SOUTH FLORIDA WATER MANAGEMENT DISTRICT

Large-scale Ecological Drivers of Hydrologic Restoration for the Everglades

Hydrologic Targets Workshop

January 14-16, 2009

Fred Sklar, Everglades Division Director

sfwmd.gov

Greater Everglades Hydrology Needs

- **Resource Needs:** What is the flow, depth, timing, distribution and quality of freshwater needed to restore the ecological structure and function of the Everglades?
- **Management Needs:** What are the upstream storage requirements for an un-impounded Greater Everglades, where Water Conservation Areas and Everglades National Park are re-connected and where sheet-flow is no longer impeded?
- **Decision Needs:** What information, assessment and modeling tools will (decreasing uncertainties, addressing constraints) to specify restoration needs and guide restoration projects?

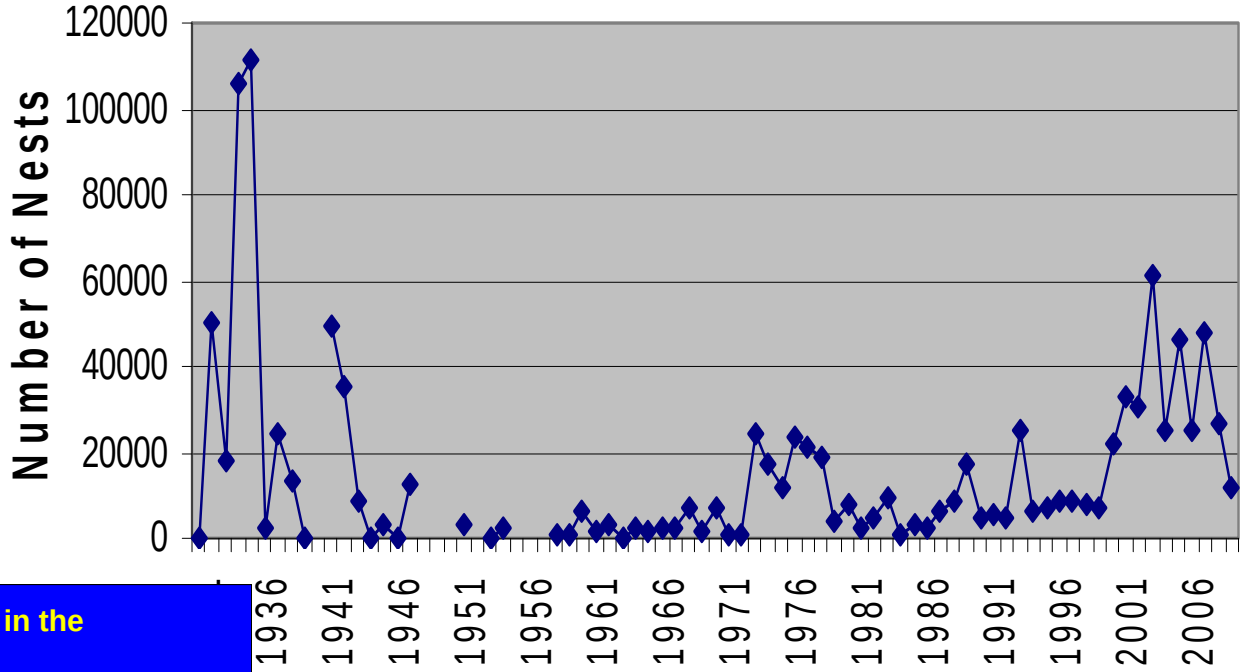
Natural Resource Needs

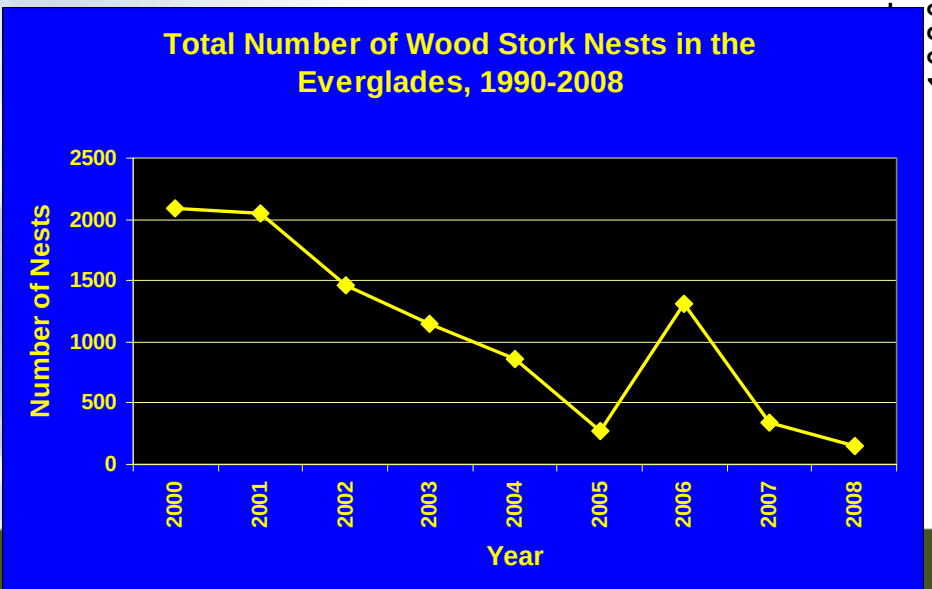
- Depths and recession rates that restore wading bird nesting in the southern part of the system.
- Flow patterns and velocities that restore historic ridge and slough microtopography.
- Depth profiles that sustain wildlife
- Hydroperiods that prevent peat fires and minimize soil oxidation rates.
- Coastal discharges that support estuarine restoration.

Why is there a natural resource need?

Total number of nests in the Everglades, 1931-2008 (GREG, WHIP, WOST, SMHE)

Data from annual South Florida Wading Bird reports





Wood Storks are a Particular Cause for Concern

	2007	2008
# Nests	340	145
# Chicks fledged	40	0
Nesting date	March	March

Optimum Wading Bird Area Index (water depth & weekly recession rate).

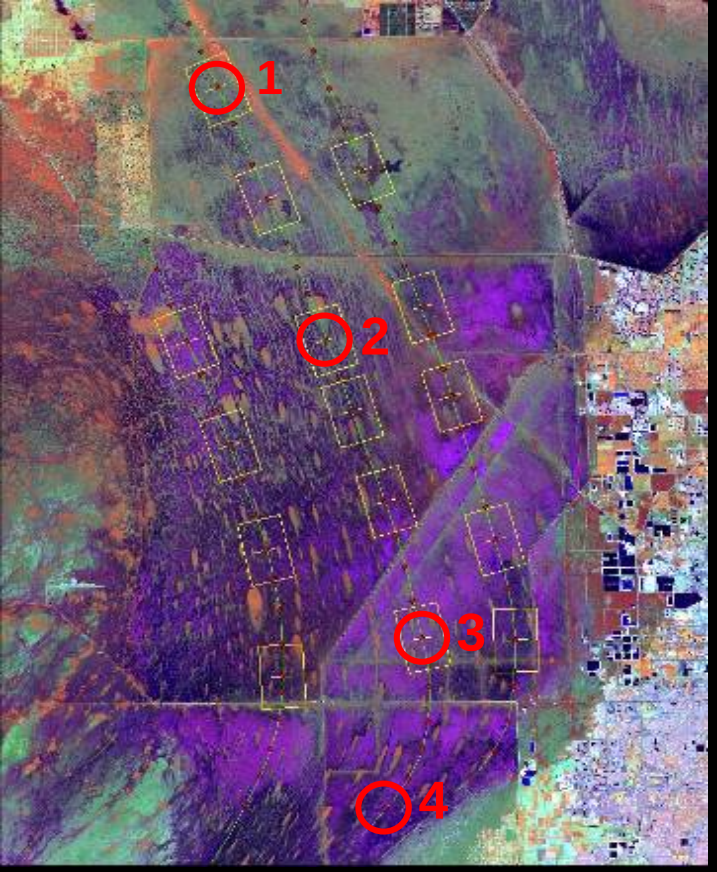
Daily Water Depth Criteria

Bad: > 1.0’
Fair: 0.80' to 1.0'
Good: 0.1' to 0.79'
Fair: 0.02 to 0.09’
Bad: = .01’

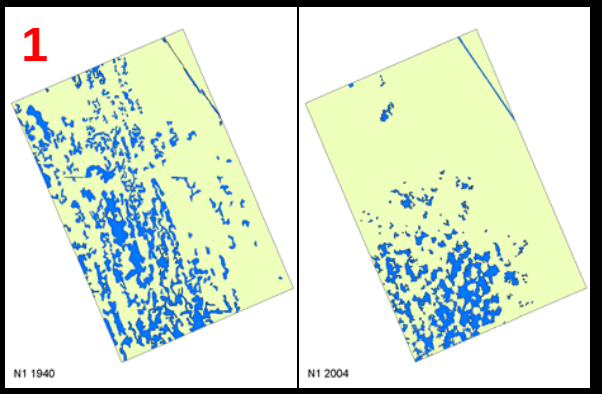
Weekly Recession Rate Criteria

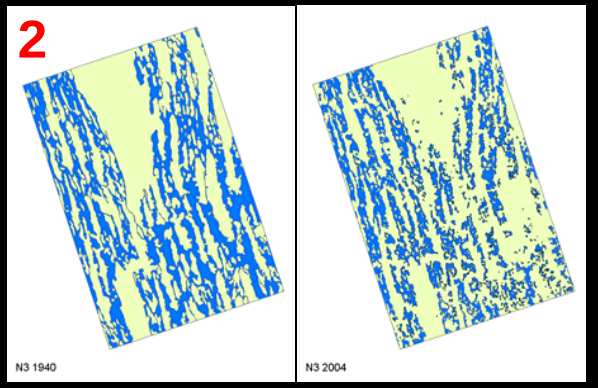
Bad: = -0.60
Fair: -0.17' to -0.59'
Good: - 0.05' to - 0.16'
Fair: -0.04 to +0.04' for one week
Bad: -0.04 to +0.04' for 2 weeks or ≥ +0.041' for one week

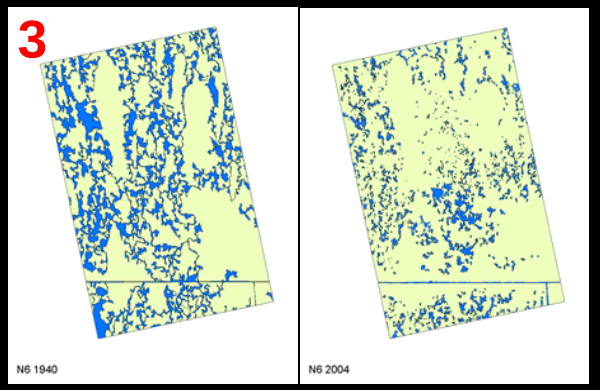
Gawlik, D. E., 2002. The effects of prey availability on the numerical response of wading birds. Ecological Monographs 72, 329–346.



