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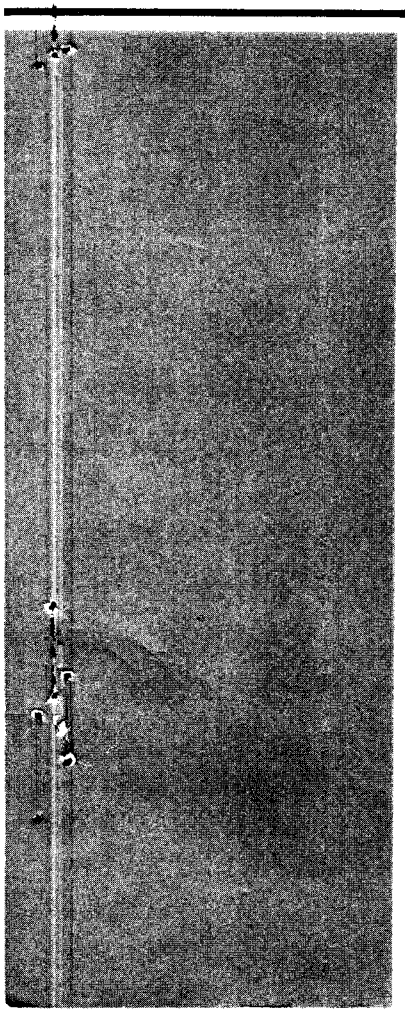
An Evaluation of Two Hydrograph Separation Methods of Potential Use in Regional Water Quality Assessment

D. D. Huff C. L. Begovich

Environmental Sciences Division Publication No. 714



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COMPUTER SCIENCES DIVISION

AN EVALUATION OF TWO HYDROGRAPH SEPARATION METHODS OF POTENTIAL USE IN REGIONAL WATER QUALITY ASSESSMENT

D. D. Huff 42
Environmental Sciences Division

C. L. Begovich 63
Computer Sciences Division

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ACKNOWLEDGMENTS

Since the work described in this report depended upon the existence of computer programs for hydrograph separation, we are indebted to those who first developed and implemented the programs we evaluated. In addition to J. Curlin and W. Snyder, M. T. Heath contributed heavily to the implementation of the Snyder and Curlin package of programs. We are grateful for the cooperation given to us by the staff at the Coweeta Hydrologic Laboratory of the U.S.D.A. Forest Service. Drs. L. W. Swift, Jr. and W. T. Swank reviewed our description of the program, and G. B. Cunningham supplied the program and answered our questions in the early stages of the work. We acknowledge the work of J. L. Clutter and G. B. Cunningham for the original implementation based on concepts by A. R. Hibbert and J. D. Hewlett. G. B. Cunningham has maintained and since made substantial modifications in the program.

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AN EVALUATION OF TWO HYDROGRAPH SEPARATION METHODS OF POTENTIAL USE IN REGIONAL WATER QUALITY ASSESSMENT

D. D. Huff and C. L. Begovich

ABSTRACT

Streamflow data are more useful for evaluating hydrologic model results and studying water quality once baseflow and storm runoff have been separated. However, it is important to select an appropriate hydrograph separation method. We examined two methods and evaluated their conceptual basis, ease of application, cost of data processing, and acceptability of results. We chose the quick flow hydrograph separation method, which is in use at the Coweeta Hydrologic Laboratory, because it gives acceptable results and is easy and inexpensive to use. For regional assessment, we anticipate that the Coweeta program will be useful as an aid in developing general quantitative relationships between changes in land use and the associated changes in surface runoff yield and water quality degradation.

I. INTRODUCTION

The usual form of streamflow data has limited our ability to evaluate the performance of hydrologic simulation models and our attempts to gain a deeper understanding of the importance of storm events to water quality. However, hydrograph separation techniques can make observed streamflow data more useful. For example, continuous records of streamflow can be used to evaluate the adequacy and reliability (Mankin, et al. 1974) of simulated hydrographs, but they cannot be used directly to test the reliability of simulated individual components of flow. Observed streamflow, separated into storm runoff and baseflow components, can be used for a more comprehensive test of hydrologic simulation models. In addition, a measurement of the concentration of a water quality constituent in streamflow cannot reveal the fraction that resulted directly from storm runoff. However, knowledge of the quantity and quality of baseflow together with measured total flow quantity and quality can be used to estimate the chemical composition of storm runoff. In either of the foregoing examples, it is important to have an appropriate method for separating streamflow hydrographs into storm runoff and baseflow. We think this is a key step in relating changes in regional land use and the associated changes in surface runoff yield and quality.

Since there is more than one method for hydrograph separation, we reviewed common approaches and selected two methods for evaluation. Our appraisal criteria were the conceptual basis, ease of application, cost of data processing, and acceptability of the results from each method. One method that was evaluated was the quick-flow hydrograph separation

(Hibbert and Cunningham, 1967) developed at Coweeta Hydrologic Laboratory (Franklin, NC). The second method, recession curve projection, has been applied to the Walker Branch Watershed near Oak Ridge, Tennessee, and is described by W. M. Snyder and J. W. Curlin (1969).

The following sections of this report describe the Coweeta and Snyder and Curlin methods for hydrograph separation. The conceptual basis for each method is presented together with a description of the program that implements it. Finally, a comparative application of the two methods to data from Walker Branch Watershed (near Oak Ridge, Tennessee) is described and used as the basis for evaluating the methods.

II. THE COWEETA HYDROGRAPH ANALYSIS PROGRAM

Concept

The basic concept embodied in the Coweeta hydrograph analysis program is the stormflow separation procedure described by Hewlett and Hibbert (1967). The method assumes that quick flow may be separated from delayed flow by a straight line of arbitrary slope, as illustrated in Fig. 1. The area between the hydrograph and the baseflow separation line is defined by Hewlett as quick flow, and the area below the baseflow separation line as delayed flow. We assume that quick flow is equivalent to storm flow, and hereafter use the terms interchangeably. We also equate delayed flow and baseflow and use the term baseflow in the subsequent discussions.

Storm Event Definition

The beginning of a storm event is defined by an increase in stream discharge rate. When the slope of the hydrograph between two discrete

data points exceeds an arbitrarily determined rate β (often 0.05 csm/mi^2 per hour), the first of these points is assumed to define both the starting time (t_s) and initial discharge rate (q_s) for the storm (see Fig. 1). From that point, a straight line of slope β is projected forward until it crosses the hydrograph at a later time. This intersection is defined as the end of the storm (t_f,q_f), and the line connecting (t_s,q_s) to (t_f,q_f) is the baseflow separation line. Usually, the end of a storm event will not coincide exactly with a flow observation. In this case, the method uses linear interpolation between the two observed points bounding the end of the storm to estimate t_f and q_f.

As additional information, the program uses the maximum recorded flow rate between t_s and t_f to establish the time of occurrence of peak flow. Runoff during storm events is then summarized as stormflow volume and baseflow volume both before and after the hydrograph peak. Note that for complex storms, hydrograph peaks other than the maximum are ignored, and the overlapping storms are combined into one event in the summary.

Non-Storm Event Definition

Flow volume between the end of one storm ($t_f(1)$) and the beginning of a second storm ($t_s(2)$) is accumulated by the program, and presented as baseflow in the program summary. The analysis also makes a provision for eliminating minor rises in the flow hydrograph from the storm runoff summary. If the total volume of stormflow for any event is less than 0.001 inches over the whole watershed, the event is placed in the nonstorm category, and the calculated storm runoff is added to the baseflow between storms.

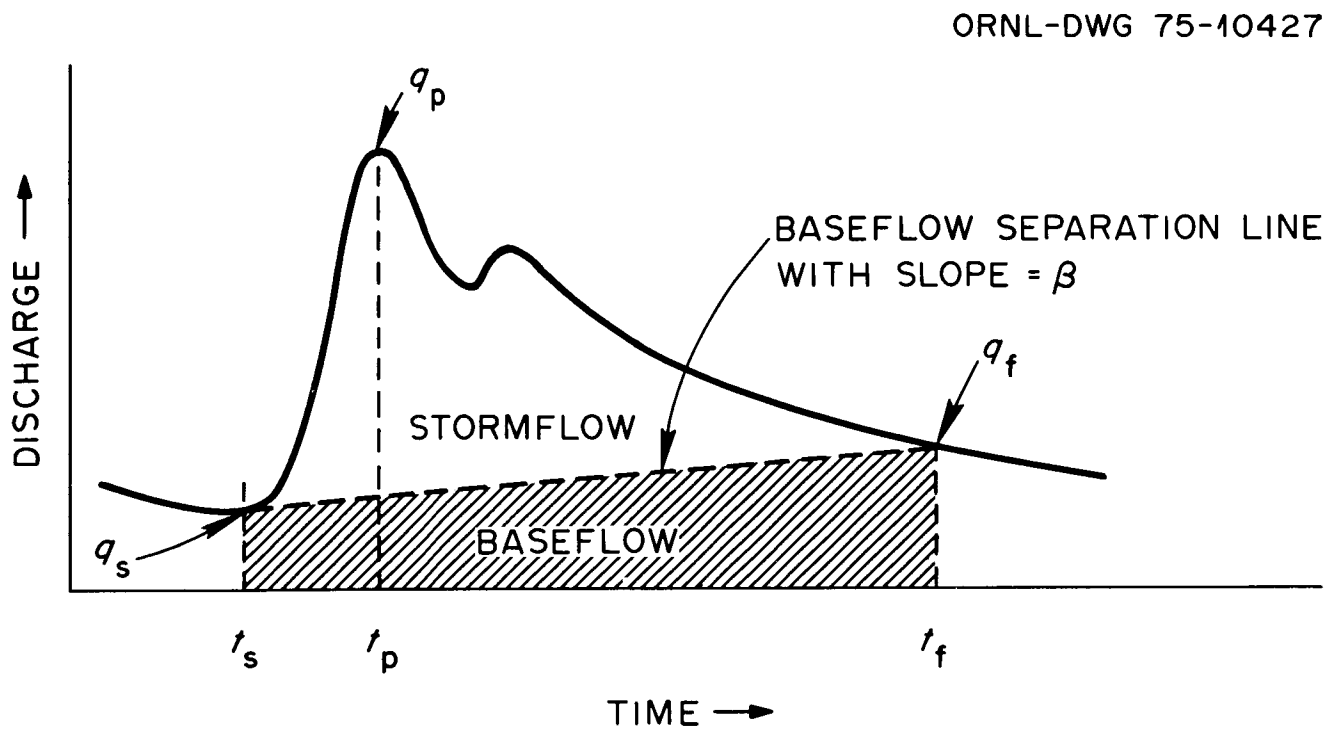

Fig. 1. Schematic diagram of the quick-flow hydrograph separation method.

Coweeta Hydrograph Analysis Program Description

The following discussion is presented as a detailed guide to the Fortran computer program implemented at ORNL to carry out the analysis described above for flows on Walker Branch Watershed.

The program analyzes up to one month of data at a time, operating from corresponding pairs of military time and stage height. The initial operation consists of reading the data set to be analyzed, counting the data points, and converting stage height (feet) into discharge rate per unit area (csm).

During hydrograph analysis, only two data points are considered at a time. As an illustrative example of program operation, consider the flow sequence shown in Fig. 2., depicting the first 12 data points in a hypothetical data set.

Analysis begins by considering flow between points 0 and 1. The slope of a straight line connecting these points is compared with β (baseflow separation line slope). So long as the actual slope is less than β (and a storm is not already in progress), the interval represents a non-storm period, and a trapezoidal integration is used to sum the non-storm baseflow. This process continues until point 4 is reached. In the interval between points 3 and 4, the hydrograph slope exceeds β so the storm is assumed to start at point 3. The baseflow separation line is defined by the equation

$$Q_I = \alpha + \beta t_I \qquad (1)$$

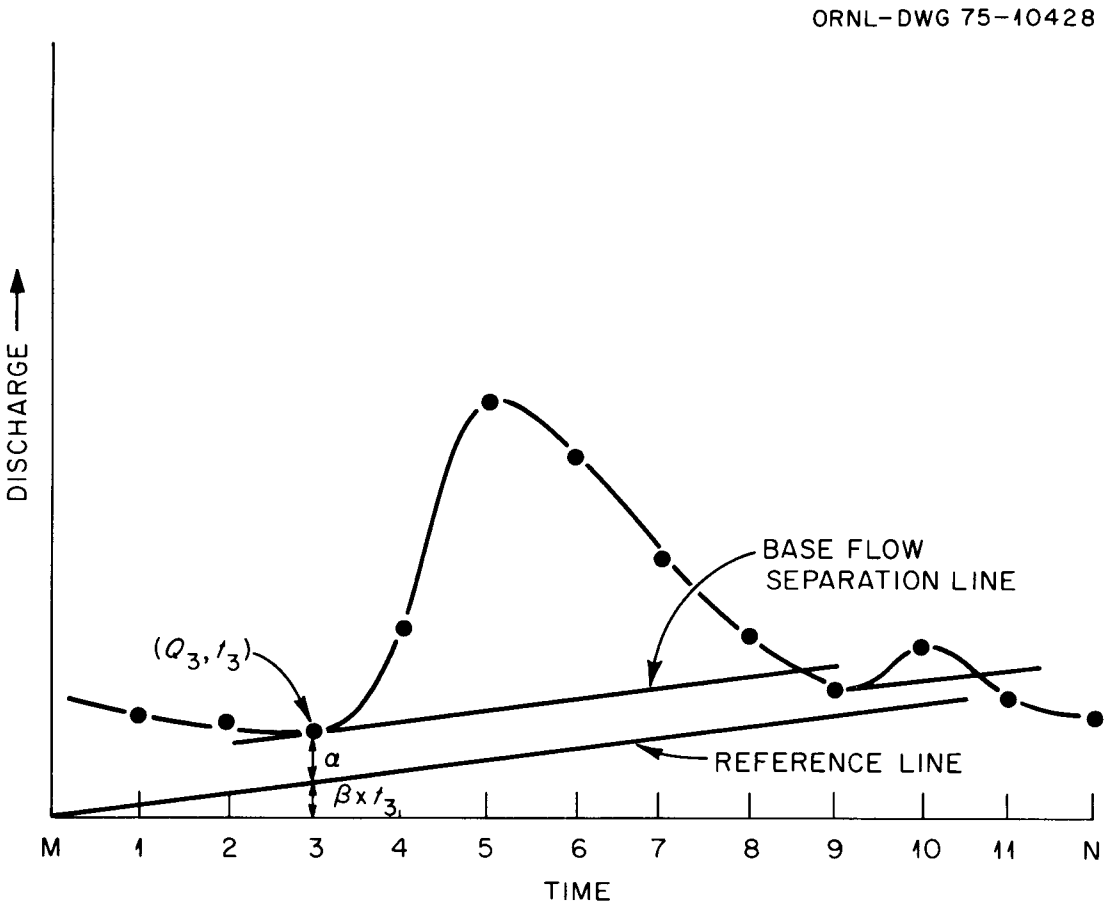

Fig. 2. Schematic diagram illustrating hydrograph separation computations with the Coweeta Hydrograph Analysis Program.

where

α = displacement between the baseflow reference line and the baseflow separation line for the storm event,

β = slope of the baseflow separation line

t_I = elapsed time between midnight and flow point I, and

Q_I = flow value for baseflow separation line at point I.

The reference line, which has been introduced for programming convenience, originates at the midnight just before the start of the storm. It has a slope of β and defines the value α by its displacement from the baseflow separation line.

While a storm event is in progress, each flow point in the data is compared against the maximum recorded flow since the beginning of the storm, and the highest value together with its time of occurrence is retained. Thus in Fig. 2, the flow at time equal to 5 is recorded as the peak discharge for the storm. In the program output, the peak discharge is the difference between the peak total flow and the baseflow at time t_p. The total flow volume recorded since the start of the storm is also accumulated. Whenever the slope of the hydrograph drops below β, as at point 6 the process of defining the end of the storm begins. The computation method is shown in Fig. 3.

The end of a storm is defined as the point when discharge of baseflow equals total discharge. Hence, using a linear extension of the total flow hydrograph from Point A in Fig. 3, the end point of the storm is defined by the equation

$$q_A + \gamma \cdot \Delta t = (\beta \cdot t_A + \alpha) + \beta \cdot \Delta t \qquad (2)$$

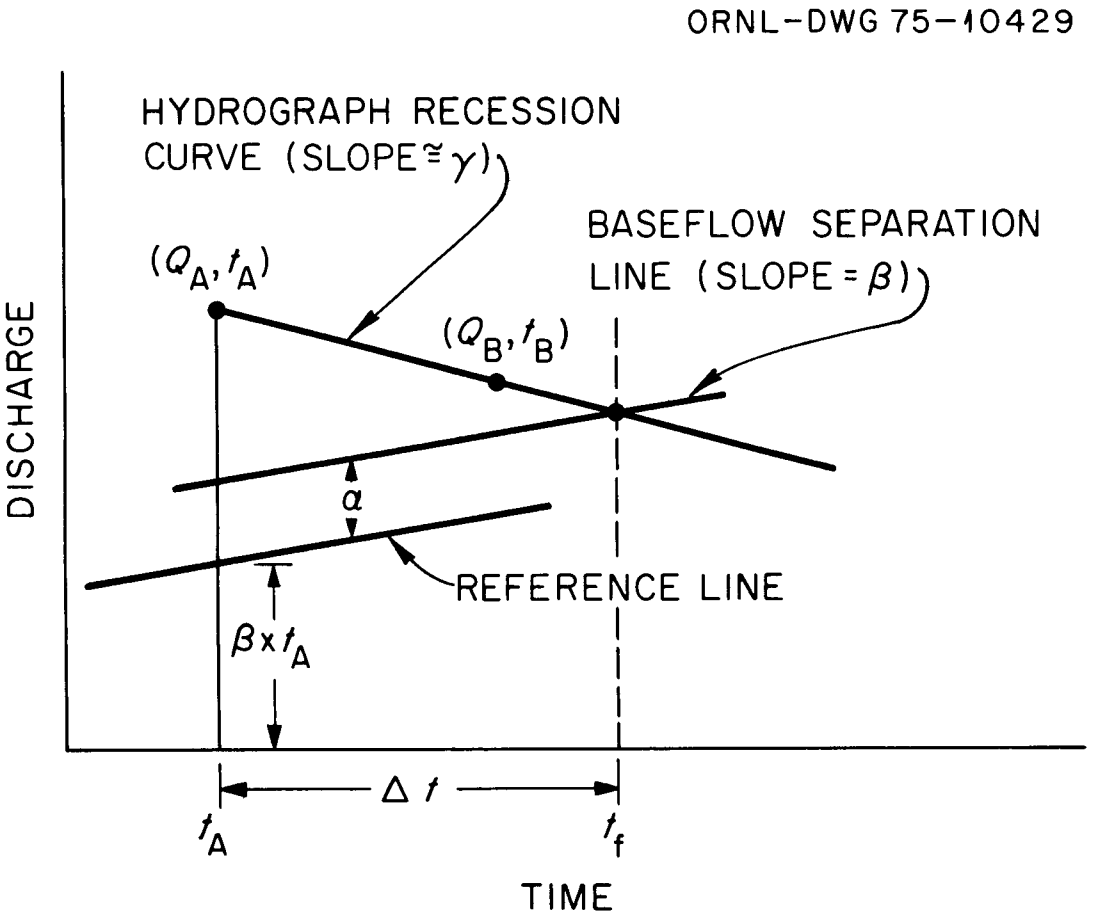

Fig. 3. Schematic illustration of the end of storm determination.

where

q_A = discharge at point A,

γ = slope of the hydrograph between points A and B, i.e., $\frac{q_B - q_A}{t_B - t_A}$

Δt = time between point A and the end of the storm, $t_f - t_A$

β = slope of the baseflow separation line,

t_A = elapsed time since the midnight preceding the start of the storm, and

α = displacement between the baseflow reference line and the baseflow separation line for the storm event.

The above equation may be solved for the discharge rate and time of occurrence of the end of the storm to yield the following equations:

$$t_f = (q_A - \gamma \cdot t_A) - \alpha)/(\beta - \gamma) \quad (3)$$

$$q_f = (\beta \cdot (q_A - \gamma \cdot t_A) - \alpha \cdot \gamma)/(\beta - \gamma) \quad (4)$$

where

t_f = time of end of storm, and

q_f = final discharge rate (end of storm).

To test for the end of a storm, t_f is compared with t_B in Fig. 3. If $t_f > t_B$, the storm is still in progress and the runoff summation continues. If $t_f \leq t_B$, the storm event is over for computation purposes. In the latter case, the total flow volume between point A and the storm end is added to the storm total, and the computed end point of the storm (q_f, t_f) is substituted into the data set for the point A values.

At this point, the baseflow and the total runoff during the storm are calculated and their difference is computed as the storm runoff for the event. If this storm runoff is less than 0.001 inch for the

basin, a brief summary of the event is printed, giving the starting point for the rise in flow. For example, points 9, 10, and 11 of Fig. 2 could fall into this category. Then the total runoff for the event is added to the baseflow total, and the program returns to non-storm event processing with variables modified as though the rise had not occurred.

If storm runoff exceeds 0.001 inch, the storm period hydrograph is separated into three components. They are:

1. The quantity of baseflow accumulated during the storm.
2. The quantity of stormflow accumulated before the maximum peak flow occurs.
3. The quantity of stormflow after the maximum peak.

When a storm event ends, an output summary is printed, and the program returns to processing the next sequence of flow data points. The original Coweeta program did not retain flow summary information once it had been used to generate printed and punched card output. We modified the program so it keeps running sums of total flow, stormflow, and delayed flow components for output at the end of each month (see Appendix III, Section A for an example). To achieve this capability we changed the program to allow it to stop processing data in the middle of a storm (if the end of a record period occurred), and generate printed and punched output. Thus the input for any record period contains enough information to allow computations to begin in the middle of a storm event. This feature is most useful when records are processed for fixed intervals, such as one calendar month.

III. THE SNYDER AND CURLIN HYDROGRAPH ANALYSIS PACKAGE

Concept

The Snyder and Curlin hydrograph analysis package uses rainfall data to define storm events and then separates stormflow from baseflow by projecting a baseflow recession curve during the storm event. The method is fully described by Snyder and Curlin (1969). Fig. 4 shows the major features of the separation method. Since the storm hydrograph duration is estimated from rainfall records, the projected baseflow recession curve will generally lie below the actual hydrograph at the end of the storm (t_f). At that point (t_f), the Snyder and Curlin method assumes that a storm runoff "tail" may be defined by extending recession curves for both the baseflow and the actual flow. The volume of the hydrograph "tail" is estimated by integrating the difference between the two curves from the storm endpoint (t_f) to infinity. The stormflow volume is thus represented by the area between the observed hydrograph and the baseflow recession curve, plus the volume of the storm runoff "tail".

Storm Event Definition

A storm event begins when the accumulated volume of rainfall exceeds certain determined minima as shown in Fig. 5 (Snyder and Curlin, 1969). The beginning time (t_s) of the storm event is recorded as the first interval where rainfall begins, and the end time of the storm rainfall (t_e) is recorded as the last interval at which the slope of the accumulated rainfall exceeds a lower decision line. In practice, this can lead to problems when a very heavy rainfall occurs and is followed by

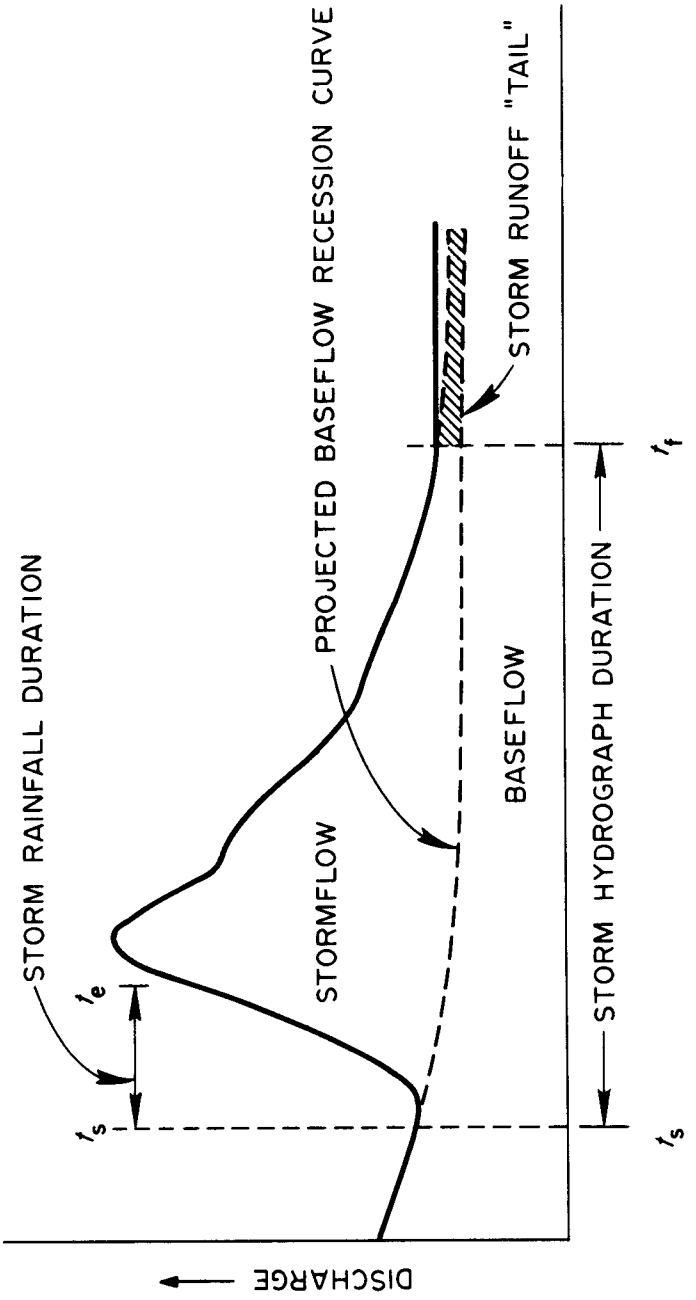

Fig. 4. An idealized example of stormflow separation from an observed hydrograph with the Snyder and Curlin Method.

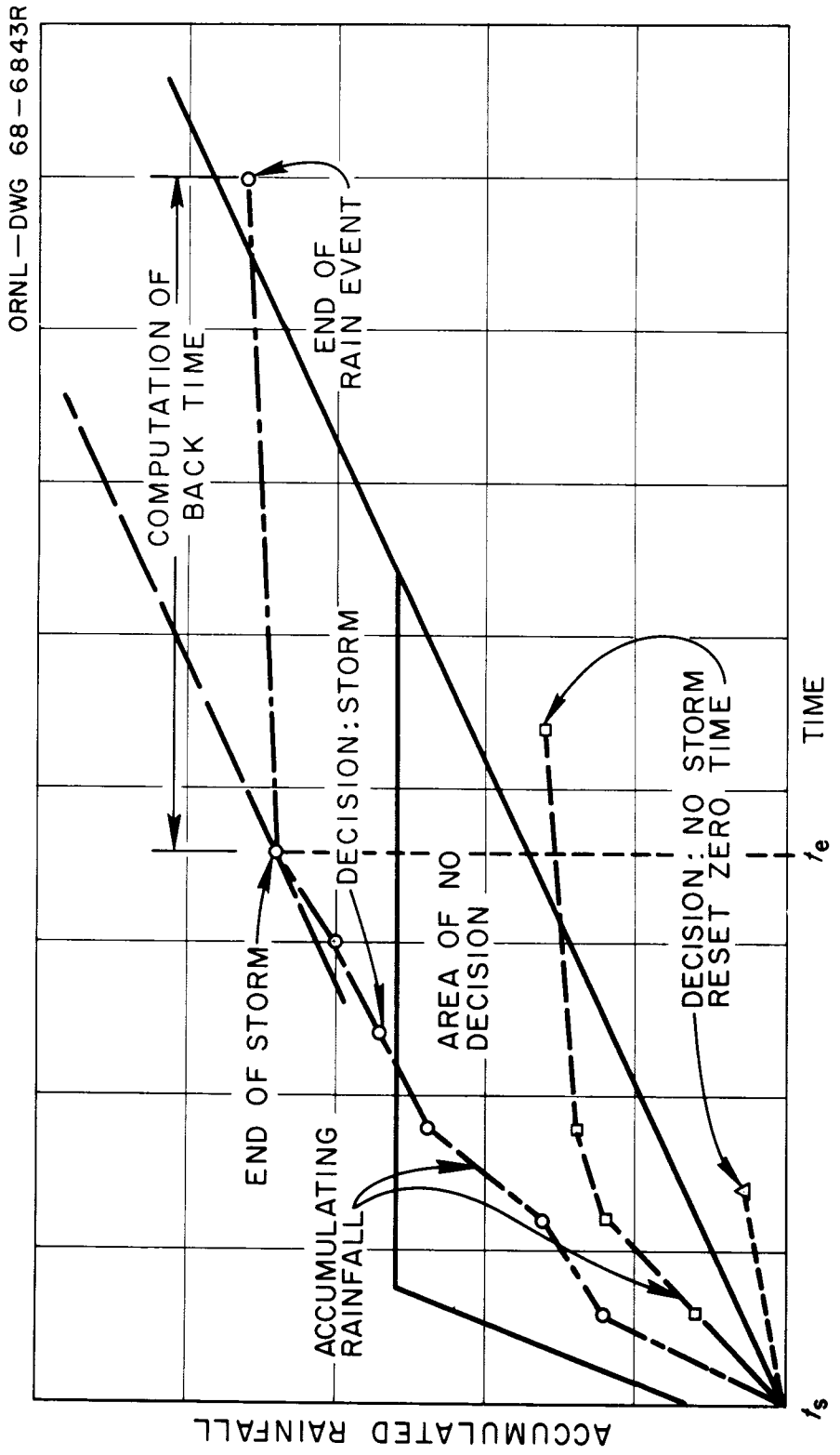

Fig. 5. Mechanics of the sequential decision algorithm used for storm and no-storm decisions. (Adapted from Snyder and Curlin, 1969).

showers. In that case, an excessive storm duration will result. The storm hydrograph duration is calculated from storm rainfall duration by the relationships shown in Table 1. Baseflow volume for a storm event is the integrated baseflow volume from the start of the event (t_s). If another storm event occurs before the endpoint of the previous storm hydrograph is reached (t_f), a recession curve for the combined stormflow and baseflow curve is projected forward in time to allow computation of stormflow and baseflow volumes for the first storm. This combined recession flow rate is subtracted from the total hydrograph to determine storm runoff for the second storm. The same procedure can be followed for multiple overlapping storm hydrographs. It should be noted, however, that when storm hydrographs overlap, only the last storm hydrograph is assumed to have a "tail". Baseflow for the second storm is assumed to begin at the end of the first storm. A representative example of overlapping storm hydrographs is sketched in Fig. 6.

Non-Storm Event Definition

Baseflow volume between the end of the storm hydrograph of one storm ($t_N(1)$) and the beginning of a second storm ($t_s(2)$) is accumulated by the program. However, volume of the "tail" of the preceding storm hydrograph is subtracted out of the baseflow volume which immediately follows that storm.

Program Descriptions

The following is a detailed description of the four Fortran programs which are a part of the hydrograph analysis package. This package was

Table 1. Relationships between duration of storm rainfall and storm hydrographs.

Upper Limit on Storm Duration (T) (Hours)	Storm Hydrograph Duration (H) (Hours)
1	6+T-0.083
4	24+T-0.083
16	96+T-0.083
64	384+T-0.083
T>64	7T-0.083

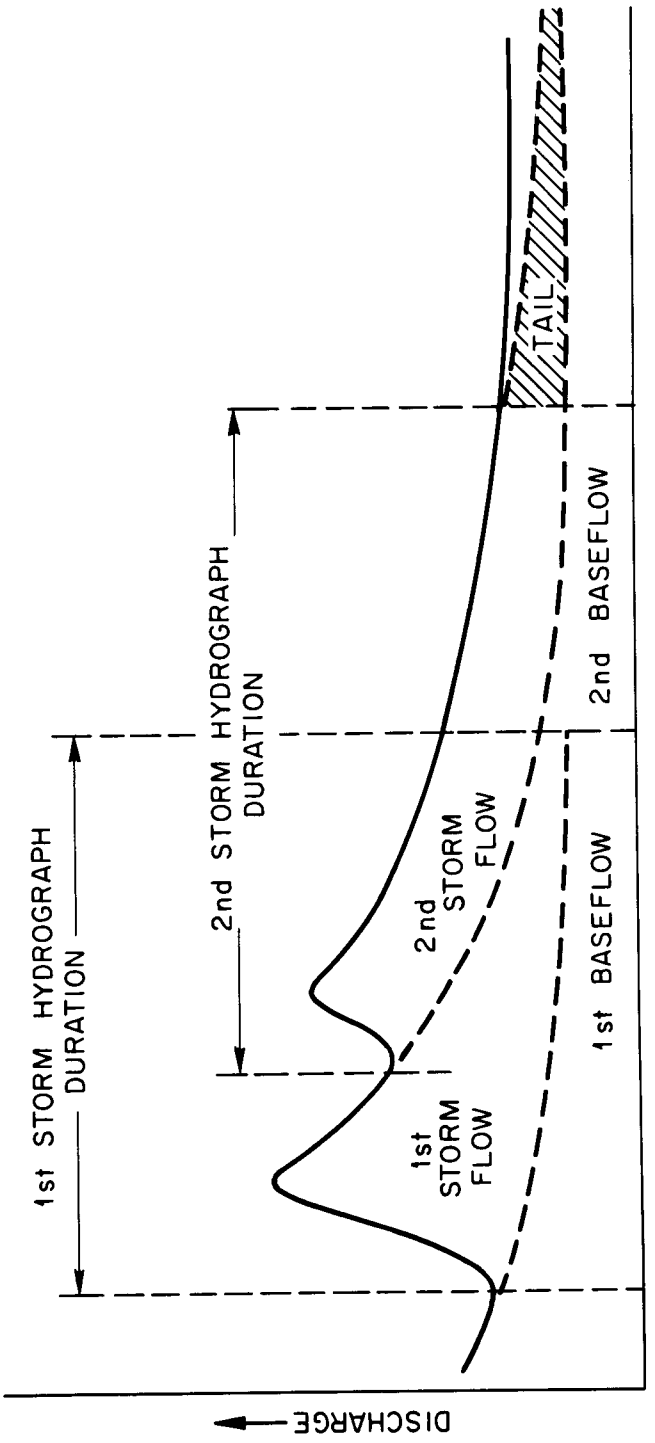

Fig. 6. Hypothetical overlapping storm hydrograph analysis using the method of Snyder and Curlin.

originally designed to carry out an analysis of one month's data of rainfall and streamflow on Walker Branch Watershed.

