

2011 CGWQMN/WUPNet Vol. VI Report

- **Analysis of sampling data collected from wells over a 13 counties in the SWFWMD over a 16-year period (1991-2007).**

Data organized by aquifers/zones in temporal groupings for statistical comparisons of chloride and sulfate trends

Spatial presentation of sites across the District with a percent increasing/decreasing (or no change) in salinity parameters

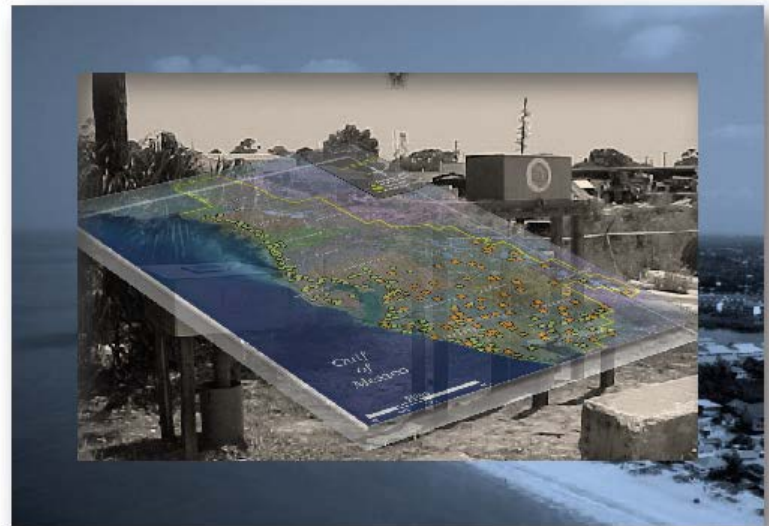
Spatial presentation of the chemical character of groundwater at monitored sites using hydrochemical facies analysis

Period of record plots of chloride and sulfate concentrations for each well, with LOWESS trend line fitted to data

- **Groundwater-quality resource monitoring and reporting , 2006 Recovery Strategy, Southern Water Use Caution Area (SWUCA)**



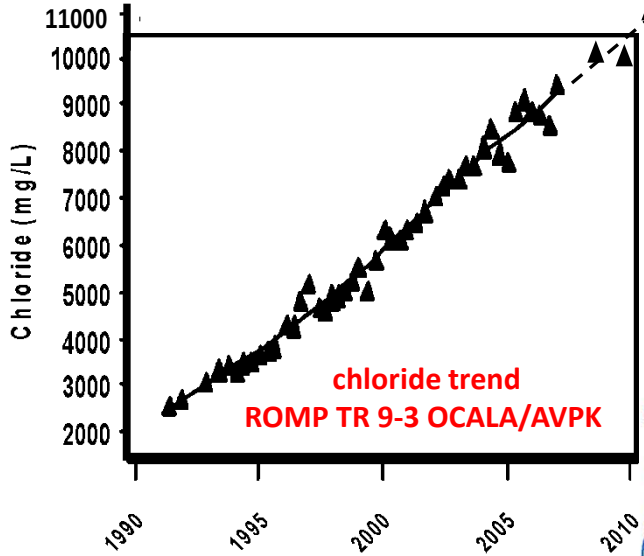
Coastal Groundwater Quality Monitoring Network/Water-Use Permit Network Report Volume VI



**Water Quality Monitoring Program
Resource Data and Restoration Department**

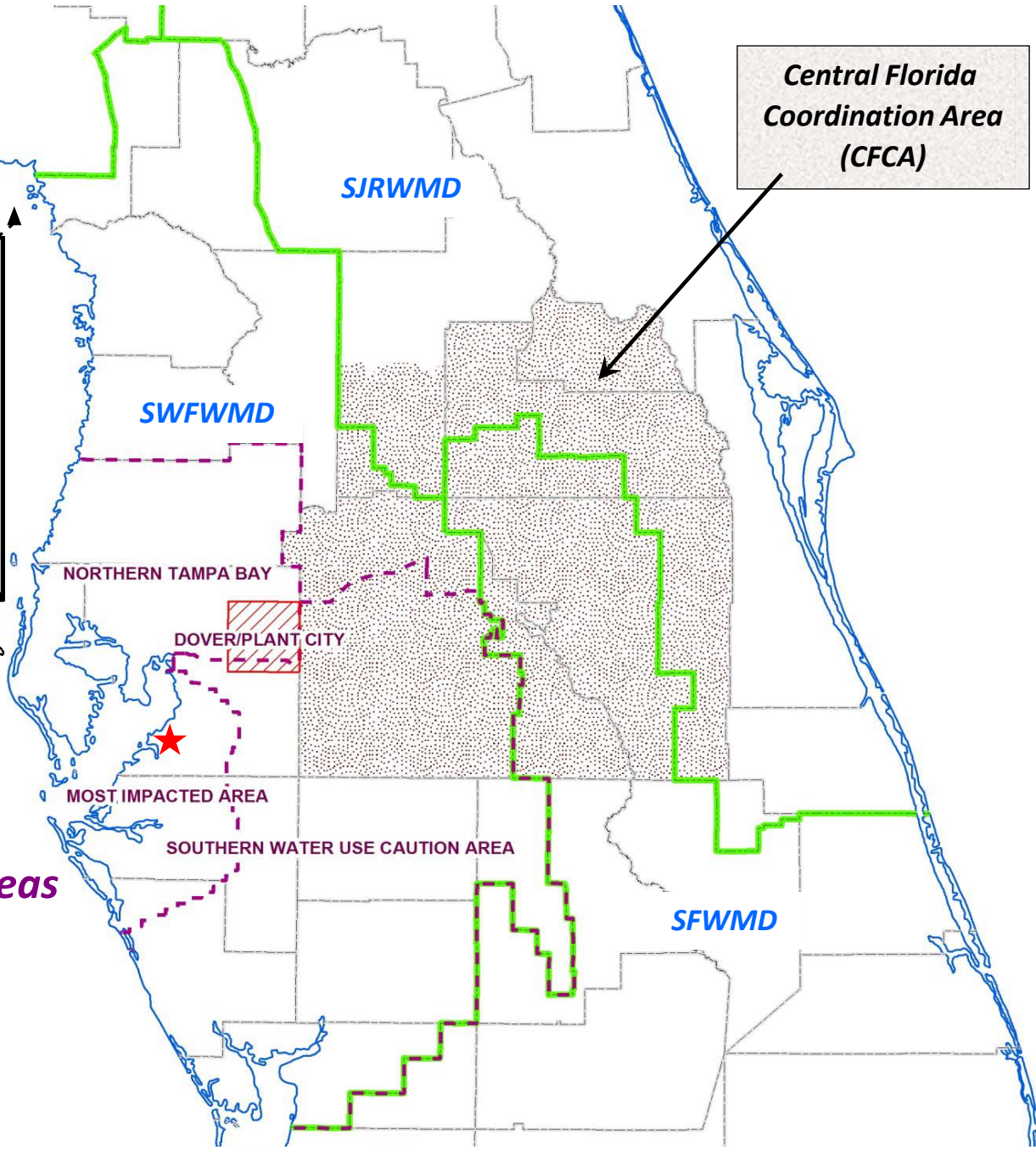
Southwest Florida Water Management District

August 2011



Central Florida
Coordination Area
(CFCA)

