AGENDA
St. Lucie River Watershed Protection Plan
Working Team Meeting #5

Tuesday, March 25, 2008
1330 - 1630

SFWMD Martin/St. Lucie Service Center
780 Southeast Indian Street
Stuart, FL 34997
(772) 223-2600

Conference Call Information:
Local: 561-682-6700
Nationwide Toll-Free: 866-433-6299
MEETING ID# 4471

1. Introduction and Opening Remarks

2. Coordinating Agencies Update

3. DRAFT - Proposed Schedule

4. Water Quantity Modeling:
    a. Regional Simulation Model Update
    b. Salinity & Oyster Response Analysis

5. Water Quality Spreadsheet Analysis Update

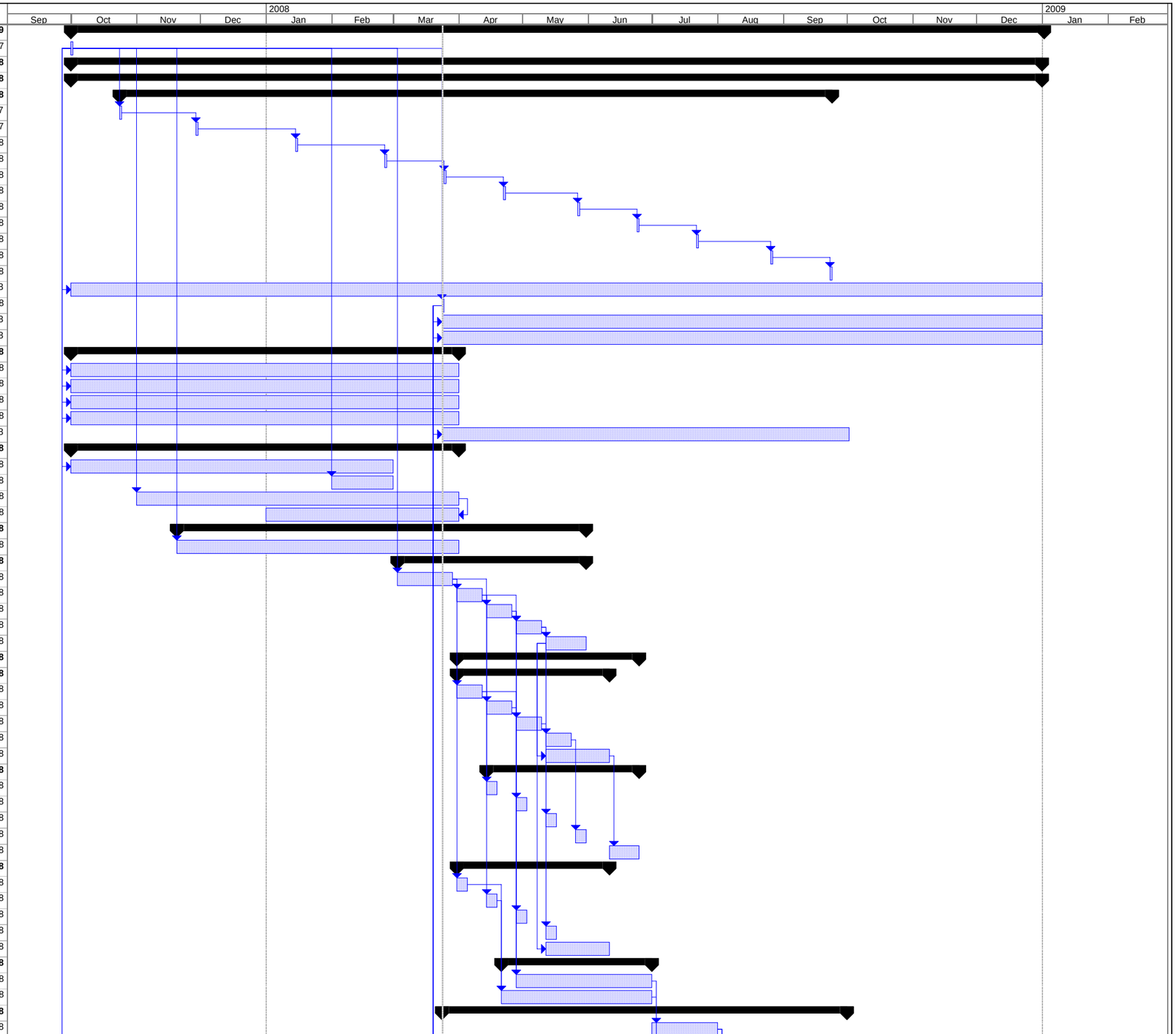
6. DRAFT Management Measures
    a. Review Current List
    b. Development of Alternative 1

7. Public Comment Period*

8. Closing Remarks and Action Items (Next Meeting – Tuesday, April 22, 2008)

* As time permits, brief Public Comment Periods will also be held after major discussion items in the agenda

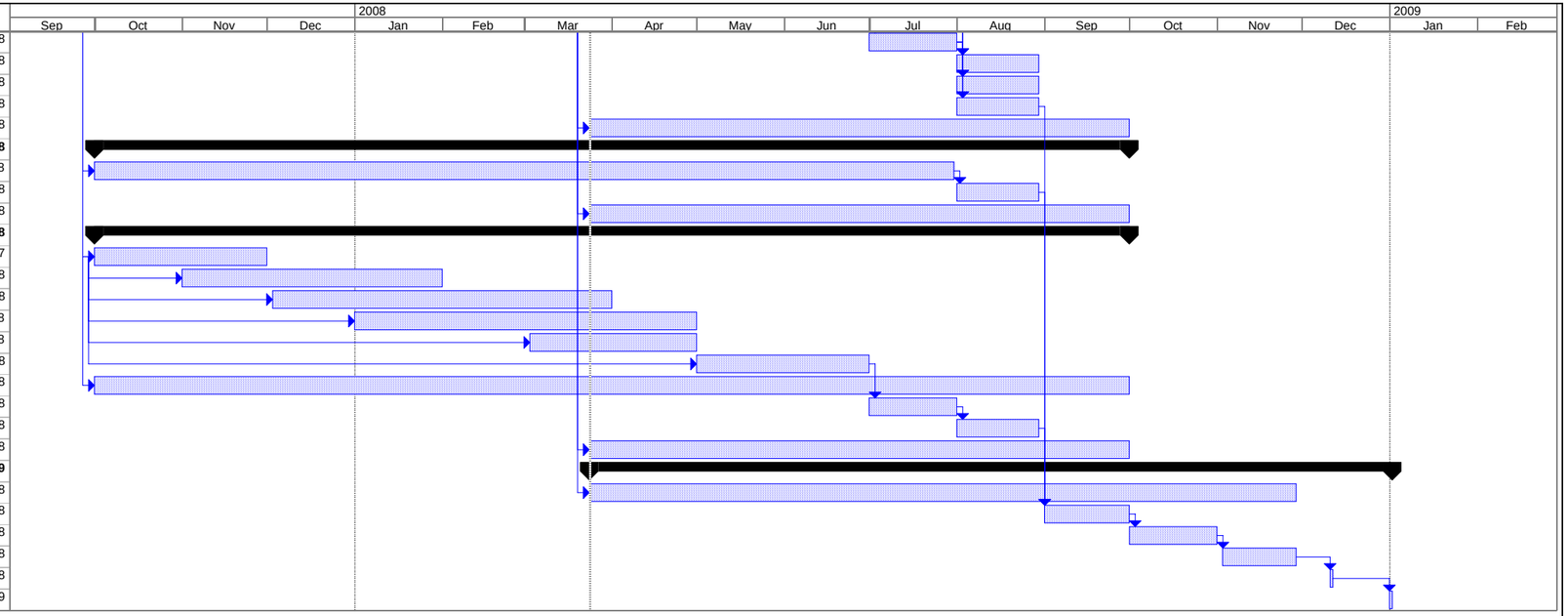
ID	Task Name	Duration	Start	Finish
1	**St. Lucie River Watershed Protection Plan**	**329 days?**	**Mon 10/1/07**	**Thu 1/1/09**
2	Initiate Project Efforts	1 day?	Mon 10/1/07	Mon 10/1/07
3	**Watershed Construction Project**	**328 days?**	**Mon 10/1/07**	**Wed 12/31/08**
4	**Project Management & Support**	**328 days?**	**Mon 10/1/07**	**Wed 12/31/08**
5	**Working Team Meetings**	**240 days**	**Wed 10/24/07**	**Tue 9/23/08**
6	Working Team Meeting #1	1 day	Wed 10/24/07	Wed 10/24/07
7	Working Team Meeting #2	1 day	Thu 11/29/07	Thu 11/29/07
8	Working Team Meeting #3	1 day	Tue 1/15/08	Tue 1/15/08
9	Working Team Meeting #4	1 day	Tue 2/26/08	Tue 2/26/08
10	Working Team Meeting #5	1 day	Tue 3/25/08	Tue 3/25/08
11	Working Team Meeting #6	1 day	Tue 4/22/08	Tue 4/22/08
12	Working Team Meeting #7	1 day	Tue 5/27/08	Tue 5/27/08
13	Working Team Meeting #8	1 day	Tue 6/24/08	Tue 6/24/08
14	Working Team Meeting #9	1 day	Tue 7/22/08	Tue 7/22/08
15	Working Team Meeting #10	1 day	Tue 8/26/08	Tue 8/26/08
16	Working Team Meeting #11	1 day	Tue 9/23/08	Tue 9/23/08
17	Internal and External Team Meetings	328 days?	Mon 10/1/07	Wed 12/31/08
18	TetraTech Work Order - NTP	1 day?	Mon 3/24/08	Mon 3/24/08
19	Work Order - Task 1: Interagency Coordination and Public Involvement	203 days?	Mon 3/24/08	Wed 12/31/08
20	Work Order - Task 7: Project Management Support	203 days?	Mon 3/24/08	Wed 12/31/08
21	**Step 1 - Goals, Objectives and Performance Measures**	**131 days**	**Mon 10/1/07**	**Mon 3/31/08**
22	Identification of Problems and Opportunities	131 days	Mon 10/1/07	Mon 3/31/08
23	Determination of planning objectives	131 days	Mon 10/1/07	Mon 3/31/08
24	Identification of planning constraints	131 days	Mon 10/1/07	Mon 3/31/08
25	Selection of Performance Measures	131 days	Mon 10/1/07	Mon 3/31/08
26	Work Order - Task 2: Planning Process	138 days	Mon 3/24/08	Wed 10/1/08
27	**Step 2 - Existing and Future Conditions**	**131 days?**	**Mon 10/1/07**	**Mon 3/31/08**
28	Summary of existing water quality and quantity conditions	110 days?	Mon 10/1/07	Fri 2/29/08
29	Establish Current and Future Base Model Scenarios	21 days?	Fri 2/1/08	Fri 2/29/08
30	Watershed Model Development	108 days?	Thu 11/1/07	Mon 3/31/08
31	Watershed Model - Base Condition Runs	65 days?	Tue 1/1/08	Mon 3/31/08
32	**Step 3 - Formulation of Alterntives**	**139 days?**	**Tue 11/20/07**	**Fri 5/30/08**
33	Identification of Management Measures	95 days	Tue 11/20/07	Mon 3/31/08
34	**Formulation of Alternatives**	**65 days?**	**Mon 3/3/08**	**Fri 5/30/08**
35	Alternative 1 - Common Elements	20 days?	Mon 3/3/08	Fri 3/28/08
36	Alternative 2 - Water Storage Option?	10 days?	Mon 3/31/08	Fri 4/11/08
37	Alternative 3 - Water Quality Option?	10 days?	Mon 4/14/08	Fri 4/25/08
38	Alternative 4 - Combination of 2 and 3?	10 days?	Mon 4/28/08	Fri 5/9/08
39	Additional Alternatives?	15 days?	Mon 5/12/08	Fri 5/30/08
40	**Step 4 - Evaluation of Alternatives**	**62 days**	**Mon 3/31/08**	**Tue 6/24/08**
41	**Modeling of Storage Alternatives with RSM**	**52 days**	**Mon 3/31/08**	**Tue 6/10/08**
42	Alternative 1	10 days	Mon 3/31/08	Fri 4/11/08
43	Alternative 2	10 days	Mon 4/14/08	Fri 4/25/08
44	Alternative 3	10 days	Mon 4/28/08	Fri 5/9/08
45	Alternative 4	10 days	Mon 5/12/08	Fri 5/23/08
46	Additional Alternatives?	22 days	Mon 5/12/08	Tue 6/10/08
47	**Salinity and Oyster Response Modeling**	**52 days**	**Mon 4/14/08**	**Tue 6/24/08**
48	Alternative 1	5 days	Mon 4/14/08	Fri 4/18/08
49	Alternative 2	5 days	Mon 4/28/08	Fri 5/2/08
50	Alternative 3	5 days	Mon 5/12/08	Fri 5/16/08
51	Alternative 4	5 days	Mon 5/26/08	Fri 5/30/08
52	Additional Alternatives?	10 days	Wed 6/11/08	Tue 6/24/08
53	**Water Quality Spreadsheet Modeling**	**52 days**	**Mon 3/31/08**	**Tue 6/10/08**
54	Alternative 1	5 days	Mon 3/31/08	Fri 4/4/08
55	Alternative 2	5 days	Mon 4/14/08	Fri 4/18/08
56	Alternative 3	5 days	Mon 4/28/08	Fri 5/2/08
57	Alternative 4	5 days	Mon 5/12/08	Fri 5/16/08
58	Additional Alternatives?	22 days	Mon 5/12/08	Tue 6/10/08
59	**Step 5 - Comparison of Alternatives**	**51 days**	**Mon 4/21/08**	**Mon 6/30/08**
60	Evaluation of Modeling Results for Water Quantity	46 days	Mon 4/28/08	Mon 6/30/08
61	Evaluation of Modeling Results for Water Quantity	51 days	Mon 4/21/08	Mon 6/30/08
62	**Step 6 - Selected Plan**	**137 days?**	**Mon 3/24/08**	**Tue 9/30/08**
63	Water Quality Summary	23 days	Tue 7/1/08	Thu 7/31/08



Project: DRAFT_ProjectSchedule_032
Date: Mon 3/24/08

Task
Split
Progress
Milestone
Summary
Project Summary
External Tasks
External Milestone
Deadline

