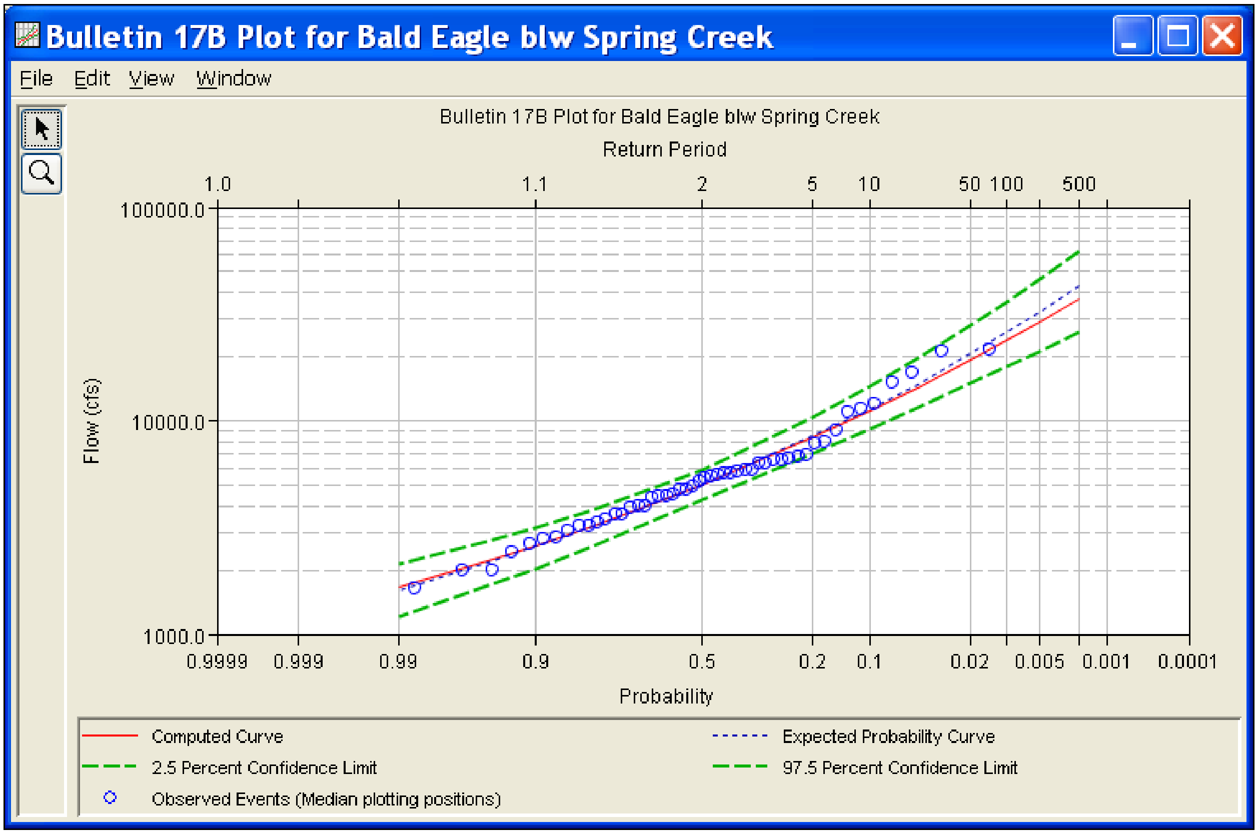
US Army Corps
of Engineers
Hydrologic Engineering Center

HEC-SSP
Statistical Software Package



User's Manual

Version 2.0
October 2010

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14. ABSTRACT
The Hydrologic Engineering Center's Statistical Software Package (HEC-SSP) allows the user to perform statistical analyses of hydrologic data. The current version of HEC-SSP can perform flood flow frequency analysis based on Bulletin 17B, a general frequency analysis using any type of hydrologic data, a volume frequency analysis, a duration analysis, a coincident frequency analysis, and a curve combination analysis. Data storage and management is handled either through the use of text files (ASCII, XML), as well as the Hydrologic Engineering Center's Data Storage System (HEC-DSS).

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Statistical Software Package, HEC-SSP
Software Distribution and Availability Statement

The HEC-SSP executable code and documentation are public domain and were developed by the Hydrologic Engineering Center for the U.S. Army Corps of Engineers. The software was developed with United States Federal Government resources, and is therefore in the public domain. This software can be downloaded for free from the HEC internet site (www.hec.usace.army.mil). HEC does not provide technical support for this software to non-Corps users. However, we will respond to all documented instances of program errors. Documented errors are bugs in the software due to programming mistakes not model problems due to user-entered data.

Table of Contents

Foreword

The U.S. Army Corps of Engineers' Statistical Software Package (HEC-SSP) is software that allows you to perform statistical analyses of hydrologic data.

The first official version of HEC-SSP (version 1.0) was released in August of 2008. Version 1.1 was released in April, 2009 and included improvements to data entry, results visualization and reporting, and added capability to the volume frequency analysis. These new features are discussed in the User's Manual and in the release notes for Version 1.1. Version 2.0 was released in October 2010 and included three new analyses: a duration analysis, a coincident frequency analysis, and a curve combination analysis. These new features are discussed in the User's Manual and in the release notes for Version 2.0.

The HEC-SSP software was designed by Mr. Gary Brunner, Mr. Jeff Harris, Dr. Beth Faber, and Mr. Matthew Fleming. The HEC-SSP user interface was programmed by Mr. Mark Ackerman, and the computational code was programmed by Mr. Paul Ely. This manual was written by Mr. Gary Brunner and Mr. Matthew Fleming.

CHAPTER 1

Introduction

Welcome to the U.S. Army Corps of Engineers Statistical Software Package (HEC-SSP) developed by the Hydrologic Engineering Center. This software allows you to perform statistical analyses of hydrologic data. The current version of HEC-SSP can perform flood flow frequency analysis based on Bulletin 17B, "Guidelines for Determining Flood Flow Frequency" (1982), a generalized frequency analysis on not only flow data but other hydrologic data as well, a volume frequency analysis on high and low flows, a duration analysis, a coincident frequency analysis, and a curve combination analysis.

The HEC-SSP software system was developed as a part of the Hydrologic Engineering Center's "Next Generation" (NexGen) development of hydrologic engineering software. The NexGen project encompasses several aspects of hydrologic engineering, including rainfall-runoff analysis, river hydraulics, reservoir system simulation, flood damage analysis, and real-time river forecasting for reservoir operations.

This chapter discusses the general philosophy of HEC-SSP and gives a brief overview of the capabilities of the software system. An overview of this manual is also provided.

Contents

General Philosophy of the HEC-SSP

HEC-SSP is an integrated system of software, designed for interactive use in a multi-tasking environment. The system is comprised of a graphical user interface (GUI), separate statistical analysis components, data storage and management capabilities, mapping, graphics, and reporting tools.

Over a period of many years, the Hydrologic Engineering Center has supported a variety of statistical packages that perform frequency analysis and other statistical computations. Historically, the programs that received the most use within the Corps of Engineers were HEC-FFA (Flood Frequency Analysis) and STATS (Statistical Analysis of Time Series Data). FFA incorporates Bulletin 17B procedures that have been adopted by the Corps for flow frequency analysis. The STATS software package is used for statistical analysis of time series data. STATS can provide either analytical or graphical frequency analysis, specified by the user. STATS has the capability of computing monthly and annual maximum, minimum, and mean values along with computing a volume-duration analysis. Two other packages that have received a lot of use within the Corps of Engineers are REGFRQ (Regional Frequency Computation) and MLRP (Multiple Linear Regression Program). REGFRQ performs regional frequency analysis and MLRP is a multiple linear regression analysis tool.

The goal of HEC-SSP is to ultimately combine all of the statistical analyses capabilities of HEC-FFA, STATS, REGFRQ and MLRP. The current version of HEC-SSP supports performing flood flow frequency analyses based on Bulletin 17B Guidelines, general frequency analyses, volume frequency analyses, duration analyses, coincident frequency analyses, and curve combination analyses. New features and additional capabilities will be added in future releases.

Overview of Program Capabilities

HEC-SSP is designed to perform statistical analyses of hydrologic data. The following is a description of the major capabilities of HEC-SSP.

User Interface

The user interacts with HEC-SSP through a graphical user interface (GUI). The main focus in the design of the interface was to make it easy to use the software, while still maintaining a high level of efficiency for the user. The interface provides for the following functions:

- File management
- Data entry, importing, and editing
- Statistical analyses
- Tabulation and graphical displays of results
- Reporting facilities

Statistical Analysis Components

Flow Frequency Analysis (Bulletin 17B) – This component of the software allows the user to perform annual peak flow frequency analyses. The software implements procedures in Bulletin 17B, "Guidelines for Determining Flood Flow Frequency", by the Interagency Advisory Committee on Water Data.

General Frequency Analysis – This component of the software allows the user to perform annual peak flow frequency analyses by various methods. Additionally the user can perform frequency analysis of variables other than peak flows, such as stage and precipitation data.

Volume Frequency Analysis – This component of the software allows the user to perform a volume frequency analyses on daily flow or stage data.

Duration Analysis – This component of the software allows the user to perform a duration analysis on any type of data recorded at regular intervals. The duration analysis can be used to show the percent of time that a hydrologic variable is likely to equal or exceed some specific value of interest.

Coincident Frequency Analysis – This component of the software assists the user in computing the exceedance frequency relationship for a variable that is a function of two other variables.

Curve Combination Analysis – This component provides a tool for combining frequency curves from multiple sources into one frequency curve.

Data Storage and Management

Data storage is accomplished through the use of "text" files (ASCII and XML), as well as the HEC Data Storage System (HEC-DSS). User input data are stored in flat files under separate categories of study, analyses, and a data storage list. Gage data are stored in a project HEC-DSS file as time series data. Output data is predominantly stored in HEC-DSS, while a summary of the results is written to an XML file. Additionally, an analysis report file is generated whenever a computation is made. This report file is written to a standard ASCII text file.

Data management is accomplished through the user interface. The modeler is requested to enter a Name and Description for each study being developed. Once the study name is entered, a directory with that name is created, as well as a study file. Additionally, a set of subdirectories is created with the following names: Bulletin17bResults, GeneralFrequencyResults, VolumeFrequencyAnalysisResults, DurationAnalysisResults, CoicidentFreqResults, CurveCombinationAnalysis, Layouts, and Maps. As the user creates new analyses, an analysis file is created in the main project directory. The interface provides for renaming and deletion of files on a study-by-study basis.

Graphical and Tabular Output

Graphics include a map window, plots of the data, and plots of analysis results. The map window can be used to display background map layers. Locations of the data being analyzed can be displayed on top of the map layers. Once data are brought into HEC-SSP, they can be plotted for visual inspection. The frequency curve plots show the results of the analyses, which include the analytically computed curve, the expected probability curve, confidence limits, and the raw data points plotted based on the selected plotting position method. Tabular output consists of tables showing the computed frequency curves, confidence limits, and summary statistics. All graphical and tabular output can be displayed on the screen, sent directly to a printer (or plotter), or passed through the Windows Clipboard to other software, such as a word-processor or spreadsheet.

A report file is available for each analysis. This report file includes the input data, preliminary results, all of the statistical tests (Low and High Outliers, Broken Record, Zero Flows Years, Incomplete Record, Regional Skews, and Historic Information), and final results. This report file is similar to the FFA output file.

Overview of This Manual

This user's manual is the primary documentation on how to use HEC-SSP. The manual is organized as follows:

- Chapters 1-2 provide an introduction and overview of HEC-SSP, as well as instructions on how to install the software.
- Chapter 3 provides an overview on how to use the HEC-SSP software in a step-by-step procedure, including a sample problem that the user can follow.
- Chapter 4 explains in detail how to enter and view data.
- Chapter 5 provides a detailed discussion on how to perform the Bulletin 17B flow frequency analysis. Additionally, this chapter describes all of the output capabilities available for displaying and printing the results.
- Chapter 6 provides a detailed discussion on how to use the general frequency analysis editor.

- Chapter 7 provides a detailed discussion on how to use the volume frequency analysis editor.
- Chapter 8 provides a detailed discussion on how to use the duration analysis editor.
- Chapter 9 provides a detailed discussion on how to use the coincident frequency analysis editor.
- Chapter 10 provides a detailed discussion on how to use the curve combination analysis editor.
- Appendix A contains a list of references.
- Appendix B has a series of example analyses that demonstrate the various capabilities of performing a Bulletin 17B flow frequency analysis, a general frequency analysis, a volume-duration frequency analysis, a duration analysis, a coincident frequency analysis, and a curve combination analysis.

CHAPTER 2

Installing HEC-SSP

You install HEC-SSP using the program installation package available from HEC's web site. The setup program installs the software, documentation, and the example applications. This chapter discusses the hardware and system requirements needed to use HEC-SSP, how to install the software, and how to uninstall the software.

Contents

Hardware and Software Requirements

Before you install the HEC-SSP software, make sure that your computer has at least the minimum required hardware and software. In order to get the maximum performance from the HEC-SSP software, recommended hardware and software is shown in parentheses. This version of HEC-SSP will run on a computer that has the following:

- Intel Based PC or compatible machine with Pentium processor or higher (a Pentium 4 or higher is recommended).
- A hard disk with at least 100 megabytes of free space
- A CD-Rom drive (or CD-R, CD-RW, DVD), if installing from a CD.
- A minimum of 512 megabytes of RAM (1 Gigabyte or more is recommended).
- A mouse.
- Color Video Display (Recommend running in 1280x1024 or higher resolution, and as large a monitor as possible). Recommend at least a 17" monitor.
- Microsoft Windows NT 4.0, 2000, XP, or Vista (or later versions).

Installation Procedure

Installation of the HEC-SSP software is accomplished through the use of the Setup program.

To install the software onto your hard disk do the following:

1. Insert the HEC-SSP CD into your CD drive (or download the software from our web site: www.hec.usace.army.mil).

2. The setup program should run automatically if installing from a CD. When downloading from the web page you will need to save the setup file in a temporary directory and then execute the “HEC-SSP_2_Setup.exe” file to run the setup program.

3. If the setup program does not automatically run from the CD, use the windows explorer to start the HEC-SSP_2_Setup.exe program on the CD.

4. Follow the setup instructions on the screen.

The setup program automatically creates a program group called HEC. This program group will be listed under the Programs menu, which is under the Start menu. The HEC-SSP program icon will be contained within the HEC program group, within the HEC-SSP subdirectory. The user can request that a shortcut icon for HEC-SSP be created on the desktop. If installed in the default directory, the HEC-SSP executable can be found in the C:\Program Files\HEC\HEC-SSP\2.0 directory with the name "HEC-SSP.EXE".

The HEC-SSP User's Manual and example data sets are also installed with the software. The User's Manual can be viewed by selecting **User's Manual** from the **Help** menu. You must have Adobe Acrobat Reader to view the user's manual. This viewer can be obtained for free from the Adobe web page.

A zip file containing the example data sets described in Appendix B have been installed in the "**…\Examples**" folder within the program directory. You can install the example data sets by selecting the **Install Example Data** option from the **Help** menu. After selecting the Install Example Data menu option, a window will open for you to choose a location to install the example data sets. The program will create a subdirectory within your chosen folder called **SSP_Examples**. A project file called "SSP_EXAMPLES.ssp" will be contained in the SSP_Examples folder. You can load the test data sets by using the **Open Study** option from the File menu and then use the file chooser to select this file.

Uninstall Procedure

The HEC-SSP Setup program automatically registers the software with the Windows operating system. To uninstall the software, do the following:

- From the Start Menu select Control Panel.
- Select Add/Remove Programs from within the Control Panel folder.
- From the list of installed software, select the HEC-SSP program and press the Remove button.
- Follow the uninstall directions on the screen and the software will be removed from your hard disk.

CHAPTER 3

Working With HEC-SSP - An Overview

HEC-SSP is an integrated package of statistical analysis modules, in which the user interacts with the system through the use of a Graphical User Interface (GUI). The current version is capable of performing flow frequency analyses based on Bulletin 17B "Guidelines for Determining Flood Flow Frequency", dated March 1982, general frequency analyses, volume frequency analyses, duration analyses, coincident frequency analyses, and curve combination analyses. This chapter provides an overview of how a Bulletin 17B flow frequency analyses can be performed with the HEC-SSP software. General frequency and volume-duration frequency analyses can be developed in a similar manner as outlined for the Bulletin 17B analysis.

In HEC-SSP terminology, a **Study** is a set of files associated with a particular set of data and statistical analyses being performed. The files for a study are categorized as follows: study information, data list, and analysis data.

Contents

Starting HEC-SSP

When you run the HEC-SSP Setup program, a new program group called **HEC** and a program icon called **HEC-SSP** are created. They should appear in the start menu under the section called **All Programs**. The user also has the option of creating a shortcut on the desktop. If a shortcut is created, the icon for HEC-SSP will look like the following:

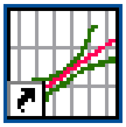


Figure 3-1. The HEC-SSP Icon.

To Start HEC-SSP from Windows:

- Double-click on the HEC-SSP Icon. If you do not have an HEC-SSP shortcut on the desktop, go to the **Start** menu and select **All Programs → HEC → HEC-SSP → HEC-SSP 2.0**.

Overview of the Software Layout

When you first start HEC-SSP, you will see the main window as shown in Figure 3-2, except you will not have any study data on your main window. As shown in Figure 3-2, the main window is laid out with a Menu Bar, a Tool Bar, and four window panes.

The upper right pane (which occupies most of the window area) is the **Desktop Area** (Referred to as the "Desktop" from this point in the manual). This area is used for displaying maps, data editors, and analysis windows.

The upper left pane is called the **Study Explorer**. The Study Explorer acts like an explorer tree for the study. The top level of the tree is the study (SSP Examples in this example). Below the study is an analysis branch, a data branch, and a map branch. Under the analysis branch, the first level is the type of analysis. Under each analysis type will be the current user-defined analyses for that type. The data branch lists all of the available data sets that have been brought into the current study. Generally, a data set represents a piece of data at a specific gage location. For example, all of the peak annual flows at a single gage would be stored as a single data set. When an analysis is created, the user selects a data set to be used for that particular analysis. The map branch of the tree contains any maps the user has put together for the study. By default there is automatically a "Base Map" listed under the maps folder.

The lower left pane, and associated tabs, also belongs to the study explorer. This window is used to show additional information about items selected in the study explorer. The tabs are used to switch to different views within the study explorer window. The first tab, labeled Study, shows the explorer view of the study. The second tab, labeled Maps, lists the available maps and map layers associated with each map. The last tab, labeled Files, shows all of the files that make up the current study.

The lower right pane is called the **Message Window**. This window is used to display messages from the software as to what it is doing.

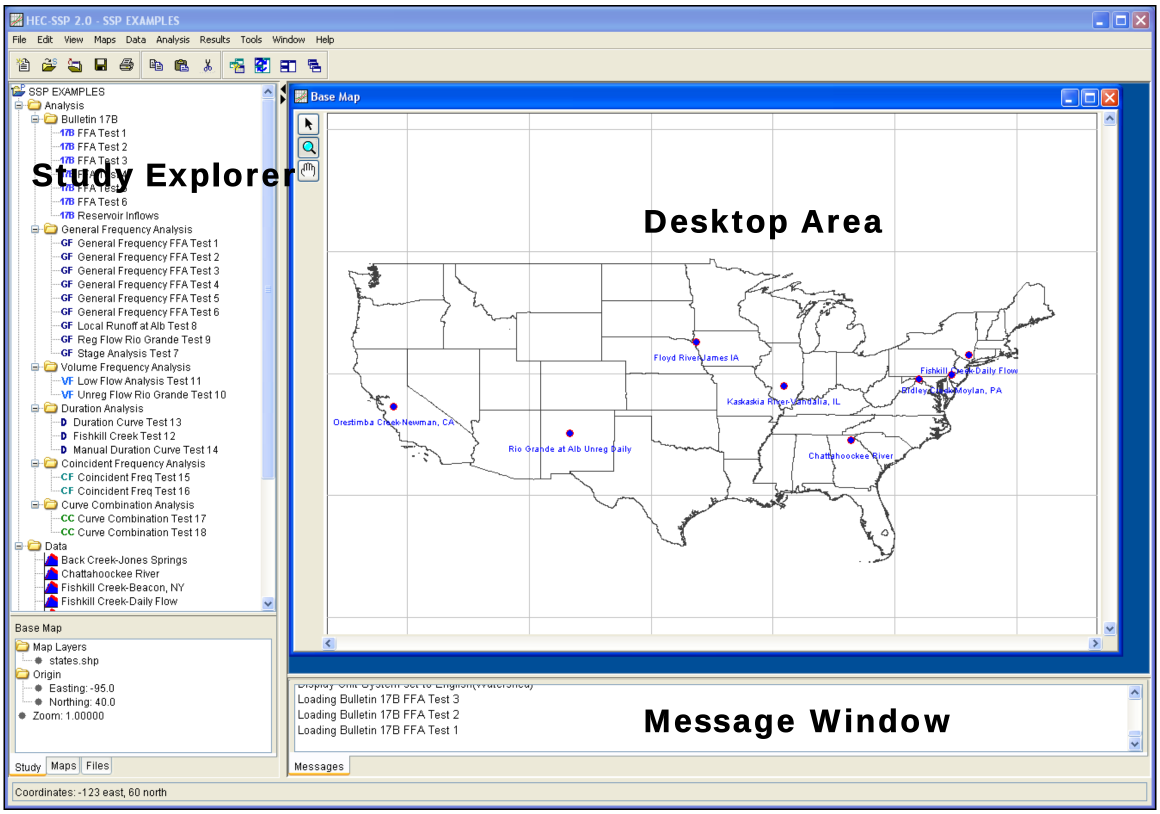
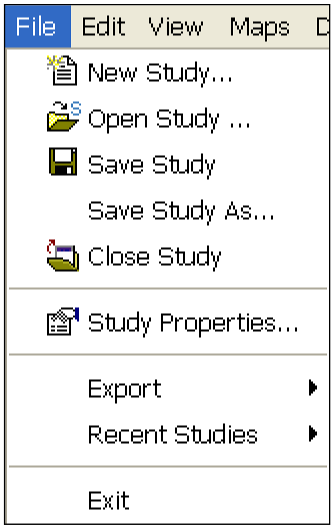


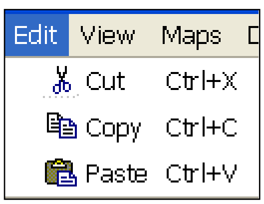
Figure 3-2. The HEC-SSP Main Window.

At the top of the HEC-SSP main window is a Menu bar with the following options:

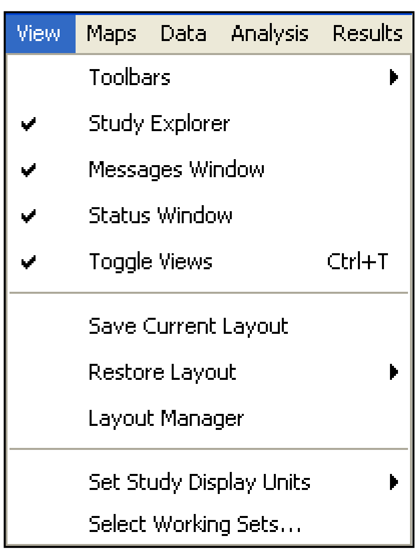
File: This menu is used for file management. Options available under the File menu include New Study, Open Study, Save Study, Save Study As, Close Study, Study Properties, Export, Recent Studies, and Exit. The Study Properties option is used to describe the study and to set the units system. The Export option is used to export HEC-SSP results, stored in the study DSS file, to another DSS file. The Recent Studies option lists the most recently opened studies, which allows the user to quickly open a study that was recently worked on.



Edit: This menu is used for applying the Cut, Copy, and Paste clipboard features to data in editable fields and tables.



View: The View menu allows the user to control display of the toolbars and the study windows. The user can also toggle between viewing all of the panes or just the Main View Pane. The View menu also has options for saving the current layout (currently opened windows and their sizes and locations) and restoring a previously saved layout. The Set Study Display Units option allows the user to switch output between English and metric units. The Select Working Sets menu option allows the user to group items in each folder and then display only those items in the user interface. For example, Figure 3-3 shows the Bulletin 17B folder in the study explorer. The Edit Working Set editor, Figure 3-4, was used to group all Bulletin 17B analyses that started with "FFA" into one working set. The working set



was named "FFA Analyses". This working set was activated by right clicking on top of the Bulletin 17B folder in the study explorer and selecting **Select Working Sets→FFA Analyses**, as shown in Figure 3-5. Only the Bulletin 17B analyses within the working set will then be displayed in the study explorer, as shown in Figure 3-6. To display all Bulletin 17B analysis, right click on top of the Bulletin 17B folder in the study explorer and select **Select Working Sets→No Working Set**.

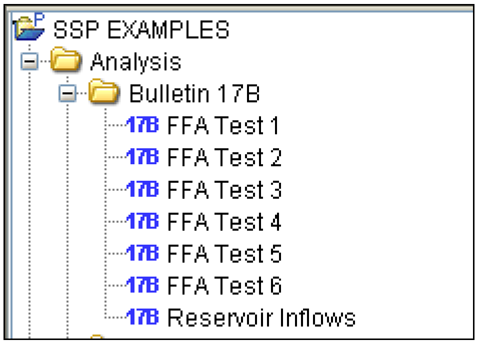


Figure 3-3. Study Explorer before Defining a Working Set.

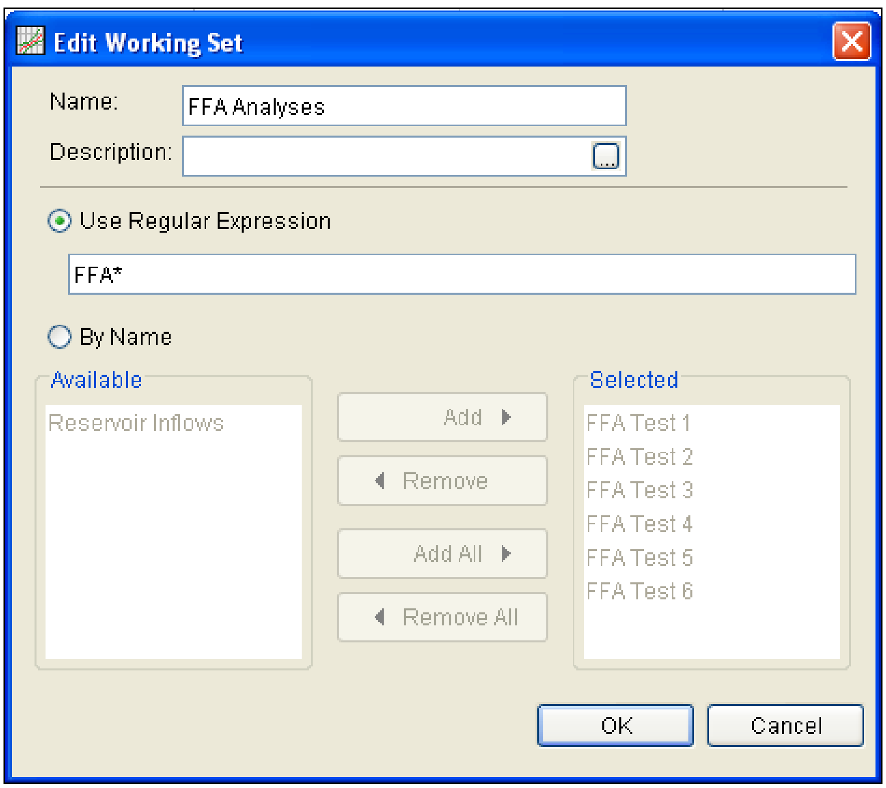


Figure 3-4. Edit Working Set Editor.

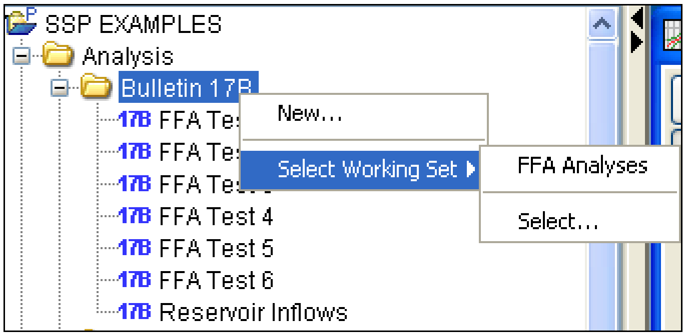


Figure 3-5. Activate a Working Set from the Study Explorer.

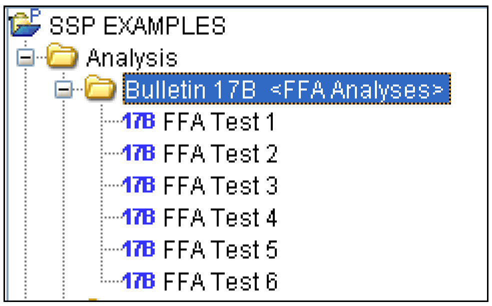
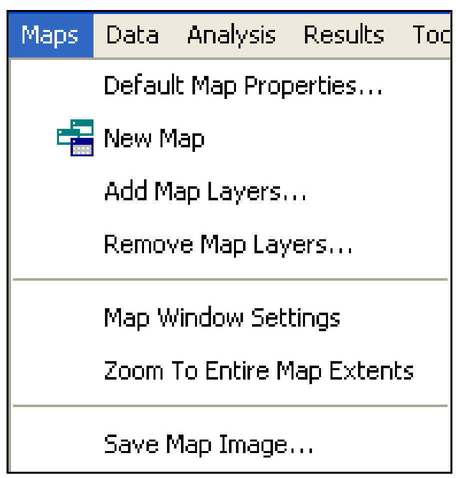
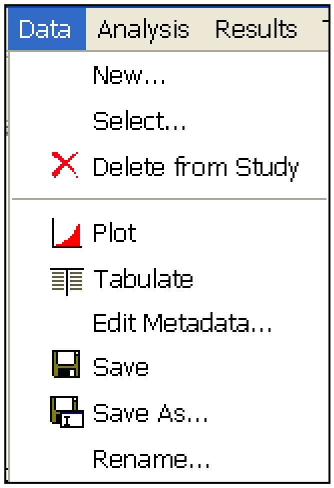


Figure 3-6. Bulletin 17B Folder Only Displays Analyses in Working Set.

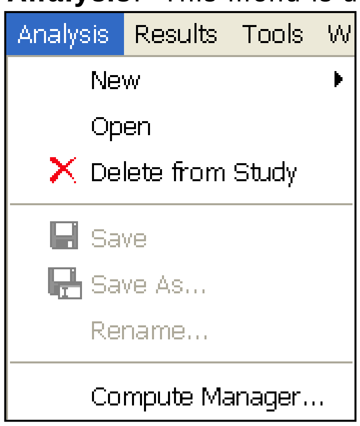
Maps: This menu is used to set the Default Map Properties (Coordinate system, extents, etc...), define a new map, add map layers to the study, and remove a map. Additionally, this menu has the following options available: Map Window Settings (allows the user to turn map layers on and off), Zoom To Entire Map Extents, Save Map Image, Import, and Export. The Zoom To Entire Map Extents option displays the entire set of map layers within the map window. The Save Map Image option can be used to save the current view of the map to a file.



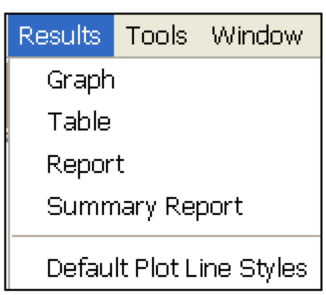
Data: This menu allows the user to define a new data set, open the metadata editor, and delete any existing data sets from the data list. Other options include opening a plot and table of the data.

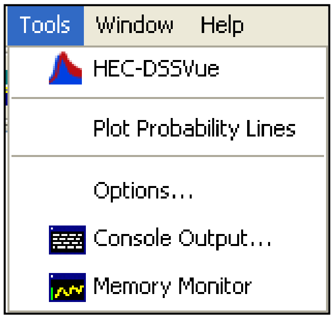


Analysis: This menu is used to create the various statistical analyses available in the software. Each statistical analysis is saved as a separate file containing the information that is pertinent to that specific analysis type. The current options under this menu item include New, Open, Delete from Study, Save, Save As, Rename, and Compute Manager. The compute manager allows the user to select one, several, or all of the analyses, and then have them all recomputed.

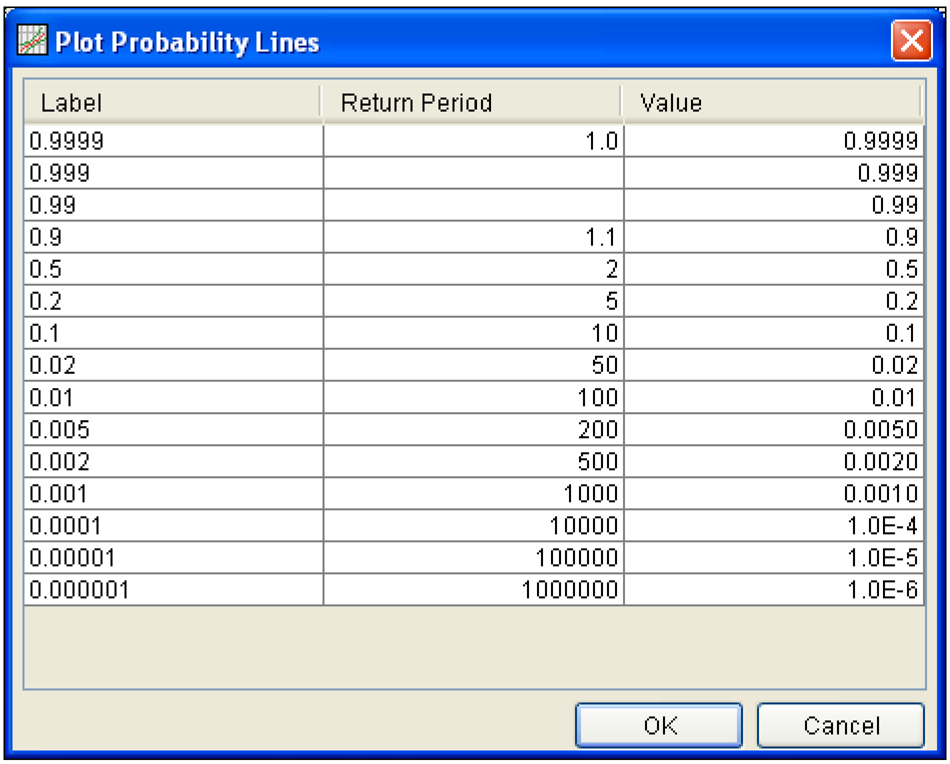


Results: This menu allows the user to graph and tabulate any of the existing analyses that have been computed. Additionally, the user can request to view the report file from a analysis. Users must select at least one analysis in the Study Explorer before selecting Graph, Table, Report, or Summary Report. If more than one analysis of the same type are selected (this is accomplished by holding down the control key while clicking on the various analyses), the Graph and Summary Report options will include results from all analyses that are selected. However, when multiple analyses are selected, the Table and Report option bring up separate windows for each of the selected analyses. The Default Plot Line Styles menu option lets the user change the default line styles applied to different data types that are plotted in a graph. For example, the user can change the default line style for high outliers so that they are displayed as black triangular data points when a plot is opened.





Tools: This menu includes HEC-DSSVue, Plot Probability Lines, Options, Console Output, and Memory Monitor. The HEC-DSSVue option brings up the HEC-DSSVue program and automatically loads the current study DSS file. HEC-DSSVue is a DSS utility to tabulate, graph, edit, and enter data into DSS. The Plot Probability Lines option opens an editor, shown in Figure 3-7, that lets the user add, delete, or edit the probability lines and axis labels that are displayed in all frequency curve plots. The Options menu item opens the Options editor that allows the user to set default HEC-SSP options. The **Results** tab in the Options editor, shown in Figure 3-8, allows the user to set the number of decimal digits that are displayed in all results.



Label	Return Period	Value
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0.999		0.999
0.99		0.99
0.9	1.1	0.9
0.5	2	0.5
0.2	5	0.2
0.1	10	0.1
0.02	50	0.02
0.01	100	0.01
0.005	200	0.0050
0.002	500	0.0020
0.001	1000	0.0010
0.0001	10000	1.0E-4
0.00001	100000	1.0E-5
0.000001	1000000	1.0E-6

Figure 3-7. Plot Probability Lines Editor.

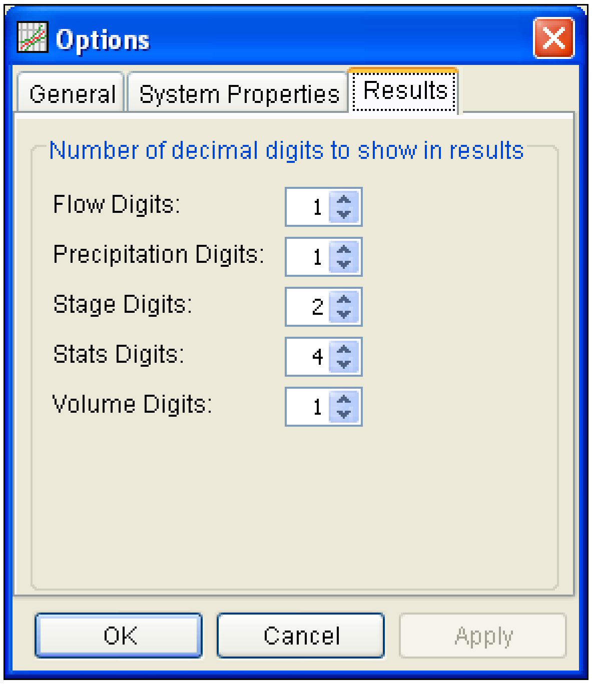
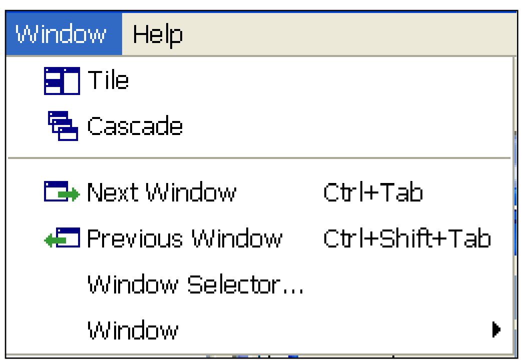


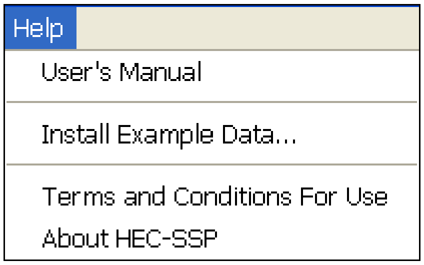
Figure 3-8. Dialog for Controlling the Number of Decimal Digits Shown in Result Tables and Reports.

Window: This menu includes Tile, Cascade, Next Window, Previous Window, Window Selector, and Window. These options are used to control the appearance of the windows in the Desktop area. When more than one window is open (such as a data importer, and various analysis windows), these menu items will help the user organize the windows, or quickly navigate to a specific window. The Tile option can be used to organize all of the currently opened windows in either a vertical or horizontal tile. The Cascade option puts one window on top of the next in a cascading fashion. The Next Window option brings the next window in the list of currently opened windows to the top. The Previous Window brings the last window that was on top back to the top. The Window Selector option brings up a pick list of the currently opened windows and allows you to select the one you want. The Window option has a sub menu list of all the opened windows and allows you to select one.



Help: This menu allows the user to open the HEC-SSP User’s Manual, install example data sets, read the terms and conditions of use statement, and display the current version information about HEC-

SSP.



Also on the HEC-SSP main window is a Tool Bar. The buttons on the tool bar provide quick access to the most frequently used options under the HEC-SSP File and Edit menus.

Steps in Performing a Bulletin 17B Frequency Analysis

There are five main steps in performing a Bulletin 17B flow frequency analysis using HEC-SSP. Similar steps are required when performing other statistical analyses.

- Starting a new study
- Adding a Background Map (Optional)
- Importing, Entering, and Editing Data
- Performing the Bulletin 17B Frequency Analysis
- Viewing and Printing Results

Starting a New Study

The first step in performing a Flow Frequency analysis with HEC-SSP is to establish which directory you wish to work in and to enter a title for the new study. To start a new study, go to the **File** menu and select **New Study**. This will open the **Create New Study** window as shown in Figure 3-9. The user is required to enter a name for the study, select a directory to work in (a default location is provided), and select the desired units system. Adding a description of the study is optional. Once you have entered all the information, press the **OK** button to have the information accepted. After the **OK** button is pressed, a subdirectory will be created under the user chosen directory. The subdirectory will be labeled with the same name as the user-entered study name. This study directory is where the HEC-SSP project file, as well as other study files and directories will be located. Additionally, a default map window will appear in the Main View Pane. However, the map window will be blank when it first opens.

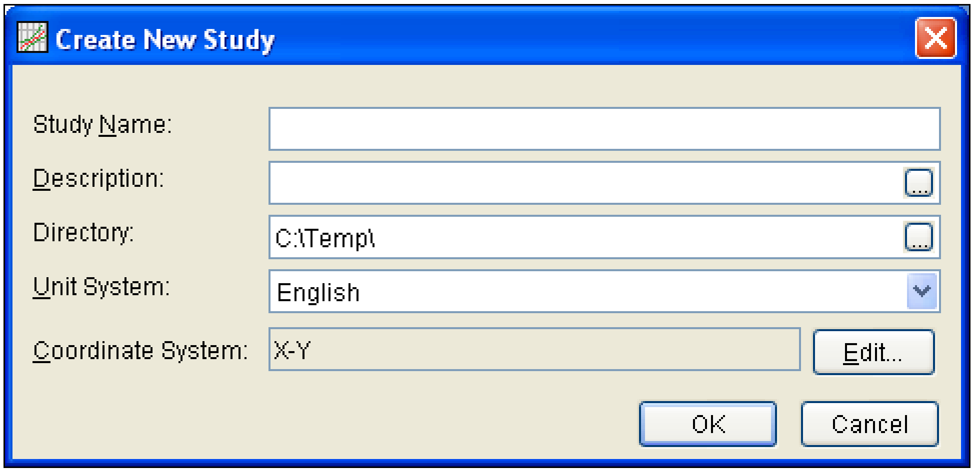


Figure 3-9. New Study Window.

Adding a Background Map

By default, when you start a new project in HEC-SSP a default map window (called Base Map) will open in the Desktop window. Having a background map is optional in HEC-SSP. Not having a map does not prevent the user from importing and entering data, or performing an analysis and viewing results. The map is mostly a visual aid of the study area. Additionally, when you bring in gage data you can enter the map coordinates of the gage and it will show up on the map. Once a gage is located on the map you can right click on it to open a shortcut menu for viewing the data, or graphing and tabulating the results.

To add a map layer to the default map, go to the **Maps** menu and select **Add Map Layers**. When this option is selected a file chooser window will appear, as shown in Figure 3-10, allowing the user to select map layers to bring into the map. The **Create Copy** option on the window will make a copy of the selected map and place it in the Maps subdirectory within the study folder.

Currently, the HEC-SSP software can load the following types of map layers: USGS DLG, AutoCAD DXF, shapefile, Raster Image, USGS DEM, Arc Info DEM, ASCII NetTIN, and Mr Sid.

An example map is shown in Figure 3-11. This map contains a shapefile of state boundaries and data locations.

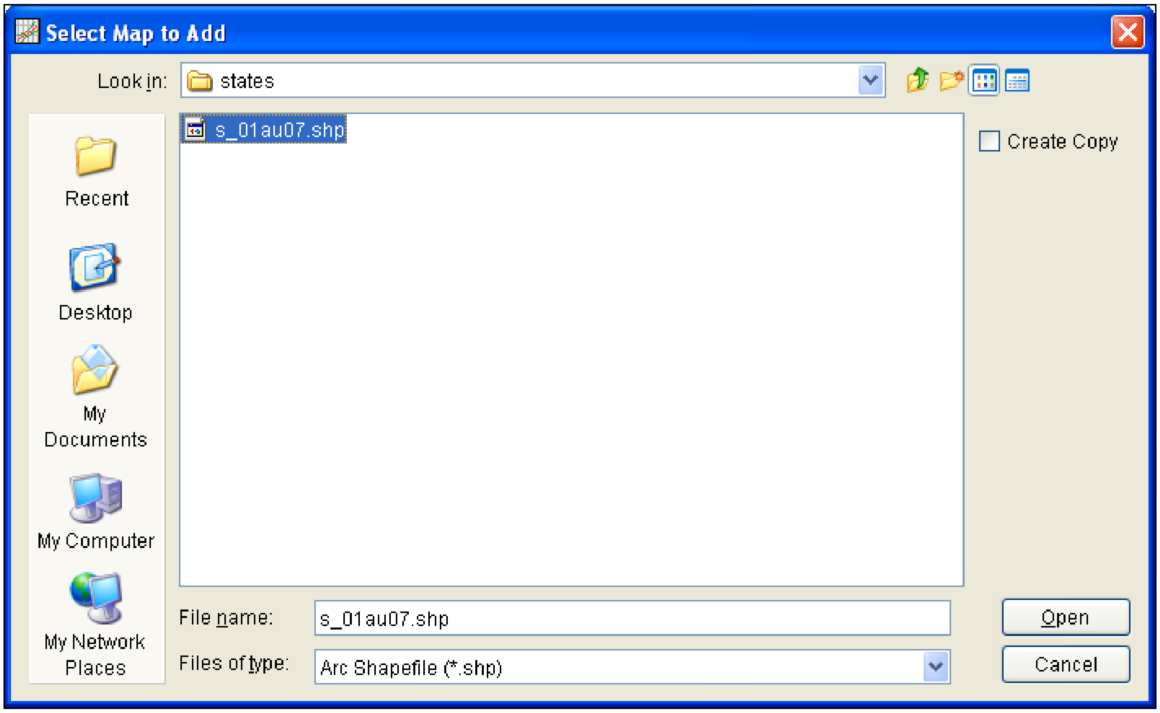


Figure 3-10. Select a Map Layer to add to the Base Map.

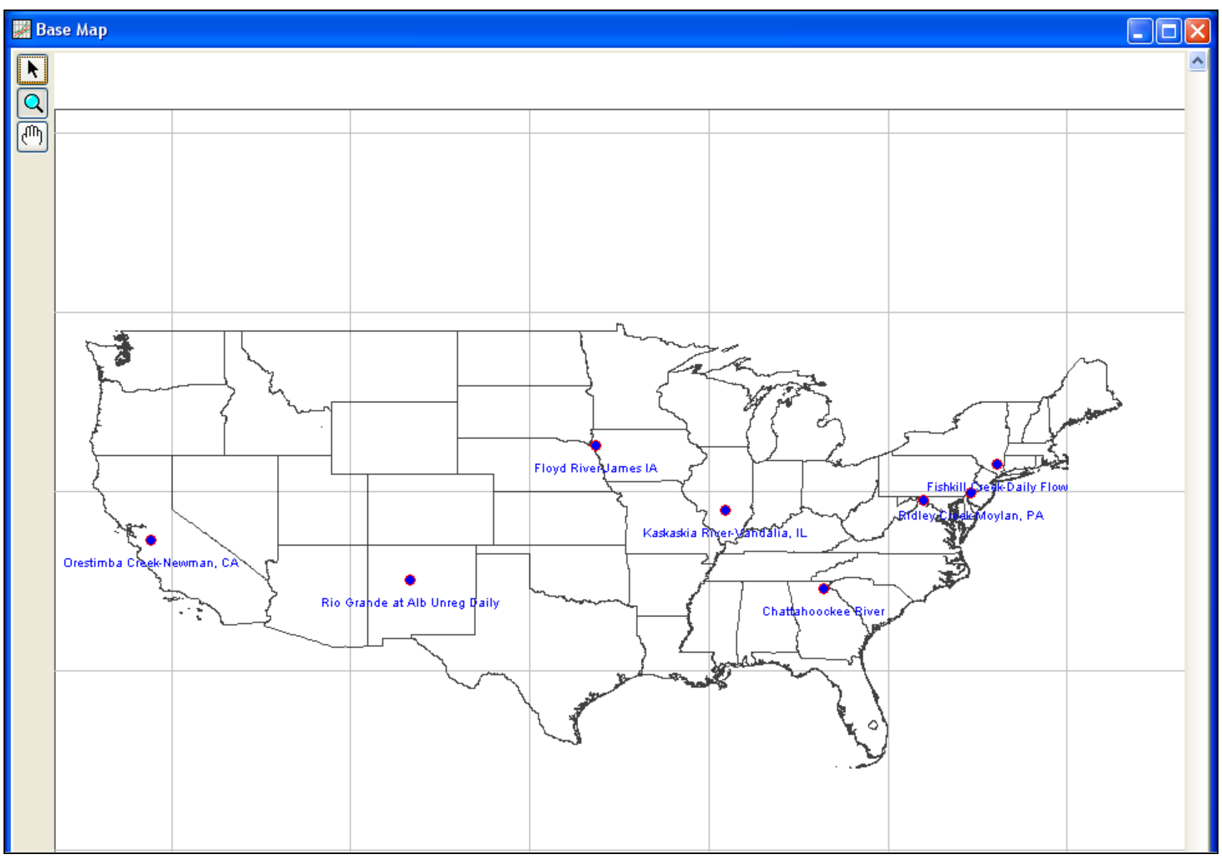


Figure 3-11. Example Background Map.

If more than one map layer is going to be added to a map, then it is up to the user to ensure that all map layers are in the same coordinate system. HEC-SSP does not perform coordinate system projections. Also, HEC-SSP cannot always determine the coordinate system for all map layers entered. However, under the **Maps** menu is an option called **Default Map Properties**. This menu option can be used to set the default coordinate system for the map layers displayed in HEC-SSP. The user should set the default coordinate system first and then bring in map layers to the study.

Importing, Entering, and Editing Data

Before any analyses can be performed, the user must bring data into the HEC-SSP study. For a peak flow frequency analysis following guidelines in Bulletin 17B, the data must consist of peak annual flow values. To bring data into HEC-SSP go to the **Data** menu and select **New**. This will bring up the **Data Importer** as shown in Figure 3-12.

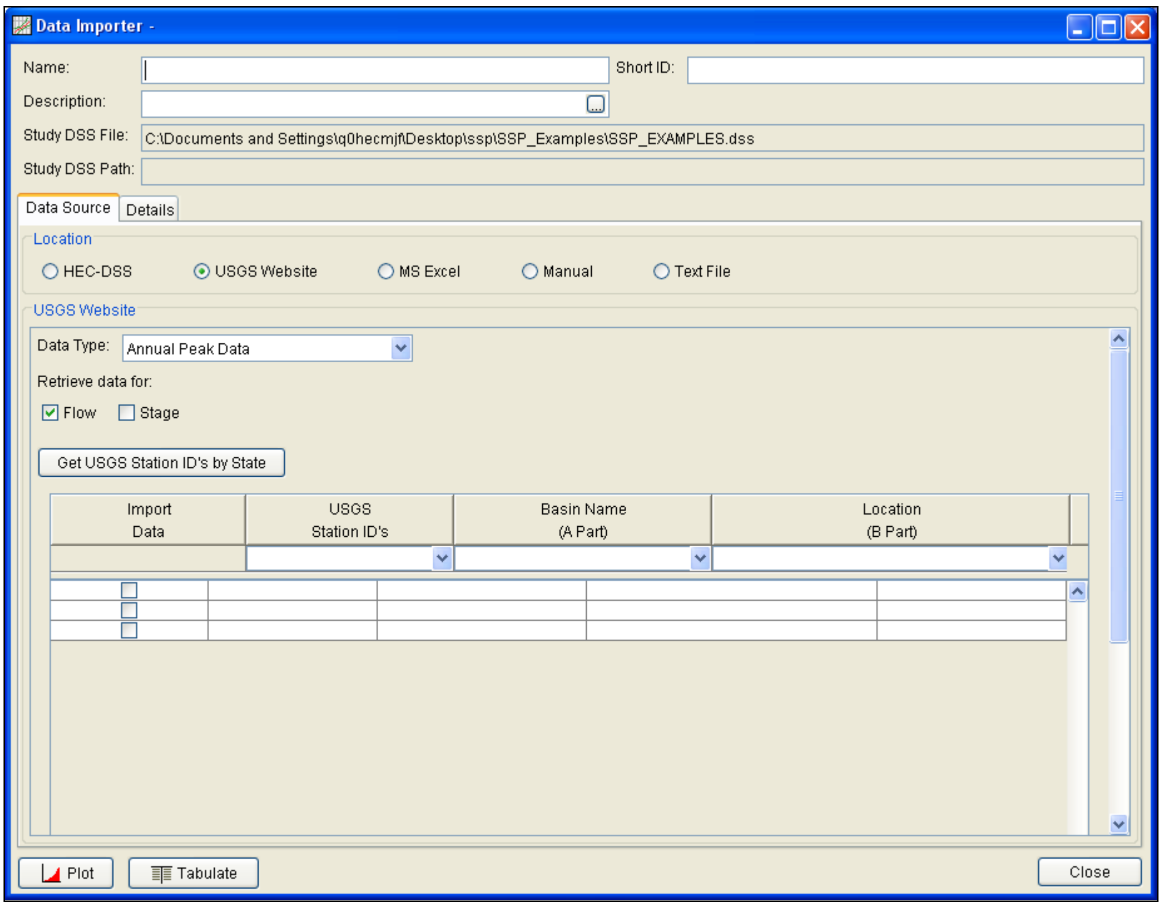


Figure 3-12. HEC-SSP Data Importer.

As shown in Figure 3-12, the Data Importer has fields for the Name, Short Identifier, and the Description of the data at the top of the window. Additionally, it lists the study DSS file name that the data will be stored in once it is brought into the study. The study DSS file is always labeled the same name as your study with the .DSS file extension.

The Data Importer contains two tabs, **Data Source** and **Details**. The **Data Source** tab is shown first. This tab is used for selecting and defining a source for bringing data into the HEC-SSP study. Currently, there are five ways to bring data into an HEC-SSP study: import from another HEC-DSS file, import data from the USGS web site, import from a Microsoft Excel spreadsheet, manually entering the data into a table, and import the data from a text file. All of these methods will import data into the study DSS file.

For this example, importing data from the USGS website will be shown. For a complete description of the data importer see Chapter 4. To import data from the USGS website, first select the **USGS Website** option from the list of five options available in the Location panel. Next, select **Annual Peak Data** as the data type and make sure the **Flow** option is selected. The next step is to press the button labeled **Get USGS Station ID's by State**. When this button is pressed a window will appear (Figure 3-13) allowing the user to select a state from which to get data.

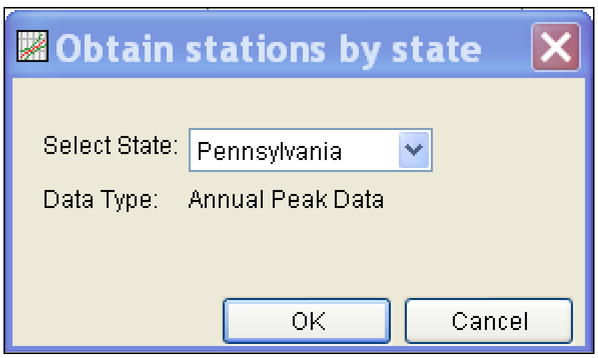


Figure 3-13. Window to Select a State for Downloading Data.

Once a state is selected, press the **OK** button and a list of the available gages from that state will appear in a pick list as shown in Figure 3-14. Check the boxes for all of the gages you would like to import and then press the **Import to Study DSS File** button. Once the import button is pressed, a process will begin during which the data will be downloaded from the USGS website and saved to the study DSS file. HEC-SSP will automatically name the data when importing multiple gages at one time. The USGS import process will download annual peak flow data, and the USGS data quality codes. The quality codes will be added as an addition object to the Data folder.

In addition to the data itself, any metadata that is available will be downloaded and stored with the data. The metadata can be viewed from the **Details** Tab on the Data Importer. Metadata can also be viewed or edited by opening the **Metadata Editor**. To open this editor, place the mouse on top of a data object in the Data folder and click the right mouse button. The shortcut menu contains an **Edit Metadata** option, as shown in Figure 3-15. The metadata editor is shown in Figure 3-16.

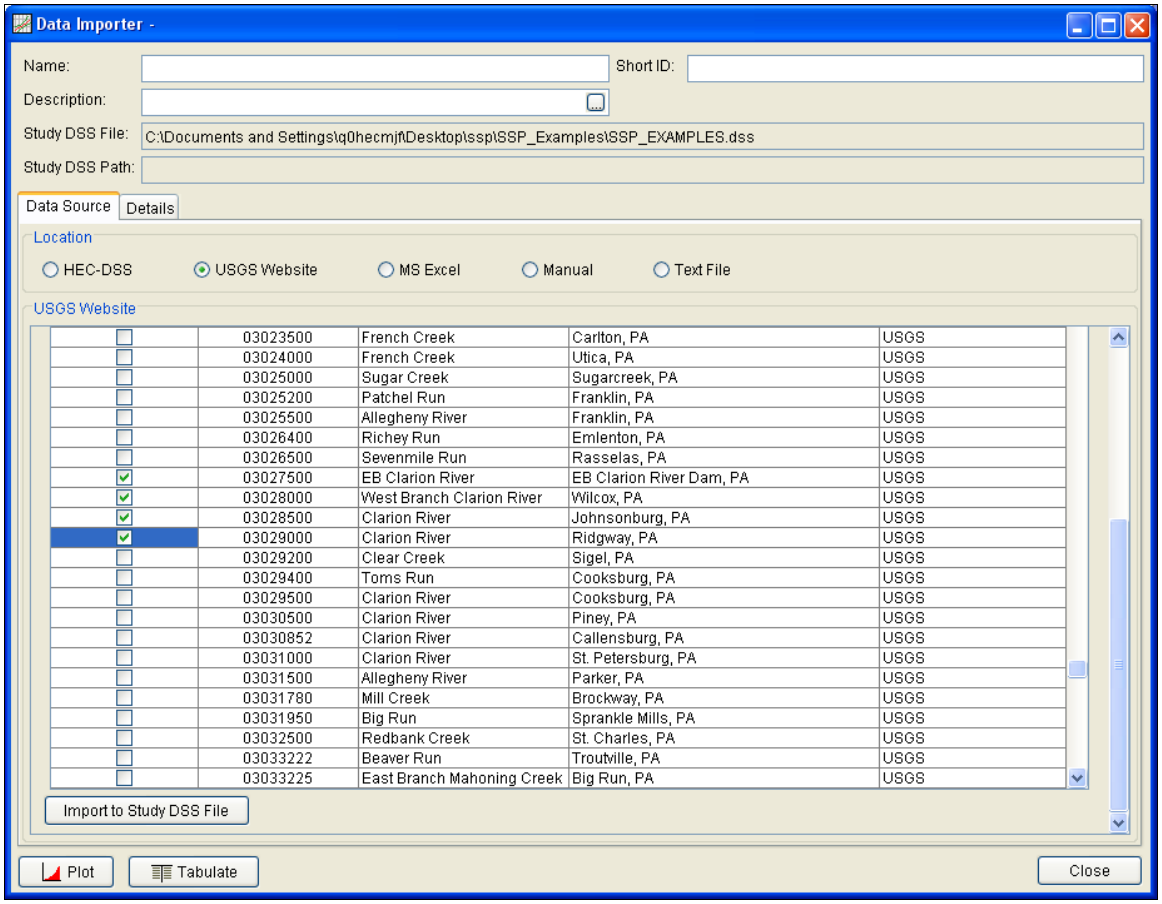


Figure 3-14. Example of Choosing Gages from a USGS State List to Import.

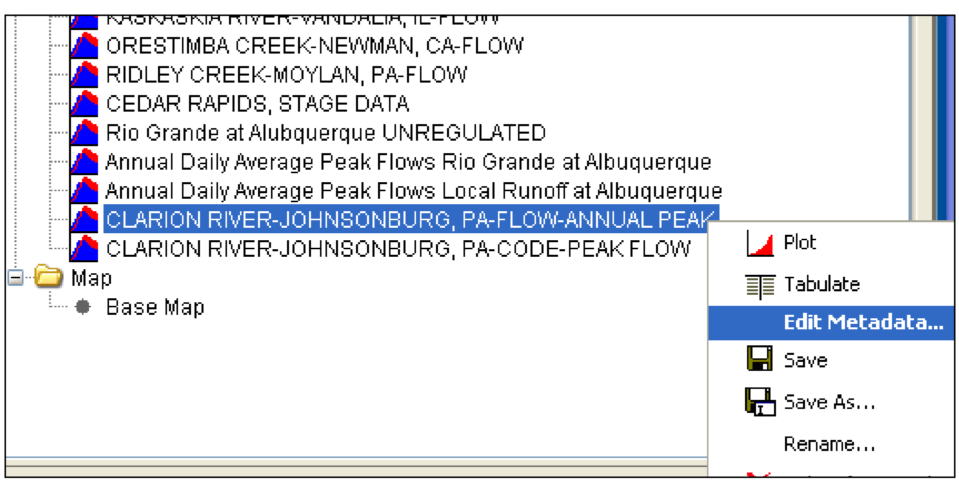


Figure 3-15. Open the Metadata Editor Using the Right Mouse Click Menu.

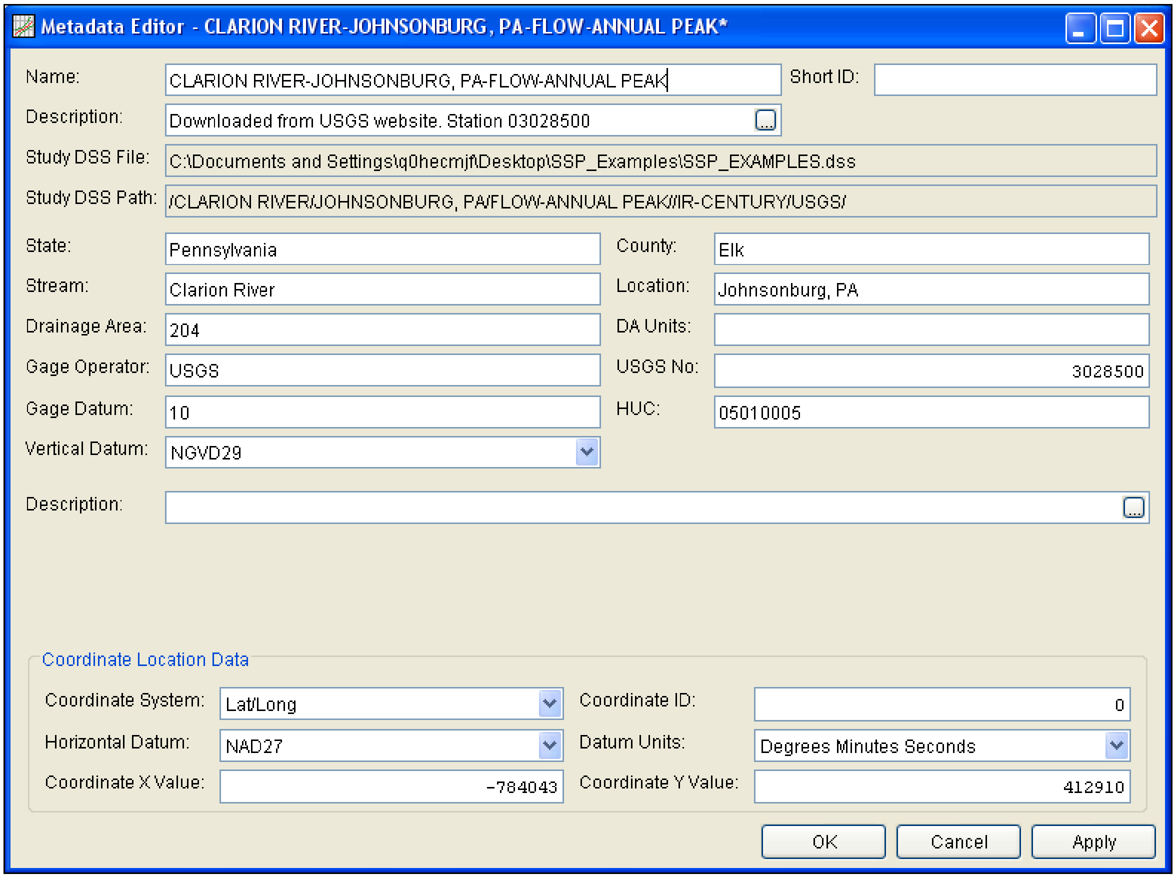


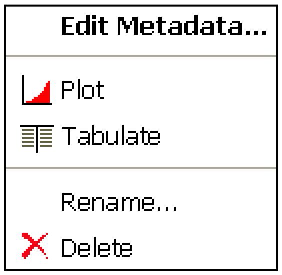
Figure 3-16. Metadata can be Viewed or Edited by Opening the Metadata Editor.

As shown in Figure 3-16, the metadata consists of the State, County, Stream, Location, Drainage Area, DA Units, Gage Operator, USGS Gage No., Gage Datum, HUC (Hydrologic Unit Code), Vertical Datum, and a description field. Additionally, the coordinate location of the data is shown. The coordinate location consists of Coordinate System, Coordinate ID, Horizontal Datum, Datum Units, Coordinate X Value, and Coordinate Y Value. Most of the USGS data is retrieved with the Latitude/Longitude coordinate system as shown in the example. In addition to editing the metadata, the Metadata Editor allows the user to change the name of the data, enter a short identifier, and enter a longer description.

If the metadata does not download automatically, the user has the option to enter any of the information by hand. Metadata is not generated automatically for any of the other four data sources. Therefore, entering the metadata is required if the user wants it to be carried along with the study.

After the data is imported into the study, the user can select any one of the gages in the Data folder and **Plot** or **Tabulate** the data. The plot and tabulate options are available from the Data menu and from a shortcut menu that opens by clicking the right mouse button when the pointer is located on top of the gage object in the Data folder. If you select the **Plot** option, you will get a plot of the peak flow data for that gage. If you select the **Tabulate** option, you will get a table containing the data. Data values can be edited within the table; however, the editing mode must be turned on. To turn on editing, select the **Edit→Allow Editing** menu option. Use the **File→Save** or **File→Save As** menu option to save the data when you are satisfied with edits.

If the data has coordinate location information, it will then be plotted on top of the background maps. The software will convert the coordinates of the point data to the default coordinate system of the base map. The user can interact with the plotted points by right clicking on the gage icon in the map and a shortcut menu will appear as shown. The user has the option to edit the metadata, plot, tabulate, rename, or delete the data.



Performing the Bulletin 17B Flow Frequency Analysis

To perform a Bulletin 17B flow frequency analysis, go to the **Analysis** menu and select **New → Bulletin 17B Flow Frequency**. This will bring up an empty Bulletin 17B editor. As shown in Figure 3-17, the user must enter a name for the analysis, a description (optional), and select a flow data set (gage data stored in study DSS file). The DSS File Name and Report File are automatically filled in by the program. For now, the DSS File Name will be the study DSS file and the report file will have the same name as the analysis.

The editor window contains three tabs: General, Options, and Tabular Results. The **General** tab contains settings for Generalized Skew, Expected Probability Curve, Plotting Positions, Confidence limits, and a Time Window Modification. Default settings are already established for each of the options on the General tab; however, the user can change the default settings.

The **Options** tab contains information on Low Outlier Threshold, Historic Period Data, and User-Specified Frequency Ordinates. These options are not required for most analyses but may be necessary depending upon the data.

A detailed description of each of the Bulletin 17B settings and options can be found in Chapter 5, Performing a Bulletin 17B Flow Frequency Analysis. Once all of the settings and options have been selected, the user presses the **Compute** button to have the computations performed. When the computations have finished a message window will open stating **Compute Complete**. Press the **OK** button on the message window to close the window. Once the computations have finished the user can begin to look at output.

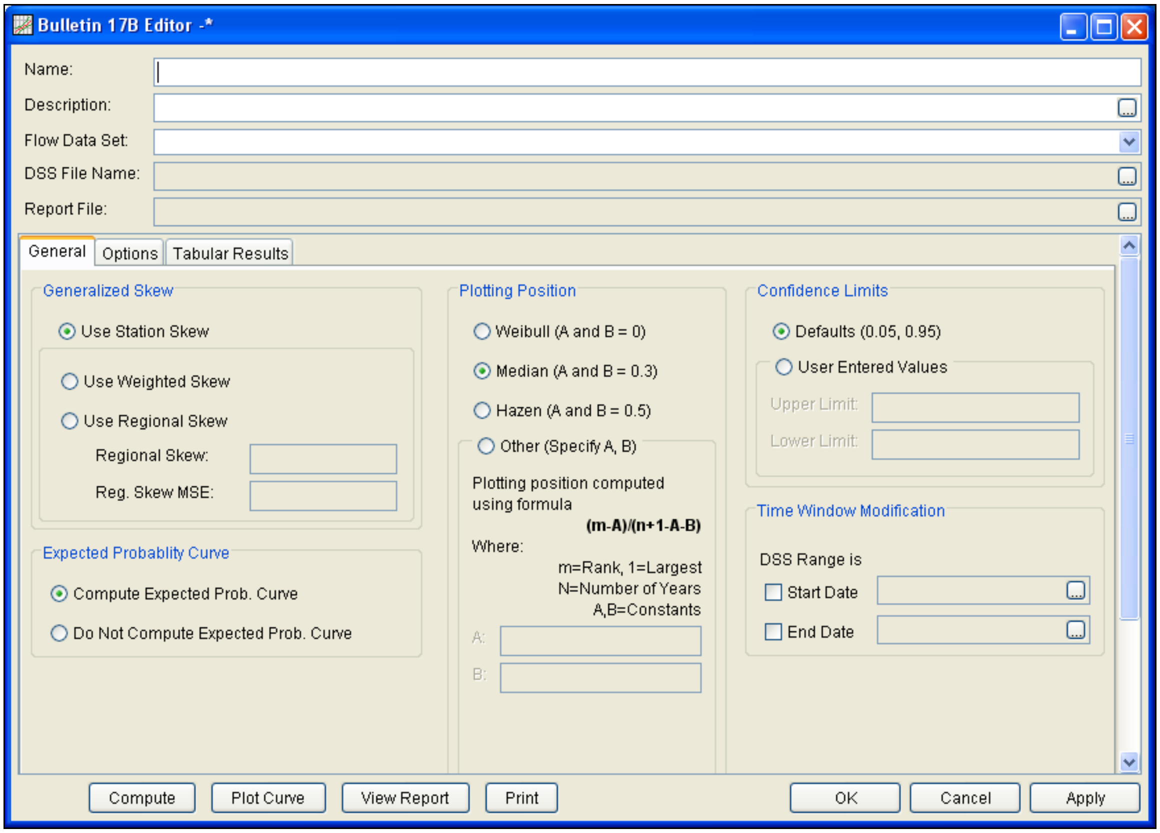
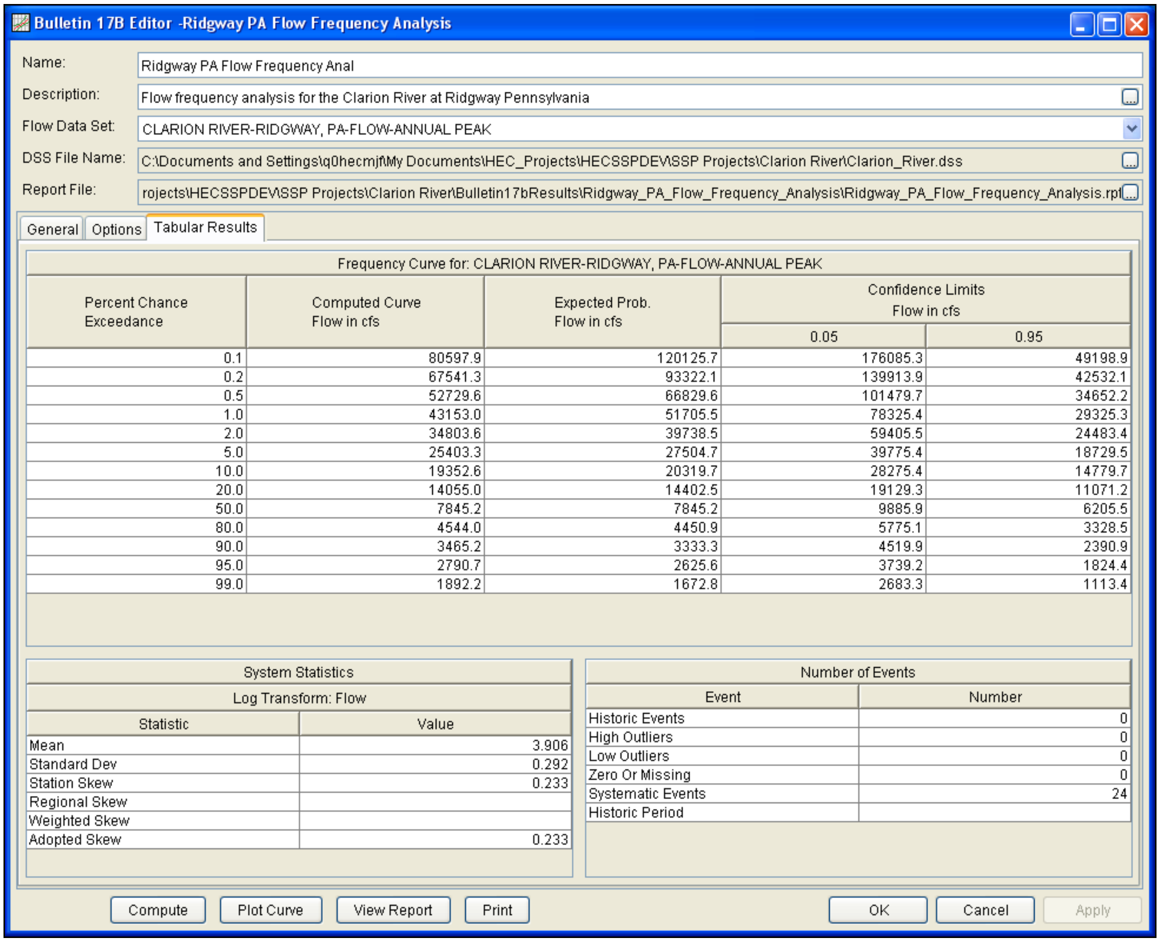


Figure 3-17. Bulletin 17B Flow Frequency Analysis Editor.

Viewing and Printing Results

Tabular output can be viewed by selecting the **Tabular Results** tab. When this tab is pressed, a set of tables will appear as shown in Figure 3-18. The primary table on the **Tabular Results** tab consists of percent chance exceedance, computed flow frequency curve, the expected probability adjusted curve, and the 5 and 95 percent confidence limits. The second table (bottom left) contains general statistics about the data, such as the mean, standard deviation, station skew, regional skew, weighted skew, and the adopted skew of the analysis. The third table (bottom right) contains the number of historic events, high outliers, low outliers, zero or missing values, systematic events in the data set, and the number of years in the historic period. The table can be sent to the printer by pressing the **Print** button at the bottom of the analysis window. The user can control the number of decimal digits shown in the result tables and in reports. Select **Options** from the **Tools** menu and then open the **Results** tab, as shown in Figure 3-8.



Frequency Curve for: CLARION RIVER-RIDGWAY, PA-FLOW-ANNUAL PEAK

Percent Chance Exceedance	Computed Curve Flow in cfs	Expected Prob. Flow in cfs	Confidence Limits Flow in cfs 0.05	Confidence Limits Flow in cfs 0.95
0.1	80597.9	120125.7	176085.3	49198.9
0.2	67541.3	93322.1	139913.9	42532.1
0.5	52729.6	66829.6	101479.7	34652.2
1.0	43153.0	51705.5	78325.4	29325.3
2.0	34803.6	39738.5	59405.5	24483.4
5.0	25403.3	27504.7	39775.4	18729.5
10.0	19352.6	20319.7	28275.4	14779.7
20.0	14055.0	14402.5	19129.3	11071.2
50.0	7845.2	7845.2	9885.9	6205.5
80.0	4544.0	4450.9	5775.1	3328.5
90.0	3465.2	3333.3	4519.9	2390.9
95.0	2790.7	2625.6	3739.2	1824.4
99.0	1892.2	1672.8	2683.3	1113.4

System Statistics
Log Transform: Flow

Statistic	Value
Mean	3.906
Standard Dev	0.292
Station Skew	0.233
Regional Skew	
Weighted Skew	
Adopted Skew	0.233

Number of Events

Event	Number
Historic Events	0
High Outliers	0
Low Outliers	0
Zero Or Missing	0
Systematic Events	24
Historic Period	

Figure 3-18. Tabular Results of Bulletin 17B Editor.

Graphical output can be obtained by pressing the **Plot Curve** button at the bottom of the analysis editor. When this button is pressed, a plot will appear like the one in Figure 3-19. This plot contains the computed frequency curve, the expected probability adjusted curve, the confidence limits, and the data points plotted by the user-selected plotting position method. Additionally, a plot title is listed at the top. The plot title is by default the user-defined name of the analysis. The user can modify the plot properties by selecting the **Edit→Plot Properties** menu option. A plot properties window will open that lets the user change the line style for each data type, change the axis labels, modify the plot title, and edit other plot properties. The user can also edit line styles by placing the mouse on top of the line or data point in the plot or legend and clicking the right mouse button. Then select the **Edit Properties** menu option in the shortcut menu. The plot can be printed or sent to the windows clipboard by using the **Print** and **Copy to Clipboard** options found under the **File** menu.

Additional points and lines can be added to a plot by placing the mouse anywhere in the plot area and clicking the right mouse button. Then select the **Add Marker** option to add a line or **Add Marker**

Point to add a point. Draw properties can be edited for these user-defined lines and points by placing the mouse on top of the point or line and clicking the right mouse button. Then select the **Edit Properties** option in the shortcut menu.

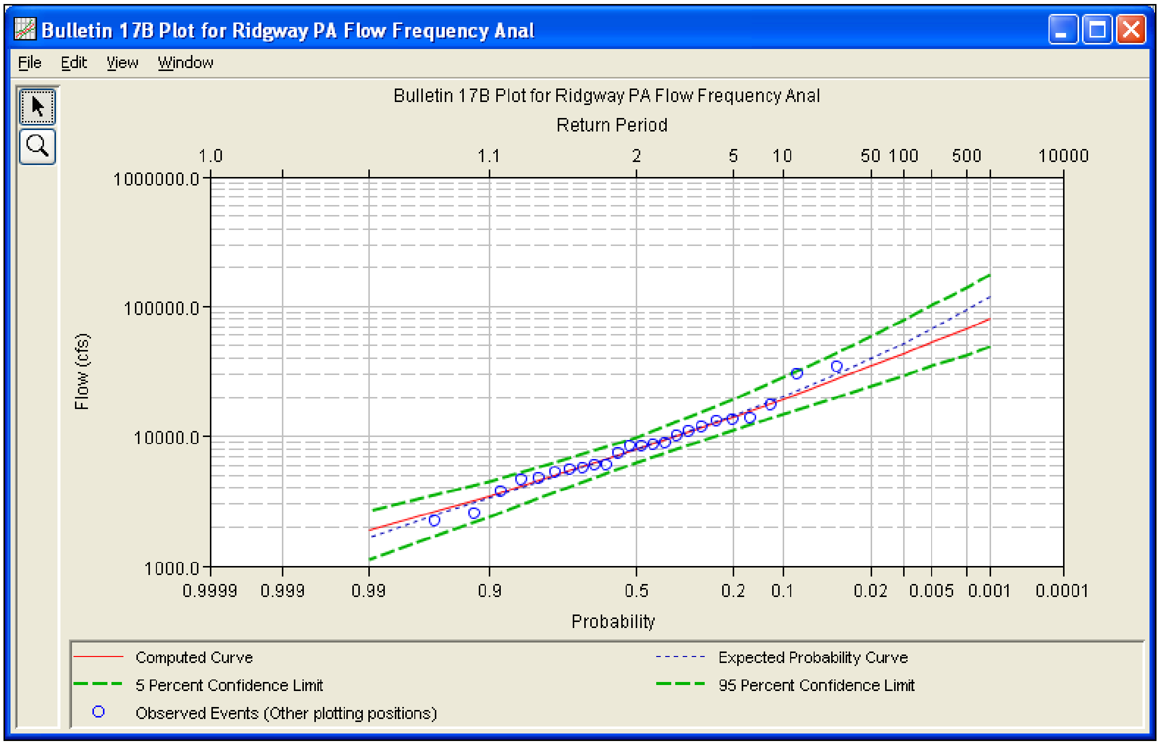


Figure 3-19. Flow Frequency Curve Plot.

The final piece of output available from a flow frequency analysis is a text report file. The report file lists all of the input data and user settings, plotting positions of the data points, intermediate results, each of the various statistical tests performed (i.e. high and low outliers, historical data, etc.), and the final results. This file is often useful for understanding how the software arrived at the final frequency curve. Press the **View Report** button at the bottom of the analysis editor to view the report file. When this button is pressed, a window will appear containing the report as shown in Figure 3-20.

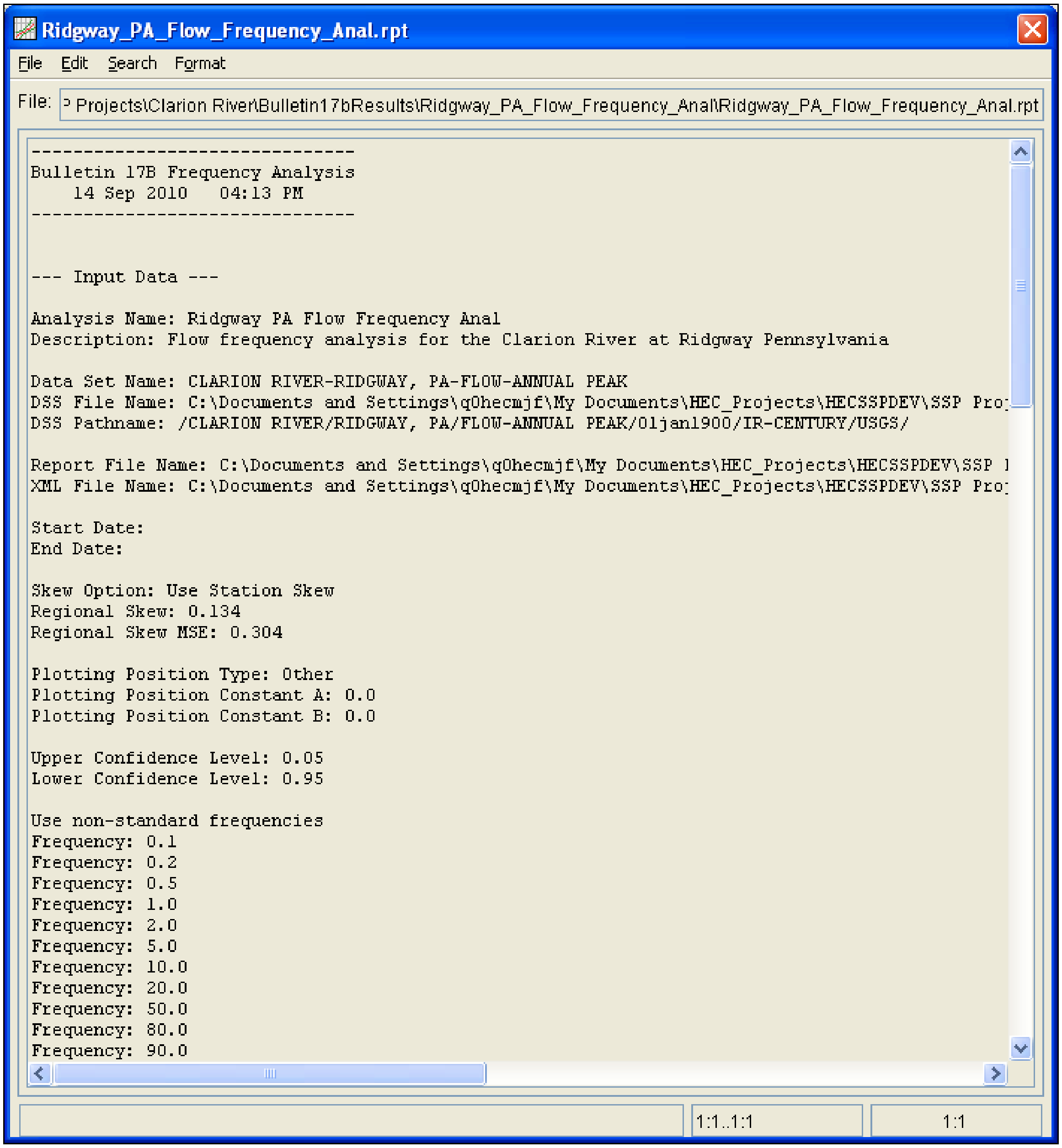


Figure 3-20. Report File from Bulletin 17B Frequency Analysis.

CHAPTER 4

Using the HEC-SSP Data Importer

The HEC-SSP Data Importer is used to import, enter, and view data and the corresponding metadata used in an HEC-SSP study. The current version of HEC-SSP can be used to import annual peak data (flow and stage) and data stored at regular intervals, like hourly flow data.

Contents

Developing a New Data Set

Before any analyses can be performed in HEC-SSP, the user must import or enter data into the study. Importing, entering, and viewing data is accomplished in the **Data Importer**. To open the data importer, go to the **Data** menu and select **New** from the list of options. This will bring up a data importer as shown in Figure 4-1.

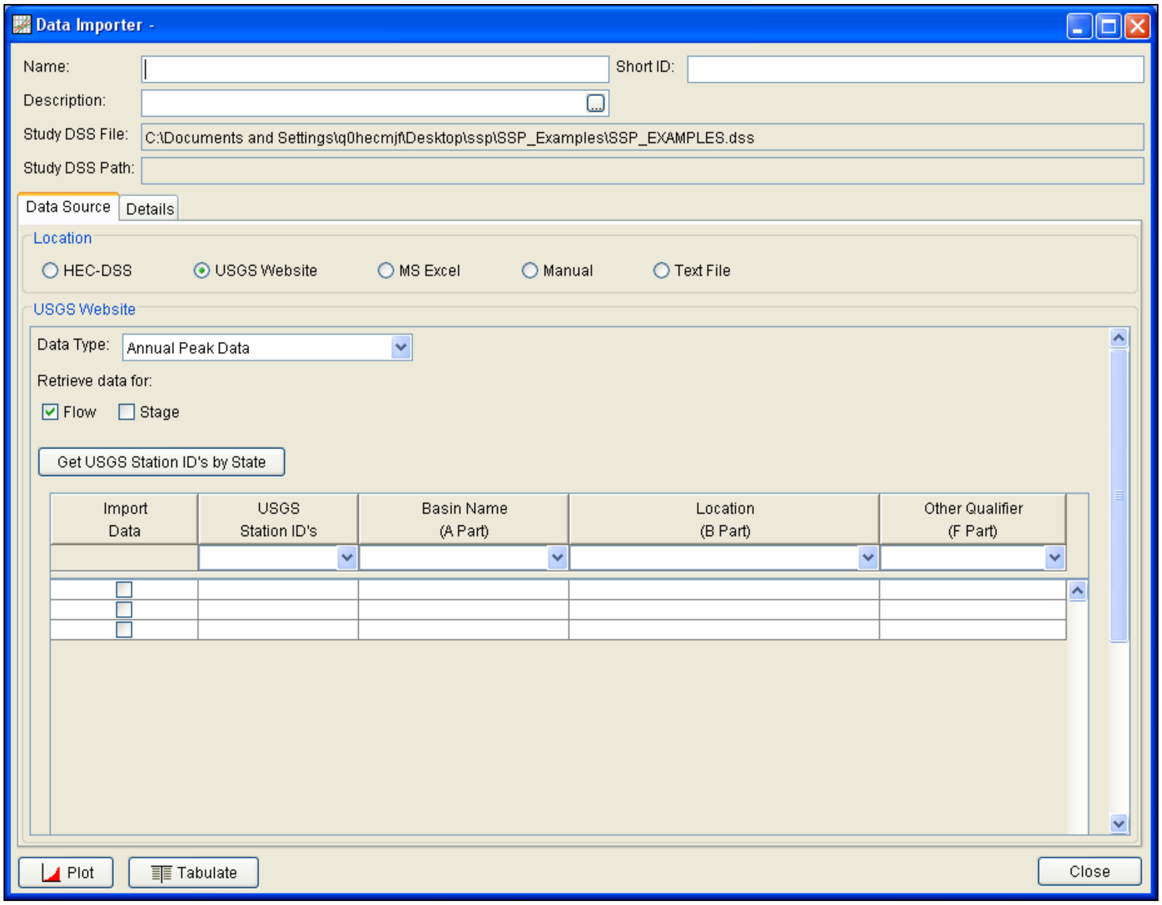


Figure 4-1. HEC-SSP Data Importer.

At the top of the Data Importer, the user can enter a **Name** for the new data set. Optionally, the user can enter a short identifier (limited to 16 characters) and a **Description** of the data set. The study DSS file name is provided. The DSS file is used for storing the data for the study. The user does not have to enter a name when importing or manually entering data. The program will automatically name the data using USGS names or HEC-DSS pathname parts. If a **Name** is entered then it will be combined with the USGS gage name or HEC-DSS pathname parts to create a unique name. The user can rename a data set by selecting the data set in the study explorer and clicking the right mouse button. A shortcut menu should open with a **Rename** menu option. The **Data** menu also contains a **Rename** menu option;

however, the data set must be selected in the study explorer before this menu option is active.

The Data Importer contains two main tabs, **Data Source** and **Details**. The **Data Source** tab is used for importing or entering data manually while the **Details** tab is used to describe the data (i.e. metadata). The **Data Source** tab contains five options for getting data into the study DSS file: Importing from an existing HEC-DSS file, importing from the USGS Website, importing from an Excel spreadsheet, entering the data manually, and importing from a text file.

Importing Data from an HEC-DSS File

To import data from an HEC-DSS file into the HEC-SSP study DSS file, first select the **HEC-DSS** radio button on the data importer. Selecting **HEC-DSS** will change the view of the Data Importer to look like Figure 4-2.

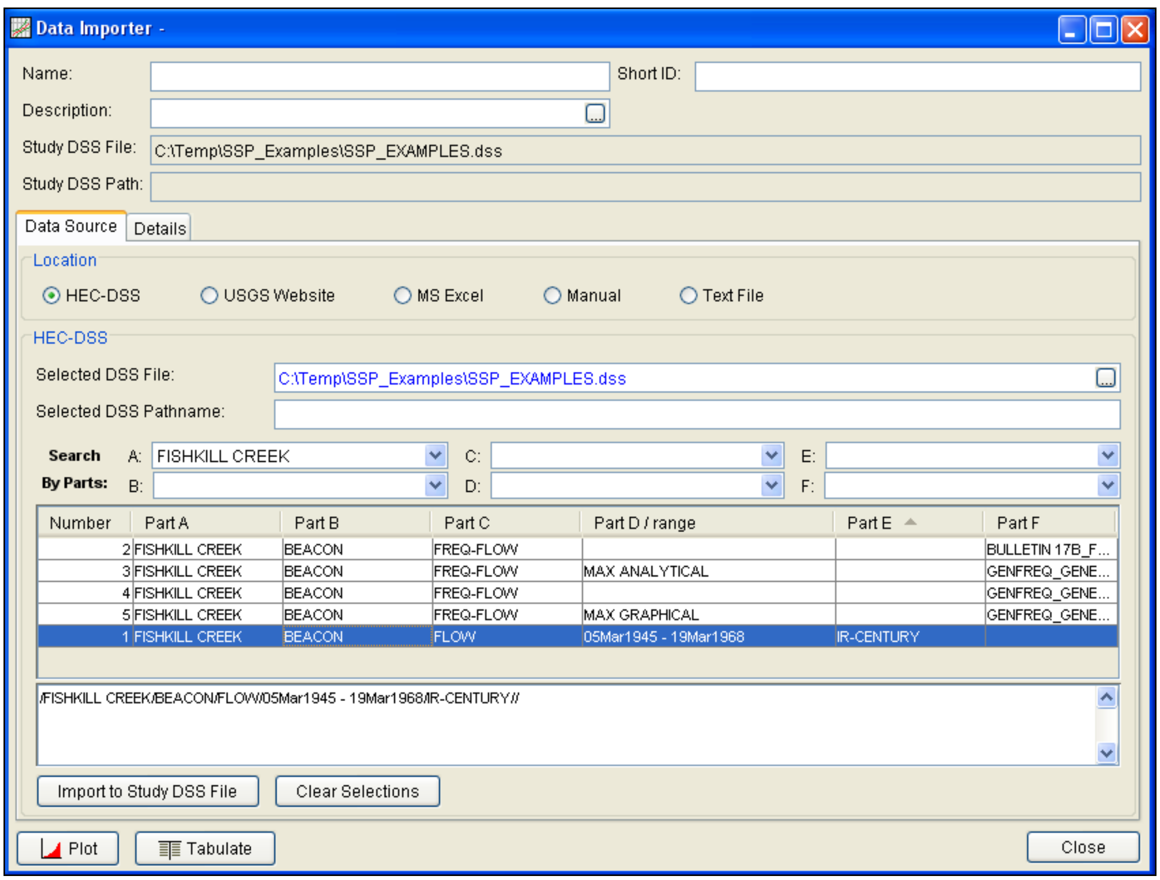


Figure 4-2. Data Importer with HEC-DSS Import Option.

As shown in Figure 4-2, the user first selects a DSS file to import from by typing the path and name or by choosing the file browser at the end of the input field. Once a DSS file is selected, the table of pathnames will be filled with the records that are contained in that DSS file. The user can reduce the number of listed pathnames by selecting pathname parts to filter in the pathname part selection area just above the table. Any pathname part can be used to filter the list down to a more manageable number of pathnames to select from. The user can then select pathnames to import by double clicking on one or more of the listed pathnames in the table. Each selected pathname will show up in the list below the table. Once the user has selected all of the pathnames that they want to import, pressing the **Import to Study DSS File** button enacts the import process. An HEC-SSP data set will be developed for each pathname that was selected.

Importing Data from the USGS Website

The second way to import data into HEC-SSP is to use the **USGS Website** option. When this option is selected, the data importer will look like Figure 4-3.

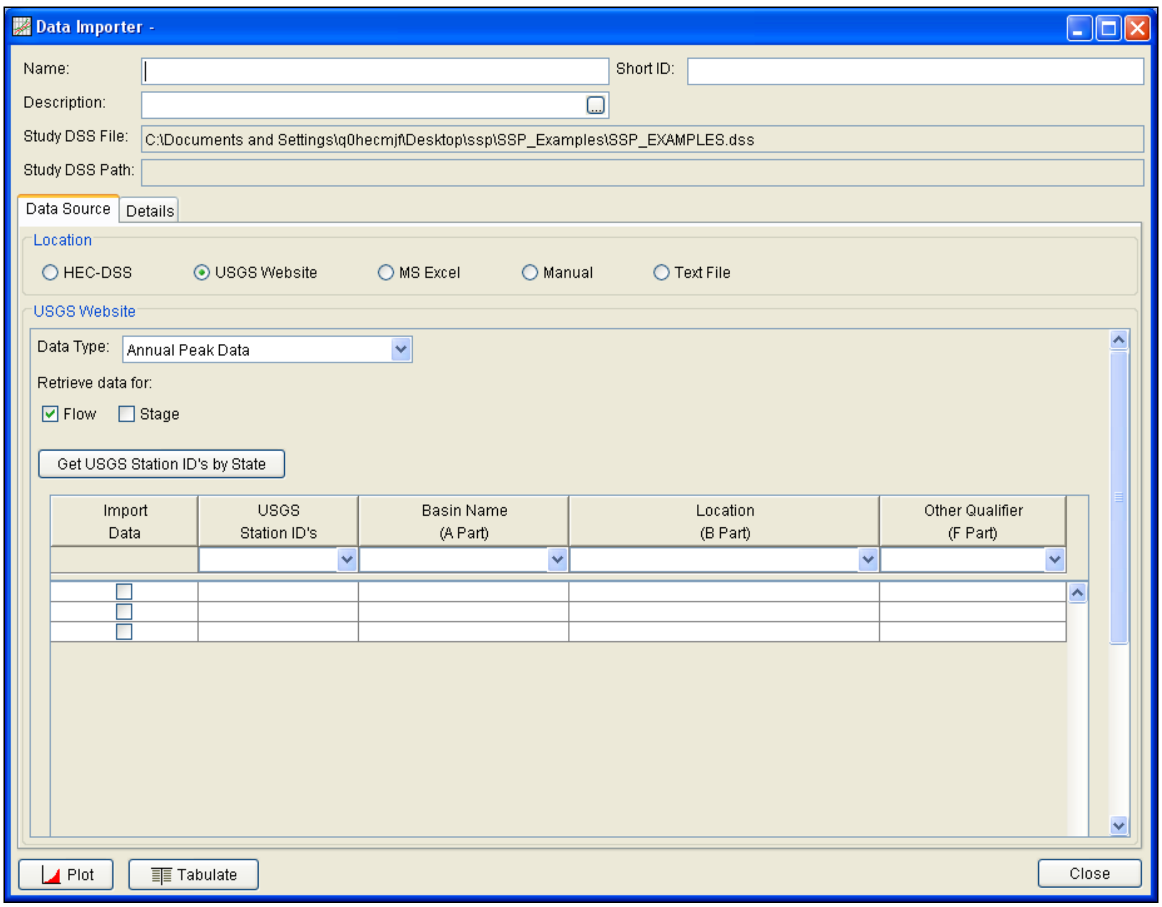


Figure 4-3. HEC-SSP Data Importer with USGS Website Import Option.

The first step in using the USGS import option is to select a data type to import (e.g. Annual Peak Data). Then choose to import **Flow** and/or **Stage** data. Next the user should select the **Get USGS Station ID's by State** button. Selecting this button will bring up a small window that allows the user to select a state in which to acquire data, as shown in Figure 4-4.

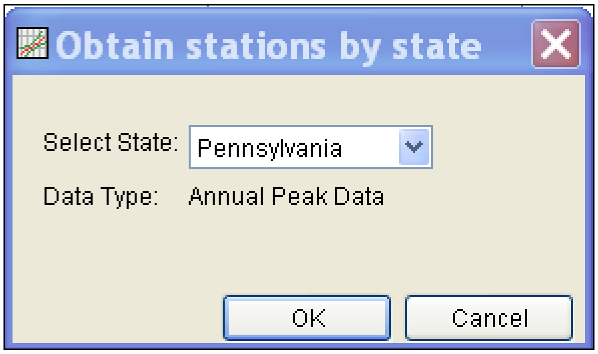


Figure 4-4. Window to Select a State for Importing USGS Data.

Once the user selects a state and presses the **OK** button, a process will begin in which all of the gage locations for that state will be downloaded from the USGS website. A listing of all the gages for that state will then be displayed in the table at the bottom of the data importer. An example of the data importer with a list of USGS gages is shown in Figure 4-5.

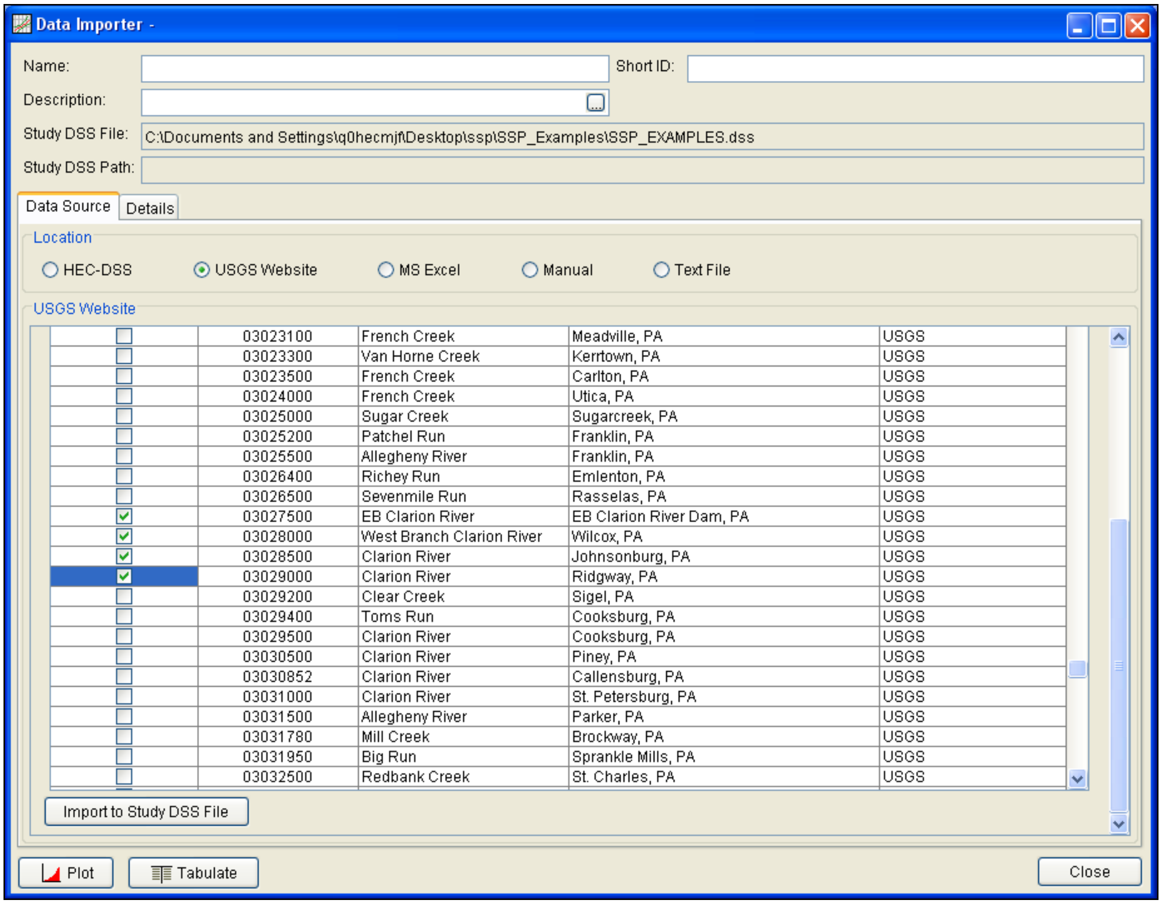


Figure 4-5. Data Importer with USGS Gages Listed in Table.

The next step is to select the desired gages for importing into the HEC-SSP study. The user can filter the list to a smaller number of gages by using the filter drop down boxes at the top of the table. To select a gage for importing, simply check the box in the left hand column for each gage location that is to be imported. After all of the desired locations are selected, press the **Import to DSS File** button to import the data into the study DSS file. Pressing this button will start a process of downloading data from the USGS website. For each selected location, the software will download the Data Quality Codes if they are available. The program issues a message that data quality codes are available and adds the codes as an additional data set to the Data folder. For an explanation of the codes, please visit the USGS website.

Warning: all data downloaded from the USGS website should be reviewed to ensure it is appropriate before any analyses are performed on the data. Some data stored on the USGS website are estimated, not measured. The user should check the data on the USGS website and be aware of the quality of all the data before using it. HEC-SSP will import the annual peak flow and stage quality codes (the program does not import quality codes for daily, instantaneous, and real time data). A description of the quality codes for annual peak flows is contained in Table 4-1 and a description of the quality codes for annual peak stages is contained in Table 4-2.

Table 4-1. Quality Codes for USGS Annual Peak Flow Data.

Code	Description
1	Discharge is a Maximum Daily Average
2	Discharge is an Estimate
3	Discharge affected by Dam Failure
4	Discharge less than indicated value which is Minimum Recordable Discharge at this site
5	Discharge affected to unknown degree by Regulation or Diversion
6	Discharge affected by Regulation or Diversion
7	Discharge is an Historic Peak
8	Discharge actually greater than indicated value
9	Discharge due to Snowmelt, Hurricane, Ice-Jam or Debris Dam breakup
A	Year of occurrence is unknown or not exact
B	Month or Day of occurrence is unknown or not exact
C	All or part of the record affected by Urbanization, Mining, Agricultural changes, Channelization, or other
D	Base Discharge changed during this year
E	Only Annual Maximum Peak available for this year

Table 4-2. Quality Codes for USGS Annual Peak Stage Data.

Code	Description
1	Gage height affected by backwater
2	Gage height not the maximum for the year
3	Gage height at different site and(or) datum
4	Gage height below minimum recordable elevation
5	Gage height is an estimate
6	Gage datum changed during this year

Importing Data from an Excel Spreadsheet

The third option for importing data into HEC-SSP is **MS Excel**. When this option is selected, the data importer will change as shown in Figure 4-6. The first step in importing data from an Excel spreadsheet is to select browse button, ..., at the end of the **Excel File** field. Once an Excel file is selected, a data view window will open showing the data contained in the selected spreadsheet. An example Excel® Data Viewer is shown in Figure 4-7.

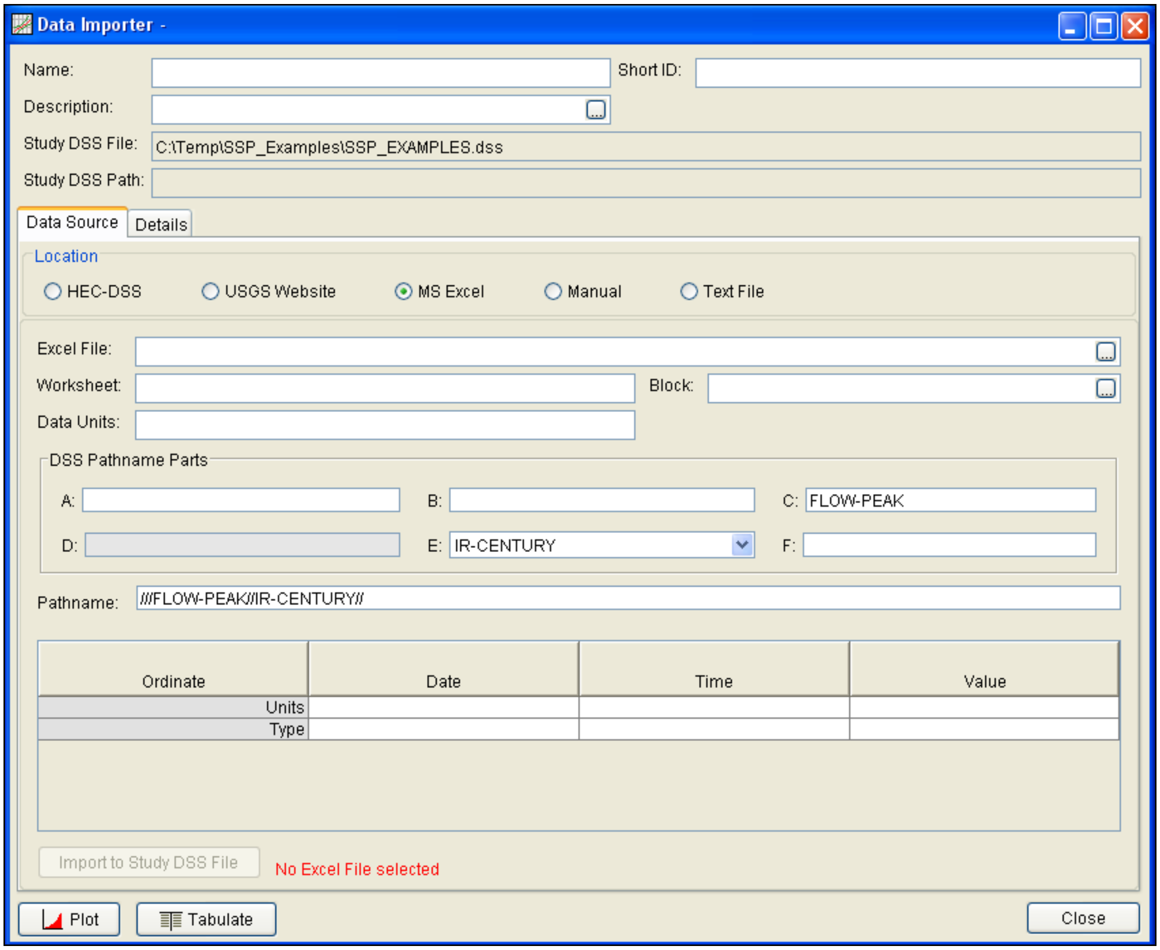


Figure 4-6. Data Importer with MS Excel Import Option Selected.

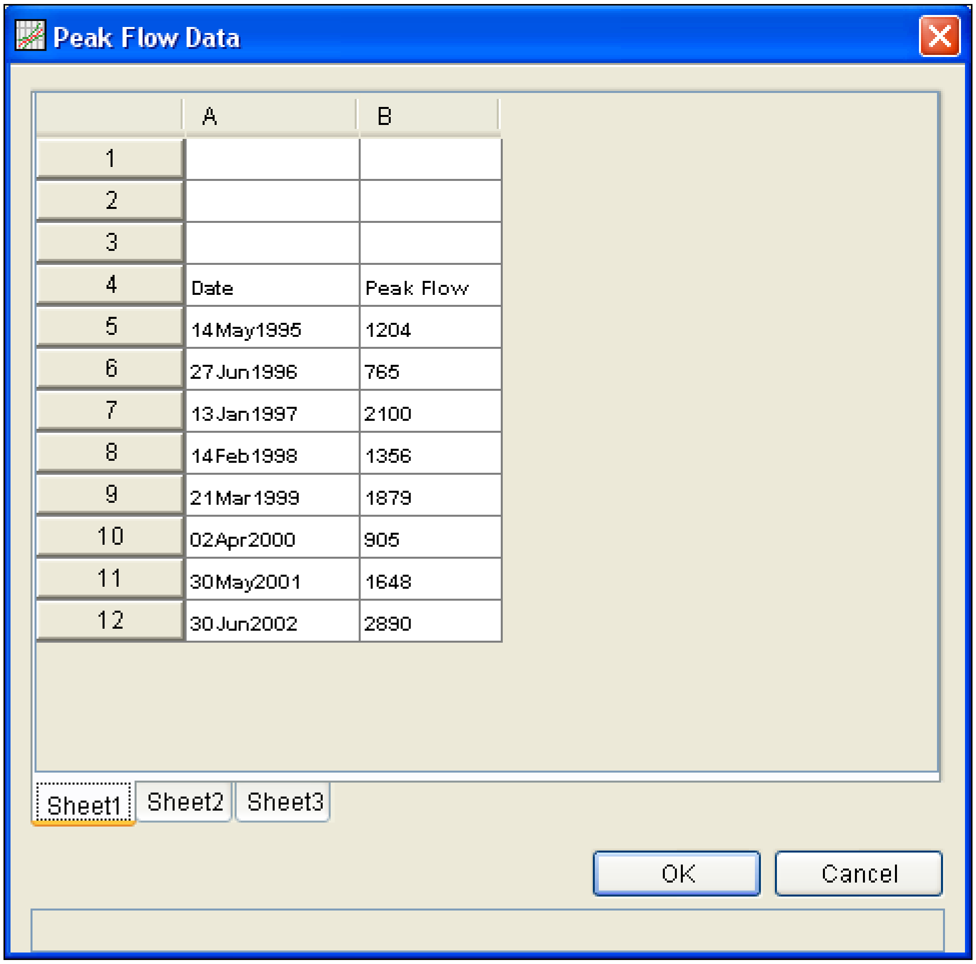


Figure 4-7. Example Excel Data Viewer.

The next step is to highlight the date and data values to be imported into the study (only highlight the data, not the column headings). The data must be in a format of Date in the first column and Data in the second column. The date must be in the Day, Month, Year format (ddmmyyyy) as shown in Figure 4-7. Next, press the **OK** button and the data will be placed in the table at the bottom of the editor. The last step before importing the data is to specify the units of the data, and each of the pathname parts for storing the data in the study DSS file (make sure to edit the C-part pathname if data is not annual peaks). Enter units of **cfs** for data in cubic feet per second or units of **cms** for data in cubic meters per second. The final step is to press the **Import to Study DSS File** button, and the data will be imported.

Entering Data Manually

Another option for getting data into the study is to enter the data manually. When the **Manual** option is selected, the window will change to what is shown in Figure 4-8.

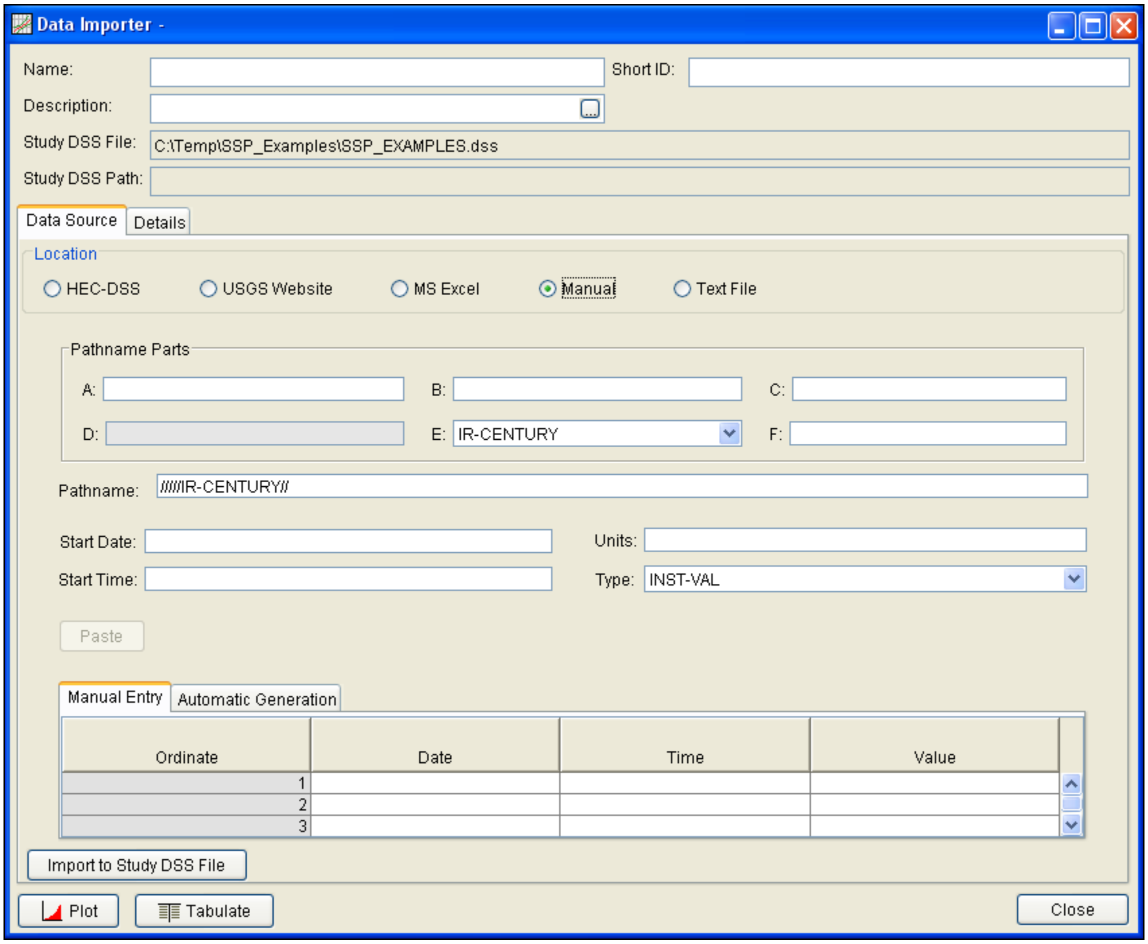


Figure 4-8. Data Importer with Manual Data Entry Option Selected.

