Long-term Water Quality Trends and BMPs in the Everglades Agricultural Area

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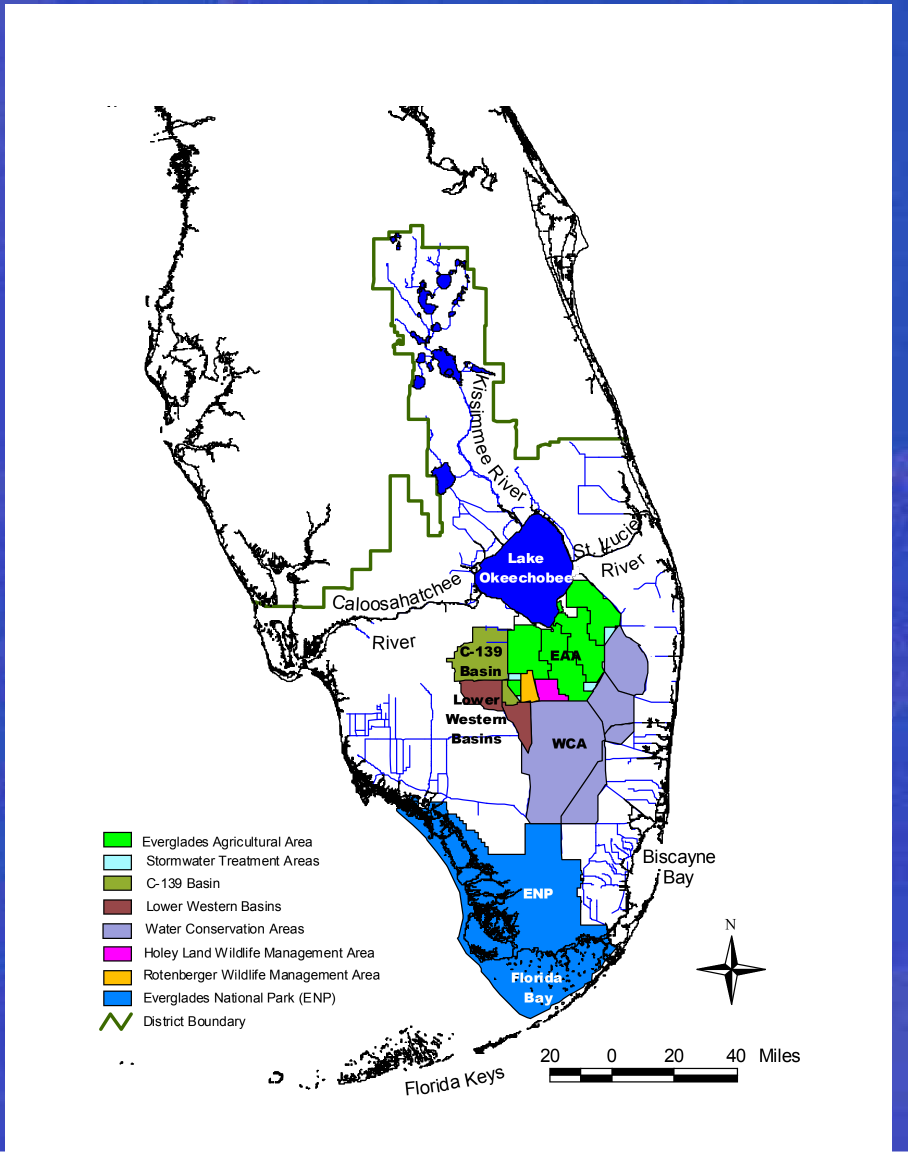
INTRODUCTION

- The Everglades Agricultural Area (EAA): 283,000 ha of highly productive land south and downstream of Lake Okeechobee



CROPS & SOILS IN THE EAA

- Sugarcane is the major crop; also vegetables, sod, and rice
- Histosol (organic soil)- predominant soil order in the EAA
- Soils were drained in the early 1900's for agricultural production
- Soil oxidation (subsidence)

FARM DRAINAGE

- All farms in the EAA are actively drained by means of pumps moving water from farm ditches and canals to SFWMD conveyance canals

EVERGLADES REGULATORY PROGRAM

- Concerns about P leaving the EAA via drainage water
- Everglades Forever Act 1994 (and 2003)
- Goal of the regulatory program is to reduce P loads out of the EAA by 25% compared to a ten year pre-BMP base period
- BMPs in place in the EAA by February 1, 1995