Raw data are in the form of rain gauge and stage height observations. Many computations are done to check and reduce these readings. In addition, the reduced data are accumulated, summarized and tabulated by individual programs. A description of the four programs follows, and Fig. 7 shows a schematic diagram of the linkages between programs.

Reduce

Reduce is the first program of the hydrograph analysis package. Input consists of cumulative rain gauge data for one month, which is read from either cards or a tape. The data are converted to 5-minute rainfall totals, then listed in an easily read format, noting any missing records. Identical readings of consecutive time periods are discarded, and the amount of rain and time during periods of change are tabulated. Punched output consists of the reduced rain and time data. Reduce must be run for each month, and two months of reduced rain data are used by the next step, the storm definition program.

Storm definition

The storm definition program uses the algorithm shown earlier in Fig. 5 to calculate the occurrence of storms at each rain gauge. Input consists of reduced rain gauge data for the month to be processed and the following month. Two months of rain data must be used in order to evaluate any storm which begins in one month but does not end until the next month. The begin times, end times, and amount of rain for each storm and for each rain gauge is first determined. Composite

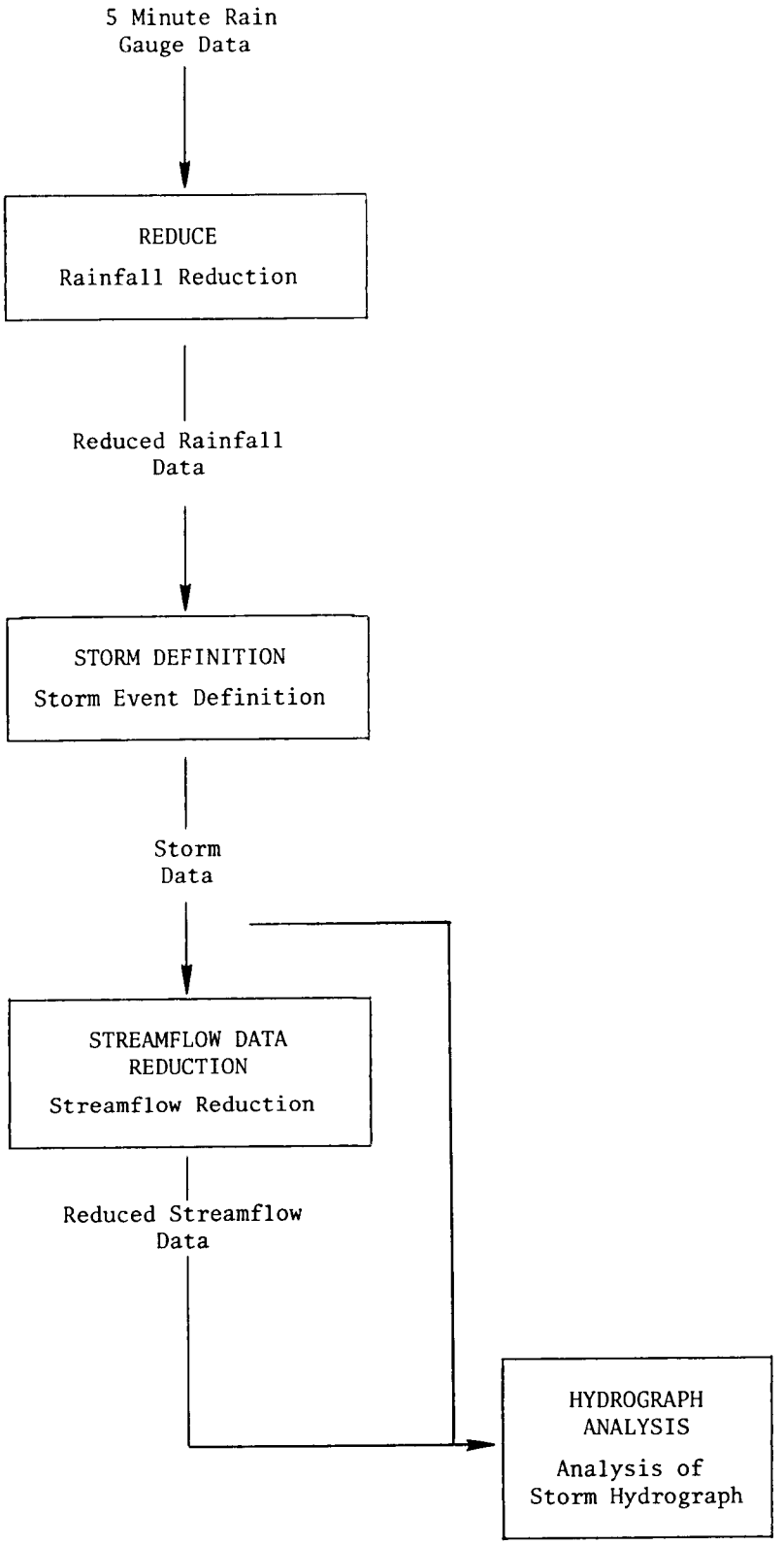

Fig. 7. A schematic diagram of the linkages between programs in the Snyder and Curlin hydrograph analysis.

begin and end times for each storm are then calculated for each branch and for the entire watershed. The composite times are chosen such that a storm at any gauge represents a storm for the watershed area considered. Output consists of extensive tables including information such as the number and dates of the storms, begin and end times of each storm, and amount of precipitation of each storm. The frequency of occurrence of storms is also ranked according to the amount of precipitation.

Streamflow data reduction

The streamflow data reduction program uses stream height (stage) values at five-minute time intervals. The stage heights are then converted to flow rates. The begin and end time for each storm are used as the basis for retaining average streamflow values at 160-minute intervals during non-storm periods and at 5-minute intervals during storm periods. Reduction is done for each branch separately.

Tables of daily flows, weekly flows, maximum and minimum flow readings for each storm and each branch, and the total volume for each storm are printed by the program. The daily flows are also put into frequency classes. Punched output consists of cards containing the reduced time and streamflow values.

Hydrograph analysis

This is the final program of the Snyder and Curlin Hydrograph Analysis Package. Storm begin and end times generated by the storm definition program and streamflow data from the streamflow reduction program are both used by this program. To explain the procedure used in the hydrograph analysis, the time and streamflow points shown in Fig. 8 will be used as a hypothetical data set.

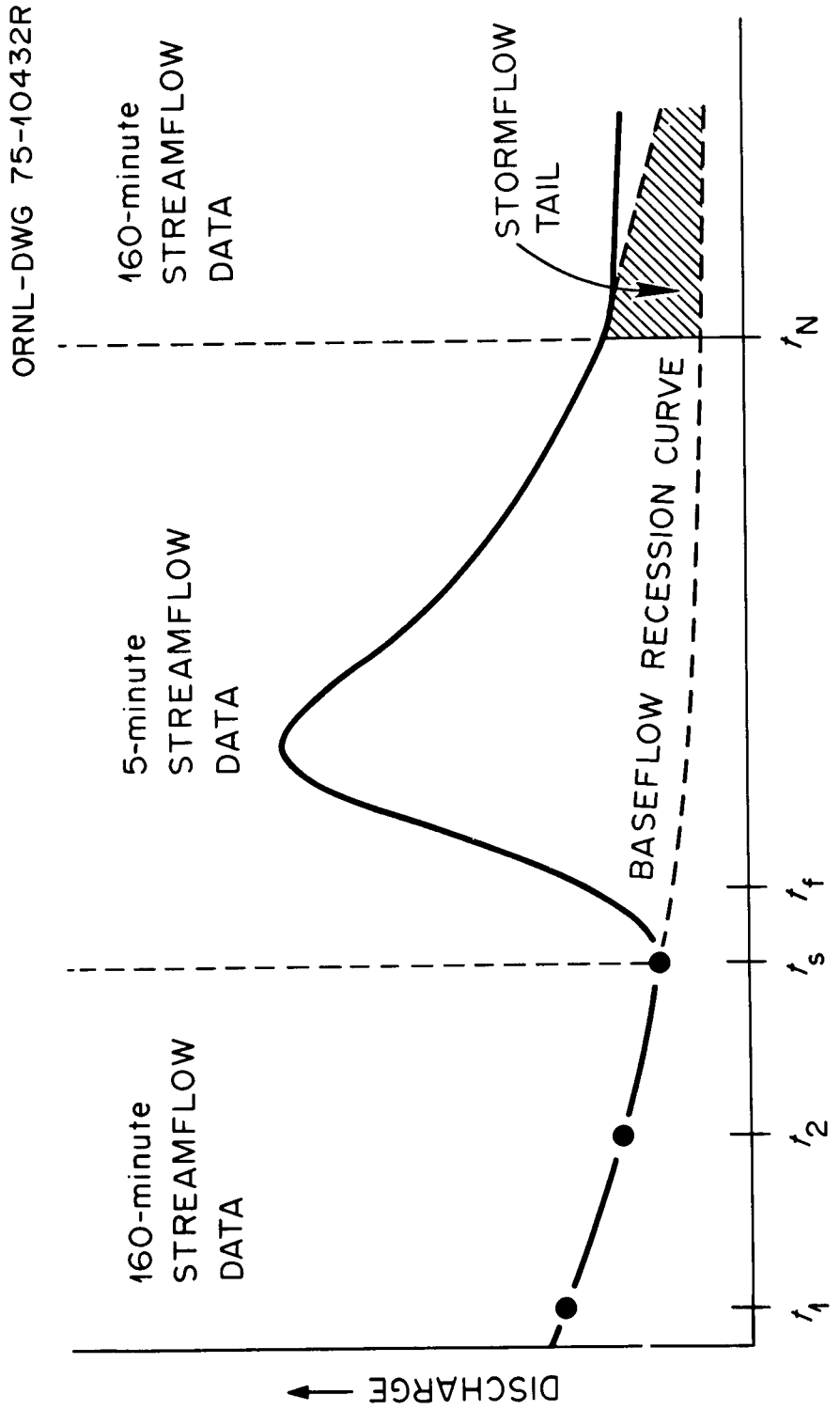

Fig. 8. Schematic illustration of Hydrograph components determined by the Snyder and Curlin method.

Starting at the beginning of the month, baseflow volumes are summed until the first storm begin time, t_s, is encountered. Next, the baseflow recession curve is approximated by finding two times t_1 and t_2 prior to t_s such that $q_1 > q_2 > q_s$ (where q_s is the streamflow at t_s) and then solving

$$q = ae^{-bT^m} \tag{5}$$

where

$$T = \frac{t-t_1}{t_2-t_1} \quad , \tag{6}$$

$$a = q_1(q_2/q_1) \quad , \text{ and} \tag{7}$$

$$m = \frac{\log \frac{\log(q_s/q_1)}{\log(q_2/q_1)}}{\log t_s} \quad . \tag{8}$$

The length of the storm hydrograph, $t_N - t_s$, is determined from the criteria given in Table 1, presented in an earlier section of the report. For example, in Fig. 8, assume $t_f - t_s$ is fifty minutes; then the length of the storm hydrograph will be six hours and forty-five minutes. Numerical integration is performed from t_s to t_N to find the storm runoff volume, which is represented by the area between the baseflow recession curve and the measured streamflow. Fig. 9 shows the computation performed to find the area between data points t_i and t_j. The stormflow "tail", which is also included in the storm runoff volume is calculated by assuming that t_N is zero time and integrating the resulting formulation of equation (5) from t_N to infinity.

Complex storms can occur if a storm begin time occurs before the end of the preceding storm hydrograph. If this occurs, a recession

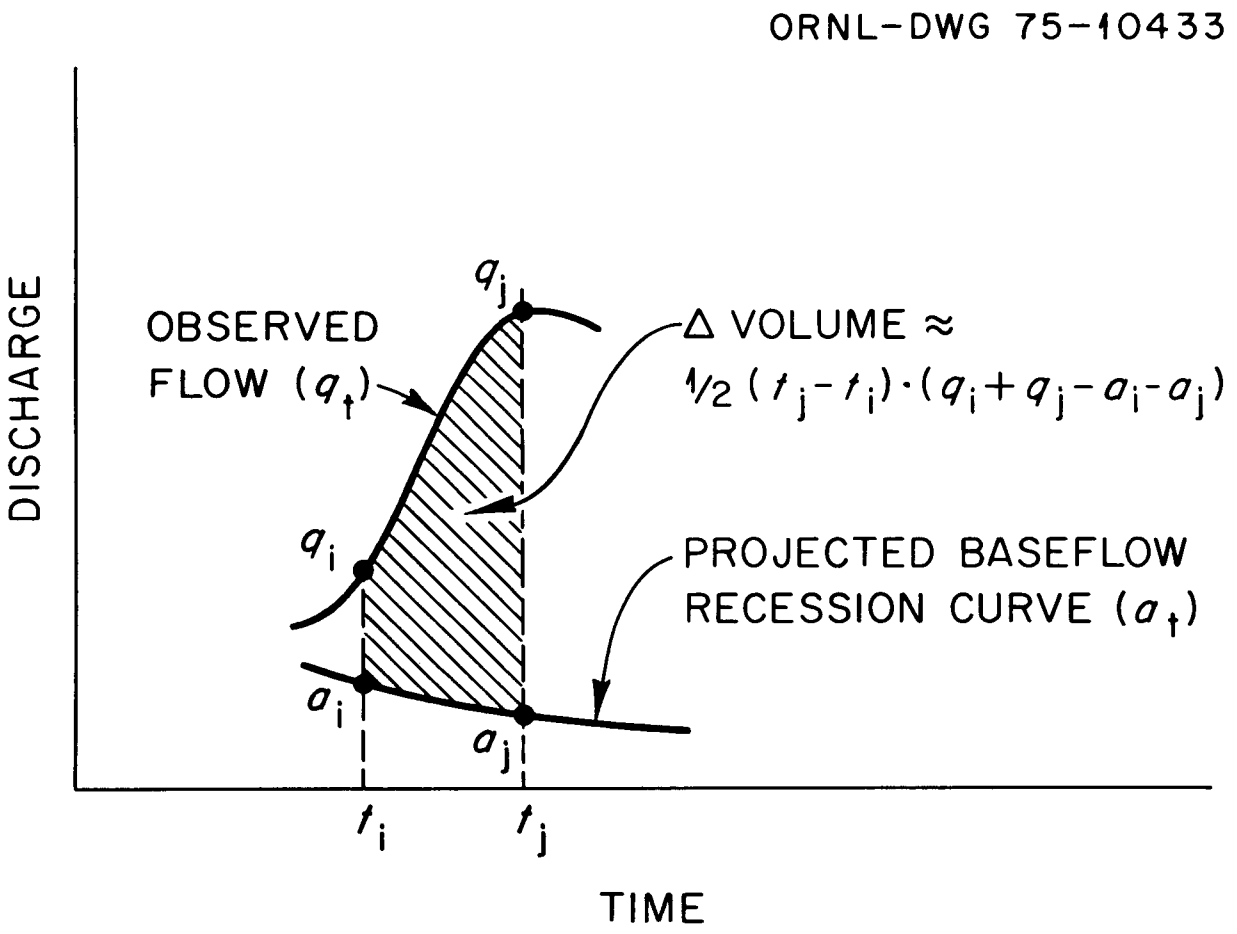

Fig. 9. An illustration of the computation of stormflow volume.

curve is projected for the first storm beginning at the starting time of the second storm ($t_s(2)$) and continuing to infinity. The volume of storm runoff of the second storm is again the area between the actual hydrograph and the recession curve beginning at $t_s(2)$.

After a storm event, the flow volumes for the storm are retained, and the program returns to summing up non-storm baseflow until the next storm begins. Once one month's data for one drainage area is completed, the program begins execution for a second drainage area; the program is set up to treat the East and West Branches of Walker Branch Watershed. A final summary table containing baseflow and stormflow for each branch and for the total watershed is printed after analysis has been completed for both of the branches.

IV. APPLICATION OF PROGRAM TO WALKER BRANCH WATERSHED

Both the Coweeta hydrograph analysis program and the Snyder and Curlin hydrograph analysis package were applied to Walker Branch Watershed, a 97.5 ha oak-hickory forested watershed on the U.S. Energy Research and Development Administration Oak Ridge Reservation in East Tennessee. The watershed is divided into two drainage areas, the East and the West Branch. An analysis was made of runoff for both branches during November and December, 1973. The data consisted of five-minute readings from five rain gauges, located throughout the watershed, and of five-minute stage height values from two stage height recorders, one for each branch.

The Coweeta program only required the use of the stage-height data. No fixed interval of time has to be used with this program, but the

five-minute data were used in order to minimize rounding and interpolation errors. Analysis of data for one month for both branches required approximately fifteen seconds of CPU time to execute and used approximately 120,000 bytes of core storage on an IBM 360/91 computer. The cost for processing data for one month on the ORNL computing system was about $2.50. The total assembly and turnaround time was about one half day.

As shown in Fig. 7, the Snyder and Curlin package uses both five-minute rain gauge (for two months) and stream height data. In addition, the reduce, storm definition, and streamflow reduction programs generate output data which must be used as input for at least one other program of the package. The approximate CPU time required to run the package for one month's data on an IBM 360/91 is one minute with the space required for Reduce, Storm Definition, Streamflow Reduction, and the Hydrograph Analysis being 60,000, 280,000, 115,000, and 160,000 bytes of core storage, respectively. The total cost to run the package is approximately $25.00 on the ORNL system and the assembly and turnaround time required is two days, since each program requires about one-half day.

Tables 2 and 3 summarize the output for the two months, November and December for both programs. Totals are given in terms of the East Branch, the West Branch, and a weighted total of the two for the entire watershed. A more detailed listing of the output for the December runs is included in Appendix B, Section 3.

Table 2. Hydrograph Analysis results for November, 1973, for Walker Branch Watershed

Coweeta					Snyder and Curlin			
Branch	Number of Storms	Runoff		Percent Storm Runoff of Total	Number of Storms	Runoff		Percent Storm Runoff of Total
		Storm (in.)	Base (in.)			Storm (in.)	Base (in.)	
EAST	1	4.178	0.609	87	3	4.670	0.115	98
WEST	3	4.533	1.781	72	3	5.208	1.091	83
TOTAL	3	4.318	1.071	80	3	4.882	0.496	91

Table 3. Hydrograph Analysis results for December, 1973, for Walker Branch Watershed

Coweeta					Snyder and Curlin			
Branch	Number of Storms	Runoff		Percent Storm Runoff of Total	Number of Storms	Runoff		Percent Storm Runoff of Total
		Storm (in.)	Base (in.)			Storm (in.)	Base (in.)	
EAST	6	3.694	2.475	59	4	4.948	1.228	80
WEST	7	4.000	4.613	45	4	5.480	3.077	64
TOTAL	8	3.815	3.318	52	4	5.157	1.957	72

Discussion of Results

The final selection of a preferred method for hydrograph separation must be subjective, and based upon the needs of the user. Thus, even though there are significant differences between the results given in Tables 2 and 3, it is not possible to select a method exclusively on the basis of these data. Examination of observed flows suggests that the results produced by the Snyder and Curlin package more nearly correspond to a subjective determination of base- and storm-flow. However, one must recognize that selection of a different hydrograph test slope parameter (β) in the Coweeta program would bring the results of the two methods into much closer agreement. Thus, other criteria must be examined before one of the two methods is recommended. One other criterion is the accuracy with which total flow is determined. In Tables 2 and 3, the Coweeta method is the most accurate. This is because 5-minute flows were used instead of the longer term averages employed by the Snyder and Curlin method. However, the maximum errors are negligible compared to normal errors in flow measurement.

The Coweeta Hydrograph Analysis Program has a definite advantage over the Snyder and Curlin Hydrograph Analysis Package in terms of ease of application and cost. Because the Snyder and Curlin package consists of four separate programs which must be executed sequentially, it takes about four times as long to process one month's data as the Coweeta program. In addition, the user must shuffle and reshuffle output data from one program of the Snyder and Curlin package to put it in the correct form for the next step. On the other hand, the Coweeta program only requires one simple input data set.

If the user needs to run a hydrograph analysis program on a series of different watersheds, the Coweeta Program is more adaptable to different input data. The time intervals used by the Coweeta Program are user specified and the units of the streamflow data are easily adjusted. The entire Snyder and Curlin Package was specifically written for Walker Branch Watershed; changes in the data form would require reprogramming of at least two of the four programs. This package is also highly dependent on five-minute intervals of both rainfall and streamfall data.

Output from the Snyder and Curlin Package contains more detail than the output of the Coweeta Program, especially in the areas of rainfall and streamflow analysis. The Reduce, Storm Definition, and Streamflow Reduction programs tabulate precipitation for each storm, daily, weekly, and total flows, maximum and minimum flow readings for each storm and classify the storms and the daily flows. In addition, the Hydrograph Analysis program calculates rainfall intake and excess for each five-minute period during the storm. Both the Coweeta Program and the Snyder and Curlin Package print out the same data concerning the hydrograph analysis. The Coweeta program output contains additional information concerning the peak flow rate and time of occurrence for each storm. Many of the functions other than hydrograph analysis performed by the Snyder and Curlin Package are produced by separate and independent programs available at Coweeta.

Both methods are reliable in reproducing total flow volume. Table 4 lists the experimental and calculated total streamflow values for November and December for both branches. All calculated values are within one percent of the data input values. Tables 5 and 6 include the Coweeta Program and Snyder and Curlin Package results for particular

Table 4. Comparison of Total Calculated Streamflow and Observed Values

Total Streamflow (Inches)				
	NOV		DEC	
	East	West	East	West
Experimental	4.787	6.315	6.174	8.615
Coweeta	4.787	6.314	6.169	8.613
Snyder and Curlin	4.785	6.299	6.176	8.557

Table 5. Comparisons of Individual Storm Analysis with the Coweeta and Snyder and Curlin Programs for November, 1973

November								
East Branch					West Branch			
	Date	Duration (hrs)	Runoff (in.) Storm	Base	Date	Duration	Runoff (in.) Storm	Base
Coweeta								
	11/5	†			11/5	3	0.001	.006
	11/21	†			11/21	11	0.009	.023
	11/26	77	4.178	.312	11/26	106	4.522	.636
Snyder and Curlin								
	11/5	3	0.005	.004	11/5	3	0.006	.048
	11/21	5	0.045	.013	11/21	5	0.045	.172
	11/26	41	4.620	.014	11/26	41	5.157	.031

†Storm runoff volumes less than 0.001 inch on these dates.

Table 6. Comparison of Individual Storm Analyses with the Coweeta and Snyder and Curlin Programs for December, 1973

December								
East Branch					West Branch			
	Date	Duration (hrs)	Runoff (in.) Storm	Base	Date	Duration	Runoff (in.) Storm	Base
Coweeta	12/4	†			12/4	4	0.001	.017
						13	0.021	.062
	12/13	57	0.311	.175	12/13	66	0.382	.371
	12/20	46	0.103	.172	12/20	61	0.122	.368
	12/25	77	3.246	.423	12/25	95	3.452	.836
	12/29	7	0.006	.049	12/29	5	0.004	.065
	12/31	5	0.001	.031	12/31	13	0.018	0.148
		12	0.027	.085				
Snyder and Curlin	12/4	9	0.138	.073	12/4	9	0.200	.331
	12/13	3	0.311	.018	12/13	3	0.313	.067
	12/20	11	0.433	.136	12/20	10	0.442	.370
	12/27	102	4.065	.215	12/27	100	4.524	.557

†Storm runoff volumes less than 0.001 inch on this date.

storms during November and December, 1973. Since the Snyder and Curlin method assumes that the baseflow rate decreases throughout a storm and the Coweeta method assumes that baseflow rate increases during a storm, the Snyder and Curlin Package gives consistently higher storm runoff. This is true even though during both these months the Coweeta storm hydrographs were longer in duration than the Snyder and Curlin hydrographs.

The number of storms varies between the methods also. The Coweeta method disregards storms with less than 0.001 inch of storm runoff, so it does not include some of the storms included by the Snyder and Curlin Package. For example, on November 5, the Snyder and Curlin Package records a storm with .005 inches of storm runoff and .004 inches of base runoff, lasting a little over three hours. The Coweeta program, however, does not call it a storm, but does indicate that at two times (2:30 and at 5:15) the slope of the hydrograph exceeded the baseflow separation slope parameter (0.05 csm/mi^2 per hour).

Differences in the number of storms also indicates the ability of the methods to separate storms. In December the Coweeta Program indicates many more storms than the Snyder and Curlin Package. On December 25, 29, and 31, the Coweeta Program indicated three different storms on the west branch and four different storms on the east branch; whereas, the Snyder and Curlin Package only records one long storm beginning on the 27th for both branches. It appears that some modification of the Snyder and Curlin storm definition criteria are needed to make the results more realistic in terms of real events.

Conclusions and Recommendations

Considering ease of application, cost of processing, and usefulness of information, we recommend the Coweeta program documented in this report for hydrograph separation. Compared to the Snyder and Curlin program, it is easier to adapt and set up, it is faster and less costly, and its results are reliable. The Snyder and Curlin Package does include more information on rainfall and streamflow, however the extra output is of limited value for most hydrograph separation studies.

One of the major potential uses of the hydrograph analysis methods we have discussed in this report is in regional assessment. It is known that the conversion from rural to urban or industrial land use produces increased localized flood flows, and generally increases the ratio of surface runoff to total flow (Water Resources Council, 1968, p. 3-3-4). At the regional scale, the increased fraction of surface runoff is important because of the degradation in the levels of non-point source water quality constituents that accompanies such a change. We anticipate that the Coweeta program will be useful as an aid in developing general quantitative relationships between changes in land use and the associated changes in surface runoff yield and water quality degradation.

V. REFERENCES

Hewlett, J. C. and A. R. Hibbert, 1967. "Factors affecting the response of small watersheds to precipitation in humid areas". pp. 275-290. In: W. E. Sopper and H. W. Lull (eds.). *International Symposium on Forest Hydrology*. Pergamon Press, Oxford.

Hibbert, A. R. and G. B. Cunningham, 1967. "Streamflow data processing opportunities and application". pp. 725-736. In: W. E. Sopper and H. W. Lull (eds.). *International Symposium on Forest Hydrology*. Pergamon Press, Oxford.

Mankin, J. B., R. V. O'Neill, H. H. Shugart, and B. W. Rust, 1975. "The importance of validation in ecosystem analysis". In: G. S. Innis (ed.). *The Future of Systems Ecology*. Simulation Council of America. La Jolla, California (in press).

Snyder, W. M. and J. W. Curlin, 1969. *Walker Branch Watershed Project: Hydrologic Analysis and Data Processing*. ORNL-4392 (1969).

