# Streamflow Characteristics of Mountain Streams in Western Montana

United States Geological Survey Water-Supply Paper 2260

Prepared in cooperation with the Montana Department of Natural Resources and Conservation

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By CHARLES PARRETT and J. A. HULL

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U.S. GEOLOGICAL SURVEY WATER-SUPPLY PAPER 2260

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# Streamflow Characteristics of Mountain Streams in Western Montana

*By* Charles Parrett *and* J. A. Hull

**Abstract**

Once-monthly streamflow measurements were used to estimate long-term mean annual flow, mean monthly flow, and various points on the flow-duration curve for 72 sites in the mountainous areas of western Montana. The estimated flow characteristics at 56 measurement sites, together with data from 22 gaging stations, were used to develop maps showing the variability of mean annual runoff, in inches, for three areas.

Data from all measurement sites plus data from 34 gaging stations were used to develop regression equations relating mean annual flow to drainage area and precipitation, and equations relating flows of 10, 20, 30, 40, 50, 60, 70, 80, and 90 percent exceedance probability to mean annual flow. The study area was divided into two regions, with a different set of estimating equations applicable to each region. The estimating equations for mean annual flow had coefficients of determination ($R^2$) of 0.944 and 0.971 in the two regions, with corresponding standard errors of estimate of 33 and 17 percent. The coefficients of determination for the estimating equations for flows of various exceedance percentages ranged from 0.849 to 0.981 in one region and from 0.889 to 0.971 in the other.

Average errors of prediction were also calculated using data withheld from the regression analyses. The estimated average error for predicting mean annual flow was −16 percent in one region and −23 percent in the other. The estimated average prediction errors for flows of various exceedance percentages ranged from +2 percent to −38 percent in one region and from +18 to −15 percent in the other.

## INTRODUCTION

Recent energy shortages, coupled with the soaring costs of conventional energy sources, have spurred interest in alternative and renewable forms of energy. In the mountainous regions of Montana this interest has focused on the development of small-scale hydroelectric power. Almost 50 applications for preliminary permits for western Montana, under the Federal Energy Regulatory Commission licensing procedures, had been granted or were pending as of November 1983.

The feasibility of small-scale hydropower development depends on the amounts of streamflow available for diversion. Unfortunately, few continuous-record streamflow-gaging stations have been established on small (drainage areas less than about 100 $mi^2$) mountain streams in Montana. This paucity of data has made it difficult to assess adequately the potential for small-scale hydropower development in Montana.

Previous studies by Boner and Buswell (1970), Farnes (1978), and Potts (1983) provided techniques for estimating mean annual streamflow at ungaged sites in the mountainous areas of Montana. A recent study by Cunningham and Peterson (1983) also provided a procedure for estimating flow-duration curves at potential hydropower sites in Montana. In each instance, however, the estimating techniques were based on existing streamflow-gaging data and, thus, might not be reliable when applied to ungaged small mountain streams.

Accordingly, the present study was undertaken in cooperation with the Montana Department of Natural Resources and Conservation. The study was conducted to expand the data base for small, mountain streamflows and to refine previously developed estimation techniques.

Annual runoff generally follows the precipitation pattern, with greater amounts occurring in areas of higher elevation. Streamflows vary greatly, on a seasonal basis: snowmelt provides the bulk of annual runoff in May and June, and the smallest streamflows generally occur during fall and winter, when base flows are entirely the result of ground-water inflow.

A significant number of applications for permits to develop hydropower on a small scale have been for the Yaak River drainage in the northwestern part of the study area and for the Swan River drainage in the east-central part. Both areas receive more than 40 in. of precipitation annually, are densely forested, and have numerous small streams with well-formed drainage patterns and steep channels. Although few applications have been made for the Bitterroot River drainage, the west side of the Bitterroot River is similar in topography and climate to the Swan River drainage. This area also receives more than 40 in. of precipitation annually, is extremely rugged and densely forested, and may thus have as much hydrologic potential for small-scale hydropower development as the Swan River drainage.

## DESCRIPTION OF THE AREA

The study area includes that part of Montana within the upper Columbia River basin, as shown in figure 1. This area, generally referred to as western Montana, is characterized largely by north- to northwest-trending mountain ranges separated by long-straight valleys. Except for the valley floor areas, the study area is generally rugged and densely forested. Almost all the potential sites for small-scale hydropower development are located in the rugged mountains of the study area.

Annual precipitation varies greatly in the study area, primarily because of the effects of the mountains. Annual precipitation tends to be greater in the mountains and generally is greater on the western slopes than on the eastern slopes. Most precipitation occurs as snow, although significant amounts of rainfall commonly occur in May and June.

Most of the streamflow-measurement sites were located in the Kootenai River basin and in the Swan River basin, the two areas of current interest in hydropower development. Where possible, the sites were located near main-traveled roads to ensure year-round access. On several streams in each area, more than one measurement site was used to determine streamflow variability within the same drainage; year-round access to most of the additional measuring sites on these streams was not possible. The rest of the 51 sites measured in 1982–83 were located on streams that, from a reconnaissance-level onsite inspection, appeared to have favorable flow characteristics and sufficient fall (slope) for hydropower development.

In addition to the measurements made in 1982–83, this study incorporates miscellaneous streamflow measurements at 21 sites made during earlier investigations. Fifteen of these sites were located in the Bitterroot River drainage, where monthly streamflow measurements were made in 1958–59. Six sites were measured sporadically in 1974–75 as part of a lake tributary study. Because the data collected at these six sites are not complete monthly data, the accuracy of the estimated streamflow characteristics may not be as good as at the other sites.

The locations of the streamflow-measuring sites are shown in figure 1. Descriptions of the measuring-site locations and the measured streamflow data are contained in table 1 at the end of the report.

The method used for estimating streamflow characteristics at the monthly measurement sites requires the use of concurrent and long-term streamflow data from nearby streamflow-gaging stations. In addition, streamflow-gaging station data from throughout the study area were required to develop a common base period of flow record at all sites used in the analysis. The locations of all the gaging stations used, either for comparison with the monthly measurement sites or for extension of the record, are also shown in figure 1.

## STREAMFLOW MEASURING SITES AND GAGING DATA

To obtain additional data on streamflow characteristics at potential hydropower sites, 51 streamflow-measurement sites were established and once-monthly streamflow measurements were made from March 1982 through February 1983. Of these sites, 10 were either active or discontinued crest-stage gage sites. These sites were chosen partly because some data on stage versus streamflow were already available there and partly as a means of minimizing travel costs. Four of the 51 sites were located at discontinued streamflow-gaging stations on Fortine Creek, Big Creek near Rexford, the St. Regis River, and Bear Creek near Essex; measurements at these sites were used for correlation purposes only.

The purposes of this report are to present the streamflow data and to describe the refined techniques for estimating streamflow characteristics developed from these data. Streamflow was measured once monthly at selected potential hydropower sites in western Montana. These data, together with miscellaneous streamflow data and gaging-station data previously collected on mountain streams, were then used to estimate long-term flow characteristics at each site. The streamflow data and estimating techniques described herein will be useful to hydropower developers, land-use managers, water-rights administrators, and others who need to estimate streamflow characteristics in the mountains of western Montana.

In addition to streamflow data collected by the U.S. Geological Survey, flow data were furnished by Bill Schultz of the Montana Division of Forestry, Wally Page of the Flathead National Forest, and Larry Meshew of the Kootenai National Forest. The assistance and cooperation of these individuals are greatly appreciated.

## METHODS OF ANALYSIS

Expanding the small-stream data base by installing conventional continuous-recording gaging stations would have been prohibitively expensive. In addition, any new stream-gaging station would have to be operated at least several years to obtain enough data to determine long-term streamflow characteristics. Accordingly, an alternative method based on once-monthly discharge measurements at selected sites was used.

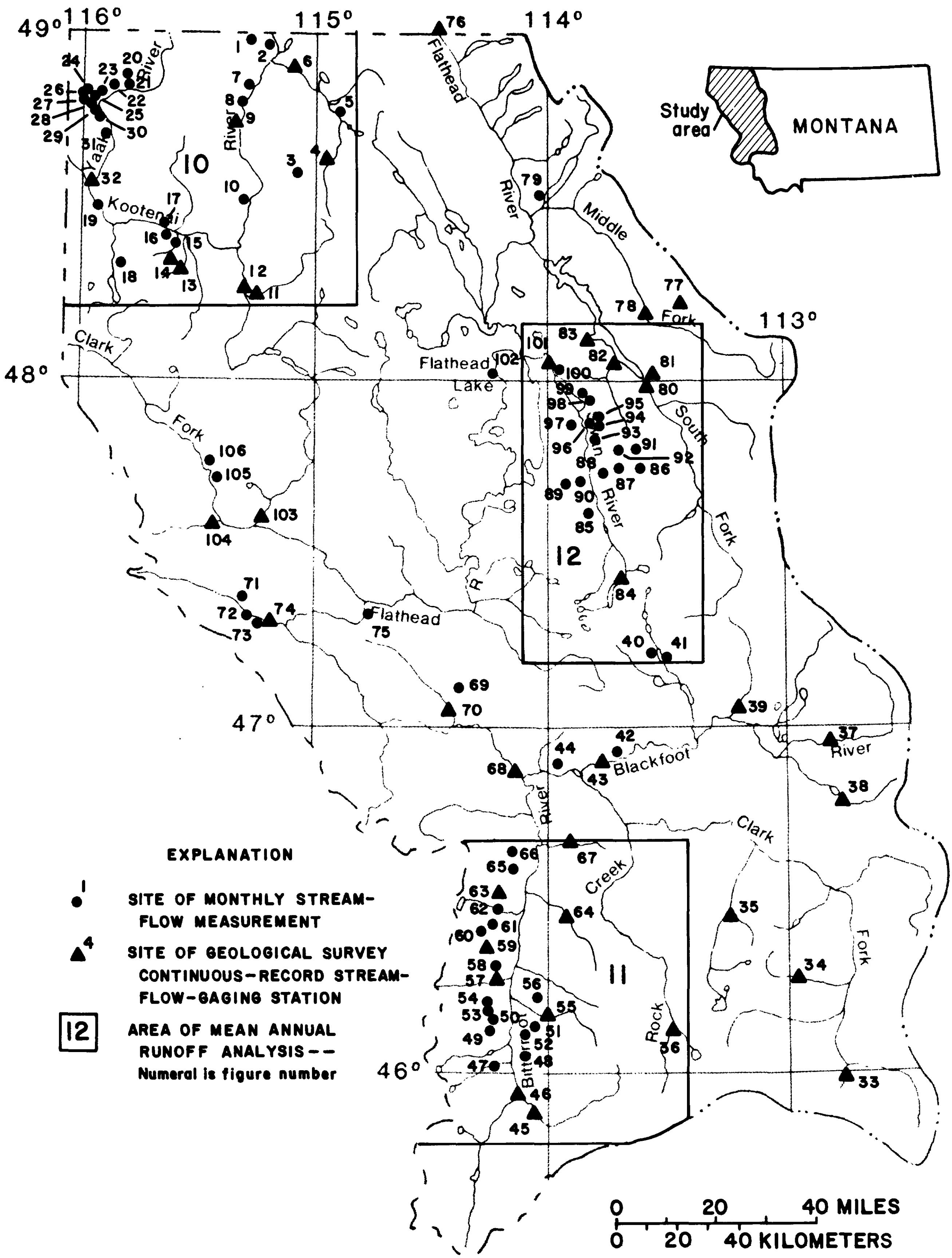



**Figure 1.** Location of streamflow-measurement sites and gaging stations.

## Estimating Streamflow Characteristics from Discharge Measurements

Riggs (1969) found that annual mean discharge could be determined from once-monthly discharge measurements with an expected error of about ±10 percent. In New York, Hunt (1963) also found that miscellaneous streamflow measurements made during base-flow periods could be used to estimate flow-duration curves with about the same accuracy. In both techniques, the streamflow measurement made at the ungaged site is compared with the daily mean discharge for the same day at a nearby gaging station. If the gaging station is in the same general hydrologic setting as the site in question, the relationship between the daily mean discharge and some streamflow characteristic at the gage can be assumed to be the same at the ungaged site. Thus, for example, if the daily mean discharge at the gaging station is one-half the monthly mean discharge, the measured discharge at the ungaged site is also assumed to be one-half its monthly mean discharge. Likewise, if the daily mean discharge at the gaging station is equal to the 50-percent exceedance discharge on the flow-duration curve, the measured discharge at the ungaged site is also assumed to be equal to the 50-percent exceedance discharge.

To obtain an estimate of the annual mean discharge at an ungaged site, Riggs recommended that discharge measurements be made each month. The measurements are made near the middle of the month on the assumption that a measured discharge at that time is closer to the mean discharge for the month than a measurement made near the beginning or the end of the month. The ratio of the monthly mean discharge to the daily mean discharge is determined for the nearby gaging site for each month. Each monthly ratio is then multiplied by the measured discharges at the ungaged site to estimate monthly mean discharge. The estimated monthly means are then averaged to obtain an estimate of the annual mean discharge for the year the measurements are made. In addition, a graphical plotting of each measured discharge versus the concurrent daily mean discharge at the gaging station can be made on log-log paper. In general, the closer the points plot to a 45°-line, the better the relationship between the ungaged and the gaged site, and the more reliable the estimates of monthly mean discharge. An application of the method is illustrated in table 2 (all tables are at the end of the report), and the plotting of concurrent discharges is shown in figure 2.

Concurrent discharges are also used to determine flow-duration curves for ungaged sites. From the period of record at the gaged site, the exceedance percentage is determined for each conrurrent daily mean discharge. The same exceedance percentage is assumed applicable to the concurrent streamflow measurement at the ungaged site, and the points are plotted on log-probability paper. A smooth curve fitted through the points, as shown in figure 3, determines the final estimated flow-duration curve for the same period of record as the gaged site. The flow-measurement data used to construct figure 3 are listed in table 3.

## Extending Streamflow Records to a Common Base Period

The techniques just described will provide for an ungaged site an annual mean discharge for the year in which the miscellaneous measurements were made and a flow-duration curve for the period of record at the concurrent gaging station. Because the length of record at the gaging stations used in this study for comparisons varied from 5 to 45 years, all records were extended to a common base period. This extension was intended to eliminate any bias in the estimated flow characteristics due to short, perhaps unrepresentative, streamflow records.

The method chosen to extend streamflow records was a statistical regression procedure developed by the U.S. Army Corps of Engineers (1971). The regression procedure (HEC-4) uses monthly flow data from several streamflow gages in an area to estimate missing monthly flow values for each gage and for each year of record. The model also preserves the variance of the unadjusted short-term record by adding a random component to the estimated values. Starting with the first year of data, missing monthly streamflows are estimated at all stations for each month in sequence. Thus, when a missing flow is being estimated, there is always a valid value for all stations already examined that month and for all remaining stations in either the current or the preceding month. The equation for estimating missing flows has the following general form:

$$Q_{i,j} = B_1 Q_{i,1} + \dots + B_{j-1} Q_{i,j-1} + B_j Q_{i-1,j} + B_{j+1} Q_{i,j+1} + \dots + B_n Q_{i,n} + \sqrt{1 - R_{i,j}^2} \cdot (Z_{i,j}), \quad (1)$$

where

$Q_{i,j}$ is the monthly flow logarithm, expressed as a standard normal deviate, for month $i$ and station $j$,

$B_j$ is the beta coefficient for station $j$ computed from a correlation matrix of flows at all $n$ stations,

$R_{i,j}$ is the multiple correlation coefficient for month $i$ and station $j$, and

$Z_{i,j}$ is a random number generated from a standard normal population.

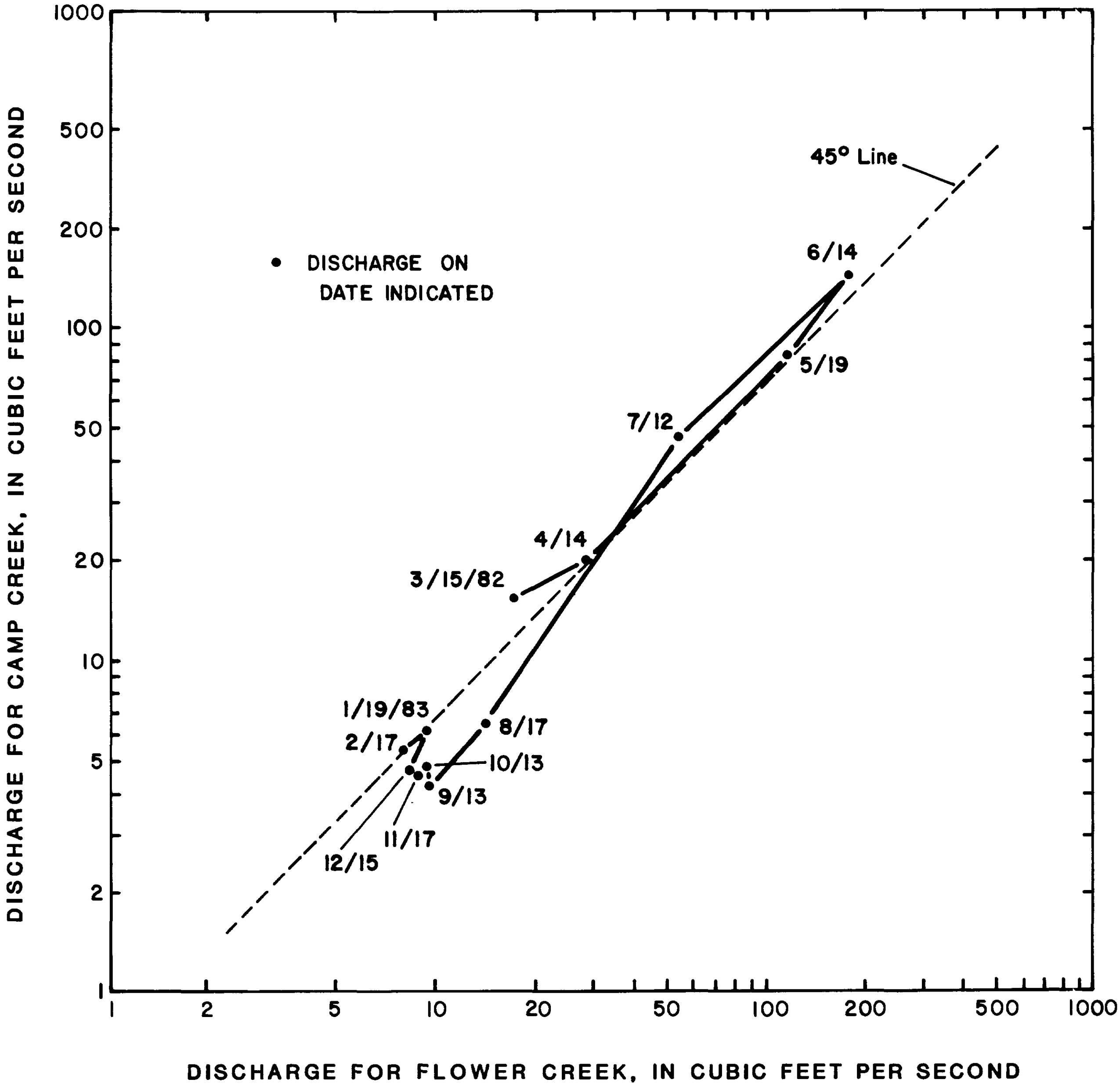



**Figure 2.** Concurrent discharges on Camp Creek and Flower Creek.

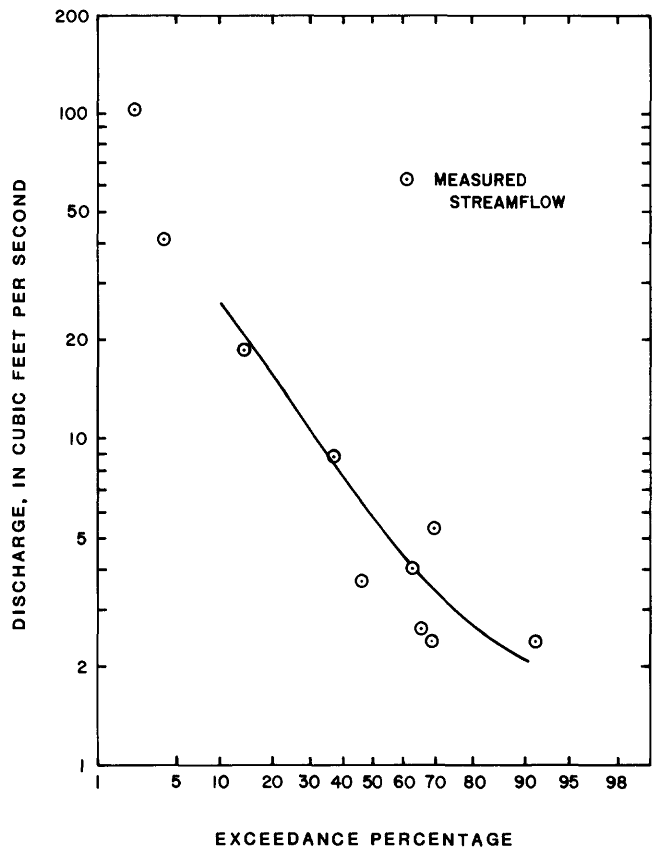



**Figure 3.** Estimated flow-duration curve for Soup Creek above Soup Creek Campground.

If any station being used to estimate a missing monthly flow is also missing a flow value for that month ($i$), then the flow for the preceding month ($i-1$) is used in the right side of equation 1. If, for example, the monthly flow at station 1 and month $i$ were missing, the first term on the right side of equation 1 would be $B_1Q_{i-1,1}$.

The HEC-4 procedure was used to develop a common record from water year 1938 to water year 1982 at 38 gaging stations in western Montana. Of these 38 gaging stations, 20 were subsequently used as concurrent flow stations for determining annual mean discharges and flow-duration curves at ungaged sites. The 20 gaging stations and the results of the long-term mean annual discharge adjustments are listed in table 4.

## Estimating Long-Term Streamflow Characteristics

To obtain an estimate of the long-term mean annual discharge from an estimate of one annual mean, data from nearby gaging stations were used. In the northwestern part of the study area (Kootenai River drainage), five gaging stations with active record from March 1982 to February 1983 (sites 6, 14, 32, 103, and 104) were used to develop a regression equation for estimating long-term mean annual discharge from the annual mean discharge for March 1982 to February 1983. The equation thus derived is:

$$Y=0.88X^{1.00}, \tag{2}$$

where

$Y$ is the long-term mean annual discharge and
$X$ is the annual mean discharge for March 1982 to February 1983.

In the Bitterroot drainage, seven gaging stations with active record during the 1958 water year (sites 36, 46, 55, 57, 59, 64, and 67) were used to develop a similar regression equation relating the long-term annual discharge to the annual mean discharge for 1958. The resulting equation is:

$$Y=1.11X^{0.99}, \tag{3}$$

where

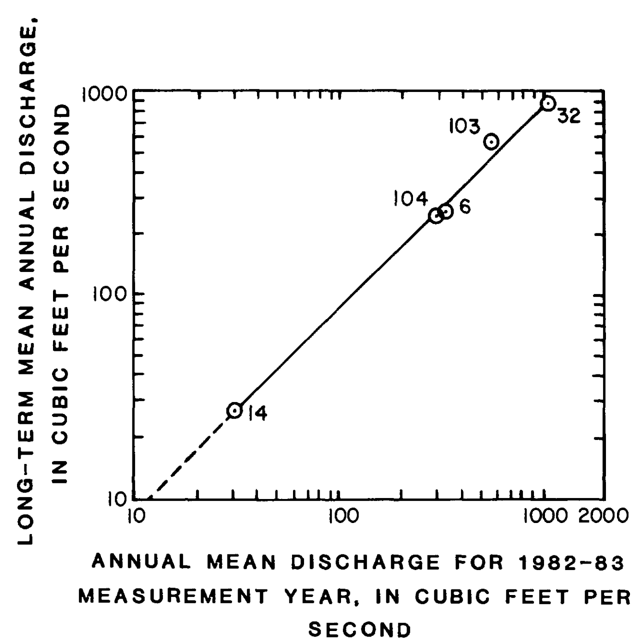
$Y$ is the long-term mean annual discharge and
$X$ is the annual mean discharge for the 1958 water year.

For the rest of the study area (Clark Fork drainage), four gaging stations with active record for March 1982 to February 1983 (sites 39, 43, 70, and 84) were used to develop the following regression equation:

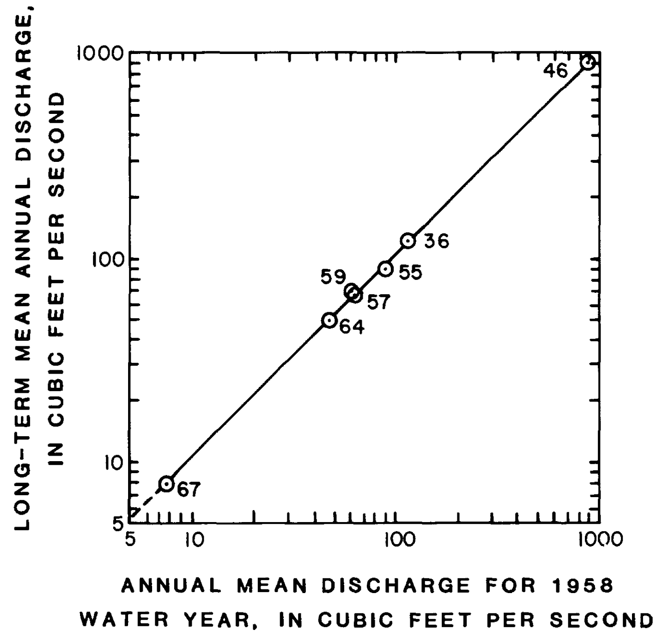
$$Y=0.77X^{1.00}, \tag{4}$$

where the terms are the same as defined for equation 2. The plots of the three regression equations thus developed are shown in figure 4. The regression equations were used to calculate a long-term mean annual discharge at each flow-measurement site where the annual mean discharge for the measurement year had previously been estimated.

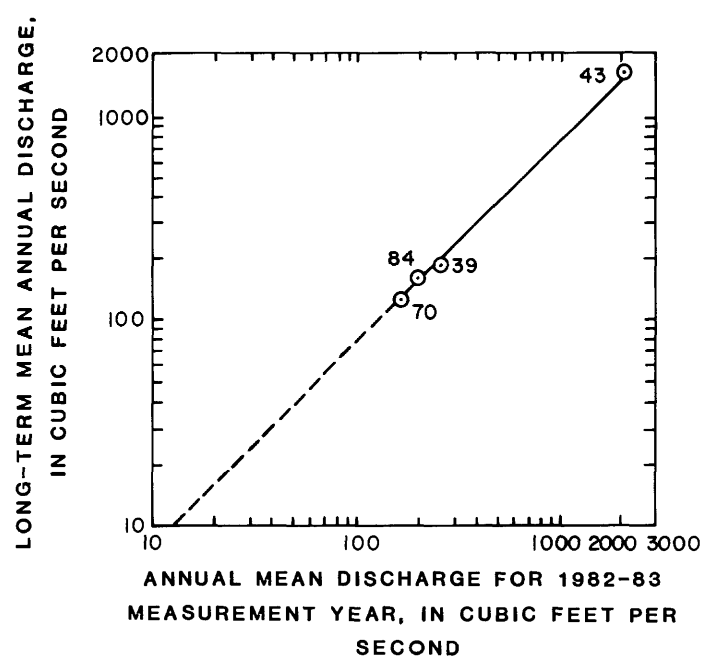
As discussed earlier, flow-duration curves were prepared for the ungaged flow-measurement sites using the period of record at the nearby gaging stations. To convert the derived flow-duration curves to the 1938–82 base period, the following procedure was used. At 26 gaging stations with essentially natural flow, six linear regression equations were developed relating daily flows of 10, 20, 30, 50, 70, and 90 percent exceedance percentages to mean annual discharge for the period of record. The six equations and their respective coefficients of determination ($R^2$) are:




A. Kootenai River drainage




B. Bitterroot River drainage




C. Clark Fork drainage

**Figure 4.** Regression equations relating long-term mean annual discharge to one annual mean discharge.

$$Q_{10} = -21.66 + 3.01Q_A \qquad R^2 = 1.00 \qquad (5)$$
$$Q_{20} = -24.46 + 1.49Q_A \qquad R^2 = 1.00 \qquad (6)$$
$$Q_{30} = 1.29 + 0.72Q_A \qquad R^2 = 0.98 \qquad (7)$$
$$Q_{50} = 8.37 + 0.35Q_A \qquad R^2 = 0.96 \qquad (8)$$
$$Q_{70} = 7.76 + 0.24Q_A \qquad R^2 = 0.95 \qquad (9)$$
$$Q_{90} = 6.94 + 0.17Q_A \qquad R^2 = 0.94 \qquad (10)$$

where

$Q_i$ is the daily flow with an exceedance percentage of $i$, which ranges from 10 to 90, and

$Q_A$ is the mean annual discharge for the period of record.

