SEDIMENTATION STUDY OF THE YAZOO RIVER BASIN

PHASE I TEMPORAL DESIGN

CONTRACT NO. DACW 38-76-C-0193

Prepared for

U. S. ARMY CORPS OF ENGINEERS
VICKSBURG DISTRICT

Vicksburg, Mississippi

Prepared by

Civil Engineering Department
Engineering Research Center
Colorado State University
Fort Collins, Colorado

D. B. Simons
R. M. Li
T. J. Ward
N. Duong

June, 1978
SEDIMENTATION STUDY OF THE
YAZOO RIVER BASIN

PHASE I TEMPORAL DESIGN

CONTRACT NO. DACW 38-76-C-0193

Prepared for

U. S. ARMY CORPS OF ENGINEERS
VICKSBURG DISTRICT

Vicksburg, Mississippi

Prepared by

Civil Engineering Department
Engineering Research Center
Colorado State University
Fort Collins, Colorado

D. B. Simons
R. M. Li
T. J. Ward
N. Duong

June, 1978
Authorization

This investigation was conducted for the U.S. Army Corps of Engineers, Vicksburg District, Lower Mississippi Division under Contract No. DACW38-76-C-0193. Larry Banks and Larry Eckenrod were the authorized Project Managers for the Vicksburg District and Daryl B. Simons and Ruh-Ming Li were the Principal Investigators for Colorado State University. The purpose of this investigation is to determine the extent of sediment problems in the main stem Yazoo-Tallahatchie-Coldwater River System and principal tributaries excluding the Sunflower River Basin. In addition, this study recommends ways to control these sedimentation problems and others that may be encountered with the proposed Upper Auxiliary Channel Alternative Project in operation. This report details techniques for developing discharge records for the Yazoo River Basin Sedimentation Study.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Content</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.</td>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>II.</td>
<td>DATA NEEDS AND SOURCES</td>
<td>4</td>
</tr>
<tr>
<td>III.</td>
<td>DEVELOPMENT OF AVERAGE DAILY DISCHARGES</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>3.1 State-Discharge Relationships</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>3.2 Computation of Daily Flow Values</td>
<td>10</td>
</tr>
<tr>
<td>IV.</td>
<td>DEVELOPMENT AND GENERATION OF WEEKLY DISCHARGES</td>
<td>13</td>
</tr>
<tr>
<td>V.</td>
<td>UNGAGED AND NON-POINT SOURCE RECORDS</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>5.1 Ungaged Sources</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>5.2 Non-Point Sources</td>
<td>22</td>
</tr>
<tr>
<td>VI.</td>
<td>SUMMARY AND CONCLUSIONS</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>APPENDIX A - Schematic of Spatial-Temporal Design for Yazoo River Basin</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>APPENDIX B - Stage-Discharge Parameters</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>APPENDIX C - Flow Statistics for Gaged, Ungaged and Non-point Sources</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>APPENDIX D - Computer Programs Used in Developing Actual and Generated Discharge Records</td>
<td>51</td>
</tr>
<tr>
<td></td>
<td>Appendix E - Plots of Actual and Simulated Weekly Discharges at Greenwood, Swan Lake and Lambert</td>
<td>65</td>
</tr>
</tbody>
</table>
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Sequence of discharge record development</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>Power function fit of the state-discharge relationship for the Coldwater River near Crenshaw</td>
<td>6</td>
</tr>
<tr>
<td>3.</td>
<td>Power and linear function fits of the state-discharge relationship for the Yalobusha River at Whaley</td>
<td>7</td>
</tr>
<tr>
<td>4.</td>
<td>Seven-day average discharge for Tallahatchie River near Lambert, observed discharges</td>
<td>18</td>
</tr>
<tr>
<td>5.</td>
<td>Seven-day average discharge for Tallahatchie River near Lambert, generated discharges</td>
<td>19</td>
</tr>
<tr>
<td>E-1.</td>
<td>50-year weekly hydrograph at Greenwood</td>
<td>66</td>
</tr>
<tr>
<td>E-2.</td>
<td>50-year weekly hydrograph at Swan Lake</td>
<td>68</td>
</tr>
<tr>
<td>E-3.</td>
<td>50-year weekly hydrograph at Lambert</td>
<td>70</td>
</tr>
</tbody>
</table>
I. INTRODUCTION

An accurate set of discharge records is necessary for modeling a river system. These records should be developed for key river system locations during a consistent time span. Before development can be initiated, a thorough review of existing records followed by the delineation of realistic spatial and temporal frameworks must be completed. Data review indicates what types of discharge information are available at specific locations. This information may include daily discharge, instantaneous stage readings, peak discharge or intermittent measurements. Once data availability and adequacy is ascertained, spatial and temporal designs can be formulated. An order of magnitude analysis of potential sediment contributions, the available gaging stations and conferring with knowledgeable field personnel leads to a spatial design that includes important river and tributary sites. These sites are determined, in part, by the discharge of water and sediment past the site, and the overall stability of the channel reach surrounding the site. Data availability is then used to determine the method of record development for each site. At some sites, an adequate set of discharge or stage records exists, however, at other sites no data exists. If the site is relatively unimportant, it may be excluded from further consideration. If it is important, a record must be synthesized for that site.

The time span of records or temporal resolution is also important in modeling. This temporal design is again determined by the availability and duration of records at each site. Some sites may have
continuous records covering a long period of time while others may have only intermittent records for a few years. Records are compared until a common time span is found allowing selection of the temporal design.

For the Yazoo River Basin Sedimentation study, both spatial and temporal designs were determined after analysis of existing data. The spatial design is shown in Appendix A, divided into upper and lower river reaches. The current spatial design of 62 sites includes 30 sites with existing stage or discharge records, 14 ungaged sites, and 18 disperse or non-point sources. The period of record chosen was from January 1, 1964 to December 31, 1974. This 11-year period was used because of data availability for discharge or stage records at the 30 gaged sites. Flows at each site were constrained to average daily discharges. However, close proximity of the sites made water travel times between adjacent sites one day or less under most flow conditions. A total of 4,018 average daily flow values for the 11-year period formed the basic data set for extension and synthesis.

One set of records developed from the 11-year data set was 574 average weekly flow values, i.e., the average daily flow for a seven day period. These 574 values were in turn used to generate an extended record of an additional 39 years for all sites, a total of 2,609 values for 50 years. This extension was conducted using statistical techniques with checks to assure generation of realistic values. The sequence used for developing sets of 11 years of daily and 50 years of weekly discharge values is shown in Figure 1. Each element in the sequence is checked to avoid unrealistic values or other errors. Development of daily and weekly discharge records are detailed in this report. Techniques and typical examples are presented to clarify the approach used.
Figure 1. Sequence of discharge record development.
II. DATA NEEDS AND SOURCES

The basic need was for a set of daily discharge records at all sites included in the spatial design. For seven sites, Coldwater River near Lambert, Tallahatchie River near Swan Lake, Yazoo River at Greenwood and outflows for the four major reservoirs of Arkabutla, Sardis, Enid, and Grenada, daily discharges were obtained from the U.S. Geological Survey on magnetic tapes. These discharges were computed from stage readings supplied by the U.S. Army Corps of Engineers, Vicksburg District.

Stage records for the other 23 gaged stations were supplied by the Corps of Engineers, Vicksburg District on magnetic tape. Stage readings were at 0800 hours (8:00 AM) for each day.

Computer conversion of the stages to discharges required development of mathematic expressions for stage-discharge relationships. Some formulations were developed from Corps of Engineers observed stage and discharge data found in "Stages and Discharges of the Mississippi River and Tributaries in the Vicksburg District," published by the Corps of Engineers. Expressions for other stations were developed from Corps of Engineers rating curves supplied by their personnel. The observed stages and discharges and rating curves formed the basis for developing mathematical expressions for stage-discharge relationships on the Yazoo River and its tributaries.
III. DEVELOPMENT OF AVERAGE DAILY DISCHARGES

3.1 Stage-Discharge Relationships

The stage-discharge data available for Yazoo River gaging stations can be adequately related by a power equation of the form

\[ Q = a(S + c)^b \]  

(1)

or by a linear equation of the form

\[ Q = mS + k \]  

(2)

where \( Q \) is the discharge, \( S \) is the stage, \( C \) is a value used to transform the stage readings, and \( a, b, k \) and \( m \) are empirical values. The parameter \( c \) is used to force the power function through a point of zero discharge at relative zero stage height. The power function, Equation 1, was used to define the stage-discharge relationships at most stations. If overbank flow occurred at the gaging section, then a linear function in the form of Equation 2 best fit the overbank data, while the power function best fit the in-bank data. An example of the power function fit is shown in Figure 2 for the Coldwater River near Crenshaw. Figure 3 shows a combined power function and linear function stage-discharge relationship for the Yalobusha River at Whaley. Although bank full stage is about 21 feet, data indicates that a match point between the two functions may be nearer to 25 feet. Therefore, stages above 25 feet were used in computing the linear function and stages less than 25 feet were used for the power function. The two functions coincide at a stage of 25.34 feet. Above this stage the linear function was used, below this stage the power function was used. A complete set of stage-discharge relationship parameters is presented in Appendix B.
III. DEVELOPMENT OF AVERAGE DAILY DISCHARGES

3.1 Stage-Discharge Relationships

The stage-discharge data available for Yazoo River gaging stations can be adequately related by a power equation of the form

\[ Q = a(S + c)^b \]  \hspace{1cm} (1)

or by a linear equation of the form

\[ Q = mS + k \]  \hspace{1cm} (2)

where \( Q \) is the discharge, \( S \) is the stage, \( C \) is a value used to transform the stage readings, and \( a, b, k \) and \( m \) are empirical values. The parameter \( c \) is used to force the power function through a point of zero discharge at relative zero stage height. The power function, Equation 1, was used to define the stage-discharge relationships at most stations. If overbank flow occurred at the gaging section, then a linear function in the form of Equation 2 best fit the overbank data, while the power function best fit the in-bank data. An example of the power function fit is shown in Figure 2 for the Coldwater River near Crenshaw. Figure 3 shows a combined power function and linear function stage-discharge relationship for the Yalobusha River at Whaley. Although bank full stage is about 21 feet, data indicates that a match point between the two functions may be nearer to 25 feet. Therefore, stages above 25 feet were used in computing the linear function and stages less than 25 feet were used for the power function. The two functions coincide at a stage of 25.34 feet. Above this stage the linear function was used, below this stage the power function was used. A complete set of stage-discharge relationship parameters is presented in Appendix B.
Figure 2. Power function fit of the stage-discharge relationship for the Coldwater River near Crenshaw.
Figure 3. Power and linear function fits of the stage-discharge relationship for the Yalobusha River at Whaley.
Six stations required particular attention when discharges were computed. The first two stations where the computed stage-discharge relationship needed to be altered were the one at Coldwater River near Prichard and the one near Marks. It was noted the original relationship for these stations produced discharges that yielded a relatively low average discharge over the 11-year base period. These average discharges were in fact less than the average discharge of the next upstream gaged site. It was also noted that the gain in average discharge between two sites was about one cfs per square mile. This observation was used to adjust the stage-discharge relationships at both stations to coincide with changes in average discharge observed elsewhere between the sites. Adjustment for the Marks relationship was facilitated by obtaining a Corps of Engineers rating curve for this site. Although different from the relationship computed from available data, the rating curve did provide the desired results. For Prichard, the parameter \( b \) in Equation 1 was increased slightly to produce the desired results. This increase had the effect of generating a higher estimated discharge at the same stage as compared to the original relationship. The adopted relationships for these two stations provided discharges consistent with other river sites.

A problem in converting stages to discharges was that of missing stage readings. Generally, only a few readings were missing from any particular site. In such cases, linear interpolation was used to estimate the discharges between two computed values as

\[
\hat{Q}_i = Q_{last} + \frac{Q_{next} - Q_{last}}{t_{next} - t_{last}} [t_i - t_{last}]
\]  

(3)
where \( \hat{Q} \) is the interpolated value, \( Q_{last} \) is the last computed 8:00 AM discharge before the missing record, \( Q_{next} \) is the next computed discharge after the missing record, and \( t_i, t_{last}, \) and \( t_{next} \) are the corresponding times in days from beginning of record for these discharges. This scheme works well for short breaks in the record on a slightly fluctuating stream. One problem site, Arkabutla Canal (Creek) southwest of Arkabutla, did not meet these criteria. Discharge in Arkabutla Canal can fluctuate highly during a single day. This fluctuation, combined with missing records of four days or more duration, produced some odd interpolated values. Of particular concern were four consecutive days in March of 1965 that had extremely high 8:00 AM stage readings for the last and next values. Linear interpolation produced a set of high discharges that were unmatched in any previous or subsequent set of records. These high values were discovered upon inspection of the record and a different approach for interpreting the missing values was used. For this site, stages were related to the stages at Coldwater River near Sarah. Although lower, the resulting discharges were still higher than what is considered realistic. Manual adjustment of the discharges was finally used to correct these abnormally large values.

Extension of records was also needed for Tchula Lake Cut-off near Mileston. Stages at this site have been collected since April 15, 1969, but data was needed from January 1, 1964. Records were estimated by relating the existing stages at Mileston to stages of the Yazoo River at Belzoni. Both linear and power functions were used to define the relationship with the linear form providing the best correlation. This relationship was

\[
S_{\text{Mileston}} = 18.74 + 0.2936 S_{\text{Belzoni}}
\]  
(4)
where $S_{\text{Mileston}}$ is the 8:00 AM stage at Mileston and $S_{\text{Belzoni}}$ is the corresponding 8:00 AM stage at Belzoni. This relationship was used to estimate the missing stages. Some other sites also required use of nearby stage readings.

