Stage-discharge relation is the relation between gage height and the amount of water flowing in a channel, expressed as volume per unit of time.

Control designates a feature downstream from the gage that determines the stage-discharge relation at the gage. This feature may be a natural constriction of the channel, a long reach of the channel, or an artificial structure.

Contents is the volume of water in a reservoir. Unless otherwise indicated, volume is computed on the basis of a level pool and does not include bank storage.

The drainage area of a stream at a specified location is that area, measured in a horizontal plane, which is so enclosed by a topographic divide that direct surface runoff from precipitation normally would drain by gravity into the river above the specified point. Figures of drainage area given herein include all closed basins, or noncontributing areas, within the area unless otherwise noted.

WSP is used as an abbreviation for "Water-Supply Paper" in references to previously published reports.

DOWNSTREAM ORDER OF LISTING GAGING STATIONS

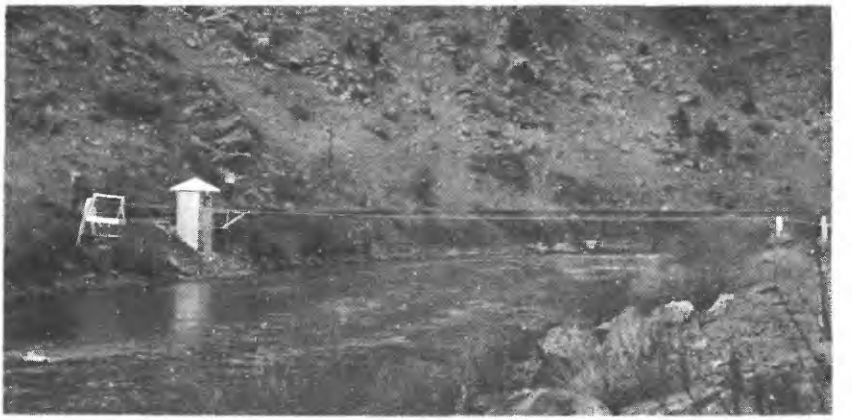
Beginning with the series of reports for the water year ending September 30, 1951, the order of listing gaging-station records was changed. In this report, in a downstream direction along the main stem all stations on a tributary entering above a main-stem station are listed before that station. If a tributary enters between two main-stem stations, it is listed between them. A similar order is followed in listing stations on first rank, second rank, and other ranks of tributaries. To indicate the rank of any tributary on which a gaging station is situated and the stream to which it is immediately tributary, each indention in the listing of gaging stations in the table of contents of this report represents one rank. This downstream order and system of indention show which gaging stations are on tributaries between any two stations on a main stem and the rank of the tributary on which each gaging station is situated.

The order of listing used before the publication of the 1951 report listed first all stations on the main stem from headwaters toward mouth, then all stations on the uppermost tributary to the main stem from the tributary's source to mouth, and then all stations from source to mouth of the uppermost tributary to the tributary.

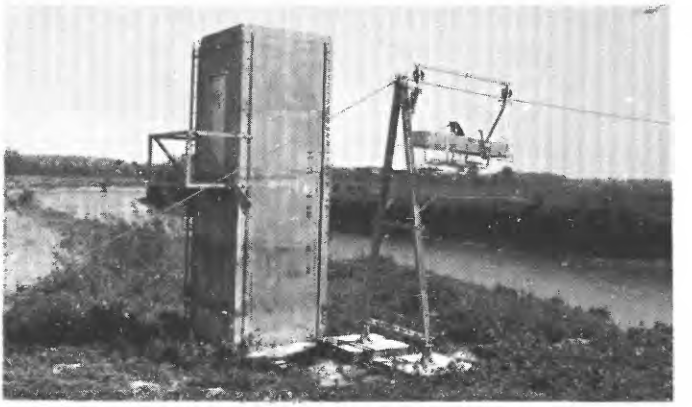
EXPLANATION OF DATA

The base data collected at gaging stations consist of records of stage and measurements of discharge. In addition, observations of factors affecting the stage-discharge relation, weather records, and other information are used to supplement base data in determining the daily flow. The records of stage are obtained either from direct readings on a nonrecording gage or from a water-stage recorder that gives a continuous record of fluctuations. Measurements of discharge are made with a current meter by the general methods adopted by the Geological Survey on the basis of experience in stream gaging since 1888. These methods are described in Water-Supply Paper 888 and are also outlined in standard textbooks on the measurement of stream discharge. Typical structures in use at gaging stations are shown in figure 1.