SWFWMD
Water Use Caution Areas



SWFWMD Coastal Groundwater Quality/Water-Use Permit Monitoring Network

- **367 wells across 13 counties**
 - 215 wells covering the coastal margin (CGWQMN)
 - 152 wells from Water Use Permit Network (WUPNet) covering the SWUCA
- **Upper Floridan aquifer and intermediate aquifers of the Hawthorn Group**
- **sampled one time per year (Full Network) or 3 times/yr (Sub-network)**

Data analysis and presentation

- **Evaluate trends in groundwater-quality with respect to salinity (Cl , SO_4 , $\text{Cl}:\text{SO}_4$)**
 - **Wilcoxon Rank-Sum test on temporal groupings of data (p-value 0.05)**
 - **scatterplots with LOWESS smooths for qualitative purposes**

Distribution of monitoring wells

- 215 wells in the CGWQMN
- 152 wells in the WUPNet
(Southern Water Use Caution Area)

Distribution by aquifer

249 wells, Upper Floridan aquifer

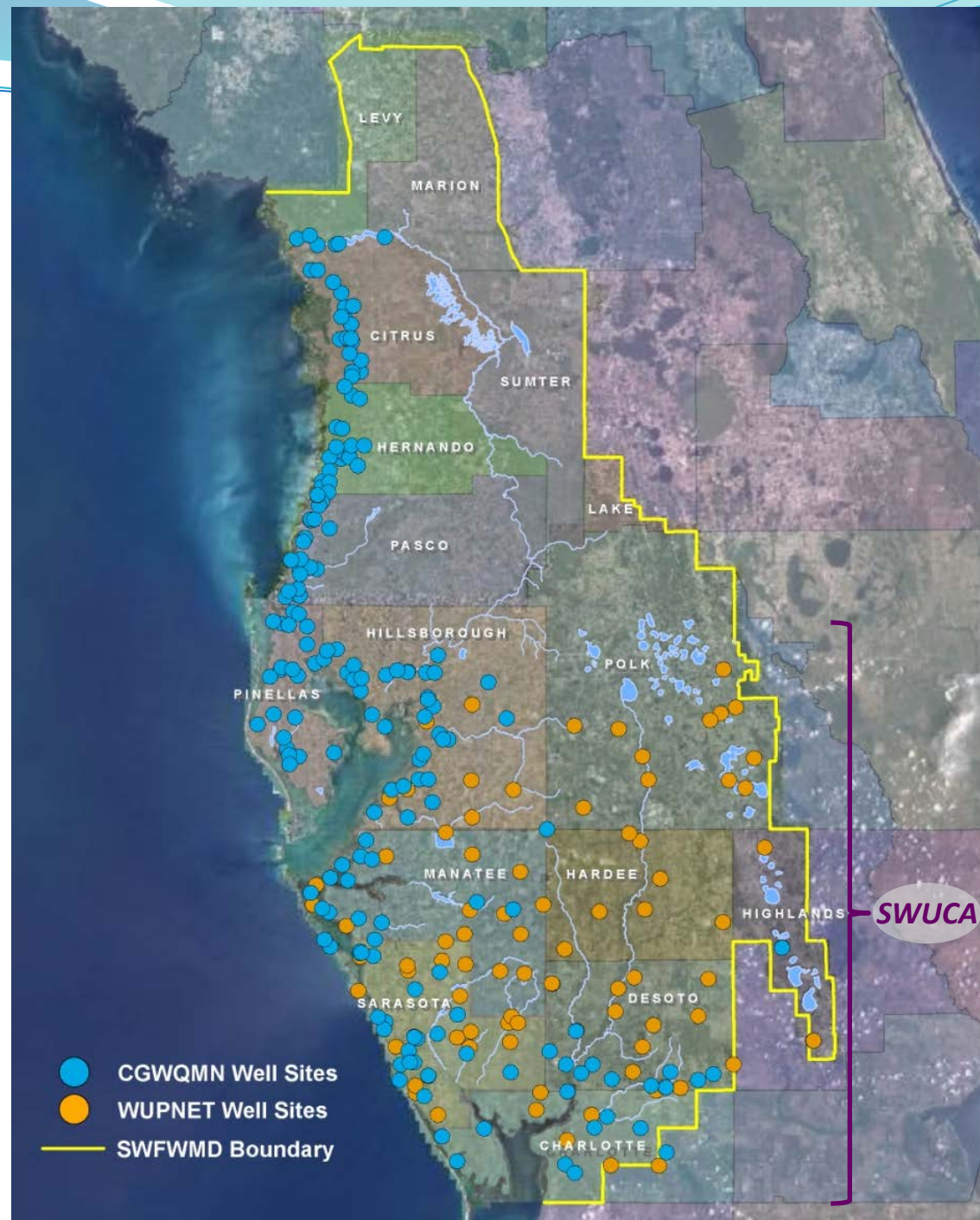
- 139 Tampa/Suwannee wells
- 110 Ocala/Avon Park wells