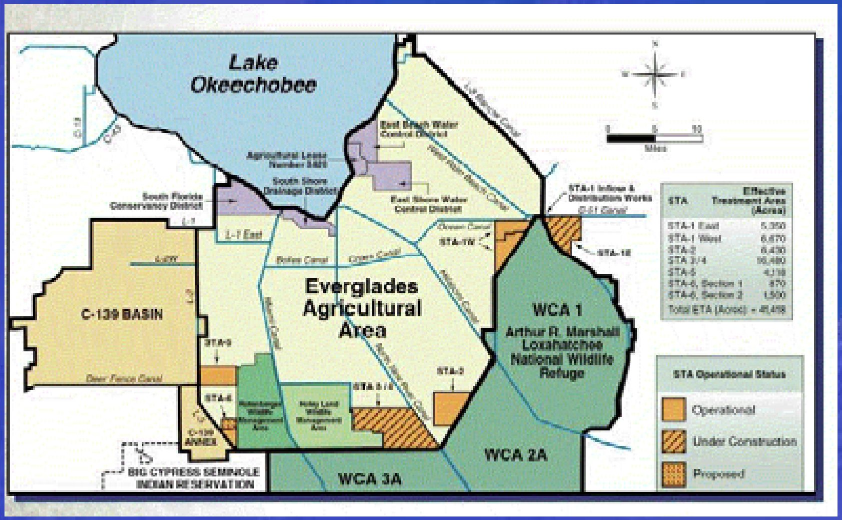
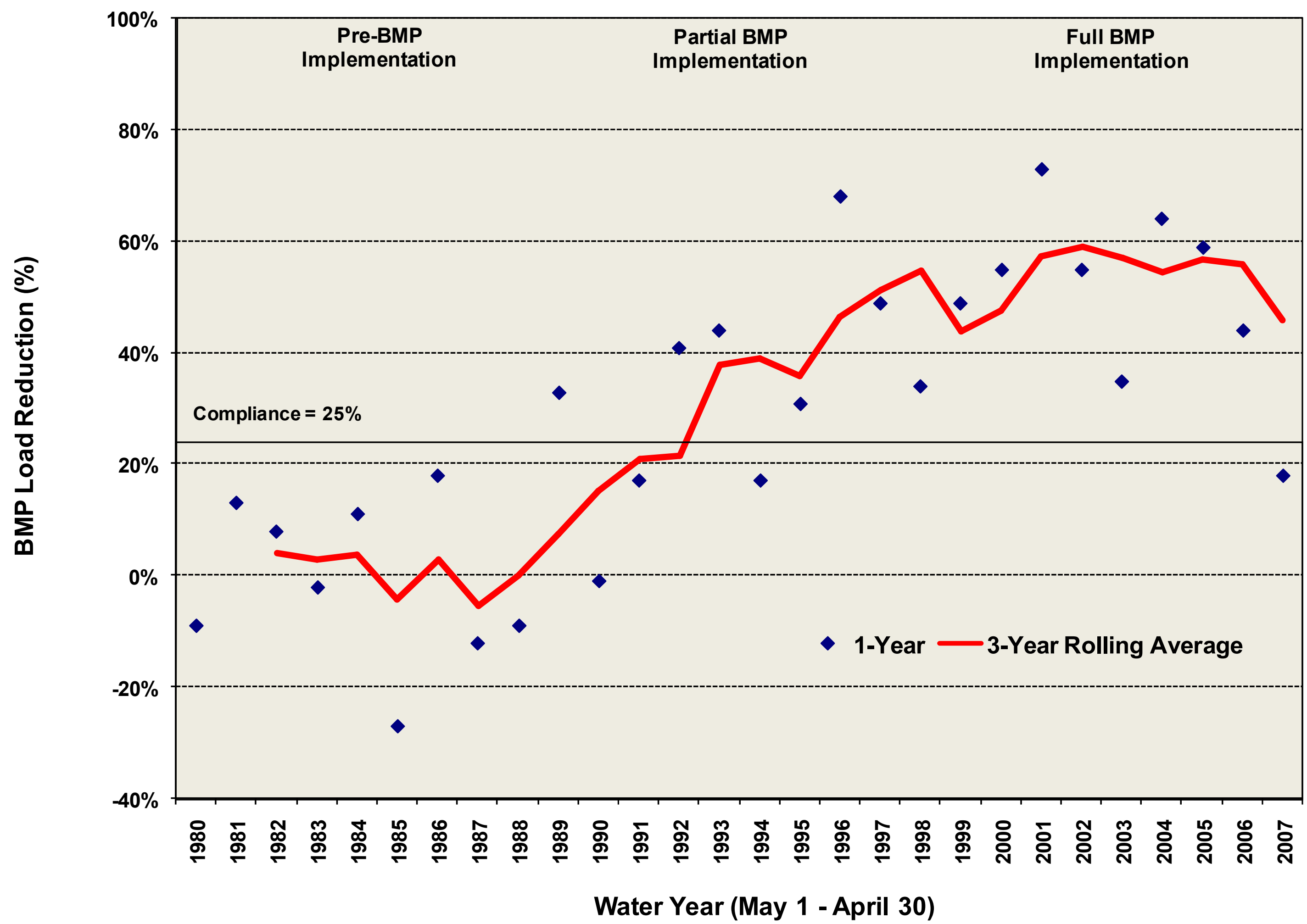


