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Introduction and overview of biogeochemistry and water quality of the greater Everglades

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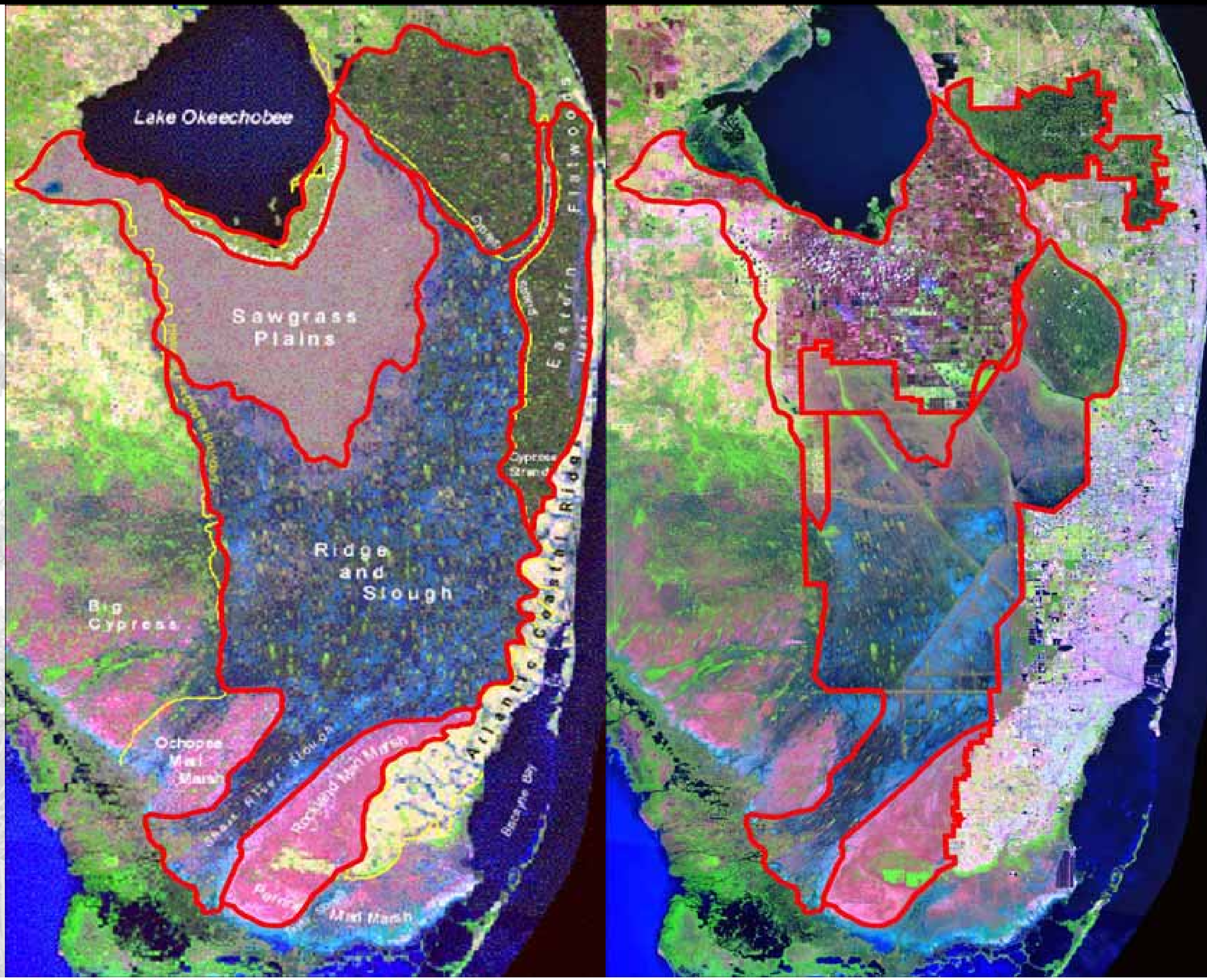


Orlando
Fort Pierce
Lake Okeechobee
West Palm Beach
Fort Myers
EAA
WCA
Naples
Fort Lauderdale
Big Cypress
Miami
ENP
Key West

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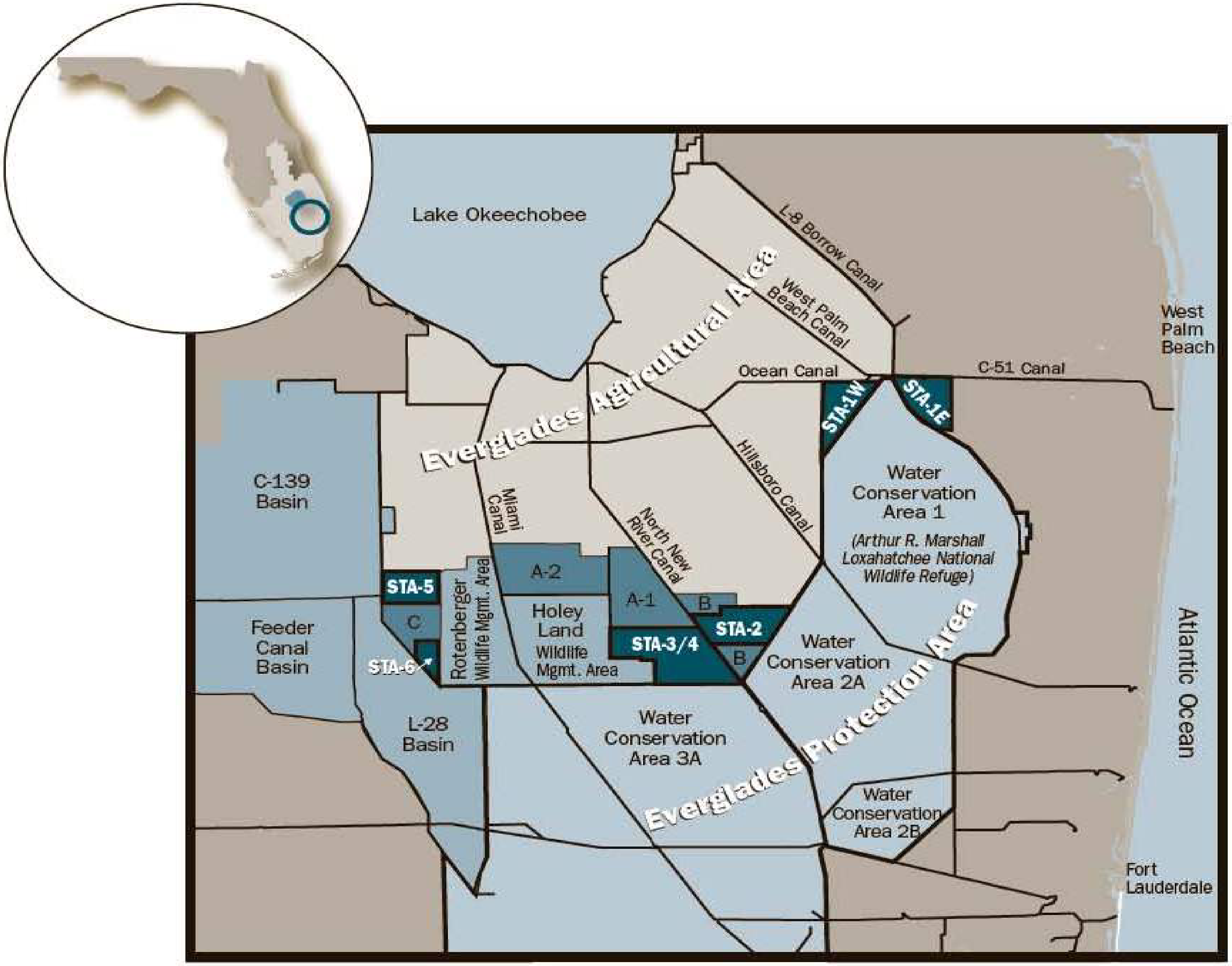