To enter data manually, the user enters a name for the data set at the top, along with a short identifier and a description (optional). A starting date and time must be entered. The units of the data must also be defined as well as the data type. The last step before entering the data is to specify the pathname parts for how the data will be stored into the study DSS file. This requires the user to enter a label for the A, B, C, E, and F part of the DSS pathname. Once all of the data labeling is completed, the data can be entered into the table at the bottom of the editor. The user must enter the **Date**, **Time**, and data **Value** for each peak flow value to be entered. After a Date, Time, and Value are entered into a row, a new row will be generated in the table when the user leaves the Value field. The date must be in the Day, Month, Year format (ddmmyyyy). Another option for getting data into the table is to copy it to the clipboard and then paste it into the table. The table supports pasting data one column at a time or you can paste the date, time, and value information all at once. When all of the data are entered into the table, the user presses the **Import to Study DSS File** button and the data will be stored in the study DSS file.

Importing Data from a Text File

The fifth option for importing data into HEC-SSP is a comma delimited **Text File**. When this option is selected, the data importer will change as shown in Figure 4-9.

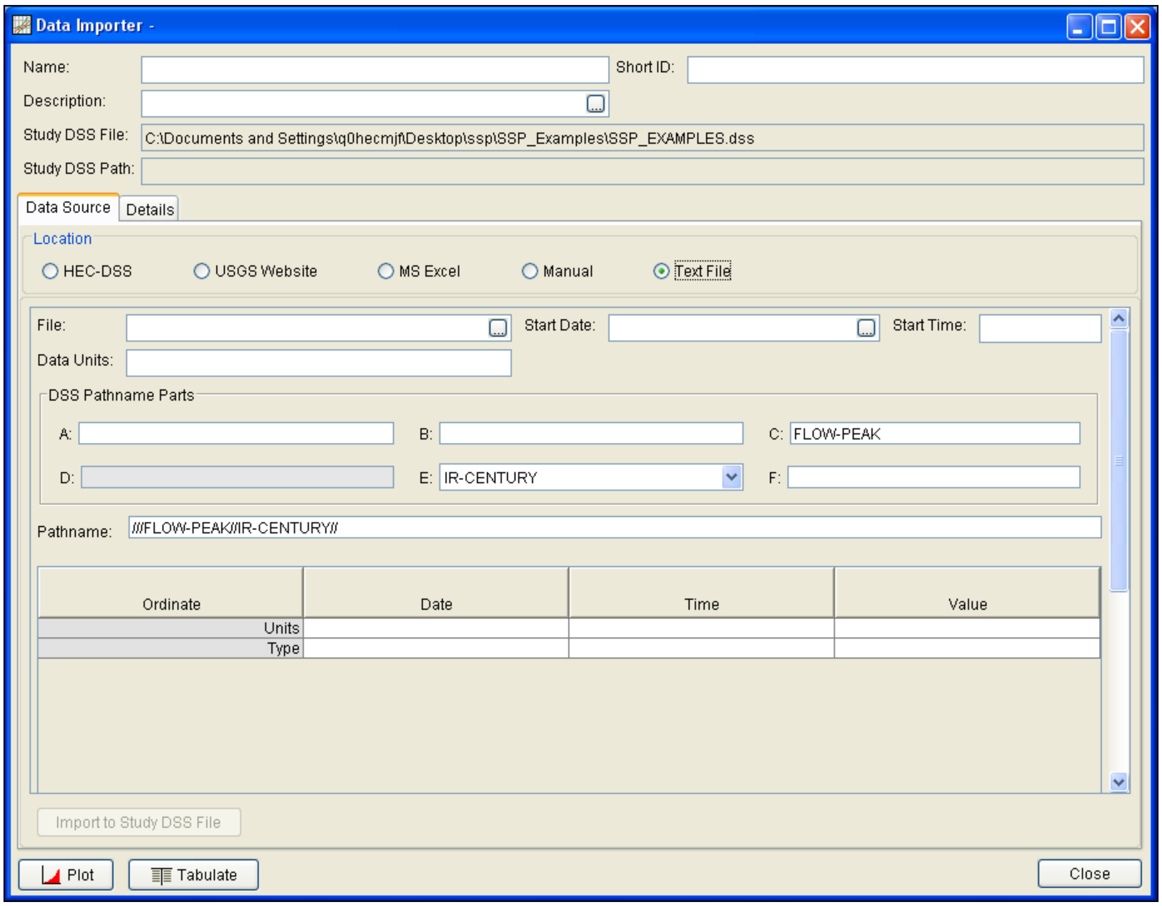


Figure 4-9. Data Importer with Text File Option Selected.

The first step in importing data from a comma delimited Text File is to press the Select File, , button at the end of the **File** field. Once a comma delimited text file is selected, a data view window will open showing the data contained in the selected file. An example text file data viewer is shown in Figure 4-10.

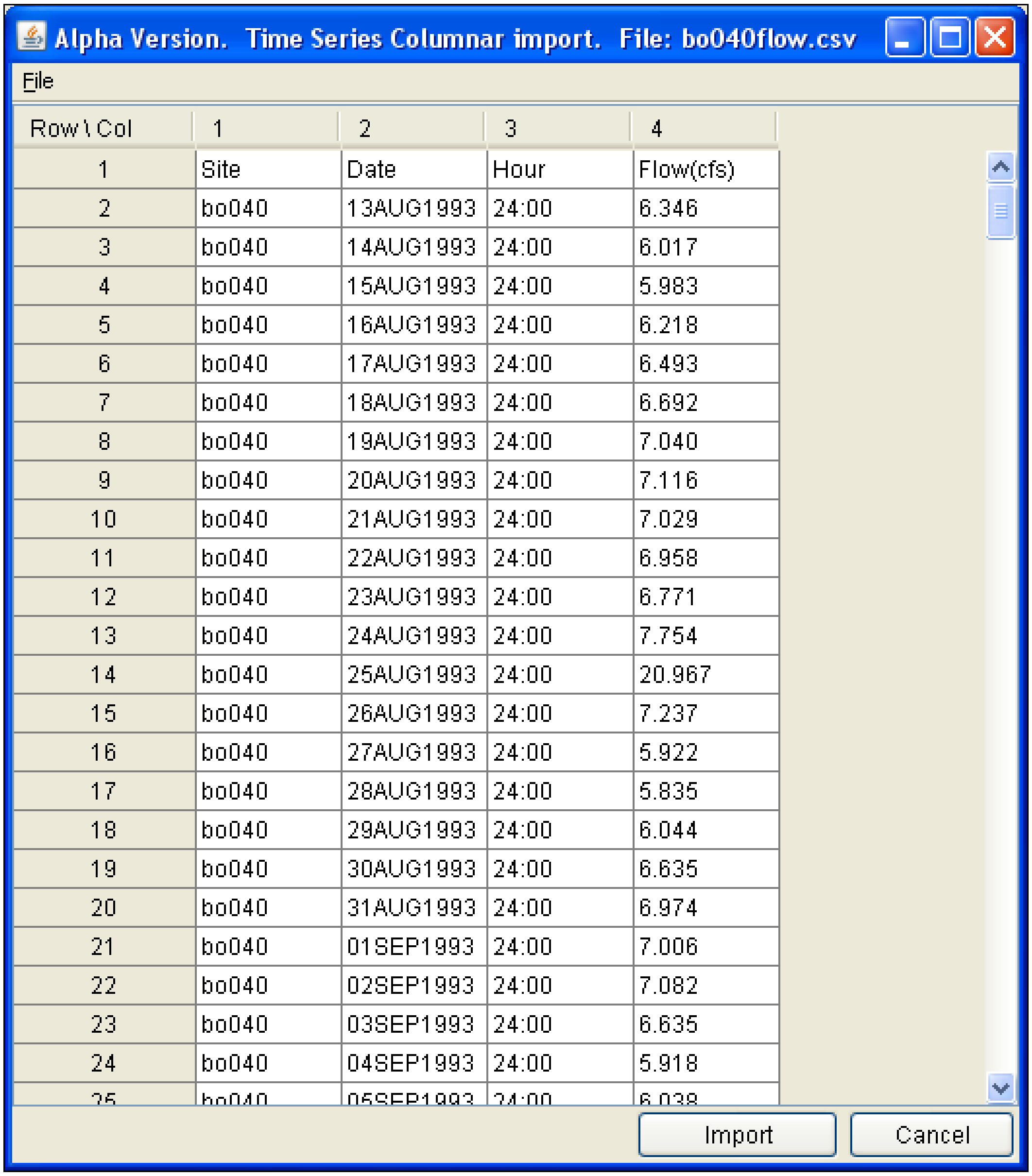
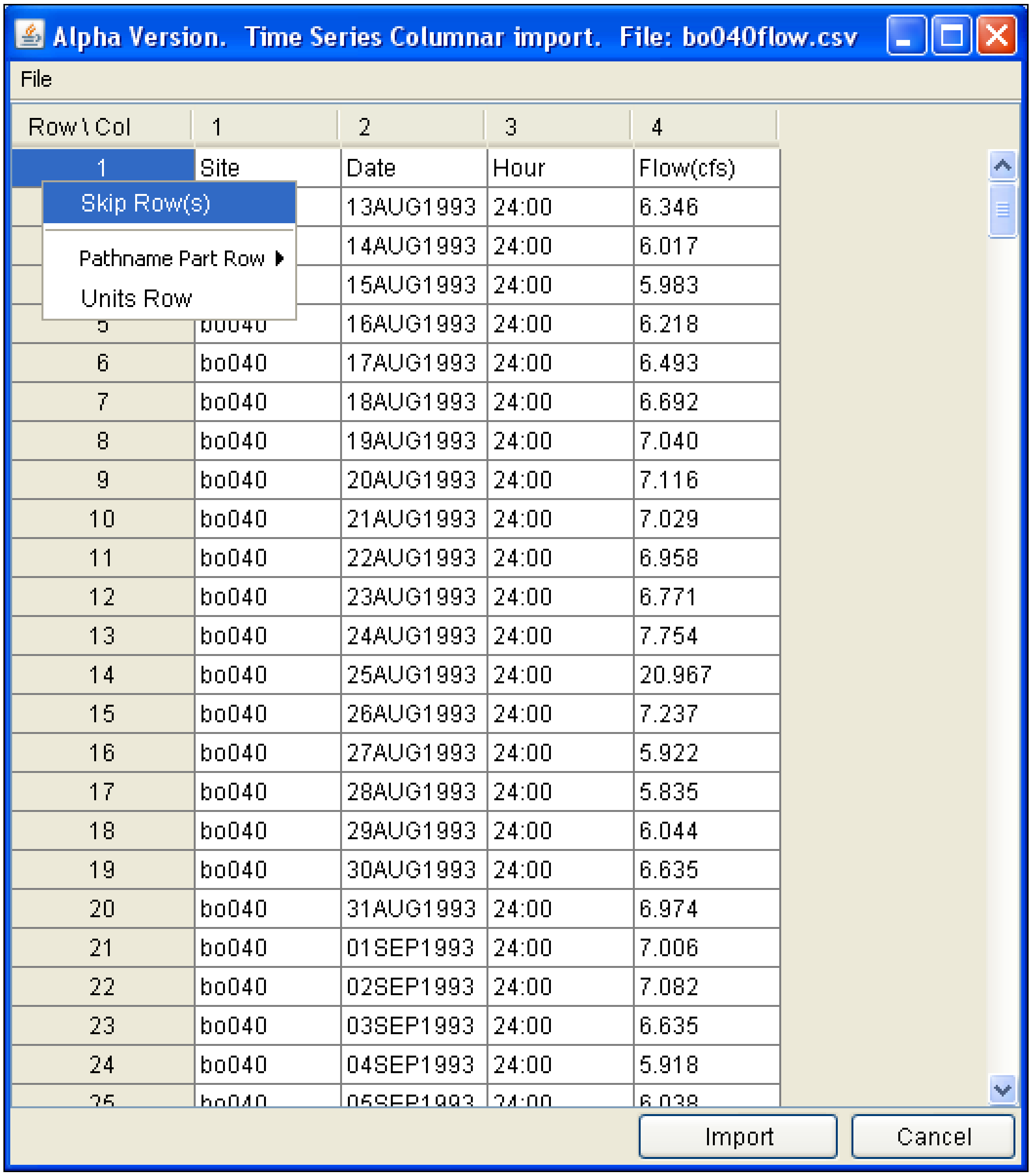


Figure 4-10. Example Text File Data Viewer.

The next step is to highlight the date, time, and data columns. Only highlight the data that will be imported, not the column headings. If there are column headings then they need to be identified. To do this, select the row or rows that do not contain data to be imported. Then click the right mouse button and select the **Skip Row(s)** menu option, as shown in Figure 4-11.



Row \ Col	1	2	3	4
1	Site	Date	Hour	Flow(cfs)
[illegible]	[illegible]	13AUG1993	24:00	6.346
[illegible]	[illegible]	14AUG1993	24:00	6.017
[illegible]	[illegible]	15AUG1993	24:00	5.983
5	[illegible]	16AUG1993	24:00	6.218
6	bo040	17AUG1993	24:00	6.493
7	bo040	18AUG1993	24:00	6.692
8	bo040	19AUG1993	24:00	7.040
9	bo040	20AUG1993	24:00	7.116
10	bo040	21AUG1993	24:00	7.029
11	bo040	22AUG1993	24:00	6.958
12	bo040	23AUG1993	24:00	6.771
13	bo040	24AUG1993	24:00	7.754
14	bo040	25AUG1993	24:00	20.967
15	bo040	26AUG1993	24:00	7.237
16	bo040	27AUG1993	24:00	5.922
17	bo040	28AUG1993	24:00	5.835
18	bo040	29AUG1993	24:00	6.044
19	bo040	30AUG1993	24:00	6.635
20	bo040	31AUG1993	24:00	6.974
21	bo040	01SEP1993	24:00	7.006
22	bo040	02SEP1993	24:00	7.082
23	bo040	03SEP1993	24:00	6.635
24	bo040	04SEP1993	24:00	5.918

Figure 4-11. Identify Rows that do not Contain Data to be Imported.

To identify the date and time columns, place the mouse pointer on the column number at the top of the table and click the right mouse button. Then move the mouse pointer to the **Date – Time Column** option to see an additional menu of options, as shown in Figure 4-12. Figure 4-12 shows that column 2 will be defined as the date column. The date must be in the Day, Month, Year format (ddmmyyyy). The data viewer will highlight the date and time columns once they have been defined.

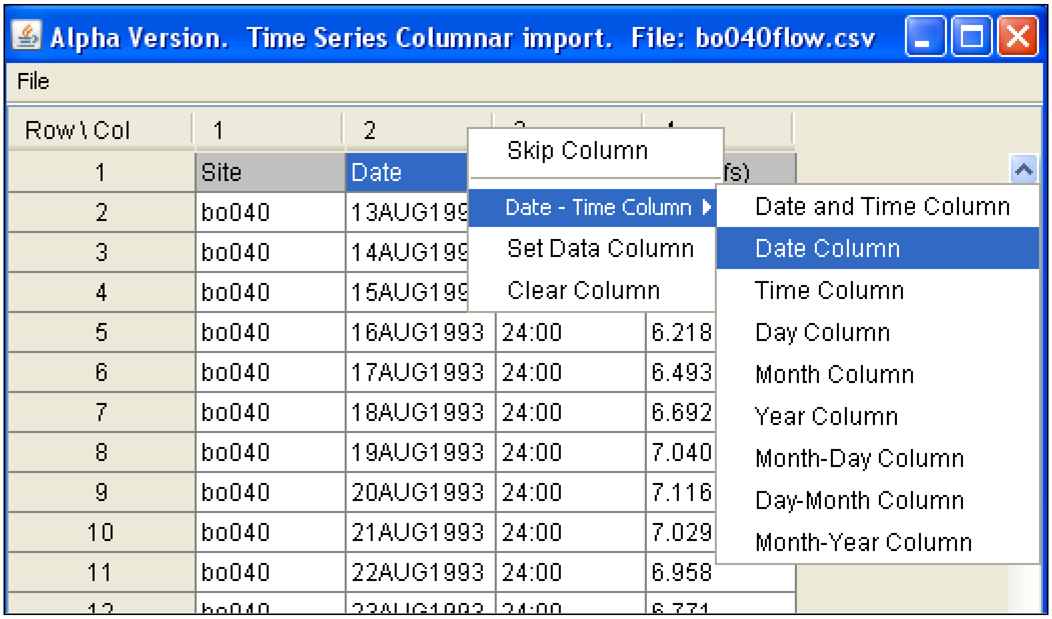


Figure 4-12. Identify Date and Time Columns.

To define the data column, place the mouse pointer on the column number at the top of the table and click the right mouse button. Then choose the **Set Data Column** menu option from the shortcut menu. Another editor will open, as shown in Figure 4-13, that allows the user to define the pathname parts, data units, and data type. After defining these data properties, click the **Import Now** button to import the data and data properties into the Data Importer. You can edit the data values or data properties in the data importer before importing the data to the study. The final step is to press the **Import to Study DSS File** button, and the data will be imported.

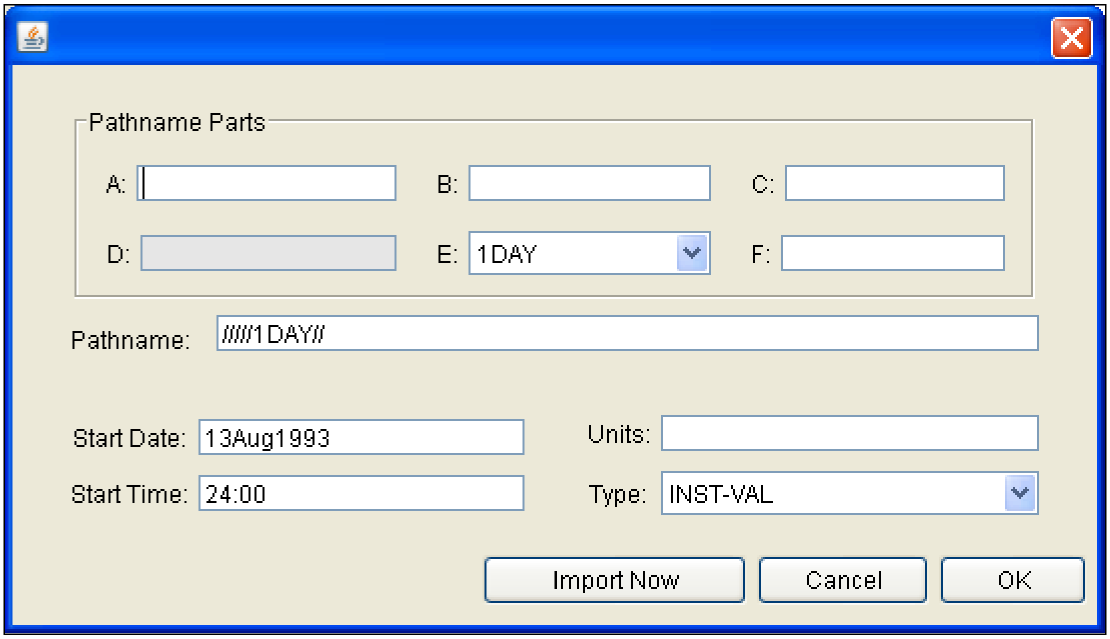


Figure 4-13. Editor for Defining the Data Properties.

Metadata

When downloading data from the USGS website, in addition to the raw data, the software will also attempt to download any metadata available for each gage location. When using one of the other four methods for importing data, the user can manually enter metadata by selecting the **Details** tab, as shown in Figure 4-14. The metadata consists of the State, County, Stream, Location, Drainage Area, DA Units, Gage Operator, USGS Gage No., Gage Datum, HUC (Hydrologic Unit Code), Vertical Datum, and a description field. Additionally, the coordinate location of the data is shown. The coordinate location consists of Coordinate System, Coordinate ID, Horizontal Datum, Datum Units, Coordinate X Value, and Coordinate Y Value. If coordinate system data are entered, data icons and text labels will show up on the background map at the specified locations.

Metadata can be viewed and edited any time after the data has been imported into the study by opening the **Metadata Editor**. To open the Metadata Editor, place the mouse pointer on top of a data set in the Data folder and then click the right mouse button. Choose the **Edit Metadata** option from the shortcut menu, as shown in Figure 4-15. The Metadata Editor will look exactly like the Details tab on the Data Importer. The Metadata Editor can also be opened from the Data menu and from a shortcut menu that opens by right clicking on a data icon in a background map.

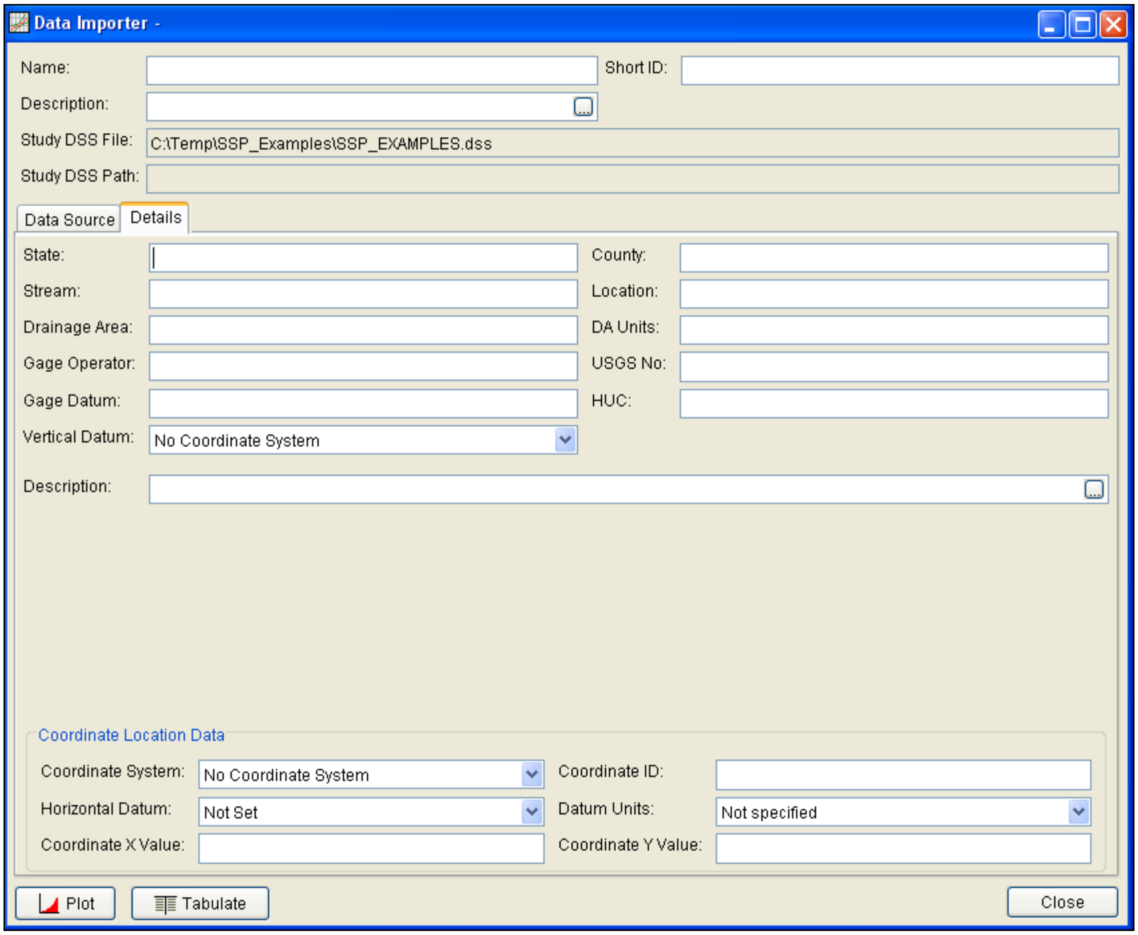


Figure 4-14. Details Tab on the HEC-SSP Data Importer.

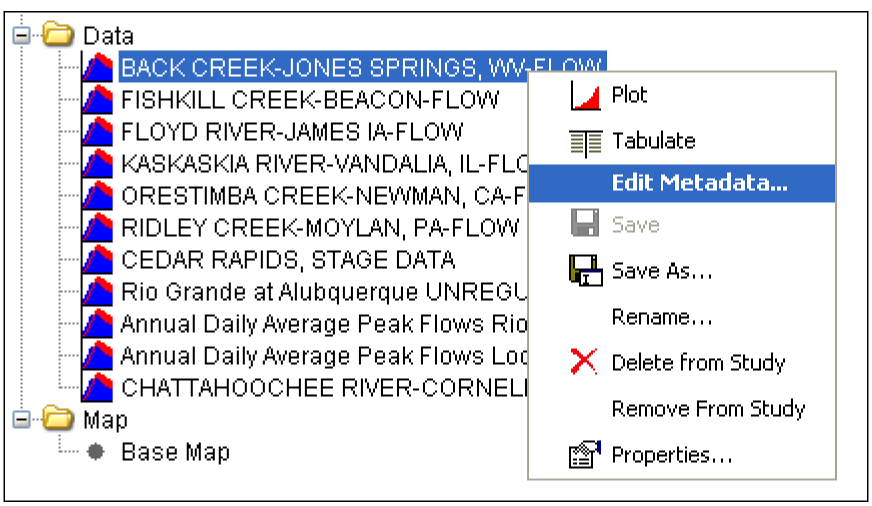


Figure 4-15. Menu Option for Opening the Metadata Editor.

Plotting and Tabulating the Data

After the data is imported into the study, the user can select any one of the data sets in the study explorer. A shortcut menu will open when clicking the right mouse button while a data set is selected. The shortcut menu contains options to change the name, plot, and tabulate the data. These options are also available from the Data menu; however, the data must be selected in the study explorer before these options are available. If you select the **Plot** option, you will get a plot similar to the one shown in Figure 4-16.

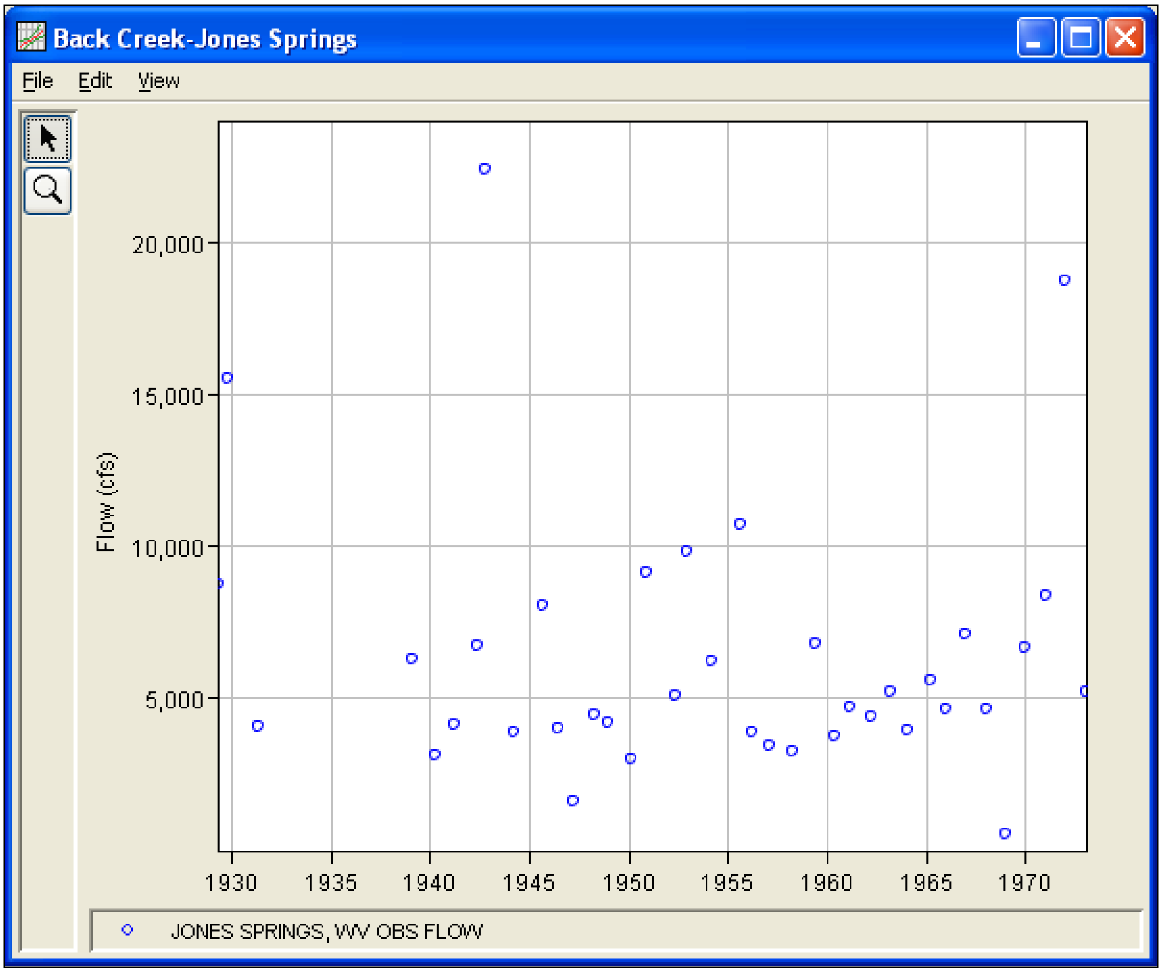
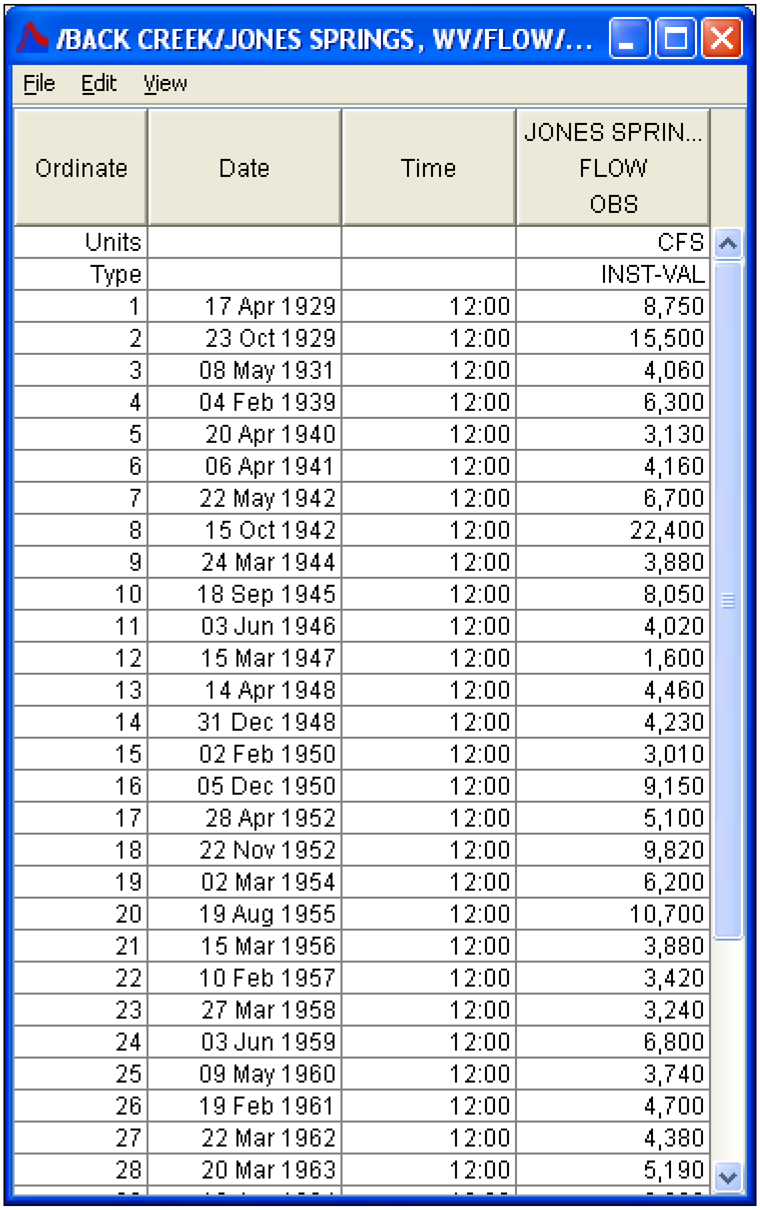


Figure 4-16. Plot of Peak Annual Flow Data.

If you select the **Tabulate** option, a table will open with the data listed as shown in Figure 4-17. Data values in the table can be edited after selecting the **Edit→Allow Editing** menu option. To save any edits, select the **File→Save** menu option.


/BACK CREEK/JONES SPRINGS, WV/FLOW/...

File Edit View

Ordinate	Date	Time	JONES SPRIN... FLOW OBS
Units			CFS
Type			INST-VAL
1	17 Apr 1929	12:00	8,750
2	23 Oct 1929	12:00	15,500
3	08 May 1931	12:00	4,060
4	04 Feb 1939	12:00	6,300
5	20 Apr 1940	12:00	3,130
6	06 Apr 1941	12:00	4,160
7	22 May 1942	12:00	6,700
8	15 Oct 1942	12:00	22,400
9	24 Mar 1944	12:00	3,880
10	18 Sep 1945	12:00	8,050
11	03 Jun 1946	12:00	4,020
12	15 Mar 1947	12:00	1,600
13	14 Apr 1948	12:00	4,460
14	31 Dec 1948	12:00	4,230
15	02 Feb 1950	12:00	3,010
16	05 Dec 1950	12:00	9,150
17	28 Apr 1952	12:00	5,100
18	22 Nov 1952	12:00	9,820
19	02 Mar 1954	12:00	6,200
20	19 Aug 1955	12:00	10,700
21	15 Mar 1956	12:00	3,880
22	10 Feb 1957	12:00	3,420
23	27 Mar 1958	12:00	3,240
24	03 Jun 1959	12:00	6,800
25	09 May 1960	12:00	3,740
26	19 Feb 1961	12:00	4,700
27	22 Mar 1962	12:00	4,380
28	20 Mar 1963	12:00	5,190

Figure 4-17. Table Containing Peak Annual Flow Data.

CHAPTER 5

Performing a Bulletin 17B Flow Frequency Analysis

The current version of HEC-SSP allows the user to perform flow frequency analyses based on Bulletin 17B, "Guidelines for Determining Flood Flow Frequency" (March 1982). This chapter discusses in detail how to perform a Bulletin 17B Flow Frequency Analysis in HEC-SSP.

Contents

Starting a New Analysis

A flow frequency analysis can be started in two ways within the software, either by right clicking on the Bulletin 17B folder in the study explorer and selecting **New**, or by going to the **Analysis** menu and selecting **New** and then **Bulletin 17B Flow Frequency**. When a new flow frequency analysis is selected, the Bulletin 17B Editor will appear as shown in Figure 5-1.

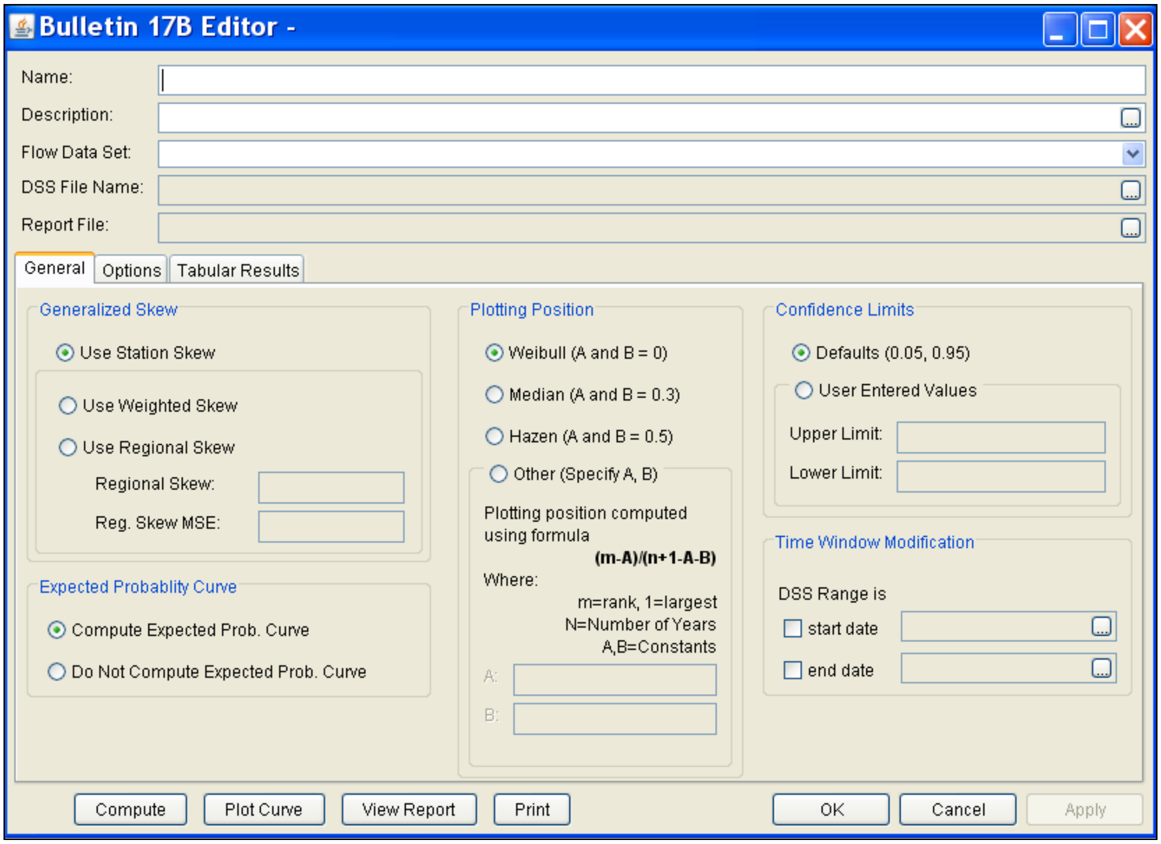


Figure 5-1. Bulletin 17B Flow Frequency Analysis Editor.

The user is required to enter a **Name** for the analysis, while a **Description** is optional. An annual peak flow data set must be selected from the available data sets stored in the current study DSS file (see chapter 4 for importing data into the study). The list of data that can be selected for a Bulletin 17B analysis will only include those data that have an irregular interval, like IR-CENTURY and IR-YEAR (E-part pathname). Once a Name is entered, and a flow data set is selected, the **DSS File Name** and **Report File** will automatically be populated. The DSS filename is by default the study DSS file. The report file is given the same name as the analysis with the extension ".rpt".

General Settings, Options, and Computations

Once the analysis name and flow data set are selected, the user can begin setting up the analysis. Three tabs are contained on the Bulletin 17B editor. The tabs are labeled **General**, **Options**, and **Tabular Results**.

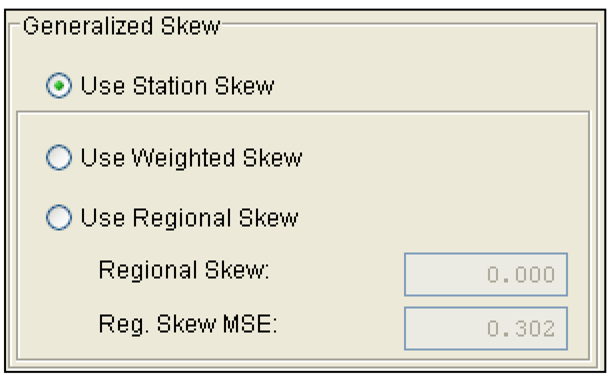
General Settings

The first tab contains general settings for performing the flow frequency analysis (Figure 5-1). These settings include:

- Generalized Skew
- Expected Probability Curve
- Plotting Positions
- Confidence Limits
- Time Window Modification

Generalized Skew

There are three options contained within the generalized skew setting: Use Station Skew, Use Weighted Skew, and Use Regional Skew. The default skew setting is **Use Station Skew**. With this setting, the skew of the computed curve will be based solely on computing a skew from the data points contained in the data set. No weighting will be performed to compute the final skew.

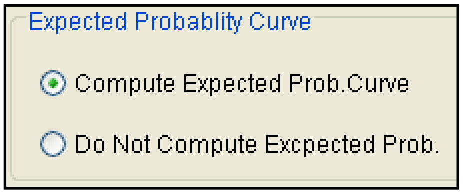


The **Use Weighted Skew** option requires the user to enter a generalized regional skew and a Mean-Square Error (MSE) of the generalized regional skew. This option weights the computed station skew with the generalized regional skew. The equation for performing this weighting can be found in Bulletin 17B (equation 6). If a regional skew is taken from Plate I of Bulletin 17B (the skew map of the United States), the value of MSE = 0.302.

The last generalized skew option is **Use Regional Skew**. When this option is selected, the user must enter a generalized regional skew and an MSE for that skew. The program will ignore the computed station skew and use only the generalized regional skew.

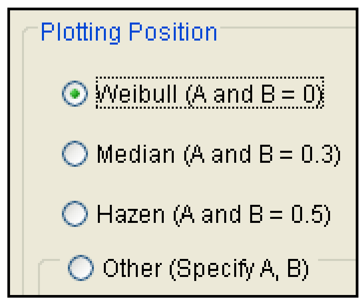
Expected Probability Curve

This setting has two options: compute the expected probability curve and do not compute the expected probability curve. The default setting is to have the expected probability curve computed. When computed, this curve will be shown in both the result tables and the plots as an additional curve to the computed curve. The expected probability adjustment is an attempt to correct for a certain bias in the frequency curve computation due to the shortness of the record. Please review the discussion in Bulletin 17B about the expected probability curve adjustment for an explanation of how and why it is computed. The use of the expected probability curve is a policy decision. It is most often used in establishing design flood criteria. The basic flood frequency curve without the expected probability curve adjustment is the curve used in computation of confidence limits, risk, and in obtaining weighted averages of independent estimates of flood frequency discharge (WRC, 1982).



Plotting Positions

Plotting positions are used for plotting the raw data points on the graph. There are four options for plotting position methodologies within HEC-SSP: Weibull, Median, Hazen, and user entered coefficients. The default method is the Median plotting position formula. The generalized plotting position equation is:



$$P = \frac{(m - A)}{(n + 1 - A - B)}$$

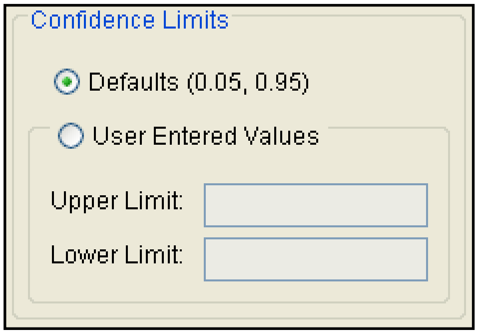
Where: m = rank of flood values with the largest equal to 1.

n = number of flood peaks in the data set.

A & B = constants dependent on which equation is used (Weibull A and B=0; Median A and B = 0.3; and Hazen A and B=0.5).

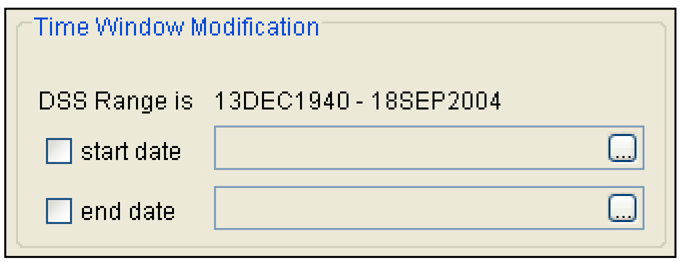
Plotting positions are estimates of the exceedance probability of each data point. Different methods can give very different values for the probabilities of the highest and lowest points in the data set. In the Bulletin 17B methodology, the plotting of data on the graph by a plotting position method is only done as a guide to assist in evaluating the computed curve. The plotting position method selected does not have any impact on the computed curve.

Confidence Limits



Confidence limits provide a measure of the uncertainty in the computed discharge for a given exceedance probability. The computation of confidence limits is outlined in Bulletin 17B, Appendix 9. By default, HEC-SSP calculates the 90 percent confidence interval (i.e. the 5% and 95% confidence limits). The confidence limits must be entered in decimal form (i.e. 95% = 0.95, and 5% = 0.05). The user has the option to override the default values and enter whatever values they would like for the confidence limits.

Time Window Modification



This option allows the user to narrow the time window used for the analysis. The default is to use all of the annual peak flow data contained in the selected data set. The user can enter either a start date for the analysis, and end date, or both a start and end date. If a start and/or end date are used, they must be dates that are encompassed within the data stored in the selected data set. The date range for the selected data set is shown in the editor just above the **Start Date** field.

Options

In addition to the general settings, there are also several options available to the user for modifying the computations of the frequency curves. These options include:

- Low Outlier Threshold
- Historic Period Data
- User-Specified Frequency Ordinates

When the Options tab is selected, the Bulletin 17B Editor will appear as shown in Figure 5-2.

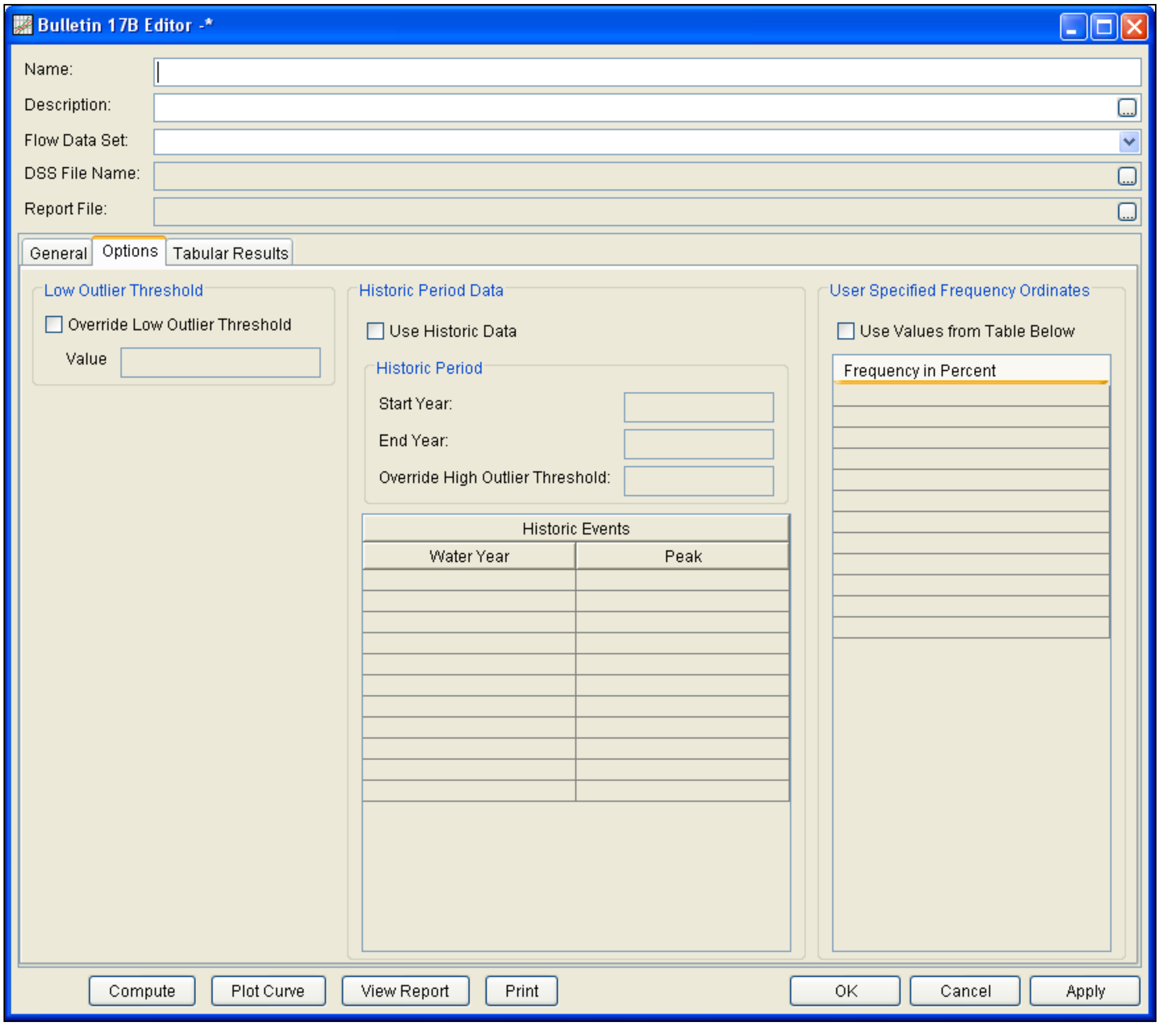
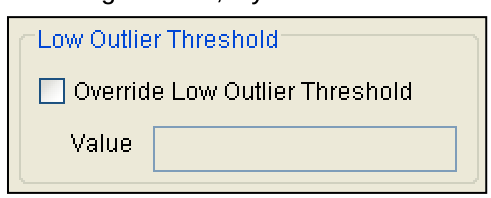


Figure 5-2. Bulletin 17B Editor with Options Tab Selected.

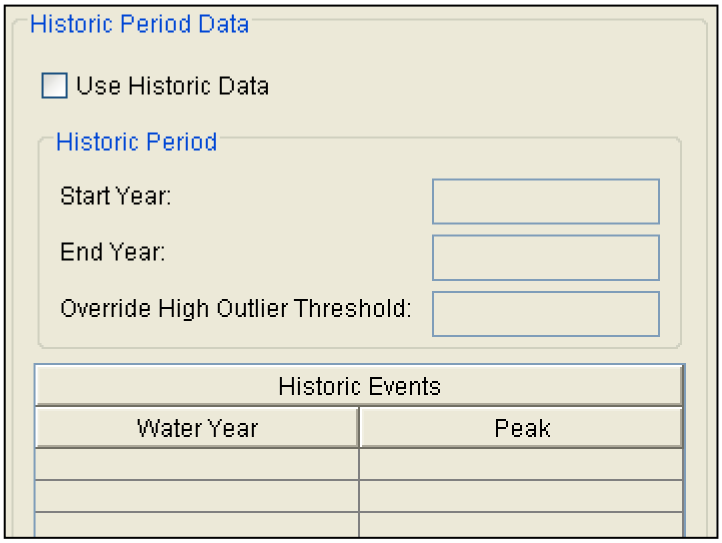
Low Outlier Threshold

High and low outlier tests are based on the procedures outlined in Bulletin 17B. The calculated outlier magnitudes, by the Bulletin 17B procedures, are used as default values for the high and low outlier thresholds in HEC-SSP. The user has the option to enter a different value for the low outlier threshold. If a value is entered for the low outlier threshold, then this value will override the computed value from Bulletin 17B procedure. When applying the outlier tests, HEC-SSP will identify both high and low outliers. However, only low outliers will be removed from the data set when performing the analysis. If a high outlier is identified in the data set, the analyst should try to incorporate historical period information to extend the time period for which the high outlier(s) is



considered to be the maximum value(s). Further discussion of outlier thresholds can be found in Bulletin 17B. To use the low outlier threshold, simply check the box and enter the value.

Historic Period Data

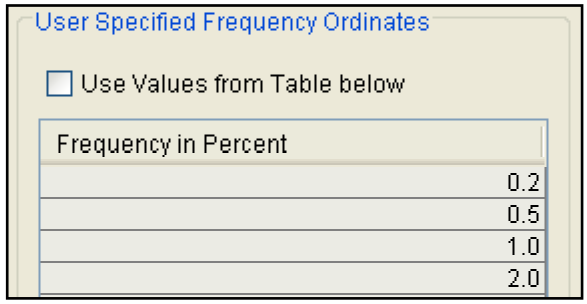


All historic data that provides reliable estimates of flood peaks outside the systematic record should be used in order to improve the frequency computations. Flood information outside of the systematic record can often be used to extend the record of the largest events to a historic period much longer than that of the systematic record. HEC-SSP uses historic data as recommended in Bulletin 17B. To use historic data in HEC-SSP, check the box labeled **Use Historic Data**. The user can enter a starting year for the historic period, ending year for a historic period, and a high threshold value. If the user enters a high threshold value, then any value in the systematic record greater than that value will also be treated as a historical flood peak. The user can also enter historic flood peaks that are not contained in the systematic record. This is done in the table at the bottom labeled **Historic Flood Peaks**. All years must be entered as water year values (October 1 through September 30). If a start year is not entered, then the assumed start year is the earliest year of the systematic record and any historical values that have been entered. If an end year is not entered, then the assumed end year is the latest year in the systematic record and any entered historic values. Further discussion of the use of historical data can be found in Bulletin 17B and the HEC-SSP Statistical Reference Guide.

Note: The program treats all data in the data set as systematic data. If historic events are included in the data set, then the user can define the analysis time window (General tab – Time Window Modification) so that it only bounds the systematic record. Then define the historic events in the Historic Events table. Instead of using the Time Window Modification option, another option is to enter a High Threshold value so that the historic data point(s) would be treated as historic data (rather than part of the systematic record). Please see test example 6 in Appendix B for an example of using the historic data adjustment.

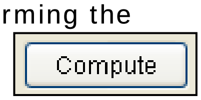
User Specified Frequency Ordinates

This option allows the user to change the frequency ordinates used in computing the resulting frequency curves and confidence limits. The default values listed in percent chance exceedance are 0.2, 0.5, 1, 2, 5, 10, 20, 50, 80, 90, 95, and 99. Check the box next to **Use Values from Table below** to change or add additional values. Once this box is checked, the user can add/remove rows and edit the frequency values. To add or remove a row from the table, select the row(s), place the mouse over the highlighted row(s) and click the right mouse button. The shortcut menu contains options to **Insert Row(s)** and **Delete Row(s)**. The program will use the default values, even if they are not contained in the table, when the **Use Values from Table below** option is not checked. Finally, all values in the table must be between 0 and 100.



Compute

Once the new analysis has been defined, and the user has all of the settings and options the way they want them, performing the computations is simply a matter of pressing the **Compute** button at the bottom of the Bulletin 17B Editor. If the computations are successful, the user will receive a message that says **Compute Complete**. At this point, the user can begin to review the results of the flow frequency analysis.



Multiple Bulletin 17B analyses can be computed using the **Compute Manager**. Select the **Analysis→Compute Manager** menu option to open the Compute Manager. Select the analyses to be computed and then press the **Compute** button. Close the compute dialogs and Compute Manager when the program finished computing the analyses.

Viewing and Printing Results

The user can view output from the flow frequency analysis directly from the Bulletin 17B Editor. The output consists of tabular results, a frequency curve plot, and a report documenting the data and computations performed.

Tabular Output

Once the computations for the flow frequency analysis are completed, the user can view tabular output by opening the **Tabular Results** tab. When this tab is pressed, the results will be displayed as shown in Figure 5-3.

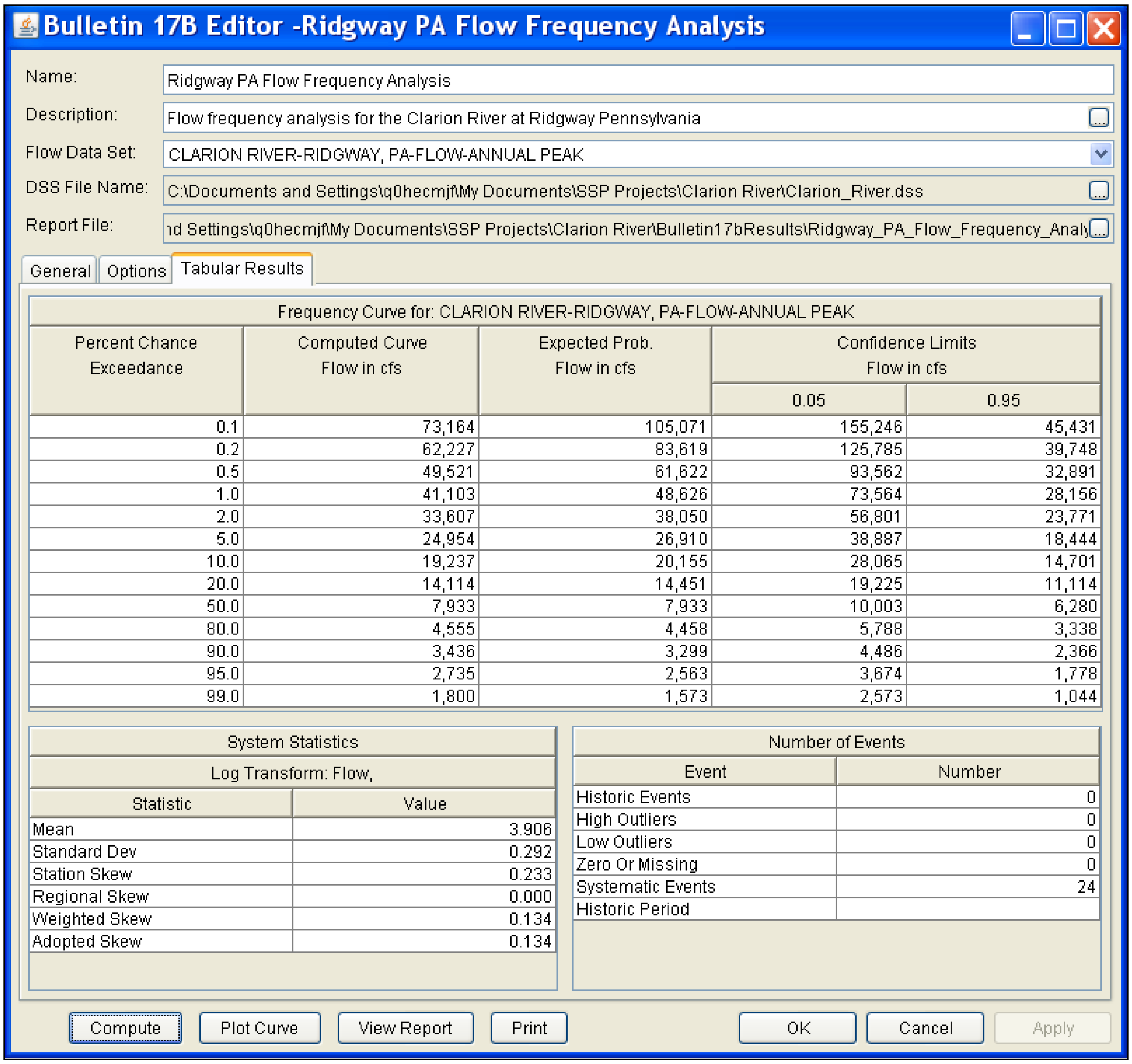


Figure 5-3. Bulletin 17B Editor with Tabular Results Tab Active.

Output on the results tab consists of three tables: Frequency Curves, System Statistics, and Number of Events. The **Frequency Curve** output table contains the percent chance of exceedance ordinates, the computed Log Pearson III frequency curve, the expected probability adjusted frequency curve, the 5% chance of exceedance confidence limit, and the 95% chance of exceedance confidence limit. Data in the frequency curve table can be re-sorted. Click the **Percent Chance Exceedance** column header (two mouse clicks are required the first time). The percent chance exceedance ordinates, along with frequency curve and confidence limits values, will sort so that the lowest values are on top or the highest values are on top. The **System Statistics** table contains the mean of the data in log space, standard deviation in log space, station skew, user entered regional skew, weighted skew (weighted between station skew and regional skew), and the adopted skew for the analysis. The **Number of Events** table tabulates the number of historic events, high outliers, low outliers, zero or missing values, systematic events, and the number of years in the historic period (this value only comes into play if the user entered historic data).

The tabular results can be printed by using the **Print** button at the bottom of the Bulletin 17B Editor. When the print button is pressed, a window will appear giving the user options for how they would like the table to be printed.

Graphical Output

Graphical output of the frequency curves can be obtained by pressing the **Plot Curve** button. When the Plot Curve button is pressed, a frequency curve plot will appear in a separate window as shown in Figure 5-4. The user can modify the plot properties by selecting the **Edit→Plot Properties** menu option. A plot properties window will open that lets the user change the line style for each data type, change the axis labels, modify the plot title, and edit other plot properties. The user can also edit line styles by placing the mouse on top of the line or data point in the plot or legend and clicking the right mouse button. Then select the **Edit Properties** menu option in the shortcut menu. Both the Y and X-axis properties can be edited by placing the mouse on top of axis and clicking the right mouse button. Then select the **Edit Properties** menu option in the shortcut menu. For example, the user can turn on minor tic marks for the y-axis and modify the minimum and maximum scale for the x-axis.

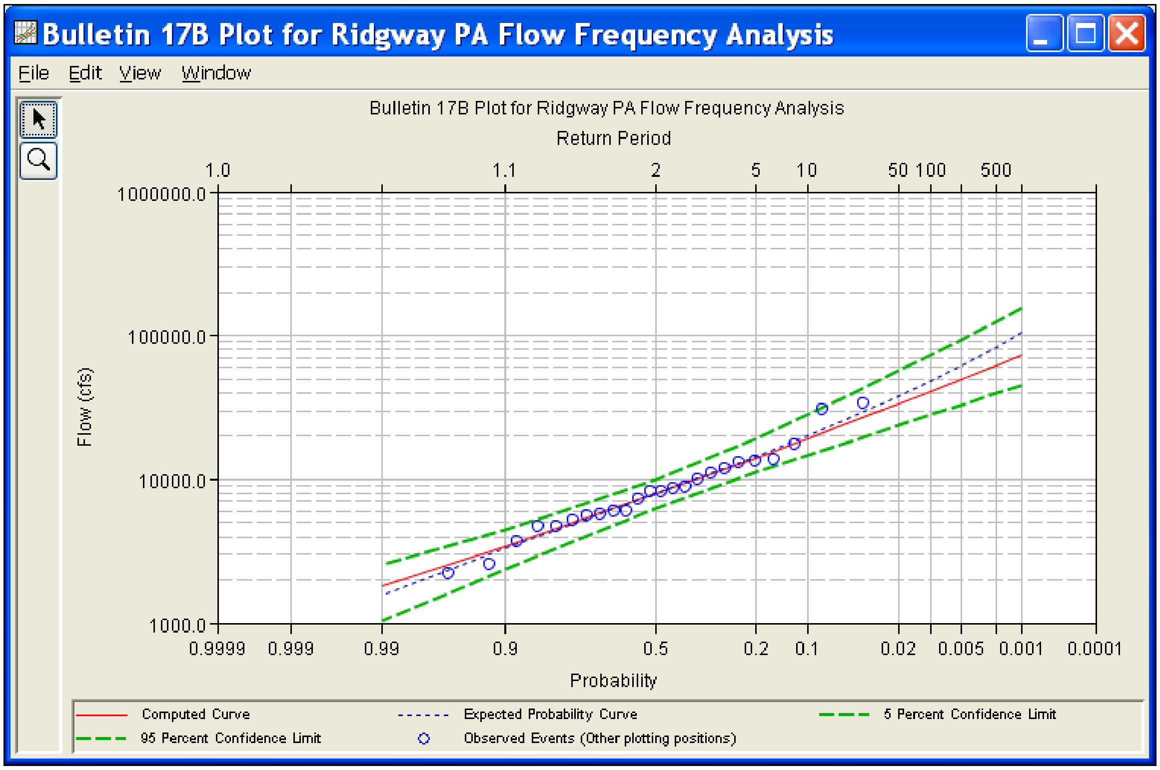


Figure 5-4. Example Frequency Curve Plot.

The frequency curve plot can be sent to the printer by selecting the **Print** option from the **File** menu at the top of the window. Additional printing options available from the File menu are Page Setup, Print Preview, and Print Multiple (used for printing multiple graphs on the same page). The graphic can also be sent to the Windows Clipboard by selecting **Copy to Clipboard** from the File menu. Additionally, the plot can be saved to a file by selecting the **Save As** option from the File menu. When the Save As option is selected, a window will appear allowing the user to select a directory, enter a filename, and select the format for saving the file. Currently, four file formats are available for saving the graphic to disk, windows metafile, postscript, JPEG, and portable network graphic.

The data contained within the plot can also be tabulated by selecting **Tabulate** from the **File** menu. When this option is selected, a separate window will appear with the data tabulated. Additional options are available from the File menu for saving the graphics options as a template (**Save Template)** and applying previously saved templates to the current graphic (**Apply Template**).

The **Edit** menu on the graphic window contains several options for customizing the graphic. These options include Plot Properties, Configure Plot Layout, Default Line Styles, and Default Plot Properties.

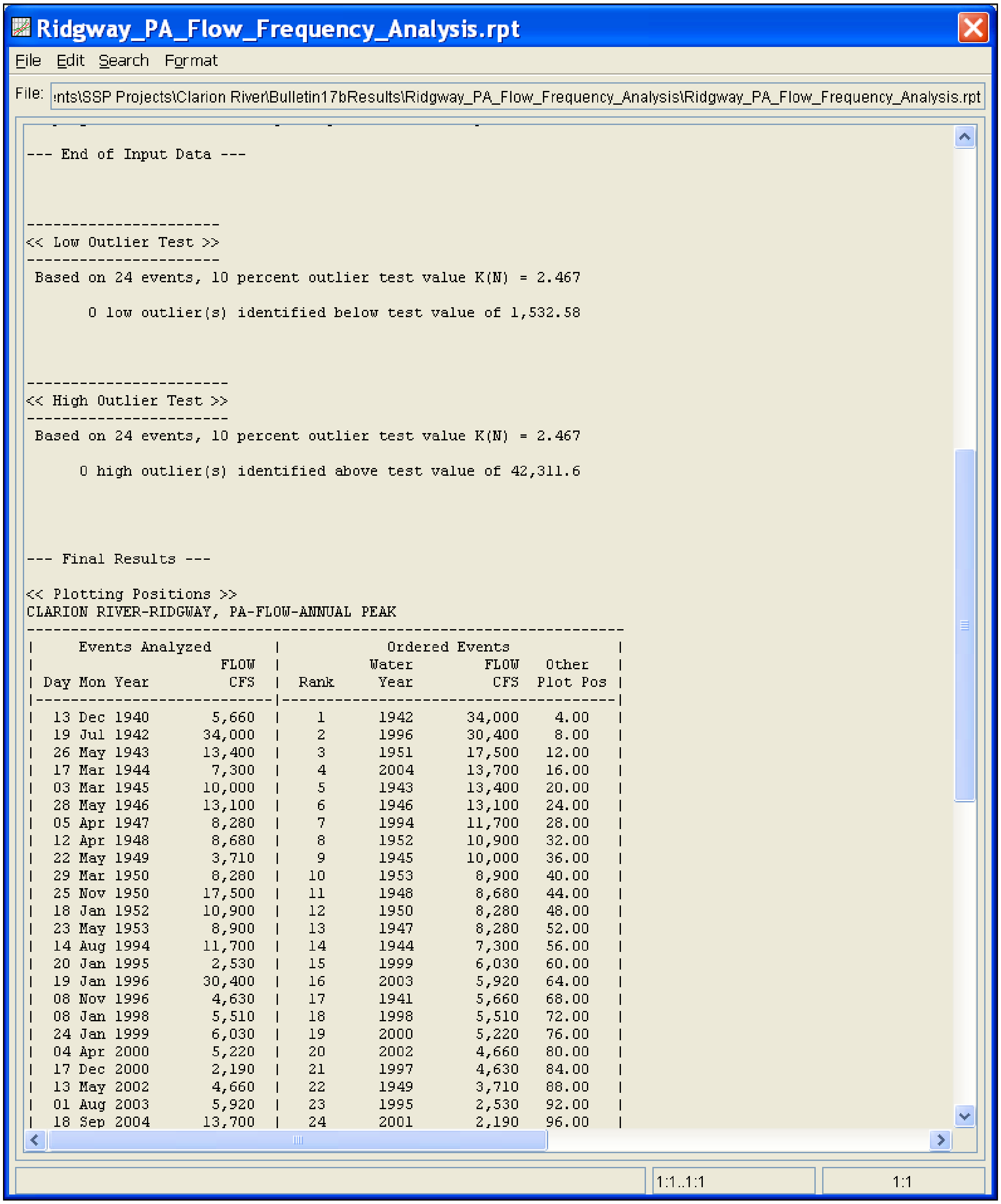
Also, a shortcut menu will appear with further customizing options when the user right-clicks on a line on the graph or the legend.

The graphic customizing capabilities within HEC-SSP are very powerful, but are also somewhat complex to use. The code used in developing the plots in HEC-SSP is the same code that is used for developing graphics in HEC-DSSVue and several other HEC software programs. Please refer to the HEC-DSSVue User's Manual for details on customizing plots.

Viewing the Report File

When the Bulletin 17B computations are performed, a report file of the statistical computations is created. The report file lists all of the input data and user settings, plotting positions of the data points, intermediate results, each of the various statistical tests performed (i.e. high and low outliers, historical data, etc…), and the final results. This file is often useful for understanding how the software arrived at the final frequency curve.

Press the **View Report** button at the bottom of the Bulletin 17B Analysis editor to view the report file. When this button is pressed a window will appear containing the report as shown in Figure 5-5.


Ridgway_PA_Flow_Frequency_Analysis.rpt

File Edit Search Format

File: nts\SSP Projects\Clarion River\Bulletin17bResults\Ridgway_PA_Flow_Frequency_Analysis\Ridgway_PA_Flow_Frequency_Analysis.rpt

--- End of Input Data ---

<< Low Outlier Test >>

Based on 24 events, 10 percent outlier test value K(N) = 2.467

0 low outlier(s) identified below test value of 1,532.58

<< High Outlier Test >>

Based on 24 events, 10 percent outlier test value K(N) = 2.467

0 high outlier(s) identified above test value of 42,311.6

--- Final Results ---

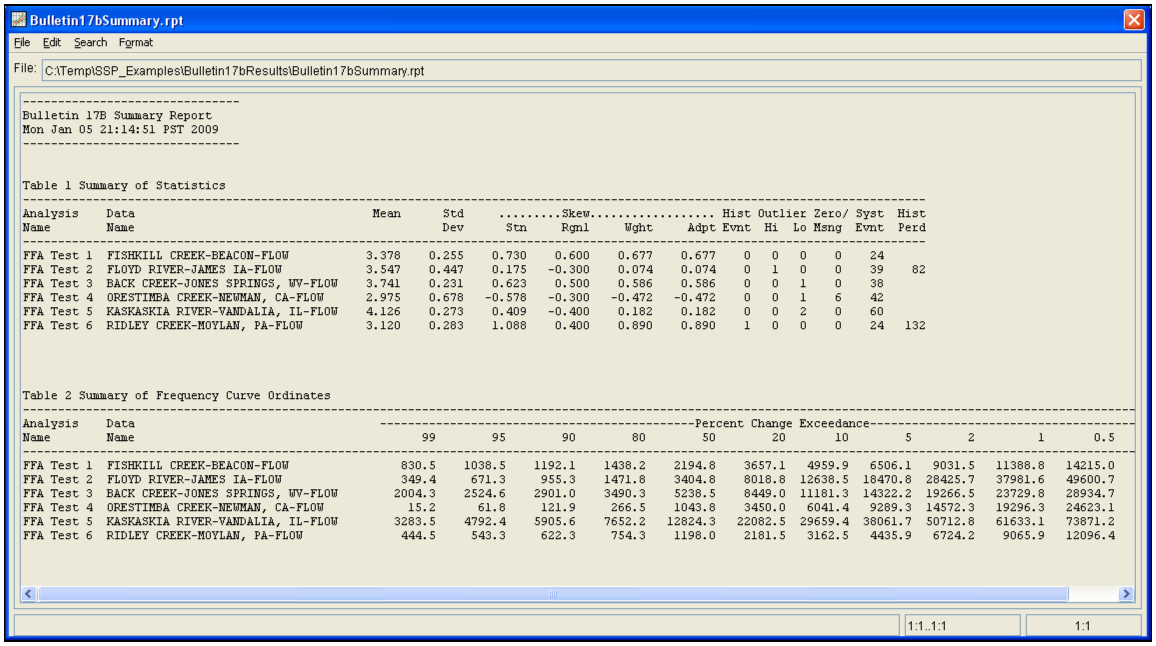
<< Plotting Positions >>
CLARION RIVER-RIDGWAY, PA-FLOW-ANNUAL PEAK

Events Analyzed				Ordered Events			
Day	Mon	Year	FLOW CFS	Rank	Water Year	FLOW CFS	Other Plot Pos
13	Dec	1940	5,660	1	1942	34,000	4.00
19	Jul	1942	34,000	2	1996	30,400	8.00
26	May	1943	13,400	3	1951	17,500	12.00
17	Mar	1944	7,300	4	2004	13,700	16.00
03	Mar	1945	10,000	5	1943	13,400	20.00
28	May	1946	13,100	6	1946	13,100	24.00
05	Apr	1947	8,280	7	1994	11,700	28.00
12	Apr	1948	8,680	8	1952	10,900	32.00
22	May	1949	3,710	9	1945	10,000	36.00
29	Mar	1950	8,280	10	1953	8,900	40.00
25	Nov	1950	17,500	11	1948	8,680	44.00
18	Jan	1952	10,900	12	1950	8,280	48.00
23	May	1953	8,900	13	1947	8,280	52.00
14	Aug	1994	11,700	14	1944	7,300	56.00
20	Jan	1995	2,530	15	1999	6,030	60.00
19	Jan	1996	30,400	16	2003	5,920	64.00
08	Nov	1996	4,630	17	1941	5,660	68.00
08	Jan	1998	5,510	18	1998	5,510	72.00
24	Jan	1999	6,030	19	2000	5,220	76.00
04	Apr	2000	5,220	20	2002	4,660	80.00
17	Dec	2000	2,190	21	1997	4,630	84.00
13	May	2002	4,660	22	1949	3,710	88.00
01	Aug	2003	5,920	23	1995	2,530	92.00
18	Sep	2004	13,700	24	2001	2,190	96.00

1:1..1:1 1:1

Figure 5-5. Example of the Bulletin 17B Report File.

Plots, tables and reports can also be created by selecting menu options from the **Results** menu. At least one Bulletin 17B analysis must be selected in the study explorer before selecting one of the menu options on the Results menu. Results from multiple analyses are combined in one graph if they are selected in the study explorer when the **Graph** menu option is selected. The **Results→Summary Report** menu option will create a summary table of statistics and frequency curve ordinates for the selected analyses as shown in Figure 5-6.



Bulletin 17B Summary Report
Mon Jan 05 21:14:51 PST 2009

Table 1 Summary of Statistics

Analysis Name	Data Name	Mean	Std Dev	Skew Stn	Skew Rgnl	Skew Wght	Skew Adpt	Hist Evnt	Outlier Hi	Outlier Lo	Zero/ Msng	Syst Evnt	Hist Perd
FFA Test 1	FISHKILL CREEK-BEACON-FLOW	3.378	0.255	0.730	0.600	0.677	0.677	0	0	0	0	24	
FFA Test 2	FLOYD RIVER-JAMES IA-FLOW	3.547	0.447	0.175	-0.300	0.074	0.074	0	1	0	0	39	82
FFA Test 3	BACK CREEK-JONES SPRINGS, WV-FLOW	3.741	0.231	0.623	0.500	0.586	0.586	0	0	1	0	38	
FFA Test 4	ORESTIMBA CREEK-NEWMAN, CA-FLOW	2.975	0.678	-0.578	-0.300	-0.472	-0.472	0	0	1	6	42	
FFA Test 5	KASKASKIA RIVER-VANDALIA, IL-FLOW	4.126	0.273	0.409	-0.400	0.182	0.182	0	0	2	0	60	
FFA Test 6	RIDLEY CREEK-MOYLAN, PA-FLOW	3.120	0.283	1.088	0.400	0.890	0.890	1	0	0	0	24	132

Table 2 Summary of Frequency Curve Ordinates

Analysis Name	Data Name	Percent Change Exceedance 99	95	90	80	50	20	10	5	2	1	0.5
FFA Test 1	FISHKILL CREEK-BEACON-FLOW	830.5	1038.5	1192.1	1438.2	2194.8	3657.1	4959.9	6506.1	9031.5	11388.8	14215.0
FFA Test 2	FLOYD RIVER-JAMES IA-FLOW	349.4	671.3	955.3	1471.8	3404.8	8018.8	12638.5	18470.8	28425.7	37981.6	49600.7
FFA Test 3	BACK CREEK-JONES SPRINGS, WV-FLOW	2004.3	2524.6	2901.0	3490.3	5238.5	8449.0	11181.3	14322.2	19266.5	23729.8	28934.7
FFA Test 4	ORESTIMBA CREEK-NEWMAN, CA-FLOW	15.2	61.8	121.9	266.5	1043.8	3450.0	6041.4	9289.3	14572.3	19296.3	24623.1
FFA Test 5	KASKASKIA RIVER-VANDALIA, IL-FLOW	3283.5	4792.4	5905.6	7652.2	12824.3	22082.5	29659.4	38061.7	50712.8	61633.1	73871.2
FFA Test 6	RIDLEY CREEK-MOYLAN, PA-FLOW	444.5	543.3	622.3	754.3	1198.0	2181.5	3162.5	4435.9	6724.2	9065.9	12096.4

Figure 5-6. Summary Table for Selected Bulletin 17B Analyses.

CHAPTER 6

Performing a General Frequency Analysis

The current version of HEC-SSP allows the user to perform generalized frequency analyses of flow and stage data, as well as other data types. The user can choose between different analytical distributions or perform a graphical fit to the data. This chapter discusses in detail how to use the General Frequency Analysis editor in HEC-SSP.

Contents

Starting a New Analysis

A general frequency analysis can be started in two ways, either by right clicking on the General Frequency Analysis folder in the study explorer and selecting **New**, or by going to the **Analysis** menu and selecting **New** and then **General Frequency Analysis**. When a new general frequency analysis is selected, the General Frequency Analysis editor will appear as shown in Figure 6-1.

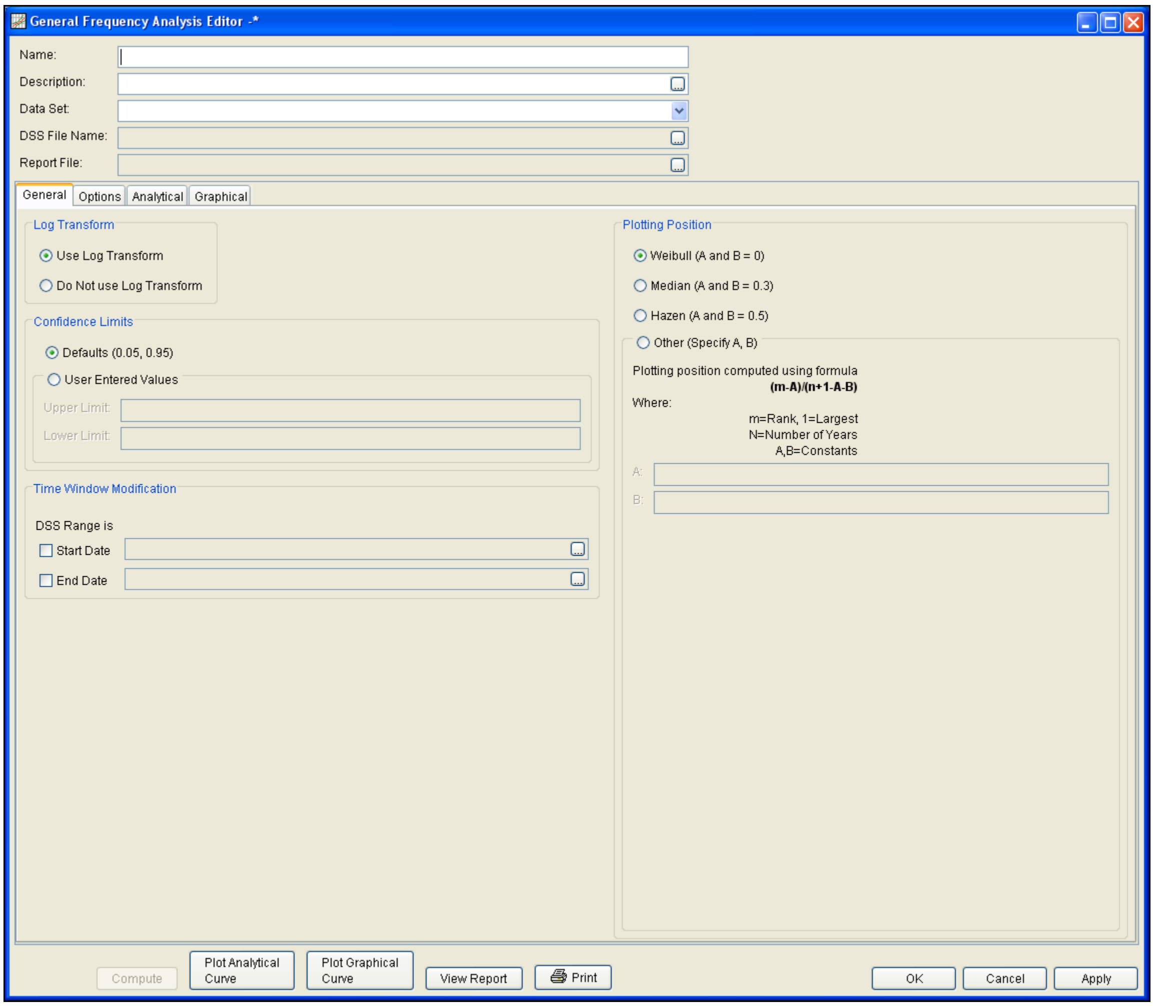


Figure 6-1. General Frequency Analysis Editor.

The user is required to enter a **Name** for the analysis, while a **Description** is optional. A data set (flow, stage, or other) must be selected from the available data sets stored in the current study DSS file (see Chapter 4 for importing data into the study). The list of data that can be selected for a general frequency analysis will only include those data that have an irregular interval, like IR-CENTURY and IR-YEAR (E-part pathname). Once a Name is entered and a data set is selected, the **DSS File Name** and **Report File** will automatically be filled out. The DSS filename is by default the study DSS file. The report file is given the same name as the analysis with the extension ".rpt".

General Settings and Options

Once the analysis name and data set are selected, the user can begin to perform the computations. Contained on the General Frequency Analysis editor are four tabs. The tabs are labeled **General**, **Options**, **Analytical**, and **Graphical**. This section of the manual explains the use of the General and Options tabs.

General Settings

The first tab contains general settings for performing the frequency analysis (Figure 6-1). These settings include:

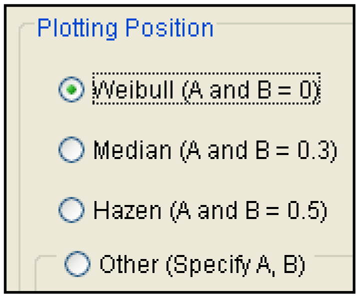
- Log Transforms
- Plotting Positions
- Confidence Limits
- Time Window Modification

Log Transform

There are two options contained within the Log Transform setting: Use Log Transform and Do not use Log Transform. If the user selects **Use Log Transform** then the logs of the data will be taken first. The frequency analysis will be performed on the logs of the data. If the user selects **Do not use Log Transform**, then the frequency analysis will be performed on the raw data values without taking the logs of the data. The default setting is **Use Log Transform**.

Plotting Positions

Plotting positions are used for plotting the raw data points on the graph. There are four options for plotting position methodologies within HEC-SSP: Weibull, Median, Hazen, and user entered coefficients. The default method is the Weibull plotting position formula. The generalized plotting position equation is:



$$P = \frac{(m - A)}{(n + 1 - A - B)}$$

Where: m = rank of flood values with the largest equal to 1.

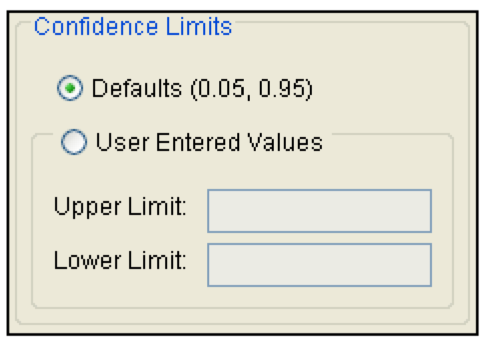
n = number of flood peaks in the data set.

A & B = constants dependent on which equation is used (Weibull A and B=0; Median A and B = 0.3; and Hazen A and B=0.5).

Plotting positions are estimates of the exceedance probability of each data point. Different methods can give very different values for the probabilities of the highest and lowest points in the data set. In the General Frequency methodology, the plotting of data on the graph by a plotting position method is only done as a guide to assist in evaluating the computed curve. The plotting position method selected does not have any impact on the computed curve.

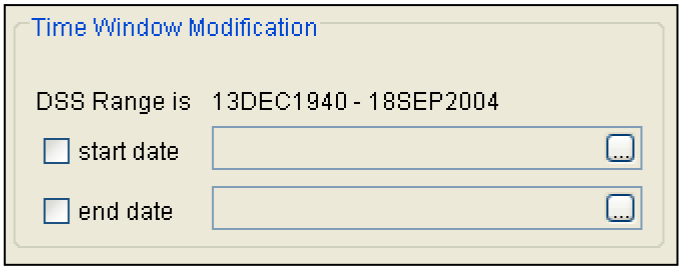
Confidence Limits

Confidence limits provide a measure of the uncertainty in the computed value for a given exceedance probability. The computation of confidence limits is outlined in Bulletin 17B, Appendix 9, and is applied in the same manner here in the general frequency analysis. By default, HEC-SSP calculates the 90 percent confidence interval (i.e. the 5% and 95% confidence limits). The confidence limits must be entered in decimal form (i.e. 95% = 0.95, and 5% = 0.05). The user has the option to override the default values.



Time Window Modification

This option allows the user to narrow the time window used for the analysis. The default is to use all of the data contained in the selected data set. The user can enter either a start date and end date or both a start and end date. If a start and/or end date are used, they must be dates that are encompassed within the data stored in the selected data set. The date range for the selected data set is shown in the editor just above the **Start Date** field.



Options

In addition to the general settings, there are also several options available to the user for modifying the computations of the frequency curves. These options include:

- Low Outlier Threshold
- Historic Period Data
- User-Specified Frequency Ordinates
- Output Labeling

When the Options tab is selected, the General Frequency Analysis editor will appear as shown in Figure 6-2.

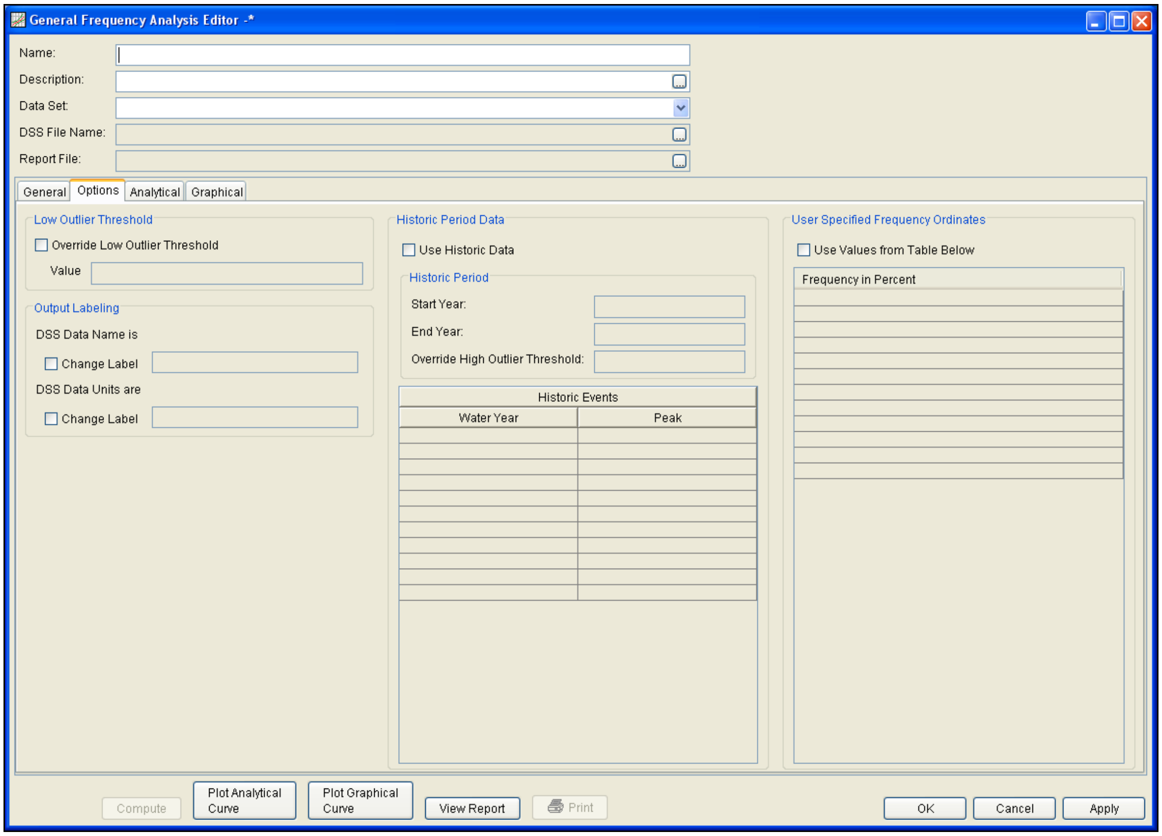
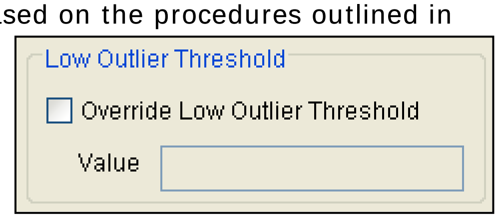


Figure 6-2. General Frequency Editor with Options Tab Selected.

Low Outlier Threshold

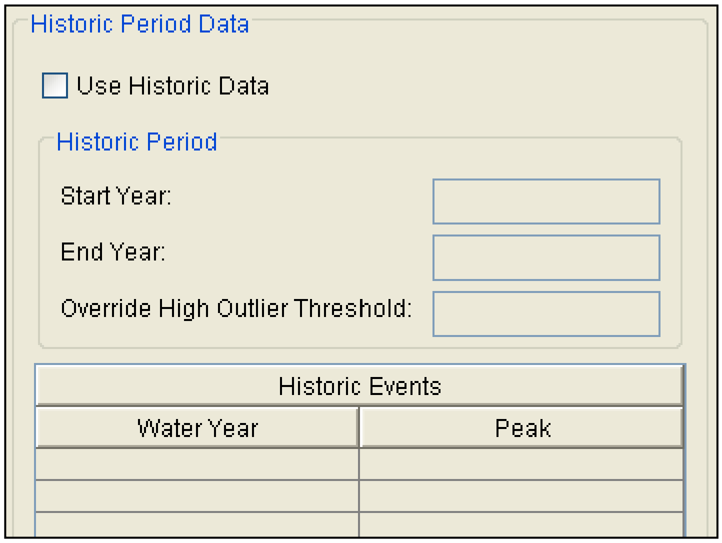
High and low outlier tests are based on the procedures outlined in Bulletin 17B, and are applied in the same manner in the General Frequency Analysis. The calculated outlier magnitudes, by the Bulletin 17B procedure, are used as



default values for the high and low outlier thresholds in HEC-SSP. The user has the option to enter a different value for the low outlier threshold. If a value is entered for the low outlier threshold, then this value will override the computed value from the Bulletin 17B methodology. When applying the outlier tests, HEC-SSP will identify both high and low outliers. However, only low outliers will be removed from the data set when performing the analysis. If a high outlier is identified in the data set, the analyst should try to incorporate historical period information to extend the time period for which the high outlier(s) is considered to be the maximum value(s). Further discussion of outlier thresholds can be found in Bulletin 17B. To use the low outlier threshold, simply check the box and enter the value.

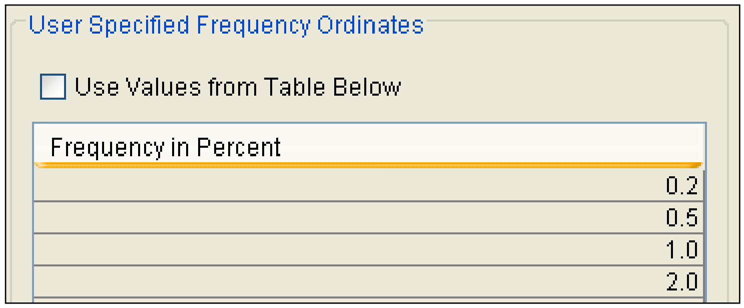
Historic Period Data

All historic data that provides reliable estimates outside the systematic record should be used in order to improve the frequency computations. Information outside of the systematic record can often be used to extend the record of the largest events to a historic period much longer than that of the systematic record. HEC-SSP uses historic data as recommended in Bulletin 17B. This calculation is applied in the same manner in the General Frequency Analysis. To use historic data, check the box labeled **Use Historic Data**. The user can enter a starting year for the historic period, ending year for a historic period, and a High Threshold value. If the user enters a high threshold value, then any data in the systematic record greater than that value will also be treated as a historical annual maximum. The user can also enter historic data that are not contained in the systematic record. This is done in the table at the bottom labeled **Historic Events**. All years must be entered as water year values (October 1 through September 30). If a start year is not entered, then the assumed start year is the earliest year of the systematic record and any historical values that have been entered. If an end year is not entered, then the assumed end year is the latest year in the systematic record and any entered historic values. Further discussion of the use of historical data can be found in Bulletin 17B.



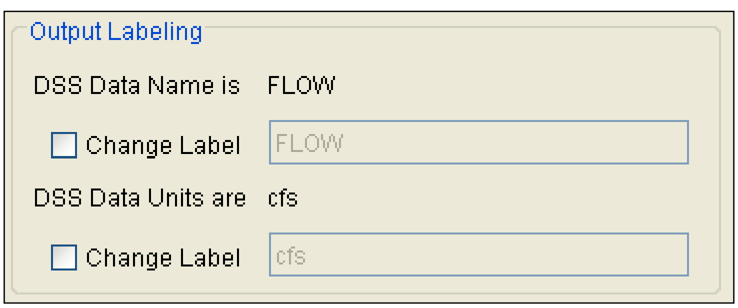
Note: The program treats all data in the data set as systematic data. If historic events are included in the data set, then the user can define the analysis time window (General tab – Time Window Modification) so that it only bounds the systematic record. Then define the historic events in the Historic Events table. Instead of using the Time Window Modification option, another option is to enter a High Threshold value so that the historic data point(s) would be treated as historic data (rather than part of the systematic record). Please see test example 6 in Appendix B for an example of using the historic data adjustment.

User Specified Frequency Ordinates



This option allows the user to change the frequency ordinates used in computing the resulting frequency curves and confidence limits. The default values listed in percent chance exceedance are 0.2, 0.5, 1, 2, 5, 10, 20, 50, 80, 90, 95, and 99. Check the box next to **Use Values from Table below** to change or add additional values. Once this box is checked, the user can add/remove rows and edit the frequency values. To add or remove a row from the table, select the row(s), place the mouse over the highlighted row(s) and click the right mouse button. The shortcut menu contains options to **Insert Row(s)** and **Delete Row(s)**. The program will use the default values, even if they are not contained in the table, when the **Use Values from Table below** option are not checked. Finally, all values in the table must be between 0 and 100.

Output Labeling



This option allows the user to change the default labels for data contained in the output tables and plots. The user can change both the name of the data as well as how the units of the data are labeled.

Analytical Frequency Analysis

Once the new analysis has been defined and the user has all of the general settings and options the way they want them, the user can choose between performing an Analytical Frequency analysis or a Graphical Frequency analysis. This section of the manual describes how to use the Analytical Frequency analysis option.

When the user selects the **Analytical** tab on the General Frequency Analysis editor, the window will appear as shown in Figure 6-3. As shown, three additional tabs will appear on the screen: Settings, Tabular Results, and Plot.

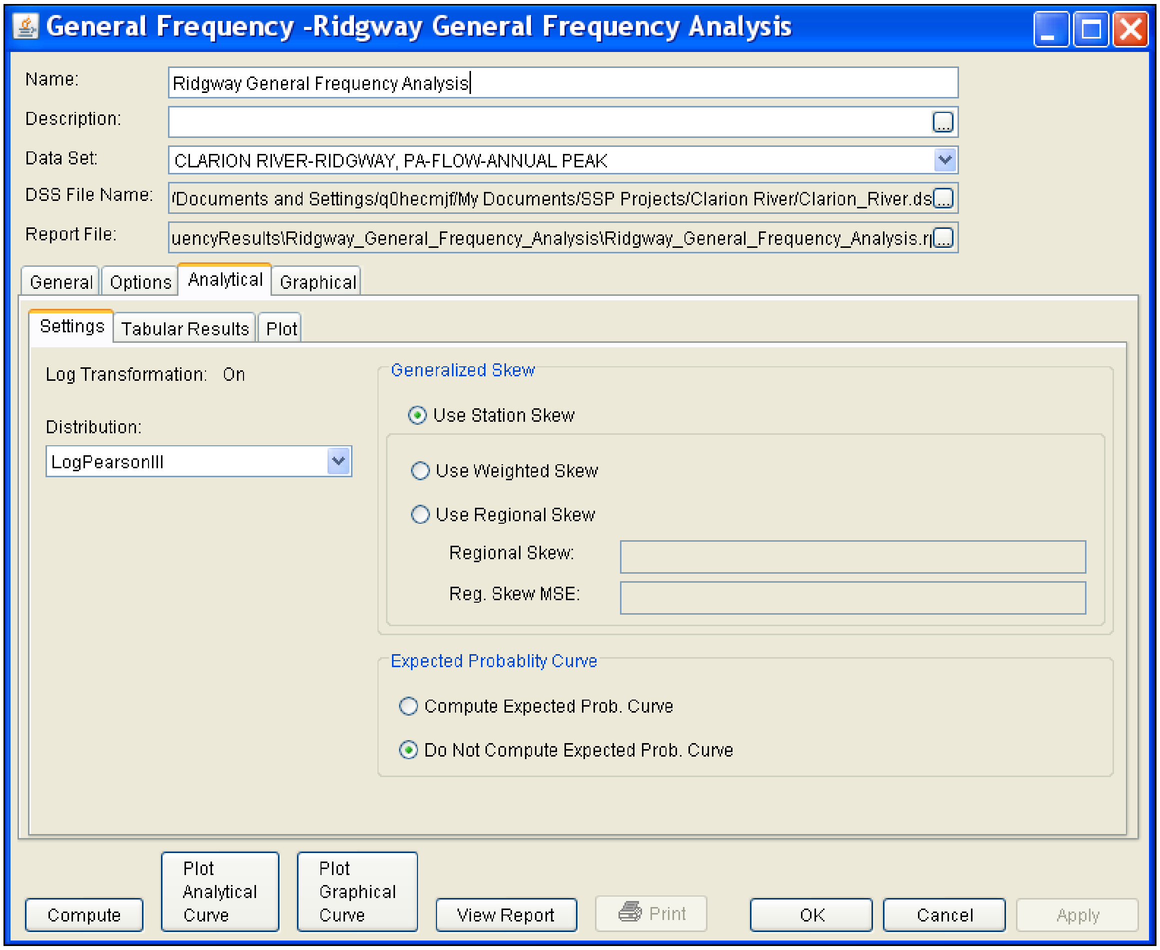


Figure 6-3. Analytical Analysis Tab of the General Frequency Analysis Editor.

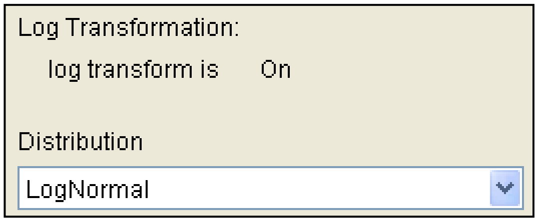
Settings

The **Settings** tab contains additional settings for the analytical frequency analysis. These settings include:

- Distribution
- Generalized Skew
- Expected Probability Curve

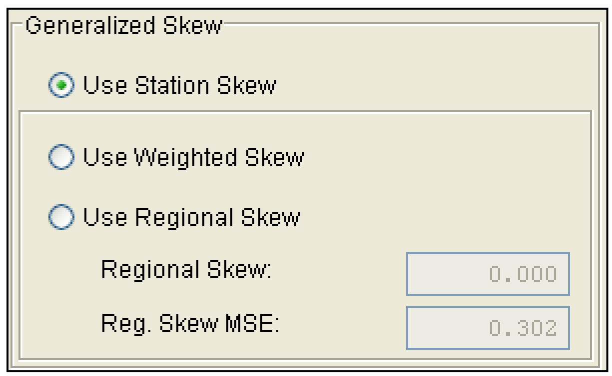
Distribution

This option allows the user to select from available analytical distributions to perform the frequency analysis. The current version of HEC-SSP contains five distribution choices: None, Normal, LogNormal, Pearson III, and LogPearson III. If the user has selected to transform the data to log space (General tab), then the only available choices for distribution will be None, LogNormal, and LogPearson III. If the user did not select the option to transform the data to log space (General tab), then the only available choices for distribution will be None, Normal and Pearson III.



Generalized Skew

There are three options contained within the generalized skew setting: Use Station Skew, Use Weighted Skew, and Use Regional Skew. The default skew setting is **Use Station Skew**. With this setting, the skew of the computed curve will be based solely on computing a skew from the data points.

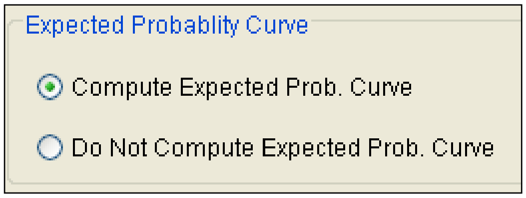


The **Use Weighted Skew** option requires the user to enter a generalized regional skew and a Mean-Square Error (MSE) of the generalized regional skew. This option weights the computed station skew with the generalized regional skew. The equation for performing this weighting can be found in Bulletin 17B (Equation 6). If a regional skew is taken from Plate I of Bulletin 17B (the skew map of the United States), the value of MSE = 0.302.

The last generalized skew option is **Use Regional Skew**. When this option is selected, the user must enter a generalized regional skew and an MSE for that skew. The program will ignore the computed station skew and use only the generalized regional skew.

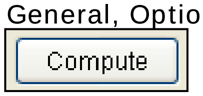
Expected Probability Curve

This setting has two options: Compute the expected probability curve and do not compute the expected probability curve. The default setting is to have the expected probability curve computed. When computed, this curve will be shown in both the tables and the plots as an additional curve to the computed curve. The expected probability adjustment is an attempt to correct for a certain bias in the frequency curve computation due to the shortness of the record. Please review the discussion in Bulletin 17B about the expected probability curve adjustment for an explanation of how and why it is computed. The use of the expected probability curve is a policy decision. It is most often used in establishing design flood criteria. The basic flood frequency curve without the expected probability curve adjustment is the curve used in computation of confidence limits, risk, and in obtaining weighted averages of independent estimates of flood frequency discharge (WRC, 1982).



Compute

Once the new analysis has been defined, and the user has all of the General, Options, and Settings information selected the way they want, performing the computations is simply a matter of pressing the **Compute** button at the bottom of the General Frequency Analysis editor. If the computations are successful, the user will receive a message that says “Compute Complete”. At this point, the user can begin to review the results of the Analytical Frequency computations.



Multiple General Frequency analyses can be computed using the **Compute Manager**. Select the **Analysis→Compute Manager** menu option to open the Compute Manager. Select the analyses to be computed and then press the **Compute** button. Close the compute dialogs and Compute Manager when the program finished computing the analyses.

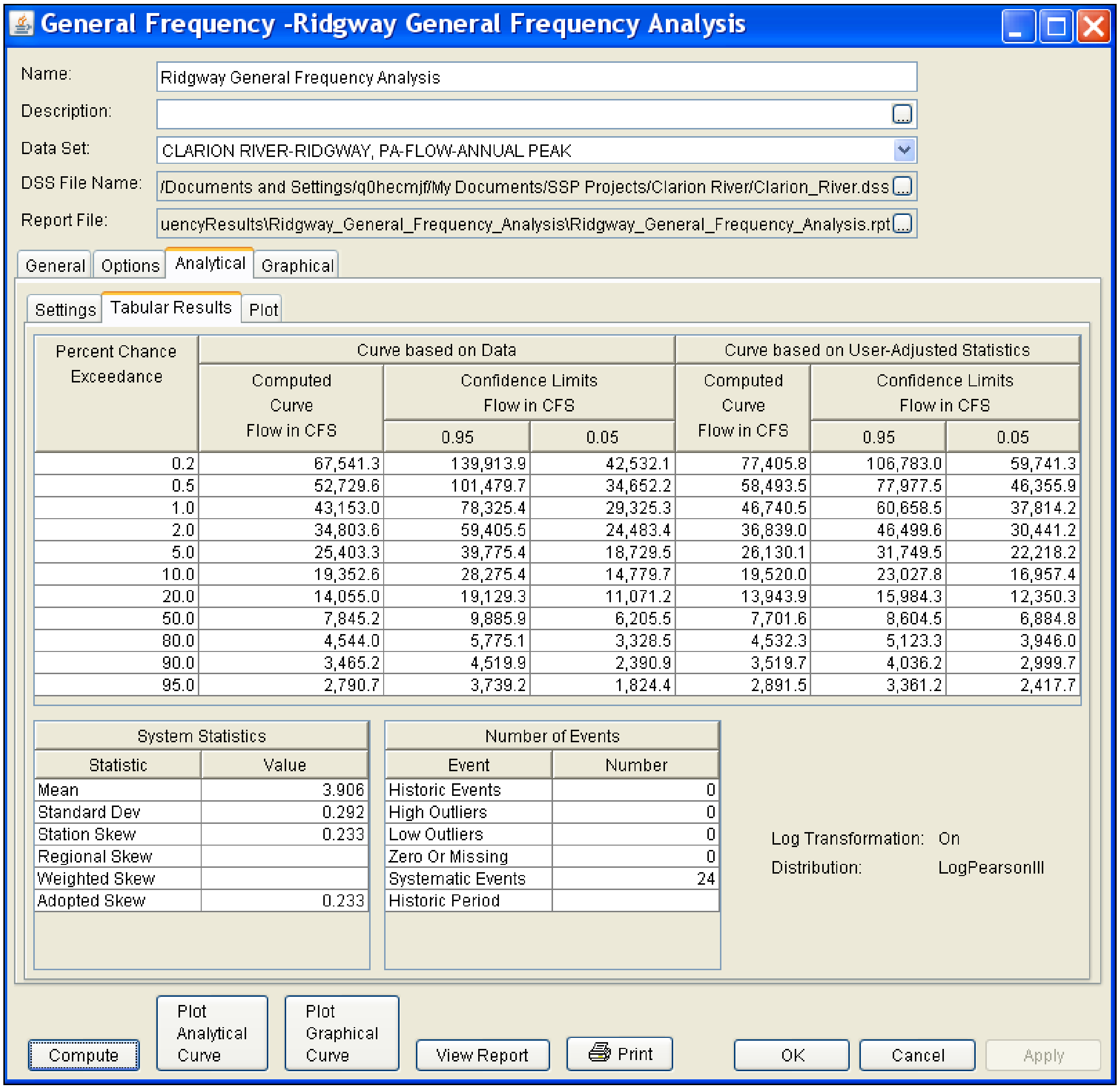
Tabular Results

The **Tabular Results** tab will bring up a table of results for the Analytical Frequency analysis. An example of the results tab is shown in Figure 6-4.

As shown in Figure 6-4, the window contains three tables. The top table contains results of the computed frequency curve. The very left column of the top table is the Percent Chance Exceedance for all the computed values. The next three columns in the top table contain the computed frequency curve and the 95% and 5% confidence limits that correspond to that computed curve. The last three columns of the top table contain a computed frequency curve and confidence limits for an analysis based on user-adjusted statistics for the mean, standard deviation, adopted skew, and equivalent years of record. User entered adjusted statistics are an option that the user can set on the **Plot** tab, which is discussed in detail in the next section of this manual. If the user has not entered adjusted statistics, then these columns will be empty. Data in the frequency curve table can be re-sorted. Click the **Percent Chance Exceedance** column header (two mouse clicks are required the first time). The percent chance exceedance ordinates, along with frequency curve and confidence limits values, will sort so that the lowest values are on top or the highest values are on top.

Two additional tables are shown at the bottom of the window: System Statistics and Number of Events. The **System Statistics** table consists of the mean, standard deviation, station skew, user entered regional skew, weighted skew (weighted between station skew and regional skew), and the adopted skew for the analysis. The **Number of Events** table contains the number of historic events, high outliers, low outliers, zero or missing values, systematic events, and the number of years in the historic period (this value only comes into play if the user entered historic data).

Additionally, the lower right portion of the table will show if Log Transform is On or Off, and which analytical distribution was selected for the analysis.



Percent Chance Exceedance	Curve based on Data			Curve based on User-Adjusted Statistics		
	Computed Curve Flow in CFS	Confidence Limits Flow in CFS		Computed Curve Flow in CFS	Confidence Limits Flow in CFS	
		0.95	0.05		0.95	0.05
0.2	67,541.3	139,913.9	42,532.1	77,405.8	106,783.0	59,741.3
0.5	52,729.6	101,479.7	34,652.2	58,493.5	77,977.5	46,355.9
1.0	43,153.0	78,325.4	29,325.3	46,740.5	60,658.5	37,814.2
2.0	34,803.6	59,405.5	24,483.4	36,839.0	46,499.6	30,441.2
5.0	25,403.3	39,775.4	18,729.5	26,130.1	31,749.5	22,218.2
10.0	19,352.6	28,275.4	14,779.7	19,520.0	23,027.8	16,957.4
20.0	14,055.0	19,129.3	11,071.2	13,943.9	15,984.3	12,350.3
50.0	7,845.2	9,885.9	6,205.5	7,701.6	8,604.5	6,884.8
80.0	4,544.0	5,775.1	3,328.5	4,532.3	5,123.3	3,946.0
90.0	3,465.2	4,519.9	2,390.9	3,519.7	4,036.2	2,999.7
95.0	2,790.7	3,739.2	1,824.4	2,891.5	3,361.2	2,417.7

System Statistics		Number of Events	
Statistic	Value	Event	Number
Mean	3.906	Historic Events	0
Standard Dev	0.292	High Outliers	0
Station Skew	0.233	Low Outliers	0
Regional Skew		Zero Or Missing	0
Weighted Skew		Systematic Events	24
Adopted Skew	0.233	Historic Period	

Figure 6-4. Tabular Results Tab for Analytical Analysis.

Plot

In addition to tabular results, a **Plot** tab is available for viewing a graphical plot of both the computed frequency curve, as well as a computed curve based on any user-adjusted statistics. When the Plot tab is selected the window will change to what is shown in Figure 6-5.

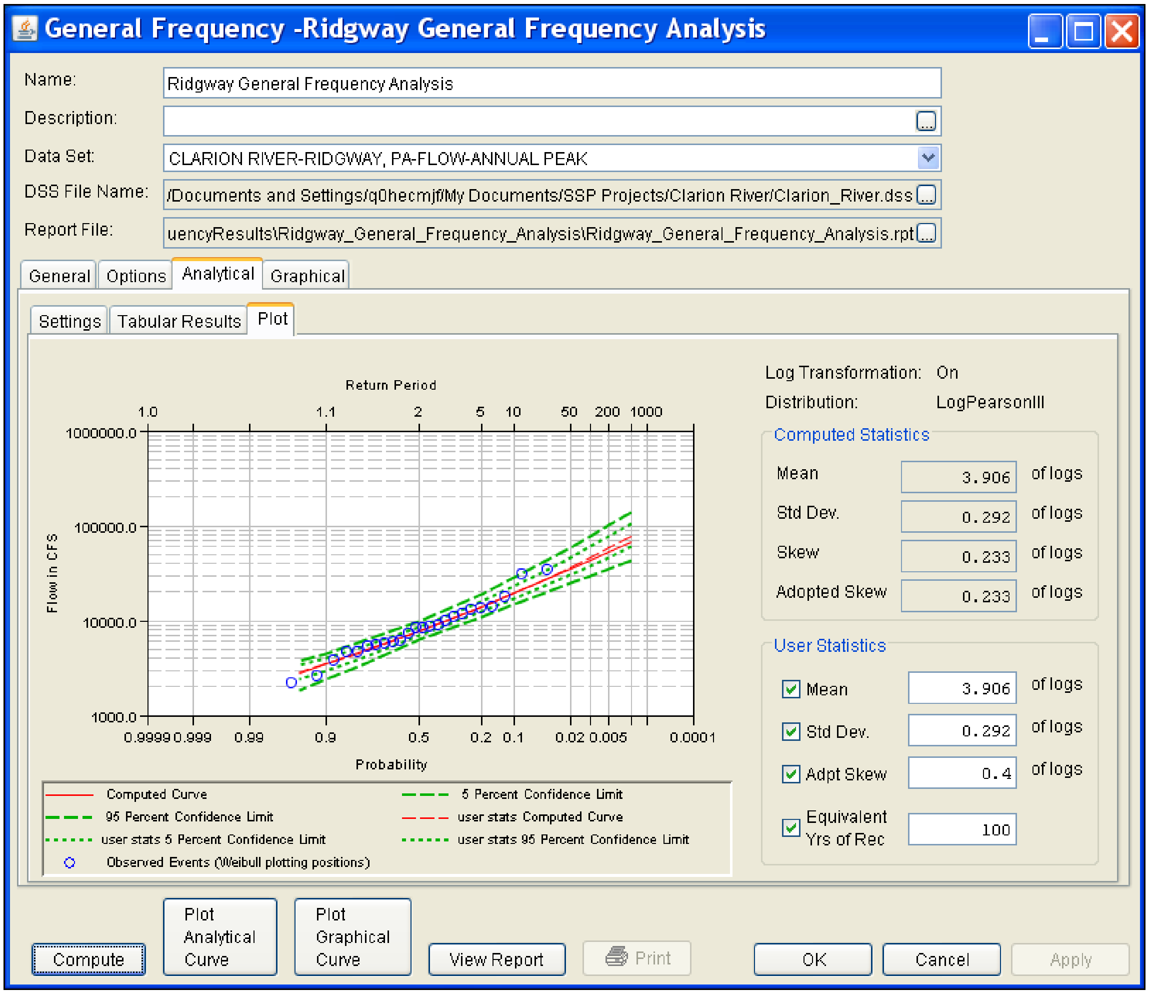


Figure 6-5. Plot Tab of the General Frequency Analytical Analysis.

As shown in Figure 6-5, the plot contains the computed frequency curve, 95% and 5% confidence limits, and raw data points plotted by the user selected plotting position method. The computed statistics for the frequency curve are shown in a table on the right side of the window. Below the computed statistics is a table labeled "User Statistics". There is a check box and a data entry field for the Mean, Standard Deviation, Adopted Skew, and Equivalent Years of Record. The user can enter values into any or all of these fields. Turning on the check box then enables that field to be used in computing a curve with the user entered statistic overriding the computed value from the raw data. The user statistics option allows the user to see how the curve would change if any or all of the statistics were different. When data is entered into the user statistics fields, and the check boxes are turned on, the user must press the compute button again in order for the computations to be performed with the user entered statistics. After the compute button is pressed, both the plot and the table on the Tabular Results tab will be updated to reflect any user entered statistics.

Graphical Frequency Analysis

In addition to an analytical frequency analysis which uses a statistical distribution fit to the data, the user has the option to graphically fit a curve to the data. A graphical fit can be very useful when the available analytical distributions do not provide a good fit to the data. One example of when a graphical frequency analysis is most appropriate is when plotting a frequency curve for flow data that is downstream of a flood control reservoir. Analytical frequency distributions are often not appropriate for describing flow data that is significantly regulated by upstream reservoirs. In general, a portion of the flow frequency data for a highly regulated stream will be very flat in the zone in which upstream regulation can control the flows for a range of frequencies. This type of data lends itself to a graphical fit analysis rather than the use of an analytical equation. Another example of using a graphical fitting technique over an analytical curve is when trying to compute a frequency curve for annual peak stage data at a point on a river. Often the stages will flatten out with decreased frequencies when flows go out into the overbank and floodplain area. Again, this type of data is fitted much better using a graphical fit curve instead of an analytical distribution.