The final two sites that required particular attention were the Yazoo River Overflow near Marksville and the Lower Auxiliary Channel Overflow near Silver City. Overflow at the Marksville site was related to the stage at Belzoni while overflow from the Yazoo River into the Lower Auxiliary Channel (LAC) is related to the Silver City stage readings.

In addition to these six specific sites, there were other problems with the stage records supplied by the Corps of Engineers. A major problem was encoding errors, particularly for 1973, where symbols were inconsistent with other years and additional keypunch errors were found. Fortunately, these errors were easily detected and corrected. The conversion of stages to discharges was conducted after stage data was edited and corrected. This conversion created a set of 8:00 AM discharges that were then changed to daily flow values.

3.2 Computation of Daily Flow Values

Because only 8:00 AM discharges were available, an interpolation scheme was needed to define the hydrograph during the 12 midnight to 12 midnight period of the day in question. The scheme utilized here interpolated the discharge for the previous and post 12 midnight times relative to the 8:00 AM discharge and then averaged these two values. Special attention was given to the first and last days. Computation of daily discharge for all days was of the form

$$
\bar{Q}_i = \frac{Q_{\text{Pi}} + Q_{\text{Ni}}}{2}
$$

(5)
where \( Q_1 \) is the average daily flow for day \( i \), \( Q_{P1} \) is the previous 12 midnight discharge and \( Q_{N1} \) is the subsequent or next 12 midnight discharge. For days 2 through 4017, \( Q_p \) and \( Q_N \) were computed as

\[
Q_{P1} = Q_i - \frac{(Q_i - Q_{i-1})}{3}
\]  

(6)

and

\[
Q_{N1} = Q_i + \frac{2}{3} (Q_{i+1} - Q_i)
\]  

(7)

where \( Q_{i-1}, Q_i, \) and \( Q_{i+1} \) are 8:00 AM discharges before, during and after day \( i \), respectively. First and last day values required extrapolation formulations. For first day values these were:

\[
Q_{P1} = Q_1 - \frac{(Q_2 - Q_1)}{3}
\]  

(8)

and

\[
Q_{N1} = Q_1 + \frac{2}{3} (Q_2 - Q_1)
\]  

(9)

Similarly, for last day values

\[
Q_{P4018} = Q_{4018} - \frac{(Q_{4018} - Q_{4017})}{3}
\]  

(10)

and

\[
Q_{N4018} = Q_{4018} + \frac{2}{3} (Q_{4018} - Q_{4017})
\]  

(11)

Statistics for the daily discharges formed by Equation 5 were also computed. These statistics included maximum, minimum, average and standard deviation. A listing of these statistics is presented in Appendix C. The computer program used to convert stages to discharges, interpolate missing discharges, compute daily flow and calculate flow
statistics is presented in Appendix D. Development of daily discharge records for gaged sites allowed creation of weekly flow records for gaged sites and computation of daily and weekly flow values for ungauged and non-point sources.
IV. DEVELOPMENT AND GENERATION OF WEEKLY DISCHARGES

Weekly discharges were found by computing the average daily discharge for seven day periods. For example, days 1 through 7 would have a single average daily discharge and days 8 through 14 another. A seven day period was chosen since it represented average time necessary for water to travel from Arkabutla Dam to Vicksburg. Seven days also produced exactly 574 time steps from the original 11 years of daily discharges. Because the sedimentation model for the main stem Yazoo River is to be operated as a predictive or management aid, realistic long term records beyond the original 574 values were required. This necessitated extension of the 11-year discharge base to 50 years, an addition of 39 years or 2035 weekly average discharges. Extension was conducted using current time series analysis techniques that preserve the mean, variance and autocorrelation structure of the historical 11-year discharge base.

Time series models are often fitted to the autocorrelation function or equivalently its Fourier transform. The stationary component of the time series is then removed. Research has shown the best method is to synthesize logarithms of the flows using an Auto-Regressive Moving Average Scheme (ARMA) with time varying auto-regressive (AR) coefficients that preserve long range dependence of the hydrologic series. The approach used here employed Kalman filtering to improve fitting of an AR (2) (auto-regressive lagged two-time periods) model to the historic data. This model was then used to extend the 11-year record.

The first step in analysis of a hydrologic time-series is the removal of the nonstationarity or periodicities in the mean and variance of the observed data. For that purpose, the fitted standardization method
was used. In this approach, hydrologic processes are assumed to be composed of a deterministic periodic component and a stochastic residual component. With the periodic mean $\mu_t$ and the periodic standard deviation $\sigma_t$, the model for the hydrologic process (discharge) $Q_{p,t}$ is

$$Q_{p,t} = \mu_t + \sigma_t \gamma_{p,t}$$

(12)

where $p$ represents a specific year, $t$ is a time period in that year (such as a weekly value or 52 weeks per year) and $\gamma_{p,t}$ is the stochastic component which is stationary at least for the mean and the variance. The parameters $\mu_t$ and $\sigma_t$ in Equation 12 were estimated by the harmonic models

$$\mu_t = m_x + \sum_{i=1}^{6} (A_i \cos \frac{2\pi it}{\omega} + B_i \sin \frac{2\pi it}{\omega})$$

(13)

$$\sigma_t = S_x + \sum_{i=1}^{6} (A_i \cos \frac{2\pi it}{\omega} + B_i \sin \frac{2\pi it}{\omega})$$

(14)

where $m_x$ and $S_x$ are the averages of the sample mean $Q_t$ and the sample standard deviation $S_t$ of $Q_{p,t}$ at time period $t$ and $\omega$ is the basic cycle for the time series (52 for this application), and $A_i$ and $B_i$ are Fourier coefficients. The sample mean $Q_t$ is found from

$$Q_t = \frac{1}{n} \sum_{p=1}^{n} Q_{p,t}$$

(15)

and the sample standard deviation is

$$S_t = [\frac{1}{n-1} \sum_{p=1}^{n} (Q_{p,t} - Q_t)^2]^{1/2}$$

(16)
where \( n \) is 11 years. Therefore, for each weekly time period, one to 52, a mean value and standard deviation was computed. The averages of these two statistics were then used in Equations 13 and 14. The Fourier coefficients \( A_i \) and \( B_i \) for this sixth order harmonic (\( i = 1, \ldots, 6 \)) were estimated by a least-squares technique. After completing the standardization process described above, the resulting stationary time-series was fitted to an AR (2) model of the form

\[
y_{p,t} = a_{t_1} y_{p,t-1} + a_{t_2} y_{p,t-2}
\]

(17)

where \( a_{t_1} \) and \( a_{t_2} \) are the AR coefficients at time period \( t \), and \( y_{p,t-1} \) and \( y_{p,t-2} \) are the stochastic components for year \( p \) at one and two previous time periods, respectively. A Kalman filtering technique was used for this purpose because of its ability to track the variations of the AR-coefficients with time and under noisy (fluctuating) observed data, which is the case for water discharge.

A sixth order harmonic polynomial of the form

\[
a_{t_2} = \sum_{i=1}^{6} \left( K_{1_i} \cos \frac{2\pi it}{\omega} + K_{2_i} \sin \frac{2\pi it}{\omega} \right)
\]

(18)

where \( K_{1_i} \) and \( K_{2_i} \) are the Fourier coefficients and \( \omega \) is again 52 (see Equation 13 or 14) was then used to extend the AR-coefficients forward in time to obtain a complete time-varying model for the standardized logarithm of the discharge time-series. After the complete time varying model was constructed, predicted, and observed discharge values were compared. The differences between predicted and observed values, residuals, were used to generate random errors, i.e., noise in the time series. Essential to this generation were the mean, standard deviation
and lag-1 autocorrelation of the residuals. These residuals were assumed to be normally distributed allowing standard random number generation techniques to be used in their estimation.

The above procedures for determining the discharge time-series can be summarized as:

1) Compute the average discharge for each seven day period
2) Take the logarithm of the average discharge data
3) Eliminate the nonstationarity in the data by the fitted standardization method
4) Fit an AR (2) model to the standardized time-series by Kalman filtering
5) Fit a 6th order harmonic model to the coefficients of the AR (2) model
6) Calculate the statistics (i.e., mean, standard deviation and lag-1 autocorrelation coefficient) of the residuals for the complete time-varying model. These statistics will be used to generate random noise which will be added to the generated data from the time-varying AR (2) model when synthesized data is desired.

Synthesized streamflow data was then obtained through the following inverse operations:

1) Generate normally distributed random numbers based on the statistics of the residuals of the model.
2) Generate the values for the coefficients of the AR (2) model based on the 6th order harmonic models.
3) Generate the standardized time-series with the AR (2) model including normally distributed random noise which was generated in step (1).
4) De-standardize the data to return to the logarithm of streamflow time-series based on Equation 12.

5) Take the exponential of the generated data.

6) Check lower and upper bounds on the generated values.

7) Check the simulated flow characteristics with the historical flow characteristics, such as frequency of occurrence of peak flow and flow volume distribution.

If the flows were realistic and consistent, the flow series was accepted for further use. Computer programs for computing a weekly time-series are presented in Appendix D.

4.1 Results of Development

A summary of daily and weekly flow values used in this study are listed in Appendix 2. As this appendix shows, the simulated record retained the characteristics of the observed record particularly for the gaged stations.

This similarity can be seen by comparing Figures 4 and 5. Figure 4 shows 574 observed historic flows for Tallahatchie (Coldwater) River near Lambert and Figure 5 shows the next 574 flows as generated by a time-series model. As these figures indicate, the time-series model retained the cyclical nature and relative magnitudes of the actual data. Similar plots for fifty years of actual and simulated records are presented in Appendix E. Completion of discharge extension allowed computation of ungaged and non-point source inputs; these computations being the final step in discharge record development.
Figure 4. Seven-day average discharge for Tallahatchie River near Lambert, observed discharges.
Figure 5. Seven-day average discharge for Tallahatchie River near Lambert, generated discharges.
V. UNGAGED AND NON-POINT SOURCE RECORDS

5.1 Ungaged Sources

An ungaged source is an important watershed of definable area that lacks continuous stage or discharge data. Ungaged sources are listed in Table 1.

Table 1. Ungaged Sources for the Yazoo River Basin Study

<table>
<thead>
<tr>
<th>Short Creek</th>
<th>Cane Creek</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piney Creek</td>
<td>Batupan Bogue</td>
</tr>
<tr>
<td>Tescheva Creek</td>
<td>Tillatoba Creek</td>
</tr>
<tr>
<td>Black Creek</td>
<td>Peters Creek</td>
</tr>
<tr>
<td>Fannegusha Creek</td>
<td>McIvor Drainage</td>
</tr>
<tr>
<td>Teoc Creek</td>
<td>Strayhorn Creek</td>
</tr>
<tr>
<td>Potococowa Creek</td>
<td>Lake Cormorant Bayou</td>
</tr>
</tbody>
</table>

These fourteen sources were computed using flow records from nearby stations. Two types of relationships were used. If nearby, similar gaged sites existed, the discharge value for the ungaged site was computed as

\[
Q_{UG} = \frac{A_{UG}}{n} \left( \sum_{J=1}^{n} \left( \frac{Q_{G}^J}{A_{G}^J} \right) \right)
\]

where \(Q_{UG}\) is the discharge at the ungaged site, \(A_{UG}\) is area of the ungaged watershed contributing to the site, \(Q_{G}^J\) is the discharge at gaged site \(J\), \(A_{G}^J\) is watershed area contributing to gaged site \(J\), and \(n\) is the number of sites used. Nine of the 14 ungaged sources were computed using Equation 19. Discharges for Short, Piney, Tescheva,
Black and Fannegusha Creeks were computed using data from Pelucia and Abiaca Creeks. Teoc, Potococowa and Cane Creek discharges were based on Big Sand and Ascalmore Creeks while Strayhorn Creek flows were developed from Arkabutla Creek only. One drawback to this approach is that those ungaged sources with records developed from the same nearby stations will have identical hydrograph timing; the peak and low flows will occur on the same day. This may not be unrealistic, however, as such groups of watersheds are in close proximity to each other and have similar characteristics.

The other type of relationship used to estimate ungaged sources was flow continuity between a gaged site above the ungaged source inflow and a gaged site below the inflow. Again, discharge per unit area was employed as

\[ Q_{UG} = A_{UG} \left[ \frac{Q_{Below} - Q_{Above}}{A_{Below} - A_{Above}} \right] \]  

(20)

where \( Q_{Above} \) is the daily or weekly discharge at the site upstream of the ungaged inflow, \( Q_{Below} \) is the discharge downstream of the site and \( A_{Below} \) and \( A_{Above} \) are the drainage areas contributing to the two sites. Five sources were estimated using this approach. Batupan Bogue was estimated by Yalobusha River at Grenada Town (Highway 51), downstream, and Yalobusha River at Grenada Dam, upstream. Tillatoba, Peters and McIvor Drainage utilized the Panola-Quitman Floodway near Batesville and Little Tallahatchie River at Sardis Dam while Lake Cormorant Bayou used Coldwater River near Prichard and Coldwater River at Arkabutla Dam. If there was a loss between gaged stations at any particular time, a default value was used for the ungaged source discharge. Addition of
these 14 ungaged sources to the 30 gaged sites produced a set of point source or specific site inputs or outputs. Non-point or undefined sources completed the flow records.

