Hydrologic Systems Modeling Evaluation

2010 Case Study with EAA Reservoir Storage Volume Doubled

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Definition of Simulation

The simulation of the components that would be implemented by 2010, also referred to as the 2010 Case Study (2010CS) was rerun with double the EAA storage volume. In this investigation the 2010CS with twice the EAA storage, referred to as EAARSX2, is compared with the 2010 Case Study simulation.

Assumptions

The footprints of the EAA reservoirs was maintained at 50,000 acres as in the 2010CS, while the maximum depth of the reservoirs was increased from six feet in 2010CS to twelve feet in EAARSX2. In order to keep the total volumetric storage capacity constant in Compartment 1 (which receives EAA runoff and supplies water for EAA irrigation requirements only), it's surface acreage was decreased from 20,000 acres in 2010CS to 10,000 acres in EAARSX2. The surface acreage of Compartment 2 (which receives regulatory releases from Lake Okeechobee and provides environmental supplies to the WCAs) increased from 30,000 acres in 2010CS to 40,000 acres in EAARSX2, an actual increase in total volumetric storage capacity of 2.67 times.

Summary of results

Increasing the EAA storage volume allowed increased regulatory flows from LOK to EAA Reservoir Compartment 2, resulting in slightly lower high lake stages and slightly higher low lake stages. Regulatory releases to the Estuaries were slightly reduced. Outflow from the EAA Reservoir Compartment to WCA-3 increased, however the operational rules and structural capacities controlling releases to WCA-3 remained the same as in the 2010CS, so there were no significant changes to the WCAs. There was slightly more flow through the WCAs to the ENP. LOSA water supply was improved by a more efficient EAA Reservoir Compartment 1.

Detailed evaluation

Lake Okeechobee

The Lake Okeechobee stage hydrograph (Fig. 1) and duration curve (Fig. 2) show that the EAARSX2 simulation had very similar lake stages compared to the 2010CS with slight decreases in high lake stages (< 0.2 ft) and increases in low lake stages (< 0.1 ft).

The EAARSX2 simulation shows a 20% increase in regulatory discharges (Fig. 3) from Lake Okeechobee to the EAA storage reservoir, over the 2010CS (346,000 vs 289,000 ac-ft/yr or an increase of 57,000 ac-ft/yr) as a result of the increased reservoir capacity. The increased reservoir capacity in the EAARSX2 simulation allowed additional LOK regulatory releases to the EAA storage reservoir which were not possible in the 2010CS when the EAA storage was full.

Regulatory discharges from Lake Okeechobee to the estuaries were 18% less (77,000 to 63,000 ac-ft/yr) to the Caloosahatchee Estuary and 16% less (31,000 to 26,000 ac-ft/yr) to the St. Lucie

Estuary. Regulatory releases from Lake Okeechobee directly to the WCAs were also reduced by 20% (82,000 to 66,000 ac-ft/yr).

<u>EAA Reservoirs</u>

The stage duration curve for EAA Reservoir Compartment 1 (used for EAA runoff, Fig. 4) shows no impact on the volume of stored water in EAARSX2 versus 2010CS simulations. The reduction of the surface acreage by half simply results in a doubling of the reservoir stage above ground elevation.

The stage duration curve for Compartment 2 (used to supply environmental needs, Fig. 5) depicts a more than doubling of the volume of stored water in EAARSX2 versus 2010CS evident during the periods of high reservoir stages. Very small differences in stage are detected during periods of low reservoir stages. Note that the increased surface area in the EAARSX2 simulation means that more water is stored than was stored for the same stage in the 2010CS. There was a 25% (346,000 vs 289,000 ac-ft/yr or an additional 57,000 ac-ft/yr) increase in flow from EAA storage, compartment 2, to the WCAs.

<u>Caloosahatchee and St. Lucie Estuaries</u>

In the EAARSX2 simulation there were slightly fewer undesirable high flows than in the 2010CS. For the Caloosahatchee Estuary salinity envelope criteria, the total number of months flows exceeded 2,800 cfs due to either local basin discharges or Lake Okeechobee regulatory releases decreased by 2 from 30 in the 2010CS to 28 in the EAARSX2 simulation (Fig. 6). For the St. Lucie Estuary, the number of exceedences of the high flow criteria due to either local basin discharges or Lake Okeechobee regulatory releases decreased from 42 in the 2010CS to 41 in the EAARSX2 simulation (Fig. 7).

<u>Water Conservation Areas</u>

In all the WCAs, the length of hydroperiods (Inundation Duration Summary, Table 1), and the high and low water exceedences (Tables 2 and 3) for the EAARSX2 simulation were very similar to those of the 2010CS simulation. Stage duration curves for the WCAs (Figs. 8-14) illustrate the similarity in stage and hydroperiod between the EAARSX2 and 2010CS simulations in the WCAs.

<u>Everglades National Park</u>

The EAARSX2 simulation had a slight increase in the total net inflow delivered to ENP (expressed as a % of NSM45) from 77% (2010CS) to 78%. However, stages were very similar (Fig. 15). The values used to compute these percentages are shown in Table 4 (Fig. 16 shows location of the TT-W and TT-E flow transects).

Table 4. Total Net Inflows to Everglades National Park
(values are mean annual flows for the 31-yr simulation in units in 1000ac-ft/yr except as noted)

Simulation	S12's	TT-W (R23,C17-21)	TT-E (R23,C22-26)	TT-gw	S356's+ max(S332's-LvSpg,0)	Total Net Inflow (% of NSM)
NSM45	-	467	739	6	425 (overland flow)	1637 (100%)
D13R	-	478	485	7	342	1312 (80%)
2010CS	602	-	276	15	369	1262 (77%)
EAARSX2	614	-	276	15	373	1278 (78%)

TT-W = Tamiami Trail west (40-mile bend to L-67)
TT-E = Tamiami Trail east (L-67 to L-31N)
TT-gw = groundwater inflow from WCA-3 to ENP

Flows to delivered to the Shark River Slough (SRS) headwaters (expressed as a % of NSM45) increased from 69% (2010CS) to 70% in the EAARSX2 simulation. The distribution of flows to the SRS headwaters was similar in the 2010CS and EAARSX2 simulations, namely approximately 45% to NWSRS and 55% to NESRS (Table 5). Shark River Slough outflows toward Whitewater and Florida Bays (Table 5) were increased from 66% of NSM in the 2010CS to 67% of NSM in the EAARSX2 simulation (Fig. 16 shows location of the NWSRS, NESRS and SRS flow transects).

Table 5. Inflows to Shark River Slough (SRS) headwaters inflows and outflows toward Whitewater and Florida Bays.
(values are mean annual flows for the 31-yr simulation in units in 1000ac-ft/yr)

Simulation	Inflow to SRS headwater			SRS outflow toward Whitewater and Florida Bays (% of NSM)
	NWSRS	NESRS	Total (% of NSM)	
NSM45	504	1030	1534 (100%)	1566 (100 %)
D13R	429	702	1131 (74%)	1110 (71%)
2010CS	483	574	1057 (69%)	1037 (66%)
EAARSX2	492	580	1072 (70%)	1050 (67%)

Hydroperiod matches (Fig. 17) for ENP increased from 75% in the 2010CS to 76% in the EAARSX2.

Biscayne Bay

There was no difference in the total inflow to Biscayne Bay between the EAARSX2 simulation and 2010CS (Fig. 18).

EAA/LOSA and LEC Service Areas

Irrigation demands not met for the Lake Service Area were slightly improved (2% lower in the EAA and 1% lower in other LOSA areas) for the EAARSX2 simulation compared to the 2010CS simulation for both mean annual years (Fig. 19) and in selected drought years (Fig. 20). These reductions in cutbacks can be attributed to a more efficient EAA Reservoir Compartment 1, and slightly higher low LOK stages. However, in the LOSA, there were still 7 years in the EAARSX2 simulation where cutbacks in water supply were greater than 40% due to Supply Side Management, the same as in the 2010CS (i.e. the severity of cutbacks is similar to the 2010CS).

The number of months of locally-triggered phase I water restrictions was the same in both the EAARSX2 simulation and 2010CS (Fig. 21). The number of lake-triggered water restriction months decreased by 2 from the 2010CS to the EAARSX2, and the number of months of restrictions triggered by the dry season criteria also decreased by 2 months.

Fig.1 Daily Stage Hydrographs for Lake Okeechobee

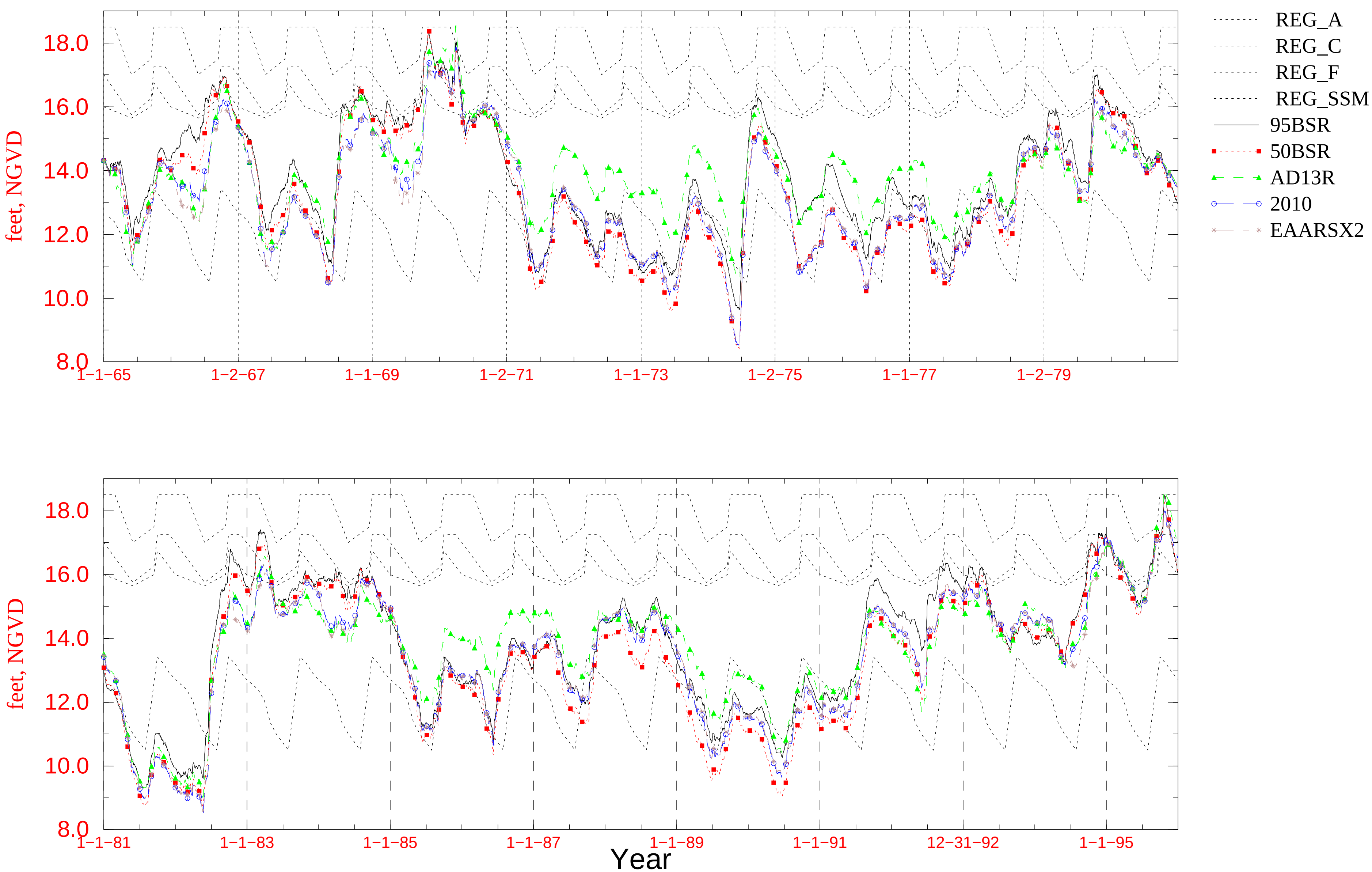

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Fig.2 Lake Okeechobee Stage Duration Curves