Source:
SFWMD
2008 SFER

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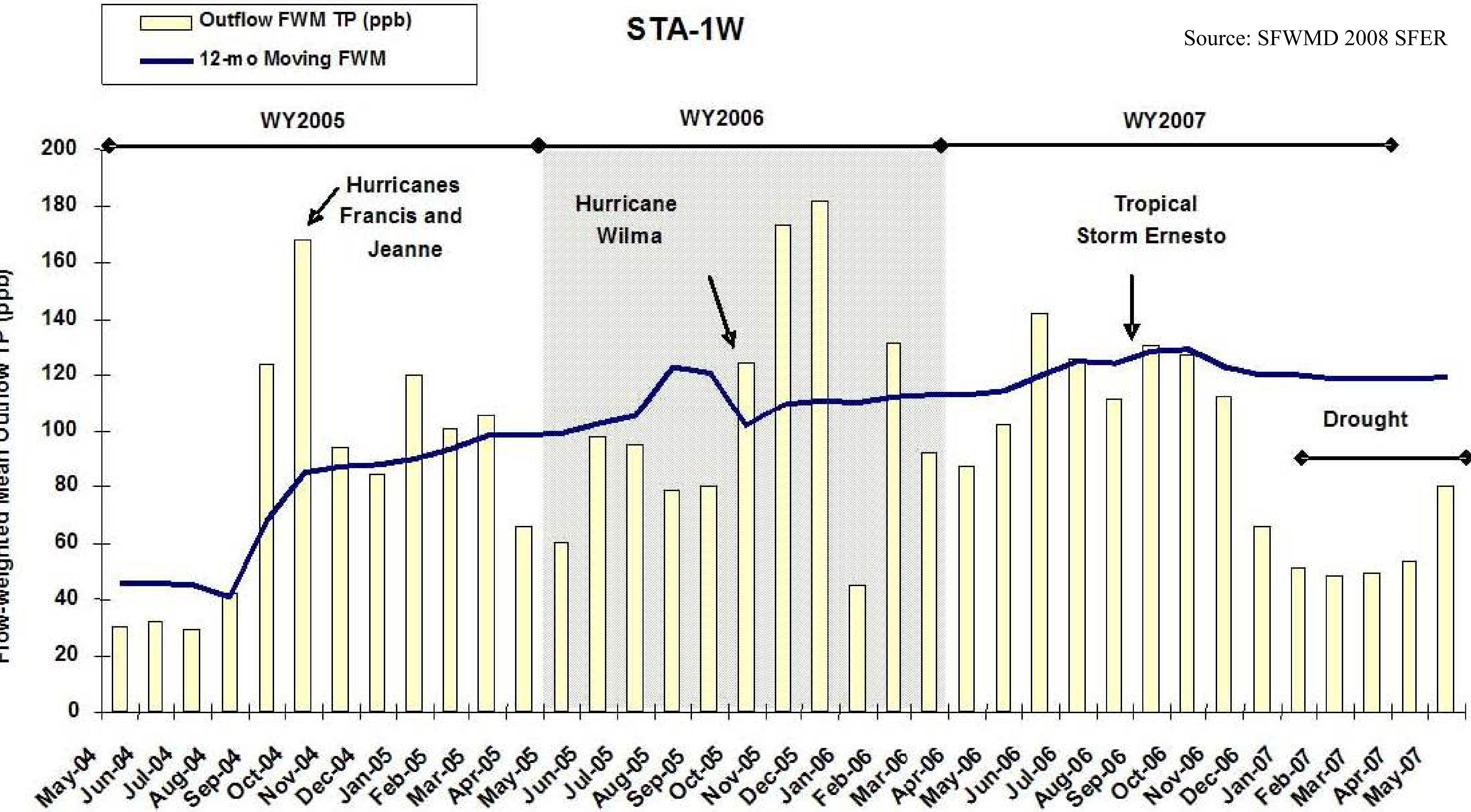

Best Management Practices

- Nutrient control (slow-release P fertilizer – 5 pts, No P import through cattle feed – 15 pts)
- Water management (0.5 inch of rainfall detained – 5 pts, temporary holding pond – 15 pts)
- Particulate matter and sediment controls (leveling fields, sediment trap in canals)
- Pasture management (shade structures – 2.5 pts, restrict cattle from waterways – 10 pts)

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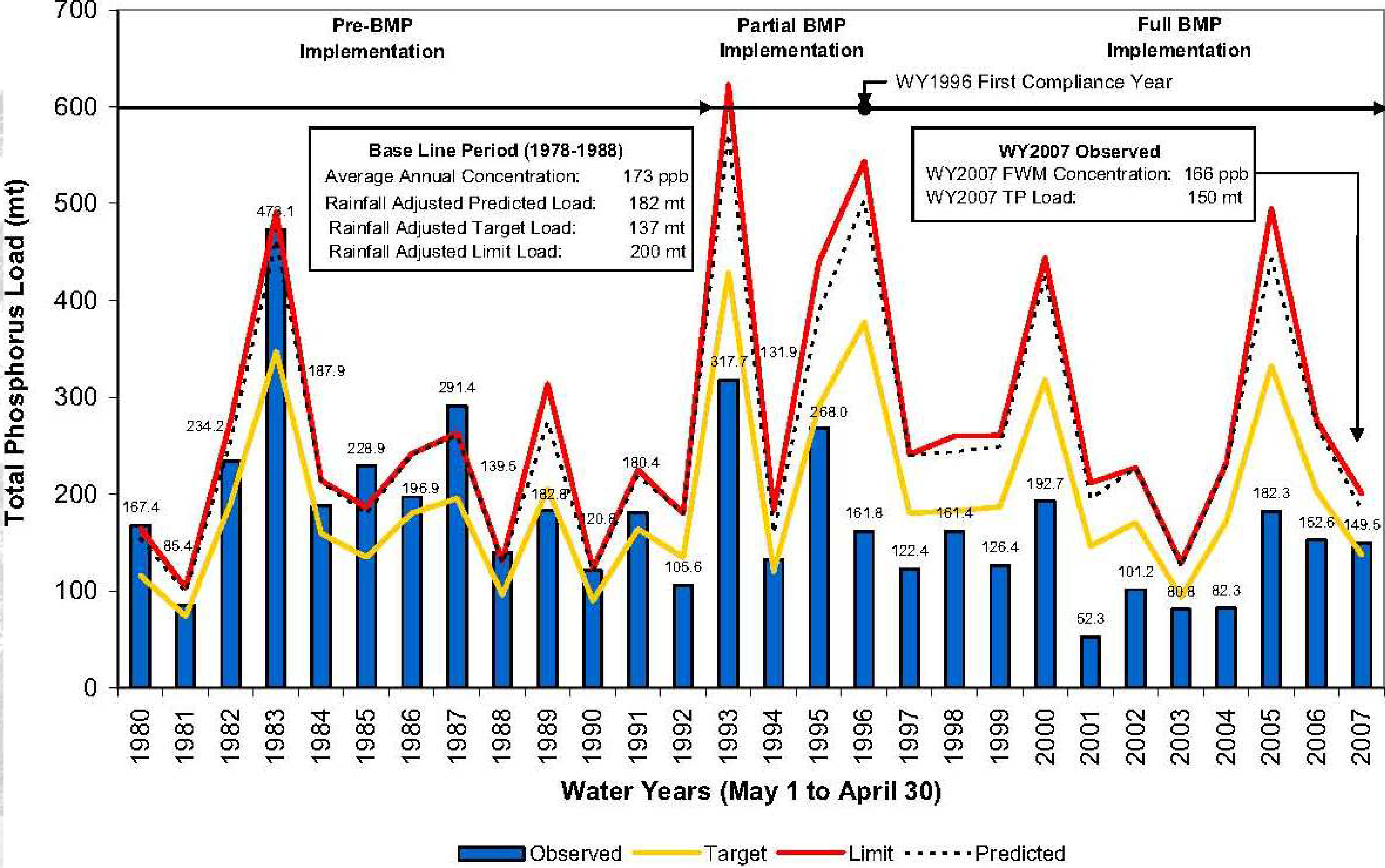

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Water quality issues and challenges

- Nutrients (N, P, S)
- Mineral constituents
- Trace metals
- Mercury
- Pesticides
- Measurement methodology
- Monitoring approaches and designs
- Data analyses, statistics
- Modeling
- Sediment/water column interactions
- Surface/ground water interactions
- Effects of fire and drought
- Ecological impacts