Rating tables giving the discharge for any stage are prepared from stage-discharge relation curves defined by discharge measurements. If extensions to the rating curves are necessary to define the extremes of discharge, they are made on the basis of indirect



A. South Platte River at South Platte, Colo.



B. Nishnabotna River Above Hamburg, Iowa.

C. Republican River at Trenton, Nebr.

FIGURE 1.—GAGING-STATION STRUCTURES

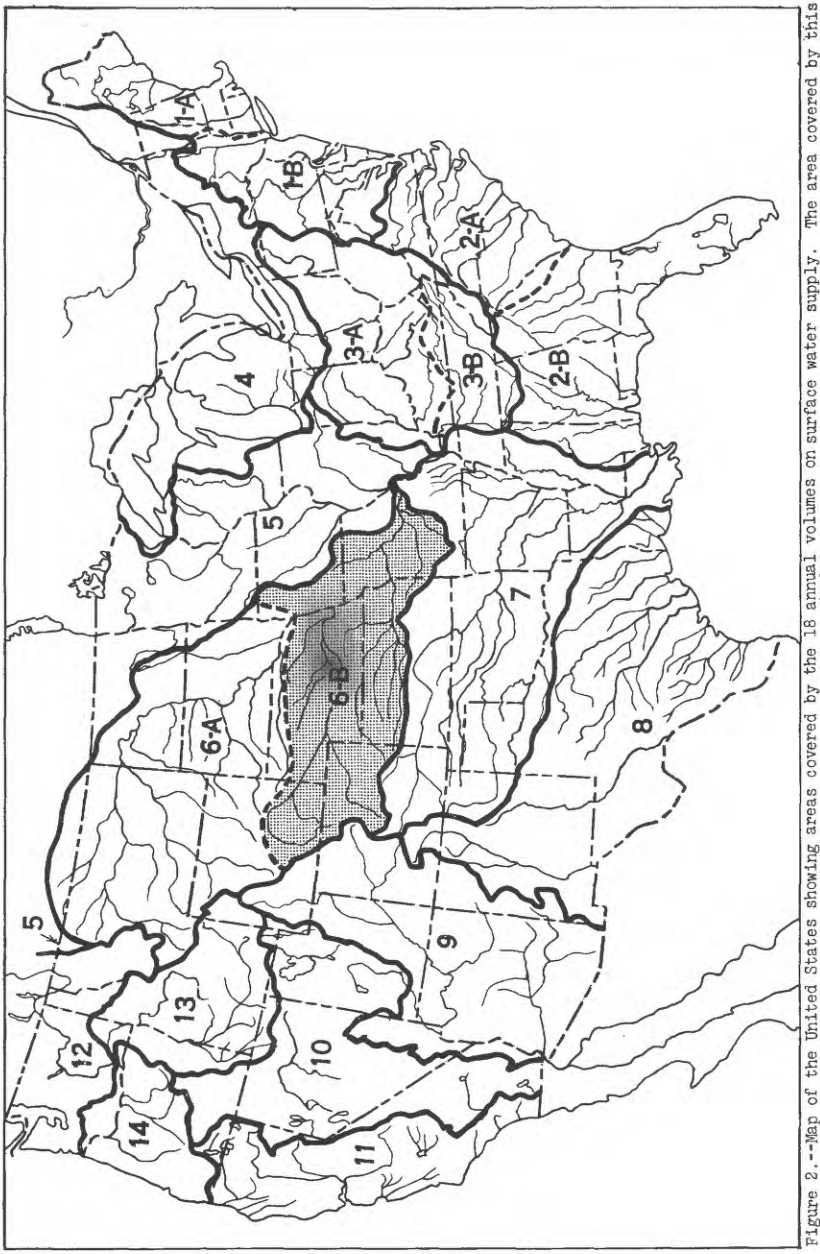


Figure 2.--Map of the United States showing areas covered by the 18 annual volumes on surface water supply. The area covered by this report is shaded.

Early records of the flow of streams in the United States are published in the reports listed below. In many of these reports records for years earlier than those indicated have been included for some streams.

