Water, Ion and Phosphorus Budgets of a Periphyton-Based Stormwater Treatment Area

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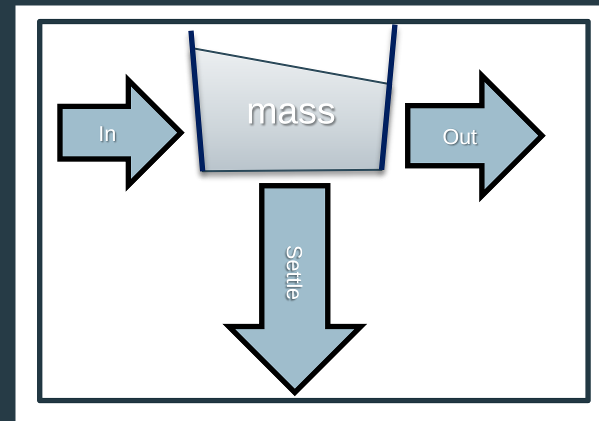
This Presentation Focuses on

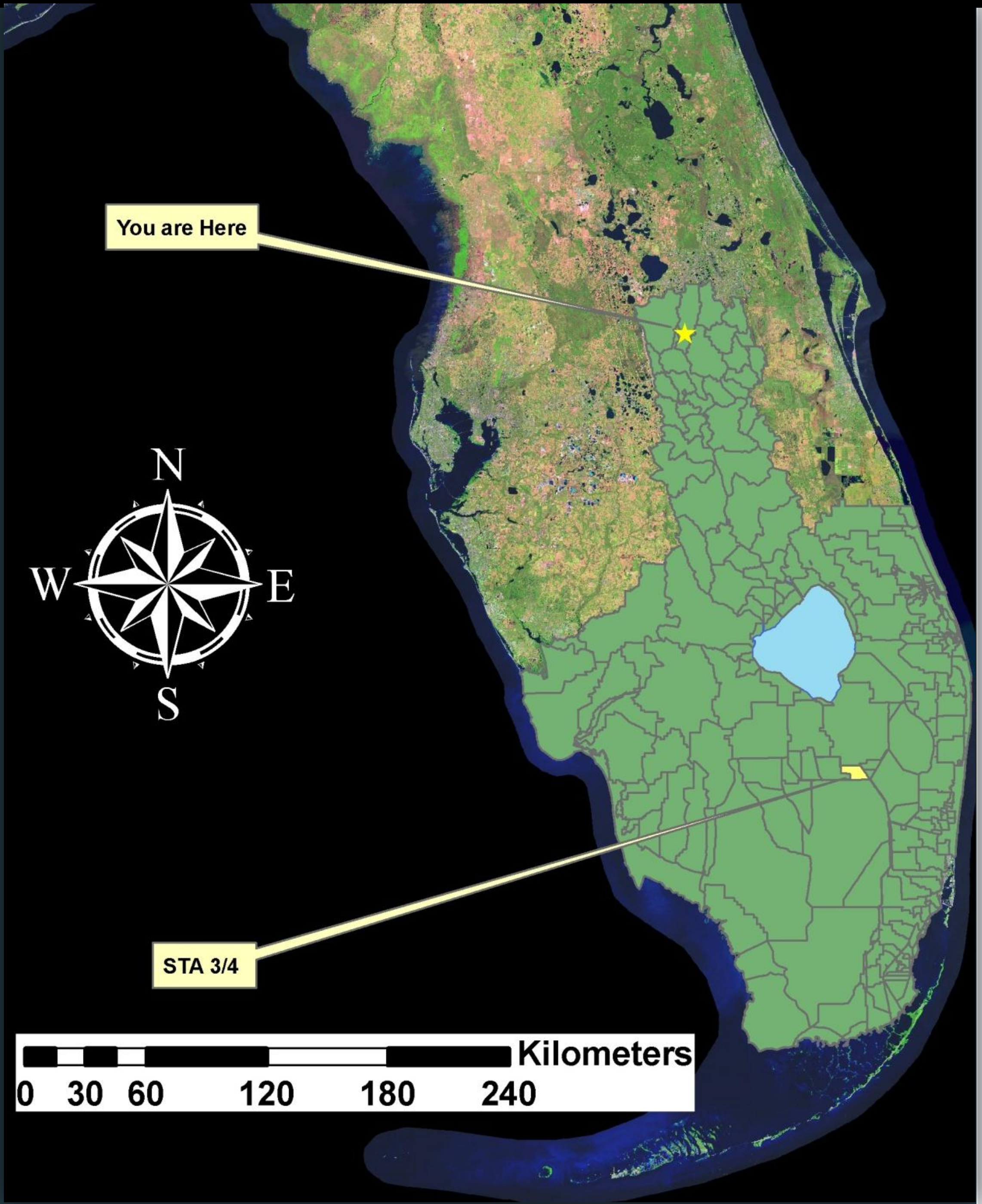
Description of PSTA



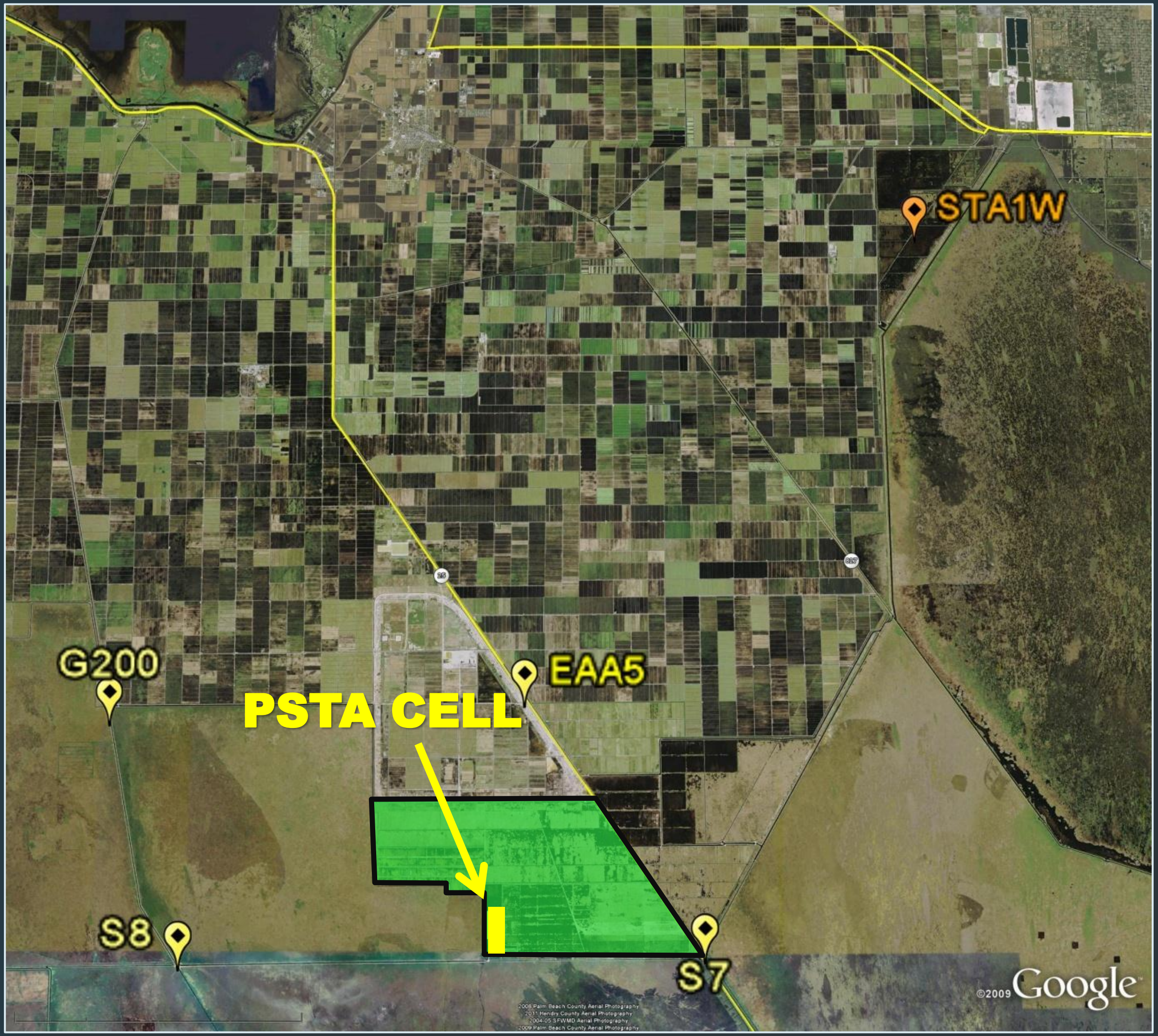
Development and analysis of ion and nutrient budgets

Improving accuracy of measurements

STA -3/4
is located
240 km SSE
from Orlando



PSTA cell is located on the south west corner of STA -3/4



This Periphyton-Based Stormwater Treatment Area is a Demonstration/Implementation Project

