User's manual for SEDCALC, a computer program for computation of suspended-sediment discharge

U.S. GEOLOGICAL SURVEY

Open-File Report 94-459

User's manual for SEDCALC, a computer program for computation of suspended-sediment discharge

By G.F. Koltun, John R. Gray, and T.J. McElhone

U.S. GEOLOGICAL SURVEY OPEN-FILE REPORT

U.S. DEPARTMENT OF THE INTERIOR

Bruce Babbitt, Secretary

U.S. GEOLOGICAL SURVEY

Gordon P. Eaton, Director

For additional information write to:

District Chief
U.S. Geological Survey
975 W. Third Ave
Columbus, OH 43214-3109

Copies of this report can be purchased from:

U.S. Geological Survey
Books and Open-File Reports Section
Box 25425, Mail Stop 517
Federal Center
Denver, CO 80225-0425

CONTENTS

FIGURES

CONVERSION FACTORS

Multiply	By	To obtain
ton, short	0.9072	megagram
tons per day (ton/day)	0.9072	megagrams per day
cubic foot (ft^3)	0.02832	cubic meter
cubic foot per second (ft^3/s)	0.02832	cubic meter per second

User's manual for SEDCALC, a computer program for computation of suspended-sediment discharge

By G.F. Koltun, John R. Gray, and T.J. McElhone

Abstract

Sediment-Record Calculations (SEDCALC), a menu-driven set of interactive computer programs, was developed to facilitate computation of suspended-sediment records. The programs comprising SEDCALC were developed independently in several District offices of the U.S. Geological Survey (USGS) to minimize the intensive labor associated with various aspects of sediment-record computations.

SEDCALC operates on suspended-sediment-concentration data stored in American Standard Code for Information Interchange (ASCII) files in a predefined card-image format. Program options within SEDCALC can be used to assist in creating and editing the card-image files, as well as to reformat card-image files to and from formats used by the USGS Water-Quality System.

SEDCALC provides options for creating card-image files containing time series of equal-interval suspended-sediment concentrations from

1. digitized suspended-sediment-concentration traces,

2. linear interpolation between log-transformed instantaneous suspended-sediment-concentration data stored at unequal time intervals, and

3. nonlinear interpolation between log-transformed instantaneous suspended-sediment-concentration data stored at unequal time intervals.

Suspended-sediment discharge can be computed from the streamflow and suspended-sediment-concentration data or by application of transport relations derived by regressing log-transformed instantaneous streamflows on log-transformed instantaneous suspended-sediment concentrations or discharges. The computed suspended-sediment discharge data are stored in card-image files that can be either directly imported to the USGS Automated Data Processing System or used to generate plots by means of other SEDCALC options.

INTRODUCTION

Techniques used by the U.S. Geological Survey (USGS) to compute daily records of suspended-sediment discharge (Porterfield, 1972; Glysson, 1987) changed little from the 1940's to the 1970's. In the 1980's, several programs for computing sediment discharge were developed independently in district offices of the USGS, Water Resources Division (WRD), to meet the needs of the respective offices. Several of these programs were combined to form SEDCALC, which was officially accepted for use by the WRD in March 1992.

SEDCALC is an interactive, menu-driven set of programs developed to facilitate computation of daily suspended-sediment discharge records. It enables one to use an entire streamflow time series to compute instantaneous and daily sediment discharges, thereby eliminating computational errors that may result from use of a subset of the streamflow time series in manual subdivision for periods of rapidly varying streamflow and (or) sediment concentrations. Other advantages of SEDCALC over traditional techniques for computing daily records of sediment discharge are that it (1) speeds record computation by automating some of the labor-intensive tasks associated with manual sediment-record computations, (2) provides a uniform set of tools for sediment-record computations, (3) facilitates exploratory data analyses, and (4) facilitates the archiving and restoration of data for later analysis and review.

Purpose and Scope

This document describes the purpose, computational approach (where appropriate), input requirements, and output characteristics of the programs that compose SEDCALC for the Unix operating system. Readers are expected to be familiar with the USGS Automated Data Processing System (ADAPS) (Dempster, 1990) and Water-Quality System (Maddy and others, 1989), both of which are part of the National Water Information System (NWIS). Readers are also expected to be familiar with standard sediment-record computation techniques.

Acknowledgments

The programs that compose SEDCALC were independently developed by a number of programmers and hydrologists in WRD district offices across the country and at USGS Headquarters in Reston, Virginia. The authors wish to acknowledge the following persons for their contributions to SEDCALC: Robert Bodoh, Wisconsin District; Steven Hindall, Ohio District; Clyde Sholar, Kentucky District; Kevin Oberg and Arthur Schmidt, Illinois District; William Johnson, Cascade Volcano Observatory, Washington; William Grey and Joseph Pruitt, formerly of the Arizona District; Colleen Babcock, Arizona District; Timothy Liebermann, Nevada District; and Harvey Jobson, Office of Surface Water, WRD, Reston, Va..

OVERVIEW OF SEDCALC

The programs that compose SEDCALC can be placed into one of five general categories: (1) data entry and editing, (2) data-format conversion, (3) data manipulation, (4) sediment-discharge computation, and (5) data display and tabling. Concentration data used in SEDCALC must be entered and stored in ASCII files in either a SEDATA or unit-values card-image format (See appendix 1 for description of card-image formats.) Data are most commonly entered into these files by means of the data entry and edit options within SEDCALC. These options enable data entry by means of the keyboard (options 1 and 3) and by means of a digitizer (option 7). Data files suitable for use in SEDCALC may also be created by reformatting ASCII files generated by means of the USGS Water-Quality System. Alternatively, concentration-data files used by SEDCALC can be reformatted for entry into the Water-Quality System (option 5). Data manipulation, with the exception of manual data editing, is limited to application of cross-section (box) coefficients (option 2). SEDCALC can be used to vary cross-section coefficients by time only.

SEDCALC provides four options for computation of sediment discharge. In two of the options (option 10, suboptions 1 and 2) a log-linear interpolation algorithm is used to obtain equal (time) interval concentration and streamflow data; in a third option (option 10, suboption 4), a nonlinear-interpolation algorithm is used. A fourth option (option 10, suboption 3) enables use of as many as four streamflow-dependent transport relations to compute equal-interval instantaneous suspended-sediment concentration. Once equal-interval concentration and streamflow data have been determined, equal-interval sediment discharge is computed by means of the following equation:

$$Q_s = Q_w C k,$$

where Q_s is instantaneous suspended-sediment discharge, in tons per day;
Q_w is instantaneous water discharge, in cubic feet per second,;
C is instantaneous suspended-sediment concentration, in milligrams per liter; and
k is a units-conversion constant that equals 0.0027 in inch-pound units.

After equal-interval sediment discharges have been computed, daily sediment discharges are determined by numerical integration. The integration is done by summing the equal-interval instantaneous sediment discharges for the calendar day and dividing by the number of intervals in the day. Unit and daily values computed within SEDCALC are stored in a format that may be imported into ADAPS for storage and archiving.

Several options are available within SEDCALC to display sediment and streamflow data. Data can be displayed in tables (option 4) or in graphs. Two options (option 6 and option 10, suboption 5) enable the user to create time-series plots of selected sediment and streamflow data. A third option (option 9) can be used to create log-log plots of concentration as a function of streamflow.

USING SEDCALC

This section describes use of individual SEDCALC options. Keystrokes for entry of commands or other information are identified by **bold** type. Computer output and sample screens are shown in

courier type. The position of the cursor (where appropriate) is represented by the symbol ❒. File names are shown in upper case in this document to help make them more identifiable; however, file names are written to the Unix file system in lowercase. Any file name entered in response to a SEDCALC prompt should be in lowercase.

Starting a SEDCALC Session

To begin a SEDCALC session, the user types **SEDCALC**. The following menu is displayed:

```
*******************************************************************************
       SEDCALC MAIN MENU (REV 93)
*******************************************************************************

CODE  PROGRAM DESCRIPTION
----  -------------------
  1 : ENTER SEDIMENT CONCENTRATION DATA
  2 : APPLY CROSS-SECTION (BOX) COEFFICIENTS
  3 : EDIT SEDIMENT CONCENTRATION DATA
  4 : TABLE SEDIMENT CONCENTRATION DATA
  5 : CREATE 1 AND * CARDS FOR INPUT TO WATER-QUALITY SYSTEM
  6 : PLOT CONCENTRATION AND STREAMFLOW DATA AGAINST TIME
  7 : DIGITIZE SEDIMENT TRACE
  8 : REFORMAT QWGRAPH CONCENTRATION DATA TO SEDATA FILE
  9 : PLOT CONCENTRATION AGAINST STREAMFLOW
 10 : COMPUTE SEDIMENT DISCHARGE SUBMENU

 99 : EXIT TO UNIX (DEFAULT)

ENTER UNIX COMMAND OR SELECT PROGRAM CODE? ❒
```

When option 10 is selected, the following submenu is displayed:

```
*******************************************************************************
      SEDCALC OPTION 10 SUBMENU (REV 93)
*******************************************************************************


CODE  PROGRAM DESCRIPTION
----  -------------------
  1 : LINEAR INTERPOLATION - UNEVEN TIME INTERVAL (1 VALUE/B-CARD)
  2 : LINEAR INTERPOLATION - EVEN TIME INTERVAL (6 VALUES/B-CARD)
      NOTE: USUALLY FROM DIGITIZER PROGRAM (MAIN MENU OPTION 6)
  3 : SEDIMENT DISCHARGE BY LOG-LOG TRANSPORT CURVE
  4 : SEDIMENT DISCHARGE BY NONLINEAR INTERPOLATION (IMSL)
  5 : PLOT SEDIMENT DISCHARGE,CONC.,AND STREAMFLOW AGAINST TIME

 98 : EXIT TO MAIN MENU (DEFAULT)
 99 : EXIT TO UNIX

ENTER UNIX COMMAND OR SELECT PROGRAM CODE? ❒
```

Either a numeric code associated with a SEDCALC program option or a Unix command may be entered at both the main-menu level and at the option 10 submenu level. Because a Unix command can be entered while a session is in progress, it is unnecessary to exit SEDCALC to do most system-level tasks such as copying, printing, or deleting of files.

Although SEDCALC options can be invoked in any order, use of some options may depend on output from others. The order that the options are presented in this document reflects their order in the SEDCALC menus. A description of each option follows.

Option 1—Enter Sediment-Concentration Data

Option 1 is selected to enter data for as many as four parameters with valid five-digit NWIS parameter codes. Data are stored in a card-image0-formatted ASCII file referred to as a "SEDATA file." For SEDCALC programs, the term "card image" implies that the data are stored in a fixed-format ASCII file with a maximum line length of 80 characters. (See appendix 1 for details of the file structure.) The extension ".SEDATA" is recommended for naming the SEDATA file.