ID	Task Name	Duration	Start	Finish
64	Water Quantity Summary	23 days	Tue 7/1/08	Thu 7/31/08
65	Selection of Recommended Projects and Actions	21 days	Fri 8/1/08	Fri 8/29/08
66	"Details" of Recommended Projects	21 days?	Fri 8/1/08	Fri 8/29/08
67	Documentation for DRAFT Final Report	21 days	Fri 8/1/08	Fri 8/29/08
68	Work Order - Task 3: Watershed Construction Project	137 days	Mon 3/24/08	Tue 9/30/08
69	**Watershed Pollutant Control Program**	**262 days?**	**Mon 10/1/07**	**Tue 9/30/08**
70	Develop Pollutant Control Program	218 days	Mon 10/1/07	Wed 7/30/08
71	Documentation for DRAFT Final Report	21 days?	Fri 8/1/08	Fri 8/29/08
72	Work Order - Task 4: Watershed Pollutant Control Program	137 days	Mon 3/24/08	Tue 9/30/08
73	**Research & Water Quality Monitoring Program**	**262 days?**	**Mon 10/1/07**	**Tue 9/30/08**
74	Identify Goals and Objectives of the Plan	45 days?	Mon 10/1/07	Fri 11/30/07
75	Establish Status, Trends and Targets in Hydrology, Water Quality and Aquatic	66 days?	Thu 11/1/07	Thu 1/31/08
76	Monitoring on a Regional Scale	86 days?	Mon 12/3/07	Mon 3/31/08
77	Monitoring on a Project Scale	87 days?	Tue 1/1/08	Wed 4/30/08
78	Research for Adaptive Management	43 days?	Mon 3/3/08	Wed 4/30/08
79	Develop Recommendations	43 days?	Thu 5/1/08	Mon 6/30/08
80	Internal and External Team Meetings	262 days?	Mon 10/1/07	Tue 9/30/08
81	Compilation of DRAFT Plan	23 days?	Tue 7/1/08	Thu 7/31/08
82	Documentation for DRAFT Final Report	21 days	Fri 8/1/08	Fri 8/29/08
83	Work Order - Task 5: Research & WQ Monitoring Program	137 days	Mon 3/24/08	Tue 9/30/08
84	**Development of River Watershed Protection Plan**	**204 days**	**Mon 3/24/08**	**Thu 1/1/09**
85	Work Order - Task 6: Final Development of Plan	180 days	Mon 3/24/08	Fri 11/28/08
86	Compile three sections of DRAFT Plan	22 days	Mon 9/1/08	Tue 9/30/08
87	Release DRAFT Plan for Public Review	23 days	Wed 10/1/08	Fri 10/31/08
88	Incorporate Public Comments	20 days	Mon 11/3/08	Fri 11/28/08
89	DRAFT Plan to SFWMD Governing Board	1 day	Thu 12/11/08	Thu 12/11/08
90	Final Plan to State of Florida	1 day	Thu 1/1/09	Thu 1/1/09



Project: DRAFT_ProjectSchedule_032
Date: Mon 3/24/08

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

St. Lucie Estuary "Salinity Envelope":

Establishing Freshwater Inflow Targets to Evaluate Alternative Management Scenarios

by

Dan Haunert

Coastal Ecosystems Division
South Florida Water Management District

Valued Ecosystem Components (VECs) Concept:

The application of a resource-based management strategy developed by the U.S. Environmental Protection Agency as part of its National Estuary Program. Through this strategy, a suitable salinity and water quality environment for VECs attains management objectives.

VECs sustain an important ecological or water resource function by providing food, living space, refuge, and foraging sites for other desirable species in the estuary.

Valued Ecosystem Components (Cont.)

The approach assumes environmental conditions suitable for VECs are suitable for other desirable species and that enhancement of VECs will lead to enhancement of other species.

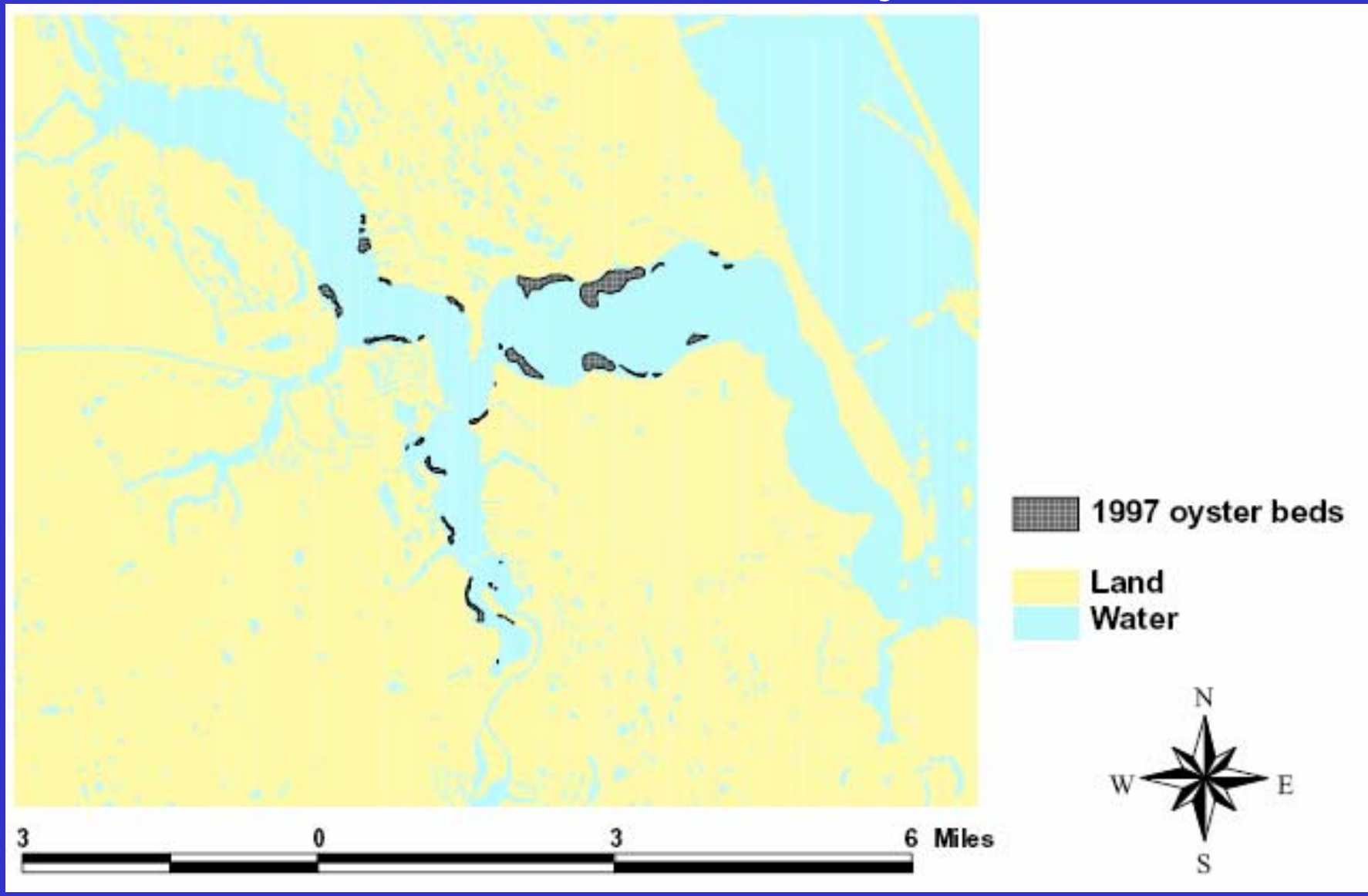
VECs identified for the St. Lucie estuary are (1) oyster populations; and (2) submerged aquatic vegetation; and (3) proposed low salinity zone/fish nursery

Oyster Bar

1. Oyster spat, 2. Skilletfish, 3. Hooked mussel, 4. Whip mud worms, 5. Sea squirts, 6. Sea anemone, 7. Barnacles, 8. Fan worms, 9. Mud crab

Oyster reef community. Illustration credit: Alice Jane Lippson, from Life in the Chesapeake Bay, by Alice Jane Lippson and Robert L. Lippson.

Oyster Distribution in the St. Lucie Estuary



Salinity tolerances for life stages of the Eastern Oyster (*Crassostrea virginica*) to address low salinity / high flow target for middle estuary

Life Stage	Salinity (ppt)	Duration (days)	J	F	M	A	M	J	J	A	S	O	N	D	Reference
Eggs			X	X	X	X									Wilson et al. 2004
Harm	7.5 - 10.0	1													Burrel 1986
Mortality	0.0 - 7.5	1													Burrel 1986
Larvae					X	X	X								Wilson et al. 2004
Stress	10.0 - 12.0	1													Loosanoff 1965; Davis 1958
Harm	0.0 - 10.0	1													Davis 1958
Mortality	0.0 - 10.0	14													Davis 1958
Spat & Juveniles						X	X	X	X						Wilson et al. 2004
Stress	5.0 – 10.0	1													Ray and Benefield 1997
Harm	0.0 -5.0	1													Loosanoff 1953
Mortality	0.0 – 5.0	7													Volety et al. 2003
Adults			X	X	X	X	X	X	X	X	X	X	X	X	
Stress	7.5 - 10.0														Woodward-Clyde 1998
Harm	5.0 – 7.5	1													Loosanoff 1953, 1965
Mortality	2.0 – 5.0	28													Loosanoff 1953; Volety et al 2003
Mortality	0.0 – 2.0	14													Roesijadi 2004

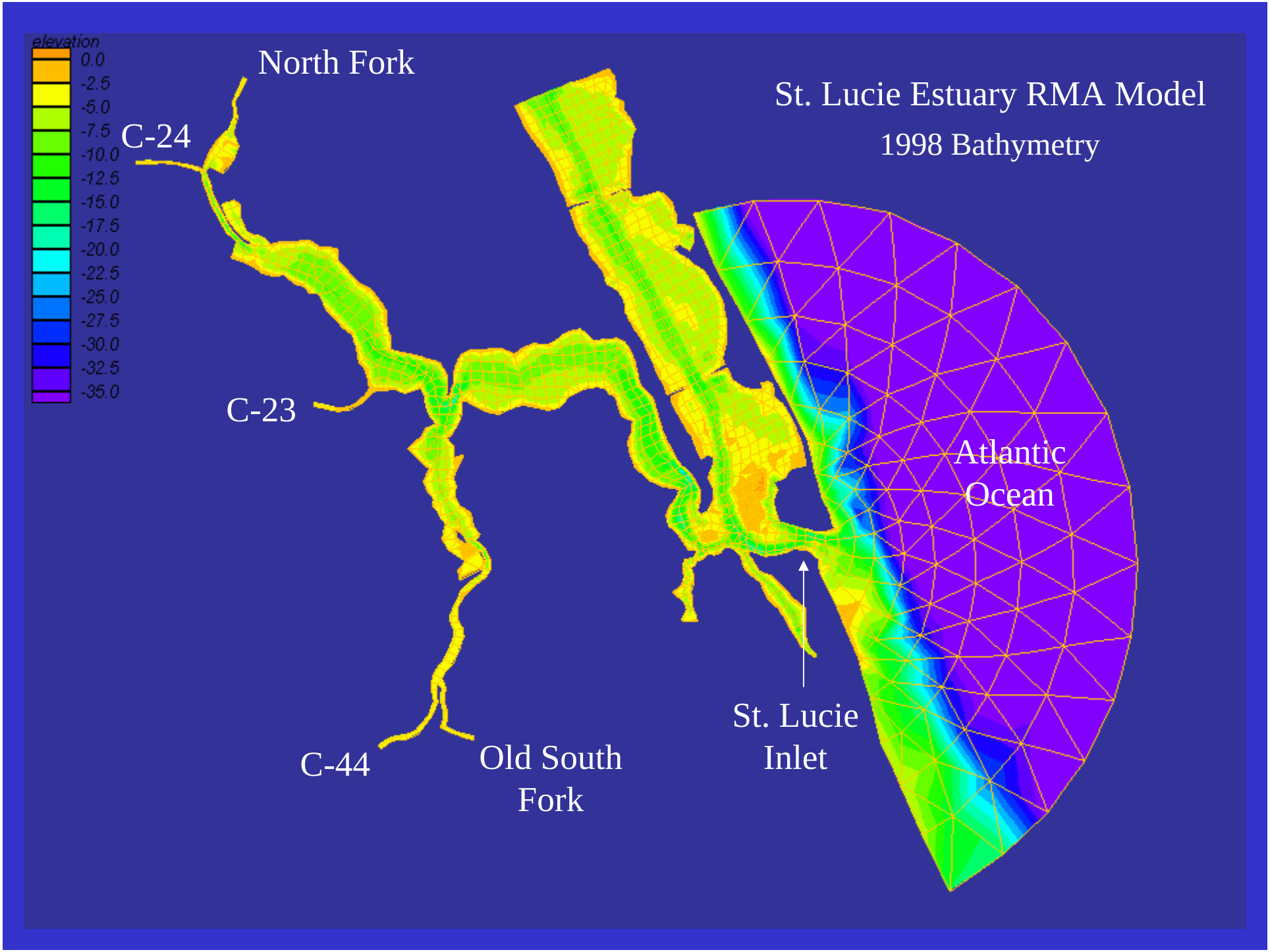
Effects of high salinity on oysters to address a low flow target

When salinity is greater than about 25 ppt:

- The prevalence of disease that causes stress (reduced egg production, reduced fat reserves) and potential mortality of oysters increases, especially when water temperatures are above approximately 20 degrees C.
- Marine oyster predators are no longer restricted to the outer estuary salinity habitats and therefore can inhabit the mid-estuary oyster reefs

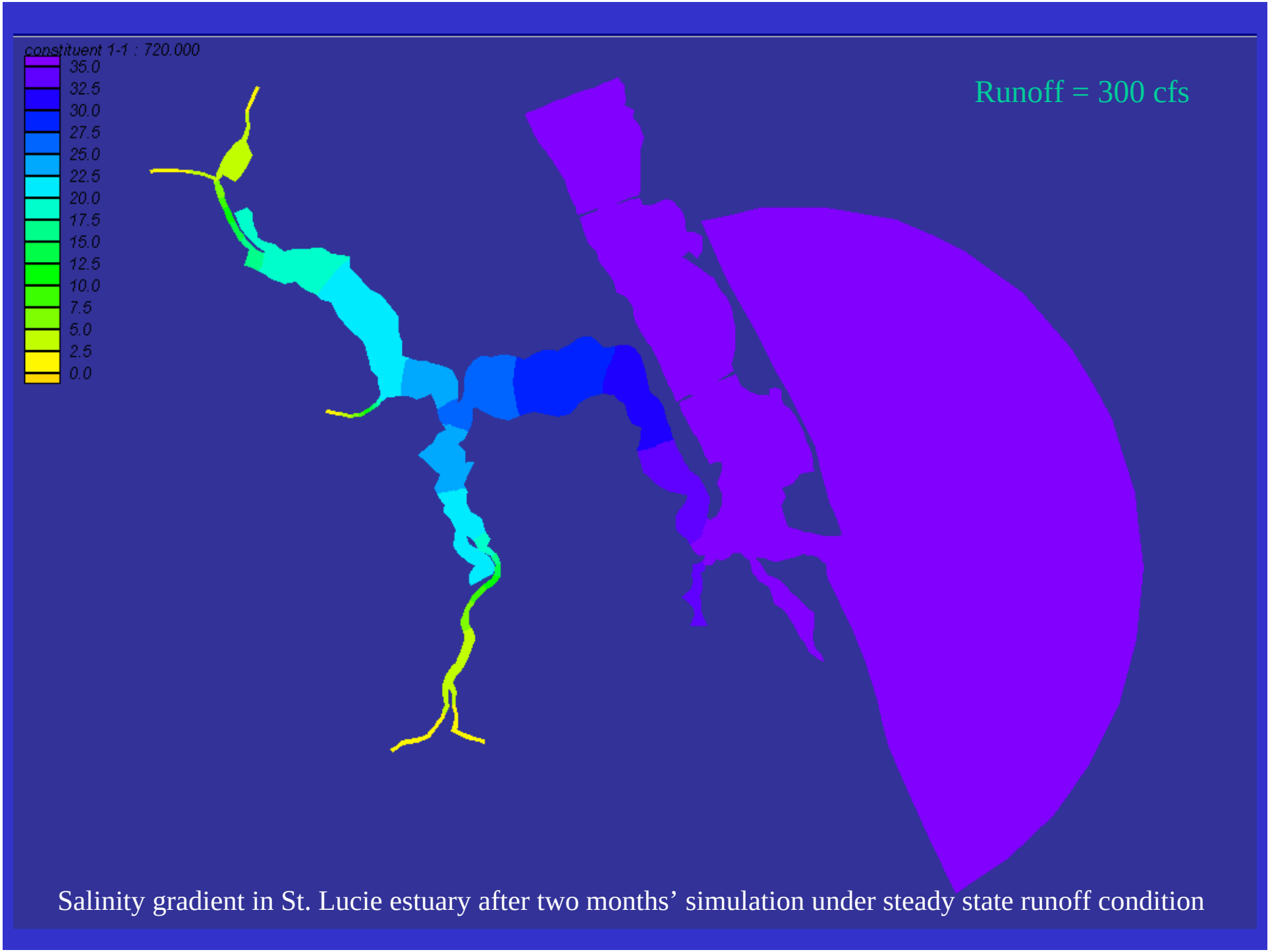
Determining the Relationships of Freshwater Inflows to Salinity for the St. Lucie Estuary:

A two dimensional depth-averaged finite element model

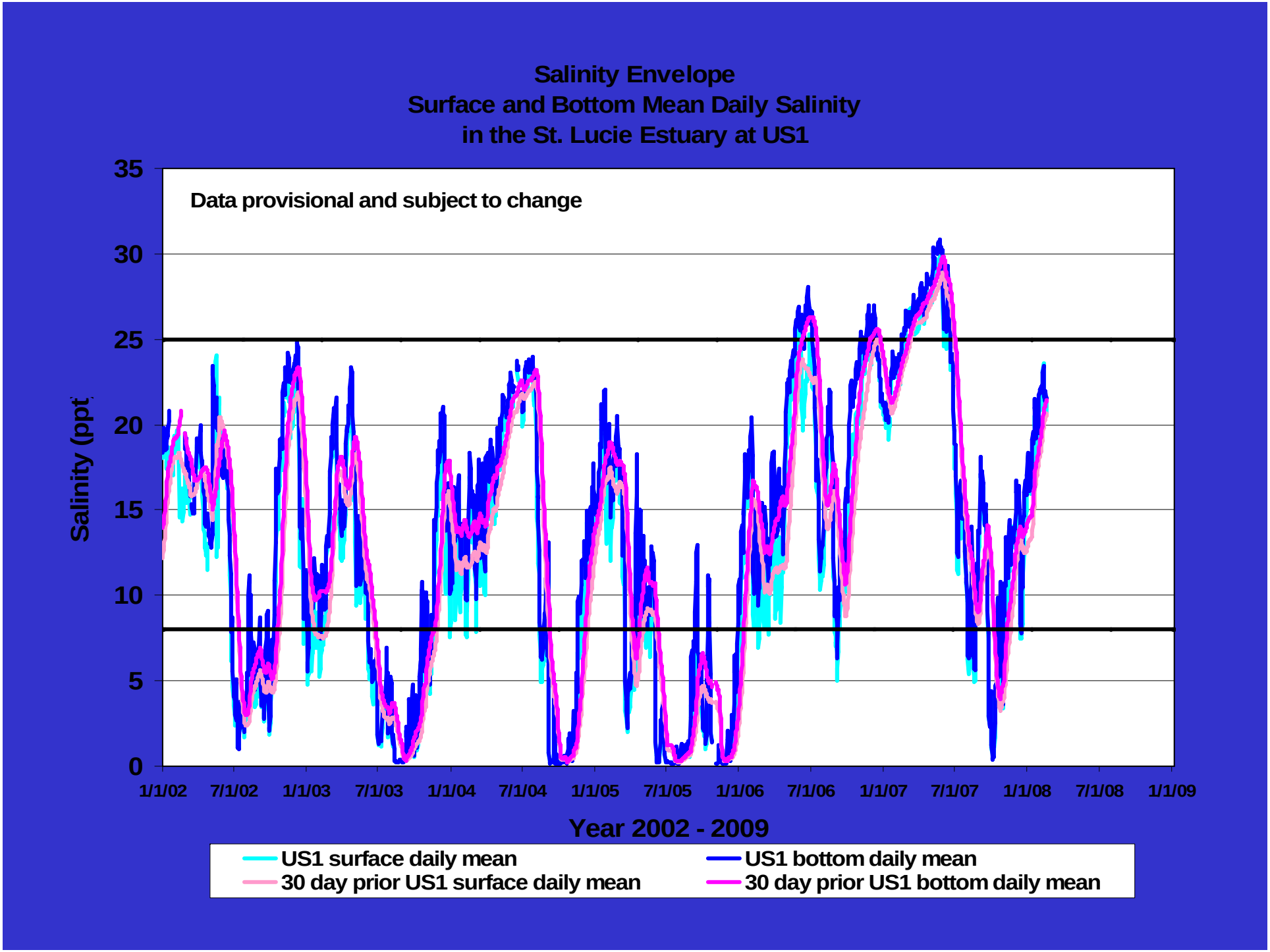

elevation
0.0
-2.5
-5.0
-7.5
-10.0
-12.5
-15.0
-17.5
-20.0
-22.5
-25.0
-27.5
-30.0
-32.5
-35.0
North Fork
C-24
C-23
C-44
Old South Fork
St. Lucie Inlet
Atlantic Ocean
St. Lucie Estuary RMA Model
1998 Bathymetry

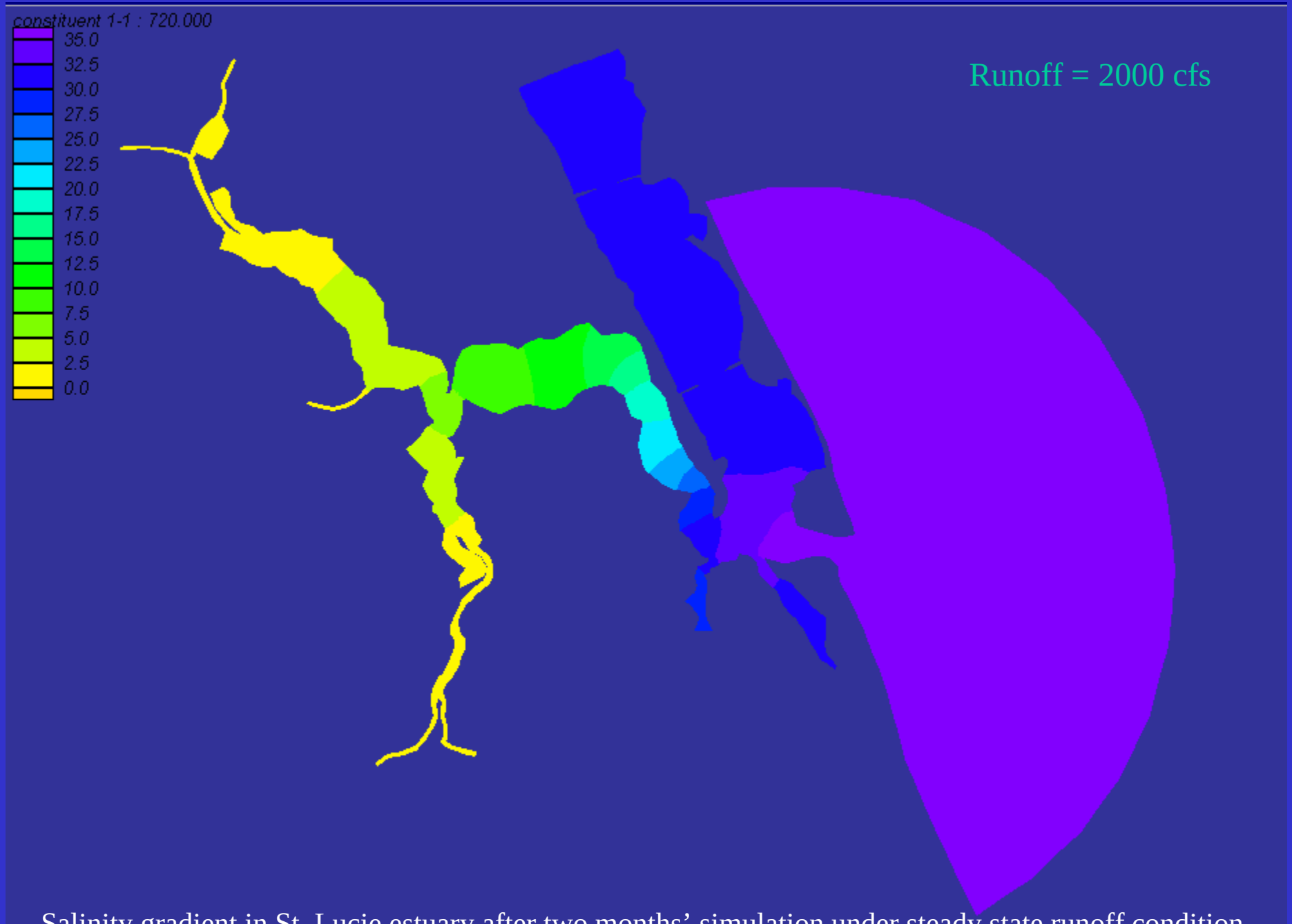
Salinity Contour Maps and Family of Salinity Gradient Curves

Net freshwater inflows of 300 to 10,000 cfs were simulated until a salinity gradient equilibrium in the estuary was obtained for each inflow.

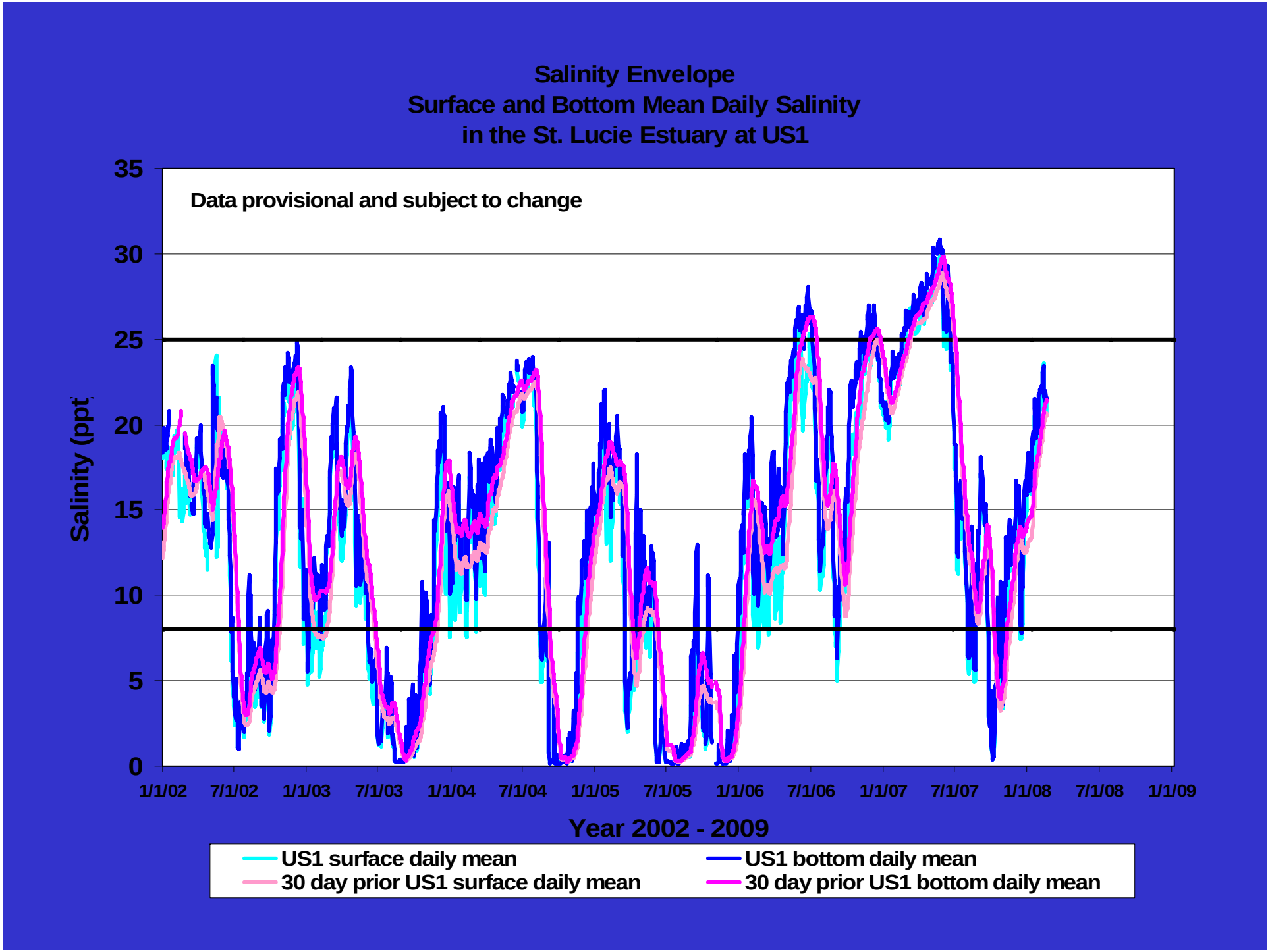


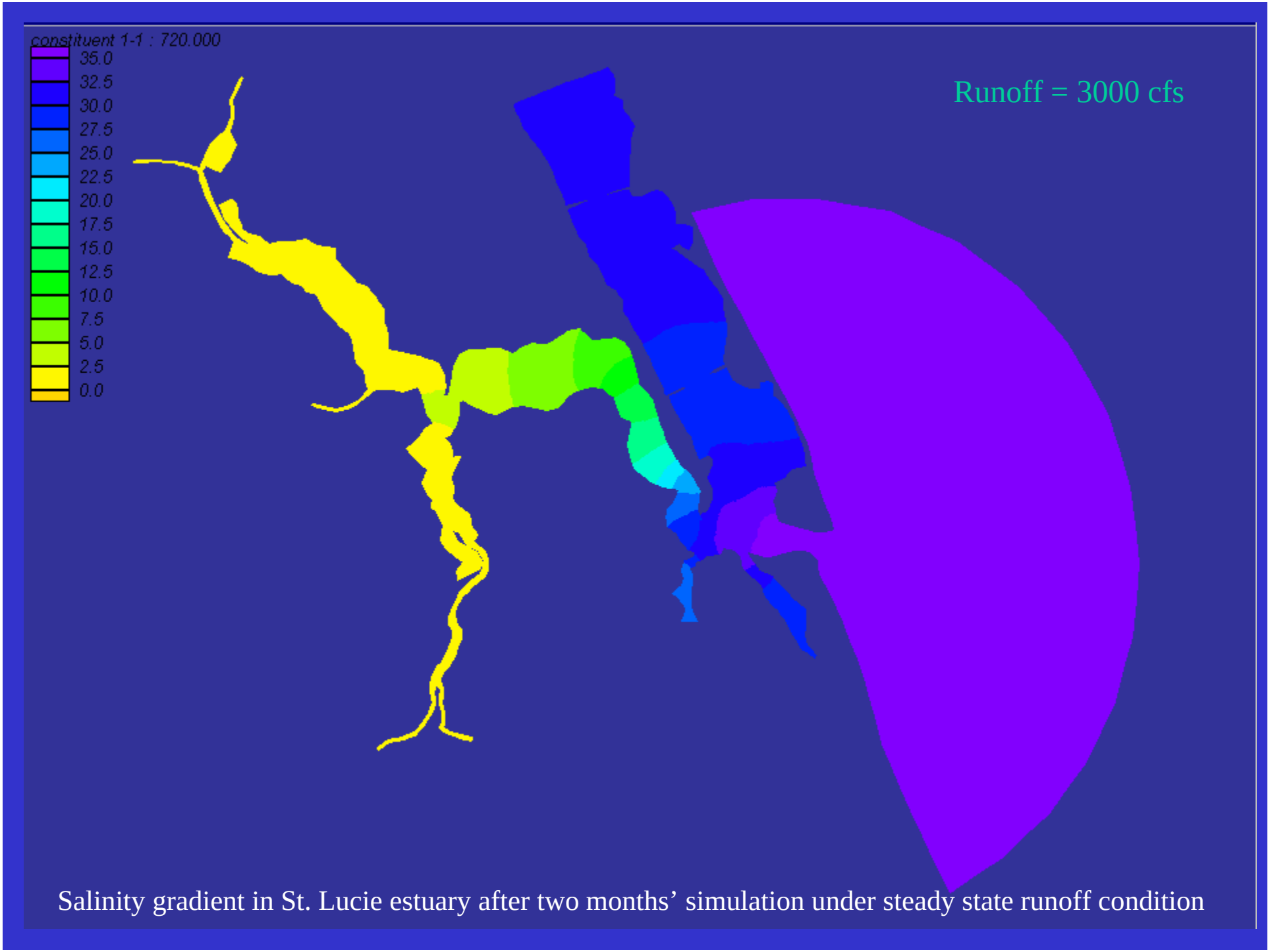
Salinity gradient in St. Lucie estuary after two months' simulation under steady state runoff condition


