

2956

Correction of 1991 to 2000 Stage Measurements Collected in Big Cypress National Preserve to a Common Datum (NGVD 1929)

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Summary:

Surface-water stage elevations collected at 12 hydrologic monitoring stations in Big Cypress National Preserve are reported as daily and monthly average values relative to the NGVD 1929 datum for the period of record of 1991 to 2000. This paper: (1) describes the sources of this data, (2) describes instances where the data is discontinuous, (3) describes methods used to correct the data to a common datum, (4) provides corrected POR data in daily-average and monthly-average intervals, and (5) identifies areas of future work.

Introduction:

Water levels have been collected on a continual basis in Big Cypress National Preserve (BICY) at 12 sites from 1991 to present, but to date this period of record (POR) has not been corrected to a common datum. A full analysis of water stage data collected in the preserve has been inhibited to date because of this deficiency.

Hydrologic monitoring stations (hydrostations) where stage data is collected by BICY staff are shown in **Figure 1**. Twelve of these stations – A1 Bear Island, A2 East Hinson Marsh, A3 East Crossing Strand, A4 Monument Lake, A5 Raccoon Point, A8 Bridge 83, A9 Pinecrest, A10 Gum Slough, A11 Roberts Lake, A12 Kissimmee Billy Strand, A13 Mullet Slough, and A14 Deep Lake Strand – have periods of record that extend back to 1991/1992, but these periods of record are not referenced to a common datum over time or relative to each other.

From 1991 to Fall of 1995, A-71 Stevens Recorders were used to collect surface water stage relative to arbitrary datums established at each station. An arbitrary datum is defined as a temporary benchmark that is established to provide a consistent measuring point over time, but is not tied in to a common datum shared by other stations. A-71 Stevens Recorders allow for stage data to be continuously recorded on chart-paper, but need to be visited on a regular basis to perform routine tests to ensure that data is being collected correctly. Typically, manual spot measurements of surface-water stage are made at this time, which are in turn are transcribed on both field notes (for filing back in the office) and directly on the chart. These spot measurements are used to adjust the continuous stage record relative to mechanical drift, identify the occurrence of paper-chart reversals, or correct other irregularities. Paper-chart reversals are defined as instances where either the upper or lower limits of the A-71 Stevens Recorder are

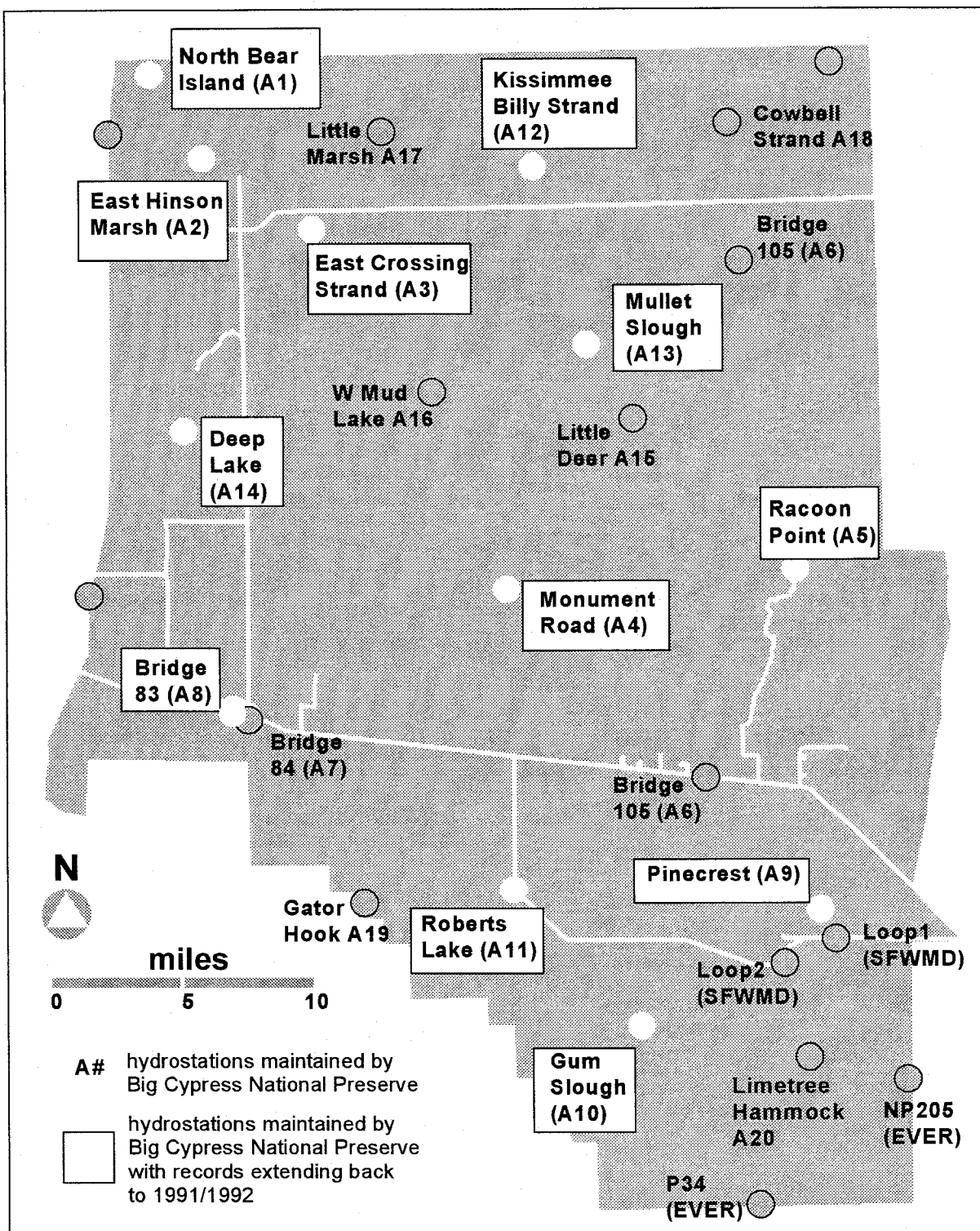


Figure 1. Map of hydrologic monitoring stations (hydrostations) within Big Cypress National Preserve.

exceeded, thereby causing an automatic reversal in direction stage is recorded on the paper-chart. The paper-chart is removed from the A-71 Stevens Recorder on an annual basis and replaced with a fresh paper-chart. The final step is to digitally enter the data, correcting for manual drift, paper-chart reversals, and other irregularities.

Major modifications were made the BICY hydrologic monitoring program in Fall 1995 as follows: (1) "mechanical" stage recording equipment (A-71 Stevens Recorders) was replaced with "digital" stage recording equipment (Campbell Scientific CR-10s and SM-192s), (2) surveying was performed to establish a common datum (NGVD 1929) at all sites, and (3) paper charts from the A-71 Stevens Recorders were sent to the South Florida Water Management District (SFWMD) to be digitally entered. Digital entry of the paper-chart data was completed in Summer 2000. While this opened the door for correcting BICY's historic stage record to a common datum for the first time, it was also recognized the methods for doing so would need to be clearly documented to ensure the accuracy and defensibility of the record.

