - Hatchet Creek Assessment
 - Design and construction of first weir
- \$65,000 from St. Johns River Water Management District
 - Allowed for construction of second weir
- \$3,000 from Stormwater Assessment
 - Design of second weir

> Treatment Wetland Concepts

- Traditional treatment wetlands can offer a wide range of benefits
 - Wetland functions, values
- Not a “one size fits all” solution to water quality issues
 - Available land/area, required area for treatment
 - Cost
 - Design/engineering constraints
- Approach: apply treatment wetland concepts to modified designs

> Treatment Wetland Concepts



Source: Modified from Bays, 2020

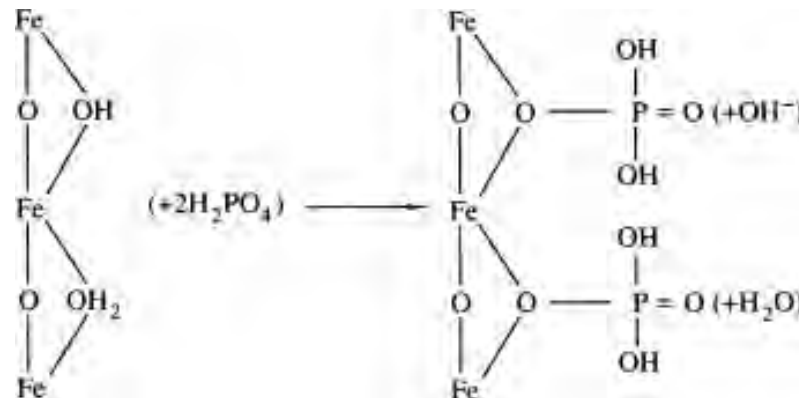
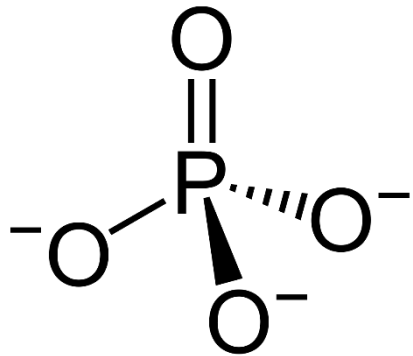
> Treatment Wetland Concepts

- Nitrification/denitrification

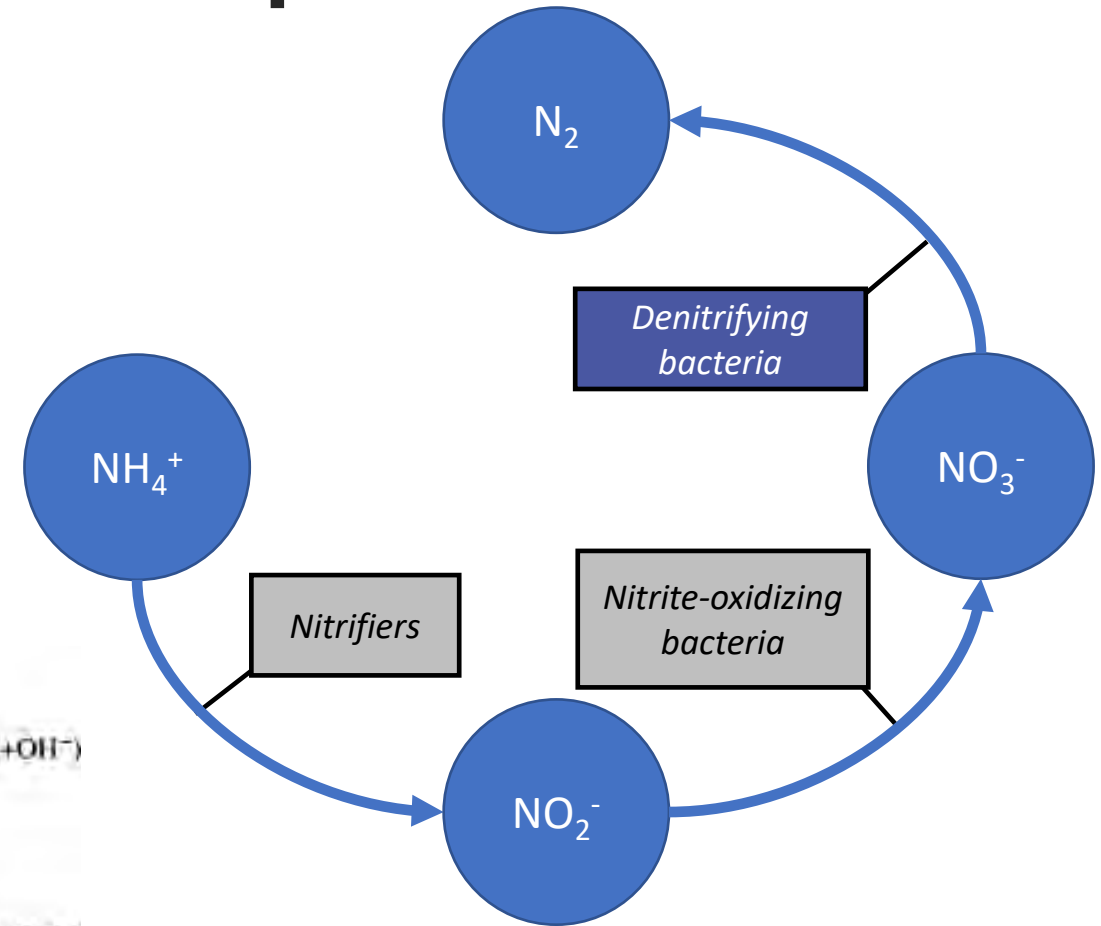
- Provide carbon source for microbes
- Provide aerobic and anaerobic environment for various microbes

