A Perspective on Florida's Large-Scale Wetland Treatment Systems for Phosphorus Removal

Thomas A. DeBusk[1] and William F. DeBusk[2]

[1]DB Environmental, Inc.
[2]Water Resources Group, LLC

Some large Florida treatment wetlands have been in operation for 25 years
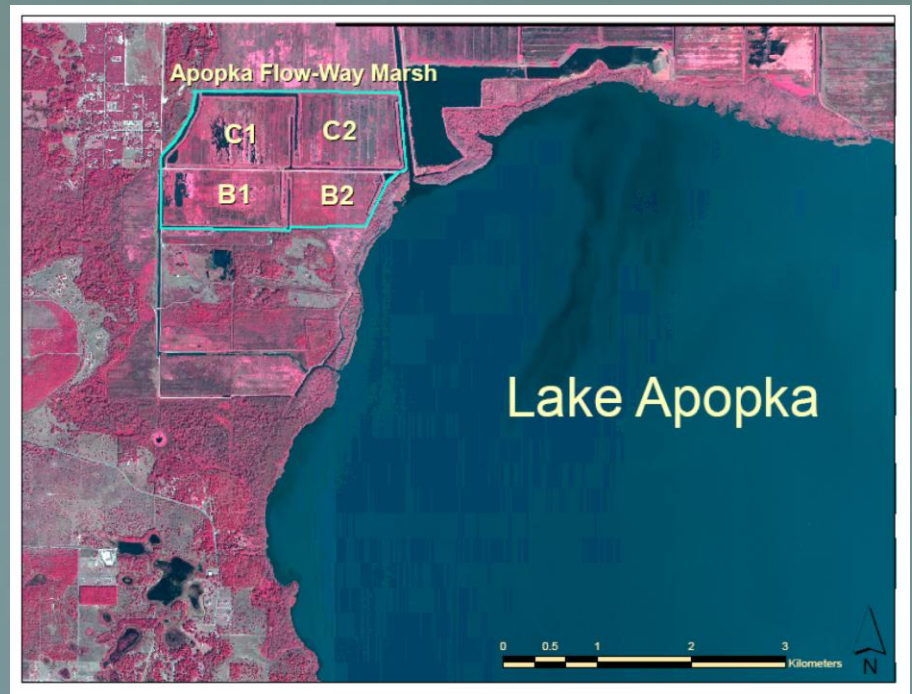
- TOPICS
  - Timeline
  - Performance
  - Interesting attributes

1980's
(total treatment wetland area ~ 1,000 ha)

- Municipal wastewater treatment
  - Orlando Easterly (518 ha)
  - Orange Co. Eastern Service Area (134 ha)
- Eutrophic Lake Waters
  - L. Apopka marsh (310 ha)

1990's
(total treatment wetland area ~ 6,600 ha)

- Municipal wastewater treatment
  - Orlando Easterly (518 ha)
  - Orange Co. Eastern Service Area (134 ha)
  - Bayou Marcus (190 ha)
  - Other (~ 500 ha)
- Eutrophic Lake Waters
  - L. Apopka marsh (310 ha)
- Runoff (agricultural, etc)
  - Everglades Nutrient Removal Project (STA pilot) (1,540 ha)
  - STAs 5 and 6 (3,400 ha)

2000's
(total treatment wetland area ~19,500 ha)

