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MAGNITUDE AND FREQUENCY OF FLOOD DISCHARGES IN NORTHEAST FLORIDA

by

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ABSTRACT

St. Johns River Water Management District has regulatory jurisdiction over management and storage of surface waters within its boundaries (Figure 1). These surface waters include a major portion of the St. Marys River Basin, all of the Nassau and St. Johns River Basins, and several coastal drainage basins. This publication presents data on past floods and the highest flood elevation recorded for 68 locations which have five or more years of streamflow records. For 62 of these sites which have 10 or more years of data, flood flow frequency analyses have been performed and the peak flow estimates for return periods, T = 5 yr, 10 yr, 25 yr, 50 yr, 100 yr, and 500 yr are presented. Regional regression models have been developed for computing approximate peak flows at ungaged sites. This information will be useful for determining expected flood elevations, project evaluation, and establishing predevelopment discharges in connection with management and storage of surface water permit requirements of the District.

INTRODUCTION

Rivers provide several benefits to mankind such as, water supply, navigation, recreation, food supply, etc. However, rivers also bring floods causing extensive damage to life and property. Many engineering techniques have been developed for harnessing the flow of rivers. Knowledge of magnitude and frequency of flood flows is essential for development of flood control and management alternatives, and for proper design, evaluation, and planning of several other activities along the rivers.

Floods of large magnitude occur due to an unusual combination of meteorologic and hydrologic phenomena. However, manmade alterations in river basin hydrologic characteristics can also contribute to increased flooding. For instance, urbanization and associated floodplain encroachment, if not accompanied by proper design, can increase the rate and volume of runoff produced during a storm event. Appropriate measures for control of these activities in very sensitive areas and provision of compensatory measures to prevent aggravation of floods are essential for flood protection oriented river basin management.

Chapter 373 of the *Florida Statutes*, also known as the "Florida Water Resources Act of 1972," created the St. Johns River Water Management District (SJRWMD) with water resource regulatory authority in all or parts of 19 counties in northeast Florida (Figure 1). By this Act, the Legislature has vested in the Department of Environmental Regulation and in the governing boards of the five water management districts the power and

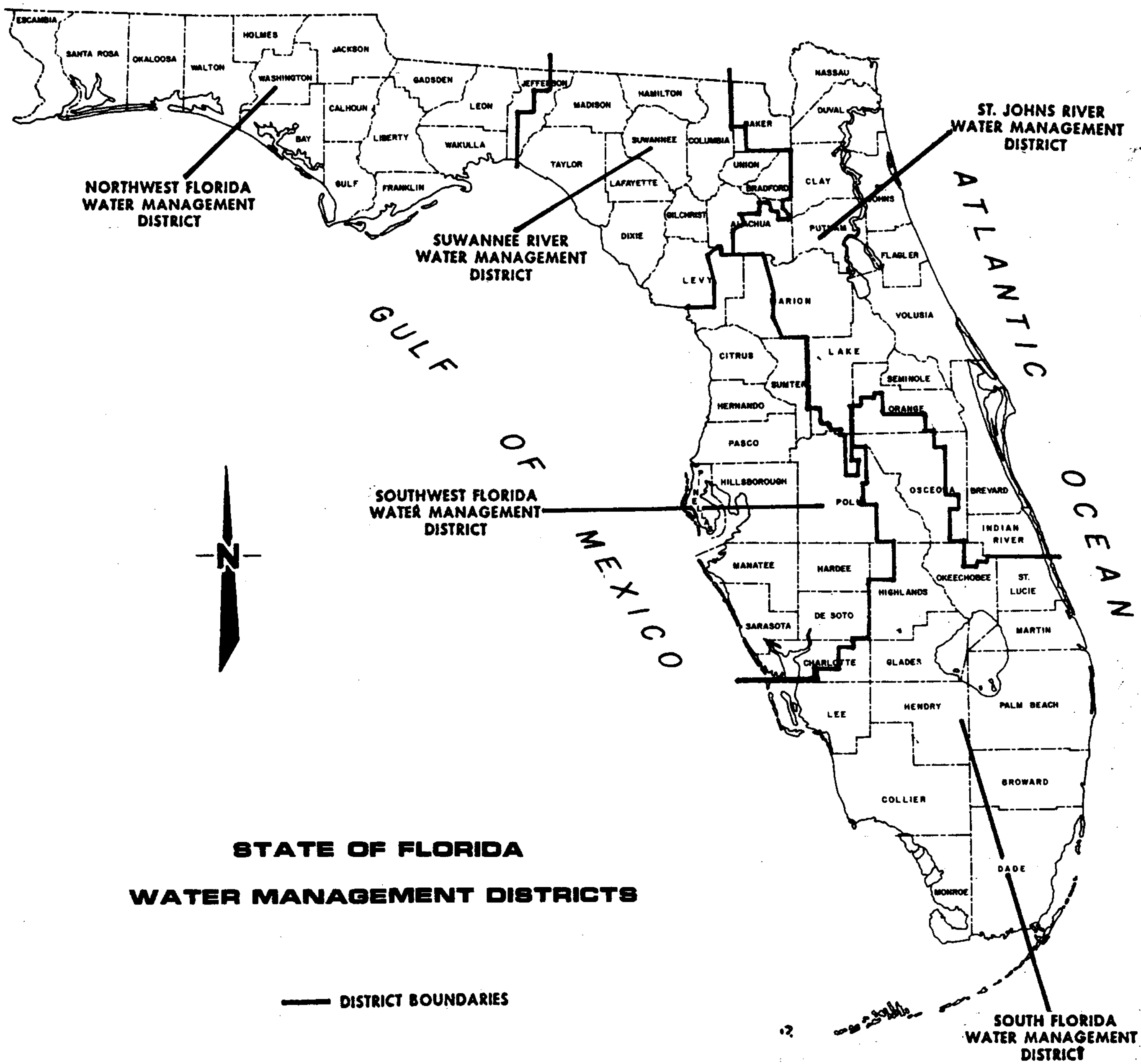

Figure 1. State of Florida Water Management Districts

responsibility to accomplish conservation, protection, management and control of waters in the state. While some of the broader objectives of the SJRWMD include development and implementation of comprehensive water management plans for different river basins, the District also has regulatory jurisdiction over management and storage of surface waters. When certain thresholds are exceeded a permit is required from the District for completion and/or implementation of surface water related developments (6).

This publication will provide streamflow information including observed high flows for streams of northeast Florida located in the SJRWMD. Additionally, for locations with 10 years or more of annual peak flow data, flood flow frequency analyses have been conducted and the peak flow estimates for return periods, T = 5 yr, 10 yr, 25 yr, 50 yr, 100 yr, and 500 yr are presented. Regional regression models are developed for computing approximate peak flows at ungaged sites. This information will be useful for determining expected flood elevations, future project evaluation, and establishing predevelopment discharges in connection with management and storage of surface water or works of the District permit requirements.

CLIMATE

The St. Johns River Water Management District, situated between 17 1/2 and 31 degrees north latitude, overlaps the transitional zone between the sub-tropical climate characteristics of South Florida, and the humid, temperate climate associated with the remainder of the southeastern United States.

Temperatures: Mean annual temperatures in the District range from 69^{o} F (Glen St. Mary) to about 74^{o} F (Orlando). Daily summer maximums and minimums average about 90^{o} F and 72^{o} F, respectively. The mean daily lows range from 66^{o} F (Glen St. Mary) to 71^{o} F (Vero Beach). Freezing temperatures occur on an average 10 to 15 times per winter in northern parts.

Precipitation: Precipitation in the District occurs primarily as rainfall. The normal District-wide rainfall is about 52 inches, a major portion of which occurs as short duration showers and thunderstorms from May through October. Tropical disturbances can affect District rainfall patterns and contribute large amounts of rain over a short period of time.

Evaporation: Average annual pan evaporation in northeast Florida ranged from 59.2 inches (Lisbon, 1960-1984) to 70.7 inches (Lake Alfred, 1965-1984). Three other stations in the region, i.e. Lake City, Gainesville, and Vero Beach, recorded 65.5 inches (1965-1984), 65.1 inches (1954-1984), and 67.1 inches (1952-1984), respectively. Using a pan coefficient of 0.72 to determine lake evaporation, the mean annual lake evaporation for the District is determined as about 47 inches.

THE DATA ANALYZED

A systematic collection of water resources data in the State of Florida began in 1930 by the U.S. Geological Survey (USGS) in cooperation with state, other federal, and local agencies. Recording discharges and stage of streams is a part of this program. The consolidated water resources data (e.g., stages on lakes and streams, discharges, water quality parameters, etc.) are published in yearly volumes (see, for example, Reference No. 13).

The USGS operates three types of stations for discharge measurements: (1) continuous stations, (2) partial-record stations, and (3) miscellaneous sites. Continuous stations provide daily discharge including instantaneous peak flow for several sites. At partial-record stations two types of data, low-flow and crest-stage, are collected. A crest-stage gage is a device which will register the peak stage occurring between inspections of the gage. A stage-discharge relation for the gage gives the corresponding flow value. Crest-stage partial-record stations furnish annual peak flows. In addition, discharge measurements are made at miscellaneous sites generally in times of drought or flood to give better areal coverage to those events.

To evaluate and analyze water resource related data from a regional perspective, the SJRWMD has been divided into nine hydrologic planning units based on surface water divides (Figure 2). Discharge measurements are available at about 150 sites within these units. However, only 82 are continuous stations,

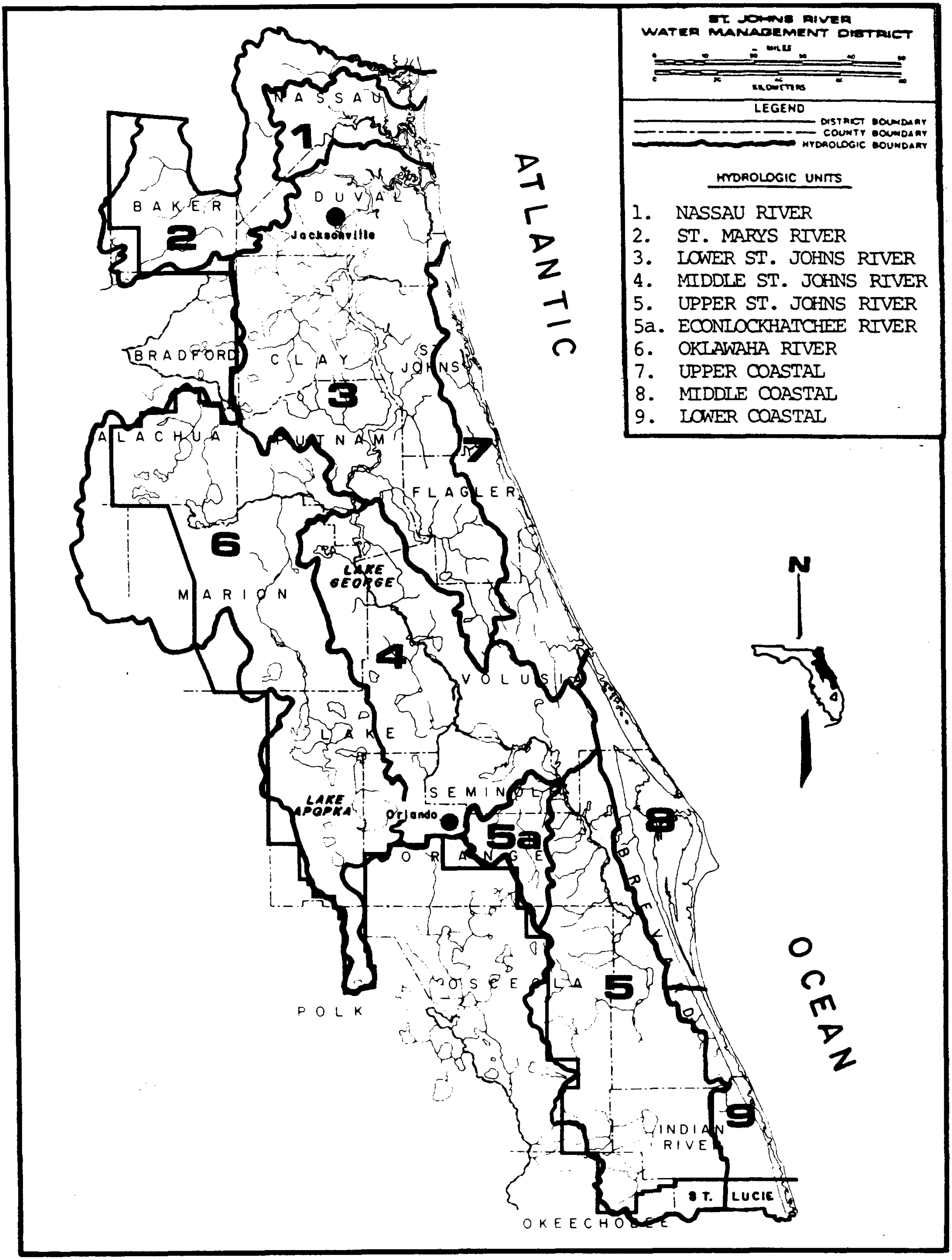

Figure 2. Hydrologic (Planning) Units Within the St. Johns River Water Management District

of which 18 were discontinued. Stations with no regulation of flow and with at least 10 years of data are chosen for analysis. Stations with 8 or 9 years of data also were analyzed if they are discontinued stations or the results appeared reasonable. A climatic year ending May 31 was chosen as the reference year. In this part of Florida, maximum floods occur normally during the period from June through October. Occasionally, some flooding occurs also in spring (March-April), especially in the northern portion of the District. Thus, the end of May appears to be a cutoff point in the year to distinguish yearly maximum flows.

The maximum discharge data and results are presented by Hydrologic Planning Units. For stations with 5 or more years of continuous records, the highest mean discharge recorded for 1-, 7-, 14-, 30-, 60-, 120-, 183-, and 274 consecutive days are presented. For crest-stage partial record stations, only the annual peak flow data are presented. (Note: the 1983-84 data were not officially published at the time of this report, but provided by the USGS on a preliminary basis.)

METHODOLOGY

Flood magnitudes for different return periods (T) are determined by the statistical technique of frequency analysis. If P is the annual exceedance probability of a maximum event (like the annual flood) the return period is given by $T = 1/P$. Thus, the analysis consists of determining flood flows associated with several P values of interest. The common technique consists of choosing an appropriate probability distribution and fitting it to sample data by one of the available statistical procedures. The sample data consist of observed annual peak flows.

Several probability distributions have been used to determine the frequencies of hydrologic variables (2, 7, 8). These vary in complexity from the simple two-parameter Gumbel distribution (4) to the five-parameter Wakeby distribution (5). The United States Water Resources Council has recommended the use of log Pearson type 3 distribution by the moments of logarithmic data and provided detailed guidelines in their Bulletin #17B (3). However, they have made a provision that where the Bulletin #17B does not give reasonable estimates, other approaches may be used provided they are properly documented and comparisons are made with Bulletin #17B results.

In this publication estimates of flood flows were obtained for return periods T = 5 yr, 10 yr, 25 yr, 50 yr, 100 yr, and 500 yr by using guidelines provided in Bulletin #17B and also by fitting log Pearson type 3 distribution by the method of Mixed Moments. By a study conducted at the District, it is shown that the logarithmic moments method recommended by Bulletin #17B gives positively biased estimates of flood flows when the logarithmic skew of data is negative (9, 10, 11); the logarithms of annual peak flows of Florida streams are, in general, negatively skewed. A separate section is provided at the end regarding interpretation and use of these results. The method of Mixed Moments is described in Appendix A. In applying Bulletin #17B, a regional log skew of -0.15 was used.

PREVIOUS STUDIES

The U.S. Geological Survey completed a flood flow frequency analysis report for Florida in 1982 in cooperation with Florida Department of Transportation (1). This report used guidelines provided in Water Resources Council Bulletin 17A (1977) and the flood flow data available through September 1978.

The flood flow estimates presented in this report may be regarded as up-to-date and more accurate than those given in the USGS report due to the following reasons:

1. Water Resources Council Bulletin #17B (1982) is used, which has several important revisions over Bulletin #17A.
2. Peak flow data available through 1984 is used.
3. For choosing annual peak flows from daily data, a climatic year ending May 31 is used in this report whereas the Water Year (ending September 30) was used in the USGS report. Use of the Water Year for this purpose is inaccurate because major floods occur through the month of October in this part of Florida. As a result, in many instances high flows from the same flooding event may be counted as annual peak flows for two consecutive years. For example, Hurricane David in 1979 produced floods in late September, and high flows persisted for several days in October. Using Water Years will pick up September and October 79 maximum discharges as annual peak flows for 1979 and 1980, respectively. This is incorrect since both high flows are from the same flooding season.

THE NASSAU AND THE ST. MARYS RIVER BASINS

The Nassau and the St. Marys River basins (Hydrologic Planning Units 1 and 2, respectively) are located in the northern portion of the District (Figure 2). The St. Marys River Basin (Figure 3) has a total drainage area of 1505 sq. mi. of which a 540 sq. mi. area is in Georgia. The north prong of the St. Marys River originates in the Okefenokee Swamp in Georgia, and flows south until it joins the South Prong near Macclenny. It then flows north to Boulogne where the river turns easterly and flows to the Atlantic Ocean. In downstream reaches the flow reverses twice daily as a result of ocean tides.

The Nassau River drains an area of 435 sq. mi. and extends for a length of 32 mi. eastward (Figure 4). It has two principal tributaries; the Thomas Creek and the Mills Creek.

Table 1 presents some general information on the USGS long-term stream gaging stations. Flood discharges for different return periods are summarized in Table 2 for eight sites. Tables 3 through 11 furnish high flow data for selected gaging stations. (Note: The 1-day highest discharges appearing in these tables represent instantaneous peak flows. For crest-stage partial record stations only annual peak flows are given; data might be missing for some years.)

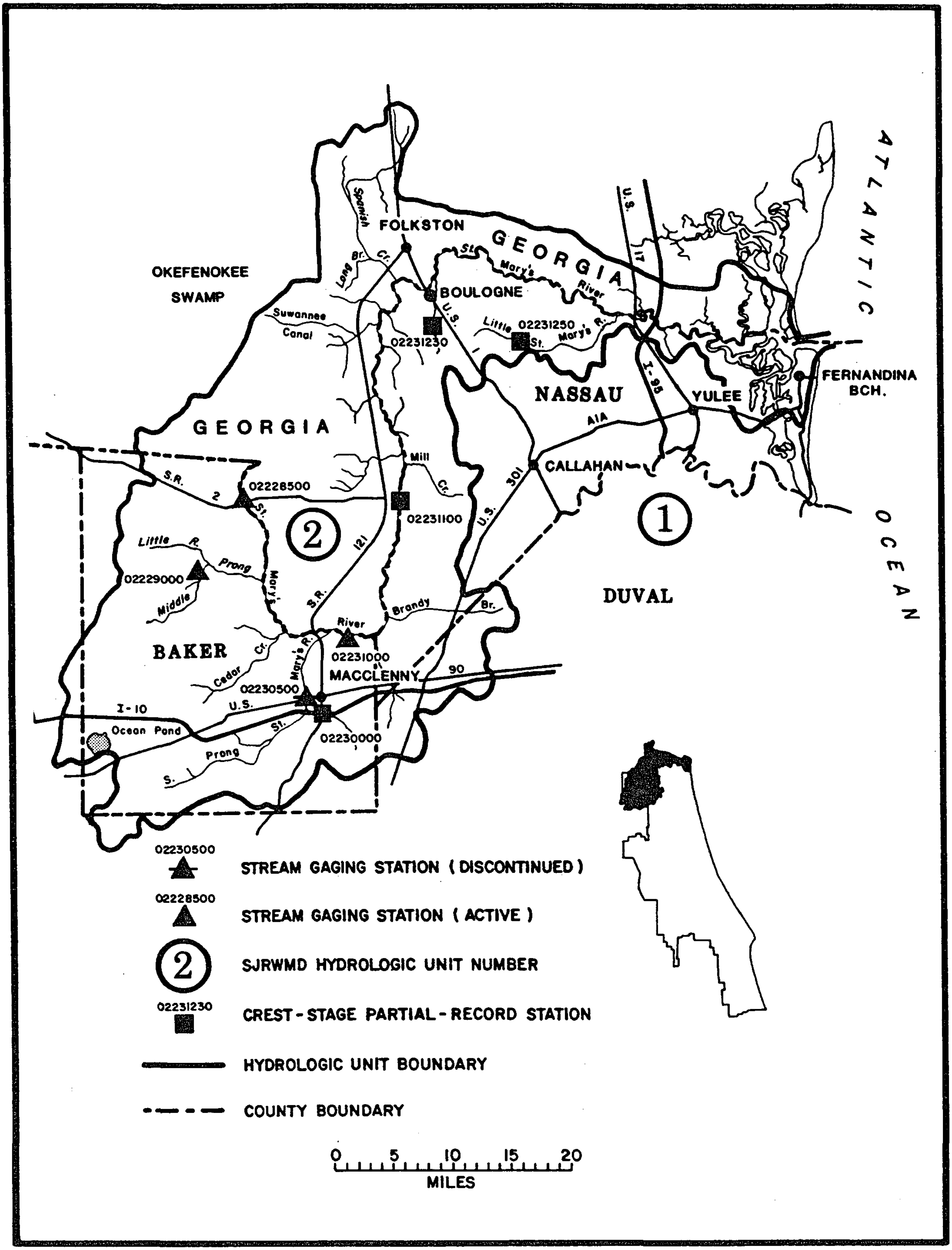

Figure 3. The St. Marys River Basin (Hydrologic Unit Number 2)

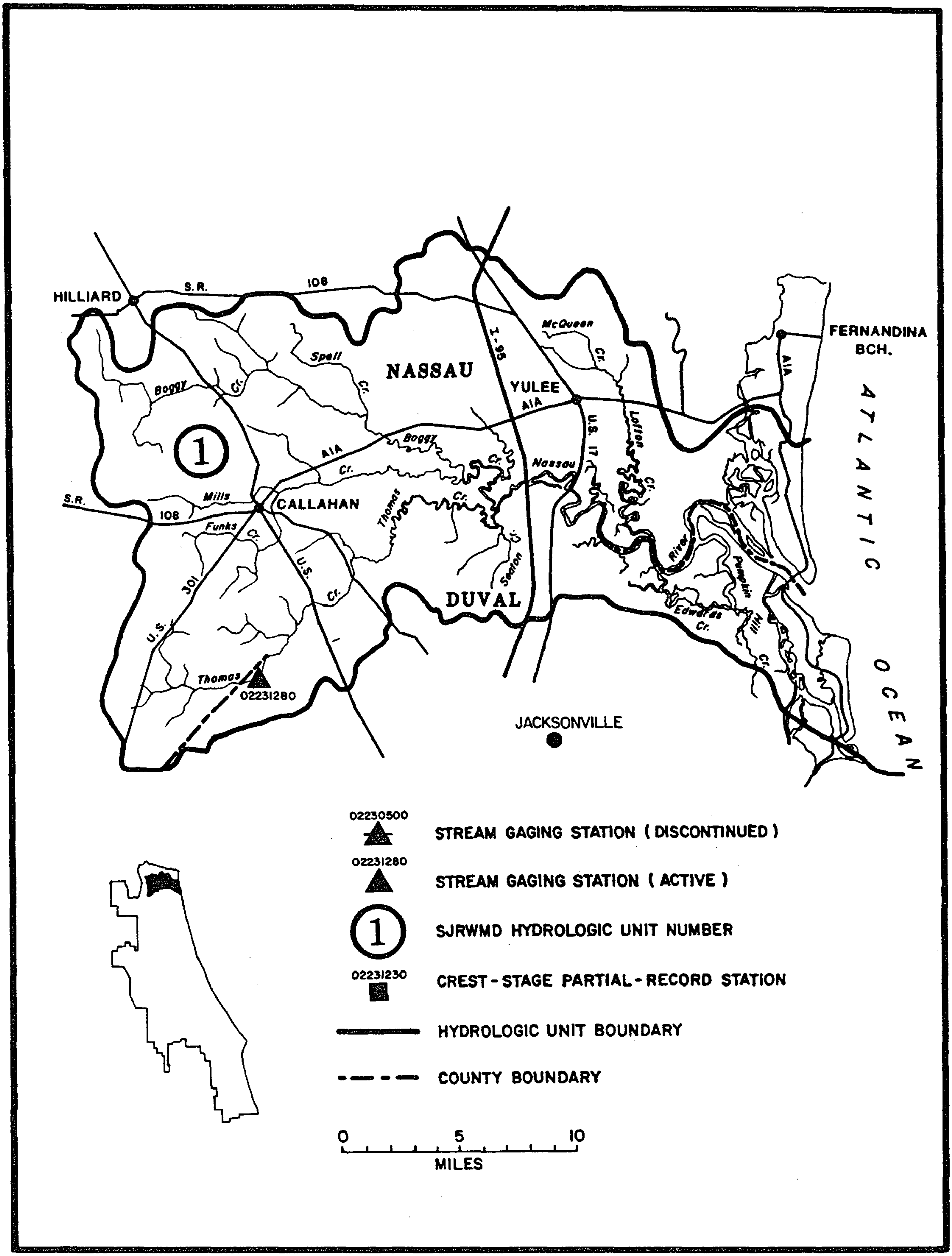

Figure 4. The Nassau River Basin (Hydrologic Unit Number 1)

TABLE 1. General Information on the Long-Term Stream Gaging Stations in the Nassau and St. Marys River Basins

USGS Station No. and Name	Location	Drainage Area Sq. Mi.	Period of Record	Recorded Peak Elv. ft. NGVD	Remarks
Nassau River Basin: (Hydrologic Unit No. 1, Fig. 3)					
02231280 Thomas Creek near Crawford	Duval Co.: At bridge on Acree Rd., 4.4 mi. southeast of Crawford	29.9	Jan 1965-Current Yr	21.04 (1973)	Peak flood mark = 23.3 ft, Sept. 1950
St. Marys River Basin: (Hydrologic Unit No. 2, Fig. 3)					
02228500 North Prong St. Marys Rvr at Moniac	Baker Co.: At bridge on SR 2 & 94	160 (Approx)	Jan 1923-Dec 23 Jan 27 -Jun 30 July 32 -Jun 34 Oct 50 -Current Year	112.38 (1973)	
02229000 Middle Prong St. Marys Rvr at Taylor	Baker Co.: At bridge on SR 125	125 (Approx)	Sept 1955-Sept 67 Apr 76 -Current Year	104.00 (1964)	
02230000 Turkey Creek at Macclenny	Baker Co.: At bridge on SR 121	19.9	Sept 1955-Sept 69 1970-Current Year*	108.35 (1964)	*Crest-Stage Partial-Record Station
02230500 South Prong St. Marys Rvr at Glen St. Mary	Baker Co.: At bridge on US 90	130	Jan 1950-Sept 71	91.36 (1964)	Gaging station discontinued.
02231000 St. Marys Rvr near Macclenny	Baker Co.: Nr former Stokes Bridge, 6 mi. northeast of Macclenny	700 (Approx)	Oct 1926-Current Year	63.25 (1964)	
02231100 St. Marys Rvr near St. George	Nassau Co.: At bridge on SR 2	900 (Approx)	1947, 54, 64-73	42.43 (1964)	Crest-Stage Partial-Record Station Discontinued.
02231230 Pigeon Creek at Boulogne	Nassau Co.: At bridge on US 1 and 301	9.36	Oct 1968-Sept 76	23.98 (1970)	Crest-Stage Partial-Record Station
02231250 Little St. Marys Rvr near Hilliard	Nassau Co.: At bridge on SR 115A	19.8	1961-65* 1965-67 1968-Current Year*	15.96 (1964)	*Crest-Stage Partial-Record Station

TABLE 2. Estimates of Flood Flows at Gaged Sites in the Nassau and St. Marys River Basins

(First Line: Log Pearson type 3 analysis using the WRC guidelines, Bulletin #17B.)
(Second Line: Log Pearson type 3 analysis using the Method of Mixed Moments.)

Gaging Station	Record Length (Years)	Highest Discharge During Period of Record (cfs)	Mean Annual High Discharge (cfs)	Discharge in cfs which may be equaled or exceeded in: 5 Yr	10 Yr	25 Yr	50 Yr	100 Yr	500 Yr
Nassau River Basin									
1. Thomas Creek near Crawford	19	4,020	1,040	1,520	2,280	3,530	4,680	6,030	10,100
				1,550	2,230	3,230	4,070	4,960	7,280
St. Marys River Basin									
1. North Prong St. Marys River at Moniac	40	11,600	1,997	2,830	3,930	5,580	7,000	8,590	13,000
				2,950	4,250	6,180	7,810	9,580	14,300
2. Middle Prong St. Marys River at Taylor	20	3,920	1,242	1,740	2,390	3,360	4,200	5,150	7,820
				1,740	2,360	3,280	4,060	4,920	7,280
3. Turkey Creek at Macclenny	25	2,600	1,030	1,380	1,730	2,190	2,570	2,950	3,940
				1,370	1,710	2,160	2,510	2,890	3,820
4. South Prong St. Marys at Glen St. Mary	23	7,510	2,634	4,050	5,510	7,480	9,020	10,600	14,300
				4,180	5,530	7,060	8,060	8,930	10,600
5. St. Marys River near Macclenny	57	28,100	7,454	10,300	14,900	22,500	29,500	38,000	64,400
				11,100	15,800	22,600	28,200	34,300	50,000
6. Pigeon Creek at Boulogne	8	682	384	533	653	805	917	1,030	1,290
				515	621	754	851	947	1,170
7. Little St. Marys River near Hilliard	17	3,000	923	1,260	1,720	2,420	3,050	3,770	5,880
				1,260	1,720	2,410	3,020	3,710	5,700

TABLE 3. HIGH FLOW DATA FOR THOMAS CREEK NEAR CRAWFORD.

@@@@@ THOMAS CREEK NEAR CRAWFORD, DISCH CFS(1966-84)

HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1966	552.00	237.71	219.93	159.37	127.07	87.06	68.19	61.11	56.40
1967	1610.00	369.00	203.33	125.85	89.82	69.37	51.55	49.54	38.61
1968	1100.00	313.29	198.14	127.49	82.64	50.83	35.21	27.95	21.81
1969	1920.00	796.00	490.93	267.46	152.54	102.87	74.74	56.67	47.67
1970	2930.00	686.86	370.07	220.83	180.05	136.24	130.39	101.44	77.38
1971	672.00	232.14	217.00	138.83	93.35	53.10	38.13	30.61	24.47
1972	560.00	243.57	191.07	135.60	93.00	69.69	56.59	45.51	38.85
1973	4020.00	978.29	552.07	300.43	182.28	107.95	77.09	53.92	49.64
1974	1740.00	332.57	205.36	108.55	97.99	62.49	45.86	38.86	32.69
1975	720.00	274.86	161.79	102.15	89.47	60.64	41.79	36.52	33.58
1976	257.00	153.29	93.07	84.53	53.32	43.25	30.93	24.80	22.17
1977	197.00	107.29	77.79	57.40	51.45	36.55	27.15	20.80	16.74
1978	744.00	223.43	128.36	74.80	66.70	55.01	42.78	34.76	27.04
1979	345.00	216.00	157.36	85.74	51.39	38.49	28.33	21.24	20.26
1980	1030.00	442.00	309.71	247.37	146.16	108.44	76.19	61.39	53.39
1981	213.00	124.00	95.71	74.33	49.50	28.02	20.45	15.49	13.26
1982	146.00	81.14	55.00	38.39	30.93	25.22	19.02	14.01	11.28
1983	582.00	254.00	184.14	143.27	117.93	85.99	58.98	46.83	37.47
1984	430.00	180.86	149.36	108.87	80.02	61.29	53.20	38.57	41.84

TABLE 4. HIGH FLOW DATA FOR NORTH PRONG ST. MARYS RIVER AT MONIAC.

@@@@@ N.P. ST. MARYS RIVER AT MONIAC, GA, DISCH CFS(1922-23,28-30,52-84)

HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1922	2200.00	1665.00	1173.93	666.93	382.88	193.76	130.27	119.27	90.96
1923	670.00	545.00	411.79	276.83	186.95	159.30	146.93	127.86	115.22
1928	1870.00	1092.86	962.86	780.00	558.15	314.95	208.20	152.81	162.53
1929	6060.00	4334.29	3146.43	1833.17	1048.33	802.88	553.07	503.12	423.44
1930	2640.00	2055.71	1424.64	831.83	666.23	502.38	391.96	414.53	349.74
1933	1870.00	1471.43	1017.14	619.27	457.77	381.40	309.16	316.66	254.69
1934	890.00	620.71	413.64	210.43	138.62	77.23	51.02	34.18	25.86
1952	1330.00	853.00	606.29	528.00	354.85	256.38	204.76	143.80	108.15
1953	390.00	288.00	241.50	141.80	76.41	44.29	29.94	28.65	21.70
1954	2140.00	1891.43	1532.57	955.33	622.33	391.41	318.78	225.53	169.81
1955	7.80	5.19	3.66	2.33	1.51	1.01	0.76	0.51	0.39
1956	429.00	224.43	194.50	160.27	94.91	55.35	42.75	39.82	31.46
1957	244.00	196.43	162.50	92.73	51.26	29.58	29.81	24.38	20.95
1958	3110.00	2195.71	1455.21	791.90	427.90	280.34	212.33	172.81	191.53
1959	2650.00	1992.86	1456.07	1259.13	751.32	448.44	318.57	213.85	170.74
1960	1410.00	967.29	644.57	512.70	376.60	221.82	186.84	203.96	168.75
1961	821.00	490.00	387.29	303.07	243.30	237.74	173.12	152.44	121.45
1962	2730.00	1676.71	1054.79	566.87	319.82	165.99	109.91	121.01	94.17
1963	729.00	597.43	475.29	432.73	352.20	202.41	163.08	149.56	113.27
1964	2760.00	1826.29	1122.36	570.57	528.55	413.15	292.51	207.54	158.59
1965	4590.00	3414.29	2260.64	1495.93	964.27	557.83	464.17	391.85	299.21
1966	1640.00	1264.00	872.07	728.93	632.90	406.82	321.60	280.80	248.99
1967	2020.00	1380.29	1017.07	642.17	552.38	432.28	338.37	309.96	238.97
1968	1500.00	926.71	644.21	515.93	305.18	180.32	136.30	111.04	84.78
1969	764.00	510.57	371.71	225.40	170.85	98.28	72.66	85.28	70.12
1970	4080.00	1537.43	1011.93	586.87	476.28	426.47	400.01	336.85	258.78
1971	1080.00	930.29	800.93	542.63	339.43	199.67	140.90	122.89	99.08
1972	1770.00	1351.43	1172.43	798.33	489.55	292.90	268.21	256.98	205.44
1973	11600.00	6848.57	4338.57	2237.63	1295.52	811.93	577.98	398.33	351.25
1974	1050.00	692.43	571.79	519.37	311.42	244.76	169.41	137.09	126.91
1975	2180.00	1734.29	1231.86	665.77	473.95	337.05	257.01	270.46	240.10
1976	1360.00	1170.00	912.00	686.50	487.63	316.28	224.91	168.04	136.64
1977	1150.00	943.71	695.14	569.10	533.12	404.91	344.37	275.80	214.90
1978	1340.00	1113.00	880.93	724.50	542.33	394.90	355.93	322.26	252.03
1979	1430.00	1149.29	864.64	487.77	272.56	173.38	116.12	85.10	79.13
1980	2160.00	1230.14	896.64	699.13	416.47	306.15	217.09	221.70	202.57
1981	828.00	547.00	370.79	350.93	240.30	137.82	114.04	94.32	80.63
1982	894.00	577.00	411.43	290.07	241.33	195.95	135.88	95.30	72.08
1983	1800.00	1253.57	995.00	847.53	692.23	545.41	381.08	294.97	230.09
1984	1690.00	1253.57	995.00	847.53	676.78	544.02	378.42	282.33	220.02

TABLE 5. HIGH FLOW DATA FOR MIDDLE PRONG ST. MARYS RIVER AT TAYLOR.

@@@@@ M.P. ST. MARYS RIVER AT TAYLOR, DISCH CFS(1957-67,77-84)

HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1957	327.00	332.57	272.00	178.90	97.57	50.36	35.76	26.06	19.88
1958	2030.00	990.71	784.86	490.47	338.93	224.37	170.69	172.06	167.45
1959	1400.00	1194.29	959.57	650.37	383.58	283.95	192.43	131.62	114.85
1960	1320.00	957.86	709.79	512.57	351.05	199.20	143.39	118.69	107.00
1961	544.00	436.57	384.29	304.27	194.53	165.08	114.80	86.33	68.75
1962	776.00	635.71	504.07	318.10	191.48	107.79	71.33	50.03	38.19
1963	454.00	397.43	333.79	275.63	240.25	147.69	99.96	80.48	60.83
1964	3590.00	1999.71	1284.00	663.43	469.07	408.00	288.14	216.28	167.25
1965	3920.00	2762.86	1823.86	997.60	689.78	404.67	353.77	294.24	225.22
1966	985.00	765.00	675.79	589.30	491.55	317.71	242.73	227.32	192.28
1967	1230.00	708.57	572.00	398.83	282.48	233.71	193.94	184.42	143.80
1977	353.00	332.86	309.71	242.17	208.87	174.17	118.02	88.91	72.79
1978	1030.00	647.14	500.93	409.80	363.00	297.79	239.12	208.73	162.14
1979	784.00	480.57	360.43	233.20	154.76	98.24	65.12	44.92	41.99
1980	1620.00	1342.86	1011.29	705.83	468.62	277.33	204.92	215.70	175.99
1981	584.00	409.86	309.57	213.27	201.53	110.74	82.02	68.99	55.95
1982	789.00	460.00	321.43	224.67	150.85	132.72	90.86	63.36	47.96
1983	981.00	709.71	606.93	494.60	376.08	258.88	171.82	153.83	129.28
1984	1620.00	1186.30	885.17	653.96	494.59	350.02	253.52	212.43	184.39

TABLE 6. HIGH FLOW DATA FOR TURKEY CREEK AT MACCLENNY.