106 wells, intermediate aquifers

12 surficial aquifer wells *

2 Lower Floridan aquifer wells *

* not included in statistical analysis



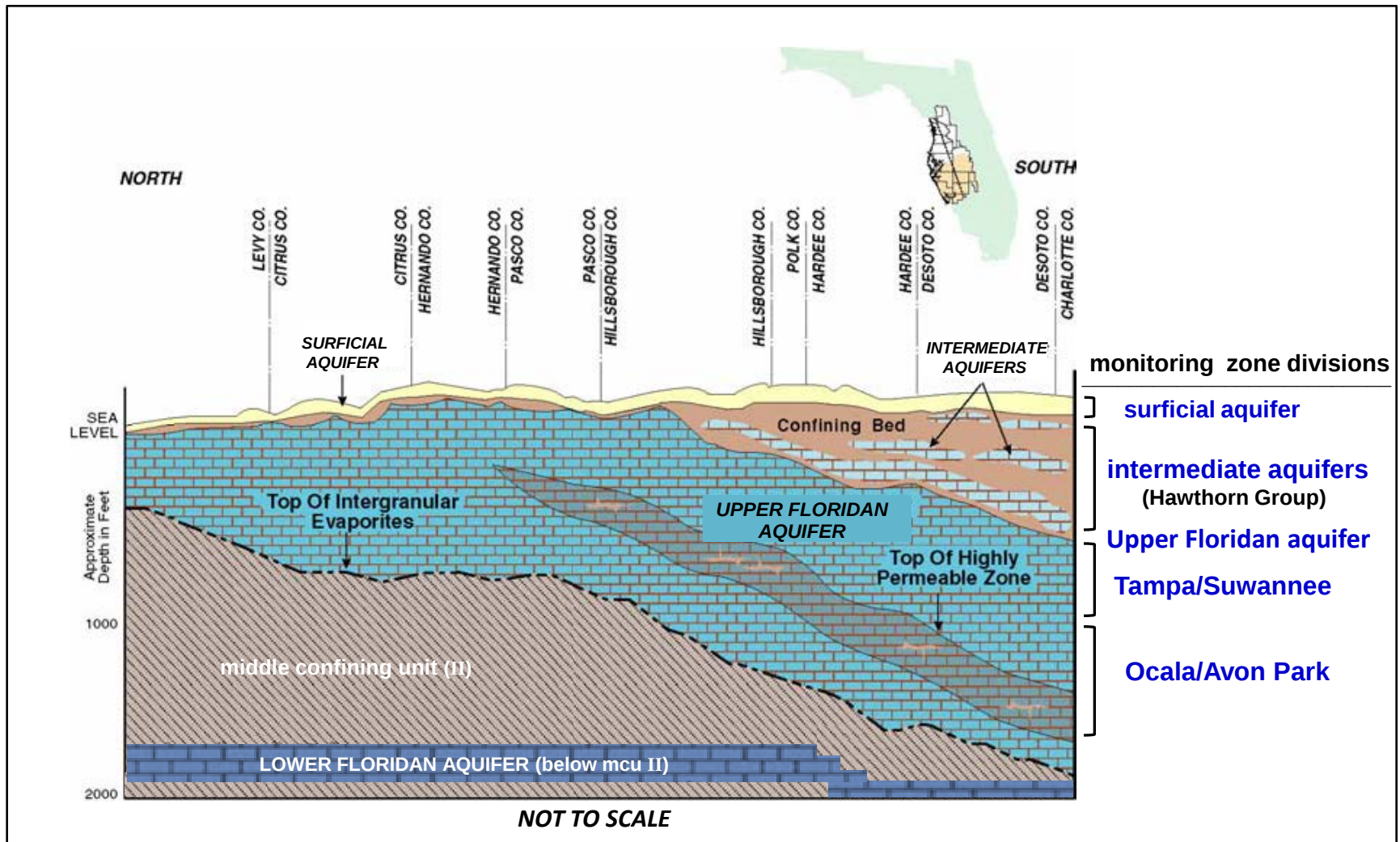


Diagram showing aquifers and monitoring zone divisions used in well groupings

Data analysis for the CGWMN/WUPNet Report Vo. VI

- General period of record, 1991 - 2007 (WUPNet data record, 2000 - 2007)
- Data partitioned into four 2-year temporal groups, and two 7-year groups

Table 14. Two year temporal groups

Temporal Group	Begin Date	End Date
A (Baseline)	April 20, 1993	April 19, 1995
B (last 2 years from previous report)	April 20, 2001	April 19, 2003
C	April 20, 2003	April 19, 2005
D	April 20, 2005	April 19, 2007

Table 15. Seven year temporal groups

Temporal Group	Begin Date	End Date
E	April 20, 1993	April 19, 2000
F	April 20, 2000	April 19, 2007

Statistical analyses using Wilcoxon Rank-Sum test: A → C, A → D
(done for each aquifer or monitored zone)

B → C

C → D

E → F

Table 16. Percentage of wells that demonstrate significantly increasing or decreasing trends...

Aquifer/Formation Group	Direction of Trend	Group A vs. Group C (4/20/1993-4/19/1995 vs. 4/20/2003-4/19/2005)				Group A vs. Group D (4/20/1993-4/19/1995 vs. 4/20/2005-4/19/2007)			
		Total # of wells	Chloride	Sulfate	Cl/SO ₄	Total # of wells	Chloride	Sulfate	Cl/SO ₄
Intermediate Aquifers	Increasing Trend	21	29%	14%	19%	20	20%	15%	25%
	Decreasing Trend		10%	19%	14%		5%	40%	10%
Tampa/Suwannee zone	Increasing Trend	37	30%	22%	16%	37	27%	19%	27%
	Decreasing Trend		14%	5%	19%		16%	14%	27%
Ocala/Avon Park zone	Increasing Trend	32	50%	28%	50%	32	50%	25%	50%
	Decreasing Trend		3%	3%	3%		3%	6%	3%

Aquifer/Formation Group	Direction of Trend	Group B vs. Group C (4/20/2001-4/19/2003 vs. 4/20/2003-4/19/2005)				Group C vs. Group D (4/20/2003-4/19/2005 vs. 4/20/2005-4/19/2007)				Group E vs. Group F (4/20/1993-4/19/2000 vs. 4/20/2000-4/19/2007)			
		Total # of wells	Chloride	Sulfate	Cl/SO ₄	Total # of wells	Chloride	Sulfate	Cl/SO ₄	Total # of wells	Chloride	Sulfate	Cl/SO ₄
Intermediate Aquifers	Increasing Trend	72	10%	10%	6%	68	9%	4%	16%	60	22%	15%	17%
	Decreasing Trend		14%	7%	10%		6%	13%	3%		23%	23%	18%
Tampa/Suwannee zone	Increasing Trend	71	10%	18%	1%	72	8%	7%	15%	103	26%	16%	22%
	Decreasing Trend		11%	3%	17%		8%	14%	4%		17%	17%	15%
Ocala/Avon Park zone	Increasing Trend	55	20%	15%	16%	60	25%	3%	35%	89	40%	25%	36%
	Decreasing Trend		9%	5%	11%		3%	13%	3%		4%	10%	6%

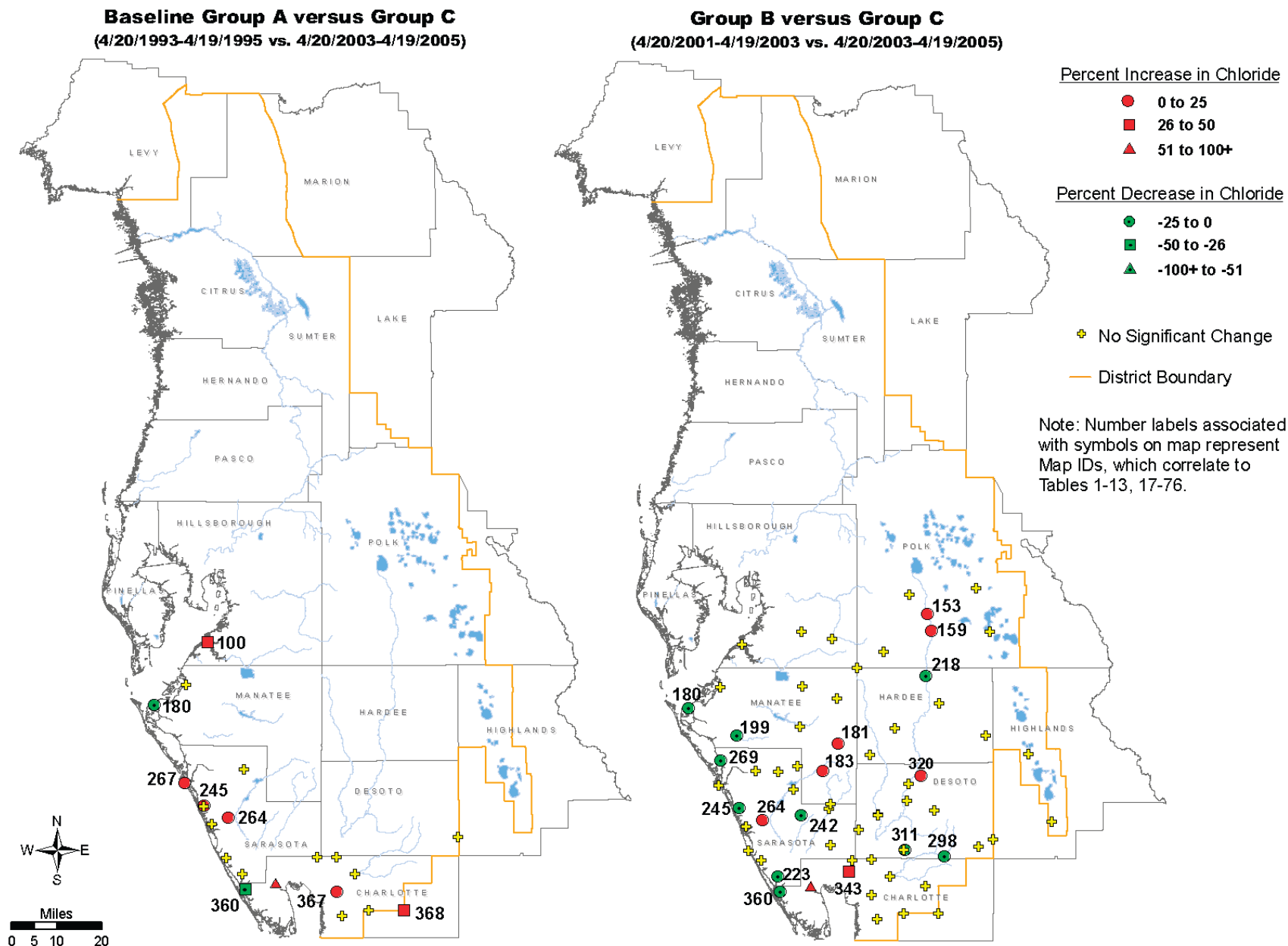


Figure 20. Chloride trends in the intermediate aquifers (Baseline Group A vs. Group C and Group B vs. Group C)

