Technical Memorandum
WRE # 381

Hydrologic Report for Martin County

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by

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EXECUTIVE SUMMARY

The objectives of this report are to present a summary of hydrometeorologic data (rainfall, evaporation, stage and flow) available from the District Database (DBHYDRO) for Martin County, and to develop a preferred data set after filling missing data and checking for Quality Assurance (QA) and Quality Control (QC). The preferred data set will be stored later as preferred keys in the District Database.

A set of procedures is presented for selecting and developing the preferred database. The major issues with the climatic data set are temporal and spatial distribution. Five rainfall stations out of 46 and two pan evaporation stations out of nine are selected from the database. Monthly and yearly rainfall statistics (mean, median, standard deviation, maximum, and minimum values) for each station are reported as well as monthly and yearly areal rainfall for the county (tabular and graphical formats).

Surface water data are presented for six major water control structure sites: S-308, S-153, S-135, S-80, S-48, and S-97. Historical daily data and corresponding monthly and annual statistics are presented. Based on these statistics, a few comments regarding the performance of these structures related to their operating criteria are also presented. Taking into account the importance of the St. Lucie Canal, C-44, and the complexity of the system, a schematic plot for the hydrologic system is presented for better understanding. Monthly rainfall data plotted against net flow (difference between outflows and inflows) data show a poor relationship probably due to major losses occurring along the C-44 canal.

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1. INTRODUCTION

Martin County (Figure 1) is located in between Lake Okeechobee and the Atlantic Ocean on the west and east, and St. Lucie and Palm Beach counties on the north and south.

Seven major drainage basins are within Martin County: C-23, C-59, S-153, S-135, C-44 (the Cs are named after the drainage canals, and the Ss after the control structures), the Tidal St. Lucie River, and the North Fork St. Lucie River Basins. The other sub-basins within the county are: Palmar, Middle Coastal, South Coastal, Intracoastal, Loxahatchee River, Basin 2, Basin 4, Basin 5, Basin 6, Basin 8, Lake Okeechobee, and Jonathan Dickinson.

Almost 50 percent of these major drainage basin areas are in Martin County (400 square miles). The rest belongs to St. Lucie County (273 square miles) and Okeechobee County (182 square miles). Table 1 summarizes the different major drainage basin areas within the different counties.

In addition to flood protection, the canals in these basins have other functions such as water supply during periods of low flow, maintaining adequate groundwater table elevation to prevent saltwater intrusion into local groundwater, and navigation from Lake Okeechobee to the Intracoastal Waterway. C-44 canal, among the first constructed drainage District works during the early 1900 (1916-1928), drains most of the Central Martin County (189.8 square miles). Water supply for the County is from local rainfall, Lake Okeechobee, and from pumping of groundwater from both the Surficial and the Floridan Aquifer Systems.

Six major structures are located in the County area: S-48, S-80, S-97, S-135, S-153, and S-308. A description of these structures is given in Table 2. The U.S. Army Corps of Engineers operates and maintains project works on the St. Lucie Canal, locks and major spillways, while the South Florida Water Management District operates the remaining structures in accordance with regulations prescribed by the Corps.

This report presents a summary of the hydrometeorologic data set (rainfall, evaporation, stage and flow) available from the District database (DBHYDRO) for Martin County, and subsequently, a preferred data set will be developed after filling missing data and checking for Quality Assurance (QA) and Quality Control (QC). The preferred data set will be stored later on as preferred key in the District database.

Monthly and yearly rainfall statistics (mean, median, standard deviation, maximum, and minimum values) for each station are reported as well as monthly and yearly areal rainfall for the county (tabular and graphical formats). The same statistics are reported for the whole data set.

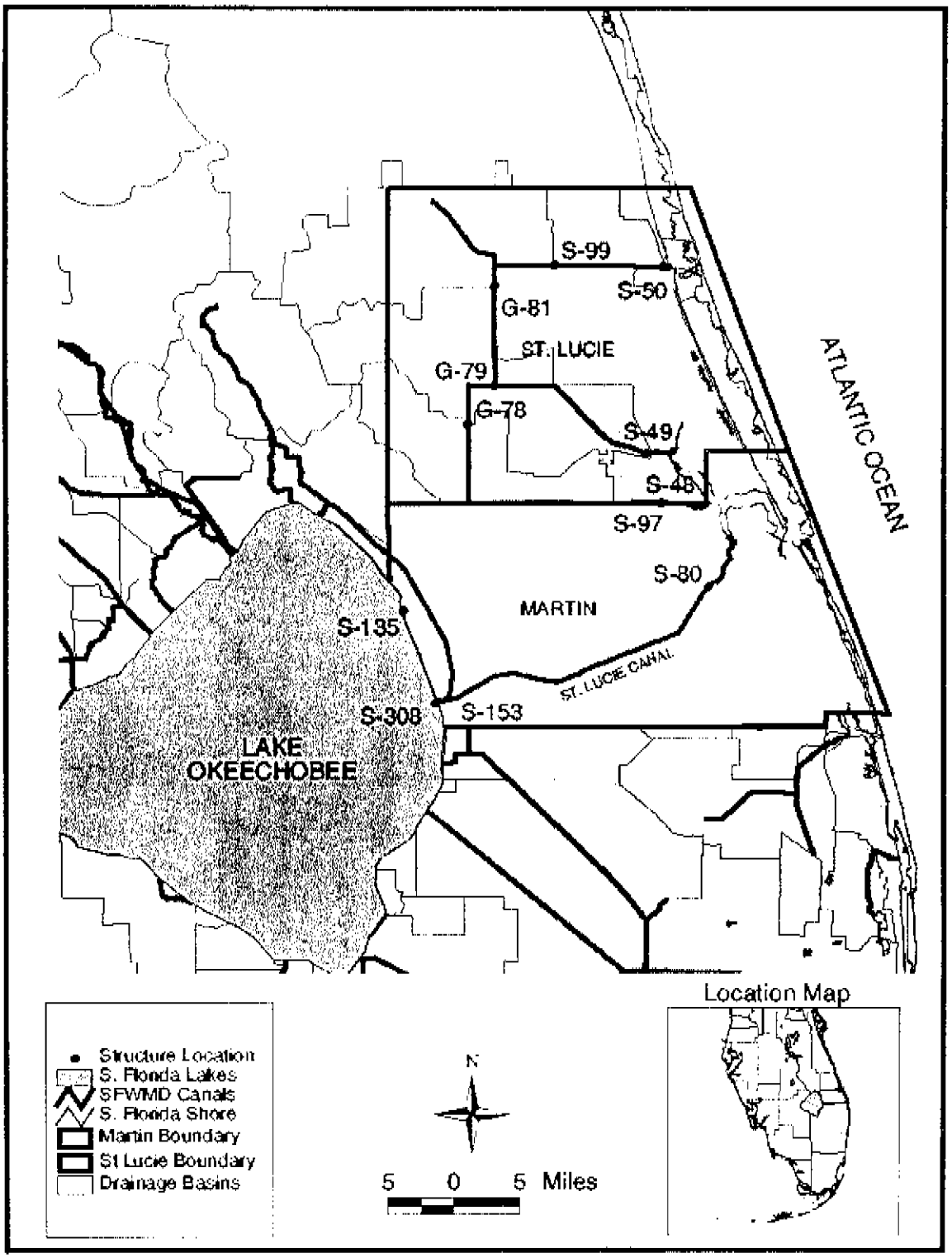


Figure 1. Martin County location map

Table 1: Major drainage basins in Martin County

Basin	Martin County (mi^2)	St. Lucie County (mi^2)	Okeechobee County (mi^2)	Indian River County (mi^2)	Total (mi^2)
C-23	71	82.7	14	0	167.7
C-44	189.8	0	0	0	189.8
C-59	18.7	9.4	159.8	0	187.9
S-135	20	0	8.3	0	28.3
S-153	19.9	0	0	0	19.9
Tidal St. Lucie	69.8	0	0	0	69.8
North Fork of the St. Lucie River Basin	10.9	180.7	0	0	191.6
Total (mi^2)	**400.1**	272.8	182.1	0	855

Table 2: Description of major structures in Martin County

Control structures	Type	Location (basin)	Specifications
S-48	Fixed crest weir	Outlet of C-23	Maintains stage greater than 8ft. in the lower reach when flow in the canal is adequate
S-80	Gated spillway, navigation lock	Tidal St. Lucie	When S-308 closed, optimum stage: 15.0 ft. ≥ HW ≥ 14.0 ft.
S-97	Gated spillway	C-23	When flow is adequate, headwater stage maintained between 20.5 and 22.2 ft. during wet season, and 22.2 and 23.2 ft. during dry season
S-135	Gated spillway, navigation lock, pump station	S-135	Pumping initiated when HW stage rises to 14 ft. and terminated when HW stage is less than 13.5 ft. When stage below 13 ft. and HW greater than 13 ft. spillway can discharge to Lake Okeechobee by gravity
S-153	Gated spillway	S-153	Optimum stage is 18.8 ft.; 19.1≥ HW ≥ 18.6 ft.
S-308	Gated spillway, navigation lock	C-44, outlet for Lake Okeechobee	Optimum stage: Lake Okeechobee regulation schedule

2. CLIMATIC DATA

2.1 EXISTING DATA

2.1.1 Rainfall

There are 46 rainfall stations located at 36 sites in Martin County (Figure 2). However, these sites are not uniformly distributed throughout the County and most of them are concentrated in C-44 basin, along the C 44 canal. The oldest station is INDIAN3, a National Oceanic and Atmospheric Administration (NOAA) site with data starting in 1929, but with a large gap of missing data between 1934 and 1962. Table 3 gives the list of the rainfall stations with location and years of data. Data availability for each rainfall station is also summarized in Figure 3. Only seven rainfall stations have records for more than 20 years. The majority falls in the category of less than ten years of data. Figure 4 gives a representation of daily rainfall data availability for the whole set of rainfall stations before QA/QC. It is obvious, from Figure 4, that daily rainfall data are not available at the same time for the whole set of stations. The maximum number of concurrent stations is 20 for the period 1982 and 1986, which is relatively short and with some gaps of missing data.

2.1.2 Evaporation

There are nine evaporation sites in Martin County. Data availability ranges from two to fifteen years. A summary of this information is given in Table 4. Along with rainfall stations, temporal and space distribution of evaporation stations are major issues, as it can be seen in Figures 5 and 6. The maximum number of daily information available is for six evaporation sites, during the short period of 1983-1984.

2.1.3 Other Climatic Data

A few other climatic data are also available in the County, such as solar radiation, air temperature and water temperature. These climatic data are not part of this report.

2.2 METHODOLOGY

2.2.1 Station and Site Selection

The first step is to select among the different climatic stations the best set of data required for further analysis. The selection procedure is presented as follows:

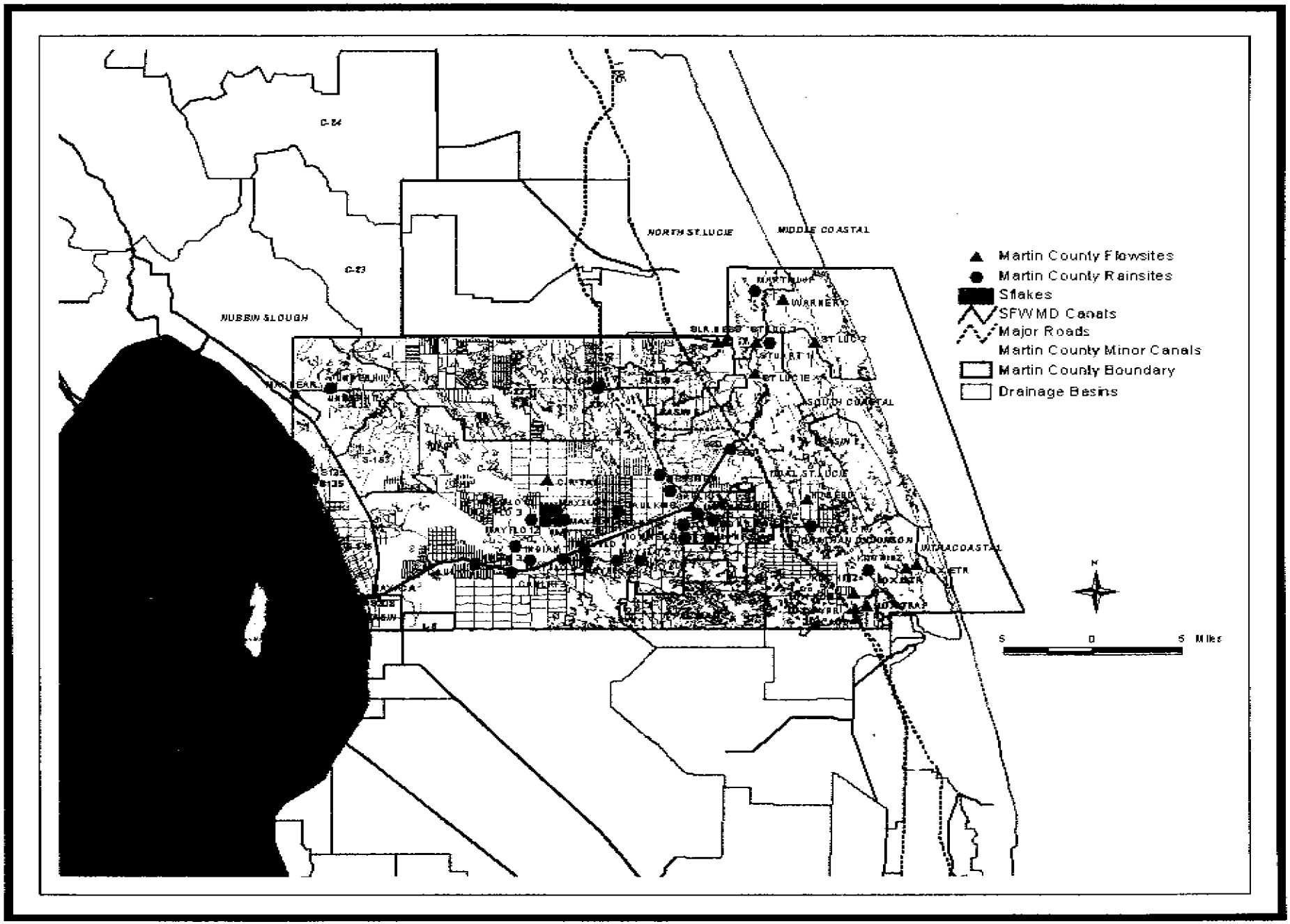


Figure 2. Monitoring sites in Martin County

Table 3. Rainfall stations in Martin County

STATION	ALTERNATE ID	AGCY	RCDR	START	END	STATION DESCRIPTION	DBKEY	LAT	LONG	yrs*
A308	A308+R	WMD	CRUE	1993	1999	ATMOSPHERIC DEPOSITION SITE NEA	15647	265858	802712	7
S308	MRF7037	NOAA	RECO	1940	1991	PORT MAYACA LOCK RAINFALL (CORP	06239	265907	802705	52
S308_R	MRF51	COE	????	1951	1993	PORT MAYACA LOCK RAINFALL (CORP	06119	265907	802705	43
S308_R		WMD	OMD	1991	1999	PORT MAYACA LOCK RAINFALL (CORP	16588	265907	802705	9
S308_R		COE	????	1992	1999	PORT MAYACA LOCK RAINFALL (CORP	16349	265907	802705	8
S153_R		WMD	OMD	1991	1999	S-153 SPILLWAY ON LEVEE L-65 AT	16582	265920	802616	9
CAULKI3_R	MRF350	WMD	????	1982	1985	CAULKINS LAND DIV. VEN I	06008	270023	802855	4
KITCHING_R	270022080094601	USGS	????	1988	1992	KITCHINGS CREEK NR HOBE SOUND F	12376	270023	800945	5
KITCHING_R	270022080094601	USGS	RECO	1988	1989	KITCHINGS CREEK RAINFALL STATIO	12379	270023	800945	2
CAULKI2_R	MRF349	WMD	????	1982	1985	CAULKINS LAND DIV. VEN II	05998	270027	802856	4
MAYFLO 6_R	MRF360	WMD	????	1982	1986	INDIAN SUN GROVES BLOCK 12 (ROB	06006	270055	802455	5
MAYFLO 8_R	MRF362	WMD	????	1981	1986	INDIAN SUN GROVES BLOCK 27 (ROB	06008	270058	802233	6
MAYFLO 7_R	MRF361	WMD	????	1982	1986	INDIAN SUN GROVES BLOCK 21 (ROB	06007	270056	802203	5
INDIAN 3_R	MRF6078	NOAA	CAN	1929	1968	INDIAN TOWN	06284	270101	802759	40
MAYFLO 9_R	MRF363	WMD	????	1982	1986	INDIAN SUN GROVES BLOCK 30 (ROB	06008	270104	802612	5
MAYFLO 4_R	MRF358	WMD	????	1982	1986	INDIAN SUN GROVES BLOCK 1 (ROB	06003	270130	802510	5
INDIAN T_R	MRF5031	FS	????	1976	1983	INDIAN TOWN TOWER	06100	270143	802842	8
JDWX	JDWX+R	WMD	CRUE	1997	1999	JONATHAN DICKINSON STATE PARK	06559	270143	800955	3
MONREV 5_R	MRF4016	USDA	????	1958	1973	MONREVE RANCH - 4	06062	270208	801817	16
MONREV 3_R	MRF4014	USDA	????	1958	1973	MONREVE RANCH - 2	06060	270208	801936	6
HOBE GRO_R	MRF326	WMD	????	1982	1984	HOBE GROVE	05997	270239	801248	3
MONREV 4_R	MRF4015	USDA	????	1958	1973	MONREVE RANCH - 3	06061	270247	801950	16
MAYFLO 5_R	MRF359	WMD	????	1981	1987	INDIAN SUN GROVES BLOCK 16 (CIR	06004	270300	802628	7
MONREV 6_R	MRF4017	USDA	????	1958	1973	MONREVE RANCH - 5	06063	270300	801803	16
MAYFLO12_R	MRF366	WMD	????	1981	1987	INDIAN SUN GROVES BLOCK 21 (CIR	06012	270300	802703	7
MAYFLO 2_R	MRF321	WMD	????	1981	1987	INDIAN SUN GROVES BLOCK 2 (CIR	05983	270303	802604	7
MAYFLO 3_R	MRF322	WMD	????	1981	1987	INDIAN SUN GROVES BLOCK 35 (CIR	05984	270303	802750	7
MONREV 2_R	MRF4013	USDA	????	1958	1973	MONREVE RANCH - 1	06059	270321	801852	16
MAYFLO11_R	MRF365	WMD	????	1981	1987	INDIAN SUN GROVES BLOCK 56 (CIR	06011	270325	802529	7
MAYFLO10_R	MRF364	WMD	????	1981	1987	INDIAN SUN GROVES BLOCK 49 (CIR	06010	270329	802556	7
CAULKINS_R	MRF348	WMD	????	1982	1985	CAULKINS INDIANTOWN GROVE	05997	270330	802309	4
CAULKI4_R	MRF351	WMD	????	1982	1985	CAULKINS CITRUS GROVES	06001	270425	802023	4
S135_R	MRF150	WMD	????	1971	1999	S-135	05849	270511	803940	27
S135_R		WMD	OMD	1993	1999	S-135	16580	270511	803940	6
S135_R	S135+R	WMD	CRUE	1993	1999	S-135	16283	270511	803940	8
BESSMER_R	MRF331	WMD	????	1982	1983	BESSMER CITRUS GROVES	05900	270520	802954	2
S80_R	MRF7025	NOAA	RECO	1940	1991	S-80 SPILLWAY AND LOCK ON ST.LUC	06237	270648	801705	52
S80_R	MRF49	WMD	????	1957	1993	S-80 SPILLWAY AND LOCK ON ST.LUC	06025	270648	801705	37
S80_R		WMD	OMD	1991	1999	S-80 SPILLWAY AND LOCK ON ST.LUC	6638	270648	801705	9
S80_R		COE	????	1993	1999	S-80 SPILLWAY AND LOCK ON ST.LUC	6436	270648	801705	7
KAYE_R	MRF368	WMD	????	1982	1983	K ONE GROVE	06013	270945	802415	2
KAYE_R	MRF368C	WMD	CAN	1984	1984	K ONE GROVE	06014	270945	802415	1
UNDERHI_R	UNDE+R	WMD	SPOT	1989	1989	UNDERHILL DAIRY OUTLET CULVERT	12392	270947	803843	1
STUART I_R	MRF6082	NOAA	CAN	1956	1998	STUART IN	06187	271200	801459	63
S97_R		WMD	OMD	1991	1999	S-97 SPILLWAY ON CANAL C-23 NEA	16627	271219	802026	9
MARTINWP_R	MRF417	WMD	POST	1988	1989	MARTIN COUNTY WATER PLANT	12856	271439	801543	2

* years (rounded) of data available

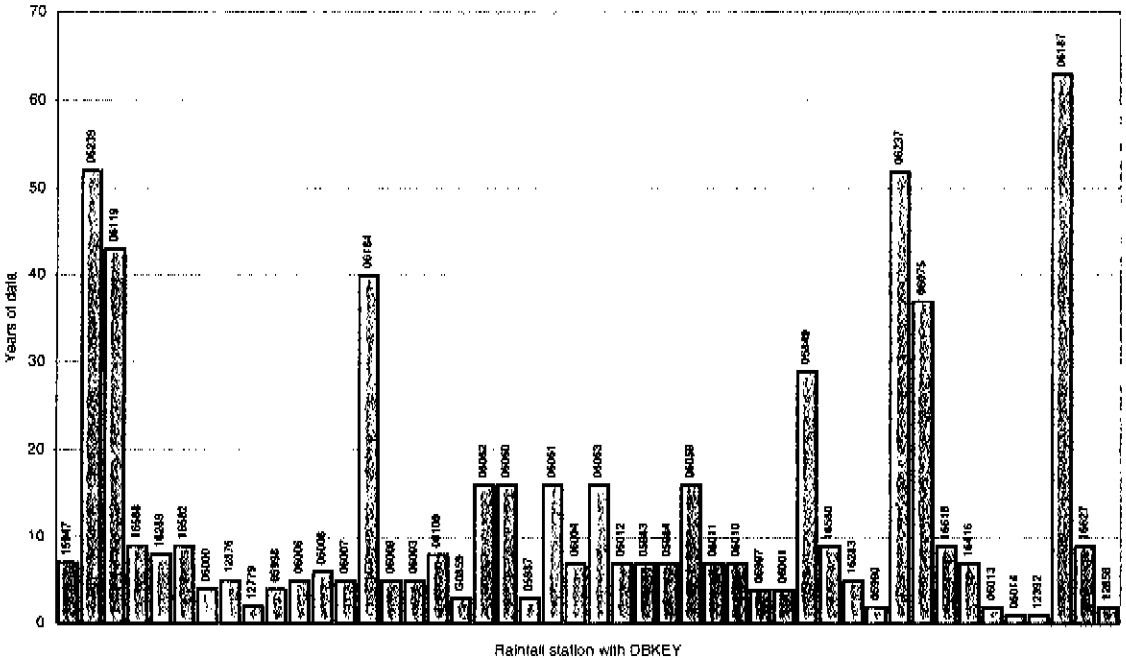


Figure 3. Rainfall data available for Martin County

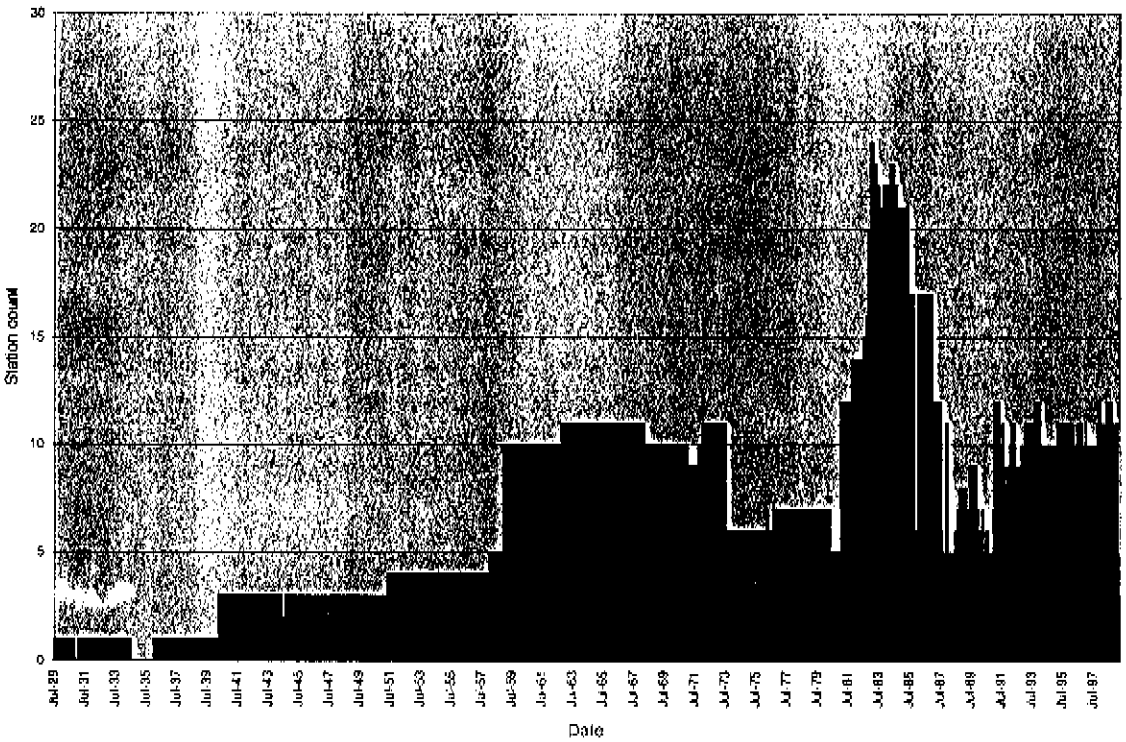


Figure 4. Daily historical rainfall data available for Martin County
(situation before QA/QC)

Table 4. Evaporation stations in Martin County (9 stations)

STATION	ALTERNATE ID	AGCY	STRT	END	STATION DESCRIPTION	DBKEY	LAT	LONG	yrs*
CAULKINS 1	EVP348	NOAA	1982	1985	CAULKINS INDIANTOWN GROVE	06313	270330	802309	4
S308 E	EVP737	NOAA	1941	1945	PORT MAYACA LOCK EVAPORATION (C	06380**	265907	801705	1
			1946	1947		07193**			1
			1948	1954		06376			7
MONREV 2 E	EVP413	USDA	1959	1973	MONREVE RANCH 1	06353	270321	801852	15
MAYFLO 2 E	EVP321	WMD	1983	1987	INDIAN SUN GROVES BLOCK 2 (CIR	06340	270303	802604	5
HOBE GRO E	EVP326	WMD	1982	1983	HOBE GROVE	06341	270239	801248	3
CAULKI 2 E	EVP349	WMD	1982	1985	CAULKINS LAND DIV. VEN II	06344	270049	803054	4
CAULKI 3 E	EVP350	WMD	1982	1985	CAULKINS LAND DIV. VEN I	06345	270021	802855	4
CAULKI 4 E	EVP351	WMD	1982	1985	CAULKINS CITRUS GROVES	06346	270428	802023	4
MARTINWP E	EVP417	WMD	1988	1989	MARTIN COUNTY WATER PLANT	12857	271437	801543	2

*: years (rounded) of data available **: only monthly data are available

a. Stations are grouped based on their proximity (same site, close distance). Eighteen groups are determined.

b. Stations with long period of record are considered within each group.

c. All stations with less than ten years of effective record (e.g. days with data) are disregarded inside the groups for QA/QC, but will be used for completing missing data for selected rainfall stations.

d. All stations with more than ten percent of missing data in the series are disregarded. Missing information includes N (not processed), X (unknown value), A (accumulated) and M (truly missing) tags in the database. As in (c), these data are used in filling missing gaps in selected rainfall stations.

e. The new list of rainfall stations is considered for QA/QC.

Using this procedure, five rainfall stations have been selected out of 46 and listed in Table 5. For S-80 and S-308 sites, two (2) pairs of stations located in the same site, have been used in order to complete the long series of historical data (S-80: DBKEYs 16618 and 06237; S-308: DBKEYs 16588 and 06239). For the five USDA stations located in Monreve Ranch (MONREV2, MONREV3, MONREV4, MONREV5, MONREV6), only one (MONREV5) has been considered from the group.

2.2.2 QA/QC

<u>For cumulative daily rainfall values</u>

This is a common case in the database (DBHYDRO) for manual recorders, where daily values are sometimes cumulated during weekend and holidays, and then recorded only on Monday or the next business day. Therefore the cumulated value may very often go over a three-day period. The case is tagged in DBHYDRO as an A (for cumulated) preceded by X tags (unknown values).

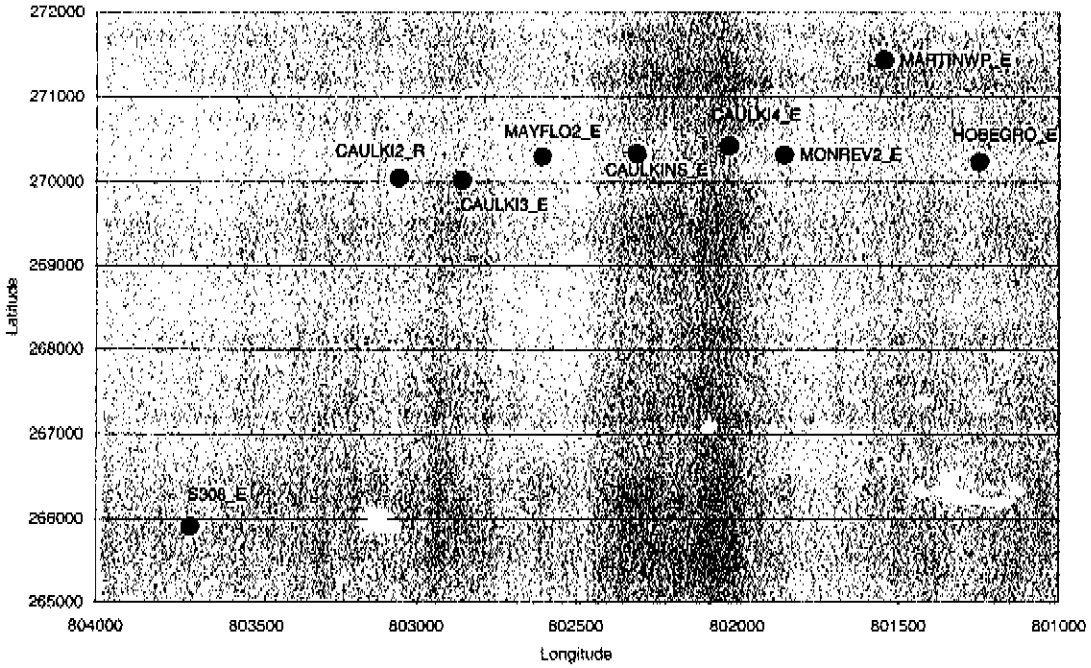


Figure 5. Location of pan evaporation sites in Martin County

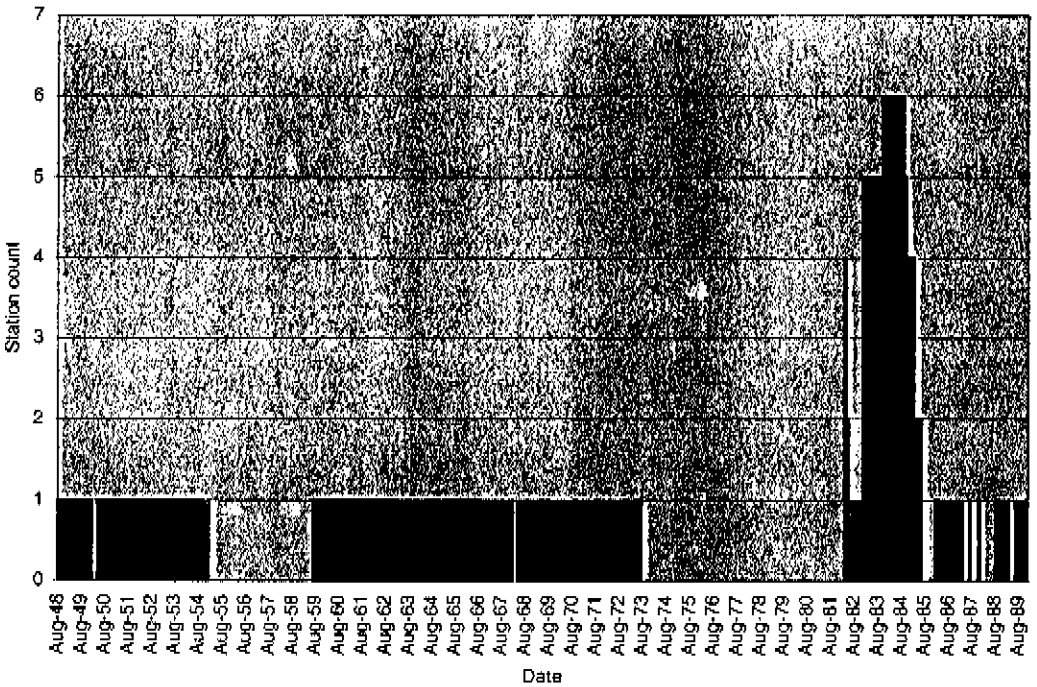


Figure 6. Daily historical pan evaporation data available for Martin County (situation before QA/QC)

Table 5. Selected rainfall sites for Martin County

Group	STATION	AGCY	RCDR	STRT	END	STATION DESCRIPTION	DBY	LAT	LONG	years	Observations
1	MARTINWP_R	WMD	POST	1988	1989	MARTIN COUNTY WATER PLANT	12856	27[illegible]	80[illegible]	2	Too short
2	STUART_N	NOAA	CAN	939	1998	STUART_N	08182	27[illegible]	80[illegible]	63	Selected
3	KAYI_R	WMD	CAN	1984	1984	K ONE GROVE	08244	270945	8024.5	1	Too short
	KAYI_R	WMD	[illegible]	1982	1983	K ONE GROVE	08243	270945	8024.5	2	Too short
4	UNDERHIL_R	WMD	SPCI	1989	1989	UNDERHILL DAIRY OUTLET CULVERT	12352	270945	80.8441	1	Too short
5	S80_R	COE	[illegible]	993	1999	S-80 SPILLWAY AND LOCK ON ST.LUC	16416	270640	801705	7	Too short
	S80_R	WMD	OMD	1991	1999	S-80 SPILLWAY AND LOCK ON ST.LU	06515	270640	801705	9	Too short
	S80_R	WMD	[illegible]	1957	1997	S-80 SPILLWAY AND LOCK ON ST.LU	06035	270640	801705	37	
	S80_R	NOAA	RECO	1940	1991	S-80 SPILLWAY AND LOCK ON ST.LU	06237	270640	801705	52	Selected
	S97_R	WMD	OMD	1991	1999	S-97 SPILLWAY ON CANAL C-23 NEA	06027	27[illegible]	802026	9	Too short
6	BESSMER_R	WMD	[illegible]	1982	1987	BESSMER CITRUS GROVES	05963	270520	802954	2	Too short
	CAULKIN4_R	WMD	[illegible]	1982	1985	CAULKINS CITRUS GROVES	06061	270428	802023	4	Too short
7	S135_R	WMD	CRIS	1995	2000	S-135	06282	27[illegible]	803440	5	Too short
	S135_R	WMD	OMD	1991	1999	S-135	06389	27[illegible]	803440	9	Too short
	S135_R	WMD	[illegible]	1971	1999	S-135	05864	27[illegible]	803440	29	Selected
8	CAULKINS_R	WMD	[illegible]	1982	1985	CAULKINS INDIANTOWN GROVE	05997	270320	802609	4	Too short
	MAYFLO2_R	WMD	[illegible]	198[illegible]	1987	INDIAN SUN GROVES BLOCK 2 CIR	05983	270303	802924	7	Too short
	MAYFLO3_R	WMD	[illegible]	198[illegible]	1987	INDIAN SUN GROVES BLOCK 35 CIR	05984	270303	802750	7	Too short
	MAYFLO5_R	WMD	[illegible]	198[illegible]	1987	INDIAN SUN GROVES BLOCK 10 CIR	06004	270300	802928	7	Too short
	MAYFLO10_R	WMD	[illegible]	198[illegible]	1987	INDIAN SUN GROVES BLOCK 49 CIR	06016	270329	802959	7	Too short
	MAYFLO[illegible]_R	WMD	[illegible]	198[illegible]	1987	INDIAN SUN GROVES BLOCK 56 CIR	06011	270328	802929		Too short
	MAYFLO[illegible]_R	WMD	[illegible]	198[illegible]	1987	INDIAN SUN GROVES BLOCK 21 CIR	06012	270[illegible]	802777	7	Too short
10	MONREV2_R	USDA	[illegible]	1958	1973	MONREVE RANCH	06059	270321	80.852	16	
	MONREV3_R	USDA	[illegible]	1958	1973	MONREVE RANCH - 2	06060	270298	80.936	16	
	MONREV4_R	USDA	[illegible]	1958	1973	MONREVE RANCH - 3	06061	270247	80.940	16	
	MONREV5_R	USDA	[illegible]	1958	1973	MONREVE RANCH - 4	06062	270298	80.813	16	Selected
	MONREV6_R	USDA	[illegible]	1958	1973	MONREVE RANCH - 5	06063	270320	80.803	16	
11	HOBE GRO_R	WMD	[illegible]	1982	1984	HOBE GROVE	05987	270239	80.298	3	Too short
12	CAULKIN3_R	WMD	[illegible]	1982	1985	CAULKINS LAND DIV. VENT	06000	270721	802855	4	Too short
	INDIAN7_R	FS	[illegible]	1976	1983	INDIAN TOWN TOWER	06100	270141	802842	8	Too short
	INDIAN3_R	NOAA	CAN	1929	1968	INDIAN TOWN	05184	270121	802759	40	Large gaps
13	MAYFLO4_R	WMD	[illegible]	982	1986	INDIAN SUN GROVES BLOCK 1 ROB	05990	270135	802901	5	Too short
	MAYFLO6_R	WMD	[illegible]	982	1986	INDIAN SUN GROVES BLOCK 2 ROB	05996	270355	802855	5	Too short
	MAYFLO9_R	WMD	[illegible]	982	1986	INDIAN SUN GROVES BLOCK 30 ROB	05998	270324	8026.2	5	Too short
14	CAULKIN2_R	WMD	[illegible]	982	1985	CAULKINS LAND DIV. VENT	05965	270021	8[illegible]	4	Too short
15	KITCHIN2_R	USGS	RECO	1988	1989	KITCHINGS CREEK RAINFALL STATIO	12779	270023	80.9945	2	Too short
	KITCHING_R	USGS	[illegible]	1988	1992	KITCHINGS CREEK NR HOBE SOUND F	12856	270023	80.9945	5	Too short
16	A308	WMD	CRIS	1993	1999	ATMOSPHERIC DEPOSITION S72 NEA	15047	265088	8037.2	7	Too short
	S308_R	COE	[illegible]	1992	1999	PORT MAYACA LOCK RAINFALL (CORP	16284	265917	803705	8	Too short
	S308_R	WMD	OMD	1991	1999	PORT MAYACA LOCK RAINFALL (CORP	6388	265917	803705	9	Too short
	S308_R	COE	[illegible]	1951	1999	PORT MAYACA LOCK RAINFALL (CORP	06116	265917	803705	48	
	S308_R	NOAA	RECO	1940	1991	PORT MAYACA LOCK RAINFALL (CORP	06236	265917	803705	52	Selected
	S153_R	WMD	OMD	1991	1999	S-153 SPILLWAY ON LEVEE L-65 AT	6582	265920	803516	9	Too short
17	MAYFLO7_R	WMD	[illegible]	1982	1985	INDIAN SUN GROVES BLOCK 21 ROB	06007	270959	802703	5	Too short
	MAYFLO8_R	WMD	[illegible]	198[illegible]	1986	INDIAN SUN GROVES BLOCK 27 ROB	06008	270958	802313	6	Too short
18	JDWX	WMD	CRIS	1997	1999	JONATHAN DICKINSON STATE PARK	C0859	270243	803355	3	Too short

A two-step approach is performed:

a. Horizontal distances between rainfall stations are used (under the assumption that there is not much concern about the station elevation; which is, indeed, the case for the South Florida area, where the topography is flat).

b. The cumulative daily rainfall values are distributed in proportion to that of the nearest station, which involves an iterative process whenever the nearest station also has cumulative value. The relationship between the two gages can be expressed as (Downey, 1999):

$$P_A(t) = [P_A©/P_B©] * P_B(t). \qquad (1)$$

where:

$P_A(t)$	= estimated rainfall for station A on day t, inches
$P_A©$	= cumulative rainfall for station A, inches
$P_B(t)$	= observed rainfall for station B on day t, inches
$P_B©$	= cumulative rainfall for station B, inches

Whenever the cumulative daily rainfall values can not be distributed over the period (no data available for nearby station), and the gap falls between two consecutive months, the specific months will not be included in statistical analysis (monthly and yearly).

For missing daily rainfall values

It also involves a two-step procedure where horizontal distances are used to assign rainfall value from the nearest station with value (zero or non-zero) to the missing daily value station. If the nearest station has a missing value, it is necessary to proceed with the value for the next nearest station. An M tag will be reassigned to the missing daily rainfall value if there is no close station with data for the day.