Table 3 – Best Management Practices Summary and "BMP Equivalent" Points

BMP	PTS	DESCRIPTION
WATER DETENTION ½ Inch Detained 1 Inch Detained	 5 10	• water table management by controlling levels in canals, field ditches, soil profile, fallow fields, aquatic cover crop fields, prolonged crop flood; • measured on a per event basis – rainfall vs. runoff
FERTILIZER APPLICATION CONTROL	2 ½	uniform and controlled boundary fertilizer application (e.g. direct application to plant roots by banding or side-dressing; pneumatic controlled-edge application such as AIRMAX)
FERTILIZER CONTENT CONTROLS		
Fertilizer Spill Prevention	2 ½	• formal spill prevention protocols (handling and transfer) • side-throw broadcast spreading near ditch banks
Soil Testing	5	avoid excess application by determining P levels needed
Plant Tissue Analysis	2 ½	avoid excess application by determining P levels needed
Split P Application	5	apply small P portions at various times during the growing season vs. entire application at beginning to prevent excess P from washing into canals (rarely used on cane in EAA)
Slow Release P Fertilizer	5	avoid flushing excess P from soil by using specially treated fertilizer which breaks down slowly thus releasing P to the plant over time (rarely used in EAA)
SEDIMENT CONTROLS		EACH SEDIMENT CONTROL MUST BE CONSISTENTLY IMPLEMENTED OVER THE ENTIRE ACREAGE
Any 2 Any 4 Any 6	2 ½ 5 10	• leveling fields • ditch bank berm • sediment sump in canal • strong canal cleaning program • field ditch drainage sump • slow field ditch drainage near pumps • sump upstream of drainage pump intake • cover crops • raised culvert bottoms • veg. on ditch banks • other BMP
OTHER Pasture Management	 5	reduce cattle waste nutrients in surface water runoff by "hot spot" fencing, provide watering holes, low cattle density, shade, pasture rotation, feed & supplement rotation, etc.
Improved Infrastructure	5	uniform drainage by increased on-farm control structures
Urban Xeriscape	5	lower runoff & P by using plants that require less of each
Det. Pond Littoral Zone	5	vegetative filtering area for property stormwater runoff
Other BMP Proposed	TBD	proposed by permittee and accepted by SFWMD

BMP PERFORMANCE



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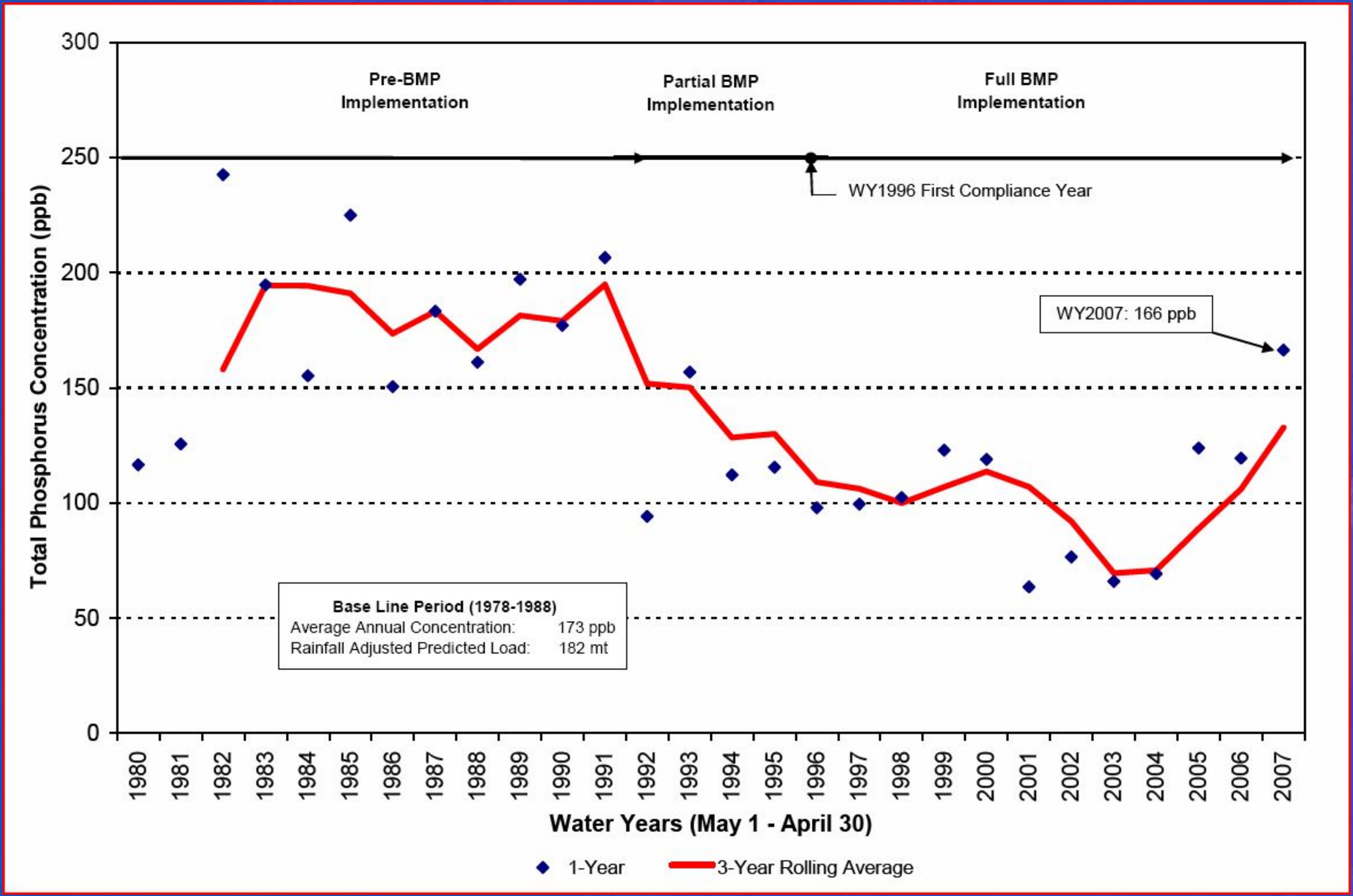
P CONCENTRATION TRENDS