Methods:

Description of Data: The period of record considered for this work is shown for each station in **Figure 2**. It should be noted that stage data is available for several stations prior to 1991, but is not considered as a part of this work. Data within the 1991 to 2000 record is described as follows:

- 1991 to 4/1995 – This data was recorded on A-71 Stevens Recorders that were generally visited on a monthly time frame by field personnel, at which time spot stage measurements were also made and recorded on the paper chart. Paper charts for this time period were sent "in bulk" to the SFWMD for digitizing. This chart data was digitized to the arbitrary (but consistent) datums established at each site in 1991.
- 4/1995 to 10/1995 – This data was recorded on A-71 Stevens Recorders that were visited on a monthly time frame by field personnel, at which time spot stage measurements were also made and recorded on the paper chart. Paper chart data for this time period was sent into the SFWMD for digitizing as a separate bundle than the 1991 to 4/1995 data set. The chart data was digitized relative to the NGVD 1929 – a task that was made possible by NGVD 1929 conversion information transcribed at the terminus of each paper chart.
- 10/1995 to 2000 – This data was digitally recorded in 15-minute increments using CR10 and SM192 continuous recording and storage devices (provided with power using a dual battery and solar panel system). Sites have generally been visited on a monthly time frame by field personnel, at which time spot stage measurements are also performed to ensure accuracy. Digital, staff, and distance to water measurements are made relative to a common datum (NGVD 1929).

Stations A1 (Bear Island), A3 (East Crossing Strand), A4 (Monument Road), A9 (Pinecrest), A13 (Mullet Slough), and A14 (Deep Lake) have uninterrupted stage records from 1991 to present, with all other sites having interruptions of varying lengths. Five of

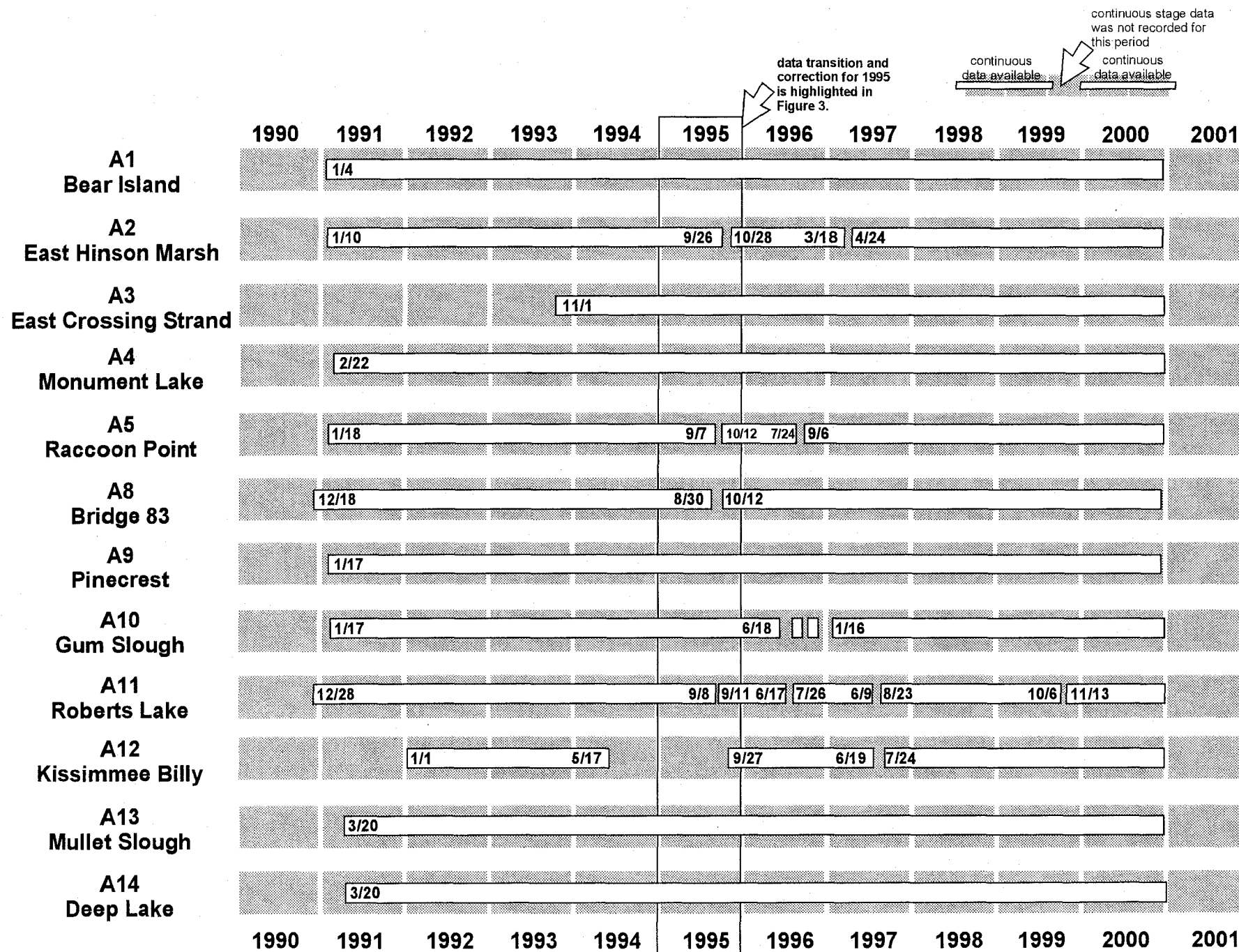


Figure 2. Available Period of Record for hydrostations in BICY that has been corrected to NGVD1929 vertical datum

the stations show interruptions during 1995, the year in which the transition from paper-chart to digital stage recording took place.

Correcting full POR to the NGVD 1929 Datum: The keystone time interval for correcting BICY's historic stage record to a common datum occurred in 1995, the year that digital equipment replacement and surveying occurred for the stations. **Figure 3** shows the dates in which the transition from paper-chart to digital recording devices occurred in 1995. The white-coded horizontal bars in **Figure 3** represent the time period for each station where SFWMD staff were only able to digitize the paper-chart data to the arbitrary reference point provided for each site. All twelve sites show continuous data collection through this transition. The black-coded horizontal bars represent the paper-chart data that SFWMD staff digitized relative to the NGVD 1929 datum. SFWMD staff was able to directly digitize this period of time to NGVD 1929 because relevant survey information was transcribed at the terminus (Fall 1995) of the paper chart provided for this interval. Digital recording devices were installed and began operation between 9/11/95 and 10/28/95 for all the sites as indicated by the gray-coded horizontal bars. Seven of the twelve sites (A1, A3, A4, A9, A10, A13, A14) have continuous data collection during the physical transition from paper-chart to digital stage recording equipment.

Data Conversion and Verification: Data conversion and verification procedures applied to the paper-chart stage data for the periods of (1) 1991 to 4/1995 and (2) 4/1995 to 10/1995 are described below.

(1) 1991 to 4/1995: Hydrostation-specific correction factors were applied to paper-chart data digitized by SFWMD staff between the time period of 1991 and 4/1995. The numeric values used to correct pre-4/95 data to the NGVD 1929 datum are shown in **Table 1**. Daily-average stage from 4/14/95 to 4/28/95 are also shown to provide comparison between pre- and post-4/95 digitized data. With the exception of a 0.05 ft hitch at A5 Raccoon Point, all sites show a steady decline of stage during this period. This validity of this trend is supported by the relative absence of rainfall during the transition period, as shown in **Table 2**, which reports the daily rainfall at 4 remote access weather stations (RAWS) during this transition period.

(2) 4/1995 to 10/1995: No correction factor was applied to the data that fell between 4/1995 to Fall 1995 (exact dates vary among stations) because this data was digitized directly to the NGVD 1929 datum by SFWMD staff. Daily-average stage data during the transition from paper-chart to digital recording devices are shown in **Table 3**. Seven of the twelve sites have a continuous stage record through this transition (no missing days), and these sites show smooth stage movement during this period. The A2 East Hinson marsh, A5 Raccoon Point, A7 Bridge 83, A11 Roberts Lake, and A12 Kissimmee Billy stations have data gaps of 33, 36, 44, 2, and 499 days, respectively.