To obtain the regression coefficient (the number multiplied by $Q_A$) for any exceedance percentage, a smooth curve relating the coefficient to exceedance percentage was drawn, as shown in figure 5. To compute a point on the long-term (1938–82 base period) flow-duration curve for an ungaged site, the difference between the long-term mean annual discharge and the mean annual discharge for the period of record is calculated for the nearby gaging station used to estimate the flow-duration curve. This difference is multiplied by the appropriate regression coefficient in figure 5 and is algebraically added to the flow value determined from the estimated flow-duration curve.

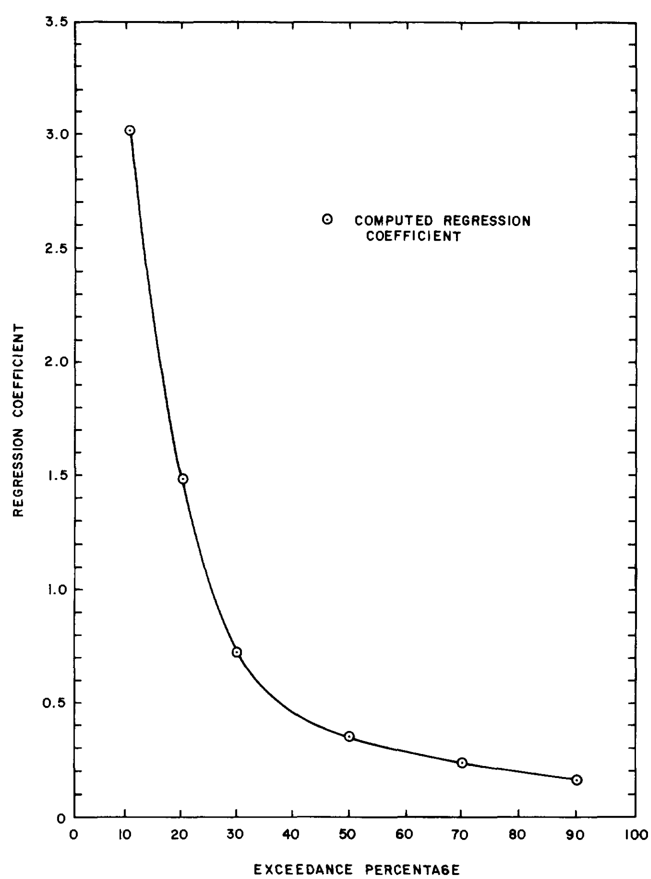



**Figure 5.** Relationship of regression coefficient to exceedance percentage.

To illustrate, assume that the flow-duration curve for an ungaged site was estimated using the methods previously described. Further assume that the flow-duration curve shows that the 10-percent exceedance discharge is 210 ft³/s. At the nearby gaging station, the mean annual discharge for the period of record is assumed to be 30 ft³/s, and the long-term mean annual discharge is assumed to be 40 ft³/s. The adjusted long-term daily discharge with an exceedance percentage of 10 is computed for the ungaged site as follows:

$$\begin{aligned} Q'_{10} &= 3.01\ (Q_A' - Q_A) + Q_{10} \\ &= 3.01\ (40 - 30) + 210 \\ &= 240 \text{ ft}^3/\text{s} \end{aligned}$$

where the terms with primes are long-term values.

To compute long-term mean monthly discharges at the ungaged measurement sites, several techniques were tried. The first was to adjust the monthly mean values already computed as a part of the procedure to determine annual mean flow. This technique was discarded because the error associated with an individual monthly mean estimate was too large; tests with gaging station data showed that individual monthly mean estimates could be in error by as much as 40–50 percent, even when the annual mean flow estimates were within 10 percent. Computing long-term monthly estimates directly by using the ratio of the concurrent daily discharge at a gaging station to the long-term mean monthly discharge at the gaging station did not improve the estimates. The technique finally used to estimate long-term mean monthly discharges at the ungaged measurement sites was to assume that the same monthly distribution of annual flow would occur at the ungaged measurement site as at some nearby gaging station. Thus, if the long-term mean annual discharge at an ungaged measurement site were estimated to be 23 ft³/s, and if the long-term mean October discharge at a similar gaging station were determined to be 4.1 percent of the long-term mean annual discharge at the gaging station, then the best estimate of the long-term mean discharge for October at the ungaged measurement site would be 4.1 percent of 23 ft³/s, or 0.9 ft³/s.

Adjustments to the computed long-term mean monthly discharges were made subjectively when it was known that the streams on which the ungaged measurement sites were located functioned differently from the gaged streams considered most similar. Parmenter Creek (site 15), for example, becomes completely dry in late summer, but none of the nearby streams monitored by gaging stations do so. Conversely, South Woodward Creek near its mouth (site 90) has a fairly even discharge, whereas the nearby gaged streams show a large seasonal variation in discharge. The general variation in monthly streamflow at gaging stations within the study area is illustrated in figure 6. The final, long-term streamflow characteristics estimated for each ungaged measurement site and for selected streamflow-gaging stations are given in tables 5 through 10.

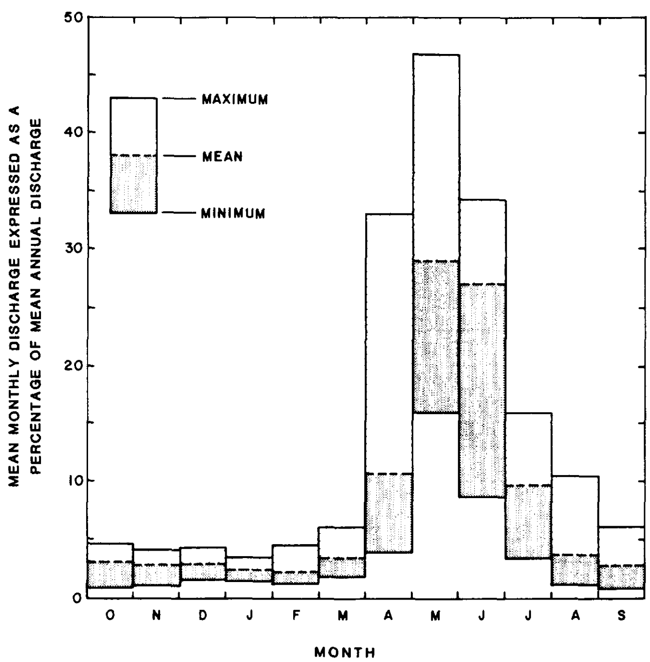



**Figure 6.** Range of mean monthly discharges at gaging stations.

## APPRAISAL OF ACCURACY

The accuracy of the streamflow estimates made at ungaged sites by using the monthly measurement technique cannot be determined directly. An indication of the accuracy can be obtained, however, by applying the technique to gaged sites for which long-term streamflow data are available. Accordingly, one gaged site in each of the three major areas of potential hydropower development was chosen as the site where streamflow estimates were required. A gaged site suitable for comparison purposes was selected, and the daily mean discharge on the 15th of each month was used to make the monthly and annual mean discharge estimates and the flow estimates for selected points on the flow-duration curve. The sites for which flow estimates were made were Flower Creek near Libby (site 14), Bear Creek near Victor (site 59), and Swan River near Condon (site 84). The sites used as nearby concurrent-flow gaging stations were, respectively, Yaak River near Troy (site 32), Bitterroot River near Darby (site 46), and Monture Creek near Ovando (site 39). The results of the accuracy tests for determining an annual mean discharge and the long-term mean annual discharge are given in tables 11-13.

As indicated by tables 11-13, the estimates of a single annual mean discharge have an error range (percent difference) of −3 to −11 percent. The estimates for long-term mean annual discharge range in error from −2 to −15 percent. Because the three test streams are considered to be generally representative of the streams actually measured, it is concluded that the estimates of long-term mean annual discharge have an average error of about ±10 percent.

The estimated flow-duration curves for the three test streams are plotted in figures 7-9. The plotted points are taken from tables 11-13, and final values from the smoothed curves and the associated errors are listed in tables 14-16. The average error for the estimated flow-duration curves ranged from 6 to 17 percent. The duration curves estimated for the ungaged flow measurement sites are thus believed to have a comparable average error of 10-15 percent.

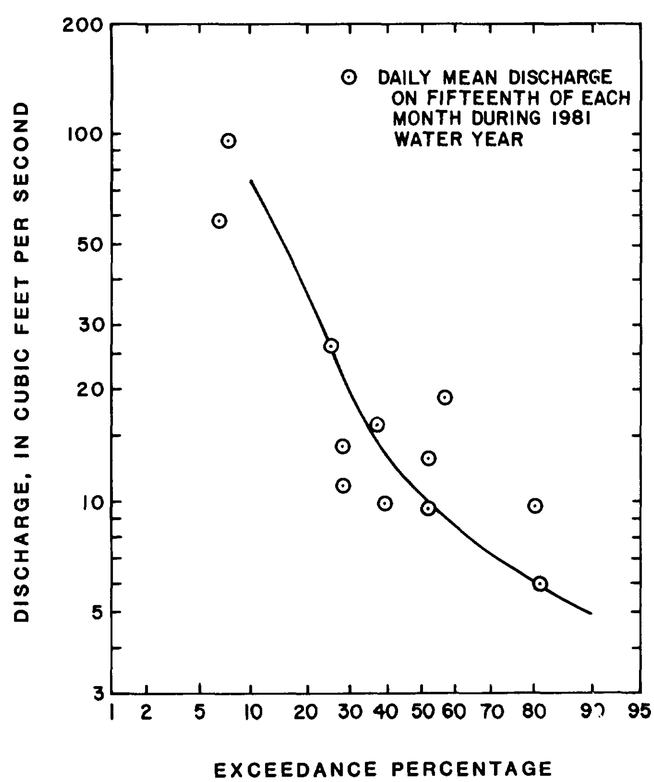



**Figure 7.** Estimated flow-duration curve for Flower Creek near Libby.

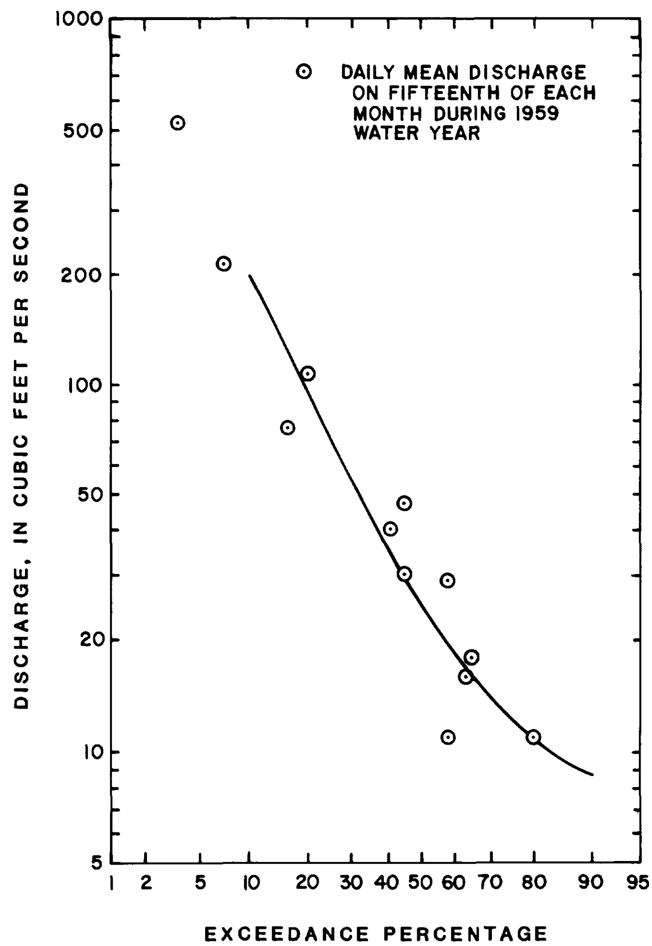



**Figure 8.** Estimated flow-duration curve for Bear Creek near Victor.

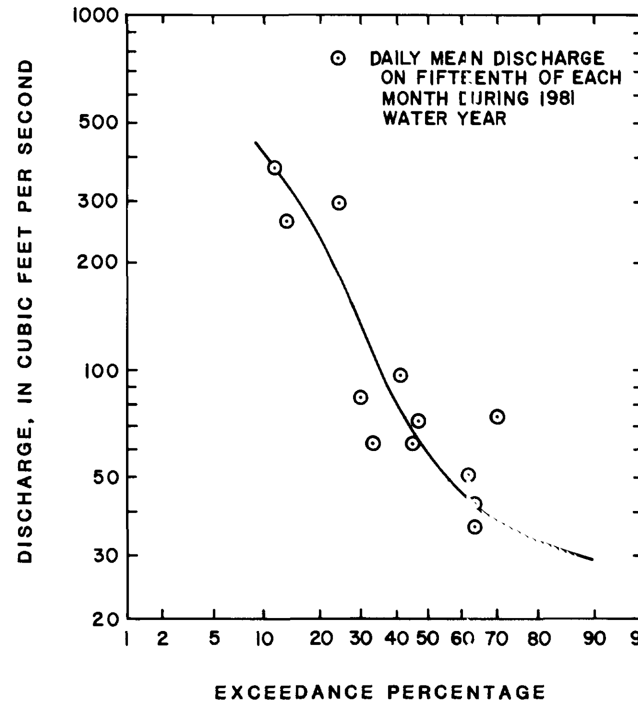


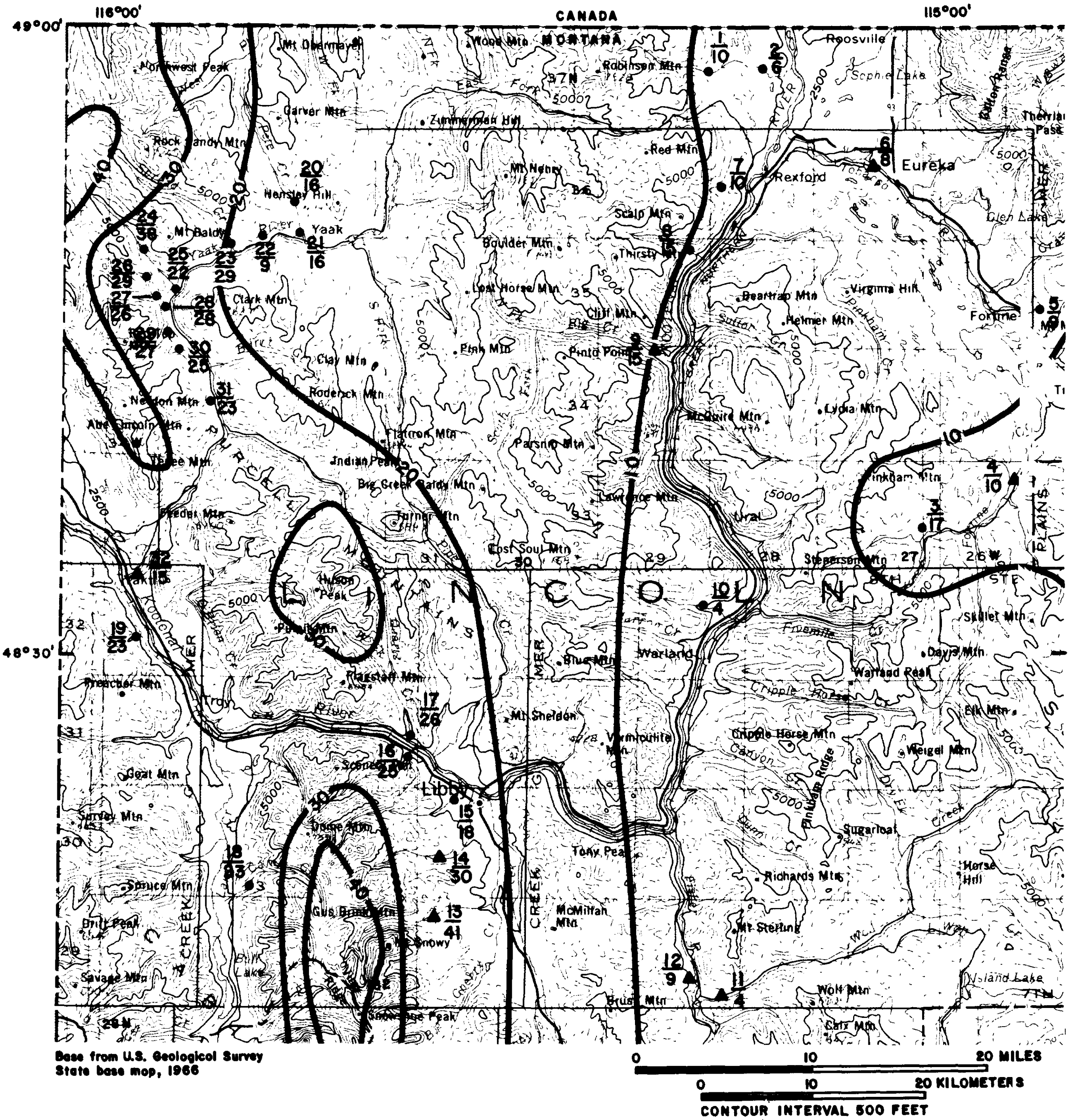

**Figure 9.** Estimated flow-duration curve for Swan River near Condon.

The estimated long-term mean monthly discharges and the associated errors for the three test sites are given in tables 17–19. As indicated by the tables, the errors associated with the estimates of mean monthly discharge are much more variable and generally larger than the errors for estimating the mean annual discharge or the flow-duration curve. For each of the three test streams, at least one mean monthly discharge estimate was in error by more than 40 percent. On two of the test streams, the largest error for a monthly mean estimate exceeded 50 percent. The mean monthly discharge estimates made for the measurement sites are believed to have comparably large errors. The accuracy of the mean monthly flow estimates could be significantly improved only if more than one flow measurement per month were used or if the once-monthly flow-measurement program were continued for several years.

## VARIATIONS IN MEAN ANNUAL RUNOFF

To more fully explore the variations in mean annual runoff throughout the study area, the three areas with the greatest concentrations of streamflow gages and flow-measurement sites are shown in detail in figures 10–12. Each figure shows the site number and location of each streamflow measurement site and streamflow-gaging station in the area. Also shown is the long-term mean annual runoff at each site.

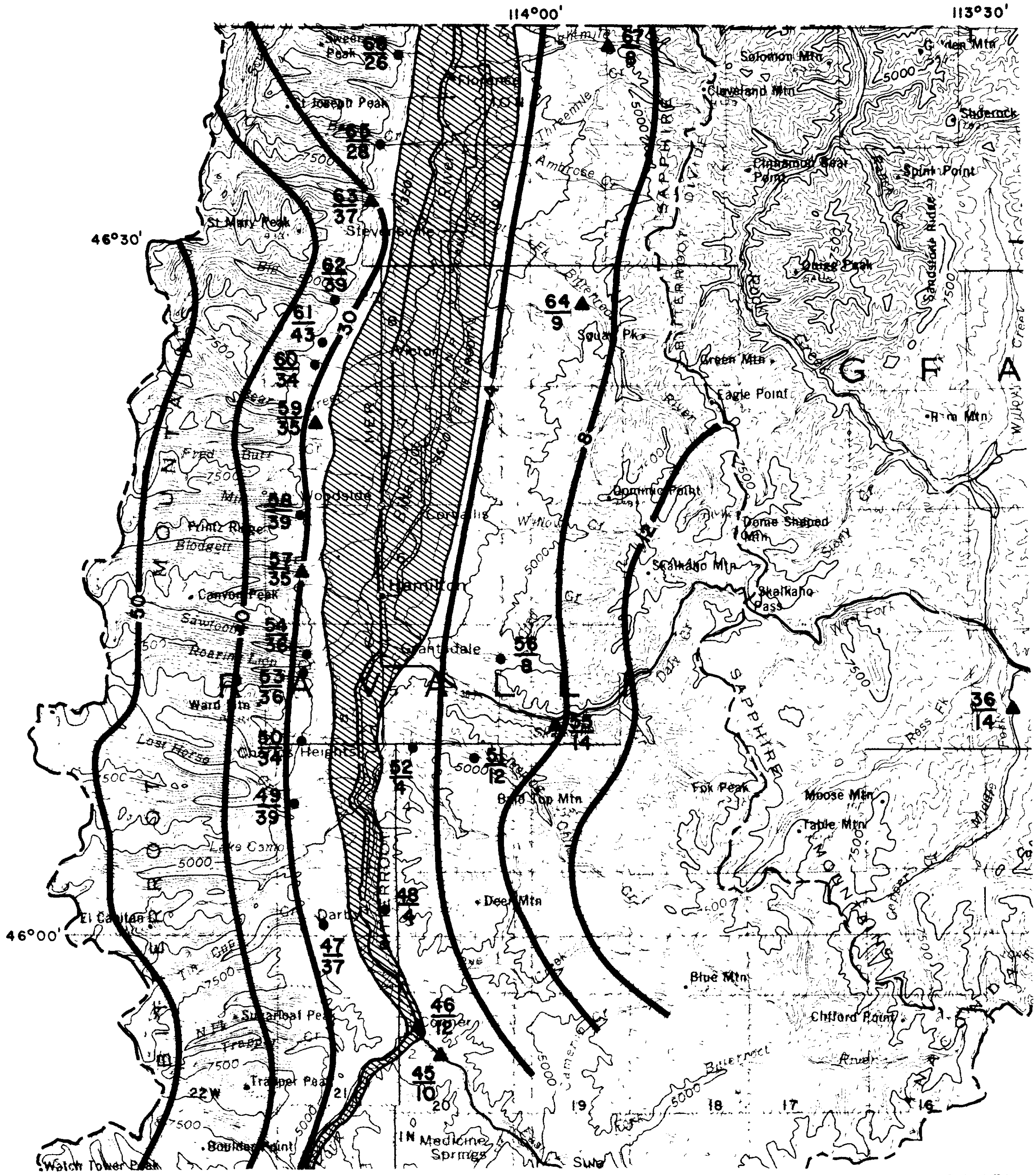
The first area is in the northwestern part of the study area and includes most of the Kootenai River drainage in Montana (fig. 10). As shown by the lines on the map, mean annual runoff generally increases from east to west in the Kootenai River area. The greatest annual runoff occurs in the mountainous regions southwest of Libby and west of the Yaak River. The streams in the Yaak River drainage having multiple measuring sites indicate that annual runoff generally increases with elevation. Lines of equal mean annual runoff were drawn in figure 10 by assuming that the computed values of mean annual runoff were effectively located at the centroids of the individual drainage basins. Elevation and maps showing average annual precipitation (U.S. Soil Conservation Service, 1977) were used as a guide in drawing lines where no runoff data were available. The lines of equal mean




**EXPLANATION**

| | | | |
|---|---|---|---|
| ● | STREAMFLOW-MEASUREMENT SITE | $\frac{32}{15}$ | UPPER NUMERAL IS SITE NUMBER; BOTTOM NUMERAL IS MEAN ANNUAL RUNOFF, IN INCHES |
| ▲ | STREAMFLOW-GAGING STATION | —30— | LINE OF EQUAL MEAN ANNUAL RUNOFF-- Interval 10 inches |

**Figure 10.** Mean annual runoff in the Kootenai River area.




Base from U.S. Geological Survey State base map, 1968

0 10 20 MILES

0 10 20 KILOMETERS

CONTOUR INTERVAL 500 FEET
DATUM IS SEA LEVEL

EXPLANATION

● STREAMFLOW-MEASUREMENT SITE

▲ STREAMFLOW-GAGING STATION

63/37 UPPER NUMERAL IS SITE NUMBER; BOTTOM NUMERAL IS MEAN ANNUAL RUNOFF, IN INCHES

—30— LINE OF EQUAL MEAN ANNUAL RUNOFF -- Interval, in inches, is variable

AREA WHERE MEAN ANNUAL RUNOFF LINES DO NOT APPLY

Figure 11. Mean annual runoff in the Bitterroot River area.

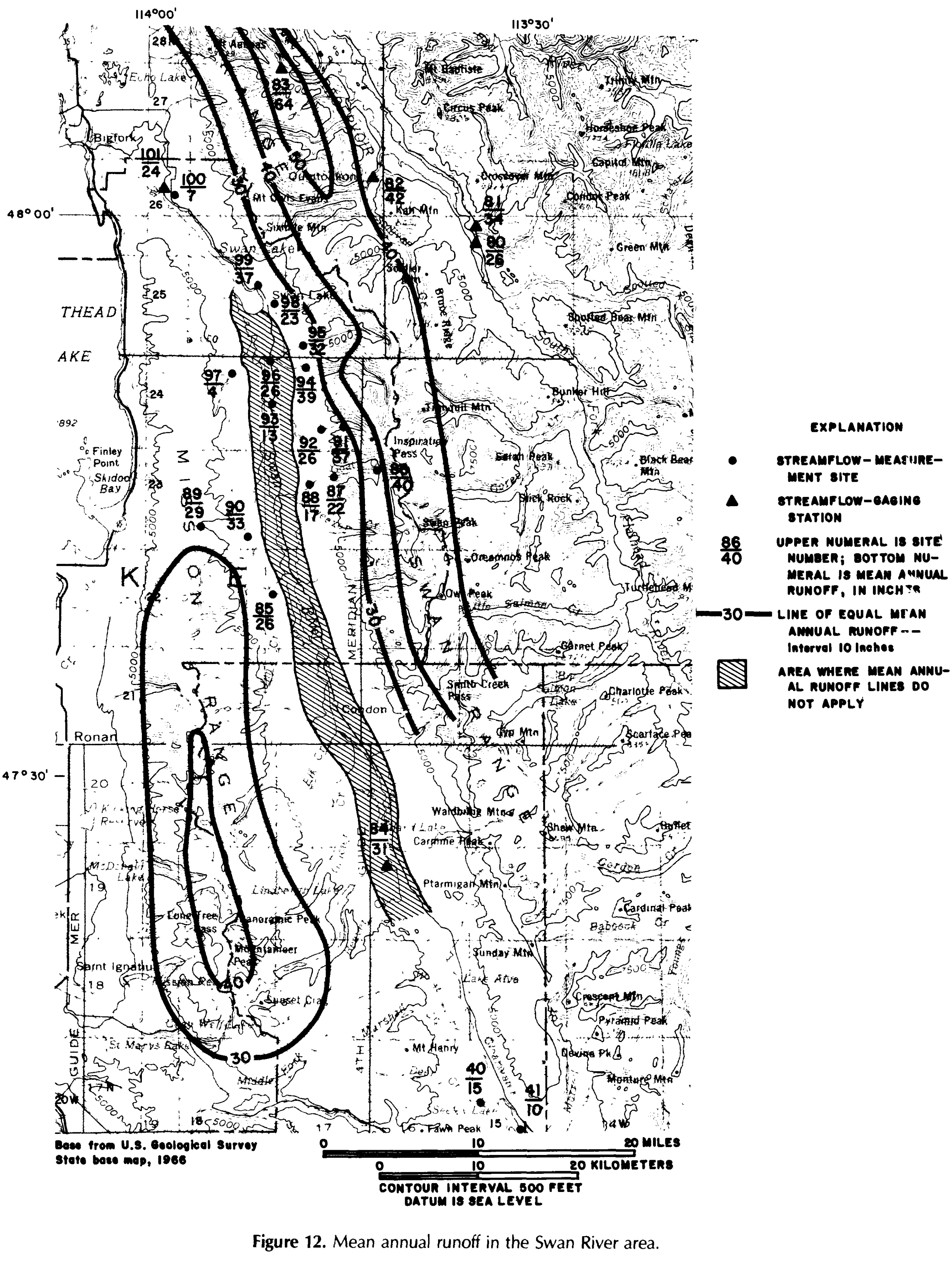



**Figure 12.** Mean annual runoff in the Swan River area.

annual runoff can be used to estimate mean annual runoff at any ungaged site in the area. It needs to be emphasized, however, that mean annual runoff is determined at the centroid of the drainage area upstream from the site and not at the site itself. Also, the locations of the lines are based on a limited number of flow-measurement sites, and considerable variation between the lines is possible.

