STATISTICAL MODELS FOR ESTIMATING FLOW CHARACTERISTICS OF MICHIGAN STREAMS

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CONVERSION FACTORS

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

Multiply inch-pound units	by	To obtain SI units
inch (in.)	25.40	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
square mile (mi^2)	2.590	square kilometer (km^2)
foot per mile (ft/mi)	0.1894	meter per kilometer (m/km)
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)

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ABSTRACT

Multiple-regression equations were developed to estimate flow characteristics at ungaged sites. Several readily measureable basin characteristics and an areal adjustment factor are required in the equations. Equations have been prepared to estimate mean and mean monthly flow, flow duration, low flow, peak flow, and flood volume.

The precision of the flow estimate varies with the flow characteristic being estimated, and the basin characteristics at the site of interest. Mean and mean monthly flow characteristics have the lowest standard error while the peak flow and low flow characteristics have the highest standard errors. Sites that have basin characteristics similar to the basin characteristics used to develop the regression equations can be estimated more precisely. Confidence limits can be computed about the estimate using information included in this report.

Five regions were designated in Michigan to account for the areal variation in the standard error of regression equations. Increased gaging activity in regions having higher standard errors may provide the greatest potential for increasing the precision of regional transfer of flow information provided by regression equations. Accordingly, additional continuous-record stations may be most useful in region 3 for reducing the standard error of mean and mean monthly flow equations. Additional partial-record stations may be most beneficial in region 4 for reducing the standard error of low flow and peak-flow regression equations.

INTRODUCTION

Determination of natural streamflow characteristics is one of the primary goals of the streamflow data collection program of the U.S. Geological Survey. This report was prepared to assist those needing flow information at ungaged sites and to lead to the improvement of the data-collection network.

Statistical models are often used to transfer streamflow information from gaged to ungaged sites. The multiple-regression equation is a common statistical model to estimate flow characteristics of streams. Bent (1970, 1971) developed equations for estimating flow characteristics at ungaged sites in Michigan. However new equations were needed to take advantage of: (1) longer periods of record available at most stations, (2) a greater number of stations with adequate definition of flow characteristics, (3) improved methods for determining basin characteristics, and (4) improved computational procedures. Symbols used thoughout the report are shown in table 1 (at end of report).

Purpose and Scope

The purpose of this report is to provide a means of estimating flow characteristics at ungaged sites, and to describe the uncertainty of the estimates of streamflow characteristics. The regional variability of the standard error of the equations is used as an indication of the potential for improving the accuracy of flow information transfered from gaged to ungaged sites by changing the level of gaging station activity in the region.

Acknowledgments

Acknowledgment is made to V. D. Herreid, who determined most of the basin characteristics, and to S. M. Beall, who prepared the illustrations.

METHOD OF INVESTIGATION

Data Base

Basic data needed to determine relations between basin characteristics and the characteristics of streamflow under natural conditions were derived from the surface-water gaging-station network maintained by the U.S. Geological Survey. Stations selected had 10 or more years of unregulated flow record (figs. 1, 2, 2a, 2b). Basins in heavily urbanized areas and those with gaged streams having drainage areas greater than 1,000 square miles (mi^2) were excluded. For stations with non-homogeneous periods of record, flow characteristics were computed only for periods representing natural-flow conditions. Flow characteristics were computed with data available through 1982.

Computation of Streamflow Characteristics

Streamflow characteristics summarize flow data at gaging stations. In this report, computed characteristics are considered approximate because detailed analyses of each station record was not made for all characteristics. Detailed analysis including correlation and extension with nearby station records may be desirable for many design purposes. Also, estimates of flow characteristics computed for a particular site will change to some degree depending on the length of record. Detailed analysis may, in some cases, indicate flow values different from those in this report.

Data from both continuous-record and crest-stage partial-record stations were used. Mean and mean monthly flows, flow duration, low flows and flood volumes were based on daily mean flow data available at continuous-record stations. Peak flow-frequency computations also included data from crest-stage stations. Computational procedures are outlined in "WATSTORE User's Guide" (Hutchison, 1975). Flow characteristics were defined as:

(1) Mean and mean monthly flow values--computed for 146 stations (table 2, at end of report). Q_A represents mean flow and Q_m, where m refers to the chronological order of months having January as one, represents the mean monthly flow.

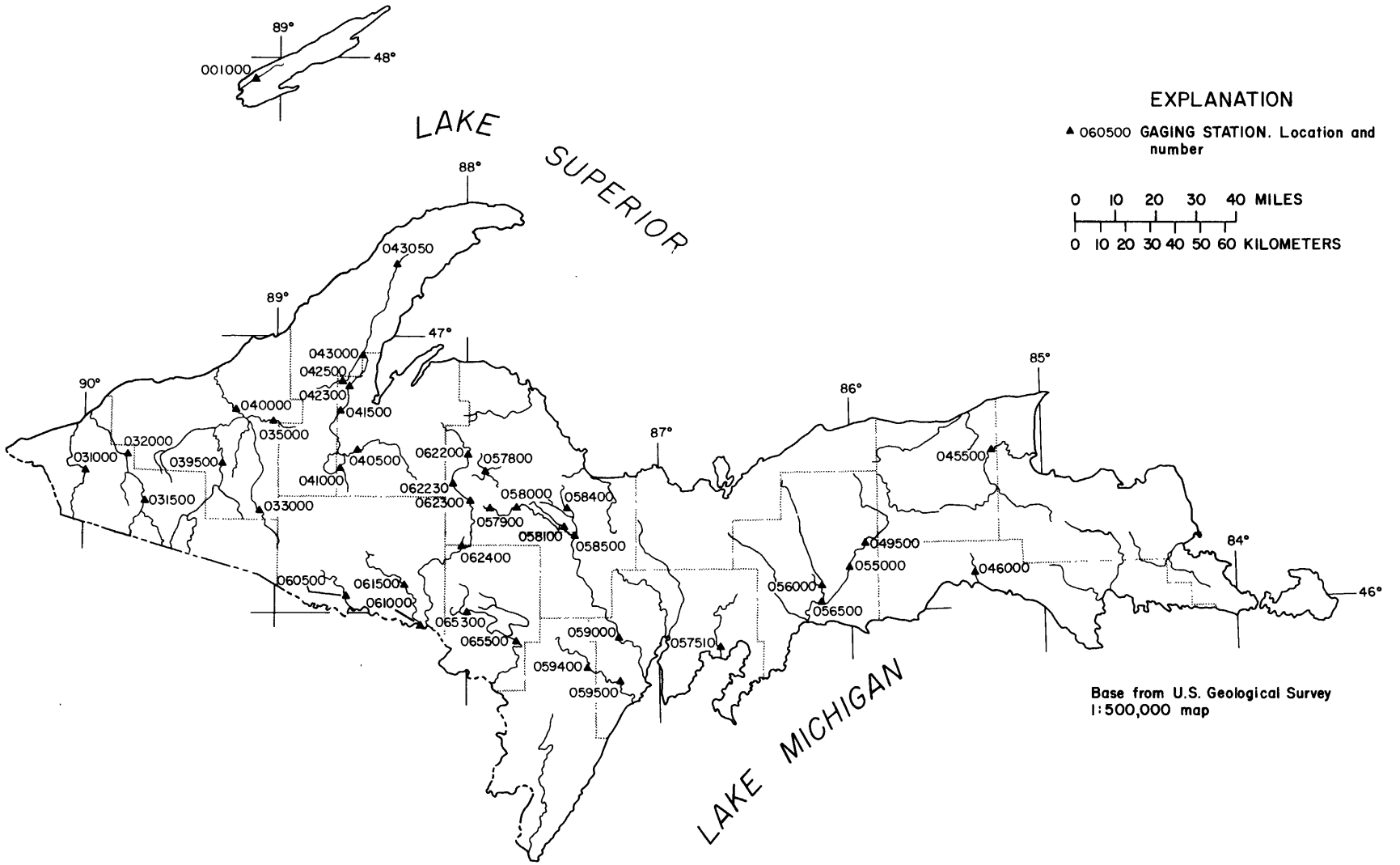

Figure 1.--Location of selected gaging stations in Michigan's Upper Peninsula (Prefix 04 to all station numbers)

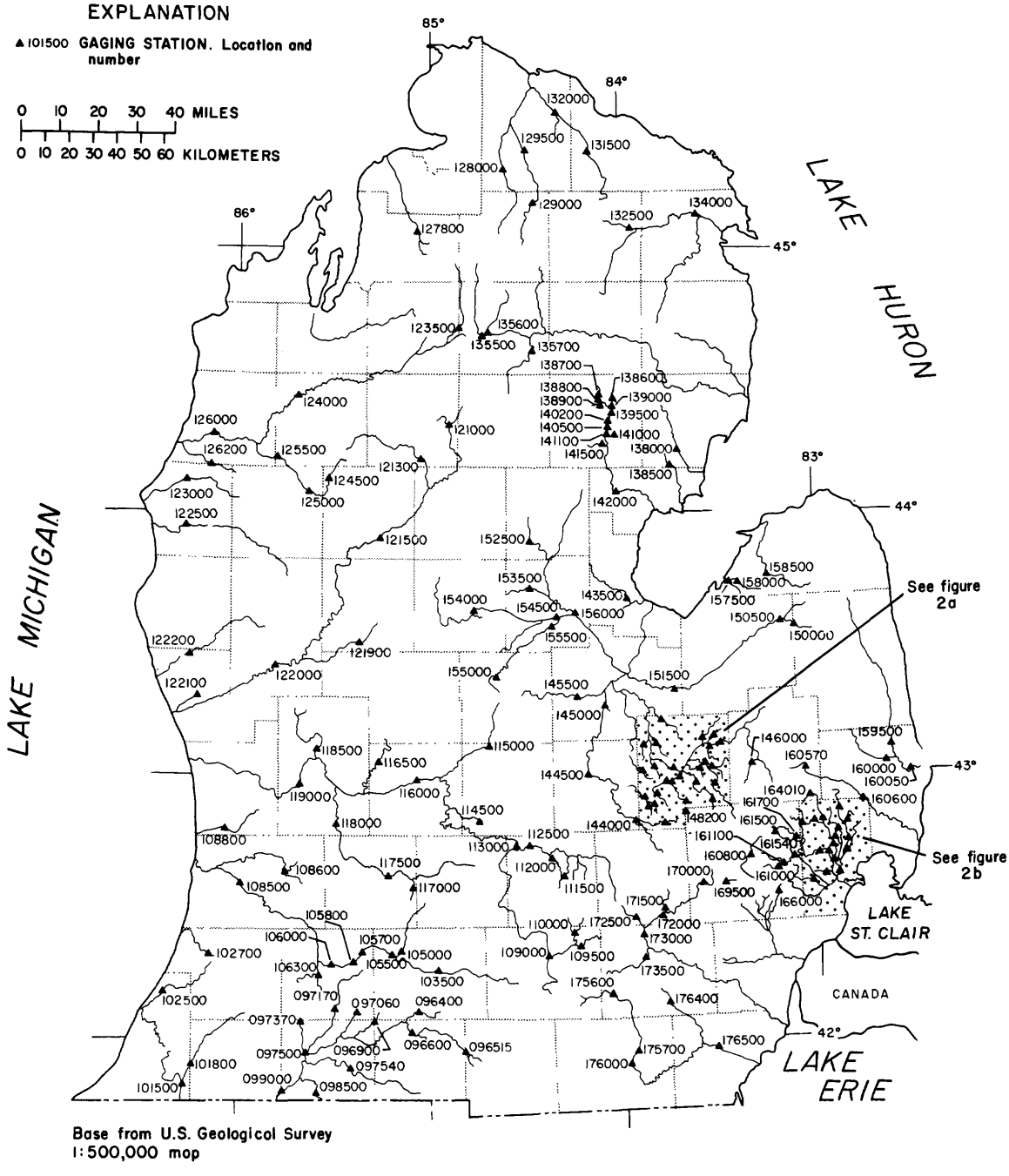

Figure 2.--Location of selected gaging stations in Michigan's Lower Peninsula (Prefix 04 to all station numbers)

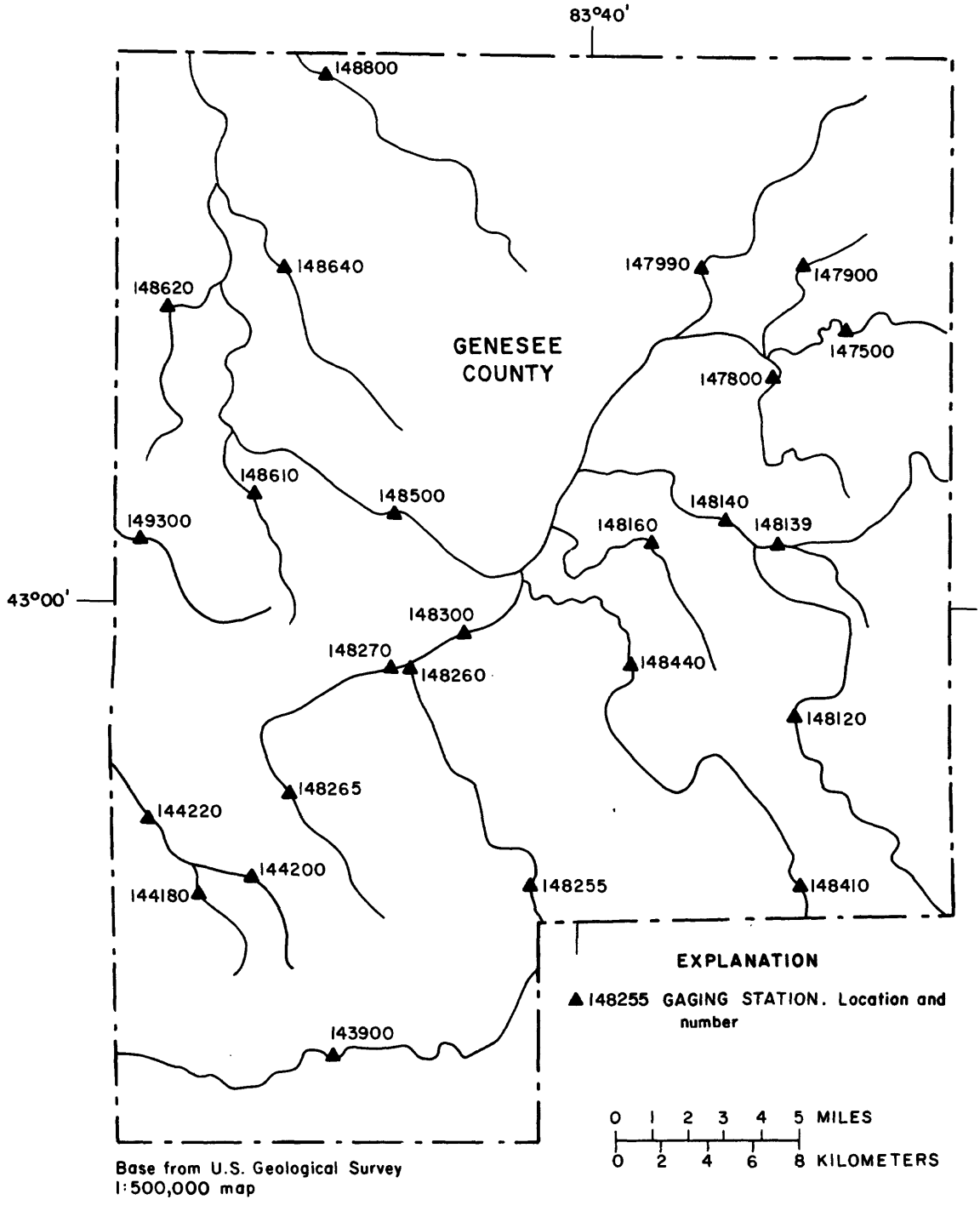

Figure 2a.--Location of selected gaging stations in Genesee County, Michigan (Prefix 04 to all station numbers)

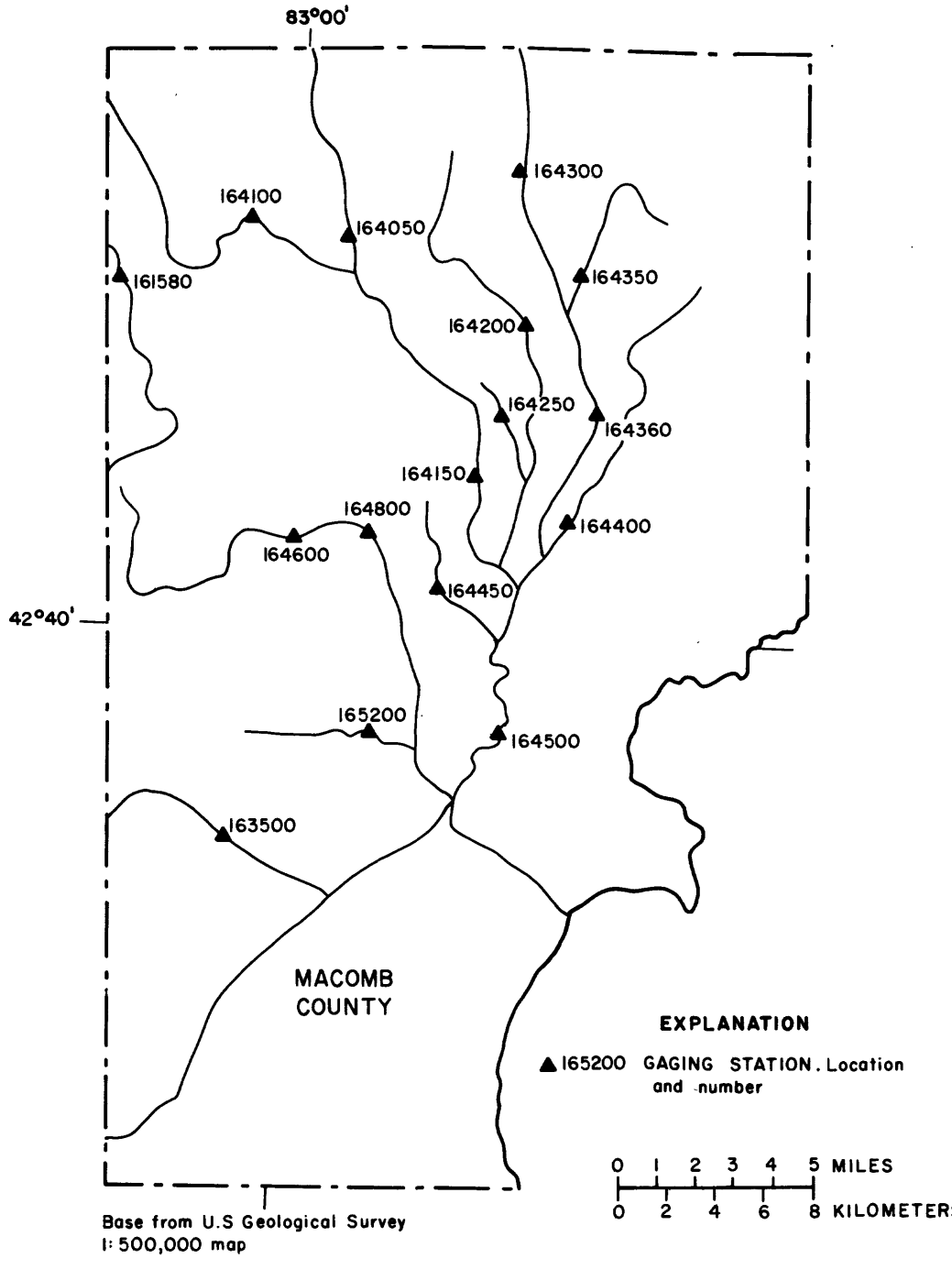

Figure 2b.--Location of selected gaging stations in Macomb County, Michigan (Prefix 04 to all station numbers)

(2) Flow-duration values--computed for 112 stations (table 3, at end of report). D_p indicates the daily mean flow exceeded a specified 'p' percentage of time. Frequency estimates were adjusted to include the affect of zero flow.

(3) Low flow values--computed for 112 stations (table 3). Annual low flow values represent the lowest average daily mean flows observed during any consecutive 7- or 30-day period between April 1 and March 31. Low flow frequency, $M_{d,t}$, is determined by fitting a Pearson type III distribution to logarithms of the series of annual minimum flows. The 10-year recurrence interval flow for 7-day periods ($M_{7,10}$), and 30-day periods ($M_{30,10}$) were used as low flow indices.

(4) Peak flow values--computed for 185 stations (table 4, at end of report). The computed 5-, 10-, 25-, 50-, and 100-year recurrence interval peak flow values are represented by P_5, P_{10}, P_{25}, P_{50}, and P_{100}. A detailed evaluation of each flood flow frequency curve was made following procedures recommended by the U. S. Water Resources Council (1981), using generalized flood skew coefficients recommended for Michigan (Croskey and Holtschlag, 1983). Adjustments were made for historical flood data, and both low and high outliers. In some cases, records were correlated and extended using nearby station records.

(5) Flood volume values--computed for 143 stations (table 4). Annual flood volumes represent the highest daily mean flows observed during any consecutive 7- or 30-day period between October 1 and September 30. Flood volume frequency, $V_{d,t}$, is determined by fitting a Pearson type III distribution to logarithms of annual flood volume. The 10-year recurrence interval flow for 7-day periods ($V_{7,10}$), and 30-day periods ($V_{30,10}$) were used as flood volume indices.

Determination of Drainage Basin Characteristics

Much of the variability in streamflow characteristics can be accounted for by differences in physical, geological, and meteorological conditions in the drainage basin. Basin characteristics used in this report were selected on the basis of probable hydrologic, hydraulic, geologic, or meteorologic significance, on the degree of success experienced in similar studies, and on the ease of determination. Basin characteristics were defined as follows:

(1) Total drainage area of a river basin, AREA, in mi^2, (table 5, at end of report) is a measure of, in a horizontal plain, the area enclosed by topographic divides, such that surface runoff from precipitation normally drains to the enclosed river. Areas within the basin that would not contribute to surface runoff were measured separately and subtracted from the total area to obtain the contributing area, CONTDA. Noncontributing areas were usually identified as those areas draining into surface depressions, as indicated by two or more depression contours, having sufficient volume to store the runoff from a 100-year flood. Due to the time limitations of the study, CONTDA was set equal to AREA for basins having drainage areas greater than 200 mi^2. (2) Channel length, LENGTH, in miles (mi), (table 5), was measured along a map representation of the main channel from the outlet to the basin divide. The main channel was chosen at each bifurcation by following the fork that had the largest drainage area. The upstream end of the channel was determined by extending the main channel from the end of the mapped representation of the stream to the basin divide.

(3) Slope of the main channel, SLOPE, in ft/mi, (table 5), computed from the difference in streambed elevation in feet, between points 10 and 85 percent of the distance along the main channel from the outlet to the basin divide, divided by 0.75 times the channel length (LENGTH), in miles.

(4) Main channel swamp, CHSWAMP (table 5), defines the percent of main channel length, LENGTH, that passes through swamp, lake, or pond.

(5) Point rainfall depth, in inches, during a 24-hour period that is on the average exceeded only once in 2-years or once in a 100-years (figs. 3 and 4), adjusted for drainage area (fig. 5), are represented as $I_{24,2}$ and $I_{24,100}$, (table 5).

(6) Slenderness ratio, SLENRAT (table 5), is a measure of the shape of a basin computed as the ratio of the channel length, LENGTH, squared divided by the contributing area, CONTDA.

(7) Forested area, FOREST (table 5), expressed as percent of contributing area, CONTDA, were determined using U.S. Geological Survey topographic maps and State county maps.

(8) Mean snowfall depth, SNOFALL, in inches per year, (table 5), determined from figure 6. Reported depth is dry snow and not water equivalent.

(9) January average daily minimum temperature, JANMIN, in degrees Fahrenheit, (table 5), were determined from figure 7.

(10) Percentage of each designated surficial geologic material contained within contributing drainage areas (table 6, at end of report), was derived from geologic maps showing drainage divides, (Farrand and Bell, reprinted 1984). Hydrologically similar surficial materials where combined to form the geologic variables. The following definition of the geologic variables is taken from the definitions given in bold type on these geologic maps: CLAY, lacustrine clay and silt; CORGT, coarse-textured glacial till; FINEM, end moraines of fine-textured till; FINGT, fine-textured glacial till; MEDTILL, medium-textured glacial till, and end moraines of medium-textured glacial till; MUCK, peat and muck; OUTWASH, postglacial alluvium, glacial outwash sand and gravel and post-glacial alluvium, and ice contact outwash sand and gravel; and TILROCK, thin to discontinous glacial till over bedrock.

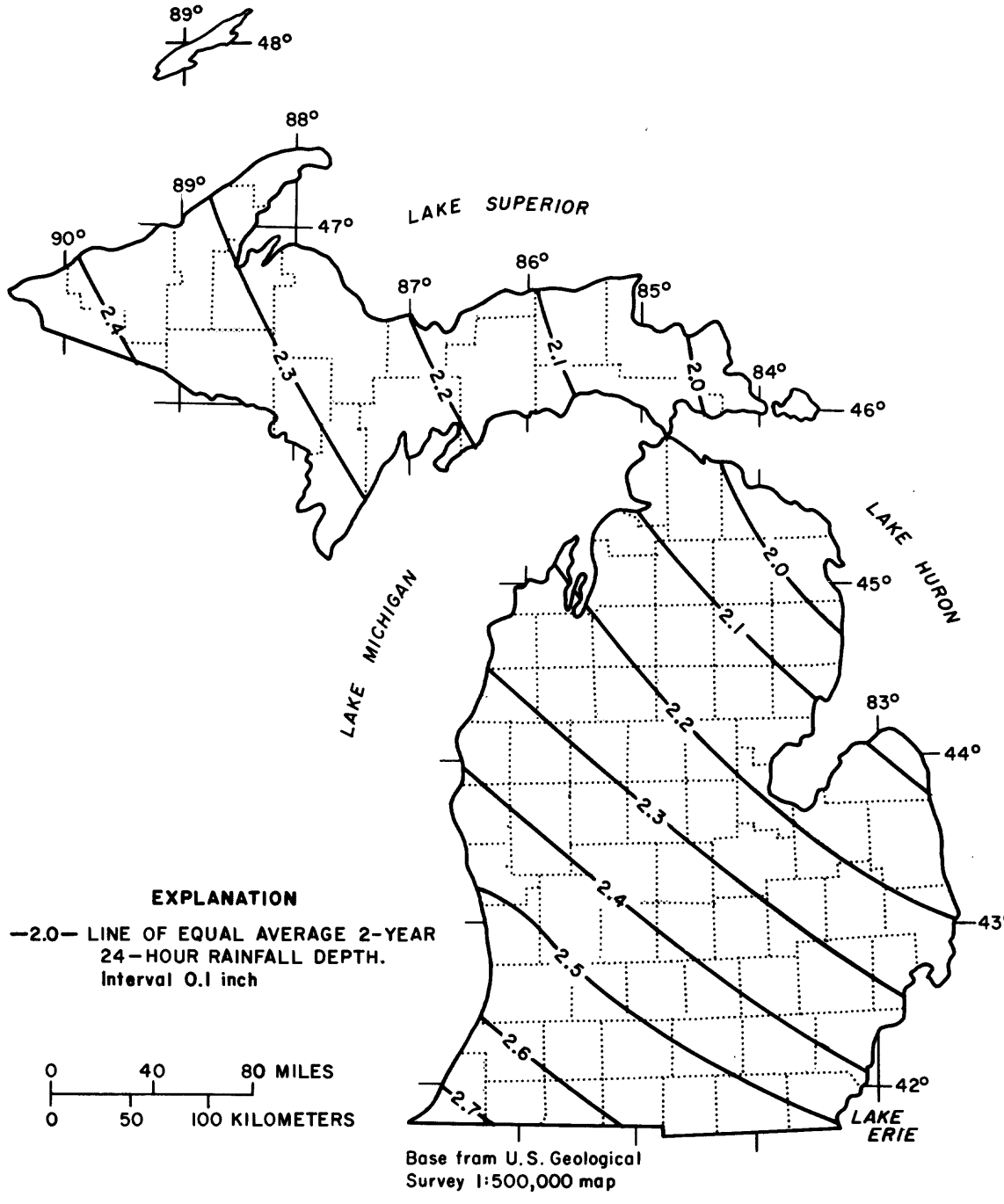

Figure 3.--Two-year 24-hour point rainfall depths
(Adapted from U.S. Weather Bureau, 1961)

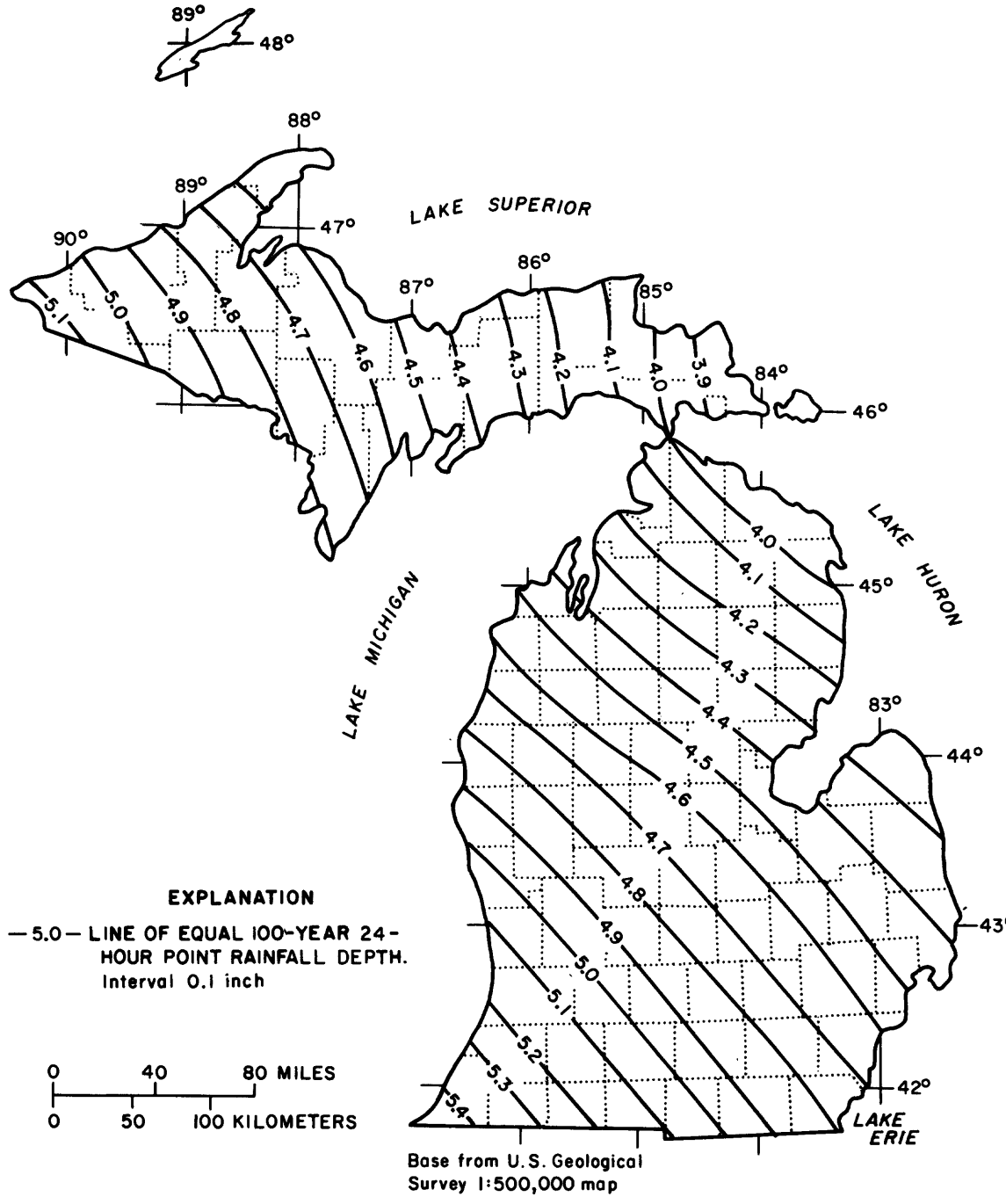

Figure 4.--One-hundred-year 24-hour point rainfall depths (Adapted from U.S. Weather Bureau, 1961)

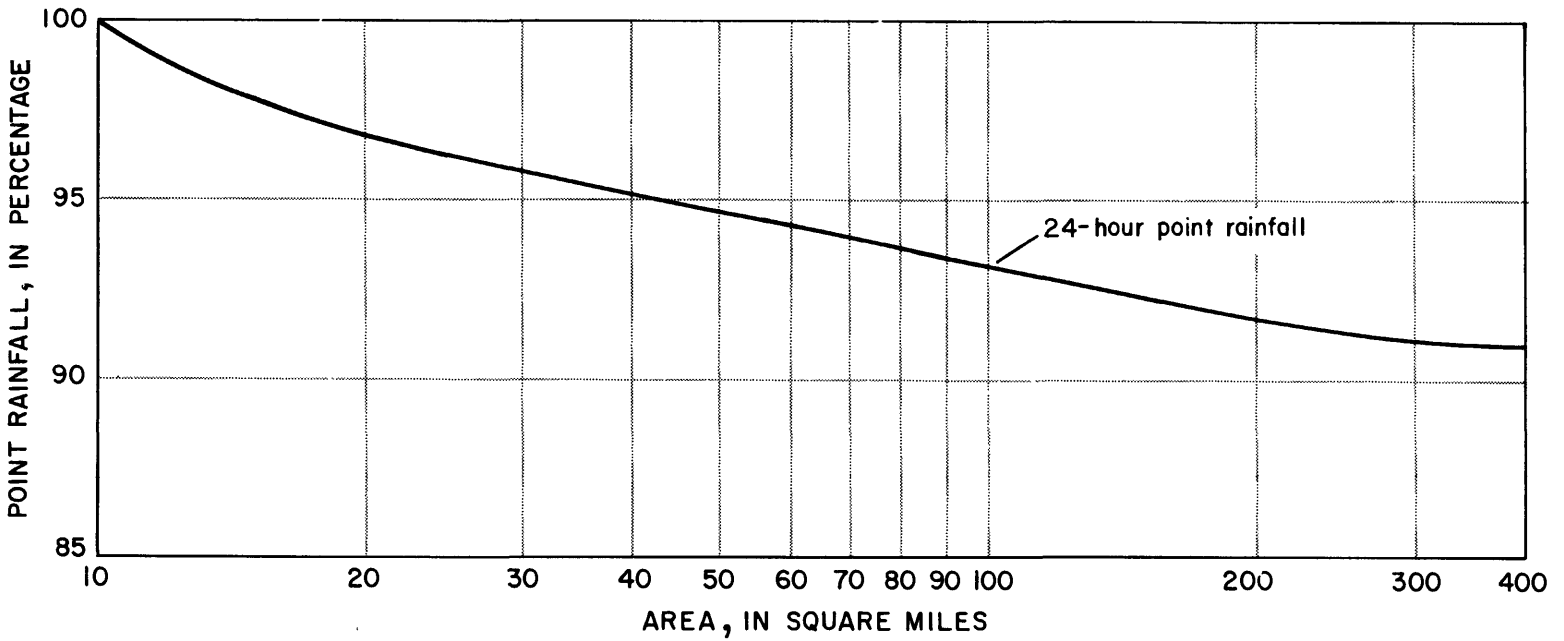

Figure 5.--Area-depth curve for adjustment of point rainfall (Adapted from U.S. Weather Bureau, 1961)

