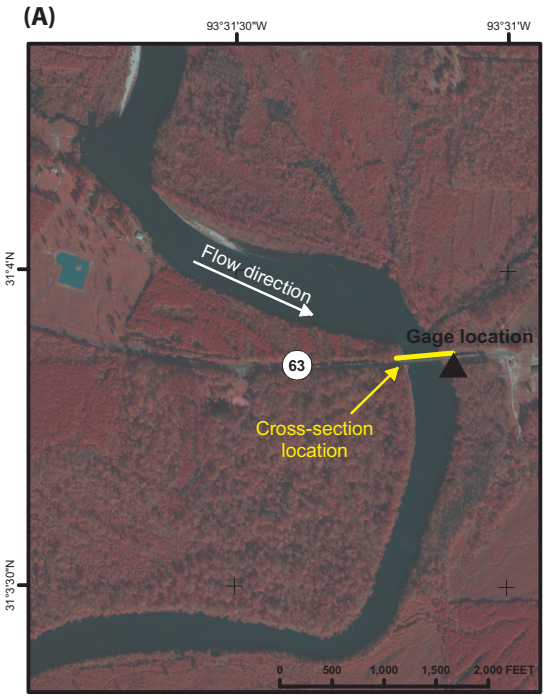


(B)

Figure 4. U.S. Geological Survey streamflow-gaging station 08026000 Sabine River near Burkeville, Texas, (A) 2004 digital orthophoto quarter-quadrangle; and (B) photograph looking upstream from bridge on State Highway 63, November 9, 2006.

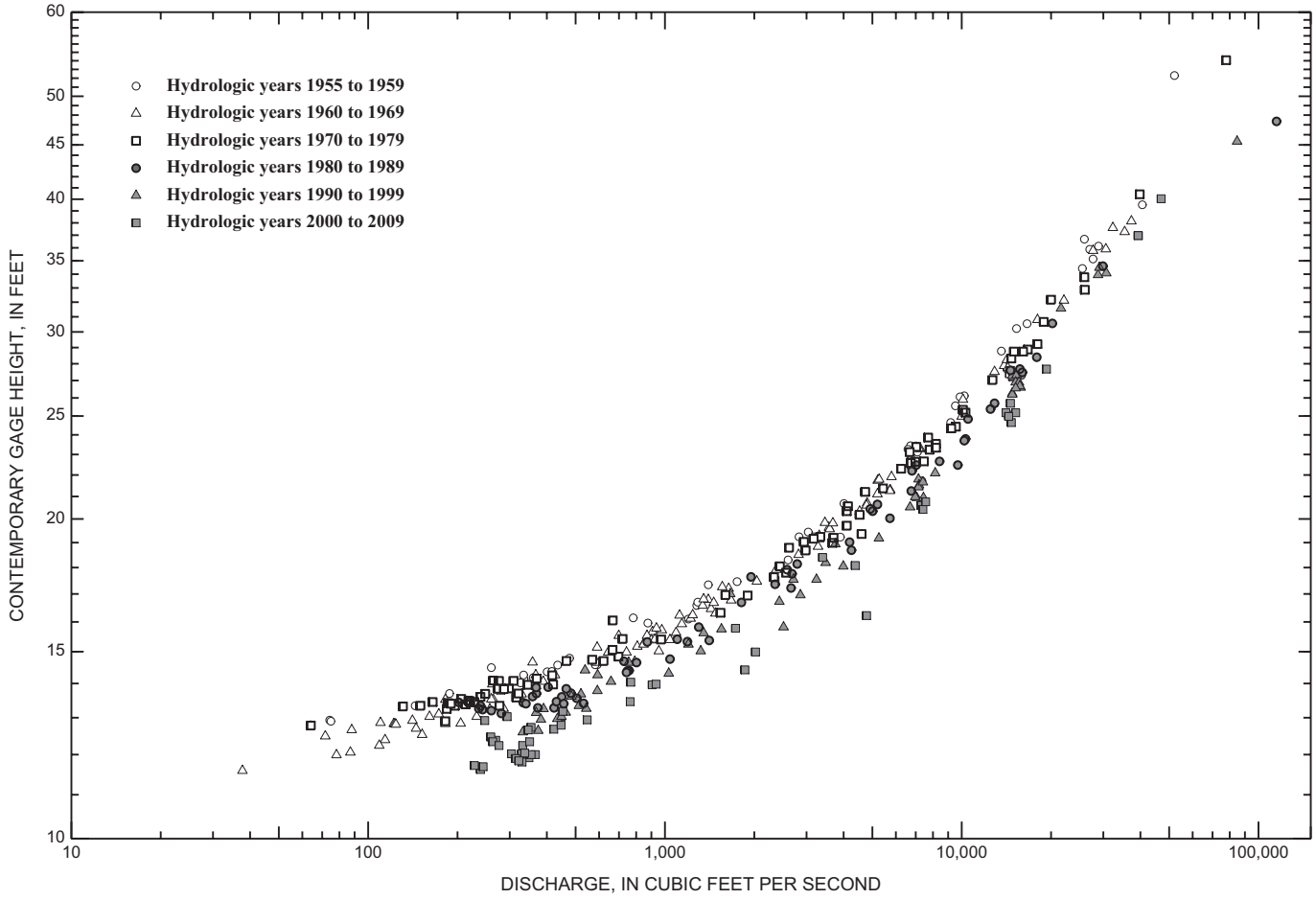


Figure 5. Stage-discharge relations of field measurements for U.S. Geological Survey streamflow-gaging station 08026000 Sabine River near Burkeville, Texas, 1955–2009.

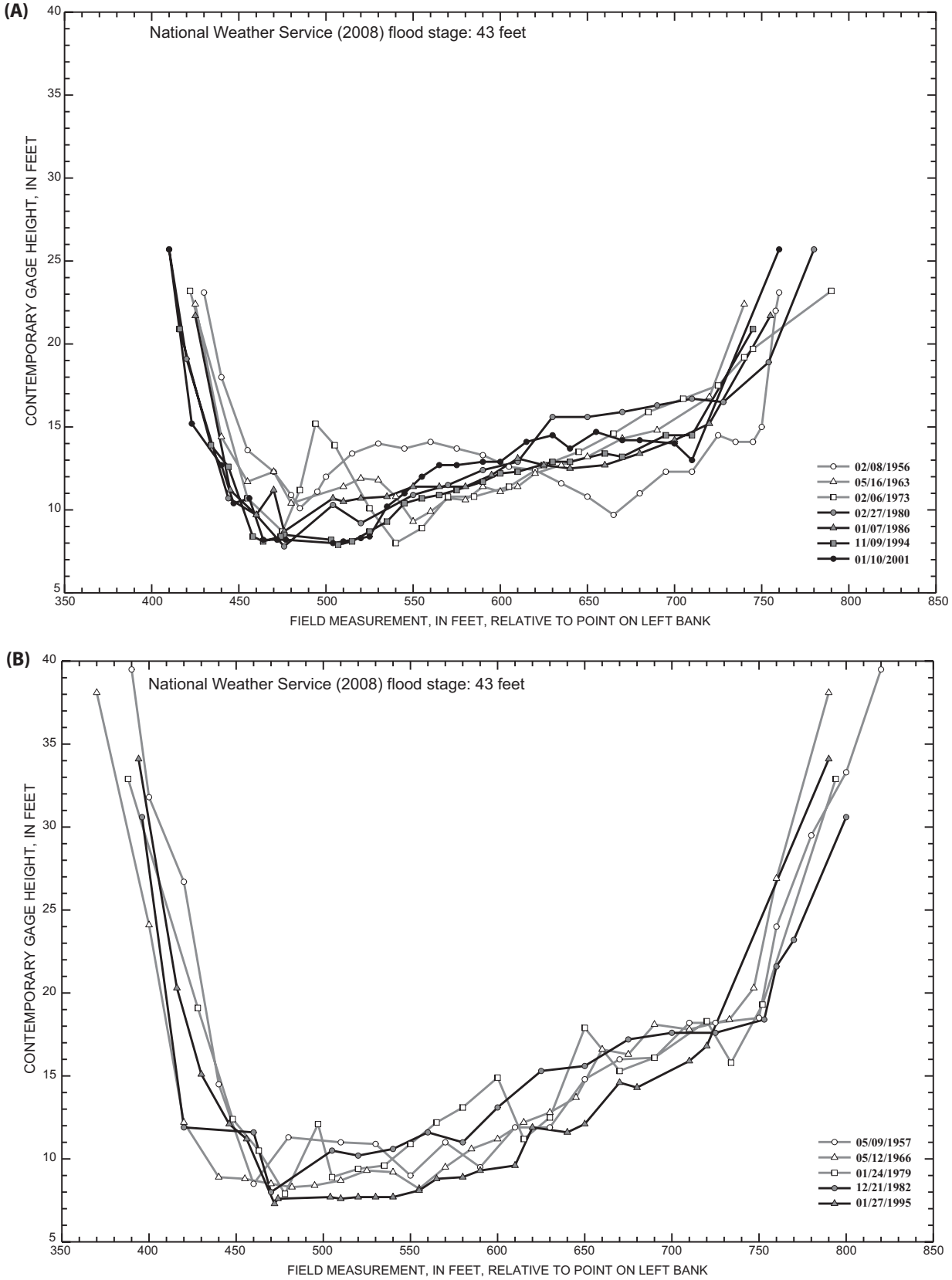


Figure 6. Historical cross-sectional channel geometry for U.S. Geological Survey streamflow-gaging station 08026000 Sabine River near Burkeville, Texas, (A) at moderate-flow conditions (greater than 5,000 cubic feet per second and less than 15,000 cubic feet per second), 1956–2001; and (B) at high-flow conditions (greater than 15,000 cubic feet per second), 1957–95.

Table 8. Hydraulic computations for historical cross sections of U.S. Geological Survey streamflow-gaging station 08026000, Sabine River near Burkeville, Texas, 1956–2001.

[ft, feet; ft^3/s, cubic feet per second; ft^2, square feet; ft/s, feet per second; lb/ft^2, pounds per square foot; >, greater than; <, less than]

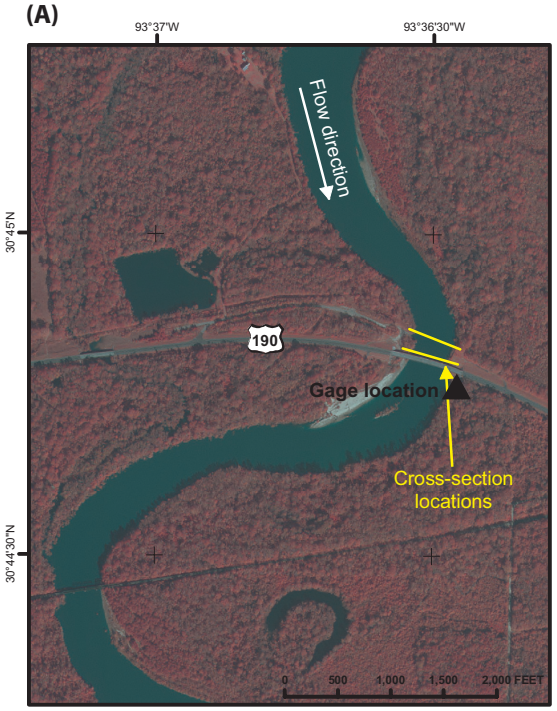
Date	Contemporary stage (ft)	Discharge[1] (ft^3/s)	Width[2] (ft)	Hydraulic depth[2, 3] (ft)	Cross-sectional area[2] (ft^2)	Mean velocity[2] (ft/s)	Bed shear stress[2] (lb/ft^2)	Froude number[2]
Moderate flow (>5,000 ft^3/s, <15,000 ft^3/s)								
15.0-foot target stage								
Feb. 8, 1956	15.2	7,090	300.7	2.60	782.9	0.81	0.02	0.09
May 16, 1963	14.8	6,780	250.8	2.91	729.9	.91	.03	.09
Feb. 6, 1973	15.0	7,800	225.4	3.48	785.2	1.05	.03	.10
Feb. 27, 1980	14.8	11,400	191.8	3.98	764.1	1.11	.04	.10
Jan. 7, 1986	15.2	7,340	282.6	3.30	932.6	1.06	.03	.10
Nov. 9, 1994	14.9	7,430	280.8	3.61	1,013	1.18	.03	.11
Jan. 10, 2001	15.0	14,600	293.5	3.05	894.9	.99	.03	.10
20.0-foot target stage								
Feb. 8, 1956	20.2	7,090	320.3	7.31	2,340	1.69	.07	.11
May 16, 1963	19.8	6,780	300.8	7.12	2,143	1.82	.07	.12
Feb. 6, 1973	20.0	7,800	318.4	6.84	2,179	1.84	.06	.12
Feb. 27, 1980	19.8	11,400	338.5	6.51	2,204	1.65	.06	.11
Jan. 7, 1986	20.2	7,340	319.1	7.64	2,437	2.15	.07	.14
Nov. 9, 1994	19.9	7,430	321.0	7.84	2,517	2.37	.07	.15
Jan. 10, 2001	20.0	14,600	320.5	7.59	2,433	2.05	.07	.13
High flow (>15,000 ft^3/s)								
25.0-foot target stage								
May 9, 1957	25.0	40,600	340.8	11.4	3,871	2.36	.10	.12
May 12, 1966	25.2	37,300	359.0	12.3	4,404	2.41	.11	.12
Jan. 24, 1979	24.9	27,000	358.1	10.6	3,795	2.50	.10	.14
Dec. 21, 1982	25.0	19,400	374.1	10.8	4,028	2.30	.10	.12
Jan. 27, 1995	24.8	30,700	343.5	12.6	4,329	2.64	.12	.13
30.0-foot target stage								
May 9, 1957	30.0	40,600	375.6	15.1	5,654	2.99	.14	.14
May 12, 1966	30.2	37,300	381.9	16.4	6,254	3.03	.15	.13
Jan. 24, 1979	29.9	27,000	388.0	14.6	5,661	3.38	.13	.16
Dec. 21, 1982	30.0	19,400	400.8	14.9	5,966	3.00	.14	.14
Jan. 27, 1995	29.8	30,700	371.8	16.5	6,118	3.34	.15	.15

[1] Discharge is for measurement, not a subdivided estimate based on hydraulic analyses.