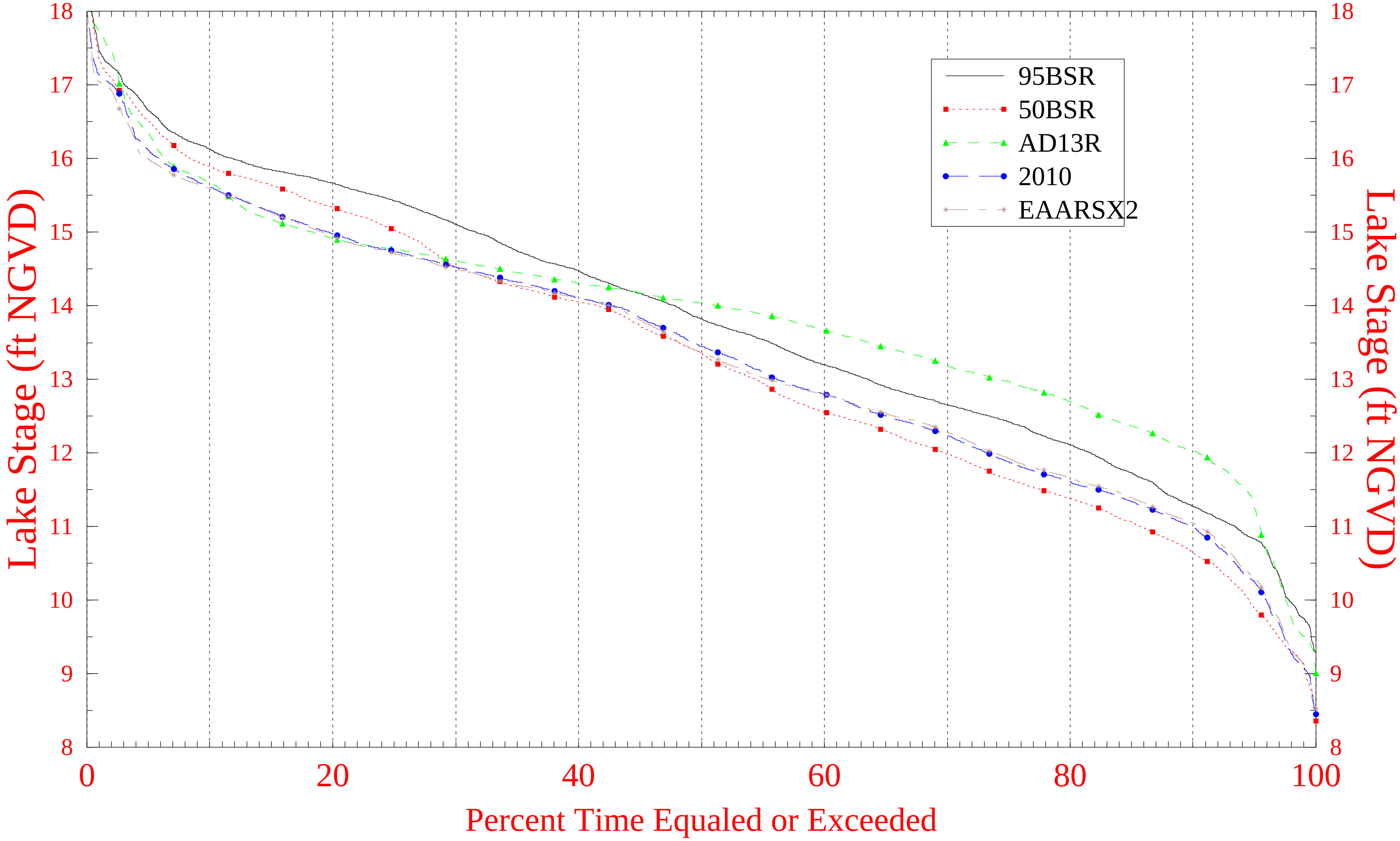

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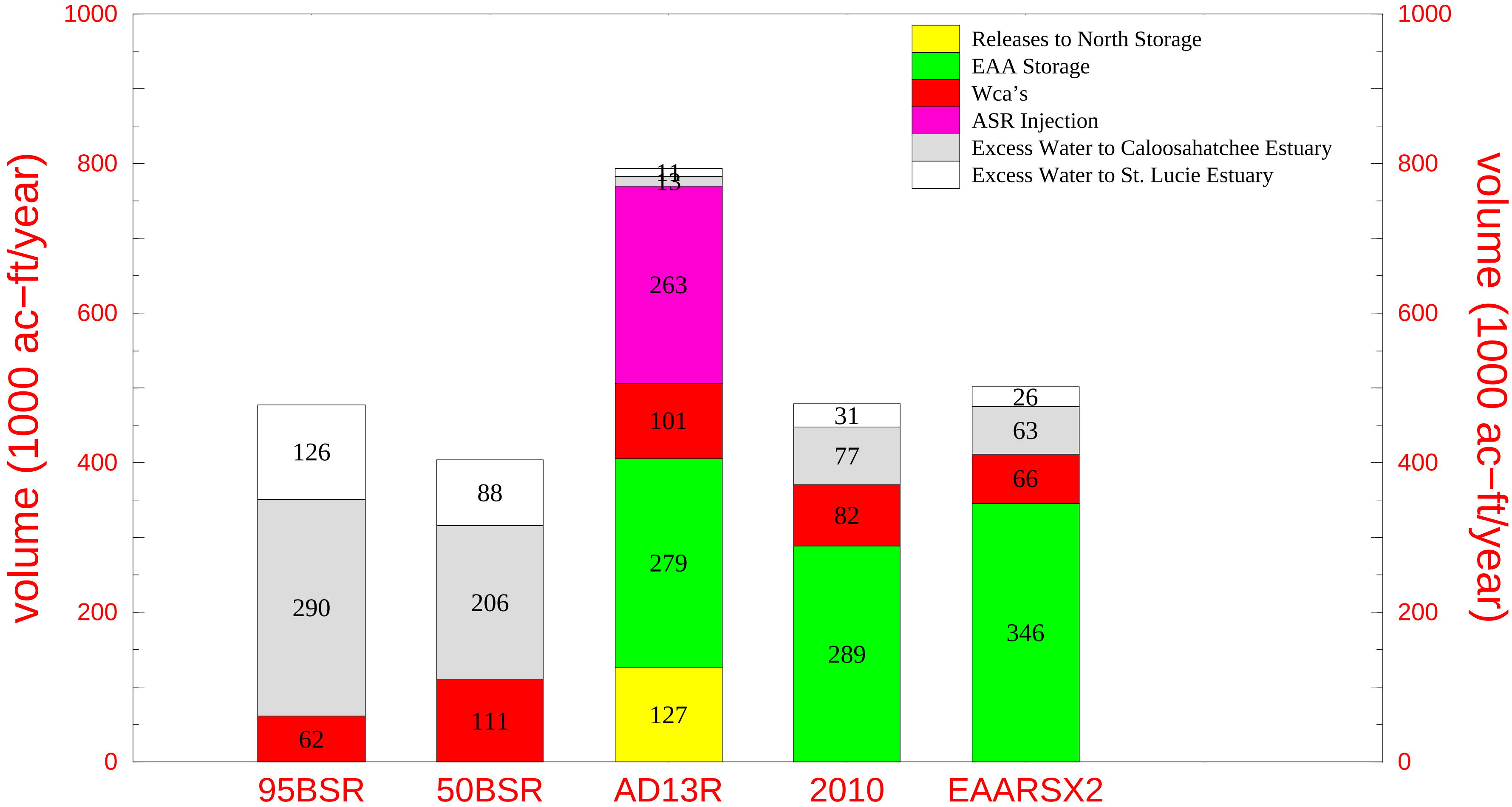
Fig.3 Mean Annual Flood Control Releases from Lake Okeechobee for the 31 yr (1965 − 1995) Simulation



Note: Although regulatory (flood control) discharges are summarized here in mean annual values, they do not occur every year. Typically they occur in 2−4 consecutive years and may not occur for up to 7 consecutive years.

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Fig.4 Stage Duration Curves at EAA Compartment 1 Reservoir

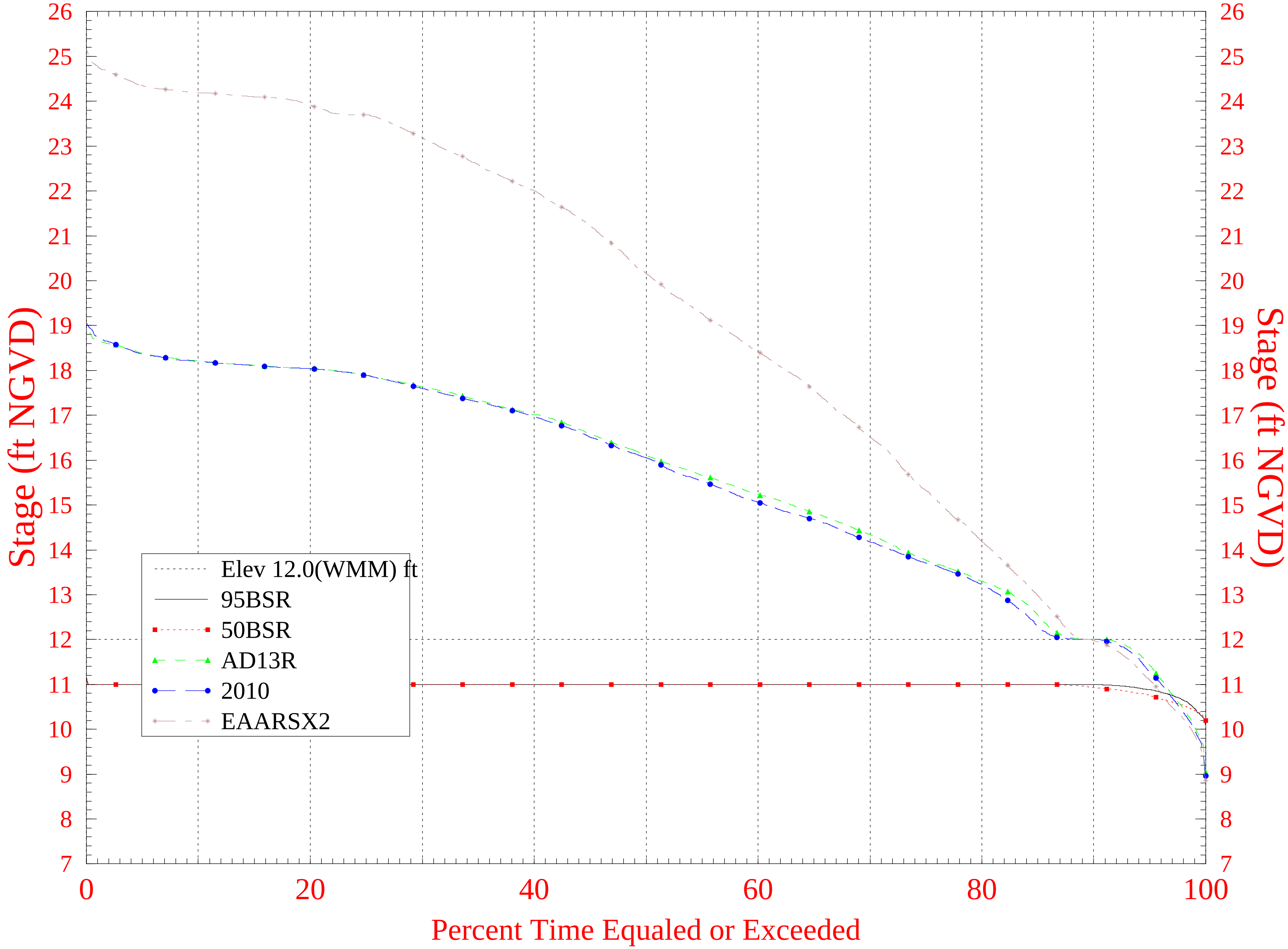

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Fig.5 Stage Duration Curves at EAA Compartment 2A Reservoir

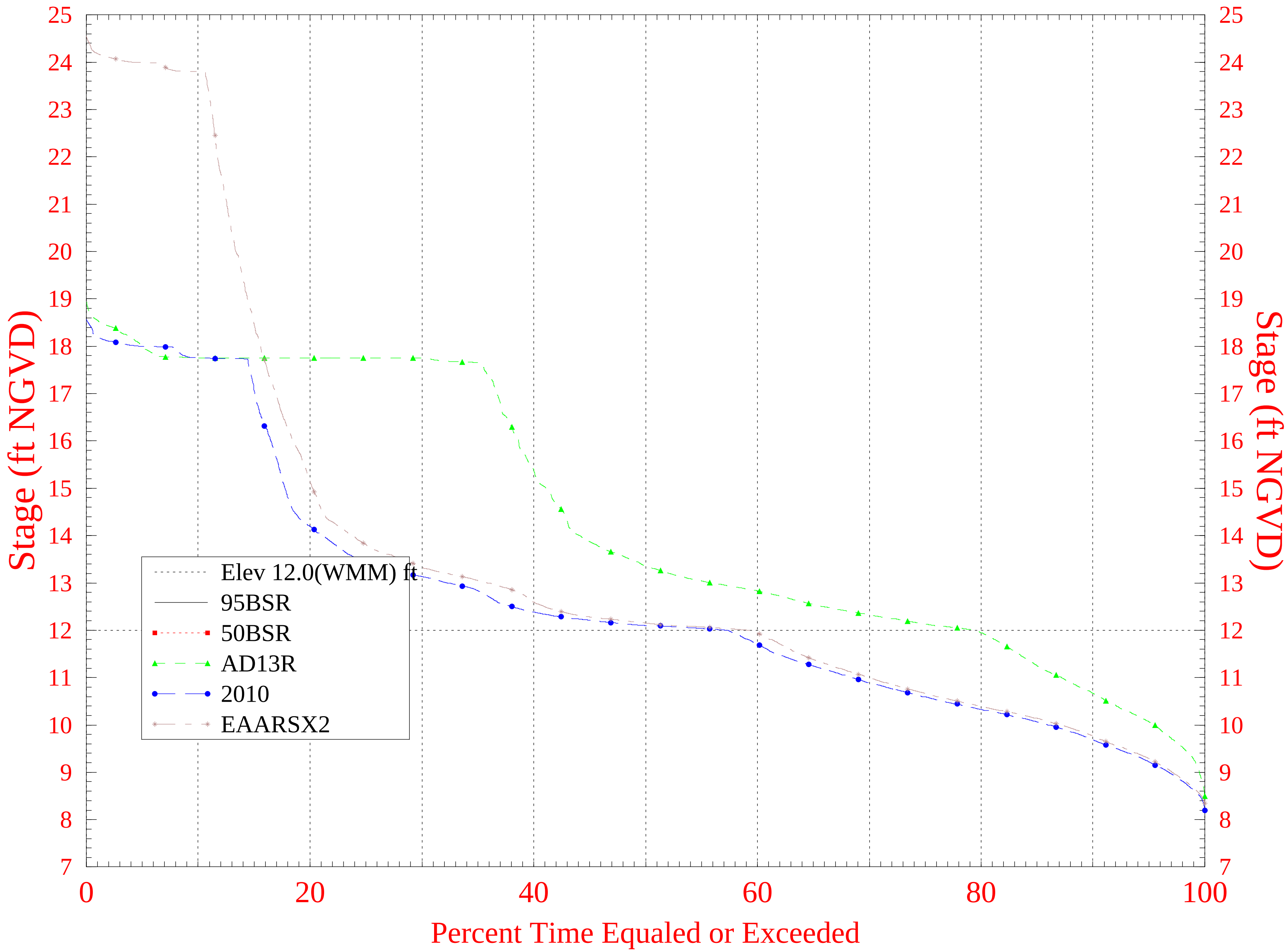

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Fig.6 Number of times Salinity Envelope Criteria were NOT met for the Caloosahatchee Estuary (mean monthly flows 1965 − 1995)