The second area is composed largely of the Bitterroot River drainage (fig. 11). In this area, mean annual runoff varies markedly from the east side of the Bitterroot River, where computed values range from 4 to 14 in., to the west side of the Bitterroot River, where mean annual runoff ranges from 26 to 43 in. On the west side, the computed values of mean annual runoff are consistent from south to north, except for the two northernmost streams, Bass Creek and Sweeney Creek (sites 65 and 66). Although multiple measuring sites were not used on streams in the Bitterroot area, mean annual runoff was assumed to increase with elevation, and the lines of equal mean annual runoff were drawn accordingly. A previous study by McMurtrey and others (1972) indicated that streams on the west side of the Bitterroot River generally lose a substantial amount of their flow when they leave the mountain canyons and flow over the porous alluvium of the valley floor. Consequently, the lines of equal mean annual flow shown in figure 11 will not provide accurate estimates of mean annual flow at locations on the valley floor.

The third area is drained by the Swan River and the South Fork Flathead River (fig. 12). Mean annual runoff tends to be greater on the east side of the Swan River than on the west side, although the east-west variation is not as pronounced as in the Bitterroot area. Mean annual runoff also generally increases from south to north on the east side of the Swan River. The multiple measuring sites in the Swan River area indicate a large increase in mean annual runoff from the valley floor to the mountains. As in the Bitterroot area, substantial streamflow losses evidently occur as the mountain streams enter the alluvium of the valley floor. Consequently, the lines of equal mean annual runoff will not provide accurate estimates of mean annual flow in the valley-floor area.

Several anomalies in the general pattern of mean annual runoff variation also occur in the Swan River area. Porcupine Creek (site 97) and Johnson Creek (site 100) both have mean annual runoff values substantially smaller than those from any nearby measuring site. These streams may traverse sections of very permeable or fractured bedrock that intercept a large percentage of the annual streamflow. Also, the mean annual runoff of South Woodward Creek evidently is increased by springs between measuring sites 89 and 90. These anomalies serve to emphasize that generalized maps such as figures 10–12 can be used to accurately estimate mean annual runoff only where local geology and ground-water/surface-water interactions remain fairly uniform.

## EQUATIONS FOR ESTIMATING STREAMFLOW CHARACTERISTICS

Because maps of mean annual runoff could be developed for only three parts of the western Montana study area, prediction equations for estimating mean annual discharge anywhere in the study area were derived using multiple regression techniques. Prediction equations relating streamflows for various points on the flow-duration curves to mean annual discharge were also developed using multiple regression.

### Mean Annual Discharge

To estimate mean annual discharge, a multiple-regression equation of the following log-linear form was derived:

$$Q_A = aA^bP^c, \tag{11}$$

where

- $Q_A$ is mean annual discharge in cubic feet per second,
- $A$ is drainage area,
- $P$ is mean annual precipitation,
- $a$ is the regression constant, and
- $b$ and $c$ are regression coefficients.

Drainage area is expressed in square miles and is determined for ungaged sites by planimetering the area outlined on the best-scale topographic map available. Mean annual precipitation is the basin average, in inches, determined from the maps of the U.S. Soil Conservation Service (1977). No other basin characteristics such as basin elevation or channel slope were considered for inclusion in the regression equations because previous studies by Potts (1983) and Farnes (1978) showed no other variables to be significant in estimating mean annual discharge. An equation for the entire study area was first derived using data from 92 streamflow-measuring sites and gaging stations. Examination of the residuals from the preliminary regression equation indicated that better results would be obtained if the study area were separated into two regions. Consequently, the study area was divided into the two regions shown in figure 13.

In Region 1, data from 47 sites were used to develop the following regression equation:

$$Q_A = 0.0165A^{0.974}P^{1.159}, \tag{12}$$

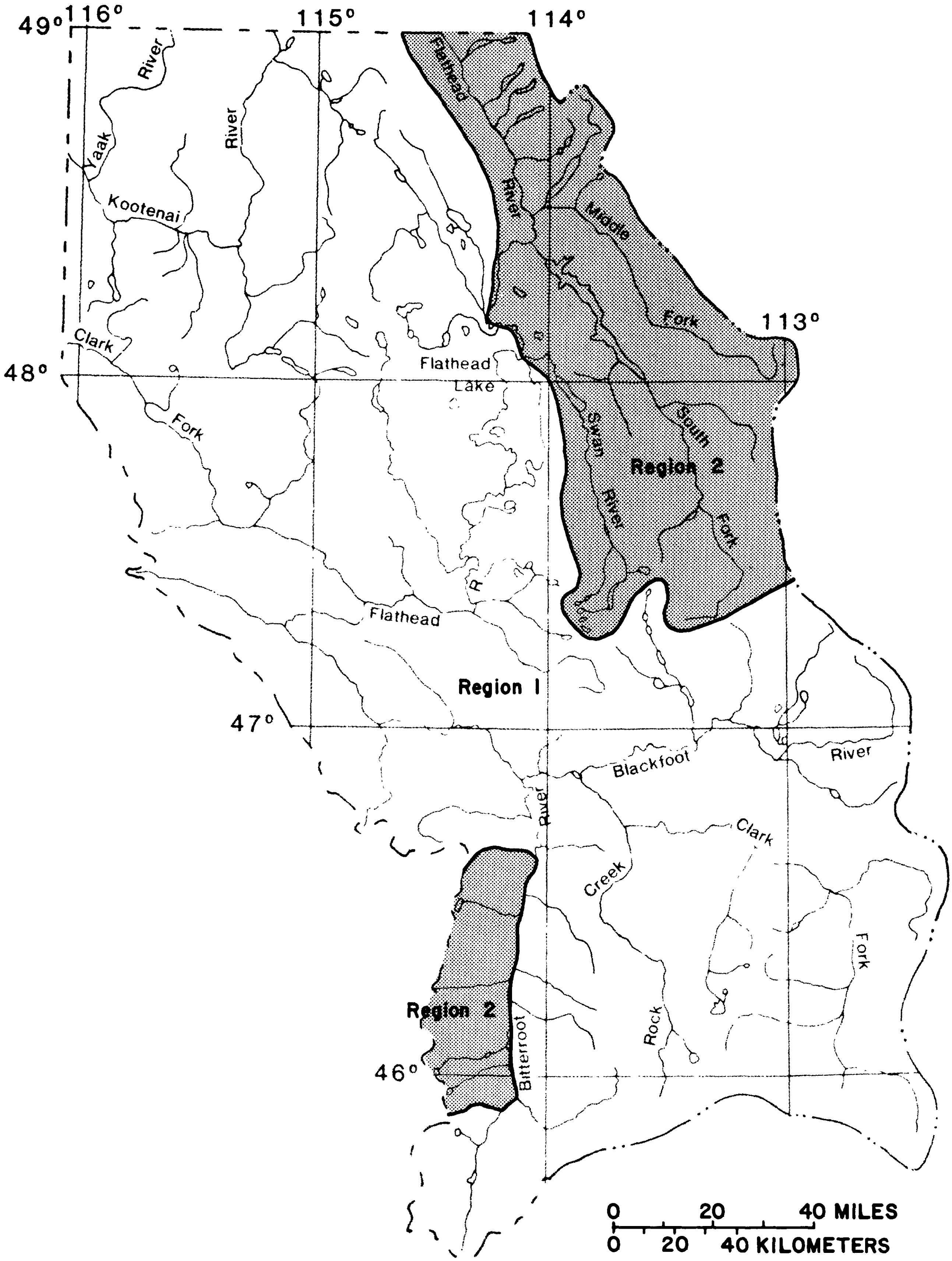



**Figure 13.** Regional boundaries.

where the terms are as previously defined. The coefficient of determination ($R^2$) for this prediction equation was 0.944, and the standard error of estimate was 33 percent. The prediction equation developed by Potts for the same general area as Region 1 (Region 3 in the Potts report) is similar:

$$Q_A = 0.0292\,(A \cdot P)^{1.003}. \tag{13}$$

Equation 13 yields estimates of mean annual discharge that are slightly larger than those from equation 12. For a drainage area of 10 $mi^2$ and a mean annual precipitation of 10 in., the result from equation 13 is about 32 percent larger than the result from equation 12. For a drainage area of 10 $mi^2$ and a mean annual precipitation of 40 in., the result from equation 13 is about 7 percent larger. Because equation 12 was developed specifically for mountainous areas and smaller streams (drainage areas smaller than 100 $mi^2$) in western Montana, equation 12 is probably more reliable than equation 13 in those instances.

Region 2 includes the west side of the Bitterroot River drainage and the Swan River and Flathead River drainages. This region corresponds generally with Region 4 defined by Potts (1983). The regression equation for mean annual discharge derived for Region 2 was based on data from 24 sites and is:

$$Q_A = 0.0313\,(A \cdot P)^{1.045}. \tag{14}$$

The coefficient of determination was 0.971, and the standard error of estimate was 17 percent. The corresponding prediction equation developed by Potts is:

$$Q_A = 0.0411\,(A \cdot P)^{0.995}. \tag{15}$$

Again, equations 14 and 15 are very similar. In this instance, the Potts equation yields larger estimates of mean annual discharge for values of drainage area ($A$) times mean annual precipitation ($P$) to a maximum of about 200. For values of $A \cdot P$ greater than 200, equation 14 gives larger estimates of mean annual discharge. For a value of $A \cdot P$ of 50, the difference between equations 14 and 15 is about 8 percent, and for a value of $A \cdot P$ of 10,000, the difference is about 17 percent. As before, equation 14 is considered to be slightly more reliable than equation 15 when applied to smaller streams in mountainous areas of Region 2.

## Flows of Various Exceedance Percentages

Regression equations for estimating flows for various exceedance percentages were also developed for Regions 1 and 2. For these areas, the equations derived were log-linear regression equations relating flows of various exceedance percentages to mean annual flow. The form of the estimating equations was:

$$Q_n = aQ_A^{\,b}, \tag{16}$$

where

$Q_n$ is the daily discharge, in cubic feet per second, for exceedance percentage of $n$,
$a$ is the regression constant,
$b$ is the regression coefficient, and
$Q_A$ is the mean annual discharge, in cubic feet per second.

The equations developed for Region 1 and their corresponding coefficients of determination are listed in table 20. Similarly, the estimating equations for flows of various exceedance percentages in Region 2 are given in table 21.

The coefficients of determination in tables 20 and 21 are all close to 1.00, indicating very good correlation between mean annual discharge and flows of various exceedance percentages. In both regions, the coefficients of determination generally increase as the streamflows being estimated increase. Low flows (exceedance percentages greater than 50) thus are not as closely correlated with mean annual discharges as are the higher flows (exceedance percentages less than 50).

The equations for estimating discharges of various exceedance percentages can be compared with results obtained by Cunningham and Peterson (1983) by first dividing each equation by $Q_{10}$. Thus, in Region 1, the right side of each equation in table 20 must be divided by $2.866\, Q_A^{0.995}$, and in Region 2 the right side of each equation in table 21 must be divided by $1.390\, Q_A^{1.170}$. Solving the dimensionless equations for Region 1 for the smallest and largest values of $Q_A$ (2.00 and 888 $ft^3/s$) produces two dimensionless flow-duration curves that are compared in figure 14 with the dimensionless flow-duration curves developed by Cunningham and Peterson (1983). Similarly, the dimensionless equations for Region 2 were solved for the smallest and largest values of $Q_A$ in region 2 (6.20 and 210 $ft^3/s$), and the resulting flow-duration curves are compared in figure 15 with the Cunningham and Peterson curves.

The two curves defined by Cunningham and Peterson were considered applicable in all mountainous regions of Montana and thus are the same curves in both figures 14 and 15. The upper curve defined by Cunningham and Peterson represents the expected flow response of mountain streams having the most stable streamflows. According to Cunningham and Peterson, such streams are generally located in densely forested areas with deep soil cover and have relatively flat slopes. The lower curve defined by Cunningham and Peterson is representative of mountain streams having the greatest variation in stream-

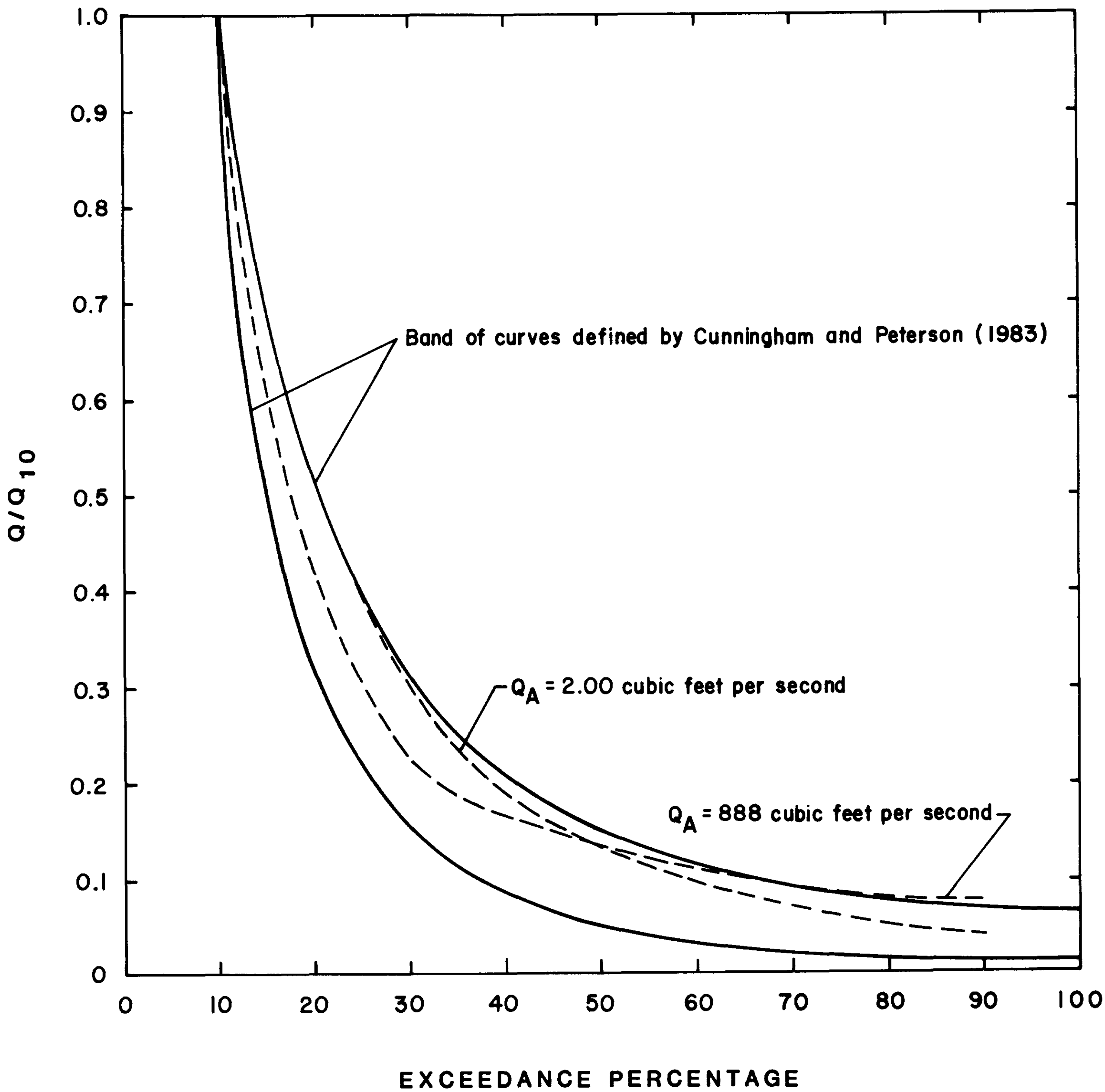



**Figure 14.** Dimensionless flow-duration curves for Region 1.

flow. Such sites, according to Cunningham and Peterson, are generally characterized by steep, rocky terrain with thin soil cover.

In Region 1, the dimensionless flow-duration curve for the smallest mean annual discharge lies totally within the band of curves defined by Cunningham and Peterson (fig. 14). The curve for the largest mean annual discharge falls well within the band of curves for smaller exceedance percentages, but lies slightly above the band for exceedance percentages greater than 70. The pronounced flattening of the curve indicates that base flows on streams having large mean annual discharges generally tend to be more constant than those on streams having small mean annual flows.

In Region 2, the curve for the largest mean annual discharge lies totally within the band defined by Cunningham and Peterson, but the curve for the smallest mean annual discharge lies above the band for exceedance percentages between 20 and 80 (fig. 15). In this region, streamflows evidently fluctuate more on streams having large mean annual discharges than on streams having small mean annual discharges. This result may reflect the fact that many of the measuring sites on small streams (those having small mean annual discharges) in this re-

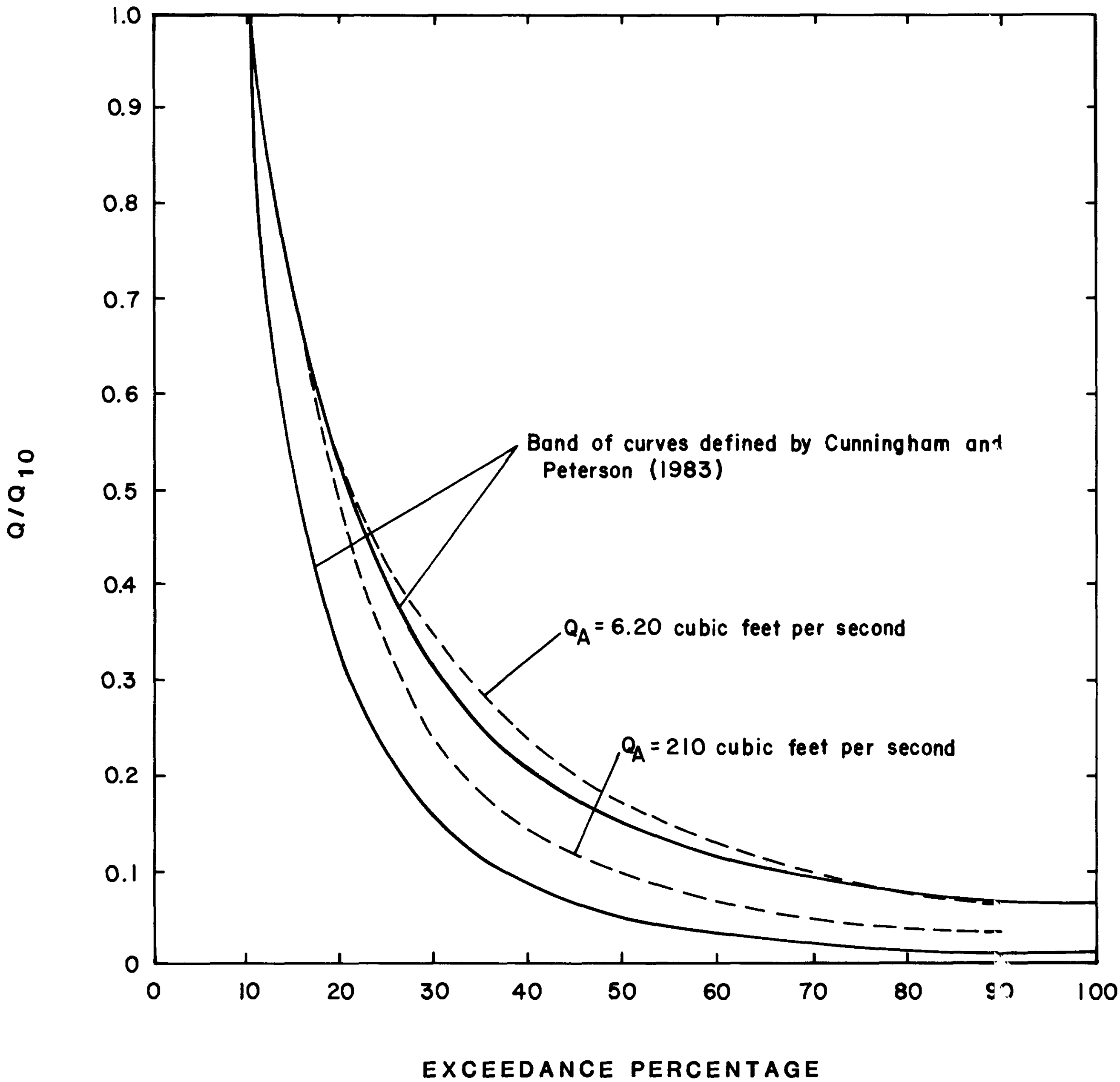



**Figure 15.** Dimensionless flow-duration curves for Region 2.

gion were located at higher elevations, where snowmelt is more gradual and takes place over a longer period of time than at lower elevations.

Because the curves developed in this study plot fairly closely to the band of curves defined by Cunningham and Peterson, the results obtained from either method probably will not be significantly different in most instances. The equations in tables 20 and 21 are considered to be more reliable for the study area than the dimensionless curves developed by Cunningham and Peterson, primarily because of the additional small-stream data used.

## Prediction Accuracy and Limitations

Using the equations in tables 20 and 21 to estimate flow for any exceedance percentage requires an estimate of mean annual discharge. The error associated with an estimate of a flow of any exceedance percentage is thus composed of the error associated with making the mean annual discharge estimate as well as the error associated with the estimating equations in tables 20 and 21. To obtain an indication of the prediction accuracy of the equations in tables 20 and 21 as well as the prediction accuracy of the equations for mean annual flow (eq. 13, 15), 10 sites in Region 1 and 5 sites in Region 2 were randomly selected and withheld from the regression analysis. Applying the estimating equations to the 15 sites not used resulted in the average errors of prediction given in table 22.

Somewhat surprisingly, perhaps, in both regions the average prediction error for flows of most exceedance percentages is less than the prediction error for mean annual discharge. In each region, however, the calculated prediction error for mean annual discharge was largely affected by one poor estimate. If the single poor estimate is eliminated, the average prediction error for mean annual discharge becomes −6 percent for Region 1 and −11 percent for Region 2.

Because the long-term flow characteristics at the flow-measurement sites were determined by correlation with gage sites, and because the correlations reduced the actual site-to-site variability of streamflow, it might be argued that the computed prediction errors are artificially small. To test this assumption, the average errors of prediction were recalculated using only the 6 gage sites from among the 15 sites withheld from the regression analyses. This recalculation reduced the number of sites for calculating average prediction error to five in Region 1 and to only one in Region 2. The average prediction errors calculated using only the six gage sites are given in table 23.

Because the prediction errors calculated from the gage data only are generally less than the prediction errors calculated from all 15 randomly selected sites, the results in table 22 are considered to approximate the average error that can be expected from an estimate of streamflow at an ungaged site. As with any regression analysis, however, it needs to be emphasized that the equations are valid only within the range of values of the variables used to derive the equations and only for locations within the study region. For this study, the range of values of the independent variables is listed in table 24. Extrapolation beyond the range of values listed or application to sites outside the study area may give unrealistic estimates of streamflow.

The regression equations are also not applicable to mountain streams that are spring-fed or that periodically go dry because of very permeable streambeds or other unique localized geologic features. The equations thus are not applicable to the valley-floor areas of the Bitterroot River and Swan River drainages. The equations also may not be applicable for sites where upstream storage in lakes and ponds is significant, or for sites that have upstream diversions. Some knowledge of the local hydrology and geology is a necessary prerequisite to the successful application of the regression equations. In some instances, a program of monthly streamflow measurements may be required to ascertain whether flow conditions in an area are unique. When very accurate flow estimates are required, the prediction equations can be supplemented and verified by miscellaneous streamflow measurements.

## SUMMARY


Miscellaneous measurements were used to estimate streamflow characteristics at 72 sites in the mountainous areas of western Montana. The characteristics included mean annual discharge, mean monthly discharge, and points on the flow-duration curve. A streamflow-correlation program permitted synthesizing the missing record at 38 gaging stations in the study area to develop a common 1938–82 period of record at all streamflow-measurement sites. Tests of the accuracy obtained when miscellaneous measurements are used to estimate long-term streamflow characteristics indicated that mean annual flow can be estimated at a measurement site with an expected error of about ±10 percent. The flow-duration curve can be estimated at a streamflow-measurement site with an expected error of about 10–15 percent. Estimates of long-term mean monthly flow have the poorest accuracy, with expected errors of as much as +60 percent and −21 percent.

The estimates of long-term mean annual flow were used, together with applicable gaging data, to prepare maps showing the areal variability of mean annual runoff. The maps were prepared for the three areas in western Montana having the greatest concentration of flow-measurement sites and gaging stations.

Streamflow characteristics determined for the streamflow-measurement sites and gaging stations were also used to develop regression equations for estimating mean annual flow and flows of various exceedance percentages anywhere within western Montana. The best results were obtained when the study area was divided into two regions, with separate equations for each region. The regression equations for mean annual discharge used drainage area and mean annual precipitation as independent variables and had determination coefficients of 0.944 and 0.971 in the two regions, with corresponding standard errors of estimate of 33 and 17 percent. The mean annual flow equations were compared with similar equations developed in a previous study and were found to give differences of 7 to 32 percent.

The regression equations for flows of various exceedance percentages used mean annual discharge as the only dependent variable and had coefficients of determination ranging from 0.849 to 0.981. The equations were converted to a dimensionless form and were compared graphically with results from a previous study. Data from sites not used in the regression analyses were used to develop estimates of expected average errors of prediction when applying the equations to ungaged sites.

The estimated average error for mean annual discharge was −16 percent in one region and −23 percent in the other, but would have been reduced to −6 percent and −11 percent had one poor estimate been excluded. The estimated errors for flows of various exceedance percentages ranged from +2 to −38 percent in one region and from +18 to −15 percent in the other.

## REFERENCES CITED


Boner, F. C., and Buswell, G. W., 1970, A proposed streamflow data program for Montana: U.S. Geological Survey open-file report, 96 p.

Cunningham, A. B., and Peterson, D. A., 1983, A procedure for estimating flow-duration curves for ungaged mountainous and high plains streams in Montana: Montana University Joint Water Resources Research Center, 43 p.

Farnes, P. E., 1978, Hydrology of mountain watersheds: U.S. Soil Conservation Service, 8 p.

Hunt, O. P., 1963, Use of low-flow measurements to estimate flow-duration curves: U.S. Geological Survey Professional Paper 475-C, p. C196–C197.

McMurtrey, R. G., Konizeski, R. L., Johnson, M. V., and Bartells, J. H., 1972, Geology and water resources of the Bitterroot Valley, southwestern Montana: U.S. Geological Survey Water-Supply Paper 1889, 80 p.

Potts, D. F., 1983, Streamflow regionalization in western Montana: School of Forestry, University of Montana Research Note 19, 5 p.

Riggs, H. C., 1969, Mean streamflow from discharge measurements: International Association of Scientific Hydrology Bulletin 14, p. 95–110.

U.S. Army Corps of Engineers, 1971, HEC-4 monthly streamflow simulation: Hydrologic Engineering Center, 113 p.

U.S. Soil Conservation Service, 1977, Average annual precipitation, Montana, based on 1941–1970 base period: Bozeman, Mont., 13 p.