@@@@@ TURKEY CR AT MACCLENNY, DISCH CFS(1957-82)

HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1957	1130.00	222.71	142.86	71.85	38.69	23.52	17.38	12.90	11.02
1958	994.00	309.43	167.29	102.63	65.60	59.98	41.45	37.05	35.59
1959	1160.00	382.00	216.71	166.07	102.80	80.27	65.52	47.24	47.11
1960	736.00	280.29	170.07	110.30	70.88	53.88	41.23	40.87	33.58
1961	530.00	227.71	166.21	123.13	76.23	67.18	44.77	34.78	26.95
1962	445.00	143.57	119.00	63.56	62.09	39.40	26.39	18.20	14.06
1963	946.00	207.14	126.43	61.73	41.57	24.31	16.53	19.02	15.14
1964	2600.00	455.43	254.07	122.67	76.88	68.04	46.85	46.35	45.08
1965	1730.00	750.00	403.71	240.88	146.82	80.90	67.70	55.72	42.21
1966	707.00	201.71	137.86	89.10	77.21	53.28	42.20	36.36	30.74
1967	460.00	152.14	93.64	50.08	32.38	24.61	18.78	19.95	15.67
1968	646.00	155.57	103.36	64.13	52.71	29.80	20.12	15.60	12.19
1969	1190.00	342.00	187.79	98.80	53.17	39.64	28.05	22.85	21.27

YEAR:	1970	1971	1972	1973	1975	1976	1977	1978	1979	1980	1982
DISCH:	1200.0	592.0	1200.0	1260.0	510.0	420.0	650.0	955.0	776.0	2020.0	1780.0

TABLE 7. HIGH FLOW DATA FOR SOUTH PRONG ST. MARYS RIVER AT GLEN ST. MARY.

@@@@@ S.P. ST. MARYS RIVER AT GLEN ST. MARY, DISCH CFS(1951-71)

HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1951	5680.00	2900.00	1857.14	946.50	871.33	502.57	345.59	238.15	180.40
1952	240.00	225.86	208.93	145.77	93.93	56.92	41.83	30.04	23.23
1953	1930.00	648.14	540.14	323.27	180.05	112.79	76.08	70.54	55.78
1954	2140.00	1575.71	1274.36	799.67	735.37	445.77	399.84	277.30	209.85
1955	84.00	69.57	53.57	44.87	27.67	17.04	14.10	11.21	9.20
1956	1150.00	391.57	231.50	130.47	72.00	57.89	40.45	33.72	34.96
1957	1130.00	541.14	443.21	244.70	129.99	70.79	58.13	56.85	49.54
1958	2750.00	1918.57	1194.00	610.77	445.23	290.09	214.03	194.66	202.50
1959	3200.00	2231.43	1481.71	1051.63	614.78	495.93	374.74	258.24	254.89
1960	2570.00	1827.14	1190.71	849.87	555.20	305.32	243.43	239.02	211.56
1961	1300.00	879.57	720.14	569.27	404.88	327.22	219.43	172.43	137.05
1962	2150.00	1107.71	1087.14	679.70	461.67	254.57	169.24	115.75	89.08
1963	915.00	610.29	471.93	386.53	330.40	193.98	132.22	103.48	81.22
1964	6340.00	3384.29	1987.29	987.30	585.27	544.94	376.82	343.70	296.17
1965	7510.00	5191.43	3333.07	1856.43	1194.43	651.43	538.24	445.36	336.24
1966	2190.00	1368.14	1053.86	839.80	672.40	431.26	343.09	286.94	253.17
1967	1220.00	978.71	690.79	391.93	260.05	219.86	182.66	180.28	140.78
1968	1070.00	803.86	581.50	375.87	254.90	151.00	103.63	87.11	67.85
1969	3250.00	1857.14	1182.43	638.63	392.08	258.38	174.35	140.85	122.79
1970	4400.00	1847.14	1226.29	714.57	644.32	579.63	474.76	394.42	299.63
1971	1860.00	1470.00	1234.71	922.43	579.08	313.00	210.91	164.32	129.37

TABLE 8. HIGH FLOW DATA FOR ST. MARYS RIVER NEAR MACCLENNY.

@@@@@ ST. MARYS RIVER NR MACCLENNY, DISCH-CFS(1928-84)

HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1928	5720.00	4961.43	4317.86	3252.33	2115.67	1174.10	782.75	690.66	645.81
1929	26100.00	15140.00	11066.43	6714.00	3843.42	2747.42	1924.89	1671.39	1422.37
1930	11400.00	9440.00	6765.71	4106.00	2978.33	2136.00	1688.39	1713.38	1424.65
1931	3930.00	2880.00	2203.57	1500.00	1081.58	987.96	816.80	634.16	634.52
1932	270.00	179.57	149.86	108.57	105.02	84.45	62.16	48.17	43.53
1933	5250.00	4052.86	3300.00	2575.67	1629.10	1335.22	1003.85	1041.05	867.18
1934	5250.00	4017.14	2761.79	1489.43	1066.10	659.72	442.96	304.28	235.83
1935	8260.00	6881.43	4424.64	2382.57	1413.57	911.38	628.56	441.32	340.06
1936	4990.00	4052.86	3540.00	2930.67	1879.85	1154.47	780.40	728.16	557.47
1937	3820.00	2871.43	2034.21	1387.23	1174.53	778.37	564.28	441.20	365.17
1938	7580.00	6328.57	5335.71	3783.93	2262.42	1444.32	1090.81	838.00	640.99
1939	7920.00	5827.14	3960.71	2643.80	1499.20	1200.71	850.08	631.66	506.99
1940	3720.00	3204.29	2717.14	1752.93	1739.97	1135.17	785.20	658.35	534.57
1941	1820.00	1386.29	1084.71	857.30	703.00	403.01	298.49	307.13	250.09
1942	6800.00	5707.14	4582.14	4069.67	2618.37	2321.97	1701.17	1311.15	1015.78
1943	1840.00	1304.29	1037.21	750.50	518.95	492.61	339.48	242.11	192.80
1944	2060.00	1592.86	1336.43	1034.27	828.57	466.25	323.91	295.51	254.77
1945	16100.00	10488.57	6635.00	3482.40	2373.17	2301.66	1666.77	1351.49	1033.25
1946	7750.00	6295.71	5255.71	3429.00	2947.93	1782.55	1341.20	1103.30	930.70
1947	6260.00	4617.14	3468.57	2304.17	1981.05	1717.14	1255.50	970.52	910.78
1948	28100.00	17365.71	10567.14	7644.33	6997.50	4488.10	3864.42	3257.33	2489.04
1949	8230.00	5672.86	3944.29	2266.23	1518.22	1225.44	906.68	914.08	721.18
1950	4850.00	4198.57	3180.00	1772.57	1058.42	658.82	489.22	366.18	291.10
1951	26600.00	14152.86	9406.43	4901.20	4433.28	2480.65	1725.27	1196.83	909.55
1952	1810.00	1522.86	1435.71	1184.70	792.32	541.59	435.45	320.29	249.48
1953	1710.00	1524.29	1247.21	753.60	420.75	263.13	186.51	161.96	134.01
1954	11900.00	8937.14	7299.29	4535.33	3357.05	2005.88	1748.44	1230.20	934.99
1955	321.00	267.14	208.86	164.67	111.93	77.41	71.69	58.90	50.87
1956	2010.00	1050.57	672.93	355.83	223.63	174.30	128.45	137.01	125.08
1957	2570.00	1947.14	1673.57	981.13	543.50	317.37	258.52	214.37	192.68
1958	8420.00	7188.57	4902.86	2642.40	1872.18	1346.49	1013.29	923.67	965.26
1959	10000.00	8902.86	6666.43	4998.00	2884.18	2006.31	1443.69	994.93	899.82
1960	7770.00	5858.57	3948.57	2886.17	1978.95	1147.08	915.85	919.82	817.17
1961	3670.00	3307.14	2629.29	1940.47	1367.77	1149.77	825.71	675.30	560.24
1962	5770.00	4828.57	3762.86	2479.13	1603.73	947.41	640.78	509.83	416.54
1963	3070.00	2657.14	2152.86	1859.47	1547.03	931.99	664.99	607.93	472.82
1964	16500.00	11035.71	6824.29	3499.23	2509.85	2168.47	1537.21	1271.73	1036.56
1965	26000.00	17471.43	11466.43	6708.90	4503.45	2534.32	2189.55	1812.81	1384.48
1966	5210.00	4501.43	3669.29	3304.33	2703.53	1747.48	1364.44	1303.40	1129.36
1967	5030.00	3997.14	2964.29	1892.47	1608.03	1398.99	1123.87	1050.98	823.53
1968	2520.00	1787.14	1316.00	1246.17	832.52	515.20	372.17	326.69	257.87
1969	3710.00	2857.14	2076.29	1274.07	886.33	625.82	450.25	424.24	371.08
1970	14500.00	7489.70	4973.42	2732.83	2361.01	2097.02	1792.06	1512.47	1163.03
1971	5620.99	4774.28	4625.70	3538.66	2162.40	1183.16	812.28	630.36	500.57
1972	6240.00	4490.00	3820.71	2422.67	1622.52	1149.83	989.39	952.82	786.11
1973	28000.00	19614.29	12840.00	6634.57	4042.98	2509.17	1775.59	1253.87	1134.98
1974	2520.00	2187.14	1935.00	1864.33	1226.50	957.50	657.28	506.28	477.02
1975	5550.00	4785.71	3447.86	3290.33	2305.48	1402.95	967.95	919.28	813.89
1976	3800.00	3184.29	2538.57	2029.00	1541.97	1119.74	796.04	599.81	528.92
1977	2650.00	2104.29	1842.86	1455.60	1317.02	1070.25	811.96	656.22	542.00
1978	4370.00	3222.86	2380.00	2006.00	1787.00	1499.62	1248.02	1154.45	906.84
1979	4080.00	3430.00	2470.14	1476.70	942.70	645.23	445.99	335.94	333.24
1980	6950.00	5922.86	4238.57	3020.13	2041.53	1278.33	943.04	1057.82	919.91
1981	2120.00	1668.57	1234.50	1129.87	968.40	554.27	428.23	379.84	322.96
1982	3220.00	2627.14	2138.57	1442.57	1073.82	802.57	564.73	434.28	348.77
1983	4610.00	3768.57	3064.29	2578.70	2024.98	1456.79	1004.11	873.16	746.76
1984	8050.00	6131.99	5977.56	3971.45	2809.86	2002.68	1481.92	1141.69	981.41

TABLE 9. ANNUAL PEAK FLOW DATA FOR ST. MARYS RIVER NEAR ST. GEORGE.

ST. MARYS RIVER NEAR GEORGE, PEAK DISCH CFS (1947,55,65-73), CREST-STAGE GAGE

YEAR:	1947	1955	1965	1966	1967	1969	1970	1972	1973
DISCH:	28500.0	12000.0	26700.0	7270.0	6480.0	8600.0	16100.0	7630.0	28000.0

TABLE 10. ANNUAL PEAK FLOW DATA FOR PIGEON CREEK AT BOULOGNE.

PEGEON CREEK AT BOULOGNE, PEAK DISCH CFS, CREST-STAGE GAGE, (65-77)

YEAR:	1965	1966	1967	1970	1972	1973	1975	1977
DISCH:	558.0	293.0	472.0	682.0	150.0	205.0	339.0	378.0

TABLE 11. ANNUAL PEAK FLOW DATA FOR LITTLE ST. MARYS RIVER NEAR HILLIARD.

LITTLE ST. MARYS RIVER NR HILLIARD, PEAK DISCH CFS (CREST-STAGE GAGE, 1961-1983)

YEAR:	1961	1962	1964	1965	1966	1967	1968	1969	1970	1971
DISCH:	762.0	768.0	363.0	2150.0	424.0	841.0	938.0	515.0	1830.0	345.0

YEAR:	1973	1975	1977	1978	1980	1981	1983
DISCH:	3000.0	800.0	966.0	414.0	678.0	360.0	544.0

THE UPPER AND THE MIDDLE ST. JOHNS RIVER BASINS

The St. Johns River originates in a broad marshy area in St. Lucie and Indian River counties and flows north for about 300 miles into the Atlantic Ocean at Jacksonville (Figure 2). The drainage areas from the source to the upstream end of Lake Harney, and Lake Harney to downstream of Lake George have been designated as the Upper and Middle St. Johns River basins, respectively (see Hydrologic Unit Numbers 5, 5A, and 4 in Figures 2, 5 and 6). The Econlockhatchee River Basin, which discharges into the St. Johns River upstream of Lake Harney, is designated as Hydrologic Unit No. 5A for distinguishing planning and other studies conducted for that basin.

Table 12 presents some general information on the USGS long-term stream gaging stations. Flood discharges for different return periods are summarized in Table 13 for sixteen sites. Tables 14 through 31 furnish high flow data for selected gaging stations. (Note: The 1-day highest discharges appearing in these tables represent instantaneous peak flows. For crest-stage partial record stations only annual peak flows are given; data might be missing for some years.)

A Special Note: During the gaging period, several developments have taken place in the Upper St. Johns River Basin, especially above the gaging station near Melbourne. The boundaries of the floodplain have been altered by agricultural activities. A plan for flood control was evolved during the 1960's as a part of which construction of a major levee (L-73)

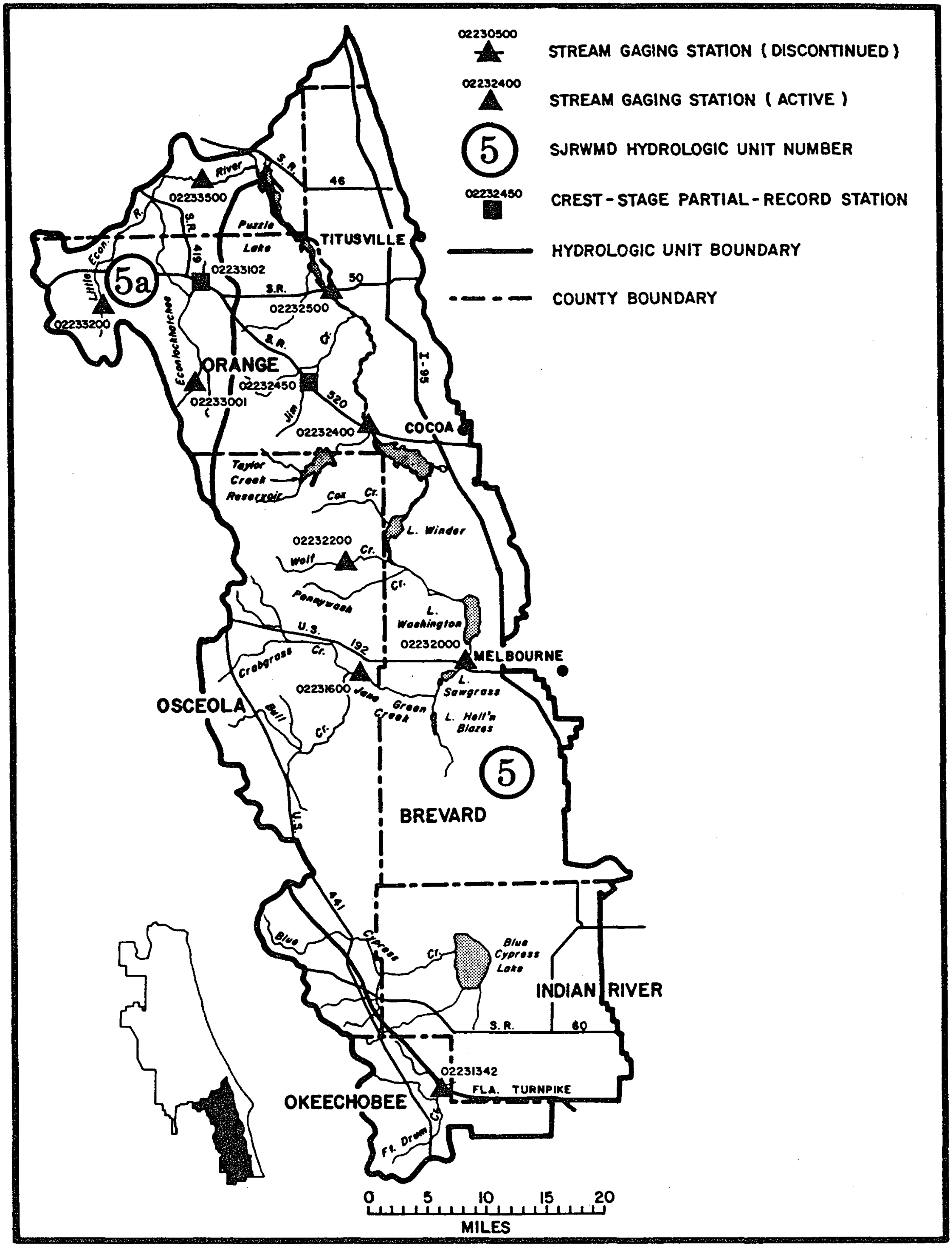

Figure 5. The Upper St. Johns River Basin (Hydrologic Unit Number 5)

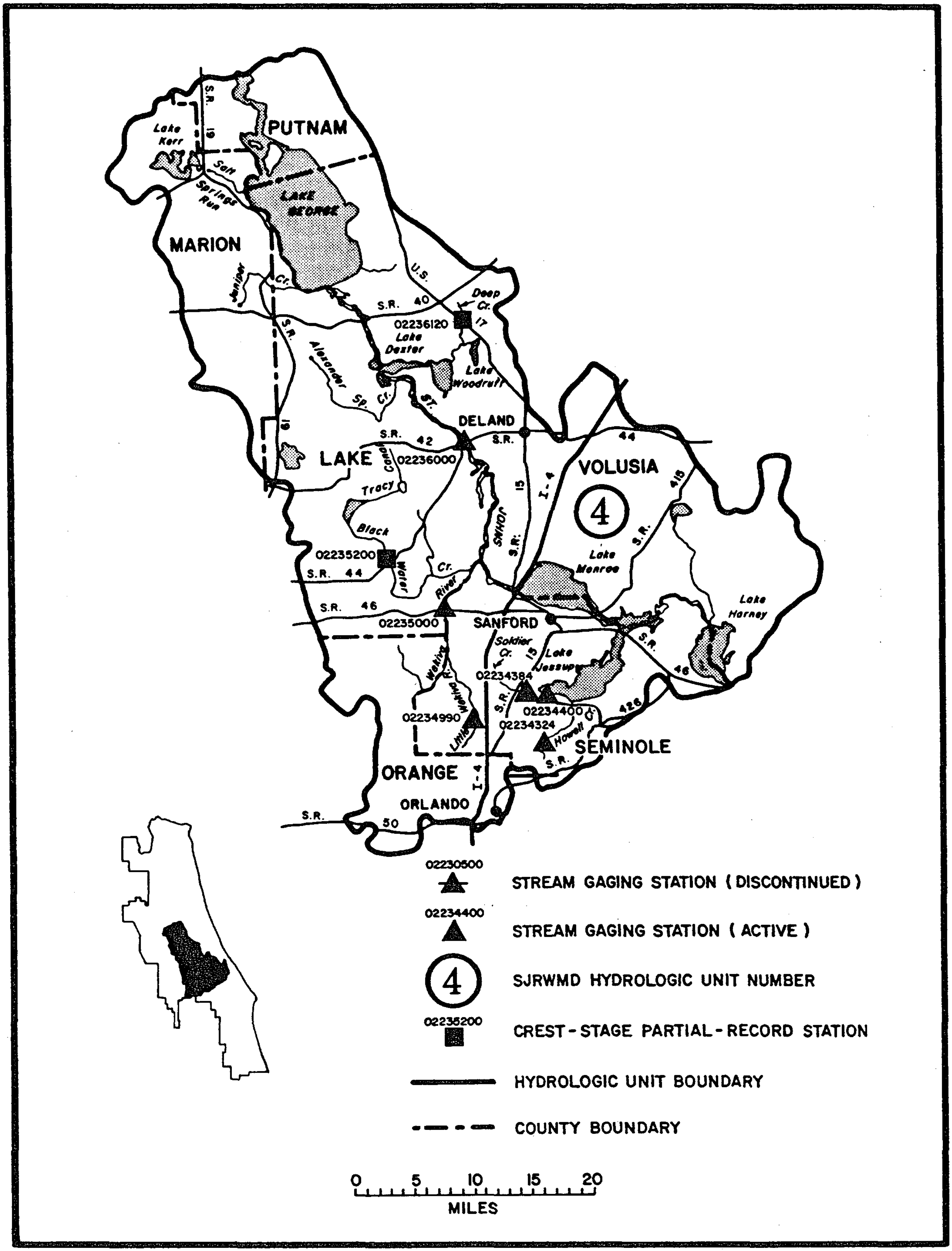

Figure 6. The Middle St. Johns River Basin (Hydrologic Unit Number 4)

was completed in the western uplands. Although it has some gaps, this levee tends to provide flood detention. Due to these developments the annual peak flow data for the asterisked stations in Table 13 may not be considered homogeneous. For these stations the flood estimates shown in Table 13 are rather conservative. For the main stem of the upper St. Johns River, flood profiles have been derived by a simulation study (12). The reader may refer to this publication (Technical Publication SJ 85-3 of the District) for more details.

TABLE 12. General Information on the Long-Term Stream Gaging Stations in the Upper and Middle St. Johns River Basins

USGS Station No. and Name	Location	Drainage Area Sq. Mi.	Period of Record	Recorded Peak Elv. ft. NGVD	Remarks
Upper St. Johns River Basin: (Hydrologic Unit No. 5, Fig. 4)					
02231342 Fort Drum Creek at Sunshine State Parkway near Fort Drum	Okeechobee Co.: At bridge on Sunshine State Parkway	52.6	June 77-Current Yr.	38.35 (1979)	
02231600 Jane Green Creek near Deer Park	Osceola Co.: At bridge on County Rd., 1.2 mi southeast of Deer Park	248	Oct 1953-Current Yr.	29.50 (1956)	Records may not be considered homogeneous due to construction of Jane Green Reservoir
02232000 St. Johns River near Melbourne	Brevard Co.: At bridge on US 192	968	Oct 1939-Current Yr.	20.88 (1960)	Records may not be considered homogeneous due to development in the Upper St. Johns River Basin.
02232200 Wolf Creek near Deer Park	Osceola Co.: At bridge on SR 419	25.7	Jan 1956-Current Yr.	29.55 (1964)	
02232400 St. Johns River near Cocoa	Brevard Co.: At bridge on SR 520	1,331	Oct 1953-Current Yr.	16.96 (1953)	Same as Station 02232000
02232450 Jim Creek near Christmas	Orange Co.: At bridge on SR 520	22.7	1960-Current Yr.	30.63 (1960)	Crest-Stage Partial-Record Station
02232500 St. Johns River near Christmas	Orange Co.: At bridge on SR 50	1,539	Oct 1933-Current Yr.	12.43 (1960)	Same as Station 02232000
02233001 Econlockhatchee River at Magnolia Ranch near Bithlo	Orange Co.: At bridge on Wewahootee Road	32.9	Oct 1972-Current Yr.	62.58 (1982)	
02233102 Econlockhatchee River Tributary near Bithlo	Orange Co.: at culvert on SR 50	1.83	1969-Current Yr.	56.23 (1969)	Crest-Stage Partial-Record Station

TABLE 12. Continued.

USGS Station No. and Name	Location	Drainage Area Sq. Mi.	Period of Record	Recorded Peak Elv. ft. NGVD	Remarks
02233200 Little Econlockhatchee River near Union Park	Orange Co.: At Berry-Deese Road	27.1	Oct 1959-Current Yr.	67.83 (1960)	
02233500 Econlockhatchee River near Chuluota	Seminole Co.: At bridge on SR 13	241	Oct 1935-Current Yr.	20.83 (1960)	Records include some flow diverted from Lake Mary Jane in Kissimmee River Basin thru Disston Canal
Middle St. Johns River Basin: (Hydrologic Unit No. 4, Fig. 4)					
02234324 Howell Creek near Slavia	Seminole Co.: At box culvert on Red Bug Rd.	29.2	Feb 1972-Sept 1979 Oct 1980-Current Yr.	36.71 (1974)	
02234384 Soldier Creek near Longwood	Seminole Co.: At culvert on SR 419	21.2	Feb 1972-Sept 75 July 77-Sept 79 Oct 80-Current Yr.**	14.41 (1973)	**Partial-Record Station
02234400 Gee Creek near Longwood	Seminole Co.: At box culvert on SR 419	12.8	Feb 1972-Sept 79 Oct 80-Current Yr.**	14.69 (1974)	**Partial-Record Station
02234990 Little Wekiva River near Altamonte Springs	Seminole Co.: At bridge on SR 434	90.7	Feb 1972-Sept 79 Oct 82-Current Yr.	26.81 (1976)	Flow regulated at times by citrus plant upstream
02235000 Wekiva River near Sanford	Seminole Co.: At bridge on SR 46	189	Oct 1931-Current Yr.	11.05 (1960)	Flow includes large ground water inflow
02235200 Blackwater Creek near Cassia	Lake Co.: At bridge on SR 44A	126	1962-67*, 1970-80* Aug 67-Sept 69, Mar 81-Apr 82	28.48 (1968)	*Crest-Stage Partial-Record Station
02236000 St. Johns River near Dealnd	Lake Co.: At bridge on SR 44	3,066	Oct 1933-Current Yr.	6.06 (1953)	Flow occasionally reverses due to tide and wind effect.
02236120 Deep Creek near Barberville	Volusia Co.: At bridge on US 17	35.4	1964-Current Yr.	8.74 (1968)	Crest-Stage Partial-Record Station

TABLE 13. Estimates of Flood Flows at Gaged Sites in the Upper and Middle St. Johns River Basins

(First Line: Log Pearson type 3 analysis using the WRC guidelines, Bulletin #17B.)
(Second Line: Log Pearson type 3 analysis using the Method of Mixed Moments.)

Gaging Station	Record Length (Years)	Highest Discharge During Period of Record (cfs)	Mean Annual High Discharge (cfs)	Discharge in cfs which may be equaled or exceeded in: 5 Yr	10 Yr	25 Yr	50 Yr	100 Yr	500 Yr
Upper St. Johns River Basin									
1. Jane Green Creek near Deer Park *	31	18,400	3,870	5,700 5,980	8,550 8,660	13,100 12,400	17,300 15,300	22,100 18,300	36,300 25,400
2. St. Johns River near Melbourne *	44	18,000	4,296	6,670 6,690	9,750 9,370	14,200 12,900	18,000 15,500	21,900 18,100	32,000 23,800
3. Wolf Creek near Deer Park	28	7,700	1,460	2,050 2,150	3,040 3,180	4,670 4,750	6,200 6,100	8,000 7,580	13,600 11,600
4. St. Johns River near Cocoa *	31	10,700	3,810	5,820 5,920	7,880 7,670	10,700 9,670	12,800 11,000	15,000 12,100	20,300 14,300
5. Jim Creek near Christmas	22	3,750	1,100	1,600 1,610	2,250 2,200	3,250 3,030	4,120 3,700	5,100 4,390	7,830 6,150
6. St. Johns River near Christmas *	50	11,700	4,900	6,920 7,180	8,870 8,950	11,500 11,000	13,500 12,300	15,700 13,600	20,900 16,000
7. Econlockhatchee River at Magnolia Ranch near Bithlo	11	474	166	240 250	326 338	455 455	566 544	690 633	1,030 839
8. Econlockhatchee River Tributary near Bithlo	13	338	70	92 94	132 139	198 216	259 291	333 386	563 701
9. Little Econlock-hatchee River near Union Park	25	1,640	480	758 755	1,090 1,010	1,570 1,330	1,950 1,550	2,360 1,750	3,390 2,150
10. Econlockhatchee River near Chuluota	49	11,000	3,240	4,690 4,750	6,530 6,470	9,250 8,870	11,560 10,770	14,100 12,760	20,900 17,700

* Annual peak flow data may not be considered homogeneous for these stations.

TABLE 13. Continued.

(First Line: Log Pearson type 3 analysis using the WRC guidelines, Bulletin #17B.)
(Second Line: Log Pearson type 3 analysis using the Method of Mixed Moments.)

Gaging Station	Record Length (Years)	Highest Discharge During Period of Record (cfs)	Mean Annual High Discharge (cfs)	Discharge in cfs which may be equaled or exceeded in: 5 Yr	10 Yr	25 Yr	50 Yr	100 Yr	500 Yr
Middle St. Johns River Basin									
1. Howell Creek near Slavia	11	412	169	229 225	294 289	387 381	463 459	545 545	766 782
2. Little Wekiva River near Altamonte Springs	10	454	297	413 404	500 465	606 528	682 566	754 598	914 654
3. Wekiva River near Sanford	48	2,060	908	1,200 1,190	1,440 1,430	1,740 1,750	1,970 1,990	2,200 2,230	2,740 2,820
4. Blackwater Creek near Cassia	18	749	346	443 435	531 526	645 654	735 758	826 870	1,050 1,170
5. St. Johns River near Deland	50	17,100	7,950	10,400 10,400	12,500 12,500	15,300 15,000	17,500 16,900	19,600 18,900	24,900 23,400
6. Deep Creek near Barberville	16	1,100	370	547 553	785 756	1,150 1,030	1,470 1,250	1,830 1,470	2,840 1,990

TABLE 14. HIGH FLOW DATA FOR FORT DRUM CREEK AT SUNSHINE STATE PARKWAY NEAR FORT DRUM.

@@@@@ FORT DRUM CREEK AT SUNSHINE ST PARKWAY NEAR FORT DRUM, DISCH CFS

HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1978	332.00	208.43	141.86	96.50	69.22	52.23	45.02	39.22	30.24
1979	676.00	314.71	251.79	178.40	139.18	116.56	88.71	79.04	72.38
1980	1410.00	744.57	658.00	523.00	296.20	154.70	108.48	79.72	62.65
1981	57.00	20.29	16.50	11.21	6.82	4.58	3.10	3.22	2.48
1982	75.00	56.86	42.00	39.19	28.79	17.92	11.92	12.82	10.93
1983	806.00	537.29	389.43	300.53	211.87	138.93	100.29	96.61	81.23
1984	226.00	148.95	108.13	64.63	57.57	49.00	44.08	41.98	35.61

TABLE 15. HIGH FLOW DATA FOR JANE GREEN CREEK NEAR DEER PARK.

@@@@@ JANE GREEN CREEK, DISCHARGE-CFS(55-84)

HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1955	3950.00	2681.43	1937.79	1535.60	969.12	802.91	765.45	562.17	429.61
1956	4580.00	3068.57	2166.14	1369.00	925.65	697.60	464.46	314.96	235.79
1957	18400.00	8508.57	5030.29	3008.27	1641.72	880.17	586.92	431.24	336.60
1958	2690.00	2014.29	1373.79	1050.87	681.45	584.22	428.63	422.41	366.64
1959	4170.00	2654.29	1757.14	1096.97	667.70	377.51	257.64	185.94	147.15
1960	10700.00	6138.57	3567.00	1800.40	1111.08	658.76	581.57	540.51	465.16
1961	6050.00	3731.43	2816.21	2441.10	1563.87	1440.62	1027.43	705.57	535.48
1962	476.00	394.29	280.43	207.23	120.37	93.34	63.94	43.94	35.45
1963	1280.00	960.71	791.57	696.47	613.33	357.91	246.53	257.75	195.34
1964	2490.00	1467.14	1123.50	687.23	549.08	492.03	442.97	339.32	270.48
1965	8060.00	4644.29	3241.43	2449.70	1453.18	807.45	560.78	400.75	304.06
1966	6810.00	3638.57	2278.57	1350.17	960.58	538.43	510.67	408.90	312.67
1967	1740.00	1261.43	1192.29	895.10	705.60	641.87	495.19	334.15	251.58
1968	885.00	725.71	620.29	504.70	401.50	253.47	168.42	113.93	85.30
1969	5150.00	3385.71	2606.43	1956.83	1457.02	759.93	574.30	404.71	389.28
1970	8940.99	4617.14	2899.00	1769.60	1253.25	871.17	679.66	504.47	396.43
1971	879.00	556.86	335.00	191.83	113.95	63.79	47.13	37.21	28.11
1972	730.00	638.71	589.86	454.10	272.48	165.77	124.91	128.06	96.42
1973	1960.00	1298.43	945.21	610.13	402.80	357.47	259.45	231.58	219.20
1974	2350.00	1672.86	1173.36	989.43	821.03	563.02	386.58	263.64	197.91
1975	4880.00	3910.00	2696.57	1533.70	1361.53	899.78	593.87	399.89	300.24
1976	2050.00	1477.14	1157.79	735.70	516.80	363.76	262.51	177.45	132.89
1977	2020.00	1552.86	1078.00	764.17	566.95	553.20	383.35	275.20	208.41
1978	630.00	591.00	484.93	465.10	331.40	226.25	158.53	126.05	94.82
1979	2040.00	1750.00	1445.07	1199.83	752.00	398.51	264.02	210.33	168.96
1980	5050.00	3802.86	3255.00	2425.27	1408.25	728.75	504.20	361.97	273.43
1981	121.00	112.57	97.36	64.30	37.19	28.85	21.15	19.84	15.62
1982	1190.00	784.00	567.07	358.00	187.62	98.91	68.52	66.26	49.74
1983	1990.00	1597.14	1189.43	873.10	669.17	507.04	387.99	347.28	335.78
1984	776.00	706.00	587.64	511.23	344.85	295.15	250.11	204.58	175.76

TABLE 16. HIGH FLOW DATA FOR ST. JOHNS RIVER NEAR MELBOURNE.

@@@@@ ST. JOHNS RIVER NEAR MELBOURNE, DISCH CFS(1941-84)

HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1941	994.00	963.00	897.00	828.73	767.07	696.31	554.03	503.84	407.37
1942	3730.00	3538.57	3142.14	2542.33	2031.17	1831.09	1740.17	1478.17	1206.20
1943	1360.00	1338.57	1307.86	1203.63	991.15	642.50	452.31	329.80	264.16
1944	2300.00	2270.00	2152.86	1976.00	1569.97	1251.68	912.96	641.71	493.10
1945	4370.00	3755.71	3225.71	2309.00	1695.42	1300.84	970.10	704.91	542.32
1946	6380.00	5142.86	4437.14	3484.00	2432.75	2013.40	1593.58	1165.32	894.21
1947	3270.00	2964.29	2670.71	2041.33	1670.00	1209.52	870.78	704.85	569.35
1948	9690.00	7860.00	7687.86	6540.00	5197.50	3473.83	2862.24	2227.09	1700.68
1949	12500.00	9358.57	8730.00	6716.67	4411.50	2694.91	1917.96	1327.28	1010.25
1950	6570.00	5875.71	5335.00	4370.00	3447.17	2301.53	1702.13	1182.64	904.71
1951	9280.00	6250.00	4836.43	3323.33	2233.67	1323.59	934.25	680.56	524.44
1952	2740.00	2598.57	2374.29	1861.33	1404.33	1067.00	829.83	661.60	533.94
1953	6610.00	5791.43	5150.71	3983.33	2840.00	1808.38	1321.01	939.55	723.50
1954	11300.00	9077.14	7977.86	7093.00	5948.00	4317.08	3141.45	2167.84	1637.88
1955	3290.00	3175.71	3035.00	2538.67	1806.28	1441.82	1355.66	1068.74	815.37
1956	2140.00	2095.71	1952.14	1550.97	1216.73	1020.39	731.58	505.81	379.51
1957	18000.00	11680.00	8782.86	6014.67	4039.67	2414.26	1688.98	1218.18	916.55
1958	1780.00	1677.14	1511.43	1444.67	1264.65	924.32	878.67	828.44	740.24
1959	3150.00	2892.86	2462.14	1788.17	1212.42	757.97	537.50	412.15	348.03
1960	8680.00	6348.57	5011.43	3486.00	2505.50	1890.97	1790.99	1531.23	1356.19
1961	8720.00	7564.29	6561.43	5922.00	4771.83	3622.33	2878.75	2033.41	1559.37
1962	307.00	268.00	255.57	214.07	162.47	142.44	108.07	76.20	58.69
1963	2540.00	2422.86	2302.14	2006.00	1682.33	1175.83	839.99	737.46	563.01
1964	2260.00	1767.14	1563.57	1263.07	1102.32	1018.08	941.04	688.14	543.91
1965	6160.00	5238.57	4458.57	3955.33	2658.13	1527.02	1045.35	741.89	576.02
1966	4320.00	3347.14	2732.14	2021.13	1354.65	817.81	724.63	580.51	464.34
1967	3490.00	2578.57	2388.57	2128.00	1842.83	1608.09	1349.09	946.59	729.33
1968	1070.00	1032.71	1000.50	837.17	597.28	386.21	283.19	201.63	155.56
1969	4690.00	4301.43	3906.43	3676.67	3178.00	1961.88	1653.08	1182.26	1076.04
1970	11100.00	8792.86	6475.71	4171.33	3065.17	2245.83	1790.45	1362.57	1093.73
1971	365.00	204.43	177.71	168.67	151.55	128.09	105.57	95.19	80.61
1972	816.00	735.86	667.00	527.33	441.78	320.02	308.58	273.86	221.17
1973	1470.00	1371.43	1208.36	887.97	622.62	565.97	413.18	432.78	391.74
1974	2090.00	2041.43	1934.29	1748.00	1528.00	1212.88	945.71	686.70	527.28
1975	2520.00	2388.57	2210.00	2085.67	2029.67	1761.32	1254.64	875.38	662.51
1976	1830.00	1762.86	1670.71	1387.67	1047.13	795.42	618.89	453.15	356.51
1977	2410.00	2275.71	2112.14	1949.67	1708.83	1510.25	1193.05	881.39	673.17
1978	1060.00	1045.71	993.86	929.10	835.22	777.63	666.40	531.43	422.69
1979	2820.00	2725.71	2710.00	2542.00	2074.25	1277.17	908.21	839.91	698.53
1980	5290.00	5000.00	4707.14	4152.00	3090.83	1790.66	1306.59	984.38	806.13
1981	264.00	238.86	219.36	180.37	148.07	129.84	123.34	120.78	108.02
1982	510.00	476.86	433.71	372.33	287.73	205.65	169.66	183.89	143.14
1983	3170.00	3030.00	2883.57	2692.33	2355.17	1991.00	1577.64	1453.05	1308.45
1984	1620.00	1571.43	1532.14	1416.33	1145.25	1048.50	971.11	805.93	659.33

TABLE 17. HIGH FLOW DATA FOR WOLF CREEK NEAR DEER PARK.