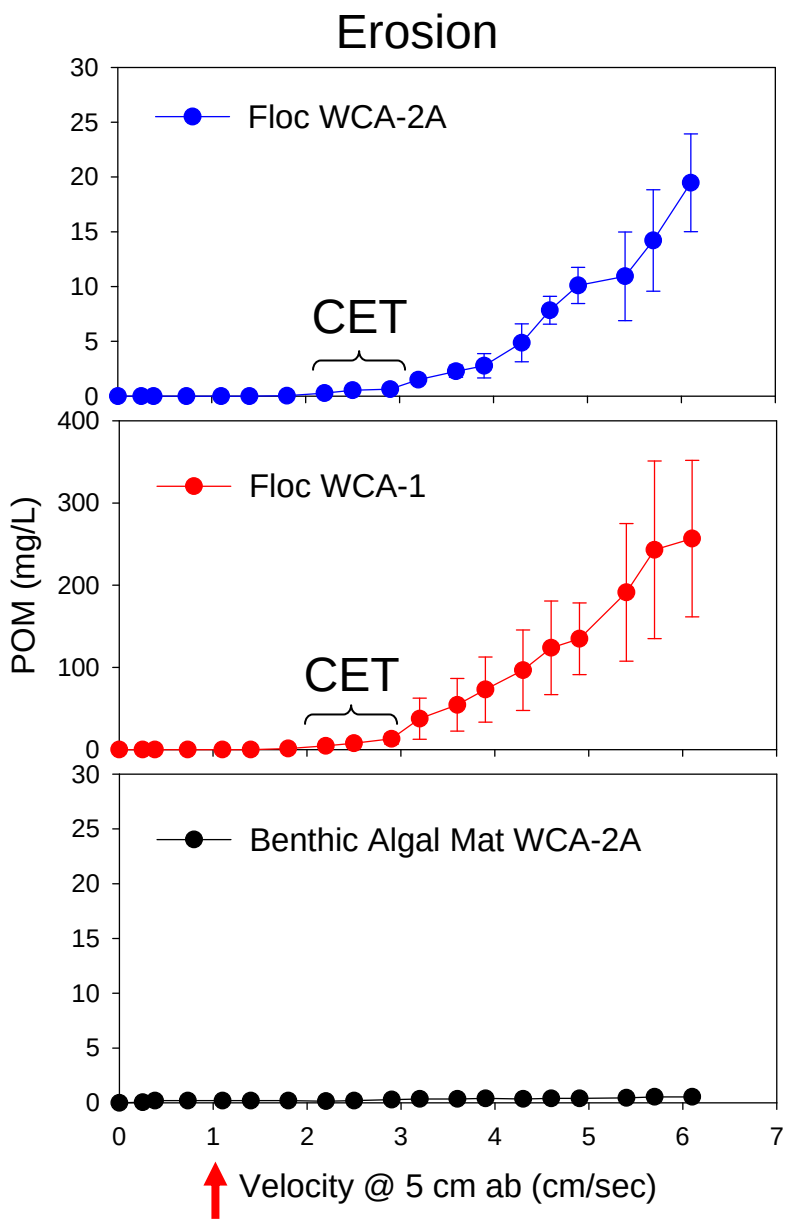
1940 2004







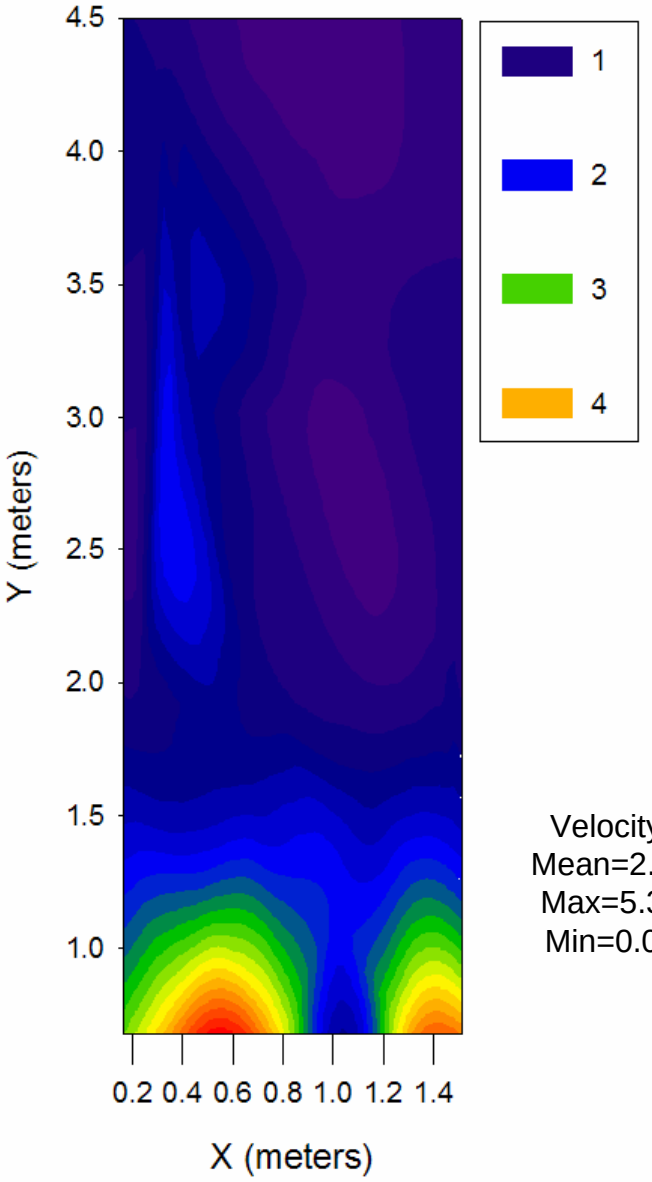
In situ erosion measurements



Flow in the Everglades is <1 cm/sec

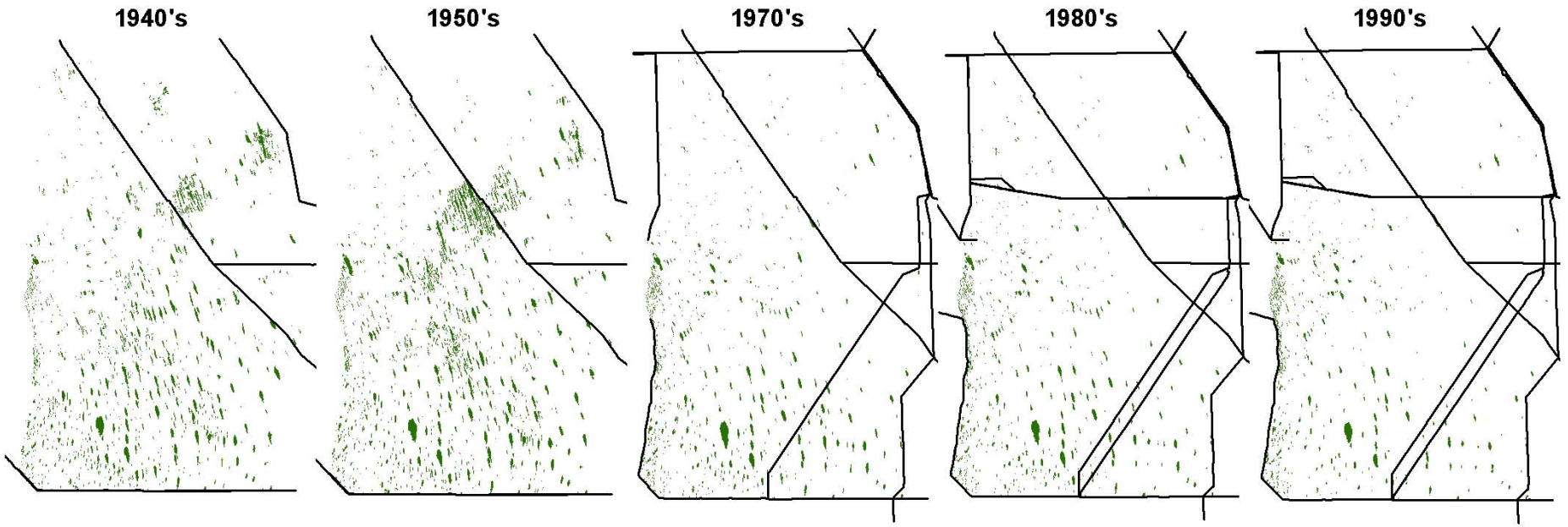
Sediment Transport & Artificial Floc

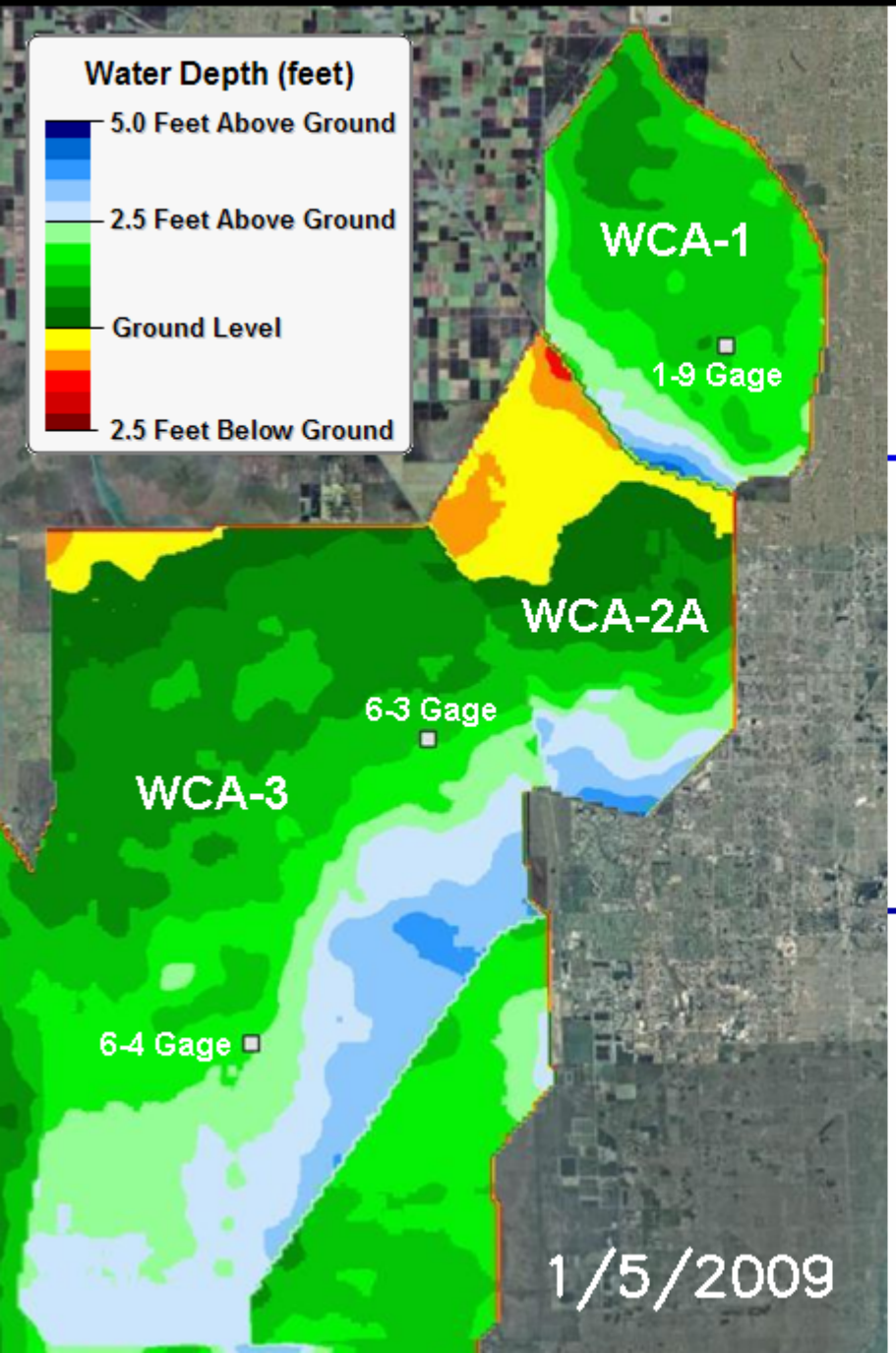
Tracer distribution in the unvegetaded slough flume after 48 hrs.