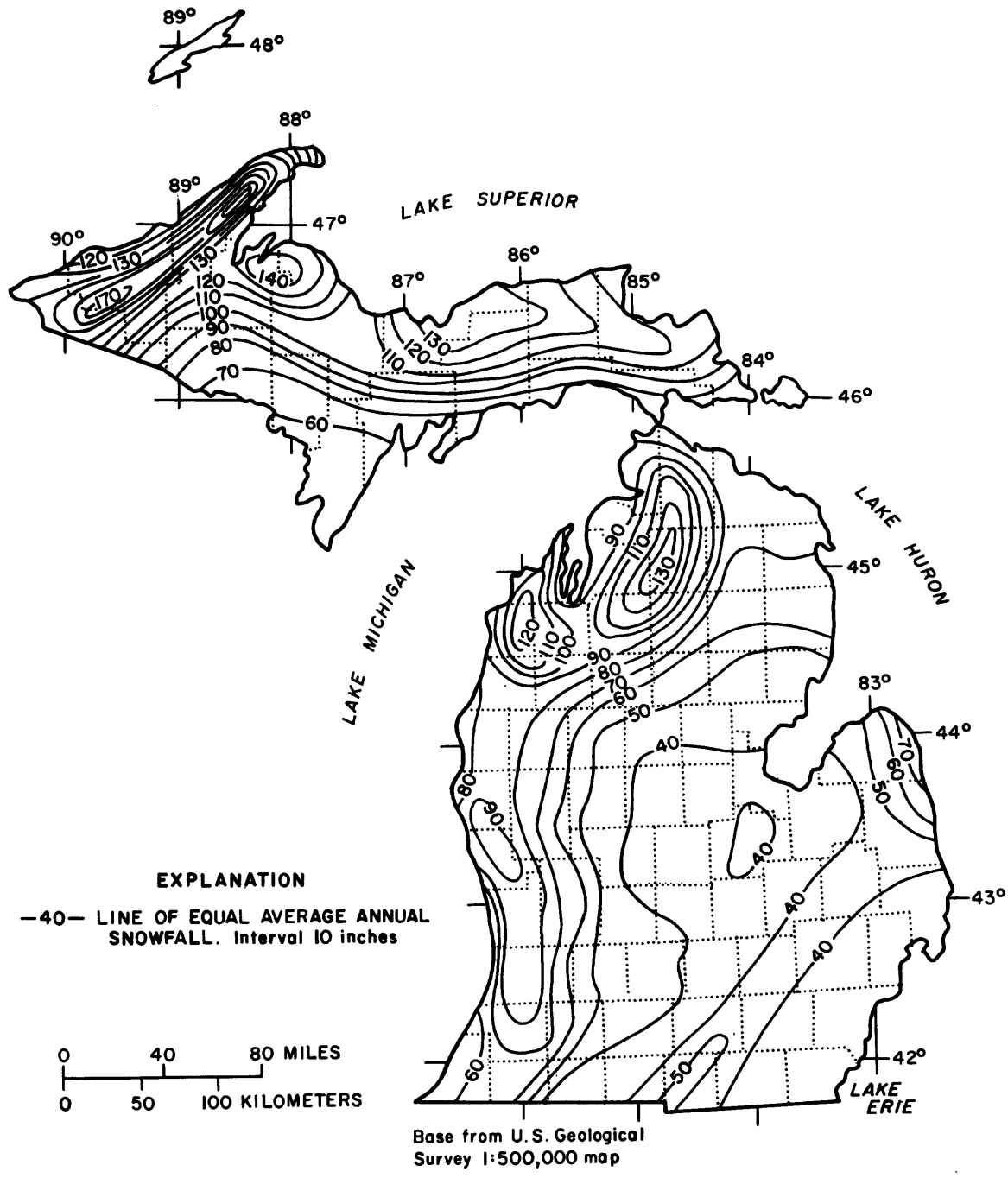

Figure 6.--Average snowfall (Adapted from Michigan Weather Service, 1971)

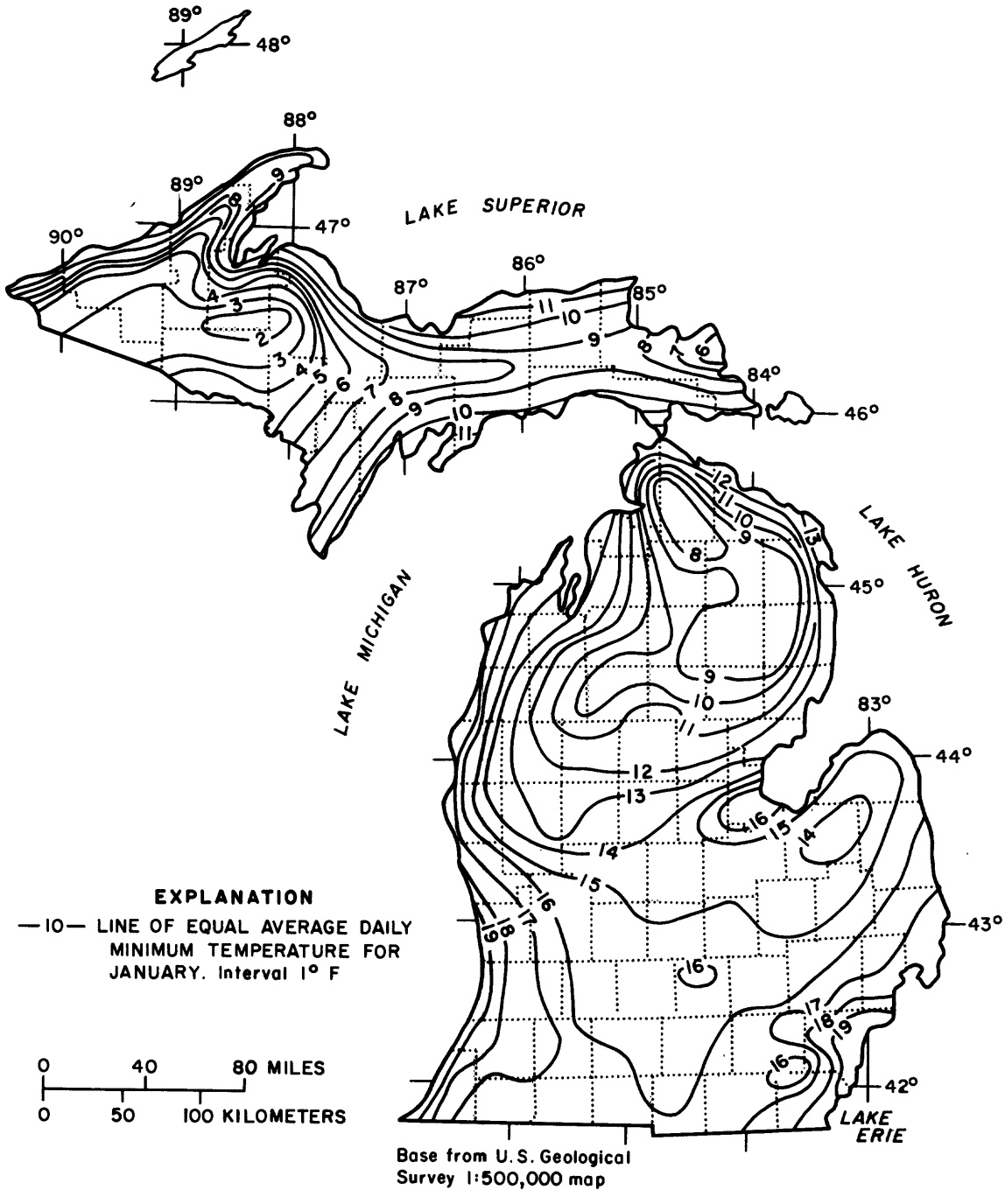

Figure 7.--January average daily minimum temperature
(Adapted from Michigan Weather Service, 1976)

Development of Statistical Models

Equation Formulation

Previous studies indicate that a nonlinear equation can be used as a statistical model to describe the relation between most basin and streamflow characteristics (Bent, 1970, 1971; and Thomas and Benson, 1975). The form of the equation is:

$$Y=10^{a} X_1^{b_1} X_2^{b_2} \ldots X_n^{b_n},$$

where: Y = dependent variable (streamflow characteristic),

X_1 to X_n = independent variables (basin characteristics),

a = regression constant, and

b_1 to b_n = regression coefficients.

To simplify development of regression constants and coefficients, the nonlinear equation was transformed to a linear equation by taking logarithms, to the base 10, of all variables. However, to avoid computing the logarithm of zero, one percent was added to the following variables before logarithms were computed CHSWAMP, CLAY, CORGT, FINEM, FINGT, FOREST, MEDTILL, MUCK, OUTWASH, and TILROCK, and 0.2 ft^3/s was added to D_p and $M_{d,t}$. The equivalent linear equation is:

$$\log_{10} Y = a + b_1 \log_{10} X_1 + b_2 \log_{10} X_2 + \ldots + b_n \log_{10} X_n.$$

Basin Characteristic Selection

Stepwise multiple regression analysis was used to select independent variables for estimating flow characteristics. Briefly, this technique introduces one or more independent variables into an equation in a stepwise manner, to account for the variability of the dependent characteristic (streamflow) according to a least-squares fitting procedure (Ray, 1982). A coefficient applied to each independent variable indicates the statistical relation between the basin and flow characteristics. An analysis of variance indicates the mean-square error of the equation and statistical significance of each independent variable. Influential data diagnostics (Belsley, Kuh, and Welsh, 1980) were used to identify possible outliers and highly influential data. Stations which exceeded test criteria limits, when accompanied by sufficient justification from other sources, were deleted.

Regionalization

Regionalization is a technique which attempts to define homogeneous hydrologic subregions within a large region, for which seperate regression analyses can be made. In areas where meaningful subregions can be defined, regression equations can be fitted more precisely, even though fewer observations are available for estimating regression coefficients. Regionalization was attempted by inspection of the areal distribution of residuals determined by state-wide equations, by grouping basins within major hydrologic unit areas (U.S. Geological Survey, 1974), and grouping basins by discriminate analysis.

A pattern of areal variation was found among residuals from state-wide equations. Therefore, sets of regionalized equations, based on geographic boundaries and discriminate functions, were developed. Residuals of the regionalized equations were not found to have a pattern of areal variation, and accounted for a significant, at the 5 percent level, reduction in mean-square error. However, regionalized equations produced coefficients which lacked stability and apparent physical significance. Moreover, the improved fit of the observed data did not necessarily mean an improved predictive ability of the model (Tasker, 1982). Therefore, state-wide equations were selected.

In order to account for the pattern of areal variation observed in residuals of some state-wide equations, adjustment factors, AREAL (table 7), were developed to regionalize flow estimates. Figure 8 shows areal adjustment regions. These factors were developed to (1), compensate for some local bias exhibited by state-wide equations, (2), estimate the regional precision of regression equations, and (3), maintain stable coefficients present in state-wide equations. AREAL is based on the mean residual, computed in logarithmic units, for each designated region (figs. 1 and 2) and represents the mean residual raised to the power of 10 after residuals found to be outliers at the 5 percent level of significance, were removed (Snedecor and Cochran, 1973).

Model Selection

Three sets of regression equations, (tables 8-10, at end of report) were developed to estimate streamflow characteristics based on basin characteristics and areal adjustment factors. Final selection of independent variables was influenced by (1), reduction in estimation error caused by inclusion of a basin characteristic, (2), the desire to have common sets of independent variables included in a flow characteristic series, (3), the stability and hydrologic reasonability of coefficients estimated for independent variables, and (4) the statistical significance of the estimated coefficients, generally maintained at the 5 percent level. The stability of coefficients is related to the degree of intercorrelation among independent variables (table 11, at end of report). Collinearity diagnostics as described by Belsley, Kuh, and Welsh, (1980), did not indicate degraded coefficient estimates because of intercorrelation. The algebraic sign and magnitude of coefficients generally seem appropriate with respect to their normally understood impact on flow characteristics.

Although initial selection of basin characteristics for the equations was based on hydrologic knowledge, the basis for retention was primarily statistical. Cause and effect relations between basin and streamflow characteristics are indeterminate because of interrelations among basin indices and the inability of the indices to describe completely a drainage basin. Despite the inability of the statistical relations to describe causes of streamflow variation, the basin indices are numerical measures that are related to streamflow variation (Thomas and Benson, 1975).

Results of regression analysis indicate mean and mean monthly flow characteristics can be estimated most precisely, based on percent mean-square-error in tables 8-10. Mean monthly flow estimates for July, August, September, and October are less precise than for the remaining months. The flow duration series covers a wide range of flow conditions from fairly high flow, D_{10}, to low flow, D_{95}. It is interesting to note the change in signs for the coefficients associated with variables CLAY and OUTWASH with the change in flow conditions. Also, the precision of the flow estimates decreases with decreasing flow within

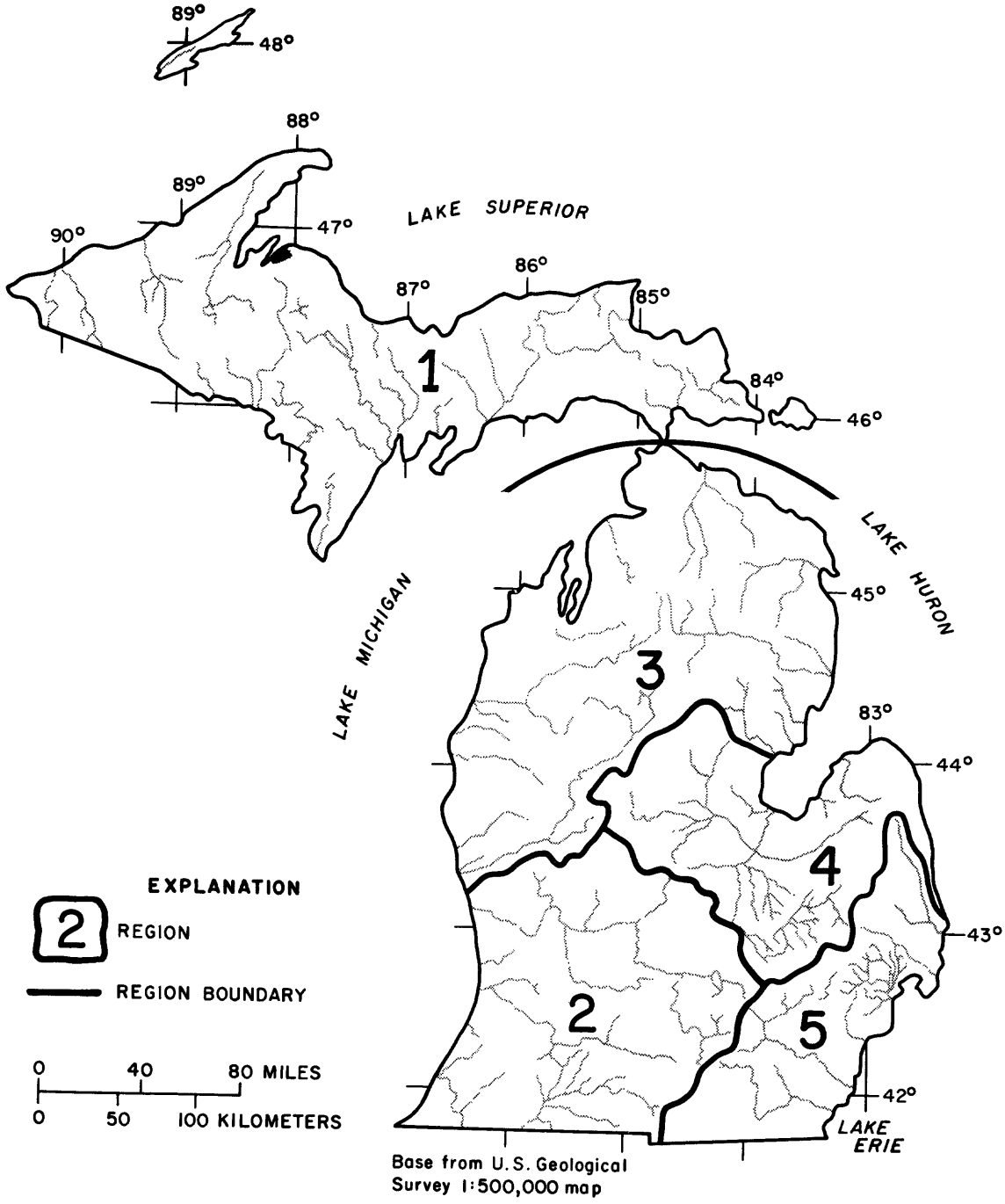

Figure 8.--Regions

the duration series. This decrease in precision at lower flows can also be observed in the low flow series, which have the least precision of any series examined. The precision of estimated peak flow values decreases with increasing recurrence intervals. The precision of the flood volume estimates also decrease under shorter duration, higher flow conditions. In general, the precision of flow estimates decreases for less frequent high and low flow conditions. And low flows can be estimated with less precision, as measured by percent mean-square-error, than either high or mean flows.

Percent standard errors of regression equations are shown (table 12, at end of report) by regions to indicate the areal variability in estimated flows. Region 3 had the highest average standard error for mean and for most mean monthly flows. Region 4 had the highest standard error for low flow characteristics $M_{7,10}$, $M_{30,10}$, and D_{95} and for peak flow. Only small differences occurred among regions for flow duration D_{10} through D_{75} and flood volumes $V_{7,10}$ and $V_{30,10}$. Variability in standard error among the five regions was used as an indication of the relative need for gaging stations. Additional continuous-record stations may be most useful in region 3 for reducing errors in estimating mean and mean monthly flow while additional partial-record stations may be useful in region 4 in order to reduce errors in estimating low flow and peak flow characteristics.

APPLICATION OF REGRESSION EQUATIONS

Application of regression equations to estimate streamflow characteristics at ungaged sites should be restricted. The basin of interest should be unaffected by urbanization and have unregulated streamflow. Irrigation, municipal, and industrial withdrawals either from the ground or stream, and unusual channel constrictions or surface storage conditions will alter a streams flow characteristics from what might be considered natural. In addition, basin characteristics should be typical of those available for the development of the regression equation. This limitation is not always apparent by examining the maximum and minimun values indicated in table 13, (at end of report) because of the interrelation of basin characteristics in multivariate analysis.

In some cases, the regression equations will estimate a value less than zero discharge for a flow characteristic. Negative estimates are more likely on smaller drainage basins when low flows are being estimated. In application, negative values are assumed to be zero.

Mean flow, Q_A, can be computed, for example, for Washington Creek (U.S. Geological Survey station number 04001000), using the equation:

$$Q_A = \text{AREAL}\ 10^{a}\ \text{AREA}^{b1}\ \text{SNOFALL}^{b2}\ I_{24,2}{}^{b3}$$

AREAL is from table 7; AREA, SNOFALL, AND $I_{24,2}$ are from table 5; and the statistical model is from table 8. The result is:

$$Q_A = 1.0097\ 10^{-1.4813}\ 13.2^{1.0217}\ 90^{0.5385}\ 2.10^{1.1703}$$

$$Q_A = 12.5\ ft^3/s$$

Confidence limits (CL) can be calculated within which $\mu|x$ will fall with a specified probability, using the following equation:

$$CL = \hat{Y} \pm t_{\alpha/2,\ n-k}\ S_{\hat{Y}}$$

Given the variance of $\hat{Y}$ about $\mu|x$:

$$S_{\hat{Y}o}^2 = S^2(\ 1/n + X'CX)$$

where S^2 is the mean-square error of the regression equation, in $\log_{10}$ units, (tables 8-10),

n is the number of observations in the regression, indicated in the definition of each flow characteristic,

k is the number of variables in the regression equation plus one,

X is the matrix of differences between the $\log_{10}$ of basin characteristics at the site of interest and the mean $\log_{10}$ of the basin characteristics used in developing the regression equation (table 13), individual values in the matrix are denoted as x_i.

C inverse crossproduct matrix of basin characteristics (table 14 at end of report), individual values in the matrix are denoted as c_{ij},

$S_{\hat{Y}}$ decreases with increasing n and increases with X'CX, which accounts for the increased uncertainty of estimates using basin characteristic values different than the mean of the $\log_{10}$ of basin characteristics used in developing the equation.

Table 15. --Example computation of the X'CX term used in estimating standard error.

	c_{ij}			x_i	cx_i
	LAREA	LSNOFALL	$LI_{24,2}$		
LAREA	0.02757	-0.006255	0.1748	(1.1206-2.1073)	-0.03006
LSNOFALL	-0.006255	0.2080	0.3430	(1.9542-1.7629)	0.04270
LI24,2	0.1748	0.3430	10.62	(0.3222-0.3317)	-0.2077
				X'CX	= 0.03980

To obtain cx_i values shown in the above table multiply the C matrix by the column X matrix (C·X). To obtain X'CX, multipy the transpose of the X matrix, denoted as X', by the CX matrix. Since the number of observations used in developing the regression equation for mean and mean monthly flow is 146 and the mean-square regression error, S^2, equals 0.008549, (table 8) this gives

$$S_{\hat{Y}O} = (0.008549 (1/146 + 0.03980))^{0.5} = 0.01997$$

To be 95 percent certain that CL will contain $\mu_{Y|x}$, multiply $S_{\hat{Y}}$ by a Student's t value depending on n-k degrees of freedom and the 5 percent level of probability specified for a two-tailed test. For n equal to 146, $t_{0.025}$ equals 1.96 (Snedecor and Cochran, 1973). The $\log_{10}$ of the confidence limits (LCL) = $LQ_A \pm 1.96 * 0.01997$, or transformed to ft^3/s, lower and upper confidence limits are 11.4 to 13.7 ft^3/s.

When estimating Q_A for an individual new observation, the standard error of the estimate Y about $y_{Y|x}$ contains an additional source of randomness accounted for according to the following equation:

$$S_{\hat{Y}p}^2 = S^2 (1 + 1/n + X'CX)$$

$$S_{\hat{Y}p} = (0.008549 (1 + 1/146 + 0.03980))^{0.5} = 0.09459$$

For the 5 percent level of probability, the confidence limits are 8.16 to 19.2 ft^3/s.

SUMMARY AND CONCLUSIONS

Multiple-regression equations were developed to provide an estimate of streamflow characteristics based on basin characteristics at ungaged sites. Several readily measurable basin characteristics and an areal adjustment factor are required. Equations have been developed for mean and mean monthly flow, flow duration, low flow, peak flow, and flood volume.

The standard error of estimate varies with the flow characteristic being estimated, and the basin characteristics at the site of interest. Mean and mean monthly flow characteristics have the lowest standard error while peak flow and low flow characteristics have the highest standard errors. Sites having basin characteristics near the mean of $\log_{10}$ of basin characteristics used to develop the regression equations can be estimated more precisely. Information needed to compute confidence limits for estimated values is included.

The standard error of residuals among the five regions designated in Michigan are thought to be proportional to the need for additonal gaging stations. Additional continuous-record stations may be most useful in region 3 for reducing the standard error of mean and mean monthly flow equations. Additional partial-record stations may be most beneficial in region 4 for reducing the standard error of low flow and peak flow regression equations.

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TABLES

Table 1.--Symbols and definitions

Symbol	Definition
a	Constant in regression equation.
AREA	Drainage area of a river basin, in square miles.
AREAL	Areal adjustment factor to regionalize flow estimate.
$b_1, b_2, b_3 \ldots b_n$	Regression coefficients.
C	Inverse cross product matrix of basin characteristics.
c_{ij}	Elements of the C matrix.
CHSWAMP	Percent of main channel length, LENGTH, that passes through swamp, lake, or pond.
CL	Confidence limits.
CLAY	Lacustrine clay and silt, as percent of CONTDA.
CONTDA	Contributing drainage area, in square miles.
CORGT	Coarse-textured glacial till, as percent of CONTDA.
D_p	Daily mean flow value exceeded, 'p' percentage of the time, in cubic feet per second.
d(subscript)	Duration, in days.
FINEM	End moraines of fine-textured till, as percent of CONTDA.
FINGT	Fine-textured glacial till, as percent of CONTDA.
FOREST	Forested area as a percent of CONTDA.
h (subscript)	Duration in hours.
$I_{h,t}$	Intensity of h-hour, t-year point rainfall, multiplied by a area-depth adjustment factor, in inches.
JANMIN	January average daily minimum temperature, in degrees Fahrenheit.
k	Number of variables in the regression equation plus one.
LENGTH	Length of main channel, in miles.
$M_{d,t}$	Minimum d-day average flow having a t-year recurrence interval, in cubic feet per second.
MEDTILL	Medium-textured glacial till, and end moraines of medium-textured glacial till, as percent of CONTDA.
MUCK	Peat and muck, as percent of CONTDA.
n	Number of observations used in developing regression equations.

Table 1.--Symbols and definitions--Continued

Symbol	Definition
OUTWASH	Postglacial alluvium, glacial outwash sand and gravel and postglacial alluvium, and ice-contact outwash sand and gravel, as percent of CONTDA.
P_t	Peak flow having a t-year recurrence interval, in cubic feet per second.
p (subscript)	Percentage of time during which flow is equalled or exceeded.
Prob>|T|	The probability that a t statistic would obtain a greater absolute value than that observed given that the true parameter is zero. This is a two-tailed test.
Q_A	Mean flow, in cubic feet per second.
Q_m	Mean monthly flow for month m, where January is one, in cubic feet per second.
S	Estimated standard error of the regression equation. Square root of the mean-square error.
$S_{\hat{Y}o}$	Estimated standard error of $\hat{Y}$ about $\mu \mid x$.
$S_{\hat{Y}p}$	Estimated standard error of $\hat{Y}$ about $Y \mid x$.
SLENRAT	Slenderness ratio, LENGTH squared divided by CONTDA.
SLOPE	Slope of main channel, in feet per mile.
SNOFALL	Mean dry snowfall depth, in inches per year.
$t_{\alpha/2,n-k}$	Two tailed Student's t value at n-k degrees of freedom.
t (subscript)	Average recurrence interval in years.
TILROCK	Thin to discontinous glacial till over bedrock, as percent of CONTDA.
$V_{d,t}$	Maximum d-day average flow having a t-year recurrence interval, in cubic feet per second.
X	Matrix of differences between the $\log_{10}$ of basin characteristics at a site and the mean $\log_{10}$ of basin characteristics used in developing the regression equation.
x_i	Elements of the X matrix.
$X_1, X_2, X_3 \ldots X_n$	Basin characteristics.
Y	Streamflow characteristic.
$\hat{Y}$	Predicted value from a regression equation.
μ	Population mean.

Table 1.--Symbols and definitions--Continued

Symbol	Definition
LAREA	Log_{10} transformation of LAREA.
LCHSWAMP	Log_{10} transformation of (CHSWAMP + 1 percent).
LCLAY	Log_{10} transformation of (CLAY + 1 percent).
LCONTDA	Log_{10} transformation of CONTDA
LCORGT	Log_{10} transformation of (CORGT + 1 percent).
LD_p	Log_{10} transformation of (D_p + 0.2 cubic feet per second).
LFINEM	Log_{10} transformation of (FINEM + 1 percent).
LFINGT	Log_{10} transformation of (FINGT + 1 percent).
LFOREST	Log_{10} transformation of (FOREST + 1 Percent).
$LI_{h,t}$	Log_{10} transformation of $I_{h,t}$.
LJANMIN	Log_{10} transformation of JANMIN.
$LM_{d,t}$	Log_{10} transformation of ($M_{d,t}$ + 0.2 cubic feet per second).
LMEDTILL	Log_{10} transformation of (MEDTILL + 1 percent).
LMUCK	Log_{10} transformation of (MUCK + 1 percent).
LOUTWASH	Log_{10} transformation of (OUTWASH + 1 percent).
LP_t	Log_{10} transformation of P_t.
LQ_A	Log_{10} transformation of Q_A.
LQ_m	Log_{10} transformation of Q_m.
LSLENRAT	Log_{10} transformation of SLENRAT.
LSLOPE	Log_{10} transformation of SLOPE.
LSNOFALL	Log_{10} transformation of SNOFALL.
LTILROCK	Log_{10} transformation of (TILROCK + 1 percent).
$LV_{d,t}$	Log_{10} transformation of $V_{d,t}$.

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Table 2.--Computed and estimated mean

USGS station number	Station name	Mean flow (ft^3/s) Q_A	Mean monthly flow, Q_m (ft^3/s) Q_1	Q_2	Q_3	Q_4	Q_5
04001000	WASHINGTON CREEK AT WINDIGO, MICH.	[a]17.5 12.5	4.47 3.77	3.90 3.75	14.3 8.88	80.4 55.5	44.2 33.4
04031000	BLACK RIVER NEAR BESSEMER, MICH.	235 281	67.0 108	58.6 81.8	210 153	1,090 851	385 612
04031500	PRESQUE ISLE RIVER AT MARENISCO, MICH.	177 225	87.5 78.2	81.5 57.6	140 118	494 710	351 509
04032000	PRESQUE ISLE RIVER NEAR TULA, MICH.	279 359	109 136	99.2 99.8	231 187	916 1,100	573 764
04033000	MIDDLE BRANCH ONTONAGON RIVER NEAR PAULDING, MICH.	173 184	109 80.8	109 70.8	145 122	363 626	288 479
04035000	EAST BRANCH ONTONAGON RIVER NEAR MASS, MICH.	258 329	146 142	138 130	262 222	722 1,090	393 751
04040500	STURGEON RIVER NEAR SIDNAW, MICH.	214 189	69.8 77.9	59.6 67.8	155 121	779 672	491 467
04041500	STURGEON RIVER NEAR ALSTON, MICH.	421 379	210 167	196 153	353 258	1,180 1,300	846 953
04042500	OTTER RIVER NEAR ELO, MICH.	216 226	112 81.8	106 73.0	198 169	800 592	403 372
04043000	STURGEON RIVER NEAR ARNHEIM, MICH.	824 908	418 448	383 365	723 630	2,570 2,310	1,690 1,670
04043050	TRAP ROCK RIVER NEAR LAKE LINDEN, MICH.	44.7 32.7	19.9 17.9	19.2 14.5	42.4 28.3	191 77.4	85.2 43.3
04045500	TAHQUAMENON RIVER NEAR TAHQUAMENON PARADISE, MICH.	937 815	479 479	459 452	673 800	2,790 1,960	1,880 1,110
04046000	BLACK RIVER NEAR GARNET, MICH.	29.4 31.1	15.9 15.0	13.5 14.7	21.7 33.9	92.8 80.9	48.6 42.7
04049500	MANISTIQUE RIVER AT GERMFASK, MICH.	447 346	382 238	359 227	416 351	829 868	659 484
04055000	MANISTIQUE RIVER NEAR BLANEY, MICH.	834 734	625 479	568 477	785 769	2,170 1,760	1,320 1,060
04056000	WEST BRANCH MANISTIQUE RIVER NEAR MANISTIQUE MICH.	411 362	253 232	217 208	354 339	1,270 855	774 487
04057510	STURGEON RIVER NEAR NAHMA JUNCTION, MICH.	211 186	125 134	113 123	180 183	608 469	329 300
04057800	MIDDLE BRANCH ESCANABA RIVER AT HUMBOLT, MICH.	60.0 56.4	22.8 30.0	19.3 22.1	37.2 36.9	205 160	140 99.4
04057900	BLACK RIVER NEAR REPUBLIC, MICH.	32.9 37.8	12.9 11.2	9.62 10.1	24.0 23.7	109 149	74.6 96.3
04058000	MIDDLE BRANCH ESCANABA RIVER NEAR ISHPEMING, MICH.	139 147	57.2 63.7	46.8 55.0	72.5 94.5	440 514	327 336
04058400	GOOSE LAKE OUTLET NEAR SANDS STATION, MICH.	33.0 41.4	17.0 26.9	15.3 25.6	25.7 43.0	112 102	65.2 64.7
04058500	EAST BRANCH ESCANABA RIVER AT GWINN, MICH.	105 133	48.6 83.3	42.0 82.0	69.1 137	343 334	207 219
04059000	ESCANABA RIVER AT CORNELL, MICH.	848 965	376 536	404 494	624 824	2,750 2,460	1,840 1,790
04059500	FORD RIVER NEAR HYDE, MICH.	382 410	116 193	92.1 203	222 408	1,370 1,160	877 896
04061000	BRULE RIVER NEAR FLORENCE, WISC.	359 356	250 195	282 196	357 318	686 1,100	525 935

[a] Upper values based on analysis of station records, lower values based on regression equations.

and mean monthly flow values

Mean monthly flow, Q_m (ft^3/s)							
Q_6	Q_7	Q_8	Q_9	Q_{10}	Q_{11}	Q_{12}	Station name
15.4	6.13	3.96	8.44	10.4	11.7	6.94	WASHINGTON CREEK AT WINDIGO,
11.3	5.62	4.01	5.83	7.75	9.67	6.18	MICH.
187	88.7	104	128	193	223	108	BLACK RIVER NEAR BESSEMER,
332	200	150	209	229	256	163	MICH.
217	143	107	122	132	151	111	PRESQUE ISLE RIVER AT
247	138	97.4	141	163	188	120	MARENISCO, MICH.
337	220	153	161	192	234	150	PRESQUE ISLE RIVER NEAR
405	242	178	249	277	313	204	TULA, MICH.
211	152	130	142	153	157	125	MIDDLE BRANCH ONTONAGON
229	148	115	150	166	184	115	RIVER NEAR PAULDING, MICH.
283	193	173	189	204	236	176	EAST BRANCH ONTONAGON RIVER
384	251	194	256	284	314	203	NEAR MASS, MICH.
230	130	79.4	133	159	181	112	STURGEON RIVER NEAR SIDNAW,
214	135	102	136	156	176	113	MICH.
455	311	230	289	320	367	262	STURGEON RIVER NEAR ALSTON,
448	296	225	293	326	362	233	MICH.
191	125	110	120	137	165	133	OTTER RIVER NEAR ELO, MICH.
212	108	72.4	112	137	164	122	
847	594	431	472	563	680	513	STURGEON RIVER NEAR ARNHEIM,
1,050	681	503	684	749	827	597	MICH.
39.7	22.1	16.1	25.3	26.4	31.5	23.9	TRAP ROCK RIVER NEAR LAKE
30.6	17.1	13.0	17.8	21.5	26.0	24.6	LINDEN, MICH.
736	523	443	643	830	993	755	TAHQUAMENON RIVER NEAR TAH-
741	463	331	452	552	641	584	QUAMENON PARADISE, MICH.
25.9	18.7	14.6	20.5	24.3	31.8	25.3	BLACK RIVER NEAR GARNET,
24.1	11.9	8.13	11.9	16.1	20.8	20.3	MICH.
461	340	259	333	418	480	436	MANISTIQUE RIVER AT GERMFASK,
344	238	190	239	278	313	288	MICH.
810	553	380	481	684	875	767	MANISTIQUE RIVER NEAR BLANEY,
738	500	379	490	567	640	574	MICH.
456	265	173	176	265	399	331	WEST BRANCH MANISTIQUE RIVER
364	242	188	246	284	320	290	NEAR MANISTIQUE MICH.
216	130	122	148	173	212	180	STURGEON RIVER NEAR NAHMA
213	153	128	156	174	191	162	JUNCTION, MICH.
64.0	33.1	28.4	43.4	49.5	50.7	35.0	MIDDLE BRANCH ESCANABA RIVER
64.9	42.1	35.3	45.8	51.3	56.9	42.6	AT HUMBOLT, MICH.
47.3	19.4	10.5	20.7	21.8	22.3	17.8	BLACK RIVER NEAR REPUBLIC,
36.1	18.1	12.5	18.6	23.6	28.9	18.2	MICH.
159	96.8	58.4	93.9	104	120	87.6	MIDDLE BRANCH ESCANABA RIVER
167	108	85.3	112	126	141	92.9	NEAR ISHPEMING, MICH.
38.6	20.8	15.1	18.2	21.7	25.2	22.2	GOOSE LAKE OUTLET NEAR SANDS
46.8	30.4	25.4	32.2	36.5	41.2	35.2	STATION, MICH.
120	73.1	52.7	69.7	77.8	88.7	68.0	EAST BRANCH ESCANABA RIVER
149	97.7	78.1	100	114	128	106	AT GWINN, MICH.
1,010	650	521	662	696	733	547	ESCANABA RIVER AT CORNELL,
1,100	728	537	707	789	877	670	MICH.
434	212	184	282	279	335	192	FORD RIVER NEAR HYDE, MICH.
419	239	159	222	272	323	244	
418	356	303	323	327	333	319	BRULE RIVER NEAR FLORENCE,
446	302	229	286	317	353	243	WISC.