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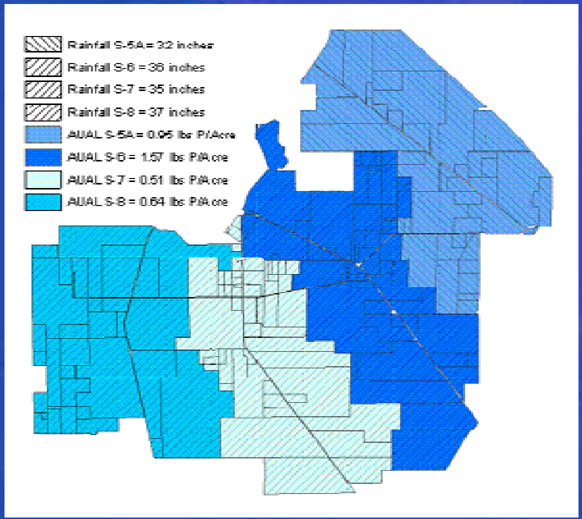
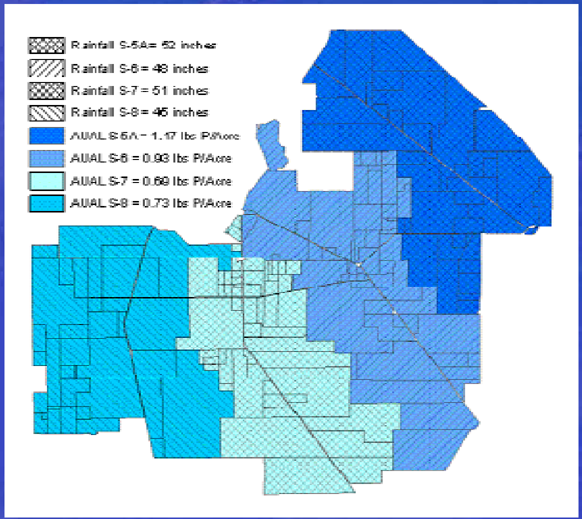
BMP PROGRAM SUCCESSFUL
P load Differences between sub-basins

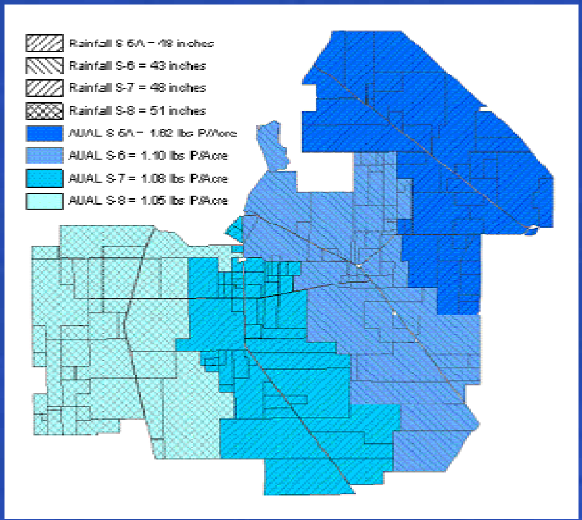
Adjusted Unit Area Loads (AUAL) Lb P/Acre



