Influence of Mineral Precipitation and Aquatic Vegetation on Phosphorus Removal in Canal Water from the Everglades Agricultural Area of Southern Florida

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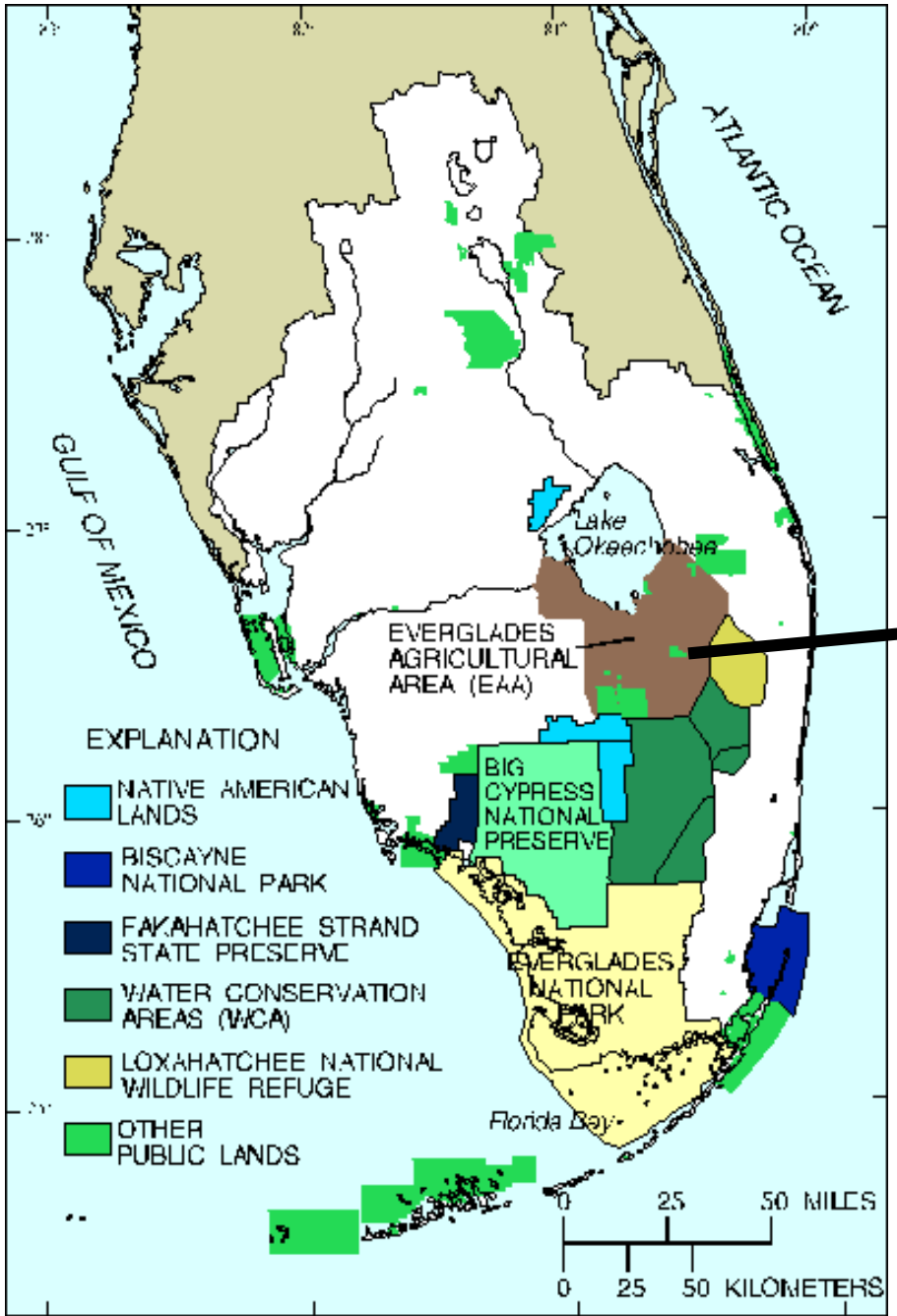
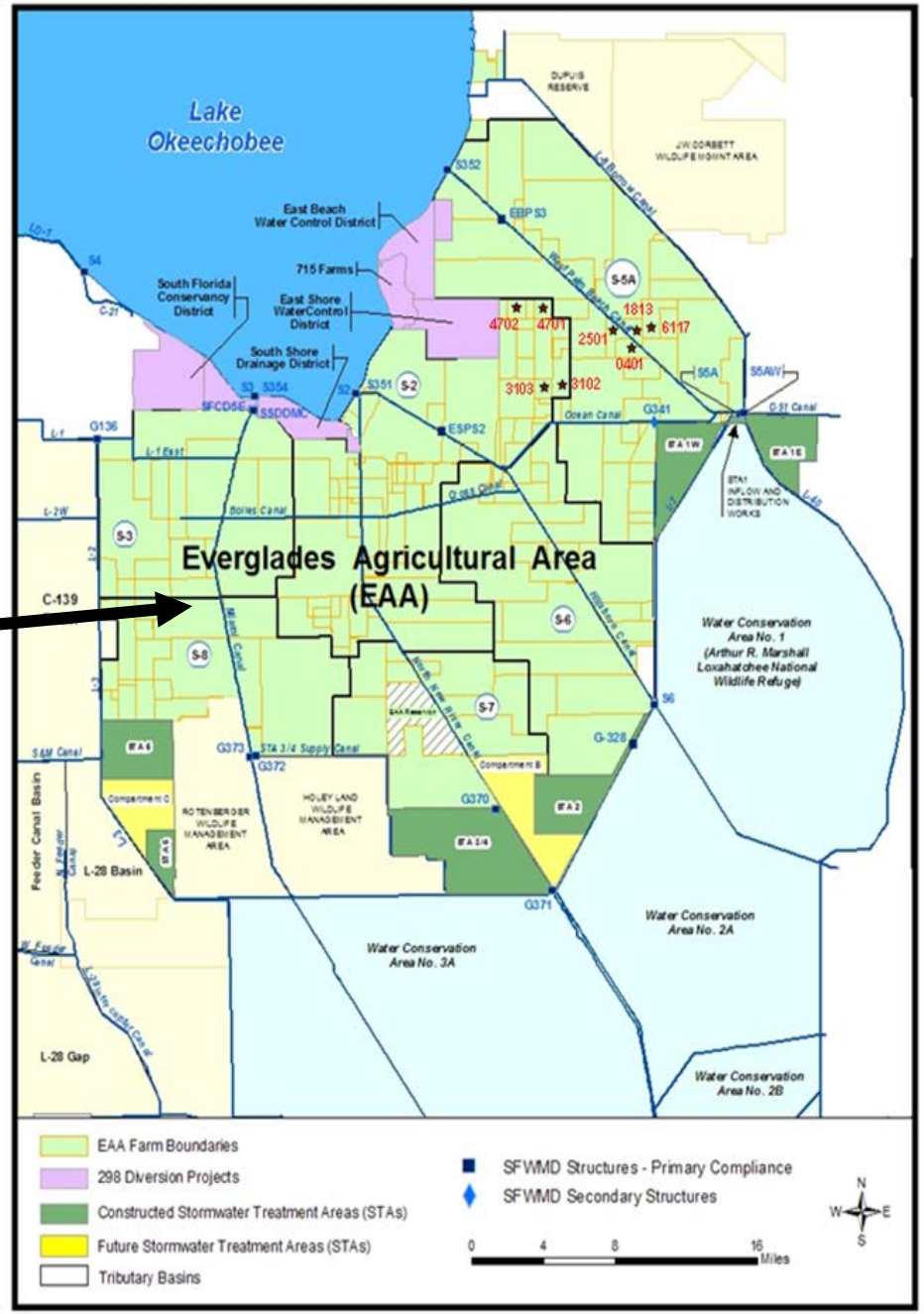
Study Area