[2] Hydraulic computations before October 3, 1966, are pre-regulation of flow by reservoirs or other structures.

[3] Hydraulic depth is ratio of cross-sectional area to width, equivalent to mean depth.

(A)



2004 National Agriculture Imagery Program color infrared imagery
Projection: Universal Transverse Mercator Zone 15 North
Datum: North American Datum 1983

(B)

Figure 7. U.S. Geological Survey streamflow-gaging station 08028500 Sabine River near Bon Wier, Texas, (A) 2004 digital orthophoto quarter-quadrangle; and (B) photograph looking from left bank adjacent to U.S. Highway 190 bridge, May 30, 1999.

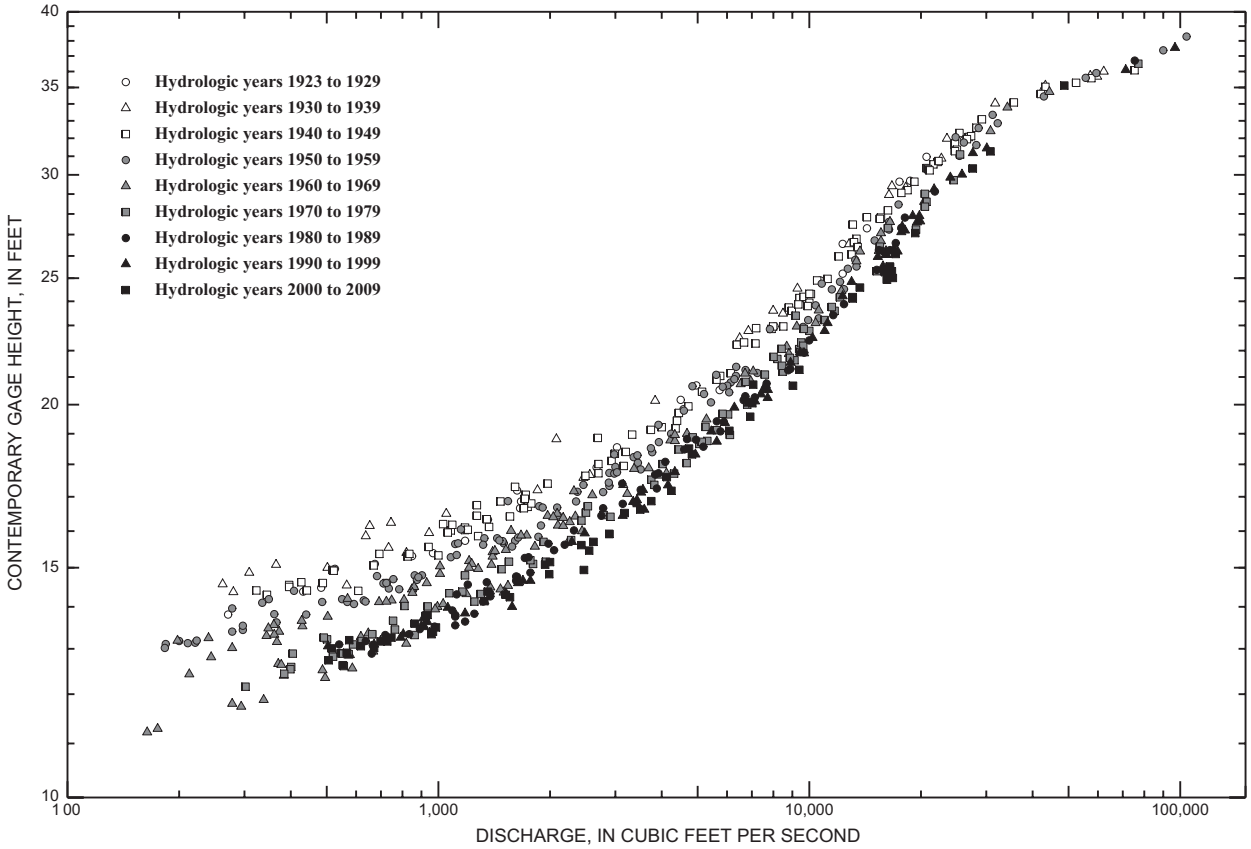


Figure 8. Stage-discharge relations of field measurements for U.S. Geological Survey streamflow-gaging station 08028500 Sabine River near Bon Wier, Texas, 1923–2009.

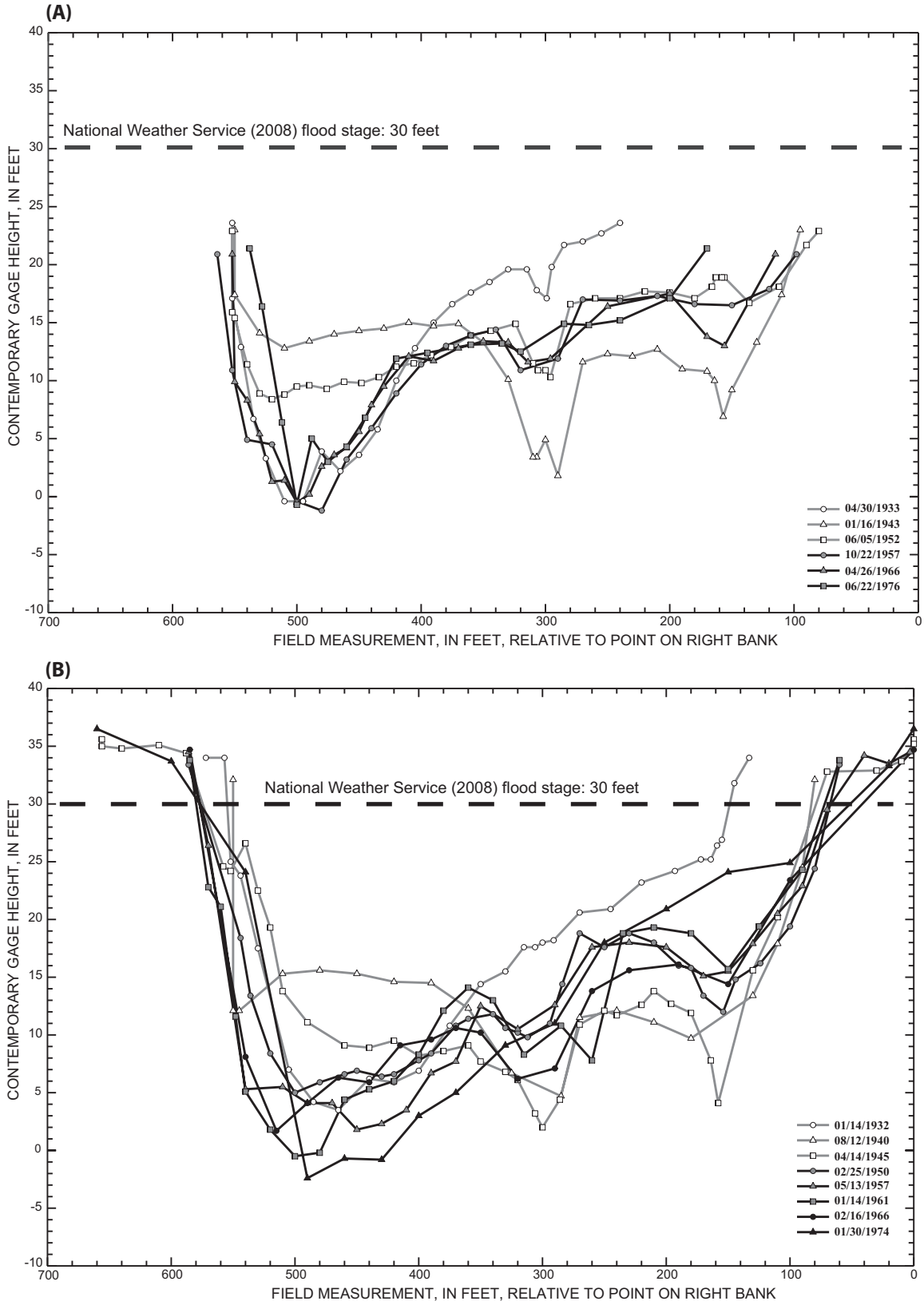
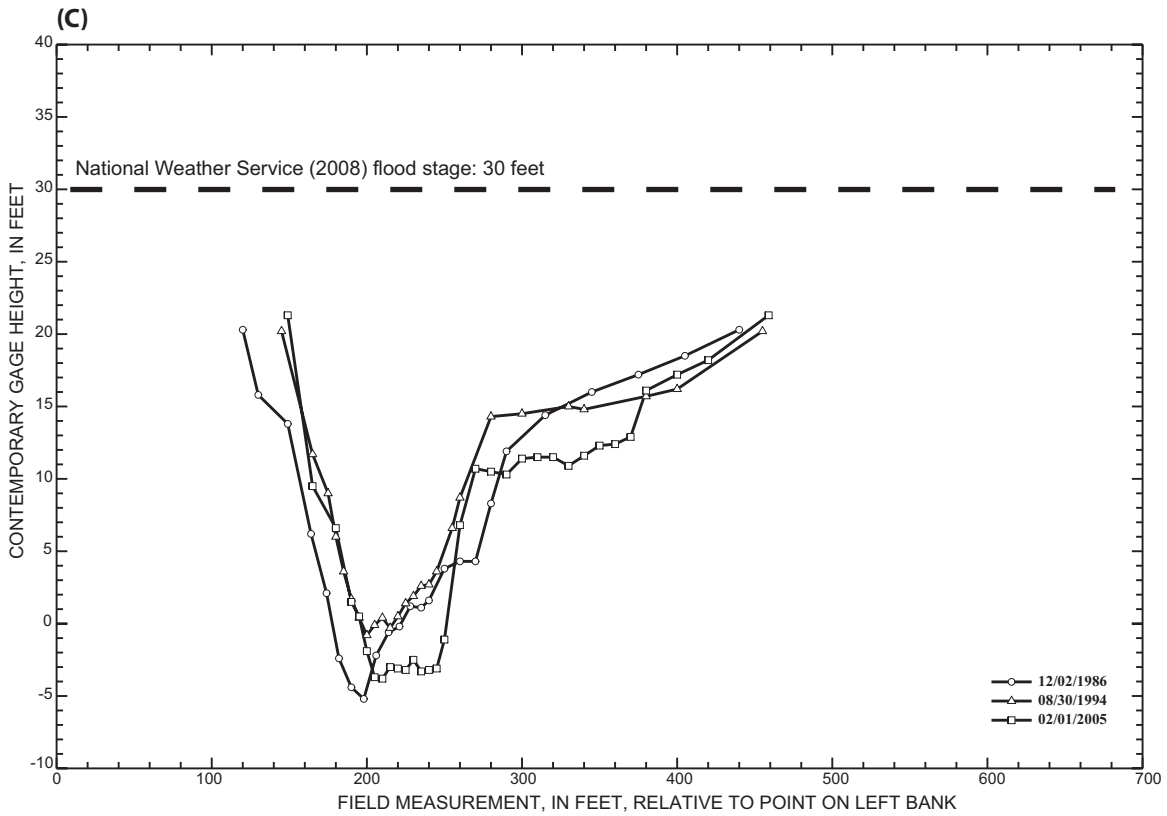


Figure 9. Historical cross-sectional channel geometry for U.S. Geological Survey streamflow-gaging station 08028500 Sabine River near Bon Wier, Texas, (A) at moderate-flow conditions (greater than 5,000 cubic feet per second and less than 10,000 cubic feet per second), 1933–76; (B) at high-flow conditions (greater than 10,000 cubic feet per second), 1932–74; (C) at moderate-flow conditions, 1986–2005; and (D) at high-flow conditions, 1984–2003.