@@@@@ WOLF CREEK NEAR DEER PARK, DISCH CFS(1958-84)

HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1958	629.00	297.43	178.21	120.96	87.81	53.96	41.06	38.57	32.39
1959	1690.00	693.57	397.50	238.33	156.92	87.17	58.72	41.81	31.86
1960	2700.00	831.43	436.43	219.13	117.02	60.82	68.53	54.31	45.07
1961	1930.00	728.86	573.71	434.70	254.65	167.08	112.74	77.67	58.67
1962	320.00	112.29	82.14	49.41	35.21	22.85	15.39	10.92	8.49
1963	570.00	210.86	174.43	139.27	108.52	69.11	47.29	45.10	34.16
1964	1860.00	397.71	218.50	181.67	109.07	90.98	77.28	58.26	45.32
1965	4240.00	810.86	535.29	379.60	219.11	119.13	81.00	58.80	44.58
1966	2840.00	547.71	316.93	185.27	125.63	79.27	61.36	55.75	49.48
1967	933.00	352.43	312.93	201.40	130.78	99.82	71.93	49.63	37.46
1968	387.00	196.86	179.57	144.20	103.28	68.96	46.22	31.87	23.97
1969	2500.00	785.29	476.36	308.30	190.17	102.48	78.31	57.23	50.75
1970	1050.00	409.57	247.50	179.27	130.85	100.97	78.91	61.70	46.65
1971	695.00	182.86	118.57	72.70	45.11	28.51	19.89	15.79	12.09
1972	635.00	212.00	123.57	66.33	39.28	24.17	18.07	17.73	13.91
1973	1200.00	345.29	218.36	179.30	100.25	58.47	40.26	39.09	35.02
1974	346.00	174.29	107.14	72.47	57.18	45.10	32.82	22.74	17.24
1975	1700.00	566.43	461.00	244.70	189.50	126.92	83.98	56.92	42.82
1976	592.00	212.14	161.71	119.00	99.50	65.65	49.56	33.84	25.83
1977	297.00	156.71	111.86	77.33	65.20	52.01	36.35	28.82	21.97
1978	311.00	149.43	90.21	63.50	54.58	46.93	34.06	26.21	20.59
1979	908.00	291.43	244.71	178.03	125.67	77.75	52.79	45.67	37.89
1980	1850.00	453.57	350.50	296.63	194.70	107.22	74.04	57.80	43.85
1981	41.00	14.86	7.86	5.11	4.01	3.38	2.50	2.16	1.62
1982	860.00	223.43	149.07	98.14	51.90	28.77	21.38	19.36	16.36
1983	1250.00	424.29	263.36	177.33	108.70	74.32	56.51	53.13	47.96
1984	728.00	293.86	168.57	84.66	62.57	55.12	49.78	35.21	27.46

TABLE 18. HIGH FLOW DATA FOR ST. JOHNS RIVER NEAR COCOA.

@@@@@ ST. JOHNS RIVER NEAR COCOA, DISCHARGE-CFS(1955-84)

HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1955	3120.00	3024.29	2871.43	2525.00	2226.17	2026.67	1979.34	1633.35	1294.85
1956	2320.00	2242.86	2193.57	2155.00	1963.17	1617.92	1282.17	935.70	726.30
1957	8440.00	8191.43	7657.14	6192.00	4221.67	2717.47	1983.56	1477.66	1131.38
1958	3630.00	3490.00	3226.43	3057.33	2653.17	2042.42	1794.29	1711.62	1493.31
1959	3980.00	3545.71	3105.00	2625.67	2097.67	1435.00	1060.70	855.44	742.73
1960	7710.00	6808.57	6015.71	4573.33	3166.83	2417.67	2193.22	2102.42	1875.60
1961	9990.00	9261.43	8746.43	8009.67	6279.17	5032.42	3924.59	2902.25	2251.20
1962	869.00	701.14	632.71	497.10	416.37	359.92	292.56	218.00	176.75
1963	3200.00	3094.29	3043.57	2752.00	2204.33	1640.11	1281.33	1165.80	906.99
1964	3000.00	2740.00	2551.43	2486.00	2119.17	1982.08	1864.50	1377.47	1087.33
1965	7160.00	6588.57	5907.86	5044.00	3840.00	2513.68	1781.95	1297.89	1008.45
1966	3550.00	3430.00	3359.29	3036.33	2234.67	1538.90	1353.55	1135.84	947.72
1967	2720.00	2537.14	2460.00	2334.67	2173.50	2070.50	1845.21	1392.19	1075.70
1968	2180.00	2111.43	1992.86	1776.00	1634.67	1266.85	910.68	649.38	499.61
1969	6480.00	6072.86	5927.86	5678.67	4541.50	2895.54	2444.36	1799.75	1581.74
1970	4940.99	4797.13	4544.27	4154.66	3551.33	2795.75	2366.23	1911.17	1598.10
1971	546.00	503.57	477.50	411.47	384.68	346.49	291.06	248.00	220.11
1972	660.00	652.57	637.50	602.10	547.67	506.84	470.50	437.40	368.07
1973	1490.00	1478.57	1452.14	1329.00	1125.52	949.28	757.94	785.14	722.07
1974	2490.00	2442.86	2421.43	2312.67	2117.67	1618.56	1305.48	982.24	765.59
1975	4140.00	3928.57	3824.29	3728.00	3281.83	2938.92	2166.72	1502.71	1145.47
1976	1610.00	1604.29	1592.14	1556.67	1335.78	1032.66	825.74	607.19	473.36
1977	3360.00	3245.71	3055.71	2657.67	2306.50	1940.67	1579.27	1206.18	927.13
1978	1340.00	1312.86	1302.14	1275.67	1168.68	1096.03	921.43	751.62	576.55
1979	4770.00	4570.00	4311.43	3833.00	3279.50	2255.41	1632.64	1420.69	1145.81
1980	5130.00	4995.71	4921.43	4578.67	3757.00	2475.89	1836.45	1427.08	1163.58
1981	288.00	278.29	250.29	200.93	143.60	108.25	81.96	76.69	71.50
1982	737.00	506.14	393.79	337.00	300.62	215.17	181.77	157.46	120.90
1983	4780.00	4447.14	4203.57	3911.67	3717.50	3120.50	2480.38	2134.30	2085.34
1984	2850.00	2817.14	2785.71	2679.33	2541.00	2361.17	1931.54	1524.60	1286.98

TABLE 19. ANNUAL PEAK FLOW DATA FOR JIM CREEK NEAR CHRISTMAS.

JIM CREEK NR CHRISTMAS (CREST STAGE GAGE: 1960-83)

YEAR:	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
DISCH:	3750.0	1600.0	234.0	342.0	2540.0	2220.0	835.0	700.0	676.0	2040.0
YEAR:	1970	1971	1972	1974	1975	1976	1977	1978	1979	1980
DISCH:	845.0	537.0	509.0	617.0	1170.0	648.0	558.0	282.0	730.0	1330.0
YEAR:	1981	1983								
DISCH:	210.0	1840.0								

TABLE 20. HIGH FLOW DATA FOR ST. JOHNS RIVER NEAR CHRISTMAS.

@@@@@ ST. JOHNS RIVER NEAR CHRISTMAS, DISCH-CFS(1935-84)
HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1935	4700.00	4542.86	4302.14	4099.67	3587.50	2712.92	2154.07	1568.24	1200.06
1936	4700.00	4485.71	4290.00	3874.00	3558.83	2739.00	2605.03	2377.32	1911.81
1937	1860.00	1698.57	1416.07	1386.00	1274.57	1117.60	1117.15	975.27	840.42
1938	3620.00	3551.43	3374.29	3070.67	3010.83	2556.50	2029.85	1465.64	1156.07
1939	1240.00	1061.43	956.07	942.33	767.75	592.97	515.15	385.36	311.65
1940	2860.00	2775.71	2674.29	2588.00	2396.67	2067.33	1730.44	1476.49	1196.90
1941	2880.00	2750.00	2545.00	2236.00	2202.00	2046.92	1596.39	1482.49	1254.38
1942	5270.00	5207.14	4959.29	4447.67	3906.50	3355.67	3099.18	2662.92	2249.39
1943	2350.00	2210.00	2107.14	1942.00	1717.83	1493.00	1201.29	844.19	651.37
1944	3700.00	3664.29	3493.57	3263.00	3069.67	2539.42	1969.97	1386.73	1059.17
1945	4270.00	4040.00	3715.00	3284.67	2762.17	2379.58	1949.89	1483.20	1144.26
1946	9230.00	8920.00	8087.14	6464.00	4507.83	4116.50	3282.43	2397.34	1834.60
1947	3500.00	3194.29	2889.29	2627.67	2328.50	1888.59	1424.62	1198.54	969.04
1948	10700.00	10357.14	10187.14	9522.67	7593.33	5274.67	4354.97	3497.34	2711.26
1949	10200.00	9890.00	9550.00	8423.00	6334.00	4053.17	3000.29	2103.45	1602.85
1950	6600.00	6571.43	6407.14	5689.67	4584.33	3421.42	2588.17	1912.25	1477.75
1951	4910.00	4884.29	4740.00	4304.33	3185.00	2089.10	1503.30	1078.33	829.88
1952	4850.00	4421.43	3915.00	3350.00	2764.67	2214.75	1740.25	1422.69	1151.40
1953	5720.00	5648.57	5503.57	4851.00	3707.83	2601.01	1961.86	1533.62	1192.82
1954	11700.00	11442.86	11042.86	10402.67	9231.17	6728.83	5091.42	3613.74	2763.79
1955	3330.00	3111.43	2821.43	2710.33	2595.33	2227.58	2233.11	1854.61	1479.16
1956	2380.00	2310.00	2257.14	2193.00	2006.00	1567.98	1276.32	956.90	739.86
1957	10200.00	9124.29	8603.57	7365.67	5253.50	3384.15	2488.08	1886.72	1434.81
1958	4290.00	3935.71	3638.57	3492.67	3259.50	2371.08	2087.86	2081.89	1783.62
1959	4980.00	4628.57	4097.86	3417.33	2767.00	1863.99	1389.76	1093.03	911.74
1960	9850.00	9391.43	8431.43	6628.67	4401.17	2730.88	2721.27	2543.99	2250.66
1961	11000.00	10671.43	10180.00	9307.33	7678.33	5988.75	4631.37	3369.99	2600.79
1962	2440.00	1982.86	1529.00	1087.03	812.37	560.43	423.92	309.57	247.61
1963	3320.00	3208.57	3158.57	2932.33	2432.17	1860.67	1458.40	1336.81	1057.65
1964	4380.00	3892.86	3330.00	2945.33	2478.83	2350.92	2159.34	1618.03	1277.42
1965	8930.00	8624.29	8061.43	6614.33	5023.50	3154.12	2236.53	1635.90	1267.85
1966	4500.00	4168.57	3916.43	3521.67	2566.50	1722.49	1517.01	1256.39	1072.46
1967	4370.00	4002.86	3545.71	3202.00	2968.33	2734.25	2523.66	1888.50	1466.12
1968	3630.00	3417.14	3050.71	2662.33	2308.83	1804.77	1314.07	930.35	713.88
1969	9070.00	8490.00	8026.43	7679.33	6427.50	4005.83	3441.29	2563.75	2205.81
1970	7190.99	6952.84	6526.41	5663.98	4844.32	3945.15	3375.02	2675.97	2184.26
1971	1080.00	922.57	758.57	587.57	554.75	474.96	389.42	320.95	271.84
1972	1760.00	1482.86	1172.93	1062.40	935.42	758.84	723.53	671.97	554.93
1973	2160.00	2057.14	1984.29	1882.00	1735.83	1387.38	1135.68	1172.16	1044.95
1974	3130.00	3075.71	3003.57	2945.00	2749.83	2300.67	1863.73	1396.21	1079.08
1975	5990.00	5647.14	5347.86	4931.67	4458.67	4089.42	3036.75	2093.82	1590.07
1976	1950.00	1850.00	1617.86	1472.00	1378.00	1272.84	1109.38	832.36	640.85
1977	5450.00	5281.43	5021.43	4424.00	3880.00	3145.33	2490.32	1902.22	1464.08
1978	2230.00	2098.57	1986.43	1929.00	1735.00	1582.92	1288.91	1034.30	796.50
1979	5200.00	5060.00	4947.14	4654.00	4278.33	3176.42	2295.25	1981.69	1621.02
1980	7070.00	6774.29	6526.43	5778.33	4694.00	3344.83	2673.47	2033.78	1644.67
1981	322.00	277.14	241.86	192.07	173.90	148.60	116.31	116.16	99.92
1982	1920.00	1605.71	1224.50	771.10	540.85	352.74	288.45	262.05	204.05
1983	5810.00	5497.14	5374.29	5024.00	4530.17	4038.42	3234.11	2643.99	2609.27
1984	1980.00	1938.57	1906.43	1884.00	1781.17	1631.50	1490.77	1255.38	1077.19

TABLE 21. HIGH FLOW DATA FOR ECONLOCKHATCHEE RIVER AT MAGNOLIA RANCH NEAR BITHLO.

@@@@@ ECONLOCKHATCHEE RIVER AT MAGNOLIA RANCH NEAR BITHLO (1973-84), DISCH-CFS
HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1974	74.00	63.29	58.07	53.47	48.77	38.52	27.09	18.37	13.80
1975	122.00	116.00	112.14	93.93	87.23	74.85	51.24	34.47	25.88
1976	72.00	69.71	62.86	53.90	50.80	32.76	22.40	15.00	11.23
1977	122.00	80.71	70.43	55.37	42.13	38.74	28.26	22.45	17.06
1978	81.00	77.29	67.86	59.30	47.00	32.12	27.06	19.65	14.84
1979	187.00	178.29	155.71	129.07	82.75	46.75	31.62	27.97	23.32
1980	281.00	253.14	243.29	217.33	157.82	90.30	61.74	44.57	34.40
1981	17.00	4.91	3.69	2.40	1.27	0.71	0.47	0.42	0.39
1982	113.00	83.14	73.29	51.23	35.64	18.77	12.64	9.31	6.99
1983	474.00	419.29	311.50	180.93	129.75	101.47	77.00	62.57	61.79
1984	283.00	232.86	182.00	136.70	95.08	66.85	55.03	49.51	43.85

TABLE 22. ANNUAL PEAK FLOW DATA FOR ECONLOCKHATCHEE RIVER TRIBUTARY NEAR BITHLO, CFS.

YEAR:	1970	1971	1973	1974	1975	1976	1977	1978	1979	1980
DISCH:	338.0	23.0	31.0	31.0	103.0	25.0	70.0	37.0	71.0	61.0

YEAR:	1981	1983	1984
DISCH:	27.0	42.0	55.0

TABLE 23. HIGH FLOW DATA FOR LITTLE ECONLOCKHATCHEE RIVER NEAR UNION PARK, CFS.

HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1961	960.00	512.86	299.93	173.50	147.59	96.86	65.07	45.07	34.25
1962	180.00	103.57	58.96	33.59	20.42	12.98	9.75	8.18	6.43
1963	390.00	200.43	131.43	120.17	75.95	46.32	32.52	29.58	22.64
1964	608.00	255.86	150.29	78.27	61.66	51.13	44.51	35.36	27.77
1965	824.00	387.29	255.14	209.57	130.58	70.72	47.67	35.72	27.45
1966	320.00	221.00	178.00	107.97	66.75	39.92	29.03	35.05	28.41
1967	523.00	220.00	166.00	100.90	86.93	64.31	45.57	32.99	25.42
1968	460.00	170.29	113.29	101.33	81.23	47.59	32.43	23.04	17.89
1969	1000.00	360.29	205.14	139.73	99.02	63.67	53.65	40.12	35.12
1970	734.00	309.71	248.43	150.80	100.30	76.52	65.10	49.96	38.35
1971	35.00	14.81	11.13	7.69	7.06	5.33	4.51	4.52	4.43
1972	110.00	70.71	48.29	34.63	27.33	21.56	18.90	16.36	13.23
1973	369.00	166.57	121.71	86.17	53.48	38.57	39.90	32.89	26.74
1974	710.00	211.86	135.71	95.87	71.45	45.17	33.56	25.18	21.15
1975	1000.00	386.57	294.00	163.93	142.20	104.23	73.22	51.78	40.75
1976	96.00	57.71	45.71	37.63	35.57	31.30	26.89	21.02	17.95
1977	290.00	94.29	89.64	82.93	73.28	57.94	43.88	36.45	29.31
1978	117.78	80.62	56.72	36.64	27.47	21.67	18.40	16.26	13.97
1979	128.06	104.47	90.42	75.13	50.64	33.62	25.01	24.19	21.18
1980	386.00	144.86	116.56	105.62	95.13	68.06	51.46	39.02	32.42
1981	64.00	33.86	24.79	16.44	12.60	12.07	10.19	8.78	8.20
1982	231.00	85.86	78.79	50.93	36.08	29.43	26.51	25.75	23.28
1983	550.00	236.14	185.36	117.77	85.12	77.97	59.52	51.35	47.24
1984	282.00	114.71	114.50	83.00	68.43	52.29	43.38	37.42	28.09

TABLE 24. HIGH FLOW DATA FOR ECONLOCKHATCHEE RIVER NEAR CHULUOTA.

@@@@@ ECONLOCKHATCHEE RIVER NEAR CHULOUTA, DISCH CFS(1937-84)

HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1937	1760.00	1451.43	1021.50	641.73	430.22	361.14	301.23	224.15	196.39
1938	1760.00	1314.00	911.00	833.90	572.68	459.48	344.16	239.77	183.59
1939	1490.00	1210.86	846.71	616.63	393.58	230.99	175.36	123.54	104.16
1940	2430.00	1800.00	1344.79	1077.33	639.67	606.71	429.32	301.56	248.38
1941	1790.00	1314.29	886.86	512.33	431.98	405.11	278.16	306.67	264.76
1942	2160.00	1725.71	1343.57	1200.80	829.95	673.02	583.79	465.68	366.00
1943	1360.00	1063.71	896.86	674.80	436.27	302.82	207.73	145.42	122.13
1944	2000.00	1644.29	1278.64	866.33	752.25	575.80	393.63	277.80	224.88
1945	6100.00	3550.00	2042.50	1044.53	743.60	667.17	481.81	343.74	261.40
1946	9040.00	5167.14	3087.21	1856.47	1149.72	866.70	597.17	424.55	323.20
1947	1200.00	1049.29	938.79	736.50	582.25	392.02	274.42	267.53	218.27
1948	4560.00	2990.00	2151.57	1264.00	938.73	865.38	667.48	582.48	452.07
1949	10000.00	6287.14	4609.29	2768.93	1736.83	1082.53	727.23	493.56	373.98
1950	3700.00	2671.43	1793.79	1041.80	988.73	660.66	481.39	366.10	284.33
1951	7350.00	4272.86	2659.29	1378.73	780.65	475.97	354.69	253.72	196.88
1952	2000.00	1487.14	1076.50	889.67	637.77	541.75	444.60	372.02	293.51
1953	2590.00	1935.71	1440.43	862.83	621.02	368.78	271.58	248.05	196.73
1954	4080.00	3000.00	2592.14	2085.30	1716.73	1098.47	856.81	590.47	451.18
1955	1740.00	1170.86	773.71	523.43	371.40	241.25	247.95	189.80	149.85
1956	1350.00	1073.43	861.93	608.63	447.45	317.42	235.82	175.69	136.47
1957	8850.00	4855.71	3057.43	1706.03	1190.47	673.77	456.46	353.67	277.69
1958	2360.00	1909.29	1429.36	1347.27	917.47	581.53	432.17	435.06	371.79
1959	4290.00	2794.29	1802.86	1200.77	820.60	527.14	409.39	320.78	281.52
1960	11000.00	6521.43	3853.14	2008.63	1131.62	625.80	584.96	560.07	484.48
1961	7240.00	4651.43	3749.29	2494.33	1857.78	1482.44	1017.20	707.49	542.32
1962	4100.00	2319.14	1331.29	824.03	477.27	275.91	198.43	149.76	119.61
1963	1840.00	1427.14	1160.29	961.63	658.47	414.27	346.82	309.50	239.47
1964	3520.00	2791.43	1820.64	941.17	759.43	622.35	550.95	423.52	336.35
1965	5450.00	3500.00	2495.00	2159.60	1505.00	863.53	586.54	429.28	331.85
1966	2300.00	1755.71	1493.29	925.00	631.47	425.70	315.68	355.48	283.50
1967	2280.00	1488.71	1218.36	949.37	778.28	685.64	487.36	352.62	274.59
1968	2260.00	1565.71	1163.29	838.97	800.75	503.98	345.63	247.64	192.75
1969	6600.00	3622.86	2404.07	1600.80	1152.38	706.63	563.16	423.70	363.96
1970	4660.99	3051.43	2222.57	1546.47	1257.87	910.24	825.43	636.09	488.64
1971	300.00	256.29	236.07	200.37	136.23	96.64	79.54	71.92	66.60
1972	1370.00	991.57	772.50	507.10	314.87	250.02	197.85	174.69	146.73
1973	1520.00	1229.57	958.79	645.47	382.98	287.22	250.33	232.10	195.45
1974	1510.00	1046.71	678.36	566.57	517.47	367.13	270.05	201.15	162.60
1975	3850.00	2370.00	1875.00	1189.67	1140.72	828.27	572.38	402.52	315.22
1976	820.00	728.57	647.79	443.53	408.40	335.47	260.49	193.81	164.62
1977	890.00	736.43	667.21	621.47	538.02	477.07	357.64	279.82	222.94
1978	1230.00	962.29	703.00	576.37	410.33	277.56	228.75	207.71	168.46
1979	1440.00	1374.29	1259.93	1043.33	684.50	417.13	296.43	269.32	229.74
1980	1840.00	1281.00	1176.79	1072.27	732.65	496.93	370.38	276.66	230.99
1981	448.00	270.86	210.29	143.27	118.22	90.48	85.44	84.06	76.38
1982	1360.00	1096.86	812.36	503.13	315.20	204.67	171.11	159.59	133.66
1983	4030.00	2188.57	1549.50	1039.17	809.27	719.99	564.52	478.06	443.52
1984	1290.00	949.43	847.64	687.43	538.32	419.61	367.22	279.57	209.87

TABLE 25. HIGH FLOW DATA FOR HOWELL CREEK NEAR SLAVIA.

@@@@@ HOWELL CREEK AT REDBUG ROAD NEAR SLAVIA (1973-80, 82-84), DISCH CFS
HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1973	142.00	128.00	109.79	75.77	50.50	37.99	36.90	32.37	28.95
1974	186.00	109.71	90.86	79.00	68.60	61.72	46.75	36.18	30.07
1975	412.00	316.00	275.07	187.40	131.27	99.09	72.22	54.19	43.18
1976	236.00	149.29	136.14	124.47	96.75	80.66	66.83	49.56	43.38
1977	81.00	77.71	72.57	59.00	52.93	49.17	39.80	33.14	27.39
1978	101.00	82.00	66.93	60.97	49.25	34.97	31.51	31.34	27.06
1979	271.00	179.43	167.57	144.93	103.85	67.40	49.07	46.79	40.23
1980	151.00								
1982	84.00	76.57	66.29	46.27	31.06	23.07	19.43	18.16	16.14
1983	95.00	76.43	68.79	63.43	55.75	47.77	37.32	35.87	32.31
1984	100.00	85.43	75.93	61.40	47.53	39.17	33.61	30.24	26.61

TABLE 26A. HIGH FLOW DATA FOR SOLDIER CREEK NEAR LONGWOOD.

@@@@@ SOLDIER CREEK NEAR LONGWOOD, DISCH CFS (1973-75, 78-79)

HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1973	48.00	20.57	16.61	14.60	12.93	10.42	8.68	6.74	5.58
1974	416.00	60.57	55.57	45.67	32.12	24.08	16.99	12.97	10.24
1975	356.00	141.00	116.57	68.70	47.44	32.17	22.42	16.27	12.60
1976	396.00								
1978	166.00	38.57	30.86	26.80	18.39	12.50	9.57	9.19	7.74
1979	429.00	98.43	85.93	63.93	40.54	25.04	19.16	18.21	15.04
1980	404.00								

TABLE 26B. HIGH FLOW DATA FOR GEE CREEK NEAR LONGWOOD.

@@@@@ GEE CREEK NEAR LONGWOOD, DISCH CFS (1973-79)
HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1973	64.00	35.29	25.57	17.69	16.47	14.41	12.68	11.23	9.62
1974	156.00	77.00	54.79	47.43	36.42	31.01	23.57	17.60	14.23
1975	208.00	171.86	131.57	83.03	64.55	48.37	34.78	25.18	19.52
1976	175.00	86.71	67.64	61.33	49.72	45.47	35.53	26.19	21.30
1977	78.00	55.14	45.50	33.93	31.52	23.14	19.52	16.69	13.65
1978	63.00	42.43	34.00	30.17	22.76	17.56	14.56	14.10	11.45
1979	200.00	157.29	145.43	114.80	74.78	46.31	31.59	26.62	22.41

TABLE 27. HIGH FLOW DATA FOR LITTLE WEKIVA RIVER NEAR ALTAMONTE SPRINGS.

@@@@@ LITTLE WEKIVA RIVER NEAR ALTAMONTE SPRINGS, DISCH CFS (1972-79,83-84)
HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1972	280.00								
1973	119.00	99.43	75.57	55.60	36.75	27.65	27.12	25.25	22.76
1974	334.00	158.29	125.71	108.03	75.62	59.45	43.94	34.10	28.94
1975	384.00	333.43	284.79	182.60	121.97	89.33	64.03	46.89	37.98
1976	409.00	168.43	144.43	120.17	87.37	77.98	60.18	45.46	39.11
1977	454.00	62.14	60.57	54.43	49.95	46.30	36.22	31.09	26.86
1978	151.00	71.71	58.34	53.74	40.54	30.51	24.92	25.32	22.02
1979	394.00	229.37	199.54	151.14	102.18	63.94	46.23	41.68	37.77
1983	280.00								
1984	309.00	138.43	112.71	79.80	64.57	53.14	43.44	37.81	36.21

TABLE 28. HIGH FLOW DATA FOR WEKIVA RIVER NEAR SANFORD.

@@@@@ WEKIVA RIVER NEAR SANFORD, DISCH(1937-84)

HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1937	912.00	676.71	541.71	464.17	353.33	295.48	292.97	285.81	274.52
1938	673.00	583.29	478.57	376.07	320.55	313.35	296.24	263.17	239.97
1939	490.00	466.14	431.50	372.50	301.33	253.28	238.27	226.78	211.07
1940	711.00	517.00	420.79	369.90	295.48	294.00	264.08	250.66	239.09
1941	658.00	513.14	403.64	355.03	335.23	304.10	265.57	262.31	250.27
1942	927.00	790.71	642.36	500.07	423.67	374.80	359.55	340.69	311.65
1943	511.00	431.43	389.79	314.43	275.78	267.72	244.32	234.26	228.67
1944	844.00	574.86	462.86	374.53	365.53	318.22	274.46	258.27	240.61
1945	1580.00	940.14	617.57	406.00	344.67	332.97	301.68	275.64	253.17
1946	2060.00	1394.86	964.86	667.67	555.25	471.70	395.20	356.31	322.50
1947	890.00	784.00	714.57	541.97	414.32	362.38	323.49	311.27	292.62
1948	1130.00	765.14	591.29	462.23	428.40	374.23	338.97	329.47	301.09
1949	594.00	563.14	540.00	459.93	420.63	340.67	292.88	261.53	239.35
1950	929.00	779.43	611.00	449.10	405.48	337.38	312.70	281.04	258.88
1951	1610.00	980.14	703.93	489.70	407.37	337.70	308.30	271.64	245.96
1952	551.00	469.71	399.29	329.50	282.25	273.71	265.16	257.93	244.67
1953	670.00	549.86	514.71	425.70	330.87	280.85	276.64	259.31	246.92
1954	1100.00	944.86	811.29	625.77	541.70	444.31	418.13	365.37	329.34
1955	952.00	601.29	452.29	381.10	308.30	270.00	254.30	242.70	231.96
1956	380.00	326.14	317.86	297.93	260.97	244.86	233.52	230.52	219.95
1957	748.00	587.14	435.14	331.20	281.72	243.52	233.75	233.41	226.19
1958	920.00	731.43	609.00	500.70	404.58	354.46	317.28	323.54	308.99
1959	1280.00	1045.00	816.29	611.60	496.35	403.78	363.99	327.14	312.70
1960	1950.00	1512.86	1096.86	728.57	571.17	446.05	399.56	393.79	368.29
1961	1860.00	1650.00	1399.29	1212.10	877.83	741.65	626.33	554.38	483.97
1962	338.00	313.00	306.86	295.93	283.20	267.16	254.67	244.42	236.81
1963	707.00	523.86	434.86	413.90	366.27	313.38	306.25	285.67	270.10
1964	1090.00	897.43	731.93	578.30	478.42	418.15	374.16	346.19	324.92
1965	1570.00	1244.29	1007.79	708.13	522.62	395.54	354.15	325.75	298.23
1966	884.00	845.57	786.64	604.57	453.83	364.43	324.22	333.46	307.23
1967	1150.00	835.29	724.00	564.63	496.40	476.07	400.77	354.13	317.83
1968	743.00	571.86	473.79	405.57	366.22	331.19	301.84	284.95	264.55
1969	978.00	844.00	745.29	621.13	545.68	459.39	452.89	408.31	380.30
1970	1170.00	978.00	780.07	634.90	599.57	531.10	524.21	484.61	429.75
1971	972.00	799.00	587.57	467.43	391.37	337.88	340.57	327.90	307.27
1972	804.00	687.14	596.29	535.90	458.62	376.00	340.85	323.18	309.21
1973	482.00	446.00	407.07	368.40	344.25	308.91	293.61	283.85	270.19
1974	755.00	631.00	537.29	522.83	469.62	412.42	354.40	314.05	287.22
1975	1160.00	1075.71	1012.86	755.87	567.03	474.67	395.25	341.37	307.89
1976	661.00	598.29	556.36	474.47	399.95	367.72	330.99	297.00	274.67
1977	572.00	436.29	391.21	356.27	338.08	311.17	300.26	297.71	274.68
1978	592.00	542.86	464.79	443.87	380.98	322.63	301.55	299.33	277.72
1979	935.00	773.14	683.43	598.80	475.23	389.63	354.67	357.65	338.37
1980	756.00	702.14	633.07	592.80	477.12	390.91	352.44	330.64	317.92
1981	275.00	248.57	240.43	233.60	227.27	225.63	216.37	210.42	211.00
1982	722.00	616.00	473.57	352.37	286.17	239.08	219.75	213.44	209.71
1983	740.00	559.71	485.86	428.73	408.83	363.13	319.26	313.61	313.40
1984	609.00	511.57	493.57	425.43	389.83	356.33	332.32	313.67	298.80

TABLE 29. HIGH FLOW DATA FOR ST. JOHNS RIVER NEAR DELAND.

@@@@@ ST. JOHNS RIVER NEAR DELAND, DISCH-CFS(1935-84)-
HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1935	10600.00	10471.43	10364.29	9729.33	8847.33	7140.83	5648.91	4213.79	3344.55
1936	7900.00	7770.00	7652.86	7195.33	6401.50	5025.58	4843.22	4280.69	3515.00
1937	4070.00	3997.14	3859.29	3618.33	3119.67	2753.50	2703.33	2454.05	2221.21
1938	6290.00	6245.71	6189.29	5916.00	5429.17	4970.00	4100.05	3175.44	2583.70
1939	3880.00	3784.29	3688.57	3613.33	2915.67	2027.04	1850.27	1540.68	1411.21
1940	5120.00	5010.00	4778.57	4633.00	4289.17	3798.67	3453.55	2891.11	2473.77
1941	5260.00	5080.00	4891.43	4561.67	4423.50	4034.50	3265.32	3175.41	2831.25
1942	9020.00	8897.14	8743.57	8287.67	7450.50	6628.42	6257.76	5522.26	4740.41
1943	4580.00	4464.29	4398.57	4105.67	3633.83	3105.25	2701.08	2180.99	1882.59
1944	7800.00	7677.14	7521.43	7371.67	6576.83	5415.50	4421.42	3420.49	2857.65
1945	8290.00	8092.86	7934.29	7406.33	6235.17	5670.83	4927.76	3966.13	3265.14
1946	14400.00	14014.29	13242.86	11392.33	9187.83	7921.33	6526.99	5132.27	4140.12
1947	6230.00	6128.57	6009.29	5682.33	5567.00	4843.67	3986.78	3465.16	3115.40
1948	13400.00	13142.86	12857.14	12176.67	10692.67	8300.58	7223.72	6206.06	5117.57
1949	13900.00	13600.00	13185.71	12390.00	10316.33	7429.42	6004.75	4663.47	3892.85
1950	10000.00	9797.14	9428.57	8880.00	7852.33	6373.17	5396.23	4309.28	3528.64
1951	10800.00	10657.14	10420.00	9397.33	7668.83	5314.33	4143.33	3173.63	2588.95
1952	7500.00	7214.29	6628.57	6256.67	5665.50	4782.00	3980.00	3400.26	2837.75
1953	8560.00	8392.86	8235.00	7757.33	6463.17	4977.08	3956.61	3537.12	2885.97
1954	17100.00	16914.29	16650.00	15873.33	14148.33	11558.67	9373.28	6935.36	5474.58
1955	5360.00	5072.86	4848.57	4407.00	4111.00	3623.33	3714.48	3289.31	2824.85
1956	4180.00	3978.57	3690.00	3505.67	3359.00	2828.08	2548.03	2258.28	1869.62
1957	9910.00	9718.57	9630.71	9338.67	8015.67	5529.67	4269.40	3555.84	2940.99
1958	8410.00	8242.86	7937.86	7262.67	6608.50	5024.83	4346.07	4370.99	3850.66
1959	9060.00	8977.14	8764.29	8022.33	6939.50	4887.17	4075.41	3218.28	2811.97
1960	13000.00	12857.14	12400.00	11099.33	8465.67	6030.17	5840.11	5624.93	5233.50
1961	16000.00	15857.14	15721.43	15266.67	13995.00	11926.08	9767.98	7429.85	5903.82
1962	4730.00	4468.57	4180.00	3306.00	2841.00	2041.37	1719.86	1411.46	1154.17
1963	6000.00	5900.00	5785.71	5349.00	4514.00	3691.90	3611.71	3284.10	2633.40
1964	6920.00	6808.57	6679.29	6591.33	6189.83	5766.42	5394.97	4289.69	3521.44
1965	13400.00	13185.71	12757.14	11484.33	9613.17	6834.75	5299.90	4255.72	3492.53
1966	7540.00	7152.86	7031.43	6649.67	5744.50	4263.67	3823.01	3527.28	3136.21
1967	7880.00	7817.14	7570.71	6821.33	6736.17	6247.17	5587.16	4466.35	3581.19
1968	6030.00	5990.00	5855.00	5478.33	5199.17	4435.33	3473.17	2696.97	2153.81
1969	12800.00	12371.43	12050.00	11883.33	10577.17	7465.83	6612.79	5258.28	4549.70
1970	9050.00	8942.86	8697.14	8170.00	7712.83	7352.17	6805.46	5783.58	4765.78
1971	3530.00	3210.00	2941.43	2712.67	2224.83	1857.83	1688.91	1566.72	1352.99
1972	4060.00	3872.86	3455.71	2712.67	2519.50	2053.83	2081.37	1846.97	1575.35
1973	4670.00	4550.00	4323.57	3852.33	3647.50	3107.59	2755.79	2792.51	2526.78
1974	5190.00	5074.29	4816.43	4475.67	4421.83	4141.67	3640.11	2883.62	2267.51
1975	8680.00	8471.43	8339.29	8102.33	7585.17	7043.08	5667.75	4060.94	3195.39
1976	4670.00	4507.14	4412.14	4126.00	3877.00	3733.25	3401.80	2747.34	2248.90
1977	5440.00	5314.29	5301.43	4950.67	4683.00	4290.50	3908.58	3457.23	2880.55
1978	6550.00	6297.14	6185.00	5880.33	4987.33	3987.50	3337.42	3004.35	2596.80
1979	7210.00	7135.71	6944.29	6690.67	6202.17	5017.42	4201.04	4100.80	3577.40
1980	9500.00	9317.14	9202.86	8737.33	7824.17	6262.67	5195.25	4193.49	3581.34
1981	2990.00	2254.29	2097.14	1496.00	1316.80	1083.23	811.83	780.94	751.50
1982	5890.00	5728.57	5504.29	4694.00	3393.73	2135.18	1834.30	1545.30	1285.33
1983	8930.00	8505.71	7947.86	7789.00	7538.17	6895.50	5933.93	5200.46	5302.62
1984	5360.00	5122.86	4974.29	4678.33	4562.83	4488.33	4343.00	3854.20	3618.88

TABLE 30. ANNUAL PEAK FLOW DATA FOR BLACKWATER CREEK NEAR CASSIA.