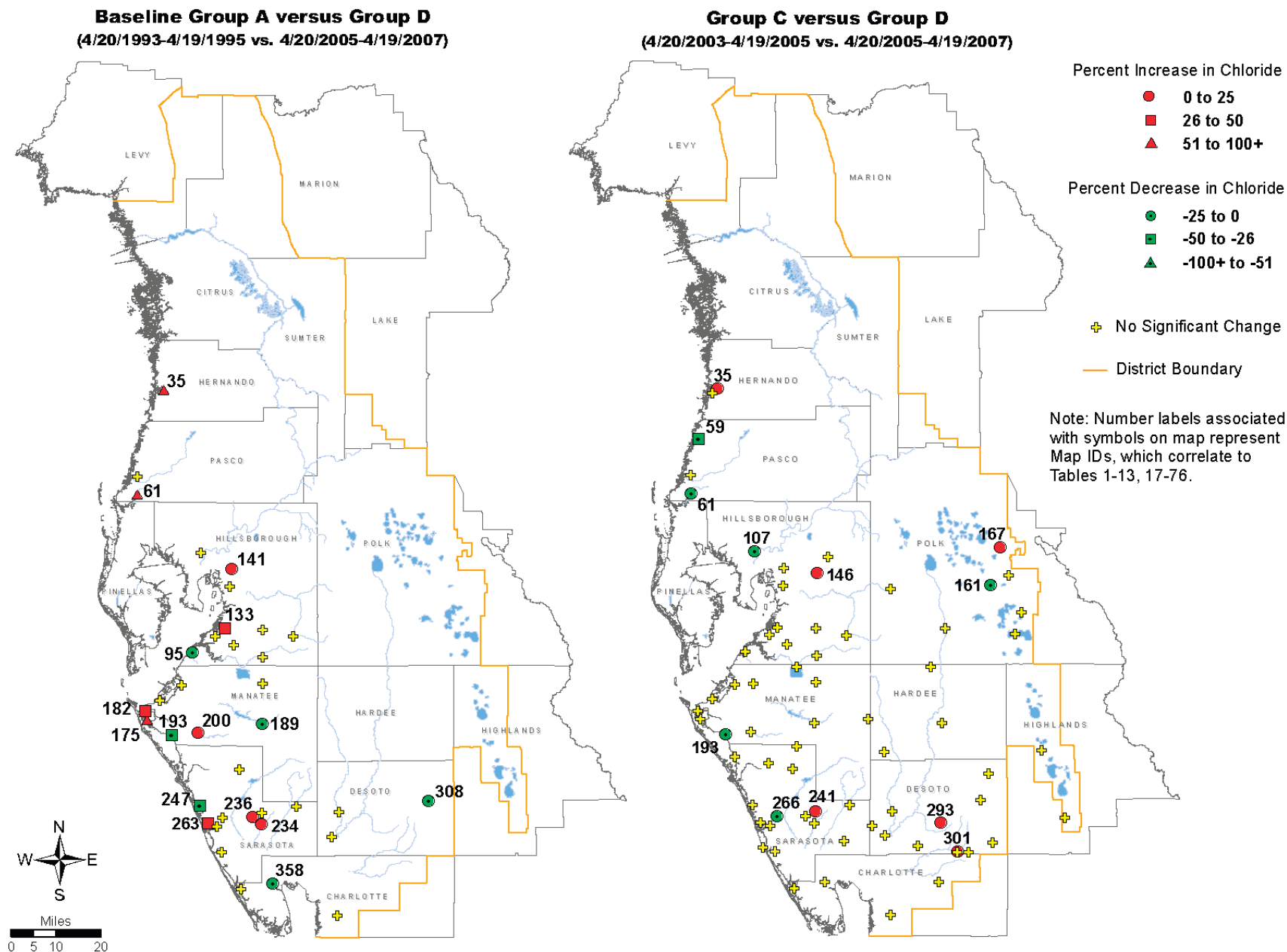
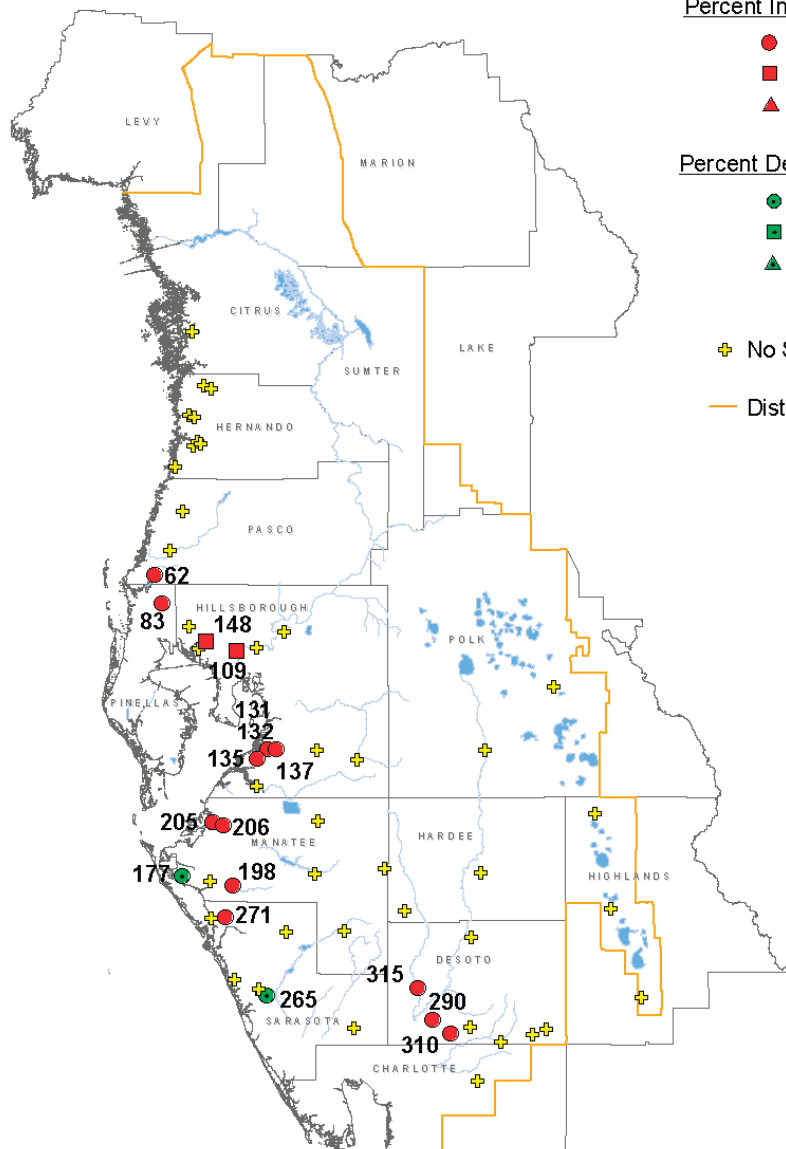


