SWEETWATER BRANCH/PAYNES PRAIRIE SHEETFLOW RESTORATION PROJECT

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INTRODUCTION

The Sweetwater Branch/Paynes Prairie Sheetflow Restoration Project (Project) is a nutrient reduction and environmental restoration project that intercepts and treats nutrients and other pollutants from a 2,100-acre urbanized watershed in Gainesville, Florida. Stormwater runoff, industrial discharges, and effluent from the Main Street Water Reclamation Facility (MSWRF) are conveyed to Paynes Prairie via Sweetwater Branch, an urban stream that was historically channelized, allowing the direct discharge of these combined flows to the Floridan Aquifer at Alachua Sink, and impacting the hydrology of natural wetlands on the Prairie. The project was designed to meet Total Maximum Daily Load (TMDL) requirements for reducing total nitrogen (TN) discharges from the watershed to Alachua Sink, which is an impaired water body located within Paynes Prairie Preserve State Park (the Park). The TMDL required a 55% reduction in TN load from point sources and a 45% reduction from nonpoint sources (stormwater). The Project was developed through a multi-agency partnership as a comprehensive solution to address the above environmental concerns. Figure 1 shows the location of the Project and key elements which include:

- Upgrades to the MSWRF for additional phosphorus removal (1);
- Sweetwater Branch channel improvements to stabilize the channel and capture sediment and trash (2a);
- Creation of a 125-acre treatment wetland to provide a unique and innovative approach to achieving TMDL requirements (2b);
- Construction of a sheetflow distribution channel to restore downstream hydrology (3); and
- Backfilling an existing canal to eliminate short circuiting (4).

The project was completed as a collaborative effort with FDEP, EPA, FDOT, Florida Wildlife Commission, St. Johns River Water Management District, Alachua County, the City of Gainesville Public Works Department and Gainesville Regional Utilities. Construction was completed in 2015 at a cost of $27.5 million. The approved and completed project meets Alachua Sink TMDL and NNC requirements for sources entering Sweetwater Branch under current and build-out conditions. This paper presents an overview of the development and construction of the project along with a summary of water quality performance data. The project was designed by Jones Edmunds and Associates and Wetland Solutions, Inc., and was constructed by Wharton Smith, Inc.

