Restoration Strategies – P Dynamics in the Everglades Stormwater Treatment Areas Study Summary

Project Name: P Dynamics in the Everglades Stormwater Treatment Areas

Project Purpose: Evaluate mechanisms and factors affecting outflow TP concentrations from the Everglades Stormwater Treatment Areas that are currently exceeding the water quality based effluent limit (WQBEL).

Introduction:

This study will investigate selected flow-ways of STAs that are not meeting the WQBEL requirements by applying lessons learned from a previous Restoration Strategies science plan study (the P Flux study) and will conduct similar research to evaluate mechanisms and factors that may influence higher outflow TP concentrations.

Five main components will be evaluated: water quality, soils, vegetation, ultra-fine particulates, and microbial processes. Internal loading, which was considered a primary driver of outflow TP concentrations from the P Flux Study, will be a major focus of this effort. This effort will evaluate the roles of vegetation communities and conditions and soil conditions to determine and how these components affect internal loading among poorer and better performing flow-ways. High-flow vs no-flow profiles will be evaluated and compared among poorer and well-performing FWs. Internal loading will be compared between EAV vs SAV communities and seasonally after wet season (high PLR) vs after dry season (low PLR). Ultra-fine particulates will be examined to determine the importance and nature of ultrafine phosphorus in the inflows and the outflows of STAs and examine how STA design (e.g. EAV vs SAV) may affect ultrafine P within STA outflow discharge.

Study results will provide further insight into why these poorer performing STAs are not meeting the WQBEL.

The focus will be on two STAs and five flow-ways:

- STA-1E Central FW and Eastern FW
- STA-2 Cells 2, 3, and 4
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Currently the study is in the development phase assimilating previous data sets and inflow and outflow data from the cells/flow-ways of interest. This study plan may be revised and enhanced as new information becomes available. Considerations to STA construction improvement projects also may affect selected flow-ways and may alter study locations. The study will be conducted over two years and the bulk of sampling will be conducted over a 4-6 month monitoring period capturing a minimum of one wet season and one dry season.

Objectives:

1. Collect water quality samples in poorer and well performing STAs along flow-ways transects during normal operations over a 4 to 6 month monitoring period (wet and dry season).
2. Collect water quality samples at locations away from the transects during 2 high flow and 2 no flow conditions to evaluate effects of flows on internal loading/P removal effectiveness.
3. Evaluate vegetation health and coverage at study sites to determine the role and influence of vegetation on internal loading.
4. Evaluate the soil conditions and conduct soil phosphorus fractionation in STA-1E Central Flow-way.
5. Evaluate the influence of ultra-fine particulates at the inflow and outflow of selected flow-ways.
6. Evaluate the influence of microbial communities within selected flow-ways.

Applications of Findings:

1. Establish and/or confirm the STA components/processes (i.e. internal loading) that are influencing the inability to meet the WQBEL and how these factors may be improved.
2. Compare the effects of high flow/no flow conditions that may support operation and management to enhance P removal.
3. Determine the processes that inhibit the attainment of the water quality-based effluent limit (WQBEL) at the STA discharge points and provide management actions to reduce their effects.

Relevant Science Plan Key Questions & Sub-questions:

- How can internal loading of P to the water column be reduced or controlled, especially in the lower reaches of the STAs?
    - Are there design or operational changes that can be implemented in the STAs to reduce PP and DOP in the water column?
- How can the biogeochemical or physical mechanisms, including internal flux of P, be managed to further reduce SRP, PP, and DOP concentrations at the outflow of the STAs?
    - What are the sources, forms, and transformation mechanisms controlling residual P pools within the STAs, and how do they compare to the natural system?
    - What is the role of vegetation in modifying P availability in low P environments, including the transformation of refractory forms of P?

Proposed Approach:

There are six tasks in this approach:

1. Surface Water Quality Monitoring-Transect Study

   Water Quality samples will be taken along established transect locations from inflow to outflow of selected flow-ways. The monitoring will occur over 2 wet and 2 dry periods on a regular basis to establish water quality conditions and changes along the flow path.

2. Spatial Water Quality Sampling and Vegetation Assessment

   In addition to the transect monitoring. Water quality samples will be taken within two flow-ways, from 4 locations away from the transect to more thoroughly analyze the spatial variability within the flow-

ways. In addition, vegetation and floc will be collected and analyzed to determine their effect on the spatial variability.

3. Spatial and Transect Soil Sampling and Analysis

   Intact soil cores will be collected within the STA-1E CFW to document the current soil conditions. These will be compared to previous values to determine the changes over time.

4. Soil Phosphorus Fractionation

   A portion of the collected cores will be fractionated to analyze the various P forms P of the floc and recently accreted soil layers.

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5. Evaluation of Ultra-fine Particulates

   Ultra fine particulates, that are less than 0.45 microns in diameter could be an as an incorrectly identified portion of the TP in outflow from the STAs. Water samples from inflow midflow and outflow locations of STA flowways will be filtered through various pore sized filters to collect these ultrafine particles that until now have been classified as a dissolved organic component. Various methods will be used to characterize the particles including ^{31}P nuclear magnetic resonance (NMR) spectroscopy and X-ray absorbance spectroscopy (XAS).

6. Microbial Processes-

   Microbial processes will be evaluated in concert with those proposed in the Periphyton Study. These will include evaluation of enzyme activity and the effects of various standard enzymes on the bioavailability of particulate and dissolved organic P.

PROJECT SCHEDULE

Task	Description	FY20	FY21	FY22
1	Surface Water Quality Monitoring-Transect Study	X	X	X
2	Spatial Water Quality Sampling and Vegetation Assessment	X	X	X
3	Spatial and Transect Soil Sampling and Analysis		X	X
4	Soil Phosphorus Fractionation		X	X
5	Evaluation of Ultra-Fine Particulates		X	X
6	Microbial Processes		X	X