APPENDIX I

FORTRAN IV LISTING OF THE COWEETA HYDROGRAPH ANALYSIS PROGRAM AND THE SNYDER AND CURLIN HYDROGRAPH ANALYSIS PACKAGE

Section A

Coweeta Hydrograph Analysis Program

```
LEVEL  21.6  (DEC 72)                    OS/360  FORTRAN H

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=000CK,
                             SOURCE,EBCDIC,NOLIST,NODECK,ICAD,MAP,NOEDIT,NOID,NOXREF
                C     ******************************************************************SPS001
                C                                                                        *SPS002
                C       COMPUTATION OF STORMFLOW DISCHARGE                               *SPS003
                C      FOR COWEETA HYDROLOGIC LAB. FRANKLIN,N.C.                         *SPS004
                C                                                                        *SPS005
                C     INPUT IS TIME-CSM COORDINATES FROM DISCHARGE INTEGRATION PROGRAM.*SPS006
                C                                                                        *SPS007
                C          BRYANT CUNNINGHAM                                             *SPS007A
                C     ******************************************************************SPS008
   ISN 0002           DIMENSION RTH(8),RTM(8),RC(8),T(8930,2),C(8930,2),RT(8),AREAID(8)
   ISN 0003           DIMENSION BFLOW1(20,2),BASFLO(2),ESBSWF(20),FBSFLO(2),TBSNSP(2),
                     + FRCNT(2),TOTFLO(2),HT(2),HC(2)
   ISN 0004           DIMENSION NSTM(2),KBEG(20,2),KDUR(20,2),KTIM(20,2),FACT(2)
   ISN 0005           DATA BFLOW1/40*0./,BASFLC/2*0./,BASWFI/0./,KBEG/40*0/,
                     +FBSFLO/2*0./,TESNSP/2*0./,FBWFLO/0./,TOTFLO/2*0./,TOFLCW/0./
   ISN 0006           REAL BSFT(20,2)/40*0./,VSRT(20,2)/40*0./,VSRW(20)/20*0./
                     + ,BSFW(20)/20*0./,VSBSUM(2)/2*0./,VEFSUM(2)/2*0./,VSRWSM/0./,
                     + ESFWSM/0./
   ISN 0007           LOGICAL DATE,TIMEL,AGAIN
   ISN 0008             DATA AGAIN/.FALSE./,IB/1/
   ISN 0009           LOGICAL ONE,TWO
   ISN 0010           INTEGER DAY,CNO,DOW,TIME,HYDRT
   ISN 0011           DIMENSION AREA(2),HBGNN(2),HYDFT(2),IX(2),IEND(2)
   ISN 0012             DATA AREA/146.,95./,NNCR/0/
   ISN 0013           KWS=0.0
   ISN 0014           FUDGE=.0001                                                    SPS011
   ISN 0015           FGK=12./(640.*43560.)                                          SPS012
   ISN 0016            ID=0                                                          SPS013
                                                                                     SPS014
                C     ******************************************************************SPS015
                C                                                                        *SPS016
                C     READ AREA ID AND SLOPE PARAMETER....                               *SPS017
                C                                                                        *SPS018
                C     ******************************************************************SPS019
   ISN 0017             READ(5,911) AREAID,BETA
   ISN 0018     911     FORMAT(8A4,F8.6)
   ISN 0019           IEND(1)=0
   ISN 0020             IEND(2)=C
   ISN 0021           ZZ= .00                                                        SPS022
   ISN 0022           BETA = BETA + ZZ                                               SPS023
   ISN 0023           IBETA=BETA*10000.+.5                                           SPS024
                C     ******************************************************************SPS027
                C                                                                        *SPS028
                C      ZERO STORM PARAMETERS  ..                                         *SPS029
                C                                                                        *SPS030
                C     ******************************************************************SPS031
   ISN 0024     900     DO 31 K=1,20
   ISN 0025             VSRW(K)=C.0
   ISN 0026     31      BSFW(K)=0.0
   ISN 0027             DO 32 K=1,2
   ISN 0028             BASFLO(K)=0.0
   ISN 0029             FBSFLO(K)=0.0
   ISN 0030             TBSNSP(K)=C.0
   ISN 0031             VSBSUM(K)=C.0
   ISN 0032             VERSUM(K)=0.0
   ISN 0033             TOTFLC(K)=C.0
   ISN 0034             DO 3C J=1,20
   ISN 0035             BFLOW1(J,K)=0.0
   ISN 0036             KBEG(J,K)=C
   ISN 0037             BSFT(J,K)=C.0
   ISN 0038             VSRT(J,K)=0.0
   ISN 0039     30      CONTINUE
   ISN 0040     32      CONTINUE
   ISN 0041             BSFWSM=0.0
   ISN 0042             FBWFLC=0.0
   ISN 0043             BASWFI=0.0
   ISN 0044             TOFLCW=0.0
   ISN 0045             VSRWSM=0.0
   ISN 0046       901 IEVSW=0                                                       SPS032
   ISN 0047           NPO = 0                                                       SPS037
   ISN 0048           KPO = C                                                       SPS038
   ISN 0049           NEVENT=0                                                      SPS039
   ISN 0050           NLINE=50                                                      SPS040
   ISN 0051           BFLOW=0.                                                      SPS041
   ISN 0052           KK=0                                                          SPS042
   ISN 0053           EPSUM=0.                                                      SPS043
   ISN 0054           BPSUM=0.                                                      SPS044
   ISN 0055           IK=0                                                          SPS045
   ISN 0056           NPAGE=1                                                       SPS046
   ISN 0057           INMTHS=0                                                      SPS047
   ISN 0058           INDAYS=0                                                      SPS048
   ISN 0059           IOTINS=0                                                      SPS049
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ISN 0060          IOTDS=0                                                        SPS050
ISN 0061          IPKT=0                                                         SPS051
ISN 0062          BFLOS=C.                                                       SPS052
ISN 0063          PKFLOW=0                                                       SPS053
ISN 0064          CF=0.                                                          SPS054
ISN 0065          V=0.                                                           SPS055
ISN 0066          A1=0.                                                          SPS056
ISN 0067          INDAY=C                                                        SPS057
ISN 0068          IOTIM=0                                                        SPS058
ISN 0069          DUR=0.                                                         SPS059
ISN 0070          IOTD=0                                                         SPS060
ISN 0071          BEGFLO=0.                                                      SPS061
ISN 0072          QP=0.                                                          SPS062
ISN 0073            IF(AGAIN) GO TO 16
ISN 0075            IF(IE.EQ.2) GO TO 615
                C     ***************************************************************SPS063
                C                                                                 *SPS064
                C     THIS SEGMENT READS ONE MONTH OF M.T.-CSM DATA INTO CORE      *SPS065
                C     ***************************************************************SPS066
                C                                                                 *SPS067
                C     ***************************************************************SPS068
ISN 0077          CONST=4.43*2.5**2.449
                C$$$$$IEND IS A VARIABLE WHICH DETERMINES IF THE MONTH STARTS DURING A STORM
                C*****  OR IF IT ENDS DURING A STORM IT IS SET TO 1
ISN 0078            READ(5,500) NMC,KYR,IEND,NMO,HBGNN
ISN 0079            READ(5,550) BC(1),HT(1),HC(2),HT(2)
ISN 0080      500   FORMAT(5I5,2F5.2)
ISN 0081      550   FORMAT(4F10.0)
ISN 0082      5     READ(1,501) IMT,IDT,IYR,ITIME,HYDRT
ISN 0083            WRITE(6,501) IMT,IDT,IYR,ITIME,HYDRT
ISN 0084      501   FORMAT(2I,3I2,I4,10X,2I4)
ISN 0085            IF(IYR.NE.KYR) GO TO 120C
ISN 0087            IF(IMT.EQ.NMC) GO TC 10
ISN 0089            GO TC 5
ISN 0090      10    IHR=ITIME/100
ISN 0091            DO 15 IB=1,2
ISN 0092      15    IX(IB)=HYDRT(IB)
ISN 0093      16    INC=1
ISN 0094      25    DO 20 IB=1,2
ISN 0095          IF(IX(IB).LT.200.AND.HYDRT(IB).GT.800) HBGNN(IB)=HBGNN(IB)-1.
ISN 0097          IF(IX(IB).GT.700.AND.HYDRT(IB).LT.300) HBGNN(IB)=HBGNN(IB)+1
ISN 0099          IX(IB)=HYDRT(IB)
ISN 0100          HGT=HYDRT(IB)*1.0E-3+HBGNN(IB)
ISN 0101          IF(HGT.GT.2.5) GO TO 2210
ISN 0103          DUM=4.43*HGT**2.449
ISN 0104          GO TO 2220
ISN 0105      2210  DUM=CONST+66.8*(HGT-2.5)**1.47
ISN 0106      2220  C(INC,IB) = 640.*DUM/AREA(IB)
ISN 0107          T(INC,IB) =  (ITIME-IHR*100)/60. + IHR
ISN 0108            IF(T(INC,IB).EQ.0.) T(INC,IB)=24.0C
ISN 0110      20    CONTINUE
ISN 0111            READ(1,5C1,END=24) IMT,IDT,IYR,ITIME,HYDRT
ISN 0112            INC=INC+1
ISN 0113            IHR=ITIME/100
ISN 0114            IF(IMT.EQ.NMO) GO TO 25
ISN 0116            IF(ITIME.EQ.0) GO TC 25
ISN 0118      24    CONTINUE
ISN 0119            NMOR=NMOE+1
ISN 0120            IB=1
ISN 0121            AGAIN=.FALSE.
                C     ***************************************************************SPS089
                C                                                                 *SPS090
                C     EXIT HERE TC NEXT PROGRAM SEGMENT                           *SPS091
                C                                                                 *SPS092
                C     INITIALIZATICN FOR MONTHLY CALCULATIONS                     *SPS093
                C                                                                 *SPS094
                C     ***************************************************************SPS095
ISN 0122        615 ICTDAY=1                                                      SPS096
ISN 0123          NDP=INC-1
ISN 0124            IF(KMO.EQ.12) NDP=INC
ISN 0126          I=2                                                           SPS098
ISN 0127            GO TC 10C
ISN 0128      616   CONTINUE
ISN 0129          IF(IEVSW-1)617,154,210
ISN 0130        617 IF((C(I,IB)-C(I-1,IB))          /(T(I,IE)-T(I-1,IB)) -BETA-FUDGE)
                   +100,10C,20C
                C     ***************************************************************SPS101
                C
                C     NONSTORMFLCW CYCLE PRCGRAM SEGMENT
                C
                C     ***************************************************************SPS105
ISN 0131        100 BFSUM=0.                                                      SPS106
ISN 0132          EFSUM=0.                                                      SPS107
ISN 0133          DUR=0.                                                        SPS108
ISN 0134          IEVSW=1                                                       SPS109
ISN 0135          TITR=T(I-1,IB)
ISN 0136          INMTH=KMO                                                     SPS111
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```
ISN 0137            INDAY=ICTDAY                                                    SPS112
ISN 0138            TIMIN=TITR                                                      SPS113
ISN 0139            BEGFLO=C(I-1,IB)
ISN 0140            IF(IEND(IB).EQ.1) GO TO 200
ISN 0142              IF(I.EQ.2) GO TO 616
ISN 0144          151 FLOW=1800.*(C(I,IB)+C(I-1,IB))*(T(I,IB)-T(I-1,IB))
ISN 0145            BFSUM=BFSUM+FLOW                                                SPS116
ISN 0146            EFSUM=EFSUM+FLOW                                                SPS117
ISN 0147            IF(T(I,IB)-24.00)152,153,153
ISN 0148          153 T(I,IB)=0.
ISN 0149            DUR=DUR+24.00-TITR                                              SPS120
ISN 0150            TITR=0.                                                         SPS121
ISN 0151            ICTDAY=ICTDAY+1                                                 SPS122
ISN 0152          152 I=I+1                                                         SPS123
ISN 0153            IF(I-NDP)154,154,828                                            SPS124
ISN 0154          828 ID=1                                                          SPS125
ISN 0155            GO TO 800                                                       SPS126
ISN 0156          154 IF(T(I,IB).EQ.0.) GO TO 151
ISN 0158            INMTHS=KMO                                                      SPS128
ISN 0159            IF((C(I,IB)-C(I-1,IB))/(T(I,IB)-T(I-1,IB))-BETA-FUDGE)151,151,200
                C   ************************************************************SPS130
                C                                                                 *SPS131
                C   STORMFLOW CYCLE PROGRAM SEGMENT                               *SPS132
ISN 0160      200 ALPHA=C(I-1,IB)-BETA*T(I-1,IB)
ISN 0161            IF(IEND(IB).NE.0) ALPHA=HC(IB)-BETA*HT(IB)
ISN 0163            DUR = DUR+T(I-1,IB)-TITR
ISN 0164            QF=C(I-1,IB)
ISN 0165              HC(IB)=C(I-1,IB)
ISN 0166              HT(IB)=T(I-1,IB)
ISN 0167            BFLOW=C.                                                        SPS139
ISN 0168            FLSUM=0.                                                        SPS140
ISN 0169            PKFLOW=0.                                                       SPS141
ISN 0170            TITRS=T(I-1,IB)
ISN 0171            DURS=0.                                                         SPS143
ISN 0172            INMTHS=KMO                                                      SPS144
ISN 0173            INDAYS=ICTDAY                                                   SPS145
ISN 0174            TIMINS=TITRS                                                    SPS146
ISN 0175            BFLOS=C(I-1,IB)
ISN 0176            IEVSW=2                                                         SPS148
ISN 0177      210 IF(T(I,IB).EQ.T(I-1,IB))GO TO 252
ISN 0179            IEND(IB)=0
ISN 0180            BINT=(C(I,IB)-C(I-1,IB))/(T(I,IB)-T(I-1,IB))
ISN 0181            AINT=C(I-1,IB)-BINT*T(I-1,IB)
ISN 0182            IF(BINT-BETA)211,212,212                                        SPS152
ISN 0183      211 CF  =(BETA*AINT-BINT*ALPHA)/(BETA-BINT)                           SPS153
ISN 0184            TF=(AINT-ALPHA)/(BETA-BINT)                                     SPS154
ISN 0185            IF(TF-T(I-1,IB))212,213,213
ISN 0186      213 IF (TF.LE.T(I,IB)) GO TO 214
ISN 0188            IF (TF-T(I,IE) .LT. .0001) T(I,IB) = TF
ISN 0190            IF (TF-T(I,IE) .LE. 0.) GO TO 214
ISN 0192      212 IF(C(I,IB)-PKFLOW-BFLOS)222,222,220
ISN 0193      220 PKFLOW=C(I,IE)-BFLOS
ISN 0194            PKTIME=DURS+T(I,IB)-TITRS
ISN 0195            PEAK=C(I,IE)
ISN 0196            DRS=PKTIME                                                      SPS163
ISN 0197            IM=0                                                            SPS164
ISN 0198      222 SFLOW=1800.*(C(I,IB)+C(I-1,IB))*(T(I,IE)-T(I-1,IB))
ISN 0199            FLSUM=FLSUM+SFLOW                                               SPS166
ISN 0200            IF(IM.EQ.0) EFLOW=FLSUM                                         SPS167
ISN 0202            IM=1                                                            SPS168
ISN 0203            IF(T(I,IB)-24.00)252,253,253
ISN 0204      253 T(I,IB)=0.
ISN 0205            DURS=DURS+24.00-TITRS                                           SPS171
ISN 0206            TITRS=0.                                                        SPS172
ISN 0207            ICTDAY=ICTDAY+1                                                 SPS173
ISN 0208            ALPHA=ALPHA+BETA*24.                                            SPS174
ISN 0209      252 I=I+1                                                             SPS175
ISN 0210            IF(I-NDP)210,210,802                                            SPS176
                C   ************************************************************SPS177
                C                                                                 *SPS178
                C   EXIT FROM STORMFLOW CYCLE                                     *SPS179
                C                                                                 *SPS180
                C   ************************************************************SPS181
ISN 0211      214 FLSUM=FLSUM+1800.*(CF + C(I-1,IB))*(TF - T(I-1,IB))
ISN 0212            C(I-1,IB)=CF
ISN 0213            DURS=DURS+TF-TITRS                                              SPS184
ISN 0214            T(I-1,IB)=TF
ISN 0215            A1=1800.*(BFLOS+CF)*DURS*FGK                                    SPS186
ISN 0216            SPV=FLSUM*FGK                                                   SPS187
ISN 0217            IF(SPV-A1-.001)270,272,272                                      SPS188
ISN 0218      270 IOSTT=ITMII(TIMINS)                                               SPS189
ISN 0219      118 IF(NLINE-50)117,119,119                                           SPS190
ISN 0220      119 CALL HEADER(NPAGE,NLINE,KYR,BETA,AREAII,IE)
ISN 0221      117 WRITE(6,271)INMTHS,INDAYS,IOSTT                                   SPS192
ISN 0222      271 FORMAT(1H ,2X,3H999,1X,2I4,1X,I5)                                 SPS193
ISN 0223            IF(IK.EQ.1) GO TO 71                                            SPS194
```

```
ISN 0225           GO TO 72                                                    SPS195
ISN 0226        71 A2=(EPSUM+FLSUM)*PGK                                        SPS196
ISN 0227           IK=0                                                        SPS198
ISN 0228           KK=0                                                        SPS199
ISN 0229           EPSUM=0.                                                    SPS200
ISN 0230           IEND(IE)=0
ISN 0231           GO TO 803
ISN 0232        72 NLINE=NLINE+1                                               SPS201
ISN 0233           BPSUM=BPSUM+FLSUM                                           SPS202
ISN 0234           EPSUM=EPSUM+FLSUM                                           SPS203
ISN 0235           DUR=DUR+DURS                                                SPS204
ISN 0236           TITR=TF                                                     SPS205
ISN 0237           IEVSW=1                                                     SPS206
ISN 0238           GO TO 151                                                   SPS207
ISN 0239       272 NEVENT=NEVENT+1                                             SPS208
ISN 0240           ISTM=NEVENT
ISN 0241           CPF=BFICS+BETA*DRS                                          SPS209
ISN 0242           A1B=1800.*(BFLCS+CPF)*D RS*PGK                              SPS210
ISN 0243           KSMO=KMO                                                    SPS211
                C  ***************************************************************SPS212
                C                                                              *SPS213
                C     EVENT AND BETWEEN EVENT OUTPUT PROGRAM SEGMENT           *SPS214
                C                                                              *SPS215
                C  ***************************************************************SPS216
ISN 0244       164 IF(NLINE-50)185,187,187                                     SPS217
ISN 0245       187 CALL HEADER(NPAGE,NLINE,KYR,BETA,AREAID,IE)
ISN 0246       185 IOTINS=ITMIL(TIMINS)                                        SPS219
ISN 0247           IOTDS=ITMIL(DURS)                                           SPS220
ISN 0248           IPKT=ITMIL(PKTIME)                                          SPS221
ISN 0249           A1=1800.*(BFIOS+CF)*DURS*PGK                                SPS222
ISN 0250           V=FLSUM*PGK-A1                                              SPS223
ISN 0251           IF(V.EQ.0.)GO TO 1101                                       SPS224
ISN 0253       1101 CONTINUE                                                   SPS225
ISN 0254       165 IOTIN=ITMIL(TIMIN)                                          SPS226
ISN 0255           IOTD=ITMIL(DUR)                                             SPS227
ISN 0256           PC7=BPSUM*PGK
ISN 0257       1901 IBETA=BETA*10000.+.5                                       SPS229
ISN 0258           BFLO=BFIOW*PGK-A1B                                          SPS230
ISN 0259           AFLO=V-BFLC                                                 SPS231
ISN 0260           NPO=AFIO*10000.+.5                                          SPS232
ISN 0261           KPC=BFLC*10000.+.5                                          SPS233
                C  ***************************************************************SPS234
                C                                                              *SPS235
                C     PRINT ROUTINE ****                                       *SPS236
                C                                                              *SPS237
                C  ***************************************************************SPS238
ISN 0262       1900 WRITE(6,170)INMTH,INDAY,IOTIN,IOTD,BEGFLO,QF,PC7,BFLO
ISN 0263        170 FORMAT(1H ,6X,2I4,I6,I9,17X,F8.2,18X,F8.2,19X,F8.3,F14.4)   SPS240
ISN 0264           WRITE(6,186)NEVENT,INMTHS,INDAYS,IOTINS,IOTDS,IPKT,BFLOS,PKFLOW,SPS241
                  1CF,V,A1,AFIC                                                SPS242
ISN 0265       186 FORMAT(1H ,I3,3X,2I4,I6,I9,2X,I8,5X,F10.2,5X,F9.2,2X,F10.2,3X,SPS243
                  *F10.3,4X,F10.3,F14.4)                                       SPS244
ISN 0266           NLINE=NLINE+2                                               SPS245
ISN 0267           KBEG(ISTM,IB)=INDAYS
ISN 0268           KDUR(ISTM,IB)=DURS
ISN 0269           NSTM(IE)=ISTM
ISN 0270           KTIM(ISTM,IB)=TIMINS
ISN 0271           BSFT(ISTM,IE)=A1
ISN 0272           BFLOW1(ISTM,IB)=PC7
ISN 0273           BASFLO(IB)=BASFLO(IB)+BFICW1(ISTM,IB)+ESFI(ISTM,IB)
ISN 0274           FACT(IE)=AREA(IE)/241.0
ISN 0275           IBSNSP(IB)=IBSNSP(IB)+BFICW1(ISTM,IB)
ISN 0276           VSRI(ISTM,IB)=V
ISN 0277           VSRSUM(IB)=VSRSUM(IB)+V
ISN 0278           VBRSUM(IB)=VERSUM(IB)+BSFT(ISTM,IE)
ISN 0279           VSRWSM=VSRWSM+V*FACT(IB)
ISN 0280           BSFWSM=BSFWSM+BSFT(ISTM,IB)*FACT(IB)
                C  ***************************************************************SPS246
                C                                                              *SPS247
                C     PUNCH ROUTINE  ****                                      *SPS248
                C  ***************************************************************SPS249
                C                                                              *SPS250
ISN 0281           IF(IEND(IB).EQ.1) GO TO 776
ISN 0283           GO TO 100                                                   SPS281
                C  ***************************************************************SPS282
                C                                                              *SPS283
                C     END OF EVENT OUTPUT PROGRAM SEGMENT                      *SPS284
                C                                                              *SPS285
                C     END OF MONTH PROGRAM SEGMENT                             *SPS286
                C                                                              *SPS287
                C  ***************************************************************SPS288
ISN 0284       802 KK=1                                                        SPS289
ISN 0285           WRITE(6,9000)
ISN 0286       9000 FORMAT('0','STCRM CONTINUES PAST END OF MONTH')
ISN 0287              DURS=DURS+T(I-1,IB)-TITBS
ISN 0288            FL=FLSUM
ISN 0289           CFA=BFIOS+BETA*DURS                                         SPS291
```

```
ISN 0290            DF=1800.*(EFLOS*CPA)*DURS*FGK                                  SFS292
ISN 0291            QFF=FL*FGK-DF                                                  SFS293
ISN 0292            CFF=BFLOS+BETA*DRS                                             SFS294
ISN 0293            DF1=1800.*(BFLOS+CFF)*DRS*FGK                                  SFS295
ISN 0294             BFL=BFLOW*FGK-DF1                                             SFS296
ISN 0295            AFL=QFF-BFI                                                    SFS297
ISN 0296            NFL=AFL*100C0.+.5                                              SFS298
ISN 0297            KFL=BFI*100C0.+.5                                              SFS299
ISN 0298            PEAK1=PEAK                                                     SFS300
ISN 0299            IK=1                                                           SFS301
ISN 0300             KEVENT=NEVENT+1                                               SFS302
ISN 0301            IEND(IE)=1
ISN 0302              CF=BFLOS+BETA*DURS
ISN 0303            GO TO 272
ISN 0304      776    CONTINUE
ISN 0305        80C A2=EFSUM*FGK                                                   SFS304
ISN 0306      803   CONTINUE
ISN 0307            IF(IEND(IB).NE.1) FBSFLO(IB)=A2
ISN 0309            BASFLO(IB)=BASFLO(IB)+FBSFLO(IE)
ISN 0310            BASWFL=BASWFL+(BASFLO(IB)*FACT(IB))
ISN 0311            TOTFLO(IB)=TOTFLO(IB)+BASFLO(IB)+VSFSUM(IE)
ISN 0312            TOFLOW=TOFLOW+TOTFLO(IB)*FACT(IB)
ISN 0313            PRCNT(IB)=VSFSUM(IB)/TOTFLO(IB)*100.
ISN 0314            PRCNTT=VSRWSM/TOFLOW*100.
ISN 0315            TBSNSP(IB)=TBSNSP(IB)+FBSFLO(IE)
ISN 0316              IOTINS=ITMIL(TIMIN)
ISN 0317              IOTID=ITMIL(DUR)
ISN 0318              IF(IEND(IB).NE.1)WRITE(6,275) INMTH,INDAY,IOTINS,IOTID,
                   +BEGFLO,C(NIF,IE),A2
ISN 0320      275     FORMAT('    END ',2I4,I6,I9,17X,F8.2,18X,F8.2,19X,F8.3)
ISN 0321            IF(IB.EQ.2) GO TO 778
ISN 0323              IB=2
ISN 0324              GO TC 901
ISN 0325       778  WRITE(6,1000)
ISN 0326            WRITE(6,10C5)
ISN 0327            JSTM=NSTM(1)+NSTM(2)
ISN 0328            DO 950 J=1,JSTM
ISN 0329            ONE=KBEG(J,1) .EQ. 0
ISN 0330            TWO=KBEG(J,2) .EQ. 0
ISN 0331            IF(ONE.AND.TWO) GO TO 975
ISN 0333            IF(ONE.OR.TWO) GO TO 950
ISN 0335            DATE=.FALSE.
ISN 0336            TIMEL=.FALSE.
ISN 0337              DA1=KBEG(J,1)+KDUR(J,1)/24
ISN 0338              DA2=KBEG(J,2)+KDUR(J,2)/24
ISN 0339              IF(KBEG(J,1).GE.KBEG(J,2).AND.KBEG(J,1).LE.DA2) DATE=.TRUE.
ISN 0341              IF(KBEG(J,2).GE.KBEG(J,1).AND.KBEG(J,2).LE.DA1) DATE=.TRUE.
ISN 0343              IF(.NOT.DATE) GO TO 956
ISN 0345              DIFF=(KBEG(J,1)-KBEG(J,2))
ISN 0346              IF(DIFF) 951,952,953
ISN 0347      951     BEF1=0.0
ISN 0348              AFT1=KDUR(J,1)-DIFF*24
ISN 0349              BEF2=KTIM(J,2)
ISN 0350              AFT2=KDUR(J,2)+KTIM(J,2)
ISN 0351              GC TC 954
ISN 0352      952     BEF1=KTIM(J,1)
ISN 0353              AFT1=KDUR(J,1)+KTIM(J,1)
ISN 0354              BEF2=KTIM(J,2)
ISN 0355              AFT2=KDUR(J,2)+KTIM(J,2)
ISN 0356              GO TC 954
ISN 0357      953     BEF1=KTIM(J,1)
ISN 0358              AFT1=KDUR(J,1)+KTIM(J,1)
ISN 0359              BEF2=0.0
ISN 0360              AFT2=KDUR(J,2)-DIFF*24
ISN 0361      954     IF(BEF2.GE.BEF1.AND.BEF2.LE.AFT1) TIMEL=.TRUE.
ISN 0363              IF(BEF1.GE.BEF2.AND.BEF1.LE.AFT2) TIMEL=.TRUE.
ISN 0365            IF(DATE.AND.TIMEL) GO TO 950
ISN 0367             GO TO 955
ISN 0368      956      IB=2
ISN 0369            IF(KBEG(J,2).LT.KBEG(J,1)) IB=1
ISN 0371            GC TC 960
ISN 0372       955  IB=2
ISN 0373            IF(KTIM(J,2).LT.KTIM(J,1))IB=1
ISN 0375      960   CONTINUE
ISN 0376            MAX=NSTM(IE)
ISN 0377            NSTM(IE)=NSTM(IE)+1
ISN 0378            DC 958 I=1,MAX
ISN 0379            K=MAX-I+1
ISN 0380            IF(K.LT.J) GC TO 958
ISN 0382            VSRT(K+1,IE)=VSRT(K,IB)
ISN 0383            BSRT(K+1,IE)=BSRT(K,IB)
ISN 0384            BFLOW1(K+1,IE)=BFLOW1(K,IB)
ISN 0385            KBEG(K+1,IE)=KBEG(K,IB)
ISN 0386            KDUR(K+1,IE)=KDUR(K,IB)
ISN 0387            KTIM(K+1,IE)=KTIM(K,IB)
ISN 0388      958   CONTINUE
ISN 0389            VSRT(J,IE)=0.
```

```
ISN 0390            BSFT(J,IB)=0.
ISN 0391             BFLOW1(J,IB)=0.
ISN 0392       950  CONTINUE
ISN 0393       975  CONTINUE
ISN 0394            ISTM=J-1
ISN 0395            DO 970 I=1,ISTM
ISN 0396            DO 970 IB=1,2
ISN 0397            VSRW(I)=VSRW(I)+VSRT(I,IB)*FACT(IB)
ISN 0398            BSFW(I)=BSFW(I)+BSPT(I,IB)*FACT(IB)
ISN 0399       970  CONTINUE
ISN 0400            DO 50 I=1,ISTM
ISN 0401            WRITE(6,2000)(I,VSRT(I,IB),BSPT(I,IB),BFLOW1(I,IB),IB=1,2)
ISN 0402        50  CONTINUE
ISN 0403            WRITE(6,2002) (FBSFLC(IB),IB=1,2)
ISN 0404            WRITE(6,2001) (VSRSUM(IB),VBRSUM(IB),TBSNSP(IB),IB=1,2)
ISN 0405            WRITE(6,3000)
ISN 0406            WRITE(6,3005)
ISN 0407            WRITE(6,4000) (I,VSRW(I),BSFW(I),I=1,ISTM)
ISN 0408            WRITE(6,4001) VSRWSM,BSFWSM
ISN 0409       1000 FORMAT('1',56X,'SUMMARY OF RUNOFF'///
                   + 23X,'EAST BRANCH',44X,'WEST BRANCH'//
                   +11X,'STORM',7X,'TOTAL STORM',4X,'EASE RUNOFF',4X,'EASE RUNOFF',11X
                   +,'STORM',7X,'TOTAL STORM',4X,'EASE RUNOFF',4X,'BASE RUNOFF'/
                   +12X,'NO.',11X,'RUNOFF',7X,'FOR STORM',4X,'BEFORE STORM',13X,
                   +'NO.',11X,'RUNOFF',7X,'FOR STORM',4X,'BEFORE STORM'/)
ISN 0410        2000 FORMAT('0',11X,I2,11X,F6.3,9X,F6.3,9X,F6.3,14X,
                   +I2,11X,F6.3,9X,F6.3,9X,F6.3)
ISN 0411       2002 FORMAT('0',54X,F6.3,57X,F6.3)
ISN 0412       2001 FORMAT('0',11X,'SUM',10X,F6.3,9X,F6.3,9X,F6.3,13X,'SUM',11X,
                   +F6.3,9X,F6.3,9X,F6.3///)
ISN 0413       3000 FORMAT('0',56X,'WATERSHED'//
                   +42X,'STORM',7X,'TOTAL STORM',4X,'BASE RUNOFF'/
                   +43X,'NO.',11X,'RUNOFF',7X,'FOR STORM'/)
ISN 0414       1005 FORMAT('0',28X,'IN.',11X,'IN.',11X,'IN.',
                   +33X,'IN.',11X,'IN.',11X,'IN.'//)
ISN 0415       3005 FORMAT('0',59X,'IN.',11X,'IN.'/)
ISN 0416       4000 FORMAT('0',44X,I2,11X,F6.3,9X,F6.3)
ISN 0417       4001  FORMAT('0',43X,'SUM',11X,F6.3,9X,F6.3)
ISN 0418             WRITE(6,5000)
ISN 0419       5000 FORMAT('0',55X,'FLOW SUMMARY'//
                   +46X,'TOTAL BASE',5X,'TOTAL STORM',9X,'TOTAL',6X,'PERCENT STORM'/
                   + 48X,'RUNOFF',10X,'RUNOFF',10X,'RUNOFF',5X,'RUNOFF OF TOTAL'//)
ISN 0420             WRITE(6,5001)(BASFLO(I),VSRSUM(I),TOTFLO(I),PRCNT(I),I=1,2),
                   +BASWFL,VSRWSM,TOFLOW,PRCNTI
ISN 0421       5001 FORMAT('0',32X,'EAST',10X,F6.3,9X,F6.3,9X,F6.3,9X,F6.3/
                   +33X,'WEST',10X,F6.3,9X,F6.3,9X,F6.3,9X,F6.3/
                   +32X,'TOTAL',10X,F6.3,9X,F6.3,9X,F6.3,9X,F6.3)
ISN 0422       779   CONTINUE
ISN 0423              IF(NMOR.GE.NMO) GO TO 1200
ISN 0425              KMC=KMO+1
ISN 0426              AGAIN=.TRUE.
ISN 0427              GO TO 900
ISN 0428       1200   CONTINUE
ISN 0429            STOP                                                    SPS335
ISN 0430            END                                                     SPS336
```

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LEVEL  21.6  (DEC 72)                    OS/360  FORTRAN H

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                             SOURCE,EBCDIC,NOLIST,NODECK,LOAD,MAP,NOEDIT,NOID,XREF
ISN 0002            SUBROUTINE HEADER(NPAGE,NLINE,KWS,KYR,BETA,AREAID)      SPS337
                C   ************************************************************SPS338
                C                                                              *SPS339
                C    SUBROUTINE TO PRINT PAGE HEADERS.                         *SPS340
                C                                                              *SPS341
                C   ************************************************************SPS342
ISN 0003            DIMENSION AREAID(8)                                        SPS343
                C                                                              SPS344
ISN 0004            WRITE(6,1)AREAID,KWS,KYR,NPAGE,BETA                        SPS345
ISN 0005          1 FORMAT(1H1,27X,8A4,12H   WATERSHED,I3,5X,9HWATERYEAR,I3,22X4HPAGE,SPS346
                   1I5/51X,23HFLOW SEPARATION SLOPE =,F7.4)                    SPS347
ISN 0006            WRITE(6,2)                                                 SPS348
ISN 0007          2 FORMAT(130H EVENT   MO. DAY TIME  DURATION   TIME TILL   INITIAL FSPS349
                   1LOW   PEAK FLOW   FINAL FLOW   QUICK FLOW   DELAYED FLOW   QUICK FSPS350
                   2LOW      )                                                SPS351
ISN 0008            WRITE(6,3)                                                 SPS352
ISN 0009          3 FORMAT(130H  NO.                                PEAKING        RATE SPS353
                   1         RATE        RATE        VOLUME        VOLUME      BEFORE SPS354
                   *AND      )                                                SPS355
ISN 0010            WRITE(6,4)                                                 SPS356
```

```
ISN 0011          4 FORMAT(130H                          (HRS-MINS)   (HRS-MINS)       (CSM) SPS357
                    1          (CSM)        (CSM)       (INCHES)      (INCHES)     AFTER PSPS358
                    *BAK       )                                                          SPS359
ISN 0012            WRITE(6,5)                                                          SPS360
ISN 0013          5 FORMAT(130H                                                         SPS361
                    *                                                                  (INCHSPS362
                    2FS)       )                                                        SPS363
ISN 0014            NLINE=0                                                             SPS364
ISN 0015            NPAGE=NPAGE+1                                                       SPS365
ISN 0016            RETURN                                                              SPS366
ISN 0017            END                                                                 SPS367
```

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LEVEL  21.6  (DEC 72)                          OS/360  FORTRAN H

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                             SOURCE,EBCDIC,NOLIST,NODECK,LOAD,MAP,NOEDIT,NOID,XREF
ISN 0002                FUNCTION ITMIL(TDEC)                                        SPS368
                  C     ************************************************************SPS369
                  C                                                                 *SPS370
                  C     SUBPROGRAM FOR CONVERSION TO MILITARY TIME                  *SPS371
                  C                                                                 *SPS372
                  C     ************************************************************SPS373
ISN 0003                TINT=IFIX(TDEC)                                             SPS374
ISN 0004                IMIN=(TDEC-TINT)*60.+.5                                     SPS375
ISN 0005                ITMIL=IFIX(100.*TINT)+IMIN                                  SPS376
ISN 0006                RETURN                                                      SPS377
ISN 0007                END                                                         SPS378
```

Section B

Reduce Program of the Snyder and Curlin Hydrograph Analysis Package

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LEVEL  21.6  (DEC 72)                          OS/360  FORTRAN H

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                             SOURCE,BCD,NOLIST,NODECK,LOAD,MAP,NOEDIT,NOID,XREF
                COMMENT  DATA REDUCTION
 ISN 0002               DIMENSION DUM%24<,RAIN%200<,DELRN%200<,TIME%200<,DELTIM%200<
 ISN 0003               DIMENSION NDAYS(12),RDNO(5)
 ISN 0004               DIMENSION COVER(5)
 ISN 0005               INTEGER DAY,CNO,DOW,DAYI(200),CNOI(200),RDN(200)
 ISN 0006               INTEGER RG,YEAR,ONE,TIME,TIMEO,DELTIM
 ISN 0007               INTEGER ODDAYS
 ISN 0008               INTEGER RUN
 ISN 0009               LOGICAL ERROR,EMPTY
 ISN 0010               DATA NDAYS/31,28,31,30,31,30,31,31,30,31,30,31/
 ISN 0011               DATA LASTID/9999/
 ISN 0012               READ(5,4999) NT,RUN
 ISN 0013            4999 FORMAT(2I3)
 ISN 0014            1000 READ(NT,5000,END=1000) YEAR,MONTH
 ISN 0015                 READ(NT,770) RDNO
 ISN 0016            5000 FORMAT(5I4)
 ISN 0017             770 FORMAT(5F4.1,60X)
 ISN 0018                 IF(MOD(YEAR,4).EQ.0) NDAYS(2)=29
 ISN 0020                 TIMEO=       288*NDAYS(MONTH-1)
 ISN 0021                 IF(MONTH.EQ.1) TIMEO=       288*NDAYS(12)
 ISN 0023                 DO 100 RG=1,5
 ISN 0024                 LDAY=0
 ISN 0025                 LCNO=0
 ISN 0026                 RAINO=RDNO(RG)
 ISN 0027                 REF=0.0
 ISN 0028                 X=RDNO(RG)
 ISN 0029                 EMPTY=.FALSE.
 ISN 0030                 IF(X.EQ.0.0) EMPTY=.TRUE.
 ISN 0032                 I=1
 ISN 0033                 TIME(1)=0
 ISN 0034                 DELRN(1)=0.0
 ISN 0035                 RAIN(1)=0.0
 ISN 0036                 RDN(1)=1
 ISN 0037                 DELTIM%1<#0
 ISN 0038                 CNOI(1)=1
 ISN 0039                 DAYI(1)=1
 ISN 0040                 N=NDAYS(MONTH)
 ISN 0041               1 CONTINUE
 ISN 0042                 ERROR=.FALSE.
 ISN 0043                 READ(NT,500) DAY,DOW,CNO,DUM
 ISN 0044             500 FORMAT(3X,I2,I1,I2,24F3.1)
 ISN 0045                 IF(MOD(DAY,4).EQ.1.AND.CNO.EQ.1) WRITE(6,6000)
 ISN 0047            6000 FORMAT('1RG YR MO DAY DOW CNO    1    2    3    4    5    6    7    8    9
                     1   10   11   12       13   14   15   16   17   18   19   20   21   22   23   24')
 ISN 0048                 IF(DAY.NE.LDAY+1) GO TO 50
 ISN 0050                 IF(CNO.NE.LCNO+1) GO TO 50
 ISN 0052                 LCNO=CNO
 ISN 0053                 IF(CNO.LT.12) GO TO 5
 ISN 0055                 LCNO=0
 ISN 0056                 LDAY=DAY
 ISN 0057               5 CONTINUE
 ISN 0058                 WRITE(6,6005) RG,YEAR,MONTH,DAY,DOW,CNO,DUM
 ISN 0059            6005 FORMAT(I3,2I3,I4,I3,I5,1X,2(12F4.1,3X))
 ISN 0060                 IF(CNO.EQ.12) WRITE(6,6006)
 ISN 0062            6006 FORMAT('0')
 ISN 0063                 IF(RUN.EQ.0) GO TO 1
 ISN 0065                 IF(DUM(1).EQ.9.9.AND.X.EQ.0.0) DUM(1)=0.0
 ISN 0067                 IF(DUM(1).EQ.X) GO TO 15
 ISN 0069                 IF(EMPTY) GO TO 8
 ISN 0071                 IF(DUM(1).EQ.0.0) GO TO 14
 ISN 0073               8 DUMRN=DUM(1)-RAINO+REF
 ISN 0074                 IF(DUMRN.EQ.RAIN(I)) GO TO 15
 ISN 0076                 RAIN(I+1)=DUMRN
 ISN 0077                 IF(RAIN(I+1).LT.0.0) GO TO 13
 ISN 0079                 DELRN(I+1)=RAIN(I+1)-RAIN(I)
 ISN 0080                 IF(ERROR) GO TO 10
 ISN 0082                 IF(DELRN(I+1).GT.1.0) GO TO 15
 ISN 0084              10 IF(DELRN(I+1).LT.-0.15) GO TO 15
 ISN 0086                 TIME2=       (DAY-1)*288+(CNO-1)*24+0
 ISN 0087                 TIME(I+1)=TIME2
 ISN 0088                 DELTIM(I+1)=TIME(I+1)-TIME(I)
 ISN 0089                 DAYI(I+1)=DAY
 ISN 0090                 CNOI(I+1)=CNO
 ISN 0091                 RDN(I+1)=1
 ISN 0092                 I=I+1
 ISN 0093                 GO TO 15
 ISN 0094              13 CONTINUE
                C*****    RAIN GAGE HAS BEEN EMPTIED
 ISN 0095                 IF(DUM( 1 ).EQ.0.0) GO TO 14
 ISN 0097                 RAINO=DUM(1)
 ISN 0098                 GO TO 15
 ISN 0099              14 CONTINUE
 ISN 0100                 WRITE(6,6008)
```