When the **Graphical** tab is selected, the editor will display a plot and table as shown in Figure 6-6. In the plot, the data will be plotted using the user selected plotting position method. The table to the right of the plot allows the user to enter data values for the frequency ordinates defined on the Options tab. The **Data Type** and **Equivalent Years of Record** options are required to compute the confidence limits using the order statistics method that is discussed in ETL 1110-2-537. If the data is not flow or stage, select the **Flow** data type when the graphical frequency curve is approximately analytic for extreme probabilities (frequency curve is not relatively flat for extreme probabilities). Select the **Stage** data type when the graphical frequency curve is relatively flat for extreme probabilities (ETL 1110-2-537). When the user enters values into the frequency curve table, those values will be plotted as a line on the plot after the **Compute** button is pressed. The idea is to enter values in the table that will create a best fit line of the data, based on the user's judgment.

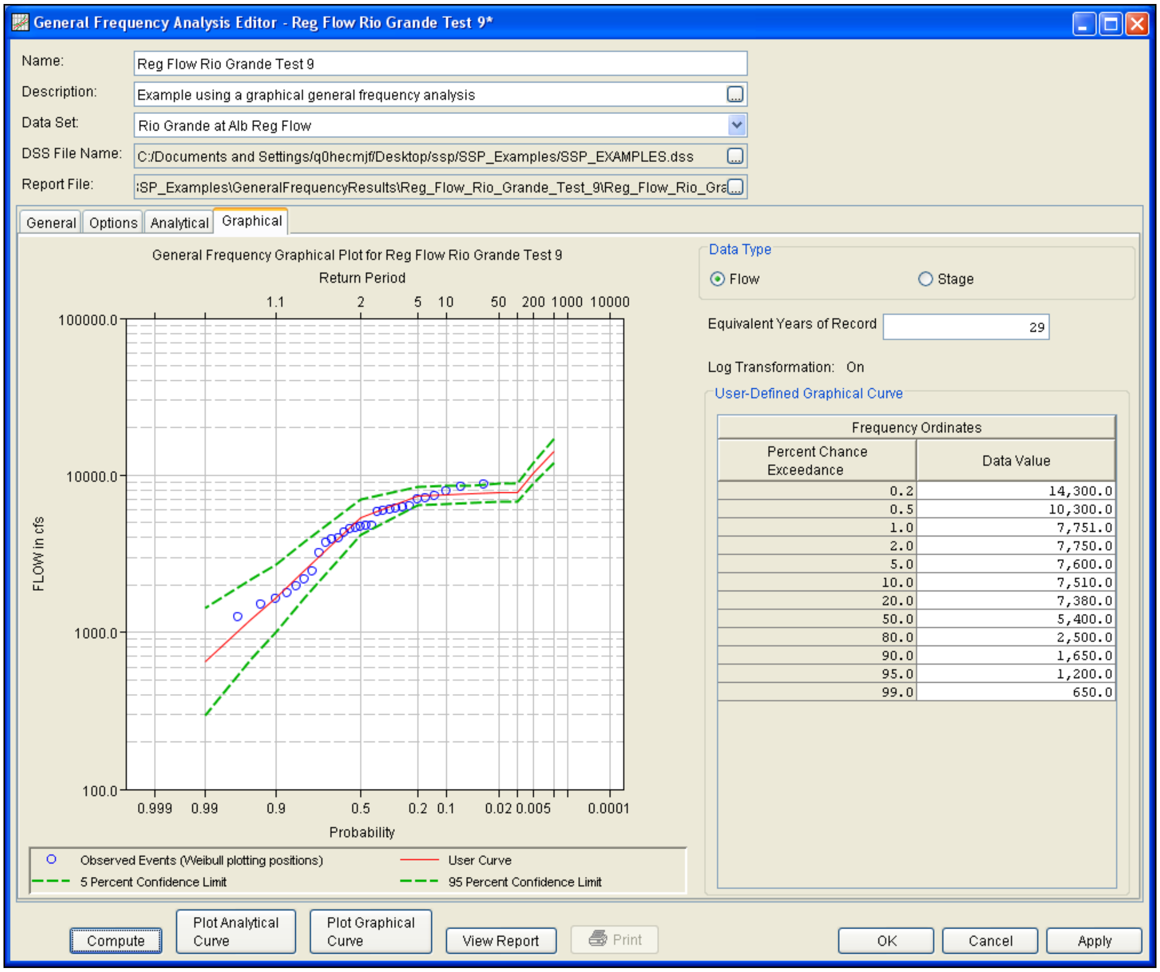


Figure 6-6. Graphical Tab of the General Frequency Analysis Editor.

Viewing and Printing Results

The user can view output for the frequency analysis directly from the General Frequency Analysis editor (Tabular and Graphical output) or by using the plot and view buttons at the bottom of the editor. The output consists of tabular results, an analytical frequency curve plot, a graphical frequency curve plot, and a report documenting the data and computations performed.

Tabular Output

Once the computations for the analytical frequency analysis are completed, the user can view tabular output by selecting the **Tabular Results** tab under the **Analytical** analysis tab. The details of this table were discussed under the analytical analysis option above.

The tabular results can be printed by using the **Print** button at the bottom of the General Frequency Analysis editor. When the print button is pressed, a window will appear giving the user options for how they would like the table to be printed.

Graphical Output

Graphical output of the analytical frequency curve can be obtained by selecting either the **Plot** tab under the analytical analysis tab, or by pressing the button labeled **Plot Analytical Curve** at the bottom of the general frequency editor. When the Plot Analytical Curve button is pressed, a frequency curve plot will appear in a separate window as shown in Figure 6-7.

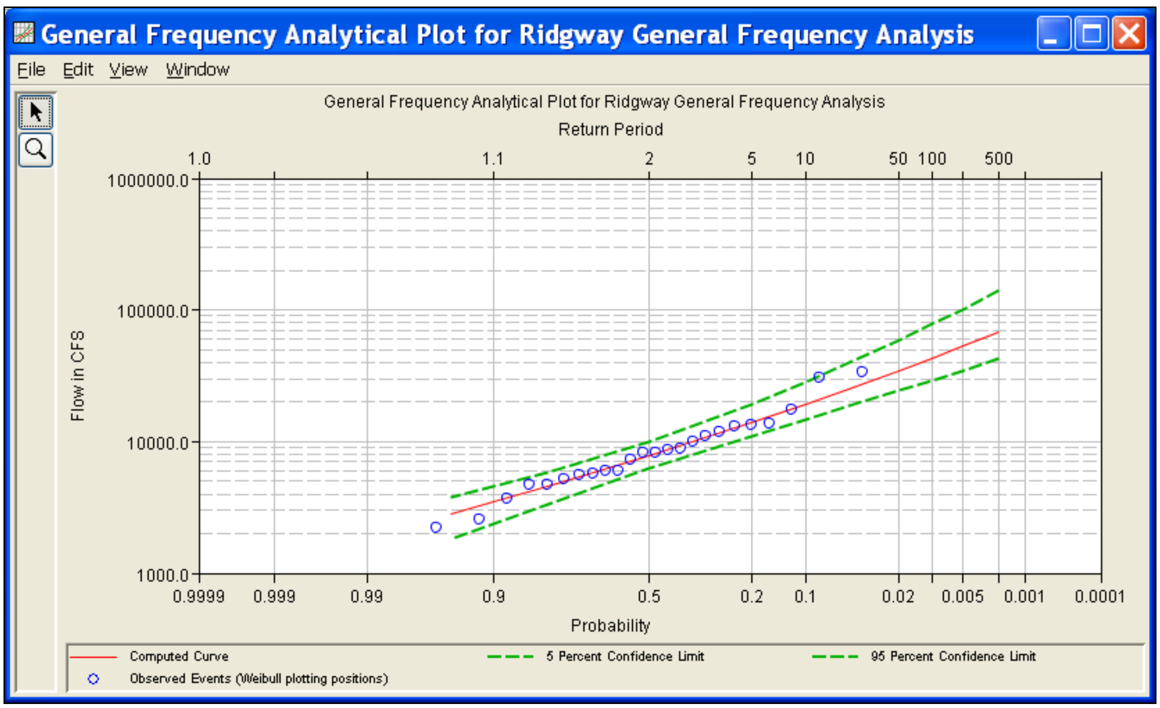


Figure 6-7. Analytical Analysis Frequency Curve Plot.

The analytical frequency curve plot can be sent to the printer by selecting the **Print** option from the **File** menu at the top of the window. Additional printing options available from the File menu are Page Setup, Print Preview, and Print Multiple (used for printing multiple graphs on the same page). The graphic can also be sent to the Windows Clipboard by selecting **Copy to Clipboard** from the File menu. Additionally, the plot can be saved to a file by selecting the **Save As** option from the File menu. When the Save As option is selected, a window will appear allowing the user to select a directory, enter a filename, and select the format for saving the file. Currently four file formats are available for saving the graphic to disk: windows metafile, postscript, JPEG, and portable network graphic.

The data contained within the plot can also be tabulated by selecting **Tabulate** from the File menu. When this option is selected, a separate window will appear with the data tabulated. Additional options are available from the File menu for saving the plot options as a template (**Save Template)** and applying previously saved templates to the current plot (**Apply Template**).

The **Edit** menu contains several options for customizing the graphic. These options include Plot Properties, Configure Plot Layout, Default Line Styles, and Default Plot Properties. Also, a shortcut menu will appear with further customizing options when the user right-clicks on a line on the graph or the legend. Both the Y and X-axis properties can be edited by placing the mouse on top of axis and clicking the right mouse button. Then select the **Edit Properties** menu option in the shortcut menu. For example, the user can turn on minor tic marks for the y-axis and modify the minimum and maximum scale for the x-axis. The graphic customizing capabilities within HEC-SSP are very powerful, but are also somewhat complex to use. The code used in developing the plots in HEC-SSP is the same code that is used for developing plots in HEC-DSSVue and several other HEC software programs. Please refer to the HEC-DSSVue User's Manual for details on customizing plots.

A plot of the graphical frequency curve can be obtained by pressing either the **Graphical** tab, or by pressing the button labeled **Plot Graphical Curve** at the bottom of the general frequency editor. When the Plot Graphical Curve button is pressed, a frequency curve plot will appear in a separate window as shown in Figure 6-8. All of the same options for tabulating, printing, and sending results to the windows clipboard are available for this plot as they are for the analytical frequency curve plot.

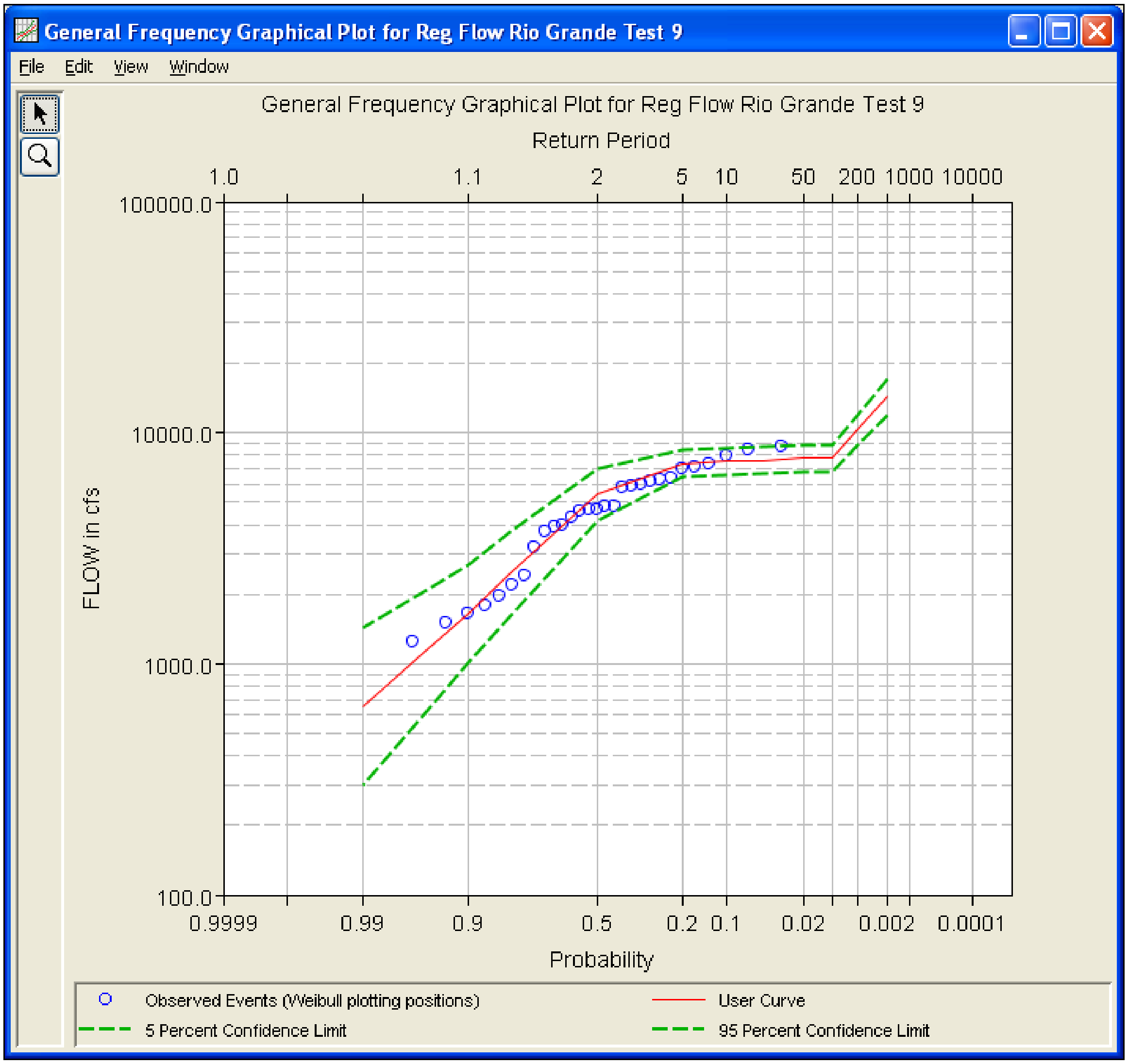
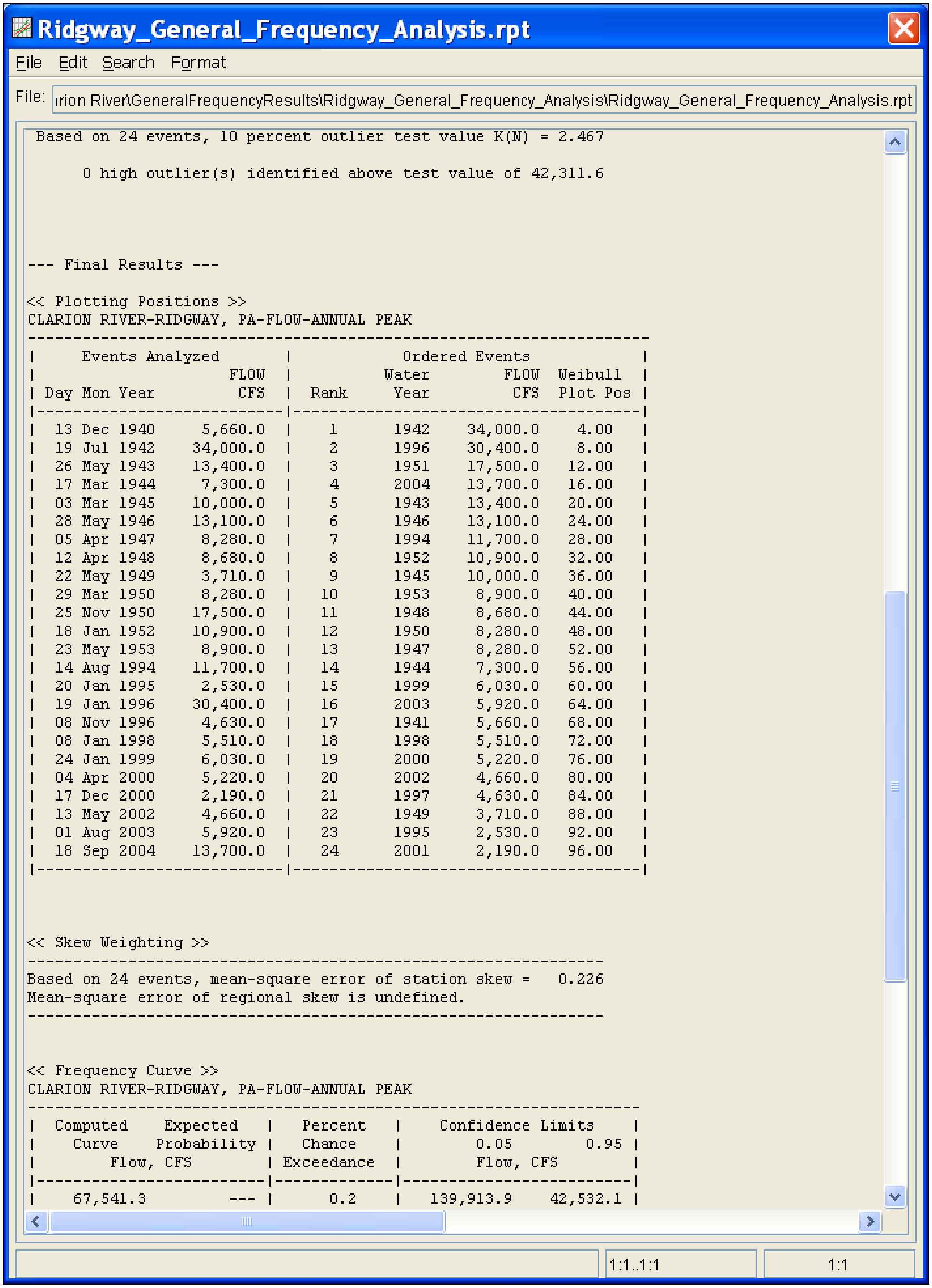


Figure 6-8. Graphical Analysis Frequency Curve Plot.

Viewing the Report File

When the General Frequency analysis computations are performed, a report file of the statistical computations is created. The report file lists all of the input data and user settings, plotting positions of the data points, intermediate results, each of the various statistical tests performed (i.e. high and low outliers, historical data, etc…), and the final results. This file is often useful for understanding and describing how the software arrived at the final frequency curve.

To view the report file press the **View Report** button at the bottom of the General Frequency analysis editor. When this button is pressed, a window will appear containing the report as shown in Figure 6-9.



Ridgway_General_Frequency_Analysis.rpt

File Edit Search Format

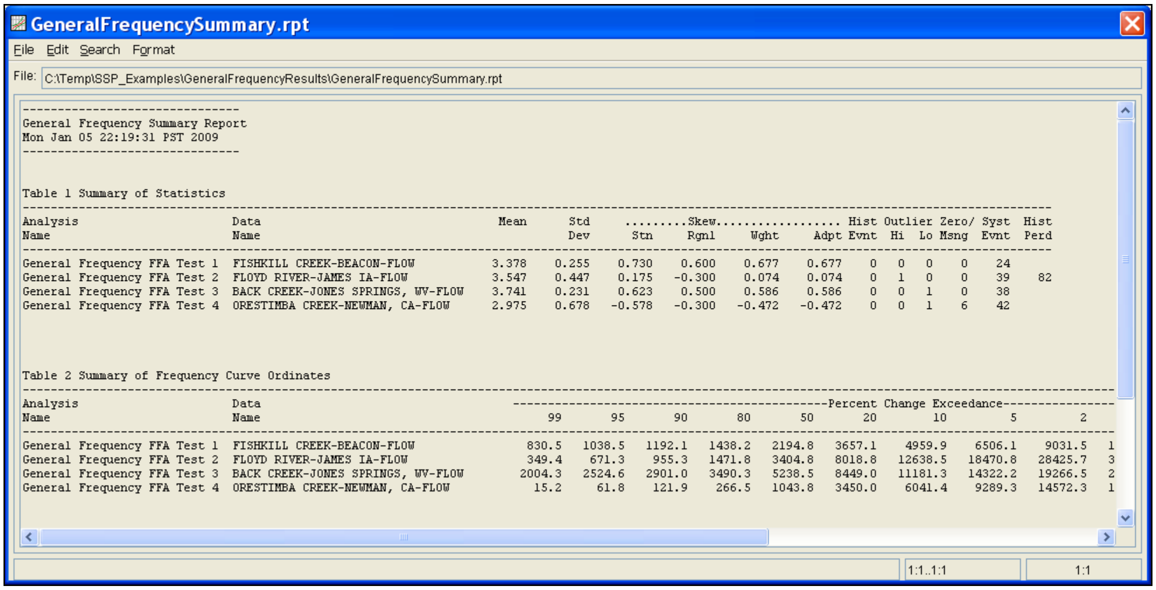
File: ırion River\GeneralFrequencyResults\Ridgway_General_Frequency_Analysis\Ridgway_General_Frequency_Analysis.rpt

```
 Based on 24 events, 10 percent outlier test value K(N) = 2.467

      0 high outlier(s) identified above test value of 42,311.6




--- Final Results ---

<< Plotting Positions >>
CLARION RIVER-RIDGWAY, PA-FLOW-ANNUAL PEAK
-------------------------------------------------------------------
|     Events Analyzed        |           Ordered Events           |
|                     FLOW   |           Water         FLOW  Weibull |
| Day Mon Year         CFS   |  Rank     Year          CFS  Plot Pos |
|----------------------------|------------------------------------|
|  13 Dec 1940     5,660.0   |    1      1942     34,000.0     4.00  |
|  19 Jul 1942    34,000.0   |    2      1996     30,400.0     8.00  |
|  26 May 1943    13,400.0   |    3      1951     17,500.0    12.00  |
|  17 Mar 1944     7,300.0   |    4      2004     13,700.0    16.00  |
|  03 Mar 1945    10,000.0   |    5      1943     13,400.0    20.00  |
|  28 May 1946    13,100.0   |    6      1946     13,100.0    24.00  |
|  05 Apr 1947     8,280.0   |    7      1994     11,700.0    28.00  |
|  12 Apr 1948     8,680.0   |    8      1952     10,900.0    32.00  |
|  22 May 1949     3,710.0   |    9      1945     10,000.0    36.00  |
|  29 Mar 1950     8,280.0   |   10      1953      8,900.0    40.00  |
|  25 Nov 1950    17,500.0   |   11      1948      8,680.0    44.00  |
|  18 Jan 1952    10,900.0   |   12      1950      8,280.0    48.00  |
|  23 May 1953     8,900.0   |   13      1947      8,280.0    52.00  |
|  14 Aug 1994    11,700.0   |   14      1944      7,300.0    56.00  |
|  20 Jan 1995     2,530.0   |   15      1999      6,030.0    60.00  |
|  19 Jan 1996    30,400.0   |   16      2003      5,920.0    64.00  |
|  08 Nov 1996     4,630.0   |   17      1941      5,660.0    68.00  |
|  08 Jan 1998     5,510.0   |   18      1998      5,510.0    72.00  |
|  24 Jan 1999     6,030.0   |   19      2000      5,220.0    76.00  |
|  04 Apr 2000     5,220.0   |   20      2002      4,660.0    80.00  |
|  17 Dec 2000     2,190.0   |   21      1997      4,630.0    84.00  |
|  13 May 2002     4,660.0   |   22      1949      3,710.0    88.00  |
|  01 Aug 2003     5,920.0   |   23      1995      2,530.0    92.00  |
|  18 Sep 2004    13,700.0   |   24      2001      2,190.0    96.00  |
|----------------------------|------------------------------------|



<< Skew Weighting >>
--------------------------------------------------------------
Based on 24 events, mean-square error of station skew =    0.226
Mean-square error of regional skew is undefined.
--------------------------------------------------------------


<< Frequency Curve >>
CLARION RIVER-RIDGWAY, PA-FLOW-ANNUAL PEAK
-------------------------------------------------------------------
|  Computed    Expected  |  Percent   |    Confidence Limits    |
|    Curve    Probability |  Chance    |        0.05        0.95 |
|        Flow, CFS       | Exceedance |        Flow, CFS        |
|------------------------|------------|-------------------------|
|    67,541.3         --- |     0.2    |   139,913.9    42,532.1 |
```

1:1..1:1 1:1

Figure 6-9. General Frequency Analysis Report File.

Plots, tables and reports can also be created by selecting menu options from the **Results** menu. At least one General Frequency analysis must be selected in the study explorer before selecting one of the menu options on the Results menu. Results from multiple analyses are combined in one graph if they are selected in the study explorer when the **Graph** menu option is selected. The **Results→Summary Report** menu option will create a summary table of statistics and frequency curve ordinates for the selected analyses as shown in Figure 6-10.



General Frequency Summary Report
Mon Jan 05 22:19:31 PST 2009

Table 1 Summary of Statistics

Analysis Name	Data Name	Mean	Std Dev	Skew Stn	Skew Rgnl	Skew Wght	Skew Adpt	Hist Evnt	Outlier Hi	Outlier Lo	Zero/ Msng	Syst Evnt	Hist Perd
General Frequency FFA Test 1	FISHKILL CREEK-BEACON-FLOW	3.378	0.255	0.730	0.600	0.677	0.677	0	0	0	0	24	
General Frequency FFA Test 2	FLOYD RIVER-JAMES IA-FLOW	3.547	0.447	0.175	-0.300	0.074	0.074	0	1	0	0	39	82
General Frequency FFA Test 3	BACK CREEK-JONES SPRINGS, WV-FLOW	3.741	0.231	0.623	0.500	0.586	0.586	0	0	1	0	38	
General Frequency FFA Test 4	ORESTIMBA CREEK-NEWMAN, CA-FLOW	2.975	0.678	-0.578	-0.300	-0.472	-0.472	0	0	1	6	42	

Table 2 Summary of Frequency Curve Ordinates

Analysis Name	Data Name	Percent Change Exceedance 99	95	90	80	50	20	10	5	2	
General Frequency FFA Test 1	FISHKILL CREEK-BEACON-FLOW	830.5	1038.5	1192.1	1438.2	2194.8	3657.1	4959.9	6506.1	9031.5	1
General Frequency FFA Test 2	FLOYD RIVER-JAMES IA-FLOW	349.4	671.3	955.3	1471.8	3404.8	8018.8	12638.5	18470.8	28425.7	3
General Frequency FFA Test 3	BACK CREEK-JONES SPRINGS, WV-FLOW	2004.3	2524.6	2901.0	3490.3	5238.5	8449.0	11181.3	14322.2	19266.5	2
General Frequency FFA Test 4	ORESTIMBA CREEK-NEWMAN, CA-FLOW	15.2	61.8	121.9	266.5	1043.8	3450.0	6041.4	9289.3	14572.3	1

Figure 6-10. Summary Table for Selected General Frequency Analyses.

CHAPTER 7

Performing a Volume Frequency Analysis

The current version of HEC-SSP allows the user to perform a volume frequency analysis of flow data. In this type of analysis, frequency curves are developed using daily average flows. Runoff volumes are expressed as average flows over a time duration. For example, the 3-day flow is the average flow over a three day period. The volume from the 3-day flow would be computed by multiplying the 3-day flow (in cfs) by 259200 seconds (3-days). Typical volume frequency analyses would develop frequency curves for a number of volumes (flow-duration), like the 1, 3, 7, 15, 30, 60, 90, 120, and 180 day volumes. The user can choose between different analytical distributions as well as perform a graphical fit to the data. This chapter discusses in detail how to use the Volume Frequency Analysis editor in HEC-SSP.

Contents

Starting a New Volume Frequency Analysis

A volume frequency analysis can be started in two ways within the software, either by right clicking on the Volume Frequency Analysis folder in the study explorer and selecting **New**, or by going to the **Analysis** menu and selecting **New** and then **Volume-Frequency Analysis**. When a new volume frequency analysis is selected, the Volume Frequency Analysis editor will appear as shown in Figure 7-1.

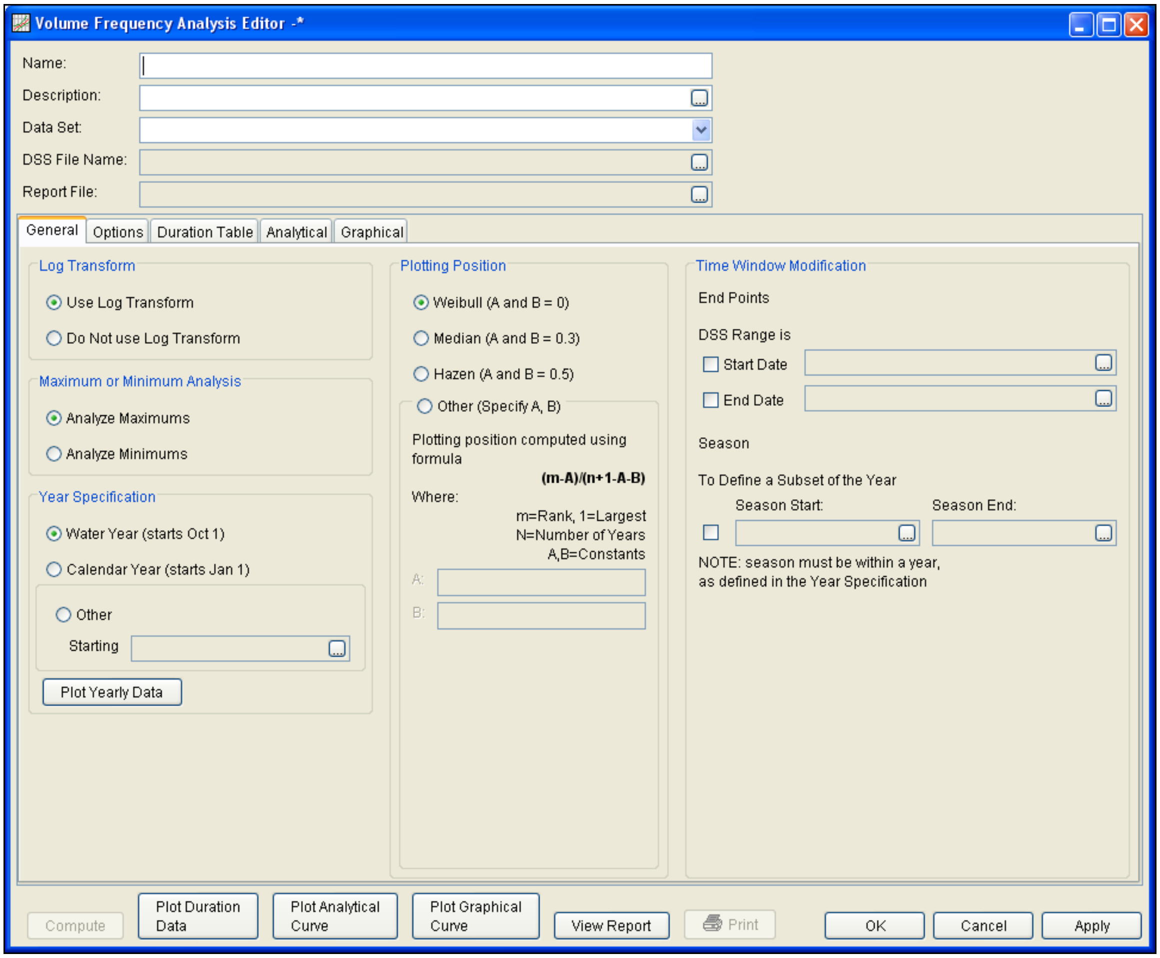


Figure 7-1. Volume Frequency Analysis Editor.

The user is required to enter a **Name** for the analysis; while a **Description** is optional. A data set must be selected from the available data sets stored in the current study DSS file (see Chapter 4 for importing daily flow data into the study). The list of data that can be selected for a volume frequency analysis will only include those data that have a regular interval, like 1HOUR and 1DAY (E-part pathname). Once a **Name** is entered and a data set is selected, the **DSS File Name** and **Report File** will automatically be filled out. The DSS filename is by default the same name as the study DSS file. The report file is given the same name as the analysis with the extension ".rpt".

General Settings and Options

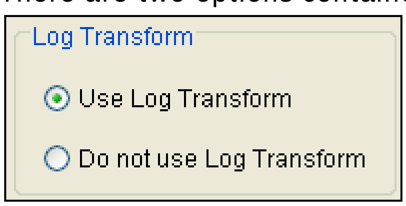
Once the analysis name and data set are selected, the user can begin defining the analysis. Five tabs are contained on the Volume Frequency Analysis editor. The tabs are labeled **General**, **Options**, **Duration Table**, **Analytical**, and **Graphical**. This section of the manual explains the use of the General and Options tabs.

General Settings

The first tab contains general settings for performing the frequency analysis (Figure 7-1). These settings include:

- Log Transforms
- Plotting Positions
- Maximum or Minimum Analysis
- Year Specification
- Time Window Modification

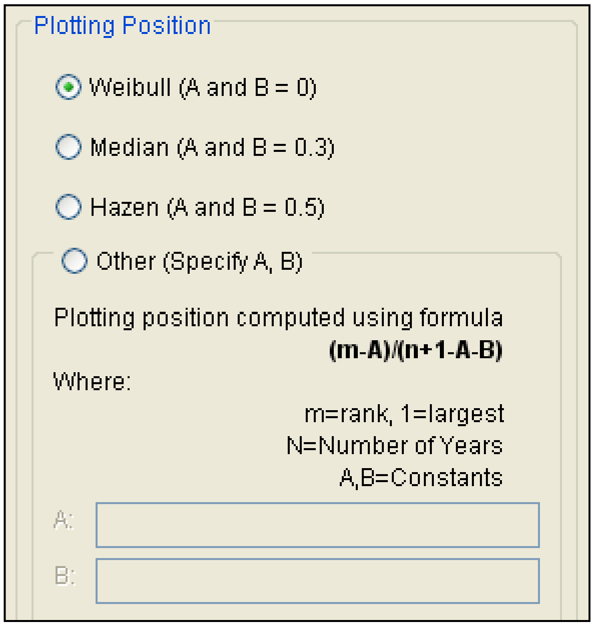
Log Transform



There are two options contained within the Log Transform setting: **Use Log Transform** and **Do not use Log Transform**. If the user selects **Use Log Transform**, then the logs of the data will be computed first, and the frequency analysis will be performed on the logs of the data. If the user selects **Do not use Log Transform**, then the frequency analysis will be performed on the raw data values without taking the logs of the data. The default setting is **Use Log Transform**.

Plotting Positions

Plotting positions are used for plotting the raw data points on the graph. There are four options for plotting position within HEC-SSP: Weibull, Median, Hazen, and user entered coefficients. The default method is the Weibull plotting position method.



The generalized plotting position equation is:

$$P = \frac{(m - A)}{(n + 1 - A - B)}$$

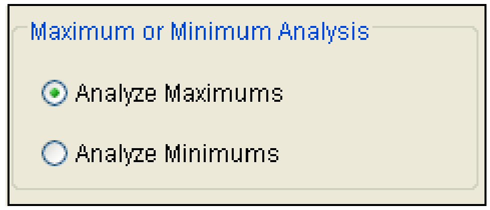
Where: m = rank of flood values with the largest equal to 1.

n = number of flood peaks in the data set.

A & B = constants dependent on which equation is used (Weibull A and B=0; Median A and B = 0.3; and Hazen A and B=0.5).

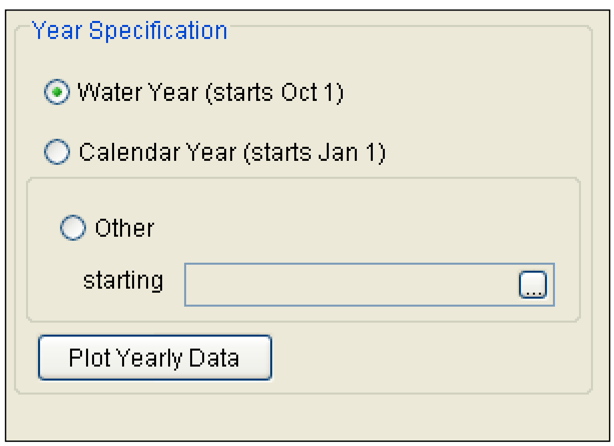
Plotting positions are estimates of the exceedance probability for each data point. Different methods can give different values for the probabilities of the highest and lowest points in the data set. The plotting of data on the graph by a plotting position method is only done as a guide to assist in evaluating the computed curve. The plotting position method selected does not have any impact on the computed curve.

Maximum or Minimum Analysis



A volume frequency analysis can be performed using annual maximum or minimum flows. A maximum flow analysis could be used for determining the amount of reservoir storage required for a flood of specific frequency. A minimum flow, or low flow analysis, could be used determine if a river could supply a given demand. A low flow analysis could also be beneficial for water quality and reservoir storage projects. There are two options contained in the Maximum or Minimum Analysis section. If **Analyze Maximums** is selected, then the program will extract annual maximum volumes for all durations. The program will extract annual minimum volumes for all durations if **Analyze Minimums** is selected.

Year Specification



This option allows the user to define the beginning and ending date for what will be considered as the analysis year for extracting the data. These dates are used for extracting the annual maximum or minimum flows, in order to get one value for each analysis year. It is important to choose a start date that captures all flood events from a certain hydrologic regime. If high flows generally occur between November and May, then the year should not start between these months. This will minimize the possibility that the same flood event is used for consecutive years. There are three options contained in the Year Specification section. If **Water Year** is selected, the program uses a starting date of October 1 and an ending date of September 30. If **Calendar Year** is selected, the program uses a starting date of January 1 and an ending date of December 31. The **Other** option lets the user define the starting date. One way to determine when the year should begin is to plot each year of record on top of one another, as shown in Figure 7-2. The program will create a graph like the one shown in Figure 7-2 when the **Plot Yearly Data** button is pressed. This data set is from an area that experiences both snowmelt floods and summer/fall rain floods. Starting the year on January 1 would be more appropriate for this data set because a few large flood events occurred around October 1.

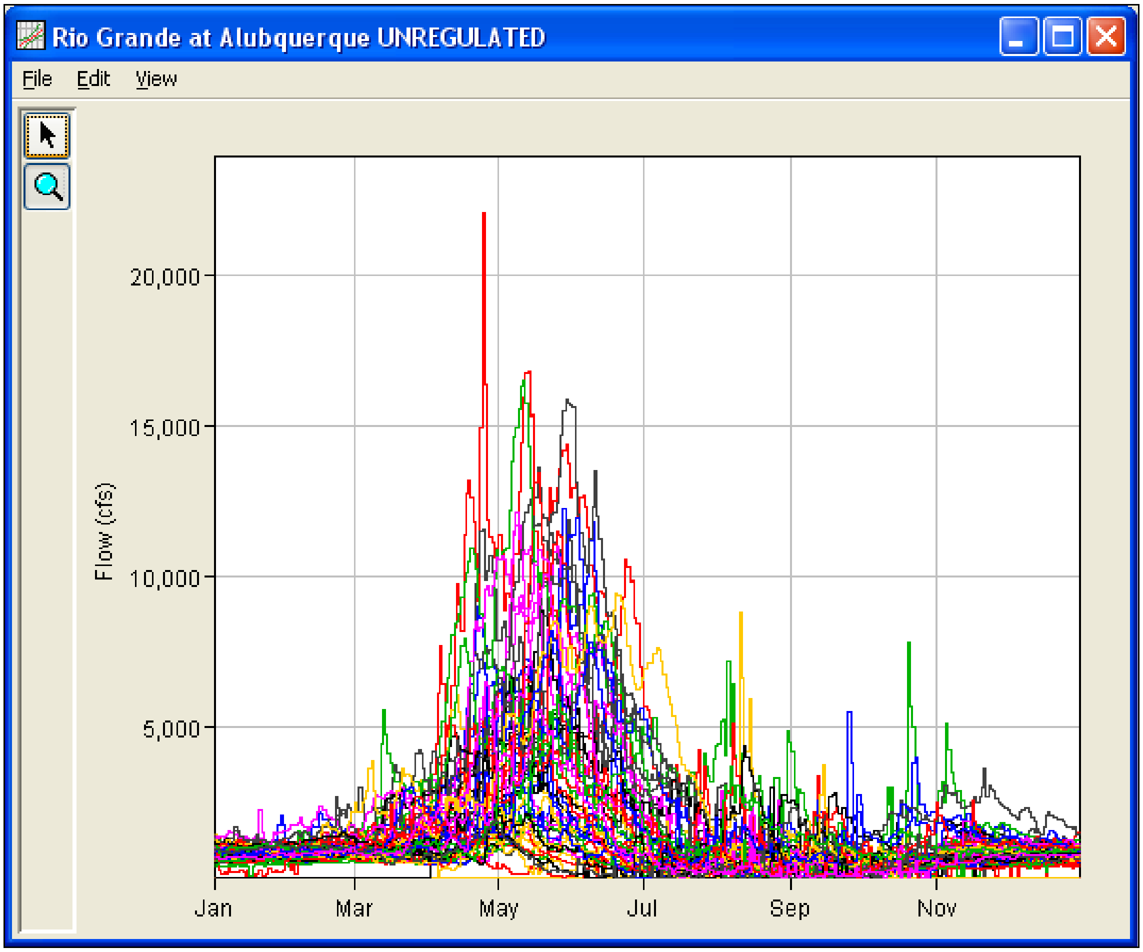
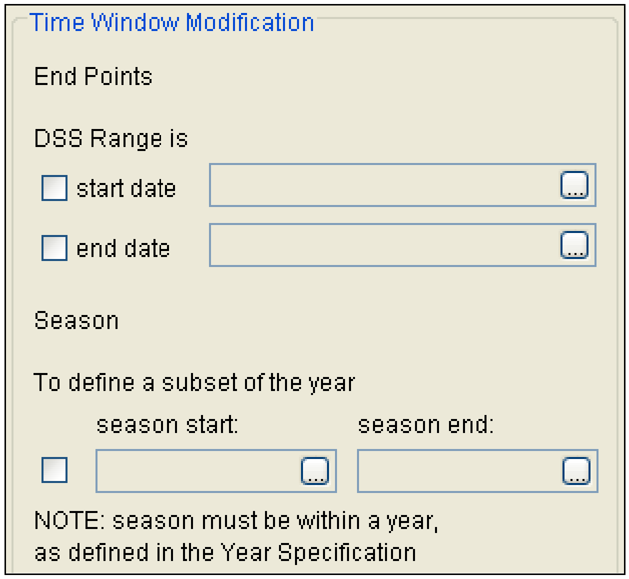


Figure 7-2. Plot Showing when Flood Events Typically Occur.

Time Window Modification

This option allows the user to narrow the time window used for the analysis. When left unchecked, the program will use all of the data contained in the selected data set. The user can enter either a start or end date or both a start and end date. If a start and/or end date are used, they must be dates that are included within the selected data set. The date range for the selected data set is shown in the editor just above the Start Date field.

An additional option at the bottom of the time window modification section allows the user to define a shorter duration, a **Season**, within the year in which the program extracts maximum or minimum flows. This option allows the user to analyze floods that typically occur during a specific season, like snowmelt floods. When left unchecked, the program will examine all flow records during the year. The season start and end dates must be entered using a two digit day followed by the month, example 15May. The season start and end dates must fall within a year as defined in the Year Specification. The user must enter both start and end dates to define the season subset.



Options

In addition to the general settings, there are also several options available to the user for modifying the computation of the volume-frequency curves. These options include:

- Flow-durations
- User-Specified Frequency Ordinates
- Output Labeling
- Low Outlier Threshold
- Historic Period Data

When the Options tab is selected, the Volume Frequency Analysis editor will appear as shown in Figure 7-3.

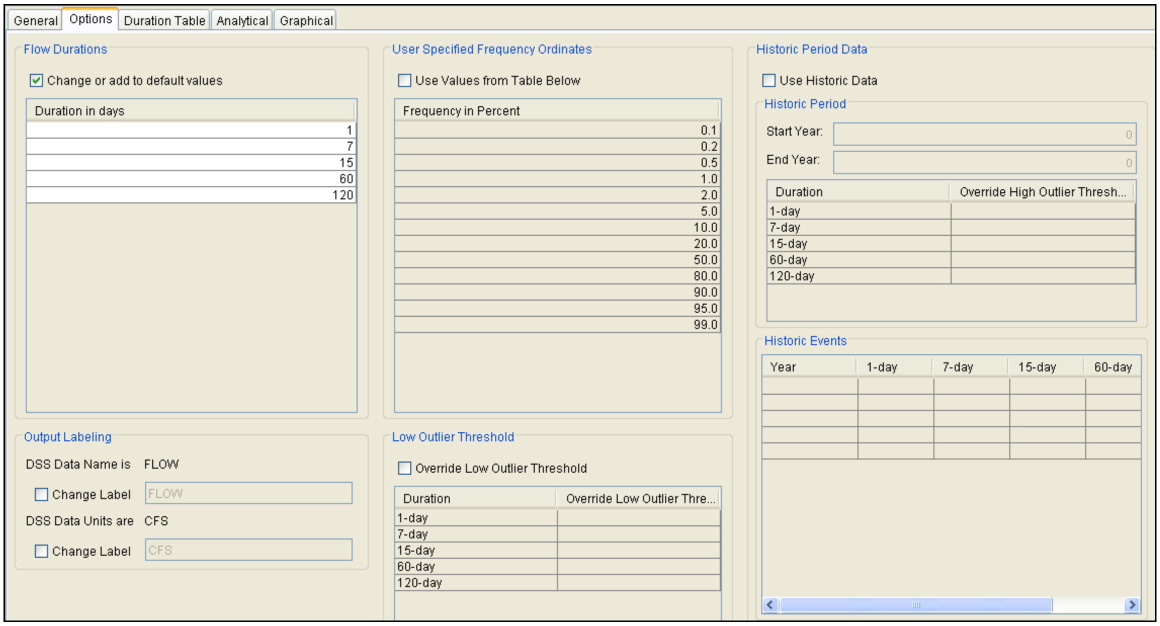
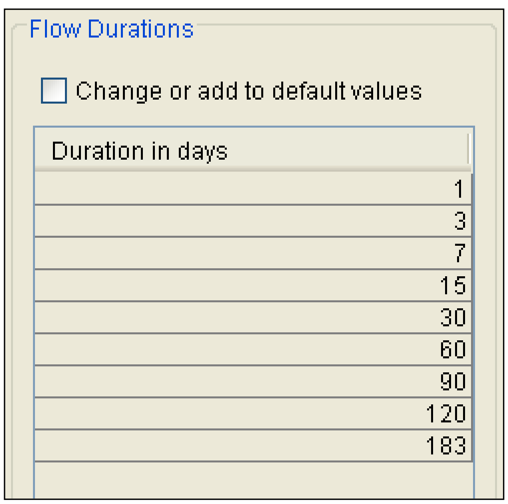


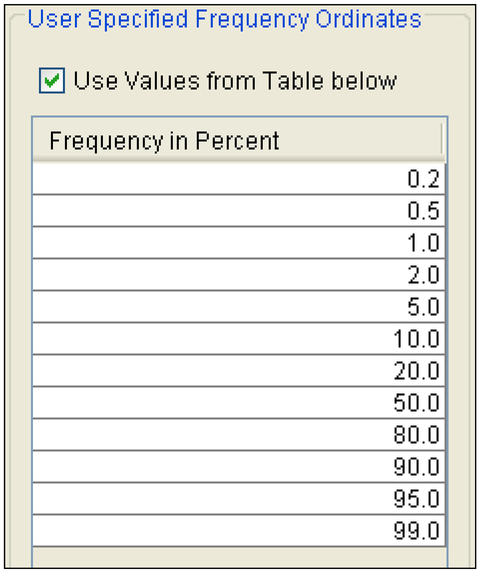
Figure 7-3. Volume Frequency Analysis Editor with Options Tab Selected.

Flow-Durations

This option lets the user define which durations are used in the volume frequency analysis. The program will extract annual maximum or minimum volumes based on the durations defined in this table. The default durations are 1, 3, 7, 15, 30, 60, 120, and 183 days. Check the box next to **Change or add to default values** to change or add additional durations to the analysis. Once this box is checked, the user can add/remove rows and edit the duration values. To add or remove a row from the table, select the row(s), place the mouse over the highlighted row(s) and click the right mouse button. The shortcut menu contains options to **Insert Row(s)** and **Delete Row(s)**. The program will use the default durations, even if they are not contained in the table, when the **Change or add to default values** option is not checked.



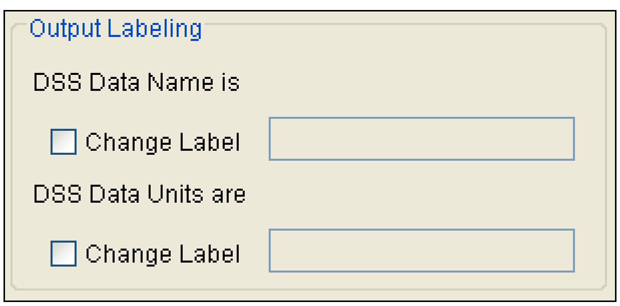
User Specified Frequency Ordinates



This option allows the user to change the frequency ordinates used for creating result tables and graphs. The default values listed in percent chance exceedance are 0.2, 0.5, 1, 2, 5, 10, 20, 50, 80, 90, 95, and 99. Check the box next to **Use Values from Table below** to change or add additional values. Once this box is checked, the user can add/remove rows and edit the frequency values. To add or remove a row from the table, select the row(s), place the mouse over the highlighted row(s) and click the right mouse button. The shortcut menu contains options to **Insert Row(s)** and **Delete Row(s)**. The program will use the default values, even if they are not contained in the table, when the **Use Values from Table below** option is not checked. Finally, all values in the table must be between 0 and 100.

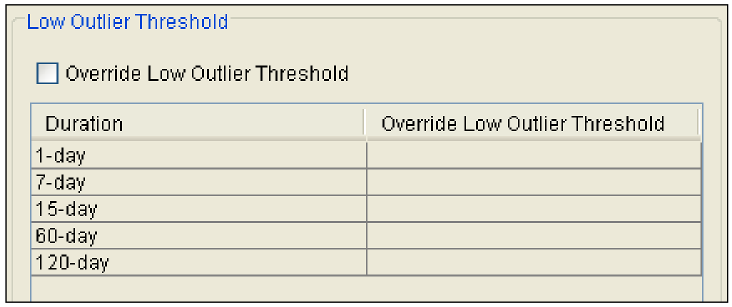
Output Labeling

This option allows the user to change the default labels for data contained in the output tables and plots. The user can change both the name of the data and how the units of the data are labeled.



Low Outlier Threshold

High and low outlier tests are based on the procedures outlined in Bulletin 17B, and are applied in the same manner in the Volume Frequency Analysis. The outlier magnitudes calculated by the Bulletin 17B procedure are used as default values for the high and low outlier thresholds in HEC-SSP. The user has the option to enter a different low outlier threshold for each duration. If a value is entered for the low outlier threshold, then this value will override the computed value from the Bulletin 17B methodology. When analyzing maximum flows, HEC-SSP will identify both high and low outliers. However, only low outliers will be removed from the data set when performing the analysis. If a high outlier is identified in the data set, the analyst should try to incorporate historical period information to extend the time period for which the high outlier(s) is considered to be the maximum value(s). Further discussion of outlier thresholds can be found in Bulletin 17B and the HEC-SSP Statistical Reference Guide. To use the low outlier threshold, simply check the box and enter a value for one duration or all durations.



When **Analyzing Minimums** is selected on the General tab, then the Low Outlier Threshold criteria becomes the High Outlier Threshold. When applying the outlier tests, HEC-SSP will identify both high and low outliers. However, only high outliers will be removed from the data set when performing the analysis. If a low outlier is identified in the data set, the analyst should try to incorporate historical period information to extend the time period for which the low outlier(s) is considered to be the minimum value(s).

Historic Period Data

All historic data that provides reliable estimates outside the systematic record should be used in order to improve the frequency computations. Information outside of the systematic record can often be used to extend the record of the largest events to a historic period much longer than that of the systematic record. HEC-SSP uses historic data as recommended in Bulletin 17B. This calculation is applied in the same manner in the Volume Frequency Analysis. To use historic data, check the box labeled **Use Historic Data**. The user can enter a starting year for the historic period, ending year for a historic period and a High Threshold value for each duration as shown in Figure 7-4. If the user enters a high threshold value, then any data in the systematic record greater than that value will also be treated as a historical annual maximum. The user can also enter historic data that are not contained in the systematic record. This is done in the table at the bottom labeled **Historic Events**. If a start year is not entered, then the assumed start year is the earliest year of the systematic record and any historical values that have been entered. If an end year is not entered, then the assumed end year is the latest year in the systematic record and any entered historic values. Further discussion of the use of historical data can be found in Bulletin 17B. If **Analyze Minimums** is selected on the General tab then the High Threshold becomes the Low Threshold. The program will treat systematic values that are lower than the low threshold as historic annual minimums.

Note: The program treats all data in the data set as systematic data. If historic events are included in the data set, then the user can define the analysis time window (General tab – Time Window Modification) so that it only bounds the systematic record. Then define the historic events in the Historic Events table. Instead of using the Time Window Modification option, another option is to enter a High Threshold value so that the historic data point(s) would be treated as historic data (rather than part of the systematic record).

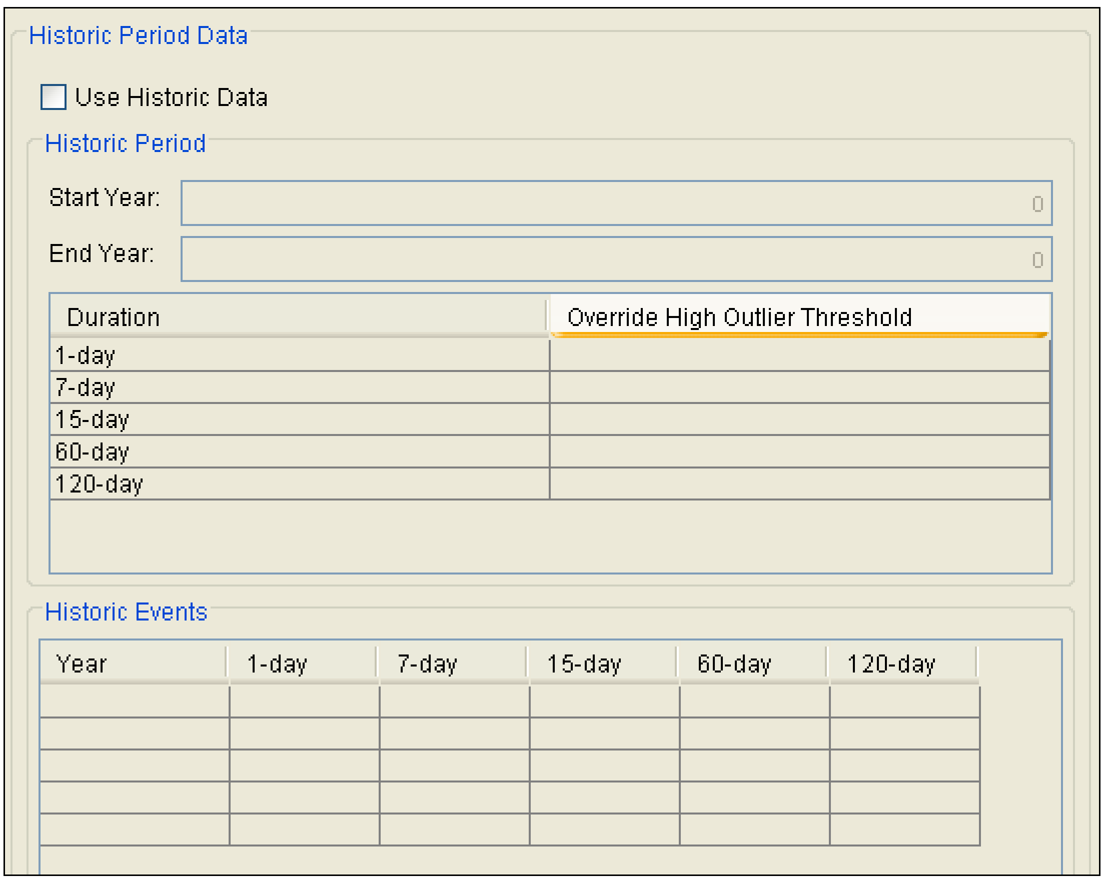


Figure 7-4. Historic Period Data on the Options Tab.

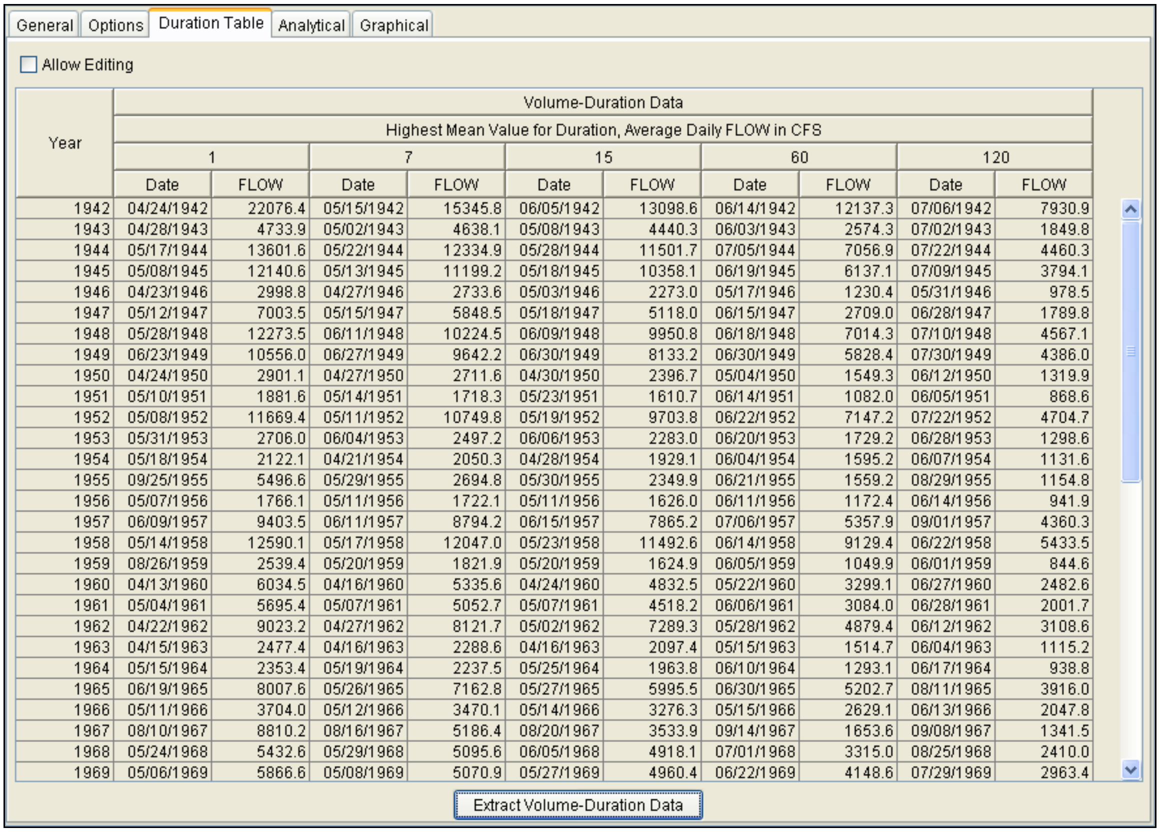
Extracting The Volume-Duration Data

The user can extract the volume-duration data once settings have been defined on the General and Options tabs. When the Duration Table tab is selected, the Volume Frequency Analysis editor will appear as shown in Figure 7-5. The program will compute the annual maximum or minimum average flows for the durations specified on the Options tab when the user presses the **Extract Volume-Duration Data** button at the bottom of the Duration Table.

The program computes the maximum/minimum flows by evaluating the flow record as one continuous record. For each duration, the program computes a time-series of average flow. These time-series are written to the study DSS file and can be viewed using HEC-DSSVue. Then the program extracts the annual maximum/minimum flows and populates the duration table.

The **Allow Editing** checkbox in the upper left portion of the Duration Table tab allows the user to manually edit values in the volume-duration table. The table becomes editable when the **Allow Editing** box is checked. Then the user can overwrite the extracted volume-duration data. In addition, the program will no longer extract volume-duration data during a compute and the **Extract Volume-Duration Data** button becomes inactive.

When computing the analysis, the program will issue a warning message if any of the maximum/minimum flows occur a specific number of days after the beginning of the year. The number of days is determined by the duration plus five days. For example, for a fifteen-day duration, the program issues a warning if the maximum/minimum is within twenty days after the beginning of the year. If water year is chosen, then the program issues a warning if the maximum/minimum occurs between October 1 – October 20. This warning is an attempt to let the user know if a maximum or minimum flow is generated by an event that began in the previous year. The goal is to prevent a scenario in which the same flow event causes maximum/minimum flows in consecutive years; this is why it is important to choose an appropriate annual starting date.



Year	Volume-Duration Data									
	Highest Mean Value for Duration, Average Daily FLOW in CFS									
	1		7		15		60		120	
	Date	FLOW	Date	FLOW	Date	FLOW	Date	FLOW	Date	FLOW
1942	04/24/1942	22076.4	05/15/1942	15345.8	06/05/1942	13098.6	06/14/1942	12137.3	07/06/1942	7930.9
1943	04/28/1943	4733.9	05/02/1943	4638.1	05/08/1943	4440.3	06/03/1943	2574.3	07/02/1943	1849.8
1944	05/17/1944	13601.6	05/22/1944	12334.9	05/28/1944	11501.7	07/05/1944	7056.9	07/22/1944	4460.3
1945	05/08/1945	12140.6	05/13/1945	11199.2	05/18/1945	10358.1	06/19/1945	6137.1	07/09/1945	3794.1
1946	04/23/1946	2998.8	04/27/1946	2733.6	05/03/1946	2273.0	05/17/1946	1230.4	05/31/1946	978.5
1947	05/12/1947	7003.5	05/15/1947	5848.5	05/18/1947	5118.0	06/15/1947	2709.0	06/28/1947	1789.8
1948	05/28/1948	12273.5	06/11/1948	10224.5	06/09/1948	9950.8	06/18/1948	7014.3	07/10/1948	4567.1
1949	06/23/1949	10556.0	06/27/1949	9642.2	06/30/1949	8133.2	06/30/1949	5828.4	07/30/1949	4386.0
1950	04/24/1950	2901.1	04/27/1950	2711.6	04/30/1950	2396.7	05/04/1950	1549.3	06/12/1950	1319.9
1951	05/10/1951	1881.6	05/14/1951	1718.3	05/23/1951	1610.7	06/14/1951	1082.0	06/05/1951	868.6
1952	05/08/1952	11669.4	05/11/1952	10749.8	05/19/1952	9703.8	06/22/1952	7147.2	07/22/1952	4704.7
1953	05/31/1953	2706.0	06/04/1953	2497.2	06/06/1953	2283.0	06/20/1953	1729.2	06/28/1953	1298.6
1954	05/18/1954	2122.1	04/21/1954	2050.3	04/28/1954	1929.1	06/04/1954	1595.2	06/07/1954	1131.6
1955	09/25/1955	5496.6	05/29/1955	2694.8	05/30/1955	2349.9	06/21/1955	1559.2	08/29/1955	1154.8
1956	05/07/1956	1766.1	05/11/1956	1722.1	05/11/1956	1626.0	06/11/1956	1172.4	06/14/1956	941.9
1957	06/09/1957	9403.5	06/11/1957	8794.2	06/15/1957	7865.2	07/06/1957	5357.9	09/01/1957	4360.3
1958	05/14/1958	12590.1	05/17/1958	12047.0	05/23/1958	11492.6	06/14/1958	9129.4	06/22/1958	5433.5
1959	08/26/1959	2539.4	05/20/1959	1821.9	05/20/1959	1624.9	06/05/1959	1049.9	06/01/1959	844.6
1960	04/13/1960	6034.5	04/16/1960	5335.6	04/24/1960	4832.5	05/22/1960	3299.1	06/27/1960	2482.6
1961	05/04/1961	5695.4	05/07/1961	5052.7	05/07/1961	4518.2	06/06/1961	3084.0	06/28/1961	2001.7
1962	04/22/1962	9023.2	04/27/1962	8121.7	05/02/1962	7289.3	05/28/1962	4879.4	06/12/1962	3108.6
1963	04/15/1963	2477.4	04/16/1963	2288.6	04/16/1963	2097.4	05/15/1963	1514.7	06/04/1963	1115.2
1964	05/15/1964	2353.4	05/19/1964	2237.5	05/25/1964	1963.8	06/10/1964	1293.1	06/17/1964	938.8
1965	06/19/1965	8007.6	05/26/1965	7162.8	05/27/1965	5995.5	06/30/1965	5202.7	08/11/1965	3916.0
1966	05/11/1966	3704.0	05/12/1966	3470.1	05/14/1966	3276.3	05/15/1966	2629.1	06/13/1966	2047.8
1967	08/10/1967	8810.2	08/16/1967	5186.4	08/20/1967	3533.9	09/14/1967	1653.6	09/08/1967	1341.5
1968	05/24/1968	5432.6	05/29/1968	5095.6	06/05/1968	4918.1	07/01/1968	3315.0	08/25/1968	2410.0
1969	05/06/1969	5866.6	05/08/1969	5070.9	05/27/1969	4960.4	06/22/1969	4148.6	07/29/1969	2963.4

Figure 7-5. Volume-Duration Table.

The user must **Compute** the analysis before viewing a frequency plot of the volume-duration data. The plot created by pressing the **Plot Duration Data** button, located at the bottom of a Volume Frequency Analysis editor, shows the annual maximum/minimum volumes plotted using the user specified plotting position method, as shown in Figure 7-6.

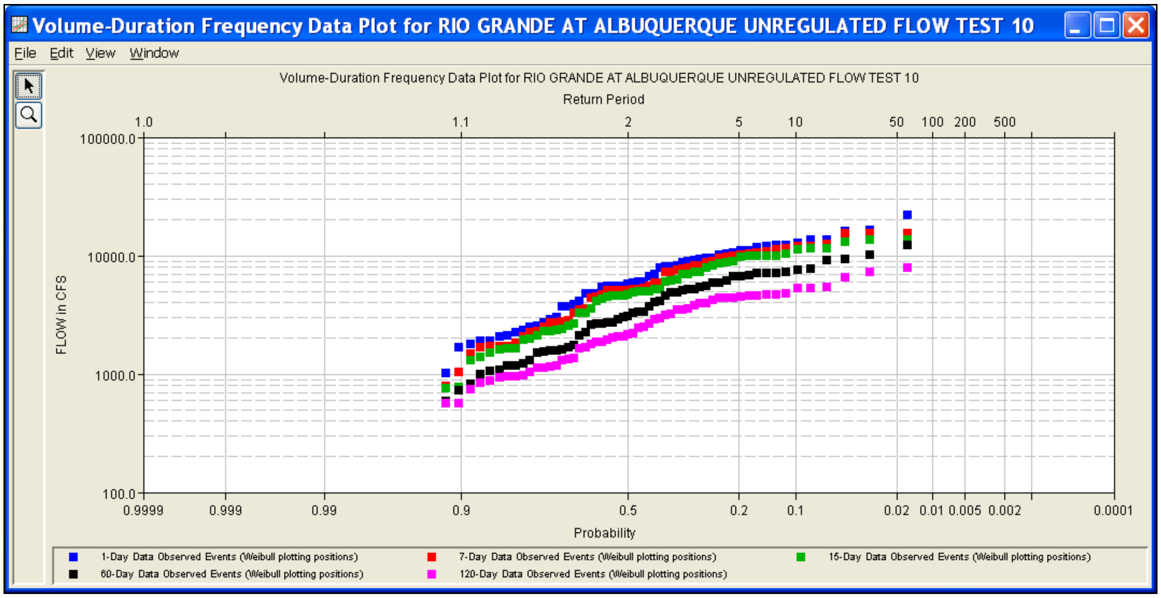


Figure 7-6. Plot of Volume-Duration Data.

Analytical Frequency Analysis

The user can choose between performing an Analytical Frequency Analysis or a Graphical Frequency Analysis once settings have been defined on the General and Options tabs. The Duration Data does not have to be extracted before computing an analysis. The program will automatically extract the duration data when the **Compute** button is pressed. This section of the manual describes how to compute and view results for an Analytical Frequency Analysis.

When the user selects the **Analytical** tab on the Volume Frequency Analysis editor, the window will appear as shown in Figure 7-7. As shown, four additional tabs will appear on the screen: Settings, Tabular Results, Plot, and Statistics.

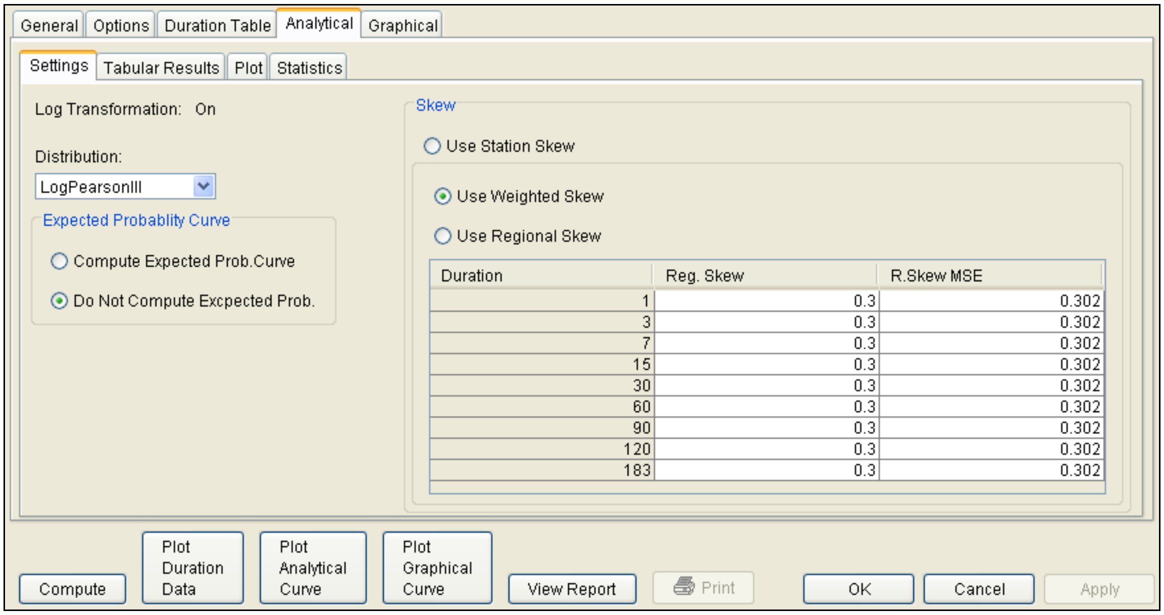


Figure 7-7. Analytical Tab of the Volume Frequency Analysis Editor.

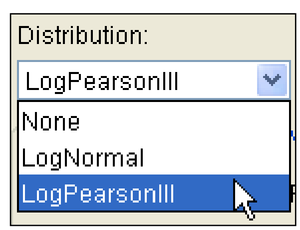
Settings

In addition to settings on the General and Options tabs, there are more options on the Settings tab the user must define in order to perform an Analytical Frequency analysis on the volume-duration data. These settings include:

- Distribution
- Expected Probability Curve
- Skew

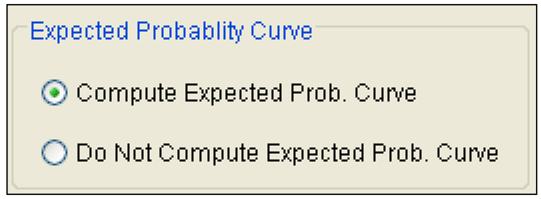
Distribution

This option allows the user to select a distribution to perform the frequency analysis. The current version of HEC-SSP contains five distribution choices: None, Normal, LogNormal, Pearson III, and LogPearson III. If the user has selected the **Use Log Transform** option, located on the General tab, then the available choices for distribution are None, LogNormal, and LogPearson III. If the user has selected the **Do not use Log Transform** option, located on the General tab, then the distribution choices are None, Normal, and Pearson III.



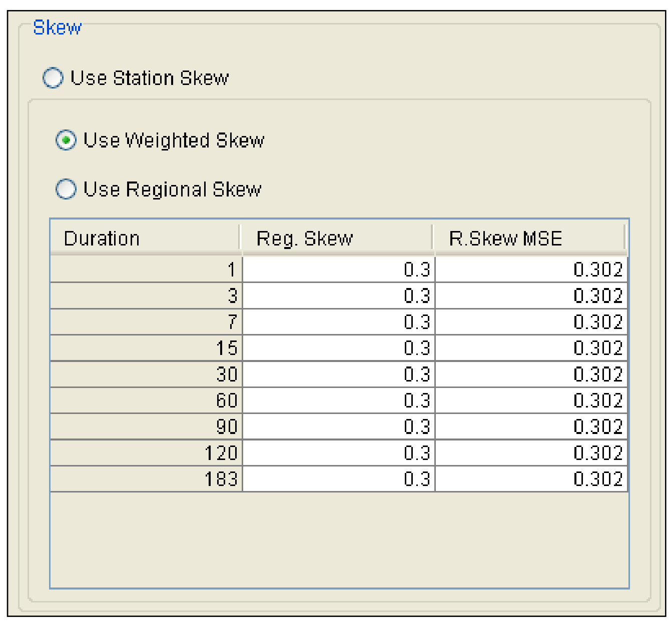
Expected Probability Curve

This setting has two options, **Compute Expected Prob. Curve** and **Do Not Compute Expected Prob. Curve**. The default setting is to have the expected probability curve computed. When computed, this curve will be shown in both the result table and the plot as an additional curve to the computed curve. The expected probability adjustment is an attempt to correct for a certain bias in the frequency curve computation due to the shortness of the record. Please review the discussion in Bulletin 17B about the expected probability curve adjustment for an explanation of how and why it is computed. The use of the expected probability curve is a policy decision. It is most often used in establishing design flood criteria. The basic flood frequency curve without the expected probability curve adjustment is the curve used in computation of confidence limits, risk, and in obtaining weighted averages of independent estimates of flood frequency discharge (WRC, 1982).



Skew

The skew option is only available whenever the analytical distribution is set to PearsonIII or LogPearsonIII. There are three options contained within the skew setting, **Use Station Skew**, **Use Weighted Skew**, and **Use Regional Skew**. The default skew setting is **Use Station Skew**. With this setting, the skew of the computed curve will be based solely on computing a skew from the data points.

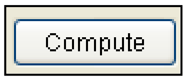


The **Use Weighted Skew** option requires the user to enter a generalized regional skew and a mean-square error (MSE) of the generalized regional skew. This option weights the computed station skew with the generalized regional skew. The equation for performing this weighting can be found in Bulletin 17B (Equation 6). If a regional skew is taken from Plate I of Bulletin 17B (the skew map of the United States), the value of MSE = 0.302.

The **Use Regional Skew** option requires the user to enter a generalized regional skew and a mean-square error (MSE) of the generalized regional skew. The program will ignore the computed station skew and use only the generalized regional skew.

Compute

Press the **Compute** button, located at the bottom of the Volume Frequency Analysis editor, once options have been set on the General, Options, and Settings tabs. If the compute is successful, the user will receive a message that says **Compute Complete**. At this point, the user can review results from the analytical analysis by selecting the Tabular Results and Plot tabs.

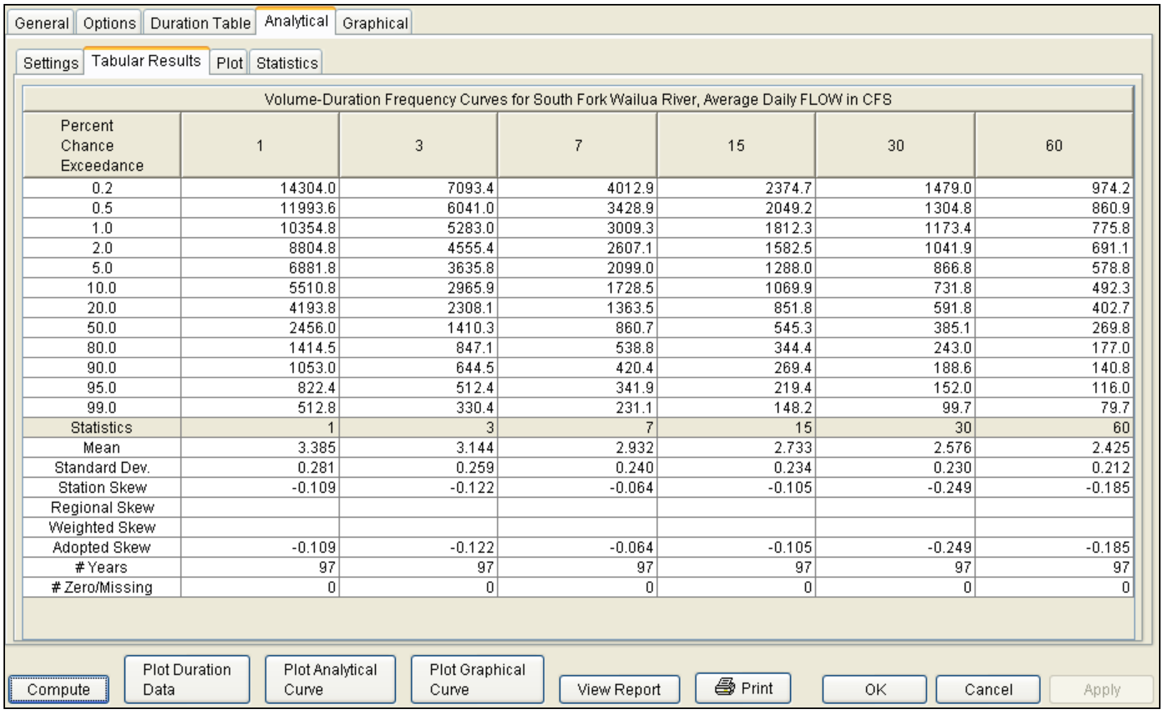


Multiple Volume Frequency analyses can be computed using the **Compute Manager**. Select the **Analysis→Compute Manager** menu option to open the Compute Manager. Select the analyses to be computed and then press the **Compute** button. Close the compute dialogs and Compute Manager when the program finishes computing the analyses.

Tabular Results

The **Tabular Results** tab contains a table of results for the analytical frequency analysis. An example of the results table is shown in Figure 7-8. The top portion of this table contains the analytical frequency curves for each duration. Data in the frequency curves can be re-sorted. Click the **Percent Chance Exceedance** column header (two mouse clicks are required the first time). The percent chance exceedance ordinates, along with the frequency curves, will sort so that the lowest values are on top or the highest values are on top. The statistics of the analytical frequency curves are contained below the frequency curve ordinates. The statistics include the mean, standard deviation, station skew, regional skew, weighted skew, adopted skew, number of years of record, and number of years with zero or missing flow.

User-adjusted statistics can be defined by the user on the **Statistics** tab. If the user has not entered statistics on the Statistics tab, then the results table will look similar to Figure 7-8. If the user does enter statistics on the Statistics tab, then the results table will include the adjusted mean, adjusted standard deviation, and adjusted skew. If specified by the user, the program will use the user-adjusted statistics when computing the analytical curves.



Volume-Duration Frequency Curves for South Fork Wailua River, Average Daily FLOW in CFS						
Percent Chance Exceedance	1	3	7	15	30	60
0.2	14304.0	7093.4	4012.9	2374.7	1479.0	974.2
0.5	11993.6	6041.0	3428.9	2049.2	1304.8	860.9
1.0	10354.8	5283.0	3009.3	1812.3	1173.4	775.8
2.0	8804.8	4555.4	2607.1	1582.5	1041.9	691.1
5.0	6881.8	3635.8	2099.0	1288.0	866.8	578.8
10.0	5510.8	2965.9	1728.5	1069.9	731.8	492.3
20.0	4193.8	2308.1	1363.5	851.8	591.8	402.7
50.0	2456.0	1410.3	860.7	545.3	385.1	269.8
80.0	1414.5	847.1	538.8	344.4	243.0	177.0
90.0	1053.0	644.5	420.4	269.4	188.6	140.8
95.0	822.4	512.4	341.9	219.4	152.0	116.0
99.0	512.8	330.4	231.1	148.2	99.7	79.7
Statistics	1	3	7	15	30	60
Mean	3.385	3.144	2.932	2.733	2.576	2.425
Standard Dev.	0.281	0.259	0.240	0.234	0.230	0.212
Station Skew	-0.109	-0.122	-0.064	-0.105	-0.249	-0.185
Regional Skew						
Weighted Skew						
Adopted Skew	-0.109	-0.122	-0.064	-0.105	-0.249	-0.185
# Years	97	97	97	97	97	97
# Zero/Missing	0	0	0	0	0	0

Figure 7-8. Tabular Results for a Volume Frequency Analysis.

Plot

In addition to tabular results, a **Plot** tab is available for viewing results, as shown in Figure 7-9. The results graph includes the systematic annual maximum/minimum volumes, plotted using the specified plotting position method, and the analytical frequency curves. The analytical frequency curves are based on the computed statistics or user-adjusted statistics if they are defined on the Statistics tab.

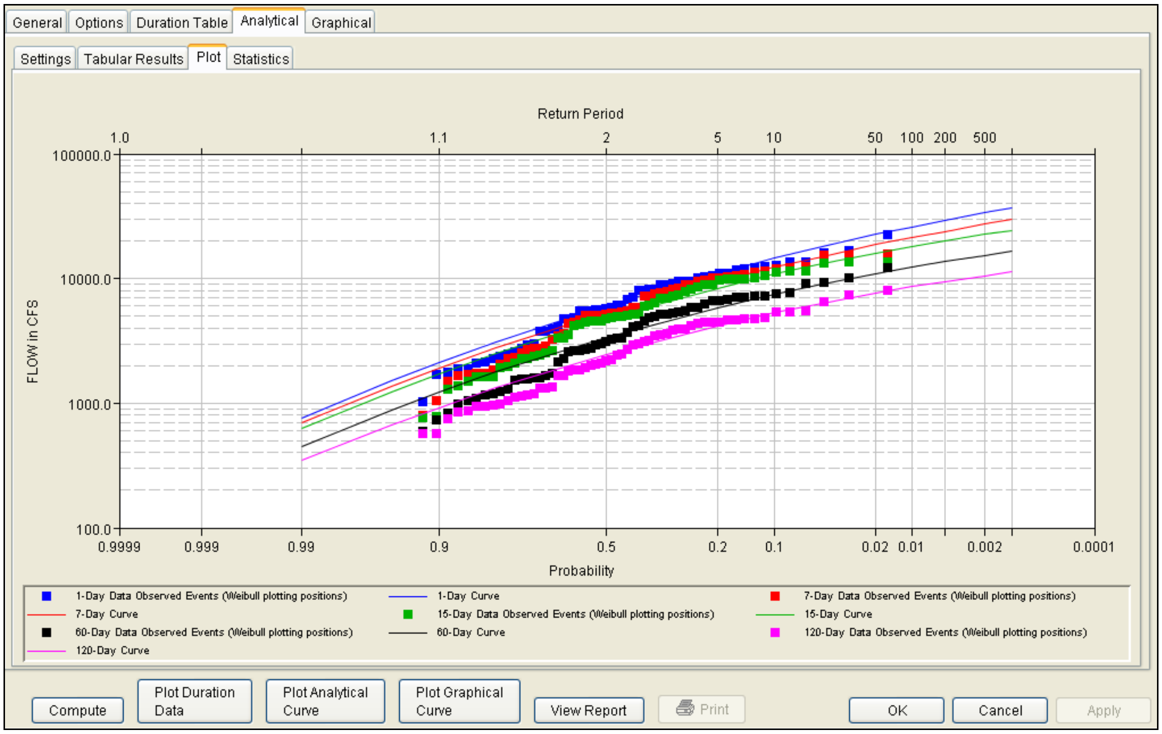


Figure 7-9. Plot of Analytical Results for a Volume Frequency Analysis.

Statistics

As discussed in EM 1110-2-1415, a necessary step in a volume-frequency analysis is to make sure the analytical frequency curves are consistent across all durations (USACE, 1993). In some situations, frequency curves from different durations might cross one another. The **Statistics** tab contains tools allowing the user to modify the mean, standard deviation, and skew to make sure frequency curves do not cross one another.

When the user selects the **Statistics** tab, the window will appear as shown in Figure 7-10. The upper portion of the Statistics tab contains a plot of the computed and user-adjusted statistics. The user has the option of choosing the parameter to be plotted in the comparison graph. Computed statistics are plotted as black data points and user-adjusted statistics are plotted as blue data points. The first table, **Sample Statistics**, contains the statistics computed from the systematic data. In addition, the adopted skew value in this table can be the station skew, weighted skew, or regional skew. The adopted skew is set by the user on the **Settings** tab. The lower table is where the user enters the adjusted statistics. Before entering adjusted statistics, the user must check the box in Column 1. User-adjusted statistics entered in this table are used when the program computes the analytical frequency curve.

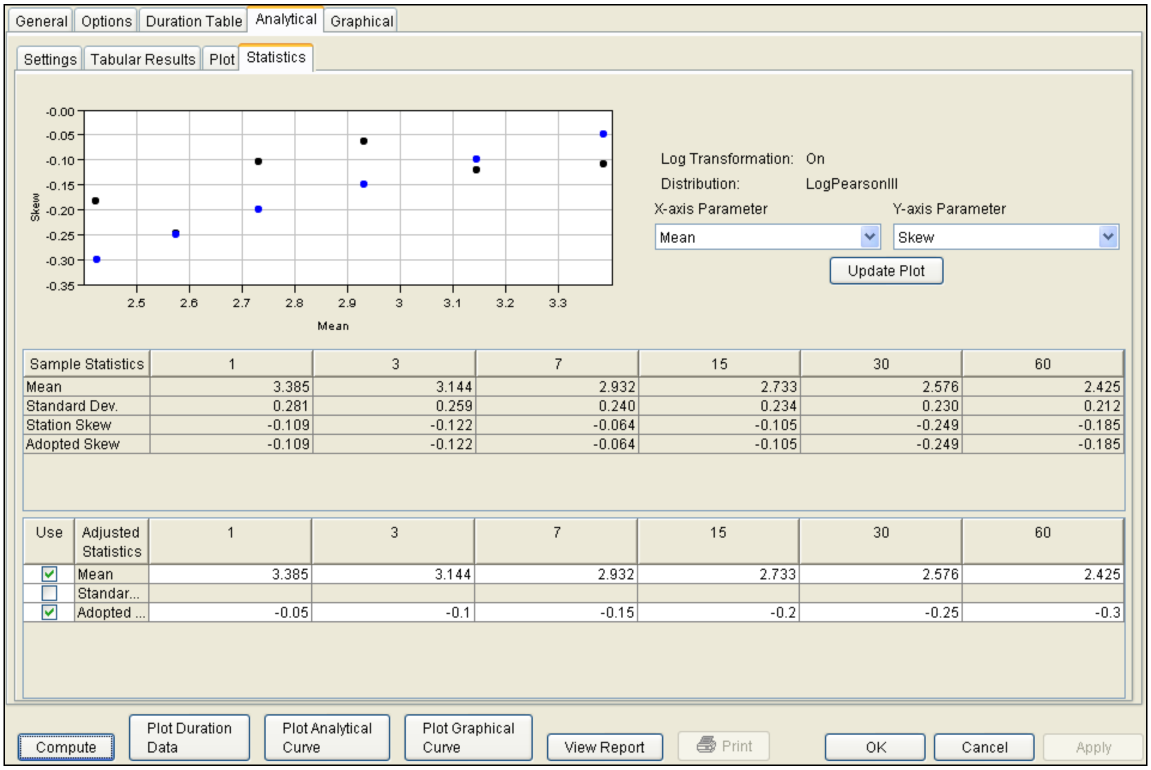


Figure 7-10. Statistics Tab in the Volume Frequency Analysis Editor.

Graphical Frequency Analysis

In addition to an analytical frequency analysis, which uses a statistical distribution to fit the data, the user has the option to graphically fit a frequency curve to the data. A graphical curve can be very useful when the available analytical distributions do not provide a good fit. One example of when a graphical frequency analysis is more appropriate is when plotting a frequency curve for flow data that is downstream of a flood control reservoir. Analytical frequency distributions are often not appropriate for fitting flow data that is significantly regulated by upstream reservoirs. In general, a portion of the flow frequency data for a highly regulated stream will be very flat in the zone in which upstream regulation can control the flow. This type of data lends itself to a graphical fit.

When the **Graphical** tab is selected on the Volume Frequency analysis editor, the window will appear as shown in Figure 7-11. As indicated, two additional tabs will appear on the screen, **Curve Input** and **Plot**.

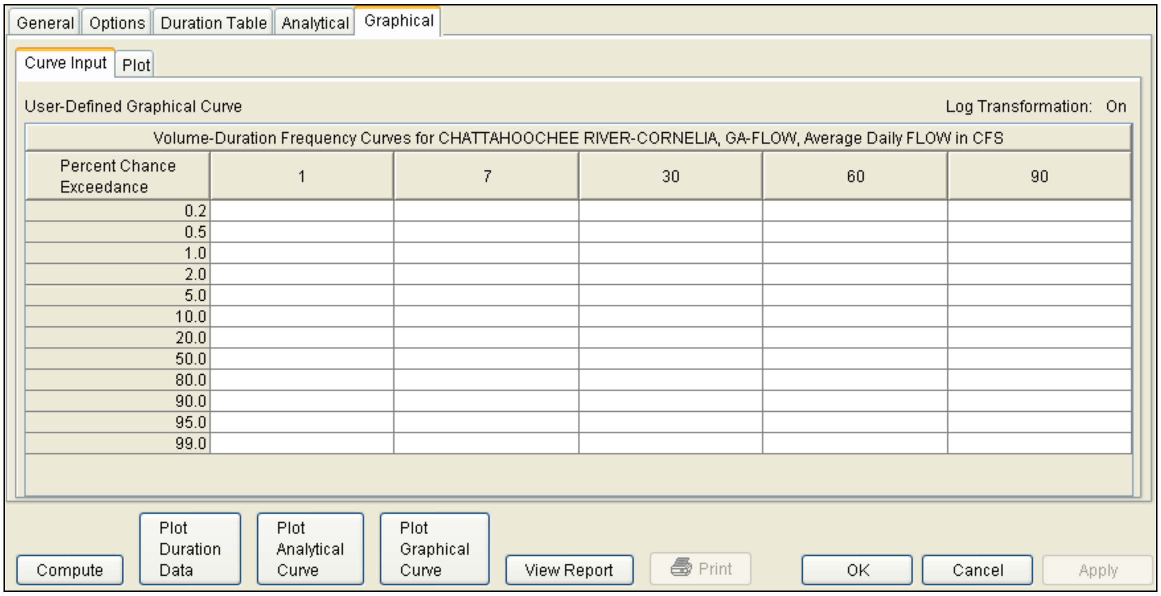


Figure 7-11. Graphical Curve Table for a Volume Frequency Analysis.

Curve Input

The user manually enters the frequency ordinates for all durations in the table on the **Curve Input** tab. As previously mentioned, the number of frequency ordinates and durations are set on the Options tab. The idea is to enter values in the table that will create a best fit line of the data, based on the user's judgment. Data entered in the graphical curve table will be plotted as a line in the graph on the **Plot** tab after the **Compute** button is pressed.

Plot

The graphical analysis **Plot** tab is available for viewing results, as shown in Figure 7-12. The results graph includes the historic annual maximum/minimum flows, plotted using the specified plotting position method, and the user-defined graphical curve, which was entered in the table on the **Curve Input** tab.

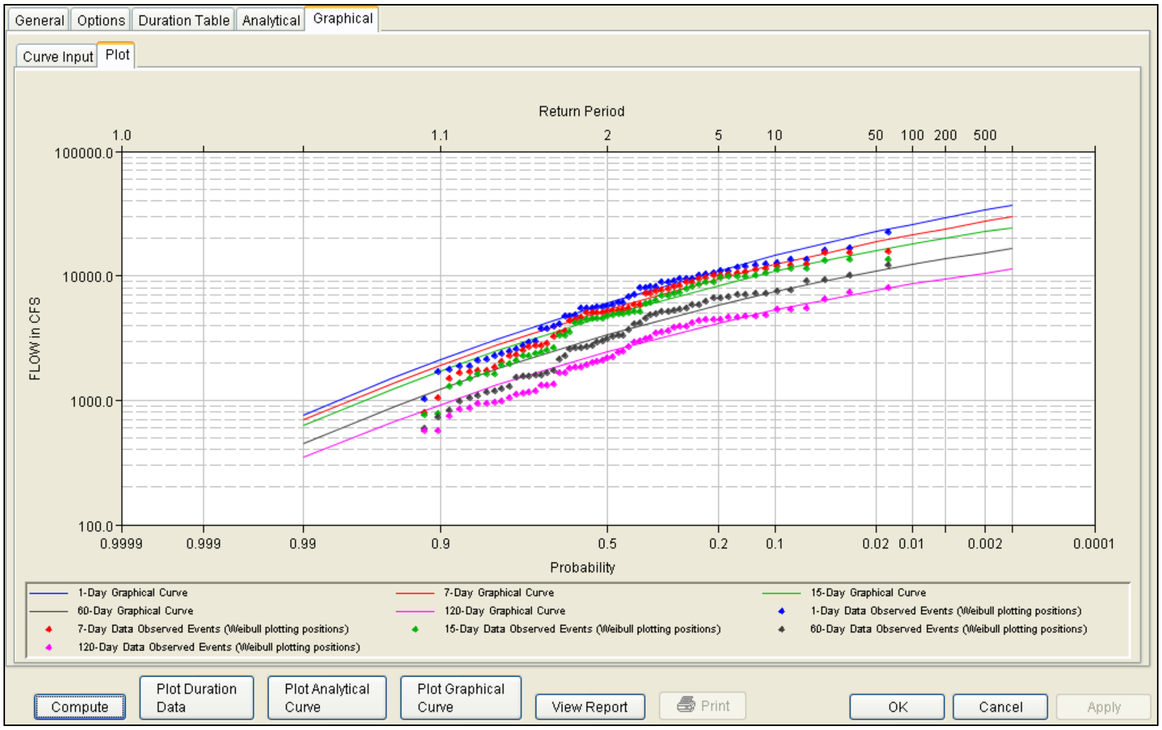


Figure 7-12. Plot Tab for a Graphical Analysis.

Viewing and Printing Results – Volume Frequency Analysis

The user can view output for the frequency analysis directly from the Volume Frequency Analysis editor (Tabular and Graphical output) or by using the plot and view report buttons at the bottom of the editor. The output consists of tabular results, an analytical frequency curve plot, a graphical frequency curve plot, and a report documenting the data and computations performed.

Tabular Output

Once the computations for the analytical frequency analysis are completed, the user can view tabular output by opening the **Tabular Results** tab under the **Analytical** analysis tab. The details of this table were discussed above. The tabular results can be printed by using the **Print** button at the bottom of the Volume Frequency Analysis editor. When the print button is pressed, a window will appear, giving the user options for how the table is to be printed.

Graphical Output

Graphical output can be opened by selecting one of the plot buttons at the bottom of the Volume Frequency Analysis editor or by selecting the **Plot** tab under the Analytical or Graphical tabs. There are three plot buttons at the bottom of the Volume Frequency Analysis editor, Plot Duration Data, Plot Analytical Curve, and Plot Graphical Curve. Pressing the Plot Duration Data button will open a new window containing a graph showing the systematic data plotted using the user-defined plotting position method. Pressing the Plot Analytical Curve button will open a new window containing a graph with both the systematic data and the computed analytical frequency curves, as shown in Figure 7-13. Pressing the Plot Graphical Curve button will open a new window containing a graph with both the systematic data and the user-defined frequency curves.

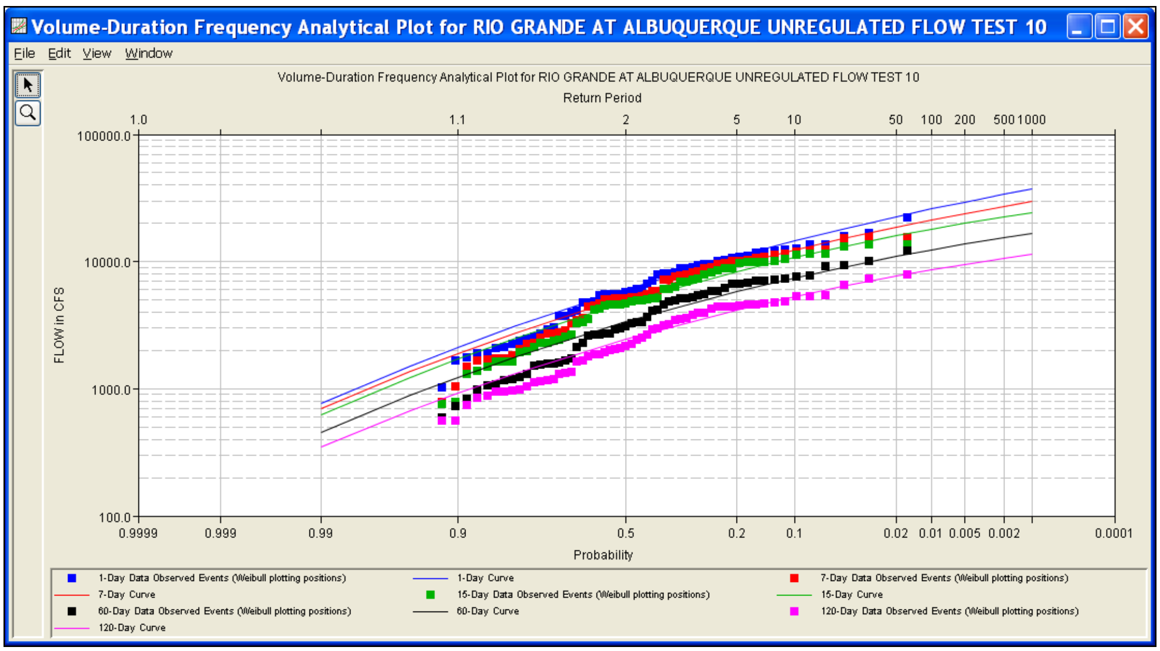


Figure 7-13. Plot of Systematic Data and Analytical Frequency Curves.

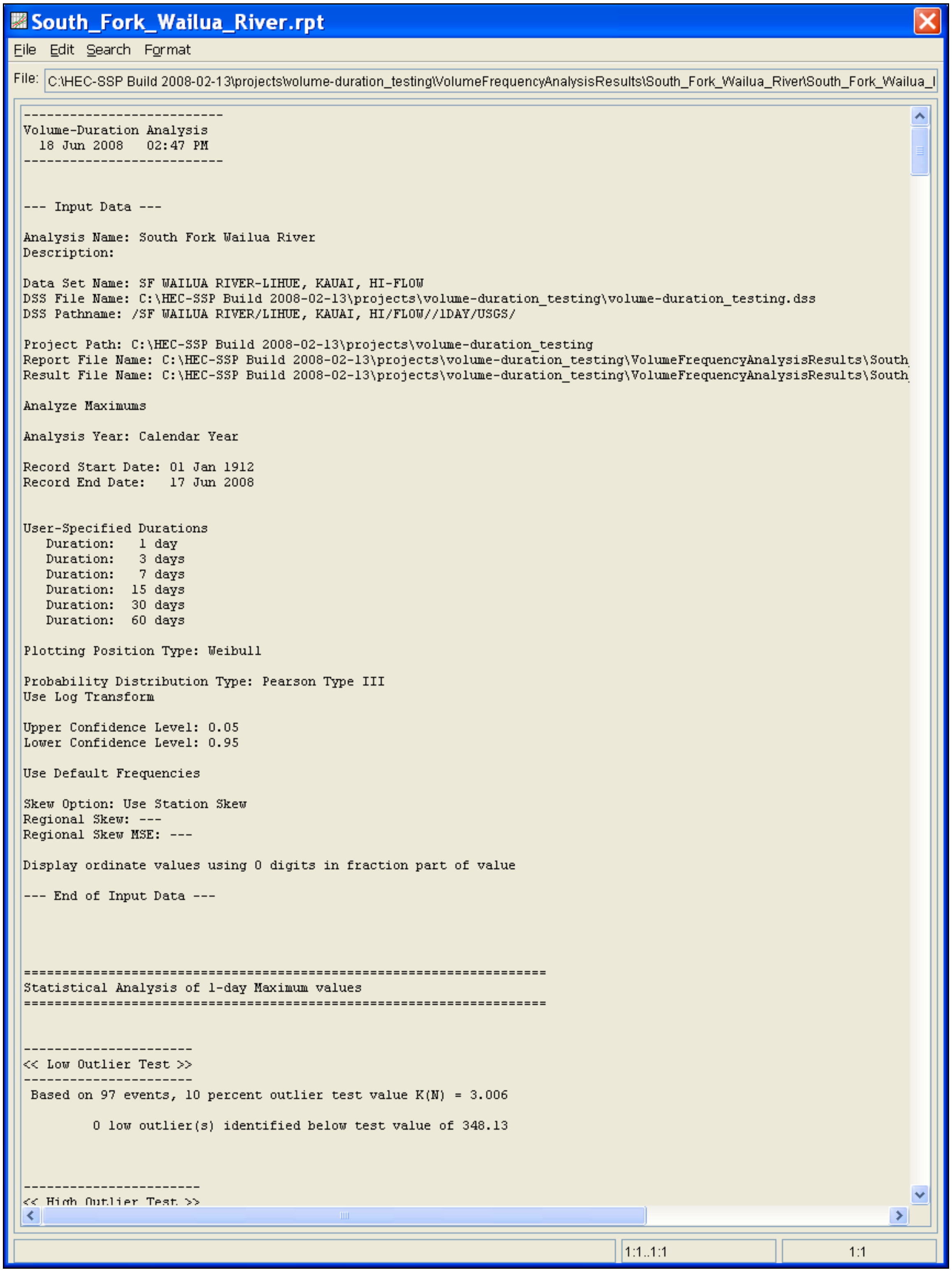
All plots opened by selecting one of the plot buttons at the bottom of the Volume Frequency Analysis editor contain menu options for printing, editing, and saving the plots.

Plots can be sent to the printer by selecting the **Print** option located on the **File** menu. Additional printing options available from the File menu are Page Setup, Print Preview, and Print Multiple (used for printing multiple graphs on the same page). The plot can also be sent to the Windows Clipboard by selecting **Copy to Clipboard** from the File menu. Additionally, the plot can be saved to a file by selecting the **Save As** option from the File menu. When the Save As option is selected, a window will appear allowing the user to select a directory, enter a filename, and select the format for saving the file. Currently four file formats are available for saving the plot to disk: windows metafile, postscript, JPEG, and portable network graphic. The data contained within the plot can also be tabulated by selecting **Tabulate** from the File menu. When this option is selected, a separate window will appear with the data tabulated. Additional options are available from the File menu for saving the plot properties as a template (**Save Template**) and applying previously saved templates to the current plot (**Apply Template**).

The **Edit** menu contains several options for customizing the plot properties. These options include Plot Properties, Configure Plot Layout, Default Line Styles, and Default Plot Properties. Also, the user can right-click on a line or data point in the plot area or in the legend and a shortcut menu will open with customization options. Both the Y and X-axis properties can be edited by placing the mouse on top of axis and clicking the right mouse button. Then select the **Edit Properties** menu option in the shortcut menu. For example, the user can turn on minor tic marks for the y-axis and modify the minimum and maximum scale for the x-axis. The graphic customizing capabilities within HEC-SSP are very powerful, but are also somewhat complex to use. The code used in developing the plots in HEC-SSP is the same code that is used for developing plots in HEC-DSSVue and several other HEC software programs. Please refer to the HEC-DSSVue User's Manual for details on customizing plots.

Viewing the Report File

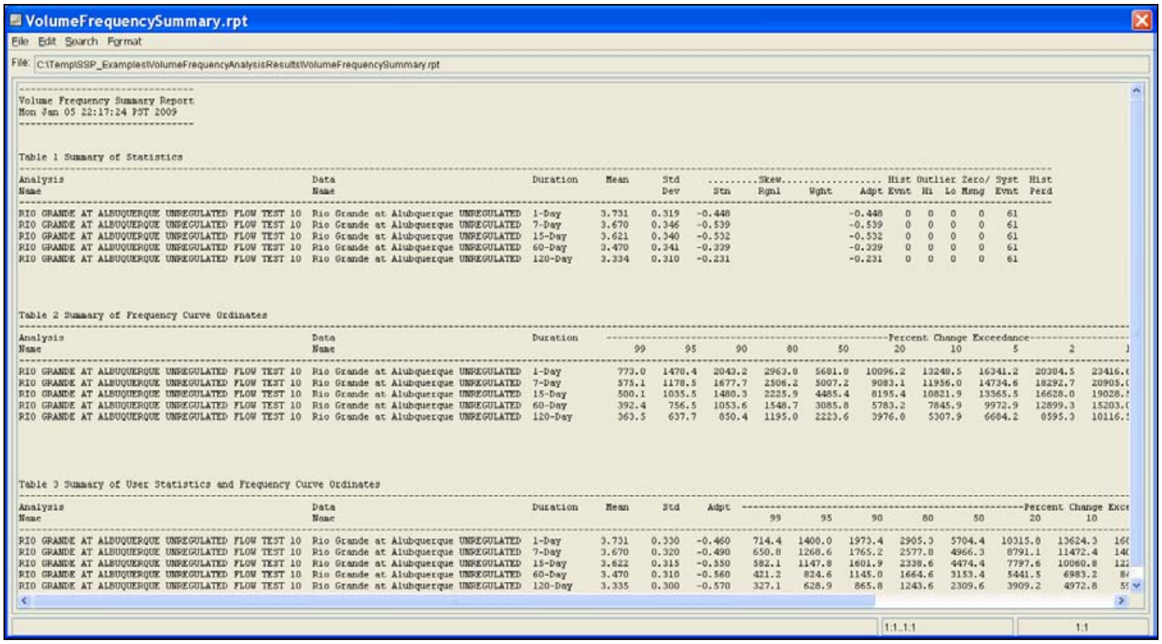
Computational results for a volume frequency analysis are written to a report file. The report file lists all of the input data and user settings, plotting positions of the data points, intermediate results, each of the various statistical tests performed (i.e. high and low outliers, historical data, etc…), and the final results. This file is often useful for understanding how the software arrived at the final frequency curves. Press the **View Report** button at the bottom of the Volume Frequency Analysis editor to open the report, as shown in Figure 7-14.




```
-------------------------
Volume-Duration Analysis
  18 Jun 2008   02:47 PM
-------------------------


--- Input Data ---

Analysis Name: South Fork Wailua River
Description:

Data Set Name: SF WAILUA RIVER-LIHUE, KAUAI, HI-FLOW
DSS File Name: C:\HEC-SSP Build 2008-02-13\projects\volume-duration_testing\volume-duration_testing.dss
DSS Pathname: /SF WAILUA RIVER/LIHUE, KAUAI, HI/FLOW//1DAY/USGS/

Project Path: C:\HEC-SSP Build 2008-02-13\projects\volume-duration_testing
Report File Name: C:\HEC-SSP Build 2008-02-13\projects\volume-duration_testing\VolumeFrequencyAnalysisResults\South
Result File Name: C:\HEC-SSP Build 2008-02-13\projects\volume-duration_testing\VolumeFrequencyAnalysisResults\South

Analyze Maximums

Analysis Year: Calendar Year

Record Start Date: 01 Jan 1912
Record End Date:   17 Jun 2008


User-Specified Durations
   Duration:   1 day
   Duration:   3 days
   Duration:   7 days
   Duration:  15 days
   Duration:  30 days
   Duration:  60 days

Plotting Position Type: Weibull

Probability Distribution Type: Pearson Type III
Use Log Transform

Upper Confidence Level: 0.05
Lower Confidence Level: 0.95

Use Default Frequencies

Skew Option: Use Station Skew
Regional Skew: ---
Regional Skew MSE: ---

Display ordinate values using 0 digits in fraction part of value

--- End of Input Data ---



====================================================================
Statistical Analysis of 1-day Maximum values
====================================================================


---------------------
<< Low Outlier Test >>
---------------------
 Based on 97 events, 10 percent outlier test value K(N) = 3.006

         0 low outlier(s) identified below test value of 348.13



----------------------
<< High Outlier Test >>
```

Figure 7-14. Volume Frequency Analysis Report.

Plots, tables and reports can also be created by selecting menu options from the **Results** menu. At least one volume frequency analysis must be selected in the study explorer before selecting one of the menu options on the Results menu. Results from multiple analyses are combined in one graph if they are selected in the study explorer when the **Graph** menu option is selected. The **Results→Summary Report** menu option will create a summary table of statistics and frequency curve ordinates for the selected analyses as shown in Figure 7-15.



Volume Frequency Summary Report
Mon Jan 05 22:17:24 PST 2009

Table 1 Summary of Statistics

Analysis Name	Data Name	Duration	Mean	Std Dev	Skew Stn	Skew Rgnl	Skew Wght	Skew Adpt	Hist Evnt	Outlier Hi	Outlier Lo	Zero/ Msng	Syst Evnt	Hist Perd
RIO GRANDE AT ALBUQUERQUE UNREGULATED FLOW TEST 10	Rio Grande at Alubquerque UNREGULATED	1-Day	3.731	0.319	-0.448			-0.448	0	0	0	0	61	
RIO GRANDE AT ALBUQUERQUE UNREGULATED FLOW TEST 10	Rio Grande at Alubquerque UNREGULATED	7-Day	3.670	0.346	-0.539			-0.539	0	0	0	0	61	
RIO GRANDE AT ALBUQUERQUE UNREGULATED FLOW TEST 10	Rio Grande at Alubquerque UNREGULATED	15-Day	3.621	0.340	-0.532			-0.532	0	0	0	0	61	
RIO GRANDE AT ALBUQUERQUE UNREGULATED FLOW TEST 10	Rio Grande at Alubquerque UNREGULATED	60-Day	3.470	0.341	-0.339			-0.339	0	0	0	0	61	
RIO GRANDE AT ALBUQUERQUE UNREGULATED FLOW TEST 10	Rio Grande at Alubquerque UNREGULATED	120-Day	3.334	0.310	-0.231			-0.231	0	0	0	0	61	

Table 2 Summary of Frequency Curve Ordinates

Analysis Name	Data Name	Duration	Percent Change Exceedance 99	95	90	80	50	20	10	5	2	1
RIO GRANDE AT ALBUQUERQUE UNREGULATED FLOW TEST 10	Rio Grande at Alubquerque UNREGULATED	1-Day	773.0	1470.4	2043.2	2963.0	5681.0	10096.2	13240.5	16341.2	20304.5	23416.
RIO GRANDE AT ALBUQUERQUE UNREGULATED FLOW TEST 10	Rio Grande at Alubquerque UNREGULATED	7-Day	575.1	1178.5	1677.7	2506.2	5007.2	9083.1	11956.0	14734.6	18292.7	20905.
RIO GRANDE AT ALBUQUERQUE UNREGULATED FLOW TEST 10	Rio Grande at Alubquerque UNREGULATED	15-Day	500.1	1035.5	1480.3	2225.9	4485.4	8195.4	10821.9	13365.5	16628.0	19028.
RIO GRANDE AT ALBUQUERQUE UNREGULATED FLOW TEST 10	Rio Grande at Alubquerque UNREGULATED	60-Day	392.4	756.5	1053.6	1548.7	3085.8	5783.2	7845.9	9972.9	12899.3	15203.
RIO GRANDE AT ALBUQUERQUE UNREGULATED FLOW TEST 10	Rio Grande at Alubquerque UNREGULATED	120-Day	363.5	637.7	850.4	1195.0	2223.6	3976.0	5307.9	6604.2	8595.3	10116.

Table 3 Summary of User Statistics and Frequency Curve Ordinates

Analysis Name	Data Name	Duration	Mean	Std	Adpt	Percent Change Exce… 99	95	90	80	50	20	10	
RIO GRANDE AT ALBUQUERQUE UNREGULATED FLOW TEST 10	Rio Grande at Alubquerque UNREGULATED	1-Day	3.731	0.330	-0.460	714.4	1400.0	1973.4	2905.3	5704.4	10315.8	13624.3	16
RIO GRANDE AT ALBUQUERQUE UNREGULATED FLOW TEST 10	Rio Grande at Alubquerque UNREGULATED	7-Day	3.670	0.320	-0.490	650.8	1268.6	1765.2	2577.8	4966.3	8791.1	11472.4	14
RIO GRANDE AT ALBUQUERQUE UNREGULATED FLOW TEST 10	Rio Grande at Alubquerque UNREGULATED	15-Day	3.622	0.315	-0.550	582.1	1147.8	1601.9	2338.6	4474.4	7797.6	10060.8	12
RIO GRANDE AT ALBUQUERQUE UNREGULATED FLOW TEST 10	Rio Grande at Alubquerque UNREGULATED	60-Day	3.470	0.310	-0.560	421.2	824.6	1145.0	1664.6	3153.4	5441.5	6983.2	8
RIO GRANDE AT ALBUQUERQUE UNREGULATED FLOW TEST 10	Rio Grande at Alubquerque UNREGULATED	120-Day	3.335	0.300	-0.570	327.1	628.9	865.8	1243.6	2309.6	3909.2	4972.8	5

Figure 7-15. Summary Table for a Volume Frequency Analysis.

CHAPTER 8

Performing a Duration Analysis

This chapter discusses in detail how to use the Duration Analysis editor in HEC-SSP. A duration analysis can be performed on flow and stage data as well as other data types. All regular interval data can be used in a duration analysis and an option is included to manually define a duration curve.

Contents

Starting a New Analysis

A duration analysis can be started in two ways, either by right clicking on the Duration Analysis folder in the study explorer and selecting **New**, or by going to the **Analysis** menu and selecting **New** and then **Duration Analysis**. When a new duration analysis is selected, the Duration Analysis editor will appear as shown in Figure 8-1.

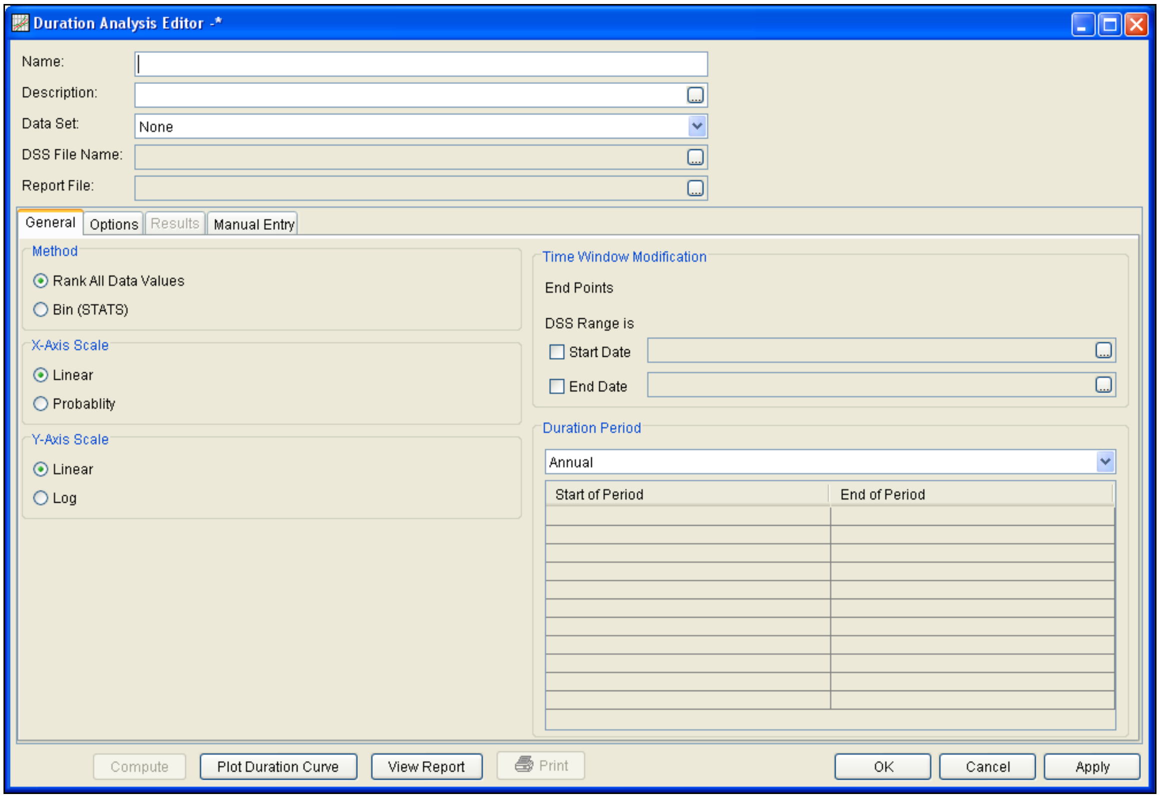


Figure 8-1. Duration Analysis Editor.

