**Columbia River Statistical
Update Model—Version 4.0
(COLSTAT4): Background
Documentation and User's Guide**

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August 1987

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EXECUTIVE SUMMARY

Columbia River temperatures and flow rates are collected daily at Priest Rapids Dam and Vernita Bridge. These data are necessary for assessing trends or changes in river conditions downstream of Priest Rapids Dam. To analyze these data, Pacific Northwest Laboratory developed a computerized data base using existing U.S. Geological Survey flow and temperature records at Priest Rapids Dam and Vernita Bridge.

Daily-averaged temperature and flow information on the Columbia River just downstream of Priest Rapids Dam and upstream of river mile 380 were collected and stored in a data base. The flow information corresponds to discharges that were collected daily from October 1, 1959, through July 28, 1986. The temperature information corresponds to values that were collected daily from January 1, 1965, through May 27, 1986. The computer model, COLSTAT4 (Columbia River Statistical Update--Version 4.0 model), uses the temperature-discharge data base to statistically analyze temperature and flow conditions by computing the frequency of occurrence and duration of selected temperatures and flow rates for the Columbia River. The COLSTAT4 code analyzes the flow and temperature information in a sequential time frame (i.e., a continuous analysis over a given time period); it also analyzes this information in a seasonal time frame (i.e., a periodic analysis over a specific season from year to year). A provision is included to enable the user to edit and/or extend the data base of temperature and flow information. This report describes the COLSTAT4 code and the information contained in its data base.

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SYMBOLS

g_m	index
G	frequency of occurrence of temperatures greater than T_0 and discharges less than Q_0
h_m	index when discharges/temperatures exceed the k-th discharge/temperature
H_k	relative cumulative frequency for the k-th discharge/temperature
i	index on record length for discharges/temperatures
j	index on the month of year
k	index on discharge/temperature
ℓ	index on day of month
m	index on discharge/temperature
n	length of record for discharges/temperatures
Q_m	m-th discharge
Q_0	user-specified discharge
$S_{j,\ell}$	standard deviation for month j and day ℓ
T_m	m-th temperature
T_0	user-specified temperature
$U_{i,j,\ell}$	daily averaged temperature/discharge for year i , month j , and day ℓ
$\overline{U}_{j,\ell}$	mean daily averaged temperature/discharge for month j and day ℓ

1.0 INTRODUCTION

Daily Columbia River flow and temperature data have been collected by the U.S. Geological Survey (USGS) at Priest Rapids Dam^(a) and Vernita Bridge during the past 21 to 27 years, respectively. The average daily river flow records at Priest Rapids Dam date back to October 1, 1959, and the average daily temperatures date back to January 1, 1965. These river flow and temperature records are important in determining trends and changes in the water quality of the Hanford Reach of the Columbia River. For example, if one wants to know the percent of time the Columbia River has a temperature greater than 3°C (37°F) when the corresponding discharge is less than 6000 m³/s (212,000 ft³/s), the information contained in this report would indicate that this condition occurs approximately 85% of the time.

To analyze river flow and temperature conditions, a numerical model (i.e., COLSTAT4) was developed that statistically collates existing water flow and temperature data recorded at Priest Rapids Dam and Vernita Bridge. Vernita Bridge is approximately 9 river miles downstream of Priest Rapids Dam. For a given discharge and water temperature, the model reports frequency of occurrence and event duration. The model also provides a statistical summary of all recorded data.

The COLSTAT4 code can analyze historical flow and temperature conditions in a "sequential mode" or in a "seasonal mode". In the sequential mode, COLSTAT4 statistically analyzes a user-designated data set (i.e., flow and temperature information) over a specified time period (e.g., March 16, 1975, through June 15, 1980). The specified time period is continuous from the beginning date until the ending date. For example, specifying the sequential mode with the dates of March 16, 1975, through June 15, 1980, will result in a statistical analysis on all days within this time period (i.e., all days and months between and including March 16, 1975, and June 15, 1980).

In the seasonal mode, COLSTAT4 statistically analyzes flow and temperature conditions during a user-specified season (e.g., springtime). Under the seasonal mode, only the data associated with the season are analyzed over the

(a) Location is approximately 2.5 to 2.6 mi downstream of Priest Rapids Dam.

period of record. For example, specifying the seasonal mode with the dates of March 16, 1975, through June 15, 1980 (i.e., springtime), will result in a statistical analysis on all days between the designated beginning and ending months over the 5-year period (i.e., the days associated with January, February, first half of March, latter half of June, and July through December are not included in the analysis). The seasonal model of analysis is useful because many events in nature occur seasonally (e.g., fish spawning), and inclusion of data from the other seasons would bias the analysis.

This report is divided into two main chapters. Chapter 2.0 presents a brief environmental description of the Columbia River and a history of the temperature and discharge measurements at Priest Rapids Dam and Vernita Bridge. Chapter 3.0 describes the statistical model COLSTAT4 (Columbia River Statistical Update Model--Version 4.0). Included in Chapter 3.0 are the theoretical developments on which the code is based, input requirements, output results, and sample problems. Appendix A presents a statistical summary of Columbia River flow rates and temperatures from October 1, 1959, to July 28, 1986. Appendixes B, C, and D present results from three sample problems, Appendix E presents a flow diagram of the COLSTAT4 program, and Appendix F provides a complete FORTRAN listing of the COLSTAT4 computer code.

2.0 COLUMBIA RIVER FLOW AND TEMPERATURE HISTORY

The Columbia River is the third largest river in the United States;^(a) it originates in Canada, flows through eastern Washington, and forms the border between western Oregon and Washington as it flows to the Pacific Ocean. The length of the Columbia River from the Canadian border to the Pacific Ocean is approximately 745 river miles. Eleven dams exist along the Columbia River in the United States (Figure 1). Priest Rapids Dam, located at river mile 397.1, is the dam nearest the northern boundary of the U.S. Department of Energy's Hanford Site (Figure 2). McNary Dam is the dam closest to the southern boundary of the Hanford Site. The only free-flowing (i.e., no backwater effects) portion of the river is upstream of Ringold Flat and downstream of Priest Rapids Dam (Figure 2).

Before the McNary and Priest Rapids Dams were completed, temperature and discharge measurements were collected near Richland, Washington. After the dams became operational, recording stations were moved to locations just downstream of Priest Rapids Dam. Since 1959, several locations have been used to record flow and temperature data. The locations of the discharge and temperature recording stations and the dates the stations were in operation are presented in Tables 1 and 2. Figure 2 indicates the approximate locations of the recording stations listed in Tables 1 and 2.

2.1 DISCHARGE HISTORY

Flow conditions on the Columbia River have been studied for the past 100 years. The largest reported discharge at Pasco, Washington, just downstream of the Hanford Site is 22,654 m³/s (800,000 ft³/s) in 1894. The lowest discharge recorded is 566 m³/s (20,000 ft³/s) in 1931.

Collection of discharge information by the USGS at Priest Rapids Dam began in 1959 and continues to the present. Since the construction of the dams on the Columbia River, flows have been closely regulated. Because the flow from Priest Rapids Dam is regulated, characteristics pertaining to the Columbia

(a) The Mississippi River is the largest river in the U.S., and the St. Lawrence River is the second largest.

FIGURE 1. Dams on the Main Stem of the Columbia River

River just downstream of Priest Rapids Dam can be more accurately quantified. The Columbia River near river mile 380 is relatively shallow and straight. River widths are approximately $450 \text{ m} \pm 50 \text{ m}$ ($1476 \text{ ft} \pm 164 \text{ ft}$) with surface current velocities ranging up to 3.4 m/s (11.15 ft/s). The average depth of water for a discharge of $1557 \text{ m}^3/\text{s}$ ($55,000 \text{ ft}^3/\text{s}$) is approximately 5 m (16.4 ft). The minimum flow at Priest Rapids Dam is administratively set at $1019 \text{ m}^3/\text{s}$ ($36,000 \text{ ft}^3/\text{s}$). The lowest daily-averaged flow from October 1959 through July 1986 was $1048 \text{ m}^3/\text{s}$ ($37,000 \text{ ft}^3/\text{s}$) on January 23, 1971, and November 11, 1973, while the maximum daily-averaged flow for the same time period was $14,527 \text{ m}^3/\text{s}$ ($513,000 \text{ ft}^3/\text{s}$) on June 11, 1961. High flows during spring run-off usually range from $7079 \text{ m}^3/\text{s}$ ($250,000 \text{ ft}^3/\text{s}$) to $12,743 \text{ m}^3/\text{s}$ ($450,000 \text{ ft}^3/\text{s}$). In addition, the median flow near the N Reactor at river

FIGURE 2. Columbia River Near the Hanford Site

mile 380 is approximately $2905 \text{ m}^3/\text{s}$ ($102,600 \text{ ft}^3/\text{s}$). (a) Daily flow variations can cause changes in river stage up to 2 m (6.6 ft) (WPPSS 1978).

The riverbed consists mainly of large rocks and cobbles and has small amounts of sand and cohesive material. Flows downstream of Priest Rapids Dam are not necessarily the same as those measured at Priest Rapids Dam. Because of shallow storage zones and river hydraulic dynamics, short-term flow fluctuations at Priest Rapids Dam are more extreme than those in downstream locations. For example, during one 4-day period in 1978, flow at river mile 380 was measured to be 39% higher than that at the dam (WPPSS 1978).

- (a) Updated median flow rate since information reported by Whelan, G., R. S. Argo, D. W. Damschen, and C. A. Newbill in COLSTAT3, Version 3.0, Columbia River Statistical Update Model (unpublished report), and by Whelan and Newbill (unpublished report).

TABLE 1. Discharge Recording Stations, 1959 to Present^(a)

October 1959 to September 1963

- Latitude 46° 37' 45"
- Longitude 119° 52' 00"
- Located in SE 1/4 NW 1/4 s. 7, T.13 N., R.24 E.,
4.0 km (2.5 mi) downstream of Priest Rapids Dam, and 22.5 km
(14.0 mi) south of Beverly, Washington.

October 1964 to June 1974

- Latitude 46° 37' 44"
- Longitude 119° 51' 49"
- Located in SE 1/4 NW 1/4 s. 7, T.13 N., R.24 E.,
Grant County, Hydrologic Unit 17020016, 4.2 km (2.6 mi) downstream
of Priest Rapids Dam, 23.7 km (14.7 mi) south of Beverly,
Washington, and at river mile 394.5.

July 1974 to September 1980

- Latitude 46° 38' 34"
- Longitude 119° 43' 54"
- Located in NW 1/4 SE 1/4 s. 6, T.13 N., R.25 E.,
Grant County, Hydrologic Unit 17020016, at State Highway 24 Vernita
Bridge crossing, 14.5 km (9.0 mi) downstream of Priest Rapids Dam,
and at river mile 388.1

December 1979 to Present

- Latitude 46° 37' 44"
- Longitude 119° 51' 49"
- Located in SE 1/4 NW 1/4 s. 7, T.13 N., R.24 E.,
Grant County, Hydrologic Unit 17020016, 4.2 km (2.6 mi) downstream
of Priest Rapids Dam, 23.7 km (14.7 mi) south of Beverly,
Washington, and at river mile 394.5.

(a) Locations obtained from Water Resources Data, Washington. U.S.
Geological Survey Water-Data Reports, Tacoma, Washington.

TABLE 2. Temperature Recording Stations, 1965 to Present (a)

January 1965 to June 1974

- Latitude 46° 37' 44"
- Longitude 119° 51' 49"
- Located in SE $\frac{1}{4}$ NW $\frac{1}{4}$ s. 7, T.13 N., R.24 E., Grant County, Hydrologic Unit 17020016, 4.2 km (2.6 mi) downstream of Priest Rapids Dam, 23.7 km (14.7 mi) south of Beverly, Washington, and at river mile 394.5.

July 1974 to September 1980

- Latitude 46° 38' 34"
- Longitude 119° 43' 54"
- Located in NW $\frac{1}{4}$ SE $\frac{1}{4}$ s. 6, T.13 N., R.25 E., Grant County, Hydrologic Unit 17020016, at State Highway 24 Vernita Bridge crossing, 14.5 km (9.0 mi) downstream of Priest Rapids Dam, and at river mile 388.1.

December 1979 to Present

- Latitude 46° 37' 44"
- Longitude 119° 51' 49"
- Located in SE $\frac{1}{4}$ NW $\frac{1}{4}$ s. 7, T.13 N., R.24 E., Grant County, Hydrologic Unit 17020016, 4.2 km (2.6 mi) downstream of Priest Rapids Dam, 23.7 km (14.7 mi) south of Beverly, Washington, and at river mile 394.5.

(a) Locations obtained from Water Resources Data, Washington. U.S. Geological Survey Water-Data Reports, Tacoma, Washington.

The daily-averaged flow rates just downstream of Priest Rapids Dam for the time period of October 1959 through July 1986 were statistically analyzed (Figures 3, 4, and 5 and Appendix A). The distribution of daily-averaged flows over the period of record (Figure 3) exemplifies the degree to which the dams control river flows. A majority of the flow rates are between 1416 m³/s (50,000 ft³/s) and 5664 m³/s (200,000 ft³/s). The daily composite of flow

FIGURE 3. Daily-Averaged Flow Rates Just Downstream of Priest Rapids Dam on the Columbia River

rates for each day of the year is presented in Figure 4. This figure includes curves for the maximum, minimum, and mean daily-averaged flows as well as the standard deviations about the means. As the figure shows, the largest discharges occur after the spring snowmelt in June. Figure 5 presents the relative cumulative frequency distribution (RCFD) of the daily-averaged flow rates. The RCFD is represented as the percentage of time the daily-averaged flow rate is exceeded. Figure 5 shows for example, that the flow rate at which 50% of the discharges are exceeded equals approximately $2905 \text{ m}^3/\text{s}$ ($102,600 \text{ ft}^3/\text{s}$).

FIGURE 4. Daily Composite of Daily-Averaged Flow Rates Just Downstream of Priest Rapids Dam on the Columbia River

Appendix A presents the tabulated results from which Figures 3, 4, and 5 were generated. The results in Appendix A represent the statistically analyzed daily-averaged flows using the computer code CDLSTAT4 operating in sequential mode for the entire recording period. Information in the appendix is presented in the following forms:

FIGURE 5. Relative Cumulative Frequency Distribution for Daily Averaged Flow Rates Just Downstream of Priest Rapids Dam on the Columbia River

- the RCFD of daily-averaged flows between 1000 m³/s (35,313 ft³/s) and 15,500 m³/s (547,357 ft³/s) for the period of record (i.e., October 1959 through July 1986) using a flow interval of 50 m³/s (1766 ft³/s).

- the number of days and percent of time a given flow is exceeded
- the number of days and percent of time a given flow is within the range encompassed by $\pm 25 \text{ m}^3/\text{s}$ ($\pm 883 \text{ ft}^3/\text{s}$).
- the daily composite of maximum, minimum, and mean daily flows for each day of each month during the period of record, including the standard deviation about the mean for each day.

The theoretical basis for these computations is described in Section 3.1. A statistical analysis of the temperature data is provided in Appendix A.

2.2 TEMPERATURE HISTORY

Columbia River temperatures vary seasonally. Minimum temperatures are usually recorded in February, and maximum temperatures are usually recorded in August. Thermal characteristics of the Columbia River depend largely on flow and storage management of the dams. The free-flowing Columbia River at the Hanford Site responds more rapidly than impounded areas to thermal modifications from weather and industrial inputs. Therefore, in the river reach near Hanford, summer warming and winter cooling occur more rapidly than at other locations along the river. The temperature rise from natural heating at Hanford during late summer and early fall is about 0.50°C (0.90°F) to 0.75°C (1.35°F) between Priest Rapids Dam and Richland. The lowest daily-averaged temperature recorded just downstream of Priest Rapids Dam from January 1, 1965, through May 27, 1986, was 0.1°C (32.2°F), while the highest daily-averaged temperature recorded was 20.33°C (68.5°F) on August 18, 1977, and August 20-21, 1977.

The daily-averaged river temperatures just downstream of Priest Rapids Dam for the time period of January 1965 through May 1986 were statistically analyzed (Figures 6, 7, and 8 and Appendix A). The distribution of daily-averaged temperatures over the period of record is shown in Figure 6. The high temperature peaks reflect summer months, while the lower temperatures reflect the winter months. Figure 7 presents the daily composite of temperatures for each day of the year. This figure includes curves for maximum, minimum, and mean daily-averaged temperatures as well as the standard deviations about the means.

FIGURE 6. Daily-Averaged Temperatures Just Downstream of Priest Rapids Dam on the Columbia River

Figure 7 exemplifies the sinusoidal form of temperature distribution over a 1-year period. As the figure shows, the maximum temperatures occur in August, while the minimum temperatures occur in February. Figure 8 presents the RCFD of the daily-averaged temperatures. The RCFD is presented as the percentage of time the daily-averaged temperature is exceeded. This figure shows that the temperature at which 50% of the temperatures are exceeded equals approximately 10.7°C (51.3°F).

Appendix A presents the tabulated results from which Figures 6, 7, and 8 were generated. The results in Appendix A represent the statistically analyzed

FIGURE 7. Daily Composite of Daily-Averaged Temperatures Just Downstream of Priest Rapids Dam on the Columbia River

daily-averaged temperatures using the computer code COLSTAT4 operating in sequential mode for the entire recording period. Information in the appendix is presented in the following forms:

- the RCFD of daily-averaged temperatures between 0°C (32°F) and 22°C (71.6°F) for the period of record (i.e., January 1965 to May 27, 1986) using a temperature interval of 1°C (1.8°F)
- the number of days and percent of time a given temperature is exceeded

FIGURE 8. Relative Cumulative Frequency Distribution for the Daily Averaged Temperatures Just Downstream of Priest Rapids Dam on the Columbia River

- the number of days and percent of time a given temperature is within the range encompassed by $\pm 0.5^{\circ}\text{C}$ ($\pm 0.9^{\circ}\text{F}$)
- the daily composite of maximum, minimum, and mean daily-averaged temperatures for each day of each month during the period of record, including the standard deviation about the mean for each day.

The theoretical basis for these computations is presented in Section 3.1. A statistical analysis of the flow-rate data is provided in Appendix A.

2.3 TEMPERATURE-DISCHARGE JOINT FREQUENCIES

The most important aspect of the COLSTAT4 code is associated with its temperature-discharge joint frequency analysis. With this analysis, the COLSTAT4 code can identify the percentage of time Columbia River temperatures exceed and corresponding discharges are less than user-specified values. Figure 9 illustrates results of the temperature-discharge joint frequency

FIGURE 9. Percentage of Time Columbia River Temperatures Exceed and Corresponding Discharges are Less Than User-Specified Values, January 1, 1965 Through May 27, 1986

analysis for the entire period of record; Columbia River temperatures are correlated with discharges for data beginning January 1, 1965, and ending May 27, 1986 (inclusive). This figure illustrates the frequency of occurrence of temperatures greater than and discharges less than any specified temperature-discharge set of values. For example, 45% of the time, Columbia River temperatures were greater than 10°C (50°F) while flow rates were less than 5664 m³/s (200,000 ft³/s). Because the temperature-discharge correlation requires a corresponding set of values for temperature and discharge, the historical analysis for Figure 9 begins on January 1, 1965 (i.e., date of first recorded temperature measurement) and ends on May 27, 1986 (i.e., date of last recorded river temperature that has been processed before preparation of this report). Therefore, because no temperatures have been recorded before January 1, 1965, or after May 27, 1986, the results corresponding to the period between October 1, 1959, and July 28, 1986 (i.e., the entire data set), are equivalent to those corresponding to the period between January 1, 1965, and May 27, 1986.

3.0 COLUMBIA RIVER STATISTICAL UPDATE CODE--VERSION 4.0

This chapter summarizes the Columbia River Statistical Update--Version 4.0 (COLSTAT4) code. The COLSTAT4 code statistically analyzes flow rates and temperatures from recording stations located just downstream of Priest Rapids Dam. The code computes the 1) relative cumulative frequency distribution based on the number of times a given discharge/temperature is exceeded; 2) percent of time a given discharge/temperature is within a user-designated range; 3) daily composite of minimum, maximum, and mean daily-averaged temperatures or discharges for each day of each month during a user-designated period of record as well as the respective standard deviations about the means; and 4) frequency of occurrence of temperatures exceeding and discharges less than a user-specified set of values.

Section 3.1 presents the theoretical formulations on which the results of the model are based. The basic computations performed are for the mean, standard deviation, and relative cumulative frequency distribution. Section 3.2 presents a brief description of the COLSTAT4 code. Section 3.3 discusses input requirements to the code and the manner in which the user enters the data. Section 3.4 describes the output results, and Section 3.5 presents six sample problems with problem descriptions, input information, and output results.

3.1 THEORETICAL DEVELOPMENT

The COLSTAT4 code was developed to statistically analyze Columbia River flow rates and temperatures over a given period of record. Four basic computations are performed in this statistical package: mean of the daily-averaged temperatures or flow rates, standard deviation, relative cumulative frequency distribution, and frequency of occurrence of temperatures exceeding and discharges less than a user-specified temperature-discharge set of values.

3.1.1 Mean Daily-Averaged Temperatures/Flows

The mean daily-averaged temperatures/flows represent the mean of the daily-averaged temperatures/flows over a period of record for each day of each month. Mathematically, the mean is defined as follows:

$$\bar{U}_{j,\ell} = \frac{1}{n} \sum_{i=1}^n U_{i,j,\ell} \quad (1)$$

where $U_{i,j,\ell}$ = daily-averaged temperature/discharge for year i , month j , and day ℓ

$\bar{U}_{j,\ell}$ = mean daily-averaged temperature/discharge for month j and day ℓ

n = length of record for discharges/temperatures (e.g., number of years in the record length)^(a)

i = index on record length for discharges/temperatures ($1 \leq i \leq n$)

j = index on the month of year (e.g., 1 represents January, 2 represents February, ..., and 12 represents December; $j = 1, 2, 3, \dots, 12$)

ℓ = index on day of month (e.g., 1 represents the first day of month j , 2 represents the second day of month j ; $\ell = 1, 2, 3, \dots, 31$).

3.1.2 Standard Deviation

The unbiased standard deviation is defined as the positive square root of the expected value of the square of the difference between a random variable (e.g., flow or temperature) and its mean (Lapedes 1978). In other words, the standard deviation represents the degree to which the random variable differs from the mean of the record. Mathematically, the standard deviation is expressed as:

$$S_{j,\ell}^2 = \frac{1}{n-1} \sum_{i=1}^n (U_{i,j,\ell} - \bar{U}_{j,\ell})^2 \quad (2)$$

where $S_{j,\ell}$ is the standard deviation for month j and day ℓ and all other parameters are as previously defined.

(a) Years in which data are missing are not included in the period of record. For February 29, only leap years are included in the record length.

3.1.3 Relative Cumulative Frequency Distribution (RCFD)

The RCFD, as defined in this report, is the sum of the relative frequencies or probabilities that a variable (e.g., discharge/temperature) can be exceeded by a set of values (e.g., discharges/temperatures). For example, the no-flow case (i.e., zero discharge) does not occur during the period of record; therefore, the probability that all recorded flows exceed a discharge of zero is 100%. Mathematically, this is defined as follows:

$$H_k = \frac{1}{n} \sum_{m=1}^n h_m \quad (3)$$

in which

$$h_m = 0 \quad \text{for} \quad U_m \leq U_k \quad (4)$$

$$h_m = 1 \quad \text{for} \quad U_m > U_k \quad (5)$$

where H_k = relative cumulative frequency for the k-th discharge/temperature (U_k)

h_m = index when discharges/temperatures exceed the k-th discharge/temperature

k = index on the discharge/temperature (e.g., 1 refers to largest discharge/temperature, 2 refers to second largest discharge/temperature, ..., and n refers to smallest discharge/temperature on record; $1 \leq k \leq n$)

m = index on the discharge/temperature (see definition for k ; $1 \leq m \leq n$)

All other parameters are as previously defined.

The above equation can also be expressed in the following form:

$$H_k = \frac{\left[\begin{array}{l} \text{Number of times a given variable} \\ \text{(e.g., discharge/temperature) is exceeded} \\ \text{in magnitude in the record length} \end{array} \right]}{\left[\begin{array}{l} \text{Total number of variables} \\ \text{in the record length} \end{array} \right]} \quad (6)$$

It should be noted that the RCFD could also have been computed based on the percentage of time that the discharges/temperatures were within a certain range (e.g., frequency histogram of discharge/temperature ranges).

3.1.4 Frequency of Occurrence of Temperatures Greater Than and Discharges Less Than a User-Specified Temperature-Discharge Set

The frequency of occurrence of daily temperatures greater than and discharges less than a user-specified temperature-discharge set of values represents the probability that the Columbia River temperatures are greater than a user-specified temperature, and discharges are less than a corresponding user-specified flow rate. For example, there is zero probability that all recorded flows are less than a discharge of zero and all temperatures exceed 20.3°C (68.5°F) (i.e., maximum recorded temperature). Conversely, the probability that all recorded flows are less than 15,000 m³/s (529,701 ft³/s), which includes all flows, and all temperatures exceed 0°C (32°F) is 100%. It should be noted that the temperatures and discharges, which are being compared to the set of specified values, correspond to the same day.

Mathematically, the frequency of occurrence is defined as follows:

$$G = \frac{1}{n} \sum_{m=1}^n g_m \quad (7)$$

$$\text{in which } g_m = 0 \quad \text{for} \quad \left\{ \begin{array}{l} (T_m < T_o) \text{ and } (Q_m > Q_o) \\ (T_m = T_o) \text{ and } (Q_m > Q_o) \\ (T_m < T_o) \text{ and } (Q_m = Q_o) \end{array} \right. \quad (8)$$

$$g_m = 1 \quad \text{for} \quad \begin{cases} (T_m > T_o) \text{ and } (Q_m < Q_o) \\ (T_m = T_o) \text{ and } (Q_m < Q_o) \\ (T_m = T_o) \text{ and } (Q_m = Q_o) \end{cases} \quad (9)$$

where G = frequency of occurrence of temperatures greater than T_o and discharges less than Q_o

g_m = index

T_o and Q_o = user-specified temperature and discharge sets

T_m and Q_m = temperature and corresponding discharge associated with the same day

All other parameters are as previously defined.

3.2 COLSTAT4 MODEL

The Columbia River Statistical Update--Version 4.0 (COLSTAT4) model computes the maximum, minimum, mean, standard deviation, and RCFD for river flow rates and temperatures. The model also computes the frequency of occurrence of temperatures greater than and discharges less than user-specified values. The COLSTAT4 data base uses daily-averaged river temperatures and river flow rates. The daily-averaged values (i.e., temperatures/flow rates) represent the mean for each day over the length of the day. The maximum, minimum, mean, standard deviation, and RCFD temperatures/discharges are computed from the daily-averaged temperatures or flow rates and are computed for each day of each month over the period of record. The period of record for river discharges is October 1, 1959, through July 28, 1986, while for river temperatures the period of record is January 1, 1965, through May 27, 1986. The daily-averaged river temperatures and flow rates were compiled from information supplied by the USGS at locations just downstream of Priest Rapids Dam. The exact locations of the recording stations are presented in Tables 1 and 2. The measurement error as defined by the USGS in temperature data is $\pm 0.25^\circ\text{C}$ ($\pm 0.45^\circ\text{F}$) and in flow rate data is 5% of the measured flow rate.

The COLSTAT4 model was developed to meet certain criteria:

- FORTRAN computer language - The model is written in ASCII (American Standard Code for Information Interchange) FORTRAN and should run on most computing systems with little modification.
- interactive mode - The model allows continuous dialogue between the user and the system by way of the CRT (Cathode-Ray Tube) screen. The interactive mode is used in place of the batch mode (i.e., job control language and data are entered to the computing system with key-punched cards).
- user oriented - The model prompts answers from the user by providing easily understood questions on the CRT screen. In addition to the questions, sample answers are provided.
- units - Output results are either in English units, metric units, or a combination of the two. For example, temperature can be expressed in degrees Celsius ($^{\circ}\text{C}$), while discharge is expressed in cubic feet per second (ft^3/s).
- time span - The model allows the user to specify the time span for which the statistical summary is generated. The period of record for the flow rates (i.e., October 1, 1959, through July 28, 1986) is the largest time span currently available. The user may specify any time span within the period of record. For more information and examples, refer to Sections 3.3 and 3.5, respectively.
- results - The model produces four sets of information. The first set is the distribution of the daily-averaged river temperatures over the time span specified by the user. The second set is the distribution of the daily flow rates over the time span specified by the user. The third set is the daily composite of maximum, minimum, mean, and standard deviation of the daily-averaged temperatures and flows for each day of each month over the time span specified by the user. The fourth set of information identifies the frequency of occurrence of temperatures greater than and discharges less than a user-specified

temperature-discharge set of values. For more information and examples, refer to Sections 3.3 and 3.5, respectively.

3.3 INPUT REQUIREMENTS

This section describes user input requirements of the COLSTAT4 code. The code is constructed to require a minimal amount of user-generated information. The code requires eight types of information:

- options available for analysis
- background information for plotting results
- beginning and ending dates of analysis
- temperature and flow units
- minimum, maximum, and incremental flow rates and temperatures
- user-specified temperature-discharge set
- commands for plotting results
- available options for editing the data base.

Each of the eight requirements will be discussed, and examples will be provided.

3.3.1 Options Available for Analysis

After accessing the COLSTAT4 computer code, the user will see a list of documentation information displayed on the screen. This information will be followed by a list of options for implementing the code.

Documentation Information

The computer program provides the following documentation information for the user:

COLUMBIA RIVER STATISTICAL UPDATE MODEL--VERSION 4.0

DEVELOPED BY: R. D. BROCKHAUS, D. W. DAMSCHEN, R. S. ARGO,
C. A. NEWBILL, AND G. WHELAN, PACIFIC NORTHWEST
LABORATORY, RICHLAND, WASHINGTON

DOCUMENTATION: WHELAN, G., D. W. DAMSCHEN, AND R. D. BROCKHOUS. 1986.
"COLUMBIA RIVER STATISTICAL UPDATE MODEL--VERSION 4.0
(COLSTAT4): BACKGROUND DOCUMENTATION AND USER'S GUIDE,
PACIFIC NORTHWEST LABORATORY, RICHLAND, WASHINGTON.

WHELAN, G., R. S. ARGO, D. W. DAMSCHEN, AND
C. A. NEWBILL. 1985. COLUMBIA RIVER STATISTICAL UPDATE
MODEL--VERSION 3.0 (COLSTAT3): UPDATE OF COLUMBIA RIVER
FLOW AND TEMPERATURE DATA MEASURED AT PRIEST RAPIDS DAM
AND VERNITA BRIDGE." PACIFIC NORTHWEST LABORATORY,
RICHLAND, WASHINGTON.

WHELAN, G., AND C. A. NEWBILL. 1983. "UPDATE OF COLUMBIA
RIVER FLOW AND TEMPERATURE DATA MEASURED AT PRIEST RAPIDS
DAM AND VERNITA BRIDGE." PNL-4868. PACIFIC NORTHWEST
LABORATORY, RICHLAND, WASHINGTON.

Following the information on documentation, the COLSTAT4 program types:

TYPE "1" TO CONTINUE--

The box indicated above represents the location where the user must supply
an answer. The user types "1" to continue. The COLSTAT4 program then
welcomes the user by typing:

THE COLSTAT4 COMPUTER CODE WELCOMES YOU
PLEASE READ ALL TEXT AND ANSWER ALL QUESTIONS
TYPE "1" TO CONTINUE--

Options Available to the User

Currently, the COLSTAT4 code allows the user to implement one of three
options. The first option allows the user to plot historical flow (see

Figures 3 through 5) or temperature (see Figures 6 through 8) information contained in the entire data base. The second option allows the user to analyze a designated flow and temperature record in a sequential or a seasonal mode. The second option also allows the user to plot the percentage of time river temperatures exceed and corresponding discharges are less than user-specified values (see Figure 9 for sample plot). Finally, the third option allows the user to 1) edit the existing temperature or flow files to change incorrect values or 2) expand the time duration associated with the existing temperature or flow data files by appending new files. The former allows the user to correct data that are incorrect; the latter allows the user to update the data files to include more current time periods. It should be noted that the user can choose only one option per run. The computer program provides the following information and prompts the user to select an option in the following manner:

THE COLSTAT4 COMPUTER PROGRAM CURRENTLY HAS THREE OPTIONS:

- 1) ALLOWS THE USER TO PLOT HISTORICAL FLOW OR TEMPERATURE INFORMATION INCLUDED IN THE ENTIRE COLSTAT4 DATA BASE OR
- 2) ALLOWS THE USER TO ANALYZE A USER-DESIGNATED FLOW AND TEMPERATURE RECORD IN A SEQUENTIAL OR SEASONAL MODE OR
- 3) ALLOWS THE USER TO EDIT THE TEMPERATURE OR FLOW FILES

ONLY ONE OPTION MAY BE IMPLEMENTED PER RUN.

PLEASE SELECT THE OPTION YOU WISH TO IMPLEMENT (1, 2, OR 3).

The box indicated above represents the location where the user must supply an answer: type "1" for Option 1, type "2" for Option 2, or type "3" for Option 3.

Option 1. If Option 1 is chosen, the user will be prompted to respond to a series of questions pertaining to the computing system implementing the plotting option prior to the plotting sequence. Option 1 is not described in this

section; it is described in detail in Sections 3.3.2 ("Background Information for Plotting Results") and 3.3.7 ("Commands for Plotting Results").

Option 2. If Option 2 is chosen, the computer program prompts the user to choose one of three analyses. The first choice, "no analysis", is an escape option. The second choice represents the sequential analysis option. If chosen, the flow and temperature data are sequentially analyzed from a beginning date to an ending date. The third choice represents the seasonal analysis option. If chosen, the data are analyzed seasonally for the combination of months and days specified by the beginning and ending dates of the analysis. An example of the sequential and seasonal analyses are presented in Section 3.3.3. The following information will appear on the CRT screen:

II. OPTION 2--FLOW AND TEMPERATURE ANALYSIS

PLEASE SELECT THE TYPE OF ANALYSIS TO BE PERFORMED BY COLSTAT4. TYPE THE APPROPRIATE NUMBER ASSOCIATED WITH YOUR SELECTION:

- (1) NO ANALYSIS (ESCAPE ANALYSIS OPTION)
- (2) SEQUENTIAL ANALYSIS
- (3) SEASONAL ANALYSIS

ENTER YOUR CHOICE (1-3)

If the "NO ANALYSIS" option is chosen, the computer will prompt the user by asking:

DO YOU WANT TO RUN AGAIN? (Y/N)

The information input by the user in the location of the box is either a "Y" for yes or an "N" for no. By requesting another run, the computer program will automatically begin again. If another run is not requested, the program will end.

If the "SEQUENTIAL ANALYSIS" or "SEASONAL ANALYSIS" option is chosen, the user will be asked if he would like a plot depicting discharge-temperature-percent exceeded curves. The computer program prompts the user for an answer by asking:

WOULD YOU LIKE A PLOT DEPICTING TEMPERATURE VERSUS FLOW VERSUS PERCENT
EXCEEDED FOR THE SEQUENTIAL/SEASONAL ANALYSIS OPTION CHOSEN ABOVE
(INDICATE ANSWER WITH A "Y" FOR YES OR "N" FOR NO)

The above box represents the location where the user supplies an answer. If the user answers with a yes, the user will be prompted to respond to a series of questions pertaining to the computing system implementing the plotting option prior to the plotting sequence; the user then proceeds to Section 3.3.2 ("Background Information for Plotting Results"). If the user answers with a no, the user then proceeds to Section 3.3.3 ("Beginning and Ending Dates of Analysis").

Option 3. If Option 3 is chosen, COLSTAT4 allows the user to edit either the temperature data base or the discharge data base. Either data base can be corrected (i.e., incorrect data replaced by correct data) or appended (i.e., extend the data base to include a more current time period). Option 3 is not discussed in this section; it is described in detail in Section 3.3.8 ("Available Options for Editing the Data Base").

3.3.2 Background Information for Plotting Results

If the user wants plots associated with the historical data (see Figures 3 through 8) or with the seasonal/sequential analysis (see Figure 9), he must be implementing the COLSTAT4 code on a PNL DEC VAX 11/780 computing system. Only this computing system can be used with the plotting option because the plotting capabilities associated with COLSTAT4 are machine-dependent at this time. The computer program prompts the user with the following question:

ARE YOU IMPLEMENTING THE COLSTAT4 PROGRAM ON THE PACIFIC NORTHWEST
LABORATORY (PNL) DEC VAX 11/780 COMPUTING SYSTEM (INDICATE ANSWER WITH A
"Y" FOR YES OR "N" FOR NO)?

The information input by the user in the location of the box is either a "Y"
for yes or an "N" for no. If the user answers no, the computer program prompts
the user with the following question:

DO YOU WANT TO RUN AGAIN? (Y/N)

The information input by the user in the location of the box is either "Y" for
yes or an "N" for no. By requesting another run, the computer program will
automatically begin again. If another run is not requested, the program will
end.

If the user answers yes, the next prompt by the computer program is
dictated by the initial option selected by the user. If the user originally
selected the sequential/seasonal analyses (i.e., Option 2), the computer
program proceeds to the topics outlined under Section 3.3.3 ("Beginning and
Ending Dates of Analysis"). If Option 1 (i.e., plotting historical data) was
chosen, the user is prompted to select the type of plot:

PLEASE SELECT ONLY ONE OPERATION FROM THE FOLLOWING CHOICES BY TYPING THE
APPROPRIATE NUMBER ASSOCIATED WITH EACH SELECTION.

- (1) NO DATA TO BE PLOTTED (ESCAPE FROM PLOTTING OPTION)
- (2) PLOT FLOW VERSUS TIME (SEQUENTIALLY FROM THE BEGINNING OF DATA
RECORDS)
- (3) PLOT FLOW VERSUS TIME ON A MONTHLY BASIS
- (4) PLOT FLOW VERSUS PERCENT EXCEEDED
- (5) PLOT TEMPERATURE VERSUS TIME (SEQUENTIALLY FROM THE BEGINNING OF
DATA RECORDS)
- (6) PLOT TEMPERATURE VERSUS TIME ON A MONTHLY BASIS
- (7) PLOT TEMPERATURE VERSUS PERCENT EXCEEDED

ENTER YOUR CHOICE (1-7)

Only one number from 1 to 7 can be entered in the box. Choice 1 represents an escape from the plotting option; if chosen, the user is asked if he wants to perform another run:

DO YOU WANT TO RUN AGAIN? (Y/N)

If the user answers with a "Y" for yes, the COLSTAT4 program starts from the beginning again; if with an "N" for no, the program ends.

Choices (2) through (7) provide plots that correspond to Figures 3 through 8, respectively. If the user identifies an option other than (1), he should proceed to Section 3.3.7 ("Commands for Plotting Results") to implement the option for plotting the results.

3.3.3 Beginning and Ending Dates of Analysis

As previously mentioned, the periods of record for river flow rates and temperatures are October 1, 1959, through July 28, 1986, and January 1, 1965, through May 27, 1986, respectively. However, the user need not analyze the data over the entire range of recorded values. The user may analyze a subset of the data by entering the beginning and ending dates of the subset to be analyzed. Only one beginning and ending date is necessary because the code uses them for both analyses (i.e., for temperatures and flow rates) for the user-specified sequential/seasonal analysis. The beginning date represents the start of the sequential or seasonal analysis, and the ending date represents the completion time of the analysis. Under the sequential analysis, the COLSTAT4 code uses all data between the beginning and ending dates in its analysis. Under the seasonal analysis option, the COLSTAT4 code uses only those data between the beginning month-day (inclusive) and the ending month-day (inclusive) for each designated year of the analysis. For example, assume a beginning date of March 3, 1971, (3,3,71) and an ending date of June 22, 1973, (6,22,73). The temperature and flow rate data used in the sequential analysis

for these dates are illustrated in Table 3. The data used in the seasonal analysis for this example are presented in Table 4. Note that the seasonal analysis (Table 4) repeats the user-designated month-day time span for each year, while in the sequential analysis all of the data between the beginning and ending dates are used in the computations. If the user wants to ensure that both temperature and flow rate records are analyzed in their entirety, October 1, 1959, should be used as the beginning date of the analysis and July 28, 1986, as the ending date. The computer program prompts the user for the beginning and ending dates in the following manner:

DATES FOR WHICH DATA ARE AVAILABLE
 TEMP: 1/ 1/65 TO 5/27/86
 FLOW: 10/ 1/59 TO 7/28/86
 ENTER BEGINNING AND ENDING DATES FOR DATA ANALYSIS
 ENTER DATES IN THIS FORMAT: 8,1,72 FOR AUGUST 1, 1972
 ENTER BEGINNING DATE:
 ENTER ENDING DATE:

TABLE 3. Example Illustrating the Months, Days, and Years for Which Flow and Temperature Data are Used in a Sequential Analysis from March 3, 1971, Through June 22, 1973

<u>Month</u>	<u>Days</u>	<u>Year</u>
March	3-31	1971
April	1-30	1971
May	1-31	1971
June	1-30	1971
July	1-31	1971
May	1-31	1973
June	1-22	1973

TABLE 4. Example Illustrating the Months, Days, and Years for Which Flow and Temperature Data are Used in a Seasonal Analysis from March 3, 1971, Through June 22, 1973

	<u>Month</u>	<u>Days</u>	<u>Year</u>
	March	3-31	1971
	April	1-30	1971
	May	1-31	1971
	June	1-22	1971
Repeat for next year	March	3-31	1972
	:	:	:
	June	1-22	1972
Repeat for next year	March	3-31	1973
	:	:	:
	June	1-22	1973

The box after each colon represents the location where the user must supply an answer. Dates are entered by the user in a numbered format. For example, August 1, 1972, is typed in as "8,1,72"; December 31, 1982, is typed in as "12,31,82". Following the selection of the beginning and ending dates of the analysis, proceed to Section 3.3.4 ("Temperature and Flow Units").

3.3.4 Temperature and Flow Units

The user has the option of having the results of the analysis expressed in English units, metric units, or both (e.g., flow rates presented in English units and temperatures presented in metric units). Units for flow rate are cubic feet per second (ft^3/s) or cubic meters per second (m^3/s). Temperature units are degrees Fahrenheit ($^{\circ}\text{F}$) or degrees Celsius ($^{\circ}\text{C}$). The computer program prompts the user for temperature units in the following manner:

SELECT TEMPERATURE UNITS:

1 = CELSIUS

2 = FAHRENHEIT

and later on for discharge units

SELECT FLOW UNITS:

1 = CUBIC METERS/SECOND

2 = CUBIC FEET/SECOND

The information supplied by the user in the location of the boxes is either a "1" or a "2". Following the selection of units, proceed to Section 3.3.5 ("Maximum, Minimum, and Incremental Flow Rates and Temperatures").

3.3.5 Maximum, Minimum, and Incremental Flow Rates and Temperatures

The temperature or discharge range, over which the RCFD^(a) and the interval distribution^(b) are computed, is identified by the maximum and minimum values defined herein. For example, if the RCFD and interval range are to be computed over the entire discharge range (i.e., in English units, 37,000 ft³/s to 513,000 ft³/s) for the period of record, the minimum discharge may be defined as any value less than or equal to 37,000 ft³/s, while the maximum discharge may be defined as any value greater than or equal to 513,000 ft³/s. If a statistical analysis is desired by the user over a smaller range, then discharge values for the minimum and maximum flow rate are defined greater than 37,000 ft³/s and less than 513,000 ft³/s, respectively. This example also applies to the temperature input where the maximum and minimum temperatures recorded for the period of record are 20.3°C (58.5°F) and 0.1°C (32.3°F).

The RCFD and interval distribution are computed at values between the maximum and minimum values. The increments at which these computations are made are designated by the user. For example, if the user wants a statistical summary of discharges between 513,000 ft³/s and 37,000 ft³/s at 1000 ft³/s increments, then the computer program would analyze the data at 37,000 ft³/s,

(a) Defined as the number of times a discharge/temperature is exceeded in magnitude.

(b) Defined as the number of times a discharge or temperature falls within a user-defined range.