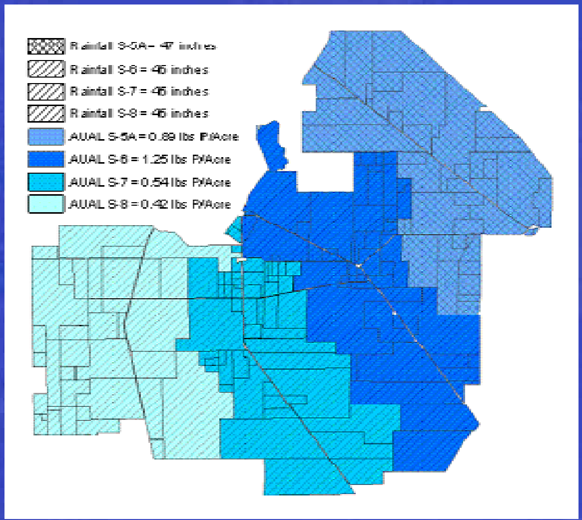
WY2001



WY2002



WY2003

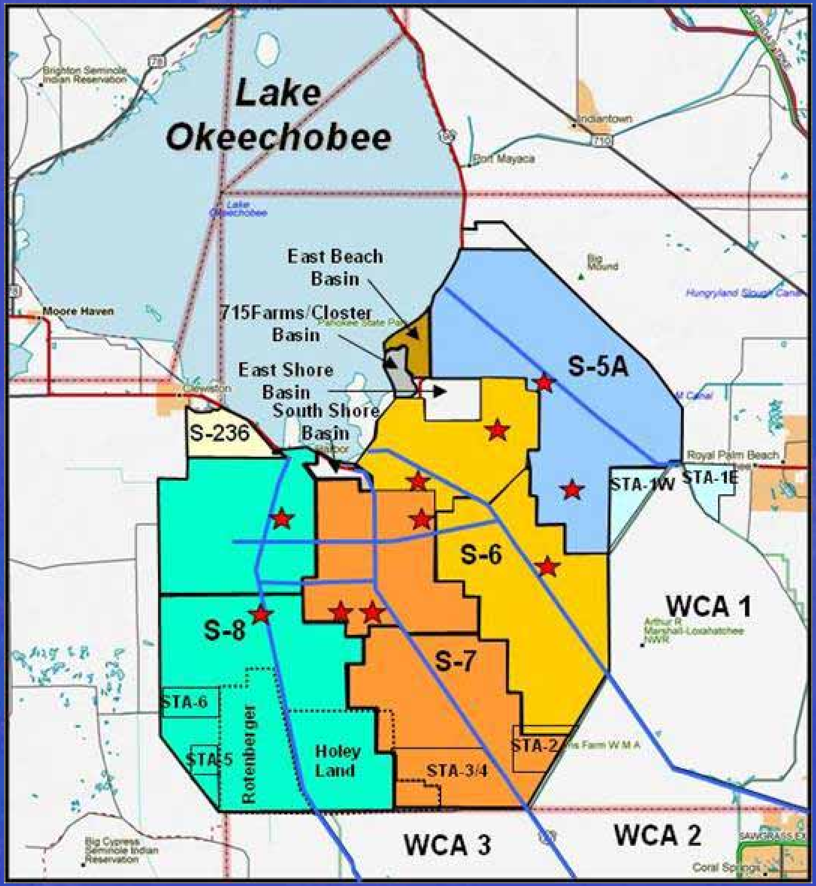


WY2004

EAA BASIN COMPLIANCE DATA

OBJECTIVES

- Water quality trends (Phosphorus) in the EAA basin, sub-basins, and selected farms.
- Factors that may be impacting the trends



WATER QUALITY TRENDS IN THE EAA

I. Data bases used

1. EAA basin compliance data base (1992-2002) & Lake Okeechobee water quality – SFWMD
2. UF/IFAS research and monitoring data (1992-2002)

II. Statistical Analysis

1. Seasonal and non-seasonal Mann-Kendall Analysis
2. Regression analysis

EAA BASIN COMPLIANCE DATA

- Current inflow and outflow points defining boundary of the EAA – monitored by SFWMD
- TP samples by automatic samples on a flow proportional basis

Trend analysis inflow & outflow FWTP (mgL^{-1}) 1992-2002

Basin†	Months	Kendall K	z-Score	z-Prob	Trend	Seasonal
			Inflow FWTP (mg L^{-1})			
S5A	105	1128	5.898	0.001	increasing	yes
S6/7	101	175	0.927	0.354	insignificant	yes
S8	117	-175	-0.783	0.434	insignificant	yes
EAA	117	692	1.628	0.104	insignificant	no
			Outflow FWTP (mg L^{-1})			
S5A	115	-1993	-4.815	0.001	decreasing	no
S6/7	115	388	0.935	0.350	insignificant	no
S8	117	-541	-2.430	0.015	decreasing	yes
EAA	117	-745	-2.120	0.034	decreasing	no
Basin†	Months	Kendall K	z-Score	z-Prob	Trend	Seasonal