5.2 Non-Point Sources

Non-point source (NPS) inflows or outflows are comprised of several hydrologic units. Notable non-point sources are groundwater flow, overbank flow, low gradient backwater swamps, channels or bayous, small tributaries, or overland flow. To account for each of these sources would be an enormous task not worthwhile to this study. Therefore, each of these small or diffuse sources were lumped into non-point sources. Eighteen non-point sources were determined for this study, one for each reach or subreach as noted in the spatial design. Fifteen were developed between Belzoni and Arkabutla Dam and only three were developed downstream from Belzoni. Non-point source flows were computed by flow continuity or

\[ Q_{\text{NPS}} = Q_{\text{OUT}} - \sum_{i=1}^{n} Q_{\text{IN}_i} \]  

(21)

where \( Q_{\text{NPS}} \) is the weekly or daily discharge for the non-point source, \( Q_{\text{OUT}} \) is the outflow station of the reach being processed, \( Q_{\text{IN}_i} \) is the individual inflow to the reach and \( n \) is the number of inflows.

For example, the reach from Satartia to Yazoo City has an outflow site at Satartia and inflows from Short Creek (ungaged estimate) and Yazoo River at Yazoo City, all other sources are considered as part of non-point source flows. Because non-point sources can be either inflows or outflows there was no constraint upon discharge being positive or negative. A computer program for calculating non-point sources is presented in Appendix D. Statistics for ungaged and non-point sources are presented in Appendix C.
VI. SUMMARY AND CONCLUSIONS

The addition of 18 non-point sources to 30 gaged and 14 ungaged sites completed development of the Yazoo River discharge records needed for the water and sediment routing models. Much time and effort was spent in converting stage data on magnetic tapes, and printed data on graphs and in books into daily and weekly discharges. The approach and techniques devised for producing discharge files of the magnitude (over 400,000 values) needed for a large river basin study is one key component of this project. This approach will prove to be useful when other river basins are analyzed.
APPENDIX A

Schematic of Spatial-Temporal Design for Yazoo River Basin
YAZOO RIVER BASIN MODEL STUDY

DISTRIBUTION OF FLOWS BY RIVER REACH

UPPER RIVER

REACH 1

Belzoni to Greenwood

Belzoni = Greenwood + Abiaca + Pelucia + NPS1 (including Marksville Overflow)

<table>
<thead>
<tr>
<th>Station</th>
<th>R.M.</th>
<th>Area</th>
<th>Records</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belzoni</td>
<td>116.2</td>
<td>7830</td>
<td>Yes, SD</td>
<td>Downstream Station</td>
</tr>
<tr>
<td>Abiaca Cr.</td>
<td>140.34</td>
<td>~112</td>
<td>Yes, SD</td>
<td>Planimetered Area</td>
</tr>
<tr>
<td>Pelucia Cr.</td>
<td>155.7</td>
<td>64</td>
<td>Yes, SD</td>
<td>Area at Gaging Station</td>
</tr>
<tr>
<td>Greenwood</td>
<td>166.0</td>
<td>7450</td>
<td>Yes</td>
<td>Key Station</td>
</tr>
</tbody>
</table>

Change in area = 7830 - 7450 = 380 sq. mi.

Gaged streams = 176 sq. mi. = 46.3% of change in area

Non-Point Sources = 204 sq. mi. = 53.7%

1) Name of gaging station or tributary stream

2) River Mile

3) Drainage area above gaging station or area of tributaries, in sq. miles.
4) Availability of flow records and source

SD - COE stage records converted to discharge

USGS - United States Geological Survey Daily Flow Records

*NPS - Non-point source inflows
REACH 2

Greenwood to Money includes Yalobusha River from Grenada Dam to Greenwood.

There are three subsections in this reach.

Subsection 1

Greenwood = Money + Whaley + Ascalmore + Big Sand
+ Teoc + Potococowa + NPS2

<table>
<thead>
<tr>
<th>Station</th>
<th>R.M.</th>
<th>Area</th>
<th>Flow Records</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greenwood</td>
<td>166</td>
<td>7450</td>
<td>Yes</td>
<td>Key Station</td>
</tr>
<tr>
<td>Big Sand Cr.</td>
<td>1.05*</td>
<td>110</td>
<td>Yes, SD</td>
<td></td>
</tr>
<tr>
<td>Teoc Cr.</td>
<td>7.65*</td>
<td>40</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Potococowa Cr.</td>
<td>8.65*</td>
<td>78</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Ascalmore Cr.</td>
<td>8.77*</td>
<td>32</td>
<td>Yes, SD</td>
<td></td>
</tr>
<tr>
<td>Yalobusha at</td>
<td>9.05*</td>
<td>1960</td>
<td>Yes, SD</td>
<td></td>
</tr>
<tr>
<td>Whaley</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Money</td>
<td>192.9</td>
<td>5221</td>
<td>Yes, SD</td>
<td></td>
</tr>
</tbody>
</table>

*Upstream on Yalobusha from confluence with Yazoo River
Change in area = \(7450 - 5221 - 1960 = 269\) sq. mi.

Ungaged Streams = \(118\) sq. mi. = 43.9%

Gaged streams = \(142\) sq. mi. = 52.8%

Non-Point Sources = \(9\) sq. mi = 3.3%

Subsection 2
Yalobusha River
Whaley to Grenada town (Highway 51)
Whaley = Grenada town + Cane Creek + NPS3

<table>
<thead>
<tr>
<th>Station</th>
<th>R.M.</th>
<th>Area</th>
<th>Flow Records</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whaley</td>
<td>9.05</td>
<td>1960</td>
<td>Yes, SD</td>
<td></td>
</tr>
<tr>
<td>Cane Cr.</td>
<td>21.74</td>
<td>25</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Grenada town</td>
<td>45.59</td>
<td>1570</td>
<td>Yes, SD</td>
<td></td>
</tr>
</tbody>
</table>

Change in area = 1960 - 1570 = 390 sq. mi.

Ungaged streams = 25 sq. mi. = 6.4%

Non-Point Sources = 365 sq. mi. = 93.6%

Subsection 3
Grenada town to Grenada Dam
Grenada town = Grenada Dam + Batupan Bogue + NPS4

<table>
<thead>
<tr>
<th>Station</th>
<th>R.M.</th>
<th>Area</th>
<th>Flow Records</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grenada town</td>
<td>45.59</td>
<td>1570</td>
<td>Yes, SD</td>
<td></td>
</tr>
<tr>
<td>Batupan Bogue</td>
<td>46.60</td>
<td>162</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Grenada Dam</td>
<td>47</td>
<td>1320</td>
<td>Yes, USGS</td>
<td></td>
</tr>
</tbody>
</table>

Change in area = 1570 - 1320 = 250 sq. mi.

Ungaged Streams = 162 sq. mi. = 64.8%

Non-Point Sources = 88 sq. mi. = 35.2%
REACH 3

Money to Swan Lake

<table>
<thead>
<tr>
<th>Station</th>
<th>R.M.</th>
<th>Area</th>
<th>Flow Records</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Money</td>
<td>192.90</td>
<td>5221</td>
<td>Yes, SD</td>
<td></td>
</tr>
<tr>
<td>Swan Lake</td>
<td>219.08</td>
<td>5130</td>
<td>Yes, USGS</td>
<td></td>
</tr>
</tbody>
</table>

Change in Area = 5221 - 5130 = 91 sq. mi.
Non-Point Sources = 91 sq. mi. = 100%
REACH 4

Swan Lake to Locopolis

- Locopolis
- Swan Lake

Swan Lake = Locopolis + NPS6

<table>
<thead>
<tr>
<th>Station</th>
<th>R.M.</th>
<th>Area</th>
<th>Flow Records</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swan Lake</td>
<td>219.08</td>
<td>5130</td>
<td>Yes, USGS</td>
<td></td>
</tr>
<tr>
<td>Locopolis</td>
<td>230.65</td>
<td>4920</td>
<td>Yes, SD</td>
<td></td>
</tr>
</tbody>
</table>

Change in Area = 5130 - 4920 = 210 sq. mi.

Non-Point sources = 210 sq. mi. = 100%
REACH 5

Locopolis to Lambert includes P-Q Floodway

There are two subsections in this reach

![Diagram showing locations of Locopolis, Lambert, Sardis Dam, Batesville, Peters Cr., and Enid Dam]

Subsection 1

Locopolis = Lambert + Batesville + Enid Dam + Peters Creek
+ Tillatoba Creek + NPS7

<table>
<thead>
<tr>
<th>Station</th>
<th>R.M.</th>
<th>Area</th>
<th>Flow Records</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locopolis</td>
<td>230.65</td>
<td>4920</td>
<td>Yes, SD</td>
<td></td>
</tr>
<tr>
<td>Batesville</td>
<td>23.30*</td>
<td>1802</td>
<td>Yes, SD</td>
<td></td>
</tr>
<tr>
<td>Enid Dam</td>
<td>13.5*</td>
<td>560</td>
<td>Yes, USGS</td>
<td></td>
</tr>
<tr>
<td>Peters Cr.</td>
<td>6.1*</td>
<td>71</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Tillatoba Cr.</td>
<td>234.65</td>
<td>157</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Lambert</td>
<td>253.19</td>
<td>1980</td>
<td>Yes, USGS</td>
<td></td>
</tr>
</tbody>
</table>

Change in Area = 4920 - 1802 - 560 - 1980 = 578 sq. mi.

Ungaged Streams = 228 sq. mi. = 39.4%

Non-Point Sources = 350 sq. mi. = 60.6%

* R.M. on P-Q, Yocona, or Little Tallahatchie
Subsection 2

Batesville = Sardis Dam + McIvor Drainage + NPS8

<table>
<thead>
<tr>
<th>Station</th>
<th>R.M.</th>
<th>Area</th>
<th>Flow Records</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Batesville</td>
<td>23.30</td>
<td>1802</td>
<td>Yes, SD</td>
<td></td>
</tr>
<tr>
<td>McIvor Drainage</td>
<td>24.74</td>
<td>76</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Sardis Dam</td>
<td>49.70</td>
<td>1545</td>
<td>Yes, USGS</td>
<td></td>
</tr>
</tbody>
</table>

Change in Area = 1802 - 1545 = 257 sq. mi.

Ungaged Streams = 76 sq. mi. = 29.6%

Non-Point Sources = 181 sq. mi. = 70.4%
**REACH 6**

Lambert to Marks

Lambert = Marks + NPS9

<table>
<thead>
<tr>
<th>Station</th>
<th>R.M.</th>
<th>Area</th>
<th>Flow Records</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lambert</td>
<td>253.19</td>
<td>1980</td>
<td>Yes, USGS</td>
<td></td>
</tr>
<tr>
<td>Marks</td>
<td>261.4</td>
<td>1810</td>
<td>Yes, SD</td>
<td></td>
</tr>
</tbody>
</table>

Change in Area - 1980 - 1810 = 170 sq. mi.

Non-Point Sources = 170 sq. mi. = 100%  NPS9
REACH 7

Marks to Darling

Darling

Marks

Marks = Darling + NPS10

<table>
<thead>
<tr>
<th>Station</th>
<th>R.M.</th>
<th>Area</th>
<th>Flow Records</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marks</td>
<td>261.4</td>
<td>1810</td>
<td>Yes, SD</td>
<td></td>
</tr>
<tr>
<td>Darling</td>
<td>272.5</td>
<td>1620</td>
<td>Yes, SD</td>
<td></td>
</tr>
</tbody>
</table>

Change in Area - 1810 - 1620 = 190 sq. mi.

Non-Point Sources = 190 sq. mi. = 100%  NPS10
REACH 8

Darling to Sledge

Darling = Sledge + NPS11

<table>
<thead>
<tr>
<th>Station</th>
<th>R.M.</th>
<th>Area</th>
<th>Flow Records</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Darling</td>
<td>272.5</td>
<td>1620</td>
<td>Yes, SD</td>
<td></td>
</tr>
<tr>
<td>Sledge</td>
<td>278.84</td>
<td>1404</td>
<td>Yes, SD</td>
<td></td>
</tr>
</tbody>
</table>

Change in Area = 1620 - 1404 = 216 sq. mi.
Non-Point Source = 216 sq. mi. = 100% NPS11
REACH 9

Sledge to Crenshaw

\[ \text{Sledge} = \text{Crenshaw} + \text{NPS12} \]

<table>
<thead>
<tr>
<th>Station</th>
<th>R.M.</th>
<th>Area</th>
<th>Flow Records</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sledge</td>
<td>278.84</td>
<td>1404</td>
<td>Yes, SD</td>
<td></td>
</tr>
<tr>
<td>Crenshaw</td>
<td>284.00</td>
<td>1403</td>
<td>Yes, SD</td>
<td></td>
</tr>
</tbody>
</table>

Change in Area = 1404 - 1403 = 1 sq. mi.

Non-Point Sources = 1 sq. mi. = 100%  \[ \text{NPS12} \]
REACH 10

Crenshaw to Sarah

Crenshaw = Sarah + NPS13

<table>
<thead>
<tr>
<th>Station</th>
<th>R.M.</th>
<th>Area</th>
<th>Flow Records</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crenshaw</td>
<td>284.0</td>
<td>1403</td>
<td>Yes, SD</td>
<td></td>
</tr>
<tr>
<td>Sarah</td>
<td>288.7</td>
<td>1395</td>
<td>Yes, SD</td>
<td></td>
</tr>
</tbody>
</table>

Change in Area = 1403 - 1395 = 8 sq. mi.

