STREAMFLOW

The daily mean surface-water discharge values for the sites presented in table 2 (sheet 2) are published by the U.S. Geological Survey in a series of annual reports; annual records were published in a series of water-supply papers ending in 1960 (for example, U.S. Geological Survey, 1961) and from 1961 to the present in a series of annual data reports (U.S. Geological Survey, 1961-). Mean, maximum, and minimum mean monthly discharges for 12 of these gaging stations are shown in figures 6a through 17a. Daily discharges at these stations for years when precipitation is considerably higher than normal, years when precipitation is considerably lower than normal, and mean daily discharges for period of record are shown in figures 6b through 17b. With the exception of the Columbia and Snake Rivers, the variations in discharges shown in these figures are typical of most unregulated streamflow in the study area.

Discharge data for drainage areas receiving low precipitation and having low channel and basin slopes are represented by Providence Coulee (fig. 11b). The streams in these areas remain dry during most years and have high flows of short duration during the wet years. Most runoff is the result of warm rains on snow-covered frozen ground.

The discharge data for drainage areas partly on the arid or semiarid plateau and partly in steeper terrain are represented by Douglas Creek (fig. 8b) and Willow Creek (fig. 17b). Streamflow begins to increase when precipitation exceeds evapotranspiration demand and fluctuates at fairly high discharges from spring snowmelt until June or July. Streamflow gradually declines as the snowpack decreases. The pattern of streamflow is the result of rainfall and snowmelt at lower elevations during the fall and winter and the gradual decrease of snowmelt at higher elevations during the spring.

The discharge data for the Columbia River (fig. 9b) and the Snake River (fig. 14b) represent large drainage areas where streamflow is regulated by reservoirs and diversions. Streamflow is regulated to meet irrigation and power needs by storing large volumes of snowmelt runoff from the mountains during May, June, and July for release later.

Streamflows in mountainous areas are represented by the North Fork Walla Walla River (fig. 15b). These areas receive large quantities of precipitation in the fall and winter, much of the winter precipitation falling as snow that subsequently melts in the late spring.

The diverse topography in the study area means that streamflow at a gaging station usually represents several hydrologic and physical settings such as low-high precipitation, low-high basin slopes, and low-high elevations, all of which cause variation in daily discharges. Streamflow recession in the summer is affected by summer precipitation, and "base flow" probably does not occur in many streams in the study area. This is because of the fluctuation in streamflow due to summer rains and thunderstorms that move a considerable amount of water in and out of bank storage. Thus, the streamflow is supported by bank storage during these periods.

Drainages with higher precipitation, such as the John Day, Umatilla, and North Fork Walla Walla Rivers and Ahtanum and Willow Creeks, tend to have a more gradual rise or fall in streamflow than drainages with low precipitation, such as Douglas, Crab, and Meadow Creeks. Usually, a storm causes a greater percentage of change in streamflow in dry areas than in wet areas.

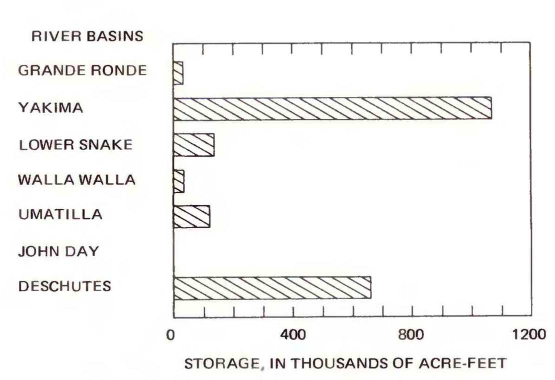


FIGURE 18.--Streamflow storage on the major tributary basins in the study area.

SURFACE-WATER STORAGE

In the central part of the plateau, large quantities of surface water are stored for irrigation use because little streamflow is available during much of the irrigation season except for the regulated streamflow in the Columbia and Snake Rivers (figs. 9a and 14a). This is shown by the minimum, maximum, and monthly mean discharges in figures 6a through 17a, and these monthly streamflows are not generally sufficient for most irrigation practices. Because streamflow is generally insufficient for irrigation use, water is stored in drainages with high precipitation. Thus, along many of the streams originating in the mountains most of the streamflow that is stored is used for irrigation during the summer and early fall.

About 32 million acre-feet of water can be stored in the Columbia and Snake River basins upstream from the study area. The reservoir storage capacity within the study area is listed in table 3 for all reservoirs of more than 40,000 acre-feet capacity, and the locations of the dams are shown on this sheet (Washington Department of Ecology, 1981; Oregon Water Resources, written commun., 1985). Most of the storage of streamflow in the reservoirs is used for power generation. The active (usable) storage for the major tributary basins in the study area is shown in figure 18 (Pacific Northwest River Basins Commission, 1970). More than 2.2 million acre-feet of surface water is diverted annually from the Columbia River at Grand Coulee Dam into a series of supply canals for irrigation on the central Columbia Plateau in Washington. Little of this diverted water is returned to the Columbia River except as ground water. Because of the large storage upstream and in the study area, the regulated streamflows in the Columbia and Snake Rivers are less during high flows and greater during the late summer and winter months (figs. 9b and 14b) than would occur without regulation.