Salinity Envelope
Surface and Bottom Mean Daily Salinity
in the St. Lucie Estuary at US1
Data provisional and subject to change
Salinity (ppt)
35
30
25
20
15
10
5
0
1/1/02
7/1/02
1/1/03
7/1/03
1/1/04
7/1/04
1/1/05
7/1/05
1/1/06
7/1/06
1/1/07
7/1/07
1/1/08
7/1/08
1/1/09
Year 2002 - 2009
US1 surface daily mean
US1 bottom daily mean
30 day prior US1 surface daily mean
30 day prior US1 bottom daily mean



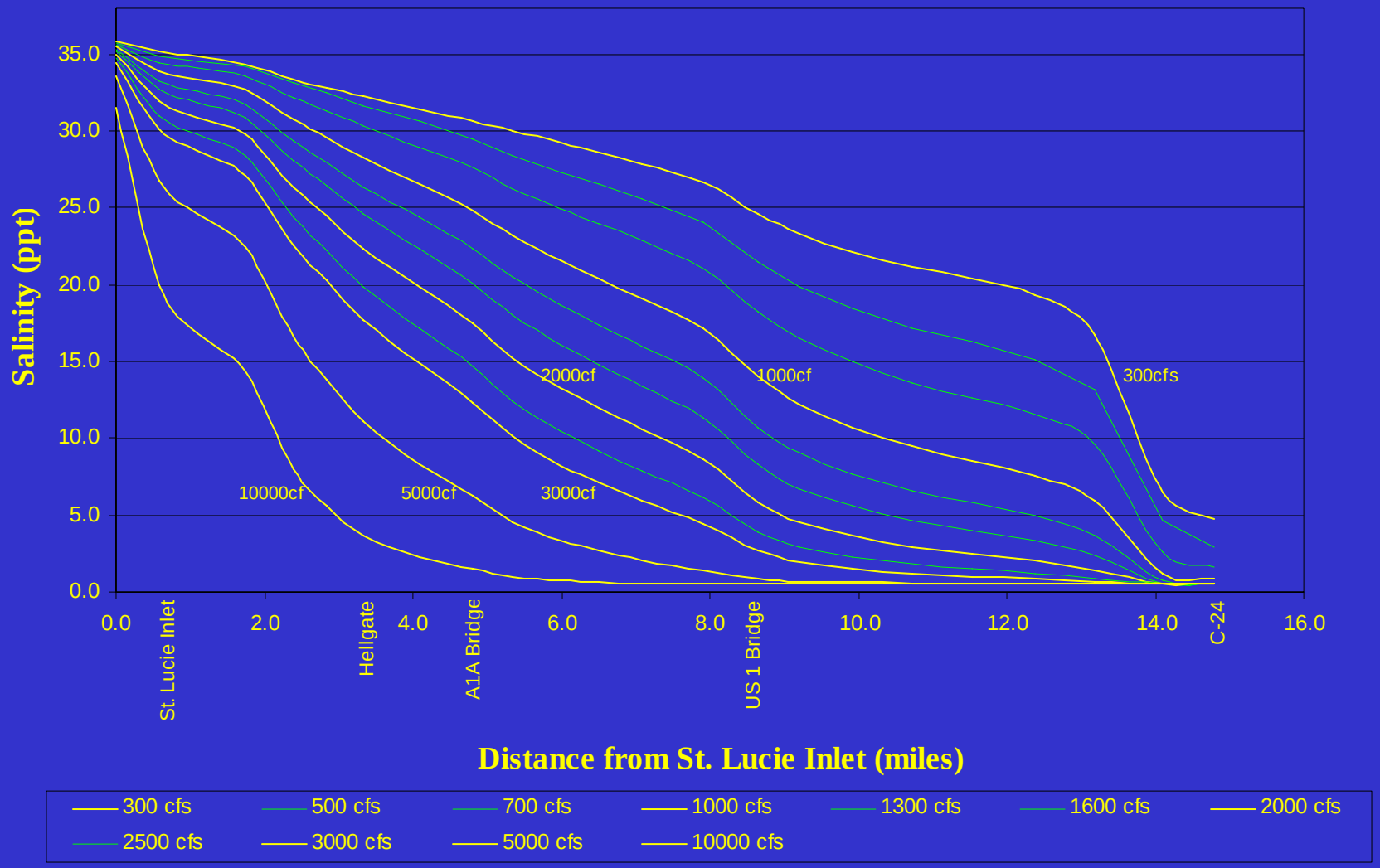
Salinity gradient in St. Lucie estuary after two months' simulation under steady state runoff condition


Salinity Envelope
Surface and Bottom Mean Daily Salinity
in the St. Lucie Estuary at US1
Data provisional and subject to change
Salinity (ppt)
35
30
25
20
15
10
5
0
1/1/02
7/1/02
1/1/03
7/1/03
1/1/04
7/1/04
1/1/05
7/1/05
1/1/06
7/1/06
1/1/07
7/1/07
1/1/08
7/1/08
1/1/09
Year 2002 - 2009
US1 surface daily mean
US1 bottom daily mean
30 day prior US1 surface daily mean
30 day prior US1 bottom daily mean

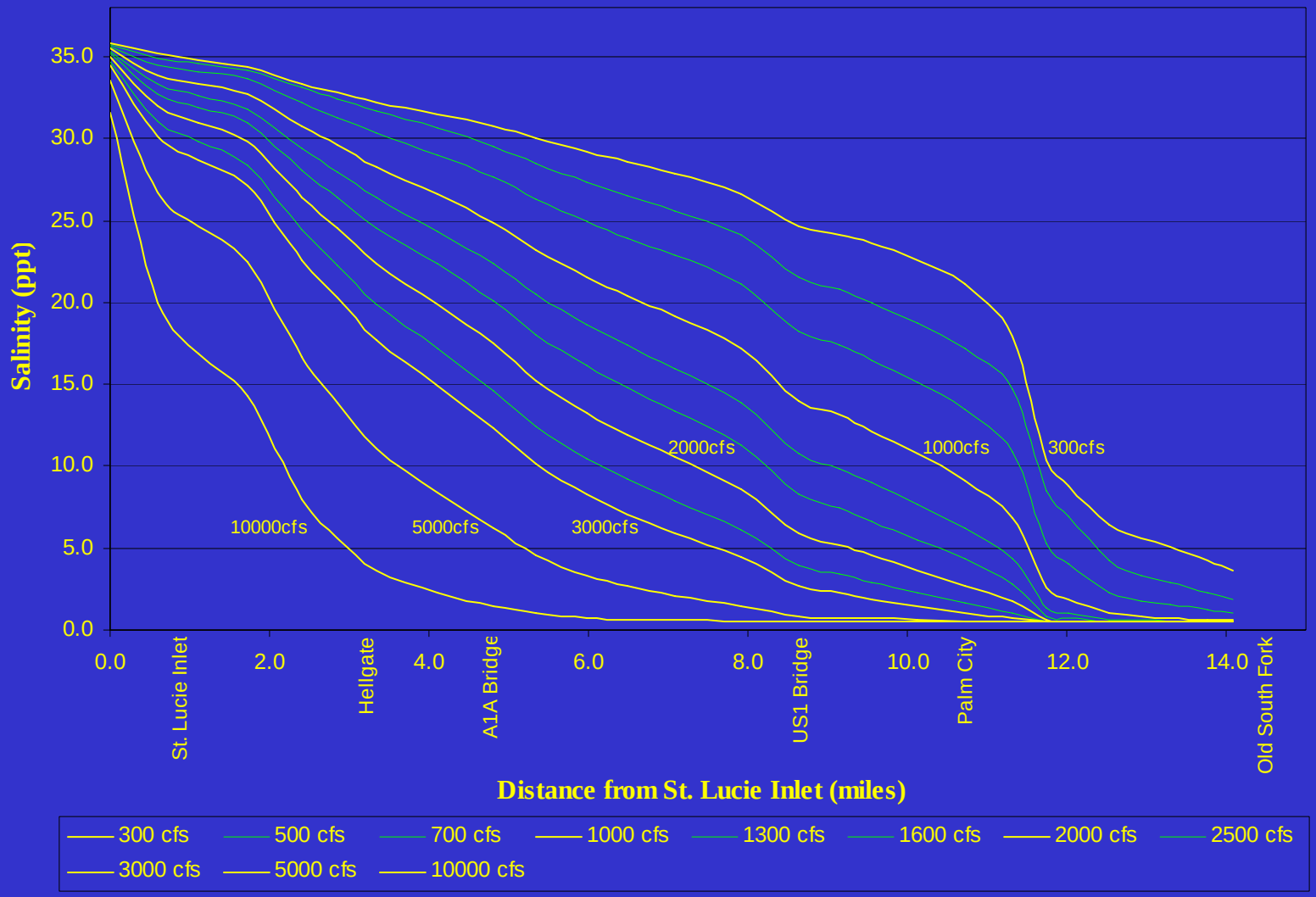


Salinity gradient in St. Lucie estuary after two months' simulation under steady state runoff condition

Salinity gradient in St. Lucie Estuary at various magnitude of freshwater inflow



Salinity gradient in St. Lucie Estuary at various magnitude of freshwater inflow



What is “Net Freshwater Inflow”?

- **The net freshwater inflow includes all surface water** (surface water runoff from all basins in the watershed, Structure S-80 lockage and leakage from S-80, S-49, Gordy Road) **and all groundwater; minus evaporation** from the surface of the estuary.

- **This relates to a net inflow that may range from about 125 to 200 cfs (best estimate at this time) from all sources except surface water runoff in the dry and wet season, respectively. (The salinity at the U.S. 1 Bridge indicates the quantity of net freshwater inflow to the inner estuary using the figures shown)**

Summary of Inflow Threshold Targets for Culling Alternative Management Scenarios

- High, Net Freshwater Inflow Target: 2000 cfs (about 200 cfs is not surface water runoff, therefore, about 1800 cfs from surface water).

- Low, Net Freshwater Inflow Target: 350 cfs (about 125 cfs is not surface water runoff, therefore, about 225 cfs from surface water to enhance the Low Salinity Zone Habitat/fish nursery function in the North Fork with special emphasis on winter and spring spawning times).

Refining Freshwater Inflow Targets by adding frequency of occurrence

List of natural flow-frequency distributions compared to existing condition (1995) distributions based with 1965-1995 climatic conditions (Haunert and Konyha 2004)

flow range		probability in each range (%)			
		NSM (target)	HSPF	Peace River	1995 Base
<350 cfs	<21,130 af/m	54.8%	47.6%	51.9%	31.2%
350 to 680 cfs	21,130 to 41,053 af/m	17.7%	19.9%	20.4%	24.2%
680 to 1010 cfs	41,053 to 60,976 af/m	6.5%	9.7%	12.6%	12.1%
1010 to 1340 cfs	60,976 to 80,898 af/m	6.5%	5.9%	4.3%	8.9%
1340 to 1670 cfs	80,898 to 100,821 af/m	4.3%	4.0%	4.6%	7.8%
1670 to 2000 cfs	100,821 to 120,744 af/m	3.0%	4.8%	2.2%	4.3%
2000 to 3000 cfs	120,744 to 181,116 af/m	4.6%	5.9%	2.4%	7.5%
>3000 cfs	>181116 af/m	2.7%	2.2%	1.6%	4.0%
average annual runoff (in/y)		11.3	14.6	10	16.1

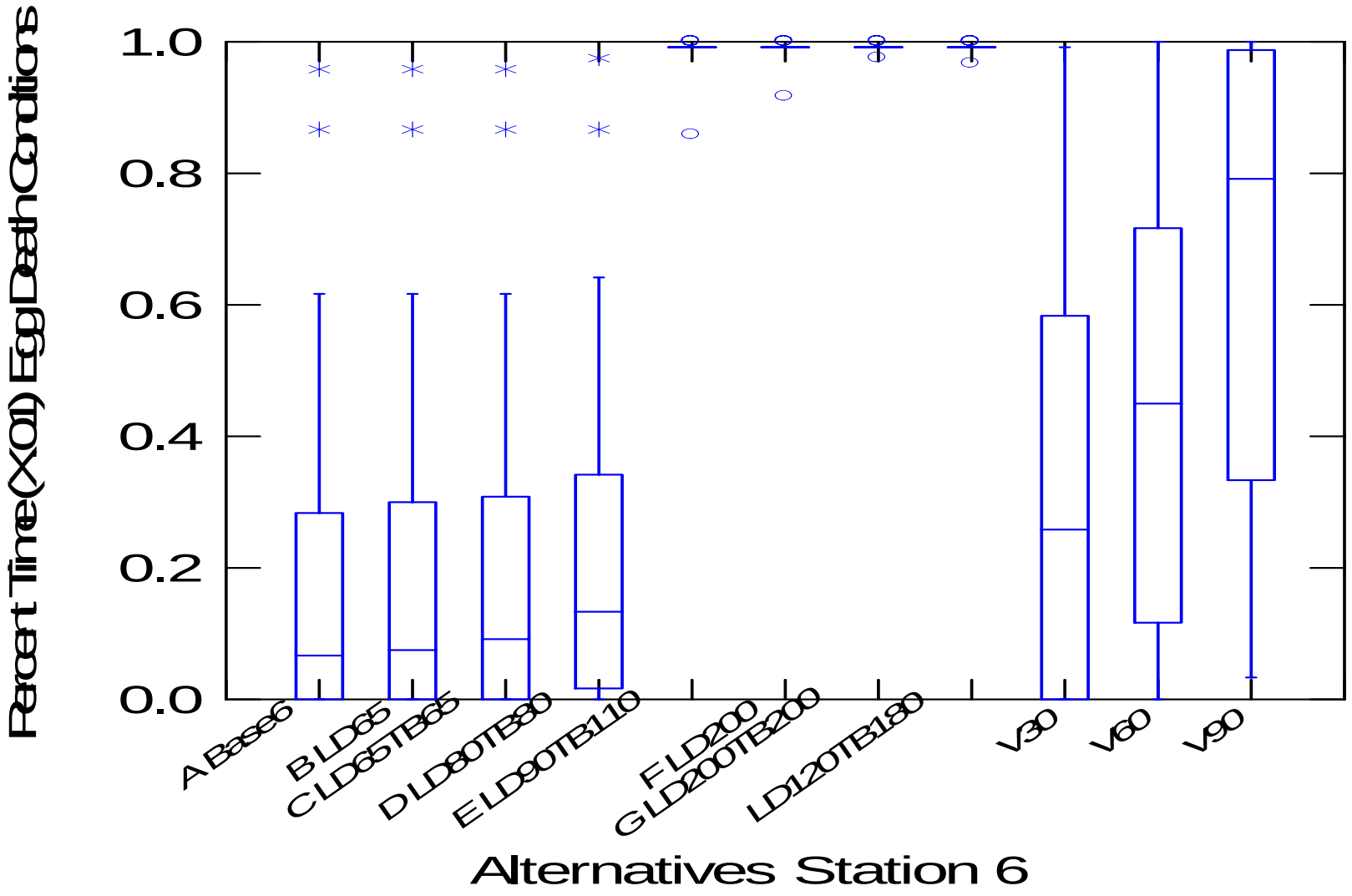
Estimated average monthly flows obtained from the NSM-SLE model (31 year or 372 month POR) to address the frequency of occurrence

