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Flood-Frequency Characteristics of Wisconsin Streams

Water-Resources Investigations Report 03-4250

U.S. Department of the Interior
U.S. Geological Survey

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By J.F. Walker and W.R. Krug

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Cover and envelope photo: Wisconsin River at flood stage, Nekoosa, Wisconsin (date unknown); source: Bonnie Young postcard collection, McMillan Memorial Library, Wisconsin Rapids, Wisconsin.

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Flood-Frequency Characteristics of Wisconsin Streams

By J.F. Walker and W.R. Krug

Abstract

Flood-frequency characteristics for 312 gaged sites on Wisconsin streams are presented for recurrence intervals of 2 to 100 years using flood-peak data collected through water year 2000. Equations of the relations between flood-frequency and drainage-basin characteristics were developed by multiple-regression analyses. Flood-frequency characteristics for ungaged sites on unregulated, rural streams can be estimated by use of these equations. The state was divided into five areas with similar physiographic characteristics. The most significant basin characteristics are drainage area, main-channel slope, soil permeability, storage, rainfall intensity, and forest cover. The standard error of prediction for the equation for the 100-year flood discharge ranges from 22 to 44 percent in the state. A graphical method for estimating flood-frequency characteristics of regulated streams was developed from the relation of discharge and drainage area. Graphs for the major regulated streams are presented.

Introduction

Flood-frequency information is needed for the design of bridges, culverts, highways, flood-protection structures, and for effective flood-plain management. This study was done in cooperation with the Wisconsin Department of Transportation. This report is the fifth within a long-term study of flood-frequency characteristics of Wisconsin streams. Collectively these studies make up what is referred to as the flood-frequency project.

Previous Work

The first report in the series (Ericson, 1961) developed two sets of regression equations (with and without channel slope as a parameter) for several geographic areas in the state. The second report in the series (Conger, 1971) updated the original report by including additional flood-peak data, refining the geographic areas, and including snowfall as an independent variable. The next version of the report (Conger, 1981) included updated flood-peak data, refined the geographic areas, and added rainfall intensity as an independent variable. The fourth incarnation of the report (Krug and others, 1992) included updated flood-peak data, provided further refinement of the geographic areas, and included an evaluation of alternative land-use data and various regionalization techniques. Other reports that include methods for estimating flood-frequency characteristics of Wisconsin streams were done by Wiitala (1965) and Patterson and Gamble (1968). This report uses the same geographic areas as in the previous report (Krug and others, 1992), includes additional flood-peak data, and updates the values for snowfall and rainfall intensity. Additional data used in this report increase the confidence in estimating techniques and supersede those published in previous reports.

Purpose and Scope

This report includes a description of flood-frequency characteristics of Wisconsin streams where annual peak streamflow data have been collected, presents equations for estimating flood-frequency characteristics at ungaged sites, and includes a discussion of the development of the equations. Additional flood-peak data were collected at the crest-gage stations at most of the same sites as previous studies, with the data-collection period ending in 2000. These stations help provide a uniform distribution of sites throughout the state and a long-term record of flood-peak data.

Because operation of continuous-record streamflow-gaging stations is not part of the flood-frequency project, the locations and lengths of record at these sites are controlled by other needs. Therefore, the distribution and lengths of record are not as uniform as at crest-gage sites. Continuous-record flood-peak data in this study were collected at 175 streamflow-gaging stations whereas the data used by Conger (1981) were collected at 78 stations.

Acknowledgments

Mari Dantz and Bernard Lenz of the Wisconsin District Office of the U.S. Geological Survey (USGS) were instrumental in updating rainfall and snowfall data and performing some of the preliminary regression analyses.

Flood-Peak Data-Collection Network

Flood-peak data used in this study were collected at 137 crest-gage stations and 175 continuous-record streamflow-gaging stations located throughout the state (plate 1). Only the peak stage of a flood is recorded at a crest-stage station. The recorded maximum stage for each year is converted to discharge by a stage-discharge relation for each station. At continuous-record streamflow-gaging stations, a continuous record of stream stage is recorded. The maximum stage for the year is selected and is converted to discharge by a stage-discharge relation. Stations with at least 10 years of record located on rural streams were included. On the basis of these criteria, 312 stations were included in the report. Flood-peak data are available for 104 crest-gage stations and for 108 streamflow-gaging stations now operated (2000) and from 33 crest-gage stations and 67 streamflow-gaging stations that have been discontinued. Of the continuous-record stations, 32 are on streams that are regulated. Sites were classified as regulated based on knowledge of the flow system and hydrologic judgement. The 104 crest-gage stations are operated as part of the flood-frequency project. Most of the crest gages have been operated since the late 1950's or early 1960's. Several stations started to operate around 1970 in northeastern Wisconsin when the first analysis of the data showed the need for more data in this area. Data through the 2000 water year were used for the analysis in this report. Therefore, at least 28 years of flood-peak data were used for most stations; however, about 18 years of flood-peak data were used for some stations in the northeastern part of the state.

Annual peak stages and discharges for all crest-gage stations and streamflow-gaging stations used in the study are available by request from the Wisconsin District Office of USGS or from the world-wide-web on the internet via the following URL: http://waterdata.usgs.gov/wi/nwis/peak.

Flood-Frequency Analysis

Flood-frequency analyses define the relation of flood-peak magnitude to probability of exceedance or recurrence interval. Probability of exceedance is the percentage chance that a given flood magnitude will be exceeded in any year. Recurrence interval is the reciprocal of percent probability of exceedance divided by 100 and is the average number of years between exceedances. For example, a flood having a probability of exceedance of 1 percent has a recurrence interval of 100 years. Recurrence intervals imply no regularity of exceedance; a 100-year flood might be exceeded in consecutive years or it might not be exceeded in a 100-year period.

Flood-frequency analyses were performed at all rural streamflow-gaging stations with a period of record equal to or exceeding 10 years. Guidelines in Interagency Advisory Committee on Water Data (1982)(commonly referred to as Bulletin 17B) were used to fit logarithms of annual peak discharges to the Pearson Type III distribution. For stations on unregulated streams, the generalized skew from the map in Bulletin 17B was weighted with the station skew to give a weighted skew. Estimates of discharges at several recurrence intervals in the range from 2 to 100 years for each station were computed and are given in Appendix table A-1.

Sites on the main stem of the Wisconsin River received additional analyses. Krug and House (1980) modeled the system of reservoirs and their operation to simulate the flood peaks on the Wisconsin River for water years 1915 through 1976. The flood frequencies given for the Wisconsin River in this study (Appendix table A-2) include the simulated peaks (Krug and House, 1980, Appendix B) and the observed peaks for water years 1977 through 2000. These flood frequencies are considered the most up-to-date estimates of the flood potential of the existing system of reservoirs and their operating policies.

Regression Analysis and Flood-Frequency Equations

Multiple-regression analysis was used to estimate the relation between flood discharges for given frequencies and drainage-basin characteristics for 200 selected streamflow-gaging stations in Wisconsin. The sites selected, which were the same as those used by Krug and others (1992), were rural, unregulated sites with at least 10 years of record and known basin characteristics. The multiple regression technique is a means of transferring flood-peak characteristics from sites where observed data are available to ungaged locations. The relation is presented by flood-frequency equations.

The regression equations are used to relate the most significant drainage-basin characteristics (independent variables) to flood-peak characteristics (dependent variables; Q_2, Q_5…, Q_{100}). The multiple-regression model can be expressed in the following form:

$$Q_T = \alpha A^a B^b C^c \ldots M^m \quad (1)$$

where

- Q_T is flood magnitude, in cubic feet per second, having a T-year recurrence interval;
- α is regression constant defined by regression analysis;
- $A, B, C, \ldots M$ are basin characteristics; and
- $a, b, c, \ldots m$ are regression coefficients defined by regression analysis.

This form of the multiple-regression model is achieved by linear regression of the logarithms of the variables.

The principal method of regression analysis used in the study is called generalized least squares (GLS) and was developed by Tasker and others (1986) and Stedinger and Tasker (1985). This method was used because of its theoretical advantages over the ordinary least squares (OLS) method and the conventional weighted least squares (WLS) method.

In the OLS method, all the estimates of T-year floods are implicitly assumed to have equal variance; that is, the T-year flood estimate at each streamflow-gaging station is assumed to be as accurate as the T-year flood estimates at all other stations used in the regression, regardless of record length and site variability. Furthermore, in the OLS method, the concurrent flood peaks at different sites are assumed to be uncorrelated or independently distributed. In general, these two conditions are not met by flood-peak records. The accuracy of the T-year flood estimates varies with the length of record and variability of the annual peak discharges at each site. Many concurrent annual floods in an area are cross-correlated because the stations in the area are subject to similar weather systems.

In the GLS method, the variable accuracy of the T-year flood estimates and the cross-correlation between stations are considered. With this method, information is provided for analyzing the network of streamflow-gaging stations and crest gages. This network analysis capability may prove to be useful in future studies.

Drainage-Basin Characteristics

The drainage-basin characteristics determined by the multiple-regression analyses to be significant were drainage area, main-channel slope, storage, forest cover, 25-year precipitation index, mean annual snowfall, and soil permeability. The characteristics used in the regression equations are listed in Appendix table A-2 at the back of this report for each station. They are defined as follows:

1. Drainage area (*A*), in square miles, is the area contributing directly to surface runoff. This area can be planimetered from topographic maps or can be taken directly for some sites from the report on drainage ares in Wisconsin by Henrich and Daniel (1983). If the drainage area is taken from the report by Henrich and Daniel, any area not contributing directly to surface runoff should be subtracted from the total drainage area.
2. Main-channel slope (*S*), in feet per mile, is the slope of the stream between points that are 10 percent and 85 percent of the distance along the channel from the streamflow-gaging station to the basin divide, determined from topographic maps.
3. Storage (*ST*), expressed as a percentage of the drainage area, includes lakes, ponds, and wetlands determined from USGS maps and Soil Conservation Service data. A constant of 1 percent is added to storage to obtain *ST* (to avoid zero values in the regression equations).
4. Forest cover (*FOR*) is expressed as a percentage of the drainage area shown on USGS maps, determined by the grid method, or is data from the Soil Conservation Service. A constant of 1 percent is added to forest cover to obtain *FOR* (to avoid zero values in the regression equations).
5. The 25-year precipitation index (I_{25}) is computed by subtracting 4.2 from the 25-year, 24-hour rainfall, expressed in inches (Huff and Angel, 1992). The maximum 25-year, 24-hour rainfall has a recurrence interval of 25 years. Precipitation indices were computed for recurrence intervals of 2-, 10-, 25-, 50- and 100-years. The 25-year recurrence interval subsequently proved to be the best precipitation index for predicting the selected recurrence-interval flood discharges. The 25-year, 24-hour rainfall amounts for

the 9 climatic sections in Wisconsin (Huff and Angel, 1992) are shown in figure 1. Values of I_{25} were determined at each streamflow-gaging station.

6. Mean annual snowfall (*SN*) for 1961 through 1990, in inches, is determined from climate data processed by the Spatial Climate Analysis Service at Oregon State University (Daly and others, 2000) and is shown in figure 2. *SN* is interpolated from the contours for the location of the streamflow-gaging station.
7. Soil permeability (*SP*), in inches per hour, is based on the least-permeable soil horizon in the soil column. The median rate is used for each range of soil permeability. Ranges of soil permeability were obtained from a soils table published by the U.S. Department of Agriculture, Soil Conservation Service (1964) and overlaid on a soils map of Wisconsin (Hole and others, 1968). The weighted-average soil permeability (*SP*) is shown on plate 2. A grid is printed on the back of plate 2 to facilitate estimating the percent of the basin in each soil-permeability range.

Flood-Frequency Areas in Wisconsin

The state was divided into five flood-frequency areas by Conger (1981). Several boundaries between areas were adjusted in north-central Wisconsin on the basis of physical characteristics (Krug and others, 1992) and residuals from the regression equations when applied to particular sites (fig. 3 and pl. 1).

The five-area arrangement of the state is useful in reducing the errors in the regression equations. Different basin characteristics are significant in estimating the flood frequency in the various areas. For example, soil permeability is not a significant variable in flood-frequency equations for the southern part of the state (areas 1 and 5), but it is significant in the central and northern parts of the state (areas 2, 3 and 4). Note that the driftless area is contained almost entirely in area 1 (plate 1 and fig. 3).

Flood-Frequency Equations and Accuracy Evaluation

For this study, a combination of OLS and GLS regressions was used to determine the best-fit regression equations for each flood-frequency area (fig. 3). A stepwise OLS procedure was used as a screening tool to determine the suite of variables that best predicted the T-year flood for each area. The stepwise procedure selects a subset of variables from a group of candidate basin characteristics (as described in the previous section) beginning with the variable that explains the most variability in the dependent variable, and continues with each successive variable that explains the most remaining variability given the effects of the variables already chosen. A variable was selected when its coefficient was determined to be significantly different from zero at the 5-percent level (significance level less than 0.05).

To facilitate comparison of various regressions, the standard error of estimate was used (a measure of the error in the use of regression equations to predict T-year floods at sites used in the regression analysis). Because the regression equations were computed using a logarithmic transformation of the dependent and independent variables, the standard error in log space was used to determine confidence intervals for predictions of the logarithm of a particular T-year discharge. The true value of the log of the T-year flood will be within plus or minus one standard error of the regression estimate at about two-thirds of the sites. Because of the nonlinear nature of the logarithmic transformation, the resulting confidence intervals transformed to actual discharges are not symmetrical. For comparison purposes, an "equivalent" standard error as a percent of predicted discharge was computed as follows:

$$ESE = \frac{10^{SE} - 10^{-SE}}{2} \quad (2)$$

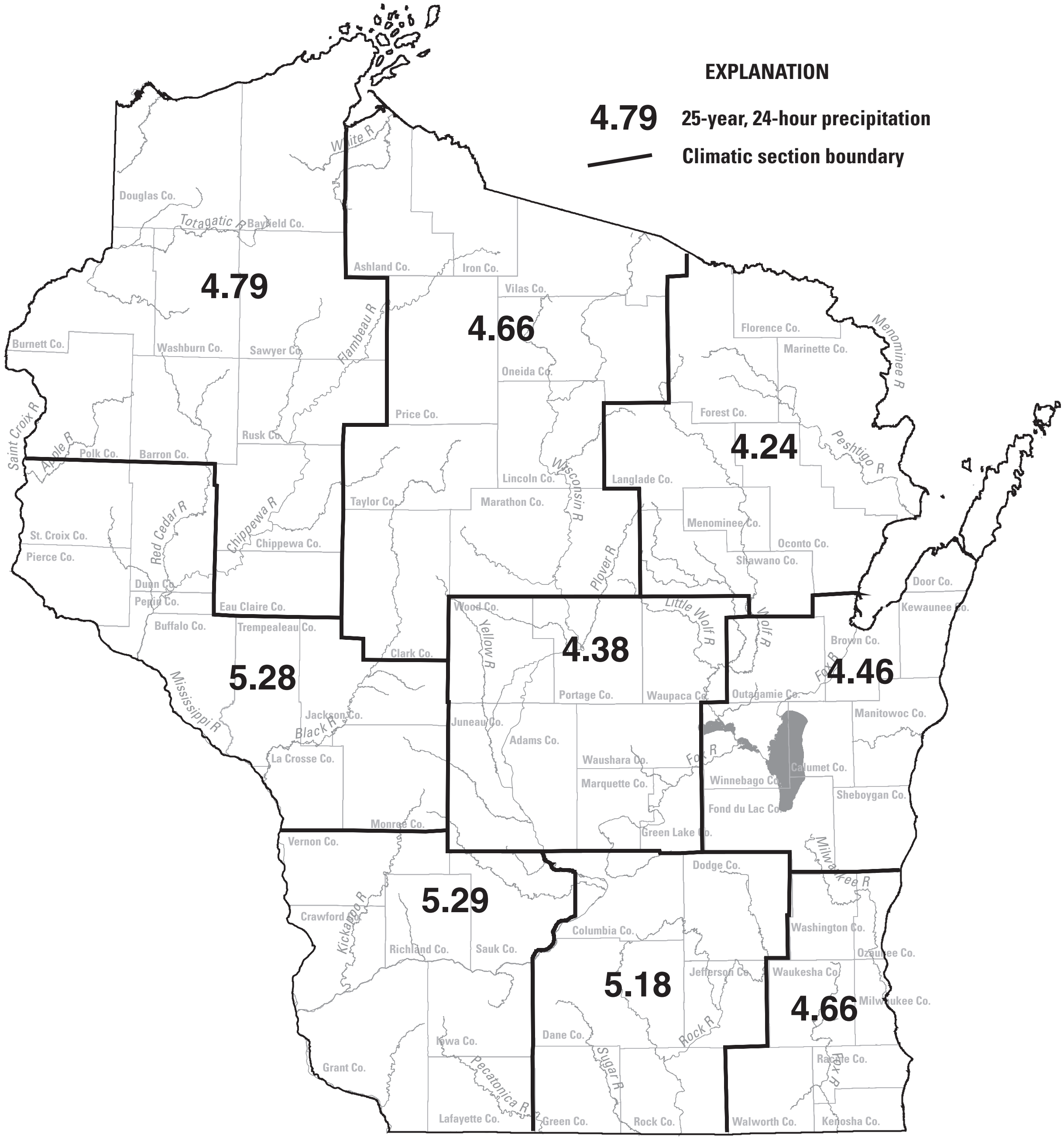
where

ESE is the equivalent standard error in percent of predicted discharge, and

SE is the standard error of the logarithm of discharge.