The user is required to enter a **Name** for the analysis, while a **Description** is optional. A data set (flow, stage, or other) can be selected from the available data sets stored in the current study DSS file (see Chapter 4 for importing data into the study). The list of data that can be selected for a duration analysis will only include those data that have a regular interval, like 1HOUR and 1DAY (E-part pathname). Choose “None” for the Data Set when defining the duration curve manually on the **Manual Entry** tab. Once a Name is entered and a data set is selected, the **DSS File Name** and **Report File** will automatically be filled out. The DSS filename is by default the study DSS file. The report file is given the same name as the analysis with the extension ".rpt".

General Settings and Options

Once the analysis name and data set are selected, the user can begin to perform the analysis. Contained on the Duration Analysis editor are four tabs. The tabs are labeled **General**, **Options**, **Results**, and **Manual Entry**. This section of the manual explains the use of the General and Options tabs.

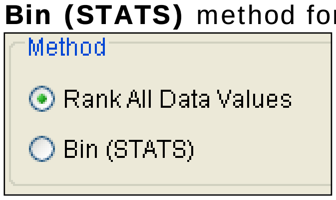
General

The first tab contains general settings for performing the duration analysis (Figure 8-1). These settings include:

- Method
- X-Axis Scale
- Y-Axis Scale
- Time Window Modification
- Duration Period

Method

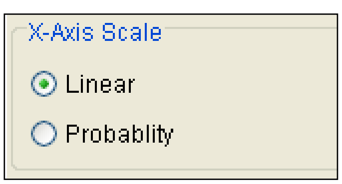
This option allows the user to choose the **Rank All Data Values** or **Bin (STATS)** method for computing the duration analysis; the rank all



data values method is the preferred choice. This method computes the duration curve by sorting the data from largest to smallest, ranking the values from 1 to n, and using: $P = 100*[M/(n+1)]$ where M is the ranked position and n is the number of events. The Bin method uses a similar procedure as in the STATS program for computing the duration curve (HEC, 1996). The data is grouped into bins (classes) and the duration curve is computed using the number of data in each bin.

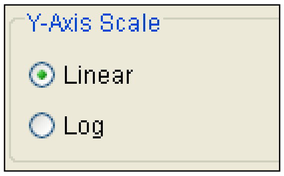
X-Axis Scale

This option allows the user to choose the scale of the x-axis. The



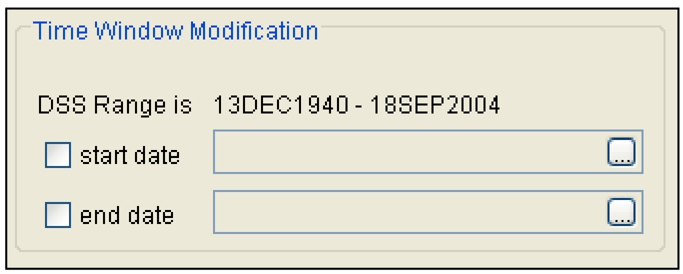
options are **Linear** and **Probability**. This option will affect the x-axis scale in the duration curve plot and how the “interpolated” frequency curve is computed. The program will use a probability scale when interpolating the final duration curve to the user specified exceedance ordinates.

Y-Axis Scale



This option allows the user to choose the scale of the y-axis. The options are **Linear** and **Log**. This option will affect the y-axis scale in the duration curve plot, how the program computes evenly spaced bins when the Bin (Stats) method is selected, and how the "interpolated" frequency curve is computed. One option for computing bins is to let the program define the bins at evenly spaced intervals between the minimum and maximum values from the selected data set. When **Log** is set as the y-axis scale, the program will convert the minimum and maximum values to log space before computing the evenly spaced bin limits. Also, the program will use log scale when interpolating the final duration curve to the user specified exceedance ordinates.

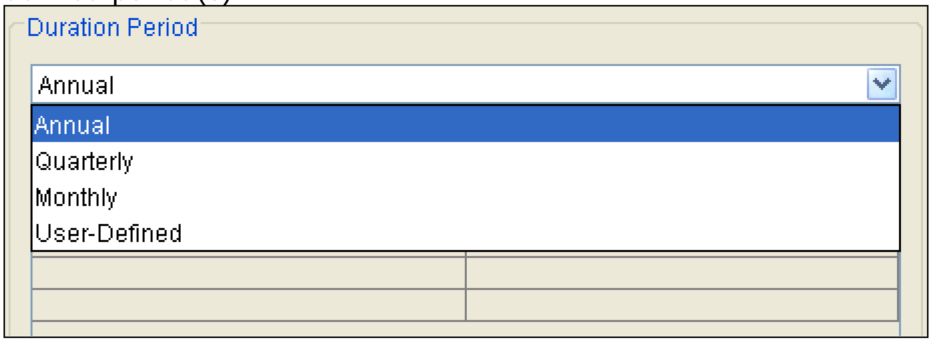
Time Window Modification



This option allows the user to narrow the time window used for the analysis. The default is to use all of the data contained in the selected data set. The user can enter either a start date and end date or both a start and end date. If a start and/or end date are used, they must be dates that are contained within the data stored in the selected data set. The date range for the selected data set is shown in the editor just above the **Start Date** field.

Duration Period

This option allows the user to compute multiple duration curves for different time windows within the year. If **Annual** is selected, then the program uses all the data when computing the duration curve. If **Quarterly** is selected, then the program separates the data into quarters and computes a separate duration curve for each quarter. For example, a duration curve for the 1st quarter includes all data measured from Jan 1 – March 31. The program will compute a separate duration curve for each month of the year when the **Monthly** option is selected. The **User-Defined** option lets the user define one or multiple periods within the year. Then the program will perform the duration analysis using data only measured during the user-defined period(s).



Options

In addition to the general settings, there are also several options available to the user for modifying the computations of the duration curve. These options include:

- Output Labeling
- Plotting Position Formula
- User-Specified Exceedance Ordinates
- Bin Limits

When the Options tab is selected, the Duration Analysis editor will appear as shown in Figure 8-2.

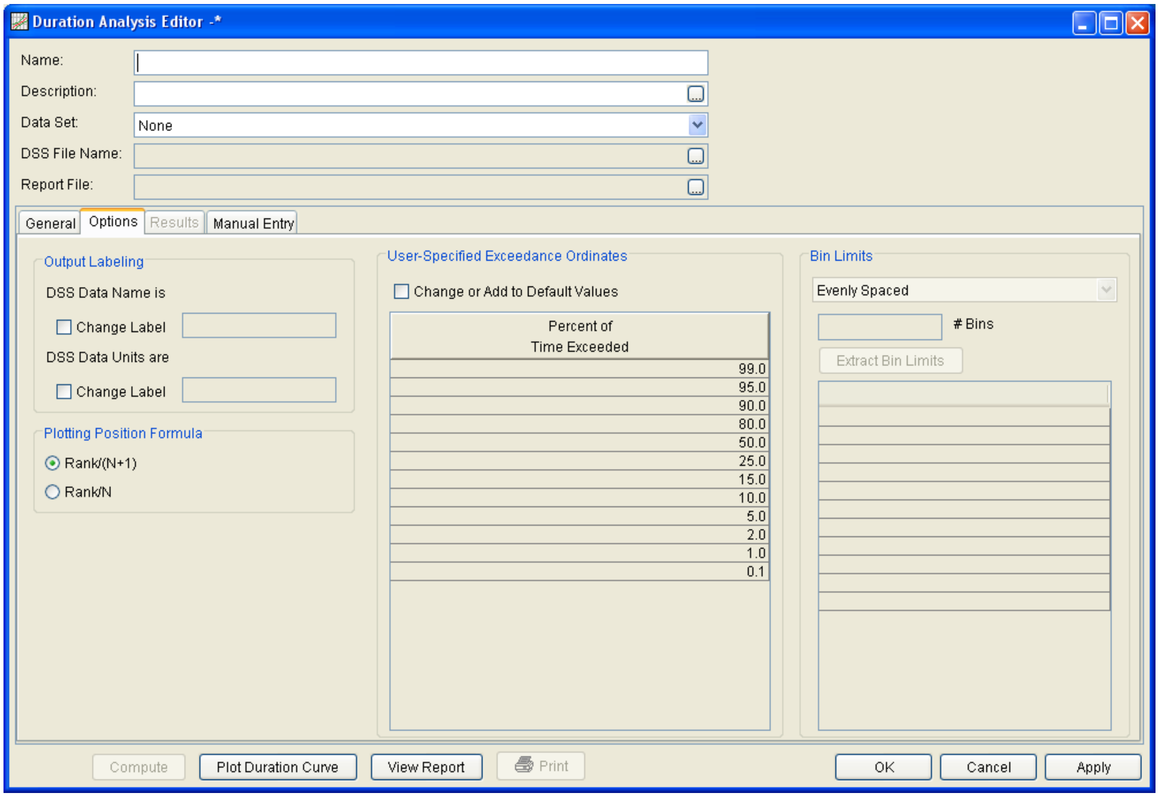
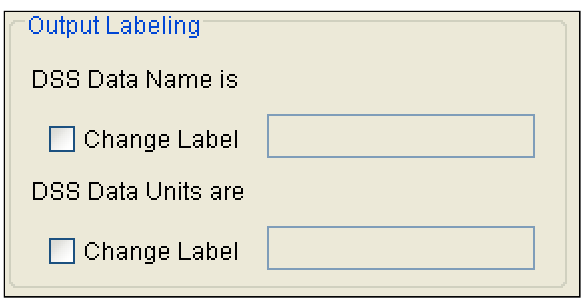


Figure 8-2. Duration Analysis Editor with Options Tab Selected.

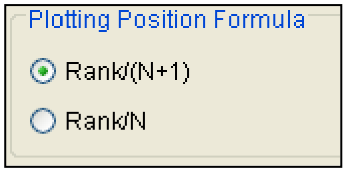
Output Labeling

This option allows the user to change the default labels for data contained in the output tables and plots. The user can change both the name of the data as well as the units of the data. The output labeling does not result in the conversion of data from one unit system to another; it only affects what is displayed on table headings and the y-axis of the results plot.



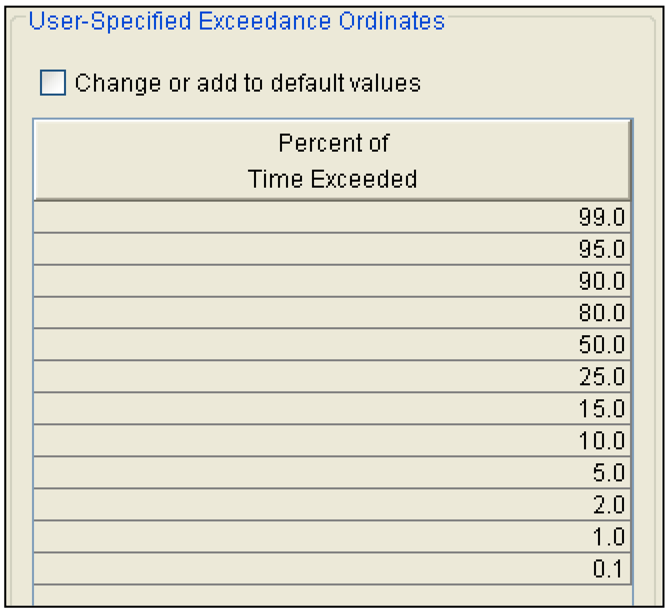
Plotting Position Formula

This option allows the user to choose how the duration curve is computed (this option is not available when the **Bin** method is selected). When **Rank/(N+1)** is selected the program will compute the duration curve using: $P = 100 * [M/(n+1)]$ where M is the ranked position and n is the number of events. When **Rank/N** is selected the program will compute the duration curve using: $P = 100 * [M / n]$ where M is the ranked position and n is the number of events.



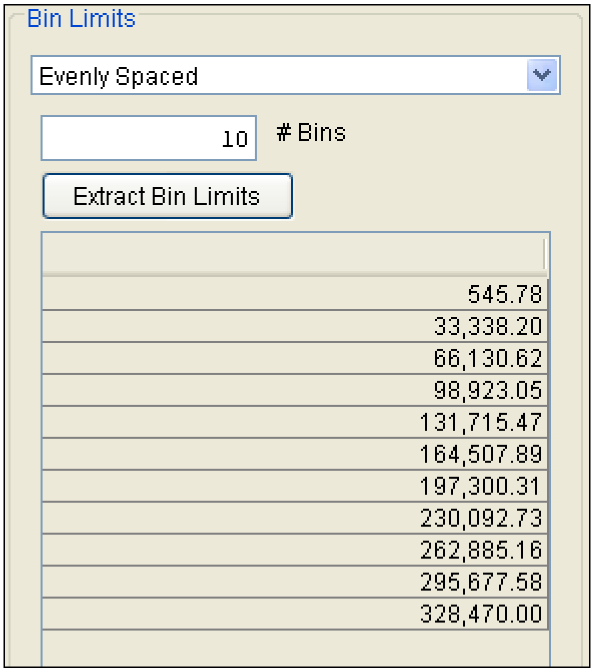
User-Specified Exceedance Ordinates

This option allows the user to change the ordinates used in computing the resulting duration curves. The default values listed in percent of time exceedance are 99, 95, 90, 80, 50, 25, 15, 10, 5, 2, 1, and 0.1. Check the box next to **Change or add to default values** to change or add additional values. Once this box is checked, the user can add/remove rows and edit the ordinates. To add or remove a row from the table, select the row(s), place the mouse over the highlighted row(s) and click the right mouse button. The shortcut menu contains options to **Insert Row(s)** and **Delete Row(s)**. The program will use the default values, even if they are not contained in the table, when the **Change or add to default values** option is not checked. Finally, all values in the table must be between 0 and 100.



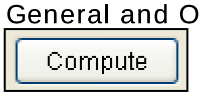
Bin Limits

The **Bin Limits** panel is only active when the **Bin (STATS)** method is selected on the General tab. This option helps the user to define the limits, the minimum and maximum values, for each bin. There are two options; **Evenly Spaced** and **User-Defined**. When **Evenly Spaced** is selected the user must also enter the number of bins. The **Extract Bin Limits** button will automatically populate the bin limits table by first extracting the minimum and maximum values from the data set and then linearly interpolating evenly spaced bin limits. If Log is selected as the Y-axis scale on the General tab, then the program converts the minimum and maximum values to log space before computing the evenly spaced bin limits. The **User-Defined** option lets the user manually enter the bin limits. The user must ensure the minimum and maximum values from the data set are contained in the bin limits table. For example, if the minimum flow from the data set is 100.0 then the first row in the table must be less than or equal to 100.0. Additional rows can be added to the table. Place the mouse pointer on top of the table and click the right mouse button. Then select the **Insert Row(s)…** menu option to open an editor for specifying the number of rows to insert into the table.



Compute

Once the new analysis has been defined, and the user has all of the General and Options information selected the way they want,



performing the computations is simply a matter of pressing the **Compute** button at the bottom of the Duration Analysis editor. If the computations are successful, the user will receive a message that says “Compute Complete”. At this point, the user can begin to review the results.

Multiple Duration analyses can be computed using the **Compute Manager**. Select the **Analysis→Compute Manager** menu option to open the Compute Manager. Select the analyses to be computed and then press the **Compute** button. Close the compute dialogs and Compute Manager when the program finished computing the analyses.

Results

This section of the manual describes results that are available for the Duration analysis. When the user selects the **Results** tab on the Duration Analysis editor, the window will appear as shown in Figure 8-3. As shown, two additional tabs will appear on the screen: **Tabular Results** and **Plot**.

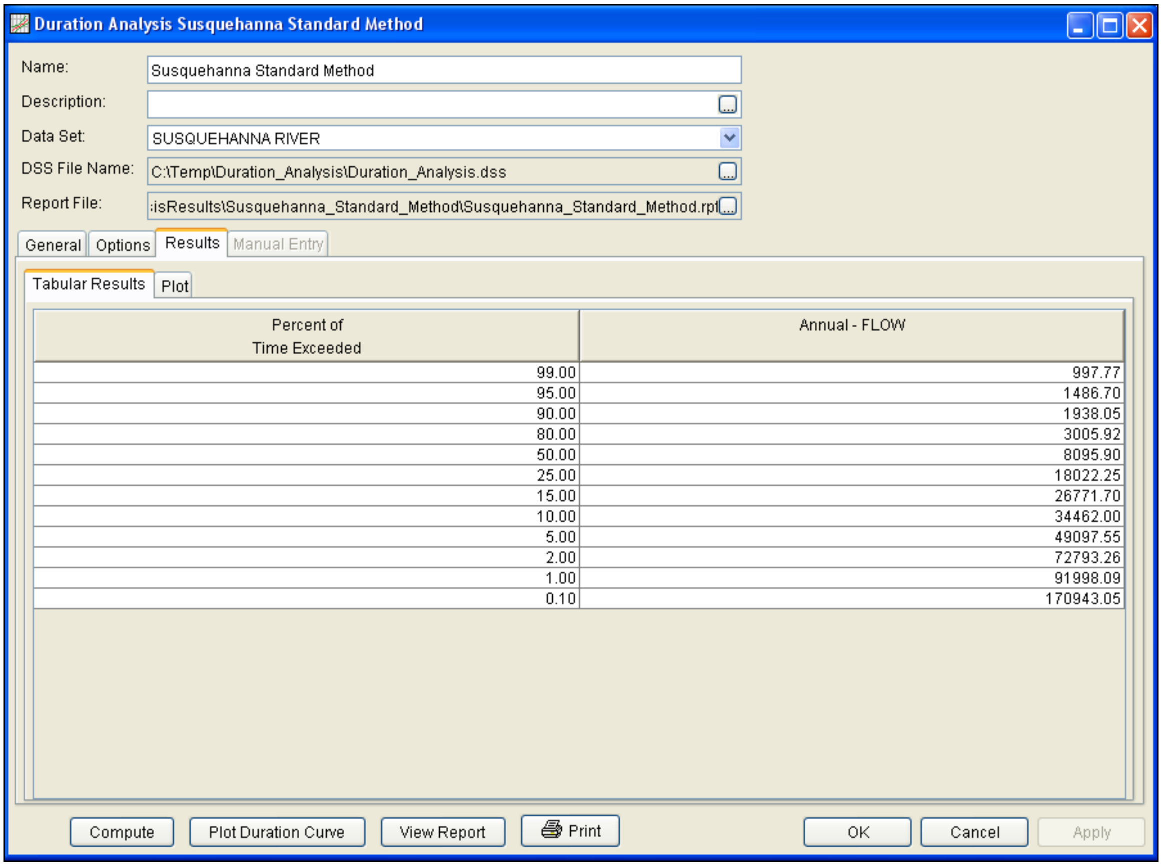
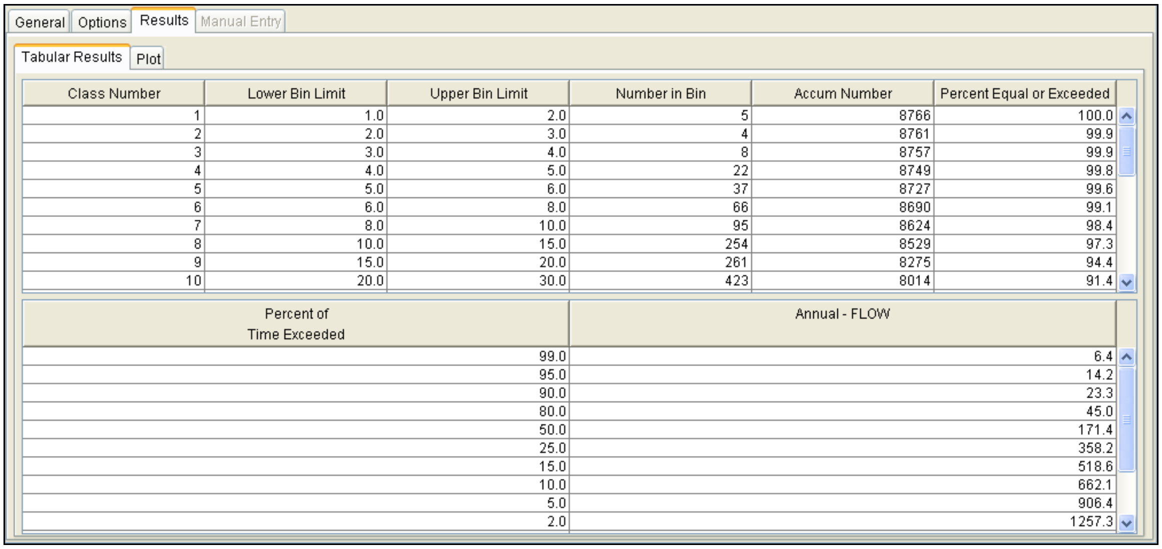


Figure 8-3. Results Tab of the Duration Analysis Editor.

Tabular Results

The **Tabular Results** tab will bring up a table of results for the duration analysis. The tabular results are different for the **Rank All Data Values** and **Bin (STATS)** methods. An example of tabular results for a **Rank All Data Values** analysis is shown in Figure 8-3. The results table will contain multiple duration curves if the Quarterly, Monthly, or the User Defined options are selected as the Duration Period. Data in the duration curve table can be re-sorted. Click the **Percent of Time Exceeded** column header (two mouse clicks are required the first time). The percent of time exceeded ordinates, along with the duration curve values, will sort so that the lowest values are on top or the highest values are on top.

The tabular results tab will look different when the **Bin (STATS)** method is used to compute the duration analysis. As shown in Figure 8-4, there are two tables. The first table contains summary information about the bins and the second table contains the interpolated duration curve.



Class Number	Lower Bin Limit	Upper Bin Limit	Number in Bin	Accum Number	Percent Equal or Exceeded
1	1.0	2.0	5	8766	100.0
2	2.0	3.0	4	8761	99.9
3	3.0	4.0	8	8757	99.9
4	4.0	5.0	22	8749	99.8
5	5.0	6.0	37	8727	99.6
6	6.0	8.0	66	8690	99.1
7	8.0	10.0	95	8624	98.4
8	10.0	15.0	254	8529	97.3
9	15.0	20.0	261	8275	94.4
10	20.0	30.0	423	8014	91.4

Percent of Time Exceeded	Annual - FLOW
99.0	6.4
95.0	14.2
90.0	23.3
80.0	45.0
50.0	171.4
25.0	358.2
15.0	518.6
10.0	662.1
5.0	906.4
2.0	1257.3

Figure 8-4. Results Tab for a Bin (STATS) analysis.

Plot

In addition to tabular results, a **Plot** tab is available for viewing a graphical plot of the duration curves. When the Plot tab is selected the window will change to what is shown in Figure 8-5. The plot contains the computed duration curve and the duration curve interpolated to the user-defined ordinates (defined on the Options tab). Multiple duration curves will be graphed if the Quarterly, Monthly, or User Defined options are selected as the duration period.

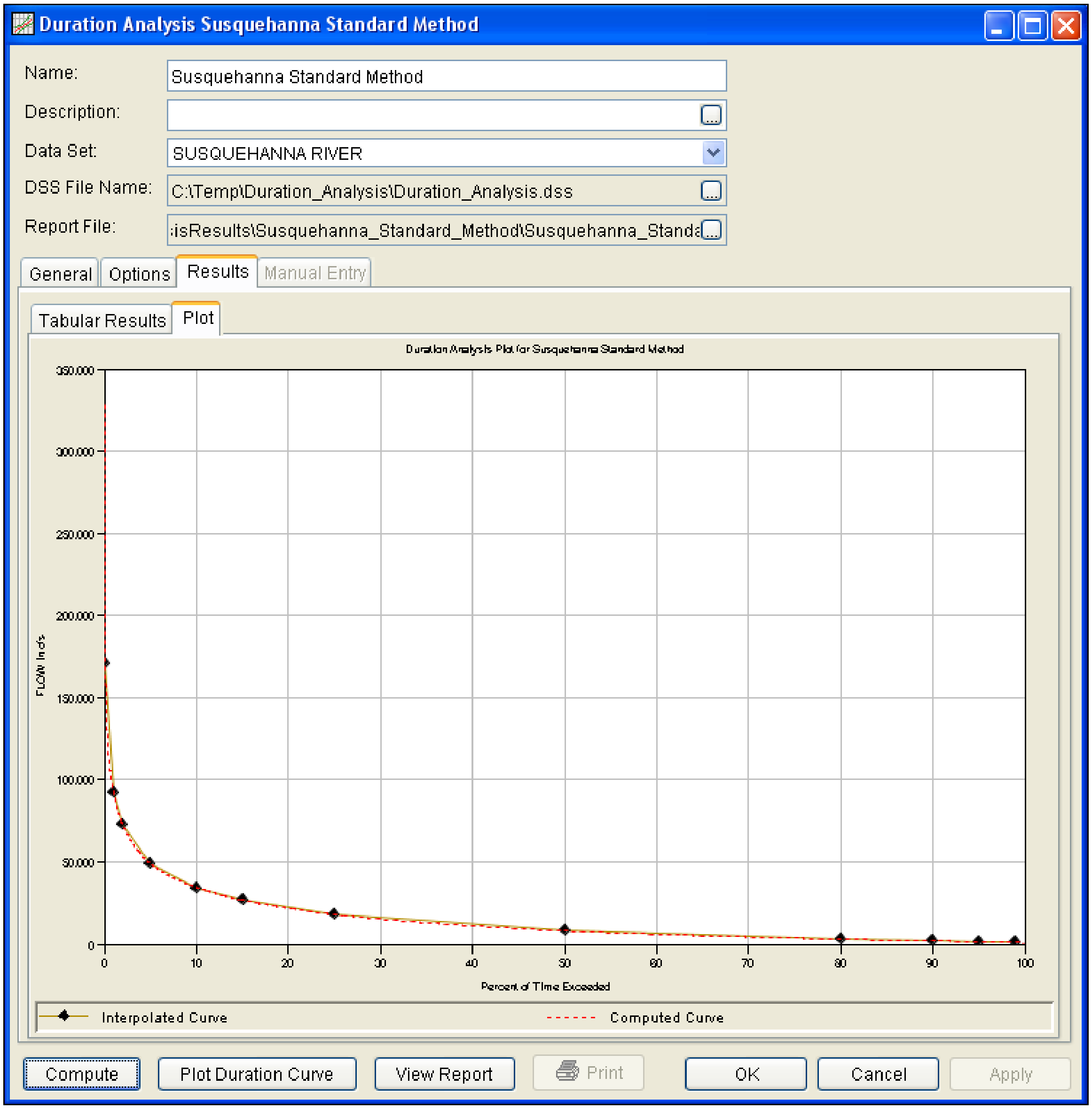


Figure 8-5. Plot Tab of the Duration Analysis.

Manual Duration Analysis

The user has the option to manually define a duration curve. This option would be used when a duration curve has been computed outside of HEC-SSP. The "None" data set must be selected in order to define a duration curve manually. When the **Manual Entry** tab is selected, the editor will display a plot and table as shown in Figure 8-6. The table allows the user to enter data values for the percent of time exceedance ordinates defined on the Options tab. When the user enters values in this table, those values will be plotted as a line on the plot after the **Compute** button is pressed.

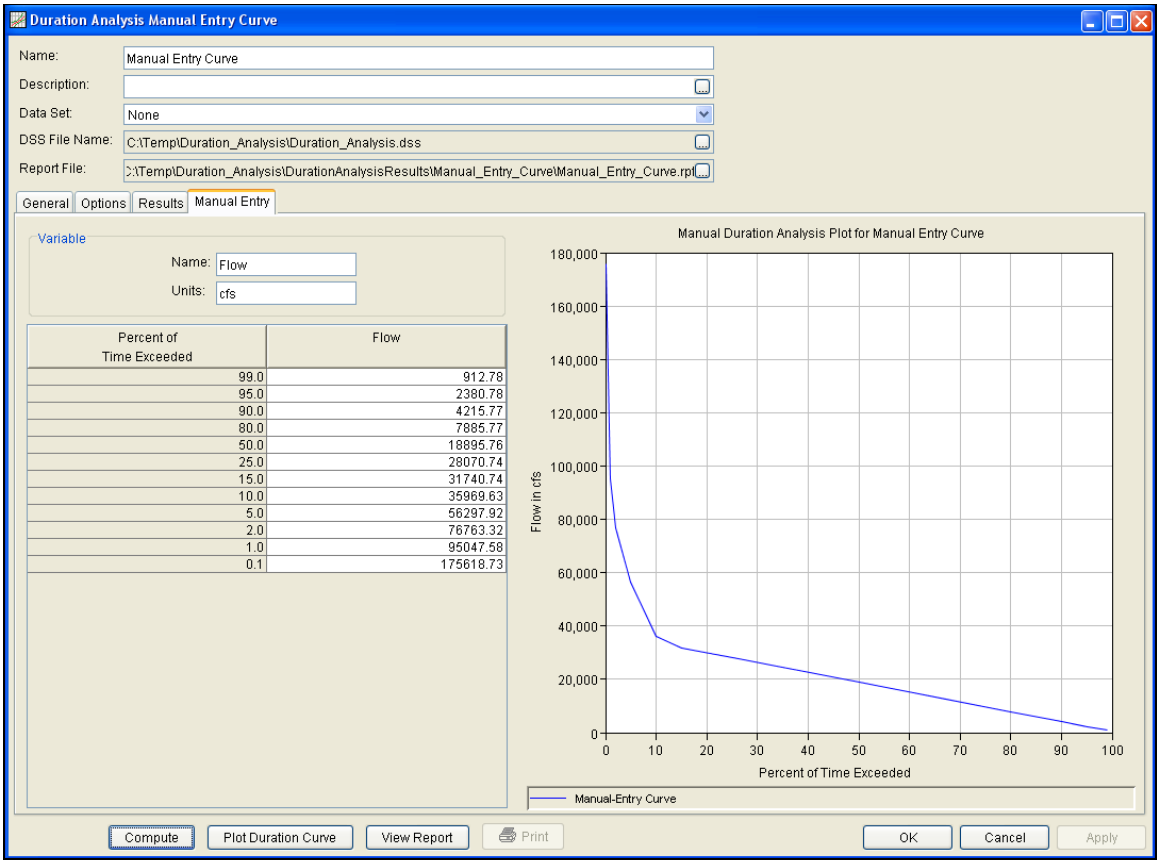


Figure 8-6. Manual Entry Tab of the Duration Analysis Editor.

Viewing and Printing Results

The user can view output for the duration analysis directly from the Duration Analysis editor (Tabular and Graphical output) or by using the buttons at the bottom of the editor. Results can also be opened by selecting the duration analysis in the study explorer and then choosing the **Graph**, **Table**, or **Report** option available from the **Results** menu.

Tabular Output

Once the computations for the duration analysis are completed, the user can view tabular output by selecting the **Tabular Results** tab under the **Results** tab. The details of this table were discussed above.

The tabular results can be printed by using the **Print** button at the bottom of the Duration Analysis editor. When the print button is pressed, a window will appear giving the user options for how they would like the table to be printed.

Graphical Output

Graphical output of the duration curve can be obtained by selecting either the **Plot** tab under the results tab, or by pressing the button labeled **Plot Duration Curve** at the bottom of the Duration Analysis editor. When the Plot Duration Curve button is pressed, a duration curve plot will appear in a separate window as shown in Figure 8-7.

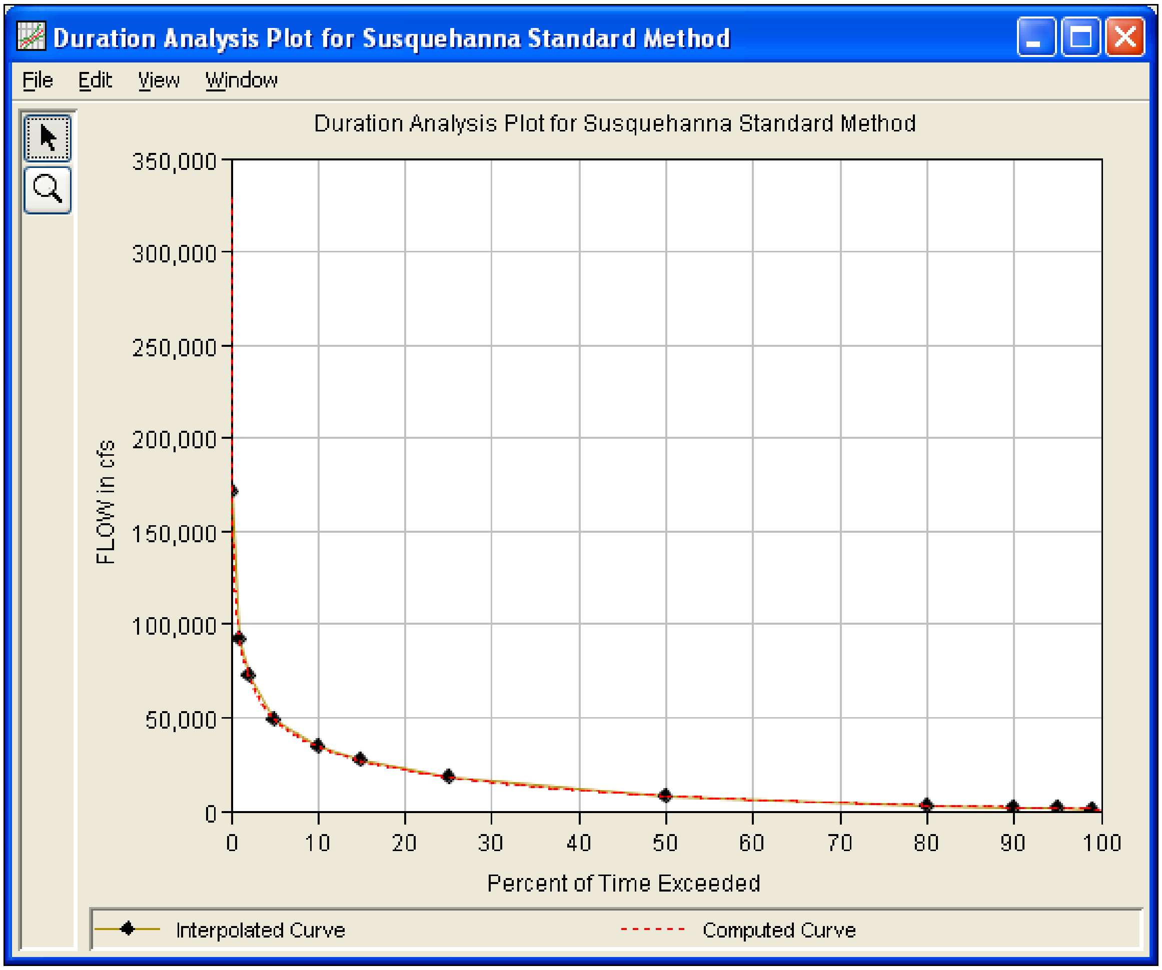


Figure 8-7. Duration Curve Plot.

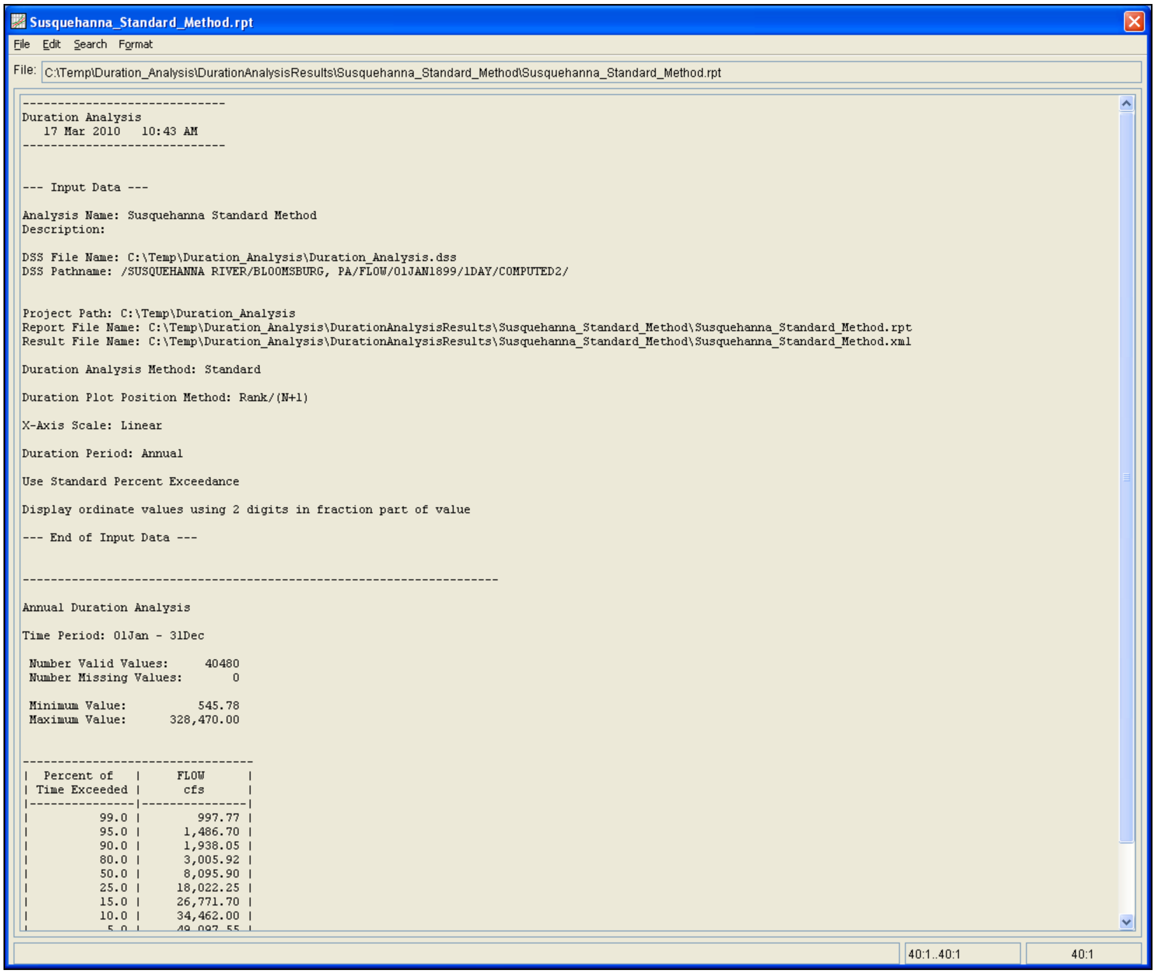
The duration curve plot can be sent to the printer by selecting the **Print** option from the **File** menu at the top of the window. Additional printing options available from the File menu are Page Setup, Print Preview, and Print Multiple (used for printing multiple graphs on the same page). The graphic can also be sent to the Windows Clipboard by selecting **Copy to Clipboard** from the File menu. Additionally, the plot can be saved to a file by selecting the **Save As** option from the File menu. When the Save As option is selected, a window will appear allowing the user to select a directory, enter a filename, and select the format for saving the file. Currently four file formats are available for saving the graphic to disk: windows metafile, postscript, JPEG, and portable network graphic.

The data contained within the plot can also be tabulated by selecting **Tabulate** from the File menu. When this option is selected, a separate window will appear with the data tabulated. Additional options are available from the File menu for saving the plot options as a template (**Save Template)** and applying previously saved templates to the current plot (**Apply Template**).

The **Edit** menu contains several options for customizing the graphic. These options include Plot Properties, Configure Plot Layout, Default Line Styles, and Default Plot Properties. Also, a shortcut menu will appear with further customizing options when the user right-clicks on a line on the graph or the legend. Both the Y and X-axis properties can be edited by placing the mouse on top of axis and clicking the right mouse button. Then select the **Edit Properties** menu option in the shortcut menu. For example, the user can turn on minor tic marks for the y-axis and modify the minimum and maximum scale for the x-axis. The graphic customizing capabilities within HEC-SSP are very powerful, but are also somewhat complex to use. The code used in developing the plots in HEC-SSP is the same code that is used for developing plots in HEC-DSSVue and several other HEC software programs. Please refer to the HEC-DSSVue User's Manual for details on customizing plots.

Viewing the Report File

A report file is created when the duration analysis computations are performed. The report file contains information about the duration analysis and the final results. To view the report file press the **View Report** button at the bottom of the Duration Analysis editor. When this button is pressed, a window will appear containing the report as shown in Figure 8-8.



Susquehanna_Standard_Method.rpt

File Edit Search Format

File: C:\Temp\Duration_Analysis\DurationAnalysisResults\Susquehanna_Standard_Method\Susquehanna_Standard_Method.rpt

```
----------------------------
Duration Analysis
   17 Mar 2010   10:43 AM
----------------------------


--- Input Data ---

Analysis Name: Susquehanna Standard Method
Description:

DSS File Name: C:\Temp\Duration_Analysis\Duration_Analysis.dss
DSS Pathname: /SUSQUEHANNA RIVER/BLOOMSBURG, PA/FLOW/01JAN1899/1DAY/COMPUTED2/


Project Path: C:\Temp\Duration_Analysis
Report File Name: C:\Temp\Duration_Analysis\DurationAnalysisResults\Susquehanna_Standard_Method\Susquehanna_Standard_Method.rpt
Result File Name: C:\Temp\Duration_Analysis\DurationAnalysisResults\Susquehanna_Standard_Method\Susquehanna_Standard_Method.xml

Duration Analysis Method: Standard

Duration Plot Position Method: Rank/(N+1)

X-Axis Scale: Linear

Duration Period: Annual

Use Standard Percent Exceedance

Display ordinate values using 2 digits in fraction part of value

--- End of Input Data ---


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

Annual Duration Analysis

Time Period: 01Jan - 31Dec

 Number Valid Values:     40480
 Number Missing Values:       0

 Minimum Value:          545.78
 Maximum Value:      328,470.00


--------------------------------
|  Percent of   |      FLOW      |
| Time Exceeded |      cfs       |
|--------------|--------------|
|         99.0 |       997.77 |
|         95.0 |     1,486.70 |
|         90.0 |     1,938.05 |
|         80.0 |     3,005.92 |
|         50.0 |     8,095.90 |
|         25.0 |    18,022.25 |
|         15.0 |    26,771.70 |
|         10.0 |    34,462.00 |
|          5.0 |    49,097.55 |
```

40:1..40:1 40:1

Figure 8-8. Duration Analysis Report File.

CHAPTER 9

Performing a Coincident Frequency Analysis

This chapter discusses in detail how to use the Coincident Frequency Analysis editor in HEC-SSP. A coincident frequency analysis can be performed on any data type; flow, stage, precipitation, wind, etc. The coincident frequency analysis requires both duration and frequency curves. These can be computed by existing analyses in the HEC-SSP study or they can be entered manually in the coincident frequency analysis editor.

The Coincident Frequency Analysis is designed following guidelines in EM 1110-2-1415. This analysis tool can be used to compute the exceedance frequency relationship for a variable that is a function of two other variables. An example is illustrated in Figure 9-1. In this example, the stage at the damage site on the tributary, variable C, is a function of stream flow from the tributary, variable A, and the stage in the mainstem river, variable B.

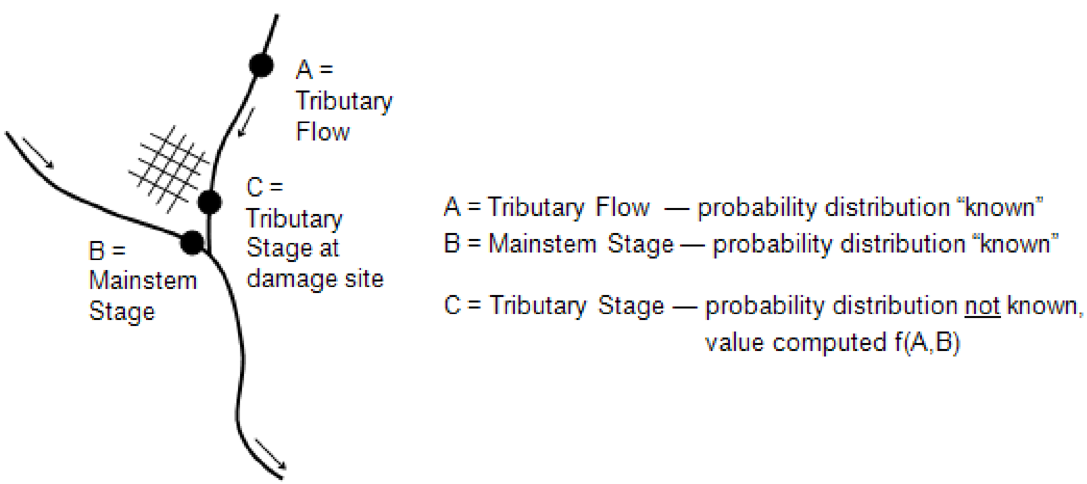


Figure 9-1. Example Application of the Coincident Frequency Analysis.

The general procedure for performing a coincident frequency analysis, using HEC-SSP is described below.

1) Develop a duration curve for variable B. This can be done using the Duration Analysis editor or it can be defined manually in the Coincident Frequency Analysis editor. Then discretize the duration curve to determine index values for variable B. The index values

should be defined so that the area under the discretized duration curve approximates the original duration curve. Figure 9-2 shows a flow duration curve that has been discretized using 9 index points. The index points are taken at the midpoint of each discrete segment and there are more index points along the steeper portion of the duration curve. The Coincident Frequency Analysis editor can be used to define the index points and to estimate the proportion of time for each index point. For example, the 9th index point in Figure 9-2 is taken at the midpoint for the discrete segment from 100 to 60 percent of time exceeded. The flow value at this point represents the variable B index occurring 40 percent of the time. The 8th index point is taken at the midpoint for the discrete segment from 60 to 40 percent of time exceeded. The flow value at this point represents the variable B index occurring 20 percent of the time. The proportion of time assigned to each index point will be used to compute the variable C frequency curve.

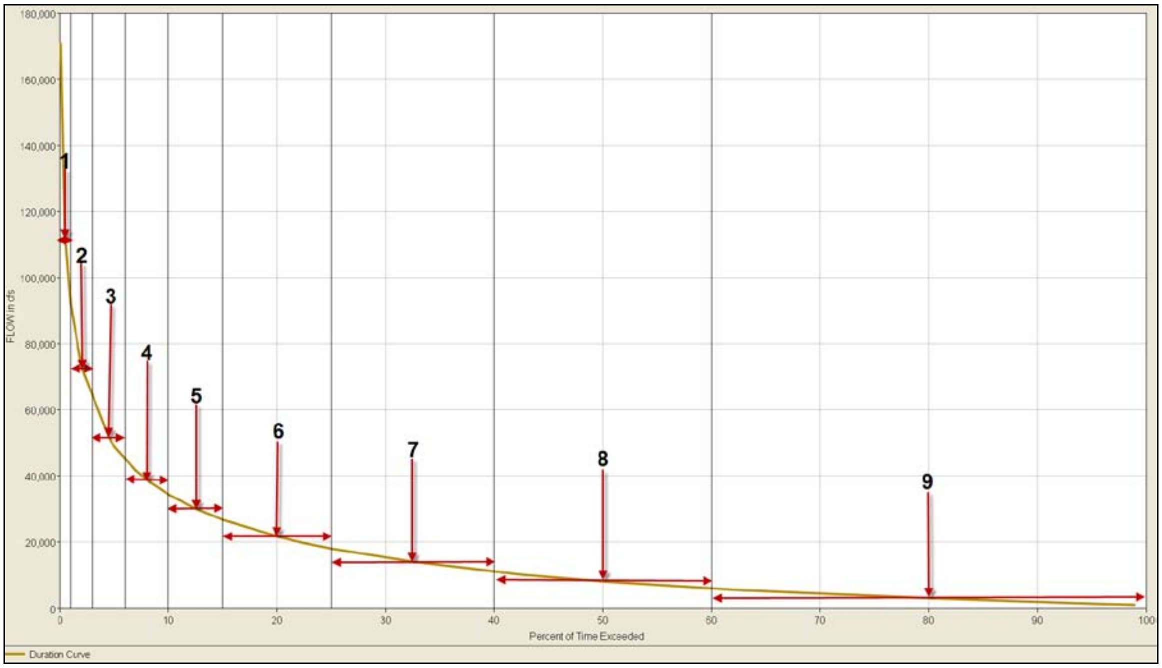


Figure 9-2. Variable B Duration Curve Divided into Discrete Segments.

2) Different procedures are required depending on whether variables A and B are independent or not independent of one another. When variables A and B are assumed independent of one another, develop a frequency curve of variable A. The frequency curve can come from an existing Bulletin 17B or General Frequency analysis or it can be defined manually in the Coincident Frequency Analysis editor. If variables A and B are not independent of one another, then develop a frequency curve of variable A for each variable B index value. In this case, the variable A frequency curves must be defined manually in the Coincident Frequency Analysis editor. This involves extracting annual peak values for variable A that occur for

each discrete range identified on the variable B duration curve and performing a separate frequency analysis on each set of variable A data.

3) Develop the response of variable C for combinations of variable A and variable B. This could be done using a hydrology or hydraulics model. For the example shown in Figure 9-1, a flow value from the variable A frequency curve would be applied to the tributary and the index flow (or stage) from the variable B duration curve would be applied to the mainstem. The hydraulics model would be used to compute the variable C stage at some reference point on the tributary. This model simulation would be computed for many combinations of variable A and variable B. Figure 9-3 shows example output from a hydraulics model. The model was used to generate output from multiple combinations of variable A and B values. In this example, there were 12 variable A values and 9 index values from variable B. This resulted in 108 simulation results. The table shown in Figure 9-3 is referred to as the Response Curves table in HEC-SSP and these values must be entered by the user.

Variable B Index Values

Variable A	B1=3005.92	B2=8095.90	B3=14053.68	B4=21795.00	B5=30089.62	B6=38967.52	B7=51657.13	B8=72793.26	B9=112646.41
	C = f(A,B1)	C = f(A,B2)	C = f(A,B3)	C = f(A,B4)	C = f(A,B5)	C = f(A,B6)	C = f(A,B7)	C = f(A,B8)	C = f(A,B9)
66,039	481.38	481.37	481.37	481.37	481.37	481.36	481.36	481.36	481.69
54,354	477.24	477.24	477.25	477.26	477.28	477.32	477.37	477.5	477.91
46,370	475.02	475.03	475.05	475.07	475.11	475.18	475.31	475.48	475.97
39,053	473.03	473.04	473.07	473.11	473.18	473.28	473.47	473.77	474.45
30,296	470.94	470.95	470.98	471.02	471.09	471.2	471.42	471.89	472.78
24,265	469.59	469.61	469.64	469.69	469.77	469.9	470.13	470.71	471.74
18,631	467.78	467.91	467.97	468.07	468.22	468.42	468.78	469.54	470.82
11,395	465.04	465.06	465.27	465.47	465.71	466.04	466.64	467.86	469.75
7,095	463.82	463.82	463.82	463.89	464.09	464.52	465.33	466.87	469.21
5,578	463.37	463.37	463.36	463.38	463.52	463.99	464.88	466.57	469.03
4,589	463.02	463.02	463.02	463.02	463.14	463.65	464.62	466.36	468.94
3,210	462.47	462.47	462.47	462.47	462.59	463.2	464.28	466.12	468.82

Variable A Values

Variable C Results from Hydraulics Model

Figure 9-3. Response of Variable C for Combinations of Variable A and Variable B.

4) The program computes the variable C frequency curve by first using the response curves to compute conditional frequency curves of variable C. This is done by assigning the same frequency from the variable A value to the corresponding variable C value. Then for a selected value of variable C, the frequency value from each condition frequency curve is multiplied by the corresponding proportion of time (probability) from the variable B index value. The values are summed to obtain the frequency of the selected

value of variable C. This is done for a number of values of variable C until a complete frequency curve is created.

Contents

Starting a New Analysis

A coincident frequency analysis can be started in two ways, either by right clicking on the Coincident Frequency Analysis folder in the study explorer and selecting **New**, or by going to the **Analysis** menu and selecting **New** and then **Coincident Frequency Analysis**. When a new coincident frequency analysis is selected, the Coincident Frequency Analysis editor will appear as shown in Figure 9-4.

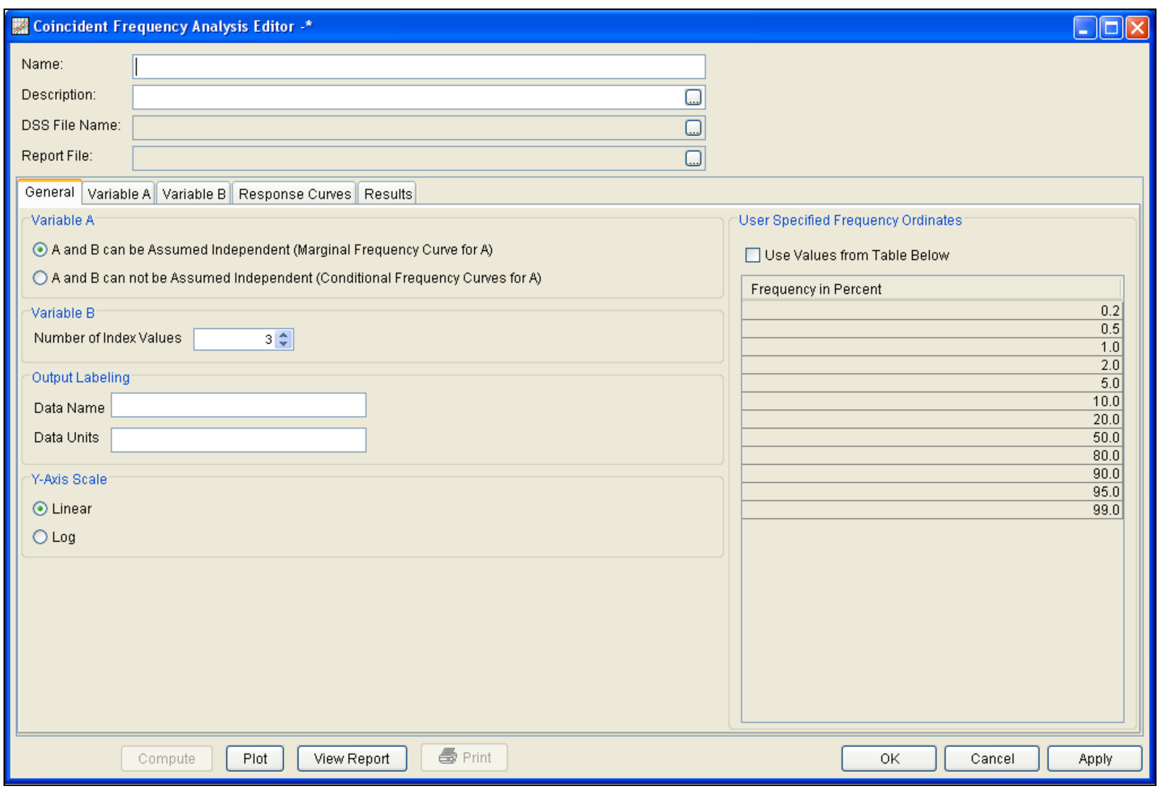


Figure 9-4. Coincident Frequency Analysis Editor.

The user is required to enter a **Name** for the analysis, while a **Description** is optional. Once a Name is entered, the **DSS File Name** and **Report File** will automatically be filled out. The DSS filename is by default the study DSS file. The report file is given the same name as the analysis with the extension ".rpt".

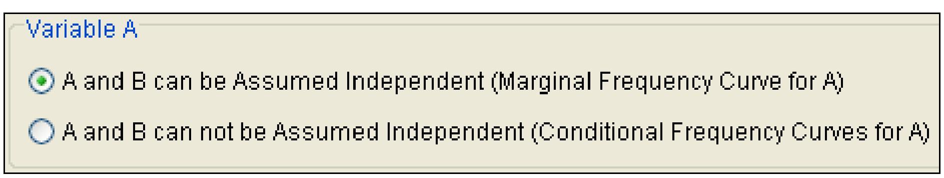
General Settings

Once the analysis name has been entered, the user can begin to perform the computations. Contained on the Coincident Frequency Analysis editor are five tabs. The tabs are labeled **General**, **Variable A**, **Variable B**, **Response Curves**, and **Results**. The first tab contains general settings for performing the coincident frequency analysis (Figure 9-4). These settings include:

- Variable A
- Variable B
- Output Labeling
- Y-Axis Scale
- User Specified Frequency Ordinates

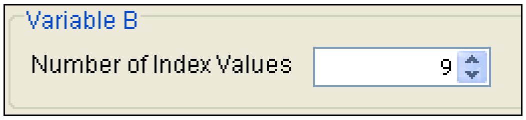
Variable A

This option allows the user to choose whether the coincident frequency analysis assumes variables A and B are independent or dependent. When variables A and B can be assumed independent, there will be only one frequency curve for variable A. A conditional variable A frequency curve assumes variables A and B are not independent, so there will be a separate variable A frequency curve for each variable B index value.



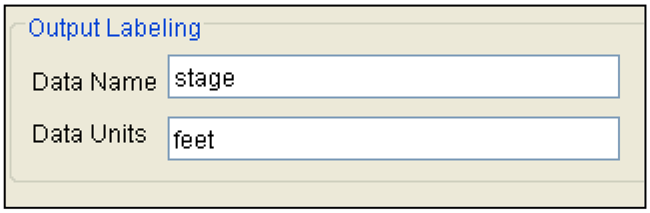
Variable B

This option allows the user to define the number of index values for variable B. The index points are used to discretize the duration curve. A probability, or a proportion of time, will be assigned to each index point.



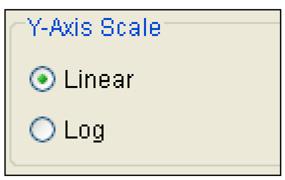
Output Labeling

This option allows the user to enter labels for data contained in the output tables and plots. The user must enter the name of the data as well as the data units. The output labeling does not result in the conversion of data from one unit system to another; it only affects what is displayed on table headings and the y-axis of the results plot.

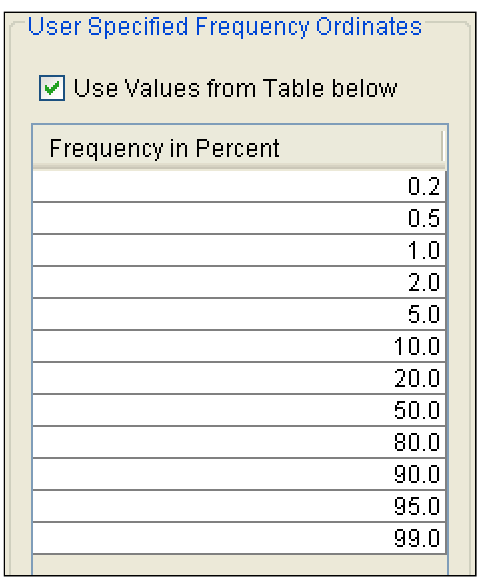


Y-Axis Scale

This option allows the user to choose the scale of the y-axis. The options are **Linear** and **Log**. This option will affect the y-axis scale in the coincident frequency curve plot.



User Specified Frequency Ordinates



This option allows the user to change the frequency ordinates used for creating result tables and graphs. The default values listed in percent chance exceedance are 0.2, 0.5, 1, 2, 5, 10, 20, 50, 80, 90, 95, and 99. Check the box next to **Use Values from Table below** to change or add additional values. Once this box is checked, the user can add/remove rows and edit the frequency values. To add or remove a row from the table, select the row(s), place the mouse over the highlighted row(s) and click the right mouse button. The shortcut menu contains options to **Insert Row(s)** and **Delete Row(s)**. The program will use the default values, even if they are not contained in the table, when the **Use Values from Table below** option is not checked. Finally, all values in the table must be between 0 and 100.

Variable A

The **Variable A** tab is used to define the frequency curve for variable A. This tab will look different based on the user's selection on the General Tab. The Variable A tab will look like Figure 9-5 when "A and B can be Assumed Independent" is selected on the General tab. Since variables A and B are independent, there will only be one frequency curve for variable A.

As shown in Figure 9-5, the user can choose to define the curve manually or select an existing study analysis. When the **Manual Entry** option is selected, the user must define the **Data Name** and **Data Units**. Then the user must enter the frequency curve for variable A. A frequency curve value must be defined for each percent chance exceedance ordinate in the table. When the **Existing Study Analysis** option is selected, the dropdown list will be active and the user can choose any Bulletin 17B or General Frequency analysis in the HEC-SSP study. The variable A frequency curve table will be populated with the frequency curve when an analysis is selected. The program uses the statistics from the selected analysis and computes the frequency curve that populates the table.

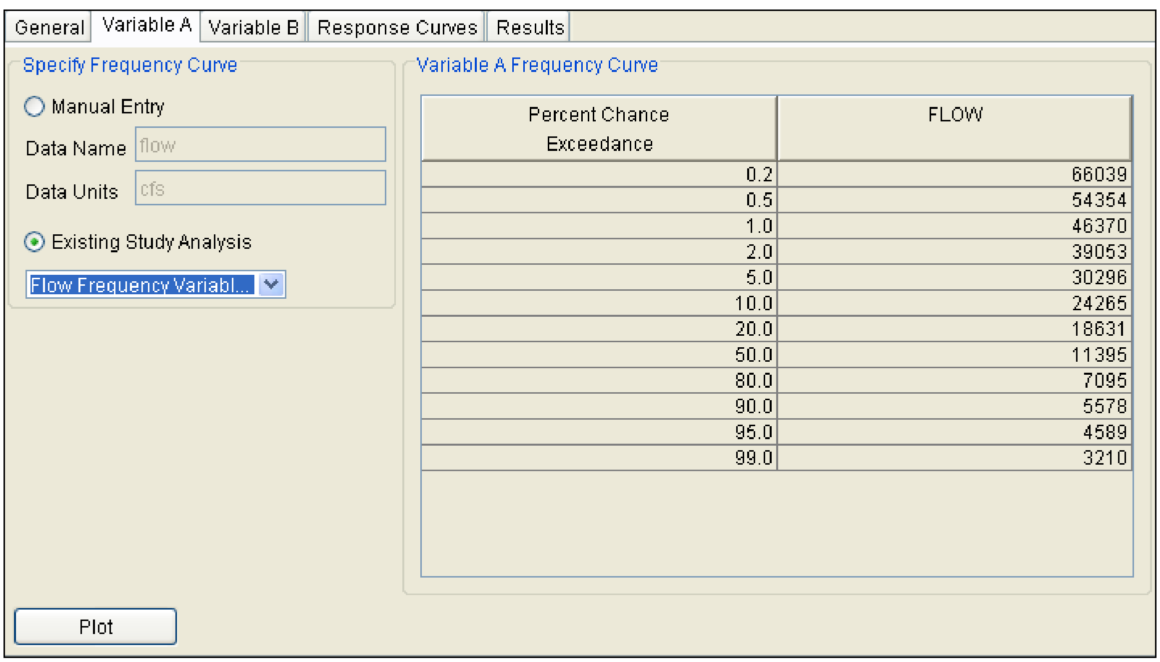
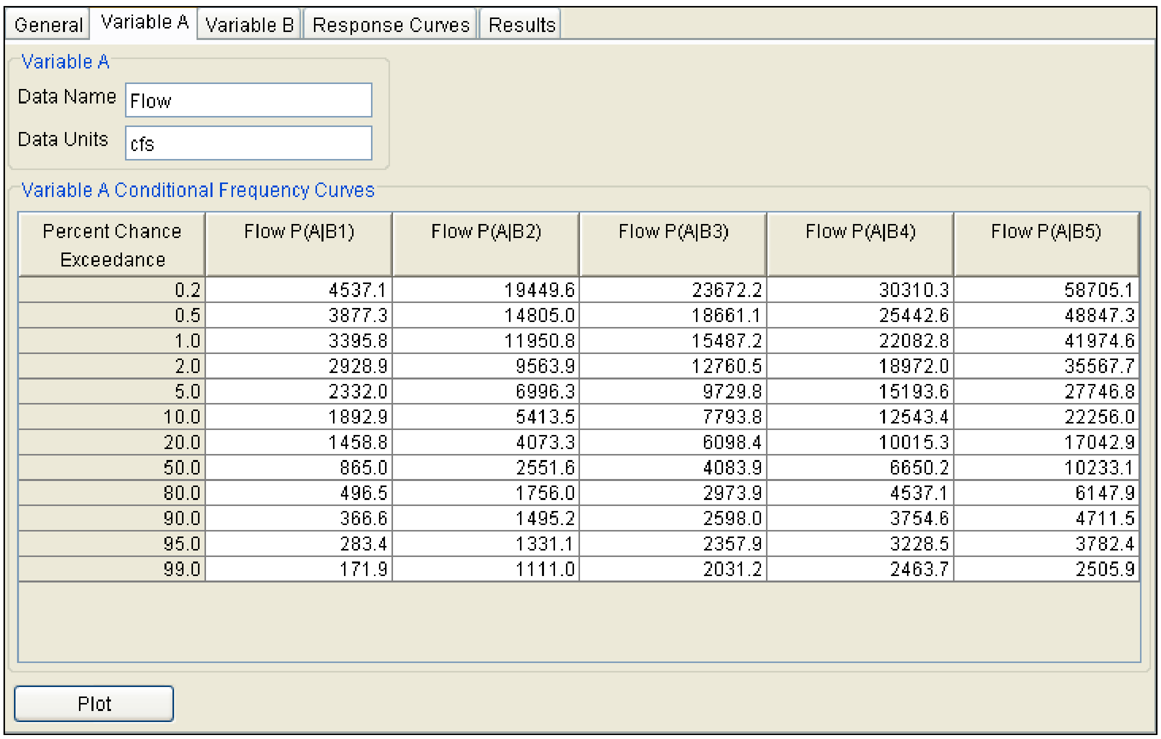


Figure 9-5. Variable A Tab when Variable A and B are Independent.

The Variable A tab will look like Figure 9-6 when “A and B can not be Assumed Independent” is selected on the General tab. A conditional variable A frequency curve assumes variables A and B are not independent, so there will be a separate variable A frequency curve for each variable B index value.

As shown in Figure 9-6, the user must define the **Data Name** and **Data Units**. Then the user must manually enter the variable A frequency curve for each index value of variable B. This involves extracting the annual peak values for variable A that occur for each discrete range identified on the variable B duration curve and performing a separate frequency analysis on each set of variable A data. Also, a frequency curve value must be defined for each Percent Chance Exceedance ordinate in the table.



Percent Chance Exceedance	Flow P(A|B1)	Flow P(A|B2)	Flow P(A|B3)	Flow P(A|B4)	Flow P(A|B5)
0.2	4537.1	19449.6	23672.2	30310.3	58705.1
0.5	3877.3	14805.0	18661.1	25442.6	48847.3
1.0	3395.8	11950.8	15487.2	22082.8	41974.6
2.0	2928.9	9563.9	12760.5	18972.0	35567.7
5.0	2332.0	6996.3	9729.8	15193.6	27746.8
10.0	1892.9	5413.5	7793.8	12543.4	22256.0
20.0	1458.8	4073.3	6098.4	10015.3	17042.9
50.0	865.0	2551.6	4083.9	6650.2	10233.1
80.0	496.5	1756.0	2973.9	4537.1	6147.9
90.0	366.6	1495.2	2598.0	3754.6	4711.5
95.0	283.4	1331.1	2357.9	3228.5	3782.4
99.0	171.9	1111.0	2031.2	2463.7	2505.9

Figure 9-6. Variable A Tab when Variable A and B are not Independent.

Press the **Plot** button located at the lower left corner of the Variable A tab to open a plot of the variable A frequency curve(s).

Variable B

The **Variable B** tab is used to define the duration curve for variable B and the index points with an associated probability. The index points will be used by the user when developing the response curves (response of variable C to each combination of variables A and B). The associated probability represents the proportion of time that each index point can be expected to occur.

As shown in Figure 9-7, the left side of the variable B tab is used to select the duration curve from an existing Duration Curve analysis. Once selected, the program populates the duration curve table. Press the **Plot** button located at the lower left corner of the Variable B tab to open a plot of the variable B duration curve.

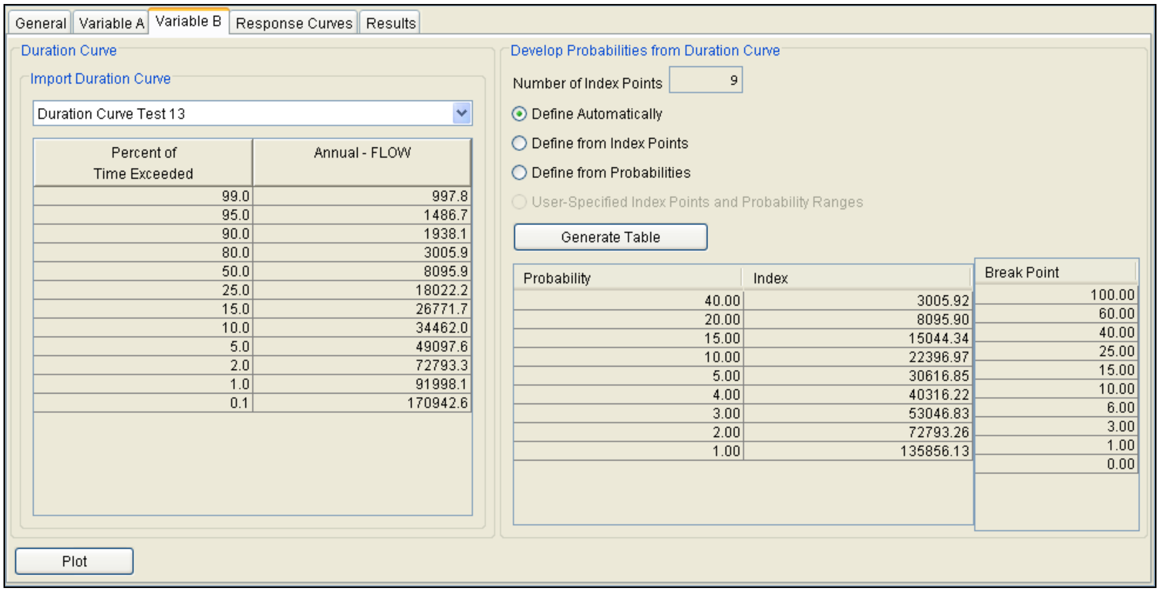


Figure 9-7. Variable B Tab.

After the duration curve has been selected, the right side of the variable B tab is used to define the index points and associated probabilities used to discretize the duration curve. The number of index points is defined on the General tab and is included on the Variable B tab to let the user know how many index points must be defined in the table. There are 4 methods for defining the index values and the associated probabilities. The user selects one of the methods, edits the table, and then clicks the **Generate Table** button in order for the program to finish populating the table. The following text describes each method.

Define Automatically. The program will use a predefined pattern of probability ranges when this option is selected, as contained in Table 9-1, to populate the **Probability** column. The pattern is dependent on the number of index points and the default probability patterns do not extend beyond nine index points. If more than nine index points have been selected for the analysis, then use one of the other methods for defining the index points and associated probabilities. The program will compute the **Index** and **Break Point** columns when the **Generate Table** button is pressed. The **Break Point** column is computed using the probability pattern. The first row in this column is always 100. The second break point is computed by subtracting the first probability value from the first break point value. The third break point is computed by subtracting the second probability value from the second break point value. This procedure is followed until the last break point is computed; it should always have a value of 0. The **Index** values are taken from the duration curve at the midpoint between each break point range. For example, if the first break point was 100 and the second was 60 then the first **Index** value would be the value from the duration curve at 80 percent time exceeded.

Table 9-1. Default Probability Patterns.

	Number of Index Points						
Index	3	4	5	6	7	8	9
1	20	15	45	35	35	35	40
2	60	35	40	30	25	20	20
3	10	35	10	20	20	15	15
4		15	4	10	10	10	10
5			1	4	6	10	5
6				1	3	6	4
7					1	3	3
8						1	3
9							1

Define from Index Points. The number of rows is set by the number of index points. In this case, the **Index** column is edited by the user; the user must enter an index value in each row. When the **Generate Table** button is pressed, the program will compute the **Break Point** and the **Probability** values. First, the program will use the selected duration curve and interpolate a percent of time exceeded for each user-defined index value. Then break points are computed so that they are half way between the percent of time exceeded values (the first and last break points will be 100 and 0). The probability values are computed based on the break points. For example, the first probability value is computed by subtracting the second break point value from the first. The second probability value is computed by subtracting the third break point value from the second. This procedure is followed until the last probability value is computed.

Define from Probabilities. The number of rows is set by the number of index points. In this case, the **Probability** column is edited by the user; the user must enter a probability value in each row (the probability values should add up to 100). When the **Generate Table** button is pressed, the **Break Point** column is computed using the user-entered probability pattern. For example, the first row in the break point column is 100; therefore, the second break point is computed by subtracting the first probability value from the first break point value. The third break point is computed by subtracting the second probability value from the second break point value. This procedure is followed until the last break point is computed; it should always have a value of 0. The **Index** values are taken from the duration curve at the midpoint between each break point range. For example, if the first break point was 100 and the second was 60 then the first **Index** value would be the value from the duration curve at 80 percent time exceeded.

User-Specified Index Points and Probability Ranges. This option can only be selected when the user does not select an existing Duration Curve to import. This would be applicable for the case where the user developed the duration curve outside of HEC-SSP and developed the index points and associated probabilities. As shown in Figure 9-8, the user must specify both the **Probability** and **Index** values; the user must enter values in each row. When the **Generate Table** button is pressed, the **Break Point** column is computed using the user-entered probability pattern. For example, the first row in the break point column is 100; therefore, the second break point is computed by subtracting the first probability value from the first break point value. The third break point is computed by subtracting the second probability value from the second break point value. This procedure is followed until the last break point is computed; it should always have a value of 0.

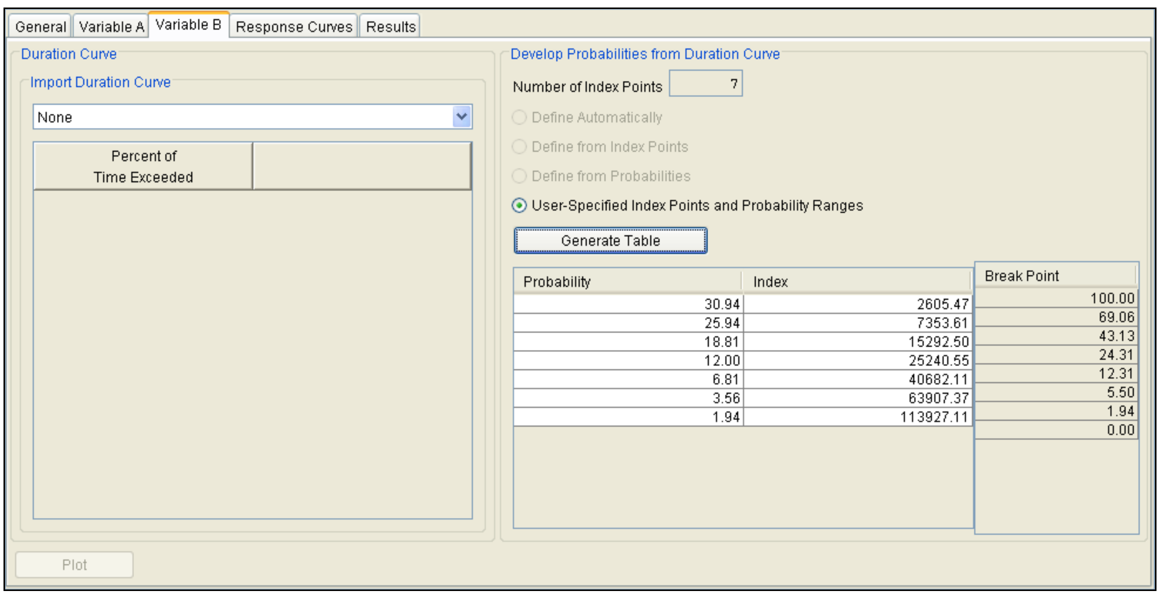


Figure 9-8. User-Specified Option to Define Index Points and Probability Ranges.

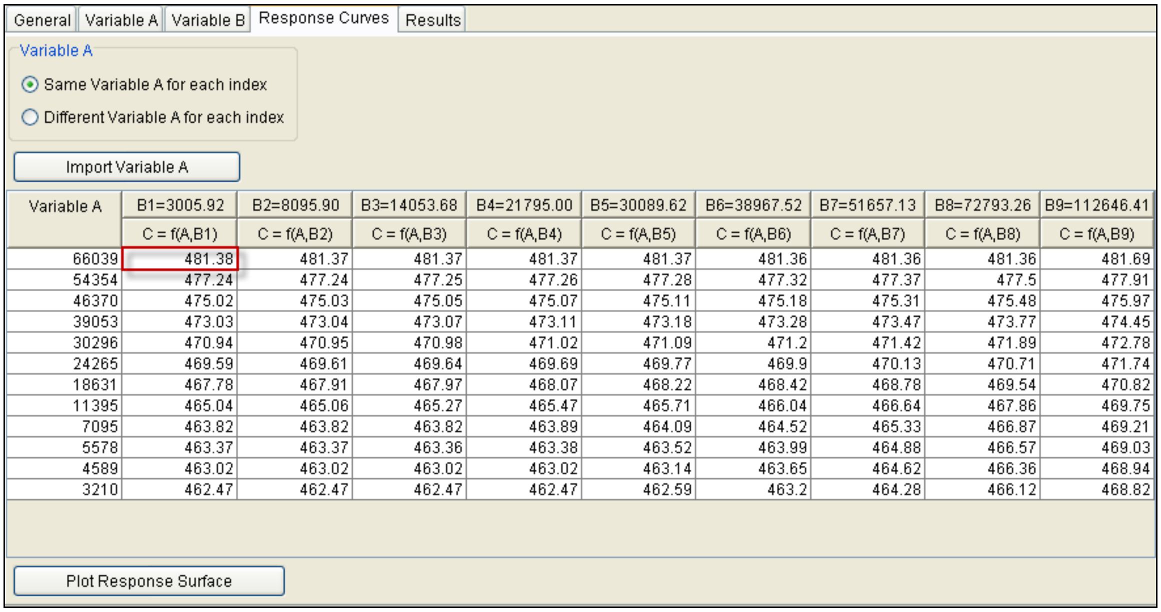
Response Curves

The Response Curves tab is used to define the response of variable C to each combination of variable A and variable B. This analysis is performed outside of HEC-SSP. For example, a hydraulics model could be used to apply flow values from the variable A frequency curve to the tributary and the index flow (or stage) from the variable B duration curve would be applied to the mainstem. The hydraulics model would be used to compute the variable C stage at some reference point on the tributary for multiple combinations of variable A and variable B. The peak variable C stage is the value to input into the Response Curves table.

As shown in Figure 9-9, there are two options for the Response Curves table; **Same Variable A for each index** or **Different Variable A for each index**. When the **Same Variable A for each index** option is selected, there is only one **Variable A** column in the response curves table. The user can manually fill in the values for Variable A or press the **Import Variable A** button. When the button is pressed, the program will import the values on the Variable A tab. The user can edit the Variable A values after they are imported. When the **Different Variable A for each index** option is selected, there is a separate **Variable A** column for each variable B index value, as shown in Figure 9-10. The user can manually fill in the values for Variable A or press the **Import Variable A** button. When the button is pressed, the program will import the values from the Variable A tab. The user can edit the Variable A values after they are imported. In most cases, the Different Variable A for each index options will be used when performing a conditional analysis (variables A and B can not be assumed independent). In this case, a separated variable A frequency curve was defined for each variable B index value; therefore, when the **Import Variable A** button is pressed the program will import the corresponding frequency curve into the response curves table.

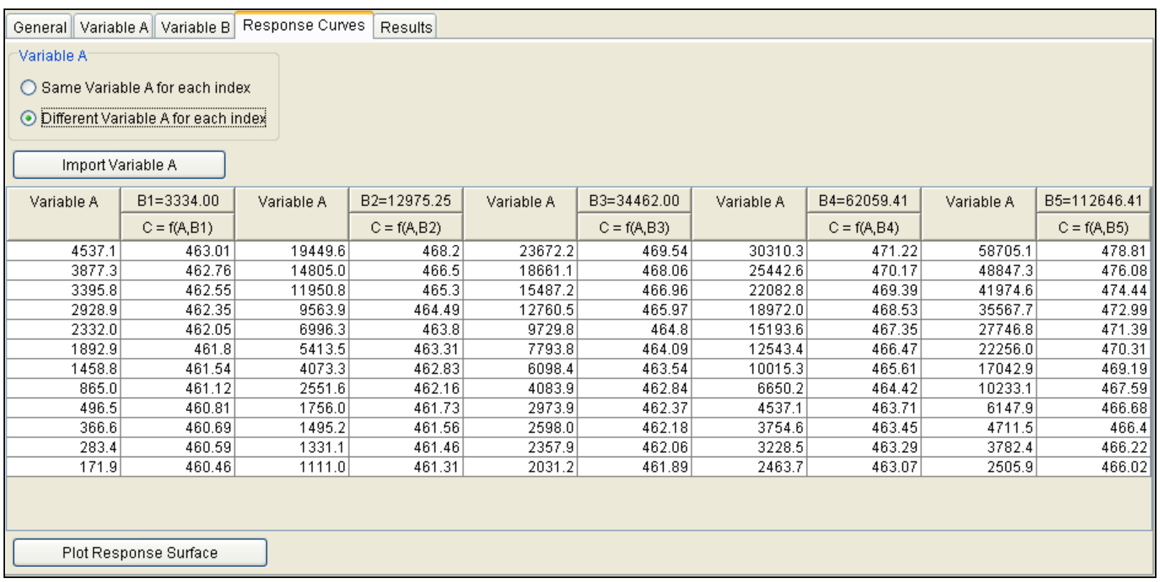
The user must compute the variable C value given the combinations of variables A and B. Figure 9-9 contains 12 values of variable A and 9 index values for variable B. Therefore, the user would have 108 combinations of variables A and B to compute values of variable C. Once computed, the user would manually enter the variable C values into the response curves table. For example, the first value in the first variable C column in Figure 9-9 is 481.38. This was computed using a variable A value of 66039 and a variable B value of 3005.92.

The **Plot Response Surface** button will open a plot similar to the one shown in Figure 9-11. Each line in the response surface plot shows the variable C versus variable A relationship for a given variable B index value.



Variable A	B1=3005.92	B2=8095.90	B3=14053.68	B4=21795.00	B5=30089.62	B6=38967.52	B7=51657.13	B8=72793.26	B9=112646.41
	C = f(A,B1)	C = f(A,B2)	C = f(A,B3)	C = f(A,B4)	C = f(A,B5)	C = f(A,B6)	C = f(A,B7)	C = f(A,B8)	C = f(A,B9)
66039	481.38	481.37	481.37	481.37	481.37	481.36	481.36	481.36	481.69
54354	477.24	477.24	477.25	477.26	477.28	477.32	477.37	477.5	477.91
46370	475.02	475.03	475.05	475.07	475.11	475.18	475.31	475.48	475.97
39053	473.03	473.04	473.07	473.11	473.18	473.28	473.47	473.77	474.45
30296	470.94	470.95	470.98	471.02	471.09	471.2	471.42	471.89	472.78
24265	469.59	469.61	469.64	469.69	469.77	469.9	470.13	470.71	471.74
18631	467.78	467.91	467.97	468.07	468.22	468.42	468.78	469.54	470.82
11395	465.04	465.06	465.27	465.47	465.71	466.04	466.64	467.86	469.75
7095	463.82	463.82	463.82	463.89	464.09	464.52	465.33	466.87	469.21
5578	463.37	463.37	463.36	463.38	463.52	463.99	464.88	466.57	469.03
4589	463.02	463.02	463.02	463.02	463.14	463.65	464.62	466.36	468.94
3210	462.47	462.47	462.47	462.47	462.59	463.2	464.28	466.12	468.82

Figure 9-9. Response Curves Tab for Same Variable A for Each Variable B Index.



Variable A	B1=3334.00	Variable A	B2=12975.25	Variable A	B3=34462.00	Variable A	B4=62059.41	Variable A	B5=112646.41
	C = f(A,B1)		C = f(A,B2)		C = f(A,B3)		C = f(A,B4)		C = f(A,B5)
4537.1	463.01	19449.6	468.2	23672.2	469.54	30310.3	471.22	58705.1	478.81
3877.3	462.76	14805.0	466.5	18661.1	468.06	25442.6	470.17	48847.3	476.08
3395.8	462.55	11950.8	465.3	15487.2	466.96	22082.8	469.39	41974.6	474.44
2928.9	462.35	9563.9	464.49	12760.5	465.97	18972.0	468.53	35567.7	472.99
2332.0	462.05	6996.3	463.8	9729.8	464.8	15193.6	467.35	27746.8	471.39
1892.9	461.8	5413.5	463.31	7793.8	464.09	12543.4	466.47	22256.0	470.31
1458.8	461.54	4073.3	462.83	6098.4	463.54	10015.3	465.61	17042.9	469.19
865.0	461.12	2551.6	462.16	4083.9	462.84	6650.2	464.42	10233.1	467.59
496.5	460.81	1756.0	461.73	2973.9	462.37	4537.1	463.71	6147.9	466.68
366.6	460.69	1495.2	461.56	2598.0	462.18	3754.6	463.45	4711.5	466.4
283.4	460.59	1331.1	461.46	2357.9	462.06	3228.5	463.29	3782.4	466.22
171.9	460.46	1111.0	461.31	2031.2	461.89	2463.7	463.07	2505.9	466.02

Figure 9-10. Response Curves Tab for Different Variable A for Each Variable B Index.

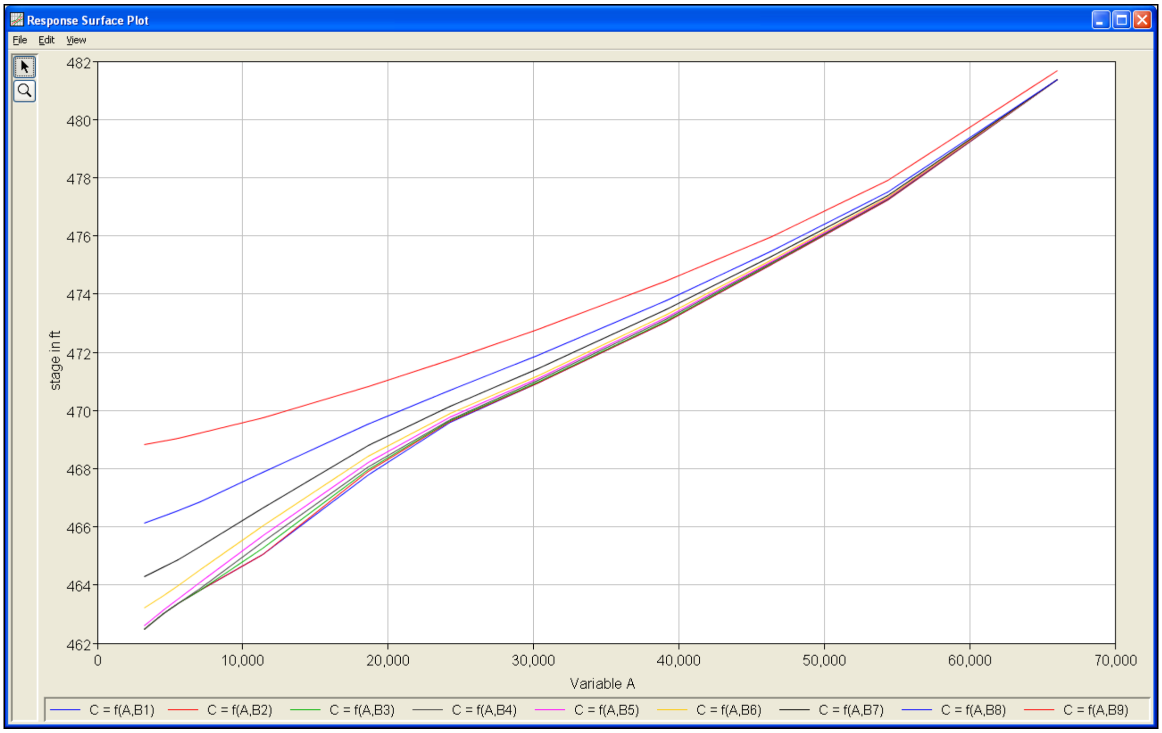
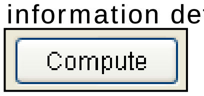


Figure 9-11. Plot of Response Curves.

Compute



Once the new analysis has been defined, and the user has all of the information defined on the General, Variable A, Variable B, Response Curves tabs, performing the computations is simply a matter of pressing the **Compute** button at the bottom of the Coincident Frequency Analysis editor. If the computations are successful, the user will receive a message that says “Compute Complete”. At this point, the user can begin to review the results.

The following describes how the variable C coincident frequency curve is computed.

1) The program uses the variable A frequency curve(s) and the variable A values in the response curves table to assign a frequency of exceedance to each variable C value in the response curves table.

2) The program finds the minimum and maximum values of variable C in the response curves table.

3) The program defines 20 evenly spaced values of variable C in-between the minimum and maximum values (20 values include the minimum and maximum values).

4) For each variable C from step 3, the program will look-up the exceedance frequency value from each response curve in step 1 and multiply by the corresponding proportion of time (using the probability defined on the Variable B tab) obtained from the variable B index value. These “weighted” values from each response curve are summed to compute the variable C frequency curve.

5) The curve is interpolated to the selected exceedance ordinates defined on the General tab.

Multiple coincident frequency analyses can be computed using the **Compute Manager**. Select the **Analysis→Compute Manager** menu option to open the Compute Manager. Select the analyses to be computed and then press the **Compute** button. Close the compute dialogs and Compute Manager when the program finishes computing the analyses.

Results

This section of the manual describes results that are available for the Coincident Frequency analysis. When the user selects the **Results** tab on the Coincident Frequency Analysis editor, the window will appear as shown in Figure 9-12. Both tabular and graphical results are included. The percent chance exceedance ordinates are the same as those defined on the General tab. In addition, the Data Name and Data Units defined on the General tab are used in the column header in the results table and the y-axis label in the plot. Data in the frequency curve table can be re-sorted. Click the **Percent Chance Exceedance** column header (two mouse clicks are required the first time). The percent chance exceedance ordinates, along with frequency values, will sort so that the lowest values are on top or the highest values are on top.

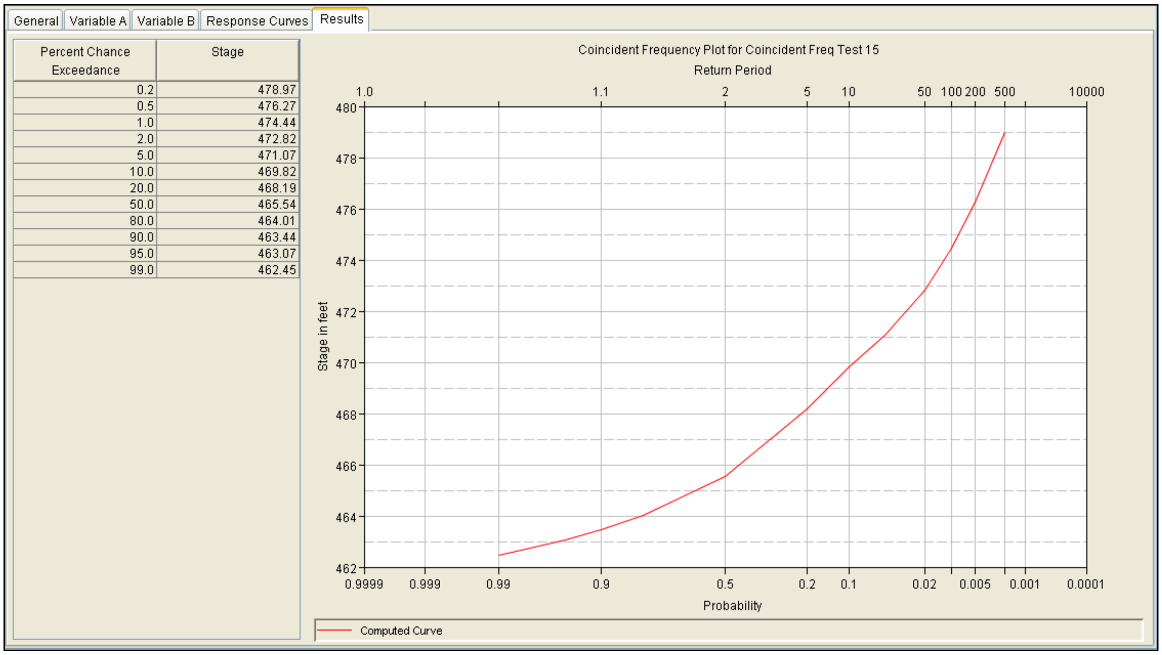


Figure 9-12. Results Tab of the Coincident Frequency Analysis Editor.

Viewing and Printing Results

The user can view output for the coincident frequency analysis directly from the Coincident Frequency Analysis editor (tabular and graphical output) or by using the buttons at the bottom of the editor.

Tabular Output

Once the computations for the coincident frequency analysis are completed, the user can view tabular output by selecting the **Results** tab. The tabular results can be printed by using the **Print** button at the bottom of the coincident frequency analysis editor. When the print button is pressed, a window will appear giving the user options for how they would like the table to be printed. Result tables can also be created from the **Results** menu. At least one coincident frequency analysis must be selected in the study explorer before selecting the **Results→Table** option.

Graphical Output

Graphical output of the coincident frequency analysis can be obtained by selecting either the **Results** tab, or by pressing the **Plot** button at the bottom of the coincident frequency analysis editor. When the Plot button is pressed, a frequency curve plot will appear in a separate window as shown in Figure 9-13. Result graphs can also be created from the **Results** menu. At least one coincident frequency analysis must be selected in the study explorer before selecting the **Results→Graph** option. Results will be graphed in the same plot if multiple coincident frequency analyses are selected in the study explorer when opening a graph from the **Results** menu.

The coincident frequency curve plot can be sent to the printer by selecting the **Print** option from the **File** menu at the top of the window. Additional printing options available from the File menu are Page Setup, Print Preview, and Print Multiple (used for printing multiple graphs on the same page). The graphic can also be sent to the Windows Clipboard by selecting **Copy to Clipboard** from the File menu. Additionally, the plot can be saved to a file by selecting the **Save As** option from the File menu. When the Save As option is selected, a window will appear allowing the user to select a directory, enter a filename, and select the format for saving the file. Currently four file formats are available for saving the graphic to disk: windows metafile, postscript, JPEG, and portable network graphic.

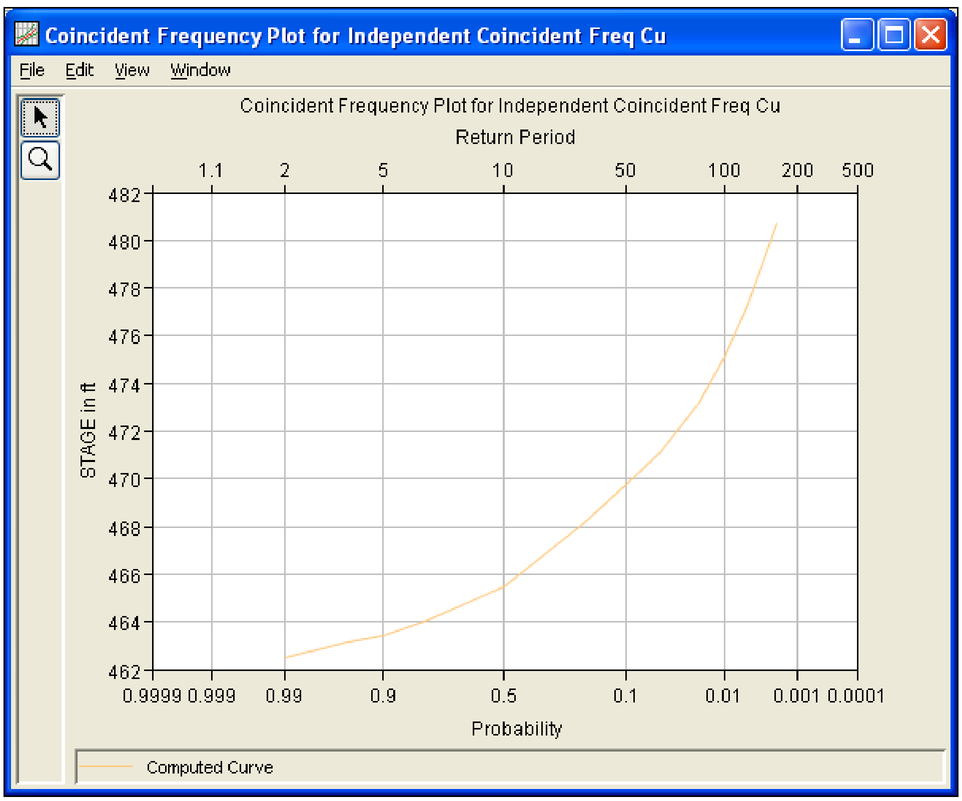


Figure 9-13. Coincident Frequency Analysis Plot.

The data contained within the plot can also be tabulated by selecting **Tabulate** from the File menu. When this option is selected, a separate window will appear with the data tabulated. Additional options are available from the File menu for saving the plot options as a template (**Save Template)** and applying previously saved templates to the current plot (**Apply Template**).

The **Edit** menu contains several options for customizing the graphic. These options include Plot Properties, Configure Plot Layout, Default Line Styles, and Default Plot Properties. Also, a shortcut menu will appear with further customizing options when the user right-clicks on a line on the graph or the legend. Both the Y and X-axis properties can be edited by placing the mouse on top of axis and clicking the right mouse button. Then select the **Edit Properties** menu option in the shortcut menu. For example, the user can turn on minor tic marks for the y-axis and modify the minimum and maximum scale for the x-axis. The graphic customizing capabilities within HEC-SSP are very powerful, but are also somewhat complex to use. The code used in developing the plots in HEC-SSP is the same code that is used for developing plots in HEC-DSSVue and several other HEC software programs. Please refer to the HEC-DSSVue User's Manual for details on customizing plots.

Viewing the Report File

A report file is created when the coincident frequency analysis computations are performed. The report file lists the input data, user settings, and the final results. This file is often useful for understanding how the software arrived at the final frequency curve.

To view the report file press the **View Report** button at the bottom of the Coincident Frequency Analysis editor. When this button is pressed, a window will appear containing the report as shown in Figure 9-14.

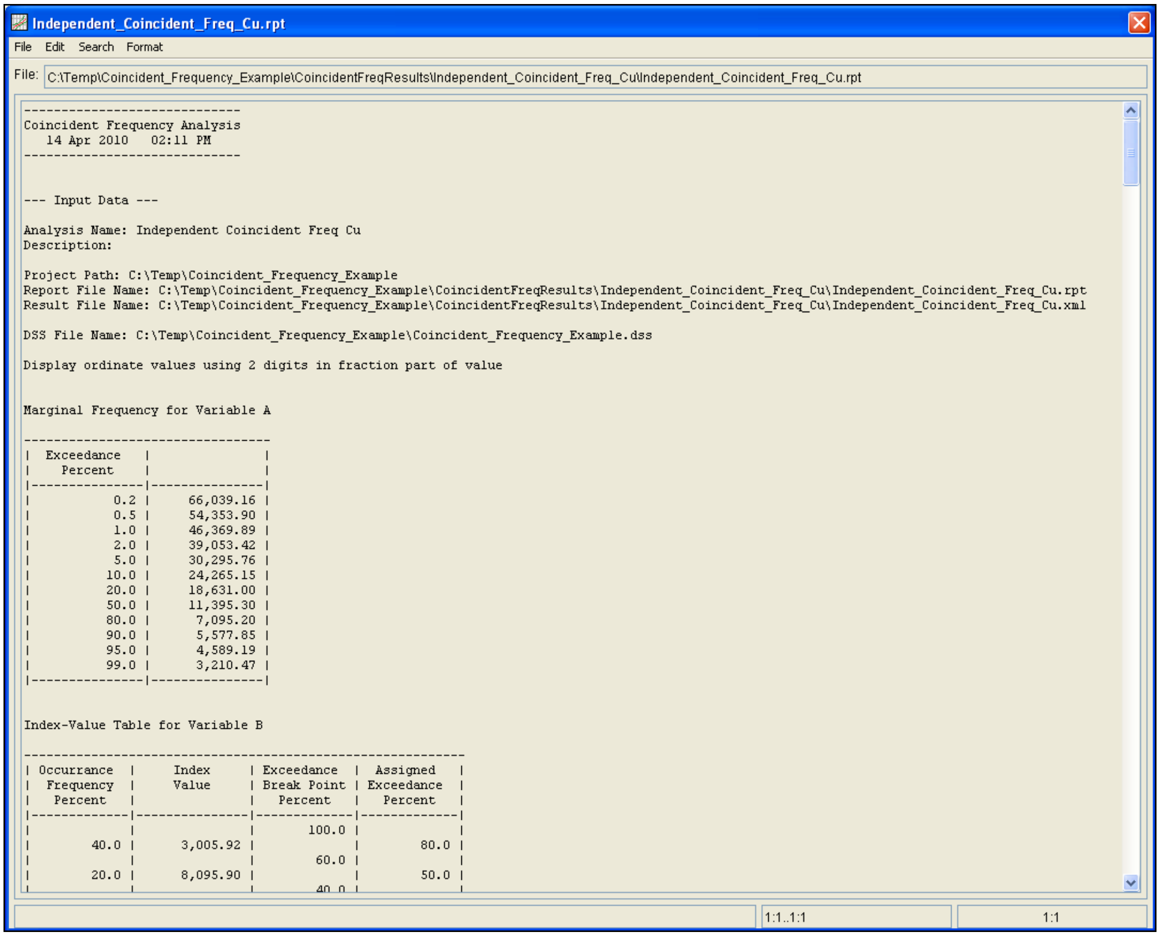


Figure 9-14. Coincident Frequency Analysis Report File.

CHAPTER 10

Performing a Curve Combination Analysis

The Curve Combination analysis provides a tool for combining frequency curves (and confidence limits) from multiple sources. One example is shown in Figure 10-1. This example includes observed historic measurements of annual maximum stage, results from a hydrology model, and an estimate of the maximum stage from the probable maximum flood. The curve combination tool can be used to develop one frequency curve that combines all these sources of information.

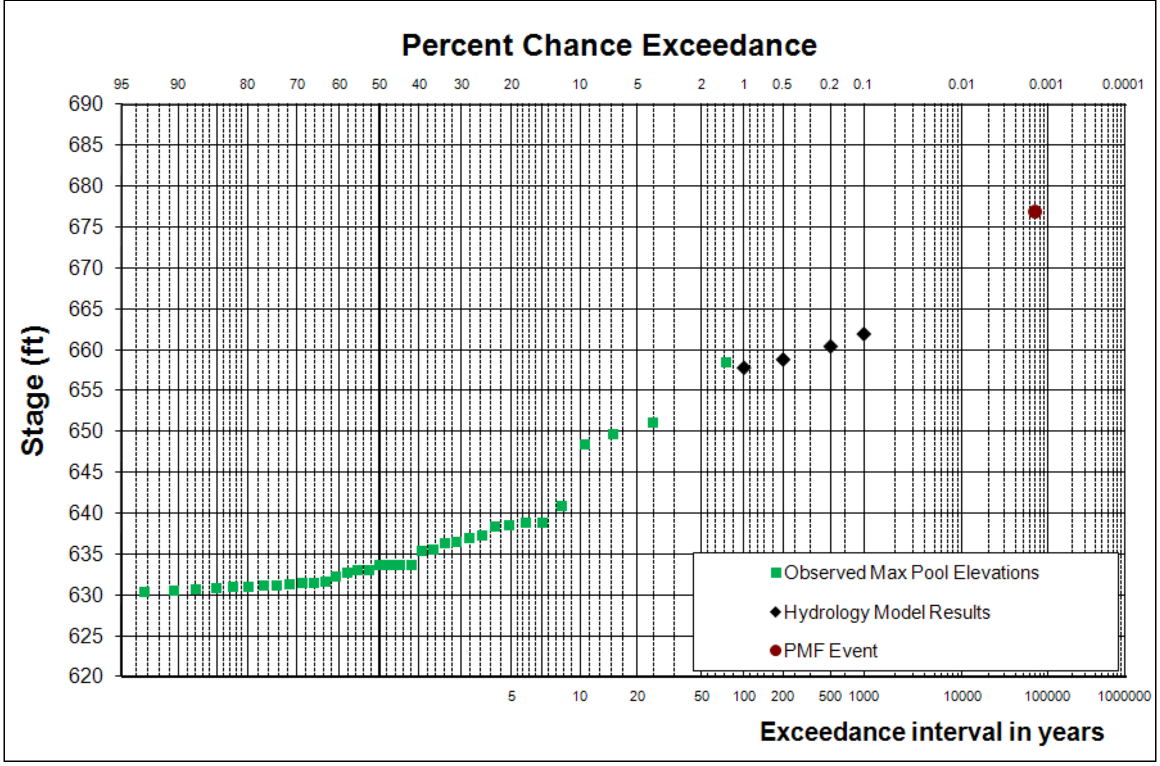


Figure 10-1. Example of Data used in a Curve Combination Analysis.

Contents

Starting a New Analysis

A curve combination analysis can be started in two ways, either by right clicking on the Curve Combination Analysis folder in the study explorer and selecting **New**, or by going to the **Analysis** menu and selecting **New** and then **Curve Combination Analysis**. When a new curve combination analysis is selected, the Curve Combination Analysis editor will appear as shown in 10-2.

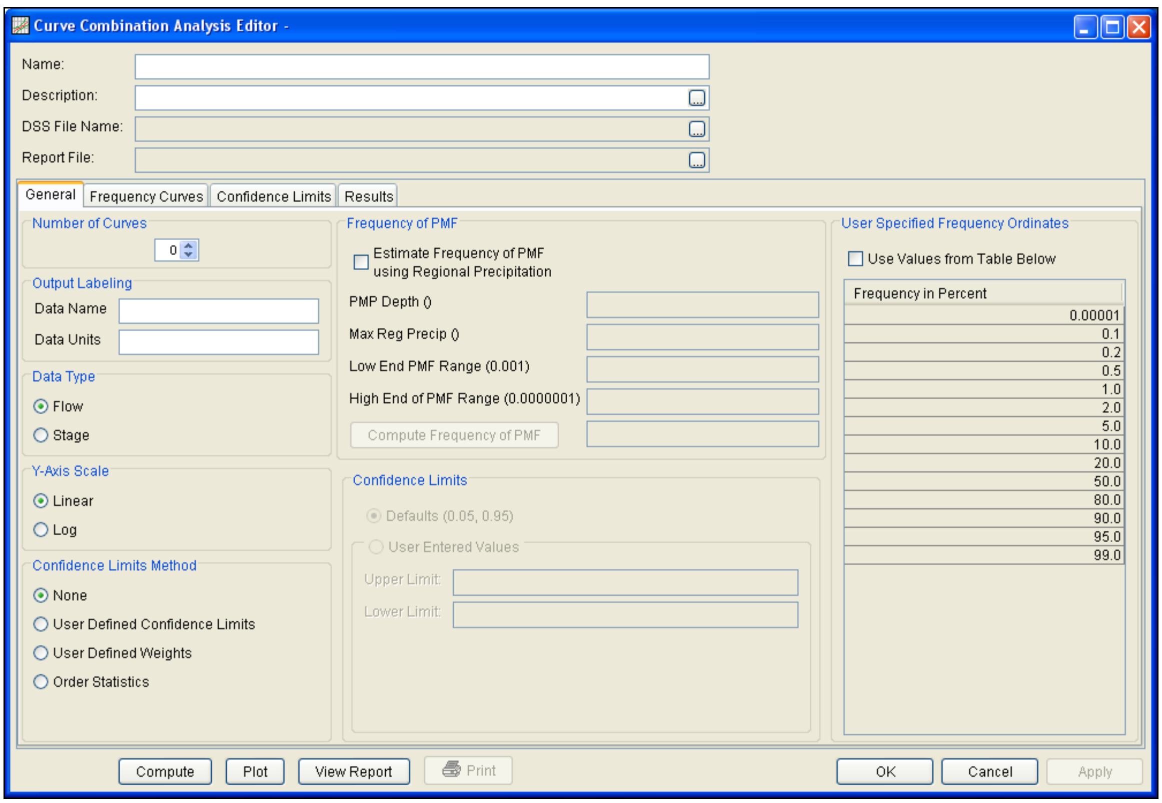


Figure 10-2. Curve Combination Analysis Editor.

The user is required to enter a **Name** for the analysis, while a **Description** is optional. Once a Name is entered, the **DSS File Name** and **Report File** will automatically be filled out. The DSS filename is by default the study DSS file. The report file is given the same name as the analysis with the extension ".rpt".

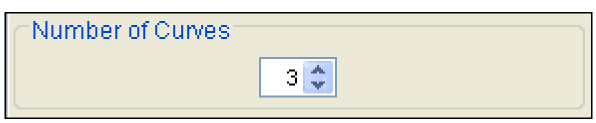
General Settings

Once the analysis name has been entered, the user can begin to perform the analysis. Contained on the Curve Combination Analysis editor are four tabs. The tabs are labeled **General**, **Frequency Curves**, **Confidence Limits**, and **Results**. The first tab contains general settings for performing the curve combination analysis (Figure 10-2). These settings include:

- Number of Curves
- Output Labeling
- Data Type
- Y-Axis Scale
- Confidence Limits Method
- Frequency of PMF
- Confidence Limits
- User Specified Frequency Ordinates

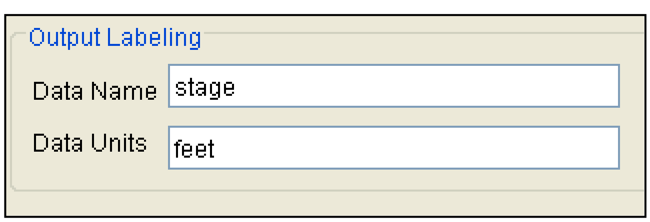
Number of Curves

This option lets the user choose the number of frequency curves to combine. Both the Frequency Curves and Confidence Limits tabs will update based on the number of curves.



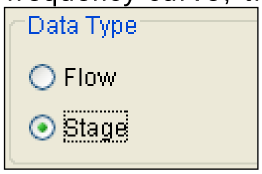
Output Labeling

This option allows the user to enter labels for data contained in the output tables and plots. The user must enter the name of the data as well as the data units. The output labeling does not result in the conversion of data from one unit system to another; it only affects what is displayed on table headings and the y-axis of the results plot.



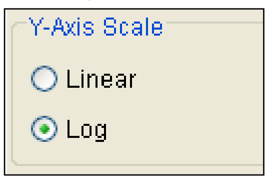
Data Type

The user is required to select the data type for the combined frequency curve; the options are **Flow** and **Stage**. This is required for the Order Statistics method to compute the confidence limits, different equations are used depending on the data type. Developing confidence limits for graphical frequency curves and the order statistics method is discussed in ETL 1110-2-537. If the data is not flow or stage, select the **Flow** data type when the graphical frequency curve is approximately analytic for extreme probabilities (frequency curve is not relatively flat for extreme probabilities). Select the **Stage** data type when the graphical frequency curve is relatively flat for extreme probabilities (ETL 1110-2-537).



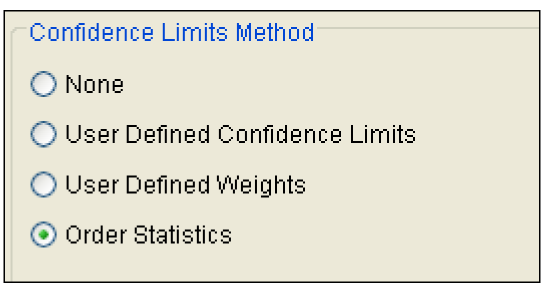
Y-Axis Scale

This option allows the user to choose the scale of the Y-axis in the curve combination plot. The options are **Linear** and **Log**.



Confidence Limits Method

This option lets the user choose the method for computing the confidence limits around the combined frequency curve. The options include **None**, **User Defined Confidence Limits**, **User Defined Weights**, and **Order Statistics**.



None. When the None option is selected, the Confidence Limits tab will become disabled and the program will only compute the combined frequency curve.

User Defined Confidence Limits. When the User Defined Confidence Limits option is select, the Confidence Limits tab will become disabled and the Upper and Lower Confidence Limits columns in the table on the Results tab will become enabled. The user can manually enter the confidence limits into this table and the program will plot the curves along with the combined frequency curve when the compute button is pressed. The user must specify an upper and lower confidence limit value for each ordinate in the table on the Results tab before pressing the compute button.

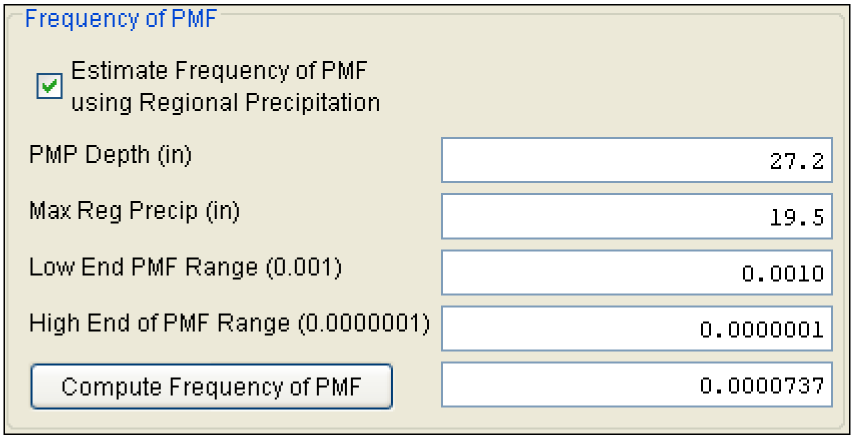
User Defined Weights. When the User Defined Weights option is selected, the Confidents Limits panel on the General tab becomes active as well as the Confidence Limits tab. The Confidence Limits tab provides tables for defining the upper and lower confidence limits for each frequency curve in the analysis. The user can select the confidence limits from an existing analysis, define the limits manually, or have HEC-SSP compute them using the order statistics method. After the confidence limits have been defined, the user must provide a weight for each pair of confidence limits. The program uses the weight for computing the combined confidence limits.

Order Statistics. When the Order Statistics option is selected, the Confidents Limits panel on the General tab becomes active as well as the Confidence Limits tab. The Confidence Limits tab is used to compute the confidence limits using the order statistics method. The order statistics method is described in ETL 1110-2-537.

Frequency of PMF

This option provides a tool for estimating the frequency of the Probable Maximum Flood (PMF) using regional precipitation. The method scales the probability of the PMF by comparing the Probable Maximum Precipitation (PMP) to the largest observed regional historical precipitation and using an established institutional range of probabilities for the PMF. By utilizing regional precipitation data, this procedure inherently includes the effects of regional weather patterns, distance from moisture sources, orographic effects, etc. In areas where the largest observed regional historical precipitation has approached the PMP, the method would yield a probability towards the more frequent end of the established institutional range. Likewise, in areas where the largest observed regional historical precipitation is much lower than the PMP, the probability of the PMF would tend towards the less frequent end of the established institutional range.

This option is not necessary in order to use the Curve Combination analysis to combine frequency curves. It was added to assist users when developing frequency curves that included estimates of the PMF. The user must check the box, **Estimate Frequency of PMF using Regional Precipitation**, to use this tool to estimate the probability of the PMF. Before the **Compute Frequency of PMF** button can be pressed, the user must enter the PMP depth, the maximum regional historic precipitation, and probabilities for the low and high ends of the established range of the PMF. The frequency of the PMF, estimated with this tool, should be multiplied by 100 before entering it into the User Specified Frequency Ordinates table.