When option 1 is selected from the main menu, the following screen is displayed:

```
                    CONCENTRATION INPUT ROUTINE  REV 93

This program allows the user to enter concentration data and store them in
a unique format that is used by the other SEDCALC programs.  Input to this
program is the name of the file the concentration data will be stored in.

The following restrictions apply when entering data:
   1) Only one station i.d. may be entered into a file.
   2) A maximum of 4 parameter codes may be entered into a file.
   3) A date and time MUST be entered for each concentration value.


Enter output file name (CR=STOP):❒
```

The output file name that is requested is the name of the SEDATA file. If the file name entered already exists, the following message is displayed:

```
This file already exists
 1) Write over current file
 2) Add to current file?

Enter number of choice or (CR) for new file: ❒
```

Entering **1** at the prompt will cause the existing SEDATA file to be deleted and a new SEDATA file to be created. Entering **2** will cause data entered during the session to be added to the existing file. The data are sorted by time before being written to the SEDATA file so data do not have to be entered in chronological order.

A remark code can be associated with each constituent concentration entered. The remark code is primarily used within SEDCALC to identify whether the constituent concentration was determined for a non-depth-width integrated sample (identified by a null remark code), determined for an equal-width-increment or equal-discharge-increment sample (identified by an "I" remark code), or estimated (identified by an "E" remark code). Concentrations flagged with null remark codes can subsequently be adjusted through application of cross-section (box) coefficients. Remark code prompting is optional. If remark-code prompting is not selected, then a null remark code is assumed.

After the user chooses whether to be prompted for remark codes, the following screen is displayed:

```
NOTE:

 1. 80154 Should be entered without a decimal point.
 2. Other parameters can be entered with a decimal point.
 3. Enter the water year not the calendar year.
 ------------------------------------------------------------------------


    Site I.D. :
 1) Year(YYYY):           [Water Year]

 2) Date(MMDD):           [CR quit program]
 3) Time(HHMM):

 Enter up to 4 parameters codes that will appear on one card

 4)❒
```

As many as four five-digit parameter codes can be entered one line at a time. At least one parameter code, 80154 (suspended-sediment concentration in milligrams per liter), must be entered. Entering parameter code 00061 (instantaneous streamflow, in cubic feet per second) is recommended for subsequent use in evaluating transport relations; however, streamflow data obtained from ADAPS can also be used for such evaluations. Entering a carriage return (enter key) without a corresponding parameter code signifies that all desired parameter codes have been entered.

After the desired parameter codes have been entered, a screen entry form similar to that shown below is displayed (The example below shows the screen that is displayed if remark code prompting is on and parameter codes 80154 and 00061 are entered):

```
NOTE:

 1. 80154 Should be entered without a decimal point.
 2. Other parameters can be entered with a decimal point.
 3. Enter the water year not the calendar year.
 ------------------------------------------------------------------------


    Site I.D. : ❒
 1) Year(YYYY):           [Water Year]

 2) Date(MMDD):           [CR quit program]
 3) Time(HHMM):
                                                    < , >
                                  Remark Codes      E = Estimated Sample
                                  ------------      I = EWI Sample
 4) 80154     :               R4) 80154 :
 5) 00061     :               R5) 00061 :
```

A valid eight-digit station identification number (“Site I.D.”) and water year must be entered. Once those data have been specified, the following information must be entered for each observation: (1) date, as a two-digit month and two-digit day (MMDD), (2) military time, as a two-digit hour and two-digit minute (HHMM)’ (3) values for each parameter code specified in the previous step, and (4) remark code associated with each value.

After data for each parameter code are entered, a prompt informs the user that change to any parameter value or associated remark code is permitted. This prompt is repeated after each change until successive carriage returns are typed. The user should note that the input program will accept duplicate dates and times, but the computational component will not. When all data are entered, a carriage return at the Date prompt causes the data to be sorted into chronological order and stored in the SEDATA file. Once the data are saved, the main menu is displayed.

Option 2—Apply Cross-Section (Box) Coefficients

Option 2 is used to enter and apply cross-section coefficients. Cross-section coefficients, also known as box coefficients, are used to adjust the concentration obtained from point or single-vertical samples to reflect the mean concentration in the cross section.

When option 2 is selected from the main menu, the following screen is displayed:

```
This program reads a SEDCALC data file, prompts for
box coefficients, and produces a second SEDCALC data
file that has the box coefficients applied to sample
concentrations that have no associated remark code.

The SEDCALC data file will be scanned for a 2 card
with an associated parameter code of 80154.  With
every occurrence of an I remark code for parameter
code 80154, the user will be prompted for a box
coefficient value.  An I remark code denotes a
depth/width integrated sample (EDI/EWI).
Sample concentrations with null remark codes will
be multiplied by the box coefficient that is
determined by interpolating linearly, in time,
between coefficients entered for bounding I values.
All other data will simply be echoed unchanged to
the output file.

ENTER SEDATA FILE NAME>❒
```

Input to this program is a data file in the SEDATA file format. After entry of a valid input file name, the following prompt is displayed:

```
ENTER COMPUTED VALUES FILE NAME>❒
```

The file name entered at the above prompt is used to create a new SEDATA file that contains the concentration data as adjusted by use of cross-section coefficients. If this second file already exists, a prompt is displayed asking whether to overwrite the file. A **yes** responsel causes the specified file to be overwritten. A **no** response causes the program to stop and return to the main menu, leaving the file unchanged.

Once the input and output file names have been specified, the input file is scanned to determine if data for parameter code 80154 (suspended-sediment concentration) are present. If no data for parameter code 80154 parameter code are found, the program stops and returns to the main menu prompt.

With every occurrence of a card image having a remark code of "I" (indicating a depth-width integrated sample) and parameter code of 80154, a prompt is displayed requesting a cross-section coefficient. After assigning a cross-section coefficient to each concentration with an "I" remark code, any intervening concentrations having a null remark code are adjusted through multiplication by a time-weighted cross-section coefficient. This coefficient is determined by linear interpolation in

time between cross-section coefficients entered for depth-width integrated samples occurring most closely in time before and after the given sample concentration. Concentration data in the SEDATA file that precede the first value with an "I" remark code or follow the last value with an "I" remark code are considered by the program to have a cross-section coefficient of 1.0. Estimated values, denoted by a remark code of "E," are written to the output file unchanged.

After the program computes the adjusted concentration values, the following prompt is displayed:

```
REPORT TO  0-NO REPORT  1-SCREEN  2-FILE>❒
```

The report referred to in the above prompt is a summary of all the original concentrations, the adjusted concentrations, and the interpolated cross-section coefficients used in the adjustment. If the report to file option is selected, a unique file name must be entered (there is no default). The SEDATA file containing the adjusted concentrations should be used for subsequent SEDCALC operations.

Option 3—Edit Sediment-Concentration Data

Option 3 is used to add, delete, or edit data contained in a SEDATA file. When a **3** is selected from the main menu, the following screen is displayed:

```
                    SEDIMENT EDIT ROUTINE   REV 93

Input to this program is a concentration file like those created in the
input routine of this package.


Enter concentration input file name, (CR=STOP)❒
```

Input to this program is the name of the SEDATA file created with option 1. If the specified file does not exist, a warning is displayed and the user is prompted for the correct file name. After the input file name is entered, a screen similar to the following screen is displayed (the data values listed are for example only):

```
******************** SD_EDIT ******************** Station: 00000203 *******


*****************************************************************************
      Year Date Time     (80154) R    (00060) R    (     ) R    (     ) R
      1989 0305 0005          10 E     24.083 _
      1989 0305 0035          50 E     24.083 _
      1989 0305 0105         100 E     24.083 _
      1989 0305 0135         195 I     24.083 _
      1989 0305 0205         263 I     24.083 _
      1989 0305 0235         395 _     24.083 _
      1989 0305 0305         220 _     24.083 _
      1989 0305 0335         120 _     24.083 _
      1989 0305 0405         120 _     24.083 _
      1989 0305 0435          65 _     24.083 _
      1989 0305 0505          41 _     24.083 _
      1989 0305 0535         150 E     24.083 _
      1989 0305 0605         100 E     24.909 _
      1989 0305 0635         100 E     25.191 _

 "P"= add parameter   "Q"= del/change parm  "A"= add to end   "C"= change line
 "F"= forward 1 page  "U"= up 1 line        "D"= delete line  "E"= exit program
 "B"= backward 1 page "M"= down 1 line     "I"= insert line  "S"= save and exit
```

The screen is divided into three areas. The top area, between the rows of asterisks, is used for prompts and other dialog. The middle area contains the data that are being edited. The bottom area lists available commands.

An description of each command is given in the table below:

Commands	Description
P or p	Add a parameter code (up to a maximum of four parameter codes). If an invalid parameter code is entered, an error message appears and a valid parameter code must be entered. When a valid parameter code is entered, the parameter code is displayed in the data area of the screen, heading an empty column. Data values for the new parameter can be entered by use of the **C** command (described below).
F or f	Move forward a screen.
B or b	Move backward a screen.
Q or q	Change a parameter code or delete a parameter and all data associated with that parameter. When **Q** is typed, the following prompt is displayed in the dialog area: `Do you want to change or delete a parameter? [C,D,CR=QUIT]` ❒ If a **C** is typed, a prompt is displayed in the dialog area asking which parameter code to change. Once the parameter code to be changed is entered, a second prompt is displayed in the dialog area asking for the new parameter code. After the new parameter code is entered, the new parameter code replaces the old parameter code in the column heading and any previously entered data are retained. If a **D** is typed, the following prompt is displayed in the dialog area: `Enter parameter code to delete [CR to quit delete]` ❒ Once the five-digit parameter code is entered, a second prompt is displayed requesting verification that the parameter (and associated data) should be deleted.
U or u	Move up 1 line.
M or m	Move down 1 line
A or a	Add data to the end of the existing data set. Once in the add mode, data can be entered simply by spacing to the appropriate column and typing the desired values. Alternatively, data can be entered by separating the required input values by one or more spaces. If data are not available for all parameters for a given date and time, a comma must be placed in the numeric data column (but not the remark column) for the missing parameter. Add mode is exited by entry of an **X** in the first character position of a line and then a carriage return. Because the data are sorted into chronological order before being stored, data can be entered at any position within the time series with assurance that it will be stored in proper chronological order.
D or d	Delete a line. When **D** is typed, a prompt is displayed in the dialog area requesting verification that the line (where the cursor is) should be deleted. A **Y** response deletes the current line. An **N** response causes the delete command to be canceled.