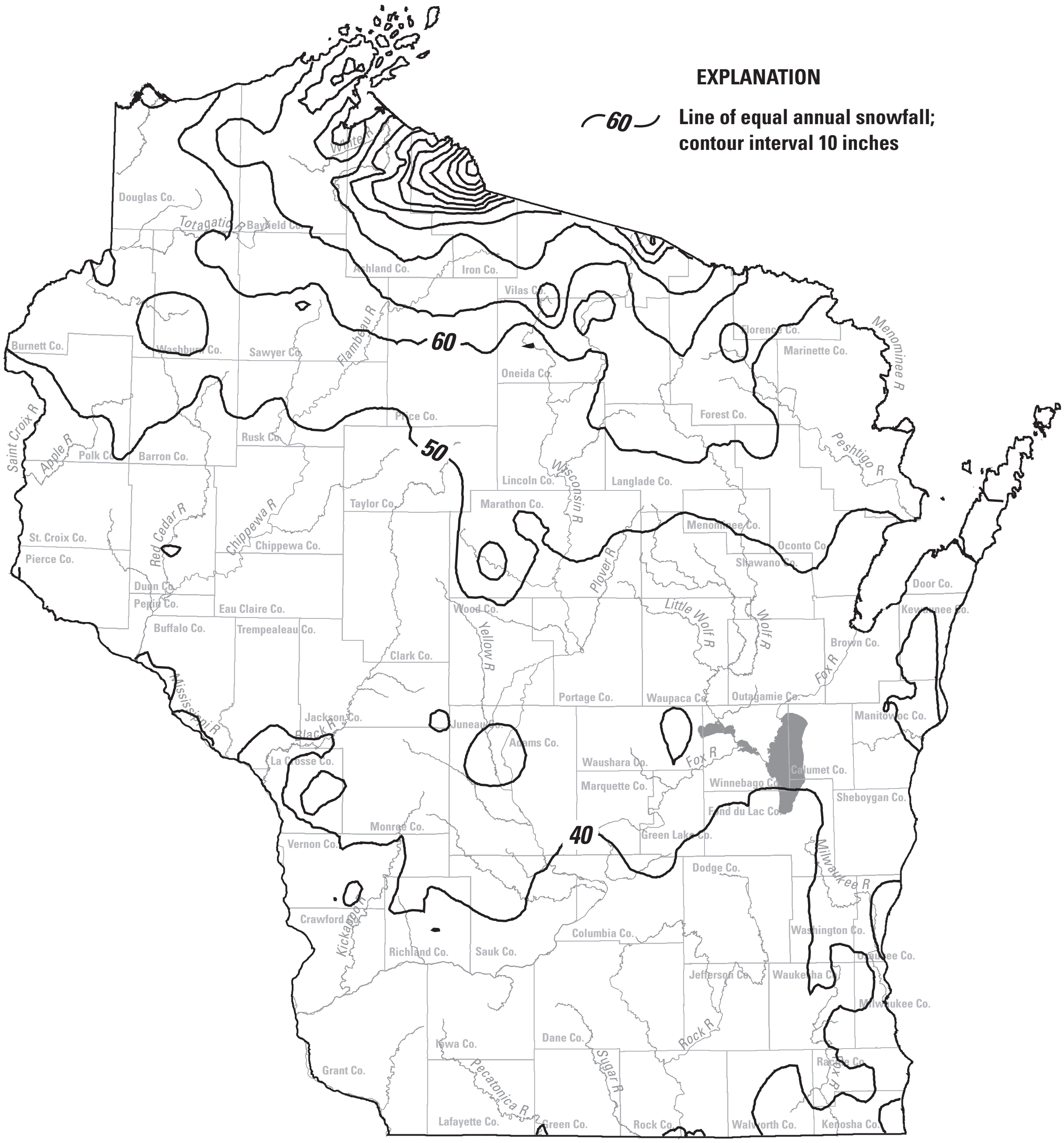
Note that the ESE essentially results in a confidence interval that has the same width as the true confidence interval for two-thirds of the predicted values; however, the upper and lower bounds computed with the ESE will not be correct because of the asymmetry of the confidence intervals.

For most areas, the stepwise procedure results in a slightly different set of independent variables for each of the T-year floods (2-, 5-, 10-, 25-, 50- and 100-year). To maintain consistency, a common set of variables was chosen to predict each of the T-year floods in a particular area; in general, the set of variables explaining the most variability of the higher recurrence interval floods (50- and 100-year) was chosen. This set of variables was then used to estimate the regressions using the GLS procedure. Selecting a set of variables that deviates from the stepwise results will produce a somewhat diminished accuracy of prediction for the regression. To illustrate the differences



Base from Wisconsin Department of Natural Resources
1:100,000 digital data, 1998.
Wisconsin Transverse Mercator Projection

Figure 1. 25-year, 24-hour rainfall in Wisconsin by climatic section (rainfall data from Huff and Angel, 1992).



Base from Wisconsin Department of Natural Resources
1:100,000 digital data, 1998.
Wisconsin Transverse Mercator Projection

Figure 2. Mean annual snowfall from 1961 through 1990, in inches, in Wisconsin (snowfall data from Daly and others, 2000). This map contains data from the Climate Source, and is used herein by permission.

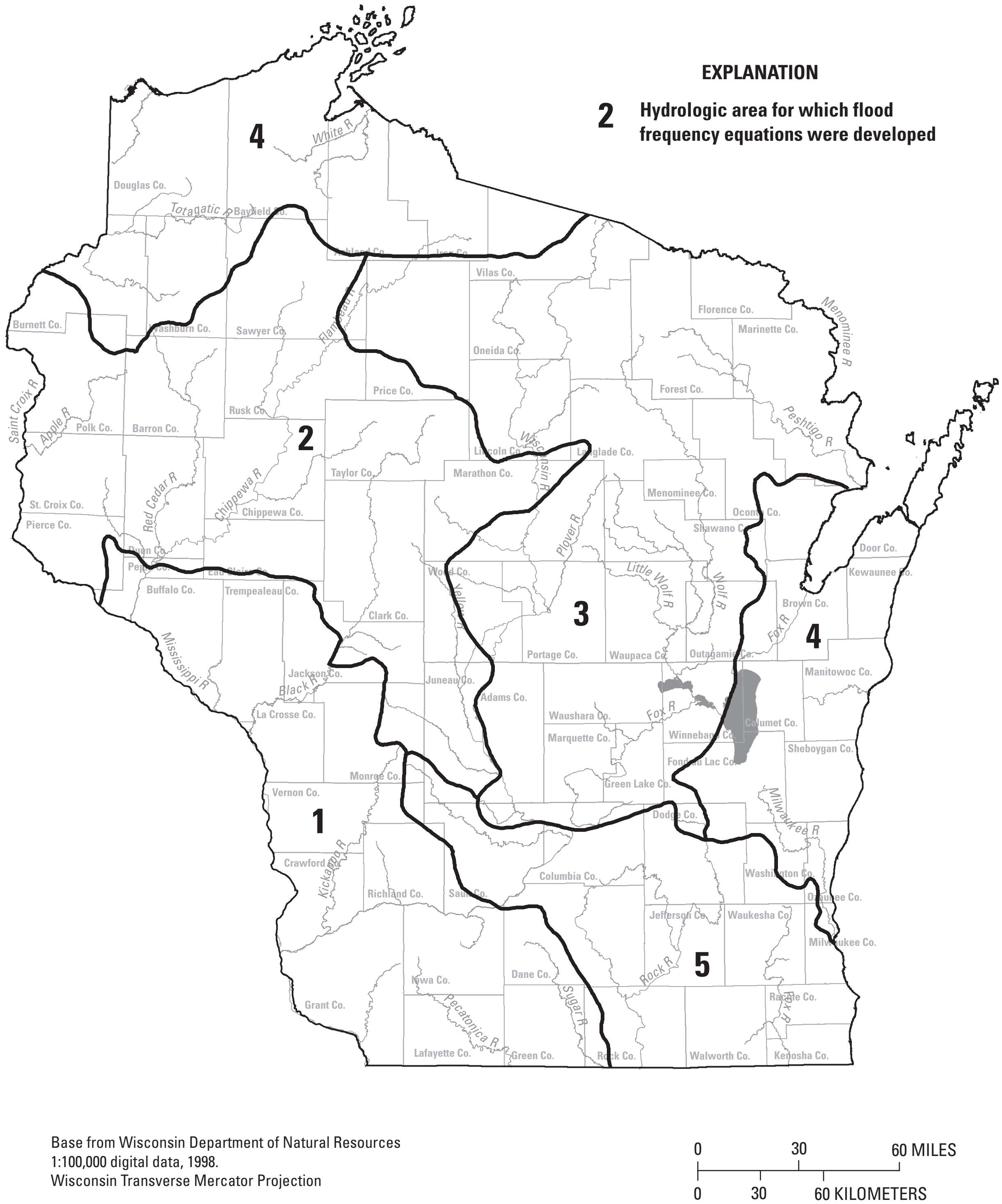


Figure 3. Flood-frequency areas in Wisconsin.

in model accuracy, the estimated standard errors in log space (approximated by the model error) and an equivalent standard error of estimate in percent were determined for three separate regressions: (1) the best set of variables using OLS stepwise estimation, (2) a common set of variables using OLS regression; and (3) a common set of variables using GLS regression (table 1). For the most part, the increase in standard error for the common set of variables is relatively small, and in some cases is compensated for by the improvements afforded by the GLS procedure.

The flood-frequency equations developed for streams in Wisconsin, along with the standard error of estimate in log space and equivalent standard error of estimate in percent are presented in table 2. The equivalent standard error of estimate is shown for comparison with similar data published in previous reports (Conger, 1971 and 1981; Krug and others, 1992); however, it is computed differently in this study and the comparison is not exact. The standard error of estimate for the regression equations for the 100-year flood in the Conger (1971) report ranged from 37 to 41 percent. The comparable range of standard error of prediction was 35 to 40 percent in the Conger (1981) report. The range of standard error of prediction for the 100-year flood was 22 to 33 percent in the Krug and others (1992) report. The range of standard error of prediction for the 100-year flood in table 3 is 22 to 44 percent.

The biggest discrepancy between the equivalent standard errors in the previous report and this report occur for the most part in areas 1 and 5 (fig. 3), which constitute a large portion of the driftless area. Recent evidence indicates that floods in the driftless area of the state have been decreasing over time (Gebert and Krug, 1996). The issue of stationarity in the record is beyond the scope of this study; however, it is a likely topic to be considered in the next revision of the regression equations.

The regression equations are valid for streams without significant regulation. For the purposed of this report, a dam on a stream or river does not constitute regulation unless the dam is used to control the flow during a flood.

The regression equations and the associated accuracy are considered valid only within the area for which they were developed and only for basin-characteristic values that are within the range used to calculate the regression equations. Flood estimates can be made using basin characteristics outside the range of values from which the equations were derived, but it is not possible to estimate the error in those values. The ranges of the basin characteristics of the streamflow-gaging stations used in the regression analysis are summarized in table 3.

Application of Estimation Techniques

The estimation techniques in this report can be applied to four types of rural sites. The first case is where the site is at a streamflow-gaging station; for this case, a weighted estimate is calculated based on the gaging record and the appropriate regression equation. The second case is where the site is near a streamflow-gaging station; for this case, the discharge from the appropriate regression equation is adjusted using information from the station. The third case is where there is no streamflow-gaging station on the stream; for this case, the appropriate regression equation is applied directly. The fourth case is where the site is on a regulated stream; for this case, the discharge is estimated based on drainage area and the appropriate relation for the particular regulated stream (figs. 4-7). A detailed description for applying each technique is given in the examples that follow. To estimate flood frequencies for urban streams, the reader is referred to Conger (1986).

Sites at Streamflow-Gaging Stations

Flood-frequency characteristics of sites at streamflow-gaging stations can be estimated from the station streamflow record and by the regression equations. The two methods can be considered independent when a large number of sites were used to develop the regression equations. This is because the influence of a given station on determining the regression equations is roughly inversely proportional to the number of stations used to determine the equations. When independent flood-frequency estimates are available, the Interagency Committee Advisory Committee on Water Data (1982, Appendix 8) recommends that the weighted average of the estimates be used as the best estimate of the flow frequency. If the estimates are weighted in inverse proportion to their variances, the variance of the weighted average will be less than the variance of either of the independent estimates. Flood-frequency characteristics estimated from flood-peak data are listed in Appendix table A-1.

Table 1. Comparison of regression results for ordinary least squares (OLS) and generalized least squares (GLS)

[SE, standard error of estimate in log units; ESE, equivalent standard error of estimate in percent; Best, results using stepwise OLS regression; Common, results using OLS and a common set of independent variables; Q_n, the *n*-year recurrence interval flood. Flood frequency areas are shown in figure 3.]

Flood discharge	OLS SE		GLS SE	OLS ESE		GLS ESE
	Best	Common	Common	Best	Common	Common
Area 1						
Q_2	0.1867	0.1867	0.1803	44	44	43
Q_5	.1692	.1787	.1709	40	42	40
Q_{10}	.1591	.1746	.1631	37	41	38
Q_{25}	.1852	.1852	.1691	44	44	40
Q_{50}	.1690	.1963	.1764	40	47	42
Q_{100}	.1777	.2090	.1855	42	50	44
Area 2						
Q_2	.1123	.1182	.1091	26	28	25
Q_5	.1117	.1207	.1086	26	28	25
Q_{10}	.1157	.1253	.1086	27	29	25
Q_{25}	.1233	.1327	.1100	29	31	26
Q_{50}	.1300	.1387	.1118	30	32	26
Q_{100}	.1380	.1458	.1153	32	34	27
Area 3						
Q_2	.1569	.1626	.1591	37	38	37
Q_5	.1489	.1518	.1470	35	36	34
Q_{10}	.1495	.1515	.1449	35	36	34
Q_{25}	.1522	.1525	.1439	36	36	34
Q_{50}	.1547	.1547	.1446	36	36	34
Q_{100}	.1580	.1581	.1466	37	37	34
Area 4						
Q_2	.1305	.1305	.1233	31	31	29
Q_5	.1177	.1238	.1131	27	29	26
Q_{10}	.1153	.1213	.1063	27	28	25
Q_{25}	.1197	.1197	.0995	28	28	23
Q_{50}	.1203	.1203	.0964	28	28	22
Q_{100}	.1226	.1226	.0954	29	29	22
Area 5						
Q_2	.1069	.1248	.1179	25	29	27
Q_5	.1113	.1214	.1127	26	28	26
Q_{10}	.1306	.1306	.1196	31	31	28
Q_{25}	.1494	.1494	.1349	35	35	32
Q_{50}	.1655	.1655	.1490	39	39	35
Q_{100}	.1821	.1821	.1637	43	43	39

Table 2. Flood-frequency equations for streams in Wisconsin

[A, contributing drainage area in square miles; S, main-channel slope in feet per mile; I_{25}, 25-year, 24-hour precipitation intensity, in inches minus 4.2; ST, storage, in percent of basin area plus 1.0; SP, soil permeability of the least-permeable soil horizon in inches per hour; SN, mean annual snowfall for 1961 through 1990 in inches; FOR, forest cover in percent of basin area plus 1; Q_n, peak flood discharge in cubic feet per second, with an *n*-year recurrence interval; SE, standard error of estimate of regression, in log units; ESE, equivalent standard error of estimate, in percent. Flood frequency areas are shown in figure 3.]