# TABLES 1–24

**Table 1.** Streamflow measurements and site descriptions
[ft, foot; ft³/s, cubic foot per second; mi, mile]

| Site No. | Stream name | Tributary to | Location | Date | Discharge ($ft^3/s$) |
|---|---|---|---|---|---|
| | | | Kootenai River Basin | | |
| 1 | Young Creek below South Fork | Kootenai River | Lat 48°58'05", long 115°17'24", in SE¼NW¼SE¼ sec. 18, T. 37 N., R. 28 W., Lincoln County, Kootenai National Forest, at U.S. Forest Service bridge, 1.9 mi downstream from South Fork Young Creek, and 7.4 mi northwest of Rexford, Mont. | 04-15-82 | 7.78 |
| | | | | 05-14-82 | 53.8 |
| | | | | 06-15-82 | 67.2 |
| | | | | 07-15-82 | 23.6 |
| | | | | 08-16-82 | 15.4 |
| | | | | 09-14-82 | 9.01 |
| | | | | 10-15-82 | 7.58 |
| | | | | 11-16-82 | 6.50 |
| | | | | 12-15-82 | 5.37 |
| | | | | 01-19-83 | 4.90 |
| 2 | Young Creek at mouth | Kootenai River | Lat 49°57'44", long 113°11'26", in NE¼NW¼NW¼ sec. 24, T. 37 N., R. 28 W., Lincoln County, on left bank 600 ft upstream from Lake Koocanusa flow line, 0.3 mi downstream from culvert on county road, and 4.2 mi northwest of present site of Rexford, Mont. | 03-16-82 | 6.70 |
| | | | | 04-15-82 | 10.1 |
| | | | | 05-14-82 | 44.9 |
| | | | | 06-15-82 | 78.2 |
| | | | | 07-15-82 | 23.5 |
| | | | | 08-16-82 | 11.3 |
| | | | | 09-14-82 | 6.36 |
| | | | | 10-15-82 | 6.34 |
| | | | | 11-16-82 | 6.11 |
| | | | | 12-15-82 | 7.73 |
| | | | | 01-19-83 | 6.23 |
| | | | | 02-16-83 | 5.74 |
| 3 | Cayuse Creek (12300400) | Swamp Creek | Lat 48°36'33", long 115°01'42", in SW¼SW¼NE¼ sec. 24, T. 33 N, R. 27 W., Lincoln County, at culvert on U.S. Forest Service road, 9.8 mi southwest of Trego, Mont., at site of crest-stage station. | 03-15-82 | 1.85 |
| | | | | 04-14-82 | 10.5 |
| | | | | 05-13-82 | 36.0 |
| | | | | 06-14-82 | 4.75 |
| | | | | 07-16-82 | 3.66 |
| | | | | 08-17-82 | 1.09 |
| | | | | 09-15-82 | .89 |
| | | | | 10-12-82 | .58 |
| | | | | 11-16-82 | .58 |
| | | | | 02-16-83 | .92 |
| 4 | Fortine Creek (12300500) | Tobacco River | Lat 48°38'41", long 114°54'36", in NE¼ sec. 11, T. 33 N., R. 26 W., Lincoln County, 5.5 mi southwest of Trego, Mont., at site of crest-stage station. | 03-15-82 | 68.3 |
| | | | | 04-14-82 | 182 |
| | | | | 05-13-82 | 376 |
| | | | | 06-14-82 | 108 |
| | | | | 07-16-82 | 58.7 |
| | | | | 08-17-82 | 13.0 |
| | | | | 09-15-82 | 9.48 |
| | | | | 10-12-82 | 9.85 |
| | | | | 11-16-82 | 10.2 |
| | | | | 12-16-82 | 12.2 |
| | | | | 01-19-83 | 23.8 |
| | | | | 02-16-83 | 21.6 |
| 5 | Deep Creek (12300800) | Fortine Creek | Lat 48°45'41", long 114°52'32", in SW¼ sec. 30, T. 35 N., R. 25 W., Lincoln County, at culvert on county road, 1.2 mi east of Fortine, Mont., at site of crest-stage station. | 03-15-82 | 2.31 |
| | | | | 04-14-82 | 1.89 |
| | | | | 05-13-82 | 8.16 |
| | | | | 06-14-82 | 101 |
| | | | | 06-15-82 | 99.7 |
| | | | | 07-16-82 | 39.4 |
| | | | | 08-17-82 | 10.8 |
| | | | | 09-15-82 | 5.63 |
| | | | | 10-12-82 | 6.06 |
| | | | | 11-16-82 | 3.08 |
| | | | | 12-16-82 | 3.46 |
| | | | | 01-19-83 | 2.39 |
| | | | | 02-16-83 | 2.19 |
| 7 | Sullivan Creek | Kootenai River | Lat 48°52'15", long 115°15'25", in SE¼SE¼NW¼ sec. 20, T. 36 N., R. 28 W., Lincoln County, Kootenai National Forest, at culvert on county road near Lake Koocanusa flow line 5.0 mi west of Rexford, Mont. | 03-16-82 | 7.18 |
| | | | | 04-15-82 | 14.6 |
| | | | | 05-14-82 | 36.8 |
| | | | | 06-15-82 | 24.1 |
| | | | | 07-15-82 | 24.3 |
| | | | | 08-16-82 | 8.38 |
| | | | | 09-14-82 | 5.56 |
| | | | | 10-15-82 | 4.09 |
| | | | | 11-15-82 | 3.64 |
| | | | | 12-15-82 | 2.17 |
| | | | | 01-18-83 | 3.45 |
| | | | | 02-15-83 | 3.80 |

Table 1. Streamflow measurements and site descriptions—Continued

| Site No. | Stream name | Tributary to | Location | Date | Discharge (ft³/s) |
|---|---|---|---|---|---|
| | | | Kootenai River Basin--Continued | | |
| 8 | Boulder Creek | Kootenai River | Lat 48°49'18", long 115°17'30", in NW¼SW¼SE¼ sec. 1, T. 35 N., R. 29 W., Lincoln County, Kootenai National Forest, at culvert near mouth on county road 8.0 mi southeast of Rexford, Mont. | 03-16-82 | 9.46 |
| | | | | 04-15-82 | 20.7 |
| | | | | 05-14-82 | 77.7 |
| | | | | 06-14-82 | 86.0 |
| | | | | 07-14-82 | 31.1 |
| | | | | 08-16-82 | 10.1 |
| | | | | 09-14-82 | 5.69 |
| | | | | 10-15-82 | 6.49 |
| | | | | 11-15-82 | 3.58 |
| | | | | 12-15-82 | 5.02 |
| | | | | 01-18-83 | 6.90 |
| | | | | 02-15-83 | 5.11 |
| 9 | Big Creek near Rexford (12301810) | Kootenai River | Lat 48°44'53", long 115°21'09", in SE¼SW¼SE¼ sec. 33, T. 35 N., R. 29 W., Lincoln County, Kootenai National Forest, on left bank 500 ft downstream from highway bridge, 0.3 mi upstream from Lake Koocanusa flow line, and 13.6 mi southwest of present site of Rexford, Mont., at site of former gaging station. | 03-16-82 | 67.2 |
| | | | | 04-15-82 | 162 |
| | | | | 05-13-82 | -- |
| | | | | 06-14-82 | -- |
| | | | | 07-14-82 | 154 |
| | | | | 08-16-82 | 30.4 |
| | | | | 09-14-82 | 21.2 |
| | | | | 10-15-82 | 18.7 |
| | | | | 11-15-82 | 7.14 |
| | | | | 12-15-82 | 10 |
| | | | | 01-18-83 | 35.0 |
| | | | | 02-15-83 | 38.4 |
| 10 | Bristow Creek | Kootenai River | Lat 48°32'40", long 115°17'20", in SE¼ sec. 10, T. 32 N., R. 29 W., Lincoln County, at bridge on county road west of Lake Koocanusa, 9.0 mi upstream from the dam, and 12.0 mi northwest of Libby, Mont. | 09-16-74 | .35 |
| | | | | 05-15-75 | 229 |
| | | | | 05-28-75 | 52.2 |
| | | | | 06-04-75 | 67.8 |
| | | | | 09-30-75 | .32 |
| 15 | Parmenter Creek | Kootenai River | Lat 48°23'27", long 115°33'34", in SE¼SE¼SW¼ sec. 33, T. 31 N., R. 31 W., Lincoln County, Kootenai National Forest at bridge on U.S. Highway 2, 0.8 mi upstream from Kootenai River in Libby, Mont. | 03-16-82 | 25.2 |
| | | | | 04-15-82 | 43.3 |
| | | | | 05-20-82 | 107 |
| | | | | 06-15-82 | 187 |
| | | | | 07-14-82 | 46.8 |
| | | | | 08-19-82 | 1.82 |
| | | | | 09-14-82 | 1.22 |
| | | | | 10-13-82 | .31 |
| | | | | 11-17-82 | 1.39 |
| | | | | 12-13-82 | 0 |
| | | | | 01-20-83 | 1.93 |
| | | | | 02-17-83 | 1.67 |
| 16 | Cedar Creek | Kootenai River | Lat 48°25'50", long 115°37'41", in NW¼SE¼SE¼ sec. 24, T. 31 N., R. 32 W., Lincoln County, Kootenai National Forest, at bridge on U.S. Highway 2, 0.1 mi upstream from Kootenai River, and 5.0 mi northwest of Libby, Mont. | 03-16-82 | 34.4 |
| | | | | 04-15-82 | 41.4 |
| | | | | 05-20-82 | 105 |
| | | | | 06-15-82 | 137 |
| | | | | 07-14-82 | 27.0 |
| | | | | 08-19-82 | 11.8 |
| | | | | 09-13-82 | 7.83 |
| | | | | 10-13-82 | 7.78 |
| | | | | 11-17-82 | 8.51 |
| | | | | 12-13-82 | 7.09 |
| | | | | 01-20-83 | 8.93 |
| | | | | 02-17-83 | 6.55 |
| 17 | Quartz Creek | Kootenai River | Lat 48°26'21", long 115°38'08", in SW¼NE¼NW¼ sec. 24, T. 31 N., R. 32 W., Lincoln County, Kootenai National Forest, at county road bridge, 0.1 mi upstream from mouth, and 5.0 mi northwest of Libby, Mont. | 03-16-82 | 90.7 |
| | | | | 04-14-82 | 156 |
| | | | | 05-20-82 | 330 |
| | | | | 06-15-82 | 278 |
| | | | | 07-14-82 | 61.0 |
| | | | | 08-19-82 | 31.1 |
| | | | | 09-13-82 | 32.8 |
| | | | | 10-13-82 | 21.2 |
| | | | | 11-15-82 | 18.7 |
| | | | | 12-13-82 | 31.9 |
| | | | | 01-19-83 | 44.4 |
| | | | | 02-15-83 | 38.1 |

**Table 1.** Streamflow measurements and site descriptions—Continued

| Site No. | Stream name | Tributary to | Location | Date | Discharge ($ft^3/s$) |
|---|---|---|---|---|---|
| | | | Kootenai River Basin--Continued | | |
| 18 | Camp Creek (12303440) | Lake Creek | Lat 48°18'46", long 115°50'35", in SW¼SE¼ sec. 32, T. 30 N., R. 33 W., Lincoln County, at bridge on U.S. Forest Service road, 0.8 mi east of Highway 202, 12.6 mi south of Troy, Mont., at site of crest-stage station. | 03-15-82 | 15.1 |
| | | | | 04-14-82 | 20.0 |
| | | | | 05-19-82 | 82.0 |
| | | | | 06-14-82 | 143 |
| | | | | 07-12-82 | 47.2 |
| | | | | 08-17-82 | 6.41 |
| | | | | 09-13-82 | 4.16 |
| | | | | 10-13-82 | 4.78 |
| | | | | 11-17-82 | 4.53 |
| | | | | 12-15-82 | 4.63 |
| | | | | 01-19-83 | 6.20 |
| | | | | 02-17-83 | 5.27 |
| 19 | Ruby Creek | Kootenai River | Lat 48°31'07", long 115°57'00", NW¼SE¼SE¼ sec. 21, T. 32 N., R. 34 W., Lincoln County, Kootenai National Forest, at bridge on county road, 0.3 mi upstream from Kootenai River, and 5.0 mi northwest of Troy, Mont. | 03-15-82 | 62.5 |
| | | | | 04-14-82 | 94.8 |
| | | | | 05-19-82 | 135 |
| | | | | 06-14-82 | 71.0 |
| | | | | 07-13-82 | 14.8 |
| | | | | 08-18-82 | 6.65 |
| | | | | 09-14-82 | 4.63 |
| | | | | 10-13-82 | 4.26 |
| | | | | 11-17-82 | 5.02 |
| | | | | 12-15-82 | 6.68 |
| | | | | 01-19-83 | 23.6 |
| | | | | 02-17-83 | 23.6 |
| 20 | Pete Creek below Hensley Creek | Yaak River | Lat 48°51'19", long 115°46'20", landline description unsurveyed, Lincoln County, Kootenai National Forest, at U.S. Forest Service road culvert 100 ft downstream from Hensley Creek, 1.7 mi upstream of Yaak River, 1.9 mi north of junction with FAS 508, and 3.5 mi west of Yaak, Mont. | 03-15-82 | 52.3 |
| | | | | 04-13-82 | 126 |
| | | | | 05-20-82 | 219 |
| | | | | 06-14-82 | 83.1 |
| | | | | 07-13-82 | 27.2 |
| | | | | 08-18-82 | 4.84 |
| | | | | 09-14-82 | 4.13 |
| | | | | 10-14-82 | 2.97 |
| | | | | 11-16-82 | 5.10 |
| | | | | 12-14-82 | 11.8 |
| | | | | 01-18-83 | 29.7 |
| | | | | 02-16-83 | 23.0 |
| 21 | Pete Creek at mouth | Yaak River | Lat 48°49'53", long 115°45'55", landline description unsurveyed, Lincoln County, Kootenai National Forest, at county bridge on FAS 508, 0.1 mi upstream from Yaak River, and 2.0 mi west of Yaak, Mont. | 03-15-82 | 64.1 |
| | | | | 04-13-82 | 178 |
| | | | | 05-20-82 | 222 |
| | | | | 06-14-82 | 83.6 |
| | | | | 07-13-82 | 26.0 |
| | | | | 08-18-82 | 6.29 |
| | | | | 09-14-82 | 3.94 |
| | | | | 10-14-82 | 3.16 |
| | | | | 11-16-82 | 6.90 |
| | | | | 12-14-82 | 13.5 |
| | | | | 01-18-83 | 34.0 |
| | | | | 02-16-83 | 30.0 |
| 22 | Whitetail Creek (12304250) | Yaak River | Lat 48°49'42", long 115°48'45", in NE¼ sec. 1, T. 35 N., R. 33 W., Lincoln County, 500 ft upstream from mouth, 5.0 mi west of Yaak, Mont., at site of former crest-stage station. | 03-15-82 | 3.92 |
| | | | | 04-13-82 | 10.9 |
| | | | | 05-20-82 | 9.59 |
| | | | | 06-14-82 | 2.43 |
| | | | | 07-13-82 | .61 |
| | | | | 08-18-82 | 0 |
| | | | | 09-14-82 | 0 |
| | | | | 10-14-82 | 0 |
| | | | | 11-16-82 | 0 |
| | | | | 12-13-82 | 0 |
| | | | | 01-18-83 | 1.63 |
| | | | | 02-16-83 | 1.45 |
| 23 | Spread Creek | Yaak River | Lat 48°49'23", long 115°51'01", landline description unsurveyed, Lincoln County, Kootenai National Forest, at bridge on FAS 508, 0.3 mi upstream from Yaak River, and 6.5 mi west of Yaak, Mont. | 03-15-82 | 40.8 |
| | | | | 04-13-82 | 99.1 |
| | | | | 05-19-82 | 398 |
| | | | | 06-14-82 | 592 |
| | | | | 07-13-82 | 81.5 |
| | | | | 08-18-82 | 19.6 |
| | | | | 09-14-82 | 17.0 |
| | | | | 10-14-82 | 16.4 |
| | | | | 11-16-82 | 17.2 |
| | | | | 12-14-82 | 31.5 |
| | | | | 01-18-83 | 31.0 |
| | | | | 02-16-83 | 28.3 |

**Table 1.** Streamflow measurements and site descriptions—Continued

| Site No. | Stream name | Tributary to | Location | Date | Discharge (ft³/s) |
|---|---|---|---|---|---|
| | | | Kootenai River Basin--Continued | | |
| 24 | Hell-roaring Creek at Forest Service bridge | Yaak River | Lat 48°50'07", long 115°58'05", landline description unsurveyed, Lincoln County, Kootenai National Forest, at U.S. Forest Service bridge, 4.0 mi upstream from Yaak River, and 11.5 mi west of Yaak, Mont. | 05-19-82 | 189 |
| | | | | 06-15-82 | 172 |
| | | | | 07-13-82 | 15.3 |
| | | | | 08-18-82 | 4.78 |
| | | | | 09-14-82 | 4.38 |
| | | | | 10-14-82 | 4.17 |
| | | | | 11-16-82 | 5.77 |
| 25 | Hell-roaring Creek at mouth | Yaak River | Lat 48°47'16", long 115°55'08", landline description unsurveyed, Lincoln County, Kootenai National Forest, at bridge on FAS 508, 0.1 mi upstream from Yaak River, and 10.1 mi southwest of Yaak, Mont. | 03-15-82 | 21.8 |
| | | | | 04-13-82 | 51.1 |
| | | | | 05-19-82 | 185 |
| | | | | 06-15-82 | 179 |
| | | | | 07-13-82 | 20.3 |
| | | | | 08-18-82 | 2.91 |
| | | | | 09-14-82 | 3.79 |
| | | | | 10-14-82 | 3.96 |
| | | | | 11-16-82 | 6.64 |
| | | | | 12-14-82 | 11.8 |
| | | | | 01-18-83 | 14.7 |
| | | | | 02-16-83 | 9.31 |
| 26 | North Fork Meadow Creek | Yaak River | Lat 48°47'56", long 115°56'57", landline description unsurveyed, Lincoln County, Kootenai National Forest, near switchback in U.S. Forest Service road, 1.2 mi upstream from Meadow Creek, 1.6 mi west of FAS 508, and 11.5 mi southwest of Yaak, Mont. | 05-19-82 | 86.7 |
| | | | | 06-15-82 | 90.3 |
| | | | | 07-13-82 | 12.4 |
| | | | | 08-18-82 | 2.62 |
| | | | | 09-14-82 | 2.03 |
| | | | | 10-14-82 | 1.47 |
| | | | | 11-16-82 | 3.49 |
| 27 | North Fork Meadow Creek at mouth | Yaak River | Lat 48°47'14", long 115°56'16", landline description unsurveyed, Lincoln County, Kootenai National Forest, at U.S. Forest Service bridge 0.2 mi upstream from Meadow Creek,0.8 mi west of FAS 508, and 11.0 mi southwest of Yaak, Mont. | 05-19-82 | 91.8 |
| | | | | 06-15-82 | 71.0 |
| | | | | 07-13-82 | 10.1 |
| | | | | 08-18-82 | 2.53 |
| | | | | 09-14-82 | 3.22 |
| | | | | 10-14-82 | 2.96 |
| | | | | 11-16-82 | 4.28 |
| 28 | Meadow Creek | Yaak River | Lat 48°47'01", long 115°55'20", landline description unsurveyed, Lincoln County, Kootenai National Forest, at bridge on FAS 508, 0.1 mi upstream from Yaak River, and 10.5 mi southwest of Yaak, Mont. | 03-15-82 | 40.2 |
| | | | | 04-13-82 | 74.1 |
| | | | | 05-18-82 | 355 |
| | | | | 06-15-82 | 186 |
| | | | | 07-13-82 | 42.4 |
| | | | | 08-18-82 | 7.78 |
| | | | | 09-14-82 | 6.46 |
| | | | | 10-14-82 | 6.27 |
| | | | | 11-16-82 | 10.7 |
| | | | | 12-15-82 | 19.4 |
| | | | | 01-18-83 | 20.8 |
| | | | | 02-16-83 | 18.1 |
| 29 | Red Top Creek | Yaak River | Lat 48°45'42", long 115°55'58", landline description unsurveyed, Lincoln County, Kootenai National Forest, at Red Top Creek Campground, 0.2 mi upstream from Yaak River, and 10.7 mi west of Yaak, Mont. | 03-82 | 19.1[1] |
| | | | | 04-82 | 27.8 |
| | | | | 05-82 | 105 |
| | | | | 06-82 | 44.6 |
| | | | | 07-82 | 14.0 |
| | | | | 08-82 | 6.00 |
| | | | | 09-82 | 3.70 |
| | | | | 10-82 | 4.74 |
| | | | | 11-82 | 15.8 |
| 30 | Cyclone Creek (12304300) | Yaak River | Lat 48°45'01", long 115°54'06", in SE¼ sec. 32, T. 35 N., R. 33 W., Lincoln County, at bridge 0.2 mi upstream from mouth, 10.5 mi southwest of Yaak, Mont., at site of crest-stage station. | 03-16-82 | 11.9 |
| | | | | 04-14-82 | 25.9 |
| | | | | 05-18-82 | 92.9 |
| | | | | 06-15-82 | 48.0 |
| | | | | 07-13-82 | 8.94 |
| | | | | 08-18-82 | 4.05 |
| | | | | 09-14-82 | 1.33 |
| | | | | 10-14-82 | 3.04 |
| | | | | 11-16-82 | 3.25 |
| | | | | 12-15-82 | 5.24 |
| | | | | 01-18-83 | 6.71 |
| | | | | 02-16-83 | 6.85 |

**Table 1.** Streamflow measurements and site descriptions—Continued

| Site No. | Stream name | Tributary to | Location | Date | Discharge ($ft^3/s$) |
|---|---|---|---|---|---|
| | | | Kootenai River Basin--Continued | | |
| 31 | Fourth of July Creek (12304400) | Yaak River | Lat 48°42'04", long 115°52'04", in NW¼ sec. 22, T. 34 N., R. 33 W., Lincoln County, at bridge 500 ft upstream from mouth, 12.0 mi southwest of Yaak, Mont., at site of crest-stage station. | 03-16-82 | 13.1 |
| | | | | 04-14-82 | 41.8 |
| | | | | 05-18-82 | 148 |
| | | | | 06-15-82 | 39.6 |
| | | | | 07-13-82 | 10.5 |
| | | | | 08-18-82 | 2.89 |
| | | | | 09-14-82 | 2.40 |
| | | | | 10-14-82 | 2.55 |
| | | | | 11-16-82 | 2.92 |
| | | | | 12-15-82 | 3.61 |
| | | | | 01-18-83 | 8.16 |
| | | | | 02-16-83 | 9.53 |
| | | | Pend Oreille River Basin | | |
| 40 | Deer Creek (12339300) | Clearwater River | Lat 47°12'37", long 113°32'27", in SE¼SW¼ sec. 20, T. 17 N., R. 15 W., Missoula County, at bridge on county road, 2.3 mi northwest of bridge over Clearwater River, and 3.5 mi northwest of Seeley Lake, Mont., at site of crest-stage station. | 03-15-82 | 11.5 |
| | | | | 04-19-82 | 36.8 |
| | | | | 05-20-82 | 139 |
| | | | | 06-14-82 | 110 |
| | | | | 07-13-82 | 27.0 |
| | | | | 08-17-82 | 5.00 |
| | | | | 09-16-82 | 3.49 |
| | | | | 10-18-82 | 4.53 |
| | | | | 11-15-82 | 3.25 |
| | | | | 12-13-82 | 3.01 |
| | | | | 01-17-83 | 3.72 |
| | | | | 02-15-83 | 3.65 |
| 41 | Seeley Creek | Clearwater River | Lat 47°11'00", long 113°28'52", in SE¼ sec. 35, T. 17 N., R. 15 W., Missoula County, at culvert on county road, 0.2 mi east of U.S. Highway 83, at Seeley Lake, Mont. | 09-12-74 | 25.8 |
| | | | | 05-14-75 | 24.6 |
| | | | | 06-12-75 | 4.29 |
| 42 | West Twin Creek (12339900) | Clark Fork | Lat 46°54'44", long 113°42'50", in SW¼ sec. 2, T. 13 N., R. 17 W., Missoula County, at bridge on State Highway 200, 8.0 mi east of Bonner, Mont., at site of crest-stage station. | 03-17-82 | 9.47 |
| | | | | 04-14-82 | 34.6 |
| | | | | 05-20-82 | 59.3 |
| | | | | 06-17-82 | 68.0 |
| | | | | 07-15-82 | 14.9 |
| | | | | 08-19-82 | 4.30 |
| | | | | 09-18-82 | 3.52 |
| | | | | 10-21-82 | 3.42 |
| | | | | 11-18-82 | 2.31 |
| | | | | 12-17-82 | 2.38 |
| | | | | 01-20-83 | 4.42 |
| | | | | 02-17-83 | 3.03 |
| 44 | Marshall Creek (12340200) | Clark Fork | Lat 46°53'15", long 113°55'27", in NW¼ sec. 18, T. 13 N., R. 18 W., Missoula County, at culvert on U.S. Highway 10, 3.0 mi east of Missoula, Mont., at site of former crest-stage station. | 03-17-82 | 3.29 |
| | | | | 04-14-82 | 6.87 |
| | | | | 05-20-82 | 13.8 |
| | | | | 06-17-82 | 3.00 |
| | | | | 07-15-82 | 2.52 |
| | | | | 08-19-82 | 1.00 |
| | | | | 09-18-82 | 1.08 |
| | | | | 10-21-82 | 2.09 |
| | | | | 11-18-82 | 1.39 |
| | | | | 12-16-82 | 1.57 |
| | | | | 01-20-83 | 1.42 |
| | | | | 02-17-83 | 1.88 |

**Table 1.** Streamflow measurements and site descriptions—Continued

| Site No. | Stream name | Tributary to | Location | Date | Discharge (ft3/s) |
|---|---|---|---|---|---|
| | | | Pend Oreille River Basin--Continued | | |
| 47 | Tin Cup Creek | Bitterroot River | Lat 46°00'50", long 114°13'20", in SE¼ sec. 17, T. 3 N., R. 21 W., Ravalli County, 4.0 mi upstream from mouth, and 2 mi southeast of Darby, Mont. | 04-16-58 | 103 |
| | | | | 05-07-58 | 294 |
| | | | | 05-14-58 | 293 |
| | | | | 05-22-58 | 519 |
| | | | | 06-12-58 | 289 |
| | | | | 07-12-58 | 79.9 |
| | | | | 08-08-58 | 51.4 |
| | | | | 09-09-58 | 14.6 |
| | | | | 10-10-58 | 24.2 |
| | | | | 11-19-58 | 59.7 |
| | | | | 12-31-58 | 32.2 |
| | | | | 01-27-59 | 32.8 |
| | | | | 02-27-59 | 12.9 |
| | | | | 04-01-59 | 24.2 |
| | | | | 04-30-59 | 153 |
| | | | | 06-08-59 | 530 |
| | | | | 07-07-59 | 182 |
| | | | | 08-02-59 | 65.8 |
| | | | | 09-01-59 | 46.8 |
| | | | | 10-01-59 | 50.5 |
| 48 | Burke Gulch | Bitterroot River | Lat 46°01'28", long 114°08'45", in S½ sec. 12, T. 3 N., R. 21 W., Ravalli County, 1.0 mi upstream from mouth, and 1.5 mi east of Darby, Mont. | 03-29-58 | .90 |
| | | | | 04-16-58 | 2.40 |
| | | | | 05-06-58 | 9.00 |
| | | | | 05-12-58 | 11.0 |
| | | | | 05-13-58 | 8.10 |
| | | | | 07-11-58 | .90 |
| | | | | 08-07-58 | .60 |
| | | | | 09-09-58 | .20 |
| | | | | 10-10-58 | .40 |
| | | | | 11-19-58 | .80 |
| | | | | 01-01-59 | .40 |
| | | | | 01-27-59 | .80 |
| | | | | 02-27-59 | .80 |
| | | | | 04-01-59 | 1.40 |
| | | | | 04-02-59 | 2.70 |
| | | | | 04-28-59 | 2.30 |
| | | | | 05-16-59 | 5.00 |
| | | | | 06-08-59 | 1.60 |
| | | | | 07-07-59 | 1.00 |
| | | | | 08-01-59 | .30 |
| | | | | 09-01-59 | .10 |
| | | | | 10-01-59 | .60 |
| 49 | Lost Horse Creek | Bitterroot River | Lat 46°06'08", long 114°15'50", in SW¼ sec. 18, T. 4 N., R. 21 W., Ravalli County, 5.0 mi upstream from mouth, and 7.0 mi northwest of Darby, Mont. | 03-31-58 | 49.4 |
| | | | | 04-17-58 | 179 |
| | | | | 05-02-58 | 168 |
| | | | | 05-15-58 | 703 |
| | | | | 05-22-58 | 1,310 |
| | | | | 06-16-58 | 440 |
| | | | | 07-11-58 | 133 |
| | | | | 08-07-58 | 33.7 |
| | | | | 09-10-58 | 22.0 |
| | | | | 10-11-58 | 89.8 |
| | | | | 11-19-58 | 117 |
| | | | | 01-01-59 | 71.2 |
| | | | | 01-28-59 | 78.5 |
| | | | | 02-28-59 | 31.0 |
| | | | | 04-02-59 | 255 |
| | | | | 04-30-59 | 485 |
| | | | | 06-09-59 | 974 |
| | | | | 07-07-59 | 366 |
| | | | | 08-02-59 | 84.3 |
| | | | | 09-03-59 | 25.4 |
| | | | | 10-01-59 | 104 |