```
ISN 0101      6008 FORMAT('0*****  RAIN GAGE EMPTIED')
ISN 0102           REF=RAIN(I)
ISN 0103           RAIN0=0.0
ISN 0104           EMPTY=.TRUE.
ISN 0105        15 CONTINUE
ISN 0106           DO 25 J=1,23
ISN 0107           IF(DUM(J+1).EQ.9.9.AND.DUM(J).EQ.0.0) DUM(J+1)=0.0
ISN 0109           IF(DUM(J).EQ.DUM(J+1)) GO TO 25
ISN 0111           IF(EMPTY) GO TO 18
ISN 0113           IF(DUM(J+1).EQ.0.0) GO TO 24
ISN 0115        18 DUMRN=DUM(J+1)-RAIN0+REF
ISN 0116           IF(DUMRN.EQ.RAIN(I)) GO TO 25
ISN 0118           RAIN(I+1)=DUMRN
ISN 0119           IF(RAIN(I+1).LT.0.0) GO TO 23
ISN 0121           DELRN(I+1)=RAIN(I+1)-RAIN(I)
ISN 0122           IF(ERROR) GO TO 20
ISN 0124           IF(DELRN(I+1).GT.1.0) GO TO 25
ISN 0126        20 IF(DELRN(I+1).LT.-0.15) GO TO 25
ISN 0128           TIME2=       (DAY-1)*288+(CNO-1)*24+J
ISN 0129           TIME(I+1)=TIME2
ISN 0130           DELTIM(I+1)=TIME(I+1)-TIME(I)
ISN 0131           DAYI(I+1)=DAY
ISN 0132           CNOI(I+1)=CNO
ISN 0133           RDN(I+1)=J+1
ISN 0134           I=I+1
ISN 0135           GO TO 25
ISN 0136        23 CONTINUE
                C*****    RAIN GAGE HAS BEEN EMPTIED
ISN 0137           IF(DUM(J+1).EQ.0.0) GO TO 24
ISN 0139           RAIN0=DUM(J+1)
ISN 0140           GO TO 25
ISN 0141        24 CONTINUE
ISN 0142           WRITE(6,6008)
ISN 0143           REF=RAIN(I)
ISN 0144           RAIN0=0.0
ISN 0145           EMPTY=.TRUE.
ISN 0146        25 CONTINUE
ISN 0147           X=DUM(24)
ISN 0148           GO TO 1
ISN 0149        50 CONTINUE
                COMMENT  RECORD(S) MISSING     CONTINUE PROCESSING
ISN 0150           IF(DAY.EQ.99) GO TO 75
ISN 0152           WRITE(6,6010)
ISN 0153      6010 FORMAT('0***** DATA ERROR. RECORD(S) MISSING.')
ISN 0154           WRITE(6,6006)
ISN 0155           IF(LDAY.NE.DAY-1) RAIN0#0.
ISN 0157           ERROR=.TRUE.
ISN 0158           LCNO=CNO
ISN 0159           LDAY=DAY-1
ISN 0160           GO TO 5
ISN 0161        75 CONTINUE
ISN 0162           IF(RUN.EQ.0) GO TO 100
ISN 0164           ITOT=I
ISN 0165           WRITE(6,625) RG,MONTH,YEAR
ISN 0166       625 FORMAT('1RAIN GUAGE',I2, 6X,I2,'/',I2/
                  X  'DAY-DAY OF THE MONTH'/
                  X 'CNO-CONSECUTIVE NUMBER OF DATA CARD(1-12)'/
                  X'RDN-NUMBER OF FIVE MINUTE INTERVALS ON A CARD(1-24)'/
                  X'RAIN-AMOUNT OF RAIN SINCE THE BEGINNING OF THE MONTH'/
                  X 'DELRAIN-DELTA RAIN'/
                  X 'TIME-NUMBER OF FIVE MINUTE INTERVALS SINCE THE BEGINNING OF THE
                  XMONTH'/
                  X 'DELTIME-DELTA TIME'/
                  X        'ODAY CNO RDN  RAIN DELRAIN   TIME   DELTIME'<
ISN 0167           WRITE(6,650) (DAYI(I),CNOI(I),RDN(I),RAIN(I),DELRN(I),
                  X TIME(I),DELTIM(I),I=1,ITOT)
ISN 0168       650 FORMAT%3I4,2F6.1,5X,I4,4X,I4<
ISN 0169           NINE=9
ISN 0170           ONE=1
ISN 0171           ID=0
ISN 0172           WRITE(7,725) YEAR,MONTH,RG,ID,TIME0,RDN0(RG),ITOT
ISN 0173       800 CONTINUE
ISN 0174           IF(NINE.GT.ITOT) NINE=ITOT
ISN 0176           ID=ID+1
ISN 0177           WRITE(7,750) YEAR,MONTH,RG,ID,(TIME(I),RAIN(I),I=ONE,NINE)
ISN 0178           IF(NINE.EQ.ITOT) GO TO 825
ISN 0180           ONE=ONE+9
ISN 0181           NINE=NINE+9
ISN 0182           GO TO 800
ISN 0183       825 CONTINUE
ISN 0184       725 FORMAT(2I2,I1,13,I4,F4.1,I3,61X)
ISN 0185       750 FORMAT(2I2,I1,13,9(I4,F4.1))
ISN 0186           COVER(RG)=0.0
ISN 0187           M=NDAYS(MONTH)
ISN 0188           MDAYS=0
ISN 0189           IF(MONTH.EQ.12) GO TO 199
ISN 0191           DO 198 IM=1,MONTH
```

```
ISN 0192            MDAYS=MDAYS+NDAYS(IM)
ISN 0193        198 CONTINUE
ISN 0194        199 CONTINUE
ISN 0195            ODDAYS=MOD(MDAYS,7)
ISN 0196            K=M-ODDAYS+1
ISN 0197            IF(K.GT.DAYI(ITOT)) GO TO 150
ISN 0199            DO 300 I=1,ITOT
ISN 0200            J=ITOT-I+1
ISN 0201            IF(K.LE.DAYI(J)) GO TO 300
ISN 0203            INDEX=J+1
ISN 0204            GO TO 250
ISN 0205        300 CONTINUE
ISN 0206        250 CONTINUE
ISN 0207            IF(INDEX.GT.ITOT) GO TO 150
ISN 0209            DO 200 J=INDEX,ITOT
ISN 0210        200 IF(DELRN(J).GT.0.0) COVER(RG)=COVER(RG)+DELRN(J)
ISN 0212        150 CONTINUE
ISN 0213            RDNO(RG)=X
ISN 0214        100 CONTINUE
ISN 0215            WRITE(7,775) YEAR,MONTH,LASTIC,ODDAYS,(COVER(RG),RG=1,5)
ISN 0216        775 FORMAT(2I2,I4,I2,2X,5F4.1,48X)
ISN 0217            WRITE(7,776)  RDNO
ISN 0218            GO TO 1000
ISN 0219            END
```

Section C

Storm Definition Program

of the Snyder and Curlin Hydrograph Analysis Package

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LEVEL  21.6  (DEC 72)                          OS/360  FORTRAN H

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                             SOURCE,BCD,NOLIST,NODECK,LOAD,MAP,NOEDIT,NOID,XREF
                COMMENT     INVENT PRODUCES TABLES OF PRECIPITATION
                C      AND FLOWS.
   ISN 0002             COMMON/ALPHA /PRERN,RAIN(300),TIME(300),DAY(200),ITOT,RG
   ISN 0003             COMMON/GAMMA /WAE(50),WAW(50),MONTH,YEAR
   ISN 0004             COMMON/DELTA /TABLE (32,5),TABMET(32,5)
   ISN 0005             DIMENSION NDAYS(12)
   ISN 0006             DIMENSION AE(5),AW(5)
   ISN 0007             DIMENSION WKRAIN(7,5),WKMET(6,5),TOTAL(5),TOTMET(5),COVER(5),
                       1          EDAILY(32),WDAILY(32),EWKLY(6),WWKLY(6)
   ISN 0008             COMMON/WKCORL/WKRAIN,LWEEKS
   ISN 0009             INTEGER RG,YEAR,ONE,TIME,DAY
   ISN 0010             INTEGER ODDAYS,DATE(6),SEVEN,TALLY(5)
   ISN 0011             DATA TOTAL,TALLY/5*0.0,5*0/
   ISN 0012             DATA AE,TOTAE,AW,TOTAW/4.61,0.0,75.8,30.5,35.0,145.91,
                       1                       34.53,33.23,27.24,0.0,0.0,94.0/
   ISN 0013             DATA NDAYS/31,28,31,30,31,30,31,31,30,31,30,31/
   ISN 0014             PRERN=0.0
   ISN 0015          1000 CONTINUE
   ISN 0016             READ(5,500) YEAR,LMONTH,LASTID,ODDAYS,COVER
   ISN 0017           500 FORMAT(2I2,I4,I2,2X,5F4.1)
   ISN 0018             DO 100 RG=1,5
   ISN 0019             TOTAL(RG)=0.0
   ISN 0020             TALLY(RG)=0
                COMMENT     READ COMPACT DATA.
                C
   ISN 0021             CALL READER(RG,ITOT,RAIN,TIME,YEAR,MONTH)
   ISN 0022             M=NDAYS(MONTH)
   ISN 0023             L=1
   ISN 0024             TIME(ITOT+1)=288
   ISN 0025             DAY(1)=1
   ISN 0026             DO 50 I=1,ITOT
   ISN 0027             DAY(I+1)=TIME(I+1)/288+1
   ISN 0028            35 CONTINUE
   ISN 0029             IF(DAY(I).EQ.L) GO TO 40
   ISN 0031             TABLE(L,RG)=0.0
   ISN 0032             L=L+1
   ISN 0033             IF(L.GT.M) GO TO 36
   ISN 0035             GO TO 35
   ISN 0036            36 CONTINUE
   ISN 0037             WRITE(6,6000)
   ISN 0038          6000 FORMAT('1*****ERROR IN INVENT, L > M, DUMP FOLLOWS')
   ISN 0039             CALL DUMP
   ISN 0040             RETURN
   ISN 0041            40 CONTINUE
   ISN 0042             DR=RAIN(I)-RAIN(I-1)
   ISN 0043             IF(DR.GT.0.0) TABLE(L,RG)=TABLE(L,RG)+DR
   ISN 0045             IF(DAY(I).NE.DAY(I+1)) L=L+1
   ISN 0047            50 CONTINUE
   ISN 0048             DO 75 J=L,M
   ISN 0049             TABLE(J,RG)=0.0
   ISN 0050             TABMET(J,RG)=0.0
   ISN 0051            75 CONTINUE
   ISN 0052             DO 60 K=1,L
   ISN 0053             IF(TABLE(K,RG).NE.0.0) TALLY(RG)=TALLY(RG)+1
   ISN 0055             TABMET(K,RG)=TABLE(K,RG)*25.4
   ISN 0056            60 TOTAL(RG)=TOTAL(RG)+TABLE(K,RG)
   ISN 0057             TOTMET(RG)=TOTAL(RG)*25.4
   ISN 0058             NDAYS=0
   ISN 0059             IF(MONTH.EQ.1) GO TO 70
   ISN 0061             MON1=MONTH-1
   ISN 0062             DO 65 IM=1,MON1
   ISN 0063             NDAYS=NDAYS+NDAYS(IM)
   ISN 0064            65 CONTINUE
   ISN 0065            70 CONTINUE
   ISN 0066             L=1
   ISN 0067             WKRAIN(1,RG)=COVER(RG)
   ISN 0068             ONE=1
   ISN 0069             SEVEN=7-ODDAYS
   ISN 0070            80 CONTINUE
   ISN 0071             DO 85 I=ONE,SEVEN
   ISN 0072             WKRAIN(L,RG)=WKRAIN(L,RG)+TABLE(I,RG)
   ISN 0073            85 CONTINUE
   ISN 0074             WKMET(L,RG)=WKRAIN(L,RG)*25.4
   ISN 0075             DATE(L)=(SEVEN+NDAYS+6)/7
   ISN 0076             WKRAIN(L+1,RG)=0.0
   ISN 0077             ONE=SEVEN+1
   ISN 0078             SEVEN=SEVEN+7
   ISN 0079             IF(SEVEN.GT.M) GO TO 90
   ISN 0081             L=L+1
   ISN 0082             GO TO 80
   ISN 0083            90 CONTINUE
   ISN 0084             IF(MONTH.NE.12) GO TO 95
   ISN 0086             IF(SEVEN.EQ.M+7) GO TO 95
```

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ISN 0088            SEVEN=M
ISN 0089            L=L+1
ISN 0090            GO TO 80
ISN 0091         95 CONTINUE
ISN 0092            LWEEKS=L
ISN 0093            CALL STORMY
ISN 0094        100 CONTINUE
ISN 0095            DO 110 I=1,M
ISN 0096            ESUM=0.0
ISN 0097            WSUM=0.0
ISN 0098            DO 105 RG=1,5
ISN 0099            IF(TABLE(I,RG).EQ.0.0) GO TO 105
ISN 0101            ESUM=ESUM+TABLE(I,RG)*AE(RG)
ISN 0102            WSUM=WSUM+TABLE(I,RG)*AW(RG)
ISN 0103        105 CONTINUE
ISN 0104            EDAILY(I)=ESUM/TOTAE
ISN 0105            WDAILY(I)=WSUM/TOTAW
ISN 0106        110 CONTINUE
ISN 0107            DO 120 L=1,LWEEKS
ISN 0108            ESUM=0.0
ISN 0109            WSUM=0.0
ISN 0110            DO 115 RG=1,5
ISN 0111            IF(WKRAIN(L,RG).EQ.0.0) GO TO 115
ISN 0113            ESUM=ESUM+WKRAIN(L,RG)*AE(RG)
ISN 0114            WSUM=WSUM+WKRAIN(L,RG)*AW(RG)
ISN 0115        115 CONTINUE
ISN 0116            EWKLY(L)=ESUM/TOTAE
ISN 0117            WWKLY(L)=WSUM/TOTAW
ISN 0118        120 CONTINUE
ISN 0119            WTOT=0
ISN 0120            ETOT=0
ISN 0121            ETOTM=0
ISN 0122            WTOTM=0
ISN 0123            DO 125 RG=1,5
ISN 0124            WTOT=WTOT+TOTAL(RG)*AW(RG)
ISN 0125            ETOT=ETOT+TOTAL(RG)*AE(RG)
ISN 0126            ETOTM=ETOTM+TOTMET(RG)*AE(RG)
ISN 0127            WTOTM=WTOTM+TOTMET(RG)*AW(RG)
ISN 0128        125 CONTINUE
ISN 0129            WTOT=WTOT/TOTAW
ISN 0130            ETOT=ETOT/TOTAE
ISN 0131            ETOTM=ETOTM/TOTAE
ISN 0132            WTOTM=WTOTM/TOTAW
ISN 0133            WRITE(6,600) MONTH,YEAR,MONTH,YEAR
ISN 0134            WRITE(6,625) (RG,RG=1,5),(RG,RG=1,5)
ISN 0135            DO 140 L=1,M
ISN 0136            WRITE(6,650) L,(TABLE(L,RG),RG=1,5),L,(TABMET(L,RG),RG=1,5)
ISN 0137        140 CONTINUE
ISN 0138            WRITE(6,670)
ISN 0139            DO 150 L=1,LWEEKS
ISN 0140            WRITE(6,650) DATE(L),(WKRAIN(L,RG),RG=1,5),DATE(L),(WKMET(L,RG),RG=1,5)
                   1   =1,5)
ISN 0141        150 CONTINUE
ISN 0142            WRITE(6,675) (TOTAL(RG),RG=1,5),(TOTMET(RG),RG=1,5)
ISN 0143            WRITE(6,695) ETOT,ETOTM,WTOT,WTOTM
ISN 0144            WRITE(6,680) (TALLY(RG),RG=1,5),(TALLY(RG),RG=1,5)
ISN 0145            WRITE(6,600) MONTH,YEAR,MONTH,YEAR
ISN 0146            WRITE(6,705)
ISN 0147            DO 175 I=1,M
ISN 0148            IF(EDAILY(I)+WDAILY(I).EQ.0.0) GO TO 175
ISN 0150            EMDALY=EDAILY(I)*25.4
ISN 0151            WMDALY=WDAILY(I)*25.4
ISN 0152            WRITE(6,700) I,EDAILY(I),WDAILY(I),I,EMDALY,WMDALY
ISN 0153        175 CONTINUE
ISN 0154            WRITE(6,715)
ISN 0155            DO 180 L=1,LWEEKS
ISN 0156            EMWKLY=EWKLY(L)*25.4
ISN 0157            WMWKLY=WWKLY(L)*25.4
ISN 0158            WRITE(6,700) DATE(L),EWKLY(L),WWKLY(L),DATE(L),EMWKLY,WMWKLY
ISN 0159        180 CONTINUE
ISN 0160            WRITE(6,710)
ISN 0161            CALL FIXIDX
ISN 0162            RETURN
ISN 0163        600 FORMAT('1                    PRECIPITATION IN INCHES FOR ',I2,'/',I2,
                   1        31X,'PRECIPITATION IN MILLIMETERS FOR ',I2,'/',I2)
ISN 0164        625 FORMAT('0',30X,'GAGE NUMBER',58X,'GAGE NUMBER'/
                   1        ' DATE',I6,4I12,12X,'DATE',I7,4I12)
ISN 0165        650 FORMAT(' ',I3,4X,5(F4.1,8X),3X,I3,4X,4(F5.1,7X),F5.1)
ISN 0166        670 FORMAT('0WEEKLY SUBTOTALS',54X,'WEEKLY SUBTOTALS')
ISN 0167        675 FORMAT('0TOTAL',2X,5(F4.1,8X),3X,'TOTAL',2X,4(F5.1,7X),F5.1)
ISN 0168        680 FORMAT('0NUMBER OF DAYS WITH RAIN',46X,'NUMBER OF DAYS WITH RAIN'/
                   1        5I12,10X,5I12)
ISN 0169        695 FORMAT('0AREA WEIGHTED TOTALS',50X,'AREA WEIGHTED TOTALS'/
                   1        ' ',4X,'EAST BRANCH',2X,F5.1,52X,'EAST BRANCH',2X,F5.1/
                   2        ' ',4X,'WEST BRANCH',2X,F5.1,52X,'WEST BRANCH',2X,F5.1)
ISN 0170        700 FORMAT(' ',14X,I2,6X,F5.1,15X,F5.1,34X,I2,6X,F5.1,15X,F5.1)
ISN 0171        705 FORMAT('-'19X,'AREA WEIGHTED DAILY TOTALS',
                   1          41X,'AREA WEIGHTED DAILY TOTALS'/
                   2        '0'13X,'DATE',3X,'EAST BRANCH',9X,'WEST BRANCH',
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LEVEL  21.6  (DEC 72)                          OS/360  FORTRAN H

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                             SOURCE,BCD,NOLIST,NODECK,LOAD,MAP,NOEDIT,NOID,XREF
   ISN 0002            SUBROUTINE STORMY                                          0101
                      COMMENT    STORMY ANALYZES RAIN GAGE AND PRODUCES           0102
                      C     TABLES OF STORM DURATION AND AMOUNT.                  0103
                      C     @STORM@ IS A FLAG. A VALUE YES INDICATES              0104
                      C     A STORM IS IN PROGRESS, NO, IF THERE IS               0105
                      C     NO STORM.                                             0106
   ISN 0003           COMMON/ALPHA /PRERN,RAIN(300),TIME(300),DAY(200),ITOT,RG
   ISN 0004           COMMON/BETA  /STMAMT(50,5),STMBGN(50,5),STMEND(50,5),NUMSTM(5)
   ISN 0005           COMMON/GAMMA /WAE(50),WAW(50),MONTH,YEAR
   ISN 0006           COMMON/SDATA /SRAIN(100,50,5),STIME(100,50,5),NREADS(50,5)
   ISN 0007           INTEGER STIME
   ISN 0008           DIMENSION RR(300),DELRN(300)
   ISN 0009           DIMENSION NDAYS(12)
   ISN 0010           DIMENSION DUMTIM(200),DUMRN(200)
   ISN 0011           INTEGER DUMTIM
   ISN 0012           INTEGER RG,YEAR,ONE,TIME,DAY
   ISN 0013           LOGICAL STORM                                              0108
   ISN 0014           DATA ERROR/0.0/
   ISN 0015           DATA NDAYS/31,28,31,30,31,30,31,31,30,31,30,31/
   ISN 0016           DATA NLAG / 4 /
                     C******
                     C          NLAG = NUMBER OF DAYS TO PROCESS INTO MONTH N+1.
                     C          CHANGE NLAG IF 'STORMY' DOES NOT RECORD ALL STORMS.
                     C******
   ISN 0017           IF(ERROR.NE.0.0) GO TO 200
   ISN 0019           IF(RG.NE.1) GO TO 15
   ISN 0021           READ(5,500) NYEAR,NMONTH,BGNTIM
   ISN 0022         500 FORMAT(2I3,F10.0)
                     C*****      BGNTIM IS READ AS NUMBER OF 5 MINUTE INTERVALS FOR ACCURACY.
   ISN 0023           BGNTIM=BGNTIM/12.
                     C*****      IT IS NOW CONVERTED TO HOURS.
   ISN 0024           IF(MONTH.EQ.12.AND.NMONTH.EQ.1) GO TO 5
   ISN 0026           IF(NMONTH.EQ.MONTH+1) GO TO 10
   ISN 0028           WRITE(6,600) MONTH,NMONTH
   ISN 0029         600 FORMAT('1*****ERROR IN STORMY, THIS MONTH =',I4,
                     1       ', NEXT MONTH =',I4)
   ISN 0030           ERROR=99.0
   ISN 0031           GO TO 200
   ISN 0032         5 CONTINUE
   ISN 0033           IF(NYEAR.EQ.YEAR+1) GO TO 15
   ISN 0035           WRITE(6,605) MONTH,YEAR,NMONTH,NYEAR
   ISN 0036         605 FORMAT('1*****ERROR IN STORMY, MONTH/YEAR =', I4,'/',I2,
                     1       ', NMONTH/NYEAR =',I4,'/',I2)
   ISN 0037           ERROR=99.0
   ISN 0038           GO TO 200
   ISN 0039        10 CONTINUE
   ISN 0040           IF(NYEAR.EQ.YEAR) GO TO 15
   ISN 0042           WRITE(6,605) MONTH,YEAR,NMONTH,NYEAR
   ISN 0043           ERROR=99.0
   ISN 0044           GO TO 200
   ISN 0045        15 CONTINUE
                     C*****
                     C          THE FOLLOWING SECTION OF CODING READS REDUCED R.G.
                     C     DATA FOR MONTH N+1. THIS DATA IS USED IN PROCESSING
                     C     STORMS IN MONTH N.
                     C
   ISN 0046           READ(5,525) NYEAR,NMONTH,NTOT
   ISN 0047         525 FORMAT(2I2,12X,I3)
   ISN 0048           NTOT=ITOT+NTOT
   ISN 0049           IF(NTOT.LE.300) GO TO 1000
   ISN 0051           WRITE(6,610) RG,ITOT,NTOT
   ISN 0052         610 FORMAT('1*****ERROR IN STORMY, ITOT + NTOT > 300.'/
                     1       '       RG =',I2,'  ITOT =',I4,'  NTOT =',I4)
   ISN 0053           GO TO 200
   ISN 0054        1000 CONTINUE
   ISN 0055           ONE=1
   ISN 0056           NINE=9
   ISN 0057        1010 CONTINUE
   ISN 0058           IF(NINE.GT.NTOT) NINE=NTOT
   ISN 0060           READ(5,550) (DUMTIM(I),DUMRN(I),I=ONE,NINE)
   ISN 0061         550 FORMAT(8X,9(I4,F4.1))
   ISN 0062           IF(NINE.EQ.NTOT) GO TO 1025
   ISN 0064           ONE=ONE+9
   ISN 0065           NINE=NINE+9
   ISN 0066           GO TO 1010
   ISN 0067        1025 CONTINUE
   ISN 0068           DO 1050 I=2,ITOT
   ISN 0069           DELRN(I)=RAIN(I)-RAIN(I-1)
   ISN 0070        1050 CONTINUE
   ISN 0071           IF(MOD(YEAR,4).EQ.0) NDAYS(2)=29
   ISN 0073           ITIME=288*NDAYS(MONTH)
                     C*****      ENDTIM = TIME AT WHICH TO END PROCESSING IN MONTH N+1.
   ISN 0074           ENDTIM = 24.0*(NDAYS(MONTH) + NLAG)
```

```
ISN 0075            DO 1075 I=1,NTOT
ISN 0076            INDEX=ITOT+I
                C****       INDEX = ITOT+1, ITOT+NTOT
ISN 0077            DELRN(INDEX)=DUMRN(I+1)-DUMRN(I)
ISN 0078            RAIN(INDEX)=RAIN(INDEX-1)+DELRN(INDEX)
ISN 0079            TIME(INDEX)=DUMTIM(I+1)+ITIME
ISN 0080         1075 CONTINUE
ISN 0081            WRITE(6,5000)
ISN 0082         5000   FORMAT('1RG IS THE RAIN GAUGE NUMBER'/
                       +'0MONTH IS THE MONTH BEING PROCESSED'/
                       +'0ITIME IS THE TOTAL NUMBER OF 5 MIN. READINGS IN THIS MONTH'/
                       +'0ITOT IS THE NUMBER OF READINGS OF THE REDUCED RAIN DATA FOR THIS
                       + MONTH'/
                       +'0NTOT IS THE NUMBER OF READINGS OF THE REDUCED RAIN DATA FOR',
                       +' NEXT MONTH'/)
ISN 0083            WRITE(6,6000) RG,MONTH,ITIME,ITOT,NTOT
ISN 0084         6000   FORMAT('0RG, MONTH, ITIME, ITOT, NTOT'/'0',I2,4I6/
                       +'0DELTA RAIN AND TIME FOLLOW, WITH THE TIME BEING THE NUMBER OF ',
                       +'HOURS SINCE THE BEGINNING OF THE MONTH')
                C*****
ISN 0085            IST=2
ISN 0086            L=0
ISN 0087            STORM=.FALSE.
ISN 0088            RR%1<@0.0
ISN 0089            R@0.0
ISN 0090            TZERO=BGNTIM
ISN 0091            DO 100 I=2,NTOT
ISN 0092            HOUR@TIME%I</12.0                                          0209
ISN 0093            IF(HOUR.LE.BGNTIM) GO TO 100
ISN 0095            INEXT=I
ISN 0096            R@R&DELRN%I<                                               0208
ISN 0097            RR%I<@R
ISN 0098            HOUR5@%TIME%I<-1.0</12.0                                   0210
ISN 0099            DT@HOUR-TZERO                                              0211
ISN 0100            RSUBC@0.05*%HOUR5-TZERO<                                   0212
ISN 0101            IF%STORM< GO TO 50                                         0213
ISN 0103            RCR@0.5                                                    0214
ISN 0104            IF%DT.LE.3.0< RCR@0.2&0.1*DT
ISN 0106            IF%DT.GT.9.0< RCR@0.05&0.05*DT
ISN 0108            IF%R.GE.RCR< GO TO 25                                      0217
ISN 0110            IF%RR%I-1<.GT.RSUBC< GO TO 100
ISN 0112            R@0.0                                                      0219
ISN 0113            TZERO@HOUR5
ISN 0114            IF(TZERO.GE.ENDTIM) GO TO 150
ISN 0116            IST=I+1
ISN 0117            GO TO 100                                                  0221
ISN 0118         25 CONTINUE                                                   0222
ISN 0119            STORM@.TRUE.                                               0223
ISN 0120            GO TO 100                                                  0224
ISN 0121         50 CONTINUE                                                   0301
ISN 0122            IF%RR%I-1<.GT.RSUBC< GO TO 100
                COMMENT     A STORM HAS BEEN LOCATED. FIND                     0303
                C     AMOUNT AND DURATION.                                     0304
ISN 0124            J@1                                                        0305
ISN 0125            BTZERO@HOUR5                                               0306
ISN 0126            BR@0.0                                                     0307
ISN 0127         55 CONTINUE                                                   0308
ISN 0128            HOUR5@%TIME%I-J<-1.0</12.0                                 0309
ISN 0129            BDT@BTZERO-HOUR5                                           0310
ISN 0130            BR@DELRN%I-J&1<
ISN 0131            BRSUBC@0.05*BDT                                            0312
ISN 0132            IF%BR.GT.BRSUBC< GO TO 75                                  0313
ISN 0134            BTZERO@HOUR5                                               0314
ISN 0135            J@J&1                                                      0318
ISN 0136            GO TO 55                                                   0319
ISN 0137         75 CONTINUE                                                   0320
ISN 0138            L=L+1
ISN 0139            IEND=I-J+1
ISN 0140            STMBGN(L,RG)=TZERO
ISN 0141            STMAMT%L,RG<@RR%IEND<
ISN 0142            STMEND%L,RG<@TIME%IEND</12.0
ISN 0143            WRITE(6,7000) STMBGN(L,RG),STMEND(L,RG),STMAMT(L,RG)
ISN 0144         7000 FORMAT(' BEGIN, END, AMOUNT',5X,3F10.3)
                C*****
                C          SRAIN(I,L,RG) AND STIME(I,L,RG) ARE RAIN AND TIME READINGS
                C     WITHIN EACH STORM.
                C          I = 1,NREADS(L,RG)
                C          L = 1,NUMSTM(RG)
                C         RG = 1,5
                C ****
ISN 0145            NREAD=IEND-IST+2
ISN 0146            NREADS(L,RG)=NREAD
ISN 0147            SRAIN(1,L,RG)=0.0
ISN 0148            STIME(1,L,RG)=TZERO*12.0+0.5
ISN 0149            CALL STORE(RR(IST),SRAIN(2,L,RG),NREAD)
ISN 0150            CALL STORE(TIME(IST),STIME(2,L,RG),NREAD)
```

```
ISN 0151            WRITE(6,700) RG,L,NREAD
ISN 0152            WRITE(6,704)
ISN 0153            WRITE(6,705) (SRAIN(K,L,RG),STIME(K,L,RG),K=1,NREAD)
ISN 0154       700  FORMAT('0','RAIN GAGE NUMBER',I2,2X,'CONSECUTIVE NUMBER OF THE',
                   +' STORM',I3/'ONUMBER OF READINGS AT THIS RAIN GAUGE FOR THIS STOR'
                   +,'M',I4)
ISN 0155       704  FORMAT('0','THE TIMES FOR THIS STORM AT THIS RAIN GAUGE IN THE '
                   +'NUMBER OF 5 MIN. INTERVALS SINCE THE BEGINNING OF THE MONTH'/
                   +'0AND THE CUMULATIVE AMOUNT OF RAIN FOR THAT STORM AT THAT TIME',
                   +'FOLLOW.')
ISN 0156       705  FORMAT((' ',10(F3.1,I5,2X)/))
               C*****    SUBROUTINE 'STORE' PROVIDES (HOPEFULLY) AN OPTIMUM METHOD
               C    FOR STORING INDIVIDUAL READINGS OF STORM RAINFALL AND TIME.
               C    THE ROUTINE IN USE IS WRITTEN IN 360 ASSEMBLER LANGUAGE. THE
               C    FOLLOWING FORTRAN ROUTINE IS ITS EQUIVALENT.
               C*****    JHB  4/18/68
               C    SUBROUTINE STORE(SOURCE,OBJECT,LENGTH)
               C    DIMENSION SOURCE(1),OBJECT(1)
               C    DO 10 I=1,LENGTH
               C    OBJECT(I)=SOURCE(I)
               C 10 CONTINUE
               C    RETURN
               C    END
ISN 0157            TZERO=*%TIME%I<-1.0</12.0                                    0403
ISN 0158            IF(TZERO.GE.ENDTIM) GO TO 150
ISN 0160            R=0.0                                                        0404
ISN 0161            STORM=.FALSE.                                                0405
ISN 0162            IST=I+1
ISN 0163       100  CONTINUE                                                     0406
ISN 0164       150  CONTINUE
ISN 0165            NUMSTM(RG)=L
ISN 0166       200  CONTINUE
ISN 0167            RETURN
ISN 0168            END
```

```
LEVEL  21.6  (DEC 72)                    OS/360  FORTRAN H

      COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                         SOURCE,BCD,NOLIST,NODECK,LOAD,MAP,NOEDIT,NOID,XREF
ISN 0002            SUBROUTINE FIXIDX
               C*****
               C          SUBROUTINE 'FIXIDX' (FIX INDEX),
               C
               C*****
ISN 0003            DIMENSION RGB(4,2)
ISN 0004            INTEGER RGB
ISN 0005            DATA RGB/1,3,4,5,1,2,3,0/
ISN 0006            COMMON/BETA  /STMAMT(50,5),STMBGN(50,5),STMEND(50,5),NUMSTM(5)
ISN 0007            COMMON/GAMMA /WAE(50),WAW(50),MONTH,YEAR
ISN 0008            COMMON/FIX   /A(250),B(250),X(250),AMT(50,5),DUR(50,5),
                   1              DATE(50),INDEX(50,5),NSTORM
ISN 0009            COMMON/SDATA /SRAIN(100,50,5),STIME(100,50,5),NREADS(50,5)
ISN 0010            INTEGER STIME
ISN 0011            INTEGER LST(5)/5*1/
ISN 0012            DIMENSION Y(250),Z(250),E(250)
ISN 0013            DIMENSION K(5)
ISN 0014            DIMENSION DURE(50),DURW(50),TOTAMT(5),TOTDUR(5),AE(5),AW(5)
ISN 0015            DIMENSION NDAYS(12)
ISN 0016            DATA NDAYS/31,28,31,30,31,30,31,31,30,31,30,31/
ISN 0017            DATA AE,TOTAE,AW,TOTAW/ 4.61,0.0,75.8,30.5,35.0,145.91,
                   1                        34.53,33.23,27.24,0.0,0.0,95.0/
ISN 0018            INTEGER DATE,RG,YEAR
ISN 0019            IF(MOD(YEAR,4).EQ.0)  NDAYS(2)=29
ISN 0021            ENDMON=24.*NDAYS(MONTH)
               C*****    ENDMON = TOTAL NUMBER OF HOURS IN THE MONTH BEING PROCESSED.
ISN 0022            DO 15 RG=1,5
ISN 0023            K(RG)=1
ISN 0024         15 CONTINUE
ISN 0025            N1=NUMSTM(1)
ISN 0026            N2=NUMSTM(2)
ISN 0027            N3=NUMSTM(3)
ISN 0028            N4=NUMSTM(4)
ISN 0029            N5=NUMSTM(5)
ISN 0030            IF(N1.EQ.0)  N1=1
ISN 0032            IF(N2.EQ.0)  N2=1
ISN 0034            IF(N3.EQ.0)  N3=1
ISN 0036            IF(N4.EQ.0)  N4=1
ISN 0038            IF(N5.EQ.0)  N5=1
ISN 0040            ENDPT = AMAX1(STMEND(N1,1),STMEND(N2,2),STMEND(N3,3),
                   1              STMEND(N4,4),STMEND(N5,5)) + 10.0
```