- Flows less than 350 cfs for 178 months or less (or 47.8% of the time) Further refinement needed and planned for using LSZ concept
- Flows between 350 and 2,000 cfs for 171 months or more (or 46.0%)
- Flows between 2,000 and 3,000 cfs for 18 months or less (or 4.8%)
- Flows greater than 3,000 cfs for 5 months or less (1.3%)

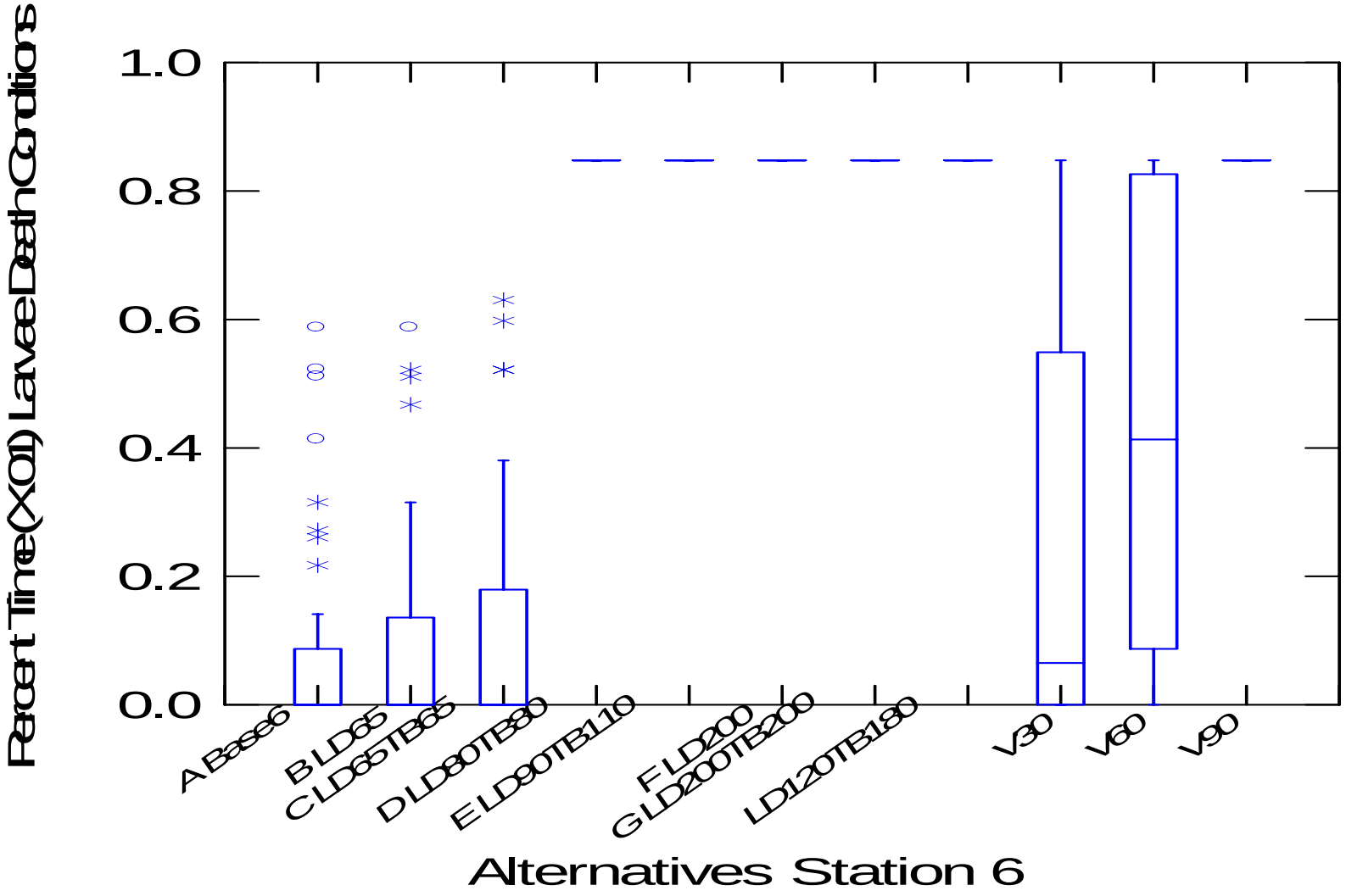
Salinity tolerances for Oyster life stages to address high flow target (seasonality and daily salinity for greater resolution)

Life Stage	Salinity (ppt)	Duration (days)	J	F	M	A	M	J	J	A	S	O	N	D	Reference
Eggs			X	X	X	X									Wilson et al. 2004
Harm	7.5 - 10.0	1													Burrel 1986
Mortality	0.0 - 7.5	1													Burrel 1986
Larvae					X	X	X								Wilson et al. 2004
Stress	10.0 - 12.0	1													Loosanoff 1965; Davis 1958
Harm	0.0 - 10.0	1													Davis 1958
Mortality	0.0 - 10.0	14													Davis 1958
Spat & Juveniles						X	X	X	X						Wilson et al. 2004
Stress	5.0 – 10.0	1													Ray and Benefield 1997
Harm	0.0 -5.0	1													Loosanoff 1953
Mortality	0.0 – 5.0	7													Volety et al. 2003
Adults			X	X	X	X	X	X	X	X	X	X	X	X	
Stress	7.5 - 10.0														Woodward-Clyde 1998
Harm	5.0 – 7.5	1													Loosanoff 1953, 1965
Mortality	2.0 – 5.0	28													Loosanoff 1953; Volety et al 2003
Mortality	0.0 – 2.0	14													Roesijadi 2004

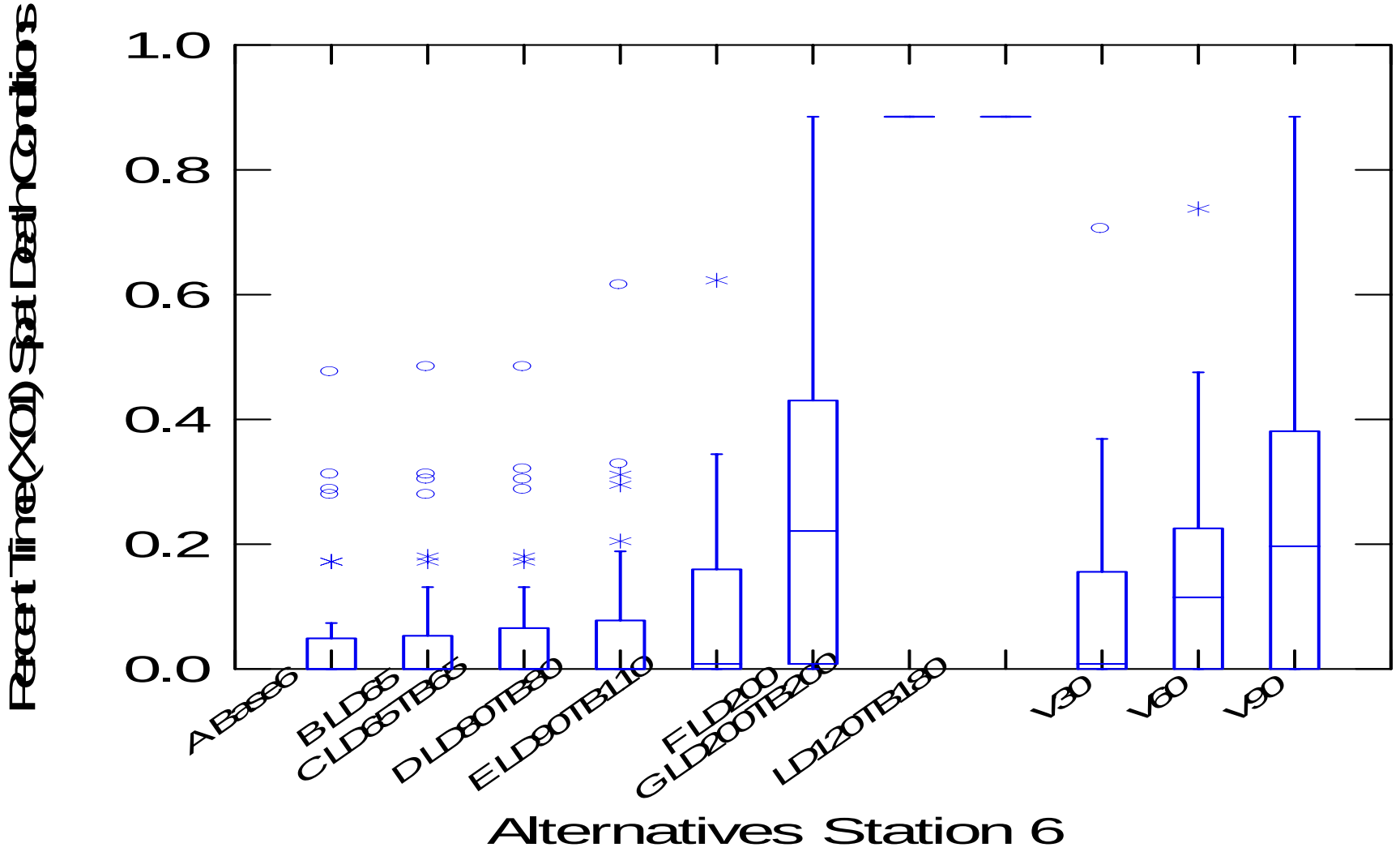
Example: Oyster Model Results (Eggs) for Alternative Water Management Scenarios for Loxahatchee Management Plan



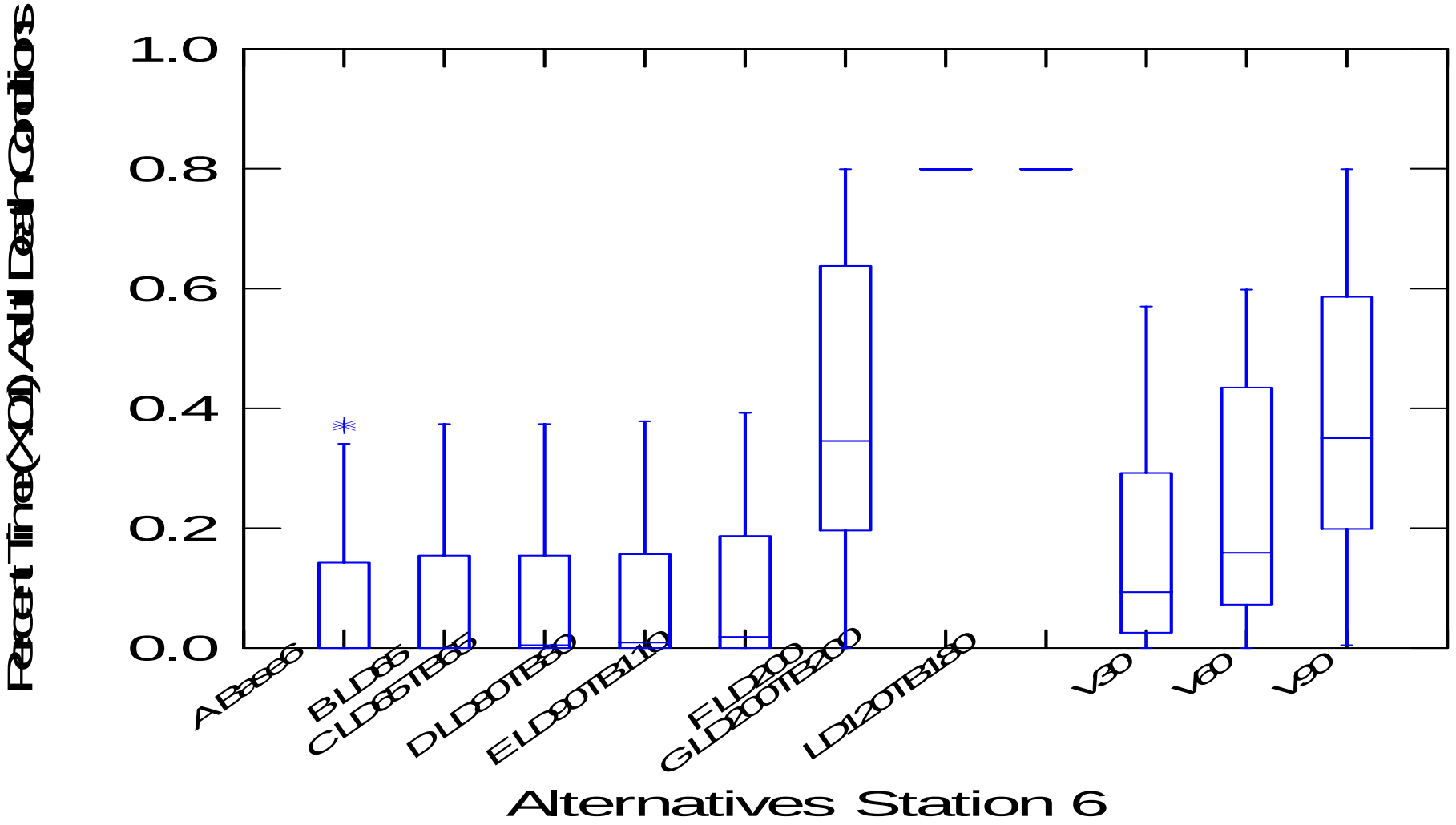
Example: Oyster Model Results (Larvae) for Alternative Water Management Scenarios for Loxahatchee Management Plan



Example: Oyster Model Results (Spat) for Alternative Water Management Scenarios for Loxahatchee Management Plan



Example: Oyster Model Results (Adults) for Alternative Water Management Scenarios for Loxahatchee Management Plan



Future Enhancement of Low Flow Target Using Low Salinity Zone/Fish Nursery Function as a VEC

Effects of dredging the North and South Forks of the SLE on salinity gradients and available fish nursery habitat

CH3D SLE Model simulations to develop a family of curves and salinity time series for “historical” conditions.