Table 2.--Computed and estimated mean

USGS station number	Station name	Mean flow (ft^3/s) Q_A	Mean monthly flow, Q_m (ft^3/s) Q_1	Q_2	Q_3	Q_4	Q_5
04061500	PAINT RIVER AT CRYSTAL FALLS, MICH.	595 590	311 261	295 270	452 461	1,590 2,060	1,090 1,690
04062200	PESHEKEE RIVER NEAR CHAMPION, MICH.	211 167	70.6 50.9	56.2 39.6	129 90.4	784 562	558 348
04062230	MICHIGAMME RIVER NEAR MICHIGAMME, MICH.	286 231	131 79.8	104 65.4	152 135	801 793	850 493
04062400	MICHIGAMME RIVER NEAR WITCH LAKE, MICH.	428 370	192 141	158 120	251 229	1,120 1,240	1,180 805
04065300	WEST BRANCH STURGEON RIVER NEAR RANDVILLE, MICH.	39.9 48.4	17.1 23.9	16.0 23.5	31.3 41.6	111 170	77.1 135
04065500	STURGEON RIVER NEAR FOSTER CITY, MICH.	185 203	76.8 106	67.3 113	131 204	547 627	386 512
04096400	ST. JOSEPH RIVER NEAR BURLINGTON, MICH.	167 152	159 158	197 198	318 312	323 291	229 203
04096515	HOG CREEK NEAR ALLEN, MICH.	41.7 40.3	35.9 39.6	49.0 41.3	99.5 68.6	87.6 75.4	56.7 49.7
04096600	COLDWATER RIVER NEAR HODUNK, MICH.	241 221	239 232	289 281	477 434	505 420	320 251
04096900	NOTTAWA CREEK NEAR ATHENS, MICH.	143 121	132 128	163 155	249 240	246 235	186 155
04097170	PORTAGE RIVER NEAR VICKSBURG, MICH.	61.2 59.9	64.4 64.9	72.3 73.3	103 114	108 106	80.9 62.9
04097540	PRAIRIE RIVER NEAR NOTTAWA, MICH.	90.1 81.7	94.2 90.2	108 113	144 173	161 154	120 108
04098500	FAWN RIVER NEAR WHITE PIGEON, MICH.	159 150	164 168	184 184	226 271	247 275	217 191
04101800	DOWAGIAC RIVER AT SUMNERVILLE, MICH.	282 261	286 278	310 279	405 419	403 418	335 294
04102500	PAW PAW RIVER AT RIVERSIDE, MICH.	439 425	479 432	518 388	683 596	643 655	512 479
04102700	BLACK RIVER NEAR BANGOR, MICH.	105 92.7	124 83.4	140 80.4	202 143	180 146	113 136
04103500	KALAMAZOO RIVER AT MARSHALL, MICH.	315 335	305 342	344 401	478 628	493 638	386 495
04105000	BATTLE CREEK AT BATTLE CREEK, MICH.	201 186	191 176	229 203	398 340	389 358	269 255
04105500	KALAMAZOO RIVER NEAR BATTLE CREEK, MICH.	651 644	619 644	731 750	1,110 1,180	1,090 1,180	847 948
04105700	AUGUSTA CREEK NEAR AUGUSTA, MICH.	42.9 33.7	41.2 36.5	44.1 34.3	55.6 51.8	59.9 62.6	47.9 43.0
04105800	GULL CREEK NEAR GALESBURG, MICH.	25.00 34.7	32.9 38.4	34.8 35.0	34.5 51.6	24.7 62.9	21.3 36.9
04108600	RABBIT RIVER NEAR HOPKINS, MICH.	56.9 69.3	60.9 69.0	74.2 71.0	111 114	100 120	59.5 64.2
04108800	MACATAWA RIVER NEAR ZEELAND, MICH.	64.5 72.6	68.0 67.5	103 88.0	189 157	116 116	58.9 49.4
04109500	PORTAGE RIVER BELOW LITTLE PORTAGE LAKE NEAR MUNITH, MICH.	41.4 39.2	39.4 44.1	43.6 48.5	92.9 71.9	105 80.4	67.1 66.1
04110000	ORCHARD CREEK AT MUNITH, MICH.	37.2 34.8	39.8 35.7	44.9 66.0	82.0 112	89.2 73.1	62.4 42.0

and mean monthly flow values--Continued

Mean monthly flow, Q_m (ft^3/s)							
Q_6	Q_7	Q_8	Q_9	Q_{10}	Q_{11}	Q_{12}	Station name
709 714	499 469	381 344	454 445	496 496	502 555	366 348	PAINT RIVER AT CRYSTAL FALLS, MICH.
196 155	84.7 78.8	59.5 52.9	122 80.7	154 101	182 122	123 80.7	PESHEKEE RIVER NEAR CHAMPION, MICH.
306 224	157 124	108 86.8	156 126	226 152	258 180	191 121	MICHIGAMME RIVER NEAR MICHIGAMME, MICH.
501 380	263 225	182 161	282 226	342 265	394 306	285 206	MICHIGAMME RIVER NEAR WITCH LAKE, MICH.
47.0 57.5	24.6 35.9	24.2 27.8	35.5 35.2	35.9 41.1	36.8 47.3	22.4 32.1	WEST BRANCH STURGEON RIVER NEAR RANDVILLE, MICH.
217 232	124 145	104 105	150 136	150 159	161 184	105 133	STURGEON RIVER NEAR FOSTER CITY, MICH.
189 138	124 92.6	93.0 70.5	86.0 73.5	86.4 84.3	103 107	158 151	ST. JOSEPH RIVER NEAR BURLINGTON, MICH.
49.0 35.8	23.9 22.5	20.6 17.5	20.2 18.6	17.0 21.5	23.1 27.8	37.3 40.4	HOG CREEK NEAR ALLEN, MICH.
266 173	162 114	118 84.3	118 86.7	118 100	152 133	231 219	COLDWATER RIVER NEAR HODUNK, MICH.
163 106	115 71.8	90.0 55.4	82.1 57.1	82.0 65.9	102 84.1	138 123	NOTTAWA CREEK NEAR ATHENS, MICH.
55.2 51.4	41.0 34.0	30.6 27.2	33.7 27.9	37.3 31.3	44.2 40.5	59.2 65.0	PORTAGE RIVER NEAR VICKSBURG, MICH.
93.8 77.6	61.5 53.1	53.5 42.2	50.5 42.9	52.6 48.2	65.5 60.7	95.6 86.9	PRAIRIE RIVER NEAR NOTTAWA, MICH.
153 140	121 96.7	109 75.4	100 76.2	105 84.6	130 107	155 159	FAWN RIVER NEAR WHITE PIGEON, MICH.
272 269	219 189	186 151	199 162	224 173	267 206	309 277	DOWAGIAC RIVER AT SUMNERVILLE, MICH.
395 454	314 317	275 252	281 279	342 299	400 348	475 436	PAW PAW RIVER AT RIVERSIDE, MICH.
93.8 122	62.6 80.1	46.4 65.5	53.0 77.7	49.3 85.9	78.1 94.6	129 90.1	BLACK RIVER NEAR BANGOR, MICH.
317 328	267 224	224 167	215 178	235 204	259 251	300 321	KALAMAZOO RIVER AT MARSHALL, MICH.
192 169	109 109	83.2 80.4	91.6 88.2	105 104	137 131	174 172	BATTLE CREEK AT BATTLE CREEK, MICH.
668 642	473 441	397 323	403 350	438 397	508 482	594 601	KALAMAZOO RIVER NEAR BATTLE CREEK, MICH.
44.0 34.2	35.2 23.4	32.2 19.8	34.3 20.3	36.5 22.6	40.9 27.7	45.5 37.2	AUGUSTA CREEK NEAR AUGUSTA, MICH.
20.6 31.3	19.7 21.3	13.6 18.0	15.8 18.2	24.7 20.1	29.0 25.5	35.5 39.5	GULL CREEK NEAR GALESBURG, MICH.
48.0 57.6	30.3 37.4	23.6 30.1	28.5 32.5	32.1 36.9	43.3 47.0	70.2 73.0	RABBIT RIVER NEAR HOPKINS, MICH.
40.2 47.6	21.3 28.0	13.8 21.1	21.9 23.5	21.6 27.5	45.6 37.9	88.6 73.2	MACATAWA RIVER NEAR ZEELAND, MICH.
41.1 45.6	15.2 33.0	6.31 28.4	9.74 28.9	21.5 32.7	27.4 38.1	30.4 43.2	PORTAGE RIVER BELOW LITTLE PORTAGE LAKE NEAR MUNITH, MICH.
42.7 27.8	12.4 17.8	7.25 13.9	7.51 14.5	14.1 17.5	17.4 23.1	25.4 35.6	ORCHARD CREEK AT MUNITH, MICH.

Table 2.--Computed and estimated mean

USGS station number	Station name	Mean flow (ft^3/s) Q_A	Mean monthly flow, Q_m (ft^3/s) Q_1	Q_2	Q_3	Q_4	Q_5
04111500	DEER CREEK NEAR DANSVILLE, MICH.	10.6 11.7	8.88 10.1	15.5 18.4	30.3 36.9	23.9 24.9	12.2 14.8
04112000	SLOAN CREEK NEAR WILLIAMSTON, MICH.	5.55 6.76	4.37 4.58	7.52 8.43	16.7 21.1	13.3 14.4	6.39 8.33
04112500	RED CEDAR RIVER AT EAST LANSING, MICH.	201 248	189 217	276 290	490 526	468 507	290 339
04114500	LOOKING GLASS RIVER NEAR EAGLE, MICH.	172 194	157 171	212 232	439 415	403 407	253 237
04115000	MAPLE RIVER AT MAPLE RAPIDS, MICH.	253 298	231 264	270 370	703 651	615 633	367 373
04116500	FLAT RIVER NEAR SMYRNA, MICH.	428 397	440 363	426 462	694 770	757 808	547 580
04117000	QUAKER BROOK NEAR NASHVILLE, MICH.	6.48 6.10	6.50 6.06	7.87 6.56	11.9 11.2	10.3 12.3	7.84 9.01
04117500	THORNAPPLE RIVER AT HASTINGS, MICH.	311 298	327 287	371 372	694 617	643 570	413 407
04118000	THORNAPPLE RIVER NEAR CALEDONIA, MICH.	630 630	703 593	773 766	1,270 1,270	1,240 1,150	736 856
04118500	ROGUE RIVER NEAR ROCKFORD, MICH.	230 216	215 198	238 202	397 330	391 404	284 295
04121000	MUSKEGON RIVER NEAR MERRITT, MICH.	230 280	201 257	195 255	275 370	520 570	373 417
04121300	CLAM RIVER AT VOGEL CENTER, MICH.	124 223	111 197	107 184	171 285	246 399	153 268
04121900	LITTLE MUSKEGON RIVER NEAR MORLEY, MICH.	123 106	121 102	115 108	184 170	211 192	151 127
04122100	BEAR CREEK NEAR MUSKEGON, MICH.	16.0 16.9	17.2 14.8	19.9 16.4	32.2 30.5	29.4 24.0	19.2 17.5
04122200	WHITE RIVER NEAR WHITEHALL, MICH.	425 416	425 386	430 316	620 491	682 622	495 461
04122500	PERE MARQUETTE RIVER AT SCOTTVILLE, MICH.	661 675	649 633	658 569	913 861	1,020 1,040	764 854
04123000	BIG SABLE RIVER NEAR FREESOIL, MICH.	140 131	136 131	137 114	178 171	206 201	159 160
04123500	MANISTEE RIVER NEAR GRAYING, MICH.	184 138	174 125	171 97.8	183 142	219 243	195 143
04124000	MANISTEE RIVER NEAR SHERMAN, MICH.	1,060 1,010	999 883	977 731	1,180 1,070	1,540 1,650	1,210 1,040
04124500	EAST BRANCH PINE RIVER NEAR TUSTIN, MICH.	25.9 52.3	14.4 32.4	17.9 34.3	46.8 75.3	79.9 101	34.9 57.8
04125000	PINE RIVER NEAR LE ROY, MICH.	88.0 101	64.9 83.6	71.0 87.2	125 146	184 193	108 118
04125500	PINE RIVER NEAR HOXEYVILLE, MICH.	288 227	254 194	262 216	350 350	440 411	316 287
04126200	LITTLE MANISTEE RIVER NEAR FREESOIL, MICH.	175 176	158 170	159 154	191 227	242 291	205 234
04128000	STURGEON RIVER NEAR WOLVERINE, MICH.	213 222	194 167	191 138	239 220	311 424	235 225
04129000	PIGEON RIVER NEAR VANDERBILT, MICH.	77.8 66.6	70.7 49.9	70.0 38.7	84.9 63.2	121 134	87.1 71.6

and mean monthly flow values--Continued

Mean monthly flow, Q_m (ft^3/s)							
Q_6	Q_7	Q_8	Q_9	Q_{10}	Q_{11}	Q_{12}	Station name
8.04	4.06	2.17	2.27	4.07	5.68	10.4	DEER CREEK NEAR DANSVILLE,
8.98	5.04	3.78	4.20	5.37	7.31	10.7	MICH.
3.87	2.02	1.26	1.12	2.22	2.70	5.51	SLOAN CREEK NEAR WILLIAMSTON,
4.47	2.08	1.39	1.71	2.35	3.45	5.19	MICH.
162	81.9	52.2	64.8	77.9	108	159	RED CEDAR RIVER AT EAST
199	121	83.6	94.5	118	155	211	LANSING, MICH.
120	76.2	48.2	62.1	73.7	94.8	133	LOOKING GLASS RIVER NEAR
139	83.9	58.1	64.6	82.0	111	167	EAGLE, MICH.
161	95.3	55.8	87.2	114	124	207	MAPLE RIVER AT MAPLE RAPIDS,
217	133	91.7	102	128	171	255	MICH.
369	265	256	293	331	389	424	FLAT RIVER NEAR SMYRNA, MICH.
363	240	175	194	231	286	352	
5.69	3.61	3.49	3.41	4.84	6.09	6.98	QUAKER BROOK NEAR NASHVILLE,
6.42	4.08	3.49	3.71	4.32	5.32	6.51	MICH.
247	155	117	127	164	203	287	THORNAPPLE RIVER AT HASTINGS,
273	180	132	145	170	212	277	MICH.
525	367	297	321	374	453	649	THORNAPPLE RIVER NEAR
589	390	280	312	362	445	568	CALEDONIA, MICH.
193	144	139	154	176	206	229	ROGUE RIVER NEAR ROCKFORD,
226	153	121	137	158	183	205	MICH.
233	169	122	115	151	196	209	MUSKEGON RIVER NEAR MERRITT,
282	240	225	232	258	288	270	MICH.
109	88.6	78.8	86.0	96.1	112	120	CLAM RIVER AT VOGEL CENTER,
209	166	153	164	183	209	215	MICH.
118	88.1	79.6	91.4	103	115	124	LITTLE MUSKEGON RIVER NEAR
89.5	68.2	60.4	61.9	69.9	86.2	106	MORLEY, MICH.
12.3	6.56	8.28	7.82	12.9	14.1	18.3	BEAR CREEK NEAR MUSKEGON,
17.2	12.0	11.4	12.8	14.0	16.4	17.5	MICH.
391	301	285	329	351	404	435	WHITE RIVER NEAR WHITEHALL,
412	324	289	315	336	383	409	MICH.
643	512	460	503	550	633	663	PERE MARQUETTE RIVER AT
727	599	537	579	608	673	657	SCOTTVILLE, MICH.
136	114	104	109	117	138	139	BIG SABLE RIVER NEAR FREESOIL,
153	127	126	134	141	151	142	MICH.
187	179	173	177	182	188	181	MANISTEE RIVER NEAR GRAYING,
139	118	122	131	142	152	146	MICH.
1,050	937	884	910	959	1,030	1,020	MANISTEE RIVER NEAR SHERMAN,
958	807	746	817	874	960	971	MICH.
19.8	13.3	13.7	10.9	18.4	24.6	17.8	EAST BRANCH PINE RIVER
33.9	19.6	14.9	17.9	23.0	31.2	38.4	NEAR TUSTIN, MICH.
78.7	66.7	63.8	58.8	77.0	89.5	74.0	PINE RIVER NEAR LE ROY,
82.7	60.7	53.6	57.7	66.5	81.4	93.0	MICH.
279	248	243	249	264	280	280	PINE RIVER NEAR HOXEYVILLE,
213	166	149	161	179	207	211	MICH.
183	161	148	153	155	169	170	LITTLE MANISTEE RIVER NEAR
204	173	170	180	190	203	184	FREESOIL, MICH.
205	182	176	196	202	215	205	STURGEON RIVER NEAR WOLVERINE,
191	151	143	162	184	206	202	MICH.
71.2	65.4	62.4	71.0	74.4	79.8	75.4	PIGEON RIVER NEAR VANDERBILT,
58.3	44.8	43.7	49.1	56.9	64.3	62.0	MICH.

Table 2.--Computed and estimated mean

USGS station number	Station name	Mean flow (ft^3/s) Q_A	Mean monthly flow, Q_m (ft^3/s) Q_1	Q_2	Q_3	Q_4	Q_5
04129500	PIGEON RIVER AT AFTON, MICH.	139 145	117 108	114 90.4	174 145	260 296	172 165
04131500	RAINY RIVER NEAR OCQUEOC, MICH.	42.3 68.5	20.2 44.1	19.2 45.1	60.5 88.6	167 154	79.9 86.0
04132000	BLACK RIVER NEAR CHEBOYGAN, MICH.	453 523	408 391	404 377	499 602	1,000 1,130	676 656
04132500	THUNDER BAY RIVER NEAR HILLMAN MICH.	215 183	186 143	181 152	240 249	382 403	264 277
04134000	NORTH BRANCH THUNDER BAY RIVER NEAR BOLTON, MICH.	118 148	68.7 109	58.9 115	199 199	475 329	173 178
04135500	AU SABLE RIVER AT GRAYLING, MICH.	74.5 107	68.2 93.7	65.9 69.6	79.1 101	108 195	86.4 113
04135600	EAST BRANCH AU SABLE RIVER AT GRAYLING, MICH.	44.2 70.7	37.1 62.3	35.5 52.8	45.5 77.5	70.6 138	55.3 84.3
04135700	SOUTH BRANCH AU SABLE RIVER NEAR LUZERNE, MICH.	221 313	197 285	183 290	253 414	400 664	290 508
04138000	EAST BRANCH AU GRES RIVER AT MCIVOR, MICH.	64.1 58.9	46.1 44.4	50.2 63.2	90.5 117	139 137	94.1 94.9
04138500	AU GRES RIVER NEAR NATIONAL CITY, MICH.	97.3 99.9	60.6 60.3	80.0 80.6	218 179	280 229	145 145
04139000	HOUGHTON CREEK NEAR LUPTON, MICH.	51.2 21.3	44.9 18.4	46.8 24.2	67.4 38.9	84.4 50.4	58.2 32.7
04139500	RIFLE RIVER AT "THE RANCH" NEAR LUPTON, MICH.	91.7 39.9	79.7 35.1	84.5 47.1	119 73.9	157 93.5	108 61.0
04140000	PRIOR CREEK NEAR SELKIRK, MICH.	17.1 15.3	13.1 12.9	13.4 15.7	31.5 26.5	42.4 34.5	22.6 20.2
04140500	RIFLE RIVER AT SELKIRK, MICH.	143 81.5	126 70.7	131 98.2	214 155	280 188	178 123
04141000	SOUTH BRANCH SHEPARDS CREEK NEAR SELKIRK, MICH.	0.54 0.79	0.28 0.46	0.45 0.71	2.09 1.80	1.61 1.99	0.59 0.77
04141500	WEST BRANCH RIFLE RIVER NEAR SELKIRK, MICH.	60.1 45.4	45.9 40.5	51.1 55.4	109 88.6	121 101	76.7 65.9
04142000	RIFLE RIVER NEAR STERLING, MICH.	306 212	251 180	283 247	547 403	643 470	390 329
04143500	NORTH BRANCH KAWKAWLIN RIVER NEAR KAWKAWLIN, MICH.	58.6 61.5	35.0 40.1	52.2 59.8	190 153	188 143	103 101
04143900	SHIAWASSEE RIVER AT LINDEN, MICH.	60.8 52.3	61.2 50.1	67.4 62.0	115 114	125 114	72.9 60.7
04144000	SHIAWASSEE RIVER AT BYRON, MICH.	249 237	242 217	324 277	554 517	528 499	334 327
04144500	SHIAWASSEE RIVER AT OWOSSO, MICH.	328 355	285 328	395 432	789 801	739 723	460 485
04145000	SHIAWASSEE RIVER NEAR FERGUS, MICH.	419 420	396 380	538 525	993 990	903 853	588 554
04145500	BAD RIVER NEAR BRANT, MICH.	62.9 57.2	68.1 37.3	87.3 75.5	182 201	144 126	59.4 62.4
04146000	FARMERS CREEK NEAR LAPEER, MICH.	29.8 32.8	27.9 29.4	41.2 37.6	72.5 72.8	69.3 74.8	42.2 41.9
04147500	FLINT RIVER NEAR OTISVILLE, MICH.	295 333	238 304	347 401	777 734	648 730	371 371

and mean monthly flow values--Continued

Mean monthly flow, Q_m (ft^3/s)							
Q_6	Q_7	Q_8	Q_9	Q_{10}	Q_{11}	Q_{12}	Station name
131 129	108 101	95.5 97.2	114 109	123 125	137 140	126 131	PIGEON RIVER AT AFTON, MICH.
30.2 50.8	19.9 33.8	11.8 28.6	14.5 34.0	21.3 44.1	28.6 54.0	35.2 53.1	RAINY RIVER NEAR OCQUEOC, MICH.
370 438	294 347	258 308	286 344	358 406	447 464	455 442	BLACK RIVER NEAR CHEBOYGAN, MICH.
212 171	177 133	163 120	173 132	187 155	208 177	206 159	THUNDER BAY RIVER NEAR HILLMAN MICH.
91.2 112	48.0 82.4	32.3 72.3	33.5 81.5	57.5 101	80.2 121	89.0 125	NORTH BRANCH THUNDER BAY RIVER NEAR BOLTON, MICH.
77.8 108	67.1 91.5	61.6 95.0	65.2 102	68.9 111	73.7 119	72.0 112	AU SABLE RIVER AT GRAYLING, MICH.
44.8 71.8	37.8 60.7	34.9 62.9	37.5 66.4	40.8 72.9	42.0 79.1	41.0 73.4	EAST BRANCH AU SABLE RIVER AT GRAYLING, MICH.
213 333	170 292	145 278	168 286	194 315	209 344	221 300	SOUTH BRANCH AU SABLE RIVER NEAR LUZERNE, MICH.
68.1 48.9	48.4 34.4	42.8 29.3	40.2 32.3	45.6 40.6	51.7 49.7	52.6 48.7	EAST BRANCH AU GRES RIVER AT MCIVOR, MICH.
76.3 66.5	42.6 39.7	33.4 29.1	34.8 35.1	49.6 47.4	68.2 63.2	79.3 67.9	AU GRES RIVER NEAR NATIONAL CITY, MICH.
46.8 19.4	41.9 15.1	40.2 14.6	41.2 14.9	45.2 17.5	49.3 20.7	50.3 20.7	HOUGHTON CREEK NEAR LUPTON, MICH.
83.1 36.2	72.7 28.9	68.6 27.7	71.0 28.1	77.9 32.7	89.7 38.5	90.1 38.6	RIFLE RIVER AT "THE RANCH" NEAR LUPTON, MICH.
14.0 12.3	9.74 8.92	8.22 8.31	8.59 8.59	11.6 10.3	15.5 12.9	16.9 14.7	PRIOR CREEK NEAR SELKIRK, MICH.
127 72.0	100 57.2	95.4 52.9	102 54.3	112 63.6	130 75.3	138 76.3	RIFLE RIVER AT SELKIRK, MICH.
0.21 0.38	0.09 0.19	0.13 0.15	0.12 0.18	0.20 0.26	0.32 0.40	0.36 0.60	SOUTH BRANCH SHEPARDS CREEK NEAR SELKIRK, MICH.
45.8 40.2	36.9 31.5	36.8 29.6	37.1 30.3	50.0 35.5	58.3 42.3	53.1 44.0	WEST BRANCH RIFLE RIVER NEAR SELKIRK, MICH.
286 182	194 142	172 122	189 128	216 153	260 183	269 186	RIFLE RIVER NEAR STERLING, MICH.
44.8 46.8	13.9 24.8	5.25 15.7	10.7 22.3	14.5 31.3	27.4 41.2	39.7 42.4	NORTH BRANCH KAWKAWLIN RIVER NEAR KAWKAWLIN, MICH.
43.4 36.8	33.5 23.7	21.9 17.3	32.5 20.4	42.2 25.5	51.5 34.1	63.3 49.5	SHIAWASSEE RIVER AT LINDEN, MICH.
180 190	129 125	88.7 87.4	103 107	146 132	177 168	231 207	SHIAWASSEE RIVER AT BYRON, MICH.
221 286	185 190	122 131	139 160	143 194	219 247	297 309	SHIAWASSEE RIVER AT OWOSSO, MICH.
311 323	196 211	132 142	161 175	175 215	256 278	358 358	SHIAWASSEE RIVER NEAR FERGUS, MICH.
30.3 30.5	32.8 14.9	6.51 8.87	7.29 12.2	22.9 17.3	43.5 25.9	42.9 39.6	BAD RIVER NEAR BRANT, MICH.
22.0 24.0	10.1 15.0	8.50 11.0	10.4 13.3	11.6 17.0	18.6 22.5	24.4 29.8	FARMERS CREEK NEAR LAPEER, MICH.
212 212	151 137	131 92.6	162 111	133 141	163 191	235 288	FLINT RIVER NEAR OTISVILLE, MICH.

Table 2.--Computed and estimated mean

USGS station number	Station name	Mean flow (ft^3/s) Q_A	Mean monthly flow, Q_m (ft^3/s) Q_1	Q_2	Q_3	Q_4	Q_5
04147990	BUTTERNUT CREEK NEAR GENESEE, MICH.	21.5 21.7	18.9 17.7	28.9 25.2	60.7 53.7	45.5 50.6	23.3 26.2
04148140	KEARSLEY CREEK NEAR DAVISON, MICH.	70.7 63.0	62.8 56.9	93.8 76.5	176 147	166 141	79.8 79.3
04148160	GILKEY CREEK NEAR FLINT, MICH.	4.68 4.16	2.77 2.73	6.85 4.31	12.0 11.6	9.80 9.70	3.90 4.05
04148200	SWARTZ CREEK NEAR HOLLY, MICH.	7.55 8.01	7.04 8.28	7.75 9.52	16.8 16.8	18.6 17.7	12.3 10.8
04148300	SWART CREEK AT FLINT, MICH.	79.7 73.5	67.9 63.9	96.9 85.6	216 170	195 162	87.6 83.7
04148440	THREAD CREEK NEAR FLINT, MICH.	37.8 34.8	31.1 30.6	48.5 40.1	94.8 79.6	87.5 77.9	41.1 43.5
04148500	FLINT RIVER NEAR FLINT, MICH.	578 608	518 550	750 744	1,490 1,360	1,290 1,300	756 720
04150000	SOUTH BRANCH CASS RIVER NEAR CASS CITY, MICH.	123 152	102 136	165 274	465 535	310 347	131 135
04150500	CASS RIVER AT CASS CITY, MICH.	200 227	170 198	272 307	751 587	509 521	225 223
04151500	CASS RIVER AT FRANKENMUTH, MICH.	487 536	407 461	633 735	1,550 1,410	1,160 1,190	621 572
04152500	TOBACCO RIVER AT BEAVERTON, MICH.	375 323	309 279	357 384	717 686	739 768	445 451
04153500	SALT RIVER NEAR NORTH BRADLEY, MICH.	77.7 86.6	51.2 62.0	97.1 107	265 246	187 205	92.0 108
04154000	CHIPPEWA RIVER NEAR MOUNT PLEASANT, MICH.	304 283	267 258	326 351	570 624	579 627	375 399
04154500	CHIPPEWA RIVER NEAR MIDLAND, MICH.	425 382	326 344	420 514	839 943	992 846	551 565
04155000	PINE RIVER AT ALMA, MICH.	212 187	185 169	228 247	458 459	425 409	273 257
04155500	PINE RIVER NEAR MIDLAND, MICH.	294 252	246 221	340 317	668 601	616 550	354 334
04157500	SEBEWAING RIVER NEAR SEBEWAING, MICH.	34.7 40.4	37.9 26.0	61.6 56.0	129 150	68.4 97.5	26.7 31.7
04158000	EAST FORK SEBEWAING RIVER NEAR SEBEWAING, MICH.	18.2 20.3	17.2 13.0	31.7 27.7	69.7 74.8	35.1 50.1	12.3 14.9
04158500	PIGEON RIVER NEAR OWENDALE, MICH.	32.0 33.1	21.4 21.0	40.2 43.9	117 118	73.3 80.1	41.2 32.2
04159500	BLACK RIVER NEAR FARGO, MICH.	279 296	245 234	426 399	1,010 776	649 644	314 308
04160000	MILL CREEK NEAR ABBOTTSFORD, MICH.	97.0 122	102 117	142 202	338 345	229 270	122 150
04160050	BLACK RIVER NEAR PORT HURON, MICH.	289 417	185 356	556 593	956 1,080	804 892	367 468
04160570	NORTH BRANCH BELLE RIVER AT IMLAY CITY, MICH.	11.3 11.1	9.93 7.42	17.1 10.1	30.0 24.0	25.3 25.0	11.7 13.8
04160600	BELLE RIVER AT MEMPHIS, MICH.	84.3 89.7	74.0 60.3	137 101	267 234	221 197	88.5 92.7
04160800	SASHABAW CREEK NEAR DRAYTON PLAINS, MICH.	12.1 12.7	11.2 13.8	14.5 16.5	25.6 25.4	29.6 28.3	19.0 18.7

and mean monthly flow values--Continued

Mean monthly flow, Q_m (ft^3/s)							
Q_6	Q_7	Q_8	Q_9	Q_{10}	Q_{11}	Q_{12}	Station name
10.2 14.3	5.75 8.25	6.02 5.80	9.97 7.23	11.4 9.59	10.7 13.2	19.2 18.5	BUTTERNUT CREEK NEAR GENESEE, MICH.
42.2 45.6	29.1 28.9	20.6 20.8	35.3 25.1	35.9 31.9	41.0 42.1	67.1 56.6	KEARSLEY CREEK NEAR DAVISON, MICH.
1.59 2.04	1.14 0.94	2.03 0.60	3.65 0.80	1.09 1.16	1.96 1.82	5.05 3.12	GILKEY CREEK NEAR FLINT, MICH.
5.47 6.97	3.85 4.68	2.40 3.86	2.58 4.40	3.14 5.29	5.46 6.71	7.12 8.52	SWARTZ CREEK NEAR HOLLY, MICH.
36.6 47.7	19.7 28.9	21.0 19.9	31.4 24.4	38.8 31.4	40.1 43.2	80.4 63.8	SWART CREEK AT FLINT, MICH.
18.6 24.9	10.2 15.3	11.6 11.0	16.8 13.4	20.5 17.2	22.8 23.0	36.3 31.1	THREAD CREEK NEAR FLINT, MICH.
435 409	244 268	218 178	266 216	283 270	338 360	459 514	FLINT RIVER NEAR FLINT, MICH.
60.3 79.8	44.3 49.4	18.7 33.6	17.1 40.3	20.3 53.0	43.5 75.9	94.7 134	SOUTH BRANCH CASS RIVER NEAR CASS CITY, MICH.
98.6 128	61.6 80.5	28.0 54.4	51.7 66.4	52.0 87.4	82.2 121	153 194	CASS RIVER AT CASS CITY, MICH.
282 321	173 203	105 133	163 163	182 211	254 290	384 440	CASS RIVER AT FRANKENMUTH, MICH.
320 250	256 172	216 124	238 149	270 183	312 230	333 276	TOBACCO RIVER AT BEAVERTON, MICH.
56.5 53.2	31.1 29.6	12.8 19.0	16.4 24.7	26.7 33.5	42.9 47.1	53.4 64.4	SALT RIVER NEAR NORTH BRADLEY, MICH.
268 236	189 164	162 119	193 143	216 173	261 214	271 251	CHIPPEWA RIVER NEAR MOUNT PLEASANT, MICH.
336 314	280 214	208 150	197 182	252 222	350 279	384 327	CHIPPEWA RIVER NEAR MIDLAND, MICH.
175 147	103 97.3	88.8 68.9	116 83.2	141 102	178 131	191 164	PINE RIVER AT ALMA, MICH.
224 187	141 122	126 83.5	158 102	194 127	225 166	259 214	PINE RIVER NEAR MIDLAND, MICH.
27.9 15.0	8.66 6.96	5.18 4.01	5.70 5.39	10.9 8.11	15.6 13.5	20.3 27.9	SEBEWAING RIVER NEAR SEBEWAING, MICH.
14.9 7.08	2.92 3.20	1.71 1.87	1.97 2.49	5.64 3.79	6.68 6.47	9.27 14.3	EAST FORK SEBEWAING RIVER NEAR SEBEWAING, MICH.
18.5 15.5	11.2 7.52	5.07 4.57	7.53 6.29	13.6 9.33	16.6 14.3	27.7 23.1	PIGEON RIVER NEAR OWENDALE, MICH.
144 169	71.3 101	56.8 63.0	67.6 72.7	89.3 99.0	99.8 149	213 244	BLACK RIVER NEAR FARGO, MICH.
53.3 87.0	18.6 58.4	18.8 41.2	13.9 44.1	26.7 56.6	39.5 79.7	78.1 118	MILL CREEK NEAR ABBOTTSFORD, MICH.
178 263	50.4 166	48.7 107	24.7 120	32.1 159	102 231	190 359	BLACK RIVER NEAR PORT HURON, MICH.
6.98 6.85	5.10 3.44	3.04 2.18	3.98 2.67	4.53 3.80	7.17 5.90	11.0 8.64	NORTH BRANCH BELLE RIVER AT IMLAY CITY, MICH.
40.7 45.2	24.3 22.8	15.5 13.2	19.5 16.2	36.5 23.5	39.4 38.1	80.7 65.8	BELLE RIVER AT MEMPHIS, MICH.
10.8 11.9	5.26 8.60	4.15 7.08	4.54 7.16	4.06 8.65	7.39 11.4	11.0 14.6	SASHABAW CREEK NEAR DRAYTON PLAINS, MICH.