```
ISN 0041            RG=1
ISN 0042            N1=NUMSTM(1)
ISN 0043            A(1)=0.0
ISN 0044            I=1
ISN 0045            IF(N1.EQ.0) GO TO 55
ISN 0047            DO 50 L=1,N1
ISN 0048            I=I+1
ISN 0049            A(I)=STMBGN(L,1)
ISN 0050            I=I+1
ISN 0051            A(I)=STMEND(L,1)
ISN 0052         50 CONTINUE
ISN 0053         55 CONTINUE
ISN 0054            NA=I+1
ISN 0055            A(NA)=ENDPT
ISN 0056            NY=NA
ISN 0057            DO 65 I=1,NY
ISN 0058            Y(I)=A(I)
ISN 0059         65 CONTINUE
ISN 0060         75 CONTINUE
ISN 0061            I=1
ISN 0062            B(1)=0.0
ISN 0063            RG=RG+1
ISN 0064            N2=NUMSTM(RG)
ISN 0065            IF(N2.EQ.0) GO TO 105
ISN 0067            DO 100 L=1,N2
ISN 0068            I=I+1
ISN 0069            B(I)=STMBGN(L,RG)
ISN 0070            I=I+1
ISN 0071            B(I)=STMEND(L,RG)
ISN 0072        100 CONTINUE
ISN 0073        105 CONTINUE
ISN 0074            NB=I+1
ISN 0075            B(NB)=ENDPT
ISN 0076            IF(RG.EQ.2) GO TO 130
ISN 0078            NZ=NB
ISN 0079            DO 110 I=1,NZ
ISN 0080            Z(I)=B(I)
ISN 0081        110 CONTINUE
ISN 0082            CALL FCORAY(Y,Z,E,NY,NZ,NE)
ISN 0083            IF(RG.LT.5) GO TO 120
ISN 0085            NE=NE-2
ISN 0086            IF(E(NE+1).LE.ENDMON) GO TO 117
ISN 0088            DO 115 I=2,NE,2
ISN 0089            IF(X(I).GT.ENDMON) GO TO 116
ISN 0091        115 CONTINUE
ISN 0092            GO TO 117
ISN 0093        116 NE=I-2
ISN 0094        117 NTE=NE+1
ISN 0095            NE=NE/2
ISN 0096            WRITE(7,802) YEAR,MONTH,NE
ISN 0097            WRITE(6,802) YEAR,MONTH,NE
ISN 0098            WRITE(7,801) (E(I),I=2,NTE)
ISN 0099            WRITE(6,801) (E(I),I=2,NTE)
ISN 0100        802 FORMAT(2I4,'EAST',I4,10X,'STORMS ON EAST BRANCH',33X)
ISN 0101            GO TO 130
ISN 0102        120 NY=NE
ISN 0103            DO 125 I=1,NE
ISN 0104            Y(I)=E(I)
ISN 0105        125 CONTINUE
ISN 0106        130 CONTINUE
ISN 0107            CALL FCORAY(A,B,X,NA,NB,NX)
ISN 0108            IF(RG.EQ.5) GO TO 200
ISN 0110            NA=NX
ISN 0111            DO 150 J=1,NX
ISN 0112            A(J)=X(J)
ISN 0113        150 CONTINUE
ISN 0114            IF(RG.NE.3) GO TO 75
ISN 0116            NW=NX-2
ISN 0117            IF(X(NW+1).LE.ENDMON) GO TO 165
ISN 0119            DO 155 I=2,NW,2
ISN 0120            IF(X(I).GT.ENDMON) GO TO 160
ISN 0122        155 CONTINUE
ISN 0123            GO TO 165
ISN 0124        160 NW=I-2
ISN 0125        165 NTW=NW+1
ISN 0126            NW=NW/2
ISN 0127            WRITE(7,800) YEAR,MONTH,NW
ISN 0128            WRITE(6,800) YEAR,MONTH,NW
ISN 0129            WRITE(7,801) (X(I),I=2,NTW)
ISN 0130            WRITE(6,801) (X(I),I=2,NTW)
ISN 0131        800 FORMAT(2I4,'WEST',I4,10X,'STORMS ON WEST BRANCH',33X)
ISN 0132        801 FORMAT(10F8.3)
ISN 0133            GO TO 75
ISN 0134        200 CONTINUE
ISN 0135            WRITE(6,805)
ISN 0136        805   FORMAT('ONX IS THE NUMBER OF BEGIN AND END TIMES FOR THIS MONTH'
                     +/'0AND AT LEAST THE NEXT FOUR DAYS OF NEXT MONTH'/
```

```
                +'0THE FIRST TIME IS THE BEGIN TIME OF THIS MONTH'/
                +'0THE REST ARE BEGIN THEN END TIMES FOR STORMS'/)
ISN 0137         WRITE(6,803) NX,(X(I),I=1,NX)
ISN 0138       803 FORMAT('0NX =',I3,5X,'X(I)'/(' ',10F8.3))
ISN 0139         NDEX=NX-2
ISN 0140         IF(X(NDEX+1).LE.ENDMON) GO TO 275
ISN 0142         DO 225 I=2,NDEX,2
ISN 0143         IF(X(I).GT.ENDMON) GO TO 250
ISN 0145       225 CONTINUE
ISN 0146         WRITE(6,6000)
ISN 0147      6000 FORMAT('1*****     SUBROUTINE STORMY MAY NOT HAVE RECORDED',
                1            ' ALL STORM EVENTS INVOLVED IN THE LAST STORM'/
                2       '      OF THIS MONTH. TO REPROCESS THIS MONTH,',
                3            ' INCREASE THE VARIABLE MLAG IN STORMY TO A'/
                4       '      NUMBER (OF DAYS) THAT WILL SURELY INCLUDE',
                5            ' ALL EVENTS PERTINENT TO THIS (OVERLAPPING)'/
                6       '      STORM. THE VALUE OF MLAG IS SET IN A DATA',
                7            ' STATEMENT IN STORMY.')
ISN 0148         GO TO 275
ISN 0149       250 CONTINUE
ISN 0150         NDEX=I-2
ISN 0151       275 CONTINUE
ISN 0152         BGNTIM=(X(NDEX+1)-ENDMON)*12.
ISN 0153         IF(BGNTIM.LT.0.0) BGNTIM=0.0
ISN 0155         NYEAR=YEAR
ISN 0156         NMONTH=MONTH+1
ISN 0157         IF(MONTH.NE.12) GO TO 280
ISN 0159         NYEAR=YEAR+1
ISN 0160         NMONTH=1
ISN 0161      280  WRITE(6,804) NYEAR,NMONTH,BGNTIM
ISN 0162      804  FORMAT('0NEXT YEAR,NEXT MONTH, AND THE BEGIN TIME FOR PROCESSING '
                +,'NEXT MONTH FOLLOW'/2I3,F10.2)
ISN 0163         NSTORM=NDEX/2
ISN 0164         J=1
ISN 0165         DO  500 LL=1,NSTORM
ISN 0166         J=J+2
ISN 0167         DATE(LL)=X(J-1)/24 + 1
ISN 0168         DO 400 RG=1,5
ISN 0169         KK=K(RG)
ISN 0170         NN=NUMSTM(RG)
ISN 0171         DO 300 L=KK,NN
ISN 0172         IF(STMBGN(L,RG).GT.X(J)) GO TO 350
ISN 0174         IF(STMEND(L,RG).LT.X(J-1)) GO TO 400
ISN 0176         AMT(LL,RG)=AMT(LL,RG)+STMAMT(L,RG)
ISN 0177         DUR(LL,RG)=STMEND(L,RG)-STMBGN(KK,RG)
ISN 0178         INDEX(LL,RG)=L
ISN 0179       300 CONTINUE
ISN 0180         GO TO 400
ISN 0181       350 K(RG)=L
ISN 0182       400 CONTINUE
ISN 0183       500 CONTINUE
               C*****
               C          THIS SECTION OUTPUTS IN PUNCHED CARD THE INDIVIDUAL
               C     STORM RAIN AND TIME.
               C*****
ISN 0184         DO 600 LL=1,NSTORM
ISN 0185         DO 600 RG=1,5
ISN 0186         IF(RG.EQ.1.AND.LL.EQ.1) WRITE(6,6001)
ISN 0188      6001   FORMAT('0THE FOLLOWING DATA IS ALSO PUNCHED ON CARDS'/
                +'0IT IS THE TIME AND RAIN GAGE READINGS'/
                +'0FIRST FOR THE GAUGES OF THE EAST BRANCH, THEN FOR THE GAUGES OF'
                +,'THE WEST BRANCH'/)
ISN 0189         INDX=INDEX(LL,RG)
ISN 0190         IF(INDX.EQ.0) GO TO 525
ISN 0192         IF(INDX.EQ.LST(RG)) GO TO 550
               C*****     MULTIPLE STORMS ARE PARTS OF ONE COMPOSITE STORM.
ISN 0194         IC=LST(RG)
ISN 0195       510 IC=IC+1
ISN 0196         IF(INDX.EQ.IC) GO TO 575
ISN 0198         IF(IC.LT.NUMSTM(RG)) GO TO 510
ISN 0200         WRITE(6,6005) MONTH,YEAR,RG,LL,INDX,LST(RG),IC,NUMSTM(RG)
ISN 0201      6005 FORMAT('1*****  ERROR IN INDIVIDUAL STORM READINGS FOR',I3,'/',I2/
                1       8X,'RG   LL   INDEX(LL,RG)   LST(RG)   IC   NUMSTM(RG)'/
                2       8X,I2,I5,I9,I12,I9,I7)
ISN 0202         GO TO 600
ISN 0203       525 CONTINUE
               C*****     NO STORM AT RAIN GAGE(RG) FOR COMPOSITE STORM(LL).
ISN 0204         NREAD=0
ISN 0205         CALL PUNCH(RG,LL,NREAD)
ISN 0206         GO TO 600
ISN 0207       550 CONTINUE
               C*****     PUNCH STORM(LL) FOR RAIN GAGE(RG).
ISN 0208         CALL PUNCH(RG,LL,NREADS(LST(RG),RG),SRAIN(1,LST(RG),RG),
                1                                    STIME(1,LST(RG),RG))
ISN 0209         LST(RG)=LST(RG)+1
ISN 0210         GO TO 600
ISN 0211       575 CONTINUE
```

```
                C*****    PUNCH MULTIPLE STORMS WHICH MAKE UP ONE COMPOSITE STORM.
ISN 0212            LSTM=LST(RG)
ISN 0213            MSTM=LSTM+1
ISN 0214            LAST=0
ISN 0215            J=NREADS(LSTM,RG)
ISN 0216            ADD=0.0
ISN 0217            DO 585 M=MSTM,IC
ISN 0218            ADD=ADD+SRAIN(NREADS(M-1,RG),M-1,RG)
ISN 0219            LAST=J
ISN 0220            NREAD=NREADS(M,RG)
ISN 0221            DO 580 I=2,NREAD
ISN 0222            J=J+I-1
ISN 0223            SRAIN(J,LSTM,RG) = SRAIN(I,M,RG) + ADD
ISN 0224          580 CONTINUE
ISN 0225            CALL STORE(STIME(2,M,RG),STIME(LAST+1,LSTM,RG),NREAD-1)
ISN 0226          585 CONTINUE
ISN 0227            CALL PUNCH(RG,LL,J,SRAIN(1,LSTM,RG),STIME(1,LSTM,RG))
ISN 0228            LST(RG)=IC+1
ISN 0229          600 CONTINUE
ISN 0230            WRITE(6,700) MONTH,YEAR
ISN 0231          700 FORMAT('1',28X,'WALKER BRANCH STORM PRECIPITATION FOR ',I2,'/',I2/
                     1       ' ',38X,'PRECIPITATION IN INCHES'/
                     2       ' ',38X,'   DURATION IN HOURS'/
                     3       '0STORM DATE',42X,'GAGE',25X,'AREA WEIGHTED AVERAGES')
ISN 0232            DURETL=0.0
ISN 0233            DURWTL=0.0
ISN 0234            WAETOT=0.0
ISN 0235            WAWTOT=0.0
ISN 0236            DO  925 L=1,NSTORM
ISN 0237            DURE(L)=0.0
ISN 0238            DURW(L)=0.0
ISN 0239            WAE(L)=0.0
ISN 0240            WAW(L)=0.0
ISN 0241            DO 900 RG=1,5
ISN 0242            WAE(L)=WAE(L)+AE(RG)*AMT(L,RG)
ISN 0243            WAW(L)=WAW(L)+AW(RG)*AMT(L,RG)
ISN 0244            DURE(L)=DURE(L)+AE(RG)*DUR(L,RG)
ISN 0245            DURW(L)=DURW(L)+AW(RG)*DUR(L,RG)
ISN 0246          900 CONTINUE
ISN 0247            WAE(L)=WAE(L)/TOTAE
ISN 0248            WAW(L)=WAW(L)/TOTAW
ISN 0249            WAETOT=WAETOT+WAE(L)
ISN 0250            WAWTOT=WAWTOT+WAW(L)
ISN 0251            DURE(L)=DURE(L)/TOTAE
ISN 0252            DURW(L)=DURW(L)/TOTAW
ISN 0253            DURETL=DURETL+DURE(L)
ISN 0254            DURWTL=DURWTL+DURW(L)
ISN 0255          925 CONTINUE
ISN 0256            DO 950 RG=1,5
ISN 0257            TOTAMT(RG)=0.0
ISN 0258            TOTDUR(RG)=0.0
ISN 0259            DO 950 L=1,NSTORM
ISN 0260            TOTAMT(RG)=TOTAMT(RG)+AMT(L,RG)
ISN 0261            TOTDUR(RG)=TOTDUR(RG)+DUR(L,RG)
ISN 0262          950 CONTINUE
ISN 0263            WRITE(6,725) (RG,RG=1,5)
ISN 0264            WRITE(6,726)
ISN 0265          725 FORMAT('0',10X,I7,4I13,12X,'E. BRANCH',3X,'W. BRANCH')
ISN 0266          726 FORMAT('0',11X,5('PR.    DUR.    '),5X,2('PR.    DUR.    '))
ISN 0267            DO 1000 L=1,NSTORM
ISN 0268            WRITE(6,727) DATE(L),(AMT(L,RG),DUR(L,RG),RG=1,5),
                    1                    WAE(L),DURE(L),WAW(L),DURW(L)
ISN 0269         1000 CONTINUE
ISN 0270          727 FORMAT(' ',I5,5X,5(F4.1,1X,F5.1,3X),5X,2(F4.1,1X,F5.1,3X))
ISN 0271            WRITE(6,728) (TOTAMT(RG),TOTDUR(RG),RG=1,5),WAETOT,DURETL,WAWTOT,
                    1                                                       DURWTL
ISN 0272          728 FORMAT(7HOTOTALS,4X,5(F4.1,1X,F5.1,3X),5X,2(F4.1,1X,F5.1,3X))
ISN 0273            CALL TABLE3(NSTORM)
ISN 0274            CALL CORREL
ISN 0275            RETURN
ISN 0276            END
```

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LEVEL  21.6  (DEC 72)                          OS/360  FORTRAN H

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                             SOURCE,BCD,NOLIST,NODECK,LOAD,MAP,NOEDIT,NOID,XREF
   ISN 0002            SUBROUTINE TABLE3(N)
   ISN 0003            COMMON/GAMMA /WAE(50),WAW(50),MONTH,YEAR
   ISN 0004            INTEGER YEAR
   ISN 0005            INTEGER TALLY(2,31)
   ISN 0006            DO 1 I=1,62
   ISN 0007          1 TALLY(I,1)=0
   ISN 0008            DO 100 K=1,2
   ISN 0009            DO 100 L=1,N
   ISN 0010            X=WAE(L)
   ISN 0011            IF(K.EQ.2)  X=WAW(L)
   ISN 0013            IF(X.EQ.0.0) GO TO 100
   ISN 0015            IF(X.LE.0.5) GO TO   5
   ISN 0017            IF(X.LE.1.0) GO TO  10
   ISN 0019            IF(X.LE.1.5) GO TO  15
   ISN 0021            IF(X.LE.2.0) GO TO  20
   ISN 0023            IF(X.LE.3.0) GO TO  30
   ISN 0025            IF(X.LE.4.0) GO TO  40
   ISN 0027            IF(X.LE.5.0) GO TO  50
   ISN 0029            J=8
   ISN 0030            GO TO 75
   ISN 0031          5 J=1
   ISN 0032            GO TO 75
   ISN 0033         10 J=2
   ISN 0034            GO TO 75
   ISN 0035         15 J=3
   ISN 0036            GO TO 75
   ISN 0037         20 J=4
   ISN 0038            GO TO 75
   ISN 0039         30 J=5
   ISN 0040            GO TO 75
   ISN 0041         40 J=6
   ISN 0042            GO TO 75
   ISN 0043         50 J=7
   ISN 0044         75 TALLY(K,J)=TALLY(K,J)+1
   ISN 0045        100 CONTINUE
   ISN 0046            WRITE(6,620)
   ISN 0047        620 FORMAT('2')
   ISN 0048            WRITE(6,600)
   ISN 0049        600 FORMAT('0',36X,        'NUMBER OF STORMS BY CLASSES')
   ISN 0050            WRITE(6,605)
   ISN 0051        605 FORMAT('0',11X'CLASS UPPER LIMIT, AREA WTD. PRECIPITATION'/
                      1       ' ',11X'INCHES          0.5     1.0     1.5     2.0     3.0     4
                      2.0     5.0     6.0'/
                      3       ' ',11X'MILLIMETERS    13.0    25.0    38.0    51.0    76.0   102
                      4.0   127.0   152.0')
   ISN 0052            WRITE(6,610) (TALLY(2,J),J=1,8)
   ISN 0053            WRITE(6,615) (TALLY(1,J),J=1,8)
   ISN 0054        610 FORMAT('0','W. BRANCH'/' ',4X,'TOTAL'16X,8(I2,5X))
   ISN 0055        615 FORMAT('0','E. BRANCH'/' ',4X,'TOTAL'16X,8(I2,5X))
   ISN 0056            RETURN
   ISN 0057            END
```

```
LEVEL  21.6  (DEC 72)                          OS/360  FORTRAN H

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                             SOURCE,BCD,NOLIST,NODECK,LOAD,MAP,NOEDIT,NOID,XREF
   ISN 0002            SUBROUTINE PUNCH(IRG,L,N,R,IT)
   ISN 0003            DIMENSION R(1),IT(1)
   ISN 0004            WRITE(7,700) IRG,L,N
   ISN 0005            IF(IRG.EQ.1.OR.IRG.EQ.3) WRITE(7,700) IRG,L,N
   ISN 0007            WRITE(6,701) IRG,L,N
   ISN 0008            IF(N.EQ.0) GO TO 10
   ISN 0010            WRITE(7,705) (R(I),IT(I),I=1,N)
   ISN 0011            IF(IRG.EQ.1.OR.IRG.EQ.3) WRITE(7,705) (R(I),IT(I),I=1,N)
   ISN 0013            WRITE(6,706) (R(I),IT(I),I=1,N)
   ISN 0014        700 FORMAT(I2,2X,I2,2X,I3,69X)
   ISN 0015        701 FORMAT('0',I2,2X,I2,2X,I3,69X)
   ISN 0016        705 FORMAT(10(F3.1,I5))
   ISN 0017        706 FORMAT((' ',10(F3.1,I5)/))
   ISN 0018         10 CONTINUE
   ISN 0019            RETURN
   ISN 0020            END
```

```
LEVEL  21.6  (DEC 72)                          OS/360  FORTRAN H

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                             SOURCE,BCD,NOLIST,NODECK,LOAD,MAP,NOEDIT,NOID,XREF
   ISN 0002            SUBROUTINE FCORAY(A,B,C,NA,NB,NC)
   ISN 0003            DIMENSION A(NA),B(NB),C(NC)
   ISN 0004            NC=0
   ISN 0005            IF(NA.LE.0) GO TO 500
   ISN 0007            IF(NB.LE.0) GO TO 500
   ISN 0009            IF(NA.NE.NB) GO TO 100
   ISN 0011            DO 50 I=1,NA
   ISN 0012            IF(A(I).NE.B(I)) GO TO 100
   ISN 0014            C(I)=A(I)
   ISN 0015         50 CONTINUE
   ISN 0016            NC=NA
   ISN 0017            GO TO 500
   ISN 0018        100 CONTINUE
                  C*****
                  C          'I' IS INDEX ON A, I=1,NA
                  C          'J' IS INDEX ON B, J=1,NB
                  C          'K' IS INDEX ON C, K=1,NC
                  C*****
   ISN 0019            I=1
   ISN 0020            J=1
   ISN 0021            K=1
   ISN 0022        200 CONTINUE
   ISN 0023            IF(A(I)-B(J)) 215,210,205
   ISN 0024        205 IF(A(I).LT.B(J+1)) GO TO 210
   ISN 0026            J=J+2
   ISN 0027            GO TO 300
   ISN 0028        210 C(K)=A(I)
   ISN 0029            GO TO 225
   ISN 0030        215 IF(B(J).LT.A(I+1)) GO TO 220
   ISN 0032            I=I+2
   ISN 0033            GO TO 300
   ISN 0034        220 C(K)=B(J)
   ISN 0035        225 K=K+1
   ISN 0036            IF(A(I+1).GT.B(J+1)) GO TO 230
   ISN 0038            C(K)=A(I+1)
   ISN 0039            I=I+2
   ISN 0040            GO TO 250
   ISN 0041        230 C(K)=B(J+1)
   ISN 0042            J=J+2
   ISN 0043        250 K=K+1
   ISN 0044        300 IF(I.GT.NA) GO TO 450
   ISN 0046            IF(J.LT.NB) GO TO 200
   ISN 0048        450 CONTINUE
   ISN 0049            NC=K-1
   ISN 0050        500 RETURN
   ISN 0051            END
```

```
LEVEL  21.6  (DEC 72)                          OS/360  FORTRAN H

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                             SOURCE,BCD,NOLIST,NODECK,LOAD,MAP,NOEDIT,NOID,XREF
   ISN 0002            SUBROUTINE CORREL
   ISN 0003            COMMON/GAMMA /DUM(100),MONTH,YEAR
   ISN 0004            COMMON/FIX   /DUMDUM(750),AMT(50,5),DUMMY(550),NSTORM
   ISN 0005            COMMON/WKCORL/WKRAIN,LWEEKS
   ISN 0006            DIMENSION WKRAIN(7,5)
   ISN 0007            DIMENSION        SXIXJ(5,5),SUMX(5),SUMX2(5),X(50,5)
   ISN 0008            INTEGER YEAR
   ISN 0009            IPATH=0
   ISN 0010            DO 10 IRG=1,5
   ISN 0011            DO 10 I=1,NSTORM
   ISN 0012            X(I,IRG)=AMT(I,IRG)
   ISN 0013         10 CONTINUE
   ISN 0014            N=NSTORM
   ISN 0015         25 CONTINUE
   ISN 0016            DO 50 IRG=1,5
   ISN 0017            SUMX(IRG)=0.0
   ISN 0018            SUMX2(IRG)=0.0
   ISN 0019            DO 50 L=1,N
   ISN 0020            SUMX(IRG)=SUMX(IRG)+ X (L,IRG)
   ISN 0021            SUMX2(IRG)=SUMX2(IRG)+ X (L,IRG)* X (L,IRG)
   ISN 0022         50 CONTINUE
   ISN 0023            DO 100 I=1,4
   ISN 0024            J1=I+1
   ISN 0025            DO 100 J=J1,5
   ISN 0026            SXIXJ(I,J)=0.0
   ISN 0027            DO 75 L=1,N
```

```
ISN 0028            SXIXJ(I,J)=SXIXJ(I,J)+ X (L,I)* X (L,J)
ISN 0029          75 CONTINUE
ISN 0030         100 CONTINUE
ISN 0031             IF(IPATH.EQ.1) GO TO 105
ISN 0033             WRITE(6,600) MONTH,YEAR
ISN 0034         600 FORMAT('1 SUMS FOR CORRELATION COEFFICIENTS FOR STORMS OF'
                    1        I3,'/',I2)
ISN 0035             GO TO 110
ISN 0036         105 CONTINUE
ISN 0037             WRITE(6,1600) MONTH,YEAR
ISN 0038        1600 FORMAT('0 SUMS FOR CORRELATION COEFFICIENTS, WEEKLY, FOR',
                    1       I3,'/',I2)
ISN 0039         110 CONTINUE
ISN 0040             IF(IPATH.EQ.1) GO TO 115
ISN 0042             WRITE(6,615) NSTORM
ISN 0043         615 FORMAT('ONUMBER OF STORMS, N =',I2)
ISN 0044             GO TO 120
ISN 0045         115 CONTINUE
ISN 0046             WRITE(6,1615) LWEEKS
ISN 0047        1615 FORMAT('ONUMBER OF WEEKS, N =',I2)
ISN 0048         120 CONTINUE
ISN 0049             WRITE(6,620) (I,I=1,5)
ISN 0050         620 FORMAT('0SUMS(OVER N) OF:'12X,'I',I9,4I13)
ISN 0051             WRITE(6,625) (SUMX(I),I=1,5)
ISN 0052         625 FORMAT('0',17X,'X(I)',12X,5(F9.3,4X))
ISN 0053             WRITE(6,630) (SUMX2(I),I=1,5)
ISN 0054         630 FORMAT(' ',17X,'X(I)**2',9X,5(F9.3,4X))
ISN 0055             WRITE(6,635) SUMX2(1),(SXIXJ(1,J),J=2,5)
ISN 0056         635 FORMAT(' ',17X,'X(I)*X(1)',7X,5(F9.3,4X))
ISN 0057             WRITE(6,640) SUMX2(2),(SXIXJ(2,J),J=3,5)
ISN 0058         640 FORMAT(' ',17X,'X(I)*X(2)',20X,4(F9.3,4X))
ISN 0059             WRITE(6,645) SUMX2(3),(SXIXJ(3,J),J=4,5)
ISN 0060         645 FORMAT(' ',17X,'X(I)*X(3)',33X,3(F9.3,4X))
ISN 0061             WRITE(6,650) SUMX2(4),SXIXJ(4,5)
ISN 0062         650 FORMAT(' ',17X,'X(I)*X(4)',46X,2(F9.3,4X))
ISN 0063             WRITE(6,655) SUMX2(5)
ISN 0064         655 FORMAT(' ',17X,'X(I)*X(5)',59X,F9.3)
ISN 0065             IF(IPATH.EQ.1) RETURN
ISN 0067             IPATH=1
ISN 0068             DO 200 IRG=1,5
ISN 0069             DO 200 I=1,LWEEKS
ISN 0070             X(I,IRG)=WKRAIN(I,IRG)
ISN 0071         200 CONTINUE
ISN 0072             N=LWEEKS
ISN 0073             GO TO 25
ISN 0074             END
```

```
LEVEL  21.6  (DEC 72)                          OS/360  FORTRAN H

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                             SOURCE,BCD,NOLIST,NODECK,LOAD,MAP,NOEDIT,NOID,XREF
ISN 0002             SUBROUTINE READER(RG,ITOT,RAIN,TIME,YEAR,MONTH)
                C*****
                C          'READER' READS THE REDUCED R.G. FOR MONTH N, THE MONTH
                C     UNDER CONSIDERATION.
ISN 0003             DIMENSION RAIN(300),TIME(300)
ISN 0004             DIMENSION R(300,5) ,T(300,5) ,KTOT(5)
ISN 0005             INTEGER RG,ONE,YEAR,TIME,T
ISN 0006             IF(RG.NE.1) GO TO 100
ISN 0008             DO  25 IRG=1,5
ISN 0009             ONE=1
ISN 0010             NINE=9
ISN 0011             READ(5,525) YEAR,MONTH,KTOT(IRG)
ISN 0012          10 CONTINUE
ISN 0013             IF(NINE.GT.KTOT(IRG)) NINE=KTOT(IRG)
ISN 0015             READ(5,550) (T(I,IRG),R(I,IRG),I=ONE,NINE)
ISN 0016             IF(NINE.EQ.KTOT(IRG)) GO TO 25
ISN 0018             ONE=ONE+9
ISN 0019             NINE=NINE+9
ISN 0020             GO TO 10
ISN 0021          25 CONTINUE
ISN 0022         100 CONTINUE
ISN 0023             ITOT=KTOT(RG)
ISN 0024             DO 200 I=1,ITOT
ISN 0025             RAIN(I)=R(I,RG)
ISN 0026             TIME(I)=T(I,RG)
ISN 0027         200 CONTINUE
ISN 0028         525 FORMAT(2I2,12X,I3)
ISN 0029         550 FORMAT(8X,9(I4,F4.1))
ISN 0030             RETURN
ISN 0031             END
```

```
LEVEL  21.6  (DEC 72)                          OS/360  FORTRAN H

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                             SOURCE,BCD,NOLIST,NODECK,LOAD,MAP,NOEDIT,NOID,XREF
   ISN 0002            BLOCK DATA
   ISN 0003            COMMON/BETA  /STMAMT%50,5<,STMBGN%50,5<,STMEND%50,5<,NUMSTM%5<
   ISN 0004            COMMON/DELTA /TABLE %32,5<,TABMET%32,5<
   ISN 0005            COMMON/FIX   /A%250<,B%250<,X%250<,AMT%50,5<,DUR%50,5<,
                      1              DATE%50<,INDEX%50,5<,NSTORM
   ISN 0006            DATA STMAMT,STMBGN,STMEND,TABLE,A,B,X,AMT,DUR/2160*0.0/
   ISN 0007            DATA NUMSTM,DATE,INDEX/305*0/
   ISN 0008            END
```

```
LEVEL  21.6  (DEC 72)                          OS/360  FORTRAN H

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                             SOURCE,BCD,NOLIST,NODECK,LOAD,MAP,NOEDIT,NOID,XREF
   ISN 0002            SUBROUTINE STORE(SOURCE,OBJECT,LENGTH)
   ISN 0003            DIMENSION SOURCE(1),OBJECT(1)
   ISN 0004            DO 10 I=1,LENGTH
   ISN 0005            OBJECT(I)=SOURCE(I)
   ISN 0006         10 CONTINUE
   ISN 0007            RETURN
   ISN 0008            END
```