38,000 ft³/s, ..., 513,000 ft³/s. The increment chosen in this case is 1000 ft³/s. It should be noted that the program is set up to automatically default to the following values:

Flow Rate: MINIMUM = 1000 m³/s or 36,000 ft³/s
MAXIMUM = 15,500 m³/s or 550,000 ft³/s
INCREMENT = 50 m³/s or 2000 ft³/s
Temperature: MINIMUM = 0°C or 32°F
MAXIMUM = 22°C or 72°F
INCREMENT = 1°C or 2°F

The computer program prompts the user for the minimum, maximum, and incremental temperature information in the following manner (e.g., in metric units)

THE DEFAULT RANGE FOR THE CUMULATIVE TEMPERATURE DISTRIBUTION IS
MIN, MAX, INCREMENT: 0, 22, 1 DEGREES CELSIUS

DO YOU WISH TO CHANGE THE RANGE OF THE CUMULATIVE DISTRIBUTION?

0 = USE DEFAULT RANGE, 1 = CHANGE

If "0" is entered at the location of the box, no further information is required; if a "1" is used, the computer program prompts the user further in the following manner:

ENTER RANGE DESIRED (MIN, MAX, INCREMENT)

The answer is entered at the location of the box. The format used is similar to the one used in Section 3.3.3. For example, if the user wants a statistical summary of temperatures between 0 and 10°C in 2°C increments, the user types "0,10,2".

The program also prompts the user in a similar manner for the discharge information in the following way (e.g., in metric units):

THE DEFAULT RANGE FOR THE CUMULATIVE FLOW DISTRIBUTION IS
MIN, MAX, INCREMENT: 1000, 15500, 50 CUBIC METERS / SECOND

DO YOU WISH TO CHANGE THE RANGE OF THE CUMULATIVE DISTRIBUTION?

0 = USE DEFAULT RANGE, 1 = CHANGE

If "0" is entered at the location of the box, no further information is required, if a "1" is used, the computer program prompts the user further in the following manner:

ENTER RANGE DESIRED (MIN, MAX, INCREMENT)

An answer is entered at the location of the box in a format very similar to the one used in the previous temperature example. For example, if the user wants a statistical summary of discharges between 1000 m³/s and 10,000 m³/s in 100 m³/s increments, the user types "1000,10000,100". Following the section of the range over which the RCFD is computed, proceed to Section 3.3.6 ("User-Specific Temperature-Discharge Set").

3.3.6 User-Specified Temperature-Discharge Set

The user-specified river temperature-discharge set of values is used in computing the frequency of occurrence (i.e., probability) of temperatures exceeding and discharges less than said values. The temperature and discharge units are the same as those specified in Section 3.3.4. The computer program prompts the user for the river temperature to be exceeded in the following manner:

FREQUENCY OF OCCURRENCE FOR PAIRS OF
TEMPERATURE AND FLOW VALUES

THE FOLLOWING ANALYSIS WILL COUNT THE NUMBER OF TIMES
A GIVEN TEMPERATURE IS EXCEEDED WHILE AT THE SAME TIME
THE RIVER FLOW RATE IS BELOW A GIVEN VALUE.

THE USER WILL SUPPLY THE TEMPERATURE AND FLOW VALUES
AGAINST WHICH THE DATA WILL BE COMPARED.

READING DATA --- PLEASE WAIT

PLEASE ENTER THE RIVER TEMPERATURE TO BE EXCEEDED
ENTER -99 TO EXIT PROGRAM

and later for the maximum flow rate desired:

PLEASE ENTER MAXIMUM FLOW RATE DESIRED FOR THAT TEMP
ENTER -99 TO EXIT PROGRAM

The boxes represent locations where the user must supply an answer. For example, if the user wants to know (e.g., in metric units) what percentage of time the river temperatures were above 10°C and the flow rates were below 5000 m³/s, the user would type a "10" in the first box and a "5000" in the second box. On completion of the calculations, the program again prompts the user to specify another temperature-discharge set of values. If the user elects to by-pass further analysis, the user types "-99". If the user has opted (see Section 3.3.1) to plot figures of the temperature versus flow versus percent exceeded, then the user proceeds to Section 3.3.7 ("Commands for Plotting Results"); if not, the program ends.

3.3.7 Commands for Plotting Results

The user has two plotting options. The first option allows the user to plot historical flow or temperature information included in the entire COLSTAT4 data base, as illustrated in Figures 3 through 8. The second option allows the user to analyze a user-designated flow and temperature record in a sequential or seasonal mode, similar to that illustrated in Figure 9. The following commands are used to plot the information associated with Options 1 and 2.

Option 1 -- Historical Flow or Temperature Data

If Option 1 is chosen, the computer program prompts the user to identify the units that will be associated with the chosen plot. If the user is plotting discharge information, the computer program provides the following information and prompts:^(a)

SELECT FLOW UNITS:

1 = CUBIC METERS/SECOND

2 = CUBIC FEET/SECOND

If the user wants the information plotted in cubic meters per second, "1" would be entered into the box; the user would type "2" if cubic feet per second were the desired units.

The user would see similar prompts if temperature information were being plotted. In this case, the computer program would provide the following information and prompts:^(a)

SELECT TEMPERATURE UNITS:

1 = CELSIUS

2 = FAHRENHEIT

The user should enter the selected temperature units by typing "1" for Celsius or "2" for Fahrenheit.

Following the selection of units the computer program provides the user with the following information and prompts:^(a)

TO INITIATE THE PLOTTING OPTION, TYPE "DISSPOP" AND ANSWER SUCCEEDING PROMPTS AS INDICATED BELOW. TO PLOT THE SELECTION YOU INDICATED, YOU WILL BE REQUIRED TO RESPOND TO FOUR DIFFERENT PROMPTS FROM THE COMPUTER

(a) See Section 3.3.2 for accompanying information.

TERMINAL. REPLY TO EACH PROMPT WITH THE FOLLOWING RESPONSES (YOU MAY WANT TO WRITE THESE RESPONSES DOWN FOR REFERENCE AT PROMPT TIME):

- (1) "COLSTAT4.PLT" -- REPRESENTS THE INPUT FILE
- (2) "CALCMP" -- REPRESENTS THE NOMINATION ROUTINE (i.e., PLOTTING DEVICE)
- (3) PRESS THE "RETURN" KEY FOLLOWING THE PROMPT: ENTER POST PROCESSOR DIRECTIVES
- (4) PRESS THE "C" KEY WHILE HOLDING DOWN THE "CTRL" KEY WHEN PROMPTED A SECOND TIME FOR THE INPUT FILE

TYPE "1" TO CONTINUE

FORTRAN STOP

\$

The number "1" is typed into the first prompt (i.e., box). Following this, the terminal will indicate that the COLSTAT4 program has terminated (by printing "FORTRAN STOP"); the computer is now ready to receive the plotting commands. The second prompt (represented as a "\$" sign) requires the user to enter the command "DISSPOP". The computer next provides the following four prompts, for which the user responds with the four answers listed previously.

DISPLA POST-PROCESSOR (DISSPOP)

INPUT FILE?

NOMINATION ROUTINE?

INPUT FILE: COLSTAT4.PLT

DEVICE NOMINATION ROUTINE: CALCMP

ENTER POST PROCESSOR DIRECTIVES

INPUT FILE?

Option 2 -- User-Designated Flow and Temperature Record in a Sequential or Seasonal Mode

If Option 2 is chosen, the computer program provides the user with the following information and prompts:^(a)

TO PLOT THE FLOW VERSUS TEMPERATURE VERSUS PERCENT EXCEEDED, YOU WILL BE REQUIRED TO RESPOND TO FIVE DIFFERENT PROMPTS FROM THE COMPUTER TERMINAL. REPLY TO EACH PROMPT WITH THE FOLLOWING RESPONSES (YOU MAY WANT TO WRITE THESE RESPONSES DOWN FOR REFERENCE AT PROMPT TIME):

- (1) "CONTOUR.COM" -- REPRESENTS THE CONTROL FILE SPECIFICATION
- (2) "1" -- REPRESENTS THE NUMBER OF DATA SETS TO BE READ
- (3) "NO" -- REPRESENTS THE RESPONSE TO HAVING THE INPUT FILE ECHOED
- (4) "COLSTAT4.PLT" -- REPRESENTS THE OUTPUT FILE SPECIFICATION
- (5) "OXY COLSTAT4.PLT" -- INSTRUCTS THE COMPUTER TO PLOT THE APPROPRIATE FIGURE

TO INITIATE THE PLOTTING OPTION, TYPE "CONTOUR" AND ANSWER SUCCEEDING PROMPTS AS INDICATED ABOVE

FORTRAN STOP

\$

The first prompt requires the user to answer with "CONTOUR". The computer next provides the following five prompts, for which the user responds with the five answers indicated previously.

(a) See Sections 3.3.2 through 3.3.6.

*** CONTOUR PLOTTING ROUTINE (V77.2) ***

ENTER THE CONTROL FILE SPECIFICATION (26A1) >

ENTER THE NUMBER OF DATA SETS TO BE READ >

DO YOU WANT THE INPUT FILE ECHOED >

ENTER OUTPUT FILE SPECIFICATION (26A1) >

*** CONTOUR FINISHED ***

\$

An error message may result during the contour plotting exercise. The message will state that the program has exceeded the allowed number of model points for plotting. To correct the error, either 1) increase the discharge increment used in the analysis, or 2) increase the minimum and/or decrease the maximum discharge limit used in the analysis (see Section 3.3.5).

3.3.8 Available Options for Editing the Data Base

The COLSTAT4 program supports two raw temperature and flow data editing functions. The COLSTAT4 user may change the flow or temperature values for any record in the data base. The user may also append new data to the existing data files.

To accomplish these two editing functions, two new modules in the COLSTAT4 program act together to help the user edit the existing data base. The first module accepts an array of integers (presorted into ascending order), the number of items in the array, and the target value. The program then performs a binary search of the given ordered array until the target value is found. The target value's index within the array is then returned to the second module for alteration. If the target value does not exist, a message is printed informing the user. The operation of the first module is transparent to the user.

The second module's main function is to present the various user-friendly menus to the operation of the COLSTAT4 program. These menus inform the user of options connected with the operation of COLSTAT4 and request information from the user such as date of change, etc. The COLSTAT4 program also now creates a backup file consisting of the unedited data as they existed before the editing session. This backup file is created so that no existing data will be lost because of problems occurring during the editing process. If all changing and/or appending of data proceeds smoothly, this backup file may be deleted to save storage space and costs.

When Option 3 (i.e., modify temperature or discharge data base file) from Section 3.3.1 is selected by the user, the program prompts the user to select the appropriate data file in the following manner:

```
WHICH DATA FILE DO YOU WISH TO EDIT?
ENTER (1) FOR TEMPERATURE (2) FOR FLOW

```

If the user selects "1", then the temperature data base is modified; if the user selects "2", then the discharge data base is modified.

The program next prompts the user to identify the manner in which the data file will be manipulated:

```
DO YOU WANT TO APPEND NEW DATA OR CHANGE EXISTING DATA?
ENTER (1) FOR APPEND (2) FOR CHANGE

```

If the user responds by entering a "1", a new data set corresponding to a more current time period can be appended to the existing data set. If the user responds with a "2", then incorrect data that currently exist in the existing data file can be corrected. Each function (i.e., one for appending data and one for changing incorrect data) is described in more detail as follows.

Appending Data Files

To append a new data set to the existing data base, the user must have the new data set entered into a separate file on a random-access disk under the name TEMP.NEW or FLOW.NEW, depending on the type of data involved in the update process. TEMP.NEW contains the new temperature values that are to be appended to the existing temperature data base; likewise, FLOW.NEW contains the new discharge values. Figure 10 presents an example of a new temperature data set that is to be appended to an existing temperature data set (see Figure 11). The result of appending the data set presented in Figure 10 to the data set presented in Figure 11 is illustrated in Figure 12.

The first two records of the file (see Figure 10) contain the starting and ending dates of the observations (i.e., temperature or flow values). The beginning date associated with the new data set must be chronologically 1 day later than the ending date associated with the existing data set. For example, the starting date (i.e., October 9, 1986) associated with the new data set illustrated in Figure 10 is chronologically 1 day later than the ending date (i.e., October 8, 1986) associated with the existing data set illustrated in Figure 11.

The remaining records of the file contain a chronologically listed sequence number that begins at unity; day, month, and year of the observation; and the value of the observation (see Figure 10). Note that the columns of data associated with these remaining records must be right-justified according to the column numbers illustrated in Figures 10 through 12.

The file format illustrated in Figures 10 through 12 and the naming convention (i.e., use of file names TEMP.NEW and FLOW.NEW) must be strictly adhered to, or the COLSTAT4 program will halt prematurely. Improperly naming the input file will result in a "FILE-NOT-FOUND" error. Internal checks are present within COLSTAT4 to ensure that the dates, both starting and ending, will append chronologically.

If the user has selected the append option, when prompted, the program will check with the user to ensure that the new file to be appended to the

Columns ^(a)	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0
Start Date	{ 1 0 , 0 9 , 8 6																													
End Date ^(b)	{ 1 0 , 1 9 , 8 6																													
Temperature Observations	{																													
						1					9		1	0		8	6									1	2	.	4	
						2					1	0		1	0		8	6								1	1	.	4	
						3					1	1		1	0		8	6								1	2	.	3	
						4					1	2		1	0		8	6								1	1	.	6	
						5					1	2		1	0		8	6								1	0	.	6	
						6					1	4		1	0		8	6								1	0	.	2	
						7					1	5		1	0		8	6								9	.	8		
						8					1	6		1	0		8	6								9	.	2		
						9					1	7		1	0		8	6								8	.	9		
						1	0				1	8		1	0		8	6								8	.	8		
					1	1				1	9		1	0		8	6								8	.	4			

FIGURE 10. Example of a New Temperature Data Set^(a)

(a) Included for information purposes only.

(b) Commas between the numbers must be included in the first two records of the file.

Columns	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0
Start Date	{ 0 9 , 3 1 , 8 6																													
End Date	{ 1 0 , 0 8 , 8 6																													
Temperature Observations	{																													
						1					3	1		9		8	6									1	5	.	8	
						2					1		1	0		8	6									1	5	.	4	
						3					2		1	0		8	6									1	5	.	0	
						4					3		1	0		8	6									1	4	.	6	
						5					4		1	0		8	6									1	4	.	2	
						6					5		1	0		8	6									1	3	.	8	
						7					6		1	0		8	6									1	3	.	4	
						8					7		1	0		8	6									1	3	.	0	
					9					8		1	0		8	6									1	2	.	6		

FIGURE 11. Example of an Existing Temperature Data Set

Columns	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	
Start Date	{ 0 9 , 3 1 , 8 6																														
End Date	{ 1 0 , 1 9 , 8 6																														
Temperature Observations	{																														
					1					3	1			9													1	5	.	8	
					2					1			1	0														1	5	.	4
					3					2			1	0														1	5	.	0
					4					3			1	0														1	4	.	6
					5					4			1	0														1	4	.	2
					6					5			1	0														1	3	.	8
					7					6			1	0														1	3	.	4
					8					7			1	0														1	3	.	0
					9					8			1	0														1	2	.	6
					1	0				9			1	0														1	2	.	4
					1	1				1	0		1	0														1	1	.	4
					1	2				1	1		1	0														1	2	.	3
					1	3				1	2		1	0														1	1	.	6
					1	4				1	3		1	0														1	0	.	6
					1	5				1	4		1	0														1	0	.	2
					1	6				1	5		1	0														9	.	8	
					1	7				1	6		1	0														9	.	2	
					1	8				1	7		1	0														8	.	9	
					1	9				1	8		1	0														8	.	8	
					2	0				1	9		1	0														8	.	4	

FIGURE 12. Example of an Appended Temperature Data Set

existing file is correctly named. If the user has designated the existing temperature data set for modification, the program asks the following question:

IS THE NEW DATA FILE THERE AND NAMED

"TEMP.NEW"? (Y OR N)

For appending the existing flow file:

IS THE NEW DATA FILE THERE AND NAMED

"FLOW.NEW"? (Y OR N)

If the new data file has not been created or is incorrectly named, the user will respond with "N" for no; the user will then be returned to the beginning of the program.

If the user responds with "Y" for yes, the program will check to ensure that the new data set's starting date is chronologically 1 day later than the existing data set's ending date. If the dates are not sequential, the user will be returned to the beginning of the COLSTAT4 program; if the dates are sequential, the editing session is completed.

Under situations where the user has accidentally appended an incorrect file to the existing data base, the COLSTAT4 program is designed to allow the user to retrieve the original, unappended data set. To retrieve the original, unappended data set, the user would exit the COLSTAT4 program and type the following:

for temperature:

```
DELETE TEMP.DAT;*
RENAME COEDIT.BCK TEMP.DAT
```

and for discharge:

```
DELETE FLOW.DAT;*
RENAME COEDIT.BCK FLOW.DAT
```

Editing Data Files

Correcting errors in the existing data base is significantly easier than appending new data to the existing data base. If the user has indicated that incorrect data (currently in the existing data file) are to be corrected, the program prompts the user for the date associated with the incorrect value.

When editing the temperature file:

ENTER DATE OF TEMP VALUE TO BE CHANGED IN MONTH DAY YEAR FORM WITH NO SPACES, BUT INCLUDE LEADING ZEROS (E.G., 080285 IS AUGUST 2, 1985 AND 121886 IS DECEMBER 18, 1986

When editing the flow file:

ENTER DATE OF FLOW VALUE TO BE CHANGED IN MONTH DAY YEAR FORM WITH NO SPACES, BUT INCLUDE LEADING ZEROS (E.G., 080285 IS AUGUST 2, 1985 AND 121886 IS DECEMBER 18, 1986)

If the date that the user supplies is associated with the period of record of the current data base [i.e., October 1, 1959, to the present (currently July 28, 1986)] that has no data associated with that date, the program will indicate that the data were not found. In addition, if the date that the user supplies does not correspond to one in the existing data base, the program will respond with an error message indicating that the date is out of range; at this point, the program will terminate.

After the user supplies the date associated with the incorrect data, the program will provide the user with the current value in the existing data set associated with the user-supplied date^(a) and then prompt the user to enter a corrected value:

for temperature:

ENTER NEW TEMP VALUE -- >

and for discharge:

ENTER NEW FLOW VALUE -- >

The program allows the user to change as many values as necessary by prompting the user with the following question.

DO YOU WISH TO MAKE ANY MORE CHANGES? (Y/N)

(a) For dates where no data were collected, the value -88.0 will appear.

If yes, then the user types "Y"; if no, the user types "N".

As in the case of appending files, the COLSTAT4 program allows the user to retrieve the original, unedited data set if the user has accidentally edited this data set. To retrieve the original, unedited data set, the user would exit the COLSTAT4 program and type the following:

for temperature:

```
DELETE TEMP.DAT;*
RENAME COEDIT.BCK TEMP.DAT
```

and for discharge:

```
DELETE FLOW.DAT;*
RENAME COEDIT.BCK FLOW.DAT
```

3.4 OUTPUT RESULTS

This section briefly describes the output from a computer run. The output results are grouped into four tables.

The first table of output presents an analysis of the distribution of daily-averaged temperatures over the user-selected time span. An example (e.g., metric units) of the output is presented in Table 5. Column 1 presents the temperatures with the minimum, maximum, and incremental temperatures equaling 0°, 22°, and 1°C, respectively (refer to Section 3.3.5). Column 2 presents the number of times the corresponding temperature has been exceeded in magnitude over the user-designated time span, and Column 3 presents the percent of time the temperature has been exceeded (i.e., relative cumulative frequency distribution). Column 4 presents the user-designated interval range (e.g., 1°C in this case) over which the corresponding temperature is assigned (e.g., very similar to a histogram); Column 5 identifies the number of days the river temperature is within the range defined in Column 4; and Column 6 presents the percentage of the time the temperature is within the range.

TABLE 5. Distribution of Average Daily Temperatures (Sequentially)
from January 1, 1965, to August 5, 1984

TEMP (DEG C)	NO. OF TIMES EXCEEDED	PER CENT OF TIME	RANGE	DAYS WITHIN	PER CENT OF TIME
0.0	6905	100.000	-0.5 - 0.4	13	0.100
1.0	6868	99.464	0.5 - 1.4	57	0.825
2.0	6751	97.770	1.5 - 2.4	171	2.476
3.0	6485	93.828	2.5 - 3.4	399	5.778
4.0	5888	85.168	3.5 - 4.4	627	9.080
5.0	5357	77.581	4.5 - 5.4	430	6.343
6.0	4982	72.151	5.5 - 6.4	370	5.358
7.0	4609	66.749	6.5 - 7.4	350	5.069
8.0	4278	61.955	7.5 - 8.4	322	4.683
9.0	3979	57.625	8.5 - 9.4	281	4.070
10.0	3717	53.831	9.5 - 10.4	313	4.533
11.0	3384	49.008	10.5 - 11.4	289	4.185
12.0	3092	44.779	11.5 - 12.4	319	4.620
13.0	2790	40.406	12.5 - 13.4	306	4.432
14.0	2489	34.888	13.5 - 14.4	366	5.214
15.0	2079	30.109	14.5 - 15.4	337	4.881
16.0	1748	25.199	15.5 - 16.4	376	5.445
17.0	1315	19.044	16.5 - 17.4	479	6.937
18.0	757	10.963	17.5 - 18.4	611	8.849
19.0	191	2.766	18.5 - 19.4	409	5.923
20.0	0	0.118	19.5 - 20.4	78	1.130
21.0	0	0.000	20.5 - 21.4	0	0.000
22.0	0	0.000	21.5 - 22.4	0	0.000

The second table of output presents the distribution of daily-averaged discharges over the same user-selected time span. An example (e.g., in English units) of this output is presented in Table 6. This table is exactly the same as Table 5, except daily discharges rather than temperatures are used in the analysis.

The third table of output presents the daily composite of maximum, minimum, and mean temperatures and discharges for each day of each month over the user-selected time span, as well as the standard deviation for each day. An example (e.g., in metric units for temperatures and English units for discharges) of this output for the month of January is presented in Table 7. Column 1 presents the day of the month. Columns 2, 3, 4, and 5 present the daily-averaged maximum, minimum, and mean temperatures for the corresponding day over the user-designated time span, as well as the standard deviation about the mean for that day. Basically, all temperature information, which is collected on that day regardless of the year, is analyzed to form the basis of the information presented in Columns 2, 3, 4, and 5. Columns 6, 7, 8, and 9 are similar to Columns 2, 3, 4, and 5, respectively, but list flow rates rather than temperatures.

TABLE 6. Distribution of Average Daily Flow Rates (Sequentially)
from October 1, 1959, to June 15, 1984

FLOW (CFS)	NO. OF TIMES EXCEEDED	PER CENT OF TIME	RANGE	DAYS WITHIN	PER CENT OF TIME
36000	9828	100.000	35000 - 38999	0	0.000
38000	9005	99.834	37000 - 38999	26	0.268
40000	8971	99.457	39000 - 40999	32	0.355
42000	8939	99.182	41000 - 42999	38	0.421
44000	8896	98.825	43000 - 44999	41	0.455
46000	8852	98.137	45000 - 46999	38	0.421
48000	8808	97.650	47000 - 48999	54	0.599
50000	8750	97.007	49000 - 50999	59	0.654
52000	8689	96.336	51000 - 52999	69	0.765
54000	8611	95.486	53000 - 54999	85	0.942
56000	8502	94.257	55000 - 56999	100	1.197
58000	8390	93.082	57000 - 58999	119	1.319
60000	8277	91.763	59000 - 60999	116	1.286
62000	8151	90.386	61000 - 62999	123	1.364
64000	8024	88.958	63000 - 64999	140	1.552
66000	7864	87.184	65000 - 66999	150	1.729
68000	7721	85.599	67000 - 68999	140	1.641
70000	7581	83.825	69000 - 70999	156	1.729
72000	7407	82.118	71000 - 72999	185	2.051
74000	7200	79.823	73000 - 74999	180	1.998
76000	7032	77.960	75000 - 76999	178	1.973
78000	6830	75.721	77000 - 78999	215	2.384
80000	6629	73.492	79000 - 80999	194	2.151
82000	6423	71.288	81000 - 82999	200	2.217
84000	6230	69.089	83000 - 84999	202	2.239
86000	6028	66.741	85000 - 86999	197	2.184
88000	5810	64.412	87000 - 88999	207	2.295
90000	5603	62.118	89000 - 90999	206	2.284
92000	5390	59.756	91000 - 92999	198	2.173
94000	5210	57.849	93000 - 94999	175	1.940
96000	5049	55.976	95000 - 96999	173	1.918
98000	4859	53.869	97000 - 98999	179	1.984
100000	4679	51.874	99000 - 100999	186	1.940
102000	4517	50.070	101000 - 102999	155	1.718
104000	4348	48.284	103000 - 104999	188	1.883
106000	4197	46.530	105000 - 106999	148	1.641
108000	4036	44.745	107000 - 108999	184	1.818
110000	3869	42.894	109000 - 110999	109	1.874
112000	3708	41.109	111000 - 112999	156	1.729
114000	3568	39.534	113000 - 114999	146	1.608
116000	3438	38.115	115000 - 116999	128	1.419
118000	3321	36.818	117000 - 118999	119	1.319
120000	3203	35.510	119000 - 120999	115	1.275
122000	3094	34.302	121000 - 122999	111	1.231
124000	2972	32.949	123000 - 124999	110	1.286
126000	2852	31.619	125000 - 126999	122	1.353
128000	2702	30.021	127000 - 128999	93	1.031
130000	2676	29.867	129000 - 130999	82	0.909
132000	2588	28.670	131000 - 132999	93	1.031

The fourth table of output presents frequency of occurrence of temperatures greater than and discharges less than five user-specified temperature-discharge sets of values. An example (e.g., metric units) of the output is presented in Table 8. All temperatures and corresponding (i.e., same day) discharges within the period of record are compared to a user-specified

TABLE 7. Temperature and Flow Analysis (Sequentially) from October 1, 1959, to June 15, 1984, for Month of April

DATE	TEMPERATURE (DEG C)				FLOW (CFS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
4/ 1	7.6	4.6	5.56	0.70	283100	46500	118396	42682
4/ 2	6.9	4.1	5.61	0.73	187000	47500	118240	37829
4/ 3	6.8	4.0	5.70	0.73	192000	37800	108232	40818
4/ 4	6.7	4.1	5.80	0.67	188000	39800	107416	30512
4/ 5	6.7	4.6	6.00	0.59	191300	39200	112324	40420
4/ 6	6.9	4.6	6.07	0.59	194000	62100	116204	38477
4/ 7	7.3	4.6	6.17	0.66	204000	58000	112392	37718
4/ 8	7.6	4.7	6.31	0.66	210000	63800	113832	38978
4/ 9	7.7	4.9	6.42	0.64	202000	55000	115152	38183
4/10	8.0	5.2	6.57	0.61	190000	48000	111436	41424
4/11	7.7	5.3	6.63	0.59	189000	48100	111196	43212
4/12	7.7	5.4	6.68	0.58	198000	41400	117804	42197
4/13	7.7	5.6	6.71	0.56	202400	54700	122164	42500
4/14	7.8	5.6	6.84	0.57	206300	62700	119148	47102
4/15	8.1	5.7	6.96	0.62	200000	63000	123776	45309
4/16	8.4	5.7	7.05	0.70	201000	56400	122324	43196
4/17	8.6	5.7	7.15	0.73	192000	44300	119500	44700
4/18	8.3	5.8	7.20	0.70	190000	57000	122700	39733
4/19	8.3	6.0	7.24	0.70	207000	45500	125428	40873
4/20	8.5	6.2	7.37	0.70	193000	54500	122036	34702
4/21	8.8	6.6	7.60	0.67	192000	65400	119978	37497
4/22	8.7	6.6	7.64	0.71	190000	58600	121204	39263
4/23	8.8	7.0	7.84	0.60	206000	57400	120092	30142
4/24	9.1	7.1	8.00	0.71	202000	51000	122064	40100
4/25	9.3	7.6	8.67	0.70	210000	54000	119268	42612
4/26	9.5	7.2	8.23	0.69	202000	43100	115792	40082
4/27	9.6	7.3	8.32	0.65	212000	58700	119440	43612
4/28	9.7	7.2	8.48	0.70	201000	45300	119180	43722
4/29	9.9	7.2	8.57	0.75	204000	50000	121484	40041
4/30	10.1	7.4	8.78	0.75	210000	41700	122436	41672

temperature and flow rate (columns 1 and 2 of Table 8). The third column presents the number of times the above criteria are met, and Column 4 presents the percentage of time over the period of record in which the above criteria are met.

3.5 SAMPLE PROBLEMS

This section presents six sample problems to help the user understand the COLSTAT4 code. User input is presented in this section, while the output results are presented in Appdixes B through D.

TABLE 8. Percent of Time Temperature Exceeds a Given Minimum While Flow Rate is Below a Given Maximum

MINIMUM TEMPERATURE	MAXIMUM FLOW	NO. OF TIMES CRITERIA MET	PERCENT OF TIME
0.0 DEG C	1000 CMS	0	0.0
2.0 DEG C	3000 CMS	3268	49.2
4.0 DEG C	4000 CMS	4172	62.8
6.0 DEG C	5000 CMS	3892	58.5
8.0 DEG C	6000 CMS	3602	54.2
10.0 DEG C	7000 CMS	3283	49.4
12.0 DEG C	8000 CMS	2872	43.2
14.0 DEG C	9000 CMS	2379	35.8
15.0 DEG C	10000 CMS	2088	31.4

3.5.1 Sample Problem 1

A user would like to statistically analyze Columbia River data just downstream of Priest Rapids Dam for the sequential time period of October 1, 1959, through December 31, 1970. The user wants temperature in units of degrees Fahrenheit ($^{\circ}\text{F}$) and discharge in units of cubic meters per second (m^3/s). Also the user wants to use the default range supplied by the program for temperature and a discharge range of 1000 to 5000 m^3/s in 100 m^3/s increments. In addition, the user would like to know the percentage of time the river temperatures are greater than 65°F and discharges less than 2800 m^3/s . The input data for this problem are presented in Table 9, and the output results are presented in Appendix B.

3.5.2 Sample Problem 2

A user would like to statistically analyze Columbia River data just downstream of Priest Rapids Dam for the sequential time period of January 1, 1971, through June 24, 1983. The user wants temperature units in degrees Celsius ($^{\circ}\text{C}$) and discharge in units of cubic feet per second (ft^3/s). Also the user wants a temperature range of 2° to 20°C in 2°C increments and the default range supplied by the program for the discharge. In addition, the user would like to know the percentage of time the river temperatures are greater than 18°C and discharges less than 100,000 ft^3/s , and river temperatures are greater than 17°C and discharges less than 90,000 ft^3/s . The input data for this problem are presented in Table 10, and the output results are presented in Appendix C.

TABLE 9. Sample Problem 1 Input^(a)

COLUMBIA RIVER STATISTICAL UPOATE MODEL--VERSION 4.0

DEVELOPED BY: R. D. BROCKHAUS, D. W. DAMSCHEN, R. S. ARGO, C. A. NEWBILL, AND G. WHELAN. PACIFIC NORTHWEST LABORATORY, RICHLAND, WASHINGTON.

DOCUMENTATION: WHELAN, G., D. W. DAMSCHEN, AND R. D. BROCKHAUS. 1986. "COLUMBIA RIVER STATISTICAL UPDATE MODEL--VERSION 4.0 (COLSTAT4): BACKGROUND DOCUMENTATION AND USER'S GUIDE," PACIFIC NORTHWEST LABORATORY, RICHLAND, WASHINGTON.

WHELAN, G., R. S. ARGO, D. W. DAMSCHEN, AND C. A. NEWBILL. 1985. "COLUMBIA RIVER STATISTICAL UPDATE MODEL--VERSION 3.0 (COLSTAT3): UPDATE OF COLUMBIA RIVER FLOW AND TEMPERATURE DATA MEASURED AT PRIEST RAPIDS DAM AND VERNITA BRIDGE." PACIFIC NORTHWEST LABORATORY, RICHLAND, WASHINGTON.

WHELAN, G., AND C. A. NEWBILL. 1983. "UPDATE OF COLUMBIA RIVER FLOW AND TEMPERATURE DATA MEASURED AT PRIEST RAPIDS DAM AND VERNITA BRIDGE." PNL-4868. PACIFIC NORTHWEST LABORATORY, RICHLAND, WASHINGTON.

TYPE "1" TO CONTINUE--

THE COLSTAT4 COMPUTER CODE WELCOMES YOU.

PLEASE READ ALL TEXT AND ANSWER ALL QUESTIONS.

TYPE "1" TO CONTINUE--

THE COLSTAT4 COMPUTER PROGRAM CURRENTLY HAS THREE OPTIONS:

- 1) ALLOWS THE USER TO PLOT HISTDRICAL FLOW OR TEMPERATURE INFORMATION INCLUDED IN THE ENTIRE COLSTAT4 DATA BASE OR
- 2) ALLOWS THE USER TO ANALYZE A USER-DESIGNATED FLOW AND TEMPERATURE RECORD IN A SEQUENTIAL OR A SEASONAL MODE OR
- 3) ALLOWS THE USER TO EDIT THE TEMPERATURE DR FLOW FILES.

ONLY ONE OPTION MAY BE IMPLEMENTED PER RUN.

(a) Numbers in blocks are user supplied.

TABLE 9. (Contd)

PLEASE SELECT THE OPTION YOU WISH TO IMPLEMENT (1, 2, OR 3).

2

II. OPTION 2--FLOW AND TEMPERATURE ANALYSIS

PLEASE SELECT THE TYPE OF ANALYSIS TO BE PERFORMED BY COLSTAT4. TYPE THE APPROPRIATE NUMBER ASSOCIATED WITH YOUR SELECTION:

- (1) NO ANALYSIS (ESCAPE ANALYSIS OPTION)
- (2) SEQUENTIAL ANALYSIS
- (3) SEASONAL ANALYSIS

ENTER YOUR CHOICE (1-3)

2

WOULD YOU LIKE A PLOT DEPICTING TEMPERATURE VS. FLOW VS. PERCENT EXCEEDED FOR THE SEQUENTIAL/SEASONAL ANALYSIS OPTION CHOSEN ABOVE (INDICATE ANSWER WITH A "Y" FOR YES OR "N" FOR NO)

N

TYPE "1" TO CONTINUE--

1

DATES FOR WHICH DATA ARE AVAILABLE:

TEMP: 1/1/65 TO 7/28/86

FLOW: 10/1/59 TO 5/27/86

ENTER BEGINNING AND ENDING DATES FOR DATA ANALYSIS

ENTER DATES IN THIS FORMAT: 8,1,72 FOR AUGUST 1, 1972

ENTER BEGINNING DATE:

10,1,59

ENTER ENDING DATE:

12,31,70

BEGINNING OF USER RANGE PRECEDES DATA RANGE FOR TEMP ANALYSIS
WILL BEGIN WITH FIRST DATE OF DATA: 1/1/65

TABLE 9. (Contd)

SELECT TEMPERATURE UNITS:

1 = CELSIUS

2 = FAHRENHEIT

THE DEFAULT RANGE FOR CUMULATIVE TEMPERATURE DISTRIBUTION IS
MIN, MAX, INCREMENT: 32, 72, 2 DEGREES FAHRENHEIT

DO YOU WISH TO CHANGE THE RANGE OF THE CUMULATIVE DISTRIBUTION?

0 = USE DEFAULT RANGE, 1 = CHANGE

STARTING THE MAIN LOOP IN SUBROUTINE BEGIN4.FOR
PLEASE WAIT UNTIL THE CALCULATIONS ARE FINISHED

SELECT FLOW UNITS:

1 = CUBIC METERS/SECOND

2 = CUBIC FEET/SECOND

THE DEFAULT RANGE FOR CUMULATIVE FLOW DISTRIBUTION IS MIN, MAX,
INCREMENT: 1000, 15500, 50 CUBIC METERS/SECOND

DO YOU WISH TO CHANGE THE RANGE OF THE CUMULATIVE DISTRIBUTION?

0 = USE DEFAULT RANGE, 1 = CHANGE

ENTER RANGE DESIRED (MIN, MAX, INCREMENT)

STARTING THE MAIN LOOP IN SUBROUTINE BEGIN4.FOR
PLEASE WAIT UNTIL THE CALCULATIONS ARE FINISHED

FREQUENCY OF OCCURRENCE FOR PAIRS OF TEMPERATURE AND FLOW
VALUES

TABLE 9. (Contd)

THE FOLLOWING ANALYSIS WILL COUNT THE NUMBER OF TIMES A GIVEN TEMPERATURE IS EXCEEDED WHILE AT THE SAME TIME THE RIVER FLOW RATE IS BELOW A GIVEN VALUE.

THE USER WILL SUPPLY THE TEMPERATURE AND FLOW VALUES AGAINST WHICH THE DATA WILL BE COMPARED.

READING DATA--PLEASE WAIT

PLEASE ENTER THE RIVER TEMPERATURE TO BE EXCEEDED
ENTER -99 TO EXIT THE PROGRAM

PLEASE ENTER MAXIMUM FLOW RATE DESIRED FOR THAT TEMP
ENTER -99 TO EXIT THE PROGRAM

PLEASE ENTER THE RIVER TEMPERATURE TO BE EXCEEDED
ENTER -99 TO EXIT THE PROGRAM

* PLEASE WAIT WHILE THE PERCENTAGES ARE CALCULATED *

DO YOU WANT TO RUN AGAIN? (Y/N)

COLSTAT4 FINISHED--GOOD BYE
FORTRAN STOP

TABLE 10. Sample Problem 2 Input^(a)

COLUMBIA RIVER STATISTICAL UPDATE MODEL--VERSION 4.0

DEVELOPED BY: R. D. BROCKHAUS, D. W. DAMSCHEN, R. S. ARGO, C. A. NEWBILL, AND G. WHELAN. PACIFIC NORTHWEST LABORATORY, RICHLAND, WASHINGTON.

DOCUMENTATION: WHELAN, G., D. W. DAMSCHEN, AND R. D. BROCKHAUS. 1986. "COLUMBIA RIVER STATISTICAL UPDATE MODEL--VERSION 4.0 (COLSTAT4): BACKGROUND DOCUMENTATION AND USER'S GUIDE," PACIFIC NORTHWEST LABORATORY, RICHLAND, WASHINGTON.

WHELAN, G., R. S. ARGO, D. W. DAMSCHEN, AND C. A. NEWBILL. 1985. "COLUMBIA RIVER STATISTICAL UPDATE MODEL--VERSION 3.0 (COLSTAT3): UPDATE OF COLUMBIA RIVER FLOW AND TEMPERATURE DATA MEASURED AT PRIEST RAPIDS DAM AND VERNITA BRIDGE." PACIFIC NORTHWEST LABORATORY, RICHLAND, WASHINGTON.

WHELAN, G., AND C. A. NEWBILL. 1983. "UPDATE OF COLUMBIA RIVER FLOW AND TEMPERATURE DATA MEASURED AT PRIEST RAPIDS DAM AND VERNITA BRIDGE." PNL-4868. PACIFIC NORTHWEST LABORATORY, RICHLAND, WASHINGTON.

TYPE "1" TO CONTINUE--

THE COLSTAT4 COMPUTER CODE WELCOMES YOU.

PLEASE READ ALL TEXT AND ANSWER ALL QUESTIONS.

TYPE "1" TO CONTINUE--

THE COLSTAT4 COMPUTER PROGRAM CURRENTLY HAS THREE OPTIONS:

- 1) ALLOWS THE USER TO PLOT HISTORICAL FLOW OR TEMPERATURE INFORMATION INCLUDED IN THE ENTIRE COLSTAT4 DATA BASE OR
- 2) ALLOWS THE USER TO ANALYZE A USER-DESIGNATED FLOW AND TEMPERATURE RECORD IN A SEQUENTIAL OR A SEASONAL MODE.
- 3) ALLOWS THE USER TO EDIT THE TEMPERATURE OR FLOW FILES.

ONLY ONE OPTION MAY BE IMPLEMENTED PER RUN.

(a) Numbers in blocks are user supplied.

TABLE 10. (Contd)

PLEASE SELECT THE OPTION YOU WISH TO IMPLEMENT (1, 2, OR 3).

II. OPTION 2--FLOW AND TEMPERATURE ANALYSIS

PLEASE SELECT THE TYPE OF ANALYSIS TO BE PERFORMED BY COLSTAT4. TYPE THE APPROPRIATE NUMBER ASSOCIATED WITH YOUR SELECTION:

- (1) NO ANALYSIS (ESCAPE ANALYSIS OPTION)
- (2) SEQUENTIAL ANALYSIS
- (3) SEASONAL ANALYSIS

ENTER YOUR CHOICE (1-3)

WOULD YOU LIKE A PLOT DEPICTING TEMPERATURE VS. FLOW VS. PERCENT EXCEEDED FOR THE SEQUENTIAL/SEASONAL ANALYSIS OPTION CHOSEN ABOVE (INDICATE ANSWER WITH A "Y" FOR YES OR "N" FOR NO)

TYPE "1" TO CONTINUE--

DATES FOR WHICH DATA ARE AVAILABLE:

TEMP: 1/1/65 TO 7/28/86
FLOW: 10/1/59 TO 5/27/86

ENTER BEGINNING AND ENDING DATES FOR DATA ANALYSIS
ENTER DATES IN THIS FORMAT: 8,1,72 FOR AUGUST 1, 1972

ENTER BEGINNING DATE:

ENTER ENDING DATE:

SELECT TEMPERATURE UNITS:

- 1 = CELSIUS
- 2 = FAHRENHEIT

TABLE 10. (Contd)

THE DEFAULT RANGE FOR CUMULATIVE TEMPERATURE DISTRIBUTION IS
MIN, MAX, INCREMENT: 0, 22, 1 DEGREES CELSIUS

DO YOU WISH TO CHANGE THE RANGE OF THE CUMULATIVE DISTRIBUTION?

0 = USE DEFAULT RANGE, 1 = CHANGE

1

ENTER RANGE DESIRED (MIN, MAX, INCREMENT)

2,20,2

STARTING THE MAIN LOOP IN SUBROUTINE BEGIN4.FOR
PLEASE WAIT UNTIL THE CALCULATIONS ARE FINISHED

SELECT FLOW UNITS:

1 = CUBIC METERS/SECOND

2 = CUBIC FEET/SECOND

2

THE DEFAULT RANGE FOR CUMULATIVE FLOW DISTRIBUTION IS MIN, MAX,
INCREMENT: 36000, 550000, 2000 CUBIC FEET/SECOND

DO YOU WISH TO CHANGE THE RANGE OF THE CUMULATIVE DISTRIBUTION?

0 = USE DEFAULT RANGE, 1 = CHANGE

0

STARTING THE MAIN LOOP IN SUBROUTINE BEGIN4.FOR
PLEASE WAIT UNTIL THE CALCULATIONS ARE FINISHED

FREQUENCY OF OCCURRENCE FOR PAIRS OF TEMPERATURE AND FLOW
VALUES

THE FOLLOWING ANALYSIS WILL COUNT THE NUMBER OF TIMES A GIVEN
TEMPERATURE IS EXCEEDED WHILE AT THE SAME TIME THE RIVER FLOW
RATE IS BELOW A GIVEN VALUE.

THE USER WILL SUPPLY THE TEMPERATURE AND FLOW VALUES AGAINST
WHICH THE DATA WILL BE COMPARED.

READING DATA--PLEASE WAIT

TABLE 10. (Contd)

PLEASE ENTER THE RIVER TEMPERATURE TO BE EXCEEDED
ENTER -99 TO EXIT THE PROGRAM

18

PLEASE ENTER MAXIMUM FLOW RATE DESIRED FOR THAT TEMP
ENTER -99 TO EXIT THE PROGRAM

100000

PLEASE ENTER THE RIVER TEMPERATURE TO BE EXCEEDED
ENTER -99 TO EXIT THE PROGRAM

17

PLEASE ENTER MAXIMUM FLOW RATE DESIRED FOR THAT TEMP
ENTER -99 TO EXIT THE PROGRAM

90000

PLEASE ENTER THE RIVER TEMPERATURE TO BE EXCEEDED
ENTER -99 TO EXIT THE PROGRAM

-99

* PLEASE WAIT WHILE THE PERCENTAGES ARE CALCULATED *

DO YOU WANT TO RUN AGAIN? (Y/N)

N

COLSTAT4 FINISHED--GOOD BYE
FORTRAN STOP

3.5.3 Sample Problem 3

A user would like to statistically analyze Columbia River data just downstream of Priest Rapids Dam for the seasonal time period of April 16 through June 15 over the years between 1959 through 1984 (inclusive). The user wants temperature units in degrees Celsius ($^{\circ}\text{C}$) and discharge in units of cubic feet per second (ft^3/s). The user wants to use the default range supplied by the program for temperature and a discharge range of 36,000 to 550,000 ft^3/s in 1500 ft^3/s increments. In addition, the user would like to know the percentage of time the river temperatures are greater than 8° and 12°C and the flow rates less than 70,000 and 100,000 ft^3/s , respectively. Also the user wants a figure illustrating a plot of temperature versus discharge versus percent exceeded curves. The input data for this problem are presented in Table 11, and the output results are presented in Figure 13 and Appendix O.