Table 3. -- Reservoirs in study area with storage capacity greater than 40,000 arce-feet.

NAME	DAM	STREAM	COMPLETION DATE	STORAGE MAX (ACRE-FEET)	STORAGE NORMAL (ACRE-FEET)	STORAGE USABLE (ACRE-FEET)	LOCATION LONGITUDE (DEGREES)	LOCATION LATITUDE (DEGREES)
COLD SPRINGS RESERVOIR	COLD SPRINGS	- -	1908		44600	--	119.1722	45.8597
LONG LAKE	LONG LAKE	SPOKANE RIVER	1914	253000	253000	104100	117.8383	47.8367
RIMROCK LAKE	TIETON	TIETON RIVER	1925	203500	198000	198000	121.1283	46.6567
MCKAY RESERVOIR	MCKAY	MCKAY CREEK	1926		73800	--	118.7917	45.6078
MOSES LAKE	MOSES LAKE NORTH	- -	1930	50000	50000	--	119.3317	47.0850
MOSES LAKE	MOSES LAKE SOUTH	- -	1962	---	---	--	119.3333	47.0800
ROCK ISLAND POOL	ROCK ISLAND	COLUMBIA RIVER	1933	130000	130000	4550	120.0917	47.3450
FRANKLIN D. ROOSEVELT LAKE	GRAND COULEE	COLUMBIA RIVER	1942	9562000	9562000	5232000	118.9833	47.9550
LONG LAKE(BILLY CLAPP LAKE)	PINTO	- -	1948	76500	64200	1000	119.2533	47.4483
BANKS LAKE	DRY FALLS	- -	1949	1275000	1275000	761800	119.3033	47.6233
POTHOLES RESERVOIR	O'SULLIVAN	- -	1949	554300	511700	379500	119.2667	46.9833
BANKS LAKE	BANKS LAKE NORTH	- -	1951	1275000	1275000	761800	119.0167	47.9400
RUFUS WOODS LAKE	CHIEF JOSEPH	COLUMBIA RIVER	1955	593000	516000	46000	119.6267	47.9967
LAKE CELILO	THE DALLES	COLUMBIA RIVER	1957	330000	277000	53000	121.1383	45.6150
LAKE WALLULA	MCNARY	COLUMBIA RIVER	1957	1350000	1350000	185000	119.2950	45.9300
PRIEST RAPIDS RESERVOIR	PRIEST RAPIDS	COLUMBIA RIVER	1959	250200	222600	44600	119.9083	46.6450
LAKE SACAJEWEA	ICE HARBOR	SNAKE RIVER	1962	376000	376000	24800	118.8783	46.2500
LAKE ENTIAT	ROCKY REACH	COLUMBIA RIVER	1962	412000	382000	35000	120.2967	47.5317
WANAPUM RESERVOIR	WANAPUM	COLUMBIA RIVER	1963	748500	673500	160800	119.9700	46.8767
LAKE PATEROS	WELLS	COLUMBIA RIVER	1967	361200	300000	70000	119.8617	47.9483
LAKE UMATILLA	JOHN DAY	COLUMBIA RIVER	1968	2530000	530000	154000	120.6850	45.7167
LOWER MONUMENTAL LAKE	LOWER MONUMENTAL	SNAKE RIVER	1969	376000	356000	20200	118.5367	46.5650
LAKE BRYAN	LITTLE GOOSE	SNAKE RIVER	1970	556000	506000	49000	118.0333	46.5883
LOWER GRANITE LAKE	LOWER GRANITE	SNAKE RIVER	1975	483800	440200	44800	117.4067	46.6550
COLD SPRINGS RESERVOIR	COLD SPRINGS	- -	1908					
LOWER MONUMENTAL LAKE	LOWER MONUMENTAL	SNAKE RIVER	1969	376000	356000	20200	118.5367	46.5650
LAKE BRYAN	LITTLE GOOSE	SNAKE RIVER	1970	556000	506000	49000	118.0333	46.5883
LOWER GRANITE LAKE	LOWER GRANITE	SNAKE RIVER	1975	483800	440200	44800	117.4067	46.6550

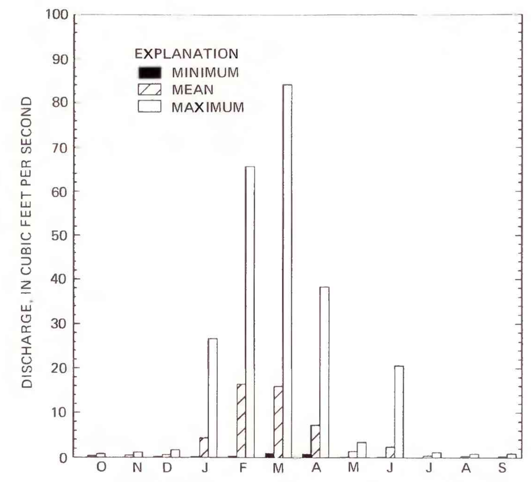


FIGURE 8a.--Monthly flows for Douglas Creek.