Figure 30. Chloride trends in the Tampa/Suwannee zone (Baseline Group A vs. Group D and Group C vs. Group D)

Group C versus Group D

(4/20/2003-4/19/2005 vs. 4/20/2005-4/19/2007)



Percent Increase in Chloride

- 0 to 25
- 26 to 50
- ▲ 51 to 100+

Percent Decrease in Chloride

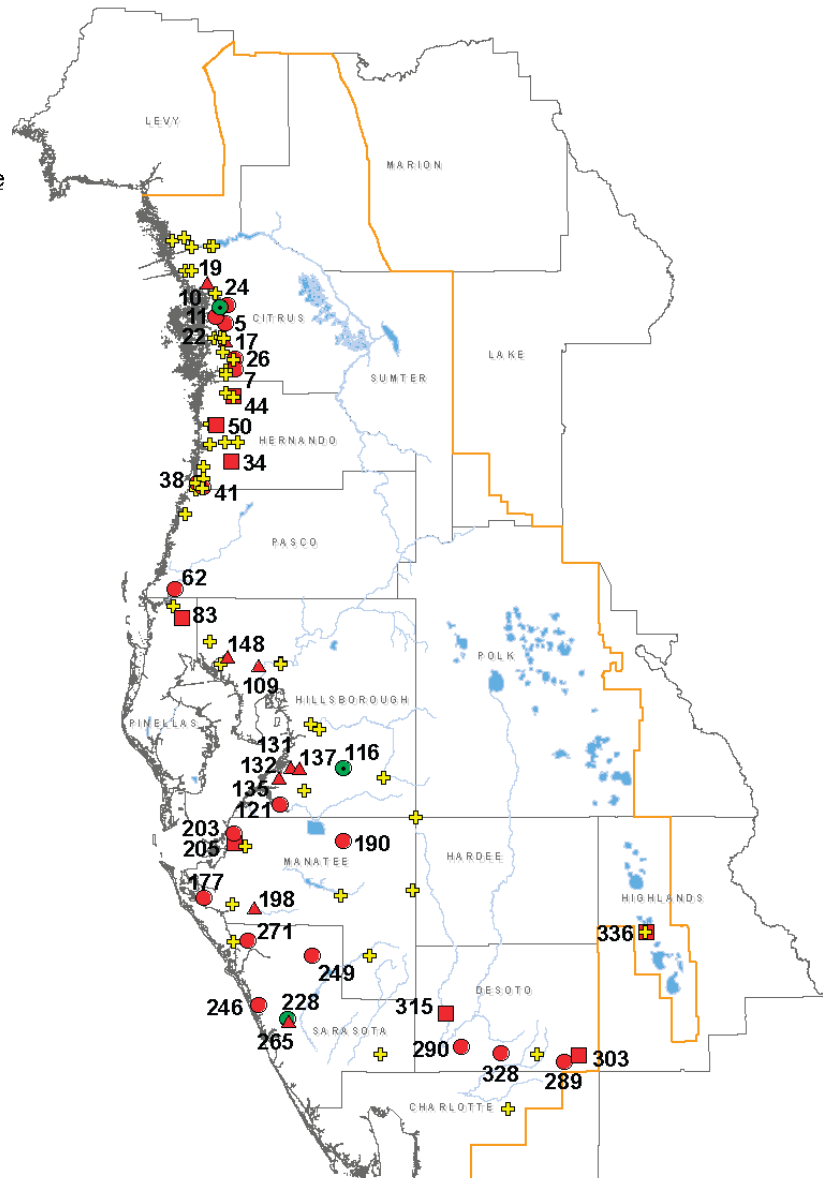
- -25 to 0
- -50 to -26
- ▲ -100+ to -51

+ No Significant Change

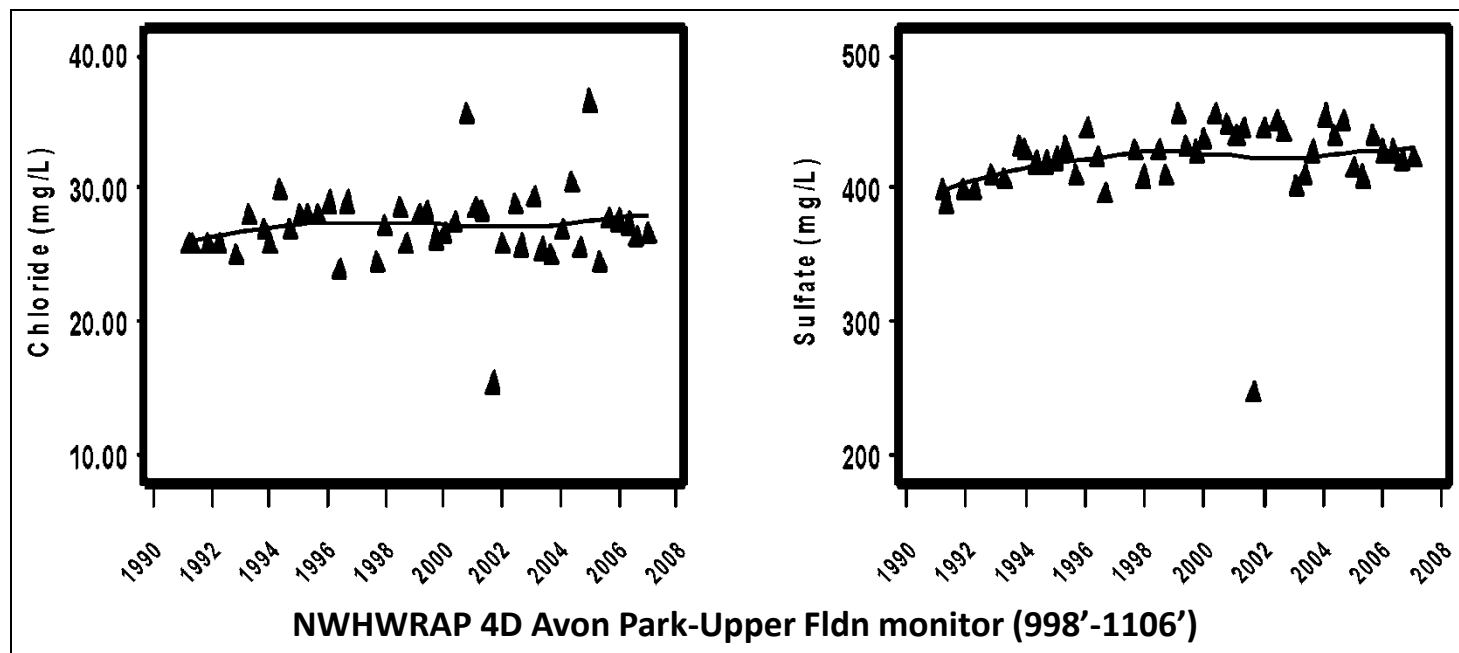
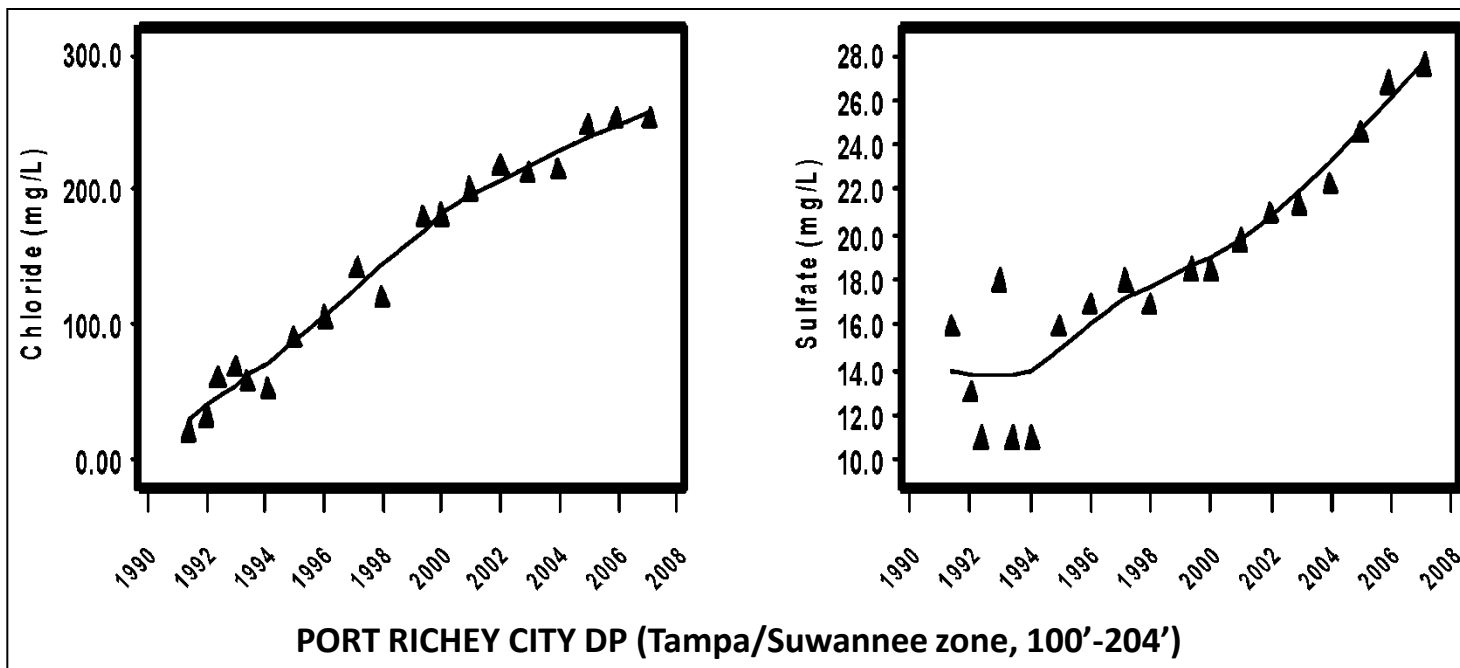
— District Boundary