Table 2.--Computed and estimated mean

USGS station number	Station name	Mean flow (ft^3/s) Q_A	Mean monthly flow, Q_m (ft^3/s) Q_1	Q_2	Q_3	Q_4	Q_5
04160900	CLINTON RIVER NEAR DRAYTON PLAINS, MICH.	50.4 50.6	51.7 54.5	56.0 67.9	81.7 104	98.0 105	64.4 66.8
04161100	GALLOWAY CREEK NEAR AUBURN HEIGHTS, MICH.	9.88 10.9	8.83 11.5	12.1 15.3	26.1 24.9	23.4 23.8	12.7 13.1
04161500	PAINT CREEK NEAR LAKE ORION, MICH.	25.4 23.7	24.3 25.7	27.8 32.9	45.6 50.2	52.8 52.4	36.3 29.5
04161540	PAINT CREEK AT ROCHESTER, MICH.	50.7 43.5	50.8 44.6	62.7 60.5	97.7 97.0	104 94.8	65.3 54.7
04161580	STONY CREEK NEAR ROMEO, MICH.	17.3 15.5	16.7 15.4	22.6 20.8	37.2 34.9	38.6 34.4	19.6 22.1
04163500	PLUM BROOK NEAR UTICA, MICH.	11.4 13.2	7.06 9.25	15.5 19.4	32.3 47.2	29.1 29.2	17.2 14.6
04164100	EAST POND CREEK AT ROMEO, MICH.	15.2 13.0	13.3 12.7	18.7 16.4	33.0 28.0	32.2 29.3	19.6 18.3
04164300	EAST BRANCH COON CREEK AT ARMADA, MICH.	6.47 7.62	5.57 5.27	11.0 10.8	22.7 26.4	16.3 17.3	5.32 7.61
04164500	NORTH BRANCH CLINTON RIVER NEAR MOUNT CLEMENS MICH.	119 112	119 94.9	197 163	364 316	281 247	142 129
04164800	MIDDLE BRANCH CLINTON RIVER AT MACOMB, MICH.	27.2 23.5	23.8 16.3	43.5 34.7	73.2 84.1	56.4 52.6	29.8 28.1
04166000	RIVER ROUGE AT BIRMINGHAM, MICH.	15.4 19.2	13.8 20.0	19.0 26.5	32.3 43.5	31.3 42.1	22.7 22.8
04169500	HURON RIVER AT COMMERCE, MICH.	37.7 36.0	40.5 39.3	43.6 46.0	63.1 69.6	71.5 76.4	52.9 50.6
04170000	HURON RIVER AT MILFORD, MICH.	91.6 86.9	91.2 93.5	101 111	148 168	165 180	114 119
04171500	ORE CREEK NEAR BRIGHTON, MICH.	22.0 19.8	20.0 20.7	23.4 24.3	40.2 38.3	42.3 42.4	31.1 28.7
04172000	HURON RIVER NEAR HAMBURG, MICH.	208 194	207 207	231 252	349 376	339 399	269 286
04173000	HURON RIVER NEAR DEXTER, MICH.	349 336	334 357	407 430	618 642	652 668	487 496
04173500	MILL CREEK NEAR DEXTER, MICH.	78.5 92.4	72.7 87.1	99.8 109	174 186	158 179	98.5 103
04175340	STONY CREEK AT OAKVILLE, MICH.	47.0 42.6	39.3 29.3	69.0 50.2	117 119	94.6 88.0	50.5 38.4
04175600	RIVER RAISIN NEAR MANCHESTER, MICH.	104 94.7	92.4 97.8	118 106	210 165	199 180	135 131
04175700	RIVER RAISIN NEAR TECUMSEH, MICH.	182 185	177 188	222 225	363 353	348 353	222 248
04176000	RIVER RAISIN NEAR ADRIAN, MICH.	312 314	315 317	434 387	689 618	602 579	384 422

and mean monthly flow values--Continued

Mean monthly flow, Q_m (ft^3/s)							
Q_6	Q_7	Q_8	Q_9	Q_{10}	Q_{11}	Q_{12}	Station name
43.2 43.6	29.9 31.4	24.5 24.2	26.4 24.6	33.3 29.2	42.8 39.4	53.5 55.5	CLINTON RIVER NEAR DRAYTON PLAINS, MICH.
7.87 8.28	3.74 5.55	2.91 4.34	2.70 4.40	2.95 5.46	5.92 7.76	10.2 12.1	GALLOWAY CREEK NEAR AUBURN HEIGHTS, MICH.
22.0 19.0	15.8 13.5	12.3 10.7	17.7 10.8	16.3 13.1	14.1 18.0	21.3 26.7	PAINT CREEK NEAR LAKE ORION, MICH.
42.7 34.0	28.3 23.5	25.0 17.8	33.0 18.4	31.1 22.7	37.3 31.4	47.5 46.0	PAINT CREEK AT ROCHESTER, MICH.
12.4 13.4	8.85 9.06	7.68 7.05	7.45 7.41	10.2 9.24	12.4 12.5	16.3 16.4	STONY CREEK NEAR ROMEO, MICH.
6.32 7.11	3.82 3.49	1.43 2.13	1.58 2.55	4.70 3.68	7.68 6.03	11.0 10.4	PLUM BROOK NEAR UTICA, MICH.
11.9 10.8	8.37 7.17	7.23 5.53	6.84 5.83	8.55 7.37	11.0 10.1	13.6 13.5	EAST POND CREEK AT ROMEO, MICH.
3.04 3.77	1.71 1.81	1.22 1.12	0.87 1.34	0.70 1.95	2.41 3.28	7.05 6.08	EAST BRANCH COON CREEK AT ARMADA, MICH.
63.5 68.0	31.3 40.4	25.9 25.8	27.4 28.9	43.6 39.1	62.4 59.3	122 97.2	NORTH BRANCH CLINTON RIVER NEAR MOUNT CLEMENS MICH.
18.2 13.5	10.9 6.78	10.1 4.12	7.49 5.01	9.55 7.22	16.0 11.5	30.4 18.1	MIDDLE BRANCH CLINTON RIVER AT MACOMB, MICH.
14.7 13.8	10.0 9.11	5.45 6.81	4.04 6.95	6.80 8.77	9.86 12.7	14.5 20.7	RIVER ROUGE AT BIRMINGHAM, MICH.
34.1 32.9	23.1 24.0	16.2 19.1	19.9 19.4	20.9 23.1	28.3 30.4	36.8 40.3	HURON RIVER AT COMMERCE, MICH.
83.1 76.9	63.1 56.3	50.1 43.0	63.0 44.0	64.8 52.3	78.2 69.4	92.6 93.8	HURON RIVER AT MILFORD, MICH.
20.9 18.4	15.7 13.0	11.2 10.4	9.73 10.6	14.9 12.7	18.1 16.9	21.2 21.8	ORE CREEK NEAR BRIGHTON, MICH.
193 181	149 136	116 102	122 105	148 124	208 160	210 204	HURON RIVER NEAR HAMBURG, MICH.
310 316	213 237	146 174	158 180	204 209	295 272	338 346	HURON RIVER NEAR DEXTER, MICH.
64.3 67.6	40.0 43.7	32.0 30.6	34.6 32.9	40.6 40.0	55.3 57.4	80.7 90.6	MILL CREEK NEAR DEXTER, MICH.
34.6 19.4	20.9 9.28	13.5 5.27	22.7 6.28	14.6 8.92	26.5 15.5	46.1 32.2	STONY CREEK AT OAKVILLE, MICH.
89.1 90.5	58.7 64.9	49.2 49.3	56.3 51.6	45.1 59.2	70.0 77.6	105 100	RIVER RAISIN NEAR MANCHESTER, MICH.
158 165	119 117	88.8 85.6	88.4 90.1	86.3 105	129 140	184 189	RIVER RAISIN NEAR TECUMSEH, MICH.
240 274	179 191	117 134	114 142	142 165	213 224	326 310	RIVER RAISIN NEAR ADRIAN, MICH.

Table 3.--Computed and estimated flow duration and low flow values

USGS station number	Station name	Flow duration, D_p (ft^3/s) D_{10}	D_{25}	D_{50}	D_{75}	D_{95}	Low flow, $M_{d,t}$ (ft^3/s) $M_{7,10}$	$M_{30,10}$
04001000	WASHINGTON CREEK AT WINDIGO, MICH.	[a]42.0 39.1	16.0 13.1	5.70 5.04	2.50 2.32	0.92 0.85	0.60 0.42	0.79 0.60
04031000	BLACK RIVER NEAR BESSEMER, MICH.	570 572	205 286	89.0 152	47.0 97.0	20.0 39.2	12.3 26.5	15.4 30.1
04031500	PRESQUE ISLE RIVER AT MARENISCO, MICH.	397 407	196 220	107 132	73.0 94.3	38.0 61.6	24.0 51.8	30.1 54.6
04032000	PRESQUE ISLE RIVER NEAR TULA, MICH.	656 630	288 347	142 206	92.0 145	51.0 104	32.1 85.6	40.4 90.0
04033000	MIDDLE BRANCH ONTONAGON RIVER NEAR PAULDING, MICH.	303 360	185 230	130 162	105 129	84.0 73.1	72.5 58.9	78.1 65.1
04035000	EAST BRANCH ONTONAGON RIVER NEAR MASS, MICH.	499 593	245 306	168 176	135 125	105 87.5	86.2 74.0	95.6 85.2
04040500	STURGEON RIVER NEAR SIDNAW, MICH.	528 483	219 220	100 108	54.0 63.4	19.0 16.1	7.98 8.79	11.2 11.3
04045500	TAHQUAMENON RIVER NEAR TAHQUAMENON PARADISE, MICH.	2,020 1,480	1,060 665	574 335	398 214	264 106	195 69.1	222 84.7
04046000	BLACK RIVER NEAR GARNET, MICH.	60.0 59.3	32.0 26.2	18.0 13.5	12.0 8.18	7.80 3.89	6.54 2.76	6.92 3.22
04049500	MANISTIQUE RIVER AT GERMFASK, MICH.	736 579	530 344	391 226	308 168	204 110	162 79.0	177 89.4
04055000	MANISTIQUE RIVER NEAR BLANEY, MICH.	1,570 1,260	932 729	625 456	464 333	283 231	219 166	240 188
04056000	WEST BRANCH MANISTIQUE RIVER NEAR MANISTIQUE MICH.	815 575	423 339	269 221	190 165	126 154	93.5 124	102 130
04057510	STURGEON RIVER NEAR NAHMA JUNCTION, MICH.	442 327	237 220	137 164	94.0 134	58.0 75.0	43.7 56.7	48.9 64.0
04057800	MIDDLE BRANCH ESCANABA RIVER AT HUMBOLT, MICH.	134 130	61.0 61.2	31.0 31.5	18.0 18.4	7.40 10.3	5.44 6.73	6.24 7.93
04058000	MIDDLE BRANCH ESCANABA RIVER NEAR ISHPEMING, MICH.	314 376	147 166	75.0 78.9	45.0 44.3	24.0 24.5	15.8 15.0	17.7 18.3
04058400	GOOSE LAKE OUTLET NEAR SANDS STATION, MICH.	67.0 104	33.0 47.9	19.0 24.1	13.0 13.6	6.60 6.64	4.87 4.08	5.56 5.01
04058500	EAST BRANCH ESCANABA RIVER AT GWINN, MICH.	216 348	110 154	60.0 73.6	42.0 41.0	28.0 22.6	23.6 13.5	24.7 16.7
04059000	ESCANABA RIVER AT CORNELL, MICH.	1,840 2,400	954 1,110	496 531	327 313	207 112	166 60.6	194 76.9
04059500	FORD RIVER NEAR HYDE, MICH.	942 964	427 489	179 273	89.0 187	41.0 101	27.2 70.5	31.8 84.1
04062200	PESHEKEE RIVER NEAR CHAMPION, MICH.	486 442	208 145	97.0 51.7	46.0 23.8	11.0 13.7	2.98 8.14	4.56 9.87
04096400	ST. JOSEPH RIVER NEAR BURLINGTON, MICH.	354 338	226 196	127 103	69.0 57.5	31.0 28.5	17.3 16.9	20.8 20.6
04096515	HOG CREEK NEAR ALLEN, MICH.	98.0 83.9	58.0 47.9	26.0 25.1	13.0 13.6	5.50 5.76	2.27 3.51	3.28 4.20
04096600	COLDWATER RIVER NEAR HODUNK, MICH.	535 455	335 240	164 109	79.0 52.2	32.0 28.6	16.6 15.9	18.8 19.4
04096900	NOTTAWA CREEK NEAR ATHENS, MICH.	280 261	181 151	111 79.5	79.0 43.8	46.0 22.4	29.8 13.3	37.1 16.1
04097170	PORTAGE RIVER NEAR VICKSBURG, MICH.	116 111	78.0 64.4	51.0 33.2	34.0 17.3	20.0 8.46	12.8 5.17	13.8 6.02

[a] Upper values based on analysis of station records, lower values based on regression equations.

Table 3.--Computed and estimated flow duration and low flow values--Continued

USGS station number	Station name	Flow duration, D_p (ft^3/s)					Low flow, $M_{d,t}$ (ft^3/s)	
		D_{10}	D_{25}	D_{50}	D_{75}	D_{95}	$M_{7,10}$	$M_{30,10}$
04097540	PRAIRIE RIVER NEAR NOTTAWA, MICH.	173 179	120 109	72.0 60.7	45.0 34.7	26.0 15.2	16.6 9.13	19.3 11.1
04102500	PAW PAW RIVER AT RIVERSIDE, MICH.	754 749	544 485	377 293	274 194	194 123	155 88.6	167 95.4
04102700	BLACK RIVER NEAR BANGOR, MICH.	224 188	123 135	73.0 103	45.0 86.8	31.0 41.8	25.2 35.2	28.2 37.4
04105000	BATTLE CREEK AT BATTLE CREEK, MICH.	416 417	234 235	129 125	80.0 73.1	48.0 41.4	33.4 25.8	37.1 31.0
04105700	AUGUSTA CREEK NEAR AUGUSTA, MICH.	66.0 66.9	51.0 44.0	40.0 27.4	32.0 17.2	22.0 7.72	16.8 5.13	18.9 5.95
04108600	RABBIT RIVER NEAR HOPKINS, MICH.	110 110	63.0 63.4	38.0 33.5	25.0 18.1	15.0 12.3	9.89 8.40	11.3 9.11
04108800	MACATAWA RIVER NEAR ZEELAND, MICH.	138 99.9	45.0 47.9	18.0 19.8	5.50 8.40	2.50 6.57	1.63 4.49	1.78 4.57
04110000	ORCHARD CREEK AT MUNITH, MICH.	88.0 72.6	42.0 40.2	17.0 20.8	7.70 11.0	4.10 5.63	2.34 3.34	2.75 4.09
04111500	DEER CREEK NEAR DANSVILLE, MICH.	24.0 25.8	10.0 13.1	3.90 6.43	1.40 3.25	0.43 1.30	0.14 0.72	0.23 0.94
04112000	SLOAN CREEK NEAR WILLIAMSTON, MICH.	13.0 15.7	4.30 6.44	1.30 2.53	0.37 1.02	0.13 0.25	0.05 0.05	0.07 0.13
04112500	RED CEDAR RIVER AT EAST LANSING, MICH.	485 585	216 293	89.0 139	44.0 74.8	19.0 47.0	9.50 28.0	13.9 34.5
04114500	LOOKING GLASS RIVER NEAR EAGLE, MICH.	425 426	207 203	82.0 89.9	43.0 44.2	25.0 29.6	16.5 17.1	18.3 21.0
04115000	MAPLE RIVER AT MAPLE RAPIDS, MICH.	625 659	287 273	104 106	38.0 49.3	16.0 31.1	7.83 18.3	10.2 23.8
04116500	FLAT RIVER NEAR SMYRNA, MICH.	768 897	522 507	346 273	248 166	172 124	128 80.1	151 94.4
04117000	QUAKER BROOK NEAR NASHVILLE, MICH.	13.0 13.4	7.00 8.83	4.40 5.93	3.00 3.95	1.80 1.28	1.14 0.83	1.33 1.03
04117500	THORNAPPLE RIVER AT HASTINGS, MICH.	673 662	339 375	180 199	116 118	72.0 71.8	50.7 44.8	57.5 53.6
04118000	THORNAPPLE RIVER NEAR CALEDONIA, MICH.	1,280 1,390	743 781	423 407	292 241	183 135	126 82.8	149 99.1
04118500	ROGUE RIVER NEAR ROCKFORD, MICH.	403 423	265 271	180 174	131 124	91.0 122	71.2 95.5	79.8 102
04121000	MUSKEGON RIVER NEAR MERRITT, MICH.	447 492	297 365	185 300	122 264	56.0 107	38.1 76.6	42.4 90.1
04121300	CLAM RIVER AT VOGEL CENTER, MICH.	211 348	146 241	100 183	77.0 148	60.0 80.0	51.9 64.6	55.6 71.1
04121900	LITTLE MUSKEGON RIVER NEAR MORLEY, MICH.	214 190	139 120	102 78.2	79.0 52.8	55.0 29.6	43.3 21.4	48.5 24.7
04122100	BEAR CREEK NEAR MUSKEGON, MICH.	30.0 25.3	18.0 17.8	12.0 14.0	6.30 11.3	3.60 5.48	2.51 5.09	3.01 5.20
04122200	WHITE RIVER NEAR WHITEHALL, MICH.	664 648	486 447	371 323	289 254	222 185	189 154	203 163
04122500	PERE MARQUETTE RIVER AT SCOTTVILLE, MICH.	989 1,120	755 816	589 627	479 529	389 341	348 282	362 303
04123000	BIG SABLE RIVER NEAR FREESOIL, MICH.	194 205	155 167	130 152	111 147	94.0 72.3	85.2 64.8	88.5 68.9

Table 3.--Computed and estimated flow duration and low flow values--Continued

USGS station number	Station name	Flow duration, D_p (ft^3/s)					Low flow, $M_{d,t}$ (ft^3/s)	
		D_{10}	D_{25}	D_{50}	D_{75}	D_{95}	$M_{7,10}$	$M_{30,10}$
04123500	MANISTEE RIVER NEAR GRAYING, MICH.	215 168	194 134	180 122	169 117	156 137	147 140	152 136
04124500	EAST BRANCH PINE RIVER NEAR TUSTIN, MICH.	53.0 91.1	25.0 42.7	15.0 21.3	10.0 11.8	6.70 7.23	5.51 5.32	6.02 6.01
04125000	PINE RIVER NEAR LE ROY, MICH.	142 162	91.0 100	66.0 66.0	56.0 45.8	48.0 32.2	43.5 25.4	45.4 27.9
04125500	PINE RIVER NEAR HOXEYVILLE, MICH.	394 372	301 252	255 184	231 145	205 107	188 88.3	198 95.9
04126200	LITTLE MANISTEE RIVER NEAR FREESOIL, MICH.	234 282	195 230	162 210	143 203	123 145	113 133	119 140
04128000	STURGEON RIVER NEAR WOLVERINE, MICH.	287 262	230 181	197 142	172 120	147 166	129 164	136 159
04135500	AU SABLE RIVER AT GRAYLING, MICH.	103 127	83.0 102	70.0 94.5	61.0 90.6	50.0 107	44.1 111	47.2 106
04135600	EAST BRANCH AU SABLE RIVER AT GRAYLING, MICH.	65.0 93.7	50.0 75.2	41.0 70.2	34.0 67.1	26.0 66.3	21.1 65.6	22.4 65.7
04135700	SOUTH BRANCH AU SABLE RIVER NEAR LUZERNE, MICH.	357 562	268 436	207 380	166 356	131 287	114 240	123 269
04138000	EAST BRANCH AU GRES RIVER AT MCIVOR, MICH.	112 122	71.0 74.2	47.0 51.7	38.0 39.5	30.0 25.3	26.2 19.5	27.5 23.1
04138500	AU GRES RIVER NEAR NATIONAL CITY, MICH.	217 212	104 97.3	52.0 50.2	29.0 30.5	16.0 18.9	10.5 14.1	13.5 16.6
04139000	HOUGHTON CREEK NEAR LUPTON, MICH.	69.0 38.7	51.0 27.5	44.0 22.2	40.0 18.1	36.0 20.6	33.2 19.0	34.8 20.1
04139500	RIFLE RIVER AT "THE RANCH" NEAR LUPTON, MICH.	131 72.5	94.0 51.4	79.0 40.9	69.0 33.2	61.0 37.8	55.3 33.8	58.1 36.1
04140000	PRIOR CREEK NEAR SELKIRK, MICH.	33.0 26.8	17.0 17.1	11.0 12.0	7.70 8.51	5.90 4.74	4.96 3.64	5.55 4.21
04140500	RIFLE RIVER AT SELKIRK, MICH.	230 150	151 102	115 77.2	96.0 61.00	78.0 75.1	65.6 65.5	72.6 70.4
04141000	SOUTH BRANCH SHEPARDS CREEK NEAR SELKIRK, MICH.	0.89 1.12	0.27 0.35	0.13 0.04	0.07 -0.11	0.02 -0.11	0.00 -0.15	0.00 -0.13
04141500	WEST BRANCH RIFLE RIVER NEAR SELKIRK, MICH.	95.0 82.8	60.0 56.9	45.0 43.7	35.0 34.4	29.0 39.0	25.2 34.4	26.8 36.9
04142000	RIFLE RIVER NEAR STERLING, MICH.	542 423	323 270	226 188	171 142	136 125	118 99	128 112
04144000	SHIAWASSEE RIVER AT BYRON, MICH.	562 633	300 301	148 139	85.0 71.0	41.0 38.6	29.7 23.5	34.1 31.5
04145000	SHIAWASSEE RIVER NEAR FERGUS, MICH.	989 1,110	482 462	214 183	114 84.2	58.0 31.7	41.6 18.0	48.0 25.7
04145500	BAD RIVER NEAR BRANT, MICH.	174 147	45.0 38.2	8.30 9.67	1.50 3.03	0.06 0.84	0.00 0.40	0.04 0.68
04146000	FARMERS CREEK NEAR LAPEER, MICH.	70.0 82.0	35.0 33.9	15.0 14.1	6.60 6.49	2.50 2.34	1.15 1.40	1.65 2.04
04147500	FLINT RIVER NEAR OTISVILLE, MICH.	700 789	320 281	140 93.0	87.0 36.2	46.0 17.8	13.6 10.1	21.6 14.5
04147990	BUTTERNUT CREEK NEAR GENESEE, MICH.	50.0 53.7	20.0 19.9	7.90 7.34	4.40 3.01	2.30 0.76	1.75 0.39	2.03 0.62
04148140	KEARSLEY CREEK NEAR DAVISON, MICH.	374 157	59.0 65.6	21.0 27.0	11.0 12.3	1.40 5.06	3.98 3.02	5.44 4.29

Table 3.--Computed and estimated flow duration and low flow values--Continued

USGS station number	Station name	Flow duration, D_p (ft^3/s)					Low flow, $M_{d,t}$ (ft^3/s)	
		D_{10}	D_{25}	D_{50}	D_{75}	D_{95}	$M_{7,10}$	$M_{30,10}$
04148160	GILKEY CREEK NEAR FLINT, MICH.	12.0 9.66	3.00 2.42	0.83 0.51	0.19 0.05	0.01 -0.10	0.00 -0.12	0.00 -0.11
04148200	SWARTZ CREEK NEAR HOLLY, MICH.	18.0 19.7	9.30 10.9	4.20 6.12	2.00 3.34	0.60 1.14	0.17 0.71	0.35 0.97
04148300	SWART CREEK AT FLINT, MICH.	203 178	83.0 67.0	28.0 24.1	10.0 9.73	2.60 2.51	0.20 1.32	1.29 1.98
04148440	THREAD CREEK NEAR FLINT, MICH.	97.0 87.0	42.0 39.5	17.0 17.6	7.20 8.22	2.20 3.86	0.39 2.34	1.49 3.15
04150000	SOUTH BRANCH CASS RIVER NEAR CASS CITY, MICH.	279 309	76.0 118	21.0 40.6	6.00 14.8	2.50 11.7	0.94 6.57	1.53 8.58
04150500	CASS RIVER AT CASS CITY, MICH.	482 488	149 192	42.0 70.3	13.0 28.0	4.50 13.1	1.87 6.80	2.89 9.29
04151500	CASS RIVER AT FRANKENMUTH, MICH.	1,200 1,230	435 477	164 169	73.0 68.0	39.0 29.3	22.4 15.2	27.8 21.1
04153500	SALT RIVER NEAR NORTH BRADLEY, MICH.	157 223	57.0 69.4	22.0 21.4	11.0 8.09	5.70 2.80	3.12 1.55	4.27 2.39
04157500	SEBEWAING RIVER NEAR SEBEWAING, MICH.	75.0 87.1	22.0 18.7	3.60 3.62	0.29 0.77	0.03 0.24	0.00 0.05	0.00 0.14
04158000	EAST FORK SEBEWAING RIVER NEAR SEBEWAING, MICH.	39.0 41.8	8.80 8.60	1.70 1.52	0.20 0.23	0.00 -0.02	0.00 -0.09	0.00 -0.06
04158500	PIGEON RIVER NEAR OWENDALE, MICH.	69.0 76.5	26.0 20.9	9.70 5.61	4.10 1.74	1.80 0.55	0.67 0.24	1.28 0.41
04159500	BLACK RIVER NEAR FARGO, MICH.	601 599	163 204	52.0 65.5	22.0 26.3	11.0 8.52	6.00 4.31	8.08 6.67
04160000	MILL CREEK NEAR ABBOTTSFORD, MICH.	259 264	68.0 111	22.0 45.5	9.90 22.1	5.80 14.2	4.11 9.03	5.08 13.0
04160050	BLACK RIVER NEAR PORT HURON, MICH.	710 876	185 322	53.0 111	22.0 48.1	13.0 18.6	6.16 9.92	7.90 15.1
04160570	NORTH BRANCH BELLE RIVER AT IMLAY CITY, MICH.	27.0 26.0	12.0 8.48	5.10 2.76	2.80 1.04	0.88 0.38	0.26 0.19	0.55 0.34
04160600	BELLE RIVER AT MEMPHIS, MICH.	193 198	68.0 55.6	24.0 14.8	12.0 5.00	5.70 3.28	3.56 1.88	4.77 2.81
04160800	SASHABAW CREEK NEAR DRAYTON PLAINS, MICH.	30.0 28.6	17.0 18.5	7.50 12.0	3.10 7.90	0.78 3.07	0.24 1.98	0.41 2.75
04160900	CLINTON RIVER NEAR DRAYTON MICH.	101 110	69.0 65.1	41.0 36.3	22.0 21.0	7.90 9.13	4.96 5.55	5.81 7.64
04161100	GALLOWAY CREEK NEAR AUBURN HEIGHTS, MICH.	26.0 22.8	12.0 12.6	4.50 6.59	1.40 3.42	0.19 1.28	0.06 0.72	0.13 1.03
04161500	PAINT CREEK NEAR LAKE ORION, MICH.	52.0 49.0	32.0 28.6	19.0 15.9	8.80 8.90	2.80 4.03	1.77 2.44	2.26 3.37
04161540	PAINT CREEK AT ROCHESTER, MICH.	104 92.7	61.0 51.3	36.0 26.9	23.0 14.8	13.0 7.17	8.80 4.32	10.7 5.96
04161580	STONY CREEK NEAR ROMEO, MICH.	39.0 35.4	21.0 20.8	11.0 12.3	5.90 7.51	2.00 3.04	1.40 1.92	1.70 2.68
04163500	PLUM BROOK NEAR UTICA, MICH.	27.0 31.0	10.0 10.4	3.10 3.25	1.20 1.10	0.20 0.26	0.00 0.07	0.07 0.17
04164100	EAST POND CREEK AT ROMEO, MICH.	33.0 29.8	19.0 15.3	9.70 7.98	4.80 4.50	2.20 1.35	1.32 0.80	1.72 1.23
04164300	EAST BRANCH COON CREEK AT ARMADA, MICH.	12.0 16.5	2.90 4.66	0.73 1.18	0.18 0.27	0.07 0.08	0.01 -0.01	0.04 0.04

Table 3.--Computed and estimated flow duration and low flow values--Continued

USGS station number	Station name	Flow duration, D_p (ft^3/s)					Low flow, $M_{d,t}$ (ft^3/s)	
		D_{10}	D_{25}	D_{50}	D_{75}	D_{95}	$M_{7,10}$	$M_{30,10}$
04164500	NORTH BRANCH CLINTON RIVER NEAR MOUNT CLEMENS MICH.	294 255	98.0 86.6	36.0 27.8	15.0 11.1	3.90 5.97	0.86 3.41	2.51 5.23
04164800	MIDDLE BRANCH CLINTON RIVER AT MACOMB, MICH.	57.0 56.9	26.0 17.9	10.0 5.50	4.90 2.03	2.00 0.49	0.67 0.20	1.35 0.39
04166000	RIVER ROUGE AT BIRMINGHAM, MICH.	35.0 41.9	17.0 20.2	7.30 9.15	3.50 4.34	1.40 2.71	0.54 1.69	1.22 2.34
04169500	HURON RIVER AT COMMERCE, MICH.	80.0 79.8	53.0 49.9	29.0 30.3	16.0 19.0	7.70 8.19	5.40 5.18	6.36 7.12
04170000	HURON RIVER AT MILFORD, MICH.	177 193	118 116	73.0 65.7	49.0 39.5	30.0 18.7	17.2 11.5	25.7 15.8
04171500	ORE CREEK NEAR BRIGHTON, MICH.	46.0 44.6	30.0 27.8	17.0 17.0	9.40 10.7	4.00 4.03	1.86 2.56	2.78 3.53
04172000	HURON RIVER NEAR HAMBURG, MICH.	388 448	264 273	171 157	110 98.8	66.0 46.8	44.1 28.6	52.2 39.6
04173000	HURON RIVER NEAR DEXTER, MICH.	721 784	452 470	262 262	154 161	83.0 64.3	52.4 37.7	61.6 53.0
04173500	MILL CREEK NEAR DEXTER, MICH.	172 189	88.0 94.1	44.0 41.9	26.0 20.0	16.0 13.0	12.0 8.02	13.6 10.4
04175600	RIVER RAISIN NEAR MANCHESTER, MICH.	225 207	146 127	79.0 72.4	40.0 44.2	19.0 18.4	11.0 11.6	13.0 15.6
04175700	RIVER RAISIN NEAR TECUMSEH, MICH.	457 409	272 233	144 121	88.0 69.1	55.0 38.8	32.9 25.1	40.8 32.7
04176000	RIVER RAISIN NEAR ADRIAN, MICH.	799 726	453 395	221 193	128 105	76.0 54.1	53.0 33.4	60.1 44.3

Table 4.--Computed and estimated peak flow and flood volume values

USGS station number	Station name	Peak flow, P_t (ft^3/s) P_5	P_{10}	P_{25}	P_{50}	P_{100}	Flood volume, $V_{d,t}$ (ft^3/s) $V_{7,10}$	$V_{30,10}$
04001000	WASHINGTON CREEK AT WINDIGO, MICH.	[a]414 382	490 448	584 532	651 596	716 663	281 224	156 124
04031000	BLACK RIVER NEAR BESSEMER, MICH.	4,950 4,030	6,260 4,830	8,170 5,930	9,780 6,810	11,600 7,750	3,380 3,180	1,640 1,780
04031500	PRESQUE ISLE RIVER AT MARENISCO, MICH.	1,710 1,850	2,090 2,210	2,600 2,710	3,000 3,090	3,420 3,500	1,490 1,370	895 859
04032000	PRESQUE ISLE RIVER NEAR TULA, MICH.	3,240 2,510	3,760 2,970	4,400 3,600	4,860 4,090	5,310 4,600	2,870 2,130	1,630 1,330
04033000	MIDDLE BRANCH ONTONAGON RIVER NEAR PAULDING, MICH.	1,240 1,280	1,480 1,500	1,790 1,800	2,020 2,040	2,260 2,290	1,100 999	657 649
04035000	EAST BRANCH ONTONAGON RIVER NEAR MASS, MICH.	3,560 2,860	4,070 3,460	4,680 4,240	5,110 4,850	5,510 5,460	1,970 1,920	1,130 1,120
04039500	SOUTH BRANCH ONTONAGON RIVER AT EWEN, MICH.	5,510 5,050	6,710 6,180	8,310 7,680	9,560 8,850	10,900 10,100	3,850 3,260	2,160 1,840
04040500	STURGEON RIVER NEAR SIDNAW, MICH.	3,040 3,300	3,540 3,890	4,120 4,680	4,540 5,300	4,930 5,930	2,470 3,120	1,350 1,740
04041000	PERCH RIVER NEAR SIDNAW, MICH.	634 446	757 533	916 648	1,040 736	1,160 826	- -	- -
04041500	STURGEON RIVER NEAR ALSTON, MICH.	4,580 4,930	5,240 5,820	6,010 6,980	6,550 7,890	7,070 8,810	3,480 4,740	2,050 2,690
04042300	STURGEON RIVER NEAR PELKIE, MICH.	5,830 8,140	6,870 9,820	8,210 12,000	9,250 13,700	10,300 15,500	- -	- -
04042500	OTTER RIVER NEAR ELO, MICH.	3,660 3,620	4,240 4,500	4,920 5,680	5,410 6,600	5,880 7,540	2,500 2,000	1,350 1,030
04043000	STURGEON RIVER NEAR ARNHEIM, MICH.	8,680 10,500	10,600 12,800	13,300 15,800	15,500 18,100	17,700 20,400	- -	- -
04043050	TRAP ROCK RIVER NEAR LAKE LINDEN, MICH.	1,030 496	1,200 582	1,430 693	1,600 779	1,770 864	608 415	315 240
04045500	TAHQUAMENON RIVER NEAR TAHQUAMENON PARADISE, MICH.	5,510 5,150	6,100 5,820	6,780 6,620	7,250 7,170	7,690 7,710	5,810 6,220	4,680 4,300
04046000	BLACK RIVER NEAR GARNET, MICH.	366 522	454 616	582 738	689 832	809 930	264 297	166 173
04049500	MANISTIQUE RIVER AT GERMFASK, MICH.	1,530 2,310	1,710 2,630	1,940 3,020	2,110 3,320	2,290 3,610	1,470 2,320	1,170 1,590
04055000	MANISTIQUE RIVER NEAR BLANEY, MICH.	5,040 4,360	5,950 4,940	7,160 5,640	8,110 6,160	9,090 6,660	4,790 4,620	3,350 3,140
04056000	WEST BRANCH MANISTIQUE RIVER NEAR MANISTIQUE MICH.	3,540 3,200	4,200 3,750	5,050 4,460	5,690 4,990	6,350 5,550	3,470 2,820	2,120 1,770
04057510	STURGEON RIVER NEAR NAHMA JUNCTION, MICH.	1,370 1,170	1,520 1,350	1,700 1,570	1,840 1,750	1,970 1,920	1,330 1,080	873 743
04057800	MIDDLE BRANCH ESCANABA RIVER AT HUMBOLT, MICH.	921 544	1,110 634	1,350 753	1,550 843	1,760 935	701 498	399 318
04057900	BLACK RIVER NEAR REPUBLIC, MICH.	432 715	513 831	615 975	692 1,080	770 1,190	304 557	205 317
04058000	MIDDLE BRANCH ESCANABA RIVER NEAR ISHPEMING, MICH.	1,590 1,330	1,890 1,530	2,280 1,770	2,590 1,950	2,890 2,130	1,410 1,400	892 878
04058100	MIDDLE BRANCH ESCANABA RIVER NEAR PRINCETON, MICH.	1,990 2,080	2,330 2,380	2,770 2,740	3,100 3,020	3,420 3,280	1,820 2,370	1,110 1,450
04058400	GOOSE LAKE OUTLET NEAR SANDS STATION, MICH.	403 430	462 494	533 573	584 633	633 691	361 370	190 225

[a] Upper values based on analysis of station records, lower values based on regression equations.