Best-fit equation	SE	ESE	Eq. no.
Area 1 (39 stations)			
$Q_2 = 99.9\,A^{0.652}\,FOR^{-0.254}\,I_{25}^{7.52}$	0.1803	43	1-1
$Q_5 = 190.0\,A^{0.634}\,FOR^{-0.260}\,I_{25}^{8.45}$	.1709	40	1-2
$Q_{10} = 35.0\,A^{0.857}\,S^{0.463}\,FOR^{-0.302}\,I_{25}^{6.92}$	.1631	38	1-3
$Q_{25} = 38.1\,A^{0.876}\,S^{0.518}\,FOR^{-0.308}\,I_{25}^{7.16}$	.1691	40	1-4
$Q_{50} = 41.4\,A^{0.884}\,S^{0.545}\,FOR^{-0.310}\,I_{25}^{7.36}$	.1764	42	1-5
$Q_{100} = 44.2\,A^{0.893}\,S^{0.571}\,FOR^{-0.312}\,I_{25}^{7.56}$	.1855	44	1-6
Area 2 (36 stations)			
$Q_2 = 13.0\,A^{0.884}\,SP^{-0.630}\,S^{0.382}$	.1091	25	2-1
$Q_5 = 15.4\,A^{0.900}\,SP^{-0.682}\,S^{0.486}$	.1086	25	2-2
$Q_{10} = 16.3\,A^{0.910}\,SP^{-0.710}\,S^{0.541}$	.1086	25	2-3
$Q_{25} = 17.3\,A^{0.922}\,SP^{-0.740}\,S^{0.600}$	.1100	26	2-4
$Q_{50} = 17.9\,A^{0.929}\,SP^{-0.758}\,S^{0.636}$	.1118	26	2-5
$Q_{100} = 18.3\,A^{0.936}\,SP^{-0.775}\,S^{0.669}$	.1153	27	2-6
Area 3 (57 stations)			
$Q_2 = 36.5\,A^{0.832}\,SP^{-0.614}\,ST^{-0.143}\,I_{25}^{0.124}$	.1591	37	3-1
$Q_5 = 61.6\,A^{0.827}\,SP^{-0.683}\,ST^{-0.169}\,I_{25}^{0.133}$	.1470	34	3-2
$Q_{10} = 80.6\,A^{0.825}\,SP^{-0.713}\,ST^{-0.186}\,I_{25}^{0.135}$	.1449	34	3-3
$Q_{25} = 107.0\,A^{0.821}\,SP^{-0.743}\,ST^{-0.204}\,I_{25}^{0.136}$	.1439	34	3-4
$Q_{50} = 127.0\,A^{0.819}\,SP^{-0.761}\,ST^{-0.215}\,I_{25}^{0.136}$	.1446	34	3-5
$Q_{100} = 149.0\,A^{0.818}\,SP^{-0.775}\,ST^{-0.227}\,I_{25}^{0.136}$	.1466	34	3-6
Area 4 (40 stations)			
$Q_2 = 2.69\,A^{0.864}\,ST^{-0.296}\,S^{0.279}\,SP^{-0.250}\,SN^{0.490}$	.1233	29	4-1
$Q_5 = 6.76\,A^{0.858}\,ST^{-0.286}\,S^{0.303}\,SP^{-0.259}\,SN^{0.370}$	.1131	26	4-2
$Q_{10} = 9.74\,A^{0.856}\,ST^{-0.286}\,S^{0.321}\,SP^{-0.255}\,SN^{0.332}$	.1063	25	4-3
$Q_{25} = 13.7\,A^{0.856}\,ST^{-0.290}\,S^{0.342}\,SP^{-0.246}\,SN^{0.299}$	.0995	23	4-4
$Q_{50} = 16.6\,A^{0.857}\,ST^{-0.293}\,S^{0.357}\,SP^{-0.238}\,SN^{0.281}$	.0964	22	4-5
$Q_{100} = 19.4\,A^{0.857}\,ST^{-0.296}\,S^{0.371}\,SP^{-0.229}\,SN^{0.269}$	.0954	22	4-6
Area 5 (28 stations)			
$Q_2 = 9.58\,A^{0.981}\,ST^{-0.293}\,S^{0.416}$	.1179	27	5-1
$Q_5 = 15.1\,A^{0.912}\,ST^{-0.358}\,S^{0.438}$	.1127	26	5-2
$Q_{10} = 18.9\,A^{0.913}\,ST^{-0.385}\,S^{0.447}$	.1196	28	5-3
$Q_{25} = 23.6\,A^{0.915}\,ST^{-0.408}\,S^{0.457}$	.1349	32	5-4
$Q_{50} = 27.0\,A^{0.916}\,ST^{-0.420}\,S^{0.463}$	.1490	35	5-5
$Q_{100} = 30.6\,A^{0.916}\,ST^{-0.430}\,S^{0.467}$	.1637	39	5-6

Example 1: Determine the 100-year flood discharge for the Jump River at Sheldon (station number 05362000).

1. Locate the data in Appendix table A-1 by station number (05362000).
2. The 100-year flood discharge for Jump River is Q_{100} = 25,000 ft^3/s.

The flood- frequency estimates presented in this report were based on the common logarithms of discharge. Therefore the weighting should be done with the logarithms of the flood-frequency estimates, and the best estimate is the antilogarithm of the weighted average. The flood-frequency estimates in Appendix tables A-1 and A-2 are essentially independent and, therefore, could be combined by this procedure to get an improved estimate at each site.

The appropriate equation (Interagency Committee Advisory Committee on Water Data, 1982) is

$$z = \frac{xV_y + yV_x}{V_x + V_y} \tag{3}$$

where

- x and y are two independent estimates of a flood-frequency characteristic,
- V_x and V_y are their respective variances, and
- z is the weighted estimate of the flood-frequency characteristic.

In the example of the Jump River at Sheldon,

x = log (25,000) = 4.398 from table A-1
V_x = $(0.0435)^2$ = 0.00189 from table A-1
y = log(41,100) = 4.614 from table A-2
V_y = $(0.1153)^2$ = 0.0133 from table 2, eq. 2-6.

$$\log(Q_{100}) = \frac{(4.398)(0.0133) + (4.614)(0.00189)}{0.0133 + 0.00189} \tag{4}$$

$$\log(Q_{100}) = \frac{0.0585 + 0.00872}{0.0152} = 4.422 \tag{5}$$

$$Q_{100} = 26{,}400 \text{ ft}^3/\text{s} \tag{6}$$

Table 3. Ranges of basin characteristics used in regression analysis

[mi^2, square miles; ft/mi, feet per mile; in., inches; in/hr, inches per hour. Flood-frequency areas are shown in figure 3.]

Basin characteristic	Minimum	Median	Maximum
Area 1 (39 stations)			
Drainage area (mi^2)	0.28	25.0	2,120
Main-channel slope (ft/mi)	2.27	27.3	270
Forested area (percent)	.00	26.6	56.9
25-year, 24-hour precipitation (in.)	5.18	5.28	5.29
Area 2 (36 stations)			
Drainage area (mi^2)	.56	27.4	1,760
Soil permeability (in/hr)	.20	.91	2.88
Main-channel slope (ft/mi)	3.65	15.56	96
Area 3 (57 stations)			
Drainage area (mi^2)	1.00	22	2,240
Soil permeability (in/hr)	.12	1.81	8.46
Storage (percent)	.00	15.5	39.7
25-year, 24-hour precipitation (in.)	4.24	4.38	5.29
Area 4 (40 stations)			
Drainage area (mi^2)	.66	35.0	696
Storage (percent)	.00	9.40	52.4
Main-channel slope (ft/mi)	1.08	11.6	204
Soil permeability (in/hr)	.12	.82	4.68
Mean annual snowfall (in.)	34.4	48.3	172
Area 5 (28 stations)			
Drainage area (mi^2)	1.32	18.9	3,340
Storage (percent)	.00	1.65	15.4
Main-channel slope (ft/mi)	.74	12.85	74.2

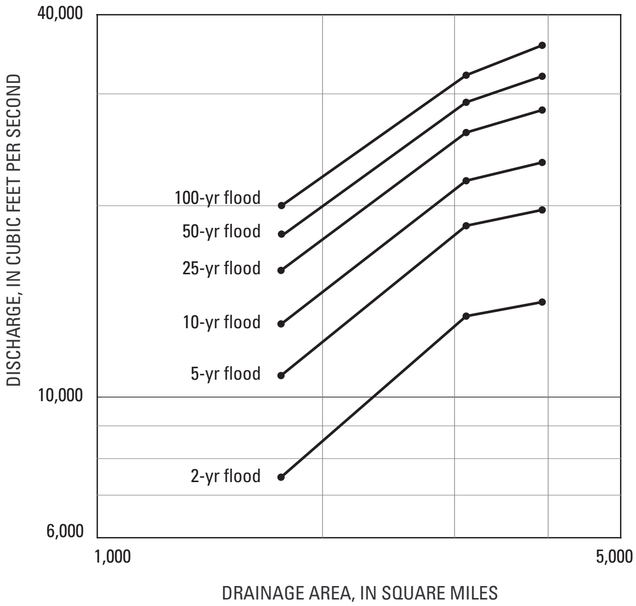


Figure 4. Relation of discharge to drainage area for selected flood frequencies along the main stem of the Menominee River, Wisconsin and Michigan.

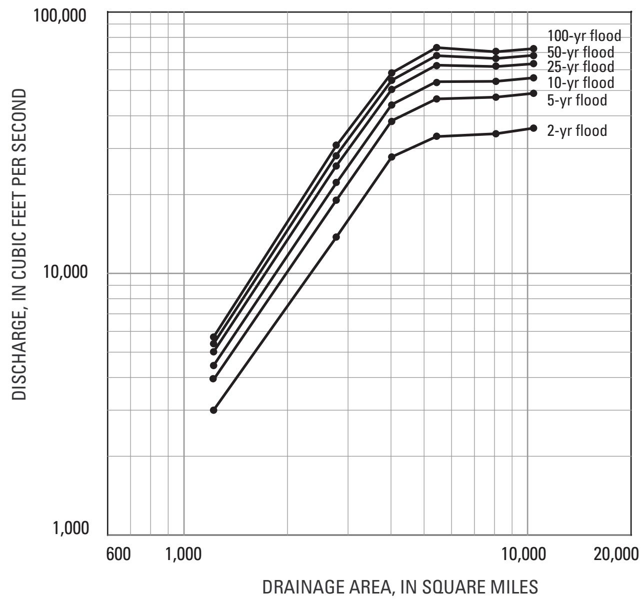


Figure 5. Relation of discharge to drainage area for selected flood frequencies along the main stem of the Wisconsin River, Wisconsin.

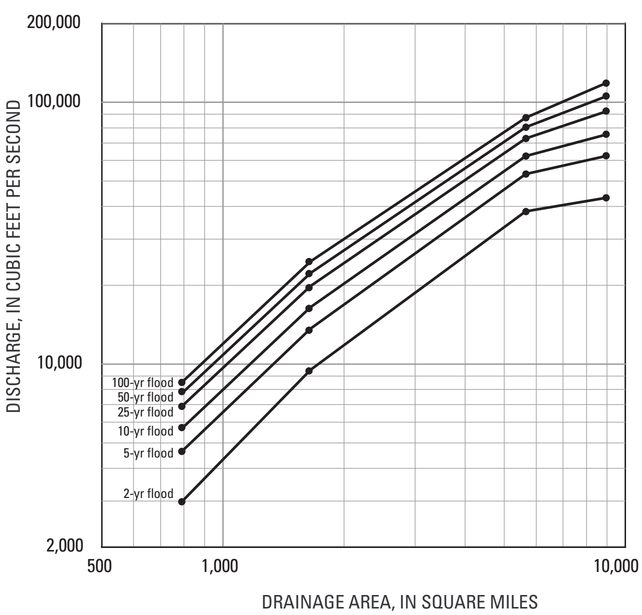


Figure 6. Relation of discharge to drainage area for selected flood frequencies along the main stem of the Chippewa River, Wisconsin.

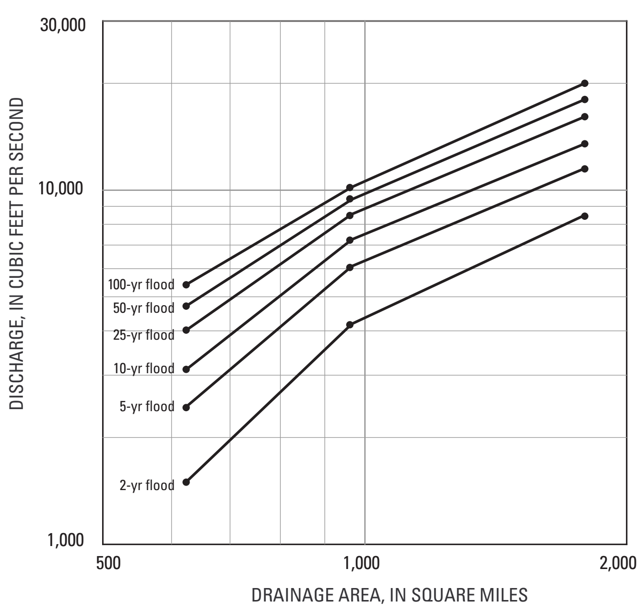


Figure 7. Relation of discharge to drainage area for selected flood frequencies along the main stem of the Flambeau River, Wisconsin.

Sites on Streams near Streamflow-Gaging Stations

Flood-frequency characteristics at sites near a streamflow-gaging station on the same stream are determined using a combination of the station's flood frequency characteristics and the characteristics determined by the regression equations. The procedure is applicable for sites that have a drainage area between 50 and 150 percent of the drainage area of the station. The suitability of the flood-frequency characteristics should be determined by comparing them with flood-frequency characteristics at the station. The following procedure was used by Curtis (1987) for streams in Illinois based on work by Sauer (1974). The procedure is as follows:

First, the ratio r' is defined by

$$r' = \frac{Q_g}{\hat{Q}_g} - \left(\frac{|A_g - A_u|}{0.5A_g}\right)\left(\frac{Q_g}{\hat{Q}_g} - 1\right) \quad (7)$$

where

- r' is the adjustment ratio,
- Q_g is a flood-frequency characteristic determined at the station,
- $\hat{Q}_g$ is a flood-frequency characteristic determined for the station by the appropriate multiple-regression equation (table 2),
- A_g is drainage area of the gaged site, and
- A_u is drainage area of the ungaged site.

The adjusted flood-frequency characteristic for the ungaged site (Q_u) is computed by the equation

$$Q_u = r'\hat{Q}_u \quad (8)$$

where

- $\hat{Q}_u$ is a flood-frequency characteristic determined for the ungaged site by the appropriate multiple-regression equation.

If the difference in drainage area between the ungaged site and the gaged site is more than 50 percent, equations 7 and 8 should not be used. In this case, the appropriate multiple-regression equation from table 2 should be used without adjustment but should be compared to the flood-frequency characteristic of the station on the stream for suitability. If the drainage area crosses the boundary of two flood-frequency areas, compute the flood frequency using equations from both areas. Compute the final flood-frequency estimates as the weighted average of the two estimates weighted by the proportion of drainage area in each of the flood-frequency areas.

Example 2: Determine the 100-year flood of Black Earth Creek at U.S. Highway 14, which is 2 miles downstream from the station Black Earth Creek at Black Earth (05406500).

First, equation 1-6 from table 2 is used to determine the 100-year flood estimate at the gaged site:

$$Q_{100} = 44.2\,A^{0.893} S^{0.571} FOR^{-0.312} I_{25}^{7.56} \quad (1\text{-}6)$$

The drainage-basin characteristics at the gaged site are given in Appendix table A-2:

A (contributing drainage area) = 42.8 mi^2,

S (main channel slope) = 9.42 ft/mi,

FOR (forest cover in percent of basin area plus 1) = 21.8 + 1 = 22.8, and

I_{25} (25-year, 24-hour precipitation index) = 5.18 – 4.2 = 0.98 inches.

Substituting into equation 1-6,

$$\hat{Q}_u = 44.2\,(42.8)^{0.893}(9.42)^{0.571}(22.8)^{-0.312}(0.98)^{7.56} = 1{,}470 \text{ ft}^3\text{/s} \quad (9)$$

$\hat{Q}_u$ at the Black Earth Creek at U.S. Highway 14 can be determined at the ungaged site by use of the same eq. 1-6 and the procedure that was used to determine $\hat{Q}_g$ at the station, as follows:

$$Q_{100} = 44.2\,A^{0.893} S^{0.571} FOR^{-0.312} I_{25}^{7.56} \quad (1\text{-}6\text{, table 2})$$

The drainage-basin characteristics at this site were determined to be:

A = 45.0 mi^2 (2.8 mi^2 non-contributing area),

S = 8.81 ft/mi,

FOR = 21.9 + 1 = 22.9, and

I_{25} = 5.18 – 4.2 = 0.98.

Substituting into equation 1-6,

$$\hat{Q}_u = 44.2\,(45.0)^{0.893}(8.81)^{0.571}(22.9)^{-0.312}(0.98)^{7.56} = 1{,}480 \text{ ft}^3\text{/s} \quad (10)$$

From Appendix table A-2, the 100-year flood at the gaging station (Q_g) is 1,650 ft³/s. Next, Equation 7 is used to determine the adjustment factor *(r´):*

$$r' = \frac{Q_g}{\hat{Q}_g} - \left(\frac{|A_g - A_u|}{0.5A_g}\right)\left(\frac{Q_g}{\hat{Q}_g} - 1\right) \quad (7)$$

$$r' = \frac{1{,}650}{1{,}470} - \left(\frac{|42.8 - 47.8|}{0.5 \bullet 42.8}\right)\left(\frac{1{,}650}{1{,}470} - 1\right) = 1.094 \quad (11)$$

Finally, Equation 8 is used to compute the adjusted discharge at the ungaged site, thus

$$Q_u = r'\hat{Q}_u = 1.094 \bullet 1{,}480 = 1{,}620 \text{ ft}^3/\text{s} \quad (12)$$

If the drainage area crosses the boundary of two flood-frequency areas, compute the flood frequency using equations from both areas. Compute the final flood-frequency estimates as the weighted average of the two estimates weighted by the proportion of drainage area in each of the flood-frequency areas.

Sites on Streams Without Streamflow-Gaging Stations

Flood-frequency characteristics at sites on ungaged streams are calculated using equations 1-1 through 5-6 from table 2.

Example 3: Determine the 100-year discharge for Tappen Coulee at Blair. This site is in area 1; therefore, use equation 1-6 from table 2:

$$Q_{100} = 44.2\, A^{0.893} S^{0.571} FOR^{-0.312} I_{25}^{7.56} \quad (1\text{-}6)$$

1. The drainage area A was determined to be 4.48 mi² from Henrich and Daniel (1983).
2. The main channel slope (S) was computed from U.S. Geological Survey topographic maps as follows:

   (a) The river or coulee length was measured from the site to the basin divide. For forked streams, the fork with the larger drainage area is followed.

   (b) The elevations at points that are 10 and 85 percent of the total stream length from the site are then determined.