Additional information and correspondences used towards applying and validating correction factors for each site are contained in **Appendix 1**.

paper-chart data digitized to an arbitrary datum for each site
 paper-chart data digitized to NGVD 1929 datum
 digitally-collected data

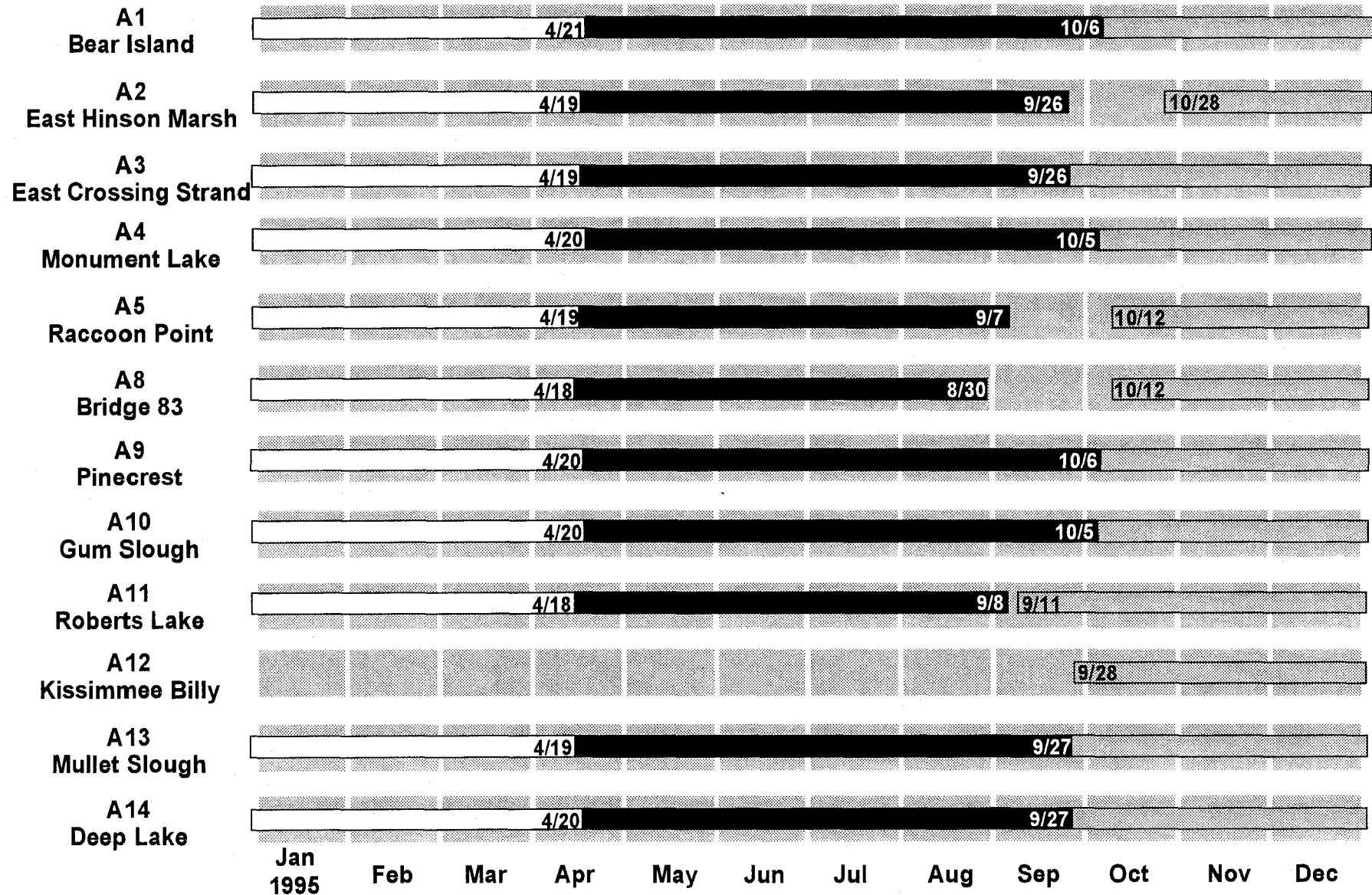


Figure 3. Sources of surface water stage data collected at BICY hydrostations in 1995

Results:

Daily-average and monthly-average stage levels measured relative to the NGVD 1929 datum from 1991 to 2000 are reported for the twelve sites in **Appendix 2** and **Table 4**, respectively. The arithmetic mean methodology for determining average values was applied for computing daily-average stage levels. In the case of CR-10 collected data, this involved daily-averaging of 15-minute interval stage measurements (96 measurements per station per day). Daily high and low stages have also been retained in the main archive file, but are not shown in Appendix 2. The arithmetic mean methodology for determining average values was also used to compute monthly-average stage levels. For the entire POR this involved monthly-averaging of the daily-average stage data listed in **Appendix 2**.

The task of correcting BICY's historic stage record (1991 to 2000) to a common datum was complicated by the fact that digital entry of the 1991-1995 paper-chart data was not completed until 2000, creating a condition where field sheets, data, and correction factors had to be carefully interpreted. Additionally, it should be pointed out that the arbitrary benchmarks established in 1991 (and used from 1991 to 10/1995) are no longer physically present in the field, thereby making the survey notes transcribed in Fall 1995 the only link for determining the adjustment factors from the 1991 arbitrary datums to the NGVD 1929 datum. Retaining such physical benchmarks would have given an additional check for confirming the accuracy of the correction in instances where there was a lapse in data during the Fall 1995 transition period. However, there was sufficient information for each hydrostations to perform the corrections, and this information was generally unambiguous. The hydrostations where the stage record is continuous through the critical Fall 1995 transition period have the greatest certainty regarding their accuracy (by confirmation of no abrupt increases or decreases in stage levels). No such test can be applied for the hydrostations where stage record is discontinuous through the Fall 1995 transition.

Conclusion:

Correcting the data to a common datum represents an important accomplishment because it makes water level data comparable at individual sites (i.e., historic averages), comparable among sites (i.e. water table mapping), and readily available for analysis for management and research purposes. Future actions to be performed relative to the expanded and corrected baseline include the following:

- Consider ways to re-constructing daily and monthly data where hydrographs are discontinuous using available "paper file" data and nearby stations,
- Consider the possibility of extending "NGVD 1929" corrected stage record back further in time where data is available,
- Analyze the newly corrected POR record at each site to determine historical averages, period of inundation, and other relevant summary information, and
- Develop a comprehensive BICY-wide hydrologic monitoring report.

Acknowledgements:

The authors would like to acknowledge Ron Clark, Pat Kenney, and Don Weeks at Big Cypress National Preserve for the role they played in overseeing BICY's hydrologic monitoring program in its early years; and June Gaishin, Nancy Little, Cherry James, Walter Smelt, and Luther Smith at the South Florida Water Management District for the role they played in digital entry of the paper-chart data. The thorough archival of field notes and tedious hours of digital entry performed by these individuals provided the baseline information needed to establish the described baseline.