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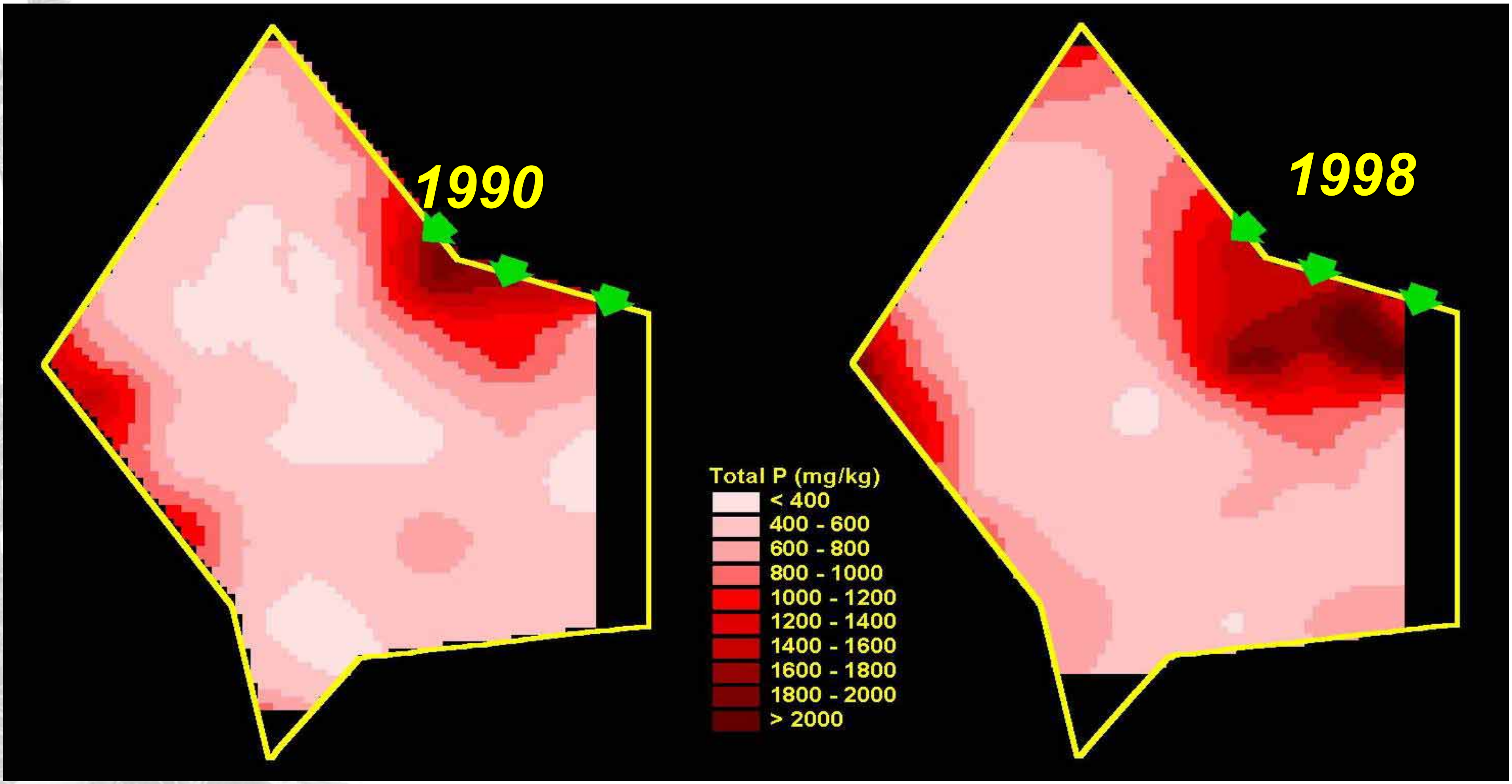
Total P concentration in WCA-2A soil (0-10 cm)



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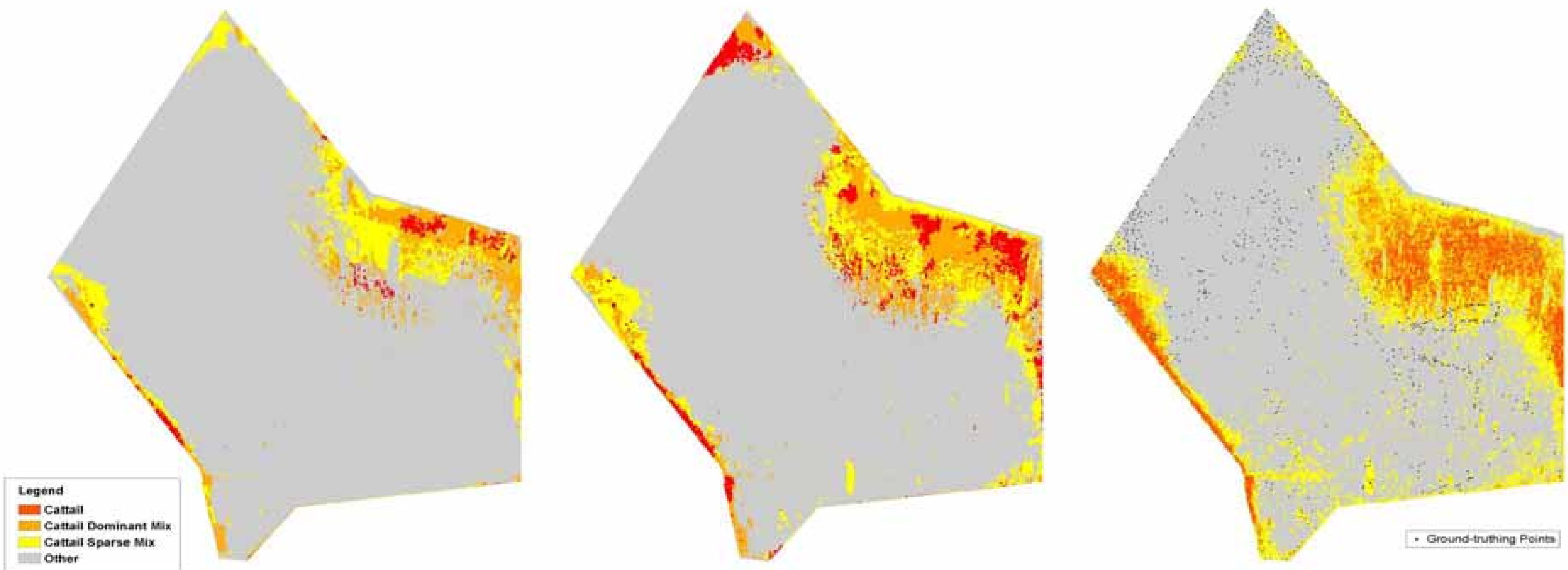
Water Conservation Area 2A Cattail Trend Analysis 1991 - 2003



1991

1995

2003

N

Time series trend analysis of cattail (Typha spp.) within Water Conservation Area 2A (WCA-2A) was performed utilizing 1:24,000 scale color infrared aerial photography captured in 1991, 1995 and 2003. Each cattail map was generated utilizing stereo photointerpretation techniques. The 1991 and 1995 cattail maps were delineated using a vector system with a minimum mapping unit of one acre. (Further discussion of 1991 and 1995 maps can be found in the February 1999 journal of Photogrammetric Engineering & Remote Sensing.) The 2003 cattail map was compiled utilizing a quarter hectare (50 x 50 meter) grid method constituting a minimum mapping unit of 0.6 acres. The quarter hectare grid was generated and superimposed over the 2003 aerial photography, resulting in 170,500 individual grid cells covering all of WCA-2A. Vegetation within each individual grid cell was observed on the aerial photography utilizing a Leica SD2000 stereo-plotter. Cattail cover was estimated for each grid cell and assigned one of four possible categories. The categories of this classification are: "cattail monotypic" (greater than or equal to 90% cattail), "cattail dominant mix" (50% - 89% cattail), "cattail sparse mix" (10% - 49% cattail), or "other" (less than 10% cattail). For ground-truthing, seven hundred and forty-two locations within WCA-2A were visited using differential GPS navigation by airboat or helicopter. These points where determined to be areas in question or "unknown" during the photointerpretation process.

Advantages of the grid system mapping include greater time and cost efficiency and the unique ability to classify vegetation within the same quarter hectare grid cells from this analysis during future mapping efforts. This allows for the past, present and future analysis of each individual quarter hectare of the entire area under study. In addition, the grid system more accurately models the overall heterogeneity of Everglades vegetation.

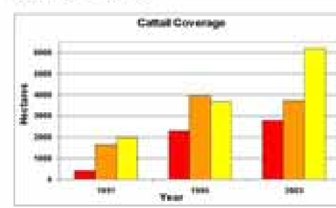
Results show that cattail continues to spread throughout WCA-2A, with monotypic cattail patches expanding throughout the eastern portion of the impoundment and along the southwestern boundary. In addition, sparse cattail continues to spread along distinct cattail-sawgrass boundaries and throughout the southern regions of WCA-2A. The rate of spread appears to be slowing down, however, when compared to the 1991-1995 period. This decrease in rate may be due to the reduction in total phosphorous load that went into the impoundment on a yearly basis during the 1995 to 2003 period. Excess nutrients, hydrologic alterations, invasive habitat availability, and fire have been shown to influence successful establishment of cattail in the Everglades. The relative importance of these factors influencing cattail coverage in WCA-2A from 1995 to 2003 still needs to be determined. One positive observation at the northern tip of WCA-2A is an actual loss of cattail. It is hypothesized that the loss of cattail in this area is due to a combination of events including fire, a reduction in phosphorous loading, and water levels with the closing of structure S10E in 1996. Structure S10E regulates water flow from the Hillsboro Canal into northern WCA-2A.

Ted Schall, Ken Rutchey, and Matt Love of the Everglades Division at the South Florida Water Management District compiled this latest 2003 cattail vegetation map. For additional information contact Ken Rutchey at (561) 682-6618 or email at krutchey@sfwmd.gov.