Commands	Description
I or i	Insert a line. When an **I** is typed, the line on which the cursor was located will move down, opening an empty line. The cursor will then move to the beginning of the empty line. Once in insert mode, the data entry operations and exit commands are functionally identical to the add command. As with the add command, data are sorted in chronological order before being stored so new data can be inserted at any point in the data file.
C or c	Change a line. When a **C** is typed, the line on which the cursor is located can be edited. When any item is changed, all data that precede that item on the line must retyped. Any data that follow the item being changed will remain unchanged. Placing a comma in the column associated with a particular parameter will set the data value associated with that parameter and its remark code to null. When the carriage return is pressed, the changes take effect, and the change mode is exited.
E or e	Exit program without saving data. When an **E** is typed, a prompt is displayed in the dialog area requesting verification that the program should be exited without saving any changes made to the data set. A **Y** response causes the program to exit to the main menu without saving the changes (the original SEDATA file remains unchanged). An **N** response will continue the editing session
S or s	Save changes and exit. Typing **S** will save all changes made in the editing session and return to the main menu prompt. The SEDATA file used as input to this option is overwritten.

Use of this option to modify the SEDATA files ensures that the data are stored in chronological order and that a one-to-one relation between entries is maintained when multiple parameters are stored. Use of an external editor can render the SEDATA file unusable by SEDCALC.

Option 4—Table Sediment-Concentration Data

Option 4 is used to table data contained in a SEDATA file in a single-station format. When **4** is selected from the main menu, the following screen is displayed:

```
                CONCENTRATION TABLING ROUTINE  REV 93

Input to this program is a concentration file in SEDATA file format.
Output is an ASCII file with the tabled concentration data.


Enter concentration input file name, (CR=STOP) ❒
```

Input to this program is a SEDATA file (like that created with option 1). Once a valid SEDATA file name is entered, the user is prompted for an output file name. The output file contains the tabled data. If the output file already exists, a prompt is displayed asking whether the file should be overwritten. A carriage return or **Y** response causes the specified file to be overwritten. If the response is **N**, the output file is prompted for again.

Once the input and output file names have been specified, the program writes the table to the output file and exits to the main-menu prompt. A sample table (shown without the page banner) is shown in figure 1.

DATE	TIME	SEDIMENT, SUSPENDED (MG/L) (80154)	TEMPERATURE WATER (DEG C) (00010)	DISCHARGE, IN CUBIC FEET PER SECOND (00060)
JAN , 1992				
10...	1200	38	2	1440
10...	1415	31I	2	1430
10...	1415	36I	2.0	1430
10...	1545	37	2.0	1410
15...	1005	5100	4.5	43400
16...	1030	8670	9	86200
17...	1010	5310	8.0	32700
17...	1900	4370I	10.0	22500
21...	0820	1490	4.5	6600
FEB				
06...	1025	110	3	1450

Figure 1. Sample table (without page banner) from SEDCALC option 4.

Option 5—Create 1 and * Cards for Input to Water-Quality System

Option 5 is used to reformat data contained in the SEDATA file to a card-image format suitable for entry into the Water-Quality System. The card-image format used by the Water-Quality System is known as the 1- and *-card format. Values flagged as estimated are skipped during reformatting to ensure that estimated values are not mistakenly entered into the Water-Quality System.

When a **5** is selected from the main menu, the following screen is displayed:

```
This program is used to convert data contained in a SEDCALC
"SEDATA" file format to a 1 and * card image format. Discharge
data are obtained from ASCII files in unit and (optionally)
daily values card image format. Data in the 1 and * card
format may be subsequently imported into the water quality
database.


Enter the name of the file with the UV discharge: ❒
```

The UV discharge file referred to in the above prompt is an ASCII file containing instantaneous streamflow data in unit-values card-image format. Once a valid file name is entered, the following prompt is printed:

```
Will you be using a daily-value discharge file (y/n) [cr]=y? ❒
```

The answer is **Y** if some unit-values data are missing and the user wishes to substitute a daily mean value from a daily-values card-image file. If a **Y** is entered, then the user is prompted for the name of the daily-values card-image file. Otherwise, if no substitutions are required, the answer is **N**, and the following prompt is printed:

```
Enter concentration input file name, (CR=STOP) ❒
```

The input being requested is the name of the SEDATA file. After a valid file name is given, a prompt is displayed requesting the name of an output file that will contain the 1- and *-card images. If the given output file name already exists, a prompt is displayed asking whether the file should be overwritten. A **Y** response causes the specified file to be overwritten. If an **N** response is given, the output file name is prompted for again.

After a valid output file name is entered, a screen similar to the following is displayed:

```
  00000203

  Dates in file range from 03/05/1989 to 09/30/1990

  Choose up to three concentration parameter codes
       1) 80154     2) 00010

  Enter concentration parameter code (CR=STOP,D=discharge only) ❒
```

This screen contains information about the data stored in the SEDATA file. This information includes the station identification number (top left), the period of record and the parameter codes contained in the SEDATA file. The last line is a prompt requesting the number (appearing to the left of the parameter code) of the parameter that should be written to the output file in 1- and *-card format. As many as three parameters can be selected. Streamflow is output by default when any other parameter is selected. If a **D** is entered, then only streamflows are written to the output file.

After all desired parameter code identifiers have been entered, the following lines are appended to the current screen:

```
--------------------------------------------------------------------------------
     Enter the water year (YYYY): ❒
     Enter up to 10 dates within the specified water year  (MMDD)
```

The water year and time period(s) must be specified for which 1- and *-card images will be written. As many as 10 time periods can be specified. A sample screen for three time periods is shown below:

```
  00000203

  Dates in file range from 03/05/1989 to 09/30/1990

  Choose up to three concentration parameter codes
       1) 80154     2) 00010

  Enter concentration parameter code (CR=STOP,D=discharge only)
--------------------------------------------------------------------------------
     Enter the water year (YYYY): 1989
     Enter up to 10 dates within the specified water year  (MMDD)
     CR when finished entering dates
   1) Begin period: 0305            End Period: 0309
   2) Begin period: 0522            End Period: 0819
   3) Begin period: 0823            End Period: 0930




            Enter number to change, CR to continue ❒
```

Time periods can be changed by entering the number to the left of the time period and then respecifying the dates. When all desired time periods have been entered, the user types a carriage return to continue.

Once the time periods have been selected, a screen similar to that shown below is displayed:

```
  00000203
  Concentration parameter code(s): 80154
  Water year: 1989                                    OOPS = Previous input
  Dates to retrieve instantaneous discharge:          RE = Restart
   1) 03/05 to 03/09
   2) 05/22 to 08/19
   3) 08/23 to 09/30


--------------------------------------------------------------------------------
       Do you want parameters 00027 and 00028 in the output? [CR=Y] ❒
```

Parameter codes 00027 and 00028 are used to store information on the collecting and analyzing agency, respectively. If a **Y** is entered at the prompt, the codes for collecting and analyzing agency

can be specified. In each case, the code for the USGS (1028) is the default. If an **N** is entered at the prompt, no information on collecting and analyzing agency is requested or written to the card-image file.

If a daily-values card-image file is not being used, then the program begins formatting and outputting the data. If a daily-values card-image file is being used, then a screen similar to that shown below is displayed:

```
  00000203
  Concentration parameter code(s): 80154
  Water year: 1989                                    OOPS = Previous input
  Dates to retrieve instantaneous discharge:          RE = Restart
   1) 03/05 to 03/09
   2) 05/22 to 08/19
   3) 08/23 to 09/30


--------------------------------------------------------------------------------

      Some unit discharge values may be affected by ice
      or any number of other problems.  Would you like to
      have some periods use the daily mean discharge
      instead of unit values? [Y/N CR=Y] ❒
```

If a **Y** is typed at the prompt, a screen similar to the following is displayed requesting dates for which daily mean streamflows are to be substituted for the instantaneous streamflows:

```
  00000203
  Concentration parameter code(s): 80154
  Water year: 1989                                    OOPS = Previous input
  Dates to retrieve instantaneous discharge:          RE = Restart
   1) 03/05 to 03/09
   2) 05/22 to 08/19
   3) 08/23 to 09/30


--------------------------------------------------------------------------------
      Parameter 00060 will be put out instead of 00061
      Periods must be within the list of dates listed above
       1) Begin period: ❒              End Period:
```

Any time period can be selected within the range of dates for which instantaneous discharge data are being retrieved. Once the time period or periods have been selected, or if daily values are not being used, the program builds the card-image output file and displays a screen similar to the following:

```
N O R M A L   T E R M I N A T I O N   -   P R O G R A M   I N Q



The file kc.error contains a summary of the retrieval options
and a list of any errors that might have occurred during
the retrieval. Please review this file before any further
processing.


ENTER <CR> TO CONTINUE: ❒
```

A file, named "outfile".ERROR is created (where "outfile" is the name supplied for the card-image file) containing information about program options selected, streamflow substitutions, and any errors that may have occurred. This file should be scanned to verify that the desired output options were implemented and that no retrieval or conversion errors were identified.

The card-image file that is created by this program can be imported into the Water-Quality System. Local data-base administrators should be contacted for assistance.

Option 6—Plot Concentration and Streamflow Data Against Time

Option 6 is used to create time-series plots of concentration and streamflow. Concentration and streamflow are both plotted on logarithmic scales. Concentration and streamflow data may be plotted at the same scale or at different scales.

When a **6** is selected from the main menu, the following prompt is printed:

```
Enter the name of the file with the UV discharge: ❒
```

The UV discharge file referred to in the above prompt is an ASCII file containing instantaneous streamflow data in unit-values card-image format. Once a valid file name has been entered, the following prompt is printed:

```
Will you be using a daily-value discharge file (y/n) [cr]=y? ❒
```

If a **Y** is entered at the above prompt, then the following prompt is printed:

```
Enter the name of the file with the DV discharge: ❒
```

The DV discharge file referred to above is an ASCII file containing daily mean streamflows in daily-values card-image format. Once appropriate file names have been supplied, a screen similar to that shown below is displayed (because SEDCALC uses the Graphics Device Installation Utility,

the available graphics devices will differ from installation to installation):

```
Graphics devices:

  1) GRAPHON                              7) HP7550
  2) TEK4107                              8) TEK4010
  3) TAB                                  9) SELANAR
  4) WYSE 85                              P) POSTSCRIPT HORIZONTAL FORMAT
  5) PRINTRONIX                           Q) POSTSCRIPT VERTICAL   FORMAT
  6) CALCOMP                              .) DISSPOP, DISSPLA post processor

Select a graphics device: ❒
```

The appropriate graphics device is selected by typing the number, letter, or character at the immediate left of the graphics-device description. Once the graphics device has been specified, the following screen is displayed:

```
Default page height and length of the output device are:
Height =   6.00
Length =   8.00

Are these values acceptable? [Y/N CR=YES] ❒
```

The default graphic page dimensions are accepted by typing **Y**. If an **N** is typed, the page height and length must be specified. Whenever page height and length are specified, the following message is displayed:

```
*WARNING* Bad page height and length settings may create misleading results.


Are these values acceptable? [Y/N CR=YES] ❒
```

The message is not intended to indicate that the height and length were misspecified, but instead to warn that misspecification of height and length values can produce undesired results on some graphics devices.