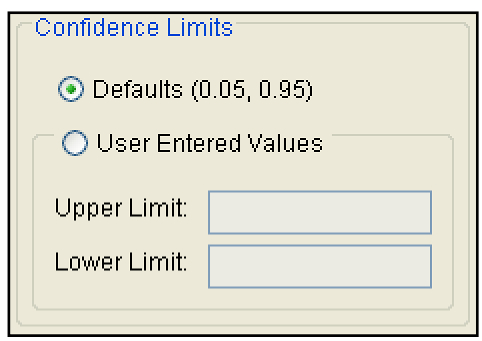
The following equation is used to calculate the probability of the PMF:

$$AEP = 10^{-[(1-Ratio)\times Range + Min.Value]}$$

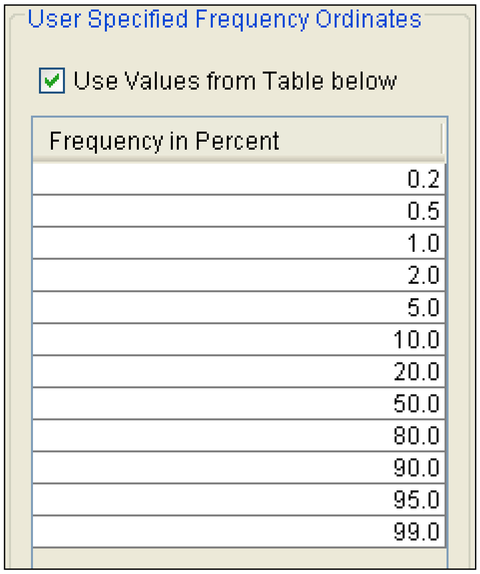
where *Ratio* is the largest observed regional historical precipitation divided by the PMP, *Range* is the established institutional range for the probability of the PMF (for the US Army Corps of Engineers this is 10^{-3} to 10^{-7}), and *MinValue* is the minimum value of the established institutional range. When solving the equation, *Range* and *MinValue* are the exponents from the established institutional range. If the institutional range was 10^{-3} to 10^{-7}, then *Range* would be 4 and the *MinValue* would be 3.

Confidence Limits

Confidence limits provide a measure of the uncertainty in the computed value for a given exceedance probability. The computation of confidence limits is an option defined in the **Confidence Limits Method** panel. The Confidence Limits panel is only active when the **User Defined Weights** or the **Order Statistics** method is selected. By default, HEC-SSP calculates the 90 percent confidence interval (i.e. the 5% and 95% confidence limits). The confidence limits must be entered in decimal form (i.e. 95% = 0.95, and 5% = 0.05). The user has the option to override the default values.



User Specified Frequency Ordinates



This option allows the user to change the frequency ordinates used for creating result tables and graphs. The default values listed in percent chance exceedance are 0.00001, 0.2, 0.5, 1, 2, 5, 10, 20, 50, 80, 90, 95, and 99. Check the box next to **Use Values from Table below** to change or add additional values. Once this box is checked, the user can add/remove rows and edit the frequency values. To add or remove a row from the table, select the row(s), place the mouse over the highlighted row(s) and click the right mouse button. The shortcut menu contains options to **Insert Row(s)** and **Delete Row(s)**. The program will use the default values, even if they are not contained in the table, when the **Use Values from Table below** option is not checked. Finally, all values in the table must be between 0 and 100.

Frequency Curves

The Frequency Curves tab is used to define the frequency curves and the user-defined weights used by the program to combine the curves into one frequency curve. As shown in Figure 10-3, the Frequency Curves tab contains a panel for each frequency curve; the number of frequency curves is defined on the General tab. The frequency curve ordinates in the **Frequency in Percent** column are defined on the General tab. The user has the option to enter the frequency curve manually or to pick an existing Bulletin 17B or General Frequency analysis. If an **Existing Study Analysis** is selected, the program uses the statistics from the selected analysis and computes the frequency curve that populates the table. The frequency curve will only be computed for those frequency ordinates included within the selected analysis. The program will not extrapolate frequency curve values. For example, if the selected Bulletin 17B analysis computed a frequency curve from 99 to 0.2 percent chance exceedance then values less than 0.2 percent chance exceedance will not be populated in the curve combination analysis. The user can always add additional frequency ordinates to a Bulletin 17B or General Frequency analysis if needed. If **Manual Entry** is selected, then the user can enter frequency curve values for a few or all the frequency curve ordinates. The user must also enter the weights used to combine the frequency curves. Finally, the equivalent years of record must be defined when using the order statistics method to compute the confidence limits.

The program will import the years of record from the selected analysis when the **Existing Study Analysis** option is selected. The user must manually enter the equivalent years of record when the **Manual Entry** option is selected.

As shown in Figure 10-3, the frequency curves do not have to have a value for each ordinate; however, each frequency curve ordinate must have at least one frequency curve value. In addition, a user-defined weight does not have to be entered for each frequency curve value; however, the weights for a frequency curve ordinate must sum to 1.

The Plot Curves button will open a graph showing all frequency curves defined on the frequency curves tab, as show in Figure 10-4.

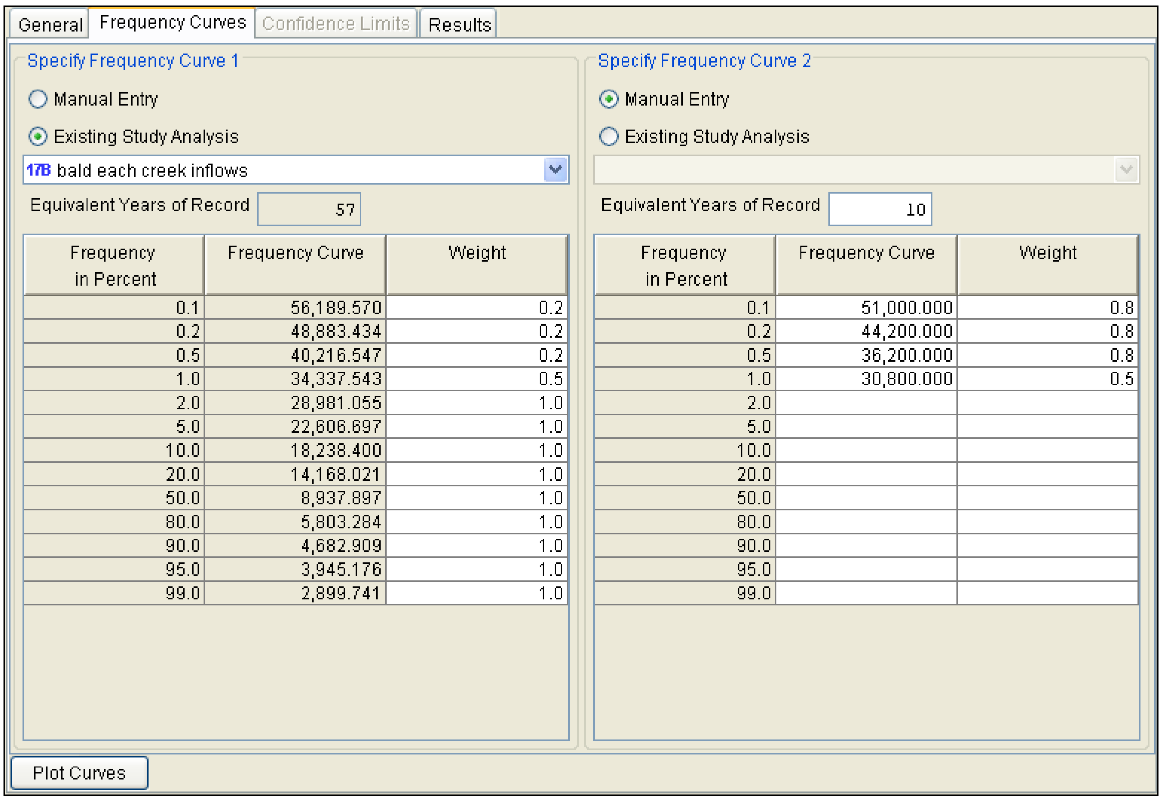


Figure 10-3. Curve Combination Analysis Frequency Curves Tab.

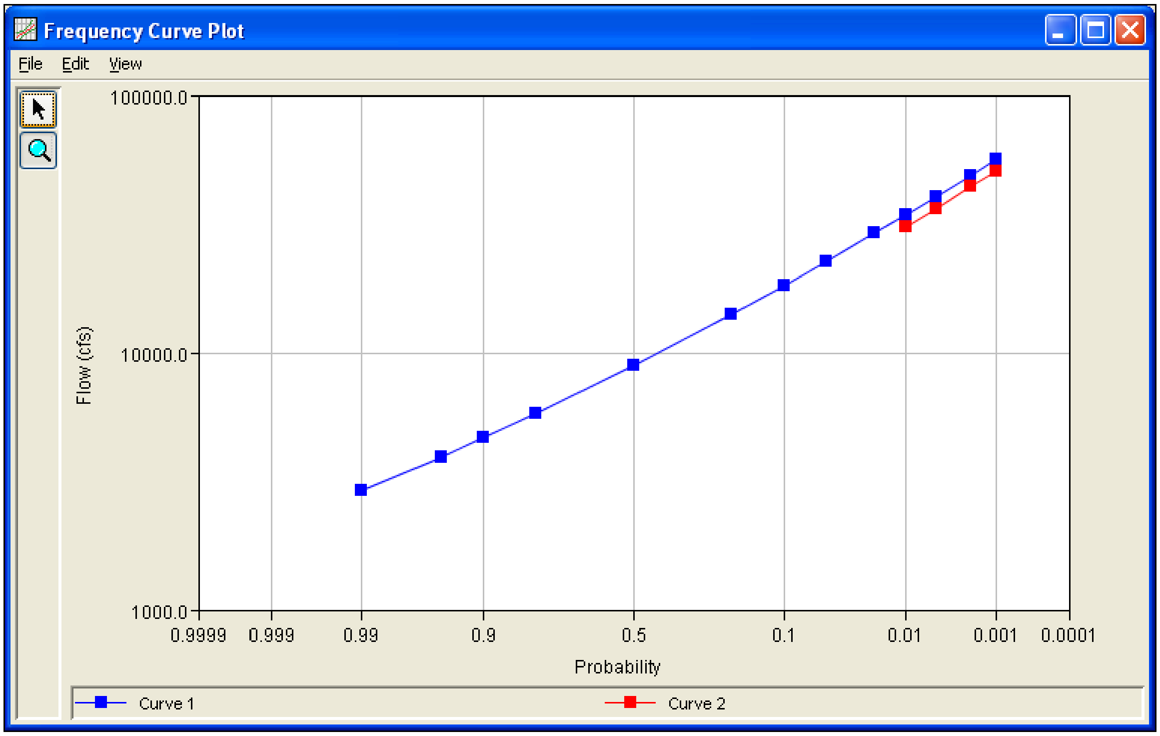


Figure 10-4. Plot of Frequency Curves Defined on the Frequency Curves Tab.

Confidence Limits

The Confidence Limits tab is used to define the confidence limits and the user-defined weights used by the program to combine the confidence limits into one pair of upper and lower confidence limits. The confidence limits tab will change based on the **Confidence Limits Method** selected on the General Tab.

The Confidence Limits tab will look similar to Figure 10-5 when the **User Defined Weights** option is selected on the General tab. The Confidence Limits tab contains a panel for each frequency curve; the number of frequency curves is defined on the General tab. The frequency curve ordinates in the **Frequency in Percent** column are defined on the General tab. The user has the option to enter the confidence limits manually, compute the confidence limits using the order statistics method, or pick an existing Bulletin 17B or General Frequency analysis. If **Manual Entry** is selected, then the user can enter confidence limits values for a few or all the frequency curve ordinates. If **Compute using Order Statistics Method** is selected, then the Compute Confidence Limits button will become active. When this button is pressed, the program will compute the upper and lower confidence limits using the order statistics method (and the equivalent years of record defined on the **Frequency Curves** tab) and automatically populate the table. If **Existing Study Analysis** is selected, the program uses the statistics from the selected analysis and computes the confidence limits that populate the table. The confidence limits will only be computed for those frequency ordinates included within the selected analysis. The program will not extrapolate confidence limits values. For example, if the selected Bulletin 17B analysis computed a frequency curve from 99 to 0.2 percent chance exceedance then values less than 0.2 percent chance exceedance will not be populated in the curve combination analysis. The user can always add additional frequency ordinates to a Bulletin 17B or General Frequency analysis if needed. The user must enter the weights used to combine the confidence limits. The **Import Weights from Frequency Curves Tab** button will import the same weights as defined on the **Frequency Curves** tab.

As shown in Figure 10-5, the confidence limits do not have to have a value for each ordinate; however, each frequency curve ordinate must have at least one upper and lower confidence limits value. In addition, a user-defined weight does not have to be entered for each upper and lower confidence limits pair; however, the weights for a frequency curve ordinate must sum to 1.

The Confidence Limits tab will look similar to Figure 10-6 when the **Order Statistics** option is selected on the General tab. The user must enter an equivalent years of record for each frequency ordinate. The program will compute the combined frequency curve and then the confidence limits using the order statistics method when the **Compute Confidence Limits** button is pressed. As shown in Figure 10-6, the upper and lower confidence limits will be populated in the table and a plot is created showing the combined frequency curve along with the computed confidence limits.

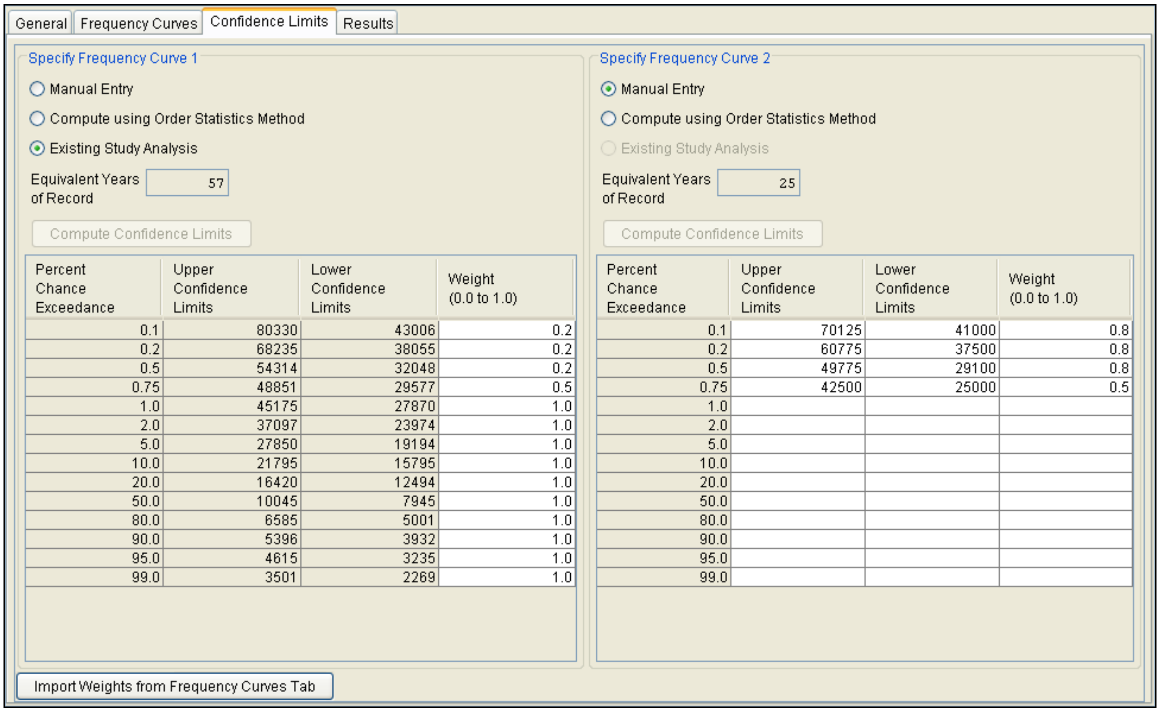


Figure 10-5. Curve Combination Analysis Confidence Limits Tab – User Defined Weights Method.

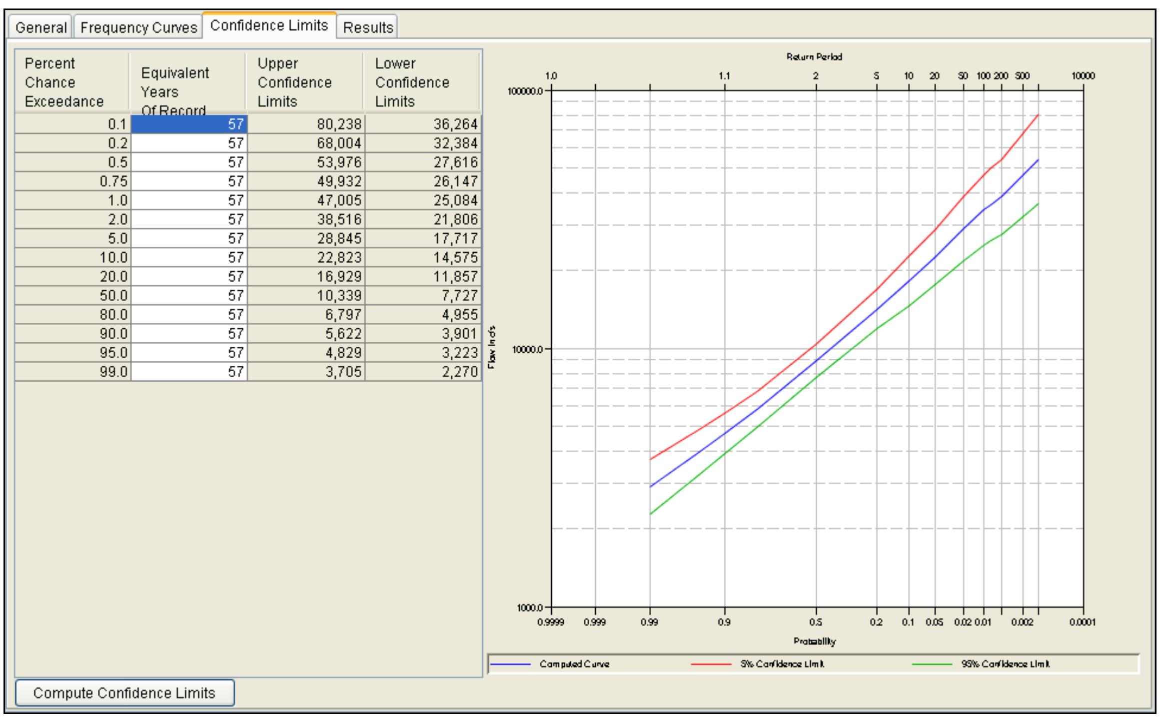
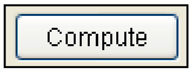


Figure 10-6. Curve Combination Analysis Confidence Limits Tab - Order Statistics Method.

Compute

Once the new analysis has been defined, and the user has all of the information defined on the General, Frequency Curves, and Confidence

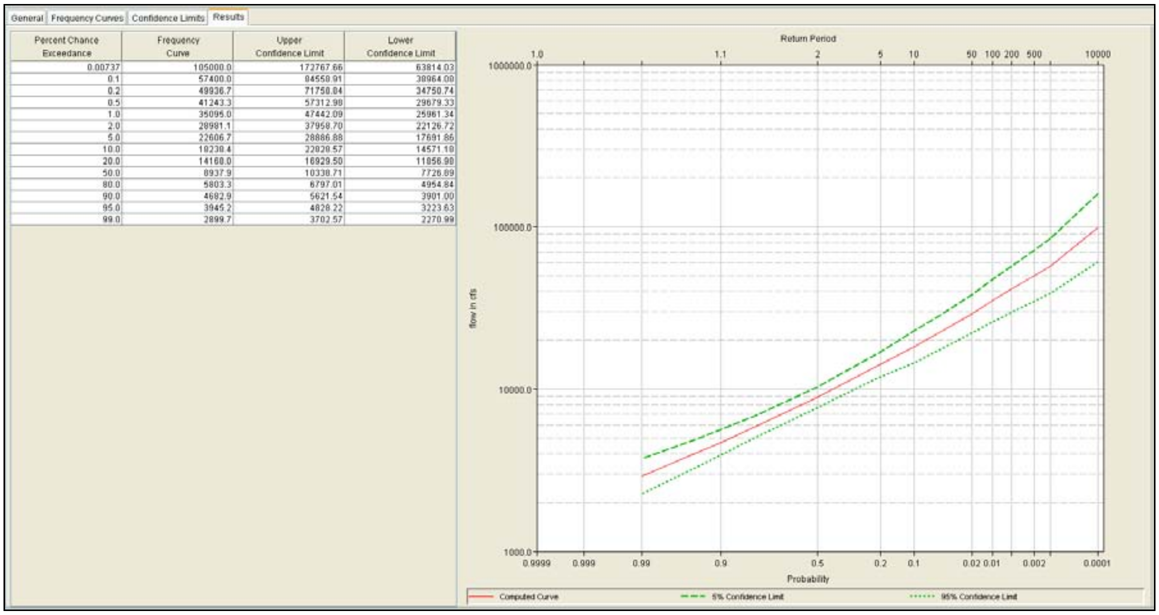


Limits tabs, performing the computation is simply a matter of pressing the **Compute** button at the bottom of the Curve Combination Analysis editor. If the computations are successful, the user will receive a message that says "Compute Complete". At this point, the user can begin to review the results.

Multiple curve combination analyses can be computed using the **Compute Manager**. Select the **Analysis→Compute Manager** menu option to open the Compute Manager. Select the analyses to be computed and then press the **Compute** button. Close the compute dialogs and Compute Manager when the program finished computing the analyses.

Results

This section describes results that are available for the Curve Combination analysis. When the user selects the **Results** tab on the Curve Combination Analysis editor, the window will appear as shown in Figure 10-7. Both tabular and graphical results are included. The percent chance exceedance ordinates are the same as those defined on the **General** tab. In addition, the Data Name and Data Units defined on the General tab are used in the y-axis label in the plot. The user must enter the upper and lower confidence limits when the **User Defined Confidence Limits** option is selected on the General tab; otherwise, the program computes the confidence limits when the compute button is pressed. Data in the frequency curve table can be re-sorted. Click the **Percent Chance Exceedance** column header (two mouse clicks are required the first time). The percent chance exceedance ordinates, along with frequency curve and confidence limits values, will sort so that the lowest values are on top or the highest values are on top.



Percent Chance Exceedance	Frequency Curve	Upper Confidence Limit	Lower Confidence Limit
0.00737	105000.0	172767.66	63814.03
0.1	57400.0	84558.91	38964.00
0.2	49936.7	71758.84	34750.74
0.5	41243.3	57312.98	29679.33
1.0	35095.0	47442.09	25961.34
2.0	28981.1	37958.70	22126.72
5.0	22606.7	28886.88	17691.86
10.0	18238.4	22828.57	14571.10
20.0	14168.0	16929.50	11856.98
50.0	8937.9	10338.71	7726.89
80.0	5803.3	6797.01	4954.84
90.0	4682.9	5621.54	3901.00
95.0	3945.2	4828.22	3223.63
99.0	2899.7	3702.57	2270.99

Figure 10-7. Results Tab of the Curve Combination Analysis Editor.

Viewing and Printing Results

The user can view output for the curve combination analysis directly from the Curve Combination Analysis editor (tabular and graphical output) or by using the buttons at the bottom of the editor.

Tabular Output

Once the computations for the curve combination analysis are completed, the user can view tabular output by selecting the **Results** tab. The tabular results can be printed by using the **Print** button at the bottom of the curve combination analysis editor. When the print button is pressed, a window will appear giving the user options for how they would like the table to be printed. Result tables can also be opened from the **Results** menu. At least one curve combination analysis must be selected in the study explorer before selecting the **Results→Table** option.

Graphical Output

Graphical output of the curve combination analysis can be obtained by selecting either the **Results** tab, or by pressing the **Plot** button at the bottom of the curve combination analysis editor. When the Plot button is pressed, a frequency curve plot will appear in a separate window as shown in Figure 10-8. Result graphs can also be created from the **Results** menu. At least one curve combination analysis must be selected in the study explorer before selecting the **Results→Graph** option. Results will be graphed in the same plot if multiple curve combination analyses are selected in the study explorer when opening a graph from the **Results** menu.

The curve combination frequency curve plot can be sent to the printer by selecting the **Print** option from the **File** menu at the top of the window. Additional printing options available from the File menu are Page Setup, Print Preview, and Print Multiple (used for printing multiple graphs on the same page). The graphic can also be sent to the Windows Clipboard by selecting **Copy to Clipboard** from the File menu. Additionally, the plot can be saved to a file by selecting the **Save As** option from the File menu. When the Save As option is selected, a window will appear allowing the user to select a directory, enter a filename, and select the format for saving the file. Currently four file formats are available for saving the graphic to disk: windows metafile, postscript, JPEG, and portable network graphic.

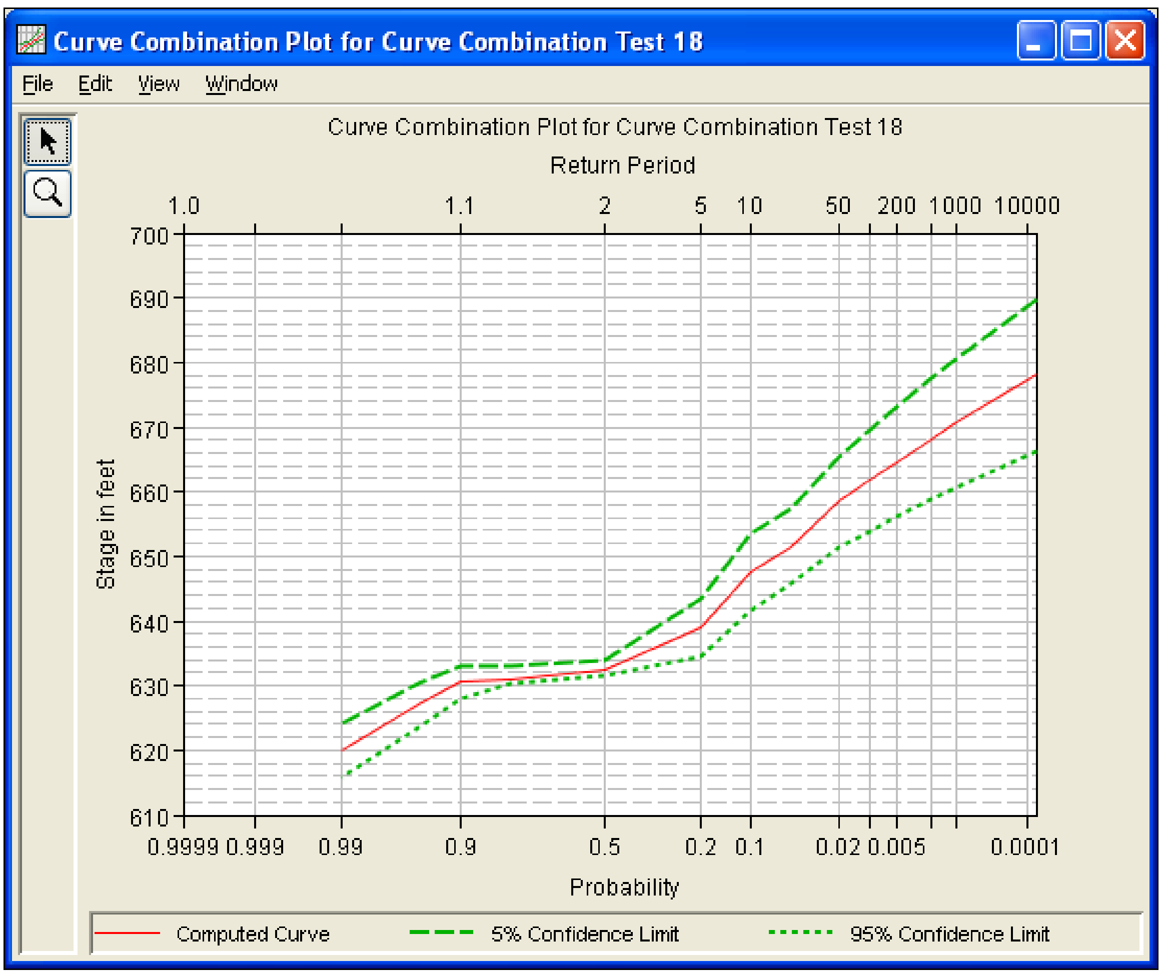


Figure 10-8. Curve Combination Analysis Plot.

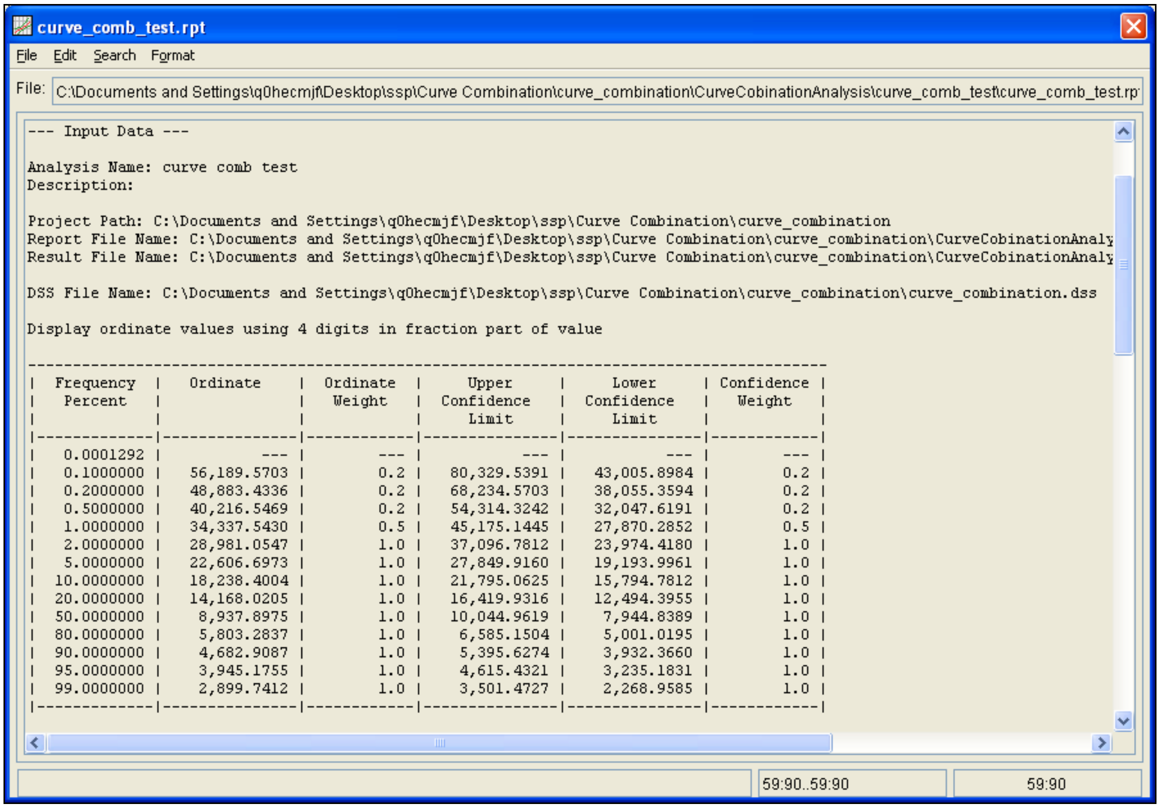
The data contained within the plot can also be tabulated by selecting **Tabulate** from the File menu. When this option is selected, a separate window will appear with the data tabulated. Additional options are available from the File menu for saving the plot options as a template (**Save Template)** and applying previously saved templates to the current plot (**Apply Template**).

The **Edit** menu contains several options for customizing the graphic. These options include Plot Properties, Configure Plot Layout, Default Line Styles, and Default Plot Properties. Also, a shortcut menu will appear with further customizing options when the user right-clicks on a line on the graph or the legend. Both the Y and X-axis properties can be edited by placing the mouse on top of axis and clicking the right mouse button. Then select the **Edit Properties** menu option in the shortcut menu. For example, the user can turn on minor tic marks for the y-axis and modify the minimum and maximum scale for the x-axis. The graphic customizing capabilities within HEC-SSP are very powerful, but are also somewhat complex to use. The code used in developing the plots in HEC-SSP is the same code that is used for developing plots in HEC-DSSVue and several other HEC software programs. Please refer to the HEC-DSSVue User's Manual for details on customizing plots.

Viewing the Report File

A report file is created when the curve combination analysis computations are performed. The report file lists the input data, user settings, and the final results. This file is often useful for understanding how the software arrived at the final frequency curve.

To view the report file press the **View Report** button at the bottom of the Curve Combination Analysis editor. When this button is pressed, a window will appear containing the report as shown in Figure 10-9.



curve_comb_test.rpt

File Edit Search Format

File: C:\Documents and Settings\q0hecmjf\Desktop\ssp\Curve Combination\curve_combination\CurveCobinationAnalysis\curve_comb_test\curve_comb_test.rp

```
--- Input Data ---

Analysis Name: curve comb test
Description:

Project Path: C:\Documents and Settings\q0hecmjf\Desktop\ssp\Curve Combination\curve_combination
Report File Name: C:\Documents and Settings\q0hecmjf\Desktop\ssp\Curve Combination\curve_combination\CurveCobinationAnaly
Result File Name: C:\Documents and Settings\q0hecmjf\Desktop\ssp\Curve Combination\curve_combination\CurveCobinationAnaly

DSS File Name: C:\Documents and Settings\q0hecmjf\Desktop\ssp\Curve Combination\curve_combination\curve_combination.dss

Display ordinate values using 4 digits in fraction part of value
```

Frequency Percent	Ordinate	Ordinate Weight	Upper Confidence Limit	Lower Confidence Limit	Confidence Weight
0.0001292	---	---	---	---	---
0.1000000	56,189.5703	0.2	80,329.5391	43,005.8984	0.2
0.2000000	48,883.4336	0.2	68,234.5703	38,055.3594	0.2
0.5000000	40,216.5469	0.2	54,314.3242	32,047.6191	0.2
1.0000000	34,337.5430	0.5	45,175.1445	27,870.2852	0.5
2.0000000	28,981.0547	1.0	37,096.7812	23,974.4180	1.0
5.0000000	22,606.6973	1.0	27,849.9160	19,193.9961	1.0
10.0000000	18,238.4004	1.0	21,795.0625	15,794.7812	1.0
20.0000000	14,168.0205	1.0	16,419.9316	12,494.3955	1.0
50.0000000	8,937.8975	1.0	10,044.9619	7,944.8389	1.0
80.0000000	5,803.2837	1.0	6,585.1504	5,001.0195	1.0
90.0000000	4,682.9087	1.0	5,395.6274	3,932.3660	1.0
95.0000000	3,945.1755	1.0	4,615.4321	3,235.1831	1.0
99.0000000	2,899.7412	1.0	3,501.4727	2,268.9585	1.0

59:90..59:90 59:90

Figure 10-9. Curve Combination Analysis Report File.

APPENDIX A

References

Interagency Advisory Committee on Water Data, March 1982. Bulletin 17B, "Guidelines for Determining Flood Flow Frequency", Published by the U.S. Department of the Interior, Geologic Survey.

U.S. Army Corps of Engineers, Hydrologic Engineering Center, May 1992. HEC-FFA, Flood Frequency Analysis, User's Manual.

U.S. Army Corps of Engineers, Hydrologic Engineering Center, December 1996. STATS, Statistical Analysis of Time Series Data, User's Manual.

U.S. Army Corps of Engineers, Hydrologic Frequency Analysis, EM 1110-2-1415. March 1993, Washington, D.C.

U.S. Army Corps of Engineers, Uncertainty Estimates for Nonanalystic Frequency Curves, ETL 1110-2-537. October 1997, Washington, D.C.

APPENDIX B

Example Data Sets

The input and output for eleven example data sets are provided to illustrate the use of selected options and to assist in verifying the correct execution of the program.

The first six example data sets are the same examples that were found in the HEC-FFA program documentation. The first six examples were duplicated with a Bulletin 17B and General Frequency analysis. This manual only shows these examples using the Bulletin 17B analysis; however, the example data sets show that results are the same whether a Bulletin 17B or General Frequency analysis was performed. As shown in the example data sets, the HEC-SSP software produces the same results as HEC-FFA for these six data sets. All of these test examples are provided with the software as a single HEC-SSP study labeled "SSP Examples". You can install this study on your computer by selecting the **Help→Install Example Data** menu option. After opening this study for the first time on your computer, you must compute each example before viewing tabular and graphical results.

A brief description of each test example is provided. In most cases the weighted skew option was selected, and a regional skew value was entered from the generalized skew map of the United States provided within Bulletin 17B (Plate 1).

The example problems shown in this section are entitled:

1. Fitting the Log-Pearson Type III Distribution.
2. Analysis with High Outliers.
3. Testing and Adjusting for a Low Outlier.
4. Zero Flood Years.
5. Confidence Limits and Low Threshold Discharge.
6. Use of Historic Data and Median Plotting Positions.
7. Analyzing Stage Data.
8. Using User-Adjusted Statistics.
9. General Frequency - Graphical Analysis.

10. Volume Frequency Analysis, Maximum Flows.

11. Volume Frequency Analysis, Minimum Flows.

12. Duration Analysis, Bin (STATS) Method.

13. Duration Analysis, Rank All Data Method.

14. Duration Analysis, Manual Entry.

15. Coincident Frequency Analysis, A and B can be Assumed Independent.

16. Coincident Frequency Analysis, A and B can not be Assumed Independent.

17. Curve Combination Analysis, Combine Flow Frequency Curves.

18. Curve Combination Analysis, Combine Stage Frequency Curves.

When the "SSP Examples" study file is open, the screen will appear as shown in Figure B-1. There are six Bulletin 17B analyses, nine General Frequency analyses, two Volume Frequency analyses, three Duration analyses, two Coincidence Frequency analyses, and two Curve Combination analyses in this study. The following sections document each of the example data sets.

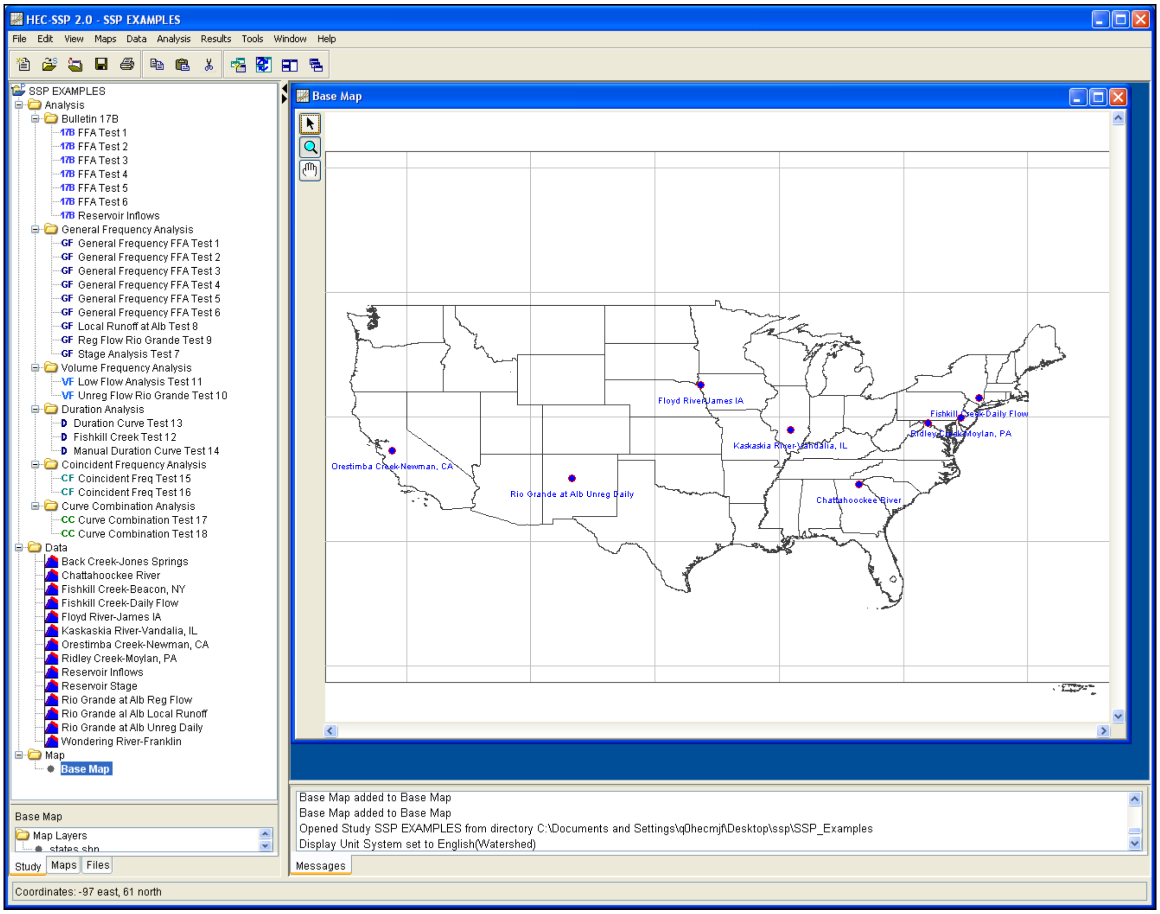


Figure B-1. SSP Examples Study.

Example 1: Fitting the Log-Pearson Type III Distribution

The input data for the HEC-SSP Example 1 is the same as that for Example 1 in Appendix 12, Guidelines for Determining Flood Flow Frequency, Water Resources Council Bulletin 17B. Example 1 illustrates the routine computation of a frequency curve by the Bulletin 17B methodology.

The data for this example is from Fishkill Creek in Beacon, New York. The period of record used for this example is from 1945 to 1968. To view the data from HEC-SSP, right-click on the data record labeled "**Fishkill Creek-Beacon, NY**" in the study explorer and then select **Tabulate**. The data will appear as shown in Figure B-2.

/FISHKILL CREEK/BEACON/FLOW/...

File Edit View

Ordinate	Date	Time	BEACON FLOW OBS
Units			cfs
Type			INST-VAL
1	05 Mar 1945	12:00	2,290.0
2	27 Dec 1945	12:00	1,470.0
3	14 Mar 1947	24:00	2,220.0
4	18 Mar 1948	24:00	2,970.0
5	01 Jan 1949	24:00	3,020.0
6	09 Mar 1950	12:00	1,210.0
7	01 Apr 1951	12:00	2,490.0
8	12 Mar 1952	12:00	3,170.0
9	25 Jan 1953	12:00	3,220.0
10	13 Sep 1954	12:00	1,760.0
11	20 Aug 1955	12:00	8,800.0
12	16 Oct 1955	12:00	8,280.0
13	10 Apr 1957	12:00	1,310.0
14	21 Dec 1957	12:00	2,500.0
15	11 Feb 1959	12:00	1,960.0
16	06 Apr 1960	12:00	2,140.0
17	26 Feb 1961	12:00	4,340.0
18	13 Mar 1962	12:00	3,060.0
19	28 Mar 1963	12:00	1,780.0
20	26 Jan 1964	12:00	1,380.0
21	09 Feb 1965	12:00	980.0
22	15 Feb 1966	12:00	1,040.0
23	30 Mar 1967	12:00	1,580.0
24	19 Mar 1968	12:00	3,630.0

Figure B-2. Tabulation of the Peak Flow Data for Fishkill Creek.

To plot the data for this example, right-click on the data record again and then select **Plot**. A plot of the data will appear as shown in Figure B-3.

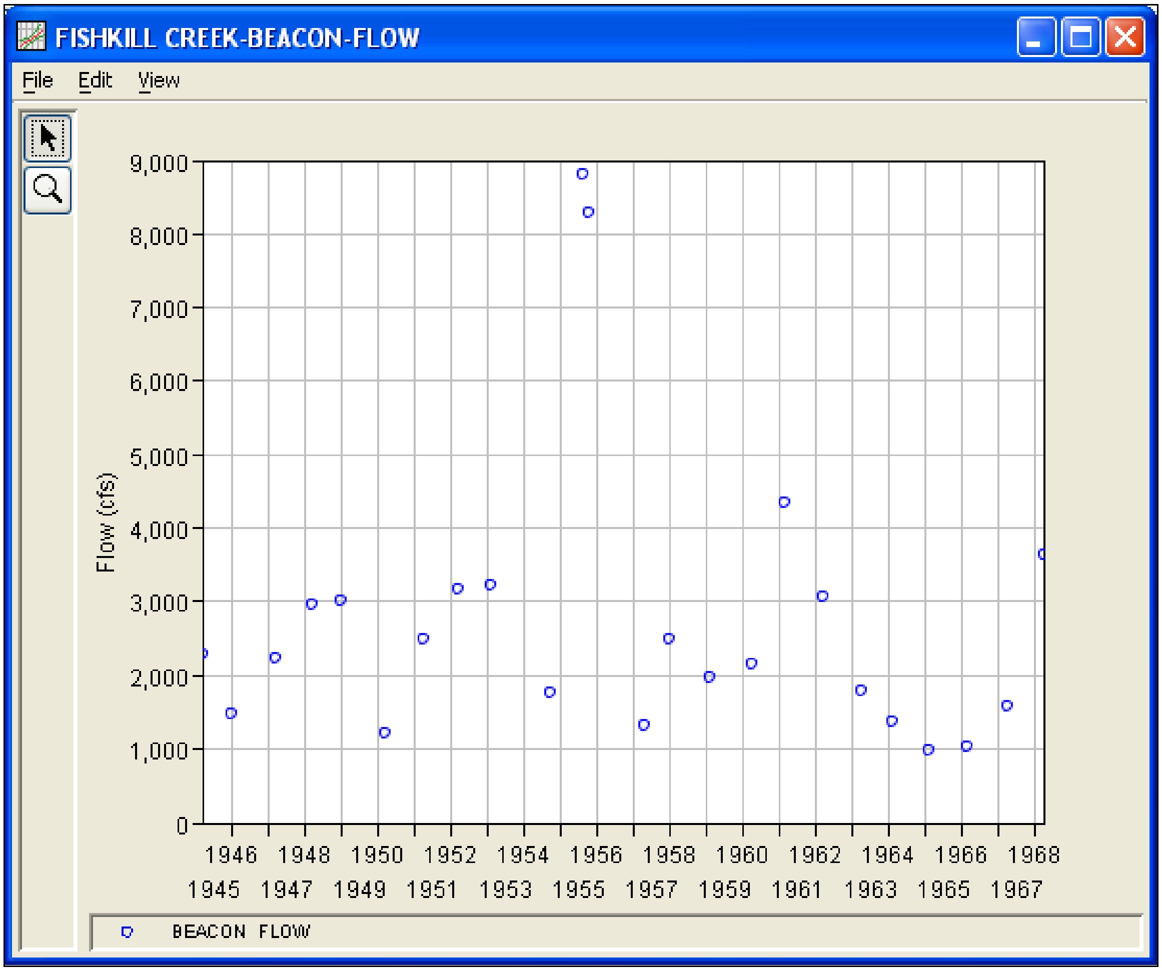


Figure B-3. Plot of the Fishkill Creek Data.

A Bulletin 17B and a General Frequency analysis have been developed for this example. To open the Bulletin 17B analysis editor for test example 1, either double-click on the analysis labeled **FFA Test 1** from the Study Explorer, or from the **Analysis** menu select open, then select **FFA Test 1** from the list of available analyses. When FFA Test 1 is selected, the Bulletin 17B analysis editor will appear as shown in Figure B-4.

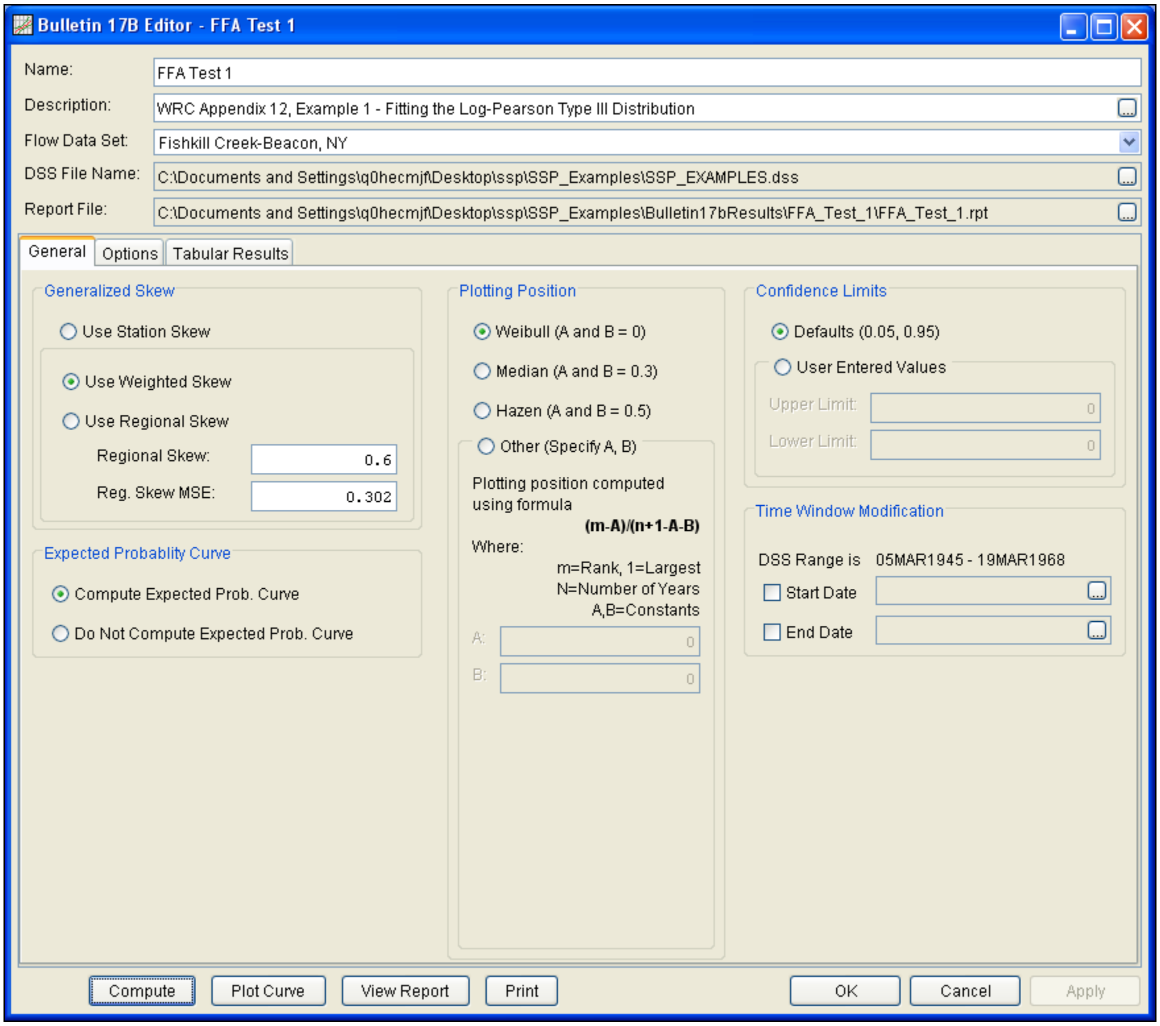


Figure B-4. Bulletin 17B Analysis Editor with Test Example 1 Data Set.

Shown in Figure B-4 are the general settings that were used to perform this frequency analysis. As shown, the **Skew** option was set to use the **Weighted Skew**. To use the weighted skew option, the user must enter a value for the Regional Skew and the Regional Skew Mean Square Error (MSE). This selection requires the user to either look up a value from the generalized skew map of the United States, which is provided with Bulletin 17B, or develop a value from a regional analysis of nearby gages. In this example a value of 0.6 was taken from the generalized skew map of the U.S. from Bulletin 17B. Bulletin 17B suggests using a Regional Skew MSE of 0.302 whenever regional skew values are taken from the map.

Also for this example, the **Expected Probability Curve** option was selected to be computed in addition to the Log Pearson III computed curve. The **Weibull** plotting position method was selected, as well as the default **Confidence Limits** of 0.05 (5 percent chance exceedance) and 0.95 (95% chance exceedance). Shown in Figure B-5 is the Bulletin 17B editor with the **Options Tab** selected.

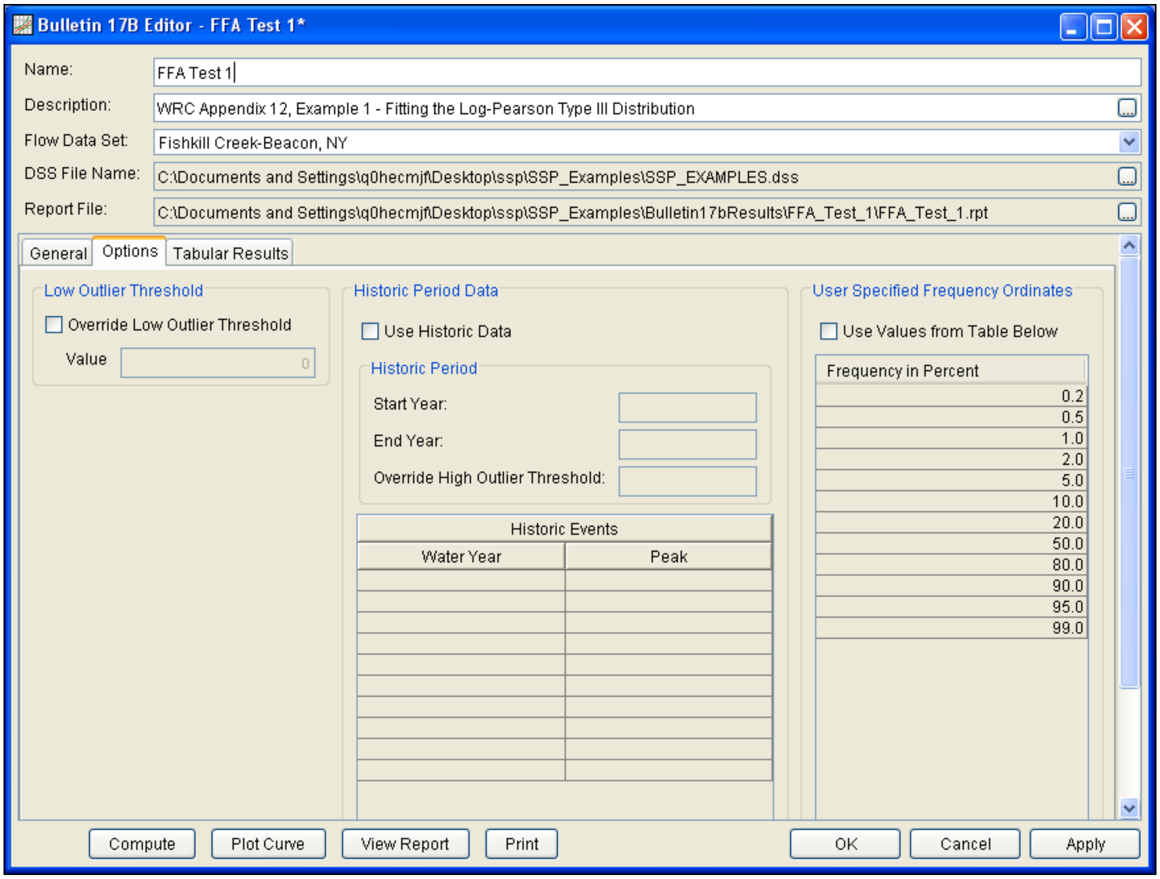


Figure B-5. Bulletin 17B Editor with Options Tab Selected for Test Example 1.

As shown in Figure B-5, none of the available options for modifying the frequency analysis were selected for this example. These options include changing the **Low Outlier Threshold** and using **Historic Data**. Additionally, the option to override the default **Frequency Ordinates** was not selected.

Once all of the General and Optional settings are set or selected, the user can press the **Compute** button to perform the analysis. Once the computations have been completed, a message window will open stating **Compute Complete.** Close this window and then select the **Tabular Results** tab. The analysis window should look like Figure B-6.

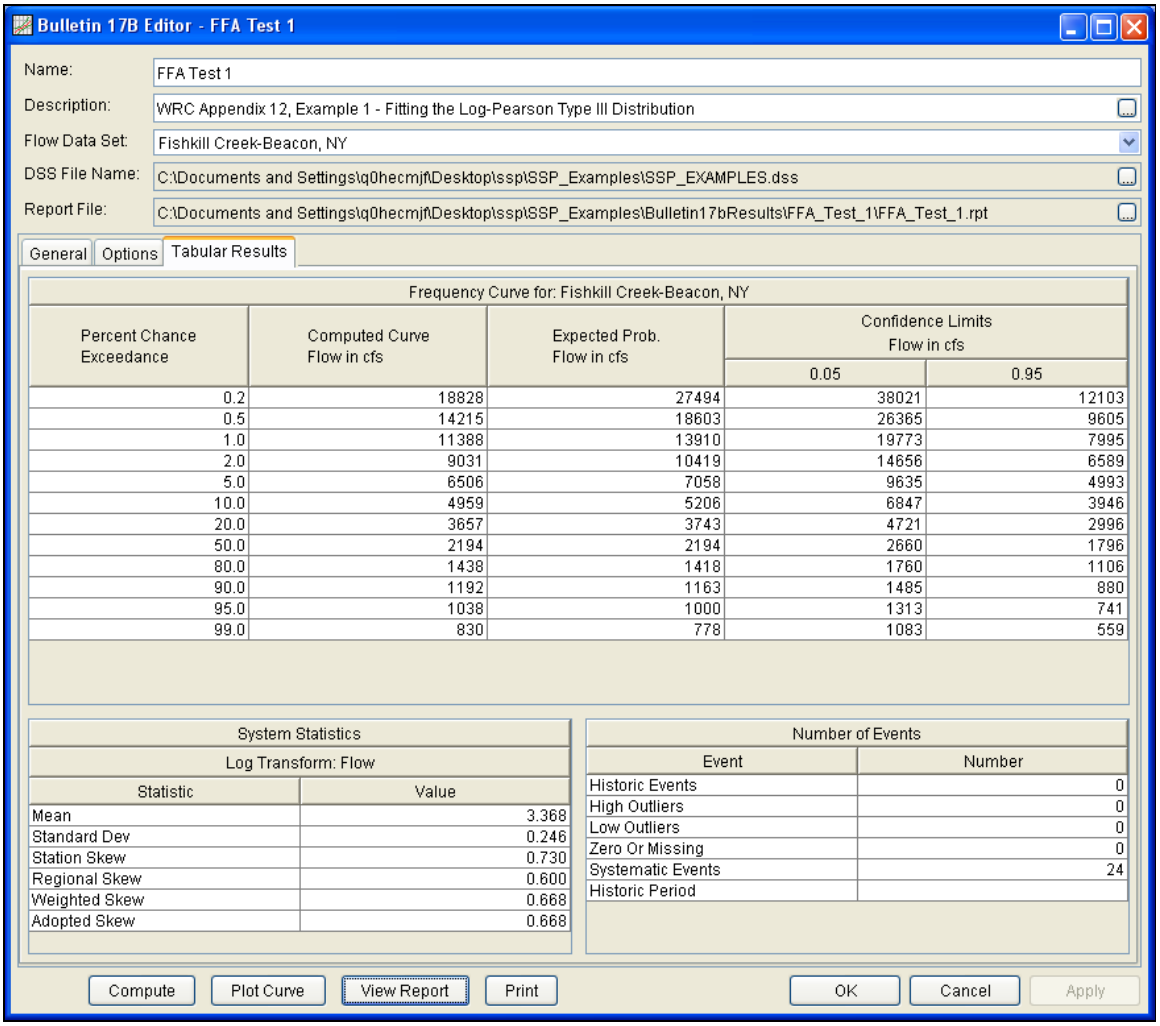


Figure B-6. Bulletin 17B Analysis Window with Results Tab Shown for Test Example 1.

As shown in Figure B-6, the Frequency Curve table contains the following results:

Percent Chance Exceedance

Computed Curve (Log-Pearson III results)

Expected Probability Curve

Confidence Limits (5% and 95% chance exceedance curves)

On the bottom, left side of the results tab is a table of System Statistics for the observed station data (mean, standard deviation, station skew) and regional adjustment (regional skew, weighted skew, and adopted skew). Also on the bottom, right side of the results tab is a Number of Events table showing the number of historic events used in the analysis, number of high outliers found, number of low outliers, number of zero or missing data years, number of systematic events in the gage record, and the historic record length (if historic data was entered).

In addition to the tabular results, a graphical plot of the computed frequency curves can be obtained by pressing the **Plot Curve** button at the bottom of the analysis window. A plot of the results for this test example is shown in Figure B-7.

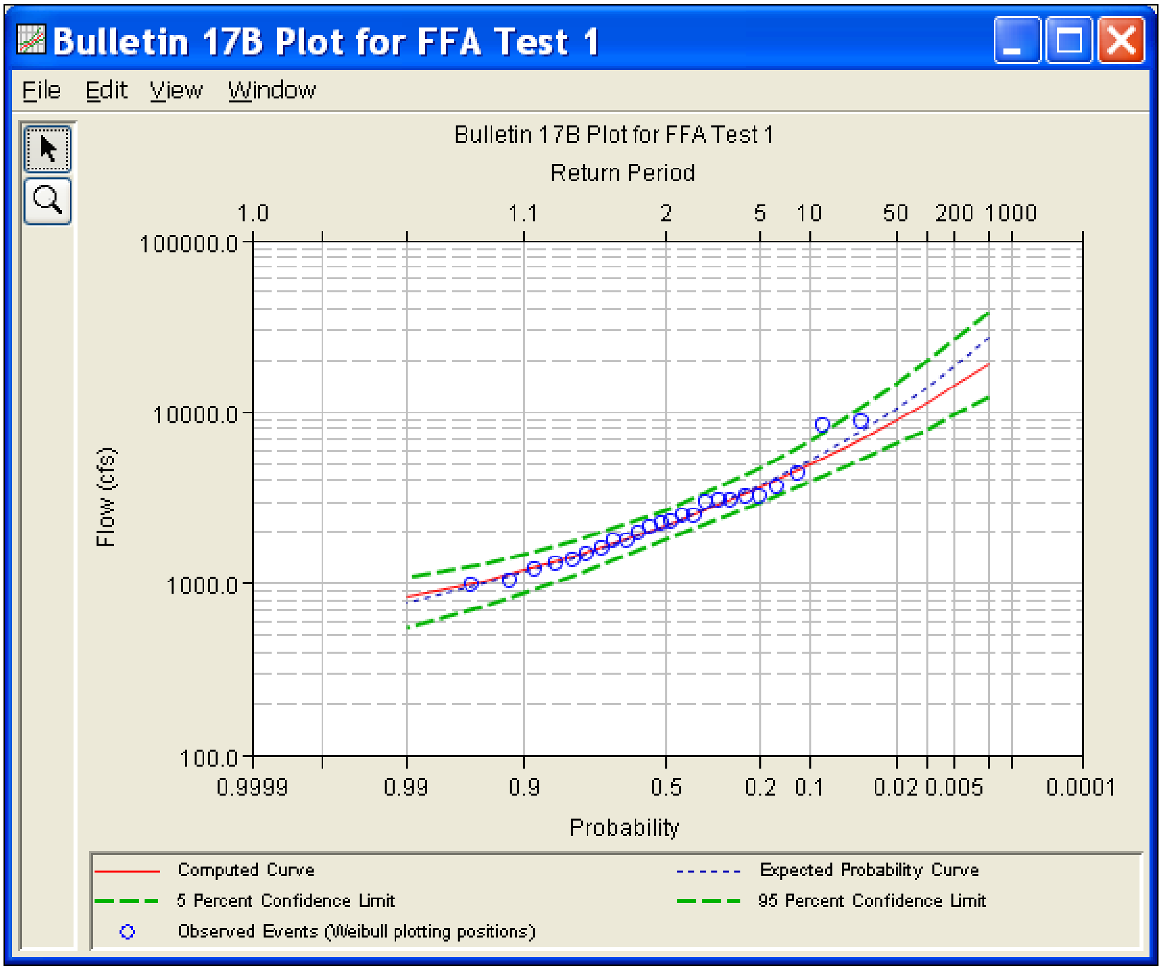
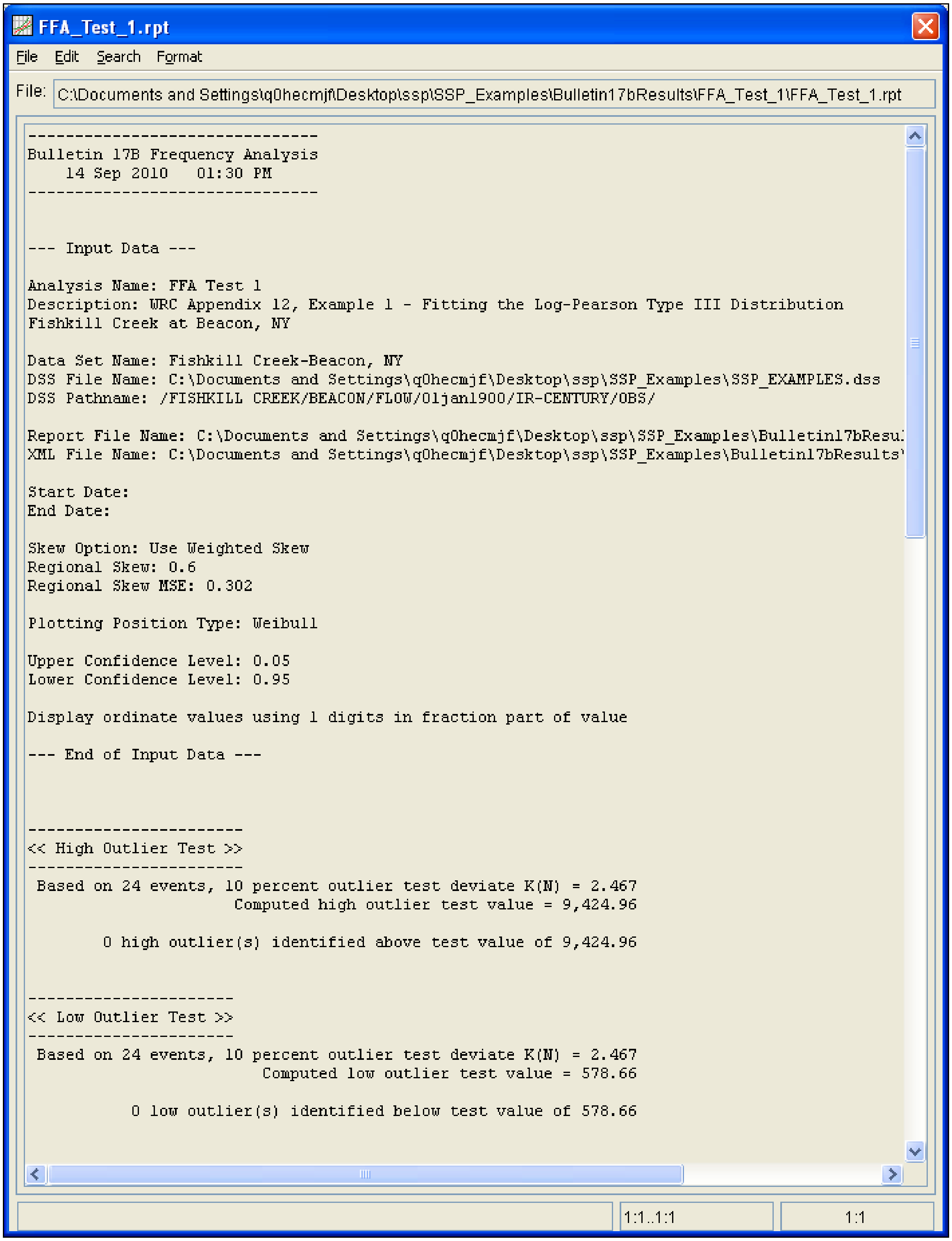


Figure B-7. Plotted Frequency Curves for Test Example 1.

The tabular and graphical results can be sent to the printer or the Windows clipboard for transfer into another piece of software. To print the tabular results, select **Print** from the bottom of the analysis window. To send the tabular results to the Windows clipboard, highlight the data you want to send to the clipboard and then press the Control-C key sequence. To print the graphical results, first bring up the graphical plot and then select **Print** from the **File** menu. To send the graphic to the windows clipboard, select **Copy to Clipboard** from the **File** menu.

In addition to the tabular and graphical results, there is a report file that shows the order in which the calculations were performed. To review the report file, press the **View Report** button at the bottom of the analysis window. When this button is selected a text viewer will open the report file and display it on the screen. Shown in Figure B-8 is the report file for test example 1.

The report file contains a listing of the input data, preliminary results, outlier and historical data tests, additional calculations needed, and the final frequency curve results. Different types and amounts of information will show up in the report file depending on the data and the options that have been selected for the analysis. The user should review the report file to understand how HEC-SSP performed the Bulletin 17B frequency curve calculations.



FFA_Test_1.rpt

File Edit Search Format

File: C:\Documents and Settings\q0hecmjf\Desktop\ssp\SSP_Examples\Bulletin17bResults\FFA_Test_1\FFA_Test_1.rpt

```
-------------------------------
Bulletin 17B Frequency Analysis
    14 Sep 2010   01:30 PM
-------------------------------


--- Input Data ---

Analysis Name: FFA Test 1
Description: WRC Appendix 12, Example 1 - Fitting the Log-Pearson Type III Distribution
Fishkill Creek at Beacon, NY

Data Set Name: Fishkill Creek-Beacon, NY
DSS File Name: C:\Documents and Settings\q0hecmjf\Desktop\ssp\SSP_Examples\SSP_EXAMPLES.dss
DSS Pathname: /FISHKILL CREEK/BEACON/FLOW/01jan1900/IR-CENTURY/OBS/

Report File Name: C:\Documents and Settings\q0hecmjf\Desktop\ssp\SSP_Examples\Bulletin17bResu
XML File Name: C:\Documents and Settings\q0hecmjf\Desktop\ssp\SSP_Examples\Bulletin17bResults\

Start Date:
End Date:

Skew Option: Use Weighted Skew
Regional Skew: 0.6
Regional Skew MSE: 0.302

Plotting Position Type: Weibull

Upper Confidence Level: 0.05
Lower Confidence Level: 0.95

Display ordinate values using 1 digits in fraction part of value

--- End of Input Data ---



-----------------------
<< High Outlier Test >>
-----------------------
 Based on 24 events, 10 percent outlier test deviate K(N) = 2.467
                      Computed high outlier test value = 9,424.96

        0 high outlier(s) identified above test value of 9,424.96


----------------------
<< Low Outlier Test >>
----------------------
 Based on 24 events, 10 percent outlier test deviate K(N) = 2.467
                         Computed low outlier test value = 578.66

           0 low outlier(s) identified below test value of 578.66
```

1:1..1:1 1:1

Figure B-8. Test Example 1 Report File.

Example 2: Analysis with High Outliers

The input data for the Example 2 is the same as that for Example 2 in Appendix 12, Guidelines for Determining Flood Flow Frequency, Water Resources Council Bulletin 17B. Example 2 illustrates the application to data with a high outlier.

The data for this example is from Floyd River in James, Iowa. The period of record used is from 1935 to 1973. To view the data from HEC-SSP, right-click on the data record labeled "**Floyd River-James IA**" in the study explorer and then select **Tabulate**. The data will appear as shown in Figure B-9.

/FLOYD RIVER/JAMES IA/FLOW/01JA...

File Edit View

Ordinate	Date / Time	JAMES IA FLOW
10	13 May 44 12:00	7,440
11	12 Mar 45 12:00	5,320
12	01 Mar 46 12:00	1,400
13	25 Jun 47 12:00	3,240
14	17 Mar 48 12:00	2,710
15	05 Mar 49 12:00	4,520
16	19 Jun 50 12:00	4,840
17	28 Mar 51 12:00	8,320
18	31 Mar 52 12:00	13,900
19	08 Jun 53 12:00	71,500
20	22 Jun 54 12:00	6,250
21	10 Jul 55 12:00	2,260
22	13 Jul 56 12:00	318
23	05 Jul 57 12:00	1,330
24	01 Jul 58 12:00	970
25	01 Jun 59 12:00	1,920
26	29 Mar 60 12:00	15,100
27	02 Mar 61 12:00	2,870
28	29 Mar 62 12:00	20,600
29	02 Jun 63 12:00	3,810
30	09 Sep 64 12:00	726
31	02 Apr 65 12:00	7,500
32	10 Feb 66 12:00	7,170
33	19 Jun 67 12:00	2,000
34	21 Jul 68 12:00	829
35	05 Apr 69 12:00	17,300
36	04 Mar 70 12:00	4,740
37	01 Jan 71 12:00	13,400
38	01 Jan 72 12:00	2,940
39	01 Jan 73 12:00	5,660

Figure B-9. Tabulation of the Peak Flow Data for the Floyd River.

To plot the data for this example, right-click on the data record and then select **Plot**. A plot of the data will appear as shown in Figure B-10.

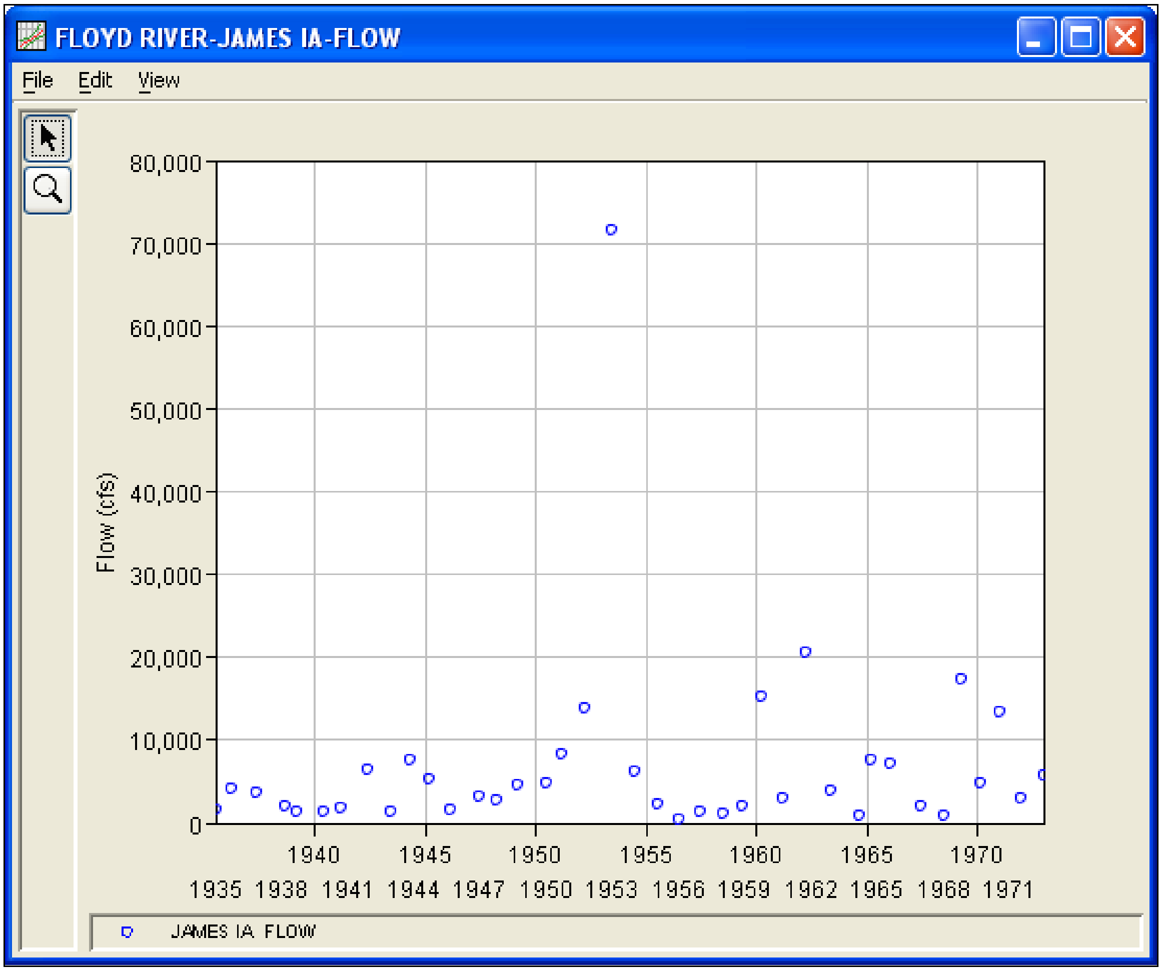


Figure B-10. Plot of Floyd River Data

A Bulletin 17B and General Frequency analysis have been developed for this example. To open the Bulletin 17B analysis editor for test example 2, either double-click on the analysis labeled **FFA Test 2** from the study pane, or from the **Analysis** menu select open and then select **FFA Test 2** from the list of available analyses. When FFA Test 2 is selected, the Bulletin 17B analysis editor will appear as shown in Figure B-11.

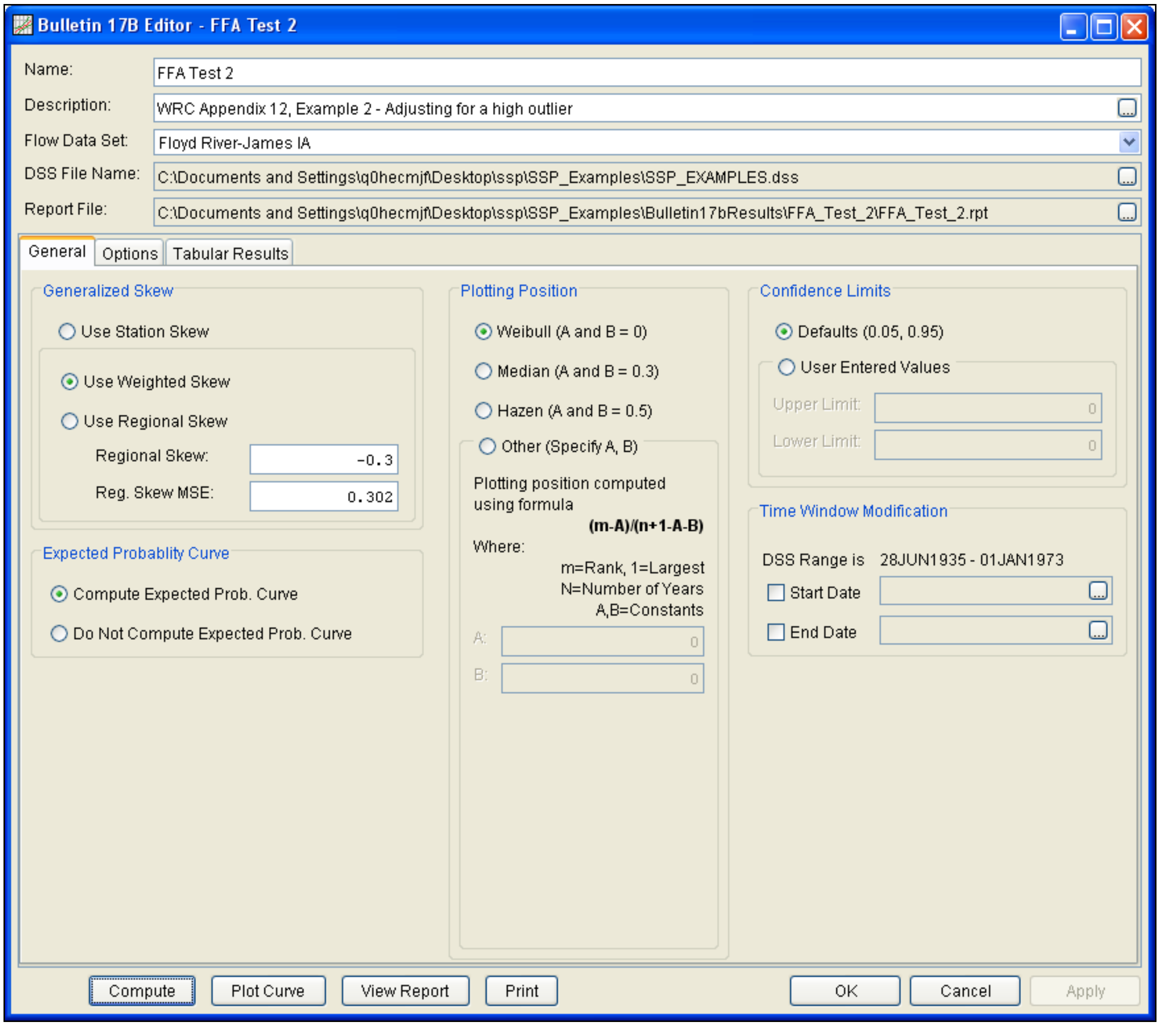


Figure B-11. Bulletin 17B Analysis Editor with Test Example 2 Data Set.

Shown in Figure B-11 are the general settings that were used to perform this frequency analysis. As shown, the **Skew** option was set to use the **Weighted Skew**. To use the weighted skew option, the user must enter a value for the Regional Skew and the Regional Skew Mean Square Error (MSE). This selection requires the user to either look up a value from the generalized skew map of the United States, which is provided with Bulletin 17B, or develop a value from a regional analysis of nearby gages. In this example a value of -0.3 was taken from the generalized skew map of the U.S. from Bulletin 17B. Bulletin 17B suggests using a Regional Skew MSE of 0.302 whenever regional skew values are taken from the map.

Also for this example, the **Expected Probability Curve** option was selected to be computed in addition to the Log Pearson III computed curve. The **Weibull** plotting position method was selected, as well as the default **Confidence Limits** of 0.05 (5 percent chance exceedance) and 0.95 (95% chance exceedance). Shown in Figure B-12 is the Bulletin 17B editor with the **Options Tab** selected.

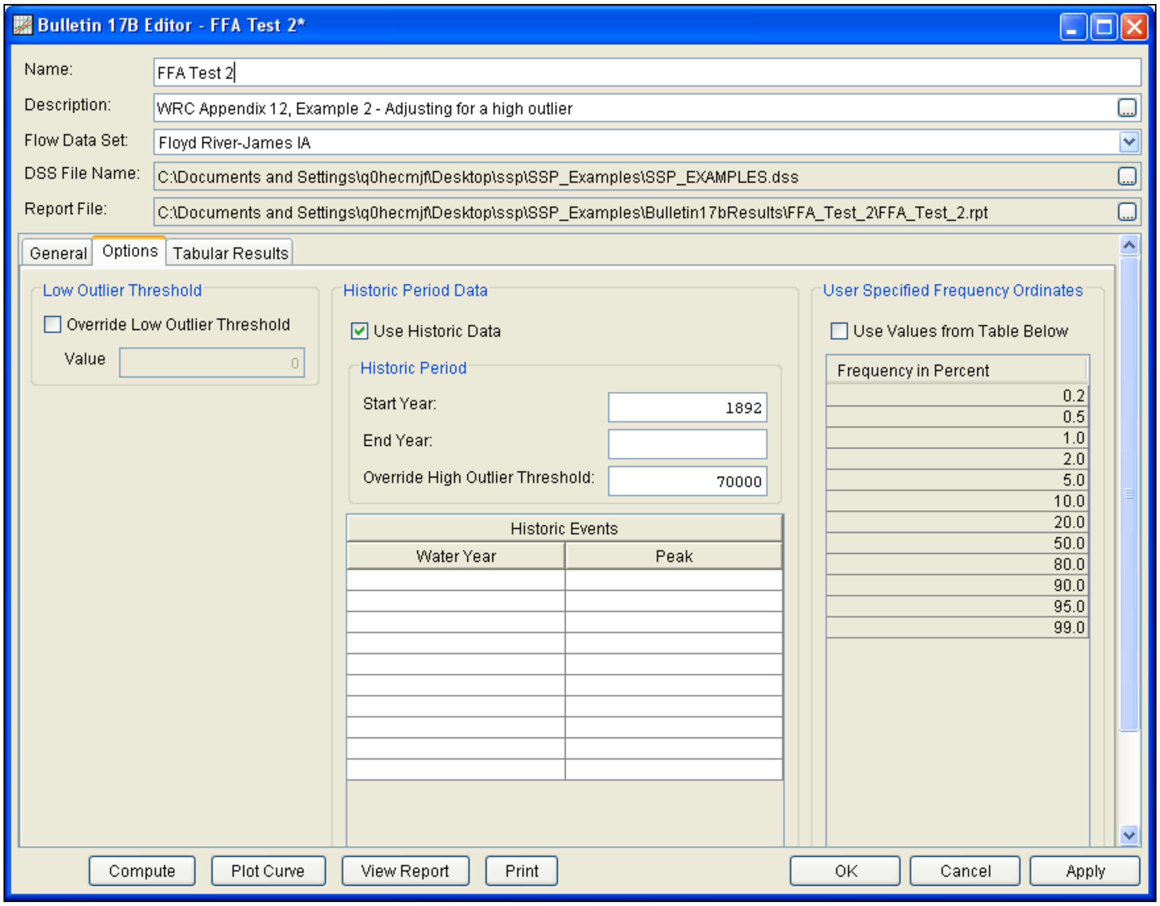


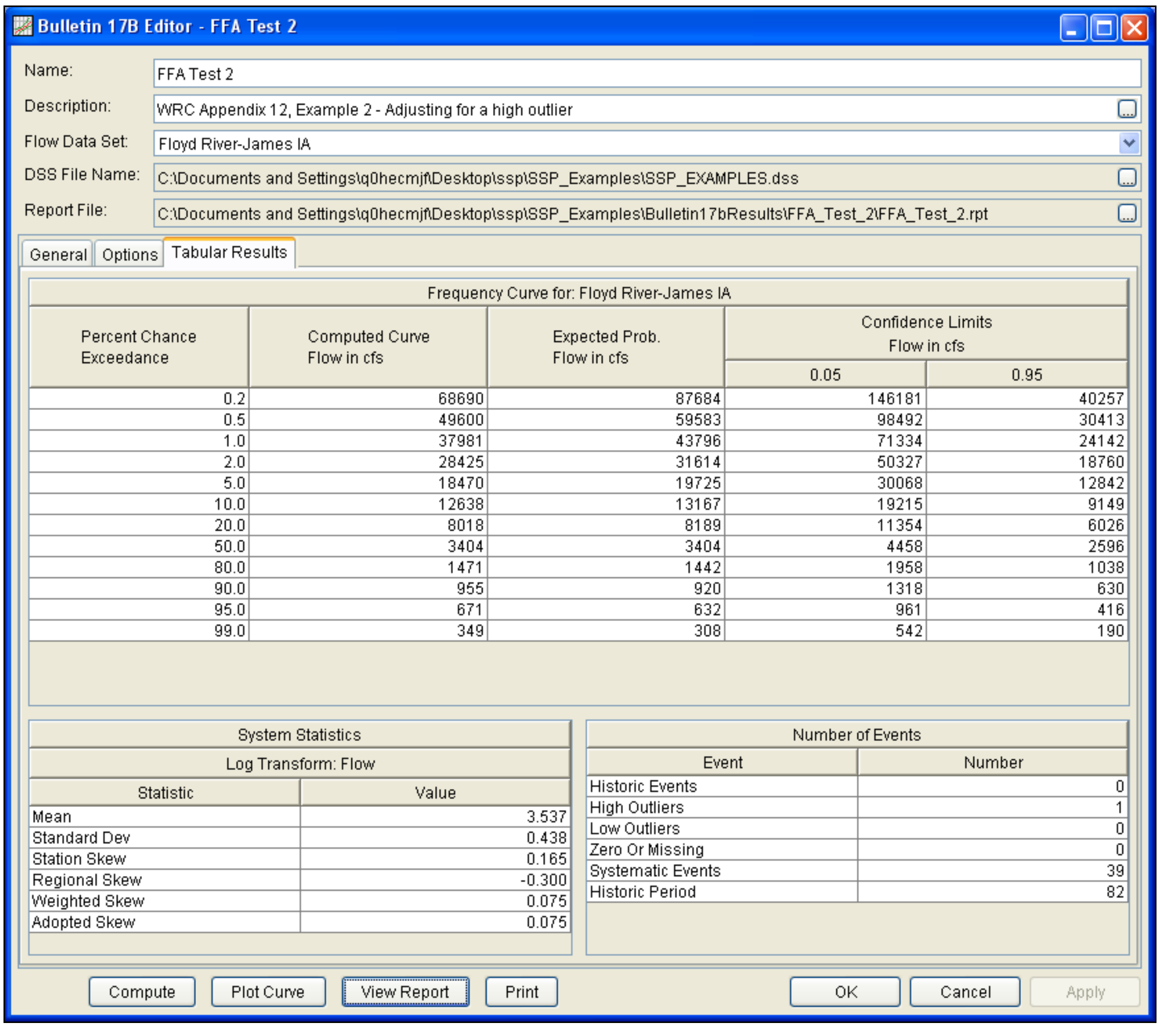
Figure B-12. Bulletin 17B Editor with Options Tab Selected for Test Example 2.

As shown in Figure B-12, the **Historic Period Data** option has been selected to reflect the fact that the 1953 flood peak of 71,500 cfs is known to be the largest flood since 1892. When the analysis was originally performed on this data set, the 1953 event was found to be a high outlier. (The reader may replicate this result by un-checking the "Use Historic Data" box, hitting the Compute button, and reviewing the Tabular Results tab.) High outliers should not be eliminated from an analysis, as they are valuable pieces of the flow record. However, when a high outlier is found in a data set, it suggests that the event might actually be the largest in a much longer period of record. The analyst should always try to locate and incorporate historic information to define a longer record and improve the quality of the frequency analysis. Since it was known that the 1953 event was the largest value since 1892, the year 1892 is entered as the **Start Year** for the historic period. Additionally, a **High Threshold Value** of 70,000 cfs was entered. By entering the High Threshold Value of 70,000 cfs, the 1953 flood of 71,500 cfs was removed from the systematic record and treated as a historic data value during the historic data adjustment calculations performed by HEC-SSP and outlined in Bulletin 17B,

Appendix 6. Since no End Year was entered for the historic period, the last year of the systematic data set will be used as the End Year.

Other features on this tab include the **Low Outlier Threshold** and the option to override the default **Frequency Ordinates,** neither of which are selected in this example.

Once all of the General and Optional settings are set or selected, the user can press the **Compute** button to perform the analysis. Once the computations have been completed, a message window will open stating **Compute Complete.** Close this window and then select the **Tabular Results** tab. The analysis window should look like Figure B-13.



Frequency Curve for: Floyd River-James IA

Percent Chance Exceedance	Computed Curve Flow in cfs	Expected Prob. Flow in cfs	Confidence Limits Flow in cfs 0.05	Confidence Limits Flow in cfs 0.95
0.2	68690	87684	146181	40257
0.5	49600	59583	98492	30413
1.0	37981	43796	71334	24142
2.0	28425	31614	50327	18760
5.0	18470	19725	30068	12842
10.0	12638	13167	19215	9149
20.0	8018	8189	11354	6026
50.0	3404	3404	4458	2596
80.0	1471	1442	1958	1038
90.0	955	920	1318	630
95.0	671	632	961	416
99.0	349	308	542	190

System Statistics — Log Transform: Flow

Statistic	Value
Mean	3.537
Standard Dev	0.438
Station Skew	0.165
Regional Skew	-0.300
Weighted Skew	0.075
Adopted Skew	0.075

Number of Events

Event	Number
Historic Events	0
High Outliers	1
Low Outliers	0
Zero Or Missing	0
Systematic Events	39
Historic Period	82

Figure B-13. Bulletin 17B Editor with Results Tab Selected for Test Example 2.

As shown in Figure B-13, the Frequency Curve table contains the following results:

Percent Chance Exceedance

Computed Curve (Log-Pearson III results)

Expected Probability Curve

Confidence Limits (5% and 95% chance exceedance curves)

On the bottom left-hand side of the results tab is the System Statistics table for the observed station data (mean, standard deviation, station skew) and regional adjustment (regional skew, weighted skew, and adopted skew). Also on the bottom right-hand side of the results tab is the Number of Events table showing the number of historic events used in the analysis, number of high outliers found, number of low outliers, number of zero or missing data years, number of systematic events in the gage record, and the historic record length (if historic data was entered).

In addition to the tabular results, a graphical plot of the computed frequency curves can be obtained by pressing the **Plot Curve** button at the bottom of the analysis window. A plot of the results for this test example is shown in Figure B-14.

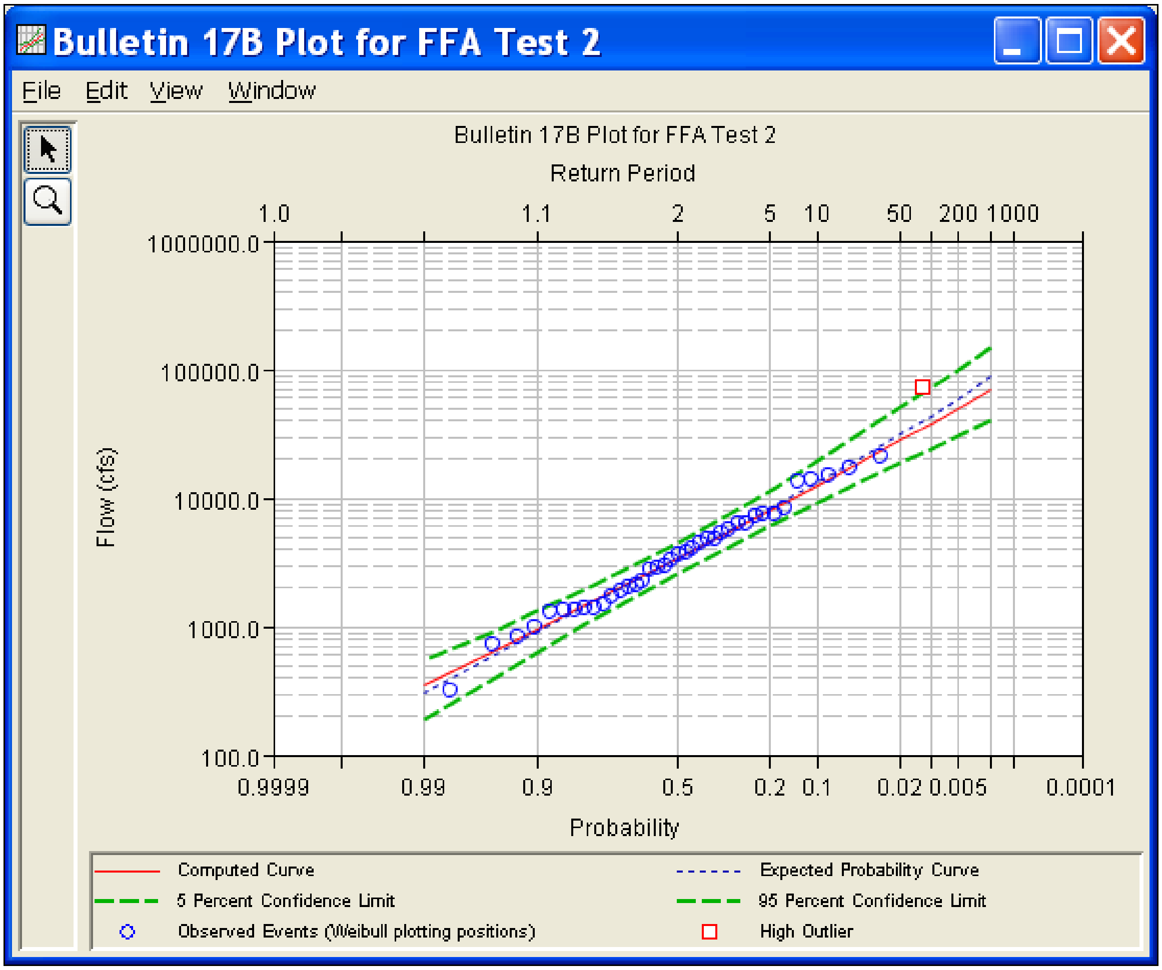


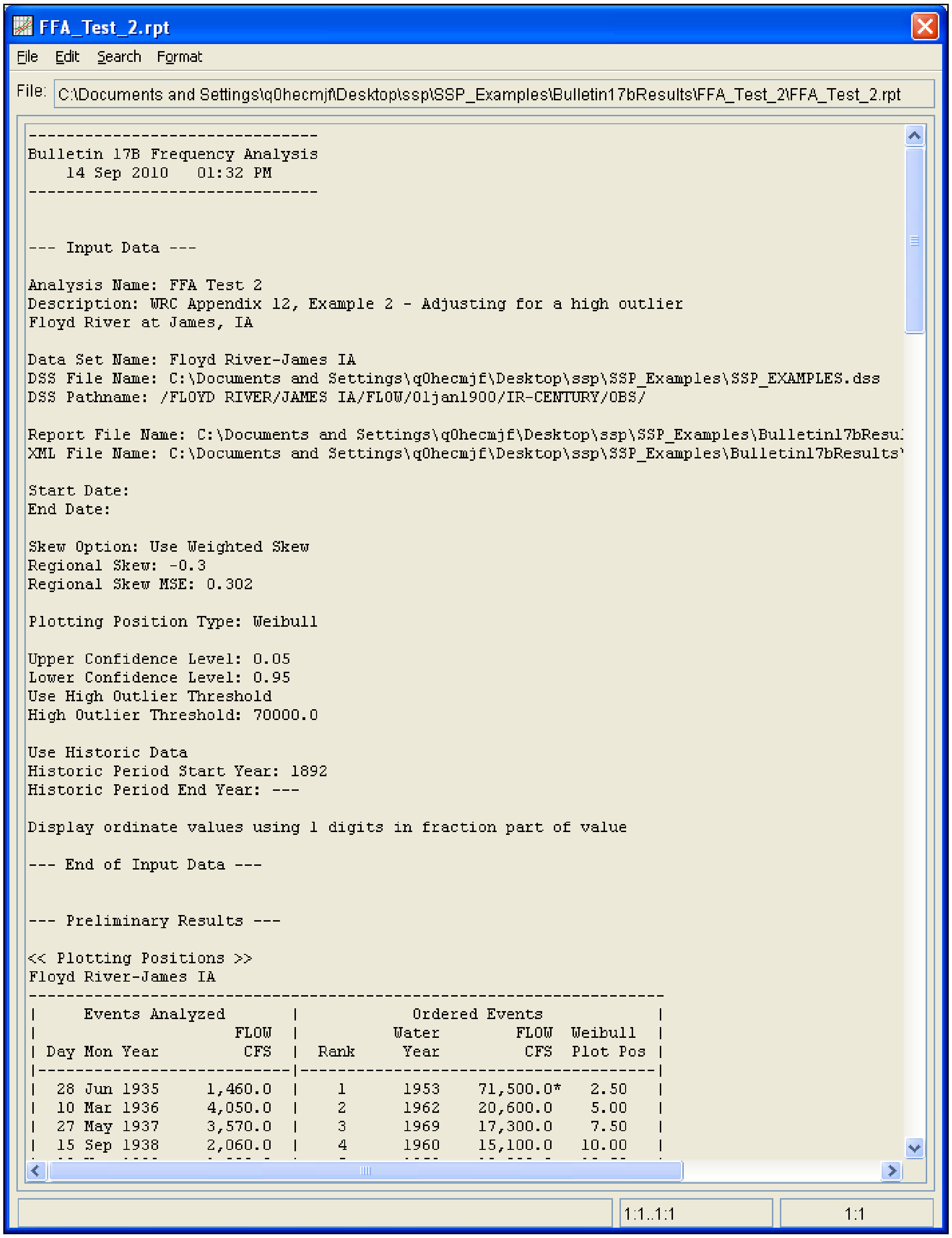
Figure B-14. Plotted Frequency Curves for Test Example 2.

The tabular and graphical results can be sent to the printer or the windows clipboard for transfer into another piece of software. To print the tabular results, select **Print** from the bottom of the analysis window. To send the tabular results to the windows clipboard, highlight the data you want to send to the clipboard and then press the Control-C key sequence. To print the graphical results, first bring up the graphical plot and then select **Print** from the **File** menu. To send the graphic to the windows clipboard, select **Copy to Clipboard** from the **File** menu.

In addition to the tabular and graphical results, there is a report file that shows the order in which the calculations were performed. To review the report file, press the **View Report** button at the bottom of the analysis window. When this button is selected a text viewer will open the report file and display it on the screen. Shown in Figure B-15 is the report file for Test Example 2.

The report file contains a listing of the input data, preliminary results, outlier and historical data tests, additional calculations needed, and

the final frequency curve results. Different types and amounts of information will show up in the report file depending on the data and the options that have been selected for the analysis. The user should review the report file to understand how HEC-SSP performed the frequency curve calculations.



```
FFA_Test_2.rpt
File  Edit  Search  Format
File: C:\Documents and Settings\q0hecmjf\Desktop\ssp\SSP_Examples\Bulletin17bResults\FFA_Test_2\FFA_Test_2.rpt

-------------------------------
Bulletin 17B Frequency Analysis
    14 Sep 2010   01:32 PM
-------------------------------


--- Input Data ---

Analysis Name: FFA Test 2
Description: WRC Appendix 12, Example 2 - Adjusting for a high outlier
Floyd River at James, IA

Data Set Name: Floyd River-James IA
DSS File Name: C:\Documents and Settings\q0hecmjf\Desktop\ssp\SSP_Examples\SSP_EXAMPLES.dss
DSS Pathname: /FLOYD RIVER/JAMES IA/FLOW/01jan1900/IR-CENTURY/OBS/

Report File Name: C:\Documents and Settings\q0hecmjf\Desktop\ssp\SSP_Examples\Bulletin17bResu
XML File Name: C:\Documents and Settings\q0hecmjf\Desktop\ssp\SSP_Examples\Bulletin17bResults

Start Date:
End Date:

Skew Option: Use Weighted Skew
Regional Skew: -0.3
Regional Skew MSE: 0.302

Plotting Position Type: Weibull

Upper Confidence Level: 0.05
Lower Confidence Level: 0.95
Use High Outlier Threshold
High Outlier Threshold: 70000.0

Use Historic Data
Historic Period Start Year: 1892
Historic Period End Year: ---

Display ordinate values using 1 digits in fraction part of value

--- End of Input Data ---


--- Preliminary Results ---

<< Plotting Positions >>
Floyd River-James IA
--------------------------------------------------------------------
|     Events Analyzed       |          Ordered Events              |
|                      FLOW |         Water         FLOW  Weibull  |
| Day Mon Year          CFS |  Rank    Year          CFS  Plot Pos |
|---------------------------|--------------------------------------|
|  28 Jun 1935      1,460.0 |   1      1953     71,500.0*    2.50  |
|  10 Mar 1936      4,050.0 |   2      1962     20,600.0     5.00  |
|  27 May 1937      3,570.0 |   3      1969     17,300.0     7.50  |
|  15 Sep 1938      2,060.0 |   4      1960     15,100.0    10.00  |

1:1..1:1    1:1
```

Figure B-15. Test Example 2 Report File.

Example 3: Testing and Adjusting for a Low Outlier

The input data for Test 3 are the same as that for Example 3 in Appendix 12 of the WRC Guidelines. Test 3 illustrates the application to data with a low outlier. Note that the program automatically screens for low outliers and, if low outliers are found, outputs the preliminary results in the report file in order to allow for comparison with the final results.

The data for this example is from Back Creek in Jones Springs, West Virginia. The period of record used for this example is from 1929 to 1973. To view the data, right-click on the data record labeled "**Back Creek-Jones Springs**" in the study pane and then select **Tabulate**. The data will appear as shown in Figure B-16.

/BACK CREEK/JONES SPRINGS, WV/F...

File Edit View

Ordinate	Date / Time	JONES SPRIN... FLOW
Units		CFS
Type		INST-VAL
1	17 Apr 29 12:00	8,750
2	23 Oct 29 12:00	15,500
3	08 May 31 12:00	4,060
4	04 Feb 39 12:00	6,300
5	20 Apr 40 12:00	3,130
6	06 Apr 41 12:00	4,160
7	22 May 42 12:00	6,700
8	15 Oct 42 12:00	22,400
9	24 Mar 44 12:00	3,880
10	18 Sep 45 12:00	8,050
11	03 Jun 46 12:00	4,020
12	15 Mar 47 12:00	1,600
13	14 Apr 48 12:00	4,460
14	31 Dec 48 12:00	4,230
15	02 Feb 50 12:00	3,010
16	05 Dec 50 12:00	9,150
17	28 Apr 52 12:00	5,100
18	22 Nov 52 12:00	9,820
19	02 Mar 54 12:00	6,200
20	19 Aug 55 12:00	10,700
21	15 Mar 56 12:00	3,880
22	10 Feb 57 12:00	3,420
23	27 Mar 58 12:00	3,240
24	03 Jun 59 12:00	6,800
25	09 May 60 12:00	3,740
26	19 Feb 61 12:00	4,700
27	22 Mar 62 12:00	4,380
28	20 Mar 63 12:00	5,190

Figure B-16. Tabulation of the Peak Flow Data for Back Creek.

To plot the data for this example, right-click on the data record and select **Plot**. A plot of the data will appear as shown in Figure B-17.

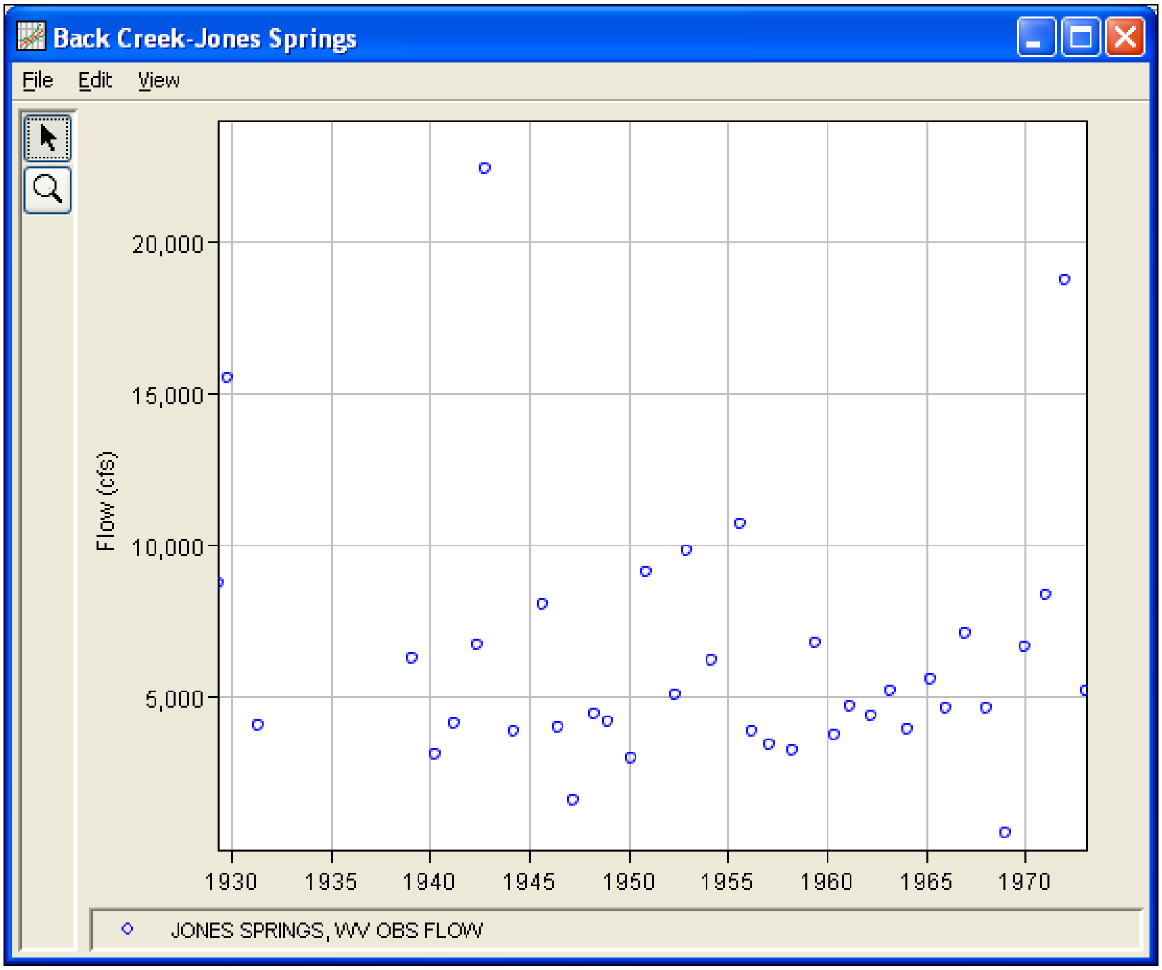


Figure B-17. Plot of Back Creek Data.

A Bulletin 17B and General Frequency analysis have been developed for this example. To open the Bulletin 17B analysis editor for test example 3, either double-click on the analysis labeled **FFA Test 3** from the study explorer, or from the **Analysis** menu select open and then select **FFA Test 3** from the list of available analyses. When FFA Test 3 is selected, the Bulletin 17B analysis editor will appear as shown in Figure B-18.

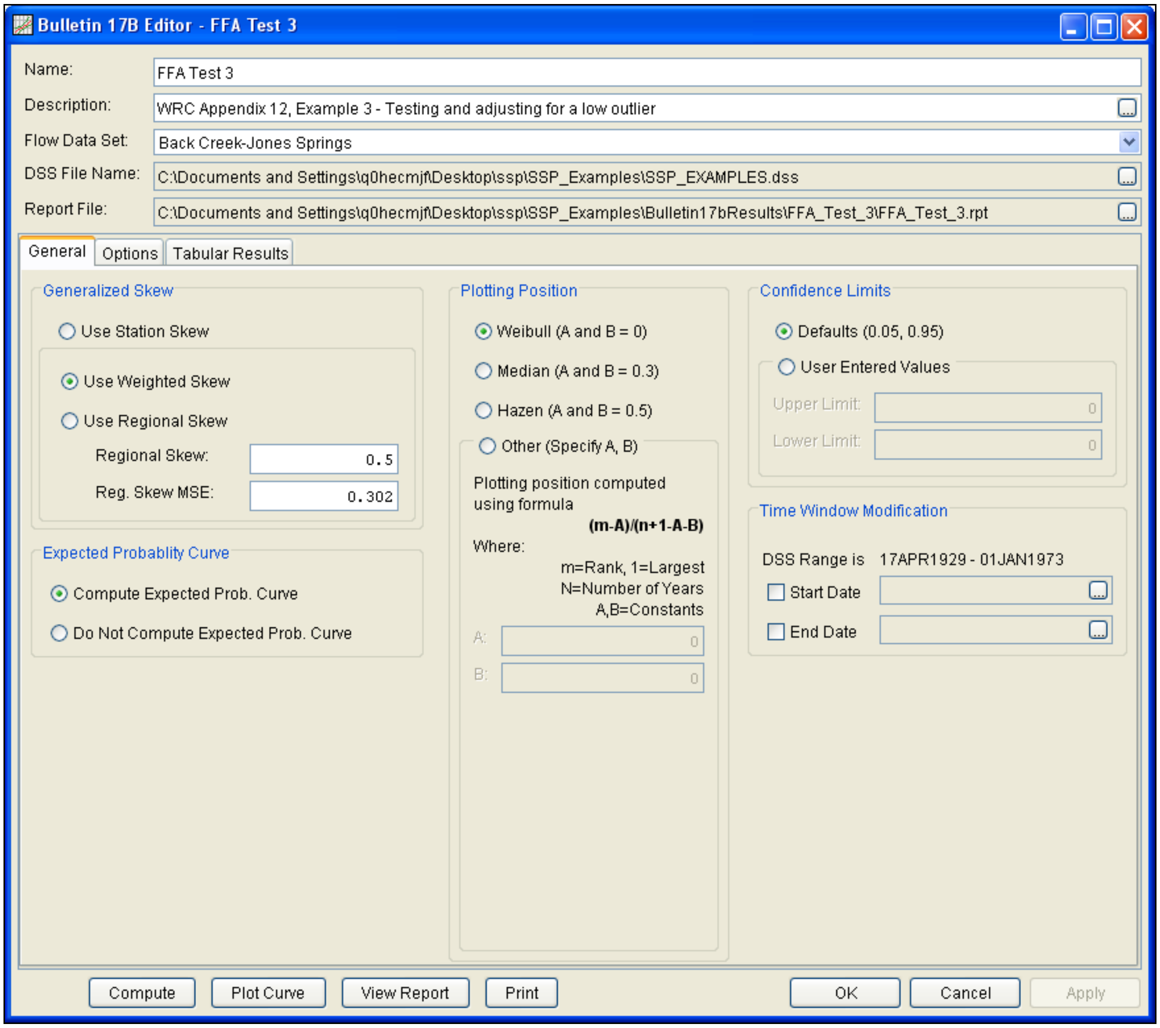


Figure B-18. Bulletin 17B Analysis Editor with Test Example 3 Data Set.

Shown in Figure B-18 are the general settings that were used to perform this frequency analysis. As shown, the **Skew** option was set to use the **Weighted Skew**. To use the weighted skew option, the user must enter a value for the Regional Skew and the Regional Skew Mean Square Error (MSE). This selection requires the user to either look up a value from the generalized skew map of the United States, which is provided with Bulletin 17B, or develop a value from a regional analysis of nearby gages. In this example, a value of 0.5 was taken from the generalized skew map of the U.S. from Bulletin 17B. Bulletin 17B suggests using a Regional Skew MSE of 0.302 whenever regional skew values are taken from the map.

Also for this example, the **Expected Probability Curve** option was selected to be computed in addition to the Log Pearson III computed curve. The **Weibull** plotting position method was selected, as well as the default **Confidence Limits** of 0.05 (5 percent chance exceedance) and 0.95 (95% chance exceedance). Shown in Figure B-19 is the Bulletin 17B editor with the **Options Tab** selected.

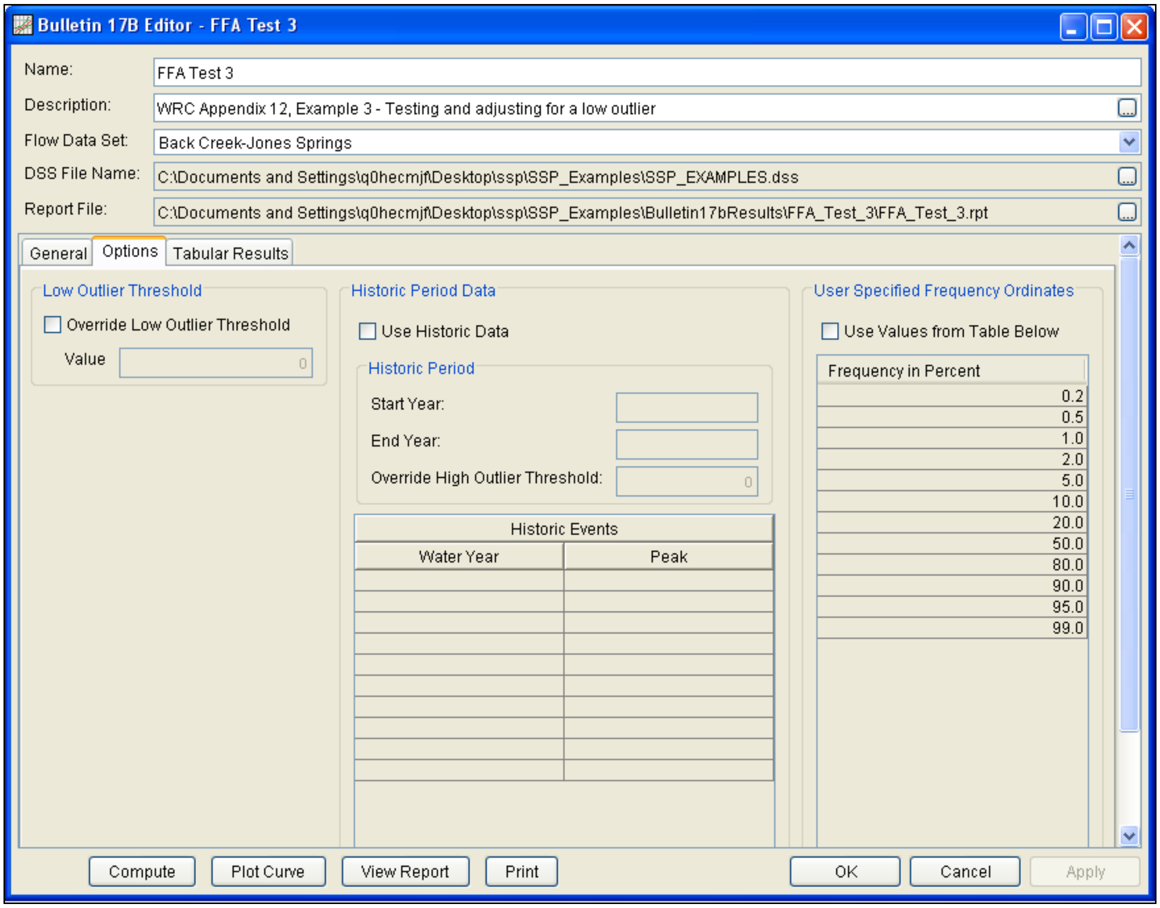


Figure B-19. Bulletin 17B Editor with the Options Tab Selected for Test Example 3.