BLACKWATER CREEK NR CASSIA (CREST-STAGE GAGE), PEAK DISCH CFS (1963-1983)

YEAR:	1963	1965	1966	1967	1968	1969	1970	1971	1972	1974
DISCH:	263.0	506.0	265.0	291.0	216.0	749.0	422.0	240.0	276.0	216.0
YEAR:	1975	1976	1977	1978	1979	1980	1982	1983		
DISCH:	342.0	296.0	324.0	155.0	385.0	605.0	396.0	281.0		

TABLE 31. ANNUAL PEAK FLOW DATA FOR DEEP CREEK NEAR BARBERVILLE.

DEEP CREEK NR BARBERVILLE (CREST-STAGE GAGE), PEAK DISCH CFS (1965-1983)

YEAR:	1965	1966	1967	1968	1969	1970	1971	1972	1973	1975
DISCH:	492.0	232.0	368.0	1100.0	908.0	692.0	138.0	89.0	178.0	149.0
YEAR:	1976	1977	1978	1979	1980	1982	1983			
DISCH:	100.0	190.0	71.0	338.0	418.0	462.0	214.0			

THE OKLAWAHA RIVER BASIN

The Oklawaha River joins the St. Johns River north of Lake George (Figure 2). Its extreme headwaters are southwest of Orlando where the Palatlakaha River flows from the Green Swamp area (Figure 7). The upper Oklawaha River Basin is predominantly an interconnected lake region. Flow is regulated throughout this region. Even though streamflow is gaged at several locations, the peak discharge estimates were computed only for unregulated stations.

Table 32 presents some general information on the USGS long-term (unregulated) stream gaging stations. Flood discharges for different return periods are summarized in Table 33 for twelve sites. At three of these stations (Oklawaha River near Ocala, Orange Springs, and at River Side Landing) discharge monitoring was discontinued a long time ago; thus, sufficient discretion should be used in using results of these stations. Tables 34 through 46 furnish high flow data for selected gaging stations. (Note: The 1-day highest discharges appearing in these tables represent instantaneous peak flows. For crest-stage partial record stations only annual peak flows are given; data might be missing for some years.)

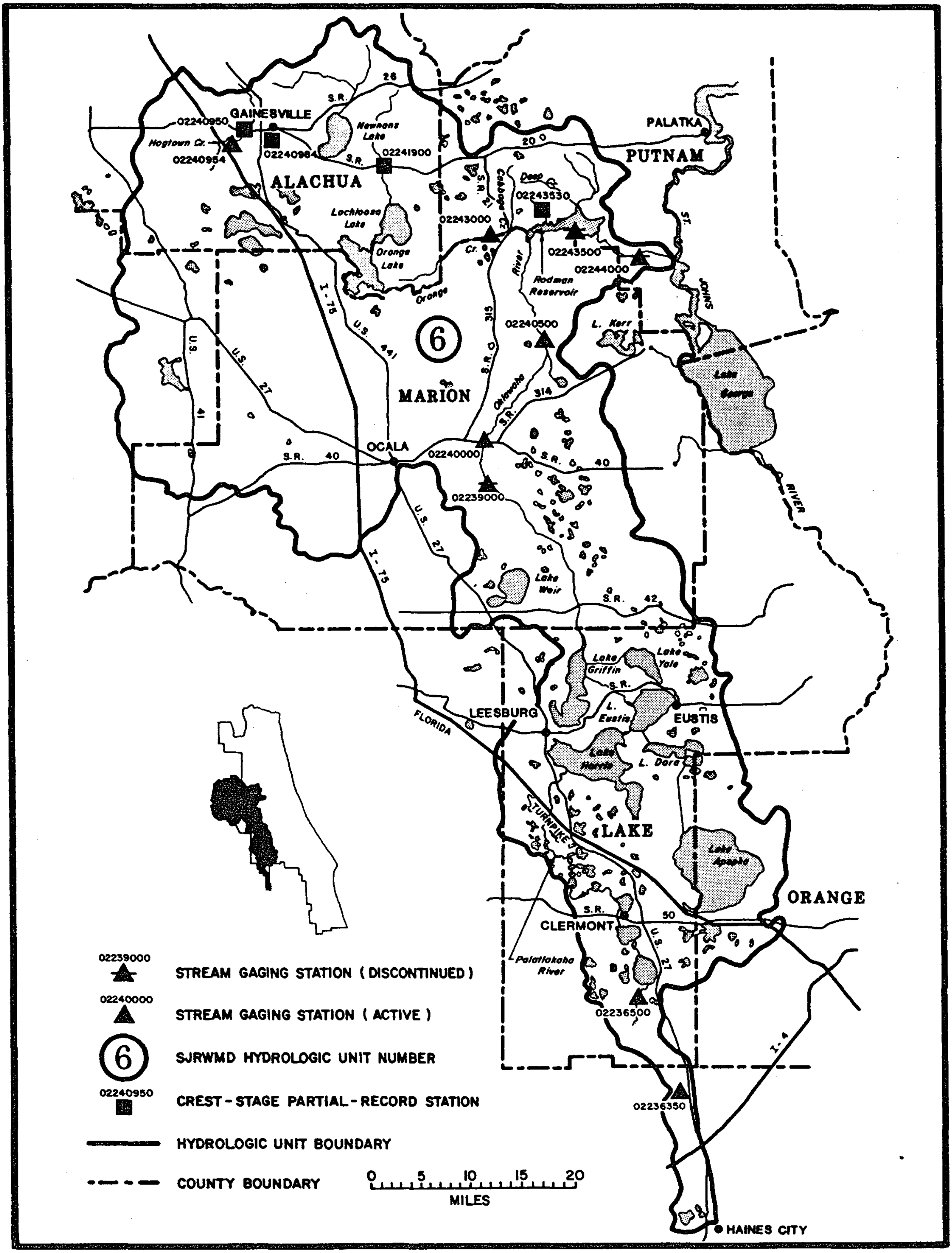

Figure 7. The Oklawaha River Basin (Hydrologic Unit No. 6)

TABLE 32. General Information on the Long-Term Stream Gaging Stations in the Oklawaha River Basin

USGS Station No. and Name	Location	Drainage Area Sq. Mi.	Period of Record	Recorded Peak Elv. ft. NGVD	Remarks
Oklawaha River Basin: (Hydrologic Unit No. 6, Fig. 5)					
02236350 Green Swamp Run near Eva	Polk Co.: At culverts on Sand Mine Rd., 1.1 mi west of US 27	43	July 1979-Current Yr.	121.41 (1982)	
02236500 Big Creek near Clermont	Lake Co.: At log bridge, 1 mi upstream from Lake Louisa	68	July 1958-Current Yr.	105.20 (1960)	Some interconnection at high stages with Little Creek and Withlacoochee River Basin
02239000 Oklawaha River near Ocala	Marion Co.: At Sharpes Ferry highway bridge	1,070	Feb 1930-July 68	42.20 (1960)	Discontinued
02240000 Oklawaha River near Conner	Marion Co.: At bridge on SR 40	1,196	Feb 1930-Sept 46 Oct 77-Current Yr.	40.93 (1982)	Some effect from Moss Bluff Dam 13.3 mi. upstream
02240500 Oklawaha River at Eureka	Marion Co.: At bridge on C-316	1,367	Feb 1930-June 34 Sept 43-Dec 52 Jan 81-Current Yr.	26.52 (1982)	
02240950 Hogtown Creek near Gainesville	Alachua Co.: At bridge on Newberry Rd.	18.5	1959-78	71.82 (1964)	Crest-Stage Partial-Record Station
02240954 Hogtown Creek Arredondo	Alachua Co.: At bridge on C-30	41.2	Dec 1971-Current Yr.	60.11 (1972)	Flow affected at times by by backwater from Haile Sink
02240984 Sweetwater Br. Trib. at Gainesville	Alachua Co.: At culvert on SE 2nd Ave.	0.79	1971-Current Yr.	148.24 (1976)	Crest-Stage Partial-Record Station
02241900 Lochloosa Creek at Grove Park	Alachua Co.: At bridge on SR 20	34.7	1958-78	82.57 (1978)	Crest-Stage Partial-Record Station
02243000 Orange Creek at Orange Springs	Marion Co.: At bridge on SR 21	1,119	Nov 1941-Current Yr. (No continuous records for some periods.)	29.67 (1941)	Drainage area includes Paynes Prairie, a diked sinkhole area of 650 sq.mi. which is noncontributing except by pumpage.

TABLE 32. Continued.

USGS Station No. and Name	Location	Drainage Area Sq. Mi.	Period of Record	Recorded Peak Elv. ft. NGVD	Remarks
02243500 Oklawaha River near Orange Springs	Marion Co.: At Jordans Ferry and mouth of Orange Crk.	2,010 (Approx)	Feb 1930-Dec 52	19.12 (1933)	Discontinued
02243530 Bruntbridge Brook at Kenwood	Putnam Co.: At culverts on SR 315	4.63	1971-Current Yr.	8.33* (1982)	Crest-Stage Partial-Record Station. *-Gage height only; datum not determined.
02244000 Oklawaha River at Riverside Landing, near Orange Springs	Putnam Co.: Near boat dock at Riverside Landing	2,100 (Approx)	Oct 1943-Sept 68	9.80 (1960)	Discontinued

TABLE 33. Estimates of Flood Flows at Gaged Sites in the Oklawaha River Basin

(First Line: Log Pearson type 3 analysis using the WRC guidelines, Bulletin #17B.)
(Second Line: Log Pearson type 3 analysis using the Method of Mixed Moments.)

Gaging Station	Record Length (Years)	Highest Discharge During Period of Record (cfs)	Mean Annual High Discharge (cfs)	Discharge in cfs which may be equaled or exceeded in: 5 Yr	10 Yr	25 Yr	50 Yr	100 Yr	500 Yr
1. Big Creek near	25	691	145	210	330	527	710	926	1,570
Clermont				213	327	508	669	850	1,360
2. Oklawaha River	37	2,270	1,110	1,490	1,760	2,090	2,310	2,530	2,990
near Ocala				1,480	1,730	2,010	2,210	2,380	2,740
3. Oklawaha River	23	4,430	2,270	2,920	3,420	4,030	4,470	4,910	5,900
near Conner				2,890	3,390	4,010	4,470	4,920	5,990
4. Oklawaha River	17	6,230	3,490	4,660	5,630	6,870	7,790	8,710	10,900
at Eureka				4,610	5,510	6,640	7,450	8,260	10,100
5. Hogtown Creek	15	1,600	769	1,070	1,400	1,870	2,260	2,690	3,850
near Gainesville				1,070	1,370	1,770	2,090	2,420	3,230
6. Hogtown Creek	11	671	361	530	691	906	1,070	1,250	1,660
near Arredondo				523	643	778	868	949	1,110
7. Sweetwater Branch	10	581	441	508	541	579	604	628	678
Trib. at Gainesville				514	557	603	634	662	719
8. Lochloosa Creek	17	1,530	616	919	1,340	2,000	2,580	3,250	5,160
at Grove Park				947	1,280	1,690	1,990	2,280	2,900
9. Orange Creek at	28	2,400	833	1,320	1,800	2,400	2,920	3,390	4,480
Orange Springs				1,300	1,650	2,030	2,260	2,460	2,800
10. Oklawaha River	22	9,760	4,140	5,300	6,430	7,970	9,190	10,500	13,900
near Orange Springs				5,230	6,410	8,080	9,460	11,000	15,000
11. Bruntbridge Brook	9	270	157	225	277	340	386	429	524
at Kenwood				218	253	290	312	330	362
12. Oklawaha River at	25	8,760	4,630	6,360	7,650	9,180	10,300	11,300	13,500
Riverside Landing				6,320	7,360	8,470	9,160	9,760	10,900
near Orange Springs									

TABLE 34. HIGH FLOW DATA FOR GREEN SWAMP RUN NEAR EVA.

@@@@@ GREEN SWAMP RUN NEAR EVA, DISCH CFS (1980-84)

HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1980	78.00	73.86	64.93	48.57	36.52	25.40	18.90	13.51	10.12
1981	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1982	32.00	28.71	23.21	13.65	8.34	4.82	4.54	3.34	2.51
1983	85.00	80.43	75.79	65.80	59.43	54.38	47.99	44.79	39.05
1984	75.00	73.68	68.70	49.82	45.67	38.59	36.90	35.40	29.07

TABLE 35. HIGH FLOW DATA FOR BIG CREEK NEAR CLERMONT.

@@@@@ BIG CREEK NEAR CLERMONT, DISCH CFS (1960-84)

HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1960	621.00	549.29	475.86	363.23	234.28	162.14	139.34	136.03	123.67
1961	691.00	608.14	576.21	475.50	328.67	239.37	172.92	128.59	99.34
1962	35.00	29.43	21.36	14.83	8.68	5.70	5.05	4.15	3.40
1963	73.00	68.00	63.79	47.30	31.63	17.67	16.12	12.12	9.24
1964	104.00	93.14	84.07	76.87	70.15	54.97	42.15	30.99	23.89
1965	414.00	316.43	265.21	190.07	119.08	73.12	53.31	40.30	30.46
1966	158.00	141.71	134.07	115.70	86.78	62.86	48.67	54.28	42.07
1967	195.00	162.00	138.14	106.00	96.98	69.88	49.68	37.23	28.23
1968	53.00	49.43	40.57	27.54	27.34	16.84	11.45	7.95	5.97
1969	121.00	93.29	85.93	76.00	68.77	62.38	55.10	48.07	41.25
1970	178.00	164.29	143.36	126.53	119.73	112.11	105.66	79.49	59.89
1971	36.00	33.57	28.64	18.06	14.51	10.93	7.80	6.40	4.96
1972	26.00	21.43	18.36	14.17	11.45	7.53	5.62	5.14	4.01
1973	74.00	64.14	55.21	35.83	30.30	27.09	18.93	17.55	15.35
1974	94.00	82.57	67.43	44.63	34.17	23.06	18.05	13.79	10.50
1975	114.00	107.00	95.93	81.27	72.97	58.87	40.95	28.50	21.48
1976	56.00	43.00	37.79	34.03	26.53	16.93	11.50	7.81	5.87
1977	30.00	28.14	21.54	18.08	13.93	9.11	7.32	6.29	4.79
1978	34.00	31.71	28.43	27.83	21.04	12.68	8.82	5.98	4.52
1979	92.00	65.00	56.14	53.43	36.58	27.26	18.15	15.17	16.01
1980	134.00	106.00	88.07	59.83	47.03	38.47	30.63	23.44	18.29
1981	6.10	3.97	2.73	2.30	1.72	0.98	0.64	0.45	0.36
1982	25.00	21.71	16.44	11.44	8.26	6.08	4.36	3.21	2.41
1983	179.00	120.86	100.93	91.63	75.13	58.16	47.79	52.73	44.41
1984	81.00	79.14	74.29	58.47	46.22	43.07	39.79	39.66	38.04

TABLE 36. HIGH FLOW DATA FOR OKLAWAHA RIVER NEAR OCALA.

@@@@@ OKLAWAHA RIVER NEAR OCALA, DISCH CFS(1931-67).

HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1931	1160.00	1065.71	1038.21	945.17	847.08	764.83	694.37	624.22	611.73
1932	665.00	637.14	616.07	566.17	518.33	490.42	432.90	377.97	341.08
1933	389.00	359.29	327.93	240.37	184.73	171.17	171.32	155.90	153.59
1934	1030.00	960.29	784.29	577.30	510.02	487.16	480.88	458.50	380.08
1935	1810.00	1371.43	1147.57	948.33	904.87	878.13	796.99	663.45	548.18
1936	862.00	808.29	768.21	753.57	750.52	620.71	511.43	481.93	403.33
1937	730.00	683.86	612.71	541.50	479.48	440.72	439.72	428.59	427.29
1938	1720.00	1230.00	1058.29	860.87	787.97	717.19	680.54	584.83	503.30
1939	736.00	715.57	688.29	615.00	503.83	453.70	406.43	350.66	288.38
1940	906.00	791.86	684.64	521.23	475.87	406.96	343.89	311.38	269.00
1941	635.00	598.71	534.21	437.20	423.10	367.00	303.66	271.40	257.28
1942	905.00	871.00	833.93	750.33	652.27	646.42	602.92	586.57	520.05
1943	874.00	856.29	824.00	740.03	659.37	531.74	438.33	365.57	319.65
1944	723.00	606.71	520.93	485.27	452.12	357.65	288.85	248.24	218.47
1945	1340.00	1035.29	881.21	673.00	529.40	449.92	402.03	357.79	304.89
1946	1220.00	1102.86	1003.07	939.17	890.95	797.18	738.62	712.97	615.23
1947	787.00	743.29	702.29	677.73	627.72	552.61	495.58	458.95	437.40
1948	1160.00	1014.71	886.21	761.30	705.17	660.05	661.60	633.07	570.92
1949	1020.00	983.43	945.64	852.40	813.12	739.04	687.98	605.07	527.29
1950	1220.00	1132.86	1033.14	939.63	932.92	853.57	759.36	642.76	550.01
1951	1590.00	1135.29	854.86	589.37	565.88	461.20	461.33	407.92	347.23
1952	968.00	765.14	743.21	589.33	535.10	424.89	375.17	337.82	313.63
1953	527.00	455.71	411.14	382.90	339.53	319.17	293.86	296.28	289.10
1954	1470.00	1271.43	1202.86	1148.67	1073.18	967.18	925.03	836.67	723.08
1955	673.00	523.14	446.71	399.83	389.58	365.11	348.08	323.15	297.23
1956	359.00	328.86	315.14	294.67	237.50	184.20	156.54	149.01	145.13
1957	408.00	299.57	200.07	137.27	117.98	115.61	105.40	85.27	74.54
1958	1360.00	1327.14	1298.57	1261.00	1228.83	917.37	676.20	549.13	441.92
1959	1740.00	1517.14	1416.43	1340.00	1258.00	999.17	740.87	582.26	579.44
1960	2270.00	1858.57	1722.14	1668.67	1606.67	1346.29	1251.78	1234.40	1226.30
1961	2070.00	1970.00	1867.86	1824.33	1725.33	1663.75	1583.06	1500.40	1237.79
1962	1410.00	293.29	210.36	190.90	155.13	139.98	107.95	76.16	63.74
1963	1410.00	390.57	381.00	346.10	260.22	173.40	129.71	109.35	90.94
1964	1130.00	1097.14	1086.43	926.10	666.23	499.83	352.24	273.03	217.16
1965	1320.00	1201.43	1104.71	1021.40	726.67	512.24	413.40	384.00	311.25
1966	1190.00	996.29	914.07	868.73	830.22	590.01	460.66	444.53	365.16
1967	1170.00	1101.43	1086.43	984.87	937.45	876.63	683.05	490.53	387.33

TABLE 37. HIGH FLOW DATA FOR OKLAWAHA RIVER NEAR CONNER.

@@@@@ OKLWAHA RIVER NEAR CONNER, DISCH CFS(1931-46,1979-84)
HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1931	2430.00	2241.43	2165.71	2042.33	1923.17	1833.42	1715.79	1649.67	1646.14
1932	1740.00	1714.29	1692.86	1619.33	1513.00	1394.00	1285.57	1169.32	1075.73
1933	1020.00	967.14	933.71	857.10	798.22	736.51	719.63	717.31	715.23
1934	3700.00	2572.86	2281.43	1943.00	1692.17	1575.67	1504.04	1392.04	1249.17
1935	3430.00	2787.14	2478.57	2197.67	2013.00	1954.67	1812.46	1639.16	1464.22
1936	1800.00	1731.43	1701.43	1655.67	1617.50	1503.92	1387.49	1394.38	1247.01
1937	1860.00	1627.14	1566.43	1472.67	1370.33	1293.33	1298.25	1257.70	1254.47
1938	2590.00	2137.14	2009.29	1835.67	1761.17	1639.92	1570.98	1442.52	1337.67
1939	1680.00	1537.14	1502.14	1449.33	1333.33	1290.92	1251.53	1171.75	1080.26
1940	1720.00	1651.43	1589.29	1425.00	1394.67	1284.43	1212.83	1141.58	1060.43
1941	1460.00	1421.43	1355.71	1249.33	1189.83	1097.38	1014.79	985.98	970.52
1942	1780.00	1731.43	1693.57	1621.67	1548.83	1538.17	1490.44	1425.80	1353.20
1943	1890.00	1754.29	1737.86	1675.33	1608.83	1507.67	1404.21	1283.04	1183.74
1944	1450.00	1407.14	1316.43	1286.33	1244.83	1136.89	1067.93	1008.12	956.45
1945	2320.00	1898.57	1746.43	1542.67	1389.83	1282.92	1216.64	1144.95	1061.85
1946	2190.00	1982.86	1880.71	1829.33	1776.50	1682.50	1644.92	1599.93	1465.64
1979	2460.00	2227.14	1846.43	1427.00	1268.75	1138.81	1022.93	934.45	945.41
1980	3260.00	3131.43	2968.57	2373.00	1728.43	1379.17	1281.51	1280.88	1167.61
1981	1030.00	949.29	903.64	867.27	833.18	821.84	809.56	799.88	782.81
1982	4430.00	2624.29	2190.00	1748.33	1460.32	1099.72	944.27	864.40	826.89
1983	2880.00	2757.14	2682.86	2365.00	2258.17	1941.25	1737.37	1635.95	1691.29
1984	2730.00	2702.86	2517.14	2331.00	2077.00	1978.33	1936.45	1853.83	1763.31

TABLE 38. HIGH FLOW DATA FOR OKLAWAHA RIVER AT EUREKA.

@@@@@ OKLAWAHA RIVER AT EUREKA (1931-34,1944-52,1982-84)
HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1931	3030.00	2580.00	2435.00	2244.67	2078.50	1929.42	1819.29	1721.79	1747.73
1932	1720.00	1685.71	1668.57	1604.67	1501.00	1450.50	1326.56	1212.79	1124.85
1933	1420.00	1381.43	1287.14	1083.00	923.63	817.57	785.86	773.55	779.72
1934	6260.00	4674.29	3610.00	2671.67	2082.17	1775.92	1657.81	1503.18	1364.00
1935	5260.	(HIGH DURING 6/35 THRU 9/35)							
1945	3950.00	2965.71	2449.29	1965.33	1631.50	1444.67	1352.40	1257.07	1168.51
1946	3520.00	2907.14	2527.14	2248.00	2124.83	1969.75	1891.75	1840.62	1669.62
1947	2150.00	2001.43	1900.71	1833.67	1791.67	1691.50	1599.07	1538.94	1483.37
1948	2940.00	2582.86	2295.00	2059.00	2051.67	1909.92	1920.27	1837.01	1714.51
1949	2750.00	2631.43	2406.43	2139.00	2044.83	1922.00	1838.85	1704.89	1581.70
1950	3230.00	2925.71	2580.71	2359.00	2270.17	2091.75	1919.40	1730.11	1574.93
1951	5370.00	3742.86	2931.43	2254.33	2138.83	1880.75	1767.10	1563.17	1416.78
1952	2460.00	2265.71	2250.00	1979.00	1784.67	1569.83	1490.71	1420.69	1340.60
1953	1700.00	1597.14	1500.71	1381.33	1300.67	1238.17	1208.85	1164.45	1141.81
1982	6180.00	4692.86	3487.14	2392.67	1762.23	1292.24	1075.02	945.13	892.89
1983	4420.00	4217.14	3905.71	3117.67	2603.67	2241.00	1966.99	1786.12	1852.70
1984	2920.00	2788.57	2612.86	2437.00	2255.67	2114.58	2017.81	1784.31	1742.53

TABLE 39. ANNUAL PEAK FLOW DATA FOR HOGTOWN CREEK NEAR GAINESVILLE.

HOGTOWN CREEK NEAR GAINESVILLE, PEAK FLOW, CFS (1959-79)

YEAR:	1959	1960	1962	1963	1964	1965	1967	1969	1970	1972
DISCH:	473.0	400.0	500.0	435.0	255.0	1210.0	558.0	522.0	1600.0	374.0

YEAR:	1973	1975	1977	1978	1979
DISCH:	1420.0	488.0	1300.0	540.0	1460.0

TABLE 40. HIGH FLOW DATA FOR HOGTOWN CREEK NEAR ARRENDONDO.

@@@@@ HOGTOWN CREEK NEAR ARREDONDO, DISCH CFS (1973-83)

HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1973	634.00	309.00	187.43	98.13	58.72	49.27	38.41	38.05	36.17
1974	160.00	87.43	77.00	48.87	36.11	25.88	19.23	16.01	14.10
1975	128.00	68.57	58.00	48.77	42.33	31.53	22.85	21.91	19.55
1976	283.00	134.57	89.64	62.33	41.63	28.91	23.49	19.15	16.78
1977	336.00	151.00	113.36	69.23	40.96	25.99	20.29	20.96	16.76
1978	132.00	85.00	62.21	49.40	35.92	29.94	23.78	19.75	16.19
1979	132.00	85.00	62.21	49.40	35.92	29.94	23.78	23.23	19.81
1980	356.00	123.86	74.21	56.97	43.63	35.56	30.98	29.32	24.81
1981	122.00	72.14	44.41	27.61	19.23	14.06	11.52	12.35	10.46
1982	404.00	191.29	108.71	62.14	40.93	32.48	23.87	18.40	15.86
1983	436.00	156.29	98.64	64.20	58.48	40.60	29.18	24.16	22.84

TABLE 41. ANNUAL PEAK FLOW DATA FOR SWEETWATER BRANCH TRIBUTARY AT GAINESVILLE.

SWEETWATER BRANCH TRIB. AT GAINESVILLE, PEAK FLOW (1973-83)

YEAR:	1973	1974	1976	1977	1978	1979	1980	1981	1982	1983
DISCH:	476.0	384.0	449.0	581.0	262.0	374.0	411.0	495.0	473.0	505.0

TABLE 42. ANNUAL PEAK FLOW DATA FOR LOCHLOOSA CREEK AT GROVE PARK.

LOCHLOOSA CREEK AT GROVEPARK, PEAK FLOW (1958-79)

YEAR:	1958	1959	1960	1961	1963	1965	1966	1968	1969	1970
DISCH:	187.0	791.0	920.0	334.0	319.0	1520.0	553.0	1040.0	351.0	1260.0

YEAR:	1972	1973	1975	1976	1977	1978	1979
DISCH:	157.0	814.0	251.0	150.0	150.0	150.0	1530.0

TABLE 43. ANNUAL PEAK FLOW DATA FOR ORANGE CREEK AT ORANGE SPRINGS.

ORANGE CREEK AT ORANGE SPRINGS, PEAK DISCH CFS (1942-84)

YEAR:	1942	1944	1945	1947	1948	1949	1951	1952	1957	1958
DISCH:	2400.0	775.0	800.0	870.0	1340.0	974.0	1240.0	655.0	102.0	538.0
YEAR:	1959	1960	1961	1963	1964	1965	1966	1968	1969	1970
DISCH:	1020.0	1230.0	840.0	202.0	191.0	2170.0	985.0	960.0	481.0	1410.0
YEAR:	1971	1976	1977	1979	1980	1981	1983	1984		
DISCH:	328.0	76.0	163.0	1100.0	405.0	280.0	1000.0	788.0		

TABLE 44. HIGH FLOW DATA FOR OKALAWAHA RIVER NEAR ORANGE SPRINGS.

@@@@@ OKLAWAHA RIVER NEAR ORANGE SPRINGS, DISCH CFS(1931-52)

HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1931	3860.00	3637.14	3432.14	3135.00	2949.33	2596.75	2361.15	2214.56	2271.21
1932	2040.00	1921.43	1872.14	1809.00	1647.67	1558.83	1402.13	1270.97	1170.28
1933	2180.00	2080.00	1972.86	1518.07	1171.30	991.01	923.13	886.54	872.35
1934	9760.00	7202.86	5427.86	3878.33	2939.33	2328.92	2107.70	1902.59	1701.23
1935	6350.00	4915.71	4130.00	3417.67	3059.50	2897.25	2556.56	2170.88	1888.66
1936	4100.00	3911.43	3482.86	3154.33	2957.00	2340.00	2072.35	2081.97	1796.48
1937	3520.00	3142.86	2625.71	2104.67	1795.67	1625.83	1585.79	1554.89	1560.44
1938	4120.00	3527.14	3007.86	2564.33	2539.17	2285.92	2148.80	1893.36	1701.34
1939	2980.00	2757.14	2634.29	2252.67	1879.67	1721.50	1615.68	1465.73	1324.46
1940	3060.00	2820.00	2639.29	2473.00	2224.67	2032.58	1787.10	1600.58	1438.25
1941	2340.00	2262.86	2050.00	1786.00	1688.17	1544.92	1366.67	1298.47	1245.50
1942	6900.00	5457.14	4532.14	4019.33	3451.00	3047.58	2966.67	2602.99	2350.92
1943	2550.00	2424.29	2336.43	2204.67	2099.00	1904.50	1732.79	1569.53	1427.68
1944	3120.00	2865.71	2495.00	2108.33	1907.33	1587.92	1442.73	1386.18	1278.88
1945	4560.00	3738.57	3095.71	2453.67	1979.17	1731.33	1623.93	1499.42	1364.75
1946	4050.00	3540.00	3075.00	2681.33	2548.50	2332.08	2220.00	2180.40	1964.77
1947	3120.00	3020.00	2895.00	2830.67	2737.33	2571.42	2310.66	2156.17	2022.45
1948	4560.00	4162.86	3801.43	3374.00	3030.17	2753.25	2772.62	2605.04	2351.56
1949	3940.00	3734.29	3459.29	2998.00	2793.50	2600.00	2423.88	2229.85	2035.26
1950	3450.00	3170.00	2851.43	2620.00	2560.67	2328.17	2120.00	1915.51	1737.04
1951	7420.00	5542.86	4268.57	3238.00	3007.67	2488.00	2293.06	1973.36	1750.82
1952	3040.00	2928.57	2815.71	2485.00	2258.83	2003.08	1923.28	1796.97	1633.58

TABLE 45. ANNUAL PEAK FLOW DATA FOR BRUNTBRIDGE BROOK AT KENWOOD.

BRUNTBRIDGE BROOK AT KENWOOD, PEAK DISCH CFS, CREST-STAGE GAGE (1971-1983)

YEAR:	1971	1973	1975	1976	1977	1979	1980	1981	1983
DISCH:	56.0	223.0	145.0	156.0	55.0	188.0	169.0	151.0	270.0

TABLE 46. HIGH FLOW DATA FOR OKLAWAHA RIVER AT RIVERSIDE LANDING NEAR ORANGE SPRINGS.

@@@@@ OKLAWAHA RIVER AT RIVERSIDE LANDING, DISCH CFS(1945-69)

HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1945	5550.00	5002.86	4197.86	3264.33	2575.33	2192.17	2066.67	1875.26	1679.75
1946	5040.00	4610.00	4014.29	3386.00	3209.00	2922.58	2792.19	2714.05	2435.67
1947	4100.00	3687.14	3590.71	3489.00	3344.00	3136.58	2820.98	2655.51	2464.16
1948	6060.00	5430.00	4789.29	4168.00	3842.67	3487.00	3583.06	3308.94	2939.54
1949	5490.00	5101.43	4629.29	3938.33	3674.00	3420.33	3166.17	2885.26	2607.92
1950	4370.00	4112.86	3724.29	3385.00	3304.00	3013.25	2715.30	2422.41	2164.41
1951	7320.00	6145.71	5017.14	3905.00	3783.83	3156.75	2823.39	2398.90	2103.48
1952	4180.00	3738.57	3547.14	3055.33	2699.33	2325.33	2247.16	2105.04	1901.15
1953	2800.00	2668.57	2537.86	2158.00	1874.17	1715.83	1669.62	1657.96	1617.97
1954	5480.00	5234.29	5051.43	4567.33	4093.83	3842.42	3716.88	3246.68	2813.97
1955	2040.00	1801.43	1740.00	1579.33	1506.67	1449.08	1443.17	1400.22	1321.09
1956	1260.00	1225.71	1200.71	1175.00	1103.48	1018.74	989.83	976.37	941.44
1957	1860.00	1672.86	1463.57	1243.60	1075.38	962.36	920.63	884.00	854.78
1958	2840.00	2794.29	2685.00	2620.67	2610.17	2153.58	1810.76	1674.34	1546.78
1959	6520.00	6022.86	5210.71	4535.00	3979.67	3122.33	2554.97	2169.63	2081.50
1960	7830.00	6778.57	5645.00	4791.33	4126.67	3561.42	3445.57	3256.31	3249.75
1961	6370.00	5988.57	5560.00	5467.00	5042.50	4706.92	4398.20	4096.09	3593.42
1962	2850.00	2120.00	2020.71	1961.33	1736.67	1554.25	1472.35	1348.02	1231.12
1963	2850.00	1475.71	1420.71	1346.67	1258.83	1115.15	1065.66	1084.81	1043.11
1964	3220.00	3010.00	2797.14	2771.00	2530.67	2265.50	1887.46	1690.68	1514.77
1965	8760.00	7777.14	6725.71	5695.33	4449.17	3468.83	3067.54	2821.64	2440.79
1966	6000.00	5725.71	5480.00	4740.00	3997.67	3338.92	2905.79	2724.60	2505.51
1967	4900.00	4080.00	3817.14	3415.33	3286.50	2910.33	2599.56	2357.12	2106.74
1968	2300.00	2160.00	2124.29	2079.67	1892.00	1667.17	1510.87	1381.24	1262.32
1969	5660.00								

THE LOWER ST. JOHNS RIVER BASIN

The St. Johns River Basin from the confluence of the Oklawaha River to its mouth at Jacksonville is denoted as the Lower St. Johns River Basin or Hydrologic Unit No. 3 (Figures 2 and 8). The river is tidal throughout this reach and the tidal influence is felt by all tributaries for some distance upstream from their mouths. No peak discharge analysis was performed for stations on the main-stem of the river or those where flow is tidal.

Table 47 presents some general information on the USGS long-term stream gaging stations. Flood discharges for different return periods are summarized in Table 48 for eighteen sites. Tables 49 through 67 furnish high flow data for selected gaging stations. (Note: The 1-day highest discharges appearing in these tables represent instantaneous peak flows. For crest-stage partial record stations only annual peak flows are given; data might be missing for some years.)