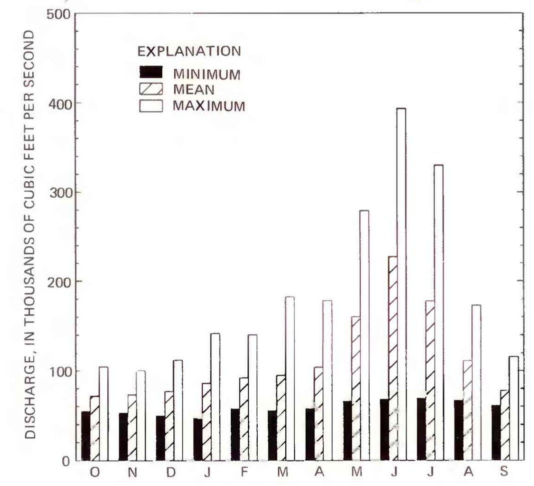


FIGURE 9a.--Monthly flows for Columbia River.

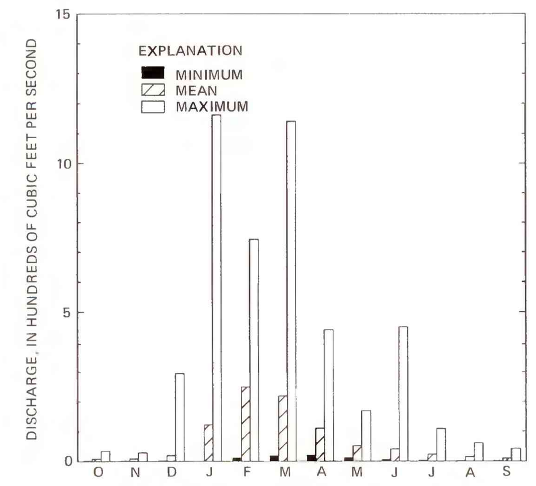


FIGURE 10a.--Monthly flows for Crab Creek.

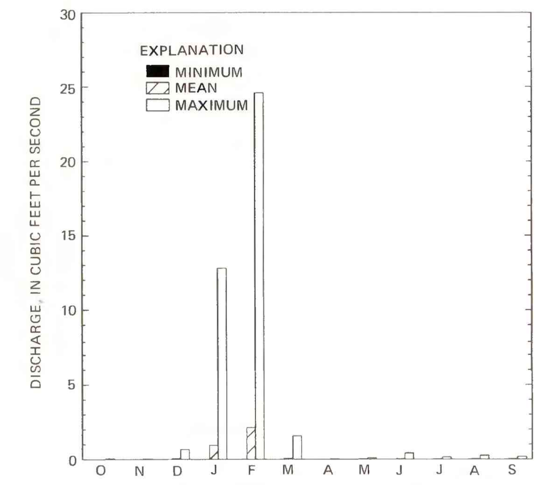


FIGURE 11a.--Monthly flows for Providence Coulee.

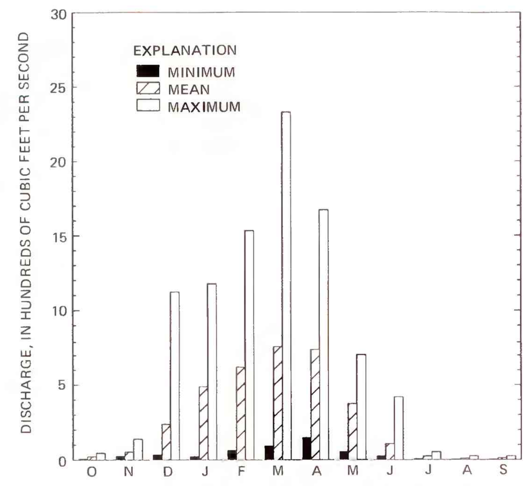


FIGURE 12a.--Monthly flows for Palouse River.