The following screen is printed after specification of graphic devices and page dimensions:

```
                CONCENTRATION-DISCHARGE PLOT ROUTINE  REV 93

Input to this program is a concentration file in the SEDATA file format.

Enter concentration input file name, (CR=STOP) ❒
```

The input being requested is the name of a SEDATA file. After a valid input filename is given, a screen similar to the following screen is displayed:

```
  00000203

  Dates in file range from 03/05/1989 to 09/30/1989

  Choose one of the following concentration parameters
       1) 80154     2) 00010

  Enter number of concentration parameter code (1-4,CR=Stop) ❒
```

This screen contains information about the data stored in the SEDATA file including the station identification number, period of record, and parameter codes. The last line is a prompt requesting the number (appearing to the left of the parameter code) of the parameter that should be plotted. Only one parameter can be selected (streamflow is output by default).

After a parameter code has been selected, the following lines are appended to the screen:

```
--------------------------------------------------------------------------------
     Enter the water year (YYYY): ❒
     Enter up to 10 dates within the specified water year  (MMDD)
```

The water year and time period (or periods) to be plotted must be selected. As many as 10 time periods can be specified. A sample screen for three time periods is shown below:

```
  00000203

  Dates in file range from 03/05/1989 to 0930/1989

  Choose up to three concentration parameter codes
       1) 80154     2) 00010

  Enter concentration parameter code (CR=STOP,D=discharge only)
--------------------------------------------------------------------------------
     Enter the water year (YYYY): 1989
     Enter up to 10 dates within the specified water year  (MMDD)
     CR when finished entering dates
    1) Begin period: 0305            End Period: 0309
    2) Begin period: 0522            End Period: 0819
    3) Begin period: 0823            End Period: 0930




             Enter number to change, CR to continue ❒
```

Time periods can be changed by entering the number to the left of the time period and then respecifying the dates. When all desired time periods have been entered, the user types a carriage return to continue, and a screen similar to that shown below is displayed:

```
  00000203
  Concentration parameter code: 80154
  Water Year: 1989                                    OOPS = Previous input
  Dates to generate plot:                             RE = Restart
   1) 03/05 to 03/11
   2) 05/22 to 08/19
   3) 08/23 to 09/30

                                                      Range of values in file:
                                                      MIN:     10.000
                                                      MAX:   1850.000

--------------------------------------------------------------------------------

  Enter the number of days that will appear on a frame  [CR=7] ❒
```

A plot frame can contain from 1 to 31 days of data. After a valid value is entered, the following prompt is appended to the screen:

```
Enter the time scale factor [CR= 0.93 inches/day] ❒
```

The time-scale factor is computed as the axis length divided by the number of days of data on a plot frame. The default time-scale factor is chosen by entering a carriage return at the prompt. After a valid time-scale factor or the default time-scale factor is selected, the following prompt is appended to the screen:

```
  Do you wish to use separate scales for discharge and
  concentration? [Y/N CR=Y] ❒
```

Concentration and streamflow may be plotted on a single scale or on separate scales. If a **Y** is entered at the above prompt, separate scales are used. Otherwise, concentration and streamflow data are plotted on a single scale. If concentration and streamflow data are being plotted on separate scales, a screen similar to the following screen is displayed:

```
  00000203
  Concentration parameter code: 80154
  Water Year: 1989                                    OOPS = Previous input
  Dates to generate plot:                             RE = Restart
   1) 03/05 to 03/06
   2) 05/22 to 08/19
   3) 08/23 to 09/30

                                                      Range of values in file:
                                                      MIN:     10.000
                                                      MAX:   1850.000

--------------------------------------------------------------------------------


  Enter Y-axis minimum value for concentration data [CR=Data dependent] ❒
```

A minimum value for the concentration axis can be entered at the prompt, or a default value (determined from the range of concentrations) can be selected by typing a carriage return. If the minimum value is specified for the concentration axis, it should, for most plots, be a power of 10. After the minimum value for the concentration axis is selected, the following line is appended to the screen:

```
Enter number of log cycles for concentration data [CR=Data dependent] ❒
```

Any whole number of log cycles can be chosen, however too many log cycles cause the data to be excessively compressed, and too few log cycles truncate the plot and cause error messages to be printed. After the minimum value and number of log cycles are specified for the concentration axis, the prompts are repeated, this time for the minimum value and number of log cycles on the streamflow axis.

If a single plotting scale was selected for concentration and streamflow, the following two prompts are displayed:

```
Enter Y-axis minimum value [CR=Data dependent] ❒

Enter the number of log cycles [CR=Data dependent] ❒
```

As is true when separate scales are selected, values can be specified or data-dependent defaults can be selected by entering carriage returns at the prompts. If a daily-values card-image file has not been specified, then the graphics device is initialized at this point. If a daily-values card-image file has been specified, a screen similar to the following is displayed:

```
  00000203
  Concentration parameter code: 80154
  Water Year: 1989                                    OOPS = Previous input
  Dates to generate plot:                             RE = Restart
   1) 03/05 to 03/06
                                                      Range of values in file:
                                                      MIN:     10.000
                                                      MAX:   1850.000

--------------------------------------------------------------------------------
      Some unit discharge values may be affected by ice
      or any number of other problems.  Would you like to
      display daily-mean discharge(s) for some periods
      instead of unit values? [Y/N CR=Y] ❒
```

As the above prompt suggests, time periods can be selected for which the daily mean streamflow is plotted instead of the unit values. If a **Y** is entered at the above prompt, the following prompt is displayed:

```
      Periods must be within the list of dates listed above
       1) Begin period: ❒               End period:
```

As many as 10 time periods can be selected. A carriage return at the above prompt indicates that all desired time periods have been entered, and the following prompt is appended to the screen:

```
          Enter number to change, CR to continue ❒
```

A time period can be changed by entering the number to the left of its entry and then respecifying the time period. Once a satisfactory set of time periods have been identified, a carriage return at the above prompt will cause the following screen to be displayed:

```
  Please wait while plot is being generated . . .

Initializing graphics device...


  Do you wish to extrapolate values to the edge of the graph (Y/N) [CR=Y]? ❒
```

If a **Y** is entered at the above prompt, then the discharge and concentration curves are extrapolated or interpolated (where appropriate) to the edges of the plot frame. Otherwise, the discharge and concentration curves are not extrapolated or interpolated to the edges of the plot frame. After a selection is made, the following prompt is displayed if a single scale was selected for concentration and streamflow (gridding is not an option when separate scales are selected):

```
Do you want gridding on the plot (Y/N), [CR=Y] ❒
```

If a **Y** is entered at the above prompt, then grid lines are plotted. Otherwise, no grid lines are plotted. After a selection is made, the plot is sent to the graphics device selected earlier. A sample plot is shown in figure 2.

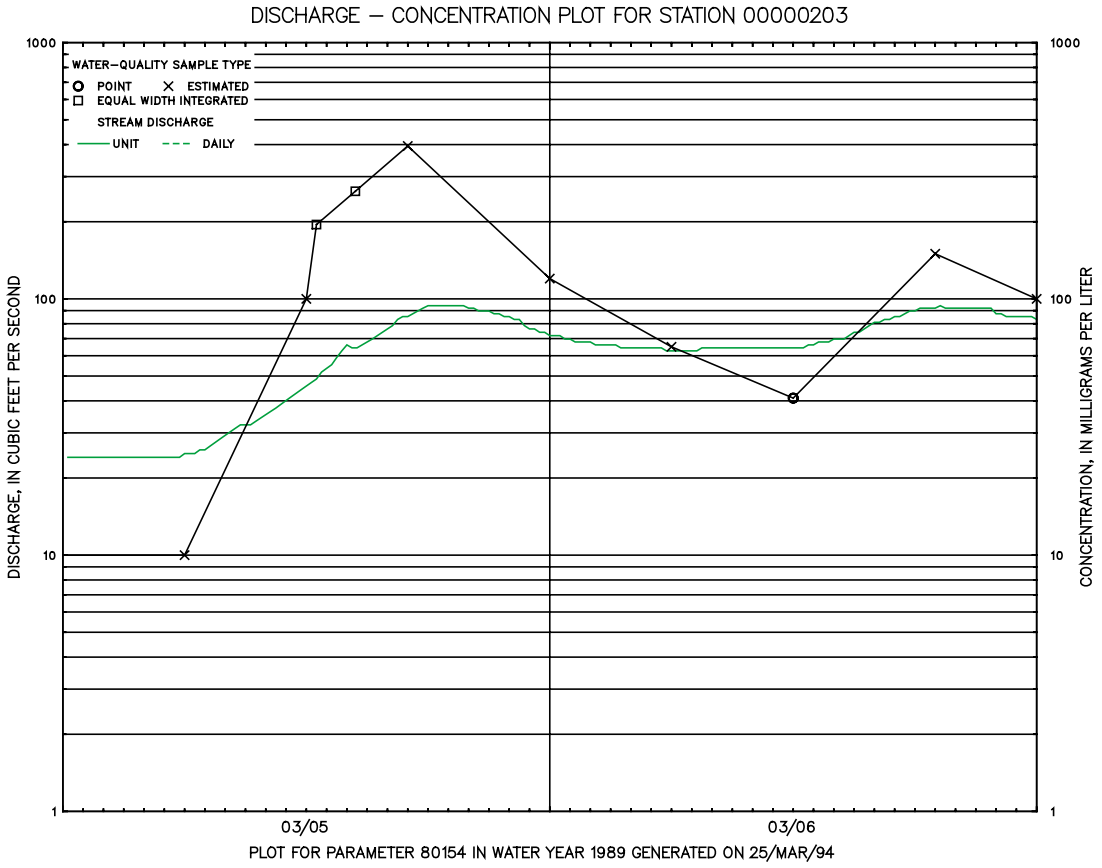

Figure 2. Sample time-series plot from SEDCALC option 6.

If the time period (or periods) selected and plot scale require multiple plots, the plots are sent to the graphics device one at a time and carriage returns will be required to proceed from plot to plot. When all the plots have been sent to the graphics device, the following messages are displayed:

```
N O R M A L   T E R M I N A T I O N   -   P R O G R A M   S D P L O T


The file plot.summary.error  contains a summary of the all plots
generated and a list of any errors that might have occurred during
their generation. Please review this file before any further processing.

ENTER <CR> TO CONTINUE: ❒
```

The file named PLOT.SUMMARY.ERROR contains information about the plotting options selected and information about the minimum and maximum concentration and streamflow on each plot. This file also contains information on plotting errors, if any should occur. A carriage return at the prompt returns the user to the main menu.