   (c) Next, the difference in elevation between the sites is determined and is divided by the distance, in miles, between the points. By use of the appropriate quadrangle maps (Blair, 1968, 1:24,000; Hegg, 1969, 1:24,000), the total length of the stream for this site was determined to be 5.20 mi. The elevation at the 10-percent point is 847.6 ft and at the 85-percent point is 963.0 ft. The main channel slope is

$$S = \frac{963.0 - 847.6}{5.20} = 29.6 \text{ ft/mi} \quad (13)$$

3. The percent forest cover was determined to be 45.8 percent based on land use/land coverage in the WISCLAN database (Reese and others, 2002) and a digitized drainage-basin outline after Henrich and Daniel (1983).
4. The precipitation intensity index (I_{25}) was determined by locating the site in figure 1 and determining the 25-year, 24-hour precipitation intensity, then subtracting 4.2. The 25-year precipitation intensity for climatic section 4 is 5.28; therefore I_{25} is 1.08.
5. Substituting these values into equation 1-6:

$$Q_{100} = 44.2\,(4.48)^{0.893}(29.6)^{0.571}(46.8)^{-0.312}(1.08)^{7.56} = 629 \quad (14)$$

If the drainage area crosses the boundary of two flood-frequency areas, compute the flood frequency using equations from both areas. Compute the final flood-frequency estimates as the weighted average of the two estimates weighted by the proportion of drainage area in each of the flood-frequency areas.

Sites on Regulated Streams

Flood-frequency characteristics at ungaged sites on regulated streams are estimated using the flood-frequency characteristics at streamflow-gaging stations on the regulated streams and adjusting the characteristics according to the relation of drainage area and discharge. Graphs showing the peak discharge of floods plotted at selected recurrence intervals against drainage area are presented in figures 4-7 for the following major regulated streams in Wisconsin:

a. Menominee River between Wisconsin and Michigan (fig. 4),
b. Wisconsin River from the mouth to Rainbow Reservoir near Lake Tomahawk (fig. 5),
c. Chippewa River from the mouth to Lake Chippewa in Sawyer County (fig. 6), and

d. Flambeau River from its mouth to Flambeau Flowage northeast of Park Falls (fig. 7).

Storage reservoirs in these basins can significantly change the flood-frequency characteristics at streamflow-gaging stations. Flood-frequency analyses were performed for stations along the main stems for the period of record beginning with the completion of the last large storage reservoir in each basin for the Menominee, Chippewa, and Flambeau Rivers. These analyses represent flood-frequency characteristics in 2000. Completion dates for the last large storage reservoir for each basin follow: 1941 for the Menominee River; 1926 for the Flambeau River; and 1923 for the Chippewa River. For the Wisconsin River, flood peaks prior to 1976 were simulated using a model of the river system (Krug and House, 1980). Observed flood peaks were used after 1976.

Summary and Conclusions

Equations, tables, and graphs presented in this report provide a means for estimating flood-frequency characteristics for rural streams in Wisconsin. Flood-frequency characteristics were determined at 104 crest-stage stations, at 33 discontinued crest-stage stations, at 108 continuous streamflow-gaging stations, and at 67 discontinued streamflow-gaging stations using the log-Pearson Type III frequency distribution. The flood-frequency characteristics at 96 crest-gage stations, 29 discontinued crest-gage stations, 48 streamflow-gaging stations, and 27 discontinued streamflow-gaging stations, and their drainage-basin characteristics, were used in a multiple-regression analysis to derive equations for estimating flood-frequency characteristics. The generalized least-square procedure was used in the multiple-regression analyses. The state was divided into five areas with similar physiographic characteristics.

For the 100-year flood discharge, the standard errors of prediction in three of the five areas were relatively unchanged from those reported in Krug and others (1992). The most notable discrepancies were in areas 1 and 5 (southwestern and south-central Wisconsin) where the standard error of estimate increased from 26 and 22 percent to 44 and 39 percent, respectively, for the 100-year floods. This discrepancy may be due to nonstationarity in the discharge record coupled with the use of relatively recent snowfall and precipitation data. The standard error of estimate for the 100-year flood equation ranged statewide from 22 percent for streams in the eastern area to 44 percent for streams in the southwestern area. Drainage area, channel slope, soil permeability, storage, rainfall intensity, and forest cover are the most significant drainage-basin characteristics for estimating flood-frequency characteristics.

Graphical relations of flood-frequency characteristics and drainage area are presented for the regulated Menominee, Flambeau, Chippewa, and Wisconsin Rivers. The relations were developed by use of data at stations for periods after the last large storage reservoir was constructed in each basin. For the Wisconsin River, the source of simulated flood discharges through 1976 was a report by Krug and House (1980). Observed flood discharges were used after 1976.

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Appendixes

Table A-1. Flood discharges at selected recurrence intervals and WRC skew for streamflow-gaging stations in the Wisconsin flood-frequency network

[WRC skew, skewness as defined in Bulletin 17B (Interagency Advisory Committee on Water Data, 1981); recurrence intervals in years; discharge in cubic feet per second; SE_{100}, standard error of 100-year discharge, in log units; C, crest-stage gage; G, continuous-record gage]

Station number	Station name	WRC skew	Discharge for indicated recurrence interval							Type	Period of record
			2	5	10	25	50	100	SE_{100}		
		Unregulated Stations									
04024400	Stoney Brook near Superior, Wis.	-0.457	182	312	402	516	599	681	0.07219	C	1959–2000
04024430	Nemadji River near South Superior, Wis.	-.093	5,250	7,510	9,020	10,900	12,400	13,800	.06607	G	1974–2000
04025200	Pearson Creek near Maple, Wis.	.415	350	609	834	1,190	1,510	1,890	.10020	C	1957–2000
04025500	Bois Brule River at Brule, Wis.	.071	607	864	1,040	1,280	1,460	1,640	.04830	G	1943–2000
04026200	Sand River tributary near Red Cliff, Wis.	.384	112	198	273	391	498	624	.10347	C	1959–2000
04026300	Sioux River near Washburn, Wis.	.477	467	780	1,050	1,470	1,840	2,280	.09817	C	1959–2000
04026400	Spillerberg Creek near Cayuga, Wis.	-.002	77	110	133	163	186	209	.07335	C	1958–1958
04026450	Bad River near Mellen, Wis.	.091	915	1,340	1,650	2,050	2,370	2,700	.07463	C	1971–2000
04026700	Trout Brook tributary near Marengo, Wis.	-.186	124	203	260	336	394	455	.09759	C	1960–1981
04027000	Bad River near Odanah, Wis.	.317	7390	10,800	13,300	16,800	19,700	22,700	.05616	G	1915–2000
04027200	Pearl Creek at Grandview, Wis.	.596	179	295	395	555	701	874	.10298	C	1960–2000
04027500	White River near Ashland, Wis.	-.113	2,640	3,970	4,890	6,090	7,000	7,920	.05505	G	1949–2000
04028000	Montreal River at Ironwood, Mich.	.239	1,080	1,650	2,090	2,700	3,200	3,750	.13014	G	1918–1962
04029000	West Branch Montreal River at Gile, Wis.	-.684	924	1,200	1,350	1,500	1,600	1,690	.06013	G	1918–1947
04029700	Boomer Creek near Saxon, Wis.	-.260	131	213	272	348	405	464	.09667	C	1958–1981
04029990	Montreal River at Saxon Falls near Saxon, Wis.	-.172	3,200	4,720	5,740	7,040	8,000	8,960	.05343	G	1939–2000
04059900	Allen Creek tributary near Alvin, Wis.	.200	13	20	26	34	40	47	.07502	C	1960–2000
04061000	Brule River near Florence, Wis.	.149	1,447	2,052	2,479	3,044	3,485	3,942	.05185	G	1944–2000
04063640	North Branch Pine River at Windsor Dam near Alvin, Wis.	-.118	73	95	109	126	139	150	.04758	C	1967–2000
04063688	South Branch Popple River near Newald, Wis.	-.212	49	58	63	69	73	77	.03289	C	1970–2000
04063700	Popple River near Fence, Wis.	.105	635	904	1,090	1,340	1,530	1,730	.06027	G	1964–2000
04063800	Woods Creek near Fence, Wis.	.570	197	277	339	427	501	582	.07562	C	1958–2000
04064500	Pine River below Pine River Powerplant near Florence, Wis.	-.028	2,000	2,730	3,200	3,800	4,250	4,690	.04076	G	1924–2000
04064800	Little Popple River near Aurora, Wis.	-.285	355	467	534	612	666	717	.05022	C	1970–2000
04066300	Cole Creek near Dunbar, Wis.	.145	21	29	34	41	47	53	.07286	C	1960–2000
04066500	Pike River at Amberg, Wis.	.139	1,010	1,400	1,660	2,010	2,270	2,540	.04494	G	1914–2000

Table A-1. Flood discharges at selected recurrence intervals and WRC skew for streamflow-gaging stations in the Wisconsin flood-frequency network—Continued

[WRC skew, skewness as defined in Bulletin 17B (nteragency Advisory Committee on Water Data, 1981); recurrence intervals in years; discharge in cubic feet per second; SE_{100}, standard error of 100-year discharge, in log units; C, crest-stage gage; G, continuous-record gage]

Station number	Station name	WRC skew	Discharge for indicated recurrence interval							Type	Period of record
			2	5	10	25	50	100	SE_{100}		
04066700	McCall Creek at Wausaukee, Wis.	-.466	13	27	37	52	63	74	.12759	C	1959–1980
04066800	Menominee River at Koss, Mich.	-.418	13,200	18,400	21,500	25,100	27,500	29,800	.03473	G	1908–2000
04067760	Peshtigo River near Cavour, Wis.	-.143	778	1,090	1,300	1,560	1,740	1,930	.05755	C	1970–2000
04067800	Armstrong Creek near Armstrong Creek, Wis.	.488	103	148	182	231	271	315	.07602	C	1958–1992
04068000	Peshtigo River at High Falls near Crivitz, Wis.	-.083	2,000	2,600	2,980	3,440	3,770	4,080	.03818	G	1913–1956
04069500	Peshtigo River at Peshtigo, Wis.	.013	4,300	5,680	6,580	7,690	8,510	9,330	.04118	G	1954–2000
04069700	North Branch Oconto River near Wabeno, Wis.	.226	139	230	303	410	502	604	.09931	C	1970–2000
04071000	Oconto River near Gillett, Wis.	-.038	2,430	3,440	4,120	4,990	5,650	6,310	.03600	G	1907–2000
04071700	North Branch Little River near Coleman, Wis.	-.538	240	373	457	557	625	690	.05680	C	1958–2000
04071800	Pensaukee River near Pulaski, Wis.	-.194	802	1,200	1,460	1,800	2,050	2,300	.05923	C	1961–2000
04071858	Pensaukee River near Pensaukee, Wis.	-.359	1,600	2,710	3,490	4,510	5,270	6,030	.09460	G	1973–1996
04072150	Duck Creek near Howard, Wis.	-.367	1,410	2,690	3,680	5,030	61,00	7,190	.16461	G	1989–2000
04073400	Bird Creek at Wautoma, Wis.	-.008	81	113	135	162	183	204	.05106	C	1959–2000
04073462	White Creek at Spring Grove Road near Green Lake, Wis.	.122	124	243	349	517	669	846	.21313	G	1982-2000
040734644	Silver Creek at South Koro Road near Ripon, Wis.	.118	206	310	385	489	571	658	.13481	G	1987–1995
04073468	Green Lake inlet at County Highway A near Green Lake, Wis.	.193	223	335	418	533	626	725	.11770	G	1987-2000
04073500	Fox River at Berlin, Wis.	–.217	3,380	4,590	5,340	6,250	6,900	7,520	.02769	G	1898-2000
04074300	Mud Creek near Nashville, Wis.	–.057	62	77	86	97	104	111	.04241	C	1970-2000
04074700	Hunting River near Elcho, Wis.	.315	80	112	135	167	193	220	.06501	C	1958–2000
04074850	Lily River near Lily, Wis.	-.268	81	127	158	198	228	257	.07377	C	1970–2000
04074950	Wolf River at Langlade, Wis.	-.315	1,480	1,850	2,050	2,290	2,450	2,590	.03439	G	1968–2000
04075200	Evergreen Creek near Langlade, Wis.	.282	43	55	62	72	80	87	.04365	G	1959–1997
04075500	Wolf River above West Branch Wolf River near Keshena, Wis.	.319	1,740	2,120	2,360	2,670	2,890	3,120	.03784	G	1928–1962
04077400	Wolf River near Shawano, Wis.	.263	2,500	3,190	3,650	4,240	4,680	5,130	.02900	G	1908–2000
0407809265	Middle Branch Embarrass River near Wittenberg, Wis.	-.027	456	640	764	922	1,040	1,160	.10083	G	1990–2000
04078500	Embarrass River near Embarrass, Wis.	-.038	2,320	3,440	4,230	5,250	6,030	6,830	.04512	G	1920–2000
04079000	Wolf River at New London, Wis.	-.285	6,690	9,370	11,100	13,100	14,500	15,900	.03470	G	1896–2000

Table A-1. Flood discharges at selected recurrence intervals and WRC skew for streamflow-gaging stations in the Wisconsin flood-frequency network—Continued

[WRC skew, skewness as defined in Bulletin 17B (nteragency Advisory Committee on Water Data, 1981); recurrence intervals in years; discharge in cubic feet per second; SE_{100}, standard error of 100-year discharge, in log units; C, crest-stage gage; G, continuous-record gage]

Station number	Station name	WRC skew	Discharge for indicated recurrence interval							Type	Period of record
			2	5	10	25	50	100	SE_{100}		
04079700	Spaulding Creek near Big Falls, Wis.	-.107	55	71	80	92	100	108	.03693	C	1959–2000
04080000	Little Wolf River at Royalton, Wis.	-.522	3,200	4,850	5,880	7,100	7,930	8,710	.04555	G	1914–1984
04081000	Waupaca River near Waupaca, Wis.	-.518	1060	1,540	1,840	2,180	2,410	2,620	.04226	G	1917–1985
04081010	Waupaca River tributary near Waupaca, Wis.	-.489	41	69	88	112	129	145	.09376	C	1959–1981
04081900	Sawyer Creek at Oshkosh, Wis.	-.234	554	1,030	1,400	1,920	2,330	2,770	.09267	C	1961–2000
04083000	West Branch Fond du Lac River at Fond du Lac, Wis.	-.698	762	1,140	1,360	1,610	1,770	1,910	.08279	G	1939–1954
04083400	East Branch Fond du Lac River tributary near Eden, Wis.	-.392	58	96	122	155	179	203	.09570	C	1961–1963
04083500	East Branch Fond du Lac River at Fond du Lac, Wis.	-.708	910	1,540	1,950	2,420	2,740	3,030	.10851	G	1939–1954
04084445	Fox River at Appleton, Wis.	-.316	12,600	15,100	16,500	18,000	19,000	19,900	.04130	G	1986–2000
04085030	Apple Creek near Kaukauna, Wis.	-.721	828	1,260	1,510	1,790	1,980	2,140	.05885	C	1960–2000
04085100	East River tributary at Greenleaf, Wis.	-.162	216	379	504	678	818	965	.11004	C	1958–1980
040851385	Fox River at Oil Tank Depot at Green Bay, Wis.	.220	15,000	19,700	22,900	27,100	30,200	33,400	.08689	G	1989–2000
04085200	Kewaunee River near Kewaunee, Wis.	-.221	2,650	4,450	5,760	7,510	8,860	10,300	.07333	G	1958–2000
04085281	East Twin River at Mishicot, Wis.	-.130	1,170	1,990	2,620	3,480	4,160	4,880	.10540	G	1973–1996
04085300	Neshota River tributary near Denmark, Wis.	-.101	191	342	460	629	767	915	.09511	C	1959–2000
04085400	Killsnake River near Chilton, Wis.	-.667	612	1,040	1,320	1,650	1,880	2,080	.07025	C	1961–2000
04085427	Manitowoc River at Manitowoc, Wis.	-.072	2220	3,670	4,760	6,250	7,440	8,700	.09349	G	1973–2000
04085700	Sheboygan River tributary near Plymouth, Wis.	-.012	113	182	233	303	360	419	.10278	C	1959–1980
040857005	Otter Creek at Willow Road near Plymouth, Wis.	-.559	137	243	315	405	470	532	.15115	G	1991–2000
04086000	Sheboygan River at Sheboygan, Wis.	-.551	3,140	4,990	6,170	7,580	8,560	9,480	.05163	G	1917–2000
04086150	Milwaukee River at Kewaskum, Wis.	-.049	901	1,450	1,850	2,410	2,840	3,300	.12381	G	1968–1981
04086200	East Branch Milwaukee River at New Fane, Wis.	-.137	214	353	455	593	702	815	.13115	G	1969–1981
04086340	North Branch Milwaukee River near Fillmore, Wis.	-.266	789	1,380	1,820	2,420	2,880	3,360	.14051	G	1969–1981
04086360	Milwaukee River at Waubeka, Wis.	-.317	2,020	3,380	4,340	5,590	6,540	7,490	.11815	G	1968–1994
04086400	Milwaukee River tributary near Fredonia, Wis.	-.576	55	105	140	185	218	251	.12300	C	1962–1980
04086500	Cedar Creek near Cedarburg, Wis.	-.136	918	1,750	2,420	3,400	4,220	5,110	.07696	G	1931–2000
04086600	Milwaukee River near Cedarburg, Wis.	-.217	2,940	3,980	4,630	5,410	5,960	6,490	.06379	G	1982–2000