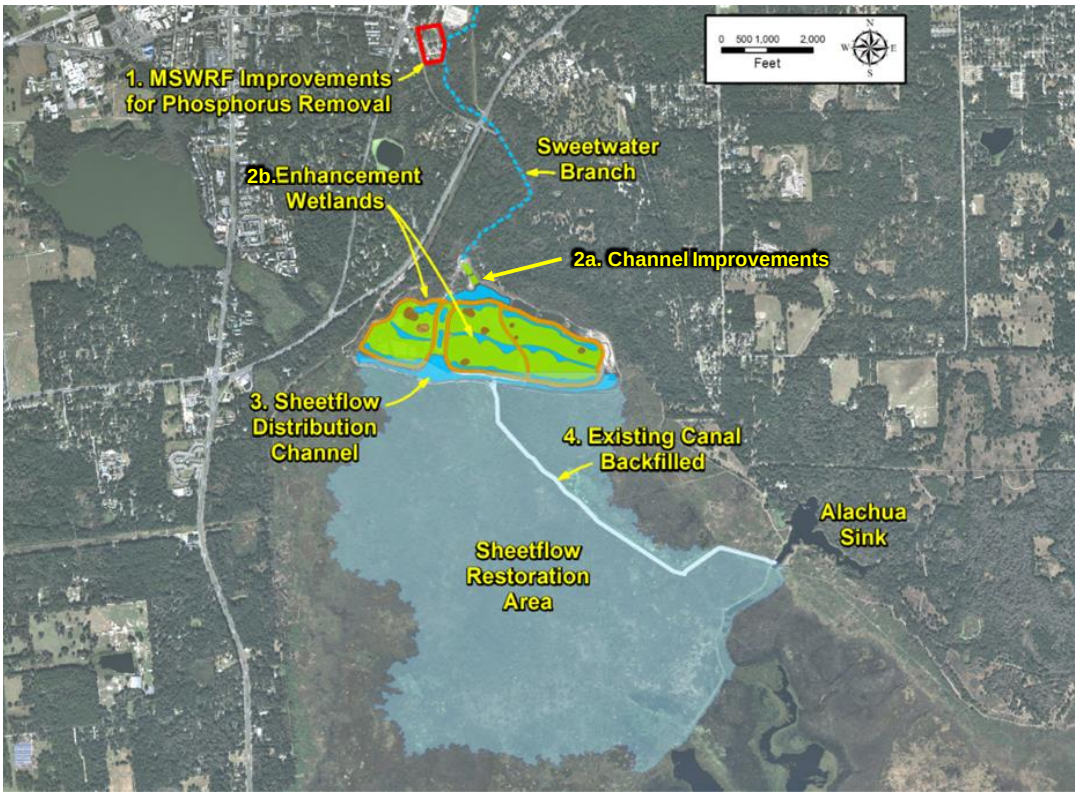


Figure 1. Sweetwater Branch/Paynes Prairie Sheetflow Restoration Project Components

PROJECT DETAILS

The "Channel Improvements" and "Enhancement Wetlands" shown in Figure 1 provide the majority of the treatment functions and the "Enhancement Wetlands" provide public access opportunities. **Error! Reference source not found.** summarizes design information for these key project components. Additional descriptive information for each key component is provided below.

Table 1. Sweetwater Branch/Paynes Prairie Sheetflow Restoration Project Details

Project Component	Surface Area (ac)	Mean Depth (ft)	Volume (ac-ft)
Sediment Basin	1.0	8.0	8.0
Trash Basin	0.7	6.0	4.2
Forebay	7.0	6.0	42
Wetland Cell 1	31	1.5	48
Wetland Cell 2	45	1.5	65
Wetland Cell 3	46	1.5	71
Distribution Channel	19	6.0	130

Sediment Basin

A 1-acre, inline basin was constructed to slow stream velocity and allow transported sediment loads to settle (Figure 2). The inlet to the basin includes a sheet pile grade control structure to stabilize the upstream channel reach and reduce head cutting. The basin is approximately 150 feet wide and 300 feet long and can be isolated from downstream project components for maintenance purposes.

Figure 2. Sweetwater Branch/Paynes Prairie Sheetflow Restoration Project Sediment Basin

Trash Basin

The trash collection basin sits immediately downstream from the sediment basin. The trash removal system includes a 160-foot floating boom that directs floating debris to a collection basket (Figure 3). The basket can be removed and emptied using a truck-mounted hoist.

Figure 3. Sweetwater Branch/Paynes Prairie Sheetflow Restoration Project Trash Basin

Forebay

A 7-acre forebay receives the inflows from the sediment and trash removal facilities (Figure 4). The forebay is approximately 6.0 feet in depth and serves multiple purposes including the distribution of flow to the three enhancement wetland cells, and routing excess flow to two bypass features, the Forested Slough and the Overflow Channel.