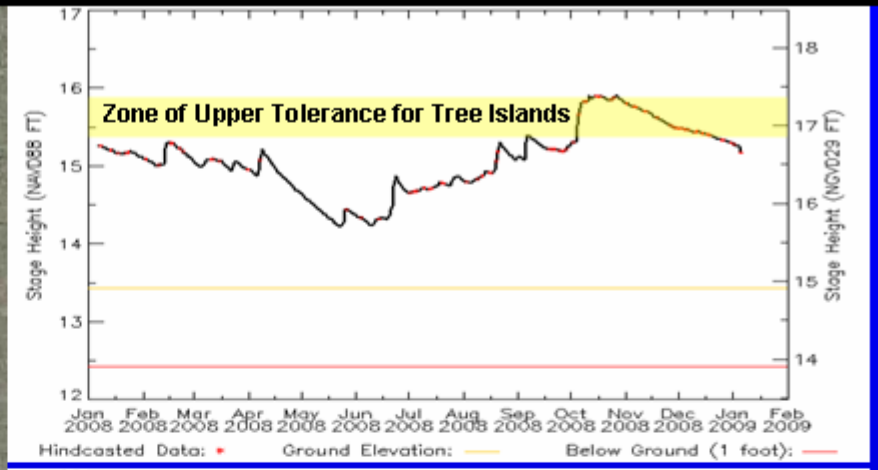


Velocity Range
Mean=2.5 cm/sec
Max=5.3 cm/sec
Min=0.0 cm/sec

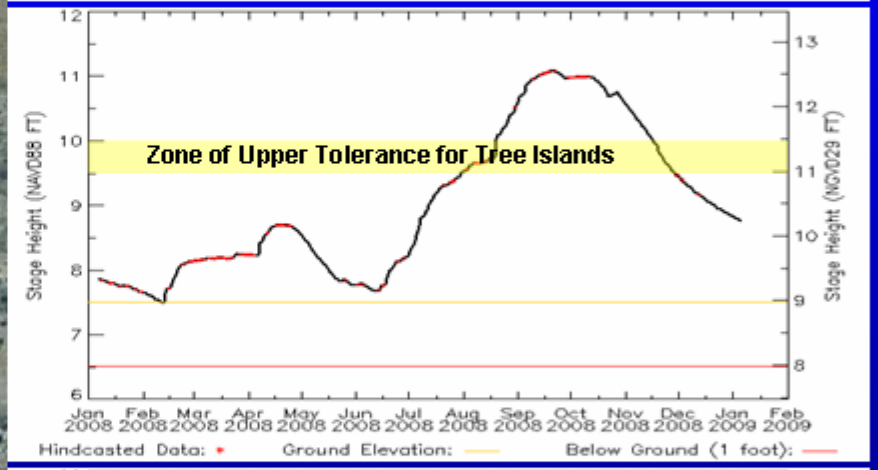
Tree islands declined due to a hydrologic regime that was, at first too dry and then impounded.



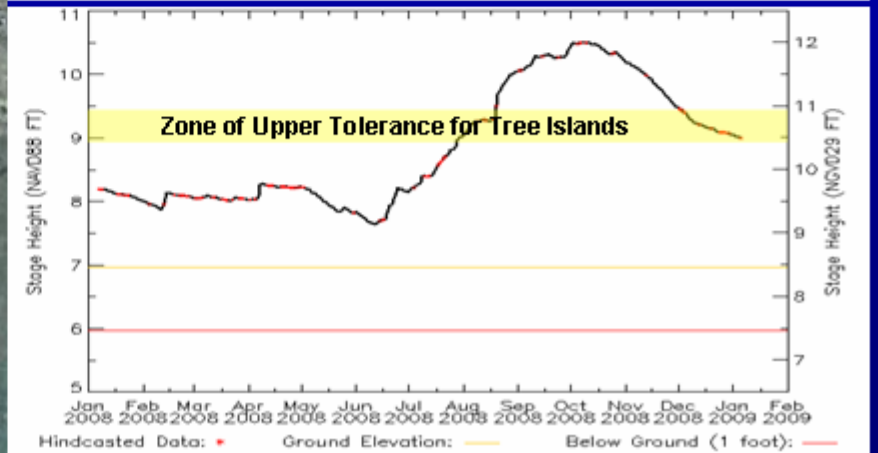




1-9 Gage



6-3 Gage



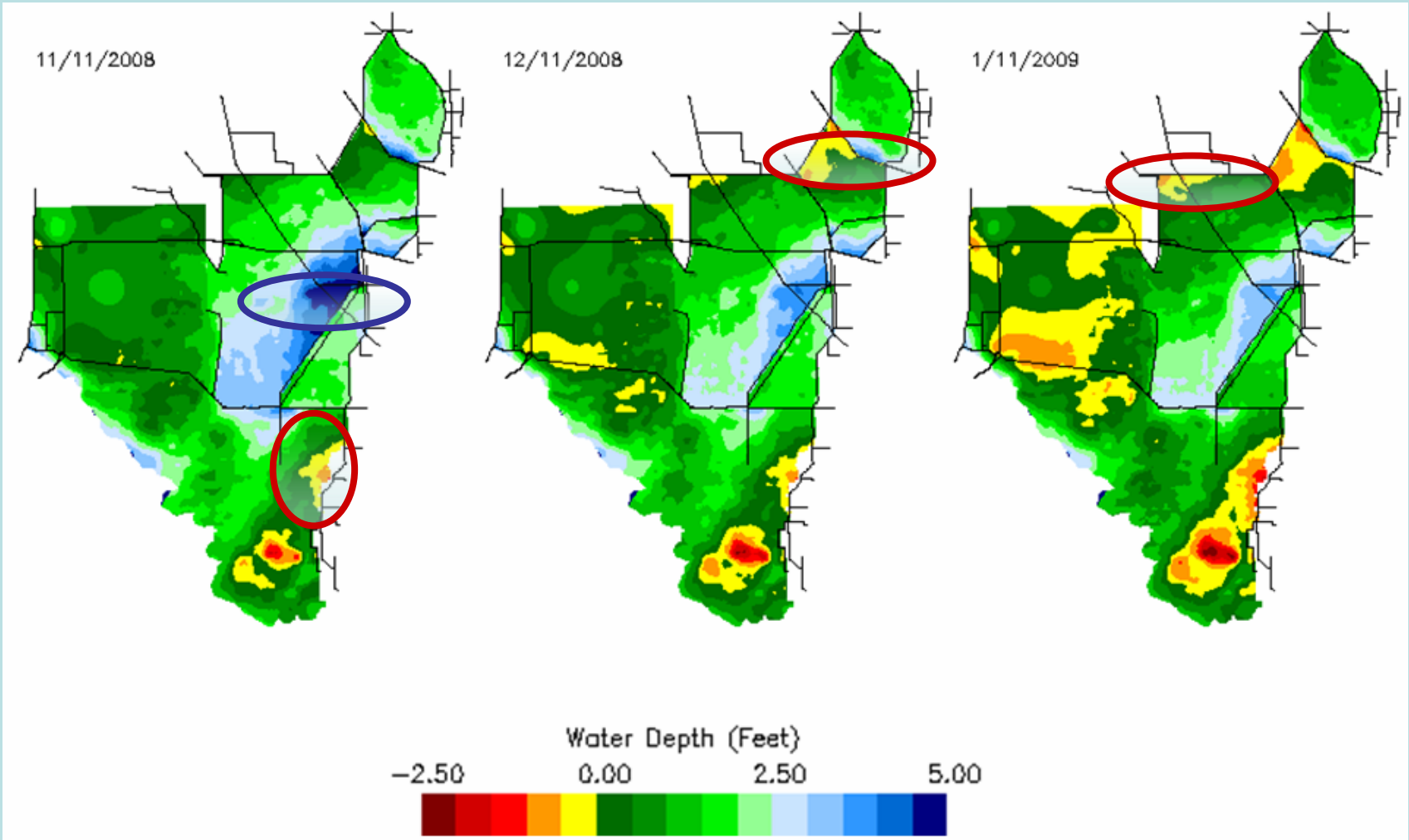
6-4 Gage

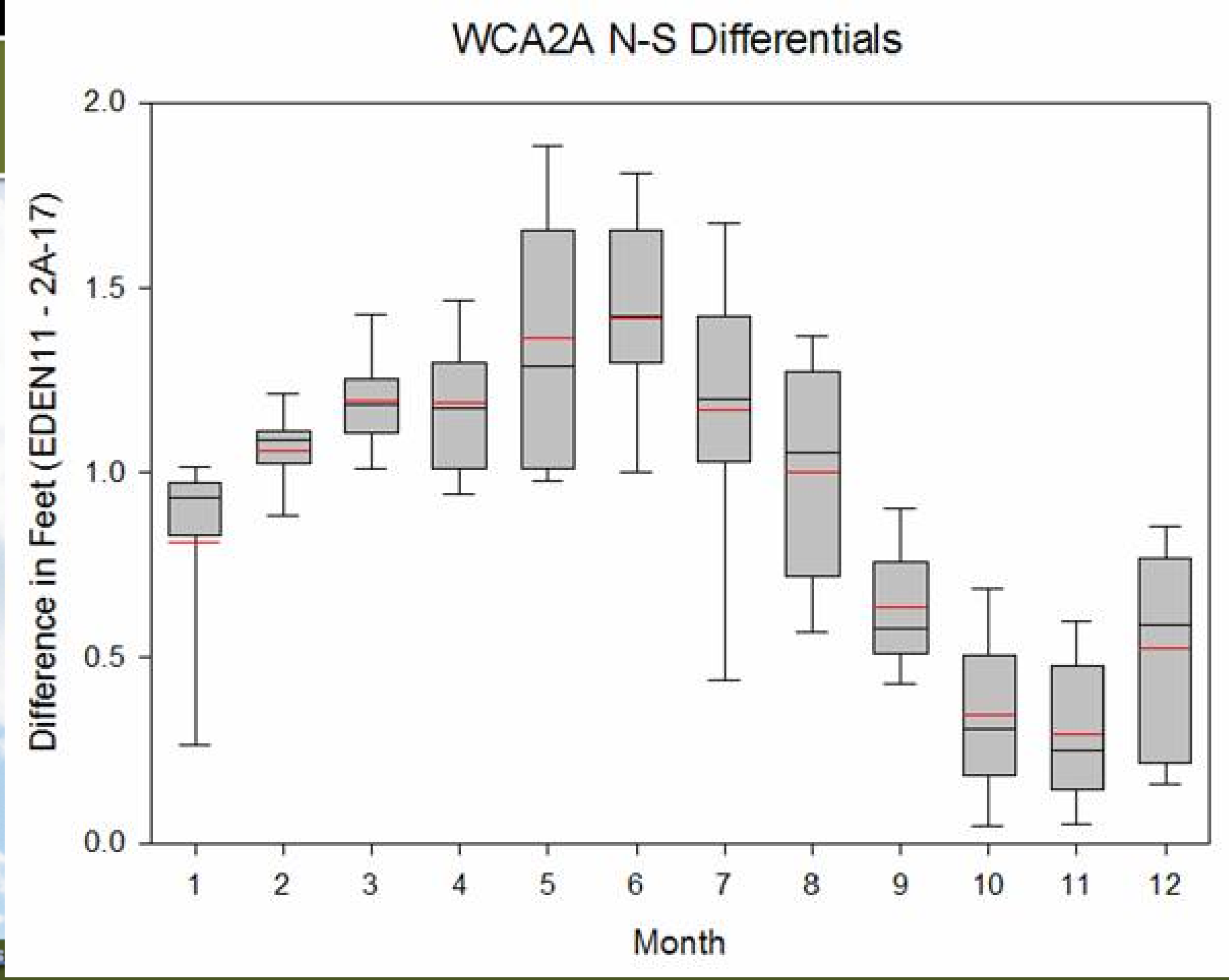
Management Needs:

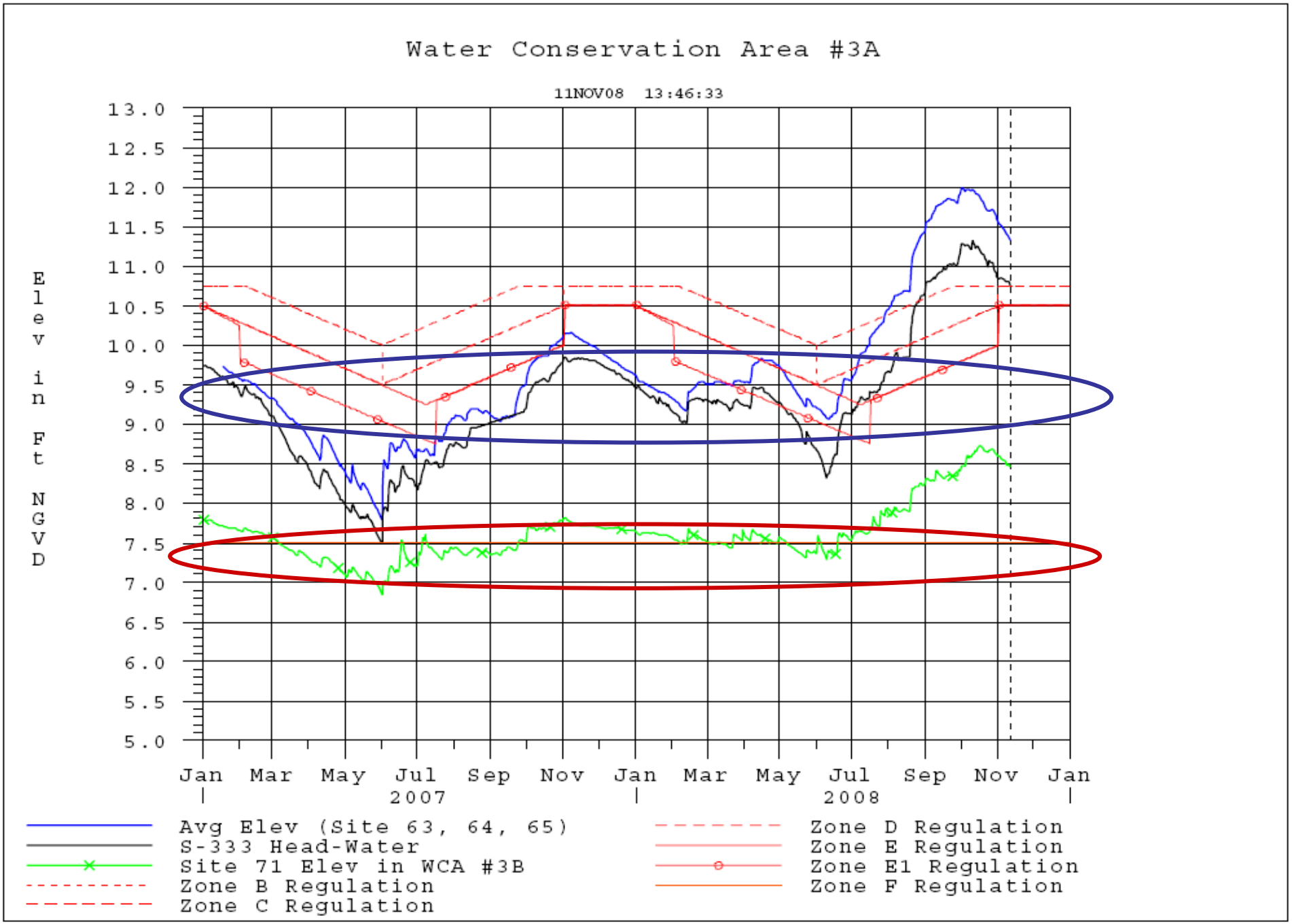
What are the upstream storage requirements for an un-impounded Greater Everglades, where sheet-flow is no longer impeded?

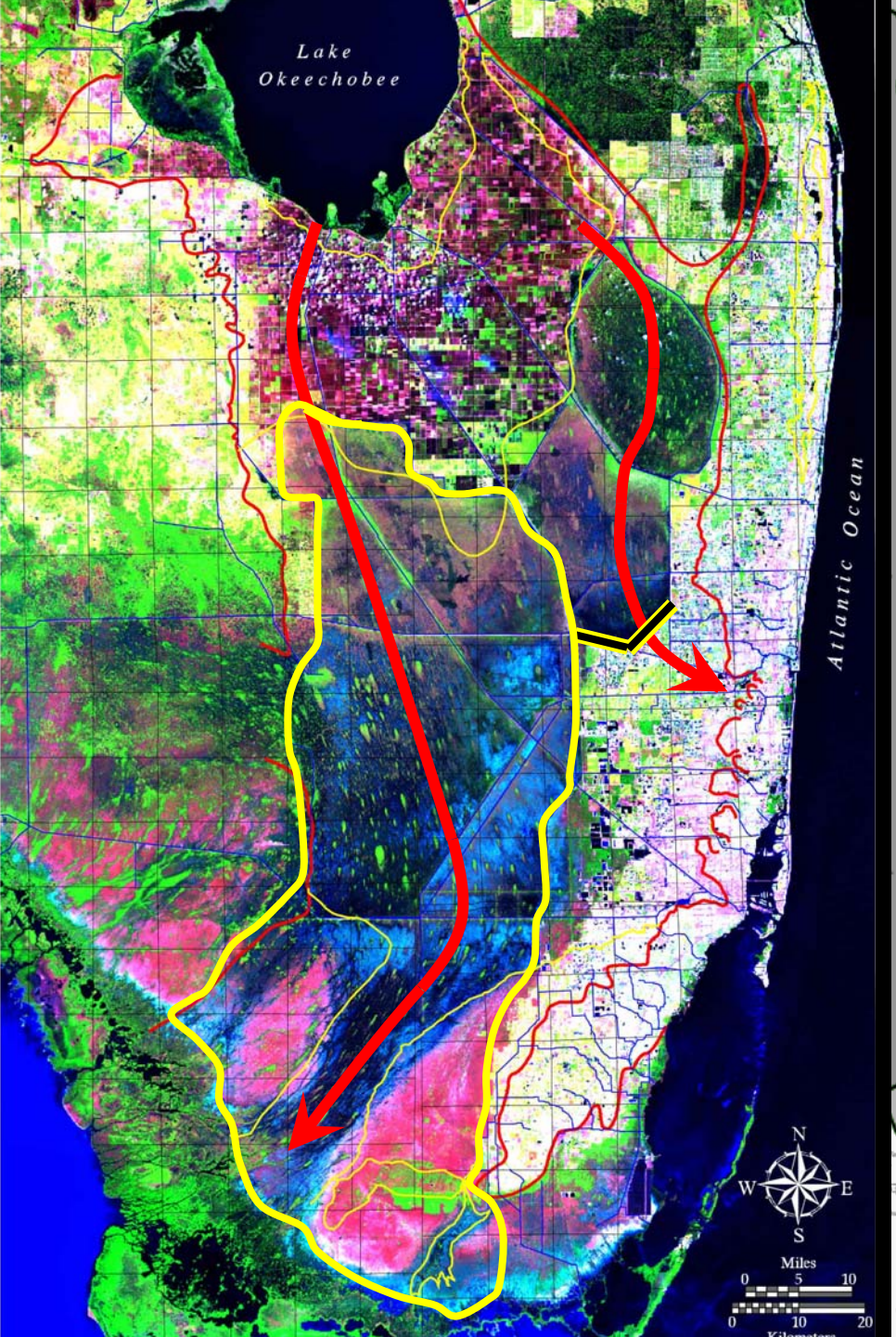
- A system-level regulation schedule that manages for historic depth distributions across WCA-3A, 3B and the ENP.
- Water storage and inflows structures that support historic sheetflow patterns and velocities.
- A design and implementation sequence that maximizes ecological benefits and minimizes negative environmental impacts.

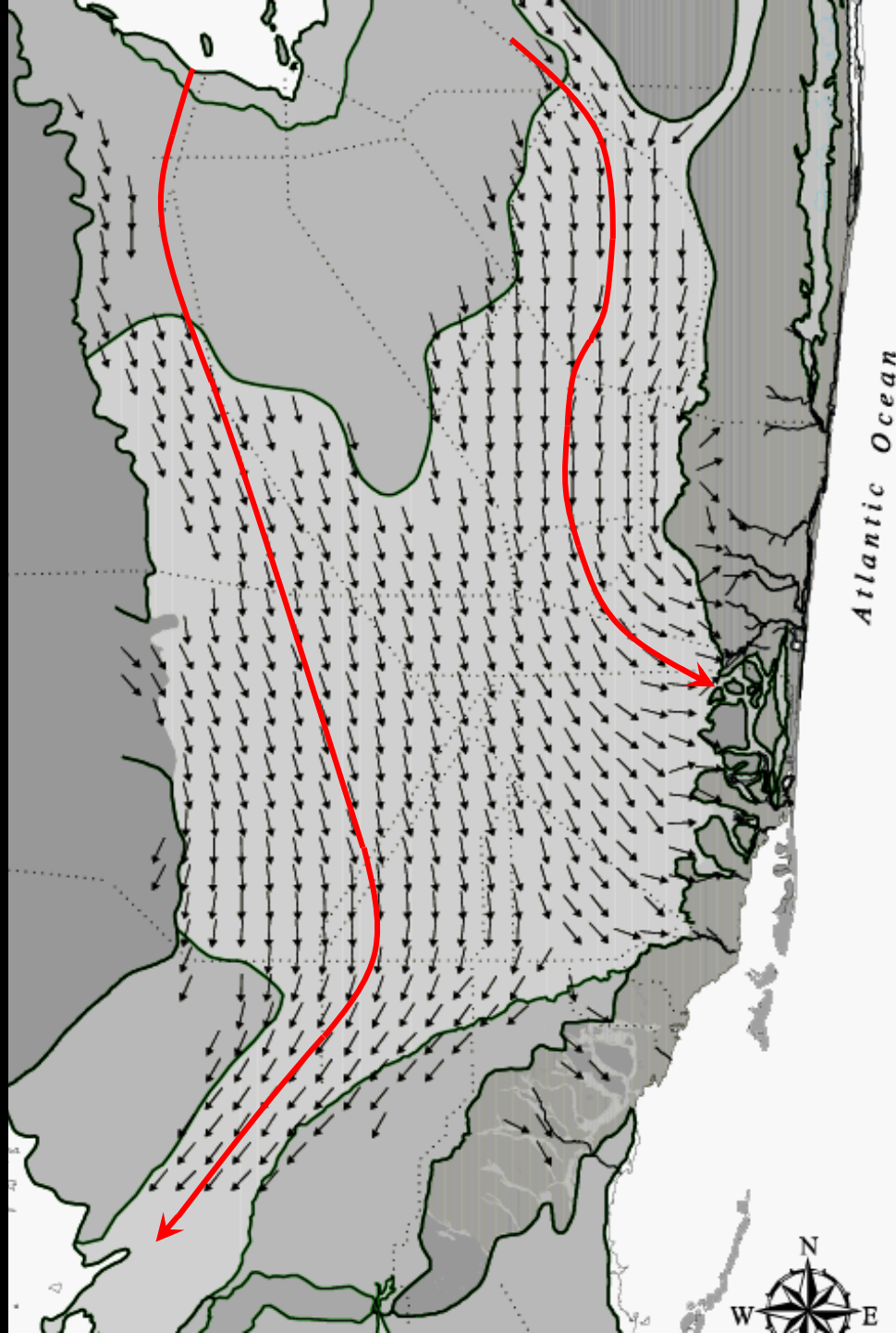
Can you spot the hydrologic issues from the last three months?