- What chemical, biological and design factors contribute to the ultra-low outflow TP levels?
- What loading rates and water depth achieve ultra-low outflow TP levels?
- What management practices sustain this performance?

PSTA Cell was Constructed by Scraping Peat to Caprock

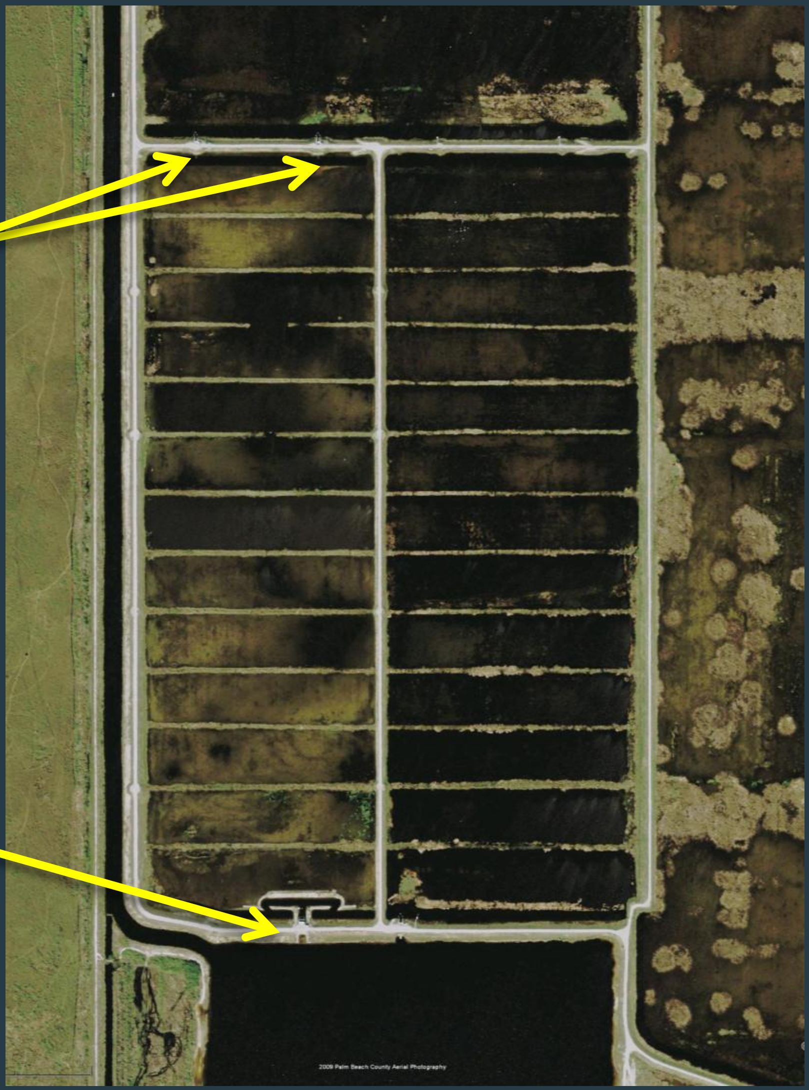
Scraping material used to create vegetation strips that improved hydraulics and reduced wind effects on Submerged Aquatic Vegetation

Peat removal reduced flux of P to water column and increased water contact with calcium caprock