For monthly rainfall values

The procedure involved is to: (i) establish regression relationships for monthly total rainfall values between pairs of stations; (ii) check monthly rainfall totals (derived from the sum of daily rainfall totals) against the estimated total monthly rainfall derived from regression equations. If they differ significantly, then an adjustment to the estimated daily values is necessary.

These three procedures described above for cumulative daily rainfall values, daily rainfall values, and monthly rainfall values, will be used jointly and iteratively when doing QA/QC. Regression relationship for pairs of stations located nearby (group of stations) will be done. Pairs of monthly data point with missing values should be disregarded. The estimated monthly value from the regression relationship will be used

jointly with procedures discussed above for estimating missing daily values. The full procedure discussed above is shown in the flow chart of Figure 7.

For pan evaporation data

The procedure involved is to:

a. Limit maximum daily pan evaporation values, based on location, month, maximum extra-terrestrial radiation (water equivalent values are 0.36, 0.43, 0.52, 0.59, 0.62, 0.64, 0.63, 0.60, 0.54, 0.46, 0.38, 0.34 inches/day for January to December), and on the fact that approximately 58 percent of the solar radiation is not reflected into universal space (Gray, D. 1970). Therefore, maximum estimated daily pan evaporation is 0.37 inches.

b. Estimate daily missing records using linear interpolation.

2.2.3 Estimating Areal Rainfall

The objective for estimating areal rainfall is to provide a data summary for the historical rainfall average over the study area. This average can be computed in two ways: (i) from a weighted average using the Thiessen polygon method, whenever digital boundary for the area is available, or (ii) simply from an arithmetic average of the data.

Since there are years for given stations without data, the Thiessen polygon method will require different weight for each subsequent layout of the rainfall stations, and therefore will not be used, being cumbersome. Arithmetic average will be used in this report.

2.3 SUMMARY OF CLIMATIC DATA

2.3.1 Rainfall

For the selected monitoring sites in Figure 8, horizontal distances are given in Table 6, and monthly regression relationships are summarized in Table 7 for six pairs of data with coefficients of determination of 0.7 or higher.

Historical daily rainfall data and associated monthly tabular statistics (e.g. mean, maximum, minimum, median, and standard deviation) are presented in Appendices A and B. The graphical statistics are also presented in Figures 9, 10, 11, 12, and 13. Monthly means for the selected data set varies within the County from 3.83 inches in the western side (S-308), to 4.77 inches in the eastern side (STUART). The maximum daily rainfall (16.05 inches) was recorded in Stuart on October 18, 1995.

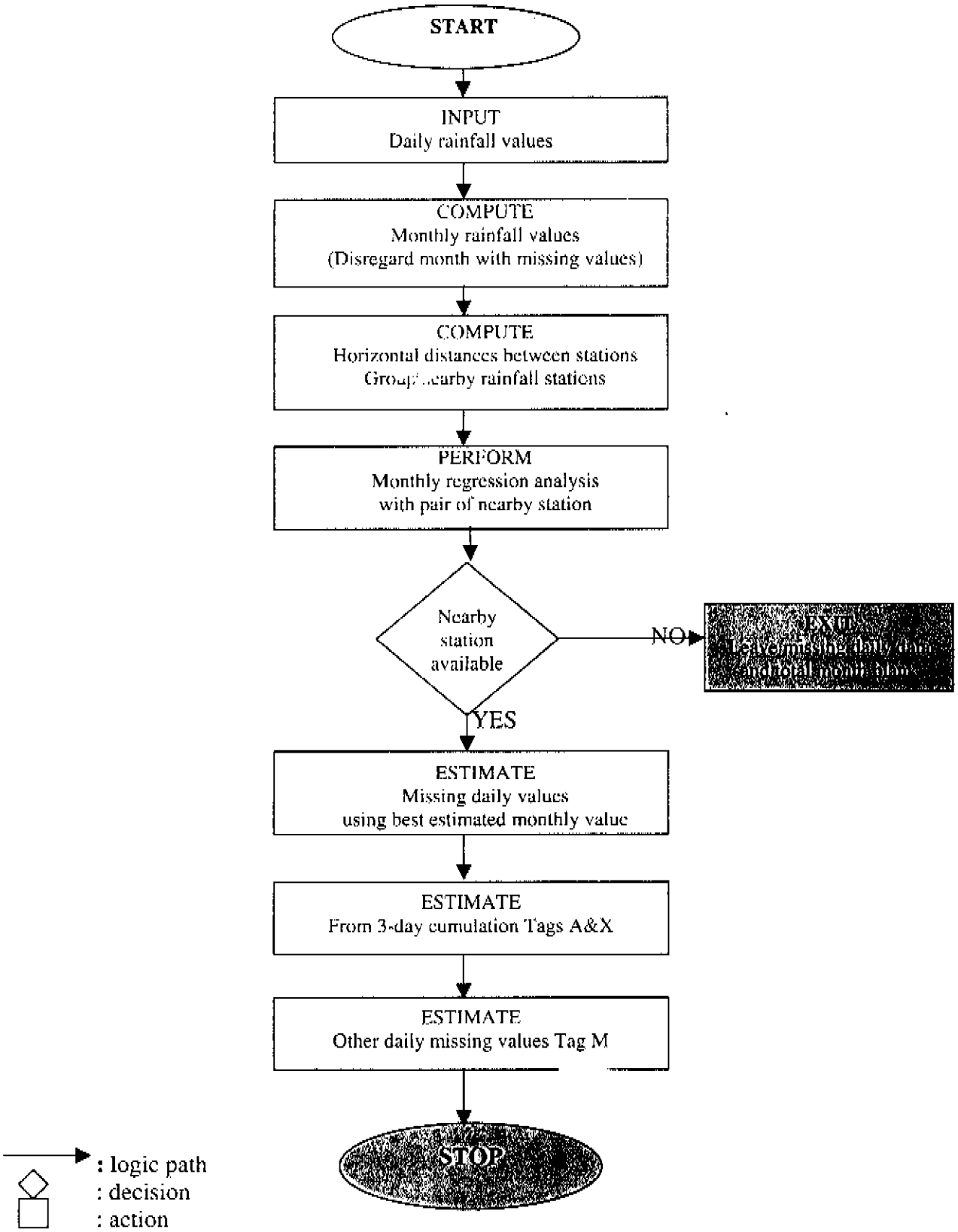


Figure 7. Flow chart for estimating missing daily rainfall values

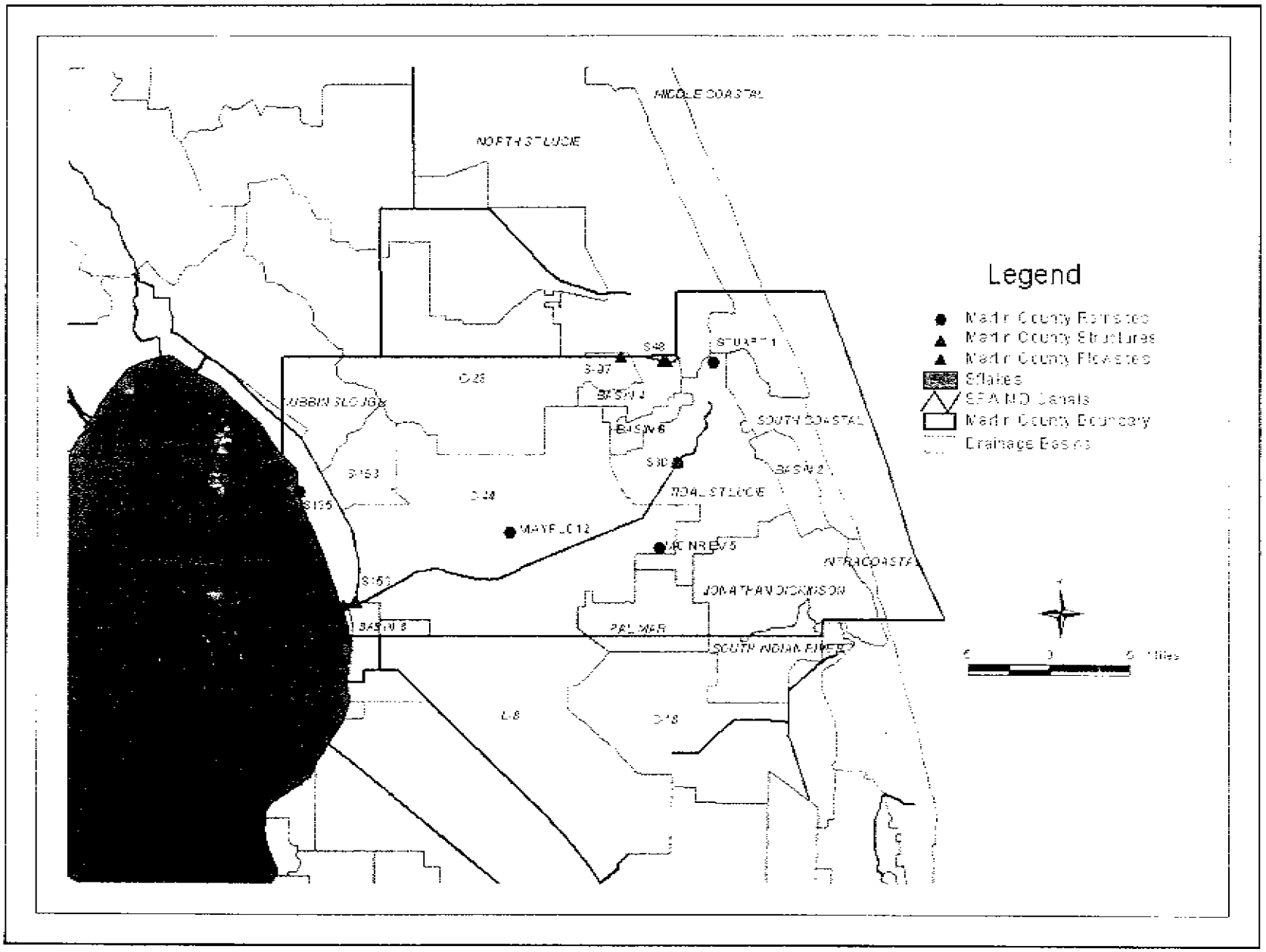


Figure 8. Selected monitoring sites in Martin County

Table 6. Distances between selected rainfall stations (miles) in Martin County

Site	S-80	S-135	MAYFLO12	MONREV5	S-308
STUART1	7	27	16	12	27
S-80		23	11	5	22
S-135			13	22	8
MAYFLO12				9	11
MONREV5					20

Table 7. Regression relationships between selected(*) rainfall stations (monthly values) within Martin County

Site X	Site Y	Equation	R^2	Period (months)**	Distances (miles)
S-80	STUART1	Y = 0.8231X + 1.0785	0.72	99	7
MONREV5	S-80	Y = 0.9174X + 0.3729	0.84	175	5
MONREV5	STUART1	Y = 0.8395X + 0.8232	0.73	175	12
INDIAN3	MONREV5	Y = 0.9768X + 0.3385	0.84	66	10
MONREV5	S-135	Y = 0.7636X + 0.5851	0.73	78	14
MAYFLO5	MAYFLO12	Y = 0.9766X + 0.0666	0.98	78	1

*: only R^2 greater than 0.7 have been considered

**: length of period for analysis

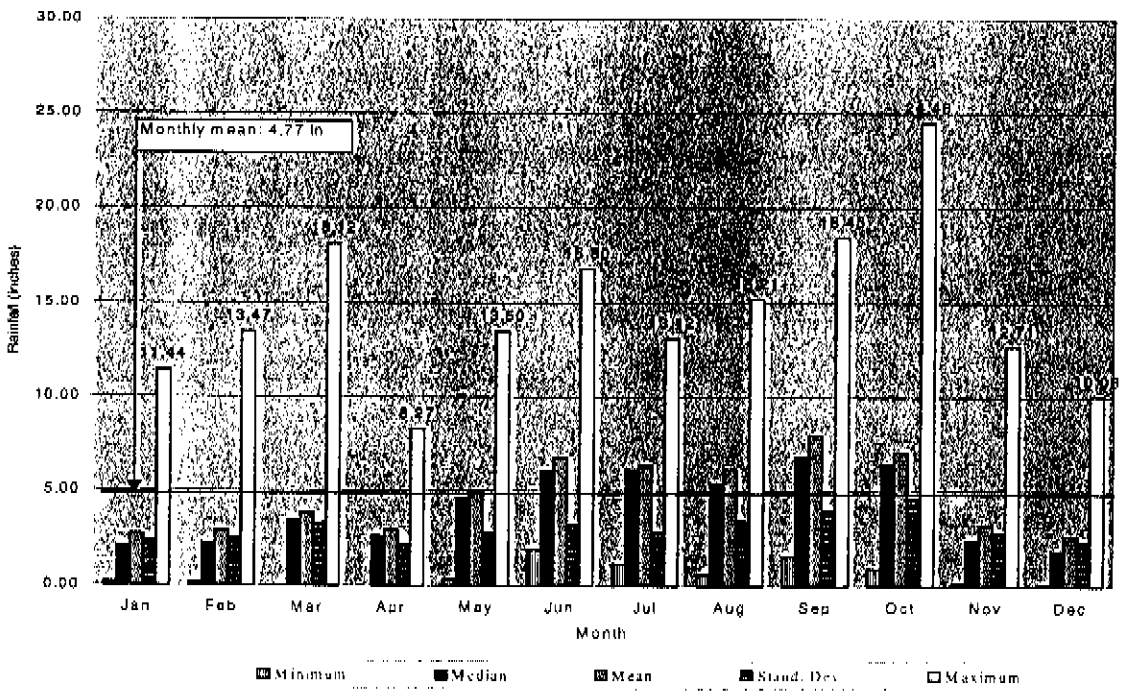


Figure 9. Statistics for monthly rainfall at station STUART1_R (Period: 01/01/36-11/30/98)

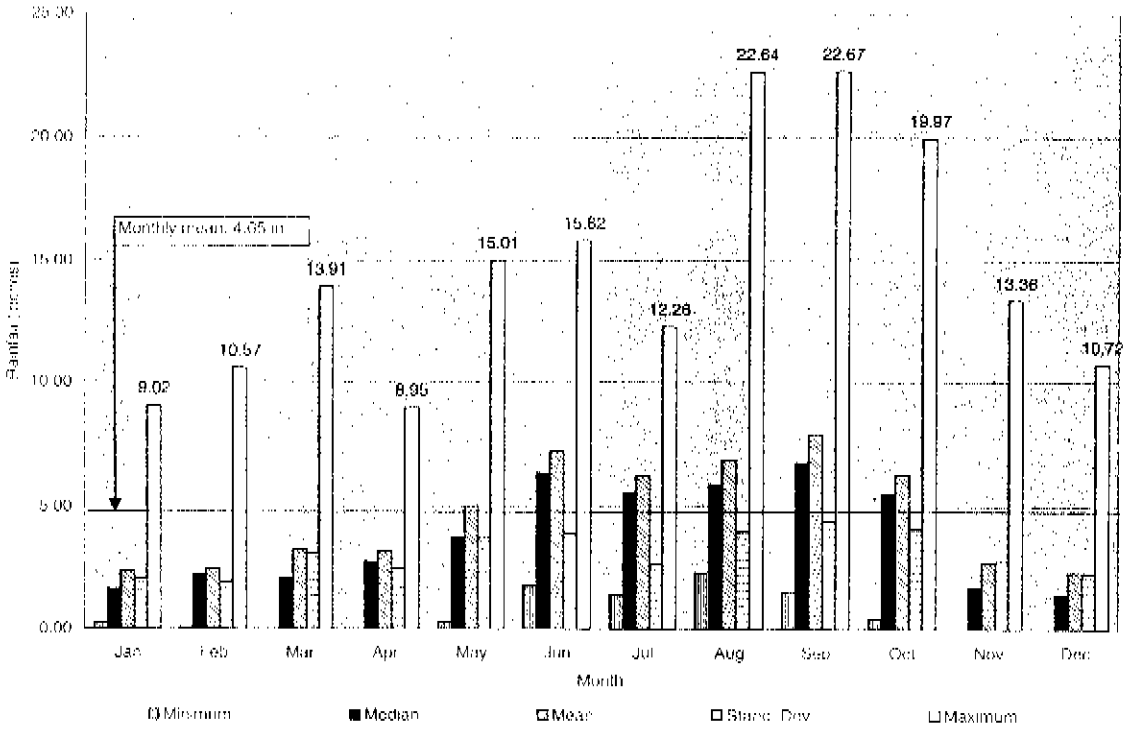


Figure 10. Statistics for monthly rainfall at station S80_R (Period: 04/01/40-03/31/99)

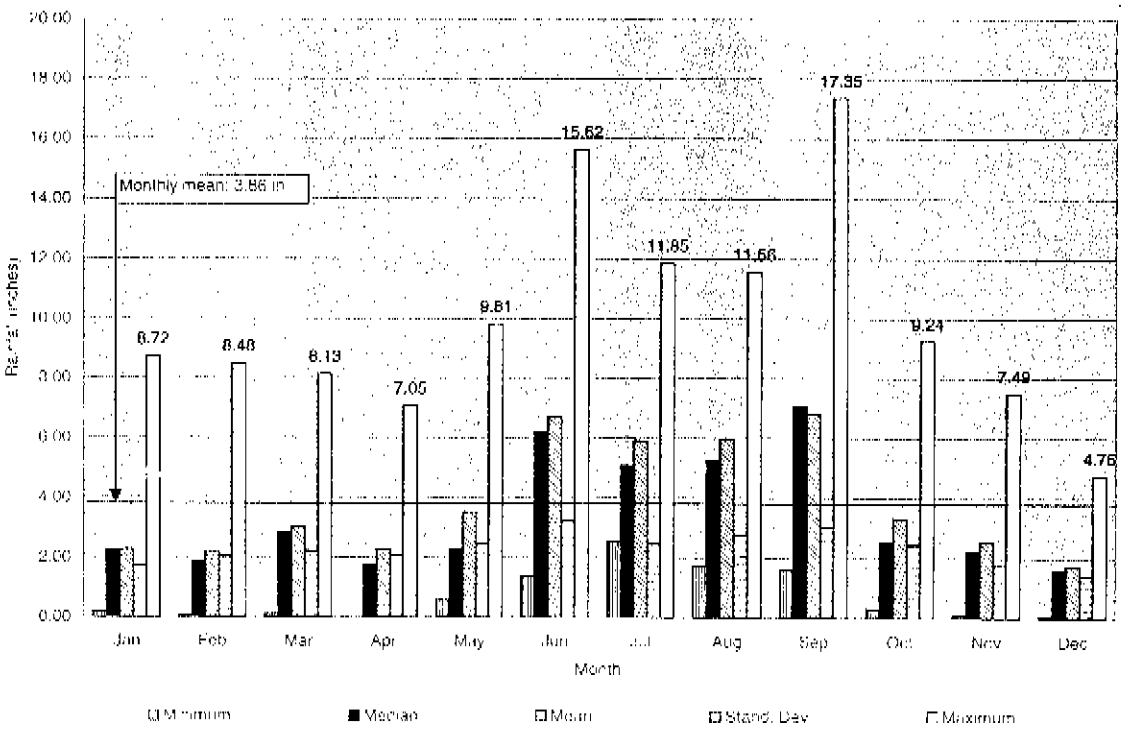


Figure 11. Statistics for monthly rainfall at station S135_R (Period: 10/01/71-03/31/99)

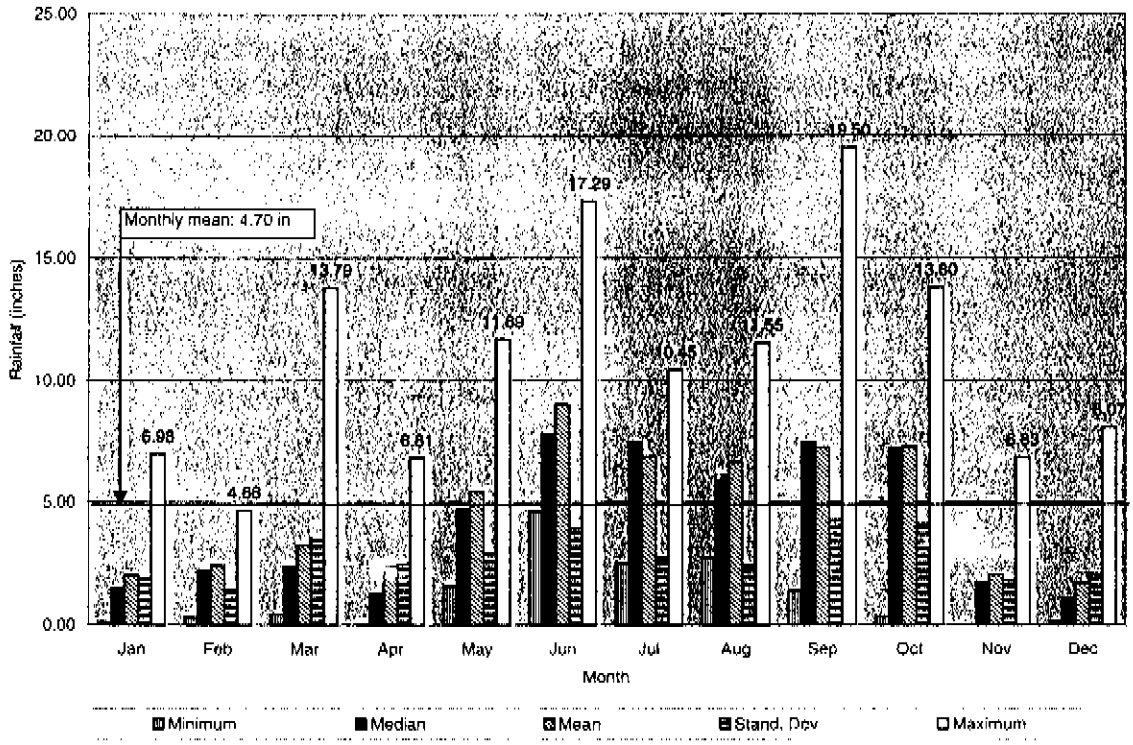


Figure 12. Statistics for monthly rainfall at station MONREV5_R (Period: 12/01/58-06/30/73)

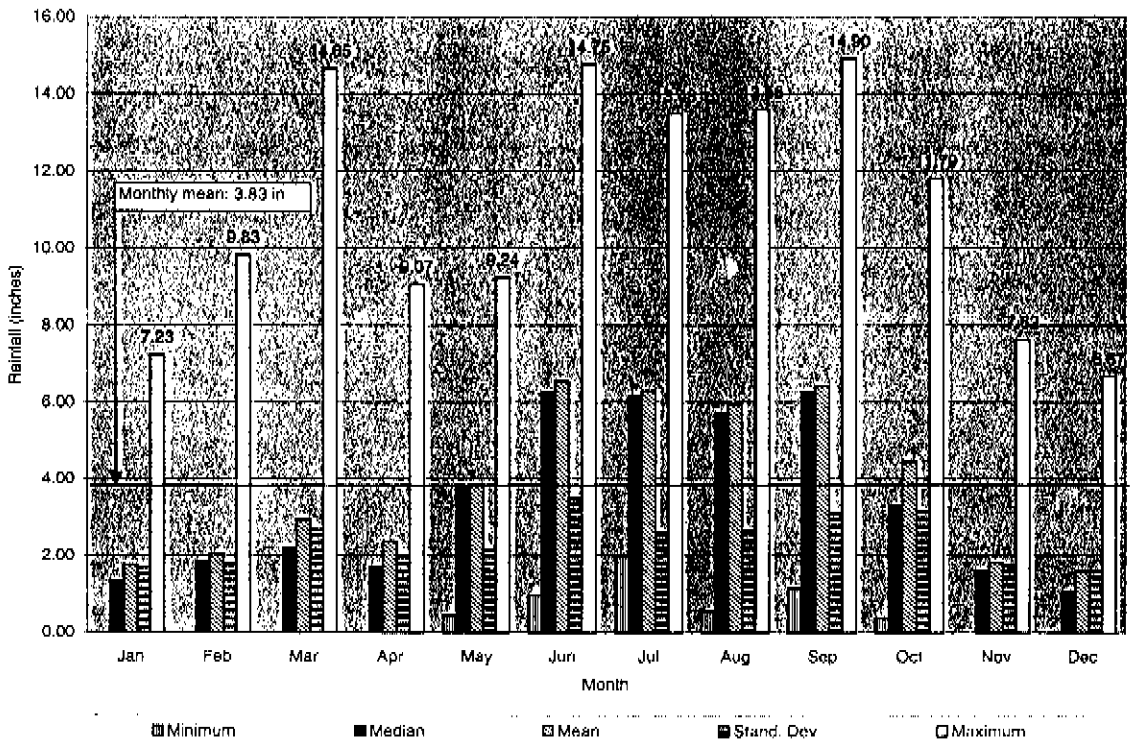


Figure 13. Statistics for monthly rainfall at station S308_R (Period: 04/01/40-03/31/99)

Historical annual areal rainfall tabulated in Appendix B is graphically summarized in Figure 14. The associated statistics are presented in Figure 15. The annual areal rainfall ranges between 35.0 inches (1981) and 78.9 inches (1994), averaging 52.8 inches for the 63-year period of record (1936-1998). Long drought period can be depicted from Figure 14. The mean monthly areal rainfall is 4.39 inches. Maximum and minimum monthly average areal rainfalls are 6.71 inches (June) and 2.64 inches (December) respectively. The wet and dry seasons are clearly depicted from Figure 15: June and October mark respectively the beginning and the end of the wet season. The wet season (32.8 inches, from June to October) accounts for 62 percent of the whole year precipitation (52.8 inches).

2.3.2 Evaporation

Two sites out of nine have been selected for pan evaporation data: MONREV2, an USDA site (DBKEY 06353), and S-308 a NOAA site (DBKEY 06376). The periods of record for these two sites are relatively short: 15 years for MONREV2 (1959-1973), and 14 years (seven years of monthly data and seven years of daily data) for S-308 (1941-1954). Historical daily evaporation data and monthly statistics are summarized in Appendices C and D. The statistics are graphically presented in Figures 16 and 17. The mean maxima are reached during the month of May for these sites and are 6.43 inches (MONREV2) and 6.84 inches (S-308). The mean monthly minima occurred in December for both sites, with 2.75 inches for MONREV2 and 2.97 inches for S-308. The year monthly averages are 4.82 inches and 4.61 inches for MONREV2 and S-308 respectively. Around 70 percent of evaporation occurs during the period of March to September.

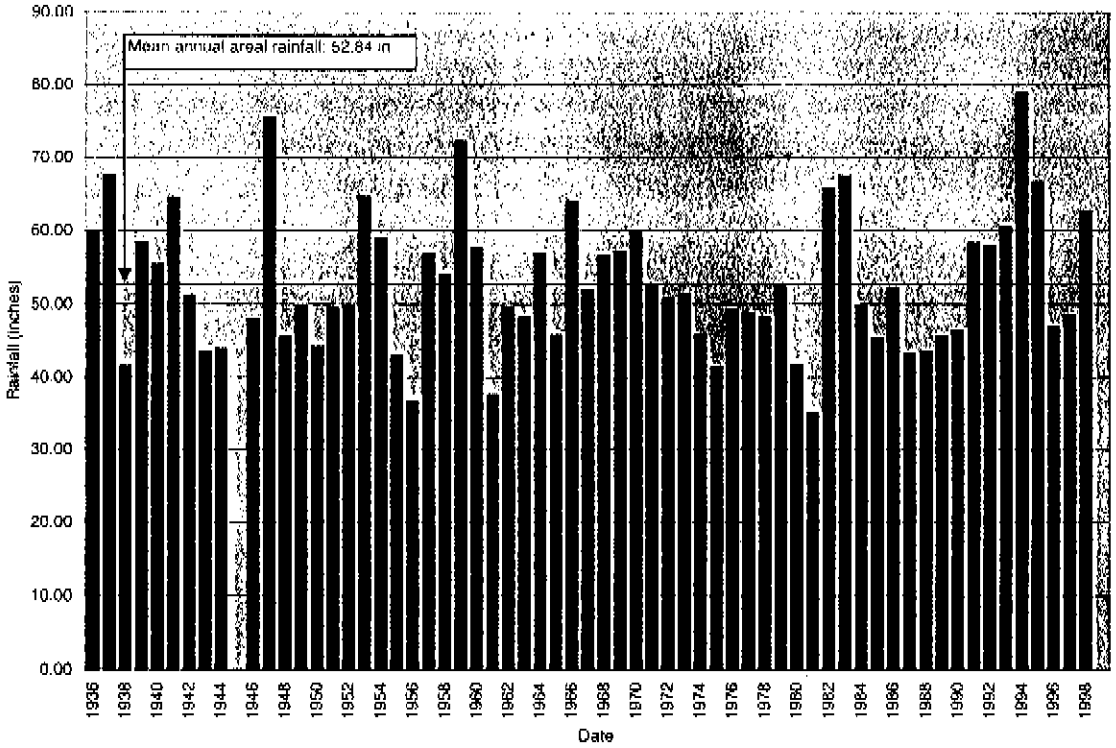


Figure 14. Historical annual areal rainfall in Martin County

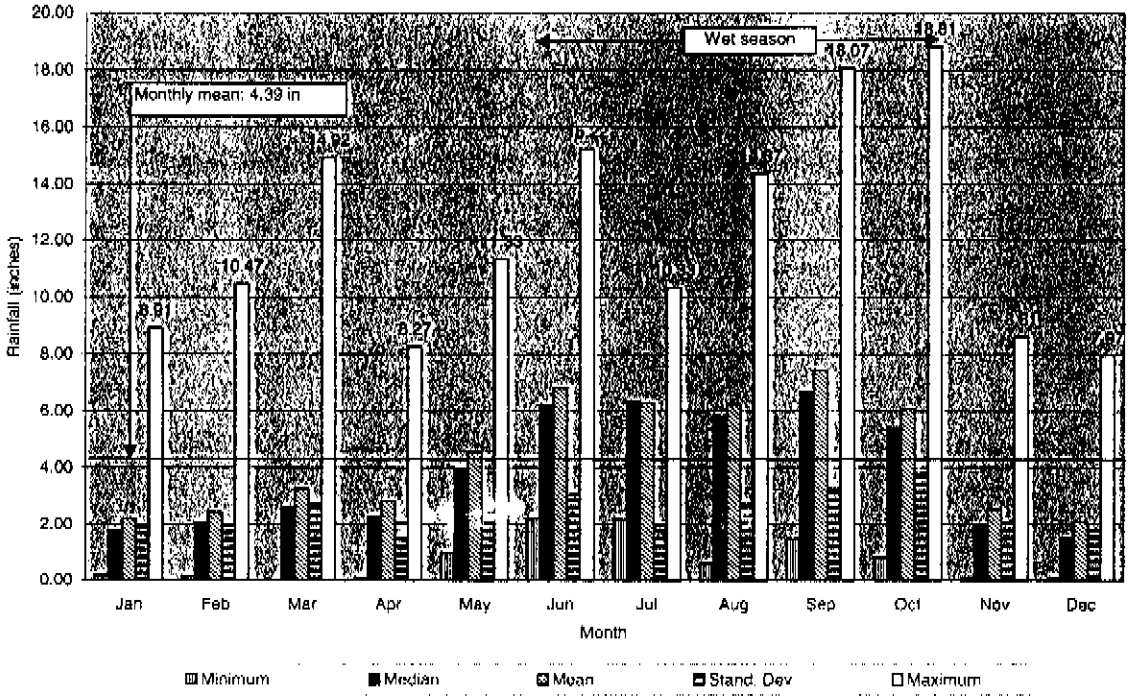


Figure 15. Statistics for monthly areal rainfall in Martin County (Period: 1936-1999)

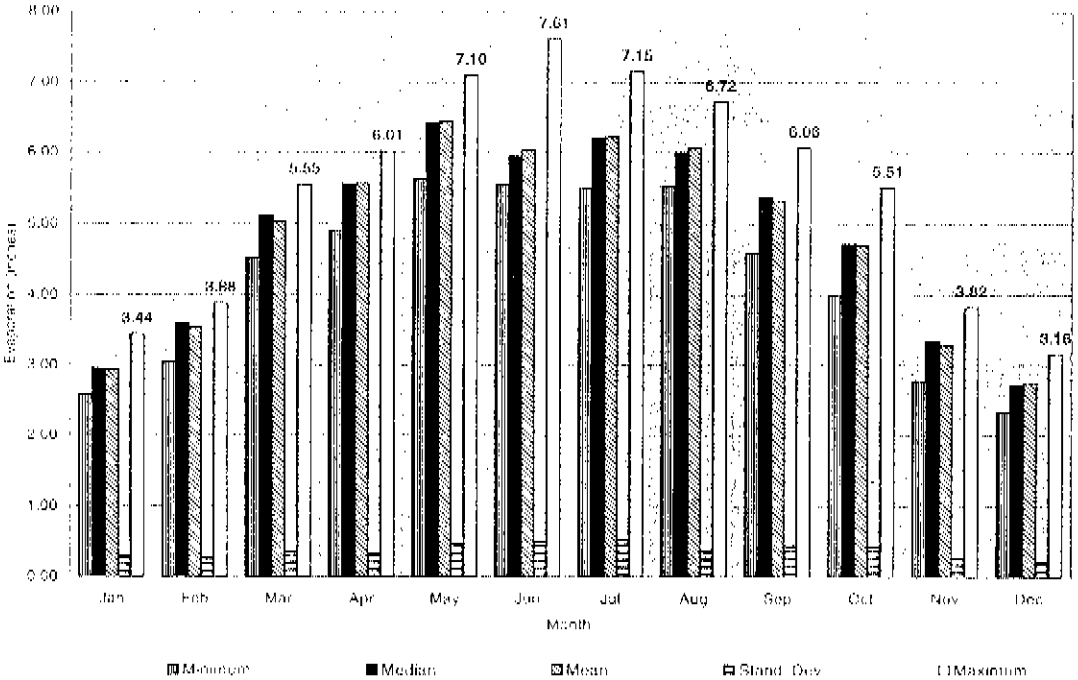


Figure 16. Statistics for monthly pan evaporation at station MONREV2_E (Period: 06/01/59-06/30/73)

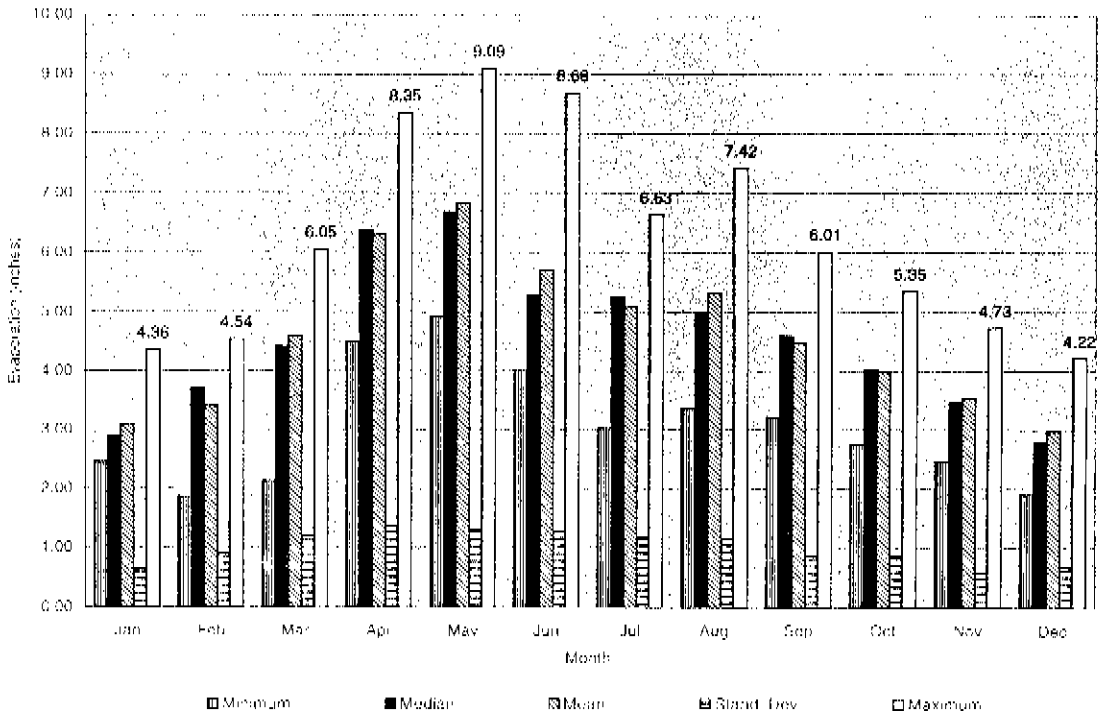


Figure 17. Statistics for monthly pan evaporation at station S308_E (Period: 01/01/41-12/31/54)

3. SURFACE WATER DATA

3.1 EXISTING DATA

3.1.1 Flow

There are 38 flow-monitoring stations in Martin County located at 15 sites. Table 8 gives a set of information pertaining to these stations. The period of record varies from one to 68 years. For S-308, the record has been extended by regression since the structure did not exist prior to 1978 (Fan, 1985). Most of these stations are located on the major structures (S-135, S-308, S-48, S-97, S-153, and S-80); the rest are located in creeks, river and ditches. Figure 18 gives the location of the flow sites in Martin County.

Due to the flat topography of the South Florida area, it is common to observe two-way gravity flow through some structures and canals. Positive flow usually characterizes the flow direction for the purpose the structure was designed. For example: (i) S-135 was designed to remove excess impounded water from the tributary drainage area; therefore, flow is positive to Lake Okeechobee when pumping is initiated, and negative for gravity discharge from the Lake to the adjacent canal (negative flows are not frequent); (ii) S-308 together with S-80 control the discharge of Lake Okeechobee to tidewater through the St. Lucie Canal, C-44, and therefore flow is positive when water is released from the Lake, and negative whenever water from C-44 is a backflow to the Lake.

The operating criteria should also be a guide in understanding flow direction and characteristics. The following is a summary of the operating criteria for the major structures in the County.

<u>Structure S-308</u>:

- The lock position depends upon the Lake Okeechobee stage reading; the lock is fully open when the Lake stage is lower than 14.5 feet, and open from 6 AM to 10 PM when the stage is higher than 14.5 feet.

- The spillway operating criteria depends on the Lake regulatory schedule and the tailwater located on C-44 canal. There is full release when the Lake schedule is higher than one foot, while moderate release happens when the Lake schedule is lower or equal to one foot. For all other times, the tailwater is maintained to 14.5 feet as water is available.