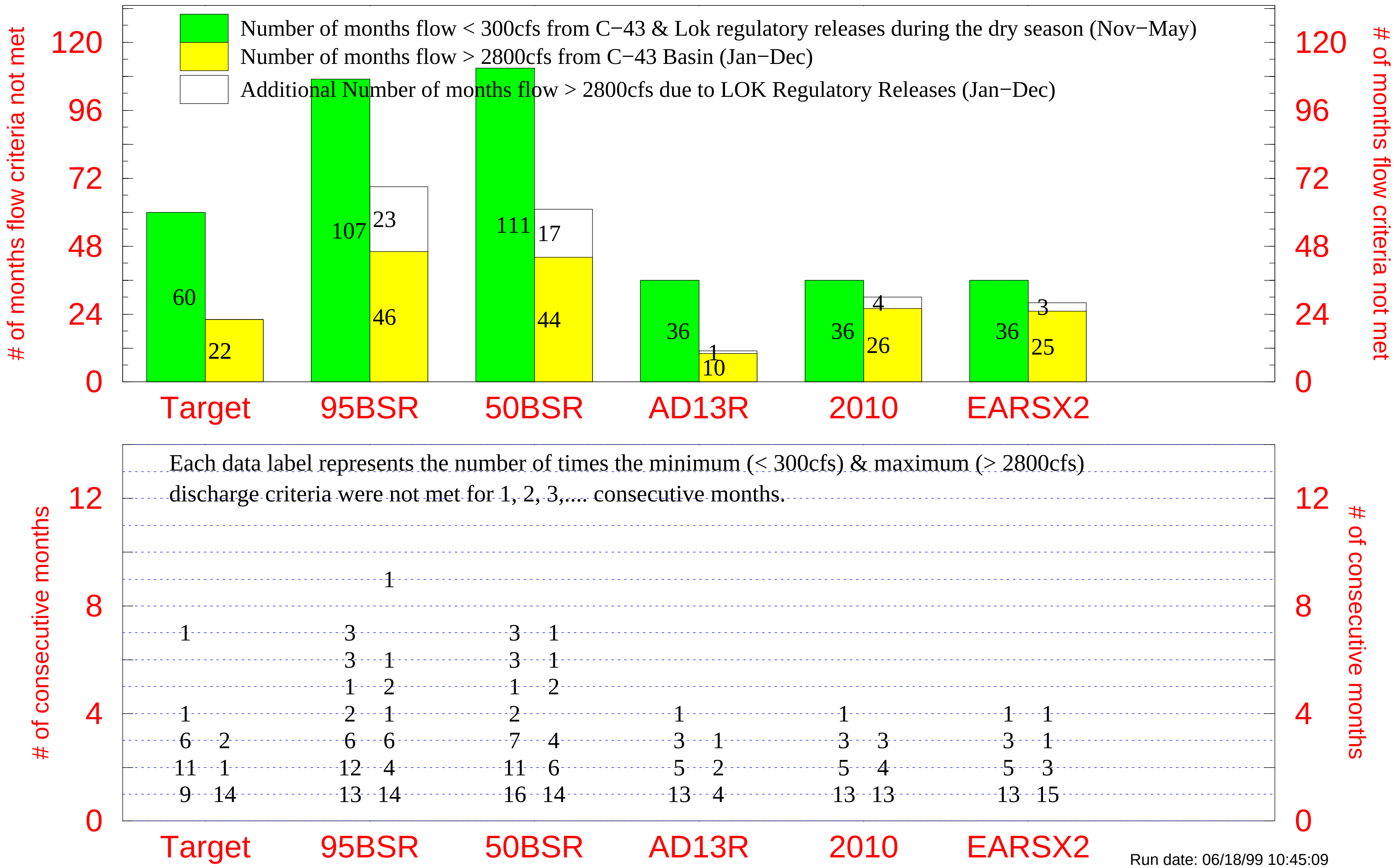

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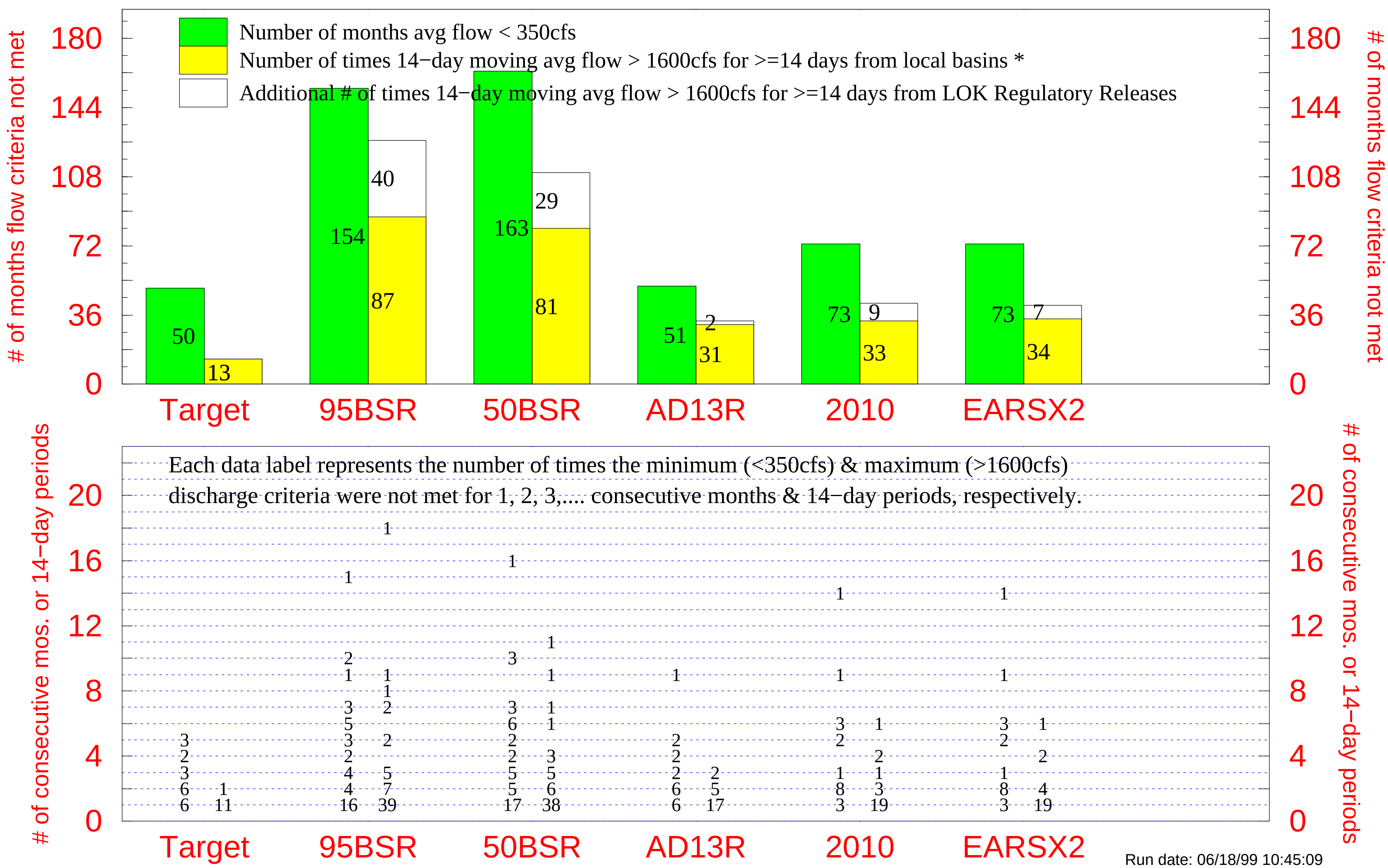
Fig.7 Number of times Salinity Envelope Criteria were NOT met for the St. Lucie Estuary



Note: local basins include the C−44, C−23, C−24, North Fork, and South Fork Basins

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Table 1 Inundation Duration Summary for Indicator Regions

#Events|Avg Flood Dur(Wks/Event)|Avg Ann Hydper(Percent of Yr)

Indicator Region Number	Name	NSM45F #Events	NSM45F Avg Flood Dur	NSM45F Avg Ann Hydper	95BSR #Events	95BSR Avg Flood Dur	95BSR Avg Ann Hydper	50BSR #Events	50BSR Avg Flood Dur	50BSR Avg Ann Hydper	AD13R #Events	AD13R Avg Flood Dur	AD13R Avg Ann Hydper	2010 #Events	2010 Avg Flood Dur	2010 Avg Ann Hydper	EAARSX2 #Events	EAARSX2 Avg Flood Dur	EAARSX2 Avg Ann Hydper
1	Taylor Slough	37	33	76	37	32	73	38	30	71	36	32	72	36	32	71	36	32	71
2	West Perrine Marl Marsh	68	9	39	70	9	39	70	9	38	67	9	39	68	9	39	68	9	39
3	Mid−Perrine Marl Marsh	43	23	60	41	24	61	51	17	53	50	17	54	50	17	53	50	17	53
4	C−111 Perrine Marl Marsh	47	21	62	73	12	55	71	13	59	44	28	76	48	22	65	49	22	66
5	Model Lands South	55	19	64	64	14	57	71	14	60	34	40	84	53	23	75	52	23	75
6	Model Lands North	43	27	72	97	6	37	87	7	36	109	7	45	96	7	40	96	7	40
7	Ochopee Marl Marsh	35	32	70	38	24	57	37	29	68	38	28	66	40	24	61	40	25	61
8	Rockland Marl Marsh	37	28	65	53	8	26	42	17	45	37	26	59	38	23	55	38	23	55
9	SW Shark River Slough	9	176	98	19	75	89	15	98	91	10	156	97	15	98	91	15	98	91
10	Mid Shark River Slough	5	321	100	16	93	92	14	108	94	4	398	99	13	116	93	13	115	93
11	NE Shark River Slough	4	402	100	21	67	88	21	68	89	7	226	98	20	73	90	19	77	90
12	New Shark River Slough	32	42	82	29	45	80	32	40	80	28	50	87	35	35	75	36	34	76
13	West Slough	38	28	66	36	30	67	38	31	74	34	32	67	38	28	67	38	28	67
14	South WCA−3A	17	88	92	6	267	99	15	101	94	11	139	95	20	74	92	20	74	92
15	West WCA−3B	20	74	92	11	141	96	19	79	93	4	398	99	16	95	94	16	95	94
16	East WCA−3B	15	102	95	18	81	90	28	50	86	6	263	98	20	73	91	20	73	91
17	South Central WCA−3A	24	59	87	14	109	95	24	59	88	14	110	95	21	71	92	19	78	92
18	North Central WCA−3A	24	59	89	17	86	91	21	69	89	12	130	97	12	126	94	12	127	94
19	East WCA−3A	25	55	86	7	227	99	15	100	93	13	115	93	21	70	91	21	69	90
20	NW WCA−3A	21	70	91	33	40	81	27	51	86	23	62	88	26	53	85	28	49	85
21	NE WCA−3A	28	49	85	40	30	74	20	73	91	30	45	84	26	53	86	27	51	86
22	NW Corner WCA−3A	20	73	91	34	36	77	19	77	91	18	85	95	22	68	93	23	65	93
23	WCA−2B	21	70	92	21	63	82	17	82	86	20	66	81	18	72	80	18	72	80
24	South WCA−2A	20	74	91	19	76	89	16	90	89	18	78	88	20	71	88	20	71	88
25	North WCA−2A	30	46	86	16	86	85	19	77	90	16	93	92	15	99	92	16	93	92
26	South LNWR (WCA−1)	25	57	89	7	229	100	16	95	94	7	228	99	7	228	99	7	228	99
27	North LNWR (WCA−1)	15	99	92	13	119	96	20	72	90	16	96	95	19	80	95	19	80	95
28	Rotenberger WMA	40	31	76	52	18	59	38	34	79	41	31	79	43	30	79	42	30	79
29	Holey Land WMA	28	50	88	14	108	94	12	128	95	28	50	88	30	47	88	28	51	88
30	Corbett WMA	61	13	50	64	3	13	55	4	13	56	3	10	50	4	13	50	4	13
31	Mullet Slough	64	14	56	56	13	46	57	13	46	59	14	50	58	13	46	58	13	46
32	Upland Pine	56	15	51	56	15	53	57	15	52	57	15	52	57	15	52	57	15	52
33	Upper Mullet Slough	64	8	33	64	8	33	64	8	33	65	8	33	64	8	33	64	8	33
34	Cypress Marsh	36	35	78	42	12	31	42	12	31	42	12	31	42	12	31	42	12	31
35	Wet Prairie	31	43	82	42	19	50	42	19	50	42	19	50	42	19	50	42	19	50
36	Wetter Prairie NE	59	18	65	59	16	60	68	14	57	64	15	59	69	14	58	69	14	58
37	Wetter Prairie SW	58	17	63	65	14	56	71	12	54	67	14	58	72	12	55	72	12	55
38	Drier Cypress NW	67	10	40	67	9	38	68	9	38	68	9	39	68	9	38	68	9	38
39	Drier Cypress NE	62	14	55	65	12	48	64	12	48	66	12	50	62	12	48	62	12	48
40	Cypress	48	23	67	50	21	65	53	20	64	48	22	65	53	20	64	53	20	64
41	NW Big Cypress	54	16	53	59	12	46	59	12	46	59	12	46	59	12	46	59	12	46
42	NE Big Cypress	44	22	61	56	12	43	56	12	43	55	16	53	56	12	43	56	12	43
43	NE Corner Big Cypress	39	31	75	37	4	10	38	4	9	45	14	38	37	4	9	37	4	9
44	SW Big Cypress	62	14	54	60	14	54	60	14	54	60	14	54	60	14	54	60	14	54
45	Racoon Point	61	11	42	67	10	40	65	10	39	64	10	40	66	10	39	66	10	40
47	North C−111	48	20	60	92	5	26	58	4	14	55	10	35	52	8	26	53	8	26
48	North Bisc. Bay Groundwater 1	14	7	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49	North Bisc. Bay Groundwater 2	49	15	46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50	Central Bisc. Bay Groundwater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
51	South Bisc. Bay Groundwater	34	5	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
52	Pennsuco Wetlands North	21	70	91	37	35	80	30	43	79	13	119	96	22	67	92	22	67	91
53	Pennsuco Wetlands South	9	176	98	30	42	79	37	32	74	18	82	91	26	53	85	25	55	85
46	Cape Sable Sparrow A	37	30	68	36	28	62	34	34	72	35	30	66	34	31	64	34	31	64
54	Cape Sable Sparrow B	69	9	40	67	9	39	68	9	39	66	10	40	67	10	40	65	10	40

55	Cape Sable Sparrow C	40	22	54	47	6	17	43	15	39	35	21	46	36	20	45	35	21	45
56	Cape Sable Sparrow D	45	22	61	43	23	62	58	15	53	53	16	54	52	16	53	52	16	53
57	Cape Sable Sparrow E	47	17	50	50	8	26	56	11	39	39	19	47	43	17	46	44	17	46
58	Cape Sable Sparrow F	36	30	67	18	3	3	40	17	42	40	23	57	42	21	55	40	22	55
61	WCA−2B1	20	72	89	49	21	63	24	50	74	46	22	62	45	23	65	44	24	65
62	WCA−2B2	24	61	91	31	37	71	20	65	80	50	19	59	29	39	71	29	39	71
63	WCA−2B3	20	74	92	16	89	89	16	91	91	19	75	89	17	82	87	18	77	86
64	WCA−2B4	25	56	87	5	320	99	8	199	99	5	319	99	8	198	98	8	198	98
65	WCA−2B5	14	110	95	10	145	90	10	149	93	14	106	92	13	111	90	13	111	90
66	N WCA−3B	27	49	82	14	109	95	22	66	89	10	156	97	15	102	95	14	109	95
67	NE WCA−3B	22	62	85	34	31	65	35	29	63	20	68	85	20	71	88	19	75	88
68	S of NE WCA−3A	28	50	86	17	89	94	28	51	88	28	50	87	26	53	85	26	53	85