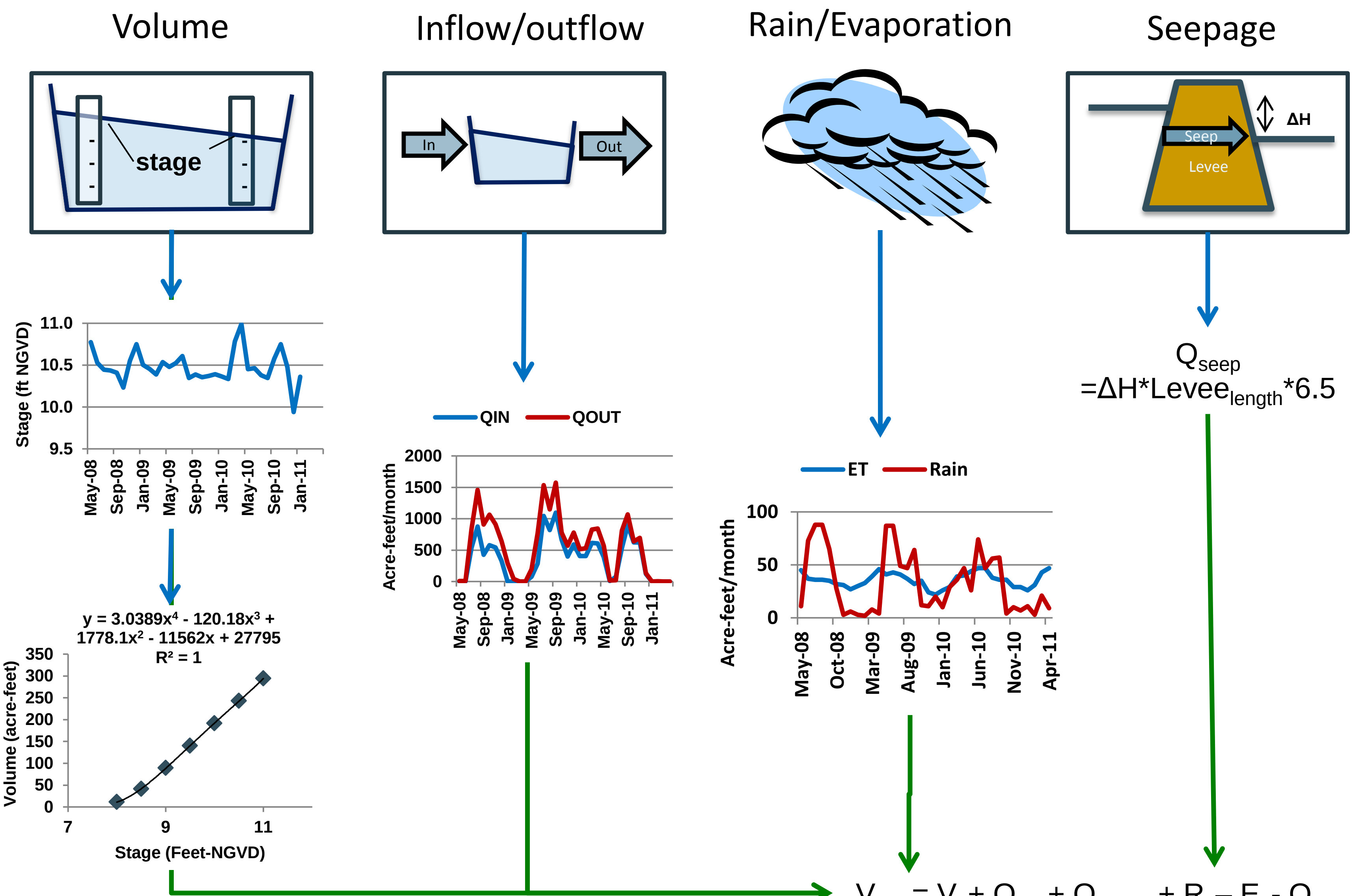
There are Two Inflow Gates and One Outflow Pump

Inflow Gates

Outflow Pump



Hydrologic Budgets Summarize Many Forms of Measured and Estimated Data

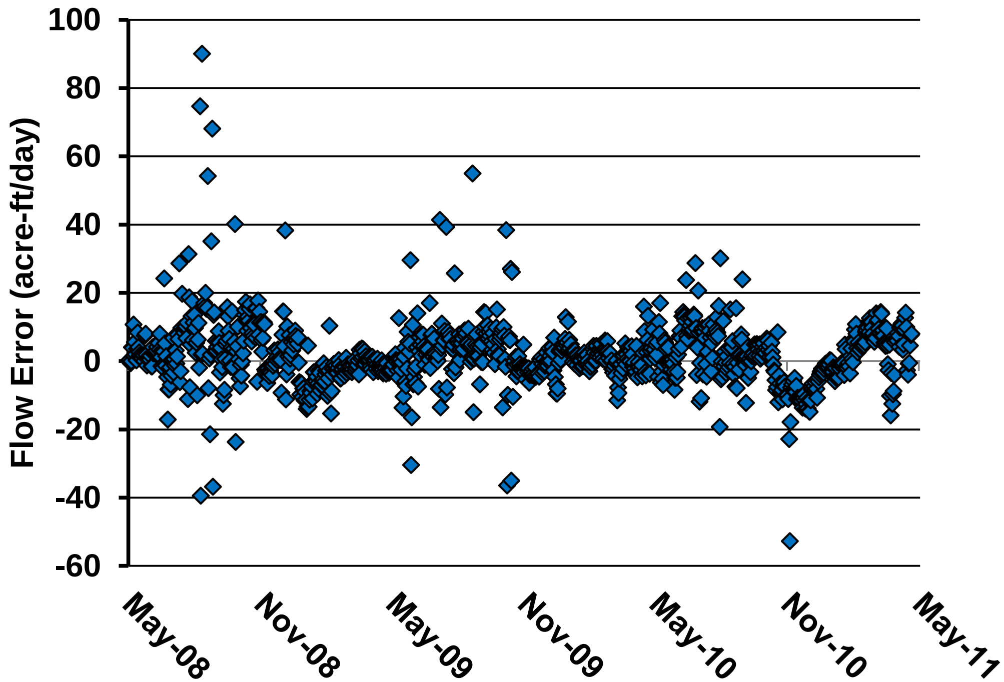


$$V_{t+1} = V_t + Q_{in,t} + Q_{seep,t} + R_t - E_t - Q_{out,t}$$

By rearranging the equation the accuracy of the inflow and outflow measurements/estimates can be determined