ATLANTIC OCEAN
GULF OF MEXICO
Lake Okeechobee
EVERGLADES AGRICULTURAL AREA (EAA)
BIG CYPRESS NATIONAL PRESERVE
EVERGLADES NATIONAL PARK
Florida Bay
EXPLANATION
NATIVE AMERICAN LANDS
BISCAYNE NATIONAL PARK
FAKAHATCHEE STRAND STATE PRESERVE
WATER CONSERVATION AREAS (WCA)
LOXAHATCHEE NATIONAL WILDLIFE REFUGE
OTHER PUBLIC LANDS
0 25 50 MILES
0 25 50 KILOMETERS


Lake Okeechobee
Everglades Agricultural Area (EAA)
C-139
L-28 Basin
L-28 Gap
Water Conservation Area No. 1 (Arthur R. Marshall Loxahatchee National Wildlife Refuge)
Water Conservation Area No. 2A
Water Conservation Area No. 3A
Water Conservation Area No. 2B
EAA Farm Boundaries
298 Diversion Projects
Constructed Stormwater Treatment Areas (STAs)
Future Stormwater Treatment Areas (STAs)
Tributary Basins
SFWMD Structures - Primary Compliance
SFWMD Secondary Structures
0 4 8 16 Miles

The Everglades Agricultural Area

- 220,000 ha of organic soils
- Sugarcane, corn, rice, vegetables
- Flat topography
- Former sawgrass marsh drained in early 1900s for agriculture and development

The Soil

- Organic soils – up to 80% organic matter
- Shallow soil
- Actively subsiding
- Limestone bedrock
- High pH

Impact on the Everglades

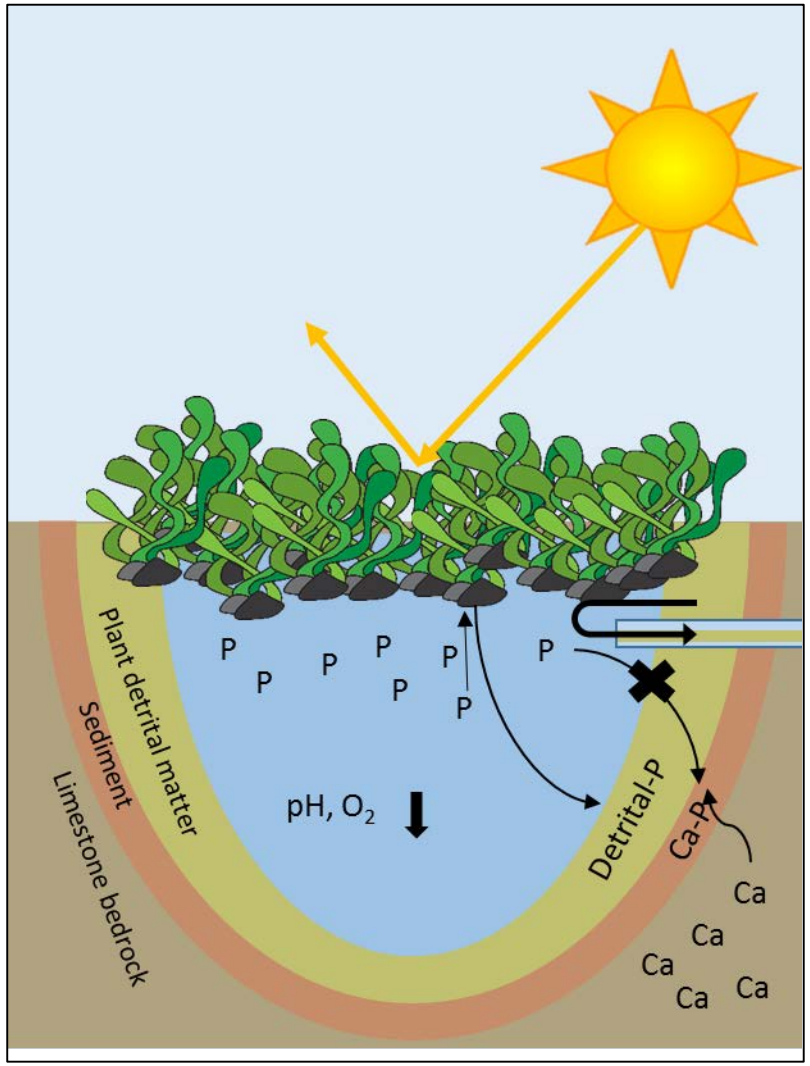
- P enrichment
- Legacy P in Lake Okeechobee
- Sawgrass → Cattail dominant
- Low water flow
- Altered salinity gradients
- Changes to ecological habitats
- Everglades Forever Act 1994

Potential Impact of Floating Aquatic Vegetation on Mineral P precipitation?