Option 7—Digitize Sediment Trace

Option 7 is selected to interactively digitize a strip chart or other time-series graph and store the digitized data at a user-specified frequency in tabular and card-image format. The data are resolved at the user-specified frequency by linear interpolation in time between log-transformed digitized values. The interpolated values are then transformed back to base 10. This option requires an Altek or Altek-compatible digitizer in an eavesdrop configuration between a computer terminal and the computer. When a digitizer is installed in an eavesdrop configuration, data typed at the terminal and data output from the digitizer are transmitted to the computer by means of the same serial data line.

Several features of the digitization program facilitate the process of digitizing data. The program enables the user to digitize strip charts or other time-series graphs with the ordinate (y-axis) in either arithmetic or base-10 logarithmic units. The program accommodates coordinate data output by the digitizer in any linear unit of measurement and automatically reconciles digitizer units to graphic units. Finally, the program compensates for skew in the time-series graph relative to the fixed (or variable) axes of the digitizer, eliminating the need for precise alignment of the graph on the digitizer surface.

The origin of the time-series graph and one additional point along the x- and y-axes must be digitized to allow reconciliation of digitizer units to graphic units and to determine the angle of rotation of the graph axes relative to the digitizer axes. Rotation angles are independently determined for the x- and y-axes and the difference in the angles (in degrees) is reported as an angular error. The program also reports the computed x- and y-axis scales. After reviewing the angular error and the reported x- and y-axis scales, the user has the options of (1) quitting the program, (2) digitizing the origin and points along the x- and y-axis again, or (3) accepting the reported rotation angle and scales and proceeding.

Lack of precision during digitization or distortion of the time-series graph may result in the output of negative graphic coordinates. Consequently, the option is given to either (1) ignore (and discard) all negative values, (2) reset negative values to zero, or (3) allow negative values.

The data are digitized in logical time-series sequences called segments. At any time during digitization of a segment, the user can (1) change the x- or y-axis scales, (2) reverse the y-axis scale (as might be necessary for a strip-chart reversal), (3) delete the last point digitized, (4) cancel all points in the current segment, or (5) end the segment. The options are selected by pressing keys on the digitizer keypad. The following menu, which shows the relation between options and keys on the digitizer keypad, is displayed as each new segment is begun:

```
ENTER 'A' FOR DATA POINTS
ENTER '8' TO CHANGE X-AXIS
ENTER '3' TO REVERSE Y-AXIS AT TOP OF CHART
ENTER '2' TO CHANGE Y-AXIS
ENTER '1' TO DELETE THE LAST POINT YOU ENTERED
ENTER 'C' TO CANCEL ALL OF YOUR POINTS
ENTER '0' TO QUIT OR TO END A SEGMENT
```

When the option to end a segment is chosen, the user is prompted to reset the axes and begin a new segment, begin a new segment without resetting the axes, add a comment to the data file, or end the program with all previously entered data saved.

Altek digitizers are capable of outputting coordinate data in a number of formats. The format is generally composed of one or more "tag" characters followed by an x and then a y coordinate. The following six digitizer formats are recognized as valid:

A_XX.XX#YY.YY
$A#XX.XX#YY.YY
ADXX.XXYY.YY
AXX.XXYY.YY_
A,XX.XX#YY.YY
AXX.XX^YY.YY

where A represents the tag character corresponding to the key pressed on the digitizer keypad,
XX.XX is the x coordinate,
YY.YY is the y coordinate,
represents any alphanumeric character (including a space), and
_ represents a required space.

All other characters must appear as shown in the formats above.

The x and y coordinates are read as five-character fields. If no decimal point is in the value output by the digitizer, the decimal point is assumed to ber at the position shown in the format above. Otherwise, the decimal point is positioned as output from the digitizer.

Required input items include (1) the number of data values to be stored per day, (2) an 8- or 15-digit station identification number, (3) a 5-digit parameter code, (4) a 5-digit statistic code, and (5) a name to be used as a prefix for output file names. The number of data values stored per day must be between 6 and 1,440 and must divide evenly into 1,440.

Four files are created by this program option. The file names are formed by use of the user-supplied output file name as a prefix, a period, and UVDATA, UVSUMM, DGDATA, or DGSUMM as a suffix. Listed below are the file suffixes and brief descriptions of the file contents:

File suffix	Description of file contents
UVDATA	Contains time-series values, in unit-values card-image format, that have been interpolated to an equal time interval.
DGDATA	Contains a formatted list of the digitized time-series data. The list shows the date, time, and time-series value for all digitized data.
DGSUMM	Contains a brief statistical summary showing the maximum and minimum time-series values for each day, the times of their occurrence, and the total number of time-series values digitized for each day.
UVSUMM	Contains a day-by-day summary of the interpolated time-series values. Included in the summary are the number of values per day; the daily minimum, maximum, and mean; and the time-series value at noon.

Option 8—Reformat QWGRAPH Concentration Data to SEDATA File

Option 8 is used to reformat output from QWGRAPH, a program that is part of the Water-Quality System, to the SEDATA format used within the SEDCALC system. Option 7 of the QWGRAPH program is used to output data from the NWIS water-quality database in a column-oriented ASCII file. In addition to creating a column-oriented ASCII file, QWGRAPH creates a second file named by appending the suffix "PARNAMES" to the base file name. The PARNAMES file contains information about the type and order of parameters present in the column-oriented ASCII file and is required to reformat the data.

To reformat the QWGRAPH output file, the user must retrieve several parameter codes in addition to the code(s) for the desired parameter(s). These parameter codes include STAID (station identification number), DATES (calendar date of sample), TIMES (military time for sample), and 82398 (sample method code).

Required input items include (1) QWGRAPH file name, (2) an output file name, and (3) the station identification number. Once these data have been entered, the PARNAMES file is read to determine if the mandatory parameter codes are present in the data file and to produce a numbered list of the parameter codes that can be selected for conversion to the SEDATA format. As many as four parameter codes can be selected for conversion to the SEDATA format. The parameter codes are prompted for one at a time. A parameter is selected by entering its list number (to the left of the parameter code) at the prompt. The data entry scheme is illustrated below for a station where two

parameters are available and one has already been selected:

```
                        QW CONVERSION ROUTINE  REV 93

Input to this routine is a "flat file" created by option 7 of QWGRAPH. In
addition to the concentration parameter(s), this file must contain the following
parameters:  STAID, DATES, TIMES and parameter code 82398.

Output is an ASCII file in the SEDATA card-image format.

Enter concentration input file name, (CR=STOP) qwflatout
Enter output file name (CR=STOP): kawich.sedata
Enter the station i.d. : 00000203
 Choose up to four of the following parameters

1 )  80154
2 )  00630

Enter parameter 1  (1- 2)
1
Enter parameter 2  (1- 2)
 ❒
```

A carriage return at the prompt signals the program that all parameters have been entered; the program then proceeds with the conversion.

During conversion, two assumptions are operational; (1) if a time value is missing for a corresponding data value, then a time of 12:03 p.m. (1203 hours) is assumed, and (2) if the value associated with parameter 82398 (the method code) is equal to 10, then the value is flagged in the SEDATA file as having been determined from an EWI/EDI sample (remark code of "I"). Any other value is assumed to be a single-vertical depth-integrated sample.

After conversion, a message is printed stating that a file named QW_CONVERSION.ERROR has been created and may contain messages about problems during the conversion process. If the conversion proceeded without error, then this file will be empty. If an error occurred, however,, one or more messages will be contained in this ASCII file.

Option 9—Log-log Plot of Concentration against Streamflow

Option 9 is used to develop a log-log plot of the relation between streamflow and sediment concentration. Option 9 is also used to create a fixed-format ASCII file containing date- and time-tagged streamflow and sediment-concentration data. The fixed-format ASCII file provides an easy means of transferring these data to a spreadsheet or statistical package for further analyses.

Required inputs are (1) the name of the SEDATA file containing the concentration data (in unit-values card-image format, one value per B-card), (2) the name of the file containing the streamflow data (in unit-values card-image format, six values per B-card), and (3) the name of an output file that will contain the fixed-format ASCII data.

The following screen is displayed when option 9 is selected from the main menu:

```
WILL DATA COME FROM A SEDATA FILE [1] ONLY, OR
FROM SEDATA AND DISCHARGE B-CARD FILES [2]???

PLEASE ENTER [1] OR [2]: ❒
```

If discharge information is stored in the same (SEDATA) file as the concentration data, then the user selects **1**; otherwise, the user selects **2**. Once the above prompt has been answered, the user will be prompted for the concentration file name and, if appropriate, the name of the file containing the streamflow information. After the names of input and output files are entered, the input file(s) are scanned to determine the starting and ending dates for which data are present. A message similar to that shown below is displayed:

```
THE FULL TIME DOMAIN FOR THE OUTPUT IS:

STARTING DAY: 890227

ENDING DAY: 890315


 CHOOSE THE TIME DOMAIN THAT
 YOU WISH TO PLOT OVER

 ENTER:
     [1]   FOR FULL
     [2]   FOR PARTIAL:
 ❒
```

If a **1** is entered at the prompt, then data for the entire time period are plotted. If a **2** is entered, then additional prompts are displayed requesting the starting and ending dates for the part of the time domain on which the program is to operate.

Control over plot format is limited to whether the plot should be gridded. Valid plotting devices and device names are identical to those described for option 6. A sample plot is shown in figure 3.