<u>Structure S-135</u>:

- Pumping is initiated only when the headwater is between 13.5 and 14.0 feet. However, when heavy rainfall is predicted to raise the

Table 8. Flow monitoring stations in Martin County

No.	STATION	ALTERNATE ID	AGCY	RCDR	STRT	END	STATION DESCRIPTION	DBKEY	LAT	LONG	years*
1	LOX.AGD_O	52940-21	WMD	NA	1984	1991	AG DITCH TRIBUTARY TO LOXAHATCH	05436	265754	801022	8
2	LOX.CYPR_O	26581608011000[illegible]	USGS	PREF	1980	1982	CYPRESS CREEK TRIB. TO LOXAHATC	02965	265825	801028	3
	LOX.CYPR_O	52940-21	WMD	NA	1985	1991	CYPRESS CREEK TRIB. TO LOXAHATC	05442	265825	801028	8
3	S308.DS	02276871	USGS	NA	1983	1982	ST LUCIE CANAL BELOW S308 AT PO	03658	265900	803659	
	S308.DS		WMD	PREF	1963	1990	ST LUCIE CANAL BELOW S308 AT PO	15017	265900	803659	28
4	S308_I.	02276870	USGS	002	1931	1998	PORT MAYACA LOCK (CORPS OF ENGI	00277	265907	803705	68
	S308_I.	02276870	WMD	PREF	1972	1998	PORT MAYACA LOCK (CORPS OF ENGI	15626	265907	803705	27
	S308_S		COE	NA	1996	1999	S-308 SPILLWAY (ONLY) ON ST. LU	00259	265907	803705	4
5	LOX.HOBE_O	26590708011[illegible]	USGS	PREF	1979	1982	HOBE DITCH TRIB. TO LOXAHATCHEE	02988	265911	801030	4
	LOX.HOBE_O	51940-21	WMD	NA	1984	1991	HOBE DITCH TRIB. TO LOXAHATCHEE	05448	265911	801030	8
6	S153L_S	21140378	WMD	TELE	1985	1999	S-153L (LATCHING GATES) ON LEVEE	06766	265919	803637	15
	S153L_S	51140378	WMD	NA	1983	1987	S-153L (LATCHING GATES) ON LEVEE	04868	265919	803637	5
	S153_S	51140371	WMD	NA	1983	1987	S-153 SPILLWAY ON LEVEE L-65 AT	04512	265924	803636	5
7	KITCHENG	2380220800[illegible]	USGS	PREF	1979	1997	KITCHINGS CREEK NR HOBE SOUND F	03906	270023	800645	19
	LOX.MTR_O	2380250800[illegible]	USGS	PREF	1979	1982	M TR NF LOXAHATCHEE R NR HOBE S	03909	270029	800741	4
	LOX.ETR_O	2380360800[illegible]	USGS	PREF	1981	1982	E TR NF LOXAHATCHEE R NR HOBE S	03913	270037	800734	2
	MONREVE	02276984	USGS	PREF	1959	1973	MONREVE RANCH DRAIN CANAL	00281	270324	800[illegible]	15
	CIR-TD_P	52039394	WMD	NA	1983	1984	CIRCLE-T GROVES AT PUMP STATION	05239	270521	800[illegible]	2
8	S135 PMP_P	21739375	WMD	TELE	1994	1999	S-135 PUMP (ONLY) FROM N.E. SHO	15800	270511	803940	6
	S135 PMP_P	40839371	WMD	PLOG	1969	1998	S-135 PUMP (ONLY) FROM N.E. SHO	06815	270511	803940	30
	S135 PMP_P	51739375	WMD	NA	1984	1991	S-135 PUMP (ONLY) FROM N.E. SHO	04068	270511	803940	8
	S135 PMP_P	61739375	WMD	NA	1989	1998	S-135 PUMP (ONLY) FROM N.E. SHO	15268	270511	803940	10
	S135 PMP_P		WMD	PREF	1972	1998	S-135 PUMP (ONLY) FROM N.E. SHO	15928	270511	803940	27
	S135 SPW_S	21739371	WMD	TELE	1995	1999	S-135 SPILLWAY (ONLY) FROM N.E.	15801	270511	803940	5
	S135 SPW_S	21739373	WMD	NA	1995	1999	S-135 SPILLWAY (ONLY) FROM N.E.	16548	270511	803940	5
	S135 SPW_S	51739371	WMD	NA	1986	1998	S-135 SPILLWAY (ONLY) FROM N.E	04072	270511	803940	13
	S135 SPW_S	71739371	WMD	NA	1992	1998	S-135 SPILLWAY (ONLY) FROM N.E	15932	270511	803940	7
9	S80_S		COE	NA	1996	1999	S-80 SPILLWAY (ONLY) ON ST. LUC	00238	270640	801705	4
	S80_T	02277000	USGS	2???	1952	1998	S-80 SPILLWAY AND LOCK ON ST. L	00280	270640	801705	47
	S80_T		WMD	PREF	1969	1998	S-80 SPILLWAY AND LOCK ON ST. L	15013	270640	801705	28
10	ST LUCIE	27102408015440[illegible]	USGS	PREF	1981	1981	SOUTH FORK ST LUCIE RIVER AT PA	03097	271025	801543	
11	ST LUC 2	27115708012310[illegible]	USGS	PREF	1981	1981	ST LUCIE RIVER NR STUART FL	03090	271158	801230	
12	ST LUC 1	27121308015410[illegible]	USGS	PREF	1981	1981	ST LUCIE RIVER AT STUART FL	03093	271210	801540	
13	S48_S	50138400	WMD	NA	1969	1969	S-48 SPILLWAY ON CANAL C-23 AT	04382	271203	801743	1
14	S97_S	23537400	WMD	TELE	1994	1999	S-97 SPILLWAY ON CANAL C-23 NEA	15780	271219	802026	6
	S97_S	53537400	WMD	NA	1964	1993	S-97 SPILLWAY ON CANAL C-23 NEA	04850	271219	802026	33
	S97_S	63537400	WMD	NA	1986	1994	S-97 SPILLWAY ON CANAL C-23 NEA	06622	271219	802026	9
15	WARNER C	02277107	USGS	PREF	1976	1977	WARNER CREEK NR JENSEN BEACH, F	00289	271400	80[illegible]41[illegible]	2

*: years (rounded) of data available

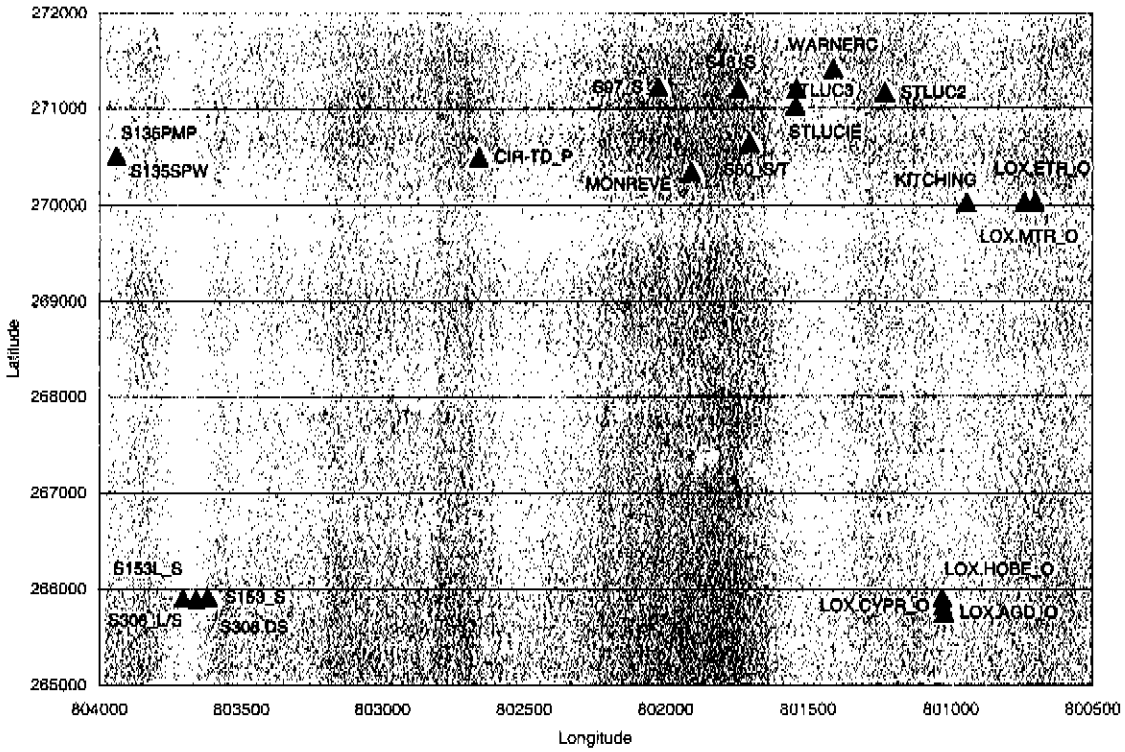


Figure 18. Location of flow sites in Martin County

headwater above 14 feet, pumping is initiated to maintain stage at 13 feet until the end of the storm.

- Gravity discharge through the spillway happens when the Lake stage (tailwater) is below elevation 13 feet.

- When the Lake stage is greater than 14.0 feet, the lock is operated as needed between 5:30 AM and 8:00 PM.

Structure S-153:

- Whenever the tailwater stage (C-44 side) rises within 0.2 feet of the headwater stage, the gates are automatically closed in order to prevent backflow through the structure.

- Upstream water control stages are maintained in the L-65 borrow canal to an optimum headwater elevation of 18.8 feet (stationary position). Gates will close when headwater falls to 18.6 feet, and will open when the headwater will rise to 19.1 feet.

Structure S-80:

- When S-308 is closed, S-80 maintains a headwater stage between 14.0 feet and 15.0 feet, as possible.

Structure S-97:

- When flow is adequate, headwater stage is maintained between 20.5 and 22.2 feet (low range conditions) during the wet season (June to October), and between 22.2 and 23.2 feet (high range conditions) during the dry season (November to May).

- During low range conditions, gates begin to open when headwater elevation rises to 22.2 feet and begin to close when headwater elevation falls to 20.5 feet.

- During high range conditions, gates begin to open when headwater elevation rises to 23.2 feet and begin to close when headwater elevation falls to 22.2 feet.

Structure S-48:

- When flow is adequate, headwater stage is maintained greater than 8 feet in the lower reach of C-23 to prevent saltwater intrusion to local groundwater.

3.1.2 Stage

There are 116 stage-monitoring stations in Martin County located at 40 sites. Table 9 gives a listing of these stations with all information pertaining to these sites. Most of these stations have less than ten years of data. Figure 19 gives a layout of the water level collection sites.

3.2 METHODOLOGY

3.2.1 Station and Site Selection

Only the flow and stage stations located in the major water structures are considered. In this manner, six sites are selected for further analysis: S-308, S-153, S-135, S-80, S-48, and S-97. For each selected site, a data set is built based on all existing flow and stage information. The longest time series within the site data set (flow and stage) are selected for QA/QC.

Table 9. Stage monitoring stations in Martin County

Site	STATION	ALTERNATE ID	AGCY	METH	RCDR	STRT	END	STATION DESCRIPTION	DBKEY	LAT	LONG	years*
1	LOX.AGD_H	AG.DITCH	WMD	MEAN	????	1984	1994	AG DITCH TRIBUTARY TO LOXAHATCH	05432	265754	801022	11
	LOX.AGD_H	LOXAGD+	WMD	MEAN	CR10	1994	1999	AG DITCH TRIBUTARY TO LOXAHATCH	15932	265754	801022	6
2	LOX.CYPR	265816080110000	USGS	MEAN	????	1980	1982	CYPRESS CREEK TRIB. TO LOXAHATC	02966	265825	801028	3
	LOX.CYPR	265816080110000	USGS	FWM	????	1980	1981	CYPRESS CREEK TRIB. TO LOXAHATC	02967	265825	801028	2
	LOX.CYPR_	H GULF.STR	WMD	MEAN	????	1984	1995	CYPRESS CREEK TRIB. TO LOXAHATC	05438	265825	801028	12
3	LOX.TRAP	265833080095100	USGS	THH	????	1979	1982	LOXAHATCHEE RIVER AT TRAPPER NE	02972	265835	800949	4
	LOX.TRAP	265833080095100	USGS	TLH	????	1979	1982	LOXAHATCHEE RIVER AT TRAPPER NE	02973	265835	800949	4
	LOX.TRAP	265833080095100	USGS	THL	????	1979	1982	LOXAHATCHEE RIVER AT TRAPPER NE	02974	265835	800949	4
	LOX.TRAP	265833080095100	USGS	TLL	????	1979	1982	LOXAHATCHEE RIVER AT TRAPPER NE	02975	265835	800949	4
	LOX.TRAP	TRAPPER	WMD	MEAN	????	1984	1990	LOXAHATCHEE RIVER AT TRAPPER NE	05566	265835	800949	7
4	LOX.RIVB	RIVERBEN	WMD	MEAN	SDIG	1986	1991	LOXAHATCHEE RIVER AT RIVERBEND	07072	265847	800810	6
	LOX.RIVB	RIVERBEN	WMD	MAX	SDIG	1986	1991	LOXAHATCHEE RIVER AT RIVERBEND	07073	265847	800810	6
	LOX.RIVB	RIVERBEN	WMD	MIN	SDIG	1986	1991	LOXAHATCHEE RIVER AT RIVERBEND	07074	265847	800810	6
5	DUPUIS2	DUPUIS2	WMD	MEAN	SDIG	1990	1994	DUPUIS RESERVE (WHITE BELT MARS	13024	265858	803205	5
	DUPUIS2	DUPUIS2+	WMD	MEAN	CR10	1994	1999	DUPUIS RESERVE (WHITE BELT MARS	15926	265858	803205	6
6	S308_H	02276870	USGS	MEAN	????	1941	1996	PORT MAYACA LOCK HEADWATER (COR	00276	265907	803705	56
	S308_T	02276871	USGS	MEAN	????	1981	1996	PORT MAYACA LOCK TAILWATER (COR	00278	265907	803705	16
7	LOX.HOBE	265907080094100	USGS	THH	????	1981	1981	HOBE DITCH TRIB. TO LOXAHATCHEE	02982	265911	801030	1
	LOX.HOBE	265907080094100	USGS	TLH	????	1981	1981	HOBE DITCH TRIB. TO LOXAHATCHEE	02983	265911	801030	1
	LOX.HOBE	265907080094100	USGS	THL	????	1981	1981	HOBE DITCH TRIB. TO LOXAHATCHEE	02984	265911	801030	1
	LOX.HOBE	265907080094100	USGS	TLL	????	1981	1981	HOBE DITCH TRIB. TO LOXAHATCHEE	02985	265911	801030	1
	LOX.HOBE	265907080103000	USGS	MEAN	????	1979	1982	HOBE DITCH TRIB. TO LOXAHATCHEE	02986	265911	801030	4
	LOX.HOBE	265907080103000	USGS	FWM	????	1980	1981	HOBE DITCH TRIB. TO LOXAHATCHEE	02987	265911	801030	2
	LOX.HOBE_	H HOBE.DCH	WMD	MEAN	????	1984	1994	HOBE DITCH TRIB. TO LOXAHATCHEE	05444	265911	801030	11
	LOX.HOBE_	H LOXHOBE+	WMD	MEAN	CR10	1994	1999	HOBE DITCH TRIB. TO LOXAHATCHEE	15931	265911	801030	6
8	LOX.HOBB	265916080083500	USGS	THH	????	1976	1982	LOXAHATCHEE RIVER NR HOBE SOUND	02995	265917	800834	7
	LOX.HOBB	265916080083500	USGS	TLH	????	1977	1982	LOXAHATCHEE RIVER NR HOBE SOUND	02996	265917	800834	6
	LOX.HOBB	265916080083500	USGS	THL	????	1977	1982	LOXAHATCHEE RIVER NR HOBE SOUND	02997	265917	800834	6
	LOX.HOBB	265916080083500	USGS	TLL	????	1976	1982	LOXAHATCHEE RIVER NR HOBE SOUND	02998	265917	800834	7
9	S153L_H	S153*H	WMD	MEAN	????	1983	1988	S-153L (LATCHING GATE) ON LEVEE	04864	265919	803617	6
	S153L_T	S153*T	WMD	MEAN	????	1983	1988	S-153L (LATCHING GATE) ON LEVEE	04866	265919	803617	6
10	S153_H	S153-H	WMD	MEAN	TELE	1985	1999	S-153 SPILLWAY ON LEVEE L-65 AT	05759	265920	803616	15
	S153_H		WMD	MEAN	????	1983	1986	S-153 SPILLWAY ON LEVEE L-65 AT	04508	265920	803616	4
	S153_T	S153-T	WMD	MEAN	TELE	1985	1999	S-153 SPILLWAY ON LEVEE L-65 AT	05763	265920	803616	15
	S153_T		WMD	MEAN	????	1983	1986	S-153 SPILLWAY ON LEVEE L-65 AT	04510	265920	803616	4
11	JD6	JD6+	WMD	MEAN	CR10	1997	1999	JONATHAN DICKINSON STATE PARK.	FF820	270007	800849	3

Table 9. Stage monitoring stations in Martin County (Continued)

Site	STATION	ALTERNATE ID	AGCY	METH	RCDR	STRT	END	STATION DESCRIPTION	DOKEY	LAT	LONG	Acres*
12	KITCHENG	270022080094500	USGS	MEAN	????	1979	1997	KITCHINGS CREEK NR HOBE SOUND,F	03904	270022	800945	19
	KITCHENG	270022080094500	USGS	FWM	????	1956	1985	KITCHINGS CREEK NR HOBE SOUND,T	03905	270022	800945	6
	KITCHENG_	H KITCHEN	WMD	MEAN	????	1984	1984	KITCHINGS CREEK NR HOBE SOUND,T	05450	270022	800945	1
3	LOX MTR	270025080074200	USGS	MEAN	????	1979	1982	M TR NF LOXAHATCHEE R NR HOBE S	03907	270025	800741	4
	LOX MTR	270025080074200	USGS	FWM	????	1980	1981	M TR NF LOXAHATCHEE R NR HOBE S	03908	270025	800741	2
4	JD26	JD26+	WMD	MEAN	CR10	1997	1999	JONATHAN DICKINSON STATE PARK.	HF823	270023	800824	5
15	LOX.ETR	270036080070500	USGS	MEAN	????	1980	1982	E TR NF LOXAHATCHEE R NR HOBE S	03912	270037	800704	3
	LOX.ETR	270036080070500	USGS	FWM	????	1980	1981	E TR NF LOXAHATCHEE R NR HOBE S	03912	270037	800704	2
16	JD22	JD12+	WMD	MEAN	CR10	1997	1999	JONATHAN DICKINSON STATE PARK.	HF822	270036	801023	3
17	MONREVE	02276984	USGS	MEAN	????	1968	1972	MONREVE RANCH DRAIN CANAL	00289	270034	801910	5
	MONREVE	02276984	USGS	FWM	????	1963	1967	MONREVE RANCH DRAIN CANAL	00289	270034	801910	5
18	HOBEAC_E	HOBE*C	WMD	MEAN	????	1982	1985	HOBE GROVES INLET CULVERT (SITE	05284	270401	801259	4
	HOBEAC_T	HOBE*A	WMD	MEAN	????	1982	1985	HOBE GROVES INLET CULVERT (SITE	05286	270401	801259	4
	HOBEBD_H	HOBE*B	WMD	MEAN	????	1982	1985	HOBE GROVES OUTLET CULVERT (SIT	05290	270401	801259	4
	HOBEBD_T	HOBE*D	WMD	MEAN	????	1982	1985	HOBE GROVES OUTLET CULVERT (SIT	05292	270401	801259	4
19	CIR-TA_T	CIR-T*A	WMD	MEAN	????	1983	1984	CIRCLE-T GROVES BELOW INLET CUL	05256	270501	802659	2
	CIR-TA1_H	CIR-T*A1	WMD	MEAN	????	1983	1984	CIRCLE-T GROVES OUTLET CULVERT	05258	270501	802659	2
	CIR-TA2_T	CIR-T*A2	WMD	MEAN	????	1982	1984	CIRCLE-T GROVES OUTLET CULVERT	05250	270501	802659	2
	CIR-TBC_H	CIR-T*B	WMD	MEAN	????	1983	1985	CIRCLE-T GROVES @ LATERAL DITCH	05260	270501	802654	3
	CIR-TBC_T	CIR-T*C	WMD	MEAN	????	1982	1985	CIRCLE-T GROVES @ LATERAL DITCH	05262	270501	802659	3
	CIR-TD_H	CIR-T*D	WMD	MEAN	????	1982	1984	CIRCLE-T GROVES AT PUMP STATION	05266	270501	802659	2
20	S135 PMP_	H S135@H	WMD	MEAN	PLOG	1984	1998	S-135 PUMP (ONLY) FROM N.E. SHO	06823	270511	803940	15
	S135 PMP_	T S135@T	WMD	MEAN	PLOG	1984	1987	S-135 PUMP (ONLY) FROM N.E. SHO	06824	270511	803940	4
	S135_E	S135*H	WMD	MEAN	2A35	1979	1991	S-135	04662	270511	803940	13
	S135_E	S135-H	WMD	MEAN	CR10	1992	1998	S-135	15339	270511	803940	7
	S135_E	S135-H	WMD	MEAN	TELE	1994	1999	S-135	15803	270511	803940	6
	S135_T	S135*T	WMD	MEAN	2A35	1979	1991	S-135	04656	270511	803940	13
	S135_T	S135*T	WMD	MAX	2A35	1979	1991	S-135	04662	270511	803940	13
	S135_T	S135*T	WMD	MIN	2A35	1979	1991	S-135	04662	270511	803940	13
	S135_T	S135-T	WMD	MEAN	CR10	1992	1998	S-135	15340	270511	803940	7
	S135_T	S135-T	WMD	MEAN	TELE	1994	1999	S-135	15802	270511	803940	6
21	S80_H	02277000	USGS	MEAN	????	1987	1995	S-80 SPILLWAY AND LOCK ON ST.LU	00285	270446	801705	9
	S80_T	02277000	USGS	MEAN	????	1987	1992	S-80 SPILLWAY AND LOCK ON ST.LU	10244	270446	801705	6
22	SLSF	SLSF+	WMD	MEAN	TELE	1998	1999	SOUTH FORK OF ST.LUCIE RIVER	HF244	270441	801523	2
23	UNDERHIL_	H UNDE+H	WMD	MEAN	SP01	1989	1989	UNDERHILL DAIRY OUTLET CULVERT	12398	270447	802841	1
	UNDERHIL_	T UNDE+T	WMD	MEAN	SP01	1989	1989	UNDERHILL DAIRY OUTLET CULVERT	12397	270447	802841	1
24	SLR.CABA	CABANA P	WMD	MEAN	SDIG	1982	1983	ST. LUCIE RIVER AT CABANA POINT	03039	270953	801503	2
	SLR.CABA	CABANA P	WMD	MAX	SDIG	1982	1983	ST. LUCIE RIVER AT CABANA POINT	03048	270953	801503	2
	SLR.CABA	CABANA P	WMD	MIN	SDIG	1982	1983	ST. LUCIE RIVER AT CABANA POINT	03047	270953	801503	2

Table 9. Stage monitoring stations in Martin County (Continued)

Site	STATION	ALTERNATE ID	AGCY	METH	RCDR	STRT	END	STATION DESCRIPTION	DBKEY	LAT	LONG	years*
25	KAY1AB_H	KAYI*B	WMD	MEAN	????	1982	1984	KAY I GROVES OUTFLOW CULVERT	05298	271001	802359	3
	KAY1AB_T	KAYI*A	WMD	MEAN	????	1982	1984	KAY I GROVES OUTFLOW CULVERT	05300	271001	802359	3
	KAY1CD_H	KAYI*D	WMD	MEAN	????	1982	1984	KAY I GROVES INFLOW CULVERT	05304	271001	802359	3
	KAY1CD_T	KAYI*C	WMD	MEAN	????	1983	1984	KAY I GROVES INFLOW CULVERT	05306	271001	802359	2
26	SLR.PALM	PALM CIT	WMD	MEAN	SDIG	1981	1983	ST. LUCIE RIVER AT PALM CITY BR	07027	271026	801539	3
	SLR.PALM	PALM CIT	WMD	MAX	SDIG	1981	1983	ST. LUCIE RIVER AT PALM CITY BR	07028	271026	801539	3
	SLR.PALM	PALM CIT	WMD	MIN	SDIG	1981	1983	ST. LUCIE RIVER AT PALM CITY BR	07029	271026	801539	3
27	SLR.HELL	HELLGATE	WMD	MEAN	SDIG	1981	1991	ST. LUCIE RIVER AT HELLGATE BRI	07021	271048	801157	11
	SLR.HELL	HELLGATE	WMD	MAX	SDIG	1982	1991	ST. LUCIE RIVER AT HELLGATE BRI	07022	271048	801157	10
	SLR.HELL	HELLGATE	WMD	MIN	SDIG	1982	1991	ST. LUCIE RIVER AT HELLGATE BRI	07023	271048	801157	10
28	SLR.A1A	A1A STLU	WMD	MEAN	SDIG	1981	1982	ST. LUCIE RIVER AT A1A BRIDGE	07018	271157	801229	2
	SLR.A1A	A1A STLU	WMD	MAX	SDIG	1981	1982	ST. LUCIE RIVER AT A1A BRIDGE	07019	271157	801229	2
	SLR.A1A	A1A STLU	WMD	MIN	SDIG	1981	1982	ST. LUCIE RIVER AT A1A BRIDGE	07020	271157	801229	2
29	S48_H	S48*H	WMD	MEAN	????	1963	1969	S-48 SPILLWAY ON CANAL C-23 AT	04378	271203	801743	7
	S48_H	S48+H	WMD	MEAN	CR10	1995	1999	S-48 SPILLWAY ON CANAL C-23 AT	16714	271203	801743	5
30	SLR.BESS	BESSEY C	WMD	MEAN	SDIG	1981	1982	BESSEY CREEK NEAR ST. LUCIE RIV	07024	271205	801719	2
31	SLR.BESS	BESSEY C	WMD	MAX	SDIG	1981	1982	BESSEY CREEK NEAR ST. LUCIE RIV	07025	271205	801719	2
	SLR.BESS	BESSEY C	WMD	MIN	SDIG	1981	1982	BESSEY CREEK NEAR ST. LUCIE RIV	07026	271205	801719	2
32	SLR.ROOS	ROOSEVEL	WMD	MEAN	SDIG	1981	1981	ST. LUCIE RIVER AT ROOSEVELT BR	07015	271211	801539	1
	SLR.ROOS	ROOSEVEL	WMD	MAX	SDIG	1981	1981	ST. LUCIE RIVER AT ROOSEVELT BR	07016	271211	801539	1
	SLR.ROOS	ROOSEVEL	WMD	MIN	SDIG	1981	1981	ST. LUCIE RIVER AT ROOSEVELT BR	07017	271211	801539	1
33	S97_H	S97*H	WMD	MEAN	????	1964	1993	S-97 SPILLWAY ON CANAL C-23 NEA	04846	271219	802026	30
	S97_H	S97+H	WMD	MEAN	SP01	1986	1994	S-97 SPILLWAY ON CANAL C-23 NEA	05582	271219	802026	9
	S97_H	S97-H	WMD	MEAN	TELE	1994	1999	S-97 SPILLWAY ON CANAL C-23 NEA	15778	271219	802026	6
	S97_T	S97+T	WMD	MEAN	SP01	1986	1994	S-97 SPILLWAY ON CANAL C-23 NEA	06921	271219	802026	9
	S97_T	S97-T	WMD	MEAN	TELE	1994	1999	S-97 SPILLWAY ON CANAL C-23 NEA	15779	271219	802026	6
	S97_T		WMD	MEAN	????	1963	1969	S-97 SPILLWAY ON CANAL C-23 NEA	04848	271219	802026	7
34	INT.STU	02253800	USGS	THH	????	1973	1977	INTERCOASTAL WATERWAY AT STUART	00081	271220	801137	5
	INT.STU	02253800	USGS	TLH	????	1974	1977	INTERCOASTAL WATERWAY AT STUART	00082	271220	801137	4
	INT.STU	02253800	USGS	THL	????	1974	1977	INTERCOASTAL WATERWAY AT STUART	00083	271220	801137	4
	INT.STU	02253800	USGS	TLL	????	1973	1977	INTERCOASTAL WATERWAY AT STUART	00084	271220	801137	5
35	IR.A1A	A1A_IR	WMD	MEAN	SDIG	1982	1984	INDIAN RIVER AT A1A BRIDGE	07051	271226	801130	3
	IR.A1A	A1A_IR	WMD	MAX	SDIG	1982	1984	INDIAN RIVER AT A1A BRIDGE	07052	271226	801130	3
	IR.A1A	A1A_IR	WMD	MIN	SDIG	1982	1984	INDIAN RIVER AT A1A BRIDGE	07053	271226	801130	3
36	WARNER C	02277107	USGS	MEAN	????	1976	1977	WARNER CREEK NR JENSEN BEACH, F	00288	271409	801411	2
37	IR.JENSE	JENSENB	WMD	MEAN	SDIG	1988	1991	ST. LUCIE RIVER AT JENSEN BEACH	07054	271513	801303	4
	IR.JENSE	JENSENB	WMD	MAX	SDIG	1988	1991	ST. LUCIE RIVER AT JENSEN BEACH	07055	271513	801303	4
	IR.JENSE	JENSENB	WMD	MIN	SDIG	1988	1991	ST. LUCIE RIVER AT JENSEN BEACH	07056	271513	801303	4
38	SAV6	SAV6+	WMD	MEAN	CR10	1997	1999	SAVANNAS PRESERVE, SITE 6	J1278	271514	801515	3
39	SAV4	SAV4+	WMD	MEAN	CR10	1997	1999	SAVANNAS PRESERVE, SITE 4	J1274	271519	801504	3
40	SAV5	SAV5+	WMD	MEAN	CR10	1997	1999	SAVANNAS PRESERVE, SITE 5	J1276	271531	801510	3

*: years (rounded) of data available

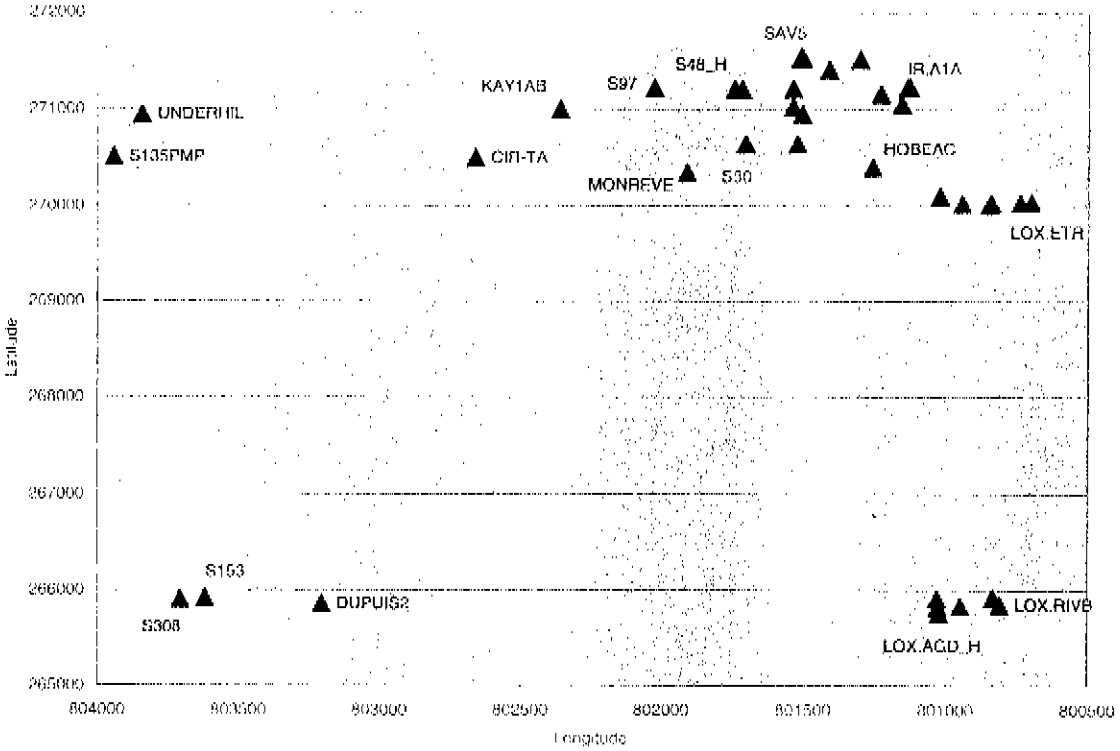


Figure 19. Location of stage monitoring sites in Martin County

3.2.2 QA/QC

A preliminary examination of the time series is done through graphical plotting. Gaps, overlaps, and relationships are depicted. The missing daily data from the selected long time series are filled using the following procedures, as presented in the flow chart in Figure 20:

a. Missing daily data in the selected long time series data are filled with daily data from other DBKEYs at the site. Most of the time, the difference is in the type of recorders.

b. Estimate of daily data is also made from linear regression relationship after downstream and upstream flow sites relationship has been established. Summaries of regression relationships for flow sites and stages are given in Tables 10 and 11.

c. When the missing gap is short (less than three days), linear interpolation is used.

d. For all other missing daily data not within these three cases, an M tag is reassigned to the data.

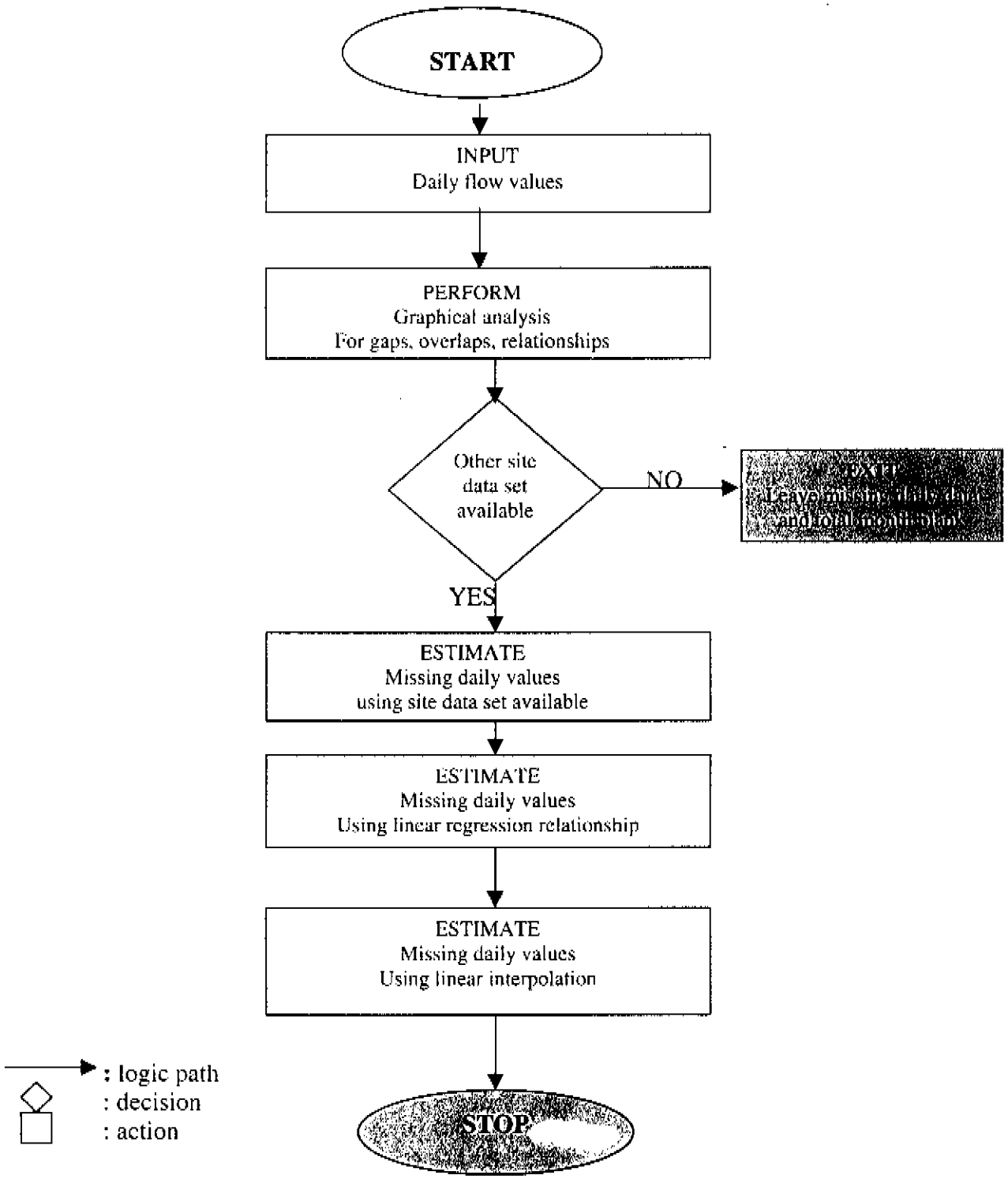


Figure 20. Flow chart for estimating missing daily flow values

Table 10: Regression relationships between flow sites

Site (X)	Site (Y)	Relationship	R^2
S97	S48	Y = 0.9873X + 20.684	0.93
S308_DS	S308_L	Y = 1.0163X - 15.788	0.98

Table 11: Regression relationships between stages

Site (X)	Site (Y)	Relationship	R^2
S97_T	S48_H	Y = 0.9053X + 0.8327	0.97
S308_H	S135_T	Y = 0.9938X + 0.0722	0.99
S308_T	S153_T	Y = 0.9874X + 0.1336	0.99
S153_T	S80_H	Y = 0.9572X + 0.5804	0.97
S308_T	S80_H	Y = 0.9572X + 0.5804	0.97

3.3 SUMMARY OF SURFACE WATER DATA

3.3.1 Flow

Historical daily flow data are presented in Appendix E, while monthly and annual flow statistics are in Appendix F. A summary of the computed values from Appendices E and F is given in Table 12. Monthly statistics for the mean daily values are also presented in Figures 21 to 27.