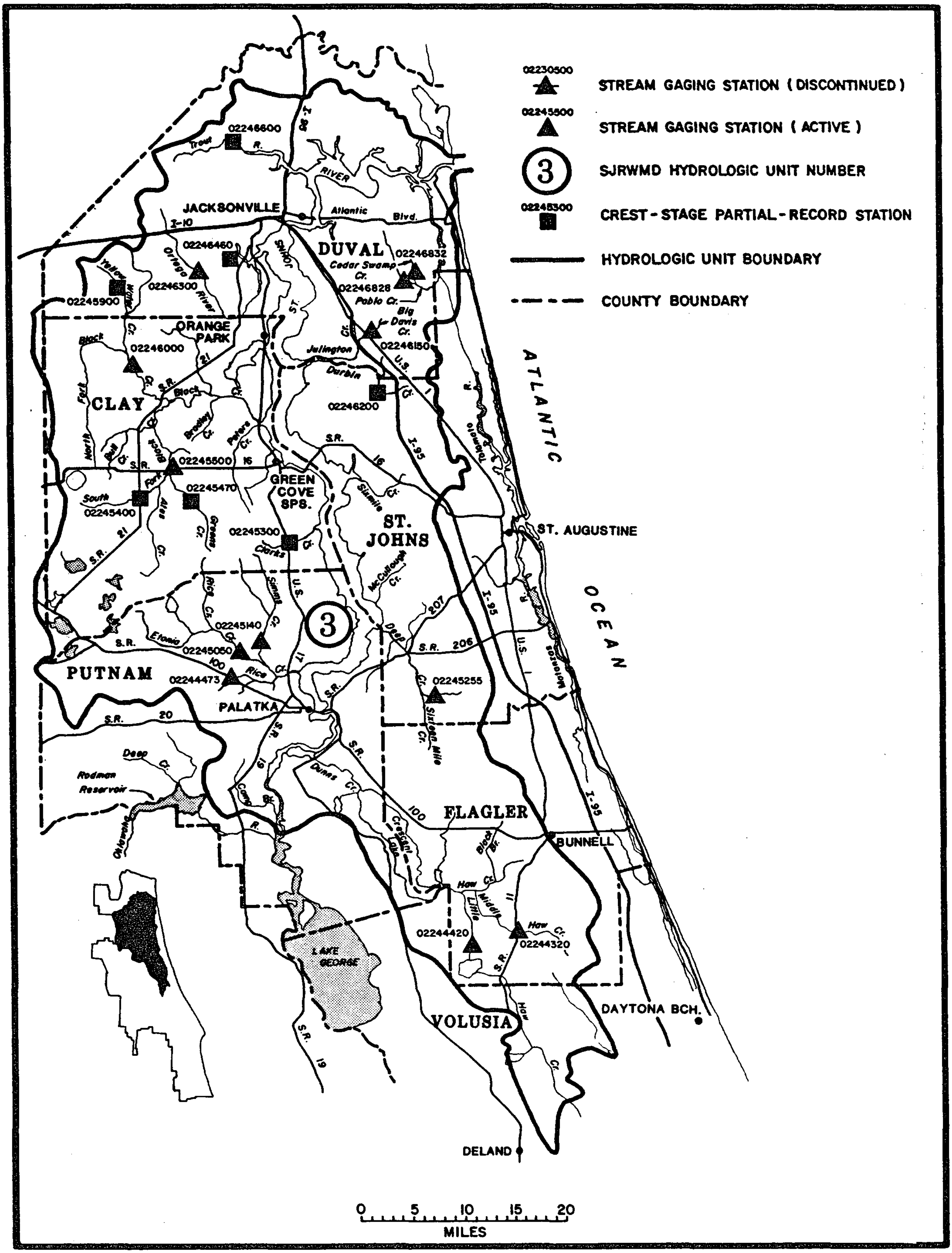

Figure 8. The Lower St. Johns River Basin (Hydrologic Unit No. 3)

TABLE 47. General Information on the Long-Term Stream Gaging Stations in the Lower St. Johns River Basin

USGS Station No. and Name	Location	Drainage Area Sq. Mi.	Period of Record	Recorded Peak Elv. ft. NGVD	Remarks
Lower St. Johns River Basin: (Hydrologic Unit No. 3, Fig. 7)					
02244320 Middle Haw Creek near Karona	Flagler Co.: At bridge on SR 11	78.3	July 75-Current Yr.	12.72 (1979)	
02244420 Little Haw Creek near Seville	Flagler Co.: Near bridge on SR 305	93.0	Jan 1951-Current Yr.	14.92 (1968)	
02244473 Rice Creek near Springside	Putnam Co.: Near bridge on SR 100	43.2	Oct 1973-Current Yr.	10.84 (1978)	
02245050 Etonia Creek at Bardin	Putnam Co.: At bridge on Bardin Rd.	219	Oct 1973-Current Yr.	15.34 (1979)	Georgia Pacific wells discharge appreciable amount of groundwater flow.
02245140 Simms Creek near Bardin	Putnam Co.: 0.4 mi. downstream from bridge on Simms Creek Road	47.3	Oct 73-Sept 75 Mar 76-Current Yr.	13.78 (1979)	
02245255 Deep Creek near Hastings	St. Johns Co.: At bridge on County Road	20.7	June 75-Current Yr.	15.3 (1982)	
02245300 Clarkes Creek near Green Cove Springs	Clay Co.: At culvert on US 17	8.81	1958-60, 69-76	24.66 (1969)	Crest-Stage Partial-Record Station
02245400 South Fork Black Creek near Camp Blanding	Clay Co.: At bridge on SR 21	34.8	Oct 1957-Sept 60 1961-Current Yr.*	52.56 (1959)	*Crest-Stage Partial-Record Station
02245470 Greens Creek near Penney Farms	Clay Co.: At bridge on County Road	14.9	1958-1982	59.49 (1969)	Crest-Stage Partial-Record
02245500 South Fork Black Creek near Penney Farms	Clay Co.: At bridge on SR 16	134	Oct 1939-Current Yr.	36.15 (1944)	
02245900 Yellow Water Creek near Maxville	Duval Co.: At bridge on SR 228	21.9	1958-Current Yr.	59.81 (1964)	Crest-Stage Partial-Record Station

TABLE 47. Continued.

USGS Station No. and Name	Location	Drainage Area Sq. Mi.	Period of Record	Recorded Peak Elv. ft. NGVD	Remarks
02246000 North Fork Black Creek near Middleburg	Clay Co.: 0.3 mi. upstream from Big Branch	177	Oct 1931-Current Yr.	24.53 (1964)	Stage-discharge relation affected by tide on some days.
02246150 Big Davis Creek at Bayard	Duval Co.: At culvert on US 1	13.6	1964-66*, 70-74* Aug 66-Sept 69 Jun 74-Current Yr.	10.47 (1968)	*Crest-Stage Partial-Record Station
02246200 Durbin CreeK near Durbin	St. Johns Co.: At bridge on County Road	36.7	1961-Current Yr.	13.86 (1964)	Crest-Stage Partial-Record Station
02246300 Ortega River at Jacksonville	Duval Co.: At bridge on 103rd St. in Jacksonville	30.9	Jan 1965-Current Yr.	39.34 (1968)	
02246460 Williamson Creek at Cedar Hills	Duval Co.: At culvert on Edwards Drive at Cedar Hills	0.92	1971-Current Yr.	12.35@ (1974)	Crest-Stage Partial-Record Station. @-gage height; datum not determined.
02246600 Trout River at Dinsmore	Duval Co.: At bridge on Kings Road	20.9	1961-82	9.62 (1968)	Crest-Stage Partial-Record Station
02246828 Pablo Creek at Jacksonville	Duval Co.: At a timber bridge on a private road	25.8	March 1974-Current Yr.	7.95 (1975)	
02246832 Cedar Swamp Creek at Jacksonville	Duval Co.: At a timber bridge on a private road	3.4	March 1974-Current Yr.	7.93 (1979)	

TABLE 48. Estimates of Flood Flows at Gaged Sites in the Lower St. Johns River Basin

(First Line: Log Pearson type 3 analysis using the WRC guidelines, Bulletin #17B.)
(Second Line: Log Pearson type 3 analysis using the Method of Mixed Moments.)

Gaging Station	Record Length (Years)	Highest Discharge During Period of Record (cfs)	Mean Annual High Discharge (cfs)	Discharge in cfs which may be equaled or exceeded in: 5 Yr	10 Yr	25 Yr	50 Yr	100 Yr	500 Yr
1. Little Haw Creek near Seville	33	1,630	610	903 913	1,150 1,160	1,460 1,440	1,690 1,640	1,900 1,810	2,380 2,160
2. Rice Creek near Springside	10	2,990	992	1,470 1,430	2,070 1,960	2,950 2,740	3,700 3,390	4,540 4,100	6,800 5,990
3. Etonia Creek at Bardin	10	1,210	636	844 822	1,040 1,020	1,310 1,290	1,520 1,520	1,740 1,770	2,300 2,420
4. Simms Creek near Bardin	10	1,490	815	1,200 1,190	1,620 1,530	2,230 1,950	2,750 2,260	3,300 2,560	4,780 3,240
5. South Fork Black Creek near Camp Blanding	19	3,240	798	1,120 1,160	1,670 1,680	2,610 2,460	3,500 3,140	4,600 3,890	8,070 5,960
6. Deep Creek near Hastings	9	297	124	171 165	220 213	290 285	347 346	408 413	569 601
7. Clarkes Creek near Green Cove Springs	8	895	390	617 586	860 767	1,200 995	1,480 1,160	1,770 1,310	2,490 1,650
8. Greens Creek near Penney Farms	19	1,780	666	948 933	1,220 1,200	1,600 1,550	1,890 1,820	2,190 2,100	2,930 2,790
9. South Fork Black Creek near Penney Farms	45	13,900	3,691	5,470 5,610	7,960 7,800	11,800 10,790	15,100 13,100	18,800 15,400	29,200 21,000
10. Yellow Water Creek near Maxville	21	3,220	968	1,350 1,330	1,800 1,780	2,450 2,450	3,000 3,020	3,590 3,660	5,190 5,430
11. North Fork Black Creek near Middleburg	52	12,600	4,543	6,870 6,940	9,350 8,970	12,720 11,400	15,400 13,000	18,100 14,400	24,700 17,300
12. Big Davis Creek at Bayard	16	1,170	346	516 520	778 751	1,200 1,080	1,580 1,360	2,020 1,650	3,300 2,380

TABLE 48. Continued.

(First Line: Log Pearson type 3 analysis using the WRC guidelines, Bulletin #17B.)
(Second Line: Log Pearson type 3 analysis using the Method of Mixed Moments.)

Gaging Station	Record Length (Years)	Highest Discharge During Period of Record (cfs)	Mean Annual High Discharge (cfs)	Discharge in cfs which may be equaled or exceeded in: 5 Yr	10 Yr	25 Yr	50 Yr	100 Yr	500 Yr
13. Durbin Creek near Durbin	19	4,140	1,030	1,430	2,170	3,400	4,570	5,980	10,400
				1,470	2,180	3,320	4,350	5,540	9,030
14. Ortega River at Jacksonville	18	2,950	848	1,270	1,730	2,380	2,900	3,460	4,860
				1,290	1,770	2,420	2,920	3,430	4,600
15. Williamson Creek at Cedar Hills	12	201	150	174	189	207	219	231	257
				171	188	210	227	244	286
16. Trout River at Dinsmore	18	1,580	529	749	1,040	1,470	1,850	2,270	3,470
				748	1,020	1,420	1,760	2,130	3,140
17. Pablo Creek at Jacksonville	10	847	392	600	782	1,010	1,190	1,360	1,740
				572	710	867	971	1,070	1,250
18. Cedar Swamp Creek at Jacksonville	10	270	127	186	252	345	422	505	723
				184	238	309	362	415	539

TABLE 49. HIGH FLOW DATA FOR MIDDLE HAW CREEK NEAR KORONA.

@@@@@ MIDDLE HAW CREEK NEAR KORONA, DISCH-CFS (1976-1984)
HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1976	910.00	703.57	583.86	414.60	332.53	229.77	174.06	118.81	89.70
1977	1360.00	737.86	472.86	346.25	253.38	215.05	146.37	153.67	116.70
1978	973.00	617.29	459.93	377.63	279.98	201.32	150.50	114.73	86.62
1979	861.00	644.29	512.43	380.03	229.00	120.47	93.81	92.39	87.13
1980	1900.00	1568.57	1254.86	958.23	548.12	308.83	223.07	159.67	123.76
1981	34.00	29.57	23.64	14.09	13.71	7.53	5.14	4.46	3.52
1982	1350.00	993.57	655.00	381.83	256.18	143.03	97.46	77.97	58.66
1983	468.00	403.86	352.36	253.17	238.93	194.31	147.91	126.79	121.63
1984	1540.00	878.96	565.48	303.99	188.61	177.22	142.26	108.28	84.65

TABLE 50. HIGH FLOW DATA FOR LITTLE HAW CREEK NEAR SEVILLE.

@@@@@ LITTLE HAW CREEK NEAR SEVILLE, DISCH-CFS (1952-1984)
HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1952	697.00	646.57	553.57	398.77	280.25	195.91	188.70	157.89	122.46
1953	613.00	539.29	438.71	379.47	302.97	176.51	126.24	122.92	92.81
1954	1490.00	1059.86	926.86	867.57	746.62	456.13	354.53	244.06	184.85
1955	162.00	145.00	121.57	76.33	53.50	38.41	31.44	23.56	18.93
1956	71.00	45.43	38.93	28.63	24.24	19.38	15.58	12.23	9.49
1957	501.00	451.29	360.86	208.47	110.78	63.10	42.89	29.55	22.56
1958	608.00	563.43	516.50	387.90	246.55	161.22	117.73	132.05	114.80
1959	649.00	612.43	543.07	386.33	262.42	188.83	160.74	133.57	114.73
1960	1600.00	1186.43	893.29	553.33	367.67	207.72	168.02	175.07	149.51
1961	664.00	620.00	555.00	483.40	363.20	338.09	237.71	177.07	136.14
1962	499.00	460.43	384.86	269.40	183.98	111.32	76.75	52.82	39.87
1963	327.00	291.29	237.29	194.07	136.43	78.32	82.96	67.37	50.73
1964	370.00	352.43	329.79	301.33	230.42	171.19	139.26	111.62	86.24
1965	1020.00	917.43	784.71	584.03	397.52	232.77	170.90	131.93	100.25
1966	388.00	362.86	354.43	296.27	231.47	144.30	102.16	97.10	78.52
1967	328.00	284.71	248.43	190.67	153.50	113.73	89.97	65.08	50.95
1968	510.00	504.86	481.14	411.97	337.97	205.87	136.38	91.58	68.63
1969	1630.00	1207.00	938.57	640.77	517.92	363.28	279.78	205.99	156.32
1970	1100.00	973.14	843.71	655.83	519.98	383.19	337.15	272.56	206.37
1971	181.00	166.00	136.71	105.80	73.68	58.97	45.30	47.77	37.02
1972	296.00	247.43	210.50	135.13	107.92	77.63	59.97	45.87	37.63
1973	480.00	367.14	301.93	247.17	190.10	175.40	153.38	121.11	100.11
1974	311.00	290.71	275.14	229.13	169.70	104.67	79.73	57.31	44.22
1975	450.00	396.71	323.57	254.33	218.68	174.42	119.66	85.75	65.48
1976	390.00	364.29	321.14	259.83	209.68	168.02	122.86	85.26	66.14
1977	455.00	378.86	325.86	265.93	212.42	169.76	129.98	136.43	106.80
1978	555.00	476.14	399.50	331.93	250.15	181.93	129.48	93.49	70.41
1979	580.00	505.29	455.86	371.43	258.43	137.10	91.13	88.05	77.91
1980	846.00	798.57	740.79	607.97	383.62	218.18	163.91	121.00	96.84
1981	42.00	40.00	32.64	23.31	17.82	11.56	8.66	8.77	7.32
1982	848.00	742.57	608.57	380.00	267.90	157.39	108.59	78.40	59.65
1983	739.00	681.00	538.29	364.97	308.45	252.65	202.32	180.14	174.24
1984	746.00	586.62	458.82	273.70	190.82	170.56	147.04	116.61	94.89

TABLE 51. HIGH FLOW DATA FOR RICE CREEK NEAR SPRINGSIDE.

@@@@@ RICE CREEK NEAR SPRINGSIDE, DISCHARGE-CFS (1975-1984)

HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1975	491.00	381.00	313.86	180.80	136.92	97.49	66.20	50.33	39.83
1976	184.00	136.57	127.07	92.87	67.47	49.10	37.88	30.99	25.36
1977	1100.00	361.03	267.83	201.20	133.96	81.26	63.85	58.73	46.44
1978	1051.99	399.19	257.14	207.96	168.40	127.15	93.87	79.20	62.23
1979	2990.00	943.43	573.21	333.30	187.16	98.41	66.60	60.02	59.12
1980	860.00	444.14	372.50	313.97	201.61	121.96	101.60	85.22	69.25
1981	520.00	232.57	144.00	93.13	57.67	33.71	25.84	20.03	16.19
1982	662.00	425.29	255.29	141.37	86.05	58.22	41.25	32.33	25.39
1983	1700.00	506.43	346.93	202.70	150.35	106.63	73.52	65.78	70.54
1984	361.00	232.29	141.79	125.80	72.54	64.42	62.43	53.23	53.10

TABLE 52. HIGH FLOW DATA FOR ETONIA CREEK AT BARDIN.

@@@@@ ETONIA CREEK AT BARDIN, DISCHARGE-CFS (1975-1984)
HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1975	346.00	279.43	242.79	200.07	188.28	158.93	134.73	124.49	112.26
1976	299.00	223.86	192.50	168.80	137.90	118.07	99.34	90.84	85.50
1977	347.00	291.14	226.14	165.00	139.32	116.61	112.25	108.00	97.36
1978	462.00	292.86	226.71	201.23	168.40	137.36	118.02	107.04	96.52
1979	1030.00	599.86	411.36	310.40	204.43	136.38	114.45	105.96	111.27
1980	537.00	468.57	358.86	309.87	194.00	155.54	150.26	131.06	113.79
1981	507.00	328.57	236.07	192.30	135.90	97.38	85.56	87.45	80.24
1982	760.00	517.14	338.21	210.13	137.23	104.07	87.36	80.86	75.78
1983	1160.00	670.00	480.00	291.67	229.52	168.77	133.18	117.89	121.47
1984	534.00	330.57	224.64	201.03	155.60	141.65	136.07	121.81	120.39

TABLE 53. HIGH FLOW DATA FOR SIMMS CREEK NEAR BARDIN.

@@@@@ SIMMS CREEK NEAR BARDIN, DISCHARGE-CFS (1975-1984)

HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1975	1410.00	421.14	292.36	199.30	165.18	119.69	84.61	67.28	53.61
1976	242.00	134.43	110.00	103.37	76.30	54.41	41.77	38.19	32.66
1977	420.00	202.71	161.79	139.13	102.55	65.07	54.07	48.67	39.82
1978	590.00	364.43	252.93	172.73	134.85	94.56	70.68	54.68	43.89
1979	1380.00	496.43	288.21	153.37	93.55	78.87	60.84	47.65	51.96
1980	1490.00	625.00	449.79	356.03	206.73	130.67	110.34	92.30	75.43
1981	339.00	215.43	145.79	104.30	60.45	35.90	29.94	32.52	26.93
1982	344.00	205.14	130.07	75.70	50.03	42.10	32.27	32.76	27.12
1983	1410.00	355.57	209.36	144.03	137.82	100.37	71.90	69.53	67.81
1984	528.00	262.57	217.71	141.20	92.93	83.27	80.07	67.15	68.00

TABLE 54. HIGH FLOW DATA FOR DEEP CREEK NEAR HASTINGS.

@@@@@ DEEP CREEK NEAR HASTINGS, DISCH CFS (1976-84)

HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1976	82.00	41.43	34.00	30.33	21.66	17.95	12.83	9.72	8.05
1977	82.00	40.57	30.14	28.07	21.50	13.81	9.86	7.52	6.55
1978	101.00	42.29	29.45	24.73	18.59	14.15	10.47	7.30	5.59
1979	101.00	25.71	20.41	15.43	12.88	9.25	6.79	5.03	4.46
1980	198.00	140.86	111.07	83.00	49.90	31.11	22.05	18.72	14.89
1981	74.00	27.71	15.14	7.53	4.56	2.56	1.85	2.00	1.81
1982	44.00	39.86	26.94	18.83	13.08	8.46	6.54	4.65	3.71
1983	297.00	128.57	97.14	59.08	38.97	35.50	26.05	22.05	19.70
1984	133.00	68.43	47.06	37.26	27.45	25.14	23.48	18.35	15.48

TABLE 55. ANNUAL PEAK FLOW DATA FOR CLARKES CREEK NEAR GREEN COVE SPRINGS.

CLARKES CREEK NEAR GREEN COVE SPRINGS, PEAK DISCH CFS (1958-77) CREST-STAGE GAGE

YEAR:	1958	1959	1961	1970	1971	1973	1975	1977
DISCH:	250.0	400.0	700.0	895.0	62.0	312.0	360.0	139.0

TABLE 56. ANNUAL PEAK FLOW DATA FOR SOUTH FORK BLACK CREEK NEAR CAMP BLANDING.

SOUTH FORK BLACK CREEK NEAR CAMP BLANDING, PEAK DISCH CFS (CREST-STAGE GAGE) 1958-83

YEAR:	1958	1959	1961	1964	1965	1966	1967	1969	1970	1972
DISCH:	288.0	3240.0	806.0	325.0	780.0	513.0	343.0	1430.0	1930.0	343.0

YEAR:	1973	1974	1975	1976	1977	1978	1980	1981	1983
DISCH:	1560.0	421.0	294.0	193.0	193.0	590.0	1420.0	193.0	308.0

TABLE 57. ANNUAL PEAK FLOW DATA FOR GREENS CREEK NEAR PENNEY FARMS.

GREENS CREEK NEAR PENNEY FARMS, PEAK DISCH CFS (CREST-STAGE GAGE) 1958-1983

YEAR:	1958	1961	1962	1963	1964	1965	1966	1968	1969	1970
DISCH:	502.0	1360.0	410.0	210.0	502.0	1270.0	563.0	563.0	830.0	1780.0

YEAR:	1971	1973	1975	1976	1977	1979	1980	1981	1983
DISCH:	150.0	667.0	800.0	345.0	384.0	805.0	671.0	273.0	575.0

TABLE 58. HIGH FLOW DATA FOR SOUTH FORK BLACK CREEK NEAR PENNEY FARMS.

@@@@@ SOUTH FORK BLACK CREEK NEAR PENNEY FARMS, DISCH CFS(1941-84)

HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1941	1650.00	784.14	486.36	319.27	241.53	176.70	126.55	114.65	102.02
1942	8560.00	2071.71	1236.14	737.00	487.05	355.36	358.52	321.23	362.62
1943	1060.00	426.43	344.36	275.97	217.07	176.59	130.99	107.46	457.11
1944	6240.00	1317.57	765.14	517.30	359.07	260.72	187.32	197.94	628.57
1945	13900.00	2249.71	1207.86	731.33	513.07	446.23	325.46	254.93	832.98
1946	2620.00	906.00	572.29	394.53	304.72	215.50	211.44	180.09	997.57
1947	1120.00	723.86	644.79	493.80	445.93	347.41	270.92	222.36	1196.05
1948	9390.00	2273.71	1296.00	843.30	819.07	495.27	523.02	414.08	1526.64
1949	5230.00	1473.71	874.07	476.60	357.83	276.83	210.61	178.71	1684.21
1950	1570.00	890.86	592.07	334.10	282.73	184.09	137.76	108.79	1776.27
1951	7970.00	1869.86	1045.21	705.27	535.63	312.90	234.68	181.47	1920.35
1952	1110.00	442.86	339.43	211.37	152.15	135.47	123.27	104.91	2004.66
1953	5790.00	1055.29	880.14	548.13	320.03	237.41	191.43	174.35	2159.65
1954	5430.00	2232.86	1641.57	1054.50	737.92	469.91	407.25	303.25	2397.99
1955	384.00	264.86	188.57	147.77	97.77	67.14	61.93	51.03	2443.02
1956	608.00	269.14	181.50	127.20	93.63	67.91	64.80	59.51	2488.01
1957	2410.00	724.43	428.86	266.13	167.88	137.56	116.17	90.55	2575.01
1958	1600.00	641.71	435.14	333.73	279.35	220.97	168.00	164.24	2730.65
1959	12500.00	2922.86	1571.64	769.47	468.65	417.41	352.55	258.96	2944.02
1960	4470.00	1319.57	774.00	471.37	325.15	291.85	234.58	204.77	3128.51
1961	4690.00	1230.86	742.93	672.40	468.60	427.66	314.89	261.07	3348.49
1962	3400.00	1184.57	780.93	482.40	425.52	270.88	206.34	158.26	3479.59
1963	1110.00	580.29	400.86	289.03	194.75	128.88	98.05	104.28	3569.55
1964	3090.00	1175.86	739.00	477.20	363.40	268.80	223.84	219.95	3754.76
1965	6440.00	2691.14	1462.14	770.23	462.28	311.85	285.47	241.31	3956.28
1966	2240.00	1039.71	798.64	513.80	431.20	336.77	246.17	254.43	4189.15
1967	2740.00	1026.86	634.86	429.07	347.48	276.09	211.93	200.03	4351.02
1968	2980.00	1241.86	1018.43	674.17	471.33	277.93	196.25	149.74	4459.85
1969	7080.00	3010.57	1945.57	1060.43	631.23	380.75	287.98	245.73	4681.86
1970	9450.99	2079.43	1323.86	801.40	595.68	459.23	444.69	366.97	4969.41
1971	380.00	212.29	192.64	158.43	128.12	99.19	80.24	79.89	5042.19
1972	2880.00	551.14	364.29	313.17	255.08	226.53	208.11	195.22	5202.10
1973	4970.00	1850.29	1151.64	615.03	399.77	319.73	253.50	254.19	5448.33
1974	1730.00	814.71	622.50	433.03	337.23	241.50	174.79	142.31	5571.95
1975	1350.00	667.14	426.93	278.07	241.03	197.63	143.34	125.79	5682.01
1976	1430.00	854.71	613.14	428.30	291.95	264.84	194.47	155.01	5796.58
1977	1020.00	656.14	446.36	279.10	221.98	152.39	145.68	125.03	5915.96
1978	1090.00	533.29	373.86	256.63	247.60	180.14	139.94	107.56	6002.71
1979	2180.00	1016.14	764.21	607.57	355.80	218.89	170.22	164.64	6166.05
1980	2880.00	1036.14	691.00	525.13	312.33	272.21	258.36	224.27	184.51
1981	665.00	553.57	375.07	246.20	181.80	115.31	88.15	84.36	74.68
1982	1940.00	995.43	566.07	330.23	246.27	204.68	157.52	144.02	116.68
1983	2330.00	739.71	556.64	402.77	320.37	271.37	204.06	201.44	189.07
1984	3290.00	1109.64	695.86	470.97	332.91	316.27	251.41	222.75	195.72

TABLE 59. HIGH FLOW DATA FOR NORTH FORK BLACK CREEK NEAR MIDDLEBURG.

@@@@@ NORTH FORK BLACK CREEK NEAR MIDDLEBURG, DISCHARGE-CFS (1933-1984)
HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1933	1740.00	951.43	815.07	547.00	325.47	218.21	199.72	166.97	150.46
1934	6000.00	2101.57	1232.07	741.27	727.97	413.73	287.04	208.60	177.81
1935	5580.00	2331.43	1307.57	682.23	453.73	299.08	213.51	153.32	118.06
1936	3340.00	1090.86	860.36	731.43	423.63	241.25	201.34	181.90	139.90
1937	2220.00	847.43	559.36	431.53	263.78	199.22	179.59	135.22	116.09
1938	4620.00	1622.14	1042.29	613.57	353.05	244.17	206.54	159.48	122.11
1939	6990.00	1688.29	1013.29	541.97	316.20	236.39	169.86	133.41	107.35
1940	1630.00	725.00	650.57	429.00	336.85	227.27	161.77	156.56	134.49
1941	1050.00	571.43	376.43	301.27	243.62	148.37	125.34	127.50	101.96
1942	5020.00	1682.29	1033.21	726.03	528.05	441.37	421.50	337.22	263.18
1943	1810.00	937.57	599.71	320.07	275.87	213.64	148.07	114.93	97.15
1944	2290.00	953.86	556.07	440.93	265.17	176.77	134.11	146.37	127.82
1945	10400.00	2752.57	1467.36	723.20	561.63	477.99	358.94	277.49	213.89
1946	3400.00	1490.00	1080.50	598.30	523.63	328.95	301.80	238.99	207.18
1947	2720.00	1168.86	849.50	677.83	535.15	428.35	337.25	291.89	271.88
1948	9560.00	2848.71	1773.29	1346.47	1192.30	717.66	709.71	560.34	440.38
1949	8840.00	2805.29	1584.50	836.10	581.83	455.21	348.98	311.11	248.69
1950	3050.00	1479.71	989.14	636.60	515.87	360.22	281.77	205.31	163.61
1951	8120.00	3455.71	1916.50	1100.87	883.10	576.17	401.89	290.95	224.68
1952	791.00	408.14	343.29	212.77	148.98	109.61	96.96	87.82	71.32
1953	1680.00	988.86	752.07	439.60	264.75	196.47	141.15	142.35	118.60
1954	4890.00	1689.57	1365.86	938.07	889.57	547.66	476.79	341.42	264.09
1955	422.00	292.29	194.36	157.83	97.67	65.59	59.28	47.78	38.97
1956	819.00	411.57	264.00	191.53	141.60	98.21	99.62	88.97	72.31
1957	6560.00	2142.43	1306.57	694.87	384.38	264.28	199.50	148.35	124.45
1958	2590.00	959.14	680.71	465.87	408.43	311.19	231.69	237.88	211.35
1959	6160.00	3234.29	1909.21	1376.37	847.33	655.51	559.57	400.37	338.29
1960	6420.00	2195.00	1257.21	815.83	550.38	363.83	288.15	300.38	262.22
1961	3800.00	2018.57	1280.57	1021.43	589.58	467.23	329.11	278.80	225.27
1962	6120.00	2288.57	1499.21	788.57	623.77	391.94	277.14	206.16	165.53
1963	3200.00	1185.00	851.21	580.53	430.75	259.03	198.93	212.33	167.93
1964	12600.00	3327.14	1853.64	905.33	514.68	503.20	359.72	333.59	315.73
1965	11200.00	5588.57	2975.93	1665.90	1025.40	643.75	550.14	464.09	359.47
1966	4770.00	1606.29	1284.86	891.27	642.90	464.19	370.46	375.35	342.20
1967	5070.00	1599.71	948.07	642.90	515.17	374.40	291.03	270.18	213.86
1968	4510.00	1608.71	994.50	615.60	488.70	296.77	208.92	169.60	136.61
1969	11700.00	5279.00	3129.50	1621.90	902.28	622.34	459.83	355.36	305.95
1970	10500.00	3021.14	1644.07	1005.30	789.53	576.01	542.99	460.11	358.34
1971	978.00	618.00	502.64	380.97	260.67	180.39	130.79	114.63	98.46
1972	4250.00	1398.14	838.07	539.03	375.32	274.77	241.89	232.63	197.77
1973	5870.00	2114.86	1329.21	778.50	568.13	387.57	290.54	258.20	247.46
1974	1680.00	976.14	625.57	376.40	350.23	253.17	188.29	156.92	151.87
1975	5040.00	2044.00	1226.29	1006.23	837.85	500.42	342.35	268.83	232.68
1976	1350.00	751.86	545.71	367.50	236.47	166.68	130.90	115.70	104.99
1977	2020.00	770.71	454.00	345.83	326.93	222.67	180.31	146.96	121.24
1978	2780.00	943.29	554.79	463.17	384.23	290.02	232.43	200.24	160.83
1979	1320.00	1019.29	811.79	620.87	379.15	238.38	179.79	160.76	169.12
1980	8440.00	2690.00	1647.71	1488.47	903.50	595.90	546.99	484.55	409.15
1981	929.00	412.57	280.07	184.63	149.35	100.59	76.84	78.12	72.06
1982	1540.00	847.43	506.86	324.17	253.55	209.83	160.81	154.04	127.07
1983	3400.00	1178.57	875.00	671.03	542.22	388.33	276.79	283.60	259.97
1984	4480.00	2296.21	1539.27	895.05	562.92	489.58	375.28	306.78	264.94

TABLE 60. HIGH FLOW DATA FOR BIG DAVIS CREEK AT BAYARD.

@@@@@ BIG DAVIS CREEK AT BAYARD, DISCHARGE-CFS (1968-69, 75-83)

HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1968	89.00	45.57	43.43	29.85	22.10	16.73	11.91	9.62	7.84
1969	1170.00	375.29	202.21	99.86	61.54	35.98	29.27	21.94	18.54
1975	196.00	78.14	54.50	40.21	29.17	21.29	14.71	11.49	10.93
1976	260.00	103.57	66.00	58.63	36.07	34.01	25.57	18.81	15.05
1977	130.00	35.00	24.00	15.46	14.44	10.18	9.54	8.87	7.15
1978	146.00	35.43	21.14	18.13	15.55	11.15	8.84	6.64	5.17
1979	264.00	127.29	76.64	38.80	21.73	20.82	16.21	11.52	11.10
1980	353.00	183.57	117.21	80.30	52.63	37.53	30.00	24.93	20.04
1981	33.00	13.81	9.69	7.32	6.92	4.40	3.39	2.69	2.36
1982	66.00	36.71	23.26	16.54	11.80	9.57	7.24	5.53	4.43
1983	190.00	54.71	47.36	32.61	25.72	22.86	18.91	18.25	15.74

TABLE 61. ANNUAL PEAK FLOW DATA FOR YELLOW WATER CREEK NEAR MAXVILLE.

YELLOW WATER CREEK NEAR MAXVILLE, PEAK DISCH CFS (CREST-STAGE GAGE) 1958-1983

YEAR:	1958	1959	1960	1962	1963	1964	1966	1967	1968	1969
DISCH:	956.0	842.0	784.0	818.0	788.0	3220.0	1300.0	756.0	962.0	2520.0
YEAR:	1970	1972	1973	1979	1976	1977	1978	1979	1980	1982
DISCH:	1490.0	524.0	1020.0	1080.0	231.0	512.0	290.0	552.0	890.0	357.0
YEAR:	1983									
DISCH:	441.0									

TABLE 62. ANNUAL PEAK FLOW DATA FOR DURBIN CREEK NEAR DURBIN.

DURBIN CREEK NEAR DURBIN, PEAK DISCH CFS (CREST-STAGE GAGE) 1962-1983

YEAR:	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
DISCH:	290.0	330.0	332.0	4140.0	903.0	1450.0	606.0	4050.0	1240.0	166.0
YEAR:	1972	1973	1975	1976	1977	1978	1980	1982	1983	
DISCH:	1010.0	612.0	447.0	1100.0	800.0	392.0	981.0	168.0	504.0	

TABLE 63. HIGH FLOW DATA FOR ORTEGA RIVER AT JACKSONVILLE.

@@@@@ ORTEGA RIVER AT JAX, DISCH CFS(1966-83)

HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1966	652.00	319.00	247.29	155.43	122.92	85.23	75.61	69.42	62.38
1967	770.00	308.14	225.79	157.23	104.78	74.34	55.79	47.94	36.89
1968	880.00	344.43	209.43	144.90	125.23	77.18	51.74	39.36	30.86
1969	2950.00	1168.00	688.64	351.37	198.43	132.10	96.70	71.41	59.49
1970	2150.00	532.29	288.36	172.57	135.32	112.34	106.76	87.53	66.58
1971	115.00	67.29	46.14	28.88	23.19	16.74	12.40	12.79	10.35
1972	420.00	176.71	123.29	84.07	60.45	44.61	36.00	35.60	29.77
1973	1440.00	626.86	371.14	233.23	153.23	95.57	67.53	52.25	47.70
1974	670.00	335.71	210.21	131.47	99.57	68.07	47.61	38.28	35.61
1975	850.00	340.57	202.79	139.80	110.38	71.51	48.04	38.24	34.89
1976	473.00	206.29	120.71	75.40	50.28	30.06	22.34	18.52	18.11
1977	513.00	192.57	109.79	69.97	66.10	41.49	32.69	28.30	22.56
1978	580.38	195.05	125.81	86.85	82.12	57.50	46.78	40.51	31.04
1979	593.00	367.00	248.57	132.50	73.17	54.84	39.25	28.05	23.74
1980	1190.00	332.00	219.86	195.60	111.79	87.01	66.54	59.86	54.32
1981	50.00	28.71	19.16	14.34	11.54	7.34	5.63	4.68	4.72
1982	269.00	141.86	91.07	57.37	47.97	43.82	36.29	32.52	26.14
1983	703.00	304.29	216.71	168.33	136.83	87.73	60.52	57.12	49.56

TABLE 64. ANNUAL PEAK FLOW DATA FOR WILLIAMSON CREEK AT CEDAR HILLS.

WILLIAMSON CREEK AT CEDAR HILLS, PEAK FLOW, CFS (1972-84)

YEAR:	1972	1973	1974	1976	1977	1978	1979	1980	1981	1982
DISCH:	159.0	116.0	201.0	176.0	170.0	155.0	129.0	189.0	130.0	111.0

YEAR:	1983	1984
DISCH:	130.0	134.0

TABLE 65. ANNUAL PEAK FLOW DATA FOR TROUT RIVER AT DINSMORE.

TROUT RIVER AT DINSMORE, PEAK FLOW, CFS (1962-83)

YEAR:	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
DISCH:	310.0	244.0	522.0	646.0	361.0	517.0	248.0	1580.0	1090.0	130.0

YEAR:	1972	1973	1975	1977	1978	1980	1982	1983
DISCH:	385.0	1480.0	431.0	373.0	350.0	526.0	122.0	201.0

TABLE 66. HIGH FLOW DATA FOR PABLO CREEK AT JACKSONVILLE.

@@@@@ PABLO CREEK AT JACKSONVILLE, DISCH CFS (1975-84)

HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1975	446.00	255.43	187.50	136.87	118.27	90.03	63.40	49.12	43.66
1976	847.00	481.00	296.79	219.43	133.92	116.41	87.58	64.81	51.34
1977	251.00	126.14	84.64	53.73	50.33	38.51	34.88	33.01	27.23
1978	198.00	96.62	65.31	54.79	51.16	36.69	29.39	23.08	18.31
1979	335.00	280.43	183.14	96.96	71.17	60.68	49.50	36.82	33.31
1980	560.00	428.43	293.79	209.13	132.77	92.93	72.64	65.52	54.06
1981	64.00	38.71	29.93	26.83	22.38	14.59	11.92	9.62	8.41
1982	287.00	95.00	63.36	44.20	33.90	30.98	24.79	19.16	15.46
1983	318.00	176.29	136.43	107.20	92.87	64.76	52.63	53.26	48.16
1984	613.00	283.57	171.62	110.45	76.62	70.53	55.86	45.84	39.64

TABLE 67. HIGH FLOW DATA FOR CEDAR SWAMP CREEK AT JACKSONVILLE.

@@@@@ CEDAR SWAMP CREEK AT JACKSONVILLE, DISCH CFS (1975-84)

HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1975	250.00	88.14	54.99	43.35	31.62	23.09	16.39	12.42	10.67
1976	151.00	81.86	49.00	34.58	21.56	19.88	15.04	11.52	9.23
1977	98.00	25.29	16.34	11.77	10.01	7.70	6.85	6.12	5.30
1978	38.29	16.01	12.52	11.38	10.30	7.89	6.49	5.74	4.78
1979	85.00	47.71	29.89	17.89	16.90	13.93	11.40	8.84	8.09
1980	270.00	117.00	76.21	50.11	29.09	18.78	15.74	14.12	12.23
1981	41.00	11.41	8.11	7.85	7.00	4.40	3.76	3.25	2.90
1982	59.00	27.27	17.40	11.98	9.78	8.34	6.66	5.28	4.37
1983	193.00	84.43	52.93	38.46	29.15	20.52	17.91	17.85	15.38
1984	87.00	56.60	38.41	25.05	18.53	14.79	11.44	10.55	9.31

THE COASTAL DRAINAGE BASINS

The coastal areas along the Atlantic Ocean not drained by the St. Marys, the Nassau or the St. Johns rivers are denoted as the Coastal Basins (Figures 2 and 9). For identifying planning and study activities, these areas are further divided into three regions: (1) The Upper Coastal Basins (Hydrologic Unit No. 7), (2) The Middle Coastal Basins (Hydrologic Unit No. 8), and (3) The Lower Coastal Basins (Hydrologic Unit No 9). Coastal streams flow directly into the estuarine lagoons or the Atlantic Ocean. In the lower coastal area (Hydrologic Unit No. 9, mostly agricultural lands), drainage is accomplished largely by artificial canals with control structures (Figure 9). No flood frequency analysis has been performed for these canals.