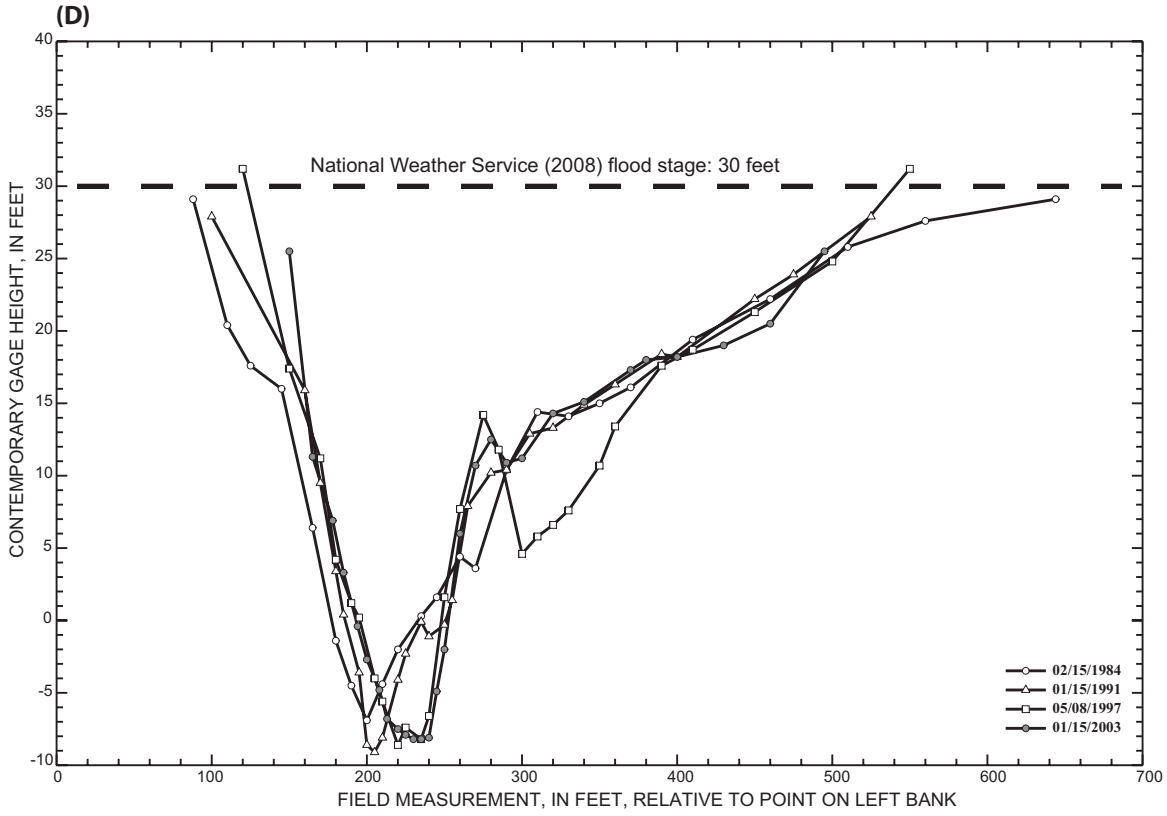


Figure 9.—Continued.

Table 9. Hydraulic computations for historical cross sections of U.S. Geological Survey streamflow-gaging station 08028500, Sabine River near Bon Wier, Texas, 1932–76.

[ft, feet; ft^3/s, cubic feet per second; ft^2, square feet; ft/s, feet per second; lb/ft^2, pounds per square foot; >, greater than; <, less than]

Date	Contemporary stage (ft)	Discharge[1] (ft^3/s)	Width[2] (ft)	Hydraulic depth[2, 3] (ft)	Cross-sectional area[2] (ft^2)	Mean velocity[2] (ft/s)	Bed shear stress[2] (lb/ft^2)	Froude number[2]
Moderate flow (>5,000 ft^3/s, <10,000 ft^3/s)								
15.0-foot target stage								
Apr. 30, 1933	15.1	7,990	159.6	9.38	1,497	1.93	0.08	0.11
Jan. 16, 1943	14.8	8,510	379.0	3.22	1,219	.80	.03	.08
June 5, 1952	14.9	7,830	264.4	3.50	926.0	.99	.03	.09
Oct. 22, 1957	14.8	6,280	278.0	6.60	1,836	1.18	.06	.08
Apr. 26, 1966	15.0	6,950	320.7	5.50	1,764	1.17	.05	.09
June 22, 1976	14.8	8,440	239.0	4.94	1,181	1.48	.05	.12
20.0-foot target stage								
Apr. 30, 1933	20.1	7,990	258.6	9.69	2,506	2.03	.09	.11
Jan. 16, 1943	19.8	8,510	446.4	7.59	3,387	1.41	.07	.09
June 5, 1952	19.9	7,830	451.0	5.98	2,699	1.48	.06	.11
Oct. 22, 1957	19.8	6,280	456.6	8.14	3,716	1.38	.07	.08
Apr. 26, 1966	20.0	6,950	432.2	8.62	3,725	1.60	.08	.10
June 22, 1976	19.8	8,440	353.6	7.91	2,796	2.23	.07	.14
High flow (>10,000 ft^3/s)								
25.0-foot target stage								
Jan. 14, 1932	25.0	31,700	375.8	10.6	4,003	2.54	.10	.14
Aug. 12, 1940	25.2	26,900	460.9	12.6	5,828	2.26	.11	.11
Apr. 14, 1945	25.0	57,600	452.6	13.8	6,262	3.31	.13	.16
Feb. 25, 1950	25.0	31,200	483.8	12.1	5,870	2.22	.11	.11
May 13, 1957	24.8	42,900	483.5	13.1	6,329	2.69	.12	.13
Jan. 14, 1961	25.0	34,200	485.2	13.2	6,428	2.31	.12	.11
Feb. 16, 1966	25.2	44,400	484.9	13.7	6,652	2.54	.13	.12
Jan. 30, 1974	25.1	80,100	448.2	13.0	5,834	3.03	.12	.15
30.0-foot target stage								
Jan. 14, 1932	30.0	31,700	406.1	14.8	5,992	3.39	.14	.16
Aug. 12, 1940	30.2	26,900	467.5	17.4	8,149	2.81	.16	.12
Apr. 14, 1945	30.0	57,600	495.6	17.5	8,653	4.26	.16	.18
Feb. 25, 1950	30.0	31,200	508.9	16.4	8,352	2.75	.15	.12
May 13, 1957	29.8	42,900	508.6	17.3	8,805	3.38	.16	.14
Jan. 14, 1961	30.0	34,200	507.8	17.6	8,911	2.80	.16	.12
Feb. 16, 1966	30.2	44,400	537.6	17.1	9,208	3.01	.16	.13
Jan. 30, 1974	30.1	80,100	527.0	15.7	8,272	3.67	.14	.16

[1] Discharge is for measurement, not a subdivided estimate based on hydraulic analyses.

[2] Hydraulic computations before October 3, 1966, are pre-regulation of flow by reservoirs or other structures.

[3] Hydraulic depth is ratio of cross-sectional area to width, equivalent to mean depth.

Table 10. Hydraulic computations for historical cross sections of U.S. Geological Survey streamflow-gaging station 08028500, Sabine River near Bon Wier, Texas, 1984–2005.

[ft, feet; ft^3/s, cubic feet per second; ft^2, square feet; ft/s, feet per second; lb/ft^2, pounds per square foot; >, greater than; <, less than]

Date	Contemporary stage (ft)	Discharge[1] (ft^3/s)	Width[2] (ft)	Hydraulic depth[2, 3] (ft)	Cross-sectional area[2] (ft^2)	Mean velocity[2] (ft/s)	Bed shear stress[2] (lb/ft^2)	Froude number[2]
Moderate flow (>5,000 ft^3/s, <10,000 ft^3/s)								
15.0-foot target stage								
Dec. 2, 1986	14.8	7,130	183.0	9.62	1,760	2.08	0.09	0.12
Aug. 30, 1994	15.2	7,720	201.0	6.19	1,244	2.03	.06	.14
Feb. 1, 2005	15.2	9,400	219.9	8.54	1,878	2.07	.08	.12
20.0-foot target stage								
Dec. 2, 1986	19.8	7,130	309.2	9.72	3,006	2.20	.09	.12
Aug. 30, 1994	20.2	7,720	310.0	8.32	2,579	2.96	.08	.18
Feb. 1, 2005	20.2	9,400	294.7	10.7	3,153	2.58	.10	.14
High flow (>10,000 ft^3/s)								
20.0-foot target stage								
Feb. 15, 1984	20.1	21,300	310.9	10.5	3,260	2.25	.10	.12
Jan. 15, 1991	19.9	19,800	281.2	10.3	2,909	2.60	.09	.14
May 8, 1997	19.9	27,600	283.9	11.7	3,312	2.54	.10	.13
Jan. 15, 2003	19.8	16,500	290.0	9.91	2,875	2.58	.09	.14
25.0-foot target stage								
Feb. 15, 1984	25.1	21,300	402.2	12.6	5,057	2.63	.12	.13
Jan. 15, 1991	24.9	19,800	372.5	12.2	4,541	3.12	.11	.16
May 8, 1997	24.9	27,600	367.1	13.5	4,944	2.95	.12	.14
Jan. 15, 2003	24.8	16,500	339.4	13.2	4,468	3.37	.12	.16

[1] Discharge is for measurement, not a subdivided estimate based on hydraulic analyses.

[2] All hydraulic computations are post regulation of flow by reservoirs or other structures.

[3] Hydraulic depth is ratio of cross-sectional area to width, equivalent to mean depth.

Figure 10. U.S. Geological Survey streamflow-gaging station 08030500 Sabine River near Ruliff, Texas, (A) 2004 digital orthophoto quarter-quadrangle; and (B) photograph looking from left bank adjacent to State Highway 12 bridge, October 24, 2006.

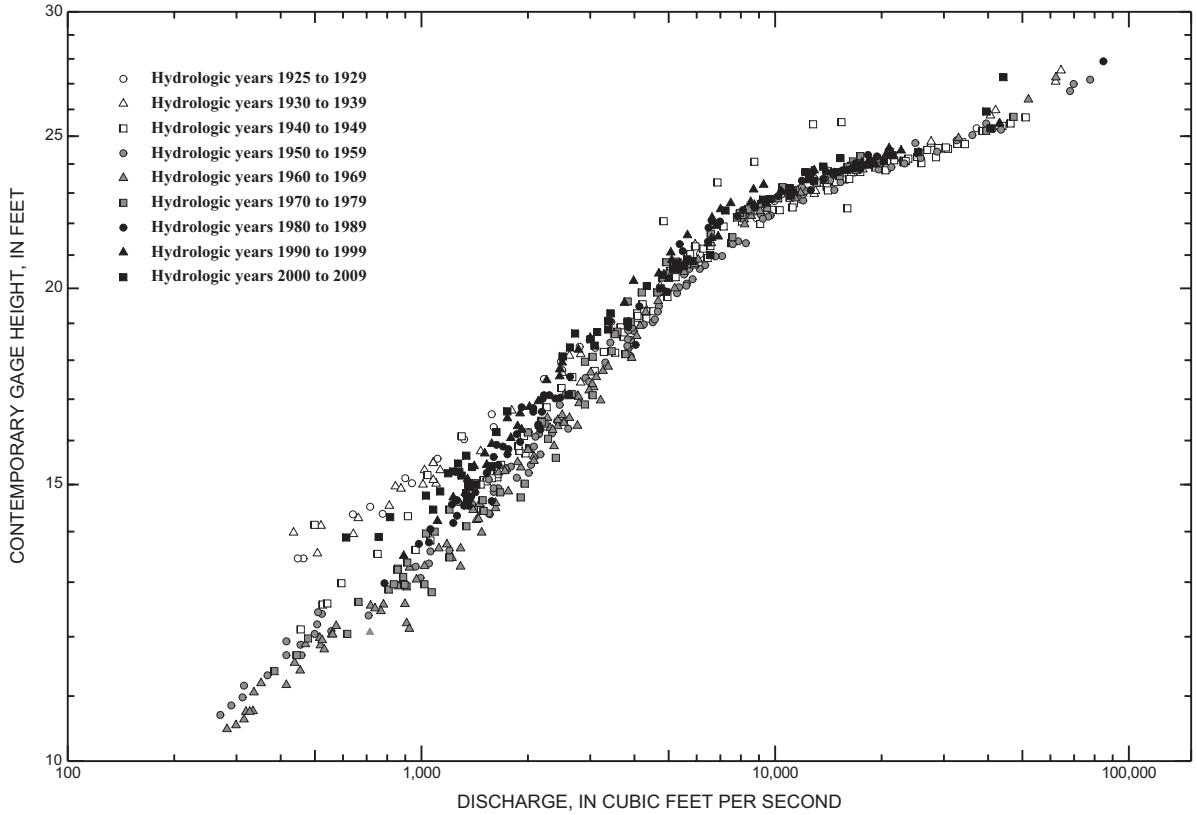
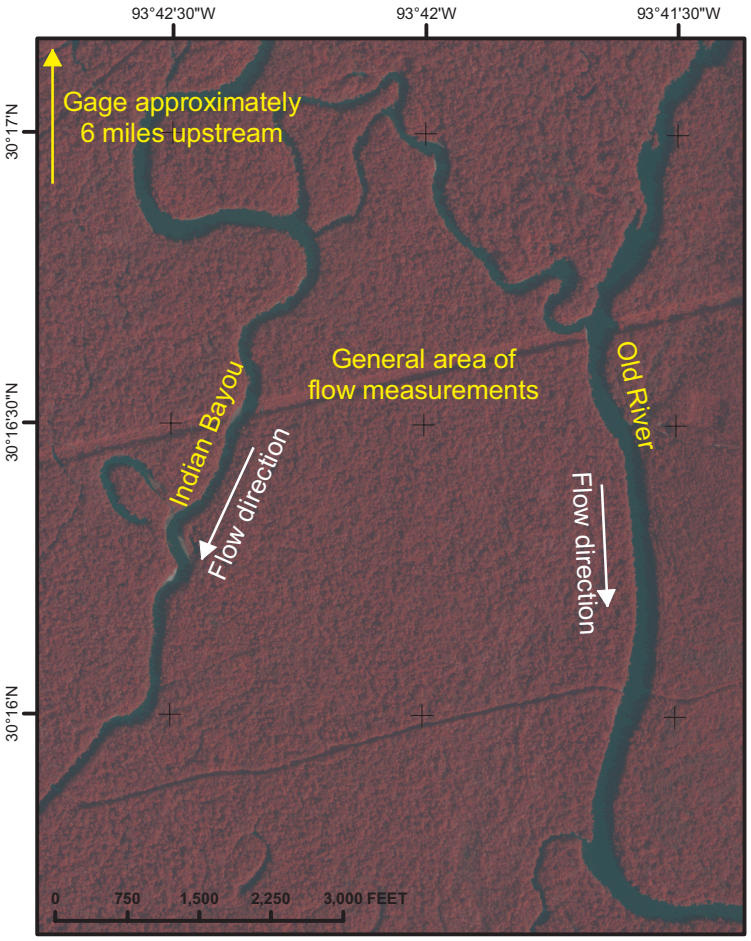


Figure 11. Stage-discharge relations of field measurements for U.S. Geological Survey streamflow-gaging station 08030500 Sabine River near Ruliff, Texas, December 1924–2009.