As shown in Figure B-19, none of the available options for modifying the frequency curve were selected for this test example. These options include the **Low Outlier Threshold** and **Historic Period Data**. Additionally, the option to override the default **Frequency Ordinates** was not selected.

Once all of the General and Optional settings are set or selected, the user can press the **Compute** button to perform the analysis. Once the computations have been completed a message window will open stating **Compute Complete.** Close this window and select the **Tabular Results** tab. The analysis window should look like Figure B-20.

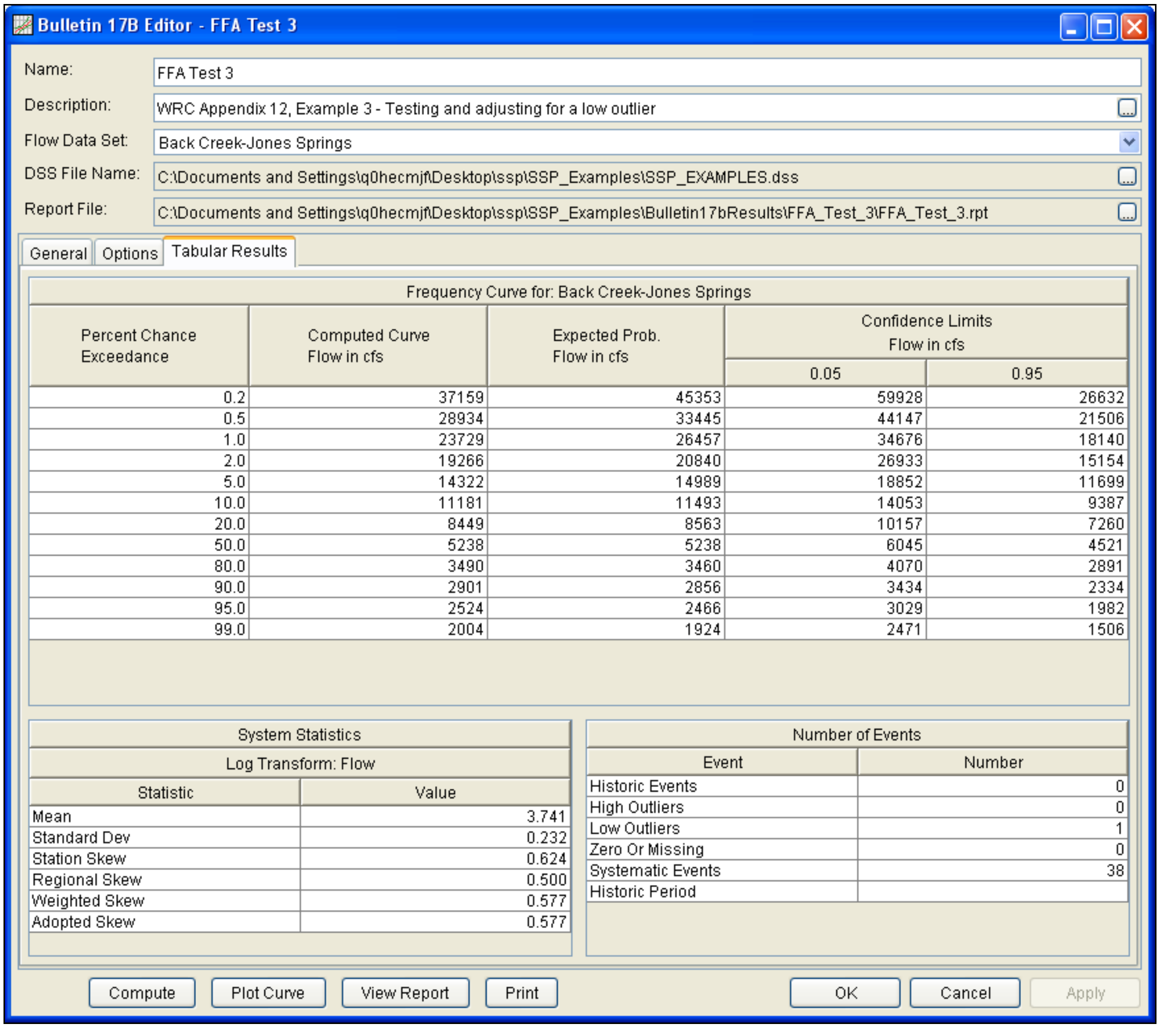


Figure B-20. Bulletin 17B Editor with the Results Tab Selected for Test Example 3.

As shown in Figure B-20, the Frequency Curve table contains the following results:

Percent Chance Exceedance

Computed Curve (Log-Pearson III results)

Expected Probability Curve

Confidence Limits (5% and 95% chance exceedance curves)

On the bottom left-hand side of the results tab is a table of System Statistics for the observed station data (mean, standard deviation, station skew) and regional adjustment (regional skew, weighted skew, and adopted skew). Also on the bottom right-hand side of the results tab is a table of Number of Events showing the number of historic events used in the analysis, number of high outliers found, number of low outliers, number of zero or missing data years, number of systematic events in the gage record, and the historic record length (if historic data was entered).

In this analysis, the software detected one low outlier in the systematic record. As recommended in Bulletin 17B, if a low outlier is detected, then that data point will be removed and the Conditional Probability Adjustment will be used to recalculate the frequency curve and then the statistics without that point. Review the report file to see the original statistics, computed curves, the low outlier test, and recomputed curves.

In addition to the tabular results, a graphical plot of the computed frequency curves can be obtained by pressing the **Plot Curve** button at the bottom of the analysis window. A plot of the results for this test example is shown in Figure B-21.

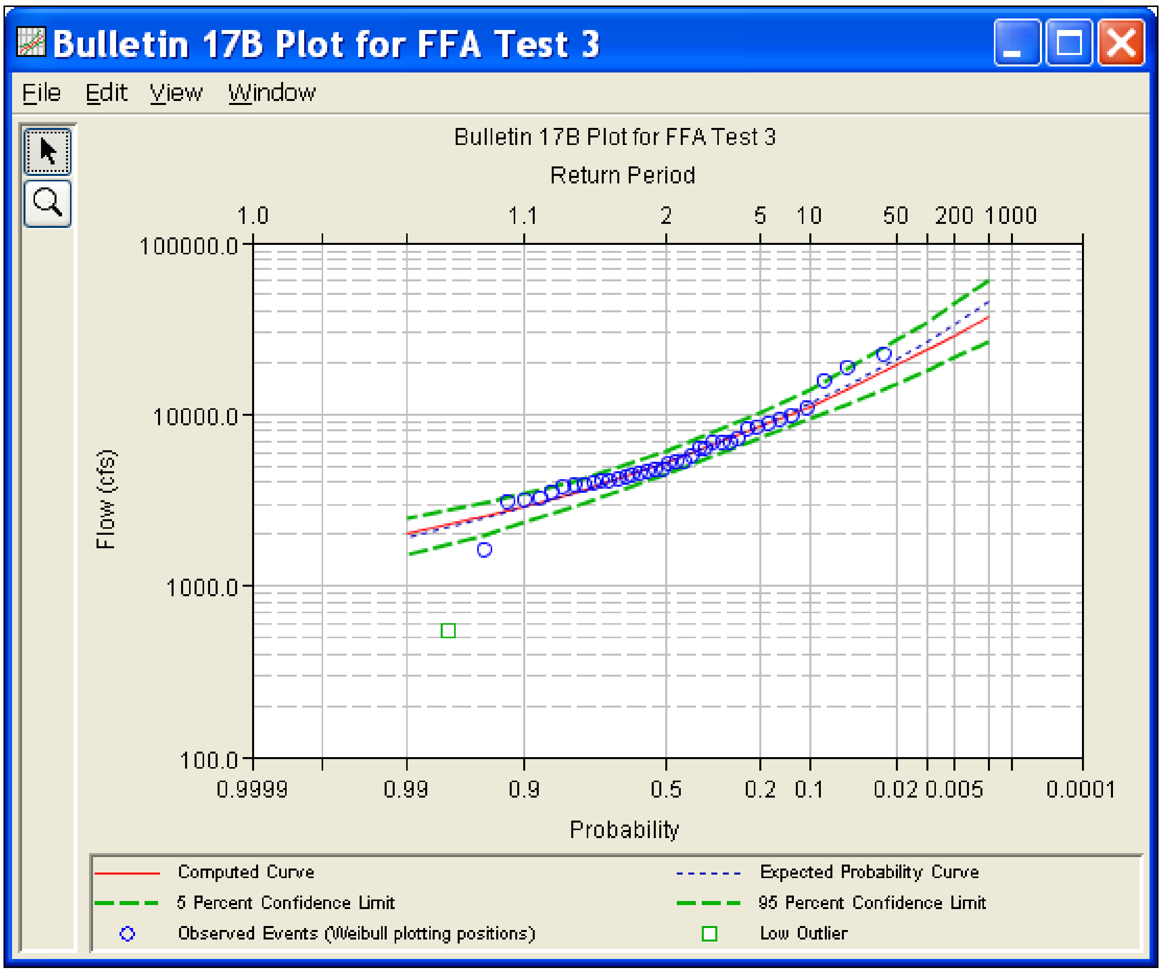
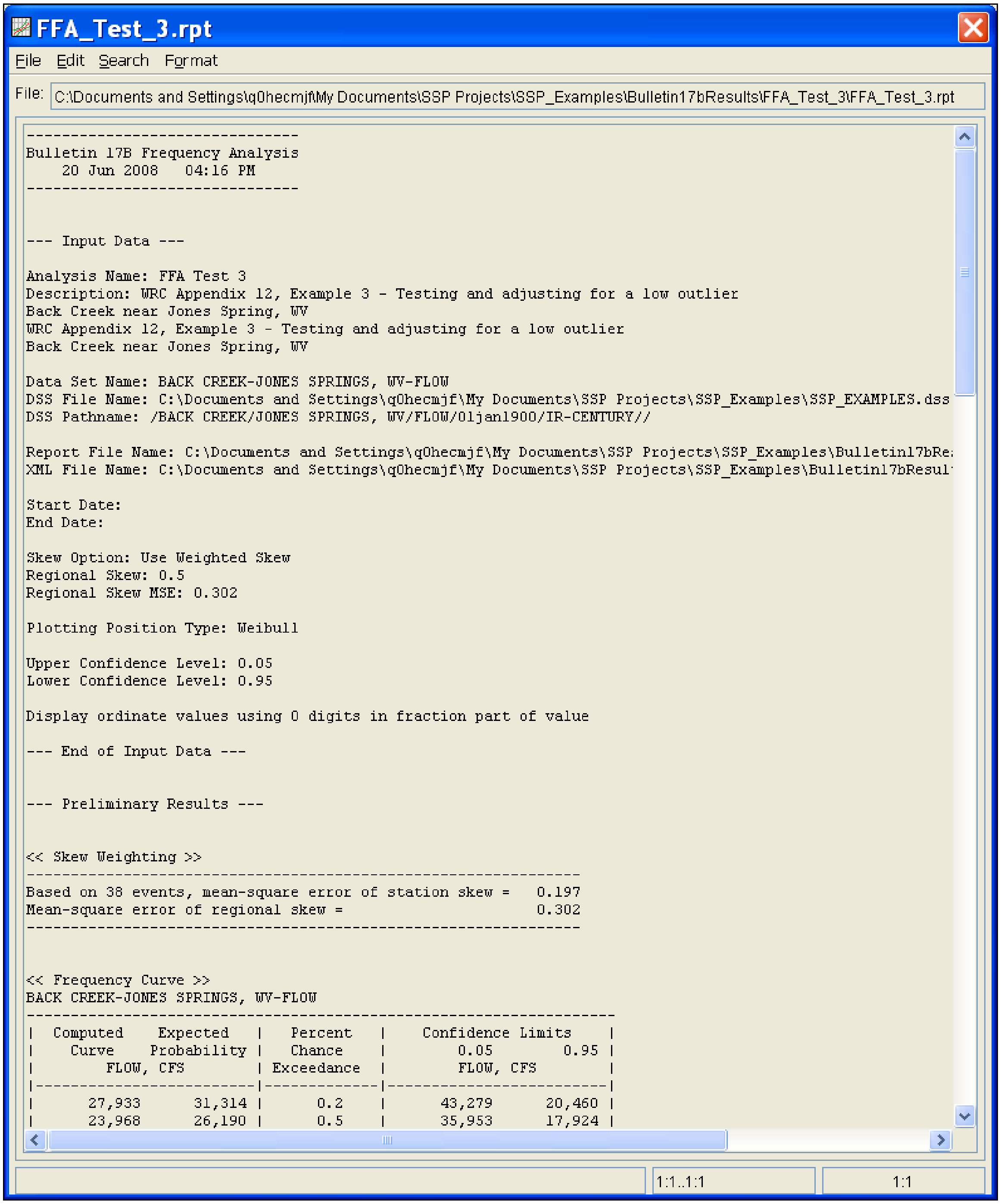


Figure B-21. Pot for Test Example 3.

In addition to the tabular and graphical results, there is a report file that shows the order in which the calculations were performed. To review the report file, press the **View Report** button at the bottom of the analysis window. When this button is selected a text viewer will open the report file and display it on the screen. Shown in Figure B-22 is the report file for test example 3.

The report file contains a listing of the input data, preliminary results, outlier and historical data tests, additional calculations needed, and the final frequency curve results. Different types and amounts of information will show up in the report file depending on the data and the options that have been selected for the analysis.



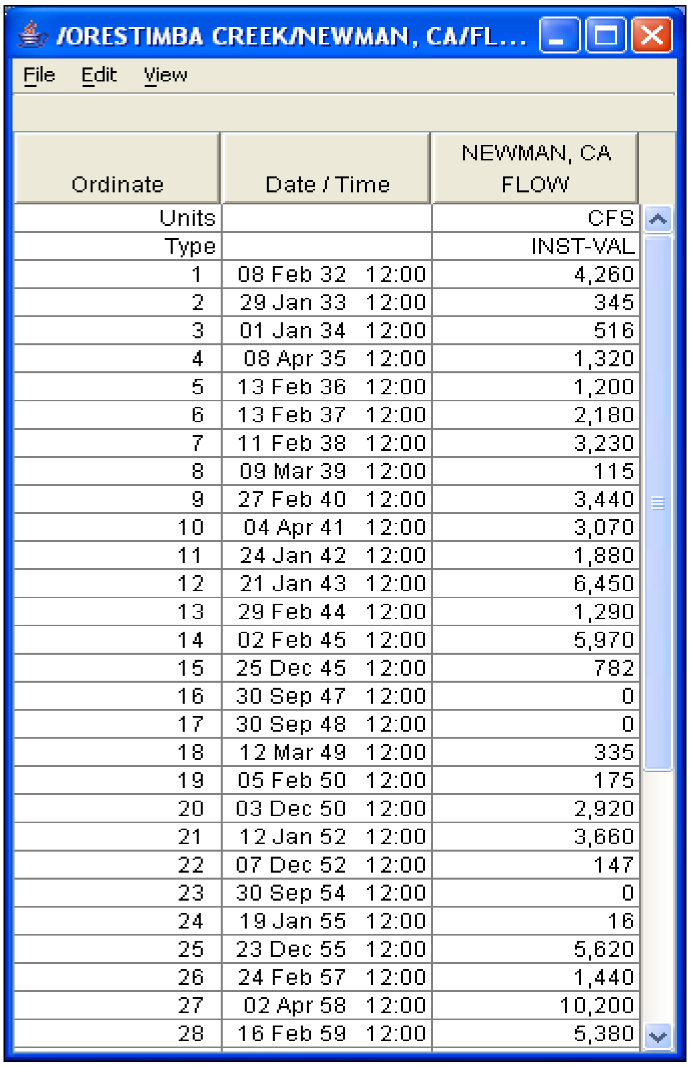

```
------------------------------
Bulletin 17B Frequency Analysis
    20 Jun 2008   04:16 PM
------------------------------


--- Input Data ---

Analysis Name: FFA Test 3
Description: WRC Appendix 12, Example 3 - Testing and adjusting for a low outlier
Back Creek near Jones Spring, WV
WRC Appendix 12, Example 3 - Testing and adjusting for a low outlier
Back Creek near Jones Spring, WV

Data Set Name: BACK CREEK-JONES SPRINGS, WV-FLOW
DSS File Name: C:\Documents and Settings\q0hecmjf\My Documents\SSP Projects\SSP_Examples\SSP_EXAMPLES.dss
DSS Pathname: /BACK CREEK/JONES SPRINGS, WV/FLOW/01jan1900/IR-CENTURY//

Report File Name: C:\Documents and Settings\q0hecmjf\My Documents\SSP Projects\SSP_Examples\Bulletin17bRe
XML File Name: C:\Documents and Settings\q0hecmjf\My Documents\SSP Projects\SSP_Examples\Bulletin17bResul

Start Date:
End Date:

Skew Option: Use Weighted Skew
Regional Skew: 0.5
Regional Skew MSE: 0.302

Plotting Position Type: Weibull

Upper Confidence Level: 0.05
Lower Confidence Level: 0.95

Display ordinate values using 0 digits in fraction part of value

--- End of Input Data ---


--- Preliminary Results ---


<< Skew Weighting >>
--------------------------------------------------------------
Based on 38 events, mean-square error of station skew =   0.197
Mean-square error of regional skew =                      0.302
--------------------------------------------------------------


<< Frequency Curve >>
BACK CREEK-JONES SPRINGS, WV-FLOW
------------------------------------------------------------------
|  Computed    Expected   |   Percent    |    Confidence Limits   |
|    Curve    Probability |   Chance     |        0.05       0.95 |
|        FLOW, CFS        |  Exceedance  |        FLOW, CFS       |
|-------------------------|--------------|------------------------|
|      27,933      31,314 |      0.2     |      43,279     20,460 |
|      23,968      26,190 |      0.5     |      35,953     17,924 |
```

Figure B-22. Report File for Test Example 3.

Example 4: Zero-Flood Years

The input data for Test 4 are the same as that for Example 4 in Appendix 12 of the WRC Guidelines. Test 4 illustrates the application to data that includes several zero flow years.

The data for this example is from Orestimba Creek in Newman, California. The period of record used for this example is from 1932 to 1973. To view the data from HEC-SSP, right-click on the data record labeled "**Orestimba Creek-Newman, CA**" in the study explorer and then select **Tabulate**. The data will appear as shown in Figure B-23.



Ordinate	Date / Time	NEWMAN, CA FLOW
Units		CFS
Type		INST-VAL
1	08 Feb 32 12:00	4,260
2	29 Jan 33 12:00	345
3	01 Jan 34 12:00	516
4	08 Apr 35 12:00	1,320
5	13 Feb 36 12:00	1,200
6	13 Feb 37 12:00	2,180
7	11 Feb 38 12:00	3,230
8	09 Mar 39 12:00	115
9	27 Feb 40 12:00	3,440
10	04 Apr 41 12:00	3,070
11	24 Jan 42 12:00	1,880
12	21 Jan 43 12:00	6,450
13	29 Feb 44 12:00	1,290
14	02 Feb 45 12:00	5,970
15	25 Dec 45 12:00	782
16	30 Sep 47 12:00	0
17	30 Sep 48 12:00	0
18	12 Mar 49 12:00	335
19	05 Feb 50 12:00	175
20	03 Dec 50 12:00	2,920
21	12 Jan 52 12:00	3,660
22	07 Dec 52 12:00	147
23	30 Sep 54 12:00	0
24	19 Jan 55 12:00	16
25	23 Dec 55 12:00	5,620
26	24 Feb 57 12:00	1,440
27	02 Apr 58 12:00	10,200
28	16 Feb 59 12:00	5,380

Figure B-23. Tabulation of the Peak Flow Data for Orestimba Creek.

To plot the data for this example, right-click on the data record and then select **Plot**. A plot of the data will appear as shown in Figure B-24. The years with peak flows measuring zero are visible.

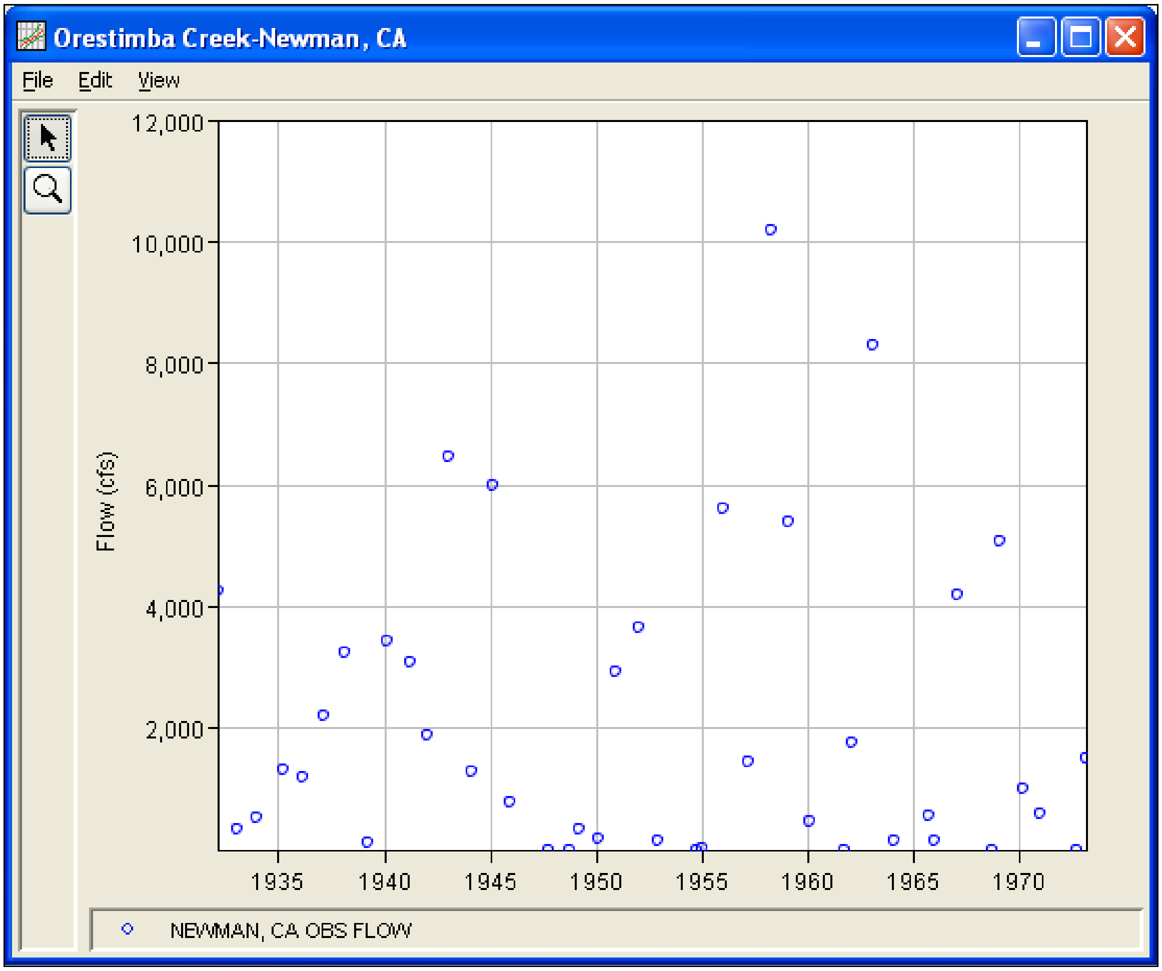


Figure B-24. Plot of Orestimba Creek Data.

A Bulletin 17B and General Frequency analysis have been developed for this example. To open the Bulletin 17B analysis editor for test example 4, either double-click on the analysis labeled **FFA Test 4** from the study explorer, or from the **Analysis** menu select open, then select **FFA Test 4** from the list of available analyses. When FFA Test 4 is selected, the Bulletin 17B analysis editor will appear as shown in Figure B-25.

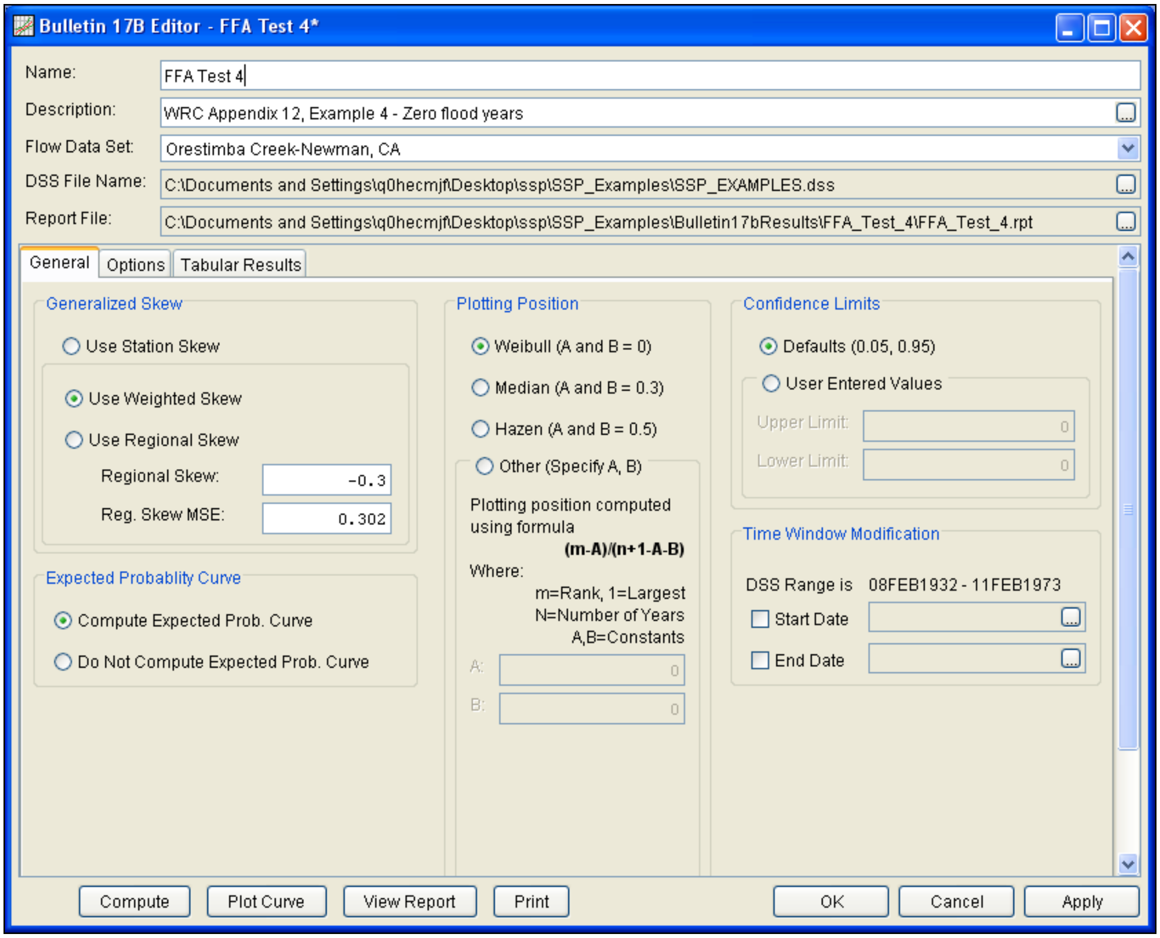


Figure B-25. Bulletin 17B Analysis Editor with Test Example 4 Data Set.

Shown in Figure B-25 are the general settings that were used to perform this frequency analysis. As shown, the **Skew** option was set to use the **Weighted Skew**. To use the weighted skew option, the user must enter a value for the Regional Skew and the Regional Skew Mean Square Error (MSE). This selection requires the user to either look up a value from the generalized skew map of the United States, which is provided with Bulletin 17B, or develop a value from a regional analysis of nearby gages. In this example a value of -0.3 was taken from the generalized skew map of the U.S. from Bulletin 17B. Bulletin 17B suggests using a Regional Skew MSE of 0.302 whenever regional skew values are taken from the map.

Also for this example, the **Expected Probability Curve** option was selected to be computed in addition to the Log Pearson III computed curve. The **Weibull** plotting position method was selected, as well as the default **Confidence Limits** of 0.05 (5 percent chance exceedance) and 0.95 (95% chance exceedance). Shown in Figure B-26 is the Bulletin 17B editor with the **Options Tab** selected.

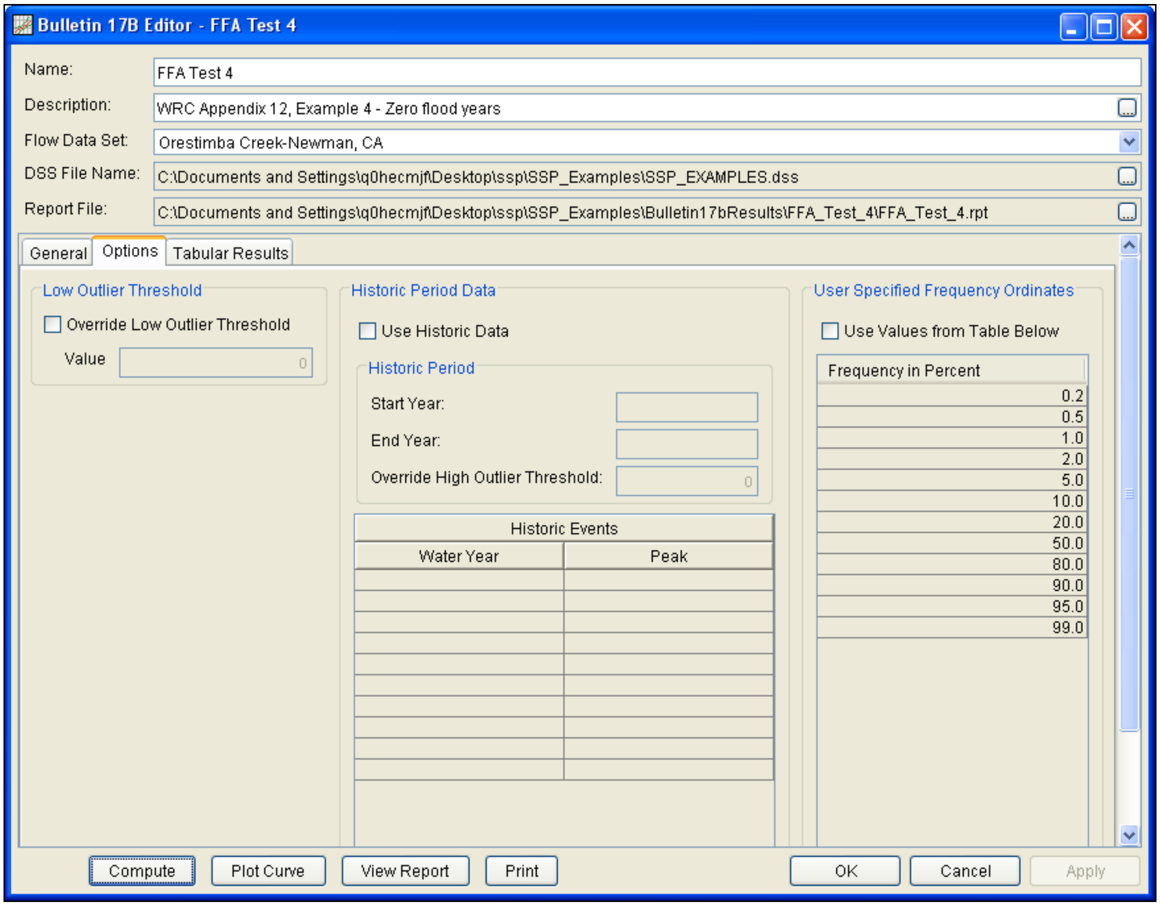
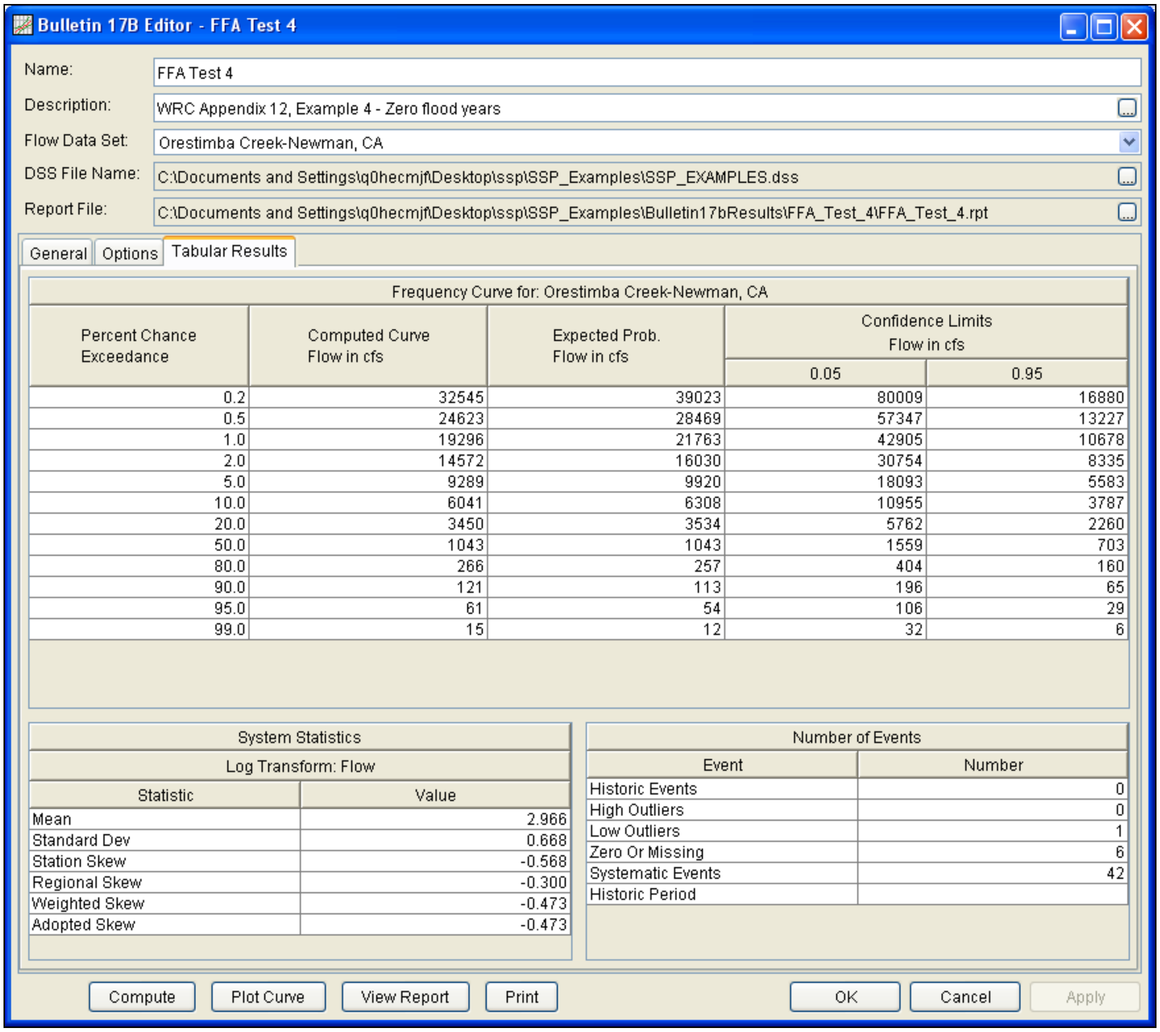


Figure B-26. Bulletin 17B Editor with the Options Tab Selected for Test Example 4.

As shown in Figure B-26, none of the available options for modifying the frequency curve were selected for this test example. These options include the **Low Outlier Threshold** and **Historic Period Data**. Additionally, the option to override the default **Frequency Ordinates** was not selected.

Once all of the General and Optional settings are set or selected, the user can press the **Compute** button to perform the analysis. Once the computations have been completed a message window will open stating **Compute Complete.** Close this window and then select the **Tabular Results** tab. The analysis window should look Figure B-27.



Bulletin 17B Editor - FFA Test 4

Name: FFA Test 4

Description: WRC Appendix 12, Example 4 - Zero flood years

Flow Data Set: Orestimba Creek-Newman, CA

DSS File Name: C:\Documents and Settings\q0hecmjf\Desktop\ssp\SSP_Examples\SSP_EXAMPLES.dss

Report File: C:\Documents and Settings\q0hecmjf\Desktop\ssp\SSP_Examples\Bulletin17bResults\FFA_Test_4\FFA_Test_4.rpt

General | Options | Tabular Results

Frequency Curve for: Orestimba Creek-Newman, CA

Percent Chance Exceedance	Computed Curve Flow in cfs	Expected Prob. Flow in cfs	Confidence Limits Flow in cfs	
			0.05	0.95
0.2	32545	39023	80009	16880
0.5	24623	28469	57347	13227
1.0	19296	21763	42905	10678
2.0	14572	16030	30754	8335
5.0	9289	9920	18093	5583
10.0	6041	6308	10955	3787
20.0	3450	3534	5762	2260
50.0	1043	1043	1559	703
80.0	266	257	404	160
90.0	121	113	196	65
95.0	61	54	106	29
99.0	15	12	32	6

System Statistics

Log Transform: Flow

Statistic	Value
Mean	2.966
Standard Dev	0.668
Station Skew	-0.568
Regional Skew	-0.300
Weighted Skew	-0.473
Adopted Skew	-0.473

Number of Events

Event	Number
Historic Events	0
High Outliers	0
Low Outliers	1
Zero Or Missing	6
Systematic Events	42
Historic Period	

Compute | Plot Curve | View Report | Print | OK | Cancel | Apply

Figure B-27. Bulletin 17B Editor with the Results Tab Selected for Test Example 4.

As shown in Figure B-27, the Frequency Curve table contains the following results:

Percent Chance Exceedance

Computed Curve (Log-Pearson III results)

Expected Probability Curve

Confidence Limits (5% and 95% chance exceedance curves)

On the bottom left-hand side of the results tab is a table of System Statistics for the observed station data (mean, standard deviation, station skew) and regional adjustment (regional skew, weighted skew, and adopted skew). Also on the bottom right-hand side of the results tab is a table of Number of Events showing the number of historic events used in the analysis, number of high outliers found, number of low outliers, number of zero or missing data years, number of systematic events in the gage record, and the historic record length (if historic data was entered).

As noted earlier, there were six zero values in this record, and also a low outlier. A zero value causes difficulty because the first step in fitting a Log Pearson III distribution is computing the base-10 log of each flow value, which is undefined for zero. Bulletin 17B recommends removing the zero values (and the low outlier) from the systematic record to compute a preliminary frequency curve, and then adjusting that curve with the Conditional Probability Adjustment. The final frequency curve and statistics are shown in the table, and the preliminary calculations can be reviewed in the report file.

In addition to the tabular results, a graphical plot of the computed frequency curves can be obtained by pressing the **Plot Curve** button at the bottom of the analysis window. A plot of the results for this test example is shown in Figure B-28.

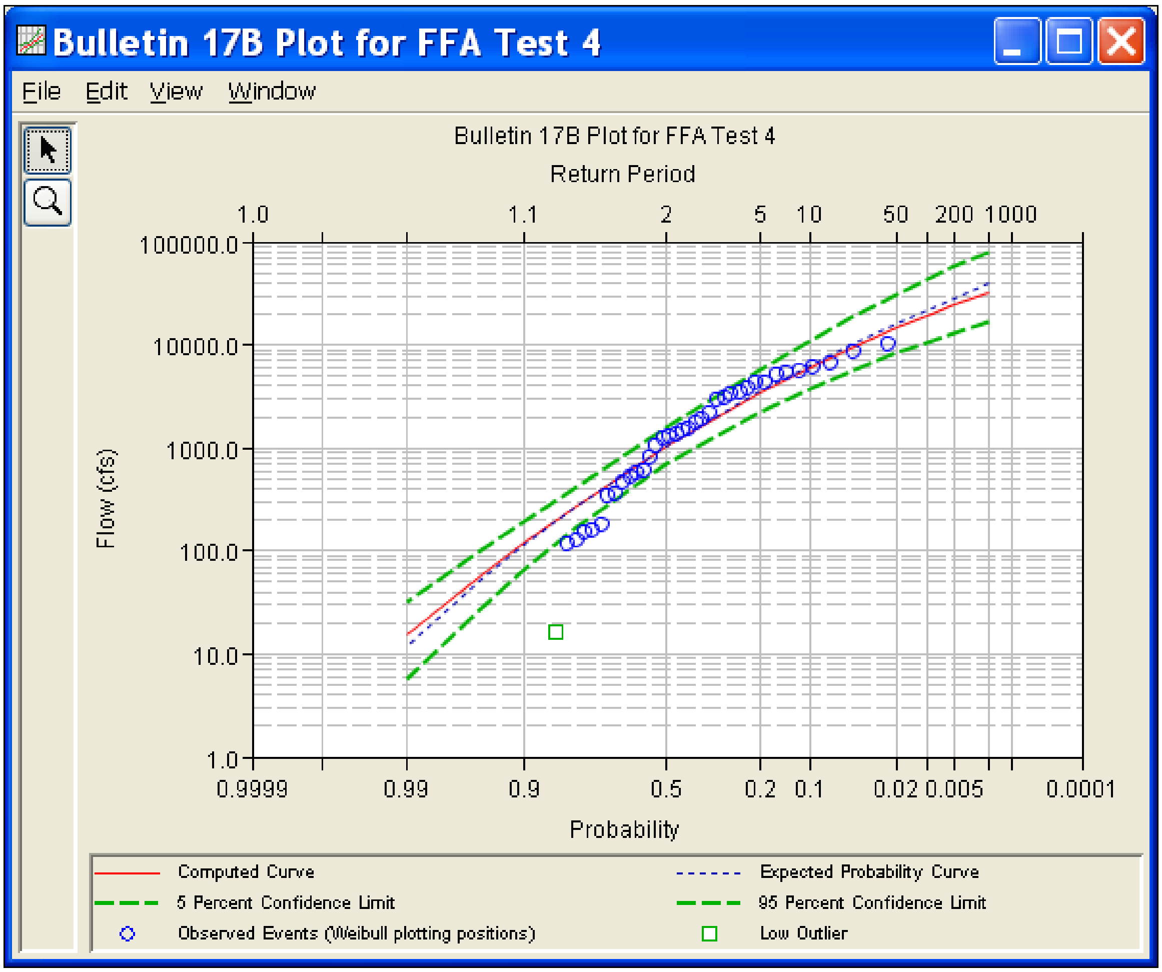


Figure B-28. Plot of Test Example 4 Results.

The tabular and graphical results can be sent to the printer or the windows clipboard for transfer into another piece of software. To print the tabular results, select **Print** from the bottom of the analysis window. To send the tabular results to the windows clipboard, highlight the data you want to send to the clipboard and then press the Control-C key sequence. To print the graphical results, first bring up the graphical plot and then select **Print** from the **File** menu. To send the graphic to the windows clipboard, select **Copy to Clipboard** from the **File** menu.

In addition to the tabular and graphical results, there is a report file that shows the order in which the calculations were performed. To review the report file, press the **View Report** button at the bottom of the analysis window. When this button is selected a text viewer will open the report file and display it on the screen. Shown in Figure B-29 is the report file for Test Example 4.

The report file contains a listing of the input data, preliminary results, outlier and historical data tests, additional calculations needed, and the final frequency curve results. Different types and amounts of information will show up in the report file depending on the data and the options that have been selected for the analysis.

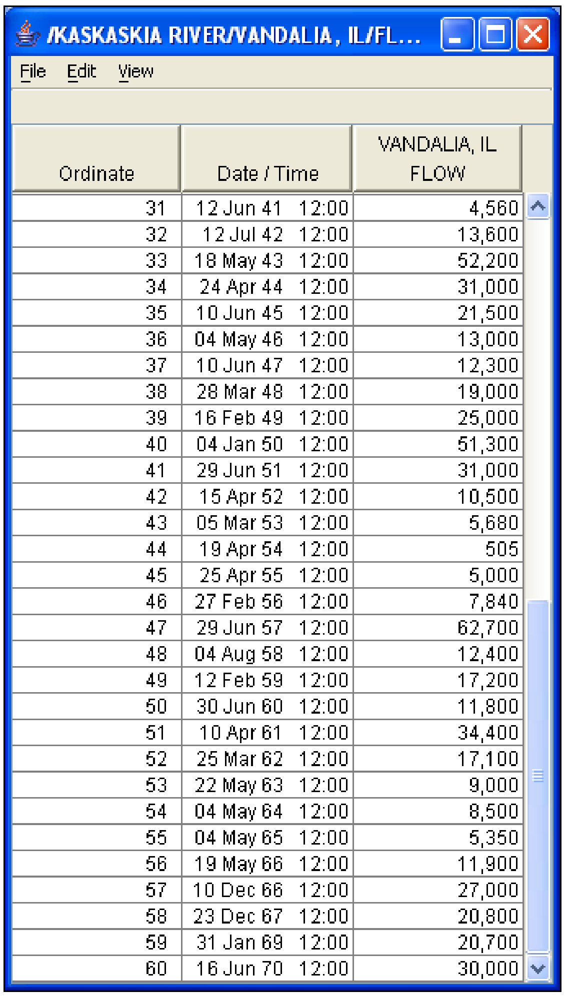

```
------------------------------
Bulletin 17B Frequency Analysis
    14 Sep 2010   01:39 PM
------------------------------


--- Input Data ---

Analysis Name: FFA Test 4
Description: WRC Appendix 12, Example 4 - Zero flood years
Orestimba Creek near Newman, CA

Data Set Name: Orestimba Creek-Newman, CA
DSS File Name: C:\Documents and Settings\q0hecmjf\Desktop\ssp\SSP_Examples\SSP_EXAMPLES.dss
DSS Pathname: /ORESTIMBA CREEK/NEWMAN, CA/FLOW/01jan1900/IR-CENTURY/OBS/

Report File Name: C:\Documents and Settings\q0hecmjf\Desktop\ssp\SSP_Examples\Bulletin17bResul
XML File Name: C:\Documents and Settings\q0hecmjf\Desktop\ssp\SSP_Examples\Bulletin17bResults\

Start Date:
End Date:

Skew Option: Use Weighted Skew
Regional Skew: -0.3
Regional Skew MSE: 0.302

Plotting Position Type: Weibull

Upper Confidence Level: 0.05
Lower Confidence Level: 0.95

Display ordinate values using 0 digits in fraction part of value

--- End of Input Data ---


--- Preliminary Results ---

Note: Adopted skew equals station skew and preliminary
frequency statistics are for the conditional frequency curve
because of zero or missing events.



<< Frequency Curve >>
Orestimba Creek-Newman, CA
-------------------------------------------------------------------
| Computed    Expected   |   Percent    |    Confidence Limits    |
|   Curve    Probability |   Chance     |       0.05       0.95   |
|        FLOW, CFS       | Exceedance   |        FLOW, CFS        |
|------------------------|--------------|-------------------------|
|      20,376     22,737 |      0.2     |      46,565     11,197  |
|      17,439     19,187 |      0.5     |      38,604      9,771  |
|      15,067     16,403 |      1.0     |      32,382      8,593  |
|      12,590     13,525 |      2.0     |      26,116      7,332  |
```

Figure B-29. HEC-SSP Report File for Test Example 4.

Example 5: Confidence Limits and Low Threshold Discharge

This test illustrates the use of user-entered confidence limits. Probabilities of .01 and .99 were entered for the computed confidence limit curves. This data set also includes two very low values, the higher of which is just above the default low outlier threshold. This example therefore also demonstrates the use of a user-entered low outlier threshold set to be higher than both values.

The data for this example is from Kaskaskia River in Vandalia, Illinois. The period of record used for this example is from 1908 to 1970. To view the data from HEC-SSP, right-click on the data record labeled "**Kaskaskia River-Vandalia, IL**" in the study explorer and then select **Tabulate**. The data will appear as shown in Figure B-30.



/KASKASKIA RIVER/VANDALIA, IL/FL...

File Edit View

Ordinate	Date / Time	VANDALIA, IL FLOW
31	12 Jun 41 12:00	4,560
32	12 Jul 42 12:00	13,600
33	18 May 43 12:00	52,200
34	24 Apr 44 12:00	31,000
35	10 Jun 45 12:00	21,500
36	04 May 46 12:00	13,000
37	10 Jun 47 12:00	12,300
38	28 Mar 48 12:00	19,000
39	16 Feb 49 12:00	25,000
40	04 Jan 50 12:00	51,300
41	29 Jun 51 12:00	31,000
42	15 Apr 52 12:00	10,500
43	05 Mar 53 12:00	5,680
44	19 Apr 54 12:00	505
45	25 Apr 55 12:00	5,000
46	27 Feb 56 12:00	7,840
47	29 Jun 57 12:00	62,700
48	04 Aug 58 12:00	12,400
49	12 Feb 59 12:00	17,200
50	30 Jun 60 12:00	11,800
51	10 Apr 61 12:00	34,400
52	25 Mar 62 12:00	17,100
53	22 May 63 12:00	9,000
54	04 May 64 12:00	8,500
55	04 May 65 12:00	5,350
56	19 May 66 12:00	11,900
57	10 Dec 66 12:00	27,000
58	23 Dec 67 12:00	20,800
59	31 Jan 69 12:00	20,700
60	16 Jun 70 12:00	30,000

Figure B-30. Tabulation of the Peak Flow Data for Kaskaskia River.

To plot the data for this example, right-click on the data record and then select **Plot**. A plot of the data will appear as shown in Figure B-31.

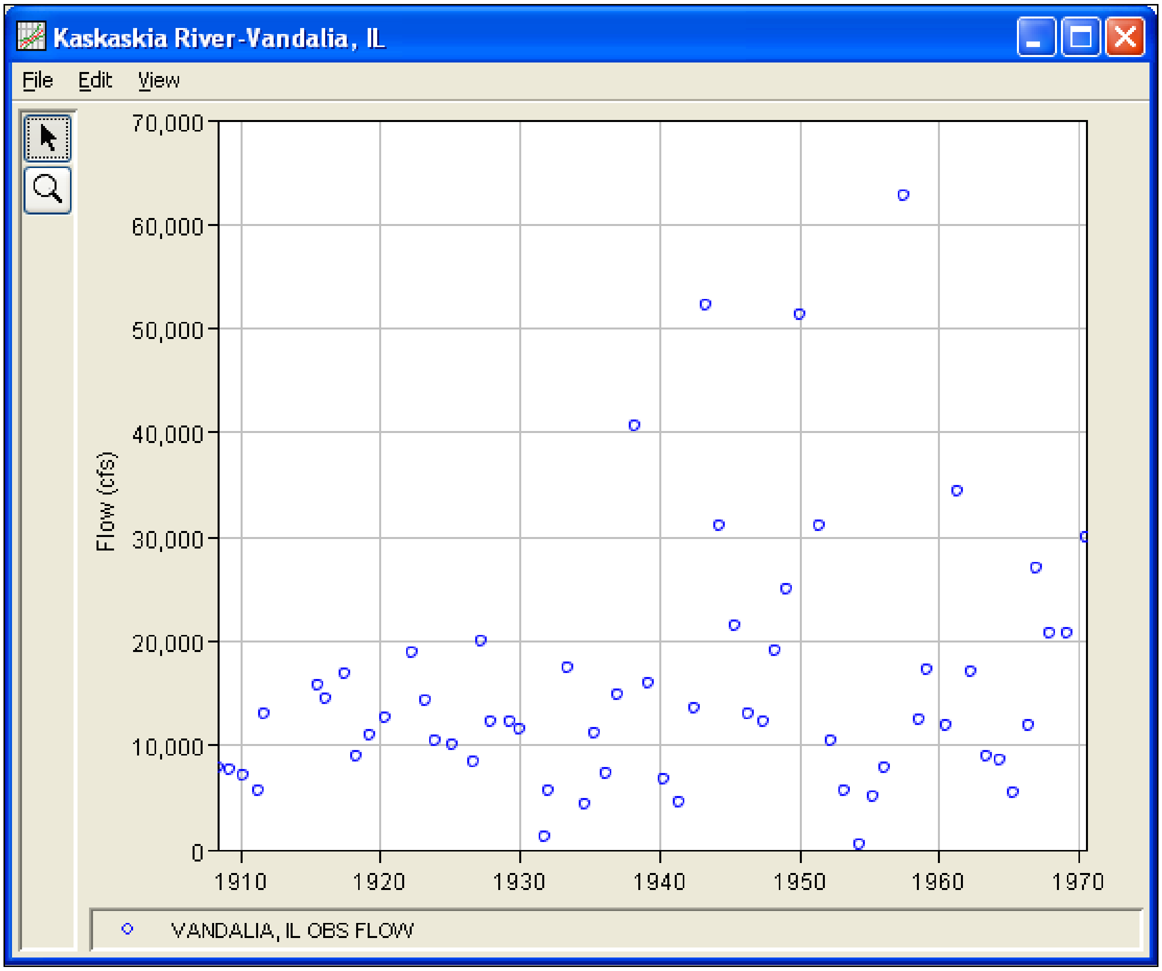


Figure B-31. HEC-SSP Plot of the Kaskaskia River Data.

A Bulletin 17B and General Frequency analysis have been developed for this example. To open the Bulletin 17B analysis editor for test example 5, either double-click on the analysis labeled **FFA Test 5** from the study explorer, or from the **Analysis** menu select **Open** and then select **FFA Test 5** from the list of available analyses. When FFA Test 5 is selected, the Bulletin 17B analysis editor will appear as shown in Figure B-32.

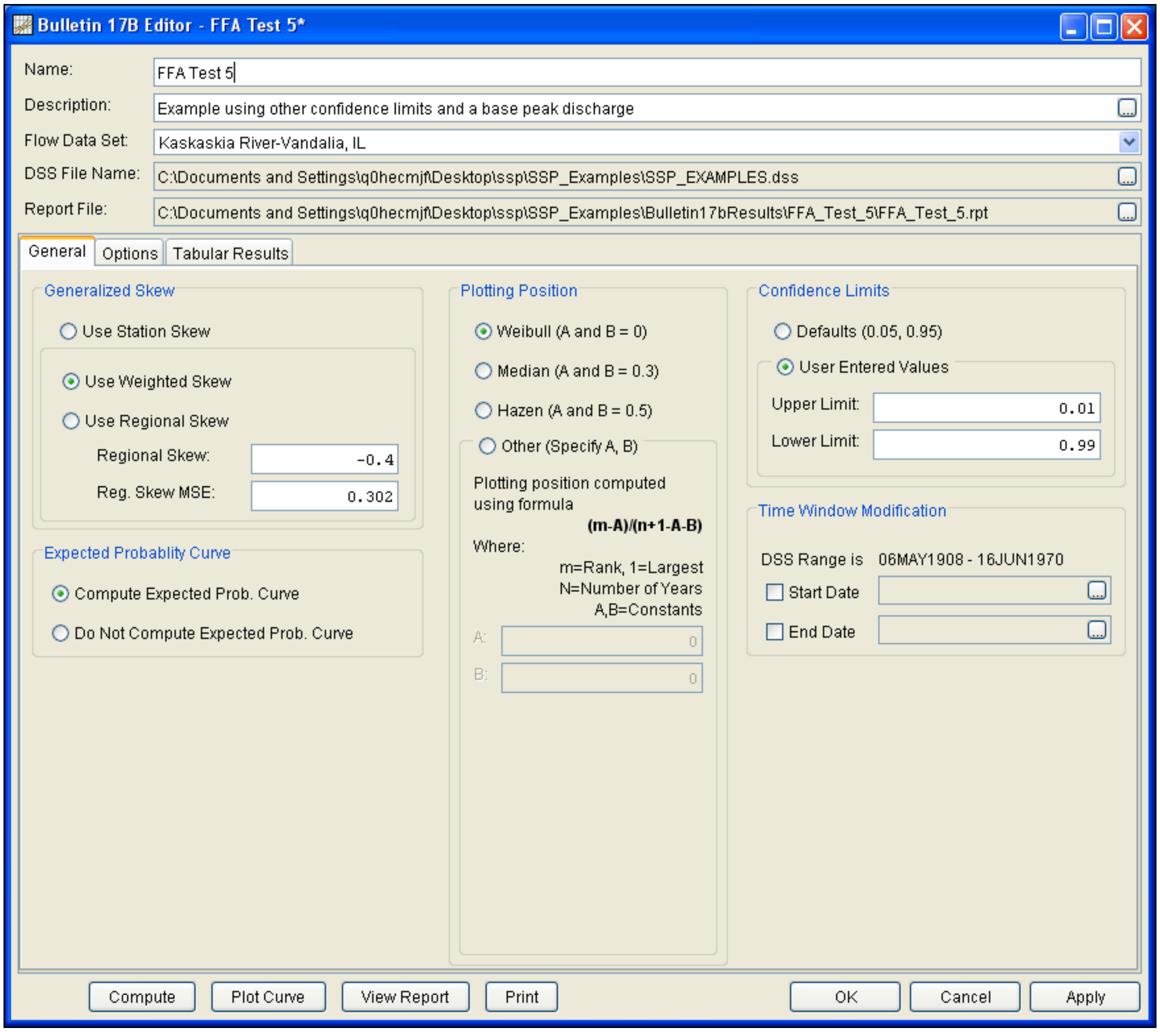


Figure B-32. Bulletin 17B Analysis Editor for Test Example 5.

Shown in Figure B-32 are the general settings that were used to perform this frequency analysis. As shown, the **Skew** option was set to use the **Weighted Skew**. To use the weighted skew option, the user must enter a value for the Regional Skew and the Regional Skew Mean Square Error (MSE). This selection requires the user to either look up a value from the generalized skew map of the United States, which is provided with Bulletin 17B, or develop a value from a regional analysis of nearby gages. In this example a value of -0.4 was taken from the generalized skew map of the U.S. from Bulletin 17B. Bulletin 17B suggests using a Regional Skew MSE of 0.302 whenever regional skew values are taken from the map.

Also for this example, the **Expected Probability Curve** option was selected to be computed in addition to the Log Pearson III computed curve. The default method of **Weibull** plotting positions was selected. The default values for confidence limits (.05 and .95) were changed to 0.01 (1 percent chance exceedance) and 0.99 (99% chance exceedance). Shown in Figure B-33 is the Bulletin 17B editor with the **Options Tab** selected.

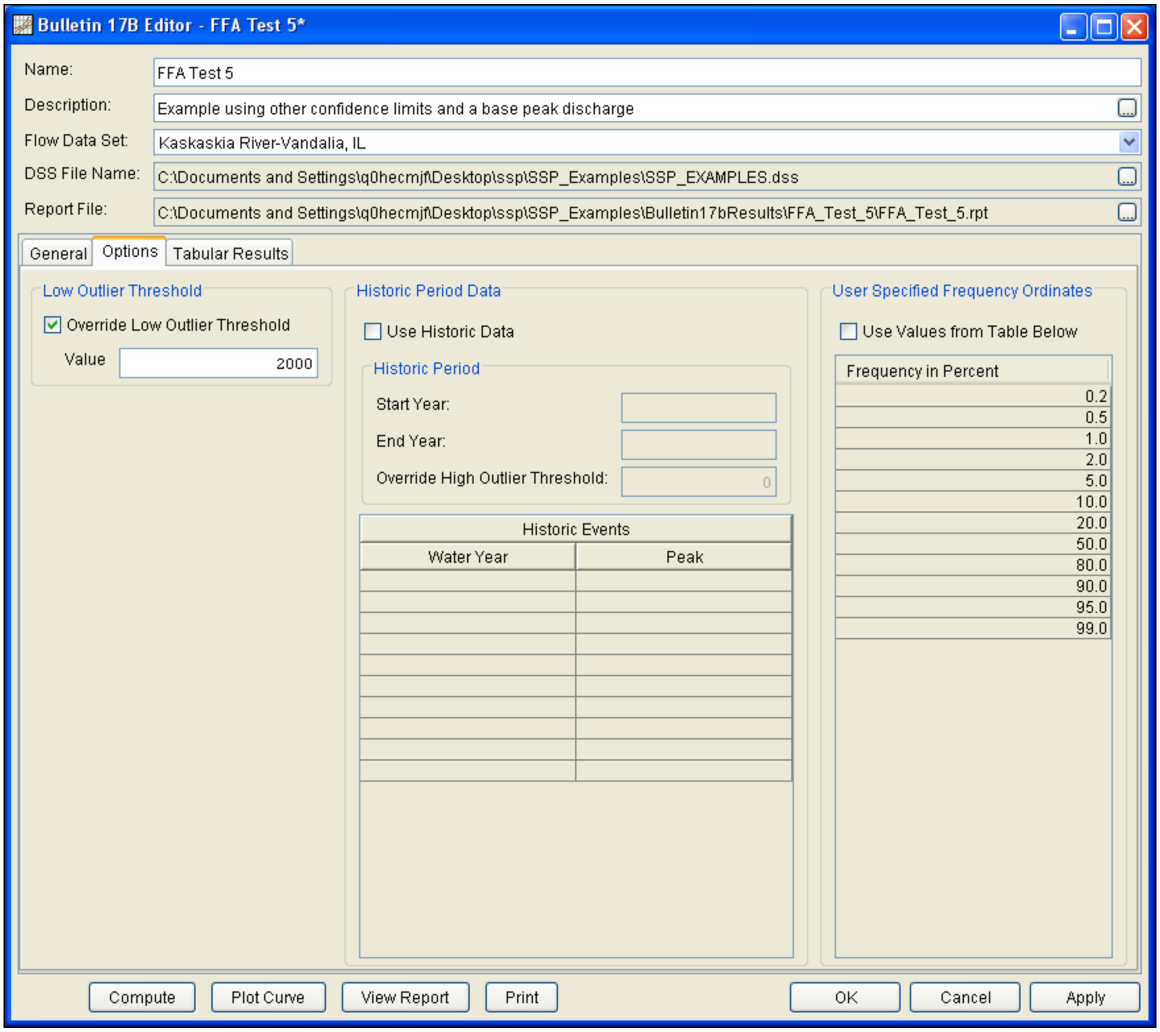
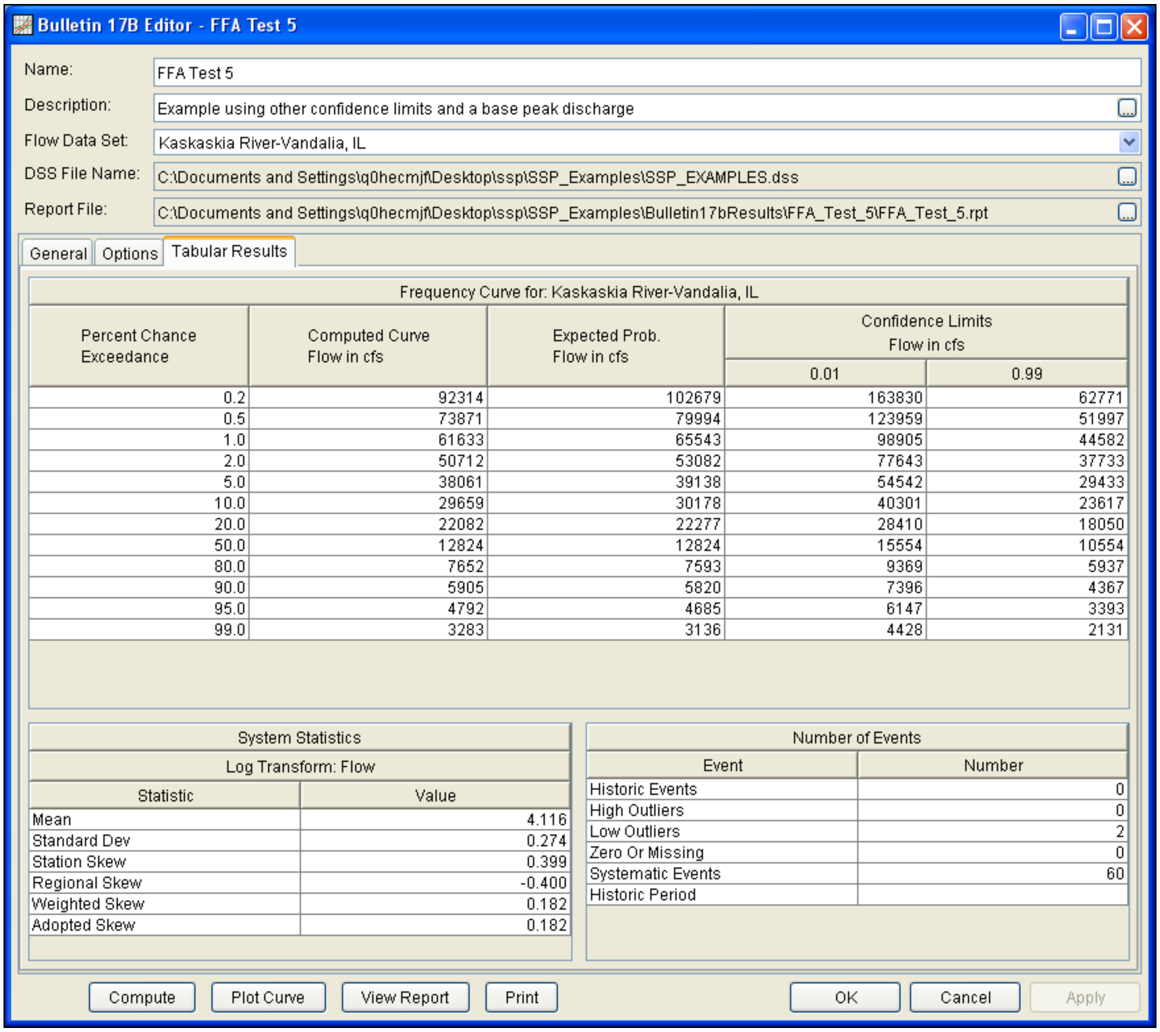


Figure B-33. Bulletin 17B Editor with the Options Tab Shown for Test Example 5.

As shown in Figure B-33, a **Low Outlier Threshold** of 2000 cfs was entered. In the initial computation with this data (which the reader can reproduce by Computing without the "Use Low Outlier Threshold" box checked), the default low outlier threshold was 1,253 cfs, just below the second lowest value of 1,270 cfs. A look at the statistics and computed frequency curve from that run shows that the 1,270 cfs value is well below the computed curve and with a station skew of -0.21 the frequency curve does not fit the upper data well. By choosing to also censor the 1,270 cfs value with a threshold of 2000 cfs, the fit is improved. None of the other available options, such as **Historic Period Data** and the option to override the default **Frequency Ordinates** were selected for this test example.

Once all of the General and Optional settings are set or selected, the user can press the **Compute** button to perform the analysis. Once the computations have been completed a message window will open stating **Compute Complete.** Close this window and then select the **Tabular Results** tab from the analysis window. The analysis window should look Figure B-34.



Frequency Curve for: Kaskaskia River-Vandalia, IL				
Percent Chance Exceedance	Computed Curve Flow in cfs	Expected Prob. Flow in cfs	Confidence Limits Flow in cfs	
			0.01	0.99
0.2	92314	102679	163830	62771
0.5	73871	79994	123959	51997
1.0	61633	65543	98905	44582
2.0	50712	53082	77643	37733
5.0	38061	39138	54542	29433
10.0	29659	30178	40301	23617
20.0	22082	22277	28410	18050
50.0	12824	12824	15554	10554
80.0	7652	7593	9369	5937
90.0	5905	5820	7396	4367
95.0	4792	4685	6147	3393
99.0	3283	3136	4428	2131

System Statistics	
Log Transform: Flow	
Statistic	Value
Mean	4.116
Standard Dev	0.274
Station Skew	0.399
Regional Skew	-0.400
Weighted Skew	0.182
Adopted Skew	0.182

Number of Events	
Event	Number
Historic Events	0
High Outliers	0
Low Outliers	2
Zero Or Missing	0
Systematic Events	60
Historic Period	

Figure B-34. Bulletin 17B Editor with the Results Tab Selected for Test Example 5.

As shown in Figure B-34, the Frequency Curve table contains the following results:

Percent Chance Exceedance

Computed Curve (Log-Pearson III results)

Expected Probability Curve

Confidence Limits (1% and 99% chance exceedance curves)

On the bottom left-hand side of the results tab is a table of System Statistics for the observed station data (mean, standard deviation, station skew) and regional adjustment (regional skew, weighted skew, and adopted skew). Also on the bottom right-hand side of the results tab is a table of Number of Events showing the number of historic events used in the analysis, number of high outliers found, number of low outliers, number of zero or missing data years, number of systematic events in the gage record, and the historic record length (only if historic data was entered).

With the user-defined low-outlier threshold of 2000 cfs, there are two low-outliers detected. The analysis report shows the program omitted these values and used the Conditional Probability Adjustment to recompute the resulting frequency curve and statistics. The report file (described below) includes the preliminary computation before removal of outliers and the default and user-defined outlier thresholds, as well as the final frequency curve and statistics.

In addition to the tabular results, a graphical plot of the computed frequency curves can be obtained by pressing the **Plot Curve** button at the bottom of the analysis window. A plot of the results for this test example is shown in Figure B-35.

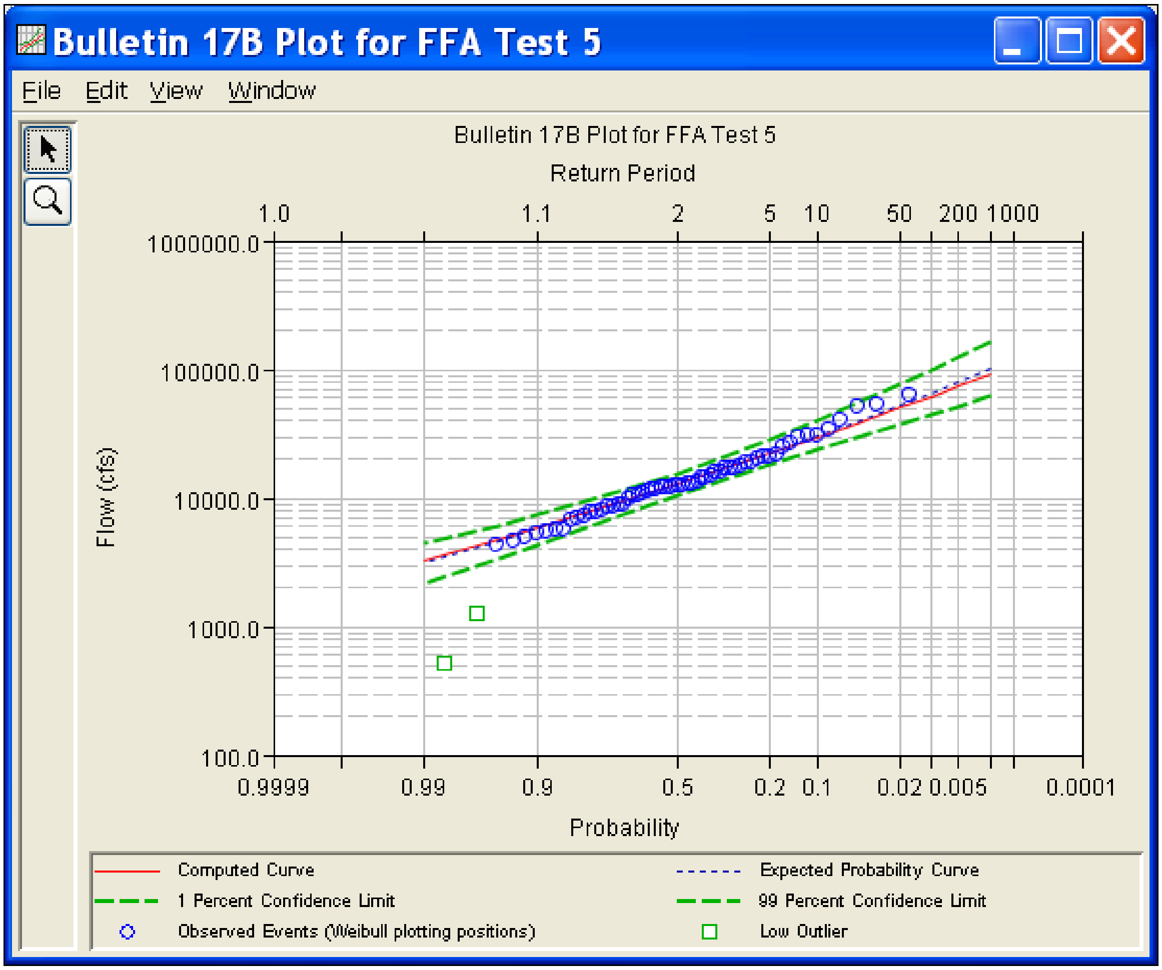


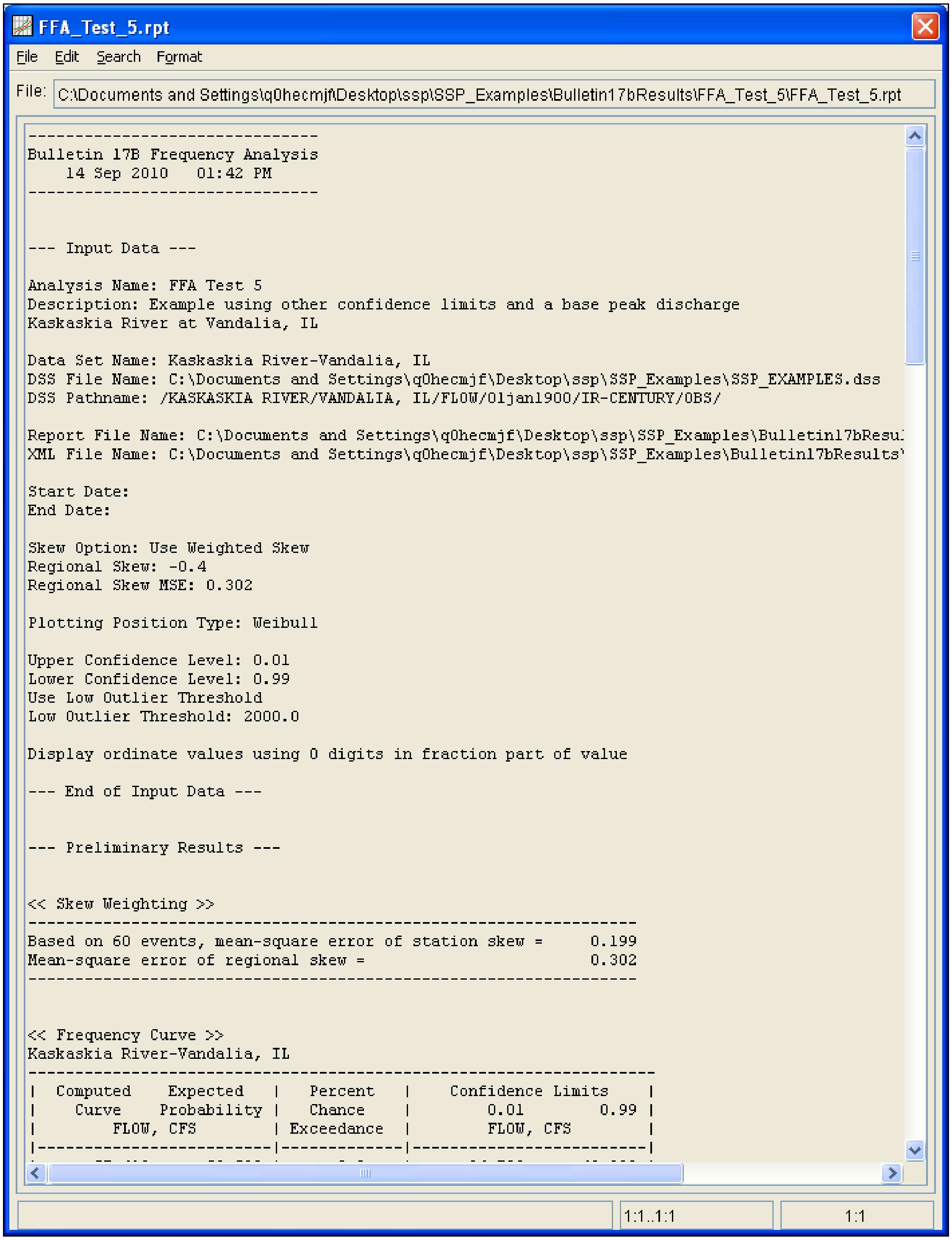
Figure B-35. Plot of the Frequency Curve Results for Test Example 5.

The tabular and graphical results can be sent to the printer or the windows clipboard for transfer into another piece of software. To print the tabular results, select **Print** from the bottom of the analysis window. To send the tabular results to the windows clipboard, highlight the data you want to send to the clipboard and then press the Control-C key sequence. To print the graphical results, first bring up the graphical plot and then select **Print** from the **File** menu. To send the graphic to the windows clipboard, select **Copy to Clipboard** from the **File** menu.

In addition to the tabular and graphical results, there is a report file that shows the order in which the calculations were performed. To review the report file, press the **View Report** button at the bottom of the analysis window. When this button is selected a text viewer will open the report file and display it on the screen. Shown in Figure B-36 is the report file for Test Example 5.

The report file contains a listing of the input data, preliminary results, outlier and historical data tests, additional calculations needed, and

the final frequency curve results. Different types and amounts of information will show up in the report file depending on the data and the options that have been selected for the analysis.




```
------------------------------
Bulletin 17B Frequency Analysis
    14 Sep 2010   01:42 PM
------------------------------


--- Input Data ---

Analysis Name: FFA Test 5
Description: Example using other confidence limits and a base peak discharge
Kaskaskia River at Vandalia, IL

Data Set Name: Kaskaskia River-Vandalia, IL
DSS File Name: C:\Documents and Settings\q0hecmjf\Desktop\ssp\SSP_Examples\SSP_EXAMPLES.dss
DSS Pathname: /KASKASKIA RIVER/VANDALIA, IL/FLOW/01jan1900/IR-CENTURY/OBS/

Report File Name: C:\Documents and Settings\q0hecmjf\Desktop\ssp\SSP_Examples\Bulletin17bResul
XML File Name: C:\Documents and Settings\q0hecmjf\Desktop\ssp\SSP_Examples\Bulletin17bResults\

Start Date:
End Date:

Skew Option: Use Weighted Skew
Regional Skew: -0.4
Regional Skew MSE: 0.302

Plotting Position Type: Weibull

Upper Confidence Level: 0.01
Lower Confidence Level: 0.99
Use Low Outlier Threshold
Low Outlier Threshold: 2000.0

Display ordinate values using 0 digits in fraction part of value

--- End of Input Data ---


--- Preliminary Results ---


<< Skew Weighting >>
------------------------------------------------------------------
Based on 60 events, mean-square error of station skew =     0.199
Mean-square error of regional skew =                        0.302
------------------------------------------------------------------


<< Frequency Curve >>
Kaskaskia River-Vandalia, IL
--------------------------------------------------------------------
|  Computed    Expected   |   Percent    |    Confidence Limits    |
|    Curve    Probability |    Chance    |       0.01        0.99 |
|        FLOW, CFS        |  Exceedance  |        FLOW, CFS        |
|-------------------------|--------------|-------------------------|
```

Figure B-36. Report File for Test Example 5.

Example 6: Use of Historic Data and Median Plotting Position

This test demonstrates how to use historic information to improve a flow frequency analysis. A historic flood peak of 15,000 cfs which occurred in 1843 is included in the analysis. This value is the highest known value up to the present time (1974 for this example), even though the systematic record stopped in 1955.

The data for this example is from Ridley Creek in Moylan, Pennsylvania. The period of record used for this example is from 1932 to 1955. To view the data from HEC-SSP, right-click on the data record labeled "**Ridley Creek-Moylan, PA**" in the study explorer and then select **Tabulate**. The data will appear as shown in Figure B-37.

/RIDLEY CREEK/MOYLAN, PA/FLOW/...

File Edit View

Ordinate	Date / Time	MOYLAN, PA FLOW
Units		CFS
Type		INST-VAL
1	28 Mar 32 12:00	891.0
2	23 Aug 33 12:00	2,680.0
3	05 Mar 34 12:00	1,080.0
4	09 Jul 35 12:00	3,000.0
5	03 Jan 36 12:00	1,590.0
6	22 Feb 37 12:00	770.0
7	23 Jul 38 12:00	3,320.0
8	03 Feb 39 12:00	978.0
9	15 Mar 40 12:00	1,770.0
10	07 Feb 41 12:00	746.0
11	13 Aug 42 12:00	1,000.0
12	30 Dec 42 12:00	980.0
13	06 Jan 44 12:00	865.0
14	18 Sep 45 12:00	1,040.0
15	26 Dec 45 12:00	1,000.0
16	22 May 47 12:00	483.0
17	05 May 48 12:00	740.0
18	30 Dec 48 12:00	1,040.0
19	03 Aug 50 12:00	1,590.0
20	25 Nov 50 12:00	5,720.0
21	11 Mar 52 12:00	1,490.0
22	22 Nov 52 12:00	918.0
23	14 Dec 53 12:00	670.0
24	18 Aug 55 12:00	4,390.0

Figure B-37. Tabulation of the Peak Flow Data for Ridley Creek.

To plot the data for this example, right-click on the data record and then select **Plot**. A plot of the data will appear as shown in Figure B-38.

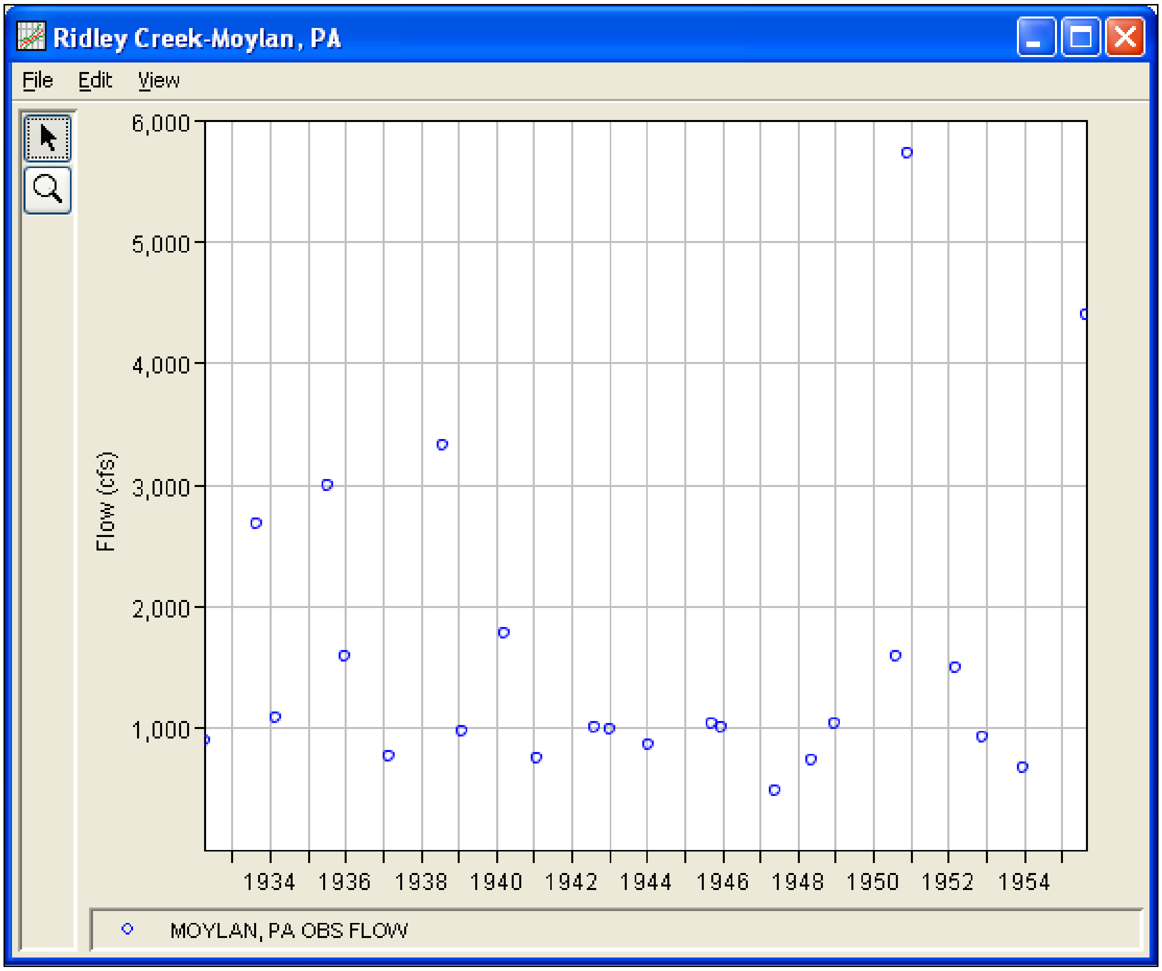


Figure B-38. Plot of the Ridley Creek Data.

A Bulletin 17B and General Frequency analysis have been developed for this example. To open the Bulletin 17B analysis editor for test example 6, either double-click on the analysis labeled **FFA Test 6** from the study explorer, or from the **Analysis** menu select open, then select **FFA Test 6** from the list of available analyses. When FFA Test 6 is selected, the Bulletin 17B analysis editor will appear as shown in Figure B-39.

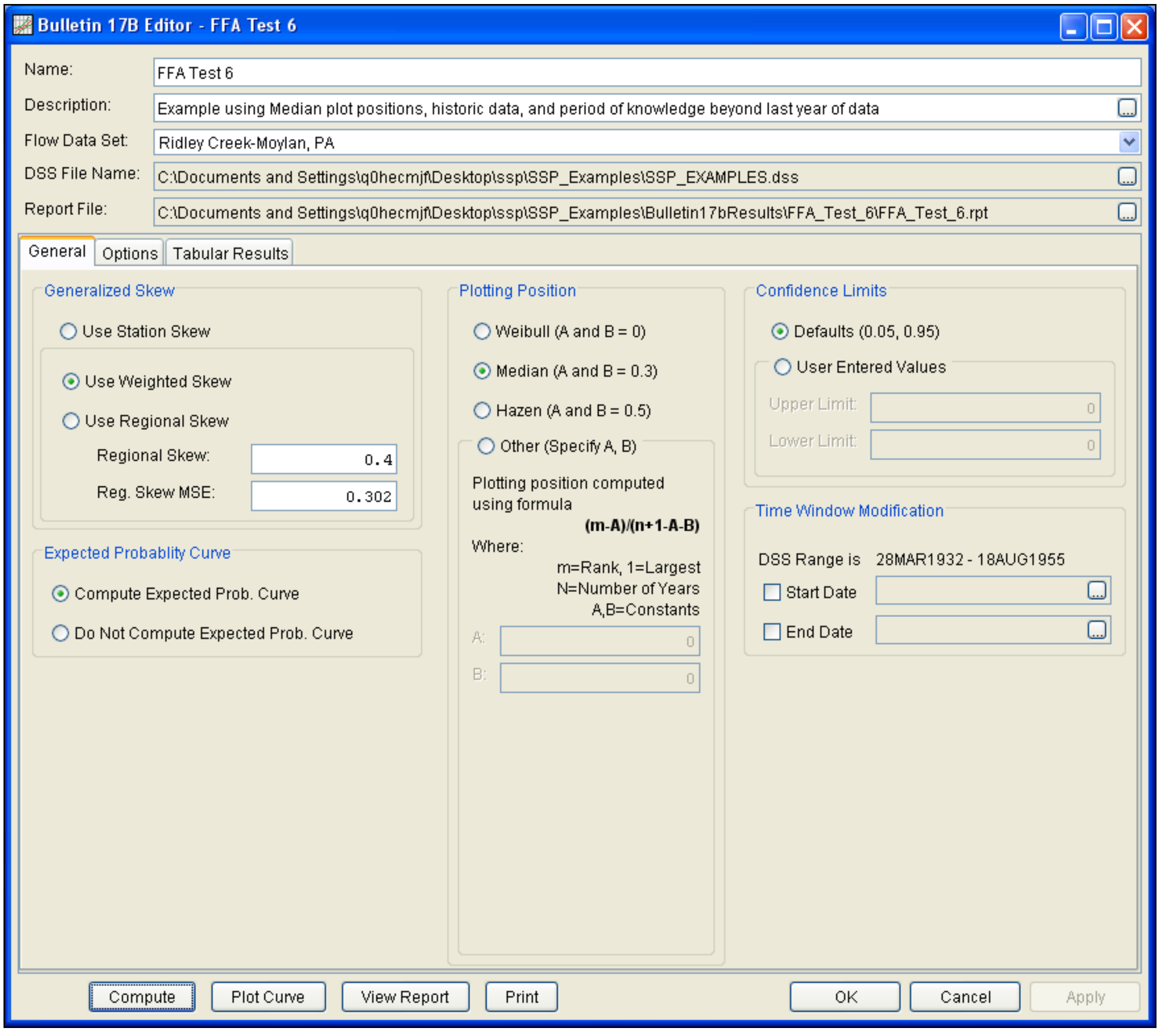


Figure B-39. Bulletin 17B Analysis Editor for Test Example 6.

Shown in Figure B-39 are the general settings that were used to perform this frequency analysis. As shown, the **Skew** option was set to use the **Weighted Skew**. To use the weighted skew option, the user must enter a value for the Regional Skew and the Regional Skew Mean Square Error (MSE). This selection requires the user to either look up a value from the generalized skew map of the United States, which is provided with Bulletin 17B, or develop a value from a regional analysis of nearby gages. In this example a value of 0.4 was taken from the generalized skew map of the U.S. from Bulletin 17B. Bulletin 17B suggests using a Regional Skew MSE of 0.302 whenever regional skew values are taken from the map.

Also for this example, the **Expected Probability Curve** option was selected to be computed in addition to the Log Pearson III computed curve. The **Median** plotting position method was selected, as well as the default **Confidence Limits** of 0.05 (5 percent chance exceedance) and 0.95 (95% chance exceedance). Shown in Figure B-40 is the Bulletin 17B editor with the **Options Tab** selected.

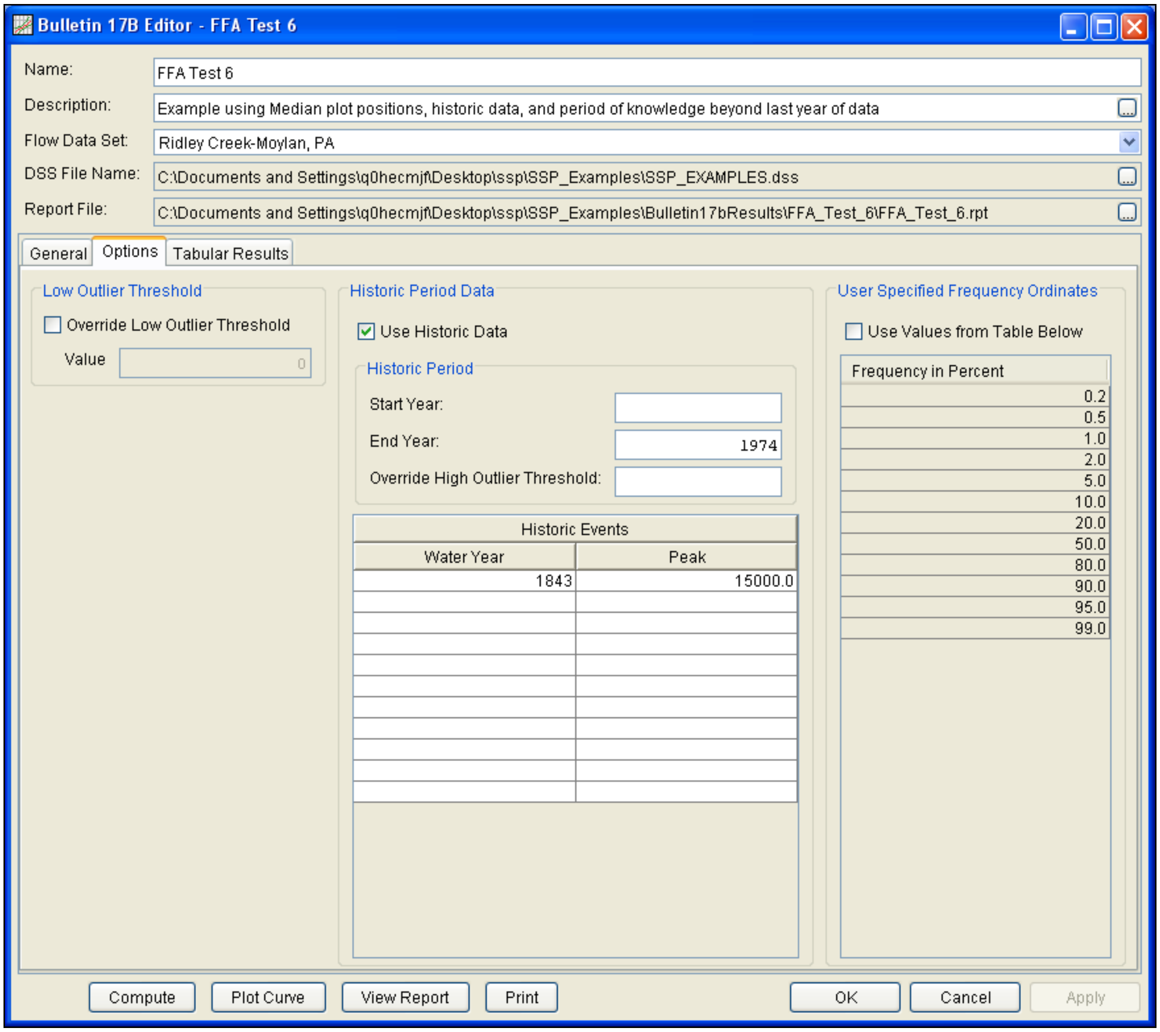


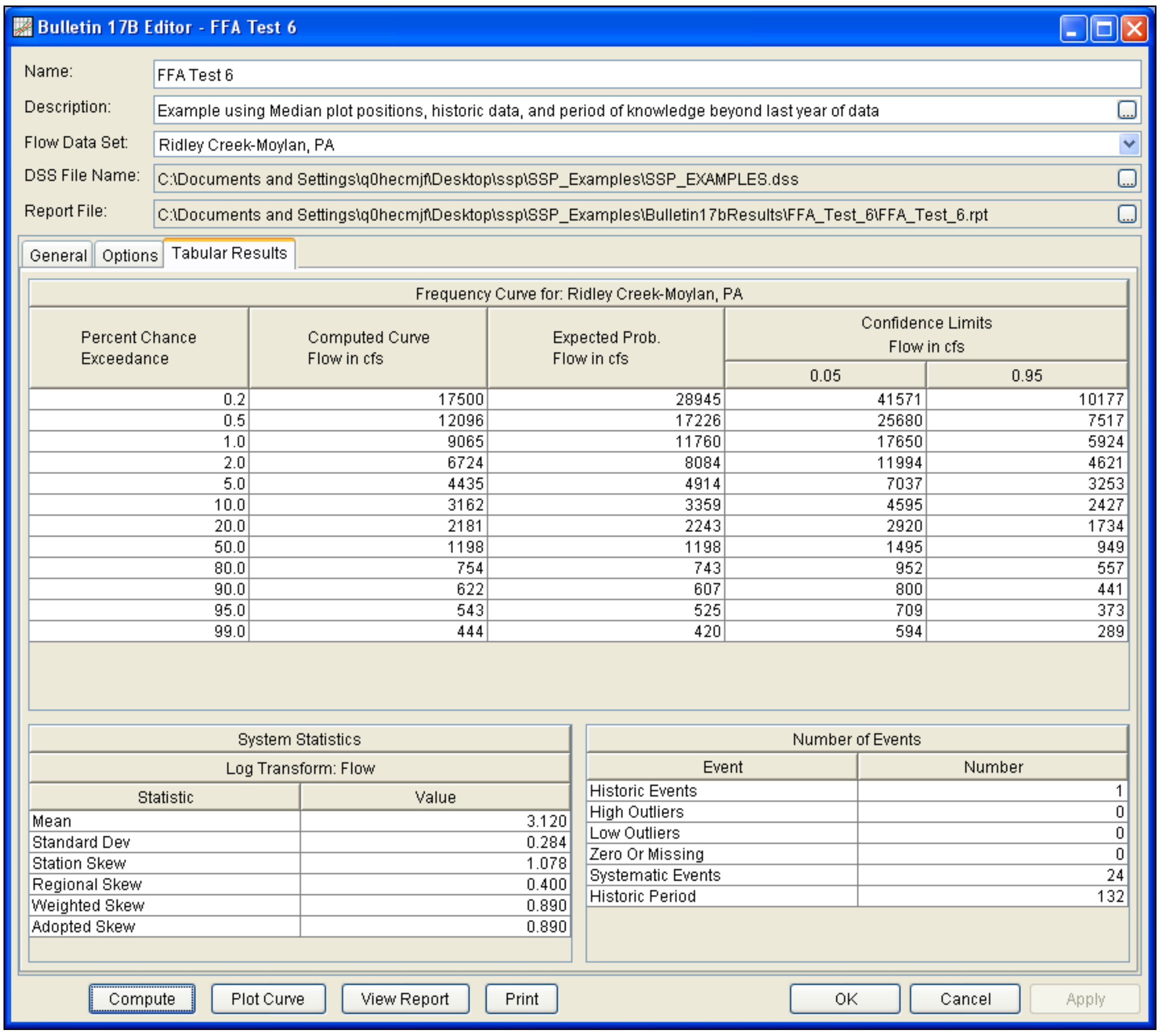
Figure B-40. Bulletin 17B Analysis Editor with Options Tab Shown for Test Example 6.

As shown in Figure B-40, the **Historic Period Data** option has been selected to reflect a historical flood event of 15,000 cfs in 1843 and an analysis period from 1843 to 1974. Historic data is used to account for historic flood events large enough to be relevant to the analysis and not contained in the systematic data record. The additional information provided by historic data can improve the flood frequency analysis, especially when the data collection period for a given area is relatively short. Information for a **Historic Flood Peak** has been entered to account for a peak flow of 15,000 cfs in the 1843 water year. The Historic Period **Start Year** has been left blank. By default this value will be the earliest year found in the historic flood peak data or the systematic record. Therefore for this example, 1843 will automatically be used for the Start Year of the Historic Period. An **End**

Year of 1974 has been entered. The systematic record for the gage ended in 1955, however when this analysis was performed in 1974, no other flood peaks of consequence had been observed between 1955 and 1974. Therefore, 1974 is set as the End Year for the historic period analysis.

Other features on this tab include the **Low Outlier Threshold** and the option to override the default **Frequency Ordinates**. Neither option is selected in this example.

Once all of the General and Optional settings are set or selected, the user can press the **Compute** button to perform the analysis. Once the computations have been completed a message window will open stating **Compute Complete.** Close this window and then select the **Tabular Results** tab from the analysis window. The analysis window should look Figure B-41.



Frequency Curve for: Ridley Creek-Moylan, PA

Percent Chance Exceedance	Computed Curve Flow in cfs	Expected Prob. Flow in cfs	Confidence Limits Flow in cfs 0.05	Confidence Limits Flow in cfs 0.95
0.2	17500	28945	41571	10177
0.5	12096	17226	25680	7517
1.0	9065	11760	17650	5924
2.0	6724	8084	11994	4621
5.0	4435	4914	7037	3253
10.0	3162	3359	4595	2427
20.0	2181	2243	2920	1734
50.0	1198	1198	1495	949
80.0	754	743	952	557
90.0	622	607	800	441
95.0	543	525	709	373
99.0	444	420	594	289

System Statistics — Log Transform: Flow

Statistic	Value
Mean	3.120
Standard Dev	0.284
Station Skew	1.078
Regional Skew	0.400
Weighted Skew	0.890
Adopted Skew	0.890

Number of Events

Event	Number
Historic Events	1
High Outliers	0
Low Outliers	0
Zero Or Missing	0
Systematic Events	24
Historic Period	132

Figure B-41. Bulletin 17B Editor with the Results Tab Selected for Test Example 6.

As shown in Figure B-41, the Frequency Curve table contains the following results:

Percent Chance Exceedance

Computed Curve (Log-Pearson III results)

Expected Probability Curve

Confidence Limits (5% and 95% chance exceedance curves)

On the bottom left-hand side of the results tab is a table of System Statistics for the observed station data (mean, standard deviation, station skew) and regional adjustment (regional skew, weighted skew, and adopted skew). Also on the bottom right-hand side of the results tab is a table of Number of Events showing the number of historic events used in the analysis, number of high outliers found, number of low outliers, number of zero or missing data years, number of systematic events in the gage record, and the historic record length (if historic data was entered).

This example reports one historical flood event, and a historical period of 132 years, between 1843 and 1974. The reported statistics reflect the use of the historical data adjustment outlined in Bulletin 17B Appendix 6. The report file (described below) shows the initial computation of the statistics and frequency curve before the historical data was used, and the resulting statistics and frequency curve after the historical data is taken into account.

In addition to the tabular results, a graphical plot of the computed frequency curves can be obtained by pressing the **Plot Curve** button at the bottom of the analysis window. A plot of the results for this test example is shown in Figure B-42.

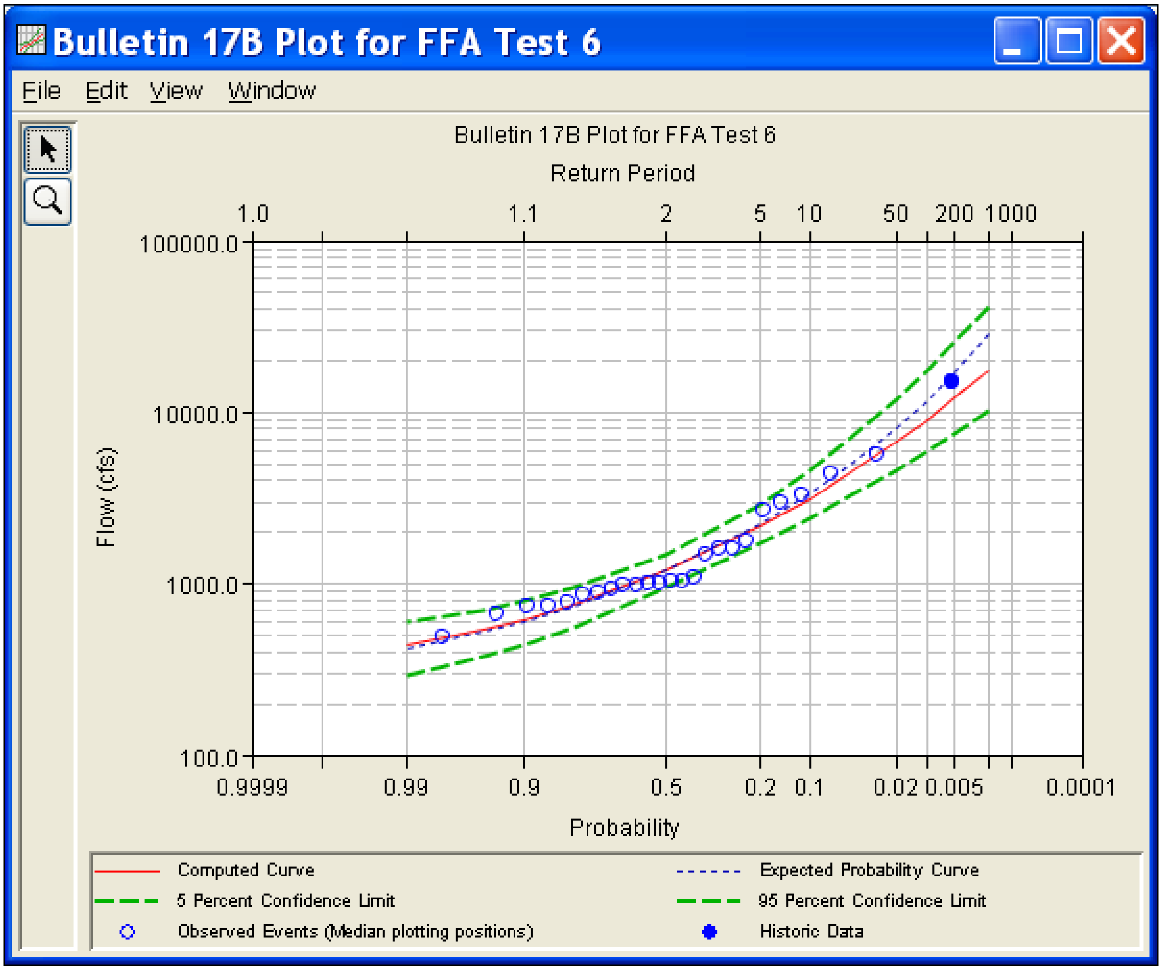


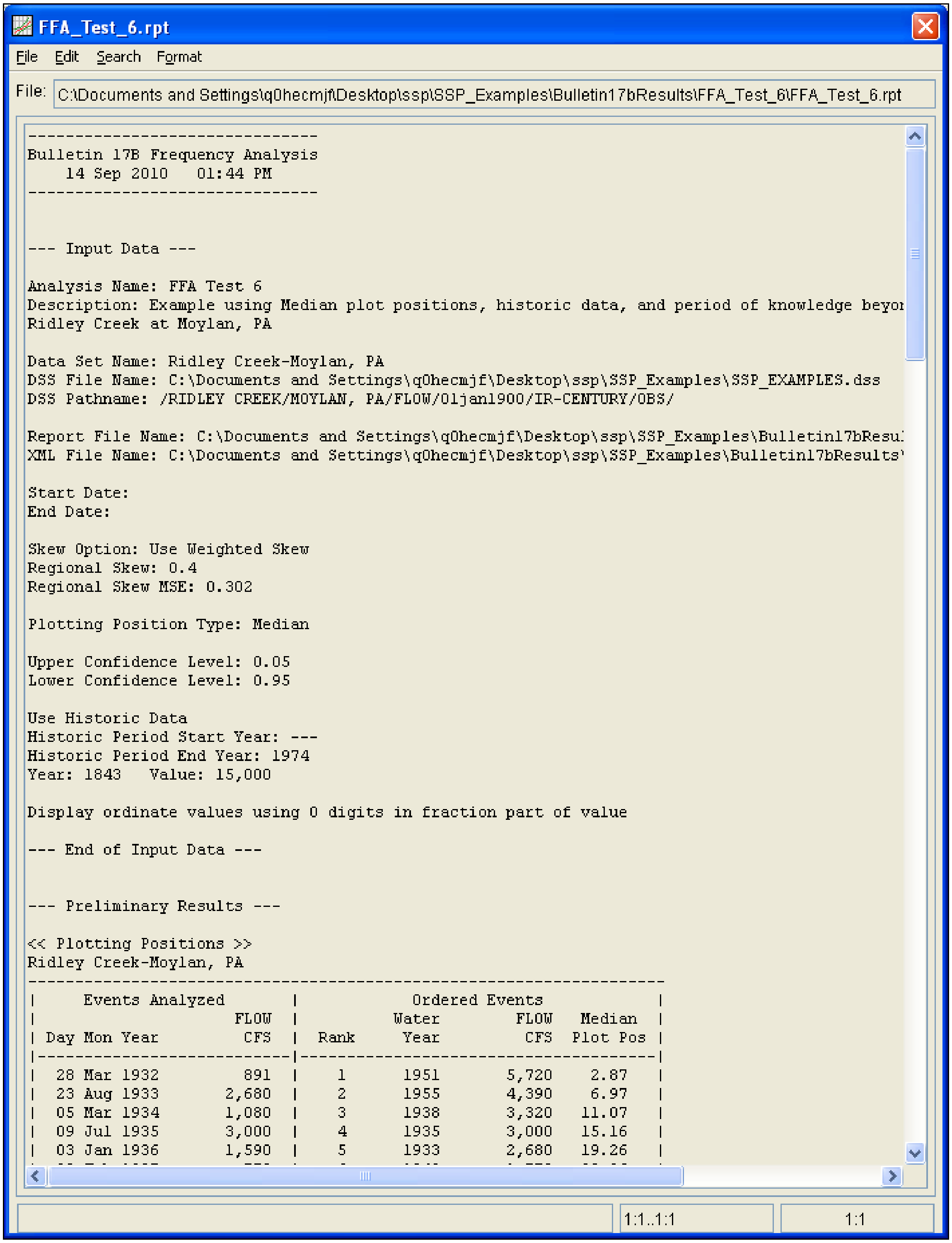
Figure B-42. Plot of the Frequency Curve Results for Test Example 6.

The tabular and graphical results can be sent to the printer or the windows clipboard for transfer into another piece of software. To print the tabular results, select **Print** from the bottom of the analysis window. To send the tabular results to the windows clipboard, highlight the data you want to send to the clipboard and then press the Control-C key sequence. To print the graphical results, first bring up the graphical plot and then select **Print** from the **File** menu. To send the graphic to the windows clipboard, select **Copy to Clipboard** from the **File** menu.

In addition to the tabular and graphical results, there is a report file that shows the order in which the calculations were performed. To review the report file, press the **View Report** button at the bottom of the analysis window. When this button is selected a text viewer will open the report file and display it on the screen. Shown in Figure B-43 is the report file for Test Example 6.

The report file contains a listing of the input data, preliminary results, outlier and historical data tests, additional calculations needed, and

the final frequency curve results. Different types and amounts of information will show up in the report file depending on the data and the options that have been selected for the analysis.



FFA_Test_6.rpt

File Edit Search Format

File: C:\Documents and Settings\q0hecmjf\Desktop\ssp\SSP_Examples\Bulletin17bResults\FFA_Test_6\FFA_Test_6.rpt

```
------------------------------
Bulletin 17B Frequency Analysis
    14 Sep 2010   01:44 PM
------------------------------


--- Input Data ---

Analysis Name: FFA Test 6
Description: Example using Median plot positions, historic data, and period of knowledge beyo
Ridley Creek at Moylan, PA

Data Set Name: Ridley Creek-Moylan, PA
DSS File Name: C:\Documents and Settings\q0hecmjf\Desktop\ssp\SSP_Examples\SSP_EXAMPLES.dss
DSS Pathname: /RIDLEY CREEK/MOYLAN, PA/FLOW/01jan1900/IR-CENTURY/OBS/

Report File Name: C:\Documents and Settings\q0hecmjf\Desktop\ssp\SSP_Examples\Bulletin17bResu
XML File Name: C:\Documents and Settings\q0hecmjf\Desktop\ssp\SSP_Examples\Bulletin17bResults

Start Date:
End Date:

Skew Option: Use Weighted Skew
Regional Skew: 0.4
Regional Skew MSE: 0.302

Plotting Position Type: Median

Upper Confidence Level: 0.05
Lower Confidence Level: 0.95

Use Historic Data
Historic Period Start Year: ---
Historic Period End Year: 1974
Year: 1843   Value: 15,000

Display ordinate values using 0 digits in fraction part of value

--- End of Input Data ---


--- Preliminary Results ---

<< Plotting Positions >>
Ridley Creek-Moylan, PA
-------------------------------------------------------------------
|     Events Analyzed       |          Ordered Events              |
|                     FLOW  |          Water          FLOW  Median |
| Day Mon Year         CFS  | Rank     Year            CFS Plot Pos |
|---------------------------|--------------------------------------|
|  28 Mar 1932         891  |   1      1951          5,720    2.87  |
|  23 Aug 1933       2,680  |   2      1955          4,390    6.97  |
|  05 Mar 1934       1,080  |   3      1938          3,320   11.07  |
|  09 Jul 1935       3,000  |   4      1935          3,000   15.16  |
|  03 Jan 1936       1,590  |   5      1933          2,680   19.26  |
```

1:1..1:1 1:1

Figure B-43. HEC-SSP Report File for Test Example 6.

Example 7: Analyzing Stage Data

This example demonstrates how to use the General Frequency analysis to analyze stage data. The data for this example is annual maximum stage data for a reservoir. The period of record used for this example is from 1948 to 2004. To view the data, right-click on the data record labeled "**Reservoir Stage**" in the study explorer and then select **Tabulate**. The data will appear as shown in Figure B-44.

//RESERVOIR/STAGE/01JAN1948 - 01JAN2004/IR-CENTUR...

File Edit View

Ordinate	Date / Time	RESERVOIR STAGE OBSERVED
Units		feet
Type		INST-VAL
1	01 Jan 1948, 12:00	631.88
2	01 Jan 1949, 12:00	630.17
3	01 Jan 1950, 12:00	647.47
4	01 Jan 1951, 12:00	631.82
5	01 Jan 1952, 12:00	632.88
6	01 Jan 1953, 12:00	655.37
7	01 Jan 1954, 12:00	647.63
8	01 Jan 1955, 12:00	638.09
9	01 Jan 1956, 12:00	640.65
10	01 Jan 1957, 12:00	634.51
11	01 Jan 1958, 12:00	634.49
12	01 Jan 1959, 12:00	637.49
13	01 Jan 1960, 12:00	632.36
14	01 Jan 1961, 12:00	638.02
15	01 Jan 1962, 12:00	630.59
16	01 Jan 1963, 12:00	626.77
17	01 Jan 1964, 12:00	630.28
18	01 Jan 1965, 12:00	630.12
19	01 Jan 1966, 12:00	630.79
20	01 Jan 1967, 12:00	637.63
21	01 Jan 1968, 12:00	632.21
22	01 Jan 1969, 12:00	632.10
23	01 Jan 1970, 12:00	623.00
24	01 Jan 1971, 12:00	630.40
25	01 Jan 1972, 12:00	658.40
26	01 Jan 1973, 12:00	630.80
27	01 Jan 1974, 12:00	631.60
28	01 Jan 1975, 12:00	638.40
29	01 Jan 1976, 12:00	633.60
30	01 Jan 1977, 12:00	635.60
31	01 Jan 1978, 12:00	640.80
32	01 Jan 1979, 12:00	637.20
33	01 Jan 1980, 12:00	630.72
34	01 Jan 1981, 12:00	632.78
35	01 Jan 1982, 12:00	635.37
36	01 Jan 1983, 12:00	631.42
37	01 Jan 1984, 12:00	638.84

Figure B-44. Tabulation of the Peak Stage Data for Example 7.

To plot the data for this example, right-click on the data record and then select **Plot**. A plot of the data will appear as shown in Figure B-45.