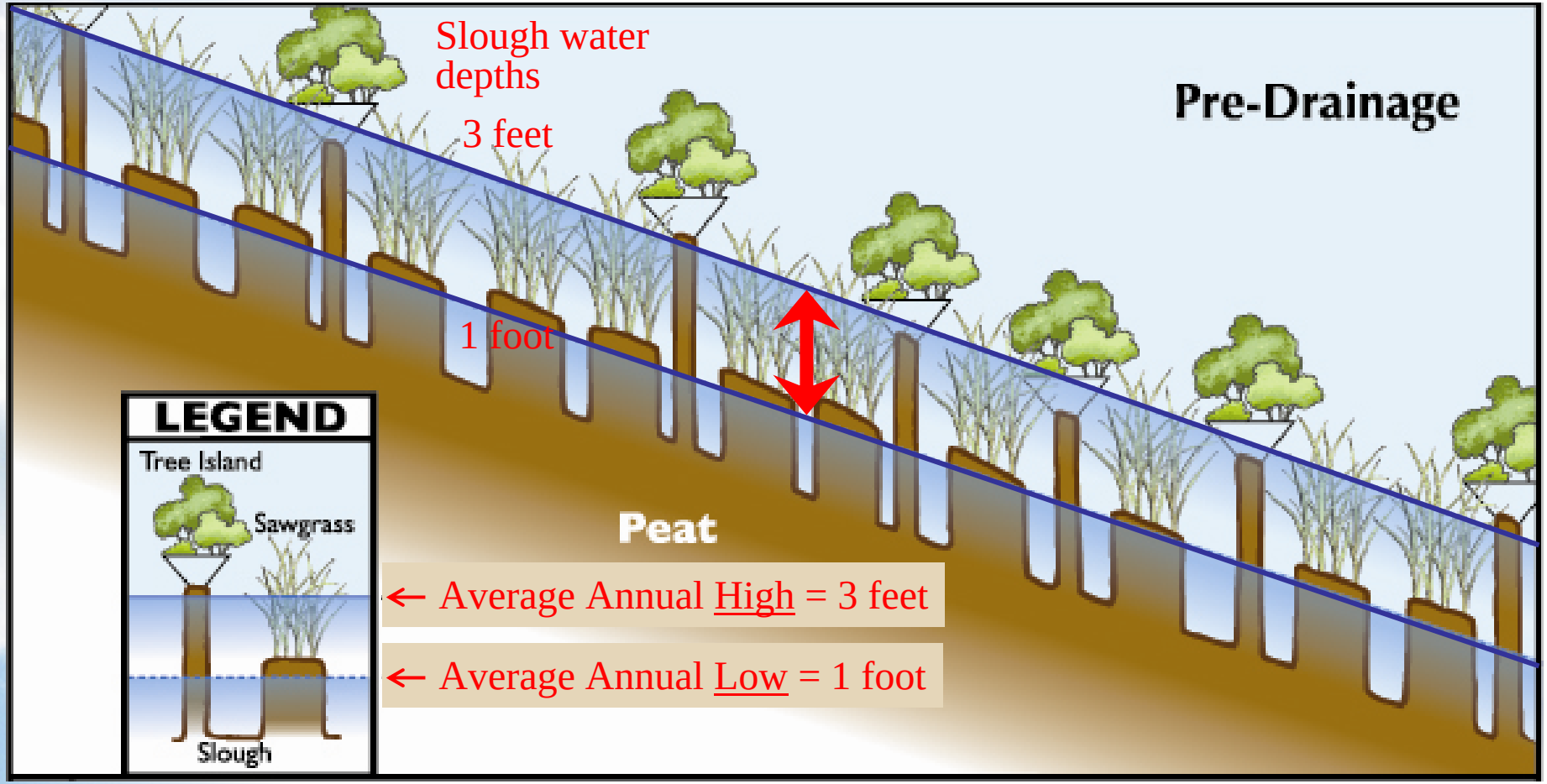

WCA2A N-S Differentials
Difference in Feet (EDEN11 - 2A-17)
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
8
9
10
11
12
Month


Water Conservation Area #3A
11NOV08 13:46:33
Elev in Ft NGVD
13.0
12.5
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
Jan Mar May Jul Sep Nov Jan Mar May Jul Sep Nov Jan
2007
2008
Avg Elev (Site 63, 64, 65)
S-333 Head-Water
Site 71 Elev in WCA #3B
Zone B Regulation
Zone C Regulation
Zone D Regulation
Zone E Regulation
Zone E1 Regulation
Zone F Regulation


Lake
Okeechobee
Atlantic Ocean
N
W
E
S
Miles
0 5 10
0 10 20


Atlantic Ocean
N
W
E

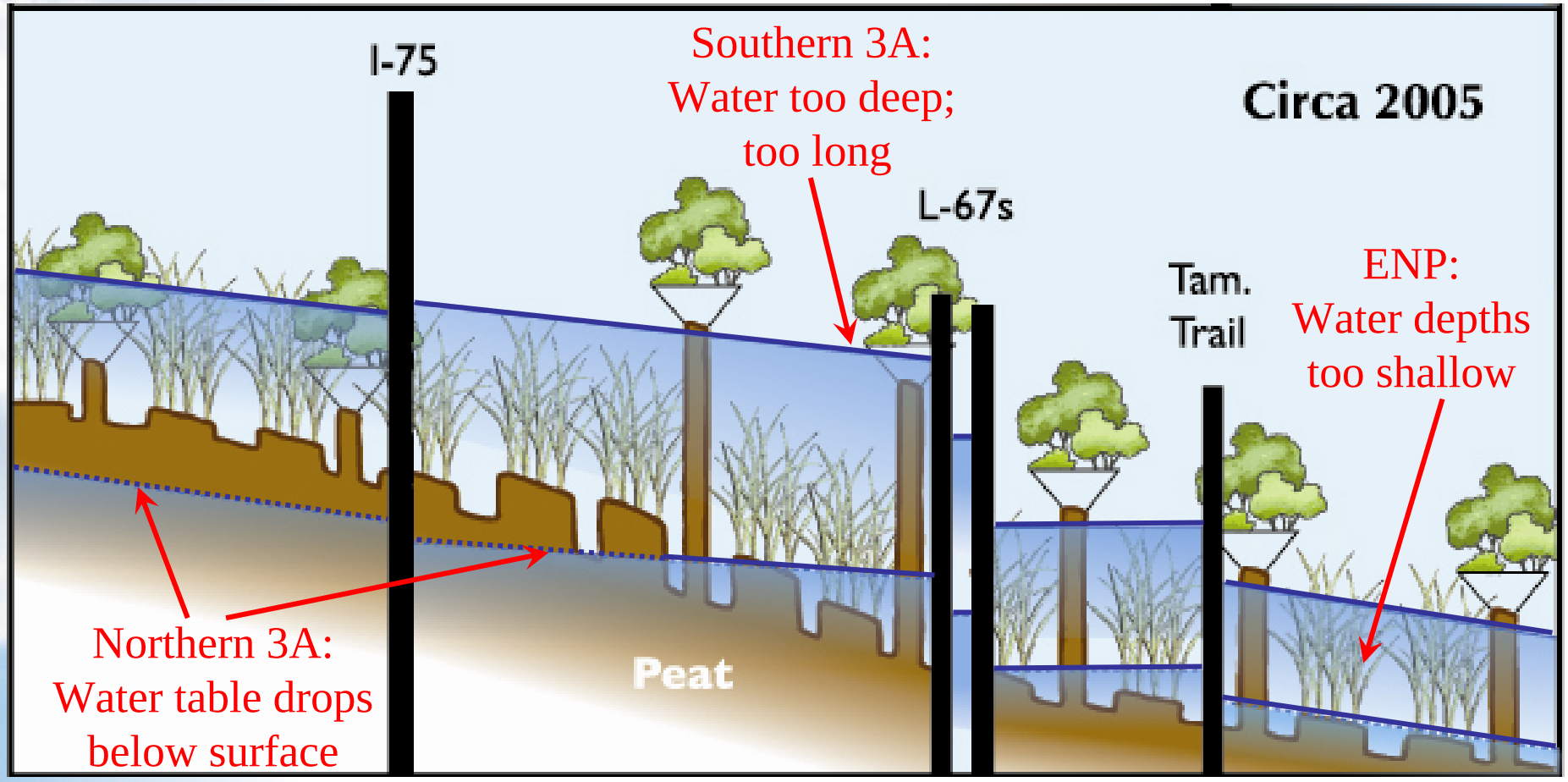
Depth Regime Approach: Pre-Drainage condition



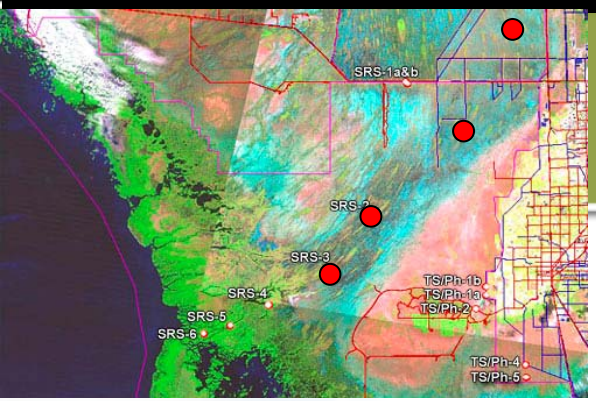
(Only longterm averages shown)

