U.S. Department of the Interior
U.S. Geological Survey

Floods in Southeast Texas, October 1994

Fact Sheet

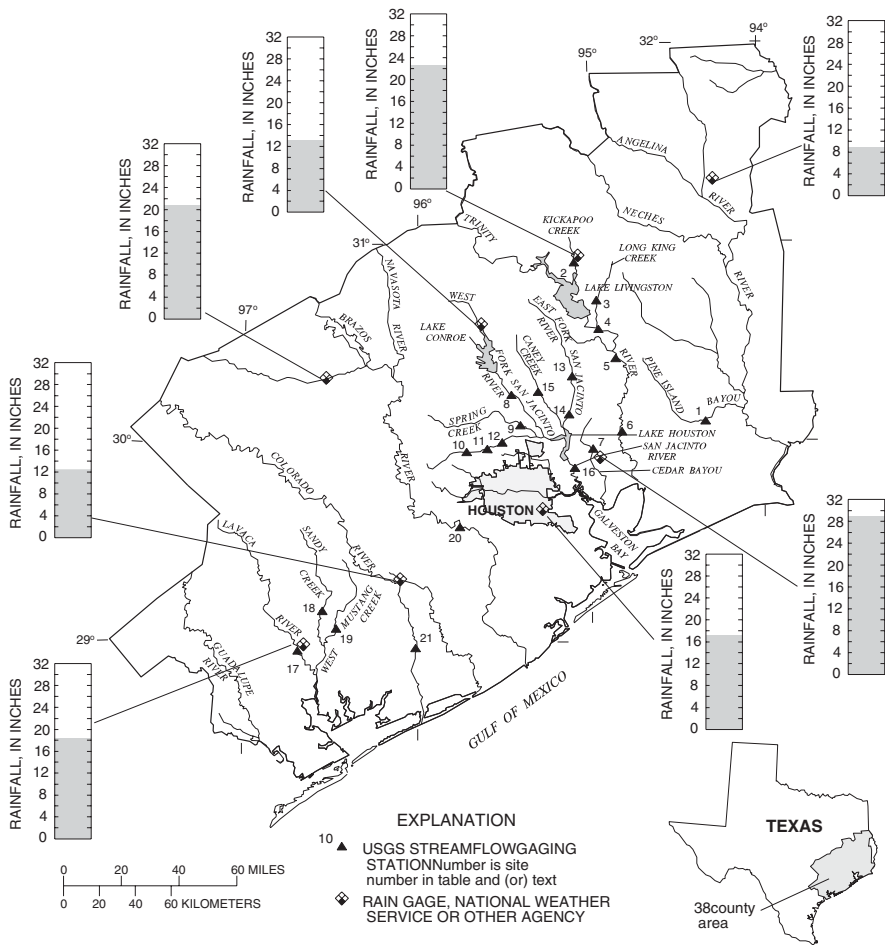
Rainfall in southeast Texas, which ranged in amounts from about 8 to more than 28 inches during October 15–19, 1994, caused severe flooding in parts of a 38-county area. A combination of meteorological events—residual atmospheric moisture over southern Texas associated with Hurricane Rosa from the Pacific Coast of Mexico and low-level moisture from the Gulf of Mexico drawn inland to a warm front by a strong low-pressure system over the southern Rocky Mountains—spawned vigorous thunderstorms that produced rainfall amounts that may exceed records for the area.

Flooding was most severe in the San Jacinto River Basin along the West and East Forks of the San Jacinto River and along Spring Creek; in the Trinity River Basin near Lake Livingston and along several tributaries to the lake; and in the Lavaca River Basin. Flooding was also severe in several coastal basins, notably Cedar and Pine Island Bayous. Many of the resulting peak stages (maximum water-surface elevation above a datum) and streamflows exceeded all observed historical values.

Assessment of the flood damage continued into November. The *Houston Chronicle* in early November listed 22 flood-related deaths and 15,775 homes damaged, including 3,069 destroyed and 6,560 requiring major repairs. As of November 8, the Federal Emergency Management Agency had declared 29 of the 38 counties to be disaster areas, received 26,000 applications for disaster assistance, and approved $54 million in disaster assistance. Railroad and highway roadbeds and bridges, and oil and gasoline pipelines, sustained major damage. Resulting spills of oil and gasoline caused environmental damage, particularly to the lower San Jacinto River and Galveston Bay. The Texas Insurance Commissioner estimates privately covered insurance losses at $700 million.