Taking into account the importance of the St. Lucie Canal, C-44, and the complexity of the system, a schematic plot for the hydrologic system is presented in Figure 28 for better understanding. As it can be seen in Figure 28, release and backflow from and to Lake Okeechobee at S-308 have been considered as inflow and outflow for C-44. From the mean monthly rainfall, inflow and outflow at C-44 shown in Figure 29, the following can be observed:

Table 12: Flow data summary

Site	Mean daily (cfs)	Maximum mean daily (cfs)	Minimum mean daily (cfs)
S153	46	381	0
S308*	139	3,370	0
S308**	371	8,150	0
S135_P	24	419	0
S97	189	1,799	0
S48	213	992	0
S80	748	9,315	0

(*): backflow (**): release

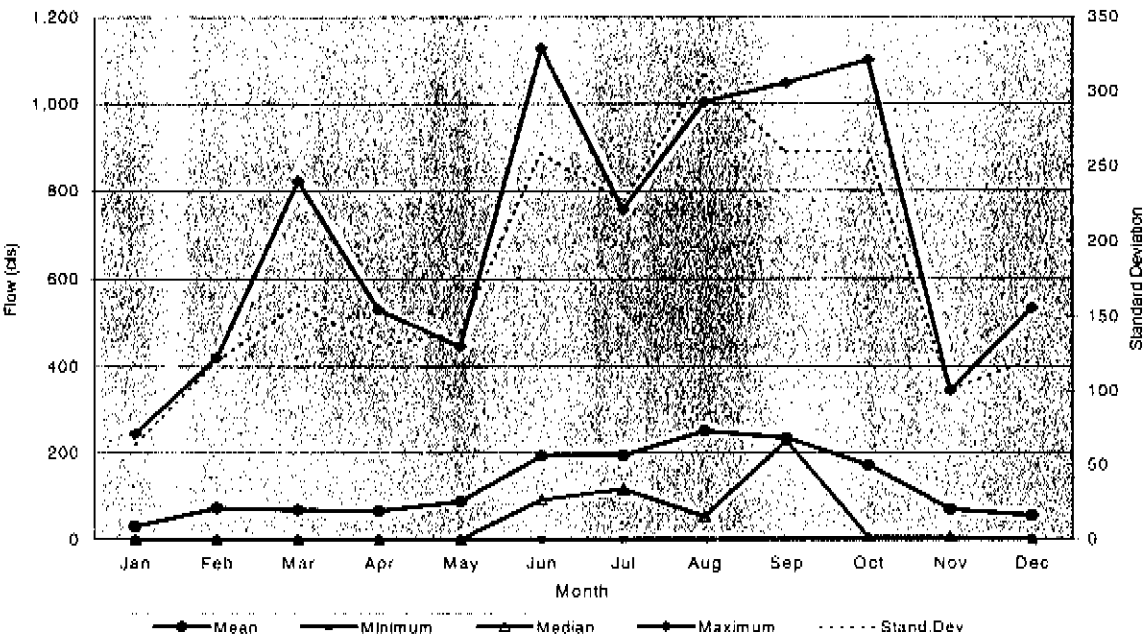


Figure 21. Monthly statistics for mean daily Lake Okeechobee backflow through S-308 (Period: 01/01/63-03/31/99)

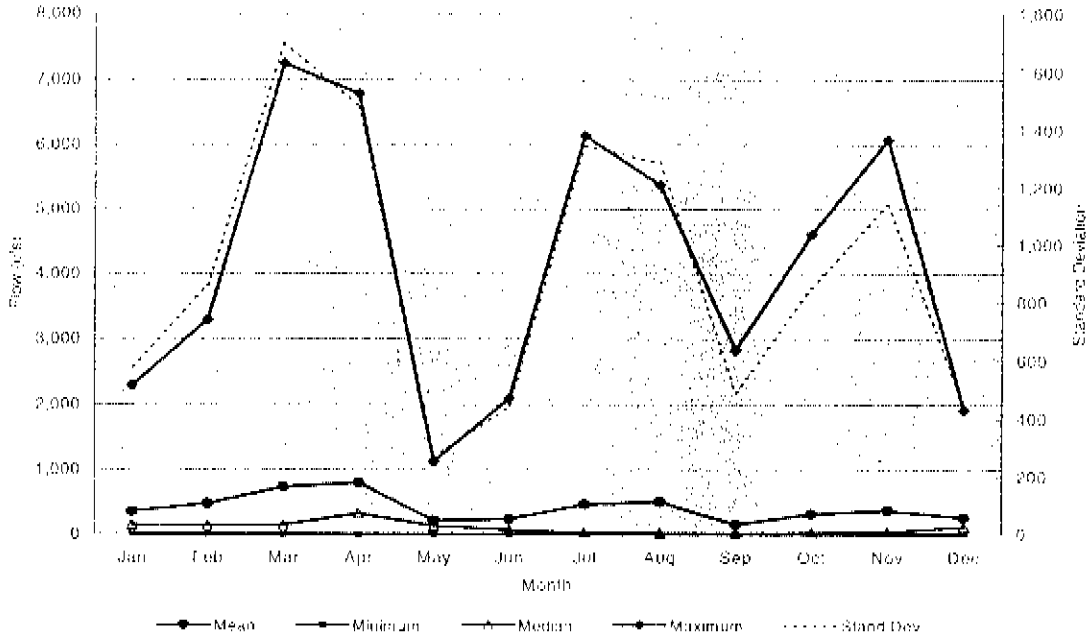


Figure 22. Monthly statistics for mean daily Lake Okeechobee release through S-308 (Period: 01/01/63-03/31/99)

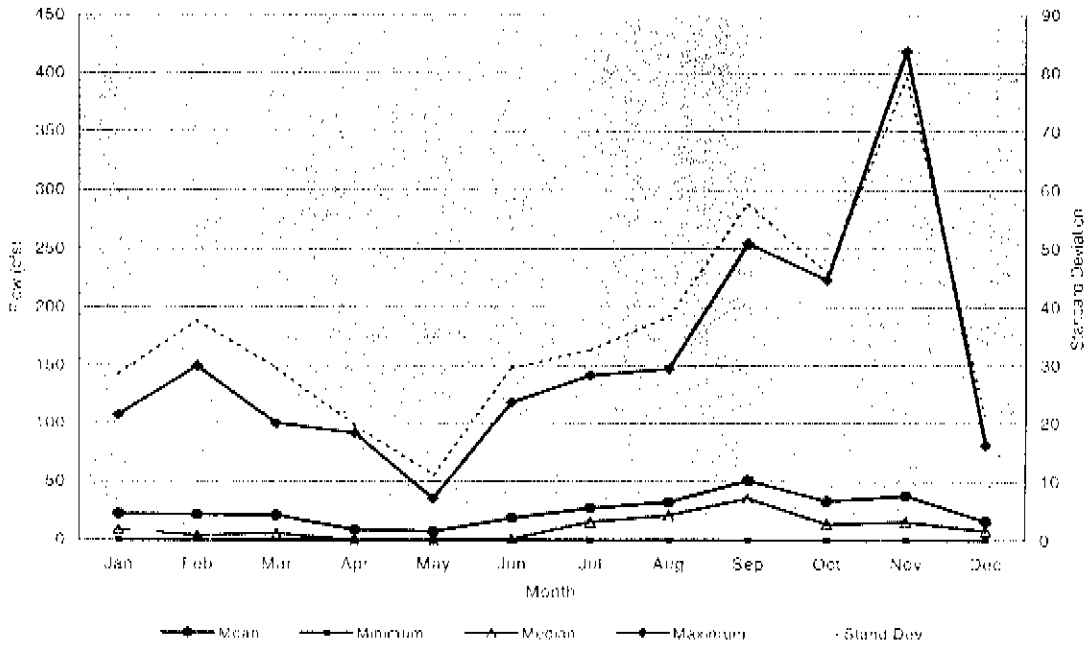


Figure 23. Monthly statistics for mean daily pumping at S-135 (Period: 12/01/69-03/31/99)

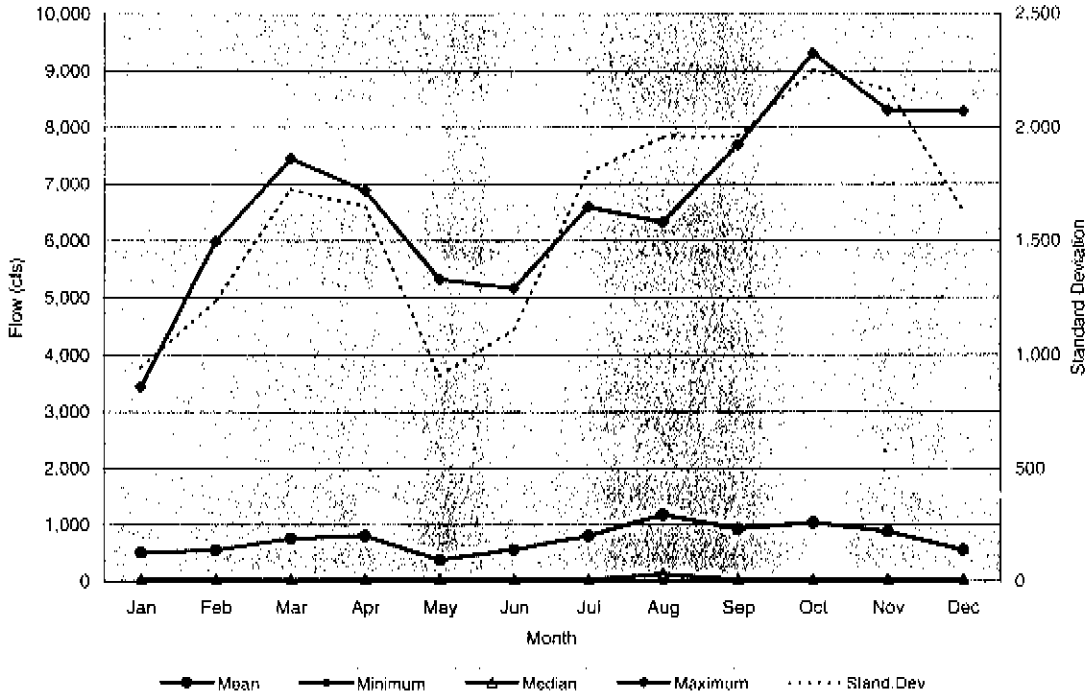


Figure 24. Monthly statistics for mean daily flow at S-80 (Period: 10/01/52-03/31/99)

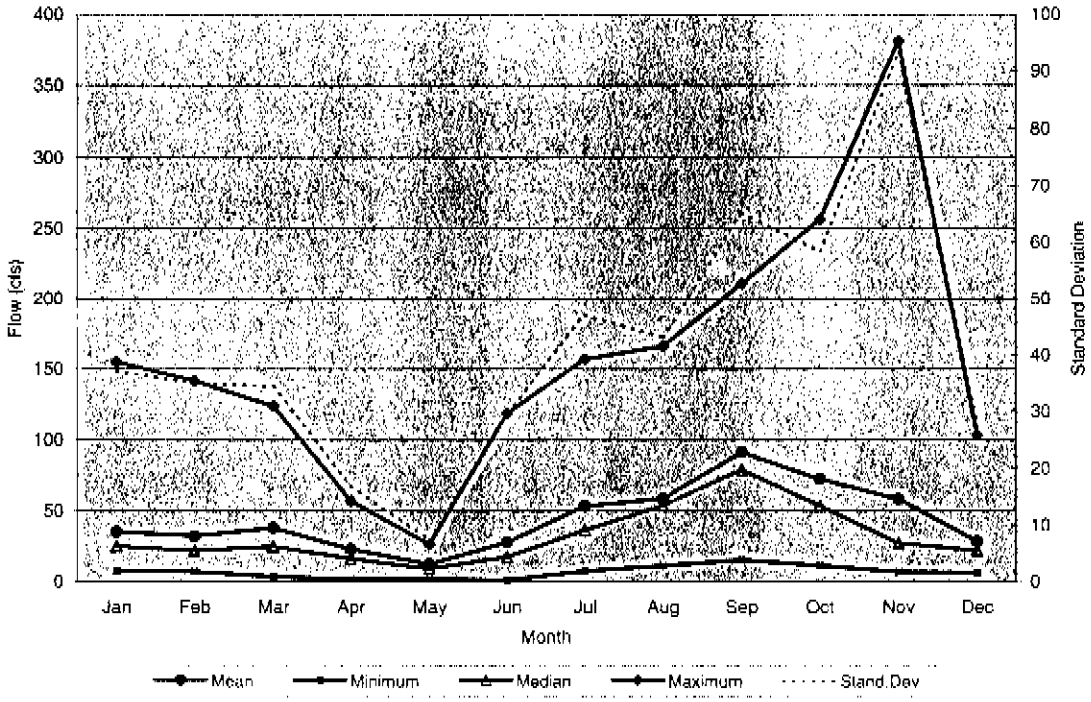


Figure 25. Monthly statistics for mean daily flow at S-153 (Period: 07/01/83-03/31/99)

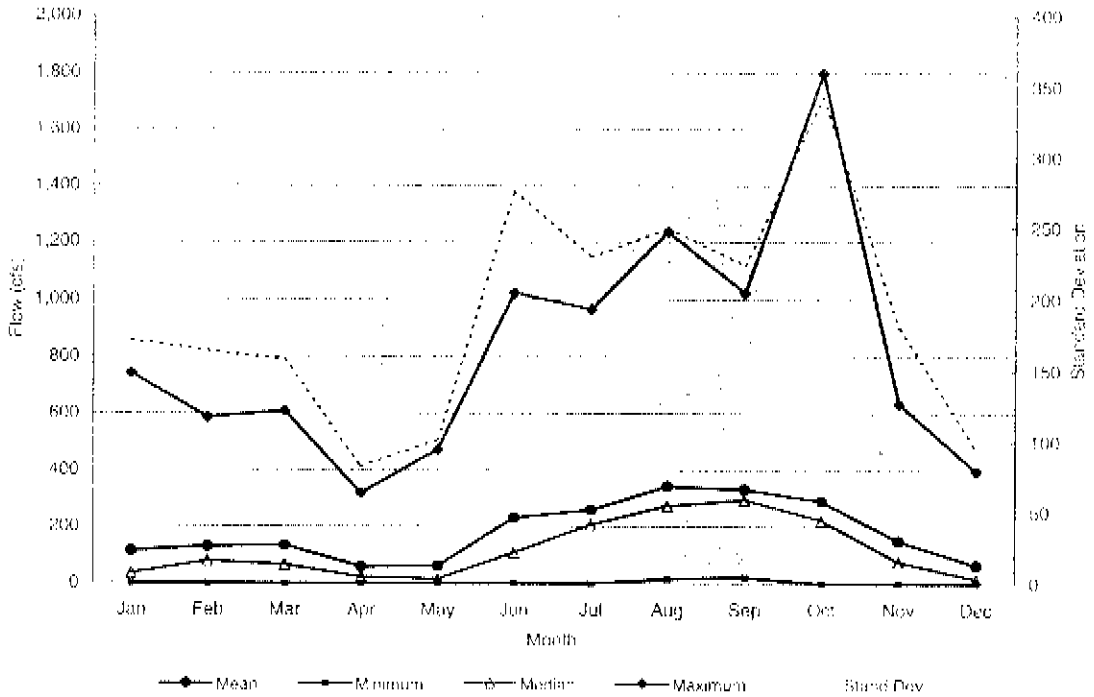


Figure 26. Monthly statistics for mean daily flow at S-97 (Period: 02/01/64-03/31/99)

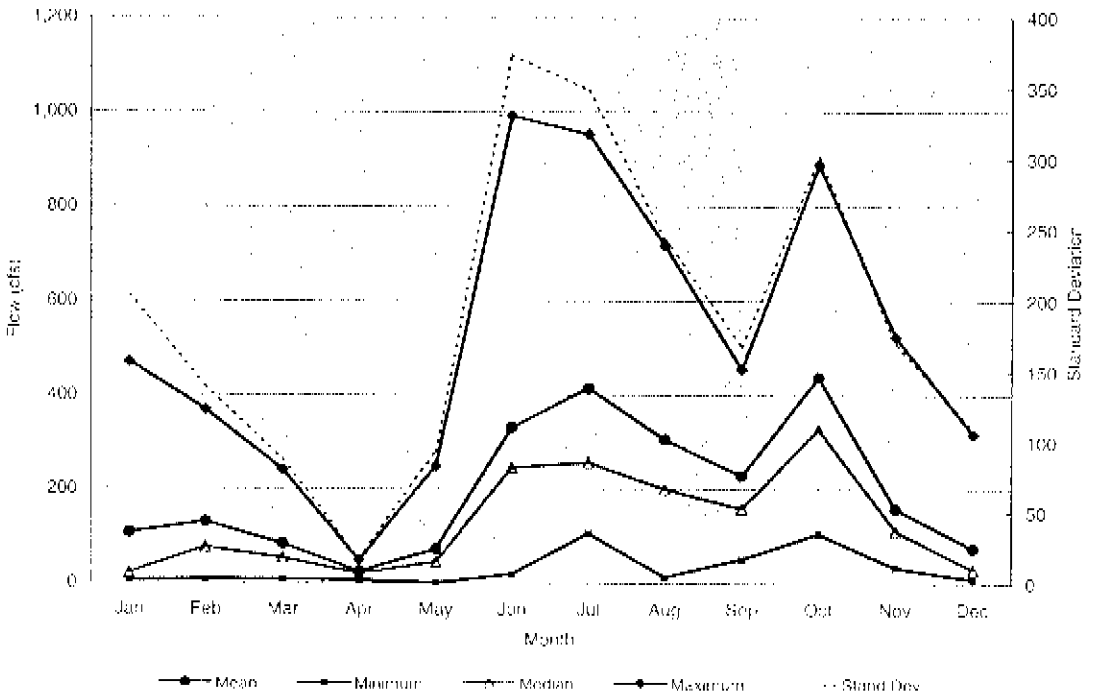
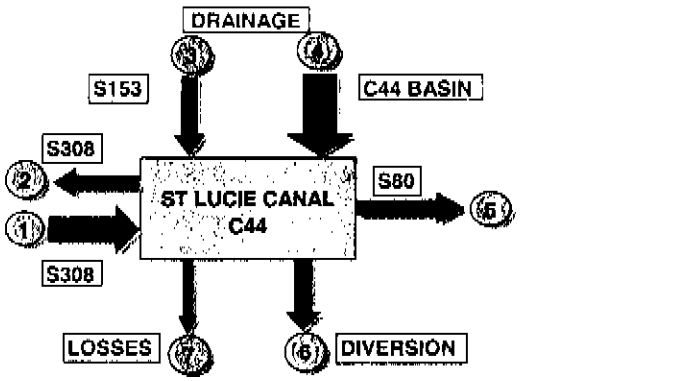


Figure 27. Monthly statistics for mean daily flow at S-48 (Period: 07/01/63-12/31/69)



1. Outflow from Lake Okeechobee, C-44 canal Inflow
2. Inflow (backflow) to Lake Okeechobee, C-44 canal Outflow
3. Drainage water from L-65 and C-153, C-44 canal Inflow
4. Drainage water from C-44 basin, C-44 canal Inflow
5. Outflow from C-44 canal
6. Diversions in C-44, C-44 canal outflow
7. Losses from C-44 canal

Figure 28. Schematic hydrologic system for C-44 canal

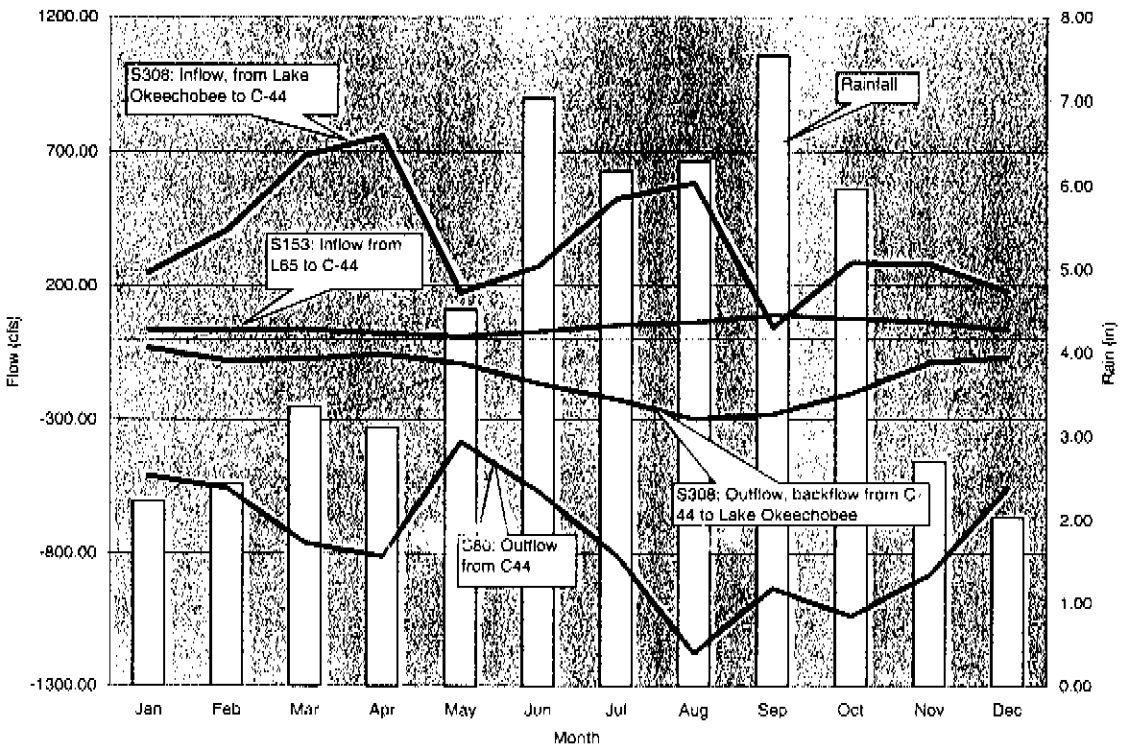


Figure 29. Mean monthly rainfall, inflow and outflow in C-44 basin

- Outflows are about twice the inflows. The difference is due to major rainfall contribution over the basin during the whole year.

- Major outflow contribution is from S-80. Backflow to Lake Okeechobee represents about 15 percent of the total outflow.

- Inflow contribution from L-65 via S-153 is relatively not significant compared to release from Lake Okeechobee through S-308. It represents only ten percent of the total inflow.

Daily rainfall and net flow (Outflow – Inflow) are plotted in Figure 30. The relationship between the monthly total rainfall and monthly total net flow is also plotted in Figure 31. Positive net flow denotes greater outflow, meaning major rainfall contribution to C-44 canal; while negative net flow denotes greater inflow, meaning major losses (evaporation, infiltration) and diversions along the C-44 canal. In the first case, net flow is mostly related to rainfall; while in the second case net flow is related to both rainfall and losses. This can explain the poor relationship between these two variables as plotted in Figure 31. A similar regression equation ($Y = 0.3016X - 0.056$) with a higher coefficient of determination (0.72) was given in 1987 for Martin County (Nealon, 1987). The positive slope (0.30) was considered typical for the region. The double mass curve plotted for cumulative rainfall and cumulative net flow in C 44 for the period 1963-1989 (Figure 32) shows that the net flow discharge relationship is relatively constant through the years. The regression coefficient is 0.99 and the relationship is given as:

$$\text{Cumulated Net flow} = (\text{Cumulated rainfall} \times 0.2261) + 0.1427 \qquad (2)$$

3.3.2 Stage

Historical daily stage data are summarized in Appendix G, while monthly and annual statistics are summarized in Appendix H. Summary of the tabulated data in Appendices G and H is given in Table 13. Monthly statistics for the mean stage data are also given in graphical format in Figures 33 to 42. The following is a few comments related to the stage data:

- For S-153 we denote a good control of the upstream stages (headwater) located in the L-65 Borrow Canal as designed. The mean monthly (19.08 feet) falls within the stage levels interval of 18.6-19.1 feet for gates closing and opening. Optimum operation with a headwater elevation of 18.8 feet is not possible.

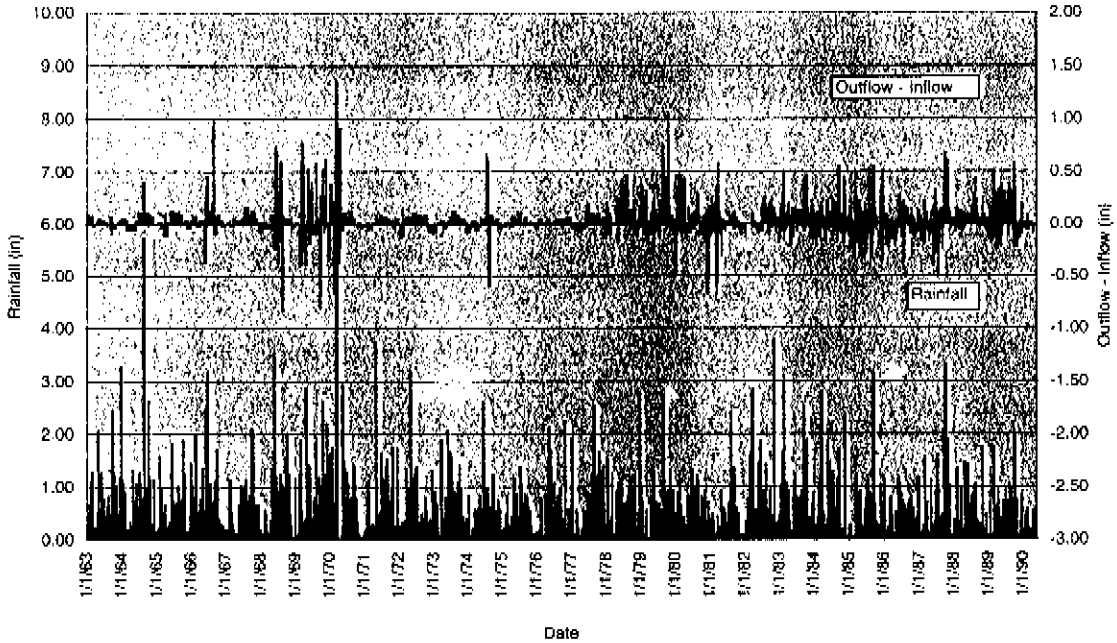


Figure 30. Daily rainfall and net flow in C-44 basin

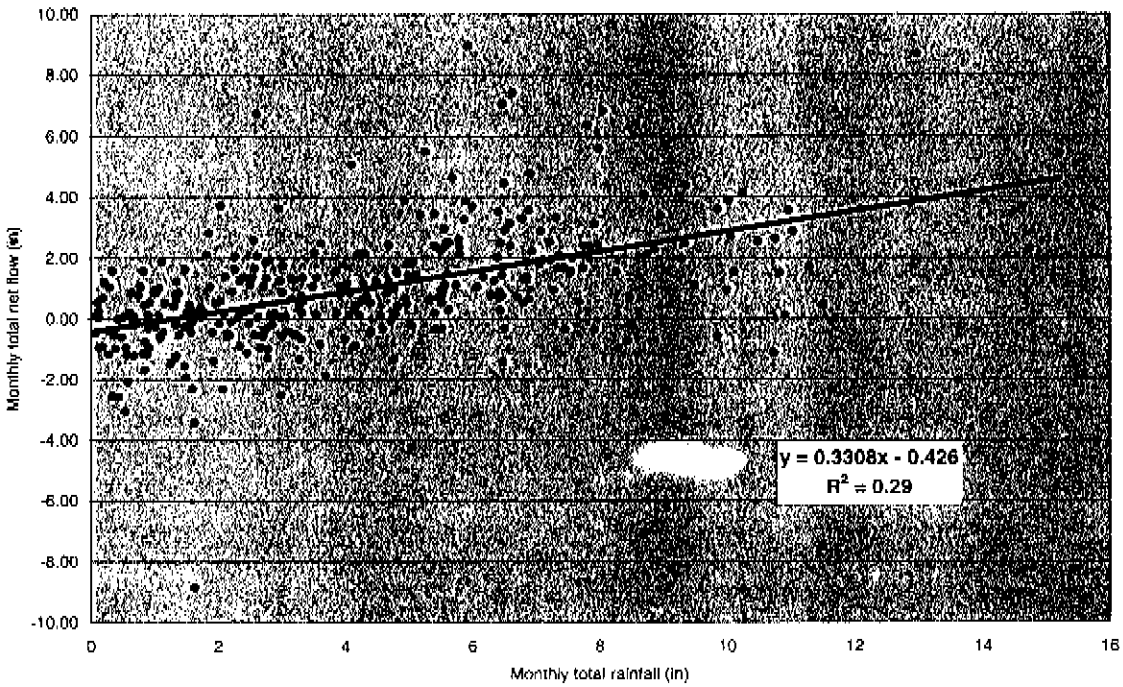


Figure 31. C-44 monthly net flow and rainfall relationship

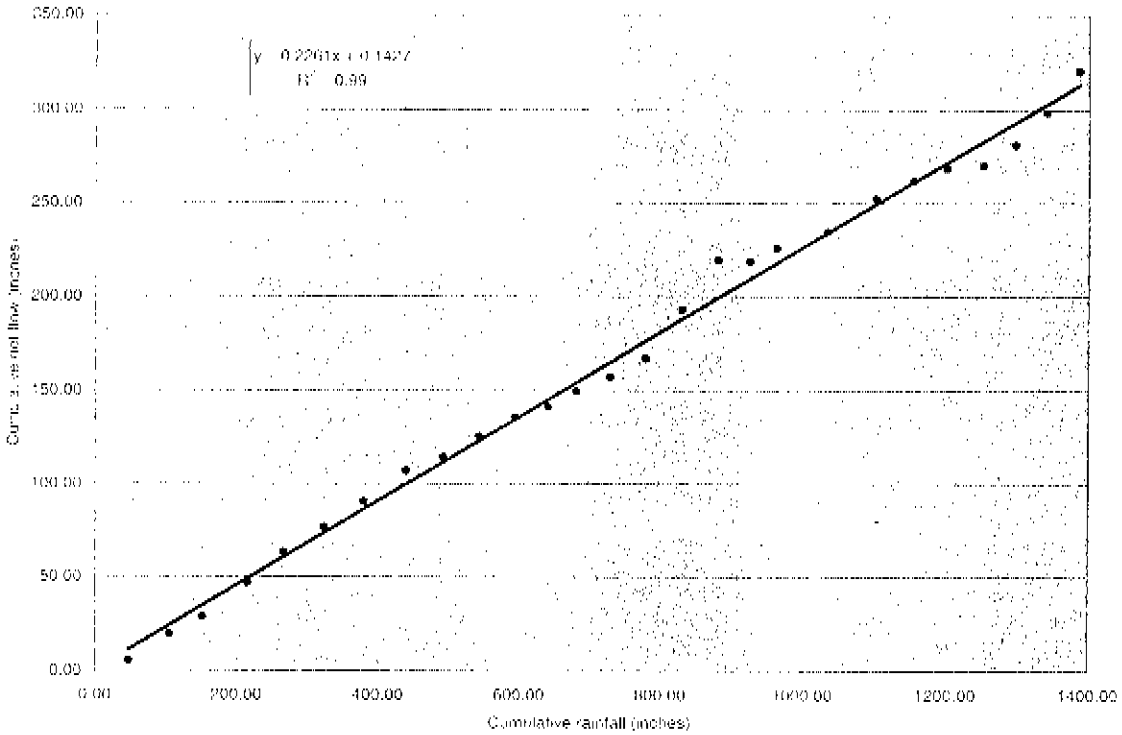


Figure 32. Double mass curve for cumulative rainfall and cumulative net flow in C-44 basin (Period: 1963-1989)

Table 13. Stage data summary

Site	Mean monthly (ft)	Maximum monthly mean (ft)	Minimum monthly mean (ft)
S153_H	19.08	19.25	18.83
S153_T	13.89	17.30	10.41
S308_H	14.68	18.29	10.11
S308_T	13.85	17.47	9.84
S80_H	13.54	14.46	10.40
S97_H	21.05	22.72	16.55
S97_T	8.38	10.69	7.85
S48_H	8.45	10.52	8.05
S135_H	13.27	15.78	9.37
S135_T	14.67	18.25	10.12

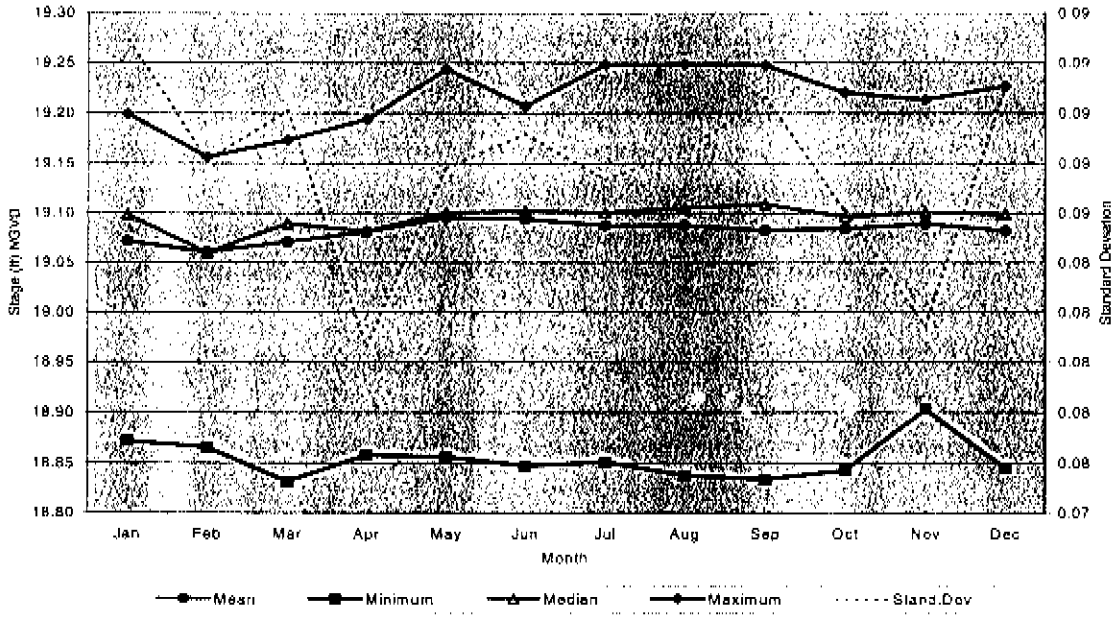


Figure 33. Monthly statistics for mean daily headwater stage at S-153 (Period: 01/01/83-03/31/99)

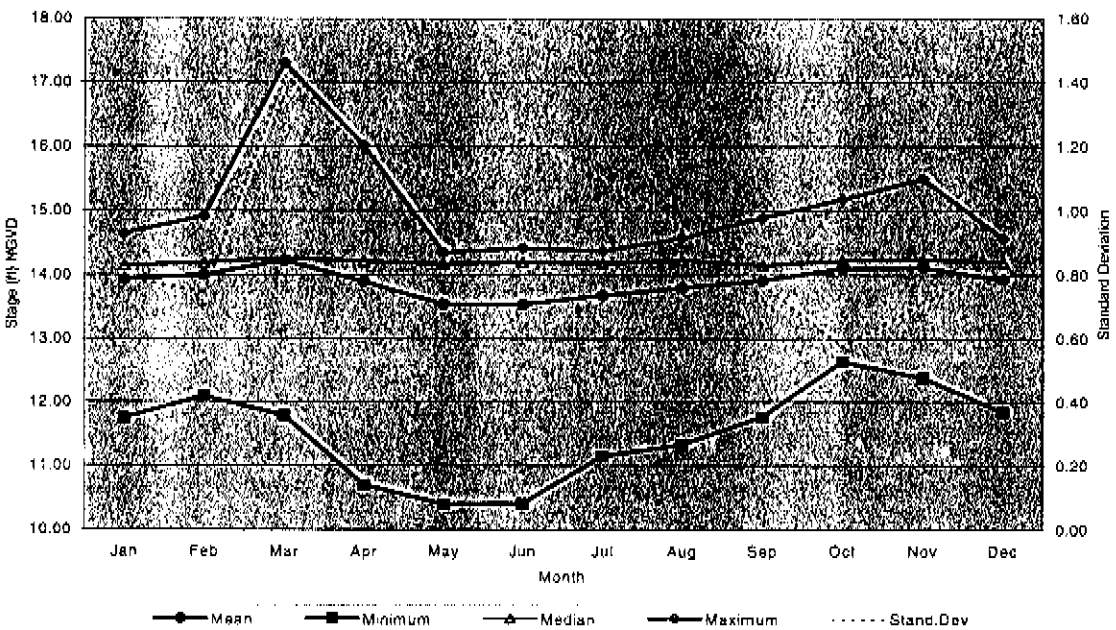


Figure 34. Monthly statistics for mean daily tailwater stage at S-153 (Period: 01/01/83-03/31/99)

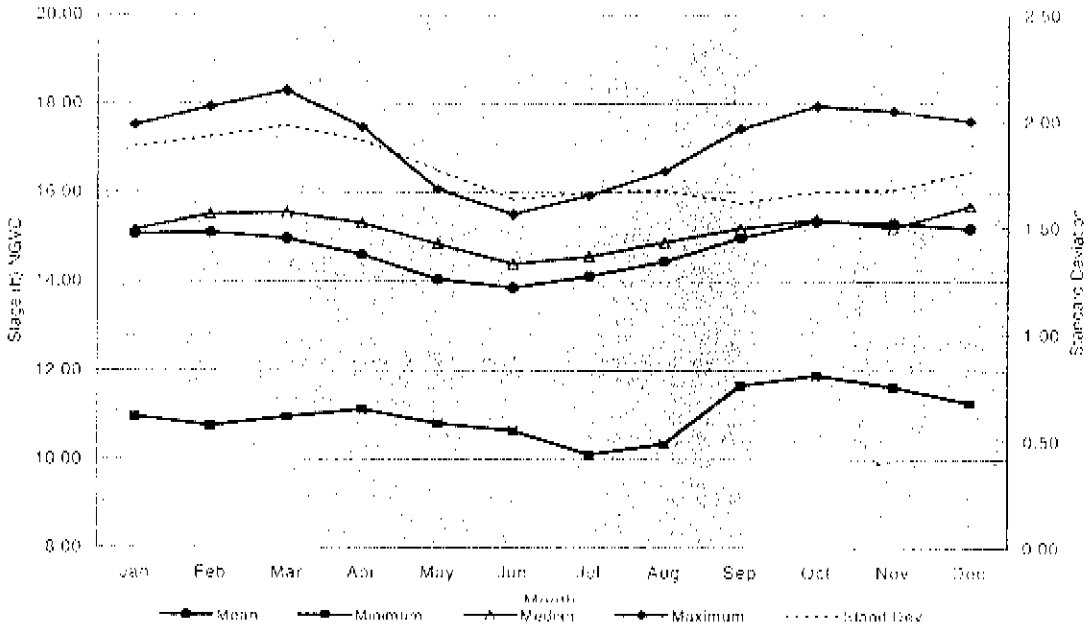


Figure 35. Monthly statistics for mean daily headwater stage at S-308 (Period: 01/15/79-03/31/99)

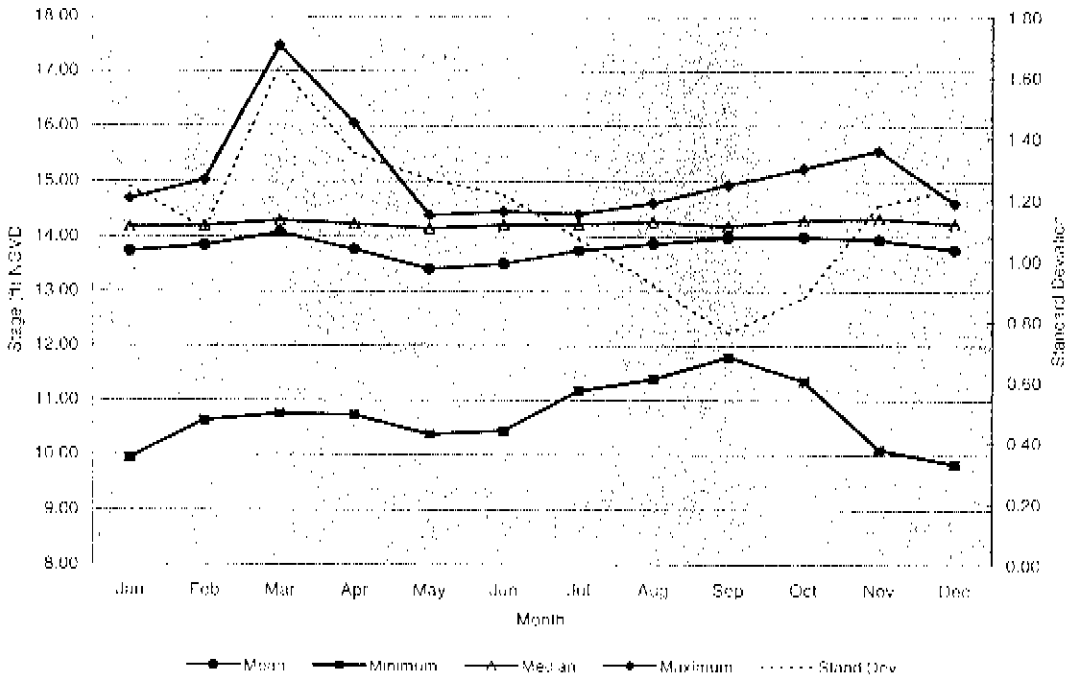


Figure 36. Monthly statistics for mean daily tailwater stage at S-308 (Period: 10/01/81-03/31/99)

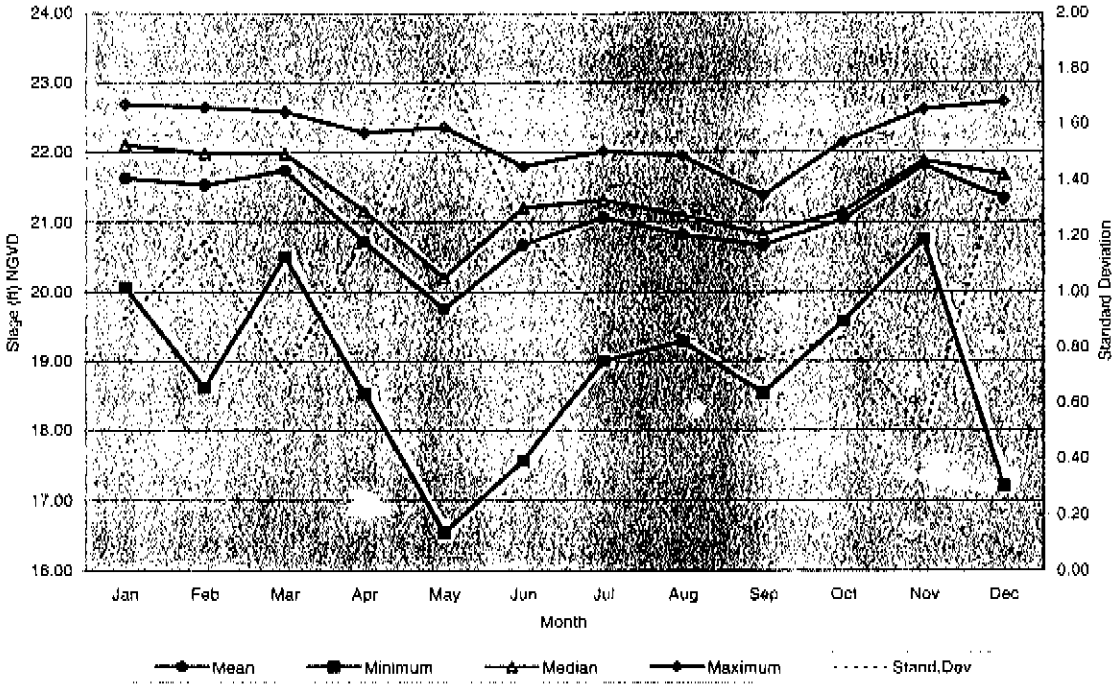


Figure 37. Monthly statistics for mean daily headwater stage at S-97 (Period: 03/01/86-03/31/99)

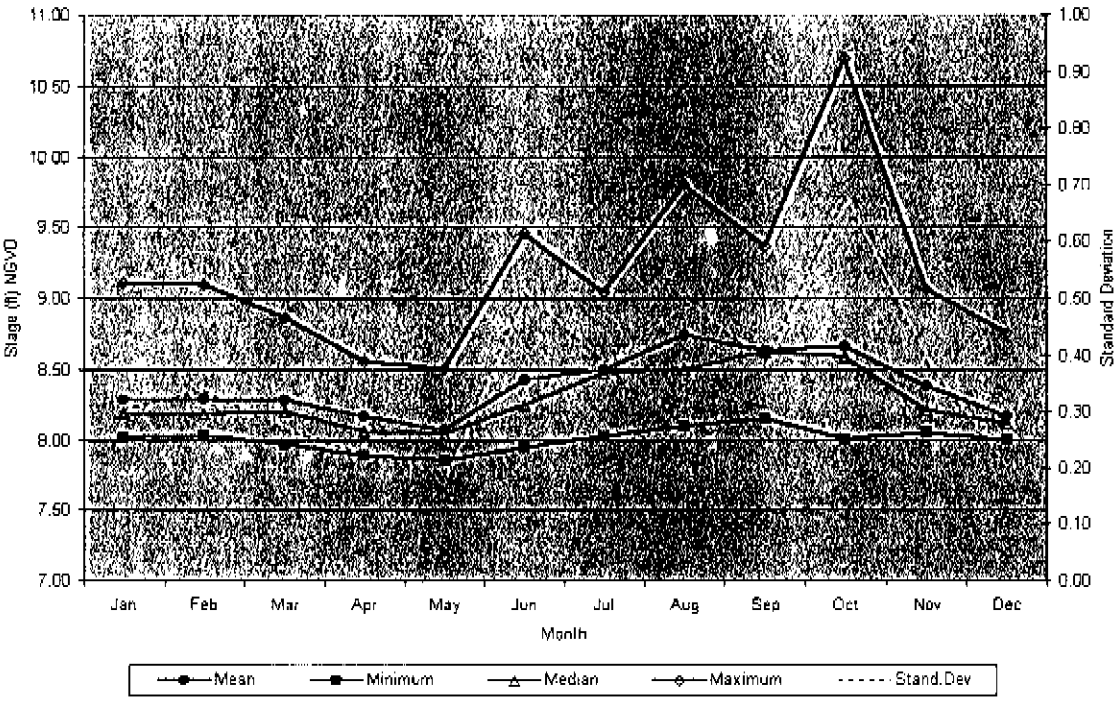


Figure 38. Monthly statistics for mean daily tailwater stage at S-97 (Period: 03/01/86-03/31/99)