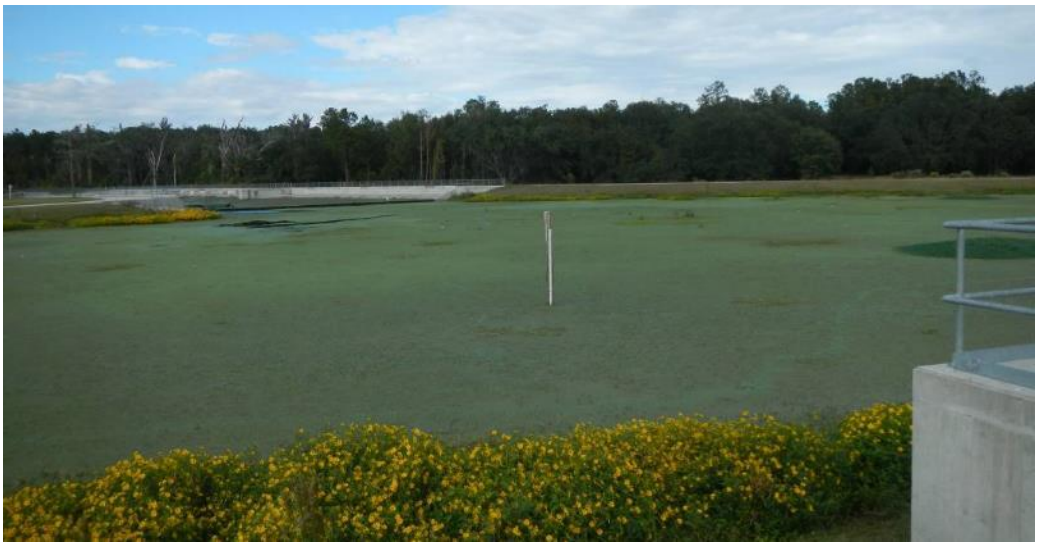


Figure 4. Sweetwater Branch/Paynes Prairie Sheetflow Restoration Project Forebay

Enhancement Wetlands

Three enhancement wetland cells, totaling about 122 acres and ranging from 31 to 46 acres each, were constructed to provide water quality treatment for nutrients (Figure 5). The marsh zones are typically operated at a water depth of about 1 foot. Transverse deep zones, about 5 feet deep, were constructed to distribute flow and minimize short-circuiting.

Figure 5. Sweetwater Branch/Paynes Prairie Sheetflow Restoration Project Wetland Cell

Sheetflow Distribution Channel

The 1.25-mile long Sheetflow Distribution Channel collects treated outflows from the three enhancement wetland cells and any bypassed flows and conveys the water to the northern edge of the Sheetflow Restoration Area (Figure 6). The channel was constructed as a level-spreader and matches the natural grade of the Prairie.

Figure 6. Sweetwater Branch/Paynes Prairie Sheetflow Restoration Project Distribution Channel

Canal Backfill

Approximately 8,300 linear feet of canal that previously routed untreated water directly to Alachua Sink was backfilled (Figure 7). The canal was filled to increase the effectiveness of the Sheetflow Distribution Channel in spreading treated water across the width of the Sheetflow Restoration Area. The uppermost 500 feet of the filled canal was planted with wetland vegetation to accelerate recovery and increase resistance to flow.

Figure 7. Sweetwater Branch/Paynes Prairie Sheetflow Restoration Project Canal Backfill

Public Access Features

Figure 8 shows the layout of the project components that are open to the public and have been named the Sweetwater Wetlands Park. Highlights of the public access features include a 3.6-mile berm system that define the three wetland cells and serve as walking paths; 1,800 linear feet of wooden boardwalks; a variety of overlooks and shade structures; interpretive signage; and parking, restroom, and ranger office facilities.

The Sweetwater Wetlands Park has been open to the public since May 2015. More than 50,000 visitors have used the Park for passive recreation activities since it opened. The site's accessibility and habitat value have made it a regional hot spot for bird enthusiasts. Over 170 species of birds have been documented using the site, with more than 90 species observed in a single day.