Cattail Coverage of Each Sampling Date

	Cattail	Cattail Dominant Mix	Cattail Sparse Mix	Other	Total Cattail
1991	421.6	2287.3	2760.9	36528.6	5469.8
1995	1646.3	3944.0	3721.7	32686.5	9312.0
2003	1982.5	3680.0	6191.5	30164.5	11854.0

* Coverage is in hectares



Everglades Division

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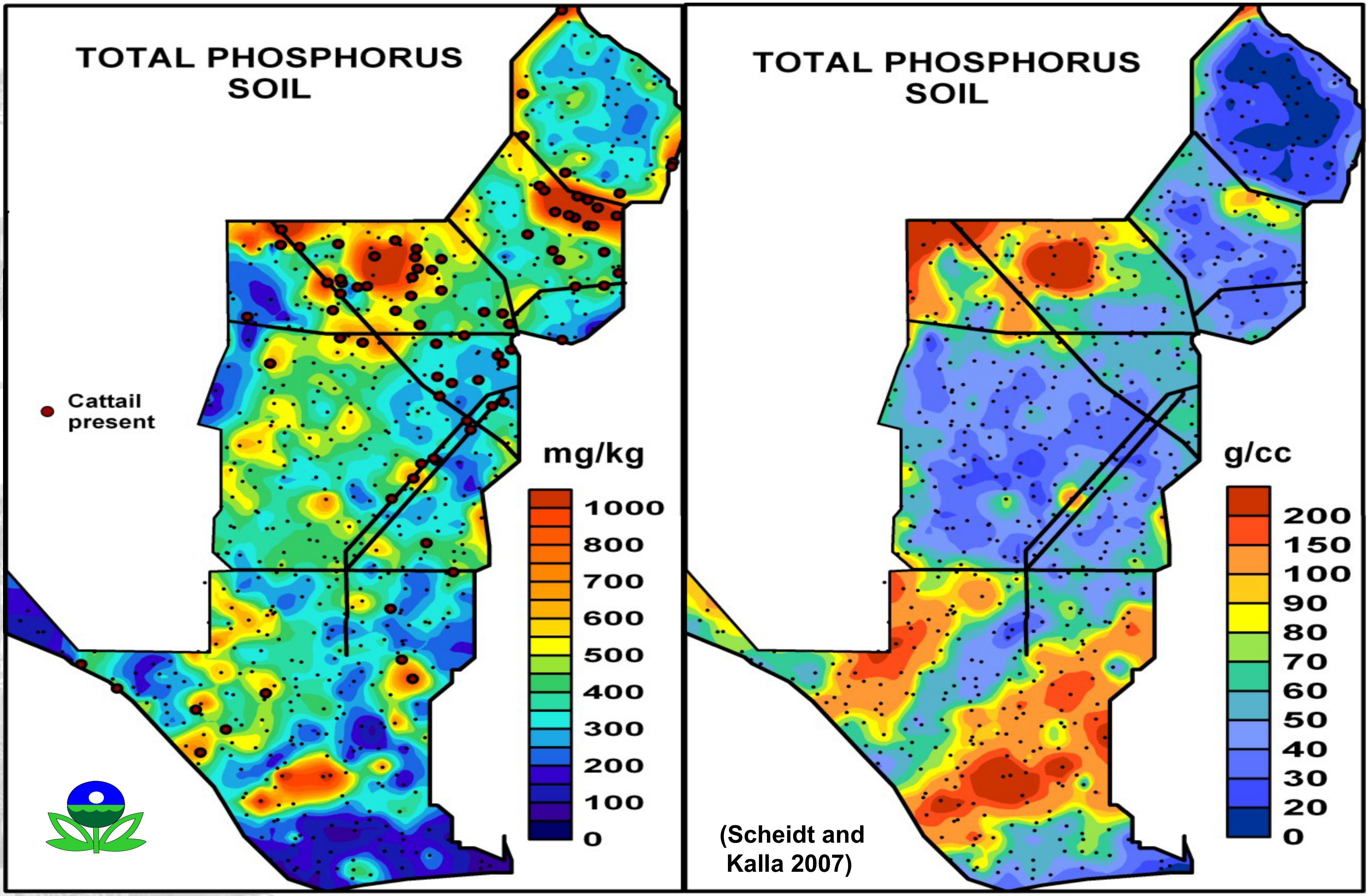

(Scheidt and Kalla 2007)

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Cause-and-effect experiments in field flumes and mesocosms

Greenhouse and laboratory experiments

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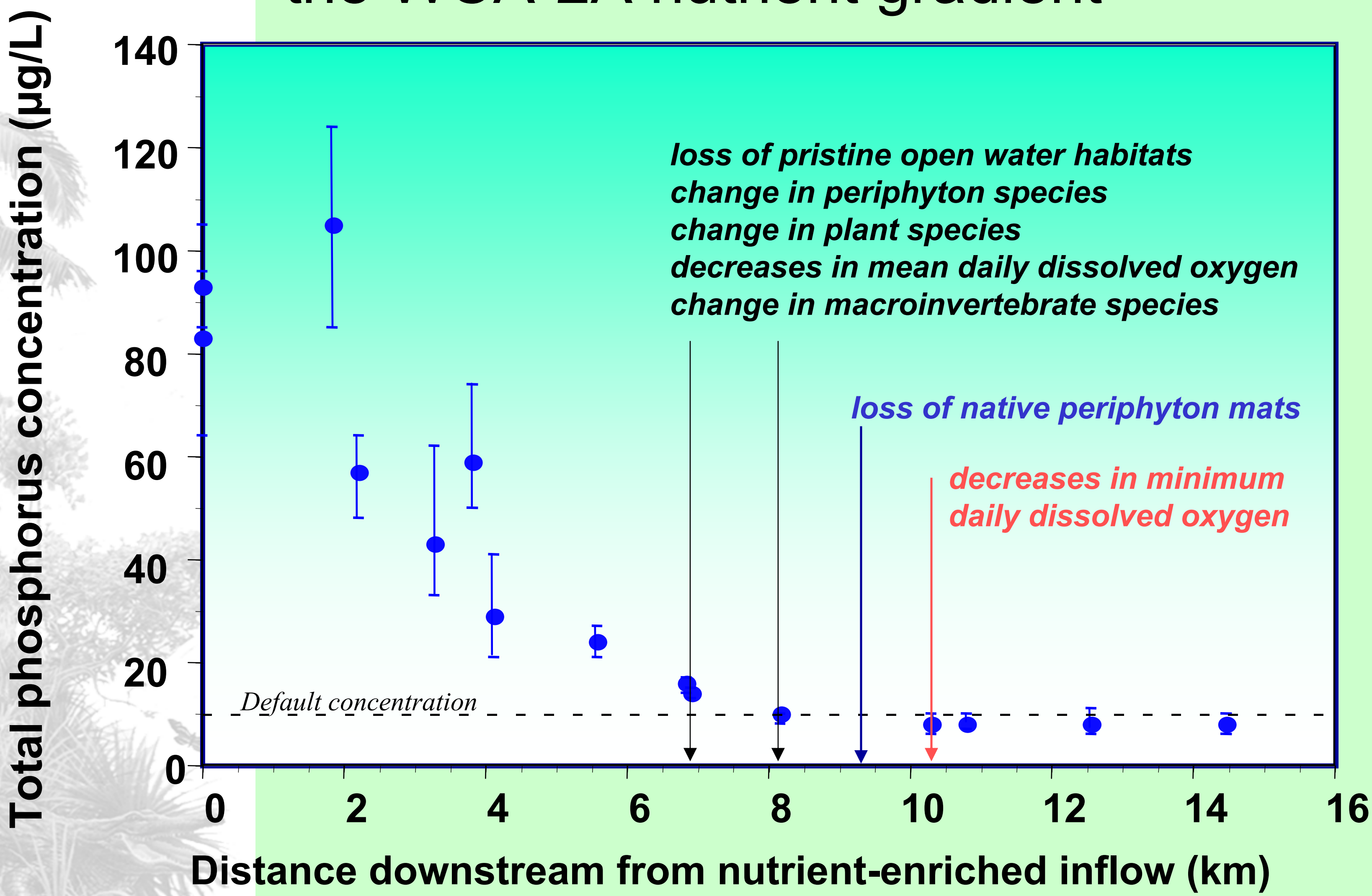
A synthesis of significant ecological changes along the WCA-2A nutrient gradient