Notes: #events = number of continuous ponding events over the period of record
Avg Flood Duration = [sum(days of ponding)/7]/#events
Avg Annual Hydroperiod = 100 x [sum(weeks of ponding per year)]/[52 x #years]

Table 2 High Water Summary for Indicator Regions

Indicator Region Number	Name	Depth(ft) Criterion	NSM45F #Events	NSM45F Avg Duration (Wks/Event)	NSM45F Avg Ann Duration (Percent of Yr)	95BSR #Events	95BSR Avg Duration (Wks/Event)	95BSR Avg Ann Duration (Percent of Yr)	50BSR #Events	50BSR Avg Duration (Wks/Event)	50BSR Avg Ann Duration (Percent of Yr)	AD13R #Events	AD13R Avg Duration (Wks/Event)	AD13R Avg Ann Duration (Percent of Yr)	2010 #Events	2010 Avg Duration (Wks/Event)	2010 Avg Ann Duration (Percent of Yr)	EAARSX2 #Events	EAARSX2 Avg Duration (Wks/Event)	EAARSX2 Avg Ann Duration (Percent of Yr)
1	Taylor Slough	> 1.5	10	2	1	7	2	1	5	2	0	5	2	1	5	2	1	5	2	1
2	West Perrine Marl Marsh	> 2.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	Mid−Perrine Marl Marsh	> 2.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	C−111 Perrine Marl Marsh	> 2.0	0	0	0	0	0	0	0	0	0	10	3	2	3	1	0	3	1	0
5	Model Lands South	> 2.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	Model Lands North	> 1.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	Ochopee Marl Marsh	> 2.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	Rockland Marl Marsh	> 2.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	SW Shark River Slough	> 2.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	Mid Shark River Slough	> 2.5	5	11	4	1	1	0	1	1	0	5	6	2	8	5	3	9	5	3
11	NE Shark River Slough	> 2.5	15	10	9	0	0	0	0	0	0	10	6	4	9	6	4	8	7	4
12	New Shark River Slough	Undefined																		
13	West Slough	Undefined																		
14	South WCA−3A	> 2.5	0	0	0	33	18	36	10	9	6	2	9	1	6	13	5	7	12	5
15	West WCA−3B	> 2.5	6	6	2	2	10	1	6	12	5	5	10	3	6	11	4	6	11	4
16	East WCA−3B	> 2.5	7	9	4	6	8	3	15	9	8	13	7	5	16	6	6	18	6	7
17	South Central WCA−3A	> 2.5	0	0	0	6	10	4	4	9	2	2	9	1	3	10	2	3	10	2
18	North Central WCA−3A	> 2.5	0	0	0	5	5	2	2	10	1	3	7	1	3	8	1	3	8	1
19	East WCA−3A	> 2.5	0	0	0	37	23	53	23	8	11	25	12	19	21	8	11	20	9	11
20	NW WCA−3A	> 2.5	0	0	0	1	7	0	1	6	0	1	1	0	2	5	1	2	5	1
21	NE WCA−3A	> 2.0	2	2	0	2	8	1	2	9	1	6	7	3	10	4	2	9	4	2
22	NW Corner WCA−3A	> 2.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	WCA−2B	> 2.5	4	5	1	20	13	17	15	60	56	25	7	10	22	7	9	22	7	9
24	South WCA−2A	> 2.5	0	0	0	3	1	0	5	2	1	4	5	1	4	4	1	4	4	1
25	North WCA−2A	> 2.5	0	0	0	0	0	0	1	1	0	3	1	0	2	1	0	2	1	0
26	South LNWR (WCA−1)	> 2.5	0	0	0	33	15	30	27	12	20	29	14	25	28	14	24	29	14	24
27	North LNWR (WCA−1)	> 2.5	0	0	0	4	1	0	1	1	0	1	1	0	1	1	0	1	1	0
28	Rotenberger WMA	> 1.5	17	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	Holey Land WMA	> 1.5	22	8	12	34	16	34	32	21	41	30	4	7	26	5	8	26	5	8
30	Corbett WMA	Undefined																		
31	Mullet Slough	Undefined																		
32	Upland Pine	Undefined																		
33	Upper Mullet Slough	Undefined																		
34	Cypress Marsh	Undefined																		
35	Wet Prairie	Undefined																		
36	Wetter Prairie NE	Undefined																		
37	Wetter Prairie SW	Undefined																		
38	Drier Cypress NW	Undefined																		
39	Drier Cypress NE	Undefined																		
40	Cypress	Undefined																		
41	NW Big Cypress	Undefined																		
42	NE Big Cypress	Undefined																		
43	NE Corner Big Cypress	Undefined																		
44	SW Big Cypress	Undefined																		
45	Racoon Point	Undefined																		
47	North C−111	> 1.8	0	0	0	0	0	0	0	0	0	5	2	0	0	0	0	0	0	0
48	North Bisc. Bay Groundwater 1	Undefined																		
49	North Bisc. Bay Groundwater 2	Undefined																		
50	Central Bisc. Bay Groundwater	Undefined																		
51	South Bisc. Bay Groundwater	Undefined																		
52	Pennsuco Wetlands North	> 2.0	16	8	8	5	2	0	5	6	2	6	4	1	15	6	6	19	5	6
53	Pennsuco Wetlands South	> 2.0	40	13	33	3	1	0	4	7	2	6	3	1	10	8	5	11	7	5
46	Cape Sable Sparrow A	Undefined																		
54	Cape Sable Sparrow B	Undefined																		

55	Cape Sable Sparrow C	Undefined																		
56	Cape Sable Sparrow D	Undefined																		
57	Cape Sable Sparrow E	Undefined																		
58	Cape Sable Sparrow F	Undefined																		
61	WCA−2B1	> 2.5	0	0	0	1	8	1	9	11	6	0	0	0	0	0	0	0	0	0
62	WCA−2B2	> 2.5	3	4	1	9	9	5	27	25	43	7	6	3	9	5	3	9	5	3
63	WCA−2B3	> 2.5	5	7	2	33	21	43	18	58	65	33	16	33	39	12	29	40	12	29
64	WCA−2B4	> 2.5	0	0	0	31	28	54	18	62	69	49	16	48	43	17	45	43	17	45
65	WCA−2B5	> 2.5	13	6	5	21	51	67	20	60	75	32	32	63	30	34	63	29	35	63
66	N WCA−3B	> 2.5	1	1	0	5	8	2	10	10	6	5	10	3	19	7	8	20	7	9
67	NE WCA−3B	> 2.5	0	0	0	7	9	4	15	8	8	5	11	3	21	9	11	20	9	11
68	S of NE WCA−3A	> 2.5	0	0	0	21	7	9	5	11	3	12	11	8	9	10	6	10	10	6

Notes: #events = number of events with depths continuously greater than the criterion over the period of record
Avg Duration of High Water Events = [sum(days over criterion)/7]/#events
Avg Annual Duration of High Water(Percent) = 100 x [sum(weeks over criterion)]/[52 x #years]

Table 3 Low Water Summary for Indicator Regions

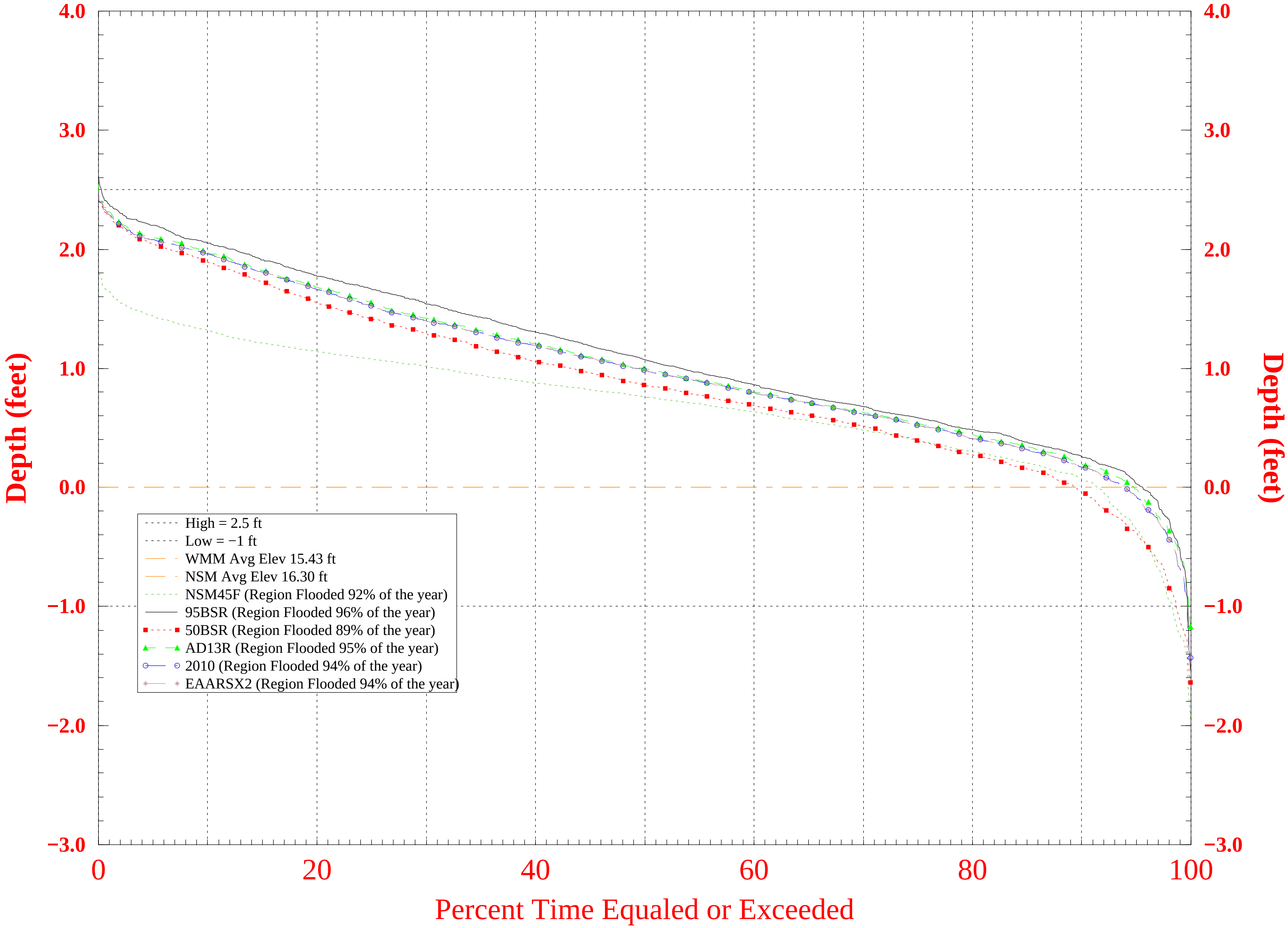
Indicator Region Number	Name	Depth(ft) Criterion	NSM45F			95BSR			50BSR			AD13R			2010			EAARSX2		
			#Events	Avg Duration (Wks/Event)	Avg Ann Duration (Percent of Yr)	#Events	Avg Duration (Wks/Event)	Avg Ann Duration (Percent of Yr)	#Events	Avg Duration (Wks/Event)	Avg Ann Duration (Percent of Yr)	#Events	Avg Duration (Wks/Event)	Avg Ann Duration (Percent of Yr)	#Events	Avg Duration (Wks/Event)	Avg Ann Duration (Percent of Yr)	#Events	Avg Duration (Wks/Event)	Avg Ann Duration (Percent of Yr)
1	Taylor Slough	< −1.5	20	4	5	24	4	6	28	4	7	28	4	7	28	4	7	28	4	7
2	West Perrine Marl Marsh	< −1.5	36	7	16	36	8	18	38	7	17	34	8	16	37	7	17	37	7	17
3	Mid−Perrine Marl Marsh	< −1.5	28	8	13	23	3	5	30	4	8	35	4	9	36	4	9	35	4	9
4	C−111 Perrine Marl Marsh	< 0.5	54	24	80	51	27	86	34	40	84	53	17	55	51	21	67	51	21	67
5	Model Lands South	< 0.5	56	23	81	48	29	87	41	37	95	80	14	68	58	21	77	58	21	77
6	Model Lands North	< 0.2	54	14	46	45	34	95	44	35	95	51	29	93	49	31	94	49	31	94
7	Ochopee Marl Marsh	< −1.5	17	8	9	21	10	13	22	7	10	22	7	10	27	7	12	26	7	12
8	Rockland Marl Marsh	< −1.5	21	10	13	45	10	29	38	10	23	22	10	14	28	11	19	27	11	19
9	SW Shark River Slough	< −1.0	1	5	0	18	4	4	12	4	3	3	2	0	12	4	3	12	4	3
10	Mid Shark River Slough	< −1.0	1	1	0	8	6	3	7	5	2	2	2	0	10	4	2	10	4	2
11	NE Shark River Slough	< −1.0	1	1	0	10	6	4	9	6	3	3	2	0	8	6	3	9	6	3
12	New Shark River Slough	< −1.0	17	7	8	17	8	9	21	6	8	13	5	4	20	8	10	18	9	10
13	West Slough	< −1.5	22	7	10	18	9	10	17	7	7	20	8	10	21	7	10	22	7	10
14	South WCA−3A	< −1.0	8	4	2	0	0	0	4	4	1	4	4	1	7	5	2	8	5	2
15	West WCA−3B	< −1.0	3	2	0	2	2	0	7	2	1	2	3	0	8	3	2	7	4	2
16	East WCA−3B	< −1.0	1	1	0	10	4	3	15	5	5	3	3	1	9	6	4	9	6	4
17	South Central WCA−3A	< −1.0	8	7	3	6	3	1	10	6	4	5	2	1	7	4	2	7	4	2
18	North Central WCA−3A	< −1.0	9	5	3	10	5	3	10	6	3	1	6	0	5	5	2	6	3	1
19	East WCA−3A	< −1.0	10	6	4	1	1	0	9	3	2	8	3	1	12	4	3	13	4	3
20	NW WCA−3A	< −1.0	6	6	2	16	7	7	11	7	5	9	5	3	10	6	4	10	7	4
21	NE WCA−3A	< −1.0	15	7	7	21	9	12	10	7	4	15	4	4	14	6	5	14	6	5
22	NW Corner WCA−3A	< −1.0	7	5	2	25	7	11	11	6	4	6	4	1	6	5	2	9	4	2
23	WCA−2B	< −1.0	5	5	1	14	7	6	11	7	5	14	7	6	16	8	7	16	8	8
24	South WCA−2A	< −1.0	6	8	3	12	5	4	8	8	4	12	7	5	11	7	5	11	7	5
25	North WCA−2A	< −1.0	8	8	4	10	9	5	8	7	3	4	9	2	7	6	3	7	6	2
26	South LNWR (WCA−1)	< −1.0	10	4	2	0	0	0	2	4	0	0	0	0	0	0	0	0	0	0
27	North LNWR (WCA−1)	< −1.0	8	4	2	1	4	0	5	5	1	1	3	0	1	5	0	1	5	0
28	Rotenberger WMA	< −1.0	18	8	9	33	9	19	20	4	6	18	3	4	18	3	4	17	4	4
29	Holey Land WMA	< −1.0	14	6	5	9	2	1	5	2	1	11	4	3	10	4	3	10	4	3
30	Corbett WMA	Undefined																		
31	Mullet Slough	Undefined																		
32	Upland Pine	< −7.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	Upper Mullet Slough	Undefined																		
34	Cypress Marsh	< −6.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	Wet Prairie	< −6.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	Wetter Prairie NE	< −6.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	Wetter Prairie SW	< −6.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	Drier Cypress NW	< −5.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	Drier Cypress NE	< −5.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	Cypress	< −4.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41	NW Big Cypress	< −3.0	13	5	4	13	5	4	13	5	4	13	5	4	13	5	4	13	5	4
42	NE Big Cypress	< −3.0	6	5	2	10	6	4	10	6	4	9	5	3	10	6	4	10	6	4
43	NE Corner Big Cypress	< −3.0	0	0	0	21	6	7	22	6	8	22	6	9	21	5	6	20	5	6
44	SW Big Cypress	< −3.0	9	6	3	10	7	4	10	7	4	10	7	4	10	7	4	10	7	4
45	Racoon Point	Undefined																		
47	North C−111	< 0.0	47	14	41	88	14	76	58	24	87	55	19	67	51	24	75	51	24	75
48	North Bisc. Bay Groundwater 1	< −5.1	18	4	5	1	1612	100	1	1612	100	1	1612	100	1	1612	100	1	1612	100
49	North Bisc. Bay Groundwater 2	< −5.0	0	0	0	21	75	98	11	145	99	11	146	100	12	134	100	12	134	100
50	Central Bisc. Bay Groundwater	< −7.5	3	3	1	76	12	56	105	10	66	130	7	59	105	10	65	105	10	65
51	South Bisc. Bay Groundwater	< −3.0	30	9	17	79	12	61	87	12	66	92	11	65	93	11	66	93	11	66
52	Pennsuco Wetlands North	< −1.0	3	2	0	22	5	7	29	5	9	4	4	1	11	5	3	10	5	3
53	Pennsuco Wetlands South	< −1.0	1	1	0	22	7	10	31	7	13	4	7	2	14	6	6	14	6	6
46	Cape Sable Sparrow A	Undefined																		
54	Cape Sable Sparrow B	Undefined																		