$$V_{t+1} - V_t = Q_{in,t} + Q_{seep} + R_t - E_t - Q_{out,t}$$

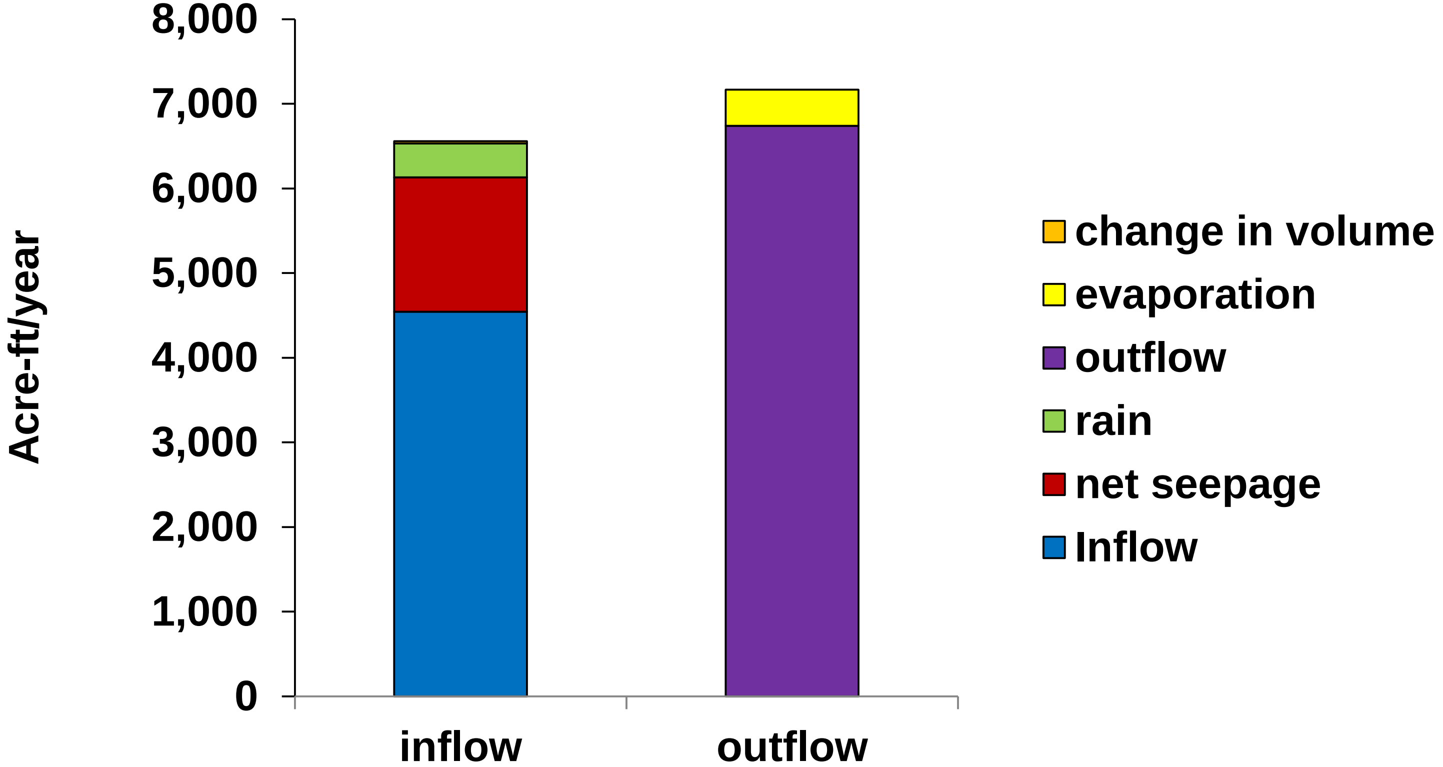
$$Error = (Q_{in,t} + Q_{seep} + R_t - E_t - Q_{out,t}) - (V_{t+1} - V_t)$$



The error ranges from - 52 to 90 ac-ft/day (average 2 ac-ft/day).

The standard deviation is ±55 ac-ft or 24% of the average volume of 257 ac-ft

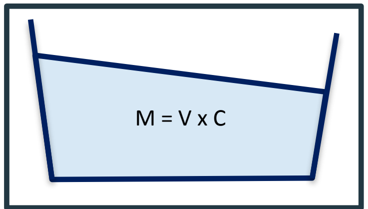
Net Seepage is a Large Proportion of the Total Inflow to the PSTA Cell

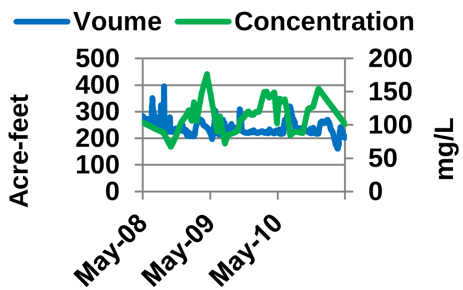


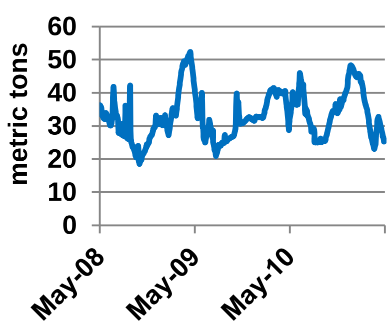
Average turnover based on outflow is 15.5 days.
Total Outflow exceeds inflow by 635 ac-ft/yr or 9.7%.
Missing inflow?