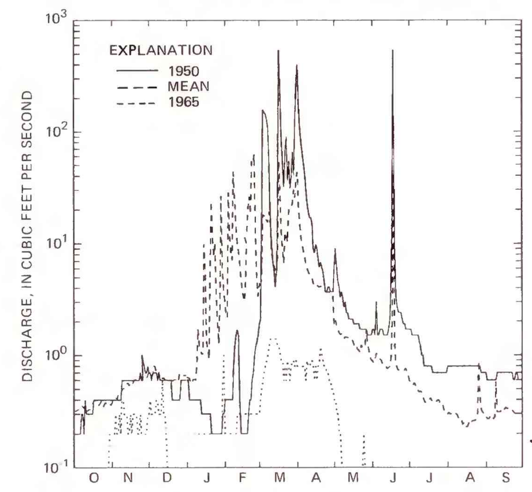


FIGURE 8b.--Daily flows for Douglas Creek.

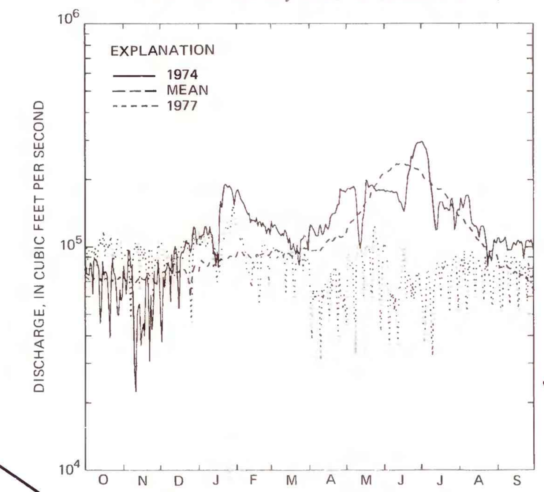


FIGURE 9b.--Daily flows for Columbia River.

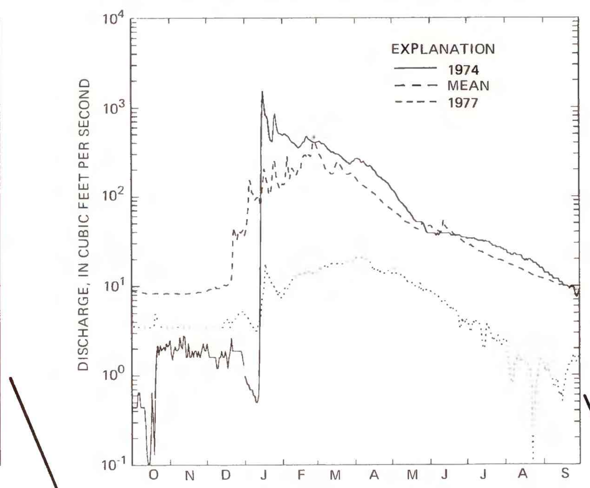


FIGURE 10b.--Daily flows for Crab Creek.

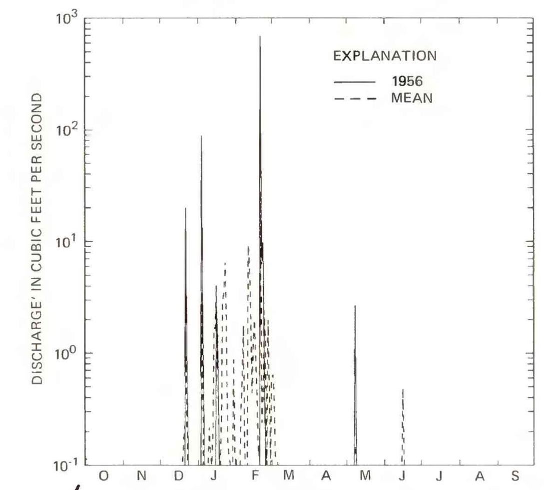


FIGURE 11b.--Daily flows for Providence Coulee.

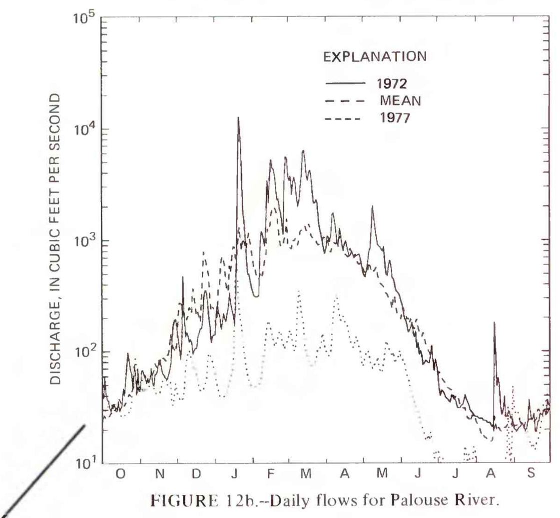


FIGURE 12b.--Daily flows for Palouse River.