Section D

Streamflow Reduction Program

of the Snyder and Curlin Hydrograph Analysis Package

```
LEVEL  21.6  (DEC 72)                          OS/360  FORTRAN H

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                             SOURCE,BCD,NOLIST,NODECK,LOAD,MAP,NOEDIT,NOID,XREF
                C****
                C         STREAM FLOW DATA REDUCTION
                C****
   ISN 0002           DIMENSION DUM(24),IDUM(24)
   ISN 0003           INTEGER ODDAYS,ENDAYS
   ISN 0004           INTEGER TIME
   ISN 0005           INTEGER DAY,DOW,YEAR,CNO,DAYI(400),CNOI(400),RDNI(400)
   ISN 0006           DIMENSION NDAYS(12),SIDE(2)
   ISN 0007           DATA NDAYS/31,28,31,30,31,30,31,31,30,31,30,31/
   ISN 0008           COMMON/TABLEC/ MONTH,YEAR,AVGFLO(32,2),AVGVOL(32,2)
   ISN 0009           COMMON/MAXONE/FLOW(5000),TIME(5000),IDXBGN(50),IDXEND(50),
                     1             TALLY(10,2),HBGN(2),DUMMY(10),NSTM,ITOT,IBRNCH,
                     2             FCOVER(2),ODDAYS,STMBGN(50,2),STMEND(50,2)
   ISN 0010           COMMON/MAXTWO/FLOMAX(50,2),FLOMIN(50,2),STMVOL(50,2),
                     1             STMDAT(50),TOTMAX(2),TOTMIN(2),NSTORM
   ISN 0011           DATA SIDE/'EAST','WEST'/
   ISN 0012           LOGICAL ERROR
   ISN 0013           CALL ZERO(AVGFLO,512)
   ISN 0014           CALL ZERO(FLOMAX,1200)
   ISN 0015           CALL ZERO(TALLY,80)
   ISN 0016           CONST=4.43*2.5**2.449
                C*****
                C       HBGN(1) = INTEGER PART OF FLOW READING AT THE BEGINNING
                C                 OF THE MONTH ON THE EAST BRANCH.
                C       HBGN(2) = SAME FOR WEST BRANCH.
                C
                C       NSTM = NUMBER OF STORMS RECORDED FOR THE BRANCH BEING PROCESSED.
                C
                C       STMBGN(I), I=1,NSTM = BEGIN TIMES FOR STORMS ON THE BRANCH
                C                             BEING PROCESSED.
                C       STMEND(I), I=1,NSTM = END TIMES FOR STORMS.
                C
                C       SIDE(1) = 'EAST', FOR OUTPUT PURPOSES
                C       SIDE(2) = 'WEST'.
                C*****
                C*****
                C      IDUM(24)      AN ARRAY TO STORE TEMPORARILY THE VALUES
                C                       OF STREAM FLOW READINGS (IN FEET) AS
                C                       THEY ARE READ FROM CARDS.
                C      DUM(24)       AN ARRAY TO STORE FLOW READINGS TEMPORARILY
                C                       AFTER CONVERSION TO CFS.
                C*****
                C*****
                C         SECTION OF CODING FROM STATEMENT 250 TO STATEMENT 300
                C     CALCULATES AVERAGE DAILY FLOW AND VOLUME. SECTION FROM
                C     250 TO 275 IS AN ATTEMPT TO KEEP THE PROGRAM GOING IF DATA
                C     IS MISSING. THIS SECTION COULD BE REMOVE IF THERE IS A
                C     DATA EDITING AND CORRECTION STEP TO EACH MONTH'S PROCESSING
                C     WHICH WOULD REPLACE ALL MISSING DATA.
                C*****
                C*****
                C       ODDAYS = NUMBER OF DAYS AT THE END OF THE PRECEDING MONTH
                C                WHICH DID NOT MAKE A FULL WEEK; THEREFORE, THEY
                C                WILL BE A PART OF THE FIRST WEEK IN THIS MONTH.
                C                ODDAYS IS PART OF INPUT DATA FOR THIS MONTH.
                C
                C       ENDAYS = NUMBER OF DAYS AT THE END OF THIS MONTH WHICH DO
                C                NOT MAKE A FULL WEEK. ENDAYS IS CALCULATED AND
                C                PRINTED TO BE USED AS ODDAYS OF THE NEXT MONTH.
                C*****
                C*****
                C       FCOVER(1) = SUM OF AVERAGE DAILY FLOW DURING THE DAYS IN
                C       FCOVER(2)   THE PRECEDING MONTH WHICH ARE REPRESENTED BY
                C                   ODDAYS. FCOVER WILL MAKE UP A PART OF THE
                C                   AVERAGE WEEKLY FLOW FOR THE FIRST WEEK IN THIS
                C                   MONTH. (DONE IN SUBROUTINE TABLE) FCOVER IS
                C                   PART OF THE INPUT DATA FOR THIS MONTH.
                C
                C       ECOVR1  = SUM OF AVERAGE DAILY FLOW DURING THE DAYS IN
                C       ECOVR2    THIS MONTH WHICH ARE REPRESENTED BY ENDAYS.
                C                 ECOVER1 AND ECOVER2 ARE CALCULATED AND
                C                 PRINTED TO BE USED AS FCOVER(1) AND FCOVER(2)
                C                 OF THE NEXT MONTH.
                C*****
   ISN 0017           NTAPE=5
   ISN 0018         1000 CONTINUE
   ISN 0019           READ(NTAPE,500) YEAR,MONTH,IRUN
   ISN 0020          500 FORMAT(3I4)
   ISN 0021           IF(MOD(YEAR,4).EQ.0) NDAYS(2)=29
   ISN 0023           READ(NTAPE,501) HBGN
   ISN 0024          501 FORMAT(2F5.0)
   ISN 0025           READ(NTAPE,504) FCOVER,ODDAYS
   ISN 0026          504 FORMAT(2F10.5,I5,55X)
```

```
C*****      ENDMON = LENGTH OF THE MONTH BEING PROCESSED, IN HOURS.
ISN 0027        ENDMON=24.0*NDAYS(MONTH)
C*****
C         IBRNCH = 1 FOR EAST BRANCH
C         IBRNCH = 2 FOR WEST BRANCH
C*****
ISN 0028        DO 100 IBRNCH=1,2
ISN 0029        SAVET=0.
ISN 0030        WRITE(6,6007)
ISN 0031     6007 FORMAT('1*****  STREAM FLOW DATA  *****'/'0')
ISN 0032        READ(NTAPE,502) IY,IM,BRANCH,NSTM
ISN 0033      502 FORMAT(2I4,A4,I4)
ISN 0034        IF(IY.NE.YEAR) GO TO 10
ISN 0036        IF(IM.NE.MONTH) GO TO 10
ISN 0038        IF(BRANCH.NE.SIDE(IBRNCH)) GO TO 10
ISN 0040        IF(NSTM.EQ.0) GO TO 13
ISN 0042        READ(NTAPE,503) (STMBGN(I,IBRNCH),STMEND(I,IBRNCH),I=1,NSTM)
ISN 0043      503 FORMAT(10F8.0)
ISN 0044        GO TO 15
ISN 0045       10 CONTINUE
ISN 0046        WRITE(6,6020) YEAR,MONTH,SIDE(IBRNCH),IY,IM,BRANCH
ISN 0047     6020 FORMAT('0***** DATA ERROR, STORM BEGIN/END CARD INCORRECT',/
                1       ' YEAR, MONTH, SIDE =',2I4,2X,A4/
                2       ' IYEAR, IMONTH, BRANCH =',2I4,2X,A4)
ISN 0048        GO TO 1500
ISN 0049       13 STMBGN(1,IBRNCH)=ENDMON
ISN 0050       15 CONTINUE
C*****     INITIALIZATION
ISN 0051        AVG=0.0
ISN 0052        N24=24
ISN 0053        NPOINT=0
ISN 0054        I=1
ISN 0055        ISTM=1
ISN 0056        CRTIME=STMBGN(1,IBRNCH)
ISN 0057        UNIT=32
ISN 0058        HBGNN=HBGN(IBRNCH)
ISN 0059        LDAY=0
ISN 0060        LCNO=0
ISN 0061        IPASS=0
C*****
C       READ FIRST CARD
ISN 0062        READ(NTAPE,505) DAY,DOW,CNO,IDUM
ISN 0063        HGT=IDUM(1)* 1.0E-3+HBGNN
ISN 0064        HGTLST=HGT
ISN 0065        FLOW(1)=4.43*HGT**2.449
ISN 0066        IF(HGT.GT.2.5) FLOW(1)=CONST*66.8*(HGT-2.5)**1.47
ISN 0068        TIME(1)=(DAY-1)*288+(CNO-1)*24
ISN 0069         IX=IDUM(1)
ISN 0070        GO TO 25
ISN 0071       20 READ(NTAPE,505) DAY,DOW,CNO,IDUM
ISN 0072      505 FORMAT(3X,I2,I1,I2,24I3)
ISN 0073       25 CONTINUE
ISN 0074        IF(DAY.EQ.99) GO TO 75
ISN 0076      250 CONTINUE
ISN 0077        LCNOP1=LCNO+1
ISN 0078        LDAYP1=LDAY+1
ISN 0079        IF(IRUN.EQ.0) GO TO 300
ISN 0081        IF(DAY.NE.LDAYP1) GO TO 255
ISN 0083        IF(CNO.EQ.1) AVG=0.
ISN 0085        GO TO 275
ISN 0086      255 CONTINUE
ISN 0087        NXDAY=LDAY+2
ISN 0088        NPOINT=NPOINT-(12-LCNO)*24
ISN 0089        AVGFLO(LDAYP1,IBRNCH)=AVG/NPOINT
ISN 0090        AVGVOL(LDAYP1,IBRNCH)=AVGFLO(LDAYP1,IBRNCH)*86400.
ISN 0091        AVG=0.
ISN 0092        NPOINT=0
ISN 0093        IF(DAY.EQ.NXDAY) GO TO 275
ISN 0095        MXDAY=DAY-1
ISN 0096        DO 265 IDAY=NXDAY,MXDAY
ISN 0097        WRITE(6,8001) IDAY
ISN 0098     8001 FORMAT('0AT LOOP 255, IDAY =',I3)
ISN 0099        AVGFLO(IDAY,IBRNCH)=0.0
ISN 0100        AVGVOL(IDAY,IBRNCH)=0.0
ISN 0101      265 CONTINUE
ISN 0102      275 CONTINUE
ISN 0103        DO 290 J=1,24
ISN 0104        IF(IX.LT.200 .AND. IDUM(J).GT. 800) HBGNN=HBGNN-1.
ISN 0106        IF(IX.GT. 700 .AND. IDUM(J).LT.300) HBGNN=HBGNN+1.
ISN 0108        IX=IDUM(J)
ISN 0109        HGT=IDUM(J)*1.0E-3 + HBGNN
ISN 0110        IF(HGT.GT.2.5) GO TO 280
C****      HERTZLER EQUATION, H LE 2.5
ISN 0112        DUM(J)=4.43*HGT**2.449
ISN 0113        GO TO 285
```

```
                C****      KING EQUATION, H GT 2.5, CONST = 4.43*2.5**2.449
ISN 0114          280 DUM(J)=CONST + 66.8*(HGT-2.5)**1.47
ISN 0115          285 AVG=AVG+DUM(J)
ISN 0116          290 CONTINUE
ISN 0117              NPOINT=NPOINT+N24
ISN 0118              IF(CNO.LT.12) GO TO 300
                C****      86400 SEC/DAY
ISN 0120              AVGFLO(DAY,IBRNCH)=AVG/NPOINT
ISN 0121              AVGVOL(DAY,IBRNCH)=AVGFLO(DAY,IBRNCH)*86400.
ISN 0122              AVG=0.
ISN 0123              NPOINT=0
ISN 0124          300 CONTINUE
ISN 0125              IF(MOD(DAY,4).EQ.1.AND.CNO.EQ.1) WRITE(6,6000)
ISN 0127         6000 FORMAT('1BRANCH YR MO DAY DOW CNO    1   2   3   4   5   6   7   8
                    1  9   10  11  12      13  14  15  16  17  18  19  20  21  22  23  2
                    24')
ISN 0128              IF(DAY.NE.LDAYP1) GO TO 60
ISN 0130              IF(CNO.NE.LCNOP1) GO TO 60
ISN 0132              LCNO=CNO
ISN 0133              IF(CNO.LT.12) GO TO 30
ISN 0135              LCNO=0
ISN 0136              LDAY=DAY
ISN 0137          30  WRITE(6,6005) BRANCH,YEAR,MONTH,DAY,DOW,CNO,IDUM
ISN 0138         6005 FORMAT(' ',A4,I4,I3,I4,I3,I5,1X,2(12I4,3X))
ISN 0139              IF(CNO.EQ.12) WRITE(6,6006)
ISN 0141         6006 FORMAT('0')
ISN 0142              IF(IRUN.EQ.0) GO TO 20
ISN 0144              LIMIT=(DAY-1)*288+CNO*24
ISN 0145              IF(IPASS.EQ.99) GO TO 31
ISN 0147              NEXT=TIME(I)+UNIT
ISN 0148              IF(CKTIME.LE.NEXT/12.) GO TO 45
ISN 0150              IF(NEXT.GT.LIMIT) GO TO 20
ISN 0152          31  IPASS=0
ISN 0153              INDEX=MOD(NEXT,24)
ISN 0154              IF(INDEX.EQ.0) INDEX=24
ISN 0156          32  CONTINUE
ISN 0157              I=I+1
ISN 0158              FLOW(I)=DUM(INDEX)
ISN 0159          40  TIME(I)=NEXT
ISN 0160              INDEXP=INDEX+UNIT
ISN 0161              IF(INDEXP.GT.24) GO TO 20
ISN 0163              INDEX=INDEXP
ISN 0164              NEXT=TIME(I)+UNIT
ISN 0165              IF(CKTIME.LT.NEXT/12.) GO TO 45
ISN 0167              GO TO 32
ISN 0168          45  CONTINUE
ISN 0169              IF(CKTIME.NE.STMBGN(ISTM,IBRNCH)) GO TO 55
                C*****
                C       THE DATA IS IN THE TIME OF A STORM. COMPUTE THE STORM
                C   HYDROGRAPH BASE AND TIME INTERVAL FOR RECORDING READINGS.
                C*****
ISN 0171              DUR=STMEND(ISTM,IBRNCH)-STMBGN(ISTM,IBRNCH)
ISN 0172              INT=DUR*12.0+0.1
ISN 0173              UNIT=1.
ISN 0174              BASE=6.
ISN 0175              IF(DUR.LE.1.) GO TO 50
ISN 0177              BASE=24.
ISN 0178              IF(DUR.LE.4.) GO TO 50
ISN 0180              BASE=96.
ISN 0181              IF(DUR.LE.16.) GO TO 50
ISN 0183              BASE=384.
ISN 0184          50  CONTINUE
ISN 0185              BASE=BASE+(INT-1)/12.
                C*****
                C       BASE NOW EQUALS LENGTH OF HYDROGRAPH IN HOURS.
                C*****
ISN 0186              NEXT=CKTIME*12. + .1
ISN 0187              CKTIME=CKTIME+BASE
ISN 0188              IF(CKTIME.GT.ENDMON) CKTIME=ENDMON
ISN 0190              IDXBGN(ISTM)=I+1
ISN 0191              IDXEND(ISTM)=CKTIME*12.+.1
ISN 0192              IF(SAVET.GT.CKTIME) GO TO 51
ISN 0194              SAVET=CKTIME
ISN 0195              SAVEU=UNIT
ISN 0196          51  CONTINUE
ISN 0197              ISTMP1=ISTM+1
ISN 0198              IF(ISTMP1.GT.NSTM) GO TO 53
ISN 0200              IF(CKTIME.LE.STMBGN(ISTMP1,IBRNCH)) GO TO 53
                C****      THE HYDROGRAPH OF STORM(ISTM) OVERLAPS THE HYDROGRAPH OF
                C**** STORM(ISTM+1). END THE FIRST HYDROGRAPH AT THE BEGINNING OF
                C**** THE SECOND STORM. SEPARATE THEM LATER.
ISN 0202              CKTIME=STMBGN(ISTMP1,IBRNCH)
ISN 0203              ISTM=ISTMP1
ISN 0204          53  CONTINUE
ISN 0205              IF(NEXT.LE.LIMIT) GO TO 31
ISN 0207              IPASS=99
ISN 0208              GO TO 20
```

```
ISN 0209          55 ISTM=ISTM+1
ISN 0210             UNIT=32
ISN 0211             NPATH=1
ISN 0212             IF(NEXT.LE.LIMIT) NPATH=2
ISN 0214             IF(ISTM.GT.NSTM) GO TO 58
ISN 0216             IF(CKTIME.EQ.SAVET) GO TO 57
ISN 0218             IF(STMBGN(ISTM,IBRNCH).LT.SAVET) GO TO 56
ISN 0220             CKTIME=SAVET
ISN 0221             UNIT=SAVEU
ISN 0222             ISTM=ISTM-1
ISN 0223             GO TO(20,31),NPATH
ISN 0224          56 UNIT=SAVEU
ISN 0225          57 CKTIME=STMBGN(ISTM,IBRNCH)
ISN 0226             GO TO(20,31),NPATH
ISN 0227          58 IF(CKTIME.GE.SAVET) GO TO 59
ISN 0229             CKTIME=SAVET
ISN 0230             UNIT=SAVEU
ISN 0231             GO TO(20,31),NPATH
ISN 0232          59 CKTIME=ENDMON
ISN 0233             GO TO(20,31),NPATH
ISN 0234          60 CONTINUE
                C*** RECORD(S) MISSING      CONTINUE PROCESSING
ISN 0235             WRITE(6,6010)
ISN 0236             WRITE(6,6006)
ISN 0237        6010 FORMAT('0***** DATA ERROR. RECORD(S) MISSING.')
ISN 0238             LCNO=CNO
ISN 0239             LDAY=DAY-1
ISN 0240             GO TO 30
ISN 0241          75 CONTINUE
ISN 0242             IF(IRUN.EQ.0) GO TO 100
ISN 0244             ITOT=I
ISN 0245             WRITE(6,6024) ITOT,(FLOW(I),TIME(I),I=1,ITOT)
ISN 0245             WRITE(7,6023) ITOT,(FLOW(I),TIME(I),I=1,ITOT)
ISN 0247        6023 FORMAT(I5/8(F6.3,I4))
ISN 0248        6024 FORMAT('OREDUCED STREAMFLOW DATA'/
                    +'ONO.OF STREAMFLOW DATA POINTS=',I5/
                    +'OSTREAMFLOW(CFS),THEN TIME(FIVE MINUTE PERIODS)'/
                    +3(F10.3,I6)/)
ISN 0249             CALL SORTER
ISN 0250           100 CONTINUE
ISN 0251             IF(IRUN.EQ.0) GO TO 1500
ISN 0253             ECOVR1=0.0
ISN 0254             ECOVR2=0.0
ISN 0255             LDAYS=NDAYS(MONTH)
ISN 0256             NSUM=0
ISN 0257             IF(MONTH.EQ.12) GO TO 130
ISN 0259             DO 125 IM=1,MONTH
ISN 0260             NSUM=NSUM+NDAYS(IM)
ISN 0261          125 CONTINUE
ISN 0262          130 CONTINUE
ISN 0263             ENDAYS=MOD(NSUM,7)
ISN 0264             IF(ENDAYS.EQ.0) GO TO 160
ISN 0266             K=LDAYS-ENDAYS+1
ISN 0267             DO 150 IDAY=K,LDAYS
ISN 0268             ECOVR1=ECOVR1+AVGFLO(IDAY,1)
ISN 0269             ECOVR2=ECOVR2+AVGFLO(IDAY,2)
ISN 0270          150 CONTINUE
ISN 0271          160 CONTINUE
                C**  WRITE(7,504) ECOVR1,ECOVR2,ENDAYS
ISN 0272             WRITE(6,504) ECOVR1,ECOVR2,ENDAYS
ISN 0273             CALL TABLE
ISN 0274         1500 CONTINUE
ISN 0275             GO TO 1000
ISN 0276             END
```

```
LEVEL  21.6  (DEC 72)                          OS/360  FORTRAN H

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                             SOURCE,BCD,NOLIST,NODECK,LOAD,MAP,NOEDIT,NOID,XREF
ISN 0002             SUBROUTINE TABLE
ISN 0003             COMMON/TABLEC/ MONTH,YEAR,AVGFLO(32,2),AVGVOL(32,2)
ISN 0004             COMMON/MAXONE/FLOW(5000),TIME(5000),IDXBGN(50),IDXEND(50),
                    1                TALLY(10,2),HBGN(2),LIMIT(10),NSTM,ITOT,IBRNCH,
                    2                FCOVER(2),ODDAYS,STMBGN(50,2),STMEND(50,2)
ISN 0005             COMMON/MAXTWO/FLOMAX(50,2),FLOMIN(50,2),STMVOL(50,2),
                    1                STMDAT(50),TOTMAX(2),TOTMIN(2),NSTORM
ISN 0006             INTEGER TALLY,STMDAT
ISN 0007             DIMENSION AVGFLM(32,2),AVGVOM(32,2),WKFLOW(7,2),WKFLOM(7,2),
                    1          WKVOL(7,2),WKVOM(7,2),STMVOM(50,2)
ISN 0008             DIMENSION FLOMXM(50,2),FLOMNM(50,2)
ISN 0009             REAL LIMIT,MLIMIT(10)
```

```
ISN 0010            INTEGER ONE,SEVEN,YEAR,DATE(7)
ISN 0011            INTEGER ODDAYS
ISN 0012            INTEGER NDAYS(12)/31,28,31,30,31,30,31,31,30,31,30,31/
ISN 0013            INTEGER IRAQ(2,8)/16*0/
ISN 0014            REAL VAL(8)/0.1,0.2,0.3,0.4,0.5,1.0,1.5,5.0/
ISN 0015            IF(MOD(YEAR,4).EQ.0) NDAYS(2)=29
ISN 0017            MDAYS=NDAYS(MONTH)
                C******
                C*****
                C           AVGFLO(L,IBRNCH)     TABLE OF AVERAGE DAILY FLOW.  (CFS)
                C           AVGVOL(L,IBRNCH)     TABLE OF AVERAGE DAILY VOLUME. (CU.FT.)
                C           AVGFLM(L,IBRNCH)     TABLE OF AVERAGE DAILY FLOW.  (CMS)
                C           AVGVOM(L,IBRNCH)     TABLE OF AVERAGE DAILY VOLUME. (CU.M.)
                C                                L = 1,NDAYS(MONTH)
                C*****
                C           WKFLOW(K,IBRNCH)     TABLE OF AVERAGE WEEKLY FLOW. (CFS)
                C           WKFLOM(K,IBRNCH)     TABLE OF AVERAGE WEEKLY FLOW. (CMS)
                C                                K = 1,NUMBER OF WEEKS/MONTH
                C*****
                C           ODDAYS               NUMBER OF DAYS FROM PREVIOUS MONTH
                C                           WHICH ARE A PART OF THE FIRST WEEK OF
                C                           THIS MONTH.
                C           FCOVER(IBRNCH)       AVERAGE FLOW FOR 'ODDAYS'.
                C*****
                C*****
ISN 0018            FTOT1=0.
ISN 0019            FTOT2=0.
ISN 0020            VTOT1=0.
ISN 0021            VTOT2=0.
ISN 0022            DO 100 L=1,MDAYS
ISN 0023            FTOT1=FTOT1+AVGFLO(L,1)
ISN 0024            FTOT2=FTOT2+AVGFLO(L,2)
ISN 0025            AVGFLM(L,1)=AVGFLO(L,1)*0.028317
ISN 0026            AVGFLM(L,2)=AVGFLO(L,2)*0.028317
ISN 0027            AVGVOM(L,1)=AVGVOL(L,1)*0.028317
ISN 0028            AVGVOM(L,2)=AVGVOL(L,2)*0.028317
ISN 0029            VTOT1=VTOT1+AVGVOL(L,1)
ISN 0030            VTOT2=VTOT2+AVGVOL(L,2)
ISN 0031          100 CONTINUE
ISN 0032            FTOT1=FTOT1/MDAYS
ISN 0033            FTOT2=FTOT2/MDAYS
ISN 0034            FTOTM1=FTOT1*0.028317
ISN 0035            FTOTM2=FTOT2*0.028317
ISN 0036            VTOTM1=VTOT1*0.028317
ISN 0037            VTOTM2=VTOT2*0.028317
                C*****
                C****       CALCULATE AVERAGE WEEKLY FLOW.
ISN 0038            LDAYS=0
ISN 0039            IF(MONTH.EQ.1) GO TO 125
ISN 0041            MON1=MONTH-1
ISN 0042            DO 120 IM=1,MON1
ISN 0043            LDAYS=LDAYS+NDAYS(IM)
ISN 0044          120 CONTINUE
ISN 0045          125 CONTINUE
ISN 0046            AWEEK=7.
ISN 0047            K=1
ISN 0048            WKFLOW(K,1)=FCOVER(1)
ISN 0049            WKFLOW(K,2)=FCOVER(2)
ISN 0050            ONE=1
ISN 0051            SEVEN=7-ODDAYS
ISN 0052          150 CONTINUE
ISN 0053            DO 155 L=ONE,SEVEN
ISN 0054            WKFLOW(K,1)=WKFLOW(K,1)+AVGFLO(L,1)
ISN 0055            WKFLOW(K,2)=WKFLOW(K,2)+AVGFLO(L,2)
ISN 0056          155 CONTINUE
ISN 0057            WKFLOM(K,1)=WKFLOW(K,1)*0.028317
ISN 0058            WKFLOM(K,2)=WKFLOW(K,2)*0.028317
ISN 0059            WKVOL(K,1)=WKFLOW(K,1)*86400.
ISN 0060            WKVOL(K,2)=WKFLOW(K,2)*86400.
ISN 0061            WKVOM(K,1)=WKVOL(K,1)*0.028317
ISN 0062            WKVOM(K,2)=WKVOL(K,2)*0.028317
ISN 0063            DATE(K)=(SEVEN+LDAYS+6)/7
ISN 0064            ONE=SEVEN+1
ISN 0065            SEVEN=SEVEN+7
ISN 0066            IF(SEVEN.GT.MDAYS) GO TO 160
ISN 0068            K=K+1
ISN 0069            WKFLOW(K,1)=0.0
ISN 0070            WKFLOW(K,2)=0.0
ISN 0071            GO TO 150
ISN 0072          160 CONTINUE
ISN 0073            IF(MONTH.NE.12) GO TO 175
ISN 0075            IF(SEVEN.EQ.MDAYS+7) GO TO 175
ISN 0077            AWEEK=MDAYS-(SEVEN-7)
ISN 0078            SEVEN=MDAYS
ISN 0079            K=K+1
ISN 0080            WKFLOW(K,1)=0.0
ISN 0081            WKFLOW(K,2)=0.0
```

```
ISN 0082            GO TO 150
ISN 0083        175 CONTINUE
ISN 0084            KWEEKS=K
ISN 0085            IF(NSTORM.EQ.0) GO TO 225
ISN 0087            DO 200 ISTM=1,NSTORM
ISN 0088            FLOMXM(ISTM,1)=FLOMAX(ISTM,1)*0.028317
ISN 0089            FLOMXM(ISTM,2)=FLOMAX(ISTM,2)*0.028317
ISN 0090            FLOMNM(ISTM,1)=FLOMIN(ISTM,1)*0.028317
ISN 0091            FLOMNM(ISTM,2)=FLOMIN(ISTM,2)*0.028317
ISN 0092            STMVOM(ISTM,1)=STMVOL(ISTM,1)*0.028317
ISN 0093            STMVOM(ISTM,2)=STMVOL(ISTM,2)*0.028317
ISN 0094        200 CONTINUE
ISN 0095        225 CONTINUE
ISN 0096            TMMX1=TOTMAX(1)*0.028317
ISN 0097            TMMX2=TOTMAX(2)*0.028317
ISN 0098            TMMN1=TOTMIN(1)*0.028317
ISN 0099            TMMN2=TOTMIN(2)*0.028317
ISN 0100            DO 880 J=1,2
ISN 0101            DO 770 L=1,MDAYS
ISN 0102            K=1
ISN 0103            RAQUEL=AVGFLO(L,J)
ISN 0104            DO 990 M=1,7
ISN 0105            IF(RAQUEL.GE.VAL(M)) K=K+1
ISN 0107        990 CONTINUE
ISN 0108            IRAQ(J,K)=IRAQ(J,K)+1
ISN 0109        770 CONTINUE
ISN 0110        880 CONTINUE
ISN 0111            WRITE(6,599)
ISN 0112        599 FORMAT('1',49X,'STREAM GAGES'/)
ISN 0113            WRITE(6,600) MONTH,YEAR
ISN 0114        600 FORMAT('0',45X,'DAILY FLOW FOR ',I2,'/',I2)
ISN 0115            WRITE(6,605)
ISN 0116        605 FORMAT('0',22X,'EAST BRANCH',49X,'WEST BRANCH'/
                   1       '0',2(' DATE',2(4X,'DISCHARGE',5X,'VOLUME'),7X)/
                   2       ' ',2(12X,'CFS',8X,'CU.FT.',7X,'CMS',8X,'CU.M.',8X)/)
ISN 0117            WRITE(6,610) ((L,AVGFLO(L,J),AVGVOL(L,J),AVGFLM(L,J),AVGVOM(L,J),
                   1                J=1,2),L=1,MDAYS)
ISN 0118        610 FORMAT(    2(I4,3X,4(1PE12.4),5X))
ISN 0119            WRITE (6,615) FTOT1,FTOTM1,FTOT2,FTOTM2
ISN 0120        615 FORMAT('0',2('AVG',3X,2(1PE12.4,12X),6X))
ISN 0121            WRITE (6,616) VTOT1,VTOTM1,VTOT2,VTOTM2
ISN 0122        616 FORMAT(' ',2('TOTAL',1X,2(12X,1PE12.4),6X))
ISN 0123            WRITE(6,620)
ISN 0124        620 FORMAT('0',55X,' TOTAL  WEEKLY FLOW'/'0',' WEEK',55X,' WEEK'/)
ISN 0125            WRITE(6,625) ((DATE(K),WKFLOW(K,J),WKVOL(K,J),
                   1                WKFLOM(K,J),WKVOM(K,J),J=1,2),K=1,KWEEKS)
ISN 0126        625 FORMAT(2(I4,3X,4(1PE12.4),5X))
ISN 0127        650 FORMAT('1')
ISN 0128            WRITE(6,660) MONTH,YEAR
ISN 0129        660 FORMAT('1',50X,'STREAM FLOW SUMMARY FOR ',I2,'/',I2, / )
ISN 0130            WRITE(6,665)
ISN 0131        665 FORMAT('0',50X,'MAXIMUM/MINIMUM FLOW READINGS'/
                   1       '0',22X,'EAST BRANCH',49X,'WEST BRANCH'/
                   2       '0',2('STORM',11X,'MAXIMUM',17X,'MINIMUM',13X)/
                   A       ' ',' DATE',55X,' DATE'/
                   3       ' ',2(3X,2(9X,'CFS',9X,'CMS'),9X) )
ISN 0132            IF(NSTORM.GT.0)
                   *WRITE(6,610) ((STMDAT(ISTM),FLOMAX(ISTM,J),FLOMXM(ISTM,J),
                   1                              FLOMIN(ISTM,J),FLOMNM(ISTM,J),
                   2                              J=1,2),ISTM=1,NSTORM)
ISN 0134            WRITE(6,695) TOTMAX(1),TMMX1,TOTMIN(1),TMMN1,
                   1             TOTMAX(2),TMMX2,TOTMIN(2),TMMN2
ISN 0135        695 FORMAT('0',2('MONTHLY',1PE11.4,1P3E12.4,6X))
ISN 0136            IF(NSTORM.EQ.0) GO TO 300
ISN 0138            WRITE(6,670)
ISN 0139        670 FORMAT('0',50X,'TOTAL VOLUME BY STORM'/
                   1       '0',22X,'EAST BRANCH',49X,'WEST BRANCH'/
                   2       '0',2('STORM',10X,'CU.FT.',19X,'CU.M.',15X)/
                   3       ' ',' DATE',55X,' DATE'/)
ISN 0140            WRITE(6,690) ((STMDAT(ISTM),STMVOL(ISTM,J),STMVOM(ISTM,J),
                   1                              J=1,2),ISTM=1,NSTORM)
ISN 0141        690 FORMAT(2(I4,8X,2(1PE12.4,12X)))
ISN 0142        300 CONTINUE
ISN 0143            WRITE (6,675)
ISN 0144        675 FORMAT('3',14X,'NUMBER OF DAYS BY FLOW CLASSES IN CFS')
ISN 0145            WRITE (6,677) (VAL(M),M=1,8)
ISN 0146        677 FORMAT('0UPPER LIMIT',8F5.1)
ISN 0147            WRITE (6,680) (IRAQ(1,K),K=1,8)
ISN 0148        680 FORMAT('0EAST BRANCH',8I5)
ISN 0149            WRITE (6,685) (IRAQ(2,K),K=1,8)
ISN 0150        685 FORMAT('0WEST BRANCH',8I5)
ISN 0151            WRITE(6,650)
ISN 0152            RETURN
ISN 0153            END
```

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LEVEL  21.6  (DEC 72)                          OS/360  FORTRAN H

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                             SOURCE,BCD,NOLIST,NODECK,LOAD,MAP,NOEDIT,NOID,XREF
   ISN 0002            SUBROUTINE SORTER
   ISN 0003            COMMON/MAXONE/FLOW(5000),TIME(5000),IDXBGN(50),IDXEND(50),
                      1             TALLY(10,2),HBGN(2),LIMIT(10),NSTM,ITOT,IBRNCH,
                      2             RCOVER(2),ODDAYS,STMBGN(50,2),STMEND(50,2)
   ISN 0004            COMMON/MAXTWO/FLOMAX(50,2),FLOMIN(50,2),STMVOL(50,2),
                      1             STMDAT(50),TOTMAX(2),TOTMIN(2),NSTORM
   ISN 0005            REAL LIMIT
   ISN 0006            INTEGER TALLY,TIME
   ISN 0007            INTEGER STMDAT
   ISN 0008            DIMENSION TEMMIN(50,2),TEMMAX(50,2),TEMVOL(50,2),A(50),B(50),X(50)
   ISN 0009            DIMENSION NDEX(5000),ZLIMIT(10)
   ISN 0010            DATA ZLIMIT/.1,.2,.4,.6,.7,.8,.9,1.0,1.5,5.0/
   ISN 0011            IF(IBRNCH.EQ.2) GO TO 30
   ISN 0013            FACTOR=10.0*HBGN(1)**3
   ISN 0014            IF(HBGN(1).EQ.0.0) FACTOR=1.0
   ISN 0016            DO 25 L=1,10
   ISN 0017            LIMIT(L)=FACTOR*ZLIMIT(L)
   ISN 0018         25 CONTINUE
   ISN 0019         30 CONTINUE
   ISN 0020            IF(NSTM.EQ.0) GO TO 70
   ISN 0022            DO 60 ISTM=1,NSTM
   ISN 0023            I1=IDXBGN(ISTM)
   ISN 0024            TEMMIN(ISTM,IBRNCH)=FLOW(I1)
   ISN 0025            TEMMAX(ISTM,IBRNCH)=FLOW(I1)
   ISN 0026            I2=I1
   ISN 0027            STMFLO=FLOW(I1)
   ISN 0028            IF(I1.EQ.ITOT) GO TO 50
   ISN 0030            I1=I1+1
   ISN 0031            DO 45 I=I1,ITOT
   ISN 0032            IF(TIME(I).GT.IDXEND(ISTM)) GO TO 50
   ISN 0034            I2=I
   ISN 0035            STMFLO=STMFLO+FLOW(I)
   ISN 0036            IF(TEMMIN(ISTM,IBRNCH).GT.FLOW(I)) TEMMIN(ISTM,IBRNCH)=FLOW(I)
   ISN 0038            IF(TEMMAX(ISTM,IBRNCH).LT.FLOW(I)) TEMMAX(ISTM,IBRNCH)=FLOW(I)
   ISN 0040         45 CONTINUE
   ISN 0041         50 CONTINUE
   ISN 0042            TEMVOL(ISTM,IBRNCH)=STMFLO*(TIME(I2)-TIME(I1))*120.0/(I2-I1+1)
   ISN 0043         60 CONTINUE
   ISN 0044         70 CONTINUE
   ISN 0045            CALL IDXSRT(FLOW,NDEX,ITOT)
   ISN 0046            TOTMAX(IBRNCH)=FLOW(NDEX(ITOT))
   ISN 0047            TOTMIN(IBRNCH)=FLOW(NDEX(1))
   ISN 0048            IF(IBRNCH.EQ.1) GO TO 200
   ISN 0050            N2=NSTM
   ISN 0051            A(1)=0.0
   ISN 0052            IF(N1.EQ.0) GO TO 111
   ISN 0054            I=2
   ISN 0055            DO 110 ISTM=1,N1
   ISN 0056            A(I)=STMBGN(ISTM,1)
   ISN 0057            I=I+1
   ISN 0058            A(I)=STMEND(ISTM,1)
   ISN 0059            I=I+1
   ISN 0060        110 CONTINUE
   ISN 0061            GO TO 112
   ISN 0062        111 CONTINUE
   ISN 0063            NA=2
   ISN 0064            A(NA)=10.
   ISN 0065            IF(N2.GT.0) A(NA)=STMEND(N2,2)+10.
   ISN 0067            GO TO 113
   ISN 0068        112 CONTINUE
   ISN 0069            NA=2*N1+2
   ISN 0070            A(NA)=AMAX1(STMEND(N1,1),STMEND(N2,2)) + 10.0
   ISN 0071        113 CONTINUE
   ISN 0072            B(1)=0.0
   ISN 0073            IF(N2.EQ.0) GO TO 116
   ISN 0075            I=2
   ISN 0076            DO 115 ISTM=1,N2
   ISN 0077            B(I)=STMBGN(ISTM,2)
   ISN 0078            I=I+1
   ISN 0079            B(I)=STMEND(ISTM,2)
   ISN 0080            I=I+1
   ISN 0081        115 CONTINUE
   ISN 0082        116 CONTINUE
   ISN 0083            NB=2*N2+2
   ISN 0084            B(NB)=A(NA)
   ISN 0085            CALL PCORAY(A,B,X,NA,NB,NX)
   ISN 0086            NSTORM=(NX-2)/2
   ISN 0087            IEAST=1
   ISN 0088            IWEST=1
   ISN 0089            J=2
   ISN 0090            DO 150 L=1,NSTORM
   ISN 0091            PROBLE=0.0
   ISN 0092            STMDAT(L)=X(J)/24 + 1
```