U.S. Geological Survey Role

The U.S. Geological Survey (USGS), U.S. Department of the Interior, develops and disseminates relevant, policy-neutral water data and information to support water-resource planning and management needs nationwide. A key part of the USGS mission is to operate the Nation's streamflow-gaging network in cooperation with other Federal, State, and local agencies. The USGS maintains about 100 streamflow-gaging stations in the 38-county area affected by the recent floods. The streamflow records (which include data on floods from as early as 1875) provide, among other information, a chronology of historical peak stages and streamflows. In southeast Texas, several agencies (including the National Weather Service; the U.S. Army Corps of Engineers; the National Transportation Safety Board; the Texas Department of Transportation; the Brazos, Lower Colorado, San Jacinto, and Trinity River Authorities; and the Harris County Flood Control District) use streamflow data to aid in flood forecasting and in the design of infrastructure to convey or withstand flood waters.



Selected streamflow-gaging stations and reported rainfall amounts at selected sites during October 15–19, 1994.

Flood Facts

USGS personnel obtained peak stages and (or) made numerous direct measurements of streamflow during flood conditions at 43 streamflow-gaging stations in the 29 counties declared disaster areas. The direct measurement of streamflow (that is, measuring the velocity of the water) under a series of streamflow conditions allows definition of a relation between stage and streamflow (known as a stage-discharge rating). The measurements made during flood conditions were used to confirm or redefine the station ratings; the ratings were used with observed peak stages to determine maximum streamflows at the stations, as shown in the table.

One of the largest direct measurements of streamflow ever obtained in Texas, 356,000 cubic feet per second (ft^3/s), was made on the San Jacinto River near

Streamflow stations where floods of October 1994 equaled or exceeded the 100-year flood

Site no.	Station no.	Streamflow station name	Year flood records began	Median		Previous known maximum			October 1994 maximum				
				Stage[1] (feet above datum)	Streamflow (cubic feet per second)	Year	Stage (feet above datum)	Streamflow[2] (cubic feet per second)	Day	Stage (feet above datum)	Streamflow[2] (cubic feet per second)	Basin yield (cubic feet per second per square mile)	Ratio of streamflow to 100-year flood
1	08041700	Pine Island Bayou near Sour Lake	1967	14.47	89	1979	34.29	25,000	20	37.49	48,800	145	2.0
2	08066170	Kickapoo Creek near Onalaska	1965	4.00	3.5	1981	30.37	24,500	17	41.85	84,600	1,480	2.9
3	08066200	Long King Creek at Livingston	1963	3.02	12	1989	27.27	27,600	17	30.54	45,000	319	1.1
4	08066250	Trinity River near Goodrich	1929	9.70	2,620	1990	46.80	107,000	18	48.93	124,000	7.36	1.1
						1942	52.00	Unknown					
5	08066500	Trinity River at Romayor	1925	13.60	2,910	1942	45.80	111,000	19	42.70	122,000	7.10	1.0
6	08067000	Trinity River at Liberty	1922	2.22	Tidal	1990	30.03	106,000	21	31.00	135,000	7.73	1.1
7	08067500	Cedar Bayou near Crosby	1946	7.58	10	1981	23.92	4,760	19	28.33	7,800	120	1.2
8	08068000	West Fork San Jacinto River near Conroe	1940	4.30	101	1940	30.85	110,000	18	32.30	115,000	139	1.3
9	08068520	Spring Creek at Spring	1879	3.28	42	1940	33.60	42,700	18	44.05	78,800	188	1.7
10	08068740	Cypress Creek at House and Hahl Road near Cypress	1975	29.40	5.5	1979	46.33	2,590	19	47.61	5,200	39.7	1.7
11	08068800	Cypress Creek at Grant Road near Cypress	1982	24.90	9.9	1982	43.48	3,550	18	47.38	10,500	49.1	1.8
12	08068900	Cypress Creek at Stuebner–Airline Road near Westfield	1982	15.75	17	1984	37.88	6,910	19	39.61	11,300	45.6	1.2
13	08070000	East Fork San Jacinto River near Cleveland	1935	3.60	49	1940	24.10	59,000	18	24.57	63,000	194	1.0
14	08070200	East Fork San Jacinto River near New Caney	1973	5.01	88	1973	29.60	39,100	18	33.00	74,100	191	1.0
						1989	24.67	16,100					
15	08070500	Caney Creek near Splendora	1885	2.97	26	1940	27.00	Unknown	17	26.40	36,000	343	1.7
16	08072050	San Jacinto River near Sheldon	1875	0.69	Tidal	1940	31.50	Unknown	19	27.09	360,000	125	1.6
17	08164000	Lavaca River near Edna	1880	3.91	53	1936	33.80	83,400	19	35.45	135,000	165	2.1
18	08164450	Sandy Creek near Louise	1977	5.28	18	1978	23.03	14,000	19	28.45	23,000	79.6	1.3
19	08164503	West Mustang Creek near Ganado	1977	5.74	22	1980	24.49	13,400	19	28.39	30,000	169	2.0