**Table 1.** Streamflow measurements and site descriptions—Continued

| Site No. | Stream name | Tributary to | Location | Date | Discharge (ft3/s) |
|---|---|---|---|---|---|
| | | | Pend Oreille River Basin--Continued | | |
| 50 | Camas Creek | Bitterroot River | Lat 46°08'42", long 114°12'58", in SW¼ sec. 34, T. 5 N., R. 21 W., Ravalli County, 8.0 mi southwest of Hamilton, Mont. | 03-31-58 | 1.70 |
| | | | | 04-17-58 | 6.40 |
| | | | | 05-07-58 | 38.9 |
| | | | | 05-15-58 | 44.4 |
| | | | | 05-20-58 | 240 |
| | | | | 05-25-58 | 103 |
| | | | | 06-12-58 | 40.8 |
| | | | | 07-12-58 | 10.2 |
| | | | | 08-08-58 | 2.50 |
| | | | | 09-10-58 | 1.10 |
| | | | | 10-11-58 | 1.50 |
| | | | | 11-21-58 | 5.80 |
| | | | | 01-01-59 | 2.20 |
| | | | | 01-28-59 | 1.80 |
| | | | | 02-28-59 | .90 |
| | | | | 04-02-59 | 18.6 |
| | | | | 04-30-59 | 16.2 |
| | | | | 06-07-59 | 190 |
| | | | | 06-09-59 | 56.6 |
| | | | | 07-09-59 | 20.0 |
| | | | | 08-02-59 | -- |
| | | | | 09-03-59 | -- |
| | | | | 10-02-59 | 3.90 |
| 51 | Sleeping Child Creek | Bitterroot River | Lat 46°08'34", long 114°05'02", in SE¼ sec. 34, T. 5 N., R. 20 W., Ravalli County, 5.0 mi upstream from mouth, and 8.5 mi southeast of Hamilton, Mont. | 03-30-58 | 14.2 |
| | | | | 04-18-58 | 34.2 |
| | | | | 05-02-58 | 44.0 |
| | | | | 05-07-58 | 158 |
| | | | | 05-13-58 | 222 |
| | | | | 05-25-58 | 392 |
| | | | | 06-14-58 | 161 |
| | | | | 06-14-58 | 152 |
| | | | | 06-19-58 | 111 |
| | | | | 07-13-58 | 45.1 |
| | | | | 08-09-58 | 20.5 |
| | | | | 09-10-58 | 12.4 |
| | | | | 10-11-58 | 15.2 |
| | | | | 11-18-58 | 11.1 |
| | | | | 01-01-59 | 9.40 |
| | | | | 01-29-59 | 13.4 |
| | | | | 03-01-59 | 14.0 |
| | | | | 03-31-59 | 15.4 |
| | | | | 05-01-59 | 70.3 |
| | | | | 06-07-59 | 339 |
| | | | | 07-06-59 | 70.2 |
| | | | | 08-02-59 | 20.7 |
| | | | | 09-03-59 | 11.8 |
| | | | | 10-02-59 | 11.8 |
| 52 | Little Sleeping Child Creek | Bitterroot River | Lat 46°06'25", long 114°06'08", in SE¼ sec. 8, T. 4 N., R. 20 W., Ravalli County, 3.5 mi upstream from mouth, and 10.0 mi southeast of Hamilton, Mont. | 03-30-58 | 2.00 |
| | | | | 04-18-58 | 5.90 |
| | | | | 05-07-58 | 23.7 |
| | | | | 05-13-58 | 22.1 |
| | | | | 05-25-58 | 12.8 |
| | | | | 06-14-58 | 6.60 |
| | | | | 07-13-58 | 2.10 |
| | | | | 08-09-58 | .70 |
| | | | | 09-10-58 | .60 |
| | | | | 10-11-58 | .80 |
| | | | | 11-18-58 | .90 |
| | | | | 01-01-59 | 1.00 |
| | | | | 01-29-59 | 1.20 |
| | | | | 03-01-59 | 1.50 |
| | | | | 03-31-59 | 1.80 |
| | | | | 05-01-59 | 7.40 |
| | | | | 06-07-59 | 7.90 |
| | | | | 07-06-59 | 1.40 |
| | | | | 08-02-59 | .70 |
| | | | | 09-03-59 | .60 |
| | | | | 10-02-59 | 1.00 |

Table 1. Streamflow measurements and site descriptions—Continued

| Site No. | Stream name | Tributary to | Location | Date | Discharge ($ft^3/s$) |
|---|---|---|---|---|---|
| | | | Pend Oreille River Basin--Continued | | |
| 53 | Roaring Lion Creek | Bitterroot River | Lat 46°11'35", long 114°13'11", in NW¼ sec. 16, T. 5 N., R. 21 W., Ravalli County, 4.5 mi upstream from mouth, and 5.0 mi southwest of Hamilton, Mont. | 04-18-58 | 91.7 |
| | | | | 06-16-58 | 147 |
| | | | | 06-19-58 | 149 |
| | | | | 07-12-58 | 47.4 |
| | | | | 08-08-58 | 12.9 |
| | | | | 09-10-58 | 4.00 |
| | | | | 10-11-58 | 33.1 |
| | | | | 11-20-58 | 35.4 |
| | | | | 01-01-59 | 15.0 |
| | | | | 01-29-59 | 15.3 |
| | | | | 02-28-59 | 7.60 |
| | | | | 04-02-59 | 80.8 |
| | | | | 05-01-59 | 193 |
| | | | | 06-10-59 | 269 |
| | | | | 07-09-59 | 88.5 |
| | | | | 08-04-59 | 24.4 |
| | | | | 09-04-59 | 7.10 |
| | | | | 10-02-59 | 23.6 |
| 54 | Sawtooth Creek | Bitterroot River | Lat 46°12'20", long 114°13'48", in NW¼ sec. 9, T. 5 N., R. 21 W., Ravalli County, 4.0 mi upstream from mouth, and 4.5 mi southwest of Hamilton, Mont. | 04-04-58 | 17.5 |
| | | | | 04-17-58 | 54.9 |
| | | | | 05-02-58 | 72.4 |
| | | | | 05-15-58 | 206 |
| | | | | 05-23-58 | 360 |
| | | | | 06-16-58 | 129 |
| | | | | 07-12-58 | 36.0 |
| | | | | 08-08-58 | 10.8 |
| | | | | 09-11-58 | 5.40 |
| | | | | 10-12-58 | 27.1 |
| | | | | 11-20-58 | 34.4 |
| | | | | 01-02-59 | 8.00 |
| | | | | 01-29-59 | 19.8 |
| | | | | 02-28-59 | 10.1 |
| | | | | 04-03-59 | 55.7 |
| | | | | 05-01-59 | 192 |
| | | | | 05-01-59 | 189 |
| | | | | 06-09-59 | 312 |
| | | | | 07-09-59 | 71.0 |
| | | | | 08-04-59 | 14.8 |
| | | | | 09-04-59 | 4.80 |
| | | | | 10-02-59 | 18.6 |
| 56 | Gird Creek | Bitterroot River | Lat 46°12'18", long 114°03'32", near center sec. 11, T. 5 N., R. 20 W., Ravalli County, 5.5 mi southeast of Hamilton, Mont. | 04-01-58 | 5.80 |
| | | | | 04-19-58 | 8.50 |
| | | | | 05-08-58 | 22.4 |
| | | | | 05-13-58 | 36.1 |
| | | | | 06-19-58 | 32.6 |
| | | | | 07-10-58 | 27.5 |
| | | | | 08-10-58 | 15.9 |
| | | | | 09-11-58 | 11.8 |
| | | | | 10-12-58 | 9.20 |
| | | | | 11-17-58 | 6.30 |
| | | | | 12-30-58 | 5.90 |
| | | | | 01-29-59 | 6.20 |
| | | | | 03-01-59 | 5.70 |
| | | | | 04-01-59 | 6.90 |
| | | | | 05-04-59 | 11.2 |
| | | | | 06-07-59 | 44.8 |
| | | | | 07-10-59 | 22.1 |
| | | | | 08-03-59 | 14.6 |
| | | | | 09-03-59 | 9.60 |
| | | | | 10-04-59 | 8.60 |
| | | | | 10-04-59 | 9.00 |

**Table 1.** Streamflow measurements and site descriptions—Continued

| Site No. | Stream name | Tributary to | Location | Date | Discharge (ft3/s) |
|---|---|---|---|---|---|
| | | | Pend Oreille River Basin--Continued | | |
| 58 | Mill Creek | Bitterroot River | Lat 46°18'41", long 114°13'36", in N½ sec. 4, T. 6 N., R. 21 W., Ravalli County, 6.5 mi upstream from mouth, and 6.0 mi northwest of Hamilton, Mont. | 04-02-58 | 10.1 |
| | | | | 04-21-58 | 72.7 |
| | | | | 05-01-58 | 39.2 |
| | | | | 05-14-58 | 147 |
| | | | | 05-26-58 | 342 |
| | | | | 06-17-58 | 116 |
| | | | | 07-13-58 | 32.4 |
| | | | | 08-09-58 | 12.6 |
| | | | | 09-12-58 | 3.70 |
| | | | | 10-13-58 | 6.60 |
| | | | | 11-21-58 | 47.4 |
| | | | | 01-03-59 | 8.00 |
| | | | | 01-31-59 | 16.4 |
| | | | | 03-04-59 | 11.2 |
| | | | | 04-03-59 | 48.7 |
| | | | | 05-02-59 | 155 |
| | | | | 06-10-59 | 206 |
| | | | | 07-08-59 | 74.8 |
| | | | | 08-05-59 | 19.0 |
| | | | | 09-04-59 | 10.7 |
| | | | | 10-04-59 | 28.6 |
| 60 | Sweat House Creek | Bitterroot River | Lat 46°24'56", long 114°13'13", in SE¼ sec. 28, T. 8 N., R. 21 W., Ravalli County, 2.0 mi upstream from Gash Creek, and 3.5 mi west of Victor, Mont. | 04-04-58 | 4.60 |
| | | | | 04-21-58 | 25.7 |
| | | | | 05-14-58 | 76.8 |
| | | | | 05-25-58 | 189 |
| | | | | 07-08-58 | 23.4 |
| | | | | 08-06-58 | 6.20 |
| | | | | 09-12-58 | 2.10 |
| | | | | 10-13-58 | 10.6 |
| | | | | 11-20-58 | 16.0 |
| | | | | 01-02-59 | 4.50 |
| | | | | 02-02-59 | 4.90 |
| | | | | 03-03-59 | 6.20 |
| | | | | 04-04-59 | 27.1 |
| | | | | 04-29-59 | 30.7 |
| | | | | 06-11-59 | 78.0 |
| | | | | 07-08-59 | 36.6 |
| | | | | 08-04-59 | 9.80 |
| | | | | 09-02-59 | 6.00 |
| | | | | 10-04-59 | 12.2 |
| 61 | Gash Creek | Bitterroot River | Lat 46°24'20", long 114°15'21", in W½ sec. 32, T. 8 N., R. 21 W., Ravalli County, 0.5 mi upstream from South Fork Gash Creek, and 5.0 mi west of Victor, Mont. | 05-14-58 | 15.1 |
| | | | | 05-21-58 | 200 |
| | | | | 05-25-58 | 99.4 |
| | | | | 06-17-58 | 14.0 |
| | | | | 07-08-58 | 10.0 |
| | | | | 08-06-58 | 3.80 |
| | | | | 09-12-58 | 1.60 |
| | | | | 10-13-58 | 2.80 |
| | | | | 11-20-58 | 3.70 |
| | | | | 01-02-59 | 2.30 |
| | | | | 02-01-59 | 1.50 |
| | | | | 04-02-59 | 5.50 |
| | | | | 04-29-59 | 8.10 |
| | | | | 06-05-59 | 160 |
| | | | | 06-11-59 | 32.8 |
| | | | | 07-08-59 | 10.5 |
| | | | | 08-04-59 | 5.00 |
| | | | | 09-02-59 | 2.00 |
| | | | | 10-04-59 | 3.00 |

**Table 1.** Streamflow measurements and site descriptions—Continued

| Site No. | Stream name | Tributary to | Location | Date | Discharge (ft3/s) |
|---|---|---|---|---|---|
| | | | Pend Oreille River Basin--Continued | | |
| 62 | Big Creek near Victor | Bitterroot River | Lat 46°27'50", long 114°12'25", near center sec. 10, T. 8 N., R. 21 W., 5.0 mi upstream from mouth, and 4.0 mi northwest of Victor, Mont. | 04-04-58 | 25.5 |
| | | | | 04-23-58 | 86.7 |
| | | | | 05-15-58 | 276 |
| | | | | 05-26-58 | 652 |
| | | | | 06-18-58 | 219 |
| | | | | 07-09-58 | 96.2 |
| | | | | 08-06-58 | 51.2 |
| | | | | 09-13-58 | 17.8 |
| | | | | 10-14-58 | 39.5 |
| | | | | 11-21-58 | 96.7 |
| | | | | 01-03-59 | 13.6 |
| | | | | 02-02-59 | 22.5 |
| | | | | 03-04-59 | 24.3 |
| | | | | 04-04-59 | 78.8 |
| | | | | 05-02-59 | 263 |
| | | | | 06-10-59 | 409 |
| | | | | 07-08-59 | 186 |
| | | | | 08-05-59 | 24.8 |
| | | | | 09-05-59 | 53.8 |
| | | | | 10-04-59 | 73.7 |
| 65 | Bass Creek | Bitterroot River | Lat 46°34'27", long 114°08'56", in SW¼ sec. 32, T. 10 N., R. 20 W., Ravalli County, 3.0 mi upstream from mouth, and 5.0 mi southwest of Florence, Mont. | 04-03-58 | 6.40 |
| | | | | 04-23-58 | 20.2 |
| | | | | 05-01-58 | 16.2 |
| | | | | 05-15-58 | 81.2 |
| | | | | 05-26-58 | 132 |
| | | | | 06-18-58 | 41.9 |
| | | | | 07-08-58 | 26.3 |
| | | | | 08-05-58 | 33.2 |
| | | | | 09-13-58 | 23.2 |
| | | | | 10-15-58 | 6.40 |
| | | | | 11-21-58 | 28.3 |
| | | | | 01-04-59 | 3.50 |
| | | | | 02-02-59 | 7.60 |
| | | | | 03-05-59 | 5.70 |
| | | | | 04-05-59 | 24.5 |
| | | | | 05-03-59 | 61.4 |
| | | | | 06-11-59 | 82.3 |
| | | | | 07-10-59 | 53.8 |
| | | | | 08-01-59 | 41.9 |
| | | | | 09-11-59 | 23.6 |
| | | | | 10-07-59 | 27.2 |
| 66 | Sweeney Creek | Bitterroot River | Lat 46°36'30", long 114°07'46", near east edge, sec. 20, T. 10 N., R. 20 W., Ravalli County, 4.0 mi upstream from mouth, and 2.5 mi southwest of Florence, Mont. | 04-03-58 | 5.80 |
| | | | | 04-23-58 | 18.9 |
| | | | | 05-15-58 | 78.1 |
| | | | | 05-26-58 | 253 |
| | | | | 06-18-58 | 94.5 |
| | | | | 07-09-58 | 39.2 |
| | | | | 08-05-58 | 9.20 |
| | | | | 09-13-58 | 2.20 |
| | | | | 10-15-58 | 10.2 |
| | | | | 11-23-58 | 29.6 |
| | | | | 01-04-59 | 6.10 |
| | | | | 02-02-59 | 8.20 |
| | | | | 03-05-59 | 4.70 |
| | | | | 04-05-59 | 23.8 |
| | | | | 05-03-59 | 63.8 |
| | | | | 07-10-59 | 81.3 |
| | | | | 08-01-59 | 29.1 |
| | | | | 09-11-59 | 21.7 |
| | | | | 10-07-59 | 28.7 |

**Table 1.** Streamflow measurements and site descriptions—Continued

| Site No. | Stream name | Tributary to | Location | Date | Discharge (ft³/s) |
|---|---|---|---|---|---|
| | | | Pend Oreille River Basin--Continued | | |
| 69 | Butler Creek | Clark Fork | Lat 47°07'33", long 114°26'09", in SE¼SW¼SW¼ sec. 19, T. 16 N., R. 22 W., Missoula County, Lolo National Forest, at U.S. Forest Service bridge, 2.6 mi upstream from Ninemile Creek, 4.5 mi northwest of Ninemile Ranger Station, and 8.7 mi north of Alberton, Mont. | 03-17-82 | 3.26 |
| | | | | 04-14-82 | 20.7 |
| | | | | 05-20-82 | 32.7 |
| | | | | 06-17-82 | 127 |
| | | | | 07-15-82 | 24.8 |
| | | | | 08-19-82 | 6.95 |
| | | | | 09-18-82 | 4.10 |
| | | | | 10-21-82 | 2.63 |
| | | | | 11-18-82 | 2.74 |
| | | | | 12-16-82 | 2.76 |
| | | | | 01-19-83 | 2.30 |
| | | | | 02-16-83 | 2.67 |
| 71 | Twelvemile Creek | St. Regis River | Lat 47°22'02", long 115°15'49", in SE¼NE¼NE¼ sec. 34, T. 19 N., R. 29 W., Mineral County, Lolo National Forest, at bridge on old Camels Hump Road, 200 ft upstream from East Fork Twelvemile Creek, 1.6 mi northeast of U.S. Interstate 90, 1.8 mi upstream from St. Regis River, and 3.9 mi east of DeBorgia, Mont. | 03-16-82 | 57.1 |
| | | | | 04-15-82 | 136 |
| | | | | 05-19-82 | 316 |
| | | | | 06-16-82 | 149 |
| | | | | 07-14-82 | 43.0 |
| | | | | 08-18-82 | 18.8 |
| | | | | 09-17-82 | 10.6 |
| | | | | 10-20-82 | 13.2 |
| | | | | 11-17-82 | 14.7 |
| | | | | 12-16-82 | 9.18 |
| | | | | 01-19-83 | 14.5 |
| | | | | 02-16-83 | 12.9 |
| 72 | Ward Creek | St. Regis River | Lat 47°18'42", long 115°13'59", in NE¼NE¼NW¼ sec. 24, T. 18 N., R. 29 W., Mineral County, Lolo National Forest, at U.S. Forest Service bridge just upstream from mouth, 6.4 mi west of St. Regis, Mont. | 04-15-82 | 93.6 |
| | | | | 05-19-82 | 214 |
| | | | | 06-16-82 | 232 |
| | | | | 07-14-82 | 48.1 |
| | | | | 08-18-82 | 15.0 |
| | | | | 09-17-82 | 10.5 |
| | | | | 10-20-82 | 10.5 |
| | | | | 11-17-82 | 9.74 |
| | | | | 12-16-82 | 13.5 |
| | | | | 01-19-83 | 13.2 |
| | | | | 02-16-83 | 12.9 |
| | | | | 03-16-83 | 51.6 |
| 73 | Twomile Creek | St. Regis River | Lat 47°17'42", long 115°10'20", in NE¼SW¼NE¼ sec. 28, T. 18 N., R. 28 W., Mineral County, Lolo National Forest, at U.S. Forest Service bridge 0.2 mi upstream from St. Regis River, and 3.5 mi west of St. Regis, Mont. | 03-16-82 | 35.3 |
| | | | | 04-15-82 | 59.8 |
| | | | | 05-19-82 | 133 |
| | | | | 06-16-82 | 102 |
| | | | | 07-14-82 | 23.9 |
| | | | | 08-18-82 | 9.85 |
| | | | | 09-17-82 | 7.23 |
| | | | | 10-20-82 | 6.29 |
| | | | | 11-17-82 | 6.42 |
| | | | | 12-16-82 | 6.70 |
| | | | | 01-19-83 | 8.68 |
| | | | | 02-16-83 | 7.32 |
| 74 | St. Regis River (12354000) | Clark Fork | Lat 47°17'49", long 115°07'18", near center of NW¼NE¼ sec. 26, T. 18 N., R. 28 W., Mineral County, 70 ft downstream from road bridge, 500 ft upstream from Little Joe Creek, 1.7 mi upstream from mouth, 1.2 mi west of St. Regis, and at site of former gaging station. | 03-16-82 | 960 |
| | | | | 04-15-82 | 1,580 |
| | | | | 05-19-82 | 2,550 |
| | | | | 06-16-82 | 2,370 |
| | | | | 07-14-82 | 660 |
| | | | | 08-18-82 | 185 |
| | | | | 09-17-82 | 130 |
| | | | | 10-20-82 | 123 |
| | | | | 11-17-82 | 127 |
| | | | | 12-16-82 | 149 |
| | | | | 01-19-83 | 258 |
| | | | | 02-16-83 | 188 |
| | | | | 03-16-83 | 1,050 |

**Table 1.** Streamflow measurements and site descriptions—Continued

| Site No. | Stream name | Tributary to | Location | Date | Discharge (ft3/s) |
|---|---|---|---|---|---|
| | | | Pend Oreille River Basin--Continued | | |
| 75 | Siegel Creek | Clark Fork | Lat 47°18'54", long 114°48'26", in NW¼SW¼SE¼ sec. 17, T. 18 N., R. 25 W., Sanders County, at culvert on FAS 461, 1.5 mi southwest of Quinns Hot Springs, and 5.0 mi south of Paradise, Mont. | 04-14-82 | 28.0 |
| | | | | 05-19-82 | 55.0 |
| | | | | 06-16-82 | 44.1 |
| | | | | 07-14-82 | 11.5 |
| | | | | 08-18-82 | 5.97 |
| | | | | 09-17-82 | 4.47 |
| | | | | 10-20-82 | 4.58 |
| | | | | 11-17-82 | 3.75 |
| | | | | 12-15-82 | 3.62 |
| | | | | 01-19-83 | 4.70 |
| | | | | 02-16-83 | 3.62 |
| | | | | 03-16-83 | 12.8 |
| 77 | Bear Creek (12356500) | Middle Fork Flathead River | Lat 48°16'50", long 113°25'30", in SE¼NW¼ sec. 18, T. 29 N., R. 14 W., Flathead County, on right bank 1.0 mi downstream from Autumn Creek, 8.5 mi east of Essex, Mont., and at site of former gaging station. | 03-17-82 | 7.60 |
| | | | | 04-13-82 | 16.6 |
| | | | | 05-17-82 | 212 |
| | | | | 06-16-82 | 320 |
| | | | | 07-19-82 | 36.8 |
| | | | | 08-19-82 | 16.6 |
| | | | | 09-16-82 | 13.6 |
| | | | | 10-18-82 | 11.0 |
| | | | | 11-18-82 | 11.0 |
| | | | | 12-16-82 | 10.1 |
| | | | | 01-13-83 | 8.04 |
| | | | | 02-14-83 | 8.17 |
| 79 | Fish Creek | McDonald Creek | Lat 48°33'51", long 113°59'29", in T. 32 N., R. 19 W., Flathead County, 50 ft upstream from Fish Creek Campground loop road, 0.1 mi east of Fish Creek Ranger station, 0.5 mi east of Glacier Route Eight Highway, and 1.6 mi north of Apgar, Mont. | 09-18-74 | 5.05 |
| | | | | 05-12-75 | 109 |
| | | | | 06-05-75 | 95.4 |
| 85 | Piper Creek | Swan River | Lat 47°39'41", long 113°49'44", in NE¼SE¼SW¼ sec. 18, T. 22 N., R. 17 W., Lake County, Flathead National Forest, at Forest Service bridge, 1.2 mi upstream from Swan River, 1.5 mi west of Highway 83, and 8.0 mi northwest of Condon, Mont. | 03-15-82 | 7.92 |
| | | | | 04-19-82 | 14.4 |
| | | | | 05-17-82 | 83.6 |
| | | | | 06-14-82 | 128 |
| | | | | 07-13-82 | 50.3 |
| | | | | 08-17-82 | 15.7 |
| | | | | 09-16-82 | 8.05 |
| | | | | 10-18-82 | 21.3 |
| | | | | 11-15-82 | 9.15 |
| | | | | 12-13-82 | 10.7 |
| | | | | 01-17-83 | 5.57 |
| | | | | 02-14-83 | 3.48 |
| 86 | Goat Creek above Scout Creek | Swan River | Lat 47°46'26", long 113°42'28", in NW¼NW¼NW¼ sec. 7, T. 23 N., R. 16 W., Lake County, Flathead National Forest, 0.5 mi upstream from Scout Creek, 0.6 mi downstream from Bethal Creek, 5.5 mi east of Highway 83, and 12 mi southeast of Swan Lake, Mont. | 05-17-82 | 69.7 |
| | | | | 06-14-82 | 137 |
| | | | | 07-13-82 | 29.3 |
| | | | | 08-17-82 | 3.55 |
| | | | | 09-16-82 | .16 |
| | | | | 10-19-82 | .96 |
| | | | | 11-16-82 | .07 |
| | | | | 12-14-82 | .35 |

**Table 1.** Streamflow measurements and site descriptions—Continued

| Site No. | Stream name | Tributary to | Location | Date | Discharge (ft3/s) |
|---|---|---|---|---|---|
| | | | Pend Oreille River Basin--Continued | | |
| 87 | Goat Creek above Squeezer Creek Road | Swan River | Lat 47°45'57", long 113°45'48", in NE¼NE¼SW¼ sec. 10, T. 23 N., R. 17 W., Lake County, Swan River State Forest, 3.0 mi east of Highway 83, and 12.0 mi southeast of Swan Lake, Mont. | 03-15-82 | 9.65 |
| | | | | 04-19-82 | 9.18 |
| | | | | 05-17-82 | 93.2 |
| | | | | 06-14-82 | 159 |
| | | | | 07-13-82 | 53.6 |
| | | | | 08-17-82 | 17.1 |
| | | | | 09-16-82 | 10.1 |
| | | | | 10-19-82 | 10.8 |
| | | | | 11-16-82 | 11.3 |
| | | | | 12-14-82 | 8.32 |
| | | | | 01-17-83 | 7.13 |
| | | | | 02-14-83 | 6.56 |
| 88 | Goat Creek at Squeezer Creek Road | Swan River | Lat 47°45'19", long 113°47'23", in NW¼NW¼NW¼ sec. 16, T. 23 N., R. 17 W., Lake County, Swan River State Forest, at U.S. Forest Service bridge on Old Squeezer Creek road, 1.5 mi east of Highway 83, and 12.0 mi southeast of Swan Lake, Mont. | 03-15-82 | 9.37 |
| | | | | 04-19-82 | 15.6 |
| | | | | 05-17-82 | 89.0 |
| | | | | 06-14-82 | 153 |
| | | | | 07-13-82 | 49.5 |
| | | | | 08-17-82 | 17.8 |
| | | | | 09-16-82 | 11.7 |
| | | | | 10-19-82 | 10.6 |
| | | | | 11-16-82 | 9.59 |
| | | | | 12-14-82 | 9.64 |
| | | | | 01-17-83 | 6.32 |
| | | | | 02-16-83 | 5.76 |
| 89 | South Woodward Creek above Fatty Creek Road | Swan Lake | Lat 47°43'31", long 113°55'25", in SE¼SE¼NW¼ sec. 28, T. 23 N., R. 18 W., Lake County, Swan River State Forest, at culvert on State Forest Service road, 3.0 mi west of the Fatty Creek Road, and 13.5 mi northwest of Condon, Mont. | 05-17-82 | 7.93 |
| | | | | 06-14-82 | 14.5 |
| | | | | 07-13-82 | 12.1 |
| | | | | 08-17-82 | 11.0 |
| | | | | 09-16-82 | 7.57 |
| | | | | 10-18-82 | 7.59 |
| | | | | 11-15-82 | 5.84 |
| 90 | South Woodward Creek near mouth | Swan River | Lat 47°43'19", long 113°51'20", in NE¼NW¼SW¼ sec. 25, T. 23 N., R. 18 W., Lake County, Flathead National Forest, at bridge on U.S. Forest Service road, 1.5 mi west of Highway 83, and 11.0 mi northwest of Condon, Mont. | 03-15-82 | 21.9 |
| | | | | 04-19-82 | 21.1 |
| | | | | 05-17-82 | 46.4 |
| | | | | 06-14-82 | 40.3 |
| | | | | 07-13-82 | 42.4 |
| | | | | 08-17-82 | 41.7 |
| | | | | 09-16-82 | 42.0 |
| | | | | 10-18-82 | 35.1 |
| | | | | 11-15-82 | 32.0 |
| | | | | 12-14-82 | 23.0 |
| | | | | 01-17-83 | 21.0 |
| | | | | 02-14-83 | 20.0 |
| 91 | Soup Creek above Soup Creek Campground | Swan River | Lat 47°48'53", long 113°44'08", in SW¼NE¼NE¼ sec. 26, T. 24 N., R. 17 W., Lake County, Swan River State Forest, at U.S. Forest Service bridge, 1.7 mi east of Soup Creek Campground, 4.3 mi east of Highway 83, and 9.0 mi southeast of Swan Lake, Mont. | 05-17-82 | 42.2 |
| | | | | 06-14-82 | 101 |
| | | | | 07-13-82 | 18.6 |
| | | | | 08-17-82 | 8.80 |
| | | | | 09-16-82 | 5.39 |
| | | | | 10-19-82 | 3.65 |
| | | | | 11-16-82 | 4.09 |
| | | | | 12-14-82 | 2.63 |
| | | | | 01-17-83 | 2.37 |
| | | | | 02-14-83 | 2.43 |
| 92 | Soup Creek at Soup Creek Campground | Swan River | Lat 47°48'37", long 113°46'11", in NE¼NW¼SW¼ sec. 27, T. 24 N., R. 17 W., Lake County, Swan River State Forest, at State Forest Service bridge, 2.6 mi east of Highway 83, and 9.0 mi southeast of Swan Lake, Mont. | 03-12-82 | 2.94 |
| | | | | 04-20-82 | 4.24 |
| | | | | 05-17-82 | 43.8 |
| | | | | 06-14-82 | 86.5 |
| | | | | 07-13-82 | 16.9 |
| | | | | 08-17-82 | 7.44 |
| | | | | 09-16-82 | 4.54 |
| | | | | 10-19-82 | 4.08 |
| | | | | 11-16-82 | 3.29 |
| | | | | 12-14-82 | 3.55 |
| | | | | 01-17-83 | 2.61 |
| | | | | 02-14-83 | 2.35 |