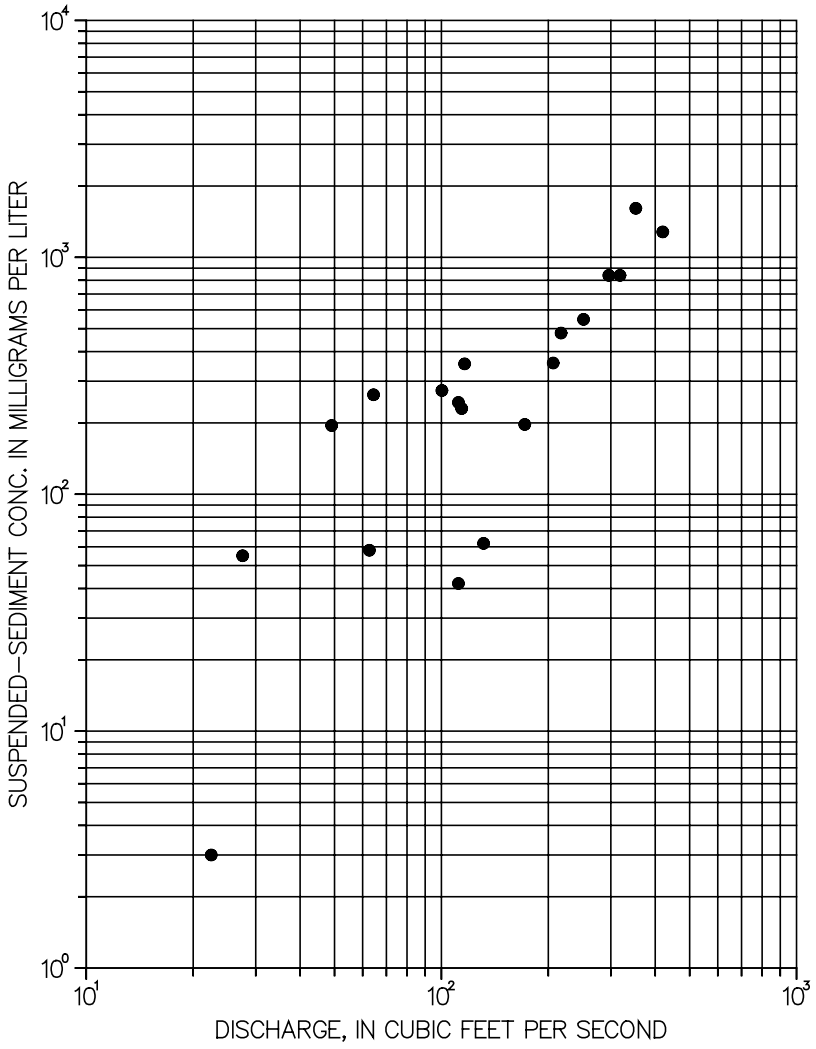

Figure 3. Sample transport-relation plot from SEDCALC option 9.

All non-estimated data (determined from the remark code) for the selected time period are sent to the plotting device and are output to the fixed-format ASCII file.

The fixed-format ASCII file contains data in the following format:

Column	Description
1 - 4	Year. Four-digit number representing the calendar year.
6 - 7	Month. Two-digit number representing month.
9 - 10	Day. Two-digit number representing day of month.
12 - 15	Time, in HHMM format (24-hour system).
16 - 25	Concentration, in milligrams per liter, right justified.
26 - 35	Streamflow, in cubic feet per second, right justified.

An example of the fixed-format ASCII file created by use of option 9 is shown below:

```
1989 02 27 1300      3.00     22.48
1989 03 02 1200     55.00     27.56
1989 03 05 1230    195.00     49.07
1989 03 05 1425    263.00     64.39
1989 03 07 1600     58.00     62.68
1989 03 08 0900    274.00    100.30
1989 03 08 1300    244.00    111.66
1989 03 08 1430    230.00    114.00
1989 03 08 1630    355.00    116.22
1989 03 09 0800    839.00    296.03
1989 03 09 1207   1610.00    352.63
1989 03 09 1530   1280.00    419.96
1989 03 10 0755    839.00    318.21
1989 03 10 1500    547.00    251.27
1989 03 11 0930    479.00    217.19
1989 03 11 1530    358.00    206.42
1989 03 12 0600    197.00    171.61
1989 03 13 1000     62.00    131.41
1989 03 14 1300     42.00    111.66
```

Option 10—Compute and Plot Sediment-Discharge Submenu

A submenu containing five additional options (hereafter called suboptions) is obtained by selecting option 10 from the main menu. Four of the five suboptions deal with the computation of suspended-sediment discharge. The fifth suboption can be selected to plot suspended-sediment discharge, suspended-sediment concentration, and (or) streamflow data.

Suboption 1—Linear Interpolation, Uneven Time Interval

Suboption 1 is selected when suspended-sediment discharge computations are desired and suspended-sediment concentration and (or) streamflow data are not stored at even time intervals. The computational procedure advances in two steps. The first step is to interpolate the suspended-sediment concentration and (or) streamflow data so that they share a common time interval. Interpolations are linear in time between log-transformed data values. The interpolated values are then retransformed by taking the antilog. The second step is to compute instantaneous suspended-sediment discharges and numerically integrate them to compute daily suspended-sediment discharge.

Required program inputs are (1) the name of the SEDATA file containing the concentration data, (2) the name of the file containing streamflow data, (3) the beginning and ending dates for which sediment discharges are to be computed, and (4) the parameter code for the concentration data (at the date of writing, 80154 was the only valid parameter code).

Suspended-sediment and streamflow data must be stored in either the SEDATA card-image format (if the data are not at equal time intervals) or in the unit-values card-image format (if the data are at equal time intervals). The suspended-sediment concentration data must have parameter code 80154 in columns 29 through 33 on the 2-card in the card-image file. Likewise, 2-cards in the streamflow data file must have parameter code 00060 or 00061 in columns 29 through 33.

A total of 12 files may be created by this process, depending on input-file characteristics. The file names will begin with the prefix P00060, P80154, or TOTAL. Files whose names begin with the prefix P00060 are created only if input streamflow data are not equal-time-interval data. Likewise, files whose names begin with the prefix P80154 are created only if sediment-concentration data entered are not equal time-interval data. (The P00060 and P80154 files are deleted on completion of this option if the user answers yes when queried whether to delete intermediate files.) Files whose names begin with the prefix TOTAL are always created. The file names and brief descriptions of file contents are listed below.

File name	Description of file contents
P00060.UVDATA	Contains streamflow data (in unit-values card-image format) that have been interpolated to an equal time interval.
P00060.DGDATA	Contains a formatted list of the streamflow data. The list shows the date, time, and streamflow for all data entered.
P00060.DGSUMM	Contains a brief statistical summary showing the maximum and minimum streamflows, the times of their occurrence, and the total number of streamflow values entered for each day.
P00060.UVSUMM	Contains a day-by-day summary of the interpolated streamflow data (found in P00060.UVDATA). Included in the summary are the number of values per day; the daily minimum, maximum, and mean; and the streamflow at noon.

File name	Description of file contents
P80154.DGDATA	Contains a formatted list of the sediment-concentration data. The list shows the date, time, and concentration for all data entered. The list does not contain an entry that allows the user to distinguish between estimated concentrations and concentrations based on laboratory measurements.
P80154.DGSUMM	Contains a brief statistical summary showing the maximum and minimum concentrations, the times of their occurrence, and the total number of concentration values entered for each day.
P80154.UVDATA	Contains the concentration data (in unit-values card-image format) interpolated to an even time interval.
P80154.UVSUMM	Contains a day-by-day summary of the interpolated concentration data (found in P80154.UVDATA). Included in the summary are the number of values per day; the daily minimum, maximum, and mean values; and the concentration occurring at noon.
TOTAL.UVSEDQ	Contains instantaneous sediment-discharge values (in unit-values card image format) interpolated to the same time increment as the unit concentration data. Instantaneous sediment-discharge data are reported only for days that have at least one corresponding streamflow entry.
TOTAL.DVSEDQ	Contains daily sediment-discharge data (in daily-values card-image format). Daily sediment-discharge data are reported only for days that have at least one corresponding streamflow entry. Daily sediment-discharges are computed and output even if only partial data are available for a day. Consequently, the file name TOTAL.SUMMARY should be reviewed to ensure that the selected computation period has complete record.
TOTAL.DVCONC	Contains time-weighted daily-mean concentration data (in daily-values card-image format). The daily mean concentration is reported only for days that have at least one corresponding streamflow entry.
TOTAL.SUMMARY	Contains a day-by-day summary that includes the daily mean streamflow, the time-weighted daily mean concentration, the daily sediment discharge (in tons per day), the discharge-weighted daily mean concentration, and the number of missing streamflow and concentration values. The summary information is reported only for days that have at least one corresponding streamflow entry.

Suboption 2—Linear Interpolation, Even Time Interval

Suboption 2 is selected when suspended-sediment discharge computations are desired and suspended-sediment-concentration and streamflow data are stored at equal time intervals. Unit suspended-sediment discharges are numerically integrated to compute daily suspended-sediment discharge.

Required inputs for this suboption are (1) the name of the file containing the concentration data,

(2) the name of the file containing streamflow data, (3) the beginning and ending dates for which sediment discharges are to be computed, and (4) the parameter code for the concentration data (at the date of writing, 80154 was the only valid parameter code).

Suspended-sediment and streamflow data must be stored in equal-time-interval unit-values card-image format. The suspended-sediment and streamflow data must have 2 to 1,440 equal-time-interval values per day, and the number of values per day for both parameters must be divisible by an integer that is 2 or greater. (The program determines the highest integer that will divide evenly into both quantities; for example if 12 suspended-sediment values per day and 96 streamflow values are in the data set, the program determines 12 to be the highest integer that divides evenly into 12 and 96). The suspended-sediment-concentration data must have parameter code 80154 in columns 29 through 33 on the 2-card in the card-image file. Likewise, 2-cards in the streamflow data file must have parameter code 00060 or 00061 in columns 29 through 33.

After the user enters the names of files containing the streamflow and sediment data that are to be used in the computations, a prompt requests the name of an output file. The name supplied is used as a prefix for the four files created by this suboption. The files created by this suboption have the following suffixes: UVSEDQ, DVSEDQ, DVCONC, and SUMMARY. These files are equivalent in content to the corresponding files prefixed with the word “TOTAL” in option 10, suboption 1. For example, if the user enters the file name ABC when prompted for an output file, then files named ABC.UVSEDQ, ABC.DVSEDQ, ABC.DVCONC, and ABC.SUMMARY are created by this option.

The file suffixes are listed below with a brief description of their contents.

File suffix	Description of file contents
UVSEDQ	Contains instantaneous sediment-discharge values (in unit-values card image format).
DVSEDQ	Contains daily sediment-discharge values (in a daily-values card-image format). Daily sediment-discharge values are computed and output even if only partial data are available for a day. Consequently, the SUMMARY file should be reviewed to ensure that the selected computation period has complete record.
DVCONC	Contains time-weighted daily-mean concentration data (in daily-values card-image format).
SUMMARY	Contains a day-by-day summary that includes the daily mean streamflow, the time-weighted daily mean concentration, the daily sediment discharge (in tons per day), the discharge-weighted daily mean concentration, and the number of missing streamflow and concentration values.

Suboption 3—Sediment Discharge by Log-Log Transport Relation

Suboption 3 is used to compute daily sediment discharges and (or) instantaneous sediment dis-

charges from one or more previously defined log-linear transport relations. Required inputs are (1) the name of the file containing the streamflow data, (2) the beginning and ending dates that define the period of interest, (3) the number of segments for which transport equations have been defined, (4) the parameters of the transport equation(s), (5) data required to correct for transformation bias (if applicable), and (6) a name to be used in generating output file names.

The discharge data file must be in unit-values card-image format. If the discharge data are stored at equal time intervals with six values per B card, then daily mean and instantaneous sediment discharges are computed. If the streamflow data are not stored at equal time intervals, then only the instantaneous sediment discharges are computed.