- Municipal wastewater treatment
  - Orlando Easterly (518 ha)
  - Orange Co. Eastern Service Area (134 ha)
  - Bayou Marcus (190 ha)
  - Other (~500 ha)
- Eutrophic Lake Waters
  - L. Apopka marsh (310 ha)
- Runoff (agricultural, etc)
  - Six Everglades STAs (17,800 ha)
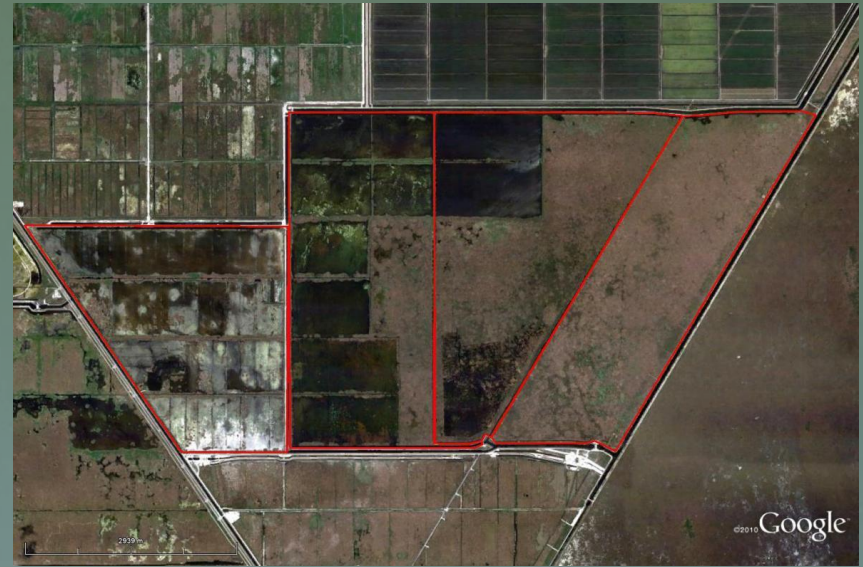
Municipal Treatment Wetlands – Initial performance, and recent five year (2006-2010) [TP] data
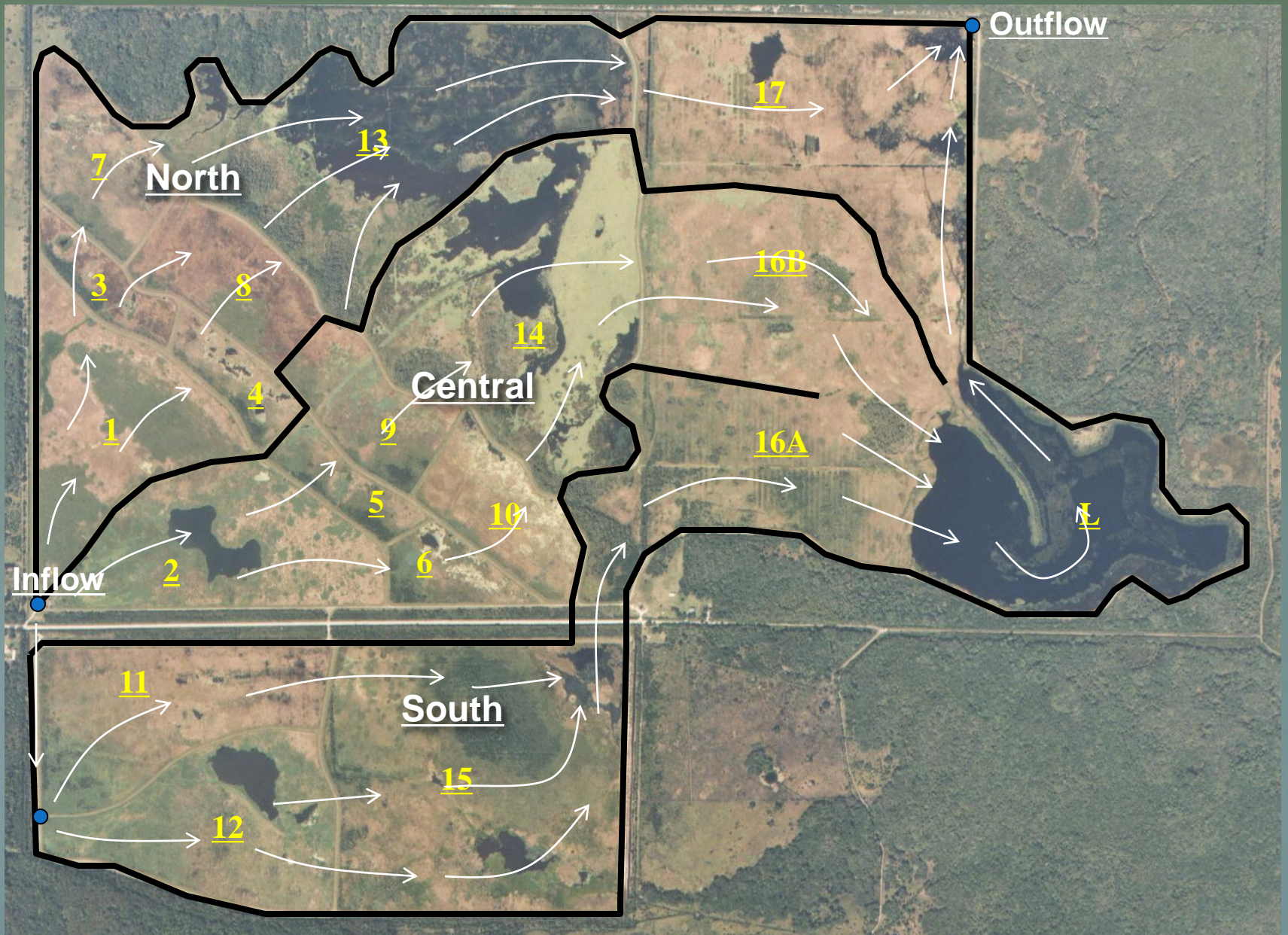
Initial 6 months of OEW operations (1987 – 1988)
Mean inflow TP = 520 µg/L; mean outflow TP = 120 µg/L