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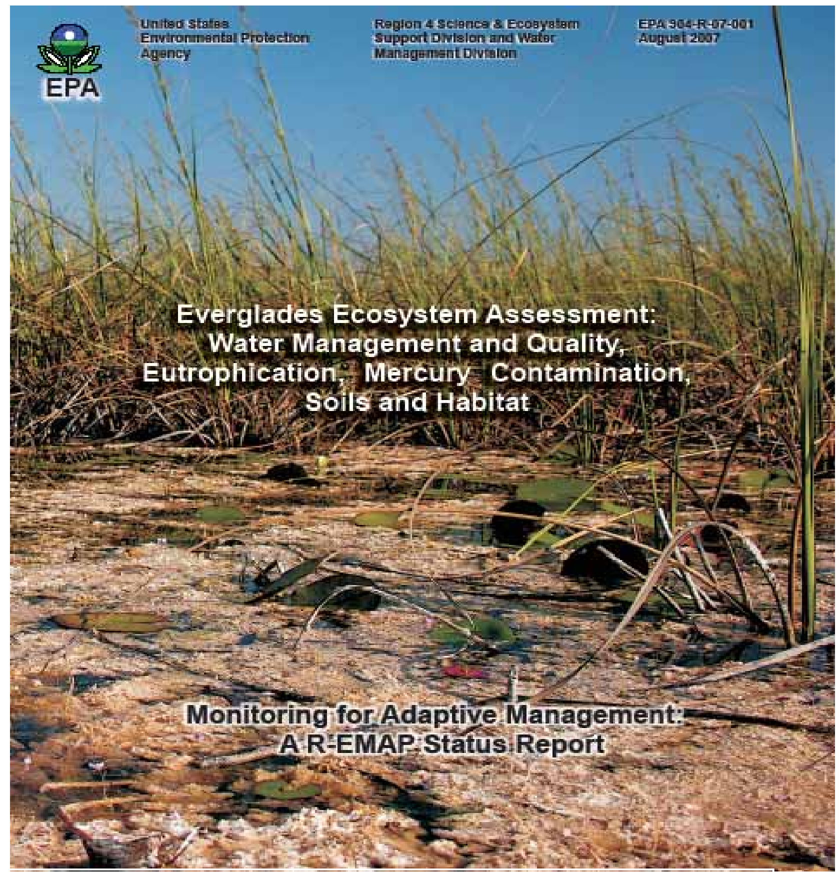
Everglades Ecosystem Assessment: Regional Environmental Monitoring and Assessment Project (R-EMAP)

Peter Kalla, Program Leader
Dan Scheidt, Associate Program Leader
USEPA Region 4

Collaborators:
Florida International University
Yong Cai, Evelyn Gaiser,
Guangliang Liu, Tom Philippi,
Jenny Richards, Len Scinto, Joel Trexler

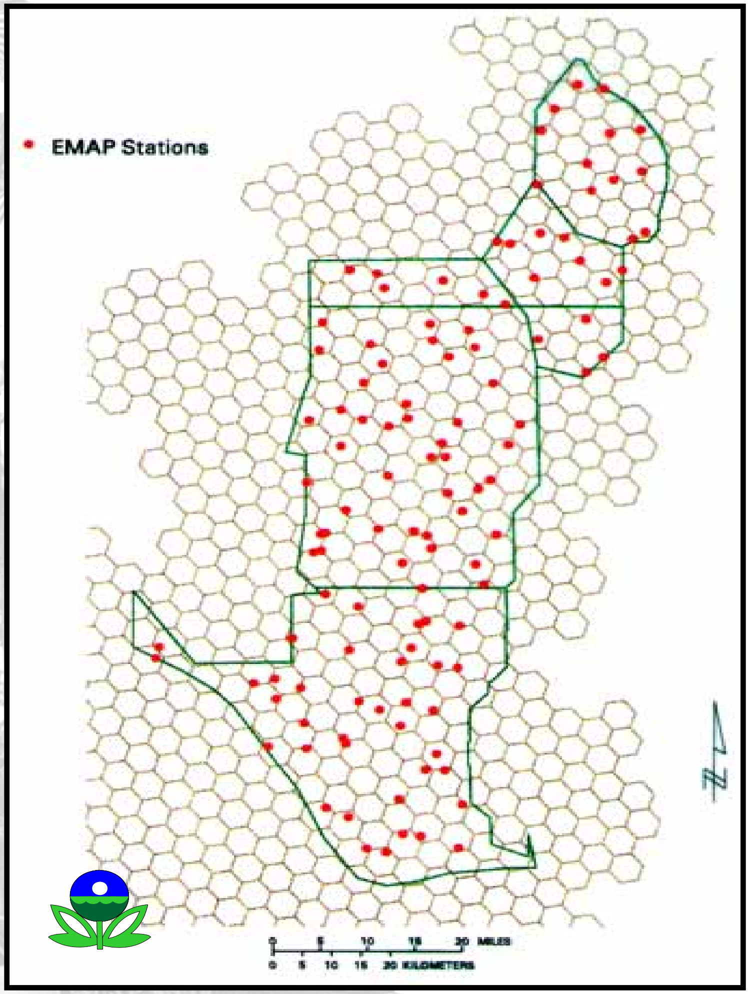
University of Georgia
Marguerite Madden

GEER Thursday afternoon session



Scheidt and Kalla 2007. http://www.epa.gov/region4/sesd/reports/epa904r07001.html

R-EMAP Probability-based Design



- Reviewed by National Academy of Sciences.
- Every member of a statistical population has a known chance of being selected and the samples are drawn at random.
- *Can estimate with known confidence the status of ecological resources (% of area ± CI, e.g.,* 24.5 ± 6.4% > 500 mg/kg TP*)*
- Only multi-media project across entire Everglades Protection Area (EPA) with probability-based design.