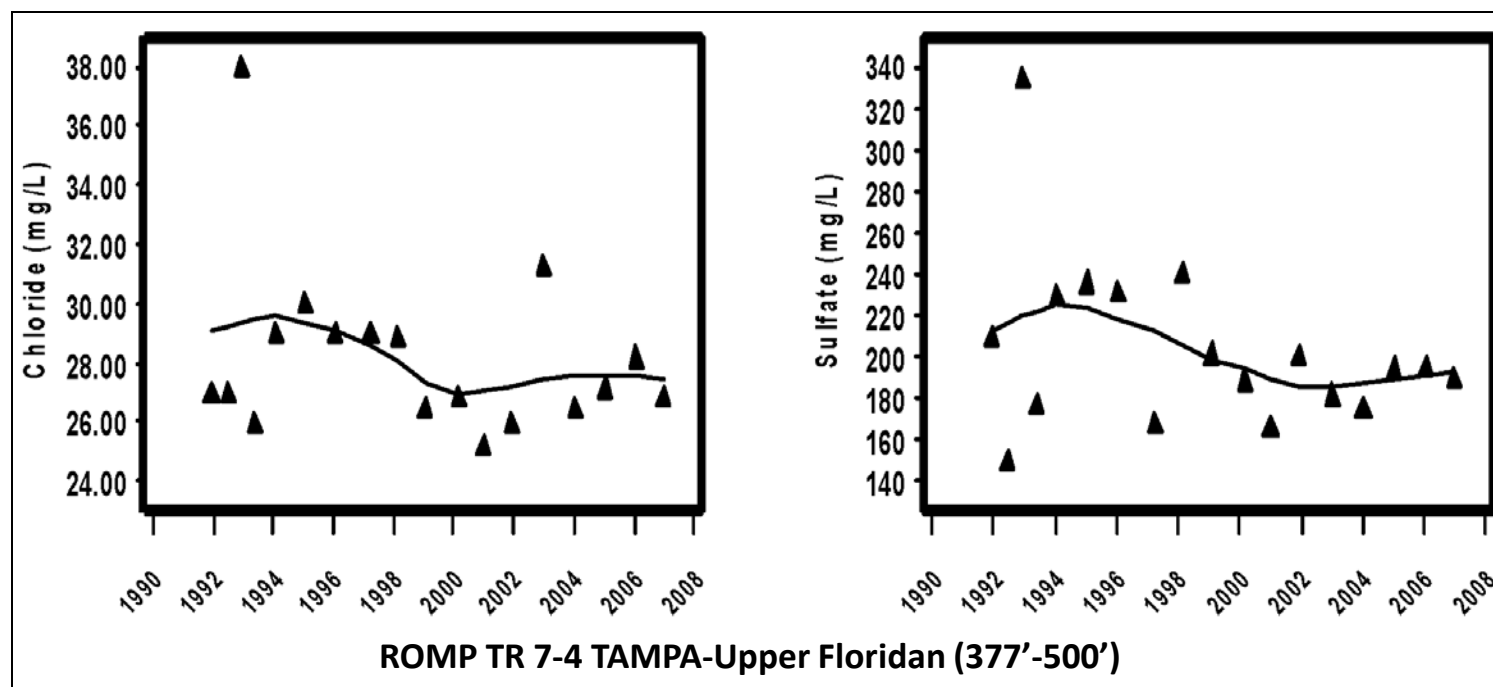
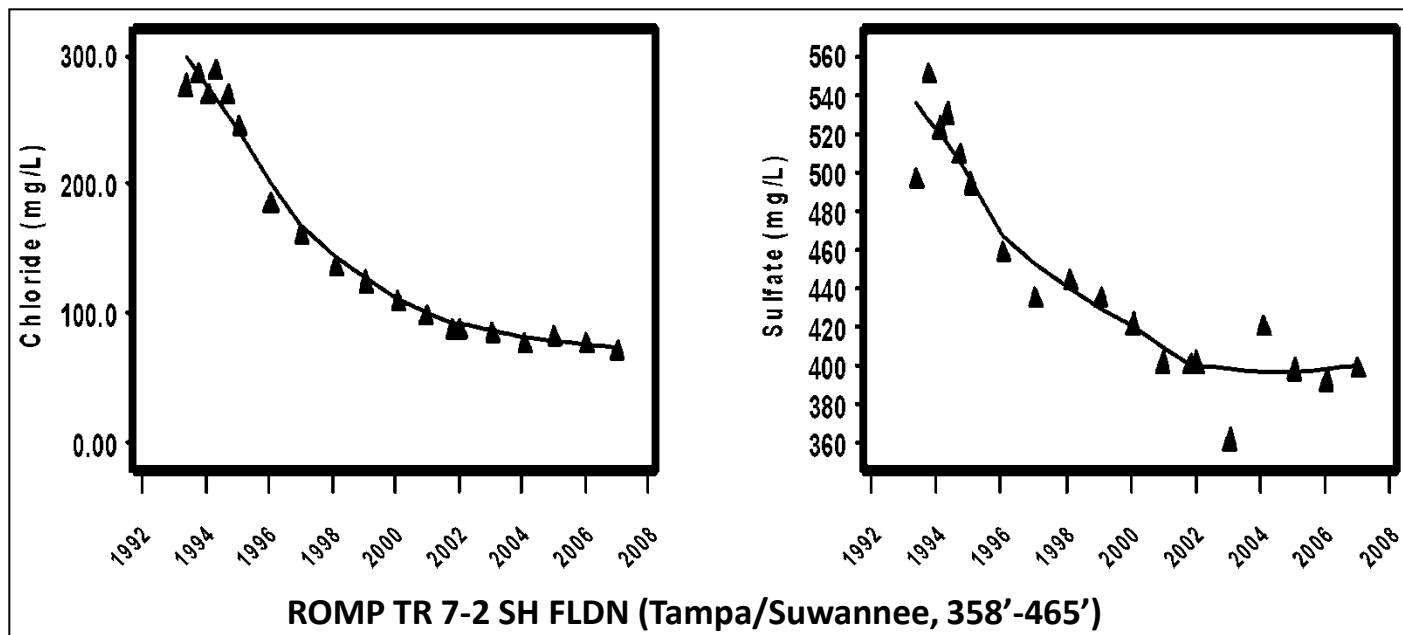
Group E versus Group F