Studies are being conducted to determine the relationship of flow/salinity on the LSZ/ fish nursery function

Thank You for Your Attention

?????

????? Time for Questions ?????

?????

Table 1. St. Lucie River Watershed Land Use Data (2004/2005) and Categories

Updated on March 20, 2008 based on data provided by Cecilia on March 18, 2009

(Including the six summary basins flow directly into SL Estuary)

Land Use Category	Land Use Description	FLUCCS	Area (ac)	Percent	Sum_Area (ac)	Percent
Residential Low Density	Residential Low Density	1100	22,050	4.3%	22,050	4.3%
Residential Medium Density	Residential Medium Density	1200	38,206	7.4%	38,206	7.4%
Residential High Density	Residential High Density	1300	7,698	1.5%	7,698	1.5%
Other Urban	Commercial and Services	1400	5,090	1.0%	15,907	3.1%
	Industrial	1500	2,034	0.4%		
	Extractive	1600	640	0.1%		
	Institutional	1700	2,977	0.6%		
	Recreational	1800	5,167	1.0%		
Improved Pastures	Improved Pastures	2110	106,321	20.7%	106,321	20.7%
Unimproved Pastures	Unimproved Pastures	2120	15,033	2.9%	15,033	2.9%
Woodland Pastures/Rangeland	Woodland Pastures	2130	25,205	4.9%	39,351	7.7%
	Rangeland	3000	14,147	2.8%		
Row Crops	Row Crops	2140	7,881	1.5%	7,881	1.5%
Sugar Cane	Sugar Cane	2156	5,562	1.1%	5,562	1.1%
Citrus	Citrus	2210	116,442	22.6%	116,442	22.6%
Sod Farms	Sod Farms	2420	294	0.1%	294	0.1%
Ornamentals	Ornamentals	2430	1,246	0.2%	1,246	0.2%
Horse Farms	Horse Farms	2510	784	0.2%	784	0.2%
Dairies	Dairies	2520	419	0.1%	419	0.1%
Other Areas	Field Crops	2150	2,800	0.5%	4,108	0.8%
	Other Groves	2230	48	0.0%		
	Cattle Feeding Operations	2310	105	0.0%		
	Poultry Feeding Operations	2320	107	0.0%		
	Tree Nurseries	2410	463	0.1%		
	Specialty Farms	2500	133	0.0%		
	Aquaculture	2540	204	0.0%		
	Fallow Crop Land	2610	248	0.0%		
Water	Water	5000	11,411	2.2%	11,411	2.2%
Natural Areas	Upland Forests	4000	37,608	7.3%	105,380	20.5%
	Wetlands	6000	61,052	11.9%		
	Barren Land	7000	2,613	0.5%		
	Open Land	1900	4,108	0.8%		
Transportation	Transportation	8100	5,665	1.1%	5,665	1.1%
Communication/Utilities	Communication	8200	91	0.0%	10,529	2.0%
	Utilities	8300	10,438	2.0%		
Total			**514,287**	**100.0%**	**514,287**	**100.0%**

Table 2. St. Lucie River Watershed Land Use Data by Summary Basin (2004/2005)

Updated on March 20, 2008 (based on data provided by Cecilia on March 18, 2008)

FLUCCS	Basins 4 5 6	C-23	C-24	C-44&S-153	North Fork*	Tidal St. Lucie**	Grand Total
1100	4315.6	1909.4	1236.1	1813.7	9445.0	3329.8	22049.7
1200	1236.1	303.7	2505.9	314.9	30453.4	3392.3	38206.3
1300	702.6		295.0	185.7	4784.2	1730.3	7697.8
1400	222.9	9.0	39.8	204.4	3453.9	1159.8	5089.8
1500	133.2	48.3	55.5	76.7	1552.3	167.8	2033.7
1600	0.8	411.5			92.3	135.2	639.8
1700	110.3	661.7	21.7	97.7	1567.1	518.3	2976.7
1800	683.8	254.8	665.6	209.5	2308.4	1045.2	5167.3
1900	110.8	9.8	74.7	148.7	3291.5	472.2	4107.5
2110	1006.7	33628.0	33949.7	23185.0	4998.8	9552.4	106320.6
2120	86.4	5062.0	6064.3	2167.9	558.4	1094.1	15033.1
2130	374.6	8697.3	6890.3	6457.9	1071.8	1712.9	25204.8
2140	156.1	1696.2	1550.3	852.5	1166.2	2459.9	7881.1
2150		1574.6	834.7	390.9			2800.2
2156				5240.1		321.7	5561.8
2210	30.2	32466.1	17487.8	42754.5	20678.2	3025.4	116442.2
2220							0.0
2230	5.0	17.1			26.2		48.3
2310		104.7					104.7
2320			44.3	62.5			106.8
2410	100.2	153.8	55.5	85.3	68.3	0.1	463.1
2420				294.1			294.1
2430	211.0		25.1	267.6	237.9	504.4	1246.0
2500				28.7	23.9	79.9	132.6
2510	53.7	54.0	14.1	591.6		71.1	784.4
2520		419.1					419.1
2540	60.1	70.4	23.3		9.5	40.8	204.2
2610		216.7			31.3		247.9
3000	394.5	1603.5	220.1	6383.5	3494.0	2051.0	14146.6
4000	2679.0	2723.8	1264.5	11535.9	12030.8	7373.6	37607.6
5000	382.5	1810.5	1218.4	1890.7	4317.3	1791.3	11410.7
6000	1262.5	16278.9	12248.2	15114.6	9485.1	6662.2	61051.5
7000		1108.1	297.8	939.0	235.2	33.2	2613.4
8100	297.6	455.4	521.1	611.2	2623.4	1156.6	5665.3
8200	10.9	10.2		5.6	64.3		91.0
8300	428.3	916.1	102.4	7808.5	1099.2	83.1	10437.6
Grand Total	15055.4	112674.5	87705.8	129718.9	119167.9	49964.7	514287.2

*North Fork basin includes North Fork and N.Mid.Estuary

**Tidal St. Lucie basin includes South Fork and S.Mid.Estuary

Table 1 Summary of Nitrogen Load to SLE

Sub-watershed	Area (acres)	Average Annual Discharge[(1)] (1995-2005) (Acre-ft)	Average Annual TN Load[(2)] (1995-2005) (MTons)	Average Annual TN Conc. (Calculated) (1995-2005) (ppb)
Basins 4 5 6	15,055	23,620	34	1,182
C-23	112,675	152,789	330	1,750
C-24	87,706	178,853	355	1,609
C-44&S-153	129,719	158,194	300	1,540
North Fork*	119,168	126,152	185	1,191
Tidal St. Lucie**	49,965	59,408	91	1,244
Lake Okeechobee	-	414,754	922	1,802
Total	514,287	1,113,771	2,218	1,615

*North Fork basin includes North Fork and N. Mid. Estuary

**Tidal St. Lucie basin includes South Fork and S. Mid. Estuary

(1) Measured data are used for flow from C-23 basin, C-24 basin, C-44&S-153 basin, and Lake Okeechobee. WaSh Model output data are used for flow from North Fork basin, South Fork basin, and Basin 4 5 6.

(2) Measured data are used for TN concentration for C-23 basin, C-24 basin, C-44&S-153 basin, and Lake Okeechobee. WaSh Model output data are used for TN concentration for North Fork basin, South Fork basin, and Basin 4 5 6.

Table 2 Summary of Phosphorus Load to SLE

Sub-watershed	Area (acres)	Average Annual Discharge[(1)] (1995-2005) (Acre-ft)	Average Annual TP Load[(2)] (1995-2005) (MTons)	Average Annual TP Conc. (Calculated) (1995-2005) (ppb)
Basins 4 5 6	15,055	23,620	6	219
C-23	112,675	152,789	91	481
C-24	87,706	178,853	76	343
C-44&S-153	129,719	158,194	40	203
North Fork*	119,168	126,152	43	278
Tidal St. Lucie**	49,965	59,408	21	285
Lake Okeechobee	-	414,754	96	188
Total	514,287	1,113,771	373	271

*North Fork basin includes North Fork and N. Mid. Estuary

**Tidal St. Lucie basin includes South Fork and S. Mid. Estuary

(1) Measured data are used for flow from C-23 basin, C-24 basin, C-44&S-153 basin, and Lake Okeechobee. WaSh Model output data are used for flow from North Fork basin, South Fork basin, and Basin 4 5 6.

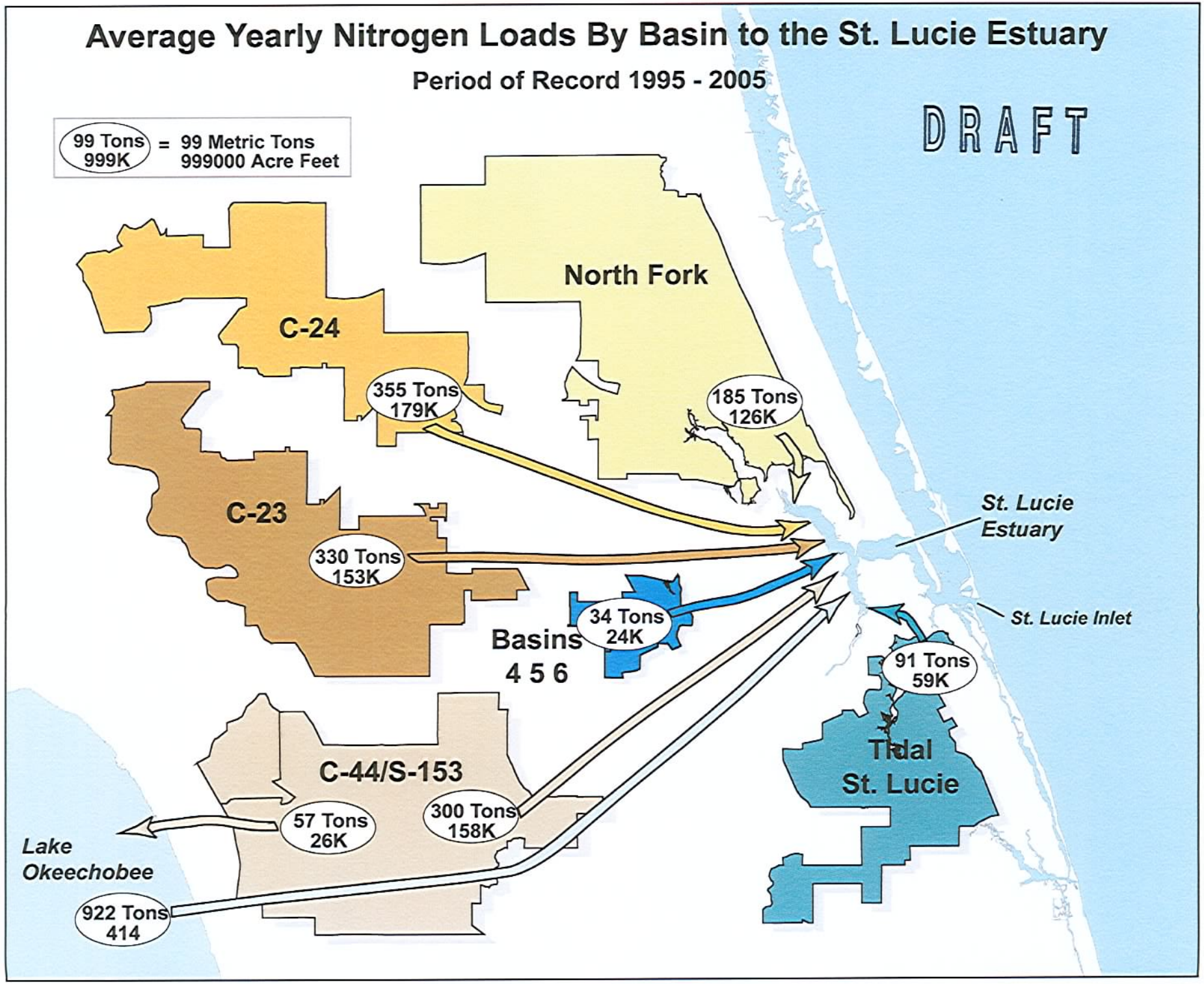
(2) Measured data are used for TP concentration for C-23 basin, C-24 basin, C-44&S-153 basin, and Lake Okeechobee. WaSh Model output data are used for TP concentration for North Fork basin, South Fork basin, and Basin 4 5 6.

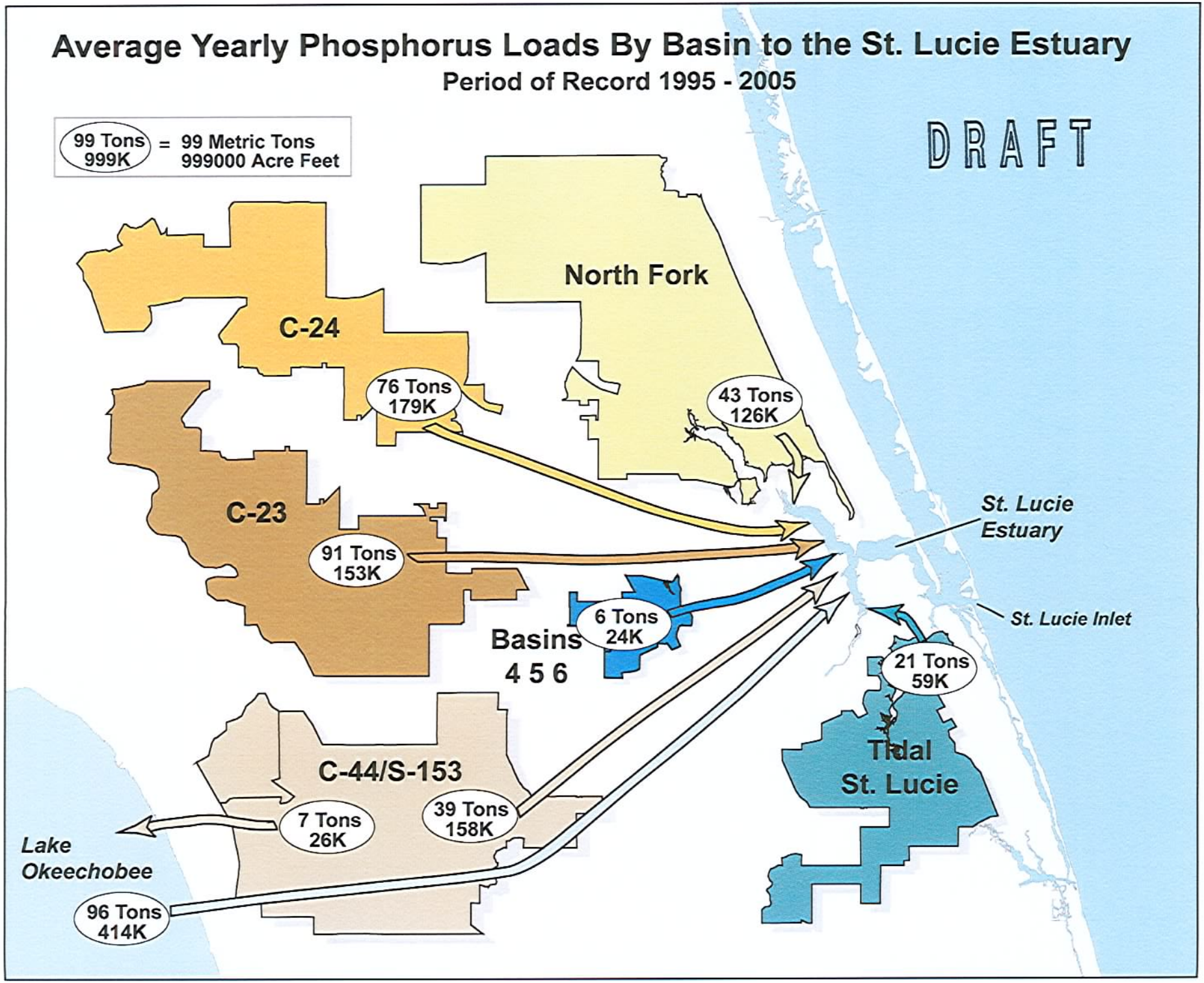
Average Yearly Nitrogen Loads By Basin to the St. Lucie Estuary