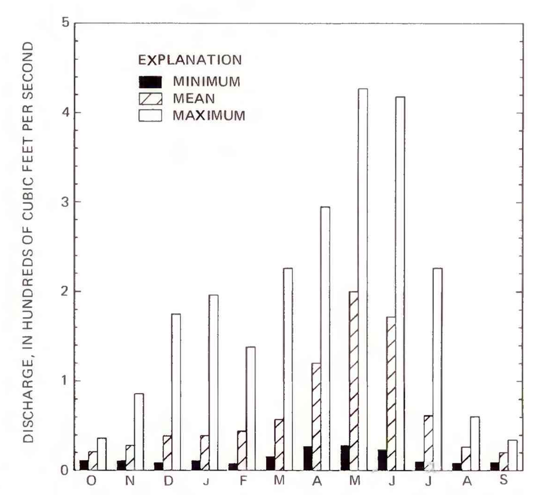


FIGURE 7a.--Monthly flows for NF Ahtanum Creek.

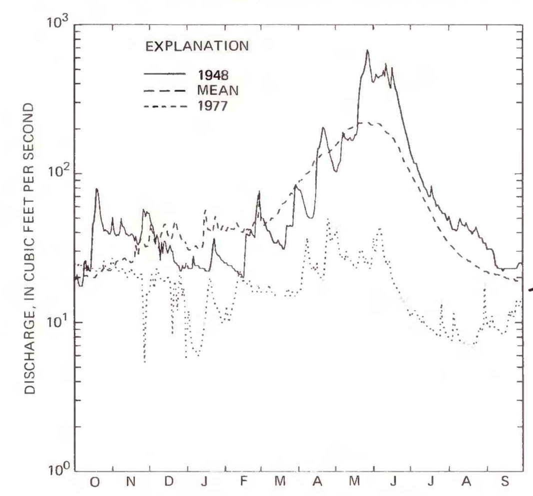


FIGURE 7b.--Daily flows for NF Ahtanum Creek.

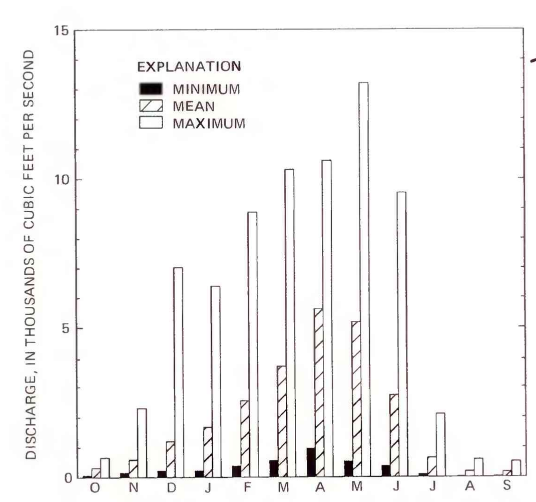


FIGURE 6a.--Monthly flows for John Day River.