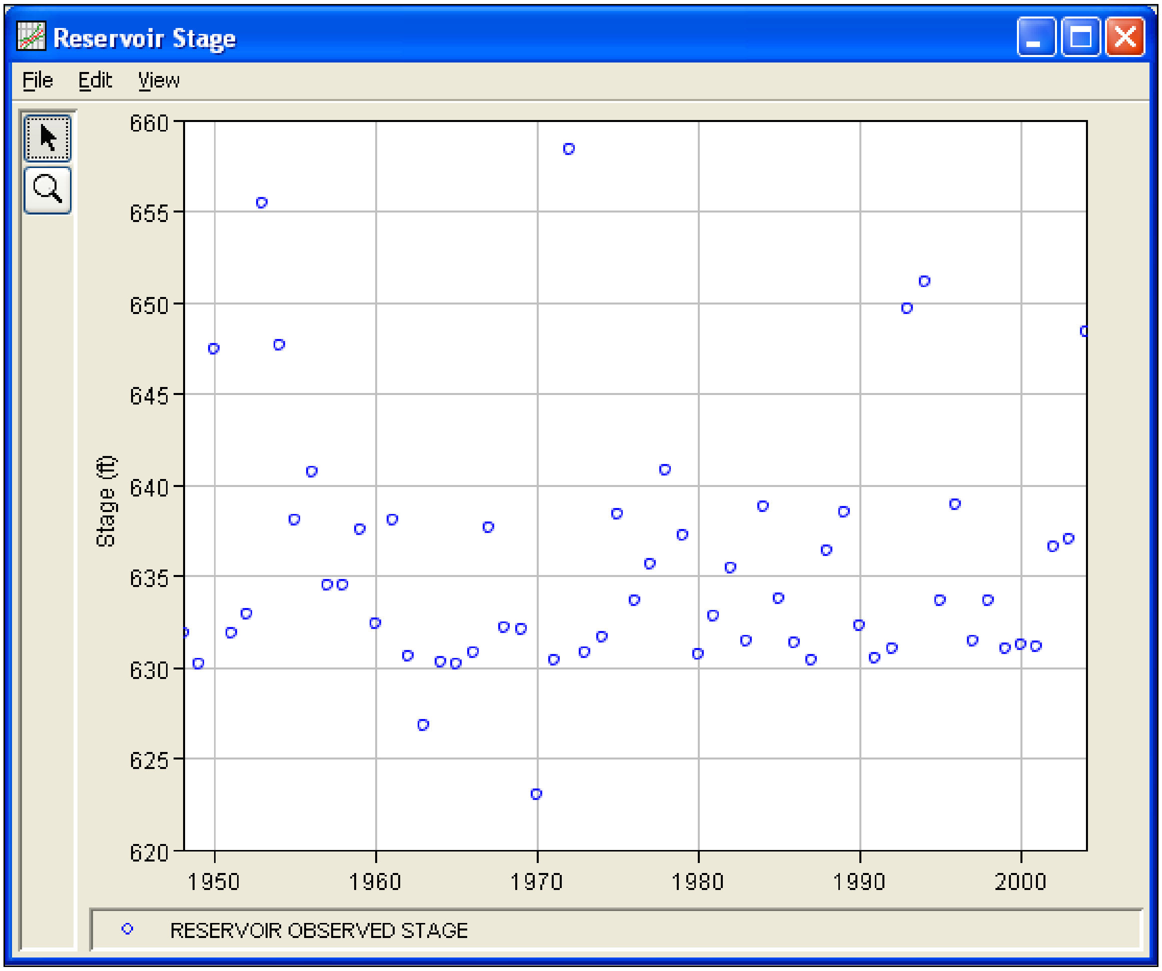


Figure B-45. Plot of the Reservoir Stage Data.

A General Frequency analysis has been developed for this example. To open the General Frequency analysis editor for Test Example 7, either double-click on the analysis labeled **Stage Analysis Test 7** from the study explorer, or from the **Analysis** menu select open, then select **Stage Analysis Test 7** from the list of available analyses. When test 7 is opened, the General Frequency analysis editor will appear as shown in Figure B-46. For this analysis, the **Do Not Use Log Transform** option was selected, the **Weibull** plotting position method was selected, the default **Confidence Limits** were selected, and no modification was made to the time window.

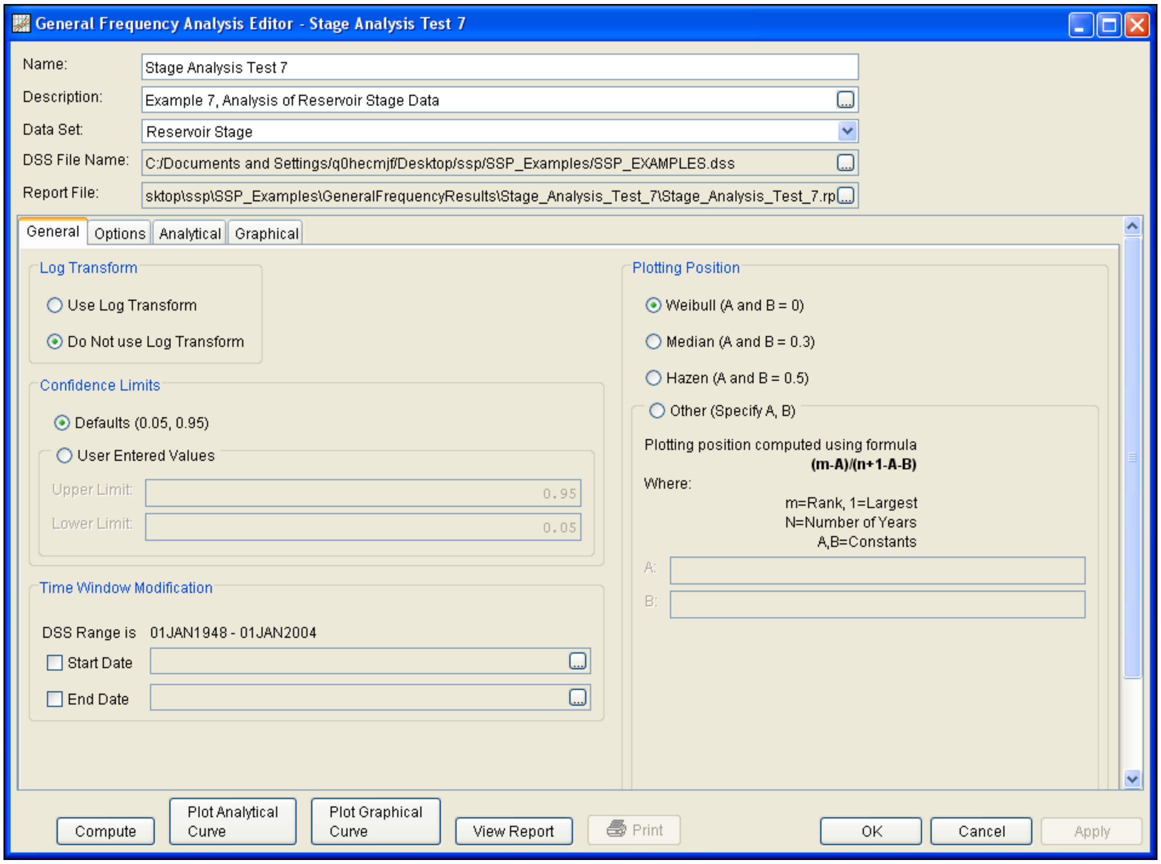


Figure B-46. General Frequency Analysis Editor for Test Example 7.

Shown in Figure B-47 is the General Frequency analysis editor with the **Options Tab** selected. Features on this tab include the **Low Outlier Threshold**, adding **Historic Date** to the analysis, an option to override the default **Frequency Ordinates**, and **Output Labeling**. The 0.1 percent frequency ordinate was added to the **User Specified Frequency Ordinates** table.

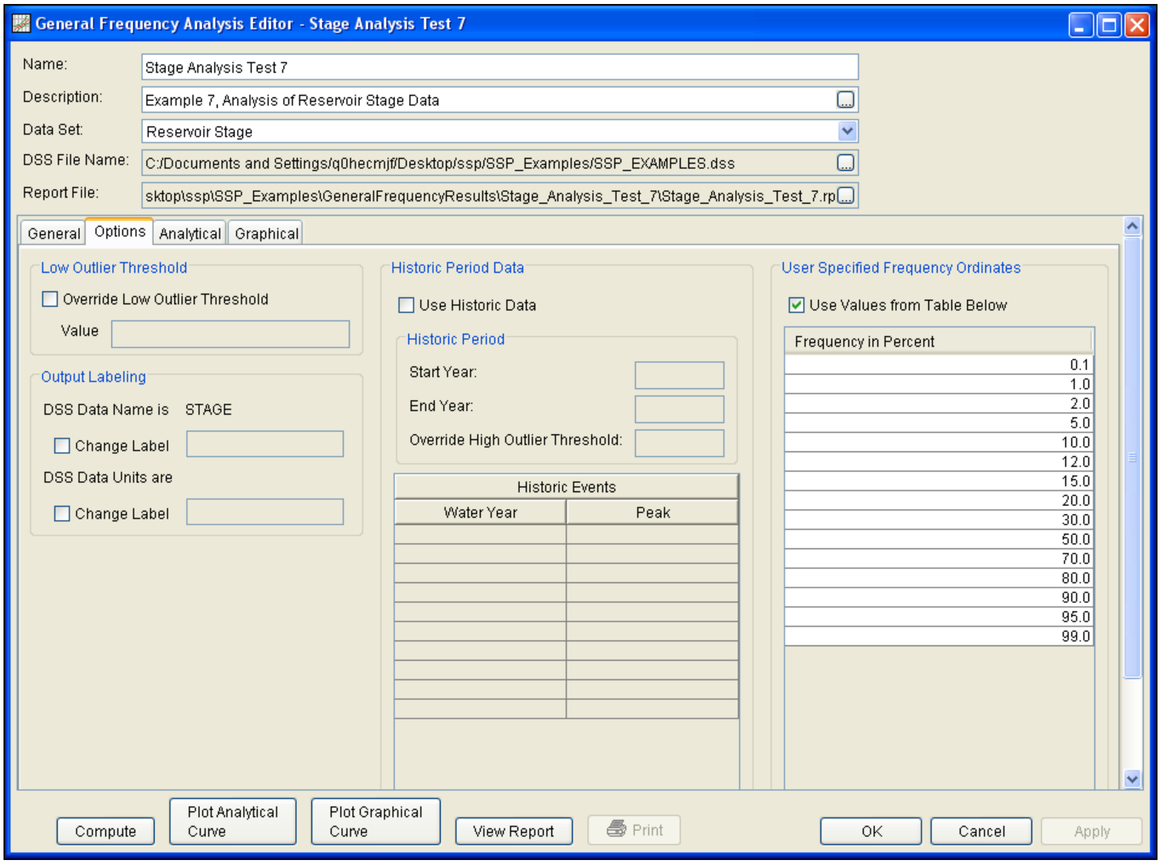


Figure B-47. General Frequency Analysis Editor with Options Tab Shown for Test Example 7.

Once all of the General and Optional settings are set or selected, the user can choose to perform an Analytical or Graphical analysis. In this example, a graphical analysis was performed on the peak stage data. Shown in Figure B-48 is the **Graphical** tab. The frequency curve was entered manually into the **User-Defined Graphical Curve** table. When the **Compute** button is pressed, the program plots the graphical frequency curve along with the annual maximum peak stage values.

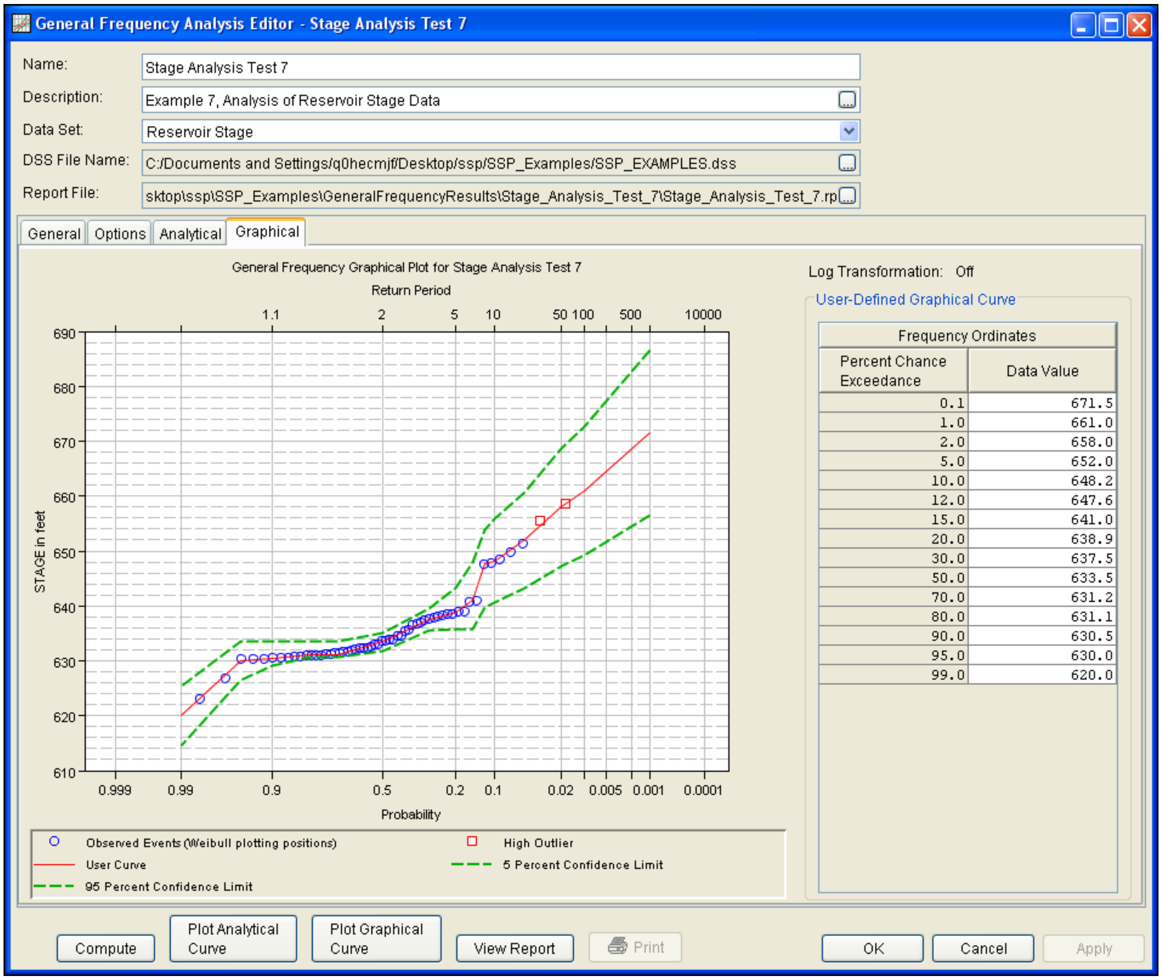


Figure B-48. General Frequency Graphical Tab Shown for Test Example 7.

In addition to the table and plot available on the Graphical tab, a plot of the graphical frequency curves can be obtained by pressing the **Plot Graphical Curve** button at the bottom of the analysis window. A plot of the results for this test example is shown in Figure B-49.

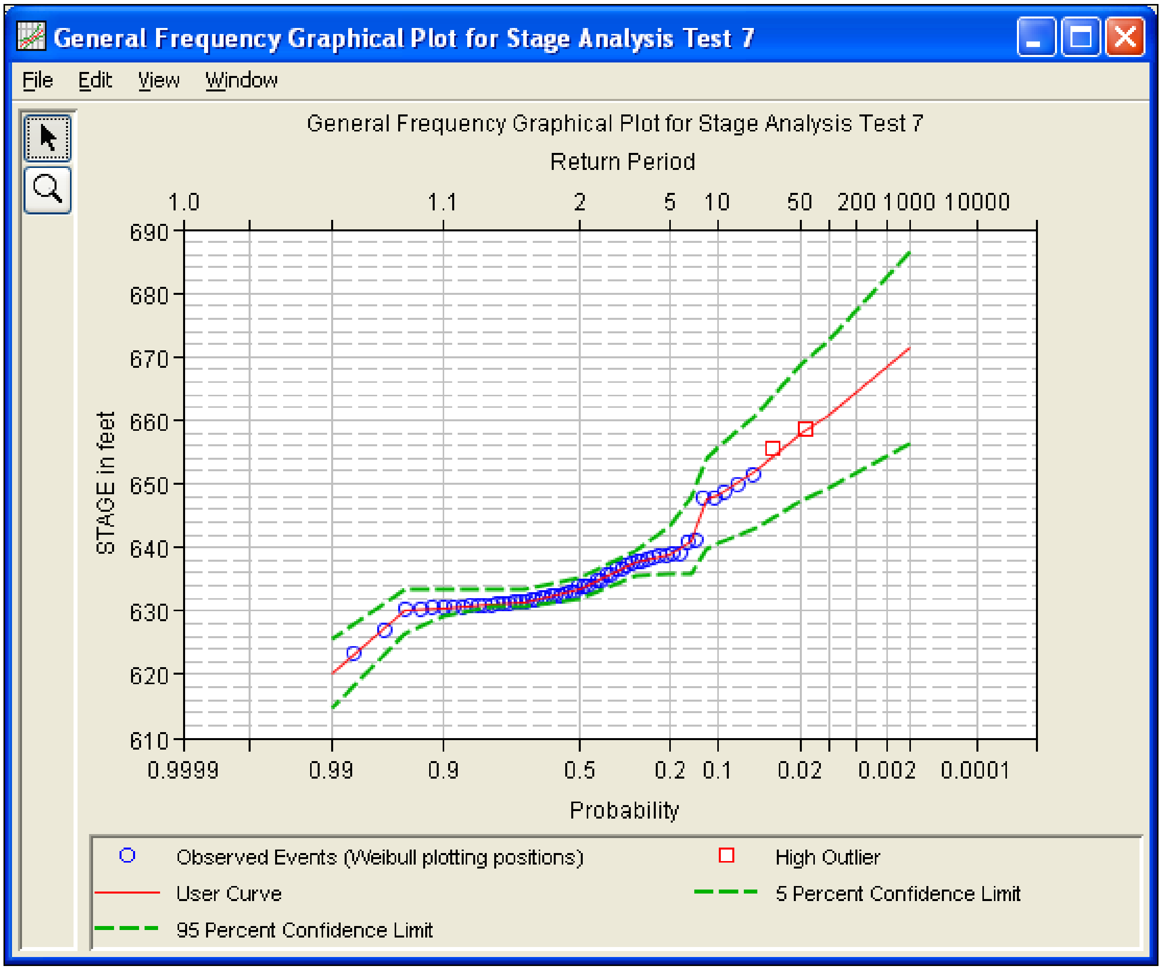
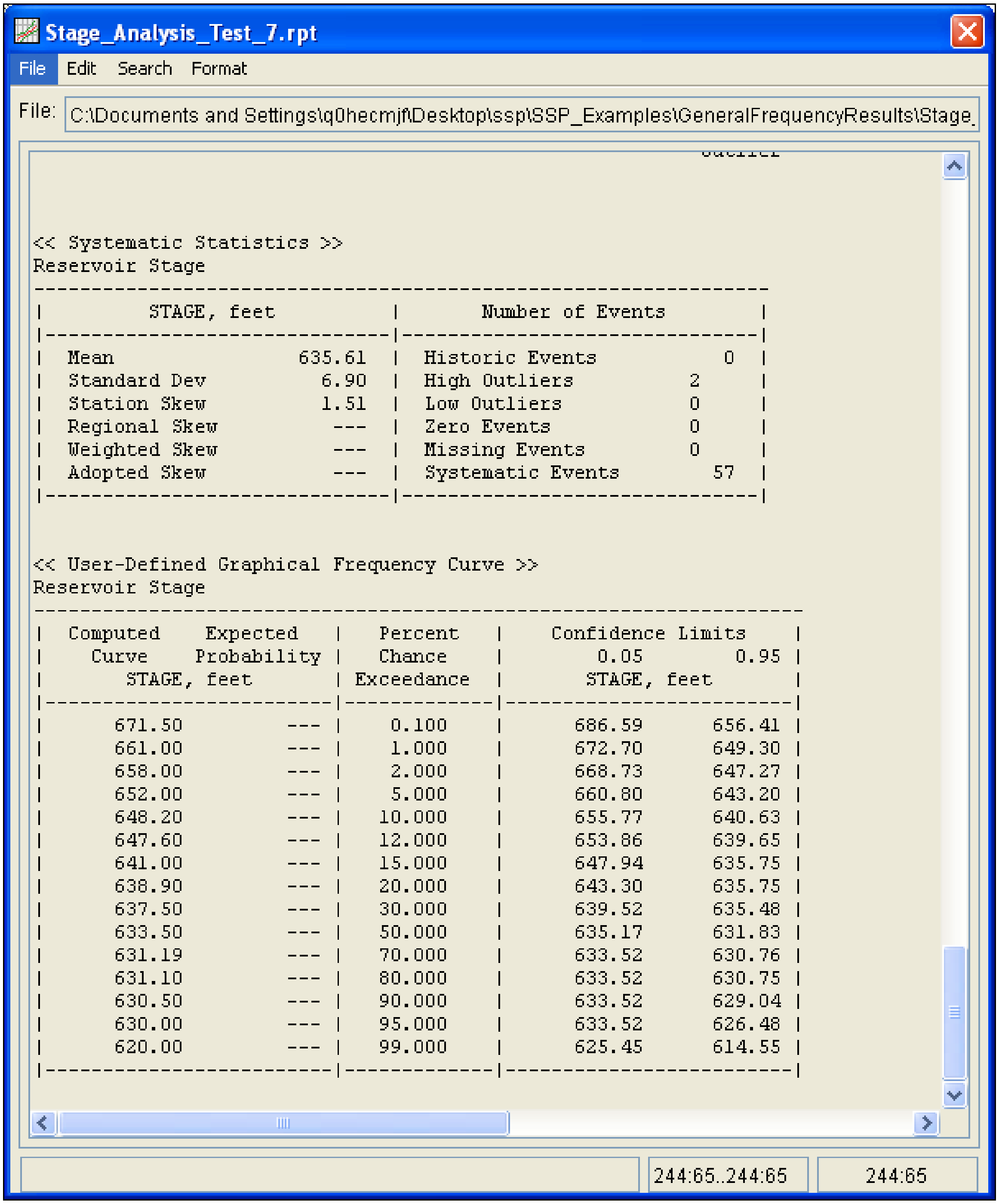


Figure B-49. Plot of the Frequency Curve Results for Test Example 7.

Graphical results can be sent to the printer or the windows clipboard for transfer into another piece of software. To print the graphical results, first bring up the graphical plot and then select **Print** from the **File** menu. To send the graphic to the windows clipboard, select **Copy to Clipboard** from the **File** menu.

In addition to the tabular and graphical results, there is a report file that shows the order in which the calculations were performed. To review the report file, press the **View Report** button at the bottom of the analysis window. When this button is selected a text viewer will open the report file and display it on the screen. Shown in Figure B-50 is the report file for Test Example 7.

The report file contains a listing of the input data, preliminary results, outlier and historical data tests, additional calculations needed, the final computed frequency curve results, and the user-defined graphical frequency curve. Different types and amounts of information will show up in the report file depending on the data and the options that have been selected for the analysis.



Stage_Analysis_Test_7.rpt

File Edit Search Format

File: C:\Documents and Settings\q0hecmjf\Desktop\ssp\SSP_Examples\GeneralFrequencyResults\Stage_

<< Systematic Statistics >>
Reservoir Stage

STAGE, feet		Number of Events	
Mean	635.61	Historic Events	0
Standard Dev	6.90	High Outliers	2
Station Skew	1.51	Low Outliers	0
Regional Skew	---	Zero Events	0
Weighted Skew	---	Missing Events	0
Adopted Skew	---	Systematic Events	57

<< User-Defined Graphical Frequency Curve >>
Reservoir Stage

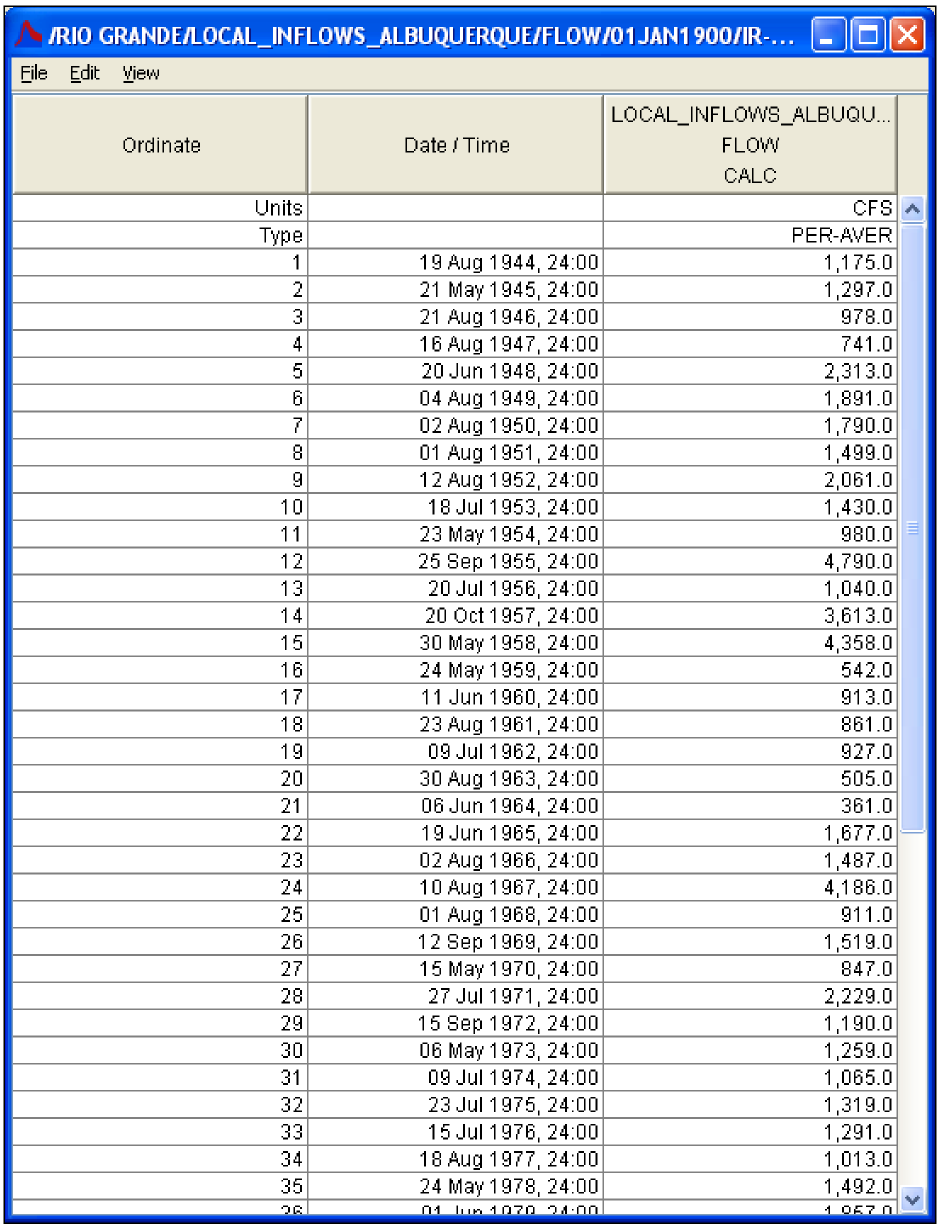
Computed Curve STAGE, feet	Expected Probability STAGE, feet	Percent Chance Exceedance	Confidence Limits 0.05 STAGE, feet	Confidence Limits 0.95 STAGE, feet
671.50	---	0.100	686.59	656.41
661.00	---	1.000	672.70	649.30
658.00	---	2.000	668.73	647.27
652.00	---	5.000	660.80	643.20
648.20	---	10.000	655.77	640.63
647.60	---	12.000	653.86	639.65
641.00	---	15.000	647.94	635.75
638.90	---	20.000	643.30	635.75
637.50	---	30.000	639.52	635.48
633.50	---	50.000	635.17	631.83
631.19	---	70.000	633.52	630.76
631.10	---	80.000	633.52	630.75
630.50	---	90.000	633.52	629.04
630.00	---	95.000	633.52	626.48
620.00	---	99.000	625.45	614.55

244:65..244:65 244:65

Figure B-50. Report File for Test Example 7.

Example 8: Using User-Adjusted Statistics

This example demonstrates how to use the General Frequency analysis and enter user-adjusted statistics. The data for this example is from an analysis that computed local runoff for the Rio Grande at Albuquerque. The data includes unregulated daily average flows generated by rainfall-runoff from areas downstream of upstream reservoirs. The period of record used for this example is from 1944 to 2000. To view the data, right-click on the data record labeled "**Rio Grande at Alb Local Runoff**" in the study explorer and then select **Tabulate**. The data will appear as shown in Figure B-51.



/RIO GRANDE/LOCAL_INFLOWS_ALBUQUERQUE/FLOW/01JAN1900/IR-...

File Edit View

Ordinate	Date / Time	LOCAL_INFLOWS_ALBUQU... FLOW CALC
Units		CFS
Type		PER-AVER
1	19 Aug 1944, 24:00	1,175.0
2	21 May 1945, 24:00	1,297.0
3	21 Aug 1946, 24:00	978.0
4	16 Aug 1947, 24:00	741.0
5	20 Jun 1948, 24:00	2,313.0
6	04 Aug 1949, 24:00	1,891.0
7	02 Aug 1950, 24:00	1,790.0
8	01 Aug 1951, 24:00	1,499.0
9	12 Aug 1952, 24:00	2,061.0
10	18 Jul 1953, 24:00	1,430.0
11	23 May 1954, 24:00	980.0
12	25 Sep 1955, 24:00	4,790.0
13	20 Jul 1956, 24:00	1,040.0
14	20 Oct 1957, 24:00	3,613.0
15	30 May 1958, 24:00	4,358.0
16	24 May 1959, 24:00	542.0
17	11 Jun 1960, 24:00	913.0
18	23 Aug 1961, 24:00	861.0
19	09 Jul 1962, 24:00	927.0
20	30 Aug 1963, 24:00	505.0
21	06 Jun 1964, 24:00	361.0
22	19 Jun 1965, 24:00	1,677.0
23	02 Aug 1966, 24:00	1,487.0
24	10 Aug 1967, 24:00	4,186.0
25	01 Aug 1968, 24:00	911.0
26	12 Sep 1969, 24:00	1,519.0
27	15 May 1970, 24:00	847.0
28	27 Jul 1971, 24:00	2,229.0
29	15 Sep 1972, 24:00	1,190.0
30	06 May 1973, 24:00	1,259.0
31	09 Jul 1974, 24:00	1,065.0
32	23 Jul 1975, 24:00	1,319.0
33	15 Jul 1976, 24:00	1,291.0
34	18 Aug 1977, 24:00	1,013.0
35	24 May 1978, 24:00	1,492.0

Figure B-51. Tabulation of the Peak Flow Data for Example 8.

To plot the data for this example, right-click on the data record and then select **Plot**. A plot of the data will appear as shown in Figure B-52.

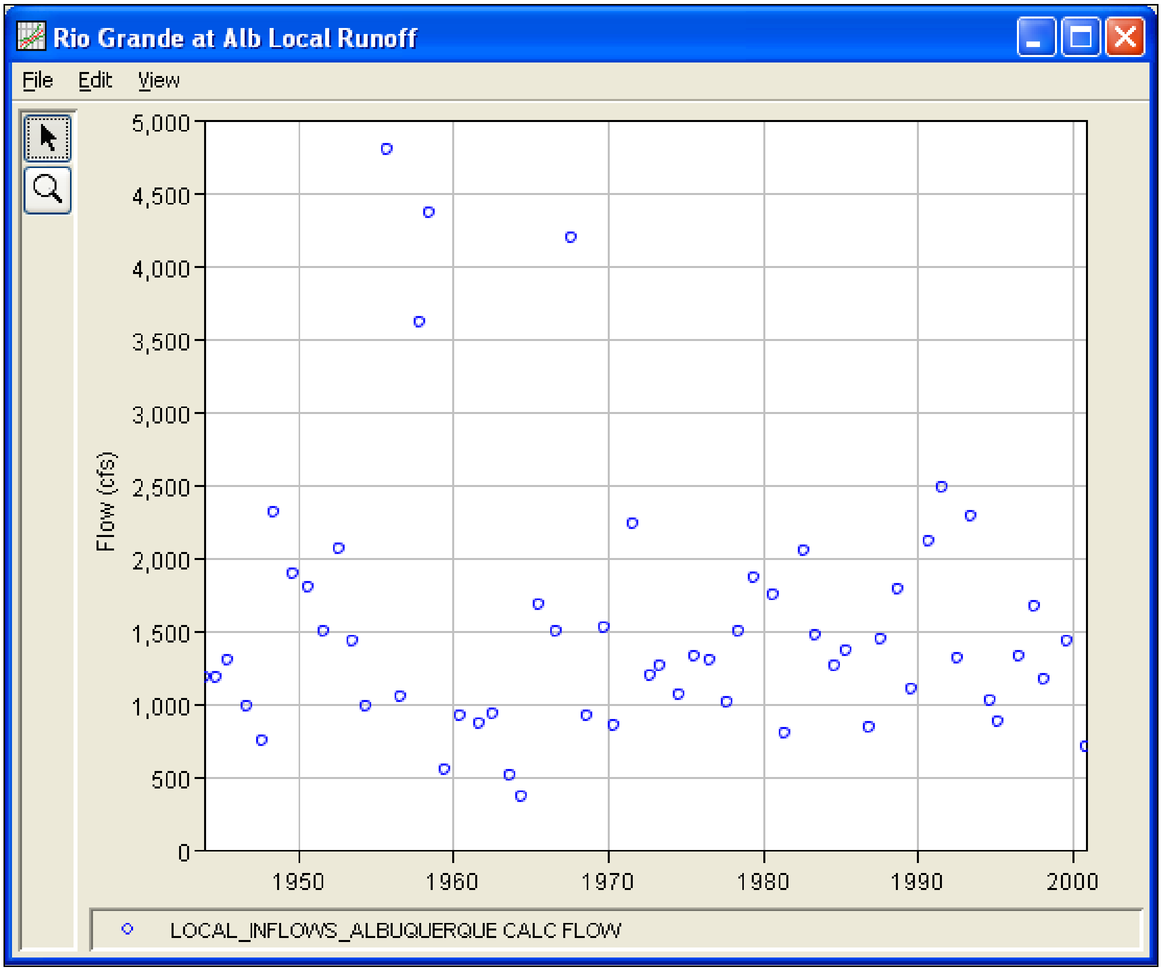


Figure B-52. Plot of Data for Example 8.

A General Frequency analysis has been developed for this example. To open the General Frequency analysis editor for Test Example 8, either double-click on the analysis labeled **Local Runoff at Alb Test 8** from the study explorer, or from the **Analysis** menu select open, then select **Local Runoff at Alb Test 8** from the list of available analyses. When test 8 is opened, the General Frequency analysis editor will appear as shown in Figure B-53.

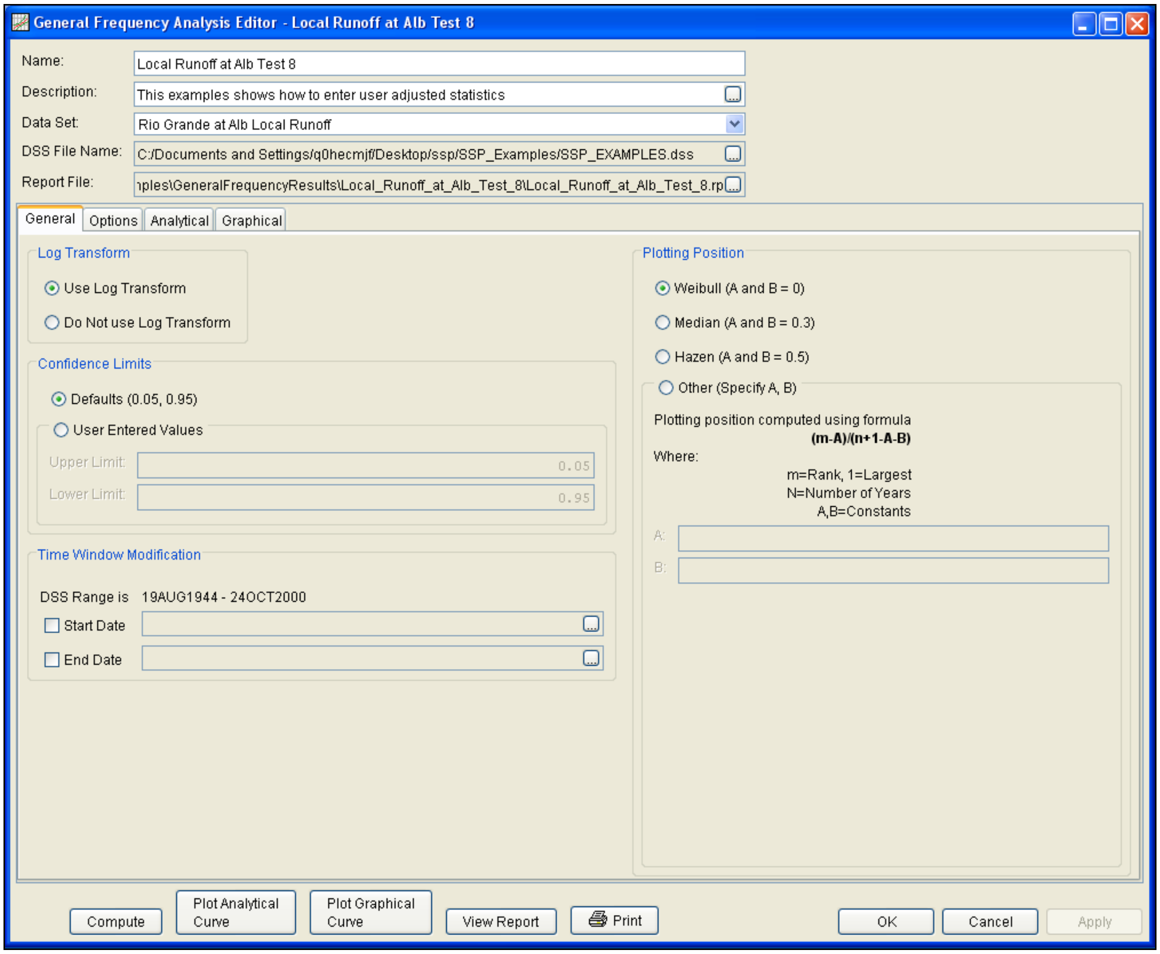


Figure B-53. General Frequency Analysis Editor for Test Example 8.

Shown in Figure B-53 are the general settings that were used to perform this frequency analysis. For this analysis, the **Use Log Transform** option was selected, the **Weibull** plotting position method was selected, the default **Confidence Limits** were selected, and no modification was made to the **Time Window**.

Shown in Figure B-54 is the General Frequency analysis editor with the **Options Tab** selected. Features on this tab include the **Low Outlier Threshold**, an option to use **Historic Data**, an option to override the default **Frequency Ordinates**, and **Output Labeling**. All defaults settings were selected for this example.

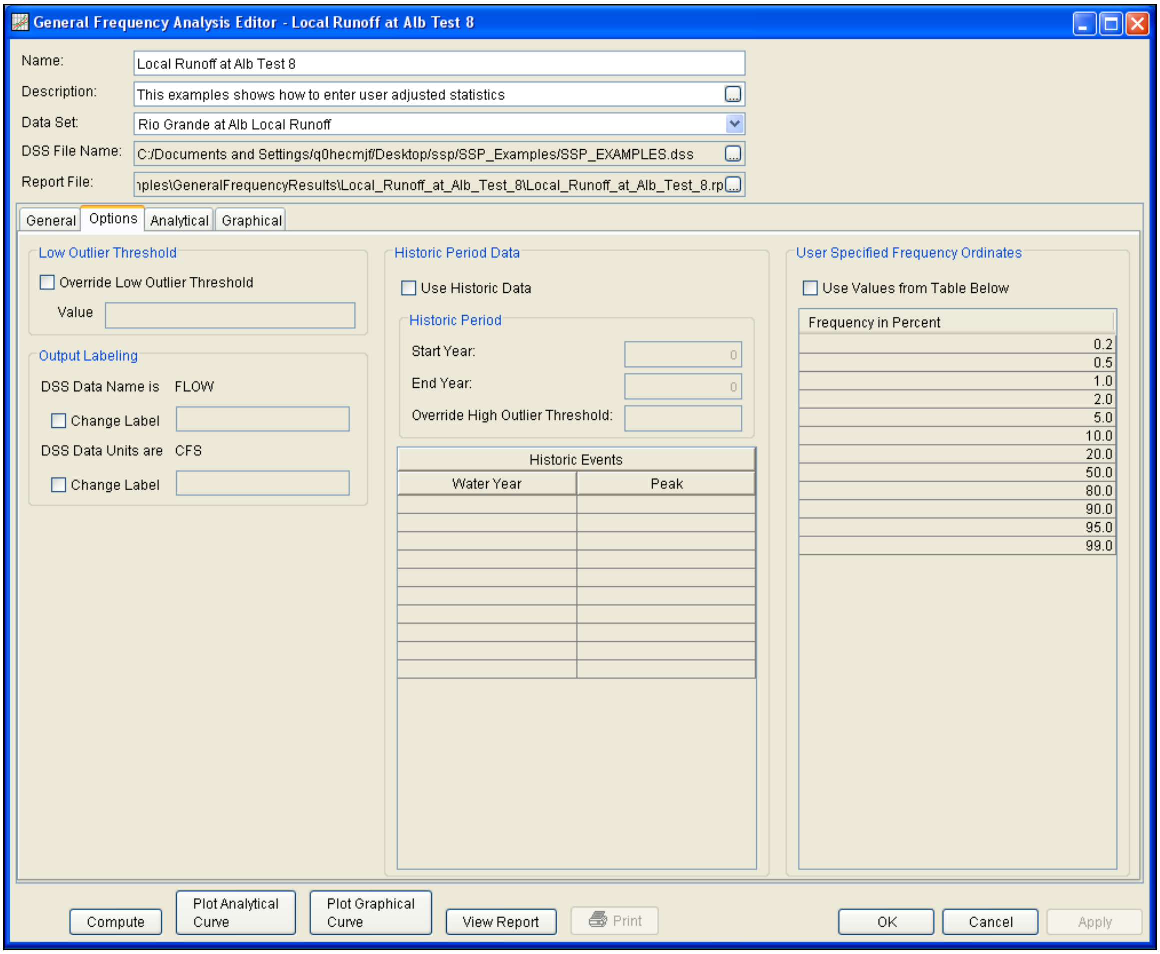


Figure B-54. General Frequency Analysis Editor with Options Tab Shown for Test Example 8.

Once all of the General and Optional settings are set or selected, the user can choose to perform an Analytical or Graphical analysis. In this example, an analytical analysis was performed. Shown in Figure B-55 is the **Settings** tab for the analytical analysis. As shown, the distribution selected for this example is LogPearsonIII. The **Skew** option was set to **Use Station Skew** and the **Do Not Compute Excepted Probability** option was selected.

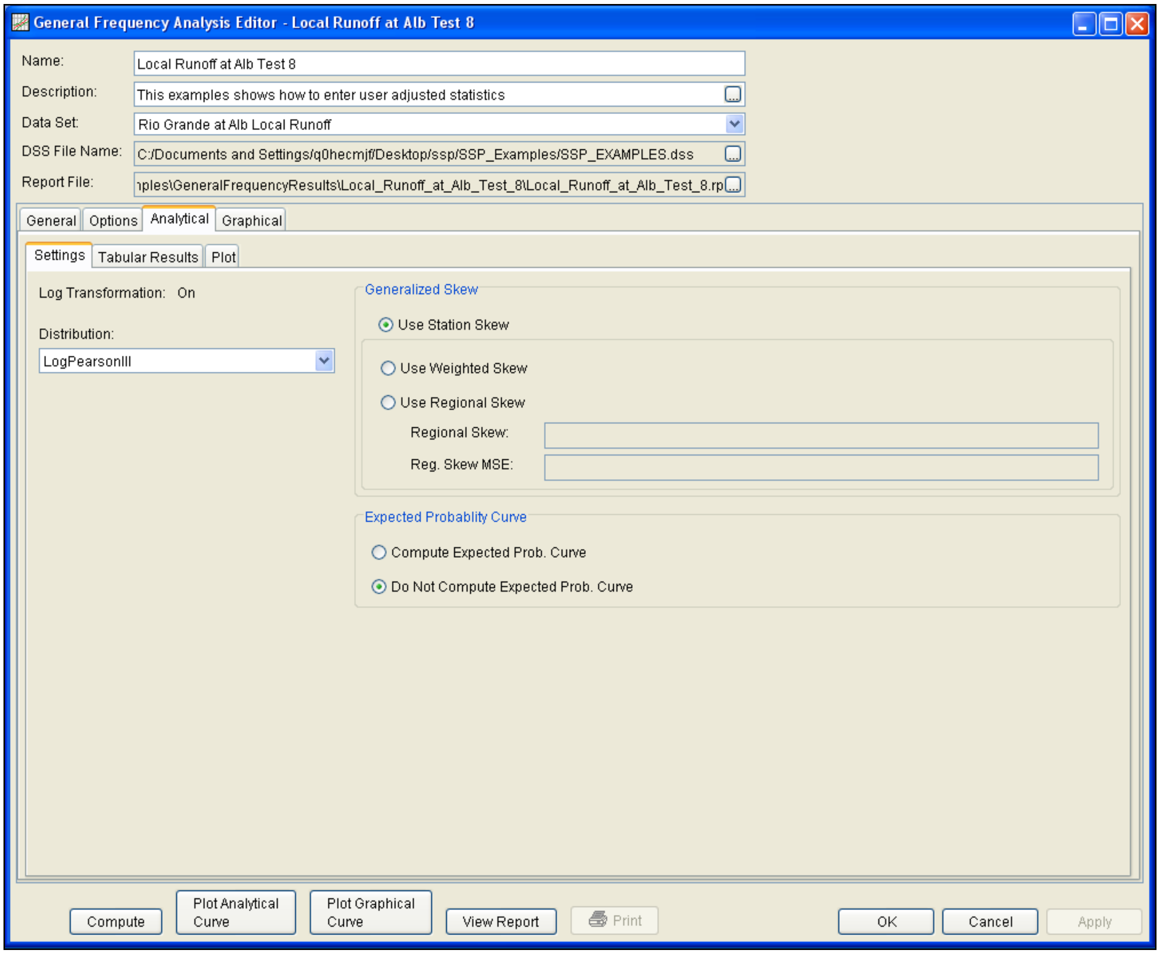


Figure B-55. General Frequency Analysis Editor with Settings Tab Shown for Test Example 8.

Press the **Compute** button to perform the analysis. Once the computations have been completed, a message window will open stating **Compute Complete.** Close this window and then select the **Plot** tab within the analytical analysis. The analytical plot window should look Figure B-56.

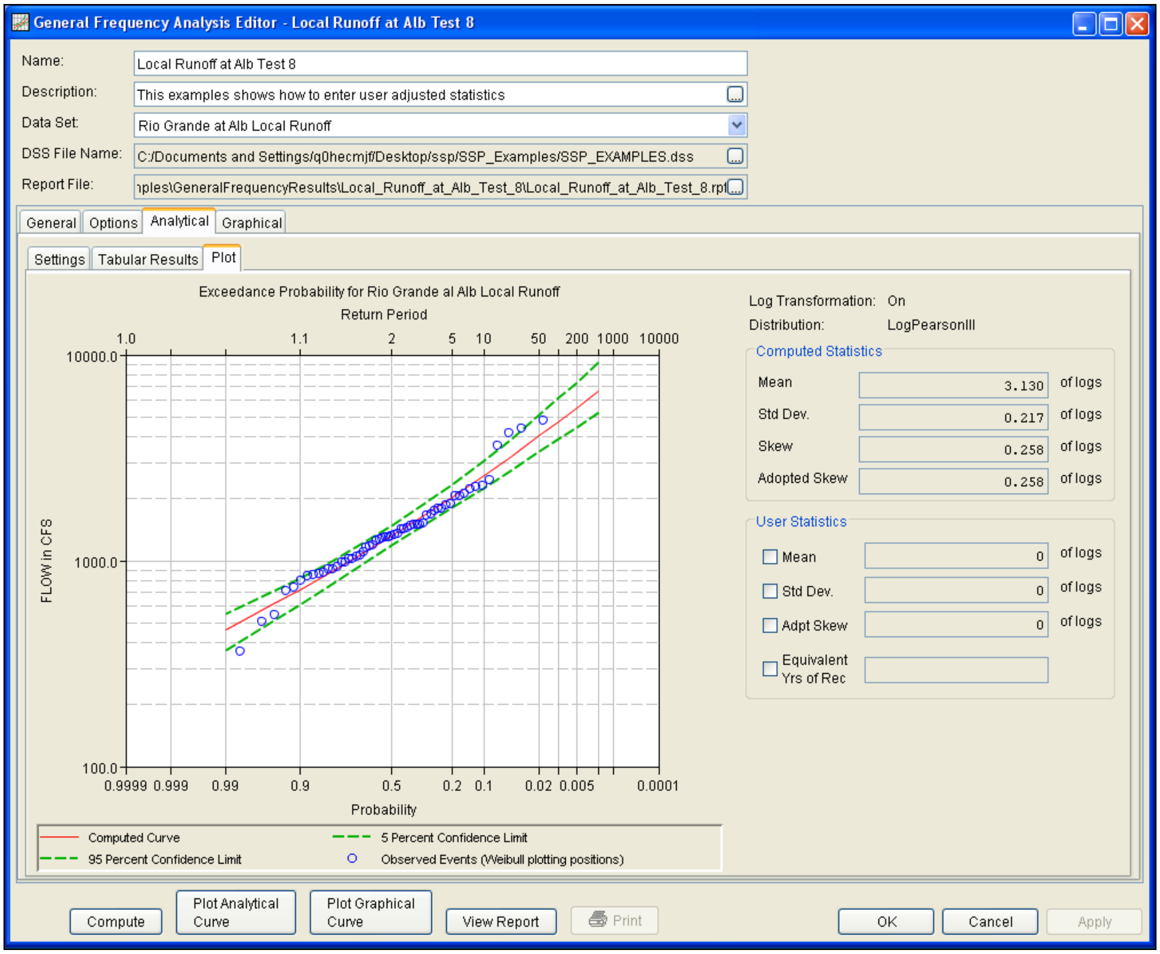


Figure B-56. The Plot Tab for Test Example 8.

As shown in Figure B-56, the **Plot** tab contains a graph of the systematic data, the computed frequency curve, and the confidence limits. The right side of the plot tab contains a table of **Computed Statistics** and **User Statistics**. The user has the option to enter a mean, standard deviation, adopted skew, and equivalent years of record in the User Statistics table. The **Compute** button must be pressed after User Statistics have been entered in order for the program to compute a frequency curve using the user statistics.

As mentioned at the beginning of this example, the annual peak flows were based on daily averaged flows. In order to compute an instantaneous peak flow frequency curve, a relationship between daily averaged flows and the corresponding instantaneous peak flows was developed. This was done by plotting daily averaged flow and the corresponding instantaneous peak flow for selected flood events. Using this relationship, a Mean of 3.731 was computed and entered in the User Statistics table and the analytical analysis was recomputed.

Figure B-57 shows that the frequency curve computed from the user-adjusted statistics is added to the graph. This figure also shows that the user does not have to enter values for all statistics in order for the program to compute a user-adjusted frequency curve. The program will use statistics computed from the systematic and historic data if the statistics are not defined in the User Statistics table. In this example, the program used the computed statistics for standard deviation, adopted skew, equivalent years of record and the user-defined mean of 3.731 when computing the user-adjusted frequency curve.

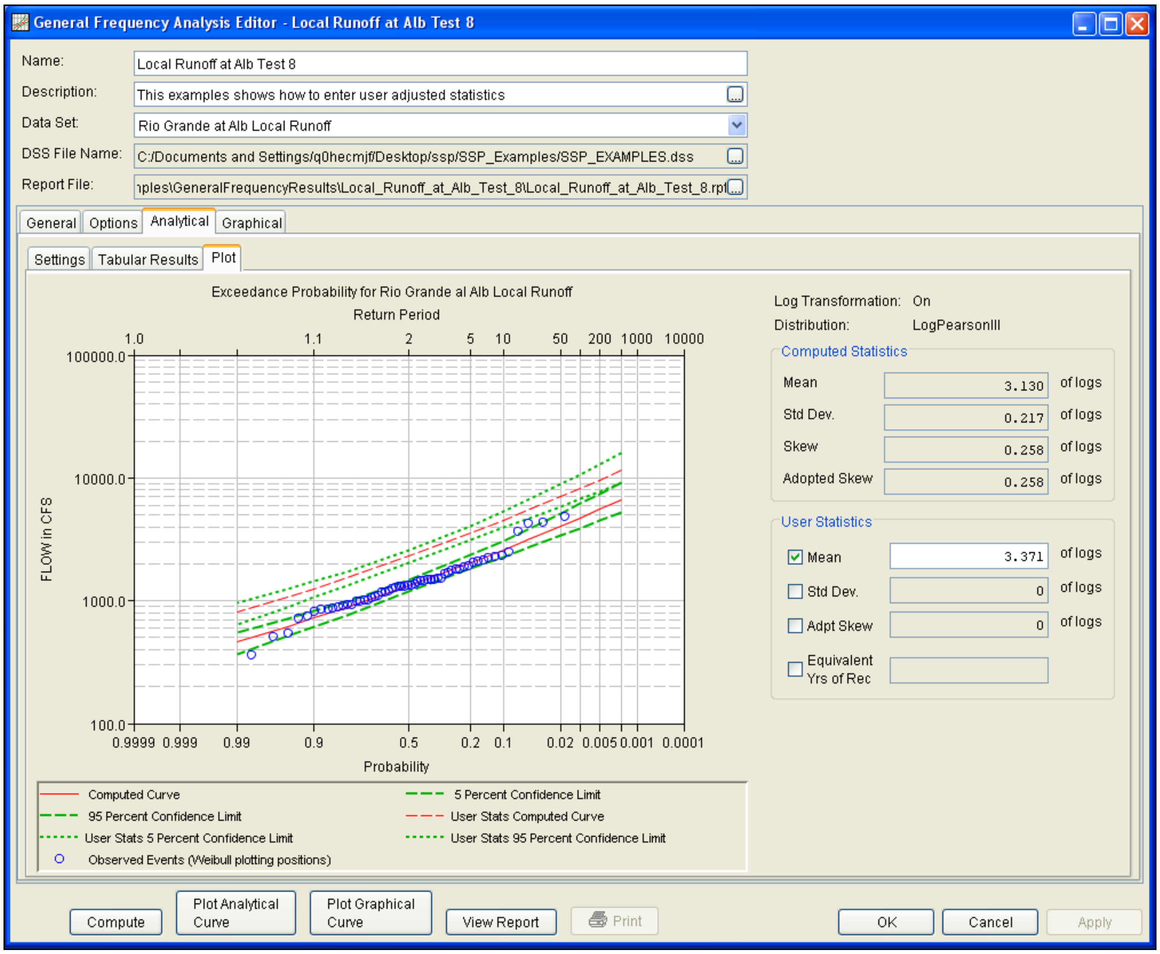
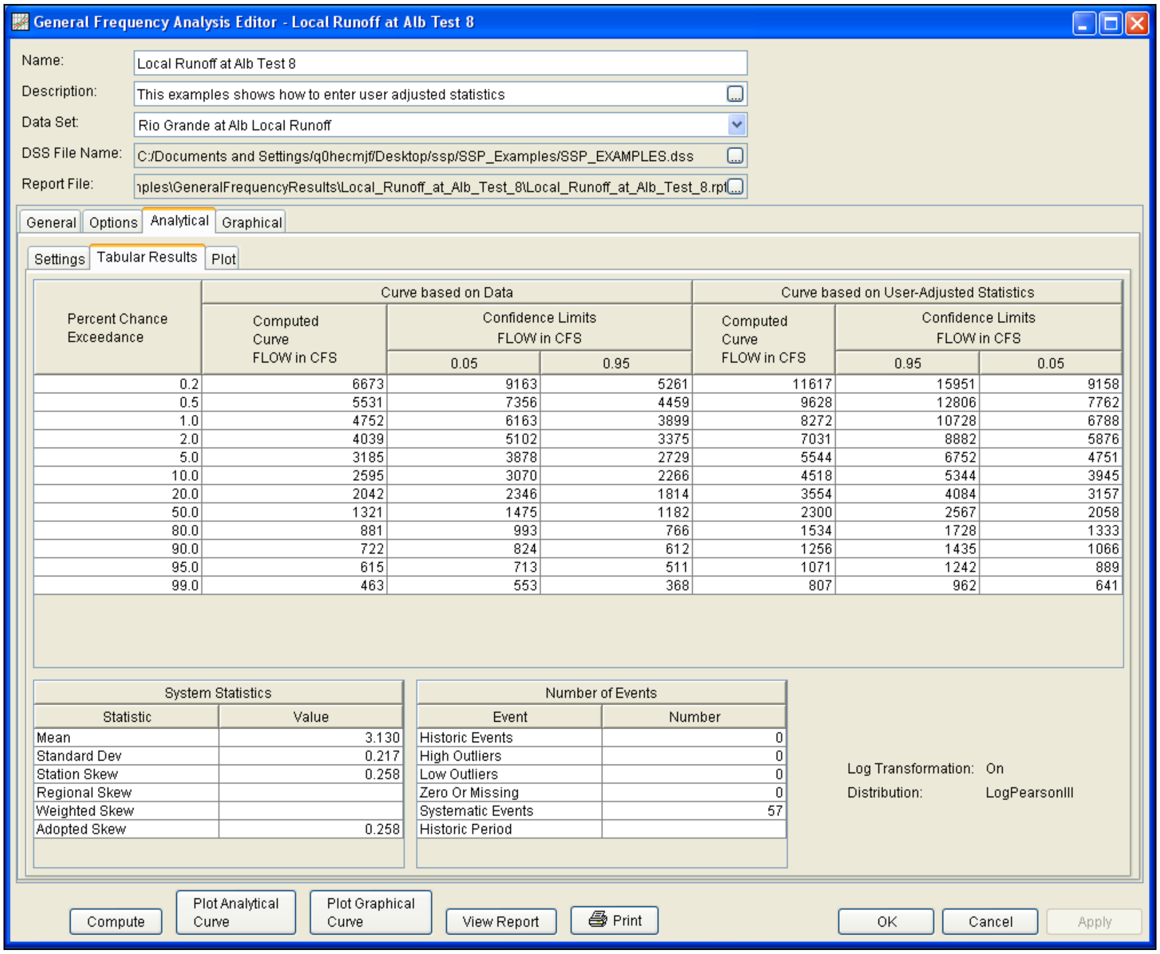


Figure B-57. Plot Tab with User Adjusted Statistics and Frequency Curves for Test Example 8.

Select the **Tabular Results** tab to see information for both the computed and user-adjusted frequency curves. As shown in Figure B-58, the Frequency Curve table contains the percent chance exceedance, computed curves (Log-Pearson III results), and the Confidence Limits (5% and 95% chance exceedance curves) for both the computed and user-adjusted statistics.

On the bottom left-hand side of the results tab is a table of System Statistics for the observed station data (mean, standard deviation, station skew) and regional adjustment (regional skew, weighted skew, and adopted skew). Also on the bottom right-hand side of the results tab is a table of Number of Events showing the number of historic events used in the analysis, number of high outliers found, number of low outliers, number of zero or missing data years, number of systematic events in the gage record, and the historic record length (if historic data was entered).



Percent Chance Exceedance	Curve based on Data: Computed Curve FLOW in CFS	Confidence Limits FLOW in CFS 0.05	Confidence Limits FLOW in CFS 0.95	Curve based on User-Adjusted Statistics: Computed Curve FLOW in CFS	Confidence Limits FLOW in CFS 0.95	Confidence Limits FLOW in CFS 0.05
0.2	6673	9163	5261	11617	15951	9158
0.5	5531	7356	4459	9628	12806	7762
1.0	4752	6163	3899	8272	10728	6788
2.0	4039	5102	3375	7031	8882	5876
5.0	3185	3878	2729	5544	6752	4751
10.0	2595	3070	2266	4518	5344	3945
20.0	2042	2346	1814	3554	4084	3157
50.0	1321	1475	1182	2300	2567	2058
80.0	881	993	766	1534	1728	1333
90.0	722	824	612	1256	1435	1066
95.0	615	713	511	1071	1242	889
99.0	463	553	368	807	962	641

System Statistics

Statistic	Value
Mean	3.130
Standard Dev	0.217
Station Skew	0.258
Regional Skew	
Weighted Skew	
Adopted Skew	0.258

Number of Events

Event	Number
Historic Events	0
High Outliers	0
Low Outliers	0
Zero Or Missing	0
Systematic Events	57
Historic Period	

Figure B-58. General Frequency Editor with Results Tab Selected for Test Example 8.

In addition to the tabular results, a graphical plot of the computed frequency curves can be obtained by pressing the **Plot Analytical Curve** button at the bottom of the analysis window. A plot of the results for this test example is shown in Figure B-59.

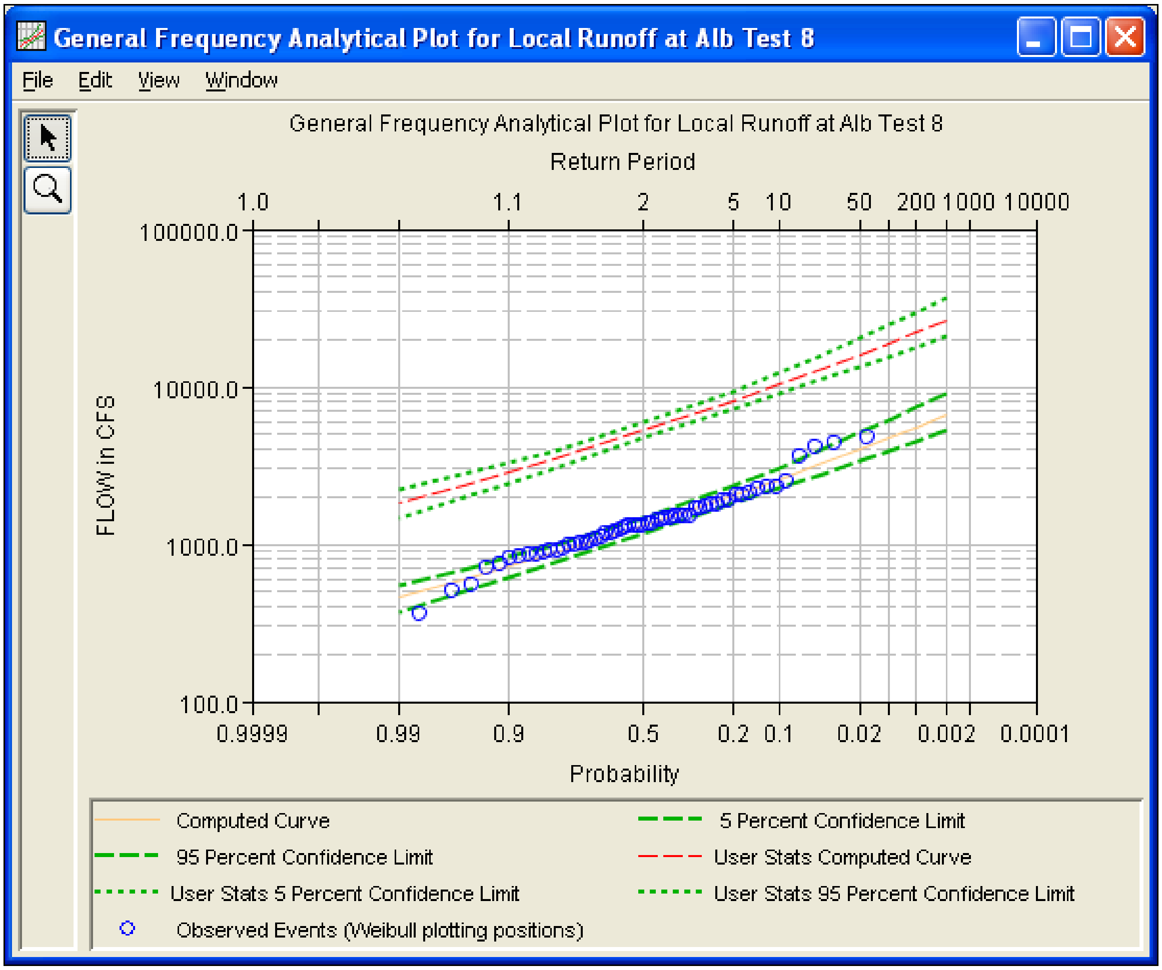


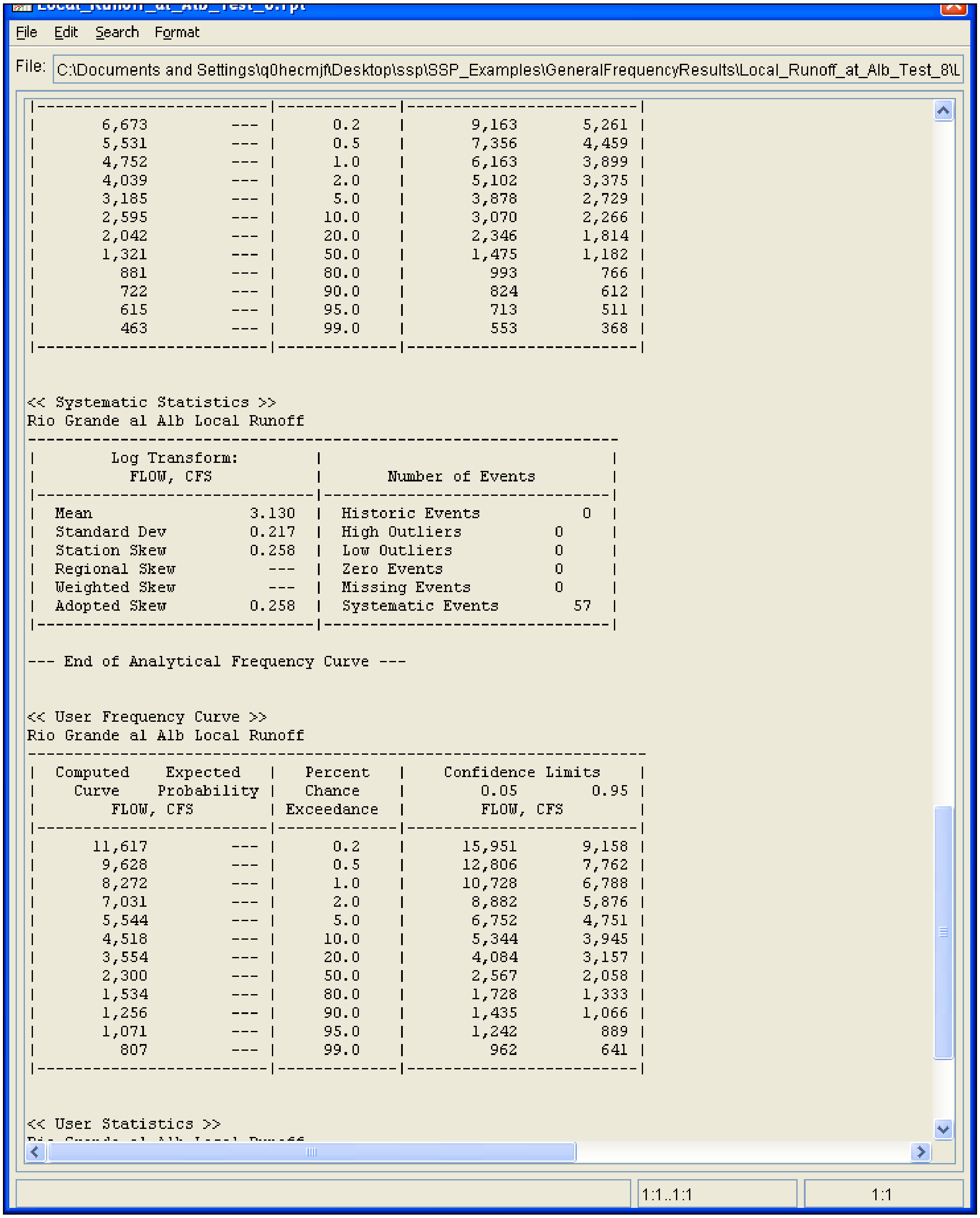
Figure B-59. Plot of the Frequency Curve Results for Test Example 8.

The tabular and graphical results can be sent to the printer or the windows clipboard for transfer into another piece of software. To print the tabular results, select **Print** from the bottom of the analysis window. To send the tabular results to the windows clipboard, highlight the data you want to send to the clipboard and then press the Control-C key sequence. To print the graphical results, first bring up the graphical plot and then select **Print** from the **File** menu. To send the graphic to the windows clipboard, select **Copy to Clipboard** from the **File** menu.

In addition to the tabular and graphical results, there is a report file that shows the order in which the calculations were performed. To review the report file, press the **View Report** button at the bottom of the analysis window. When this button is selected a text viewer will open the report file and display it on the screen. Shown in Figure B-60 is the report file for Test Example 8.

The report file contains a listing of the input data, preliminary results, outlier and historical data tests, additional calculations needed, and

the final frequency curve results. Different types and amounts of information will show up in the report file depending on the data and the options that have been selected for the analysis.



6,673	---	0.2	9,163	5,261
5,531	---	0.5	7,356	4,459
4,752	---	1.0	6,163	3,899
4,039	---	2.0	5,102	3,375
3,185	---	5.0	3,878	2,729
2,595	---	10.0	3,070	2,266
2,042	---	20.0	2,346	1,814
1,321	---	50.0	1,475	1,182
881	---	80.0	993	766
722	---	90.0	824	612
615	---	95.0	713	511
463	---	99.0	553	368

<< Systematic Statistics >>
Rio Grande al Alb Local Runoff

Log Transform: FLOW, CFS		Number of Events	
Mean	3.130	Historic Events	0
Standard Dev	0.217	High Outliers	0
Station Skew	0.258	Low Outliers	0
Regional Skew	---	Zero Events	0
Weighted Skew	---	Missing Events	0
Adopted Skew	0.258	Systematic Events	57

--- End of Analytical Frequency Curve ---

<< User Frequency Curve >>
Rio Grande al Alb Local Runoff

Computed Curve FLOW, CFS	Expected Probability	Percent Chance Exceedance	Confidence Limits 0.05 FLOW, CFS	Confidence Limits 0.95 FLOW, CFS
11,617	---	0.2	15,951	9,158
9,628	---	0.5	12,806	7,762
8,272	---	1.0	10,728	6,788
7,031	---	2.0	8,882	5,876
5,544	---	5.0	6,752	4,751
4,518	---	10.0	5,344	3,945
3,554	---	20.0	4,084	3,157
2,300	---	50.0	2,567	2,058
1,534	---	80.0	1,728	1,333
1,256	---	90.0	1,435	1,066
1,071	---	95.0	1,242	889
807	---	99.0	962	641

<< User Statistics >>

Figure B-60. Report File for Test Example 8.

Example 9: General Frequency – Graphical Analysis

This example demonstrates how to create a Graphical Analysis within a General Frequency analysis. The data for this example is from an analysis that computed regulated flow for the Rio Grande at Albuquerque. The data includes regulated daily average flows from upstream reservoirs routed downstream to Albuquerque. The period of record used for this example is from 1974 to 2002. To view the data, right-click on the data record labeled "**Rio Grande at Alb Reg Flow**" in the study explorer and then select **Tabulate**. The data will appear as shown in Figure B-61.

/RIO GRANDE/RIO GRANDE AT ALBUQ...

File Edit View

Ordinate	Date	Time	RIO GRANDE... FLOW REGULATED ...
Units			cfs
Type			INST-VAL
1	01 Jan 1974	24:00	1,950.0
2	24 May 1975	24:00	5,800.0
3	21 May 1976	24:00	3,170.0
4	18 Aug 1977	24:00	1,640.0
5	24 May 1978	24:00	4,320.0
6	01 Jun 1979	24:00	7,870.0
7	28 May 1980	24:00	7,130.0
8	05 May 1981	24:00	2,170.0
9	09 Jun 1982	24:00	4,630.0
10	12 Jun 1983	24:00	7,330.0
11	27 May 1984	24:00	8,500.0
12	24 Apr 1985	24:00	8,650.0
13	07 Aug 1986	24:00	4,670.0
14	22 Jul 1987	24:00	6,120.0
15	01 Apr 1988	24:00	3,880.0
16	27 Apr 1989	24:00	3,710.0
17	12 May 1990	24:00	2,420.0
18	07 Aug 1991	24:00	4,800.0
19	12 May 1992	24:00	5,900.0
20	05 Jun 1993	24:00	7,000.0
21	12 May 1994	24:00	6,250.0
22	25 May 1995	24:00	6,370.0
23	22 Feb 1996	24:00	1,770.0
24	11 Jun 1997	24:00	5,980.0
25	09 May 1998	24:00	3,940.0
26	01 Jun 1999	24:00	4,550.0
27	03 Jun 2000	24:00	1,500.0
28	23 May 2001	24:00	4,760.0
29	15 May 2002	24:00	1,240.0

Figure B-61. Tabulation of the Peak Flow Data for Example 9.

To plot the data for this example, right-click on the data record and then select **Plot**. A plot of the data will appear as shown in Figure B-62.

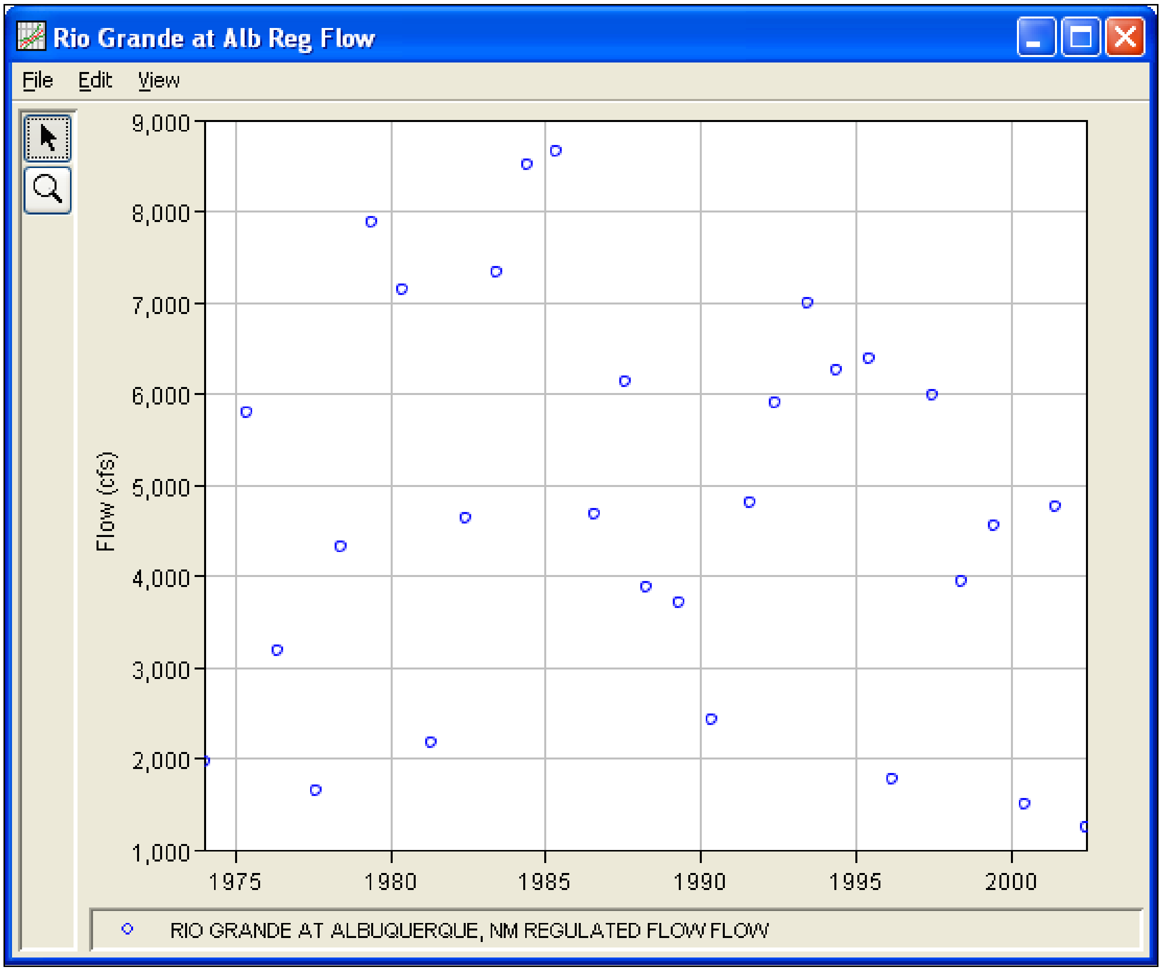


Figure B-62. Plot of Data for Example 9.

A General Frequency analysis has been developed for this example. To open the General Frequency analysis editor for test example 9, either double-click on the analysis labeled **Reg Flow Rio Grande Test 9** from the study explorer, or from the **Analysis** menu select open, then select **Reg Flow Rio Grande Test 9** from the list of available analyses. When Test 9 is opened, the General Frequency analysis editor will appear as shown in Figure B-63.

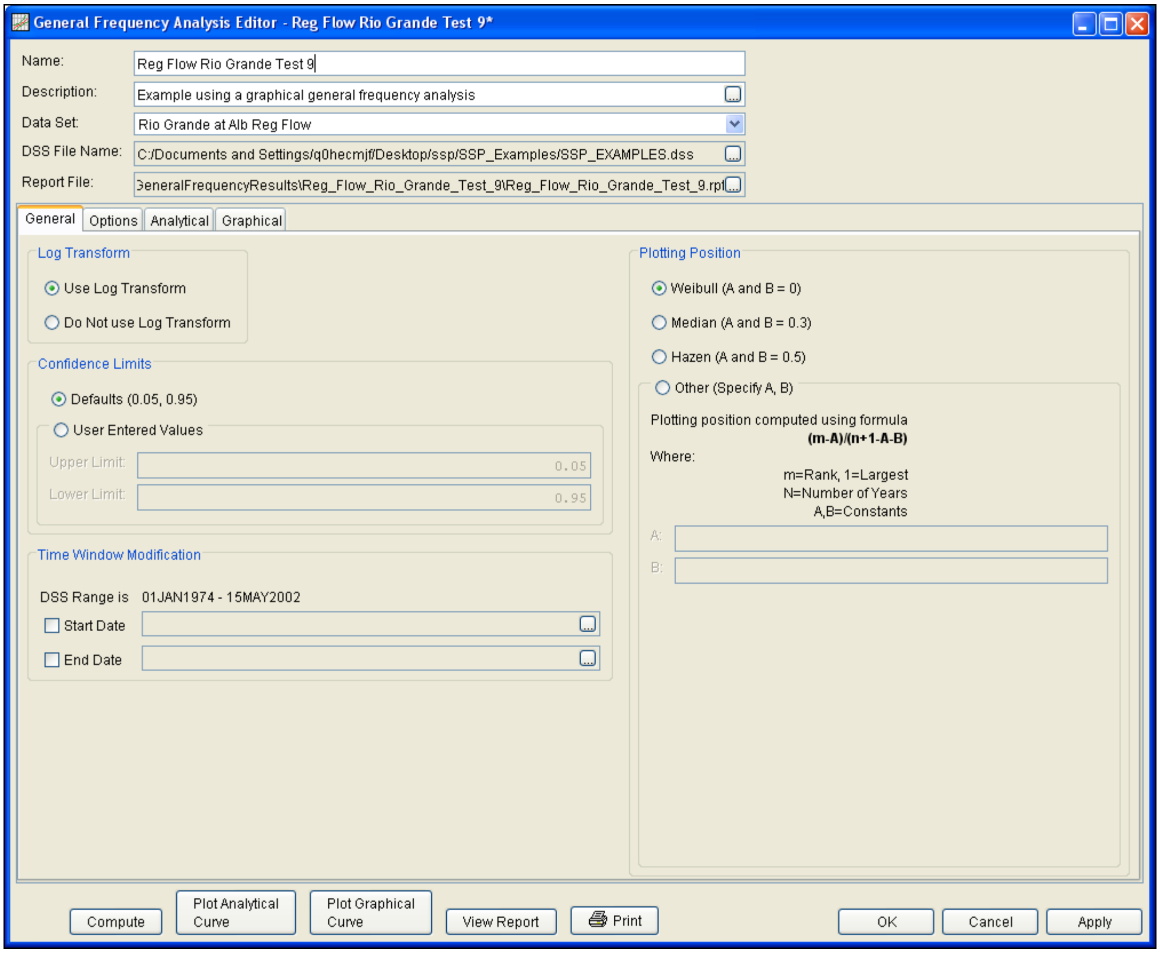


Figure B-63. General Frequency Analysis Editor for Test Example 9.

Shown in Figure B-63 are the general settings that were used to perform this frequency analysis. For this analysis, the **Use Log Transform** option was selected, the **Weibull** plotting position method was selected, the default **Confidence Limits** were selected, and no modification was made to the **Time Window**.

Shown in Figure B-64 is the General Frequency analysis editor with the **Options Tab** selected. Features on this tab include the **Low Outlier Threshold**, an option to use **Historic Data**, an option to override the default **Frequency Ordinates**, and **Output Labeling**. All defaults settings were selected for this example.

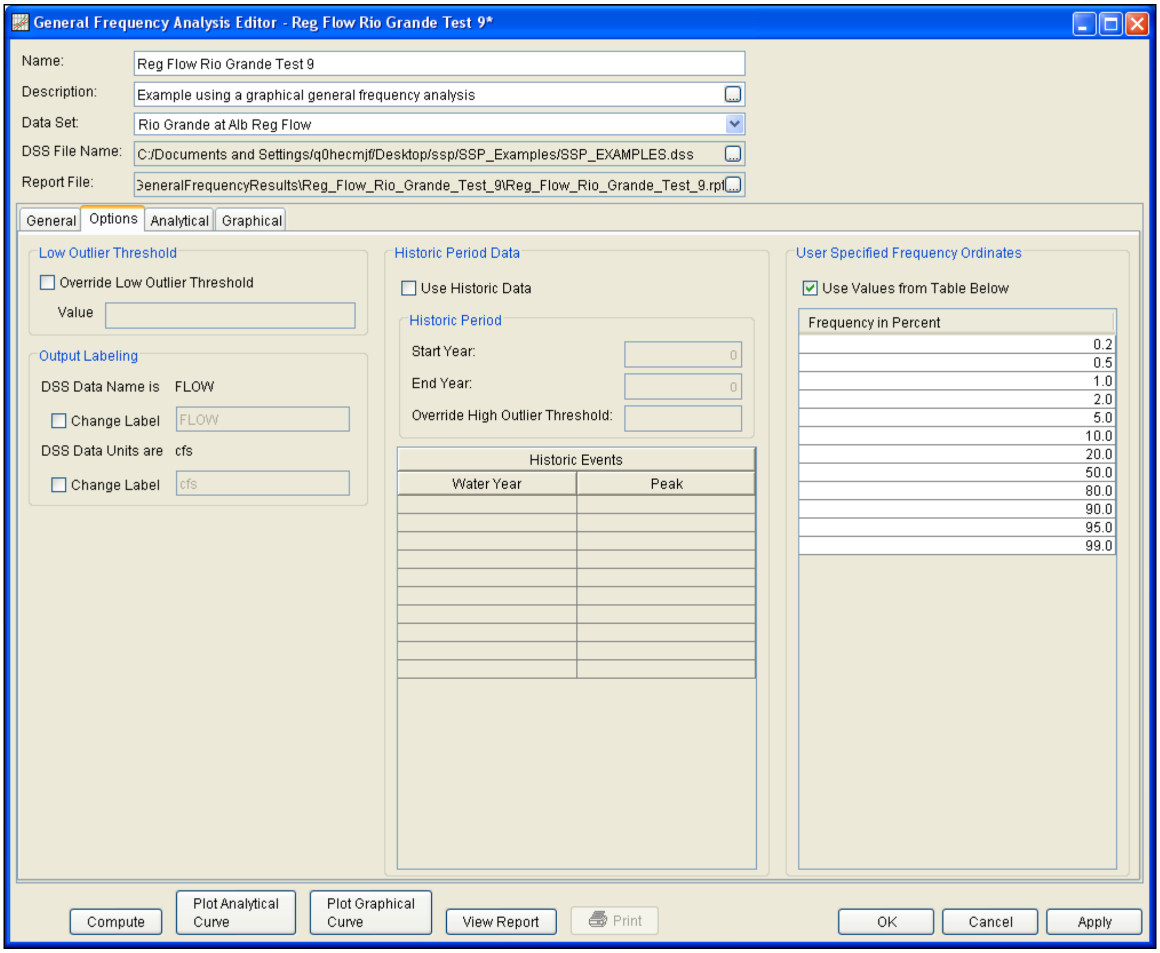


Figure B-64. General Frequency Analysis Editor with Options Tab Shown for Test Example 9.

Once all of the General and Optional settings are set or selected, the user can choose to perform an Analytical or Graphical analysis. In this example, a graphical analysis was performed. Shown in Figure B-65 is the **Graphical** analysis tab. As shown, a graph containing the systematic data and graphical curve is on the left side and a table containing the user-entered frequency curve is on the right side of the window. The frequency curve was entered manually into the **User-Defined Graphical Curve** table. When the **Compute** button is pressed, the program plots the graphical frequency curve along with the annual maximum flow values. For this example, a reservoir model was used to route synthetic hydrographs through the reservoir network upstream of Albuquerque using current operating criteria. This was done for the 0.2, 0.5, 1.0, 2.0, 10, 20, and 50 percent events. Output from the model was input into the Frequency Ordinates table. For the more frequent events (10 year and below), the graphical curve was fit to the data visually. This example shows how a reservoir network can influence the frequency curve. Notice how the frequency curve is flat for the 20 through the 1 percent chance events. The reservoir network is able to control flooding in this range. This example also shows that as flood events become larger, the reservoir network has less influence on controlling downstream flooding.

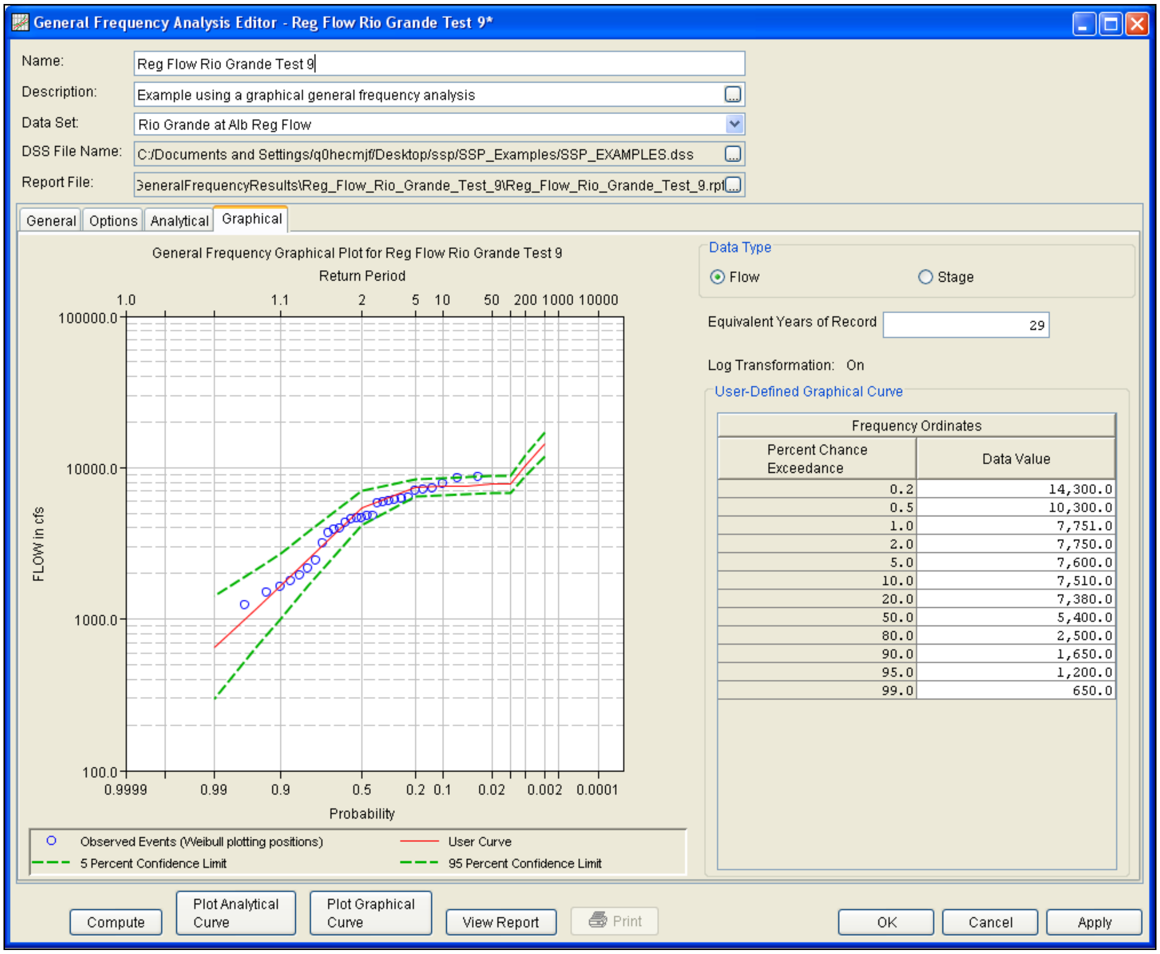


Figure B-65. Graphical Tab Shown for Test Example 9.

A graphical plot of the graphical frequency curve can be obtained by pressing the **Plot Graphical Curve** button at the bottom of the analysis window. A plot of the results for this test example is shown in Figure B-66.

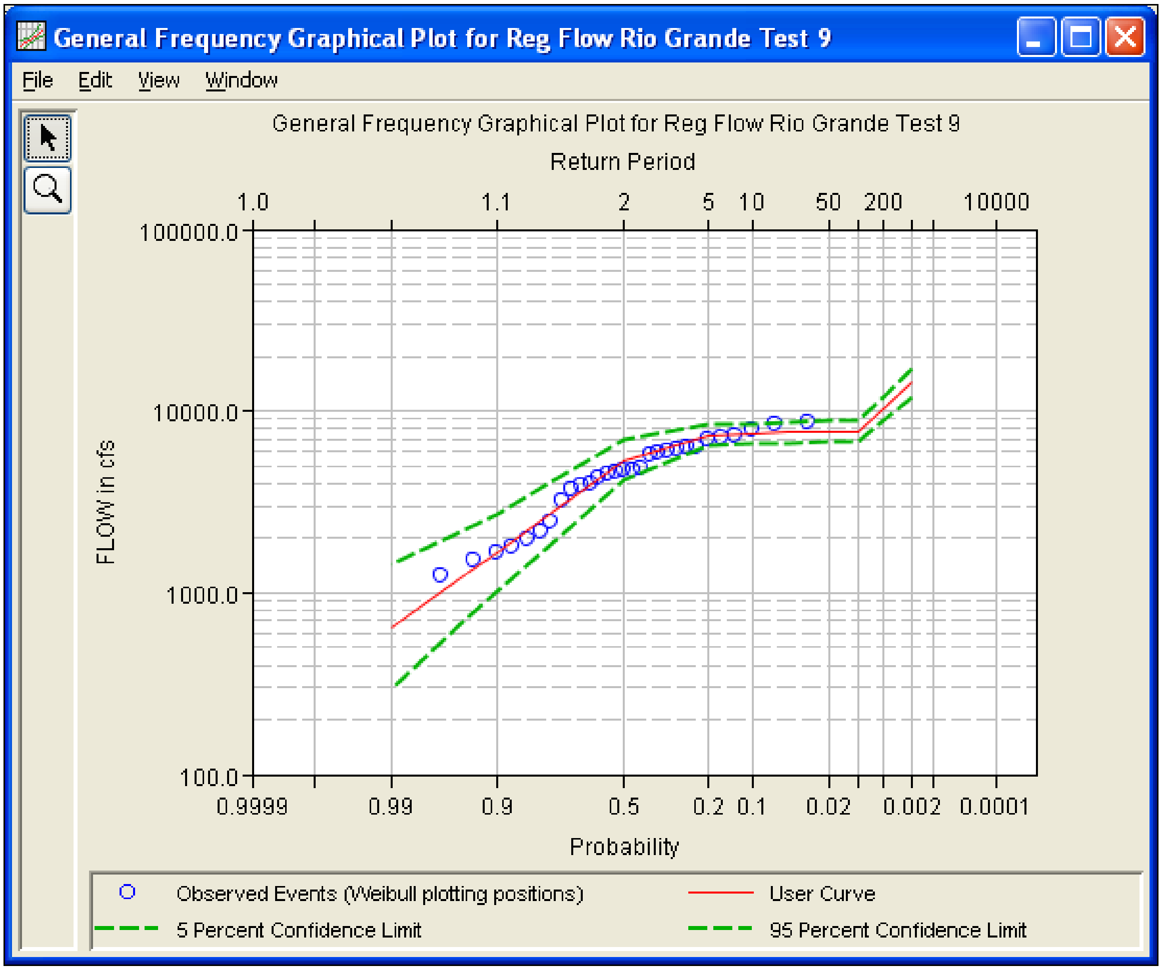


Figure B-66. Plot of the Frequency Curve Results for Test Example 9.

The graphical results can be sent to the printer or the windows clipboard for transfer into another piece of software. To print the graphical results, first bring up the graphical plot and then select **Print** from the **File** menu. To send the graphic to the windows clipboard, select **Copy to Clipboard** from the **File** menu.

In addition to the tabular and graphical results, there is a report file that shows the order in which the calculations were performed. To review the report file, press the **View Report** button at the bottom of the analysis window. When this button is selected a text viewer will open the report file and display it on the screen. Shown in Figure B-67 is the report file for Test Example 9.

The report file contains a listing of the input data, preliminary results, outlier and historical data tests, and additional calculations needed. Different types and amounts of information will show up in the report file depending on the data and the options that have been selected for the analysis.

Reg_Flow_Rio_Grande_Test_9.rpt

File Edit Search Format

File: \Desktop\ssp\SSP_Examples\GeneralFrequencyResults\Reg_Flow_Rio_Grande_Test_9\Reg_Flow_Rio_Grande_Test_9.rpt

```
----------------------------
General Frequency Analysis
   13 Sep 2010    11:06 AM
----------------------------


--- Input Data ---

Analysis Name: Reg Flow Rio Grande Test 9
Description: Example using a graphical general frequency analysis

Data Set Name: Rio Grande at Alb Reg Flow
DSS File Name: C:/Documents and Settings/q0hecmjf/Desktop/ssp/SSP_Examples/SSP_EXAMPLES.dss
DSS Pathname: /RIO GRANDE/RIO GRANDE AT ALBUQUERQUE, NM/FLOW/01JAN1900/IR-CENTURY/REGULATED FLOW/

Start Date:
End Date:

Project Path: C:\Documents and Settings\q0hecmjf\Desktop\ssp\SSP_Examples
Report File Name: C:\Documents and Settings\q0hecmjf\Desktop\ssp\SSP_Examples\GeneralFrequencyResu
Result File Name: C:\Documents and Settings\q0hecmjf\Desktop\ssp\SSP_Examples\GeneralFrequencyResu

Plotting Position Type: Weibull

Probability Distribution Type: None
Use Log Transform

User-Specified Frequencies
Frequency: 0.2
Frequency: 0.5
Frequency: 1.0
Frequency: 2.0
Frequency: 5.0
Frequency: 10.0
Frequency: 20.0
Frequency: 50.0
Frequency: 80.0
Frequency: 90.0
Frequency: 95.0
Frequency: 99.0

Display ordinate values using 1 digits in fraction part of value

--- End of Input Data ---



----------------------
<< Low Outlier Test >>
----------------------
 Based on 29 events, 10 percent outlier test deviate K(N) = 2.549
                       Computed low outlier test value = 1,004.42

         0 low outlier(s) identified below test value of 1,004.42
```

1:1..1:1 1:1

Figure B-67. Report File for Test Example 9.

Example 10: Volume Frequency Analysis, Maximum Flows

This example demonstrates how to perform a Volume Frequency analysis for maximum flows. The data for this example was derived from an analysis where a time-series of daily average unregulated flows were computed for the Rio Grande at Albuquerque. The period of record for this example is from 1941 to 2002. To view the data, right-click on the data record labeled "**Rio Grande at Alb Unreg Daily**" in the study explorer and then select **Plot**. The data will appear as shown in Figure B-68.

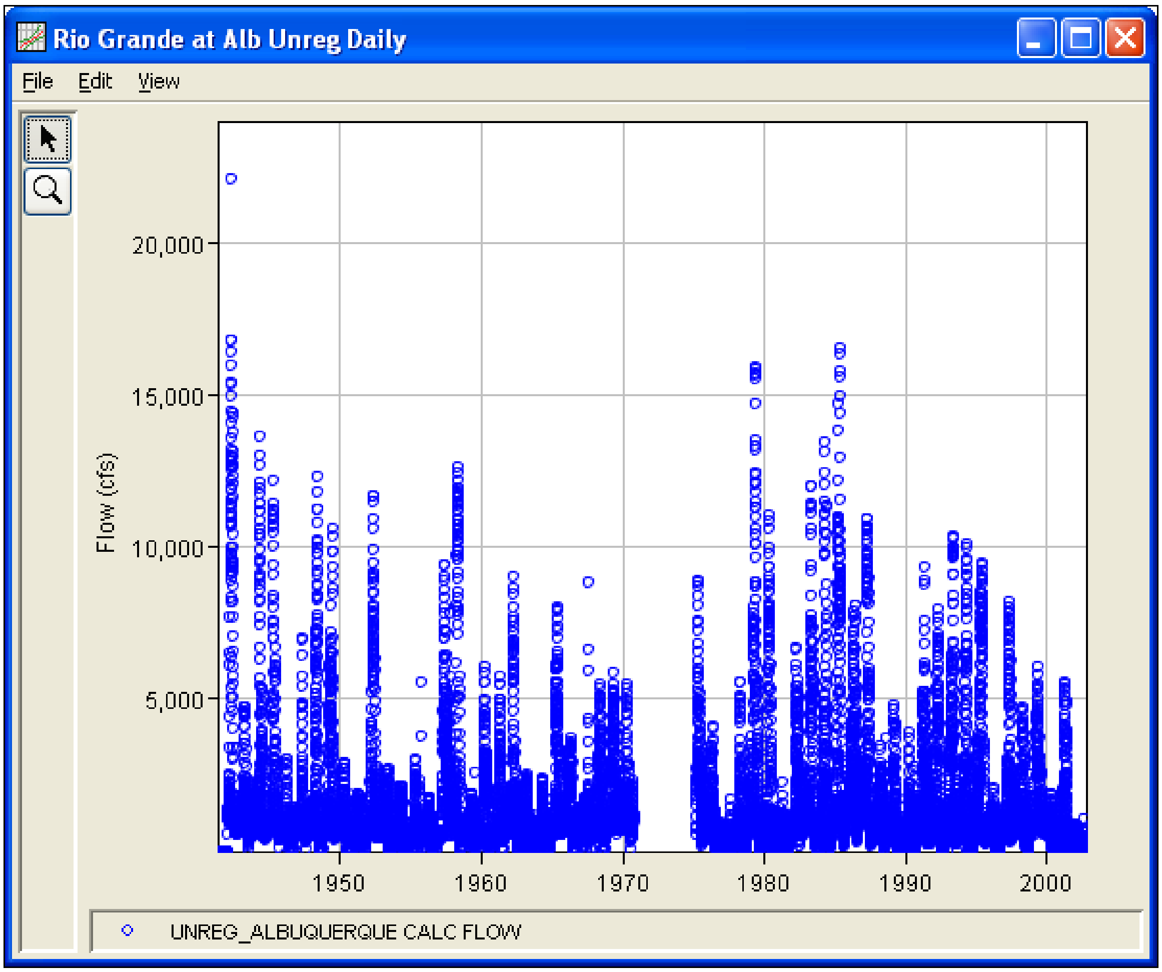


Figure B-68. Plot of Daily Average Flow for Example 10.

A Volume Frequency analysis has been developed for this example. To open the Volume Frequency Analysis editor for test example 10, either double-click on the analysis labeled **Unreg Flow Rio Grande Test 10** from the study explorer, or from the **Analysis** menu select open, then select **Unreg Flow Rio Grande Test 10** from the list of available analyses. When test 10 is opened, the Volume Frequency Analysis editor will appear as shown in Figure B-69.

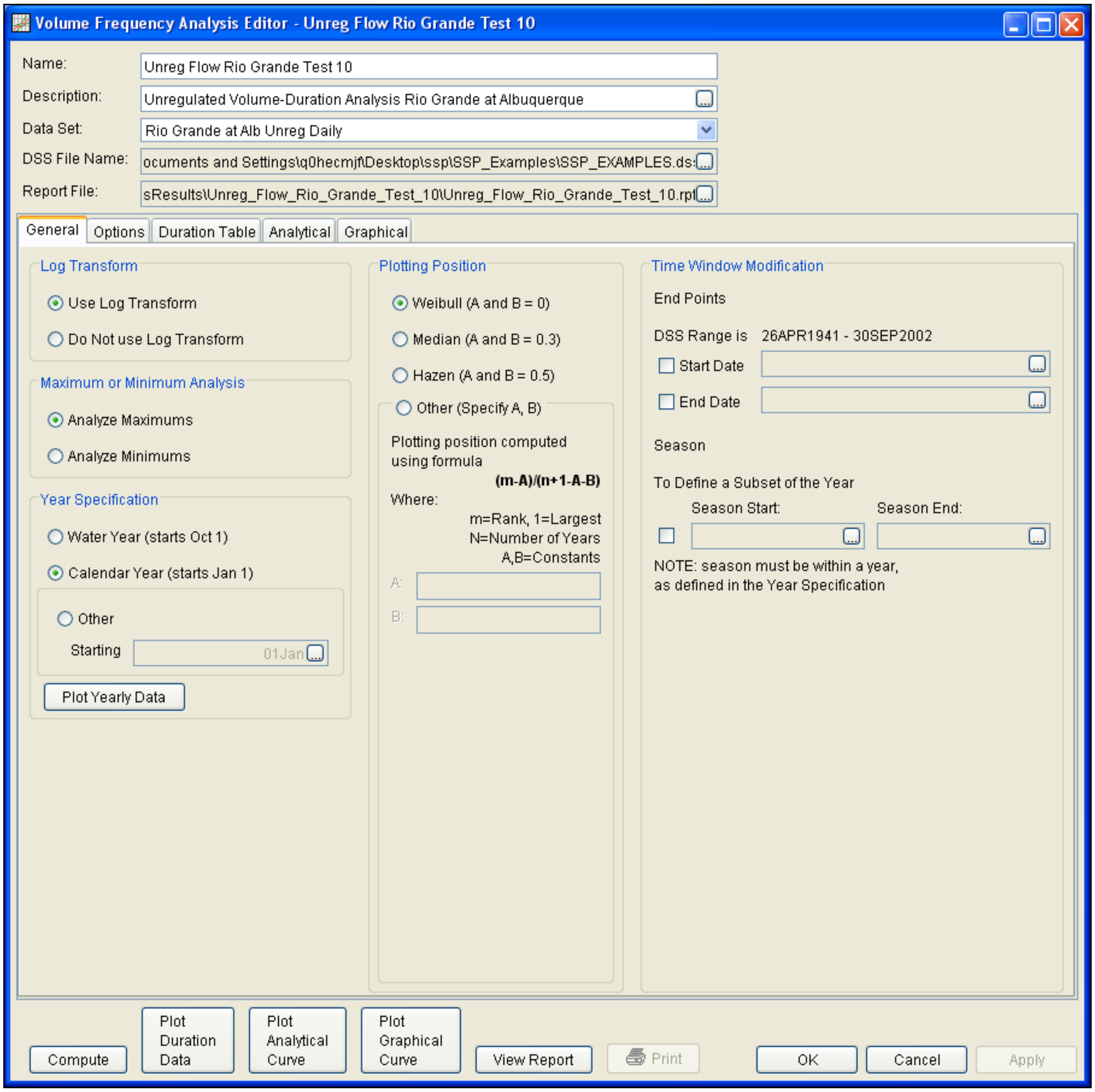


Figure B-69. Volume Frequency Analysis Editor for Test Example 10.

Shown in Figure B-69 are the general settings that were used to perform this frequency analysis. For this analysis, the **Use Log Transform** option was selected, the **Weibull** plotting position method was selected, **Analyze Maximums** was selected, the **Calendar Year** option was selected, and no modification was made to the **Time Window**.

Shown in Figure B-70 is the Volume Frequency Analysis editor with the **Options Tab** selected. Features on this tab include an option to override the default **Flow Duration** values, an option to override the default **Frequency Ordinates**, and **Output Labeling**. Both the flow-duration and frequency ordinate tables were modified.

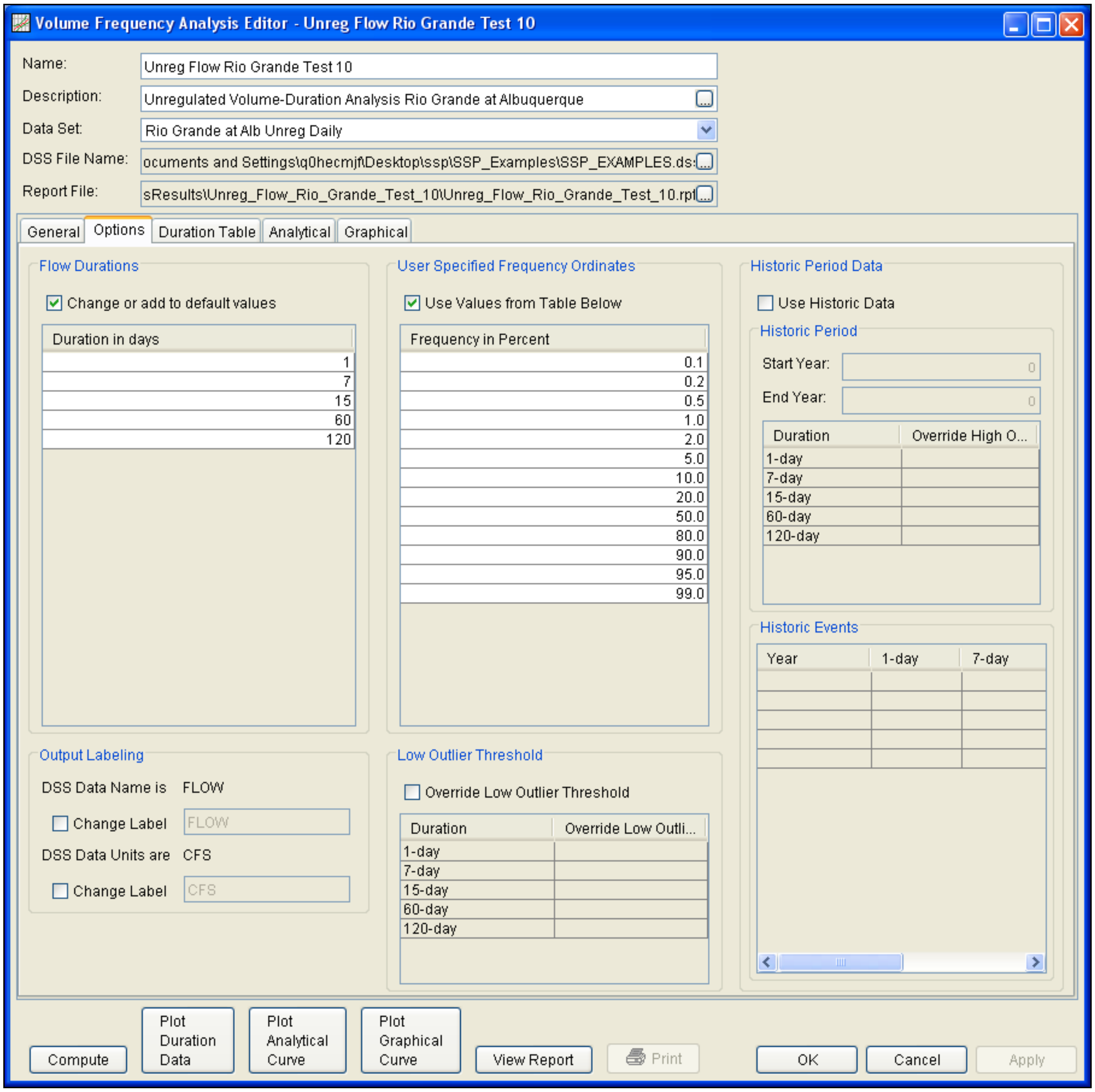
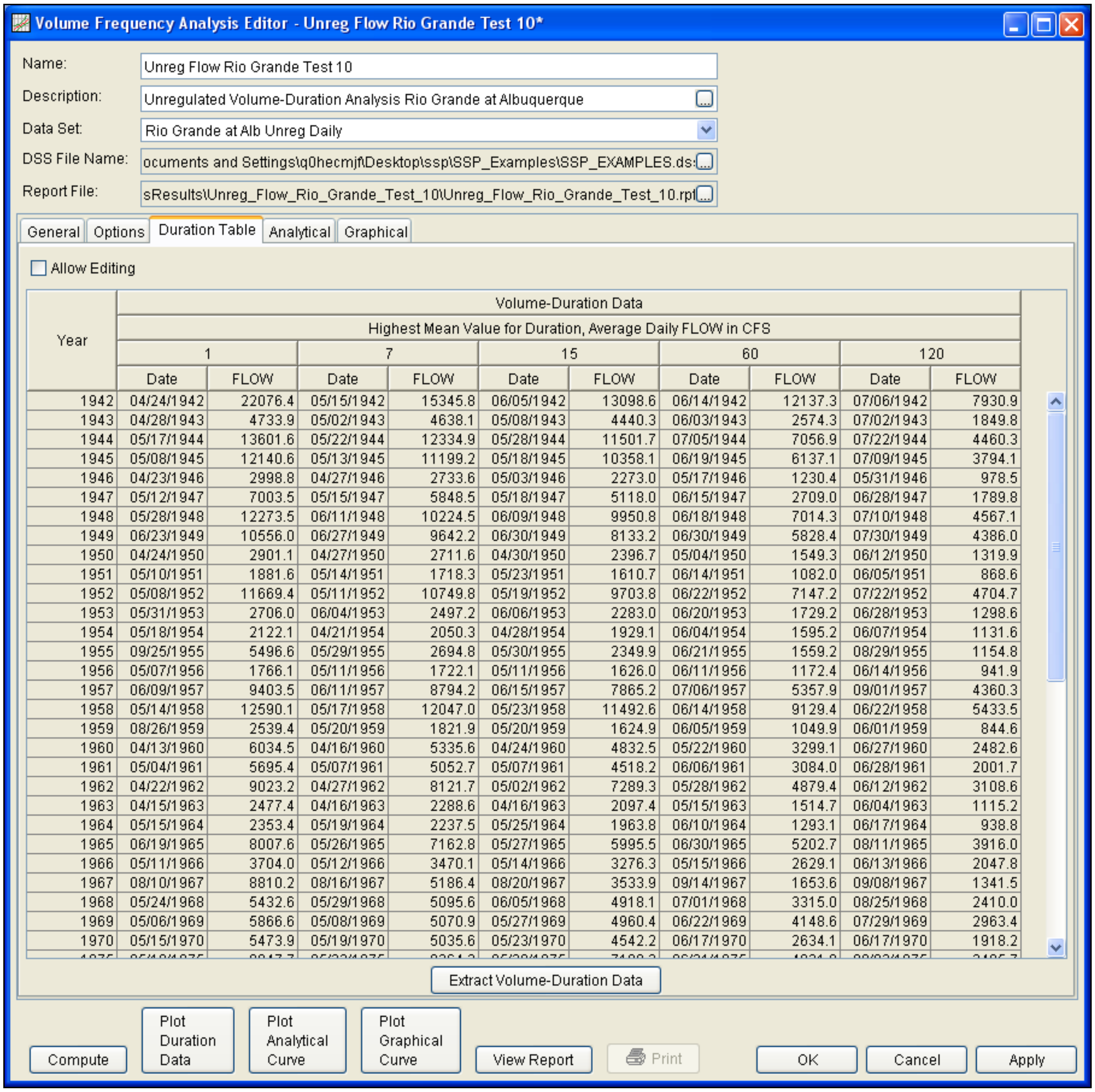


Figure B-70. Options Tab Shown for Test Example 10.

Once all of the General and Optional settings are set or selected, the user can extract the volume-duration data from the time-series of daily flows. Select the **Duration Data** tab and press the **Extract Volume-Duration Data** button at the bottom of the table. The table should then fill with the flow-duration values, as shown in Figure B-71.



Year	Volume-Duration Data									
	Highest Mean Value for Duration, Average Daily FLOW in CFS									
	1		7		15		60		120	
	Date	FLOW	Date	FLOW	Date	FLOW	Date	FLOW	Date	FLOW
1942	04/24/1942	22076.4	05/15/1942	15345.8	06/05/1942	13098.6	06/14/1942	12137.3	07/06/1942	7930.9
1943	04/28/1943	4733.9	05/02/1943	4638.1	05/08/1943	4440.3	06/03/1943	2574.3	07/02/1943	1849.8
1944	05/17/1944	13601.6	05/22/1944	12334.9	05/28/1944	11501.7	07/05/1944	7056.9	07/22/1944	4460.3
1945	05/08/1945	12140.6	05/13/1945	11199.2	05/18/1945	10358.1	06/19/1945	6137.1	07/09/1945	3794.1
1946	04/23/1946	2998.8	04/27/1946	2733.6	05/03/1946	2273.0	05/17/1946	1230.4	05/31/1946	978.5
1947	05/12/1947	7003.5	05/15/1947	5848.5	05/18/1947	5118.0	06/15/1947	2709.0	06/28/1947	1789.8
1948	05/28/1948	12273.5	06/11/1948	10224.5	06/09/1948	9950.8	06/18/1948	7014.3	07/10/1948	4567.1
1949	06/23/1949	10556.0	06/27/1949	9642.2	06/30/1949	8133.2	06/30/1949	5828.4	07/30/1949	4386.0
1950	04/24/1950	2901.1	04/27/1950	2711.6	04/30/1950	2396.7	05/04/1950	1549.3	06/12/1950	1319.9
1951	05/10/1951	1881.6	05/14/1951	1718.3	05/23/1951	1610.7	06/14/1951	1082.0	06/05/1951	868.6
1952	05/08/1952	11669.4	05/11/1952	10749.8	05/19/1952	9703.8	06/22/1952	7147.2	07/22/1952	4704.7
1953	05/31/1953	2706.0	06/04/1953	2497.2	06/06/1953	2283.0	06/20/1953	1729.2	06/28/1953	1298.6
1954	05/18/1954	2122.1	04/21/1954	2050.3	04/28/1954	1929.1	06/04/1954	1595.2	06/07/1954	1131.6
1955	09/25/1955	5496.6	05/29/1955	2694.8	05/30/1955	2349.9	06/21/1955	1559.2	08/29/1955	1154.8
1956	05/07/1956	1766.1	05/11/1956	1722.1	05/11/1956	1626.0	06/11/1956	1172.4	06/14/1956	941.9
1957	06/09/1957	9403.5	06/11/1957	8794.2	06/15/1957	7865.2	07/06/1957	5357.9	09/01/1957	4360.3
1958	05/14/1958	12590.1	05/17/1958	12047.0	05/23/1958	11492.6	06/14/1958	9129.4	06/22/1958	5433.5
1959	08/26/1959	2539.4	05/20/1959	1821.9	05/20/1959	1624.9	06/05/1959	1049.9	06/01/1959	844.6
1960	04/13/1960	6034.5	04/16/1960	5335.6	04/24/1960	4832.5	05/22/1960	3299.1	06/27/1960	2482.6
1961	05/04/1961	5695.4	05/07/1961	5052.7	05/07/1961	4518.2	06/06/1961	3084.0	06/28/1961	2001.7
1962	04/22/1962	9023.2	04/27/1962	8121.7	05/02/1962	7289.3	05/28/1962	4879.4	06/12/1962	3108.6
1963	04/15/1963	2477.4	04/16/1963	2288.6	04/16/1963	2097.4	05/15/1963	1514.7	06/04/1963	1115.2
1964	05/15/1964	2353.4	05/19/1964	2237.5	05/25/1964	1963.8	06/10/1964	1293.1	06/17/1964	938.8
1965	06/19/1965	8007.6	05/26/1965	7162.8	05/27/1965	5995.5	06/30/1965	5202.7	08/11/1965	3916.0
1966	05/11/1966	3704.0	05/12/1966	3470.1	05/14/1966	3276.3	05/15/1966	2629.1	06/13/1966	2047.8
1967	08/10/1967	8810.2	08/16/1967	5186.4	08/20/1967	3533.9	09/14/1967	1653.6	09/08/1967	1341.5
1968	05/24/1968	5432.6	05/29/1968	5095.6	06/05/1968	4918.1	07/01/1968	3315.0	08/25/1968	2410.0
1969	05/06/1969	5866.6	05/08/1969	5070.9	05/27/1969	4960.4	06/22/1969	4148.6	07/29/1969	2963.4
1970	05/15/1970	5473.9	05/19/1970	5035.6	05/23/1970	4542.2	06/17/1970	2634.1	06/17/1970	1918.2

Figure B-71. Volume-Duration Data Table for Test Example 10.