Streamflow data for the years 1884-1901, in reports of the Geological Survey

(A = Annual Report; B = Bulletin)

Report	Character of data	Year
10th A, pt. 2	Descriptive information only.	
11th A, pt. 2	Monthly discharge and descriptive information	1884 to September 1890.
12th A, pt. 2	....do	1884 to June 30, 1891.
13th A, pt. 3	Monthly discharge and descriptive information	1884-92.
14th A, pt. 2	Monthly discharge	1888-93.
B 131	Descriptions, measurements, gage heights, and ratings	1893-94.
16th A, pt. 2	Descriptive information only.	
B 140	Descriptions, measurements, gage heights, ratings, and monthly discharge.	1895.
WSP 11	Gage heights	1896.
18th A, pt. 4	Descriptions, measurements, ratings, and monthly discharge	1895-96.
WSP 15	Descriptions, measurements, and gage heights of streams east of the Mississippi River, and Missouri River and tributaries above Kansas River.	1897.
WSP 16	Descriptions, measurements, and gage heights of streams west of the Mississippi River, except Missouri River and tributaries above Kansas River.	1897.
19th A, pt. 4	Descriptions, measurements, ratings, and monthly discharge	1897.
WSP 27	Measurements, ratings, and gage heights of streams east of the Mississippi River, and Missouri River and tributaries.	1898.
WSP 28	Measurements, ratings, and gage heights of streams west of the Mississippi River, except Missouri River and tributaries.	1898.
20th A, pt. 4	Monthly discharge	1898.
WSP 35 to 39.	Descriptions, measurements, gage heights, and ratings	1899.
21st A, pt. 4	Monthly discharge	1899.
WSP 47 to 52.	Descriptions, measurements, gage heights, and ratings	1900.
22d A, pt. 4.	Monthly discharge	1900.
WSP 65, 66	Descriptions, measurements, gage heights, and ratings	1901.
WSP 75	Monthly discharge	1901.

Reports on surface-water supply containing records from 1899 to date for drainage basins in this report are listed below. The data for any particular gaging station will, in general, be found in the reports covering the years during which the station was maintained. Before 1951, records for the Missouri River basin below Sioux City, Iowa, were included with those of the other rivers of the Missouri River basin.

Numbers of water-supply papers containing results of stream measurements in Missouri River basin below Sioux City, Iowa, 1899-1956

Year	WSP	Year	WSP	Year	WSP	Year	WSP	Year	WSP
1899	37	1912	326	1925	606	1937	826	1949	1146
1900	49,a50	1913	356	1926	626	1938	856	1950	1176
1901	66,75	1914	386	1927	646	1939	876	1951	1210
1902	84	1915	406	1928	666	1940	896	1952	1240
1903	99	1916	436	1929	686	1941	926	1953	1280
1904	130,b131	1917	456	1930	701	1942	956	1954	1340
1905	172	1918	476	1931	716	1943	976	1955	1390
1906	208	1919-20	506	1932	731	1944	1006	1956	1440
1907-8	246	1921	526	1933	746	1945	1036		
1909	266	1922	546	1934	761	1946	1056		
1910	286	1923	566	1935	786	1947	1086		
1911	306	1924	586	1936	806	1948	1116		

a Loup, Platte, and Elkhorn Rivers and tributaries below Platte River.
b Platte and Kansas Rivers.

The records at most of the stations discussed in these reports extend over many years. Discharge measurements at many points other than regular gaging stations have been made each year and are published at the end of each report. The streams and points of measurement are listed in the same order as the streams and gaging stations in the body of the report. An index of the records obtained before 1904 has been published in Water-Supply Paper 119.

A compilation of records for the area covered by this report through September 1950 has been published as Water-Supply Paper 1310. That report contains a summary of monthly and annual discharges for all previously published records as well as some records not contained in the annual series of water-supply papers. All records were reexamined and revised where warranted. Estimates of discharge were made to fill short gaps whenever practical.