55	Cape Sable Sparrow C	Undefined																		
56	Cape Sable Sparrow D	Undefined																		
57	Cape Sable Sparrow E	Undefined																		
58	Cape Sable Sparrow F	Undefined																		
61	WCA−2B1	< −1.0	10	5	3	24	10	15	22	10	14	26	10	17	25	10	16	24	11	16
62	WCA−2B2	< −1.0	6	4	2	20	10	12	16	9	9	26	8	13	26	9	14	26	8	14
63	WCA−2B3	< −1.0	4	6	1	9	6	4	5	9	3	7	7	3	9	7	4	10	7	4
64	WCA−2B4	< −1.0	16	4	4	2	4	1	1	6	0	2	3	0	3	4	1	3	4	1
65	WCA−2B5	< −1.0	4	6	2	19	7	8	16	5	5	13	5	4	17	6	7	17	6	7
66	N WCA−3B	< −1.0	21	5	6	9	2	1	15	3	3	3	5	1	7	5	2	7	5	2
67	NE WCA−3B	< −1.0	15	5	5	27	9	15	39	11	26	16	5	5	9	7	4	10	6	4
68	S of NE WCA−3A	< −1.0	13	5	4	6	4	1	11	6	4	13	4	3	13	6	5	13	6	5

Notes: #events = number of events with depths continuously less than the criterion over the period of record
Avg Duration of Low Water Events = [sum(days below criterion)/7]/#events
Avg Annual Duration of Low Water(Percent) = 100 x [sum(weeks below criterion)]/[52 x #years]

Fig.8 Normalized Weekly Stage Duration Curves for North LNWR (WCA−1)

Indicator Region 27 (R47C30−34 R48C30−33 R49C30−33 R50C30−32 R51C30−31)



Note: Normalized stage is stage referenced to Land Elevation. Thus, values above zero indicate ponding
while values below zero indicate depth to the water table.

Run date: Fri Jun 18 14:06:06 EDT 1999
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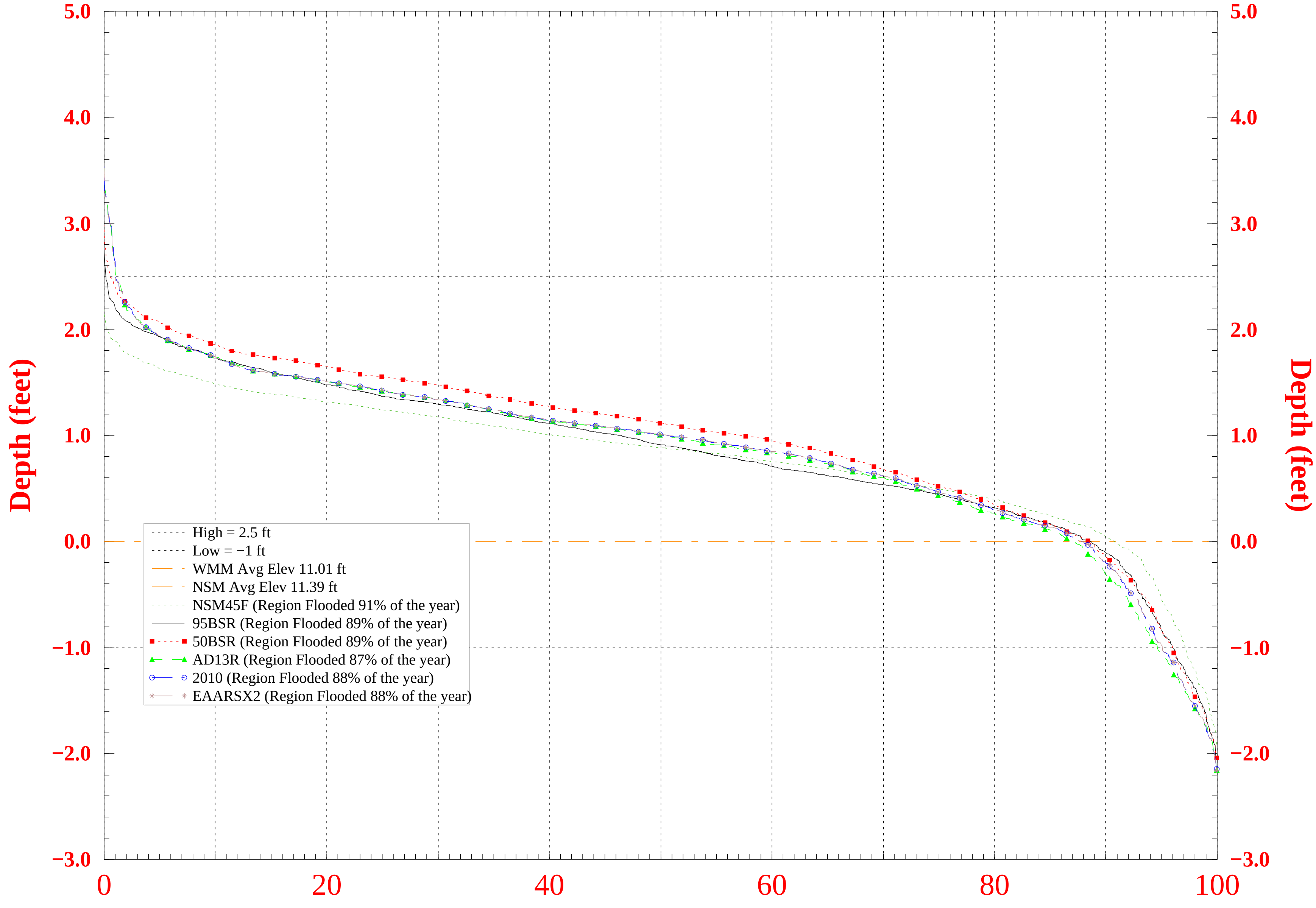
Fig.9 Normalized Weekly Stage Duration Curves for South WCA−2A

Indicator Region 24 (R39C29−31 R40C28−31 R41C28−28)



Note: Normalized stage is stage referenced to Land Elevation. Thus, values above zero indicate ponding while values below zero indicate depth to the water table.

Run date: Fri Jun 18 14:05:29 EDT 1999
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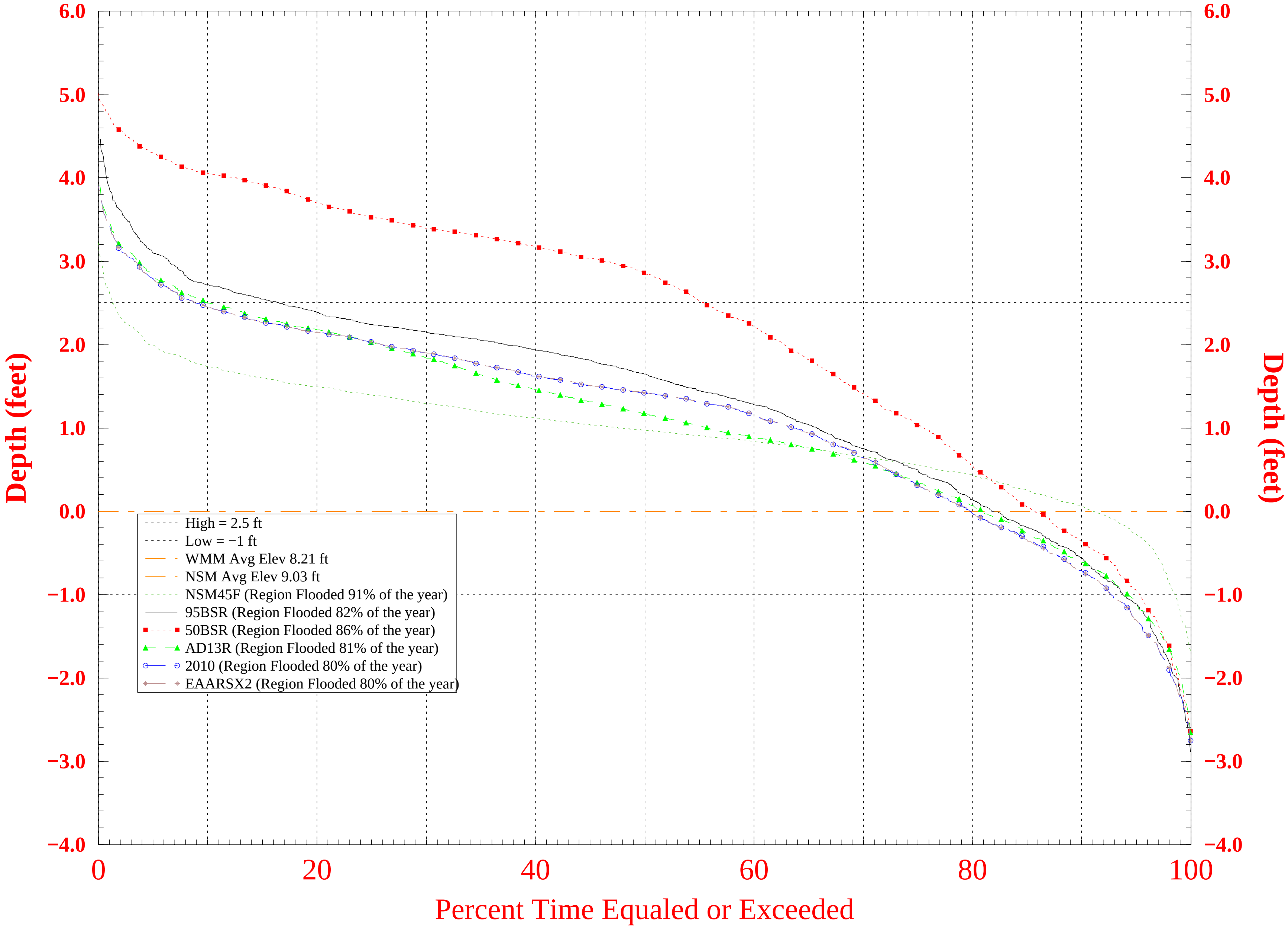
Fig.10 Normalized Weekly Stage Duration Curves for WCA−2B

Indicator Region 23 (R36C29−31 R37C30−32)



Note: Normalized stage is stage referenced to Land Elevation. Thus, values above zero indicate ponding while values below zero indicate depth to the water table.