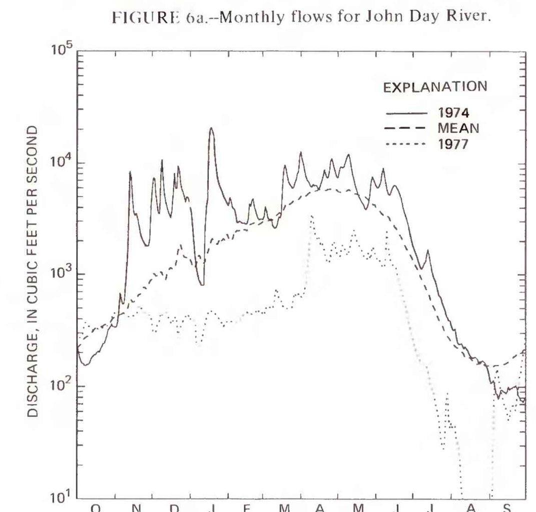
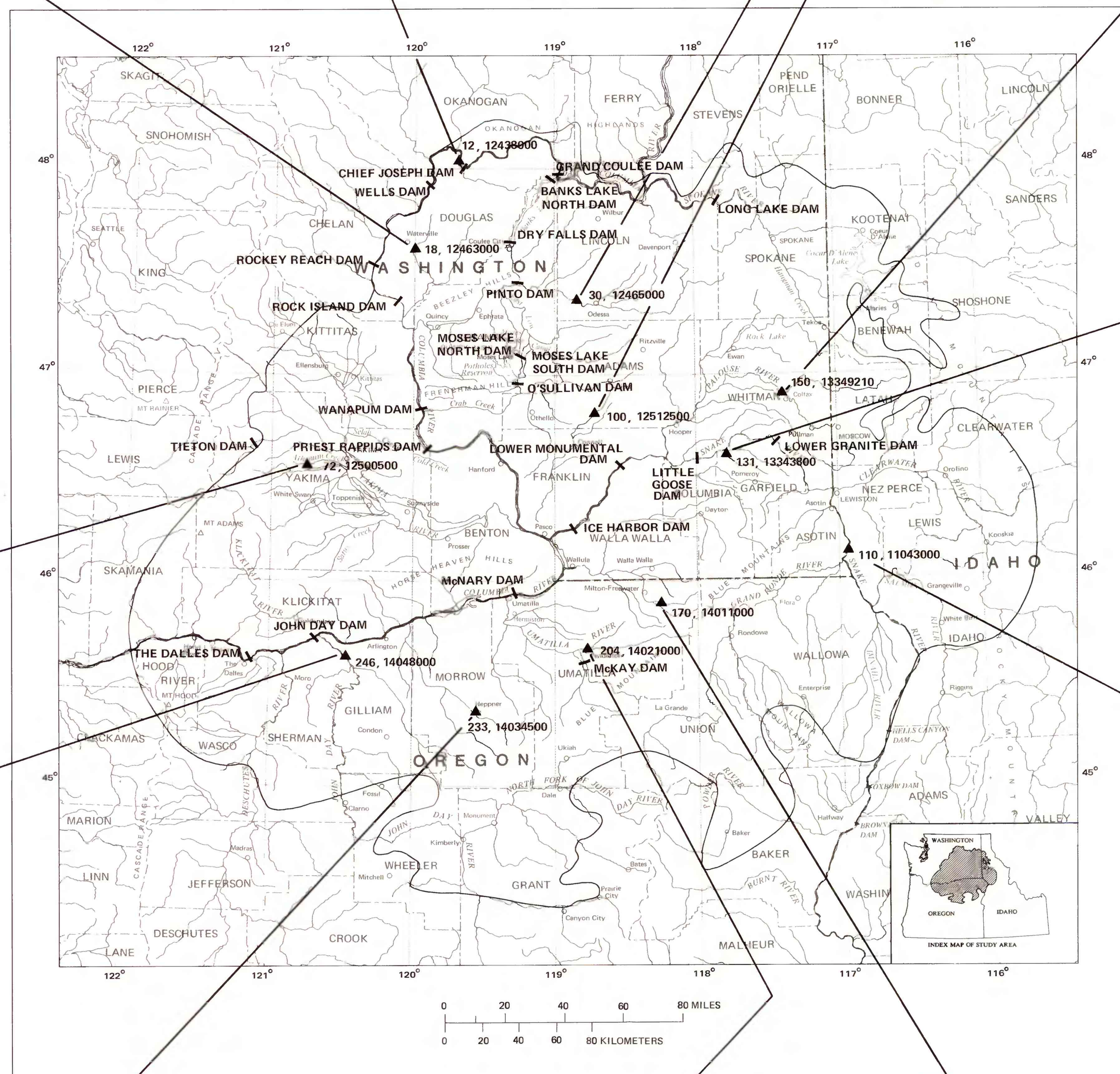


FIGURE 6b.--Daily flows for John Day River.



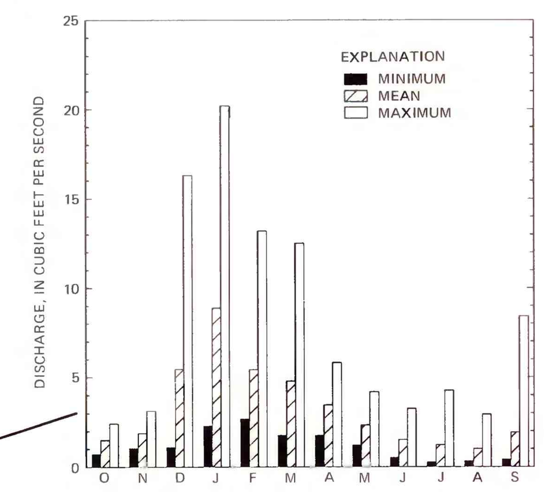


FIGURE 13a.--Monthly flows for Meadow Creek.

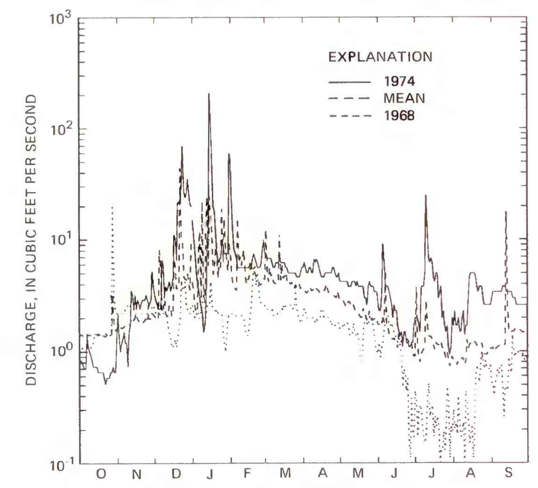


FIGURE 13b.--Daily flows for Meadow Creek.