Initial 3 yrs of OCESA operations (1988 - 1991)
Mean inflow TP = 210 – 500 µg/L; mean outflow TP = 130 µg/L

Recent 5 yr. Performance	OEW	OCESA
Mean P Loading Rate (g/m2·yr)	0.76	1.52
Mean P Removal Rate (g/m2·yr)	0.48	0.65
Mean Inflow TP (µg/L)	220	210
Mean Outflow TP (µg/L)	80	120
% Removal	63	43

Orlando Easterly Wetlands (OEW) – 518 ha

Interesting attributes of OEW

- Highly compartmentalized
    - Required to accommodate site elevations
    - Multiple flow paths
    - Multiple cells per flow path
    - Spatial differences in water depths
    - Variety of vegetation communities
- Extensive testing/implementation of soil and vegetation management techniques
- Provided critical design information for Everglades Nutrient Removal Project

Orange Co. Eastern Service Area Wetlands (OCESA) ~ 134 ha

Interesting attributes of OCESA

- Hydrid system
  - Two constructed wetlands – different depths/hydroperiods
  - Two natural, forested wetlands
- Extensive vegetation and soils characterization first 3 - 5 yrs of operation
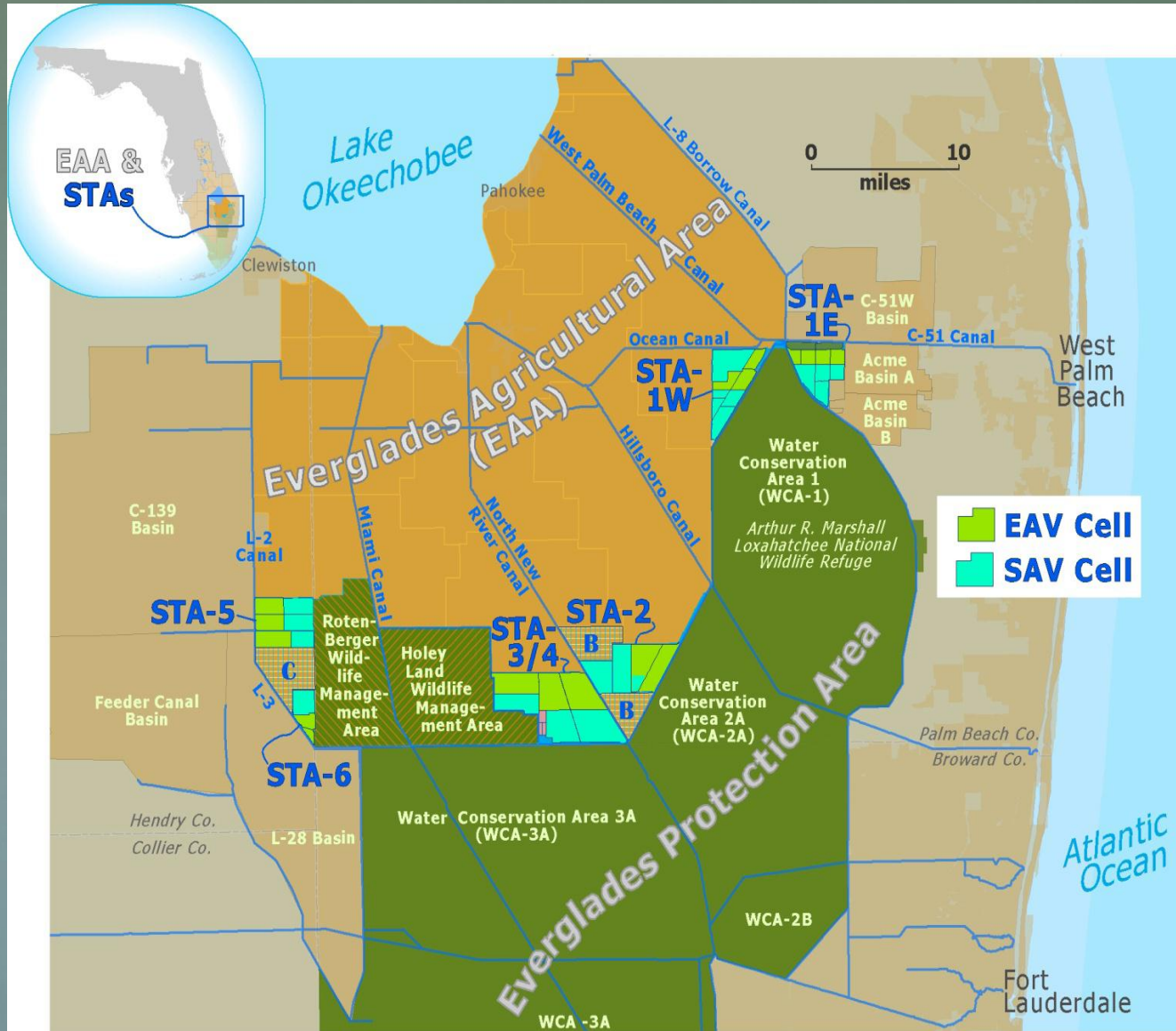
OCESA Vegetation Communities

- Extensive initial planting of constructed wetlands (13 species, 336 plants/ha)
- Only one species (*S. lancifolia*) still present at year 4
- Different hydroperiods of wetlands selected for different vegetation palettes
  - shallow – *Baccharis, Myrica, Hydrocotyle*
  - deeper – *Hydrocotyle, Panicum, Typha*

Everglades STAs

STA Performance (five year mean)

	STA-1E	STA-1W	STA-2	STA-3/4	STA-5	STA-6
Area (ha)	1630	2700	3340	6700	2500	913
Start-up Date	2004	2000	1999	2003	1998	1997
Mean P Loading (g/m2·yr)	1.28	1.92	1.13	0.87	0.98	1.28
Mean P Removal Rate (g/m2·yr)	0.94	1.37	0.84	0.75	0.63	0.96
Mean Inflow TP (µg/L)	180	221	116	115	221	131
Mean Outflow TP (µg/L)	44	51	28	17	80	49
% Removal	75	75	74	85	66	72

WY2007 – WY2011 (May 2006 – April 2011)