3.5.4 Sample Problem 4

A user wants a plot of the historical flow information included in the entire COLSTAT4 data base. The flow information is those data related to the temporally varying daily-averaged flow rates just downstream of Priest Rapids Dam on the Columbia River. The input data for this problem are presented in Table 12, and the output results are presented in Figure 3.

3.5.5 Sample Problem 5

The user wants to append new flow data to the existing flow data base. The file containing the new data is named FLDW.NEW. The input data for this problem are presented in Table 13.

3.5.6 Sample Problem 6

The user wants to edit the existing temperature data file. The water temperatures of 113° and 114°C , which are associated with July 13, 1986, and July 14, 1986, respectively, are incorrect; the correct values should be 11.3° and 11.4°C , respectively. The input data for this problem are presented in Table 14.

TABLE 11. Sample Problem 3 Input^(a)

COLUMBIA RIVER STATISTICAL UPDATE MODEL--VERSION 4.0

DEVELOPED BY: R. D. BROCKHAUS, D. W. DAMSCHEN, R. S. ARGO, C. A. NEWBILL, AND G. WHELAN. PACIFIC NORTHWEST LABORATORY, RICHLAND, WASHINGTON.

DOCUMENTATION: WHELAN, G., D. W. DAMSCHEN, AND R. D. BROCKHAUS. 1986. "COLUMBIA RIVER STATISTICAL UPDATE MODEL--VERSION 4.0 (COLSTAT4): BACKGROUND DOCUMENTATION AND USER'S GUIDE," PACIFIC NORTHWEST LABORATORY, RICHLAND, WASHINGTON.

WHELAN, G., R. S. ARGO, D. W. DAMSCHEN, AND C. A. NEWBILL. 1985. "COLUMBIA RIVER STATISTICAL UPDATE MODEL--VERSION 3.0 (COLSTAT3): UPDATE OF COLUMBIA RIVER FLOW AND TEMPERATURE DATA MEASURED AT PRIEST RAPIDS DAM AND VERNITA BRIDGE." PACIFIC NORTHWEST LABORATORY, RICHLAND, WASHINGTON.

WHELAN, G., AND C. A. NEWBILL. 1983. "UPDATE OF COLUMBIA RIVER FLOW AND TEMPERATURE DATA MEASURED AT PRIEST RAPIDS DAM AND VERNITA BRIDGE." PNL-4868. PACIFIC NORTHWEST LABORATORY, RICHLAND, WASHINGTON.

TYPE "1" TO CONTINUE--

THE COLSTAT4 COMPUTER CODE WELCOMES YOU.

PLEASE READ ALL TEXT AND ANSWER ALL QUESTIONS.

TYPE "1" TO CONTINUE--

THE COLSTAT4 COMPUTER PROGRAM CURRENTLY HAS THREE OPTIONS:

- 1) ALLOWS THE USER TO PLOT HISTORICAL FLOW OR TEMPERATURE INFORMATION INCLUDED IN THE ENTIRE COLSTAT4 DATA BASE OR
- 2) ALLOWS THE USER TO ANALYZE A USER-DESIGNATED FLOW AND TEMPERATURE RECORD IN A SEQUENTIAL OR A SEASONAL MODE OR
- 3) ALLOWS THE USER TO EDIT THE TEMPERATURE OR FLOW FILES.

ONLY ONE OPTION MAY BE IMPLEMENTED PER RUN.

(a) Numbers in blocks are user supplied.

TABLE 11. (Contd)

PLEASE SELECT THE OPTION YOU WISH TO IMPLEMENT (1, 2, OR 3).

2

II. OPTION 2--FLOW AND TEMPERATURE ANALYSIS

PLEASE SELECT THE TYPE OF ANALYSIS TO BE PERFORMED BY COLSTAT4. TYPE THE APPROPRIATE NUMBER ASSOCIATED WITH YOUR SELECTION:

- (1) NO ANALYSIS (ESCAPE ANALYSIS OPTION)
- (2) SEQUENTIAL ANALYSIS
- (3) SEASONAL ANALYSIS

ENTER YOUR CHOICE (1-3)

3

WOULD YOU LIKE A PLOT DEPICTING TEMPERATURE VS. FLOW VS. PERCENT EXCEEDED FOR THE SEQUENTIAL/SEASONAL ANALYSIS OPTION CHOSEN ABOVE (INDICATE ANSWER WITH A "Y" FOR YES OR "N" FOR NO)

Y

ARE YOU IMPLEMENTING THE COLSTAT4 PROGRAM ON THE PACIFIC NORTHWEST LABORATORY (PNL) DEC VAX 11/780 COMPUTING SYSTEM (INDICATE ANSWER WITH A "Y" FOR YES OR "N" FOR NO)

Y

TYPE "1" TO CONTINUE--

1

DATES FOR WHICH DATA ARE AVAILABLE:

TEMP: 1/1/65 TO 7/28/86
FLOW: 10/1/59 TO 5/27/86

ENTER BEGINNING AND ENDING DATES FOR DATA ANALYSIS
ENTER DATES IN THIS FORMAT: B,1,72 FOR AUGUST 1, 1972

ENTER BEGINNING DATE:

4,16,59

TABLE 11. (Contd)

ENTER ENDING DATE:

6,15,84

SELECT TEMPERATURE UNITS:

1 = CELSIUS

2 = FAHRENHEIT

1

THE DEFAULT RANGE FOR CUMULATIVE TEMPERATURE DISTRIBUTION IS
MIN, MAX, INCREMENT: 0, 22, 1 DEGREES CELSIUS

DO YOU WISH TO CHANGE THE RANGE OF THE CUMULATIVE DISTRIBUTION?

0 = USE DEFAULT RANGE, 1 = CHANGE

0

STARTING THE MAIN LOOP IN SUBROUTINE BEGIN4.FOR
PLEASE WAIT UNTIL THE CALCULATIONS ARE FINISHED

SELECT FLOW UNITS:

1 = CUBIC METERS/SECOND

2 = CUBIC FEET/SECOND

2

THE DEFAULT RANGE FOR CUMULATIVE FLOW DISTRIBUTION IS MIN, MAX,
INCREMENT: 36000, 550000, 2000 CUBIC FEET/SECOND

DO YOU WISH TO CHANGE THE RANGE OF THE CUMULATIVE DISTRIBUTION?

0 = USE DEFAULT RANGE, 1 = CHANGE

1

ENTER RANGE DESIRED (MIN, MAX, INCREMENT)

36000,550000,1500

STARTING THE MAIN LOOP IN SUBROUTINE BEGIN4.FOR
PLEASE WAIT UNTIL THE CALCULATIONS ARE FINISHED

TABLE 11. (Contd)

FREQUENCY OF OCCURRENCE FOR PAIRS OF TEMPERATURE AND FLOW
VALUES

THE FOLLOWING ANALYSIS WILL COUNT THE NUMBER OF TIMES A GIVEN
TEMPERATURE IS EXCEEDED WHILE AT THE SAME TIME THE RIVER FLOW
RATE IS BELOW A GIVEN VALUE.

THE USER WILL SUPPLY THE TEMPERATURE AND FLOW VALUES AGAINST
WHICH THE DATA WILL BE COMPARED.

READING DATA--PLEASE WAIT

PLEASE ENTER THE RIVER TEMPERATURE TO BE EXCEEDED
ENTER -99 TO EXIT THE PROGRAM

PLEASE ENTER MAXIMUM FLOW RATE DESIRED FOR THAT TEMP
ENTER -99 TO EXIT THE PROGRAM

PLEASE ENTER THE RIVER TEMPERATURE TO BE EXCEEDED
ENTER -99 TO EXIT THE PROGRAM

PLEASE ENTER MAXIMUM FLOW RATE DESIRED FOR THAT TEMP
ENTER -99 TO EXIT THE PROGRAM

PLEASE ENTER THE RIVER TEMPERATURE TO BE EXCEEDED
ENTER -99 TO EXIT THE PROGRAM

* PLEASE WAIT WHILE THE PERCENTAGES ARE CALCULATED *

TYPE "1" TO CONTINUE

TABLE 11. (Contd)

TO INITIATE THE PLOTTING OPTION, TYPE "CONTOUR" AND ANSWER SUCCEEDING PROMPTS AS INDICATED BELOW. TO PLOT THE FLOW VS. TEMPERATURE VS. PERCENT EXCEEDED, YOU WILL BE REQUIRED TO RESPOND TO FIVE DIFFERENT PROMPTS FROM THE COMPUTER TERMINAL. REPLY TO EACH PROMPT WITH THE FOLLOWING RESPONSES (YOU MAY WANT TO WRITE THESE RESPONSES DOWN FOR REFERENCE AT PROMPT TIME):

- 1) "CONTOUR.COM"--REPRESENTS THE CONTROL FILE SPECIFICATION
- 2) "1"--REPRESENTS THE NUMBER OF DATA SETS TO BE READ
- 3) "NO"--REPRESENTS THE RESPONSE TO HAVING THE INPUT FILE ECHOED
- 4) "COLSTAT4.PLT"--REPRESENTS THE OUTPUT FILE SPECIFICATION
- 5) DXY COLSTAT4.PLT"--INSTRUCTS THE COMPUTER TO PLOT THE APPROPRIATE FIGURE

FORTRAN STOP

\$ CONTOUR

CONTOUR PLOTTING ROUTINE (V77.2)

ENTER THE CONTROL FILE SPECIFICATION (26A1) > CONTOUR.COM

ENTER THE NUMBER OF DATA SETS TO BE READ > 1

DO YOU WANT THE INPUT FILE ECHOED > NO

ENTER OUTPUT FILE SPECIFICATION (26A1) > COLSTAT4.PLT

CONTOUR FINISHED

\$ DXY COLSTAT4.PLT

FIGURE 13. Percentage of Time Columbia River Temperatures Exceed and Corresponding Discharges are Less Than User-Specified Values, January 1, 1965 Through June 15, 1984.

TABLE 12. Sample Problem 4 Input^(a)

COLUMBIA RIVER STATISTICAL UPDATE MODEL--VERSION 4.0

DEVELOPED BY: R. D. BROCKHAUS, D. W. DAMSCHEN, R. S. ARGO, C. A. NEWBILL, AND G. WHELAN. PACIFIC NORTHWEST LABORATORY, RICHLAND, WASHINGTON.

DOCUMENTATION: WHELAN, G., D. W. DAMSCHEN, AND R. D. BROCKHAUS. 1986. "COLUMBIA RIVER STATISTICAL UPDATE MODEL--VERSION 4.0 (COLSTAT4): BACKGROUND DOCUMENTATION AND USER'S GUIDE," PACIFIC NORTHWEST LABORATORY, RICHLAND, WASHINGTON.

WHELAN, G., R. S. ARGO, D. W. DAMSCHEN, AND C. A. NEWBILL. 1985. "COLUMBIA RIVER STATISTICAL UPDATE MODEL--VERSION 3.0 (COLSTAT3): UPDATE OF COLUMBIA RIVER FLOW AND TEMPERATURE DATA MEASURED AT PRIEST RAPIDS DAM AND VERNITA BRIDGE." PACIFIC NORTHWEST LABORATORY, RICHLAND, WASHINGTON.

WHELAN, G., AND C. A. NEWBILL. 1983. "UPDATE OF COLUMBIA RIVER FLOW AND TEMPERATURE DATA MEASURED AT PRIEST RAPIDS DAM AND VERNITA BRIDGE." PNL-4868. PACIFIC NORTHWEST LABORATORY, RICHLAND, WASHINGTON.

TYPE "1" TO CONTINUE--

1

THE COLSTAT4 COMPUTER CODE WELCOMES YOU.

PLEASE READ ALL TEXT AND ANSWER ALL QUESTIONS.

TYPE "1" TO CONTINUE--

1

THE COLSTAT4 COMPUTER PROGRAM CURRENTLY HAS THREE OPTIONS:

- 1) ALLOWS THE USER TO PLOT HISTORICAL FLOW OR TEMPERATURE INFORMATION INCLUDED IN THE ENTIRE COLSTAT4 DATA BASE OR
- 2) ALLOWS THE USER TO ANALYZE A USER-DESIGNATED FLOW AND TEMPERATURE RECORD IN A SEQUENTIAL OR A SEASONAL MODE OR
- 3) ALLOWS THE USER TO EDIT THE TEMPERATURE OR FLOW FILES.

ONLY ONE OPTION MAY BE IMPLEMENTED PER RUN.

(a) Numbers in blocks are user supplied.

TABLE 12. (Contd)

PLEASE SELECT THE OPTION YOU WISH TO IMPLEMENT (1, 2, OR 3).

- I. OPTION 1--PLOTING OF COLSTAT4 TEMPERATURE OR FLOW DATA BASE.

THE HISTORICAL TEMPERATURE OR FLOW INFORMATION INCLUDED IN THE ENTIRE DATA BASE CAN BE PLOTTED AS A FUNCTION OF TIME OR PERCENT EXCEEDED. THESE FIGURES PLOTTED BY COLSTAT4 WOULD CORRESPOND OR BE SIMILAR TO THOSE FIGURES INCLUDED IN CHAPTER 2 OF WHELAN ET AL. (1986).

ARE YOU IMPLEMENTING THE COLSTAT4 PROGRAM ON THE PACIFIC NORTHWEST LABORATORY (PNL) DEC VAX 11/780 COMPUTING SYSTEM (INDICATE ANSWER WITH A "Y" FOR YES OR "N" FOR NO)

PLEASE SELECT THE TYPE OF ANALYSIS TO BE PERFORMED BY COLSTAT4. TYPE THE APPROPRIATE NUMBER ASSOCIATED WITH YOUR SELECTION:

- (1) NO DATA TO BE PLOTTED (ESCAPE FROM PLOTTING OPTION)
- (2) PLOT FLOW VS. TIME (SEQUENTIALLY FROM THE BEGINNING OF DATA RECORDS)
- (3) PLOT FLOW VS. TIME ON A MONTHLY BASIS
- (4) PLOT FLOW VS. PERCENT EXCEEDED
- (5) PLOT TEMPERATURE VS. TIME (SEQUENTIALLY FROM THE BEGINNING OF DATA RECORDS)
- (6) PLOT TEMPERATURE VS. TIME ON A MONTHLY BASIS
- (7) PLOT TEMPERATURE VS. PERCENT EXCEEDED

ENTER YOUR CHOICE (1-7)

TO PLOT THE SELECTION YOU INDICATED ABOVE, YOU WILL BE REQUIRED TO RESPOND TO FOUR DIFFERENT PROMPTS FROM THE COMPUTER TERMINAL. REPLY TO EACH PROMPT WITH THE FOLLOWING RESPONSES (YOU MAY WANT TO WRITE THESE RESPONSES DOWN FOR REFERENCE AT PROMPT TIME):

- (1) "COLSTAT4.PLT"--REPRESENTS THE INPUT FILE
- (2) "CALCMP"--REPRESENTS THE NOMINATION ROUTINE (I.E., PLOTTING DEVICE)

TABLE 12. (Contd)

- (3) PRESS THE "RETURN" KEY FOLLOWING THE PROMPT: ENTER POST PROCESSOR DIRECTIVES
- (4) PRESS THE "C" KEY WHILE HOLDING DOWN THE "CTRL" KEY WHEN PROMPTED A SECOND TIME FOR THE INPUT FILE

TO INITIATE THE PLOTTING OPTION, TYPE "DISSPOP" AND ANSWER SUCCEEDING PROMPTS AS INDICATED ABOVE.
TYPE "1" TO CONTINUE

FORTRAN STOP

\$

DISSPLA POST-PROCESSOR (DISSPOP)
INPUT FILE?

NOMINATION ROUTINE?

INPUT FILE: COLSTAT4.PLT
DEVICE NOMINATION ROUTINE: CALCMP

ENTER POST PROCESSOR DIRECTIVES

INPUT FILE?

TABLE 13. Sample Problem 5 Input (a)

COLUMBIA RIVER STATISTICAL UPDATE MODEL--VERSION 4.0

DEVELOPED BY: R. D. BROCKHAUS, D. W. DAMSCHEN, R. S. ARGO, C. A. NEWBILL, AND
G. WHELAN. PACIFIC NORTHWEST LABORATORY, RICHLAND, WASHINGTON.

DOCUMENTATION: WHELAN, G., D. W. DAMSCHEN, AND R. D. BROCKHAUS. 1986.
"COLUMBIA RIVER STATISTICAL UPDATE MODEL--VERSION 4.0
(COLSTAT4): BACKGROUND DOCUMENTATION AND USER'S GUIDE,"
PACIFIC NORTHWEST LABORATORY, RICHLAND, WASHINGTON.

WHELAN, G., R. S. ARGO, D. W. DAMSCHEN, AND C. A. NEWBILL.
1985. "COLUMBIA RIVER STATISTICAL UPDATE MODEL--VERSION 3.0
(CDLSTAT3): UPDATE OF COLUMBIA RIVER FLOW AND TEMPERATURE DATA
MEASURED AT PRIEST RAPIDS DAM AND VERNITA BRIDGE." PACIFIC
NORTHWEST LABORATORY, RICHLAND, WASHINGTON.

WHELAN, G., AND C. A. NEWBILL. 1983. "UPDATE OF COLUMBIA
RIVER FLOW AND TEMPERATURE DATA MEASURED AT PRIEST RAPIDS DAM
AND VERNITA BRIDGE." PNL-4868. PACIFIC NORTHWEST LABORATORY,
RICHLAND, WASHINGTON.

TYPE "1" TO CONTINUE--

THE COLSTAT4 COMPUTER CODE WELCOMES YOU

PLEASE READ ALL TEXT AND ANSWER ALL QUESTIONS

TYPE "1" TO CONTINUE--

THE COLSTAT4 COMPUTER PROGRAM CURRENTLY HAS THREE OPTIONS:

- 1) ALLOWS THE USER TO PLOT HISTORICAL FLOW OR TEMPERATURE
INFORMATION INCLUDED IN THE ENTIRE COLSTAT4 DATA BASE OR
- 2) ALLOWS THE USER TO ANALYZE A USER-DESIGNATED FLOW AND
TEMPERATURE RECORD IN A SEQUENTIAL OR A SEASONAL MODE OR
- 3) ALLOWS THE USER TO EDIT THE TEMPERATURE OR FLOW FILES.

ONLY ONE OPTION MAY BE IMPLEMENTED PER RUN.

(a) Numbers in blocks are user supplied.

TABLE 13. (Contd)

PLEASE SELECT THE OPTION YOU WISH TO IMPLEMENT (1, 2, OR 3).

WHICH DATA FILE DO YOU WISH TO EDIT?
ENTER (1) FOR TEMPERATURE (2) FOR FLOW

PLEASE WAIT WHILE I READ THE DATA FILE

DO YOU WANT TO APPEND NEW DATA OR CHANGE EXISTING DATA?
ENTER (1) FOR APPEND (2) FOR CHANGE

THE DATA TO BE APPENDED MUST RESIDE ON THE DISK AS THE FILE
"FLOW.NEW". THIS DATA FILE WILL BE DELETED AFTER IT HAS BEEN
APPENDED. IF THIS FILE DOES NOT EXIST UNDER THE PROPER NAME,
THE COLSTAT4 PROGRAM WILL HALT.

IS THE NEW DATA FILE THERE AND NAMED "FLOW.NEW"? (Y OR N)

PLEASE WAIT WHILE I WRITE THE NEW DATA FILE

THIS EDITING SESSION IS NOW COMPLETED

YOUR CORRECTED FILE HAS BEEN WRITTEN. YOU ALSO HAVE A BACKUP
COPY OF THE UNEDITED FLOW DATA AS IT EXISTED BEFORE THE
ALTERATIONS TOOK PLACE. IT IS NAMED COEDIT.BCK. IF ALL THE
CHANGES WE JUST MADE CHECK OUT OK THEN YOU MAY WANT TO DELETE
THIS BACKUP FILE TO SAVE DISK SPACE.

IF OUR EDITING SESSION DOES NOT CHECK OUT OK, AFTER YOU EXIT
THE MAIN PROGRAM, COLSTAT4, DELETE FLDW.DAT AND RENAME
COEDIT.BCK TO FLOW.DAT WITH THE FOLLOWING INSTRUCTIONS:

DELETE FLOW.DAT;*
RENAME COEDIT.BCK FLOW.DAT

(WRITE THOSE DOWN) AND NO HARM DONE.

<<< YOUR DATA FILE ENDING DATE IS 9/1/86 >>>

TABLE 13. (Contd)

TYPE "1" TO RETURN TO THE MAIN PROGRAM, COLSTAT4

DO YOU WANT TO RUN COLSTAT4 AGAIN? (Y/N)

COLSTAT4 FINISHED -- GOOD BYE
FORTRAN STOP

TABLE 14. Sample Problem 6 Input^(a)

COLUMBIA RIVER STATISTICAL UPDATE MODEL--VERSION 4.0

DEVELOPED BY: R. D. BROCKHAUS, D. W. DAMSCHEN, R. S. ARGO, C. A. NEWBILL, AND
G. WHELAN. PACIFIC NORTHWEST LABORATORY, RICHLAND, WASHINGTON.

DOCUMENTATION: WHELAN, G., D. W. DAMSCHEN, AND R. D. BROCKHAUS. 1986.
"COLUMBIA RIVER STATISTICAL UPDATE MODEL--VERSION 4.0
(COLSTAT4): BACKGROUND DOCUMENTATION AND USER'S GUIDE,"
PACIFIC NORTHWEST LABORATORY, RICHLAND, WASHINGTON.

WHELAN, G., R. S. ARGO, D. W. DAMSCHEN, AND C. A. NEWBILL.
1985. "COLUMBIA RIVER STATISTICAL UPDATE MODEL--VERSION 3.0
(COLSTAT3): UPDATE OF COLUMBIA RIVER FLOW AND TEMPERATURE DATA
MEASURED AT PRIEST RAPIDS DAM AND VERNITA BRIDGE." PACIFIC
NORTHWEST LABORATORY, RICHLAND, WASHINGTON.

WHELAN, G., AND C. A. NEWBILL. 1983. "UPDATE OF COLUMBIA
RIVER FLOW AND TEMPERATURE DATA MEASURED AT PRIEST RAPIDS DAM
AND VERNITA BRIDGE." PNL-4868. PACIFIC NORTHWEST LABORATORY,
RICHLAND, WASHINGTON.

TYPE "1" TO CONTINUE--

THE COLSTAT4 COMPUTER CODE WELCOMES YOU

PLEASE READ ALL TEXT AND ANSWER ALL QUESTIONS

TYPE "1" TO CONTINUE--

THE COLSTAT4 COMPUTER PROGRAM CURRENTLY HAS THREE OPTIONS:

- 1) ALLOWS THE USER TO PLOT HISTORICAL FLOW OR TEMPERATURE
INFORMATION INCLUDED IN THE ENTIRE COLSTAT4 DATA BASE OR
- 2) ALLOWS THE USER TO ANALYZE A USER-DESIGNATED FLOW AND
TEMPERATURE RECORD IN A SEQUENTIAL OR A SEASONAL MODE OR
- 3) ALLOWS THE USER TO EDIT THE TEMPERATURE OR FLOW FILES.

ONLY ONE OPTION MAY BE IMPLEMENTED PER RUN.

(a) Numbers in blocks are user supplied.

TABLE 14. (Contd)

PLEASE SELECT THE OPTION YOU WISH TO IMPLEMENT (1, 2, OR 3).

3

WHICH DATA FILE DO YOU WISH TO EDIT?
ENTER (1) FOR TEMPERATURE (2) FOR FLOW

1

PLEASE WAIT WHILE I READ THE DATA FILE

DO YOU WANT TO APPEND NEW DATA OR CHANGE EXISTING DATA?
ENTER (1) FOR APPEND (2) FOR CHANGE

2

ENTER DATE OF TEMP VALUE TO BE CHANGED IN MONTH DAY YEAR FORM
WITH NO SPACES, BUT INCLUDE LEADING ZEROS.
(E.G. 080285 IS AUGUST 1, 1985 AND 121886 IS DECEMBER 18, 1986)

071386

THE VALUE TO USE FOR MISSING DATA IS -88.0

THE CURRENT TEMP VALUE FOR 7 13 86 IS 113.000 DEGREES C

ENTER NEW TEMP VALUE-->

11.3

DO YOU WISH TO MAKE ANY MORE CHANGES? (Y/N)

Y

ENTER DATE OF TEMP VALUE TO BE CHANGED IN MONTH DAY YEAR FORM
WITH NO SPACES, BUT INCLUDE LEADING ZEROS.
(E.G. 080285 IS AUGUST 2, 1985 AND 121886 IS DECEMBER 18, 1986)

071486

THE VALUE TO USE FOR MISSING DATA IS -88.0

THE CURRENT TEMP VALUE FOR 7 14 86 IS 114.000 DEGREES C

ENTER NEW TEMP VALUE-->

11.4

TABLE 14. (Contd)

DO YOU WISH TO MAKE ANY MORE CHANGES? (Y/N)

PLEASE WAIT WHILE I WRITE THE NEW DATA FILE

THIS EDITING SESSION IS NOW COMPLETED.

YOUR CORRECTED FILE HAS BEEN WRITTEN. YOU ALSO HAVE A BACKUP COPY OF THE UNEDITED TEMP DATA AS IT EXISTED BEFORE THE ALTERATIONS TOOK PLACE. IT IS NAMED COEDIT.BCK. IF ALL THE CHANGES WE JUST MADE CHECK OUT OK THEN YOU MAY WANT TO DELETE THIS BACKUP FILE TO SAVE DISK SPACE.

IF OUR EDITING SESSION DOES NOT CHECK OUT OK, AFTER YOU EXIT THE MAIN PROGRAM, COLSTAT4, DELETE TEMP.DAT AND RENAME COEDIT.BCK TO TEMP.DAT WITH THE FOLLOWING INSTRUCTIONS:

DELETE TEMP.DAT;*
RENAME COEDIT.BCK TEMP.DAT

(WRITE THOSE DOWN) AND NO HARM DONE.

<<< YOUR DATA FILE ENDING DATE IS 8 1 86 >>>

TYPE "1" TO RETURN TO THE MAIN PROGRAM, COLSTAT4

DO YOU WANT TO RUN COLSTAT4 AGAIN? (Y/N)

COLSTAT4 FINISHED -- GOOD BYE
FORTRAN STOP

REFERENCES

- Lapedes, D. N. ed. 1978. Dictionary of Scientific and Technical Terms. 2nd ed. McGraw-Hill, New York.
- Whelan, G., R. S. Argo, D. W. Damschen, and C. A. Newbill. 1985. Columbia River Statistical Update Model--Version 3.0 (COLSTAT3): Update of Columbia River Flow and Temperature Data Measured at Priest Rapids Dam and Vernita Bridge. Pacific Northwest Laboratory, Richland, Washington.
- WPPSS. 1978. Supplemental Information on the Hanford Generating Project in Support of a 316(a) Demonstration. Washington Public Power Supply System, Richland, Washington.

APPENDIX A

STATISTICAL ANALYSIS OF
COLUMBIA RIVER FLOW RATES AND TEMPERATURES
OCTOBER 1, 1959, TO JULY 28, 1986

DISTRIBUTION OF AVERAGE DAILY TEMPERATURES (SEQUENTIALLY) FROM 1/ 1/85 TO 5/27/86

TEMP (DEG C)	NO. OF TIMES EXCEEDED	PER CENT OF TIME	RANGE	DAYS WITHIN	PER CENT OF TIME
0.0	7605	100.000	-0.5 - 0.4	13	0.171
1.0	7562	99.436	0.5 - 1.4	67	0.881
2.0	7416	97.515	1.5 - 2.4	221	2.906
3.0	7049	92.689	2.5 - 3.4	476	6.259
4.0	6423	84.458	3.5 - 4.4	661	8.692
5.0	5856	77.002	4.5 - 5.4	479	6.298
6.0	5445	71.598	5.5 - 6.4	404	5.312
7.0	5038	66.246	6.5 - 7.4	381	5.010
8.0	4680	61.538	7.5 - 8.4	361	4.747
9.0	4355	57.265	8.5 - 9.4	297	3.905
10.0	4067	53.478	9.5 - 10.4	343	4.510
11.0	3899	48.639	10.5 - 11.4	321	4.221
12.0	3391	44.589	11.5 - 12.4	334	4.392
13.0	3071	40.381	12.5 - 13.4	324	4.260
14.0	2656	34.924	13.5 - 14.4	395	5.194
15.0	2299	30.230	14.5 - 15.4	372	4.892
16.0	1929	25.385	15.5 - 16.4	403	5.299
17.0	1454	19.119	16.5 - 17.4	529	6.956
18.0	862	11.335	17.5 - 18.4	654	8.600
19.0	245	3.222	18.5 - 19.4	466	6.128
20.0	11	0.145	19.5 - 20.4	104	1.368
21.0	0	0.000	20.5 - 21.4	0	0.000
22.0	0	0.000	21.5 - 22.4	0	0.000

DISTRIBUTION OF AVERAGE DAILY FLOW (SEQUENTIALLY) FROM 10/ 1/59 TO 7/28/86

FLOW (CFS)	NO. OF TIMES EXCEEDED	PER CENT OF TIME	RANGE	DAYS WITHIN	PER CENT OF TIME
36000	9791	99.980	35000 - 36999	0	0.000
38000	9778	99.828	37000 - 38999	28	0.286
40000	9740	99.459	39000 - 40999	33	0.337
42000	9705	99.101	41000 - 42999	40	0.400
44000	9659	98.632	43000 - 44999	44	0.449
46000	9614	98.172	45000 - 46999	48	0.488
48000	9568	97.702	47000 - 48999	55	0.562
50000	9507	97.080	49000 - 50999	62	0.633
52000	9444	96.436	51000 - 52999	74	0.756
54000	9360	95.578	53000 - 54999	89	0.909
56000	9244	94.394	55000 - 56999	120	1.225
58000	9129	93.220	57000 - 58999	126	1.287
60000	8999	91.892	59000 - 60999	130	1.327
62000	8857	90.442	61000 - 62999	137	1.399
64000	8722	89.064	63000 - 64999	152	1.552
66000	8546	87.266	65000 - 66999	168	1.718
68000	8387	85.643	67000 - 68999	172	1.756
70000	8212	83.858	69000 - 70999	164	1.675
72000	8048	82.181	71000 - 72999	201	2.052
74000	7824	79.894	73000 - 74999	192	1.961
76000	7642	78.035	75000 - 76999	189	1.930
78000	7432	75.891	77000 - 78999	221	2.257
80000	7217	73.895	79000 - 80999	212	2.185
82000	7001	71.490	81000 - 82999	214	2.185
84000	6789	69.325	83000 - 84999	217	2.216
86000	6567	67.058	85000 - 86999	207	2.114
88000	6341	64.750	87000 - 88999	228	2.328
90000	6118	62.473	89000 - 90999	220	2.247
92000	5893	60.176	91000 - 92999	204	2.083
94000	5704	58.246	93000 - 94999	195	1.991
96000	5522	56.387	95000 - 96999	189	1.930
98000	5314	54.283	97000 - 98999	192	1.961
100000	5123	52.313	99000 - 100999	177	1.807
102000	4948	50.528	101000 - 102999	188	1.718
104000	4771	48.718	103000 - 104999	179	1.826
106000	4604	47.013	105000 - 106999	164	1.675
108000	4428	45.216	107000 - 108999	178	1.818
110000	4247	43.368	109000 - 110999	186	1.899
112000	4068	41.519	111000 - 112999	176	1.797
114000	3909	39.916	113000 - 114999	180	1.834
116000	3784	38.436	115000 - 116999	139	1.419
118000	3638	37.129	117000 - 118999	135	1.379
120000	3502	35.760	119000 - 120999	129	1.317
122000	3379	34.504	121000 - 122999	123	1.256
124000	3250	33.187	123000 - 124999	124	1.266
126000	3117	31.829	125000 - 126999	138	1.389
128000	3011	30.748	127000 - 128999	109	1.113
130000	2913	29.746	129000 - 130999	104	1.062
132000	2798	28.551	131000 - 132999	114	1.164

DISTRIBUTION OF AVERAGE DAILY FLOW (SEQUENTIALLY) FROM 10/ 1/59 TO 7/28/86

FLOW (CFS)	NO. OF TIMES EXCEEDED	PER CENT OF TIME	RANGE	DAYS WITHIN	PER CENT OF TIME
134000	2887	27.438	133000 - 134999	187	1.893
136000	2805	26.601	135000 - 136999	81	0.827
138000	2508	25.610	137000 - 138999	94	0.960
140000	2429	24.803	139000 - 140999	72	0.735
142000	2366	24.160	141000 - 142999	68	0.694
144000	2300	23.488	143000 - 144999	71	0.725
146000	2229	22.761	145000 - 146999	64	0.654
148000	2181	22.087	147000 - 148999	68	0.694
150000	2106	21.505	149000 - 150999	56	0.572
152000	2049	20.923	151000 - 152999	59	0.602
154000	1975	20.187	153000 - 154999	70	0.715
156000	1921	19.616	155000 - 156999	56	0.572
158000	1868	19.075	157000 - 158999	52	0.531
160000	1802	18.401	159000 - 160999	67	0.684
162000	1743	17.798	161000 - 162999	50	0.511
164000	1691	17.267	163000 - 164999	60	0.613
166000	1648	16.828	165000 - 166999	41	0.419
168000	1606	16.399	167000 - 168999	40	0.408
170000	1568	16.011	169000 - 170999	35	0.357
172000	1520	15.521	171000 - 172999	52	0.531
174000	1481	15.123	173000 - 174999	40	0.408
176000	1439	14.694	175000 - 176999	48	0.490
178000	1404	14.337	177000 - 178999	24	0.245
180000	1366	13.949	179000 - 180999	41	0.419
182000	1332	13.802	181000 - 182999	34	0.347
184000	1287	13.142	183000 - 184999	45	0.460
186000	1259	12.856	185000 - 186999	26	0.265
188000	1220	12.458	187000 - 188999	43	0.439
190000	1189	12.141	189000 - 190999	28	0.286
192000	1156	11.804	191000 - 192999	33	0.337
194000	1131	11.549	193000 - 194999	22	0.225
196000	1106	11.294	195000 - 196999	24	0.245
198000	1088	11.110	197000 - 198999	18	0.183
200000	1062	10.844	199000 - 200999	33	0.337
202000	1034	10.559	201000 - 202999	25	0.255
204000	997	10.181	203000 - 204999	35	0.357
206000	980	10.007	205000 - 206999	20	0.204
208000	952	9.721	207000 - 208999	26	0.265
210000	930	9.497	209000 - 210999	21	0.214
212000	909	9.282	211000 - 212999	19	0.194
214000	887	9.057	213000 - 214999	26	0.255
216000	868	8.863	215000 - 216999	19	0.194
218000	847	8.649	217000 - 218999	24	0.245
220000	825	8.424	219000 - 220999	20	0.204
222000	796	8.128	221000 - 222999	28	0.288
224000	782	7.985	223000 - 224999	15	0.153
226000	757	7.730	225000 - 226999	24	0.245
228000	733	7.485	227000 - 228999	25	0.255
230000	711	7.260	229000 - 230999	19	0.194
232000	700	7.148	231000 - 232999	12	0.123

DISTRIBUTION OF AVERAGE DAILY FLOW (SEQUENTIALLY) FROM 10/ 1/59 TO 7/28/86

FLOW (CFS)	NO. OF TIMES EXCEEDED	PER CENT OF TIME	RANGE	DAYS WITHIN	PER CENT OF TIME
234000	663	6.974	233000 - 234999	18	0.184
236000	663	6.770	235000 - 236999	18	0.184
238000	646	6.597	237000 - 238999	17	0.174
240000	627	6.403	239000 - 240999	20	0.204
242000	608	6.209	241000 - 242999	20	0.204
244000	587	5.994	243000 - 244999	18	0.184
246000	572	5.841	245000 - 246999	15	0.153
248000	560	5.718	247000 - 248999	12	0.123
250000	545	5.565	249000 - 250999	17	0.174
252000	530	5.412	251000 - 252999	16	0.163
254000	511	5.218	253000 - 254999	20	0.204
256000	498	5.085	255000 - 256999	9	0.092
258000	484	4.942	257000 - 258999	16	0.163
260000	472	4.820	259000 - 260999	11	0.112
262000	460	4.697	261000 - 262999	11	0.112
264000	450	4.595	263000 - 264999	11	0.112
266000	440	4.493	265000 - 266999	10	0.102
268000	425	4.340	267000 - 268999	14	0.143
270000	417	4.258	269000 - 270999	9	0.092
272000	412	4.207	271000 - 272999	4	0.041
274000	408	4.146	273000 - 274999	6	0.061
276000	399	4.074	275000 - 276999	9	0.092
278000	384	3.921	277000 - 278999	13	0.133
280000	379	3.870	279000 - 280999	5	0.051
282000	371	3.788	281000 - 282999	10	0.102
284000	357	3.645	283000 - 284999	12	0.123
286000	350	3.574	285000 - 286999	9	0.092
288000	339	3.482	287000 - 288999	11	0.112
290000	328	3.349	289000 - 290999	10	0.102
292000	313	3.198	291000 - 292999	16	0.163
294000	304	3.104	293000 - 294999	9	0.092
296000	290	2.961	295000 - 296999	12	0.123
298000	271	2.767	297000 - 298999	21	0.214
300000	258	2.636	299000 - 300999	12	0.123
302000	245	2.502	301000 - 302999	12	0.123
304000	235	2.400	303000 - 304999	11	0.112
306000	224	2.287	305000 - 306999	10	0.102
308000	212	2.165	307000 - 308999	13	0.133
310000	204	2.083	309000 - 310999	8	0.082
312000	194	1.981	311000 - 312999	9	0.092
314000	193	1.971	313000 - 314999	1	0.010
316000	189	1.930	315000 - 316999	4	0.041
318000	184	1.879	317000 - 318999	5	0.051
320000	181	1.848	319000 - 320999	3	0.031
322000	178	1.797	321000 - 322999	5	0.051
324000	171	1.748	323000 - 324999	5	0.051
326000	169	1.726	325000 - 326999	2	0.020
328000	165	1.685	327000 - 328999	4	0.041
330000	162	1.654	329000 - 330999	3	0.031
332000	159	1.624	331000 - 332999	3	0.031

DISTRIBUTION OF AVERAGE DAILY FLOW (SEQUENTIALLY) FROM 10/ 1/59 TO 7/28/86

FLOW (CFS)	NO. OF TIMES EXCEEDED	PER CENT OF TIME	RANGE	DAYS WITHIN	PER CENT OF TIME
334000	156	1.593	333000 - 334999	3	0.031
336000	146	1.491	335000 - 336999	10	0.102
338000	143	1.480	337000 - 338999	3	0.031
340000	139	1.419	339000 - 340999	4	0.041
342000	135	1.379	341000 - 342999	4	0.041
344000	129	1.317	343000 - 344999	6	0.061
346000	126	1.287	345000 - 346999	3	0.031
348000	124	1.268	347000 - 348999	2	0.020
350000	118	1.205	349000 - 350999	8	0.081
352000	118	1.205	351000 - 352999	0	0.000
354000	117	1.195	353000 - 354999	1	0.010
356000	114	1.164	355000 - 356999	3	0.031
358000	114	1.164	357000 - 358999	0	0.000
360000	112	1.144	359000 - 360999	2	0.020
362000	111	1.133	361000 - 362999	1	0.010
364000	111	1.133	363000 - 364999	0	0.000
366000	110	1.123	365000 - 366999	1	0.010
368000	109	1.113	367000 - 368999	1	0.010
370000	109	1.113	369000 - 370999	0	0.000
372000	108	1.103	371000 - 372999	1	0.010
374000	106	1.082	373000 - 374999	2	0.020
376000	105	1.072	375000 - 376999	1	0.010
378000	103	1.052	377000 - 378999	2	0.020
380000	101	1.031	379000 - 380999	2	0.020
382000	99	1.011	381000 - 382999	2	0.020
384000	99	1.011	383000 - 384999	0	0.000
386000	97	0.991	385000 - 386999	2	0.020
388000	98	0.980	387000 - 388999	1	0.010
390000	95	0.970	389000 - 390999	1	0.010
392000	94	0.960	391000 - 392999	1	0.010
394000	92	0.939	393000 - 394999	2	0.020
396000	89	0.909	395000 - 396999	3	0.031
398000	88	0.899	397000 - 398999	1	0.010
400000	88	0.899	399000 - 400999	0	0.000
402000	86	0.878	401000 - 402999	2	0.020
404000	80	0.817	403000 - 404999	6	0.061
406000	77	0.788	405000 - 406999	3	0.031
408000	75	0.766	407000 - 408999	2	0.020
410000	74	0.756	409000 - 410999	1	0.010
412000	73	0.745	411000 - 412999	1	0.010
414000	71	0.725	413000 - 414999	2	0.020
416000	70	0.715	415000 - 416999	1	0.010
418000	69	0.705	417000 - 418999	1	0.010
420000	67	0.684	419000 - 420999	2	0.020
422000	66	0.674	421000 - 422999	1	0.010
424000	64	0.654	423000 - 424999	2	0.020
426000	60	0.613	425000 - 426999	4	0.041
428000	58	0.592	427000 - 428999	2	0.020
430000	54	0.551	429000 - 430999	4	0.041
432000	51	0.521	431000 - 432999	3	0.031

DISTRIBUTION OF AVERAGE DAILY FLOW (SEQUENTIALLY) FROM 10/ 1/59 TO 7/28/86

FLOW (CFS)	NO. OF TIMES EXCEEDED	PER CENT OF TIME	RANGE	DAYS WITHIN	PER CENT OF TIME
434000	49	0.500	433000 - 434999	2	0.020
436000	43	0.439	435000 - 436999	6	0.061
438000	41	0.419	437000 - 438999	2	0.020
440000	39	0.398	439000 - 440999	2	0.020
442000	37	0.378	441000 - 442999	2	0.020
444000	37	0.378	443000 - 444999	0	0.000
446000	34	0.347	445000 - 446999	3	0.031
448000	34	0.347	447000 - 448999	0	0.000
450000	33	0.337	449000 - 450999	1	0.010
452000	31	0.317	451000 - 452999	2	0.020
454000	27	0.276	453000 - 454999	4	0.041
456000	27	0.276	455000 - 456999	0	0.000
458000	24	0.245	457000 - 458999	3	0.031
460000	22	0.225	459000 - 460999	2	0.020
462000	19	0.194	461000 - 462999	3	0.031
464000	18	0.184	463000 - 464999	1	0.010
466000	16	0.163	465000 - 466999	2	0.020
468000	14	0.143	467000 - 468999	2	0.020
470000	13	0.133	469000 - 470999	1	0.010
472000	12	0.123	471000 - 472999	1	0.010
474000	11	0.112	473000 - 474999	1	0.010
476000	11	0.112	475000 - 476999	0	0.000
478000	11	0.112	477000 - 478999	0	0.000
480000	10	0.102	479000 - 480999	1	0.010
482000	9	0.092	481000 - 482999	1	0.010
484000	9	0.092	483000 - 484999	0	0.000
486000	9	0.092	485000 - 486999	0	0.000
488000	9	0.092	487000 - 488999	0	0.000
490000	8	0.082	489000 - 490999	1	0.010
492000	8	0.082	491000 - 492999	0	0.000
494000	7	0.071	493000 - 494999	1	0.010
496000	6	0.061	495000 - 496999	1	0.010
498000	5	0.051	497000 - 498999	0	0.000
500000	5	0.051	499000 - 500999	1	0.010
502000	3	0.031	501000 - 502999	2	0.020
504000	3	0.031	503000 - 504999	0	0.000
506000	2	0.020	505000 - 506999	1	0.010
508000	2	0.020	507000 - 508999	0	0.000
510000	2	0.020	509000 - 510999	0	0.000
512000	1	0.010	511000 - 512999	1	0.010
514000	0	0.000	513000 - 514999	1	0.010
516000	0	0.000	515000 - 516999	0	0.000
518000	0	0.000	517000 - 518999	0	0.000
520000	0	0.000	519000 - 520999	0	0.000
522000	0	0.000	521000 - 522999	0	0.000
524000	0	0.000	523000 - 524999	0	0.000
526000	0	0.000	525000 - 526999	0	0.000
528000	0	0.000	527000 - 528999	0	0.000
530000	0	0.000	529000 - 530999	0	0.000
532000	0	0.000	531000 - 532999	0	0.000