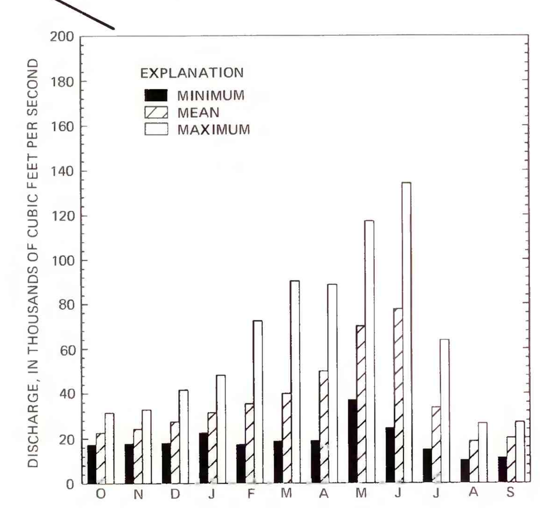


FIGURE 14a.--Monthly flows for Snake River.

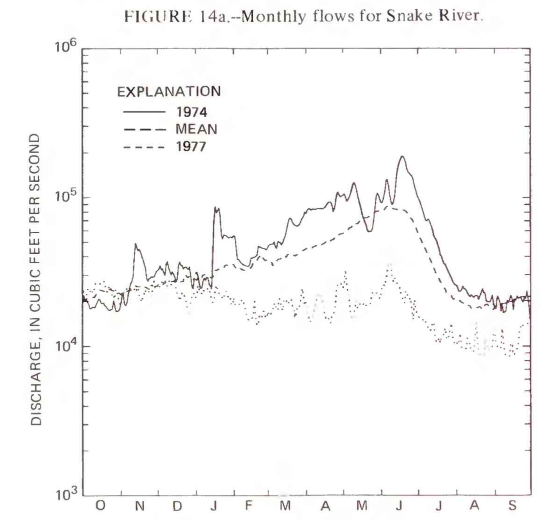


FIGURE 14b.--Daily flows for Snake River.

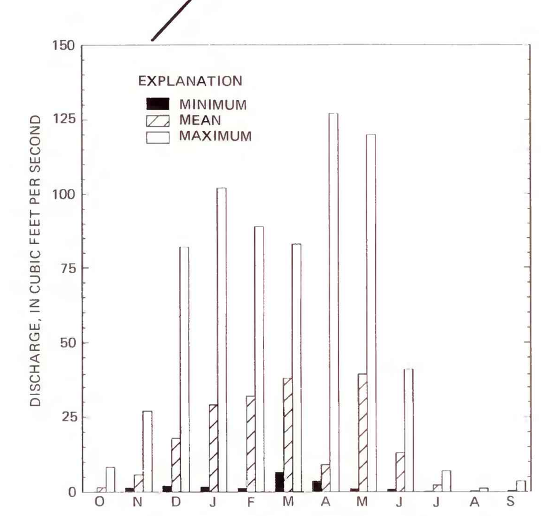


FIGURE 17a.--Monthly flows for Willow Creek.

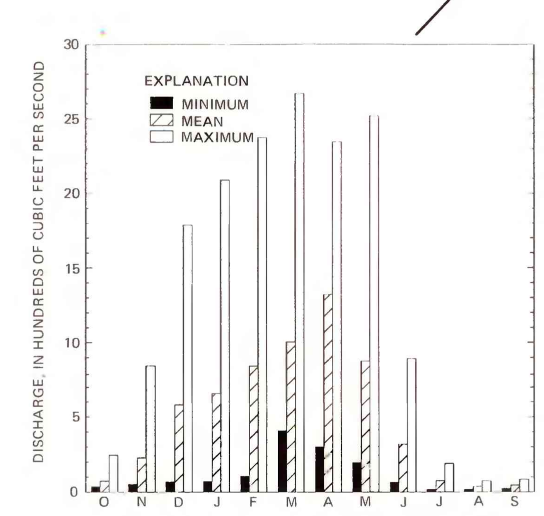


FIGURE 16a.--Monthly flows for Umatilla River.