Table 4.--Computed and estimated peak flow and flood volume values--Continued

USGS station number	Station name	Peak flow, P_t (ft^3/s)					Flood volume, $V_{d,t}$ (ft^3/s)	
		P_5	P_{10}	P_{25}	P_{50}	P_{100}	$V_{7,10}$	$V_{30,10}$
04058500	EAST BRANCH ESCANABA RIVER AT GWINN, MICH.	1,290 1,370	1,550 1,570	1,910 1,820	2,190 2,000	2,480 2,180	1,050 1,330	620 801
04059400	TENMILE CREEK AT PERRONVILLE, MICH.	558 596	671 733	825 910	947 1,040	1,080 1,180	- -	- -
04059500	FORD RIVER NEAR HYDE, MICH.	3,910 5,030	4,610 6,100	5,560 7,470	6,310 8,520	7,090 9,600	3,690 4,330	2,460 2,370
04060500	IRON RIVER AT CASPIAN, MICH.	780 684	972 820	1,220 1,000	1,410 1,150	1,610 1,290	- -	- -
04061000	BRULE RIVER NEAR FLORENCE, WISC.	2,180 2,500	2,650 3,030	3,270 3,720	3,760 4,250	4,270 4,800	1,920 2,310	1,210 1,430
04061500	PAINT RIVER AT CRYSTAL FALLS, MICH.	5,830 5,300	7,090 6,330	8,810 7,690	10,200 8,740	11,600 9,820	4,990 4,610	3,000 2,790
04062200	PESHEKEE RIVER NEAR CHAMPION, MICH.	2,980 1,970	3,310 2,260	3,700 2,620	3,970 2,890	4,240 3,150	2,480 1,840	1,430 1,110
04062230	MICHIGAMME RIVER NEAR MICHIGAMME, MICH.	2,590 2,340	3,000 2,670	3,510 3,080	3,890 3,380	4,270 3,670	2,660 2,470	1,680 1,530
04062300	MICHIGAMME RIVER AT REPUBLIC, MICH.	3,050 2,710	3,520 3,080	4,120 3,540	4,560 3,870	5,010 4,200	- -	- -
04062400	MICHIGAMME RIVER NEAR WITCH LAKE, MICH.	3,650 3,700	4,220 4,190	4,930 4,800	5,450 5,260	5,970 5,710	3,740 4,380	2,330 2,700
04065300	WEST BRANCH STURGEON RIVER NEAR RANDVILLE, MICH.	429 819	496 1,000	583 1,240	648 1,430	715 1,620	- -	- -
04065500	STURGEON RIVER NEAR FOSTER CITY, MICH.	1,580 2,970	1,850 3,600	2,200 4,400	2,470 5,010	2,750 5,620	- -	- -
04096400	ST. JOSEPH RIVER NEAR BURLINGTON, MICH.	900 1,090	1,080 1,310	1,300 1,600	1,470 1,820	1,640 2,050	837 947	601 609
04096515	HOG CREEK NEAR ALLEN, MICH.	337 360	407 443	501 557	573 647	648 743	259 254	179 165
04096600	COLDWATER RIVER NEAR HODUNK, MICH.	1,620 1,740	1,940 2,130	2,350 2,650	2,650 3,070	2,950 3,510	1,360 1,410	939 911
04096900	NOTTAWA CREEK NEAR ATHENS, MICH.	663 910	765 1,100	898 1,360	1,000 1,570	1,110 1,780	660 774	406 505
04097060	LITTLE PORTAGE CREEK NEAR FULTON, MICH.	330 285	405 356	508 455	590 535	676 622	- -	- -
04097170	PORTAGE RIVER NEAR VICKSBURG, MICH.	267 500	309 610	363 760	403 878	442 1,000	264 313	185 198
04097370	FLOWERFIELD CREEK AT FLOWERFIELD, MICH.	87 96.9	96.9 115	109 139	117 159	125 180	- -	- -
04097540	PRAIRIE RIVER NEAR NOTTAWA, MICH.	460 559	545 669	651 818	730 936	808 1,060	406 432	276 284
04098500	FAWN RIVER NEAR WHITE PIGEON, MICH.	532 692	608 828	696 1,010	757 1,150	815 1,300	446 668	358 459
04101800	DOWAGIAC RIVER AT SUMNERVILLE, MICH.	1,040 1,380	1,130 1,650	1,250 2,020	1,330 2,310	1,410 2,620	785 1,110	568 771
04102500	PAW PAW RIVER AT RIVERSIDE, MICH.	1,910 1,990	2,320 2,410	2,890 2,980	3,360 3,420	3,870 3,890	1,590 1,860	1,080 1,220
04102700	BLACK RIVER NEAR BANGOR, MICH.	1,020 961	1,210 1,210	1,460 1,560	1,650 1,840	1,850 2,140	647 601	361 332
04103500	KALAMAZOO RIVER AT MARSHALL, MICH.	1,330 2,060	1,540 2,460	1,810 3,000	2,020 3,420	2,220 3,850	1,180 1,900	825 1,310

Table 4.--Computed and estimated peak flow and flood volume values--Continued

USGS station number	Station name	Peak flow, P_t (ft^3/s)					Flood volume, $V_{d,t}$ (ft^3/s)	
		P_5	P_{10}	P_{25}	P_{50}	P_{100}	$V_{7,10}$	$V_{30,10}$
04105000	BATTLE CREEK AT BATTLE CREEK, MICH.	1,860 1,220	2,310 1,480	2,930 1,810	3,430 2,060	3,970 2,320	1,640 1,060	915 690
04105500	KALAMAZOO RIVER NEAR BATTLE CREEK, MICH.	3,520 4,120	4,260 5,000	5,250 6,160	6,030 7,060	6,840 8,020	3,360 3,700	2,120 2,430
04105700	AUGUSTA CREEK NEAR AUGUSTA, MICH.	140 130	179 153	252 185	328 211	428 238	136 98.5	84.7 73.5
04105800	GULL CREEK NEAR GALESBURG, MICH.	109 111	128 132	152 161	170 184	189 209	- -	- -
04106300	PORTAGE CREEK NEAR KALAMAZOO, MICH.	176 103	205 124	242 152	271 175	301 200	75.5 63.3	57.4 43.5
04106400	WEST FORK PORTAGE CREEK AT KALAMAZOO, MICH.	- -	- -	- -	- -	- -	23.2 23.9	17.8 17.4
04108600	RABBIT RIVER NEAR HOPKINS, MICH.	812 609	972 756	1,180 959	1,340 1,120	1,510 1,290	377 347	206 202
04109000	GRAND RIVER AT JACKSON, MICH.	762 582	864 680	991 810	1,090 909	1,180 1,010	649 580	462 434
04109500	PORTAGE RIVER BELOW LITTLE PORTAGE LAKE NEAR MUNITH, MICH.	429 247	541 293	697 356	823 406	957 459	394 175	223 132
04110000	ORCHARD CREEK AT MUNITH, MICH.	776 824	1,020 1,030	1,360 1,320	1,650 1,540	1,950 1,760	475 386	228 190
04111500	DEER CREEK NEAR DANSVILLE, MICH.	407 421	528 533	702 685	847 804	1,000 930	169 149	69.6 68.9
04112000	SLOAN CREEK NEAR WILLIAMSTON, MICH.	408 420	576 541	846 707	1,090 840	1,390 984	106 121	41.4 50.6
04112500	RED CEDAR RIVER AT EAST LANSING, MICH.	3,190 2,220	4,040 2,700	5,210 3,320	6,150 3,780	7,160 4,260	2,390 1,700	1,190 1,050
04114500	LOOKING GLASS RIVER NEAR EAGLE, MICH.	1,770 1,750	2,180 2,130	2,690 2,620	3,060 2,990	3,430 3,360	1,520 1,600	1,030 955
04115000	MAPLE RIVER AT MAPLE RAPIDS, MICH.	3,500 3,810	4,660 4,780	6,270 6,060	7,570 7,020	8,950 8,030	3,280 2,630	1,750 1,510
04116500	FLAT RIVER NEAR SMYRNA, MICH.	1,920 3,680	2,550 4,520	3,600 5,640	4,400 6,510	5,400 7,420	1,950 3,120	1,320 1,880
04117000	QUAKER BROOK NEAR NASHVILLE, MICH.	214 124	279 159	368 209	438 251	512 297	51 51.7	22.7 28.6
04117500	THORNAPPLE RIVER AT HASTINGS, MICH.	3,240 2,440	4,050 2,990	5,120 3,700	5,950 4,240	6,820 4,800	2,980 1,900	1,530 1,160
04118000	THORNAPPLE RIVER NEAR CALEDONIA, MICH.	4,820 4,860	6,000 5,920	7,520 7,300	8,660 8,360	9,810 9,470	4,510 3,870	2,540 2,330
04118500	ROGUE RIVER NEAR ROCKFORD, MICH.	1,790 1,630	2,180 2,020	2,720 2,540	3,140 2,950	3,590 3,380	1,350 1,330	768 805
04121000	MUSKEGON RIVER NEAR MERRITT, MICH.	1,010 1,070	1,130 1,200	1,280 1,360	1,370 1,460	1,460 1,570	965 1,350	756 1,060
04121300	CLAM RIVER AT VOGEL CENTER, MICH.	748 926	885 1,060	1,060 1,230	1,190 1,350	1,330 1,470	625 773	393 555
04121900	LITTLE MUSKEGON RIVER NEAR MORLEY, MICH.	685 672	794 786	932 932	1,040 1,040	1,140 1,150	529 532	357 369
04122100	BEAR CREEK NEAR MUSKEGON, MICH.	398 276	517 332	689 407	832 465	988 526	134 103	65 53.9
04122200	WHITE RIVER NEAR WHITEHALL, MICH.	2,560 1,650	3,290 1,920	4,320 2,270	5,160 2,530	6,070 2,790	1,830 1,580	1,130 1,110

Table 4.--Computed and estimated peak flow and flood volume values--Continued

USGS station number	Station name	Peak flow, P_t (ft^3/s)					Flood volume, $V_{d,t}$ (ft^3/s)	
		P_5	P_{10}	P_{25}	P_{50}	P_{100}	$V_{7,10}$	$V_{30,10}$
04122500	PERE MARQUETTE RIVER AT SCOTTVILLE, MICH.	2,380 2,930	2,730 3,420	3,130 4,040	3,400 4,500	3,670 4,980	2,230 2,620	1,550 1,810
04123000	BIG SABLE RIVER NEAR FREESOIL, MICH.	436 438	485 504	538 586	573 647	605 709	409 349	294 247
04123500	MANISTEE RIVER NEAR GRAYING, MICH.	324 364	341 414	360 474	373 518	384 560	297 287	257 213
04124000	MANISTEE RIVER NEAR SHERMAN, MICH.	2,770 2,470	3,020 2,790	3,310 3,170	3,510 3,440	3,700 3,700	2,600 2,800	1,990 2,040
04124500	EAST BRANCH PINE RIVER NEAR TUSTIN, MICH.	604 585	794 700	1,060 849	1,280 962	1,520 1,080	357 337	163 197
04125000	PINE RIVER NEAR LE ROY, MICH.	851 705	1,020 831	1,250 993	1,430 1,120	1,620 1,240	583 456	322 289
04125500	PINE RIVER NEAR HOXEYVILLE, MICH.	1,430 1,290	1,690 1,490	2,020 1,730	2,280 1,910	2,550 2,090	1,040 998	645 632
04126200	LITTLE MANISTEE RIVER NEAR FREESOIL, MICH.	497 688	556 789	622 914	667 1,010	709 1,100	446 550	330 386
04127800	JORDAN RIVER NEAR EAST JORDAN, MICH.	913 560	1,060 660	1,240 786	1,380 882	1,510 976	382 345	288 210
04128000	STURGEON RIVER NEAR WOLVERINE, MICH.	860 979	968 1,140	1,100 1,330	1,190 1,470	1,280 1,610	602 707	419 470
04129000	PIGEON RIVER NEAR VANDERBILT, MICH.	580 484	695 588	843 721	957 821	1,070 921	249 315	160 187
04129500	PIGEON RIVER AT AFTON, MICH.	858 807	978 956	1,110 1,140	1,210 1,270	1,290 1,400	656 643	404 396
04131500	RAINY RIVER NEAR OCQUEOC, MICH.	617 566	748 657	914 768	1,040 848	1,160 922	543 437	303 280
04132000	BLACK RIVER NEAR CHEBOYGAN, MICH.	2,000 2,700	2,300 3,150	2,660 3,690	2,920 4,080	3,180 4,450	2,110 2,450	1,740 1,620
04132500	THUNDER BAY RIVER NEAR HILLMAN MICH.	1,090 1,530	1,230 1,830	1,400 2,210	1,510 2,480	1,610 2,750	801 1,150	554 696
04134000	NORTH BRANCH THUNDER BAY RIVER NEAR BOLTON, MICH.	2,070 1,170	2,460 1,330	2,920 1,510	3,260 1,640	3,580 1,760	1,740 1,160	880 759
04135500	AU SABLE RIVER AT GRAYLING, MICH.	201 251	222 285	245 326	260 355	275 384	183 198	143 147
04135600	EAST BRANCH AU SABLE RIVER AT GRAYLING, MICH.	144 245	165 280	190 321	208 352	225 382	142 180	104 129
04135700	SOUTH BRANCH AU SABLE RIVER NEAR LUZERNE, MICH.	764 913	879 1,020	1,020 1,150	1,120 1,240	1,230 1,320	775 938	571 752
04138000	EAST BRANCH AU GRES RIVER AT MCIVOR, MICH.	736 978	889 1,180	1,070 1,440	1,200 1,630	1,320 1,820	385 502	231 271
04138500	AU GRES RIVER NEAR NATIONAL CITY, MICH.	1,840 1,720	2,190 2,060	2,610 2,480	2,900 2,790	3,180 3,100	1,020 1,050	551 592
04138700	BIXBY CREEK NEAR ROSE CITY, MICH.	144 149	187 192	248 249	299 295	354 344	- -	- -
04138900	WILKINS CREEK NEAR ROSE CITY, MICH.	211 239	274 294	365 368	442 426	527 487	- -	- -
04139000	HOUGHTON CREEK NEAR LUPTON, MICH.	442 430	530 536	648 678	740 789	837 904	232 179	130 92.8
04139500	RIFLE RIVER AT "THE RANCH" NEAR LUPTON, MICH.	648 754	767 939	924 1,180	1,050 1,370	1,170 1,570	393 314	234 166

Table 4.--Computed and estimated peak flow and flood volume values--Continued

USGS station number	Station name	Peak flow, P_t (ft^3/s)					Flood volume, $V_{d,t}$ (ft^3/s)	
		P_5	P_{10}	P_{25}	P_{50}	P_{100}	$V_{7,10}$	$V_{30,10}$
04140000	PRIOR CREEK NEAR SELKIRK, MICH.	- -	- -	- -	- -	- -	149 115	78.2 60.9
04140500	RIFLE RIVER AT SELKIRK, MICH.	1,260 1,310	1,510 1,610	1,840 2,000	2,090 2,300	2,360 2,610	825 638	457 340
04141000	SOUTH BRANCH SHEPARDS CREEK NEAR SELKIRK, MICH.	102 88.5	132 116	170 153	200 183	230 214	13.3 19.4	5.21 7.32
04141100	SHEPARDS CREEK NEAR SELKIRK, MICH.	304 234	434 305	638 403	821 482	1,030 567	- -	- -
04141500	WEST BRANCH RIFLE RIVER NEAR SELKIRK, MICH.	941 938	1,100 1,160	1,290 1,450	1,430 1,670	1,570 1,910	510 430	236 223
04142000	RIFLE RIVER NEAR STERLING, MICH.	3,010 2,660	3,520 3,210	4,140 3,910	4,590 4,420	5,040 4,940	2,130 1,690	1,190 976
04143500	NORTH BRANCH KAWKAWLIN RIVER NEAR KAWKAWLIN MICH.	1,110 1,290	1,350 1,550	1,670 1,880	1,910 2,110	2,140 2,330	914 838	463 460
04143900	SHIAWASSEE RIVER AT LINDEN, MICH.	297 610	348 741	412 909	461 1,040	510 1,160	306 491	224 284
04144000	SHIAWASSEE RIVER AT BYRON, MICH.	2,100 2,530	2,570 3,080	3,170 3,790	3,640 4,300	4,130 4,830	2,050 2,080	1,190 1,210
04144180	JONES CREEK NEAR GAINES, MICH.	153 194	189 244	234 310	268 360	302 412	- -	- -
04144200	PORTER DRAIN NEAR GAINES, MICH.	100 129	126 161	158 203	183 234	207 266	- -	- -
04144220	JONES CREEK AT DUFFIELD, MICH.	477 542	567 674	674 844	750 973	822 1,110	- -	- -
04144500	SHIAWASSEE RIVER AT OWOSSO, MICH.	3,700 3,370	4,520 4,060	5,530 4,930	6,270 5,560	6,990 6,190	3,010 3,040	1,770 1,750
04145000	SHIAWASSEE RIVER NEAR FERGUS, MICH.	5,130 4,650	6,190 5,660	7,460 6,910	8,350 7,830	9,190 8,720	3,980 4,030	2,310 2,210
04145500	BAD RIVER NEAR BRANT, MICH.	1,970 2,590	2,470 3,230	3,120 4,010	3,590 4,580	4,070 5,140	959 1,060	477 448
04146000	FARMERS CREEK NEAR LAPEER, MICH.	527 627	696 782	931 986	1,120 1,140	1,310 1,300	358 345	182 186
04147500	FLINT RIVER NEAR OTISVILLE, MICH.	3,510 4,480	4,500 5,530	5,830 6,880	6,860 7,880	7,920 8,870	- -	- -
04147800	POWERS-CULLEN DRAIN NEAR GENESEE, MICH.	338 245	446 306	595 383	715 442	841 501	- -	- -
04147900	LEFLER-SCOTHAN DRAIN NEAR OTISVILLE, MICH.	114 121	144 153	183 195	213 228	243 262	- -	- -
04147990	BUTTERNUT CREEK NEAR GENESEE, MICH.	1,080 596	1,440 751	1,910 953	2,260 1,110	2,610 1,260	250 287	141 141
04148120	KEARSLEY CREEK NEAR ATLAS, MICH.	465 452	606 550	812 676	988 771	1,180 865	- -	- -
04148139	BLACK CREEK NEAR DAVISON, MICH.	336 337	402 421	484 528	543 610	600 690	- -	- -
04148140	KEARSLEY CREEK NEAR DAVISON, MICH.	920 930	1,130 1,150	1,390 1,420	1,580 1,620	1,780 1,820	714 663	397 355
04148160	GILKEY CREEK NEAR FLINT, MICH.	242 279	293 362	357 473	404 558	452 646	70.7 90.3	34.1 37.1
04148200	SWARTZ CREEK NEAR HOLLY, MICH.	78.9 122	98.2 151	125 189	146 219	169 250	74.3 75.4	38.9 43.4

Table 4.--Computed and estimated peak flow and flood volume values--Continued

USGS station number	Station name	Peak flow, P_t (ft^3/s)					Flood volume, $V_{d,t}$ (ft^3/s)	
		P_5	P_{10}	P_{25}	P_{50}	P_{100}	$V_{7,10}$	$V_{30,10}$
04148255	SWARTZ CREEK NEAR GRAND BLANC, MICH.	144 315	167 387	196 481	217 552	239 623	- -	- -
04148260	SWARTZ CREEK NEAR SWARTZ CREEK, MICH.	1,030 688	1,320 850	1,690 1,060	1,970 1,210	2,250 1,370	- -	- -
04148265	KIMBALL DRAIN NEAR SWARTZ CREEK, MICH.	281 227	338 283	409 355	460 411	511 468	- -	- -
04148270	WEST BRANCH SWARTZ CREEK NEAR SWARTZ CR, MICH.	1,150 575	1,440 714	1,820 893	2,100 1,030	2,380 1,170	- -	- -
04148300	SWART CREEK AT FLINT, MICH.	1,990 1,230	2,430 1,530	2,980 1,910	3,380 2,200	3,760 2,480	926 806	483 424
04148410	THREAD CREEK NEAR GOODRICH, MICH.	236 330	280 410	333 518	372 602	410 688	- -	- -
04148440	THREAD CREEK NEAR FLINT, MICH.	716 520	897 637	1,130 786	1,320 901	1,500 1,010	453 361	218 192
04148500	FLINT RIVER NEAR FLINT, MICH.	7,220 7,580	8,830 9,370	10,900 11,600	12,400 13,300	13,900 15,000	6,230 5,910	3,460 3,310
04148610	COLE CREEK NEAR FLUSHING, MICH.	230 325	270 408	317 516	350 598	381 680	- -	- -
04148620	FREEMAN DRAIN NEAR MONTROSE, MICH.	272 337	337 421	416 530	473 612	528 695	- -	- -
04148640	ARMSTRONG CREEK NEAR MONTROSE, MICH.	277 477	316 600	360 756	390 875	419 993	- -	- -
04148800	PINE RUN NEAR MONTROSE, MICH.	669 765	801 952	958 1,190	1,070 1,360	1,170 1,540	- -	- -
04149300	MISTEGUAY CREEK NEAR FLUSHING, MICH.	955 627	1,260 788	1,660 996	1,960 1,150	2,260 1,310	- -	- -
04150000	SOUTH BRANCH CASS RIVER NEAR CASS CITY, MICH.	4,470 2,930	5,410 3,520	6,510 4,230	7,270 4,720	7,980 5,180	2,480 1,760	1,090 837
04150500	CASS RIVER AT CASS CITY, MICH.	5,780 3,480	7,040 4,150	8,600 4,970	9,710 5,560	10,800 6,140	3,590 2,760	1,690 1,500
04151500	CASS RIVER AT FRANKENMUTH, MICH.	11,000 7,010	13,500 8,350	16,700 9,960	19,100 11,100	21,400 12,200	7,070 5,990	3,570 3,240
04152500	TOBACCO RIVER AT BEAVERTON, MICH.	4,850 4,950	5,860 6,100	7,180 7,590	8,180 8,720	9,190 9,870	- -	- -
04153500	SALT RIVER NEAR NORTH BRADLEY, MICH.	4,140 2,810	5,680 3,520	7,840 4,430	9,580 5,090	11,400 5,760	1,690 1,290	686 593
04154000	CHIPPEWA RIVER NEAR MOUNT PLEASANT, MICH.	2,850 2,840	3,590 3,410	4,580 4,110	5,350 4,630	6,150 5,140	2,240 2,410	1,290 1,380
04154500	CHIPPEWA RIVER NEAR MIDLAND, MICH.	5,440 4,640	7,010 5,620	9,160 6,830	10,900 7,720	12,700 8,580	3,760 3,820	2,050 2,080
04155000	PINE RIVER AT ALMA, MICH.	2,370 2,220	3,010 2,660	3,880 3,210	4,550 3,620	5,240 4,000	1,780 1,960	999 1,090
04155500	PINE RIVER NEAR MIDLAND, MICH.	3,710 3,140	4,470 3,840	5,390 4,700	6,050 5,330	6,670 5,920	2,510 2,740	1,430 1,480
04157500	SEBEWAING RIVER NEAR SEBEWAING, MICH.	2,310 2,130	2,630 2,630	2,990 3,250	3,230 3,710	3,450 4,140	733 752	321 329
04158000	EAST FORK SEBEWAING RIVER NEAR SEBEWAING, MICH.	1,140 1,290	1,370 1,590	1,660 1,960	1,880 2,230	2,110 2,490	402 447	164 197
04158500	PIGEON RIVER NEAR OWENDALE, MICH.	1,360 1,760	1,680 2,190	2,080 2,730	2,380 3,120	2,690 3,490	505 649	259 263

Table 4.--Computed and estimated peak flow and flood volume values--Continued

USGS station number	Station name	Peak flow, P_t (ft^3/s)					Flood volume, $V_{d,t}$ (ft^3/s)	
		P_5	P_{10}	P_{25}	P_{50}	P_{100}	$V_{7,10}$	$V_{30,10}$
04159500	BLACK RIVER NEAR FARGO, MICH.	8,930 8,530	10,800 10,800	13,000 13,800	14,500 16,000	15,800 18,300	5,900 5,040	2,560 2,560
04160000	MILL CREEK NEAR ABBOTTSFORD, MICH.	2,470 2,330	3,150 2,920	4,020 3,690	4,680 4,260	5,330 4,820	1,750 1,340	923 756
04160050	BLACK RIVER NEAR PORT HURON, MICH.	9,100 10,500	11,500 13,400	14,600 17,100	17,100 19,900	19,600 22,800	5,750 6,480	2,470 3,400
04160600	BELLE RIVER AT MEMPHIS, MICH.	2,590 2,720	3,400 3,450	4,510 4,410	5,380 5,130	6,280 5,850	1,450 1,300	690 689
04160800	SASHABAW CREEK NEAR DRAYTON PLAINS, MICH.	108 106	130 129	158 160	180 183	202 207	71.3 70.6	53.9 50.8
04160900	CLINTON RIVER NEAR DRAYTON PLAINS, MICH.	- -	- -	- -	- -	- -	190 251	159 175
04161100	GALLOWAY CREEK NEAR AUBURN HEIGHTS, MICH.	171 198	212 250	268 321	313 377	362 436	104 93.5	52.1 55.6
04161500	PAINT CREEK NEAR LAKE ORION, MICH.	260 186	329 222	420 269	489 306	560 341	225 135	121 97.8
04161540	PAINT CREEK AT ROCHESTER, MICH.	604 551	772 685	997 862	1,170 1,000	1,350 1,140	351 350	206 212
04161580	STONY CREEK NEAR ROMEO, MICH.	198 264	244 330	303 419	347 490	391 563	134 128	80.5 77.1
04161760	WEST BRANCH STONY CREEK NEAR WASHINGTON, MICH.	214 114	280 142	377 179	460 209	552 238	- -	- -
04163500	PLUM BROOK NEAR UTICA, MICH.	643 714	837 906	1,100 1,160	1,300 1,350	1,500 1,550	172 234	84.1 107
04164010	NORTH BRANCH CLINTON RIVER AT ALMONT, MICH.	339 230	436 305	564 411	661 496	760 587	- -	- -
04164050	NORTH BRANCH CLINTON.RIVER NEAR ROMEO, MICH.	1,350 935	1,900 1,230	2,720 1,630	3,430 1,950	4,210 2,270	- -	- -
04164100	EAST POND CREEK AT ROMEO, MICH.	232 233	304 296	402 381	480 447	562 515	133 118	72.1 69.4
04164150	NORTH BRANCH CLINTON RIVER NEAR MEADE, MICH.	2,110 1,420	2,820 1,840	3,830 2,410	4,640 2,850	5,490 3,300	- -	- -
04164200	COON CREEK NEAR ARMADA, MICH.	355 530	465 705	611 945	722 1,140	835 1,330	- -	- -
04164250	TUPPER BROOK AT RAY CENTER, MICH.	289 386	379 504	509 661	616 784	731 909	- -	- -
04164300	EAST BRANCH COON CREEK AT ARMADA, MICH.	592 618	773 817	1,000 1,090	1,170 1,300	1,330 1,520	170 187	73.8 78.8
04164350	HIGHBANK CREEK NEAR ARMADA, MICH.	825 734	1,130 969	1,560 1,290	1,920 1,540	2,310 1,800	- -	- -
04164360	EAST BRANCH COON CREEK NEAR NEW HAVEN, MICH.	1,300 1,270	1,650 1,670	2,120 2,210	2,480 2,630	2,860 3,060	- -	- -
04164400	DEER CREEK NEAR MEADE, MICH.	501 390	582 490	680 620	751 719	820 815	- -	- -
04164500	NORTH BRANCH CLINTON RIVER NEAR MOUNT CLEMENS,MICH.	3,880 3,210	5,040 4,130	6,620 5,350	7,880 6,280	9,200 7,220	1,790 1,540	866 803
04164600	MIDDLE BRANCH CLINTON RIVER NEAR MACOMB, MICH.	763 814	977 1,050	1,270 1,350	1,500 1,590	1,750 1,840	- -	- -
04164800	MIDDLE BRANCH CLINTON RIVER AT MACOMB, MICH.	1,210 1,530	1,500 1,980	1,870 2,580	2,150 3,040	2,410 3,510	365 446	173 198

Table 4.--Computed and estimated peak flow and flood volume values--Continued

USGS station number	Station name	Peak flow, P_t (ft^3/s)					Flood volume, $V_{d,t}$ (ft^3/s)	
		P_5	P_{10}	P_{25}	P_{50}	P_{100}	$V_{7,10}$	$V_{30,10}$
04165200	GLOEDE DITCH NEAR WALDENBURG, MICH.	388 453	492 565	630 710	737 820	847 930	- -	- -
04166000	RIVER ROUGE AT BIRMINGHAM, MICH.	536 503	725 659	1,010 880	1,240 1,060	1,500 1,250	185 224	89.4 127
04169500	HURON RIVER AT COMMERCE, MICH.	153 223	182 267	219 325	247 370	275 415	166 161	133 120
04170000	HURON RIVER AT MILFORD, MICH.	440 455	518 545	616 660	688 747	761 834	387 374	292 280
04171500	ORE CREEK NEAR BRIGHTON, MICH.	113 153	134 188	160 233	180 269	199 305	119 105	80.7 71.8
04172000	HURON RIVER NEAR HAMBURG, MICH.	961 1,060	1,160 1,260	1,410 1,530	1,600 1,730	1,790 1,920	914 959	663 712
04172500	PORTAGE RIVER NEAR PINCKNEY, MICH.	257 404	312 499	385 626	441 725	499 824	- -	- -
04173000	HURON RIVER NEAR DEXTER, MICH.	1,740 1,800	2,130 2,160	2,630 2,640	3,010 2,990	3,410 3,340	1,940 1,730	1,410 1,260
04173500	MILL CREEK NEAR DEXTER, MICH.	1,040 1,390	1,190 1,780	1,370 2,310	1,490 2,740	1,610 3,190	694 718	366 418
04175340	STONY CREEK AT OAKVILLE, MICH.	- -	- -	- -	- -	- -	531 690	283 351
04175600	RIVER RAISIN NEAR MANCHESTER, MICH.	420 546	520 652	700 793	860 902	990 1,010	435 490	363 363
04175700	RIVER RAISIN NEAR TECUMSEH, MICH.	1,740 1,430	2,180 1,750	2,720 2,170	3,130 2,500	3,500 2,830	1,040 1,250	782 842
04176000	RIVER RAISIN NEAR ADRIAN, MICH.	3,750 2,630	4,480 3,210	5,340 3,990	5,940 4,600	6,520 5,220	2,470 2,290	1,730 1,560
04176400	SALINE RIVER NEAR SALINE, MICH.	1,690 1,330	2,120 1,680	2,720 2,160	3,200 2,540	3,720 2,940	- -	- -

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Table 5.--Physical and climatological

USGS station number	Station name	Record length: [a]combined (yr)	Record length: continuous (yr)	AREA (mi^2)	CONTDA (mi^2)	LENGTH (mi)	SLOPE (ft/mi)	CHSWAMP (percent)
04001000	WASHINGTON CREEK AT WINDIGO, MICH.	17	17	13.2	13.2	6.80	51.2	37
04031000	BLACK RIVER NEAR BESSEMER, MICH.	27	27	200	200	25.0	19.5	25
04031500	PRESQUE ISLE RIVER AT MARENISCO, MICH.	37	36	171	171	23.7	7.40	62
04032000	PRESQUE ISLE RIVER NEAR TULA, MICH.	37	28	261	261	43.1	10.3	45
04033000	MIDDLE BRANCH ONTONAGON RIVER NEAR PAULDING, MICH.	39	39	164	153	31.4	7.70	32
04035000	EAST BRANCH ONTONAGON RIVER NEAR MASS, MICH.	37	37	272	272	49.0	14.4	14
04039500	SOUTH BRANCH ONTONAGON RIVER AT EWEN, MICH.	43	29	348	348	54.0	13.7	35
04040000	ONTONAGON RIVER NEAR ROCKLAND, MICH.	39	39	1340	1340	61.0	10.7	39
04040500	STURGEON RIVER NEAR SIDNAW, MICH.	42	38	171	171	32.1	20.3	44
04041000	PERCH RIVER NEAR SIDNAW, MICH.	25	-	63.1	63.1	23.1	6.90	76
04041500	STURGEON RIVER NEAR ALSTON, MICH.	50	48	346	346	58.5	19.0	32
04042300	STURGEON RIVER NEAR PELKIE, MICH.	11	-	506	506	75.3	16.0	26
04042500	OTTER RIVER NEAR ELO, MICH.	37	30	167	167	24.4	9.40	11
04043000	STURGEON RIVER NEAR ARNHEIM, MICH.	32	32	705	705	91.0	12.9	35
04043050	TRAP ROCK RIVER NEAR LAKE LINDEN, MICH.	15	15	28.0	29.7	16.4	33.2	55
04045500	TAHQUAMENON RIVER NEAR TAHQUAMENON PARADISE, MICH.	28	28	790	790	67.0	0.90	77
04046000	BLACK RIVER NEAR GARNET, MICH.	30	27	33.1	25.1	10.2	20.9	71
04049500	MANISTIQUE RIVER AT GERMFASK, MICH.	44	32	341	341	43.6	4.80	53
04055000	MANISTIQUE RIVER NEAR BLANEY, MICH.	42	32	704	704	70.3	3.30	33
04056000	WEST BRANCH MANISTIQUE RIVER NEAR MANISTIQUE MICH.	19	18	322	322	46.9	4.80	44
04056500	MANISTIQUE RIVER NEAR MANISTIQUE, MICH.	44	43	1100	1100	85.4	2.70	27
04057510	STURGEON RIVER NEAR NAHMA JUNCTION, MICH.	15	16	183	181	42.4	6.30	56
04057800	MIDDLE BRANCH ESCANABA RIVER AT HUMBOLT, MICH.	22	22	46.0	46.0	12.3	17.4	78
04057900	BLACK RIVER NEAR REPUBLIC, MICH.	19	7	34.4	34.4	12.4	13.0	31
04058000	MIDDLE BRANCH ESCANABA RIVER NEAR ISHPEMING, MICH.	18	17	128	128	29.3	10.7	33
04058100	MIDDLE BRANCH ESCANABA RIVER NEAR PRINCETON, MICH.	11	20	210	210	51.3	9.40	19
04058400	GOOSE LAKE OUTLET NEAR SANDS STATION, MICH.	15	16	37.5	33.9	15.3	12.4	15
04058500	EAST BRANCH ESCANABA RIVER AT GWINN, MICH.	26	26	124	121	32.0	12.8	18
04059000	ESCANABA RIVER AT CORNELL, MICH.	36	33	870	870	85.2	9.77	38
04059400	TENMILE CREEK AT PERRONVILLE, MICH.	11	6	43.9	43.9	22.6	7.60	58
04059500	FORD RIVER NEAR HYDE, MICH.	27	27	450	450	92.1	6.60	54
04060500	IRON RIVER AT CASPIAN, MICH.	33	32	92.1	91.4	20.9	10.4	49
04061000	BRULE RIVER NEAR FLORENCE, WISC.	39	38	389	389	60.8	7.48	52
04061500	PAINT RIVER AT CRYSTAL FALLS, MICH.	37	37	597	597	50.4	6.14	24
04062200	PESHEKEE RIVER NEAR CHAMPION, MICH.	20	17	133	133	24.7	11.6	68
04062230	MICHIGAMME RIVER NEAR MICHIGAMME, MICH.	13	13	194	194	34.8	9.90	58
04062300	MICHIGAMME RIVER AT REPUBLIC, MICH.	20	14	240	240	43.5	9.20	59