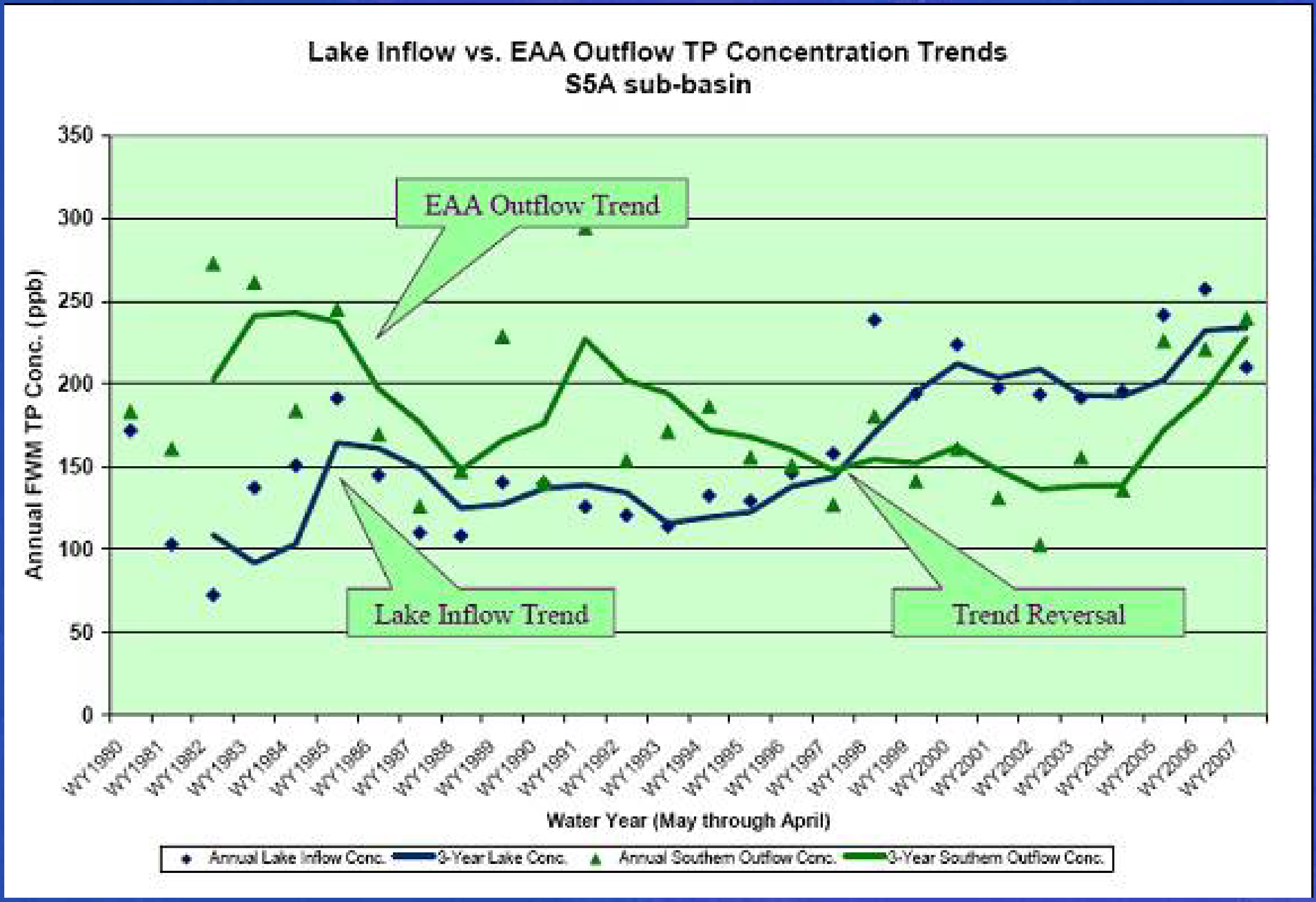
EAA BASIN COMPLIANCE DATA

TREND ANALYSIS OUTFLOW P LOADS 1992-2002

Basin†	Months	Kendall K	z-Score	z-Prob	Trend	Seasonal
			Outflow Load (Kg ha^{-1})			
S5A	117	-799	-3.592	0.001	decreasing	yes
S6/7	117	-340	-1.526	0.127	insignificant	yes
S8	117	-584	-2.624	0.009	decreasing	yes
EAA basin	117	-662	-2.975	0.003	decreasing	yes