**Table 1.** Streamflow measurements and site descriptions—Continued

| Site No. | Stream name | Tributary to | Location | Date | Discharge (ft3/s) |
|---|---|---|---|---|---|
| | | | Pend Oreille River Basin--Continued | | |
| 93 | Soup Creek at Highway 83 | Swan River | Lat 47°50'55", long 113°49'43", in NW¼SE¼SW¼ sec. 18, T. 24 N., R. 17 W., Lake County, Swan River State Forest, at bridge on Highway 83, 0.7 mi upstream from Swan River, and 6.0 mi south of Swan Lake, Mont. | 03-12-82 | 10.6 |
| | | | | 04-20-82 | 14.2 |
| | | | | 05-17-82 | 52.1 |
| | | | | 06-14-82 | 87.0 |
| | | | | 07-13-82 | 21.2 |
| | | | | 08-17-82 | 9.34 |
| | | | | 09-16-82 | 5.89 |
| | | | | 10-19-82 | 6.27 |
| | | | | 11-16-82 | 5.77 |
| | | | | 12-14-82 | 3.64 |
| | | | | 01-17-83 | 5.60 |
| | | | | 02-14-83 | 3.70 |
| 94 | South Fork Lost Creek | Swan River | Lat 47°52'04", long 113°47'36", in NW¼NW¼SW¼ sec. 4, T. 24 N., R. 17 W., Lake County, Flathead National Forest, at U.S. Forest Service bridge, 1.5 mi upstream from Lost Creek, and 4.7 mi southeast of Swan Lake, Mont. | 10-19-82 | 13.1 |
| | | | | 11-16-82 | 9.37 |
| | | | | 12-14-82 | 9.88 |
| | | | | 01-18-83 | 8.39 |
| | | | | 02-15-83 | 7.14 |
| 95 | North Fork Lost Creek | Swan River | Lat 47°53'06", long 113°47'53", in NE¼NW¼SE¼ sec. 31, T. 25 N., R. 17 W., Lake County, Flathead National Forest, at U.S. Forest Service bridge on North Fork Lost Creek road, 1.5 mi upstream from Lost Creek, and 4.0 mi southeast of Swan Lake, Mont. | 03-12-82 | 13.0 |
| | | | | 04-20-82 | 28.9 |
| | | | | 05-18-82 | 190 |
| | | | | 06-15-82 | 203 |
| | | | | 07-14-82 | 60.4 |
| | | | | 08-18-82 | 16.3 |
| | | | | 09-17-82 | 7.29 |
| | | | | 10-19-82 | 8.03 |
| | | | | 11-16-82 | 7.61 |
| | | | | 12-14-82 | 7.29 |
| | | | | 01-18-83 | 8.74 |
| | | | | 02-15-83 | 6.16 |
| 96 | Lost Creek | Swan River | Lat 47°52'26", long 113°50'00", in NE¼NW¼NW¼ sec. 6, T. 24 N., R. 17 W., Lake County, Flathead National Forest, at bridge on Highway 83, 0.7 mi upstream from Swan River, and 3.5 mi south of Swan Lake, Mont. | 03-12-82 | 26.3 |
| | | | | 04-20-82 | 46.1 |
| | | | | 05-18-82 | 400 |
| | | | | 06-15-82 | 475 |
| | | | | 07-13-82 | 93.2 |
| | | | | 08-18-82 | 22.4 |
| | | | | 09-17-82 | 11.5 |
| | | | | 10-19-82 | 13.1 |
| | | | | 11-16-82 | 12.1 |
| | | | | 12-15-82 | 11.8 |
| | | | | 01-18-83 | 13.5 |
| | | | | 02-15-83 | 7.95 |
| 97 | Porcupine Creek | Swan River | Lat 47°51'41", long 113°52'46", in SW¼SE¼SE¼ sec. 3, T. 24 N., R. 18 W., Lake County, Flathead National Forest, at culvert on U.S. Forest Service road, 2.0 mi upstream from Swan River, and 5.0 mi southwest of Swan Lake, Mont. | 03-15-82 | 3.53 |
| | | | | 04-19-82 | 4.13 |
| | | | | 05-18-82 | 15.3 |
| | | | | 06-15-82 | 4.79 |
| | | | | 07-14-82 | 3.79 |
| | | | | 08-18-82 | 3.42 |
| | | | | 09-17-82 | 3.40 |
| | | | | 10-18-82 | 2.49 |
| | | | | 11-16-82 | 2.86 |
| | | | | 12-13-82 | 3.40 |
| | | | | 01-18-83 | 2.29 |
| | | | | 02-15-83 | 1.12 |
| 98 | Bond Creek | Swan River | Lat 47°55'21", long 113°50'25", in SE¼SW¼SE¼ sec. 14, T. 25 N., R. 18 W., Lake County, Flathead National Forest, at bridge on Highway 83 in town of Swan Lake, Mont., 0.2 mi upstream from Swan Lake, Mont. | 03-15-82 | 6.19 |
| | | | | 04-20-82 | 8.22 |
| | | | | 05-18-82 | 76.5 |
| | | | | 06-15-82 | 112 |
| | | | | 07-14-82 | 19.9 |
| | | | | 08-18-82 | 3.01 |
| | | | | 09-17-82 | 1.98 |
| | | | | 10-19-82 | 1.37 |
| | | | | 11-16-82 | 1.40 |
| | | | | 12-15-82 | 2.05 |
| | | | | 01-18-83 | 2.01 |
| | | | | 02-14-83 | 1.57 |

**Table 1.** Streamflow measurements and site descriptions—Continued

| Site No. | Stream name | Tributary to | Location | Date | Discharge (ft$^3$/s) |
|---|---|---|---|---|---|
| | | | Pend Oreille River Basin--Continued | | |
| 99 | Hall Creek | Swan River | Lat 47°56'17", long 113°50'25", in NW¼ sec. 11, T. 25 N., R. 18 W., Lake County, at unimproved road crossing about 0.7 mi east of junction with Highway 83, at Swan Lake, Mont. | 09-12-74 | 4.79 |
| | | | | 05-15-75 | 65.8 |
| | | | | 06-30-75 | 20.7 |
| | | | | 09-10-75 | 4.36 |
| 100 | Johnson Creek | Swan River | Lat 48°01'19", long 113°58'05", in NW¼ sec. 14, T. 26 N., R. 19 W., Lake County, at bridge on unpaved road, 1.3 mi northwest of junction with Highway 83, 2.1 mi south of Flathead-Lake County line, and 9.0 mi northwest of Swan Lake, Mont. | 09-12-74 | 3.46 |
| | | | | 05-16-75 | 27.3 |
| | | | | 06-30-75 | 14.1 |
| | | | | 09-10-75 | 3.97 |
| 102 | Stoner Creek | Flathead River | Lat 48°01'00", long 114°13'25", in NW¼ sec. 18, T. 26 N., R. 20 W., Flathead County, at bridge on U.S. Highway 93, 0.3 mi north of junction with Stoner Creek road, 0.2 mi south of Lakeside, Mont. | 09-19-74 | 3.56 |
| | | | | 05-09-75 | 17.4 |
| | | | | 06-03-75 | 46.7 |
| | | | | 09-08-75 | 2.32 |
| 105 | Graves Creek | Clark Fork | Lat 47°41'09", long 115°24'13", in NW¼NW¼NE¼ sec. 11, T. 22 N., R. 30 W., Sanders County, at culvert on county road, 0.3 mi upstream from Clark Fork, and 7.0 mi northwest of Thompson Falls, Mont. | 03-16-82 | 5.31 |
| | | | | 04-15-82 | 15.3 |
| | | | | 05-18-82 | 265 |
| | | | | 06-15-82 | 280 |
| | | | | 07-12-82 | 85.5 |
| | | | | 08-17-82 | 25.6 |
| | | | | 09-13-82 | 13.8 |
| | | | | 10-20-82 | 7.74 |
| | | | | 11-17-82 | 5.10 |
| | | | | 12-15-82 | 3.18 |
| | | | | 01-19-83 | 4.36 |
| | | | | 02-15-83 | 1.79 |
| 106 | Deep Creek | Clark Fork | Lat 47°44'46", long 115°26'27", in SE¼SE¼SE¼ sec. 16, T. 23 N., R. 30 W., Sanders County, Kootenai National Forest, at culvert on county road, 0.8 mi upstream from Clark Fork, 2.0 mi northeast of White Pine, Mont., and 12.0 mi northeast of Thompson Falls, Mont. | 03-16-82 | 15.5 |
| | | | | 04-15-82 | 39.4 |
| | | | | 05-18-82 | 93.5 |
| | | | | 06-15-82 | 83.0 |
| | | | | 07-12-82 | 24.2 |
| | | | | 08-17-82 | 8.30 |
| | | | | 09-13-82 | 4.79 |
| | | | | 10-20-82 | 3.00 |
| | | | | 11-17-82 | 2.91 |
| | | | | 12-15-82 | 3.73 |
| | | | | 01-19-83 | 6.94 |
| | | | | 02-15-83 | 4.07 |

[1] Discharge at Red Top Creek site estimated from U.S. Forest Service records.

**Table 2.** Annual mean discharge computation for Camp Creek (site 18)
[ft³/s, cubic feet per second]

| Date | Flower Creek (gaged): Recorded daily mean discharge[1] (ft³/s) | Flower Creek (gaged): Monthly mean discharge (ft³/s) | Flower Creek (gaged): Ratio of monthly mean to daily mean | Camp Creek (ungaged): Measured discharge[1] (ft³/s) | Camp Creek (ungaged): Estimated monthly mean discharge (ft³/s) |
|---|---|---|---|---|---|
| 03-15-82 | 17 | 14.0 | 0.82 | 15.1 | 12.4 |
| 04-14-82 | 28 | 20.6 | 0.74 | 20.0 | 14.7 |
| 05-19-82 | 115 | 83.8 | 0.73 | 82.0 | 59.9 |
| 06-14-82 | 172 | 127 | 0.74 | 143 | 106 |
| 07-12-82 | 53 | 50.9 | 0.96 | 47.2 | 45.3 |
| 08-17-82 | 14 | 14.2 | 1.01 | 6.41 | 6.5 |
| 09-13-82 | 9.7 | 9.2 | 0.95 | 4.16 | 3.9 |
| 10-13-82 | 9.4 | 11.2 | 1.19 | 4.78 | 5.7 |
| 11-17-82 | 8.9 | 9.1 | 1.02 | 4.53 | 4.6 |
| 12-15-82 | 8.4 | 9.0 | 1.07 | 4.63 | 5.0 |
| 01-19-83 | 9.2 | 9.4 | 1.02 | 6.20 | 6.3 |
| 02-17-83 | 8.0 | 9.0 | 1.13 | 5.27 | 6.0 |
| | | | Estimated annual mean discharge | | 23.0 |

[1] Data used to prepare figure 2.

**Table 3.** Flow-duration curve computation for Soup Creek above Soup Creek Campground (site 91)
[ft³/s, cubic feet per second]

| Date | Swan River near Condon (gaged): Recorded daily mean discharge (ft³/s) | Swan River near Condon (gaged): Exceedance percentage[1,2] | Soup Creek (ungaged): Measured discharge[1] (ft³/s) |
|---|---|---|---|
| 05-17-82 | 680 | 4 | 42.2 |
| 06-14-82 | 744 | 2.5 | 101 |
| 07-13-82 | 377 | 14 | 18.6 |
| 08-17-82 | 115 | 37 | 8.80 |
| 09-16-82 | 49 | 70 | 5.39 |
| 10-19-82 | 83 | 46 | 3.65 |
| 11-16-82 | 55 | 63 | 4.09 |
| 12-14-82 | 52 | 66 | 2.63 |
| 01-17-83 | 50 | 69 | 2.37 |
| 02-14-83 | 35 | 92 | 2.43 |

[1] Data used to prepare figure 3.

[2] From Swan River flow-duration curve.

**Table 4.** Mean annual discharge adjustments for selected gaging stations
[ft$^3$/s, cubic feet per second]

| Site No. | Stream name and gaging station number | Actual period of flow record | Mean annual discharge for period of record (ft$^3$/s) | Mean annual discharge for 1938-82 (ft$^3$/s) |
|---|---|---|---|---|
| 4 | Fortine Creek (12300500) | 1948-53 | 84.7 | 82.0 |
| 6 | Tobacco River (12301300) | 1959-82 | 273 | 268 |
| 9 | Big Creek near Rexford (12301810) | 1973-81 | 125 | 149 |
| 14 | Flower Creek (12303100) | 1961-82 | 27.1 | 27.0 |
| 32 | Yaak River (12304500) | 1957-82 | 900 | 888 |
| 36 | Middle Fork Rock Creek (12332000) | 1938-82 | 124 | 124 |
| 39 | Monture Creek (12338690) | 1974-82 | 197 | 184 |
| 43 | Blackfoot River (12340000) | 1940-82 | 1,658 | 1,629 |
| 46 | Bitterroot River near Darby (12344000) | 1938-82 | 934 | 934 |
| 55 | Skalkaho Creek (12346500) | 1949-79 | 93.5 | 91.0 |
| 57 | Blodgett Creek (12347500) | 1948-69 | 71.0 | 68.0 |
| 59 | Bear Creek near Victor (12350000) | 1939-59 | 66.0 | 70.0 |
| 64 | Burnt Fork Bitterroot River (12351000) | 1939-62 | 48.0 | 50.0 |
| 67 | Eightmile Creek (12351400) | 1958-63 | 7.20 | 8.00 |
| 70 | Ninemile Creek (12353280) | 1974-82 | 136 | 124 |
| 74 | St. Regis River (12354000) | 1959-75 | 580 | 541 |
| 77 | Bear Creek near Essex (12356500) | 1947-52 | 46.0 | 43.0 |
| 84 | Swan River near Condon (12369200) | 1973-82 | 168 | 160 |
| 103 | Thompson River (12389500) | 1957-82 | 479 | 480 |
| 104 | Prospect Creek (12390700) | 1957-82 | 259 | 258 |

**Table 5.** Basin characteristics and mean annual discharge for streamflow-measurement sites (1938-82 base period)

[mi², square miles; ft³/s, cubic feet per second]

| Site No. | Stream name and gaging station number | Drainage area ($mi^2$) | Mean annual precip-itation (inches) | Mean annual discharge ($ft^3/s$) | Mean annual runoff (inches) |
|---|---|---|---|---|---|
| 1 | Young Creek below South Fork | 19.0 | 31 | 15.1 | 10.7 |
| 2 | Young Creek at mouth | 36.0 | 29 | 14.5 | 5.3 |
| 3 | Cayuse Creek (12300400) | 5.29 | 28 | 6.6 | 16.9 |
| 4 | Fortine Creek (12300500) | 112 | 28 | 82.0 | 9.9 |
| 5 | Deep Creek | 18.9 | 50 | 12.8 | 9.2 |
| 7 | Sullivan Creek | 14.1 | 33 | 10.1 | 9.7 |
| 8 | Boulder Creek | 18.1 | 34 | 19.4 | 14.5 |
| 9 | Big Creek near Rexford (12301810). | 139 | 37 | 149 | 14.5 |
| 10 | Bristow Creek | 25.8 | 34 | 8.0 | 4.2 |
| 15 | Parmenter Creek | 17.7 | 57 | 22.9 | 17.6 |
| 16 | Cedar Creek | 12.9 | 61 | 23.8 | 25.0 |
| 17 | Quartz Creek | 35.4 | 47 | 69.0 | 26.4 |
| 18 | Camp Creek (12303440) | 11.3 | 63 | 19.3 | 23.2 |
| 19 | Ruby Creek | 15.8 | 64 | 26.8 | 23.0 |
| 20 | Pete Creek below Hensley Creek | 29.8 | 35 | 34.7 | 15.8 |
| 21 | Pete Creek at mouth | 33.8 | 34 | 39.4 | 15.8 |
| 22 | Whitetail Creek (12304250) | 2.48 | 35 | 1.7 | 9.3 |
| 23 | Spread Creek | 37.3 | 50 | 80.5 | 29.3 |
| 24 | Hellroaring Creek at Forest Service bridge. | 9.65 | 70 | 27.0 | 38.0 |
| 25 | Hellroaring Creek at mouth | 16.9 | 66 | 27.6 | 22.2 |
| 26 | North Fork Meadow Creek | 6.33 | 72 | 13.6 | 29.2 |
| 27 | North Fork Meadow Creek at mouth. | 7.04 | 69 | 13.3 | 25.6 |
| 28 | Meadow Creek | 20.4 | 68 | 42.6 | 28.3 |
| 29 | Red Top Creek | 9.96 | 69 | 19.7 | 26.8 |
| 30 | Cyclone Creek (12304300) | 5.71 | 67 | 10.7 | 25.4 |
| 31 | Fourth of July Creek (12304400) | 7.84 | 64 | 13.1 | 22.7 |
| 40 | Deer Creek (12339300) | 19.8 | 39 | 21.1 | 14.5 |
| 41 | Seeley Creek | 5.11 | 30 | 3.9 | 10.4 |

**Table 5.** Basin characteristics and mean annual discharge for streamflow-measurement sites (1938-82 base period)—Continued

| Site No. | Stream name and gaging station number | Drainage area ($mi^2$) | Mean annual precip-itation (inches) | Mean annual discharge ($ft^3/s$) | Mean annual runoff (inches) |
|---|---|---|---|---|---|
| 42 | West Twin Creek (12339900) | 7.33 | 25 | 11.3 | 20.9 |
| 44 | Marshall Creek (12340200) | 5.63 | 23 | 2.3 | 5.5 |
| 47 | Tin Cup Creek | 33.4 | 65 | 91.0 | 37.0 |
| 48 | Burke Gulch (12344300) | 6.28 | 22 | 2.0 | 4.3 |
| 49 | Lost Horse Creek | 66.3 | 68 | 190 | 38.9 |
| 50 | Camas Creek (12345800) | 6.01 | 62 | 15.2 | 34.3 |
| 51 | Sleeping Child Creek (12345850) | 64.7 | 31 | 58.6 | 12.3 |
| 52 | Little Sleeping Child Creek. | 11.2 | 21 | 3.3 | 4.0 |
| 53 | Roaring Lion Creek | 23.9 | 67 | 63.5 | 36.1 |
| 54 | Sawtooth Creek | 22.6 | 63 | 60.3 | 36.2 |
| 56 | Gird Creek | 28.8 | 23 | 17.1 | 8.1 |
| 58 | Mill Creek | 17.6 | 62 | 50.3 | 38.8 |
| 60 | Sweat House Creek | 10.2 | 66 | 25.3 | 33.7 |
| 61 | Gash Creek (12350200) | 3.37 | 60 | 10.7 | 43.1 |
| 62 | Big Creek | 32.9 | 61 | 93.3 | 38.5 |
| 65 | Bass Creek | 13.1 | 58 | 27.3 | 28.3 |
| 66 | Sweeney Creek | 16.4 | 60 | 31.0 | 25.7 |
| 69 | Butler Creek | 10.7 | 38 | 11.9 | 15.1 |
| 71 | Twelvemile Creek | 40.7 | 50 | 44.4 | 14.8 |
| 72 | Ward Creek | 22.8 | 57 | 40.9 | 24.3 |
| 73 | Twomile Creek | 17.1 | 52 | 23.0 | 18.3 |
| 74 | St. Regis River (12354000) | 303 | 52 | 541 | 24.2 |
| 75 | Siegel Creek | 14.2 | 40 | 10.5 | 10.0 |
| 77 | Bear Creek (12356500) | 20.4 | 47 | 43.0 | 28.6 |
| 79 | Fish Creek | 15.3 | 44 | 24.7 | 21.9 |
| 85 | Piper Creek | 11.8 | 55 | 22.2 | 25.5 |
| 86 | Goat Creek above Scout Creek. | 8.27 | 72 | 24.2 | 39.7 |
| 87 | Goat Creek above Squeezer Creek Road. | 14.9 | 67 | 24.6 | 22.4 |
| 88 | Goat Creek at Squeezer Creek Road. | 19.7 | 60 | 24.2 | 16.7 |

**Table 5.** Basin characteristics and mean annual discharge for streamflow-measurement sites (1938–82 base period)—Continued

| Site No. | Stream name and gaging station number | Drainage area ($mi^2$) | Mean annual precip-itation (inches) | Mean annual discharge ($ft^3/s$) | Mean annual runoff (inches) |
|---|---|---|---|---|---|
| 89 | South Woodward Creek above Fatty Creek Road. | 2.88 | 60 | 6.2 | 29.2 |
| 90 | South Woodward Creek near mouth | 10.5 | 51 | 25.2 | 32.6 |
| 91 | Soup Creek above Soup Creek Campground | 4.50 | 67 | 12.2 | 36.8 |
| 92 | Soup Creek at Soup Creek Campground | 5.87 | 61 | 11.2 | 25.9 |
| 93 | Soup Creek at Highway 83 | 14.5 | 49 | 14.0 | 13.1 |
| 94 | South Fork Lost Creek | 14.8 | 61 | 42.9 | 39.3 |
| 95 | North Fork Lost Creek | 13.0 | 60 | 30.7 | 32.0 |
| 96 | Lost Creek | 31.7 | 58 | 61.5 | 26.3 |
| 97 | Porcupine Creek | 10.0 | 49 | 3.0 | 4.1 |
| 98 | Bond Creek | 7.58 | 53 | 12.8 | 22.9 |
| 99 | Hall Creek | 4.66 | 54 | 12.7 | 37.0 |
| 100 | Johnson Creek | 12.1 | 50 | 6.4 | 7.2 |
| 102 | Stoner Creek | 22.6 | 25 | 11.9 | 7.1 |
| 105 | Graves Creek | 28.3 | 56 | 42.9 | 20.6 |
| 106 | Deep Creek | 12.6 | 56 | 18.2 | 19.6 |

**Table 6.** Discharge for various exceedance percentages for streamflow-measurement sites (1938–82 base period)

| Site No. | Stream name and gaging station number | Discharge, in cubic feet per second, for indicated exceedance percentage | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 |
| 1 | Young Creek below South Fork. | 40.0 | 28.0 | 21.0 | 16.0 | 12.0 | 8.9 | 6.6 | 5.1 | 4.0 |
| 2 | Young Creek at mouth | 40.0 | 29.0 | 21.0 | 16.0 | 11.0 | 8.3 | 7.0 | 6.0 | 5.3 |
| 3 | Cayuse Creek (12300400) | 20.0 | 7.3 | 2.9 | 1.6 | 1.0 | .7 | .5 | .4 | .4 |
| 4 | Fortine Creek (12300500) | 240.0 | 82.5 | 45.0 | 32.5 | 25.0 | 19.0 | 13.0 | 10.0 | 8.6 |
| 5 | Deep Creek | 97.0 | 52.0 | 30.0 | 19.0 | 12.0 | 7.4 | 4.8 | 3.1 | 2.0 |
| 7 | Sullivan Creek | 29.0 | 21.0 | 15.0 | 11.0 | 7.8 | 5.4 | 3.9 | 2.9 | 2.0 |
| 8 | Boulder Creek | 59.0 | 39.0 | 26.0 | 18.5 | 12.5 | 8.2 | 5.7 | 3.9 | 2.8 |
| 9 | Big Creek near Rexford (12301810). | 458.0 | 169.0 | 83.0 | 51.0 | 33.0 | 27.0 | 23.0 | 19.0 | 15.0 |
| 10 | Bristow Creek | 55.0 | 27.0 | 14.0 | 7.1 | 4.0 | 2.5 | 1.8 | 1.3 | 1.0 |
| 15 | Parmenter Creek | 95.0 | 45.0 | 18.0 | 6.6 | 2.7 | 1.4 | .7 | .4 | 3 |
| 16 | Cedar Creek | 87.0 | 41.0 | 21.0 | 14.0 | 9.6 | 7.3 | 5.8 | 4.8 | 4.0 |
| 17 | Quartz Creek | 200.0 | 110.0 | 65.0 | 45.0 | 34.0 | 27.0 | 22.0 | 19.0 | 16.0 |
| 18 | Camp Creek (12303440) | 66.0 | 33.0 | 16.0 | 9.8 | 7.1 | 5.7 | 4.9 | 4.4 | 4.0 |
| 19 | Ruby Creek | 96.0 | 62.0 | 39.0 | 21.0 | 11.4 | 7.2 | 5.1 | 3.7 | 3.0 |
| 20 | Pete Creek below Hensley Creek. | 114.0 | 59.0 | 33.0 | 19.0 | 12.0 | 6.9 | 4.6 | 3.1 | 2.3 |
| 21 | Pete Creek at mouth | 148.0 | 79.0 | 44.0 | 24.0 | 12.0 | 6.9 | 4.6 | 3.1 | 2.3 |
| 22 | Whitetail Creek (12304250) | 7.0 | 2.8 | 1.3 | .7 | .3 | .1 | .0 | .0 | .0 |
| 23 | Spread Creek | 148.0 | 60.0 | 38.0 | 27.0 | 22.0 | 19.0 | 17.0 | 15.0 | 13.0 |
| 24 | Hellroaring Creek at Forest Service Bridge. | 61.0 | 22.0 | 12.0 | 7.8 | 5.9 | 4.9 | 4.4 | 4.0 | 3.7 |
| 25 | Hellroaring Creek at mouth | 73.0 | 31.0 | 16.0 | 10.0 | 7.1 | 5.1 | 3.9 | 3.0 | 2.4 |
| 26 | North Fork Meadow Creek | 36.0 | 15.0 | 8.2 | 5.6 | 4.5 | 3.4 | 2.7 | 2.2 | 1.8 |
| 27 | North Fork Meadow Creek at mouth. | 36.0 | 15.0 | 8.2 | 5.6 | 4.5 | 3.4 | 2.7 | 2.2 | 1.8 |
| 28 | Meadow Creek | 109.0 | 55.0 | 32.0 | 20.0 | 13.0 | 8.5 | 6.1 | 4.4 | 3.4 |
| 29 | Red Top Creek | 65.0 | 27.0 | 13.0 | 8.1 | 5.9 | 4.6 | 3.8 | 3.2 | 2.7 |
| 30 | Cyclone Creek (12304300) | 32.0 | 16.0 | 8.9 | 5.9 | 4.3 | 3.3 | 2.6 | 2.2 | 1.8 |
| 31 | Fourth of July Creek (12304400) | 44.0 | 18.0 | 8.9 | 5.7 | 4.0 | 3.1 | 2.6 | 2.2 | 1.9 |
| 40 | Deer Creek (12339300) | 61.0 | 29.0 | 14.0 | 8.2 | 5.4 | 4.0 | 3.0 | 2.5 | 2.1 |
| 41 | Seeley Creek | 7.4 | 5.4 | 4.0 | 3.2 | 2.6 | 2.3 | 2.0 | 1.9 | 1.8 |
| 42 | West Twin Creek (12339900) | 34.0 | 20.0 | 12.5 | 7.8 | 5.0 | 3.5 | 2.5 | 1.9 | 1.4 |
| 44 | Marshall Creek (12340200) | 10.5 | 7.2 | 5.2 | 3.8 | 2.7 | 2.0 | 1.4 | 1.1 | .8 |
| 47 | Tin Cup Creek | 255.0 | 140.0 | 84.0 | 54.0 | 36.0 | 25.0 | 18.5 | 13.6 | 10.0 |
| 48 | Burke Gulch (12344300) | 3.5 | 1.9 | 1.0 | .6 | .4 | .3 | .2 | .1 | .1 |
| 49 | Lost Horse Creek | 636.0 | 340.0 | 164.0 | 91.0 | 59.0 | 42.0 | 31.0 | 25.0 | 21.0 |
| 50 | Camas Creek (12345800) | 22.0 | 8.7 | 5.1 | 3.5 | 2.5 | 2.0 | 1.5 | 1.3 | 1.1 |
| 51 | Sleeping Child Creek (12345850). | 129.0 | 60.0 | 35.5 | 25.0 | 19.0 | 15.5 | 13.0 | 12.0 | 11.0 |
| 52 | Little Sleeping Child Creek. | 8.9 | 5.0 | 3.0 | 1.9 | 1.3 | .9 | .7 | .6 | .5 |
| 53 | Roaring Lion Creek | 195.0 | 107.0 | 60.0 | 34.0 | 21.5 | 14.0 | 9.5 | 6.6 | 4.6 |
| 54 | Sawtooth Creek | 186.0 | 83.0 | 38.5 | 23.0 | 16.0 | 12.0 | 9.3 | 7.7 | 6.4 |
| 56 | Gird Creek | 36.0 | 23.0 | 16.0 | 12.5 | 10.0 | 8.6 | 7.3 | 6.3 | 5.7 |
| 58 | Mill Creek | 161.0 | 71.0 | 33.0 | 19.0 | 12.5 | 8.7 | 6.5 | 5.0 | 4.0 |
| 60 | Sweat House Creek | 74.0 | 37.0 | 23.0 | 13.0 | 8.8 | 6.3 | 4.6 | 3.5 | 2.6 |
| 61 | Gash Creek (12350200) | 21.0 | 9.6 | 5.6 | 3.8 | 2.8 | 2.2 | 1.8 | 1.5 | 1.4 |
| 62 | Big Creek | 260.0 | 125.0 | 68.0 | 44.0 | 31.0 | 24.0 | 19.0 | 16.0 | 14.0 |
| 65 | Bass Creek | 72.0 | 44.0 | 29.0 | 22.0 | 17.0 | 13.0 | 11.0 | 8.2 | 6.3 |
| 66 | Sweeney Creek | 103.0 | 63.0 | 40.0 | 26.0 | 18.0 | 13.0 | 9.6 | 7.1 | 5.2 |
| 69 | Butler Creek | 49.5 | 23.0 | 11.5 | 6.4 | 4.1 | 2.9 | 2.1 | 1.7 | 1.5 |
| 71 | Twelvemile Creek | 105.0 | 47.0 | 27.0 | 19.0 | 14.5 | 12.0 | 10.0 | 8.8 | 8.0 |
| 72 | Ward Creek | 87.0 | 52.5 | 33.0 | 21.5 | 15.5 | 12.0 | 9.8 | 8.4 | 7.2 |
| 73 | Twomile Creek | 56.0 | 35.5 | 20.0 | 12.0 | 9.0 | 7.2 | 6.1 | 5.4 | 4.7 |
| 74 | St. Regis River (12354000). | 1,500.0 | 823.0 | 465.0 | 304.0 | 211.0 | 163.0 | 134.0 | 112.0 | 94.0 |
| 75 | Siegel Creek | 28.0 | 14.0 | 8.8 | 6.6 | 5.2 | 4.3 | 3.8 | 3.4 | 3.1 |
| 77 | Bear Creek (12356500) | 130.0 | 51.0 | 29.0 | 20.5 | 16.0 | 13.0 | 10.0 | 8.4 | 6.9 |
| 79 | Fish Creek | 94.0 | 56.0 | 31.0 | 18.0 | 12.0 | 10.0 | 8.5 | 7.5 | 6.9 |