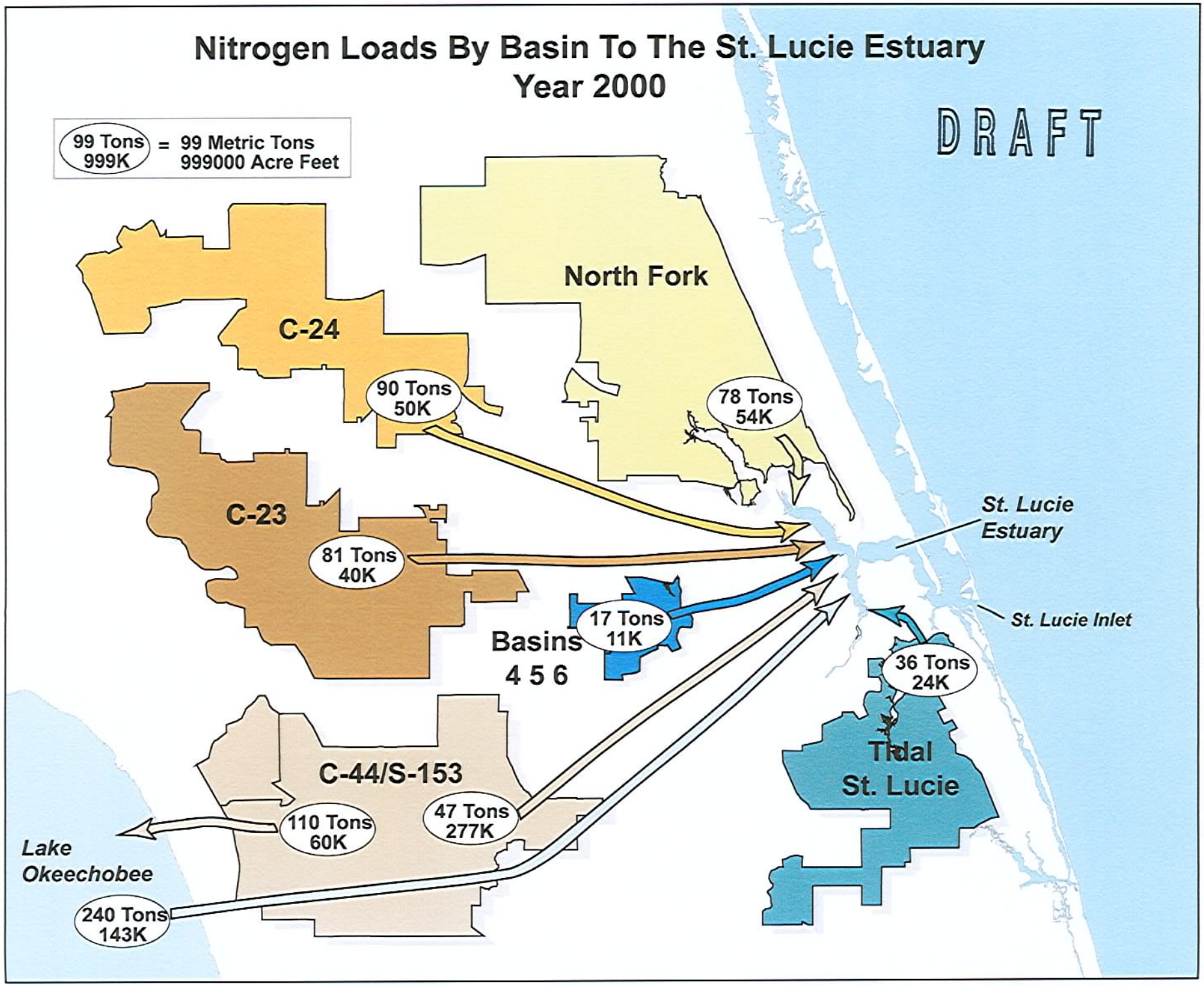
Period of Record 1995 - 2005

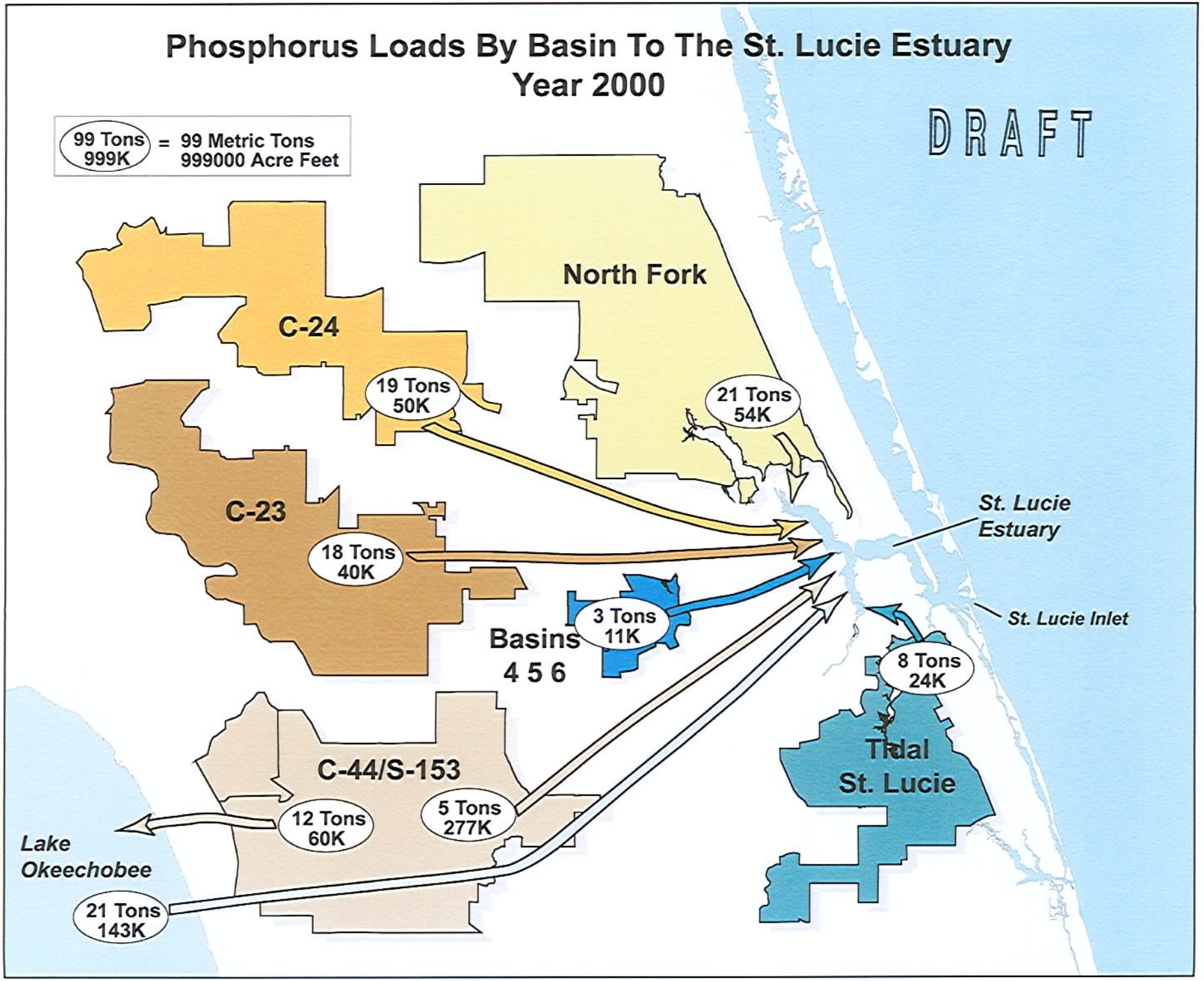
DRAFT

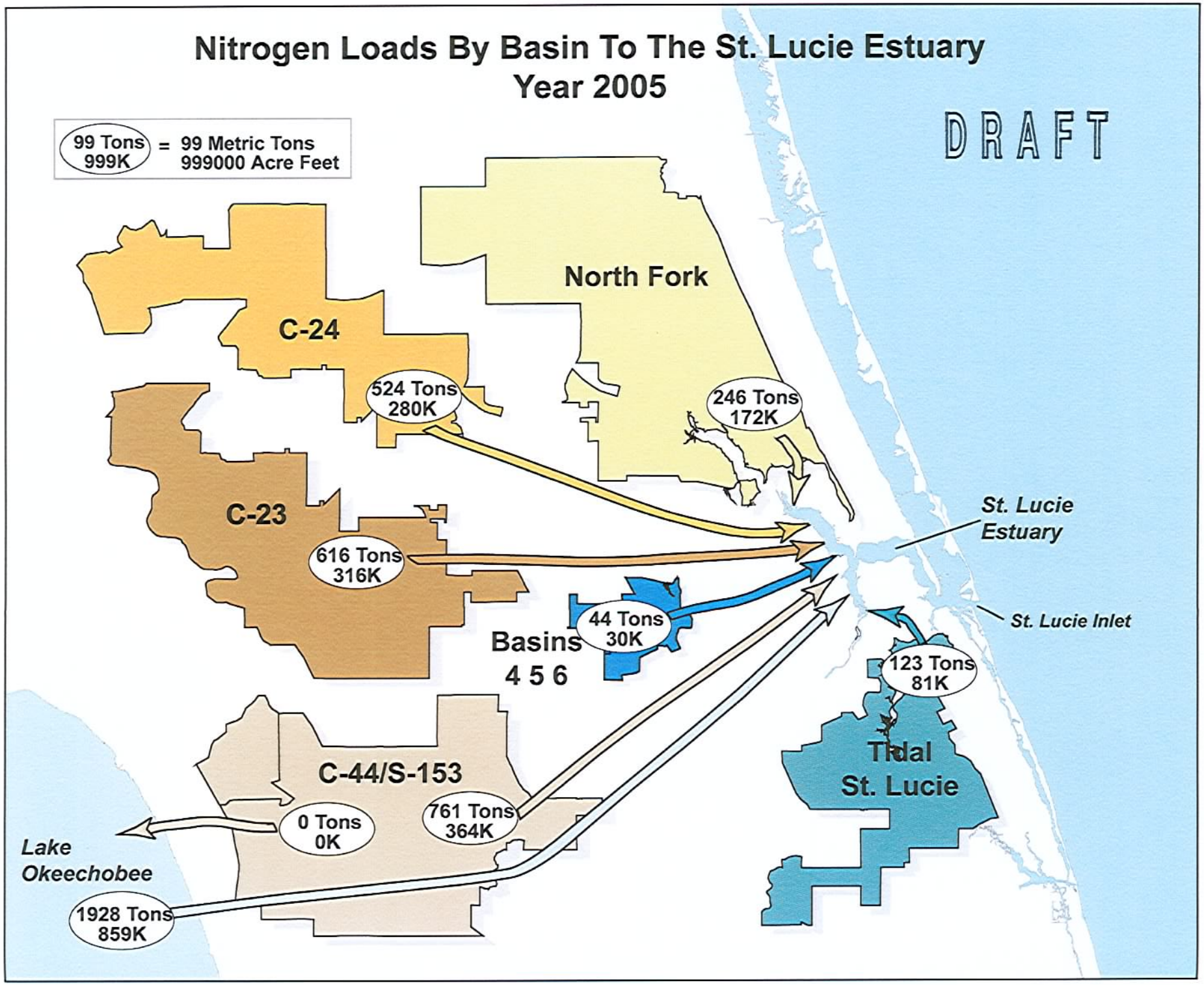
99 Tons 999K = 99 Metric Tons 999000 Acre Feet

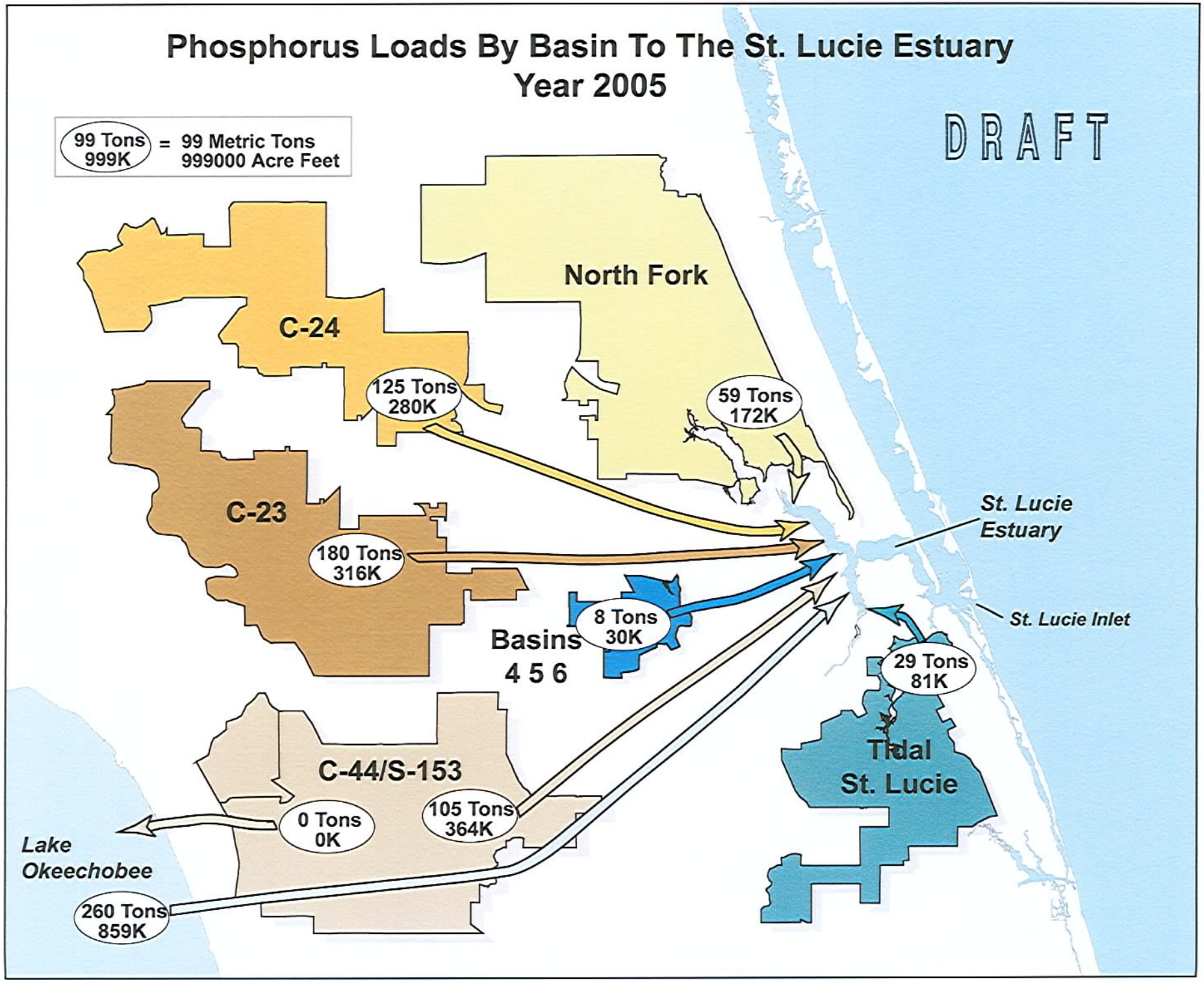



Average Yearly Phosphorus Loads By Basin to the St. Lucie Estuary
Period of Record 1995 - 2005
DRAFT
99 Tons 999K = 99 Metric Tons 999000 Acre Feet
North Fork
C-24
76 Tons 179K
43 Tons 126K
C-23
91 Tons 153K
St. Lucie Estuary
St. Lucie Inlet
6 Tons 24K
Basins 4 5 6
21 Tons 59K
Tidal St. Lucie
C-44/S-153
7 Tons 26K
39 Tons 158K
Lake Okeechobee
96 Tons 414K