[a] Combined record length includes continuous and crest-stage partial-record data used to determine peak flow

$I_{24,2}$ (in.)	$I_{24,100}$ (in.)	SLENRAT	FOREST (percent)	SNOFALL (in./yr)	JANMIN (°F)	REGION	Station name
2.10	4.42	3.50	99.0	90	2.5	1	WASHINGTON CREEK AT WINDIGO, MICH.
2.27	4.73	3.13	88.4	140	3.0	1	BLACK RIVER NEAR BESSEMER, MICH.
2.24	4.69	3.28	91.0	130	3.0	1	PRESQUE ISLE RIVER AT MARENISCO, MICH.
2.23	4.63	7.12	84.0	140	3.0	1	PRESQUE ISLE RIVER NEAR TULA, MICH.
2.21	4.59	6.44	96.0	100	3.0	1	MIDDLE BRANCH ONTONAGON RIVER NEAR PAULDING, MICH.
2.14	4.42	8.83	94.9	120	3.0	1	EAST BRANCH ONTONAGON RIVER NEAR MASS, MICH.
2.17	4.50	8.38	94.4	90	3.2	1	SOUTH BRANCH ONTONAGON RIVER AT EWEN, MICH.
2.17	4.50	2.78	91.0	130	3.0	1	ONTONAGON RIVER NEAR ROCKLAND, MICH.
2.13	4.38	6.03	97.0	105	2.9	1	STURGEON RIVER NEAR SIDNAW, MICH.
2.20	4.57	8.46	98.0	90	2.5	1	PERCH RIVER NEAR SIDNAW, MICH.
2.13	4.37	9.89	94.4	100	3.0	1	STURGEON RIVER NEAR ALSTON, MICH.
2.11	4.37	11.2	89.1	115	3.5	1	STURGEON RIVER NEAR PELKIE, MICH.
2.14	4.37	3.56	93.4	150	5.0	1	OTTER RIVER NEAR ELO, MICH.
2.14	4.32	11.8	94.9	130	5.0	1	STURGEON RIVER NEAR ARNHEIM, MICH.
2.17	4.39	9.06	61.0	120	8.5	1	TRAP ROCK RIVER NEAR LAKE LINDEN, MICH.
1.87	3.75	5.68	96.7	115	9.0	1	TAHQUAMENON RIVER NEAR TAHQUAMENON PARADISE, MICH.
2.00	3.98	4.15	71.0	95	9.5	1	BLACK RIVER NEAR GARNET, MICH.
1.91	3.82	5.57	88.4	110	8.5	1	MANISTIQUE RIVER AT GERMFASK, MICH.
1.93	3.84	7.02	88.9	110	8.5	1	MANISTIQUE RIVER NEAR BLANEY, MICH.
1.97	3.96	6.83	87.2	125	8.5	1	WEST BRANCH MANISTIQUE RIVER NEAR MANISTIQUE MICH.
1.96	3.92	6.63	88.9	120	8.5	1	MANISTIQUE RIVER NEAR MANISTIQUE, MICH.
22.0	4.09	9.93	95.0	100	8.0	1	STURGEON RIVER NEAR NAHMA JUNCTION, MICH.
2.16	4.44	3.29	95.0	130	5.0	1	MIDDLE BRANCH ESCANABA RIVER AT HUMBOLT, MICH.
2.18	4.50	4.47	91.0	105	2.5	1	BLACK RIVER NEAR REPUBLIC, MICH.
2.12	4.35	6.71	96.0	115	3.0	1	MIDDLE BRANCH ESCANABA RIVER NEAR ISHPEMING, MICH.
2.08	4.29	12.5	92.7	105	4.0	1	MIDDLE BRANCH ESCANABA RIVER NEAR PRINCETON, MICH.
2.16	4.39	6.91	83.0	108	8.0	1	GOOSE LAKE OUTLET NEAR SANDS STATION, MICH.
2.09	4.27	8.46	90.7	105	7.5	1	EAST BRANCH ESCANABA RIVER AT GWINN, MICH.
2.07	4.23	8.34	93.6	105	6.0	1	ESCANABA RIVER AT CORNELL, MICH.
2.16	4.45	11.6	95.0	69	6.8	1	TENMILE CREEK AT PERRONVILLE, MICH.
2.07	4.27	18.9	91.9	75	6.0	1	FORD RIVER NEAR HYDE, MICH.
2.20	4.60	4.78	67.7	70	4.0	1	IRON RIVER AT CASPIAN, MICH.
2.15	4.46	9.50	91.4	70	4.5	1	BRULE RIVER NEAR FLORENCE, WISC.
2.14	4.42	4.25	92.7	80	3.0	1	PAINT RIVER AT CRYSTAL FALLS, MICH.
2.12	4.35	4.59	94.0	135	3.0	1	PESHEKEE RIVER NEAR CHAMPION, MICH.
2.09	4.31	6.24	90.0	125	3.0	1	MICHIGAMME RIVER NEAR MICHIGAMME, MICH.
2.09	4.30	7.88	91.0	125	3.0	1	MICHIGAMME RIVER AT REPUBLIC, MICH.

Table 5.--Physical and climatological

USGS station number	Station name	Record length: [a]combined (yr)	Record length: continuous (yr)	AREA (mi^2)	CONTDA (mi^2)	LENGTH (mi)	SLOPE (ft/mi)	CHSWAMP (percent)
04062400	MICHIGAMME RIVER NEAR WITCH LAKE, MICH.	16	16	316	316	58.6	9.06	45
04065300	WEST BRANCH STURGEON RIVER NEAR RANDVILLE, MICH.	23	23	56.1	55.8	18.7	15.9	77
04065500	STURGEON RIVER NEAR FOSTER CITY, MICH.	25	26	237	237	40.9	10.8	52
04096400	ST. JOSEPH RIVER NEAR BURLINGTON, MICH.	20	19	201	196	57.7	4.00	27
04096515	HOG CREEK NEAR ALLEN, MICH.	13	12	48.7	48.7	11.8	3.10	59
04096600	COLDWATER RIVER NEAR HODUNK, MICH.	20	19	293	286	34.2	4.00	42
04096900	NOTTAWA CREEK NEAR ATHENS, MICH.	16	15	162	162	37.2	3.2	40
04097060	LITTLE PORTAGE CREEK NEAR FULTON, MICH.	11	3	28.3	27.5	14.3	7.50	22
04097170	PORTAGE RIVER NEAR VICKSBURG, MICH.	22	20	68.2	66.0	19.0	4.90	17
04097370	FLOWERFIELD CREEK AT FLOWERFIELD, MICH.	16	-	37.6	21.4	13.5	3.50	85
04097500	ST. JOSEPH RIVER AT THREE RIVERS, MICH.	31	28	1350	1350	79.4	2.99	47
04097540	PRAIRIE RIVER NEAR NOTTAWA, MICH.	20	19	106	92.0	31.8	4.30	18
04098500	FAWN RIVER NEAR WHITE PIGEON, MICH.	25	18	192	165	61.6	3.20	67
04099000	ST. JOSEPH RIVER AT MOTTVILLE, MICH.	59	58	1870	1870	95.1	2.79	55
04101500	ST JOSEPH RIVER AT NILES, MICH.	52	52	3670	3670	148	2.19	47
04101800	DOWAGIAC RIVER AT SUMNERVILLE, MICH.	22	21	255	255	24.4	2.29	20
04102500	PAW PAW RIVER AT RIVERSIDE, MICH.	31	30	390	390	64.7	2.50	43
04102700	SOUTH BRANCH BLACK RIVER NEAR BANGOR, MICH.	16	15	83.6	81.3	24.3	3.80	16
04103500	KALAMAZOO RIVER AT MARSHALL, MICH.	34	33	449	449	57.1	3.85	70
04105000	BATTLE CREEK AT BATTLE CREEK, MICH.	49	47	241	241	53.9	2.23	63
04105500	KALAMAZOO RIVER NEAR BATTLE CREEK, MICH.	44	44	824	824	73.3	3.80	59
04105700	AUGUSTA CREEK NEAR AUGUSTA, MICH.	18	17	38.9	26.9	17.6	6.40	94
04105800	GULL CREEK NEAR GALESBURG, MICH.	10	8	38.1	21.8	12.4	6.00	82
04106000	KALAMAZOO RIVER AT COMSTOCK, MICH.	47	47	1010	1010	96.5	3.43	67
04106300	PORTAGE CREEK NEAR KALAMAZOO, MICH.	18	17	19.5	14.7	10.6	7.20	23
04106400	WESTFORK PORTAGE CREEK AT KALAMAZOO, MICH.	22	22	25.0	6.00	6.50	4.50	59
04108500	KALAMAZOO RIVER NEAR FENNVILLE, MICH.	50	51	1600	1600	147	3.38	59
04108600	RABBIT RIVER NEAR HOPKINS, MICH.	16	16	68.5	62.1	18.7	6.70	15
04108800	MACATAWA RIVER NEAR ZEELAND, MICH.	21	21	65.8	65.8	10.9	5.80	0
04109000	GRAND RIVER AT JACKSON, MICH.	46	46	174	159	37.0	2.40	73
04109500	PORTAGERIVER BELOW LITTLE PORTAGE LAKE NEAR MUNITH, MICH.	12	12	54.0	49.4	11.7	5.90	96
04110000	ORCHARD CREEK AT MUNITH, MICH.	12	12	49.0	49.0	11.1	3.30	0
04111500	DEER CREEK NEAR DANSVILLE, MICH.	27	28	16.3	16.3	7.60	6.50	0
04112000	SLOAN CREEK NEAR WILLIAMSTON, MICH.	27	27	9.34	9.34	5.60	11.7	0
04112500	RED CEDAR RIVER AT EAST LANSING, MICH.	73	52	355	355	44.2	1.93	42
04113000	GRAND RIVER AT LANSING, MICH.	81	52	1230	1230	98.9	1.54	56
04114500	LOOKING GLASS RIVER NEAR EAGLE, MICH.	37	38	281	281	60.2	1.75	39

[a] Combined record length includes continuous and crest-stage partial-record data used to determine peak flow

basin characteristics--Continued

$I_{24,2}$ (in.)	$I_{24,100}$ (in.)	SLENRAT	FOREST (percent)	SNOFALL (in./yr)	JANMIN (°F)	REGION	Station name
2.08	4.29	10.9	92.0	120	3.1	1	MICHIGAMME RIVER NEAR WITCH LAKE, MICH.
2.19	4.53	6.27	90.0	65	4.0	1	WEST BRANCH STURGEON RIVER NEAR RANDVILLE, MICH.
2.12	4.34	7.06	91.6	65	5.2	1	STURGEON RIVER NEAR FOSTER CITY, MICH.
2.34	4.64	17.0	13.0	40	16.0	2	ST. JOSEPH RIVER NEAR BURLINGTON, MICH.
2.46	4.79	2.86	11.0	45	16.0	2	HOG CREEK NEAR ALLEN, MICH.
2.32	4.65	4.09	7.0	40	16.0	2	COLDWATER RIVER NEAR HODUNK, MICH.
2.32	4.70	8.54	12.0	40	16.0	2	NOTTAWA CREEK NEAR ATHENS, MICH.
2.48	4.94	7.44	18.0	45	16.4	2	LITTLE PORTAGE CREEK NEAR FULTON, MICH.
2.45	4.84	5.47	8.0	50	17.0	2	PORTAGE RIVER NEAR VICKSBURG, MICH.
2.51	5.03	8.52	16.0	65	16.3	2	FLOWERFIELD CREEK AT FLOWERFIELD, MICH.
2.37	4.66	4.67	19.0	50	16.5	2	ST. JOSEPH RIVER AT THREE RIVERS, MICH.
2.41	4.84	11.0	12.0	40	16.4	2	PRAIRIE RIVER NEAR NOTTAWA, MICH.
2.41	4.76	23.0	10.0	40	16.4	2	FAWN RIVER NEAR WHITE PIGEON, MICH.
2.39	4.68	4.85	17.7	50	16.5	2	ST. JOSEPH RIVER AT MOTTVILLE, MICH.
2.44	4.79	5.93	13.6	55	16.5	2	ST. JOSEPH RIVER AT NILES, MICH.
2.42	4.86	2.33	17.0	65	17.0	2	DOWAGIAC RIVER AT SUMNERVILLE, MICH.
2.37	4.73	10.7	24.9	75	17.5	2	PAW PAW RIVER AT RIVERSIDE, MICH.
2.43	4.90	7.26	73.0	78	17.9	2	BLACK RIVER NEAR BANGOR, MICH.
2.28	4.53	7.26	20.1	40	16.0	2	KALAMAZOO RIVER AT MARSHALL, MICH.
2.27	4.52	12.1	19.7	44	16.0	2	BATTLE CREEK AT BATTLE CREEK, MICH.
2.27	4.51	6.52	22.2	43	16.0	2	KALAMAZOO RIVER NEAR BATTLE CREEK, MICH.
2.45	4.87	11.5	16.0	50	16.0	2	AUGUSTA CREEK NEAR AUGUSTA, MICH.
2.47	4.92	7.05	9.0	54	16.0	2	GULL CREEK NEAR GALESBURG, MICH.
2.27	4.54	9.22	22.2	45	16.0	2	KALAMAZOO RIVER AT COMSTOCK, MICH.
2.53	5.08	7.64	16.0	60	17.0	2	PORTAGE CREEK NEAR KALAMAZOO, MICH.
2.59	5.16	7.04	16.0	65	17.2	2	WEST FORK PORTAGE CREEK AT KALAMAZOO, MICH.
2.29	4.62	13.5	22.8	50	16.2	2	KALAMAZOO RIVER NEAR FENNVILLE, MICH.
2.37	4.80	5.63	11.0	70	16.6	2	RABBIT RIVER NEAR HOPKINS, MICH.
2.40	4.81	1.81	4.6	80	18.0	2	MACATAWA RIVER NEAR ZEELAND, MICH.
2.26	4.49	8.61	13.0	45	16.0	2	GRAND RIVER AT JACKSON, MICH.
2.32	4.56	2.77	35.0	40	16.0	2	PORTAGE RIVER BELOW LITTLE PORTAGE LAKE NEAR MUNITH, MICH.
2.28	4.58	2.51	11.0	40	16.0	2	ORCHARD CREEK AT MUNITH, MICH.
2.34	4.68	3.54	13.0	40	16.0	2	DEER CREEK NEAR DANSVILLE, MICH.
2.39	4.80	3.36	11.0	40	16.0	2	SLOAN CREEK NEAR WILLIAMSTON, MICH.
2.17	4.32	5.50	18.6	40	16.0	2	RED CEDAR RIVER AT EAST LANSING, MICH.
2.22	4.41	7.95	18.1	40	16.0	2	GRAND RIVER AT LANSING, MICH.
2.15	4.32	12.9	12.6	40	15.6	2	LOOKING GLASS RIVER NEAR EAGLE, MICH.

Table 5.--Physical and climatological

USGS station number	Station name	Record length [a] combined (yr)	Record length continuous (yr)	AREA (mi^2)	CONTDA (mi^2)	LENGTH (mi)	SLOPE (ft/mi)	CHSWAMP (percent)
04115000	MAPLE RIVER AT MAPLE RAPIDS, MICH.	37	38	434	434	54.6	2.27	31
04116000	GRAND RIVER AT IONIA, MICH.	33	30	2840	2840	163	2.23	38
04116500	FLAT RIVER NEAR SMYRNA, MICH.	31	31	528	528	62.5	3.63	36
04117000	QUAKER BROOK NEAR NASHVILLE, MICH.	27	21	7.60	7.40	5.50	26.7	37
04117500	THORNAPPLE RIVER AT HASTINGS, MICH.	37	37	385	385	45.9	1.95	21
04118000	THORNAPPLE RIVER NEAR CALEDONIA, MICH.	37	22	773	773	77.2	2.56	17
04118500	ROGUE RIVER NEAR ROCKFORD, MICH.	30	30	234	234	47.2	3.05	52
04119000	GRAND RIVER AT GRAND RAPIDS,	81	55	4900	4900	209	2.02	35
04121000	MUSKEGON RIVER NEAR MERRITT, MICH.	32	27	355	355	42.6	0.53	90
04121300	CLAM RIVER AT VOGEL CENTER, MICH.	15	15	243	243	43.4	4.40	49
04121500	MUSKEGON RIVER AT EVERT, MICH.	48	48	1450	1450	126	1.41	67
04121900	LITTLE MUSKEGON RIVER NEAR MORLEY, MICH.	15	15	138	136	24.3	4.70	47
04122000	MUSKEGON RIVER AT NEWAYGO, MICH.	56	59	2350	2350	204	2.70	52
04122100	BEAR CREEK NEAR MUSKEGON, MICH.	16	16	14.8	14.8	7.2	12.6	0
04122200	WHITE RIVER NEAR WHITEHALL, MICH.	24	24	405.9	405.9	65.1	6.06	72
04122500	PERE MARQUETTE RIVER AT SCOTTVILLE, MICH.	42	42	681	681	68.2	5.79	40
04123000	BIG SABLE RIVER NEAR FREESOIL, MICH.	33	31	127	104	32.9	4.50	30
04123500	MANISTEE RIVER NEAR GRAYING, MICH.	39	31	123	101	25.5	4.80	47
04124000	MANISTEE RIVER NEAR SHERMAN, MICH.	61	61	900	900	125	3.05	40
04124500	EAST BRANCH PINE RIVER NEAR TUSTIN, MICH.	26	11	63.0	48.8	14.6	11.9	34
04125000	PINE RIVER NEAR LE ROY, MICH.	11	11	118	94.7	21.0	11.6	24
04125500	PINE RIVER NEAR HOXEYVILLE, MICH.	29	29	251	225	55.4	6.50	9
04126000	MANISTEE RIVER NEAR MANISTEE,	30	30	1780	1780	174	3.87	48
04126200	LITTLE MANISTEE RIVER NEAR FREESOIL, MICH.	25	19	178	163	50.0	8.50	30
04127800	JORDAN RIVER NEAR EAST JORDAN, MICH.	15	15	67.6	65.0	20.5	22.1	20
04128000	STURGEON RIVER NEAR WOLVERINE, MICH.	39	39	197.7	171.7	27.2	11.5	36
04129000	PIGEON RIVER NEAR VANDERBILT, MICH.	30	31	62.6	58.3	18.0	17.7	78
04129500	PIGEON RIVER AT AFTON, MICH.	39	39	139.4	133.5	38.7	10.6	53
04131500	RAINY RIVER NEAR OCQUEOC, MICH.	29	27	85.0	84.0	25.0	8.10	71
04132000	BLACK RIVER NEAR CHEBOYGAN, MICH.	34	31	597	597	62.0	7.20	73
04132500	THUNDER BAY RIVER NEAR HILLMAN MICH.	36	27	232	232	30.8	7.40	48
04134000	NORTH BRANCH THUNDER BAY RIVER NEAR BOLTON, MICH.	35	35	184	184	50.5	4.40	53
04135500	AU SABLE RIVER AT GRAYLING, MICH.	39	39	93.4	68.9	25.8	6.30	59
04135600	EAST BRANCH AU SABLE RIVER AT GRAYLING, MICH.	25	23	69.4	57.9	25.0	8.80	40
04135700	SOUTH BRANCH AU SABLE RIVER NEAR LUZERNE, MICH.	15	15	401	401	50.6	1.76	75
04138000	EAST BRANCH AU GRES RIVER AT MCIVOR, MICH.	31	23	91.0	87.0	22.8	12.8	13
04138500	AU GRES RIVER NEAR NATIONAL CITY, MICH.	31	31	153.5	152.9	40.8	7.10	33

[a] Combined record length includes continuous and crest-stage partial-record data used to determine peak flow

basin characteristics--Continued

$I_{24,2}$ (in.)	$I_{24,100}$ (in.)	SLENRAT	FOREST (per-cent)	SNOFALL (in./yr)	JANMIN (°F)	REGION	Station name
2.13	4.28	6.87	13.0	40	15.0	2	MAPLE RIVER AT MAPLE RAPIDS, MICH.
2.17	4.34	9.36	15.5	40	15.5	2	GRAND RIVER AT IONIA, MICH.
2.17	4.38	7.40	25.5	45	14.5	2	FLAT RIVER NEAR SMYRNA, MICH.
2.48	4.97	4.09	24.0	45	16.0	2	QUAKER BROOK NEAR NASHVILLE, MICH.
2.24	4.50	5.47	20.4	45	16.0	2	THORNAPPLE RIVER AT HASTINGS, MICH.
2.24	4.50	7.71	21.8	48	16.0	2	THORNAPPLE RIVER NEAR CALEDONIA, MICH.
2.22	4.51	9.52	41.2	65	15.0	2	ROGUE RIVER NEAR ROCKFORD, MICH.
2.18	4.41	8.91	17.5	45	15.8	2	GRAND RIVER AT GRAND RAPIDS, MICH.
1.99	4.00	5.11	78.1	60	10.0	3	MUSKEGON RIVER NEAR MERRITT, MICH.
2.06	4.14	7.75	60.0	75	11.5	3	CLAM RIVER AT VOGEL CENTER, MICH.
2.03	4.09	11.1	55.7	60	10.0	3	MUSKEGON RIVER AT EVART, MICH.
2.16	4.38	4.34	27.0	50	13.0	3	LITTLE MUSKEGON RIVER NEAR MORLEY, MICH.
2.07	4.23	17.7	43.0	60	11.5	3	MUSKEGON RIVER AT NEWAYGO, MICH.
2.41	4.87	3.50	50.0	90	16.0	3	BEAR CREEK NEAR MUSKEGON, MICH.
2.18	4.43	10.4	50.6	80	14.0	3	WHITE RIVER NEAR WHITEHALL, MICH.
2.16	4.36	6.83	65.2	75	13.0	3	PERE MARQUETTE RIVER AT SCOTTVILLE, MICH.
2.18	4.41	10.4	92.0	85	14.5	3	BIG SABLE RIVER NEAR FREESOIL, MICH.
2.00	3.99	6.44	97.0	120	11.0	3	MANISTEE RIVER NEAR GRAYING, MICH.
2.00	4.04	17.4	69.2	110	11.0	3	MANISTEE RIVER NEAR SHERMAN, MICH.
2.15	4.37	4.37	25.0	60	11.0	3	EAST BRANCH PINE RIVER NEAR TUSTIN, MICH.
2.11	4.28	4.66	35.0	65	10.8	3	PINE RIVER NEAR LE ROY, MICH.
2.10	4.23	13.6	55.0	70	11.0	3	PINE RIVER NEAR HOXEYVILLE, MICH.
2.05	4.15	17.0	57.4	100	14.0	3	MANISTEE RIVER NEAR MANISTEE, MICH.
2.14	4.31	15.3	96.0	80	12.5	3	LITTLE MANISTEE RIVER NEAR FREESOIL, MICH.
2.03	4.02	6.47	80.0	110	12.0	3	JORDAN RIVER NEAR EAST JORDAN, MICH.
1.94	3.84	4.31	81.2	125	9.0	3	STURGEON RIVER NEAR WOLVERINE, MICH.
1.97	3.91	5.56	86.6	115	9.0	3	PIGEON RIVER NEAR VANDERBILT, MICH.
1.94	3.80	11.2	91.0	110	8.5	3	PIGEON RIVER AT AFTON, MICH.
1.88	3.78	7.44	84.7	75	9.5	3	RAINY RIVER NEAR OCQUEOC, MICH.
1.84	3.69	6.44	87.3	85	8.5	3	BLACK RIVER NEAR CHEBOYGAN, MICH.
1.94	3.79	4.09	94.0	65	9.0	3	THUNDER BAY RIVER NEAR HILLMAN MICH.
1.85	3.64	13.9	73.0	75	9.5	3	NORTH BRANCH THUNDER BAY RIVER NEAR BOLTON, MICH.
2.01	3.97	9.66	97.0	125	10.0	3	AU SABLE RIVER AT GRAYLING, MICH.
2.02	4.00	10.8	94.0	100	9.6	3	EAST BRANCH AU SABLE RIVER AT GRAYLING, MICH.
1.97	3.93	6.38	98.0	60	9.2	3	SOUTH BRANCH AU SABLE RIVER NEAR LUZERNE, MICH.
1.97	3.97	5.98	68.0	45	10.0	3	EAST BRANCH AU GRES RIVER AT MCIVOR, MICH.
1.96	3.95	10.9	46.0	45	10.0	3	AU GRES RIVER NEAR NATIONAL CITY, MICH.

Table 5.--Physical and climatological

USGS station number	Station name	Record length: [a]combined (yr)	Record length: continuous (yr)	AREA (mi^2)	CONTDA (mi^2)	LENGTH (mi)	SLOPE (ft/mi)	CHSWAMP (percent)
04138700	BIXBY CREEK NEAR ROSE CITY, MICH.	25	-	2.68	2.68	2.80	90.5	3
04138800	HOUGHTON CREEK AT ROSE CITY, MICH.	25	-	13.3	9.40	5.45	41.8	17
04138900	WILKINS CREEK NEAR ROSE CITY, MICH.	26	-	9.15	8.72	6.80	55.5	0
04139000	HOUGHTON CREEK NEAR LUPTON, MICH.	31	22	30.2	25.3	10.6	23.4	9
04139500	RIFLE RIVER AT "THE RANCH" NEAR LUPTON, MICH.	28	21	56.8	48.3	11.2	21.9	8
04140000	PRIOR CREEK NEAR SELKIRK, MICH.	28	22	21.4	18.6	9.24	31.0	17
04140200	KLACKING CREEK NEAR SELKIRK, MICH.	28	-	7.51	6.70	5.00	82.7	10
04140500	RIFLE RIVER AT SELKIRK, MICH.	31	31	117	104	19.8	11.3	7
04141000	SOUTH BRANCH SHEPARDS CREEK NEAR SELKIRK, MICH.	30	27	1.15	1.15	2.47	57.2	1
04141100	SHEPARDS CREEK NEAR SELKIRK, MICH.	25	-	4.44	4.44	4.00	36.3	7
04141500	WEST BRANCH RIFLE RIVER NEAR SELKIRK, MICH.	12	12	64.5	63.6	20.5	24.1	7
04142000	RIFLE RIVER NEAR STERLING, MICH.	45	45	320	320	42.4	6.20	17
04143500	NORTH BRANCH KAWKAWLIN RIVER NEAR KAWKAWLIN MICH.	31	30	101	101	40.5	2.77	29
04143900	SHIAWASSEE RIVER AT LINDEN, MICH.	15	15	81.2	77.9	25.3	5.90	63
04144000	SHIAWASSEE RIVER AT BYRON, MICH.	34	34	368	368	36.9	3.54	68
04144180	JONES CREEK NEAR GAINES, MICH.	13	-	7.60	7.60	5.90	9.20	14
04144200	PORTER DRAIN NEAR GAINES, MICH.	13	-	4.68	4.68	5.40	6.60	5
04144220	JONES CREEK AT DUFFIELD, MICH.	12	-	23.4	23.4	9.60	8.50	9
04144500	SHIAWASSEE RIVER AT OWOSSO, MICH.	51	27	538	538	71.0	3.32	42
04145000	SHIAWASSEE RIVER NEAR FERGUS, MICH.	41	41	637	637	103	3.61	29
04145500	BAD RIVER NEAR BRANT, MICH.	18	10	89.0	89.0	32.5	4.90	0
04146000	FARMERS CREEK NEAR LAPEER, MICH.	50	48	51.9	48.9	16.4	14.2	54
04147500	FLINT RIVER NEAR OTISVILLE, MICH.	29	29	530	530	54.9	5.08	65
04147800	POWERS-CULLEN DRAIN NEAR GENESEE, MICH.	13	-	9.17	9.17	8.19	8.80	0
04147900	LEFLER-SCOTHAN DRAIN NEAR OTISVILLE, MICH.	13	-	4.69	3.91	4.29	14.0	13
04147990	BUTTERNUT CREEK NEAR GENESEE, MICH.	13	12	34.5	34.5	15.3	9.40	20
04148120	KEARSLEY CREEK NEAR ATLAS, MICH.	13	-	55.6	51.1	22.1	8.20	54
04148139	BLACK CREEK NEAR DAVISON, MICH.	13	-	22.8	22.8	15.7	5.50	11
04148140	KEARSLEY CREEK NEAR DAVISON, MICH.	17	17	99.4	94.7	37.7	6.30	37
04148160	GILKEY CREEK NEAR FLINT, MICH.	13	11	6.43	6.43	6.92	13.1	5
04148200	SWARTZ CREEK NEAR HOLLY, MICH.	27	19	12.1	11.2	7.00	11.6	61
04148255	SWARTZ CREEK NEAR GRAND BLANC, MICH.	13	-	36.0	32.5	18.1	6.10	60
04148260	SWARTZ CREEK NEAR SWARTZ CREEK, MICH.	13	-	67.3	63.6	31.7	6.40	40
04148265	KIMBALL DRAIN NEAR SWARTZ CREEK, MICH.	13	-	10.6	10.2	8.50	9.50	18
04148270	WEST BRANCH SWARTZ CREEK NEAR SWARTZ CR, MICH.	13	-	40.6	40.1	15.8	8.20	13
04148300	SWART CREEK AT FLINT, MICH.	13	12	115	111	32.9	6.70	38
04148410	THREAD CREEK NEAR GOODRICH, MICH.	13	-	28.8	23.7	11.5	21.2	48

[a] Combined record length includes continuous and crest-stage partial-record data used to determine peak flow

basin characteristics--Continued

$I_{24,2}$ (in.)	$I_{24,100}$ (in.)	SLENRAT	FOREST (percent)	SNOFALL (in./yr)	JANMIN (°F)	REGION	Station name
2.14	4.30	2.93	36.0	50	9.0	3	BIXBY CREEK NEAR ROSE CITY, MICH.
2.14	4.30	3.16	40.0	50	9.0	3	HOUGHTON CREEK AT ROSE CITY, MICH.
2.14	4.30	5.30	70.0	50	9.0	3	WILKINS CREEK NEAR ROSE CITY, MICH.
2.06	4.14	4.44	55.0	50	9.0	3	HOUGHTON CREEK NEAR LUPTON, MICH.
2.10	4.20	4.59	35.0	50	10.0	3	PRIOR CREEK NEAR SELKIRK, MICH.
2.03	4.08	2.60	55.0	50	9.0	3	RIFLE RIVER AT "THE RANCH" NEAR LUPTON, MICH.
2.14	4.30	3.73	85.0	50	9.6	3	KLACKING CREEK NEAR SELKIRK, MICH.
1.99	3.99	3.75	55.0	50	9.2	3	RIFLE RIVER AT SELKIRK, MICH.
2.15	4.32	5.31	12.0	50	9.8	3	SOUTH BRANCH SHEPARDS CREEK NEAR SELKIRK, MICH.
2.15	4.32	3.60	14.0	50	9.8	3	SHEPARDS CREEK NEAR SELKIRK, MICH.
2.03	4.10	6.61	52.0	50	10.0	3	WEST BRANCH RIFLE RIVER NEAR SELKIRK, MICH.
1.96	3.94	5.62	55.8	45	10.0	3	RIFLE RIVER NEAR STERLING, MICH.
2.06	4.19	16.2	55.0	40	15.0	4	NORTH BRANCH KAWKAWLIN RIVER NEAR KAWKAWLIN MICH.
2.17	4.31	8.22	13.0	40	15.5	4	SHIAWASSEE RIVER AT LINDEN, MICH.
2.11	4.23	3.70	25.0	40	15.5	4	SHIAWASSEE RIVER AT BYRON, MICH.
2.29	4.65	4.58	13.0	40	14.9	4	JONES CREEK NEAR GAINES, MICH.
2.29	4.65	6.23	13.0	40	14.9	4	PORTER DRAIN NEAR GAINES, MICH.
2.21	4.49	3.94	10.0	40	14.9	4	JONES CREEK AT DUFFIELD, MICH.
2.14	4.26	9.37	22.0	40	15.5	4	SHIAWASSEE RIVER AT OWOSSO, MICH.
2.13	4.25	16.7	19.5	40	15.5	4	SHIAWASSEE RIVER NEAR FERGUS, MICH.
2.16	4.37	11.9	10.0	40	15.0	4	BAD RIVER NEAR BRANT, MICH.
2.15	4.31	5.50	18.9	40	14.8	4	FARMERS CREEK NEAR LAPEER, MICH.
2.05	4.08	5.69	11.4	40	14.6	4	FLINT RIVER NEAR OTISVILLE, MICH.
2.26	4.55	7.31	7.0	40	14.5	4	POWERS-CULLEN DRAIN NEAR GENESEE, MICH.
2.26	4.55	4.71	13.0	40	14.5	4	LEFLER-SCOTHAN DRAIN NEAR OTISVILLE, MICH.
2.16	4.35	6.77	15.0	40	14.5	4	BUTTERNUT CREEK NEAR GENESEE, MICH.
2.17	4.33	9.56	25.0	40	15.2	4	KEARSLEY CREEK NEAR ATLAS, MICH.
2.18	4.39	10.8	14.8	40	14.6	4	BLACK CREEK NEAR DAVISON, MICH.
2.13	4.26	15.0	17.9	40	14.9	4	KEARSLEY CREEK NEAR DAVISON, MICH.
2.28	4.58	7.45	6.0	40	14.8	4	GILKEY CREEK NEAR FLINT, MICH.
2.30	4.58	4.38	20.5	40	15.4	4	SWARTZ CREEK NEAR HOLLY, MICH.
2.21	4.40	10.1	19.0	40	15.2	4	SWARTZ CREEK NEAR GRAND BLANC, MICH.
2.18	4.35	15.8	15.0	40	15.1	4	SWARTZ CREEK NEAR SWARTZ CREEK, MICH.
2.30	4.62	7.08	9.0	40	15.0	4	KIMBALL DRAIN NEAR SWARTZ CREEK, MICH.
2.20	4.42	6.23	7.0	40	15.0	4	WEST BRANCH SWARTZ CREEK NEAR SWARTZ CR, MICH.
2.14	4.29	9.75	12.0	40	15.0	4	SWART CREEK AT FLINT, MICH.
2.23	4.44	5.58	22.0	40	15.4	4	THREAD CREEK NEAR GOODRICH, MICH.