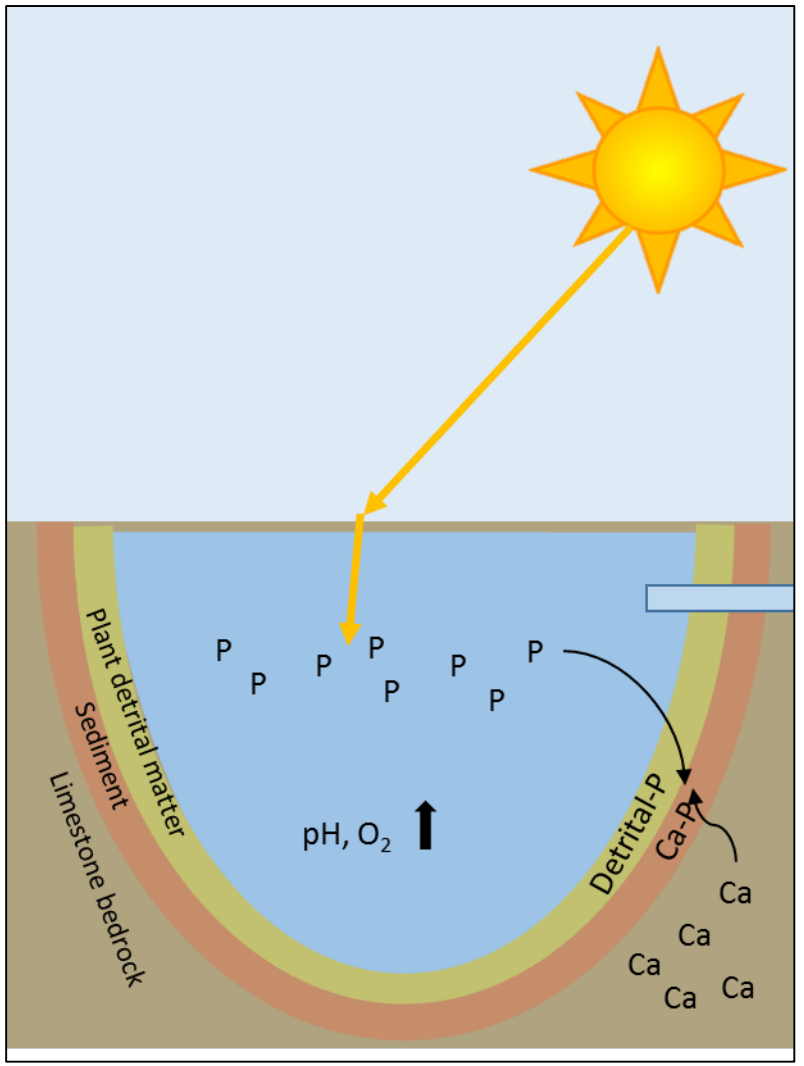
No Suppression

Suppression of FAV

Background



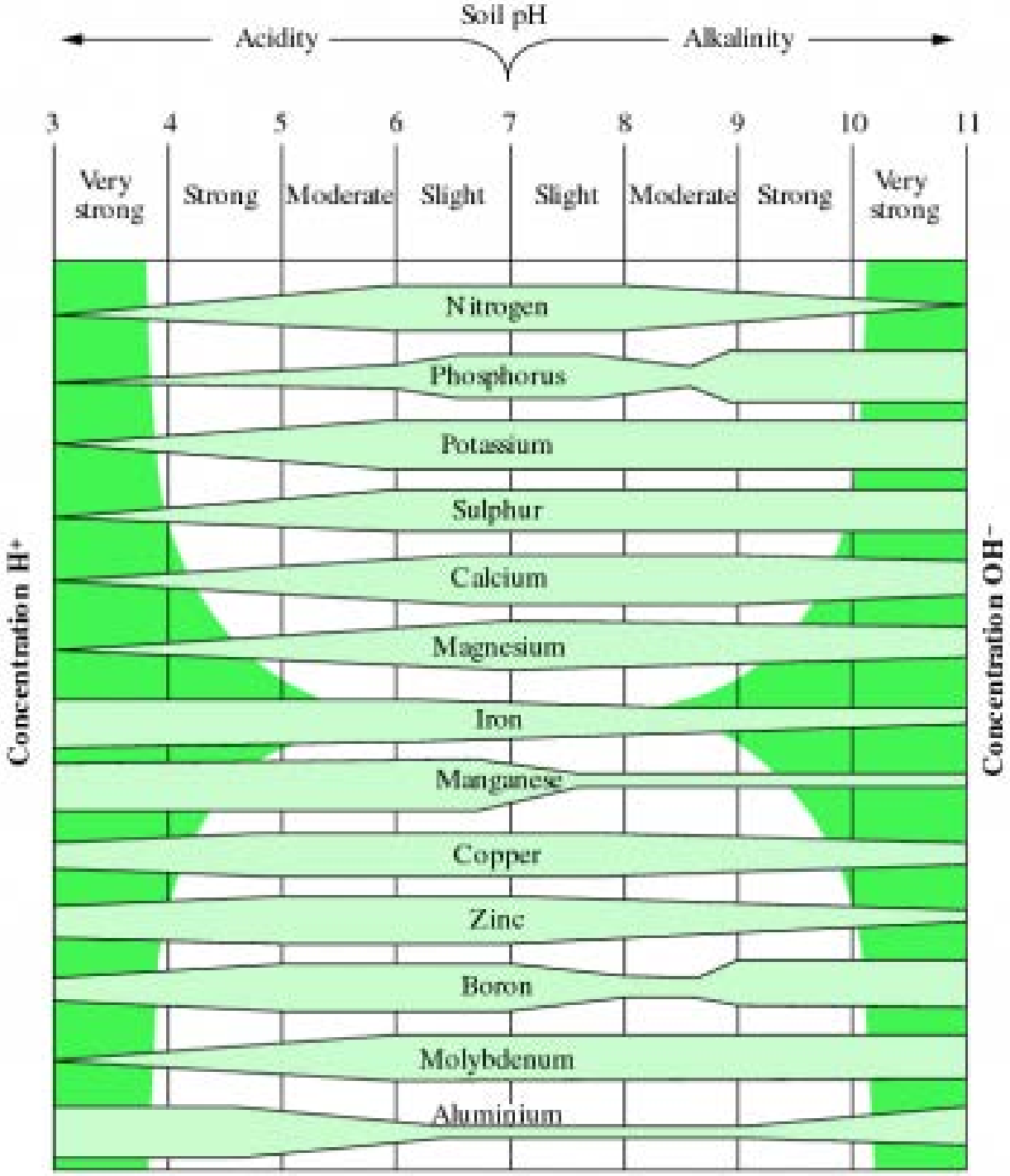
Light weight/labile P-sediments



Denser/recalcitrant P-precipitates

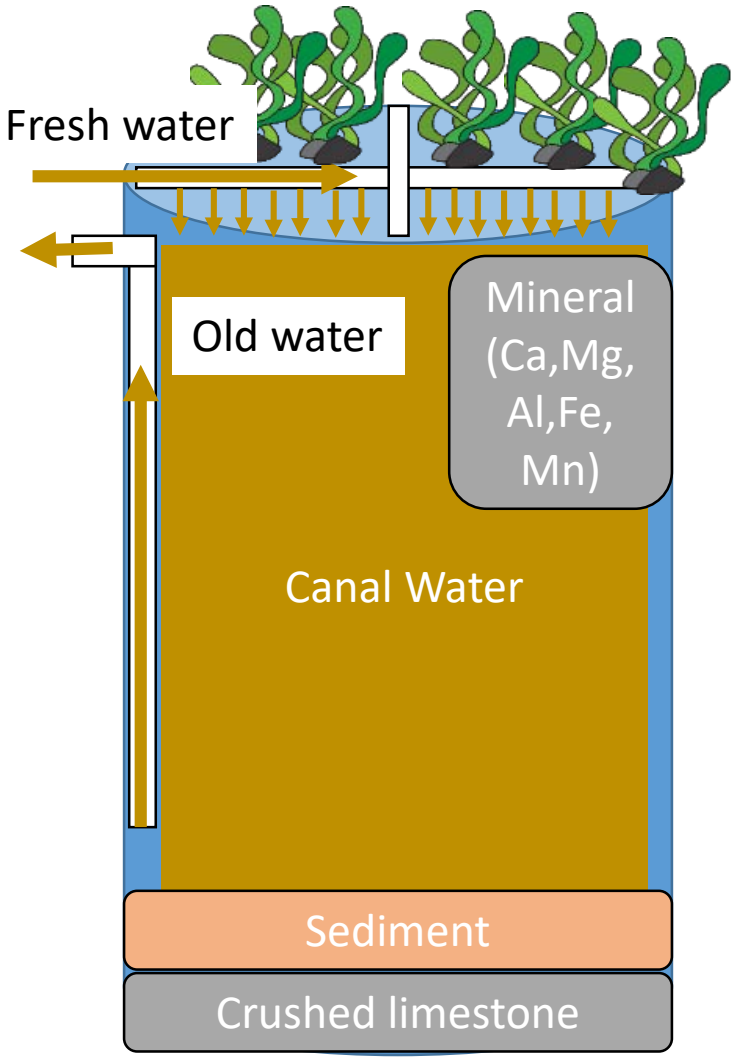
Justification

- Alkaline pH in the EAA
- Ca, Mg precipitate with P at high pH
- Fe, Al, and Mn precipitate with P at lower PH
- Fe and Mn are redox active and may become available under reduced conditions