2004 National Agriculture Imagery Program color infrared imagery
Projection: Universal Transverse Mercator Zone 15 North
Datum: North American Datum 1983

Figure 12. 2004 Digital orthophoto quarter-quadrangle showing Indian Bayou, Old River, and overflow channels where flow measurements have been made since the mid-1970s for U.S. Geological Survey streamflow-gaging station 08030500 Sabine River near Ruliff, Texas.

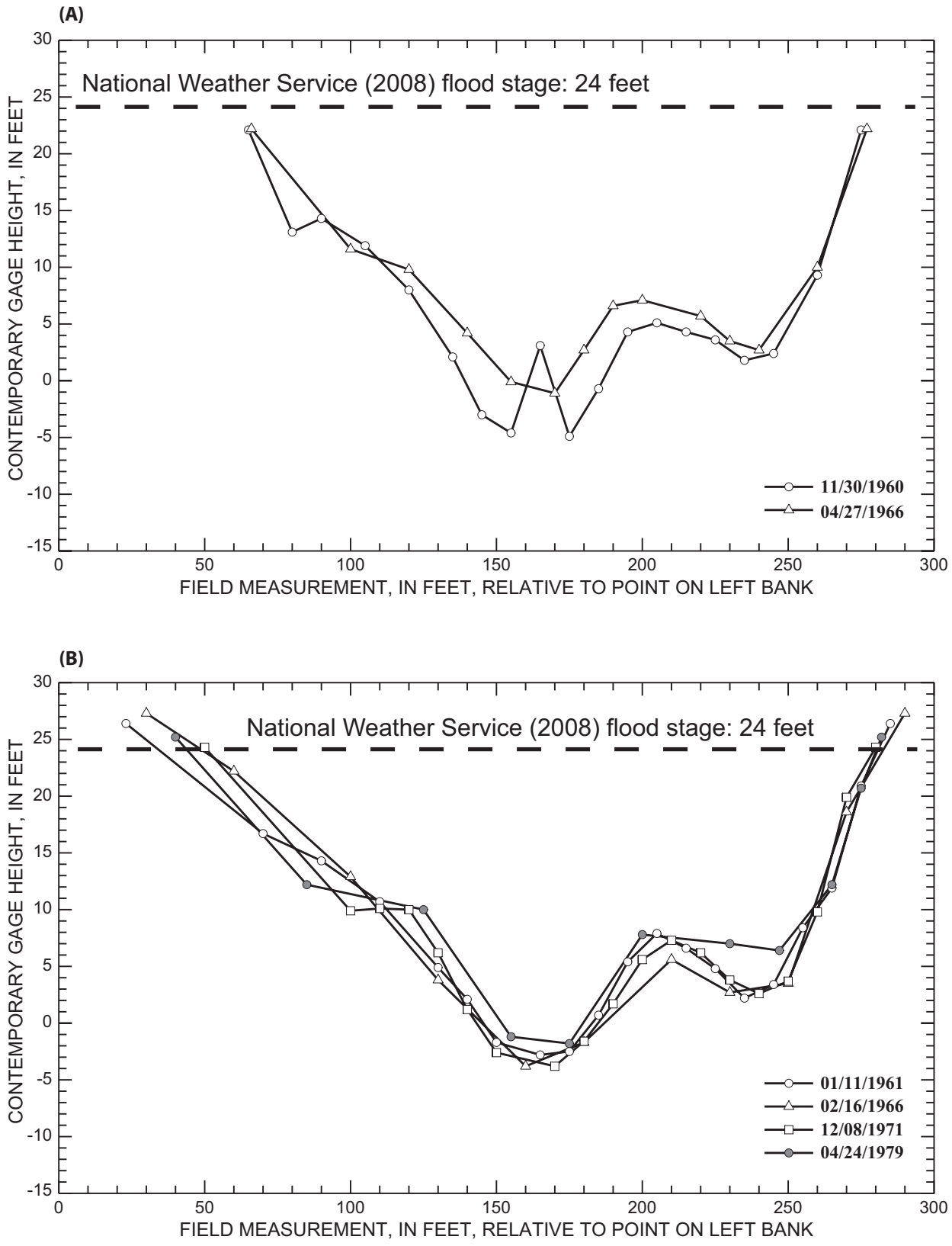


Figure 13. Historical cross-sectional channel geometry for U.S. Geological Survey streamflow-gaging station 08030500 Sabine River near Ruliff, Texas, (A) at moderate-flow conditions (greater than 5,000 cubic feet per second and less than 10,000 cubic feet per second), 1960–66; and (B) at high-flow conditions (greater than 10,000 cubic feet per second), 1961–79.

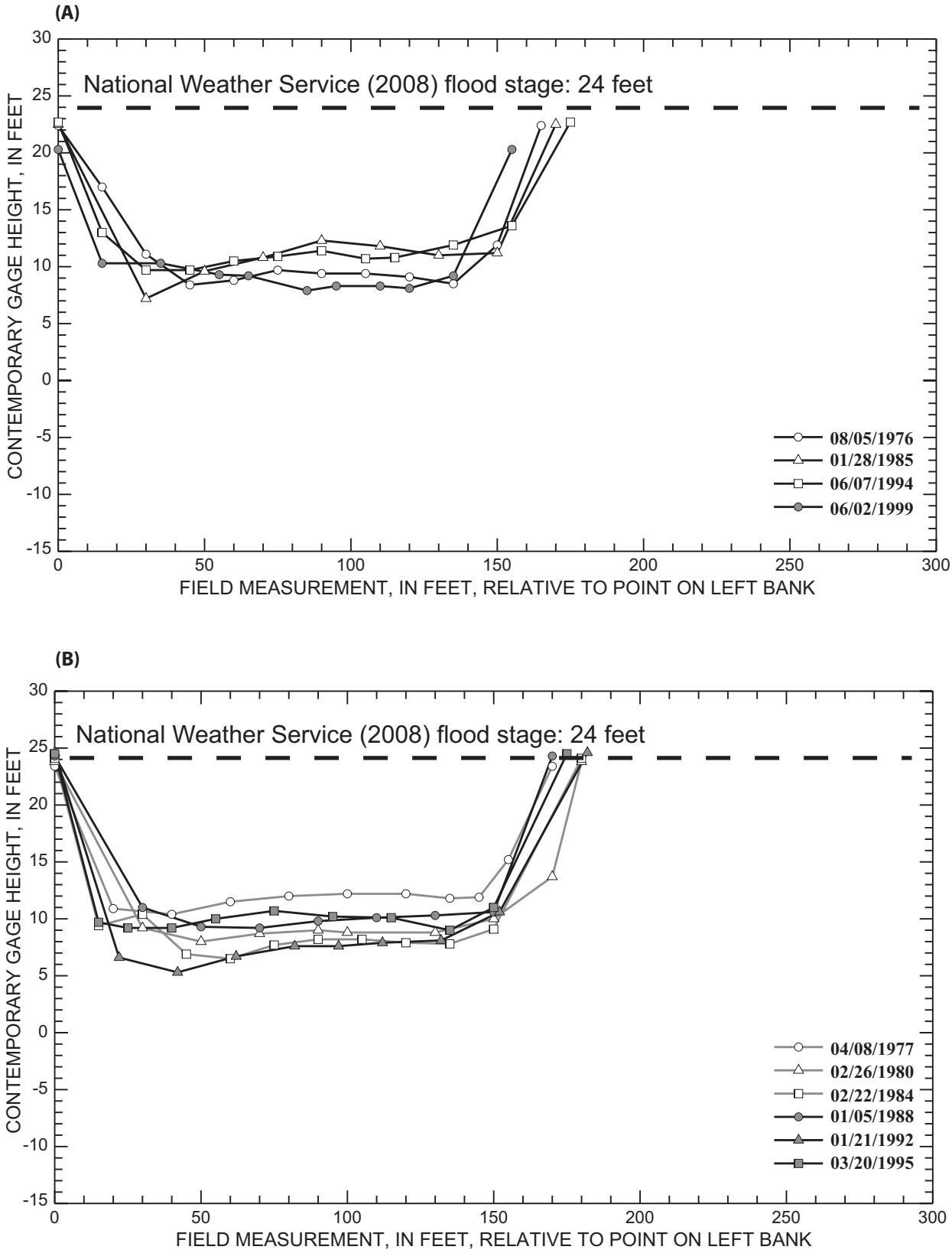


Figure 14. Historical cross-sectional channel geometry for Indian Bayou (U.S. Geological Survey streamflow-gaging station 08030500 Sabine River near Ruliff, Texas), (A) at moderate-flow conditions (total streamflow greater than 5,000 cubic feet per second and less than 10,000 cubic feet per second), 1976–99; and (B) at high-flow conditions (total streamflow greater than 10,000 cubic feet per second), 1977–95.

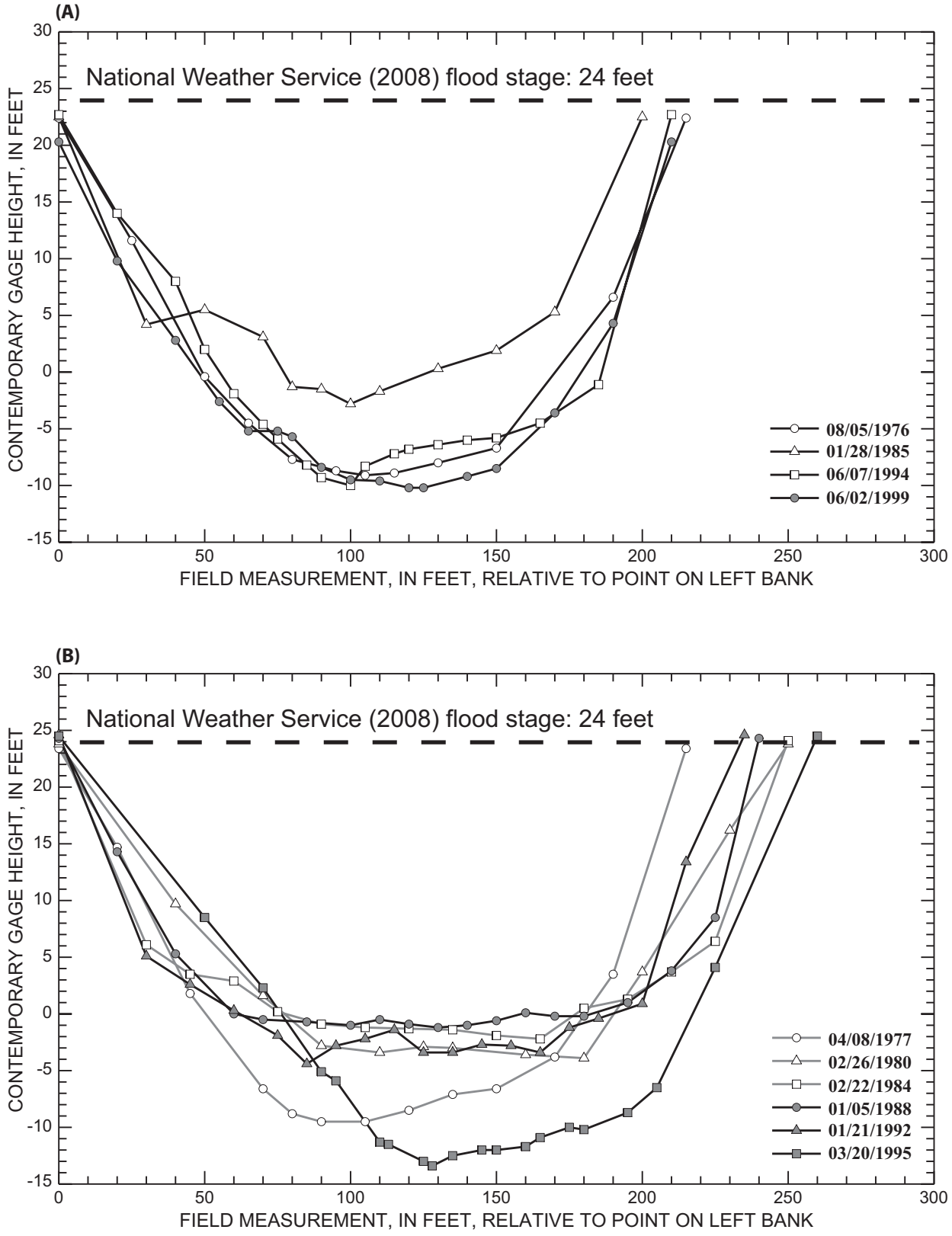


Figure 15. Historical cross-sectional channel geometry for Old River (U.S. Geological Survey streamflow-gaging station 08030500 Sabine River near Ruliff, Texas), (A) at moderate-flow conditions (total streamflow greater than 5,000 cubic feet per second and less than 10,000 cubic feet per second), 1976–99; and (B) at high-flow conditions (total streamflow greater than 10,000 cubic feet per second), 1977–95.

Table 11. Hydraulic computations for historical cross sections of U.S. Geological Survey streamflow-gaging station 08030500, Sabine River near Ruliff, Texas, 1960–79.