Table 5.--Physical and climatological

USGS station number	Station name	Record length: [a]combined (yr)	Record length: continuous (yr)	AREA (mi^2)	CONTDA (mi^2)	LENGTH (mi)	SLOPE (ft/mi)	CHSWAMP (percent)
04148440	THREAD CREEK NEAR FLINT, MICH.	13	12	54.4	49.3	27.3	9.40	39
04148500	FLINT RIVER NEAR FLINT, MICH.	49	49	956	956	77.0	4.14	52
04148610	COLE CREEK NEAR FLUSHING, MICH.	13	-	8.51	8.51	7.00	6.60	0
04148620	FREEMAN DRAIN NEAR MONTROSE, MICH.	13	-	8.21	8.21	7.10	10.0	0
04148640	ARMSTRONG CREEK NEAR MONTROSE, MICH.	13	-	11.9	11.9	11.4	9.60	0
04148800	PINE RUN NEAR MONTROSE, MICH.	13	-	28.2	28.2	14.8	8.70	3
04149300	MISTEGUAY CREEK NEAR FLUSHING, MICH.	13	-	17.3	17.3	6.40	5.30	0
04150000	SOUTH BRANCH CASS RIVER NEAR CASS CITY, MICH.	32	32	238	238	38.1	2.70	0
04150500	CASS RIVER AT CASS CITY, MICH.	34	34	359	359	41.3	2.42	14
04151500	CASS RIVER AT FRANKENMUTH, MICH.	42	31	841	841	84.9	2.60	11
04152500	TOBACCO RIVER AT BEAVERTON, MICH.	35	33	487	487	39.2	9.25	26
04153500	SALT RIVER NEAR NORTH BRADLEY, MICH.	47	37	138	138	29.0	6.44	4
04154000	CHIPPEWA RIVER NEAR MOUNT PLEASANT, MICH.	50	50	416	416	71.0	4.90	22
04154500	CHIPPEWA RIVER NEAR MIDLAND, MICH.	31	25	597	597	99.4	4.46	16
04155000	PINE RIVER AT ALMA, MICH.	48	51	288	307	63.3	3.50	16
04155500	PINE RIVER NEAR MIDLAND, MICH.	38	37	390	390	93.2	3.15	22
04156000	TITTABAWASSEE RIVER AT MIDLAND, MICH.	72	45	2400	2400	71.7	4.65	48
04157500	SEBEWAING RIVER NEAR SEBEWAING, MICH.	15	15	67.3	62.0	18.5	7.70	0
04158000	EAST FORK SEBEWAING RIVER NEAR SEBEWAING, MICH.	15	14	33.9	38.0	15.2	8.10	0
04158500	PIGEON RIVER NEAR OWENDALE, MICH.	29	29	53.2	53.0	21.3	8.30	0
04159500	BLACK RIVER NEAR FARGO, MICH.	38	37	480	480	56.3	3.00	6
04160000	MILL CREEK NEAR ABBOTTSFORD, MICH.	17	17	208	208	50.9	3.88	5
04160050	BLACK RIVER NEAR PORT HURON, MICH.	11	11	684	684	69.0	3.36	8
04160570	NORTH BRANCH BELLE RIVER AT IMLAY CITY, MICH.	16	16	18.0	18.0	7.30	8.20	30
04160600	BELLE RIVER AT MEMPHIS, MICH.	19	19	151	151	35.1	4.30	9
04160800	SASHABAW CREEK NEAR DRAYTON PLAINS, MICH.	22	22	20.9	20.0	8.70	3.20	74
04160900	CLINTON RIVER NEAR DRAYTON PLAINS, MICH.	23	23	79.2	67.6	20.5	5.20	41
04161000	CLINTON RIVER AT AUBURN HEIGHTS, MICH.	30	28	123	110	38.8	4.40	43
04161100	GALLOWAY CREEK NEAR AUBURN HEIGHTS, MICH.	22	22	17.9	17.7	8.80	16.6	25
04161500	PAINT CREEK NEAR LAKE ORION, MICH.	26	20	38.5	35.5	15.7	6.80	38
04161540	PAINT CREEK AT ROCHESTER, MICH.	22	22	70.9	67.5	26.4	12.3	27
04161580	STONY CREEK NEAR ROMEO, MICH.	17	17	25.6	24.5	11.8	22.6	28
04161760	WEST BRANCH STONY CREEK NEAR WASHINGTON, MICH.	15	-	22.5	13.5	13.7	10.5	59
04163500	PLUM BROOK NEAR UTICA, MICH.	13	12	22.9	22.8	12.7	12.6	0
04164010	NORTH BRANCH CLINTON RIVER AT ALMONT, MICH.	23	6	9.56	9.56	5.20	21.8	48
04164050	NORTH BRANCH CLINTON RIVER NEAR ROMEO, MICH.	23	5	49.7	49.6	16.7	11.3	18
04164100	EAST POND CREEK AT ROMEO, MICH.	23	23	21.8	20.8	15.4	17.3	46

[a] Combined record length includes continuous and crest-stage partial-record data used to determine peak flow

basin characteristics--Continued

$I_{24,2}$ (in.)	$I_{24,100}$ (in.)	SLENRAT	FOREST (percent)	SNOFALL (in./yr)	JANMIN (°F)	REGION	Station name
2.17	4.36	15.1	17.0	40	15.0	4	THREAD CREEK NEAR FLINT, MICH.
2.05	4.13	6.20	13.6	40	14.5	4	FLINT RIVER NEAR FLINT, MICH.
2.29	4.64	5.76	5.9	40	14.7	4	COLE CREEK NEAR FLUSHING, MICH.
2.28	4.62	6.14	8.6	40	14.8	4	FREEMAN DRAIN NEAR MONTROSE, MICH.
2.27	4.55	10.9	6.0	40	14.6	4	ARMSTRONG CREEK NEAR MONTROSE, MICH.
2.18	4.37	7.77	9.5	40	14.5	4	PINE RUN NEAR MONTROSE, MICH.
2.24	4.51	2.37	6.7	40	14.8	4	MISTEGUAY CREEK NEAR FLUSHING, MICH.
2.00	3.99	6.10	7.0	45	14.5	4	SOUTH BRANCH CASS RIVER NEAR CASS CITY, MICH.
1.97	3.96	4.75	10.7	45	14.4	4	CASS RIVER AT CASS CITY, MICH.
1.99	3.99	8.57	11.8	43	14.2	4	CASS RIVER AT FRANKENMUTH, MICH.
2.04	4.13	3.16	24.4	45	11.5	4	TOBACCO RIVER AT BEAVERTON, MICH.
2.10	4.26	6.09	15.0	40	13.0	4	SALT RIVER NEAR NORTH BRADLEY, MICH.
2.09	4.24	12.1	27.4	45	13.0	4	CHIPPEWA RIVER NEAR MOUNT PLEASANT, MICH.
2.08	4.23	16.6	27.1	40	13.5	4	CHIPPEWA RIVER NEAR MIDLAND, MICH.
2.13	4.30	13.1	21.0	40	14.0	4	PINE RIVER AT ALMA, MICH.
2.11	4.27	22.3	18.8	40	14.0	4	PINE RIVER NEAR MIDLAND, MICH.
2.17	4.19	2.14	32.1	45	13.0	4	TITTABAWASSEE RIVER AT MIDLAND, MICH.
2.05	4.10	5.52	3.1	40	14.4	4	SEBEWAING RIVER NEAR SEBEWAING, MICH.
2.07	4.15	6.08	2.2	40	14.2	4	EAST FORK SEBEWAING RIVER NEAR SEBEWAING, MICH.
2.03	4.11	8.56	10.0	44	14.3	4	PIGEON RIVER NEAR OWENDALE, MICH.
1.98	3.97	6.60	12.2	45	15.5	5	BLACK RIVER NEAR FARGO, MICH.
2.04	4.06	12.5	17.4	40	16.0	5	MILL CREEK NEAR ABBOTTSFORD, MICH.
1.99	3.99	6.96	14.4	43	15.7	5	BLACK RIVER NEAR PORT HURON, MICH.
2.22	4.33	2.96	15.0	40	15.5	5	NORTH BRANCH BELLE RIVER AT IMLAY CITY, MICH.
2.07	4.11	8.16	8.8	40	16.0	5	BELLE RIVER AT MEMPHIS, MICH.
2.22	4.41	3.78	27.0	39	16.0	5	SASHABAW CREEK NEAR DRAYTON PLAINS, MICH.
2.23	4.43	6.22	17.0	40	16.0	5	CLINTON RIVER NEAR DRAYTON PLAINS, MICH.
2.17	4.28	13.7	14.0	39	16.1	5	CLINTON RIVER AT AUBURN HEIGHTS, MICH.
2.25	4.43	4.38	12.0	38	16.5	5	GALLOWAY CREEK NEAR AUBURN HEIGHTS, MICH.
2.19	4.35	6.94	15.0	40	15.6	5	PAINT CREEK NEAR LAKE ORION, MICH.
2.16	4.27	10.3	16.0	40	15.8	5	PAINT CREEK AT ROCHESTER, MICH.
2.20	4.34	5.68	25.0	39	16.1	5	STONY CREEK NEAR ROMEO, MICH.
2.25	4.43	13.9	32.0	39	16.4	5	WEST BRANCH STONY CREEK NEAR WASHINGTON, MICH.
2.22	4.39	7.07	8.0	35	17.0	5	PLUM BROOK NEAR UTICA, MICH.
2.26	4.48	2.83	12.0	39	16.1	5	NORTH BRANCH CLINTON RIVER AT ALMONT, MICH.
2.14	4.23	5.62	14.0	38	16.1	5	NORTH BRANCH CLINTON RIVER NEAR ROMEO, MICH.
2.20	4.33	11.4	23.0	38	16.0	5	EAST POND CREEK AT ROMEO, MICH.

Table 5.--Physical and climatological

USGS station number	Station name	Record length: [a]combined (yr)	Record length: continuous (yr)	AREA (mi^2)	CONTDA (mi^2)	LENGTH (mi)	SLOPE (ft/mi)	CHSWAMP (percent)
04164150	NORTH BRANCH CLINTON RIVER NEAR MEADE, MICH.	23	5	89.6	88.5	27.2	10.5	13
04164200	COON CREEK NEAR ARMADA, MICH.	24	5	10.0	10.0	10.3	12.0	0
04164250	TUPPER BROOK AT RAY CENTER, MICH.	22	5	8.62	8.62	9.40	16.7	0
04164300	EAST BRANCH COON CREEK AT ARMADA, MICH.	23	23	13.0	13.0	10.1	5.50	0
04164350	HIGHBANK CREEK NEAR ARMADA, MICH.	23	5	14.9	14.6	7.30	18.8	0
04164360	EAST BRANCH COON CREEK NEAR NEW HAVEN, MICH.	23	5	36.1	35.8	18.3	10.5	3
04164400	DEER CREEK NEAR MEADE, MICH.	23	5	12.7	12.7	10.0	8.80	0
04164450	MC BRIDE DRAIN NEAR MACOMB, MICH.	22	5	5.79	5.79	6.40	12.7	0
04164500	NORTH BRANCH CLINTON RIVER NEAR MOUNT CLEMENS MICH.	34	34	199	198	41.9	7.20	9
04164600	MIDDLE BRANCH CLINTON RIVER NEAR MACOMB, MICH.	11	5	22.2	22.2	10.0	15.5	0
04164800	MIDDLE BRANCH CLINTON RIVER AT MACOMB, MICH.	12	18	41.0	41.0	12.4	13.7	0
04165200	GLOEDE DITCH NEAR WALDENBURG, MICH.	12	5	16.0	16.0	6.90	7.70	0
04166000	RIVER ROUGE AT BIRMINGHAM, MICH.	20	20	33.3	32.6	11.2	20.2	49
04169500	HURON RIVER AT COMMERCE, MICH.	33	29	57.3	48.1	19.9	7.80	80
04170000	HURON RIVER AT MILFORD, MICH.	33	23	138	118	30.2	3.90	84
04171500	ORE CREEK NEAR BRIGHTON, MICH.	17	17	31.0	26.0	16.9	5.80	61
04172000	HURON RIVER NEAR HAMBURG, MICH.	30	30	308	308	49.9	2.83	79
04172500	PORTAGE RIVER NEAR PINCKNEY, MICH.	35	26	79.1	76.4	25.3	3.10	59
04173000	HURON RIVER NEAR DEXTER, MICH.	34	28	522	522	60.5	2.44	76
04173500	MILL CREEK NEAR DEXTER, MICH.	30	29	133	121	17.8	9.60	25
04175600	RIVER RAISIN NEAR MANCHESTER, MICH.	12	11	132	127	34.8	5.10	64
04175700	RIVER RAISIN NEAR TECUMSEH, MICH.	24	24	267	249	65.6	5.20	41
04176000	RIVER RAISIN NEAR ADRIAN, MICH.	25	25	463	463	74.5	4.92	45
04176400	SALINE RIVER NEAR SALINE, MICH.	17	12	93.5	88.7	20.7	8.80	5
04176500	RIVER RASIN NEAR MONROE, MICH.	44	44	1042	1042	139.0	3.09	24

[a] Combined record length includes continuous and crest-stage partial-record data used to determine peak flow

basin characteristics--Continued

$I_{24,2}$ (in.)	$I_{24,100}$ (in.)	SLENRAT	FOREST (percent)	SNOFALL (in./yr)	JANMIN (°F)	REGION	Station name
2.12	4.17	8.36	16.0	38	16.3	5	NORTH BRANCH CLINTON RIVER NEAR MEADE, MICH.
2.26	4.42	10.6	9.0	37	16.5	5	COON CREEK NEAR ARMADA, MICH.
2.26	4.48	10.3	13.0	36	16.6	5	TUPPER BROOK AT RAY CENTER, MICH.
2.22	4.38	7.85	6.0	37	16.5	5	EAST BRANCH COON CREEK AT ARMADA, MICH.
2.21	4.36	3.65	8.0	36	16.8	5	HIGHBANK CREEK NEAR ARMADA, MICH.
2.16	4.25	9.35	8.6	35	16.6	5	EAST BRANCH COON CREEK NEAR NEW HAVEN, MICH.
2.23	4.40	7.87	9.0	35	17.0	5	DEER CREEK NEAR MEADE, MICH.
2.27	4.50	7.07	13.0	34	17.0	5	MC BRIDE DRAIN NEAR MACOMB, MICH.
2.07	4.09	8.87	11.0	36	16.5	5	NORTH BRANCH CLINTON RIVER NEAR MOUNT CLEMENS MICH.
2.20	4.36	4.50	10.0	35	16.6	5	MIDDLE BRANCH CLINTON RIVER NEAR MACOMB, MICH.
2.16	4.28	3.75	12.0	36	16.6	5	MIDDLE BRANCH CLINTON RIVER AT MACOMB, MICH.
2.24	4.39	2.98	18.0	35	17.1	5	GLOEDE DITCH NEAR WALDENBURG, MICH.
2.21	4.38	3.85	10.5	35	17.0	5	RIVER ROUGE AT BIRMINGHAM, MICH.
2.21	4.42	8.23	23.0	40	16.1	5	HURON RIVER AT COMMERCE, MICH.
2.18	4.32	7.73	21.0	40	16.1	5	HURON RIVER AT MILFORD, MICH.
2.27	4.52	11.0	23.0	40	15.6	5	ORE CREEK NEAR BRIGHTON, MICH.
2.15	4.26	8.08	26.2	40	15.8	5	HURON RIVER NEAR HAMBURG, MICH.
2.25	4.60	8.38	16.0	40	16.0	5	PORTAGE RIVER NEAR PINCKNEY, MICH.
2.17	4.29	7.01	24.4	40	15.8	5	HURON RIVER NEAR DEXTER, MICH.
2.27	4.48	2.62	10.0	44	16.2	5	MILL CREEK NEAR DEXTER, MICH.
2.31	4.54	9.54	21.0	45	16.0	5	RIVER RAISIN NEAR MANCHESTER, MICH.
2.26	4.44	17.3	18.0	43	16.0	5	RIVER RAISIN NEAR TECUMSEH, MICH.
2.27	4.45	12.0	15.8	40	16.8	5	RIVER RAISIN NEAR ADRIAN, MICH.
2.27	4.47	4.83	7.0	40	16.5	5	SALINE RIVER NEAR SALINE, MICH.
2.25	4.41	18.5	14.5	40	16.6	5	RIVER RASIN NEAR MONROE, MICH.

Table 6.--Surficial geological basin characteristics

USGS station number	Station name	Surficial geologic material (percent of contributing drainage area) CLAY	CORGT	FINEM	FINGT	MEDTILL	MUCK	OUTWASH	TILROCK
04001000	WASHINGTON CREEK AT WINDIGO, MICH.	-	-	-	-	-	-	-	97.2
04031000	BLACK RIVER NEAR BESSEMER, MICH.	-	66.8	-	-	-	8.2	6.8	7.3
04031500	PRESQUE ISLE RIVER AT MARENISCO, MICH.	-	13.4	-	-	-	2.9	2.0	-
04032000	PRESQUE ISLE RIVER NEAR TULA, MICH.	-	32.1	-	-	-	1.9	6.0	0.6
04033000	MIDDLE BRANCH ONTONAGON RIVER NEAR PAULDING, MICH.	-	5.5	-	-	-	3.3	16.9	-
04035000	EAST BRANCH ONTONAGON RIVER NEAR MASS, MICH.	18.9	15.4	-	-	-	-	17.7	0.4
04039500	SOUTH BRANCH ONTONAGON RIVER AT EWEN, MICH.	29.1	11.6	-	-	-	1.3	0.8	-
04040000	ONTONAGON RIVER NEAR ROCKLAND, MICH.	31.1	16.5	-	-	0.7	1.1	6.9	0.6
04040500	STURGEON RIVER NEAR SIDNAW, MICH.	-	28.9	-	2.8	2.7	10.7	11.0	29.3
04041000	PERCH RIVER NEAR SIDNAW, MICH.	-	7.8	-	2.7	2.1	-	9.9	-
04041500	STURGEON RIVER NEAR ALSTON, MICH.	0.3	17.1	-	4.8	4.0	5.3	18.6	14.8
04042300	STURGEON RIVER NEAR PELKIE, MICH.	7.1	21.1	1.4	3.3	2.7	3.6	15.4	10.2
04042500	OTTER RIVER NEAR ELO, MICH.	1.7	59.7	22.5	3.4	-	0.2	-	-
04043000	STURGEON RIVER NEAR ARNHEIM, MICH.	5.2	33.2	6.5	-	2.7	2.9	12.7	7.1
04043050	TRAP ROCK RIVER NEAR LAKE LINDEN, MICH.	-	42.9	-	-	-	-	4.3	40.9
04045500	TAHQUAMENON RIVER NEAR TAHQUAMENON PARADISE, MICH.	5.2	6.8	-	-	-	41.7	8.0	0.9
04046000	BLACK RIVER NEAR GARNET, MICH.	-	7.6	-	-	-	22.6	-	-
04049500	MANISTIQUE RIVER AT GERMFASK, MICH.	-	14.9	-	-	-	24.9	38.3	0.3
04055000	MANISTIQUE RIVER NEAR BLANEY, MICH.	-	14.1	-	-	-	19.1	24.8	0.1
04056000	WEST BRANCH MANISTIQUE RIVER NEAR MANISTIQUE MICH.	-	3.3	7.4	-	1.6	30.4	23.1	-
04056500	MANISTIQUE RIVER NEAR MANISTIQUE, MICH.	-	10.9	-	-	2.6	22.2	22.3	2.5
04057510	STURGEON RIVER NEAR NAHMA JUNCTION, MICH.	-	1.5	-	-	1.2	16.3	62.7	-
04057800	MIDDLE BRANCH ESCANABA RIVER AT HUMBOLT, MICH.	-	18.5	-	-	-	-	22.9	58.6
04057900	BLACK RIVER NEAR REPUBLIC, MICH.	-	2.3	-	-	-	-	-	97.7
04058000	MIDDLE BRANCH ESCANABA RIVER NEAR ISHPEMING, MICH.	-	13.8	-	-	-	-	17.3	68.9
04058100	MIDDLE BRANCH ESCANABA RIVER NEAR PRINCETON, MICH.	-	23.3	-	-	0.4	0.7	29.1	46.4
04058400	GOOSE LAKE OUTLET NEAR SANDS STATION, MICH.	-	3.4	-	-	-	-	25.7	63.0
04058500	EAST BRANCH ESCANABA RIVER AT GWINN, MICH.	-	4.8	-	-	1.0	-	22.6	69.0
04059000	ESCANABA RIVER AT CORNELL, MICH.	-	14.0	-	-	29.8	15.6	17.2	22.5
04059400	TENMILE CREEK AT PERRONVILLE, MICH.	-	-	-	-	98.9	-	0.3	0.9
04059500	FORD RIVER NEAR HYDE, MICH.	-	3.9	-	-	83.8	5.7	2.0	-
04060500	IRON RIVER AT CASPIAN, MICH.	-	76.0	-	-	-	-	24.0	-
04061000	BRULE RIVER NEAR FLORENCE, WISC.	-	65.8	-	-	9.4	-	24.8	-
04061500	PAINT RIVER AT CRYSTAL FALLS, MICH.	-	47.6	-	-	3.0	2.0	15.6	0.5
04062200	PESHEKEE RIVER NEAR CHAMPION, MICH.	-	2.3	-	-	-	-	-	97.7
04062230	MICHIGAMME RIVER NEAR MICHIGAMME, MICH.	-	3.8	-	-	-	0.2	1.7	93.5
04062300	MICHIGAMME RIVER AT REPUBLIC, MICH.	-	4.1	-	-	-	0.2	1.4	84.0

Table 6.--Surficial geological basin characteristics--Continued

USGS station number	Station name	Surficial geologic material (percent of contributing drainage area) CLAY	CORGT	FINEM	FINGT	MEDTILL	MUCK	OUTWASH	TILROCK
04062400	MICHIGAMME RIVER NEAR WITCH LAKE, MICH.	-	5.8	-	-	-	3.0	4.7	63.9
04065300	WEST BRANCH STURGEON RIVER NEAR RANDVILLE, MICH.	-	22.3	-	-	31.3	-	12.4	21.2
04065500	STURGEON RIVER NEAR FOSTER CITY, MICH.	-	25.5	-	-	43.2	-	8.8	19.7
04096400	ST. JOSEPH RIVER NEAR BURLINGTON, MICH.	-	7.1	-	-	7.1	-	47.2	-
04096515	HOG CREEK NEAR ALLEN, MICH.	-	13.7	-	-	6.5	-	29.6	-
04096600	COLDWATER RIVER NEAR HODUNK, MICH.	-	19.7	-	-	8.7	-	51.6	-
04096900	NOTTAWA CREEK NEAR ATHENS, MICH.	-	10.6	-	-	9.3	-	55.4	-
04097060	LITTLE PORTAGE CREEK NEAR FULTON, MICH.	-	-	-	-	52.1	-	47.9	-
04097170	PORTAGE RIVER NEAR VICKSBURG, MICH.	-	-	-	-	10.2	-	65.5	-
04097370	FLOWERFIELD CREEK AT FLOWER-FIELD, MICH.	-	-	-	-	-	-	100	-
04097500	ST. JOSEPH RIVER AT THREE RIVERS, MICH.	-	13.0	0.2	-	8.5	-	63.2	-
04097540	PRAIRIE RIVER NEAR NOTTAWA, MICH.	-	5.1	-	-	1.7	-	71.3	-
04098500	FAWN RIVER NEAR WHITE PIGEON, MICH.	-	1.4	-	-	12.2	-	83.5	-
04099000	ST. JOSEPH RIVER AT MOTTVILLE, MICH.	-	9.9	0.2	-	6.1	-	70.0	-
04101500	ST. JOSEPH RIVER AT NILES, MICH.	-	5.6	0.1	-	20.0	-	66.5	-
04101800	DOWAGIAC RIVER AT SUMNER-VILLE, MICH.	-	23.8	-	-	-	-	74.0	-
04102500	PAW PAW RIVER AT RIVERSIDE, MICH.	-	6.3	1.3	3.8	10.1	-	52.5	-
04102700	BLACK RIVER NEAR BANGOR, MICH.	-	2.8	4.2	14.0	34.6	-	15.8	-
04103500	KALAMAZOO RIVER AT MARSHALL, MICH.	-	9.7	-	-	4.1	-	40.4	-
04105000	BATTLE CREEK AT BATTLE CREEK, MICH.	-	-	-	-	47.9	-	21.8	-
04105500	KALAMAZOO RIVER NEAR BATTLE CREEK, MICH.	-	5.7	-	-	18.7	-	36.6	-
04105700	AUGUSTA CREEK NEAR AUGUSTA, MICH.	-	-	-	-	-	-	75.9	-
04105800	GULL CREEK NEAR GALESBURG, MICH.	-	-	-	-	-	-	100	-
04106000	KALAMAZOO RIVER AT COMSTOCK, MICH.	-	4.3	-	-	14.8	-	44.8	-
04106300	PORTAGE CREEK NEAR KALAMAZOO, MICH.	-	-	-	-	-	-	100	-
04106400	WEST FORK PORTAGE CREEK AT KALAMAZOO, MICH.	-	-	-	-	-	-	100	
04108500	KALAMAZOO RIVER NEAR FENNVILLE, MICH.	-	4.3	-	-	12.6	-	50.2	-
04108600	RABBIT RIVER NEAR HOPKINS, MICH.	-	-	-	-	44.3	-	45.2	-
04108800	MACATAWA RIVER NEAR ZEELAND, MICH.	-	-	33.1	42.5	-	-	21.6	-
04109000	GRAND RIVER AT JACKSON, MICH.	-	16.2	-	-	-	-	65.6	-
04109500	PORTAGE RIVER BELOW LITTLE POR TAGE LAKE NEAR MUNITH, MICH.	-	2.4	-	-	-	-	88.0	-
04110000	ORCHARD CREEK AT MUNITH, MICH.	-	15.8	-	-	45.4	-	38.4	-
04111500	DEER CREEK NEAR DANSVILLE, MICH.	-	-	-	-	92.5	-	7.5	-
04112000	SLOAN CREEK NEAR WILLIAMSTON, MICH.	-	-	-	-	100	-	-	-
04112500	RED CEDAR RIVER AT EAST LANSING, MICH.	-	-	-	-	84.5	-	9.4	-
04113000	GRAND RIVER AT LANSING, MICH.	-	8.0	-	-	51.1	-	30.0	-
04114500	LOOKING GLASS RIVER NEAR EAGLE, MICH.	-	17.5	-	-	71.1	-	11.4	-

Table 6.--Surficial geological basin characteristics--Continued

USGS station number	Station name	Surficial geologic material (percent of contributing drainage area) CLAY	CORGT	FINEM	FINGT	MEDTILL	MUCK	OUTWASH	TILROCK
04115000	MAPLE RIVER AT MAPLE RAPIDS, MICH.	15.6	0.7	2.4	0.1	52.1	-	13.2	-
04116000	GRAND RIVER AT IONIA, MICH.	2.4	5.7	2.5	3.3	54.7	-	23.3	-
04116500	FLAT RIVER NEAR SMYRNA, MICH.	-	28.0	2.1	1.0	21.8	-	22.7	-
04117000	QUAKER BROOK NEAR NASHVILLE, MICH.	-	-	-	-	60.0	-	30.6	-
04117500	THORNAPPLE RIVER AT HASTINGS, MICH.	-	1.5	-	-	60.3	-	25.9	-
04118000	THORNAPPLE RIVER NEAR CALEDONIA, MICH.	-	0.8	0.1	1.9	57.8	-	23.6	-
04118500	ROGUE RIVER NEAR ROCKFORD, MICH.	-	4.7	3.5	-	53.1	-	29.2	-
04119000	GRAND RIVER AT GRAND RAPIDS, MICH.	1.4	6.6	3.0	2.5	52.8	-	23.2	-
04121000	MUSKEGON RIVER NEAR MERRITT, MICH.	-	4.2	-	0.3	-	11.8	83.5	-
04121300	CLAM RIVER AT VOGEL CENTER, MICH.	-	-	-	11.2	0.6	-	46.5	-
04121500	MUSKEGON RIVER AT EVART, MICH.	-	9.5	1.6	12.0	-	3.4	58.5	-
04121900	LITTLE MUSKEGON RIVER NEAR MORLEY, MICH.	-	8.2	-	-	-	-	44.9	-
04122000	MUSKEGON RIVER AT NEWAYGO, MICH.	-	11.3	1.9	8.8	0.6	2.0	49.1	-
04122100	BEAR CREEK NEAR MUSKEGON, MICH.	-	-	-	-	-	-	15.3	-
04122200	WHITE RIVER NEAR WHITEHALL, MICH.	-	12.2	-	-	-	-	40.4	-
04122500	PERE MARQUETTE RIVER AT SCOTTVILLE, MICH.	-	6.4	0.7	2.6	-	-	54.4	-
04123000	BIG SABLE RIVER NEAR FREESOIL, MICH.	-	-	-	6.4	-	-	72.7	-
04123500	MANISTEE RIVER NEAR GRAYING, MICH.	-	-	-	-	-	-	99.6	-
04124000	MANISTEE RIVER NEAR SHERMAN, MICH.	-	7.7	-	-	-	-	72.9	-
04124500	EAST BRANCH PINE RIVER NEAR TUSTIN, MICH.	-	22.2	-	-	-	-	0.9	-
04125000	PINE RIVER NEAR LE ROY, MICH.	-	10.9	-	-	-	-	25.5	-
04125500	PINE RIVER NEAR HOXEYVILLE, MICH.	-	6.8	-	-	-	-	35.9	-
04126000	MANISTEE RIVER NEAR MANISTEE, MICH.	-	7.2	-	-	0.7	-	59.6	-
04126200	LITTLE MANISTEE RIVER NEAR FREESOIL, MICH.	-	-	-	-	-	-	83.0	-
04127800	JORDAN RIVER NEAR EAST JORDAN, MICH.	-	40.6	-	-	-	-	27.5	-
04128000	STURGEON RIVER NEAR WOLVERINE, MICH.	-	25.9	-	-	-	-	38.5	-
04129000	PIGEON RIVER NEAR VANDERBILT, MICH.	-	34.8	-	-	20.9	-	32.5	-
04129500	PIGEON RIVER AT AFTON, MICH.	-	47.8	-	-	9.5	-	37.4	-
04131500	RAINY RIVER NEAR OCQUEOC, MICH.	-	95.8	-	-	-	-	4.2	-
04132000	BLACK RIVER NEAR CHEBOYGAN, MICH.	-	53.8	-	-	4.4	-	30.9	-
04132500	THUNDER BAY RIVER NEAR HILLMAN MICH.	-	55.3	-	-	16.6	-	28.0	-
04134000	NORTH BRANCH THUNDER BAY RIVER NEAR BOLTON, MICH.	-	65.0	-	-	-	10.9	15.5	-
04135500	AU SABLE RIVER AT GRAYLING, MICH.	-	-	-	-	-	-	100	-
04135600	EAST BRANCH AU SABLE RIVER AT GRAYLING, MICH.	-	-	-	-	-	-	100	-
04135700	SOUTH BRANCH AU SABLE RIVER NEAR LUZERNE, MICH.	-	-	-	-	-	-	100	-
04138000	EAST BRANCH AU GRES RIVER AT MCIVOR, MICH.	-	-	-	-	50.7	-	9.7	-
04138500	AU GRES RIVER NEAR NATIONAL CITY, MICH.	0.6	-	25.1	46.9	2.1	-	0.6	-

Table 6.--Surficial geological basin characteristics--Continued

USGS station number	Station name	Surficial geologic material (percent of contributing drainage area) CLAY	CORGT	FINEM	FINGT	MEDTILL	MUCK	OUTWASH	TILROCK
04138700	BIXBY CREEK NEAR ROSE CITY, MICH.	-	-	-	-	100	-	-	-
04138800	HOUGHTON CREEK AT ROSE CITY, MICH.	-	-	6.6	-	29.4	-	64.0	-
04138900	WILKINS CREEK NEAR ROSE CITY, MICH.	-	-	42.1	-	-	-	57.9	-
04139000	HOUGHTON CREEK NEAR LUPTON, MICH.	-	-	32.2	-	15.0	-	52.9	-
04139500	RIFLE RIVER AT "THE RANCH" NEAR LUPTON, MICH.	-	-	21.5	-	16.3	-	62.2	-
04140000	PRIOR CREEK NEAR SELKIRK, MICH.	-	-	-	-	70.0	-	30.0	-
04140200	KLACKING CREEK NEAR SELKIRK, MICH.	-	-	-	-	-	-	100	-
04140500	RIFLE RIVER AT SELKIRK, MICH.	-	-	19.7	-	27.6	-	52.5	-
04141000	SOUTH BRANCH SHEPARDS CREEK NEAR SELKIRK, MICH.	-	-	16.7	-	83.3	-	-	-
04141100	SHEPARDS CREEK NEAR SELKIRK, MICH.	-	-	56.1	-	43.9	-	-	-
04141500	WEST BRANCH RIFLE RIVER NEAR SELKIRK, MICH.	-	-	19.9	-	17.6	-	50.1	-
04142000	RIFLE RIVER NEAR STERLING, MICH.	-	-	20.1	7.0	15.0	-	31.1	-
04143500	NORTH BRANCH KAWKAWLIN RIVER NEAR KAWKAWLIN MICH.	22.1	-	18.0	-	-	-	-	-
04143900	SHIAWASSEE RIVER AT LINDEN, MICH.	-	35.0	-	-	23.0	-	24.9	-
04144000	SHIAWASSEE RIVER AT BYRON, MICH.	-	8.3	-	-	65.8	-	17.6	-
04144180	JONES CREEK NEAR GAINES, MICH.	-	-	-	36.8	63.2	-	-	-
04144200	PORTER DRAIN NEAR GAINES, MICH.	-	-	-	49.4	50.6	-	-	-
04144220	JONES CREEK AT DUFFIELD, MICH.	-	-	-	48.0	52.0	-	-	-
04144500	SHIAWASSEE RIVER AT OWOSSO, MICH.	-	5.7	-	2.5	67.3	-	18.9	-
04145000	SHIAWASSEE RIVER NEAR FERGUS, MICH.	4.0	4.8	-	2.1	62.9	-	16.0	-
04145500	BAD RIVER NEAR BRANT, MICH.	72.7	-	-	-	9.9	-	-	-
04146000	FARMERS CREEK NEAR LAPEER, MICH.	9.0	2.0	-	-	24.0	-	15.6	-
04147500	FLINT RIVER NEAR OTISVILLE, MICH.	19.9	2.3	3.5	2.8	17.2	-	21.0	-
04147800	POWERS-CULLEN DRAIN NEAR GENESEE, MICH.	-	-	-	-	90.9	-	9.1	-
04147900	LEFLER-SCOTHAN DRAIN NEAR OTISVILLE, MICH.	-	-	-	-	100	-	-	-
04147990	BUTTERNUT CREEK NEAR GENESEE, MICH.	-	-	-	2.9	78.5	-	-	-
04148120	KEARSLEY CREEK NEAR ATLAS, MICH.	-	9.8	-	-	27.5	-	21.0	-
04148139	BLACK CREEK NEAR DAVISON, MICH.	8.1	1.4	-	-	73.0	-	17.4	-
04148140	KEARSLEY CREEK NEAR DAVISON, MICH.	5.6	6.2	-	-	46.8	-	16.9	-
04148160	GILKEY CREEK NEAR FLINT, MICH.	51.8	-	-	-	48.2	-	-	-
04148200	SWARTZ CREEK NEAR HOLLY, MICH.	-	32.3	-	-	10.2	-	47.4	-
04148255	SWARTZ CREEK NEAR GRAND BLANC, MICH.	-	10.2	-	-	69.6	-	17.0	-
04148260	SWARTZ CREEK NEAR SWARTZ CREEK, MICH.	2.2	5.5	-	-	80.1	-	10.4	-
04148265	KIMBALL DRAIN NEAR SWARTZ CREEK, MICH.	-	-	-	48.5	51.5	-	-	-
04148270	WEST BRANCH SWARTZ CREEK NEAR SWARTZ CR, MICH.	4.6	-	-	37.8	42.2	-	15.5	-
04148300	SWART CREEK AT FLINT, MICH.	6.6	3.2	-	13.6	63.8	-	11.6	-
04148410	THREAD CREEK NEAR GOODRICH, MICH.	-	14.2	-	-	30.6	-	16.7	-