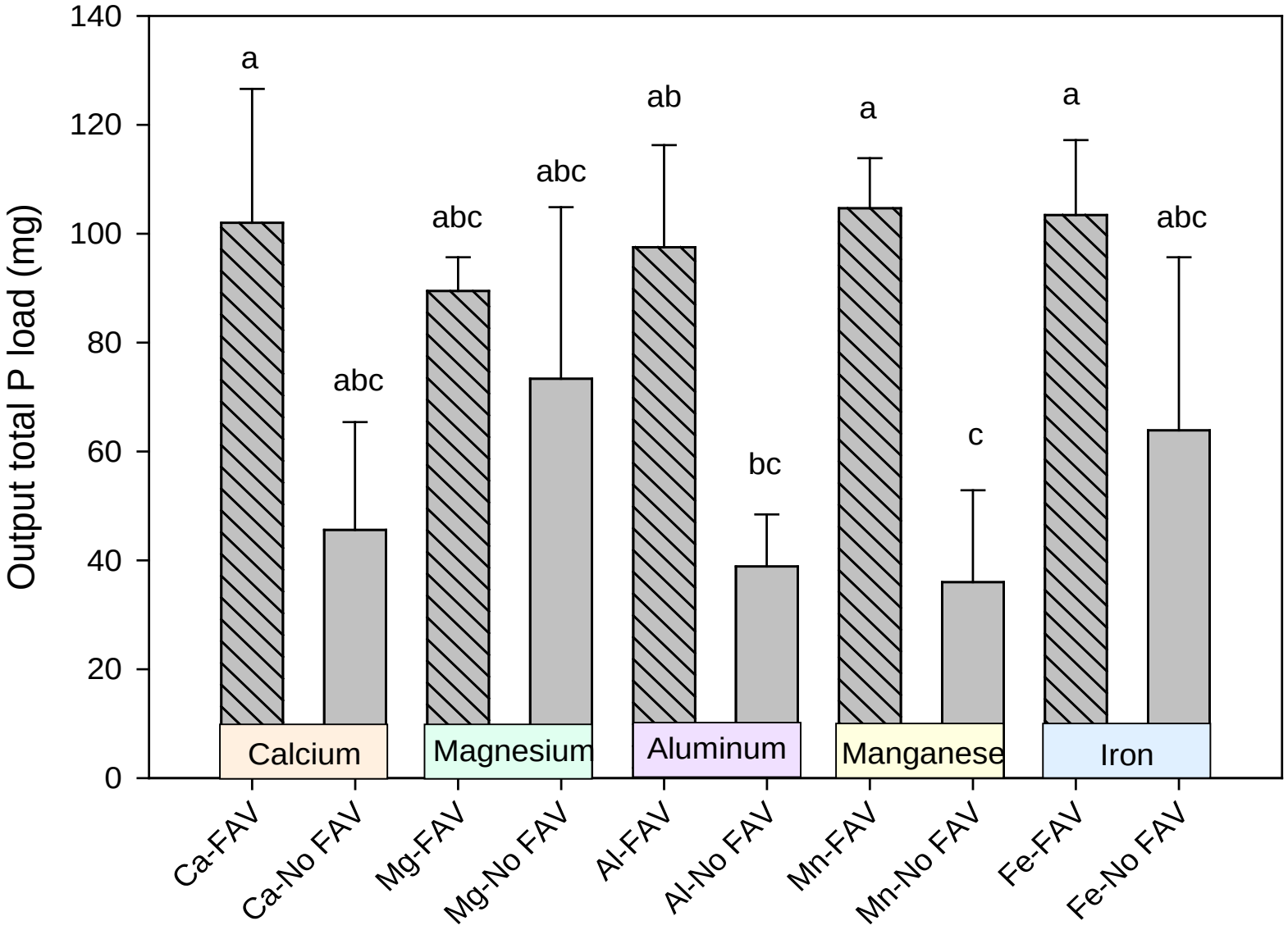
The Experiment

- 30 drums (each treatment replicated 3x)
- Mineral: Ca, Mg, Fe, Al, Mn
- Floating aquatic vegetation: Yes or no