Nutrient and Ion Budgets Rely Heavily on Hydrology

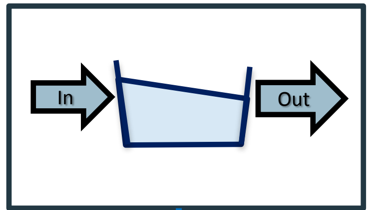
Mass





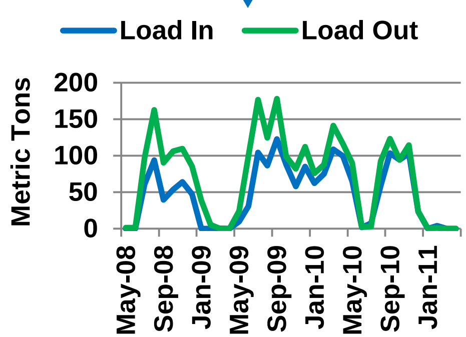


Loads In and Out



$L_{IN} = Q_{in} * C_{in}$

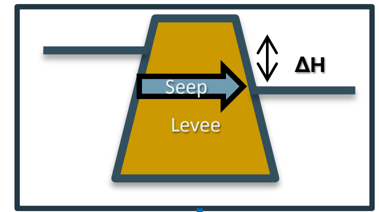
$L_{out} = Q_{out} * C_{out}$



Atmospheric Deposition

L_A = various methods

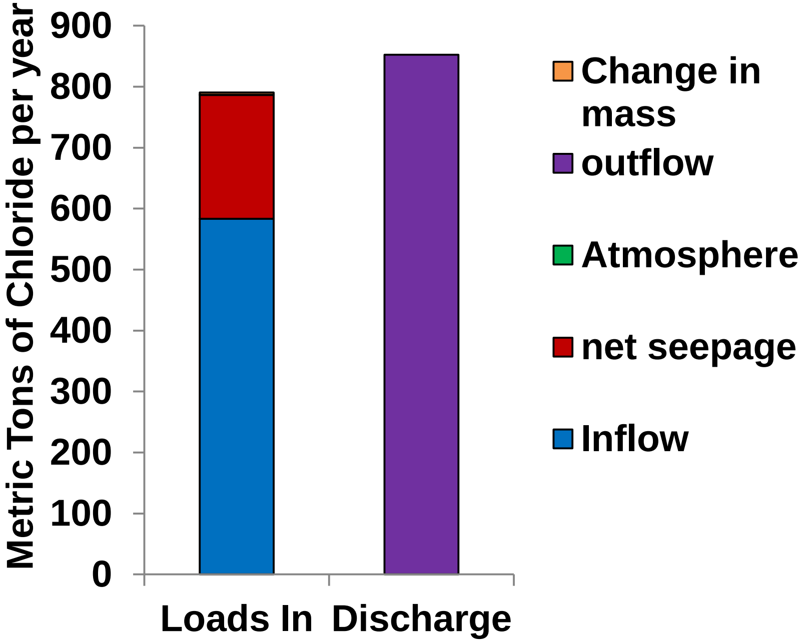
Seepage



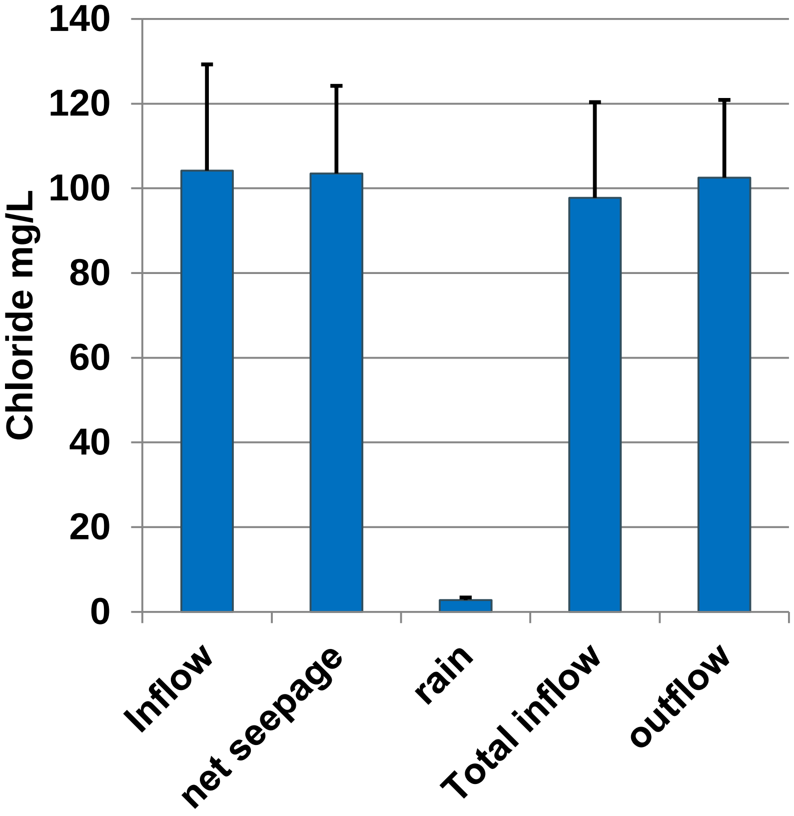
$L_{seep} = Q_{seep} * C_{seep}$

$$M_{t+1} = M_t + L_{in,t} + L_{seep,t} + L_{A,t} - L_{out,t}$$

Chloride is a conservative tracer.
The budget is similar to hydrologic budget.



Total Inflow and outflow concentrations are nearly the same

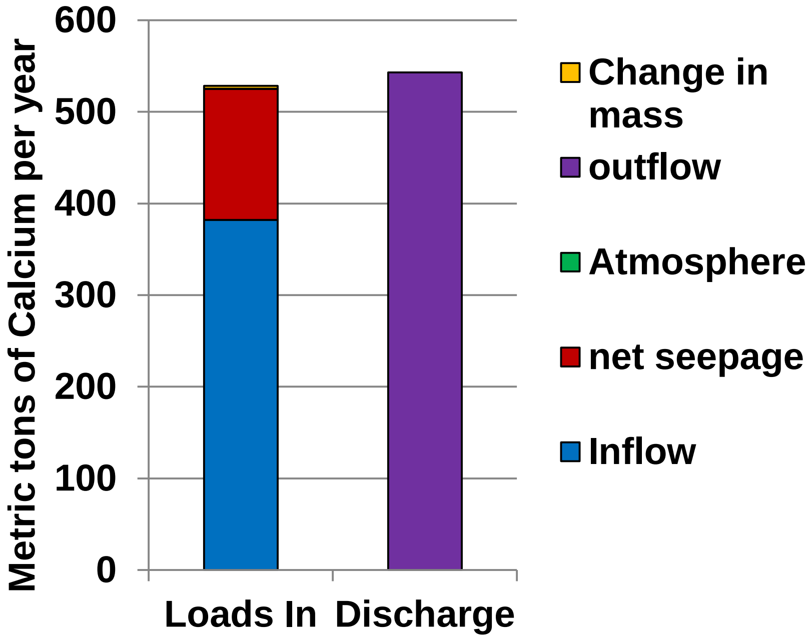


Averaged turnover
based on discharge is12 days.

Discharge exceeds loads in
by 64 metric tons per year or 8.2%.

Missing inflow?