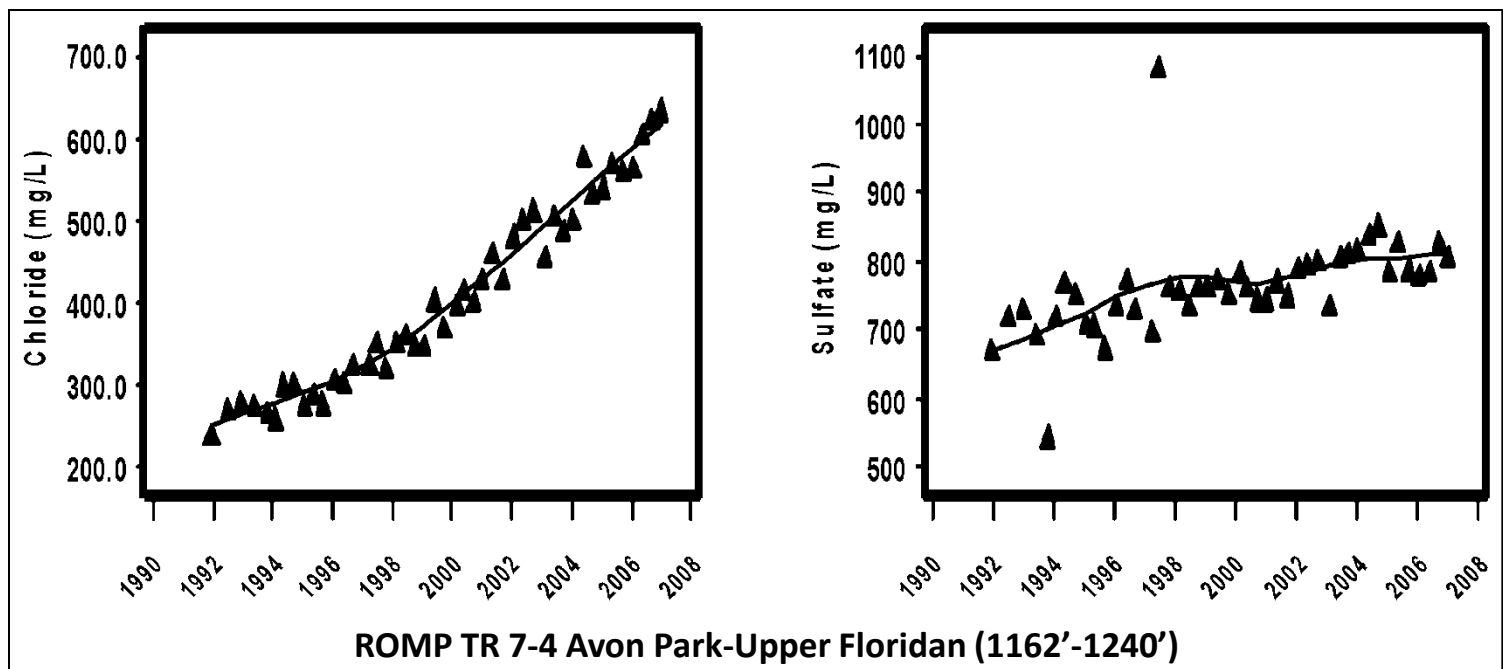
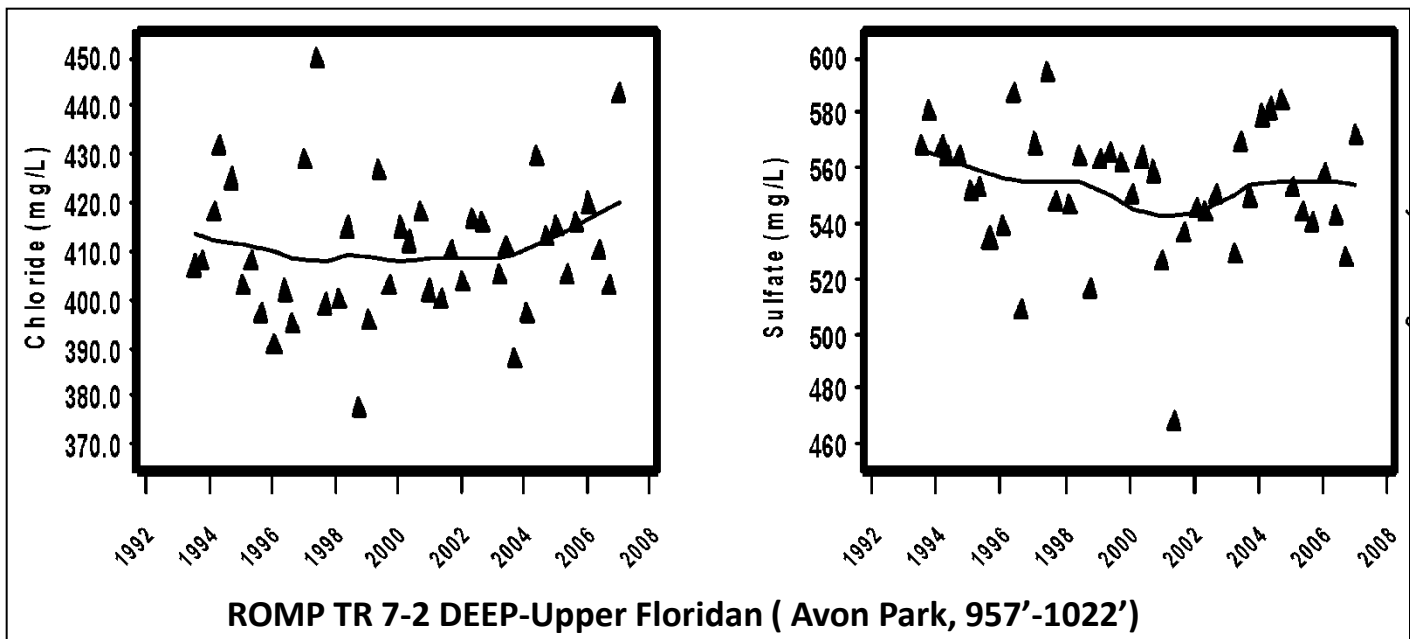
(4/20/1993-4/19/2000 vs. 4/20/2000-4/19/2007)