**Table 6.** Discharge for various exceedance percentages for streamflow-measurement sites (1938-82 base period)—Continued

| Site No. | Stream name and gaging station number | Discharge, in cubic feet per second, for indicated exceedance percentage | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 |
| 85 | Piper Creek | 50.0 | 29.0 | 20.0 | 14.0 | 12.0 | 8.0 | 6.1 | 4.7 | 3.5 |
| 86 | Goat Creek above Scout Creek. | 43.0 | 15.0 | 5.5 | 2.2 | .8 | .3 | .1 | .0 | .0 |
| 87 | Goat Creek above Squeezer Creek Road. | 64.0 | 36.0 | 22.0 | 15.0 | 11.0 | 8.5 | 6.7 | 5.4 | 4.7 |
| 88 | Goat Creek at Squeezer Creek Road. | 58.0 | 31.0 | 20.0 | 13.5 | 10.0 | 7.7 | 6.3 | 5.2 | 4.5 |
| 89 | South Woodward Creek above Fatty Creek Road. | 11.5 | 10.0 | 9.0 | 8.1 | 7.2 | 6.4 | 5.7 | 5.0 | 4.2 |
| 90 | South Woodward Creek near mouth. | 38.0 | 36.0 | 34.0 | 31.0 | 29.5 | 27.5 | 25.5 | 24.0 | 21.0 |
| 91 | Soup Creek above Soup Creek Campground. | 24.0 | 14.5 | 10.0 | 7.3 | 5.4 | 4.1 | 3.3 | 2.6 | 2.0 |
| 92 | Soup Creek at Soup Creek Campground. | 20.0 | 9.2 | 6.1 | 4.4 | 3.5 | 2.8 | 2.4 | 2.0 | 1.7 |
| 93 | Soup Creek at Highway 83 | 33.0 | 19.0 | 13.0 | 9.3 | 7.0 | 5.4 | 4.2 | 3.4 | 2.7 |
| 94 | South Fork Lost Creek | 74.0 | 42.0 | 26.5 | 18.0 | 13.0 | 10.0 | 8.1 | 6.7 | 5.7 |
| 95 | North Fork Lost Creek | 71.0 | 40.0 | 24.0 | 15.0 | 11.0 | 8.3 | 6.5 | 5.3 | 4.4 |
| 96 | Lost Creek | 141.0 | 70.0 | 41.0 | 26.0 | 18.0 | 13.0 | 10.0 | 8.3 | 6.9 |
| 97 | Porcupine Creek | 7.6 | 5.7 | 4.5 | 3.6 | 2.9 | 2.5 | 2.0 | 1.6 | 1.2 |
| 98 | Bond Creek | 24.0 | 12.0 | 6.9 | 4.5 | 3.1 | 2.2 | 1.6 | 1.2 | .9 |
| 99 | Hall Creek | 37.0 | 23.0 | 15.0 | 9.5 | 6.8 | 5.0 | 3.8 | 3.1 | 2.4 |
| 100 | Johnson Creek | 18.0 | 11.0 | 7.1 | 4.5 | 3.1 | 2.3 | 1.7 | 1.3 | 1.0 |
| 102 | Stoner Creek | 43.0 | 13.0 | 8.0 | 6.0 | 4.7 | 3.7 | 2.9 | 2.3 | 1.6 |
| 105 | Graves Creek | 175.0 | 90.0 | 45.0 | 23.0 | 11.5 | 5.2 | 2.4 | 1.0 | .4 |
| 106 | Deep Creek | 43.0 | 23.0 | 13.0 | 8.5 | 6.0 | 4.5 | 3.5 | 2.8 | 2.3 |

**Table 7.** Mean monthly discharge for streamflow-measurement sites (1938–82 base period)

| Site No. | Stream name and gaging station number | Mean discharge, in cubic feet per second, for indicated month | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
| 1 | Young Creek below South Fork. | 6.7 | 6.6 | 6.4 | 5.3 | 5.5 | 7.1 | 22.1 | 48.4 | 41.7 | 17.4 | 6.8 | 6.4 |
| 2 | Young Creek at mouth. | 6.6 | 6.4 | 6.1 | 5.2 | 5.3 | 6.8 | 21.4 | 46.8 | 40.3 | 16.8 | 6.7 | 6.2 |
| 3 | Cayuse Creek (12300400). | 1.4 | 1.5 | 1.6 | 1.4 | 1.5 | 2.6 | 20.0 | 34.1 | 9.9 | 2.6 | 1.2 | 0.9 |
| 4 | Fortine Creek (12300500). | 17.0 | 19.0 | 20.0 | 17.0 | 18.0 | 33.0 | 248.0 | 424.0 | 123.0 | 33.0 | 15.0 | 11.0 |
| 5 | Deep Creek | 1.5 | 1.7 | 2.9 | 2.3 | 2.8 | 4.1 | 22.0 | 70.5 | 37.5 | 4.7 | 1.6 | 1.2 |
| 7 | Sullivan Creek | 4.5 | 4.4 | 4.3 | 3.4 | 3.7 | 4.8 | 14.9 | 32.6 | 28.0 | 11.7 | 4.6 | 4.3 |
| 8 | Boulder Creek | 8.6 | 8.4 | 8.2 | 6.8 | 7.1 | 9.1 | 28.5 | 62.4 | 53.6 | 22.4 | 8.7 | 8.2 |
| 9 | Big Creek near Rexford (12301810). | 18.0 | 20.0 | 34.0 | 27.0 | 33.0 | 47.0 | 256.0 | 822.0 | 437.0 | 55.0 | 19.0 | 14.0 |
| 10 | Bristow Creek | 4.0 | 4.5 | 2.0 | 1.0 | 1.0 | 2.0 | 5.0 | 10.0 | 45.0 | 13.0 | 5.0 | 4.0 |
| 15 | Parmenter Creek | .3 | 1.2 | .3 | 1.8 | 1.6 | 19.4 | 31.2 | 81.7 | 96.4 | 37.3 | 1.7 | 1.0 |
| 16 | Cedar Creek | 8.7 | 9.6 | 10.6 | 7.8 | 8.7 | 7.8 | 27.2 | 76.8 | 80.2 | 27.5 | 7.8 | 6.9 |
| 17 | Quartz Creek | 25.2 | 27.7 | 30.9 | 22.7 | 25.2 | 22.7 | 78.9 | 223.0 | 233.0 | 80.0 | 22.7 | 20.1 |
| 18 | Camp Creek (12303440). | 3.9 | 3.5 | 5.4 | 8.0 | 8.8 | 11.4 | 13.9 | 61.4 | 65.7 | 40.9 | 4.5 | 3.5 |
| 19 | Ruby Creek | 4.7 | 4.9 | 6.3 | 6.3 | 9.3 | 41.0 | 71.7 | 97.8 | 55.4 | 12.6 | 6.3 | 4.9 |
| 20 | Pete Creek below Hensley Creek. | 6.1 | 6.3 | 13.1 | 10.6 | 12.2 | 26.1 | 75.2 | 156.0 | 77.3 | 19.7 | 7.8 | 6.7 |
| 21 | Pete Creek at mouth. | 7.0 | 7.2 | 14.8 | 12.0 | 14.0 | 29.7 | 85.4 | 177.0 | 87.7 | 22.2 | 8.8 | 7.7 |
| 22 | Whitetail Creek (12304250). | .0 | .0 | .0 | .4 | .5 | 2.9 | 5.3 | 7.6 | 3.7 | .5 | .0 | .0 |
| 23 | Spread Creek | 23.7 | 24.5 | 30.3 | 24.6 | 28.3 | 41.8 | 174.0 | 361.0 | 179.0 | 45.5 | 18.0 | 15.7 |
| 24 | Hellroaring Creek at Forest Service Bridge. | 7.9 | 8.2 | 10.1 | 8.2 | 9.6 | 14.0 | 58.3 | 121.0 | 59.9 | 15.2 | 6.0 | 5.3 |
| 25 | Hellroaring Creek at mouth. | 8.1 | 8.4 | 10.4 | 8.4 | 9.7 | 14.3 | 59.8 | 125.0 | 61.5 | 15.6 | 6.2 | 5.4 |
| 26 | North Fork Meadow Creek. | 4.0 | 4.1 | 5.2 | 4.2 | 4.8 | 7.0 | 29.4 | 61.0 | 30.3 | 7.7 | 3.1 | 2.7 |
| 27 | North Fork Meadow Creek at mouth. | 3.9 | 4.0 | 5.1 | 4.1 | 4.7 | 6.9 | 28.8 | 59.7 | 29.6 | 7.5 | 3.0 | 2.6 |
| 28 | Meadow Creek | 12.5 | 12.9 | 16.0 | 13.0 | 15.0 | 22.0 | 92.0 | 191.0 | 94.6 | 24.1 | 9.6 | 8.3 |
| 29 | Red Top Creek | 5.8 | 6.0 | 7.4 | 6.0 | 6.9 | 10.2 | 42.7 | 88.4 | 43.9 | 11.1 | 4.4 | 3.8 |
| 30 | Cyclone Creek (12304300). | 3.1 | 3.2 | 4.0 | 3.3 | 3.8 | 5.5 | 23.3 | 48.0 | 23.8 | 6.0 | 2.4 | 2.2 |
| 31 | Fourth of July Creek (12304400). | 3.9 | 4.0 | 4.9 | 4.0 | 4.6 | 6.8 | 28.5 | 58.8 | 29.3 | 7.4 | 2.9 | 2.6 |
| 40 | Deer Creek (12339300). | 5.1 | 5.4 | 4.7 | 4.7 | 4.7 | 5.7 | 24.9 | 75.5 | 82.3 | 24.4 | 9.0 | 6.2 |
| 41 | Seeley Creek | 2.0 | 2.0 | 2.5 | 2.0 | 2.0 | 2.5 | 4.0 | 18.0 | 6.0 | 2.0 | 2.0 | 2.0 |
| 42 | West Twin Creek (12339900). | 2.8 | 2.9 | 2.5 | 2.5 | 2.5 | 3.1 | 13.3 | 40.6 | 44.3 | 13.0 | 4.8 | 3.3 |
| 44 | Marshall Creek (12340200). | 1.8 | 1.1 | 1.1 | 1.3 | 1.6 | 2.4 | 4.8 | 8.7 | 1.7 | 1.4 | .9 | .7 |
| 47 | Tin Cup Creek | 38.6 | 33.2 | 28.9 | 25.7 | 26.1 | 34.3 | 98.5 | 305.0 | 328.0 | 104.0 | 36.4 | 33.2 |
| 48 | Burke Gulch (12344300). | .7 | .7 | .6 | .4 | .4 | .5 | 2.1 | 7.0 | 7.8 | 2.7 | .6 | .4 |
| 49 | Lost Horse Creek | 76.1 | 64.7 | 60.4 | 38.0 | 32.2 | 47.0 | 208.0 | 682.0 | 740.0 | 253.0 | 38.0 | 27.7 |
| 50 | Camas Creek (12345800). | 5.4 | 5.2 | 4.6 | 3.0 | 3.2 | 3.9 | 16.1 | 53.0 | 59.2 | 20.9 | 4.6 | 3.3 |
| 51 | Sleeping Child Creek (12345850). | 24.8 | 21.4 | 18.6 | 16.5 | 16.8 | 22.1 | 63.5 | 197.0 | 211.0 | 66.9 | 23.5 | 21.4 |
| 52 | Little Sleeping Child Creek. | 1.6 | 1.6 | 1.2 | 1.2 | 1.3 | 1.7 | 5.8 | 10.1 | 8.0 | 2.9 | 1.6 | 1.6 |
| 53 | Roaring Lion Creek. | 25.4 | 21.6 | 20.2 | 12.7 | 10.8 | 15.7 | 69.5 | 228.0 | 248.0 | 84.5 | 12.7 | 9.3 |
| 54 | Sawtooth Creek | 24.1 | 20.5 | 19.2 | 12.1 | 10.2 | 14.9 | 66.1 | 216.0 | 235.0 | 80.2 | 12.1 | 8.8 |
| 56 | Gird Creek | 7.0 | 6.2 | 5.0 | 4.2 | 4.9 | 4.8 | 10.3 | 46.8 | 71.8 | 25.8 | 9.8 | 7.2 |
| 58 | Mill Creek | 20.1 | 17.1 | 16.0 | 10.1 | 8.5 | 12.4 | 55.1 | 181.0 | 196.0 | 66.9 | 10.1 | 7.3 |

**Table 7.** Mean monthly discharge for streamflow-measurement sites (1938–82 base period)—Continued

| Site No. | Stream name and gaging station number | Mean discharge, in cubic feet per second, for indicated month | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
| 60 | Sweat House Creek. | 10.1 | 8.6 | 8.0 | 5.1 | 4.3 | 6.2 | 27.7 | 91.0 | 98.6 | 33.6 | 5.1 | 3.7 |
| 61 | Gash Creek (12350200). | 4.3 | 3.6 | 3.4 | 2.2 | 1.8 | 2.6 | 11.7 | 38.5 | 41.7 | 14.2 | 2.2 | 1.6 |
| 62 | Big Creek | 39.5 | 34.0 | 29.7 | 26.4 | 26.8 | 35.2 | 101.0 | 313.0 | 336.0 | 107.0 | 37.4 | 34.0 |
| 65 | Bass Creek | 10.9 | 11.0 | 10.3 | 9.3 | 9.3 | 9.6 | 21.3 | 74.9 | 104.0 | 39.2 | 17.4 | 10.6 |
| 66 | Sweeney Creek | 12.4 | 12.4 | 11.7 | 10.6 | 10.5 | 11.0 | 24.1 | 85.0 | 118.0 | 44.5 | 19.7 | 13.6 |
| 69 | Butler Creek | 2.9 | 3.2 | 3.5 | 3.6 | 4.3 | 7.4 | 27.1 | 44.1 | 30.5 | 9.4 | 3.5 | 3.2 |
| 71 | Twelvemile Creek. | 10.5 | 12.9 | 22.9 | 20.0 | 24.4 | 33.4 | 90.0 | 160.0 | 104.0 | 29.3 | 15.6 | 11.5 |
| 72 | Ward Creek | 9.6 | 11.9 | 21.2 | 18.3 | 22.4 | 30.8 | 83.0 | 147.0 | 96.0 | 27.0 | 14.4 | 10.5 |
| 73 | Twomile Creek | 5.4 | 6.7 | 11.9 | 10.3 | 12.6 | 17.3 | 46.7 | 82.6 | 54.0 | 15.2 | 8.1 | 5.9 |
| 74 | St. Regis River (12354000). | 143.0 | 191.0 | 254.0 | 213.0 | 245.0 | 347.0 | 1,108.0 | 2,099.0 | 1,278.0 | 341.0 | 152.0 | 119.0 |
| 75 | Siegel Creek | 2.5 | 3.1 | 5.4 | 4.7 | 5.8 | 7.9 | 21.3 | 37.7 | 24.6 | 6.9 | 3.7 | 2.7 |
| 77 | Bear Creek (12356500). | 16.0 | 14.0 | 11.0 | 10.0 | 8.0 | 10.0 | 46.0 | 191.0 | 143.0 | 37.0 | 17.0 | 13.0 |
| 79 | Fish Creek | 14.0 | 15.0 | 11.0 | 11.0 | 9.0 | 8.0 | 12.0 | 110.0 | 60.0 | 20.0 | 15.0 | 10.0 |
| 85 | Piper Creek | 5.4 | 5.7 | 4.9 | 4.9 | 4.9 | 6.0 | 26.2 | 79.4 | 86.6 | 25.7 | 9.5 | 6.5 |
| 86 | Goat Creek above Scout Creek. | .3 | .3 | .3 | .2 | .2 | .9 | .9 | 60.6 | 89.4 | 20.8 | 1.7 | .4 |
| 87 | Goat Creek above Squeezer Creek Road. | 5.8 | 6.0 | 5.2 | 4.9 | 5.1 | 5.2 | 20.9 | 95.6 | 112.0 | 20.8 | 7.2 | 6.0 |
| 88 | Goat Creek at Squeezer Creek Road. | 5.7 | 5.9 | 5.1 | 4.8 | 5.0 | 5.1 | 20.6 | 94.0 | 110.0 | 20.5 | 7.1 | 5.9 |
| 89 | South Woodward Creek above Fatty Creek Road. | 5.1 | 5.3 | 5.1 | 3.7 | 4.4 | 4.3 | 6.4 | 10.2 | 11.3 | 7.3 | 5.8 | 5.3 |
| 90 | South Woodward Creek near mouth. | 26.7 | 24.5 | 23.7 | 20.8 | 19.7 | 17.8 | 18.4 | 29.7 | 38.6 | 29.7 | 29.7 | 30.7 |
| 91 | Soup Creek above Soup Creek Campground. | 3.0 | 3.1 | 2.7 | 2.7 | 2.7 | 3.3 | 14.4 | 43.8 | 47.8 | 14.1 | 5.2 | 3.6 |
| 92 | Soup Creek at Soup Creek Campground. | 2.8 | 2.9 | 2.5 | 2.5 | 2.5 | 3.0 | 13.2 | 40.2 | 43.8 | 13.0 | 4.7 | 3.3 |
| 93 | Soup Creek at Highway 83. | 3.5 | 3.6 | 3.1 | 3.1 | 3.1 | 3.8 | 16.5 | 50.3 | 54.8 | 16.2 | 5.9 | 4.1 |
| 94 | South Fork Lost Creek. | 10.6 | 11.0 | 9.6 | 9.6 | 9.5 | 16.7 | 57.4 | 145.0 | 153.0 | 55.6 | 22.7 | 13.0 |
| 95 | North Fork Lost Creek. | 7.5 | 7.8 | 6.8 | 6.8 | 6.8 | 8.3 | 36.2 | 110.0 | 120.0 | 35.5 | 13.1 | 9.1 |
| 96 | Lost Creek | 15.0 | 15.6 | 13.6 | 13.6 | 13.6 | 16.6 | 72.5 | 220.0 | 240.0 | 71.1 | 26.2 | 18.2 |
| 97 | Porcupine Creek | 2.5 | 2.2 | 1.8 | 1.4 | 1.2 | 2.8 | 3.7 | 8.8 | 2.9 | 2.8 | 2.8 | 2.9 |
| 98 | Bond Creek | 1.5 | 1.6 | 1.5 | 1.5 | 1.7 | 4.5 | 8.6 | 49.7 | 62.3 | 15.1 | 3.0 | 2.3 |
| 99 | Hall Creek | 4.0 | 3.5 | 3.0 | 3.0 | 3.0 | 3.5 | 15.0 | 55.0 | 28.0 | 16.0 | 12.0 | 5.0 |
| 100 | Johnson Creek | 3.0 | 2.5 | 1.8 | 1.0 | .8 | 1.0 | 10.0 | 20.0 | 20.0 | 10.0 | 4.0 | 3.0 |
| 102 | Stoner Creek | 5.0 | 5.0 | 5.0 | 4.0 | 4.0 | 5.0 | 10.0 | 34.0 | 50.0 | 15.0 | 4.0 | 2.0 |
| 105 | Graves Creek | 10.1 | 5.2 | 2.5 | 2.5 | 2.8 | 12.6 | 20.9 | 172.0 | 177.0 | 70.7 | 25.3 | 10.4 |
| 106 | Deep Creek | 4.3 | 5.3 | 9.4 | 8.2 | 10.0 | 13.7 | 36.9 | 65.4 | 42.7 | 12.0 | 6.4 | 4.7 |

**Table 8.** Basin characteristics and mean annual discharge for streamflow-gaging stations (1938–82 base period)

[$mi^2$, square miles; $ft^3/s$, cubic feet per second]

| Site No. | Stream name and gaging station number | Number of years of record | Drainge area ($mi^2$) | Mean annual precip-itation (inches) | Mean annual dis-charge ($ft^3/s$) | Mean annual runoff (inches) |
|---|---|---|---|---|---|---|
| 6 | Tobacco River (12301300) | 24 | 440 | 31 | 268 | 8.3 |
| 11 | Wolf Creek near Libby (12301999) | 10 | 216 | 27 | 67.0 | 4.2 |
| 12 | Fisher River near Jennings (12302000). | 18 | 780 | 32 | 510 | 8.9 |
| 13 | Granite Creek (12302500) | 16 | 23.6 | 67 | 71.0 | 40.8 |
| 14 | Flower Creek (12303100) | 22 | 11.1 | 67 | 27.0 | 33.0 |
| 32 | Yaak River (12304500) | 26 | 766 | 43 | 888 | 15.7 |
| 33 | German Gulch (12323500) | 14 | 40.6 | 18 | 21.0 | 7.0 |
| 34 | Racetrack Creek (12324100) | 16 | 39.5 | 35 | 59.0 | 20.3 |
| 35 | Boulder Creek (12330000) | 43 | 71.3 | 31 | 48.0 | 9.1 |
| 36 | Middle Fork Rock Creek (12332000). | 45 | 123 | 35 | 124 | 13.6 |
| 37 | Blackfoot River near Helmville (12335000). | 13 | 481 | 15 | 342 | 9.6 |
| 38 | Nevada Creek (12335500) | 43 | 116 | 23 | 38.0 | 4.4 |
| 39 | Monture Creek (12338690) | 9 | 140 | 35 | 184 | 17.8 |
| 43 | Blackfoot River (12340000) | 46 | 2,290 | 29 | 1,629 | 9.7 |
| 45 | East Fork Bitterroot River (1234300). | 16 | 381 | 32 | 282 | 10.0 |
| 46 | Bitterroot River (12344000) | 45 | 1,049 | 22 | 934 | 12.1 |
| 55 | Skalkaho Creek (12346500) | 26 | 87.8 | 36 | 91.0 | 14.1 |
| 57 | Blodgett Creek (12347500) | 22 | 26.4 | 64 | 68.0 | 35.0 |
| 59 | Bear Creek (12350000) | 18 | 26.8 | 63 | 70.0 | 35.4 |
| 63 | Kootenai Creek (12350500) | 10 | 28.9 | 64 | 78.0 | 36.6 |
| 64 | Burnt Fork Bitterroot (12351000) | 24 | 74.0 | 32 | 50.0 | 9.2 |
| 67 | Eightmile Creek (12351400) | 2 | 20.6 | 21 | 8.0 | 5.3 |
| 68 | Clark Fork below Missoula (12353000). | 53 | 9,003.0 | 17 | 5,800 | 8.7 |
| 70 | Ninemile Creek (12353280) | 9 | 170.0 | 38 | 124 | 9.9 |
| 76 | North Fork Flathead River (12355500). | 53 | 1,548.0 | 26 | 3,050 | 26.7 |
| 78 | Middle Fork Flathead River at Essex (12357000). | 22 | 510.0 | 52 | 1,100 | 29.3 |
| 80 | South Fork Flathead River above Twin Creek (12359800). | 17 | 1,160.0 | 52 | 2,170 | 25.4 |
| 81 | Twin Creek (12360000) | 11 | 47.0 | 53 | 112 | 32.3 |
| 82 | Sullivan Creek (12361000) | 25 | 71.3 | 53 | 210 | 40.0 |
| 83 | Graves Creek near Hungry Horse (12361500). | 11 | 27.0 | 67 | 127 | 63.8 |
| 84 | Swan River near Condon (12369200). | 10 | 69.1 | 54 | 160 | 31.4 |
| 101 | Swan River near Big Fork (12370000). | 60 | 671.0 | 46 | 1,180 | 23.9 |
| 103 | Thompson River (12389500) | 26 | 642.0 | 41 | 480 | 10.1 |
| 104 | Prospect Creek (12390700) | 26 | 182.0 | 54 | 258 | 19.2 |