Table A-1. Flood discharges at selected recurrence intervals and WRC skew for streamflow-gaging stations in the Wisconsin flood-frequency network—Continued

[WRC skew, skewness as defined in Bulletin 17B (nteragency Advisory Committee on Water Data, 1981); recurrence intervals in years; discharge in cubic feet per second; SE_{100}, standard error of 100-year discharge, in log units; C, crest-stage gage; G, continuous-record gage]

Station number	Station name	WRC skew	Discharge for indicated recurrence interval							Type	Period of record
			2	5	10	25	50	100	SE_{100}		
04087000	Milwaukee River at Milwaukee, Wis.	.044	4,730	7,090	8,780	11,000	12,800	14,700	.04427	G	1915–2000
04087030	Menomonee River at Menomonee Falls, Wis.	.073	590	888	1,100	1,390	1,620	1,860	.08530	G	1975–2000
04087050	Little Menomonee River near Freistadt, Wis.	-.373	168	253	309	376	424	471	.05998	C	1958–1993
04087088	Underwood Creek at Wauwatosa, Wis.	.156	952	2,020	3,020	4,700	6,280	8,190	.15610	G	1975–2000
04087100	Honey Creek at Milwaukee, Wis.	.048	388	637	828	1,100	1,320	1,550	.07748	C	1959-2000
04087120	Menomonee River at Wauwatosa, Wis.	.086	3,680	6,240	8,260	11,200	13,600	16,300	.08698	G	1962–2000
04087159	Kinnickinnic River at S. 11th St. at Milwaukee, Wis.	-.059	3,840	5,380	6,410	7,700	8,670	9,640	.07739	G	1982–2000
04087200	Oak Creek near South Milwaukee, Wis.	-.241	316	550	725	962	1,150	1,340	.07723	C	1958–2000
04087204	Oak Creek at South Milwaukee, Wis.	.157	607	811	948	1,130	1,260	1,400	.05081	G	1964–2000
04087220	Root River near Franklin, Wis.	.261	999	1710	2,310	3,210	3,990	4,880	.09745	G	1960–2000
04087230	West Branch Root River Canal tributary near North Cape, Wis.	-.713	96	140	165	192	209	225	.05445	C	1962–1993
04087233	Root River Canal near Franklin, Wis.	-.362	767	1,020	1,170	1,350	1,460	1,570	.04115	G	1964–2000
04087240	Root River at Racine, Wis.	-.090	1,900	2,660	3,150	3,770	4,230	4,690	.05264	G	1964–2000
04087250	Pike Creek near Kenosha, Wis.	-.528	92	149	186	230	261	291	.06323	C	1960–2000
04087257	Pike River near Racine, Wis.	-.436	944	1,200	1,340	1,500	1,600	1,690	.03787	G	1972–2000
05332000	Namekagon River at Trego, Wis.	.121	1,050	1,330	1,510	1,740	1,900	2,060	.06880	G	1915–1927
05332500	Namekagon River near Trego, Wis.	.927	1,250	1,810	2,270	2,990	3,620	4,360	.07686	G	1928–2000
05333100	Little Frog Creek near Minong, Wis.	-.324	200	357	473	628	747	870	.09064	C	1961–2000
05334100	Sawyer Creek near Shell Lake, Wis.	-.144	44	68	84	105	121	138	.08758	C	1960–1980
05335380	Bashaw Brook near Shell Lake, Wis.	.155	98	174	236	331	413	505	.10232	C	1959–1993
05339500	St. Croix River near Rush City, Minn.	-.426	19,500	30,800	38,300	47,500	54,100	60,400	.06335	G	1923–1961
05340300	Trade River near Fredric, Wis.	.447	121	220	309	455	592	757	.11123	C	1958–2000
05341500	Apple River near Somerset, Wis.	-.299	1,180	1,650	1,930	2,280	2,520	2,760	.03314	G	1905–2000
05341700	Willow River tributary near New Richmond, Wis.	-.776	59	109	142	181	208	233	.10752	C	1959–1980
05341900	Kinnickinnic River tributary at River Falls, Wis.	-.381	789	2,060	3,250	5,140	6,800	8,660	.13070	C	1959–2000
05344500	Mississippi River at Prescott, Wis.	-.190	62,200	95,600	119,000	14,8000	171,000	193,000	.04694	G	1929–2000
05346600	Little Trimbelle Creek near Bay City, Wis.	.034	650	1,260	1,790	2,610	3,330	4,150	.14984	C	1961–1980

Table A-1. Flood discharges at selected recurrence intervals and WRC skew for streamflow-gaging stations in the Wisconsin flood-frequency network—Continued

[WRC skew, skewness as defined in Bulletin 17B (nteragency Advisory Committee on Water Data, 1981); recurrence intervals in years; discharge in cubic feet per second; SE_{100}, standard error of 100-year discharge, in log units; C, crest-stage gage; G, continuous-record gage]

Station number	Station name	WRC skew	Discharge for indicated recurrence interval							Type	Period of record
			2	5	10	25	50	100	SE_{100}		
05356200	Kenyon Creek near Radisson, Wis.	-.340	167	254	312	383	434	484	.08118	C	1960–1980
05357360	Bear River near Powell, Wis.	-.233	414	591	706	846	948	1,050	.05852	C	1970–2000
05357390	Weber Creek near Mercer, Wis.	-.011	90	145	186	242	287	334	.09569	C	1970–2000
05358100	Smith Creek near Park Falls, Wis.	-.217	166	229	269	318	352	386	.06055	C	1970–2000
05359200	South Fork Flambeau River tributary near Park Falls, Wis.	-.399	30	56	76	103	124	145	.12375	C	1960–1980
05359500	South Fork Flambeau River near Phillips, Wis.	-.378	4,290	5,880	6,850	7,980	8,750	9,480	.04089	G	1930–1975
05359600	PRICE Creek near Phillips, Wis.	.456	145	212	264	339	402	470	.07159	C	1958–2000
05360200	Flambeau River tributary at Ladysmith, Wis.	–.023	17	27	34	43	51	59	.09680	C	1960–1980
05361400	Hay Creek near Prentice, Wis.	-.357	483	764	953	1,190	1,360	1,530	.06369	C	1961–2000
05361420	Douglas Creek near Prentice, Wis.	.125	545	798	980	1,220	1,420	1,620	.07195	C	1970–2000
05361500	South Fork Jump River near Ogema, Wis.	-.008	4,740	6,390	7,470	8,820	9,820	10,800	.08911	G	1944–1954
05361600	North Fork Jump River near Phillips, Wis.	-.532	132	196	236	282	313	342	.06865	C	1970–2000
05362000	Jump River at Sheldon, Wis.	-.051	8,130	12,300	15,200	19,000	22,000	25,000	.04348	G	1916–2000
05364000	Yellow River at Cadott, Wis.	.270	4,590	7,140	9,120	12,000	14,300	16,900	.06554	C	1943–2000
05364100	Seth Creek near Cadott, Wis.	–.344	247	410	524	670	780	889	.07158	C	1962–2000
05364500	Duncan Creek at Bloomer, Wis.	.057	879	1,820	2,680	4,050	5,310	6,780	.10483	C	1945–2000
05365000	Duncan Creek at Chippewa Falls, Wis.	-.176	1,940	2,770	3,310	3,990	4,480	4,970	.09169	G	1934–1954
05365700	Goggle-Eye Creek near Thorp, Wis.	.151	437	896	1,320	2,020	2,660	3,430	.12687	C	1958–2000
05365707	North Fork Eau Claire River near Thorp, Wis.	-.014	1,960	3,670	5,100	7,230	9,050	11,100	.16058	G	1986–2000
05366000	Eau Claire River near Augusta, Wis.	-.189	5,750	7,110	7,910	8,830	9,460	10,100	.05710	G	1915–1926
05366500	Eau Claire River near Fall Creek, Wis.	-.277	8,180	13,500	17,300	22,200	26,000	29,800	.06094	C	1943–2000
05367030	Willow Creek near Eau Claire, Wis.	.002	138	205	252	314	362	412	.05979	C	1958–2000
05367480	East Branch Pine Creek tributary near Dallas, Wis.	.161	137	226	296	398	484	578	.09158	C	1960–2000
05367500	Red Cedar River near Colfax, Wis.	.400	5,800	8,740	11,000	14,300	17,100	20,200	.05985	C	1914–1990
05367700	Lightning Creek at Almena, Wis.	-.416	471	781	993	1,260	1,460	1,650	.06759	C	1958–2000
05368000	Hay River at Wheeler, Wis.	-.109	3,340	5,630	7,350	9,720	11,600	13,600	.07039	G	1934–2000
05369000	Red Cedar River at Menomonie, Wis.	-.031	8,920	13,400	16,500	20,600	23,800	27,000	.04271	G	1908–2000

Table A-1. Flood discharges at selected recurrence intervals and WRC skew for streamflow-gaging stations in the Wisconsin flood-frequency network—Continued

[WRC skew, skewness as defined in Bulletin 17B (nteragency Advisory Committee on Water Data, 1981); recurrence intervals in years; discharge in cubic feet per second; SE_{100}, standard error of 100-year discharge, in log units; C, crest-stage gage; G, continuous-record gage]

Station number	Station name	WRC skew	Discharge for indicated recurrence interval							Type	Period of record
			2	5	10	25	50	100	SE_{100}		
05369800	Eau Galle River tributary near Hersey, Wis.	.210	76	151	219	330	433	555	.16192	C	1960–1980
05369945	Eau Galle River at low-water bridge at Spring Valley, Wis.	-.254	2,600	4,210	5,350	6,830	7,950	9,080	.12645	G	1982–1995
05370000	Eau Galle River at Spring Valley, Wis.	-.608	1,390	2,290	2,870	3,550	4,030	4,470	.07449	G	1942–2000
05370500	Eau Galle River at Elmwood, Wis.	.140	3,760	7,670	11,300	17,100	22,500	28,900	.21708	G	1942–1953
05370600	Arkansaw Creek tributary near Arkansaw, Wis.	-.141	181	272	335	416	477	538	.06516	C	1959–1993
05370900	Spring Creek near Durand, Wis.	-.304	171	311	416	560	673	789	.08562	C	1962–2000
05371300	By Golly Creek near Nelson, Wis.	-.311	10	36	68	129	193	273	.27526	C	1962–1980
05371800	Buffalo River tributary near Osseo, Wis.	-.234	67	101	124	153	175	196	.05853	C	1960–2000
05371920	Buffalo River near Mondovi, Wis.	.063	1,450	2,490	3,300	4,490	5,480	6,560	.10734	C	1974–2000
05372000	Buffalo River near Tell, Wis.	-.252	2,910	5,190	6,890	9,220	11,100	13,000	.12334	G	1933–1950
05378200	Eagle Creek near Fountain City, Wis.	.342	891	1,530	2,080	2,920	3,670	4,530	.11289	C	1961–2000
05378500	Mississippi River at Winona, Minn.	-.197	89,400	128,000	153,000	184,000	207,000	229,000	.03003	G	1879–2000
05379400	Trempealeau River at Arcadia, Wis.	-.138	4,240	7,580	10,200	13,800	16,800	20,000	.17306	G	1968–2000
05379500	Trempealeau River at Dodge, Wis.	-.162	3,920	6,610	8,610	11,300	13,500	15,700	.05763	G	1914–2000
05380800	Black River tributary near Whittlesey, Wis.	-.233	114	168	203	248	281	313	.06181	C	1960–2000
05380900	Poplar River near Owen, Wis.	-.037	4,610	7,140	8,960	11,400	13,300	15,300	.06617	C	1958–2000
05380970	Cawley Creek near Neillsville, Wis.	-.189	2,020	3,740	5,090	7,010	8,570	10,200	.09001	C	1961–2000
05381000	Black River at Neillsville, Wis.	-.271	12,900	19,800	24,500	30,300	34,700	39,000	.04130	G	1905–2000
05382000	Black River near Galesville, Wis.	-.169	20,800	32,000	39,600	49,600	57,100	64,700	.04836	G	1932–2000
05382200	French Creek near Ettrick, Wis.	-.297	818	1,460	1,940	2,590	3,100	3,620	.10613	C	1960–2000
05382300	Beaver Creek tributary near Sparta, Wis.	.040	127	178	213	258	292	327	.07281	C	1959–1980
05382500	Little La Crosse River near Leon, Wis.	–.237	999	1,700	2,210	2,890	3,420	3,960	.07038	C	1934–1981
05383000	La Crosse River near West Salem, Wis.	-.117	2,470	3,820	4,770	6,030	6,990	7,980	.05457	G	1914–1978
05386300	Mormon Creek near La Crosse, Wis.	-.292	788	2,020	3,190	5,090	6,800	8,760	.14656	C	1961–2000
05386500	Coon Creek at Coon Valley, Wis.	-.183	2,180	3,900	5,230	7,070	8,560	10,100	.17065	G	1934–1981
05387100	North Fork Bad Axe River near Genoa, Wis.	-.132	851	2,090	3,290	5,300	7,170	9,380	.13241	C	1959–2000
05388460	Du Charme Creek at Eastman, Wis.	.018	70	131	183	261	329	405	.13863	C	1961–1981

Table A-1. Flood discharges at selected recurrence intervals and WRC skew for streamflow-gaging stations in the Wisconsin flood-frequency network—Continued

[WRC skew, skewness as defined in Bulletin 17B (nteragency Advisory Committee on Water Data, 1981); recurrence intervals in years; discharge in cubic feet per second; SE_{100}, standard error of 100-year discharge, in log units; C, crest-stage gage; G, continuous-record gage]

Station number	Station name	WRC skew	Discharge for indicated recurrence interval							Type	Period of record
			2	5	10	25	50	100	SE_{100}		
05389500	Mississippi River at McGregor, Ia.	-.133	109,500	148,300	172,900	203,100	224,900	246,200	.03576	G	1880–2000
05390140	Muskrat Creek at Conover, Wis.	-.131	62	85	99	117	130	143	.06163	C	1970–2000
05390240	Fourmile Creek near Three Lakes, Wis.	-.105	80	98	108	120	128	136	.03814	C	1970–2000
05391260	Gudegast Creek near Starks, Wis.	.175	68	88	101	117	130	143	.05001	C	1970–2000
05391950	Squaw Creek near Harrison, Wis.	-.108	25	36	42	51	58	64	.05962	C	1970–2000
05392150	Mishonagon Creek near Woodruff, Wis.	-.326	68	85	94	105	112	119	.02959	C	1958–2000
05392350	Bearskin Creek near Harshaw, Wis.	.394	76	100	117	139	156	174	.05049	C	1959–2000
05393500	Spirit River at Spirit Falls, Wis.	-.549	1,630	2,400	2,860	3,390	3,750	4,080	.04202	G	1942–2000
05393620	Skanawan Creek near Tomahawk, Wis.	.263	75	123	160	216	263	316	.16362	C	1970–1981
05393640	Little Pine Creek near Irma, Wis.	.014	126	178	214	259	294	328	.06279	C	1970–2000
05394000	New Wood River near Merrill, Wis.	-.031	1,230	1,960	2,490	3,230	3,810	4,410	.08813	C	1953–1980
05394200	Devil Creek near Merrill, Wis.	.452	290	442	563	741	893	1,060	.08165	C	1960–2000
05394500	Prairie River near Merrill, Wis.	-.062	1,410	2,120	2,610	3,250	3,750	4,250	.04415	G	1914–2000
05395020	Lloyd Creek near Doering, Wis.	-.170	296	449	554	689	790	892	.06970	C	1970–2000
05395100	Trappe River tributary near Merrill, Wis.	-.181	133	233	308	413	497	585	.08058	C	1959–2000
05396000	Rib River at Rib Falls, Wis.	-.480	6,950	11,800	15,200	19,400	22,400	25,400	.08037	G	1925–1957
05396100	Pet Brook near Edgar, Wis.	-.009	717	1170	1,520	1,990	2,380	2,780	.08734	C	1962–2000
05396300	Wisconsin River tributary at Wausau, Wis.	-.068	243	427	572	777	946	1130	.13267	C	1983–2000
05397500	Eau Claire River at Kelly, Wis.	-.215	3,180	4,740	5,780	7,100	8,070	9,030	.04256	G	1914–2000
05397600	Big Sandy Creek near Wausau, Wis.	.219	496	804	1,050	1,400	1,700	2,030	.08156	C	1959–2000
05399000	Big Eau Pleine River near Colby, Wis.	-.132	2,640	4,530	5,970	7,950	9,530	11,200	.14161	G	1942–1954
05399200	Marsh Creek tributary near Abbotsford, Wis.	-.313	124	223	296	395	471	550	.11085	C	1959–1980
05399500	Big Eau Pleine River near Stratford, Wis.	-.192	7,890	13,200	17,100	22,300	26,400	30,600	.05463	G	1914–2000
05400025	Johnson Creek near Knowlton, Wis.	.369	892	1,360	1,720	2,240	2,680	3,170	.09500	C	1973–2000
05400500	Plover River near Stevens Point, Wis.	.052	738	1,040	1,250	1,520	1,720	1,930	.09319	G	1914–1951
05400600	Little Plover River near Arnott, Wis.	-.473	41	61	73	88	98	108	.08562	G	1960–1975
05400650	Little Plover River at Plover, Wis.	-.462	48	69	83	99	109	120	.06093	G	1960–1987