Source: McVoy, Said, Obeysekera and VanArman

Depth Regime Approach: Current condition

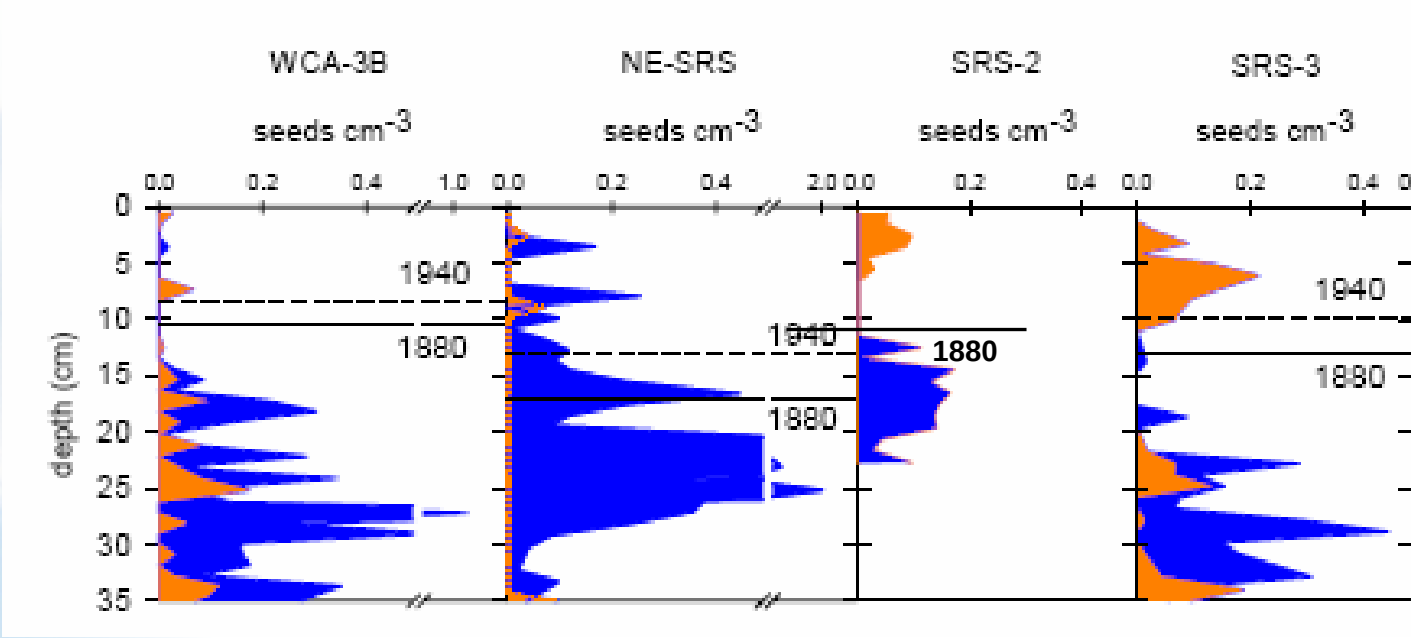


Source: McVoy, Said, Obeysekera and VanArman



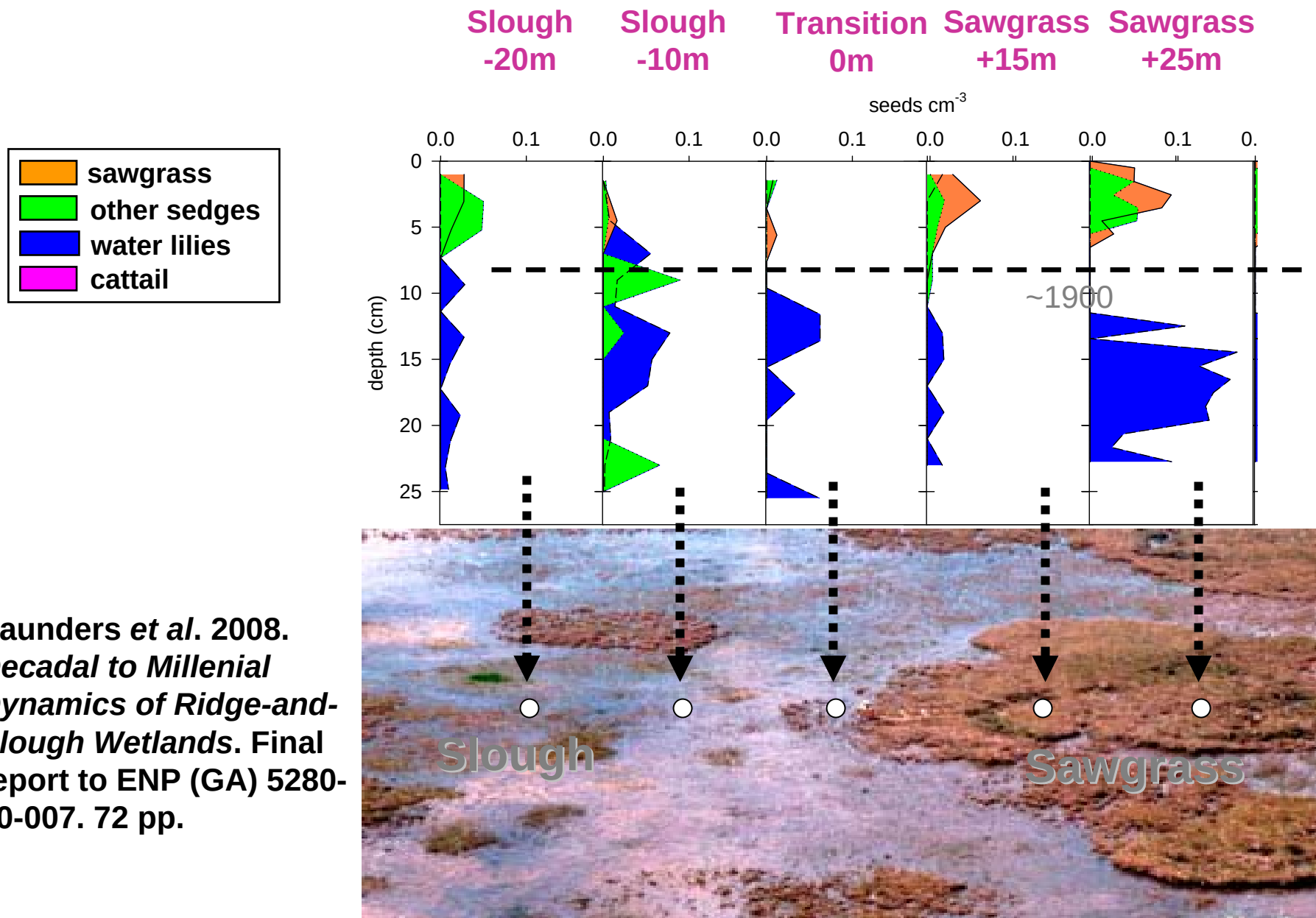
Cladium jamaicense
Nymphaea + Nymphoides

20th Century changes in Shark Slough



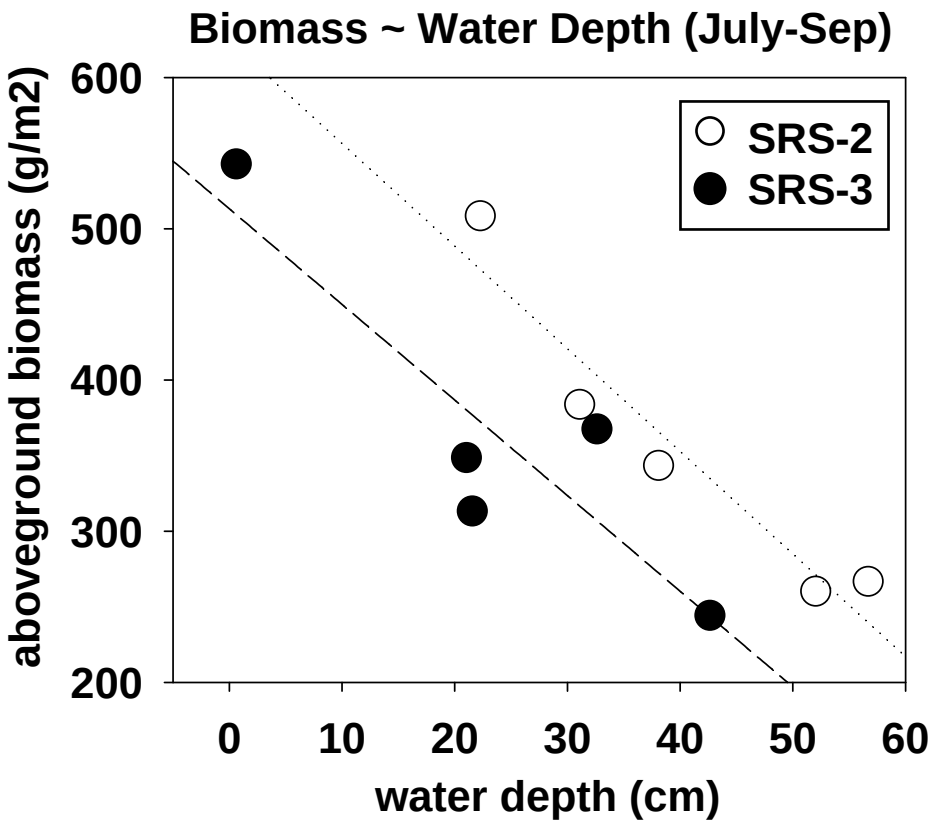
Sklar *et al.* 2008 Chapter 6 Ecology of the Everglades Protection Area. *2008 South Florida Environmental Report*

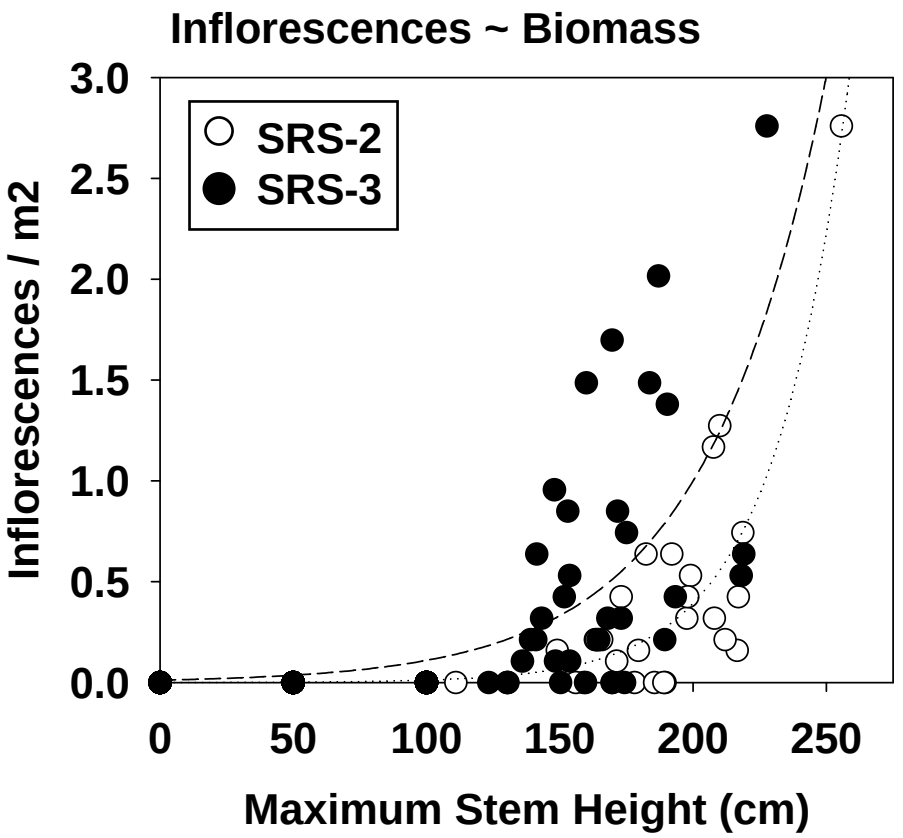
SRS-2 profile transect



Saunders *et al*. 2008. *Decadal to Millenial Dynamics of Ridge-and-Slough Wetlands*. Final report to ENP (GA) 5280-00-007. 72 pp.

Turning seed profiles into reconstructed vegetation & water depths

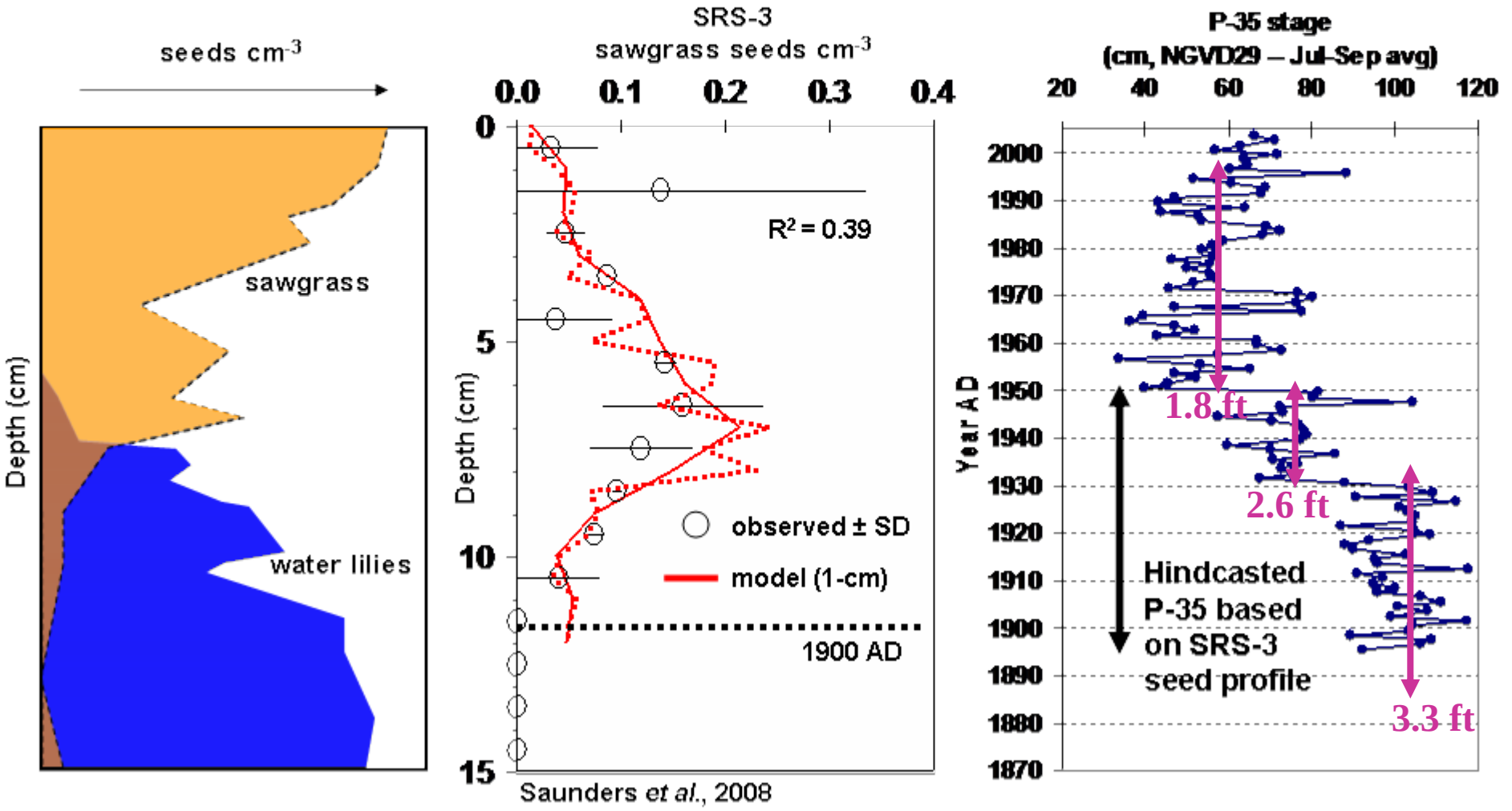




Saunders *et al.* 2006. *Hydrobiologia*

http://fcelter.fiu.edu

SRS-3 Sawgrass seed profiles and reconstructed water depths



Decision Needs: Approaches to Evaluate

Alternative 1: Performance Measures

- RECOVER Performance Measures and Targets
- CERP Master Implementation Sequencing Plan (MISP)