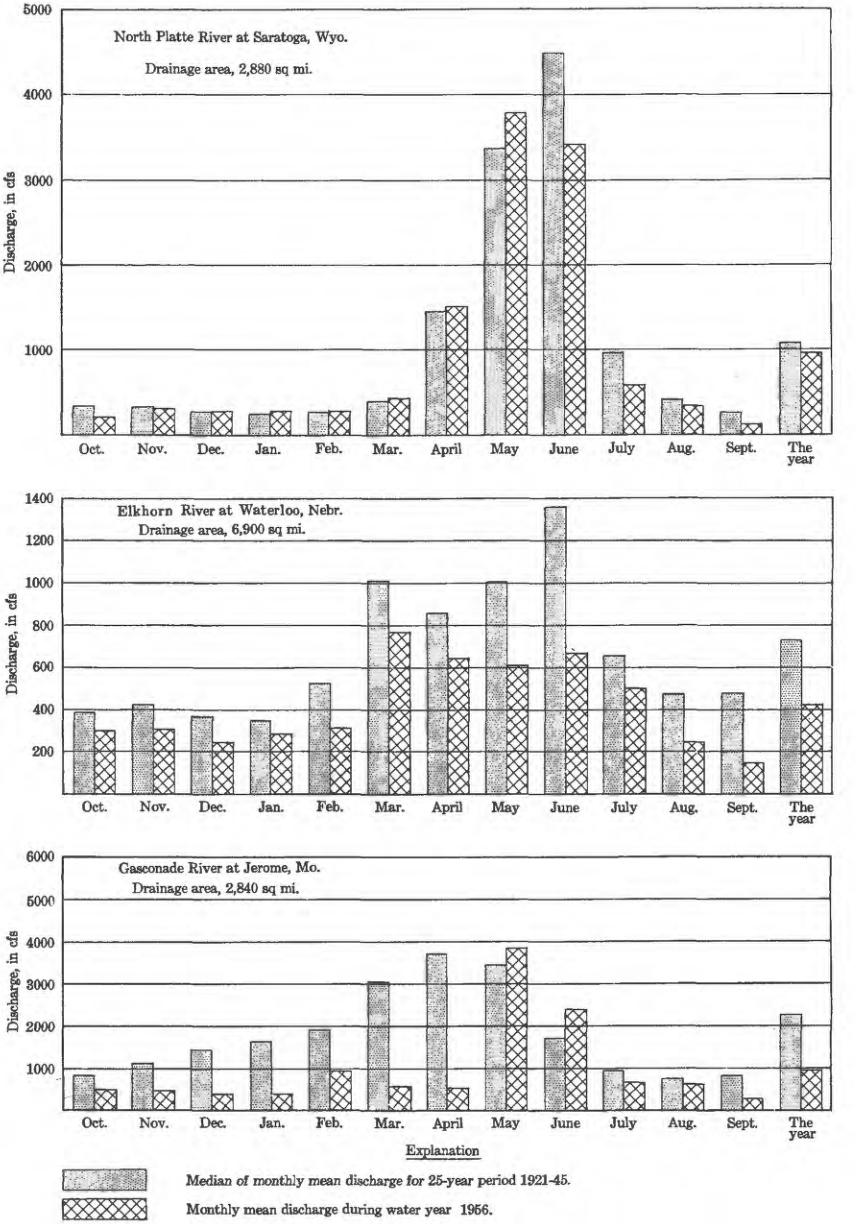


Figure 3. Comparison of discharge at three key gaging stations during 1956 water year with median discharge for 25-year period.

MISSOURI RIVER MAIN STEM

Missouri River at Sioux City, Iowa

Location (revised).--Lat 42°29'10", long 96°24'45", in NW¼SE¼ sec. 16, T. 29 N., R. 9 E., sixth principal meridian, on right bank on upstream side of bridge on U. S. Highway 77 at Sioux City, 2.0 miles downstream from Big Sioux River.

Drainage area.--314,600 sq mi, approximately.

Records available.--October 1897 to September 1956 in reports of Geological Survey (October 1897 to September 1928 and October 1931 to September 1938, monthly discharge only, based on record for station at Williston, N. Dak., in Cir. 108). January 1879 to December 1890 (monthly discharges only) in House Document 238, 73rd Congress, 2d session. Gage-height records collected in this vicinity September 1878 to December 1899 are contained in reports of Missouri River Commission and since July 1889 are contained in reports of U. S. Weather Bureau.

Gage.--Water-stage recorder. Datum of gage is 1,076.96 ft above mean sea level, datum of 1929. Sept. 2, 1878, to Dec. 31, 1905, staff, cable, and chain gages at various locations within 1.7 miles of present site and at various datums. Jan. 1, 1906, to Feb. 14, 1935, chain gage at present site and datum.

Average discharge.--21 years (1928-31, 1938-56), 30,050 cfs (21,760,000 acre-ft per year).

Extremes.--Maximum discharge during year, 38,900 cfs Aug. 18 (gage height, 7.10 ft); minimum daily, 8,100 cfs Nov. 26, Jan. 31; minimum gage height, -1.44 ft Nov. 25.
1928-31, 1938-56: Maximum discharge, 441,000 cfs Apr. 14, 1952; maximum gage height, 24.28 ft Apr. 14, 1952; minimum discharge, 2,500 cfs Dec. 29, 1941; minimum gage height observed, -3.34 ft Dec. 27, 1946.

Remarks.--Records good except those for periods of ice effect, which are fair. Flow partly regulated by upstream main stem reservoirs. Discharge measurements generally made six times a month, three times a month during winter.

Revisions (water years).--WSP 716: 1929-30. WSP 876: Drainage area.