R-EMAP Sampling 1993-2005

EMAP probability-based design

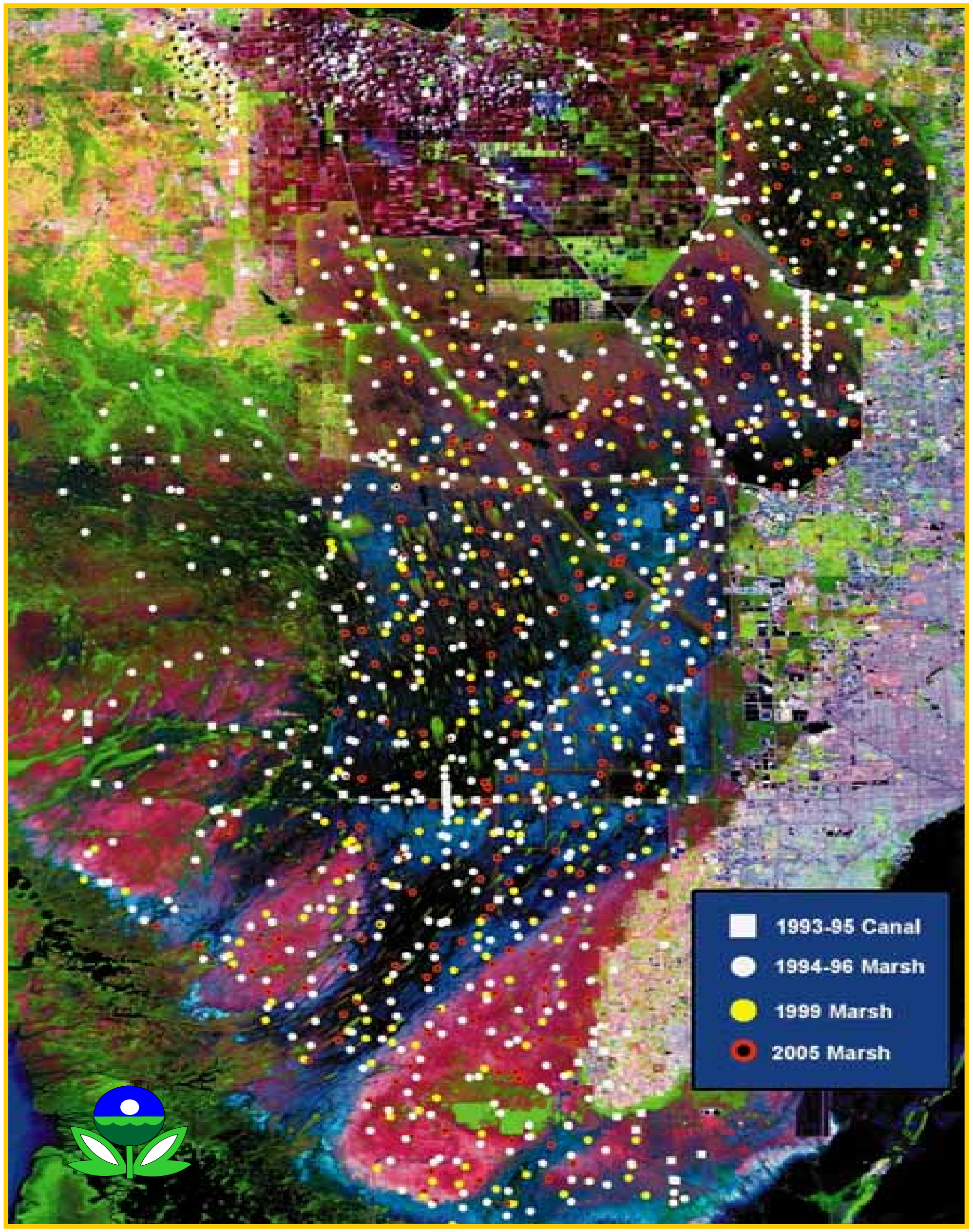
Canal = 1993-95

Marsh = 1995-96; 1999; 2005

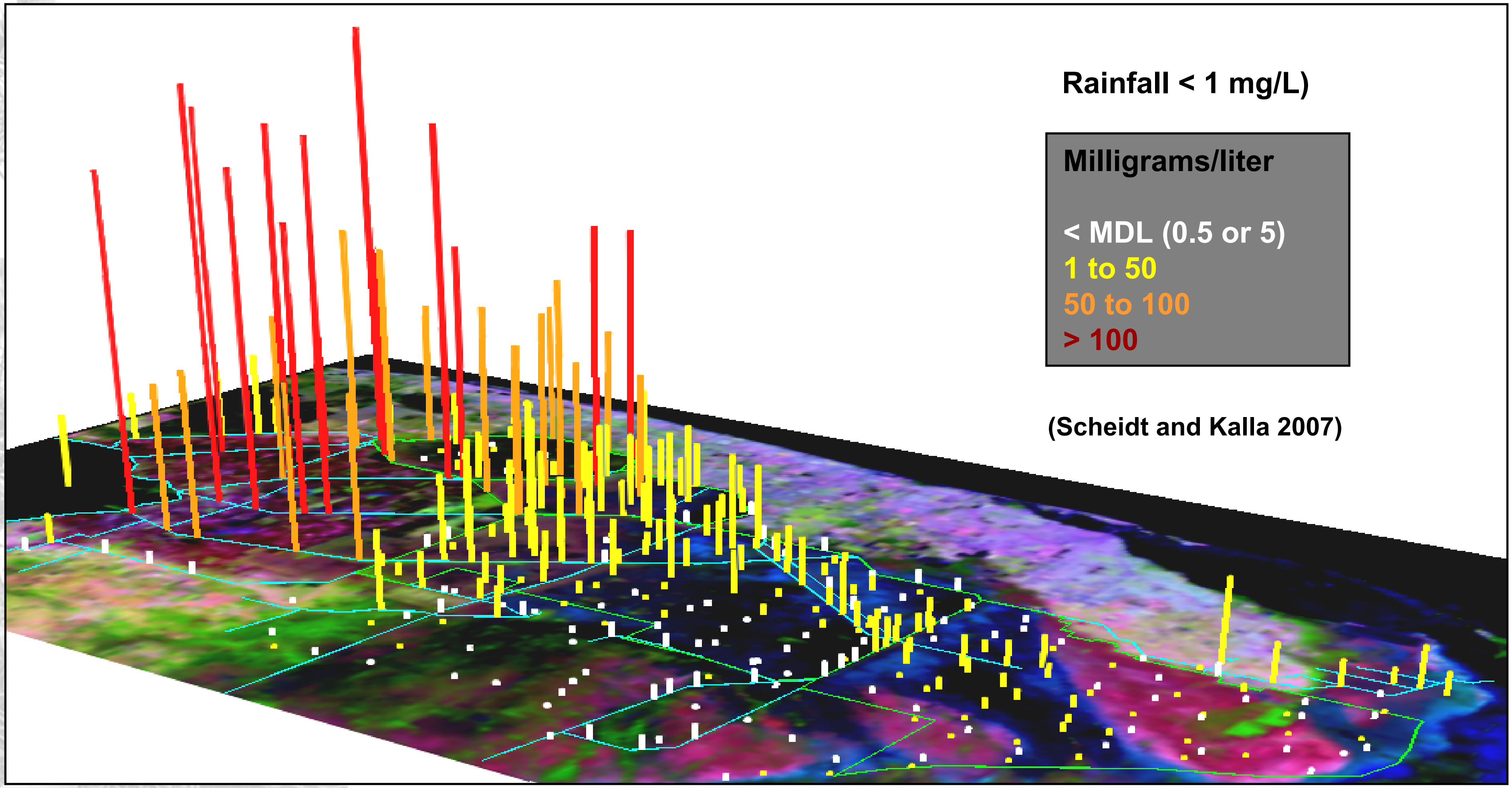
1145 distinct sample sites

~ biogeochemistry (~100,000 data values); periphyton; macrophytes; community ecology

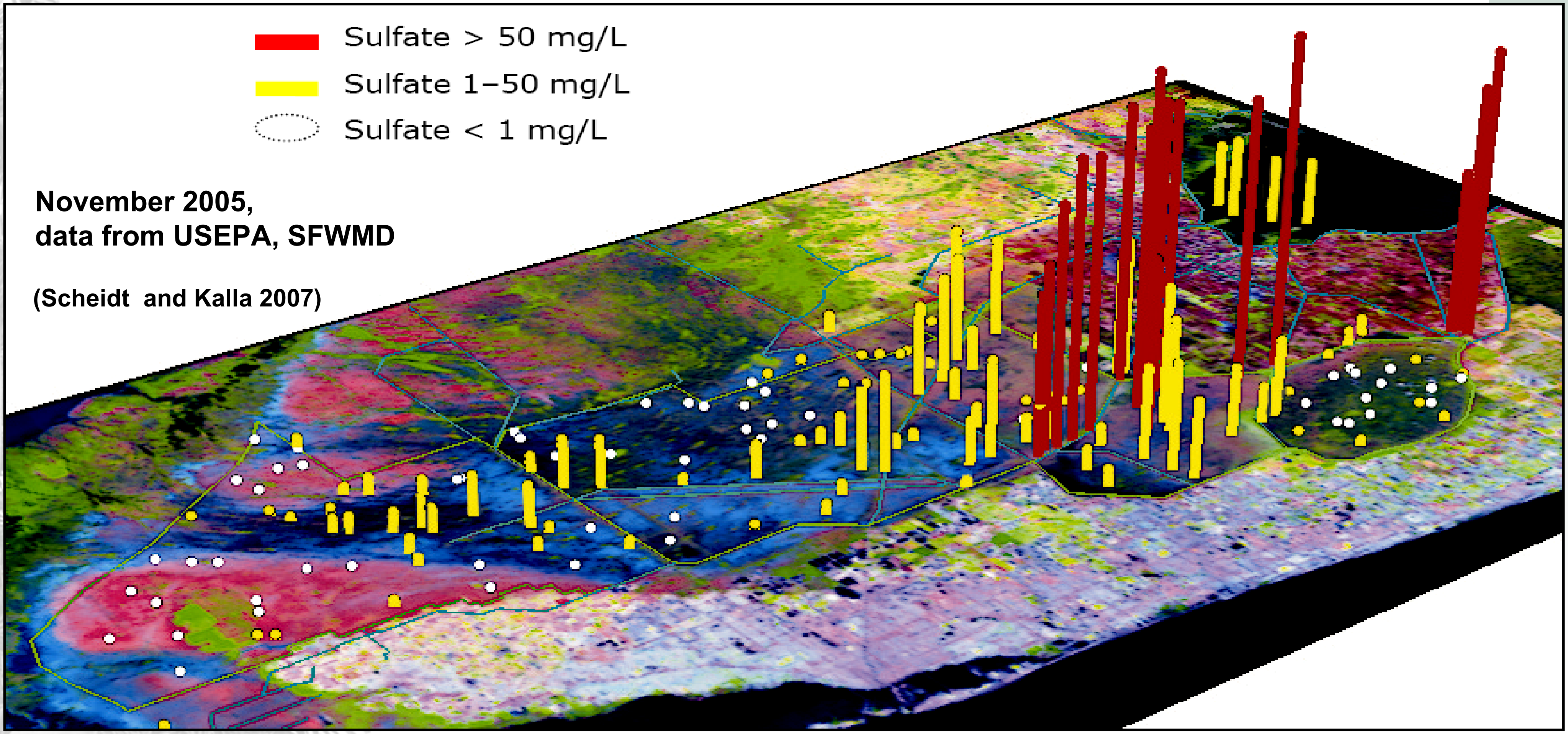
~$6M investment to date



Surface water sulfate 1993-96 wet season



Surface water sulfate 2005 wet season



R-EMAP Example Findings in the EPA

- Soil Phosphorus
  - 2005 impacted area [> 500 mg/kg Florida Code] 24.5 (± 6.4%); 1995-96 impacted area 16.3 (± 4.1%). 49% exceeded the 400 mg/kg CERP restoration goal.
  - 2005 soil TP median 390 mg/kg > 1995-96 TP median 343 mg/kg ($P < 0.05$).
- Surface water sulfate
  - 2005 57.3 ± 6.0% of EPA exceeded 1.0 mg/L CERP goal. Background < 0.2 mg/L.