The transport relation is assumed to have been developed in one of the two following forms:

$$\log(C) = ((m * \log(Q_w)) + b$$

or

$$\log(Q_s) = ((m * \log(Q_w)) + b$$

where
- log is base 10 or base e logarithm;
- C is instantaneous concentration, in milligrams per liter;
- Q_w is instantaneous streamflow, in cubic feet per second;
- Q_s is instantaneous sediment discharge, in tons per day;
- m is slope; and
- b is offset.

If the first form of the equation is used, then the transport relation is applied as follows to compute instantaneous sediment discharge:

$$Q_s = Q_w * 10^{((m * \log(Q_w)) + b)} * k * BCF$$

where
- Q_s is instantaneous suspended-sediment discharge in tons per day;
- k is units conversion factor (0.0027); and
- BCF is bias correction factor.

If the second form of the equation is used, then the transport relation is applied as follows:

$$Q_s = 10^{((m * \log(Q_w)) + b)} * BCF.$$

Parameters for as many as four transport equations can be entered. If more than one transport equation is entered, each transport equation is considered to form one segment of the transport relation and is applicable over a range of streamflows specified by the user. The individual transport equations are applied only when the streamflow falls within the specified range. Few restrictions are placed on the parameters of the transport equations or the streamflow range over which they are applied. As a consequence, one can define a transport relation composed of two to four segments that are discontinuous at streamflows where one segment is in transition to the next. Thus, the user

should take great care in defining appropriate transport relations and in determining and entering their parameters.

The bias correction factor is used to correct for bias introduced when retransforming the sediment-discharge estimate (derived from the transport equation) from log space to base 10 space. The USGS recommends the minimum variance unbiased estimator (MVUE) described by Finney (1941) and Bradu and Mundlak (1970) for determining the bias-correction factor when the errors (regression residuals) are normally distributed . Duan's smearing estimator (Duan, 1983) is recommended when the errors are not normally distributed. Both forms of bias correction are supported. Alternatively, computations can be done without bias correction.

After option 10, suboption 3 is selected, the program prompts for the beginning and ending dates for the period over which the transport relation will be applied. Next, the program prompts for the number of segments making up the transport relation. After the number of segments has been entered, the following prompt is displayed:

```
Correct the estimates for bias (Y/N)?: ❒
```

If a **Y** is entered at the above prompt, then the following prompt is displayed:

```
Correct bias by (1) Smearing Estimator or (2) MVUE [1 or 2]: ❒
```

After the type of bias correction is selected, the program prompts for the form and parameters of the transport equation(s). The program also prompts for the bia- correction factor(s) if bias correction is being done by use of a smearing estimator. If MVUE bias correction is being used, the program prompts for parameters required to compute the bias-correction factors. An excerpt from a session demonstrating entry of MVUE parameters is shown below:

```
Enter number of segments (up to 4) [CR = 1]: 1
Correct the estimates for bias (Y/N)?: y
Correct bias by (1) Smearing Estimator or (2) MVUE [1 or 2]: 2
Was regression performed in (1) log base 10 or (2) log base e units [1 or 2]: 2
Is transport equation (1) Q vs SedQ or (2) Q vs concentration (C) [1 or 2]: 1

 For equation of form: log(SedQ[or C]) = a + (b * log(Q))

Slope value (b) =   2.76
Offset (intercept) value (antilog(a)) = .02
Number of data pairs [XN] = 7
Mean of ln(Q) [QBAR] = 3.739
Sum of ((Ln(Q)- MEAN(Ln(Q)))**2) [QVAR] = 3.452
No. of degrees of freedom [XM] = 5
Mean square error [S2] = .3465
```

If the transport relation had been composed of more than one segment, then the program would have prompted for the discharge transition value, equation, and bias-correction parameters corresponding to each segment.

As many as three files are created by suboption 3. A file named "out_file".UVSEDQ.REG, con-

taining instantaneous sediment-discharge data in unit-values card-image format, is always created (where "out_file" is a user-supplied file name). The remaining two files are created only if the streamflow data are stored at equal time intervals. These files are named “out_file” and "out_-file".DVSEDQ.REG. The file named “out_file” contains daily sediment-discharge data in table form, as well as computation-period statistics identifying the maximum and minimum instantaneous streamflows and daily sediment loads. The file named "out_file".DVSEDQ.REG contains the daily sediment-discharge data in daily-values card-image format. Unlike suboptions 1 and 2, daily mean concentrations are not computed.

Suboption 4—Sediment Discharge by Nonlinear Interpolation

Suboption 4 is used to interpolate unequal-time-interval sediment-concentration data to an equal time interval and to compute daily sediment discharges. The data are interpolated by means of a cubic spline function (IMSL, Inc., 1989) that approximates a manually drawn curve. The spline function uses the method described by Akima (1970) to interpolate the concentration data to an equal time interval. This suboption should be used with extreme caution because it can produce unrealistic concentration and sediment-discharge estimates (including negative concentrations and sediment discharges). Given adequate and sufficient input concentration data, however, this suboption should provide reasonable results.

Required inputs include (1) the name of the SEDATA file containing sediment concentration data, (2) the name of the file containing equal-time-interval streamflow data, in unit-values card image format, and (3) a name to be used for generating output file names.

Four files are created by suboption 4. The file "out_file".UVSEDQ.NL contains instantaneous sediment-discharge data in unit-values card-image format (where "out_file" is a user-supplied file name). The remaining three files are named “out_file”, “out_file”.DVSEDQ.NL, and “out_file”.REPORT. The file named “out_file” contains a tabular listing of streamflow data and interpolated concentration and loading data, an abbreviated sample of which is shown below:

```
            SEDIMENT DISCHARGE BY NONLINEAR INTERPOLATION (IMSL)

    Station: 00000203

    Date: 890227

 Time   Discharge    Sed Conc    Unit SedQ    Sed Tons    Acc Tons

 0015      26.618      42.707       3.069      0.0320       0.032
 0030      26.618      43.418       3.120      0.0325       0.064
 0045      27.500      44.132       3.277      0.0341       0.099
 0100      27.500      44.847       3.330      0.0347       0.133
 0115      27.500      45.562       3.383      0.0352       0.169
 0130      27.500      46.276       3.436      0.0358       0.204
 0145      27.500      46.986       3.489      0.0363       0.241
 0200      27.500      47.693       3.541      0.0369       0.278
 0215      27.500      48.393       3.593      0.0374       0.315
 0230      28.409      49.084       3.765      0.0392       0.354
 0245      28.409      49.766       3.817      0.0398       0.394
 0300      28.409      50.435       3.869      0.0403       0.434
```

Listed under the heading “Unit SedQ” are instantaneous sediment-discharge data (in tons per day) determined as the product of the instantaneous streamflow, the instantaneous concentration, and the units conversion factor 0.0027. Sediment load data are reported under the headings “Sed Tons” and “Acc Tons.” Listed under the heading “Sed Tons” are load data (in tons), for the given time interval, determined by dividing the corresponding value of “Unit SedQ” by the number of equal time intervals into which the day is divided. Finally, under the heading “Acc Tons” are the cumulative load data (in tons) for the given day. Values in this column are equal to the sum of all values in the “Sed Tons” column for that day, up to and including the value occurring on the same line.

The file named “out_file”.DVSEDQ.NL contains daily sediment-discharge data in daily-values card-image format. The file named “out_file”.REPORT contains a tabular summary showing the daily load, daily mean streamflow, the time-weighted mean concentration (determined by summing all n concentrations for the day and dividing by n), and the discharge-weighted mean concentration (determined by dividing the daily load by the product of the daily mean discharge and the units conversion factor 0.0027). Concentrations are reported in milligrams per liter.

Suboption 5—Plot of Sediment Discharge, Concentration, and Streamflow Against Time

Suboption 5 is used to plot sediment-discharge, concentration, and (or) streamflow data that are contained in card-image files. Data from as many as 6 different sources can be plotted concurrently for a given station. Data for more than one station cannot be plotted concurrently.

The data can be plotted from six potential sources. These sources include the equal-time-interval unit-values card-image files containing streamflow and instantaneous sediment-discharge data determined by (1) linear interpolation (option 10, suboptions 1 or 2), (2) transport relation (option 10, suboption 3), (3) nonlinear interpolation (option 10, suboption 4), and (4) digitization (option 7). In addition, concentration data contained in the SEDATA file also can be plotted. All or only some of the sources listed above can be plotted concurrently. If a plot of data from all sources is not selected, then a prompt is displayed requesting a list of data sources to be plotted. The example below illustrates a SEDCALC session in which streamflow and sediment concentration are selected for plotting:

```
 FILES THAT MAY BE PLOTTED:

1) SEDQ-LINEAR INTERPOLATION     4) DISCHARGE
2) SEDQ-TRANSPORT CURVE          5) SEDIMENT POINTS
3) SEDQ-NONLINEAR INTERPOLATION  6) DIGITIZED SEDIMENT POINTS

SELECT ALL(A) OR SOME(S) TO BE PLOTTED,[CR]=SOME: S


 ENTER THE NUMBERS FOR THE FILES YOU WISH
 TO PLOT. e.g.(1236 or 1,2,3,6): 45
```

File names for the data sources selected are prompted for after selection of data sources.

If any data source having equal-interval sediment-discharge data is selected, then the following prompt is displayed:

```
DO YOU WISH TO PLOT CONCENTRATION VALUES
CALCULATED FROM THE INSTANTANEOUS SEDQ
INSTEAD OF THE SEDQ (Y/N), [CR]=N : ❒
```

If a **Y** is entered at the prompt, instantaneous concentrations are computed and plotted instead of instantaneous sediment discharges. This is true for all selected sediment-discharge data sources. Instantaneous streamflow data are necessary to compute the instantaneous concentration. Consequently, the name of the file containing the equal-time-interval streamflow data will be prompted for and the streamflow data will be plotted, even if the streamflow file was not explicitly selected as a data source.

After data sources have been selected and identified, the starting and ending dates of the data to be plotted must be specified. Once the starting and ending dates have been specified, the following prompt is displayed requesting information on the page size for the graphics device:

```
THE DEFAULT PAGE SIZE IS 8.5 BY 11.
DO YOU WISH TO CHANGE TO 11. BY 17? (Y/N, [CR=N] ❒
```

If a **Y** is entered at the prompt, the page size is changed to 11 by 17 inches; otherwise, the page size remains at 8.5 by 11 inches.