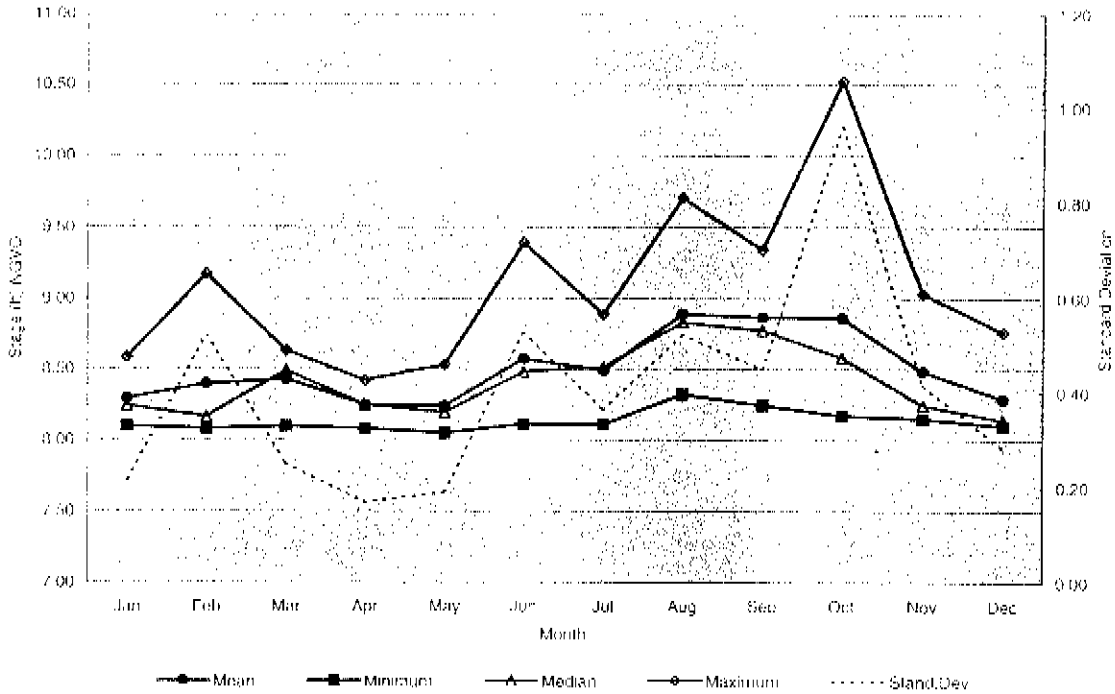


Figure 39. Monthly statistics for mean daily headwater stage at S-48 (Period: 05/01/94-03/31/99)

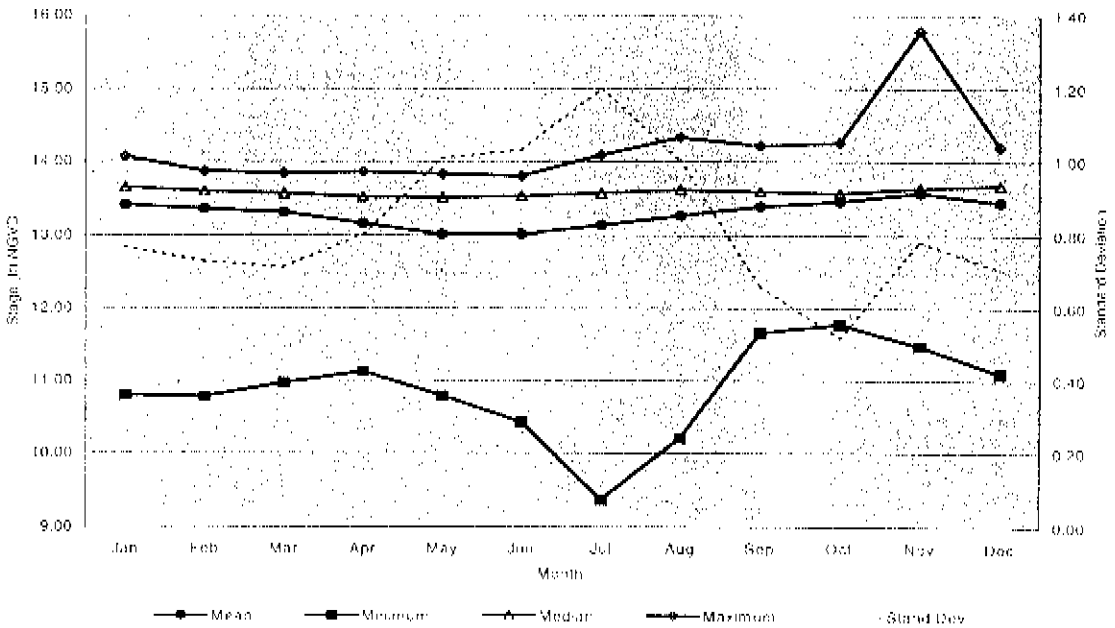


Figure 40. Monthly statistics for mean daily headwater stage at S-135 (Period: 01/01/79-03/31/99)

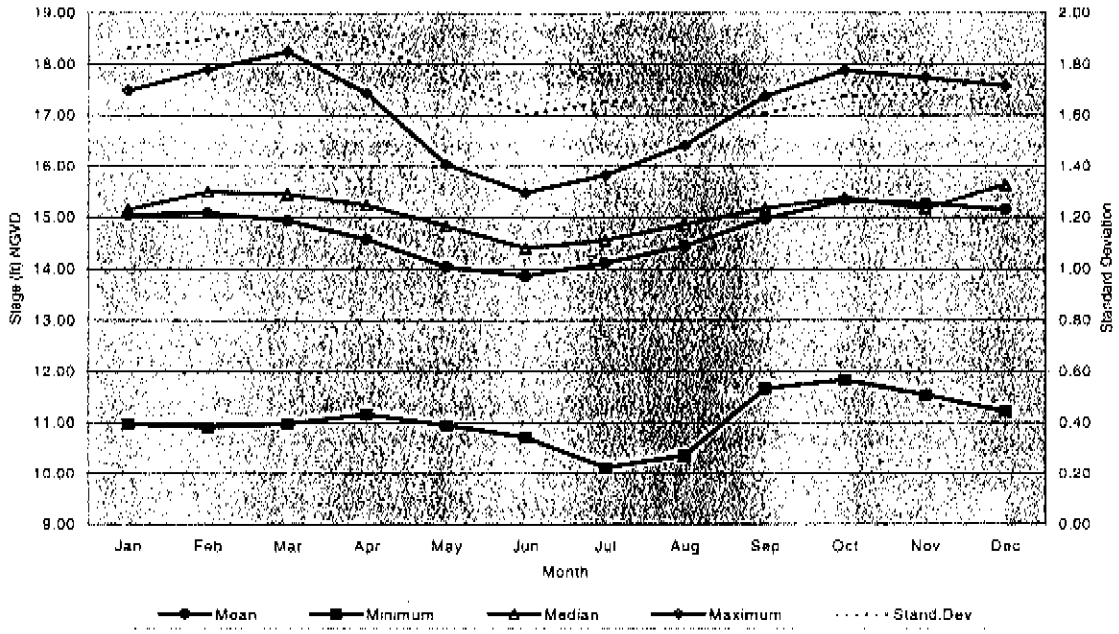


Figure 41. Monthly statistics for mean daily tailwater stage at S-135 (Period: 01/01/79-03/31/99)

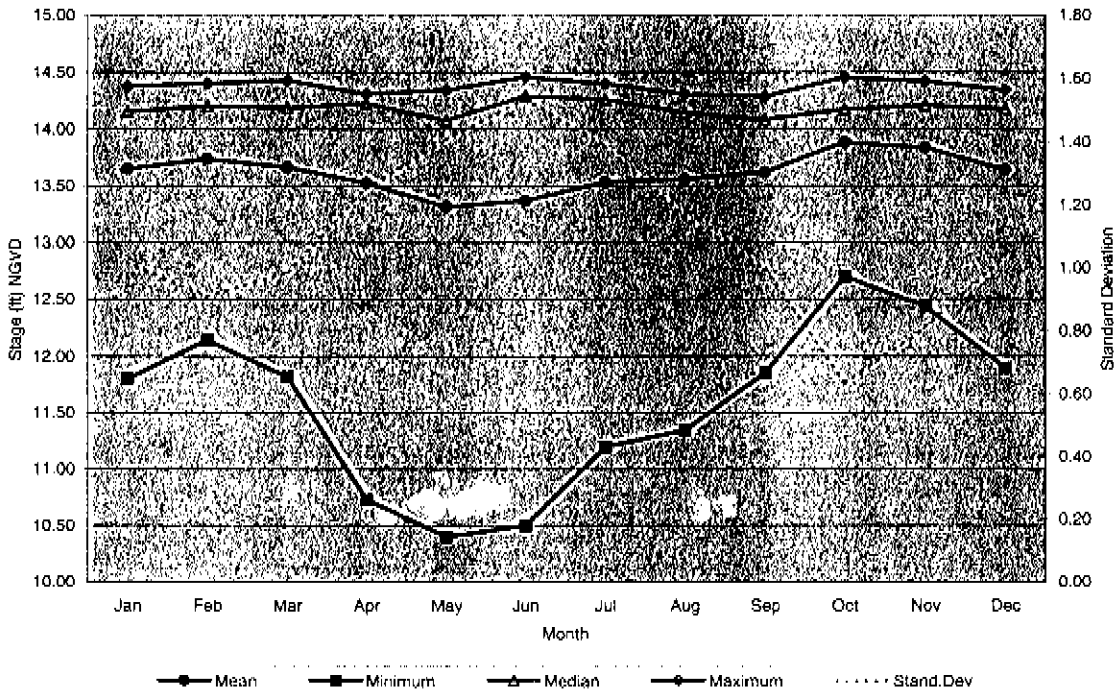


Figure 42. Monthly statistics for mean daily headwater stage at S-80 (Period: 10/01/87-09/30/95)

- For S-153, backflow from C-44 to L-65 has been fully controlled during the period of record. The closest the tailwater (located in St. Lucie Canal) rose was 1.01 feet (03/24/98) within the headwater, which is beyond the operational limit of 0.2 feet.

- For S-97, with a mean monthly of 21.05 feet for the headwater stage, the structure has been mostly operated in low range conditions during the period of record.

- For S-48, maintaining headwater stage greater than 8 feet in the lower reach of C-23 has been achieved during the period of record as dictated by operating criteria in order to prevent saltwater intrusion.

- For S-135, with a mean monthly of 14.67 feet for the tailwater stage, gravity discharge through the spillway does not happen most of the time, only a few days during the year.

4. SUMMARY

This report presented a summary of hydrometeorologic data such as: rainfall, evaporation, stage and flow data for Martin County. A methodology has been presented in order to fill missing data in the District database. The resulted data has been presented in graphical (daily historical, monthly statistics) and tabular formats for a better understanding of the results.

There are many rainfall stations located in Martin County. However, most of them are inactive, only seven have records for more than 20 years and are not equally distributed in the County. Wet and dry seasons have been depicted; June and October mark respectively the beginning and the end of the wet season. The wet season (32.8 inches, from June to October) accounted for 62 percent of the whole year precipitation (52.8 inches). Long drought periods have been also depicted during the seventy-year period of record (1929-1998). The driest year was 1981 with 35.0 inches, while 1994 was the wettest year for the County with 78.9 inches.

Two sites have been selected out of nine for pan evaporation data. The periods of record were relatively short (14 to 15 years). Around 70 percent of evaporation occurred during the period of March to September, with mean maxima reached during the month of May and varying from 6.43 to 6.84 inches.

Flow and stage data have been presented for the major structures located in the County. A schematic plot for the hydrologic system has been presented for the St. Lucie Canal, C44, for better understanding. Negative flows have been verified with both stage and flow data. Net flow (Outflow - Inflow) has been plotted against rainfall and poor relationship has been found due to important losses (evaporation, infiltration, and diversions) in the canal.

In terms of operation of the system, it is observed that a good control at the headwater in S-153 of the upstream stages in the L-65 Borrow Canal was maintained as designed; however, the optimum operation headwater elevation of 18.8 feet was not possible. At the tailwater of S-153 located in St. Lucie Canal, C-44, backflow from C-44 to L-65 has been fully controlled during the period of record (01/01/83-03/31/99). Headwater stage at S-97 has been mostly operated in low range conditions during the period of record (03/01/86-03/31/99). Maintaining headwater stage at S-48 greater than 8 feet in the lower reach of C-23 has been achieved during the period of record (05/01/94-03/31/99) as dictated by operating criteria in order to prevent saltwater intrusion. Gravity discharge through the spillway of S-135 occasionally happened during a few days of the year.

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APPENDICES

APPENDIX A

Historical Daily Rainfall Data

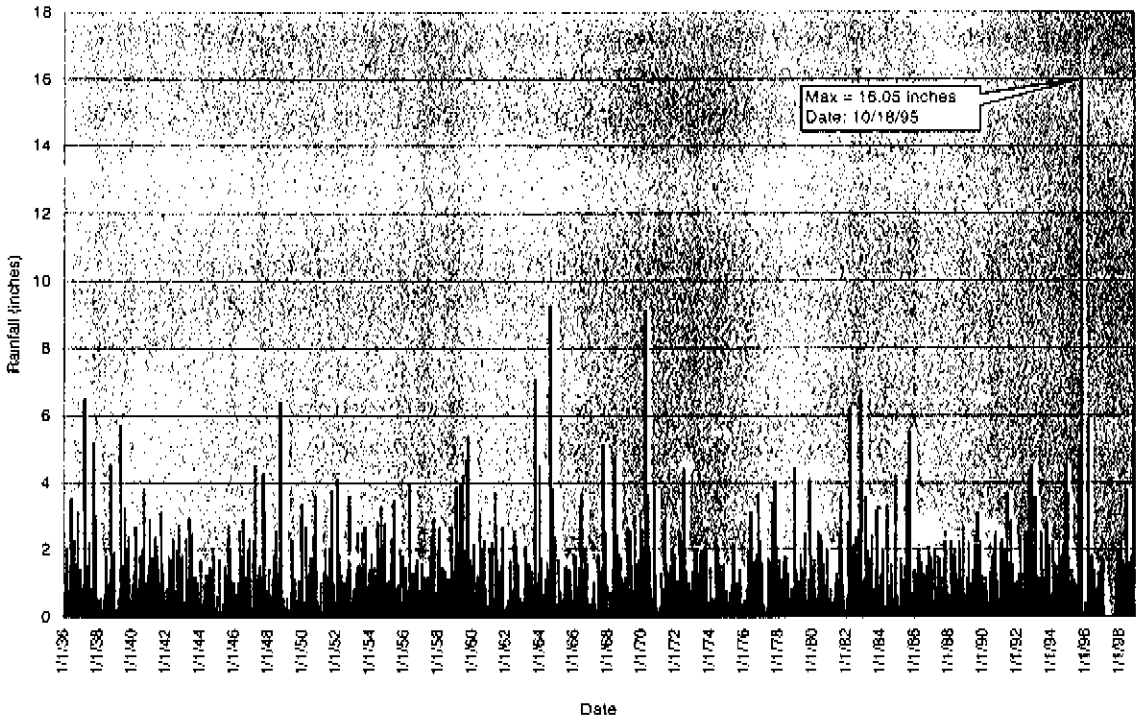

Figure A1. Daily historical rainfall at station STUART1_R

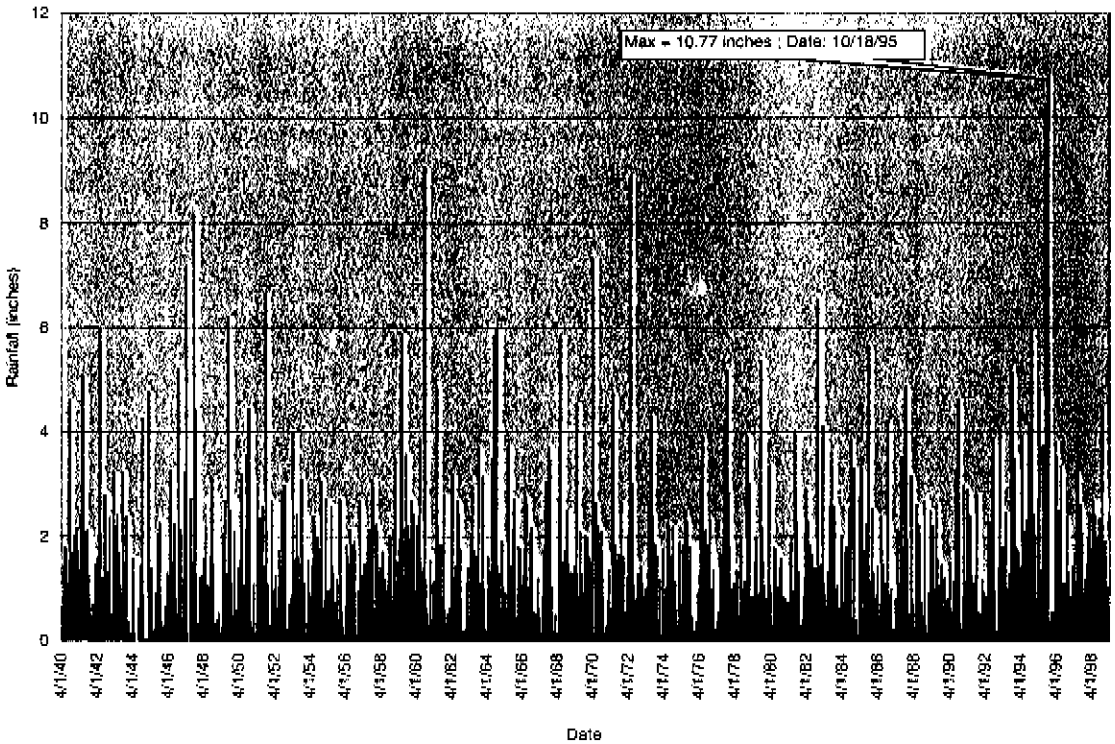

Figure A2. Daily historical rainfall at station S80_R

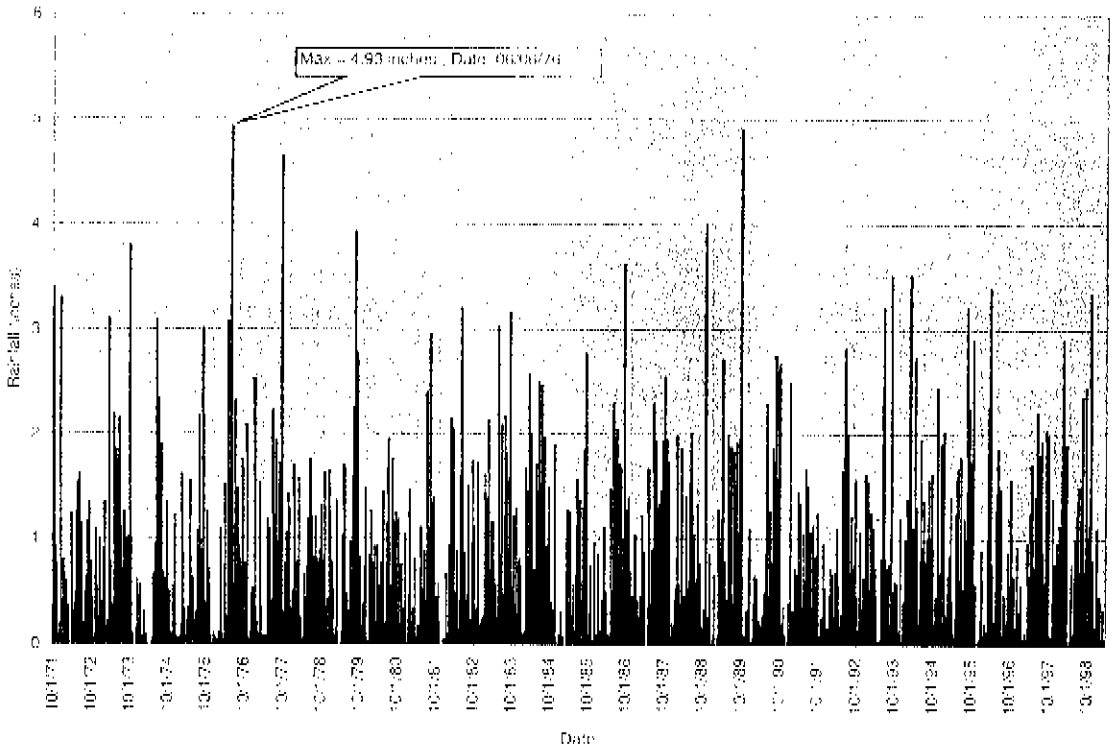

Figure A3. Daily historical rainfall at station S135_R

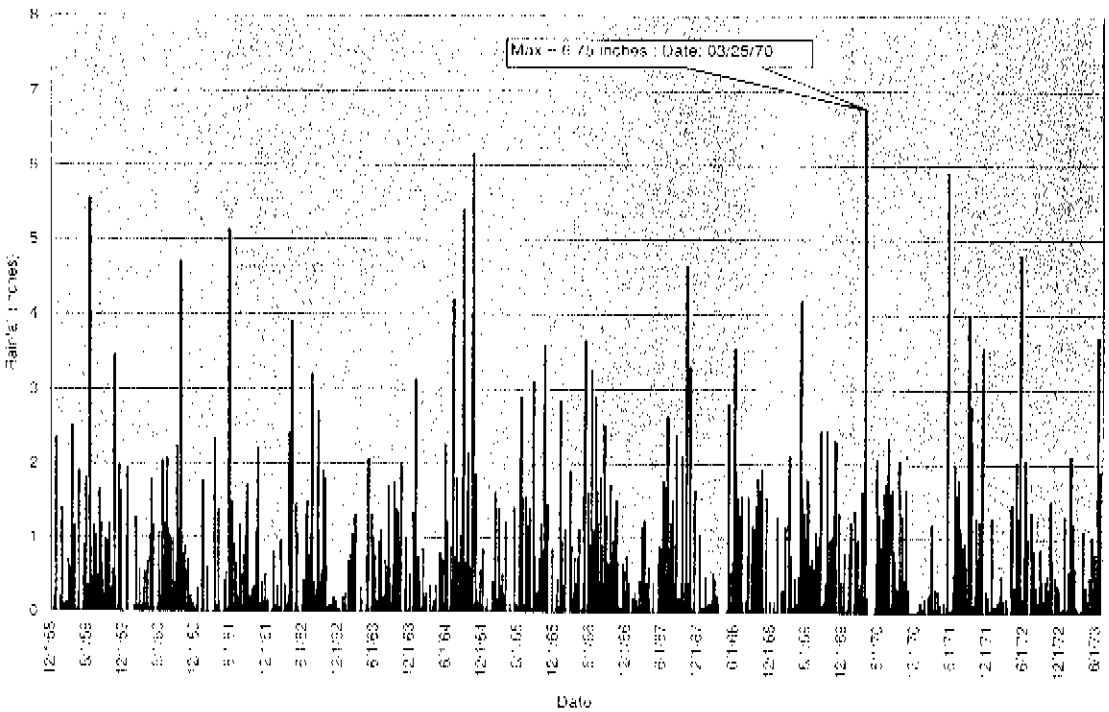

Figure A4. Daily historical rainfall at station MONREV5_R

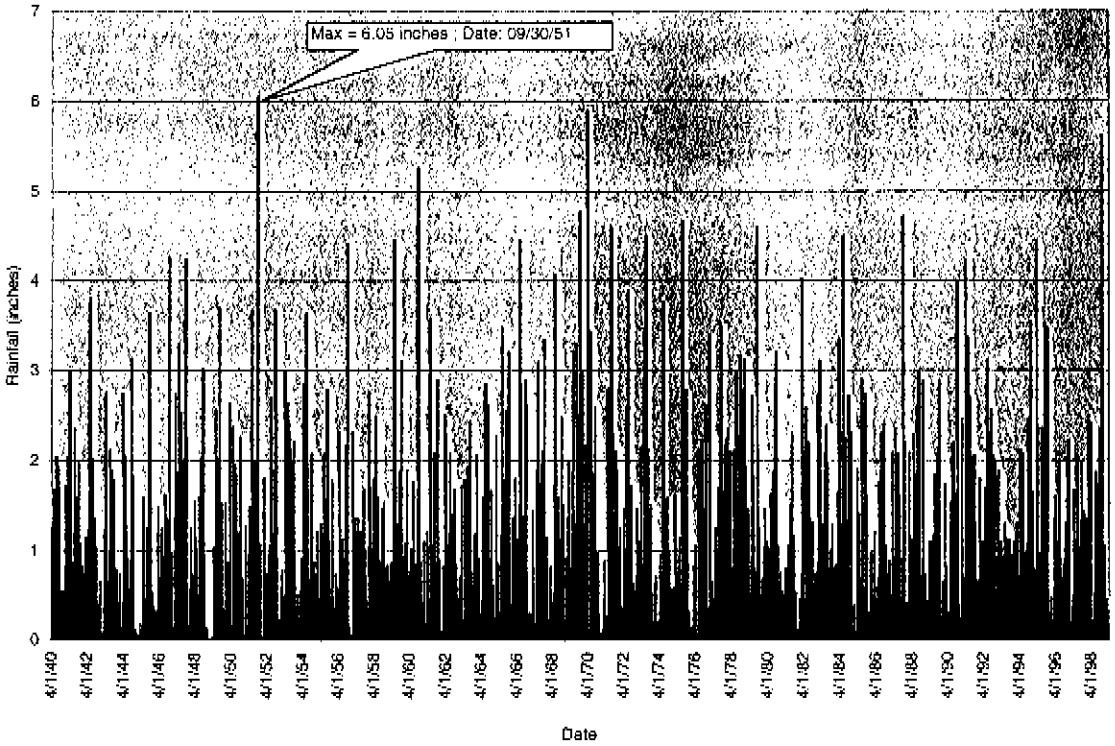

Figure A5. Daily historical rainfall at station S308_R

APPENDIX B

Monthly and Annual Rainfall Statistics

Table B1. Monthly and annual rainfall (inches) at station STUART1_R

Year	Month												Year
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1936	1.87	4.58	4.15	2.12	5.60	7.26	5.48	4.23	6.39	8.70	4.78	4.56	59.72
1937	1.65	1.88	5.65	8.27	2.94	4.88	3.97	2.99	9.42	18.81	5.92	1.06	67.44
1938	1.00	1.32	0.38	0.08	1.94	7.64	5.64	0.61	6.66	11.14	3.03	2.06	41.50
1939	0.34	0.17	1.33	5.16	8.99	4.50	4.94	12.06	7.19	11.04	0.89	1.67	58.28
1940	2.20	3.48	6.85	1.20	2.50	5.59	3.40	7.56	16.40	3.31	0.15	6.34	58.98
1941	6.27	5.47	2.50	6.38	4.87	9.72	8.56	1.66	9.51	4.71	3.44	1.70	64.79
1942	2.42	3.32	5.50	1.83	6.93	12.82	2.04	4.67	9.42	5.56	0.78	3.25	58.54
1943	0.49	0.67	4.34	1.91	7.05	5.56	8.93	3.66	7.91	2.40	3.25	0.80	46.97
1944	2.31	0.25	0.53	2.18	2.69	4.18	9.80	4.07	8.17	10.11	0.51	0.88	45.68
1945	--	2.00	0.02	0.71	--	6.05	8.34	--	12.84	7.33	2.77	2.12	**
1946	2.64	1.45	1.73	0.00	0.19	6.51	8.51	5.42	4.18	2.17	5.86	1.84	49.50
1947	1.29	2.44	3.02	6.62	3.13	9.03	9.11	4.73	17.24	11.85	3.44	1.27	73.17
1948	3.50	0.83	1.87	4.86	3.38	3.29	5.09	4.33	14.86	4.12	1.16	1.30	48.59
1949	--	0.87	0.42	0.45	4.07	9.40	4.56	--	--	5.84	1.05	8.67	**
1950	0.49	0.97	3.70	--	3.08	3.36	4.52	6.74	7.21	8.33	1.19	0.58	**
1951	0.55	2.11	0.28	3.65	5.04	3.73	5.20	8.27	4.97	10.57	2.36	1.23	47.96
1952	1.29	6.62	4.04	1.51	2.30	2.86	--	6.39	5.10	17.36	0.58	0.62	**
1953	1.97	2.80	4.31	3.92	1.94	8.66	10.77	6.63	14.51	--	2.14	5.00	**
1954	0.33	3.31	4.37	4.01	6.77	10.38	7.80	8.88	12.27	6.75	4.20	1.01	70.08
1955	2.49	1.93	2.29	5.25	3.51	9.61	3.08	4.06	2.18	5.09	0.17	3.86	43.52
1956	2.17	2.60	1.15	2.75	5.17	2.60	6.55	4.43	5.12	5.66	0.63	1.85	40.68
1957	1.77	4.02	3.43	5.77	5.78	4.76	8.42	7.97	6.14	8.70	1.53	3.67	61.96
1958	10.66	0.69	5.58	2.62	8.35	3.04	4.34	3.30	5.04	9.19	2.30	5.52	60.63
1959	5.14	0.55	8.65	6.30	4.35	11.46	6.86	9.42	13.24	11.86	6.64	3.31	87.78
1960	0.23	4.58	1.74	5.47	1.73	7.71	11.53	4.60	18.45	2.12	1.68	1.06	60.90
1961	4.46	0.76	4.98	1.63	11.02	4.33	1.13	6.32	2.39	4.80	1.80	0.14	43.76
1962	1.39	0.77	3.53	2.56	1.44	8.18	13.12	11.91	6.18	0.89	1.42	0.20	51.59
1963	0.90	4.59	1.54	0.82	2.73	6.10	2.17	2.51	10.05	10.36	2.80	10.06	54.63
1964	2.25	3.95	1.37	2.84	3.85	4.40	6.58	15.11	5.18	11.81	2.38	2.51	62.23
1965	0.61	4.28	2.27	1.10	0.65	7.13	7.69	2.62	5.36	6.47	1.62	0.77	40.57
1966	6.36	3.86	3.37	4.12	3.69	15.48	3.70	5.66	8.11	6.91	1.20	1.27	63.73
1967	1.09	1.86	2.56	0.11	0.33	9.90	7.66	7.99	4.95	9.25	2.84	1.11	49.65
1968	0.52	2.22	0.93	1.78	8.38	13.72	8.29	6.15	6.57	6.39	2.65	0.12	57.72
1969	2.02	1.28	5.52	1.17	7.12	3.31	3.45	8.54	6.79	6.82	2.41	3.45	51.88
1970	4.94	4.56	18.12	0.00	5.31	7.59	2.40	1.50	8.12	9.37	0.40	0.28	62.59
1971	0.46	2.33	1.68	1.98	6.75	4.14	7.01	2.87	8.44	5.43	4.21	4.72	50.02
1972	1.67	1.85	3.68	6.45	7.37	11.12	11.14	3.30	3.60	2.49	4.61	2.63	59.91
1973	4.51	6.03	2.07	0.89	4.30	7.92	5.56	6.94	6.82	6.87	0.91	1.48	54.30
1974	1.87	0.80	1.40	1.36	3.47	8.25	12.44	5.06	3.59	4.40	3.22	2.04	47.90
1975	0.16	1.53	1.59	1.46	8.82	7.48	4.55	1.97	6.04	3.04	0.90	1.30	38.84
1976	0.46	2.63	0.03	2.57	9.17	6.68	3.15	[illegible]	6.53	2.82	4.08	5.94	48.98
1977	3.52	0.68	0.59	0.21	3.37	3.56	5.49	3.96	12.40	6.99	3.65	4.46	48.88
1978	3.10	2.19	2.28	2.61	4.99	3.92	6.14	3.42	3.22	4.25	3.08	7.23	46.43
1979	7.03	0.66	1.05	4.08	6.38	3.84	3.07	5.36	--	2.70	5.42	1.95	**
1980	3.42	3.30	1.41	1.42	5.01	5.17	--	3.26	4.71	2.47	4.20	0.30	**
1981	0.67	1.82	0.65	0.71	4.21	1.89	2.72	8.72	10.86	3.39	1.93	0.45	38.02
1982	0.81	7.28	13.01	3.56	13.50	9.07	8.74	5.17	6.63	2.41	12.71	2.35	85.24
1983	3.83	13.47	5.72	2.85	2.32	6.79	6.89	--	6.73	12.69	2.20	5.49	**

Table B1. Continued

Year	Month												Year Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1984	0.88	5.77		1.07	11.13	4.80	3.98	4.39	--	1.65	11.01	0.42	**
1985	1.54	0.16	5.01	5.94	0.67	5.95	12.23	6.36	12.55	1.18	2.45	3.98	61.02
1986	4.90	1.99	9.17	1.28	4.58	5.86	6.71	7.39	2.97	7.39	2.03	6.41	60.68
1987	2.95	1.67	6.42	0.83	3.33	4.95	5.78	1.88	6.95	7.87	1.65	0.40	42.68
1988	2.70	3.39	4.41	2.78	5.08	1.12	6.98	10.72	1.55	4.84	3.45	1.35	51.37
1989	1.74	0.32	4.07	3.83	4.37	2.85	7.40	6.03	6.32	7.01	0.81	3.11	47.86
1990	2.45	2.21	2.66	0.66	3.77	4.98	10.22	8.35	15.01	3.58	1.99	0.66	56.54
1991	6.83	5.83	6.37	7.92	7.68	10.22	7.17	7.34	6.87	4.56	0.87	1.76	73.42
1992	1.15	2.70	4.16	2.98	2.14	16.80	3.95	15.21	6.29	6.26	10.71	0.53	72.88
1993	11.44	2.27	6.15	3.22	6.49	5.92	2.77	4.20	10.54	17.95	9.16	3.28	83.39
1994	5.31	6.81	4.84	6.89	4.73	9.62	8.56	11.48	13.80	9.35	10.17	8.37	99.93
1995	2.56	2.25	3.48	3.49	2.27	6.15	3.47	14.71	3.81	24.48	0.24		**
1996	1.02	0.34	11.84	2.60	8.15	4.05	4.42	2.62	3.81	6.91	1.63	2.44	49.86
1997	3.85	--	--	--	-			-	--	1.54	5.44	2.82	**
1998	5.11	10.13	5.99	4.06	5.32	4.88	6.05	10.24	9.55	2.52	7.40	--	**

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	P.O.R.*
Mean	2.68	2.86	3.80	2.90	5.00	6.71	6.34	6.12	7.93	7.03	3.22	2.64	57.02
Stand. Dev	2.37	2.46	3.28	2.13	2.77	3.20	2.85	3.40	3.99	4.57	2.81	2.32	13.14
Minimum	0.16	0.16	0.02	0.00	0.33	1.89	1.13	0.61	1.55	0.89	0.15	0.12	38.02
Median	2.02	2.22	3.43	2.60	4.58	6.00	6.10	5.36	6.79	6.43	2.41	1.85	54.63
Maximum	11.44	13.47	18.12	8.27	13.50	16.80	13.12	15.21	18.45	24.48	12.71	10.06	99.93

* : indicates period of records for station and excludes partial year results

** : indicates partial year

-- : indicates no data available or large gaps of missing data

Table B2. Monthly and annual rainfall (inches) at station S80_R

Year	Month												Year Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1940	--	--	--	0.96	3.73	6.26	5.12	6.66	13.51	4.02	0.15	4.58	**
1941	6.11	4.49	2.81	7.05	3.22	15.82	8.25	5.88	7.91	3.79	2.04	0.96	68.33
1942	1.36	3.22	3.70	3.00	5.26	11.53	2.09	2.91	12.16	2.70	1.58	3.15	52.66
1943	0.75	1.12	6.15	3.06	5.99	4.75	4.61	2.43	9.16	2.95	4.78	0.18	45.93
1944	0.84	0.22	0.92	4.81	--	--	--	4.49	4.55	13.09	0.61	0.02	**
1945	--	4.94	0.00	2.54	0.47	--	4.47	--	--	4.37	--	1.21	**
1946	1.83	0.81	1.69	0.17	12.19	4.90	10.36	6.63	--	1.03	7.80	5.64	**
1947	0.50	2.75	10.98	8.25	--	--	11.86	5.95	22.67	11.79	0.74	0.87	**
1948	3.03	0.17	1.89	4.47	4.70	3.31	3.32	5.94	15.50	2.71	0.44	0.67	46.15
1949	0.47	0.95	0.22	1.07	5.20	8.89	4.40	12.98	6.76	3.42	0.92	7.04	52.32
1950	1.24	0.55	3.31	2.76	5.78	3.81	3.22	7.21	7.58	13.77	1.46	0.96	51.65
1951	0.41	2.06	0.58	6.26	6.20	4.75	7.54	4.86	2.33	12.90	1.69	0.69	50.27
1952	1.40	6.27	3.64	1.84	1.74	2.74	6.42	5.95	5.86	11.63	0.12	0.43	48.04
1953	2.18	2.18	2.50	4.88	0.27	11.26	10.29	5.89	11.11	9.60	1.62	2.38	64.16
1954	0.46	2.73	2.69	3.39	6.18	10.08	6.25	7.67	10.91	4.76	3.43	1.03	59.58
1955	1.29	3.36	1.29	2.98	1.99	10.66	3.87	3.77	2.54	3.15	0.02	5.67	40.59
1956	1.00	0.54	0.23	2.72	3.07	5.87	4.65	6.61	4.64	5.73	0.22	2.58	37.86
1957	2.76	3.12	3.17	5.07	5.06	5.17	9.67	10.24	4.55	9.29	1.10	3.81	63.01
1958	9.02	0.69	4.93	2.82	7.17	3.64	4.66	2.63	6.43	7.42	1.50	5.93	56.84
1959	4.34	0.31	7.26	4.48	9.80	12.69	5.65	7.13	9.10	8.23	5.42	3.88	78.29
1960	0.25	5.41	1.66	7.36	4.85	10.07	8.68	4.88	19.42	3.79	1.19	0.48	68.04
1961	3.97	0.64	1.28	1.77	9.50	3.82	1.39	6.97	1.55	4.88	1.64	0.02	37.43
1962	0.98	0.64	3.20	5.30	2.10	7.82	8.90	12.78	9.49	0.76	0.81	0.08	52.86
1963	0.77	4.08	1.36	0.23	4.74	6.43	3.51	3.26	8.82	5.70	2.88	8.11	49.89
1964	2.03	2.53	0.23	2.63	3.42	4.15	7.38	12.79	4.89	11.48	1.18	1.62	54.33
1965	0.82	4.79	1.92	1.26	0.36	9.04	3.34	4.21	6.13	8.16	0.52	0.68	41.23
1966	7.00	4.57	2.53	4.31	3.66	15.08	4.01	4.17	7.64	9.05	2.41	1.19	65.62
1967	1.28	3.45	1.74	0.07	1.30	7.95	5.09	9.74	5.89	14.78	1.10	1.24	53.63
1968	0.33	1.97	0.43	0.25	8.44	15.10	7.15	7.76	7.59	9.45	2.36	0.00	60.83
1969	1.64	1.45	4.74	1.29	13.19	2.59	5.06	4.83	4.50	9.83	2.14	2.33	53.59
1970	5.39	4.11	13.13	0.00	4.57	9.27	4.06	4.39	7.88	5.91	0.00	0.11	58.82
1971	0.47	3.69	1.66	0.19	10.19	3.86	8.89	5.74	7.19	5.09	4.76	2.37	54.10
1972	0.59	2.51	3.11	5.38	14.31	14.16	5.81	3.07	3.03	3.56	3.26	2.26	61.05
1973	2.58	1.99	1.49	1.34	3.48	6.36	11.26	8.29	9.02	5.19	2.19	1.17	54.36
1974	2.16	0.12	2.27	0.93	3.53	10.98	12.26	3.31	4.91	5.43	3.19	1.21	50.30
1975	0.39	2.43	1.01	0.83	8.70	9.28	8.42	2.51	8.73	3.20	1.58	0.57	47.65
1976	0.31	2.65	0.03	2.09	15.01	8.03	4.97	9.22	6.25	1.43	3.64	2.91	56.54
1977	2.74	0.23	0.21	1.29	1.10	6.14	6.74	5.29	9.56	8.70	4.17	4.43	50.60
1978	1.92	1.67	1.82	1.74	3.43	--	6.96	2.31	3.92	4.71	3.08	10.72	**
1979	5.79	0.25	0.97	3.63	8.73	3.25	2.46	2.55	17.12	2.70	3.26	1.63	52.34
1980	1.83	4.31	2.06	1.30	4.84	3.77	6.88	2.74	2.90	4.38	2.59	2.39	39.99
1981	0.61	1.98	1.02	0.28	4.52	2.09	4.74	15.73	5.75	2.57	0.99	0.57	40.85
1982	0.89	2.63	11.46	4.50	12.28	12.01	10.06	5.93	5.63	2.95	12.53	2.22	83.09
1983	4.26	--	4.12	2.76	0.65	6.47	8.93	14.14	6.78	11.20	3.67	3.99	**
1984	0.90	2.09	5.61	1.69	3.63	4.40	5.21	4.94	10.69	1.30	6.62	0.02	47.10
1985	0.95	0.06	4.74	8.39	0.49	4.00	6.78	5.37	10.29	--	1.28	3.45	**
1986	5.72	1.30	4.20	0.04	2.08	14.53	3.99	4.37	1.62	7.35	1.77	2.98	49.95
1987	1.22	0.46	1.26	0.08	3.24	2.79	8.21	3.74	6.17	6.69	7.82	0.03	41.71
1988	2.25	4.23	2.10	--	3.30	3.06	10.30	2.76	1.54	0.42	3.65	--	**