DISTRIBUTION OF AVERAGE DAILY FLOW (SEQUENTIALLY) FROM 10/ 1/59 TO 7/28/86

FLOW (CFS)	NO. OF TIMES EXCEEDED	PER CENT OF TIME	RANGE	DAYS WITHIN	PER CENT OF TIME
534000	0	0.000	533000 - 534999	0	0.000
536000	0	0.000	535000 - 536999	0	0.000
538000	0	0.000	537000 - 538999	0	0.000
540000	0	0.000	539000 - 540999	0	0.000
542000	0	0.000	541000 - 542999	0	0.000
544000	0	0.000	543000 - 544999	0	0.000
546000	0	0.000	545000 - 546999	0	0.000
548000	0	0.000	547000 - 548999	0	0.000
550000	0	0.000	549000 - 550999	0	0.000

TEMPERATURE AND FLOW ANALYSIS (SEQUENTIALLY) FROM 10/ 1/59 TO 7/28/86

FOR MONTH OF JANUARY

DATE	TEMPERATURE (DEG C)				FLOW (CFS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
1/ 1	6.9	1.8	4.90	1.29	183000	37300	78922	31198
1/ 2	6.9	1.8	4.72	1.28	159000	42500	95500	28400
1/ 3	6.7	1.6	4.62	1.22	155500	53300	98937	28598
1/ 4	6.7	1.5	4.50	1.27	158000	43600	100462	29331
1/ 5	6.7	1.5	4.38	1.27	154000	45700	99792	27049
1/ 6	6.7	1.5	4.27	1.29	144500	42500	100044	26352
1/ 7	6.6	1.5	4.21	1.30	158100	43100	97785	29904
1/ 8	6.4	1.3	4.19	1.27	154000	40700	96666	33028
1/ 9	6.2	1.5	4.18	1.18	154000	38300	93192	30051
1/10	6.2	1.6	4.10	1.10	155000	51400	94822	28063
1/11	6.2	1.7	4.05	1.05	154900	41400	97396	31811
1/12	6.1	1.6	3.94	1.06	162000	45000	95096	28184
1/13	6.0	1.6	3.92	1.02	163000	49300	96748	29046
1/14	6.0	1.6	3.92	1.05	162000	42400	93277	29921
1/15	6.2	1.7	3.94	0.98	161000	54300	93355	26427
1/16	6.0	1.0	3.74	1.13	157000	40400	94925	29984
1/17	5.9	1.0	3.70	1.08	162000	55000	96096	28067
1/18	5.8	1.0	3.69	1.06	161400	6850	94042	34119
1/19	5.9	1.0	3.70	1.07	166600	44100	99118	32094
1/20	5.9	1.0	3.70	1.10	170000	57500	101307	31007
1/21	5.8	1.0	3.66	1.13	162000	47700	102744	34605
1/22	5.8	1.0	3.59	1.13	162000	48200	100466	33626
1/23	5.7	1.0	3.52	1.12	208000	37000	99914	37849
1/24	5.5	1.0	3.49	1.12	202000	38000	99048	36583
1/25	5.4	0.9	3.39	1.12	197000	45700	102048	34501
1/26	5.3	0.9	3.27	1.11	195000	41400	102566	34540
1/27	5.3	0.7	3.17	1.15	198000	59300	102277	33942
1/28	5.4	0.4	3.08	1.22	203000	52300	103188	35874
1/29	5.6	0.3	3.10	1.36	182000	39000	100566	37797
1/30	5.4	0.4	3.02	1.36	183000	38000	101437	38064
1/31	5.5	0.2	2.87	1.34	168000	38500	103188	36837

TEMPERATURE AND FLOW ANALYSIS (SEQUENTIALLY) FROM 10/ 1/59 TO 7/28/86

FOR MONTH OF FEBRUARY

DATE	TEMPERATURE (DEG C)				FLOW (CFS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
2/ 1	5.4	0.1	2.90	1.38	177000	49800	101703	31469
2/ 2	5.4	0.5	3.00	1.24	191000	47900	105770	33682
2/ 3	5.6	0.6	2.96	1.24	193000	52100	104790	34600
2/ 4	5.8	0.8	2.88	1.23	171000	46000	100166	32319
2/ 5	5.7	1.0	2.84	1.20	185400	46400	110192	35014
2/ 6	5.5	1.0	2.80	1.15	187100	46900	110290	38496
2/ 7	5.6	0.2	2.70	1.25	183000	42800	107059	32334
2/ 8	5.5	0.2	2.66	1.24	169000	38500	106240	32834
2/ 9	5.5	0.3	2.61	1.19	188000	64100	109044	30157
2/10	5.5	0.4	2.66	1.17	167000	74200	108703	28172
2/11	5.5	0.4	2.70	1.14	185000	59300	105092	29680
2/12	5.6	0.5	2.78	1.12	158000	53000	103590	30303
2/13	5.4	0.8	2.84	1.04	148000	57800	105074	25911
2/14	5.3	1.1	2.89	1.03	148100	55400	106677	25927
2/15	5.2	1.0	2.93	1.03	154200	44800	103444	23967
2/16	5.2	1.0	2.99	0.99	147500	60800	99202	20142
2/17	5.2	1.1	3.04	1.00	147000	60100	100390	23950
2/18	5.0	1.1	3.06	0.97	162000	41400	104018	30769
2/19	5.0	1.1	3.10	0.99	155000	61900	102280	28027
2/20	4.8	1.1	3.14	1.00	158000	42100	101040	29291
2/21	4.8	1.1	3.13	0.99	148700	56000	103607	25400
2/22	4.8	1.1	3.11	0.94	154400	58400	103825	27404
2/23	4.8	1.1	3.19	0.91	195200	49100	105825	31758
2/24	4.8	1.1	3.24	0.91	178500	38500	105688	32403
2/25	5.1	1.1	3.28	0.96	187500	39800	103255	35078
2/26	5.1	1.3	3.35	0.96	185400	49100	104414	35288
2/27	5.0	1.4	3.37	0.94	196300	50000	103937	35654
2/28	5.2	1.5	3.43	0.89	192700	58900	105407	31398
2/29	4.2	2.5	3.34	0.60	151700	53900	97428	42812

TEMPERATURE AND FLOW ANALYSIS (SEQUENTIALLY) FROM 10/ 1/59 TO 7/28/88

FOR MONTH OF JUNE

DATE	TEMPERATURE (DEG C)				FLOW (CFS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
6/ 1	14.4	11.0	12.32	0.84	404000	107000	216750	74937
6/ 2	14.3	11.0	12.51	0.87	424000	83000	217985	85309
6/ 3	14.4	11.0	12.58	0.91	441000	59000	217904	92203
6/ 4	14.6	11.3	12.69	0.95	453000	58000	221907	93757
6/ 5	14.9	11.5	12.88	1.00	481000	42000	221803	98280
6/ 6	15.0	11.5	12.93	0.98	479000	80000	226870	96685
6/ 7	15.0	11.8	13.08	0.94	493000	80000	228592	100212
6/ 8	14.9	11.8	13.21	0.93	499000	66700	229411	108565
6/ 9	14.8	12.1	13.24	0.84	502000	74000	228311	111090
6/10	14.9	12.2	13.32	0.83	511000	53000	230788	117780
6/11	15.1	12.2	13.39	0.86	513000	52000	238196	117305
6/12	15.2	12.2	13.47	0.93	506000	51000	236281	114250
6/13	15.2	12.3	13.58	0.92	502000	88000	235781	112311
6/14	15.1	12.5	13.68	0.88	496000	83000	236125	114079
6/15	15.1	12.8	13.84	0.85	490000	80000	236314	116099
6/16	15.3	12.8	13.94	0.83	486000	54000	238614	117683
6/17	15.4	13.1	14.07	0.84	488000	44000	237559	121609
6/18	15.7	13.0	14.21	0.89	470000	66000	241496	116987
6/19	16.1	13.0	14.39	0.95	473000	69000	237182	114742
6/20	16.1	12.9	14.48	1.03	468000	80000	235118	113153
6/21	16.0	12.8	14.51	1.06	458000	89000	238788	112082
6/22	16.2	12.5	14.58	1.11	453000	85000	235600	114808
6/23	16.4	12.4	14.63	1.11	436000	61000	233322	115045
6/24	16.7	12.1	14.65	1.17	437000	70000	232759	114241
6/25	16.7	12.3	14.73	1.18	458000	87000	235948	110412
6/26	16.8	12.8	14.79	1.18	482000	82000	231474	113092
6/27	17.1	13.2	14.90	1.20	471000	84000	228914	109796
6/28	16.9	13.3	14.93	1.11	480000	77000	222740	105883
6/29	16.8	13.4	15.02	1.08	482000	72000	220429	106457
6/30	16.8	13.6	15.07	1.06	434000	62000	214688	105464

TEMPERATURE AND FLOW ANALYSIS (SEQUENTIALLY) FROM 10/ 1/59 TO 7/28/86

FOR MONTH OF JULY

DATE	TEMPERATURE (DEG C)				FLOW (CFS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
7/ 1	18.8	13.4	15.20	1.00	425000	70000	211351	104821
7/ 2	18.8	13.2	15.27	1.06	419000	41000	211759	102464
7/ 3	18.9	13.3	15.43	1.07	425000	48000	207211	100060
7/ 4	17.2	13.3	15.57	1.10	380000	39000	194422	100487
7/ 5	17.3	13.6	15.72	1.05	378000	43300	197488	94427
7/ 6	17.4	13.8	15.79	1.02	390000	44000	197125	86815
7/ 7	17.7	13.8	15.85	1.03	372000	70400	201770	84324
7/ 8	18.1	14.0	15.94	1.06	356000	69000	196022	86639
7/ 9	18.6	13.9	16.09	1.15	360000	43000	195592	82801
7/10	18.7	13.9	16.11	1.18	343000	39000	192344	78002
7/11	18.8	14.0	16.21	1.24	336000	84000	187325	75058
7/12	18.9	14.2	16.25	1.22	333000	66000	183266	72952
7/13	18.9	14.5	16.29	1.15	339000	55700	177548	74837
7/14	19.3	14.8	16.43	1.17	336000	56500	180886	72137
7/15	19.3	14.8	16.53	1.14	335000	59000	177655	71895
7/16	19.3	15.0	16.62	1.12	330000	77000	181903	59797
7/17	19.2	15.4	16.71	1.04	315000	53000	181848	59319
7/18	19.4	15.5	16.84	1.03	310000	77700	179381	61219
7/19	19.6	15.4	16.98	1.08	307000	66000	173285	58951
7/20	19.9	15.3	17.05	1.13	314000	59200	169044	59988
7/21	20.0	15.5	17.15	1.05	295000	62400	169040	54558
7/22	19.9	15.5	17.18	0.97	276000	78000	162833	51413
7/23	19.9	15.6	17.29	0.98	257000	72000	162570	48058
7/24	19.6	15.7	17.43	0.94	240000	73000	159487	43764
7/25	19.6	15.6	17.53	0.97	238000	79000	154625	44346
7/26	19.5	15.8	17.72	0.89	228000	61700	150037	47030
7/27	19.5	16.1	17.79	0.88	239000	53800	144625	48253
7/28	19.9	16.3	17.97	0.85	212000	51600	139514	45475
7/29	20.1	16.8	18.01	0.83	197000	59000	137257	43683
7/30	20.0	16.8	18.01	0.80	205000	58000	140476	37406
7/31	20.2	16.9	18.12	0.83	189600	58000	139138	35952

TEMPERATURE AND FLOW ANALYSIS (SEQUENTIALLY) FROM 10/ 1/59 TO 7/28/86

FOR MONTH OF AUGUST

DATE	TEMPERATURE (DEG C)				FLOW (CFS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
8/ 1	19.8	18.6	18.18	0.78	200000	60000	138657	37938
8/ 2	19.8	18.7	18.21	0.71	202000	55700	133434	38775
8/ 3	19.9	18.8	18.28	0.71	228000	41100	133092	44109
8/ 4	20.1	18.9	18.35	0.75	225000	38900	132676	44441
8/ 5	19.8	17.0	18.32	0.72	226000	56000	133988	43505
8/ 6	19.9	17.1	18.35	0.70	218000	62000	131253	38748
8/ 7	19.8	17.0	18.37	0.70	214000	58000	131419	33580
8/ 8	19.4	18.0	18.39	0.71	204000	79900	132150	31332
8/ 9	19.8	17.2	18.46	0.64	180000	72500	127376	31391
8/10	19.8	17.4	18.54	0.69	193000	82000	122457	35739
8/11	19.5	17.2	18.60	0.62	210000	31100	124503	36877
8/12	19.8	17.3	18.66	0.62	199000	57000	121092	34389
8/13	19.8	17.4	18.70	0.63	182000	79000	120919	27227
8/14	19.8	17.3	18.70	0.62	177100	58000	119338	28114
8/15	19.9	17.1	18.72	0.67	185000	65000	118838	22069
8/16	20.1	16.8	18.72	0.78	160000	42000	111815	29120
8/17	20.1	16.8	18.82	0.60	155000	53000	109034	27560
8/18	20.3	16.7	18.59	0.81	223000	84700	111700	31441
8/19	20.1	16.8	18.55	0.79	219000	41000	108519	34778
8/20	20.3	17.0	18.53	0.81	203000	56200	105350	29106
8/21	20.3	17.1	18.57	0.60	175000	49000	103796	28488
8/22	20.0	17.4	18.60	0.73	187000	55000	105823	25318
8/23	20.1	16.9	18.59	0.79	172000	58400	102288	23397
8/24	20.2	16.8	18.60	0.79	168000	43000	98611	26297
8/25	20.0	16.8	18.65	0.81	153000	45000	95515	24999
8/26	20.0	16.8	18.61	0.80	161000	48000	98553	22024
8/27	19.9	16.7	18.62	0.84	154000	55000	97896	21635
8/28	19.8	16.8	18.58	0.86	217000	47100	102888	33638
8/29	19.9	16.8	18.56	0.94	190000	55900	99826	28497
8/30	20.0	16.7	18.51	0.92	179000	65000	100326	23614
8/31	19.9	16.8	18.49	0.85	170000	43500	97130	26774

TEMPERATURE AND FLOW ANALYSIS (SEQUENTIALLY) FROM 10/ 1/59 TO 7/28/86
FOR MONTH OF SEPTEMBER

DATE	TEMPERATURE (DEG C)				FLOW (CFS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
9/ 1	20.0	17.1	18.51	0.81	165000	52200	89834	25849
9/ 2	19.6	17.1	18.45	0.78	152000	38000	85287	28878
9/ 3	19.8	17.2	18.40	0.82	153000	38000	82073	23363
9/ 4	19.8	17.0	18.39	0.75	148000	39000	82461	22428
9/ 5	19.6	16.9	18.39	0.85	146000	42000	79530	22310
9/ 6	19.6	17.2	18.35	0.56	137000	41400	80388	22857
9/ 7	19.6	17.5	18.33	0.52	184000	39000	83976	34180
9/ 8	19.5	17.4	18.29	0.54	194000	40200	89776	30507
9/ 9	19.4	17.5	18.29	0.51	180000	53000	88065	28774
9/10	19.1	17.2	18.23	0.48	171000	47200	84934	29822
9/11	19.3	17.1	18.20	0.53	158000	43200	82850	28111
9/12	19.4	16.8	18.14	0.83	119000	44200	80483	18211
9/13	19.5	16.5	18.07	0.71	132000	49000	82069	22002
9/14	19.5	16.5	18.08	0.73	124000	41800	81584	19947
9/15	19.5	16.5	17.97	0.74	120000	38500	79034	19500
9/16	19.4	16.7	17.93	0.73	114000	48700	80992	17583
9/17	19.2	16.7	17.83	0.74	115000	52200	80000	16196
9/18	19.1	16.8	17.75	0.76	118000	43000	79492	18577
9/19	19.4	16.3	17.71	0.76	117000	43100	75900	19210
9/20	19.8	16.1	17.64	0.77	117000	38100	75442	19219
9/21	19.5	16.0	17.53	0.76	118000	45400	77578	19762
9/22	19.3	15.8	17.48	0.76	119000	55900	78950	15835
9/23	19.3	15.8	17.39	0.81	111000	47500	74984	15924
9/24	19.5	15.8	17.37	0.82	117000	47700	77015	14588
9/25	19.6	16.1	17.40	0.77	119000	45000	77848	17889
9/26	19.5	16.2	17.37	0.74	123000	41500	78680	17419
9/27	19.1	16.2	17.24	0.69	114000	40500	78340	18469
9/28	19.0	16.2	17.14	0.75	112000	42300	78861	16319
9/29	18.8	16.1	17.10	0.69	109000	49100	76228	16804
9/30	18.8	16.1	17.07	0.67	112000	48900	78861	18204

TEMPERATURE AND FLOW ANALYSIS (SEQUENTIALLY) FROM 10/ 1/59 TO 7/28/86

FOR MONTH OF MARCH

DATE	TEMPERATURE (DEG C)				FLOW (CFS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
3/ 1	5.3	1.6	3.41	0.83	208500	51700	108837	36193
3/ 2	5.0	1.7	3.42	0.78	202300	42900	107825	37849
3/ 3	5.0	1.7	3.45	0.81	221000	45700	112362	40516
3/ 4	5.1	1.7	3.49	0.84	216200	53800	108248	38261
3/ 5	5.1	1.8	3.56	0.84	216800	53000	106681	38487
3/ 6	5.2	1.9	3.66	0.85	203100	54700	110300	38491
3/ 7	5.2	2.2	3.70	0.82	187100	51200	110437	34192
3/ 8	5.3	2.3	3.77	0.83	200400	43900	106696	37928
3/ 9	5.4	2.4	3.89	0.82	196300	58400	107525	35300
3/10	5.5	2.5	3.94	0.83	182200	56500	106777	31884
3/11	5.6	2.5	4.00	0.83	207800	45700	103296	36895
3/12	5.8	2.7	4.06	0.78	207800	47900	105492	39844
3/13	5.7	2.7	4.10	0.83	221800	37100	107982	40928
3/14	5.9	2.6	4.13	0.80	229200	59200	108659	36281
3/15	5.9	2.8	4.19	0.75	228400	55000	106840	41842
3/16	6.0	2.9	4.32	0.75	229200	53100	106037	40743
3/17	5.8	3.1	4.38	0.68	228500	50000	106107	41290
3/18	5.9	3.2	4.43	0.69	225000	51300	106081	41918
3/19	6.0	3.2	4.48	0.69	218500	55900	103737	42067
3/20	6.1	3.3	4.57	0.69	225500	57400	104844	41254
3/21	6.2	3.3	4.67	0.71	218700	58200	107177	42533
3/22	6.3	3.3	4.76	0.73	218000	54200	110744	46575
3/23	6.2	3.3	4.84	0.70	237700	59400	111918	45764
3/24	6.2	3.4	4.90	0.72	226300	55600	108174	43803
3/25	6.1	3.6	4.95	0.68	237900	52400	111640	45853
3/26	6.3	3.5	5.01	0.76	221300	59100	112800	43246
3/27	6.3	3.5	5.07	0.78	224500	53400	114218	42544
3/28	6.5	3.6	5.22	0.81	224900	48400	108714	42956
3/29	6.8	3.7	5.27	0.82	222800	45100	106092	37890
3/30	6.5	4.0	5.36	0.70	228000	50100	115451	43208
3/31	6.8	4.0	5.47	0.71	214900	57300	117240	41368

TEMPERATURE AND FLOW ANALYSIS (SEQUENTIALLY) FROM 10/ 1/59 TO 7/28/86

FOR MONTH OF APRIL

DATE	TEMPERATURE (DEG C)				FLOW (CFS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
4/ 1	7.0	4.0	5.57	0.72	203100	40500	110362	42692
4/ 2	6.9	4.1	5.82	0.70	187000	47500	110318	37318
4/ 3	6.8	4.0	5.71	0.70	192000	37800	109362	40153
4/ 4	6.7	4.1	5.82	0.85	188000	39000	107340	38058
4/ 5	6.7	4.6	6.03	0.57	191300	39200	111377	40246
4/ 6	6.9	4.6	6.10	0.57	194000	62000	114782	38554
4/ 7	7.3	4.6	6.21	0.84	204000	58800	110870	37659
4/ 8	7.5	4.7	6.38	0.85	219000	80800	112477	38976
4/ 9	7.7	4.9	6.48	0.84	202000	55000	113725	38245
4/10	8.0	5.2	6.62	0.81	190000	40000	109968	41031
4/11	7.8	5.3	6.68	0.81	189000	48100	109859	42719
4/12	8.2	5.4	6.76	0.84	198000	41400	110448	42201
4/13	8.3	5.5	6.78	0.84	202400	54700	121444	43432
4/14	8.7	5.6	6.93	0.67	206300	62400	118114	46933
4/15	8.3	5.7	7.03	0.66	200000	63000	123844	45148
4/16	8.4	5.7	7.08	0.72	201000	50400	125274	43859
4/17	8.6	5.7	7.18	0.74	192000	44300	121307	43759
4/18	8.3	5.8	7.23	0.71	190000	57800	123281	38280
4/19	8.3	6.0	7.26	0.70	207000	45500	124825	39354
4/20	8.5	6.2	7.38	0.88	193000	54500	122877	33448
4/21	8.6	6.5	7.52	0.85	192000	65400	118959	36579
4/22	8.7	6.5	7.66	0.67	199000	58800	123229	39138
4/23	8.8	7.0	7.83	0.64	208000	57400	123114	37552
4/24	9.1	7.1	7.97	0.68	202000	51000	124514	40064
4/25	9.3	7.0	8.02	0.69	210000	54000	121714	42357
4/26	9.5	7.2	8.17	0.68	202000	43100	117392	44798
4/27	9.6	7.3	8.27	0.63	212000	50700	120092	42002
4/28	9.7	7.2	8.44	0.68	201000	45300	120233	42325
4/29	9.9	7.2	8.53	0.73	204000	58000	123481	39841
4/30	10.1	7.4	8.72	0.73	210000	41700	124892	40643

TEMPERATURE AND FLOW ANALYSIS (SEQUENTIALLY) FROM 10/ 1/59 TO 7/28/88

FOR MONTH OF MAY

DATE	TEMPERATURE (DEG C)				FLOW (CFS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
5/ 1	10.3	7.5	8.88	0.77	213000	52000	127870	38647
5/ 2	10.4	7.7	9.05	0.78	243000	57200	136122	43242
5/ 3	10.6	7.7	9.21	0.78	214000	65000	137485	42742
5/ 4	10.7	7.8	9.33	0.80	251000	70500	138959	46590
5/ 5	10.9	7.8	9.41	0.82	244000	63600	141937	45830
5/ 6	10.8	7.9	9.53	0.74	249000	59300	140718	48277
5/ 7	10.7	8.2	9.63	0.64	252000	49000	143074	48738
5/ 8	10.9	8.5	9.79	0.60	270000	42000	148462	53747
5/ 9	10.8	9.0	9.92	0.50	272000	70300	154374	49631
5/10	10.8	9.1	9.98	0.48	270000	65300	155014	48710
5/11	11.2	9.2	10.07	0.52	270000	59300	155737	49591
5/12	11.3	9.4	10.18	0.54	280000	64000	153181	50697
5/13	11.7	9.5	10.34	0.50	281000	62000	157800	55252
5/14	12.1	9.8	10.41	0.53	283000	55500	160292	53070
5/15	12.6	9.8	10.61	0.60	290000	52000	162522	65335
5/16	13.0	9.8	10.68	0.70	309000	78100	165762	57170
5/17	13.3	9.9	10.78	0.71	298000	86000	165859	60769
5/18	13.6	10.1	10.90	0.76	295000	85000	171133	60376
5/19	13.8	10.3	11.06	0.82	286000	62000	171581	60505
5/20	13.8	10.3	11.14	0.79	289000	66000	173788	60393
5/21	13.9	10.4	11.35	0.81	285000	67000	178444	59279
5/22	14.0	10.3	11.48	0.84	302000	60000	181518	61661
5/23	14.1	10.4	11.63	0.85	297000	89200	186403	57240
5/24	13.9	10.2	11.69	0.88	302000	94000	192325	58430
5/25	13.7	10.1	11.81	0.86	318000	85000	190488	59588
5/26	13.7	10.5	11.89	0.85	349000	47000	192237	68417
5/27	13.8	10.7	11.93	0.81	350000	47000	194748	70446
5/28	14.0	10.9	11.98	0.78	360000	40000	197822	75041
5/29	14.4	11.1	12.09	0.78	376000	46000	203337	74211
5/30	14.6	11.1	12.15	0.80	387000	72000	212959	74951
5/31	14.5	11.1	12.23	0.78	395000	78000	214333	74858

TEMPERATURE AND FLOW ANALYSIS (SEQUENTIALLY) FROM 10/ 1/59 TO 7/28/86
FOR MONTH OF OCTOBER

DATE	TEMPERATURE (DEG C)				FLOW (CFS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
10/ 1	18.8	18.2	17.02	0.83	133100	39000	82270	22633
10/ 2	18.6	15.9	16.90	0.68	129000	42500	80159	24393
10/ 3	18.6	15.6	16.85	0.76	129000	39500	80348	22014
10/ 4	18.6	15.3	16.66	0.78	135000	40000	80800	22798
10/ 5	18.6	15.2	16.83	0.78	114700	43300	77281	19879
10/ 6	18.5	15.2	16.48	0.79	112000	41500	73614	18494
10/ 7	18.5	15.1	16.39	0.81	109500	44000	78022	17953
10/ 8	18.3	14.9	16.29	0.82	111000	48700	78985	18832
10/ 9	18.1	15.0	16.22	0.79	115000	48000	80300	20400
10/10	17.8	14.8	16.07	0.77	109000	50000	79859	18252
10/11	17.8	14.7	15.98	0.76	108000	47300	81414	15487
10/12	17.6	14.5	15.77	0.76	114000	46900	75955	18654
10/13	17.8	14.2	15.59	0.84	121000	50900	77433	17505
10/14	17.6	14.2	15.50	0.78	114000	47000	80237	18440
10/15	17.6	14.0	15.36	0.77	106800	40000	81055	17232
10/16	17.5	13.8	15.28	0.78	109200	38000	78033	19501
10/17	17.1	13.8	15.19	0.76	112100	39100	79392	15008
10/18	17.0	13.6	15.05	0.84	116300	53300	81592	17093
10/19	16.8	13.5	14.98	0.83	117000	40000	79762	20983
10/20	16.7	13.2	14.85	0.85	116700	42600	76500	19103
10/21	16.7	13.4	14.73	0.78	122100	42000	77581	19416
10/22	16.7	13.1	14.58	0.82	121200	47700	80848	20454
10/23	16.6	13.3	14.54	0.79	127500	40300	75851	21797
10/24	16.5	13.4	14.45	0.77	129300	47600	80840	19002
10/25	16.5	13.4	14.36	0.76	127000	55500	80570	17838
10/26	16.2	13.3	14.18	0.71	131400	54500	79318	15957
10/27	16.1	12.9	14.08	0.76	130100	46800	80288	19465
10/28	16.0	12.5	13.95	0.78	131900	43800	81211	20270
10/29	15.7	12.4	13.82	0.73	137600	39700	80703	21616
10/30	15.5	12.2	13.69	0.72	130900	38300	85081	24137
10/31	15.4	11.8	13.58	0.79	129800	42100	80183	21312

TEMPERATURE AND FLOW ANALYSIS (SEQUENTIALLY) FROM 10/ 1/59 TO 7/28/86

FOR MONTH OF NOVEMBER

DATE	TEMPERATURE (DEG C)				FLOW (CFS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
11/ 1	15.3	11.3	13.41	0.86	125700	42300	78459	19938
11/ 2	15.2	11.4	13.31	0.84	124800	39500	79762	21397
11/ 3	15.1	11.3	13.28	0.84	121500	42300	78503	19250
11/ 4	15.0	11.3	13.09	0.86	118600	46400	81196	17588
11/ 5	15.0	11.2	12.95	0.93	119700	48400	83596	19226
11/ 6	14.8	11.2	12.82	0.90	115200	38900	82685	20299
11/ 7	14.7	11.2	12.68	0.87	116000	48200	80833	18145
11/ 8	14.7	11.0	12.54	0.92	116800	41800	84448	19829
11/ 9	14.5	10.9	12.38	0.93	116000	44100	81470	19209
11/10	14.3	10.8	12.17	0.93	123000	39000	79733	22091
11/11	14.2	10.4	11.98	0.98	120000	37000	81148	22782
11/12	14.1	10.1	11.88	0.99	109500	50400	80908	21171
11/13	13.9	9.9	11.73	0.97	122000	43800	81733	22000
11/14	13.8	9.8	11.58	0.98	121000	38700	79868	18903
11/15	13.8	9.6	11.39	1.03	130000	47000	84977	21660
11/16	13.7	9.5	11.27	1.03	151000	44300	85196	23644
11/17	13.7	9.2	11.18	1.09	132000	40800	82377	20480
11/18	13.6	8.8	10.95	1.12	127000	40000	84729	22458
11/19	13.5	8.4	10.77	1.17	134000	49000	83374	22722
11/20	13.4	8.2	10.62	1.21	119000	45400	85451	22352
11/21	13.4	8.0	10.51	1.24	134000	41000	87492	24888
11/22	13.3	7.5	10.35	1.29	135800	41200	86566	22644
11/23	13.2	7.0	10.18	1.34	180000	51400	87329	26395
11/24	13.2	7.0	10.03	1.29	131000	43000	83011	26735
11/25	13.1	6.7	9.85	1.30	141300	49300	83677	24221
11/26	12.7	6.6	9.68	1.24	147200	58900	85218	23709
11/27	12.5	6.1	9.53	1.28	149500	46000	87870	26434
11/28	12.5	5.7	9.39	1.34	137000	47700	87325	24795
11/29	12.4	5.5	9.29	1.34	133900	56000	91688	20044
11/30	12.4	5.4	9.12	1.33	137500	54000	93062	21126

TEMPERATURE AND FLOW ANALYSIS (SEQUENTIALLY) FROM 10/ 1/59 TO 7/28/88

FOR MONTH OF DECEMBER

DATE	TEMPERATURE (DEG C)				FLOW (CFS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
12/ 1	12.2	5.2	9.00	1.36	141100	51000	92901	25400
12/ 2	11.9	4.8	8.86	1.39	146500	42000	89011	26299
12/ 3	11.4	4.8	8.73	1.37	147700	41000	89851	26799
12/ 4	11.0	4.8	8.60	1.34	135800	39400	92481	27259
12/ 5	10.7	4.7	8.43	1.26	139300	48000	91662	25865
12/ 6	10.1	5.1	8.28	1.12	147100	55000	92359	23100
12/ 7	9.5	5.3	8.16	1.00	147000	58400	94392	23872
12/ 8	9.3	5.5	8.02	0.97	157000	52000	93914	27954
12/ 9	9.2	5.5	7.87	0.99	146000	56000	91633	23977
12/10	9.1	5.5	7.78	0.96	147200	56300	95314	22875
12/11	9.1	5.2	7.65	0.98	150000	45000	93240	28539
12/12	9.2	5.1	7.57	1.02	151000	52400	93477	28117
12/13	9.3	4.8	7.43	1.08	170000	38300	94406	28633
12/14	9.3	4.5	7.33	1.11	145700	49600	88842	20955
12/15	9.2	4.2	7.27	1.12	150000	44500	89888	26021
12/16	9.1	4.0	7.18	1.11	143000	55000	91818	20437
12/17	8.8	3.8	7.06	1.14	147800	56900	92592	24109
12/18	8.6	3.6	6.96	1.19	153200	44500	96866	27684
12/19	8.5	3.5	6.84	1.21	153900	51400	96851	27456
12/20	8.3	3.4	6.74	1.24	140500	49000	93488	26886
12/21	8.2	3.3	6.54	1.29	139500	43100	90800	23454
12/22	8.3	3.4	6.40	1.30	131900	50800	93211	20728
12/23	8.2	3.1	6.29	1.30	167800	46900	90962	24721
12/24	8.1	3.0	6.21	1.34	156900	37700	78237	27539
12/25	8.0	3.0	6.12	1.33	101500	37300	63482	19710
12/26	7.9	2.7	5.97	1.37	123000	44900	78511	23196
12/27	7.9	2.5	5.85	1.38	141000	40900	92400	23943
12/28	7.9	2.4	5.73	1.39	151000	47200	96518	23955
12/29	7.8	2.2	5.62	1.44	172000	43300	97737	28459
12/30	7.7	2.0	5.39	1.48	183000	44800	95425	31104
12/31	7.6	1.8	5.26	1.47	166000	37500	90255	29170

APPENDIX B

OUTPUT RESULTS FOR SAMPLE PROBLEM 1

DISTRIBUTION OF AVERAGE DAILY TEMPERATURES (SEQUENTIALLY) FROM 1/ 1/65 TO 12/31/70

TEMP (DEG F)	NO. OF TIMES EXCEEDED	PER CENT OF TIME	RANGE	DAYS WITHIN	PER CENT OF TIME
32.0	2190	100.000	31.0 - 32.9	6	0.274
34.0	2178	99.452	33.0 - 34.9	15	0.685
36.0	2150	98.174	35.0 - 36.9	35	1.598
38.0	2081	95.023	37.0 - 38.9	121	5.525
40.0	1881	85.890	39.0 - 40.9	238	10.868
42.0	1676	76.530	41.0 - 42.9	187	8.539
44.0	1531	69.909	43.0 - 44.9	131	5.982
46.0	1410	64.384	45.0 - 46.9	128	5.845
48.0	1288	58.721	47.0 - 48.9	88	3.927
50.0	1195	54.566	49.0 - 50.9	105	4.795
52.0	1084	49.498	51.0 - 52.9	101	4.612
54.0	951	43.425	53.0 - 54.9	128	5.845
56.0	829	37.854	55.0 - 56.9	148	6.667
58.0	683	31.187	57.0 - 58.9	117	5.342
60.0	588	26.849	59.0 - 60.9	132	6.027
62.0	449	20.502	61.0 - 62.9	170	7.783
64.0	233	10.639	63.0 - 64.9	232	10.694
66.0	51	2.329	65.0 - 66.9	98	4.475
68.0	2	0.091	67.0 - 68.9	14	0.639
70.0	0	0.000	69.0 - 70.9	0	0.000
72.0	0	0.000	71.0 - 72.9	0	0.000

DISTRIBUTION OF AVERAGE DAILY FLOW (SEQUENTIALLY) FROM 10/ 1/59 TO 12/31/70

FLOW (CMS)	NO. OF TIMES EXCEEDED	PER CENT OF TIME	RANGE	DAYS WITHIN	PER CENT OF TIME
1000	4110	100.000	950 - 1049	0	0.000
1100	4092	99.562	1050 - 1149	41	0.998
1200	4047	98.467	1150 - 1249	48	1.168
1300	3994	97.178	1250 - 1349	45	1.095
1400	3937	95.791	1350 - 1449	74	1.800
1500	3863	93.990	1450 - 1549	89	2.165
1600	3745	91.119	1550 - 1649	131	3.187
1700	3607	87.762	1650 - 1749	154	3.747
1800	3459	84.161	1750 - 1849	160	3.893
1900	3278	79.757	1850 - 1949	181	4.404
2000	3093	75.255	1950 - 2049	173	4.209
2100	2905	70.681	2050 - 2149	195	4.745
2200	2718	66.131	2150 - 2249	211	5.134
2300	2514	61.168	2250 - 2349	191	4.647
2400	2317	56.375	2350 - 2449	199	4.842
2500	2134	51.922	2450 - 2549	182	4.428
2600	1946	47.348	2550 - 2649	160	3.893
2700	1825	44.404	2650 - 2749	119	2.895
2800	1702	41.411	2750 - 2849	102	2.482
2900	1596	38.832	2850 - 2949	118	2.871
3000	1506	36.642	2950 - 3049	91	2.214
3100	1399	34.039	3050 - 3149	96	2.336
3200	1314	31.971	3150 - 3249	59	1.436
3300	1254	30.511	3250 - 3349	67	1.630
3400	1198	29.148	3350 - 3449	42	1.022
3500	1155	28.102	3450 - 3549	51	1.241
3600	1102	26.813	3550 - 3649	44	1.071
3700	1060	25.791	3650 - 3749	42	1.022
3800	1018	24.769	3750 - 3849	34	0.827
3900	992	24.136	3850 - 3949	29	0.708
4000	965	23.479	3950 - 4049	29	0.706
4100	945	22.993	4050 - 4149	20	0.487
4200	924	22.482	4150 - 4249	18	0.438
4300	912	22.190	4250 - 4349	13	0.316
4400	889	21.830	4350 - 4449	26	0.633
4500	872	21.217	4450 - 4549	18	0.438
4600	846	20.584	4550 - 4649	21	0.511
4700	832	20.243	4650 - 4749	12	0.292
4800	818	19.903	4750 - 4849	20	0.487
4900	797	19.392	4850 - 4949	19	0.462
5000	775	18.856	4950 - 5049	17	0.414

TEMPERATURE AND FLOW ANALYSIS (SEQUENTIALLY) FROM 10/ 1/59 TO 12/31/70

FOR MONTH OF JANUARY

DATE	TEMPERATURE (DEG F)				FLOW (CMS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
1/ 1	44.1	37.2	41.21	2.72	2279	1058	1640	421
1/ 2	43.9	37.4	41.12	2.48	3398	1203	2196	725
1/ 3	43.5	37.9	41.12	2.08	3511	1509	2255	582
1/ 4	43.7	37.6	40.97	2.24	3029	1234	2253	589
1/ 5	43.2	37.0	40.81	2.19	3794	1294	2257	664
1/ 6	42.8	37.0	40.55	2.04	3426	1203	2263	610
1/ 7	42.8	37.0	40.46	1.99	3284	1220	2108	631
1/ 8	43.2	37.6	40.55	1.90	3398	1152	2034	639
1/ 9	42.8	38.3	40.70	1.59	2916	1084	2127	607
1/10	43.2	39.0	40.64	1.45	2616	1455	2021	441
1/11	43.2	39.0	40.58	1.48	2647	1172	1916	512
1/12	43.0	38.5	40.19	1.70	2916	1274	2156	575
1/13	42.8	38.3	40.22	1.72	2836	1396	2123	456
1/14	42.8	38.3	40.62	1.52	2661	1200	1971	455
1/15	43.2	38.1	40.40	1.75	3341	1537	2168	563
1/16	42.8	37.8	40.13	1.75	3228	1144	2212	655
1/17	42.6	37.4	39.86	1.83	2746	1585	2199	391
1/18	42.4	37.0	39.92	1.83	2726	1448	2122	435
1/19	42.6	37.0	40.04	1.90	2746	1248	2242	455
1/20	42.6	36.9	40.16	1.99	3341	1628	2288	489
1/21	42.4	36.5	40.22	2.10	3709	1350	2260	645
1/22	42.4	35.8	39.86	2.30	3567	1364	2300	631
1/23	42.3	35.2	39.68	2.43	3114	1407	2220	514
1/24	41.9	34.9	39.50	2.48	3341	1407	2158	525
1/25	41.7	34.2	39.17	2.63	2973	1294	2236	520
1/26	41.5	34.0	38.96	2.60	2687	1172	2272	419
1/27	41.5	33.3	38.75	2.83	4105	1670	2229	684
1/28	41.7	32.7	38.51	3.06	4366	1460	2244	768
1/29	42.1	32.5	38.67	3.29	3596	1104	2070	750
1/30	41.7	32.7	38.54	3.14	3228	1076	2154	620
1/31	41.9	32.6	38.42	3.17	3624	1090	2214	707

TEMPERATURE AND FLOW ANALYSIS (SEQUENTIALLY) FROM 10/ 1/59 TO 12/31/70
FOR MONTH OF FEBRUARY

DATE	TEMPERATURE (DEG F)				FLOW (CMS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
2/ 1	41.7	32.6	38.39	3.12	3511	1410	2210	640
2/ 2	41.7	32.9	38.39	2.93	3398	1356	2201	487
2/ 3	42.1	33.1	38.48	2.94	4134	1475	2306	680
2/ 4	42.4	33.4	38.63	2.93	3709	1302	2319	632
2/ 5	42.3	34.0	38.60	2.73	3907	1313	2444	759
2/ 6	41.9	34.2	38.54	2.57	3596	1328	2333	566
2/ 7	42.1	34.0	38.54	2.68	3284	1211	2416	514
2/ 8	41.9	34.2	38.60	2.66	3567	1090	2358	590
2/ 9	41.9	34.2	38.33	2.65	3050	1015	2453	372
2/10	41.9	34.2	38.24	2.64	3171	2101	2539	326
2/11	41.9	34.5	38.42	2.54	3313	1679	2462	500
2/12	42.1	35.1	38.46	2.44	3511	1829	2562	585
2/13	41.7	35.1	38.39	2.28	3794	1636	2610	561
2/14	41.5	34.9	38.42	2.37	3794	1566	2560	621
2/15	41.4	35.1	38.33	2.36	2973	1268	2432	465
2/16	41.4	35.6	38.33	2.18	3454	1970	2506	420
2/17	41.4	35.4	38.36	2.17	3454	1701	2438	501
2/18	41.0	35.4	38.48	1.98	3964	1172	2354	778
2/19	41.0	35.8	38.66	2.00	3822	1752	2360	616
2/20	40.6	35.4	38.66	2.04	3539	1192	2257	588
2/21	40.6	35.1	38.51	2.07	3567	1505	2338	533
2/22	40.6	35.1	38.39	2.02	3284	1653	2309	506
2/23	40.6	35.1	38.42	1.96	2888	1390	2326	443
2/24	40.6	35.1	38.45	1.98	3567	1090	2401	611
2/25	41.2	34.9	38.54	2.17	3511	1127	2286	725
2/26	41.2	35.1	38.63	2.07	3596	1390	2347	644
2/27	40.8	35.1	38.69	1.98	3313	1432	2303	542
2/28	40.8	35.6	38.72	1.77	3171	1667	2387	483
2/29	39.6	39.6	39.56	0.00	2072	1526	1730	298

TEMPERATURE AND FLOW ANALYSIS (SEQUENTIALLY) FROM 10/ 1/59 TO 12/31/70

FOR MONTH OF MARCH

DATE	TEMPERATURE (DEG F)				FLOW (CMS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
3/ 1	40.8	36.0	38.57	1.85	2973	1540	2280	483
3/ 2	40.8	36.1	38.63	1.58	2777	1214	2189	544
3/ 3	40.6	36.0	38.78	1.87	3341	1294	2302	574
3/ 4	40.8	36.3	38.81	1.81	3511	1523	2283	583
3/ 5	40.6	36.7	38.98	1.47	3482	1500	2230	598
3/ 6	40.8	36.7	39.11	1.47	3341	1548	2349	573
3/ 7	40.6	36.7	39.05	1.42	3822	1449	2501	728
3/ 8	40.6	36.9	39.20	1.39	3768	1243	2351	878
3/ 9	40.6	37.0	39.35	1.25	3768	1853	2552	616
3/10	40.5	36.9	39.32	1.26	3768	1699	2460	860
3/11	40.8	37.0	39.35	1.24	3938	1294	2354	829
3/12	41.0	37.0	39.35	1.31	3794	1358	2319	756
3/13	41.4	36.9	39.59	1.52	4502	1850	2370	923
3/14	40.5	36.7	39.44	1.42	3737	1878	2309	825
3/15	40.5	37.2	39.82	1.28	3199	1557	2243	542
3/16	40.6	37.2	39.77	1.30	2944	1503	2274	530
3/17	40.6	37.6	39.85	1.10	3284	1415	2325	558
3/18	41.0	37.8	39.74	1.15	4134	1452	2355	784
3/19	41.0	37.8	39.80	1.21	3886	1582	2221	492
3/20	41.0	38.1	39.95	1.06	3143	1625	2311	538
3/21	41.4	38.3	40.16	1.11	3567	1648	2315	622
3/22	41.7	38.8	40.40	1.07	3681	1602	2306	857
3/23	41.4	39.7	40.81	0.88	2990	1682	2360	491
3/24	41.7	39.2	40.55	0.98	3426	1574	2379	593
3/25	41.9	39.2	40.76	0.98	3709	1483	2409	594
3/26	42.1	39.2	40.97	1.11	3284	1873	2389	683
3/27	42.1	39.0	41.00	1.11	3398	1512	2444	874
3/28	43.2	39.6	41.45	1.21	3284	1370	2254	556
3/29	43.0	39.8	41.60	1.19	2837	1277	2292	554
3/30	42.6	40.1	41.60	0.88	3341	1418	2546	528
3/31	42.5	40.5	41.78	0.79	4021	1822	2738	789