After specification of page size, the following prompt is displayed:

```
FOR DISCHARGE AND INTERPOLATED-SEDIMENT CURVES ONLY--
ENTER THE OPTION NUMBER FOR DATA-SYMBOL FREQUENCY:
(1) NO SYMBOLS
(2) ALL SYMBOLS
(3) SYMBOLS EVERY N POINTS
(4) 12 SYMBOLS FOR TIME WINDOW
❒
```

Four options are given for selecting the frequency at which symbols are plotted for data sources containing equal time-interval data. If the third option (one symbol every N points) is selected, then the value corresponding to N must also be entered. If the fourth option is selected then 1 symbol is plotted for every N divided by 12 data points (where N is the total number of data points contained within the time frame of a given plot). One symbol is plotted for each data value of an unequal-time-interval data set.

The option is given to use data-based default scaling for the y-axes. If the data-based default is not chosen, then the default scaling parameters and a prompt are displayed, as illustrated below:

```
 THE DEFAULT VALUES FOR THE SCALES ARE:

                    SEDQ       DISCHARGE  CONCENTRATION
                 (TONS/DAY)      (CFS)       (MG/L)
                ============  =========  ============
  LOG CYCLES  |      6            7             6
  ORIGIN VALUE|      1.         .01           100.
  FOR GRIDDING ON GRAPH NUMBER OF LOG CYCLES MUST BE THE SAME.

 DO YOU WISH TO CHANGE THE LOG SCALES? (Y/N) [CR=Y]? ❒
```

If, after viewing the default scale parameters, the user decides that one or more scales require modification,then the user enters **N** at the prompt and the program subsequently prompts for the origin value and number of log cycles for the sediment discharge, streamflow, and concentration axes. All scale parameters must be entered, even if they do not all require change.

The following prompt is displayed after scale-parameter questions have been resolved:

```
 ENTER YOUR TIME-SCALE OPTION NUMBER:
 (1) ONE DAY IN HOURS
 (2) 10 DAYS IN DAYS
 (3) UP TO A YEAR IN MONTHS
 ❒
```

Three options are given for selecting the x-axis (time) scale. These options include (1) 1 day with tick mark labeled at 1-hour intervals, (2) 1 or more days with tick marks labeled at 1-day intervals, and (3) 1 or more days with tick marks demarcating the month boundaries and month-name labels placed within the interval. The first option should be selected when the time window spans 1 day only (if the time window spans more than 1 day, then only the first day is plotted).

Selection of a graphics output device is the last step in the process. A screen similar to that shown below is displayed (because SEDCALC uses the Graphics Device Installation Utility, the available graphics output devices will differ from installation to installation):

```
Graphics devices:

  1) GRAPHON                          7) HP7550
  2) TEK4107                          8) TEK4010
  3) TAB                              9) SELANAR
  4) WYSE 85                          P) POSTSCRIPT HORIZONTAL FORMAT
  5) PRINTRONIX                       Q) POSTSCRIPT VERTICAL   FORMAT
  6) CALCOMP                          .) DISSPOP, DISSPLA post processor

Select a graphics device: ❒
```

After entry of the graphics output device code (the number, letter, or character to the left of the device description), plot information is sent to the selected graphics device. A sample plot is shown in figure 4. In figure 4, the tick marks on the time axis demarcate the beginning of the numbered day.

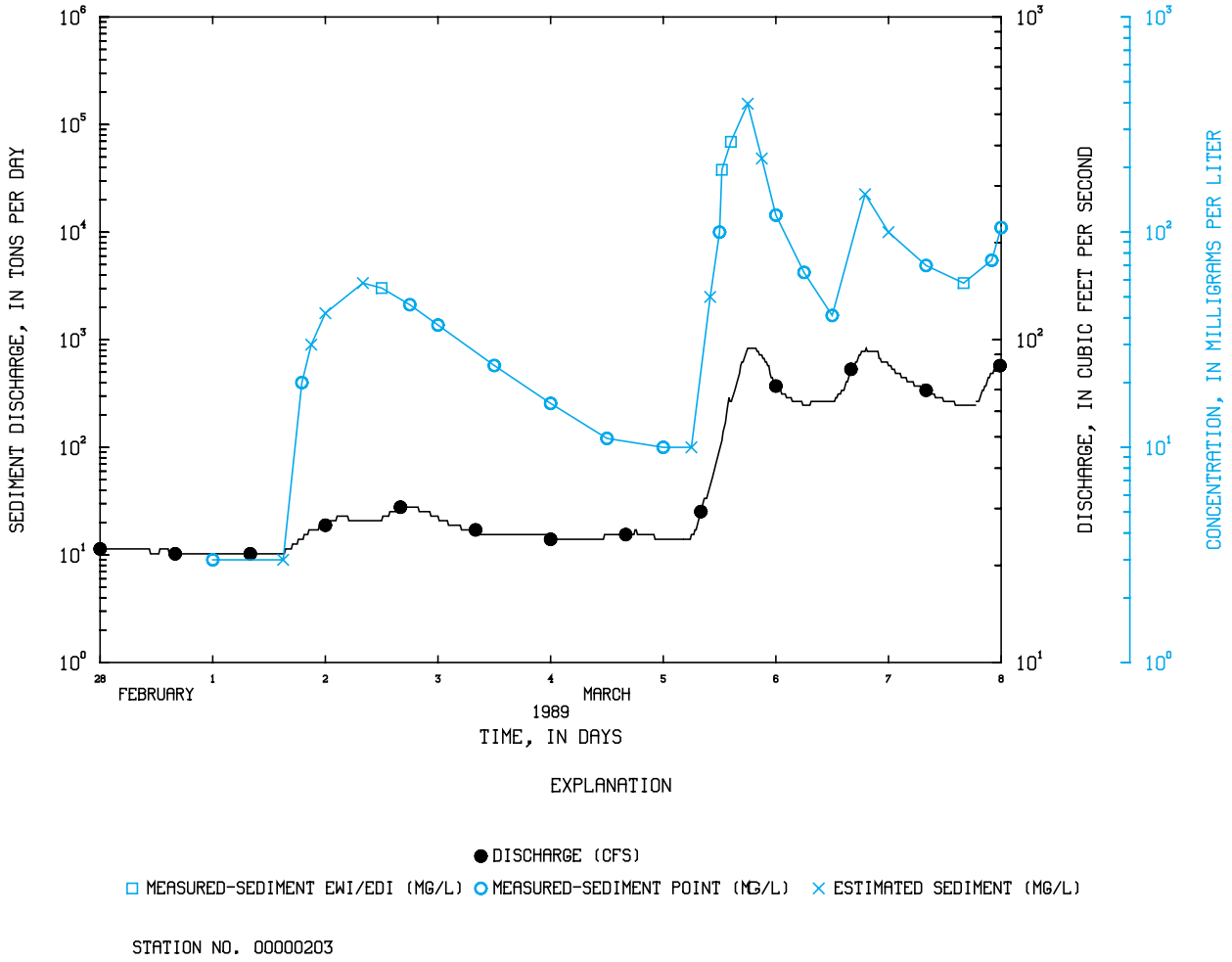

Figure 4. Sample time-series plot from SEDCALC option 10, suboption 5.

REFERENCES CITED

Akima, H., 1970, A new method of interpolation and smooth curve fitting based on local procedures, Journal of the ACM, v. 17, p. 589-602.

Bradu, D., and Mundlak, Y., 1970, Estimation in lognormal linear models: Journal of the American Statistical Association, v. 65, no. 329, p. 198-211.

Dempster, G.R., compiler, 1990, National Water Information System user's manual, Automated Data Processing System: U.S. Geological Survey Open-File Report 90-116, v. 2, chap. 3 [variously paginated].

Duan, N., 1983, Smearing estimate—a nonparametric retransformation method: Journal of the American Statistical Association, v. 78, no. 383, p. 605-610.

Finney, D.J., 1941, On the distribution of a variate whose logarithm is normally distributed: Journal of the Royal Statistical Society, Supplement, v. 7, p. 155-161.

Glysson, G.D., 1987, Sediment-transport curves: U.S. Geological Survey Open-File Report 87-218, 47 p.

IMSL, Inc., 1989, User’s manual--IMSL Math/Library: chap. I, 1,151 p.

Maddy, D.V., Lopp, L.E., Jackson, D.L., Coupe, R.H., and Schertz, T.L., 1989, National Water Information System user’s manual, Water-Quality System: U.S. Geological Survey Open-File Report 89-617, v. 2, chap. 2 [variously paginated].

Porterfield, George, 1972, Computation of fluvial-sediment discharge: U.S. Geological Survey Techniques of Water-Resources Investigations, book 3, chap. C3, 66 p.

APPENDIXES

APPENDIX 1. SEDATA Card-Image Formats

SEDATA (2-card) card-image format

Column	Description
1	Enter a 2.
2 - 16	Station identification number (left justified)
17 - 28	Blank
29 - 33	Parameter code.
34 - 38	Statistic code.
39 - 80	Blank.

SEDATA (B-card) card-image format

Column	Description
1	Enter a B.
2 - 16	Station identification number (left justified).
17 - 20	Calendar year. Four-digit number representing the calendar year in which the observation was made.
21 - 22	Month. Two-digit number representing the month on which the observation was made.
23 - 24	Day. Two-digit number representing the day on which the observation was made.
25 - 30	Time of the observation coded in columns 39-44. Columns 25-26, hour (24-hour system) 27-28, minute 29-30, second
31 - 35	Enter 1440.
36	Remark code.
37 - 38	Blank.
39 - 44	Unit value for date and time listed in columns 17-30.

APPENDIX 2. Unit- and Daily-values Card-Image Formats

Unit-values (B-card) card-image format

Column	Description
1	Enter a B.
2 - 16	Station identification number (left justified).
17 - 20	Calendar year. Four-digit number representing the calendar year in which the observation was made.
21 - 22	Month. Two-digit number representing the month on which the observation was made.
23 - 24	Day. Two-digit number representing the day on which the observation was made.
25 - 30	Time of the observation coded in columns 39-45. Columns 25-26, hour (24-hour system) 27-28, minute 29-30, second
31 - 35	Readings per day. Right justify, and number evenly divisible into 2880.
36 - 38	Blank.
39 - 80	Unit value for six consecutive intervals of time. Each value is in a seven-column field (39-45, 46-52, etc.).

Daily-values (3-Card) card-image format

Column	Description
1	Enter a 3.
2 - 16	Station identification number.
17 - 20	Calendar year. Four-digit number representing actual calendar year of data on the card.
21 - 22	Month. Two-digit number representing the month. For example, March is punched as 03, November as 11.
23 - 24	Card number. A two-digit number representing the fraction of the month that the data were collected. This number is coded as follows:

Card no.	Days
01	1 - 8
02	9 - 16
03	17 - 24
04	25 - 31

25 - 80	Daily values. Eight seven-column fields in which the daily values are entered for the designated days. The value should include significant digits to the right of the decimal point where needed. Whole numbers need no decimal point. Blank fields are interpreted as "no data available".