[ft, feet; ft^3/s, cubic feet per second; ft^2, square feet; ft/s, feet per second; lb/ft^2, pounds per square foot; >, greater than; <, less than]

Date	Contemporary stage (ft)	Discharge[1] (ft^3/s)	Width[2] (ft)	Hydraulic depth[2, 3] (ft)	Cross-sectional area[2] (ft^2)	Mean velocity[2] (ft/s)	Bed shear stress[2] (lb/ft^2)	Froude number[2]
Moderate flow (>5,000 ft^3/s, <10,000 ft^3/s)								
15.0-foot target stage								
Nov. 30, 1960	15.1	8,170	190.1	10.4	1,982	1.20	0.06	0.07
Apr. 27, 1966	14.9	8,560	177.4	8.95	1,587	1.37	.05	.08
20.0-foot target stage								
Nov. 30, 1960	20.1	8,170	204.3	14.5	2,968	1.51	.08	.07
Apr. 27, 1966	19.9	8,560	200.4	12.6	2,532	1.76	.08	.09
High flow (>10,000 ft^3/s)								
15.0-foot target stage								
Jan. 11, 1961	15.2	52,000	186.2	9.91	1,846	1.46	.06	.08
Feb. 16, 1966	15.2	62,200	175.4	11.3	1,983	1.64	.07	.09
Dec. 8, 1971	15.2	21,200	183.8	10.5	1,925	1.46	.06	.08
Apr. 24, 1979	15.2	39,500	193.9	8.42	1,633	1.25	.05	.08
20.0-foot target stage								
Jan. 11, 1961	20.2	52,000	221.2	13.0	2,873	1.80	.08	.09
Feb. 16, 1966	20.2	62,200	205.1	14.3	2,932	1.98	.09	.09
Dec. 8, 1971	20.2	21,200	206.4	14.0	2,899	1.79	.08	.08
Apr. 24, 1979	20.2	39,500	217.1	12.2	2,660	1.62	.07	.08

[1] Discharge is for measurement, not a subdivided estimate based on hydraulic analyses.

[2] Hydraulic computations before October 3, 1966, are pre-regulation of flow by reservoirs or other structures.

[3] Hydraulic depth is ratio of cross-sectional area to width, equivalent to mean depth.

Table 12. Hydraulic computations for historical cross sections of Indian Bayou (U.S. Geological Survey streamflow-gaging station 08030500, Sabine River near Ruliff, Texas), 1976–99.

[ft, feet; ft^3/s, cubic feet per second; ft^2, square feet; ft/s, feet per second; lb/ft^2, pounds per square foot; >, greater than; <, less than]

Date	Contemporary stage (ft)	Discharge[1] (ft^3/s)	Width[2] (ft)	Hydraulic depth[2, 3] (ft)	Cross-sectional area[2] (ft^2)	Mean velocity[2] (ft/s)	Bed shear stress[2] (lb/ft^2)	Froude number[2]
Moderate flow (>5,000 ft^3/s, <10,000 ft^3/s)								
15.0-foot target stage								
Aug. 5, 1976	14.9	8,520	134.0	5.16	690.8	1.03	0.03	0.08
Jan. 28, 1985	15.2	8,760	142.8	4.25	606.9	.93	.03	.08
June 7, 1994	15.2	8,530	146.9	3.98	584.3	.86	.02	.08
June 2, 1999	14.9	5,000	137.2	5.47	750.4	.79	.03	.06
20.0-foot target stage								
Aug. 5, 1976	19.9	8,520	154.5	9.13	1,411	1.56	.06	.09
Jan. 28, 1985	20.2	8,760	161.4	8.47	1,367	1.55	.05	.09
June 7, 1994	20.2	8,530	165.6	8.25	1,366	1.43	.05	.09
June 2, 1999	19.9	5,000	153.7	9.61	1,478	1.17	.06	.07
High flow (>10,000 ft^3/s)								
15.0-foot target stage								
Apr. 8, 1977	14.9	13,800	140.5	3.11	437.4	.80	.02	.08
Feb. 26, 1980	15.0	17,400	153.2	5.49	841.4	1.14	.03	.09
Feb. 22, 1984	15.0	18,700	152.5	6.45	983.1	1.35	.04	.09
Jan. 5, 1988	15.2	19,400	136.2	4.91	669.3	1.31	.03	.10
Jan. 21, 1992	14.8	21,000	149.0	6.88	1,025	1.39	.04	.09
Mar. 20, 1995	15.0	22,700	147.8	4.86	717.6	1.34	.03	.11
20.0-foot target stage								
Apr. 8, 1977	19.9	13,800	158.0	7.50	1,184	1.68	.05	.11
Feb. 26, 1980	20.0	17,400	168.4	9.77	1,645	1.73	.06	.10
Feb. 22, 1984	20.0	18,700	167.6	10.6	1,783	1.94	.06	.10
Jan. 5, 1988	20.2	19,400	154.8	9.02	1,397	2.06	.05	.12
Jan. 21, 1992	19.8	21,000	165.8	10.9	1,812	1.93	.07	.10
Mar. 20, 1995	20.0	22,700	162.1	9.21	1,492	2.23	.06	.13

[1] Discharge is for measurement, not a subdivided estimate based on hydraulic analyses.

[2] All hydraulic computations are post regulation of flow by reservoirs or other structures.

[3] Hydraulic depth is ratio of cross-sectional area to width, equivalent to mean depth.

Table 13. Hydraulic computations for historical cross sections of Old River (U.S. Geological Survey streamflow-gaging station 08030500, Sabine River near Ruliff, Texas), 1976–99.

[ft, feet; ft^3/s, cubic feet per second; ft^2, square feet; ft/s, feet per second; lb/ft^2, pounds per square foot; >, greater than; <, less than]

Date	Contemporary stage (ft)	Discharge[1] (ft^3/s)	Width[2] (ft)	Hydraulic depth[2, 3] (ft)	Cross-sectional area[2] (ft^2)	Mean velocity[2] (ft/s)	Bed shear stress[2] (lb/ft^2)	Froude number[2]
Moderate flow (>5,000 ft^3/s, <10,000 ft^3/s)								
15.0-foot target stage								
Aug. 5, 1976	14.9	8,520	185.8	16.6	3,092	0.87	0.10	0.04
Jan. 28, 1985	15.2	8,760	175.3	12.0	2,099	1.21	.07	.06
June 7, 1994	15.0	8,530	184.2	16.8	3,090	.99	.10	.04
June 2, 1999	14.8	5,000	192.6	17.4	3,353	.62	.10	.03
20.0-foot target stage								
Aug. 5, 1976	19.9	8,520	205.3	19.8	4,069	.99	.12	.04
Jan. 28, 1985	20.2	8,760	192.2	15.7	3,017	1.48	.09	.07
June 7, 1994	20.0	8,530	201.0	20.2	4,053	1.13	.12	.04
June 2, 1999	19.8	5,000	208.4	20.9	4,356	.70	.12	.03
High flow (>10,000 ft^3/s)								
15.0-foot target stage								
Apr. 8, 1977	15.0	13,800	185.1	17.6	3,260	1.46	.10	.06
Feb. 26, 1980	15.1	17,400	202.7	13.6	2,754	2.03	.08	.10
Feb. 22, 1984	14.8	18,700	221.4	12.9	2,857	1.77	.08	.09
Jan. 5, 1988	14.8	19,400	212.0	12.9	2,743	1.98	.08	.10
Jan. 21, 1992	15.1	21,000	203.4	14.7	2,983	2.15	.09	.10
Mar. 20, 1995	15.1	22,700	214.5	18.4	3,957	2.14	.11	.09
20.0-foot target stage								
Feb. 26, 1980	20.0	17,400	229.8	16.7	3,835	2.39	.10	.10
Feb. 22, 1984	19.8	18,700	236.8	16.9	4,002	2.17	.10	.09
Jan. 5, 1988	19.8	19,400	226.7	16.9	3,840	2.43	.10	.10
Jan. 21, 1992	20.1	21,000	220.0	18.4	4,042	2.56	.11	.11
Mar. 20, 1995	20.1	22,700	238.7	21.3	5,090	2.38	.13	.09

[1] Discharge is for measurement, not a subdivided estimate based on hydraulic analyses.

[2] All hydraulic computations are post regulation of flow by reservoirs or other structures.

[3] Hydraulic depth is ratio of cross-sectional area to width, equivalent to mean depth.

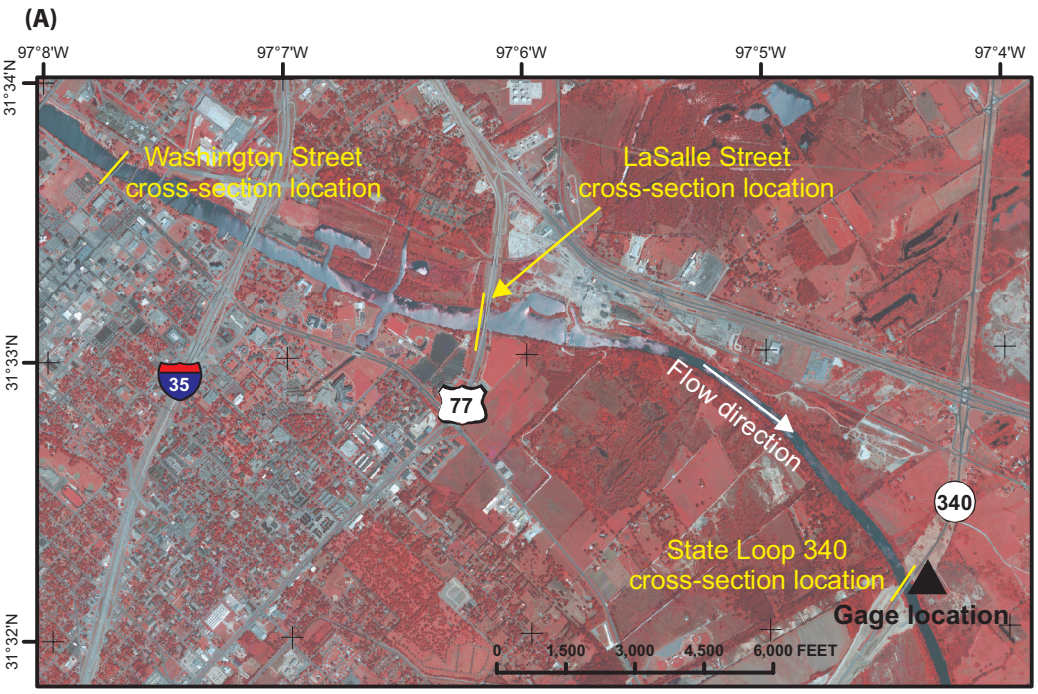


Figure 16. U.S. Geological Survey streamflow-gaging station 08096500 Brazos River at Waco, Texas, (A) 2004 digital orthophoto quarter-quadrangle; and (B) photograph looking upstream at the Brazos River (Lake Brazos) from the State Loop 340 bridge, October 25, 2006.

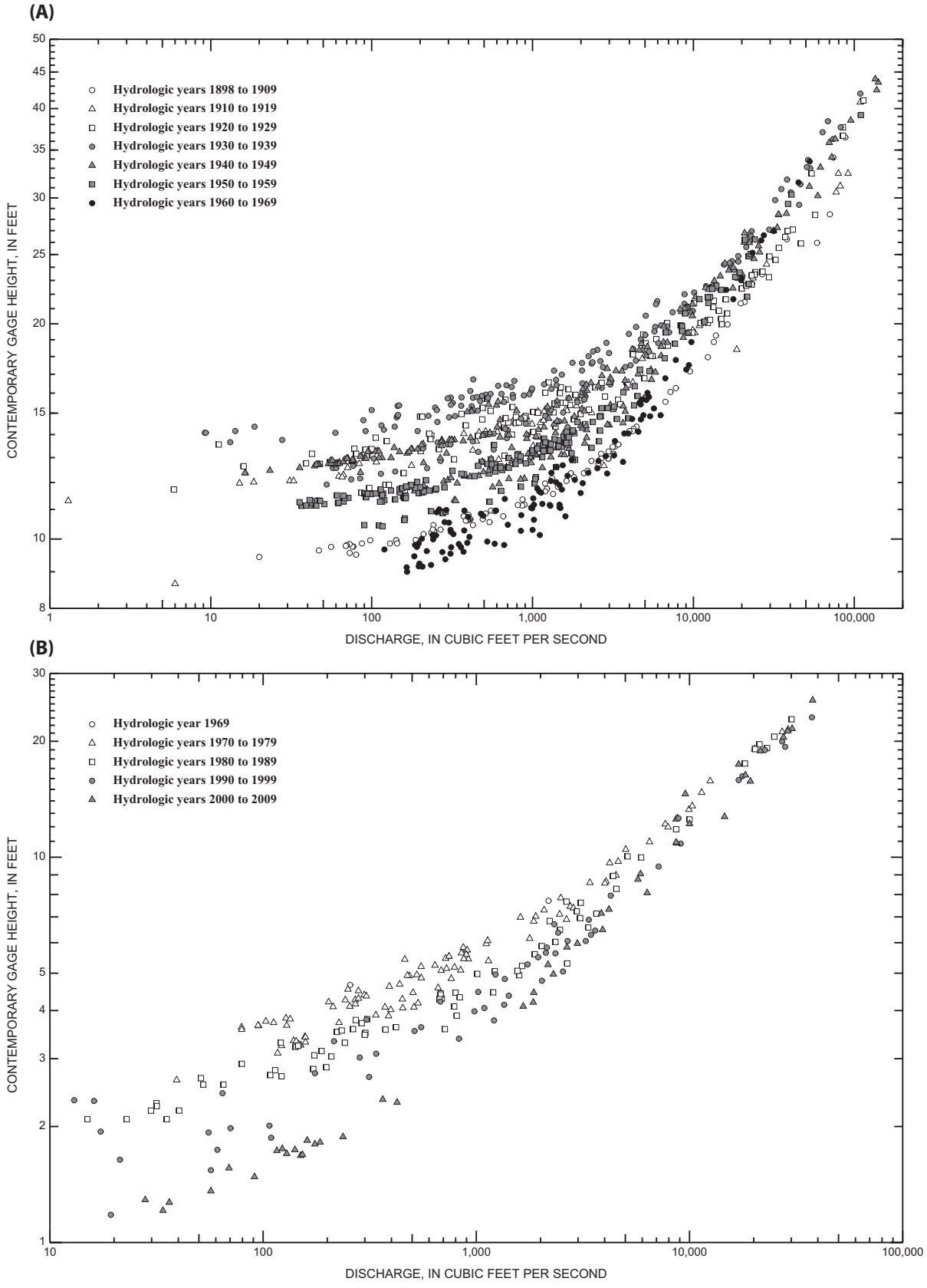


Figure 17. Stage-discharge relations of field measurements for U.S. Geological Survey streamflow-gaging station 08096500 Brazos River at Waco, Texas, (A) 1898–1969, and (B) 1969–2009.