Non-Point Sources = 8 sq. mi. = 100%  NPS13
REACH 11

Sarah to Prichard

Sarah = Prichard + Arkabutla Creek + Strayhorn Creek + NPS14

<table>
<thead>
<tr>
<th>Station</th>
<th>R.M.</th>
<th>Area</th>
<th>Flow Records</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sarah</td>
<td>288.7</td>
<td>1395</td>
<td>Yes, SD</td>
<td></td>
</tr>
<tr>
<td>Arkabutla Cr.</td>
<td>291.2</td>
<td>104</td>
<td>Yes, SD</td>
<td></td>
</tr>
<tr>
<td>Strayhorn Cr.</td>
<td></td>
<td>47</td>
<td>No</td>
<td>Location not fixed</td>
</tr>
<tr>
<td>Prichard</td>
<td>299.54</td>
<td>1214</td>
<td>Yes, SD</td>
<td></td>
</tr>
</tbody>
</table>

Change in Area = 1395 - 1214 = 181 sq. mi.

Gaged Streams = 104 sq. mi. = 57.5%

Ungaged Streams = 47 sq. mi. = 26.0%

Non-Point Sources = 30 sq. mi. = 16.5%
REACH 12

Prichard to Arkabutla Dam

Prichard = Arkabutla Dam + Lake Cormorant Bayou + NPS15

<table>
<thead>
<tr>
<th>Station</th>
<th>R.M.</th>
<th>Area</th>
<th>Flow Records</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prichard</td>
<td>299.54</td>
<td>1214</td>
<td>Yes, SD</td>
<td></td>
</tr>
<tr>
<td>Lake Cormorant Bayou</td>
<td>301.8</td>
<td>101</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Arkabutla Dam</td>
<td>307.5</td>
<td>1000</td>
<td>Yes, USGS</td>
<td>Upstream Station</td>
</tr>
</tbody>
</table>

Change in Area = 1214 - 1000 = 214 sq. mi.

Ungaged streams = 101 sq. mi. = 47.2%

Non-Point Sources = 113 sq. mi. = 52.8%
YAZOO RIVER BASIN MODEL STUDY

DISTRIBUTION OF FLOWS BY RIVER REACH

LOWER RIVER

REACH 1

Yazoo River at mouth of Big Sunflower to Satartia

Yazoo River at mouth of Big Sunflower = Satartia + Big Sunflower + NPS 953

<table>
<thead>
<tr>
<th>Station</th>
<th>R. M.</th>
<th>Area</th>
<th>Flow Records</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satartia</td>
<td>53.3</td>
<td>9020</td>
<td>Yes, SD</td>
<td></td>
</tr>
<tr>
<td>Big Sunflower</td>
<td>44.4</td>
<td>*</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Yazoo River at</td>
<td>44.4</td>
<td>*</td>
<td>Yes, SD</td>
<td></td>
</tr>
<tr>
<td>mouth of Big Sunflower</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Change in area = Undetermined

Ungaged Streams = Undetermined

Non Point Sources = Undetermined

* Undetermined
REACH 2

Satartia to Yazoo City

Satartia = Yazoo City + Short + NPS 952

<table>
<thead>
<tr>
<th>Station</th>
<th>R. M.</th>
<th>Area</th>
<th>Flow Records</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satartia</td>
<td>53.3</td>
<td>9020</td>
<td>Yes, SD</td>
<td></td>
</tr>
<tr>
<td>Short</td>
<td>72.50</td>
<td>36</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Yazoo City</td>
<td>75.00</td>
<td>8900</td>
<td>Yes, SD</td>
<td></td>
</tr>
</tbody>
</table>

Change in Area = 9020 - 8900 = 120 sq. mi.

Ungaged Streams = 36 sq. mi. = 30%
Non-Point Sources = 84 sq. mi. = 70%
**REACH 3**

Belzoni to Yazoo City

<table>
<thead>
<tr>
<th>Station</th>
<th>R. M.</th>
<th>Area</th>
<th>Records</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yazoo City</td>
<td>75.0</td>
<td>8900</td>
<td>Yes, SD</td>
<td></td>
</tr>
<tr>
<td>Piney Cr.</td>
<td>84.8</td>
<td>78</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Techeva Cr.</td>
<td>95.9</td>
<td>59</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Black Cr.</td>
<td>95.9</td>
<td>111</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Fannegusha Cr.</td>
<td>95.9</td>
<td>99</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Tchula Lake</td>
<td>105.2</td>
<td>*</td>
<td>Yes, SD</td>
<td>Stage records extended from Belzoni gage</td>
</tr>
<tr>
<td>Lower Auxiliary Channel Outflow</td>
<td>107.1</td>
<td>-</td>
<td>Yes, SD</td>
<td>Silver City gaged used to determine discharge</td>
</tr>
<tr>
<td>Belzoni</td>
<td>116.2</td>
<td>7830</td>
<td>Yes, SD</td>
<td></td>
</tr>
</tbody>
</table>

Change in area = 1070 sq. mi.

Ungaged streams = 347 sq. mi. = 32.4%

Non-Point Sources = 723 sq. mi. = 67.6%

* Not determined
APPENDIX B

Stage-Discharge Parameters
PARAMETERS FOR YAZOO RIVER BASIN
STAGE-DISCHARGE RELATIONSHIPS

\[ Q = a(S + c)^b \]
\[ Q = mS + k \]

<table>
<thead>
<tr>
<th>NAME</th>
<th>Parameter</th>
<th>Breakpoint</th>
<th>Stage*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yazoo River at mouth of Big Sunflower</td>
<td>a 923.322</td>
<td>b 1.007</td>
<td>c -55.00</td>
</tr>
<tr>
<td>Yazoo River at Satartia</td>
<td>a 804.407</td>
<td>b .864</td>
<td>c -</td>
</tr>
<tr>
<td>Yazoo River at Yazoo City</td>
<td>a 679.170</td>
<td>b .939</td>
<td>c -</td>
</tr>
<tr>
<td>Lower Auxiliary Channel overflow nr. Silver City(^1)</td>
<td>a 960</td>
<td>b 1</td>
<td>c -90</td>
</tr>
<tr>
<td>Tchula Lake Cut-off nr. Mileston(^2)</td>
<td>a -</td>
<td>b -</td>
<td>c -</td>
</tr>
<tr>
<td>Yazoo River at Belzoni</td>
<td>a 154.80</td>
<td>b 1.457</td>
<td>c -</td>
</tr>
<tr>
<td>Yazoo River Overflow at Marksville(^3)</td>
<td>a 399.972</td>
<td>b 1</td>
<td>c -25</td>
</tr>
<tr>
<td>Abiaca Creek near Pine Bluff</td>
<td>a 30.594</td>
<td>b 2.120</td>
<td>c -4</td>
</tr>
<tr>
<td>Pelucia Creek near Valley Hill</td>
<td>a 58.843</td>
<td>b 2.373</td>
<td>c -7.5</td>
</tr>
<tr>
<td>Yazoo River at Greenwood</td>
<td>a discharge already determined by USGS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tallahatchie River at Money</td>
<td>a 57.808</td>
<td>b 1.704</td>
<td>c -3</td>
</tr>
<tr>
<td>Big Sand Creek at Valley Hill</td>
<td>a 30.478</td>
<td>b 2.646</td>
<td>c -1.5</td>
</tr>
<tr>
<td>Ascalmore Creek at Paynes</td>
<td>a 8.492</td>
<td>b 2.615</td>
<td>c -1</td>
</tr>
<tr>
<td>Yalobusha River at Whaley</td>
<td>a 0.323</td>
<td>b 3.209</td>
<td>c -</td>
</tr>
<tr>
<td>Yalobusha River at Grenada</td>
<td>a 3.392</td>
<td>b 2.921</td>
<td>c -</td>
</tr>
<tr>
<td>Yalobusha River at Grenada Dam</td>
<td>a discharge already determined by USGS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tallahatchie River near Swan Lake</td>
<td>a discharge already determined by USGS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NAME</td>
<td>Parameter</td>
<td>Breakpoint Stage*</td>
<td></td>
</tr>
<tr>
<td>------------------------------------</td>
<td>-----------</td>
<td>------------------</td>
<td></td>
</tr>
<tr>
<td>Tallahatchie River at Locopolis</td>
<td>a = 65.578, b = 1.717, c = -10, k = -145805.21, m = 4953.34</td>
<td>32.14</td>
<td></td>
</tr>
<tr>
<td>Yocona River at Enid Dam</td>
<td>discharge already determined by USGS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Little Tallahatchie River near Batesville</td>
<td>a = 122.211, b = 1.654, c = -91680.72, m = 5880.49</td>
<td>18.09</td>
<td></td>
</tr>
<tr>
<td>Little Tallahatchie River at Sardis Dam</td>
<td>discharge already determined by USGS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tallahatchie River near Lambert</td>
<td>discharge already determined by USGS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coldwater River at Marks</td>
<td>a = 6.301, b = 2.280, c = -10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coldwater River near Darling</td>
<td>a = 5.940, b = 2.347, c = -3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coldwater River near Sledge</td>
<td>a = 27.573, b = 1.860, c = 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coldwater River near Crenshaw</td>
<td>a = 29.549, b = 2.030, c = 2.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coldwater River near Sarah</td>
<td>a = 74.880, b = 1.594, c = 1.2, k = -32552.65, m = 2181.99</td>
<td>19.07</td>
<td></td>
</tr>
<tr>
<td>Arkabutla Canal near Arkabutla</td>
<td>a = 2.944, b = 2.566, c = -43900, m = 2700</td>
<td>17.90</td>
<td></td>
</tr>
<tr>
<td>Coldwater River near Prichard</td>
<td>a = 24.096, b = 1.970, c = -7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coldwater River at Arkabutla Dam</td>
<td>discharge already determined by USGS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Key**

* Stage at which dual stage-discharge relationships match.