Interesting attributes of STAs

- Extremely low outflow TP targets
- Multiple flow paths, often multiple cells per FP
- Initial emergent plantings attempted, but unsuccessful
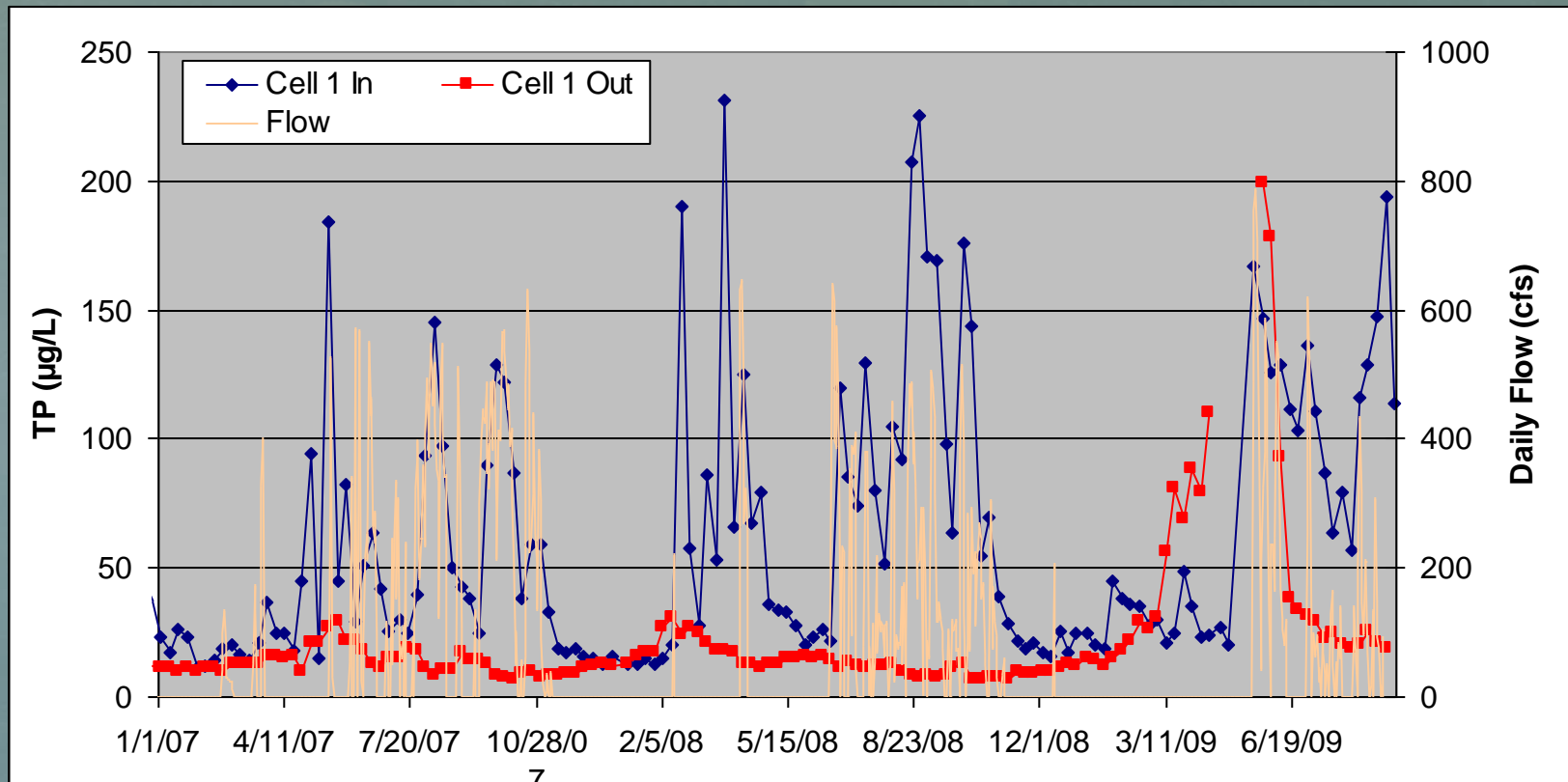- Sequenced vegetation communities (EAV then SAV), control by water depth/hydroperiod