[1] Stage corresponding to median streamflow.

[2] Instantaneous maximum corresponding to maximum stage.

Sheldon (site 16 in figure and table) on October 19 at a stage of 27.00 feet (ft). During the measurement, velocities of water that exceeded 15 ft/s (about 10 miles per hour) were observed. The stage at that flow was about 26 ft above that which occurs at the median streamflow (flow exceeded 50 percent of the time). This measurement, which redefined the station rating, and the maximum observed peak stage of 27.09 ft, were used to determine a peak streamflow of 360,000 ft^3/s.

Other direct measurements of streamflow were obtained at various stations to help determine the peak streamflows for the floods. Measurements that exceeded 50,000 ft^3/s include those made at the West Fork San Jacinto River near Conroe (site 8 in figure and table), where a measurement of 92,600 ft^3/s at a stage of about 27 ft above that which occurs at the median flow helped to determine a peak streamflow of 115,000 ft^3/s; at the Brazos River at Richmond (site 20 in figure), where a measurement of 85,700 ft^3/s at a stage of about 35 ft above that which occurs at the median flow helped to determine a peak streamflow of 88,100 ft^3/s; and at the Colorado River near Bay City (site 21 in figure), where a measurement of 67,400 ft^3/s at a stage of about 33 ft above that which occurs at the median flow helped to determine a peak streamflow of 74,500 ft^3/s.

Another measure of the severity of flood conditions is the peak-flow basin yield (the ratio of the peak streamflow to the contributing drainage area). Peak-flow basin yields exceeded 100 ft^3/s per square mile at 22 of the 43 stations monitored in the area. The largest basin yield was 1,480 ft^3/s per square mile in the Trinity River Basin at Kickapoo Creek near Onalaska (site 2 in figure and table). These values greatly exceed basin yields for median streamflows of about 0.10 ft^3/s per square mile.

Lake Houston was inundated by flood waters. Roughly twice as much water (249,000 acre-ft) was in the lake at its maximum flood stage than is normally in the lake when the level is at the spillway crest (134,000 acre-ft).

Historical Comparison

By any measure, the flooding of October 1994 was an extreme and dangerous event. Historical peak streamflows were exceeded at 23 of the 43 stations monitored in the area. The 100-year flood, which is defined as the peak streamflow that has a 1-percent chance of being equaled or exceeded in any given year, was equaled at 3 stations and exceeded at 16 of the 43 stations. For those stations where the 100-year flood was exceeded, the magnitude of exceedance ranged from 1.1 times the 100-year flood at several stations (sites 3, 4, and 6 in figure and table) to 2.9 times the 100-year flood at Kickapoo Creek near Onalaska (site 2 in figure and table).

At 25 of the 43 stations, the peak stages for the floods exceeded the historical maximums. For example, the largest increase above a previous maximum stage occurred at Kickapoo Creek near Onalaska (site 2 in figure and table), where the historical maximum was exceeded by more than 11 ft. At Spring Creek at Spring (site 9 in figure and table), the October flood produced a new record peak stage more than 10 ft above the historical peak; and at Sandy Creek near Louise (site 18 in figure and table), the peak stage was more than 5 ft above the previous record.

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For more information, please contact:

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