TABLE 1: Surface water stage before and after correcting each station to NGVD 1929 datum
(in feet above sea level NGVD29)

Date	A1			A2			A3			A4			A5			A8		
	BEAR ISLAND			E HINSON MARSH			E CROSSING STRAND			MONUMENT LAKE			RACCOON POINT			BRIDGE 83		
	before	c.f.	after	before	c.f.	after	before	c.f.	after	before	c.f.	after	before	c.f.	after	before	c.f.	after
4/14/95	11.12	3.98	15.09	11.87	2.28	14.15	12.33	1.39	13.72	10.03	-0.63	9.40	10.93	-0.65	10.28	2.29	-0.18	2.11
4/15/95	11.09	3.98	15.07	11.83	2.28	14.11	12.30	1.39	13.69	9.95	-0.63	9.32	10.90	-0.65	10.25	2.23	-0.18	2.05
4/16/95	11.07	3.98	15.05	11.80	2.28	14.08	12.28	1.39	13.67	9.83	-0.63	9.20	10.88	-0.65	10.23	2.18	-0.18	2.00
4/17/95	11.04	3.98	15.02	11.77	2.28	14.05	12.25	1.39	13.64	9.70	-0.63	9.07	10.85	-0.65	10.20	2.12	-0.18	1.94
4/18/95	11.03	3.98	15.01	11.75	2.28	14.03	12.21	1.39	13.60	9.60	-0.63	8.97	10.81	-0.65	10.16			1.88
4/19/95	11.02	3.98	14.93	14.01		14.01			13.60	9.48	-0.63	8.85			10.12			1.81
4/20/95	11.00	3.98	14.74	13.94		13.94			13.57			8.77			10.18			1.73
4/21/95	14.87		14.87	13.89		13.89			13.54			8.60			10.16			1.65
4/22/95	14.84		14.84	13.86		13.86			13.50			8.50			10.13			1.57
4/23/95	14.81		14.81	13.82		13.82			13.47			8.39			10.10			1.48
4/24/95	14.78		14.78	13.78		13.78			13.44			8.31			10.06			1.40
4/25/95	14.84		14.84	14.02		14.02			13.47			8.24			10.03			1.34
4/26/95	14.86		14.86	14.10		14.10			13.53			8.22			10.00			1.31
4/27/95	14.84		14.84	14.06		14.06			13.56			8.19			9.97			1.29
4/28/95	14.90		14.90	14.16		14.16			13.76			8.43			9.97			1.44

Date	A9			A10			A11			A12			A13			A14		
	PINECREST			GUM SLOUGH			ROBERTS LAKE			KISSIMMEE BILLY			MULLET SLOUGH			DEEP LAKE		
	before	c.f.	after	before	c.f.	after	before	c.f.	after	before	c.f.	after	before	c.f.	after	before	c.f.	after
4/14/95	8.15	-0.55	7.60	3.28	0.99	4.27	12.36	-7.46	4.90	na	na	na	11.46	0.94	12.40	10.30	-0.68	10.30
4/15/95	8.13	-0.55	7.58	3.26	0.99	4.25	12.33	-7.46	4.87	na	na	na	11.39	0.94	12.33	10.26	-0.68	10.26
4/16/95	8.12	-0.55	7.57	3.23	0.99	4.22	12.31	-7.46	4.85	na	na	na	11.34	0.94	12.28	10.22	-0.68	10.22
4/17/95	8.10	-0.55	7.55	3.20	0.99	4.19	12.27	-7.46	4.81	na	na	na	11.26	0.94	12.20	10.19	-0.68	10.19
4/18/95	8.08	-0.55	7.53	3.17	0.99	4.16			4.79	na	na	na	11.17	0.94	12.11	10.17	-0.68	10.17
4/19/95	8.07	-0.55	7.52	3.15	0.99	4.14			4.77	na	na	na			12.04			10.14
4/20/95			7.51			4.09			4.74	na	na	na			11.85			10.12
4/21/95			7.50			4.06			4.71	na	na	na			11.73			10.10
4/22/95			7.48			4.02			4.68	na	na	na			11.61			10.07
4/23/95			7.47			3.97			4.65	na	na	na			11.51			10.05
4/24/95			7.45			3.91			4.61	na	na	na			11.42			10.02
4/25/95			7.44			3.86			4.57	na	na	na			11.44			10.00
4/26/95			7.44			3.83			4.55	na	na	na			11.52			9.98
4/27/95			7.45			3.87			4.56	na	na	na			11.47			9.96
4/28/95			7.50			4.01			4.58	na	na	na			11.92			10.42

before = uncorrected stage value digitized from paper chart
c.f. = correction factor applied to uncorrected "before" data
after = corrected stage value

Note: Transition date where data was joined is indicated by a horizontal line for each station

**Table 2. Rainfall reported in inches
for available RAWS* rain gages**

Days in April 1995	Oasis 401	Miles City 402	Ochopee 403	Raccoon Point 404
1	0	0	0	0
2	0.61	0.26	0.61	0.53
3	0	0	0	0
4	0	0	0	0
5	0	0	0	0
6	0.06	1.06	0.03	0.59
7	0.24	0.46	0.32	0.21
8	0	0	0	0
9	0	0	0	0
10	0	0	0	0
11	0	0	0	0
12	0	0	0	0
13	0	0	0	0
14	0	0	0	0
15	0	0	0	0
16	0	0	0	0
17	0	0.1	0	0
18	0	0.18	0	0
19	0	na	0	0
20	0	0	0	0
21	0	0	0	0
22	0	0	0	0
23	0	0	0	0
24	0	0	0	0
25	0	1.24	0	0

* RAWS = Remote Access Weather Station

Table 3. Surface Water Stage at BICY Hydrostations during the transition from paper-chart to digitally collected stage

to digitally collected stage											
A1		A2		A3		A4		A5		A8	
BEAR ISLAND		E HINSON MARSH		CROSSING STRAND		MONUMENT LAKE		RACCOON POINT		BRIDGE 83	
10/1/95	16.67	9/21/95	15.94	9/18/95	14.81	9/29/95	10.11	9/2/95	11.07	8/25/95	4.69
10/2/95	16.65	9/22/95	15.92	9/19/95	14.79	9/30/95	10.09	9/3/95	11.10	8/26/95	4.82
10/3/95	16.67	9/23/95	15.90	9/20/95	14.77	10/1/95	10.06	9/4/95	11.13	8/27/95	4.83
10/4/95	16.67	9/24/95	15.88	9/21/95	14.75	10/2/95	10.04	9/5/95	11.15	8/28/95	4.79
10/5/95	16.75	9/25/95	15.86	9/22/95	14.74	10/3/95	10.02	9/6/95	11.16	8/29/95	4.66
10/6/95	16.82	9/26/95	15.84	9/23/95	14.72	10/4/95	9.99	9/7/95	11.16	8/30/95	4.53
10/7/95	16.84	33 day gap		9/24/95	14.70	10/5/95	9.98	36 day gap		44 day gap	
10/8/95	16.85			9/25/95	14.69	10/6/95	10.15				
10/9/95	16.85			9/26/95	14.68	10/7/95	10.19				
10/10/95	16.84	10/29/95	16.11	9/27/95	14.67	10/8/95	10.19	10/13/95	11.37	10/13/95	3.73
10/11/95	16.83	10/30/95	16.07	9/28/95	14.71	10/9/95	10.19	10/14/95	11.44	10/14/95	3.80
10/12/95	16.81	10/31/95	16.04	9/29/95	14.70	10/10/95	10.18	10/15/95	11.49	10/15/95	3.89
10/13/95	16.80	11/1/95	16.02	9/30/95	14.73	10/11/95	10.16	10/16/95	11.58	10/16/95	3.89
10/14/95	16.87	11/2/95	15.99	10/1/95	14.74	10/12/95	10.13	10/17/95	11.57	10/17/95	3.88
10/15/95	17.05	11/3/95	15.96	10/2/95	14.75	10/13/95	10.10	10/18/95	11.56	10/18/95	3.93