1. Two linear relationships used $Q = 960(S - 90)$ for $90 < S \leq 105$
   $Q = 14400 + 1600(S - 105)$ for $S > 105$

2. Linear relationship only of $Q = 586.83(S - 20) - 1819.32$

3. Linear relationship only of $Q = 399.972(S - 25)$ for $S > 25$

4. Stages less than or equal to zero were assumed as no flow
APPENDIX C

Flow Statistics for Gaged,
Ungaged and Non-point Sources
<table>
<thead>
<tr>
<th>Station</th>
<th>Statistic</th>
<th>11 Years Daily</th>
<th>11 Years Weekly</th>
<th>50 Years Weekly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belzoni</td>
<td>Max</td>
<td>28158.76</td>
<td>28114.91</td>
<td>28114.91</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>1539.75</td>
<td>1466.92</td>
<td>1466.92</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>11335.60</td>
<td>11335.60</td>
<td>12183.22</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>5777.74</td>
<td>5734.42</td>
<td>4436.44</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>4228.31</td>
<td>4228.31</td>
<td>4228.31</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>.01</td>
<td>1.10</td>
<td>0.15</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>297.67</td>
<td>298.51</td>
<td>83.96</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>789.46</td>
<td>784.52</td>
<td>396.67</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>10539.55</td>
<td>3948.73</td>
<td>3948.73</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>1.00</td>
<td>119.58</td>
<td>119.58</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>476.89</td>
<td>476.89</td>
<td>457.86</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>476.61</td>
<td>341.75</td>
<td>259.72</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>6403.50</td>
<td>2379.39</td>
<td>2379.39</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>1.00</td>
<td>3.38</td>
<td>3.38</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>208.78</td>
<td>208.78</td>
<td>150.99</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>647.81</td>
<td>324.26</td>
<td>210.84</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>43800.00</td>
<td>40857.14</td>
<td>40857.14</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>971.00</td>
<td>1065.71</td>
<td>1065.71</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>11727.19</td>
<td>11727.19</td>
<td>12674.57</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>6515.33</td>
<td>6426.53</td>
<td>4924.74</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>7364.89</td>
<td>6481.17</td>
<td>6481.17</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>-20330.45</td>
<td>-13843.61</td>
<td>-13843.61</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>-1077.26</td>
<td>-1077.26</td>
<td>-1100.20</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>2132.62</td>
<td>1897.64</td>
<td>1318.76</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>22830.88</td>
<td>22419.91</td>
<td>22419.91</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>516.73</td>
<td>561.00</td>
<td>561.37</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>8145.13</td>
<td>8145.13</td>
<td>9183.14</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>4785.18</td>
<td>4731.65</td>
<td>3860.66</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>13919.67</td>
<td>7083.45</td>
<td>7083.45</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>16.89</td>
<td>23.65</td>
<td>23.65</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>292.48</td>
<td>292.48</td>
<td>285.80</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>835.58</td>
<td>598.69</td>
<td>509.29</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>3713.75</td>
<td>1722.54</td>
<td>1885.01</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>26.42</td>
<td>28.42</td>
<td>19.49</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>148.27</td>
<td>148.27</td>
<td>136.26</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>254.20</td>
<td>182.40</td>
<td>145.80</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>7241.81</td>
<td>3358.95</td>
<td>3675.77</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>51.52</td>
<td>55.42</td>
<td>38.01</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>289.12</td>
<td>289.12</td>
<td>265.70</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>495.69</td>
<td>355.67</td>
<td>284.31</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>4333.67</td>
<td>1609.67</td>
<td>1609.67</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>7.09</td>
<td>7.09</td>
<td>7.09</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>152.14</td>
<td>152.14</td>
<td>134.87</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>237.91</td>
<td>159.64</td>
<td>105.10</td>
</tr>
<tr>
<td>Whaley</td>
<td>Max</td>
<td>22087.90</td>
<td>19427.96</td>
<td>19427.96</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>225.52</td>
<td>295.96</td>
<td>295.96</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>2884.23</td>
<td>2884.23</td>
<td>2607.21</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>2471.49</td>
<td>2424.75</td>
<td>1554.94</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>3231.09</td>
<td>1076.29</td>
<td>1178.13</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>16.51</td>
<td>17.76</td>
<td>12.18</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>92.67</td>
<td>92.67</td>
<td>85.16</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>158.87</td>
<td>114.00</td>
<td>91.13</td>
</tr>
<tr>
<td>Grenada</td>
<td>Max</td>
<td>32415.49</td>
<td>12813.53</td>
<td>12813.53</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>43.75</td>
<td>54.60</td>
<td>54.60</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>1972.50</td>
<td>1972.50</td>
<td>1754.88</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>2165.90</td>
<td>1850.21</td>
<td>1521.37</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>21002.00</td>
<td>8183.94</td>
<td>8183.94</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>.06</td>
<td>.57</td>
<td>.19</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>599.33</td>
<td>373.17</td>
<td>283.27</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>1013.22</td>
<td>714.64</td>
<td>472.37</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>6510.00</td>
<td>5685.71</td>
<td>5685.71</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>5.00</td>
<td>5.00</td>
<td>5.00</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>1837.74</td>
<td>1837.74</td>
<td>1677.91</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>1447.49</td>
<td>1381.19</td>
<td>1197.99</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>4592.03</td>
<td>2636.33</td>
<td>2636.33</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>-31638.51</td>
<td>-45808.51</td>
<td>-18808.51</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>-184.20</td>
<td>-184.20</td>
<td>61.58</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>-2244.82</td>
<td>-1856.51</td>
<td>1434.37</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>-20090.50</td>
<td>-16221.96</td>
<td>16224.96</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>-19218.66</td>
<td>-5243.69</td>
<td>-6024.33</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>819.06</td>
<td>819.06</td>
<td>767.17</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>1995.63</td>
<td>1595.03</td>
<td>1026.68</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>11408.49</td>
<td>4445.59</td>
<td>4445.59</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>-2179.63</td>
<td>-1284.83</td>
<td>-206.30</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>-264.56</td>
<td>-238.40</td>
<td>-1614.37</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>772.84</td>
<td>633.21</td>
<td>489.13</td>
</tr>
<tr>
<td>Station</td>
<td>Statistic</td>
<td>11 Years Daily</td>
<td>50 Years Max</td>
<td>50 Years Min</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------</td>
<td>----------------</td>
<td>--------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Swan Lake</td>
<td>Max</td>
<td>44900.00</td>
<td>36428.57</td>
<td>36428.57</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>612.00</td>
<td>774.14</td>
<td>774.14</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>7929.28</td>
<td>7929.28</td>
<td>8917.06</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>4857.45</td>
<td>4750.23</td>
<td>3842.77</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>5298.14</td>
<td>5164.42</td>
<td>5164.42</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>-22780.45</td>
<td>-14816.10</td>
<td>-14816.10</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>215.86</td>
<td>215.86</td>
<td>266.08</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>1643.91</td>
<td>1509.93</td>
<td>880.87</td>
</tr>
<tr>
<td>Locopolis</td>
<td>Max</td>
<td>33753.57</td>
<td>29802.49</td>
<td>29802.49</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>650.53</td>
<td>713.15</td>
<td>713.15</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>7291.47</td>
<td>7291.47</td>
<td>8260.64</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>4767.61</td>
<td>4685.40</td>
<td>3641.99</td>
</tr>
<tr>
<td>NPS6</td>
<td>Max</td>
<td>12054.75</td>
<td>6626.08</td>
<td>6626.08</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>-4122.35</td>
<td>-2124.90</td>
<td>-2124.90</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>637.81</td>
<td>637.81</td>
<td>656.42</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>842.32</td>
<td>720.32</td>
<td>455.69</td>
</tr>
<tr>
<td>Lambert</td>
<td>Max</td>
<td>15100.00</td>
<td>14571.43</td>
<td>14571.43</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>85.00</td>
<td>116.43</td>
<td>116.43</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>2843.12</td>
<td>2843.12</td>
<td>3400.68</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>2785.66</td>
<td>2670.86</td>
<td>2681.66</td>
</tr>
<tr>
<td>Tillatoba Cr.</td>
<td>Max</td>
<td>12577.58</td>
<td>4185.77</td>
<td>4185.77</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>.12</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>458.44</td>
<td>448.73</td>
<td>621.04</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>830.75</td>
<td>561.25</td>
<td>429.67</td>
</tr>
<tr>
<td>Enid Dam</td>
<td>Max</td>
<td>4510.00</td>
<td>3925.71</td>
<td>3925.71</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>5.00</td>
<td>5.00</td>
<td>1.20</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>940.23</td>
<td>939.90</td>
<td>950.62</td>
</tr>
<tr>
<td>Peters Cr.</td>
<td>Max</td>
<td>5687.95</td>
<td>1892.91</td>
<td>1892.91</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>.06</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>207.23</td>
<td>202.93</td>
<td>280.85</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>375.69</td>
<td>253.81</td>
<td>194.31</td>
</tr>
<tr>
<td>Batesville</td>
<td>Max</td>
<td>21444.78</td>
<td>13815.14</td>
<td>13815.14</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>78.91</td>
<td>96.67</td>
<td>96.67</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>3139.52</td>
<td>3139.52</td>
<td>3545.70</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>2100.59</td>
<td>1858.89</td>
<td>1939.34</td>
</tr>
<tr>
<td>P-Q Floodway</td>
<td>Max</td>
<td>11900.00</td>
<td>10997.14</td>
<td>10997.14</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>15.00</td>
<td>15.00</td>
<td>15.00</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>2425.86</td>
<td>2424.74</td>
<td>2557.92</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>1676.13</td>
<td>1588.02</td>
<td>1880.29</td>
</tr>
<tr>
<td>Melivor Drainage</td>
<td>Max</td>
<td>6088.51</td>
<td>2026.21</td>
<td>2026.21</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>.06</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>211.92</td>
<td>217.22</td>
<td>300.63</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>402.15</td>
<td>271.69</td>
<td>207.99</td>
</tr>
<tr>
<td>NPS7</td>
<td>Max</td>
<td>12883.41</td>
<td>7118.75</td>
<td>7118.75</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>-33045.56</td>
<td>-942.66</td>
<td>-16959.32</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>-297.07</td>
<td>-282.75</td>
<td>-558.26</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>2074.60</td>
<td>1906.34</td>
<td>2287.05</td>
</tr>
<tr>
<td>NPS8</td>
<td>Max</td>
<td>15006.54</td>
<td>4825.58</td>
<td>4825.58</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>-2317.98</td>
<td>-542.32</td>
<td>-542.32</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>491.74</td>
<td>497.56</td>
<td>687.15</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>1112.19</td>
<td>663.52</td>
<td>542.38</td>
</tr>
<tr>
<td>Marks</td>
<td>Max</td>
<td>15152.42</td>
<td>14854.86</td>
<td>14854.86</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>214.70</td>
<td>219.50</td>
<td>219.50</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>2974.33</td>
<td>2974.33</td>
<td>3486.62</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>2826.98</td>
<td>2747.32</td>
<td>2643.54</td>
</tr>
<tr>
<td>NPS9</td>
<td>Max</td>
<td>4167.45</td>
<td>1477.78</td>
<td>3439.12</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>-3459.24</td>
<td>-2045.71</td>
<td>-2045.71</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>-131.21</td>
<td>-131.21</td>
<td>-85.93</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>620.54</td>
<td>550.42</td>
<td>447.33</td>
</tr>
<tr>
<td>Darling</td>
<td>Max</td>
<td>14795.23</td>
<td>14866.54</td>
<td>14866.54</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>153.73</td>
<td>154.82</td>
<td>154.82</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>2322.37</td>
<td>2322.37</td>
<td>2677.74</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>2626.63</td>
<td>2538.88</td>
<td>2538.88</td>
</tr>
<tr>
<td>NPS10</td>
<td>Max</td>
<td>3535.05</td>
<td>3854.46</td>
<td>3854.46</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>-4880.56</td>
<td>-1222.18</td>
<td>-1222.18</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>651.96</td>
<td>651.96</td>
<td>808.88</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>521.18</td>
<td>462.46</td>
<td>314.99</td>
</tr>
<tr>
<td>Sledge</td>
<td>Max</td>
<td>11376.99</td>
<td>11091.25</td>
<td>11091.25</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>100.11</td>
<td>100.11</td>
<td>100.11</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>2054.47</td>
<td>2054.47</td>
<td>2057.91</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>1779.88</td>
<td>1695.05</td>
<td>1581.18</td>
</tr>
<tr>
<td>NPS11</td>
<td>Max</td>
<td>10492.78</td>
<td>9275.45</td>
<td>9275.45</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>-2499.25</td>
<td>-1095.45</td>
<td>-1095.45</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>287.90</td>
<td>287.90</td>
<td>359.83</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>1064.85</td>
<td>1001.45</td>
<td>805.52</td>
</tr>
<tr>
<td>Cronshaw</td>
<td>Max</td>
<td>14398.82</td>
<td>13631.35</td>
<td>13631.35</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>1.32</td>
<td>41.75</td>
<td>41.75</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>2063.29</td>
<td>2063.29</td>
<td>2375.11</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>1927.51</td>
<td>1813.23</td>
<td>1831.92</td>
</tr>
</tbody>
</table>
### Upper River Weekly Flows—continued

<table>
<thead>
<tr>
<th>Station</th>
<th>Statistic</th>
<th>11 Years Daily</th>
<th>11 Years Weekly</th>
<th>50 Years Weekly</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPS12</td>
<td>Max</td>
<td>5083.17</td>
<td>2954.02</td>
<td>2954.02</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>-9329.93</td>
<td>-7235.88</td>
<td>-7235.88</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>-28.82</td>
<td>-28.82</td>
<td>-57.20</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>652.06</td>
<td>542.73</td>
<td>106.62</td>
</tr>
<tr>
<td>Sarah</td>
<td>Max</td>
<td>15676.88</td>
<td>13949.71</td>
<td>13949.71</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>29.45</td>
<td>77.42</td>
<td>77.42</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>1855.67</td>
<td>1855.67</td>
<td>2300.05</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>1752.80</td>
<td>1609.35</td>
<td>1660.44</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>7604.51</td>
<td>2798.56</td>
<td>2798.56</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>-4966.82</td>
<td>-1216.69</td>
<td>-1216.69</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>207.63</td>
<td>207.63</td>
<td>144.16</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>421.13</td>
<td>344.49</td>
<td>239.36</td>
</tr>
<tr>
<td>Strayhorn Cr.</td>
<td>Max</td>
<td>5343.09</td>
<td>4617.86</td>
<td>4617.86</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>0.05</td>
<td>0.45</td>
<td>0.15</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>96.15</td>
<td>96.38</td>
<td>131.45</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>462.51</td>
<td>389.62</td>
<td>555.59</td>
</tr>
<tr>
<td>Arkabutla Cr.</td>
<td>Max</td>
<td>12265.57</td>
<td>5061.57</td>
<td>5061.57</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>0.01</td>
<td>0.02</td>
<td>106.65</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>170.72</td>
<td>164.41</td>
<td>105.26</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>814.91</td>
<td>534.28</td>
<td>467.34</td>
</tr>
<tr>
<td>Prichard</td>
<td>Max</td>
<td>13584.13</td>
<td>13050.41</td>
<td>13050.41</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>35.49</td>
<td>47.27</td>
<td>47.27</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>1750.69</td>
<td>1750.69</td>
<td>2098.88</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>1729.77</td>
<td>1648.80</td>
<td>1712.65</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>4925.99</td>
<td>1900.78</td>
<td>1900.78</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>-17637.32</td>
<td>-15332.64</td>
<td>-16199.09</td>
</tr>
<tr>
<td>NPS14</td>
<td>Mean</td>
<td>-205.94</td>
<td>-204.68</td>
<td>-290.26</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>1351.74</td>
<td>1158.42</td>
<td>1793.55</td>
</tr>
<tr>
<td>Lake Cormorant Bayou</td>
<td>Max</td>
<td>4502.44</td>
<td>2674.14</td>
<td>3150.18</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>0.05</td>
<td>0.09</td>
<td>0.09</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>204.04</td>
<td>205.48</td>
<td>262.27</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>458.11</td>
<td>386.50</td>
<td>314.15</td>
</tr>
<tr>
<td>Arkabutla Dam</td>
<td>Max</td>
<td>10200.00</td>
<td>7675.71</td>
<td>7675.71</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>5.00</td>
<td>5.00</td>
<td>5.00</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>1338.75</td>
<td>1338.75</td>
<td>1557.72</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>1205.91</td>
<td>1141.00</td>
<td>1728.14</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>5037.39</td>
<td>2991.86</td>
<td>3502.08</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>-812.24</td>
<td>-201.05</td>
<td>-201.05</td>
</tr>
<tr>
<td>NPS15</td>
<td>Mean</td>
<td>207.90</td>
<td>208.47</td>
<td>278.89</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>524.15</td>
<td>445.53</td>
<td>365.93</td>
</tr>
</tbody>
</table>