Table 6.--Surficial geological basin characteristics--Continued

USGS station number	Station name	Surficial geologic material (percent of contributing drainage area) CLAY	CORGT	FINEM	FINGT	MEDTILL	MUCK	OUTWASH	TILROCK
04148440	THREAD CREEK NEAR FLINT, MICH.	-	7.8	-	-	58.4	-	12.5	-
04148500	FLINT RIVER NEAR FLINT, MICH.	15.0	2.7	2.0	3.3	34.3	-	20.0	-
04148610	COLE CREEK NEAR FLUSHING, MICH.	-	-	-	-	100	-	-	-
04148620	FREEMAN DRAIN NEAR MONTROSE, MICH.	17.0	-	-	39.7	3.8	-	-	-
04148640	ARMSTRONG CREEK NEAR MONTROSE, MICH.	12.1	-	-	-	21.0	-	-	-
04148800	PINE RUN NEAR MONTROSE, MICH.	3.6	-	-	-	37.6	-	-	-
04149300	MISTEGUAY CREEK NEAR FLUSHING, MICH.	-	-	-	-	100	-	-	-
04150000	SOUTH BRANCH CASS RIVER NEAR CASS CITY, MICH.	-	6.4	-	-	62.3	-	18.8	-
04150500	CASS RIVER AT CASS CITY, MICH.	-	7.5	-	1.4	46.5	4.2	16.0	-
04151500	CASS RIVER AT FRANKENMUTH, MICH.	0.4	6.8	0.3	7.0	36.5	1.8	14.4	-
04152500	TOBACCO RIVER AT BEAVERTON, MICH.	3.2	7.2	3.6	13.3	12.2	-	30.7	-
04153500	SALT RIVER NEAR NORTH BRADLEY, MICH.	43.8	-	-	-	32.1	-	2.6	-
04154000	CHIPPEWA RIVER NEAR MOUNT PLEASANT, MICH.	0.8	9.3	0.5	1.3	15.3	-	32.9	-
04154500	CHIPPEWA RIVER NEAR MIDLAND, MICH.	5.6	6.8	0.3	0.9	21.3	-	23.6	-
04155000	PINE RIVER AT ALMA, MICH.	0.2	29.5	-	-	18.7	-	22.3	-
04155500	PINE RIVER NEAR MIDLAND, MICH.	17.4	22.1	-	-	18.4	-	16.9	-
04156000	TITTABAWASSEE RIVER NEAR MIDLAND, MICH.	14.4	6.9	1.6	5.0	12.7	-	18.8	-
04157500	SEBEWAING RIVER NEAR SEBEWAING, MICH.	59.3	-	9.4	12.0	-	-	-	-
04158000	EAST FORK SEBEWAING RIVER NEAR SEBEWAING, MICH.	71.0	-	3.2	14.1	-	-	-	-
04158500	PIGEON RIVER NEAR OWENDALE, MICH.	12.2	-	-	4.5	53.2	-	-	-
04159500	BLACK RIVER NEAR FARGO, MICH.	26.6	2.8	3.9	4.1	34.6	7.0	4.5	-
04160000	MILL CREEK NEAR ABBOTTSFORD, MICH.	28.0	0.6	26.5	2.0	4.1	-	21.0	-
04160050	BLACK RIVER NEAR PORT HURON, MICH.	28.4	2.1	9.9	4.0	25.3	4.9	8.8	-
04160570	NORTH BRANCH BELLE RIVER AT IMLAY CITY, MICH.	46.2	-	15.2	-	-	-	-	-
04160600	BELLE RIVER AT MEMPHIS, MICH.	49.7	-	18.3	-	3.3	-	-	-
04160800	SASHABAW CREEK NEAR DRAYTON PLAINS, MICH.	-	-	-	-	11.3	-	60.4	-
04160900	CLINTON RIVER NEAR DRAYTON PLAINS, MICH.	-	31.1	-	-	9.4	-	59.5	-
04161000	CLINTON RIVER AT AUBURN HEIGHTS, MICH.	-	-	-	-	22.4	-	55.7	-
04161100	GALLOWAY CREEK NEAR AUBURN HEIGHTS, MICH.	-	-	-	-	60.1	-	39.9	-
04161500	PAINT CREEK NEAR LAKE ORION, MICH.	-	9.4	-	-	-	-	66.2	-
04161540	PAINT CREEK AT ROCHESTER, MICH.	-	5.0	-	-	42.5	-	39.5	-
04161580	STONY CREEK NEAR ROMEO, MICH.	-	-	-	-	31.5	-	27.0	-
04161760	WEST BRANCH STONY CREEK NEAR WASHINGTON, MICH.	-	-	-	-	58.0	-	24.6	-
04163500	PLUM BROOK NEAR UTICA, MICH.	3.6	-	-	-	21.3	-	-	-
04164010	NORTH BRANCH CLINTON RIVER AT ALMONT, MICH.	25.6	-	-	-	65.6	-	2.2	-
04164050	NORTH BRANCH CLINTON RIVER NEAR ROMEO, MICH.	38.7	-	16.7	-	26.3	-	11.2	-
04164100	EAST POND CREEK AT ROMEO, MICH.	6.3	-	-	-	49.0	-	22.4	-

Table 6.--Surficial geological basin characteristics--Continued

USGS station number	Station name	Surficial geologic material (percent of contributing drainage area) CLAY	CORGT	FINEM	FINGT	MEDTILL	MUCK	OUTWASH	TILROCK
04164150	NORTH BRANCH CLINTON RIVER NEAR MEADE, MICH.	37.6	-	8.7	-	28.5	-	12.6	-
04164200	COON CREEK NEAR ARMADA, MICH.	52.0	-	6.9	-	41.2	-	-	-
04164250	TUPPER BROOK AT RAY CENTER, MICH.	88.9	-	-	-	11.1	-	-	-
04164300	EAST BRANCH COON CREEK AT ARMADA, MICH.	44.1	-	42.8	-	13.1	-	-	-
04164350	HIGHBANK CREEK NEAR ARMADA, MICH.	73.8	-	-	-	26.2	-	-	-
04164360	EAST BRANCH COON CREEK NEAR NEW HAVEN, MICH.	67.9	-	15.5	-	16.5	-	-	-
04164400	DEER CREEK NEAR MEADE, MICH.	100	-	-	-	-	-	-	-
04164450	MC BRIDE DRAIN NEAR MACOMB, MICH.	100	-	-	-	-	-	-	-
04164500	NORTH BRANCH CLINTON RIVER NEAR MOUNT CLEMENS MICH.	60.6	-	9.9	-	17.9	-	5.2	-
04164600	MIDDLE BRANCH CLINTON RIVER NEAR MACOMB, MICH.	9.0	-	-	-	20.1	-	-	-
04164800	MIDDLE BRANCH CLINTON RIVER AT MACOMB, MICH.	31.7	-	-	-	20.1	-	-	-
04165200	GLOEDE DITCH NEAR WALDENBURG, MICH.	21.1	-	-	-	-	-	-	-
04166000	RIVER ROUGE AT BIRMINGHAM, MICH.	3.3	-	21.6	-	43.9	-	31.3	-
04169500	HURON RIVER AT COMMERCE, MICH.	-	-	-	-	2.1	-	65.2	-
04170000	HURON RIVER AT MILFORD, MICH.	-	-	-	-	6.1	-	59.4	-
04171500	ORE CREEK NEAR BRIGHTON, MICH.	-	-	-	-	17.1	-	47.6	-
04172000	HURON RIVER NEAR HAMBURG, MICH.	-	0.2	-	0.4	12.9	-	60.3	-
04172500	PORTAGE RIVER NEAR PINCKNEY, MICH.	-	10.9	-	-	20.3	-	57.3	-
04173000	HURON RIVER NEAR DEXTER, MICH.	-	1.9	-	2.6	16.3	-	57.8	-
04173500	MILL CREEK NEAR DEXTER, MICH.	-	-	4.8	-	56.7	-	19.3	-
04175600	RIVER RAISIN NEAR MANCHESTER, MICH.	-	19.8	-	-	-	-	46.7	-
04175700	RIVER RAISIN NEAR TECUMSEH, MICH.	0.2	9.8	20.0	6.8	0.8	-	39.9	-
04176000	RIVER RAISIN NEAR ADRIAN, MICH.	0.1	5.8	30.5	15.8	0.5	-	30.7	-
04176400	SALINE RIVER NEAR SALINE, MICH.	4.7	2.6	55.4	16.4	-	-	20.9	-
04176500	RIVER RASIN NEAR ADRIAN, MICH.	28.4	2.7	23.7	8.7	0.2	-	15.3	-

Table 7.--Areal adjustment factors, AREAL, for regionalized flow estimates

Streamflow characteristic	Adjustment factor				
	Region 1	Region 2	Region 3	Region 4	Region 5
Q_A	1.0097	1.0340	1.0349	0.9831	0.9445
Q_1	0.9554	1.0371	1.0632	.9799	.9496
Q_2	.9879	1.0671	0.9813	.9874	.9612
Q_3	.9528	1.0583	.9654	1.0735	.9423
Q_4	1.0824	1.0849	.8863	1.0170	.9751
Q_5	1.0965	1.0750	.9076	.9725	.9730
Q_6	1.0760	1.0651	.9732	.9497	.9448
Q_7	1.0283	1.0534	1.0718	.9603	.9861
Q_8	.9665	1.0440	1.1757	.9190	.9386
Q_9	1.0200	1.0264	1.1064	1.0021	.9131
Q_{10}	1.0079	1.0500	1.0737	1.0207	.9333
Q_{11}	.9986	1.0209	1.0568	.9993	.9714
Q_{12}	.9786	1.0283	1.0639	.9627	.9836
D_{10}	1.1171	1.0216	.8964	1.1008	.9363
D_{25}	1.0529	1.0578	.9579	.9998	.9530
D_{50}	1.0000	1.0877	1.0568	.9009	.9462
D_{75}	.9552	1.1275	1.1410	.8074	.9515
D_{95}	.9911	1.3286	1.0732	.7616	.8835
$M_{7,10}$	.9745	1.3456	1.1572	.7635	.8736
$M_{30,10}$	.9872	1.2945	1.1046	.8020	.9508
P_5	.9890	1.0209	.9986	1.0705	.9171
P_{10}	.9840	1.0238	.9940	1.0639	.9303
P_{25}	.9790	1.0301	.9886	1.0546	.9447
P_{50}	.9761	1.0354	.9849	1.0479	.9539
P_{100}	.9741	1.0426	.9820	1.0409	.9605
$V_{7,10}$	1.0259	0.9883	.9781	1.0952	.8997
$V_{30,10}$	1.0433	1.0072	.9672	1.0525	.9544

Table 8.--Statistical models for determining mean and mean monthly flow

[$Y = AREAL\ 10^{a}\ AREA^{b_1}\ SNOFALL^{b_2}\ I_{24,2}{}^{b_3}\ (OUTWASH+1)^{b_4}\ (FOREST+1)^{b_5}\ JANMIN^{b_6}\ (CHSWAMP+1)^{b_7}$]

Streamflow characteristic	Regression constant	Regression coefficients, for characteristics shown by							Mean-square error		R^2
	(a)	(b_1)	(b_2)	(b_3)	(b_4)	(b_5)	(b_6)	(b_7)			
		AREA	SNOFALL	$I_{24,2}$	OUTWASH	FOREST	JANMIN	CHSWAMP	Log_{10}	Percent	
Mean flow											
Q_A	-1.4813	1.0217	0.5385	1.1703	-	-	-	-	0.008549	21.5	0.97
Prob>|T|[a]		0.0001	.0001	0.0002							
Mean Monthly flow											
Q_1	-1.9083	1.0178	.4324	1.1703	0.1143	-	0.3576	-	.01455	28.3	.96
Prob>|T|		0.0001	.0001	.0045	.0001		.0001				
Q_2	-.5423	1.0179	-	-	.1008	-	.3755	-0.1068	.01505	28.8	.95
Prob>|T|		.0001			.0001		.0001	.0001			
Q_3	-.1182	1.0050	-	-	-	-	.3662	-.1172	.01068	24.1	.96
Prob>|T|		.0001					.0001	.0001			
Q_4	.1493	.9780	.3199	-	-	-	-.4040	-	.01190	25.5	.96
Prob>|T|		.0001	.0001				.0001				
Q_5	-.8441	1.0415	-	2.3012	-	.2848	-.3784	-	.01208	25.7	.97
Prob>|T|		.0001		.0001		.0001	.0001				
Q_6	-2.5217	1.0447	.4589	2.9298	.0632	.2663	-	-	.01448	28.3	.96
Prob>|T|		.0001	.0001	.0001	.0001	.0001					
Q_7	-2.9063	1.0595	.4468	2.9523	.1437	.3163	-	-	.02302	36.0	.95
Prob>|T|		.0001	.0002	.0001	.0001	.0001					
Q_8	-3.1734	1.0252	.4984	2.9556	.2030	.3578	-	-	.03248	43.4	.93
Prob>|T|		.0001	.0004	.0001	.0001	.0001					
Q_9	-3.2444	1.0327	.5745	3.0000	.1545	.3775	-	-	.03707	46.6	.92
Prob>|T|		.0001	.0001	.0001	.0001	.0001					
Q_{10}	-2.7495	1.0150	.5311	2.3292	.1182	.3549	-	-	.02658	38.9	.94
Prob>|T|		.0001	.0001	.0002	.0001	.0001					
Q_{11}	-2.3098	1.0060	.4988	2.0495	.0901	.2668	-	-	.01633	30.1	.96
Prob>|T|		.0001	.0001	.0001	.0001	.0001					
Q_{12}	-1.8881	.9903	.5657	1.1866	.0927	-	.2281	-	.01395	27.7	.96
Prob>|T|		.0001	.0001	.0033	.0001		.0011				

[a] The probability that a t statistic would obtain a greater absolute value than that observed given that the true parameter is zero. This is a two-tailed test, (Ray, 1982).

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Table 9.--Statistical models for determining flow duration and low flow

[$Y = (AREAL\ 10^{a}\ AREA^{b1}\ (FOREST+1)^{b2}\ SNOFALL^{b3}\ (OUTWASH+1)^{b4}\ (MUCK+1)^{b5}\ (CLAY+1)^{b6}$
$(TILROCK+1)^{b7}\ (FINEM+1)^{b8}\ (FINGT+1)^{b9}\ I_{24,2}{}^{b10}\ ) - 0.2$]

Streamflow characteristic	Regression constant (a)	Regression coefficients, for characteristics shown by										Mean-square error		R^2
		(b_1) AREA	(b_2) FOREST	(b_3) SNOFALL	(b_4) OUTWASH	(b_5) MUCK	(b_6) CLAY	(b_7) TILROCK	(b_8) FINEM	(b_9) FINGT	(b_{10}) $I_{24,2}$	Log_{10}	Percent	
Flow duration														
D_{10}	-0.6742	1.0434	0.1353	-	-0.0329	-	-	0.0891	-	-	1.8712	0.01041	23.8	0.97
Prob>|T|		0.0001	.0001		.0885			.0004			0.0001			
D_{25}	-1.5015	1.0306	.3004	-	.0590	-	-0.0525	-	-	-	2.5788	.01142	25.0	.97
Prob>|T|		.0001	.0001		.0105		.0366				.0001			
D_{50}	-2.2927	0.9925	.5434	-	.1443	-	-.0975	-.0819	-	-	3.0289	.02182	35.0	.95
Prob>|T|		.0001	.0001		.0001		.0053	.0223			.0001			
D_{75}	-3.1064	.9815	.8103	-	.1994	-	-.1194	-.1610	-	-	3.4963	.04436	51.5	.93
Prob>|T|		.0001	.0001		.0001		.0162	.0018			.0004			
D_{95}	-3.2533	1.0152	.7082	0.6800	.2074	-0.2436	-.2347	-.3031	0.1884	-0.1676	-	.07648	70.7	.89
Prob>|T|		.0001	.0001	.0127	.0010	.0040	.0003	.0001	.0022	.0368				
Low flow														
$M_{7,10}$	-3.9188	.9857	.8074	.9138	.2169	-.2942	-.2409	-.3941	.2245	-.1866	-	.10518	86.4	.88
Prob>|T|		.0001	.0001	.0045	.0032	.0031	.0013	.0001	.0019	.0472				
$M_{30,10}$	-3.5097	.9911	.8097	.7163	.2130	-.2756	-.2113	-.3581	.2013	-.1749	-	.08215	73.9	.89
Prob>|T|		.0001	.0001	.0113	.0011	.0018	.0015	.0001	.0017	.0355				

Table 10.--Statistical models for determining peak flow and flood volume

[$Y = (AREAL\ 10^{a}\ CONTDA^{b1}\ SLOPE^{b2}\ (CHSWAMP+1)^{b3}\ SLENRAT^{b4}\ I_{24,100}{}^{b5}\ (OUTWASH+1)^{b6}\ (MUCK+1)^{b7}$
$(FINEM+1)^{b8}\ (MEDTILL+1)^{b9}\ (CLAY+1)^{b10}\ (TILROCK+1)^{b11}\ (CORGT+1)^{b12}$]

Streamflow characteristic	Regression constant (a)	Regression coefficients, for characteristics shown by												Mean-square error		R^2
		(b_1) CONTDA	(b_2) SLOPE	(b_3) CHSWAMP	(b_4) SLENRAT	(b_5) $I_{24,100}$	(b_6) OUTWASH	(b_7) MUCK	(b_8) FINEM	(b_9) MEDTILL	(b_{10}) CLAY	(b_{11}) TILROCK	(b_{12}) CORGT	Log_{10}	Percent	
Peak flow																
P_5	0.6869	0.8931	0.2164	-0.1741	-0.1148	1.0458	-0.1524	0.1669	0.1017	0.0884	0.0905	0.0963	0.0400	0.01724	30.1	0.93
Prob>|T|		.0001	.0001	.0001	.0240	.0141	.0001	.0001	.0001	.0001	.0001	.0001	.0648			
P_{10}	.6688	.8902	.2256	-.1749	-.1240	1.1936	-.1548	.1660	.1100	.1004	.0999	.0901	.0443	.01908	32.6	.93
Prob>|T|		.0001	.0001	.0001	.0210	.0078	.0001	.0001	.0001	.0001	.0001	.0006	.0520			
P_{25}	.6099	.8878	.2372	-.1744	-.1351	1.4077	-.1564	.1666	.1194	.1117	.1091	.0831	.0489	.02167	34.9	.92
Prob>|T|		.0001	.0001	.0001	.0180	.0033	.0001	.0001	.0001	.0001	.0001	.0027	.0440			
P_{50}	.5569	.8860	.2464	-.1738	-.1414	1.5657	-.1569	.1681	.1254	.1184	.1142	.0784	.0521	.02388	36.7	.91
Prob>|T|		.0001	.0001	.0001	.0180	.0019	.0001	.0001	.0001	.0001	.0001	.0069	.0420			
P_{100}	.4936	.8853	.2558	-.1727	-.1487	1.7299	-.1574	.1703	.1308	.1242	.1181	.0740	.0539	.02620	38.6	.90
Prob>|T|		.0001	.0001	.0001	.0180	.0011	.0001	.0001	.0001	.0001	.0001	.0150	.0440			
Flood volume																
$V_{7,10}$	.2313	.9663	.0920	-.0862	-	1.0109	-.1129	.1807	.0823	.0659	.0499	.1761	.0669	.01100	24.5	.97
Prob>|T|		.0001	.0199	.0002		.0044	.0001	.0001	.0002	.0001	.0266	.0001	.0004			
$V_{30,10}$	.0649	.9751	.0557	-.0324	-	.8424	-.0828	.1630	.0619	.0281	.0304	.1648	.0518	.00707	19.5	.98
Prob>|T|		.0001	.0775	.0720		.0031	.0001	.0001	.0006	.0115	.0909	.0001	.0007			

Table 11.--Pearson product-moment correlations of logarithms of basin characteristics

	LAREA	LCONTDA	LSLOPE	LCHSWAMP	$LI_{24,2}$	$LI_{24,100}$	LSLENRAT	LFOREST	LSNOFALL	LJANMIN	LCLAY	LCORGT	LFINEM	LMEDTILL	LMUCK	LOUTWASH	LTILROCK
LAREA	1.00																
LCONTDA	0.99	1.00															
LSLOPE	-.59	-0.58	1.00														
LCHSWAMP	.47	.45	-0.23	1.00													
LI24_2	-.41	-.42	.02	-0.10	1.00												
LI24_100	-.36	-.37	.06	-.07	0.96	1.00											
LSLENRAT	.30	.29	-.27	.20	-.09	-0.09	1.00										
LFOREST	.36	.36	.14	.49	-.44	-.32	0.04	1.00									
LSNOFALL	.30	.29	.16	.35	-.31	-.18	-.01	0.83	1.00								
LJANMIN	-.23	-.24	-.30	-.24	.30	.12	.05	-.73	-0.77	1.00							
LCLAY	-.10	-.08	.05	-.48	-.09	-.13	.10	-.42	-.35	0.21	1.00						
LCORGT	.49	.50	-.10	.43	-.23	-.16	.08	.43	.45	-.44	-0.30	1.00					
LFINEM	.00	.00	.14	-.22	-.16	-.20	-.04	-.11	-.16	.09	.31	-0.21	1.00				
LMEDTILL	-.24	-.22	.01	-.24	.15	.09	-.01	-.51	-.61	.41	.09	-.29	0.00	1.00			
LMUCK	.31	.32	-.13	.17	-.38	-.33	.00	.36	.43	-.37	-.05	.27	-.04	-0.24	1.00		
LOUTWASH	.44	.41	-.34	.55	.03	.00	.16	.25	.11	.10	-.49	.23	-.12	-.17	-0.01	1.00	
LTILROCK	.06	.06	.29	.17	-.09	.03	-.03	.44	.54	-.65	-.15	.23	-.13	-.30	.12	-0.14	1.00

Table 12.--Percent standard errors of estimate of regression equations by regions

Stream-flow character-istic	Region 1	2	3	4	5
Q_A	17.7	13.1	37.4	11.1	11.6
Q_1	30.4	10.3	42.3	15.7	18.4
Q_2	34.6	15.5	40.5	13.1	20.4
Q_3	31.2	19.5	29.6	8.0	14.4
Q_4	28.2	11.8	28.0	14.6	8.6
Q_5	38.5	19.5	28.0	10.1	12.5
Q_6	21.1	23.2	40.1	26.6	12.3
Q_7	20.6	23.6	46.3	30.9	22.7
Q_8	25.5	34.0	49.2	32.8	41.2
Q_9	29.2	30.0	51.2	39.3	33.0
Q_{10}	26.1	24.6	43.4	39.5	34.2
Q_{11}	26.6	20.8	39.5	26.0	23.6
Q_{12}	26.7	16.7	39.9	22.0	21.0
D_{10}	23.3	10.6	30.6	25.6	10.3
D_{25}	26.5	17.7	31.6	18.1	23.3
D_{50}	33.8	29.9	37.8	31.3	35.1
D_{75}	41.4	46.0	51.0	55.5	50.3
D_{95}	51.5	58.8	48.9	108	62.8
$M_{7,10}$	72.1	67.9	57.6	141	62.0
$M_{30,10}$	62.2	64.0	53.8	104	48.9
P_5	29.8	31.1	24.7	34.8	26.1
P_{10}	30.4	32.5	27.0	37.5	27.7
P_{25}	31.4	34.7	30.1	40.5	29.8
P_{50}	33.1	37.0	32.7	42.7	31.4
P_{100}	33.0	39.5	35.0	44.5	33.1
$V_{7,10}$	23.3	24.7	22.1	23.3	23.3
$V_{30,10}$	20.1	21.6	20.7	9.9	11.8

Table 13.--Summary statistics of logarithms of basin characteristics

Regression	Variable	Mean of logarithms	Standard deviation of logarithms	Minimum value	Maximum value
Q_A, Q_m	LAREA	2.107	0.5363	0.0607	2.980
	LSNOFALL	1.763	.1899	1.544	2.176
	$LI_{24,2}$	0.3317	.02799	0.2648	0.3945
	LOUTWASH	1.222	.5947	.0	2.004
	LFOREST	1.492	.3915	.5052	2.000
	LJANMIN	1.041	.2326	.3979	1.255
	LCHSWAMP	1.388	.5331	.0	1.987
D_{10},D_{25},D_{50}, D_{75},D_{95}, $M_{7,10}$,$M_{30,10}$					
	LAREA	2.039	.5457	.0607	2.940
	LFOREST	1.450	.3864	.5052	2.000
	LSNOFALL	1.748	.1850	1.544	2.152
	LOUTWASH	1.227	.6037	.0	2.004
	LMUCK	0.1622	.3985	.0	1.630
	LCLAY	.3075	.5858	.0	1.868
	LTILROCK	.1413	.4651	.0	1.994
	LFINEM	.2742	.5036	.0	1.641
	LFINGT	.1957	.3919	.0	1.680
	$LI_{24,2}$	.3333	.02702	.2718	0.3945
P_{100},P_{50}, P_{25},P_{10},P_5,					
	LCONTDA	1.934	.6143	.06070	2.981
	LSLOPE	0.8634	.3290	-.2757	1.757
	LCHSWAMP	1.302	.5981	.0	1.987
	LSLENRAT	0.8404	.2106	.3682	1.362
	$LI_{24,100}$	0.6380	.02730	.5611	0.7126
	LOUTWASH	1.107	.6593	.0	2.004
	LMUCK	0.1189	.3285	.0	1.630
	LFINEM	.2312	.4757	.0	1.641
	LMEDTILL	.9350	.7434	.0	2.004
	LCLAY	.3484	.6011	.0	1.868
	LTILROCK	.1717	.5015	.0	1.994
	LCORGT	.5962	.6044	.0	1.986
$V_{7,10}$, $V_{30,10}$					
	LCONTDA	2.071	.5478	.0607	2.981
	LSLOPE	0.8183	.3336	-.2757	1.757
	LCHSWAMP	1.388	.5226	.0	1.987
	LSLENRAT	0.8461	.2127	.3682	1.362
	$LI_{24,100}$	0.6352	.0292	.5611	0.7126
	LOUTWASH	1.236	.6028	.0	2.004
	LMUCK	0.1445	.3628	.0	1.630
	LFINEM	.2231	.4628	.0	1.641
	LMEDTILL	.8250	.7318	.0	2.004
	LCLAY	.2809	.5555	.0	1.868
	LTILROCK	.1743	.5180	.0	1.994
	LCORGT	.6544	.6039	.0	1.986

Table 14.--Inverse crossproduct matrix of logarithms of basin characteristics

Regression	Variable	LAREA	LSNOFALL	$LI_{24,2}$	LOUTWASH	LJANMIN	LCHSWAMP	LFOREST
Q_A	LAREA	0.02757						
	LSNOFALL	-.006255	0.2080					
	$LI_{24,2}$	.1748	.3430	10.62				
Q_1	LAREA	.03158						
	LSNOFALL	-.0004523	.4800					
	$LI_{24,2}$	.2220	.2388	11.29				
	LOUTWASH	-.009939	-.02784	-0.1085	0.02536			
	LJANMIN	.006315	.3027	-.1179	-.0306	0.3368		
Q_2	LAREA	.02811						
	LOUTWASH	-.005478			.03003			
	LJANMIN	.007777			-.02668	.1576		
	LCHSWAMP	-.005965			-.01623	.02591	0.03714	
Q_3	LAREA	.02712						
	LJANMIN	.002912				.1339		
	LCHSWAMP	-.008924				.01150	.02837	
Q_4	LAREA	.02471						
	LSNOFALL	-.01335	.4481					
	LJANMIN	-.001568	.2718			.2941		
Q_5	LAREA	.02787						
	$LI_{24,2}$	.1609		11.78				
	LJANMIN	-.006856		.04062		.2717		
	LFOREST	-.007230		.3278		.1207		0.1096
Q_{6-11}	LAREA	.03156						
	LSNOFALL	-.01219	.5744					
	$LI_{24,2}$	.2393	-.5660	13.52				
	LOUTWASH	-.009892	.03158	-.1984	.02535			
	LFOREST	.004025	-.2433	.6048	-.02117			.1616
Q_{12}	LAREA	.03158						
	LSNOFALL	-.0004523	.4800					
	$LI_{24,2}$	.2220	.2388	11.29				
	LOUTWASH	-.009939	-.02784	-.1085	.02536			
	LJANMIN	.006315	.3027	-.1179	-.03064	.3368		

Regression	Variable	LCONTDA	LSLOPE	LCHSWAMP	LOUTWASH	LMEDTILL	LFINEM
P_{100}, P_{50}, P_{25}, P_{10}, P_5	LCONTDA	.05000					
	LSLOPE	.04720	.1146				
	LCHSWAMP	-.005842	-.001666	.03075			
	LOUTWASH	-.009858	-.0006025	-.009029	.02714		
	LMEDTILL	-.001384	-.001144	.0006744	.003859	.01284	
	LFINEM	-.008871	-.01554	.003113	-.0008675	.001725	.03139
	LMUCK	-.007026	.004338	-.002773	.008054	.005425	.002767
	$LI_{24,100}$	.2367	.2304	.003678	-.03797	-.002807	.07515
	LCLAY	-.007905	-.003424	.007635	.01114	.002051	-.003696
	LSLENRAT	-.007331	.01359	-.01008	-.004133	-.001772	.003870
	LTILROCK	-.01270	-.02541	-.004047	.01018	.006140	.005099
	LCORGT	-.01668	-.01551	-.003168	.002737	.003130	.006707

Regression	Variable	LMUCK	$LI_{24,100}$	LCLAY	LSLENRAT	LTILROCK	LCORGT
P_{100}, P_{50}, P_{25}, P_{10}, P_5--Ccontinued	LMUCK	.06641					
	$LI_{24,100}$	.2009	10.31				
	LCLAY	.003104	.03242	.02776			
	LSLENRAT	.008718	.03659	-.01392	.1474		
	LTILROCK	.0006057	-.08560	.005639	-.002631	.03441	
	LCORGT	-.002471	-.01599	.005192	.0007922	.001816	.02693

Table 14.--Inverse crossproduct matrix of logarithms of basin characteristics--Continued

Regression	Variable	LCONTDA	LCLAY	LOUTWASH	LMEDTILL	LTILROCK	LMUCK
$V_{7,10}$, $V_{30,10}$	LCONTDA	0.06167					
	LCLAY	-.008885	0.04508				
	LOUTWASH	-.006571	.02196	0.04192			
	LMEDTILL	-.003960	.002462	.002530	0.01701		
	LTILROCK	-.01166	.009236	.01405	.008060	0.04164	
	LMUCK	-.006166	.006455	.01171	.006151	.001433	0.06996
	LSLOPE	.05814	.004031	.007509	-.002314	-.02630	.007245
	$LI_{24,100}$	.2558	.05335	-.008510	-.0007802	-.07837	.2301
	LCHSWAMP	-.008375	.008877	-.01276	.004452	-.003851	-.003811
	LFINEM	-.008295	-.004097	.003567	.002866	.007474	.004025
	LCORGT	-.01895	.008331	.005907	.004474	.003301	-.002141

	Variable	LSLOPE	$LI_{24,100}$	LCHSWAMP	LFINEM	LCORGT
$V_{7,10}$, $V_{30,10}$--Continued	LSLOPE	.1385				
	$LI_{24,100}$	.2684	11.07			
	LCHSWAMP	-.001508	.007724	.04502		
	LFINEM	-.01291	.08791	.005052	.04325	
	LCORGT	-.01555	-.008903	-.002941	.008866	.03134

Regression	Variable	LAREA	LFOREST	$LI_{24,2}$	LOUTWASH	LCLAY	LTILROCK
D_{10}	LAREA	.04054					
	LFOREST	-.001214	.1056				
	$LI_{24,2}$	.3301	.5612	18.28			
	LOUTWASH	-.01193	-.02503	-.2849	.03507		
	LTILROCK	.0007626	-.03880	-.1602	.01368		.05695
D_{25}, D_{50}, D_{75}	LAREA	.04075					
	LFOREST	-.003495	.1304				
	$LI_{24,2}$	.3096	.7850	20.30			
	LOUTWASH	-.01337	-.009356	-.1438	.04496		
	LCLAY	-.003358	.03658	.3294	.02307	.05385	
	LTILROCK	.0005771	-.03678	-.1420	.01496	.002974	.05712

Regression	Variable	LAREA	LFOREST	LOUTWASH	LMUCK	LCLAY
$M_{7,10}$, $M_{30,10}$, D_{95}	LAREA	.04619				
	LFOREST	-.01271	.2096			
	LOUTWASH	-.01763	-.01507	.04913		
	LMUCK	-.02228	-.007832	.01728	.08967	
	LCLAY	-.01013	.02097	.02633	.001746	.05074
	LTILROCK	.0002831	-.01128	.01455	.01486	.003735
	LFINEM	.005755	-.01079	-.0005902	-.0007998	-.009673
	LFINGT	-.02110	.02561	.008188	.01126	.004500
	LSNOFALL	.007477	-.2933	.01596	-.08461	.007802

	Variable	LTILROCK	LFINEM	LFINGT	LSNOFALL
$M_{7,10}$, $M_{30,10}$, D_{95}--Continued	LTILROCK	.06357			
	LFINEM	.003740	.04720		
	LFINGT	.002911	-.02421	.08203	
	LSNOFALL	-.07480	.02280	-.03868	.9391

DEFINITION OF TERMS

Annual peak flow. The highest instantaneous peak flow in a water year.

Computed flow value. Used in this report to refer specifically to a value for a flow characteristic determined by analyzing flow records collected at a gaging station.

Confidence limits. End points of a confidence interval which describe the range in which the true value, with a specified level of assurance, is expected to occur.

Continuous-record station. A gaging station where observations of stage are recorded continually, usually at one hour intervals, throughout the period of record.

Discharge. The rate of flow of water in a stream at a given place and within a given period of time.

Estimated flow value. Used in this report to refer specifically to a value for a flow characteristic determined on the basis of a regression equation.

Flood. A relatively high flow; usually overtops natural banks along some reaches of the stream.

Flood frequency. The percent chance that a flood of a given magnitude will be exceeded in any one year.

Flood peak. The maximum rate of flow that occurred during a flood event.

Gaging station. A particular site on a stream where systematic observations of stage and flow are obtained.

Mean-square error. Sum of the squared differences between computed and estimated flow values divided by the number of observations.

Natural flow. Flow that is unaffected or only insignificantly affected by man's activities; also unregulated flow.

Partial-record station. A gaging station where limited streamflow data are collected to define particular flow characteristics. Classified as crest-stage partial-record station for peak flow and low-flow partial-record for low flow.

R^2 coefficient. Coefficient of linear determination which measures the closeness of a statistical relationship. The square of the correlation coefficient.

Recurrence interval. The average time, in years, in which an event of a specified magnitude will be exceeded.

Residual. The difference between observed or computed values and estimated values based on a regression equation.

Stage. The height of a water surface above an established datum plane; also gage height.

Surface runoff. Runoff which travels over the soil surface to the nearest stream channel. It is also defined as that part of the runoff of a drainage basin that has not passed beneath the surface.

t_{alpha}. A statistic whose sampling distribution is based on the Student-t distribution. A value of t is computed as $(x-\mu)/(s/\sqrt{n})$, where x is the sample mean, μ is the population mean, s is the sample standard deviation and n is the number of observations. The alpha value describes the degree of certainty.

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