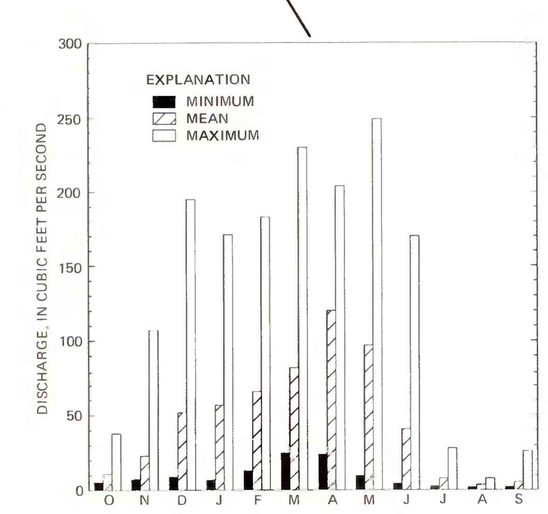


FIGURE 15a.--Monthly flows for NF Walla Walla River.

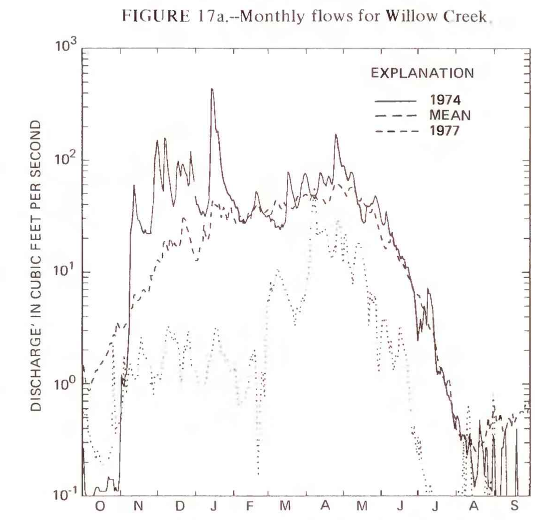


FIGURE 17b.--Daily flows for Willow Creek.

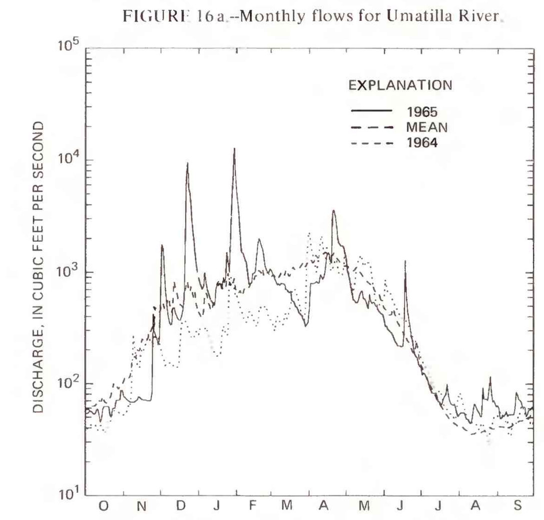


FIGURE 16b.--Daily flows for Umatilla River.

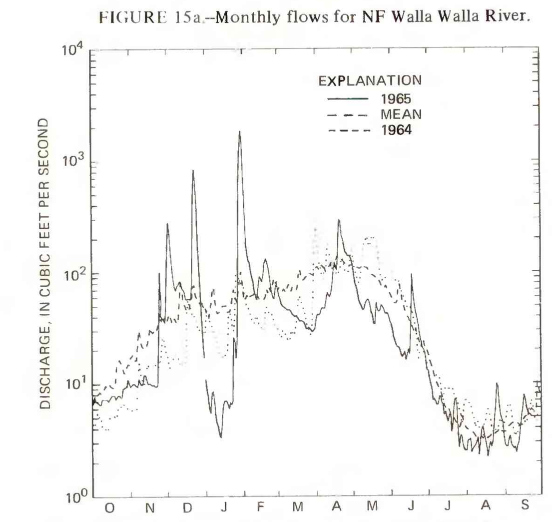


FIGURE 15b.--Daily flows for NF Walla Walla River.

EXPLANATION

30 12465000 ▲ SURFACE-WATER GAGING STATION -- With daily discharge data, reference number, station number, tabulated on sheet 2, for mean annual runoff and precipitation data see below

REFERENCE NUMBER	STATION NUMBER	DRAINAGE AREA SQUARE MILES	MEAN ANNUAL RUNOFF IN INCHES	MEAN ANNUAL PRECIPITATION IN INCHES
12	12438000	75,700	20.24	
18	12463000	99.9	.57	10.24
30	12465000	1,042	.97	12.5
100	12512500	27.8	.13	8.4
150	13349210	796	6.68	24.4
131	13343800	66.2	.68	15.8
72	12500500	68.9	13.77	29.3
170	14011000	43.8	14.08	32.3
110	11043000	92,960	5.22	
246	14084000	7,580	3.65	19
233	14034500	87	2.98	14.5
204	14021000	637	10.72	24.6

STREAMFLOW

SURFACE-WATER RESOURCES OF THE COLUMBIA PLATEAU IN PARTS OF WASHINGTON, OREGON, AND IDAHO

By
L. M. Nelson
1991