Discharge, in cubic feet per second, water year October 1955 to September 1956

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	31,200	29,800	9,400	8,800	8,800	11,300	28,600	30,900	28,900	30,200	33,400	34,000
2	31,200	27,200	10,500	8,550	8,800	11,300	28,600	29,200	28,900	30,900	33,700	32,600
3	31,600	24,200	12,000	9,300	8,800	12,700	31,200	28,900	29,800	30,900	32,300	32,600
4	32,000	21,500	11,300	9,400	8,800	11,900	30,900	29,800	29,800	28,300	31,200	32,600
5	32,600	18,000	10,700	9,500	8,800	11,500	30,600	29,500	29,800	27,400	31,200	32,300
6	32,600	15,700	9,800	9,500	8,800	11,300	30,900	29,200	30,900	27,100	31,600	32,000
7	32,600	12,900	9,800	9,450	8,800	12,100	29,500	28,900	30,600	26,800	32,300	30,600
8	32,000	10,900	9,400	9,300	8,700	13,500	28,000	29,200	29,200	27,100	32,600	30,900
9	31,200	10,200	8,800	9,300	8,700	14,100	28,300	29,200	28,600	28,300	32,300	32,000
10	31,200	10,000	8,500	9,300	8,600	16,300	28,300	29,500	29,200	28,900	33,700	33,000
11	31,200	10,000	8,400	9,300	8,800	18,500	28,300	29,800	28,900	31,000	33,000	33,000
12	30,900	10,000	8,300	9,300	9,000	19,800	28,600	29,500	28,900	34,300	33,000	33,000
13	30,900	9,900	8,300	9,200	8,900	21,000	29,200	28,900	29,800	31,600	33,700	34,000
14	31,200	9,750	8,300	9,200	8,800	27,800	29,500	29,200	31,200	30,900	34,400	33,400
15	31,600	9,900	8,250	9,000	8,800	33,700	29,800	28,900	31,200	32,300	34,800	35,400
16	31,600	9,000	8,250	8,800	8,800	32,600	29,800	28,600	32,300	31,200	35,100	35,400
17	31,600	8,800	8,500	8,550	8,900	30,600	29,500	28,600	32,300	30,600	35,400	35,100
18	31,600	8,800	9,200	8,500	9,000	30,900	29,200	28,900	32,600	30,900	36,500	35,400
19	31,600	8,800	9,600	8,400	9,100	30,900	29,200	29,200	32,600	29,500	34,400	35,400
20	32,600	10,000	10,200	8,400	9,300	32,000	29,500	30,600	32,000	28,300	33,000	35,100
21	32,600	11,000	10,300	8,400	9,400	31,200	29,200	30,900	32,600	27,700	34,000	34,800
22	32,600	10,900	10,400	8,500	9,600	32,300	29,500	30,600	34,000	28,000	33,700	34,800
23	33,000	9,900	10,500	8,700	9,800	31,600	29,800	30,200	32,300	28,300	33,000	33,700
24	33,000	8,400	10,400	9,000	10,200	28,000	30,200	31,600	29,200	29,200	33,700	33,000
25	32,600	8,250	10,200	9,200	10,500	29,500	31,200	29,800	20,600	30,600	33,400	33,700
26	31,600	8,100	9,500	9,400	11,000	29,500	31,600	30,200	33,000	33,000	32,600	33,400
27	32,600	8,850	9,250	9,300	11,300	30,900	31,600	29,500	29,800	33,700	33,400	34,400
28	32,300	8,500	9,000	9,300	11,300	31,200	31,600	29,500	27,100	34,000	33,400	34,400
29	32,000	8,600	8,800	9,200	11,300	29,800	31,200	29,800	27,700	34,400	34,400	34,400
30	32,000	8,800	8,600	9,000	------	28,900	31,200	29,500	29,800	34,400	34,800	35,100
31	31,600	------	8,800	8,100	------	29,200	------	28,900	------	34,400	35,100	------
Total	988,900	366,650	293,250	279,150	271,400	735,900	894,600	917,000	913,600	944,200	ǂ1,039.1	ǂ1,009.5
Mean	31,900	12,220	9,460	9,005	9,359	23,740	29,820	29,580	30,450	30,460	33,520	33,650
Ac-ft	ǂ1,961	727,200	581,700	553,700	538,300	ǂ1,460	ǂ1,774	ǂ1,819	ǂ1,812	ǂ1,873	ǂ2,061	ǂ2,002

Calendar year 1955: Max 36,500 Min 6,200 Mean 22,230 Ac-ft 16,090,000
Water year 1955-56: Max 36,500 Min 8,100 Mean 23,640 Ac-ft 17,160,000

Peak discharge (base, 80,000 cfs).--No peak above base.
ǂ Expressed in thousands.
Note.--Stage-discharge relation affected by ice Nov. 17-21, Nov. 28 to Mar. 2.