Table 68 presents some general information on the USGS long-term stream gaging stations. Flood discharges for different return periods are summarized in Table 69 for eight sites. Tables 71 through 78 furnish high flow data for selected gaging stations. (Note: The 1-day highest discharges appearing in these tables represent instantaneous peak flows. For crest-stage partial record stations only annual peak flows are given; data might be missing for some years.)

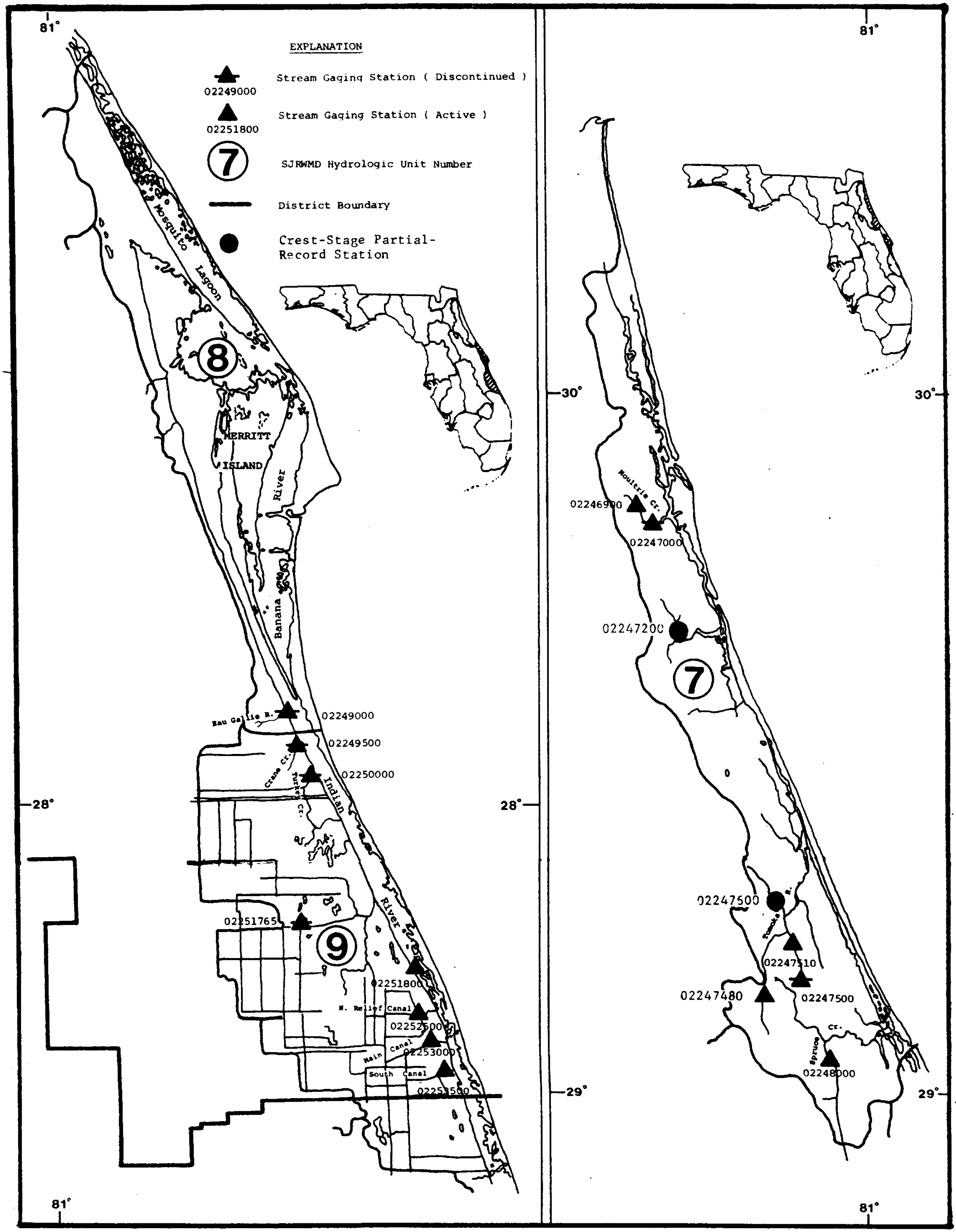

Figure 9. The Coastal Basins
(Hydrologic Unit Numbers 7, 8, and 9)

TABLE 68. General Information on the Long-Term Stream Gaging Stations in the Coastal Basins

USGS Station No. and Name	Location	Drainage Area Sq. Mi.	Period of Record	Recorded Peak Elv. ft. NGVD	Remarks
Upper Coastal Basins: (Hydrologic Unit No. 7, Fig. 8)					
02246900 Moultrie Creek at State Highway 207, near St. Augustine	St. Johns Co.: At box culverts on SR 207	19.8	Oct 1961-Current Yr.	23.4 (1969)	
02247000 Moultrie Creek near St. Augustine	St. Johns Co.: 1.6 mi. downstream from bridge on SR 207	23.3	Oct 1939-Sept 64	11.48 (1941)	Discontinued
02247200 Fish Swamp Outlet near Summer Haven	St. Johns Co.: At culvert on SR 204	4.62	1962-Current Yr.	24.8 (1963)	Crest-Stage Partial-Record Station
02247480 Tiger Bay Canal near Daytona Beach	Volusia Co.: At bridge on Indian Lake Road	29	Jan 1978-Current Yr.	32.94 (1979)	
02247510 Tomoka River near Holly Hill	Volusia Co.: At bridge on 11th St. Ext.	76.8	Oct 1964-Current Yr.	12.92 (1968)	
02247600 Little Tomoka River near Ormond Beach	Volusia Co.: At culverts on SR 40	10 (Approx)	1962-Current Yr.	24.48 (1968)	Crest-Stage Partial-Record Station
02248000 Spruce Creek near Samsula	Volusia Co.: At bridge on SR 40A	33.4	May 1951-Current Yr.	21.74 (1953)	Some diversion for irrigation above station.
Middle Coastal Basins: (Hydrologic Unit No. 8; Fig.)					
02249500 Crane Creek at Melbourne	Brevard Co.: At bridge on US 192	12.6	March 1951-June 68	14.43 (1956)	Discontinued
02250000 Turkey Creek near Palm Bay	Brevard Co.: At bridge on SR 507	95.5	Jan 1956-June 68	12.70 (1956)	Discontinued (An undetermined amount of water was pumped to St. Johns River)

TABLE 69. Estimates of Flood Flows at Gaged Sites in the Coastal Basins

(First Line: Log Pearson type 3 analysis using the WRC guidelines, Bulletin #17B.)
(Second Line: Log Pearson type 3 analysis using the Method of Mixed Moments.)

Gaging Station	Record Length (Years)	Highest Discharge During Period of Record (cfs)	Mean Annual High Discharge (cfs)	Discharge in cfs which may be equaled or exceeded in: 5 Yr	10 Yr	25 Yr	50 Yr	100 Yr	500 Yr
1. Moultrie Creek at	22	860	386	598	812	1,100	1,330	1,560	2,120
SR 207 near				647	787	899	949	981	1,020
St. Augustine									
2. Moultrie Creek near	25	1,450	625	1,100	1,590	2,280	2,810	3,340	4,570
St. Augustine				1,040	1,220	1,350	1,400	1,430	1,460
3. Fish Swamp Outlet	18	638	171	269	416	650	857	1,090	1,750
near Summer Haven				268	387	550	674	798	1,080
4. Tomoka River near	19	2,100	745	1,100	1,540	2,190	2,730	3,320	4,980
Holly Hill				1,110	1,490	1,980	2,350	2,730	3,600
5. Little Tomoka River	17	420	172	234	302	401	484	574	819
near Ormond Beach				232	299	395	474	560	792
6. Spruce Creek near	33	1,610	539	732	904	1,130	1,310	1,480	1,920
Samsula				744	925	1,150	1,330	1,500	1,890
7. Crane Creek at	18	665	298	418	531	683	803	928	1,240
Melbourne				432	538	662	747	825	985
8. Turkey Creek near	12	2,790	1,282	1,660	1,940	2,300	2,580	2,870	3,580
Palm Bay				1,800	2,110	2,440	2,640	2,820	3,130

TABLE 70. HIGH FLOW DATA FOR MOULTRIE CREEK AT STATE HIGHWAY 207 NEAR ST. AUGUSTINE.

@@@@@ MOULTRIE CREEK AT HIGHWAY 207, DISCH CFS(1963-84)

HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1963	309.00	125.14	80.50	56.20	35.50	23.20	15.52	14.17	10.71
1964	682.00	398.14	365.93	200.70	105.74	64.67	62.95	53.71	43.27
1965	836.00	467.14	294.64	194.83	114.26	87.57	62.47	46.75	35.83
1966	438.00	248.71	182.71	104.77	58.68	31.83	22.05	18.39	14.77
1967	424.00	179.14	116.64	67.04	48.41	39.74	26.99	23.33	17.84
1968	88.00	57.29	54.93	35.77	26.03	13.76	10.06	7.50	5.67
1969	210.00	105.14	66.21	39.82	29.40	17.18	14.09	13.90	11.89
1970	860.00	439.86	364.14	228.13	147.58	97.40	83.69	61.56	46.30
1971	55.00	32.00	25.01	17.41	12.06	7.45	4.99	4.86	3.96
1972	111.00	73.71	69.86	49.43	35.23	27.83	26.04	18.36	13.89
1973	479.00	204.43	128.86	108.57	72.91	58.52	53.44	44.14	38.25
1974	254.00	117.00	80.93	49.07	32.57	27.81	22.58	16.96	13.35
1975	548.00	234.71	164.86	87.61	60.45	38.85	25.59	18.23	13.90
1976	505.00	261.14	167.50	88.60	50.79	27.87	19.54	13.86	11.11
1977	134.00	79.29	59.86	56.50	39.58	21.74	14.42	12.93	9.93
1978	306.00	113.71	78.36	58.23	39.64	29.39	20.15	13.59	10.24
1979	193.00	74.57	43.83	21.24	20.32	15.99	11.28	7.59	5.88
1980	788.00	458.14	319.86	207.83	127.45	78.47	64.00	48.16	36.65
1981	3.60	2.60	1.93	1.75	1.31	0.82	0.64	0.48	0.39
1982	254.00	119.86	81.00	46.10	29.19	19.49	14.95	11.47	8.72
1983	785.00	274.29	188.57	100.59	72.25	57.36	45.04	43.60	41.48
1984	228.00	117.76	94.05	59.04	42.21	41.81	39.47	30.84	24.44

TABLE 71. HIGH FLOW DATA FOR MOULTRIE CREEK NEAR ST. AUGUSTINE.

@@@@@ MOULTRIE CREEK NEAR ST. AUGUSTINE, DISCH CFS(1941-1964)

HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1941	97.00	64.29	42.91	36.99	28.77	21.82	16.43	16.49	13.20
1942	1370.00	559.43	325.79	214.97	128.78	78.80	62.89	52.54	39.85
1943	39.00	31.71	23.93	15.15	10.54	8.72	6.13	4.56	3.68
1944	564.00	364.43	221.36	164.23	96.23	50.91	35.61	36.24	27.37
1945	1320.00	408.00	239.86	124.03	68.21	59.10	40.65	28.46	21.58
1946	711.00	308.29	188.07	130.73	103.83	78.48	61.09	49.66	37.67
1947	546.00	268.29	169.79	144.90	114.70	78.04	54.22	50.41	39.50
1948	763.00	355.57	211.21	115.30	92.32	55.04	61.14	52.23	41.82
1949	612.00	297.43	269.07	152.57	89.40	56.12	37.72	28.06	21.32
1950	909.00	488.14	349.79	189.87	128.67	67.08	44.52	30.15	22.84
1951	661.00	243.14	149.93	84.57	57.21	32.72	23.59	16.66	12.65
1952	333.00	122.71	99.29	78.40	53.52	32.69	29.23	20.36	15.45
1953	738.00	414.43	278.29	148.67	80.84	42.40	37.44	29.89	22.60
1954	654.00	466.43	361.07	240.40	217.25	117.28	85.08	58.06	43.79
1955	53.00	31.29	19.94	18.54	11.33	8.09	5.85	4.14	3.24
1956	63.00	46.57	39.71	25.34	15.77	9.04	8.66	6.35	4.95
1957	49.00	22.29	15.48	8.70	4.80	3.04	2.78	2.61	2.09
1958	576.00	271.43	163.21	125.57	90.88	70.08	51.96	43.33	36.51
1959	537.00	359.14	236.21	133.20	84.25	59.57	42.56	29.45	22.29
1960	936.00	426.29	251.00	130.90	74.63	41.45	41.79	34.33	26.74
1961	385.00	209.71	152.50	142.17	90.80	53.23	36.31	28.41	21.85
1962	763.00	284.71	158.64	84.44	44.04	26.62	19.49	14.10	10.91
1963	398.00	165.14	103.00	71.50	45.11	28.67	19.39	17.48	13.38
1964	1100.00	605.00	544.50	288.10	149.98	88.36	82.29	70.60	56.83
1965	1450.00								

TABLE 72. ANNUAL PEAK FLOW DATA FOR FISH SWAMP OUTLET NEAR SUMMER HAVEN.

FISH SWAMP OUTLET NEAR SUMMER HAVEN, DISCH CFS (1963-1983)

YEAR:	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
DISCH:	200.0	638.0	357.0	111.0	145.0	65.0	483.0	248.0	24.0	92.0

YEAR:	1973	1975	1976	1977	1978	1980	1981	1983
DISCH:	156.0	81.0	20.0	75.0	30.0	164.0	12.0	176.0

TABLE 73. HIGH FLOW DATA FOR TIGER BAY CANAL NEAR DAYTONA BEACH.

@@@@@ TIGER BAY CANAL NEAR DAYTONA BEACH, DISCH CFS (1979-84)

HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1979	263.00	206.57	147.00	94.83	78.05	52.62	41.76	39.65	33.47
1980	226.00	176.14	155.86	145.20	110.08	65.33	45.68	32.78	24.94
1981	60.00	53.86	46.36	31.69	26.21	15.49	10.33	7.55	5.79
1982	119.00	107.29	83.36	50.77	31.38	18.25	12.24	8.22	6.17
1983	153.00	122.43	110.50	90.13	74.55	59.06	44.81	48.74	42.78
1984	144.29	127.49	123.66	106.05	74.11	55.22	46.63	35.30	29.19

TABLE 74. HIGH FLOW DATA FOR TOMOKA RIVER NEAR HOLLY HILL.

@@@@@ TOMOKA RIVER NEAR HOLLY HILL, DISCH CFS(1967-84)

HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1967	1240.00	538.00	383.64	309.10	250.60	176.24	144.39	105.88	81.00
1968	608.00	395.43	364.86	283.37	194.13	134.69	90.52	61.72	46.63
1969	1580.00	862.29	559.71	342.03	296.27	210.70	173.55	123.55	95.67
1970	1320.00	874.71	771.43	508.93	371.48	260.80	222.08	164.25	124.42
1971	139.00	94.14	80.00	62.20	39.95	22.71	19.68	19.17	15.28
1972	305.00	193.43	141.64	102.27	75.75	54.94	58.61	47.39	36.71
1973	576.00	448.14	341.86	229.97	163.32	144.11	129.61	104.15	84.61
1974	300.00	232.86	181.43	144.33	124.22	89.65	66.58	47.50	36.38
1975	995.00	549.57	356.07	233.77	221.50	148.41	99.47	68.50	52.10
1976	417.00	252.71	175.43	127.57	107.82	85.92	76.54	54.46	46.42
1977	1440.00	808.57	551.36	343.03	219.67	149.02	103.20	97.02	75.80
1978	329.00	235.86	197.21	188.70	136.82	86.28	61.56	47.31	36.53
1979	871.00	499.57	332.57	211.07	182.85	124.03	99.98	88.50	73.84
1980	606.00	409.86	348.57	316.83	219.17	152.67	111.12	84.15	65.13
1981	89.00	48.14	41.93	34.93	27.01	16.60	11.78	10.12	8.25
1982	374.00	277.71	208.79	134.47	85.62	50.12	36.27	27.34	21.05
1983	405.00	261.29	224.07	182.87	159.30	119.31	83.57	90.12	80.59
1984	682.00	419.71	320.57	208.70	142.77	105.34	92.82	71.63	61.24

TABLE 75. ANNUAL PEAK FLOW DATA FOR LITTLE TOMOKA RIVER NEAR ORMOND BEACH.

LITTLE TOMOKA RIVER NEAR ORMOND BEACH, PK DISCH CFS (1963-1983)

YEAR:	1963	1964	1965	1967	1968	1969	1970	1971	1972	1973
DISCH:	74.0	100.0	392.0	128.0	130.0	420.0	228.0	78.0	80.0	100.0

YEAR:	1975	1976	1978	1979	1980	1982	1983
DISCH:	200.0	150.0	303.0	141.0	179.0	144.0	84.0

TABLE 76. HIGH FLOW DATA FOR SPRUCE CREEK NEAR SAMSULA.

@@@@@ SPRUCE CREEK NEAR SAMSULA, DISCH CFS(1952-84)

HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1952	300.00	237.14	150.00	118.27	73.84	42.55	35.32	26.59	20.03
1953	417.00	300.71	192.29	123.87	76.62	47.90	40.31	40.60	31.17
1954	796.00	552.57	414.29	318.10	280.77	167.72	120.73	81.84	62.14
1955	172.00	89.43	51.35	25.62	21.03	12.46	9.59	6.84	5.36
1956	258.00	150.86	131.57	75.64	47.08	36.55	29.42	20.64	15.57
1957	207.00	137.00	85.21	44.45	23.23	12.17	8.59	6.25	5.06
1958	462.00	360.86	250.93	220.90	194.98	136.30	92.46	78.81	61.30
1959	380.00	332.00	242.29	176.67	110.58	72.42	59.41	47.16	37.75
1960	452.00	315.14	197.50	128.87	100.05	55.55	55.62	48.08	42.83
1961	602.00	478.86	328.29	247.73	174.05	125.50	84.11	60.28	46.26
1962	338.00	186.43	108.43	70.01	41.81	24.38	16.49	11.27	8.52
1963	294.00	138.86	96.21	84.70	64.90	36.88	37.75	31.86	25.41
1964	438.00	323.43	215.36	155.20	102.55	79.93	71.59	61.51	49.45
1965	1280.00	773.00	480.00	338.20	216.77	123.52	83.77	60.37	45.74
1966	200.00	134.14	104.86	68.97	48.35	29.14	19.78	18.25	15.51
1967	466.00	229.57	152.36	139.23	98.77	75.60	64.92	45.61	34.69
1968	327.00	265.71	206.86	190.40	121.32	70.05	46.50	31.73	23.99
1969	755.00	502.57	329.00	182.03	101.67	64.79	62.42	44.69	36.10
1970	717.00	559.86	479.64	300.83	223.60	158.63	132.48	98.54	74.81
1971	285.00	123.57	71.50	35.83	23.11	12.66	9.67	7.71	6.23
1972	449.00	212.29	122.43	76.47	70.54	39.98	31.24	24.40	19.63
1973	414.00	331.43	245.36	142.17	104.87	89.39	73.84	59.23	46.04
1974	198.00	101.29	82.93	60.20	39.45	22.52	16.08	11.61	9.07
1975	431.00	348.43	293.57	180.37	169.20	117.42	77.78	52.48	39.71
1976	281.00	141.14	111.43	86.07	65.78	50.19	38.16	26.11	20.93
1977	527.00	354.14	292.71	185.67	139.65	126.47	88.98	83.26	63.85
1978	467.00	235.43	198.57	176.40	109.95	63.59	43.57	35.61	27.08
1979	465.00	231.14	177.43	125.00	89.93	58.81	44.37	37.62	31.28
1980	900.00	543.00	356.71	277.60	166.93	108.58	74.28	53.12	40.74
1981	66.00	22.91	14.01	8.68	5.61	3.44	2.56	2.60	2.21
1982	478.00	319.00	216.93	119.05	65.96	42.63	29.55	21.66	16.65
1983	566.00	360.86	315.29	166.83	137.53	110.04	80.68	68.09	67.92
1984	491.00	327.71	226.29	147.57	94.03	81.38	65.84	52.77	42.68

TABLE 77. HIGH FLOW DATA FOR CRANE CREEK AT MELBOURNE.

@@@@@ CRANE CREEK AT MELBOURNE, DISCH CFS(1952-67)

HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1952	233.00	114.00	68.43	45.13	36.29	23.88	19.21	15.88	12.90
1953	310.00	143.57	107.79	65.60	46.03	27.08	21.05	17.29	14.20
1954	265.00	148.29	119.00	101.63	80.98	57.82	41.47	30.08	24.43
1955	145.00	75.86	49.43	45.57	30.17	22.83	21.96	17.67	14.61
1956	43.00	19.86	14.45	12.04	10.22	8.60	7.86	7.26	6.76
1957	437.00	163.57	102.50	61.67	35.70	20.68	16.39	13.47	11.42
1958	91.00	45.71	34.86	28.90	22.38	18.90	15.02	14.96	12.97
1959	104.00	65.71	46.07	30.83	23.39	18.80	16.66	15.88	14.11
1960	182.00	100.14	65.57	40.90	28.83	21.50	19.10	18.89	18.21
1961	160.00	130.14	102.86	78.33	56.45	45.32	35.08	26.30	21.60
1962	127.00	76.86	48.21	38.43	26.19	23.09	17.94	13.88	11.65
1963	177.00	108.00	67.93	45.17	43.85	27.99	21.16	19.07	15.96
1964	221.00	154.57	100.07	58.90	38.57	31.56	26.81	21.64	18.61
1965	318.00	138.86	95.07	72.73	50.58	33.20	25.07	20.19	17.10
1966	107.00	64.86	49.29	34.77	28.42	20.99	16.80	15.76	15.21
1967	193.00	107.71	75.50	56.40	41.95	39.88	31.39	23.91	19.70

TABLE 78. HIGH FLOW DATA FOR TURKEY CREEK NEAR PALM BAY.

@@@@@ TURKEY CREEK NEAR PALM BAY, DISCH CFS(1957-67)

HIGHEST MEAN VALUES FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING MAY 31

YEAR	1	7	14	30	60	120	183	274	1 YEAR
1957	2500.00	1707.14	1454.29	1027.90	662.47	403.35	293.76	227.44	182.86
1958	1000.00	613.71	407.71	363.33	273.95	222.06	169.85	165.09	140.85
1959	1060.00	756.43	502.57	285.90	190.08	129.43	104.52	89.75	77.21
1960	1540.00	1250.00	950.29	519.37	327.95	202.77	198.73	173.34	174.24
1961	1580.00	1497.14	1410.71	1122.87	726.43	605.88	438.19	310.20	243.21
1962	213.00	150.14	136.71	114.10	78.32	64.99	54.26	46.45	40.57
1963	1180.00	958.43	676.00	436.03	378.08	239.76	173.24	145.35	117.14
1964	1170.00	880.29	759.43	465.43	315.48	225.00	200.50	156.23	126.27
1965	1120.00	961.71	781.64	602.53	374.33	218.63	158.62	121.46	99.62
1966	1250.00	771.71	521.00	292.13	221.05	135.15	119.32	111.61	95.88
1967	1140.00	796.43	642.57	560.50	347.85	289.88	251.43	185.51	147.65

ESTIMATING PEAK DISCHARGES AT UNGAGED SITES

Often, peak discharge estimates are needed at ungaged sites. These are determined by analyses of hydrologic data or by formulas developed empirically. Empirical formulas provide quick results, but they are considered inadequate for engineering design. With the advent of high speed digital computers, hydrologic methods have advanced to a great degree of sophistication, e.g., the U. S. Army Corps of Engineers' Flood Hydrograph Package (HEC-1), Technical Release No. 20 (Project Formulation Program-Hydrology) of the Soil Conservation Service, and continuous simulation models developed by several other agencies. However, calibration and application of those models is rather time consuming and requires a major effort. Regression models are presented in this section for obtaining approximate peak flows.

Regional Regression Models

For the streams of Florida, Bridges (1) has found that flood-peak discharge (dependent variable) is significantly related to three drainage-basin characteristics (independent variables), i.e., contributing drainage area (DA), lake area (LK) within DA, and the channel slope (SL). The regression model has the following form for the region covered by the SJRWMD.

$$Q_T = C\ DA^{B_1}\ SL^{B_2}\ (LK+3.0)^{B_3} \ldots\ldots\ldots\ldots (1)$$

in which

Q_T is the discharge for a recurrence interval of T-years, in cubic feet per second;

C is the regression constant;

DA is the drainage area, in square miles;

SL is the channel slope, minimum value set at 0.9, in feet per mile (for example, if SL is less than 0.9 foot per mile, then SL = 0.9 foot per mile);

LK is lake area in percent (Note: the independent variable = LK+3.0, in percent);

B_1, B_2, B_3 are exponents of the regression.

By using T-Year flood flows (log Pearson estimates) presented in this report, the regression constants and the exponents of Eq. 1 are derived by multiple regression analysis and presented in Table 79 for the entire SJRWMD. The degree of correlation of flood discharges with the three independent variables considered (DA, LK, and SL) is measured by several statistical parameters most common among which are the multiple correlation coefficient (R), and the standard deviation of residuals (S). The R value indicates the linear association between the actual flood values (Q_i) used and the estimates ($\hat{Q}_i$) given by Eq. 1. The S, the standard deviation of ($Q_i-\hat{Q}_i$), measures the closeness with which the Q_i approach the estimates, $\hat{Q}_i$. For a perfect fit, R = 1, and S = 0. In general, a high R and a low S indicate a

Table 79.--Regression Model for the St. Johns River Water Management District

A. From log Pearson estimates by the WRC guidelines (Bulletin #17B)

Recurrence interval T, in years	Exceedance probability	Regression constant C	Regression exponents DA B_1	SL B_2	(LK+3) B_3	R	S % of mean Q
5	0.2	104	0.768	0.374	-0.635	0.922	37.8
10	0.1	153	0.764	0.378	-0.675	0.917	41.6
25	0.04	230	0.761	0.385	-0.722	0.907	46.5
50	0.02	299	0.760	0.391	-0.754	0.898	50.1
100	0.01	372	0.759	0.397	-0.784	0.888	54.0
500	0.002	596	0.758	0.412	-0.848	0.864	63.1

B. From log Pearson estimates by the method and mixed moments (MXM1)

Recurrence interval T, in years	Exceedance probability	Regression constant C	Regression exponents DA B_1	SL B_2	(LK+3) B_3	R	S % of mean Q
5	0.2	107	0.771	0.369	-0.650	0.921	38.3
10	0.1	153	0.772	0.370	-0.700	0.918	41.4
25	0.04	219	0.772	0.374	-0.753	0.910	45.3
50	0.02	273	0.772	0.377	-0.786	0.904	47.8
100	0.01	334	0.771	0.380	-0.817	0.896	50.0
500	0.002	483	0.770	0.389	-0.878	0.874	55.8

good regression model. In Table 79, S is given as a percent of mean Q.

Further analyses have shown that development of regression models for individual sub-regions of the District will provide better correlation in regression than the model given by Table 79. Tables 80 through 82 present separate regression models for the Nassau and St. Mary's, the Upper and Middle St. Johns, and the Oklawaha River basins, respectively. No improvement over the model given in Table 79 is seen for the Lower St. Johns and the Coastal River basins.

In general, results given by the foregoing regression models should not be the sole basis for engineering design. They should be used only as alternative design values for comparison with other estimates. For locations on the main-stem of a river, e.g., St. Johns, Oklawaha, and St. Marys rivers, flood flows should be computed by interpolating other station values on the basis of drainage area; using regression models may result in inconsistencies.

Table 80.--Regression Model for the Nassau and St. Marys River Basins.

A. From log Pearson estimates by the WRC guidelines (Bulletin #17B)

Recurrence interval T, in years	Exceedance probability	Regression constant C	Regression exponents DA B_1	SL B_2	(LK+3) B_3	R	S % of mean Q
5	0.2	284.3	0.713	0.165	-0.991	0.952	22.4
10	0.1	340.4	0.753	0.186	-1.04	0.953	25.6
25	0.04	403.4	0.801	0.215	-1.12	0.950	25.9
50	0.02	454.9	0.833	0.235	-1.17	0.944	29.1
100	0.01	497.7	0.866	0.256	-1.22	0.938	32.4
500	0.002	601.8	0.934	0.304	-1.34	0.920	37.3

B. From log Pearson estimates by the method and mixed moments (MxMl)

Recurrence interval T, in years	Exceedance probability	Regression constant C	Regression exponents DA B_1	SL B_2	(LK+3) B_3	R	S % of mean Q
5	0.2	281.5	0.738	0.166	-1.06	0.954	22.4
10	0.1	383.8	0.766	0.154	-1.15	0.957	23.4
25	0.04	533.8	0.788	0.140	-1.22	0.956	24.8
50	0.02	658.5	0.799	0.132	-1.27	0.952	23.2
100	0.01	796.3	0.807	0.124	-1.31	0.917	21.7
500	0.002	1164.4	0.817	0.110	-1.37	0.922	21.4

Table 81.--Regression Model for the Upper and Middle St. Johns River Basins.

A. From log Pearson estimates by the WRC guidelines (Bulletin #17B)

Recurrence interval T, in years	Exceedance probability	Regression constant C	Regression exponents DA B_1	SL B_2	(LK+3) B_3	R	S % of mean Q
5	0.2	41.26	0.926	0.903	-0.765	0.993	21.4
10	0.1	66.02	0.917	0.908	-0.823	0.990	29.1
25	0.04	112.17	0.905	0.912	-0.896	0.986	35.2
50	0.02	160.77	0.897	0.914	-0.956	0.984	38.0
100	0.01	225.88	0.888	0.911	-1.01	0.981	40.2
500	0.002	464.05	0.867	0.905	-1.14	0.975	42.1

B. From log Pearson estimates by the method and mixed moments (MXM1)

Recurrence interval T, in years	Exceedance probability	Regression constant C	Regression exponents DA B_1	SL B_2	(LK+3) B_3	R	S % of mean Q
5	0.2	43.38	0.930	0.904	-0.794	0.994	21.8
10	0.1	77.45	0.912	0.877	-0.895	0.992	25.6
25	0.04	154.47	0.885	0.829	-1.02	0.985	28.8
50	0.02	247.15	0.862	0.788	-1.10	0.987	29.8
100	0.01	391.50	0.838	0.736	-1.19	0.986	29.8
500	0.002	1085.72	0.779	0.612	-1.39	0.981	31.0

Table 82.--Regression Model for the Oklawaha River Basin.

A. From log Pearson estimates by the WRC guidelines (Bulletin #17B)

Recurrence interval T, in years	Exceedance probability	Regression constant C	Regression exponents DA B_1	SL B_2	(LK+3) B_3	R	S % of mean Q
5	0.2	5.70	0.864	0.864	0.058	0.940	48.1
10	0.1	11.59	0.833	0.792	-0.036	0.936	46.9
25	0.04	25.03	0.807	0.717	-0.156	0.921	45.5
50	0.02	40.45	0.793	0.671	-0.241	0.907	45.9
100	0.01	64.07	0.785	0.629	-0.332	0.889	45.2
500	0.002	160.77	0.776	0.545	-0.540	0.837	46.3

B. From log Pearson estimates by the method of mixed moments (MXM1)

Recurrence interval T, in years	Exceedance probability	Regression constant C	Regression exponents DA B_1	SL B_2	(LK+3) B_3	R	S % of mean Q
5	0.2	5.87	0.863	0.860	0.049	0.939	47.9
10	0.1	12.30	0.851	0.776	-0.107	0.934	46.8
25	0.04	27.66	0.851	0.683	-0.315	0.925	46.0
50	0.02	47.47	0.858	0.622	-0.470	0.917	44.8
100	0.01	76.71	0.869	0.568	-0.625	0.908	45.1
500	0.002	208.51	0.901	0.454	-0.964	0.888	44.2

A NOTE ON USING THE RESULTS

The flood estimates presented in this report were computed for gaged sites by the log Pearson type 3 analysis using, (1) The U.S. Water Resources Council (WRC) Guidelines (Bulletin #17B), and (2) The Method of Mixed Moments (see Appendix A). The WRC method requires an estimate of logarithmic skew for deriving the results. The limited available station data do not provide an accurate estimate of logarithmic skew, thus a weighted skew is obtained based on a regional estimate and the station value. The Method of Mixed Moments eliminates the use of skewness coefficient. Further, the logarithmic moments method recommended by the WRC tends to produce rather conservative (positively biased) estimates of flood flows for higher return periods when the population logarithmic skew is negative. For stations considered in this report, the skew estimate is, in general, negative.

For $T = 5$ yr, 10 yr, and 25 yr the flood estimates given by the two methods did not differ greatly for most of the stations. For $T \geq 50$ yr the estimates given by the two methods do differ widely for several stations, the WRC estimate being the higher. The user should recognize that there is no uniform technique which may be rigidly applied to define the flood potential of a watershed. Statistical analysis alone may not provide the final answer in many situations. The user will be required to exercise professional engineering/hydrologic judgement. The economic consequences of using one design flood value or the other will provide an apparent decision tool. Sometimes even though the magnitude of a given flood may 'appear' large, the increase in flood elevation may not be substantial over a flood of smaller magnitude if a major increase occurs in the conveyance capacity of the river at that elevation. Other factors need to be considered are the past major floods at the site and nearby watersheds, record length, floods due to major storms beyond the period of record, etc. In general, when the length of systematic record is short and flood magnitudes are required for $T \geq 100$ Yr, flood estimates should be obtained by: (1) Statistical analysis, (2) comparisons with similar watersheds, and (3) hydrologic methods, i.e., from precipitation. All types of analyses should be incorporated when defining these high flood magnitudes. Bulletin #17B (3) describes appropriate procedures for improving the flood estimates.

The District has plans to complete detailed hydrologic investigations for each hydrologic unit (Figure 2) within the SJRWMD. These studies will compute flood profiles for different streams in the region and present detailed hydrologic information. The user may contact the District to find out if a report has been completed for a region of his interest.

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APPENDIX A

FITTING LOG PEARSON TYPE 3 DISTRIBUTION

INTRODUCTION

Knowledge of extreme hydrologic events associated with certain probability level (or return period/recurrence interval) is essential in evaluation and design of water control projects and in dealing with several other aspects of water environment. These events may be flood flows, droughts, rainfalls, storages, water levels, etc. The common technique for estimating these events consists of choosing an appropriate probability distribution and fitting it to sample data by one of the available statistical procedures. Sample data comprise of observed annual maximum or minimum values. If P is the exceedance probability of the annual events, the return period T is given by 1/P for maximum values (e.g., floods) and 1/(1-P) for minimum values (e.g., low flows). A distribution widely recommended for use is log Pearson (2). This Appendix describes some theoretical properties of log Pearson type 3 distribution and illustrates its application by two methods for parameter estimation.

LOG PEARSON TYPE 3 (LP) DISTRIBUTION

The LP is a three-parameter probability distribution. Let a, b, and c be the parameters of LP and X the LP variable and Y = ln X. The logarithmic variable Y is distributed as Pearson type 3 (P3) and the parameters a, b, and c are common for both P3 and LP. The probability density function of P3, f(y), is given by:

$$f(y) = \frac{|a|}{\Gamma(b)} [a(y-c)]^{b-1} \exp[-a(y-c)] \quad \ldots\ldots (1)$$

The density function of LP distribution was derived by Bobee (3) as:

$$f(x) = \frac{|a|}{\Gamma(b)} \frac{\exp(ac)}{x^{1+a}} [a(\ln x - c)]^{b-1} \quad \ldots\ldots (2)$$

If a > 0, the P3 distribution is positively skewed, and $c \leq y \leq +\infty$. In this case, the LP distribution is also positively skewed, and $\exp(c) \leq x < +\infty$.

If a < 0, the P3 distribution is negatively skewed and, $-\infty < y \leq c$. In this case, the LP distribution is either positively or negatively skewed depending on the values of a and b and, $0 < x \leq \exp(c)$. At x = 0, f(x) may be defined as zero for this case.