TEMPERATURE AND FLOW ANALYSIS (SEQUENTIALLY) FROM 10/ 1/59 TO 12/31/70

FOR MONTH OF APRIL

DATE	TEMPERATURE (DEG F)				FLOW (CMS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
4/ 1	43.0	40.8	42.17	0.78	3907	1146	2478	905
4/ 2	43.7	40.8	42.35	0.96	3964	1345	2440	934
4/ 3	44.2	41.2	42.53	1.02	4332	1070	2430	1002
4/ 4	43.7	41.4	42.71	0.85	3964	1127	2445	945
4/ 5	44.1	41.5	42.92	0.94	4389	1110	2849	1030
4/ 6	44.4	41.5	43.13	0.99	4765	1750	2717	1017
4/ 7	45.0	41.5	43.28	1.13	5012	1659	2719	1105
4/ 8	45.5	42.1	43.52	1.20	5323	1806	2899	1132
4/ 9	45.9	42.3	43.97	1.21	5153	1772	2922	1144
4/10	46.4	42.4	44.33	1.29	5232	1470	2930	1252
4/11	45.9	43.2	44.51	0.96	5323	1362	2870	1294
4/12	45.9	43.5	44.45	0.85	5431	1172	3009	1265
4/13	45.3	43.6	44.33	0.71	5595	2214	3083	1189
4/14	46.0	43.7	44.69	0.85	5800	1775	3017	1305
4/15	46.6	43.9	45.02	0.97	5840	1820	3157	1222
4/16	47.1	44.4	45.20	1.13	5453	1427	3120	1399
4/17	47.5	44.2	45.26	1.27	5436	1254	3120	1407
4/18	46.6	44.2	45.14	0.95	5300	1631	3296	1200
4/19	46.4	43.9	44.90	1.01	5801	1288	3542	1263
4/20	46.4	44.1	45.05	1.00	5485	2412	3430	1037
4/21	46.6	43.9	45.20	1.06	5436	1851	3320	1129
4/22	47.1	43.7	45.41	1.25	5635	2002	3550	1203
4/23	47.5	44.8	45.80	1.12	5833	2055	3420	1194
4/24	47.8	44.8	46.04	1.11	5720	1766	3425	1218
4/25	47.7	45.1	46.22	0.88	5948	1546	3400	1340
4/26	47.1	45.3	46.28	0.62	5720	1220	3362	1412
4/27	47.5	45.5	46.43	0.78	6003	1435	3523	1326
4/28	48.2	45.5	46.79	0.93	5691	1282	3266	1276
4/29	48.7	45.7	46.88	1.11	5770	2058	3350	1170
4/30	49.3	46.2	47.30	1.20	5940	1180	3295	1371

TEMPERATURE AND FLOW ANALYSIS (SEQUENTIALLY) FROM 10/ 1/59 TO 12/31/70

FOR MONTH OF MAY

DATE	TEMPERATURE (DEG F)				FLOW (CMS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
5/ 1	49.1	48.0	47.48	1.19	5948	1888	3283	1199
5/ 2	49.1	48.8	47.72	1.12	6881	1819	3623	1602
5/ 3	49.8	48.6	48.08	1.37	5948	1840	3522	1384
5/ 4	50.6	48.6	48.38	1.55	6399	1998	3635	1432
5/ 5	50.4	48.2	48.65	1.61	6512	1800	3689	1442
5/ 6	50.6	48.6	49.10	1.44	6371	1879	3640	1484
5/ 7	50.4	47.1	49.25	1.19	5918	1387	3573	1456
5/ 8	50.9	47.8	49.61	1.05	6286	2115	3863	1546
5/ 9	50.7	48.8	49.79	0.85	6314	1990	4061	1501
5/10	51.1	48.7	49.94	0.83	6569	1849	4273	1523
5/11	52.2	48.6	50.15	1.16	6512	1879	4288	1618
5/12	52.3	48.9	50.42	1.10	6541	1900	4213	1654
5/13	52.0	49.5	50.67	0.93	6824	1863	4531	1837
5/14	51.8	49.5	50.69	0.73	6909	1571	4602	1843
5/15	51.8	49.3	50.75	0.88	6994	2293	4705	1727
5/16	53.4	49.3	51.23	1.39	6965	2211	4775	1719
5/17	52.5	49.8	51.29	0.98	7334	2973	4819	1879
5/18	52.9	50.2	51.53	1.03	7362	2406	4957	1773
5/19	53.2	50.5	51.77	1.18	7447	2449	5107	1752
5/20	53.1	50.5	51.95	1.01	7419	2480	5286	1689
5/21	54.0	50.7	52.37	1.15	7532	2775	5838	1533
5/22	54.5	51.1	52.55	1.21	7730	2602	5739	1624
5/23	54.9	51.1	52.70	1.27	7872	2525	5829	1536
5/24	55.2	51.3	52.82	1.36	8268	4530	6294	1858
5/25	55.0	51.6	52.97	1.24	9004	4842	6554	1892
5/26	54.7	51.6	53.09	1.15	9802	5068	6811	1278
5/27	54.5	51.4	53.12	1.10	9910	4983	6758	1291
5/28	54.0	51.6	53.21	0.86	10194	5408	7008	1313
5/29	54.0	52.0	53.48	0.79	10647	4389	7004	1583
5/30	54.0	52.0	53.45	0.80	10958	5833	7306	1495
5/31	54.1	52.3	53.48	0.89	11185	5891	7434	1581

TEMPERATURE AND FLOW ANALYSIS (SEQUENTIALLY) FROM 10/ 1/59 TO 12/31/70

FOR MONTH OF JUNE

DATE	TEMPERATURE (DEG F)				FLOW (CMS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
6/ 1	54.7	52.0	53.63	1.12	11440	5153	7527	1708
6/ 2	55.4	53.1	54.32	0.98	12008	5776	7802	1787
6/ 3	55.8	52.3	54.47	1.39	12487	5182	7992	1991
6/ 4	56.7	52.5	54.83	1.61	12827	4077	8180	2299
6/ 5	57.0	52.7	55.31	1.67	13054	4077	8233	2410
6/ 6	57.6	52.9	55.48	1.89	13563	5439	8435	2386
6/ 7	57.7	53.4	55.65	1.86	13980	5221	8555	2510
6/ 8	57.6	53.8	56.03	1.47	14130	4666	8802	2581
6/ 9	57.4	53.8	55.62	1.35	14215	4779	8791	2647
6/10	57.2	54.0	55.73	1.23	14469	4989	9043	2633
6/11	57.2	54.0	55.70	1.24	14526	5408	9311	2556
6/12	58.1	54.0	55.88	1.57	14328	4884	9147	2687
6/13	58.5	54.1	55.94	1.62	14216	5156	9196	2578
6/14	58.6	54.5	56.03	1.57	14045	5208	9240	2583
6/15	59.0	54.7	56.18	1.66	13875	5185	9170	2736
6/16	59.0	55.0	56.36	1.49	13195	5176	9210	2581
6/17	59.0	55.6	56.60	1.39	13195	5244	9251	2678
6/18	59.4	55.6	56.90	1.49	13308	5977	9282	2463
6/19	59.5	55.4	57.26	1.70	13393	5043	9026	2678
6/20	60.3	55.2	57.50	2.13	13252	4813	8802	2755
6/21	60.8	55.0	57.65	2.28	12969	5031	8996	2572
6/22	61.2	54.5	57.88	2.51	12827	4949	8935	2588
6/23	61.5	54.3	57.86	2.60	12346	5133	8835	2459
6/24	62.1	53.8	57.86	2.88	12374	4963	8677	2495
6/25	62.1	54.1	58.10	2.64	12969	4944	8706	2575
6/26	62.2	55.0	58.28	2.39	13648	4808	8602	2691
6/27	62.8	55.8	58.65	2.35	13337	3852	8400	2728
6/28	61.9	56.1	58.46	1.95	13025	3701	8188	2598
6/29	61.0	56.1	58.40	1.71	13082	3814	8025	2535
6/30	61.2	56.5	58.49	1.76	12289	3665	7925	2383

TEMPERATURE AND FLOW ANALYSIS (SEQUENTIALLY) FROM 10/ 1/59 TO 12/31/70

FOR MONTH OF JULY

DATE	TEMPERATURE (DEG F)				FLOW (CMS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
7/ 1	61.3	56.1	58.70	1.89	12034	3766	7843	2231
7/ 2	61.5	55.8	58.91	2.13	11864	3879	7804	2077
7/ 3	62.1	55.9	59.42	2.19	12034	4040	7705	2023
7/ 4	62.8	55.9	59.66	2.28	10760	3024	7407	1938
7/ 5	63.1	56.5	60.02	2.21	10703	3964	7493	1878
7/ 6	63.3	57.0	60.20	2.08	11043	3893	7351	1795
7/ 7	63.1	57.7	60.50	1.83	10533	4224	7401	1898
7/ 8	63.1	58.5	60.62	1.74	10080	4097	7332	1720
7/ 9	63.7	58.8	60.86	1.90	10194	4222	7392	1706
7/10	64.0	59.0	61.04	2.02	9712	3766	7196	1710
7/11	64.8	59.6	61.19	2.27	9514	3378	7018	1811
7/12	64.9	59.0	61.13	2.30	9429	3429	6905	1721
7/13	64.8	59.0	61.07	2.02	9599	3341	6612	1930
7/14	64.8	59.4	61.25	1.96	9514	3774	6721	1614
7/15	65.1	59.2	61.40	2.08	9486	3596	6552	1650
7/16	65.7	59.5	61.55	2.21	9344	3669	6400	1543
7/17	65.7	59.9	61.81	2.13	8919	3075	6284	1619
7/18	65.8	60.3	61.91	2.03	8778	2755	6120	1625
7/19	66.8	60.5	62.24	2.23	8893	2565	5829	1594
7/20	66.0	60.4	62.09	2.16	8891	3024	5810	1438
7/21	65.1	60.8	61.97	1.82	8353	3819	5680	1255
7/22	63.9	60.6	61.91	1.41	7815	2973	5408	1318
7/23	64.4	60.6	62.18	1.61	7277	3398	5335	1232
7/24	64.9	60.8	62.63	1.71	6796	3375	5201	1094
7/25	65.3	61.0	62.81	1.75	6739	2508	4988	1237
7/26	66.0	62.1	63.84	1.64	6456	2641	4765	1247
7/27	65.8	61.7	63.53	1.59	6767	2752	4606	1269
7/28	65.8	62.1	63.86	1.39	6003	2653	4440	1106
7/29	65.3	62.4	63.89	1.03	5210	3398	4312	649
7/30	64.9	62.4	63.98	0.89	5210	3052	4221	585
7/31	64.9	62.4	64.10	0.91	4983	3313	4236	592

TEMPERATURE AND FLOW ANALYSIS (SEQUENTIALLY) FROM 10/ 1/59 TO 12/31/70

FOR MONTH OF AUGUST

DATE	TEMPERATURE (DEG F)				FLOW (CMS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
8/ 1	85.1	82.8	84.25	0.83	5883	2752	4079	929
8/ 2	85.1	83.1	84.34	0.72	5720	2222	3997	1050
8/ 3	85.3	83.7	84.40	0.57	5153	2245	3927	929
8/ 4	85.7	83.9	84.52	0.73	5153	2916	3888	848
8/ 5	85.3	83.5	84.28	0.82	4757	3055	3935	578
8/ 6	85.5	83.7	84.40	0.83	4530	2814	3691	589
8/ 7	85.7	83.5	84.55	0.89	4547	3001	3700	478
8/ 8	86.2	83.7	84.55	1.00	4275	2831	3607	511
8/ 9	86.0	83.3	84.76	0.95	4182	2548	3503	658
8/10	86.2	83.3	84.88	1.03	4190	2220	3352	815
8/11	86.9	83.0	85.00	1.39	4247	2579	3378	554
8/12	87.1	83.1	85.09	1.48	4134	2944	3467	399
8/13	86.9	83.5	85.15	1.31	3879	2824	3269	388
8/14	86.8	83.9	85.30	1.10	3879	2749	3282	388
8/15	86.7	83.5	85.42	1.35	3984	2641	3266	388
8/16	87.1	83.3	85.57	1.57	3992	2813	3103	857
8/17	86.8	83.1	85.09	1.35	4332	1854	3081	645
8/18	86.0	83.1	84.94	1.11	3879	2282	3107	483
8/19	86.4	83.0	84.94	1.30	3879	2511	3117	365
8/20	86.7	83.0	85.00	1.47	3228	1945	2879	382
8/21	86.7	83.0	85.12	1.44	3587	1594	2938	556
8/22	87.6	83.3	85.38	1.52	3199	2273	2945	291
8/23	88.2	82.4	85.36	1.96	3587	2081	2841	436
8/24	88.4	82.2	85.27	1.99	3709	1217	2768	848
8/25	88.0	82.2	85.15	1.88	3454	2463	2849	388
8/26	87.1	82.2	84.78	1.74	3454	2489	2779	316
8/27	87.8	82.1	84.73	2.05	3539	2135	2752	399
8/28	87.5	82.2	84.43	2.02	4021	1333	2841	699
8/29	87.8	82.2	84.19	2.17	4021	1582	2810	737
8/30	87.5	82.1	84.13	2.02	3511	1886	2681	581
8/31	87.8	82.2	84.49	2.05	3256	1789	2571	584

TEMPERATURE AND FLOW ANALYSIS (SEQUENTIALLY) FROM 10/ 1/59 TO 12/31/70

FOR MONTH OF SEPTEMBER

DATE	TEMPERATURE (DEG F)				FLOW (CMS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
9/ 1	88.8	82.8	84.82	1.98	2944	1781	2354	324
9/ 2	87.1	82.8	84.81	1.65	2823	1487	2284	443
9/ 3	86.7	83.0	84.25	1.88	2973	1665	2283	427
9/ 4	85.5	82.8	83.98	1.24	3143	1121	2181	643
9/ 5	85.5	82.4	84.84	1.11	2788	1214	2188	456
9/ 6	85.3	83.0	84.18	0.98	2591	1172	1977	426
9/ 7	85.1	83.5	84.34	0.68	3829	1184	2823	653
9/ 8	85.3	83.3	84.37	0.82	2973	1889	2283	371
9/ 9	85.5	83.7	84.55	0.84	2944	1795	2314	388
9/10	85.5	83.9	84.64	0.89	2944	1338	2119	399
9/11	85.7	83.7	84.61	0.82	2918	1319	2168	417
9/12	85.7	83.3	84.37	0.92	2789	1251	2117	389
9/13	84.8	82.8	83.95	0.84	2888	1529	2149	437
9/14	84.4	82.4	83.88	0.73	2818	1978	2255	288
9/15	83.9	82.8	83.58	0.47	2523	1588	2124	337
9/16	84.2	82.8	83.44	0.82	2554	1379	2073	378
9/17	84.8	82.4	83.38	0.88	2545	1478	2045	297
9/18	84.8	81.9	83.23	0.92	2888	1885	2121	428
9/19	83.9	81.3	82.99	0.93	2888	1228	2085	588
9/20	83.9	81.8	82.93	1.08	3258	1878	2848	587
9/21	84.8	80.8	82.99	1.32	3341	1285	2188	549
9/22	84.8	80.1	82.93	1.58	2784	1582	2095	322
9/23	84.8	80.1	82.89	1.64	2888	1497	2045	352
9/24	84.8	80.4	82.63	1.54	2483	1381	2068	318
9/25	84.8	81.8	82.89	1.33	3881	1571	2168	493
9/26	84.6	81.2	82.72	1.28	2735	1175	1987	466
9/27	84.9	81.2	82.75	1.28	2557	1146	2017	439
9/28	85.1	81.2	82.84	1.38	2585	1588	2112	298
9/29	84.9	81.5	82.93	1.21	2973	1398	2131	524
9/30	84.2	81.5	82.84	0.95	2788	1384	2214	438

TEMPERATURE AND FLOW ANALYSIS (SEQUENTIALLY) FROM 10/ 1/59 TO 12/31/70

FOR MONTH OF OCTOBER

DATE	TEMPERATURE (DEG F)				FLOW (CMS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
10/ 1	82.8	61.2	62.36	0.63	3768	1104	2136	764
10/ 2	82.8	60.6	61.94	0.80	3618	1203	2135	787
10/ 3	83.1	60.4	61.85	1.05	3449	1118	2111	606
10/ 4	83.1	60.4	61.73	1.01	3381	1132	2080	580
10/ 5	82.4	60.3	61.52	0.92	3233	1226	2073	604
10/ 6	81.9	59.7	61.13	0.79	3126	1175	2068	546
10/ 7	81.9	59.2	61.01	1.02	3100	1543	2223	479
10/ 8	82.1	58.8	60.77	1.23	2984	1379	2076	501
10/ 9	82.1	59.0	60.74	1.19	2922	1390	2128	479
10/10	81.7	58.6	60.41	1.28	2882	1656	2090	382
10/11	81.7	58.5	60.26	1.31	2857	1339	2102	401
10/12	81.0	58.1	59.66	1.22	2877	1353	2003	542
10/13	80.8	57.8	59.33	1.47	2956	1441	2189	547
10/14	80.6	57.6	59.18	1.42	2990	1676	2197	463
10/15	80.1	57.2	58.79	1.20	3080	1132	2127	591
10/16	80.1	56.8	58.49	1.21	3092	1076	2152	584
10/17	80.4	56.8	58.34	1.35	3174	1107	2100	514
10/18	59.9	56.5	58.01	1.29	3293	1509	2142	499
10/19	59.2	56.3	57.74	1.16	3273	1132	2089	622
10/20	59.0	55.8	57.56	1.23	3304	1206	2067	603
10/21	59.0	56.1	57.62	1.01	3457	1432	2052	540
10/22	58.5	55.6	57.26	1.09	3432	1350	2049	584
10/23	57.9	55.9	57.32	0.88	3610	1141	1975	700
10/24	57.7	56.1	57.14	0.84	3681	1347	2187	629
10/25	57.2	56.5	56.93	0.36	3596	1687	2188	488
10/26	57.2	56.3	56.72	0.41	3720	1543	2193	602
10/27	57.0	55.9	56.54	0.48	3684	1325	2218	601
10/28	57.2	55.8	56.42	0.82	3735	1240	2252	594
10/29	57.2	55.4	56.27	0.71	3896	1124	2149	689
10/30	57.2	55.2	56.24	0.87	3876	1084	2152	873
10/31	57.2	54.9	56.06	0.98	3675	1192	2042	594

TEMPERATURE AND FLOW ANALYSIS (SEQUENTIALLY) FROM 10/ 1/59 TO 12/31/70

FOR MONTH OF NOVEMBER

DATE	TEMPERATURE (DEG F)				FLOW (CMS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
11/ 1	57.2	54.5	55.88	1.05	3559	1197	1948	577
11/ 2	57.0	54.1	55.84	1.15	3533	1118	2058	595
11/ 3	58.7	54.1	55.52	1.08	3440	1197	2140	585
11/ 4	58.5	54.1	55.22	1.15	3358	1721	2287	544
11/ 5	58.3	53.8	55.04	1.18	3389	1370	2197	592
11/ 6	55.8	53.6	54.74	0.97	3282	1101	2124	616
11/ 7	55.6	53.4	54.50	0.90	3284	1384	2121	588
11/ 8	55.2	53.4	54.29	0.81	3307	1183	2017	530
11/ 9	55.2	53.1	54.08	0.96	3194	1248	1989	512
11/10	55.2	52.7	53.76	0.98	3123	1264	2009	538
11/11	55.0	52.5	53.48	0.99	3029	1325	2006	533
11/12	54.9	52.3	53.51	0.86	3029	1427	2065	529
11/13	54.3	52.3	53.38	0.86	2743	1240	2002	491
11/14	53.8	52.0	53.21	0.67	3114	1095	1990	496
11/15	53.4	51.3	52.82	0.82	2582	1614	2025	306
11/16	53.4	50.9	52.68	0.88	2477	1254	1965	304
11/17	53.4	50.5	52.28	0.97	2973	1155	2029	483
11/18	53.4	50.4	52.01	1.01	2678	1421	2030	454
11/19	53.2	50.5	51.77	0.88	2944	1387	1989	428
11/20	52.9	50.4	51.53	0.90	3086	1285	2029	498
11/21	52.3	49.5	51.11	1.10	2918	1160	2028	539
11/22	51.8	48.7	50.72	1.14	2824	1166	2054	420
11/23	51.8	48.0	50.39	1.33	2831	1455	2061	447
11/24	51.3	48.2	50.18	1.24	3137	1223	2068	612
11/25	51.1	48.0	49.78	1.18	3384	1413	2211	613
11/26	50.5	47.7	49.46	1.08	3754	1611	2284	637
11/27	50.7	47.1	49.25	1.24	3961	1574	2274	743
11/28	50.5	46.6	48.95	1.35	3879	1350	2185	791
11/29	50.9	46.4	48.80	1.52	3791	1585	2321	806
11/30	50.7	45.9	48.47	1.59	3748	1529	2298	592

TEMPERATURE AND FLOW ANALYSIS (SEQUENTIALLY) FROM 10/ 1/59 TO 12/31/70

FOR MONTH OF DECEMBER

DATE	TEMPERATURE (DEG F)				FLOW (CMS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
12/ 1	50.5	45.1	48.23	1.78	3718	1633	2375	700
12/ 2	50.4	45.0	47.99	1.77	3692	1483	2343	683
12/ 3	50.2	44.8	47.93	1.82	3681	1160	2213	701
12/ 4	50.0	44.2	47.66	1.93	3681	1115	2218	674
12/ 5	49.5	44.1	47.30	1.80	3497	1359	2238	618
12/ 6	49.3	44.2	47.09	1.86	3358	1580	2199	520
12/ 7	48.4	44.6	46.97	1.34	3188	1597	2182	450
12/ 8	48.2	44.4	46.76	1.37	3171	1495	2087	525
12/ 9	48.4	44.2	46.52	1.40	3284	1585	2198	436
12/10	47.8	44.2	46.46	1.23	2828	1594	2193	343
12/11	47.8	43.9	46.22	1.38	2726	1274	2100	498
12/12	47.8	43.7	46.10	1.50	3029	1403	2047	494
12/13	47.5	43.3	45.83	1.58	3114	1084	2113	618
12/14	47.3	43.2	45.65	1.59	2735	1404	2100	388
12/15	46.9	43.0	45.47	1.54	3029	1260	2073	543
12/16	46.8	43.3	45.28	1.35	3258	1557	2303	475
12/17	46.6	43.2	45.02	1.40	2973	1611	2261	441
12/18	46.6	43.2	44.81	1.54	3454	1260	2339	654
12/19	46.6	43.0	44.60	1.45	3567	1455	2303	712
12/20	46.6	43.0	44.54	1.53	3001	1387	2170	626
12/21	46.2	42.1	44.21	1.77	3088	1220	2181	505
12/22	46.0	42.1	43.97	1.73	3428	1438	2323	640
12/23	45.9	41.9	43.76	1.82	3154	1299	2292	615
12/24	46.0	41.7	43.82	1.62	3143	1067	1857	602
12/25	46.0	41.7	43.62	1.71	2423	1056	1542	531
12/26	45.1	41.2	43.22	1.69	3086	1271	1974	613
12/27	45.0	41.2	42.92	1.61	3114	1158	2191	655
12/28	45.0	39.9	42.65	1.84	3228	1336	2255	602
12/29	44.8	37.8	42.05	2.42	3369	1226	2290	668
12/30	44.4	36.5	41.90	2.80	3511	1268	2220	575
12/31	44.1	36.9	41.75	2.55	3114	1061	2025	532

PERCENT OF TIME TEMPERATURE EXCEEDS A GIVEN MINIMUM
WHILE FLOW RATE IS BELOW A GIVEN MAXIMUM

MINIMUM TEMPERATURE	MAXIMUM FLOW	NO. OF TIMES CRITERIA MET	PERCENT OF TIME
65.0 DEG F	2800 CMS	45	2.1

APPENDIX C

OUTPUT RESULTS FOR SAMPLE PROBLEM 2

DISTRIBUTION OF AVERAGE DAILY TEMPERATURES (SEQUENTIALLY) FROM 1/ 1/71 TO 6/24/83

TEMP (DEG C)	NO. OF TIMES EXCEEDED	PER CENT OF TIME	RANGE	DAYS WITHIN	PER CENT OF TIME
2.0	4247	97.297	1.0 - 2.9	298	6.827
4.0	3817	82.884	3.0 - 4.9	783	16.105
6.0	3124	71.589	5.0 - 6.9	437	10.011
8.0	2695	61.741	7.0 - 8.9	389	8.912
10.0	2330	53.379	9.0 - 10.9	381	8.729
12.0	1950	44.674	11.0 - 12.9	337	7.721
14.0	1552	35.555	13.0 - 14.9	452	10.355
16.0	1119	25.636	15.0 - 16.9	455	10.424
18.0	530	12.348	17.0 - 18.9	727	16.655
20.0	8	0.137	19.0 - 20.9	171	3.918

DISTRIBUTION OF AVERAGE DAILY FLOW (SEQUENTIALLY) FROM 1/ 1/71 TO 6/24/83

FLOW (CFS)	NO. OF TIMES EXCEEDED	PER CENT OF TIME	RANGE	DAYS WITHIN	PER CENT OF TIME
35000	4553	100.000	35000 - 36999	0	0.000
36000	4548	99.846	37000 - 38999	7	0.154
40000	4540	99.714	39000 - 40999	6	0.132
42000	4531	99.517	41000 - 42999	10	0.220
44000	4517	99.209	43000 - 44999	13	0.286
46000	4504	98.924	45000 - 46999	14	0.307
48000	4490	98.616	47000 - 48999	14	0.307
50000	4471	98.199	49000 - 50999	19	0.417
52000	4448	97.694	51000 - 52999	23	0.505
54000	4425	97.189	53000 - 54999	27	0.593
56000	4391	96.442	55000 - 56999	30	0.659
58000	4363	95.827	57000 - 58999	31	0.681
60000	4328	95.058	59000 - 60999	33	0.725
62000	4291	94.246	61000 - 62999	40	0.879
64000	4251	93.367	63000 - 64999	37	0.813
66000	4208	92.423	65000 - 66999	49	1.076
68000	4156	91.324	67000 - 68999	45	0.988
70000	4115	90.380	69000 - 70999	45	0.988
72000	4058	89.128	71000 - 72999	61	1.340
74000	3983	87.481	73000 - 74999	73	1.603
76000	3925	86.207	75000 - 76999	62	1.362
78000	3846	84.472	77000 - 78999	78	1.713
80000	3760	82.583	79000 - 80999	86	1.889
82000	3681	80.840	81000 - 82999	82	1.801
84000	3595	78.959	83000 - 84999	90	1.977
86000	3507	77.026	85000 - 86999	82	1.801
88000	3404	74.764	87000 - 88999	103	2.262
90000	3300	72.611	89000 - 90999	99	2.174
92000	3201	70.305	91000 - 92999	100	2.196
94000	3107	68.241	93000 - 94999	98	2.152
96000	3006	66.022	95000 - 96999	100	2.196
98000	2905	63.804	97000 - 98999	100	2.328
100000	2783	61.125	99000 - 100999	118	2.592
102000	2689	59.060	101000 - 102999	91	1.989
104000	2584	56.754	103000 - 104999	103	2.262
106000	2501	54.931	105000 - 106999	81	1.779
108000	2399	52.691	107000 - 108999	103	2.262
110000	2289	50.275	109000 - 110999	111	2.438
112000	2178	47.837	111000 - 112999	109	2.394
114000	2079	45.662	113000 - 114999	104	2.284
116000	1998	43.883	115000 - 116999	79	1.735
118000	1915	42.066	117000 - 118999	81	1.779
120000	1832	40.237	119000 - 120999	85	1.867
122000	1750	38.612	121000 - 122999	71	1.559
124000	1675	36.789	123000 - 124999	83	1.823
126000	1595	35.032	125000 - 126999	80	1.757
128000	1535	33.714	127000 - 128999	62	1.362
130000	1480	32.506	129000 - 130999	51	1.120
132000	1414	31.056	131000 - 132999	69	1.515

DISTRIBUTION OF AVERAGE DAILY FLOW (SEQUENTIALLY) FROM 1/ 1/71 TO 6/24/83

FLOW (CFS)	NO. OF TIMES EXCEEDED	PER CENT OF TIME	RANGE	DAYS WITHIN	PER CENT OF TIME
134000	1358	29.783	133000 - 134999	58	1.238
136000	1312	28.818	135000 - 136999	48	1.054
138000	1263	27.740	137000 - 138999	47	1.032
140000	1214	26.864	139000 - 140999	45	0.988
142000	1179	25.895	141000 - 142999	38	0.791
144000	1141	25.060	143000 - 144999	44	0.968
146000	1102	24.284	145000 - 146999	33	0.725
148000	1065	23.413	147000 - 148999	37	0.813
150000	1038	22.754	149000 - 150999	31	0.681
152000	1006	22.095	151000 - 152999	32	0.703
154000	965	21.195	153000 - 154999	39	0.857
156000	948	20.846	155000 - 156999	29	0.637
158000	904	19.855	157000 - 158999	34	0.747
160000	861	18.911	159000 - 160999	36	0.835
162000	833	18.298	161000 - 162999	28	0.615
164000	798	17.483	163000 - 164999	41	0.901
166000	769	16.896	165000 - 166999	27	0.593
168000	738	16.289	167000 - 168999	27	0.593
170000	721	15.838	169000 - 170999	19	0.417
172000	684	15.023	171000 - 172999	37	0.813
174000	662	14.548	173000 - 174999	24	0.527
176000	637	13.991	175000 - 176999	24	0.527
178000	618	13.573	177000 - 178999	17	0.373
180000	598	12.958	179000 - 180999	30	0.659
182000	572	12.563	181000 - 182999	18	0.395
184000	545	11.970	183000 - 184999	28	0.615
186000	525	11.531	185000 - 186999	19	0.417
188000	501	11.084	187000 - 188999	29	0.637
190000	477	10.477	189000 - 190999	21	0.461
192000	459	10.081	191000 - 192999	15	0.329
194000	442	9.700	193000 - 194999	17	0.373
196000	419	9.283	195000 - 196999	22	0.483
198000	405	8.895	197000 - 198999	12	0.264
200000	392	8.610	199000 - 200999	19	0.417
202000	375	8.236	201000 - 202999	15	0.329
204000	358	7.867	203000 - 204999	23	0.505
206000	342	7.512	205000 - 206999	11	0.242
208000	322	7.072	207000 - 208999	18	0.395
210000	312	6.853	209000 - 210999	9	0.198
212000	300	6.589	211000 - 212999	10	0.220
214000	284	6.238	213000 - 214999	19	0.417
216000	268	5.886	215000 - 216999	16	0.351
218000	254	5.579	217000 - 218999	15	0.329
220000	244	5.359	219000 - 220999	9	0.198
222000	229	5.030	221000 - 222999	15	0.329
224000	223	4.898	223000 - 224999	8	0.132
226000	213	4.678	225000 - 226999	9	0.198
228000	204	4.481	227000 - 228999	10	0.220
230000	195	4.283	229000 - 230999	6	0.132
232000	191	4.195	231000 - 232999	5	0.110

DISTRIBUTION OF AVERAGE DAILY FLOW (SEQUENTIALLY) FROM 1/ 1/71 TO 6/24/83

FLOW (CFS)	NO. OF TIMES EXCEEDED	PER CENT OF TIME	RANGE	DAYS WITHIN	PER CENT OF TIME
234000	187	4.107	233000 - 234999	5	0.110
236000	177	3.888	235000 - 236999	9	0.198
238000	172	3.778	237000 - 238999	4	0.088
240000	170	3.734	239000 - 240999	3	0.066
242000	168	3.690	241000 - 242999	3	0.066
244000	162	3.558	243000 - 244999	4	0.088
246000	158	3.470	245000 - 246999	4	0.088
248000	158	3.470	247000 - 248999	0	0.000
250000	156	3.426	249000 - 250999	4	0.088
252000	152	3.338	251000 - 252999	4	0.088
254000	148	3.251	253000 - 254999	4	0.088
256000	141	3.097	255000 - 256999	5	0.110
258000	137	3.009	257000 - 258999	5	0.110
260000	134	2.943	259000 - 260999	2	0.044
262000	134	2.943	261000 - 262999	0	0.000
264000	131	2.877	263000 - 264999	4	0.088
266000	129	2.833	265000 - 266999	2	0.044
268000	128	2.811	267000 - 268999	0	0.000
270000	123	2.702	269000 - 270999	5	0.110
272000	120	2.636	271000 - 272999	3	0.066
274000	119	2.614	273000 - 274999	1	0.022
276000	119	2.614	275000 - 276999	0	0.000
278000	118	2.592	277000 - 278999	1	0.022
280000	115	2.526	279000 - 280999	3	0.066
282000	109	2.394	281000 - 282999	6	0.132
284000	106	2.328	283000 - 284999	3	0.066
286000	102	2.240	285000 - 286999	4	0.088
288000	99	2.174	287000 - 288999	3	0.066
290000	95	2.087	289000 - 290999	4	0.088
292000	92	2.021	291000 - 292999	3	0.066
294000	90	1.977	293000 - 294999	2	0.044
296000	85	1.887	295000 - 296999	5	0.110
298000	78	1.689	297000 - 298999	9	0.198
300000	72	1.581	299000 - 300999	4	0.088
302000	67	1.472	301000 - 302999	5	0.110
304000	68	1.450	303000 - 304999	1	0.022
306000	62	1.362	305000 - 306999	4	0.088
308000	60	1.318	307000 - 308999	2	0.044
310000	58	1.274	309000 - 310999	2	0.044
312000	55	1.208	311000 - 312999	3	0.066
314000	55	1.208	313000 - 314999	0	0.000
316000	54	1.186	315000 - 316999	1	0.022
318000	54	1.186	317000 - 318999	0	0.000
320000	53	1.164	319000 - 320999	1	0.022
322000	51	1.120	321000 - 322999	2	0.044
324000	51	1.120	323000 - 324999	0	0.000
326000	50	1.098	325000 - 326999	1	0.022
328000	48	1.054	327000 - 328999	2	0.044
330000	47	1.032	329000 - 330999	1	0.022
332000	46	1.010	331000 - 332999	1	0.022

DISTRIBUTION OF AVERAGE DAILY FLOW (SEQUENTIALLY) FROM 1/ 1/71 TO 8/24/83

FLOW (CFS)	NO. OF TIMES EXCEEDED	PER CENT OF TIME	RANGE	DAYS WITHIN	PER CENT OF TIME
334000	45	0.988	333000 - 334999	1	0.022
336000	45	0.988	335000 - 336999	0	0.000
338000	44	0.988	337000 - 338999	1	0.022
340000	43	0.944	339000 - 340999	1	0.022
342000	39	0.857	341000 - 342999	4	0.088
344000	34	0.747	343000 - 344999	5	0.110
346000	32	0.703	345000 - 346999	2	0.044
348000	31	0.681	347000 - 348999	1	0.022
350000	28	0.615	349000 - 350999	3	0.066
352000	28	0.615	351000 - 352999	0	0.000
354000	27	0.593	353000 - 354999	1	0.022
356000	26	0.571	355000 - 356999	1	0.022
358000	26	0.571	357000 - 358999	0	0.000
360000	26	0.571	359000 - 360999	0	0.000
362000	25	0.549	361000 - 362999	1	0.022
364000	25	0.549	363000 - 364999	0	0.000
366000	25	0.549	365000 - 366999	0	0.000
368000	24	0.527	367000 - 368999	1	0.022
370000	24	0.527	369000 - 370999	0	0.000
372000	24	0.527	371000 - 372999	0	0.000
374000	24	0.527	373000 - 374999	0	0.000
376000	24	0.527	375000 - 376999	0	0.000
378000	23	0.505	377000 - 378999	1	0.022
380000	23	0.505	379000 - 380999	0	0.000
382000	22	0.483	381000 - 382999	1	0.022
384000	22	0.483	383000 - 384999	0	0.000
386000	21	0.461	385000 - 386999	1	0.022
388000	21	0.461	387000 - 388999	0	0.000
390000	21	0.461	389000 - 390999	0	0.000
392000	20	0.439	391000 - 392999	1	0.022
394000	19	0.417	393000 - 394999	1	0.022
396000	18	0.395	395000 - 396999	1	0.022
398000	17	0.373	397000 - 398999	1	0.022
400000	17	0.373	399000 - 400999	0	0.000
402000	16	0.351	401000 - 402999	1	0.022
404000	14	0.307	403000 - 404999	2	0.044
406000	12	0.264	405000 - 406999	2	0.044
408000	10	0.220	407000 - 408999	2	0.044
410000	9	0.198	409000 - 410999	1	0.022
412000	8	0.176	411000 - 412999	1	0.022
414000	7	0.154	413000 - 414999	1	0.022
416000	7	0.154	415000 - 416999	0	0.000
418000	6	0.132	417000 - 418999	1	0.022
420000	5	0.110	419000 - 420999	1	0.022
422000	4	0.088	421000 - 422999	1	0.022
424000	3	0.066	423000 - 424999	1	0.022
426000	2	0.044	425000 - 426999	1	0.022
428000	1	0.022	427000 - 428999	1	0.022
430000	0	0.000	429000 - 430999	1	0.022
432000	0	0.000	431000 - 432999	0	0.000

DISTRIBUTION OF AVERAGE DAILY FLOW (SEQUENTIALLY) FROM 1/ 1/71 TO 6/24/83

FLOW (CFS)	NO. OF TIMES EXCEEDED	PER CENT OF TIME	RANGE	DAYS WITHIN	PER CENT OF TIME
434000	0	0.000	433000 - 434999	0	0.000
436000	0	0.000	435000 - 436999	0	0.000
438000	0	0.000	437000 - 438999	0	0.000
440000	0	0.000	439000 - 440999	0	0.000
442000	0	0.000	441000 - 442999	0	0.000
444000	0	0.000	443000 - 444999	0	0.000
446000	0	0.000	445000 - 446999	0	0.000
448000	0	0.000	447000 - 448999	0	0.000
450000	0	0.000	449000 - 450999	0	0.000
452000	0	0.000	451000 - 452999	0	0.000
454000	0	0.000	453000 - 454999	0	0.000
456000	0	0.000	455000 - 456999	0	0.000
458000	0	0.000	457000 - 458999	0	0.000
460000	0	0.000	459000 - 460999	0	0.000
462000	0	0.000	461000 - 462999	0	0.000
464000	0	0.000	463000 - 464999	0	0.000
466000	0	0.000	465000 - 466999	0	0.000
468000	0	0.000	467000 - 468999	0	0.000
470000	0	0.000	469000 - 470999	0	0.000
472000	0	0.000	471000 - 472999	0	0.000
474000	0	0.000	473000 - 474999	0	0.000
476000	0	0.000	475000 - 476999	0	0.000
478000	0	0.000	477000 - 478999	0	0.000
480000	0	0.000	479000 - 480999	0	0.000
482000	0	0.000	481000 - 482999	0	0.000
484000	0	0.000	483000 - 484999	0	0.000
486000	0	0.000	485000 - 486999	0	0.000
488000	0	0.000	487000 - 488999	0	0.000
490000	0	0.000	489000 - 490999	0	0.000
492000	0	0.000	491000 - 492999	0	0.000
494000	0	0.000	493000 - 494999	0	0.000
496000	0	0.000	495000 - 496999	0	0.000
498000	0	0.000	497000 - 498999	0	0.000
500000	0	0.000	499000 - 500999	0	0.000
502000	0	0.000	501000 - 502999	0	0.000
504000	0	0.000	503000 - 504999	0	0.000
506000	0	0.000	505000 - 506999	0	0.000
508000	0	0.000	507000 - 508999	0	0.000
510000	0	0.000	509000 - 510999	0	0.000
512000	0	0.000	511000 - 512999	0	0.000
514000	0	0.000	513000 - 514999	0	0.000
516000	0	0.000	515000 - 516999	0	0.000
518000	0	0.000	517000 - 518999	0	0.000
520000	0	0.000	519000 - 520999	0	0.000
522000	0	0.000	521000 - 522999	0	0.000
524000	0	0.000	523000 - 524999	0	0.000
526000	0	0.000	525000 - 526999	0	0.000
528000	0	0.000	527000 - 528999	0	0.000
530000	0	0.000	529000 - 530999	0	0.000
532000	0	0.000	531000 - 532999	0	0.000

DISTRIBUTION OF AVERAGE DAILY FLOW (SEQUENTIALLY) FROM 1/ 1/71 TO 8/24/83

FLOW (CFS)	NO. OF TIMES EXCEEDED	PER CENT OF TIME	RANGE	DAYS WITHIN	PER CENT OF TIME
534000	0	0.000	533000 - 534999	0	0.000
538000	0	0.000	535000 - 536999	0	0.000
538000	0	0.000	537000 - 538999	0	0.000
540000	0	0.000	539000 - 540999	0	0.000
542000	0	0.000	541000 - 542999	0	0.000
544000	0	0.000	543000 - 544999	0	0.000
546000	0	0.000	545000 - 546999	0	0.000
548000	0	0.000	547000 - 548999	0	0.000
550000	0	0.000	549000 - 550999	0	0.000

TEMPERATURE AND FLOW ANALYSIS (SEQUENTIALLY) FROM 1/ 1/71 TO 6/24/83

FOR MONTH OF JANUARY

DATE	TEMPERATURE (DEG C)				FLOW (CFS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
1/ 1	8.9	4.3	5.28	0.75	183000	54000	97415	33582
1/ 2	8.9	4.0	5.01	0.89	159000	79000	110248	23262
1/ 3	8.7	3.5	4.82	0.94	153000	60000	114815	21891
1/ 4	8.7	3.1	4.87	1.00	158000	85000	118489	20419
1/ 5	8.7	3.0	4.55	1.08	154000	83000	115089	19384
1/ 6	8.7	2.1	4.38	1.17	144500	72000	112930	19833
1/ 7	8.6	1.5	4.29	1.23	158100	87400	114838	24333
1/ 8	8.4	1.3	4.20	1.20	154000	85000	115348	29208
1/ 9	8.2	1.5	4.18	1.09	154000	59400	104084	30799
1/10	6.0	1.7	4.04	0.98	155000	83000	110500	21879
1/11	5.0	1.0	3.98	0.89	150000	94000	117830	17847
1/12	5.7	1.8	3.88	0.91	182000	76000	105578	23879
1/13	5.8	2.0	3.84	0.81	163000	70000	109392	27990
1/14	5.4	1.8	3.78	0.85	182000	54000	106023	27287
1/15	5.2	2.4	3.87	0.87	181000	83000	102207	25458
1/16	5.0	1.0	3.82	1.08	157000	58000	103007	29617
1/17	4.8	1.0	3.82	1.03	162000	55000	105569	28549
1/18	4.7	1.0	3.59	1.00	152000	69000	107107	22278
1/19	4.7	1.0	3.57	0.99	181000	88000	108200	27208
1/20	4.8	1.0	3.55	0.98	170000	75000	113284	27738
1/21	4.8	1.0	3.48	0.95	182000	59000	118415	29478
1/22	4.7	1.0	3.49	0.97	182000	86000	112115	34173
1/23	4.8	1.0	3.40	0.94	208000	37000	112915	42632
1/24	4.8	1.0	3.40	0.97	202000	38000	113278	38195
1/25	4.5	0.9	3.31	0.95	197000	58000	118830	34118
1/26	4.5	0.9	3.18	0.98	195000	81000	120884	34890
1/27	4.3	0.8	3.05	0.97	198000	66000	121361	32085
1/28	4.3	0.7	2.95	1.06	203000	71000	121438	33081
1/29	5.1	0.5	2.94	1.24	182000	59000	122800	32167
1/30	5.0	0.4	2.83	1.27	183000	43000	120484	35978
1/31	4.3	0.2	2.80	1.19	188000	45000	120948	32282