Run date: Fri Jun 18 14:05:19 EDT 1999
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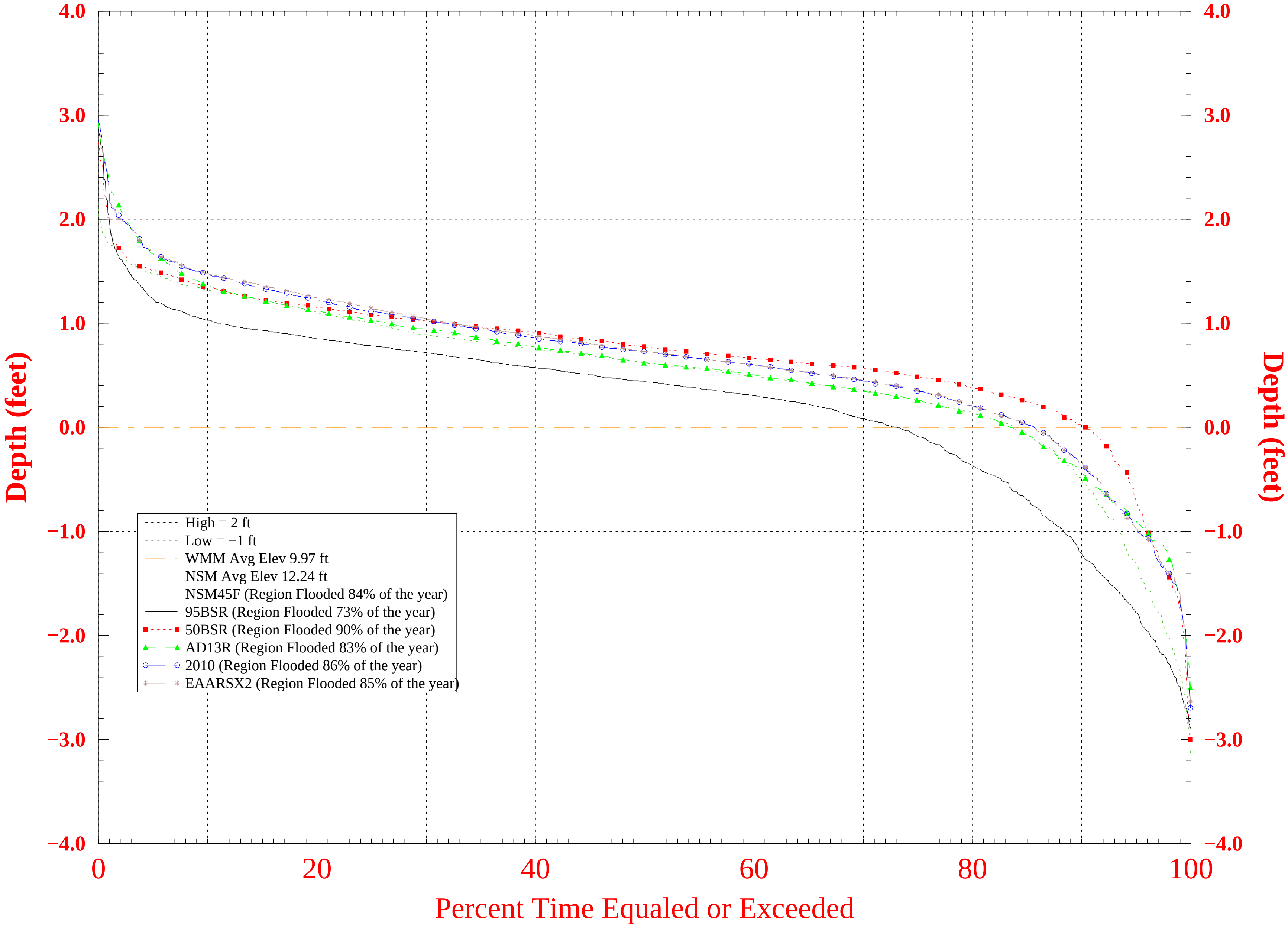
Fig.11 Normalized Weekly Stage Duration Curves for NE WCA−3A

Indicator Region 21 (R38C23−24 R39C23−25 R40C22−25)



Note: Normalized stage is stage referenced to Land Elevation. Thus, values above zero indicate ponding while values below zero indicate depth to the water table.

Run date: Fri Jun 18 14:05:02 EDT 1999
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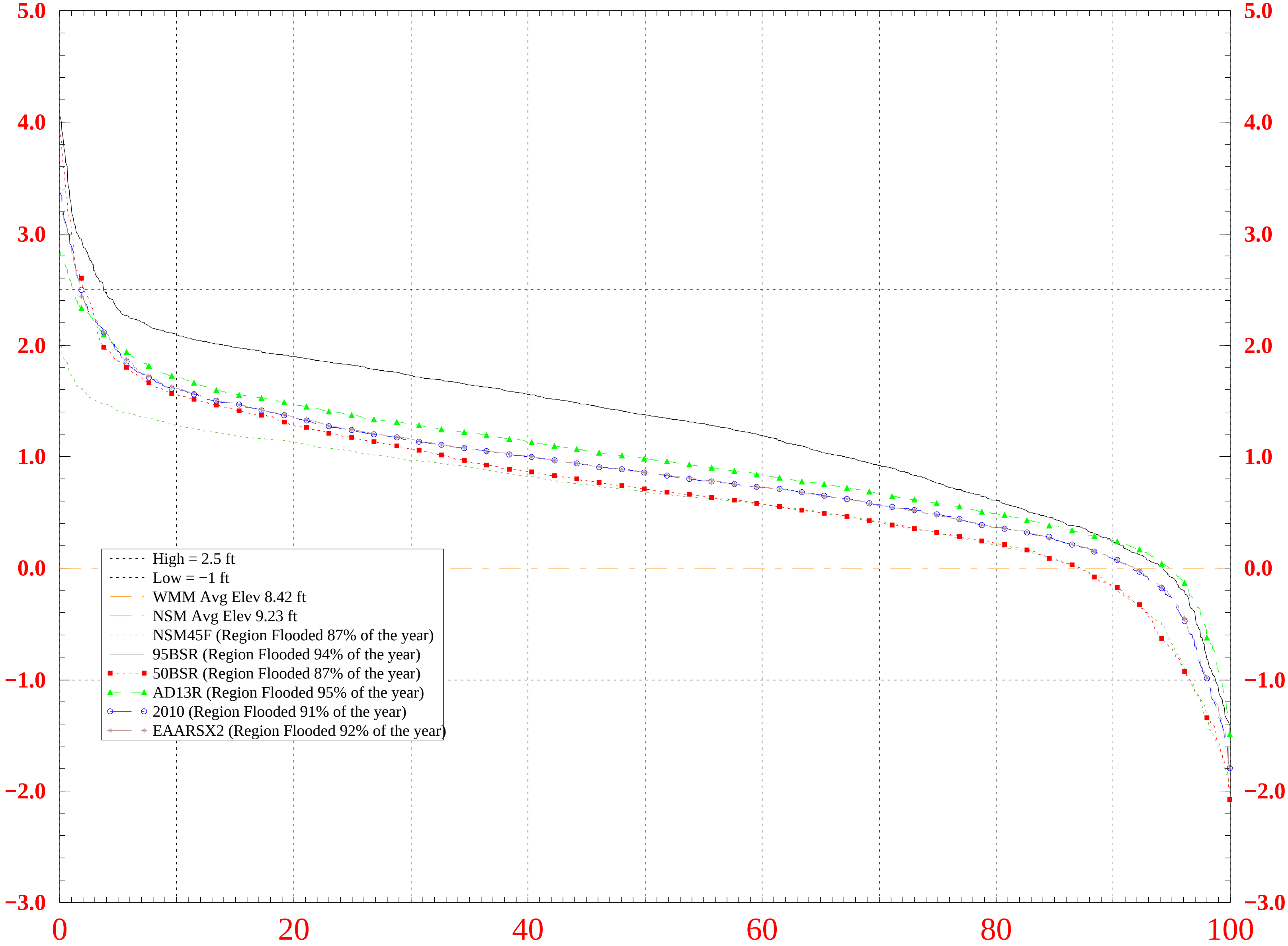
Fig.12 Normalized Weekly Stage Duration Curves for South Central WCA−3A

Indicator Region 17 (R28C17−21 R29C17−22 R30C18−22 R31C18−22)



Note: Normalized stage is stage referenced to Land Elevation. Thus, values above zero indicate ponding while values below zero indicate depth to the water table.

Run date: Fri Jun 18 14:04:24 EDT 1999
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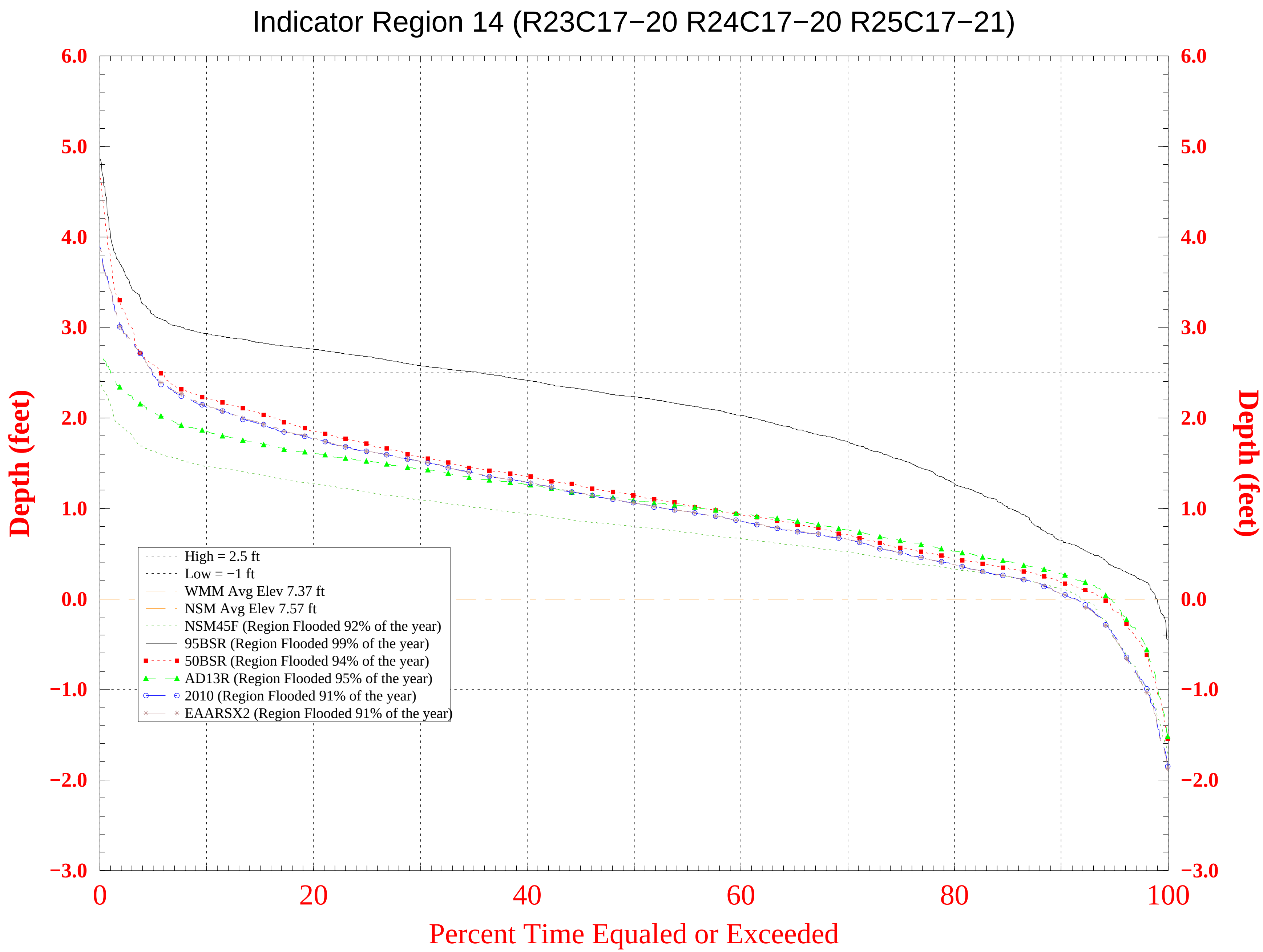
Fig.13 Normalized Weekly Stage Duration Curves for South WCA−3A



Note: Normalized stage is stage referenced to Land Elevation. Thus, values above zero indicate ponding while values below zero indicate depth to the water table.

Run date: Fri Jun 18 14:03:45 EDT 1999
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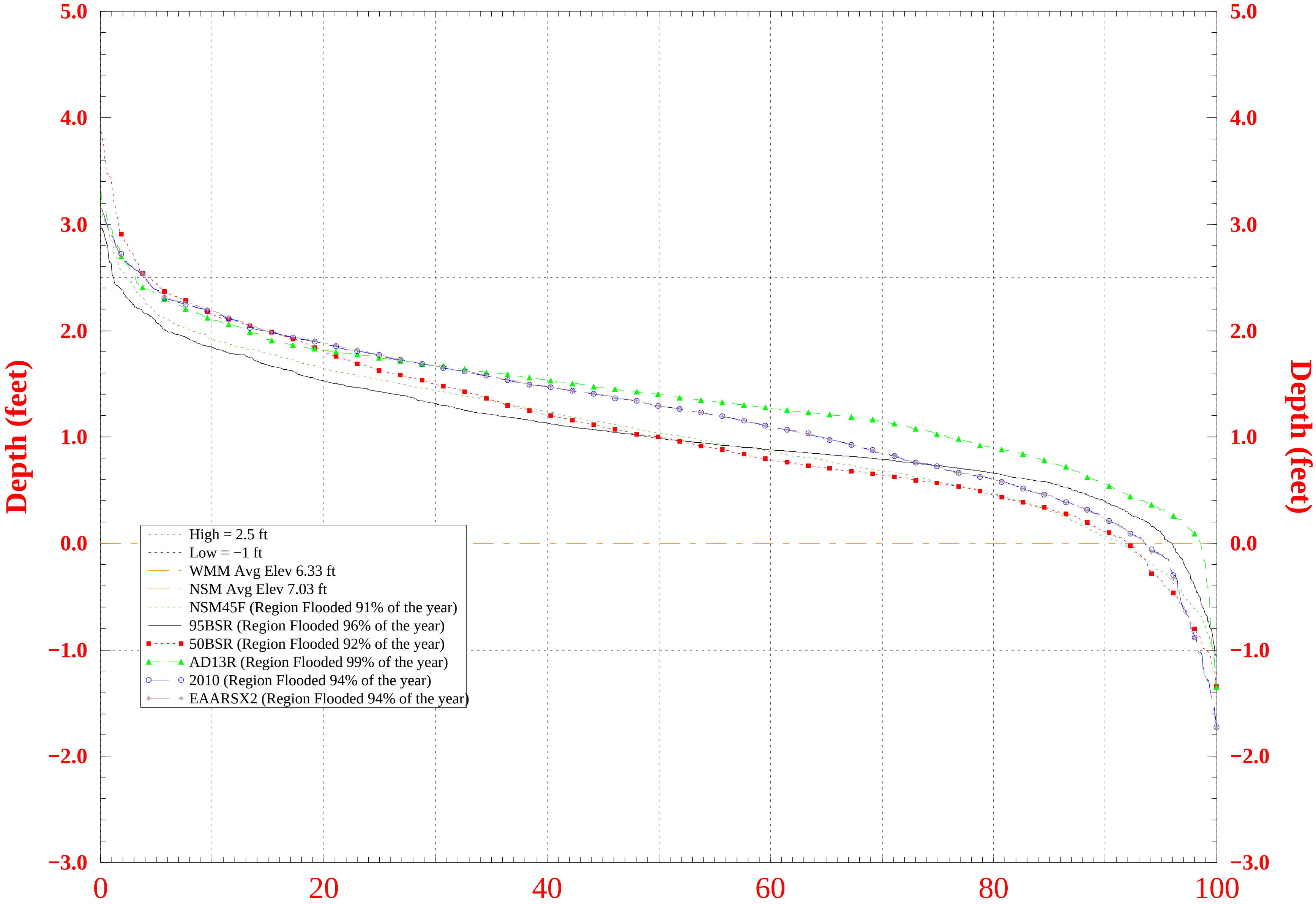
Fig.14 Normalized Weekly Stage Duration Curves for West WCA−3B

Indicator Region 15 (R23C23−23 R24C23−24 R25C24−25 R26C25−25 R27C25−25)



Note: Normalized stage is stage referenced to Land Elevation. Thus, values above zero indicate ponding while values below zero indicate depth to the water table.