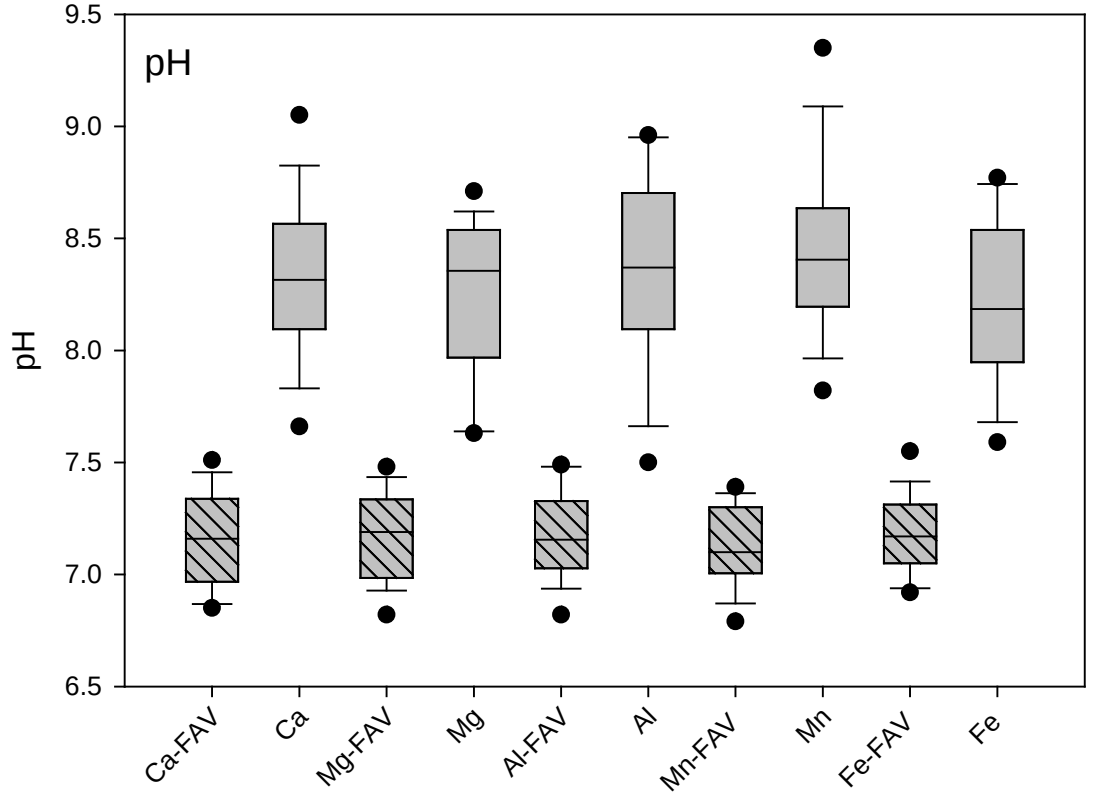


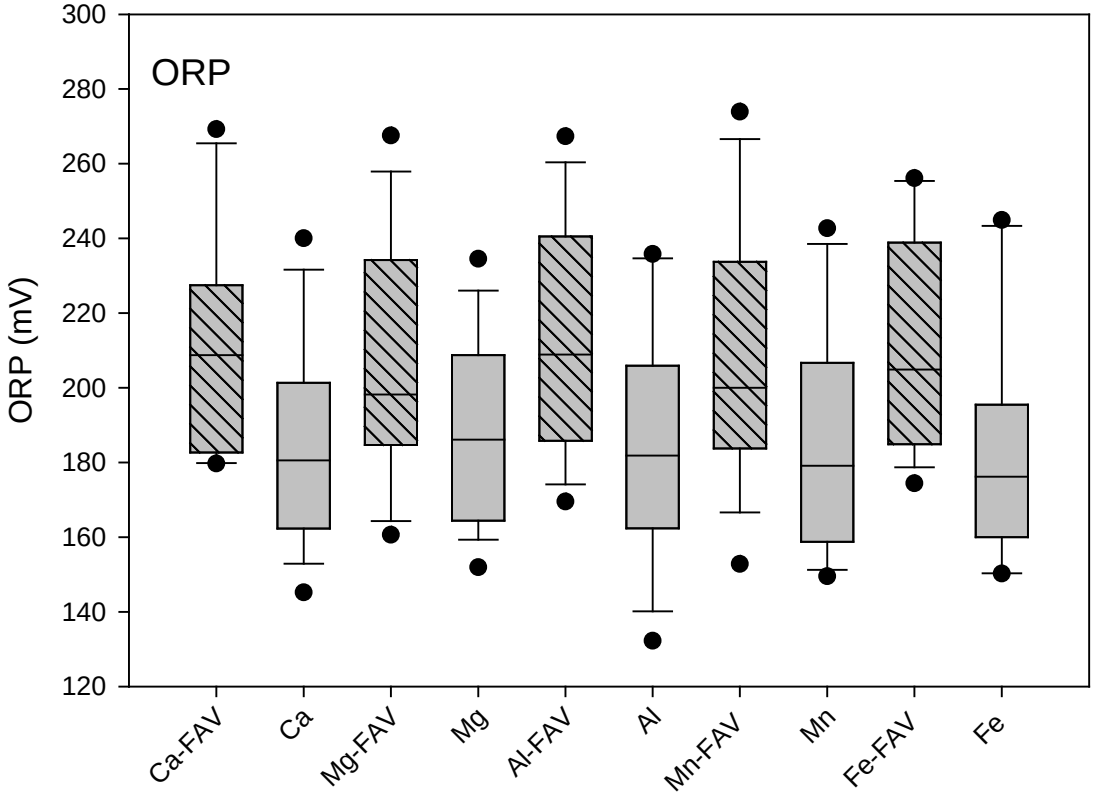
Bi-weekly addition of canal water

Output Phosphorus Load



Influence of Floating Aquatic Vegetation





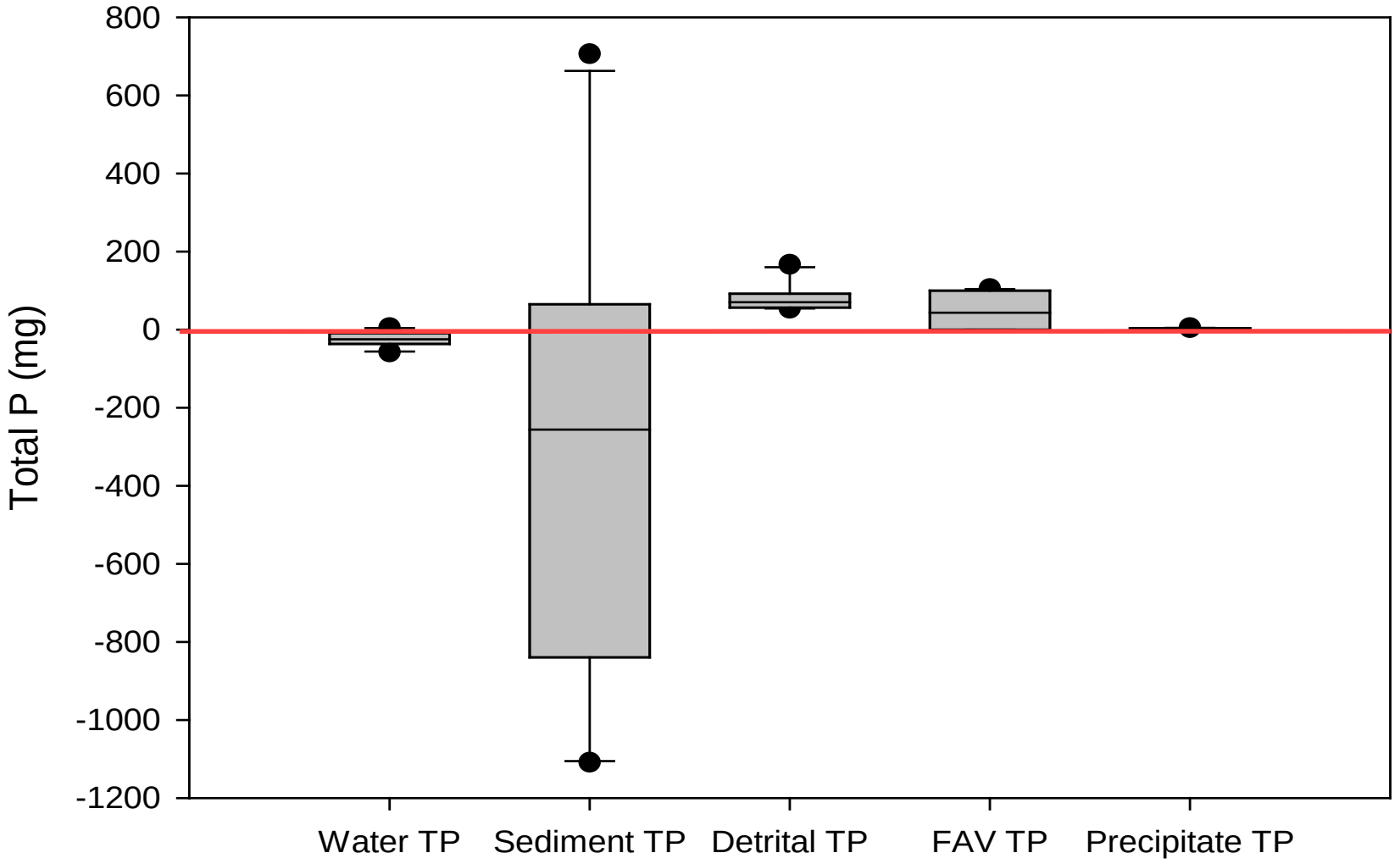
Correlations with pH and ORP

Mineral	Ca		Mg		Al		Mn		Fe	
FAV	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Correlations with output soluble reactive phosphorus										
pH									Negative	
ORP	Negative	Negative		Negative					Negative	
Correlations with output total phosphorus mass										
pH			Negative							
ORP								Positive		
Correlations with percentage total P removal										
pH				Positive		Negative				
ORP								Negative		

<u>Calcium/Magnesium/Iron:</u>
High total P removal at high pH and high ORP

<u>Aluminum:</u> high total P removal at low pH
<u>Manganese:</u> high total P removal at low ORP

Mass Flux of Phosphorus (preliminary)



Conclusions

- Manganese and aluminum provided the lowest output total P mass
  - Manganese had high TP removal at low ORP
  - Aluminum had high TP removal at low pH
- The presence of floating aquatic vegetation lowered pH, increased ORP
- Sediments are the largest sink/source of TP