A9		A10		A11		A12		A13		A14			
PINECREST		GUM SLOUGH		ROBERTS LAKE		KISSIMMEE BILLY		MULLET SLOUGH		DEEP LAKE			
9/28/95	8.40	9/27/95	4.85	9/2/95	5.87	499 day gap		9/20/95	13.45	9/20/95	10.96		
9/29/95	8.41	9/28/95	4.93	9/3/95	5.86			9/21/95	13.43	9/21/95	10.94		
9/30/95	8.41	9/29/95	4.97	9/4/95	5.88			9/22/95	13.39	9/22/95	10.93		
10/1/95	8.41	9/30/95	4.99	9/5/95	5.90			9/23/95	13.35	9/23/95	10.91		
10/2/95	8.42	10/1/95	4.98	9/6/95	5.90			9/24/95	13.30	9/24/95	10.90		
10/3/95	8.42	10/2/95	4.98	9/7/95	5.86			9/25/95	13.25	9/25/95	10.88		
10/4/95	8.43	10/3/95	5.04	9/8/95	5.84			9/26/95	13.21	9/26/95	10.89		
10/5/95	8.44	10/4/95	5.07	3 day gap				9/27/95	13.18	9/27/95	10.87		
10/6/95	8.49	10/5/95	5.05					9/28/95	13.51	9/28/95	11.11		
10/7/95	8.41	10/6/95	5.07			9/28/95	14.88	9/29/95	13.46	9/29/95	11.10		
10/8/95	8.40	10/7/95	5.05			9/29/95	14.87	9/30/95	13.43	9/30/95	11.08		
10/9/95	8.41	10/8/95	5.03			9/30/95	14.87	10/1/95	13.50	10/1/95	11.08		
10/10/95	8.42	10/9/95	5.05			10/1/95	14.90	10/2/95	13.45	10/2/95	11.10		
10/11/95	8.41	10/10/95	5.04			10/2/95	14.87	10/3/95	13.42	10/3/95	11.07		
10/12/95	8.40	10/11/95	5.02			10/3/95	14.88	10/4/95	13.39	10/4/95	11.08		

Table 4. Calculated Monthly Average Water Levels at BICY Hydrostations (1991-2000)

Year	Month	1 North Bear Island	2 East Hinson Marsh	3 East Crossing Strand	4 Monument Road	5 Raccoon Point	8 Bridge 83 Turner R.	9 Pinecrest	10 Gum Slough	11 Roberts Lake	12 Kissimmee Billy Strand	13 Mullet Slough	14 Deep Lake
91	Jan	14.18	13.25	na	na	na	1.64	na	na	3.88	na	na	na
91	Feb	15.11	14.13	na	na	9.82	1.91	5.88	3.15	3.94	na	na	na
91	Mar	15.01	14.10	na	8.22	9.01	1.15	5.29	2.52	4.06	na	na	na
91	Apr	14.46	13.53	na	7.63	8.32	1.00	5.61	3.12	3.75	na	12.10	8.67
91	May	14.13	13.09	na	8.48	8.92	1.63	6.54	3.70	3.76	na	12.56	9.56
91	Jun	15.16	13.85	na	9.89	10.07	2.73	7.25	4.40	4.92	na	12.60	10.53
91	Jul	15.95	15.03	na	10.15	10.56	2.94	7.68	4.63	5.16	na	12.92	10.81
91	Aug	16.49	15.30	na	10.27	10.67	3.05	7.71	4.63	5.26	na	13.15	10.84
91	Sep	16.35	15.18	na	10.25	10.57	3.12	7.86	4.64	5.33	na	13.14	10.78
91	Oct	16.02	14.99	na	10.08	10.63	2.96	7.60	4.52	5.25	na	13.08	10.71
91	Nov	15.72	14.70	na	9.92	10.42	2.73	7.35	4.32	5.00	na	12.88	10.51
91	Dec	15.40	14.40	na	9.86	10.31	2.22	7.22	4.11	4.86	na	12.75	10.27
92	Jan	15.05	13.96	na	9.43	10.09	1.44	6.86	3.77	4.72	11.48	12.39	9.83
92	Feb	15.00	13.74	na	9.41	10.19	1.64	6.78	3.67	4.67	11.56	12.51	10.06
92	Mar	15.05	13.97	na	9.14	9.88	1.30	6.67	3.16	4.26	11.35	12.36	10.16
92	Apr	14.82	13.85	na	9.62	10.05	1.64	6.62	3.75	4.48	11.21	12.31	10.22
92	May	13.74	12.85	na	9.02	9.68	1.04	5.64	2.93	3.98	10.32	11.47	9.44
92	Jun	14.08	13.23	na	9.67	10.00	2.38	6.97	3.99	4.81	11.03	12.39	9.93
92	Jul	16.25	15.26	na	10.11	10.67	3.01	7.53	4.37	4.93	11.69	13.03	10.73
92	Aug	16.11	15.25	na	10.14	10.65	3.02	7.74	4.57	5.24	11.79	13.13	10.77
92	Sep	16.02	15.17	na	10.18	10.76	3.32	7.92	4.49	5.62	11.79	13.15	10.93
92	Oct	15.82	14.89	na	9.85	10.48	2.96	7.87	4.39	5.44	11.51	12.84	10.58
92	Nov	15.37	14.46	na	9.75	10.48	2.42	7.73	4.38	5.11	11.18	12.78	10.42
92	Dec	15.15	14.15	na	9.61	10.37	2.25	7.53	4.36	5.10	10.88	12.54	10.28
93	Jan	15.49	14.47	na	9.90	10.51	2.64	7.36	4.44	5.05	11.43	12.78	10.50
93	Feb	15.46	14.54	na	9.84	10.50	2.66	7.17	4.20	4.96	11.58	12.81	10.50
93	Mar	15.34	14.39	na	9.82	10.41	2.39	6.99	3.86	4.81	11.49	12.76	10.51
93	Apr	15.11	14.16	na	9.91	10.39	2.64	7.11	4.07	4.82	11.38	12.68	10.47
93	May	14.66	13.57	na	9.40	9.82	2.05	7.29	3.30	4.54	11.06	11.64	9.67
93	Jun	14.22	13.17	na	10.14	10.52	2.80	7.51	4.45	5.38	10.64	12.57	10.33
93	Jul	14.48	13.74	na	10.21	10.60	2.80	7.21	4.41	5.22	10.02	12.83	10.58
93	Aug	14.97	14.03	na	10.05	10.70	2.98	7.18	4.30	5.02	11.07	12.87	10.50
93	Sep	15.54	14.83	na	10.28	10.77	3.15	7.49	4.56	5.28	11.43	12.95	10.69
93	Oct	15.77	15.00	na	10.43	10.95	3.37	7.72	4.57	5.56	11.43	13.06	10.84
93	Nov	15.40	14.62	13.71	9.92	10.52	2.74	7.49	4.38	5.17	11.27	12.74	10.46
93	Dec	15.07	14.17	13.71	9.61	10.18	2.24	7.18	4.26	4.85	11.04	12.57	10.13
94	Jan	14.98	14.01	13.66	9.65	10.26	2.25	7.17	4.27	4.90	10.93	12.60	10.12
94	Feb	15.12	14.18	13.83	9.79	10.28	2.51	7.03	4.07	4.83	11.18	12.67	10.40
94	Mar	14.97	13.90	13.64	9.80	9.99	1.92	7.35	3.61	4.41	11.15	12.40	10.21
94	Apr	14.58	13.68	13.56	9.89	9.55	1.96	7.25	2.77	3.56	11.09	12.11	9.83
94	May	14.49	13.52	13.58	9.14	9.92	1.49	6.03	2.72	3.36	11.15	12.58	9.13
94	Jun	14.32	13.72	13.71	9.89	9.67	2.34	6.97	3.88	4.23	na	12.50	9.73
94	Jul	14.55	14.02	13.84	9.93	10.11	2.54	7.32	4.05	4.32	11.78	12.94	10.19
94	Aug	15.07	14.11	14.05	10.13	10.41	2.52	7.38	4.47	5.11	na	13.03	10.43
94	Sep	16.13	15.13	14.40	10.37	10.62	3.19	7.68	4.63	5.44	na	13.19	10.59
94	Oct	16.23	15.39	14.43	10.40	10.70	3.35	8.04	4.63	5.57	na	13.23	10.62
94	Nov	16.03	15.26	14.37	10.35	11.08	3.24	8.32	4.97	5.80	na	13.22	10.96
94	Dec	16.42	15.59	14.66	10.53	11.14	3.48	8.35	5.01	5.80	na	13.42	10.98
95	Jan	16.25	15.50	14.59	10.34	11.17	3.40	8.35	4.98	5.79	na	13.27	10.94
95	Feb	15.69	15.19	14.41	10.07	11.04	3.06	8.14	4.77	5.61	na	12.97	10.77
95	Mar	15.34	14.71	14.09	9.86	10.67	2.69	7.89	4.56	5.37	11.49	12.78	10.58
95	Apr	15.01	14.13	13.70	9.12	10.24	1.96	7.59	4.20	4.86	na	12.19	10.28
95	May	14.80	13.89	13.62	9.88	10.32	2.20	7.59	4.45	4.98	na	12.13	10.07
95	Jun	15.18	14.33	13.97	10.33	10.62	3.36	7.70	4.70	5.34	na	12.71	10.70
95	Jul	15.35	14.58	13.99	10.08	10.68	3.05	7.78	4.66	5.26	na	12.84	10.64
95	Aug	16.39	15.39	14.37	10.22	10.81	3.43	7.99	4.69	5.44	na	13.07	10.98
95	Sep	17.14	16.06	14.78	10.22	11.03	3.40	8.35	4.83	5.71	na	13.43	11.01
95	Oct	16.71	15.42	14.92	10.01	11.21	3.87	8.34	5.00	5.94	15.08	13.47	11.18
95	Nov	16.43	15.64	14.57	9.79	11.24	3.36	8.16	4.78	5.67	14.69	13.12	10.84
95	Dec	15.70	15.00	14.21	9.52	10.87	2.90	7.84	4.58	5.31	14.32	12.84	10.66