The distribution parameters (a, b, and c) are related to the statistical parameters (SP), mean, variance and skew, by the following equations:

1. P3 distribution:

$$\text{Mean: } \mu_y = c + ba^{-1} \quad \ldots\ldots (3)$$

$$\text{Variance: } \sigma_y^2 = ba^{-2} \quad \ldots\ldots (4)$$

$$\text{Skew: } \gamma_y = \frac{a}{|a|} 2b^{-1/2} \quad \ldots\ldots (5)$$

2. LP distribution:

$$\text{Mean: } \mu_x = \frac{\exp(c)}{\left(1 - \frac{1}{a}\right)^b} \quad \ldots\ldots (6)$$

$$\text{Variance: } \sigma_x^2 = \exp(2c) \left[\frac{1}{\left(1 - \frac{2}{a}\right)^b} - \frac{1}{\left(1 - \frac{1}{a}\right)^{2b}} \right] \quad \ldots\ldots (7)$$

$$\text{Skew: } \gamma_x = \exp(3c) \frac{\left\{ \frac{1}{\left(1 - \frac{3}{a}\right)^b} - \frac{3}{\left[\left(1 - \frac{2}{a}\right)\left(1 - \frac{1}{a}\right)\right]^b} + \frac{2}{\left(1 - \frac{1}{a}\right)^{3b}} \right\}}{\sigma_x^3} \quad (8)$$

The forms taken by LP probability density function, f(x), and its bounds are of some concern in fitting hydrologic data. Parameters a and b, known as scale and shape parameters, govern the overall geometric form of LP density which takes four basic forms, viz., J, reverse J, bell (unimodal) and U. In addition, several transitional shapes varying from one basic form to the other occur (Fig. 1). Fig. 2 shows the regions of SP which produce different forms of LP. Note that the coefficient of variation $\eta_x = \sigma_x/\mu_x$. The forms which need particular attention are the J, reverse J, and U. If the solution indicates one of these forms, it should be ensured that data are really distributed accordingly. With regard to bounds, a comparative study of different three-parameter probability distributions shows that for a given hydrologic sample, in general, the LP fit will have better applicable properties or its estimates of design events compare well with other distributions (15, 17).

THE_SAMPLE_MOMENTS

For a sample of size n ($X_1 \ldots X_i \ldots X_n$, in which i is the ith item of data), the sample moments or SP are commonly calculated by:

$$\text{Mean:} \quad \bar{X} = \frac{1}{n} \sum_{i=1}^{n} X_i \quad \ldots \ldots \quad (9)$$

$$\text{Variance:} \quad S_x^2 = \frac{1}{(n-1)} \sum_{i=1}^{n} (X_i - \bar{X})^2 \quad \ldots \ldots \quad (10)$$

$$\text{Skew:} \quad CS_x = \frac{n}{S_x^3 (n-1)(n-2)} \sum_{i=1}^{n} (X_i - \bar{X})^3 \quad \ldots \ldots \quad (11)$$

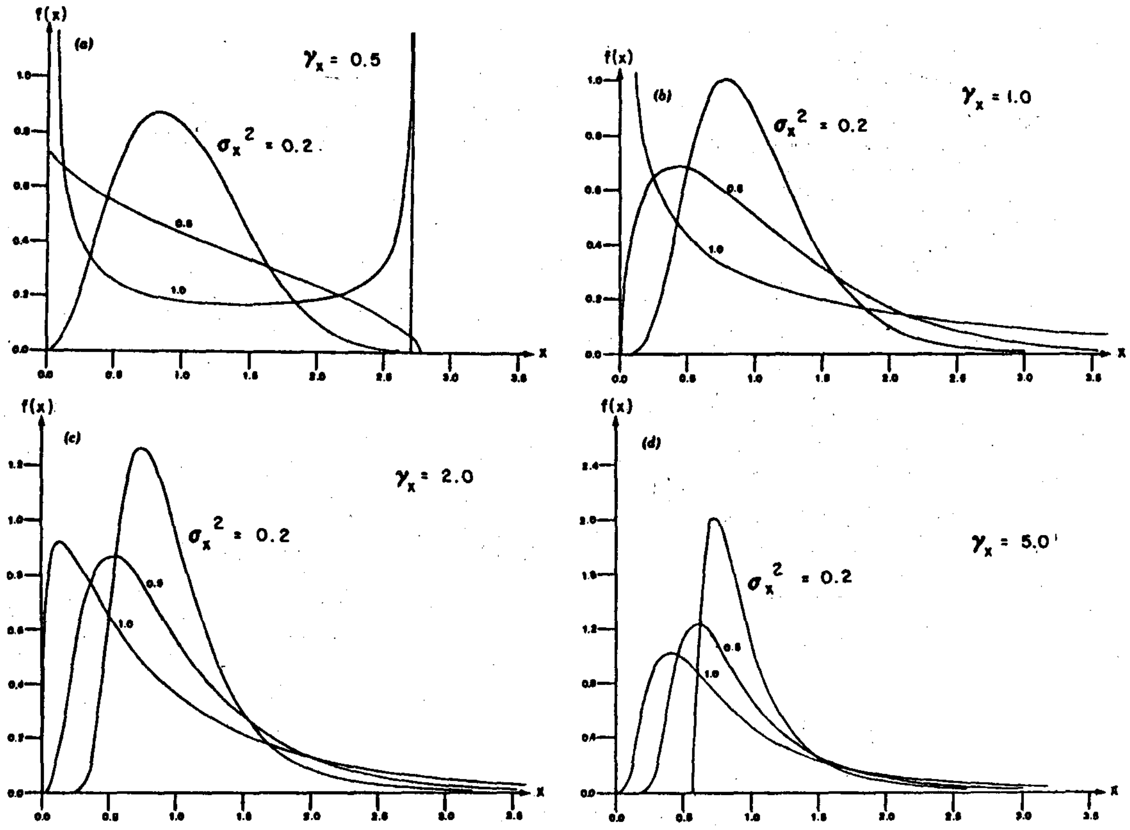

Figure 1. Log Pearson Probability Densities ($\mu_x = 1.0$)

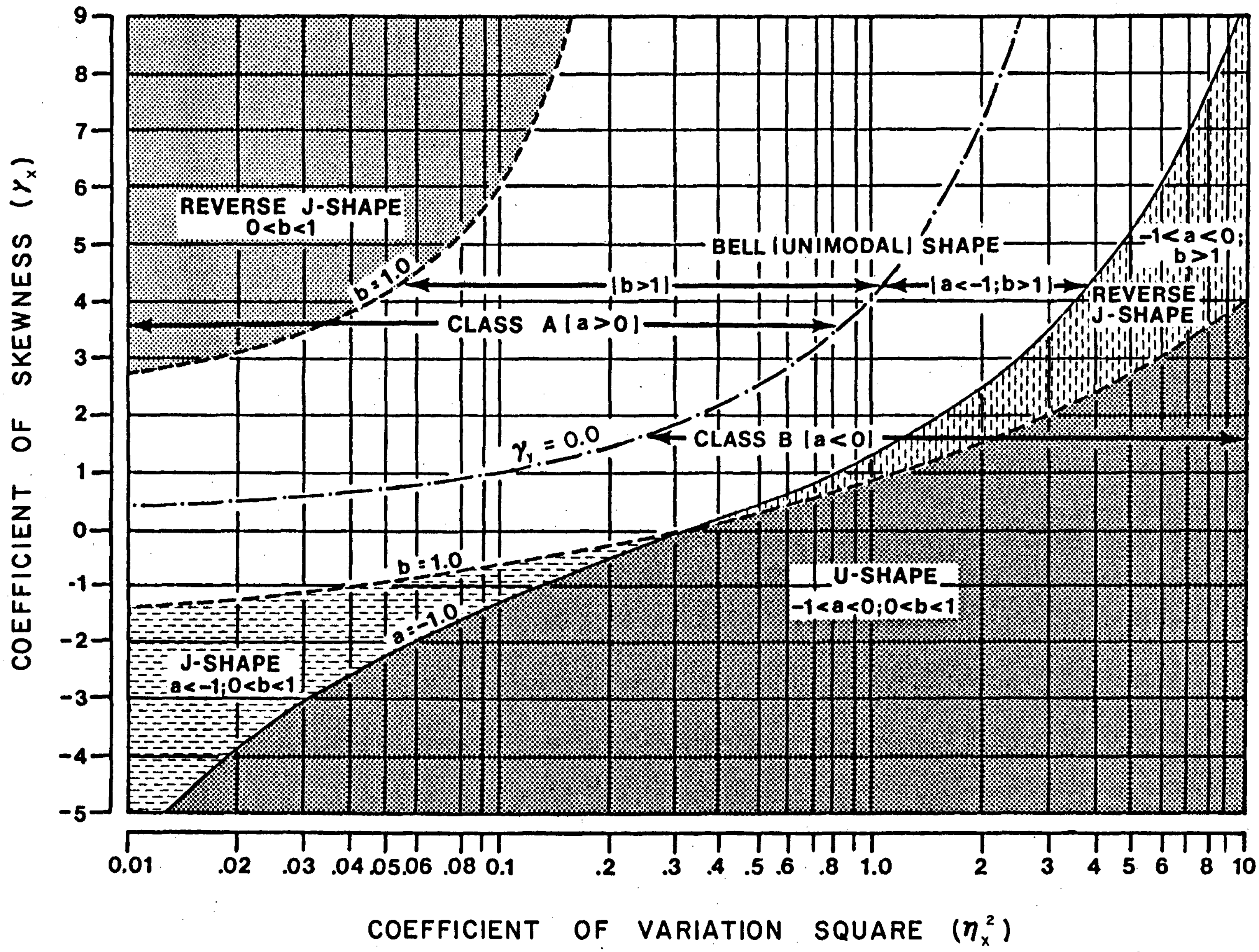

Figure 2. Regions of Different Forms of Log Pearson Type 3 Distribution

Likewise, the logarithmic moments (for data $Y = \ln X$), $\bar{Y}$, S_y^2, and CS_y are obtained from Eqs. 9-11, respectively, by substituting Y for X. The sample moments are the estimates of the corresponding population SP, i.e., $\bar{X}$ for μ_x, etc.

EVALUATION OF LP QUANTILES

For given exceedance probability P, the log Pearson quantile (design value), X_p, is given by:

$$X_p = \exp\left(\mu_y + K'\sigma_y\right) \tag{12}$$

in which K' = Pearson frequency factor (Table 1). Value of K' depends upon P and γ_y. The simplest approach for solving Eq. 12 is through the logarithmic sample moments (log moments method), i.e.,

1. set $\mu_y = \bar{Y}$; $\sigma_y = S_y$; and $\gamma_y = CS_y$.
2. Obtain K' values from Table 1 for P values of interest. Calculate X_p values by Eq. 12.

Calculation of LP quantiles is somewhat indirect in other methods (3, 5, 7, 13, 14) which solve for distribution parameters (a, b, and c). Then the log SP are obtained by Eqs. 3-5 and X_p are calculated by Eq. 12.

BIAS IN ESTIMATED QUANTILES

In 1967, the United States Water Resources Council recommended the use of LP distribution (by log moments method) for estimating frequencies of flood flows (1). Intensive research by

TABLE 1. PEARSON FREQUENCY FACTORS (K' VALUES) FOR USE IN EQ. 12.

LOGARITHMIC SKEWNESS COEFFICIENT (γ_Y)

P	0.0	-0.1	-0.2	-0.3	-0.4	-0.5	-0.6	-0.7	-0.8	-0.9	-1.0	-1.1	-1.2	-1.3
0.995	-2.5758	-2.6697	-2.7632	-2.8564	-2.9490	-3.0410	-3.1323	-3.2228	-3.3124	-3.4011	-3.4887	-3.5753	-3.6607	-3.7450
0.990	-2.3264	-2.3996	-2.4723	-2.5442	-2.6154	-2.6857	-2.7551	-2.8236	-2.8910	-2.9574	-3.0226	-3.0866	-3.1494	-3.2110
0.980	-2.0538	-2.1070	-2.1594	-2.2108	-2.2613	-2.3108	-2.3593	-2.4067	-2.4530	-2.4981	-2.5421	-2.5848	-2.6263	-2.6666
0.960	-1.7507	-1.7846	-1.8176	-1.8495	-1.8804	-1.9102	-1.9390	-1.9666	-1.9931	-2.0185	-2.0427	-2.0657	-2.0876	-2.1082
0.900	-1.2816	-1.2918	-1.3011	-1.3094	-1.3167	-1.3231	-1.3285	-1.3329	-1.3364	-1.3389	-1.3404	-1.3409	-1.3405	-1.3390
0.800	-0.8416	-0.8364	-0.8304	-0.8238	-0.8164	-0.8083	-0.7995	-0.7900	-0.7799	-0.7690	-0.7575	-0.7454	-0.7326	-0.7192
0.500	0.0000	0.0166	0.0333	0.0499	0.0665	0.0830	0.0995	0.1158	0.1320	0.1481	0.1640	0.1797	0.1952	0.2104
0.200	0.8416	0.8461	0.8499	0.8529	0.8551	0.8565	0.8572	0.8570	0.8561	0.8543	0.8516	0.8481	0.8437	0.8384
0.100	1.2816	1.2704	1.2582	1.2452	1.2311	1.2162	1.2003	1.1835	1.1657	1.1471	1.1276	1.1073	1.0861	1.0641
0.040	1.7507	1.7158	1.6800	1.6433	1.6057	1.5674	1.5283	1.4885	1.4481	1.4072	1.3658	1.3241	1.2823	1.2403
0.020	2.0538	1.9997	1.9450	1.8896	1.8336	1.7772	1.7203	1.6633	1.6060	1.5489	1.4919	1.4353	1.3793	1.3241
0.010	2.3264	2.2526	2.1784	2.1039	2.0293	1.9547	1.8803	1.8062	1.7327	1.6600	1.5884	1.5181	1.4494	1.3827
0.005	2.5758	2.4819	2.3880	2.2942	2.2009	2.1083	2.0164	1.9258	1.8366	1.7492	1.6639	1.5811	1.5011	1.4244
0.002	2.8782	2.7571	2.6367	2.5174	2.3994	2.2831	2.1688	2.0570	1.9481	1.8424	1.7406	1.6431	1.5502	1.4623
0.001	3.0902	2.9483	2.8079	2.6692	2.5326	2.3987	2.2678	2.1405	2.0174	1.8989	1.7857	1.6783	1.5770	1.4822

LOGARITHMIC SKEWNESS COEFFICIENT (γ_Y)

P	-1.4	-1.5	-1.6	-1.7	-1.8	-1.9	-2.0	-2.1	-2.2	-2.3	-2.4	-2.5	-2.6	-2.7
0.995	-3.8280	-3.9097	-3.9902	-4.0693	-4.1470	-4.2234	-4.2983	-4.3719	-4.4440	-4.5147	-4.5839	-4.6518	-4.7182	-4.7831
0.990	-3.2713	-3.3304	-3.3880	-3.4444	-3.4994	-3.5530	-3.6052	-3.6560	-3.7054	-3.7535	-3.8001	-3.8454	-3.8893	-3.9318
0.980	-2.7056	-2.7433	-2.7796	-2.8147	-2.8485	-2.8809	-2.9120	-2.9418	-2.9703	-2.9974	-3.0233	-3.0479	-3.0712	-3.0932
0.960	-2.1277	-2.1459	-2.1629	-2.1787	-2.1933	-2.2067	-2.2189	-2.2299	-2.2397	-2.2483	-2.2558	-2.2622	-2.2674	-2.2716
0.900	-1.3367	-1.3333	-1.3290	-1.3238	-1.3176	-1.3105	-1.3026	-1.2938	-1.2841	-1.2737	-1.2624	-1.2504	-1.2377	-1.2242
0.800	-0.7051	-0.6905	-0.6753	-0.6596	-0.6434	-0.6266	-0.6094	-0.5918	-0.5738	-0.5555	-0.5368	-0.5179	-0.4987	-0.4793
0.500	0.2254	0.2400	0.2542	0.2681	0.2815	0.2944	0.3069	0.3187	0.3300	0.3406	0.3506	0.3599	0.3685	0.3764
0.200	0.8322	0.8252	0.8172	0.8084	0.7987	0.7882	0.7769	0.7648	0.7521	0.7388	0.7250	0.7107	0.6960	0.6811
0.100	1.0414	1.0181	0.9942	0.9698	0.9450	0.9199	0.8946	0.8694	0.8442	0.8193	0.7947	0.7706	0.7471	0.7242
0.040	1.1984	1.1568	1.1157	1.0751	1.0354	0.9967	0.9592	0.9230	0.8881	0.8549	0.8232	0.7931	0.7646	0.7377
0.020	1.2700	1.2172	1.1658	1.1163	1.0686	1.0231	0.9798	0.9388	0.9001	0.8637	0.8296	0.7977	0.7678	0.7399
0.010	1.3182	1.2561	1.1968	1.1404	1.0871	1.0370	0.9900	0.9461	0.9052	0.8672	0.8320	0.7992	0.7688	0.7405
0.005	1.3511	1.2817	1.2162	1.1548	1.0975	1.0443	0.9950	0.9495	0.9074	0.8686	0.8328	0.7997	0.7691	0.7407
0.002	1.3798	1.3028	1.2313	1.1653	1.1047	1.0490	0.9980	0.9513	0.9085	0.8693	0.8332	0.7999	0.7692	0.7407
0.001	1.3941	1.3128	1.2381	1.1697	1.1074	1.0507	0.9990	0.9519	0.9089	0.8695	0.8333	0.8000	0.7692	0.7407

TABLE 1. CONTINUED.

LOGARITHMIC SKEWNESS COEFFICIENT (γ_Y)

P	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3
0.995	-2.5758	-2.4819	-2.3880	-2.2942	-2.2009	-2.1083	-2.0164	-1.9258	-1.8366	-1.7492	-1.6639	-1.5811	-1.5011	-1.4244
0.990	-2.3264	-2.2526	-2.1784	-2.1039	-2.0293	-1.9547	-1.8803	-1.8062	-1.7327	-1.6600	-1.5884	-1.5181	-1.4494	-1.3827
0.980	-2.0538	-1.9997	-1.9450	-1.8896	-1.8336	-1.7772	-1.7203	-1.6633	-1.6060	-1.5489	-1.4919	-1.4353	-1.3793	-1.3241
0.960	-1.7507	-1.7158	-1.6800	-1.6433	-1.6057	-1.5674	-1.5283	-1.4885	-1.4481	-1.4072	-1.3658	-1.3241	-1.2823	-1.2403
0.900	-1.2816	-1.2704	-1.2582	-1.2452	-1.2311	-1.2162	-1.2003	-1.1835	-1.1657	-1.1471	-1.1276	-1.1073	-1.0861	-1.0641
0.800	-0.8416	-0.8461	-0.8499	-0.8529	-0.8551	-0.8565	-0.8572	-0.8570	-0.8561	-0.8543	-0.8516	-0.8481	-0.8437	-0.8384
0.500	0.0000	-0.0166	-0.0333	-0.0499	-0.0665	-0.0830	-0.0995	-0.1158	-0.1320	-0.1481	-0.1640	-0.1797	-0.1952	-0.2104
0.200	0.8416	0.8364	0.8304	0.8238	0.8164	0.8083	0.7995	0.7900	0.7799	0.7690	0.7575	0.7454	0.7326	0.7192
0.100	1.2816	1.2918	1.3011	1.3094	1.3167	1.3231	1.3285	1.3329	1.3364	1.3389	1.3404	1.3409	1.3405	1.3390
0.040	1.7507	1.7846	1.8176	1.8495	1.8804	1.9102	1.9390	1.9666	1.9931	2.0185	2.0427	2.0657	2.0876	2.1082
0.020	2.0538	2.1070	2.1594	2.2108	2.2613	2.3108	2.3593	2.4067	2.4530	2.4981	2.5421	2.5848	2.6263	2.6666
0.010	2.3264	2.3996	2.4723	2.5442	2.6154	2.6857	2.7551	2.8236	2.8910	2.9574	3.0226	3.0866	3.1494	3.2110
0.005	2.5758	2.6697	2.7632	2.8564	2.9490	3.0410	3.1323	3.2228	3.3124	3.4011	3.4887	3.5753	3.6607	3.7450
0.002	2.8782	2.9998	3.1217	3.2437	3.3657	3.4874	3.6087	3.7296	3.8498	3.9693	4.0880	4.2058	4.3226	4.4384
0.001	3.0902	3.2332	3.3770	3.5214	3.6661	3.8109	3.9557	4.1002	4.2444	4.3881	4.5311	4.6734	4.8149	4.9555

LOGARITHMIC SKEWNESS COEFFICIENT (γ_Y)

P	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7
0.995	-1.3511	-1.2817	-1.2162	-1.1548	-1.0975	-1.0443	-0.9950	-0.9495	-0.9074	-0.8686	-0.8328	-0.7997	-0.7691	-0.7407
0.990	-1.3182	-1.2561	-1.1968	-1.1404	-1.0871	-1.0370	-0.9900	-0.9461	-0.9052	-0.8672	-0.8320	-0.7992	-0.7688	-0.7405
0.980	-1.2700	-1.2172	-1.1658	-1.1163	-1.0686	-1.0231	-0.9798	-0.9388	-0.9001	-0.8637	-0.8296	-0.7977	-0.7678	-0.7399
0.960	-1.1984	-1.1568	-1.1157	-1.0751	-1.0354	-0.9967	-0.9592	-0.9230	-0.8881	-0.8549	-0.8232	-0.7931	-0.7646	-0.7377
0.900	-1.0414	-1.0181	-0.9942	-0.9698	-0.9450	-0.9199	-0.8946	-0.8694	-0.8442	-0.8193	-0.7947	-0.7706	-0.7471	-0.7242
0.800	-0.8322	-0.8252	-0.8172	-0.8084	-0.7987	-0.7882	-0.7769	-0.7648	-0.7521	-0.7388	-0.7250	-0.7107	-0.6960	-0.6811
0.500	-0.2254	-0.2400	-0.2542	-0.2681	-0.2815	-0.2944	-0.3069	-0.3187	-0.3300	-0.3406	-0.3506	-0.3599	-0.3685	-0.3764
0.200	0.7051	0.6905	0.6753	0.6596	0.6434	0.6266	0.6094	0.5918	0.5738	0.5555	0.5368	0.5179	0.4987	0.4793
0.100	1.3367	1.3333	1.3290	1.3238	1.3176	1.3105	1.3026	1.2938	1.2841	1.2737	1.2624	1.2504	1.2377	1.2242
0.040	2.1277	2.1459	2.1629	2.1787	2.1933	2.2067	2.2189	2.2299	2.2397	2.2483	2.2558	2.2622	2.2674	2.2716
0.020	2.7056	2.7433	2.7796	2.8147	2.8485	2.8809	2.9120	2.9418	2.9703	2.9974	3.0233	3.0479	3.0712	3.0932
0.010	3.2713	3.3304	3.3880	3.4444	3.4994	3.5530	3.6052	3.6560	3.7054	3.7535	3.8001	3.8454	3.8893	3.9318
0.005	3.8280	3.9097	3.9902	4.0693	4.1470	4.2234	4.2983	4.3719	4.4440	4.5147	4.5839	4.6518	4.7182	4.7831
0.002	4.5530	4.6665	4.7788	4.8897	4.9994	5.1077	5.2146	5.3201	5.4243	5.5269	5.6282	5.7280	5.8263	5.9232
0.001	5.0951	5.2335	5.3709	5.5070	5.6419	5.7755	5.9078	6.0387	6.1682	6.2963	6.4229	6.5481	6.6719	6.7942

numerous investigators since then contributed to both development of alternative fitting methods for LP (3, 14) and greater understanding of the statistics of frequency analysis (8, 9, 18, 19). Bobee (3) showed that the LP distribution can also be fitted through the moments of real data. Studies by Wallis, et al. (19) and Kirby (8) showed that CS (Eq. 11) on the average, is an underestimate of γ for sample sizes normally found in practice. Table 2 summarizes the effect of such bias on LP quantiles. Note that when γ_y is negative, CS_y will be an over-estimate of γ_y algebraically. Ref. 6 suggests development and use of regional log skew coefficient for improving the accuracy of flood flow estimates. Others have proposed bias correction factors for CS (4, 10).

METHOD OF MIXED MOMENTS

Since parameters a, b, and c are common for LP (Eq. 2) and P3 (Eq. 1) distributions, it is possible to solve for these values by mixing the log and real data moments and choosing any three moments. This approach gives rise to methods which eliminate the use of CS from calculations, e.g., values of a, b, and c can be solved from: (1) $\bar{X}$, S_x^2, and $\bar{Y}$ (MXM1 Method); (2) $\bar{Y}$, S_y^2, and $\bar{X}$ (MXM2 Method); (3) $\bar{X}$, S_x^2, and S_y^2 (MXM3 Method); and (4) $\bar{Y}$, S_y^2, and S_x^2 (MXM4 Method). By simulation experiments it was shown earlier (14) that the MXM1 method has generally superior statistical properties compared to logarithmic moments and MXM2

TABLE 2.—Effect of Bias in Estimate of γ_y on Log Pearson Quantiles by Logarithmic Moments Method

Return period, in years, *T* (1)	γ_y Positive; Bias Negative		γ_y Negative; Bias Algebraically Positive	
	Annual smallest events (2)	Annual largest events (3)	Annual smallest events (4)	Annual largest events (5)
	Quantiles will:	Quantiles will:	Quantiles will:	Quantiles will:
2	Increase for γ_y = 0 to 3.7; decrease for $\gamma_y > 3.7$	Increase for γ_y = 0 to 3.7; decrease for $\gamma_y > 3.7$	Decrease for $\|\gamma_y\|$ = 0 to 3.7; increase for $\|\gamma_y\| >$ 3.7	Decrease for $\|\gamma_y\|$ = 0 to 3.7; increase for $\|\gamma_y\| >$ 3.7
5	Decrease	Increase	Decrease	Increase
10	Decrease	Decrease for γ_y = 0 to 1.1; increase for $\gamma_y > 1.1$	Increase for $\|\gamma_y\|$ = 0 to 1.1; decrease for $\|\gamma_y\| > 1.1$	Increase
25	Decrease	Decrease for γ_y = 0 to 3.1; increase for $\gamma_y > 3.1$	Increase for $\|\gamma_y\|$ = 0 to 3.1; decrease for $\|\gamma_y\| >$ 3.1	Increase
50	Decrease	Decrease for γ_y = 0 to 4.8; increase for $\gamma_y > 4.8$	Increase for $\|\gamma_y\|$ = 0 to 4.8; decrease for $\|\gamma_y\| >$ 4.8	Increase
100	Decrease	Decrease for γ_y = 0 to 7.1; increase for $\gamma_y > 7.1$	Increase for $\|\gamma_y\|$ = 0 to 7.1; decrease for $\|\gamma_y\| >$ 7.1	Increase
≧200	Decrease	Decrease	Increase	Increase

Methods. The experiments generated 1000 log Pearson samples from each of four sets of appropriate population parameters (i.e., a, b, and c) with sample sizes N = 10, 20, 30, 50, and 100. For each sample, the log Pearson quantiles for several P values were obtained by different estimation methods. The mean and standard deviation of quantile estimates were used in evaluating the performance of each method, i.e., a method showing a combination of low bias and low standard deviation for quantile estimates is considered superior. The MXM3 and MXM4 Methods were not considered in that study. The MXM3 is a variation of MXM1 (two moments are common for both methods); similarly, MXM4 is a variation of MXM2. Two first moments and one second moment (of data) are used for parameter estimation in the MXM1 and MXM2 Methods while one first moment and two second moments are to be used in MXM3 and MXM4 Methods. Since the sample moments become less reliable with increasing order, the methods using (more) higher moments are less appealing, thus the MXM3 and MXM4 Methods may not be expected to be superior to MXM1 and MXM2, respectively. However, in a later study (12), Phien and Hira considered MXM3 and MXM4 Methods and using a questionable criterion they have concluded that MXM3 provides the best estimates. The criterion used by them is based on relative errors of parameter estimates, e.g., for the parameter a the error is given by,

$$\mathrm{rel}\ (a) = (a - \hat{a})/a$$

in which, a = population value, and $\hat{a}$ = the estimate. The average relative error of all three parameters is calculated for a given sample by each method, and the method having the lowest average error is considered the best. This criterion will not yield satisfactory results because the parameter estimates of LP are highly biased and extremely variable (11). Matalas and Wallis (11) express, "Although the (parameter) estimates are highly biased and variable, on the average, reasonably good estimates of theoretic (quantiles) may be derived...". The quantiles are the combined expression of the parameters. The interactive nature of LP parameters is such that even though the parameter estimates may be widely different from the population values, the quantile estimates preserve the population structure. Thus, the performance of LP fitting methods should be judged on the basis of the bias and variability of quantile estimates rather than parameter estimates.

For the four parameter sets of Ref. 14, the mean and standard deviation of quantile estimates were obtained by MXM3 method and compared with MXM1 method in Table 3. As intuitively expected, it may be seen that the MXM3 does not yield quantile estimates superior to MXM1. In general, the MXM3 estimates of LP quantiles are more biased and more variable than MXM1 estimates.

TABLE 3--Mean ($\overline{X}$) and Standard Deviation [S(x)] of Log Pearson Quantile Estimates Based on 1000 Samples

Sample Size (1)	Method (2)	Parameters Set No. 1 $\overline{X}$ (3)	S(x) (4)	Parameters Set No. 2 $\overline{X}$ (5)	S(x) (6)	Parameters Set No. 3 $\overline{X}$ (7)	S(x) (8)	Parameters Set No. 4 $\overline{X}$ (9)	S(x) (10)
Return Period, T = 50 Yr (Exceedance Probability = 0.02)									
Theoretic		2.107		2.823		2.252		2.200	
100	MXM1	2.095	0.161	2.807	0.237	2.216	0.233	2.147	0.255
	MXM3	2.090	0.162	2.803	0.243	2.215	0.234	2.146	0.255
50	MXM1	2.092	0.222	2.808	0.334	2.191	0.320	2.124	0.337
	MXM3	2.082	0.224	2.802	0.340	2.186	0.322	2.120	0.338
30	MXM1	2.086	0.276	2.789	0.422	2.167	0.392	2.093	0.397
	MXM3	2.069	0.279	2.777	0.427	2.157	0.396	2.084	0.403
20	MXM1	2.083	0.332	2.781	0.502	2.153	0.475	2.066	0.460
	MXM3	2.057	0.337	2.761	0.508	2.135	0.482	2.050	0.466
10	MXM1	2.084	0.460	2.789	0.715	2.118	0.606	2.006	0.591
	MXM3	2.029	0.467	2.752	0.720	2.074	0.620	1.965	0.606
Return Period, T = 100 Yr (Exceedance Probability = 0.01)									
Theoretic		2.315		3.082		2.583		2.559	
100	MXM1	2.305	0.210	3.074	0.297	2.532	0.325	2.476	0.361
	MXM3	2.295	0.210	3.068	0.307	2.529	0.327	2.475	0.362
50	MXM1	2.305	0.287	3.086	0.417	2.500	0.438	2.440	0.470
	MXM3	2.287	0.289	3.076	0.428	2.489	0.442	2.433	0.473
30	MXM1	2.302	0.349	3.076	0.526	2.467	0.528	2.397	0.545
	MXM3	2.270	0.352	3.057	0.536	2.445	0.535	2.379	0.552
20	MXM1	2.306	0.419	3.081	0.625	2.449	0.631	2.361	0.617
	MXM3	2.258	0.423	3.049	0.636	2.412	0.642	2.329	0.629
10	MXM1	2.323	0.567	3.134	0.881	2.409	0.790	2.285	0.771
	MXM3	2.224	0.573	3.064	0.885	2.323	0.806	2.203	0.791
Return Period, T = 500 Yr (Exceedance Probability = 0.002)									
Theoretic		2.775		3.539		3.446		3.558	
100	MXM1	2.777	0.355	3.565	0.460	3.359	0.638	3.385	0.732
	MXM3	2.754	0.353	3.557	0.481	3.348	0.639	3.382	0.737
50	MXM1	2.790	0.481	3.618	0.649	3.313	0.832	3.309	0.927
	MXM3	2.746	0.480	3.601	0.672	3.281	0.839	3.288	0.940
30	MXM1	2.779	0.572	3.648	0.828	3.254	0.982	3.232	1.037
	MXM3	2.725	0.570	3.610	0.846	3.194	0.994	3.181	1.057
20	MXM1	2.830	0.685	3.704	0.986	3.231	1.145	3.168	1.143
	MXM3	2.718	0.681	3.636	1.001	3.131	1.163	3.076	1.168
10	MXM1	2.910	0.897	3.914	1.380	3.184	1.386	3.045	1.349
	MXM3	2.673	0.881	3.747	1.369	2.954	1.398	2.822	1.374

Estimating LP parameters by MXM1 method involves an iterative process in which either parameter a or parameter b is optimized (16). The method which optimizes parameter b is described below as it is computationally efficient.

Parameters a, b, c, μ_x, and σ_x^2 are related as follows (13, 16):

$$b = \frac{\ln\left(\frac{\mu_x^2 + \sigma_x^2}{\mu_x^2}\right)}{\ln\left[\frac{\left(1 - \frac{1}{a}\right)^2}{\left(1 - \frac{2}{a}\right)}\right]} \quad \text{...(13)}$$

$$c = \ln \mu_x + b \ln\left(1 - \frac{1}{a}\right) \quad \text{...(14)}$$

Eq. 13 can be rearranged in the form of a quadratic equation in a as:

$$a^2 - 2a - \frac{1}{Z} = 0 \quad \text{...(15)}$$

in which Z is given by

$$Z = \left(\frac{\mu_x^2 + \sigma_x^2}{\mu_x^2}\right)^{b^{-1}} - 1 \quad \text{...(16)}$$

Eq. 15 yields:

$$a = 1 \pm \left(1 + \frac{1}{Z}\right)^{0.5} \quad \text{...(17)}$$

Parameter a has the same sign as γ_y and b is related to γ_y by Eq. 5. Thus, if an initial estimate of γ_y is available, it would provide an initial value for b, and the sign of a. Then the procedure consists of: (1) calculating Z, a, c, and μ_y by Eqs. 16, 17, 14, and 3, respectively; and (2) adjusting b until $\mu_y \approx \bar{Y}$. However, optimization of parameters is greatly facilitated if calculations are performed by converting real data into dimensionless variates by the transform $K_i = X_i/\bar{X}$. For the transformed data K_i, the mean $\bar{K} = 1.0$ and the final results (e.g., flood flows for different return periods) are obtained as ratios to mean. Substituting $\mu_x = \mu_k = 1.0$ and $\sigma_x^2 = \sigma_k^2$ (in which μ_k and σ_k^2 are the population mean and variance of K, respectively) in Eqs. 14 and 16, a Newton-Raphson iteration scheme can be formulated for optimizing parameter b (see Appendix I). Also, for choosing an appropriate initial value for γ_y, Tables 4, 5, and 6 present $\mu_y - \sigma_k^2 - \gamma_y$ relations for the variate K.

The following algorithm may be used to obtain LP quantiles by MXM1 method for a given sample.

Let the given data (e.g., annual flood flows) be represented by $X_1, \ldots X_i, \ldots X_n$.

Step 1. Calculate the mean of data, $\bar{X}$ (Eq. 9).