Calcium Loads and Discharges are Nearly Equal

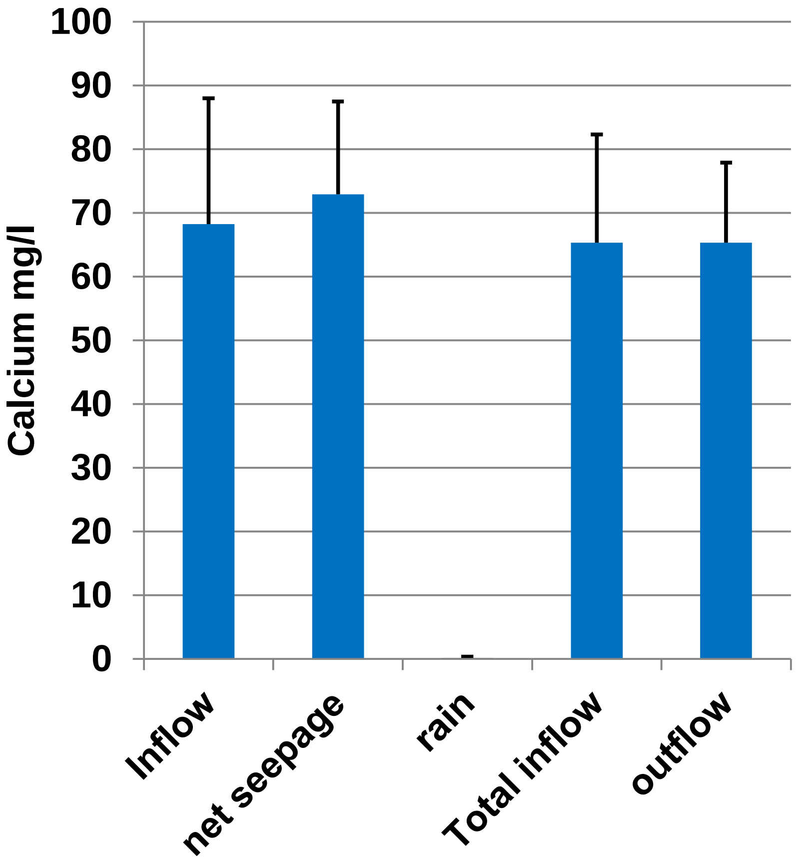


Averaged turnover based on discharge is12 days.

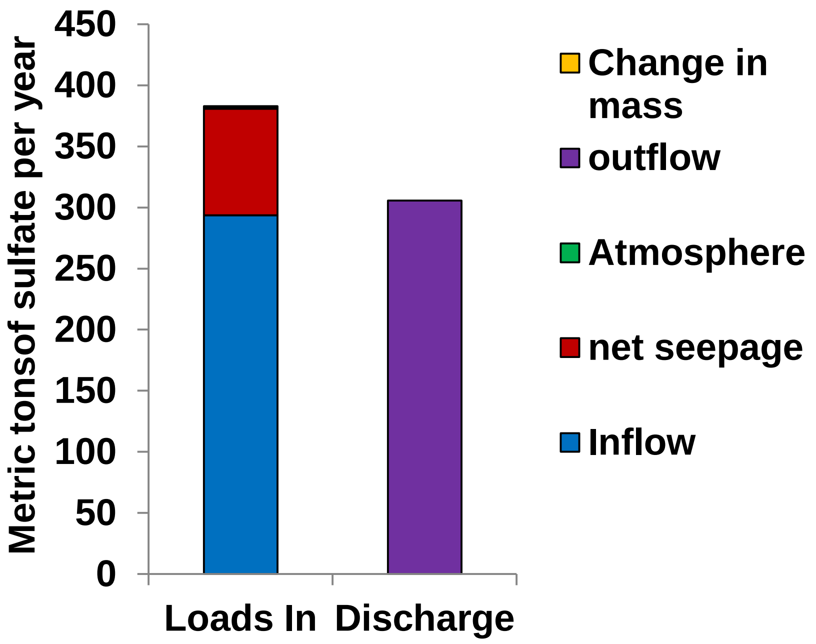
Discharge exceeds measured loads by 17.5 metric tons/year or 3.3%

If some inflow is missing then PSTA cell may be removing some calcium

Calcium discharge concentration is the same as the total inflow concentration



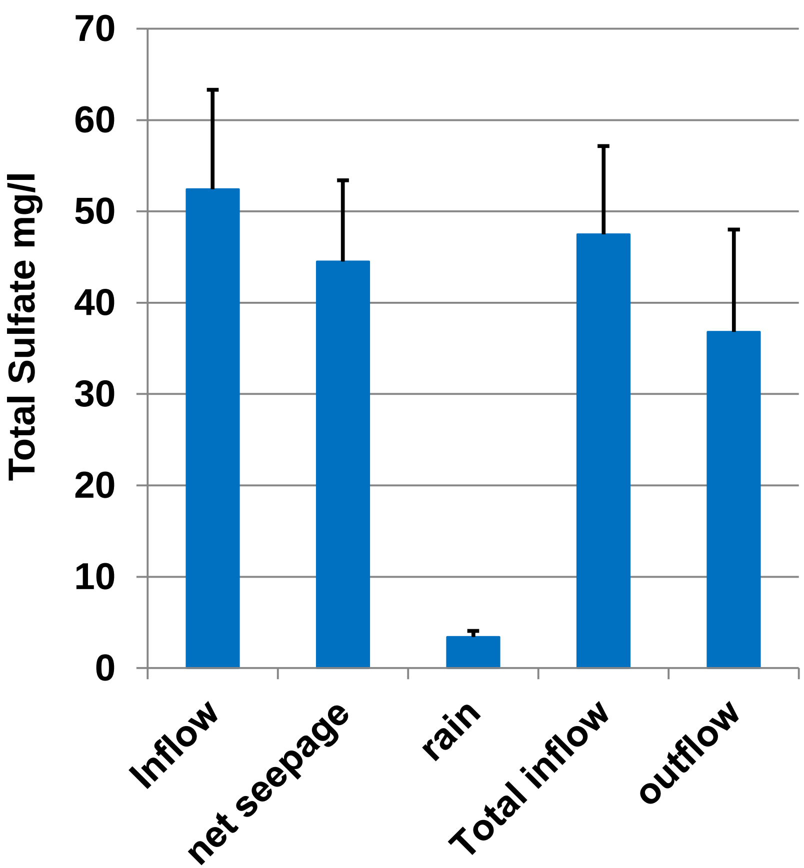
Sulfate is Being Removed Within the PSTA Cell



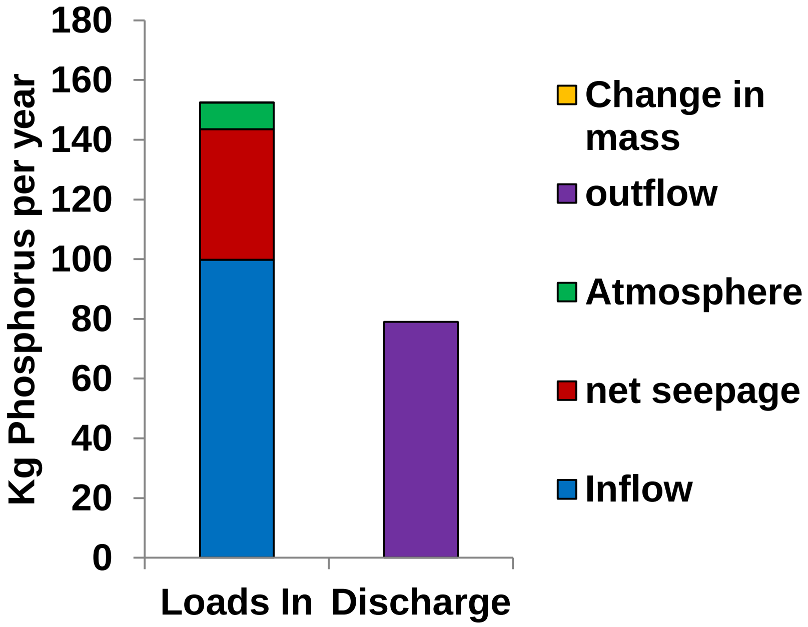
Averaged turnover based on discharge is14 days.