Table A-1. Flood discharges at selected recurrence intervals and WRC skew for streamflow-gaging stations in the Wisconsin flood-frequency network—Continued

[WRC skew, skewness as defined in Bulletin 17B (nteragency Advisory Committee on Water Data, 1981); recurrence intervals in years; discharge in cubic feet per second; SE_{100}, standard error of 100-year discharge, in log units; C, crest-stage gage; G, continuous-record gage]

Station number	Station name	WRC skew	Discharge for indicated recurrence interval							Type	Period of record
			2	5	10	25	50	100	SE_{100}		
05401050	Tenmile Creek near Nekoosa, Wis.	-.268	191	261	304	356	392	427	.05763	G	1964–2000
05401100	Fourteenmile Creek near New Rome, Wis.	.101	231	308	358	423	471	519	.06962	G	1961–1979
05401535	Big Roche A Cri Creek near Adams, Wis.	.205	167	251	313	398	468	542	.11350	G	1964–1978
05401800	Yellow River tributary near Pittsville, Wis.	-.346	388	551	653	774	860	941	.04770	C	1959–2000
05402000	Yellow River at Babcock, Wis.	-.654	4,850	7,100	8,410	9,870	10,800	11,700	.04208	G	1944–2000
05402500	Yellow River at Sprague, Wis.	-.521	3,520	5,430	6,630	8,060	9,050	9,980	.09808	G	1927–1940
05403000	Yellow River at Necedah, Wis.	-.646	5,990	9,150	11,100	13,200	14,700	16,000	.08511	G	1941–1957
05403500	Lemonweir River at New Lisbon, Wis.	-.695	2,860	4,290	5,130	6,070	6,680	7,220	.05027	G	1944–1994
05403520	Webster Creek at New Lisbon, Wis.	-.710	196	328	410	506	571	630	.07333	C	1961–2000
05403550	Onemile Creek near Mauston, Wis.	-.214	550	1,080	1,510	2,130	2,650	3,210	.10311	C	1958–2000
05403610	Wisconsin River tributary at Wisconsin Dells, Wis.	-.501	10	20	27	37	45	53	.13681	C	1962–1980
05403630	Hulbert Creek near Wisconsin Dells, Wis.	.269	97	162	216	297	366	445	.12340	C	1972–2000
05403700	Dell Creek near Lake Delton, Wis.	.205	286	512	703	995	1,250	1,550	.09854	C	1958–2000
05404116	South Branch Baraboo River at Hillsboro, Wis.	-.345	915	1,950	2,800	4,050	5,070	6,170	.18487	G	1988–2000
05404200	Narrows Creek at Loganville, Wis.	-.566	1,730	3,130	4,110	5,340	6,230	7,090	.08325	C	1958–2000
05405000	Baraboo River near Baraboo, Wis.	-.401	2,940	4,480	5,480	6,700	7,570	8,400	.04486	G	1914–2000
05405600	Rowan Creek at Poynette, Wis.	-.059	265	558	820	1,230	1,600	2,020	.11453	C	1961–2000
05406470	Brewery Creek at Cross Plains, Wis.	-.209	118	206	273	363	435	510	.14838	G	1985–2000
05406491	Garfoot Creek near Cross Plains, Wis.	.102	87	122	146	179	203	229	.10722	G	1985–1998
05406500	Black Earth Creek at Black Earth, Wis.	-.239	443	735	945	1,220	1,440	1,650	.06723	G	1954–2000
05406800	Rocky Branch near Richland Center, Wis.	-.022	107	243	374	589	790	1,030	.13916	C	1960–2000
05407100	Richland Creek near Plugtown, Wis.	-.003	687	1,410	2,050	3,060	3,970	5,010	.11895	C	1958–2000
05407200	Crooked Creek near Boscobel, Wis.	.055	399	768	1,090	1,580	2,010	2,500	.10273	C	1959–2000
05407400	Morris Creek tributary near Norwalk, Wis.	-.580	377	690	909	1,190	1,380	1,580	.11341	C	1959–1980
05408000	Kickapoo River at La Farge, Wis.	.196	2,510	4,250	5,650	7,740	9,520	11,500	.07215	G	1939–2000
05408500	Knapp Creek near Bloomingdale, Wis.	-.122	537	1,100	1,580	2,320	2,950	3,660	.17523	G	1954–1969
05408800	Bishops Branch near Viroqua, Wis.	-.354	1,060	2,630	4,070	6,320	8,270	10,400	.24061	C	1959–1969

Table A-1. Flood discharges at selected recurrence intervals and WRC skew for streamflow-gaging stations in the Wisconsin flood-frequency network—Continued

[WRC skew, skewness as defined in Bulletin 17B (nteragency Advisory Committee on Water Data, 1981); recurrence intervals in years; discharge in cubic feet per second; SE_{100}, standard error of 100-year discharge, in log units; C, crest-stage gage; G, continuous-record gage]

Station number	Station name	WRC skew	Discharge for indicated recurrence interval							Type	Period of record
			2	5	10	25	50	100	SE_{100}		
05409830	North Fork Nederlo Creek near Gays Mills, Wis.	.136	60	129	193	301	403	525	.23001	G	1968–1979
05409890	Nederlo Creek near Gays Mills, Wis.	.122	324	1,060	2,000	3,990	6,270	9,460	.34378	G	1968–1980
05410000	Kickapoo River at Gays Mills, Wis.	-.121	3,060	5,160	6,740	8,910	10,600	12,500	.08414	G	1913–1977
05410490	Kickapoo River at Steuben, Wis.	.218	2,730	4,870	6,670	9,440	11,900	14,700	.07703	G	1982–2000
05413400	Piegon Creek near Lancaster, Wis.	.111	406	838	1,240	1,880	2,480	3,180	.11778	C	1960–2000
05413449	Kickapoo Creek near North Andover, Wis.	.074	900	2,150	3,420	5,620	7,780	10,400	.28172	G	1987–1996
05413500	Grant River at Burton, Wis.	-.395	5,520	11,000	15,200	21,100	25,800	30,600	.07369	G	1935–2000
05414000	Platte River near Rockville, Wis.	-.209	3,730	7,440	10,500	15,000	18,700	22,800	.07883	G	1935–2000
05414200	Bear Branch near Platteville, Wis.	-.489	387	663	852	1,090	1,260	1,430	.07644	C	1958–2000
05414213	Little Platte River near Platteville, Wis.	-.184	1,950	3,540	4,770	6,490	7,890	9,370	.15923	C	1988–2000
05414900	Pats Creek near Elk Grove, Wis.	.422	481	1,150	1,890	3,320	4,850	6,910	.16637	C	1960–2000
05415000	Galena River at Buncombe, Wis.	.137	4,310	7,390	9,880	13,500	16,700	20,100	.07721	G	1937–1992
05415500	East Fork Galena River at Council Hill, Illi.	.051	1,980	4,180	6,190	9,450	12,400	16,000	.13815	G	1940–1969
05423000	West Branch Rock River near Waupun, Wis.	-.626	323	670	931	1,270	1,530	1,770	.10544	G	1949–1981
05423300	South Branch Rock River tributary near Waupun, Wis.	-.506	163	377	556	811	1,020	1,230	.15136	C	1959–1980
05423500	South Branch Rock River at Waupun, Wis.	-.496	447	778	1,010	1,300	1,510	1,710	.08080	G	1949–2000
05423800	East Branch Rock River tributary near Slinger, Wis.	-.085	164	222	260	307	341	374	.05026	C	1960–1993
05424000	East Branch Rock River near Mayville, Wis.	-.249	1,060	1,990	2,720	3,740	4,570	5,440	.11921	G	1950–2000
05424300	Rock River tributary near Watertown, Wis.	-.699	108	190	244	308	351	392	.09865	C	1959–1980
05425500	Rock River at Watertown, Wis.	-.253	2,110	3,110	3,770	4,580	5,180	5,770	.04439	G	1932–2000
05425700	Robbins Creek near Columbus, Wis.	-.753	151	253	316	389	437	480	.07576	C	1960–2000
05425827	Dup-Maunesha River near Sun Prairie, Wis.	-.258	448	661	802	976	1,100	1,230	.08569	C	1973–2000
05426000	Crawfish River at Milford, Wis.	-.476	2,280	3,290	3,910	4,630	5,120	5,580	.03772	G	1931–2000
05426031	Rock River at Jefferson, Wis.	.077	4,620	6,440	7,680	9,280	10,500	11,800	.08277	G	1978–1994
05426100	Scuppernong Creek near Wales, Wis.	.080	97	126	145	169	187	204	.06193	C	1962–1980
05426250	Bark River near Rome, Wis.	-.297	290	364	408	456	490	521	.04965	G	1984–2000
05426500	Whitewater Creek near Whitewater, Wis.	-.249	14	22	28	36	41	47	.24343	G	1926–1954

Table A-1. Flood discharges at selected recurrence intervals and WRC skew for streamflow-gaging stations in the Wisconsin flood-frequency network—Continued

[WRC skew, skewness as defined in Bulletin 17B (nteragency Advisory Committee on Water Data, 1981); recurrence intervals in years; discharge in cubic feet per second; SE_{100}, standard error of 100-year discharge, in log units; C, crest-stage gage; G, continuous-record gage]

Station number	Station name	WRC skew	Discharge for indicated recurrence interval							Type	Period of record
			2	5	10	25	50	100	SE_{100}		
05427000	Whitewater Creek at Willis Ray Road near Whitewater, Wis.	-.062	185	306	398	524	625	732	.13602	G	1927–1981
05427200	Allen Creek near Fort Atkinson, Wis.	-.108	101	161	204	262	306	353	.07360	C	1958–1993
05427570	Rock River at Indianford, Wis.	-.110	5,650	7,600	8,850	10,400	11,500	12,500	.05515	G	1976–2000
05427718	Yahara River at Windsor, Wis.	.199	405	667	874	1,180	1,430	1,720	.13485	G	1976–2000
05427800	Token Creek near Madison, Wis.	-.351	232	406	532	698	825	954	.08741	C	1961–2000
05427948	Pheasant Branch at Middleton, Wis.	-.546	324	564	727	930	1,080	1,220	.09161	G	1975–2000
05427965	Spring Harbor Storm Sewer at Madison, Wis.	-.470	397	567	670	789	871	947	.06103	G	1976–2000
05429500	Yahara River near McFarland, Wis.	.068	416	536	614	710	780	849	.03143	G	1930–2000
05430100	Badfish Creek near Stoughton, Wis.	-.494	461	675	806	958	1,060	1,160	.10237	G	1957–1966
05430150	Badfish Creek near Cooksville, Wis.	-.455	616	783	876	980	1,050	1,110	.05724	G	1978–2000
05430175	Yahara River near Fulton, Wis.	.502	1,560	2,190	2,670	3,350	3,910	4,510	.08950	G	1978–2000
05430403	Fisher Creek tributary at Janesville, Wis.	-.103	425	607	728	882	996	1,110	.08026	C	1982–2000
05430500	Rock River at Afton, Wis.	-.374	6,350	8,730	10,200	11,900	13,000	14,100	.03043	G	1914–2000
05431014	Jackson Creek at Petrie Road near Elkhorn, Wis.	-.134	177	287	367	473	557	643	.13122	G	1984–1995
054310157	Jackson Creek tributary near Elkhorn, Wis.	-.636	126	167	189	212	228	241	.05609	G	1984–2000
05431017	Delavan Lake inlet at State Hwy. 50 at Lake Lawn, Wis.	-.213	340	545	689	878	1,020	1,170	.10833	G	1984–2000
05431400	Little Turtle Creek at Allens Grove, Wis.	.048	1,330	2,233	2,936	3,939	4,769	5,667	.08519	C	1961–2000
05431486	Turtle Creek at Carvers Rock Road near Clinton, Wis.	-.123	1,810	3,400	4,690	6,560	8,120	9,820	.07659	G	1938–2000
05431500	Turtle Creek near Clinton, Wis.	-.328	2,074	3,903	5,306	7,235	8,756	10,330	.08868	G	1940–1981
05432300	Rock Branch near Mineral Point, Wis.	.363	277	574	865	1,370	1,870	2,490	.13182	C	1959–2000
05432500	Pecatonica River at Darlington, Wis.	.077	3,100	6,220	9,020	13,400	17,500	22,100	.09161	G	1937–2000
05433000	East Branch Pecatonica River near Blanchardville, Wis.	-.077	2,170	4,090	5,680	8,010	9,980	12,100	.08030	G	1940–2000
05433500	Yellowstone River near Blanchardville, Wis.	-.642	1,430	3,210	4,620	6,510	7,950	9,370	.10016	C	1955–2000
05434200	Skinner Creek tributary near Monroe, Wis.	-.463	42	75	98	129	151	173	.10576	C	1959–1980
05434500	Pecatonica River at Martintown, Wis.	-.219	5,260	8,600	11,000	14,100	16,500	19,000	.05719	G	1916–2000
05435900	Sugar River tributary near Pine Bluff, Wis.	-.056	153	287	398	561	699	851	.10646	C	1961–2000
05436000	Mount Vernnon Creek near Mount Vernon, Wis.	-.135	280	504	679	926	1,130	1,340	.13829	G	1955–1980

Table A-1. Flood discharges at selected recurrence intervals and WRC skew for streamflow-gaging stations in the Wisconsin flood-frequency network—Continued

[WRC skew, skewness as defined in Bulletin 17B (nteragency Advisory Committee on Water Data, 1981); recurrence intervals in years; discharge in cubic feet per second; SE_{100}, standard error of 100-year discharge, in log units; C, crest-stage gage; G, continuous-record gage]

Station number	Station name	WRC skew	Discharge for indicated recurrence interval							Type	Period of record
			2	5	10	25	50	100	SE_{100}		
05436200	Gill Creek near Brooklyn, Wis.	.344	106	187	258	369	469	585	.10446	C	1960–2000
05436500	Sugar River near Brodhead, Wis.	-.177	3,340	5,990	8,030	10,900	13,200	15,600	.05817	G	1914–2000
05437200	East Fork Raccoon Creek tributary near Beloit, Wis.	.052	139	320	498	801	1,090	1,440	.14133	C	1958–1993
05543830	Fox River at Waukesha, Wis.	-.103	923	1,320	1,590	1,920	2,170	2,420	.05540	G	1960–2000
05544200	Mukwonago River at Mukwonago, Wis.	-.501	214	254	274	296	310	322	.02865	G	1974–2000
05544300	Mukwonago River tributary near Mukwonago, Wis.	-.553	30	50	64	80	92	103	.09608	C	1960–1981
05545100	Sugar Creek at Elkhorn, Wis.	.166	127	215	286	391	481	580	.09021	C	1962–2000
05545200	White River tributary near Burlington, Wis.	-.062	95	158	205	270	323	378	.07519	C	1958–2000
05545300	White River near Burlington, Wis.	-.198	808	1,300	1,650	2,110	2,470	2,830	.08984	C	1959–1982
05545750	Fox River near New Munster, Wis.	.543	2,660	4,310	5,710	7,880	9,830	12,100	.07927	G	1940–2000
05548150	North Branch Nippersink Creek near Genoa City, Wis.	-.056	185	284	355	450	523	599	.06716	C	1962–2000
			Regulated Stations								
04062011	Brule River near Commonwealth, Wis.	.180	3,153	4,889	6,203	8,050	9,561	11,190	.14200	G	1990–2000
04063000	Menominee River near Florence, Wis.	-.132	7,473	10,800	13,010	15,820	17,900	19,980	.03813	G	1915–2000
04066000	Menominee River near Pembine, Wis.	-.126	13,400	18,600	21,900	26,100	29,100	32,100	.05457	G	1950–1982
04067000	Menominee River near Koss, MI	-.453	13,420	18,560	21,620	25,140	27,520	29,730	.03456	G	1908–1981
04067500	Menominee River near Mc Allister, Wis.	.070	14,100	19,700	23,400	28,300	32,000	35,800	.04829	G	1945–2000
04084500	Fox River at Rapide Croche Dam near Wrightstown, Wis.	-.819	12,800	16,800	18,800	20,900	22,100	23,200	.02402	G	1918–2000
05333500	St. Croix River near Danbury, Wis.	-.130	4,700	6,400	7,490	8,830	9,800	10,700	.03180	G	1914–2000
05336000	St. Croix River near Grantsburg, Wis.	-.121	10,300	14,400	17,100	20,400	22,900	25,300	.04641	G	1923–1970
05340500	St. Croix River at St. Croix Falls, Wis.	-.509	22,300	32,800	39,200	46,700	51,800	56,500	.03364	G	1902–2000
05356000	Chippewa River at Bishops Bridge near Winter, Wis.	-.565	2,980	4,640	5,680	6,900	7,740	8,520	.04317	G	1912–2000
05356500	Chippewa River near Bruce, Wis.	-.237	9,510	13,700	16,500	19,900	22,300	24,700	.03888	G	1914–2000
05357500	Flambeau River at Flambeau Flowage, Wis.	-.200	1,490	2,430	3,100	4,000	4,690	5,390	.07766	G	1928–1960
05358000	Flambeau River near Butternut, Wis.	.184	1,410	2,380	3,160	4,310	5,300	6,390	.16259	G	1915–1938
05358500	Flambeau River at Babbs Island, Wis.	-.576	4,190	6,100	7,250	8,550	9,420	10,200	.04650	G	1930–1975
05360000	Flambeau River near Ladysmith, Wis.	.080	8,490	11,500	13,500	16,100	18,000	20,000	.03628	G	1903–1961