Table B2. Continued

Year	Month												Year
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1989	1.35	0.52	5.82	6.88	1.68	1.77	8.46	7.80	3.96	7.12	0.78	3.14	48.78
1990	1.96	2.31	1.31	3.13	1.82	3.69	3.96	10.45	10.55	5.67	1.39	0.44	46.68
1991	5.60	3.41	1.75	7.12	5.59	7.34	5.47	6.97	4.45	6.06	1.67	1.08	59.41
1992	0.49	3.49	1.80	2.30	0.93	11.05	4.00	14.52	10.43	3.41	0.00	0.76	56.18
1993	7.90	3.40	8.85	3.20	6.78	4.44	2.97	4.43	11.95	11.68	3.90	0.45	69.95
1994	4.20	5.97	2.01	8.95	3.76	7.67	9.51	12.25	13.11	7.24	13.36	7.26	95.32
1995	2.98	2.12	3.79	8.44	2.65	10.11	5.93	22.64	6.70	19.97	0.31	1.23	86.87
1996	1.65	0.57	13.91	1.73	10.57	5.03	5.50	5.43	4.75	5.85	2.77	1.89	59.65
1997	3.39	2.58	2.46	5.54	3.44	7.17	2.50	9.75	6.75	0.82	4.67	4.78	53.85
1998	4.45	10.57	5.80	3.86	1.56	3.37	5.78	10.44	16.37	1.87	7.84	2.33	73.74
1999	3.39	1.39	0.92	--	--	--	--		.	--	--	--	**

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	P.O.R.*
Mean	2.35	2.47	3.23	3.18	5.03	7.22	6.24	6.87	7.92	6.52	2.73	2.31	55.84
Stand. Dev	2.09	1.95	3.14	2.48	3.70	3.90	2.65	4.00	4.42	4.10	2.77	2.30	12.35
Minimum	0.25	0.06	0.00	0.00	0.27	1.77	1.39	2.31	1.54	0.42	0.00	0.00	37.43
Median	1.65	2.25	2.10	2.76	3.76	6.36	5.58	5.91	6.78	5.56	1.73	1.13	53.61
Maximum	9.02	10.57	13.91	8.95	15.01	15.82	12.26	22.64	22.67	19.97	13.36	10.72	95.32

* : indicates period of records for station and excludes partial year results

** : indicates partial year

-- : indicates no data available or large gaps of missing data

Table B3. Monthly and annual rainfall (inches) at station S135_R

Year	Month												Year
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1971	--	--	--	--	--	--	--	--	--	7.53	3.07	4.03	**
1972	2.98	1.17	0.36	2.48	4.51	8.10	2.67	3.18	3.58	1.64	3.45	1.49	35.61
1973	2.71	2.05	4.46	1.17	6.45	3.67	9.78	5.76	4.36	8.90	0.10	1.26	50.67
1974	1.07	0.33	0.10	--	2.09	9.96	11.85	7.14	3.93	1.93	1.32	1.67	**
1975	0.22	2.39	1.45	0.84	5.13	1.88	2.83	5.21	9.85	3.08	1.59	0.20	34.67
1976	0.17	2.70	0.10	2.34	9.81	10.49	5.20	5.00	6.18	1.26	2.48	1.83	47.56
1977	3.49	1.96	0.58	0.19	2.28	4.58	4.72	7.82	9.31	2.13	3.77	2.95	43.78
1978	3.32	1.72	2.80	0.97	1.45	8.12	5.07	5.26	4.18	5.22	2.00	4.26	44.37
1979	4.28	0.22	2.42	0.60	8.23	1.37	3.25	9.08	17.35	1.42	1.53	1.72	51.47
1980	2.94	1.81	2.61	2.39	6.13	1.79	8.85	4.53	7.22	1.54	2.53	1.80	44.14
1981	0.77	2.13	1.30	0.23	1.87	3.83	5.01	10.54	7.53	0.81	0.92	0.07	35.01
1982	0.71	2.48	7.95	2.05	3.87	9.79	3.95	5.07	4.97	2.40	3.20	0.70	47.14
1983	3.99	8.48	5.25	3.18	1.63	8.10	5.04	7.51	7.19	3.99	2.72	3.43	60.51
1984	0.71	3.71	3.95	3.06	4.36	5.77	9.33	3.33	7.72	0.61	4.10	0.08	46.73
1985	0.45	0.19	2.12	2.32	0.99	5.53	7.41	3.02	10.33	1.59	0.51	1.94	36.40
1986	2.75	0.69	3.70	0.19	2.15	12.09	7.40	8.05	7.70	3.39	1.63	3.27	53.01
1987	2.55	1.57	3.64	0.00	4.54	4.82	7.32	2.74	6.12	5.29	6.77	0.28	45.64
1988	1.95	2.84	3.05	2.72	1.24	8.45	4.55	4.91	1.62	0.79	4.65	0.92	37.69
1989	1.02	0.07	3.13	7.05	1.41	6.05	4.65	11.45	6.90	7.35	0.57	2.32	51.97
1990	0.60	2.16	0.53	0.92	2.00	5.23	6.77	8.09	8.44	3.52	0.71	0.52	39.49
1991	3.35	1.30	2.21	5.63	2.40	--	8.99	3.74	4.18	3.51	1.62	1.17	**
1992	0.76	3.13	1.43	2.84	0.58	15.62	8.16	5.69	4.56	2.50	3.61	0.71	49.59
1993	8.72	3.13	5.52	1.21	0.93	8.19	3.27	1.75	7.34	3.41	1.91	0.60	45.98
1994	3.25	5.08	5.85	6.74	2.29	5.98	4.01	8.04	6.00	2.55	4.22	4.75	58.76
1995	2.97	1.44	3.07	0.98	5.95	6.32	5.48	11.56	7.97	9.24	0.57	0.34	55.89
1996	1.99	0.33	8.13	1.45	6.28	6.85	2.54	2.21	3.15	5.24	0.96	1.67	40.80
1997	1.20	0.19	2.85	6.45	4.75	6.75	7.45	3.11	8.85	0.30	2.90	3.94	48.74
1998	2.42	7.65	5.53	0.94	1.42	4.97	3.63	7.37	7.06	1.84	7.49	0.50	50.82
1999	2.07	0.60	0.40	--	--	--	--	--	--	--	--	--	**

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	P.O.R.*
Mean	2.26	2.20	3.02	2.27	3.51	6.70	5.90	5.97	6.80	3.32	2.53	1.73	46.26
Stand. Dev	1.76	2.05	2.22	2.06	2.44	3.25	2.49	2.77	3.03	2.48	1.81	1.39	7.23
Minimum	0.17	0.07	0.10	0.00	0.58	1.37	2.54	1.75	1.62	0.30	0.10	0.07	34.67
Median	2.25	1.89	2.83	1.75	2.29	6.19	5.07	5.26	7.06	2.53	2.24	1.58	46.73
Maximum	8.72	8.48	8.13	7.05	9.81	15.62	11.85	11.56	17.35	9.24	7.49	4.75	60.51

* : indicates period of records for station and excludes partial year results

** : indicates partial year

-- : indicates no data available or large gaps of missing data

Table B4. Monthly and annual rainfall (inches) at station MONREV5_R

Year	Month												Year Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1958	--	--	--	--	--	--	--	--	--	--	--	2.55	**
1959	3.10	0.30	7.08	4.85	4.70	10.47	5.02	6.43	7.51	9.45	6.83	4.24	69.98
1960	0.12	3.71	1.11	6.09	3.94	7.97	8.25	4.72	19.50	3.75	1.03	0.42	60.61
1961	3.95	0.60	2.40	1.51	10.53	4.73	2.52	7.35	1.40	4.13	1.38	0.75	40.76
1962	1.49	1.00	4.50	6.25	2.99	6.81	10.15	11.55	9.53	0.35	0.60	0.25	55.47
1963	1.00	4.09	0.47	0.74	5.85	4.62	2.95	5.15	7.56	4.70	2.10	8.07	47.30
1964	1.54	2.10	0.50	2.10	4.35	4.86	10.04	11.12	7.31	13.80	1.16	1.08	59.96
1965	0.52	4.58	3.12	0.10	1.59	10.36	7.86	6.30	4.92	9.77	0.84	1.00	50.96
1966	6.98	4.66	1.96	4.25	6.03	17.22	7.11	5.97	7.46	7.67	2.02	1.56	72.89
1967	0.94	2.82	2.68	0.40	2.14	10.28	8.76	5.82	3.69	13.04	1.69	1.21	53.47
1968	0.58	1.57	0.44	0.03	5.98	17.29	4.67	5.74	8.29	8.94	1.87	0.16	55.56
1969	1.86	1.49	5.28	1.27	11.69	7.63	4.41	6.46	7.46	12.34	1.83	0.89	62.61
1970	4.08	3.67	13.79	0.37	4.03	7.62	8.97	4.79	7.46	3.52	0.00	0.15	58.45
1971	0.22	2.24	0.77	0.35	6.77	6.72	10.45	8.88	7.37	6.72	5.19	2.46	58.14
1972	0.68	1.70	3.13	6.81	7.95	10.83	4.89	2.73	1.94	3.62	2.27	1.50	47.55
1973	3.44	2.32	1.37	1.01	2.71	7.82	--	--		--	--	--	**

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	P.O.R.*
Mean	2.03	2.42	3.24	2.41	5.42	9.02	6.86	6.64	7.24	7.27	2.06	1.72	56.69
Stand. Dev	1.92	1.44	3.50	2.50	2.92	3.93	2.73	2.42	4.27	4.11	1.82	2.08	8.67
Minimum	0.12	0.30	0.44	0.03	1.59	4.62	2.52	2.73	1.40	0.35	0.00	0.15	40.76
Median	1.49	2.24	2.40	1.27	4.70	7.82	7.49	6.14	7.46	7.20	1.76	1.08	56.85
Maximum	6.98	4.66	13.79	6.81	11.69	17.29	10.45	11.55	19.50	13.80	6.83	8.07	72.89

* : indicates period of records for station and excludes partial year results

** : indicates partial year

-- : indicates no data available or large gaps of missing data

Table B5. Monthly and annual rainfall (inches) at station S308_R

Year	Month												Year Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1940	--	--	--	2.92	2.93	7.44	4.92	8.02	6.71	0.96	0.18	3.13	**
1941	4.00	4.41	3.73	9.07	1.89	3.09	10.81	4.42	8.30	5.09	2.53	2.97	60.31
1942	1.40	3.17	5.11	1.79	7.66	7.66	5.25	5.88	1.76	0.40	0.79	1.67	42.54
1943	0.06	0.40	2.12	3.10	1.32	6.91	8.30	5.15	6.78	1.39	2.07	0.19	37.79
1944	1.19	0.08	1.61	3.38	5.27	1.44	--	3.46	5.72	7.37	0.27	0.16	**
1945	--	0.23	0.00	0.69	1.75	--	6.58	--	11.52	6.59	1.47	1.34	**
1946	0.82	1.86	3.27	0.00	5.37	6.09	6.38	2.98	4.98	1.71	4.70	1.63	39.79
1947	0.15	2.16	9.00	2.53	5.82	5.90	8.02	5.74	14.29	10.35	0.21	0.90	65.07
1948	2.99	0.00	1.92	3.97	1.09	2.10	9.51	7.71	10.57	1.75	0.32	0.01	41.94
1949	0.00	0.00	0.04	1.61	1.64	10.09	4.64	10.89	6.76	3.04	0.84	2.79	42.34
1950	0.02	1.64	4.70	0.33	4.65	1.41	7.54	4.90	2.84	9.57	1.47	0.65	39.72
1951	0.00	1.75	0.68	4.72	1.59	10.58	6.78	7.13	6.66	8.45	1.79	0.05	50.18
1952	0.97	4.19	1.24	1.50	3.50	2.71	6.22	5.47	10.21	9.49	0.20	0.46	46.16
1953	1.38	1.59	1.43	3.26	1.25	13.58	9.93	10.22	7.51	6.69	0.98	1.02	58.84
1954	0.00	2.56	2.42	6.88	4.16	10.22	4.95	2.75	7.34	3.29	1.09	1.41	47.07
1955	1.64	0.58	1.48	3.08	1.58	10.04	7.77	7.67	5.86	1.95	0.12	3.02	44.79
1956	0.63	1.16	0.70	3.88	1.93	3.12	1.97	3.57	5.17	8.74	0.19	0.07	31.13
1957	2.42	2.47	3.52	4.81	4.46	2.12	4.87	4.39	7.71	2.43	0.74	5.69	45.63
1958	7.06	0.51	5.85	3.32	6.64	3.33	3.50	4.35	5.52	2.39	0.06	3.45	45.98
1959	1.18	0.32	4.36	1.64	8.88	9.16	6.45	3.42	7.19	6.33	2.42	1.39	52.74
1960	0.00	5.79	0.70	3.97	2.90	4.97	3.01	3.56	11.22	3.20	1.04	0.52	40.88
1961	1.73	0.31	1.98	1.41	4.45	1.95	3.61	5.91	1.15	4.66	1.19	0.03	28.38
1962	0.26	0.92	3.86	4.17	0.45	4.38	7.22	4.07	7.53	3.25	1.87	0.16	38.14
1963	0.86	3.85	0.64	1.37	3.99	7.40	5.34	5.43	3.12	1.31	2.15	5.62	41.08
1964	1.48	2.41	0.36	4.29	3.88	8.16	11.70	9.61	3.54	4.58	0.12	0.98	51.11
1965	0.21	3.99	1.95	0.19	1.40	10.68	7.73	8.77	3.96	10.26	0.12	1.00	50.26
1966	4.00	3.73	0.80	4.50	4.47	12.05	5.45	5.23	3.50	9.37	0.34	0.40	53.84
1967	0.88	3.19	1.06	0.05	3.44	11.79	6.30	8.03	8.41	6.09	0.16	1.53	50.93
1968	0.25	2.38	0.88	0.20	8.23	14.75	5.67	3.84	5.79	8.26	2.15	0.02	52.42
1969	1.51	2.02	6.53	1.54	5.43	8.08	4.69	5.87	8.67	11.15	1.78	3.38	60.65
1970	3.11	3.64	14.65	0.03	9.24	7.19	6.97	9.04	2.45	2.90	0.09	0.19	59.50
1971	0.19	2.22	0.90	0.17	6.12	3.23	9.11	5.69	4.25	9.25	2.41	2.13	45.67
1972	1.76	1.39	2.38	4.23	3.60	10.98	10.91	5.78	2.95	1.48	1.84	2.46	49.76
1973	1.69	1.83	3.15	0.87	3.86	8.70	11.54	6.57	2.34	4.93	0.10	1.43	47.01
1974	1.29	0.22	0.19	2.20	1.75	11.28	3.67	7.60	9.19	2.17	1.66	0.97	42.19
1975	0.92	2.23	1.93	0.27	4.84	--	13.48	3.56	6.33	3.77	0.57	0.34	**
1976	0.16	2.00	0.09	1.07	--	6.47	3.38	9.86	3.57	1.74	2.87	1.06	**
1977	4.53	0.66	1.24	0.73	2.71	2.06	7.33	8.38	11.67	2.84	5.33	4.56	52.04
1978	2.94	1.66	3.07	1.46	3.89	--	8.02	6.33	9.34	3.45	3.16	4.32	**
1979	6.75	0.14	2.36	1.51	5.55	3.54	3.27	3.64	14.90	2.88	2.12	1.44	48.10
1980	2.98	1.84	1.67	2.77	5.87	1.20	4.72	4.63	9.70	2.26	1.81	1.12	40.57
1981	0.94	1.16	1.00	0.10	2.04	0.98	4.05	9.72	4.23	0.90	0.92	0.17	26.21
1982	0.46	2.35	9.62	0.75	7.63	--	7.50	4.17	5.53	1.15	1.90	0.73	**
1983	--	9.83	4.42	3.41	2.78	6.45	2.66	3.80	--	6.25	1.73	2.68	**
1984	0.81	3.30	4.19	0.56	7.41	6.13	7.77	3.31	7.80	0.40	4.61	0.07	46.36
1985	0.54	0.12	2.20	3.07	1.74	6.74	--	0.55	6.16	2.74	0.00	1.66	**
1986	2.45	0.68	3.19	0.09	1.91	9.80	7.32	4.02	7.34	2.98	2.55	2.41	44.74
1987	1.64	1.10	3.44	1.02	2.71	5.59	4.64	1.21	2.82	6.70	5.93	0.03	36.83
1988	1.99	2.83	2.32	0.14	3.69	4.83	9.55	13.58	1.19	0.38	5.38	0.83	46.71

Table B5. Continued

Year	Month												Year Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1989	0.67	0.22	4.51	2.10	1.60	3.53	3.48	6.95	3.83	1.79	0.50	2.20	33.88
1990	1.91	1.67	0.75	--	4.63	4.71	5.96	8.08	6.07	7.01	0.45	0.25	**
1991	3.97	2.77	5.65	5.08	5.91	6.14	5.77	6.42	9.04	3.20	3.12	0.18	57.25
1992	2.62	2.94	1.40	3.37	0.91	13.35	6.15	10.80	5.13	2.34	3.38	0.80	53.19
1993	7.23	3.06	4.20	1.62	3.54	5.52	3.05	3.84	5.07	3.28	2.03	0.31	42.75
1994	3.60	2.83	2.28	6.98	3.82	4.76	4.60	6.62	8.42	4.25	6.69	6.67	61.52
1995	2.15	1.36	6.96	3.22	3.83	5.67	8.07	8.58	2.99	11.79	0.86	0.37	55.85
1996	1.05	0.38	6.21	1.17	5.04	6.69	2.92	1.60	3.70	4.59	1.61	2.85	37.31
1997	1.33	0.13	1.63	4.70	4.16	6.25	2.02	4.41	7.79	0.55	2.19	5.28	40.44
1998	1.32	6.75	4.95	0.09	0.68	6.63	5.18	7.19	8.17	0.79	7.62	1.49	51.16
1999	1.60	1.25	0.49							--	--	--	**

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	P.O.R.*
Mean	1.75	2.04	2.93	2.36	3.85	6.54	6.28	5.94	6.41	4.43	1.81	1.60	46.51
Stand. Dev	1.71	1.80	2.67	1.99	2.16	3.19	2.60	2.63	3.09	3.14	1.75	1.62	8.62
Minimum	0.00	0.00	0.00	0.00	0.45	0.98	1.97	0.55	1.15	0.38	0.00	0.01	26.21
Median	1.33	1.83	2.20	1.72	3.83	6.25	6.15	5.72	6.25	3.28	1.61	1.06	46.16
Maximum	7.23	9.83	14.65	9.07	9.24	14.75	13.48	13.58	14.90	11.79	7.62	6.67	65.07

* : indicates period of records for station and excludes partial year results

** : indicates partial year

-- : indicates no data available or large gaps of missing data

Table B6. Monthly and annual areal rainfall (inches) in Martin County

Year	Month												Year
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1936	1.87	4.58	4.15	2.12	5.60	7.26	5.48	4.23	6.39	8.70	4.78	4.56	59.72
1937	1.65	1.88	5.65	8.27	2.94	4.88	3.97	2.99	9.42	18.81	5.92	1.06	67.44
1938	1.00	1.32	0.38	0.08	1.94	7.64	5.64	0.61	6.66	11.14	3.03	2.06	41.50
1939	0.34	0.17	1.33	5.16	8.99	4.50	4.94	12.06	7.19	11.04	0.89	1.67	58.28
1940	2.20	3.48	6.85	1.69	3.05	6.43	4.48	7.41	12.21	2.76	0.16	4.68	55.41
1941	5.46	4.79	3.01	7.50	3.33	9.54	9.21	3.99	8.57	4.53	2.67	1.88	64.48
1942	1.73	3.24	4.77	2.21	6.62	10.67	3.13	4.49	7.78	2.89	1.05	2.69	51.25
1943	0.43	0.73	4.20	2.69	4.79	5.74	7.28	3.75	7.95	2.25	3.37	0.39	43.56
1944	1.45	0.18	1.02	3.46	3.98	2.81	9.80	4.01	6.15	10.19	0.46	0.35	43.86
1945	--	2.39	0.01	1.31	1.11	6.05	6.46	--	11.20	6.15	2.12	1.56	**
1946	1.76	1.37	2.23	0.06	8.92	5.83	8.42	5.01	3.54	1.64	6.12	3.04	47.94
1947	0.65	2.45	7.67	5.80	4.48	7.47	9.66	5.47	18.07	11.33	1.46	1.01	75.51
1948	3.17	0.33	1.89	4.43	3.06	2.90	5.97	5.99	13.64	2.86	0.64	0.66	45.56
1949	0.24	0.61	0.23	1.04	3.64	9.46	4.53	12.16	6.76	4.10	0.94	6.17	49.87
1950	0.63	1.05	3.90	1.31	4.50	2.86	5.09	6.28	5.88	10.56	1.37	0.73	44.17
1951	0.32	1.97	0.51	4.88	4.28	6.35	6.51	6.75	4.65	10.64	1.95	0.66	49.47
1952	1.22	5.69	2.97	1.62	2.51	2.77	6.32	5.94	7.06	12.83	0.30	0.50	49.73
1953	1.84	2.19	2.75	4.02	1.15	11.17	10.33	7.58	11.04	8.15	1.58	2.80	64.60
1954	0.26	2.87	3.16	4.76	5.70	10.23	6.33	6.43	10.17	4.93	2.91	1.15	58.91
1955	1.81	1.96	1.69	3.77	2.36	10.10	4.91	5.17	3.53	3.40	0.10	4.18	42.97
1956	1.27	1.43	0.69	3.12	3.39	3.86	4.39	4.87	4.98	6.71	0.35	1.50	36.56
1957	2.32	3.20	3.37	5.22	5.10	4.02	7.65	7.53	6.13	6.81	1.12	4.39	56.87
1958	8.91	0.63	5.45	2.92	7.39	3.34	4.17	3.43	5.66	6.33	1.29	4.49	54.01
1959	3.44	0.37	6.84	4.32	6.93	10.95	6.00	6.60	9.26	8.97	5.33	3.21	72.20
1960	0.15	4.87	1.30	5.72	3.36	7.68	7.87	4.44	17.15	3.22	1.24	0.62	57.61
1961	3.53	0.58	2.66	1.58	8.88	3.71	2.16	6.64	1.62	4.62	1.50	0.11	37.58
1962	1.03	0.83	3.77	4.57	1.75	6.80	9.85	10.08	8.18	1.31	1.18	0.17	49.52
1963	0.88	4.15	1.00	0.79	4.33	6.14	3.49	4.09	7.39	5.52	2.48	7.97	48.23
1964	1.83	2.75	0.62	2.97	3.88	5.39	8.93	12.16	5.23	10.42	1.21	1.55	56.91
1965	0.54	4.41	2.32	0.66	1.00	9.30	6.66	5.48	5.09	8.67	0.78	0.86	45.76
1966	6.09	4.21	2.17	4.30	4.46	14.96	5.07	5.26	6.68	8.25	1.49	1.11	64.02
1967	1.05	2.83	2.01	0.16	1.80	9.98	6.95	7.90	5.74	10.79	1.45	1.27	51.92
1968	0.42	2.04	0.67	0.57	7.76	15.22	6.45	5.87	7.06	8.26	2.26	0.08	56.63
1969	1.76	1.56	5.52	1.32	9.36	5.40	4.40	6.43	6.86	10.04	2.04	2.51	57.18
1970	4.38	4.00	14.92	0.10	5.79	7.92	5.60	4.93	6.48	5.43	0.12	0.18	59.84
1971	0.34	2.62	1.25	0.67	7.46	4.74	8.87	5.80	6.81	6.80	3.93	3.14	52.42
1972	1.54	1.62	2.53	5.07	7.55	11.04	7.08	3.61	3.02	2.56	3.09	2.07	50.78
1973	2.99	2.84	2.51	1.06	4.16	6.89	9.82	6.89	5.64	6.47	0.83	1.34	51.43
1974	1.60	0.37	0.99	1.50	2.71	10.12	10.06	5.78	5.41	3.48	2.35	1.47	45.82
1975	0.42	2.15	1.50	0.85	6.87	6.21	7.32	3.31	7.74	3.27	1.16	0.60	41.40
1976	0.28	2.50	0.06	2.02	11.33	7.92	4.18	7.25	5.63	1.81	3.27	2.94	49.17
1977	3.57	0.88	0.66	0.61	2.37	4.09	6.07	6.36	10.74	5.17	4.23	4.10	48.83
1978	2.82	1.81	2.49	1.70	3.44	6.02	6.5[illegible]	[illegible]	5.17	4.41	2.83	6.63	48.19
1979	5.96	0.32	1.70	2.46	7.22	3.00	3.01	5.16	16.46	2.43	3.08	1.69	52.48
1980	2.79	2.82	1.94	1.97	5.46	2.98	7.03	3.79	6.13	2.66	2.78	1.40	41.76
1981	0.75	1.77	0.99	0.33	3.16	2.20	4.13	11.18	7.09	1.92	1.19	0.32	35.02
1982	0.72	3.69	10.51	2.72	9.32	9.12	7.56	5.09	5.71	2.23	7.59	1.50	65.74
1983	4.28	10.47	4.88	3.05	1.85	6.95	5.88	8.48	6.63	8.53	2.58	3.90	67.48
1984	0.83	3.72	4.58	1.60	6.63	5.38	6.57	3.99	8.74	0.99	6.59	0.15	49.76

Table B6. Continued

Year	Month												Year
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1985	0.87	0.13	3.52	4.93	0.97	5.56	8.94	3.83	9.83	2.94	1.06	2.76	45.33
1986	3.96	1.17	5.07	0.40	2.68	10.57	6.36	5.96	4.91	5.28	2.00	3.77	52.10
1987	2.09	1.29	3.70	0.18	3.46	4.54	6.66	2.39	5.52	6.64	6.29	0.19	43.24
1988	2.22	3.32	3.03	1.82	3.69	5.12	7.98	7.99	1.48	1.61	4.28	1.02	43.56
1989	1.20	0.28	4.38	4.97	2.27	3.55	6.00	8.06	5.25	6.44	0.54	2.69	45.62
1990	1.73	2.09	1.31	1.57	3.06	4.65	6.73	8.74	10.02	4.95	1.14	0.47	46.44
1991	4.94	3.33	4.75	6.44	5.40	7.03	6.85	6.13	6.25	4.33	1.82	1.05	58.30
1992	1.26	3.07	2.20	2.87	1.14	14.96	5.57	11.56	6.60	3.63	4.43	0.70	57.96
1993	8.82	2.97	6.18	2.31	4.44	6.02	3.02	3.56	8.73	9.08	4.25	1.16	60.52
1994	4.09	5.17	3.75	7.39	3.65	7.01	6.67	9.60	10.31	5.85	8.61	6.76	78.88
1995	2.67	1.79	4.33	4.03	3.68	7.06	5.89	14.37	5.37	16.37	0.50	0.65	66.69
1996	1.43	0.41	10.02	1.74	7.51	5.66	3.85	2.97	3.74	5.65	1.74	2.21	46.91
1997	2.44	0.97	2.31	5.56	1.13	6.72	3.99	5.76	7.82	0.80	3.80	4.21	48.50
1998	3.33	9.06	5.57	2.24	2.25	5.04	5.09	8.81	10.36	1.80	7.59	1.51	62.64
1999	2.35	1.08	0.60				--	--	--	--			-*

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	P.O.R.*
Mean	2.19	2.42	3.37	2.81	4.54	6.82	6.28	6.24	7.44	6.07	2.53	2.10	52.84
Stand. Dev	1.91	1.95	2.71	2.05	2.44	3.04	1.96	2.70	3.25	3.79	2.03	1.82	9.45
Minimum	0.15	0.13	0.01	0.06	0.97	2.20	2.16	0.61	1.48	0.80	0.10	0.08	35.02
Median	1.73	2.06	2.60	2.24	3.98	6.21	6.33	5.83	6.68	5.43	1.95	1.50	51.01
Maximum	8.91	10.47	14.92	8.27	11.33	15.22	10.33	14.37	18.07	18.81	8.61	7.97	78.88

* : indicates period of records for station and excludes partial year results

** : indicates partial year

-- : indicates no data available or large gaps of missing data

APPENDIX C

Historical Daily Evaporation Data

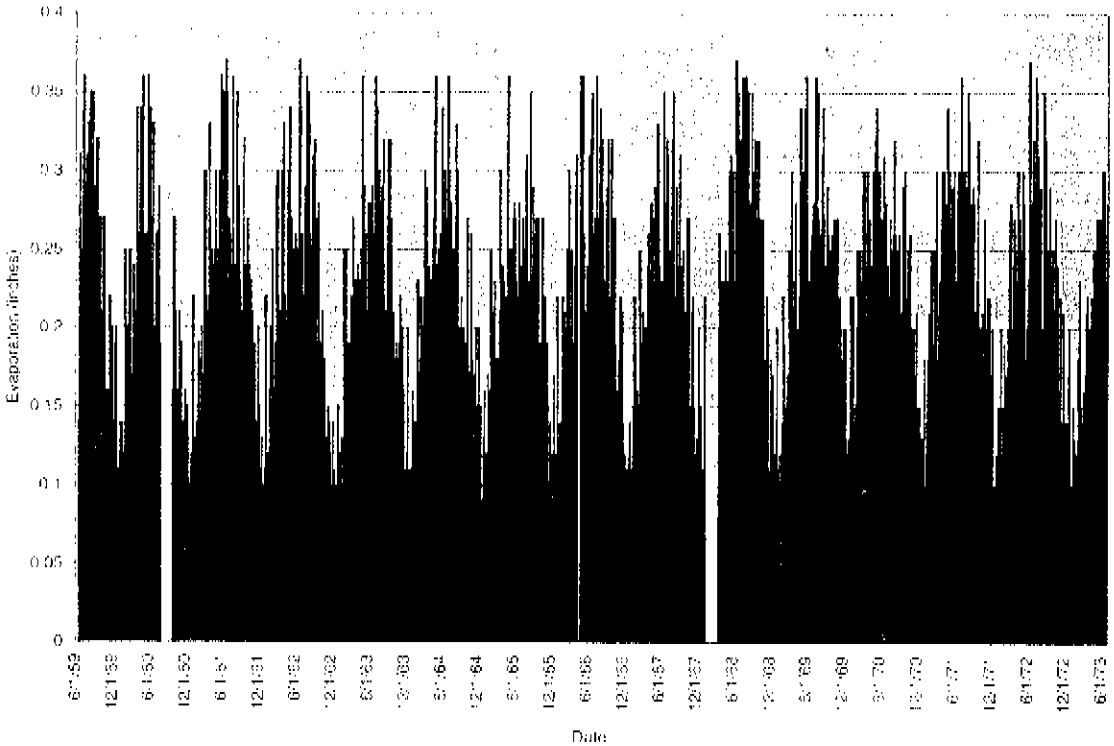

Figure C1. Daily historical pan evaporation at station MONREV2_E

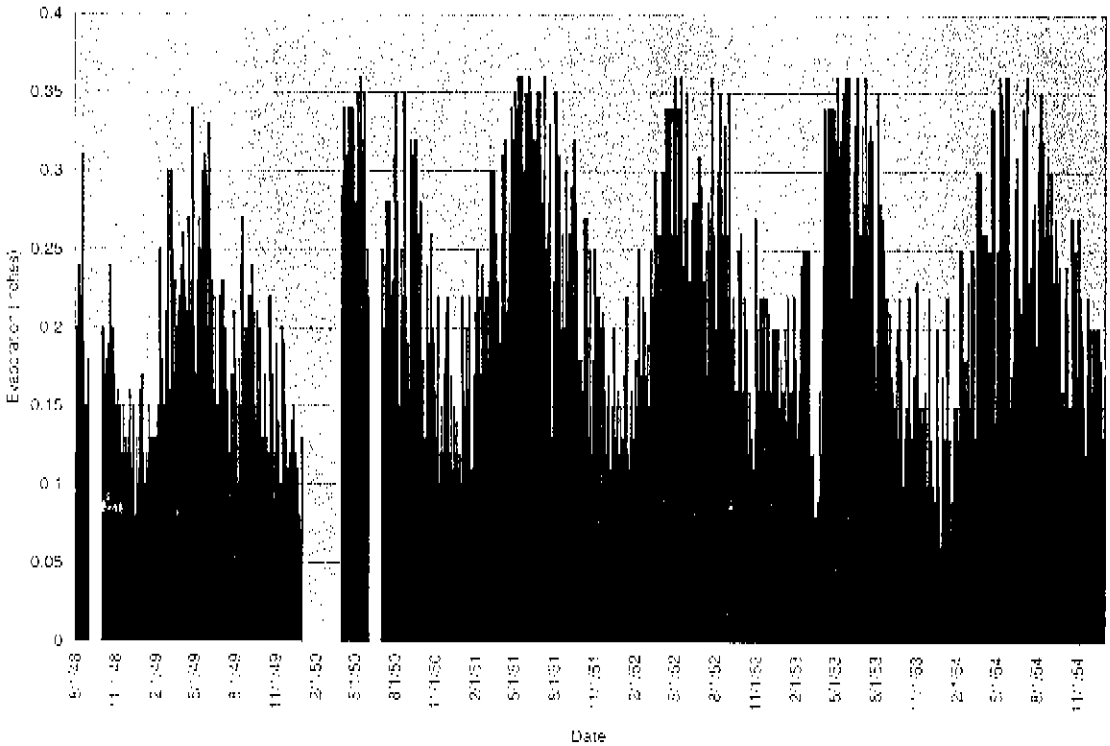

Figure C2. Daily historical pan evaporation at station S308_E

APPENDIX D

Monthly and Annual Evaporation Statistics

Table D1. Monthly and annual evaporation (inches) at station MONREV2_E

Year	Month												Year Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1959	-				-		5.51	6.17	5.22	5.05	3.33	3.16	**
1960	2.95	3.88	4.75	6.01	6.14	6.00	5.60	--		4.43	3.47	2.68	**
1961	3.33	3.30	5.12	5.90	6.51	5.82	6.13	6.48	5.84	4.93	3.37	3.03	59.76
1962	2.78	3.66	5.53	5.38	6.30	6.04	6.27	6.00	5.62	4.09	2.78	2.34	56.79
1963	2.91	3.56	5.18	5.75	5.89	6.14	6.64	5.77	4.85	4.56	3.35	2.61	57.21
1964	2.58	3.60	5.35	5.64	6.14	6.23	6.50	5.76	4.68	4.52	2.91	2.73	56.64
1965	3.02	3.79	4.69	5.56	6.86	5.78	5.90	5.79	5.37	4.70	3.21	2.71	57.38
1966	3.02	3.71	4.79		6.29	5.96	5.74	6.56	5.43	4.83	3.82	2.65	**
1967	3.22	3.42	4.59	5.96	7.10	5.55	6.28	5.91	5.17	4.28	3.35	2.53	57.36
1968	--	--		5.09	5.87	5.85	7.15	6.43	6.06	5.51	3.11	2.54	**
1969	2.68	3.09	4.52	4.91	7.00	5.93	6.01	6.04	4.59	5.29	3.13	2.90	56.39
1970	3.44	3.62	5.32	5.56	6.54	6.06	5.65	5.70	5.37	4.76	3.11	2.84	57.97
1971	3.04	3.76	5.12	5.35	7.03	5.84	7.01	6.72	5.34	4.00	3.61	2.84	59.66
1972	2.59	3.55	5.55	5.74	5.63	7.61	6.64	5.53	5.75	4.72	3.01	2.98	59.27
1973	2.60	3.04	4.79	5.49	6.77	5.66	--	--	-				**

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	P.O.R.*
Mean	2.94	3.54	5.02	5.56	6.43	6.03	6.22	6.07	5.33	4.69	3.28	2.75	57.84
Stand. Dev	0.28	0.26	0.35	0.33	0.47	0.49	0.52	0.38	0.44	0.43	0.28	0.22	1.27
Minimum	2.58	3.04	4.52	4.91	5.63	5.55	5.51	5.53	4.59	4.00	2.78	2.34	56.39
Median	2.95	3.60	5.12	5.56	6.41	5.95	6.20	6.00	5.37	4.71	3.34	2.79	57.37
Maximum	3.44	3.88	5.55	6.01	7.10	7.61	7.15	6.72	6.06	5.51	3.82	3.16	59.76

* : indicates period of records for station and excludes partial year results

** : indicates partial year

-- : indicates no data available or large gaps of missing data

Table D2. Monthly and annual evaporation (inches) at station S308_E

Year	Month												Year Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1941	--	2.51	4.25	4.55	6.09	5.64	4.79	4.61	3.73	2.76		1.9	**
1942	2.51	2.44	3.67	4.51	5.3	4.39	5.04	5.4	4.45	5.06	3.87	2.85	49.59
1943	2.82	4.04	4.23	5.86	5.84	5.05	3.92	4.74	3.81	3.01	2.91	2.19	48.42
1944		2.33	3.35	4.79	4.93	5.22	5.26	4.67	4.02	3.33	3.77	3.35	**
1945	2.55	1.86	4.59	6.75	6.98	5.23	3.02	3.37	3.43	2.91	3.33	2.36	46.42
1946	2.45	3.36	5.42	8.35	6.53	5.34	6.29	6.59	4.74	5.1	3.79	3.54	61.50
1947	2.71	3.13	4.2	4.79	5.37	4.03	4.08	4.08	-	--	2.45	2.51	**
1948	--	--	-					4.77		4.41	3.34	3.03	**
1949	3.16	4.06	5.59	6.38	6.68	4.95	4.29	4.54	4.75	3.56	3.25	2.72	53.93
1950		-	--	7.85	7.73	--	5.58	5.27	6.01	4.22	3.47	2.61	**
1951	3.80	4.20	5.77	6.82	8.35	8.68	5.27	6.21	5.71	4.27	4.05	3.51	66.84
1952	3.59	4.19	5.98	8.00	7.89	6.91	6.63	6.74	4.93	3.92	4.73	4.22	67.73
1953	4.36	4.51	2.13	7.30	9.09	6.61	6.53	6.09	3.70	4.02	3.55	2.66	60.58
1954	2.97	4.19	6.05	5.92	7.80	6.47	6.33	7.42	4.90	5.35	4.19	3.13	65.72

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	P.O.R.*
Mean	3.09	3.40	4.60	6.30	6.84	5.71	5.08	5.32	4.47	3.99	3.55	2.97	57.86
Stand. Dev	0.64	0.92	1.21	1.36	1.30	1.22	1.18	1.14	0.87	0.86	0.59	0.70	8.40
Minimum	2.45	1.86	2.13	4.51	4.93	4.03	3.02	3.37	3.21	2.76	2.45	1.90	46.42
Median	2.90	3.70	4.42	6.38	6.68	5.79	5.26	5.01	4.60	4.02	3.47	2.79	60.58
Maximum	4.36	4.51	6.05	8.35	9.09	8.68	6.63	7.42	6.01	5.35	4.73	4.22	67.73