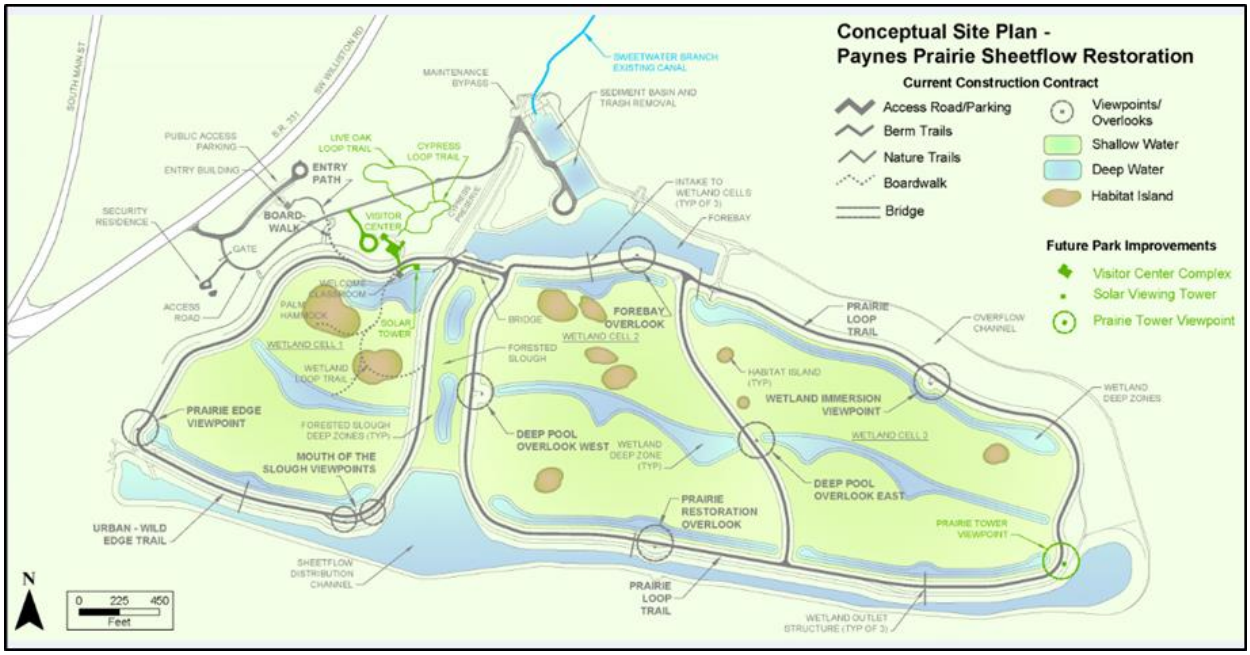


Figure 8. Sweetwater Branch/Paynes Prairie Sheetflow Restoration Project Public Access Features

PROCESS DIAGRAM

As noted above, the inflows to the project include treated municipal wastewater effluent, an industrial discharge, and stormwater from a highly-urbanized watershed. Baseflow in Sweetwater Branch is dominated by the MSWRF discharge during dry periods and has averaged about 8.5 cubic feet per second (cfs). Permitted capacity of the MSWRF is 11.6 cfs (7.5 million gallons per day). Inputs from the Kelly Generating Station are typically less than 1.0 cfs. Stormwater inputs can increase total stream discharge to more than 500 cfs as a daily average flow. The project was designed to route up to 25 cfs of flow through the wetlands with flows exceeding 25 cfs bypassed to the Forested Slough and Overflow Channel. This allows the project to capture up to 95 percent of the TN load delivered by Sweetwater Branch to the Prairie. Figure 9 shows the project process flow diagram.

At current average flows (about 10 cfs), the enhancement wetland cells provide about 9.3 days of hydraulic residence time at a nominal depth of 1 foot. At peak flow (25 cfs), the wetlands provide about 3.7 days of residence time. Inflows to the wetlands are controlled through structures that are equipped with 18-inch wide by 24-inch high adjustable orifices. Wetland outflows are controlled using adjustable 4-foot wide rectangular weirs.