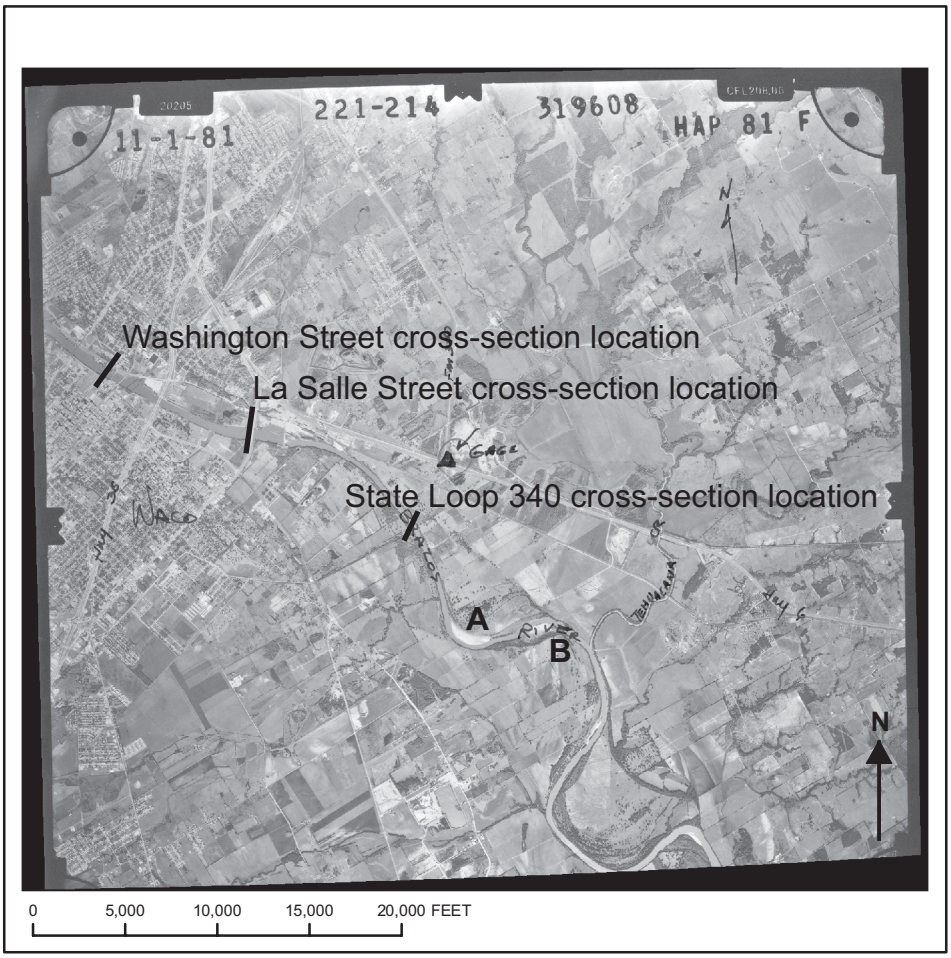


Figure 18. 1981 Aerial photograph showing U.S. Geological Survey streamflow-gaging station 08096500 Brazos River at Waco, Texas, and vicinity. ("A" and "B" denote meander bends; "gage" is not present (2009) location of streamflow-gaging station.)

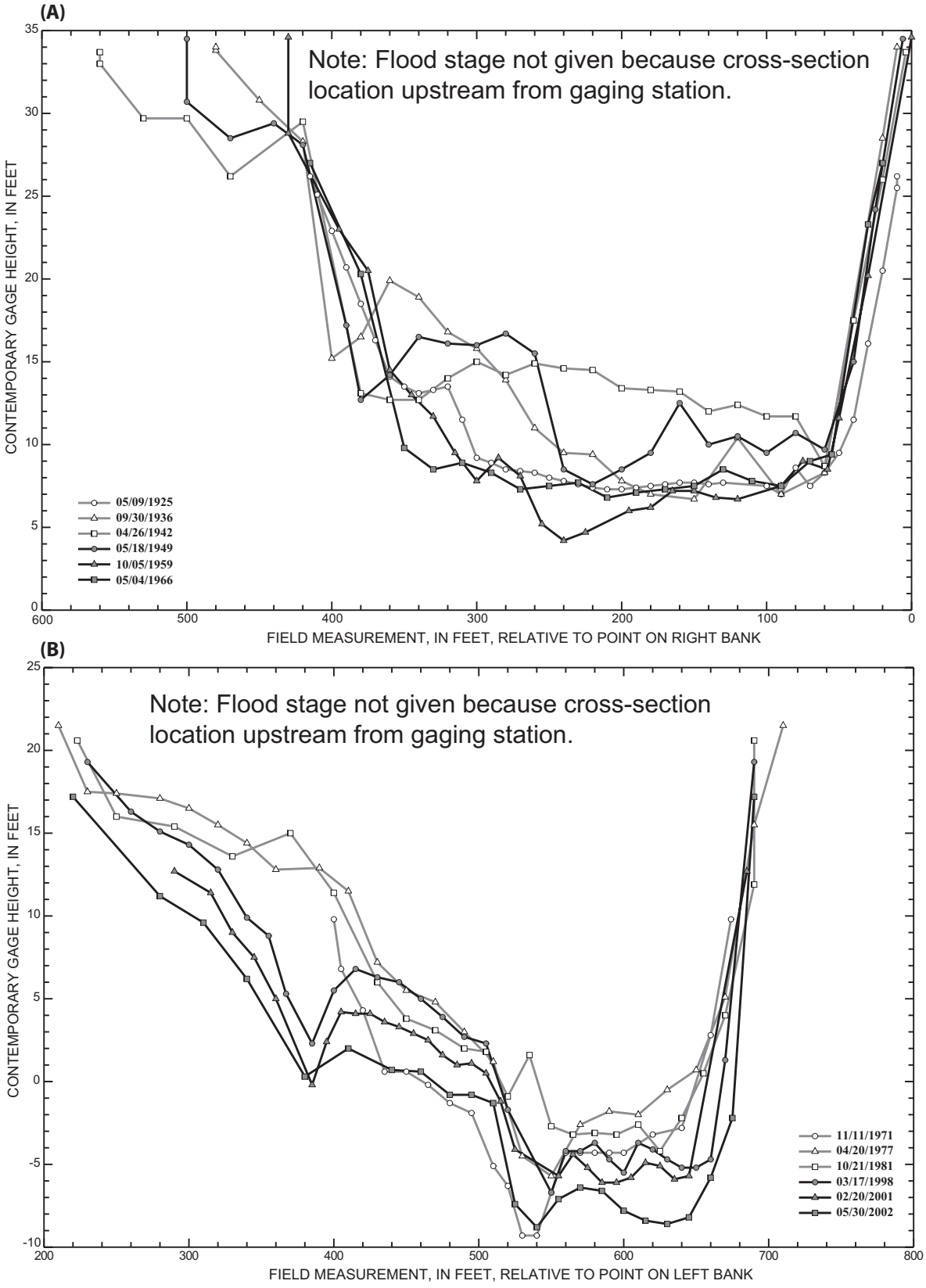


Figure 19. Historical cross-sectional channel geometry for U.S. Geological Survey streamflow-gaging station 08096500 Brazos River at Waco, Texas, (A) at Washington Street bridge at high-flow conditions (greater than 30,000 cubic feet per second), 1925–66; (B) at LaSalle Street bridge at high-flow conditions (greater than 10,000 cubic feet per second), 1971–2002; and (C) at State Loop 340 bridge at high-flow conditions (greater than 10,000 cubic feet per second), 1986–95.

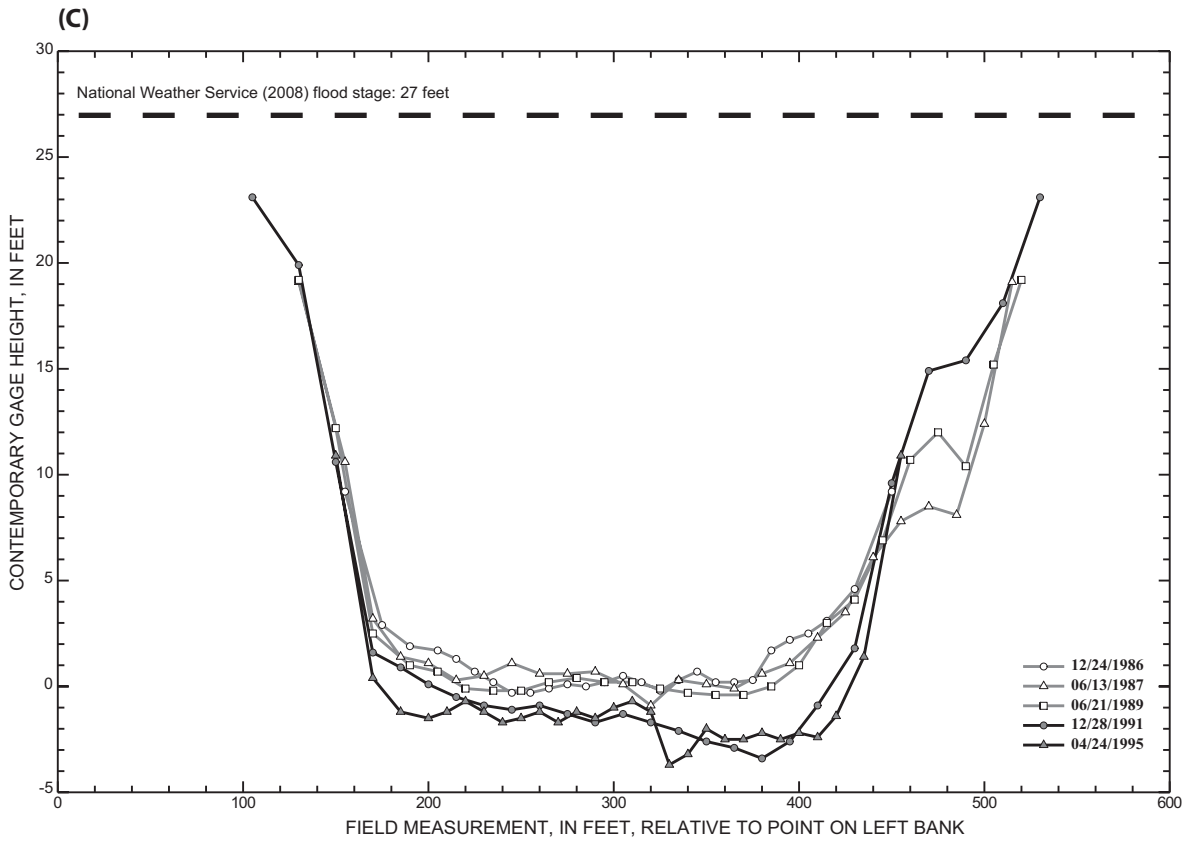


Figure 19.—Continued.

Table 14. Hydraulic computations for historical cross sections of U.S. Geological Survey streamflow-gaging station 08096500, Brazos River at Waco, Texas, at Washington Street bridge, 1925–66.

[ft, feet; ft^3/s, cubic feet per second; ft^2, square feet; ft/s, feet per second; lb/ft^2, pounds per square foot; >, greater than]

Date	Contemporary stage (ft)	Discharge[1] (ft^3/s)	Width[2] (ft)	Hydraulic depth[2, 3] (ft)	Cross-sectional area[2] (ft^2)	Mean velocity[2] (ft/s)	Bed shear stress[2] (lb/ft^2)	Froude number[2]
			High flow (>30,000 ft^3/s)					
20.0-foot target stage								
May 9, 1925	20.0	46,600	365.7	10.2	3,726	5.04	0.19	0.28
Sept. 30, 1936	20.2	51,600	371.2	8.25	3,063	3.21	.15	.20
Apr. 26, 1942	20.2	83,700	363.7	6.74	2,452	3.88	.12	.26
May 18, 1949	20.1	72,400	366.3	7.65	2,801	3.84	.14	.24
Oct. 5, 1959	20.2	52,800	344.2	11.6	3,981	3.41	.21	.18
May 4, 1966	19.8	31,600	342.3	10.9	3,741	3.55	.20	.19
25.0-foot target stage								
May 9, 1925	25.0	46,600	398.6	14.1	5,637	6.94	.26	.33
Sept. 30, 1936	25.2	51,600	388.7	12.8	4,963	4.40	.23	.22
Apr. 26, 1942	25.2	83,700	387.6	11.2	4,330	6.15	.21	.32
May 18, 1949	25.1	72,400	388.4	12.1	4,688	5.55	.22	.28
Oct. 5, 1959	25.2	52,800	388.7	15.0	5,816	4.09	.28	.19
May 4, 1966	24.8	31,600	377.6	14.7	5,536	4.53	.27	.21

[1] Discharge is for measurement, not a subdivided estimate based on hydraulic analyses.