Table A-1. Flood discharges at selected recurrence intervals and WRC skew for streamflow-gaging stations in the Wisconsin flood-frequency network—Continued

[WRC skew, skewness as defined in Bulletin 17B (nteragency Advisory Committee on Water Data, 1981); recurrence intervals in years; discharge in cubic feet per second; SE_{100}, standard error of 100-year discharge, in log units; C, crest-stage gage; G, continuous-record gage]

Station number	Station name	WRC skew	Discharge for indicated recurrence interval							Type	Period of record
			2	5	10	25	50	100	SE_{100}		
05360500	Flambeau River near Bruce, Wis.	-.305	10,500	14,120	16,310	18,880	20,660	22,360	.03734	G	1952–2000
05365500	Chippewa River at Chippewa Falls, Wis.	-.357	38,400	53,200	62,300	72,900	80,300	87,400	.03411	G	1884–2000
05367000	Chippewa River at Eau Claire, Wis.	.874	38,200	52,200	63,300	79,600	93,600	109,000	.14336	G	1903–1954
05369500	Chippewa River at Durand, Wis.	.002	43,300	62,500	75,600	92,800	106,000	119,000	.04285	G	1880–2000
05391000	Wisconsin River at Rainbow Lake near Lake Tomahawk, Wis.	-.636	1,870	2,410	2,710	3,020	3,210	3,380	.02282	G	1937–2000
05392000	Wisconsin River at Whirlpool Rapids near Rhinelander, Wis.	-.520	3,000	3,930	4,450	5,010	5,390	5,720	.02443	G	1906–1961
05393000	Tomahawk River at Bradley, Wis.	-.049	1,245	1,776	2,134	2,591	2,935	3,282	.05212	G	1930–1973
05395000	Wisconsin River at Merrill, Wis.	-.403	13,600	18,800	21,900	25,500	28,000	30,400	.03038	G	1903–2000
05398000	Wisconsin River at Rothschild, Wis.	-.624	27,900	38,300	44,200	50,500	54,700	58,400	.02830	G	1941–2000
05400000	Wisconsin River at Knowlton, Wis.	-.703	36,210	47,490	53,520	59,830	63,770	67,190	.04751	G	1921–1942
05400760	Wisconsin River at Wisconsin Rapids, Wis.	-.580	33,400	46,500	54,100	62,500	68,000	73,100	.02992	G	1982–2000
05401500	Wisconsin River near Necedah, Wis.	-.621	32,400	45,700	53,300	61,700	67,200	72,200	.03070	G	1903–1950
05404000	Wisconsin River near Wisconsin Dells, Wis.	-.764	34,200	47,200	54,300	61,700	66,400	70,400	.02845	G	1935–2000
05406000	Wisconsin River at Prairie du Sac, Wis.	-.731	37,200	51,100	58,700	66,700	71,800	76,200	.02801	G	1944–1953
05407000	Wisconsin River at Muscoda, Wis.	-.689	35,900	48,800	55,900	63,400	68,200	72,400	.02718	G	1881–2000
05425912	Beaver Dam River at Beaver Dam, Wis.	-.283	495	625	701	787	846	901	.05405	G	1986–2000
05431022	Delavan Lake Outlet at Borg Road near Delavan, Wis.	-.492	227	328	389	460	508	553	.08051	G	1984–2000

Table A-2. Drainage-basin characteristics for rural streamflow-gaging stations in Wisconsin

[mi^2, square miles; ft/mi, feet per mile; in/hr, inches per hour; in., inches; snowfall, mean annual snowfall; ft^3/s, cubic feet per second; Q_{100}, 100-year flood.]

Station number	Station name	Contributing area (mi^2)	Slope (ft/mi)	Storage (percent)	Forest (percent)	25-yr, 24-hr precipitation (in.)	Snowfall (in.)	Soil permeability (in./hr)	Q_{100} by regression (ft^3/s)	Flood-frequency area
04024400	Stony Brook near Superior, Wis.	1.86	56.3	0.00	51.8	4.79	52.9	0.12	698	4
04025200	Pearson Creek near Maple, Wis.	4.07	75.2	.00	39.6	4.79	63.1	.12	1,593	4
04025500	Bois Brule River near Brule, Wis.	118	3.60	15.4	85.0	4.79	74.9	2.98	2,021	4
04026200	Sand River tributary near Red Cliff, Wis.	1.09	204	1.75	98.0	4.79	81.5	.12	589	4
04026300	Sioux River near Washburn, Wis.	13.7	48.6	1.21	82.6	4.79	71.5	2.19	1,614	4
04026400	Spillerberg Creek near Cayuga, Wis.	6.59	11.5	39.4	81.4	4.66	88.1	1.65	240	4
04026450	Bad River near Mellen, Wis.	82.0	11.2	11.9	96.1	4.66	94.5	1.65	2,952	4
04026700	Trout Brook tributary near Marengo, Wis.	.66	179	.00	24.2	4.66	91.5	.12	511	4
04027000	Bad River near Odanah, Wis.	597	18.8	9.70	80.0	4.66	96.0	1.51	21,243	4
04027200	Pearl Creek at Grandview, Wis.	13.7	30.6	6.38	93.1	4.79	74.8	1.65	1,025	4
04027500	White River near Ashland, Wis.	301	19.1	13.1	80.0	4.66	66.1	2.18	9,106	4
04028000	Montreal River at Ironwood, Mich	61.4	8.62	15.7	81.1	4.66	172	1.65	2,271	4
04029700	Boomer Creek near Saxon, Wis.	5.33	84.6	13.1	84.1	4.66	128	1.65	636	4
04029990	Montreal River at Saxon Falls near Saxon, Wis.	264	18.6	15.9	82.1	5.28	107	1.65	9,267	4
04059900	Allen Creek tributary near Alvin, Wis.	1.02	12.0	5.60	81.2	4.24	78.3	4.18	21.0	3
04063640	North Branch Pine River at Windsor Dam near Alvin, Wis.	27.8	4.49	22.6	80.0	4.24	80.0	3.71	257	3
04063688	South Branch Popple River near Newald, Wis.	9.47	18.5	18.5	93.8	4.24	59.4	2.93	134	3
04063700	Popple River near Fence, Wis.	131	6.24	22.8	94.5	4.24	61.7	1.40	1,943	3
04063800	Woods Creek near Fence, Wis.	41.4	14.8	24.0	79.4	4.24	62.1	1.65	659	3
04066300	Cole Creek near Dunbar, Wis.	3.20	27.4	19.1	85.30	4.24	56.1	2.93	51.91	3
04066500	Pike River at Amberg, Wis.	255	12.6	17.2	86.0	4.24	54.4	3.68	1,684	3
04066700	McCall Creek at Wausaukee, Wis.	1.33	19.2	20.3	35.3	4.24	53.3	.50	103.7	3
04067760	Peshtigo River near Cavour, Wis.	150	4.40	23.6	80.7	4.24	58.6	1.45	2,097	3
04067800	Armstrong Creek near Armstrong Creek, Wis.	23.1	7.52	36.5	61.5	4.24	58.9	2.04	317	3
04069500	Peshtigo River at Peshtigo, Wis.	1,120	6.21	18.4	72.0	4.24	51.2	2.41	7,727	3
04069700	North Branch Oconto River near Wabeno, Wis.	34.1	10.0	15.5	71.9	4.24	63.5	1.65	618	3
04071000	Oconto River near Gillett, Wis.	678	7.50	16.8	88.0	4.24	51.1	2.26	5,493	3

Table A-2. Drainage-basin characteristics for rural streamflow-gaging stations in Wisconsin—Continued

[mi^2, square miles; ft/mi, feet per mile; in/hr, inches per hour; in., inches; snowfall, mean annual snowfall; ft^3/s, cubic feet per second; Q_{100}, 100-year flood.]

Station number	Station name	Contributing area (mi^2)	Slope (ft/mi)	Storage (percent)	Forest (percent)	25-yr, 24-hr precipitation (in.)	Snowfall (in.)	Soil permeability (in./hr)	Q_{100} by regression (ft^3/s)	Flood-frequency area
04071700	North Branch Little River near Coleman, Wis.	23.3	10.6	15.8	26.2	4.24	50.0	.50	1,008	4
04071800	Pensaukee River near Pulaski, Wis.	48.8	11.0	6.53	3.50	4.24	49.9	.57	2,371	4
04073400	Bird Creek at Wautoma, Wis.	3.59	27.7	5.57	31.8	4.38	41.8	4.33	70.2	3
04073500	Fox River at Berlin, Wis.	1,430	.84	12.6	22.0	4.38	41.1	3.69	9,021	3
04074300	Mud Creek near Nashville, Wis.	9.05	6.87	37.9	90.1	4.24	66.5	2.91	111	3
04074700	Hunting River near Elcho, Wis.	9.00	6.09	29.2	80.1	4.24	64.7	1.48	197	3
04074850	Lily River near Lily, Wis.	45.6	10.1	16.8	85.1	4.24	61.8	2.50	559	3
04075200	Evergreen Creek near Langlade, Wis.	4.90	19.7	9.90	86.9	4.24	55.3	1.92	124	3
04075500	Wolf River above West Branch Wolf River near Keshena, Wis.	633	9.60	15.5	76.0	4.24	50.1	2.78	4,500	3
04077000	Wolf River at Keshena Falls near Keshena, Wis.	812	9.51	13.9	69.0	4.24	49.1	2.51	6,111	3
04078500	Embarrass River near Embarrass, Wis.	395	11.9	15.0	36.0	4.24	47.4	1.72	4,470	3
04079000	Wolf River at New London, Wis.	2,240	5.80	14.6	43.0	4.38	42.8	1.81	21,919	3
04079700	Spaulding Creek near Big Falls, Wis.	4.90	18.5	20.8	84.5	4.38	44.6	1.65	146	3
04080000	Little Wolf River at Royalton, Wis.	514	8.77	15.8	35.0	4.38	44.1	1.28	8,459	3
04081000	Waupaca River near Waupaca, Wis.	272	10.0	6.20	26.0	4.38	43.4	3.23	2,974	3
04081010	Waupaca River tributary near Waupaca, Wis.	1.00	30.4	1.00	4.00	4.38	43.4	.50	172	3
04081900	Sawyer Creek at Oshkosh, Wis.	12.0	11.0	.33	1.96	4.46	45.0	.12	4,607	3
04083000	West Branch Fond du Lac River at Fond du Lac, Wis.	83.1	6.86	9.20	6.44	4.46	34.7	.48	2,710	4
04083400	East Branch Fond du Lac River tributary near Eden, Wis.	.99	70.0	1.68	3.36	4.46	35.5	1.25	172	4
04083500	East Branch Fond du Lac River at Fond du Lac, Wis.	78.4	3.85	7.30	6.00	4.46	34.4	.70	2,029	4
04085030	Apple Creek near Kaukauna, Wis.	15.2	11.8	.00	1.99	4.46	44.6	.12	2,256	4
04085100	East River tributary at Greenleaf, Wis.	7.18	40.9	12.5	13.0	4.46	44.8	.69	584	4
04085200	Kewaunee River near Kewaunee, Wis.	127	10.5	.43	8.92	4.46	38.2	.36	8,995	4
04085300	Neshota River tributary near Denmark, Wis.	4.31	22.9	.00	2.60	4.46	42.0	.12	964	4
04085400	Killsnake River near Chilton, Wis.	29.4	9.23	1.42	5.39	4.46	45.8	.22	2,448	4
04085700	Sheboygan River tributary near Plymouth, Wis.	6.51	21.0	2.54	12.5	4.46	43.9	.39	709	4
04086000	Sheboygan River at Sheboygan, Wis.	418	4.63	9.60	13.0	4.46	46.7	.68	9,202	4

Table A-2. Drainage-basin characteristics for rural streamflow-gaging stations in Wisconsin—Continued

[mi², square miles; ft/mi, feet per mile; in/hr, inches per hour; in., inches; snowfall, mean annual snowfall; ft³/s, cubic feet per second; Q_{100}, 100-year flood.]

Station number	Station name	Contributing area (mi²)	Slope (ft/mi)	Storage (percent)	Forest (percent)	25-yr, 24-hr precipitation (in.)	Snowfall (in.)	Soil permeability (in./hr)	Q_{100} by regression (ft³/s)	Flood-frequency area
04086150	Milwaukee River at Kewaskum, Wis.	138	4.70	12.1	13.1	4.66	40.6	.61	3,328	4
04086200	East Branch Milwaukee River near New Fane, Wis.	54.1	3.44	15.1	27.1	4.46	41.4	1.06	1,102	4
04086340	North Branch Milwaukee River near Fillmore, Wis.	148	4.10	6.50	14.1	4.66	42.6	.86	3,710	4
04086360	Milwaukee River at Waubeka, Wis.	432	5.89	8.86	14.6	4.66	42.2	.86	9,771	4
04086400	Milwaukee River tributary near Fredonia, Wis.	.82	27.6	1.38	.19	4.66	39.0	.12	189	4
04086500	Cedar Creek near Cedarburg, Wis.	120	9.90	10.7	3.00	4.66	42.5	.64	4,031	4
04087000	Milwaukee River at Milwaukee, Wis.	696	5.32	9.90	12.0	4.66	40.6	.77	13,939	4
04087050	Little Menomonie River near Freistadt, Wis.	8.00	30.0	.75	7.16	4.66	39.5	.50	783	5
04087204	Oak Creek at South Milwaukee, Wis.	25.0	7.64	1.60	5.70	4.66	48.9	.50	999	5
04087230	West Branch Root River Canal tributary near North Cape, Wis.	3.19	21.4	2.04	2.55	4.66	40.1	.50	231	5
04087233	Root River Canal near Franklin, Wis.	57.0	6.58	1.20	1.90	4.66	41.1	.50	2,139	5
04087240	Root River at Racine, Wis.	183	2.16	1.70	3.50	4.66	44.1	.27	3,413	5
04087250	Pike Creek near Kenosha, Wis.	7.25	8.15	.97	.42	4.66	40.0	.80	373	5
05333100	Little Frog Creek near Minong, Wis.	13.0	28.5	27.7	92.3	4.79	60.5	1.77	593	4
05334100	Sawyer Creek near Shell Lake, Wis.	1.04	67.8	.96	16.8	4.79	43.7	1.65	193	4
05335380	Bashaw Brook near Shell Lake, Wis.	22.8	16.7	11.2	41.9	4.79	50.2	2.40	900	4
05340300	Trade River near Frederic, Wis.	6.34	53.8	11.2	44.2	4.79	57.2	1.65	1,003	2
05341700	Willow River tributary near New Richmond, Wis.	1.40	50.7	.00	7.14	5.28	45.7	1.65	235	2
05341900	Kinnickinnic River tributary at River Falls, Wis.	7.26	96.0	.00	3.17	5.28	46.1	.46	4,512	2
05346600	Little Trimbelle Creek near Bay City, Wis.	19.9	34.9	.00	17.6	5.28	42.5	1.24	2,732	2
05356200	Kenyon Creek near Radisson, Wis.	7.50	12.2	24.7	87.9	4.79	58.0	1.65	435	2
05357360	Bear River near Powell, Wis.	120	1.08	52.4	62.8	4.66	80.6	4.68	856	4
05357390	Weber Creek near Mercer, Wis.	7.10	14.6	10.8	90.3	4.66	87.4	1.65	402	4
05358100	Smith Creek near Park Falls, Wis.	9.46	12.8	20.3	63.9	4.66	74.1	.80	499	3
05359500	South Fork Flambeau River near Phillips, Wis.	615	3.69	33.3	72.6	4.66	59.7	2.02	6,645	3
05359600	Price Creek near Phillips, Wis.	16.9	5.14	39.7	95.3	4.66	59.7	1.74	380	3
05360200	Flambeau River tributary at Ladysmith, Wis.	.80	15.2	28.8	48.7	4.79	56.6	1.41	70.1	2

Table A-2. Drainage-basin characteristics for rural streamflow-gaging stations in Wisconsin—Continued

[mi^2, square miles; ft/mi, feet per mile; in/hr, inches per hour; in., inches; snowfall, mean annual snowfall; ft^3/s, cubic feet per second; Q_{100}, 100-year flood.]