```
ISN 0093            IF(IEAST.GT.N1) GO TO 120
ISN 0095            IF(STMBGN(IEAST,1).GE. X(J).AND.STMEND(IEAST,1).LE.X(J+1))
                   *GO TO 125
ISN 0097            TROBLE=99.
ISN 0098        120 CONTINUE
ISN 0099            IF(IWEST.GT.N2) GO TO 135
ISN 0101            IF(STMBGN(IWEST,2).GE.X(J).AND.STMEND(IWEST,2).LE.X(J+1))
                   *GO TO 130
ISN 0103            IF(TROBLE .EQ.99.) GO TO 1000
ISN 0105            GO TO 135
ISN 0106        125 CONTINUE
ISN 0107            FLOMAX(L,1)=TEMMAX(IEAST,1)
ISN 0108            FLOMIN(L,1)=TEMMIN(IEAST,1)
ISN 0109            STMVOL(L,1)=TEMVOL(IEAST,1)
ISN 0110            IEAST=IEAST+1
ISN 0111            GO TO 120
ISN 0112        130 CONTINUE
ISN 0113            FLOMAX(L,2)=TEMMAX(IWEST,2)
ISN 0114            FLOMIN(L,2)=TEMMIN(IWEST,2)
ISN 0115            STMVOL(L,2)=TEMVOL(IWEST,2)
ISN 0116            IWEST=IWEST+1
ISN 0117        135 CONTINUE
ISN 0118            J=J+2
ISN 0119        150 CONTINUE
ISN 0120        200 CONTINUE
ISN 0121            N1=NSTM
ISN 0122            RETURN
ISN 0123       1000 WRITE(6,6000)
ISN 0124       6000 FORMAT('1*****  ERROR IN STORMS. DUMP FROM SORTER FOLLOWS.')
ISN 0125            CALL DUMP(FLOW(1),ODDAYS,5,FLOMAX(1,1),NSTORM,5)
ISN 0126            RETURN
```

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LEVEL  21.6  (DEC 72)                          OS/360  FORTRAN H

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                             SOURCE,BCD,NOLIST,NODECK,LOAD,MAP,NOEDIT,NOID,XREF
ISN 0002            SUBROUTINE IDXSRT (A,K,N)
                C ***    IDXSRT FORMS AN ARRAY OF INDEXES -K- INDICATING A NON-
                C ***           DECREASING ORDER OF THE ELEMENTS IN AN ARRAY -A- OF
                C ***           DIMENSION -N-.
                C ***           REFERENCE IN THE CALLING PROGRAM TO A(K(1)) THEN
                C ***           WILL GIVE THE SMALLEST ELEMENT IN ARRAY -A- WHILE
                C ***           REFERENCE TO A(K(N)) WILL GIVE  THE GREASTEST ELEMENT
                C ***           IN -A-.
ISN 0003            DIMENSION A(N),K(N)
ISN 0004            DO  10  I = 1,N
ISN 0005         10    K(I) =I
ISN 0006            DO 20 I = 1,N
ISN 0007               AMIN = 1.0E+38
ISN 0008               DO  15  J=I,N
ISN 0009                  JJ = K(J)
ISN 0010                  IF  (A(JJ)  -AMIN)   13,15,15
ISN 0011         13          AMIN = A(JJ)
ISN 0012                    JMIN = JJ
ISN 0013                    JHOLD =J
ISN 0014         15  CONTINUE
ISN 0015                  ISWAP = K(I)
ISN 0016            K(I) = JMIN
ISN 0017               K(JHOLD) = ISWAP
ISN 0018         20  CONTINUE
ISN 0019            RETURN
ISN 0020            END
```

```
LEVEL  21.6  (DEC 72)                          OS/360  FORTRAN H

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                             SOURCE,BCD,NOLIST,NODECK,LOAD,MAP,NOEDIT,NOID,XREF
ISN 0002            SUBROUTINE FCORAY(A,B,C,NA,NB,NC)
ISN 0003            DIMENSION A(NA),B(NB),C(NC)
ISN 0004            NC=0
ISN 0005            IF(NA.LE.0) GO TO 500
ISN 0007            IF(NB.LE.0) GO TO 500
ISN 0009            IF(NA.NE.NB) GO TO 100
ISN 0011            DO 50 I=1,NA
```

```
ISN 0012            IF(A(I).NE.B(I)) GO TO 100
ISN 0014            C(I)=A(I)
ISN 0015         50 CONTINUE
ISN 0016            NC=NA
ISN 0017            GO TO 500
ISN 0018        100 CONTINUE
                C*****
                C          'I' IS INDEX ON A, I=1,NA
                C          'J' IS INDEX ON B, J=1,NB
                C          'K' IS INDEX ON C, K=1,NC
                C*****
ISN 0019            I=1
ISN 0020            J=1
ISN 0021            K=1
ISN 0022        200 CONTINUE
ISN 0023            IF(A(I)-B(J)) 215,210,205
ISN 0024        205 IF(A(I).LT.B(J+1)) GO TO 210
ISN 0026            J=J+2
ISN 0027            GO TO 300
ISN 0028        210 C(K)=A(I)
ISN 0029            GO TO 225
ISN 0030        215 IF(B(J).LT.A(I+1)) GO TO 220
ISN 0032            I=I+2
ISN 0033            GO TO 300
ISN 0034        220 C(K)=B(J)
ISN 0035        225 K=K+1
ISN 0036            IF(A(I+1).GT.B(J+1)) GO TO 230
ISN 0038            C(K)=A(I+1)
ISN 0039            I=I+2
ISN 0040            GO TO 250
ISN 0041        230 C(K)=B(J+1)
ISN 0042            J=J+2
ISN 0043        250 K=K+1
ISN 0044        300 IF(I.GT.NA) GO TO 450
ISN 0046            IF(J.LT.NB) GO TO 200
ISN 0048        450 CONTINUE
ISN 0049            NC=K-1
ISN 0050        500 RETURN
ISN 0051            END
```

Section E

Hydrograph Analysis Program

of the Snyder and Curlin Hydrograph Analysis Package

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LEVEL  21.6  (DEC 72)                    OS/360  FORTRAN H

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                             SOURCE,EBCDIC,NOLIST,NODECK,LOAD,MAP,NOEDIT,NOID,XREF
                C                                                                    0
                C     WALKER BRANCH WATERSHED                                        5
                C     HYDROGRAPHIC ANALYSIS PROGRAM                                 10
                C     PROGRAM AUTHOR - M. T. HEATH                                  15
                C                      COMPUTING TECHNOLOGY CENTER                  20
                C                      UNION CARBIDE NUCLEAR DIVISION               25
                C                      OAK RIDGE, TENNESSEE                         30
                C                                                                   35
   ISN 0002           DIMENSION RTIME(4,20,100),RAIN(4,20,100),STREAM(5000),TIME(5000)  60
   ISN 0003             DIMENSION BFLOW(20,2),BASFLO(2),BSBSWF(20),FBSFLO(2),TBSWSF(2)
   ISN 0004             DIMENSION PRCNT(2),TOTFLO(2)
   ISN 0005             DATA BFLOW/40*0./,BASFLO/2*0./,BASWFL/0./,BSBSWF/20*0./,
                       +FBSFLO/2*0./,TBSWSF/2*0./,TAILL/0./,FBWFLO/0./
                       +,TOTFLO/2*0.0/,ZOFLOW/0.0/
   ISN 0006             REAL BSPT(20,2)/40*0./,VSRT(20,2)/40*0./,VSRW(20)/20*0./
                       +,BSPW(20)/20*0./,VSRSUM(2)/2*0./,
                       +VBRSUM(2)/2*0./
   ISN 0007            DIMENSION T(3),J(3),X(5000),Y(5000),AI(5000),SHO(5000),NRD(4,20)
   ISN 0008              DATA VSRWSM/0./,BSPWSM/0./
   ISN 0009            DIMENSION XR(100),YR(100),RX(1500),RY(1500),RT(1500,4),F(1500,4)
   ISN 0010            DIMENSION EX(1500,4),TE(4),TR(1500,4),KRD(4)
   ISN 0011            DIMENSION KBEG(20),KEND(20),DIFF(200)
   ISN 0012            INTEGER RTIME,TIME,DUR,SCALE,T,RP,SHB,ET,X,DAY,RX,XR,TR                100
   ISN 0013              INTEGER TEND
   ISN 0014            REAL AREA(2)/146.0,95.0/                                          115
   ISN 0015            REAL BRANCH(2)/'EAST','WEST'/                                     120
   ISN 0016            INTEGER GAGE(4,2)/1,3,4,5,1,2,3,0/                                125
   ISN 0017            COMMON/REAVY/VSR,FC,FA,NRG,IB,KRD,TE,RT,F,EX                      245
   ISN 0018            READ(5,10000) FAORIG,FCORIG,FZORIG                                255
   ISN 0019            READ(5,10100) CL                                                  260
   ISN 0020            FAC=.826446E-1                                                    265
   ISN 0021            DO 950 IB=1,2                                                     270
                C                                                                       275
                C     READ RAIN DATA                                                    280
                C                                                                       285
                C                                                                       290
   ISN 0022               READ(5,10200) IY,IM,NSTM
   ISN 0023             PRINT 10200,IY,IM,NSTM
   ISN 0024             IF(NSTM.EQ.0) GO TO 950                                       295
   ISN 0026               NRG=4                                                       300
   ISN 0027               IF (IB.GT.1) NRG=3                                          305
   ISN 0029               DO 20 J=1,NSTM                                              310
   ISN 0030                  DO 10 I=1,NRG                                            315
   ISN 0031                     READ(5,10300) NRD
   ISN 0032               PRINT 10300,NRD                                             320
   ISN 0033                     NRD(I,J)=NRD
   ISN 0034                     IF (NRD.EQ.0) GO TO 10                                325
   ISN 0036                     READ(5,10400) (RAIN(I,J,K),RTIME(I,J,K),K=1,NRD)      330
   ISN 0037           10        CONTINUE                                              335
   ISN 0038           20     CONTINUE                                                 340
                C                                                                     345
                C     READ STREAMFLOW DATA                                            350
                C                                                                     355
                C                                                                     360
   ISN 0039               READ(5,10500) NRD,QA,QB
   ISN 0040               READ(5,10600) (STREAM(I),TIME(I),I=1,NRD)                   365
   ISN 0041             PRINT 10500,NRD,QA,QB
   ISN 0042               ET=0                                                        370
   ISN 0043             QEND=STREAM(1)
   ISN 0044             TEND=TIME(1)
                C                                                                     375
                C     FIND BEGIN AND END TIME OF EACH STORM                           380
                C                                                                     385
                C                                                                     390
   ISN 0045               DO 50 ISTM=1,NSTM                                          395
   ISN 0046                  JBEG=10000
   ISN 0047                  JEND=0                                                  400
   ISN 0048                  DO 30 K=1,NRG                                           405
   ISN 0049                     IF (NRD(K,ISTM).EQ.0) GO TO 30                       410
   ISN 0051                     IF (JBEG.GT.RTIME(K,ISTM,1)) JBEG=RTIME(K,ISTM,1)    415
   ISN 0053                     IF (JEND.LT.RTIME(K,ISTM,NRD(K,ISTM))) JEND= RTIME(K,  420
                       >           ISTM,NRD(K,ISTM))                                 425
   ISN 0055           30        CONTINUE                                            430
   ISN 0056                  DO 40 K=1,NRG                                           435
   ISN 0057                     IF (NRD(K,ISTM).GT.0) GO TO 40                       440
   ISN 0059                     NRD(K,ISTM)=2                                        445
   ISN 0060                     RTIME(K,ISTM,1)=JBEG                                 450
   ISN 0061                     RTIME(K,ISTM,2)=JEND                                 455
   ISN 0062                     RAIN(K,ISTM,1)=0.0                                   460
   ISN 0063                     RAIN(K,ISTM,2)=0.0                                   465
   ISN 0064           40        CONTINUE                                            470
   ISN 0065                  KBEG(ISTM)=JBEG                                         475
   ISN 0066                  KEND(ISTM)=JEND                                         480
   ISN 0067           50     CONTINUE                                                485
   ISN 0068               DO 940 ISTM=1,NSTM                                         490
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                C                                                                495
                C     CALCULATE PRECIPITATION, DATE, DURATION, AND SCALE OF STORM  500
                C                                                                505
ISN 0069                STMPRC=RAIN(1,ISTM,NRD(1,ISTM))                          510
ISN 0070                DO 60 K=2,NRG                                            515
ISN 0071                   IF (STMPRC.LT.RAIN(K,ISTM,NRD(K,ISTM))) STMPRC= RAIN(K,520
     >                       ISTM,NRD(K,ISTM))                                   525
ISN 0073          60       CONTINUE                                             530
ISN 0074                DBEG=KBEG(ISTM)                                          535
ISN 0075                IEND=KEND(ISTM)                                          540
ISN 0076                DAY= (IBEG+IEND)*.5/288.+.9999999                        545
ISN 0077                DUR= IEND-IBEG                                           550
ISN 0078                STMDUR=DUR/12.                                           555
ISN 0079              BASE=1.
ISN 0080                IF (DUR.LE.12) GO TO 70                                  565
ISN 0082              BASE=24.
ISN 0083                IF (DUR.LE.48) GO TO 70                                  575
ISN 0085              BASE=96.
ISN 0086                IF (DUR.LE.192) GO TO 70                                 585
ISN 0088              BASE=384.
ISN 0089          70    CONTINUE                                                 605
ISN 0090                CON= FAC/AREA(IB)
ISN 0091                IFLAG=0                                                  615
ISN 0092                IF (IBEG.LT.ET) IFLAG=1                                  620
                C                                                                625
                C     CALCULATE NUMBER OF RUNOFF PERIODS AND                     630
                C     LENGTH AND END TIME OF STORM HYDROGRAPH                    635
                C                                                                640
ISN 0094              SHB=(BASE+(DUR-1.)/12.)*12.+1.
ISN 0095              ET=IBEG+SHB
ISN 0096              IF(ET.LE.TIME(NRD)) GO TO 80
ISN 0098              ET=TIME(NRD)
ISN 0099              SHB=ET-IBEG
ISN 0100          80  NP=SHB
ISN 0101                IF (IFLAG.NE.0) GO TO 210                                690
                C                                                                695
                C     FIND THREE DESCENDING STREAM DATA POINTS PRECEDING STORM    700
                C                                                                705
ISN 0103                DO 90 ITIME=1,NRD                                        710
ISN 0104                   IF (TIME(ITIME).GE.IBEG) GO TO 100                    715
ISN 0106              IF(TIME(ITIME+1).LT.TEND) GO TO 90
ISN 0108              IF(TIME(ITIME).GT.TEND) GO TO 95
ISN 0110              STREAM(ITIME)=QEND
ISN 0111              TIME(ITIME)=TEND
ISN 0112          95  BFLOW(ISTM,IB) = BFLOW(ISTM,IB) + .5*(STREAM(ITIME) +
     + STREAM(ITIME+1))*(TIME(ITIME+1)-TIME(ITIME))
ISN 0113          90       CONTINUE                                             720
ISN 0114         100   CONTINUE                                                 725
ISN 0115                NNRD=ITIME-1                                             730
ISN 0116              NIBEG=NNRD
ISN 0117              BFLOW(ISTM,IB) = BFLOW(ISTM,IB) - .5*(STREAM(NNRD)
     + +STREAM(NNRD+1))*(TIME(NNRD+1)-TIME(NNRD))
ISN 0118                DO 110 J=1,NNRD                                          735
ISN 0119                   JTIME=ITIME+1-J                                       740
ISN 0120                   IF (STREAM(JTIME-1).GT.STREAM(JTIME)) GO TO 120       745
ISN 0122         110       CONTINUE                                             750
ISN 0123                T(1)=-128                                                755
ISN 0124                Q(1)=QA                                                  760
ISN 0125                T(2)=-64                                                 765
ISN 0126                Q(2)=QB                                                  770
ISN 0127                JTIME=1                                                  775
ISN 0128                GO TO 170                                                780
ISN 0129         120    CONTINUE                                                 785
ISN 0130                T(2)=TIME(JTIME-1)                                       790
ISN 0131                Q(2)=STREAM(JTIME-1)                                     795
ISN 0132                NNRD=JTIME-2                                             800
ISN 0133                DO 130 J=1,NNRD                                          805
ISN 0134                   KTIME=JTIME-1-J                                       810
ISN 0135                   IF (STREAM(KTIME).GT.Q(2)) GO TO 140                  815
ISN 0137         130       CONTINUE                                             820
ISN 0138                T(1)=-64                                                 825
ISN 0139                Q(1)=QB                                                  830
ISN 0140                GO TO 170                                                840
ISN 0141         140    CONTINUE                                                 845
ISN 0142                LTIME=KTIME-1                                            850
ISN 0143                DO 150 J=1,LTIME                                         855
ISN 0144                   IF (STREAM(KTIME-J).NE.STREAM(KTIME)) GO TO 160       860
ISN 0146         150       CONTINUE                                             865
ISN 0147                T(1)=TIME(1)                                             870
ISN 0148                Q(1)=STREAM(1)                                           875
ISN 0149                GO TO 170                                                880
ISN 0150         160    CONTINUE                                                 885
ISN 0151                T(1)=TIME(KTIME-J+1)                                     890
ISN 0152                Q(1)=STREAM(KTIME-J+1)                                   895
ISN 0153         170    CONTINUE                                                 900
ISN 0154                DO 180 J=JTIME,ITIME                                     905
ISN 0155                   IF (STREAM(J).NE.STREAM(J+1)) GO TO 190               910
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ISN 0157        180          CONTINUE                                                915
ISN 0158                  T(3)=TIME(ITIME)                                          920
ISN 0159                  Q(3)=STREAM(ITIME)                                        925
ISN 0160                  GO TO 200                                                 930
ISN 0161        190       CONTINUE                                                  935
ISN 0162                  T(3)=TIME(J)                                              940
ISN 0163                  Q(3)=STREAM(J)                                            945
ISN 0164        200       CONTINUE                                                  950
                C                                                                   955
                C     CALCULATE ANTECEDENT RECESSION CURVE PARAMETERS               960
                C                                                                   965
ISN 0165                  DELT=T(2)-T(1)                                            970
ISN 0166                  A=Q(1)                                                    975
ISN 0167                  B=-ALOG(Q(2)/Q(1))                                        980
ISN 0168                  EN=ALOG(ALOG(Q(3)/Q(1))/(-B))/ ALOG(FLOAT(T(3)-T(1))/DELT)  985
ISN 0169        210       CONTINUE                                                  990
                C                                                                   995
                C     SET UP STREAMFLOW ARRAYS                                     1000
                C                                                                  1005
ISN 0170                  DO 220 I=1,NP                                            1010
ISN 0171                     X(I)=IBEG+(I-1)
ISN 0172                Y(I)=STREAM(NIBEG+I)
ISN 0173                IF(X(I).NE.TIME(NIBEG+I)) WRITE(6,900) I,X(I),TIME(I)
ISN 0175        900     FORMAT('0TIMES DO NOT MATCH',3I5)
ISN 0176        220          CONTINUE                                            1020
ISN 0177                  IF (ISTM.EQ.NSTM) GO TO 260                            1030
ISN 0179                  IF (X(NP).LE.KBEG(ISTM+1)) GO TO 260                   1035
ISN 0181                  DO 230 I=1,NP                                          1040
ISN 0182                     IF (X(I).GT.KBEG(ISTM+1)) GO TO 240                 1045
ISN 0184        230          CONTINUE                                            1050
ISN 0185        240       CONTINUE                                               1055
ISN 0186                  ITM=X(I-1)                                             1060
ISN 0187                  ORD=Y(I-1)                                             1065
ISN 0188                JJ=0
ISN 0189                  DO 250 J=I,NP                                          1070
ISN 0190                     Y(J)=ORD*EXP(-B*(FLOAT(X(J)-ITM)/DELT)**EN)         1075
ISN 0191                JJ=JJ+1
ISN 0192                DIFF(JJ)=Y(J)
ISN 0193        250          CONTINUE                                            1080
ISN 0194        260       CONTINUE
ISN 0195                  TEND=X(NP)
ISN 0196                  QEND=Y(NP)
                C                                                                  1090
                C     CALCULATE VOLUME OF STORM RESPONSE BY NUMERICAL INTEGRATION OF  1095
                C     DIFFERENCE BETWEEN STREAM AND RECESSION CURVES               1100
                C                                                                  1105
ISN 0197                  IF (IFLAG.NE.0) GO TO 280                                1110
ISN 0199                  DO 270 I=1,NP                                            1115
ISN 0200                     AI(I)=A*EXP(-B*(FLOAT(X(I)-T(1))/DELT)**EN)           1120
ISN 0201        270          CONTINUE                                             1125
ISN 0202                  GO TO 300                                                1130
ISN 0203        280       CONTINUE                                                1135
ISN 0204                  DO 290 I=1,NP                                            1140
ISN 0205                     AI(I)=Y(1)*EXP(-B*(FLOAT(X(I)-X(1))/DELT)**EN)        1145
ISN 0206        290          CONTINUE                                             1150
ISN 0207        300       CONTINUE                                                1155
ISN 0208                  SUM=0.0                                                  1160
ISN 0209                  DO 310 I=1,NP                                            1165
ISN 0210                     SHO(I)=Y(I)-AI(I)                                     1170
ISN 0211                     IF (SHO(I).LT.0.0) SHO(I)=0.0                         1175
ISN 0213                     SUM=SUM+SHO(I)                                        1180
ISN 0214        310          CONTINUE                                             1185
ISN 0215                  SUM=SUM-.5*(SHO(1)+SHO(NP))                             1190
ISN 0216                  VOL=SUM*CON                                             1195
ISN 0217                  TAIL=SHO(NP)*GAMMA((EN+1.0)/EN)/B**(1.0/EN)*(FAC/AREA(IB))  1200
ISN 0218                  IF (TAIL.LT.VOL) GO TO 320                              1205
ISN 0220                  WRITE(6,10700) TAIL                                     1210
ISN 0221                  TAIL=0.0                                                1215
ISN 0222        320       CONTINUE                                                1220
ISN 0223                  VSR=VOL+TAIL                                            1225
                C                                                                 1230
                C     DETERMINE RAINFALL RATE FOR EACH TIME INTERVAL DURING STORM  1235
                C                                                                 1240
ISN 0224                  DO 360 I=1,NRG                                          1245
ISN 0225                     NR=NRD(I,ISTM)                                       1250
ISN 0226                     DO 330 J=1,NR                                        1255
ISN 0227                        XR(J)=RTIME(I,ISTM,J)                             1260
ISN 0228                        YR(J)=RAIN(I,ISTM,J)                              1265
ISN 0229        330             CONTINUE                                          1270
ISN 0230                     RX(1)=XR(1)                                          1275
ISN 0231                     NR=RTIME(I,ISTM,NR)-RX(1)                            1280
ISN 0232                     DO 340 J=1,NR                                        1285
ISN 0233                        RX(J+1)=RX(1)+J                                   1290
ISN 0234        340             CONTINUE                                          1295
ISN 0235                     NR=NR+1                                              1300
ISN 0236                     KRD(I)=NR                                            1305
ISN 0237                     CALL INTERP(RX,RY,XR,YR,NR,NR)                       1310
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ISN 0238                    TR(1,I)=RI(1)                                          1315
ISN 0239                    RT(1,I)=0.0                                            1320
ISN 0240                    DO 350 J=2,NR                                          1325
ISN 0241                       TR(J,I)=RI(J)                                       1330
ISN 0242                       RT(J,I)=(RI(J)-RI(J-1))*12.0                        1335
ISN 0243       350             CONTINUE                                           1340
ISN 0244       360          CONTINUE                                              1345
               C                                                                  1350
               C     DETERMINE INTAKE AND EXCESS RATES FOR EACH TIME INTERVAL DURING ST   1355
               C                                                                  1360
ISN 0245             ICOUNT=0                                                     1365
ISN 0246             FC=FCORIG                                                    1370
ISN 0247             FA=FAORIG                                                    1375
ISN 0248             WFA=WGT(FA)                                                  1380
ISN 0249             WRITE(6,10800) FA,WFA                                        1385
ISN 0250             WFC=WGT(FC)                                                  1390
ISN 0251             WRITE(6,10900) FC,WFC                                        1395
ISN 0252       370   CONTINUE                                                     1400
ISN 0253             ICOUNT=ICOUNT+1                                              1405
ISN 0254             IF (WFA*WFC.LE.0.0) GO TO 400                                1410
ISN 0256             IF (ICOUNT.LE.50) GO TO 380                                  1415
ISN 0258             WRITE(6,11000)                                               1420
ISN 0259             END=FZORIG                                                   1425
ISN 0260             FA=FAORIG                                                    1430
ISN 0261             FC=FCORIG                                                    1435
ISN 0262             GO TO 430                                                    1440
ISN 0263       380   CONTINUE                                                     1445
ISN 0264             IF (ICOUNT/2*2.EQ.ICOUNT) GO TO 390                          1450
ISN 0266             FA=FA*1.5                                                    1455
ISN 0267             WFA=WGT(FA)                                                  1460
ISN 0268             WRITE(6,10900) FA,WFA                                        1465
ISN 0269             GO TO 370                                                    1470
ISN 0270       390   CONTINUE                                                     1475
ISN 0271             FC=0.5*FC                                                    1480
ISN 0272             WFC=WGT(FC)                                                  1485
ISN 0273             WRITE(6,10900) FC,WFC                                        1490
ISN 0274             GO TO 370                                                    1495
ISN 0275       400   CONTINUE                                                     1500
ISN 0276             ERT=FA                                                       1505
ISN 0277             ELF=FC                                                       1510
ISN 0278             DO 420 I=1,50                                                1515
ISN 0279                DIF=ERT-ELF                                               1520
ISN 0280                END=DIF*0.5+ELF                                           1525
ISN 0281                IF (DIF.LT.CL) GO TO 430                                  1530
ISN 0283                WEND=WGT(END)                                             1535
ISN 0284                WELF=WGT(ELF)                                             1540
ISN 0285                IF (WEND*WELF.GT.0.0) GO TO 410                           1545
ISN 0287                ERT=END                                                   1550
ISN 0288                GO TO 420                                                 1555
ISN 0289       410      CONTINUE                                                  1560
ISN 0290                ELF=END                                                   1565
ISN 0291       420      CONTINUE                                                  1570
ISN 0292             WRITE(6,11100)                                              1575
ISN 0293       430   CONTINUE                                                     1580
ISN 0294             FZ=END                                                      1585
ISN 0295             WE=WGT(FZ)+VSR                                              1590
               C                                                                 1595
               C     CONVERT DATE TO CHARACTER STRING                            1600
               C                                                                 1605
               C     PRINT PRELIMINARY RESULTS                                   1685
               C                                                                 1690
ISN 0296             WRITE(6,11200) DAY,BRANCH(IB)
ISN 0297             WRITE(6,11300) STMPRC,STMDUR,VSR,BASE
ISN 0298             WRITE(6,11400)                                              1705
ISN 0299             WRITE(6,11500) FCORIG,FAORIG,FZORIG                         1710
ISN 0300             WRITE(6,11600) FC,FA,FZ                                     1715
ISN 0301       440         CONTINUE                                              1750
ISN 0302       450       CONTINUE                                                1755
ISN 0303             WRITE(6,12000)                                              1760
ISN 0304             WRITE(6,12100)                                              1765
ISN 0305             WRITE(6,12200) A,B,EM                                       1770
ISN 0306             WRITE(6,12300) (I,I=1,3),T,Q                                1775
ISN 0307          IF(IFLAG.NE.0) GO TO 465
ISN 0309             DO 460 I=1,NP                                               1785
ISN 0310          BSFT(ISTM,IB)=BSFT(ISTM,IB)+AI(I)
ISN 0311       460      CONTINUE                                                 1795
ISN 0312          GO TO 466
ISN 0313       465   DO 461 I=1,NP
ISN 0314             IF(I.GT.JJ)GO TO 462
ISN 0316             BSFT(ISTM,IB)=BSFT(ISTM,IB)+AI(I)-DIFF(I)
ISN 0317             GO TO 461
ISN 0318       462   BSFT(ISTM,IB)=BSFT(ISTM,IB)+AI(I)
ISN 0319       461   CONTINUE
ISN 0320             BSFT(ISTM,IB)=BSFT(ISTM,IB)-TAILL
ISN 0321             IF(BSFT(ISTM,IB).GE.0.) GO TO 466
ISN 0323             TAILL=ABS(BSFT(ISTM,IB))
ISN 0324             IFLAG=0
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ISN 0325              BSFT(ISTM,IB)=0.
ISN 0326        466   WRITE(6,13200) WE
ISN 0327              BFLOW(ISTM,IB)=BFLOW(ISTM,IB)*FAC/AREA(IB)-TAILL
ISN 0328              TAILL=TAIL
ISN 0329              BSFT(ISTM,IB)=BSFT(ISTM,IB)*CON
ISN 0330              BASFLO(IB)=BASFLO(IB)+BFLOW(ISTM,IB)+BSFT(ISTM,IB)
ISN 0331              FACT=AREA(IB)/241.0
ISN 0332              BSBSWF(ISTM)=BFLOW(ISTM,IB)*FACT + BSBSWF(ISTM)
ISN 0333              TBSWSF(IB)=TBSWSF(IB)+BFLOW(ISTM,IB)
ISN 0334              VSRT(ISTM,IB)=VSR
ISN 0335              VSRW(ISTM)=VSRW(ISTM)+VSR*FACT
ISN 0336              BSFW(ISTM)=BSFW(ISTM)+BSFT(ISTM,IB)*FACT
ISN 0337              VSRSUM(IB)=VSRSUM(IB)+VSR
ISN 0338              VBRSUM(IB)=VBRSUM(IB)+BSFT(ISTM,IB)
ISN 0339              VSRWSM=VSRWSM+VSR*FACT
ISN 0340              BSFWSM=BSFWSM+BSFT(ISTM,IB)*FACT
ISN 0341        940     CONTINUE
ISN 0342              DO 945 J=1,NRD
ISN 0343              IF(TIME(J).GE.TEND) GO TO 946
ISN 0344        945   CONTINUE
ISN 0345              J=NRD-1
ISN 0346              FBSFLO(IB)=0.
ISN 0347              GO TO 948
ISN 0348         946  STREAM(J)=QEND
ISN 0349              TIME(J)=TEND
ISN 0350              J=J+1
ISN 0351              DO 947 K=J,NRD
ISN 0352              FBSFLO(IB)=.5*(STREAM(K)+STREAM(K-1))*(TIME(K)-TIME(K-1))
                     +  +FBSFLO(IB)
ISN 0353        947   CONTINUE
ISN 0354        948   FBSFLO(IB)=FBSFLO(IB)*FAC/AREA(IB)-TAILL
ISN 0355              IF(FBSFLO(IB).GE.0.) GO TO 949
ISN 0356              OVER=ABS(FBSFLO(IB))
ISN 0357              WRITE(6,901) OVER
ISN 0358        901     FORMAT('0THE VOLUME OF STORM RUNOFF AFTER THE END ',
                     +' OF THE HYDROGRAPH EXCEEDS THE AMOUNT OF BASE FLOW AFTER THE '/
                     +'THE STORM HYDROGRAPH BY',F10.4)
ISN 0359        949   BASFLO(IB)=BASFLO(IB) + FBSFLO(IB)
ISN 0360              BASWFL=BASWFL+(BASFLO(IB))*FACT
ISN 0361              TOTFLO(IB)=TOTFLO(IB)+BASFLO(IB)+VSRSUM(IB)
ISN 0362              TOFLOW=TOFLOW+TOTFLO(IB)*FACT
ISN 0363              FBWFLO=FBSFLO(IB)*FACT +FBWFLO
ISN 0364              PRCNT(IB)=VSRSUM(IB)/(TOTFLO(IB))*100.
ISN 0365              PRCNTT=VSRWSM/(TOFLOW)*100.
ISN 0366              TBSWSF(IB)=TBSWSF(IB)+FBSFLO(IB)
ISN 0367        950     CONTINUE
ISN 0368              WRITE(6,1000)
ISN 0369              WRITE(6,1005)
ISN 0370              DO 1050 I=1,NSTM
ISN 0371              WRITE(6,2000)(I,VSRT(I,IB),BSFT(I,IB),BFLOW(I,IB),IB=1,2)
ISN 0372        1050    CONTINUE
ISN 0373              WRITE(6,2002) (FBSFLO(IB),IB=1,2)
ISN 0374              WRITE(6,2001) (VSRSUM(IB),VBRSUM(IB),TBSWSF(IB),IB=1,2)
ISN 0375              WRITE(6,3000)
ISN 0376              WRITE(6,3005)
ISN 0377              WRITE(6,4000) (I,VSRW(I),BSFW(I),BSBSWF(I),I=1,NSTM)
ISN 0378              WRITE(6,4002) FBWFLO
ISN 0379        4002  FORMAT('0',87X,F6.3)
ISN 0380              WRITE(6,4001) VSRWSM,BSFWSM,BASWFL
ISN 0381        10000   FORMAT(3F6.3)
ISN 0382        10100   FORMAT(F12.0)
ISN 0383        10200   FORMAT(3I3)
ISN 0384        10300   FORMAT(8X,I3)
ISN 0385        10400   FORMAT(10(F3.1,I5))
ISN 0386        10500   FORMAT(I5,2F6.0)
ISN 0387        10600   FORMAT(8(F6.3,I4))
ISN 0388        10700   FORMAT('1TAIL TO LARGE      ',E13.6)
ISN 0389        10800   FORMAT('1',2(E13.6,6X))
ISN 0390        10900   FORMAT('0',2(E13.6,6X))
ISN 0391        11000   FORMAT('0','NO SOLUTION TO VOLUME CHECK')
ISN 0392        11100   FORMAT('0','NO CONVERGENCE IN VOLUME CHECK')
ISN 0393        11200   FORMAT('1HYDROGRAPHIC ANALYSIS FOR STORM OF',I5,'ON',
                     +A4,' BRANCH'/)
ISN 0394        11300   FORMAT('0','STORM PRECIPITATION ',F6.3,' IN.'//' ',
                     +'STORM DURATION     ',F6.2,' HR.'//' ','VOLUME OF RUNOFF   ',
                     +F6.3,'  IN.'//' ','BASE OF STORM     ',F6.1/)
ISN 0395        11400   FORMAT('0',25X,' INTAKE RATE PARAMETERS'/'0',22X,'FC',11X,'FA',
                     +11X,'FZ')
ISN 0396        11500   FORMAT('0INITIAL ESTIMATE   ',3(1PE10.3,3X))
ISN 0397        11600   FORMAT('0FINAL   VALUE    ',3(1PE10.3,3X))
ISN 0398        11700   FORMAT('1RAINFALL,INTAKE,AND EXCESS IN INCHES/HOUR FOR GAGE'
                     +I2/)
ISN 0399        11800   FORMAT('0 TIME',5X,'RAINFALL',5X,'INTAKE',6X,'EXCESS'/)
ISN 0400        11900     FORMAT(' ',I5,3(6X,F6.3))
ISN 0401        12000   FORMAT('1STREAMFLOW DATA FOR THIS STORM'/)
ISN 0402        12100   FORMAT('0 ANTECEDENT RECESSION CURVE PARAMETERS'/'0',6X,'A',12X,
                     +'B',12X,'N')
```