[2] Hydraulic computations before March 21, 1941, are pre-regulation of flow by reservoirs or other structures.

[3] Hydraulic depth is ratio of cross-sectional area to width, equivalent to mean depth.

Table 15. Hydraulic computations for historical cross sections of U.S. Geological Survey streamflow-gaging station 08096500, Brazos River at Waco, Texas, at LaSalle Street bridge, 1971–2002.

[ft, feet; ft^3/s, cubic feet per second; ft^2, square feet; ft/s, feet per second; lb/ft^2, pounds per square foot; >, greater than; <, less than]

Date	Contemporary stage (ft)	Discharge[1] (ft^3/s)	Width[2] (ft)	Hydraulic depth[2, 3] (ft)	Cross-sectional area[2] (ft^2)	Mean velocity[2] (ft/s)	Bed shear stress[2] (lb/ft^2)	Froude number[2]
Moderate flow (>4,000 ft^3/s, <10,000 ft^3/s)								
4.0-foot target stage								
Nov. 11, 1971	4.2	4,630	242.4	7.09	1,719	1.05	0.13	0.07
May 30, 2002	4.2	4,440	326.4	7.36	2,401	.34	.14	.02
9.0-foot target stage								
Nov. 11, 1971	9.2	4,630	271.8	11.1	3,018	1.41	.20	.07
May 30, 2002	9.2	4,440	370.3	11.2	4,136	.46	.20	.02
High flow (>10,000 ft^3/s)								
7.0-foot target stage								
Apr. 20, 1977	6.8	28,000	238.6	6.50	1,551	2.21	.12	.15
Oct. 21, 1981	6.8	25,000	251.5	6.57	1,654	2.15	.12	.15
Mar. 17, 1998	6.8	28,100	314.2	6.63	2,083	2.20	.12	.15
Feb. 20, 2001	6.9	14,600	323.8	7.56	2,449	2.37	.14	.15
12.0-foot target stage								
Apr. 20, 1977	11.8	28,000	277.2	10.2	2,840	3.13	.19	.17
Oct. 21, 1981	11.8	25,000	293.1	10.3	3,013	2.99	.19	.16
Mar. 17, 1998	11.8	28,100	354.8	10.6	3,744	3.11	.19	.17
Feb. 20, 2001	11.9	14,600	377.9	11.1	4,195	3.16	.20	.17

[1] Discharge is for measurement, not a subdivided estimate based on hydraulic analyses.

[2] All hydraulic computations are post regulation of flow by reservoirs or other structures.

[3] Hydraulic depth is ratio of cross-sectional area to width, equivalent to mean depth.

Table 16. Hydraulic computations for historical cross sections of U.S. Geological Survey streamflow-gaging station 08096500, Brazos River at Waco, Texas, at State Loop 340 bridge, 1986–95.

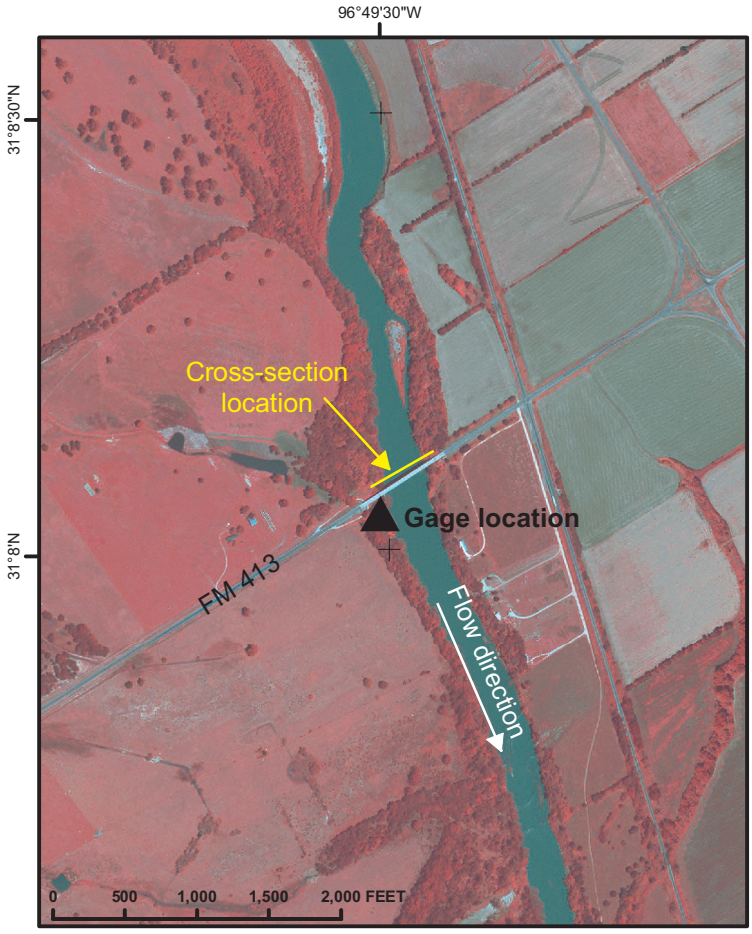
[ft, feet; ft^3/s, cubic feet per second; ft^2, square feet; ft/s, feet per second; lb/ft^2, pounds per square foot; >, greater than; <, less than]

Date	Contemporary stage (ft)	Discharge[1] (ft^3/s)	Width[2] (ft)	Hydraulic depth[2, 3] (ft)	Cross-sectional area[2] (ft^2)	Mean velocity[2] (ft/s)	Bed shear stress[2] (lb/ft^2)	Froude number[2]
Moderate flow (>4,000 ft^3/s, <10,000 ft^3/s)								
4.0-foot target stage								
Dec. 24, 1986	4.2	4,410	255.1	3.24	825.7	1.08	0.06	0.11
Apr. 24, 1995	3.8	9,090	276.5	5.22	1,445	1.47	.10	.11
9.0-foot target stage								
Dec. 24, 1986	9.2	4,410	295.0	7.48	2,206	2.01	.14	.13
Apr. 24, 1995	8.8	9,090	296.6	9.70	2,878	2.29	.18	.13
High flow (>10,000 ft^3/s)								
10.0-foot target stage								
June 13, 1987	10.1	20,300	336.0	7.79	2,616	2.04	.14	.13
June 21, 1989	10.1	23,100	303.3	8.71	2,642	2.57	.16	.15
Dec. 28, 1991	10.1	37,500	300.8	10.3	3,110	2.97	.19	.16
15.0-foot target stage								
June 13, 1987	15.1	20,300	364.3	12.0	4,370	2.85	.22	.15
June 21, 1989	15.1	23,100	363.0	12.0	4,348	3.26	.22	.17
Dec. 28, 1991	15.1	37,500	337.7	13.9	4,689	3.74	.26	.18

[1] Discharge is for measurement, not a subdivided estimate based on hydraulic analyses.

[2] All hydraulic computations are post regulation of flow by reservoirs or other structures.

[3] Hydraulic depth is ratio of cross-sectional area to width, equivalent to mean depth.



2004 National Agriculture Imagery Program color infrared imagery
Projection: Universal Transverse Mercator Zone 14 North
Datum: North American Datum 1983

Figure 20. U.S. Geological Survey streamflow-gaging station 08098290 Brazos River near Highbank, Texas, 2004 digital orthophoto quarter-quadrangle.

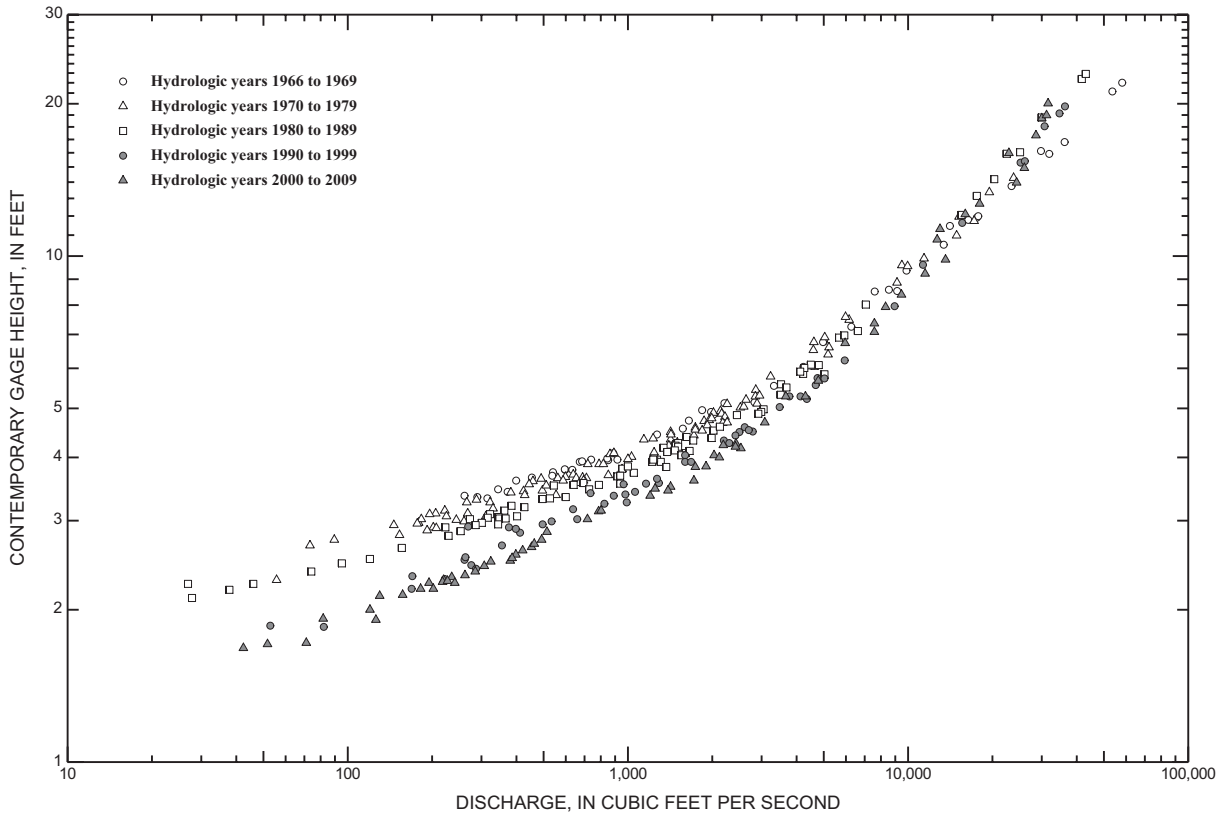


Figure 21. Stage-discharge relations of field measurements for U.S. Geological Survey streamflow-gaging station 08098290 Brazos River near Highbank, Texas, October 1965–2009.

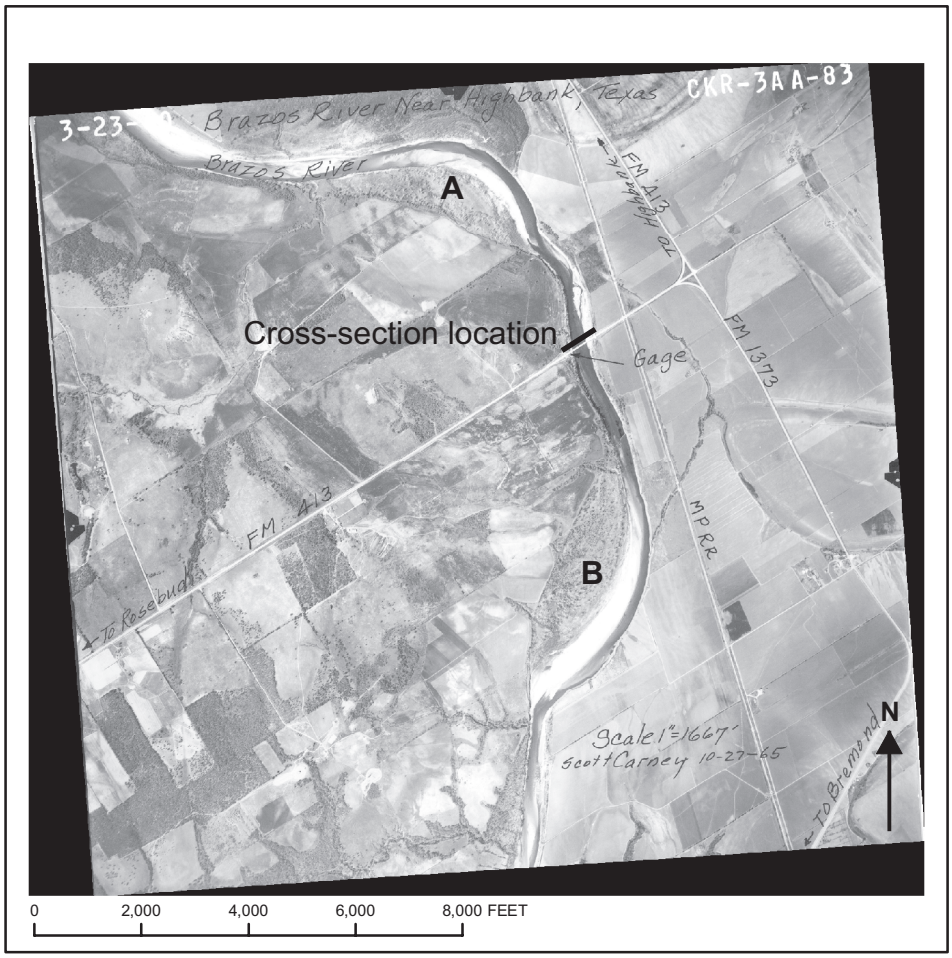
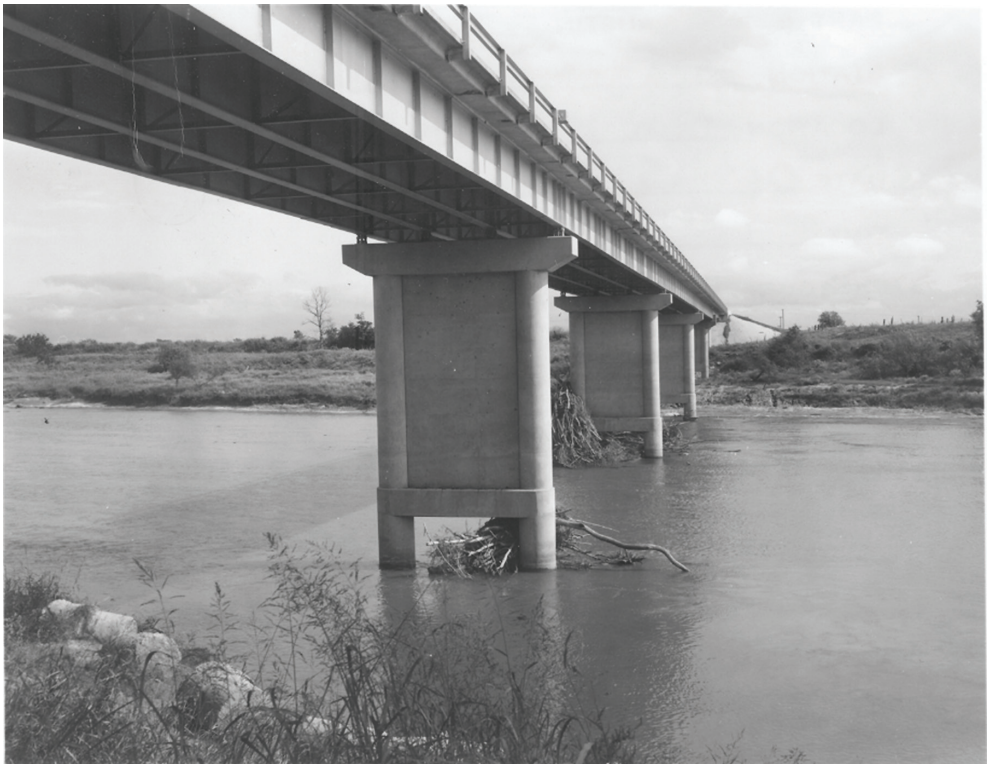