TEMPERATURE AND FLOW ANALYSIS (SEQUENTIALLY) FROM 1/ 1/71 TO 8/24/83

FOR MONTH OF FEBRUARY

DATE	TEMPERATURE (DEG C)				FLOW (CFS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
2/ 1	4.8	0.1	2.72	1.30	177000	79000	118470	23339
2/ 2	4.7	1.1	2.80	1.09	191000	80000	123800	29418
2/ 3	4.3	1.0	2.83	1.03	193000	74900	120253	31900
2/ 4	4.1	1.0	2.68	0.92	171000	92000	125100	24349
2/ 5	4.2	1.1	2.61	0.90	171000	76000	122823	27274
2/ 6	4.1	1.1	2.54	0.85	173100	61000	125692	38840
2/ 7	4.1	0.2	2.39	1.02	163000	43000	117815	32678
2/ 8	4.0	0.2	2.32	0.94	169000	85000	117938	30151
2/ 9	3.9	0.3	2.29	0.91	168000	87000	120869	29746
2/10	3.8	0.4	2.38	0.94	167000	82200	117184	30158
2/11	3.6	0.4	2.30	0.90	165000	74000	114953	33165
2/12	3.9	0.5	2.49	0.94	168000	53000	110569	35712
2/13	3.9	0.8	2.60	0.89	148000	59000	112030	28537
2/14	3.7	1.1	2.60	0.81	141000	72400	114646	23418
2/15	3.8	1.0	2.78	0.86	144000	78700	111330	19051
2/16	4.0	1.0	2.85	0.89	122000	66800	103261	18894
2/17	4.4	1.1	2.89	0.92	147000	76000	106915	19763
2/18	4.4	1.1	2.89	0.91	162000	80000	115253	22891
2/19	4.4	1.1	2.91	0.91	155000	60000	113553	25331
2/20	4.2	1.1	2.89	0.94	158000	60000	112969	25825
2/21	4.4	1.1	3.02	0.97	142000	91800	118700	15779
2/22	4.3	1.1	2.98	0.94	151000	80900	117492	18575
2/23	4.4	1.1	3.04	0.92	195200	80000	122946	28425
2/24	4.5	1.1	3.08	0.92	178500	70700	121884	29808
2/25	4.7	1.1	3.10	0.94	187500	63000	120407	32914
2/26	4.9	1.3	3.17	0.98	185400	80000	121515	36147
2/27	5.0	1.4	3.22	0.97	196300	70000	121138	39201
2/28	5.2	1.5	3.32	0.95	192700	81000	120030	33877
2/29	3.4	2.5	3.07	0.49	140000	72000	115660	37899

TEMPERATURE AND FLOW ANALYSIS (SEQUENTIALLY) FROM 1/ 1/71 TO 8/24/83

FOR MONTH OF MARCH

DATE	TEMPERATURE (DEG C)				FLOW (CFS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
3/ 1	5.3	1.8	3.32	0.98	208500	51700	127007	48423
3/ 2	5.0	1.7	3.31	0.84	202300	58600	128823	35859
3/ 3	5.0	1.7	3.32	0.84	221000	90000	135330	40917
3/ 4	5.1	1.7	3.33	0.90	216200	78000	130069	40079
3/ 5	5.1	1.8	3.40	0.91	216800	72000	125261	40122
3/ 6	5.2	1.9	3.50	0.92	203100	78000	127692	38851
3/ 7	5.2	2.2	3.55	0.89	187100	84700	123800	33360
3/ 8	5.3	2.3	3.62	0.91	200400	71700	122561	41748
3/ 9	5.4	2.4	3.74	0.90	196300	69500	123492	41205
3/10	5.5	2.5	3.82	0.92	182200	81000	122492	33226
3/11	5.6	2.5	3.91	0.95	207800	50000	117053	40050
3/12	5.6	2.7	3.95	0.67	207800	55000	124815	42327
3/13	5.7	2.8	3.98	0.89	221600	52000	124623	42760
3/14	5.9	2.8	4.05	0.87	229200	90400	129492	35714
3/15	5.9	2.8	4.09	0.81	228400	65000	128553	47811
3/16	6.0	2.9	4.25	0.82	229200	70000	126430	47178
3/17	5.8	3.1	4.31	0.73	228500	85000	129938	45439
3/18	5.9	3.2	4.38	0.72	225800	70000	125807	45886
3/19	6.0	3.3	4.44	0.73	218500	58000	123715	49341
3/20	6.1	3.3	4.52	0.74	225500	68000	125076	49215
3/21	6.2	3.3	4.63	0.78	218700	60100	127100	49095
3/22	6.3	3.3	4.72	0.81	218000	54200	130030	52212
3/23	6.2	3.3	4.78	0.82	237700	63800	130681	51840
3/24	6.2	3.4	4.85	0.81	228300	67000	131192	50975
3/25	6.1	3.6	4.89	0.77	237900	70000	135084	52595
3/26	6.3	3.5	4.95	0.85	221300	79000	135800	47502
3/27	6.3	3.5	5.05	0.88	224500	77000	138938	48458
3/28	6.5	3.6	5.13	0.89	224900	78000	132353	47819
3/29	6.8	3.7	5.18	0.91	222800	69700	124933	42372
3/30	6.5	4.0	5.32	0.78	228000	67700	132989	48362
3/31	6.5	4.0	5.38	0.80	214900	98800	138507	42064

TEMPERATURE AND FLOW ANALYSIS (SEQUENTIALLY) FROM 1/ 1/71 TO 6/24/83

FOR MONTH OF APRIL

DATE	TEMPERATURE (DEG C)				FLOW (CFS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
4/ 1	8.4	4.8	5.41	0.79	203100	90000	132676	40023
4/ 2	8.3	4.1	5.44	0.74	187000	89000	130769	31086
4/ 3	8.5	4.0	5.55	0.77	192000	48000	128476	38361
4/ 4	8.6	4.1	5.66	0.72	188000	80000	124023	36233
4/ 5	8.7	4.6	5.91	0.62	191300	65000	127246	39827
4/ 6	8.9	4.6	5.97	0.62	194000	77000	132730	34767
4/ 7	7.3	4.6	6.08	0.70	204000	61000	125530	33714
4/ 8	7.3	4.7	6.22	0.68	219000	67000	124223	38223
4/ 9	7.3	4.9	6.29	0.64	202000	55000	125015	36314
4/10	7.2	5.2	6.43	0.56	199000	40000	116384	40903
4/11	7.3	5.3	6.48	0.60	189000	54000	118053	42698
4/12	7.4	5.4	6.56	0.63	198000	58700	128076	40207
4/13	7.7	5.6	6.66	0.66	202400	54700	133323	43156
4/14	7.6	5.6	6.75	0.63	206300	88000	130146	48863
4/15	7.8	5.7	6.86	0.67	200600	63000	133030	48117
4/16	8.0	5.7	6.91	0.74	201000	72500	132123	38217
4/17	8.1	5.7	7.04	0.78	184000	48000	125900	42223
4/18	8.3	5.8	7.13	0.80	189300	67200	127223	39869
4/19	8.3	6.0	7.23	0.80	201600	67700	124253	40040
4/20	8.5	6.2	7.40	0.79	169000	54500	121715	34019
4/21	8.6	6.6	7.56	0.74	183000	69500	118684	36013
4/22	8.7	6.8	7.72	0.75	183200	68800	113489	35356
4/23	8.8	7.1	7.92	0.74	178000	57400	118507	38355
4/24	9.1	7.1	8.10	0.77	167200	51000	119246	38597
4/25	9.3	7.0	8.20	0.78	206100	69600	115438	40113
4/26	9.5	7.2	8.42	0.76	188000	51800	108646	42494
4/27	9.6	7.3	8.50	0.69	195300	60300	112084	41889
4/28	9.7	7.2	8.65	0.76	198000	50000	120384	45359
4/29	9.9	7.2	8.78	0.77	203000	56000	122884	41600
4/30	10.1	7.4	8.96	0.76	206000	62000	124700	35550

TEMPERATURE AND FLOW ANALYSIS (SEQUENTIALLY) FROM 1/ 1/71 TO 6/24/83

FOR MONTH OF MAY

DATE	TEMPERATURE (DEG C)				FLOW (CFS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
5/ 1	10.3	7.5	9.16	0.78	213000	52000	133492	38225
5/ 2	10.4	7.7	9.38	0.74	207000	72000	139307	34861
5/ 3	10.5	7.7	9.48	0.71	214000	74000	148892	40625
5/ 4	10.7	7.8	9.57	0.78	251000	86000	148507	47074
5/ 5	10.9	7.8	9.63	0.80	244000	73000	152278	45280
5/ 6	10.8	7.9	9.89	0.71	249000	61000	150615	49710
5/ 7	10.7	8.2	9.78	0.64	252000	68000	154561	49968
5/ 8	10.9	8.5	9.88	0.64	270000	42000	158753	59064
5/ 9	10.8	9.0	10.02	0.53	272000	97000	163923	52386
5/10	10.8	9.1	10.05	0.53	270000	85000	158723	51780
5/11	11.0	9.2	10.12	0.53	270000	89000	163615	49382
5/12	11.3	9.4	10.22	0.57	280000	84000	159500	51035
5/13	11.7	9.5	10.39	0.56	281000	62000	160704	53934
5/14	12.1	9.8	10.46	0.63	283000	95000	161007	50308
5/15	12.6	10.1	10.62	0.70	299000	52000	162053	61025
5/16	13.0	10.2	10.72	0.77	309000	93000	167200	62441
5/17	13.3	10.2	10.82	0.85	298000	88000	171438	67142
5/18	13.6	10.2	10.91	0.91	295000	86000	175707	65467
5/19	13.8	10.3	11.04	0.94	288000	62000	173407	64888
5/20	13.8	10.3	11.13	0.94	289000	66000	172200	66495
5/21	13.9	10.4	11.38	0.94	285000	67000	169715	65771
5/22	14.0	10.3	11.53	0.95	302000	60000	174400	66837
5/23	14.1	10.4	11.72	0.92	297000	95000	183130	58810
5/24	13.9	10.2	11.73	0.96	302000	94000	180507	62312
5/25	13.7	10.1	11.86	0.90	287000	85000	170918	55944
5/26	13.7	10.5	11.88	0.88	298000	47000	176815	69429
5/27	13.8	10.7	11.92	0.85	300000	47000	176730	71491
5/28	14.0	11.0	11.98	0.85	306000	40000	171748	78359
5/29	14.4	11.3	12.09	0.91	327000	45000	180600	77441
5/30	14.6	11.3	12.18	0.95	348000	72000	190415	79048
5/31	14.5	11.1	12.31	0.91	344000	78000	191430	72420

TEMPERATURE AND FLOW ANALYSIS (SEQUENTIALLY) FROM 1/ 1/71 TO 6/24/83

FOR MONTH OF JUNE

DATE	TEMPERATURE (DEG C)				FLOW (CFS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
6/ 1	14.4	11.0	12.40	0.93	340000	107000	193313	88575
6/ 2	14.3	11.0	12.47	1.03	350000	83000	191709	77719
6/ 3	14.4	11.0	12.53	1.04	344000	59000	182240	85785
6/ 4	14.6	11.3	12.62	1.05	330000	58000	182900	78529
6/ 5	14.9	11.5	12.75	1.10	332000	42000	183678	83182
6/ 6	15.0	11.5	12.85	1.05	337000	80000	186107	77522
6/ 7	15.0	11.6	12.97	1.03	345000	80000	187984	77654
6/ 8	14.9	11.8	13.11	1.03	361000	71000	186723	83717
6/ 9	14.8	12.1	13.23	0.90	370000	74000	184238	80072
6/10	14.9	12.2	13.35	0.91	400000	53000	182700	97936
6/11	15.1	12.3	13.44	0.91	423000	52000	190748	94285
6/12	15.2	12.2	13.52	0.98	404000	51000	187992	91154
6/13	15.2	12.4	13.65	0.94	382000	88000	187415	84788
6/14	15.1	12.5	13.80	0.88	405000	83000	184923	89312
6/15	15.0	12.0	13.95	0.78	421000	80000	184878	95103
6/16	15.0	13.0	14.05	0.78	425000	54000	189800	102790
6/17	15.4	13.1	14.22	0.82	430000	44000	185861	107678
6/18	15.7	13.0	14.34	0.87	427000	66000	190269	106608
6/19	16.1	13.0	14.50	0.92	420000	69000	190061	101030
6/20	16.1	13.2	14.53	0.91	410000	80000	190300	98556
6/21	16.0	13.3	14.60	0.91	401000	89000	192007	97068
6/22	16.1	13.5	14.89	0.91	408000	85000	195000	101691
6/23	16.1	13.4	14.72	0.93	408000	61000	193315	107230
6/24	16.3	13.4	14.70	0.99	417000	70000	194338	111589
6/25	16.3	13.3	14.78	1.09	414000	67000	205075	105100
6/26	16.5	13.3	14.78	1.18	411000	62000	196391	108368
6/27	16.8	13.3	14.85	1.20	404000	84000	199516	103522
6/28	16.9	13.3	14.90	1.16	391000	77000	193708	100667
6/29	16.8	13.5	15.03	1.10	390000	72000	192075	104310
6/30	16.6	13.0	15.10	1.10	398000	82000	184133	108454

TEMPERATURE AND FLOW ANALYSIS (SEQUENTIALLY) FROM 1/ 1/71 TO 8/24/83

FOR MONTH OF JULY

DATE	TEMPERATURE (DEG C)				FLOW (CFS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
7/ 1	18.8	13.8	15.24	0.98	393000	70000	181458	108100
7/ 2	18.8	13.8	15.29	1.03	385000	41000	185458	105103
7/ 3	18.9	13.8	15.30	1.03	367000	48000	179608	99953
7/ 4	17.1	13.9	15.48	1.01	341000	39000	163591	100934
7/ 5	17.2	13.9	15.80	0.99	328000	64000	170283	89336
7/ 6	17.1	13.8	15.63	0.95	305000	81000	171833	74830
7/ 7	17.0	13.8	15.86	0.99	298000	82000	177508	78929
7/ 8	17.0	14.0	15.75	1.02	279000	69000	170283	78903
7/ 9	17.1	13.9	15.92	1.09	258000	43000	186875	66745
7/10	17.2	13.9	15.88	1.10	231000	39000	181700	62005
7/11	17.4	14.0	15.94	1.14	227000	64000	157083	50827
7/12	17.5	14.2	16.00	1.07	226000	60000	160018	49250
7/13	17.6	14.5	16.00	1.03	229000	83000	149900	53809
7/14	17.7	14.8	16.26	1.05	257000	70000	151775	56124
7/15	17.8	14.8	16.39	1.01	265000	59000	148150	62233
7/16	17.7	15.0	16.49	0.94	213000	77000	158475	46941
7/17	17.7	15.4	16.83	0.86	217000	63000	155050	48095
7/18	17.9	15.5	16.74	0.85	242000	95000	159450	54848
7/19	18.0	15.4	16.88	0.86	238000	85000	168650	52733
7/20	18.1	15.3	17.03	0.93	240000	72000	152318	55554
7/21	18.1	15.5	17.21	0.80	227000	91000	155633	48848
7/22	18.2	15.5	17.28	0.76	207000	78000	148991	46972
7/23	18.3	15.6	17.36	0.78	199000	72000	151725	42249
7/24	18.3	15.7	17.45	0.82	218000	73000	151158	41676
7/25	18.6	15.8	17.56	0.88	214000	79000	141850	40841
7/26	18.6	15.8	17.66	0.88	208000	66000	139416	46631
7/27	18.8	16.1	17.82	0.86	194000	82000	135483	48728
7/28	18.7	16.3	17.98	0.82	189000	86000	135033	41597
7/29	18.9	16.6	18.00	0.80	197000	83000	132225	49799
7/30	19.1	16.8	17.97	0.81	205800	80000	140341	42319
7/31	19.3	17.0	18.08	0.83	189600	58000	139375	38929

TEMPERATURE AND FLOW ANALYSIS (SEQUENTIALLY) FROM 1/ 1/71 TO 8/24/83

FOR MONTH OF AUGUST

DATE	TEMPERATURE (DEG C)				FLOW (CFS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
8/ 1	19.4	16.6	18.14	0.65	196000	84000	140225	36801
8/ 2	19.5	16.7	18.19	0.79	189000	83000	133891	36092
8/ 3	19.6	16.8	18.24	0.76	228000	68000	137541	56089
8/ 4	19.7	16.9	18.30	0.79	225000	82000	139858	50648
8/ 5	19.5	17.0	18.31	0.76	226000	56000	136716	55311
8/ 6	19.4	17.1	18.33	0.73	218000	62000	137775	50327
8/ 7	19.4	17.0	18.33	0.73	214000	56000	136750	45213
8/ 8	19.4	16.8	18.38	0.76	204000	92000	139418	38330
8/ 9	19.6	17.2	18.45	0.69	180000	90000	134250	36666
8/10	19.6	17.5	18.69	0.63	193000	86500	128841	44469
8/11	19.5	17.6	18.67	0.59	210000	87000	137841	46319
8/12	19.6	17.5	18.75	0.58	199000	57000	127988	44411
8/13	19.8	17.4	18.77	0.62	182000	79000	129533	36601
8/14	19.8	17.3	18.78	0.65	177100	58000	125375	35537
8/15	19.9	17.1	18.70	0.70	165000	65000	121733	28756
8/16	20.1	16.8	18.67	0.85	160000	42000	114675	34501
8/17	20.1	16.8	18.68	0.87	155000	53000	109183	31345
8/18	20.3	16.7	18.57	0.92	223000	72000	115975	41120
8/19	20.1	16.8	18.52	0.88	219000	41000	109568	48488
8/20	20.3	17.0	18.54	0.90	203000	66000	111491	37837
8/21	20.3	17.1	18.60	0.89	175000	49000	105260	33119
8/22	20.0	17.4	18.62	0.76	187000	55000	109816	33480
8/23	19.8	17.6	18.57	0.71	172000	74000	106500	28065
8/24	19.6	17.5	18.57	0.68	188000	63000	98316	30180
8/25	19.6	17.5	18.64	0.70	153000	45000	95658	32532
8/26	20.0	17.6	18.71	0.71	161000	46000	102983	29840
8/27	19.6	17.9	18.72	0.64	154000	55000	101333	26313
8/28	19.8	17.9	18.73	0.62	217000	60000	111425	39250
8/29	19.9	18.0	18.77	0.67	198000	61000	104718	32361
8/30	20.0	17.9	18.73	0.71	179000	80000	109300	24054
8/31	19.6	17.8	18.58	0.68	179000	67400	105083	29591

TEMPERATURE AND FLOW ANALYSIS (SEQUENTIALLY) FROM 1/ 1/71 TO 6/24/83

FOR MONTH OF SEPTEMBER

DATE	TEMPERATURE (DEG C)				FLOW (CFS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
9/ 1	19.7	17.7	18.54	0.71	165000	68000	98003	31411
9/ 2	19.6	17.7	18.49	0.70	152000	38000	92616	30749
9/ 3	19.8	17.6	18.50	0.76	153000	38000	87425	30346
9/ 4	19.8	17.8	18.56	0.87	148000	56000	89216	22863
9/ 5	19.6	17.9	18.59	0.54	148000	49000	86300	27547
9/ 6	19.6	17.9	18.57	0.50	137000	56000	91616	26363
9/ 7	19.6	17.7	18.52	0.55	164000	43000	99283	39906
9/ 8	19.5	17.7	18.48	0.57	194000	68000	105458	35980
9/ 9	19.4	17.5	18.45	0.54	188000	81000	97800	37893
9/10	19.1	17.2	18.33	0.49	171000	60000	100308	36002
9/11	19.3	17.1	18.31	0.58	158000	49000	94175	30993
9/12	19.4	18.8	18.30	0.72	119000	49000	86908	21585
9/13	19.5	18.5	18.25	0.83	132000	49000	88866	26930
9/14	19.6	18.5	18.23	0.87	124000	43800	85700	25967
9/15	19.5	18.5	18.16	0.80	126000	59000	87233	22849
9/16	19.4	18.7	18.14	0.86	114000	64000	90333	17594
9/17	19.2	18.7	18.07	0.83	115000	74000	90142	15234
9/18	19.1	18.7	18.00	0.81	118000	43000	84063	22900
9/19	19.4	18.9	18.00	0.74	117000	48000	78963	18525
9/20	19.6	18.7	17.92	0.78	117000	57000	79933	19842
9/21	19.5	18.8	17.77	0.78	118000	47000	82925	20844
9/22	19.3	18.8	17.68	0.75	119000	57000	81591	18729
9/23	19.3	18.7	17.64	0.79	111000	51000	78325	18193
9/24	19.5	18.7	17.63	0.82	117000	82900	82991	15015
9/25	19.6	18.6	17.60	0.83	119000	53800	81327	17250
9/26	19.5	18.6	17.52	0.83	123000	55600	81575	18421
9/27	19.1	18.5	17.38	0.75	114000	50500	81700	21859
9/28	19.0	18.2	17.26	0.79	112000	42300	79575	22029
9/29	18.8	18.1	17.18	0.73	109000	52000	78033	16778
9/30	18.8	18.1	17.15	0.78	112000	53000	78900	20998

TEMPERATURE AND FLOW ANALYSIS (SEQUENTIALLY) FROM 1/ 1/71 TO 6/24/83

FOR MONTH OF OCTOBER

DATE	TEMPERATURE (DEG C)				FLOW (CFS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
10/ 1	18.8	16.2	17.18	0.78	118000	58000	86233	18156
10/ 2	18.6	16.0	17.09	0.78	129000	48000	84125	26706
10/ 3	18.6	15.6	17.04	0.88	129000	59100	83183	24509
10/ 4	18.6	15.3	16.83	0.94	135000	44000	86141	25601
10/ 5	18.6	15.2	16.77	0.96	114700	52000	80506	28789
10/ 6	18.5	15.2	16.65	0.97	112000	49000	73400	28778
10/ 7	18.5	15.2	16.55	0.98	109000	44000	77608	19702
10/ 8	18.3	15.1	16.45	0.94	111000	57000	83533	14997
10/ 9	18.1	15.0	16.34	0.93	114000	48000	83875	22653
10/10	17.8	14.9	16.18	0.86	109000	50000	83166	18002
10/11	17.8	14.9	16.10	0.86	108000	65000	86158	14780
10/12	17.6	14.6	15.95	0.84	114000	46900	81708	19652
10/13	17.6	14.5	15.88	0.88	121000	51000	78116	18515
10/14	17.6	14.5	15.75	0.61	114000	47000	83800	21950
10/15	17.6	14.4	15.64	0.63	99000	50000	85816	13420
10/16	17.5	14.5	15.61	0.79	109000	42000	80525	20498
10/17	17.1	14.7	15.51	0.71	109000	62000	84000	13622
10/18	17.0	14.5	15.45	0.76	116000	57800	87550	18945
10/19	16.8	14.3	15.38	0.79	117000	47300	87458	20993
10/20	16.7	14.2	15.25	0.81	107000	44000	82700	17919
10/21	16.7	13.9	15.03	0.84	108000	42000	83433	20786
10/22	16.7	13.8	14.89	0.87	116000	49000	86180	19814
10/23	16.6	13.6	14.84	0.85	108300	45000	81108	18076
10/24	16.5	13.5	14.75	0.85	104000	55000	83166	17120
10/25	16.5	13.4	14.68	0.86	117000	55500	83183	19575
10/26	16.2	13.4	14.45	0.81	99000	61100	81275	18811
10/27	16.1	13.3	14.37	0.83	114000	58000	85241	19267
10/28	16.0	13.2	14.25	0.83	122000	51000	80033	19829
10/29	15.7	13.0	14.09	0.75	113000	49000	86808	19441
10/30	15.5	12.9	13.91	0.73	119000	47000	94141	22718
10/31	15.4	12.9	13.81	0.74	118000	50000	88233	20690

TEMPERATURE AND FLOW ANALYSIS (SEQUENTIALLY) FROM 1/ 1/71 TO 6/24/83

FOR MONTH OF NOVEMBER

DATE	TEMPERATURE (DEG C)				FLOW (CFS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
11/ 1	15.3	12.8	13.87	0.79	113000	56100	85783	17268
11/ 2	15.2	12.5	13.55	0.79	123800	49300	90300	20003
11/ 3	15.1	12.4	13.49	0.81	114500	51000	85091	18440
11/ 4	15.0	12.1	13.35	0.87	107000	49000	84875	15330
11/ 5	15.0	11.7	13.21	0.97	106000	62000	90000	15852
11/ 6	14.8	11.5	13.08	0.98	115000	57000	91841	14857
11/ 7	14.7	11.4	12.92	0.97	103000	60000	85075	13741
11/ 8	14.7	11.1	12.78	1.06	112000	89500	93033	13942
11/ 9	14.5	10.9	12.59	1.08	116000	85000	89300	15925
11/10	14.3	10.8	12.39	1.09	123000	39000	87891	22892
11/11	14.2	10.7	12.24	1.10	120000	37000	92058	22494
11/12	14.1	10.5	12.09	1.11	109500	51000	90418	19894
11/13	13.9	10.3	11.91	1.12	122000	53000	92118	21428
11/14	13.8	10.1	11.74	1.14	121000	61000	87018	15958
11/15	13.8	9.8	11.63	1.21	136000	47000	95800	23887
11/16	13.7	9.8	11.39	1.23	151000	48000	97800	28041
11/17	13.7	9.4	11.33	1.29	132000	63000	89968	21139
11/18	13.6	9.2	11.07	1.30	127000	40000	95733	22768
11/19	13.5	8.8	10.85	1.37	134000	63000	95018	21529
11/20	13.4	8.2	10.69	1.43	119000	46000	93558	20877
11/21	13.4	8.4	10.85	1.43	134000	53000	97068	22544
11/22	13.3	8.8	10.52	1.44	113000	44000	94041	19913
11/23	13.2	8.5	10.32	1.43	112000	63000	93700	15844
11/24	13.2	8.8	10.18	1.38	128000	43000	88968	26887
11/25	13.1	8.5	10.05	1.39	118000	58000	85591	20781
11/26	12.7	8.4	9.88	1.38	122000	63000	87433	19719
11/27	12.5	8.1	9.75	1.26	122000	48000	89383	22333
11/28	12.5	8.0	9.64	1.27	111000	61000	89025	15981
11/29	12.4	7.9	9.51	1.22	114000	74000	95808	13510
11/30	12.4	7.9	9.39	1.22	114000	80700	98700	9811

TEMPERATURE AND FLOW ANALYSIS (SEQUENTIALLY) FROM 1/ 1/71 TO 6/24/83

FOR MONTH OF DECEMBER

DATE	TEMPERATURE (DEG C)				FLOW (CFS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
12/ 1	12.2	8.0	9.32	1.21	127000	51000	95908	21297
12/ 2	11.9	8.0	9.24	1.13	118000	42000	88825	21480
12/ 3	11.4	7.8	9.07	1.03	120100	50000	92683	22196
12/ 4	11.0	7.6	8.98	0.98	128000	57000	96325	22213
12/ 5	10.7	7.5	8.81	0.91	122000	49000	94108	21505
12/ 6	10.1	7.2	8.59	0.82	125000	78400	97283	14412
12/ 7	9.5	7.0	8.41	0.77	133000	83700	101258	14115
12/ 8	9.3	6.8	8.25	0.80	157000	77900	109933	22706
12/ 9	9.2	6.6	8.08	0.88	145000	64000	99491	23399
12/10	9.1	6.3	7.91	0.90	134000	77000	108306	17232
12/11	9.1	6.3	7.78	0.86	150000	74000	108508	24911
12/12	9.2	6.1	7.73	0.89	151000	68700	106991	22728
12/13	9.3	5.9	7.63	0.94	170000	74000	107891	22968
12/14	9.3	5.7	7.53	0.97	126000	78000	97496	13658
12/15	9.2	6.1	7.55	0.90	150000	61000	100808	23943
12/16	9.1	6.2	7.50	0.87	123000	57000	97841	16516
12/17	8.8	6.4	7.43	0.82	131000	61000	96700	23403
12/18	8.6	6.4	7.40	0.73	140000	65800	99868	22888
12/19	8.5	6.3	7.31	0.77	125000	75500	100050	15570
12/20	8.3	6.0	7.21	0.77	119000	54300	98950	17594
12/21	8.2	5.6	7.03	0.85	114000	58300	93616	15495
12/22	8.3	5.4	6.91	0.91	123000	82200	99775	12853
12/23	8.2	5.6	6.82	0.87	126000	65600	95475	19573
12/24	8.1	5.6	6.71	0.86	111000	41000	81583	22953
12/25	8.0	5.7	6.66	0.83	96000	38000	67691	17406
12/26	7.9	5.5	6.54	0.88	123000	48000	84818	24984
12/27	7.9	5.3	6.43	0.95	141000	80200	105250	18238
12/28	7.9	5.2	6.32	0.90	151000	85000	110008	19269
12/29	7.8	5.2	6.18	0.83	172000	67000	114333	27321
12/30	7.7	5.0	6.01	0.84	183000	54000	115816	32085
12/31	7.8	4.7	5.85	0.92	166000	53000	110250	28316

PERCENT OF TIME TEMPERATURE EXCEEDS A GIVEN MINIMUM
WHILE FLOW RATE IS BELOW A GIVEN MAXIMUM

MINIMUM TEMPERATURE	MAXIMUM FLOW	NO. OF TIMES CRITERIA MET	PERCENT OF TIME
18.0 DEG C	100000 CFS	297	6.8
17.0 DEG C	90000 CFS	342	7.8

APPENDIX D

OUTPUT RESULTS FOR SAMPLE PROBLEM 3

DISTRIBUTION OF AVERAGE DAILY TEMPERATURES (SEASONALLY) FROM 4/18/65 TO 8/15/84

TEMP (DEG C)	NO. OF TIMES EXCEEDED	PER CENT OF TIME	RANGE	DAYS WITHIN	PER CENT OF TIME
0.0	1189	100.000	-0.5 - 0.4	0	0.000
1.0	1189	100.000	0.5 - 1.4	0	0.000
2.0	1189	100.000	1.5 - 2.4	0	0.000
3.0	1189	100.000	2.5 - 3.4	0	0.000
4.0	1189	100.000	3.5 - 4.4	0	0.000
5.0	1189	100.000	4.5 - 5.4	0	0.000
6.0	1184	99.579	5.5 - 6.4	12	1.009
7.0	1128	94.701	6.5 - 7.4	94	7.906
8.0	995	83.684	7.5 - 8.4	146	12.279
9.0	864	72.666	8.5 - 9.4	119	10.008
10.0	714	60.050	9.5 - 10.4	216	17.682
11.0	495	41.632	10.5 - 11.4	183	15.391
12.0	318	26.745	11.5 - 12.4	191	16.064
13.0	147	12.363	12.5 - 13.4	131	11.018
14.0	53	4.458	13.5 - 14.4	70	5.887
15.0	4	0.336	14.5 - 15.4	33	2.775
16.0	0	0.000	15.5 - 16.4	0	0.000
17.0	0	0.000	16.5 - 17.4	0	0.000
18.0	0	0.000	17.5 - 18.4	0	0.000
19.0	0	0.000	18.5 - 19.4	0	0.000
20.0	0	0.000	19.5 - 20.4	0	0.000
21.0	0	0.000	20.5 - 21.4	0	0.000
22.0	0	0.000	21.5 - 22.4	0	0.000

DISTRIBUTION OF AVERAGE DAILY FLOW (SEASONALLY) FROM 4/18/68 TO 8/15/84

FLOW (CFS)	NO. OF TIMES EXCEEDED	PER CENT OF TIME	RANGE	DAYS WITHIN	PER CENT OF TIME
36000	1524	100.000	35250 - 36749	0	0.000
37500	1524	100.000	36750 - 38249	0	0.000
39000	1524	100.000	38250 - 39749	0	0.000
40500	1523	99.934	39750 - 41249	1	0.066
42000	1520	99.738	41250 - 42749	3	0.197
43500	1518	99.606	42750 - 44249	2	0.131
45000	1518	99.475	44250 - 45749	4	0.262
46500	1514	99.344	45750 - 47249	2	0.131
48000	1511	99.147	47250 - 48749	1	0.066
49500	1510	99.081	48750 - 50249	2	0.131
51000	1504	98.688	50250 - 51749	6	0.328
52500	1500	98.425	51750 - 53249	6	0.394
54000	1498	98.294	53250 - 54749	2	0.131
55500	1496	98.097	54750 - 56249	2	0.131
57000	1494	98.831	56250 - 57749	5	0.328
58500	1488	97.838	57750 - 59249	3	0.197
60000	1480	97.113	59250 - 60749	7	0.459
61500	1478	96.982	60750 - 62249	4	0.262
63000	1473	96.854	62250 - 63749	3	0.197
64500	1470	96.457	63750 - 65249	5	0.328
66000	1462	95.932	65250 - 66749	5	0.328
67500	1458	95.689	66750 - 68249	6	0.394
69000	1455	95.472	68250 - 69749	2	0.131
70500	1449	95.079	69750 - 71249	8	0.525
72000	1441	94.554	71250 - 72749	10	0.658
73500	1430	93.832	72750 - 74249	10	0.658
75000	1424	93.438	74250 - 75749	2	0.131
76500	1421	93.241	75750 - 77249	7	0.459
78000	1418	92.520	77250 - 78749	10	0.658
79500	1403	92.060	78750 - 80249	7	0.459
81000	1393	91.404	80250 - 81749	8	0.525
82500	1389	91.142	81750 - 83249	8	0.525
84000	1382	90.682	83250 - 84749	3	0.197
85500	1372	90.026	84750 - 86249	14	0.919
87000	1383	89.438	86250 - 87749	7	0.459
88500	1358	88.976	87750 - 89249	8	0.525
90000	1341	87.992	89250 - 90749	11	0.722
91500	1337	87.730	90750 - 92249	18	1.181
93000	1320	86.614	92250 - 93749	6	0.394
94500	1310	85.958	93750 - 95249	14	0.919
96000	1301	85.367	95250 - 96749	6	0.394
97500	1291	84.711	96750 - 98249	12	0.787
99000	1283	84.186	98250 - 99749	3	0.197
100500	1274	83.596	99750 - 101249	14	0.919
102000	1268	82.677	101250 - 102749	8	0.525
103500	1249	81.955	102750 - 104249	18	1.181
105000	1238	81.102	104250 - 105749	8	0.525
106500	1228	80.448	105750 - 107249	18	1.181
108000	1207	79.199	107250 - 108749	12	0.787

DISTRIBUTION OF AVERAGE DAILY FLOW (SEASONALLY) FROM 4/18/68 TO 8/15/84

FLOW (CFS)	NO. OF TIMES EXCEEDED	PER CENT OF TIME	RANGE	DAYS WITHIN	PER CENT OF TIME
109500	1192	78.215	108750 - 110249	21	1.378
111000	1174	77.834	110250 - 111749	9	0.591
112500	1168	78.509	111750 - 113249	18	1.050
114000	1147	75.282	113250 - 114749	12	0.787
115500	1144	76.068	114750 - 116249	12	0.787
117000	1127	73.950	116250 - 117749	8	0.525
118500	1119	73.425	117750 - 119249	14	0.919
120000	1109	72.769	119250 - 120749	5	0.328
121500	1101	72.244	120750 - 122249	15	0.984
123000	1083	71.063	122250 - 123749	10	0.656
124500	1073	70.407	123750 - 125249	25	1.640
126000	1048	68.635	125250 - 126749	13	0.853
127500	1041	68.307	126750 - 128249	10	0.656
129000	1026	67.267	128250 - 129749	12	0.787
130500	1018	68.067	129750 - 131249	14	0.919
132000	997	66.420	131250 - 132749	13	0.853
133500	991	65.028	132750 - 134249	11	0.722
135000	977	64.108	134250 - 135749	7	0.459
136500	969	63.583	135750 - 137249	14	0.919
138000	953	62.533	137250 - 138749	12	0.787
139500	941	61.745	138750 - 140249	21	1.378
141000	921	60.433	140250 - 141749	10	0.656
142500	914	59.974	141750 - 143249	18	1.181
144000	898	58.793	143250 - 144749	10	0.656
145500	882	57.074	144750 - 146249	19	1.247
147000	863	56.027	146250 - 147749	12	0.787
148500	853	55.971	147750 - 149249	13	0.853
150000	841	55.184	149250 - 150749	9	0.591
151500	830	54.858	150750 - 152249	10	0.656
153000	818	53.543	152250 - 153749	16	1.050
154500	801	52.559	153750 - 155249	17	1.115
156000	785	51.509	155250 - 156749	17	1.115
157500	769	50.459	156750 - 158249	17	1.115
159000	753	49.409	158250 - 159749	13	0.853
160500	737	48.360	159750 - 161249	18	1.050
162000	725	47.572	161250 - 162749	9	0.591
163500	712	46.719	162750 - 164249	22	1.444
165000	696	45.004	164250 - 165749	8	0.525
166500	687	45.079	165750 - 167249	18	1.050
168000	673	44.180	167250 - 168749	7	0.459
169500	663	43.504	168750 - 170249	17	1.115
171000	647	42.454	170250 - 171749	10	0.656
172500	632	41.470	171750 - 173249	12	0.787
174000	624	40.945	173250 - 174749	8	0.525
175500	617	40.488	174750 - 176249	18	1.050
177000	604	39.833	176250 - 177749	4	0.262
178500	599	39.304	177750 - 179249	10	0.656
180000	588	38.583	179250 - 180749	8	0.525
181500	585	38.386	180750 - 182249	5	0.328
183000	572	37.533	182250 - 183749	10	0.656

DISTRIBUTION OF AVERAGE DAILY FLOW (SEASONALLY) FROM 4/16/60 TO 8/15/64

FLOW (CFS)	NO. OF TIMES EXCEEDED	PER CENT OF TIME	RANGE	DAYS WITHIN	PER CENT OF TIME
184500	589	38.942	183750 - 185249	12	0.787
186000	557	38.549	185250 - 186749	6	0.328
187500	547	35.892	186750 - 188249	14	0.919
189000	535	35.185	188250 - 189749	9	0.591
190500	523	34.318	189750 - 191249	13	0.853
192000	513	33.661	191250 - 192749	9	0.591
193500	505	33.136	192750 - 194249	8	0.394
195000	499	32.743	194250 - 195749	7	0.459
196500	496	32.546	195750 - 197249	2	0.131
198000	491	32.218	197250 - 198749	3	0.197
199500	483	31.893	198750 - 200249	9	0.591
201000	476	31.234	200250 - 201749	9	0.591
202500	467	30.843	201750 - 203249	10	0.658
204000	455	29.856	203250 - 204749	10	0.658
205500	452	29.859	204750 - 206249	10	0.658
207000	438	28.809	206250 - 207749	8	0.525
208500	433	28.412	207750 - 209249	8	0.525
210000	418	27.297	209250 - 210749	13	0.853
211500	409	26.837	210750 - 212249	8	0.525
213000	402	26.378	212250 - 213749	4	0.262
214500	396	25.984	213750 - 215249	11	0.722
216000	387	25.394	215250 - 216749	5	0.328
217500	381	25.000	216750 - 218249	9	0.591
219000	372	24.409	218250 - 219749	6	0.394
220500	366	24.016	219750 - 221249	13	0.853
222000	352	23.097	221250 - 222749	6	0.394
223500	350	22.968	222750 - 224249	4	0.262
225000	344	22.572	224250 - 225749	5	0.328
226500	341	22.375	225750 - 227249	6	0.394
228000	336	21.854	227250 - 228749	8	0.525
229500	325	21.325	228750 - 230249	7	0.459
231000	319	20.932	230250 - 231749	3	0.197
232500	317	20.801	231750 - 233249	7	0.459
234000	311	20.407	233250 - 234749	2	0.131
235500	306	20.079	234750 - 236249	9	0.591
237000	298	19.554	236250 - 237749	4	0.262
238500	293	19.226	237750 - 239249	6	0.394
240000	283	18.570	239250 - 240749	8	0.525
241500	278	18.241	240750 - 242249	9	0.591
243000	269	17.851	242250 - 243749	7	0.459
244500	261	17.126	243750 - 245249	8	0.525
246000	255	16.732	245250 - 246749	4	0.262
247500	251	16.470	246750 - 248249	6	0.394
249000	247	16.207	248250 - 249749	4	0.262
250500	241	15.814	249750 - 251249	5	0.328
252000	239	15.682	251250 - 252749	2	0.131
253500	238	15.486	252750 - 254249	2	0.131
255000	234	15.354	254250 - 255749	2	0.131
256500	233	15.289	255750 - 257249	5	0.328
258000	225	14.784	257250 - 258749	5	0.328

DISTRIBUTION OF AVERAGE DAILY FLOW (SEASONALLY) FROM 4/16/80 TO 8/15/84

FLOW (CFS)	NO. OF TIMES EXCEEDED	PER CENT OF TIME	RANGE	DAYS WITHIN	PER CENT OF TIME
259500	221	14.501	258750 - 280249	5	0.328
261000	216	14.173	260250 - 261749	3	0.197
262500	214	14.042	261750 - 263249	4	0.262
264000	211	13.845	263250 - 264749	1	0.066
265500	210	13.780	264750 - 266249	4	0.262
267000	203	13.320	266250 - 267749	4	0.262
268500	201	13.189	267750 - 269249	3	0.197
270000	197	12.927	269250 - 270749	3	0.197
271500	197	12.927	270750 - 272249	2	0.131
273000	194	12.730	272250 - 273749	1	0.066
274500	194	12.730	273750 - 275249	1	0.066
276000	192	12.598	275250 - 276749	2	0.131
277500	190	12.467	276750 - 278249	7	0.459
279000	184	12.073	278250 - 279749	0	0.000
280500	182	11.942	279750 - 281249	7	0.459
282000	176	11.549	281250 - 282749	2	0.131
283500	173	11.352	282750 - 284249	6	0.394
285000	165	10.827	284250 - 285749	4	0.262
286500	164	10.761	285750 - 287249	7	0.459
288000	158	10.238	287250 - 288749	3	0.197
289500	153	10.039	288750 - 290249	6	0.394
291000	147	9.646	290250 - 291749	4	0.262
292500	141	9.252	291750 - 293249	5	0.328
294000	138	9.055	293250 - 294749	2	0.131
295500	135	8.858	294750 - 296249	6	0.394
297000	128	8.399	296250 - 297749	4	0.262
298500	119	7.800	297750 - 299249	12	0.787
300000	111	7.283	299250 - 300749	5	0.328
301500	107	7.021	300750 - 302249	9	0.591
303000	99	6.496	302250 - 303749	3	0.197
304500	97	6.365	303750 - 305249	5	0.328
306000	92	6.037	305250 - 306749	2	0.131
307500	88	5.774	306750 - 308249	8	0.525
309000	80	5.249	308250 - 309749	4	0.262
310500	78	5.116	309750 - 311249	7	0.459
312000	71	4.659	311250 - 312749	2	0.131
313500	71	4.659	312750 - 314249	0	0.000
315000	70	4.563	314250 - 315749	1	0.066
316500	70	4.593	315750 - 317249	2	0.131
318000	66	4.331	317250 - 318749	2	0.131
319500	65	4.265	318750 - 320249	1	0.066
321000	65	4.265	320250 - 321749	0	0.000
322500	64	4.199	321750 - 323249	2	0.131
324000	62	4.068	323250 - 324749	1	0.066
325500	62	4.068	324750 - 326249	1	0.066
327000	59	3.871	326250 - 327749	2	0.131
328500	59	3.871	327750 - 329249	0	0.000
330000	58	3.806	329250 - 330749	1	0.066
331500	57	3.740	330750 - 332249	2	0.131
333000	56	3.675	332250 - 333749	0	0.000