**Table 9.** Discharge for various exceedance percentages for streamflow-gaging stations (1938–82 base period)

| Site No. | Stream name and gaging station number | Discharge, in cubic feet per second, for indicated exceedance percentage | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 |
| 6 | Tobacco River (12301300). | 742.0 | 425.0 | 221.0 | 153.0 | 128.0 | 114.0 | 99.0 | 86.0 | 73.0 |
| 11 | Wolf Creek near Libby (12301999). | 207.0 | 68.0 | 33.0 | 19.0 | 13.0 | 11.0 | 9.3 | 8.2 | 6.7 |
| 12 | Fisher River near Jennings (12302000). | 1,400.0 | 765.0 | 423.0 | 301.0 | 232.0 | 181.0 | 149.0 | 127.0 | 105.0 |
| 13 | Granite Creek (12302500). | 205.0 | 112.0 | 63.0 | 40.0 | 29.0 | 22.0 | 17.0 | 14.0 | 9.9 |
| 14 | Flower Creek (12303100). | 82.0 | 36.0 | 20.0 | 14.0 | 11.0 | 8.8 | 7.5 | 6.5 | 5.5 |
| 32 | Yaak River (12304500). | 2,800.0 | 1,260.0 | 625.0 | 392.0 | 287.0 | 225.0 | 187.0 | 158.0 | 131.0 |
| 33 | German Gulch (12323500). | 55.0 | 25.0 | 15.0 | 11.0 | 9.2 | 8.2 | 7.3 | 6.4 | 5.6 |
| 34 | Racetrack Creek (12324100). | 140.0 | 87.0 | 58.0 | 39.0 | 29.0 | 25.0 | 22.0 | 20.0 | 18.0 |
| 35 | Boulder Creek (12330000). | 122.0 | 54.0 | 32.0 | 26.0 | 23.0 | 21.0 | 19.0 | 17.0 | 14.0 |
| 36 | Middle Fork Rock Creek (12332000). | 351.0 | 159.0 | 82.0 | 59.0 | 48.0 | 42.0 | 37.0 | 33.0 | 27.0 |
| 37 | Blackfoot River near Helmville (12335000). | 895.0 | 400.0 | 228.0 | 181.0 | 159.0 | 143.0 | 129.0 | 115.0 | 101.0 |
| 38 | Nevada Creek (12335500). | 101.0 | 48.0 | 26.0 | 19.0 | 16.0 | 13.0 | 11.0 | 8.8 | 6.3 |
| 39 | Monture Creek (12338690). | 577.0 | 262.0 | 107.0 | 72.0 | 57.0 | 45.0 | 39.0 | 35.0 | 31.0 |
| 43 | Blackfoot River (12340000). | 4,430.0 | 2,180.0 | 1,200.0 | 899.0 | 741.0 | 655.0 | 589.0 | 528.0 | 458.0 |
| 45 | East Fork Bitterroot River (12343400). | 830.0 | 321.0 | 182.0 | 137.0 | 116.0 | 103.0 | 91.0 | 83.0 | 72.0 |
| 46 | Bitterroot River (12344000). | 2,630.0 | 1,250.0 | 654.0 | 456.0 | 368.0 | 311.0 | 272.0 | 239.0 | 201.0 |
| 55 | Skalkaho Creek (12346500). | 266.0 | 110.0 | 67.0 | 49.0 | 40.0 | 34.0 | 29.0 | 26.0 | 23.0 |
| 57 | Blodgett Creek (12347500). | 222.0 | 104.0 | 49.0 | 30.0 | 22.0 | 17.0 | 13.0 | 9.2 | 6.3 |
| 59 | Bear Creek (12350000). | 225.0 | 107.0 | 51.0 | 28.0 | 19.0 | 15.0 | 12.0 | 8.5 | 5.8 |
| 63 | Kootenai Creek (12350500). | 242.0 | 125.0 | 62.0 | 38.0 | 26.0 | 19.0 | 15.0 | 12.0 | 8.8 |
| 64 | Burnt Fork Bitterroot River (12351000). | 132.0 | 62.0 | 37.0 | 28.0 | 24.0 | 21.0 | 18.0 | 17.0 | 14.0 |
| 67 | Eightmile Creek (12351400). | 21.0 | 12.0 | 7.3 | 5.6 | 4.8 | 4.3 | 3.9 | 3.5 | 3.1 |
| 68 | Clark Fork below Missoula (12353000). | 15,000.0 | 7,700.0 | 4,530.0 | 3,470.0 | 2,940.0 | 2,580.0 | 2,310.0 | 2,040.0 | 1,690.0 |
| 70 | Ninemile Creek (12353280). | 384.0 | 187.0 | 95.0 | 57.5 | 42.0 | 34.5 | 30.0 | 27.0 | 22.0 |
| 76 | North Fork Flathead River (12355500). | 8,810.0 | 4,580.0 | 2,420.0 | 1,580.0 | 1,200.0 | 968.0 | 821.0 | 698.0 | 571.0 |
| 78 | Middle Fork Flathead River at Essex (12357000). | 3,420.0 | 1,470.0 | 686.0 | 448.0 | 337.0 | 269.0 | 223.0 | 188.0 | 148.0 |
| 80 | South Fork Flathead River above Twin Creek (12359800). | 6,990.0 | 3,210.0 | 1,290.0 | 843.0 | 601.0 | 484.0 | 394.0 | 336.0 | 278.0 |
| 81 | Twin Creek (12360000) | 384.0 | 155.0 | 62.0 | 39.0 | 30.0 | 23.0 | 18.0 | 14.0 | 10.0 |
| 82 | Sullivan Creek (12361000). | 650.0 | 314.0 | 159.0 | 102.0 | 73.0 | 56.0 | 42.0 | 34.0 | 26.0 |
| 83 | Graves Creek near Hungry Horse (12361500). | 398.0 | 190.0 | 97.0 | 58.0 | 43.0 | 34.0 | 26.0 | 20.0 | 16.0 |
| 84 | Swan River near Condon (12369200). | 444.0 | 276.0 | 150.0 | 93.0 | 69.0 | 56.0 | 47.0 | 41.0 | 35.0 |
| 101 | Swan River near Big Fork (12370000). | 2,980.0 | 1,860.0 | 1,120.0 | 781.0 | 631.0 | 543.0 | 474.0 | 417.0 | 362.0 |
| 103 | Thompson River (12389500). | 1,240.0 | 656.0 | 398.0 | 303.0 | 250.0 | 218.0 | 196.0 | 176.0 | 153.0 |
| 104 | Prospect Creek (12390700). | 735.0 | 388.0 | 224.0 | 149.0 | 109.0 | 82.0 | 68.0 | 57.0 | 47.0 |

**Table 10.** Mean monthly discharge for streamflow-gaging stations (1938–82 base period)

| Site No. | Stream name and gaging station number | Mean discharge, in cubic feet per second, for indicated month | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
| 6 | Tobacco River (12301300). | 121.0 | 117.0 | 114.0 | 97.0 | 98.0 | 125.0 | 396.0 | 866.0 | 744.0 | 309.0 | 122.0 | 113.0 |
| 11 | Wolf Creek near Libby (12301999). | 11.0 | 11.0 | 12.0 | 20.0 | 21.0 | 47.0 | 269.0 | 294.0 | 71.0 | 27.0 | 11.0 | 9.3 |
| 12 | Fisher River near Jennings (12302000). | 145.0 | 194.0 | 251.0 | 223.0 | 298.0 | 369.0 | 1,452.0 | 1,804.0 | 834.0 | 288.0 | 138.0 | 123.0 |
| 13 | Granite Creek (12302500). | 24.0 | 33.0 | 33.0 | 21.0 | 25.0 | 34.0 | 107.0 | 245.0 | 212.0 | 71.0 | 25.0 | 21.0 |
| 14 | Flower Creek (12303100) | 10.0 | 11.0 | 12.0 | 9.0 | 10.0 | 10.0 | 31.0 | 87.0 | 91.0 | 31.0 | 10.0 | 8.0 |
| 32 | Yaak River (12304500) | 259.0 | 271.0 | 335.0 | 272.0 | 314.0 | 456.0 | 1,919.0 | 3,984.0 | 1,980.0 | 502.0 | 196.0 | 172.0 |
| 33 | German Gulch (12323500) | 9.2 | 8.0 | 7.3 | 6.3 | 6.6 | 8.1 | 19.0 | 67.0 | 77.0 | 26.0 | 12.0 | 9.6 |
| 34 | Racetrack Creek (12324100). | 30.0 | 23.0 | 21.0 | 20.0 | 20.0 | 20.0 | 28.0 | 111.0 | 212.0 | 111.0 | 73.0 | 44.0 |
| 35 | Boulder Creek (12330000). | 24.0 | 24.0 | 21.0 | 19.0 | 19.0 | 19.0 | 29.0 | 121.0 | 191.0 | 66.0 | 22.0 | 19.0 |
| 36 | Middle Fork Rock Creek (12332000). | 51.0 | 44.0 | 37.0 | 31.0 | 32.0 | 35.0 | 73.0 | 351.0 | 515.0 | 193.0 | 72.0 | 52.0 |
| 37 | Blackfoot River near Helmville (12335000). | 164.0 | 148.0 | 134.0 | 121.0 | 119.0 | 123.0 | 226.0 | 944.0 | 1,240.0 | 465.0 | 242.0 | 175.0 |
| 38 | Nevada Creek (12335500) | 14.0 | 15.0 | 13.0 | 11.0 | 14.0 | 33.0 | 73.0 | 127.0 | 102.0 | 28.0 | 15.0 | 11.0 |
| 39 | Monture Creek (12338690). | 46.0 | 47.0 | 42.0 | 42.0 | 41.0 | 49.0 | 217.0 | 661.0 | 720.0 | 212.0 | 78.0 | 53.0 |
| 43 | Blackfoot River (12340000). | 648.0 | 637.0 | 601.0 | 548.0 | 597.0 | 727.0 | 1,957.0 | 5,146.0 | 5,256.0 | 1,920.0 | 846.0 | 647.0 |
| 45 | East Fork Bitterroot River (12343400). | 112.0 | 104.0 | 95.0 | 83.0 | 83.0 | 104.0 | 257.0 | 907.0 | 1,050.0 | 335.0 | 138.0 | 116.0 |
| 46 | Bitterroot River (12344000). | 391.0 | 337.0 | 302.0 | 263.0 | 275.0 | 351.0 | 1,010.0 | 3,139.0 | 3,366.0 | 1,065.0 | 376.0 | 339.0 |
| 55 | Skalkaho Creek (12346500). | 40.0 | 34.0 | 30.0 | 26.0 | 25.0 | 26.0 | 50.0 | 230.0 | 370.0 | 150.0 | 67.0 | 46.0 |
| 57 | Blodgett Creek (12347500). | 24.0 | 23.0 | 21.0 | 14.0 | 14.0 | 18.0 | 72.0 | 237.0 | 265.0 | 94.0 | 21.0 | 15.0 |
| 59 | Bear Creek (12350000) | 28.0 | 24.0 | 22.0 | 14.0 | 12.0 | 17.0 | 77.0 | 251.0 | 273.0 | 93.0 | 14.0 | 10.0 |
| 63 | Kootenai Creek (12350500). | 31.0 | 27.0 | 21.0 | 13.0 | 17.0 | 19.0 | 82.0 | 242.0 | 309.0 | 135.0 | 25.0 | 18.0 |
| 64 | Burnt Fork Bitterroot River (12351000). | 20.0 | 20.0 | 19.0 | 17.0 | 17.0 | 18.0 | 39.0 | 137.0 | 190.0 | 72.0 | 32.0 | 22.0 |
| 67 | Eightmile Creek (12351400). | 4.0 | 4.0 | 3.0 | 3.0 | 3.0 | 4.0 | 14.0 | 23.0 | 18.0 | 7.0 | 4.0 | 4.0 |
| 68 | Clark Fork below Missoula (12353000). | 2,920.0 | 2,870.0 | 2,660.0 | 2,350.0 | 2,590.0 | 3,110.0 | 6,370.0 | 16,200.0 | 19,000.0 | 6,710.0 | 2,480.0 | 2,460.0 |
| 70 | Ninemile Creek (12353280). | 30.0 | 34.0 | 37.0 | 38.0 | 45.0 | 78.0 | 282.0 | 460.0 | 319.0 | 98.0 | 37.0 | 33.0 |
| 76 | North Fork Flathead River (12355500). | 1,210.0 | 1,080.0 | 924.0 | 753.0 | 735.0 | 800.0 | 3,140.0 | 10,400.0 | 10,500.0 | 4,200.0 | 1,660.0 | 1,190.0 |
| 78 | Middle Fork Flathead River at Essex (12357000). | 326.0 | 341.0 | 320.0 | 237.0 | 259.0 | 261.0 | 1,215.0 | 4,370.0 | 4,100.0 | 1,180.0 | 344.0 | 267.0 |
| 80 | South Fork Flathead River above Twin Creek (12359800). | 548.0 | 581.0 | 483.0 | 419.0 | 402.0 | 461.0 | 2,220.0 | 8,090.0 | 8,690.0 | 2,820.0 | 772.0 | 518.0 |
| 81 | Twin Creek (12360000) | 29.0 | 28.0 | 32.0 | 22.0 | 28.0 | 35.0 | 205.0 | 524.0 | 324.0 | 73.0 | 22.0 | 18.0 |
| 82 | Sullivan Creek (12361000). | 73.0 | 82.0 | 73.0 | 58.0 | 55.0 | 67.0 | 278.0 | 846.0 | 718.0 | 170.0 | 55.0 | 51.0 |
| 83 | Graves Creek near Hungry Horse (12361500). | 43.0 | 50.0 | 49.0 | 26.0 | 28.0 | 33.0 | 118.0 | 424.0 | 519.0 | 166.0 | 38.0 | 33.0 |
| 84 | Swan River near Condon (12369200). | 60.0 | 61.0 | 57.0 | 48.0 | 49.0 | 52.0 | 191.0 | 448.0 | 523.0 | 274.0 | 96.0 | 61.0 |
| 101 | Swan River near Big Fork (12370000). | 558.0 | 570.0 | 550.0 | 501.0 | 518.0 | 594.0 | 1,485.0 | 2,860.0 | 3,480.0 | 1,740.0 | 726.0 | 557.0 |
| 103 | Thompson River (12389500). | 193.0 | 198.0 | 220.0 | 205.0 | 236.0 | 311.0 | 816.0 | 1,515.0 | 1,160.0 | 438.0 | 260.0 | 212.0 |
| 104 | Prospect Creek (12390700). | 62.0 | 74.0 | 133.0 | 115.0 | 140.0 | 194.0 | 524.0 | 926.0 | 607.0 | 171.0 | 90.0 | 67.0 |

**Table 11.** Long-term mean annual discharge computation for Flower Creek near Libby (site 14)
[ft³/s, cubic feet per second]

| Date | Yaak River | | | Flower Creek | | | |
|---|---|---|---|---|---|---|---|
| | Daily mean discharge ($ft^3/s$) | Exceedance percentage[1] | Monthly mean discharge ($ft^3/s$) | Daily mean discharge[2] ($ft^3/s$) | Estimated monthly mean discharge ($ft^3/s$) | Actual monthly mean discharge ($ft^3/s$) | Percent difference |
| 10-15-80 | 168 | 80 | 155 | 9.7 | 9.0 | 8.1 | +11 |
| 11-15-80 | 234 | 57 | 278 | 19 | 22.6 | 19.1 | +18 |
| 12-15-80 | 267 | 52 | 807 | 13 | 39.4 | 40.7 | -3 |
| 01-15-81 | 442 | 37 | 654 | 16 | 23.5 | 20.4 | +15 |
| 02-15-81 | 406 | 39 | 656 | 9.9 | 16.0 | 13.6 | +18 |
| 03-15-81 | 718 | 28 | 752 | 14 | 14.7 | 13.1 | +12 |
| 04-15-81 | 732 | 28 | 1,719 | 11 | 25.6 | 32.4 | -21 |
| 05-15-81 | 3,660 | 7.5 | 3,588 | 96 | 94.1 | 81.5 | +16 |
| 06-15-81 | 4,090 | 6.5 | 2,787 | 58 | 39.5 | 70.3 | -44 |
| 07-15-81 | 857 | 25 | 909 | 26 | 27.7 | 28.0 | -1 |
| 08-15-81 | 263 | 52 | 271 | 9.5 | 9.8 | 9.7 | +1 |
| 09-15-81 | 156 | 81 | 192 | 5.9 | 7.3 | 6.8 | +7 |
| Annual mean discharge (1981 water year) | | | 1,065 | | 27.6 | 28.7 | -4 |
| Long-term mean annual discharge (1938-82 base period) | | | 888 | | [3]23.0 | 27.0 | -15 |

[1] From Yaak River flow-duration curve.

[2] Data used to prepare figure 7.

[3] Determined from an average ratio of long-term mean annual discharge to annual mean discharge for 1981 at three nearby gaging stations.

**Table 12.** Long-term mean annual discharge computation for Bear Creek near Victor (site 59)

| Date | Bitterroot River | | | Bear Creek | | | |
|---|---|---|---|---|---|---|---|
| | Daily mean discharge ($ft^3/s$) | Exceedance percentage[1] | Monthly mean discharge ($ft^3/s$) | Daily mean discharge[2] ($ft^3/s$) | Estimated monthly mean discharge ($ft^3/s$) | Actual monthly mean discharge ($ft^3/s$) | Percent difference |
| 10-15-58 | 320 | 58 | 283 | 29 | 25.6 | 21.6 | +19 |
| 11-15-58 | 410 | 45 | 419 | 47 | 48.0 | 48.8 | -2 |
| 12-15-58 | 450 | 41 | 454 | 40 | 40.4 | 41.7 | -3 |
| 01-15-59 | 290 | 65 | 334 | 18 | 20.7 | 20.2 | +3 |
| 02-15-59 | 301 | 63 | 293 | 16 | 15.6 | 15.4 | +1 |
| 03-15-59 | 238 | 80 | 318 | 11 | 14.7 | 13.6 | +8 |
| 04-15-59 | 1,360 | 16 | 1,139 | 76 | 63.6 | 73.5 | -14 |
| 05-15-59 | 3,730 | 7.0 | 2,638 | 212 | 196 | 181 | +8 |
| 06-15-59 | 5,960 | 3.5 | 4,195 | 513 | 361 | 407 | -11 |
| 07-15-59 | 1,020 | 20 | 1,058 | 108 | 112 | 101 | +11 |
| 08-15-59 | 320 | 58 | 384 | 11 | 13.0 | 13.0 | 0 |
| 09-15-59 | 405 | 45 | 420 | 30 | 31.1 | 36.4 | -15 |
| Annual mean discharge (1959 water year) | | | 994 | | 78.5 | 80.9 | -3 |
| Long-term mean annual discharge (1938-82 base period) | | | 934 | | [3]68.3 | 70.0 | -2 |

[1] From Bitterroot River flow-duration curve.

[2] Data used to prepare figure 8.

[3] Determined from an average ratio of long-term mean annual discharge to annual mean discharge for 1959 at three nearby gaging stations.

**Table 13.** Long-term mean annual discharge computation for Swan River near Condon (site 84)

| Date | Monture Creek: Daily mean discharge (ft³/s) | Monture Creek: Exceedance percentage[1] | Monture Creek: Monthly mean discharge (ft³/s) | Swan River: Daily mean discharge[2] (ft³/s) | Swan River: Estimated monthly mean discharge (ft³/s) | Swan River: Actual monthly mean discharge (ft³/s) | Swan River: Percent difference |
|---|---|---|---|---|---|---|---|
| 10-15-80 | 45 | 62 | 43.6 | 51 | 49.4 | 51.4 | -4 |
| 11-15-80 | 40 | 70 | 42.1 | 74 | 77.9 | 66.2 | +18 |
| 12-15-80 | 44 | 64 | 54.5 | 42 | 52.0 | 99.6 | -48 |
| 01-15-81 | 63 | 45 | 68.2 | 62 | 67.1 | 87.0 | -23 |
| 02-15-81 | 60 | 47 | 62.4 | 72 | 74.9 | 72.9 | +3 |
| 03-15-81 | 93 | 33 | 92.0 | 63 | 62.3 | 72.0 | -13 |
| 04-15-81 | 104 | 30 | 221 | 84 | 179 | 204 | -12 |
| 05-15-81 | 418 | 14 | 773 | 265 | 490 | 502 | -2 |
| 06-15-81 | 482 | 12 | 592 | 373 | 458 | 601 | -24 |
| 07-15-81 | 163 | 25 | 178 | 295 | 322 | 319 | +1 |
| 08-15-81 | 70 | 41 | 71.2 | 96 | 97.6 | 95.1 | +3 |
| 09-15-81 | 44 | 64 | 46.8 | 36 | 38.3 | 41.1 | -7 |
| Annual mean discharge (1981 water year) | | | 188 | | 165 | 185 | -11 |
| Long-term mean annual discharge (1938-82 base period) | | | 184 | | [3]157 | 160 | -2 |

[1] From Monture Creek flow-duration curve.

[2] Data used to prepare figure 9.

[3] Determined from an average ratio of annual mean discharge for 1981 to long-term mean annual discharge at three nearby gaging stations.

**Table 14.** Estimated flow-duration curve error for Flower Creek near Libby (site 14)

| Exceedance percentage[1] | Daily mean discharge of Flower Creek, in cubic feet per second | | Percent difference |
|---|---|---|---|
| | Estimated | Actual | |
| 90 | 4.9 | 5.5 | -11 |
| 80 | 6.0 | 6.5 | -8 |
| 70 | 7.1 | 7.5 | -5 |
| 60 | 8.5 | 8.8 | -3 |
| 50 | 10 | 11 | -9 |
| 40 | 13 | 14 | -7 |
| 30 | 19 | 20 | -5 |
| 20 | 36 | 36 | 0 |
| 10 | 75 | 82 | -9 |
| | | Average error = | -6 |

1 From figure 7.

**Table 15.** Estimated flow-duration curve error for Bear Creek near Victor (site 59)

| Exceedance percentage[1] | Daily mean discharge of Bear Creek, in cubic feet per second | | Percent difference |
|---|---|---|---|
| | Estimated | Actual | |
| 90 | 8.5 | 5.8 | +47 |
| 80 | 11 | 8.5 | +29 |
| 70 | 14 | 12 | +17 |
| 60 | 18 | 15 | +20 |
| 50 | 25 | 19 | +32 |
| 40 | 35 | 28 | +25 |
| 30 | 54 | 51 | +6 |
| 20 | 94 | 107 | -12 |
| 10 | 200 | 225 | -11 |
| | | Average error = | +17 |

1 From figure 8.

**Table 16.** Estimated flow-duration curve error for Swan River near Condon (site 84)

| Exceedance percentage[1] | Daily mean discharge of Swan River, in cubic feet per second | | Percent difference |
|---|---|---|---|
| | Estimated | Actual | |
| 90 | 28 | 35 | -20 |
| 80 | 33 | 41 | -20 |
| 70 | 38 | 47 | -19 |
| 60 | 45 | 56 | -20 |
| 50 | 58 | 69 | -16 |
| 40 | 80 | 93 | -14 |
| 30 | 140 | 150 | -7 |
| 20 | 240 | 276 | -13 |
| 10 | 420 | 444 | -5 |
| | | Average error = | -15 |

[1] From figure 9.

**Table 17.** Estimated long-term mean monthly discharges and errors for Flower Creek near Libby (site 14)

| Month | Long-term mean monthly discharge of Flower Creek, in cubic feet per second | | Percent difference |
|---|---|---|---|
| | Estimated[1] | Actual | |
| October | 9.5 | 10 | -5 |
| November | 11 | 11 | 0 |
| December | 12 | 12 | 0 |
| January | 7.6 | 9.0 | -16 |
| February | 9.5 | 10 | -5 |
| March | 12 | 10 | +20 |
| April | 44 | 31 | +42 |
| May | 90 | 87 | +3 |
| June | 80 | 91 | -12 |
| July | 26 | 31 | -16 |
| August | 7.9 | 10 | -21 |
| September | 6.9 | 8.0 | -14 |

[1] Estimated using monthly flow distribution of Granite Creek near Libby.

**Table 18.** Estimated long-term mean monthly discharges and errors for Bear Creek near Victor (site 59)

| Month | Long-term mean monthly discharge of Bear Creek, in cubic feet per second | | Percent difference |
|---|---|---|---|
| | Estimated[1] | Actual | |
| October | 28 | 28 | 0 |
| November | 24 | 24 | 0 |
| December | 19 | 22 | -14 |
| January | 12 | 14 | -14 |
| February | 16 | 12 | +33 |
| March | 17 | 17 | 0 |
| April | 73 | 77 | -5 |
| May | 218 | 251 | -13 |
| June | 278 | 273 | +2 |
| July | 121 | 93 | +30 |
| August | 22 | 14 | +57 |
| September | 16 | 10 | +60 |

[1] Estimated using monthly flow distribution of Kootenai Creek near Victor.

**Table 19.** Estimated long-term mean monthly discharges and errors for Swan River near Condon (site 84)

| Month | Long-term mean monthly discharge of Swan River, in cubic feet per second | | Percent difference |
|---|---|---|---|
| | Estimated[1] | Actual | |
| October | 75 | 60 | +25 |
| November | 78 | 61 | +28 |
| December | 75 | 57 | +32 |
| January | 68 | 48 | +42 |
| February | 71 | 49 | +45 |
| March | 81 | 52 | +56 |
| April | 195 | 191 | +2 |
| May | 388 | 448 | -13 |
| June | 467 | 523 | -11 |
| July | 235 | 274 | -14 |
| August | 98 | 96 | +2 |
| September | 76 | 61 | +25 |

[1] Estimated using monthly flow distribution of Swan River near Big Fork.

**Table 20.** Estimating equations for flow-duration curve streamflows in Region 1

| Discharge, in cubic feet per second, for indicated exceedance percentage | Equation | Coefficient of determination ($r^2$) |
|---|---|---|
| $Q_{10}$ = | $2.866\ Q_A^{0.995}$ | 0.981 |
| $Q_{20}$ = | $1.606\ Q_A^{0.959}$ | .962 |
| $Q_{30}$ = | $0.961\ Q_A^{0.941}$ | .945 |
| $Q_{40}$ = | $0.603\ Q_A^{0.957}$ | .937 |
| $Q_{50}$ = | $0.400\ Q_A^{0.985}$ | .932 |
| $Q_{60}$ = | $0.279\ Q_A^{1.015}$ | .922 |
| $Q_{70}$ = | $0.197\ Q_A^{1.049}$ | .905 |
| $Q_{80}$ = | $0.143\ Q_A^{1.084}$ | .875 |
| $Q_{90}$ = | $0.119\ Q_A^{1.082}$ | .849 |

**Table 21.** Estimating equations for flow-duration curve streamflows in Region 2

| Discharge, in cubic feet per second, for indicated exceedance percentage | Equation | Coefficient of determination ($r^2$) |
|---|---|---|
| $Q_{10}$ = | $1.390\ Q_A^{1.170}$ | 0.971 |
| $Q_{20}$ = | $0.738\ Q_A^{1.156}$ | .952 |
| $Q_{30}$ = | $0.598\ Q_A^{1.057}$ | .922 |
| $Q_{40}$ = | $0.446\ Q_A^{1.013}$ | .918 |
| $Q_{50}$ = | $0.334\ Q_A^{1.000}$ | .909 |
| $Q_{60}$ = | $0.242\ Q_A^{1.008}$ | .916 |
| $Q_{70}$ = | $0.185\ Q_A^{1.008}$ | .909 |
| $Q_{80}$ = | $0.147\ Q_A^{1.005}$ | .903 |
| $Q_{90}$ = | $0.118\ Q_A^{0.997}$ | .889 |

**Table 22.** Average prediction error for regression equations

| Region | Average error of prediction, in percent, for flow characteristic indicated | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $Q_A$ | $Q_{10}$ | $Q_{20}$ | $Q_{30}$ | $Q_{40}$ | $Q_{50}$ | $Q_{60}$ | $Q_{70}$ | $Q_{80}$ | $Q_{90}$ |
| 1 | -16 | +2 | -8 | -9 | -6 | -6 | -14 | -19 | -29 | -38 |
| 2 | -23 | -15 | -2 | +2 | +5 | +5 | +8 | +12 | +15 | +18 |

**Table 23.** Average prediction error for regression equations determined from gaged data only

| Region | Average error of prediction, in percent, for flow characteristic indicated | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $Q_A$ | $Q_{10}$ | $Q_{20}$ | $Q_{30}$ | $Q_{40}$ | $Q_{50}$ | $Q_{60}$ | $Q_{70}$ | $Q_{80}$ | $Q_{90}$ |
| 1 | -6 | -6 | -11 | -11 | -6 | -3 | -5 | -9 | -15 | -18 |
| 2[1] | -4 | +2 | +5 | -1 | -1 | -4 | -7 | -4 | -2 | -8 |

[1] Not an average for Region 2; these are the results for one site.

**Table 24.** Range of independent variables

| Region | Drainage area (A) (square miles) | Mean annual precipitation (P) (inches) |
|---|---|---|
| 1 | 5.29 - 766 | 15 - 72 |
| 2 | 2.88 - 71.3 | 47 - 72 |

## METRIC CONVERSION FACTORS

The following factors can be used to convert inch-pound units in this report to the International System of Units (SI).

| Multiple inch-pound unit | By | To obtain SI unit |
|---|---|---|
| $ft^3/s$ (cubic foot per second) | 0.02832 | cubic meter per second |
| ft (foot) | 0.3048 | meter |
| in. (inch) | 25.40 | millimeter |
| mi (mile) | 1.609 | kilometer |
| $mi^2$ (square mile) | 2.590 | square kilometer |

*National Geodetic Vertical Datum of 1929 (NGVD of 1929):* A geodetic datum derived from a general adjustment of the first-order levels nets of both the United States and Canada, formerly called mean sea level. NGVD of 1959 is referred to as sea level in this report.