96	Jan	15.48	14.67	14.05	9.54	10.59	2.49	7.63	4.51	5.13	14.15	12.73	10.54
96	Feb	15.19	14.26	13.76	8.93	10.25	1.80	7.43	4.28	4.87	13.66	12.41	10.18
96	Mar	14.92	13.90	13.56	8.30	10.10	1.29	7.22	3.86	4.64	13.12	12.32	9.86
96	Apr	14.47	13.02	13.12	7.75	9.60	0.85	6.66	3.42	4.03	12.43	11.62	9.15
96	May	14.03	12.81	13.39	8.43	9.43	0.80	7.00	3.36	3.49	12.80	11.83	9.43
96	Jun	15.20	14.19	13.96	10.03	10.60	2.47	7.35	4.29	5.14	13.82	13.04	10.46
96	Jul	15.97	15.18	14.24	10.04	10.59	3.10	7.40	4.47	5.05	14.52	13.15	10.50
96	Aug	15.45	14.81	14.03	9.79	10.52	2.89	7.41	4.64	5.02	14.44	12.87	10.45
96	Sep	15.35	14.72	14.05	9.88	10.45	3.24	7.58	4.48	5.23	14.39	12.85	10.70
96	Oct	15.83	15.02	14.11	9.74	10.78	2.94	7.67	4.53	5.43	14.60	12.79	10.58
96	Nov	15.29	14.67	13.98	9.14	10.46	2.34	7.52	4.31	5.08	14.30	12.57	10.27
96	Dec	14.96	14.17	13.75	8.19	10.09	1.66	7.41	4.11	4.81	13.92	12.26	10.00
97	Jan	14.76	13.86	13.58	8.56	9.88	2.17	7.23	3.90	4.73	13.63	12.28	9.75
97	Feb	14.51	13.35	13.33	8.56	9.45	1.82	6.99	3.44	4.60	12.99	11.58	9.31
97	Mar	13.98	12.39	13.02	7.93	8.83	1.70	6.83	2.68	3.86	12.96	11.41	8.89
97	Apr	13.29	11.86	12.82	8.25	9.05	1.46	6.51	2.66	2.57	12.65	11.80	8.37
97	May	13.47	12.60	13.14	9.52	9.51	1.76	6.96	2.98	2.73	13.88	12.31	9.40
97	Jun	14.33	13.64	13.63	9.66	10.33	2.22	7.17	4.07	3.62	14.46	12.71	10.07
97	Jul	15.03	14.06	13.69	9.88	10.37	3.05	7.30	4.36	4.44	14.59	12.83	10.56
97	Aug	15.63	14.73	14.12	9.96	10.71	3.16	7.55	4.41	5.25	14.85	12.99	10.59
97	Sep	15.29	14.66	14.25	9.93	10.98	3.12	7.76	4.59	5.29	14.84	13.09	10.64
97	Oct	15.14	14.40	14.10	9.68	10.77	3.16	7.77	4.54	5.31	14.63	13.00	10.58
97	Nov	14.95	14.02	13.75	9.62	10.64	2.87	7.55	4.38	5.03	14.30	12.88	10.26
97	Dec	15.49	14.54	14.10	9.96	10.91	3.26	7.68	4.58	5.38	14.75	13.09	10.60
98	Jan	15.39	14.52	14.03	9.73	10.75	2.98	7.49	4.39	5.16	14.61	12.96	10.49
98	Feb	15.38	14.44	13.99	9.80	10.79	2.98	7.60	4.55	5.18	14.53	12.93	10.50
98	Mar	15.62	14.59	14.09	9.83	10.78	3.02	7.56	4.52	5.19	14.59	12.96	10.58
98	Apr	15.41	14.37	13.68	9.05	10.30	2.31	7.06	3.91	4.79	13.92	12.33	10.00
98	May	14.71	13.42	12.33	7.54	9.16	0.70	6.00	2.25	3.32	12.75	10.49	7.81
98	Jun	14.39	13.03	13.20	8.31	8.63	0.67	6.50	3.33	3.29	12.42	10.42	7.66
98	Jul	14.60	13.33	13.64	9.44	9.44	2.05	7.33	3.91	3.78	12.65	12.17	8.83
98	Aug	15.54	14.37	14.06	9.98	10.43	2.82	7.27	4.51	5.01	13.43	12.59	10.25
98	Sep	15.74	14.92	14.20	9.89	10.45	2.86	7.30	4.34	5.08	14.21	12.92	10.64
98	Oct	15.76	15.00	14.20	9.78	10.71	2.82	7.49	4.48	5.18	14.53	12.94	10.55
98	Nov	16.42	15.55	14.51	9.97	10.93	3.28	7.73	4.55	5.37	14.74	13.12	10.92
98	Dec	16.03	15.28	14.31	9.68	10.76	3.06	7.54	4.38	5.17	14.58	12.92	10.74
99	Jan	15.63	14.94	14.14	9.69	10.57	3.03	7.49	4.41	5.12	14.42	12.83	10.66
99	Feb	15.29	14.55	13.96	9.47	10.42	2.58	7.29	4.18	4.98	14.13	12.71	10.42
99	Mar	14.89	13.99	13.56	8.43	10.04	1.47	6.77	3.48	4.58	13.38	11.97	9.81
99	Apr	14.15	12.57	12.53	7.15	8.59	0.36	6.27	2.51	2.75	12.43	10.41	7.90
99	May	14.00	12.94	12.64	7.49	8.55	0.71	6.62	2.90	2.76	12.41	11.81	6.97
99	Jun	14.02	13.65	13.21	9.30	10.27	1.60	7.36	4.43	4.98	12.98	12.75	7.68
99	Jul	15.14	14.29	13.94	9.78	10.93	2.58	7.72	4.58	5.52	14.44	12.84	10.42
99	Aug	15.45	14.64	14.18	9.87	10.83	2.86	7.63	4.57	5.43	14.68	12.93	10.72
99	Sep	16.25	15.31	14.51	9.99	11.04	3.38	7.94	4.77	5.64	15.04	13.27	10.80
99	Oct	16.93	15.86	14.65	10.19	11.46	3.70	8.33	4.96	5.96	15.10	13.42	10.98
99	Nov	16.36	15.49	14.40	9.90	11.36	3.43	8.31	4.79	5.86	14.73	13.05	10.84
99	Dec	15.61	14.88	14.07	9.52	10.90	2.72	8.00	4.54	5.49	14.31	12.77	10.57
2000	Jan	15.20	14.39	13.82	9.20	10.48	2.03	7.54	4.38	5.16	13.91	12.58	10.37
2000	Feb	14.92	13.97	13.55	8.84	10.26	1.35	7.28	4.31	4.96	13.60	12.45	10.01
2000	Mar	14.51	13.36	13.27	7.97	9.83	0.76	6.87	3.70	4.41	12.79	11.66	8.61
2000	Apr	14.26	12.94	13.33	8.04	9.58	0.80	6.67	3.52	3.85	13.63	11.82	7.99
2000	May	13.20	11.14	11.89	7.23	8.93	0.29	6.04	2.50	1.97	12.93	10.48	7.03
2000	Jun	12.72	10.32	11.98	9.47	9.58	1.10	7.02	3.01	1.92	13.25	11.64	6.52
2000	Jul	10.47	11.88	13.10	9.71	10.10	1.74	7.18	4.28	5.10	13.90	12.29	7.51
2000	Aug	14.27	13.46	13.67	9.61	9.91	2.60	7.22	3.96	4.93	14.37	12.69	9.01
2000	Sep	14.96	14.38	14.16	na	na	3.36	na	na	5.27	na	12.94	10.71
2000	Oct												
2000	Nov												
2000	Dec												