Run date: Fri Jun 18 14:03:54 EDT 1999
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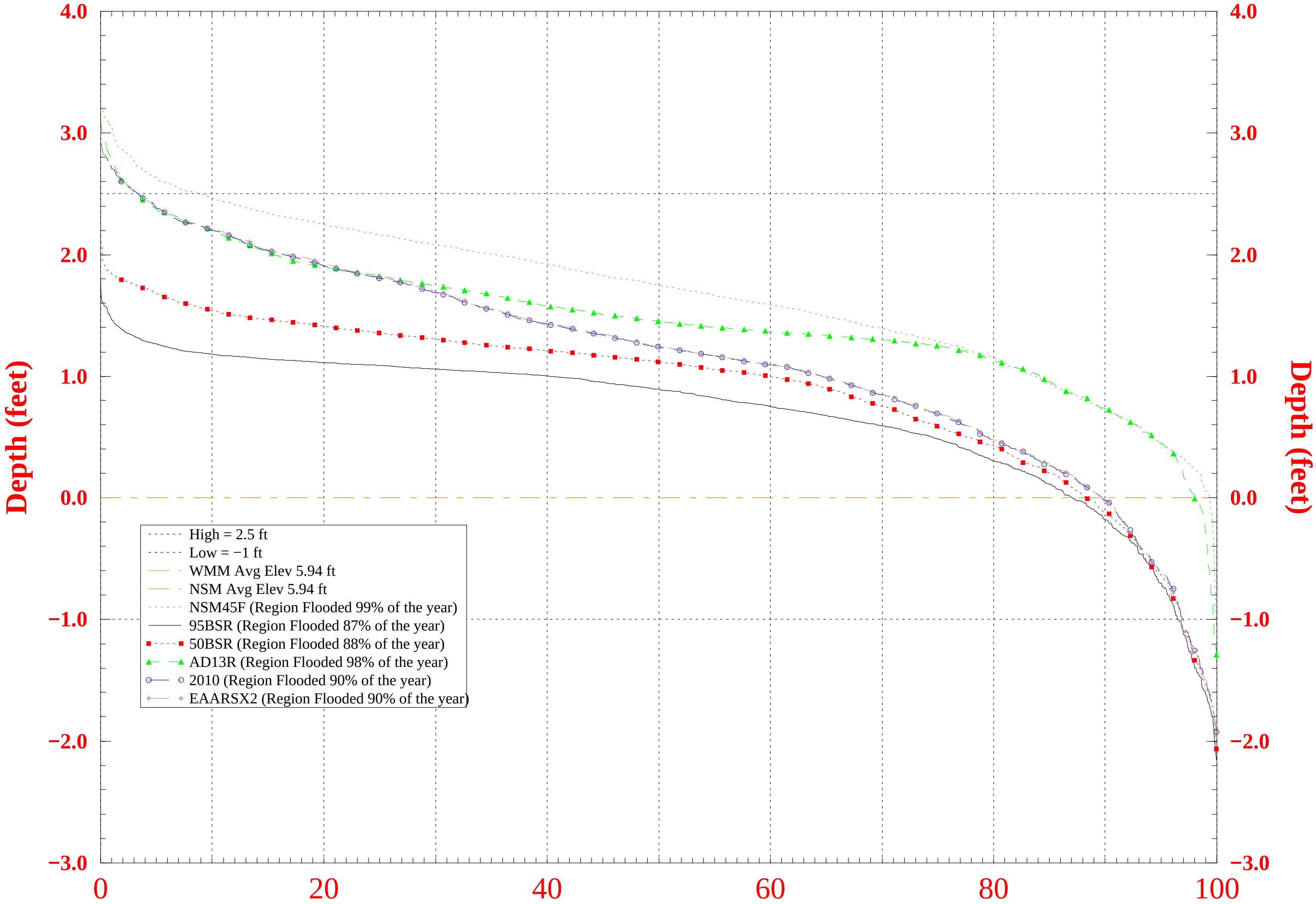
Fig.15 Normalized Weekly Stage Duration Curves for NE Shark River Slough

Indicator Region 11 (R19C22−23 R20C22−26 R21C22−26)



Note: Normalized stage is stage referenced to Land Elevation. Thus, values above zero indicate ponding while values below zero indicate depth to the water table.

Run date: Fri Jun 18 14:03:15 EDT 1999
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Fig.16 FLOW TRANSECTS

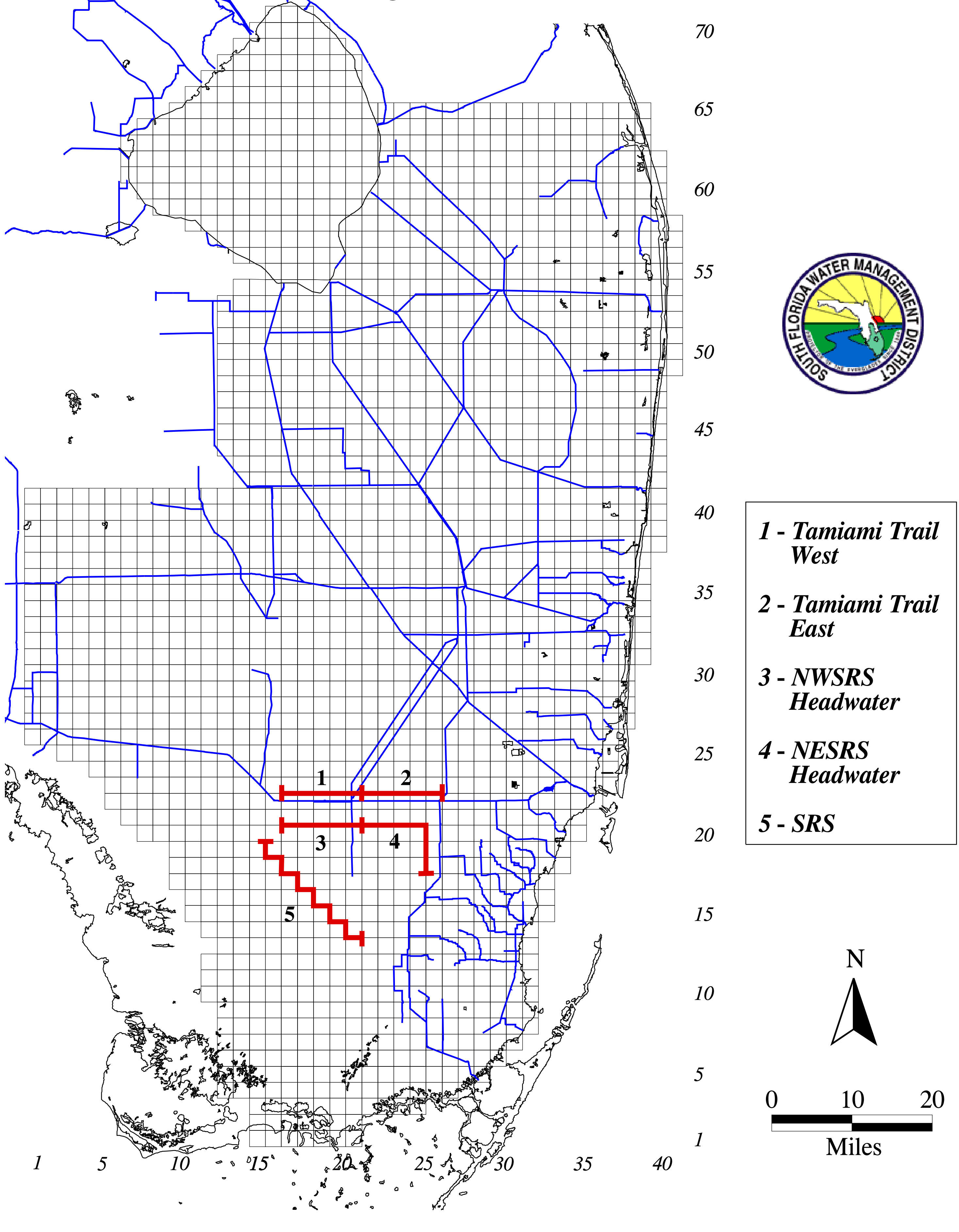
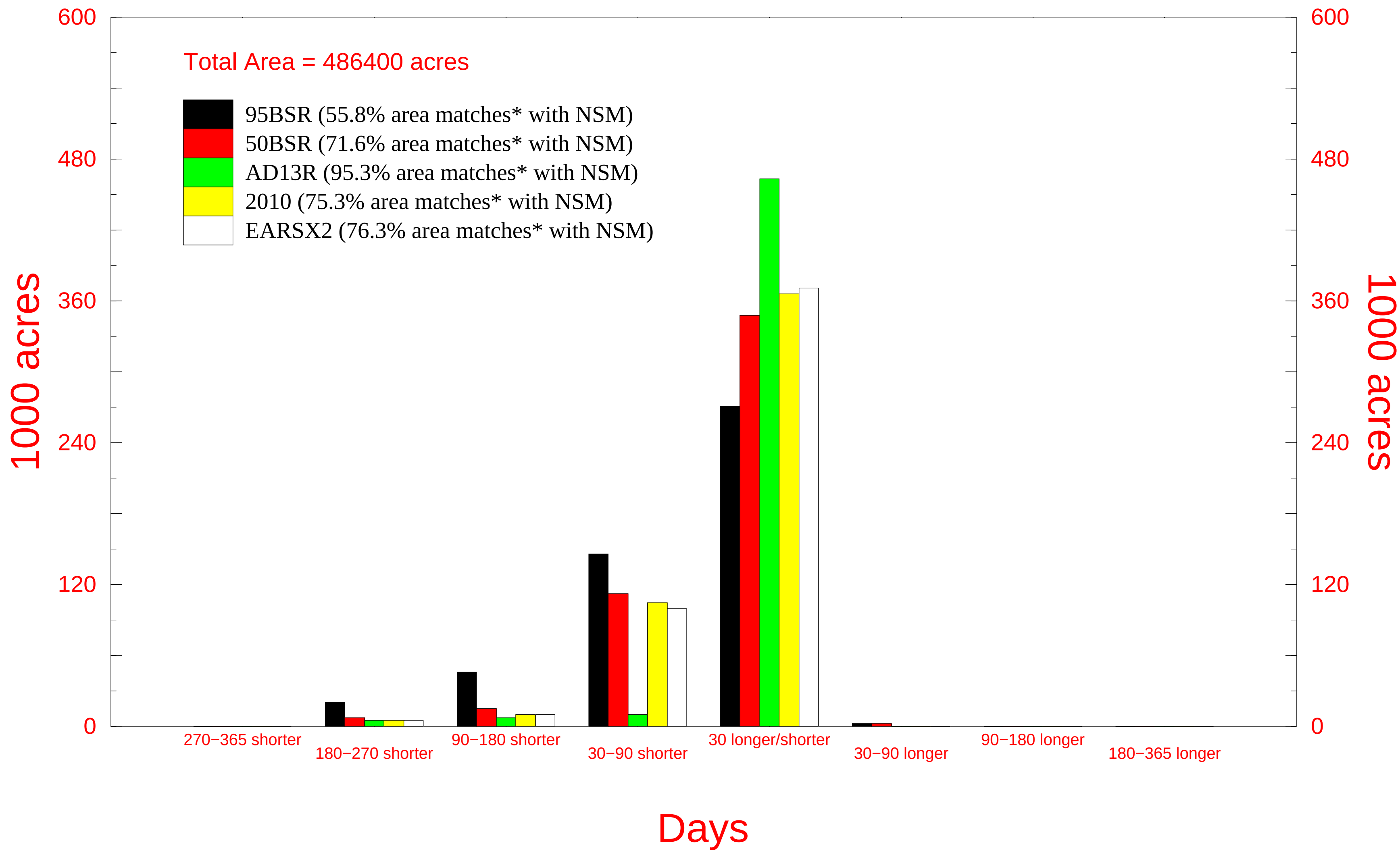


Fig.17 Mean NSM hydroperiod matches for the Everglades National Park for the 31 yr. simulation



Note: xaxis represents hydroperiod days shorter or longer as compared to NSM
*Match corresponds to 30 hydroperiod days shorter or longer than NSM.

Run date: 06/18/99 11:03:49
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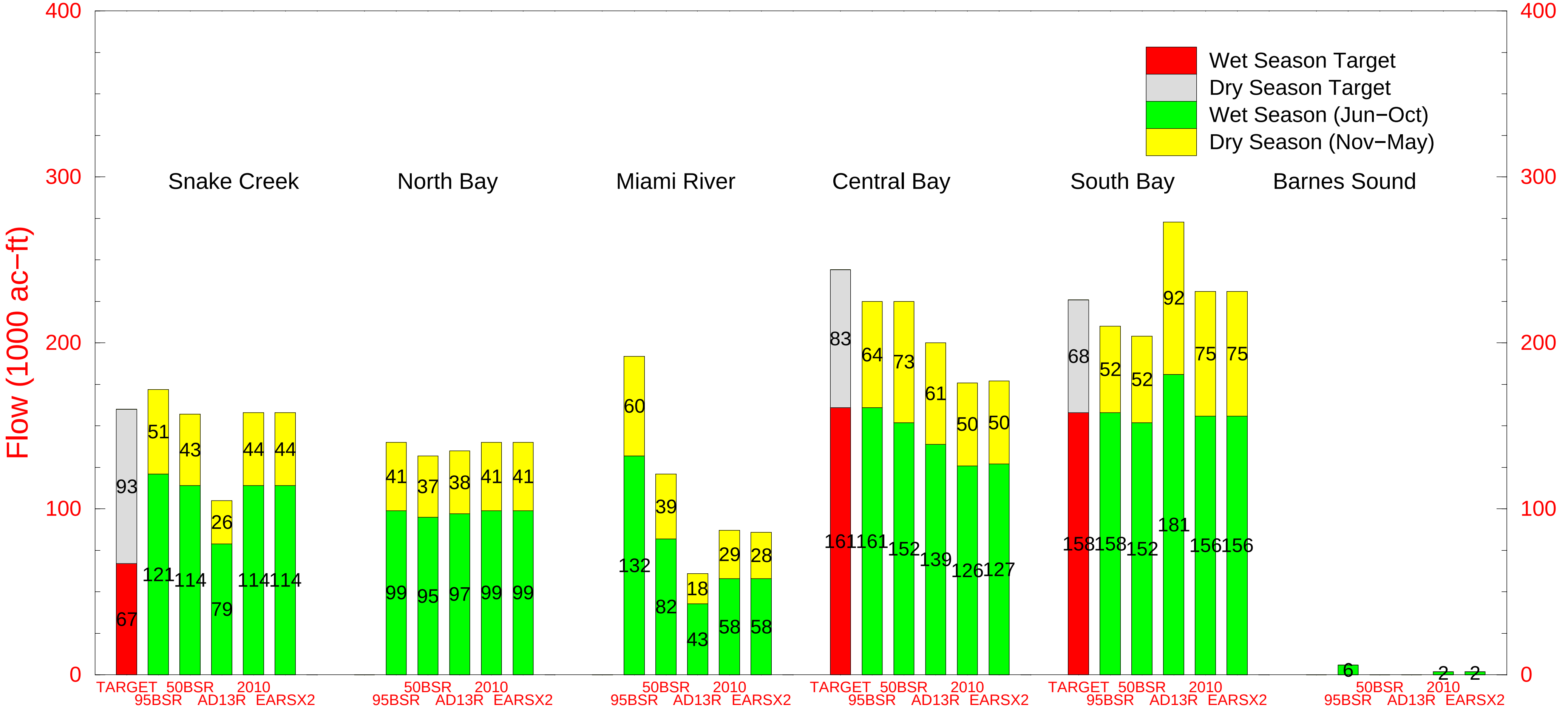
Fig.18 Simulated Mean Annual Surface Flows Discharged into Biscayne Bay for the 1965 − 1995 simulation period



Note: Snake Creek=S29; North Bay=G58+S28+S27; Miami River=S26+S25B+S25; Central=G97+S22+S123; South=S21+S21A+S20F+S20G; Barnes Sound=S197

Targets for Central and South Bay reflect a 30% increase in mean annual dry season flows over the 95 Base

Targets for Snake Creek reflect a minimum monthly flow volume of 13,300 ac−ft (x 5 months for wet season and x 7 months for dry season) to maintain salinity levels below 20 ppt.