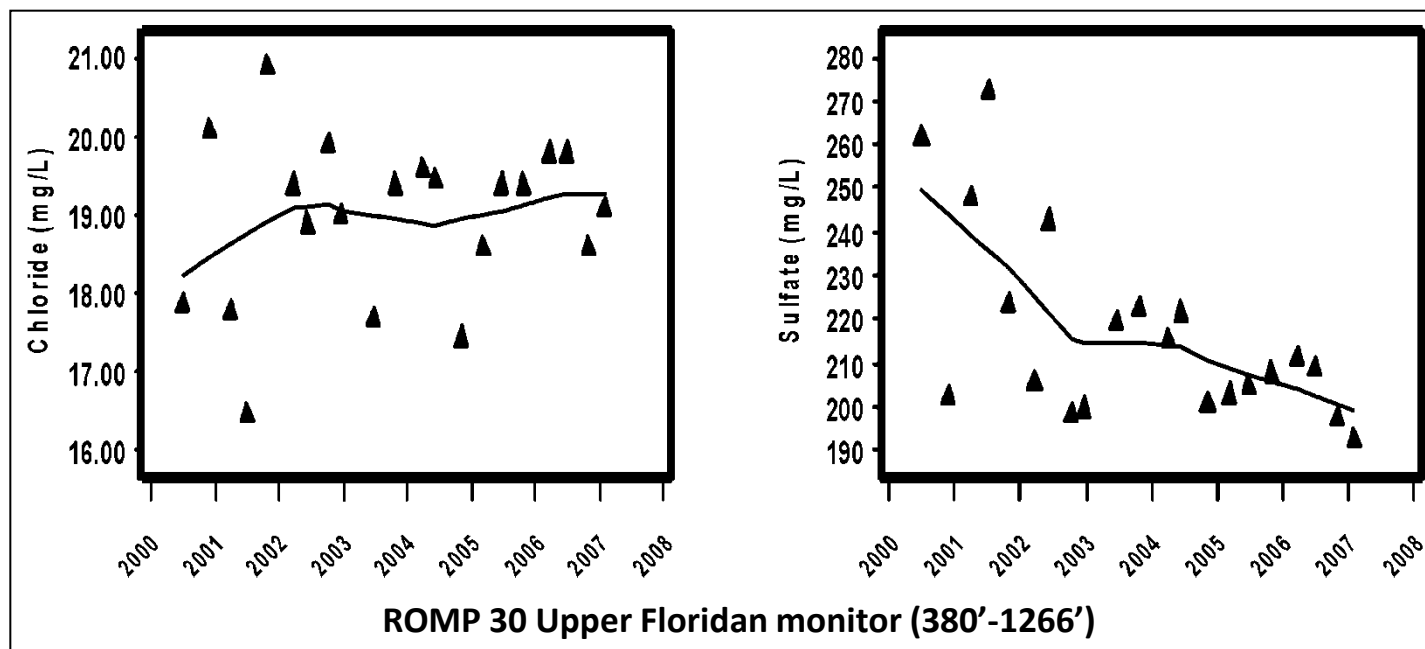
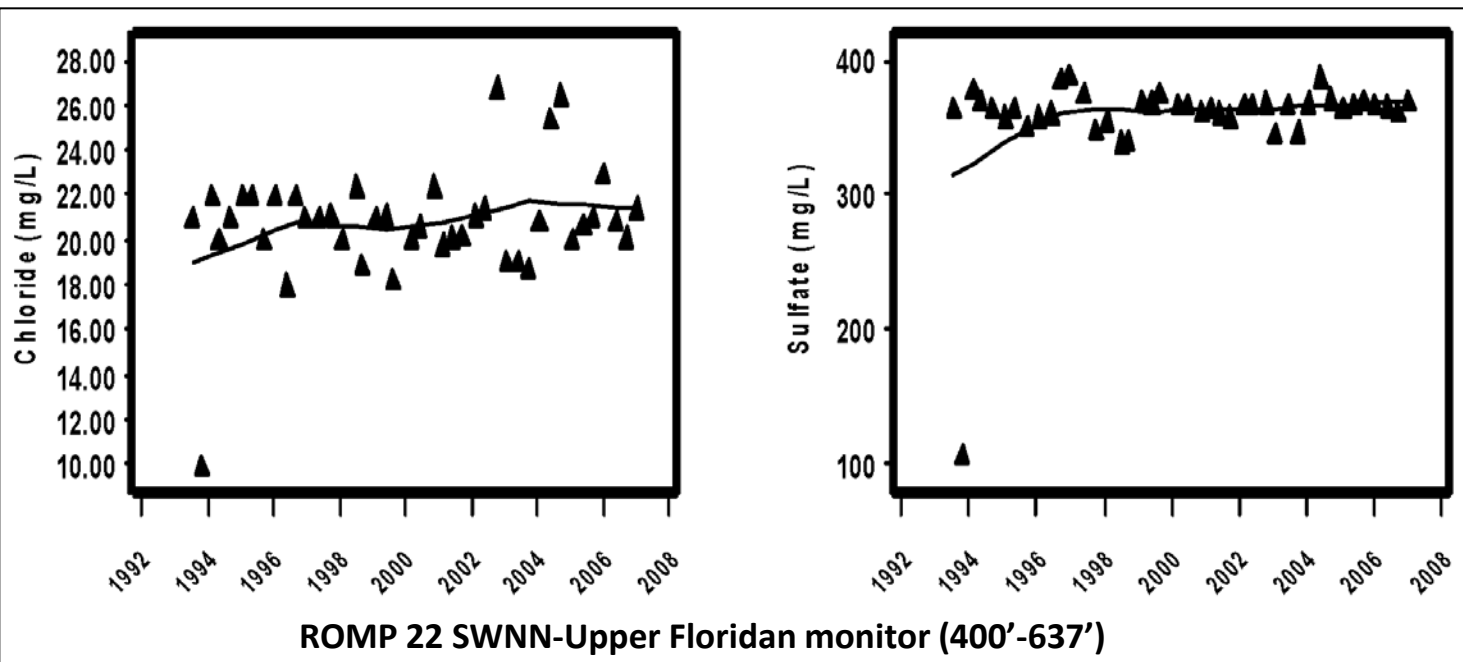


Figures 39, 40. Chloride trends in the Ocala/Avon Park zone (Group C vs. Group D and Group E vs. Group F)









Report Conclusions:

Wells sampled in the Upper Floridan aquifer, along the Gulf coastal margin and the SWUCA are showing long-term increasing trends in salinity:

- increasing Cl⁻ for the temporal groups 1993-2000 and 2000 -2007 (E vs. F)**
 - 40% of wells in the Ocala/Avon Park zone**
 - 26% of wells in the Tampa/Suwannee zone**
- analysis of the intermediate aquifers for the same groupings showed equal numbers (~25%) for both increasing and decreasing Cl⁻ trends**
- the Ocala/Avon Park zone of the Upper Floridan aquifer, had the highest percentage of increasing salinity trends across all temporal groupings**
- sulfate trends across temporal groups indicated both increasing and decreasing trends in the intermediate aquifers and Upper Floridan aquifer**
- trends in chloride-sulfate ratios indicate and increase in chloride over sulfate, as evidence of continued saline water intrusion in the SWUCA**