Key

data not available
calculated from weekly staff gage readings

Appendix 1

Additional Information and Correspondences used to Apply and Verify the Correction Factors

1. **BICY Hydrologic Station Elevations and Corrections.** This is a table prepared by Don Week and Christine Bates that describes elevations and correction factors relative to the arbitrary (1991) and NGVD 1929 (1995) datums at each station. This table was developed in 1996.
2. **Correspondence from Bob Sobczak to June Gaishin describing correction factor application.** This correspondence provides a list of the correction factors that were derived from review of the "spot measurement" field sheets from 1991 to 1995 and review of the table described above. Instances where there was initial confusion or irregularities were spotted are also described.
3. **Correspondence from Bob Sobczak to June Gaishin describing correction factor application.** This correspondence describes the sources of surface water stage data, and provides a short list of items that needed to be discussed with District staff in order to verify the applied stage corrections.
4. **Big Cypress National Preserve Hydraulic Monitoring Sites, by Luther Smith and June Gaishin.** This report documents observations made by the District during digital entry and correction of the paper chart data from 4/1995 to 10/1995.

BICY Hydrologic Station Elevations and Corrections

Site	Original Reference Elevation (Ft) (as of 1/95)	Surveyed Elevation (Ft) (Date) ¹	Corrected Elevation (Ft) ² NGVD 1929	Elevation Marked on New Shelters (ft) (Date)	Correction to be Applied to P.O.R. Chart Data	Alternative Correction ³
A1 North Bear Island	14.25	16.84	18.23	~~not marked~~ 18.31 (10/95)	+3.98	
A2 East Hinson Marsh	15.96	16.85 (6/95) 16.85	18.24	18.28 (10/95)	+2.28	+1.39
A3 East Crossing Strand	18.05	18.05	19.44	18.51 (10/95)	+1.39	Jan 92 shot up
A4 Monument Road	15.00	12.94 (6/95)	14.37	14.22 (10/95)	-0.63	+1.43
A5 Raccoon Point	15.00	12.91	14.35 <i>from measuring point is 14.31</i>	14.40 (10/95)	-0.63	
A8 Bridge 83	7.16	5.61 (9/95) 5.59	6.98	7.00 (10/95)	-1.55	-0.18
A9 Pinecrest Hammock	11.46	9.41	10.91	10.96 (10/95)	-0.55	
A10 Gum Slough	6.90	6.46 (6/95) 6.46	7.89	7.92 (10/95)	+0.99	+1.43 (except final chart)
A11 Roberts Lake Strand	15.00	6.11	7.54	7.55 (9/95)	-7.46	
A12 Kissimmee Billy Strand	17.98	17.98	19.37	19.40 (10/95)	no chart	
A13 Mullet Slough	14.55	14.55	15.94	15.97 (10/95)	+1.39	
A14 Deep Lake	15.00	15.06 (6/95) 12.93	14.32	14.42 (10/95)	-0.68	-0.74

¹ Elevations with a date associated, were marked on shelters at noted dates. Elevations without a date associated, are from initial, NAVD 1988 datum survey.

² Elevation has been corrected to accepted datum of NGVD 1929.

³ Alternative Correction should be applied to data where Surveyed elevation was used to calculate stage, and should be applied only for the months where that elevation was noted.

Date: 7/26/00 1:38 PM

Sender: Robert Sobczak

Subject: Re[2]: Graphic Big Cypress 1995

June, Here are the correction factors I used for the chart data that immediately precedes the 4/95 to ~10/95 chart data that you recently digitized and corrected. I hope to have an opportunity to reach you in the next week or two to run through this (next week is more likely). Regards, Bob Sobczak 941-695-2000 x344

Station Correction Factor
 that I applied

A1	Bear Island	+3.98
A2	EHinson Msh	+2.28
A3	E Xing Stnd	+1.39
A4	Monument Lk	-0.63
A5	Raccoon Pt	-0.65 *
A8	Bridge 83	-0.18 **
A9	Pinecrest	-0.55
A10	Gum Slough	+0.99
A11	Roberts Lk	-7.46
A12	Kissimmee Bly	+1.39 ***
A13	Mullet Slough	+0.94 ****
A14	Deep Lake	-0.68

Explanation of Asterisks (*)

* A5: the correction that i applied was different than correction sheet by -0.02. I also get a slight hitch in the connection point between the the pre and post 4/95 data for A5 as follows:

4/15	10.25	no rain
4/16	10.22	no rain
4/17	10.22	no rain
4/18	10.16	no rain
4/19	10.12	no rain
4/20	10.18	no rain
4/21	10.16	no rain

** A8: I used the alternative correction factor of "-0.18" and not "-1.55" in order to match the pre-4/95 data to the A8 data you provided us -- we need to confirm that you used the same correction factor

*** A12: I used the correction factor of "+1.39", but this correction factor was not explicitly supplied on the correction table -- it appeared to match with the data that you provided, but we will want to confirm this

**** A13: I used the correction factor "+0.94", which is different than the correction factor of "+1.39" provided in the table. My criteria for using the "+0.94" correction was that it matched with point measurements of staff gage readings we have in our files over here, and also because this correction matches well with the data you provided us will -- we just need to confirm the correction factor that you used to make sure it all makes sence

Date: 9/15/00 2:38 PM
Sender: Robert Sobczak
Subject: Big Cypress Hydro Data Mtg
9/16/00

Subject: 1995 Corrected Data Files
Big Cypress National Preserve

June,

Attached are "*.dat" files of daily water levels for 1995 at all of our hydrostations. Water level data in these files has been "corrected" and is derived from the following three sources:

- (A) 1/95 to 4/95
Source = digitized by SFWMD in 1999
* Corrected by Bob Sobczak in 2000 using table compiled by Christine Bates in 1996 that provides vertical adjustments needed to correct historic "paper chart" data to the 10/95 survey
- (B) 4/95 to 10/95
Source = digitized by June Gaishin in 2000
* Corrected by JG based on survey information transcribed on paper scroll charts on 10/95
- (C) 10/95 to 12/95
Source = CR10 digitally collected data
* A new datum was established in 10/95 by which the CR10 is referenced to, therefore no correction was applied to data

In most cases, it looks like the correction that you applied for the 4-10/95 data is the same to the correction that I applied to the 1-4/95 data. We will want to go over each station individually to confirm the match and highlight problem areas or uncertainties if they exist. It will be both Christine and me meeting with you on Monday, so we should have the full critical mass needed to figure this all out.