* : indicates period of records for station and excludes partial year results

** : indicates partial year

-- : indicates no data available or large gaps of missing data

APPENDIX E

Historical Daily Flow Data

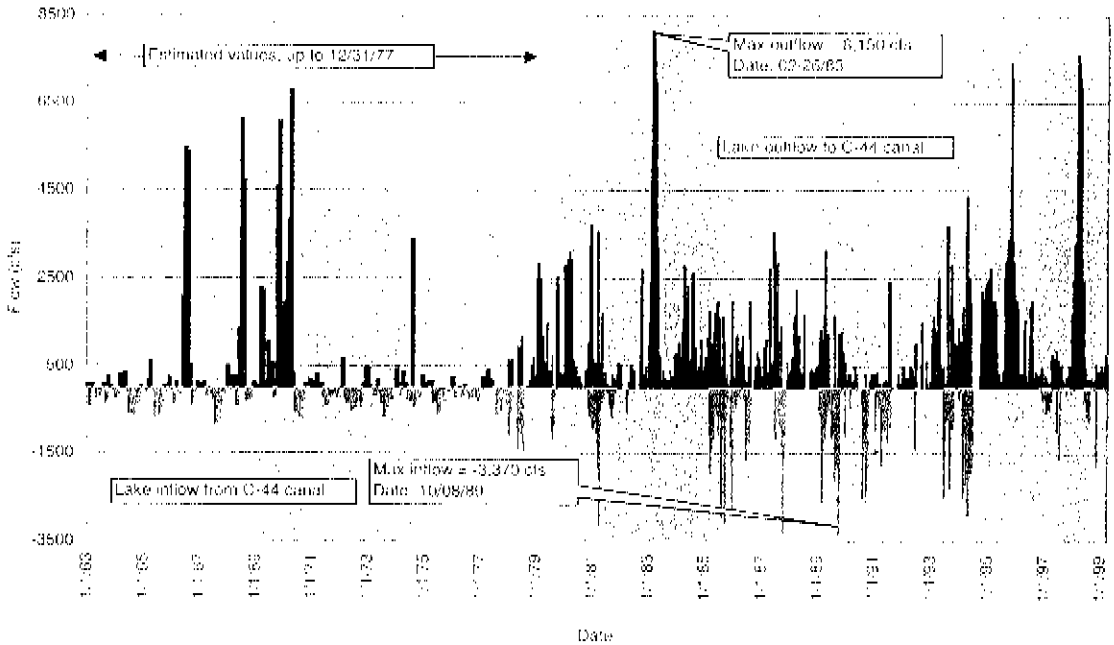

Figure E1. Historical mean daily flow at S-308

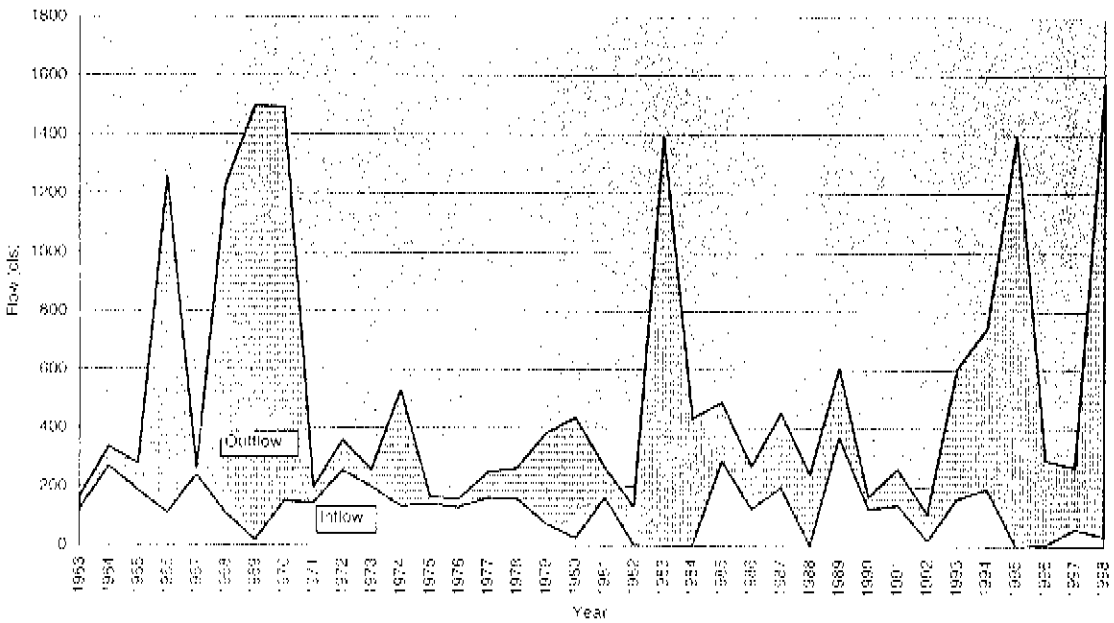

Figure E2. Mean daily Lake Okeechobee outflow and inflow through S-308

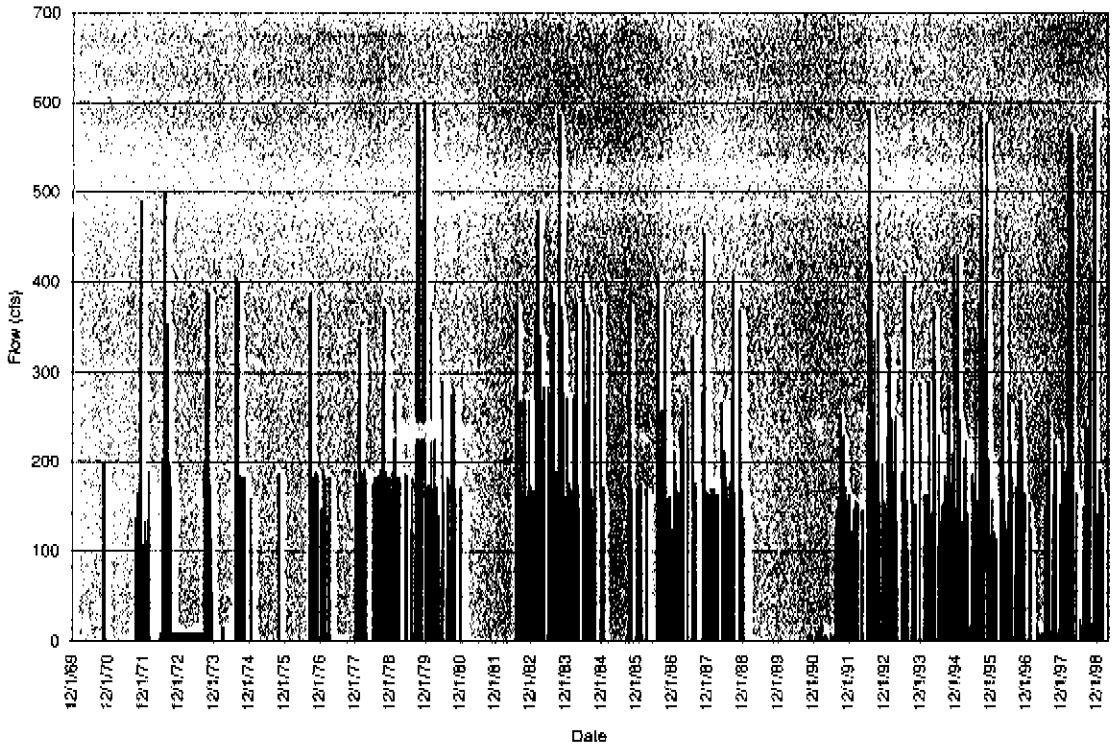

Figure E3. Historical mean daily pumping at S-135

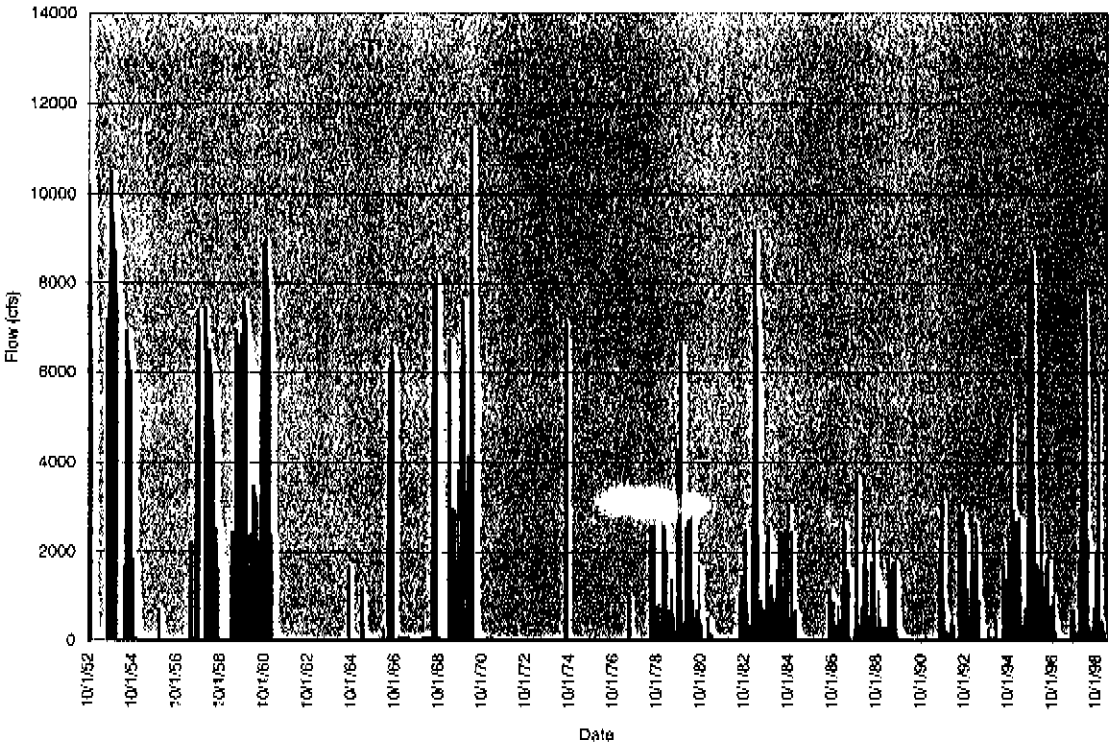

Figure E4. Historical mean daily flow at S-80

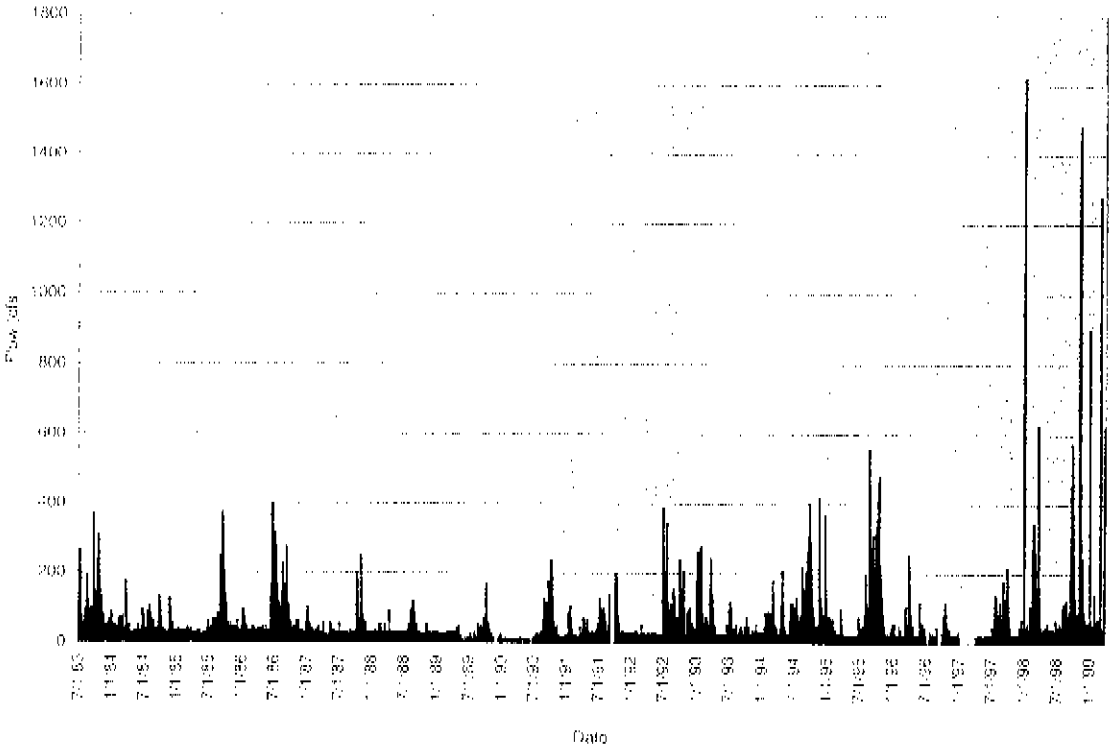

Figure E5. Historical mean daily flow at S-153

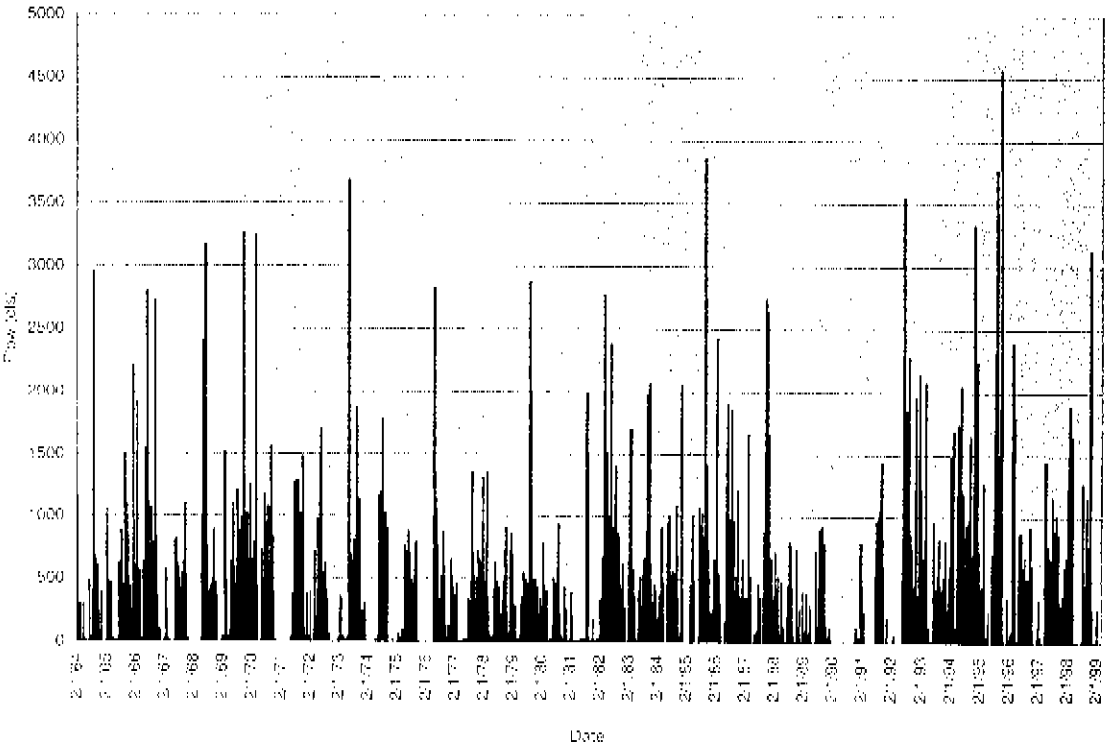

Figure E6. Historical mean daily flow at S-97

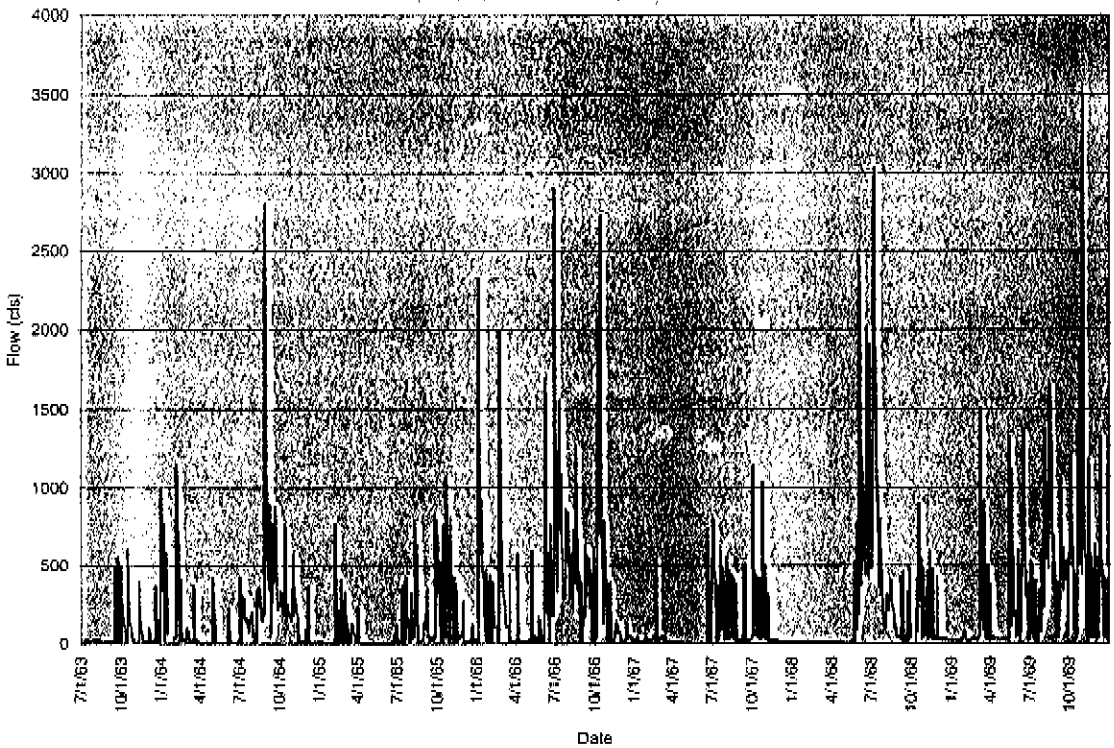

Figure E7. Historical mean daily flow at S-48

APPENDIX F

Monthly and Annual Flow Data Statistics

Table F1. Mean daily flow (cfs) over each month and year at S-308

Year	Month												Year
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
1963	67	-420	90	-10	-251	-187	-113	69	-357	249	38	-91	-76
1964	-244	-198	315	116	351	-123	-605	-592	-634	-469	-344	23	-200
1965	-5	-111	181	627	-76	-666	-152	-628	-464	39	-121	248	-94
1966	-99	-389	130	-120	-157	2,093	5,465	5,379	532	-124	-110	154	1,038
1967	17	103	140	-182	25	-147	-280	-838	-463	-719	-191	-33	-214
1968	519	-65	271	270	-402	1,372	6,143	4,744	-304	-258	-272	125	1,012
1969	16	70	2,287	2,227	51	1,065	559	581	-213	4,605	6,076	209	1,461
1970	1,966	2,855	3,840	6,789	346	-561	-245	-683	-294	89	-7	209	1,192
1971	128	35	317	87	82	-221	-403	-380	-232	-83	-180	-226	-90
1972	11	686	-229	-333	-268	-525	-500	-427	-309	-460	95	439	-152
1973	477	54	-35	-170	174	-109	-347	-637	-462	-249	-277	-95	-140
1974	440	129	-152	380	105	-275	-318	3,409	-443	-179	-225	300	264
1975	20	139	-16	161	-329	-221	-595	-27	-304	-67	-79	-19	-111
1976	232	-201	3	46	-199	72	-70	-239	-223	-71	-225	-320	-100
1977	-17	241	33	407	221	148	-92	-589	-272	-528	-59	-375	-74
1978	261	109	8	0	-381	-213	-559	0	2	6	52	91	-52
1979	808	767	524	219	92	224	78	-832	-44	921	23	48	236
1980	500	731	693	657	138	86	31	20	9	141	-10	1,630	385
1981	-55	-339	191	-211	101	-4	-5	-65	-406	-80	52	127	-58
1982	44	0	0	-18	123	225	82	0	145	846	14	42	125
1983	151	3,264	7,246	4,620	1,131	57	45	17	15	18	13	110	1,390
1984	143	155	636	1,430	363	425	549	1,032	59	66	232	114	434
1985	274	220	-116	-167	191	80	149	-425	-649	-333	-2	-225	-84
1986	-130	246	-33	484	239	-420	-506	36	0	95	100	144	21
1987	106	123	117	671	197	653	271	-247	-101	-1,101	-120	134	58
1988	118	289	772	581	360	68	202	0	82	228	130	83	243
1989	124	365	-647	424	71	0	-618	-940	-1,036	-55	603	123	-132
1990	16	-13	49	101	120	0	0	-524	-361	-522	33	93	-84
1991	-43	-24	-95	-531	-242	-402	794	-36	0	0	70	24	-40
1992	145	54	63	111	212	-54	0	45	227	0	47	10	72
1993	192	645	22	997	237	-519	-444	291	374	392	592	669	287
1994	558	427	-27	626	221	-1,107	-26	0	12	617	1,033	1,916	354
1995	2,295	1,374	855	834	141	39	76	1,523	2,831	2,290	3,396	1,069	1,394
1996	928	263	75	493	54	297	868	25	116	59	193	1	281
1997	-106	-181	-146	485	553	250	111	162	38	80	179	434	155
1998	2,095	3,289	6,954	4,494	1,031	93	-143	-51	65	81	75	117	1,508
1999	123	165	427	--	--	--	--	--	--	--	--	--	**

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	P.O.R*
Mean	326	402	669	739	128	41	261	255	-85	145	301	203	284
Stand.Dev	597	896	1,731	1,518	326	571	1,414	1,411	587	943	1,167	466	534
Minimum	-244	-420	-647	-531	-402	-1,107	-618	-940	-1,036	-1,101	-344	-375	-214
Median	124	129	90	325	121	0	-16	-14	-157	3	28	112	65
Maximum	2,295	3,289	7,246	6,789	1,131	2,093	6,143	5,379	2,831	4,605	6,076	1,916	1,508

*: indicates period of records for station and excludes partial year results

**: indicates partial year

--: indicates no data available or large gaps of missing data

Negative flows indicate lake Okeechobee inflows through S308, while positive flows are outflows from the lake

Table F2. Mean daily Lake Okeechobee inflow (cfs) through S-308

Year	Month												Year Average
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1963	0	420	0	20	251	127	113	0	357	0	0	91	119
1964	244	198	0	0	0	123	605	592	634	169	344	0	267
1965	5	111	0	0	76	666	152	628	464	0	121	0	185
1966	99	389	0	370	127	0	0	0	0	424	110	0	108
1967	0	0	0	182	0	147	280	838	163	719	191	33	238
1968	0	65	0	0	103	0	0	0	384	258	272	0	108
1969	0	0	0	0	0	0	0	0	213	0	0	0	18
1970	0	0	0	0	0	561	245	683	291	0	7	0	149
1971	0	0	0	0	0	221	403	380	232	83	180	226	144
1972	0	0	229	333	268	525	500	427	309	460	0	0	254
1973	0	0	35	170	0	109	347	637	467	249	277	95	198
1974	0	0	152	0	0	275	318	0	113	179	225	0	133
1975	0	0	16	0	329	221	595	27	304	67	29	19	138
1976	0	201	0	0	199	0	70	239	223	71	235	320	129
1977	17	0	0	0	0	0	93	589	272	328	59	375	161
1978	54	174	8	0	439	506	757	0	0	0	0	0	157
1979	0	0	0	0	0	0	0	832	14	0	0	0	73
1980	0	0	0	0	0	0	0	0	0	0	175	120	25
1981	235	399	312	282	27	71	23	68	117	102	3	0	161
1982	0	0	0	35	0	0	0	0	0	0	0	0	3
1983	0	0	0	0	0	0	0	0	0	0	0	0	0
1984	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	0	0	351	307	108	209	134	613	810	359	6	534	286
1986	158	87	68	21	31	443	534	151	0	0	0	0	124
1987	0	0	0	0	0	218	283	352	292	1,101	120	0	197
1988	0	0	0	0	0	0	0	0	0	0	0	0	0
1989	76	177	822	30	143	6	671	1,004	1,048	441	6	46	369
1990	1	73	0	0	2	0	0	524	323	524	5	0	125
1991	103	63	99	531	246	415	149	37	0	0	0	0	137
1992	0	0	0	0	0	216	0	0	0	0	0	0	18
1993	0	0	0	0	0	587	447	286	469	119	0	7	160
1994	5	159	247	318	447	1,128	26	0	0	0	0	0	194
1995	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0	0	0	2	0	68	6
1997	122	193	161	2	0	54	117	6	4	7	7	15	57
1998	0	0	0	0	7	54	176	97	2	1	59	0	33
1999	0	1	3				--	--	-			--	1*

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	P.O.R*
Mean	40	72	68	66	87	193	194	250	234	171	69	54	124
Stand.Dev	65	120	159	130	140	269	227	311	260	260	101	121	93
Minimum	0	0	0	0	0	0	0	0	0	0	0	0	0
Median	0	0	0	0	0	90	115	52	228	5	4	0	131
Maximum	244	420	822	531	447	1,128	757	1,004	1,048	1,101	344	534	369

*: indicates period of records for station and excludes partial year results

**: indicates partial year

--: indicates no data available or large gaps of missing data

Table F3. Mean daily Lake Okeechobee outflow (cfs) through S-308

Year	Month												Year
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
1963	67	0	90	0	0	0	0	69	0	249	38	0	43
1964	0	0	315	116	351	0	0	0	0	0	0	23	67
1965	0	0	181	627	0	0	0	0	0	39	0	248	91
1966	0	0	130	0	0	2,093	5,465	5,379	532	0	0	154	1,146
1967	17	103	140	0	25	0	0	0	0	0	0	0	24
1968	519	0	271	270	0	1,372	6,143	4,744	0	0	0	125	1,120
1969	16	70	2,287	2,227	51	1,065	559	581	0	4,605	6,076	209	1,479
1970	1,966	2,855	3,840	6,789	346	0	0	0	0	89	0	209	1,341
1971	128	35	317	87	82	0	0	0	0	0	0	0	54
1972	11	686	0	0	0	0	0	0	0	0	95	439	103
1973	477	54	0	0	174	0	0	0	0	0	0	0	59
1974	440	129	0	380	105	0	0	3,409	0	0	0	300	397
1975	20	139	0	161	0	0	0	0	0	0	0	0	27
1976	232	0	3	46	0	72	0	0	0	0	0	0	29
1977	0	241	33	407	221	148	0	0	0	0	0	0	88
1978	314	233	16	0	57	293	198	0	2	6	52	91	105
1979	808	767	524	219	92	224	78	0	0	921	23	48	309
1980	500	731	693	657	138	86	31	20	9	141	165	1,750	410
1981	180	60	503	71	128	67	18	3	10	22	55	127	104
1982	44	0	0	17	123	225	82	0	145	846	14	42	128
1983	151	3,264	7,246	4,620	1,131	57	45	17	15	18	13	110	1,390
1984	143	155	636	1,430	363	425	549	1,032	59	66	232	114	434
1985	274	220	235	140	299	289	283	188	161	26	5	309	202
1986	29	333	34	504	271	23	28	187	0	95	100	144	146
1987	106	123	117	671	197	870	554	104	191	0	0	134	256
1988	118	289	772	581	360	68	202	0	82	228	130	83	243
1989	200	543	175	474	213	0	3	65	12	386	603	168	237
1990	17	59	49	101	122	0	0	0	12	2	38	93	41
1991	60	39	4	0	4	14	1,271	2	0	0	70	24	124
1992	145	54	63	111	212	162	0	45	227	0	47	10	90
1993	192	645	22	997	237	68	3	576	842	511	592	677	447
1994	562	586	220	945	668	21	0	0	12	617	1,033	1,916	548
1995	2,295	1,374	855	834	141	39	76	1,523	2,831	2,290	3,396	1,069	1,394
1996	928	263	75	493	54	297	868	25	116	56	193	69	286
1997	17	12	14	487	553	304	228	168	42	87	186	449	212
1998	2,095	3,289	6,954	4,494	1,038	148	33	46	67	82	134	117	1,541
1999	123	166	430	--	--	--	--	--	--	--	--	--	**

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	P.O.R*
Mean	357	473	736	804	215	234	464	505	149	316	369	257	409
Stand.Dev	579	857	1,701	1,483	267	444	1,346	1,288	489	852	1,141	443	489
Minimum	0	0	0	0	0	0	0	0	0	0	0	0	24
Median	143	139	140	325	133	67	23	10	6	24	38	116	207
Maximum	2,295	3,289	7,246	6,789	1,131	2,093	6,143	5,379	2,831	4,605	6,076	1,916	1,541

*: indicates period of records for station and excludes partial year results

**: indicates partial year

--: indicates no data available or large gaps of missing data

Table 54. Mean daily pumping to Lake Okeechobee at S-135 (cfs)

Year	Month												Year Average
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1969					--	-				-		0	**
1970	0	0	0	0	0	0	0	0	0	7	2	0	1
1971	0	0	0	0	0	0	0	0	5	46	37	4	8
1972	8	7	0	0	0	16	14	29	17	1	1	1	10
1973	1	1	1	1	1	1	1	17	30	73	3	0	12
1974	0	0	0	0	0	0	15	91	36	21	0	10	17
1975	0	0	0	0	0	0	0	0	0	6	0	0	1
1976	0	0	0	0	0	0	0	35	35	6	6	3	7
1977	28	5	6	0	0	0	0	0	0	0	0	30	6
1978	37	19	35	0	0	18	32	44	57	67	41	45	33
1979	96	25	28	0	35	0	15	21	251	77	419	44	85
1980	54	37	24	24	24	6	33	6	95	10	0	6	26
1981	0	0	0	0	0	0	0	0	0	0	0	0	0
1982	0	0	0	0	0	0	37	63	49	46	45	27	22
1983	52	149	100	11	9	64	51	97	90	89	41	46	69
1984	31	50	54	20	15	43	97	21	31	13	34	15	36
1985	0	0	0	0	0	0	0	0	62	5	0	5	6
1986	15	0	5	0	--		71	46	132	10	16	19	**
1987	36	11	25	0	29	0	32	6	0	79	93	15	23
1988	26	45	21	0	28	37	34	103	10	0	42	3	29
1989	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	1	1	1	0	0	1	12	33	69	58	21	13	17
1992	9	15	7	14	0	118	141	63	49	43	37		**
1993	107	47	82	11	6	43	27	0	16	18	16	0	31
1994	24	40	21	91	11	56	14	59	112	54	99	81	58
1995	49	30	49	5	12	66	45	147	126	223	27	12	66
1996	21	4	58	41	27	16	13	13	7	56	5	0	24
1997	9	0	1	0	0	7	29	1	79	6	11	31	16
1998	42	138	86	5	5	1	14	40	83	1	101	17	54
1999	20	6	0	--	--	--			--			--	**

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	P.O.R*
Mean	22	21	21	9	7	19	27	32	51	33	38	16	24
Stand.Dev	28	38	30	20	11	30	33	38	58	46	79	20	23
Minimum	0	0	0	0	0	0	0	0	0	0	0	0	0
Median	9	4	5	0	0	1	15	21	36	14	16	8	17
Maximum	107	149	100	91	35	118	141	147	251	223	419	81	85

*: indicates period of records for station and excludes partial year results

**: indicates partial year

--: indicates no data available or large gaps of missing data

Table F5. Mean daily flow at S-80 (cfs)

Year	Month												Year
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
1952	--	--	--	--	--	--	--	--	--	3,108	4,325	0	**
1953	0	0	0	0	0	0	0	5,649	7,701	9,315	8,305	8,283	3,271
1954	3,445	10	10	10	1,012	5,162	6,245	5,758	1,793	635	10	12	2,009
1955	10	10	10	10	10	10	10	10	10	10	10	61	14
1956	10	10	10	10	10	10	10	10	10	10	10	10	10
1957	10	10	10	10	746	1,503	10	1,376	6,385	4,088	10	10	1,181
1958	3,295	5,986	3,777	6,117	5,322	2,148	2,382	1,599	466	10	10	10	2,593
1959	10	10	10	1,872	1,605	4,344	6,519	6,331	6,480	6,722	7,078	4,463	3,787
1960	1,699	1,423	2,644	3,339	2,791	1,442	2,542	5,533	6,924	8,604	7,941	6,155	4,253
1961	2,374	480	10	10	10	10	10	10	10	10	10	10	246
1962	10	10	10	10	10	10	10	10	10	10	10	10	10
1963	10	10	10	10	10	10	10	10	10	10	10	10	10
1964	10	10	10	10	10	10	10	64	10	10	10	10	14
1965	10	10	10	448	10	10	10	10	10	11	37	40	51
1966	40	40	46	40	40	2,528	5,880	6,006	1,083	22	40	42	1,317
1967	40	41	41	41	42	30	30	30	30	30	40	40	36
1968	50	50	50	47	35	2,396	6,598	5,339	33	26	36	41	1,225
1969	43	43	2,434	1,988	845	1,103	486	708	26	5,312	6,774	277	1,670
1970	2,067	2,724	4,665	6,887	780	26	26	27	27	26	38	44	1,445
1971	48	48	48	46	21	12	12	12	12	12	18	18	26
1972	20	20	20	18	18	14	28	28	21	12	18	18	20
1973	20	20	20	18	18	12	12	12	12	12	18	18	16
1974	20	20	20	18	18	12	175	3,850	12	12	18	18	349
1975	20	20	20	18	18	12	12	12	12	12	18	18	16
1976	20	20	20	18	5	4	12	12	12	12	18	18	14
1977	20	20	20	18	18	370	342	12	12	12	18	18	73
1978	20	20	20	18	18	985	723	1,634	263	165	141	147	346
1979	1,514	976	591	55	221	128	86	12	1,590	2,148	318	74	643
1980	322	1,435	884	1,055	99	75	157	115	350	46	18	18	381
1981	92	230	143	88	18	12	12	12	12	12	18	18	56
1982	18	20	20	18	18	12	464	571	292	1,222	414	81	263
1983	204	3,777	7,453	4,784	878	371	247	384	490	757	329	303	1,665
1984	245	186	834	1,480	306	550	902	1,169	527	219	412	125	579
1985	65	32	20	20	20	20	20	20	20	20	20	20	25
1986	20	20	20	20	20	20	12	314	376	143	110	48	94
1987	186	36	261	501	67	574	36	12	12	295	789	281	254
1988	300	575	1,022	548	480	364	658	1,069	416	282	369	286	531
1989	287	292	292	535	452	261	63	320	26	31	36	28	218
1990	34	31	23	22	19	16	12	15	19	23	31	30	23
1991	31	32	32	33	32	32	35	781	1,051	468	65	43	220
1992	42	83	42	62	35	471	475	1,449	822	493	489	140	383
1993	863	918	607	1,183	109	53	37	35	31	42	35	37	329
1994	36	35	97	35	35	35	563	639	996	1,811	1,874	2,486	720
1995	2,616	1,537	1,062	651	85	194	214	2,681	3,392	4,051	3,645	1,030	1,763
1996	857	169	416	713	317	631	943	120	169	288	79	41	395
1997	35	35	35	35	35	35	35	272	317	101	41	645	135
1998	2,317	4,058	7,185	4,461	898	75	46	138	612	184	758	95	1,736
1999	100	53	35	--	--	--	--	--	--	--	--	--	**

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	P.O.R*
Mean	509	555	760	812	382	567	807	1,178	933	1,038	880	557	748
Stand.Dev	943	1,237	1,727	1,651	909	1,113	1,800	1,958	1,961	2,256	2,167	1,634	1,046
Minimum	0	0	0	0	0	0	0	10	10	10	10	10	10
Median	40	35	33	38	35	35	36	129	32	36	37	41	296
Maximum	3,445	5,986	7,453	6,887	5,322	5,162	6,598	6,331	7,701	9,315	8,305	8,283	4,253

*: indicates period of records for station and excludes partial year results

**: indicates partial year

--': indicates no data available or large gaps of missing data

Table F6. Mean daily flow at S-153 (cfs)

Year	Month												Year Average
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1983	--	--	--	--	--	-	80	94	99	142	75	12	**
1984	42	45	54	27	23	33	41	59	81	44	40	35	40
1985	17	17	17	15	9	15	32	50	164	63	27	27	38
1986	49	53	34	19	19	119	157	110	107	30	29	23	59
1987	42	22	26	15	19	11	22	14	16	18	69	22	27
1988	19	24	21	17	13	21	24	54	25	11	20	11	22
1989	8	9	17	16	7	4	9	20	31	35	7	6	14
1990	8	7	4	2	2	1	8	28	71	92	18	8	21
1991	25	10	10	38	16	21	69	39		91	16	13	**
1992	11	16	11	13	5	47	149	84	79	104	60	25	50
1993	155	51	95	39	6	18	54	17	28	36	20	15	44
1994	25	54	53	56	27	62	74	106	211	101	108	103	82
1995	36	22	31	9	7	15	30	166	148	256	48	13	66
1996	19	12	47	57	19	29	--	14	--	54	17	12	**
1997			--	8	8	13	63	66	97	39	15	83	**
1998	30	141	124	16	9	11	18	57	173	83	381	30	90
1999	57	16	66	--	--	--	--	--	--	--	--		**

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	P.O.R*
Mean	35	32	38	23	13	28	54	59	91	72	58	28	46
Stand Dev	37	35	34	17	7	30	47	43	65	58	93	28	24
Minimum	8	7	4	2	2	1	8	11	16	11	7	6	14
Median	25	22	25	16	9	18	36	54	79	54	27	22	42
Maximum	155	141	124	57	27	119	157	166	211	256	381	103	90

*: indicates period of records for station and excludes partial year results

**: indicates partial year

-: indicates no data available or large gaps of missing data

Table F7. Mean daily flow at S-97 (cfs)

Year	Month												Year
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
1964	--	196	10	15	4	0	44	342	206	49	11	23	**
1965	0	158	81	28	3	2	152	222	260	426	180	12	127
1966	489	402	125	36	46	418	790	458	303	717	68	6	321
1967	1	23	35	2	0	108	316	212	78	234	27	0	86
1968	0	0	0	0	115	1,023	966	346	89	--	80	0	**
1969	3	9	230	24	139	329	179	566	362	744	469	257	276
1970	357	199	518	136	27	196	395	365	242	535	35	0	251
1971	0	0	0	0	0	12	253	273	305	333	234	25	120
1972	2	16	26	186	161	711	105	117	22	2	0	0	112
1973	3	158	65	2	3	489	298	263	589	308	234	125	211
1974	0	0	0	0	1	124	447	546	298	125	0	1	129
1975	0	3	2	--	--	223	320	135	217	146	0	0	**
1976	0	0	0	0	473	503	59	144	207	0	13	105	125
1977	75	24	16	0	8	15	46	110	402	22	191	259	97
1978	180	121	172	44	13	107	--	--	--	150	145	75	**
1979	383	68	24	2	70	72	116	139	1,023	256	51	68	189
1980	45	120	31	60	--	8	75	166	227	7	41	16	**
1981	1	41	0	3	2	6	7	428	--	--	21	9	**
1982	4	79	318	215	147	546	432	560	292	134	122	34	240
1983	--	584	397	71	4	71	33	228	505	529	127	73	**
1984	71	78	176	45	52	101	208	184	304	154	281	72	144
1985	0	0	66	100	15	1	339	419	773	355	57	12	178
1986	181	229	112	7	30	656	482	558	344	150	123	117	249
1987	215	119	240	69	6	18	60	17	106	313	547	218	161
1988	118	197	128	0	65	0	126	418	102	0	96	24	106
1989	36	2	59	32	4	1	52	257	146	210	17	16	69
1990	--	--	--	0	--	--	--	--	--	--	--	1	**
1991	147	--	--	--	--	--	--	467	516	336	0	10	**
1992	0	2	0	0	0	538	645	952	474	252	560	108	294
1993	740	293	609	215	37	98	206	131	259	--	73	10	**
1994	198	434	197	318	302	773	341	332	625	347	634	396	408
1995	117	112	172	6	13	54	234	1,235	675	1,799	24	0	370
1996	11	4	337	131	86	283	160	85	55	223	43	0	118
1997	36	16	0	191	80	138	389	432	279	65	109	187	160
1998	198	586	265	0	0	0	0	210	341	49	460	0	176
1999	1	12	0	--	--	--	--	--	--	--	--	--	**

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	P.O.R*
Mean	113	130	134	59	61	231	259	343	332	289	149	65	189
Stand.Dev	171	164	158	83	102	276	229	250	224	343	180	94	91
Minimum	0	0	0	0	0	0	0	17	22	0	0	0	69
Median	36	78	66	24	15	107	207	273	295	223	76	16	161
Maximum	740	586	609	318	473	1,023	966	1,235	1,023	1,799	634	396	408

*: indicates period of records for station and excludes partial year results

**: indicates partial year

--: indicates no data available or large gaps of missing data

Table F8. Mean daily flow at S-48 (cfs)

Year	Month												Year Average
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1963		--	--	-				14	95	106	31	90	**
1964		220	37	25	34	77	172	425	456	258	113	30	**
1965	6	110	70	16	1	20	106	120	159	380	181	21	99
1966	171	369	123	48	57	158	716	477	307	721	84	35	324
1967	22	12	25	8	3	99	998	193	52	277	34	9	88
1968	8	8	9	7	93	992	953	200	103		131	28	**
1969	28	31	241	44	250	392	216	717	151	889	524	317	340

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	P.O.R*
Mean	107	130	84	24	73	331	415	306	229	438	158	76	213
Stand.Dev	204	140	87	18	93	374	348	243	168	302	169	110	138
Minimum	6	8	9	7	1	20	106	14	52	106	34	9	88
Median	22	76	54	20	45	246	257	200	159	328	113	30	212
Maximum	171	369	241	48	250	992	953	717	156	889	524	317	340