- Adsorption and precipitation

- Aluminum (AlPO_4 (s)), calcium ($\text{Ca}_5(\text{OH})(\text{PO}_4)_3$ or $\text{Ca}_3(\text{PO}_4)_2$), iron (FePO_4 (s))



Source: Binkley 1998



> Treatment Wetland Concepts

Applied Treatment Processes: Denitrification in Bioreactors

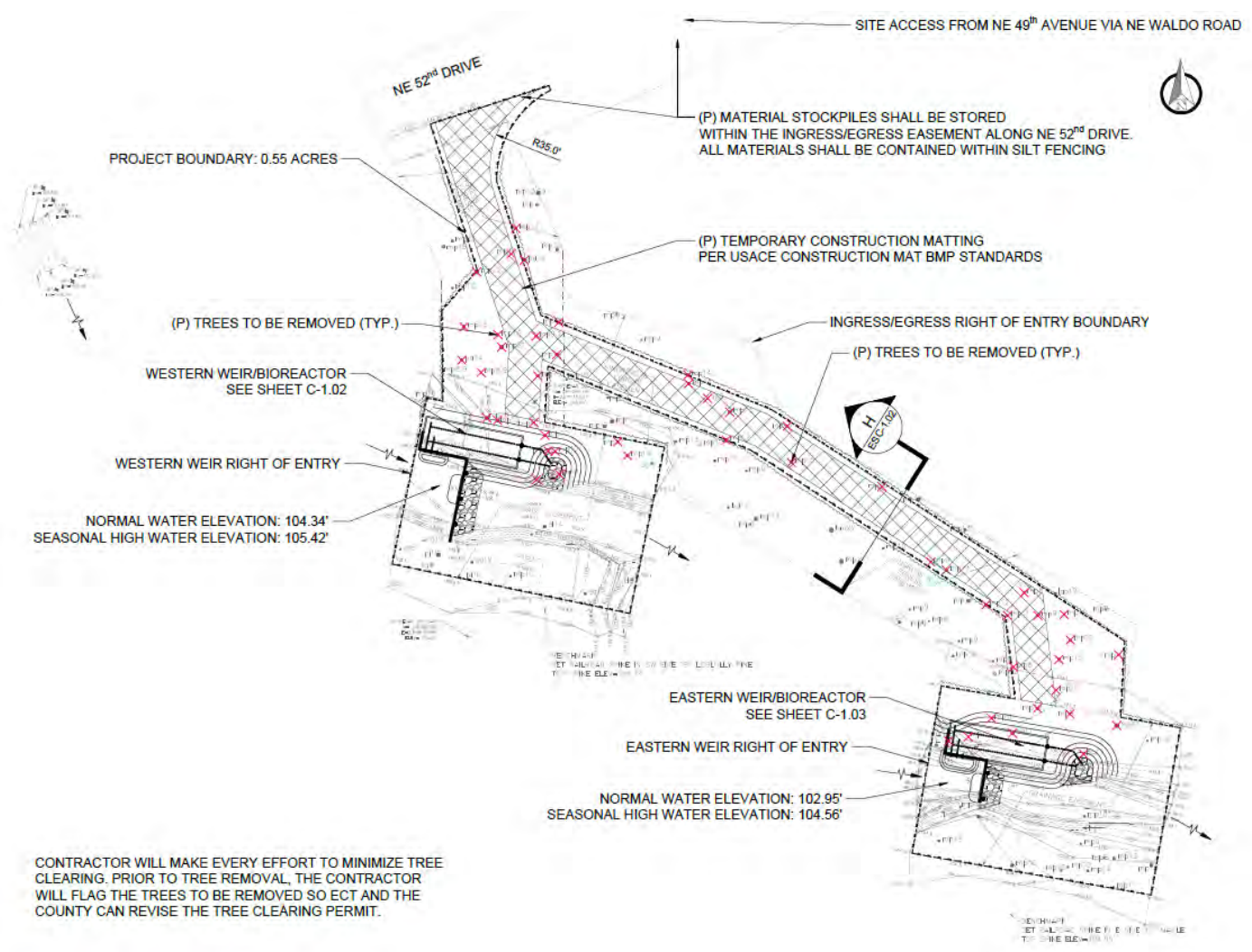
- Benefits
 - Can be very cost effective
 - Relatively easy to design
 - Little maintenance required
- Constraints
 - Media can clog as a result of biofilms or organic matter accumulation
 - Flow rates and hydrology
 - Media replacement (but is relatively simple)