Nitrogen Loads By Basin To The St. Lucie Estuary
Year 2000
DRAFT
99 Tons 999K = 99 Metric Tons 999000 Acre Feet
North Fork
C-24
90 Tons 50K
78 Tons 54K
C-23
81 Tons 40K
St. Lucie Estuary
17 Tons 11K
Basins 4 5 6
St. Lucie Inlet
36 Tons 24K
Tidal St. Lucie
C-44/S-153
110 Tons 60K
47 Tons 277K
Lake Okeechobee
240 Tons 143K


Phosphorus Loads By Basin To The St. Lucie Estuary
Year 2000
DRAFT
99 Tons 999K = 99 Metric Tons 999000 Acre Feet
North Fork
C-24
19 Tons 50K
21 Tons 54K
C-23
18 Tons 40K
St. Lucie Estuary
3 Tons 11K
Basins 4 5 6
St. Lucie Inlet
8 Tons 24K
Tidal St. Lucie
C-44/S-153
12 Tons 60K
5 Tons 277K
Lake Okeechobee
21 Tons 143K


Nitrogen Loads By Basin To The St. Lucie Estuary
Year 2005
DRAFT
99 Tons
999K
=
99 Metric Tons
999000 Acre Feet
North Fork
C-24
524 Tons
280K
246 Tons
172K
C-23
616 Tons
316K
St. Lucie
Estuary
St. Lucie Inlet
44 Tons
30K
Basins
4 5 6
123 Tons
81K
Tidal
St. Lucie
C-44/S-153
0 Tons
0K
761 Tons
364K
Lake
Okeechobee
1928 Tons
859K


Phosphorus Loads By Basin To The St. Lucie Estuary
Year 2005
DRAFT
99 Tons 999K = 99 Metric Tons 999000 Acre Feet
North Fork
C-24
125 Tons 280K
59 Tons 172K
C-23
180 Tons 316K
St. Lucie Estuary
8 Tons 30K
Basins 4 5 6
St. Lucie Inlet
29 Tons 81K
Tidal St. Lucie
C-44/S-153
0 Tons 0K
105 Tons 364K
Lake Okeechobee
260 Tons 859K

St. Lucie River Watershed Protection Plan
DRAFT Management Measures
3/25/2008

MM#	Sub-Watershed	Project Feature/Activity	Level
LO 1		Agricultural BMPs - Owner Implemented	1
LO 2		Agricultural BMPs - Funded Cost Share	1
LO 3		Urban Turf Fertilizer Rule (LOER)	1
LO 4		Land Application of Residuals	1
LO 5		Florida Yards and Neighborhoods	1
LO 7		ERP Regulatory Program	1
LO 8		NPDES Stormwater Program	1
LO 9		Coastal and Estuarine Land Conservation Program	1
LO 12		Alternative Water Storage (AWS) - Lake Okeechobee and Estuary Recovery	-
LO 12f		AWS - Indiantown Citrus Growers Association	1
LO 12j		AWS - Dupuis	4
LO 12m		AWS - Waste Management St. Lucie Site	4
LO 12q		AWS - Caulkins	4
LO 14		CERP - IRL South: C-44 Reservoir/STA	B
LO 15		St. Lucie River Watershed Works of the District Rule Regulatory Phosphorus Source Control Program	2
LO 21		LO and Estuary Watershed Basin Rule (LOER)	3
LO 38		C-44 Littoral	4
LO 49		Agricultural BMPs - Cost Share Future Funding	1
LO 50		Agricultural BMPs - Additional Agricultural BMPs	1
LO 62		Florida Power and Light Martin Cooling Pond	
LO 63		Wastewater and Stormwater Master Plans	4
LO 64		Unified Statewide Stormwater Rule	4
LO 65		L-65 Culvert to L-8 Tieback	4
LO 66		L-8 Reservoir Phase I	B
LO 68		Comprehensive Planning-Land Development Regulations	3
LO 87		Florida Ranchlands Environmental Services Projects (FRESP)	-
LO 87a_1		Alderman-Deloney Ranch (C-25 basin)	1
LO 87c		Florida Ranchlands Environmental Services Project- full implementation	5
LO 91		Farm and Ranchland Protection Program Partnership	4
LO 96		Deep Well Injection- C-44 St. Lucie Canal	4
LO 101		ECP Diversions	B
LO 102		EAA Reservoir	B
SLE 01		Harmony Heights Subdivision (Phase II – V)	1
SLE 02		White City Canal D	1
SLE 03		White City Drainage Improvements (Citrus/Saeger)	1
SLE 04		White City Drainage Improvements (canals B, C, E, F, G)	2
SLE 05		Paradise Park Stormwater Improvements (Phase III – V construction)	1
SLE 06		Indian River Estates/Savannas Ecosystem Management Project	1
SLE 07		Platt's Creek Wetland Restoration	2
SLE 08		Indian River Drive Stormwater Outfall Retrofits	1
SLE 09		Natural Lands in CERP IRL-South Project	-
SLE 09a		CERP - IRL South: PalMar Complex - Natural Storage and Water Quality Area	2
SLE 09b		CERP - IRL South: Allapattah Complex - Natural Storage and Water Quality Area	2
SLE 09c		CERP - IRL South: Cypress Creek/Trail Ridge Complex - Natural Storage and Water Quality Area	2
SLE 10		St. Lucie Watershed Natural Area Registry Program	1
SLE 11		Creation of suitable oyster substrate in the St. Lucie Estuary	2

MM#	Sub-Watershed	Project Feature/Activity	Level
SLE 12		Increased retention/detention areas within the C-23 and C-24 Basins	5
SLE 13		On-site Sewage Treatment and Disposal System (OSTDS) inspection and pump-out program	4
SLE 16		Improved management of sludge disposal in St. Lucie County through the use of an innovative technology (Plasma-Arc)	1
SLE 18		Additional Reservoir Storage and Treatment Areas	-
SLE 18a		Reservoir and/or Stormwater Treatment Area along the south side of the C-44 Canal	5
SLE 19		Conversion of existing canals into “linear wetland treatment areas”	3
SLE 22		North River Shores Vacuum Sewer System	1
SLE 23		CERP - IRL South: PalMar Complex - Natural Storage and Water Quality Area	1
SLE 24		CERP - IRL South: C-23/24 Reservoir/STA	1
SLE 26		CERP - IRL South: Northfork Natural Floodplain Restoration	1
SLE 27		CERP - IRL South: Muck Remediation and Artificial Habitat	1
SLE 28		Tropical Farms Roebuck Creek Stormwater Quality Retrofit	1
SLE 29		Old Palm City Phase III Stormwater Quality Retrofit	1
SLE 30		Manatee Pocket Dredging Project	1
SLE 31		Stormwater Baffle Box Retrofit - City of Stuart	
SLE 32		Old Palm City/Danforth Creek Stormwater Quality Retrofit	3
SLE 33		North St. Lucie River Water Control District Stormwater Retrofit; Structures 81-1-2 and 85-1-2	
SLE 34		Indiantown Citrus Growers Water Conservation Project, Phase II	
SLE 35		All American Boulevard Ditch Retrofit	3
SLE 37		Living Shoreline Initiative	3
SLE 38		Urban BMP Program	1
SLE 39		Aquifer Storage and Recovery (ASR)	4
SLE 39a		ASR at C-44 Reservoir (IRL-S)	4
SLE 39b		ASR at C-23/24 Reservoir (IRL-S)	4
SLE 40		CERP – IRL South: Southern Diversion C-23 to C-44 interconnect	1
SLE 41		Martin County Baffle Boxes	4
SLE 42		Jensen Beach Retrofit	1
SLE 43a		Leilani Hts/ Warner Creek Retrofit - Phase 1	1
SLE 43b		Leilani Hts/ Warner Creek Retrofit - Phase 2	3
SLE 43c		Leilani Hts/ Warner Creek Retrofit - Phase 3	4
SLE 44		Manatee Creek Water Quality Retrofit; PhII & PhIII; New Monrovia, Dixie Park	1

Levels:

B - Base condition; Project included in base model runs

Level 1- Already constructed/implemented or construction/implementation imminent

Level 2- Construction/implementation likely; Detailed design/activity development ongoing; Location well defined

Level 3- Implementation certainty unknown; Conceptual level of design/activity development complete; Location defined

Level 4- Implementation certainty unknown- Conceptual idea; May have rough order of magnitude cost and/or general basin location

Level 5- Implementation certainty unknown-Conceptual idea with limited information

St. Lucie River Watershed Protection Plan
DRAFT - WORKING COPY March 25, 2008
INITIAL PRELIMINARY DRAFT: SLRWPP ALTERNATIVE 1

MM#	Sub-Watershed	Project Feature/Activity	Level	Alt.
LO 101		ECP Diversions	B	0
LO 102		EAA Reservoir	B	0
LO 14		CERP - IRL South: C-44 Reservoir/STA	B	0
LO 66		L-8 Reservoir Phase I	B	0
LO 1		Agricultural BMPs - Owner Implemented	1	1
LO 12f		AWS - Indiantown Citrus Growers Association	1	1
LO 2		Agricultural BMPs - Funded Cost Share	1	1
LO 3		Urban Turf Fertilizer Rule (LOER)	1	1
LO 4		Land Application of Residuals	1	1
LO 49		Agricultural BMPs - Cost Share Future Funding	1	1
LO 5		Florida Yards and Neighborhoods	1	1
LO 50		Agricultural BMPs - Additional Agricultural BMPs	1	1
LO 7		ERP Regulatory Program	1	1
LO 8		NPDES Stormwater Program	1	1
LO 87a_1		Alderman-Deloney Ranch (C-25 basin)	1	1
LO 9		Coastal and Estuarine Land Conservation Program	1	1
SLE 16		Improved management of sludge disposal in St. Lucie County through the use of an innovative technology (Plasma-Arc)	1	1
SLE 22		North River Shores Vacuum Sewer System	1	1
SLE 23		CERP - IRL South: PalMar Complex - Natural Storage and Water Quality Area	1	1
SLE 24		CERP - IRL South: C-23/24 Reservoir/STA	1	1
SLE 26		CERP - IRL South: Northfork Natural Floodplain Restoration	1	1
SLE 27		CERP - IRL South: Muck Remediation and Artificial Habitat	1	1
SLE 28		Tropical Farms Roebuck Creek Stormwater Quality Retrofit	1	1
SLE 29		Old Palm City Phase III Stormwater Quality Retrofit	1	1
SLE 30		Manatee Pocket Dredging Project	1	1
SLE 38		Urban BMP Program	1	1
SLE 40		CERP – IRL South: Southern Diversion C-23 to C-44 interconnect	1	1
SLE 42		Jensen Beach Retrofit	1	1
SLE 43a		Leilani Hts/ Warner Creek Retrofit - Phase 1	1	1
SLE 44		Manatee Creek Water Quality Retrofit; PhII & PhIII; New Monrovia, Dixie Park	1	1
LO 15		St. Lucie River Watershed Works of the District Rule Regulatory Phosphorus Source Control Program	2	1
SLE 09a		CERP - IRL South: PalMar Complex - Natural Storage and Water Quality Area	2	1
SLE 09b		CERP - IRL South: Allapattah Complex - Natural Storage and Water Quality Area	2	1
SLE 09c		CERP - IRL South: Cypress Creek/Trail Ridge Complex - Natural Storage and Water Quality Area	2	1
LO 21		LO and Estuary Watershed Basin Rule (LOER)	3	1
LO 68		Comprehensive Planning-Land Development Regulations	3	1
LO 12j		AWS - Dupuis	4	1
LO 12m		AWS - Waste Management St. Lucie Site	4	1
LO 12q		AWS - Caulkins	4	1
LO 63		Wastewater and Stormwater Master Plans	4	1
LO 64		Unified Statewide Stormwater Rule	4	1
LO 12		Alternative Water Storage (AWS) - Lake Okeechobee and Estuary Recovery	-	1
LO 87		Florida Ranchlands Environmental Services Projects (FRESP)	-	1
LO 87c		Florida Ranchlands Environmental Services Project- full implementation	5	1
SLE 09		Natural Lands in CERP IRL-South Project	-	1

DRAFT - WORKING COPY March 25, 2008

INITIAL PRELIMINARY DRAFT: SLRWPP ALTERNATIVE 1

MM#	Sub-Watershed	Project Feature/Activity	Level	Alt.
LO 62		Florida Power and Light Martin Cooling Pond		1
SLE 01		Harmony Heights Subdivision (Phase II – V)	1	?
SLE 02		White City Canal D	1	?
SLE 03		White City Drainage Improvements (Citrus/Saeger)	1	?
SLE 05		Paradise Park Stormwater Improvements (Phase III – V construction)	1	?
SLE 06		Indian River Estates/Savannas Ecosystem Management Project	1	?
SLE 08		Indian River Drive Stormwater Outfall Retrofits	1	?
SLE 10		St. Lucie Watershed Natural Area Registry Program	1	?
SLE 04		White City Drainage Improvements (canals B, C, E, F, G)	2	?
SLE 07		Platt's Creek Wetland Restoration	2	?
SLE 11		Creation of suitable oyster substrate in the St. Lucie Estuary	2	?
SLE 31		Stormwater Baffle Box Retrofit - City of Stuart		?
SLE 33		North St. Lucie River Water Control District Stormwater Retrofit; Structures 81-1-2 and 85-1-2		?
SLE 34		Indiantown Citrus Growers Water Conservation Project, Phase II		?