Attributes of STAs

- Accretion of high calcium (~25%) sediments in SAV cells

- Some SAV cells remove ~ 500g Ca/m^2-yr

Attributes of STAs

- Inflows flashy, depth regimes variable
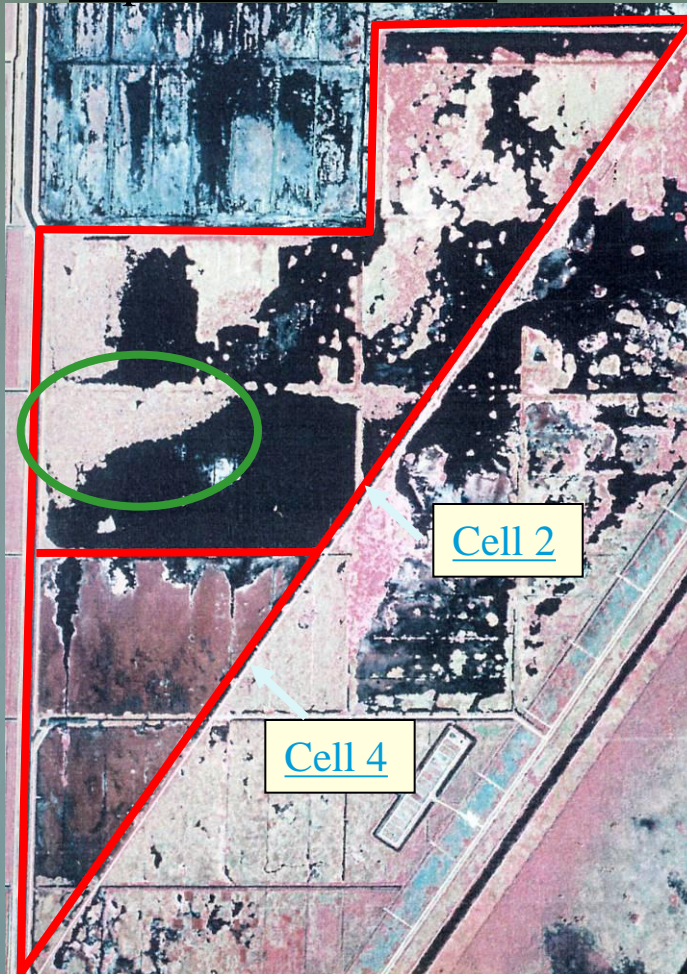- Periodic drydowns can adversely impact performance

STA attributes

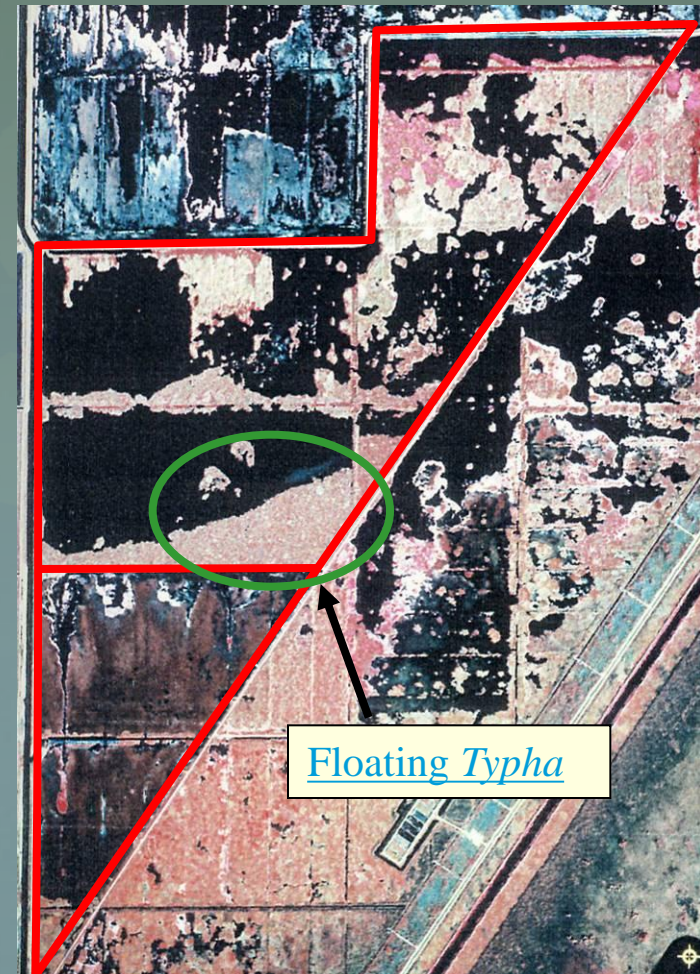Drydown effects are quite pronounced for SAV cells