EAA BASIN COMPLIANCE DATA

LAKE INFLOW & EAA OUTFLOW TP S5A SUB-BASIN



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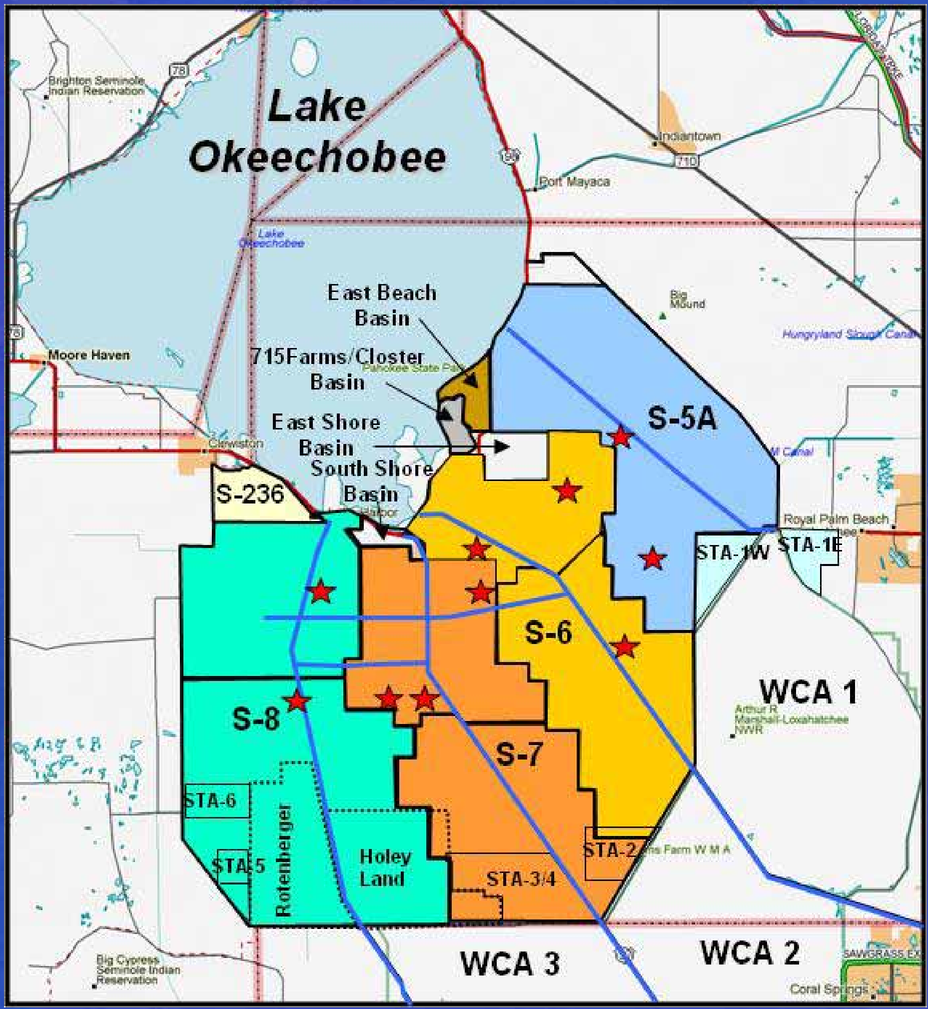
TREND ANALYSIS LAKE INFLOW TP (1992-2006)

Structure	N	Kendall K	Z Score	Z Probability	Trend	Seasonal
S6/7	268	1508	2.017	0.044	Increasing	Yes
S8	239	5946	4.813	0.001	Increasing	No
S5A	537	20033	8.938	0.001	Increasing	Yes

SFWMD DATA

UF/ IFAS DATABASE

- 10 farm BMP research data set 1992-2002
- Six farms sugarcane, four mixed crops farms
- Water quality, drainage flow, rainfall, crop maps, etc.



P LOAD TREND ANALYSIS- SUGARCANE FARMS

Site†	Months	Kendall K	z-Score	z-Prob	Trend	Season
00A	118	-587	-2.703	0.007	Decreasing	Seasonal
02A	118	-427	-2.339	0.019	Decreasing	Seasonal
03A	118	-448	-2.001	0.045	Decreasing	Seasonal
04A	118	-560	-2.629	0.009	Decreasing	Seasonal
08A	110	272	1.439	0.150	Insignificant	Seasonal
09A	118	-710	-3.174	0.002	Decreasing	Seasonal

UF/ IFAS DATABASE

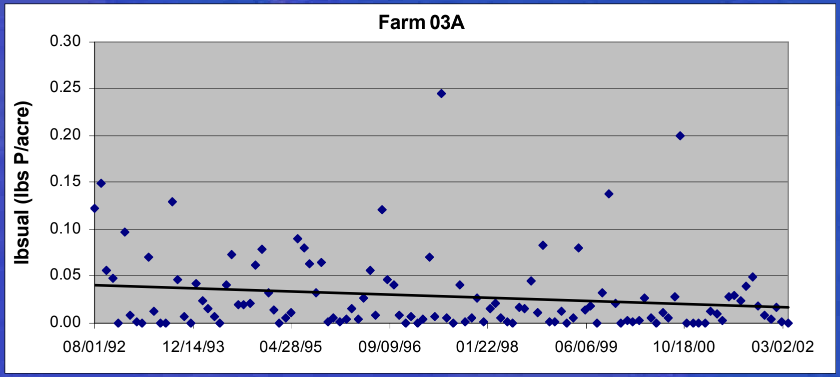
P LOAD TREND ANALYSIS-MIXED CROP FARMS

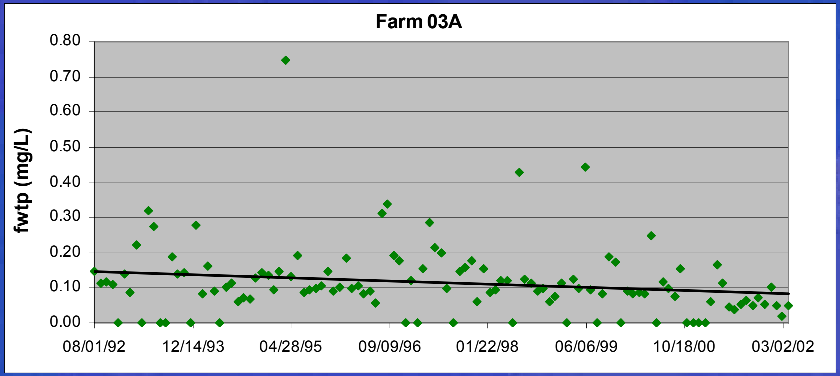
Site†	Months	Kendall K	z-Score	z-Prob	Trend	Season
01A	87	-53	-0.192	0.848	Insignificant	Non-seasonal
05A	90	-47	-0.314	0.754	Insignificant	Seasonal
06A/B	118	-447	-1.999	0.046	Decreasing	Seasonal
07A/B	118	-453	-2.051	0.040	Decreasing	Seasonal