```
ISN 0405     12200    FORMAT(' ',1X,3(1PE10.3,3X))
ISN 0406     12300    FORMAT('0 RECESSION CURVE DATA POINTS'/'0 I',I6,2I9,/'0 T',I8,
                     +2I9/'0 Q',F8.3,2F9.3/)
ISN 0407     12400    FORMAT('0 TIMES',6X,'STREAM',4X,'ANTECEDENT',5X,'STORM'/1X,12X,
                     +'FLOW',8X,'FLOW',8X,'FLOW')
ISN 0408     13200    FORMAT('0TOTAL WEIGHTED EXCESS VOLUME',1PE10.3,'INCHES')
ISN 0409     1000     FORMAT('1',56X,'SUMMARY OF RUNOFF'///
                     +23X,'EAST BRANCH',44X,'WEST BRANCH'//
                     +11X,'STORM',7X,'TOTAL STORM',4X,'BASE RUNOFF',4X,'BASE RUNOFF',11X,
                     +'STORM',7X,'TOTAL STORM',4X,'BASE RUNOFF'4X,'BASE RUNOFF'/
                     +12X,'NO.',11X,'RUNOFF',7X,'FOR STORM',4X,'BEFORE STORM',13X,
                     +'NO.',11X,'RUNOFF',7X,'FOR STORM' 4X,'BEFORE STORM'/)
ISN 0410     2000     FORMAT('0',11X,I2,11X,F6.3,9X,F6.3,9X,F6.3,14X,
                     ;I2,11X,F6.3,9X,F6.3,9X,F6.3)
ISN 0411     2002     FORMAT('0',54X,F6.3,57X,F6.3)
ISN 0412     2001     FORMAT('0',11X,'SUM',10X,F6.3,9X,F6.3,9X,F6.3,13X,'SUM',11X
                     +,F6.3,9X,F6.3,9X,F6.3///)
ISN 0413     3000     FORMAT('0',56X,'WATERSHED'//
                     +42X,'STORM',7X,'TOTAL STORM',4X,'BASE RUNOFF',4X,'BASE RUNOFF'/
                     +43X,'NO.',11X,'RUNOFF',7X,'FOR STORM' ,4X,'BEFORE STORM'/)
ISN 0414     1005     FORMAT('0',28X,'IN.',11X,'IN.',11X,'IN.',
                     +33X,'IN.',11X,'IN.',11X,'IN.'//)
ISN 0415     3005      FORMAT('0',59X,'IN.',11X,'IN.',11X,'IN.'//)
ISN 0416     4000     FORMAT('0',44X,I2,11X,F6.3,9X,F6.3,9X,F6.3)
ISN 0417     4001     FORMAT('0',43X,'SUM',11X,F6.3,9X,F6.3,9X,F6.3)
ISN 0418              WRITE(6,5000)
ISN 0419     5000     FORMAT('0',55X,'FLOW SUMMARY'//
                     +46X,'TOTAL BASE',5X,'TOTAL STORM',9X,'TOTAL',6X,
                     +'PERCENT STORM'/
                     +48X,'RUNOFF',10X,'RUNOFF',10X,'RUNOFF',5X,
                     +'RUNOFF OF TOTAL'//)
ISN 0420              WRITE(6,5001)(BASFLO(I),VSRSUM(I),TOTFLO(I),PRCNT(I),I=1,2)
                     +,BASWFL,VSRWSM,TOFLOW,PRCNTT
ISN 0421     5001     FORMAT('0',32X,'EAST',10X,F6.3,9X,F6.3,9X,F6.3,9X,F6.3/
                     +33X,'WEST',10X,F6.3,9X,F6.3,9X,F6.3,9X,F6.3/
                     +32X,'TOTAL',10X,F6.3,9X,F6.3,9X,F6.3,9X,F6.3)
ISN 0422              STOP
ISN 0423              END
```

```
LEVEL  21.6  (DEC 72)                          OS/360  FORTRAN H

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                             SOURCE,EBCDIC,NOLIST,NODECK,LOAD,MAP,NOEDIT,NOID,XREF
ISN 0002              REAL FUNCTION WGT(FZ)
ISN 0003             DIMENSION F(1500,4),RT(1500,4),EX(1500,4),KRD(4),TE(4)
ISN 0004              REAL W(4,2)/.0315753,.5191781,.2095206,.2397260,
                     +             .3634737,.3497895,.2867368,.0000000/
ISN 0005              COMMON/HEAVY/VSR,FC,FA,NRG,IB,KRD,TE,RT,F,EX
ISN 0006              WE=0.0
ISN 0007              DO 220 I=1,NRG
ISN 0008              F(1,I)=FZ
ISN 0009              NR=KRD(I)
ISN 0010              DO 22 J=2,NR
ISN 0011              FT1=F(J-1,I)
ISN 0012              RT1=RT(J,I)
ISN 0013              F(J,I)=FT1-((RT1+FA-FT1)/(RT1+FA-FC))*
                     +            ((RT1-FC)/(RT1+FC))*(FT1-FC)/12.0
ISN 0014     22       CONTINUE
ISN 0015              EX(1,I)=0.0
ISN 0016              SUM=0.0
ISN 0017              DO 11 J=2,NR
ISN 0018              DIFF=RT(J,I)-(F(J,I)+F(J-1,I))/2.0
ISN 0019              IF(DIFF.GT.0.0) GO TO 110
ISN 0021              EX(J,I)=0.0
ISN 0022              GO TO 11
ISN 0023     110      CONTINUE
ISN 0024              EX(J,I)=DIFF
ISN 0025              SUM=SUM+DIFF
ISN 0026     11       CONTINUE
ISN 0027              TE(I)=SUM/12.0
ISN 0028              WE=WE+W(I,IB)*TE(I)
ISN 0029     220      CONTINUE
ISN 0030              WGT=WE-VSR
ISN 0031              RETURN
ISN 0032              END
```

```
LEVEL  21.6  (DEC 72)                          OS/360  FORTRAN H

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=60,SIZE=0000K,
                             SOURCE,EBCDIC,NOLIST,NODECK,LOAD,MAP,NOEDIT,NOID,XREF
   ISN 0002              SUBROUTINE INTERP(X,Y,A,B,M,N)
   ISN 0003              DIMENSION X(1),Y(1),A(1),B(1)
   ISN 0004              INTEGER X,A
   ISN 0005              K=2
   ISN 0006              DO 400 I=1,M
   ISN 0007              IF(X(I).GE.A(1).AND.X(I).LT.A(N)) GO TO 100
   ISN 0009              IF(X(I).LT.A(1)) KEY=1
   ISN 0011              IF(X(I).GE.A(N)) KEY=N-1
   ISN 0013              GO TO 200
   ISN 0014      100     CONTINUE
   ISN 0015              DO 300 J=K,N
   ISN 0016              IF(X(I).GE.A(J)) GO TO 300
   ISN 0018              KEY=J-1
   ISN 0019              GO TO 500
   ISN 0020      300     CONTINUE
   ISN 0021      500     CONTINUE
   ISN 0022              K=KEY
   ISN 0023      200     CONTINUE
   ISN 0024              KEY1=KEY+1
   ISN 0025              Y(I)=B(KEY)+(X(I)-A(KEY))*(B(KEY1)-B(KEY))/(A(KEY1)-A(KEY))
   ISN 0026      400     CONTINUE
   ISN 0027              RETURN
   ISN 0028              END
```

APPENDIX II

INPUT DATA

The following is a listing of five minute rain gage and stream (stage) height data for Walker Branch Watershed on December 1, 1973. A complete listing of input data needed for both programs is too extensive to be listed here. The complete set of input data plus a listing of input needed for each program is available upon request.

Section A

Five Minute Rain Gage Data

for December 1, 1973, for the

Five Gages on Walker Branch Watershed

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13601701002002002002002002002002002002002002002002002002002002002002002002002002
13601702002002002002002002002002002002002002002002002002002002002002002002002002
13601703002002002002002002002002002002002002002002002002002002002002002002002002
13601704002002002002002002002002002002002002002002002002002002002002002002002002
13601705002002002002002002002002002002002002002002002002002002002002002002002002
13601706002002002002002002002002002002002002002002002002002002002002002002002002
13601707002002002002002002002002002002002002002002002002002002002002002002002002
13601708002002002002002002002002002002002002002002002002002002002002002002002002
13601709002002002002002002002002002002002002002002002002002002002002002002002002
13601710002002002002002002002002002002002002002002002002002002002002002002002002
13601711002002002002002002002002002002002002002002002002002002002002002002002002
13601712002002002002002002002002002002002002002002002002002002002002002002002002
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23601701003003003003003003003003003003003003003003003003003003003003003003003003
23601702003003003003003003003003003003003003003003003003003003003003003003003003
23601703003003003003003003003003003003003003003003003003003003003003003003003003
23601704003003003003003003003003003003003003003003003003003003003003003003003003
23601705003003003003003003003003003003003003003003003003003003003003003003003003
23601706003003003003003003003003003003003003003003003003003003003003003003003003
23601707003003003003003003003003003003003003003003003003003003003003003003003003
23601708003003003003003003003003003003003003003003003003003003003003003003003003
23601709003003003003003003003003003003003003003003003003003003003003003003003003
23601710003003003003003003003003003003003003003003003003003003003003003003003003
23601711003003003003003003003003003003003003003003003003003003003003003003003003
23601712003003003003003003003003003003003003003003003003003003003003003003003003
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33601701003003003003003003003003003003003003003003003003003003003003003003003003
33601702003003003003003003003003003003003003003003003003003003003003003003003003
33601703003003003003003003003003003003003003003003003003003003003003003003003003
33601704003003003003003003003003003003003003003003003003003003003003003003003003
33601705003003003003003003003003003003003003003003003003003003003003003003003003
33601706003003003003003003003003003003003003003003003003003003003003003003003003
33601707003003003003003003003003003003003003003003003003003003003003003003003003
33601708003003003003003003003003003003003003003003003003003003003003003003003003
33601709003003003003003003003003003003003003003003003003003003003003003003003003
33601710003003003003003003003003003003003003003003003003003003003003003003003003
33601711003003003003003003003003003003003003003003003003003003003003003003003003
33601712003003003003003003003003003003003003003003003003003003003003003003003003
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43601701003003003003003003003003003003003003003003003003003003003003003003003003003003

43601702003003003003003003003003003003003003003003003003003003003003003003003003003003

43601703003003003003003003003003003003003003003003003003003003003003003003003003003003

43601704003003003003003003003003003003003003003003003003003003003003003003003003003003

43601705003003003003003003003003003003003003003003003003003003003003003003003003003003

43601706003003003003003003003003003003003003003003003003003003003003003003003003003003

43601707003003003003003003003003003003003003003003003003003003003003003003003003003003

43601708003003003003003003003003003003003003003003003003003003003003003003003003003003

43601709003003003003003003003003003003003003003003003003003003003003003003003003003003

43601710003003003003003003003003003003003003003003003003003003003003003003003003003003

43601711003003003003003003003003003003003003003003003003003003003003003003003003003003

43601712003003003003003003003003003003003003003003003003003003003003003003003003003003

53601701001001001001001001001001001001001001001001001001001001001001001001001001001001

53601702001001001001001001001001001001001001001001001001001001001001001001001001001001

53601703001001001001001001001001001001001001001001001001001001001001001001001001001001

53601704001001001001001001001001001001001001001001001001001001001001001001001001001001

53601705001001001001001001001001001001001001001001001001001001001001001001001001001001

53601706001001001001001001001001001001001001001001001001001001001001001001001001001001

53601707001001001001001001001001001001001001001001001001001001001001001001001001001001

53601708001001001001001001001001001001001001001001001001001001001001001001001001001001

53601709001001001001001001001001001001001001001001001001001001001001001001001001001001

53601710001001001001001001001001001001001001001001001001001001001001001001001001001001

53601711001001001001001001001001001001001001001001001001001001001001001001001001001001

53601712001001001001001001001001001001001001001001001001001001001001001001001001001001

Section B

Five Minute Stream (Stage) Height Data

for December 1, 1973, for the

Two Stage Height Records on Walker Branch Watershed

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13E017014544534534534534524524514514514514514504504504494494494484484484
13E017024484484484474474474464464464454454454454444444444434434434434434424424
13E017034424414414414414404404404404394394394394384384384374374374374374364364
13E017044364354354344344334334324324314314314314304304294294294294294284284284284
13E017054284274274264254254244244244234234234234224224224214214204204204204194194
13E017064194184184184184174174174174164164164164164154154154154154144144144
13E017074144144144134134134124124124124114114104104104104094094094084084084084
13E017084084084084084074074074074074074074074074074074074074074074074074064064064
13E017094064064064054054054054044044044034034034034024024024024014014014004004004
13E017104004004003993993993993993993993993993983983983983983983973973963963963963
13E017114394394394394394394394394394394394394394394394394394394394394394394394394
13E017124394394394394394394394394394394394394394394394394394394394394394394394394
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23E017015265255255255255245245245245235235235235225225225215215215205205205205205
23E017025205195195195195185185185185185175175175175165165165165165165155155155155
23E017035155155155145145145145135135135135125125125125115115115115105105105105105105
23E017045095095085085085085085085075075075075065065065065055055055045045045045045045
23E017055035035035035035025025025025015015015005005005004995994994994994984984984984984984974974974974974
23E017064974964964954954954954954954944944944944934934934924924924914914914904904904
23E017074904904904894894894894894884884884884884874874874874864864864864864854854854854
23E017084864854854854854844844844844844844844834834834834824824824824824824824824824824824
23E017094824824824824824814814814814804804804804794794794794784784784784784774774774774774
23E017104774774774774764764764764764764764754754754744744744744744734734734734734734734
23E017114734724724724724714714714704704704704694694694694694694694694694684684684684684684
23E017124684684684684684674674674664664664664654654654654654654644644644634634634634634634
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APPENDIX III

LISTING OF OUTPUT FROM THE

COWEETA HYDROGRAPH ANALYSIS PROGRAM AND

THE SNYDER AND CURLIN HYDROGRAPH ANALYSIS PACKAGE

FOR DECEMBER, 1973, RUN ON WALKER BRANCH WATERSHED

Section A

Listing of Output

from the Coweeta Hydrograph Analysis Program

900 WALKER BRANCH EAST BRANCH 0.050000 1

WALKER BRANCH EAST BRANCH WATERSHED 0 WATERYEAR 73 PAGE 1

FLOW SEPARATION SLOPE = 0.0500

EVENT NO.	MO.	DAY	TIME	DURATION (HRS-MINS)	TIME TILL PEAKING (HRS-MINS)	INITIAL FLOW RATE (CSM)	PEAK FLOW RATE (CSM)	FINAL FLOW RATE (CSM)	QUICK FLOW VOLUME (INCHES)	DELAYED FLOW VOLUME (INCHES)	QUICK FLOW BEFORE AND AFTER PEAK (INCHES)
999	12	4	945								
999	12	4	1000								
999	12	4	1120								
999	12	4	1150								
999	12	4	1945								
999	12	4	2210								
999	12	5	400								
999	12	5	1000								
999	12	6	1600								
999	12	6	1830								
999	12	6	1950								
999	12	6	2055								
999	12	6	2130								
999	12	6	2310								
999	12	7	320								
999	12	7	600								
999	12	7	1400								
999	12	7	1600								
999	12	7	1800								
999	12	9	1425								
999	12	10	930								
999	12	10	1030								
999	12	10	1105								
999	12	10	1205								
999	12	10	1230								
999	12	10	1300								
999	12	10	1320								
999	12	10	1350								
999	12	10	1405								
999	12	10	1455								
999	12	10	2040								
999	12	10	2100								
999	12	10	2130								
999	12	10	2345								
999	12	12	1700								
999	12	12	1900								
999	12	12	1955								
999	12	12	2150								
999	12	13	100								
999	12	13	145								
999	12	13	315								
999	12	13	410								
999	12	13	450								
999	12	13	525								
999	12	13	550								
	12	1	5	29410		2.81		0.59		0.554	0.0479
1	12	13	615	5631	1000	0.59	9.65	3.42	0.311	0.175	0.2633
999	12	17	1310								
999	12	20	525								
999	12	20	700								

FLOW SEPARATION SLOPE = 0.0500

EVENT NO.	MO.	DAY	TIME	DURATION (HRS-MINS)	TIME TILL PEAKING (HRS-MINS)	INITIAL FLOW RATE (CSM)	PEAK FLOW RATE (CSM)	FINAL FLOW RATE (CSM)	QUICK FLOW VOLUME (INCHES)	DELAYED FLOW VOLUME (INCHES)	QUICK FLOW BEFORE AND AFTER PEAK (INCHES)
999	12	20	710								
999	12	20	730								
999	12	20	755								
999	12	20	1115								
999	12	20	1145								
999	12	20	1215								
999	12	20	1230								
	12	15	1446	11819		3.42		1.27		0.322	0.0394
2	12	20	1305	4558	1920	1.27	4.22	3.56	0.103	0.172	0.0637
	12	22	1103	7642		3.56		1.66		0.291	0.8561
3	12	25	1545	7627	1310	1.66	159.03	5.48	3.246	0.423	2.3903
	12	28	2012	2208		5.48		4.20		0.161	0.0019
4	12	29	1820	709	150	4.20	1.14	4.55	0.006	0.049	0.0040
999	12	30	950								
999	12	30	1020								
999	12	30	1125								
999	12	30	1200								
999	12	30	1240								
999	12	30	1310								
999	12	30	1340								
999	12	30	1445								
999	12	30	1535								
999	12	30	1605								
999	12	30	1825								
	12	30	129	2701		4.55		4.47		0.188	0.0005
5	12	31	430	425	230	4.47	0.54	4.69	0.001	0.031	0.0007
STORM CONTINUES PAST END OF MONTH											
	12	31	855	320		4.69		4.39		0.023	0.0265
6	12	31	1215	1145	1145	4.39	3.77	4.98	0.027	0.085	0.0

900 WALKER BRANCH WEST BRANCH 0.050000 2

WALKER BRANCH WEST BRANCH WATERSHED 0 WATERYEAR 73 PAGE 1

FLOW SEPARATION SLOPE = 0.0500

EVENT NO.	MO.	DAY	TIME	DURATION (HRS-MINS)	TIME TILL PEAKING (HRS-MINS)	INITIAL FLOW RATE (CSM)	PEAK FLOW RATE (CSM)	FINAL FLOW RATE (CSM)	QUICK FLOW VOLUME (INCHES)	DELAYED FLOW VOLUME (INCHES)	QUICK FLOW BEFORE AND AFTER PEAK (INCHES)
999	12	1	1620								
	12	1	5	8255		6.19		2.61		0.500	0.0003
1	12	4	1100	359	35	2.61	0.55	2.81	0.001	0.017	0.0011
	12	4	1459	121		2.81		2.74		0.006	0.0085
2	12	4	1620	1303	410	2.74	2.34	3.39	0.021	0.062	0.0125
999	12	5	1210								
999	12	5	1330								
999	12	5	1620								
999	12	6	1240								
999	12	7	1215								
999	12	7	1225								
999	12	10	2035								
999	12	10	2055								
999	12	10	2105								
999	12	10	2125								
999	12	10	2135								
999	12	10	2215								
999	12	11	1205								
999	12	11	1600								
999	12	12	850								
999	12	12	1000								
999	12	12	1840								
999	12	12	2345								
999	12	13	140								
999	12	13	325								
	12	5	523	19112		3.39		1.96		0.769	0.1168
3	12	13	435	6616	1650	1.96	10.28	5.27	0.382	0.371	0.2647
999	12	17	1305								
999	12	18	1200								
999	12	19	1410								
999	12	19	1545								
999	12	19	2320								
999	12	20	210								
999	12	20	330								
	12	15	2251	10154		5.27		2.40		0.529	0.0787
4	12	20	445	6042	3615	2.40	4.54	5.43	0.122	0.368	0.0432
	12	22	1727	6958		5.43		3.32		0.456	0.8005
5	12	25	1525	9448	1320	3.32	163.86	8.06	3.452	0.836	2.6512
999	12	29	1510								
999	12	29	1710								
	12	29	1413	357		8.06		7.93		0.049	0.0005
6	12	29	1810	511	30	7.93	1.15	8.19	0.004	0.065	0.0040
999	12	30	100								
999	12	30	1035								
999	12	30	1205								
999	12	30	1310								
999	12	30	1415								
999	12	30	1505								
999	12	30	1555								
999	12	30	1635								

FLOW SEPARATION SLOPE = 0.0500

EVENT NO.	MO.	DAY	TIME	DURATION (HRS-MINS)	TIME TILL PEAKING (HRS-MINS)	INITIAL FLOW RATE (CSM)	PEAK FLOW RATE (CSM)	FINAL FLOW RATE (CSM)	QUICK FLOW VOLUME (INCHES)	DELAYED FLOW VOLUME (INCHES)	QUICK FLOW BEFORE AND AFTER PEAK (INCHES)
999	12	31	415								
999	12	31	540								
STORM CONTINUES PAST END OF MONTH											
	12	29	2321	3609		8.19		7.34		0.436	0.0179
7	12	31	1130	1230	1230	7.34	2.78	7.97	0.018	0.148	0.0

SUMMARY OF RUNOFF

EAST BRANCH				WEST BRANCH			
STORM NO.	TOTAL STORM RUNOFF	BASE RUNOFF FOR STORM	BASE RUNOFF BEFORE STORM	STORM NO.	TOTAL STORM RUNOFF	BASE RUNOFF FOR STORM	BASE RUNOFF BEFORE STORM
	IN.	IN.	IN.		IN.	IN.	IN.
1	0.0	0.0	0.0	1	0.001	0.017	0.500
2	0.0	0.0	0.0	2	0.021	0.062	0.006
3	0.311	0.175	0.554	3	0.382	0.371	0.769
4	0.103	0.172	0.322	4	0.122	0.368	0.529
5	3.246	0.423	0.291	5	3.452	0.836	0.456
6	0.006	0.049	0.161	6	0.004	0.065	0.049
7	0.001	0.031	0.188	7	0.0	0.0	0.0
8	0.027	0.085	0.023	8	0.018	0.148	0.436
			0.0				0.0
SUM	3.694	0.935	1.540	SUM	4.000	1.867	2.746

WATERSHED

STORM NO.	TOTAL STORM RUNOFF	BASE RUNOFF FOR STORM
	IN.	IN.
1	0.001	0.007
2	0.008	0.024
3	0.339	0.253
4	0.110	0.249
5	3.327	0.586
6	0.005	0.055
7	0.001	0.019
8	0.023	0.110
SUM	3.815	1.303

FLOW SUMMARY

	TOTAL BASE RUNOFF	TOTAL STORM RUNOFF	TOTAL RUNOFF	PERCENT STORM RUNOFF OF TOTAL
EAST	2.475	3.694	6.169	59.882
WEST	4.613	4.000	8.613	46.440
TOTAL	3.318	3.815	7.133	53.483

IHC002I STOP 0

Section B

Listing of Output from the Hydrograph Analysis Program of the Snyder and Curlin Hydrograph Analysis Package

```
73 12  4
          0
          7
          7
          0
         12
         13
         12
         12
         10
         11
         10
         11
         48
         51
         56
         49
4833      1.     3.
```

```
0.240000E 01       -0.137607E 00
0.100000E 00        0.122571E-02
```

HYDROGRAPHIC ANALYSIS FOR STORM OF 4ONEAST BRANCH

STORM PRECIPITATION 0.600 IN.

STORM DURATION 9.25 HR.

VOLUME OF RUNOFF 0.138 IN.

BASE OF STORM 96.0

INTAKE RATE PARAMETERS

	FC	FA	FZ
INITIAL ESTIMATE	1.000E-01	2.400E 00	2.000E 00
FINAL VALUE	1.000E-01	2.400E 00	1.180E-01

STREAMFLOW DATA FOR THIS STORM

ANTECEDENT RECESSION CURVE PARAMETERS

A	B	M
2.560E-01	2.372E-02	1.246E 00

RECESSION CURVE DATA POINTS

I	1	2	3
T	928	960	992
Q	0.256	0.250	0.242

TOTAL WEIGHTED EXCESS VOLUME 7.444E-02INCHES

0.240000E 01 -0.295076E 00

0.100000E 00 0.770724E 00

HYDROGRAPHIC ANALYSIS FOR STORM OF 13ONEAST BRANCH

STORM PRECIPITATION 1.400 IN.

STORM DURATION 2.83 HR.

VOLUME OF RUNOFF 0.311 IN.

BASE OF STORM 24.0

INTAKE RATE PARAMETERS

	FC	FA	FZ
INITIAL ESTIMATE	1.000E-01	2.400E 00	2.000E 00
FINAL VALUE	1.000E-01	2.400E 00	1.160E 00

STREAMFLOW DATA FOR THIS STORM

ANTECEDENT RECESSION CURVE PARAMETERS

A	B	N
1.340E-01	1.504E-02	1.024E 00

RECESSION CURVE DATA POINTS

I	1	2	3
T	3122	3154	3346
Q	0.134	0.132	0.120

TOTAL WEIGHTED EXCESS VOLUME 3.062E-01INCHES

0.240000E 01 -0.433284E 00

0.100000E 00 -0.220658E 00

0.360000E 01 -0.433284E 00

0.500000E-01 0.594457E-01

HYDROGRAPHIC ANALYSIS FOR STORM OF 20ONEAST BRANCH

STORM PRECIPITATION 1.000 IN.

STORM DURATION 11.00 HR.

VOLUME OF RUNOFF 0.433 IN.

BASE OF STORM 96.0

INTAKE RATE PARAMETERS

	FC	FA	FZ
INITIAL ESTIMATE	1.000E-01	2.400E 00	2.000E 00
FINAL VALUE	5.000E-02	3.600E 00	6.387E-02

STREAMFLOW DATA FOR THIS STORM

ANTECEDENT RECESSION CURVE PARAMETERS

A	B	N
2.320E-01	3.064E-02	6.397E-01

RECESSION CURVE DATA POINTS

I	1	2	3
T	5446	5478	5532
Q	0.232	0.225	0.219

TOTAL WEIGHTED EXCESS VOLUME 4.596E-01 INCHES

0.240000E 01	-0.332308E 01
0.100000E 00	-0.911407E 00
0.360000E 01	-0.372553E 01
0.500000E-01	-0.407839E-01
0.540000E 01	-0.242832E 01
0.250000E-01	0.460023E 00

HYDROGRAPHIC ANALYSIS FOR STORM OF 270NEAST BRANCH

STORM PRECIPITATION 5.500 IN.

STORM DURATION 101.83 HR.

VOLUME OF RUNOFF 4.065 IN.

BASE OF STORM 384.0

INTAKE RATE PARAMETERS

	FC	FA	FZ
INITIAL ESTIMATE	1.000E-01	2.400E 00	2.000E 00
FINAL VALUE	2.500E-02	5.400E 00	3.819E-01

STREAMFLOW DATA FOR THIS STORM

ANTECEDENT RECESSION CURVE PARAMETERS

A	B	M
3.960E-01	2.558E-02	9.778E-01

RECESSION CURVE DATA POINTS

I	1	2	3
T	7040	7072	7099
Q	0.396	0.386	0.378

TOTAL WEIGHTED EXCESS VOLUME 4.066E 00 INCHES

THE VOLUME OF STORM RUNOFF AFTER THE END OF THE HYDROGRAPH EXCEEDS THE AMOUNT OF BASE FLOW AFTER THE
HE STORM HYDROGRAPH BY 0.0416

```
73 12  4
          0
          7
          7
         12
         13
         13
         10
         11
         11
         48
         58
         51
4797     1.     3.
```

0.240000E 01	-0.199946E 00
0.100000E 00	-0.832494E-01
0.360000E 01	-0.199946E 00
0.500000E-01	-0.222493E-01
0.540000E 01	-0.199946E 00
0.250000E-01	0.400748E-01

HYDROGRAPHIC ANALYSIS FOR STORM OF 4ONWEST BRANCH

STORM PRECIPITATION 0.600 IN.

STORM DURATION 8.92 HR.

VOLUME OF RUNOFF 0.200 IN.

BASE OF STORM 96.0

INTAKE RATE PARAMETERS

	FC	FA	FZ
INITIAL ESTIMATE	1.000E-01	2.400E 00	2.000E 00
FINAL VALUE	2.500E-02	5.400E 00	4.600E-02

STREAMFLOW DATA FOR THIS STORM

ANTECEDENT RECESSION CURVE PARAMETERS

A	B	M
3.980E-01	1.264E-02	1.009E 00

RECESSION CURVE DATA POINTS

I	1	2	3
T	928	960	992
Q	0.398	0.393	0.388

TOTAL WEIGHTED EXCESS VOLUME 2.171E-01INCHES

0.240000E 01	-0.270439E 00
0.100000E 00	0.763644E 00

HYDROGRAPHIC ANALYSIS FOR STORM OF 130NWEST BRANCH

STORM PRECIPITATION 1.400 IN.

STORM DURATION 2.75 HR.

VOLUME OF RUNOFF 0.313 IN.

BASE OF STORM 24.0

INTAKE RATE PARAMETERS

	FC	FA	FZ
INITIAL ESTIMATE	1.000E-01	2.400E 00	2.000E 00
FINAL VALUE	1.000E-01	2.400E 00	1.088E 00

STREAMFLOW DATA FOR THIS STORM

ANTECEDENT RECESSION CURVE PARAMETERS

A	B	M
2.890E-01	1.394E-02	1.393E 00

RECESSION CURVE DATA POINTS

I	1	2	3
T	3281	3345	3377
Q	0.289	0.285	0.282

TOTAL WEIGHTED EXCESS VOLUME 3.178E-01INCHES

0.240000E 01	-0.442013E 00
0.100000E 00	-0.233210E 00
0.360000E 01	-0.442013E 00
0.500000E-01	0.546151E-01

HYDROGRAPHIC ANALYSIS FOR STORM OF 200NWEST BRANCH

STORM PRECIPITATION 1.000 IN.

STORM DURATION 10.25 HR.

VOLUME OF RUNOFF 0.442 IN.

BASE OF STORM 96.0

INTAKE RATE PARAMETERS

	FC	FA	FZ
INITIAL ESTIMATE	1.000E-01	2.400E 00	2.000E 00
FINAL VALUE	5.000E-02	3.600E 00	6.387E-02

STREAMFLOW DATA FOR THIS STORM

ANTECEDENT RECESSION CURVE PARAMETERS

A	B	N
3.560E-01	2.273E-02	3.261E-01

RECESSION CURVE DATA POINTS

I	1	2	3
T	5286	5318	5350
Q	0.356	0.348	0.346

TOTAL WEIGHTED EXCESS VOLUME 4.643E-01INCHES

0.240000E 01	-0.377339E 01
0.100000E 00	-0.137449E 01
0.360000E 01	-0.419820E 01
0.500000E-01	-0.503803E 00
0.540000E 01	-0.287161E 01
0.250000E-01	-0.308704E-02
0.810000E 01	-0.225023E 01
0.125000E-01	0.254921E 00

HYDROGRAPHIC ANALYSIS FOR STORM OF 27ONWEST BRANCH

STORM PRECIPITATION 5.500 IN.

STORM DURATION 99.83 HR.

VOLUME OF RUNOFF 4.524 IN.

BASE OF STORM 384.0

INTAKE RATE PARAMETERS

	FC	FA	FZ
INITIAL ESTIMATE	1.000E-01	2.400E 00	2.000E 00
FINAL VALUE	1.250E-02	8.100E 00	2.494E-01

STREAMFLOW DATA FOR THIS STORM

ANTECEDENT RECESSION CURVE PARAMETERS

A	B	M
5.050E-01	1.195E-02	1.009E 00

RECESSION CURVE DATA POINTS

I	1	2	3
T	7028	7060	7092
Q	0.505	0.499	0.493

TOTAL WEIGHTED EXCESS VOLUME 4.516E 00INCHES

THE VOLUME OF STORM RUNOFF AFTER THE END OF THE HYDROGRAPH EXCEEDS THE AMOUNT OF BASE FLOW AFTER THE
HE STORM HYDROGRAPH BY 0.0861

SUMMARY OF RUNOFF

EAST BRANCH				WEST BRANCH			
STORM NO.	TOTAL STORM RUNOFF	BASE RUNOFF FOR STORM	BASE RUNOFF BEFORE STORM	STORM NO.	TOTAL STORM RUNOFF	BASE RUNOFF FOR STORM	BASE RUN(BEFORE S1
	IN.	IN.	IN.		IN.	IN.	IN.
1	0.138	0.073	0.211	1	0.200	0.331	0.458
2	0.311	0.018	0.132	2	0.313	0.067	0.342
3	0.433	0.136	0.477	3	0.442	0.370	0.907
4	4.065	0.215	0.008	4	4.524	0.557	0.131
			-0.042				-0.086
SUM	4.948	0.442	0.786	SUM	5.480	1.325	1.752

WATERSHED

STORM NO.	TOTAL STORM RUNOFF	BASE RUNOFF FOR STORM	BASE RUNOFF BEFORE STORM
	IN.	IN.	IN.
1	0.162	0.175	0.308
2	0.312	0.038	0.215
3	0.437	0.228	0.647
4	4.246	0.350	0.056
			-0.059
SUM	5.157	0.790	1.957

FLOW SUMMARY

	TOTAL BASE RUNOFF	TOTAL STORM RUNOFF	TOTAL RUNOFF	PERCENT STORM RUNOFF OF TOTAL
EAST	1.228	4.948	6.176	80.116
WEST	3.077	5.480	8.557	64.039
TOTAL	1.957	5.157	7.114	72.493

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