*. indicates period of records for station and excludes partial year results

**. indicates partial year

--. indicates no data available or large gaps of missing data

APPENDIX G

Historical Daily Stage Data

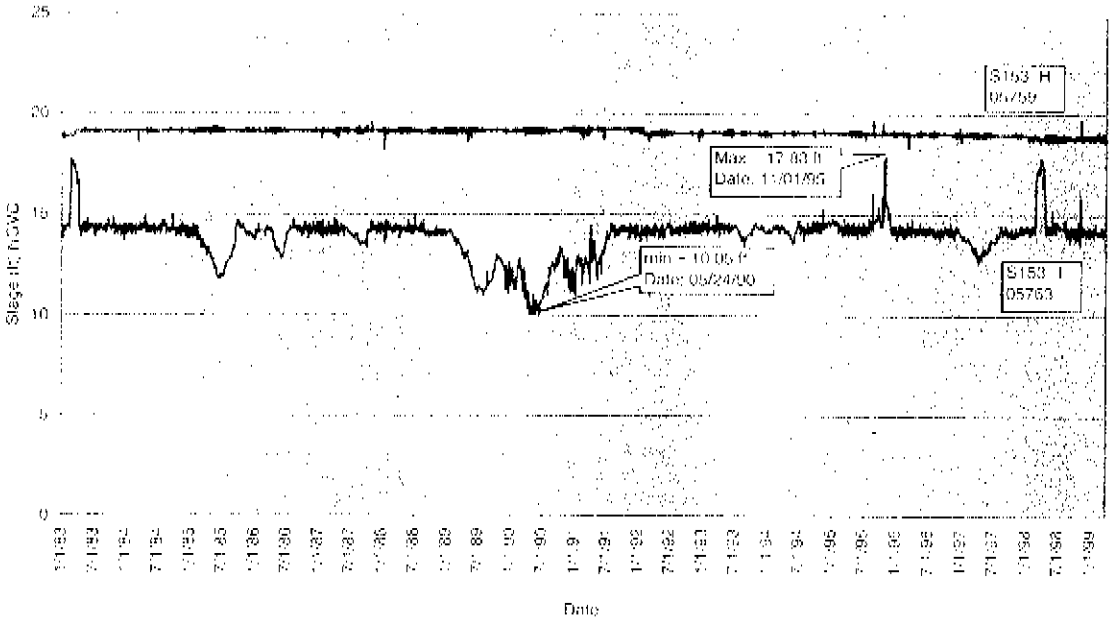

Figure G1. Historical mean daily stage at S-153

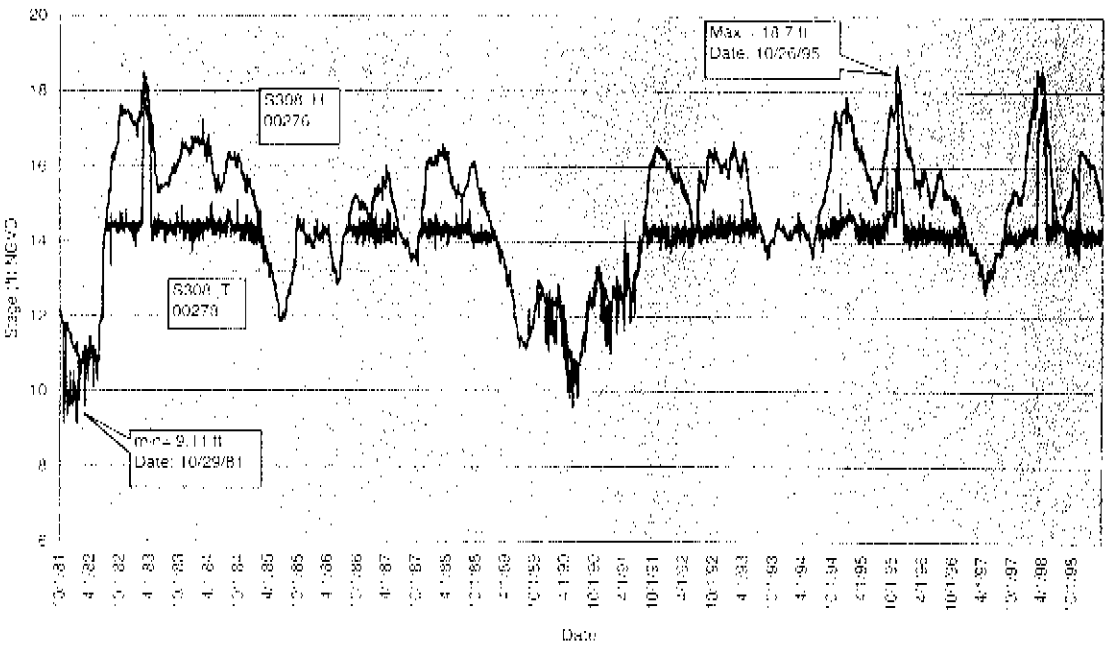

Figure G2. Historical mean daily stage at S-308

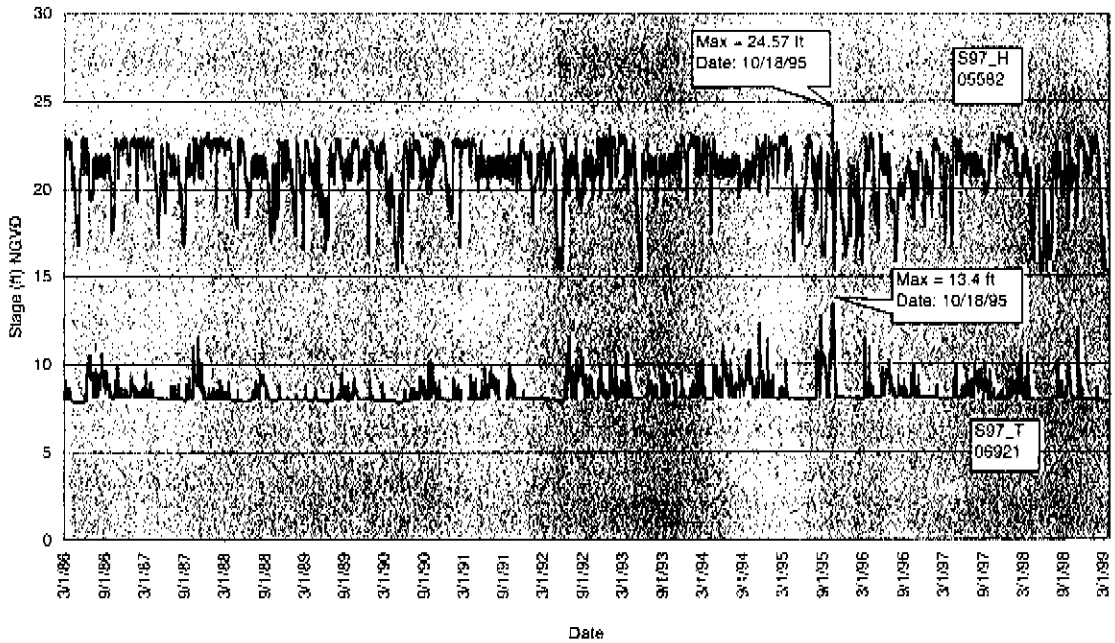

Figure G3. Historical mean daily stage at S-97

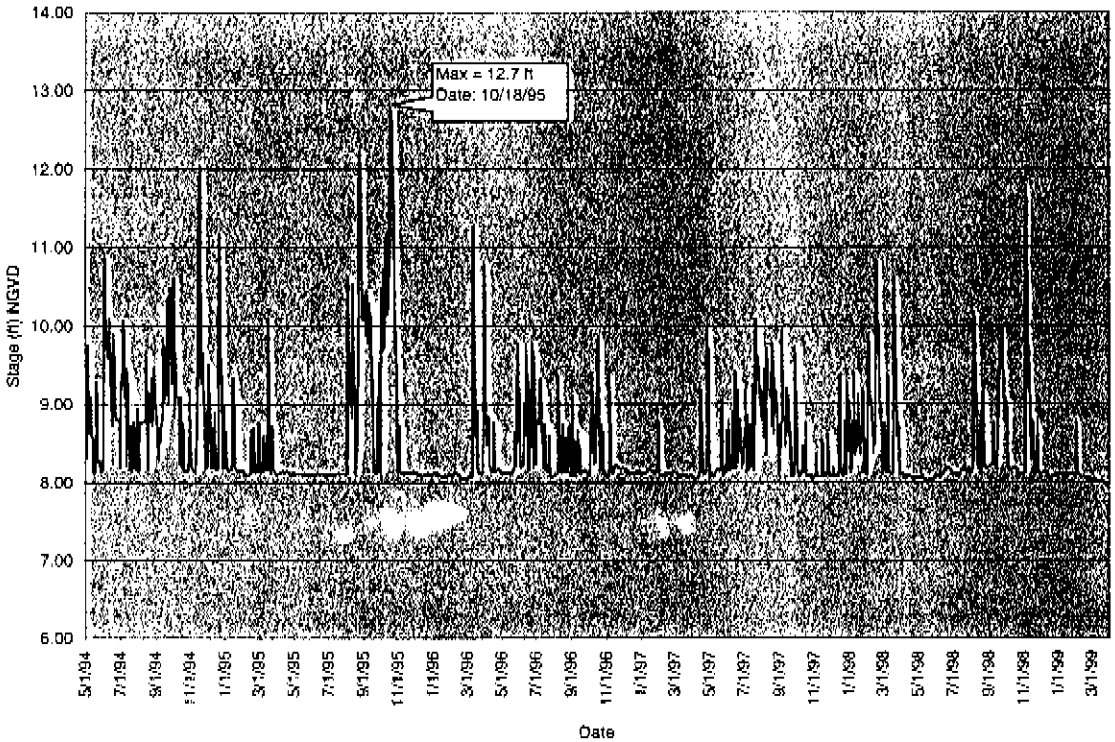

Figure G4. Historical mean daily headwater stage at S-48

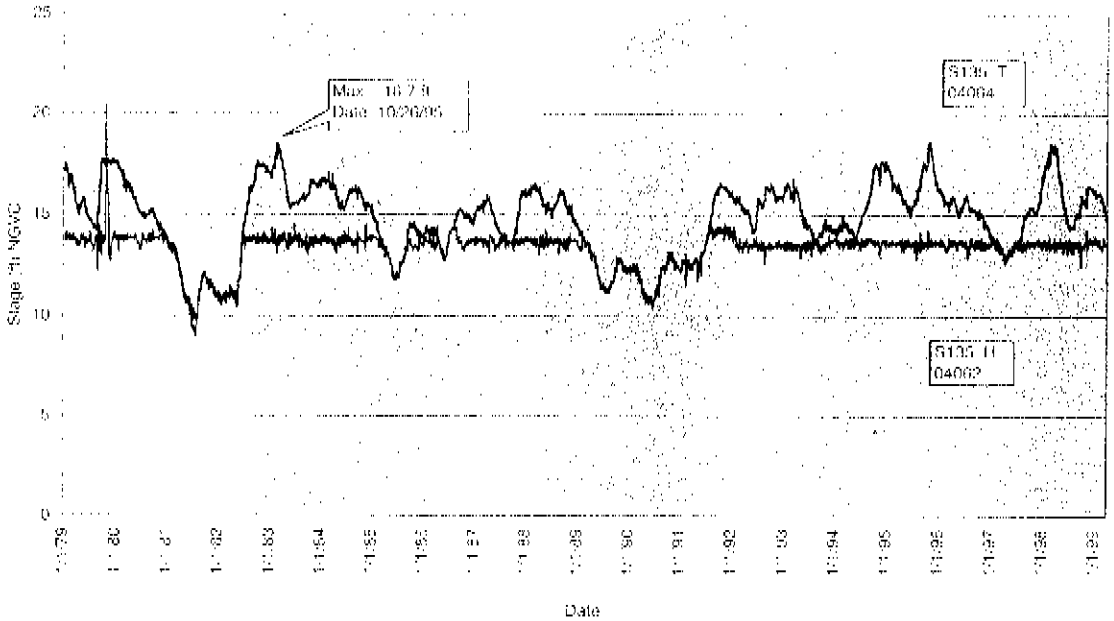

Figure G5. Historical mean daily stage at S-135

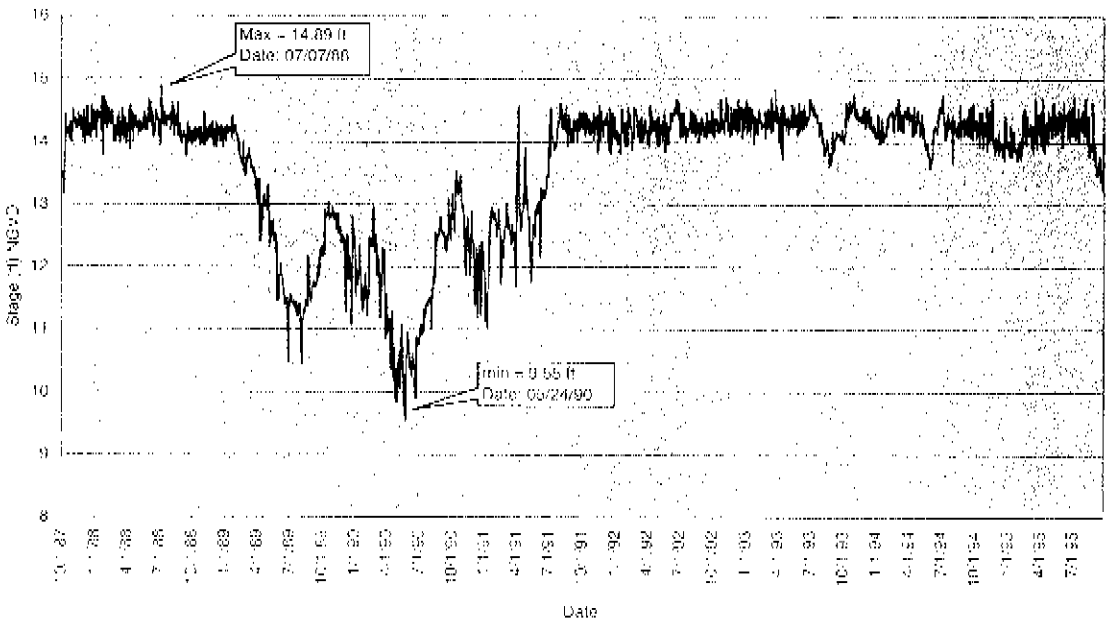

Figure G6. Historical mean daily headwater stage at S-80

APPENDIX H

Monthly and Annual Stage Data Statistics

Table III. Monthly and annual average headwater stage at S-153 (ft, NGVD)

Year	Month												Year
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
1983	18.87	18.88	18.96	19.07	19.11	19.11	19.10	19.09	19.11	19.09	19.10	19.08	19.05
1984	19.11	19.14	19.11	19.12	19.09	19.10	19.10	19.14	19.14	19.13	19.11	19.12	19.12
1985	19.11	19.14	19.16	19.15	19.17	19.17	19.15	19.14	19.13	19.10	19.15	19.13	19.14
1986	19.13	19.05	19.14	19.15	19.15	19.14	19.13	19.13	19.13	19.13	19.13	19.14	19.13
1987	19.11	19.14	19.13	19.09	19.15	19.17	19.14	19.14	19.13	19.14	19.16	19.13	19.13
1988	19.09	19.13	19.13	19.12	19.16	19.16	19.15	19.11	19.11	19.13	19.12	19.13	19.13
1989	19.13	19.16	19.13	19.14	19.12	19.17	19.14	19.14	19.14	19.15	19.14	19.12	19.14
1990	19.13	19.13	19.15	19.15	19.15	19.16	19.13	19.13	19.11	19.16	19.21	19.23	19.16
1991	19.20	19.11	19.17	19.19	19.24	19.21	19.25	19.25	19.25	19.22	19.21	19.20	19.21
1992	19.20	19.00	19.03	19.05	19.06	19.06	19.06	19.06	19.06	19.05	19.06	19.04	19.06
1993	19.04	19.06	19.06	19.06	19.07	19.06	19.07	19.06	19.06	19.07	19.04	19.05	19.06
1994	19.04	19.06	19.06	19.05	19.06	19.06	19.06	19.05	19.04	19.05	19.06	19.06	19.05
1995	19.07	19.05	19.06	19.06	19.08	19.08	19.04	19.10	19.04	19.05	19.04	19.06	19.06
1996	19.05	19.06	19.00	19.05	19.06	19.04	19.04	19.04	19.03	19.04	19.01	19.00	19.04
1997	18.98	19.01	19.00	18.99	18.99	18.99	18.99	19.00	18.99	18.99	18.99	18.98	18.99
1998	18.89	18.87	18.83	18.86	18.86	18.85	18.85	18.84	18.83	18.84	18.90	18.85	18.85
1999	18.85	18.89	18.85			--	--	--			--	--	**

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	P.O.R*
Mean	19.07	19.06	19.07	19.08	19.10	19.09	19.09	19.09	19.08	19.08	19.09	19.08	19.08
Stand Dev	0.09	0.09	0.09	0.08	0.09	0.09	0.09	0.09	0.09	0.09	0.08	0.09	0.08
Minimum	18.87	18.87	18.83	18.86	18.86	18.85	18.85	18.84	18.83	18.84	18.90	18.85	18.85
Median	19.10	19.06	19.09	19.08	19.10	19.10	19.10	19.11	19.11	19.10	19.10	19.10	19.09
Maximum	19.20	19.16	19.17	19.19	19.24	19.21	19.25	19.25	19.25	19.22	19.21	19.23	19.21

*: indicates period of records for station and excludes partial year results

**: indicates partial year

--: indicates no data available or large gaps of missing data

Table H2. Monthly and annual average tailwater stage at S-153 (ft, NGVD)

Year	Month												Year Average
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1983	14.25	14.92	17.30	15.28	14.35	14.38	14.22	14.30	14.34	14.38	14.28	14.14	14.68
1984	14.27	14.22	14.31	14.39	14.28	14.27	14.30	14.37	14.30	14.20	14.22	14.12	14.27
1985	14.08	14.06	13.51	13.15	12.61	11.94	12.13	12.76	13.73	14.45	14.19	13.97	13.38
1986	14.04	14.16	14.22	13.98	13.19	13.12	14.09	14.35	14.29	14.27	14.26	14.30	14.02
1987	14.26	14.14	14.26	14.32	14.22	14.22	13.98	13.81	13.55	13.92	14.36	14.28	14.11
1988	14.34	14.34	14.28	14.25	14.25	14.28	14.33	14.27	14.07	14.07	14.10	14.07	14.22
1989	14.14	13.80	13.53	12.97	12.52	11.53	11.31	11.33	11.76	12.64	12.59	11.98	12.51
1990	11.74	12.09	11.78	10.70	10.41	10.41	11.14	11.95	12.45	13.01	12.39	11.84	11.66
1991	12.19	12.39	12.41	13.11	12.57	13.07	13.99	14.23	14.22	14.26	14.23	14.20	13.41
1992	14.08	14.22	14.15	14.16	14.14	14.39	14.18	14.24	14.29	14.26	14.34	14.29	14.23
1993	14.39	14.36	14.39	14.42	14.31	14.33	14.30	13.79	13.98	14.33	14.36	14.21	14.26
1994	14.15	14.40	14.36	14.22	13.91	14.17	14.27	14.23	14.33	14.38	14.46	14.57	14.29
1995	14.65	14.42	14.27	14.32	14.23	14.26	14.25	14.58	14.89	15.18	15.50	14.29	14.57
1996	14.14	14.17	14.30	14.22	14.23	14.18	14.19	14.11	14.09	14.17	14.15	14.20	14.18
1997	13.85	13.72	13.27	12.89	13.15	13.57	13.76	14.20	14.16	14.06	14.13	14.27	13.75
1998	14.31	14.63	17.30	16.01	14.35	14.42	14.37	14.26	14.15	14.03	14.30	14.13	14.69
1999	14.19	14.12	14.18	--	--	--	--	--	--	--	--	--	**

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	P.O.R*
Mean	13.93	14.00	14.23	13.90	13.54	13.54	13.68	13.80	13.91	14.10	14.12	13.93	13.89
Stand.Dev	0.79	0.75	1.42	1.18	1.09	1.22	1.09	0.94	0.77	0.57	0.71	0.80	0.81
Minimum	11.74	12.09	11.78	10.70	10.41	10.41	11.14	11.33	11.76	12.64	12.39	11.84	11.66
Median	14.15	14.19	14.27	14.22	14.18	14.20	14.19	14.23	14.15	14.23	14.24	14.20	14.20
Maximum	14.65	14.92	17.30	16.01	14.35	14.42	14.37	14.58	14.89	15.18	15.50	14.57	14.69

*: indicates period of records for station and excludes partial year results

**: indicates partial year

--: indicates no data available or large gaps of missing data

Table H3. Monthly and annual average headwater stage at S-308 (ft, NGVD)

Year	Month												Year Average
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1979		16.84	16.39	15.34	15.56	15.26	14.70	14.38	15.83	17.62	17.59	17.61	**
1980	17.52	17.11	16.60	16.35	15.85	15.30	15.00	14.94	15.15	14.84	14.40	14.11	15.60
1981	13.68	13.43	13.06	12.13	11.07	10.71	10.11	10.35	11.67	11.90	11.64	11.27	11.75
1982	10.97	10.77	10.96	11.13	10.88	12.38	14.66	15.91	16.56	17.16	17.44	17.24	13.86
1983	17.14	17.69	18.03	17.08	15.77	15.41	15.52	15.78	15.97	16.32	16.30	16.16	16.47
1984	16.68	16.67	16.48	16.26	15.59	15.48	15.93	16.25	16.12	16.04	15.55	15.40	16.04
1985	14.95	14.37	13.69	13.25	12.72	12.00	12.18	12.77	13.71	14.40	14.22	14.02	13.52
1986	14.09	14.17	14.26	14.03	13.24	13.12	14.11	14.59	15.16	15.02	14.98	14.71	14.29
1987	15.16	15.33	15.50	15.65	15.00	14.35	14.04	13.85	13.59	13.94	15.16	16.09	14.81
1988	16.10	16.28	16.32	16.00	15.46	15.30	15.26	15.69	16.04	15.50	15.11	14.69	15.65
1989	14.27	13.84	13.56	13.02	12.55	11.57	11.33	11.31	11.77	12.65	12.63	12.38	12.57
1990	12.37	12.40	12.08	11.32	10.81	10.64	11.16	11.92	12.41	12.93	12.85	12.49	11.95
1991	12.48	12.58	12.54	12.71	12.68	13.13	13.87	15.08	16.07	16.42	16.31	16.14	14.17
1992	15.84	15.71	15.58	15.27	14.68	14.43	15.69	15.73	16.32	16.30	16.02	15.97	15.63
1993	16.23	16.25	16.02	15.96	14.99	14.53	14.27	13.80	14.00	14.33	14.39	14.23	14.92
1994	14.18	14.43	14.51	14.25	13.93	14.16	14.87	15.33	16.21	17.23	17.16	17.49	15.31
1995	17.28	16.63	16.41	16.01	15.63	15.31	15.67	16.48	17.44	17.95	17.83	16.68	16.61
1996	16.26	15.68	15.62	15.73	15.16	15.50	15.75	15.29	15.16	15.02	14.70	14.25	15.34
1997	13.83	13.73	13.30	12.91	13.17	13.58	13.73	14.59	15.13	15.30	15.22	16.15	14.22
1998	17.29	17.93	18.29	17.48	16.07	14.93	14.44	14.81	15.21	15.71	16.26	16.27	16.23
1999	16.08	15.88	15.24	--				--	--		--	--	**

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	P.O.R*
Mean	15.07	15.09	14.96	14.59	14.04	13.86	14.12	14.44	14.98	15.34	15.30	15.18	14.68
Stand.Dev	1.88	1.93	1.98	1.91	1.77	1.63	1.67	1.68	1.62	1.67	1.68	1.76	1.45
Minimum	10.97	10.77	10.96	11.13	10.81	10.64	10.11	10.35	11.67	11.90	11.64	11.27	11.75
Median	15.16	15.51	15.54	15.30	14.84	14.39	14.55	14.88	15.19	15.40	15.19	15.69	14.92
Maximum	17.52	17.93	18.29	17.48	16.07	15.50	15.93	16.48	17.44	17.95	17.83	17.61	16.61

*: indicates period of records for station and excludes partial year results

**: indicates partial year

--: indicates no data available or large gaps of missing data

Table H4. Monthly and annual average tailwater stage at S-308 (ft, NGVD)

Year	Month												Year Average
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1981	--	--	--	--	--	--	--	--	--	11.35	10.09	9.84	**
1982	9.95	10.63	10.75	11.02	10.76	12.47	14.36	14.36	14.38	14.47	14.46	14.32	12.66
1983	14.32	15.03	17.47	15.39	14.39	14.43	14.29	14.36	14.40	14.45	14.35	14.22	14.76
1984	14.33	14.32	14.42	14.50	14.39	14.39	14.41	14.49	14.42	14.32	14.35	14.28	14.38
1985	14.20	14.17	13.65	13.26	12.71	11.99	12.17	12.79	13.78	14.48	14.22	14.03	13.45
1986	14.12	14.16	14.26	14.00	13.23	13.13	14.13	14.36	14.30	14.30	14.32	14.32	14.05
1987	14.30	14.17	14.29	14.35	14.24	14.27	14.02	13.85	13.59	13.97	14.40	14.31	14.15
1988	14.39	14.37	14.31	14.28	14.30	14.32	14.38	14.38	14.10	14.12	14.14	14.12	14.27
1989	14.17	13.84	13.57	13.00	12.56	11.57	11.34	11.39	11.80	12.45	12.55	12.01	12.52
1990	11.77	12.12	11.82	10.73	10.37	10.44	11.18	11.98	12.46	13.03	12.42	11.88	11.68
1991	12.21	12.42	12.45	13.14	12.59	13.09	13.98	14.25	14.23	14.29	14.24	14.23	13.43
1992	14.07	14.23	14.18	14.19	14.15	14.42	14.19	14.27	14.35	14.30	14.36	14.32	14.25
1993	14.43	14.38	14.40	14.46	14.33	14.35	14.32	13.81	14.00	14.33	14.38	14.22	14.28
1994	14.17	14.42	14.38	14.23	13.93	14.18	14.28	14.27	14.35	14.40	14.49	14.61	14.31
1995	14.69	14.45	14.30	14.34	14.24	14.28	14.26	14.61	14.94	15.23	15.56	14.32	14.60
1996	14.17	14.20	14.33	14.25	14.26	14.21	14.22	14.14	14.12	14.20	14.18	14.23	14.21
1997	13.87	13.75	13.30	12.92	13.18	13.60	13.79	14.23	14.19	14.09	14.16	14.30	13.78
1998	14.34	14.66	17.35	16.05	14.38	14.45	14.41	14.29	14.18	14.06	14.33	14.16	14.72
1999	14.22	14.15	14.21	--	--	--	--	--	--	--	--	--	**

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	P.O.R*
Mean	13.74	13.84	14.07	13.77	13.41	13.51	13.75	13.87	13.98	13.99	13.94	13.76	13.85
Stand.Dev	1.24	1.10	1.63	1.35	1.27	1.22	1.07	0.92	0.76	0.88	1.18	1.24	0.85
Minimum	9.95	10.63	10.75	10.73	10.37	10.44	11.18	11.39	11.80	11.35	10.09	9.84	11.68
Median	14.17	14.20	14.29	14.23	14.15	14.21	14.22	14.27	14.19	14.29	14.33	14.23	14.21
Maximum	14.69	15.03	17.47	16.05	14.39	14.45	14.41	14.61	14.94	15.23	15.56	14.61	14.76

*: indicates period of records for station and excludes partial year results

**: indicates partial year

--': indicates no data available or large gaps of missing data

Table H5. Monthly and annual average headwater stage at S-97 (ft, NGVD)

Year	Month												Year Average
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1986		--	22.13	20.31	20.21	21.50	20.56	21.28	21.22	20.44	22.30	22.22	**
1987	22.37	22.64	22.25	21.43	20.24	21.34	21.32	19.37	20.69	21.67	21.90	22.61	21.48
1988	22.33	22.62	22.52	19.93	22.35	20.27	21.48	21.38	19.99	19.58	21.91	21.62	21.33
1989	20.41	20.16	21.98	21.17	20.12	19.08	21.77	21.94	21.15	22.12	21.62	21.02	21.04
1990	22.16	22.05	20.51	18.70	17.68	21.79	22.01	21.71	21.07	21.70	22.47	20.44	21.02
1991	21.24	22.08	22.57	22.28	21.42	21.10	21.25	21.32	21.38	21.27	21.49	21.78	21.60
1992	20.48	21.52	21.52	21.76	16.55	20.18	21.21	20.06	20.97	21.15	21.77	22.39	20.80
1993	22.03	22.28	21.91	21.80	17.90	21.55	21.33	20.97	21.33	21.43	21.78	21.83	21.35
1994	22.68	21.68	22.14	21.45	21.11	21.21	21.29	21.10	20.83	21.14	21.88	21.68	21.52
1995	22.16	22.23	22.29	19.95	18.93	20.22	21.84	20.18	18.54	19.59	20.76	17.21	20.33
1996	20.07	18.61	20.82	21.56	20.30	21.52	19.00	19.29	20.66	20.51	21.23	20.34	20.33
1997	21.25	21.91	20.64	20.59	22.02	21.55	21.55	21.16	20.37	22.14	22.61	22.72	21.54
1998	22.37	20.68	21.32	18.53	18.00	17.57	19.27	20.92	20.47	20.78	21.89	21.60	20.28
1999	22.43	20.43	15.62	--			--	--	--	--			**

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	P.O.R*
Mean	21.63	21.54	21.74	20.73	19.76	20.68	21.07	20.82	20.67	21.01	21.82	21.34	21.05
Stand.Dev	0.90	1.18	0.71	1.19	1.81	1.22	0.93	0.84	0.76	0.84	0.49	1.44	0.51
Minimum	20.07	18.61	20.51	18.53	16.55	17.57	19.00	19.29	18.54	19.58	20.76	17.21	20.28
Median	22.10	21.98	21.98	21.17	20.21	21.21	21.32	21.10	20.83	21.15	21.88	21.68	21.19
Maximum	22.68	22.64	22.57	22.28	22.35	21.79	22.01	21.94	21.38	22.14	22.61	22.72	21.60

Table H6. Monthly and annual average tailwater stage at S-97 (ft. NGVD)

Year	Month												Year Average
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1986		-	8.19	7.89	7.86	8.99	9.04	9.09	8.80	8.32	8.26	8.29	**
1987	8.48	8.23	8.45	8.23	8.07	8.04	8.17	8.10	8.20	8.97	9.02	8.12	8.34
1988	8.17	8.32	8.20	7.95	7.99	7.94	8.36	8.86	8.30	8.00	8.10	8.03	8.18
1989	8.04	8.03	8.06	8.05	7.98	7.94	8.08	8.50	8.15	8.41	8.06	8.13	8.12
1990	8.01	8.05	7.97	7.95	7.85	8.01	8.19	8.42	8.49	8.76	8.11	8.02	8.15
1991	8.22	8.23	8.06	8.56	8.16	8.54	8.95	8.47	8.19	8.67	8.09	8.10	8.38
1992	8.08	8.07	8.06	8.01	7.90	8.74	9.00	9.46	8.87	8.47	8.82	8.18	8.47
1993	9.11	8.42	8.86	8.27	8.06	8.24	8.47	8.29	8.62	8.62	8.25	8.12	8.45
1994	8.36	8.79	8.30	8.48	8.50	9.46	8.80	8.84	9.31	8.79	9.06	8.76	8.79
1995	8.27	8.15	8.32	8.06	8.01	8.04	8.04	9.79	9.37	10.69	8.11	8.08	8.58
1996	8.07	8.06	8.62	8.41	8.35	9.10	8.53	8.34	8.24	8.59	8.21	8.11	8.39
1997	8.12	8.06	8.04	8.32	8.14	8.44	8.87	8.98	8.64	8.07	8.05	8.23	8.33
1998	8.49	9.10	8.55	7.98	7.95	8.01	8.03	8.48	8.76	8.17	8.78	8.00	8.36
1999	8.01	8.01	7.92	--	--				--	--			**

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	P.O.R*
Mean	8.29	8.29	8.28	8.17	8.07	8.42	8.50	8.74	8.63	8.66	8.38	8.17	8.38
Stand.Dev	0.31	0.34	0.27	0.23	0.19	0.51	0.39	0.49	0.39	0.68	0.39	0.20	0.19
Minimum	8.01	8.03	7.97	7.89	7.85	7.94	8.03	8.10	8.15	8.00	8.05	8.00	8.12
Median	8.19	8.19	8.20	8.06	8.04	8.24	8.47	8.50	8.62	8.59	8.21	8.12	8.37
Maximum	9.11	9.10	8.86	8.56	8.50	9.46	9.04	9.79	9.37	10.69	9.06	8.76	8.79

*: indicates period of records for station and excludes partial year results

**: indicates partial year

-: indicates no data available or large gaps of missing data

Table H7. Monthly and annual average headwater stage at S-48 (ft, NGVD)

Year	Month												Year
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
1994	--	--	--	--	8.53	9.39	8.80	8.83	9.26	8.79	9.03	8.76	**
1995	8.32	8.21	8.37	8.13	8.11	8.11	8.11	9.70	9.34	10.52	8.16	8.11	8.60
1996	8.10	8.08	8.61	8.42	8.31	8.74	8.51	8.32	8.24	8.58	8.24	8.14	8.36
1997	8.16	8.12	8.10	8.36	8.19	8.48	8.89	9.02	8.71	8.17	8.15	8.33	8.39
1998	8.59	9.17	8.63	8.08	8.05	8.13	8.14	8.59	8.77	8.25	8.83	8.10	8.44
1999	8.11	8.10	8.01	--	--	--	--	--	--	--	--	--	**

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	P.O.R*
Mean	8.29	8.40	8.43	8.25	8.24	8.57	8.49	8.89	8.87	8.86	8.48	8.29	8.45
Stand.Dev	0.22	0.52	0.25	0.17	0.19	0.53	0.36	0.52	0.45	0.96	0.42	0.28	0.11
Minimum	8.10	8.08	8.10	8.08	8.05	8.11	8.11	8.32	8.24	8.17	8.15	8.10	8.36
Median	8.24	8.16	8.49	8.25	8.19	8.48	8.51	8.83	8.77	8.58	8.24	8.14	8.42
Maximum	8.59	9.17	8.63	8.42	8.53	9.39	8.89	9.70	9.34	10.52	9.03	8.76	8.60

*: indicates period of records for station and excludes partial year results
**: indicates partial year
--': indicates no data available or large gaps of missing data

Table H8. Monthly and annual average headwater stage at S-135 (ft. NGVD)

Year	Month												Year
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
1979	--	13.87	13.84	13.61	13.79	13.64	13.71	13.58	13.67	13.92	15.78	13.59	**
1980	13.80	13.83	13.82	13.86	13.84	13.60	13.68	13.75	13.85	13.83	13.88	13.82	13.80
1981	13.53	13.30	12.93	12.00	10.91	10.43	9.37	10.21	11.66	11.78	11.48	11.10	11.56
1982	10.80	10.78	10.97	11.12	10.86	12.50	13.78	13.79	13.83	13.76	13.83	13.73	12.48
1983	13.81	13.71	13.78	13.82	13.66	13.73	13.85	13.69	13.61	13.55	13.74	13.71	13.72
1984	13.81	13.75	13.71	13.47	13.66	13.81	13.79	13.66	13.65	13.75	13.70	13.84	13.72
1985	13.86	13.69	13.67	13.23	12.70	12.01	12.21	12.80	13.49	13.44	13.40	13.58	13.17
1986	13.73	13.69	13.56	13.74	13.20	13.12	14.09	14.33	13.73	13.43	13.62	13.76	13.67
1987	13.71	13.75	13.68	13.61	13.73	13.44	13.78	13.70	13.59	13.64	13.68	13.74	13.67
1988	13.81	13.74	13.64	13.54	13.65	13.67	13.70	13.68	13.64	13.51	13.74	13.76	13.67
1989	13.47	13.65	13.52	13.01	12.55	11.64	11.34	11.37	11.80	12.65	12.57	12.29	12.49
1990	12.33	12.36	12.04	11.28	10.79	10.65	11.13	11.86	12.37	12.90	12.80	12.45	11.91
1991	12.48	12.44	12.53	12.70	12.54	13.05	13.86	14.23	14.22	14.26	14.23	14.20	13.40
1992	14.07	13.58	13.51	13.51	13.48	13.63	13.48	13.36	13.47	13.43	13.54	13.55	13.55
1993	13.49	13.55	13.46	13.49	13.37	13.52	13.50	13.66	13.50	13.45	13.65	13.74	13.53
1994	13.74	13.59	13.64	13.64	13.59	13.66	13.60	13.68	13.75	13.63	13.50	13.68	13.64
1995	13.61	13.62	13.62	13.57	13.61	13.58	13.56	13.46	13.60	13.63	13.64	13.63	13.59
1996	13.65	13.43	13.58	13.65	13.63	13.62	13.39	13.59	13.57	13.61	13.52	13.57	13.57
1997	13.62	13.43	13.25	12.92	13.17	13.50	13.53	13.51	13.57	13.60	13.62	13.59	13.44
1998	13.60	13.52	13.56	13.54	13.56	13.56	13.49	13.53	13.39	13.50	13.70	13.68	13.55
1999	13.69	13.49	13.60	--	--	--	--	--	--	--	--	--	**

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	P.O.R*
Mean	13.42	13.36	13.32	13.17	13.01	13.02	13.14	13.27	13.40	13.46	13.58	13.45	13.27
Stand.Dev	0.77	0.73	0.71	0.80	1.01	1.03	1.20	1.00	0.66	0.52	0.78	0.71	0.66
Minimum	10.80	10.78	10.97	11.12	10.79	10.43	9.37	10.21	11.66	11.78	11.48	11.10	11.56
Median	13.65	13.60	13.57	13.53	13.52	13.54	13.58	13.62	13.60	13.57	13.64	13.68	13.55
Maximum	14.07	13.87	13.84	13.86	13.84	13.81	14.09	14.33	14.22	14.26	15.78	14.20	13.80

Table H9. Monthly and annual average tailwater stage at S-135 (ft, NGVD)

Year	Month												Year Average
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1979		16.81	16.36	15.32	15.54	15.24	14.68	14.36	15.81	17.58	17.56	17.58	**
1980	17.48	17.08	16.57	16.32	15.82	15.28	14.98	14.92	15.13	14.82	14.38	14.09	15.57
1981	13.66	13.42	13.05	12.13	11.07	10.71	10.12	10.35	11.67	11.84	11.55	11.22	11.73
1982	10.97	10.92	10.98	11.16	10.96	12.48	13.69	15.93	16.58	17.45	17.42	17.19	13.89
1983	17.07	17.68	18.04	17.10	15.79	15.46	15.53	15.73	15.81	16.23	16.53	16.46	16.45
1984	16.69	16.65	16.45	16.20	15.50	15.38	15.82	16.18	16.11	16.02	15.50	15.38	15.99
1985	14.92	14.31	13.61	13.18	12.70	11.96	12.14	12.77	13.71	14.45	14.26	14.02	13.50
1986	14.10	14.18	14.18	13.98	13.22	13.11	14.10	14.57	15.16	15.03	15.00	14.71	14.28
1987	15.15	15.33	15.51	15.68	15.03	14.39	14.06	13.87	13.61	13.89	15.15	16.06	14.81
1988	16.05	16.26	16.30	15.97	15.44	15.32	15.27	15.72	16.09	15.49	15.13	14.67	15.64
1989	14.28	13.84	13.55	13.05	12.62	11.65	11.38	11.36	11.81	12.63	12.61	12.33	12.59
1990	12.36	12.40	12.09	11.32	10.95	10.76	11.16	11.91	12.11	12.91	12.83	12.47	11.96
1991	12.48	12.58	12.54	12.70	12.68	13.13	13.86	15.06	16.05	16.40	16.29	16.12	14.16
1992	15.81	15.69	15.39	15.16	14.66	14.41	15.66	15.71	16.29	16.29	15.82	15.88	15.56
1993	16.22	16.25	16.04	15.96	15.01	14.57	14.32	13.82	14.02	14.33	14.42	14.28	14.94
1994	14.22	14.46	14.56	14.31	14.02	14.27	14.96	15.47	16.34	17.37	17.27	17.44	15.39
1995	17.20	16.51	16.32	15.93	15.54	15.23	15.59	16.42	17.38	17.88	17.74	16.55	16.52
1996	16.12	15.66	15.59	15.71	15.13	15.48	15.72	15.26	15.14	15.00	14.68	14.23	15.31
1997	13.82	13.72	13.29	12.90	13.16	13.57	13.72	14.57	15.11	15.28	15.20	16.12	14.20
1998	17.25	17.89	18.25	17.44	16.04	14.90	14.42	14.80	15.19	15.69	16.24	16.24	16.20
1999	16.05	15.85	15.21	--	--			--	--	--		.	**

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	P.O.R*
Mean	15.05	15.08	14.93	14.58	14.04	13.86	14.11	14.44	14.97	15.33	15.28	15.15	14.67
Stand.Dev	1.86	1.90	1.97	1.90	1.74	1.60	1.65	1.66	1.61	1.68	1.68	1.75	1.44
Minimum	10.97	10.92	10.98	11.16	10.95	10.71	10.12	10.35	11.67	11.84	11.55	11.22	11.73
Median	15.15	15.50	15.45	15.24	14.83	14.40	14.55	14.86	15.18	15.38	15.17	15.63	14.94
Maximum	17.48	17.89	18.25	17.44	16.04	15.48	15.82	16.42	17.38	17.88	17.74	17.58	16.52

Table H10. Monthly and annual average headwater stage at S-80 (ft, NGVD)

Year	Month												Year Average
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1987		--	--		--	--	--			13.91	14.32	14.27	**
1988	14.38	14.35	14.22	14.29	14.29	14.34	14.35	14.31	14.08	14.11	14.15	14.13	14.25
1989	14.19	13.84	13.60	12.97	12.48	11.53	11.39	11.34	11.86	12.70	12.64	12.06	12.55
1990	11.80	12.14	11.82	10.73	10.40	10.50	11.20	12.09	12.55	13.11	12.44	11.90	11.72
1991	12.26	12.47	12.49	13.20	12.59	13.16	14.13	14.30	14.26	14.29	14.26	14.23	13.47
1992	14.14	14.28	14.21	14.20	14.18	14.46	14.23	14.26	14.27	14.29	14.37	14.34	14.27
1993	14.35	14.31	14.43	14.28	14.34	14.40	14.40	13.89	14.06	14.45	14.42	14.27	14.30
1994	14.16	14.40	14.43	14.31	13.97	14.26	14.28	14.23	14.29	14.24	14.11	13.98	14.22
1995	13.93	14.12	14.16	14.24	14.29	14.32	14.30	14.06		--	--		**

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	P.O.R*
Mean	13.65	13.74	13.67	13.53	13.32	13.37	13.53	13.56	13.62	13.89	13.84	13.65	13.54
Stand.Dev	1.02	0.91	0.99	1.25	1.41	1.54	1.39	1.16	1.00	0.64	0.81	1.04	1.03
Minimum	11.80	12.14	11.82	10.73	10.40	10.50	11.20	11.34	11.86	12.70	12.44	11.90	11.72
Median	14.15	14.20	14.19	14.22	14.08	14.29	14.26	14.15	14.08	14.17	14.24	14.18	14.22
Maximum	14.38	14.40	14.43	14.31	14.34	14.46	14.40	14.31	14.29	14.45	14.42	14.34	14.30

*: indicates period of records for station and excludes partial year results

**: indicates partial year

--: indicates no data available or large gaps of missing data