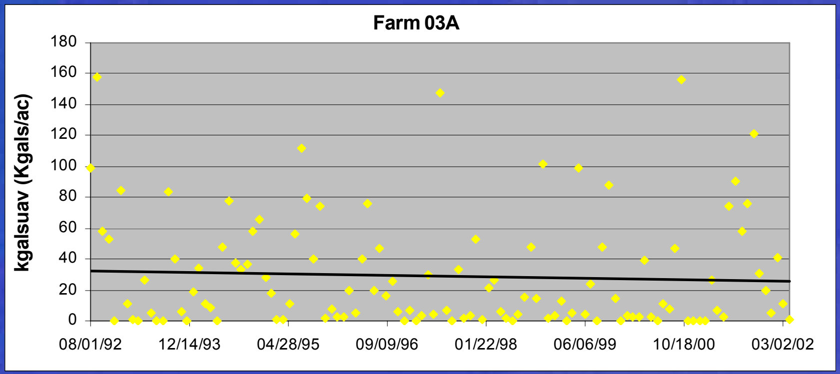
UF/ IFAS DATABASE

EX: SINGLE FARM TRENDS

<u>FARM 03A</u>
4600 acre sugarcane farm
S-7 sub-basin
1.4 foot ave soil depth
½ inch rainfall detention
1992 to 2002 period
P load decreasing
P conc. decreasing
Drainage volume same







<u>UF/ IFAS DATABASE</u>

FLOODED FALLOW FIELDS

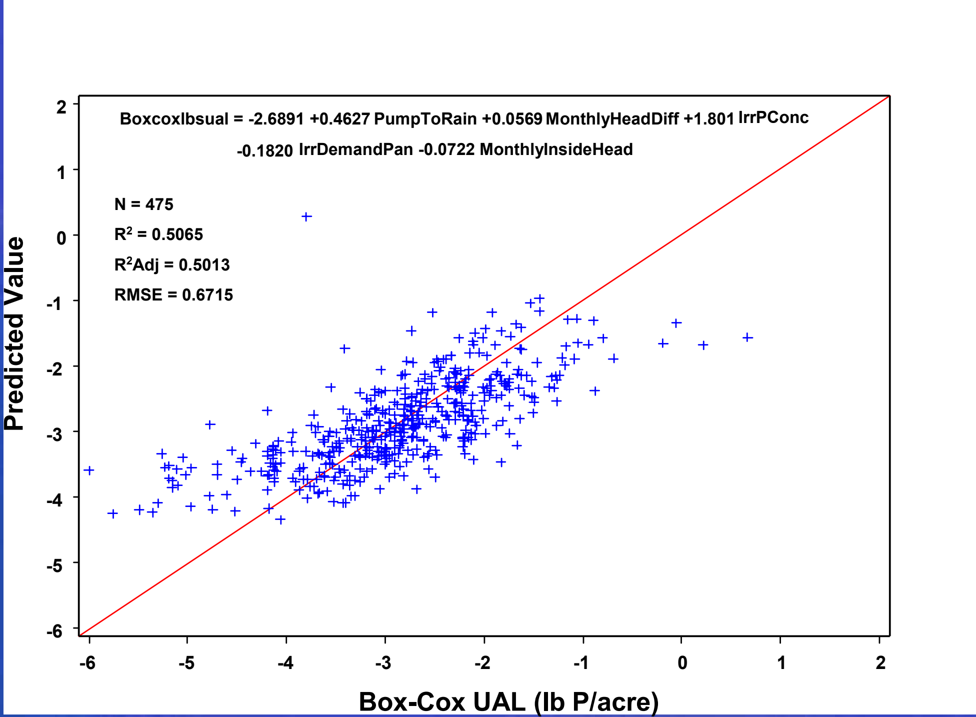
- Flooding fallow fields in summer – common practices in mixed crop farms
- Correlation between UAL and % flooded acreage.
- Effect of flooding could not be separated from other factors

FACTORS IMPACTING P LOADS

I. Water Management
   1. Pump to rainfall ratio
   2. Canal levels
   3. % flooding (mixed crop farms)
   4. Irrigation P concentration (sugarcane farms)

II. Soil depth – location

III. Percent sugarcane acreage: reduced P loads



UF/ IFAS DATABASE

CONCLUSIONS

- Long term trends are decreasing in the EAA basin
- Differences between sub basins possibly due to:
  - Differences in irrigation water quality
  - Differences in water and sediment management
  - Differences in cropping practices
  - Differences in geology – soil depth
  - ? Differences in aquatic weed management – impact of nature of sediments accreting


THANK You