DISTRIBUTION OF AVERAGE DAILY FLOW (SEASONALLY) FROM 4/16/80 TO 6/15/84

FLOW (CFS)	NO. OF TIMES EXCEEDED	PER CENT OF TIME	RANGE	DAYS WITHIN	PER CENT OF TIME
334500	58	3.675	333750 - 335249	2	0.131
336000	53	3.478	335250 - 336749	1	0.066
337500	52	3.412	336750 - 338249	1	0.066
339000	52	3.412	338250 - 339749	0	0.000
340500	51	3.346	339750 - 341249	1	0.066
342000	51	3.346	341250 - 342749	0	0.000
343500	51	3.346	342750 - 344249	2	0.131
345000	48	3.150	344250 - 345749	1	0.066
346500	48	3.150	345750 - 347249	0	0.000
348000	47	3.084	347250 - 348749	1	0.066
349500	46	3.018	348750 - 350249	3	0.197
351000	44	2.887	350250 - 351749	0	0.000
352500	44	2.887	351750 - 353249	0	0.000
354000	44	2.887	353250 - 354749	0	0.000
355500	44	2.887	354750 - 356249	0	0.000
357000	44	2.887	356250 - 357749	0	0.000
358500	44	2.887	357750 - 359249	0	0.000
360000	43	2.822	359250 - 360749	1	0.066
361500	42	2.756	360750 - 362249	1	0.066
363000	42	2.756	362250 - 363749	0	0.000
364500	42	2.756	363750 - 365249	0	0.000
366000	42	2.756	365250 - 366749	0	0.000
367500	42	2.756	366750 - 368249	0	0.000
369000	42	2.756	368250 - 369749	0	0.000
370500	42	2.756	369750 - 371249	0	0.000
372000	42	2.756	371250 - 372749	0	0.000
373500	41	2.690	372750 - 374249	2	0.131
375000	40	2.625	374250 - 375749	0	0.000
376500	39	2.559	375750 - 377249	1	0.066
378000	38	2.493	377250 - 378749	1	0.066
379500	38	2.493	378750 - 380249	0	0.000
381000	38	2.493	380250 - 381749	0	0.000
382500	36	2.382	381750 - 383249	2	0.131
384000	36	2.382	383250 - 384749	0	0.000
385500	36	2.382	384750 - 386249	0	0.000
387000	35	2.297	386250 - 387749	1	0.066
388500	35	2.297	387750 - 389249	0	0.000
390000	35	2.297	389250 - 390749	0	0.000
391500	35	2.297	390750 - 392249	0	0.000
393000	35	2.297	392250 - 393749	0	0.000
394500	35	2.297	393750 - 395249	2	0.131
396000	33	2.185	395250 - 396749	0	0.000
397500	33	2.185	396750 - 398249	0	0.000
399000	33	2.185	398250 - 399749	0	0.000
400500	33	2.185	399750 - 401249	0	0.000
402000	33	2.185	401250 - 402749	0	0.000
403500	33	2.185	402750 - 404249	3	0.197
405000	29	1.903	404250 - 405749	1	0.066
406500	28	1.837	405750 - 407249	1	0.066
408000	27	1.772	407250 - 408749	1	0.066

DISTRIBUTION OF AVERAGE DAILY FLOW (SEASONALLY) FROM 4/16/80 TO 6/15/84

FLOW (CFS)	NO. OF TIMES EXCEEDED	PER CENT OF TIME	RANGE	DAYS WITHIN	PER CENT OF TIME
409500	27	1.772	408750 - 410249	0	0.000
411000	27	1.772	410250 - 411749	0	0.000
412500	27	1.772	411750 - 413249	0	0.000
414000	27	1.772	413250 - 414749	0	0.000
415500	27	1.772	414750 - 416249	0	0.000
417000	27	1.772	416250 - 417749	0	0.000
418500	27	1.772	417750 - 419249	0	0.000
420000	27	1.772	419250 - 420749	0	0.000
421500	28	1.700	420750 - 422249	1	0.000
423000	28	1.700	422250 - 423749	1	0.000
424500	24	1.575	423750 - 425249	1	0.000
426000	24	1.575	425250 - 426749	0	0.000
427500	23	1.500	426750 - 428249	1	0.000
429000	23	1.500	428250 - 429749	0	0.000
430500	22	1.444	429750 - 431249	1	0.000
432000	22	1.444	431250 - 432749	1	0.000
433500	21	1.378	432750 - 434249	0	0.000
435000	21	1.378	434250 - 435749	0	0.000
436500	20	1.312	435750 - 437249	1	0.000
438000	20	1.312	437250 - 438749	0	0.000
439500	20	1.312	438750 - 440249	0	0.000
441000	20	1.312	440250 - 441749	1	0.000
442500	19	1.247	441750 - 443249	0	0.000
444000	19	1.247	443250 - 444749	0	0.000
445500	18	1.181	444750 - 446249	1	0.000
447000	18	1.181	446250 - 447749	0	0.000
448500	18	1.181	447750 - 449249	1	0.000
450000	17	1.115	449250 - 450749	0	0.000
451500	17	1.115	450750 - 452249	1	0.000
453000	16	1.050	452250 - 453749	1	0.000
454500	13	0.853	453750 - 455249	2	0.131
456000	13	0.853	455250 - 456749	0	0.000
457500	13	0.853	456750 - 458249	0	0.000
459000	13	0.853	458250 - 459749	0	0.000
460500	12	0.787	459750 - 461249	2	0.131
462000	11	0.722	461250 - 462749	0	0.000
463500	11	0.722	462750 - 464249	0	0.000
465000	11	0.722	464250 - 465749	0	0.000
466500	11	0.722	465750 - 467249	1	0.000
468000	10	0.656	467250 - 468749	0	0.000
469500	10	0.656	468750 - 470249	0	0.000
471000	10	0.656	470250 - 471749	0	0.000
472500	10	0.656	471750 - 473249	0	0.000
474000	10	0.656	473250 - 474749	0	0.000
475500	10	0.656	474750 - 476249	0	0.000
477000	10	0.656	476250 - 477749	0	0.000
478500	10	0.656	477750 - 479249	1	0.000
480000	9	0.591	479250 - 480749	0	0.000
481500	9	0.591	480750 - 482249	0	0.000
483000	9	0.591	482250 - 483749	0	0.000

DISTRIBUTION OF AVERAGE DAILY FLOW (SEASONALLY) FROM 4/18/68 TO 6/15/84

FLOW (CFS)	NO. OF TIMES EXCEEDED	PER CENT OF TIME	RANGE	DAYS WITHIN	PER CENT OF TIME
484500	9	0.591	483750 - 485249	0	0.000
486000	9	0.591	485250 - 486749	0	0.000
487500	9	0.591	486750 - 488249	0	0.000
489000	9	0.591	488250 - 489749	0	0.000
490500	8	0.525	489750 - 491249	1	0.066
492000	8	0.525	491250 - 492749	0	0.000
493500	7	0.459	492750 - 494249	1	0.066
495000	7	0.459	494250 - 495749	0	0.000
496500	6	0.394	495750 - 497249	1	0.066
498000	6	0.394	497250 - 498749	0	0.000
499500	5	0.328	498750 - 500249	1	0.066
501000	5	0.328	500250 - 501749	0	0.000
502500	3	0.197	501750 - 503249	2	0.131
504000	3	0.197	503250 - 504749	0	0.000
505500	3	0.197	504750 - 506249	1	0.066
507000	2	0.131	506250 - 507749	0	0.000
508500	2	0.131	507750 - 509249	0	0.000
510000	2	0.131	509250 - 510749	0	0.000
511500	1	0.066	510750 - 512249	1	0.066
513000	1	0.066	512250 - 513749	1	0.066
514500	0	0.000	513750 - 515249	0	0.000
516000	0	0.000	515250 - 516749	0	0.000
517500	0	0.000	516750 - 518249	0	0.000
519000	0	0.000	518250 - 519749	0	0.000
520500	0	0.000	519750 - 521249	0	0.000
522000	0	0.000	521250 - 522749	0	0.000
523500	0	0.000	522750 - 524249	0	0.000
525000	0	0.000	524250 - 525749	0	0.000
526500	0	0.000	525750 - 527249	0	0.000
528000	0	0.000	527250 - 528749	0	0.000
529500	0	0.000	528750 - 530249	0	0.000
531000	0	0.000	530250 - 531749	0	0.000
532500	0	0.000	531750 - 533249	0	0.000
534000	0	0.000	533250 - 534749	0	0.000
535500	0	0.000	534750 - 536249	0	0.000
537000	0	0.000	536250 - 537749	0	0.000
538500	0	0.000	537750 - 539249	0	0.000
540000	0	0.000	539250 - 540749	0	0.000
541500	0	0.000	540750 - 542249	0	0.000
543000	0	0.000	542250 - 543749	0	0.000
544500	0	0.000	543750 - 545249	0	0.000
546000	0	0.000	545250 - 546749	0	0.000
547500	0	0.000	546750 - 548249	0	0.000
549000	0	0.000	548250 - 549749	0	0.000
550500	0	0.000	549750 - 551249	0	0.000

TEMPERATURE AND FLOW ANALYSIS (SEASONALLY) FROM 4/16/59 TO 8/15/84

FOR MONTH OF APRIL

DATE	TEMPERATURE (DEG C)				FLOW (CFS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
4/16	8.4	5.7	7.05	0.70	201000	50400	122324	43198
4/17	8.6	5.7	7.15	0.73	192000	44300	119500	44700
4/18	8.3	5.8	7.20	0.70	190000	57600	122700	39733
4/19	8.3	6.0	7.24	0.70	207000	45500	125428	40873
4/20	8.5	6.2	7.37	0.70	193000	54500	122936	34702
4/21	8.6	6.5	7.50	0.67	192000	65400	119976	37497
4/22	8.7	6.5	7.64	0.71	199000	58800	121264	39263
4/23	8.8	7.0	7.84	0.68	206000	57400	120992	38142
4/24	9.1	7.1	8.00	0.71	202000	51000	122004	40190
4/25	9.3	7.0	8.07	0.70	210000	54600	119268	42612
4/26	9.5	7.2	8.23	0.69	202000	43100	115792	46082
4/27	9.6	7.3	8.32	0.65	212000	50700	119448	43612
4/28	9.7	7.2	8.48	0.70	201000	45300	119180	43722
4/29	9.9	7.2	8.57	0.75	204000	56000	121464	40041
4/30	10.1	7.4	8.78	0.75	210000	41700	122436	41072

TEMPERATURE AND FLOW ANALYSIS (SEASONALLY) FROM 4/18/59 TO 8/15/84

FOR MONTH OF MAY

DATE	TEMPERATURE (DEG C)				FLOW (CFS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
5/ 1	10.3	7.5	8.93	0.79	213000	52000	128532	39796
5/ 2	10.4	7.7	9.11	0.77	243000	57200	135220	44778
5/ 3	10.5	7.7	9.25	0.77	214000	65000	137704	44480
5/ 4	10.7	7.8	9.36	0.84	251000	70500	140500	48000
5/ 5	10.9	7.8	9.45	0.85	244000	83000	142932	47555
5/ 6	10.8	7.9	9.57	0.78	249000	59300	139084	50110
5/ 7	10.7	8.2	9.68	0.67	252000	49000	141908	50540
5/ 8	10.9	8.5	9.81	0.62	270000	42000	148212	55790
5/ 9	10.8	9.0	9.94	0.52	272000	70300	154808	51484
5/10	10.8	9.1	9.99	0.50	270000	65300	155310	50814
5/11	11.2	9.2	10.09	0.55	270000	59300	156012	51344
5/12	11.3	9.4	10.21	0.55	280000	64000	153000	52023
5/13	11.7	9.5	10.36	0.52	281000	62000	168624	57373
5/14	12.1	9.6	10.43	0.55	283000	55600	161064	55153
5/15	12.6	9.6	10.53	0.62	299000	52000	163412	58509
5/16	13.0	9.6	10.69	0.73	309000	78100	167696	59059
5/17	13.3	9.9	10.77	0.72	298000	86000	169936	61177
5/18	13.6	10.1	10.88	0.77	295000	85000	174272	61727
5/19	13.8	10.3	11.01	0.82	288000	82000	175108	61398
5/20	13.8	10.3	11.10	0.80	289000	80000	176488	62039
5/21	13.9	10.4	11.33	0.81	285000	87000	181360	60892
5/22	14.0	10.3	11.47	0.83	302000	80000	185836	62281
5/23	14.1	10.4	11.62	0.82	297000	89200	191348	58811
5/24	13.9	10.2	11.65	0.86	302000	94000	197392	55532
5/25	13.7	10.1	11.74	0.82	318000	85000	197441	58584
5/26	13.7	10.5	11.80	0.79	349000	47000	199304	66029
5/27	13.6	10.7	11.85	0.75	350000	47000	200596	69904
5/28	14.0	10.9	11.91	0.72	360000	40000	202460	76113
5/29	14.4	11.1	12.04	0.76	376000	45000	208436	74828
5/30	14.6	11.1	12.11	0.80	387000	72000	218720	74886
5/31	14.5	11.1	12.19	0.77	395000	78000	220924	73601

TEMPERATURE AND FLOW ANALYSIS (SEASONALLY) FROM 4/16/69 TO 6/15/84
FOR MONTH OF JUNE

DATE	TEMPERATURE (DEG C)				FLOW (CFS)			
	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.	MAXIMUM	MINIMUM	AVERAGE	STD. DEV.
6/ 1	14.4	11.6	12.27	0.83	404000	107000	222750	74404
6/ 2	14.3	11.0	12.44	0.84	424000	83000	225580	83354
6/ 3	14.4	11.0	12.51	0.90	441000	59000	223820	93153
6/ 4	14.6	11.3	12.83	0.94	453000	58000	228032	94423
6/ 5	14.9	11.5	12.80	0.99	461000	42000	228424	98958
6/ 6	15.0	11.5	12.89	0.98	479000	80000	233124	97528
6/ 7	15.0	11.6	13.04	0.95	493000	80000	236064	99867
6/ 8	14.9	11.8	13.16	0.93	499000	71000	239012	108398
6/ 9	14.8	12.1	13.18	0.83	502000	74000	237416	109904
6/10	14.9	12.2	13.26	0.81	511000	63000	239280	118112
6/11	15.1	12.2	13.32	0.82	513000	52000	247928	116203
6/12	15.2	12.2	13.40	0.90	508000	51000	245068	114094
6/13	15.2	12.3	13.50	0.90	502000	88000	245232	111332
6/14	15.1	12.5	13.62	0.88	498000	83000	245024	113893
6/15	15.0	12.6	13.77	0.82	490000	80000	245092	116241

PERCENT OF TIME TEMPERATURE EXCEEDS A GIVEN MINIMUM
WHILE FLOW RATE IS BELOW A GIVEN MAXIMUM

MINIMUM TEMPERATURE	MAXIMUM FLOW	NO. OF TIMES CRITERIA MET	PERCENT OF TIME
8.0 DEG C	70000 CFS	55	4.3
12.0 DEG C	100000 CFS	53	4.1

APPENDIX E

FLOW DIAGRAM OF COLSTAT4

APPENDIX F

COLSTAT4 COMPUTER LISTING

***** COLSTAT4.FOR *****

COLUMBIA RIVER STATISTICAL UPDATE MODEL -- VERSION 4.0

Developed by: R. D. Brockhaus, D. W. Damschen, R. S. Argo, C. A. Newbill, G. Whelan, Pacific Northwest Laboratory, Richland, Washington.

Documentation: Whelan, G., D. W. Damschen and R. D. Brockhaus, 1986. Columbia River Statistical Update Model - Version 4.0

(COLSTAT4): Background Documentation and User's Guide.

Pacific Northwest Laboratory, Richland, Washington.

Whelan G., R.S. Argo, D.W. Damschen and C.A. Newbill, 1985. Columbia River Statistical Update Model - Version

3.0 (COLSTAT3). Pacific Northwest Laboratory, Richland, Washington.

Whelan G. and C.A. Newbill. 1983. Update of Columbia

River Flow and Temperature Data Measured at Priest

Rapids Dam and Vernita Bridge. PNL-4868. Pacific

Northwest Laboratory, Richland, Washington.

COLSTAT4 calculates the number of days exceeding a given flow or temperature and what percentage of total days exceeds that value.

MONDYS = NUMBER OF DAYS PRECEEDING EACH MONTH
MONDS = NUMBER OF DAYS IN EACH MONTH

Author(s):

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Battelle Northwest
Richland, WA. 99352
01/02/85

Revised by:

C R. D. Brockhaus
 C Earth Sciences Department
 C Pacific Northwest Laboratory
 C Richland, Washington 99352
 C 23-August-1986

CHARACTER*6 DEV

REAL*8 CMDFIL(10)

COMMON /M/ MONDYS(12), MONDS(12)
 COMMON/EXC/RMINT,RMAXT,RINCT,RMINF,RMAXF,RINCF,
 +IP(15000),FL(15000),IUNF,IUNT

DATA MONDYS/0,31,59,90,120,151,181,212,243,273,304,334/
 DATA MONDS/31,29,31,30,31,30,31,31,30,31,30,31/
 DATA CMDFIL /,'FM1.CMD','FC3.CMD','FC2.CMD','FM4.CMD',
 1 'FP3.CMD','TC3.CMD','TM1.CMD','TC2.CMD','TC9.CMD',
 2 'TP3.CMD'/

Write the header information to the screen

IPLOTS = 0

20 WRITE(*,20)
 FORMAT(13X,'COLUMBIA RIVER STATISTICAL UPDATE MODEL --',
 1 'VERSION 4.0'//
 2 'Developed by: R.D. Brockhaus, D.W. Damschen, R.S. Argo, ',
 3 'C.A. Newbill',/
 3 'and G. Whelan, Pacific Northwest Laboratory, ',/
 4 'Richland, Washington.'///
 5 'Documentation: Whelan G., D.W. Damschen, and R.D. Brockhaus.',
 5 '1986.'//
 6 ' "Columbia River Statistical Update Model ',
 6 '-- Version 4.0 '/
 7 '(COLSTAT4): Background Documentation and ',
 7 'Users Guide" ',/
 3 'Pacific Northwest Laboratory, Richland, ',
 3 'Washington.'///
 5 'Whelan G., R.S. Argo, D.W. Damschen and C.A. ',
 5 'Newbill, 1985.'//
 6 ' "Columbia River Statistical Update Model ',
 6 '-- Version 3.0 '/
 7 '(COLSTAT3): Update of Columbia River Flow ',
 7 'and Temperature ',/
 2 'Data Measured at Priest Rapids Dam and Vernita ',
 2 'Bridge'//
 3 'Pacific Northwest Laboratory, Richland, ',
 3 'Washington.'///
 4 'Whelan G. and C.A. Newbill. 1983. "Update of ',
 4 'Columbia ',/
 5 'River Flow and Temperature Data Measured at ',
 5 'Priest Rapids '//

```

2'          Dam and Vernita Bridge". PNL-4868.'/'
3'          Pacific Northwest Laboratory, Richland, ',
3'Washington.'/)
C
25  WRITE(*,40)
   READ(5,50) ICONT
C
   IF (ICONT.NE.1) GO TO 25
C
   WRITE(*,30)
30  FORMAT(//////////20X,'The COLSTAT4 computer code welcomes you.'/'
1'////' Please read all text and answer all questions.'////)
C
35  WRITE(*,40)
40  FORMAT(//,' Type "1" to continue--')
   READ(5,50) ICONT
50  FORMAT(I1)
C
   IF (ICONT.NE.1) GO TO 35
C
C-----
C      Query the user for the major COLSTAT4 option to be used
C-----
C
60  WRITE(*,60)
   FORMAT(////////' The COLSTAT4 computer program currently has '/'
1' three options:'''
2' 1) Allows the user to plot historical flow or '/'
3' temperature information included in the entire '/'
4' COLSTAT4 data base or '/'
5' 2) Allows the user to analyze a user-designated flow '/'
6' and temperature record in a sequential or a seasonal '/'
7' mode or '/'
8' 3) Allows the user to edit the temperature or flow files.'/'
9' Only one option may be implemented per run.'////'
1' Please select the option you wish to implement (1,2 or 3).')
C
   READ(5,50) IOPTN
C
   IF (IOPTN.LT.3) GOTO 65
   CALL COLEDTT
   GOTO 280
65  IF (IOPTN.EQ.2) GO TO 110
C
C-----
C      If option 1 has been chosen continue, otherwise skip to
C      line statement 110.
C-----
C
70  WRITE(*,70)
   FORMAT(////////' I. Option 1 -- Plotting of COLSTAT4 '/'
1' temperature or flow data base.'////'
2' The historical temperature or flow information '/'
3' included in the entire data base can be plotted as a '/'
4' function of time or percent exceeded. These figures'/

```



```

C      Redefine the parameter NRETR, which determines if the analysis is
C      SEQUENTIAL (= 0) or SEASONAL (= 1).
C-----
C      NRETR = NRETR-2
C      IF (NRETR.LT.0) GO TO 310
C      WRITE(*,130)
130    FORMAT(////,      Would you like a plot depicting Discharge .vs. '//
1'    Flow .vs. Percent Exceeded for the sequential/seasonal'//
2'    analysis option chosen above (indicate answer with a "Y"//
3'    for yes or "N" for no)')
C      READ(5,320) IEXC
C      IF (IEXC.EQ.'N'.OR.IEXC.EQ.'n') GO TO 170
C      WRITE(*,140)
140    FORMAT(////,      Are you implementing the COLSTAT4 program on'//
1'    the Pacific Northwest Laboratory (PNL) DEC VAX 11/780'//
2'    computing system (indicate answer with a "Y" for yes'//
3'    or "N" for no)')
C      READ(5,320) IRUN
C      IF (IRUN.EQ.'N'.OR.IRUN.EQ.'n') GO TO 290
C      170 WRITE(*,40)
C      READ(5,50) ICONT
C      IF (ICONT.NE.1) GO TO 170
C-----
C      First calculate the standard deviation.
C-----
C      IOPT=9
C      CALL BEGIN4(NRETR, IOPT, IUNIT, NV)
C      IF (IEXC.EQ.'N'.OR.IEXC.EQ.'n') GO TO 310
C-----
C      Calculate and plot percent exceedence.
C-----
C      CALL EXCEED4(NV)
C      GO TO 250
C-----
C      *** For option 1 only, otherwise skip to line statement 250 ***
C      What happens next for option 1 depends on the type
C      of plot option chosen (IOPT=?).

```

```

C-----
C
C
180  GO TO (310,190,200,210,220,230,240), IOPT
C-----
C      Plot FLOW vs. TIME sequentially from the beginning
C      of the data records, IOPT=2.
C-----
C
190  CALL MEAN4(1,ICONVT,ICONVF)
      IF (ICONVF.EQ.1)GOTO 195
      CALL COLSTG4(7,CMDFIL(1),IOPT)
      GO TO 250
195  CONTINUE
      CALL COLSTG4(7,CMDFIL(2),IOPT)
      GO TO 250
C-----
C      Plot FLOW vs. TIME on a monthly basis, IOPT=3.
C-----
C
200  CALL AN4(1)
      IF (IUNITS.EQ.1)GOTO 205
      CALL COLSTG4(7,CMDFIL(3),IOPT)
      GO TO 250
205  CONTINUE
      CALL COLSTG4(7,CMDFIL(4),IOPT)
      GO TO 250
C-----
C      Plot FLOW vs. percent exceeded, IOPT=4.
C-----
C
210  CALL COLSTG4(7,CMDFIL(5),IOPT)
      GO TO 250
C-----
C      Plot TEMPerature vs. TIME sequentially from the beginning
C      of the data records, IOPT=5.
C-----
C
220  CALL MEAN4(2,ICONVT,ICONVF)
      IF(ICONVT.EQ.1)GOTO 225
      CALL COLSTG4(7,CMDFIL(6),IOPT)
      GO TO 250
225  CONTINUE
      CALL COLSTG4(7,CMDFIL(7),IOPT)
      GO TO 250
C
C

```

```

C -----
C      Plot TEMPerature vs. TIME on a monthly basis, IOPT=6.
C -----
C
C
C
C
230  CALL AN4(2)
      IF (IUNITS.EQ.1)GOTO 235
      CALL COLSTG4(7,CMDFIL(8),IOPT)
      GOTO 250
235  CONTINUE
      CALL COLSTG4(7,CMDFIL(9),IOPT)
      GOTO 250
C
C
C -----
C      Plot TEMPerature vs. percent exceedence, IOPT=7.
C -----
C
C
C
C
240  CALL COLSTG4(7,CMDFIL(10),IOPT)
C
250  IPLOTS = 1
C
C
C
      IF (IOPT.EQ.9)GO TO 251
      IF (IOPT.GT.1)GOTO 260
251  WRITE(*,253)
253  FORMAT(///      To plot the Flow .vs. Temperature .vs.//
1'  Percent Exceeded, you will be required to respond to five//
2'  different prompts from the computer terminal. Reply to each//
3'  prompt with the following responses (you may want to write//
4'  these responses down for reference at prompt time):'//
5'  To initiate the plotting option, type "CONTOUR" and answer//
6'  succeeding prompts as indicated below.'//
7'      1) "CONTOUR.COM" -- Represents the control file//
8'                          specification.'//
9'      2) "1" --Represents the number of data sets to be read.'//
1'      3) "NO" -- Represents the response to having the input//
1'                          file echoed.'//
2'      4) "COLSTAT4.PLT" -- Represents the output file//
3'                          specification.'//
4'      5) "DXY COLSTAT4.PLT" -- Instructs the computer to plot//
5'                          the appropriate figure.'//)
      GO TO 340
C
C
C -----
C      The program is finished. Now print the following header to the
C      screen to provide information on how to view the newly created plots.
C -----
C
C
C
260  WRITE(*,270)
270  FORMAT(///      To initiate the plotting option, type "DISSPOP"//
1'  and answer the succeeding prompts as indicated below. To//
2'  plot the selection you indicated, you will be required//
3'  to respond to four different prompts from the computer//
4'  terminal. Reply to each prompt with the following responses//

```

```

5' (you may want to write these responses down for reference'//
6' at prompt time):'//
7' 1) "COLSTAT4.PLT" -- Represents the input file.'//
8' 2) "CALCMP" -- Represents the nomination routine'//
9' (i.e. plotting device)'//
1' 3) Press the "return" key following the prompt:'//
2' ENTER POST PROCESSOR DIRECTIVES.'//
3' 4) Press the "C" key while holding down the "CTRL" key'//
4' when prompted a second time for the input file.'//)

C
280 WRITE(*,40)
    READ(5,50) ICONT
    IF (ICONT.NE.1) GO TO 280

C
    GO TO 340

C
C
290 WRITE(*,300)
300 FORMAT('/// The plotting capabilities associated with COLSTAT4'//
1' are machine dependent and can only be implemented on the PNL'//
2' DEC VAX 11/780 computing system at this time. Plotting'//
3' capabilities are not available with this computer run.'//))

C
310 WRITE (*,*) ' DO YOU WANT TO RUN AGAIN? (Y/N)'
    READ (5,320) IRUN
320 FORMAT (A1)
C
    IF (IRUN.EQ.'Y'.OR.IRUN.EQ.'y') GO TO 35
C
    IF (IPLOTS.GT.0) CALL DONEPL
C
    WRITE(*,330)
330 FORMAT('/// COLSTAT4 Finished -- good bye')
C
340 STOP
    END

```

```

C      SUBROUTINE AN4 (NTYPE)
C      ***** AN4.FOR *****
C      AN4.FOR -- This subroutine reads the output from subroutine
C                  BEGIN4. It then writes the date as a fraction
C                  of a year, the minimums, maximums, means and +-
C                  standard deviation. These can then be used for
C                  plotting by COLSTAT.FOR
C
C                  This subroutine was written for inclusion with the
C                  COLSTAT4 series for statistical analysis of the
C                  Columbia River.
C
C      Revised by:
C      R. D. Brockhaus
C      Earth Sciences Department
C      Pacific Northwest Laboratory
C      Richland, Washington 99352
C      21-August-1986
C      *****
C
C      COMMON /M/ MONDYS(12),MONTH(12)
C
C      DATA MONTH/31,29,31,30,31,30,31,31,30,31,30,31/
C
C      GO TO (10,20) , NTYPE
C      CONTINUE
C
C      -----
C      First open the old unit 1 and unit 3 files
C      -----
C
C      OPEN(UNIT=1,FILE='FN3.OUT',STATUS='OLD',READONLY)
C      OPEN(UNIT=2,FILE='FLO2.DAT',STATUS='NEW')
C      GO TO 30
C      CONTINUE
C
C      OPEN(UNIT=1,FILE='TN3.OUT',STATUS='OLD',READONLY)
C      OPEN(UNIT=2,FILE='TMP2.DAT',STATUS='NEW')
C      CONTINUE
C
C      -----
C      Calculate the date as a fraction of a year
C      -----
C
C      IMONTH = 1
C      I = 0
C      40 READ(1,60,END=99) T1,T5,T3,T4

```

```

      T2 = T3 - T4
      T4 = T3 + T4
      IF (I.NE.MONTH(IMONTH)) GO TO 50
      IMONTH = IMONTH + 1
      I = 0
50    X = IMONTH + 1.*I/MONTH(IMONTH)
      I = I + 1

```

C
C
C
C
C
C

Write the results to unit 2

C
C
C
60
70
99

```

      WRITE(2,70) X,T1,T2,T3,T4,T5
      GO TO 40

```

```

      FORMAT (9X,4F10.0)
      FORMAT(F10.3,5F10.1)
      CLOSE (UNIT=1)
      CLOSE (UNIT=2)
      RETURN
      END

```

SUBROUTINE BEGIN4 (NRETR, IOPT, IUNITS, NV)

***** BEGIN4.FOR *****

COLUMBIA RIVER STATISTICS

BEGIN4.FOR -- BEGIN4.FOR requires 2 input files - FLOW.DAT (CU. FT/SEC)
and TEMP.DAT (DEG. C).

Depending on the option chosen in COLSTAT4.FOR, BEGIN4.FOR
will either:

1. Plot the historical temperature or flow data
in the entire data base.

2. Analyze a user designated flow or temperature
record in a sequential or seasonal method.

For SEQUENTIAL analysis, the program reads average flow
and temperature data from the files FLOW.DAT and TEMP.DAT
for each day of the desired range. The subroutine then
calculates the mean over several years for a given day
each month. Finally, the standard deviation based on
several year's measurements for a given day each month
is calculated.

SEASONAL analysis works the same way as sequential analysis
except the calculations are made on a seasonal basis. The
analysis calculates the number of days exceeding a given
flow or temperature and what percentage of total days exceed
that value.

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DIMENSION TAV(31,12),TSTD(31,12),TMN(31,12),TMX(31,12)
DIMENSION VAV(31,12),VSTD(31,12),VMN(31,12),VMX(31,12)
DIMENSION VSQ(31,12),NDY(31,12)
DIMENSION MONTH(3,12),T(15000),F(15000)
DIMENSION VF1(372),VF2(372)
DIMENSION RLABEL(2,2,2), TITLE(2)

COMMON /M/ MONDYS(12),MONDS(12)
COMMON/EXC/ RMINT,RMAXT,RINCT,RMINF,RMAXF,RINCF,TP(15000),
+FL(15000),IUNF,IUNT

DATA RLABEL/'(DEG',' C) ','(DEG',' F) ','(CM','S) ','(CF',
+'S) ' /

```

DATA TITLE/'TEMP','FLOW'/
DATA MONTH/'JANU','ARY'/'FEBR','UARY'/'
+          'MARC','H'/'APRI','L'/'
+          'MAY'/'JUNE'/'
+          'JULY'/'AUGU','ST'/'
+          'SEPT','EMBE','R'/'OCTO','BER'/'
+          'NOVE','MBER'/'DECE','MBER'/'

C
NODATA = 0
ITUNIT = 1

C
C
C-----
C First open the TEMP.DAT and FLOW.DAT input files and then read the
C first lines to obtain the starting and ending dates of the data set.
C-----
C
20 OPEN(UNIT=1,FILE='TEMP.DAT',STATUS='OLD',READONLY)
30 READ(1,*) IM1,ID1,IY1
   READ(1,*) IM2,ID2,IY2
   FORMAT(17X,F10.0)
   FORMAT(1X,I5,2X,3I3,F10.0)

C
C
50 OPEN(UNIT=2,FILE='FLOW.DAT',STATUS='OLD',READONLY)
   READ(2,*) IM3,ID3,IY3
   READ(2,*) IM4,ID4,IY4
   IF (IOPT.EQ.3.OR.IOPT.EQ.6)GOTO 164
70   WRITE(*,80) IM1,ID1,IY1,IM2,ID2,IY2,IM3,ID3,IY3,IM4,ID4,IY4
80   FORMAT('/ DATES FOR WHICH DATA IS AVAILABLE: '//
+ ' TEMP: ',I2,'/',I2,'/',I2,'2X' TO '2X,I2,'/',I2,'/',I2/'
+ ' FLOW: ',I2,'/',I2,'/',I2,'2X' TO '2X,I2,'/',I2,'/',I2/)

C
C-----
C Query the user for the desired analysis range.
C-----
C
88   WRITE(*,88)
   FORMAT(' ENTER BEGINNING AND ENDING DATES FOR DATA ANALYSIS' /
+ ' IN THIS FORMAT: 8,1,72 FOR AUGUST 1,1972' /)
90   WRITE(*,100)
100  FORMAT(' ENTER BEGINNING DATE: '$)
   READ(*,110,END=999) IM1,ID1,IY1
110  FORMAT(2I5,I2)
   WRITE(*,120)
120  FORMAT(' ENTER ENDING DATE: '$)
   READ(*,110,END=999) IM2,ID2,IY2

C
C-----
C Calculate IR1, the date number corresponding to the beginning
C of the user specified range.
C
C IR1 = elapsed days since Jan 1,1959, inclusive
C-----

```



```

C
C
C      CALL TLAPSE(ID1,IM1,IY1,IR1)
C
C-----
C      Calculate IR2, the date number corresponding to the end of
C      of the user specified range.
C
C      IR2 = elapsed days since Jan 1,1959, inclusive
C-----
C
C      CALL TLAPSE(ID2,IM2,IY2,IR2)
C
C      IF(IR2.GE.IR1) GO TO 162
C      WRITE(*,161)
161  FORMAT(' ENDING DATE PRECEEDS STARTING DATE' /
C      + ' PLEASE ENTER ANOTHER TIME RANGE')
C      GO TO 90
162  CONTINUE
C
C-----
C      Initialize the temperature minimum (TMN),maximum (TMX), average
C      (TAV) and standard deviation (TSTD) arrays to zero.
C-----
C
C      DO 163 J=1,12
C        DO 163 I=1,31
C          TMN(I,J) = 1.E20
C          TMX(I,J) = -1.E20
C          TAV(I,J) = 0
C          TSTD(I,J) = 0
163  CONTINUE
164  ITF = 1
C      IF(IOPT.EQ.3) ITF=2
C
C-----
C      ** MAIN LOOP **
C
C      First time through the main loop, the temperature
C      calculations are performed. The variable ITF is
C      incrementally updated at the end of the loop (line
C      statement 800) and the process is repeated for the
C      flow calculations.
C
C      NOTES: For TEMPerature and FLOW calculations, the date variables
C      are defined as follows:
C
C      ITF = Flag for seleting TEMP or FLOW calculations, =1 TEMP,
C            =2 FLOW.
C      NDS = number of days from January 1, 1959 (inclusive) to
C            the start of data.
C
C      *** REFERENCE ALL DATES TO JAN 1, 1959 (INCLUSIVE) AND COMPARE RANGES ***
C

```

```

C-----
C
C
1      N      = 0
      NV      = 0
      IF (NRETR.LT.3)GOTO 180
C-----
C
C      For option 2 only, otherwise go to line statement 180.
C-----
C
      IF (ITF.EQ.2) GOTO 93
      CALL TLAPSE(ID1,IM1,IY1,IR1)
      CALL TLAPSE(ID2,IM2,IY2,IR2)
      IMS = IM1
      IDS = ID1
      IYS = IY1
      IRS = IR1
      IME = IM2
      IDE = ID2
      IYE = IY2
      IRE = IR2
      GOTO 95
C
93     CONTINUE
      CALL TLAPSE(ID3,IM3,IY3,IR3)
      CALL TLAPSE(ID4,IM4,IY4,IR4)
      IMS = IM3
      IDS = ID3
      IYS = IY3
      IRS = IR3
      IME = IM4
      IDE = ID4
      IYE = IY4
      IRE = IR4
95     CONTINUE
C-----
C
C      Initialize FLOW related arrays.
C-----
C
180    DO 182 J=1,12
          DO 182 I=1,31
              VAV(I,J) = 0
              VSQ(I,J) = 0
              VSTD(I,J) = 0
              VMN(I,J) = 1.E20
              VMX(I,J) = -1.E20
              NDY(I,J) = 0
182    CONTINUE
C
C
C      DO 185 I=1,372
          VF1(I) = 0

```

```

185      VF2(I) = 0
      CONTINUE

-----
      Read the first line of data and calculate the number
      of days since the reference date (1,1,59).
-----

      READ(ITF,30) LINE,ID,IM,IY,VAR
      N = N + 1
      CALL TLAPSE(ID,IM,IY,NDS)

-----
      For option 2 only, otherwise skip to line statement 220
      Save the limits of the selected user range.
-----

      IF (IOPT.EQ.3.OR.IOPT.EQ.6)GOTO 220 .
      IDS = ID1
      IMS = IM1
      IYS = IY1
      IDE = ID2
      IME = IM2
      IYE = IY2
      IRS = IR1
      IRE = IR2

-----
      Compare the selected user range with the actual data
      range for errors.
-----

      IF(IRS.GE.NDS) GO TO 220
      IF(IRE.GT.NDS) GO TO 200
      WRITE(*,190) TITLE(ITF)
190  FORMAT(/' ENTIRE USER RANGE PRECEEDS DATA RANGE FOR ',A4)
      NODATA = NODATA + 1
      GO TO 800

C
C
C
200  CONTINUE
      IF (NRETR.EQ.0) WRITE(*,210) TITLE(ITF),IM,ID,IY
210  FORMAT(/' BEGINNING OF USER RANGE PRECEEDS DATA RANGE FOR ',A4/
+ ' ANALYSIS WILL BEGIN WITH FIRST DATE OF DATA: 'I2,'/',I2,'/',I2)
      IF (NRETR.EQ.1) GO TO 215
      IDS = ID
      IMS = IM
      IYS = IY
      ND = IRE - NDS + 1
      GO TO 251
215  CONTINUE

```

```

      IF (IYS.LT.IY) IYS = IY
      IF (IMS.LT.IM) IYS = IYS + 1
      CALL TLAPSE (IDS,IMS,IYS,IRS)
C
C
C
220  ND = IRS - NDS
      IF (ND.EQ.0) GO TO 250
      IF (ND.EQ.1) GO TO 240
      NDM1 = ND - 1
C
C
C
      DO 230 I=1,NDM1
        READ(ITF,30,END=550)
230  CONTINUE
C
C
C
240  READ(ITF,30,END=550) LINE,ID,IM,IY,VAR
C
C
C
-----
C      Now set nd = number of days of data to be analyzed
C
C
C
250  ND = IRE - IRS + 1
      IF (IOPT.EQ.3.OR.IOPT.EQ.6)GOTO 260
C
C
C
-----
C      If the SEQUENTIAL analysis was choosen to be performed, the program
C      skips to line statement number 260. Otherwise, the following SEASONAL
C      is performed.
C
C
C
251  IF(NRETR.EQ.0) GO TO 260
C
C
C
-----
C      Total seasonal days to be analyzed.
C
C
C
      IF (IMS.EQ.IME) GO TO 257
      NDAF = MONDS(IMS)-(IDS-1)
      NDAL = MONDS(IME)-(MONDS(IME)-IDE)
      ND = NDAF+NDAL
      IF (IMS.GT.IME) GO TO 253
      IF (IME-IMS.LT.2) GO TO 2520
C
C
C
      DO 252 IK=IMS+1,IME-1
        ND = ND+MONDS(IK)
252  CONTINUE
C

```

```

C
C
2520 ND = ND*(IYE-IYS+1)
      IF(IMS.GT.2.OR.IME.EQ.1) GO TO 260
      GO TO 2580
253  IYSS = IYS
      IYEE = IYS+1
      IF(IMS.EQ.12) IYSS = IYS+1
      IF(IME.EQ.1) IYEE = IYE-1
      IF(IYSS.GT.IYEE) GO TO 258
      IMOS = IMS+1
      IF(IMS.EQ.12) IMOS = 1
      IMOE = IME-1
      IF(IME.EQ.1) IMOE = 12
      IDF = 1
      CALL TLAPSE(IDF,IMOS,IYSS,IMSS)

C
C
C
C
      CALL TLAPSE(MONDS(IMOE),IMOE,IYEE,IMEE)

C
C
C
      KMOS = (IMEE-IMSS+1)/28

C
C
C
      DO 255 IK=1,KMOS
        LMOS = IMS+IK
        IF(LMOS.GT.12) LMOS = LMOS-12
        ND = ND+MONDS(LMOS)
255  CONTINUE

C
C
C
      GO TO 258
257  ND = MONDS(IMS)-(IDS-1)-(MONDS(IMS)-IDE)
258  IF(IYE-IYS.GE.2) ND = ND*(IYE-IYS+1)
      IF(IMS.GT.2.AND.(IME.GT.2.OR.IME.EQ.1)) GO TO 260
2580 CONTINUE

C
C
C
      DO 259 IJ=IYS,IYE
        IF(MOD(IJ,4).NE.0) ND = ND-1
259  CONTINUE

C
C
C
      IF(IMS.EQ.2.AND.MOD(IYS,4).NE.0) ND = ND-1
      IF(IME.EQ.2.AND.MOD(IYE,4).NE.0) ND = ND-1
      IF(IMS.EQ.2.AND.IME.EQ.2.AND.IYS.EQ.IYE) ND = ND+1

C
C
C
-----
User query for the TEMP and FLOW units.
-----
C
C
C

```



```

      RINC = 50
      WRITE(*,370)
370  FORMAT(' MIN, MAX, INCREMENT: 1000, 15500, 50 CUBIC METERS /'
+ ' SECOND')
      GO TO 400

```

C
C
C

```

380  RMIN = 36000
      RMAX = 550000
      RINC = 2000
      WRITE(*,390)
390  FORMAT(' MIN, MAX, INCREMENT: 36000, 550000, 2000 CUBIC FEET',
+ ' / SECOND')

```

C
C
C
C
C
C
C
C

Query the user to change the cumulative distribution range.

```

400  IF(IOPT.EQ.3.OR.IOPT.EQ.6)GOTO 430
      WRITE(*,410)
410  FORMAT('/ DO YOU WISH TO CHANGE THE RANGE'/
+ ' OF THE CUMULATIVE DISTRIBUTION?'/
+ ' 0 = USE DEFAULT RANGE, 1 = CHANGE'/)
      READ(*,*)ICD

```

C
C
C

```

      IF(ICD.NE.1) GOTO 430
      WRITE(*,420)
420  FORMAT(' ENTER RANGE DESIRED (MIN,MAX,INCREMENT)')
      READ(*,*) RMIN,RMAX,RINC

```

C
C
C

```

430  IF(ITF.EQ.2) GO TO 480
      RMINT = RMIN
      RMAXT = RMAX
      RINCT = RINC
      GO TO 485
480  RMINF = RMIN
      RMAXF = RMAX
      RINCF = RINC
485  NI = (RMAX-RMIN)/RINC + 0.5
      IF(NI.GT.371) NI = 371
      RMAX = RMIN + NI*RINC
      NII = NI + 1

```

C
C
C

```

486  WRITE(*,*)' '
      WRITE(*,*)' ***** '
      WRITE(*,*)' Starting the main loop in subroutine BEGIN4.FOR'
      WRITE(*,*)' Please wait until the calculations are finished'
      WRITE(*,*)' ***** '
      WRITE(*,*)' '

```

C


```

C
C
C
VSQ(ID,IM) = VSQ(ID,IM) + VAR * VAR
NDY(ID,IM) = NDY(ID,IM) + 1
C
C
DINC = (VAR-RMIN)/RINC
IND = DINC + 1.5
IF(IND.LT.1) GO TO 520
IF(IND.GT.NII) GO TO 520
VF1(IND) = VF1(IND) + 1
520 IND = DINC + 0.99999
IF(IND.LT.1) GO TO 530
IF(IND.GT.NII) IND = NII
VF2(IND) = VF2(IND) + 1
C
C
C
530 READ(ITF,30,END=550) LINE,ID,IM,IY,VAR
N = N + 1
IF(N.GT.ND) GO TO 600
C
C
C
-----
The following code is for seasonal retrieval.
-----
C
C
IF (IOPT.EQ.3.OR.IOPT.EQ.6)GOTO 540
IF(NRETR.EQ.0) GO TO 540
C
C
C
-----
Check for appropriate seasonal data.
-----
C
534 CALL TLAPSE(ID,IM,IY,IDAT)
IF(IDAT.GE.IBEG) GO TO 535
N = N-1
GO TO 502
535 IF(IDAT.GT.IEND) GO TO 536
GO TO 500
536 IF(IYE-IYS.LT.2.AND.IMS.GT.IME) GO TO 600
IYSS = IYSS+1
IYEE = IYEE+1
N = N-1
GO TO 490
540 CONTINUE
C
C
C
GO TO 500
C
550 WRITE(*,560) IML,IDL,IYL
560 FORMAT(/2X' --- END OF DATA ENCOUNTERED ---'/
+ ' LAST DATE OF AVAILABLE DATA IS ',I2,'/',I2,'/',I2/
+ ' WE WILL USE THE DATA AVAILABLE TO US')
IDL = IDL
IME = IML
IYE = IYL
C

```

```

C
C-----
C      Write the cumulative distribution.
C-----
C
600  IF (IOPT.EQ.3.OR.IOPT.EQ.6)GOTO 730
      IF(NV.NE.0) GO TO 610
      WRITE(*,605) TITLE(ITF)
605  FORMAT(/' NO ',A4,' DATA IN THAT TIME RANGE')
      NODATA = NODATA + 1
      GO TO 800
C
C-----
C      If this is a SEQUENTIAL analysis, then write out the
C      cumulative results.  If this is a SEASONAL analysis
C      then skip to line statement 645 and then print the
C      SEASONAL cumulative result.
C-----
C
610  IF(NRETR.EQ.1) GO TO 645
613  IF(ITF.EQ.2) GO TO 630
615  WRITE(6,620) IMS,IDS,IYS,IME,IDE,IYE
620  FORMAT(1H1/5X' DISTRIBUTION OF AVERAGE DAILY TEMPERATURES',
+ ' (SEQUENTIALLY) FROM ',I2/'I2'/'I2' TO ' I2/'I2'/'I2//)
      GO TO 650
C
C
630  WRITE(6,640) IMS,IDS,IYS,IME,IDE,IYE
640  FORMAT(1H1/5X' DISTRIBUTION OF AVERAGE DAILY FLOW',
+ ' (SEASONALLY) FROM ',I2/'I2'/'I2' TO ' I2/'I2'/'I2//)
      GO TO 650
C
C
645  IF(ITF.EQ.2) GO TO 647
      WRITE(6,646) IMS,IDS,IYS,IME,IDE,IYE
646  FORMAT(1H1/5X' DISTRIBUTION OF AVERAGE DAILY TEMPERATURES',
+ ' (SEASONALLY) FROM ',I2/'I2'/'I2' TO ' I2/'I2'/'I2//)
      GO TO 650
C
C
647  WRITE(6,648) IMS,IDS,IYS,IME,IDE,IYE
648  FORMAT(1H1/5X' DISTRIBUTION OF AVERAGE DAILY FLOW',
+ ' (SEASONALLY) FROM ',I2/'I2'/'I2' TO ' I2/'I2'/'I2//)
650  WRITE(6,660) TITLE(ITF),RLABEL(1,IUNITS,ITF),RLABEL(2,IUNITS,ITF)
660  FORMAT(24X'NO. OF TIMES'9X'PER CENT'47X'PER CENT'/
+ 6X,A4,1X,2A4,7X'EXCEEDED',11X'OF TIME',15X'RANGE',
+ 10X'DAYS WITHIN',7X'OF TIME'/
+ 6X,12(' '),6X,12(' '),9X,8(' '),9X,15(' '),5X,
+ 11(' '),7X,8(' '))
C
C-----
C

```

C NOTE: Variables used:

C NE = NUMBER EXCEEDING THE I-TH VALUE
C PE = PORTION EXCEEDING THE I-TH VALUE
C NR = NUMBER OF DAYS WITHIN THE I-TH RANGE
C PR = PORTION OF DAYS WITHIN THE I-TH RANGE
C NV = NUMBER OF VALUES USED IN ANALYSIS
C N = TOTAL NUMBER OF DAYS OF DATA CONSIDERED
C
C
C
C
C
C
C
C
C

IF(ITF.EQ.1) OPEN(UNIT=3,FILE='CDT.OUT',STATUS='NEW')
IF(ITF.EQ.2) OPEN(UNIT=3,FILE='CDF.OUT',STATUS='NEW')
NE = 0
DO 680 I=1,NII
NE = NE + VF2(I)
680 CONTINUE
I = 0
DO 700 V=RMIN,RMAX,RINC
I = I + 1
IF(MOD(I,50).NE.0) GO TO 690
IF(NRETR.EQ.1) GO TO 685
IF(ITF.EQ.1) WRITE(6,620) IMS,IDS,IYS,IME,IDE,IYE
IF(ITF.EQ.2) WRITE(6,640) IMS,IDS,IYS,IME,IDE,IYE
GO TO 689
685 IF(ITF.EQ.1) WRITE(6,646) IMS,IDS,IYS,IME,IDE,IYE
IF(ITF.EQ.2) WRITE(6,648) IMS,IDS,IYS,IME,IDE,IYE
689 WRITE(6,660) TITLE(ITF),RLABEL(1,IUNITS,ITF),RLABEL(2,IUNITS,ITF)
690 PE = 100. * NE/NV
NR = VF1(I)
PR = VF1(I)/NV * 100.
IF(ITF.NE.1) GO TO 695
VMR = V - 0.5*RINC
VPR = V + 0.5*RINC - 0.06
WRITE(6,710) V, NE, PE, VMR,VPR, NR, PR
GO TO 697
695 IV = V
I1 = V - 0.5*RINC
I2 = V + 0.5*RINC - 1
WRITE(6,720) IV, NE, PE, I1, I2, NR, PR
697 NE = NE - VF2(I)
WRITE(3,701) V, PE
700 CONTINUE
701 FORMAT(2F10.1)
710 FORMAT(5X,F8.1,I19,F20.3,9X,F7.1,' - ',F5.1,I14,F18.3)
720 FORMAT(5X,I10,I17,F20.3,10X,I6,' - ',I6,I12,F18.3)
CLOSE (UNIT=3)
C
C
C
C
C
C
C
C
C

Set the do loop parameters and calculate the mean and standard
deviation for each day of the year.