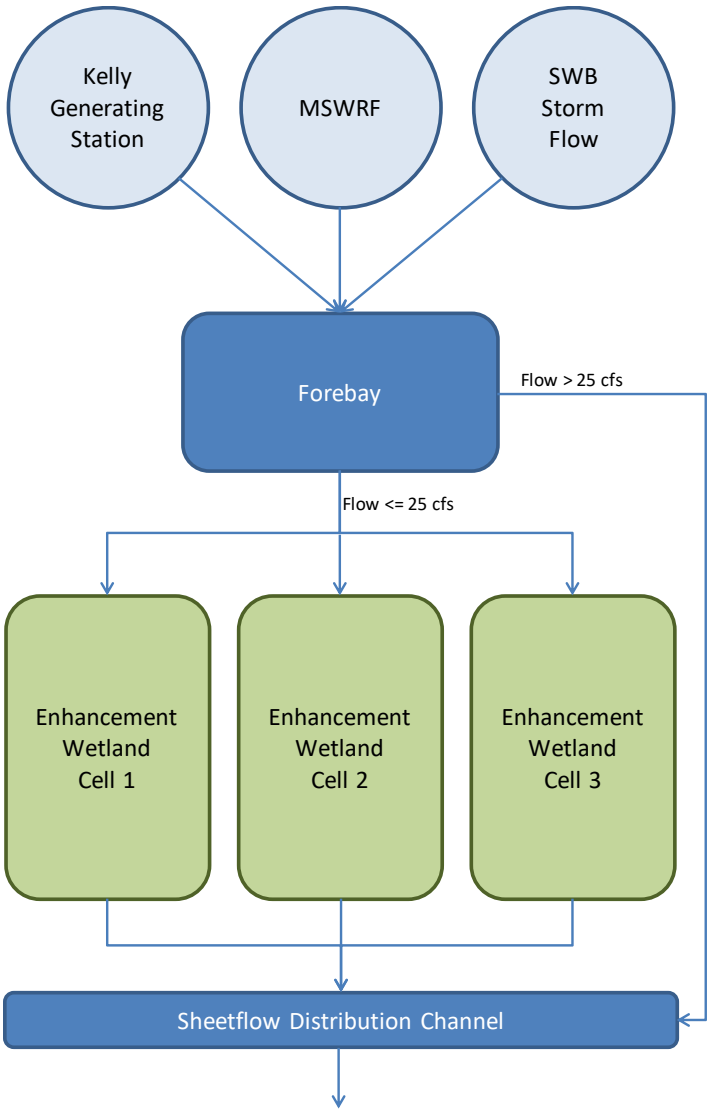


Figure 9. Sweetwater Branch/Paynes Prairie Sheetflow Restoration Project Process Diagram

CONSTRUCTION DETAILS

Construction began in September 2012 and was completed in August 2015. The cost to design and construct the facility was about $28 million. The project required movement of over 1,000,000 cubic yards of earth to construct. The wetland cells were initially planted with over 400,000 bare root marsh plants. Figure 10 shows before and after aerial imagery of the Project.

Figure 10. Sweetwater Branch/Paynes Prairie Sheetflow Restoration Project Aerial Photography