Alternative 2: Depth regime:

- Needs long-term average + rainfall-driven variance

Alternate 3: Identify target sheetflow velocity

- Use pre-drainage data
- Use physical models

Alternate 4: Identify target depth regime

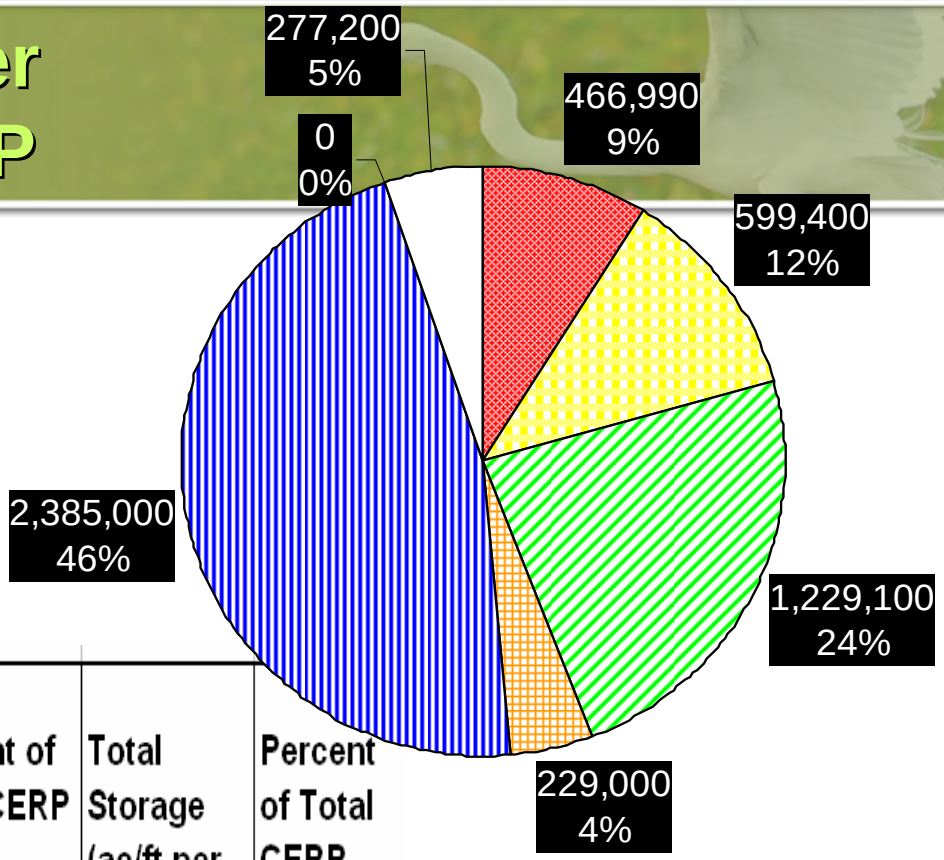
- Pre-drainage narratives (McVoy et al.)
- Paleoecological studies (soil cores) (Saunders et al.)

Greater Everglades RECOVER Performance Measures

- Dry Down Duration
- Inundation Duration
- Extreme High and Low Waters
- Flows (Continuity, Timing, and Distribution)
- Wet (marl) Prairie Vegetation
- Slough Vegetation

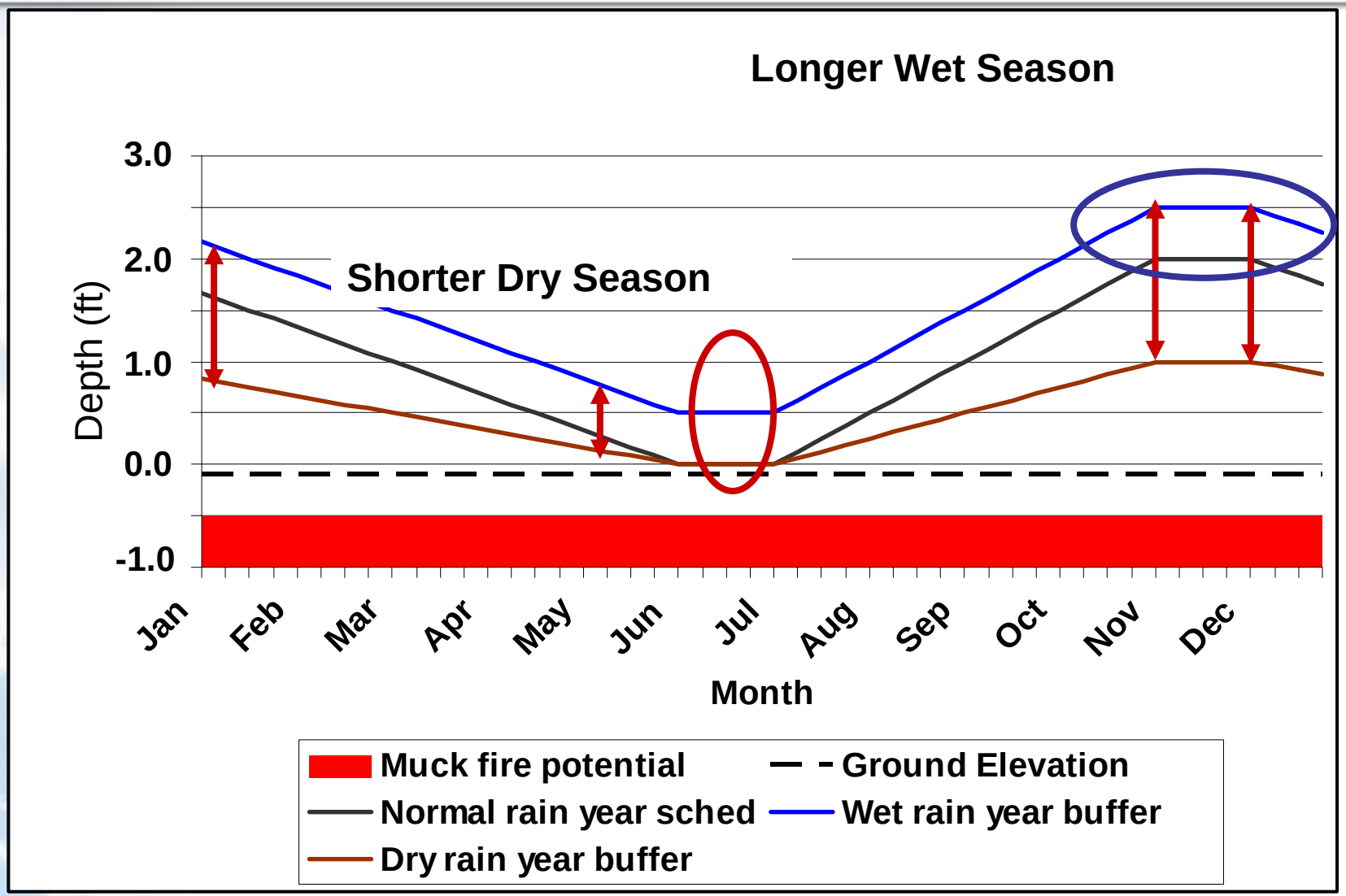
MISP Estimates of Water Storage Needs for CERP

Does this need to be recalculated to included Fl Bay Performance Measures?

