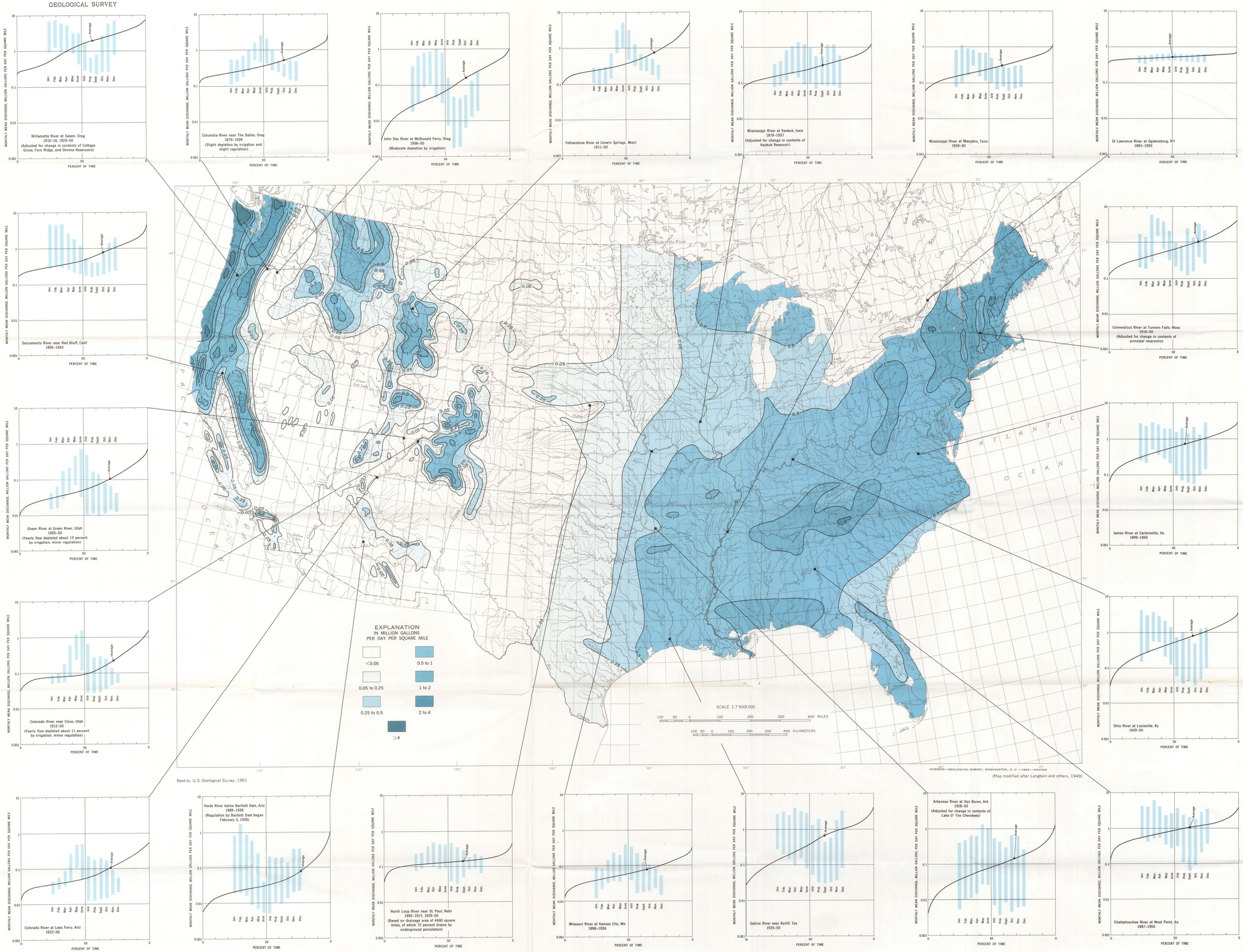

AVERAGE RUNOFF IN THE CONTERMINOUS UNITED STATES AND FLOW CHARACTERISTICS OF CERTAIN STREAMS

AVERAGE RUNOFF AND FLOW CHARACTERISTICS OF CERTAIN STREAMS

Eastward from about the 100th meridian, average runoff everywhere exceeds 0.05 mgd per mi² (million gallons per day per square mile) or about 1 inch in a year; westward from that meridian, average runoff equals or exceeds that amount only on the higher parts of mountainous areas. Average runoff exceeds 4 mgd per mi² only locally on the Pacific Slope in Oregon and Washington.

Flow characteristics of the several streams are shown around the map by diagrams whose general features are explained on plate 1. The diagrams show the following specific characteristics:

1. Among the streams diagrammed, the greatest water yield per square mile of area drained is that of the Willamette River at Salem, Oreg.; the least is that of the Verde River at (below) Bartlett Dam, Ariz. In terms of median monthly flow, yield of the Willamette is 80-fold greater than that of the Verde.

2. The most uniform flow shown, that of the St. Lawrence River at Ogdensburg, N.Y., is due to natural regulation by the Great Lakes; the least uniform, or most variable, flows are those of the John Day River at McDonald Ferry, Oreg., and the Arkansas River at Van Buren, Ark. Among the 20 streams, the ratio of average to median monthly flow ranges from 1 to 2.5; the ratio between upper and lower decile limits of the duration arrays ranges from 1.4 to 29. (See the following table.)