Station number	Station name	Contributing area (mi^2)	Slope (ft/mi)	Storage (percent)	Forest (percent)	25-yr, 24-hr precipitation (in.)	Snowfall (in.)	Soil permeability (in./hr)	Q_{100} by regression (ft^3/s)	Flood-frequency area
05361400	Hay Creek near Prentice, Wis.	21.9	15.6	24.8	61.6	4.66	53.3	.48	1,411	3
05361420	Douglas Creek near Prentice, Wis.	24.6	22.7	8.90	74.4	4.66	51.5	.80	1,301	3
05361600	North Fork Jump River near Phillips, Wis.	10.4	19.6	36.5	59.0	4.66	56.1	1.38	311	3
05362000	Jump River at Sheldon, Wis.	574	8.30	17.6	62.0	4.79	47.6	.63	41,052	2
05364000	Yellow River at Cadott, Wis.	351	5.96	14.1	63.0	4.79	44.0	.67	19,884	2
05364100	Seth Creek near Cadott, Wis.	3.04	43.8	.66	32.9	4.79	43.8	.50	1,108	2
05365000	Duncan Creek at Chippewa Falls, Wis.	114	6.75	1.60	11.0	4.79	46.2	2.01	3,223	2
05365700	Goggle-Eye Creek near Thorp, Wis.	6.70	20.0	6.42	16.9	4.66	45.3	.20	2,795	2
05366000	Eau Claire River near Augusta, Wis.	506	7.40	5.70	45.0	4.79	43.4	1.72	15,517	2
05366500	Eau Claire River near Fall Creek, Wis.	758	6.36	4.40	43.5	4.79	45.0	1.77	20,102	2
05367030	Willow Creek near Eau Claire, Wis.	4.38	57.1	.00	9.80	4.79	46.0	2.69	506	2
05367480	East Branch Pine Creek tributary near Dallas, Wis.	3.85	52.4	.00	12.2	4.79	45.3	1.34	726	2
05367500	Red Cedar River near Colfax, Wis.	1,100	4.17	7.80	38.7	5.28	44.4	2.02	19,398	2
05367700	Lightning Creek at Almena, Wis.	19.8	17.1	5.56	8.14	4.79	52.2	.79	2,393	2
05368000	Hay River at Wheeler, Wis.	426	6.12	3.20	32.4	5.28	44.4	2.12	9,872	2
05369000	Red Cedar River at Menomonie, Wis.	1,760	4.33	6.00	35.0	5.28	39.2	2.20	28,633	2
05369800	Eau Galle River tributary near Hersey, Wis.	.65	68.2	.00	33.8	5.28	45.7	.63	294	2
05370600	Arkansaw Creek tributary near Arkansaw, Wis.	2.56	102	.00	27.3	5.28	43.1	1.32	903	1
05370900	Spring Creek near Durand, Wis.	6.49	79.6	.00	56.9	5.28	43.5	1.63	1,438	1
05371300	By Golly Creek near Nelson, Wis.	.28	270	.00	50.0	5.28	42.2	1.65	182	1
05371800	Buffalo River tributary near Osseo, Wis.	1.44	67.1	.00	44.4	5.28	45.5	2.50	367	1
05371920	Buffalo River near Mondovi, Wis.	279	7.15	.41	24.9	5.28	44.7	2.39	13,473	1
05372000	Buffalo River near Tell, Wis.	406	6.30	2.10	28.6	5.28	41.9	2.36	16,738	1
05378200	Eagle Creek near Fountain City, Wis.	26.8	40.9	.00	47.6	5.28	41.8	1.65	3,684	1
05379500	Trempealeau River at Dodge, Wis.	643	3.64	1.40	25.8	5.28	45.4	1.77	18,913	1
05380800	Black River tributary near Whittlesey, Wis.	2.12	18.6	8.50	31.6	4.66	50.3	.93	276	2
05380900	Poplar River near Owen, Wis.	157	7.04	4.17	22.2	4.66	46.1	.50	13,027	2

Table A-2. Drainage-basin characteristics for rural streamflow-gaging stations in Wisconsin—Continued

[mi^2, square miles; ft/mi, feet per mile; in/hr, inches per hour; in., inches; snowfall, mean annual snowfall; ft^3/s, cubic feet per second; Q_{100}, 100-year flood.]

Station number	Station name	Contributing area (mi^2)	Slope (ft/mi)	Storage (percent)	Forest (percent)	25-yr, 24-hr precipitation (in.)	Snowfall (in.)	Soil permeability (in./hr)	Q_{100} by regression (ft^3/s)	Flood-frequency area
05380970	Cawley Creek near Neillsville, Wis.	38.6	17.2	.08	20.3	4.66	43.0	.50	6,395	2
05381000	Black River at Neillsville, Wis.	756	5.81	7.30	30.8	4.66	41.6	.62	42,318	2
05382000	Black River near Galesville, Wis.	2,120	5.51	8.20	43.7	5.28	37.7	2.15	59,559	1
05382200	French Creek near Ettrick, Wis.	14.3	33.8	.00	26.6	5.28	41.2	1.65	2,250	1
05382300	Beaver Creek tributary near Sparta, Wis.	1.72	66.2	.00	39.0	5.28	42.0	4.22	444	1
05382500	Little La Crosse River near Leon, Wis.	77.1	20.0	2.60	30.4	5.28	41.1	1.68	7,210	1
05383000	La Crosse River near West Salem, Wis.	398	6.98	3.10	31.9	5.28	39.8	2.99	16,895	1
05386300	Mormon Creek near La Crosse, Wis.	25.0	60.6	.00	36.0	5.28	39.8	1.65	4,718	1
05387100	North Fork Bad Axe River near Genoa, Wis.	80.9	27.3	.00	28.0	5.29	35.5	1.65	9,878	1
05388460	Du Charme Creek at Eastman, Wis.	.30	200	.00	30.0	5.29	37.3	1.65	204	1
05390140	Muskrat Creek at Conover, Wis.	10.2	8.45	4.47	92.3	4.66	79.7	3.37	237	3
05390240	Fourmile Creek near Three Lakes, Wis.	10.3	8.27	21.2	88.2	4.66	74.7	3.01	190	3
05391260	Gudegast Creek near Starks, Wis.	14.0	7.04	22.7	75.0	4.66	66.0	4.04	192	3
05391950	Squaw Creek near Harrison, Wis.	3.23	17.9	13.9	82.8	4.66	59.1	2.50	93	3
05392150	Mishonagon Creek near Woodruff, Wis.	13.9	6.77	26.2	82.4	4.66	83.5	6.22	132	3
05392350	Bearskin Creek near Harshaw, Wis.	19.6	6.48	28.7	69.3	4.66	57.6	6.27	170	3
05393500	Spirit River at Spirit Falls, Wis.	81.6	12.5	17.2	51.5	4.66	56.0	.85	2,877	3
05393640	Little Pine Creek near Irma, Wis.	22.0	24.0	9.55	79.9	4.66	55.7	3.30	389	3
05394000	New Wood River near Merrill, Wis.	82.2	14.7	14.5	84.2	4.66	53.7	.74	3,342	3
05394200	Devil Creek near Merrill, Wis.	9.58	10.5	2.48	26.4	4.66	52.9	.50	1,095	3
05394500	Prairie River near Merrill, Wis.	184	10.4	23.2	74.6	4.66	53.5	1.54	3,308	3
05395020	Lloyd Creek near Doering, Wis.	7.80	25.5	2.57	74.4	4.24	56.3	.71	503	3
05395100	Trappe River tributary near Merrill, Wis.	1.58	35.0	.00	34.5	4.66	53.7	.50	517	2
05396000	Rib River at Rib Falls, Wis.	303	11.8	6.80	55.4	4.66	51.4	.89	21,860	2
05396100	Pet Brook near Edgar, Wis.	6.86	54.5	.00	15.3	4.66	49.4	.42	3,144	2
05397500	Eau Claire River at Kelly, Wis.	375	8.28	11.4	45.2	4.66	50.9	1.28	7,955	3
05397600	Big Sandy Creek near Wausau, Wis.	11.5	20.3	.00	55.4	4.66	53.6	.47	1,772	3

Table A-2. Drainage-basin characteristics for rural streamflow-gaging stations in Wisconsin—Continued

[mi^2, square miles; ft/mi, feet per mile; in/hr, inches per hour; in., inches; snowfall, mean annual snowfall; ft^3/s, cubic feet per second; Q_{100}, 100-year flood.]

Station number	Station name	Contributing area (mi^2)	Slope (ft/mi)	Storage (percent)	Forest (percent)	25-yr, 24-hr precipitation (in.)	Snowfall (in.)	Soil permeability (in./hr)	Q_{100} by regression (ft^3/s)	Flood-frequency area
05399000	Big Eau Pleine River near Colby, Wis.	78.1	9.29	3.80	17.4	4.66	52.7	.25	14,023	2
05399200	Marsh Cr tributary near Abbotsford, Wis.	.56	62.2	8.93	16.0	4.66	53.7	.25	492	2
05399500	Big Eau Pleine River near Stratford, Wis.	224	10.1	1.90	21.2	4.66	66.6	.31	33,619	2
05400025	Johnson Creek near Knowlton, Wis.	25.1	32.6	2.55	56.4	4.66	47.3	.41	2,788	3
05400500	Plover River near Stevens Point, Wis.	145	5.64	18.9	40.7	4.38	44.8	1.79	2,230	3
05400650	Little Plover River at Plover, Wis.	7.91	10.7	1.50	26.5	4.38	42.7	5.96	130	3
05401050	Tenmile Creek near Nekoosa, Wis.	55.8	6.54	8.00	22.7	4.38	43.8	8.46	367	3
05401535	Big Roche A Cri Creek near Adams, Wis.	52.8	4.83	1.50	38.7	4.38	41.7	7.28	527	3
05401800	Yellow River tributary near Pittsville, Wis.	7.23	20.1	.30	27.5	4.38	44.3	.57	866	3
05402000	Yellow River at Babcock, Wis.	215	7.63	4.90	39.2	4.38	43.5	.77	13,219	2
05403000	Yellow River at Necedah, Wis.	491	6.07	9.40	48.7	4.38	34.3	1.68	13,502	2
05403500	Lemonweir River at New Lisbon, Wis.	507	3.65	15.6	44.2	4.38	41.9	2.88	6,559	2
05403520	Webster Creek at New Lisbon, Wis.	11.8	19.3	.00	41.7	4.38	43.8	1.64	908	2
05403550	Onemile Creek near Mauston, Wis.	30.2	15.9	.50	28.3	4.38	47.7	1.26	2,357	2
05403630	Hulbert Creek near Wisconsin Dells, Wis.	11.2	29.8	.09	44.3	5.29	40.4	1.65	721	3
05403700	Dell Creek near Lake Delton, Wis.	44.9	11.6	.94	28.5	5.29	40.9	2.40	1,483	3
05404200	Narrows Creek at Loganville, Wis.	40.1	29.1	.00	13.0	5.29	43.6	1.59	4,350	5
05405000	Baraboo River near Baraboo, Wis.	609	2.02	.60	28.8	5.29	38.2	1.48	12,300	5
05405600	Rowan Creek at Poynette, Wis.	10.4	30.4	.30	8.90	5.18	33.9	1.42	1,152	5
05406500	Black Earth Creek at Black Earth, Wis.	42.8	9.42	.20	21.8	5.18	34.9	1.52	1,469	1
05406800	Rocky Branch near Richland Center, Wis.	1.68	100	.00	40.9	5.29	39.6	1.65	581	1
05407100	Richland Creek near Plugtown, Wis.	19.2	51.8	.00	35.9	5.29	36.1	1.65	3,657	1
05407200	Crooked Creek near Boscobel, Wis.	12.9	51.1	.00	35.1	5.29	35.3	1.65	2,562	1
05407400	Morris Creek tributary near Norwalk, Wis.	4.59	126	.00	29.9	5.28	43.2	1.65	1,669	1
05408000	Kickapoo River at La Farge, Wis.	266	9.13	.10	34.0	5.29	38.6	1.63	14,402	1
05410500	Kickapoo River at Steuben, Wis.	690	4.30	.30	37.2	5.29	35.4	1.51	21,397	1
05413400	Pigeon Creek near Lancaster, Wis.	6.93	49.8	.00	1.62	5.29	33.3	1.65	3,294	1

Table A-2. Drainage-basin characteristics for rural streamflow-gaging stations in Wisconsin—Continued

[mi^2, square miles; ft/mi, feet per mile; in/hr, inches per hour; in., inches; snowfall, mean annual snowfall; ft^3/s, cubic feet per second; Q_{100}, 100-year flood.]

Station number	Station name	Contributing area (mi^2)	Slope (ft/mi)	Storage (percent)	Forest (percent)	25-yr, 24-hr precipitation (in.)	Snowfall (in.)	Soil permeability (in./hr)	Q_{100} by regression (ft^3/s)	Flood-frequency area
05413500	Grant River at Burton, Wis.	269	9.73	.00	22.1	5.29	31.5	1.65	17,175	1
05414000	Platte River near Rockville, Wis.	142	11.5	.00	22.3	5.29	34.1	1.65	10,672	1
05414200	Bear Branch near Platteville, Wis.	2.72	60.2	.00	1.07	5.29	37.2	1.65	1,703	1
05414900	Pats Creek near Elk Grove, Wis.	8.50	26.9	.00	4.00	5.29	35.7	1.65	2,268	1
05415000	Galena River at Buncombe, Wis.	125	11.3	.00	4.10	5.29	33.2	1.62	15,145	1
05423000	West Branch Rock River near Waupun, Wis.	40.7	9.58	10.0	1.57	4.46	38.1	.96	1,422	4
05423300	South Branch Rock River tributary near Waupun, Wis.	12.6	13.8	14.5	1.18	4.46	38.2	1.00	528	3
05423500	South Branch Rock River at Waupun, Wis.	63.6	8.33	8.20	1.50	4.46	38.2	1.51	1,624	3
05423800	East Branch Rock River tributary near Slinger, Wis.	4.42	74.2	.99	7.56	4.66	39.0	.80	663	5
05424000	East Branch Rock River near Mayville, Wis.	181	3.21	3.80	10.6	5.18	37.1	.79	4,509	4
05424300	Rock River tributary near Watertown, Wis.	4.58	13.2	.00	4.58	5.18	38.2	.56	412	5
05425500	Rock River at Watertown, Wis.	969	1.38	12.1	9.10	5.18	39.5	.99	6,454	5
05425700	Robbins Creek at Columbus, Wis.	8.01	21.0	1.99	3.86	5.18	36.2	1.65	533	5
05425827	Maunesha River near Sun Prairie, Wis.	26.0	12.9	.87	3.45	5.18	34.6	1.47	1,518	5
05426000	Crawfish River at Milford, Wis.	762	2.50	11.1	7.40	5.18	37.2	1.18	7,026	5
05426100	Scuppernong Creek near Wales, Wis.	5.69	21.1	13.1	12.7	4.66	38.7	2.67	201	5
05427200	Allen Creek near Fort Atkinson, Wis.	10.2	15.5	4.11	3.24	5.18	37.1	2.98	459	5
05427800	Token Creek near Madison, Wis.	24.3	8.53	1.24	3.43	5.18	33.6	1.65	1,102	5
05430100	Badfish Creek near Stoughton, Wis.	39.8	8.01	1.78	4.40	5.18	32.4	1.92	1,518	5
05430500	Rock River at Afton, Wis.	3,340	.74	11.4	7.90	5.18	31.5	1.20	14,853	5
05432300	Rock Branch near Mineral Point, Wis.	4.83	80.1	.00	6.42	5.29	36.5	.98	2,259	1
05432500	Pecatonica River at Darlington, Wis.	273	8.25	.00	11.7	5.29	35.4	1.57	19,189	1
05433000	East Branch Pecatonica River near Blanchardville, Wis.	221	8.25	.10	17.2	5.29	30.0	.68	14,203	1
05433500	Yellowstone River near Blanchardville, Wis.	28.5	26.4	.00	7.00	5.29	35.1	.51	5,707	1
05434200	Skinner Creek tributary near Monroe, Wis.	.48	136	.00	.00	5.18	37.9	.12	325	1
05434500	Pecatonica River at Martintown, Wis.	1,030	2.27	.30	11.5	5.18	29.6	1.08	13,577	1
05435900	Sugar River tributary near Pine Bluff, Wis.	7.42	43.9	.00	10.8	5.18	33.8	.42	910	1

Table A-2. Drainage-basin characteristics for rural streamflow-gaging stations in Wisconsin—Continued

[mi^2, square miles; ft/mi, feet per mile; in/hr, inches per hour; in., inches; snowfall, mean annual snowfall; ft^3/s, cubic feet per second; Q_{100}, 100-year flood.]

Station number	Station name	Contributing area (mi^2)	Slope (ft/mi)	Storage (percent)	Forest (percent)	25-yr, 24-hr precipitation (in.)	Snowfall (in.)	Soil permeability (in./hr)	Q_{100} by regression (ft^3/s)	Flood-frequency area
05436000	Mount Vernon Creek near Mount Vernon, Wis.	16.4	25.0	.00	13.0	5.18	34.0	.36	1,270	1
05436200	Gill Creek near Brooklyn, Wis.	3.34	57.3	.00	5.69	5.18	33.5	1.65	620	1
05436500	Sugar River near Brodhead, Wis.	523	3.18	.90	12.0	5.18	31.9	1.08	8,843	1
05437200	East Fork Raccoon Creek tributary near Beloit, Wis.	4.64	24.3	.00	3.85	5.18	30.2	.78	554	5
05543830	Fox River at Waukesha, Wis.	126	6.73	5.20	6.70	4.66	39.3	.56	2,854	5
05544300	Mukwonago River tributary near Mukwonago, Wis.	1.32	21.1	.00	4.55	4.66	39.8	3.75	164	5
05545100	Sugar Creek at Elkhorn, Wis.	6.68	12.0	3.60	4.04	4.66	42.2	.36	289	5
05545200	White River tributary near Burlington, Wis.	2.42	34.8	.83	2.48	4.66	40.1	1.08	280	5
05545300	White River near Burlington, Wis.	97.5	15.1	15.4	13.3	4.66	37.8	.81	2,171	5
05546500	Fox River at Wilmot, Wis.	868	1.11	7.80	10.0	4.66	44.2	.74	6,185	5
05548150	North Branch Nippersink Creek near Genoa City, Wis.	13.5	12.8	3.80	1.67	4.66	42.8	2.75	557	5