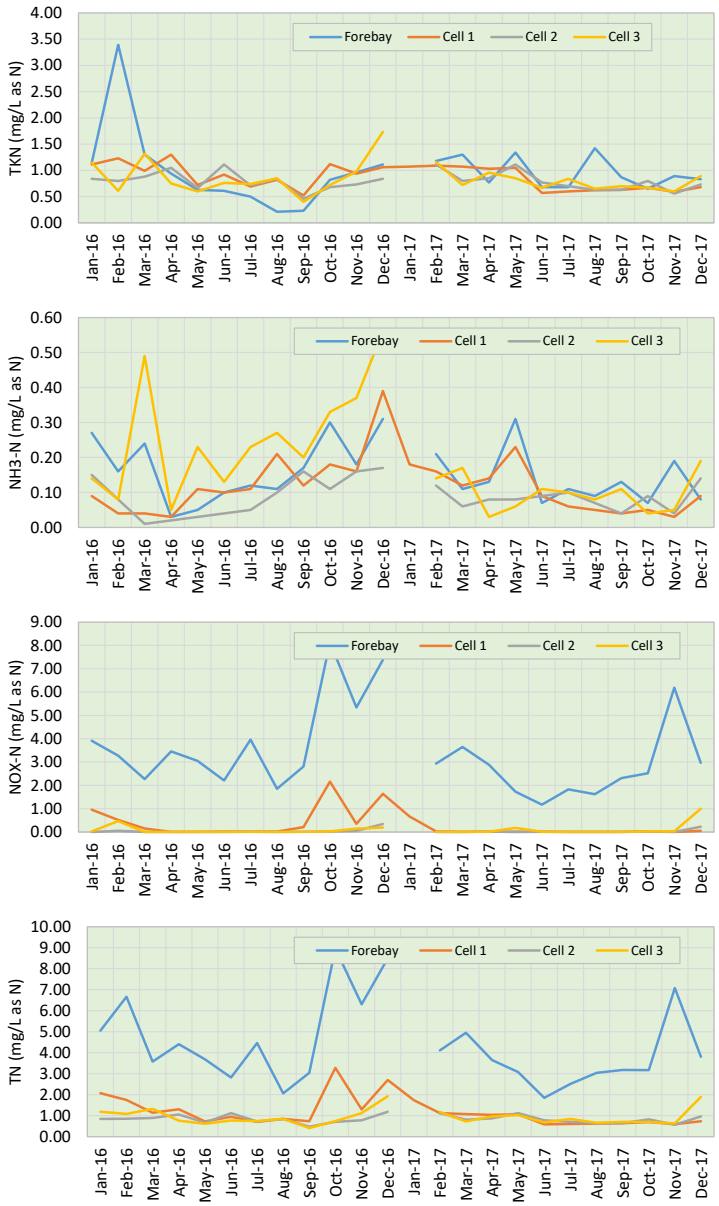
WATER QUALITY PERFORMANCE

Figure 11 summarizes nitrogen performance data for 2016-2017. Forebay (wetland inflow) total kjeldahl nitrogen (TKN) ranged from 0.21 to 3.39 mg/L and averaged 0.98 mg/L. Wetland cell outflow TKN concentrations averaged 0.88 mg/L for Cell 1, 0.80 mg/L for Cell 2, and 0.84 mg/L for Cell 3.

Ammonia nitrogen (NH3-N) concentrations were generally less than 0.5 mg/L at the forebay and in the discharge from the wetland cells. The annual average concentrations were 0.15 mg/L for the forebay, 0.12 mg/L for Cell 1, 0.09 mg/L for Cell 2, and 0.18 mg/L for Cell 3.

Nitrate+Nitrite nitrogen (NOX-N) was the dominant nitrogen form in the inflow and also showed the greatest change between the wetland inflow and outflow stations. Forebay NOX-N averaged 3.37 mg/L and ranged from 1.17 to 8.14 mg/L. Wetland outflow concentrations ranged from 0.01 to 2.16 mg/L and averaged 0.29 mg/L for Cell 1, 0.04 mg/L for Cell 2, and 0.10 mg/L for Cell 3.

Monthly TN patterns were similar to those for NOX-N. Forebay TN averaged 4.34 mg/L and wetland outflows averaged 1.17 mg/L for Cell 1, 0.83 mg/L for Cell 2, and 0.93 mg/L for Cell 3.



Statistic	Forebay	Cell 1	Cell 2	Cell 3
Min	0.21	0.52	0.46	0.40
Max	3.39	1.30	1.11	1.73
Mean	0.98	0.88	0.80	0.84
Count	23	24	23	23

Statistic	Forebay	Cell 1	Cell 2	Cell 3
Min	0.03	0.03	0.01	0.03
Max	0.31	0.39	0.17	0.56
Mean	0.15	0.12	0.09	0.18
Count	23	24	23	23

Statistic	Forebay	Cell 1	Cell 2	Cell 3
Min	1.17	0.01	0.01	0.01
Max	8.14	2.16	0.34	1.00
Mean	3.37	0.29	0.04	0.10
Count	23	24	23	23

Statistic	Forebay	Cell 1	Cell 2	Cell 3
Min	1.85	0.58	0.47	0.41
Max	8.96	3.28	1.18	1.92
Mean	4.34	1.17	0.83	0.93
Count	23	24	23	23

Figure 11. Sweetwater Branch/Paynes Prairie Sheetflow Restoration Project Nitrogen Performance

CONCLUSIONS

The project has been an overwhelming success and has achieved all of the project goals. By working together, the Gainesville Public Works Department and GRU in partnership with Florida Department of Environmental Protection, St. Johns River Water Management District, Alachua County, the Florida Department of Transportation, the Florida Fish and Wildlife Conservation Commission, and EPA were able to develop and implement a cost-effective solution that achieves the following benefits:

- Restoring approximately 1,300 acres of the Paynes Prairie Basin;

- Improving water quality in Alachua Sink and cost-effectively attaining regulatory TMDL requirements for the City of Gainesville and the Florida Department of Transportation;
- Creating a city park, the “Sweetwater Wetlands Park” which includes about 125 acres of high-quality wetland and wildlife habitat and a public use area for bird-watching and nature study;
- Naturally assimilating other nutrients, sediments, and pollutants in the Sweetwater Branch to protect Paynes Prairie, Alachua Sink, and the Floridan Aquifer; and
- Restoring part of the overall water budget to Paynes Prairie, which has been impacted by diversion of water at other locations.