Run date: 06/18/99 10:47:43

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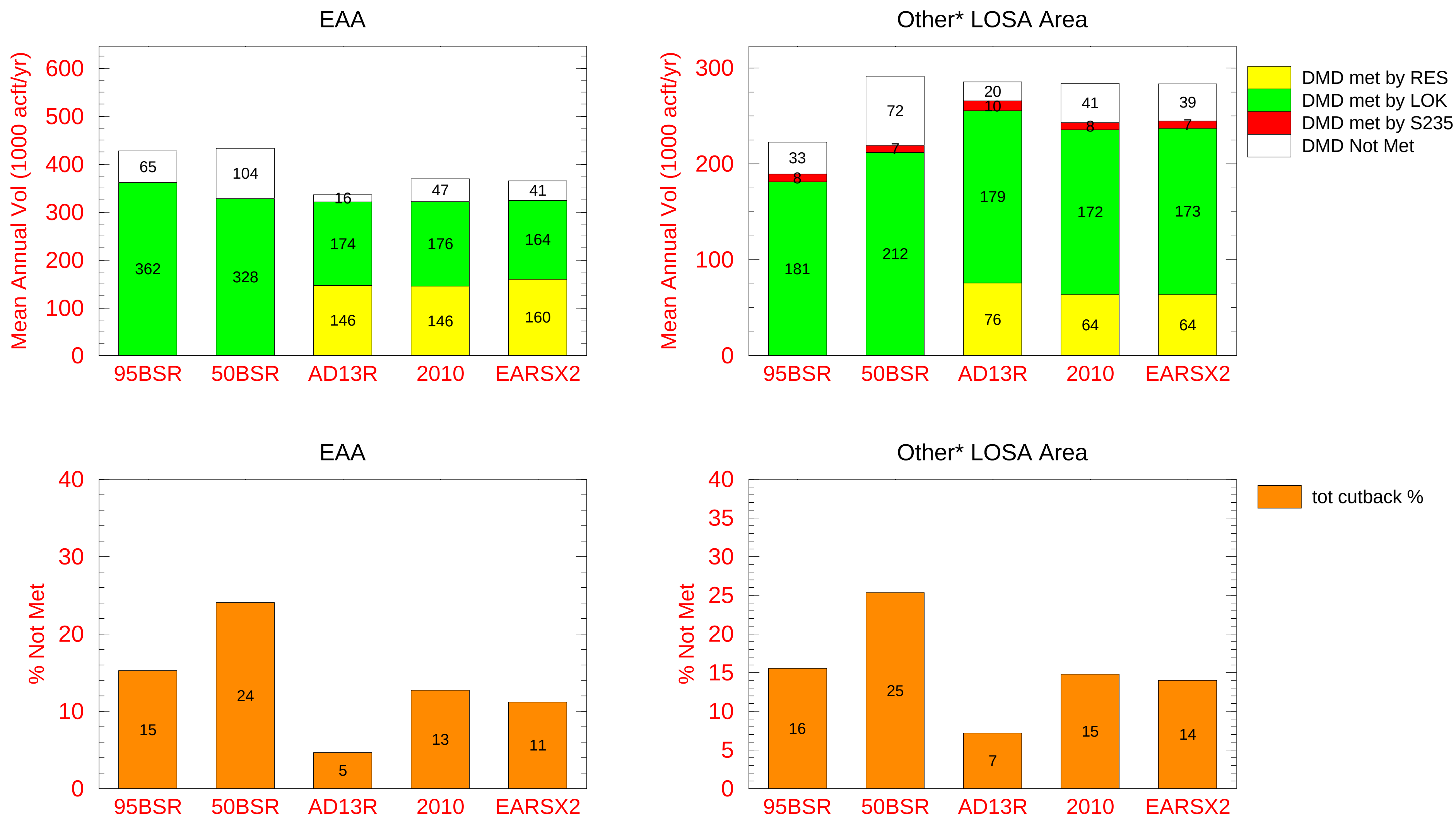
Fig.19 Mean Annual EAA/LOSA Supplemental Irrigation: Demands and Demands Not Met

for the 1965 − 1995 Simulation Period



*Other Lake Service SubAreas (S236, S4, L8, C43, C44, and Seminole Indians (Brighton & Big Cypress)).

Run date: 06/18/99 10:23:59
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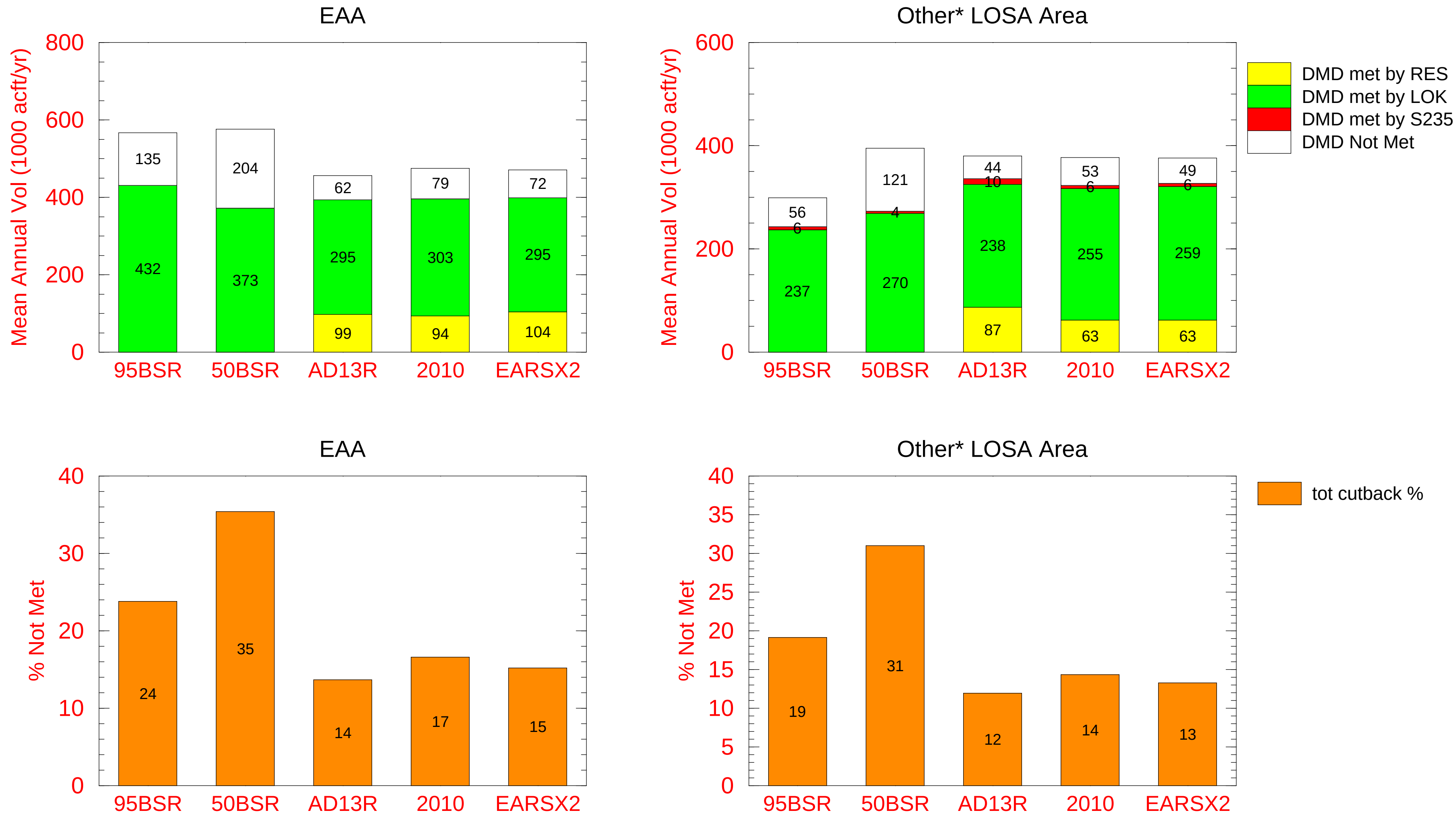
SFWMM V3.5

Fig.20 Mean Annual EAA/LOSA Supplemental Irrigation: Demands and Demands Not Met for the Drought Years: 1971, 1975, 1981, 1985, 1989 within the 1965 − 1995 Simulation Period

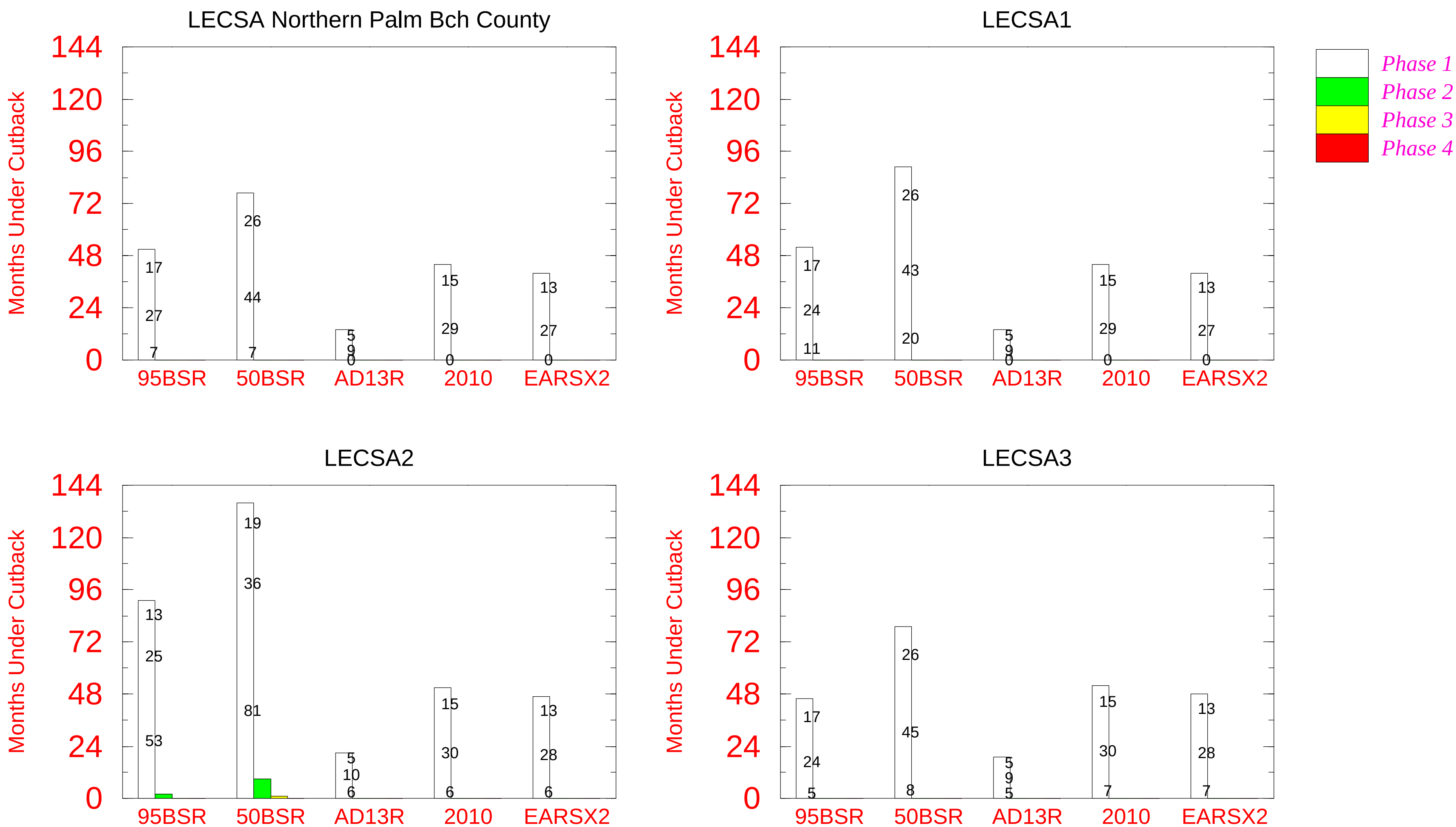


*Other Lake Service SubAreas (S236, S4, L8, C43, C44, and Seminole Indians (Brighton & Big Cypress)).

Run date: 06/18/99 10:28:00
For Planning Purposes Only
SFWMM V3.5

Fig.21 Number of Months of Simulated Water Supply Cutbacks

for the 1965 − 1995 Simulation Period



Note: Phase 1 water restrictions could be induced by a) Lake stage in Supply Side Management Zone (indicated by upper data label), b) Local Trigger well stages (lower data label), and c) Dry season criteria (indicated by middle data label).

Run date: 06/18/99 10:39:13
For Planning Purposes Only
SFWMM V3.5