> Little Hatchet Creek Bioreactor

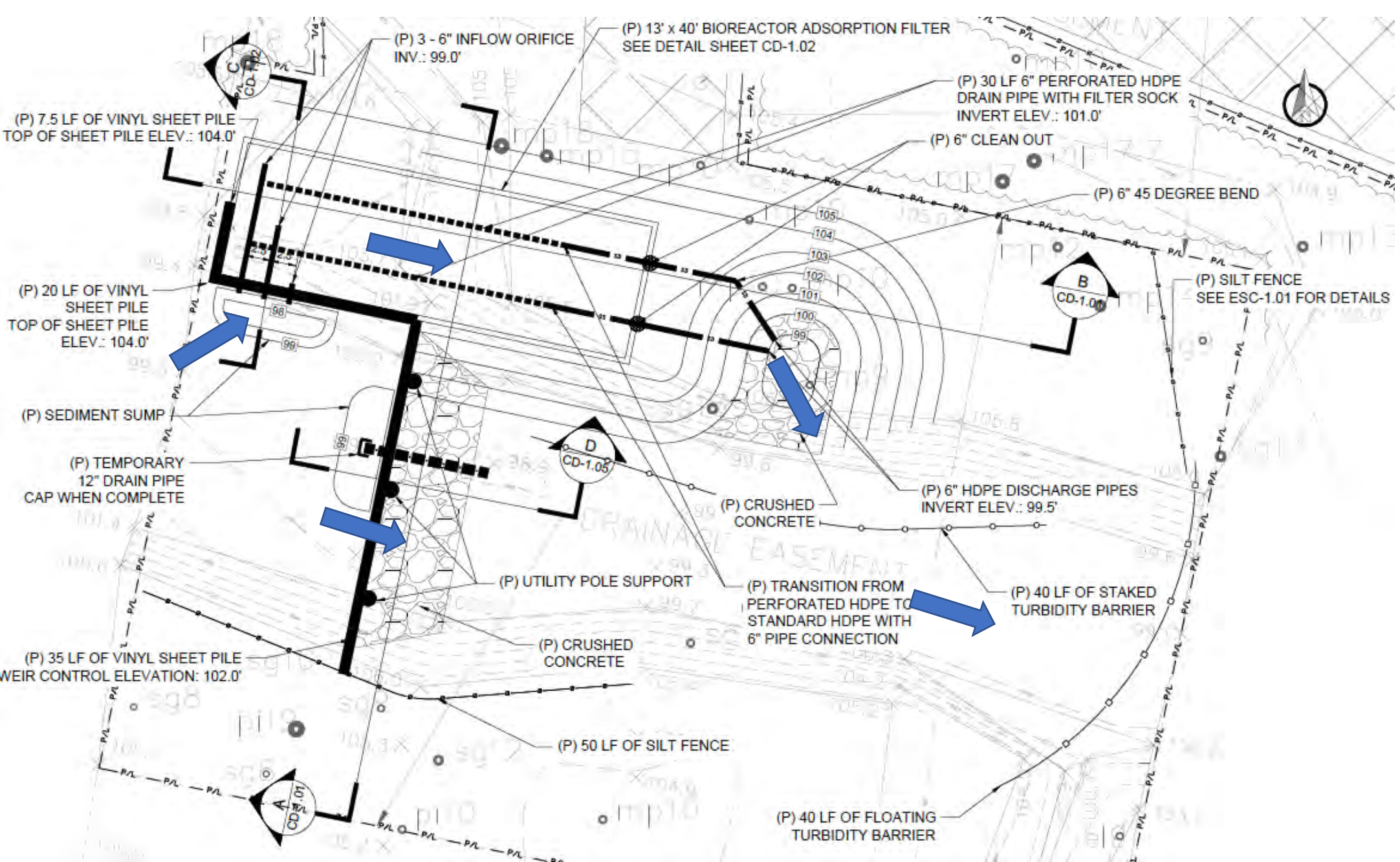
- Upflow bioreactor with alternative media to reduce TN and TP loading to Newnans Lake
 - High P
- Treat baseflow