Measured loads in exceed discharge by 77 metric tons per year or 20%, of sulfate is being removed (biological uptake)

Total inflow concentration exceed outflow concentrations by 23% (10 mg/l)

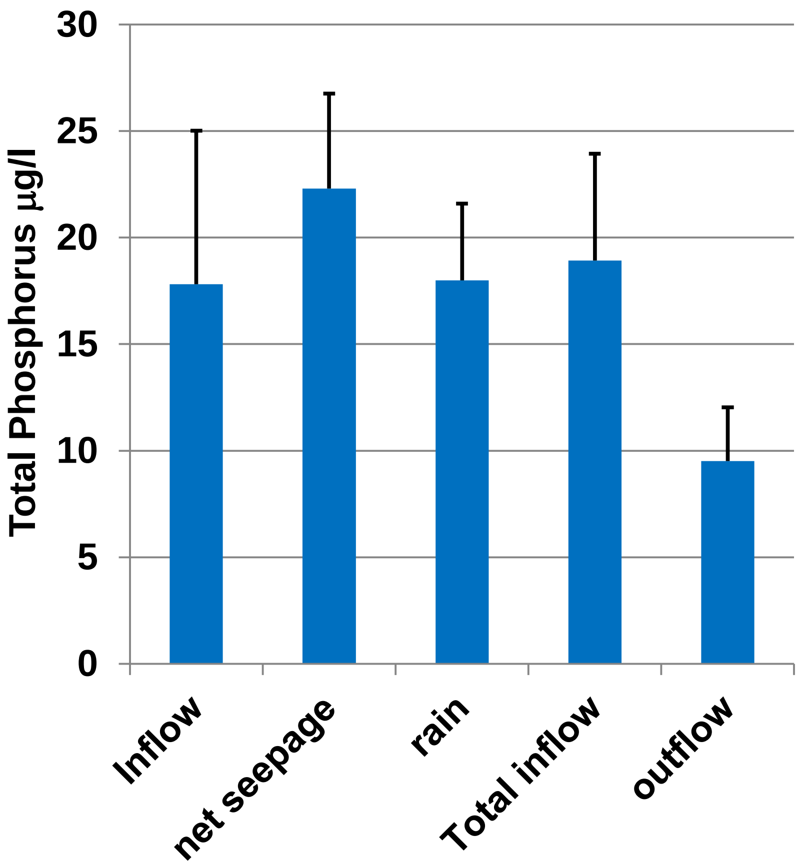


Phosphate is Being Removed Effectively Within the PSTA Cell

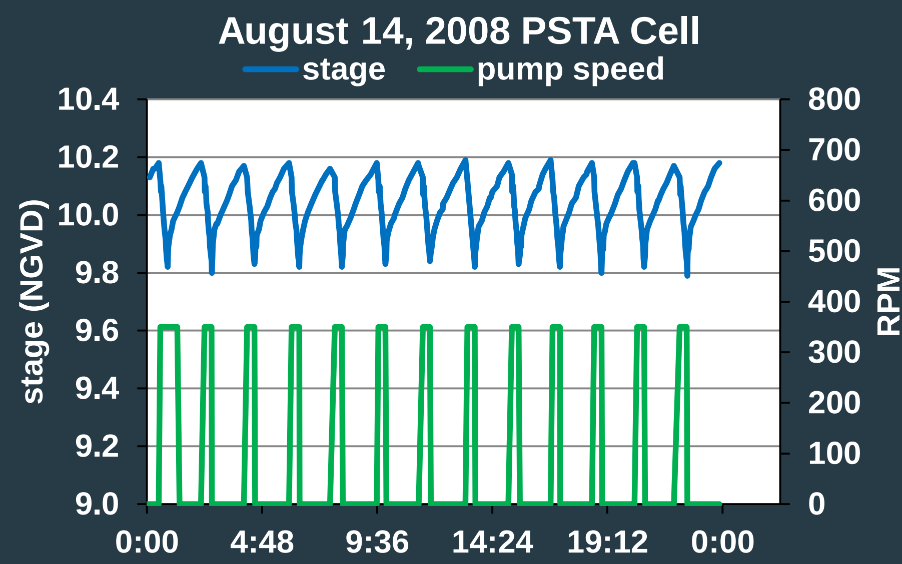


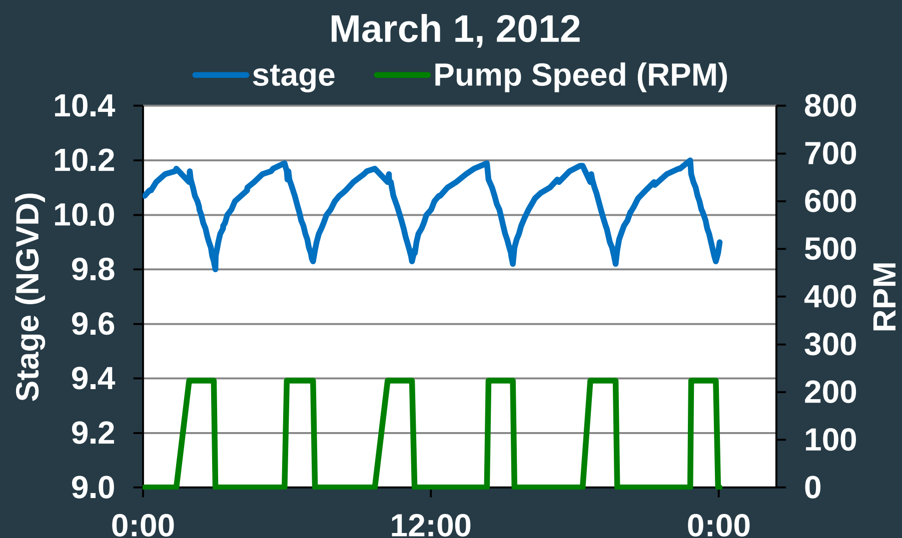
Measured loads in exceed discharge by 73 Kilograms per year or 48% phosphorus is being removed through settling or biological uptake at an average removal rate of 181 mg/m^2/year