Figure 22. 1960 Aerial photograph of U.S. Geological Survey streamflow-gaging station 08098290 Brazos River near Highbank, Texas, and vicinity. ("A" and "B" denote meander bends.)

(A)



(B)

Figure 23. U.S. Geological Survey streamflow-gaging station 08098290 Brazos River near Highbank, Texas, (A) viewed from right bank downstream from Farm-to-Market Road (FM) 413 bridge, October 15, 1965 (not known if pilings visible at base of bridge piers are result of channel-bed incision); (B) viewed from right bank downstream from FM 413 bridge, April 1, 2008; (C) looking upstream from FM 413 bridge, March 31, 1964; (D) looking downstream from FM 413 bridge, March 31, 1964; (E) looking upstream from FM 413 bridge, April 1, 2008; and (F) looking downstream from FM 413 bridge, April 1, 2008.

(C)

(D)

Figure 23.—Continued.

(E)

(F)

Figure 23.—Continued.

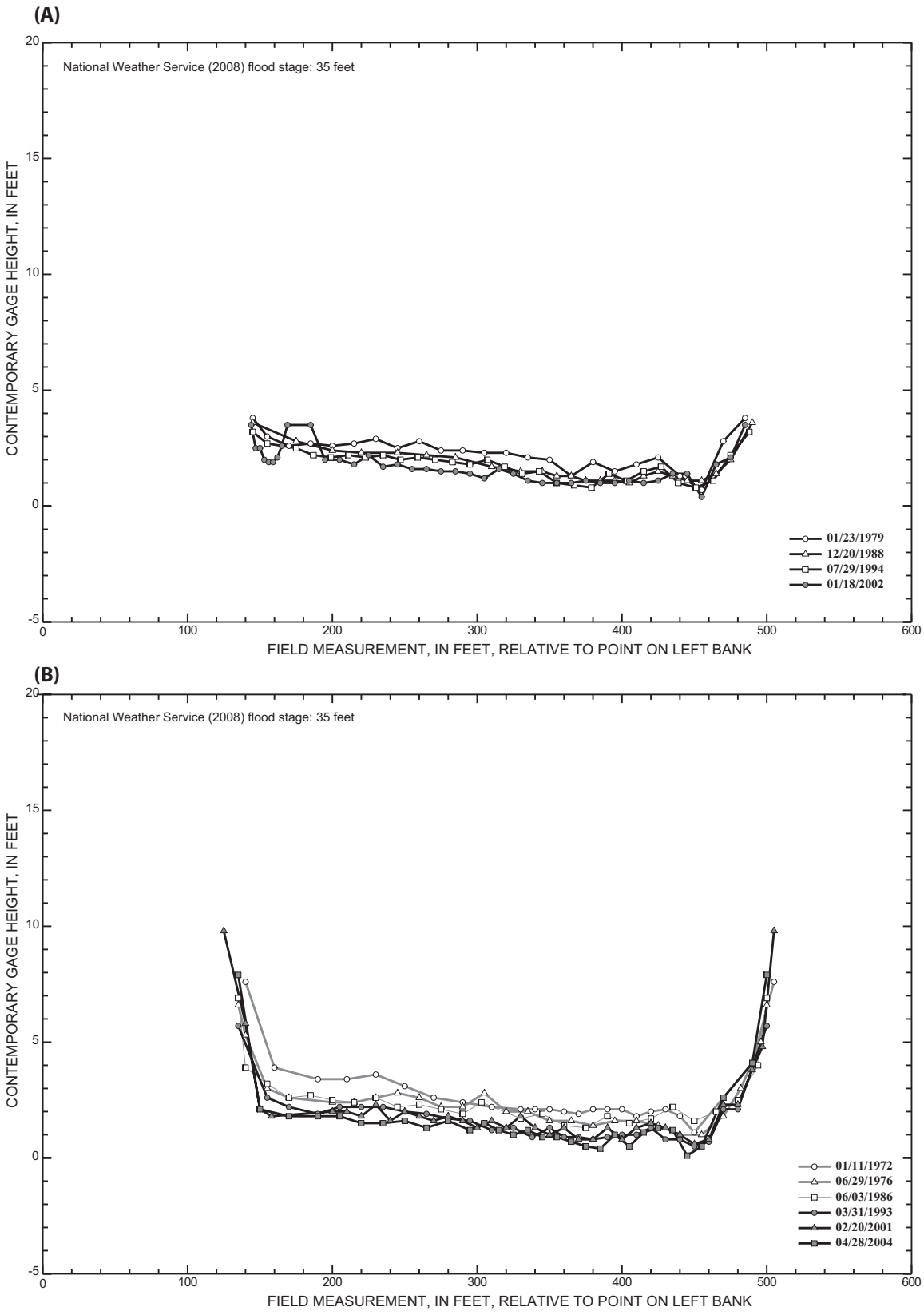


Figure 24. Historical cross-sectional channel geometry for U.S. Geological Survey streamflow-gaging station 08098290 Brazos River near Highbank, Texas, (A) at low-flow conditions (less than 1,500 cubic feet per second), 1979–2002; (B) at moderate-flow conditions (greater than 5,000 cubic feet per second and less than 15,000 cubic feet per second), 1972–2004; and (C) at high-flow conditions (greater than 15,000 cubic feet per second), 1975–97.

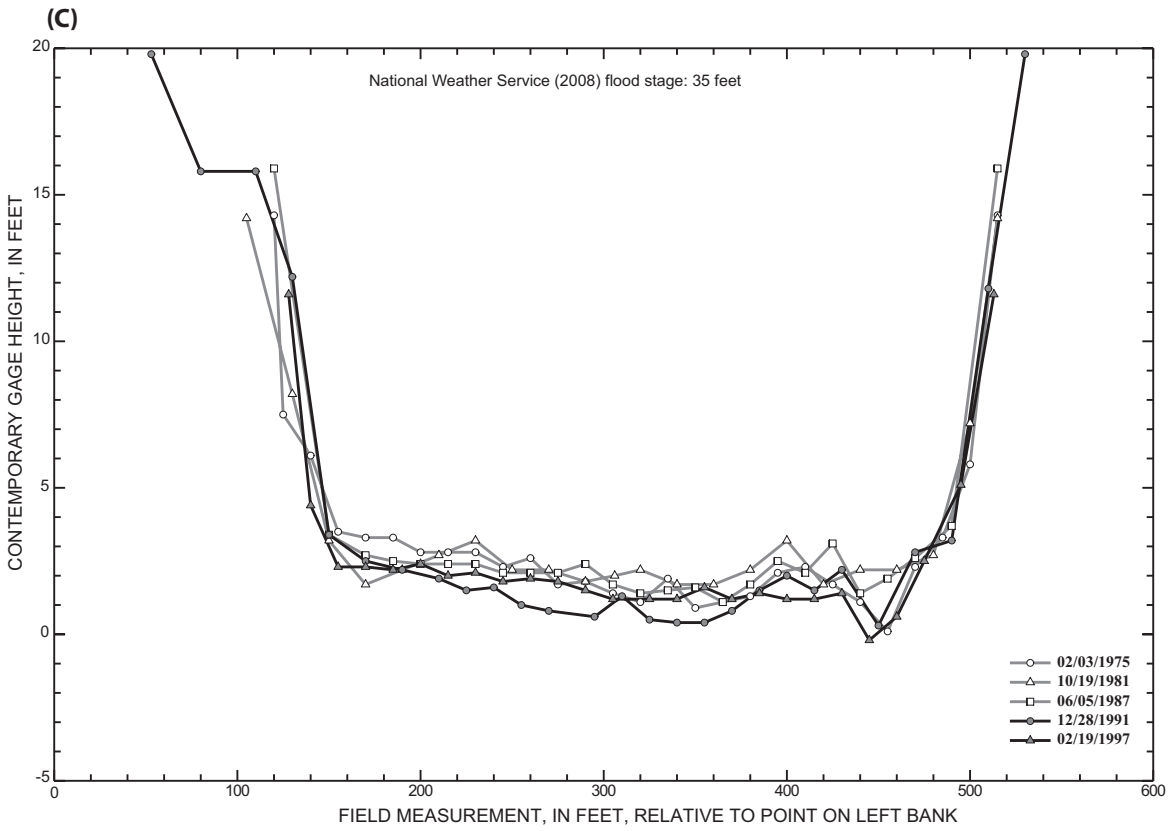


Figure 24.—Continued.

Table 17. Hydraulic computations for historical cross sections of U.S. Geological Survey streamflow-gaging station 08098290, Brazos River near Highbank, Texas, 1972–2004.

[ft, feet; ft^3/s, cubic feet per second; ft^2, square feet; ft/s, feet per second; lb/ft^2, pounds per square foot; >, greater than; <, less than]

Date	Contemporary stage (ft)	Discharge[1] (ft^3/s)	Width[2] (ft)	Hydraulic depth[2, 3] (ft)	Cross-sectional area[2] (ft^2)	Mean velocity[2] (ft/s)	Bed shear stress[2] (lb/ft^2)	Froude number[2]
Moderate flow (>5,000 ft^3/s, <15,000 ft^3/s)								
5.0-foot target stage								
Jan. 11, 1972	5.1	5,980	340.8	2.46	837.5	1.74	0.03	0.20
June 29, 1976	5.0	5,220	354.0	2.80	992.7	2.17	.03	.23
June 3, 1986	4.8	5,670	357.2	2.59	926.7	1.99	.03	.22
Mar. 31, 1993	5.0	5,030	356.6	3.31	1,179	2.98	.04	.29
Feb. 20, 2001	5.1	13,600	355.6	3.43	1,218	2.22	.04	.21
Apr. 28, 2004	5.1	8,310	350.4	3.64	1,276	2.28	.05	.21
High flow (>15,000 ft^3/s)								
5.0-foot target stage								
Feb. 3, 1975	5.1	23,800	350.0	2.97	1,039	1.64	.04	.17
Oct. 19, 1981	5.2	20,300	349.1	2.86	997.1	1.53	.04	.16
June 5, 1987	5.1	22,500	347.0	2.88	999.7	1.49	.04	.15
Dec. 28, 1991	4.8	36,300	346.9	3.25	1,128	1.60	.04	.16
Feb. 19, 1997	4.8	15,600	353.4	3.07	1,086	1.70	.04	.17
10.0-foot target stage								
Feb. 3, 1975	10.1	23,800	384.5	7.55	2,903	3.51	.09	.23
Oct. 19, 1981	10.2	20,300	384.8	7.38	2,838	3.24	.09	.21
June 5, 1987	10.1	22,500	369.2	7.56	2,790	2.99	.09	.19
Dec. 28, 1991	9.8	36,300	369.9	7.89	2,920	3.01	.10	.19
Feb. 19, 1997	9.8	15,600	377.0	7.73	2,916	3.66	.10	.23

[1] Discharge is for measurement, not a subdivided estimate based on hydraulic analyses.

[2] All hydraulic computations are post regulation of flow by reservoirs or other structures.

[3] Hydraulic depth is ratio of cross-sectional area to width, equivalent to mean depth.