> Little Hatchet Creek Bioreactor

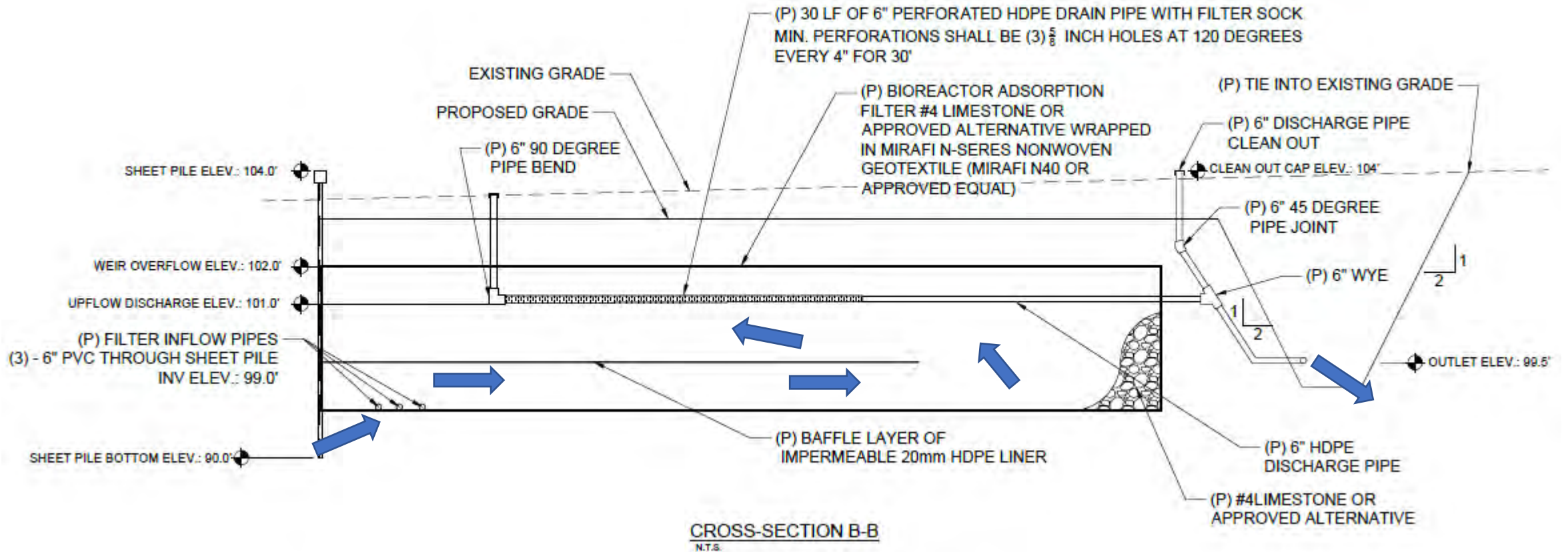


CONTRACTOR WILL MAKE EVERY EFFORT TO MINIMIZE TREE CLEARING. PRIOR TO TREE REMOVAL, THE CONTRACTOR WILL FLAG THE TREES TO BE REMOVED SO ECT AND THE COUNTY CAN REVISE THE TREE CLEARING PERMIT.



> Little Hatchet Creek Bioreactor

Bioreactor Cross-Section



> Little Hatchet Creek Bioreactor

Construction Photographs



> Little Hatchet Creek Bioreactor

Construction Photographs



> Little Hatchet Creek Bioreactor

Construction Photographs



> Little Hatchet Creek Bioreactor

Construction Photographs



> Little Hatchet Creek Bioreactor

Construction Photographs



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Construction Photographs



> Little Hatchet Creek Bioreactor

Construction Cost

- Design build contract - \$172,00
- Cost saving measures
 - Multiple construction quotes
 - Right sizing of bioreactors to meet the project budget
 - Media selection – relatively inexpensive while meeting the project objective
- Cost per pound of TP removed
 - Based on limited data - ~\$2,000/Lb

> Monitoring Results

- Four Sampling Events
 - November 2020 – March 2021
- Phosphorus Removal
 - Inflow concentration range: 0.19-0.24 mg/L
 - Upstream Bioreactor: 4%-48%
 - Downstream Bioreactor: -5%-41%

Bioreactor	11/19/2020	12/3/2020	12/10/202	3/2/2021
Upstream	48%	11%	4%	20%
Downstream	41%	6%	13%	-5%

- Discharge velocity and flow rate
 - Upstream Bioreactor: 0.8-1.5 ft/s, 0.3-0.5 cfs
 - Downstream Bioreactor: 2.7-3.8 ft/s, 0.9 -1.3 cfs

> Next Steps

- The County's final report to FDEP is due at the end of July, but the County intends to continue monitoring at least through the end of 2021.
- The pilot period runs through the end of the year at which time a decision will be made whether to remove the weirs or not.

> Questions

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