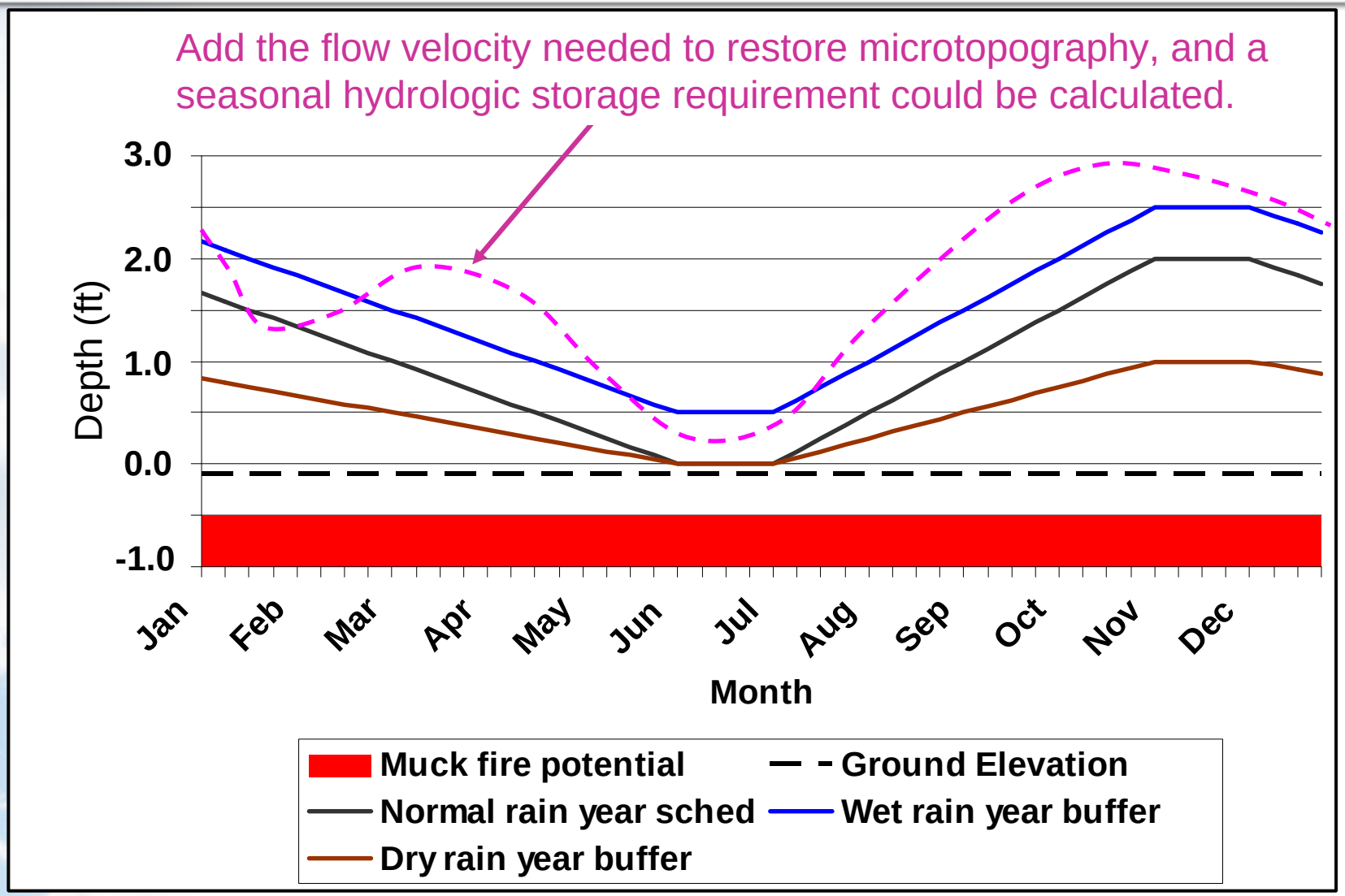


Master Implement-ation Sequence Band	Reservoir (ac/ft per year)	Percent of Total CERP Reservoir Storage	Aquifer Storage and Recovery (ac/ft per year)	Percent of Total CERP ASR Storage	Total Storage (ac/ft per year)	Percent of Total CERP Storage
Band 1	466,990	30.22%	0	0.00%	466,990	9.00%
Band 2	599,400	38.79%	0	0.00%	599,400	11.56%
Band 3	201,600	13.05%	1,027,500	28.22%	1,229,100	23.70%
Band 4		0.00%	229,000	6.29%	229,000	4.42%
Band 5		0.00%	2,385,000	65.49%	2,385,000	45.98%
Band 6		0.00%	0	0.00%	0	0.00%
Band 7	277,200	17.94%	0	0.00%	277,200	5.34%
Total	*1,545,190*	*100.00%*	*3,641,500*	*100.00%*	*5,186,690*	*100.00%*

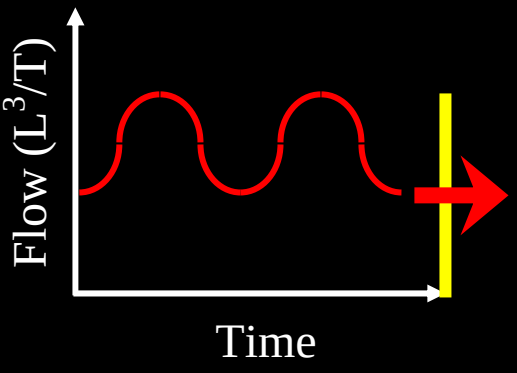
An Example of a Hypothetical Depth-Based Regulation Schedule for Calculating WCA-2A Inflows

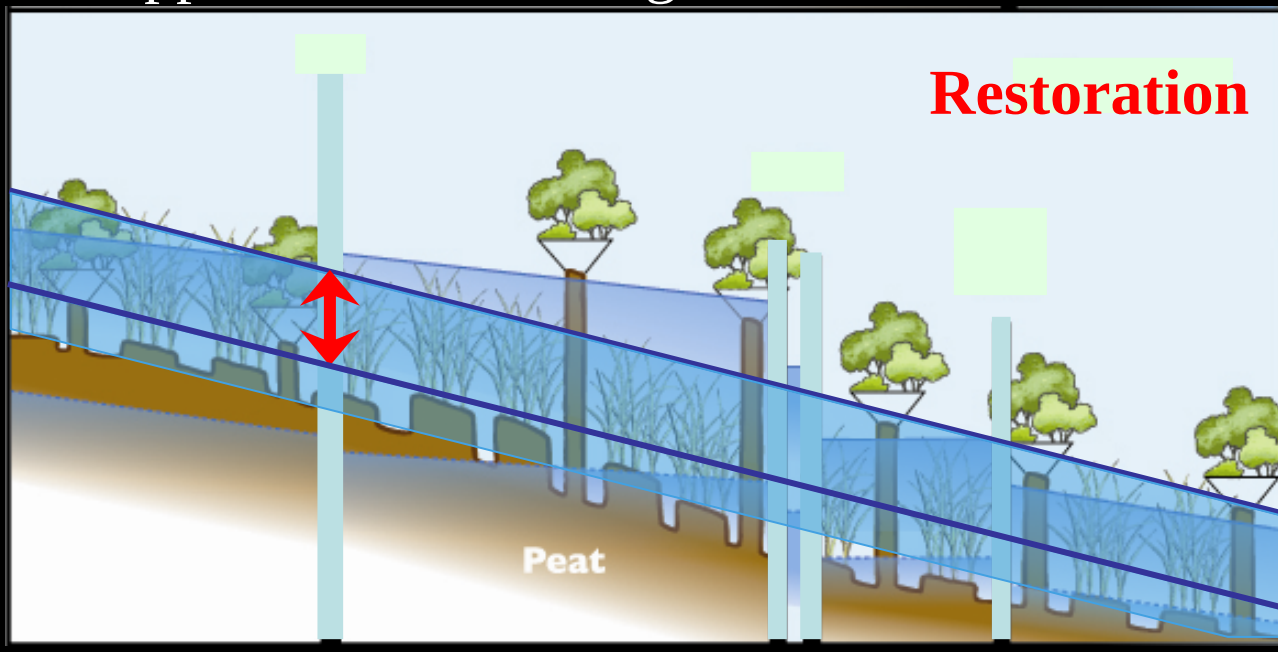


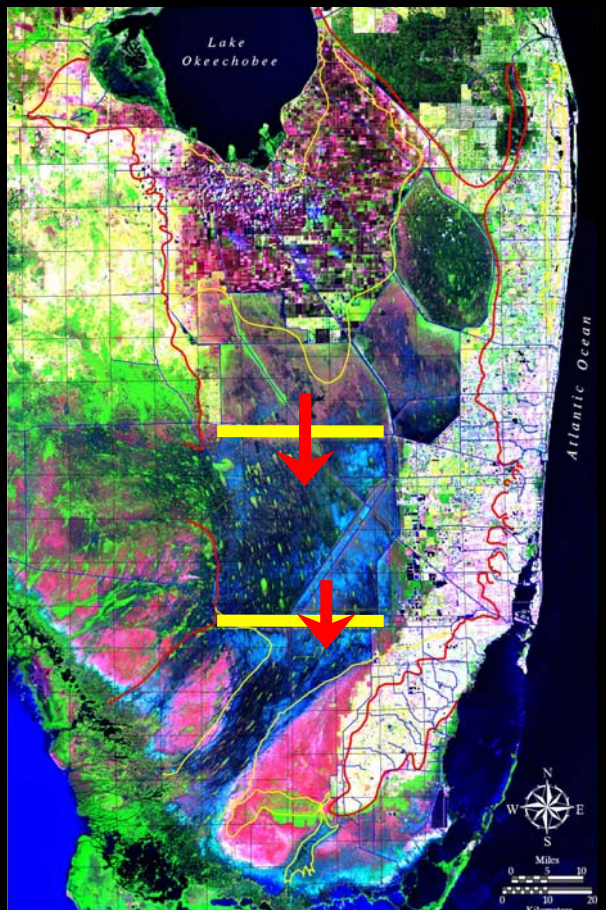
An Example of a Hypothetical Depth-Based Regulation Schedule for Calculating WCA-2A Inflows



Depth Regime Approach: Estimating needed flows

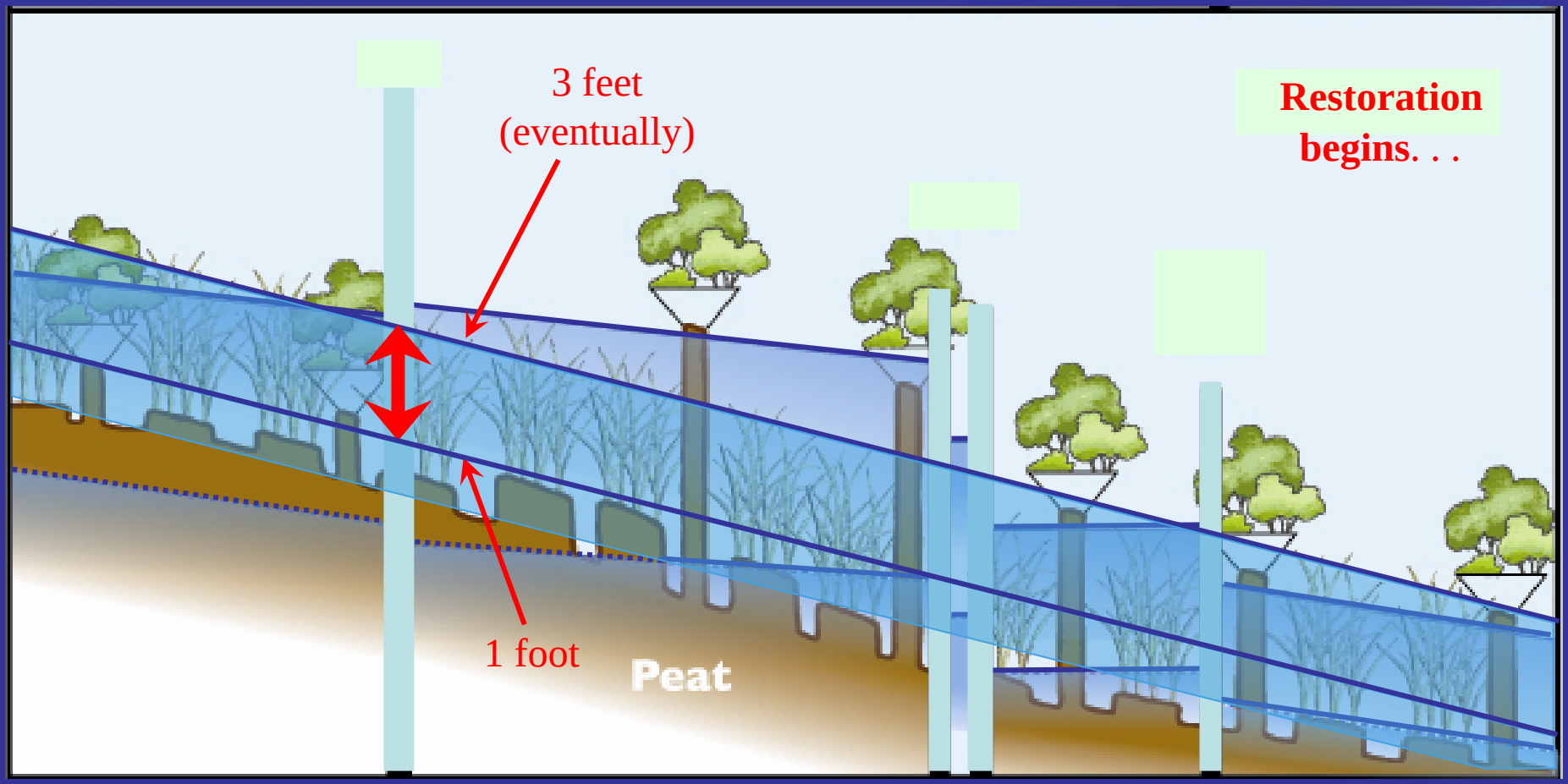






- Longterm <u>average</u> flows to achieve longterm high and low average water depths
- Actual flows = Average + Variance
- Variance based on antecedent rainfall

Depth Regime Approach: Restoration



Greater Everglades: What we know

- **Natural Resource Needs:** Current ecological drivers indicate a recession rate of 0.1 ft/week during the dry season; depth of 1-3 ft for sloughs, 11-month hydroperiods, and a minimum sheetflow velocity of 1.5 – 2 cm/sec.
- **Management Needs:** Historic ecological drivers indicate the need to manage for 1.0 - 1.5 feet of more water, sheetflow, and more homogeneous depth distributions across the Greater Everglades.
- **Decision Needs:** Future ecological drivers indicate a need for physical and/or numeric model estimates of storage requirements, and an evaluation of phased adaptive management.