Total inflow concentration exceed outflow concentrations by 50% (9 µg/l)



Improve Hydrologic Measurements by Reducing Pump Capacity



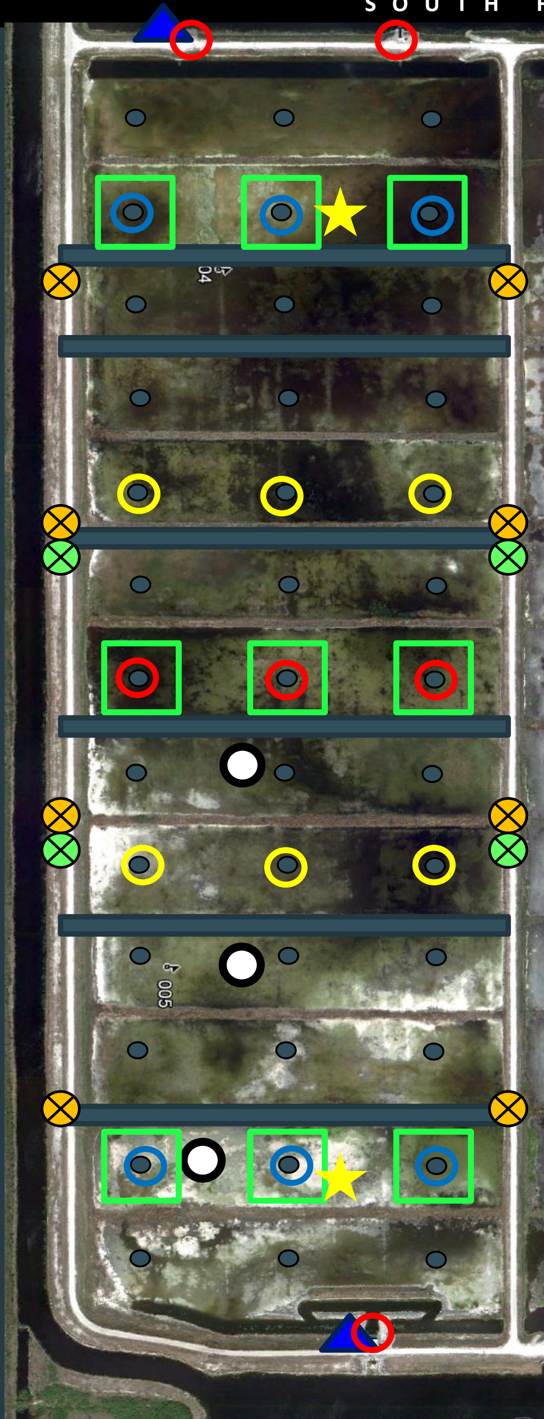


Improve Hydrologic Measurements by Reducing Cross Sectional Area of Inflow

Upstream view of inflow structure

Downstream view of inflow structure

Improve Seepage Inflow Measurements (Including Water Quality Sampling)



Enhanced Internal Water, Chemistry, Sediment and Plant Monitoring to Improve Understanding of How PSTA Works

Surface Water

- TP, TSP, SRP, DOC, UV absorbance, enzyme Alkaline phosphatase activity (APA) calcium, sulfate, NH_4-N, NOx, TKN,
- TP, TSP, SRP, DOC, UV absorbance
- Total P only
- Remote P analyzer

Vegetation and Sediment

- Monitoring for semi-quantitative SAV cover and floc depth
- Sediment, SAV and periphyton chemistry, SAV biomass, periphyton APA
- Periphytometer deployment

Hydraulic and hydrology

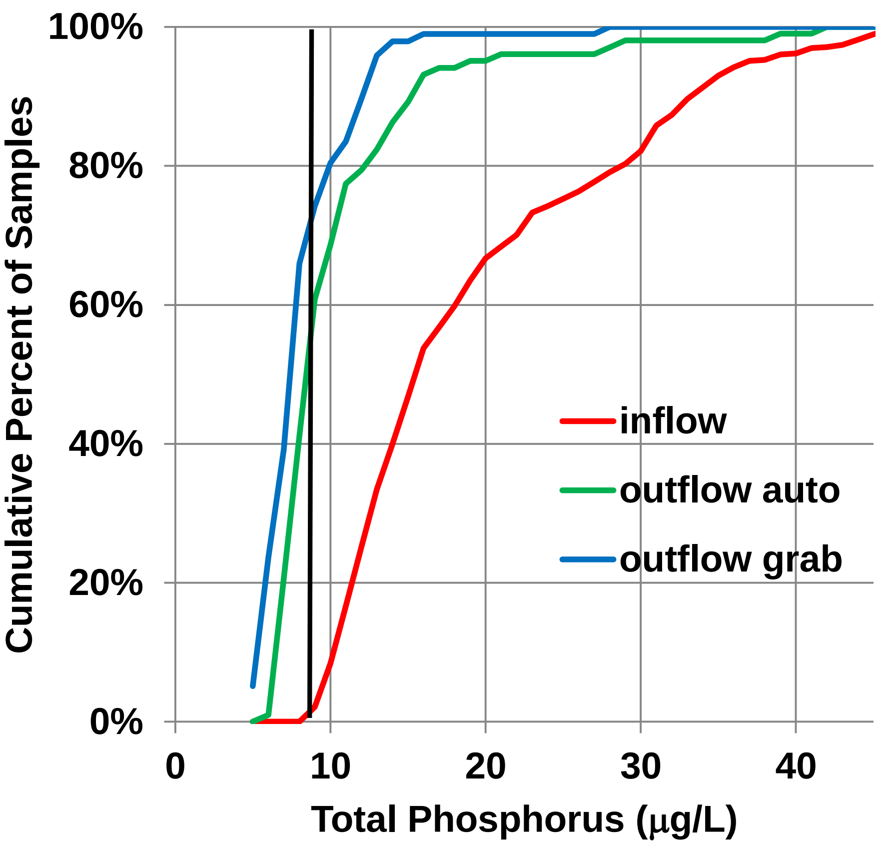
- Internal stage recorder
- Seepage water level
- Seepage water quality

(proposed): 4/24/2012

SUMMARY:
The PSTA cell is effective at removing phosphorus from the water column at low concentrations

Outflow Phosphorus concentrations are at or below 10 µg/l between 70 and 80% of the time

Less than 9% of the inflow samples are at or below 10 µg/l



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QUESTIONS?

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