3. A wide downward sweep of the duration curve at its left end, signifying that flow of the stream dwindles greatly at times, is most pronounced for the John Day and Arkansas Rivers. Conversely, a wide upward sweep of the curve at its right end, signifying relatively large flood flows at irregular intervals of time, is pronounced for the Verde River below Bartlett Dam, Ariz. It must be emphasized that these particular duration curves are based on monthly mean flows; consequently they do not show the extreme instantaneous rates of water yield. For example, for the Ohio River at Louisville, Ky., the diagram shows a maximum monthly water yield of 4.2 mgd per mi² whereas the maximum instantaneous rate is 7.9 mgd per mi².

4. Among the bar charts, note, for example, the variability in flow of the main-stem Columbia River at The Dalles, Oreg., in contrast with its two tributaries, the John Day River and Willamette River. On the main stem, maximum yield ordinarily occurs in May or June, owing to snowmelt from high, remote parts of the drainage basin. Minimum yield occurs about January, when basin-wide water content of snow and ice probably is about maximum. Yield from the John Day River basin ordinarily is greatest in April or May, a month earlier than on the main stem, also owing to snowmelt but from terrane of intermediate altitude. In all months other than April, water yield varies widely. From the relatively low Willamette River basin, yield is largely rain generated, varies widely during the rainy season from October to April, and ordinarily is greatest about in February. The bar chart for the Arkansas River shows extremely variable yield in all months; the chart for the Ohio River shows moderate variability in all months but has a pronounced swing between a maximum in March or April and a minimum from August to October.

Owing to diverse flow characteristics such as suggested by this map and diagrams, streams must be managed in different ways to make them most useful. (See table below.)

Flow characteristics of the 20 streams

Stream	Drainage area (mi²)	Term of record used	Average discharge (mgd per mi²)	Median discharge (mgd per mi²)	Average / Median	Decile limits: Upper (mgd per mi²)	Decile limits: Lower (mgd per mi²)	Decile limits: Upper / Lower
Willamette River at Salem, Oreg.[1]	7,280	1910–16, 1924–50	1.97	1.58	1.24	4.6	.33	14
Columbia River near The Dalles, Oreg.[2]	237,000	1879–1939	.538	.38	1.41	1.2	.19	6.3
John Day River at McDonald Ferry, Oreg.[3]	7,580	1906–50	.167	.069	2.44	.47	.012	39
Yellowstone River at Corwin Springs, Mont.	2,623	1911–50	.743	.374	1.97	1.9	.19	10
Mississippi River at Keokuk, Iowa[4]	119,000	1879–1937	.330	.252	1.31	.65	.12	5.4
Mississippi River at Memphis, Tenn.	932,800	1934–50	.319	.239	1.33	.62	.11	5.6
St. Lawrence River at Ogdensburg, N.Y.	295,200	1861–1950	.524	.523	1.00	.62	.44	1.4
Connecticut River at Turners Falls, Mass.[5]	7,163	1916–50	1.05	.621	1.70	2.3	.26	8.8
James River at Cartersville, Va.	6,242	1899–1950	.747	.588	1.27	1.6	.20	8.0
Ohio River at Louisville, Ky.[6]	91,170	1929–50	.796	.543	1.47	1.8	.12	15
Sacramento River near Red Bluff, Calif.[7]	9,265	1895–1943	.808	.48	1.67	1.8	.25	7.2
Green River, at Green River, Utah[8]	40,600	1905–50	.107	.052	2.08	.29	.023	13
Colorado River near Cisco, Utah[9]	24,100	1912–50	.227	.090	2.51	.62	.065	9.5
Colorado River at Lees Ferry, Ariz.[9]	107,900	1922–50	.104	.051	2.04	.26	.029	9.0
Verde River below Bartlett Dam, Ariz.	6,500	1889–1939	.077	.031	2.49	.20	.014	14
North Loup River near St. Paul, Nebr.[10]	4,460	1895–1915, 1929–50	.143	.136	1.06	.20	.092	2.2
Missouri River at Kansas City, Mo.[11]	489,200	1898–1936	.079	.059	1.33	.16	.028	5.7
Sabine River near Ruliff, Tex.	9,444	1925–50	.644	.381	1.69	1.5	.064	23
Arkansas River at Van Buren, Ark.[12]	150,218	1928–50	.142	.081	1.77	.35	.017	21
Chattahoochee River at West Point, Ga.	3,550	1897–1950	1.05	.841	1.24	2.1	.38	5.5

[1] Adjusted for change in contents of Cottage Grove, Fern Ridge, and Dorena Reservoirs.

[2] Major regulation began in 1940; previously, regulation and depletion had been nominal.

[3] Yearly flow depleted moderately by irrigation; no regulation.

[4] Adjusted for change in contents of Keokuk Reservoir.

[5] Adjusted for changes in contents of principal reservoirs.

[6] Low and medium flows affected by operation of hydroelectric plant and of navigation dams.

[7] Major regulation began Dec. 30, 1943; yearly flow depleted slightly by irrigation.

[8] Yearly flow depleted about 12 percent by irrigation; minor regulation.

[9] Yearly flow depleted about 8 percent by irrigation and ½ percent by diversions from basin; minor regulation.

[10] About 72 percent of cited drainage area contributes only by underground percolation.

[11] Major regulation by Fort Peck Reservoir began in 1937; some previous regulation by numerous small reservoirs.

[12] Adjusted for change in contents of Lake O' The Cherokees.