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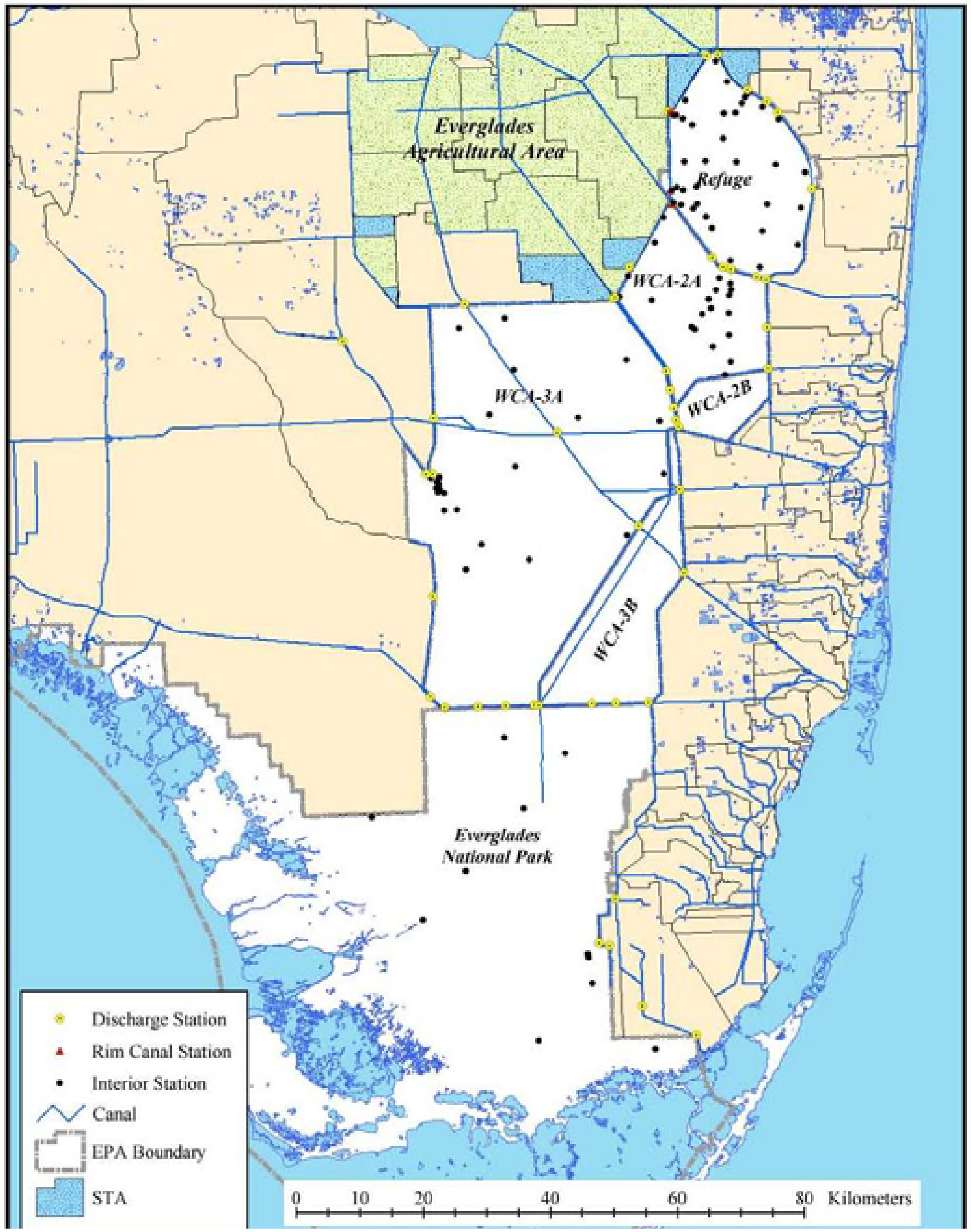
SFWMD water quality monitoring network



Source: SFWMD 2008 SFER

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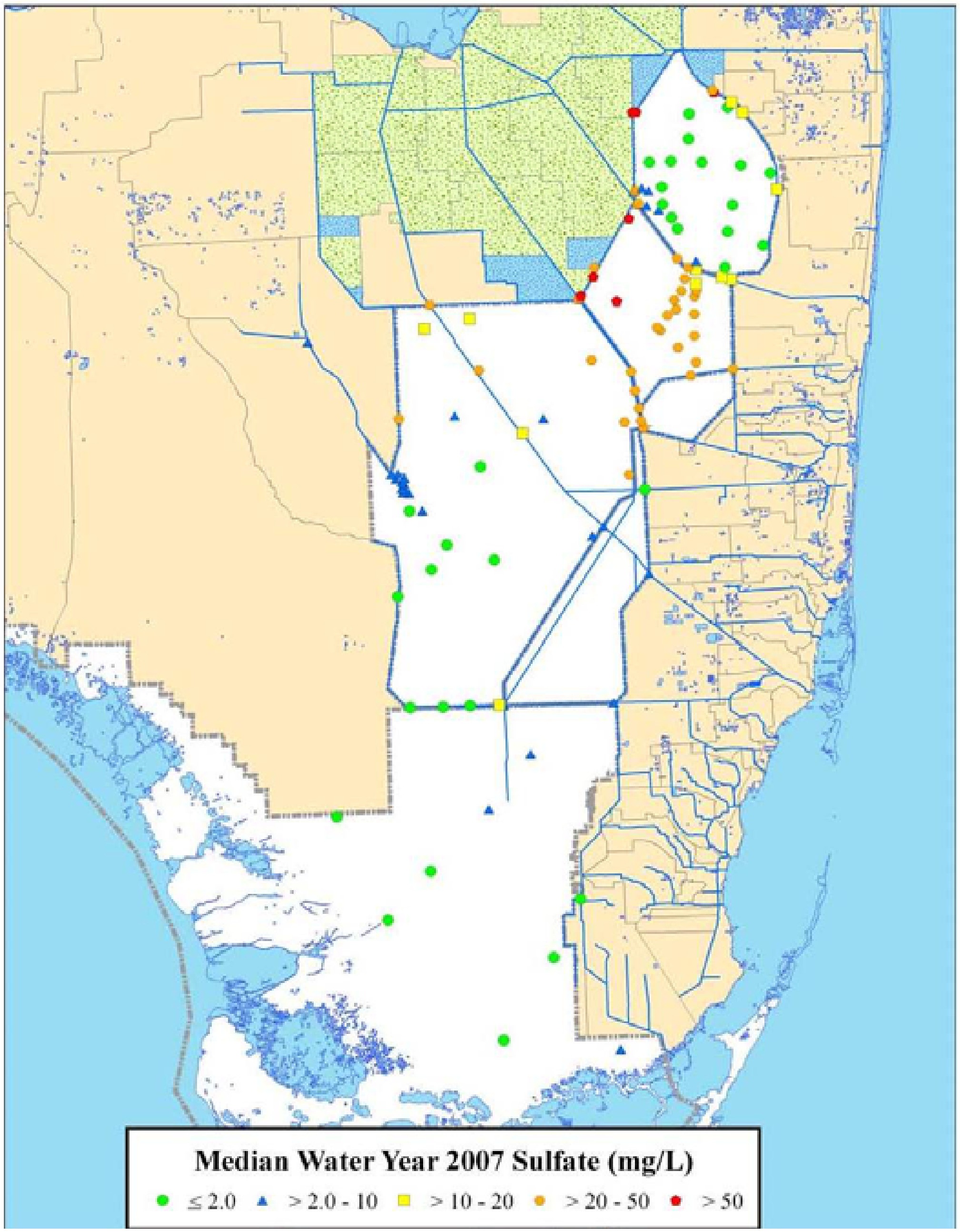
Sulfate data For WY2007