730 DO 750 J=1,12
DO 750 I=1,31
NDAYS = NDY(I,J)

```

      IF(NDAYS.LT.2) GO TO 750
      VAV(I,J) = VAV(I,J)/NDAYS
      VAVE = VAV(I,J)
      VSTD(I,J) = SQRT( (VSQ(I,J) - NDAYS*VAVE*VAVE) / (NDAYS-1) )
750  CONTINUE
C
C
C-----
C      If ITF=1, then the temperature data will be stored in unit=3
C-----
C
      IF(ITF.NE.1) GO TO 800
      OPEN(UNIT=3,FILE='TN3.OUT',STATUS='NEW')
      ITUNIT = IUNITS
      DO 760 J=1,12
        DO 760 I=1,31
          TMN(I,J) = VMN(I,J)
          TMX(I,J) = VMX(I,J)
          TAV(I,J) = VAV(I,J)
          TSTD(I,J) = VSTD(I,J)
          IF(VMN(I,J).EQ.1.E20) GO TO 760
          WRITE(3,761) I,J,VMN(I,J),VMX(I,J),VAV(I,J),VSTD(I,J)
760  CONTINUE
761  FORMAT (1X,2I3,2X,4F10.2)
      CLOSE (UNIT=3)
      IF (IOPT.EQ.6)GOTO 9999
C
C
C-----
C      Update the value of ITF and return to the top of the loop
C      for FLOW calculations if ITF = 2.
C-----
C
800  ITF = ITF + 1
      IF(ITF.LT.3)GOTO 1
C
C
C-----
C      WRITE TEMP AND FLOW RESULTS FOR EACH DAY OF THE YEAR
C-----
C
      OPEN(UNIT=3,FILE='FN3.OUT',STATUS='NEW')
C
      DO 801 J=1,12
        DO 801 I=1,31
          IF(VMN(I,J).EQ.1.E20) GO TO 801
          WRITE(3,761) I,J,VMN(I,J),VMX(I,J),VAV(I,J),VSTD(I,J)
801  CONTINUE
      CLOSE (UNIT=3)
C
C
C
999  CONTINUE
C

```

 This following part of BEGIN4.FOR is only performed if
 option 2 was selected.

```

      IF (IOPT.EQ.3.OR.IOPT.EQ.6)GOTO 9999
      J=1
      I1 = 1
      IJ = 0
      IJE = 366
      IF(ND.GT.364) GO TO 805
      IF(IMS.LT.3 .AND. IME.GT.2 .AND. MOD(IYS,4).NE.0) ND = ND + 1
      J = IMS
      I1 = IDS
      IJE = ND
  
```

 If a SEQUENTIAL analysis, then skip to line statement 809
 else print the SEASONAL information output

```

805  IF(NRETR.EQ.0) GO TO 809
      J = IMS
      I1 = IDS
      IJE = ND
806  IF(NRETR.EQ.0) GO TO 809
      WRITE(6,807) IM1,ID1,IY1,IM2,ID2,IY2,(MONTH(I,J),I=1,3)
807  FORMAT(1H1,5X,' TEMPERATURE AND FLOW ANALYSIS (SEASONALLY)',
+ ' FROM 'I2','I2','I2' TO 'I2','I2','I2//6X,' FOR MONTH OF ',
+3A4/)
      GO TO 815

809  WRITE(6,810) IM1,ID1,IY1,IM2,ID2,IY2,(MONTH(I,J),I=1,3)
810  FORMAT(1H1,5X,' TEMPERATURE AND FLOW ANALYSIS (SEQUENTIALLY)',
+ ' FROM 'I2','I2','I2' TO 'I2','I2','I2//6X,' FOR MONTH OF ',
+3A4/)
815  IF(NODATA.LT.2) GO TO 830
      WRITE(6,820)
820  FORMAT(5X,' NO DATA AVAILABLE IN THAT RANGE')
      GO TO 9999

830  WRITE(6,840) RLABEL(1,ITUNIT,1),RLABEL(2,ITUNIT,1),
+ RLABEL(1,IUNITS,2),RLABEL(2,IUNITS,2)
840  FORMAT(/26X,'TEMPERATURE ',2A4,31X,'FLOW ',2A4/26X,19('-'),
+32X,11('-'),//7X'DATE',5X'MAXIMUM',4X'MINIMUM',4X,'AVERAGE',
+4X'STD. DEV.',7X'MAXIMUM',4X'MINIMUM',4X'AVERAGE',4X,
+ 'STD. DEV.',7X'-----',5X,7('-'),2(4X,7('-')),4X,9('-'),
+ 7X,7('-'),2(4X,7('-')),4X,9('-'))

      I2 = MONDS(J)
  
```

```

C      IF(ND.LT.365 .AND. J.EQ.IME) I2 = IDE
C
C-----
C The following section of code was added for seasonal retrieval.
C-----
C
C      IF(NRETR.EQ.1.AND.J.EQ.IMS) I2 = NDAF
C      IF(NRETR.EQ.1.AND.J.EQ.IME) I2 = NDAL
C      IF (NRETR.EQ.1.AND.(J.EQ.IMS.AND.J.EQ.IME)) I1 = IDS
C      IF (NRETR.EQ.1.AND.(J.EQ.IMS.AND.J.EQ.IME)) I2 = IDE
C      IF(I2.LE.0) GO TO 940
C
C
C      DO 930 I=I1,I2
C          WRITE(6,850) J,I
850      FORMAT(1H$,5X,I2,' ',I2)
C          IF(TMN(I,J).NE.1.E20) GO TO 870
C          WRITE(6,860)
860      FORMAT(1H$,16X' NO TEMP DATA AVAILABLE')
C          GO TO 890
C
C
C      WRITE(6,880) TMX(I,J),TMN(I,J),TAV(I,J),TSTD(I,J)
870      FORMAT(1H$,2F11.1,2F11.2)
880      IF(VMN(I,J).NE.1.E20) GO TO 910
C      WRITE(6,900)
890      FORMAT(1H$,72X,' NO FLOW DATA AVAILABLE')
C      GO TO 925
C
C
C      IVMN = VMN(I,J)
C      IVMX = VMX(I,J)
C      IVAV = VAV(I,J)
C      ISTD = VSTD(I,J)
C      WRITE(6,920) IVMX,IVMN,IVAV,ISTD
910      FORMAT(1H$,59X,4I11)
C      IJ = IJ + 1
920
925
930 CONTINUE
C
C
C      IF(NRETR.EQ.1) GO TO 935
C      IF(IJ.GE.IJE) GO TO 940
C      GO TO 937
C
C
C      IF(IMS.GT.IME) GO TO 936
C      IF(IJ.GE.ND/(IYE-IYS+1)) GO TO 940
C      GO TO 937
C
C
C      IF(IJ.GE.ND/(IYE-IYS)) GO TO 940
936

```

```

937  J = J + 1
      IL = 1
      IF(J.GT.12) J = 1
      GO TO 806

```

```

-----
Check the frequency of the river temperature exceeding T while
the flow is below F.
-----

```

```

940  WRITE(*,950)
950  FORMAT(/)
      CLOSE {UNIT=1}
      CLOSE {UNIT=2}

```

```

-----
Save the selected user range dates
-----

```

```

IDS = ID1
IMS = IM1
IYS = IY1
IDE = ID2
IME = IM2
IYE = IY2

```

```

-----
Begin reading reopened data files TEMP.DAT and FLOW.DAT
-----

```

```

OPEN(UNIT=1,FILE='TEMP.DAT',STATUS='OLD',READONLY)
OPEN(UNIT=2,FILE='FLOW.DAT',STATUS='OLD',READONLY)
READ(1,*) IM1, ID1, IY1
READ(1,*) IM2, ID2, IY2
READ(2,*) IM3, ID3, IY3
READ(2,*) IM4, ID4, IY4
CALL TLAPSE(ID1, IM1, IY1, ITS)
CALL TLAPSE(ID2, IM2, IY2, ITE)
CALL TLAPSE(ID3, IM3, IY3, IFS)
CALL TLAPSE(ID4, IM4, IY4, IFE)

```

```

-----
The following code is for seasonal retrieval.
-----

```

```

IF(NRETR.EQ.0) GO TO 953
IY5 = MAX(IYS, IY1, IY3)
IF (IY5.EQ.IY1.AND.IMS.LT.IM1) IY5 = IY5 + 1
IF (IY5.EQ.IY3.AND.IMS.LT.IM3) IY5 = IY5 + 1
IYS = IY5
IYSS = IY5

```

```

CALL TLAPSE(IDS,IMS,IYSS,IRS)
IF(IMS.GT.IME) IYSS = IYSS+1
CALL TLAPSE(IDE,IME,IYSS,IRE)

-----
Find the range of applicable data.

MAXS = max start, 1st date in the user range with both temp and flow
MINE = min end, last date in user range with both temp and flow data
-----

953  MAXS = ITS
      IF(ITS.LT.IFS) MAXS = IFS
      MINE = ITE
      IF(ITE.GT.IFE) MINE = IFE
      IF(IRS.GT.MAXS) MAXS = IRS
      IF(IRE.LT.MINE) MINE = IRE
      NPT = MINE - MAXS + 1
      NST = MAXS - ITS
      NSF = MAXS - IFS

-----
Read the temperature and flow frequency data.
-----

956  WRITE(*,960)
960  FORMAT('/// FREQUENCY OF OCCURRENCE FOR PAIRS OF'/
+ ' TEMPERATURE AND FLOW VALUES'//
+3X, ' THE FOLLOWING ANALYSIS WILL COUNT THE NUMBER OF TIMES'//
+ ' A GIVEN TEMPERATURE IS EXCEEDED WHILE AT THE SAME TIME'//
+ ' THE RIVER FLOW RATE IS BELOW A GIVEN VALUE.'//
+3X, ' THE USER WILL SUPPLY THE TEMPERATURE AND FLOW VALUES'//
+ ' AGAINST WHICH THE DATA WILL BE COMPARED.')
      WRITE(*,965)
965  FORMAT('/// READING DATA --- PLEASE WAIT'//)

-----
Read in the data necessary to cover the user range.
-----

      DO 970 I=1,NST+NPT
        READ(1,20) T(I)
970  CONTINUE

      DO 980 I=1,NSF+NPT
        READ(2,20) F(I)
980  CONTINUE

-----
The following code is for seasonal retrieval

```



```

C -----
C
C IF(NRETR.EQ.0) GO TO 989
C
C -----
C      Check for appropriate seasonal data
C -----
C
C      NP = 0
C      NZ = 0
C      NT = NPT+NST
C      NF = NPT+NSF
C      IYSS = IYS
C      IYEE = IYS
984  CALL TLAPSE(IDS,IMS,IYSS,IBEG)
C      IF(IMS.GT.IME) IYEE = IYSS+1
C      CALL TLAPSE(IDE,IME,IYEE,IEND)
985  READ(1,30,END=988) LINE,ID,IM,IY,VART
C      READ(2,30,END=988) LINE,ID,IM,IY,VARF
C      NZ = NZ+1
C      IF(NPT+NZ.GT.ND) GO TO 988
C      CALL TLAPSE(ID,IM,IY,IDAT)
C      IF(IDAT.GE.IBEG) GO TO 986
C      NZ = NZ-1
C      GO TO 985
C
C
C
986  IF(IDAT.GT.IEND) GO TO 987
C      NP = NP+1
C      T(NT+NP) = VART
C      F(NF+NP) = VARF
C      GO TO 985
C
C
C
987  IF(IYE-IYS.LT.2) GO TO 988
C      IYSS = IYSS+1
C      IYEE = IYEE+1
C      NZ = NZ-1
C      GO TO 984
C
C
C
988  NPT = NPT+NP
C
C
989  CONTINUE
C
C -----
C      WRITE HEADING FOR OUTPUT
C -----
C

```



```

      IF(TV.GE.TEMP .AND. FV.LE.FLOW) NG = NG + 1
      IF(TV.EQ.TEMP .AND. FV.EQ.FLOW) NG = NG - 1
1060  CONTINUE
C
C
C
      IF (JG.GT.0) GO TO 1070
      WRITE (6,1065) TEMP, FLOW
1065  FORMAT ('// THERE WAS NO MATCHING FLOW AND TEMPERATURE '
1 'DATA'/' FOR REQUESTED DATES, WITH TEMPERATURE GREATER '
2 'THAN',F6.1,' AND FLOW LESS THAN',F9.0/)
      GO TO 1000
C
C
C
1070  PERCENT = 100. * NG/JG
      IFLOW = FLOW + 0.5
      WRITE(6,1080) TEMP, IFLOW, NG, PERCENT
1080  FORMAT(2X,F4.1,10X,I7,11X,I5,7X,F7.1)
C
C
C
      IF(IUNT.EQ.1) WRITE(6,1090)
      IF(IUNT.EQ.2) WRITE(6,1100)
1090  FORMAT(1H+,7X,'DEG C')
1100  FORMAT(1H+,7X,'DEG F')
C
C
C
      IF(IUNF.EQ.1) WRITE(6,1110)
      IF(IUNF.EQ.2) WRITE(6,1120)
1110  FORMAT(1H+,23X,'CMS')
1120  FORMAT(1H+,23X,'CFS')
      NV=JG
      GO TO 1000
C
C
C
1130  CONTINUE
C
C
C
9999  CLOSE (UNIT=1)
      CLOSE (UNIT=2)
      RETURN
      END

```

```

C ***** BINSRH.FOR *****
C
C BINSRH.FOR -- This subroutine performs a binary search of a data
C file to locate a specific piece of information.
C
C This application of the routine is passed an array,
C IDATES, of sequential dates in ascending order, the
C total number, NDATES, of dates in the IDATES array,
C and the target date, IDATE.
C
C BINSRH.FOR returns the subscript of target date in INDEX.
C
C Written by:
C D.W. Damschen
C Statistical Information Sciences Section
C Energy Systems Department
C Pacific Northwest Laboratory
C Richland, Washington 99352
C 31-July-1986
C
C Revised by:
C R. D. Brockhaus
C Earth Sciences Department
C Pacific Northwest Laboratory
C Richland, Washington 99352
C 23-August-1986
C
C *****
C
C SUBROUTINE BINSRH(IDATES,NDATES,IDATE,INDEX)
C
C DIMENSION IDATES(NDATES)
C
C -----
C Initialize search array bounds and flag for data not found
C -----
C
C ILOWER = 1
C IUPPER = NDATES
C INDEX = 0
C
C -----
C If there is data to search, find the mid point of the search array
C -----
C
10 IF (ILOWER.GT. IUPPER) RETURN
MIDDLE = (ILOWER + IUPPER) /2
C
C -----

```

C If the target date is in the upper half of the search array, adjust
C the mid point and search again

C
C
C

IF (IDATE .GE. IDATES(MIDDLE)) GO TO 20
UPPER = MIDDLE - 1
GO TO 10

C
C
C

C If the target date is in lower half of search array, adjust the mid
C point and search again

C
C
C

20 IF (IDATE .EQ. IDATES(MIDDLE)) GO TO 30
LOWER = MIDDLE + 1
GO TO 10

C
C
C

Target date is located -- return

C
C
C

C
C
C

30
C

INDEX = MIDDLE
RETURN
END

***** COLEDIT.FOR *****

COLEDIT.FOR -- This subroutine is used for editing of the raw temperature or flow data.

This routine opens the proper data file, reads the data into arrays and calls subroutine BINSRH to locate the data to be edited. COLEDIT.FOR reads the temperature or flow data file and writes the unedited information to a backup file COLEDIT.BCK so that an editing session will not completely destroy the data base. Subroutine TLAPSE is called to calculate the sequential day number from January 1, 1959 to the day of interest for editing. COLEDIT then alters the raw data and rewrites the information back to disk.

New temperature or flow data may also be appended to the appropriate file for updating raw files.

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23-August-1986

SUBROUTINE COLEDIT

DIMENSION ISEQ(15000), VALUES(15000), INUM(15000)
DIMENSION MONTH(15000), IDAY(15000), IYEAR(15000), TITLE(2)

COMMON/M/MONDYS(12)

DATA MONDYS/0,31,59,90,120,151,181,212,243,273,304,334/
DATA TITLE/'TEMP','FLOW'/

WRITE(*,5)
FORMAT(//////////)
WRITE(*,10)

```

10  FORMAT(////////// 'Which data file do you wish to edit?'/,
1'  Enter (1) for temperature (2) for flow')
READ(*,*) IUNIT
C
C
C-----
C      First open requested data file and backup file
C-----
C
C      IF (IUNIT .EQ. 1) OPEN(UNIT=IUNIT,FILE='TEMP.DAT',
1      STATUS='UNKNOWN')
C      IF (IUNIT .EQ. 2) OPEN(UNIT=IUNIT,FILE='FLOW.DAT',
1      STATUS='UNKNOWN')
C      OPEN(UNIT=22,FILE='COLEDIT.BCK',STATUS='NEW')
C
15  WRITE(*,15)
    FORMAT(///, '*****'/,
1'  *
2'  * Please wait while I read the data file */',
3'  *
4'  * */')
C
C
C-----
C      Call the subroutine TLAPSE to calculate the sequential day numbers from
C      January 1, 1959 to data file beginning and ending days
C-----
C
C      READ(IUNIT,*) IMOS, IDAS, IYRS
C      WRITE(22,20) IMOS, IDAS, IYRS
20  FORMAT(13,' ',I2,' ',I2)
C      CALL TLAPSE(IDAS,IMOS,IYRS,ISTRT)
C
C      READ(IUNIT,*) IMOE, IDAE, IYRE
C      WRITE(22,20) IMOE, IDAE, IYRE
C      CALL TLAPSE(IDAE,IMOE,IYRE,IEND)
C
C      NTOT = IEND - ISTRT + 1
C
C-----
C      Read the current data file and write to the backup file
C-----
C
C      DO 30 I=1,NTOT
C      READ(IUNIT,25,END=35) INUM(I), IDAY(I), MONTH(I),
1      IYEAR(I), VALUES(I), ISEQ(I)
C      WRITE(22,25) INUM(I), IDAY(I), MONTH(I),
1      IYEAR(I), VALUES(I), ISEQ(I)
25  FORMAT(1X,I5,2X,3I3,F10.2,I10)
30  CONTINUE
35  CLOSE(UNIT=22)
C
C-----
C      Query the user for data file changes or additions

```



```

CALL TLAPSE(ID,IM,IY,NSEQ)
IF (NSEQ.GT. ISEQ(NTOT)) GO TO 59
WRITE(*,57) TITLE(IUNIT)
57  FORMAT('////' '***** The ending date of this new',
1  ' data file will not chronologically'/' append to the',
2  ' existing ',A4,'.DAT data file.'/' Old ending date is',
3  ' 3I3,' and new ending date must be greater than old ending date.')
WRITE(*,46)
CLOSE(UNIT=IUNIT)
CLOSE(UNIT=3)
RETURN

```

```

C
C
C
59  IMOE = IM
    IDAE = ID
    IYRE = IY
    J    = NTOT + 1

```

```

C
C
C
60  READ(3,25,END=65) IN, IDAY(J), MONTH(J),
    1  IYEAR(J), VALUES(J)
CALL TLAPSE(IDAY(J),MONTH(J),IYEAR(J),NSEQ)
ISEQ(J) = NSEQ
INUM(J) = INUM(J-1) + 1
J      = J + 1
GO TO 60
65  NTOT = J - 1
GO TO 135

```

```

C
C
C
C-----
C Query the user for the date of the editing change and the new data value
C-----

```

```

70  WRITE(*,75) TITLE(IUNIT)
75  FORMAT('////' 'Enter date of ',A4,' value to be',
1  ' changed in Month Day Year form',
2  ' with no spaces, but include leading zeros.',
3  ' (e.g. 080285 is August 2,1985',
4  ' and 121886 is December 18,1986)')
READ(*,80) IM, ID, IY
80  FORMAT(3I2)

```

```

C-----
C TLAPSE calculates the sequential day numbers from January 1,
C 1959 to the date of value to be changed.
C-----

```

```

C
C
C
CALL TLAPSE(ID,IM,IY,IFIND)
CALL BINSRH(ISEQ,NTOT,IFIND>IDEX)

```

```

C-----
C BINSRH returns the subscript of the value to be changed if it is in

```

```

C the raw data file, if not, then IDEX=0
C -----
C
      IF (IDEX .EQ. 0) GO TO 110
      WRITE(*,85)
85      FORMAT(///' The value to use for missing data is -88.0')
      IF (IUNIT .EQ. 1) WRITE(*,90) TITLE(IUNIT), IM, ID, IY,
1          VALUES(IDEX)
90      1          FORMAT(///' The current ',A4,' value for',3I3,
1          ' is',F10.3' degrees C')
C
C
      IF (IUNIT .EQ. 2) WRITE(*,95) TITLE(IUNIT), IM, ID, IY,
1          VALUES(IDEX)
95      1          FORMAT(///' The current ',A4,' value for',3I3,
1          ' is',F10.3' cubic feet/second')
      WRITE(*,100) TITLE(IUNIT)
C
C
100     FORMAT(//$, ' Enter new ',A4,' value--> ')
      READ(*,105) VALUES(IDEX)
105     FORMAT(F10.0)
      GO TO 120
110     WRITE(*,115) IM, ID, IY, TITLE(IUNIT)
115     FORMAT(///' ***** ',3I3,2X,A4,' DATA NOT FOUND *****')
C
C -----
C Query the user to find out if any more corrections need to be made
C -----
C
120     WRITE(*,125)
125     FORMAT(///' Do you wish to make any more changes? (Y/N)')
      READ(*,130) IANS
130     FORMAT(A1)
      IF (IANS .EQ. 'Y' .OR. IANS .EQ. 'y') GO TO 70
C
C -----
C Rewrite the newly edited or appended data file
C -----
C
135     WRITE(*,140)
140     FORMAT(///' *****',
1         ' * Please wait while I write the new data file *',
2         ' *',
3         ' *****')
C
      REWIND(IUNIT)
      WRITE(IUNIT,20) IMOS,IDAS,IYRS
      WRITE(IUNIT,20) IMOE,IDAE,IYRE
      DO 145 I=1,NTOT
          WRITE(IUNIT,25) INUM(I), IDAY(I), MONTH(I),

```

```

1          IYEAR(I), VALUES(I), ISEQ(I)
145 CONTINUE
      CLOSE(UNIT=IUNIT)
C
150 WRITE(*,5)
      WRITE(*,155) TITLE(IUNIT), TITLE(IUNIT), TITLE(IUNIT),
1          TITLE(IUNIT), TITLE(IUNIT), IMOE, IDAE, IYRE
155 FORMAT('          This editing session is now completed.'//,
1'          Your corrected file has been written. You also'//,
2'          have a backup copy of the unedited 'A4,' data as it'//,
3'          existed before the alterations took place. It'//,
4'          is named COEDIT.BCK. If all the changes we just'//,
5'          made check out o.k. then you may want to delete'//,
6'          this backup file to save disk space.'//,
7'          If our editing session does not check out o.k.'//,
8'          after you exit the main program, COLSTAT4, delete'//,
9'          'A4,'.DAT and rename COEDIT.BCK to 'A4,'.DAT'//,
1'          with the following instructions:'//,
2'          DELETE 'A4,'.DAT;'//,
3'          RENAME COEDIT.BCK 'A4,'.DAT'//,
4'          (write those down) and no harm done.'//,
5'          <<< Your data file ending date is',3I3,' >>>'//,
6'          Type "1" to return to the main program, COLSTAT4')
      READ(*,80) IRET
      IF (IRET.NE. 1) GO TO 150
C
      CLOSE(UNIT=3,DISPOSE='DELETE')
C
      RETURN
      END

```

```

C      SUBROUTINE COLSTG4 (NQ,FILER,IOPT)
C      ***** COLSTG4.FOR *****
C      COLSTG4.FOR -- COLSTG4.FOR is responsible for plotting the
C                      Columbia River statistical data.
C
C                      The subroutine uses DISSPLA to plot the data.
C                      The input required by DISSPLA is provided by
C                      small data files labeled *.CMD. These files
C                      supply the following information:
C
C                      INPUT DATA FILE NAME
C                      OUTPUT PLOTFILE NAME
C                      X,Y PLOT LIMITS
C                      X-AXIS LABEL
C                      Y-AXIS LABEL
C                      NUMBER OF TITLES AND HEIGHT OF TITLES
C                      TITLE
C                      .
C                      .
C                      YMIN,YMAX,YINC
C                      GRAPH TYPE: 1=REGULAR 2=CALENDAR
C                      IF REGULAR (1) XMIN,XMAX,XINC
C                      IF CALENDAR (2) ----
C                      NUMBER OF CURVES AND TEMP (=1) OR FLOW (=2) FOR LEGEND
C                      "NCURVES" FORMATS
C
C                      This subroutine was written for inclusion with the
C                      COLSTAT4 series for statistical analysis of the
C                      Columbia River.
C
C      Revised by:
C      R. D. Brockhaus
C      Earth Sciences Department
C      Pacific Northwest Laboratory
C      Richland, Washington 99352
C      21-August-1986
C      *****
C      BYTE FILE(40),TITLE(80),FMT(80),FILER(8)
C      DIMENSION IPAK(1),X(15000),Y(15000)
C
C      DATA KNTER /0/
C
C      KNTER = KNTER + 1
C
C      WRITE (*,*) ' '
C      WRITE (*,*) ' *****'
C      WRITE (*,*) '      Entering the plotting routine, please wait.'
C      WRITE (*,*) ' *****'
C      WRITE (*,*) ' '

```



```

CALL FRAME
CALL XTICKS(5)
CALL YTICKS(5)
CALL YAXANG(0)
READ(3,*) IG
IF(.NOT.(IG.EQ.1)) GO TO 20
READ(3,*) XMIN,XMAX,XINC
CALL GRAF(XMIN,XINC,XMAX,YMIN,YINC,YMAX)
GO TO 30

C
C
C
20  IXF = 1
    IXL = 13
    CALL XTICKS(1)
    CALL XAXCTR
    CALL HEIGHT(.1)
    CALL XMONGR{IXF,IXL,YMIN,YINC,YMAX)
    CALL RESET('HEIGHT')
30  READ(3,*) NC,ITF
    GO TO 110

C
C
C
50  FORMAT(Q,80A1)

-----
Read and plot x,y data for "nc" curves.
-----

C
C
C
110 IF(NC.GT.1) CALL LEGLIN
    DO 230 I=1,NC
        READ(3,50) NF,FMT

C
C
C
130  DO 140 J=1,10000
        READ(1,FMT,END=150) X(J),Y(J)
140  CONTINUE

C
C
C
150  NPT = J - 1
        IF((1).NE.(I)) GO TO 160
        CALL CHNDOT
        GO TO 210

C
C
C
160  IF((2).NE.(I)) GO TO 170
        CALL DASH
        GO TO 210

C
C
C
170  IF((3).NE.(I)) GO TO 180
        CALL RESET('DASH')

```

```

      GO TO 210
C
C
C
180   IF((4).NE.(I)) GO TO 190
      CALL DASH
      GO TO 210
C
C
C
190   IF((5).NE.(I)) GO TO 200
      CALL CHNDOT
      CONTINUE
C
C
C
210   IF(.NOT.(NC.EQ.1)) GO TO 220
      CALL RESET ('DOT')
      CALL CURVE(X,Y,NPT,0)
      REWIND(1)
230   CONTINUE
C
C
C
-----
C      Plot the legend for the desired plot
C
C
C
      IF (.NOT.(IOPT.EQ.3.OR.IOPT.EQ.6))GOTO 999
      CALL HEIGHT(.1)
      J = LINEST(IPAK,100,40)
      CALL LINESP(4.0)
      CALL LINES(' STANDARD DEVIATIONS$',IPAK,2)
C
C
C
      IF(.NOT.(ITF.EQ.1))GOTO 240
      CALL LINES('MIN/MAX TEMPERATURE$',IPAK,1)
      CALL LINES('AVERAGE DAILY TEMPERATURE$',IPAK,3)
C
C
C
240   IF(.NOT.(ITF.EQ.2)) GOTO 250
      CALL LINES('MIN/MAX FLOWS$',IPAK,1)
      CALL LINES('AVERAGE DAILY FLOWS$',IPAK,3)
250   XL = XLEGND(IPAK,3)
      YL = YLEGND(IPAK,3)
      CALL LEGEND(IPAK,3,XAXIS-XL-.2,YAXIS-YL-.2)
C
C
C
999   CLOSE (UNIT=3)
      CALL ENDPL(0)
      CALL DONEPL
      CLOSE (UNIT=1)
      CLOSE (UNIT=12)
      RETURN
      END

```

***** EXCEED4.FOR *****

EXCEED4.FOR -- EXCEED4.FOR calculates and plots the percent exceedence output from a user flow and temperature range. This routine calculates the percent of time the flow rate is below a given flow rate while the temperatures are above a given temperature.

EXCEED4.FOR was written for inclusion with COLSTAT4 series for statistical analysis of the Columbia River.

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02/07/85

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27-August-1986

SUBROUTINE EXCEED4(NV)

BYTE FILE(40),A(80)

DIMENSION ISIZ(9),ALABEL(2),PLTS(3),PCT(15000)

COMMON /M/ MONDYS(12),MONDS(12)
COMMON/EXC/RMINT,RMAXT,RINCT,RMINF,RMAXF,RINCF,
+TP(15000),FL(15000),IUNF,IUNT

DATA ALABEL /'LABE','LS','/'
DATA PLTS /'EXCE','ED4.','TMP'/

Calculate the percent exceedences

IF (RINCF.GT.0 .AND. RINCT.GT.0) GO TO 800
WRITE (*,*) ' TEMP. OR FLOW INCREMENT = ZERO.'
WRITE (*,*) ' % EXCEEDED HAS NOT BEEN CALCULATED.'


```

800  RETURN
    CONTINUE
C
C
C
C  OPEN(UNIT=3,FILE='EXCEED4.TMP',STATUS='NEW')
C
C  WRITE(*,*)' '
C  WRITE(*,*)' *****'
C  WRITE(*,*)' * Please wait while the percentages are calculated *'
C  WRITE(*,*)' *****'
C  WRITE(*,*)' '
C
C  KT = 0
C  JG = 0
C
C
C
C  DO 920 AI=RMINT,RMAXT,RINCT
    KT = KT + 1
    KF = 0
    DO 910 AJ=RMINF,RMAXF,RINCF
      KF = KF + 1
      NG = 0
      DO 900 I=1,NV
        IF (TP(I) .GE. AI .AND. FL(I) .LE. AJ) NG = NG+1
        IF (TP(I) .EQ. AI .AND. FL(I) .EQ. AJ) NG = NG-1
900    CONTINUE
        JG = JG+1
        PCT(JG) = 100. * NG/NV
        WRITE(3,909) AJ,AI,PCT(JG),JG
909    FORMAT(3F10.2,I10)
910    CONTINUE
920    CONTINUE
C
C
C  -----
C  Now set up the contour.com file (including x-y labels). The command file
C  will plot the percent exceedence.
C
C  The first step is to read first three cards from the file CONTOUR.FIL
C  and then write to CONTOUR.COM
C  -----
C
C  OPEN (UNIT=9,FILE='CONTOUR.FIL',STATUS='OLD',READONLY)
C  OPEN (UNIT=10,FILE='CONTOUR.COM',STATUS='NEW',
1  CARRIAGECONTROL='LIST')
C
C
C
C  DO 1180 M=1,3
    READ (9,1210) A
1210    FORMAT (80A1)
    WRITE (10,1210) A
1180    CONTINUE
C
C
C  -----

```

C Next, read the sizing parameters and calculate new parameters where
C needed. Write the parameters to CONTOUR.COM.

```

1215  READ (9,*) ISIZ
      FORMAT (9I5)
      ISIZ(3) = KF
      ISIZ(6) = KF
      ISIZ(4) = KT
      ISIZ(8) = KT
      WRITE (10,1215) ISIZ

```

Read and write the next 9 lines and write to CONTOUR.COM.

```

DO 1185 M=5,13
  READ (9,1210) A
  WRITE (10,1210) A
1185 CONTINUE

```

Read the old plot file name, discard, and write the new file name.

```

      READ (9,1210) A
      WRITE (10,1220) PLTS
1220  FORMAT (3A4,14X,'(20X,F10.2)')

```

Read and write primary grid size title line.

```

READ (9,1210) A
WRITE (10,1210) A

```

```
C Read old grid size, discard, calculate new sizes, and write to
C CONTOUR.COM.
```

```

      READ (9,1210) A
      GRID1 = 14./KF
      GRID2 = 11./KT
1225  WRITE (10,1225) GRID1,GRID2
      FORMAT (2F10.5)

```

Write the labels.

```

C -----
C
C      WRITE (10,1220) ALABEL
C
C -----
C      Set up the x and y contour labels.
C -----
C
C      IF (IUNF.EQ.1) WRITE (10,1240) RINCF,RMINF
C      IF (IUNF.EQ.2) WRITE (10,1245) RINCF,RMINF
1240  FORMAT ('1DISCHARGE IN INCR. OF ',1PE10.4,' CMS, STARTING WITH ',
1 1PE10.4,' CMS')
1245  FORMAT ('1DISCHARGE IN INCR. OF ',1PE10.4,' CFS, STARTING WITH ',
1 1PE10.4,' CFS')
      GR1 = 0.3
      GR2 = 10.3
      GR3 = 0.14
      GR4 = 0.0
      WRITE (10,1250) GR1,GR2,GR3,GR4
1250  FORMAT ('N',4X,F10.5,F10.5,F10.2,F10.1)
C
C
C      IF (IUNT.EQ.1) WRITE (10,1230) RINCT,RMINT
C      IF (IUNT.EQ.2) WRITE (10,1235) RINCT,RMINT
1230  FORMAT ('1TEMPERATURE IN INCR. OF ',1PE8.2,' DEG C, STARTING ',
1 'WITH ',1PE8.2,' DEG C')
1235  FORMAT ('1TEMPERATURE IN INCR. OF ',1PE8.2,' DEG F, STARTING ',
1 'WITH ',1PE8.2,' DEG F')
      GR1 = 0.3
      GR2 = 0.3
      GR3 = 0.14
      GR4 = 90.0
      WRITE (10,1250) GR1,GR2,GR3,GR4
C
C -----
C      Write "end of labels", and "end of data" to CONTOUR.COM.
C -----
C
C      WRITE (10,1255)
C      WRITE (10,1260)
1255  FORMAT ('END OF LABELS.')
1260  FORMAT ('END OF DATA.')
C
C
C      1200 CONTINUE
C
9999  CONTINUE
      CLOSE(UNIT=3)
      CLOSE(UNIT=9)
      CLOSE(UNIT=10)
C
C

```

```

SUBROUTINE MEAN4 (NTYPE,ICONVT,ICONVF)
C ***** MEAN4.FOR *****
C MEAN4.FOR -- This subroutine reads the input file(s) (TEMP.DAT or
C               FLOW.DAT) to COLSTAT. It also writes the mean
C               temperature or mean flow vs time in years for the
C               period of record. This is then used for plotting
C               by the subroutine COLSTG4.
C
C               This subroutine was written for inclusion with the
C               COLSTAT4 series for statistical analysis of the
C               Columbia River
C
C Revised by:
C R. D. Brockhaus
C Earth Sciences Department
C Pacific Northwest Laboratory
C Richland, Washington 99352
C 21-August-1986
C *****
C
C   DIMENSION MONTH(12)
C
C   DATA MONTH/0,31,60,91,121,152,182,213,244,274,305,335/
C   DATA MONTH/31,29,31,30,31,30,31,31,30,31,30,31/
C
C   GO TO (20,30) , NTYPE
20  CONTINUE
C
C -----
C   Open the data file FLOW.DAT
C -----
C
C   OPEN(UNIT=1,FILE='FLOW.DAT',STATUS='OLD',READONLY)
C   OPEN(UNIT=2,FILE='FLO1.DAT',STATUS='NEW')
C   WRITE(*,25)
25  FORMAT(/' SELECT FLOW UNITS: '/' 1 = CUBIC METERS /
C   +SECOND '/' 2 = CUBIC FEET / SECOND '/')
C   READ(*,*) ICONVF
C   GO TO 35
30  CONTINUE
C
C -----
C   Open the data file TEMP.DAT
C -----
C
C   OPEN(UNIT=1,FILE='TEMP.DAT',STATUS='OLD',READONLY)
C   OPEN(UNIT=2,FILE='TMP1.DAT',STATUS='NEW')
C   WRITE(*,33)
33  FORMAT(/' SELECT TEMPERATURE UNITS: '/' 1 = CELSIUS'
C   +/' 2 = FAHRERNHEIT'/)

```

```

35      READ(*,*) ICONVT
      CONTINUE
C
C
C-----
C          Perform the calculations
C-----
C
      WRITE(*,*) ' '
      WRITE(*,*) ' ***** '
      WRITE(*,*) ' Entering the subroutine MEAN4.FOR. '
      WRITE(*,*) ' Please wait for calculations to finish. '
      WRITE(*,*) ' ***** '
      WRITE(*,*) ' '
C
C
C
      READ(1,60)
      READ(1,60)
      TSAV = 1.
      I = 0
40      I = I + 1
      READ(1,60,END=99) ID,IM,IY,T
      IF(T.EQ.-88.) GO TO 40
      IF (NTYPE.NE.1) GO TO 50
      IF(T.LT.150000 .AND. ABS(T-TSAV)/TSAV.LT.0.1) GO TO 40
50      CONTINUE
      TSAV = T
      X = IY + 1.*(MONTH(IM)+ID-1)/366.
      IF (NTYPE.EQ.1.AND.ICONVF.EQ.1) T = T/35.3145
      IF (NTYPE.EQ.2.AND.ICONVT.EQ.2) T = 9./5.*T+32.
      WRITE(2,70) X,T
      GO TO 40
C
C
C
60      FORMAT(8X,3I3,F10.0)
70      FORMAT(F10.3,F10.1)
99      CLOSE (UNIT=1)
      CLOSE (UNIT=2)
      RETURN
      END

```

```

C      SUBROUTINE TLAPSE(ID1,IM1,IY1,IRS)
C
C *****
C
C TLAPSE.FOR -- This subroutine is used to determine the elapsed
C               time from January 1, 1959, to the specified user
C               input date (IM1,ID1,IY1).
C
C Revised by:
C
C R. D. Brockhaus
C Earth Sciences Department
C Pacific Northwest Laboratory
C Richland, Washington 99352
C 21-August-1986
C *****
C
C      COMMON /M/ MONDYS(12)
C      IRS = 0
C      IDY = IY1 - 59
C      IF(IDY.LT.0) IRS = -731
C      IF(IDY.EQ.0) GO TO 20
C
C
C      DO 10 I = 1, IDY
C         IRS = IRS + 365
C         IF(MOD(58+I,4).EQ.0) IRS = IRS + 1
10      CONTINUE
C
C
C      IRS = IRS + ID1 + MONDYS(IM1)
C      IF(MOD(IY1,4).EQ.0 .AND. IM1.GT.2) IRS = IRS + 1
C      RETURN
C      END

```

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