SAV attributes: Control of max water depth critical- floating cattail islands can destroy SAV beds and impair performance
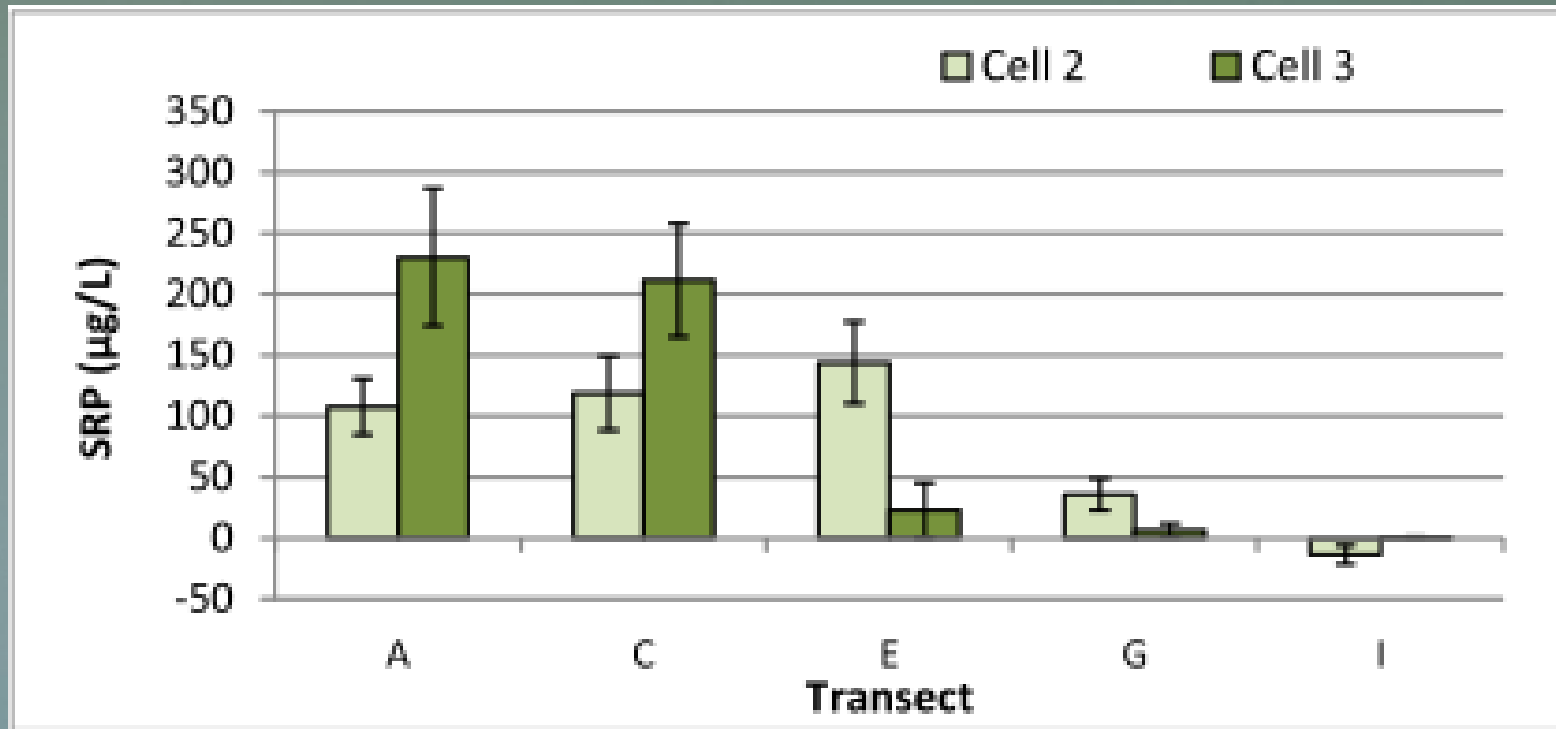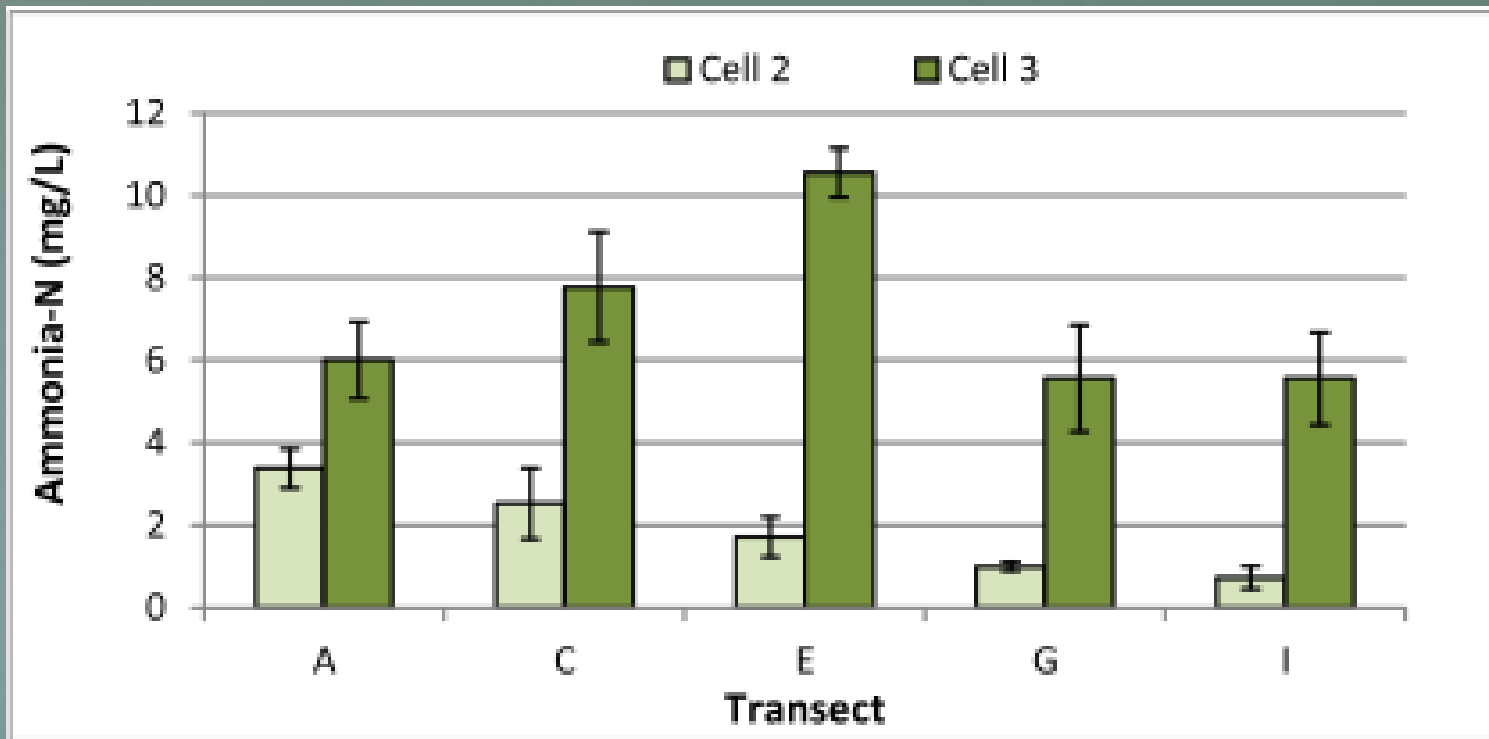
September 26, 2000

November 16, 2000

Cell 2

Cell 4

Floating *Typha*

Images courtesy of SFWMD.

STA attributes: pronounced chemical gradients in water column and soils (e.g. STA-2 porewater SRP)

STA attributes: strong influence of vegetation type on soil characteristics (e.g. STA-2 porewater ammonia)

Summary

- 25 yrs of exhaustive research on large treatment wetlands in Florida
  - OEW - Mark Sees, City of Orlando; Univ. FL; DBE
  - OCESA – Larry Schwartz, CDM-Smith; Pete Wallace Ecosystem Research Corp; Univ. FL
  - STAs – SFWMD; DBE
- Expansion/proliferation of these large wetlands is likely
  - Everglades protection
  - Effective tool for meeting stringent numeric nutrient criteria