TABLE 4. LOGARITHMIC MEAN (μ_y) VALUES FOR DIFFERENT VARIANCE AND LOGARITHMIC SKEWNESS COEFFICIENTS OF DIMENSIONLESS VARIATE, K (γ_y = -3.0- -0.7)

VARIANCE OF K	LOGARITHMIC SKEWNESS COEFFICIENT (γ_y)												
	-3.0	-2.6	-2.4	-2.2	-2.0	-1.8	-1.6	-1.4	-1.2	-1.0	-0.9	-0.8	-0.7
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
0.03	-0.0210	-0.0200	-0.0196	-0.0191	-0.0187	-0.0182	-0.0178	-0.0174	-0.0170	-0.0166	-0.0164	-0.0162	-0.0160
0.04	-0.0295	-0.0279	-0.0271	-0.0264	-0.0257	-0.0250	-0.0243	-0.0236	-0.0230	-0.0224	-0.0221	-0.0218	-0.0215
0.05	-0.0385	-0.0362	-0.0350	-0.0340	-0.0329	-0.0320	-0.0310	-0.0301	-0.0292	-0.0283	-0.0279	-0.0275	-0.0271
0.06	-0.0481	-0.0448	-0.0433	-0.0419	-0.0405	-0.0392	-0.0379	-0.0366	-0.0354	-0.0343	-0.0337	-0.0332	-0.0326
0.07	-0.0581	-0.0539	-0.0519	-0.0501	-0.0483	-0.0465	-0.0449	-0.0433	-0.0418	-0.0403	-0.0396	-0.0389	-0.0382
0.08	-0.0686	-0.0633	-0.0609	-0.0585	-0.0563	-0.0541	-0.0521	-0.0501	-0.0482	-0.0464	-0.0455	-0.0447	-0.0438
0.09	-0.0796	-0.0731	-0.0701	-0.0672	-0.0644	-0.0618	-0.0593	-0.0570	-0.0547	-0.0525	-0.0515	-0.0505	-0.0495
0.10	-0.0911	-0.0832	-0.0796	-0.0761	-0.0728	-0.0697	-0.0668	-0.0639	-0.0613	-0.0587	-0.0575	-0.0563	-0.0551
0.15	-0.1547	-0.1382	-0.1308	-0.1238	-0.1172	-0.1111	-0.1053	-0.0999	-0.0948	-0.0900	-0.0878	-0.0855	-0.0834
0.20	-0.2283	-0.2001	-0.1876	-0.1760	-0.1652	-0.1553	-0.1460	-0.1374	-0.1294	-0.1219	-0.1183	-0.1149	-0.1116
0.25	-0.3114	-0.2682	-0.2493	-0.2321	-0.2162	-0.2017	-0.1883	-0.1759	-0.1645	-0.1539	-0.1490	-0.1442	-0.1395
0.30	-0.4034	-0.3420	-0.3156	-0.2916	-0.2698	-0.2500	-0.2319	-0.2153	-0.2001	-0.1861	-0.1796	-0.1733	-0.1673
0.35	-0.5043	-0.4212	-0.3859	-0.3543	-0.3257	-0.2999	-0.2765	-0.2553	-0.2359	-0.2183	-0.2101	-0.2022	-0.1946
0.40	-0.6138	-0.5054	-0.4602	-0.4198	-0.3836	-0.3512	-0.3220	-0.2957	-0.2719	-0.2504	-0.2403	-0.2308	-0.2217
0.45	-0.7318	-0.5946	-0.5380	-0.4879	-0.4434	-0.4038	-0.3683	-0.3366	-0.3080	-0.2823	-0.2704	-0.2591	-0.2483
0.50	-0.8582	-0.6884	-0.6192	-0.5584	-0.5048	-0.4574	-0.4153	-0.3777	-0.3442	-0.3141	-0.3002	-0.2871	-0.2746
0.55	-0.9929	-0.7866	-0.7036	-0.6312	-0.5678	-0.5120	-0.4627	-0.4191	-0.3803	-0.3457	-0.3298	-0.3147	-0.3005
0.60	-1.1358	-0.8892	-0.7911	-0.7061	-0.6321	-0.5674	-0.5106	-0.4606	-0.4163	-0.3770	-0.3590	-0.3420	-0.3260
0.65	-1.2869	-0.9960	-0.8815	-0.7830	-0.6977	-0.6236	-0.5589	-0.5022	-0.4522	-0.4081	-0.3880	-0.3690	-0.3511
0.70	-1.4462	-1.1069	-0.9748	-0.8617	-0.7645	-0.6805	-0.6075	-0.5438	-0.4880	-0.4390	-0.4166	-0.3956	-0.3758
0.75	-1.6137	-1.2218	-1.0707	-0.9423	-0.8324	-0.7380	-0.6564	-0.5855	-0.5237	-0.4695	-0.4450	-0.4219	-0.4002
0.80	-1.7893	-1.3405	-1.1692	-1.0245	-0.9014	-0.7961	-0.7055	-0.6273	-0.5592	-0.4999	-0.4730	-0.4478	-0.4242
0.85	-1.9730	-1.4630	-1.2703	-1.1083	-0.9713	-0.8547	-0.7549	-0.6689	-0.5946	-0.5299	-0.5007	-0.4734	-0.4479
0.90	-2.1648	-1.5893	-1.3737	-1.1937	-1.0421	-0.9138	-0.8044	-0.7106	-0.6297	-0.5597	-0.5281	-0.4987	-0.4712
0.95	-2.3647	-1.7191	-1.4796	-1.2805	-1.1138	-0.9733	-0.8540	-0.7521	-0.6647	-0.5892	-0.5553	-0.5237	-0.4941
1.00	-2.5728	-1.8525	-1.5877	-1.3687	-1.1863	-1.0331	-0.9037	-0.7936	-0.6994	-0.6184	-0.5821	-0.5483	-0.5168
1.25	-3.7350	-2.5709	-2.1604	-1.8291	-1.5592	-1.3373	-1.1533	-0.9996	-0.8702	-0.7605	-0.7119	-0.6670	-0.6253
1.50	-5.1020	-3.3702	-2.7820	-2.3176	-1.9466	-1.6472	-1.4031	-1.2023	-1.0356	-0.8962	-0.8350	-0.7787	-0.7269
1.75	-6.6761	-4.2453	-3.4477	-2.8301	-2.3456	-1.9609	-1.6520	-1.4013	-1.1958	-1.0259	-0.9520	-0.8843	-0.8223
2.00	-8.4600	-5.1924	-4.1537	-3.3637	-2.7540	-2.2770	-1.8992	-1.5964	-1.3511	-1.1503	-1.0635	-0.9844	-0.9123
2.25	-10.4568	-6.2082	-4.8969	-3.9159	-3.1701	-2.5946	-2.1445	-1.7877	-1.5016	-1.2696	-1.1700	-1.0796	-0.9975
2.50		-7.2902	-5.6749	-4.4848	-3.5927	-2.9131	-2.3874	-1.9752	-1.6477	-1.3844	-1.2720	-1.1704	-1.0784
2.75		-8.4360	-6.4856	-5.0691	-4.0209	-3.2318	-2.6280	-2.1590	-1.7896	-1.4950	-1.3699	-1.2573	-1.1556
3.00		-9.6437	-7.3272	-5.6673	-4.4540	-3.5506	-2.8662	-2.3393	-1.9277	-1.6018	-1.4641	-1.3405	-1.2293
3.25		-10.9115	-8.1982	-6.2784	-4.8913	-3.8691	-3.1019	-2.5162	-2.0622	-1.7050	-1.5549	-1.4205	-1.2998
3.50			-9.0973	-6.9016	-5.3323	-4.1871	-3.3351	-2.6899	-2.1932	-1.8050	-1.6426	-1.4975	-1.3676
3.75			-10.0233	-7.5361	-5.7765	-4.5045	-3.5660	-2.8606	-2.3211	-1.9020	-1.7273	-1.5718	-1.4327
4.00				-8.1811	-6.2238	-4.8212	-3.7945	-3.0283	-2.4460	-1.9961	-1.8094	-1.6435	-1.4955
4.25				-8.8361	-6.6737	-5.1370	-4.0208	-3.1932	-2.5680	-2.0877	-1.8890	-1.7128	-1.5561
4.50				-9.5005	-7.1259	-5.4521	-4.2448	-3.3554	-2.6874	-2.1767	-1.9662	-1.7800	-1.6147
4.75				-10.1739	-7.5804	-5.7662	-4.4666	-3.5151	-2.8043	-2.2635	-2.0413	-1.8452	-1.6714
5.00					-8.0369	-6.0793	-4.6863	-3.6723	-2.9188	-2.3481	-2.1144	-1.9085	-1.7263
6.00					-9.8795	-7.3221	-5.5452	-4.2789	-3.3552	-2.6672	-2.3887	-2.1449	-1.9307
7.00					-11.7435	-8.5491	-6.3749	-4.8537	-3.7620	-2.9602	-2.6388	-2.3591	-2.1147
8.00						-9.7604	-7.1787	-5.4014	-4.1438	-3.2317	-2.8692	-2.5553	-2.2823
9.00						-10.9568	-7.9593	-5.9254	-4.5044	-3.4852	-3.0832	-2.7367	-2.4365
10.00							-8.7190	-6.4286	-4.8468	-3.7234	-3.2834	-2.9056	-2.5796

TABLE 5. LOGARITHMIC MEAN (μ_y) VALUES FOR DIFFERENT VARIANCE AND LOGARITHMIC SKEWNESS COEFFICIENTS OF DIMENSIONLESS VARIATE, K (γ_y = -0.6-0.6)

VARIANCE OF K	LOGARITHMIC SKEWNESS COEFFICIENT (γ_y)												
	-0.6	-0.5	-0.4	-0.3	-0.2	-0.1	0.0	0.1	0.2	0.3	0.4	0.5	0.6
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
0.03	-0.0158	-0.0157	-0.0155	-0.0153	-0.0151	-0.0149	-0.0148	-0.0146	-0.0144	-0.0143	-0.0141	-0.0140	-0.0138
0.04	-0.0212	-0.0210	-0.0207	-0.0204	-0.0201	-0.0199	-0.0196	-0.0194	-0.0191	-0.0189	-0.0186	-0.0184	-0.0181
0.05	-0.0267	-0.0263	-0.0259	-0.0255	-0.0251	-0.0248	-0.0244	-0.0240	-0.0237	-0.0233	-0.0230	-0.0227	-0.0223
0.06	-0.0321	-0.0316	-0.0311	-0.0306	-0.0301	-0.0296	-0.0291	-0.0287	-0.0282	-0.0278	-0.0273	-0.0269	-0.0265
0.07	-0.0376	-0.0369	-0.0363	-0.0356	-0.0350	-0.0344	-0.0338	-0.0332	-0.0327	-0.0321	-0.0316	-0.0310	-0.0305
0.08	-0.0430	-0.0422	-0.0414	-0.0407	-0.0399	-0.0392	-0.0385	-0.0378	-0.0371	-0.0364	-0.0357	-0.0351	-0.0345
0.09	-0.0485	-0.0475	-0.0466	-0.0457	-0.0448	-0.0439	-0.0431	-0.0423	-0.0414	-0.0406	-0.0399	-0.0391	-0.0383
0.10	-0.0540	-0.0529	-0.0518	-0.0507	-0.0497	-0.0486	-0.0477	-0.0467	-0.0457	-0.0448	-0.0439	-0.0430	-0.0422
0.15	-0.0813	-0.0792	-0.0773	-0.0753	-0.0735	-0.0716	-0.0699	-0.0682	-0.0665	-0.0649	-0.0633	-0.0618	-0.0603
0.20	-0.1084	-0.1052	-0.1022	-0.0993	-0.0965	-0.0938	-0.0912	-0.0886	-0.0861	-0.0837	-0.0814	-0.0792	-0.0770
0.25	-0.1351	-0.1308	-0.1267	-0.1227	-0.1189	-0.1151	-0.1116	-0.1081	-0.1048	-0.1016	-0.0985	-0.0955	-0.0926
0.30	-0.1615	-0.1559	-0.1506	-0.1454	-0.1405	-0.1357	-0.1312	-0.1268	-0.1226	-0.1185	-0.1146	-0.1108	-0.1071
0.35	-0.1874	-0.1805	-0.1739	-0.1676	-0.1615	-0.1556	-0.1501	-0.1447	-0.1395	-0.1346	-0.1298	-0.1253	-0.1209
0.40	-0.2130	-0.2046	-0.1967	-0.1891	-0.1818	-0.1749	-0.1682	-0.1619	-0.1558	-0.1499	-0.1443	-0.1390	-0.1338
0.45	-0.2381	-0.2283	-0.2190	-0.2101	-0.2016	-0.1935	-0.1858	-0.1784	-0.1713	-0.1646	-0.1582	-0.1520	-0.1461
0.50	-0.2627	-0.2514	-0.2407	-0.2305	-0.2208	-0.2115	-0.2027	-0.1943	-0.1863	-0.1787	-0.1714	-0.1644	-0.1577
0.55	-0.2870	-0.2741	-0.2620	-0.2504	-0.2395	-0.2290	-0.2191	-0.2097	-0.2007	-0.1922	-0.1840	-0.1762	-0.1688
0.60	-0.3108	-0.2964	-0.2828	-0.2699	-0.2576	-0.2460	-0.2350	-0.2245	-0.2146	-0.2051	-0.1961	-0.1876	-0.1794
0.65	-0.3342	-0.3182	-0.3031	-0.2888	-0.2753	-0.2625	-0.2504	-0.2389	-0.2280	-0.2176	-0.2078	-0.1984	-0.1895
0.70	-0.3572	-0.3396	-0.3230	-0.3074	-0.2926	-0.2786	-0.2653	-0.2528	-0.2409	-0.2296	-0.2190	-0.2088	-0.1992
0.75	-0.3798	-0.3606	-0.3425	-0.3254	-0.3094	-0.2942	-0.2798	-0.2662	-0.2534	-0.2412	-0.2297	-0.2188	-0.2085
0.80	-0.4020	-0.3812	-0.3616	-0.3431	-0.3257	-0.3094	-0.2939	-0.2793	-0.2655	-0.2525	-0.2401	-0.2285	-0.2174
0.85	-0.4239	-0.4014	-0.3803	-0.3604	-0.3417	-0.3242	-0.3076	-0.2920	-0.2772	-0.2633	-0.2502	-0.2377	-0.2260
0.90	-0.4454	-0.4212	-0.3986	-0.3773	-0.3574	-0.3386	-0.3209	-0.3043	-0.2886	-0.2738	-0.2599	-0.2467	-0.2343
0.95	-0.4665	-0.4407	-0.4166	-0.3939	-0.3726	-0.3527	-0.3339	-0.3163	-0.2997	-0.2840	-0.2693	-0.2554	-0.2422
1.00	-0.4874	-0.4599	-0.4342	-0.4101	-0.3876	-0.3664	-0.3466	-0.3279	-0.3104	-0.2939	-0.2784	-0.2637	-0.2499
1.25	-0.5867	-0.5509	-0.5176	-0.4865	-0.4576	-0.4307	-0.4055	-0.3819	-0.3599	-0.3393	-0.3200	-0.3018	-0.2848
1.50	-0.6791	-0.6349	-0.5940	-0.5562	-0.5211	-0.4885	-0.4581	-0.4299	-0.4036	-0.3791	-0.3562	-0.3349	-0.3149
1.75	-0.7653	-0.7130	-0.6647	-0.6202	-0.5791	-0.5410	-0.5058	-0.4731	-0.4428	-0.4146	-0.3884	-0.3640	-0.3412
2.00	-0.8463	-0.7859	-0.7304	-0.6794	-0.6325	-0.5892	-0.5493	-0.5124	-0.4782	-0.4466	-0.4172	-0.3899	-0.3646
2.25	-0.9226	-0.8543	-0.7918	-0.7346	-0.6821	-0.6338	-0.5893	-0.5484	-0.5105	-0.4756	-0.4433	-0.4133	-0.3856
2.50	-0.9949	-0.9189	-0.8495	-0.7862	-0.7283	-0.6752	-0.6264	-0.5815	-0.5403	-0.5022	-0.4671	-0.4346	-0.4046
2.75	-1.0635	-0.9799	-0.9039	-0.8347	-0.7716	-0.7138	-0.6609	-0.6123	-0.5677	-0.5267	-0.4889	-0.4541	-0.4219
3.00	-1.1288	-1.0379	-0.9555	-0.8805	-0.8123	-0.7500	-0.6931	-0.6411	-0.5933	-0.5495	-0.5092	-0.4721	-0.4379
3.25	-1.1912	-1.0931	-1.0044	-0.9239	-0.8508	-0.7842	-0.7235	-0.6680	-0.6172	-0.5706	-0.5279	-0.4887	-0.4526
3.50	-1.2509	-1.1458	-1.0509	-0.9651	-0.8872	-0.8165	-0.7520	-0.6933	-0.6396	-0.5905	-0.5455	-0.5042	-0.4663
3.75	-1.3082	-1.1962	-1.0954	-1.0043	-0.9219	-0.8471	-0.7791	-0.7172	-0.6607	-0.6091	-0.5619	-0.5187	-0.4791
4.00	-1.3632	-1.2446	-1.1379	-1.0418	-0.9548	-0.8761	-0.8047	-0.7398	-0.6806	-0.6267	-0.5774	-0.5323	-0.4910
4.25	-1.4163	-1.2911	-1.1787	-1.0776	-0.9864	-0.9039	-0.8291	-0.7612	-0.6995	-0.6433	-0.5920	-0.5451	-0.5022
4.50	-1.4674	-1.3358	-1.2179	-1.1120	-1.0165	-0.9303	-0.8524	-0.7817	-0.7175	-0.6590	-0.6058	-0.5572	-0.5128
4.75	-1.5168	-1.3790	-1.2556	-1.1450	-1.0454	-0.9557	-0.8746	-0.8012	-0.7345	-0.6740	-0.6189	-0.5686	-0.5228
5.00	-1.5646	-1.4206	-1.2920	-1.1767	-1.0732	-0.9800	-0.8959	-0.8198	-0.7508	-0.6882	-0.6313	-0.5795	-0.5323
6.00	-1.7417	-1.5743	-1.4256	-1.2930	-1.1746	-1.0684	-0.9730	-0.8870	-0.8095	-0.7393	-0.6758	-0.6182	-0.5658
7.00	-1.9001	-1.7110	-1.5438	-1.3954	-1.2633	-1.1453	-1.0397	-0.9449	-0.8597	-0.7829	-0.7135	-0.6508	-0.5940
8.00	-2.0437	-1.8344	-1.6499	-1.4869	-1.3422	-1.2135	-1.0986	-0.9958	-0.9036	-0.8208	-0.7462	-0.6789	-0.6181
9.00	-2.1753	-1.9469	-1.7464	-1.5697	-1.4134	-1.2747	-1.1513	-1.0412	-0.9426	-0.8543	-0.7750	-0.7036	-0.6392
10.00	-2.2968	-2.0504	-1.8348	-1.6453	-1.4782	-1.3303	-1.1989	-1.0820	-0.9777	-0.8843	-0.8007	-0.7255	-0.6579

TABLE 6. LOGARITHMIC MEAN (μ_y) VALUES FOR DIFFERENT VARIANCE AND LOGARITHMIC SKEWNESS COEFFICIENTS OF DIMENSIONLESS VARIATE, K (γ_y = 0.7-3.0)

VARIANCE OF K	LOGARITHMIC SKEWNESS COEFFICIENT (γ_y)												
	0.7	0.8	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	3.0
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
0.03	-0.0136	-0.0135	-0.0133	-0.0132	-0.0129	-0.0126	-0.0123	-0.0121	-0.0118	-0.0115	-0.0113	-0.0110	-0.0105
0.04	-0.0179	-0.0177	-0.0174	-0.0172	-0.0168	-0.0163	-0.0159	-0.0155	-0.0151	-0.0147	-0.0144	-0.0140	-0.0133
0.05	-0.0220	-0.0217	-0.0214	-0.0211	-0.0205	-0.0199	-0.0193	-0.0188	-0.0183	-0.0177	-0.0173	-0.0168	-0.0158
0.06	-0.0261	-0.0256	-0.0252	-0.0248	-0.0241	-0.0233	-0.0226	-0.0219	-0.0212	-0.0206	-0.0200	-0.0194	-0.0182
0.07	-0.0300	-0.0295	-0.0290	-0.0285	-0.0275	-0.0266	-0.0257	-0.0249	-0.0241	-0.0233	-0.0225	-0.0218	-0.0204
0.08	-0.0338	-0.0332	-0.0326	-0.0320	-0.0309	-0.0298	-0.0288	-0.0278	-0.0268	-0.0258	-0.0249	-0.0241	-0.0224
0.09	-0.0376	-0.0369	-0.0362	-0.0355	-0.0342	-0.0329	-0.0317	-0.0305	-0.0294	-0.0283	-0.0273	-0.0263	-0.0244
0.10	-0.0413	-0.0405	-0.0397	-0.0389	-0.0374	-0.0359	-0.0345	-0.0331	-0.0319	-0.0306	-0.0295	-0.0283	-0.0262
0.15	-0.0588	-0.0574	-0.0560	-0.0547	-0.0521	-0.0496	-0.0473	-0.0451	-0.0430	-0.0410	-0.0391	-0.0373	-0.0340
0.20	-0.0749	-0.0728	-0.0708	-0.0689	-0.0652	-0.0617	-0.0584	-0.0554	-0.0524	-0.0497	-0.0471	-0.0447	-0.0402
0.25	-0.0897	-0.0870	-0.0844	-0.0819	-0.0771	-0.0725	-0.0683	-0.0643	-0.0606	-0.0571	-0.0539	-0.0508	-0.0452
0.30	-0.1036	-0.1002	-0.0970	-0.0938	-0.0879	-0.0823	-0.0771	-0.0723	-0.0678	-0.0636	-0.0597	-0.0560	-0.0494
0.35	-0.1166	-0.1126	-0.1087	-0.1049	-0.0978	-0.0912	-0.0851	-0.0794	-0.0742	-0.0693	-0.0647	-0.0605	-0.0529
0.40	-0.1289	-0.1241	-0.1196	-0.1152	-0.1070	-0.0994	-0.0924	-0.0859	-0.0799	-0.0743	-0.0692	-0.0644	-0.0559
0.45	-0.1404	-0.1350	-0.1298	-0.1248	-0.1155	-0.1069	-0.0990	-0.0917	-0.0850	-0.0789	-0.0731	-0.0679	-0.0585
0.50	-0.1514	-0.1453	-0.1395	-0.1339	-0.1235	-0.1139	-0.1052	-0.0971	-0.0897	-0.0829	-0.0767	-0.0709	-0.0608
0.55	-0.1617	-0.1550	-0.1486	-0.1424	-0.1309	-0.1204	-0.1108	-0.1020	-0.0940	-0.0866	-0.0799	-0.0737	-0.0628
0.60	-0.1716	-0.1642	-0.1572	-0.1504	-0.1379	-0.1265	-0.1161	-0.1066	-0.0979	-0.0900	-0.0828	-0.0761	-0.0646
0.65	-0.1811	-0.1730	-0.1654	-0.1581	-0.1445	-0.1322	-0.1210	-0.1108	-0.1015	-0.0931	-0.0854	-0.0784	-0.0661
0.70	-0.1901	-0.1814	-0.1731	-0.1653	-0.1507	-0.1375	-0.1256	-0.1147	-0.1049	-0.0959	-0.0878	-0.0804	-0.0675
0.75	-0.1987	-0.1894	-0.1805	-0.1722	-0.1566	-0.1426	-0.1299	-0.1184	-0.1079	-0.0985	-0.0900	-0.0822	-0.0688
0.80	-0.2069	-0.1970	-0.1876	-0.1787	-0.1622	-0.1473	-0.1339	-0.1218	-0.1108	-0.1009	-0.0920	-0.0839	-0.0699
0.85	-0.2149	-0.2044	-0.1944	-0.1849	-0.1675	-0.1518	-0.1377	-0.1250	-0.1135	-0.1032	-0.0938	-0.0854	-0.0709
0.90	-0.2225	-0.2114	-0.2009	-0.1909	-0.1726	-0.1561	-0.1413	-0.1280	-0.1160	-0.1052	-0.0955	-0.0868	-0.0719
0.95	-0.2298	-0.2181	-0.2071	-0.1966	-0.1774	-0.1602	-0.1447	-0.1308	-0.1184	-0.1072	-0.0971	-0.0881	-0.0727
1.00	-0.2369	-0.2247	-0.2131	-0.2021	-0.1820	-0.1640	-0.1479	-0.1335	-0.1206	-0.1090	-0.0986	-0.0893	-0.0735
1.25	-0.2689	-0.2539	-0.2398	-0.2265	-0.2023	-0.1809	-0.1618	-0.1449	-0.1299	-0.1166	-0.1047	-0.0942	-0.0765
1.50	-0.2962	-0.2787	-0.2623	-0.2470	-0.2191	-0.1946	-0.1730	-0.1539	-0.1371	-0.1223	-0.1092	-0.0976	-0.0785
1.75	-0.3200	-0.3002	-0.2818	-0.2645	-0.2333	-0.2060	-0.1821	-0.1611	-0.1428	-0.1267	-0.1126	-0.1002	-0.0800
2.00	-0.3411	-0.3191	-0.2987	-0.2797	-0.2455	-0.2157	-0.1897	-0.1671	-0.1474	-0.1302	-0.1153	-0.1023	-0.0811
2.25	-0.3599	-0.3360	-0.3138	-0.2931	-0.2561	-0.2241	-0.1963	-0.1722	-0.1513	-0.1331	-0.1174	-0.1038	-0.0819
2.50	-0.3768	-0.3511	-0.3272	-0.3051	-0.2655	-0.2314	-0.2019	-0.1765	-0.1545	-0.1356	-0.1192	-0.1051	-0.0825
2.75	-0.3922	-0.3648	-0.3394	-0.3159	-0.2739	-0.2379	-0.2069	-0.1802	-0.1573	-0.1376	-0.1207	-0.1061	-0.0830
3.00	-0.4064	-0.3773	-0.3504	-0.3256	-0.2815	-0.2436	-0.2113	-0.1835	-0.1597	-0.1393	-0.1219	-0.1070	-0.0834
3.25	-0.4194	-0.3888	-0.3606	-0.3345	-0.2883	-0.2488	-0.2152	-0.1864	-0.1618	-0.1408	-0.1230	-0.1077	-0.0837
3.50	-0.4315	-0.3994	-0.3699	-0.3427	-0.2945	-0.2535	-0.2187	-0.1889	-0.1637	-0.1422	-0.1239	-0.1083	-0.0839
3.75	-0.4427	-0.4092	-0.3785	-0.3502	-0.3002	-0.2578	-0.2218	-0.1912	-0.1653	-0.1433	-0.1247	-0.1089	-0.0842
4.00	-0.4531	-0.4184	-0.3865	-0.3572	-0.3055	-0.2617	-0.2247	-0.1933	-0.1668	-0.1443	-0.1254	-0.1093	-0.0843
4.25	-0.4630	-0.4270	-0.3940	-0.3637	-0.3104	-0.2654	-0.2273	-0.1952	-0.1681	-0.1452	-0.1260	-0.1097	-0.0845
4.50	-0.4722	-0.4350	-0.4010	-0.3698	-0.3149	-0.2687	-0.2297	-0.1969	-0.1693	-0.1461	-0.1265	-0.1101	-0.0846
4.75	-0.4809	-0.4426	-0.4076	-0.3755	-0.3191	-0.2718	-0.2320	-0.1985	-0.1704	-0.1468	-0.1270	-0.1104	-0.0848
5.00	-0.4892	-0.4498	-0.4138	-0.3808	-0.3231	-0.2747	-0.2340	-0.1999	-0.1714	-0.1475	-0.1274	-0.1107	-0.0849
6.00	-0.5182	-0.4749	-0.4354	-0.3995	-0.3367	-0.2845	-0.2410	-0.2047	-0.1746	-0.1496	-0.1288	-0.1115	-0.0851
7.00	-0.5425	-0.4957	-0.4533	-0.4147	-0.3477	-0.2922	-0.2463	-0.2084	-0.1770	-0.1511	-0.1297	-0.1121	-0.0853
8.00	-0.5632	-0.5134	-0.4683	-0.4275	-0.3568	-0.2986	-0.2507	-0.2112	-0.1789	-0.1523	-0.1304	-0.1125	-0.0854
9.00	-0.5811	-0.5287	-0.4813	-0.4384	-0.3645	-0.3039	-0.2542	-0.2136	-0.1803	-0.1532	-0.1309	-0.1128	-0.0855
10.00	-0.5970	-0.5421	-0.4926	-0.4479	-0.3711	-0.3084	-0.2572	-0.2155	-0.1815	-0.1539	-0.1314	-0.1130	-0.0856

Step 2. Convert X_i into dimensionless variates by the transform, $K_i = X_i/\bar{X}$. Calculate the variance of K_i, S_k^2 (Eq. 10).

Step 3. Obtain logarithmic data, $Y_i = \ln K_i$. Calculate $\bar{Y}$.

Step 4. For $\sigma_k^2 = S_k^2$ and $\mu_y = \bar{Y}$, obtain an approximate value of γ_y from Tables 3-5. Calculate the initial value of $b = 4/\gamma_y{}^2$ (Eq. 5). Note: Col. 8, Table 4 (γ_y = 0) represents the two-parameter log normal distribution (LN_2) for which the logarithmic mean is given by:

$$\mu_{yLN2} = -\frac{1}{2}\ln(1 + \sigma_k^2) \quad (18)$$

If S_k^2 and $\bar{Y}$ indicate that γ_y may be close to zero, the sign of γ_y can be readily determined on the basis of μ_{yLN2}. At given $\sigma_k{}^2$, μ_y increases (algebraically) with γ_y (see Tables 3-5). Thus, if $\bar{Y} < \mu_{yLN2}$, parameter a and γ_y will be negative; and if $\bar{Y} > \mu_{yLN2}$, parameter a and γ_y will be positive.

Step 5. Calculate $Z = (1 + S_k^2)^{1/b} - 1$, and then the two values for a from Eq. 17. Accept the value of a which has the same sign as γ_y in Step 4.

Step 6. Calculate the value of $c = b \ln (1 - \frac{1}{a})$.

Step 7. Calculate $F(b) = \mu_y - \bar{Y} = c + \frac{b}{a} - \bar{Y}$.

If $|F(b)| \leq 10^{-5}$, go to the next step. Otherwise,

calculate $F'(b) = \ln (1 - \frac{1}{a}) + \frac{1}{a} + \frac{\ln(1 + S_k^2)}{2Za^2 b}$ ..(19)

and

$\Delta b = - \frac{F(b)}{F'(b)}$....................................(20)

Calculate the new value of b by applying the correction Δb to the old value, i.e.,

$b_{new} = b_{old} + \Delta b$

Then repeat Steps 5-7.

Step 8. Calculate the estimates of σ_y and γ_y from Eqs. 4 and 5, respectively. Obtain the LP quantiles from Eq. 12.

Choosing γ_y from Tables 4-6 in Step 4 considerably reduces the number of iterations required for optimization; this should be done if calculations are performed by pocket-type electronic calculators. However, when developing a program for the high speed or personal computers, the subroutine MXMPAR given in Fig. 3 may be used for Steps 4-7. This subroutine has S_k^2, $\bar{Y}$, and CS_y

Figure 3. Subroutine MXMPAR

```
      SUBROUTINE MXMPAR(VAK,YB,GY,A,B,C,ITR)
C-----------------------------------------------------------------------
C   PARAMETERS:
C     VAK        - VARIANCE OF DIMENSIONLESS DATA (K)
C     YB         - MEAN OF NATURAL LOGARITHMS OF DIMENSIONLESS DATA
C     GY         - SAMPLE LOGARITHMIC SKEW
C     A,B,C      - ESTIMATES OF LP PARAMETERS BY MXM1 METHOD
C     ITR        - NUMBER OF ITERATIONS REQUIRED FOR OPTIMIZATION (IF ITR=50,
C                  CALCULATIONS ARE ABANDONED AND THE VALUES OF A,B, & C
C                  OBTAINED AT 50TH ITERATION RETURNED)
C-----------------------------------------------------------------------
      DOUBLE PRECISION A,B,C,FB,FD,Z,GY,VAK,BSAVE
C DOUBLE PRECISION STATEMENT IS OPTIONAL DEPENDING ON THE TYPE OF COMPUTER USED
      GY=DABS(GY)
      CC=DLOG(1.+VAK)
      CC1=-CC/2.
C ** CC1=LOG MEAN OF 2-PARAMETER LOGNORMAL DISTRIBUTION
C     DETERMINE THE SIGN OF LOG SKEW FOR MXM1 SOLUTION
      IF(YB.LT.CC1) GY=-GY
      B=4./GY**2
      ITR=0
   20 Z=(1.+VAK)**(1./B)-1.
      IF(GY.GT.0.) A=1.+DSQRT(1.+1./Z)
      IF(GY.LT.0.) A=1.-DSQRT(1.+1./Z)
      C=B*DLOG(1.-1./A)
      CPMY=C+B/A
      FB=CPMY-YB
      ITR=ITR+1
      IF(DABS(FB).LE.0.00001) GO TO 40
      IF(ITR.EQ.50) GO TO 40
      FD=DLOG(1.-1./A)+1./A+DLOG(1.+VAK)/(2.*Z*B*A**2)
      DB=-FB/FD
C IF THE INITIAL B IS MUCH GREATER THAN OPTIMAL B, A NEGATIVE B IS GENERATED.
C  (DB WORKS OUT AS A LARGE NEGATIVE QUANTITY > INITIAL B)
C   IN THIS SITUATION REVISED B IS ASSUMED AS ONE HALF OF THE INITIAL B
C  INSTEAD OF B+DB. THIS OPERATION LEADS TO CONVERGENCE OF SOLUTION.
      BSAVE=B
      B=B+DB
      IF(B.LE.0.) B=BSAVE/2.
      GO TO 20
   40 RETURN
      END
```

as input parameters. The value of CS_y should be calculated in Step 3.

EXAMPLE

The following statistical parameters have been computed for the annual flood flow data (1941-1984), St. Johns River near Melbourne, Florida. Calculate log Pearson flood estimates by the MXM1, logarithmic moments, and the WRC methods.

Sample size, n = 44; $\bar{X}$ = 4,296 cfs (120.29 m^3/sec). For the dimensionless data (K_i): S_k^2 = 0.80941; $\bar{Y}$ = -0.41420; S_y^2 = 0.99999; and CS_y = -0.49733.

From Tables 5 and 6, for μ_y = -0.4142, and σ_k^2 = 0.8094, an approximate value of γ_y = -0.65. Table 7 presents the sequence of iterations made and different parameter estimates in each iteration (For the same example, using subroutine MXMPAR with trial γ_y = -0.49733 took 5 iterations).

The estimates of LP parameters are: a = -3.14241; b = 9.87617; and c = 2.72866. The estimates of logarithmic standard deviation and skewness coefficient may be calculated as:

$$\sigma_y = \frac{\sqrt{b}}{|a|} = \frac{\sqrt{9.87617}}{3.14241} = 1.00007$$

$$\gamma_y = \frac{a}{|a|} \cdot \frac{2}{\sqrt{b}} = -\frac{2}{\sqrt{9.87617}} = -0.63641$$

For P = 0.01, K' = 1.8533 (Table 1). The 100 yr flood estimate is given by:

Table 7.--Sequence of Iterations in Optimizing Log Pearson Parameters by MXM1 Method.

Iteration Number	b	Z	a	c	F(b)	F'(b)	Δb
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	9.46746	0.06464	-3.05839	2.67832	-0.003046	0.007726	-0.39428
2	9.86173	0.06198	-3.13947	2.72690	-0.000104	0.007208	0.01444
3	9.87617	0.06188	-3.14241	2.72866	-0.000000	0.007190	0.00002

Table 8.--Log Pearson Annual Flood Estimates for St. Johns River near Melbourne, Florida

Exceedance Probability, P	Return Period (T) Years	Flow cfs		
		MXM1 Method	Logarithmic Moments Method	WRC Method
(1)	(2)	(3)	(4)	(5)
0.995	1.005	120	136	152
0.990	1.010	176	194	211
0.980	1.020	263	282	299
0.960	1.042	404	421	436
0.900	1.111	751	756	762
0.800	1.250	1,280	1,260	1,250
0.500	2	3,150	3,080	3,020
0.200	5	6,690	6,690	6,670
0.100	10	9,370	9,580	9,750
0.040	25	12,900	13,600	14,200
0.020	50	15,500	16,800	18,000
0.010	100	18,100	20,100	21,900
0.005	200	20,600	23,400	26,100
0.002	500	23,800	27,900	32,000
0.001	1,000	26,200	31,400	36,700

NOTE: 1 cfs = 0.028 m^3/sec.

$$X_{100\ yr} = \exp\,(\mu_y + K'\sigma_y) \times \bar{X}$$
$$= \exp\,(-0.41420 + 1.8533 \times 1.00007) \times 4{,}296$$
$$= 18{,}100 \text{ cfs (rounded to three significant figures)}$$
$$(506.8\ m^3/sec).$$

By logarithmic moments method,

$\sigma_y = S_y = \sqrt{0.99999} \cong 1.00000$; $\gamma_y = CS_y = -0.49733$

For P = 0.01, K' = 1.9567. The 100 yr flood estimate is given by

$$X_{100\ yr} = \exp\,(-0.41420 + 1.9567 \times 1.00000) \times 4{,}296$$
$$= 20{,}100 \text{ cfs } (562.8\ m^3/sec).$$

By the WRC Method, a weighted logarithmic skew is calculated from the station skew (-0.49733) and regional skew (-0.15) as -0.38 from the procedure described in Bulletin #17B (Ref. 6.

For P = 0.01, K' = 2.0442. The 100-yr flood estimate is given by

$$X_{100\ yr} = \exp\,((-0.41420 + 2.0442 \times 1.00000) \times 4{,}296$$
$$= 21{,}900 \text{ cfs } (613.2\ m^3/sec).$$

Flood estimates for different significant P values are shown in Table 8.

Appendix I

Newton-Raphson iteration scheme for optimizing parameter b in estimating log Pearon parameters by MXM1 Method.
For the dimensionless variate K, the following equation can be written:

$$Z = (1 + \sigma_k^2)^{1/b} - 1 \quad (21)$$

$$a = 1 + \epsilon\left(1 + \frac{1}{Z}\right)^{1/2} \quad \text{with} \quad \epsilon = \frac{|a|}{a} \quad (22)$$

$$c = b \ln\left(1 - \frac{1}{a}\right) \quad (23)$$

$$\mu_y = c + \frac{b}{a} \quad (24)$$

Consider function $F(b)$ given by

$$F(b) = c + \frac{b}{a} - \bar{y} \quad (25)$$

in which c and a = functions of b. The MXM1 method requires that $\mu_y = \bar{Y}$ or $F(b) = 0$.

It is possible to show that

$$\frac{dc}{db} = \ln\left(1 - \frac{1}{a}\right) + \frac{b}{a(a-1)}\frac{da}{db} \quad (26)$$

$$\frac{da}{db} = \frac{\epsilon}{2Z^{3/2}}\frac{(Z+1)^{1/2}}{b^2}\ln(1 + \sigma_k^2) \quad (27)$$

$$\text{Finally} \quad \frac{dF(b)}{db} = F'(b) = \ln\left(1 - \frac{1}{a}\right) + \frac{1}{a} + \frac{\ln(1 + \sigma_k^2)}{2Z\,a^2\,b} \quad (28)$$

By the method of Newton-Raphson the correction, Δb, should be applied to parameter b at each iteration. This is given by

$$\Delta b = -\frac{F(b)}{F'(b)} \quad (29)$$

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APPENDIX III.--NOTATION

The following symbols are used in this chapter:

a,b,c	=	parameters of Pearson type 3 or Log Pearson type 3 distribution;
CS	=	sample skewness coefficient;
f( )	=	probability density function of variate in parenthesis;
K,k	=	dimensionless variate;
$\bar{K}$	=	sample mean of K;
K'	=	Pearson frequency factor;
LN2	=	two-parameter lognormal distribution;
LP	=	log Pearson type 3 distribution;
MXM1	=	method of mixed moments-I;
n	=	sample size;
P	=	exceedance probability;
P3	=	Pearson type 3 distribution;
S^2	=	sample variance;
SP	=	statistical parameters;
T	=	return period;
X,x	=	real data (log Pearson type 3 variate);
$\bar{X}$	=	sample mean of X;
Y,y	=	logarithmic data (pearson type 3 variate, ln X);
$\bar{Y}$	=	sample mean of Y;
Z	=	constant;
γ	=	population skewness coefficient;
η	=	population coefficient of variation;
μ	=	population mean;

σ = population standard deviation; and

σ^2 = population variance.

Subscripts:

i = ith value (for variates).