### Lower River

<table>
<thead>
<tr>
<th>Station</th>
<th>Statistic</th>
<th>11 Years Daily</th>
<th>11 Years Weekly</th>
<th>50 Years Weekly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beltoni</td>
<td>Max</td>
<td>28158.76</td>
<td>28114.91</td>
<td>28114.91</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>1359.75</td>
<td>1466.92</td>
<td>1466.92</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>11335.60</td>
<td>11335.60</td>
<td>12185.22</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>5777.74</td>
<td>5734.42</td>
<td>4436.44</td>
</tr>
<tr>
<td>Tchula Lake</td>
<td>Max</td>
<td>5926.84</td>
<td>5854.18</td>
<td>5854.18</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>1.00</td>
<td>1.10</td>
<td>1.10</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>786.22</td>
<td>786.24</td>
<td>905.76</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>1127.30</td>
<td>1109.72</td>
<td>1246.92</td>
</tr>
<tr>
<td>LAC</td>
<td>Max</td>
<td>17120.00</td>
<td>17062.86</td>
<td>17062.86</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>0.01</td>
<td>1.10</td>
<td>0.10</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>2856.75</td>
<td>2857.23</td>
<td>2898.84</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>4234.84</td>
<td>4202.31</td>
<td>4282.42</td>
</tr>
<tr>
<td>Fannegusha Cr.</td>
<td>Max</td>
<td>7935.12</td>
<td>2894.04</td>
<td>2894.04</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>.97</td>
<td>110.40</td>
<td>69.20</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>321.45</td>
<td>321.45</td>
<td>321.45</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>428.04</td>
<td>300.06</td>
<td>216.15</td>
</tr>
<tr>
<td>Black Cr.</td>
<td>Max</td>
<td>13946.58</td>
<td>5086.49</td>
<td>5086.49</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>1.70</td>
<td>194.04</td>
<td>121.02</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>564.98</td>
<td>564.98</td>
<td>497.14</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>752.31</td>
<td>527.38</td>
<td>380.43</td>
</tr>
<tr>
<td>Tescheva Cr.</td>
<td>Max</td>
<td>4729.01</td>
<td>1724.73</td>
<td>1724.73</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>.58</td>
<td>65.80</td>
<td>41.21</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>191.57</td>
<td>191.57</td>
<td>168.57</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>255.09</td>
<td>178.82</td>
<td>120.00</td>
</tr>
<tr>
<td>Piney Cr.</td>
<td>Max</td>
<td>6251.91</td>
<td>2280.15</td>
<td>2280.15</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>.76</td>
<td>86.99</td>
<td>54.52</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>255.27</td>
<td>255.27</td>
<td>222.85</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>337.24</td>
<td>236.41</td>
<td>170.54</td>
</tr>
<tr>
<td>Yazoo City</td>
<td>Max</td>
<td>19065.32</td>
<td>19605.04</td>
<td>19605.04</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>2000.00</td>
<td>2088.55</td>
<td>2088.55</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>9229.00</td>
<td>9229.00</td>
<td>9709.02</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>3929.38</td>
<td>3895.01</td>
<td>3078.39</td>
</tr>
<tr>
<td>NPS951</td>
<td>Max</td>
<td>5329.25</td>
<td>5197.94</td>
<td>10350.27</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>28766.87</td>
<td>-8045.81</td>
<td>-4977.73</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>-1366.75</td>
<td>-1366.28</td>
<td>-1649.98</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>2314.57</td>
<td>1907.23</td>
<td>2474.80</td>
</tr>
<tr>
<td>Station</td>
<td>Statistic</td>
<td>11 Years Daily</td>
<td>11 Years Weekly</td>
<td>50 Years Weekly</td>
</tr>
<tr>
<td>---------------</td>
<td>-----------</td>
<td>----------------</td>
<td>----------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Short Cr.</td>
<td>Max</td>
<td>2885.50</td>
<td>1052.38</td>
<td>1052.38</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>.35</td>
<td>40.15</td>
<td>25.16</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>116.89</td>
<td>116.89</td>
<td>102.86</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>153.65</td>
<td>109.11</td>
<td>76.71</td>
</tr>
<tr>
<td>Satartia</td>
<td>Max</td>
<td>20142.66</td>
<td>20122.68</td>
<td>20122.68</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>2000.00</td>
<td>2000.00</td>
<td>2000.00</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>9410.73</td>
<td>9410.73</td>
<td>9891.98</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>4218.92</td>
<td>4184.54</td>
<td>3499.55</td>
</tr>
<tr>
<td>NPS952</td>
<td>Max</td>
<td>3882.46</td>
<td>3072.02</td>
<td>3072.02</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>-6001.64</td>
<td>-2053.86</td>
<td>-2053.86</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>64.24</td>
<td>64.24</td>
<td>79.54</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>811.45</td>
<td>765.18</td>
<td>602.28</td>
</tr>
<tr>
<td>Yazoo River at Mouth Big Sunflower</td>
<td>Max</td>
<td>44171.82</td>
<td>44155.87</td>
<td>44155.87</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>2245.98</td>
<td>2411.04</td>
<td>2411.04</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>18816.81</td>
<td>18816.81</td>
<td>19723.91</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>9563.75</td>
<td>9496.20</td>
<td>8098.45</td>
</tr>
<tr>
<td>NPS953</td>
<td>Max</td>
<td>15910.47</td>
<td>15171.09</td>
<td>15171.09</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>-1666.66</td>
<td>409.94</td>
<td>-2365.22</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>6549.34</td>
<td>6548.85</td>
<td>6953.10</td>
</tr>
<tr>
<td></td>
<td>Std.Dev.</td>
<td>2806.63</td>
<td>2742.70</td>
<td>3152.09</td>
</tr>
</tbody>
</table>
APPENDIX D

Computer Programs Used in Developing Actual and Generated Discharge Records
Program for Converting Stages to Discharges and Computing Daily Flows

```fortran
PROGRAM SD(INPUT=INPUT1,OUTPUT=OUTPUT1,TAPE1=TAPE1,TAPE2=TAPE2,TAPE3=INPUT1,TAPE6=OUTPUT1)

C C THIS PROGRAM DECODES STAGES FROM TAPE1, CONVERTS STAGES TO DISCHARGES;
C FILLS IN MISSING DISCHARGES, COMPUTES AVERAGE DAILY DISCHARGES;
C AND COMPUTES THE MEAN, MEAN LOG, STD DEV, LOG STD DEV, AND RANGE OF
C THE CREATED DAILY DISCHARGES.
C
C LIST OF VARIABLES
C S = STAGE AT 6AM
C A = CONSTANT TO BE READ / B = CONSTANT TO BE READ / C = CONSTANT TO BE READ
C DISCHARGE = A * (AVGAGE STAGE + C) ** B
C Q = DISCHARGE COMPUTED FROM S = D RELATION
C DM = MEASURED DISCHARGE
C ICHECK = STATION CODE BEING CONVERTED TO DISCHARGES.
C ICHECK IS A PARAMETER TO CAUSE LINE AFTER READ CODE TO BE PRINTED ALSO.
C
DIMENSION S(4018),Q(4018)
INTEGER SIT1, S1, I
INTEGER DMINC

READ(5,510) ICHECK

READ(5,510) ICHECK

READ in station code number

READ(5,500) A

READ in station code

READ parameters for non-linear equation along with maximum and
minimum expected values

READ(5,200) C1,C2,TGMEK
C1=152 C2=255S,TGMEK=10000

READ in parameters for linear equation and breakpoint D=C1*STG=C2

IF (INPUT200) READ (5,200) C1,C2,TGMEK
DINC=0
K=5
KOUNT=0
READ (1,95) ISTA
95 FORMAT (15)
PRINT (97,95)
PRINT (97,95)
97 FORMAT (00*STATION NUMBER IS)

READ in stage data

777 CONTINUE

READ (1,100) ICODE,IMO, IDAY, IYEAR, SIT1,MCODE, S8, S1, S2, DM
IF (EOF(1)) 999, 19

CHECK to see if negative stage

15 IF (MCODE.NE.1M ) S8=S8*(-1,)
KOUNT=KOUNT+1
S (KOUNT) =S8
S1=S8
IF (ICODE.NE.ICHECK) WRITE (6,900) ICODE, IDAY, IMO, IYEAR, SIT1, S8
151 S2, DM
X=STG-C
IF (X.LE.0.0, OR, SIT1.EQ.1MA) GO TO 77
IF (INPUT2.0, OR, STG.LE.TGMEK) D=A*(STG*C) ** B
IF (INPUT2.0, AND, STG, GT, TGMEK) D=C1*STG=C2
GO TO 17
77 K=K+K2SK+1
C=0
17 CONTINUE

CHECK for max and min

IF (DM.GE.DMAX) PRINT 600, ICODE, IDAY, IMO, IYEAR, D
IF (D.GE.DMAX, AND, D.LT.799999, D=DMAX
IF (D.LE.DMIN) D=DMIN
```

IF(DLTL1.DMIN)DMINC=DMINC+1
IF(IDAY.EQ.1.AND.IMO.EQ.1)WRITE(0,300)ICODE,IDAY,IMO,IYEAR,SIT,
*SM55152515D
G(KOUNT)=0
GU TO 777
95 CONTINUE
IF(DMINC.GT.0)PRINT 700,DMINC
IF(NDSM.GT.0)PRINT 550,NDSM
100 FUMMAT(10+312+A1+F5.2+11+F7.0)
200 FUMMAT(8F10.0)
300 FUMMAT(10X*FIRST VALUE OF A NEW YEAR*5X,16,312,A1,F7.2,A1,F7.2,
*1X,F7.2,3X,F7.2)
500 FUMMAT(6110)
510 FUMMAT(16)
550 FUMMAT(10** NUMBER OF ADJUSTED STAGES LE ZERO ***15)
600 FUMMAT(10** WARNING - THE COMPUTED DISCHARGE IS GREATER*,
*+7X* THAN OR EQUAL TO THE MAXIMUM DISCHARGE. CODE =*10* DAY =*
*+1c* MONTH =*12* YEAR =*12* DISCHARGE = *F7.0)
700 FUMMAT(10**NUMBER OF SUBMINIMUM FLOWS*** *15)
900 FUMMAT(10X* FLOW CARD *5X,16,312,A1,F7.2,A1,F7.2+a1,F9.2)
IF(KOUNT.NE.018)PRINT 950,KOUNT
950 FUMMAT(10X*ERROR IN NUMBER OF VALUES*15///)
IF(KOUNT.NE.018)GO TO 199
N*KOUNT=CALL QSET(UH)
WRITE(2)K1A,NQ
199 STOP
END

SUBROUTINE QSET(Q,NUMQ)
C
C THIS SUBROUTINE COORDINATES SUBROUTINES TO FILL MISSING SPACES;
C COMPUTE DAILY DISCHARGES, AND COMPUTE STATISTICAL FOR DAILY DISCHARGES
C
DIMENSION Q(4018)
CALL QDFILL(Q,NUMQ)
CALL QDAVG(Q,NUMQ)
CALL QSTAT(Q,NUMQ)
PRINT 333,Q(I),I=3653,4018
333 FUMMAT(8F10.2)
RETURN
END

SUBROUTINE QDFILL(Q=N)
C
C THIS SUBROUTINE FILLS IN MISSING VALUES BY AVERAGING THE
C SURROUNDING DISCHARGES
C
DIMENSION Q(4018)
N*KOUNT=0
IF(Q(I),LT.0)Q(I)=0.0,Q(I)**GE.999999, Q(I)=1.
IF(Q(I)**GE.999999, Q(I)=2.*Q(2)-Q(3)
75 CONTINUE
N*START=0,NB=0,NBF=0
77 I=1
NEND=5
IF(I.EQ.NEND)GO TO 999
IF(Q(I).LT.999999)GO TO 100
IF(INSTAKT.LE.0)NB=N-1
NSTART=1
GU TO 77
100 IF(INSTAKT.LE.0)GO TO 77
NBF=1
SLOPE=(Q(NF)-Q(NB))/FLOAT(NF-NB)
KOUNT=KUNT*HF+NF-NB
DU 50 K=NBF+NF
Q(K)=Q(NB)+SLOPE*(K-NB)
50 CONTINUE
GU TO 75
995 CONTINUE
IF(Q(N)**GE.999999, Q(N)=2.*Q(N-1)-Q(N-2)
IF(Q(N)**LT.0,0,OR,Q(N)**GE.999999, Q(N)=1.
PRINT 200,KOUNT
200 FUMMAT(15X*NO. OF FILLS*15)
RETURN
END

SUBROUTINE QDAVG(Q=N)
THIS SUBROUTINE MAKES DATA INTO AVERAGE DAILY DISCHARGES BY INTERPOLATING THE PREVIOUS AND SUBSEQUENT 12 MIDNIGHT DISCHARGES

```
DIMENSION Q(4018), QAVG(4018)
G1=G(1) = (G(2) - G(1)) / 3
G2=G(1) + (G(2) - G(1)) * (2/3)
IF (G1.LE.0.0) PRINT 200, Q1
200 FORMAT (5X,*XHOUR IN FIRST VALUE=*F12.0)
IF (G1.LT.0.0) GO TO 20
QAVG(1) = (G1 + G2) / 2

100 CONTINUE
CU 100 I=2,4017
G3=G(I) = (G(I) - G(I-1)) / 3
G4=G(I) + (G(I+1) - G(I)) * (2/3)
QAVG(I) = (G3 + G4) / 2

110 CONTINUE
G5=G(N) = (G(N) - G(N-1)) / 3
G6=G(N) + (G(N-1) - G(N)) * (2/3)
IF (G2.LT.0.0) PRINT 210, G2
210 FORMAT (5X,*ERROR IN LAST VALUE=*F12.0)
IF (G2.LE.0.0) GO TO 30
QAVG(N) = (G3 + G4) / 2

30 CONTINUE
CU 150 I=1:N
G(I) = QAVG(I)
150 CONTINUE
RETURN
END

THIS SUBROUTINE CALCULATES THE STATISTICS FOR THE DAILY DISCHARGE DATA