Source: SFWMD 2008 SFER

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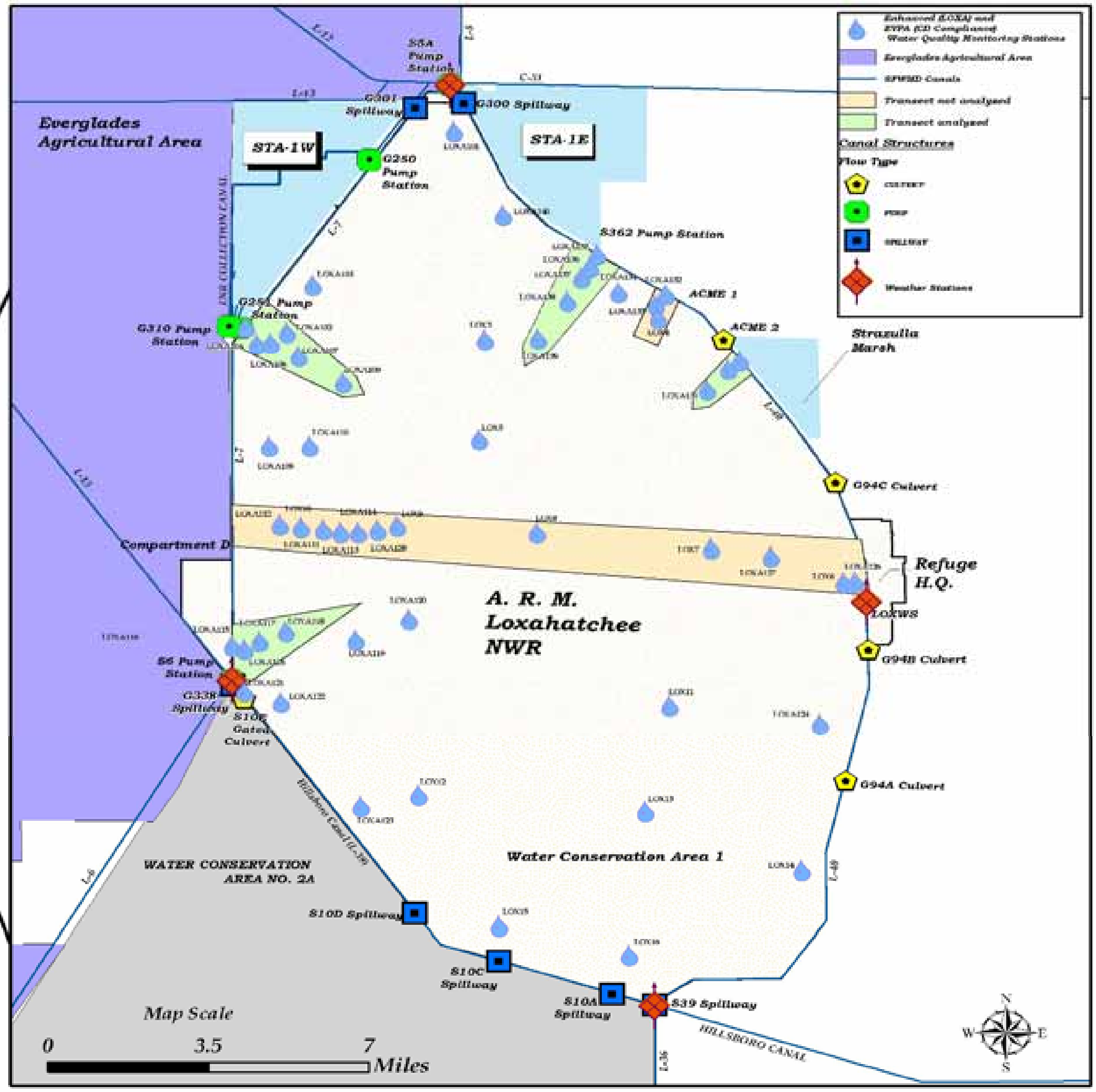
LNWR expanded water quality monitoring network



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Management Recommendations

Preliminary water management recommendations to minimize intrusion:

- Refuge inflows ≤ 5 days pulses of < 200 cfs when absolute canal/marsh stage difference is < 0.2 ft and interior water depths are < 0.5 ft
- Refuge inflow rates can be moderate (200 to 400 cfs) for short durations if marsh stage is > 0.6 ft higher than canal stage and waters depths are < 0.3 ft
- Refuge inflows should be discontinued when the canal stage is > 0.2 ft higher than marsh stage, unless the rainfall or outflow volumes are 3 to 4-times higher than the inflows.
- If Refuge inflows must be extended beyond short-duration pulses, outflow should be greater than inflow and last several days longer.
- If Refuge inflows must be maintained at high rates, the S-10s and S-39 should be opened to create outflow 3 or 4-times higher than inflow.

Modeling: Synergistic Development Using 2 Alternative Approaches

1. Simplified, spatially-aggregated, compartmental
   - Water budget for stage and flow
   - Reactive mass balance models for constituents

2. Complex, spatially explicit, 400 meter grid + 1-D Canals
   - Mike-Flood for stage and flow
   - EcoLAB for transformation modeling

MODELED VARIABLES

- Stage (flow)
- Chloride – Cl^-
  - Modeled as a conservative
- Sulfate – SO_4^{-2}
- Total phosphorus – TP

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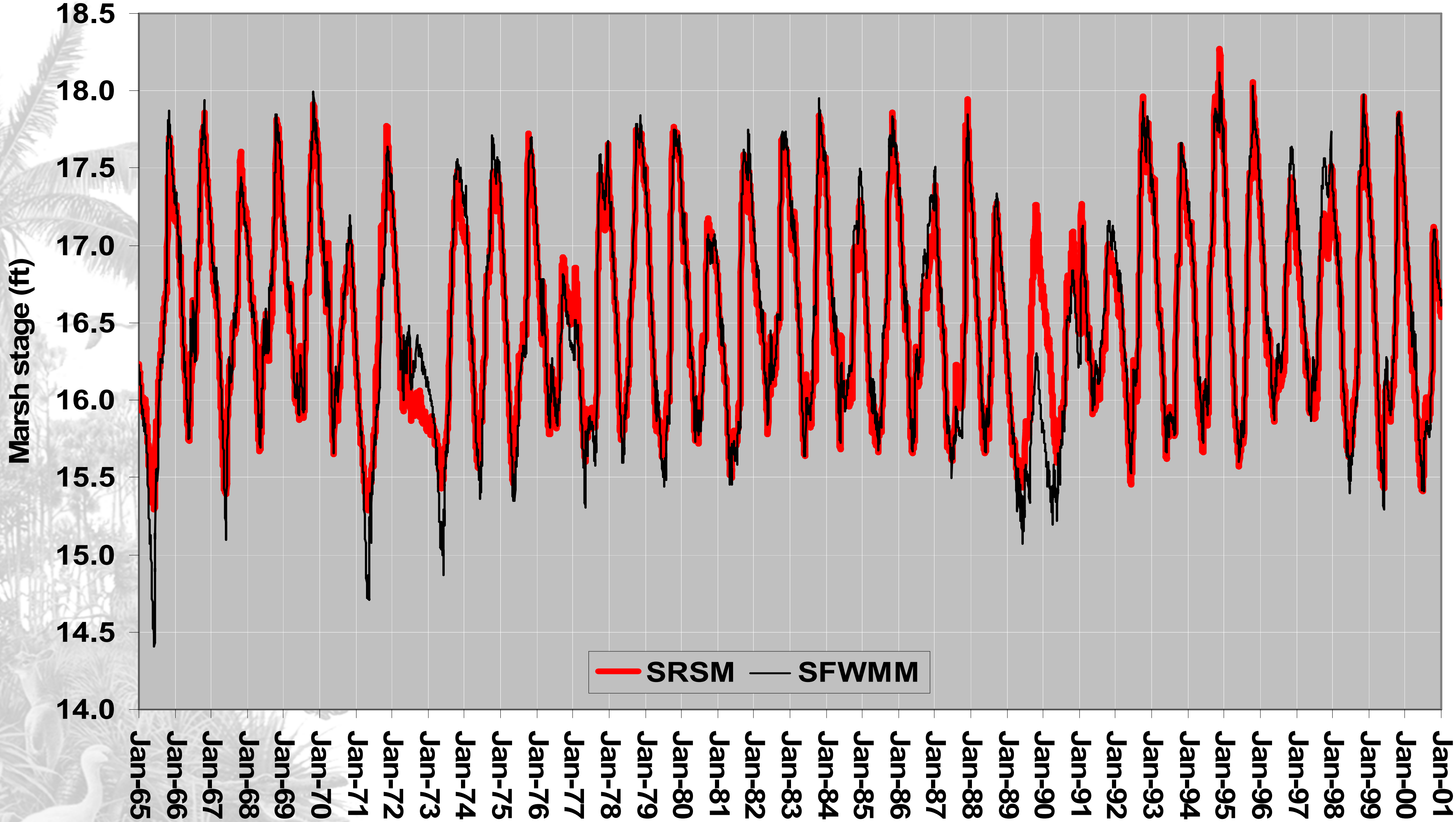
Slide courtesy of Mike Waldon, LNWR



Summary

- The success of water quality protection and restoration efforts depend heavily on an effective science/policy interface
- The extent of water quality information is both a blessing and a curse – more than for any other wetland in the world, but that provides a challenge to communicate and effectively use all that information
- This symposium will help provide a suitable framework for synthesis and integration