Information that we will be bringing include:

- Paper file containing the correction table that was used to correct the 1/95 - 4/95 data
- Monthly field sheets transcribed in 1995 that report staff gauge readings at all sites for all 12 months of 1995
- Notes that I used for making the corrections
- CD containing uncorrected wl data from 90-4/95
- corrected daily water levels for 1995 (see below)

See you Monday 9/18/00 at 10am -- we will meet you at your office.

Regards,
Bob Sobczak, Hydrologist
Big Cypress National Preserve
941-695-2000 x344



A0195a.dat



A0295a.dat



A0395a.dat



A0495a.dat



A0595a.dat



A0895a.dat



A0995a.dat



A1095a.dat



A1195a.dat



A1295a.dat



A1395a.dat



A1495a.dat

Big Cypress National Preserve Hydraulic Monitoring Sites

Luther Smith and June Gaishin

Part I

These general notes pertain to the processing of eleven Big Cypress graphic recorder sites, from **April 1995 to October 1995**. Processing and GVA review were done in February and March 2000.

SUMMARY:

Field personnel performing graphic chart set up and chart removal did not complete the full range of header information at chart on-times and off-times. At most sites, charts ran with no apparent mechanical malfunction, so processing simply necessitated establishing proper reference elevation and using DTW readings to place successive monthly charts into their proper relation. A variety of practices by field personnel, however, caused the raw, *unprocessed* stage values to appear erratic. This summary is presented to document the approach used to process this stage data for this 1995 interval.

REFERENCE ELEVATIONS:

Survey of Big Cypress sites in October 1995 established proper reference elevations at the eleven sites. Initially, data was processed using the reference elevations given in April 1995 at the beginning records of this set of charts. Complicating this was the fact that some field personnel changed reference elevations and resulting values *within* this period from April to October, adjusting pen values as their calculations suggested. Thus, the raw data occasionally exhibits monthly chart period segments out of range with adjacent chart periods.

The Big Cypress sites converted to CR10 data production in September and October of 1995. The graphic chart processing and the subsequent application of the correct reference elevation produced a **smooth transition between the graphic and CR10 data at all available sites** (though missing intervals were present at a few sites).

DTW's:

Field personnel frequently recorded DTW's to tenths of a foot, versus hundredths as is commonly the practice. Though this does not significantly affect the quality of stage data, it accounted for some slight "play" when processing individual monthly chart periods. Additionally, personnel never recorded a TAPE or STAFF value according to usual practice; they usually subtracted the DTW from the reference elevation and put the result in either the STAFF or TAPE field of the header stamp. This was clearly the practice on the majority of charts.

On one problematic chart set for BCNPA2, however, field personnel recorded *different* values for the DTW on chart pick up and the subsequent chart set up. Since the pen was also moved way out of range, placement of this segment was estimated.

PEN VALUES:

Field personnel frequently changed bases between charts and adjusted the pen start values to arbitrary values independent of the actual stage values. Since the charts themselves actually ran well with few recorder problems, the lack of consistent pen placement was easily corrected by the subsequent value shifting of each segment POR individually in GVA, using the reference elevation and the DTW's.

DATES/TIMES:

Field personnel properly established chart set up and pick up times at most sites, though recorders running slow or fast frequently necessitated revision. Some charts were put on half scale, where 1.2" equals 24 hours. Also, one site (BCNPA14) had recurrent clock stoppages days in length, requiring time shifting to correlate events with references.

Conclusion:

Absent and conflicting header information on the Big Cypress graphic charts for the April to October 1995 interval necessitated revision of typical processing procedure. Good stage data was obtained, however, due to the final establishment of the correct reference elevations, the recording of DTW's during most site visits, and the absence of major chart recorder or site mechanical problems.

Part II

The following notes detail the procedures followed while processing individual BCNPA sites, and were written at the time of GVA review.

BCNPA1

Field personnel consistently used REF ELEV of 15.00 ft., until correct elevation of 18.23 ft. established 10/06/95. Pen trace solid, no apparent mechanical problems. Applied +3.23 correction to data for this POR. (BCNPA1 legitimately overlaps previous archived data point of 4/21/95. This chart clearly supports beginning date of 4/20, with no conflict.)

BCNPA2

Many inconsistencies in header. REF ELEV changed from 15.96 ft. on 4/19/95, to 16.85 ft. on 6/21/95, to 16.95 ft. on 9/20/95. Finally established REF ELEV of 18.24 ft. on 10/27/95 survey. Pen was moved spuriously between charts, necessitating individual segment POR shifting in GVA. Chart and equipment performance looks good, however, so adequate placement of graphic values was possible. Applied +1.39 correction in GVA to this data according to October survey.

Contractor wrote that on chart

↳ plotting function

BCNPA3

Beginning REF ELEV 18.05 ft., changed to 19.44 ft. on 9/26/95 survey. No apparent chart recorder or equipment problems. Value shifted POR in GVA to account for September survey.

BCNPA4

REF ELEV given as 15.00 ft initially, changed to 12.94 ft. on 6/20/95, and maintained until 10/05/95 survey corrected REF ELEV to 14.37 ft. Some chart reversals "rode the rails" for awhile, so legitimate chart skew may have occurred. No apparent chart recorder or equipment problems; pen trace good.

BCNPA5

REF ELEV of 15.00 ft. initially, changed to 14.37 ft. at chart end, though one entry suggested they changed it to 12.91 ft. (Coincidentally, REF ELEV for BCNPA4 is also 14.37 ft.) No apparent chart recorder or equipment problems.

BCNPA8

REF ELEV of 7.16 ft, changed to 5.59 ft., then 6.98 ft. Float stuck a few times. Did value shift of some chart sets individually, using DTW's, instead of applying shift to entire April - August POR.

BCNPA9

REF ELEV of 11.46 ft. initially, changed to 10.91 on 10/06/95 survey. At chart end, field personnel noted that counterweight at bottom of well caused questionable values. Though movement may have been impinged during groundwater rises after rain, general trend looks good and compares with references. Pen went missing after 7/19, so data estimated between 7/19 and 8/16.

BCNPA10

REF ELEV initially 6.9 ft., changed to 6.46 ft. on 6/20/95, then to 7.89 ft. on final survey, probably on 10/05/95. No apparent chart recorder or equipment malfunctions. Value shifts done by individual segment POR in GVA, due to REF ELEV changes.

BCNPA11

REF ELEV 15.00 ft. initially, changed to 7.54 ft. at end, but date not given. Estimation required 6/24/95 to 7/19/95 due to slipped chain, and again on 7/30/95 to 8/21/95 due to pin coming out. Field personnel changed pen values between chart pick up and set up, necessitating segment by segment POR value shifting in GVA.

BCNPA13

REF ELEV initially 14.55 ft., changed to 15.94 ft. on 9/27/95. No apparent chart recorder or equipment malfunctions.

BCNPA14

REF ELEV initially 15.00 ft., changed to 15.06 ft on 6/20/95; final REF ELEV of 14.32 ft. on 9/27/95. The clock stopped for intervals ranging from 1-1/2 to 7 days during several of these chart POR's. Clock stoppage was clearly evident on each chart, and occurred only once, always within a few days of chart on time. Time shifting in GVA was done to correspond to clock stoppage; assumption of single stoppage and duration for each chart POR was correct, because events then lined up perfectly with references.