```
DIMENSION Q(4018)
SUM=0.0, SUME=0.0, SUML=0.0, SUML2=0.0
XSL=0.0, QMIN=10000000.0, QMAX=-10000000.0

FIND THE RANGE
CU 100 I=1:N
SUM=SUM+G(I)
IF (G(I).GE.QMAX) QMAX=G(I)
IF (G(I).LE.QMIN) QMIN=G(I)
300 IF (G(I).LE.0.0) GO TO 100
D=ALOG(G(I))
SUML=SUML+U
KSL=KSL+1
100 CONTINUE

COMPUTE MEAN AND LOG MEAN
GSL=SUML/FLOAT(KSL)
GMAX=GMAX-QMIN/10.
CU 100 I=1:N
SUM2=SUM2+(G(I)-QAS)*(G(I)-QAS)
IF (G(I).LE.0.0) GO TO 150
D=ALOG(G(I))
SUML2=SUML2+(D-GASL)*(D-GASL)
150 CONTINUE

COMPUTE STD DEV AND LOG STD DEV
SUM2=SQRT(SUM2/FLOAT(N-1))
SUML2=SQRT(SUML2/FLOAT(KSL-1))
S=EXP(GASL)

COMPUTE PLUS AND MINUS ONE DEVIATION
S1=EXP(GASL-SUML2)
S2=EXP(GASL+SUML2)
CU 150 Q=0.0
190 FORMAT (5X,*FLOW STATISTICS=./SXMAX Q=*F8.2./SXMIN Q=*F8.2./)
PRINT 200, GASL, SUML2+GASL, SUML2-S1, S2+KSL
```
200 FORMAT

55

25A*MEAN DAILY FLOW**F15.2/5X*510.DEV. OF FLOW**F15.2/**
15A*MEAN OF LOG FLOW**F15.6/5A*DEV. OF LOG FLOW**F15.6/**
25A*TRANSFORMED MEAN OF LOG FLOW**F15.2/5X*MINUS ONE DEVIATION**F15
3.2/5X*PLUS ONE DEVIATION**F15.2/5X*NUMBER OF NON ZERO FLOWS**F15/1
RETURN
END
Program for Computing Weekly Discharges

PROGRAM PWeek (Input, Output, PUNCH, TAPE2=PUNCH, TAPE7=TAPE1)

INTEGER W
REAL LMK
COMMON/WEEKC(0:018)/, W(574), LMK(574), XMEAN(11), XSTDEV(11), NYEAR
READ (5) ISTA
150 FORMAT (I5)
INDEX = 5 $ NO = 6
W = 1
NYEAR = 1
READ (WF) N, (C(I) = 1:4018)

--- CALCULATE MEAN AND STDV OF YEARLY FLOW ---
N = 0
CU 20 I = 1 + NYEAR
NPTS = 365
IF (I = 1, UC(1) = 5, UC(1) = 5) NPTS = 366
SUM = 0.
FN = FLUAW(HPTS) $ FN = FN + 1.
CU 10 J = 1 + HPTS
N = N + 1
SUM = SUM + C(N)
10 SUM = SUM + G(N) * G(N)
XMEAN(1) = SUM / FN
SUM = SUM / FN
XSTDEV(1) = SUM((SUM - XMEAN(1) * XMEAN(1)) * (FN / FN))
20 CONTINUE
PRINT 30, (1, XMEAN(1) * XSTDEV(1) = 1:1, NYEAR)
30 FORMAT (5X, 12, 5X, F10.2, 5X, F10.2)
SUM = 0.0
CU 77 I = 1, 11
SUM = SUM + XMEAN(2)
77 CONTINUE
AVG = SUM / 11.
PRINT 70, AVG
76 FORMAT (2X, 'AVERAGE LN Q*F12.6')

--- CALCULATE WEEKLY FLOW ---
KUANT = 0 $ ITEG = 0 $ SUM = 0.
N = 0
CU 50 I = 1 + NYEAR
NPTS = 365
IF (I = 1, UC(1) = 5, UC(1) = 5) NPTS = 366
CU 40 J = 1 + NPTS
KUANT = KUANT + 1
N = N + 1
SUM = SUM + G(N)
IF (KUANT, CE(1)) GO TO 35
GO TO 40
35 ITEG = ITEG + 1
WHI TE(ITEG) = SUM / 7.
XX = K(ITEG)
IF (XX > L, XX = 1,
L = K(ITEG) = AVG(XX)
KUANT = 0 $ SUM = 0.
40 CONTINUE
50 CONTINUE
NDAT = ITEG
WHI TE(7:150) ISTA
WHI TE(7:60) (WHI TE(1:1) = NDAT)
50 FORMAT (8F10.2)
WHI TE(7:70) (WHI TE(1:1) = NDAT)
60 FORMAT (8F10.5)
STOP
END
Program for Fitting a Time Series to Weekly Discharges

This is a time series analysis which generates fifty years of average weekly flow from eleven years of average weekly flow

I TAPE3
C I MENSION W1(13)*W2(13)*W3(13)*W4(13)
C COMMON/WORK/I(574),C2(574),TEMP(2609)
C COMMON/GFUNC/X(574),Y(574),YAT(574),NDATA,B12(12),AZEH0,NA,NN,
1 N2=N1,5=YN1,5=nmean(5),YYSTOV(5)
C COMMON/T TH(5),GAIN(3),P(3),Q(3),N+U+V
N=5 $ NU=6
C DATA=574
C NTMEAN=1

C --- READ INPUT DATA ---
C READ(1,10) (Y(1),I=1,NDATA)
10 FORMAT(8F10.2)
C \ REIND1
C --- FIND UPPER AND LOWER LIMITS ---
C CALL MINMAX(ULOW,ULIGH)
C \ #ITE(NG=11) LOW=GMHIGH
11 FORMAT(7X,5X,GLOW=*,F10.2,10X,*GHIGH=*,F10.2)
C --- TRANSFORM TO LOGARITHM ---
C DO 12 I=1,NDATA
Y=Y(I)
12 Y(I)=ALOG(Y)
C \ITHE(NO=60) Y(I),I=1,NDATA

C \ FORMAT(10,3X,F10.2)
C CALL DSTAT(NDATA,Y,YMEAN,YSTDV+YLAG1)
C \ITHE(NO=80) YMEAN,YSTDV+YLAG1
C --- STANDARDIZATION ---
C CALL TEND
C \55 I=1,NDATA

C \ FORMAT(10,3X,F10.2)
C CALL DSTAT(NDATA,Y,YMEAN,YSTDV+YLAG1)
C \ITHE(NO=80) YMEAN,YSTDV+YLAG1
C --- CYCLICAL COMPONENT IDENTIFICATION AND ELIMINATION ---
C \1=12 $ NAIN=1
C NN=NA+N
C NUP1=ATAN(1,1)
C DU=30 I=1,NDATA
C F1=FLOAT(I)
C \1=12 FI=F1/26,
X(1,1)=COS(W)
X(1,2)=SIN(W)
X(1,3)=COS(2,W)
X(1,4)=SIN(2,W)
X(1,5)=COS(3,W)
X(1,6)=SIN(3,W)
X(1,7)=COS(4,W)
X(1,8)=SIN(4,W)
X(1,9)=COS(5,W)
X(1,10)=SIN(5,W)
X(1,11)=COS(6,W)
X(1,12)=SIN(6,W)
30 CONTINUE
C CALL LINFREG
C DU=32 I=1,12
32 X=I(1)=E(1)
X(13)=AZEH0
C DU=50 I=1,NDATA
C DY=Y(I)=YTHAT(I)
50 Y(I)=DY
Y=Y(574) $ YY2=Y(573)
C \ITHE(NO=60)Y(I),I=1,NDATA
C --- CALCULATION OF RESIDUAL STATISTICS ---
C CALL DSTAT(NDATA,Y,YMEAN=YSTDV+YLAG1)
C \ITHE(NO=80) YMEAN=YSTDV+YLAG1

80 FORMAT(7X,5X,YMEAN=*,F10.5,10X,YSTDV=*,F10.5,10X,YLAG1=*,F10.5)
C CALL MINMAX(GMIN,GMAX)
WHITE((G,80) YMEAN1,YSTDV1,YLAG1)
CALL LINREG
DU 130 I=1,12
136 N(N)=B(I)
3(I)=A(I)
DU 135 I=1,NDATA
1(I)=Y(I)
135 Y(I)=Y(I)+2
CALL DOTAT((DATA,Y+YMEAN2,YSTDV2,YLAG2)
DU 134 I=1,NDATA
YY=Y(I)-YMEAN2/YSTDV2
134 Y(I)=YY
WHITE((G,Y,0) YMEAN2,YSTDV2,YLAG2)
CALL LINREG
DU 136 I=1,12
146 N(I)=E(I)
4(I)=A(I)
DU 138 I=1,NDATA
146 (I)=Y(I)
--- DISCHARGE GENERATION ---
NDATA=NDATA+2035
DU 100 I=1,NDATA
F(I)=F(H)
CALL HARKON(3,F(I),Y2,Y2)
CALL HARKON(3,F(I),Y1,CF1)
CUEF=CUEF*YSTDV2+YMEAN2
CUEF2=CUEF*YSTDV2+YMEAN2
X(I,D)=YY
YY=CUEF1*YY1+CUEF2*YY2+HSTDV*RX*SQRT(1,-HALO1+RLA)
IF (YY,G,MAX) YY1=MAX
IF (YY,G,MIN) YY1=MIN
YY1=YY+YH2
IF (YY,G,QH) YY1=QH
IF (YY,G,QL) YY1=QL
58 YY1=YY1
YY1=YY
TEP(I)=YY
100 CONTINUE
C --- CONVERT LOG-VALUES TO BFS ---
N=0 S=NYEAR=50
DU 102 U=1,NYEAR
102 U=15S
N=N+1
102 CONTINUE
DU 104 I=1,9
K=N+2000
104 TEMP(9)=TEMP(9)+YSTDV(I)+YMEAN(I)
102 CONTINUE
DU 110 I=1,NDATA
YY=TEMP(I)
TEMP(I)=EXP(YY)
IF (TEMP(I),6,G,HIGH) TEMP(I)=HIGH
IF (TEMP(I),6,L,G,LLOW) TEMP(I)=LLOW
110 CONTINUE
WHITE((K),122) (TEMP(I)+I=1,NDATA)
112 FUNM(I)(8,F10.2)
END FILE2
REINDU
WHITE((K),1135) (TEMP(I)+I=1,NDATA)
115 FUNM(1013,F10.2)
STOP
END
SUBROUTINE LINREG
C DIMENSION X(N,N),Y(M),A(A2),B(N),XBAR(N),YTHAT(M),AA(N,N)
DIMENSION A(144),AA(12,12),XBAR(12)
COMMON/GFUNC/X(57),Y(57),YTHAT(57),YDATA(B(12),AZERO,N3,N3)
1 N3=NYEAR+YMEAN(N52)+YSTDV(N52)
C P=NDATA $ N=NA $ N2=NN

CALCULATE AVERAGE X AND Y VALUES
DO 200 I=1,N
SUMX=0.0
DO 100 J=1,M
100 SUMX=SUMX+X(J,I)
200 XBAR(I)=SUMX/FLOAT(M)
SUMP=0.0
DO 300 J=1,M
SUMY=SUMY+Y(J)
300 YBAR=SUMY/FLOAT(M)

CALCULATE REGRESSION MATRICES
KK=1
DO 500 I=1,N
DO 500 J=1,N
SUMA=0.0
SUMB=0.0
DO 400 K=1,M
SUMA=SUMA*(X(K,I)-XBAR(I))*(X(K,J)-XBAR(J))
400 SUMB=SUMB*(Y(K)-YBAR)*(X(K,I)-XBAR(I))
AA(I,J)=SUMA
A(KK)=SUMA
KK=KK+1
500 B(I)=SUMB

SOLVE REGRESSION MATRICES FOR COEFFICIENTS
CALL SIMG(A+2*N*K+S*N)
SUMX=0.0
DO 600 I=1,N
600 SUMX=SLMX+B(I)*XBAR(I)
AZERO=YBAR-SUMX

WHITE(6,000)
008 FFORMAT(/H10X*VALUES OF THE CORRESPONDING REGRESSION COEFFICIENT '
WHITE(6,009) (JJ+B(JJ)+JJ=1,N) 009 FFORMAT(/H2(2X+5MAT1+12+6H) = $PE16.8,BA))
WHITE(6,010) AZERO
010 FFORMAT(/H2X+8hAZERO = $PE16.8)

DO 800 J=1,M
SUMJ=0.0
DO 700 K=1,N
700 SUMS1=SUMS1+B(K)*X(J,K)
SOMP=0.0
YMAT(J)=AZERO+SUMS1
CALL DCOR1(Y+YMAT+M,R2)

WHITE(6,013) R2
013 FFORMAT(/H2X*R2 =*$PE16.8)

RETURN
END

DIMENSION A(N),B(N)

FURWARD SOLUTION
TUL=0.0
KS=0
JU=0
DO 65 J=1,N
JY=1
JJ=J+JJ+1
65 silhouette
111 silhouette
DO 30 I=1,N
SEARCH FOR MAXIMUM COEFFICIENT IN COLUMN

1J=1+1
IF(ABS(BIGA)-ABS(A(1J))) 20,30,30
20 BIGA=A(1J)
IMAX=1
30 CONTINUE

TEST FOR PIVOT LESS THAN TOLERANCE (SINGULAR MATRIX)

IF(ABS(BIGA)<TOL) 35,35,40
35 K=1
RETURN

INTERCHANGE ROWS IF NECESSARY

40 I1=J+N*(J-2)
I1=IMAX=J
CU 50 K=U*K
I1=1+U
I2=I1+1
SAVE=A(I1)
A(I1)=A(I2)
A(I2)=SAVE

DIVIDE EQUATION BY LEADING COEFFICIENT

50 A(I1)=A(I1)/BIGA
SAVE=B(IPAA)
E(IMAX)=B(J)
B(J)=SAVE/BIGA

ELEIMINATE NEXT VARIABLE

IF(J=K) 55,70,55
55 I5=MIN(J,K-1)
CU 65 I5=K+Y
I5=1+Y
I5=J-1+X
CU 65 I5=K+Y
I5=1+X
I5=J-1+1
60 A(I5)=A(I5)-A(I5)*A(I5)
65 B(I5)=B(I5)-B(I5)*B(I5)

BACK SOLUTION

70 N=K-1
I1=I+1+NY
I1=I+1+NY
I1=N+J
I1=N+J
I1=N+J
B(I1)=B(I1)-A(I1)*B(I1)
I1=I+1+NY
80 I1=I+1+NY

RETURN
END

SUBROUTINE UCORL(YO,YC,NPTS,R0)

DIMENSION YU(NPTS),YC(NPTS)

SUM1=0.
SUM2=0.
SUM3=0.
SUMG1=SUMG2=0.
CU 10 J=1+NPTS
SUM1=SUM1+YO(J)
SUM2=SUM2+YC(J)

SUM3=SUM3+Y(I)*Y(I)
SUM1=SUM1+Y(I)
SUM2=SUM2+Y(I)*Y(I)

10 CONTINUE
DATA=FLOAT(NPTS)
FN=ABS(DATA-SUM3/SUM1*SUM2)
DNC=MATC (DATA-SUM1/SUM1+SOM1)*SOM1 DATA=SOM1/SUM2)
NOM=FN/DFON
RETURN

END

SUBROUTINE ALTOKAL(INSET, NLAG, MN, ERRAVG, ERRSTDV)

C C
C NSET = NUMBER OF INPUT DATA SETS, MAX = 5
C NLAG = TIME-LAG, MAX = 5
C
C DIMENSION S(3)
C CMON/OCC/C1(574)+C2(574), TEMP(2009)
C CMON/OCNC/C1(574)+C2(574)+YMA5(574)+NDATA; B(12)+AZERO+NA+NN;
C CMON/FILTER/VX(3)+GAIN(3)+P(3,3)+Q(3,3)+R+UV
C
C --- INITIALIZATION ---
C
ALPHA=5
NN=DNSET=NLAG
M=DN
NLP1=NLG+1
MLM1=NLAG+1
U=Y=0
DU 10 I=1,3
S(I)=5
P(I)=0
GAIN(I)=0
DU 10 J=1,3
P(I,J)=0
DU 10 G(I,J)=0
DU 10 C(I)=1
14 P(I,1)=1
P=0
I=0

C --- FOMP THE OBSERVATION MATRIX M ---
C CALL HFORM(ITER, NLAG, M)

C --- START ITERATION ---
C SUM1=SUM2=U
DU 30 J=1, NLAG
C(I,J)=C2(I)=5
30 CONTINUE
100 I=ITER+1
Y=H(I)
C ALL MALSOL(N0+NN1; ALPHA,YC, ITER, ERR+S)
C(I,ITER)=S(I) C2(ITER)=S(2)
SUP2=SUM1+ERR
SUP2=SUM2+ERR+ERR
C --- CHECK TO STOP ---
IF (ITER.EQ.NLATA) GO TO 120
C --- UPDATE THE OBSERVATION MATRIX M ---
DU 30 J=1, NLAG
30 P(I,J)=1
P(I,YC)=1
GO TO 100

120 CONTINUE
FN=FLOAT(NLATA) S FN1=FN-1,
ERRAVG=SUM1/FN
ERRSTDV=SOM1/SOM2+FN
ERRSTDV=SOM2+FN
ERRSTDV=SOM1/SOM2+FN
WHITE(N0+100) ERRAVG, ERRSTDV
RETURN
END

SUBROUTINE HFORM(ITER, NLAG, M)

C *** FORM THE K ARRAY ***
C
C DIMENSION K(3)
C COMMON/GFUNC/X(574+12),Y(574),*YAT(574),*NDATA(8,12),*AZEND,NN
C K2,NYEAR,THEAN(52),YSTDU(52)
C
C DO 10 I=1,NLAG
C ITER=ITER+1
C I=NLAG+1
C H(I)=Y(ITER)
C 10 CONTINUE
C RETURN
C END
C
C SUBROUTINE KALSOL(NO*NN*ALPHA*YO*ITER*ERR*X)
C
C DIMENSION X(3)*PHI(3)
C COMMON/FILTER/*K(3)*GAIN(3)*P(3,3),Q(3,3),*H*U+V
C
C I=UP=0
C EPS=.000001
C
C *** COMPUTE KALMAN GAIN ***
C DU 20 J=1,NN
C PHI(1)=0
C DU 20 J=1,NN
C 20 PHI(1)=PHI(1)+P(I,J)*H(J)
C P=U
C DU 22 J=1,NN
C 22 PHI=PHI+H(I)*PHI(1)
C DNOM=DNOM*PHI
C X=X
C DU 26 J=1,NN
C 26 X=X+H(I)*X(I)
C DEL=YO-HX
C CALL PGVAN(ITER,DNOM,DEL,U+V)
C TEST=G*V*UNCM
C IF(DEL*GT*TEST) GO TO 10
C DU 24 J=1,NN
C 24 GAIN(I)=PHI(1)/DNOM
C DU TO 15
C 15 DU 12 J=1,NN
C 12 GAIN(I)=0.
C
C *** CALCULATE THE BEST ESTIMATE FOR X ***
C DU 28 J=1,NN
C 28 X(I)=X(I)+G(I)*DEL
C
C *** UPDATE THE ERROR-COVARIANCE MATRIX P ***
C IF(I=UP,GO,01) GO TO 27
C CALL QUPDAT(NN,PHI+ALPHA)
C 27 DU 30 J=1,NN
C 30 DU 30 J=1,NN
C 30 P(I,J)=P(I,J)+G(I,J)*GAIN(I)*GAIN(J)*DNOM
C DU 31 J=1,NN
C DU 31 J=1,NN
C 31 IF(E,GO,29)
C 29 P(I,J)=0.
C GO TO 31
C 31 IF(Y(I,J)-LE-EPS) P(I,J)=EPS
C 31 CONTINUE
C YEST=YES
C 34 YEST=YEST+H(I)*X(I)
C EMK=Y(0)=YES
C RETURN
C END
C
C SUBROUTINE PGVAN(ITER,DNOM,DEL,U+V)
C U=U+I/FLUA(I,ITER)*ALOG(DNOM)*U
C V=V+I/FLUG(ITER)*((DEL*DEL/DNOM)-V)
C IF(V+LT,.00001) V=000001
C DU=U-ALOG(V)
C RETURN
C END
C
C SUBROUTINE QUPDAT(NN,PHI+ALPHA)
C DIMENSION A(3,3)*PHI(3)
COMMON/FILNEN/M(3),GAIN(3),P(3,3),Q(3,3),M=MV
DO 10 I=1,NN
DO 10 J=1,NN
10 A(I,J)=0.
DO 20 I=1,NN
DO 20 J=1,NN
20 A(I,J)=GAIN(I)*PMT(J)
CUEF(I)=ALP+R=1.
DU 30 I=1,NN
CU 30 J=1,NN
30 C(I,J)=CEF(I)*(P(I,J)-A(I,J))
RETURN
END
SUBROUTINE DSTAT(NDATA,Y,MEAN,RSTDV,LAG1)
DIMENSION Y(NDATA)
RSUM=RSSG=0.
LAG1=0.
L=1
DO 60 I=1,N01
1 IF I=1+1
60 RSUM=RSSG+Y(I)*Y(I)
DO 70 I=1,NDATA
RSUM=RSMY+Y(I)
70 FD=FLOAT(NDATA) $ FD1=FD-1.
LAG1=LAG1/RSSQ
MEAN=SUM/FD
RSSG=RSSG/FD
RSTDV=SGRT((RSSQ=MEAN*RMEAN)*(FD/FD1))
RETURN
END
SUBROUTINE HARMON(*=FI+C*FY)
DIMENSION C(13)
X1=COS(1) $ X2=SIN(1) $ X3=COS(2.0) $ X4=SIN(2.0)
X5=COS(3.0) $ X6=SIN(3.0) $ X7=COS(4.0) $ X8=SIN(4.0)
X9=COS(5.0) $ X10=SIN(5.0) $ X11=COS(6.0) $ X12=SIN(6.0)
FXY(1)=X1+C(C) $ X2+C(3) $ X3+C(4) $ X4+C(5) $ X5+C(6) $ X6+C(7) $ X7+C(8)
C(9)+X9+C(10)+X10+C(11)+X11+C(12)+X12+C(13)
RETURN
END
SUBROUTINE MIAXMIN(GMIN,GMAX)
COMMON/GFUNC/A(574+12)*Y(574)*YMA1(574)*YDATA+B(12)+AZERO+NA+NN,
1 KE+NYEAR+YMEAN(52)+YSTUDY(52)
GMIN=1000.0, $ GMAX=0.0
DU 140 I=1,N0TA
IF (Y(I).LT.GMAX) GMAX=Y(I)
IF (Y(I).LT.GMIN) GMIN=Y(I)
140 CONTINUE
RETURN
END
SUBROUTINE TREND
COMMON/GFUNC/A(574+12)*Y(574),THAT(574)*YDATA+B(12)+AZERO+NA+NN,
1 KE+NYEAR+YMEAN(52)+YSTUDY(52)
FN=11.0, $ FN=10.0
DU 20 I=1,52
SUM=SSG=0.0,
CU 10 J=1,NYEAR
WJ=I+1
K=1+52*J+1
SUM=SUM+Y(K)
15 S5w=SSG+Y(K)*Y(K)
YMEAN(1)=SUM/FN
S5w=SSG/FN
YSTUDY(1)=SGRT((SSQ=YMEAN(1)*YMEAN(1))/(FN/FN))
20 CONTINUE
AND
DU 30 J=1,52
H=1
40 NH=1
15 Y(NH)+Y(NH+1))=YSTUDY(NH)
30 CONTINUE
Y(573)+Y(573)=YMEAN(1))=YSTUDY(Y)
Y(574)+Y(574)=YMEAN(2))=YSTUDY(2)
RETURN
END
Program for Computing Weekly Discharge Non-Point Sources

PROGRAM LUSSL(INPUT,OUTPUT,TAPE1,TAPE7)
C
C THIS PROGRAM FINDS THE DIFFERENCE BETWEEN A DOWNSTREAM OUTFLOW
C AND UP TO SIX UPSTREAM INFLOWS TO CALCULATE NONPOINT SOURCES
C OF INFLOW OR OUTFLOW
C
DIMENSION INF(6*2620),OUTFL(2620),NPS(2609)
REAL INF,NPS
C
N=NUMBER OF INFLOWS  N=NUMBER OF DISCHARGE VALUES
C
READ 5,N
NAME
C DISCHARGE VALUES ARE READ FROM TAPE1 WITH OUTFLOW FIRST
C
READ(1,20) (INF(I),I=1,2620)
IF(EUF(I)) 6,100
6 DU 15 1=1*N
READ(1,20) (INF(I,J),J=1,2620)
IF(EUF(I)) 15,120
10 CONTINUE
20 FNUMAT(6F10.2)
CU 25 j=1*N
SUMINF=0.0
CU 30 i=1*N
SUMINF=SUMINF+INF(I,J)
30 CONTINUE
NPS(J)=OUTFL(J)-SUMINF
25 CONTINUE
C OUTPUT IS ENCODED TO TAPE7
C
WHITE(7,20) NPS
PINT 50,NAME,(NPS(I),I=2590,2609)
SUM=0.0
CU 40 i=1*N
SUM=SUM+NPS(I)
40 CONTINUE
NPSBAR=SUM/(FLOAT(N))
PINT 55,NPSBAR
55 FNUMAT(2X*AVGARAGE GAIN=LOSS** F12.2)
100 PINT 111
GO TO 999
120 PINT 112
112 FNUMAT(2X*INFLOW TOO BIG*)
111 FNUMAT(2X*CHECK OUT THE FILES TOO MUCH INFO OR YOU ARE DONE*)
5 FNUMAT(215+4)
50 FNUMAT(///2X *STATION=*A9/2X*NPS 2590=2609=*/(10F10.2))
999 CONTINUE
STOP
ENU
APPENDIX E

Plots of Actual and Simulated Weekly Discharge at Greenwood, Swan Lake and Lambert
Figure E-1. 50-year weekly hydrograph at Greenwood.
Figure E-3. 50-year weekly hydrograph at Lambert.