Once the data has been extracted, the user must choose to perform an Analytical or Graphical analysis. In this example, an analytical analysis was performed. Shown in Figure B-72 is the **Settings** tab for the analytical analysis. As shown, the distribution selected for this example is LogPearsonIII. The **Skew** option was set to **Use Station Skew** and the **Do Not Compute Excepted Probability** option was selected.

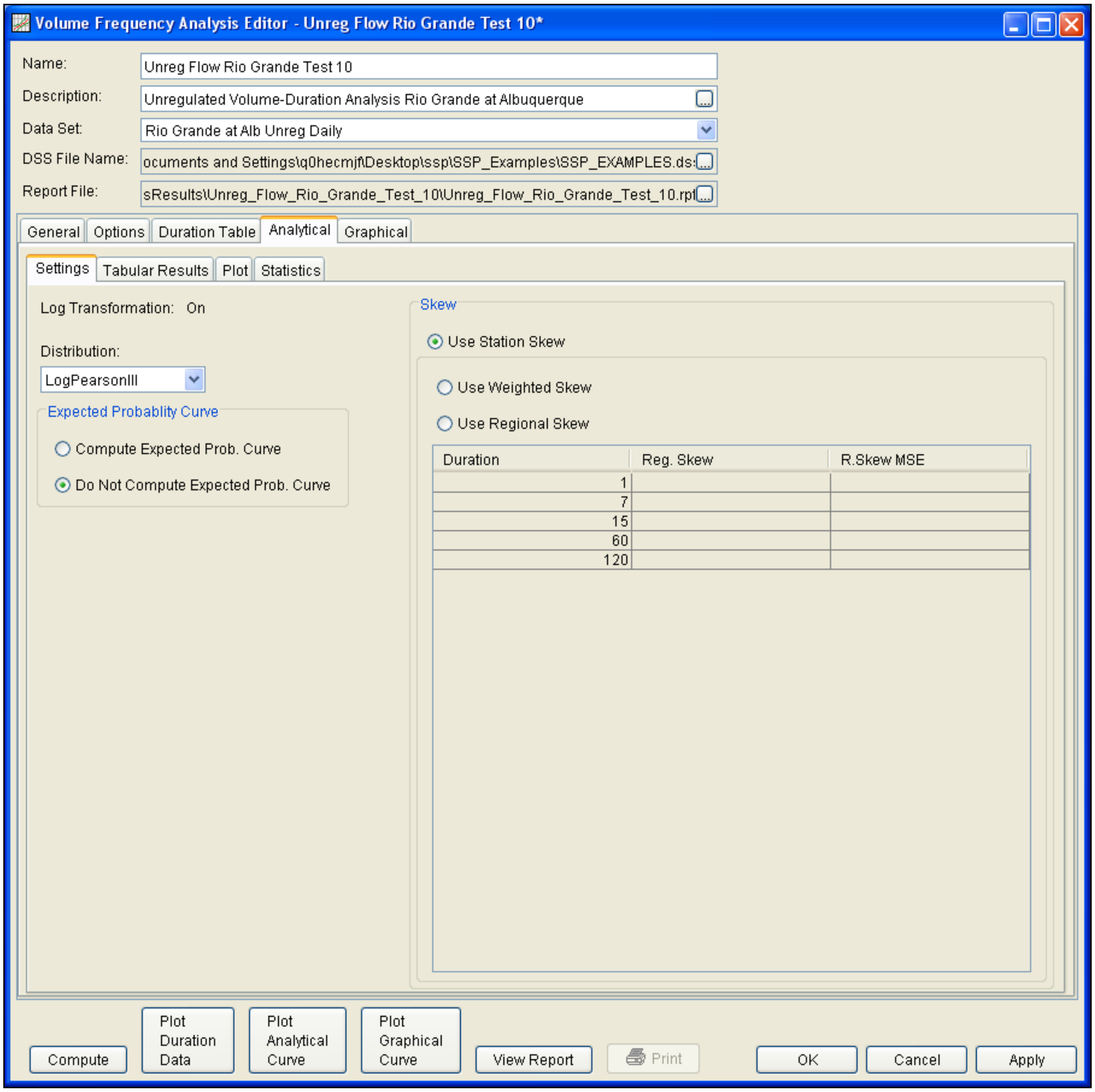
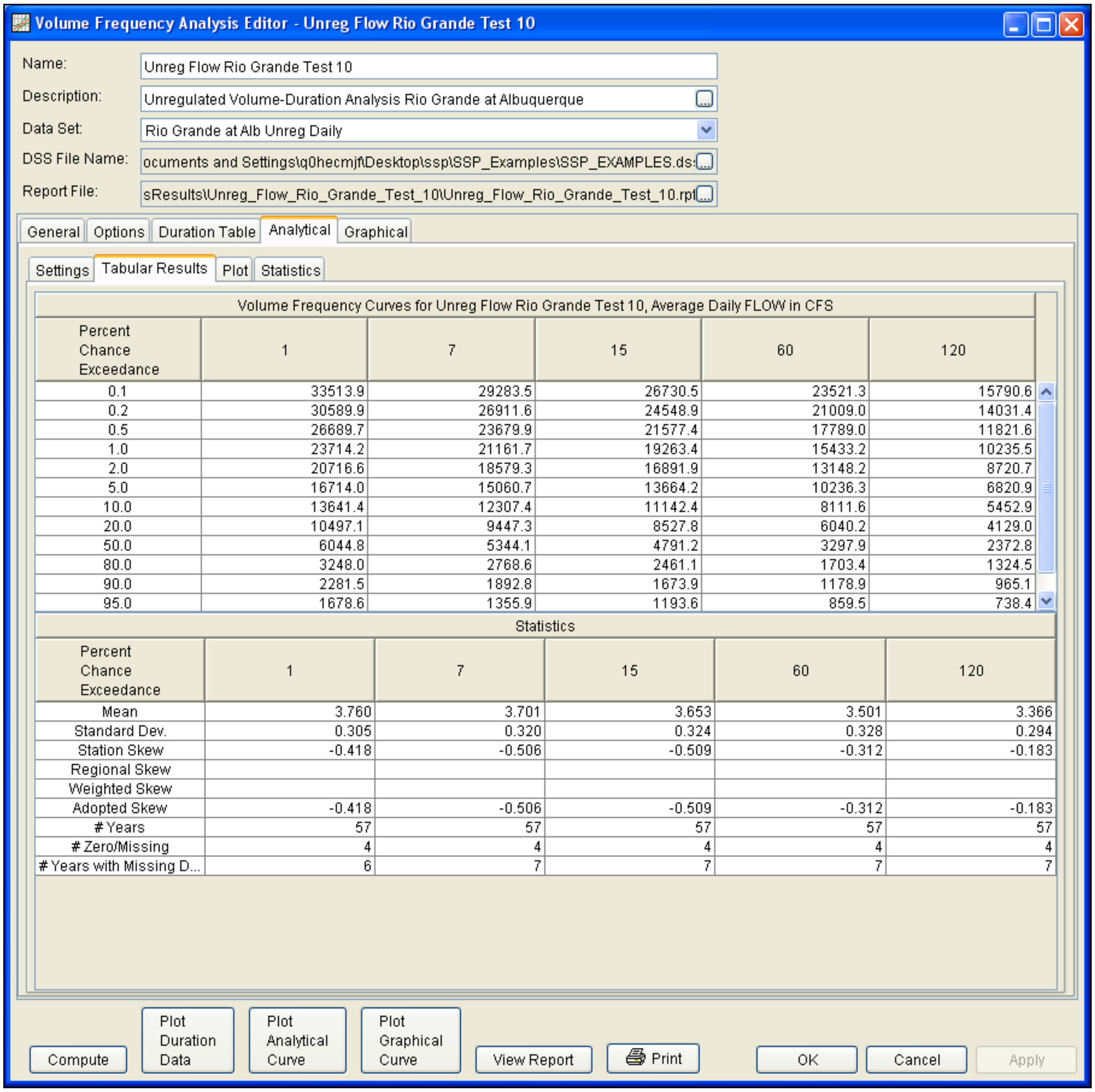


Figure B-72. Settings Tab Shown for Test Example 10.

Press the **Compute** button to perform the analysis. A message window will open stating that a few of the annual maximums occurred during the beginning of the year. The message suggests that the user change the year/season specification to capture independent events. You want to minimize the possibility that the same flood event is used for consecutive years. Press the OK button to finish the compute. Once the computations have been completed, a message window will open stating **Compute Complete.** Close this window and then select the **Tabular Results** tab within the analytical analysis. The results table should look Figure B-73. The top portion of the results table contains the percent chance exceedance for all durations (the report contains confidence limits). The bottom portion of the results table contains the statistics for all duration.



Volume Frequency Curves for Unreg Flow Rio Grande Test 10, Average Daily FLOW in CFS

Percent Chance Exceedance	1	7	15	60	120
0.1	33513.9	29283.5	26730.5	23521.3	15790.6
0.2	30589.9	26911.6	24548.9	21009.0	14031.4
0.5	26689.7	23679.9	21577.4	17789.0	11821.6
1.0	23714.2	21161.7	19263.4	15433.2	10235.5
2.0	20716.6	18579.3	16891.9	13148.2	8720.7
5.0	16714.0	15060.7	13664.2	10236.3	6820.9
10.0	13641.4	12307.4	11142.4	8111.6	5452.9
20.0	10497.1	9447.3	8527.8	6040.2	4129.0
50.0	6044.8	5344.1	4791.2	3297.9	2372.8
80.0	3248.0	2768.6	2461.1	1703.4	1324.5
90.0	2281.5	1892.8	1673.9	1178.9	965.1
95.0	1678.6	1355.9	1193.6	859.5	738.4

Statistics

Percent Chance Exceedance	1	7	15	60	120
Mean	3.760	3.701	3.653	3.501	3.366
Standard Dev.	0.305	0.320	0.324	0.328	0.294
Station Skew	-0.418	-0.506	-0.509	-0.312	-0.183
Regional Skew					
Weighted Skew					
Adopted Skew	-0.418	-0.506	-0.509	-0.312	-0.183
# Years	57	57	57	57	57
# Zero/Missing	4	4	4	4	4
# Years with Missing D...	6	7	7	7	7

Figure B-73. Tabular Results Tab for Test Example 10.

As shown in Figure B-74, the **Plot** tab contains a graph of the systematic data and the computed frequency curves. Notice how some of the frequency curves look like they might cross if the lines were extended. The **Statistics** tab can be used to modify the computed statistics to ensure that the frequency curves are consistent.

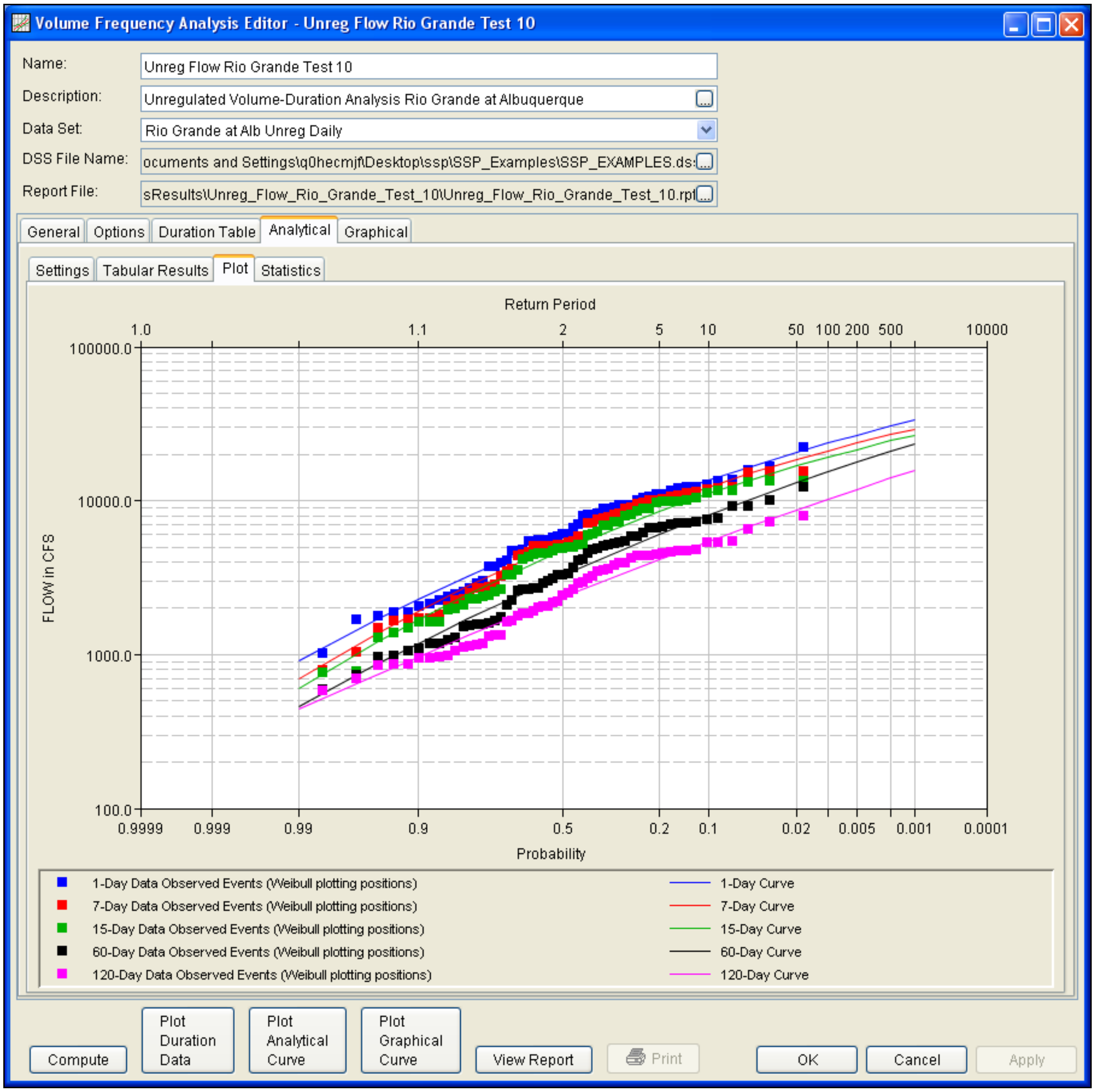


Figure B-74. Plot Tab for Example 10.

For this example, the standard deviation and the adopted skew values were modified to make sure the volume frequency curves were consistent. As shown in Figure B-75, the check boxes next to mean, standard deviation, and adopted skew were checked and then user-adjusted statistics were entered into the table for all durations. The **Compute** button must be pressed after adjusted statistics have been entered in order for the program to recompute the frequency curves using the user-adjusted statistics. Figure B-76 shows the **Plot** tab after the user-adjusted statistics were entered on the **Statistics** tab. Results on the **Tabular Results** tab will also update when user-adjusted statistics are entered on the **Statistics** tab.

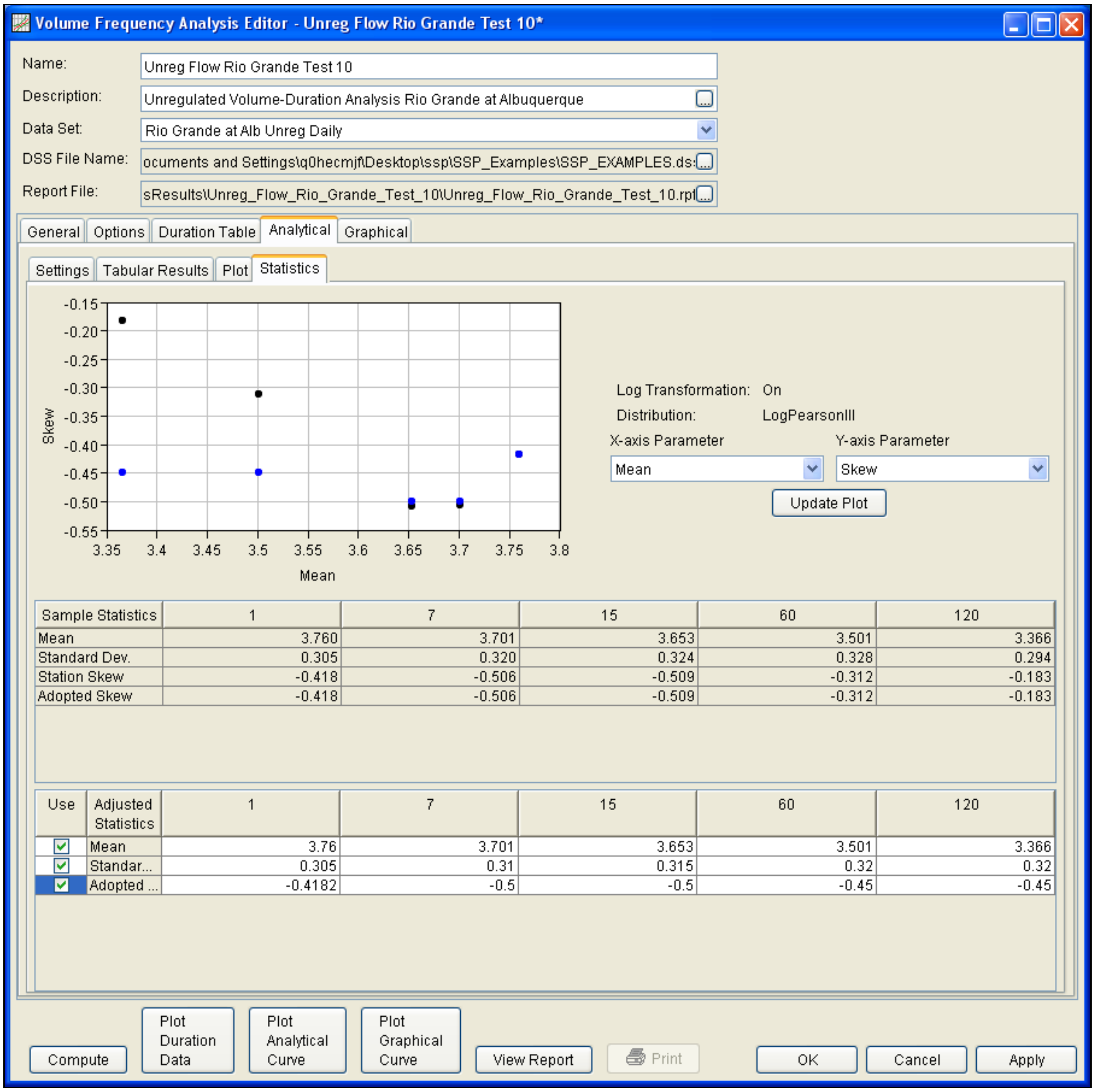


Figure B-75. Statistics Tab for Test Example 10.

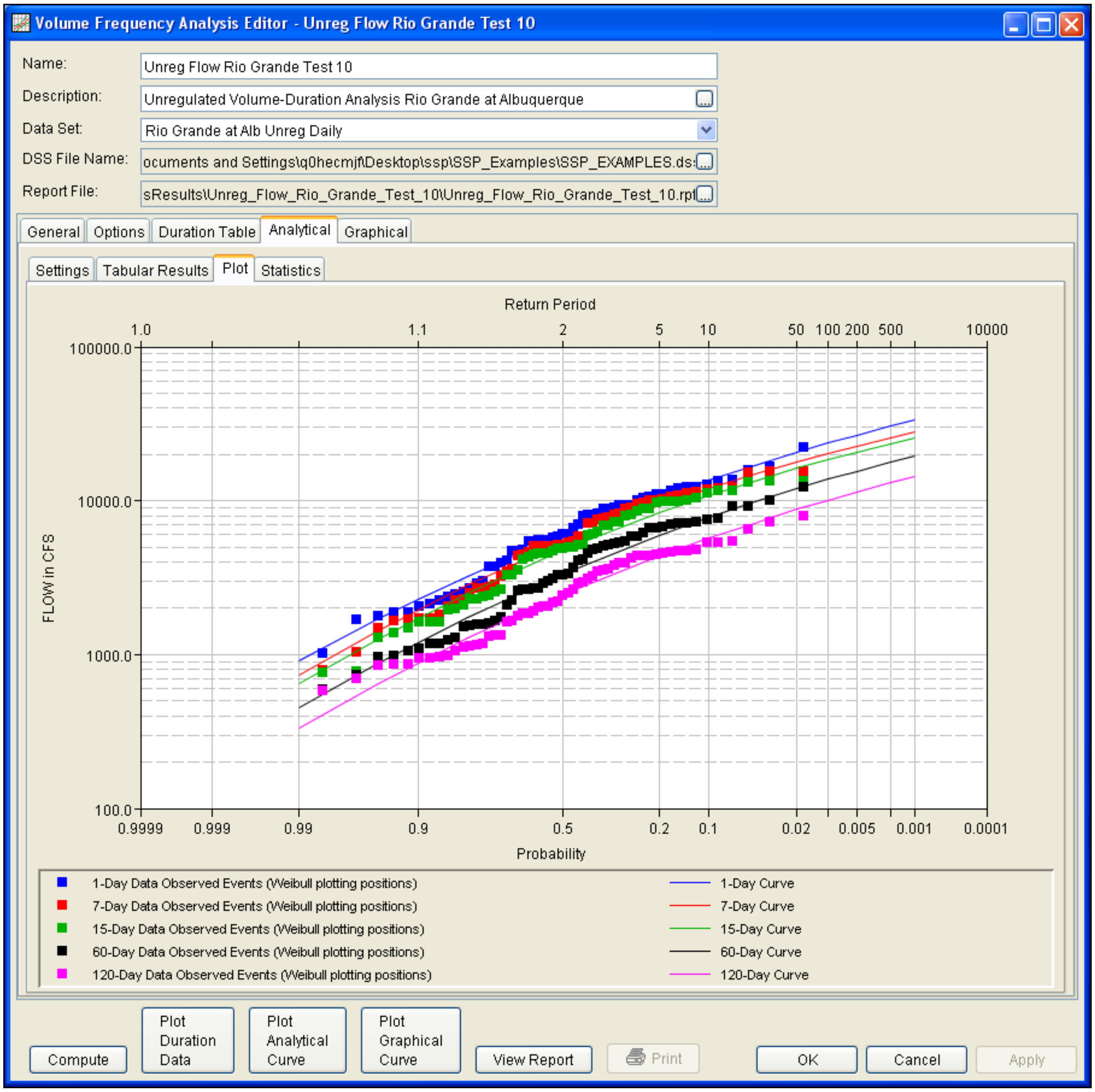


Figure B-76. Plot Tab for Example 10 After the Statistics were Adjusted on the Statistics Tab.

In addition to the Tabular Results and Plot tabs, graphical plots can be opened by selecting the **Plot Duration Data** or **Plot Analytical Curve** buttons at the bottom of the analysis window. A plot of the results for this test example is shown in Figure B-77.

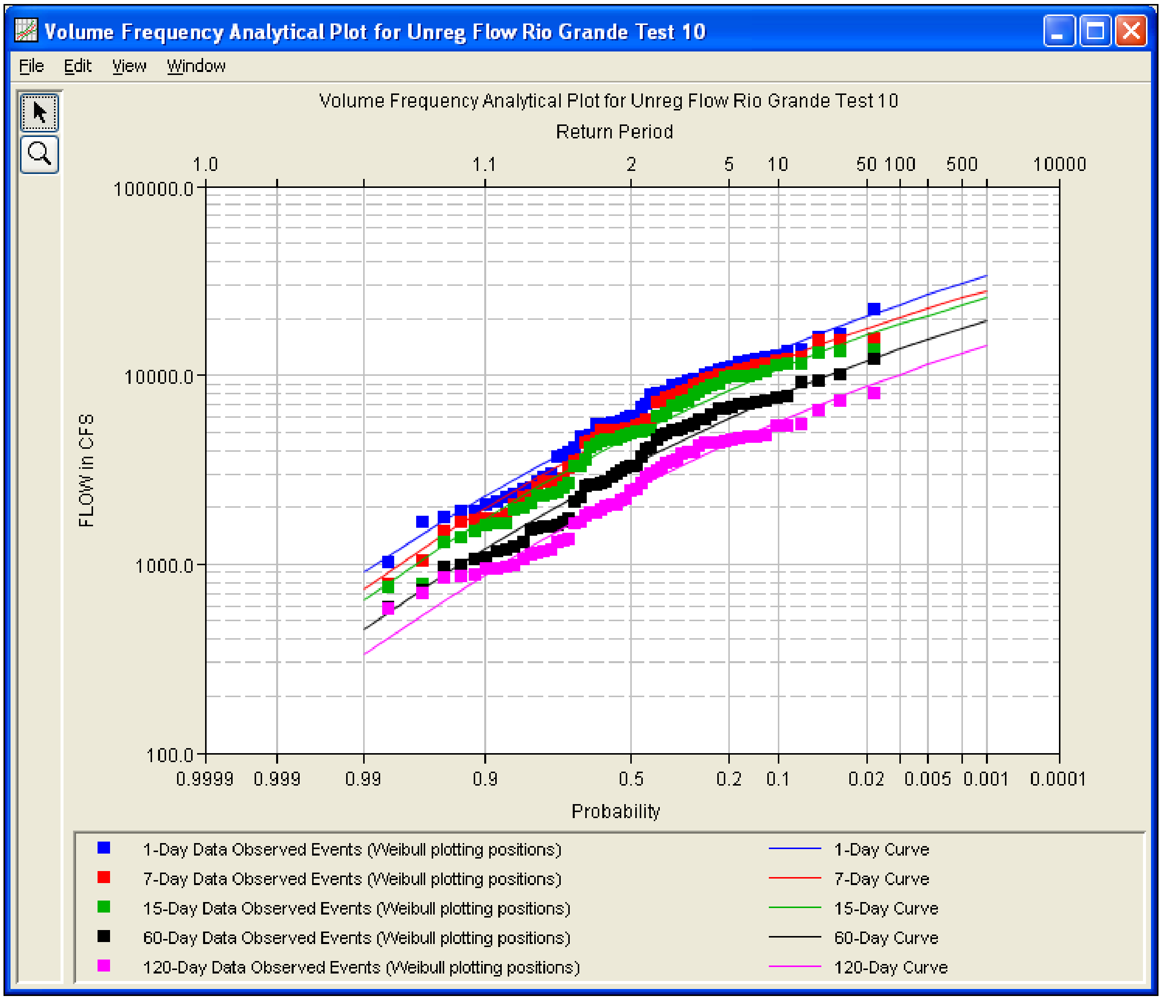
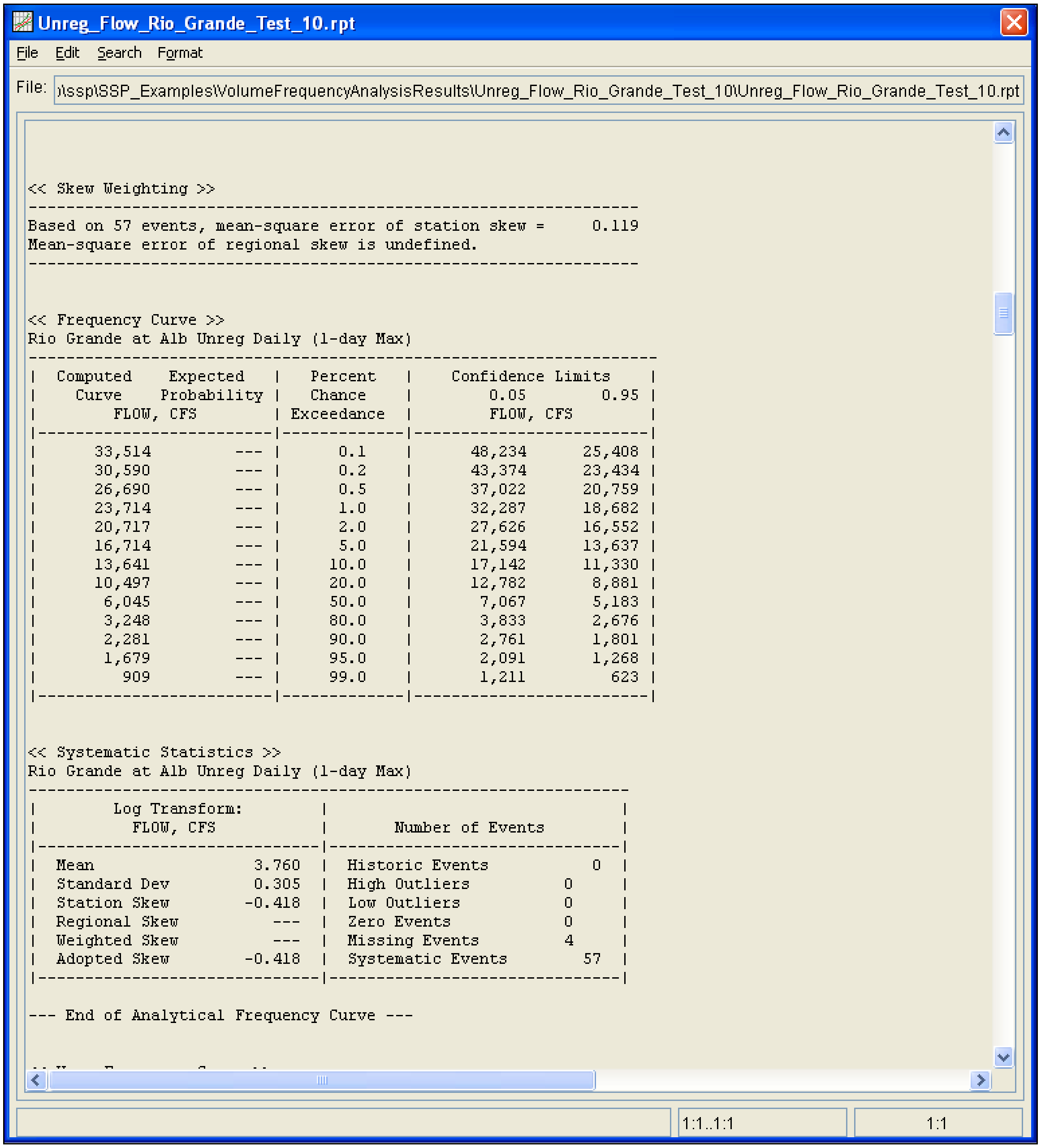


Figure B-77. Plot of the Frequency Curve Results for Test Example 10.

The tabular and graphical results can be sent to the printer or the windows clipboard for transfer into another piece of software. To print the tabular results, select **Print** from the bottom of the analysis window. To send the tabular results to the windows clipboard, highlight the data you want to send to the clipboard and then press the Control-C key sequence. To print the graphical results, first bring up the graphical plot and then select **Print** from the **File** menu. To send the graphic to the windows clipboard, select **Copy to Clipboard** from the **File** menu.

In addition to the tabular and graphical results, there is a report file that shows the order in which the calculations were performed. To review the report file, press the **View Report** button at the bottom of the analysis window. When this button is selected a text viewer will open the report file and display it on the screen. Shown in Figure B-78 is the report file for Test Example 10.

The report file contains a listing of the input data, preliminary results, outlier and historical data tests, additional calculations needed, and the final frequency curve results. Different types and amounts of information will show up in the report file depending on the data and the options that have been selected for the analysis.




```
<< Skew Weighting >>
-----------------------------------------------------------------
Based on 57 events, mean-square error of station skew =     0.119
Mean-square error of regional skew is undefined.
-----------------------------------------------------------------


<< Frequency Curve >>
Rio Grande at Alb Unreg Daily (1-day Max)
-------------------------------------------------------------------
|  Computed    Expected  |   Percent    |    Confidence Limits    |
|    Curve    Probability |    Chance    |        0.05        0.95 |
|        FLOW, CFS        | Exceedance   |        FLOW, CFS        |
|-------------------------|--------------|-------------------------|
|      33,514         --- |      0.1     |      48,234      25,408 |
|      30,590         --- |      0.2     |      43,374      23,434 |
|      26,690         --- |      0.5     |      37,022      20,759 |
|      23,714         --- |      1.0     |      32,287      18,682 |
|      20,717         --- |      2.0     |      27,626      16,552 |
|      16,714         --- |      5.0     |      21,594      13,637 |
|      13,641         --- |     10.0     |      17,142      11,330 |
|      10,497         --- |     20.0     |      12,782       8,881 |
|       6,045         --- |     50.0     |       7,067       5,183 |
|       3,248         --- |     80.0     |       3,833       2,676 |
|       2,281         --- |     90.0     |       2,761       1,801 |
|       1,679         --- |     95.0     |       2,091       1,268 |
|         909         --- |     99.0     |       1,211         623 |
|-------------------------|--------------|-------------------------|


<< Systematic Statistics >>
Rio Grande at Alb Unreg Daily (1-day Max)
----------------------------------------------------------------
|        Log Transform:        |                               |
|          FLOW, CFS           |       Number of Events        |
|------------------------------|-------------------------------|
|  Mean                  3.760 |  Historic Events          0   |
|  Standard Dev          0.305 |  High Outliers         0      |
|  Station Skew         -0.418 |  Low Outliers          0      |
|  Regional Skew           --- |  Zero Events           0      |
|  Weighted Skew           --- |  Missing Events        4      |
|  Adopted Skew         -0.418 |  Systematic Events       57   |
|------------------------------|-------------------------------|

--- End of Analytical Frequency Curve ---
```

Figure B-78. Report File for Test Example 10.

Example 11: Volume Frequency Analysis, Minimum Flows

This example demonstrates how to create a low flow Volume Frequency analysis. The data for this example was downloaded from the USGS. It is comprised of daily average flow for the Chattahoochee River at Cornelia, Georgia. Drought conditions were occurring in the region at the time of this analysis. Among other things, a low flow analysis can be used to determine the severity of a drought. The period of record for this example is from 1957 to 2007. To view the data, right-click on the data record labeled "**Chattahoochee River**" in the study explorer and then select **Plot**. The data will appear as shown in Figure B-79.

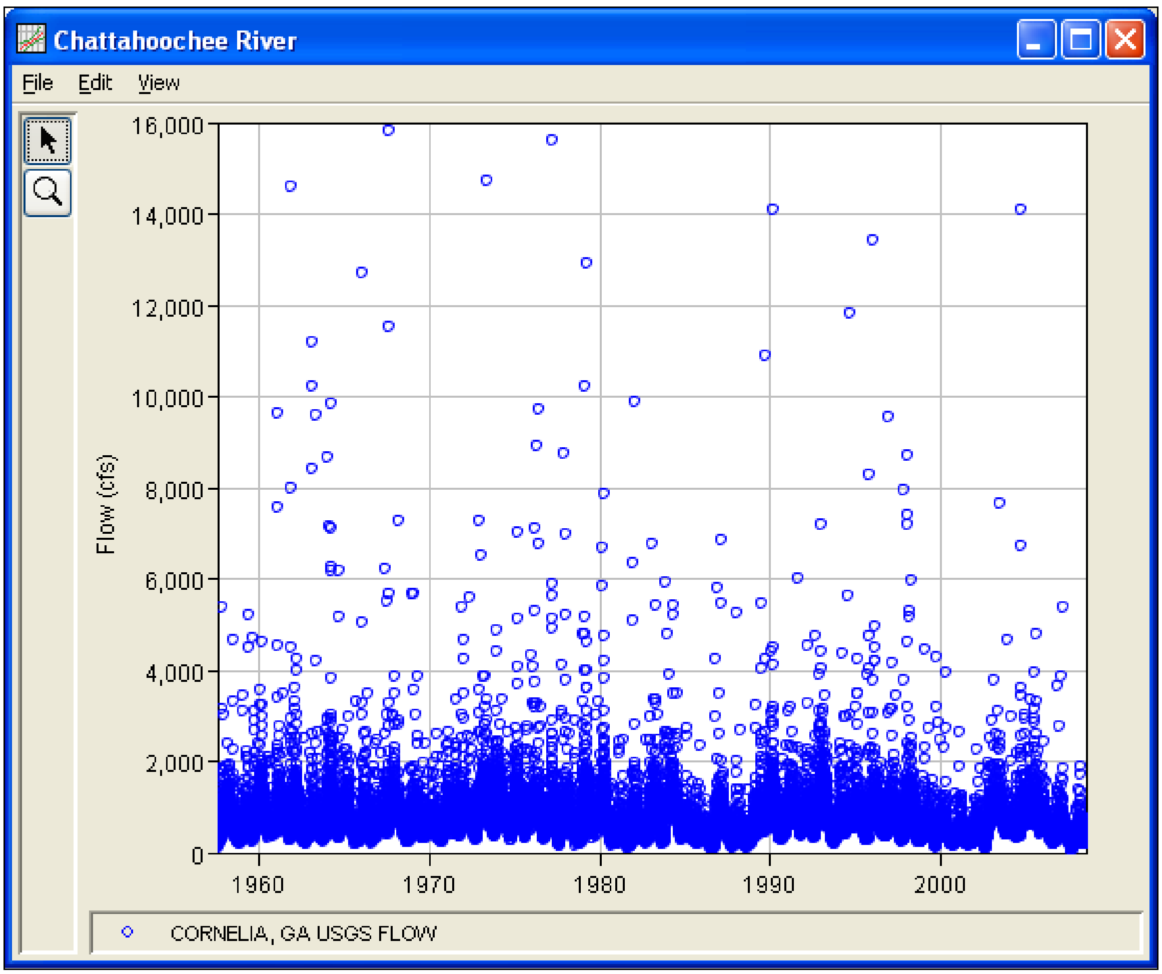


Figure B-79. Plot of Daily Average Flow for Example 11.

A Volume Frequency analysis has been developed for this example. To open the Volume Frequency Analysis editor for test example 11, either double-click on the analysis labeled **Low Flow Analysis Test 11** from the study explorer, or from the **Analysis** menu select open, then select **Low Flow Analysis Test 11** from the list of available analyses. When test 11 is opened, the Volume Frequency Analysis editor will appear as shown in Figure B-80.

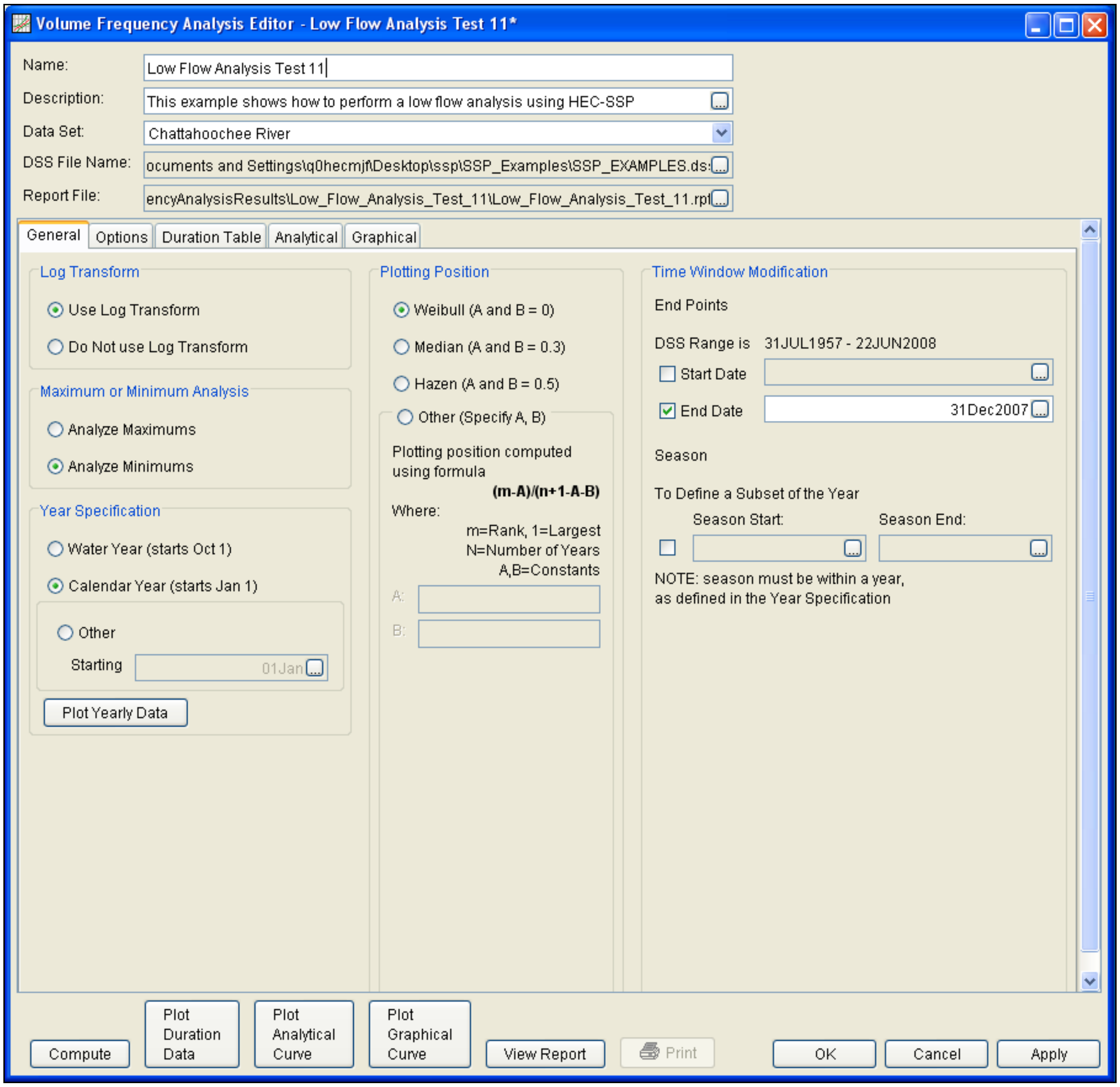


Figure B-80. Volume Frequency Analysis Editor for Test Example 11.

Shown in Figure B-80 are the general settings that were used to perform this frequency analysis. For this analysis, the **Use Log Transform** option was selected, the **Weibull** plotting position method was selected, **Analyze Minimums** was selected, and the **Calendar Year** option was selected. The Calendar Year option was selected because low flows are possible in late September, early November. Starting the year on January 1 minimizes the possibility of using the same low flow event in multiple years. An end date of 31 December 2007 was entered in the **Time Window Modification**. This end date was specified because not all the data for the summer of 2008 was available at the time of the analysis.

Shown in Figure B-81 is the Volume Frequency Analysis editor with the **Options Tab** selected. Features on this tab include an option to override the default **Flow Duration** values, an option to override the default **Frequency Ordinates**, and **Output Labeling**.

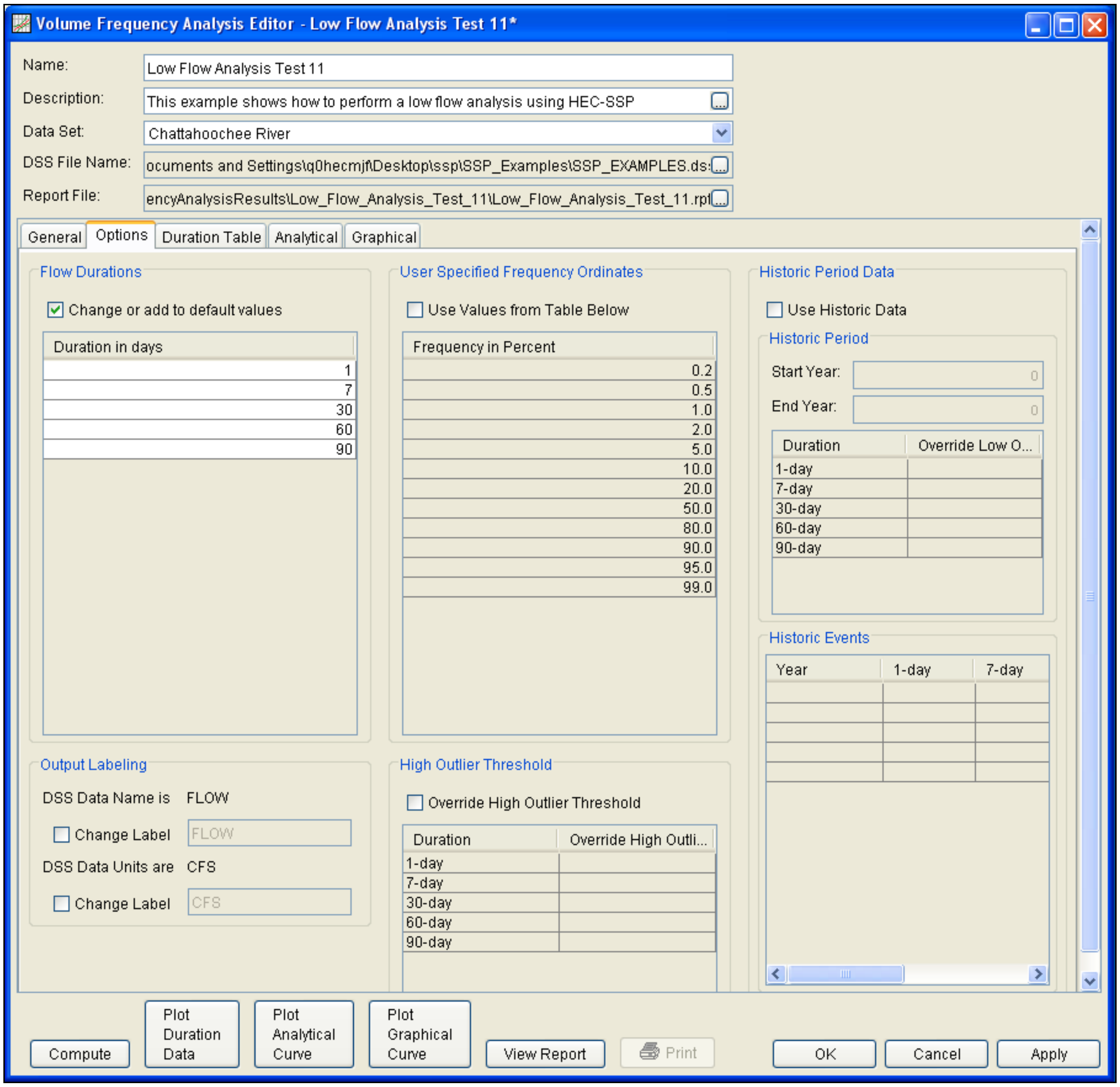
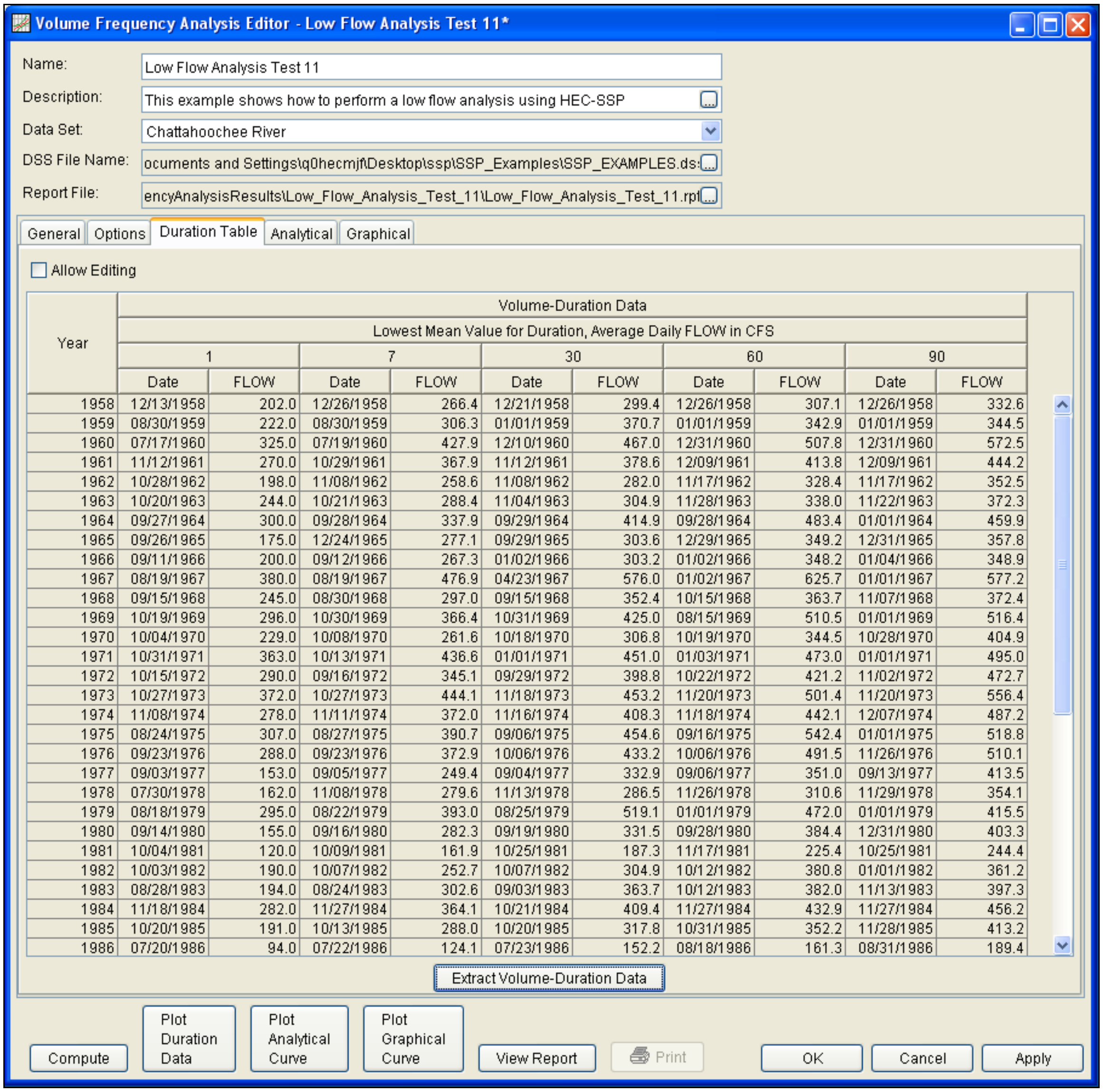


Figure B-81. Options Tab Shown for Test Example 11.

Once all of the General and Optional settings are set or selected, the user can extract the volume-duration data. Select the **Duration Data** tab and press the **Extract Volume-Duration Data** button at the bottom of the table. The table should then fill with the flow-duration values, as shown in Figure B-82.



Year	Volume-Duration Data									
	Lowest Mean Value for Duration, Average Daily FLOW in CFS									
	1		7		30		60		90	
	Date	FLOW	Date	FLOW	Date	FLOW	Date	FLOW	Date	FLOW
1958	12/13/1958	202.0	12/26/1958	266.4	12/21/1958	299.4	12/26/1958	307.1	12/26/1958	332.6
1959	08/30/1959	222.0	08/30/1959	306.3	01/01/1959	370.7	01/01/1959	342.9	01/01/1959	344.5
1960	07/17/1960	325.0	07/19/1960	427.9	12/10/1960	467.0	12/31/1960	507.8	12/31/1960	572.5
1961	11/12/1961	270.0	10/29/1961	367.9	11/12/1961	378.6	12/09/1961	413.8	12/09/1961	444.2
1962	10/28/1962	198.0	11/08/1962	258.6	11/08/1962	282.0	11/17/1962	328.4	11/17/1962	352.5
1963	10/20/1963	244.0	10/21/1963	288.4	11/04/1963	304.9	11/28/1963	338.0	11/22/1963	372.3
1964	09/27/1964	300.0	09/28/1964	337.9	09/29/1964	414.9	09/28/1964	483.4	01/01/1964	459.9
1965	09/26/1965	175.0	12/24/1965	277.1	09/29/1965	303.6	12/29/1965	349.2	12/31/1965	357.8
1966	09/11/1966	200.0	09/12/1966	267.3	01/02/1966	303.2	01/02/1966	348.2	01/04/1966	348.9
1967	08/19/1967	380.0	08/19/1967	476.9	04/23/1967	576.0	01/02/1967	625.7	01/01/1967	577.2
1968	09/15/1968	245.0	08/30/1968	297.0	09/15/1968	352.4	10/15/1968	363.7	11/07/1968	372.4
1969	10/19/1969	296.0	10/30/1969	366.4	10/31/1969	425.0	08/15/1969	510.5	01/01/1969	516.4
1970	10/04/1970	229.0	10/08/1970	261.6	10/18/1970	306.8	10/19/1970	344.5	10/28/1970	404.9
1971	10/31/1971	363.0	10/13/1971	436.6	01/01/1971	451.0	01/03/1971	473.0	01/01/1971	495.0
1972	10/15/1972	290.0	09/16/1972	345.1	09/29/1972	398.8	10/22/1972	421.2	11/02/1972	472.7
1973	10/27/1973	372.0	10/27/1973	444.1	11/18/1973	453.2	11/20/1973	501.4	11/20/1973	556.4
1974	11/08/1974	278.0	11/11/1974	372.0	11/16/1974	408.3	11/18/1974	442.1	12/07/1974	487.2
1975	08/24/1975	307.0	08/27/1975	390.7	09/06/1975	454.6	09/16/1975	542.4	01/01/1975	518.8
1976	09/23/1976	288.0	09/23/1976	372.9	10/06/1976	433.2	10/06/1976	491.5	11/26/1976	510.1
1977	09/03/1977	153.0	09/05/1977	249.4	09/04/1977	332.9	09/06/1977	351.0	09/13/1977	413.5
1978	07/30/1978	162.0	11/08/1978	279.6	11/13/1978	286.5	11/26/1978	310.6	11/29/1978	354.1
1979	08/18/1979	295.0	08/22/1979	393.0	08/25/1979	519.1	01/01/1979	472.0	01/01/1979	415.5
1980	09/14/1980	155.0	09/16/1980	282.3	09/19/1980	331.5	09/28/1980	384.4	12/31/1980	403.3
1981	10/04/1981	120.0	10/09/1981	161.9	10/25/1981	187.3	11/17/1981	225.4	10/25/1981	244.4
1982	10/03/1982	190.0	10/07/1982	252.7	10/07/1982	304.9	10/12/1982	380.8	01/01/1982	361.2
1983	08/28/1983	194.0	08/24/1983	302.6	09/03/1983	363.7	10/12/1983	382.0	11/13/1983	397.3
1984	11/18/1984	282.0	11/27/1984	364.1	10/21/1984	409.4	11/27/1984	432.9	11/27/1984	456.2
1985	10/20/1985	191.0	10/13/1985	288.0	10/20/1985	317.8	10/31/1985	352.2	11/28/1985	413.2
1986	07/20/1986	94.0	07/22/1986	124.1	07/23/1986	152.2	08/18/1986	161.3	08/31/1986	189.4

Figure B-82. Volume-Duration Data Table for Example 11.

Once the data has been extracted, the user must choose to perform an Analytical or Graphical analysis. In this example, an analytical analysis was performed. Shown in Figure B-83 is the **Settings** tab for the analytical analysis. As shown, the distribution selected for this example is LogPearsonIII. The **Skew** option was set to **Use Station Skew** and the **Do Not Compute Excepted Probability** option was selected.

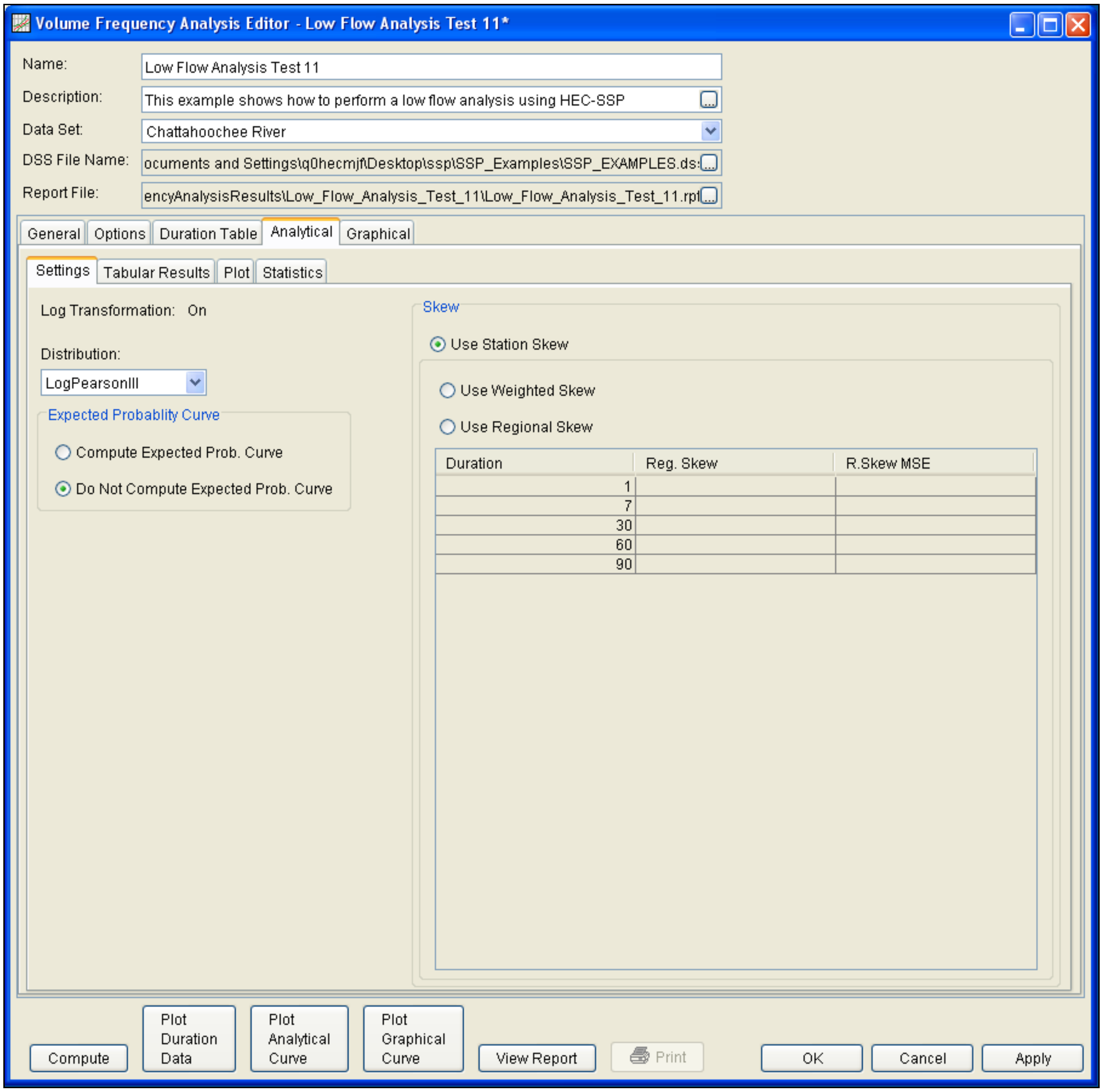
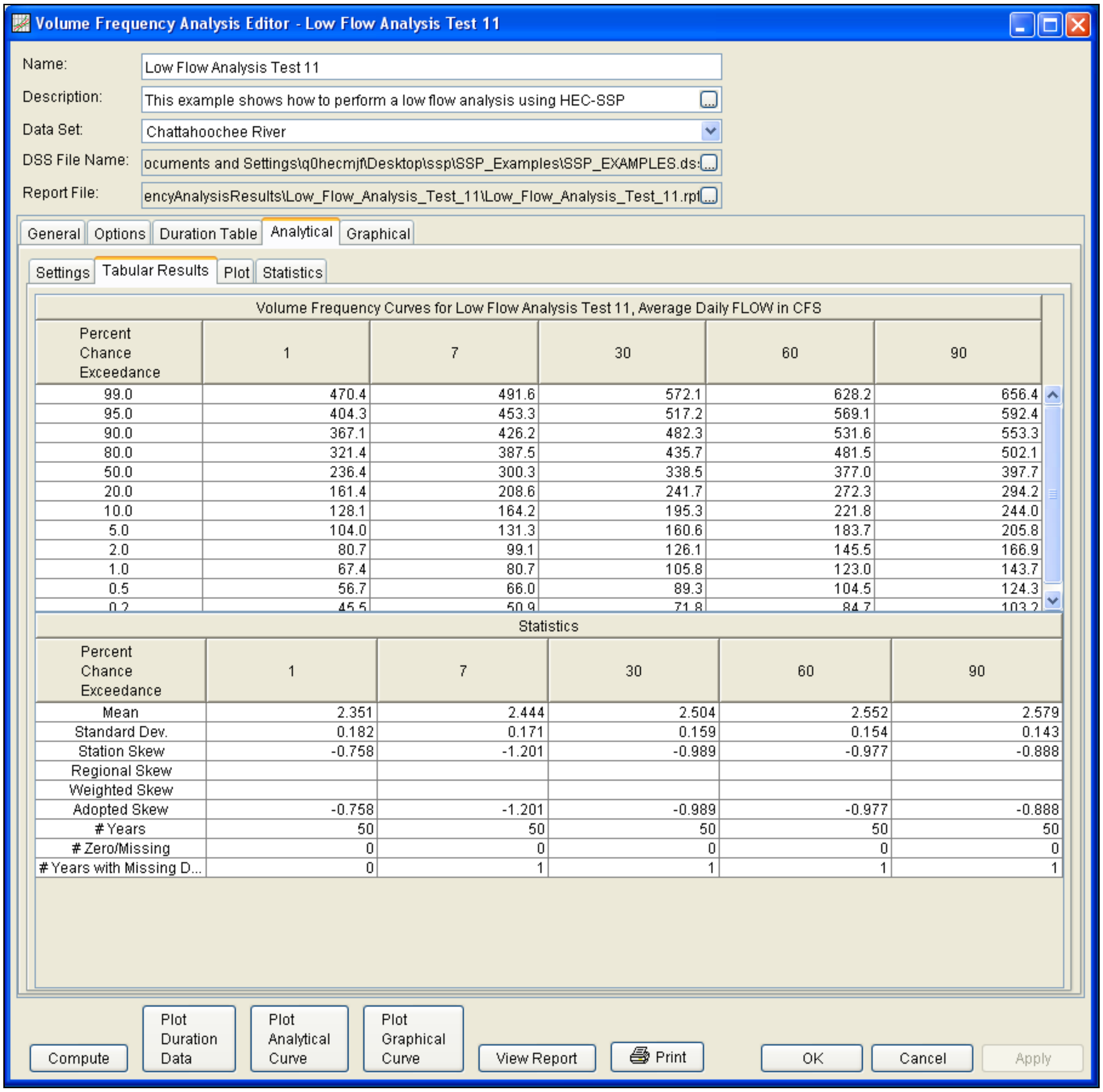


Figure B-83. Settings Tab Shown for Test Example 11.

Press the **Compute** button to perform the analysis. A message window will open stating that a few of the annual maximums occurred during the beginning of the year. The message suggests that the user change the year/season specification to capture independent events. You want to minimize the possibility that the same flood event is used for consecutive years. Press the OK button to finish the computation. Once the computations have been completed, a message window will open stating **Compute Complete.** Close this window and then select the **Tabular Results** tab within the analytical analysis. The results table should look Figure B-84. The top portion of the results table contains the percent chance exceedance for all durations (the report contains confidence limits). The bottom portion of the results table contains the statistics for all durations.



Volume Frequency Curves for Low Flow Analysis Test 11, Average Daily FLOW in CFS

Percent Chance Exceedance	1	7	30	60	90
99.0	470.4	491.6	572.1	628.2	656.4
95.0	404.3	453.3	517.2	569.1	592.4
90.0	367.1	426.2	482.3	531.6	553.3
80.0	321.4	387.5	435.7	481.5	502.1
50.0	236.4	300.3	338.5	377.0	397.7
20.0	161.4	208.6	241.7	272.3	294.2
10.0	128.1	164.2	195.3	221.8	244.0
5.0	104.0	131.3	160.6	183.7	205.8
2.0	80.7	99.1	126.1	145.5	166.9
1.0	67.4	80.7	105.8	123.0	143.7
0.5	56.7	66.0	89.3	104.5	124.3
0.2	45.5	50.9	71.8	84.7	103.2

Statistics

Percent Chance Exceedance	1	7	30	60	90
Mean	2.351	2.444	2.504	2.552	2.579
Standard Dev.	0.182	0.171	0.159	0.154	0.143
Station Skew	-0.758	-1.201	-0.989	-0.977	-0.888
Regional Skew					
Weighted Skew					
Adopted Skew	-0.758	-1.201	-0.989	-0.977	-0.888
# Years	50	50	50	50	50
# Zero/Missing	0	0	0	0	0
# Years with Missing D...	0	1	1	1	1

Figure B-84. Tabular Results Tab for Test Example 11.

As shown in Figure B-85, the **Plot** contains a graph of the systematic data and the computed frequency curves. Notice how some of the frequency curves look like they might cross if the lines were extended. The **Statistics** tab can be used to modify the computed statistics to ensure that the frequency curves are consistent.

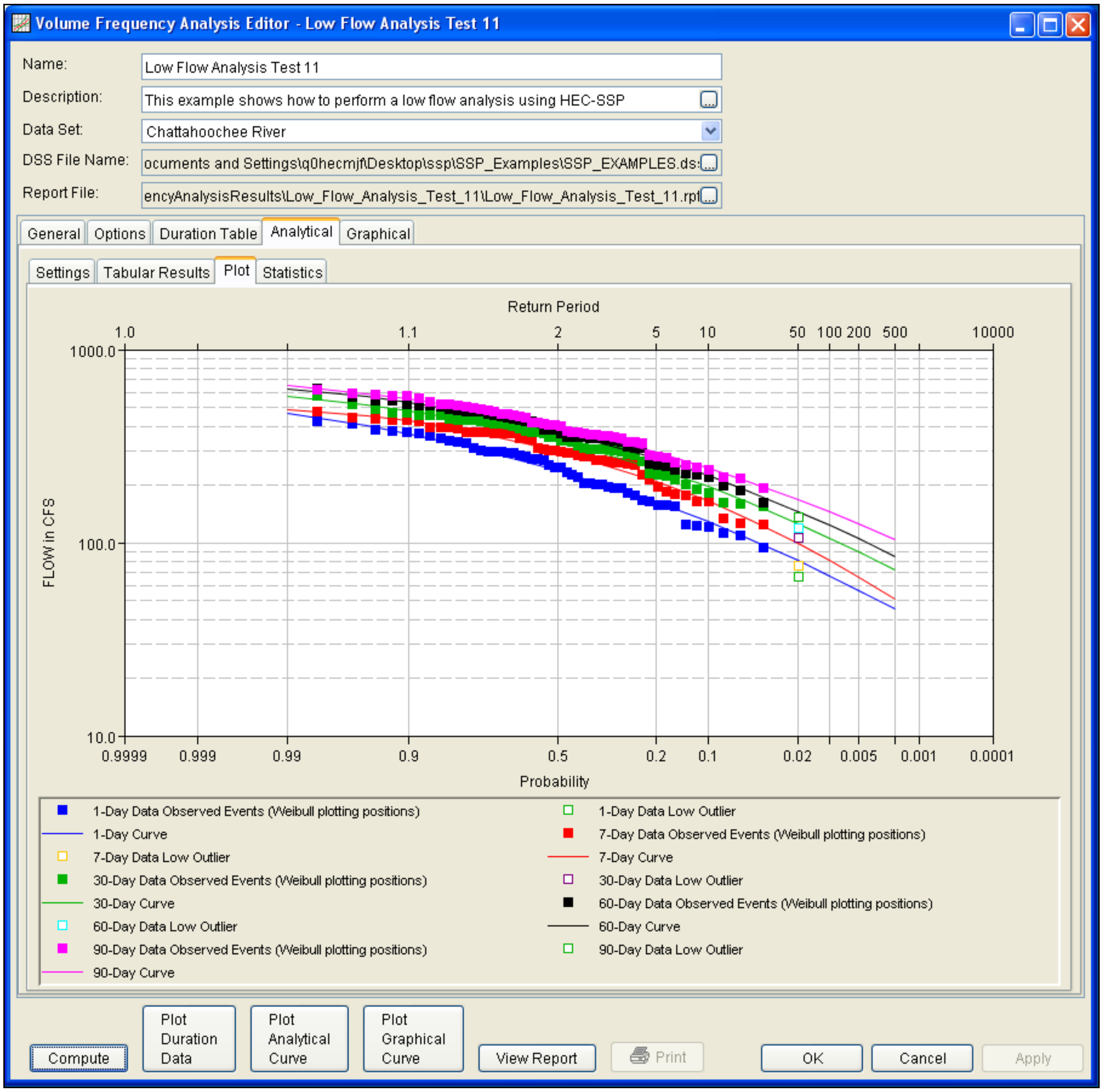


Figure B-85. Plot for Test Example 11.

For this example, the standard deviation and the adopted skew were modified to make sure the volume frequency curves were consistent. As shown in Figure B-86, the check boxes next to mean, standard deviation, and adopted skew were checked and then user-adjusted statistics were entered into the table for all durations. The **Compute** button must be pressed after adjusted statistics have been entered in order for the program to recompute the frequency curves using the user-adjusted statistics. Figure B-87 shows the **Plot** tab after the user-adjusted statistics were entered on the **Statistics** tab. Results in the **Tabular Results** table will also update when user-adjusted statistics are entered on the **Statistics** tab.

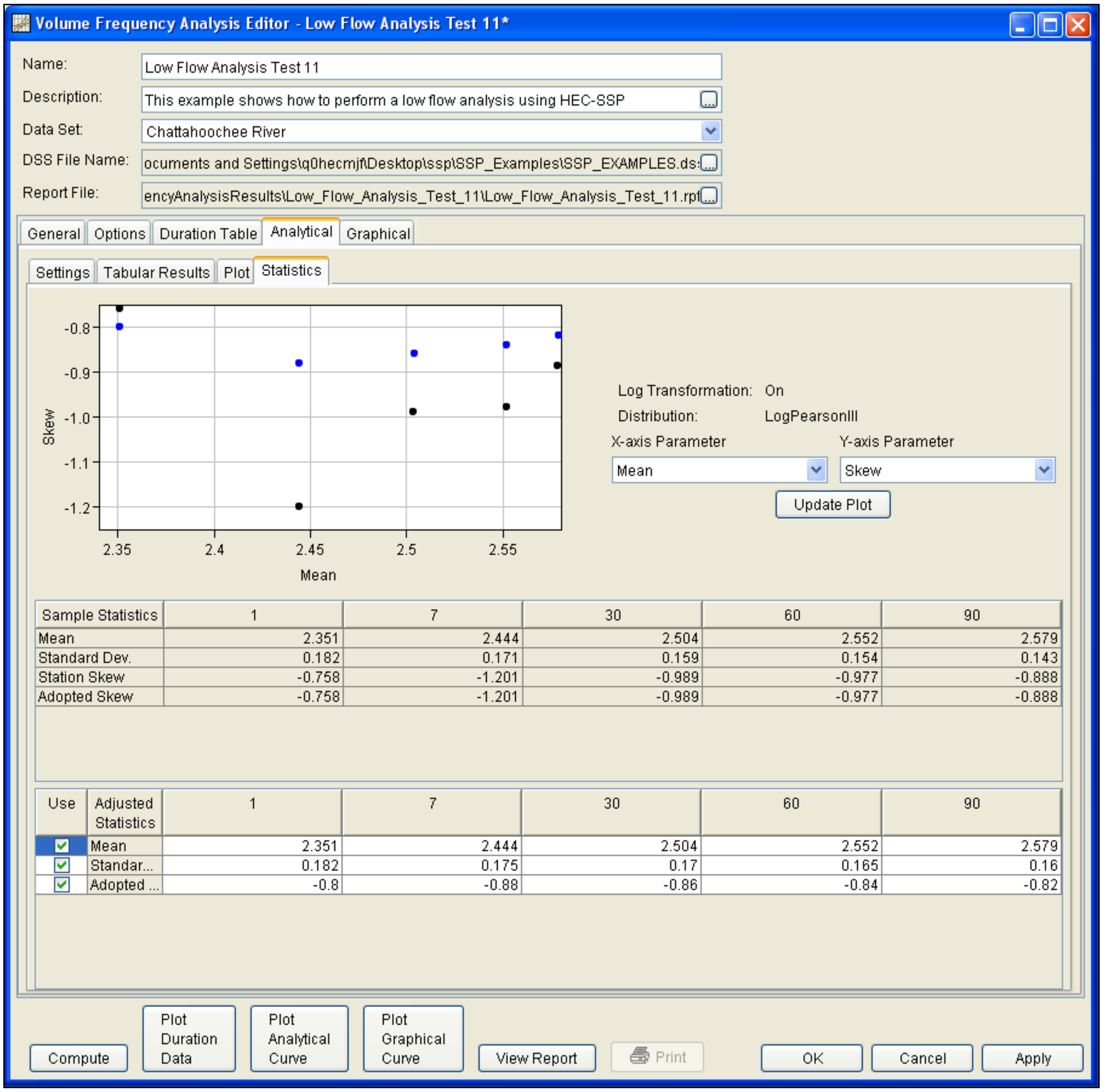


Figure B-86. Statistics Tab for Test Example 11.

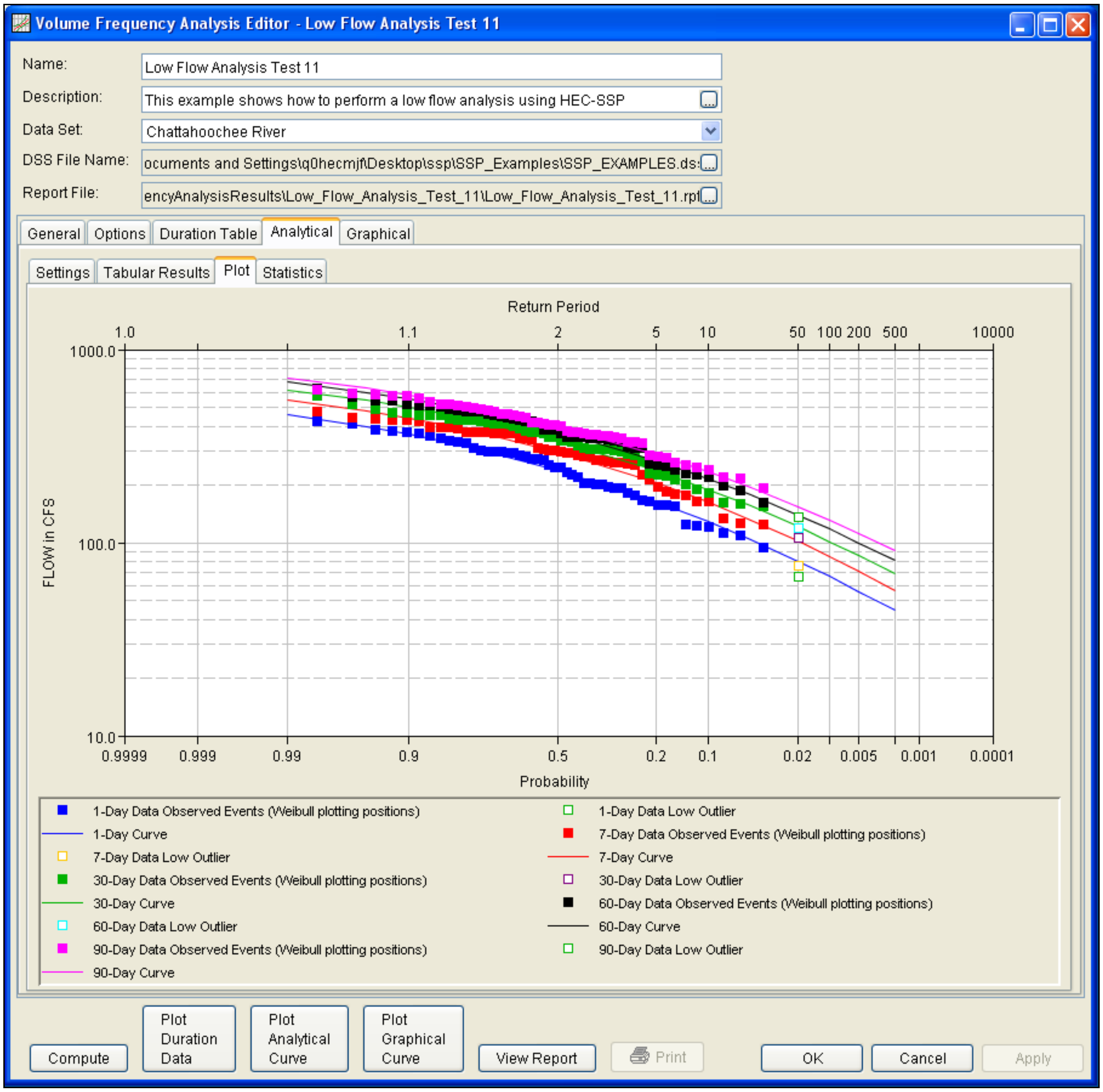


Figure B-87. Plot Tab for Test Example 11.

In addition to the Tabular Results and Plot tabs, graphical plots can be opened by selecting the **Plot Duration Data** or **Plot Analytical Curve** buttons at the bottom of the analysis window. A plot of the results for this test example is shown in Figure B-88.

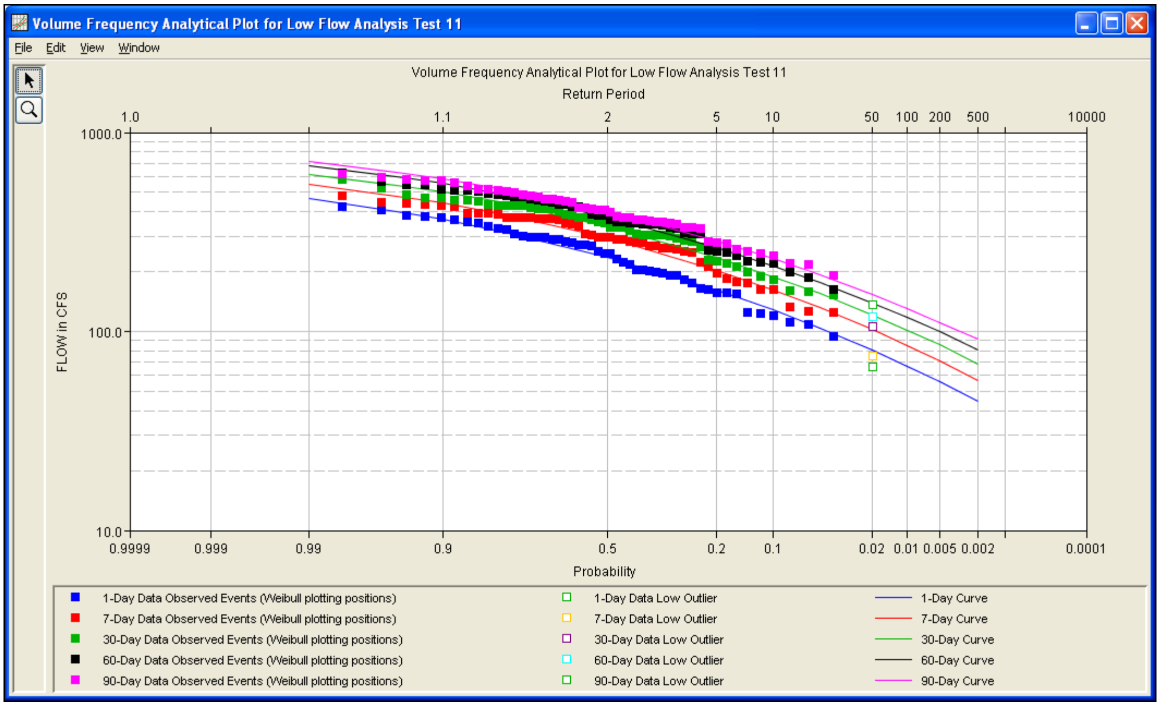
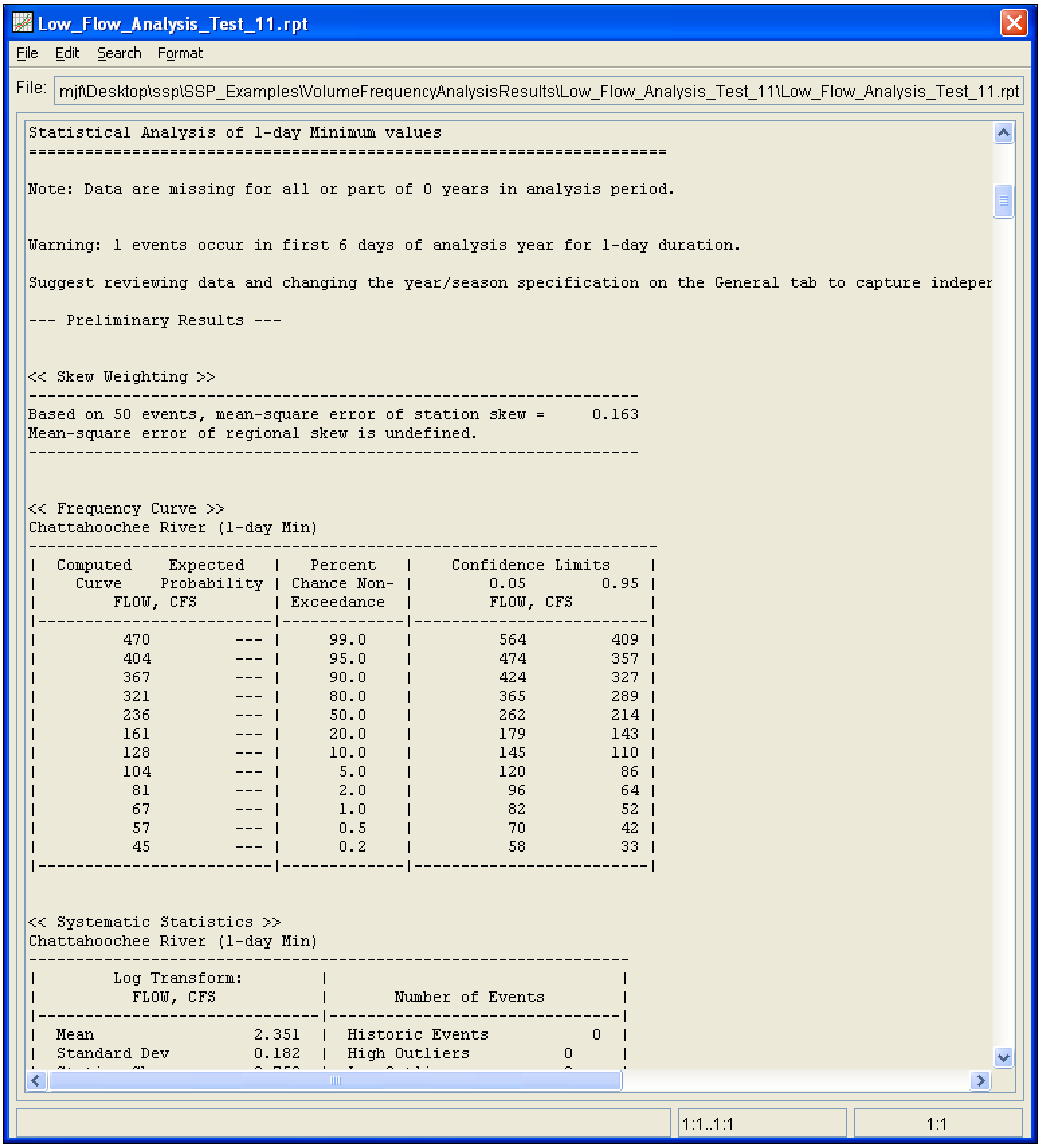


Figure B-88. Plot of the Frequency Curve Results for Test Example 11.

The tabular and graphical results can be sent to the printer or the windows clipboard for transfer into another piece of software. To print the tabular results, select **Print** from the bottom of the analysis window. To send the tabular results to the windows clipboard, highlight the data you want to send to the clipboard and then press the Control-C key sequence. To print the graphical results, first bring up the graphical plot and then select **Print** from the **File** menu. To send the graphic to the windows clipboard, select **Copy to Clipboard** from the **File** menu.

In addition to the tabular and graphical results, there is a report file that shows the order in which the calculations were performed. To review the report file, press the **View Report** button at the bottom of the analysis window. When this button is selected a text viewer will open the report file and display it on the screen. Shown in Figure B-89 is the report file for Test Example 11.

The report file contains a listing of the input data, preliminary results, outlier and historical data tests, additional calculations needed, and the final frequency curve results. Different types and amounts of information will show up in the report file depending on the data and the options that have been selected for the analysis.




```
Statistical Analysis of 1-day Minimum values
====================================================================

Note: Data are missing for all or part of 0 years in analysis period.


Warning: 1 events occur in first 6 days of analysis year for 1-day duration.

Suggest reviewing data and changing the year/season specification on the General tab to capture indeper

--- Preliminary Results ---


<< Skew Weighting >>
-----------------------------------------------------------------
Based on 50 events, mean-square error of station skew =     0.163
Mean-square error of regional skew is undefined.
-----------------------------------------------------------------



<< Frequency Curve >>
Chattahoochee River (1-day Min)
-------------------------------------------------------------------
|  Computed    Expected  |   Percent   |    Confidence Limits     |
|    Curve    Probability | Chance Non- |      0.05         0.95   |
|        FLOW, CFS        | Exceedance  |         FLOW, CFS        |
|-------------------------|-------------|--------------------------|
|         470         --- |    99.0     |        564          409  |
|         404         --- |    95.0     |        474          357  |
|         367         --- |    90.0     |        424          327  |
|         321         --- |    80.0     |        365          289  |
|         236         --- |    50.0     |        262          214  |
|         161         --- |    20.0     |        179          143  |
|         128         --- |    10.0     |        145          110  |
|         104         --- |     5.0     |        120           86  |
|          81         --- |     2.0     |         96           64  |
|          67         --- |     1.0     |         82           52  |
|          57         --- |     0.5     |         70           42  |
|          45         --- |     0.2     |         58           33  |
|-------------------------|-------------|--------------------------|


<< Systematic Statistics >>
Chattahoochee River (1-day Min)
----------------------------------------------------------------
|        Log Transform:        |                                |
|          FLOW, CFS           |        Number of Events        |
|------------------------------|--------------------------------|
|  Mean                 2.351  |  Historic Events            0  |
|  Standard Dev         0.182  |  High Outliers           0     |
```

Figure B-89. Report File for Test Example 11.

Example 12: Duration Analysis, BIN (STATS) Method

This example demonstrates how to use the Duration analysis. The data for this example is daily average flow from the Fishkill Creek (Beacon NY) USGS stream gage. The period of record used for this example is from 01 Oct, 1944 to 30 Sep, 1968. To view the data, right-click on the data record labeled "**Fishkill Creek-Daily Flow**" in the study explorer and then select **Plot**. The data will appear as shown in Figure B-90.

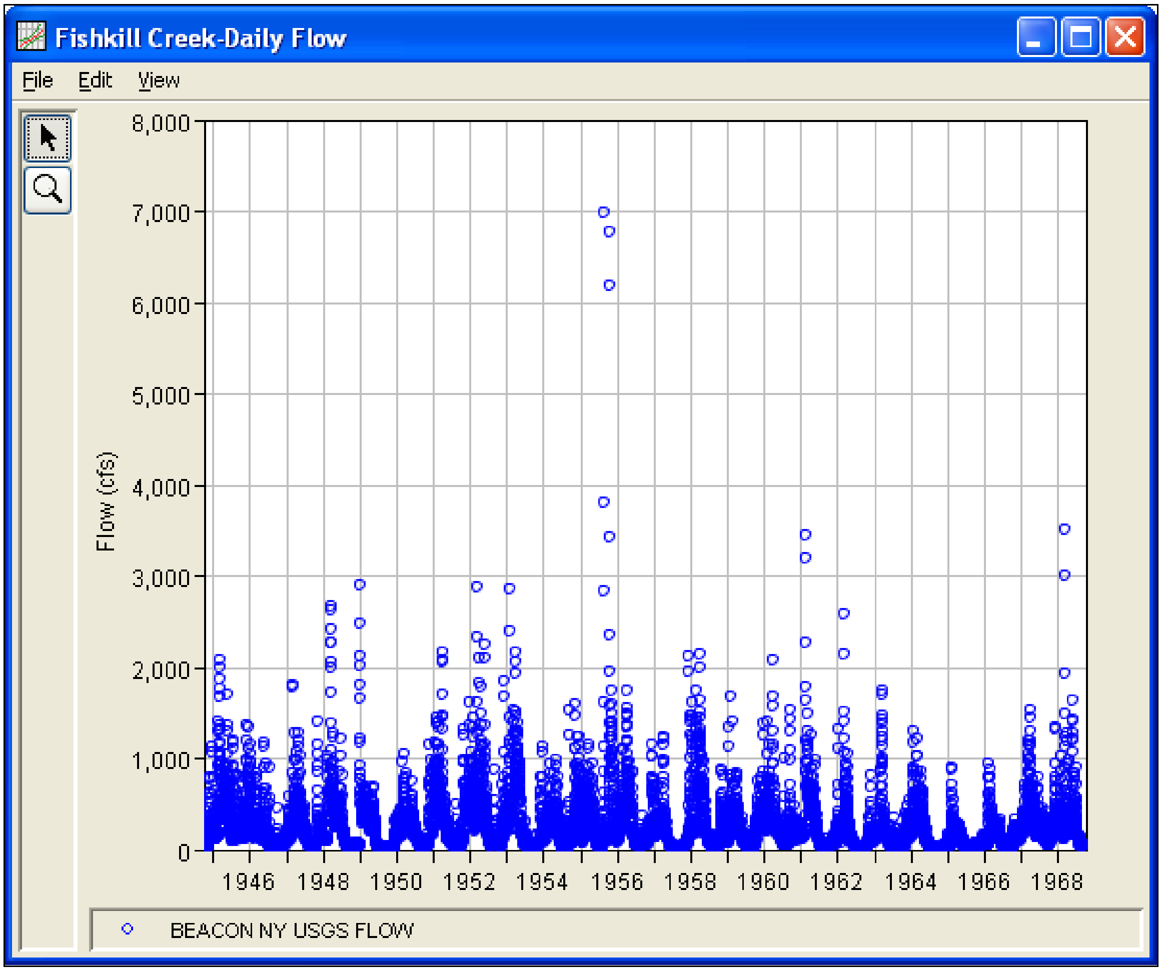


Figure B-90. Plot of the Daily Average Flow for Example 12.

A Duration analysis has been developed for this example. To open the analysis editor for Test Example 12, either double-click on the analysis labeled **Fishkill Creek Test 12** from the study explorer, or from the **Analysis** menu select open, then select **Fishkill Creek Test 12** from the list of available analyses. When Test 12 is opened, the duration analysis editor will appear as shown in Figure B-91.

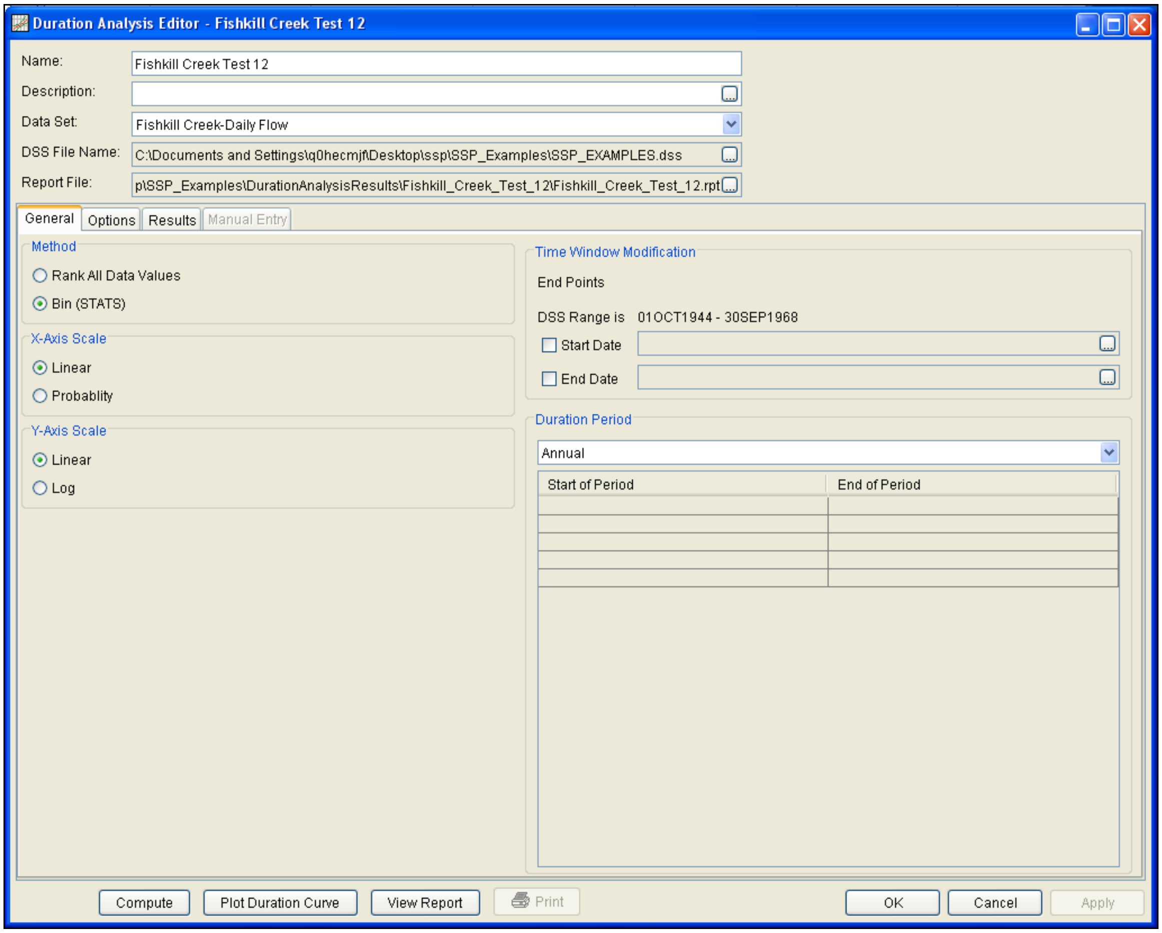


Figure B-91. Duration Analysis Editor for Test Example 12.

Shown in Figure B-91 are the general settings that were used to perform this duration analysis. For this analysis, the **Bin (STATS)** method was selected, the x-axis scale was set to **Linear**, the y-axis scale was set to **Linear**, and the **Annual** duration period was selected.

The **Options Tab** is shown in Figure B-92. Features on this tab include **Output Labeling**, the **Percent of Time Exceeded** ordinates, and **Bin Limits**. The Bin Limits panel is active in this example because the Bin (STATS) method was selected on the General tab. The User-Defined bin limits method was selected and the bin limits were entered manually.

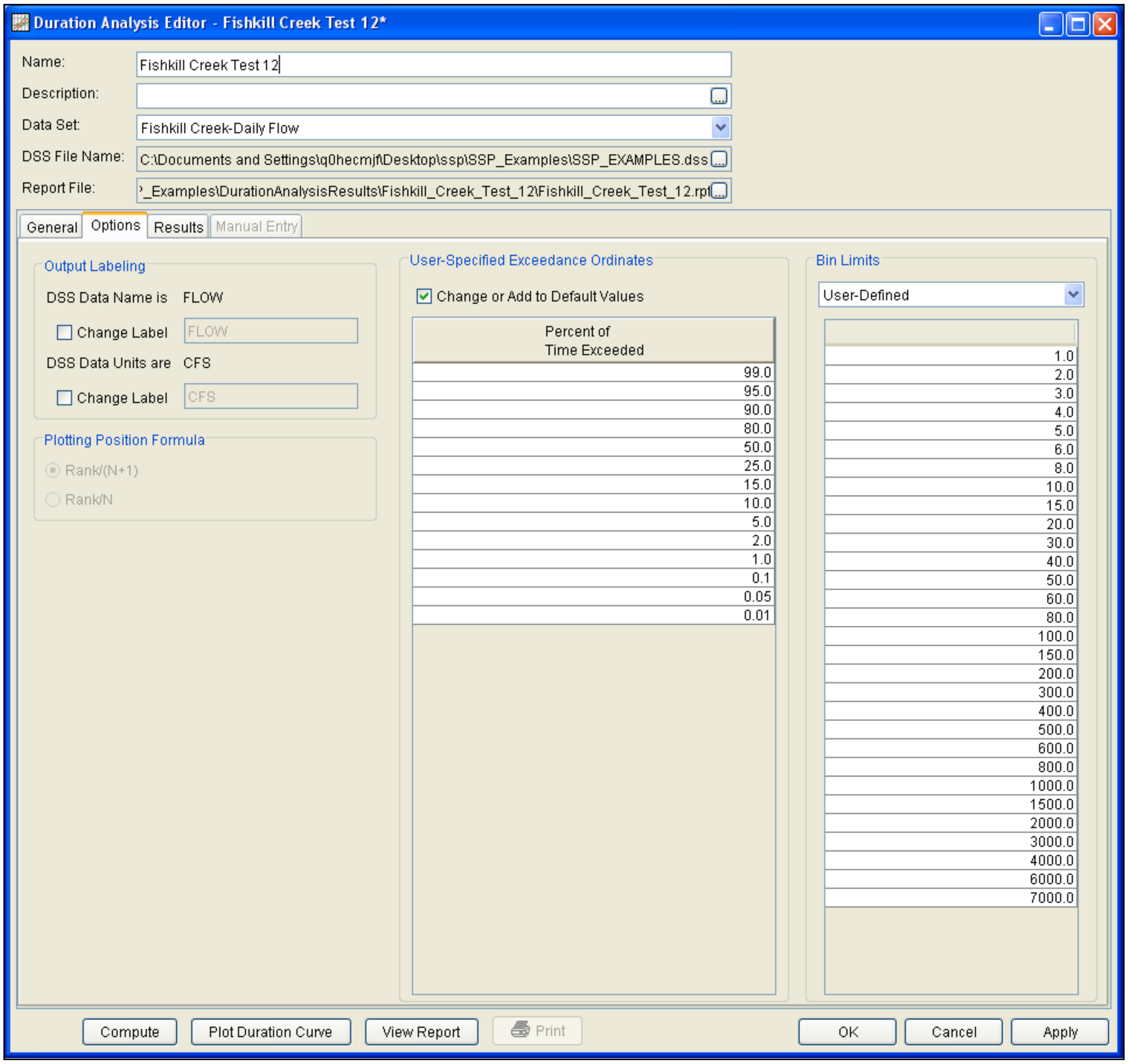
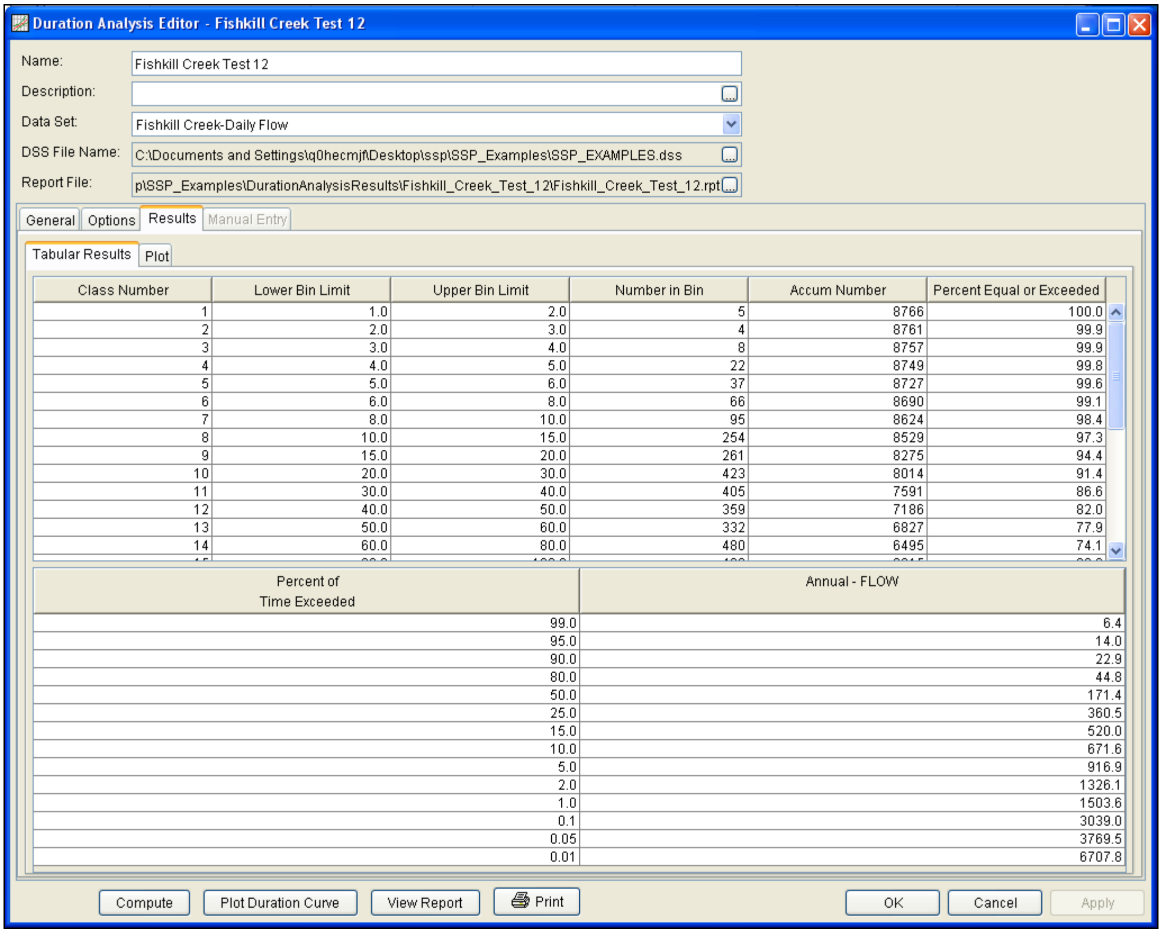


Figure B-92. Duration Analysis Editor with Options Tab Shown for Test Example 12.

Once all of the General and Optional settings are set or selected, the user can choose to compute the analysis by pressing the **Compute** button. Once the computations have been completed, a message window will open stating **Compute Complete.** Close this window and then select the **Results** tab, shown in Figure B-93.



Class Number	Lower Bin Limit	Upper Bin Limit	Number in Bin	Accum Number	Percent Equal or Exceeded
1	1.0	2.0	5	8766	100.0
2	2.0	3.0	4	8761	99.9
3	3.0	4.0	8	8757	99.9
4	4.0	5.0	22	8749	99.8
5	5.0	6.0	37	8727	99.6
6	6.0	8.0	66	8690	99.1
7	8.0	10.0	95	8624	98.4
8	10.0	15.0	254	8529	97.3
9	15.0	20.0	261	8275	94.4
10	20.0	30.0	423	8014	91.4
11	30.0	40.0	405	7591	86.6
12	40.0	50.0	359	7186	82.0
13	50.0	60.0	332	6827	77.9
14	60.0	80.0	480	6495	74.1

Percent of Time Exceeded	Annual - FLOW
99.0	6.4
95.0	14.0
90.0	22.9
80.0	44.8
50.0	171.4
25.0	360.5
15.0	520.0
10.0	671.6
5.0	916.9
2.0	1326.1
1.0	1503.6
0.1	3039.0
0.05	3769.5
0.01	6707.8

Figure B-93. The Results Tab for Test Example 12.

As shown in Figure B-93, the **Result** tab contains both tabular and graphical results. The **Tabular Results** tab contains a table with information about the bins, like the lower bin limit, the number of values in the bin, the accumulated number of values greater than or equal to the lower bin limit, and the percent of time equaled or exceeded for each bin. Tabular results also include a table of the duration curve interpolated to the percent of time exceeded ordinates defined on the Options tab. The **Plot** tab contains a graph of the duration curve, shown in Figure B-94. The plot includes the computed duration curve and the duration curve interpolated to the user-defined percent of time exceeded ordinates. The duration curve plot can also be opened by pressing the **Plot Duration Curve** button at the bottom of the analysis window.

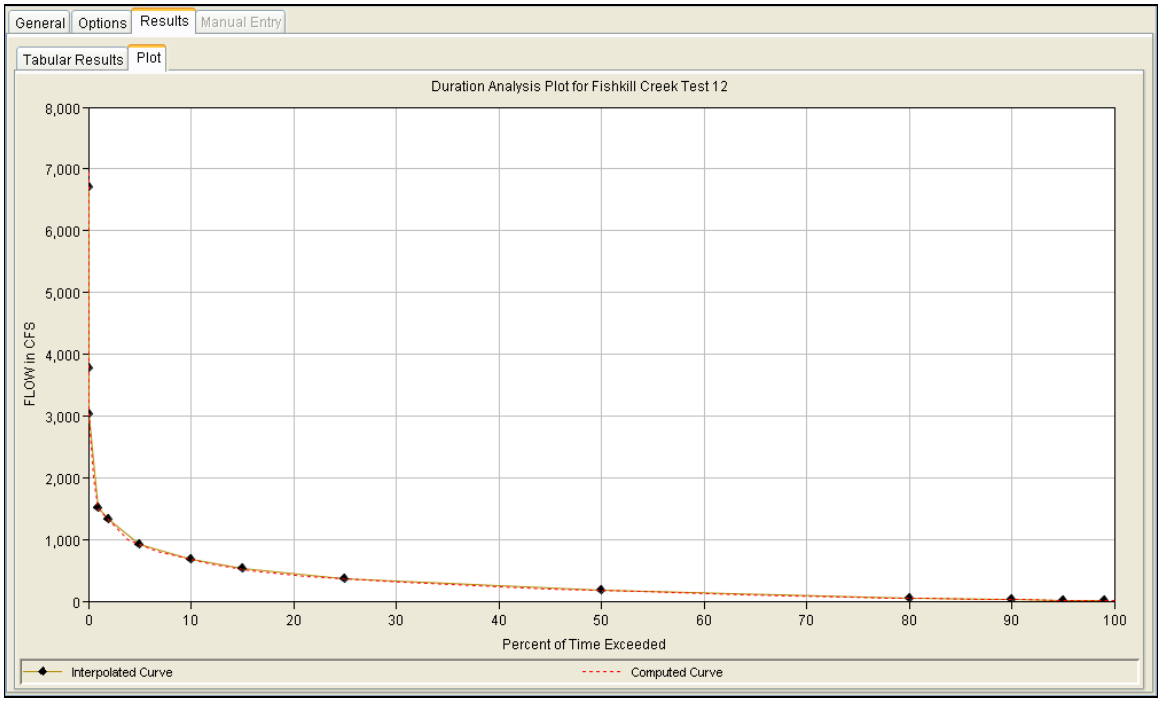


Figure B-94. Plot Tab for Test Example 12.

The tabular and graphical results can be sent to the printer or the windows clipboard for transfer into another piece of software. To print the tabular results, select **Print** from the bottom of the analysis window. To send the tabular results to the windows clipboard, highlight the data you want to send to the clipboard and then press the Control-C key sequence. To print the graphical results, first bring up the graphical plot and then select **Print** from the **File** menu. To send the graphic to the windows clipboard, select **Copy to Clipboard** from the **File** menu.

In addition to the tabular and graphical results, there is a report file that shows the input data and results for the analysis. To review the report file, press the **View Report** button at the bottom of the analysis window. When this button is selected a text viewer will open the report file and display it on the screen. Shown in Figure B-95 is the report file for Test Example 12.

Fishkill_Creek_Test_12.rpt

File Edit Search Format

File: C:\Documents and Settings\q0hecmjf\Desktop\ssp\SSP_Examples\DurationAnalysisResults\Fishkill_Creek_Test_12\Fi

```
------------------------------------------------------------------

Annual Duration Analysis
Fishkill Creek-Daily Flow

Time Period: 01Jan - 31Dec

 Number Valid Values:      8766
 Number Missing Values:       0

 Minimum Value:             1.1
 Maximum Value:         6,970.0
```

Bin Number	Lower Bin Limit	Number in Bin	Accum Number	Percent Equal or Exceeded
1	1.0	5	8766	100.000
2	2.0	4	8761	99.943
3	3.0	8	8757	99.897
4	4.0	22	8749	99.806
5	5.0	37	8727	99.555
6	6.0	66	8690	99.133
7	8.0	95	8624	98.380
8	10.0	254	8529	97.296
9	15.0	261	8275	94.399
10	20.0	423	8014	91.421
11	30.0	405	7591	86.596
12	40.0	359	7186	81.976
13	50.0	332	6827	77.880
14	60.0	480	6495	74.093
15	80.0	409	6015	68.617
16	100.0	888	5606	63.952
17	150.0	783	4718	53.822
18	200.0	1246	3935	44.889
19	300.0	822	2689	30.675
20	400.0	484	1867	21.298
21	500.0	340	1383	15.777
22	600.0	465	1043	11.898
23	800.0	239	578	6.594
24	1,000.0	251	339	3.867
25	1,500.0	47	88	1.004
26	2,000.0	32	41	0.468
27	3,000.0	6	9	0.103
28	4,000.0	0	3	0.034
29	6,000.0	3	3	0.034
30	7,000.0	0	0	0.000

1:1..1:1 1:1

Figure B-95. Report File for Test Example 12.

Example 13: Duration Analysis, Rank All Data Method

This example demonstrates how to use the Duration analysis. The data for this example is daily average flow and the period of record is from 01 Apr, 1899 to 28 Jan, 2010. To view the data, right-click on the data record labeled "**Wondering River-Franklin**" in the study explorer and then select **Plot**. The data will appear as shown in Figure B-96.

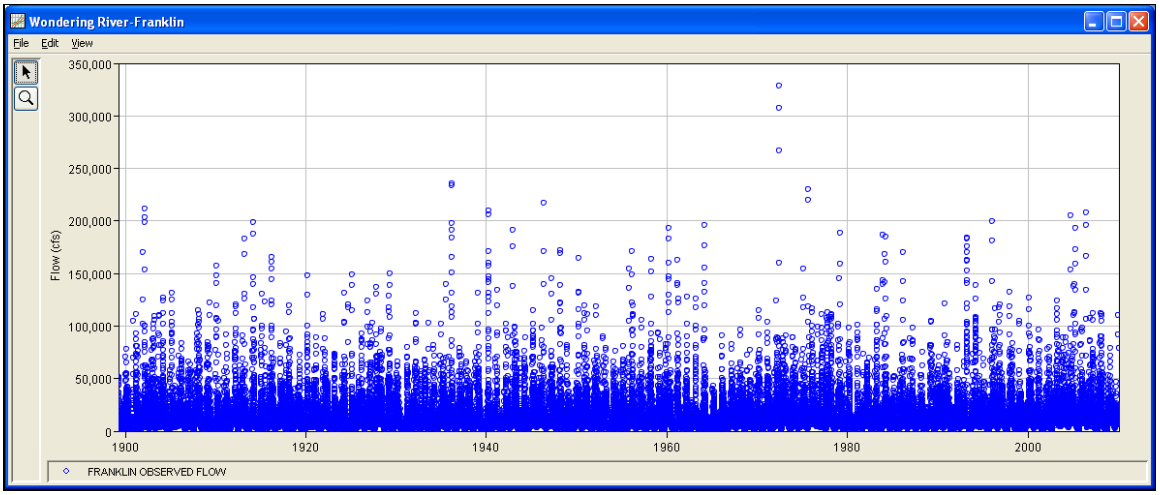


Figure B-96. Plot of the Daily Average Flow for Example 13.

A Duration analysis has been developed for this example. To open the analysis editor for Test Example 13, either double-click on the analysis labeled **Duration Curve Test 13** from the study explorer, or from the **Analysis** menu select open, then select **Duration Curve Test 13** from the list of available analyses. When Test 13 is opened, the duration analysis editor will appear as shown in Figure B-97.

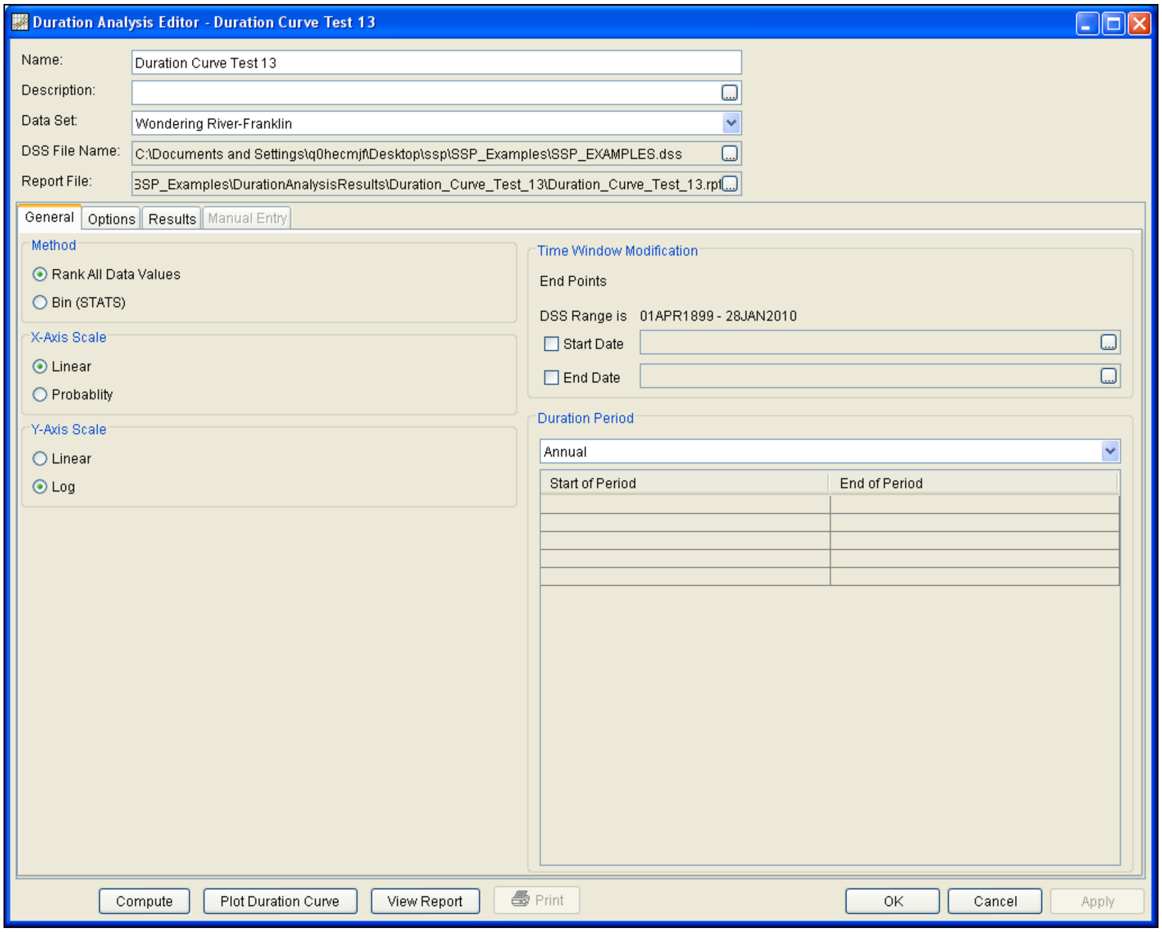


Figure B-97. Duration Analysis Editor for Test Example 13.

Shown in Figure B-97 are the general settings that were used to perform this duration analysis. For this analysis, the **Rank All DataValues** method was selected, x-axis scale was set to **Linear**, the y-axis scale was set to **Log**, and the **Annual** duration period was selected.

The **Options Tab** is shown in Figure B-98. Features on this tab include **Output Labeling**, the **Percent of Time Exceeded** ordinates, and **Bin Limits**. The Bin Limits panel is not active in this example because the Bin (STATS) method was not selected on the General tab.

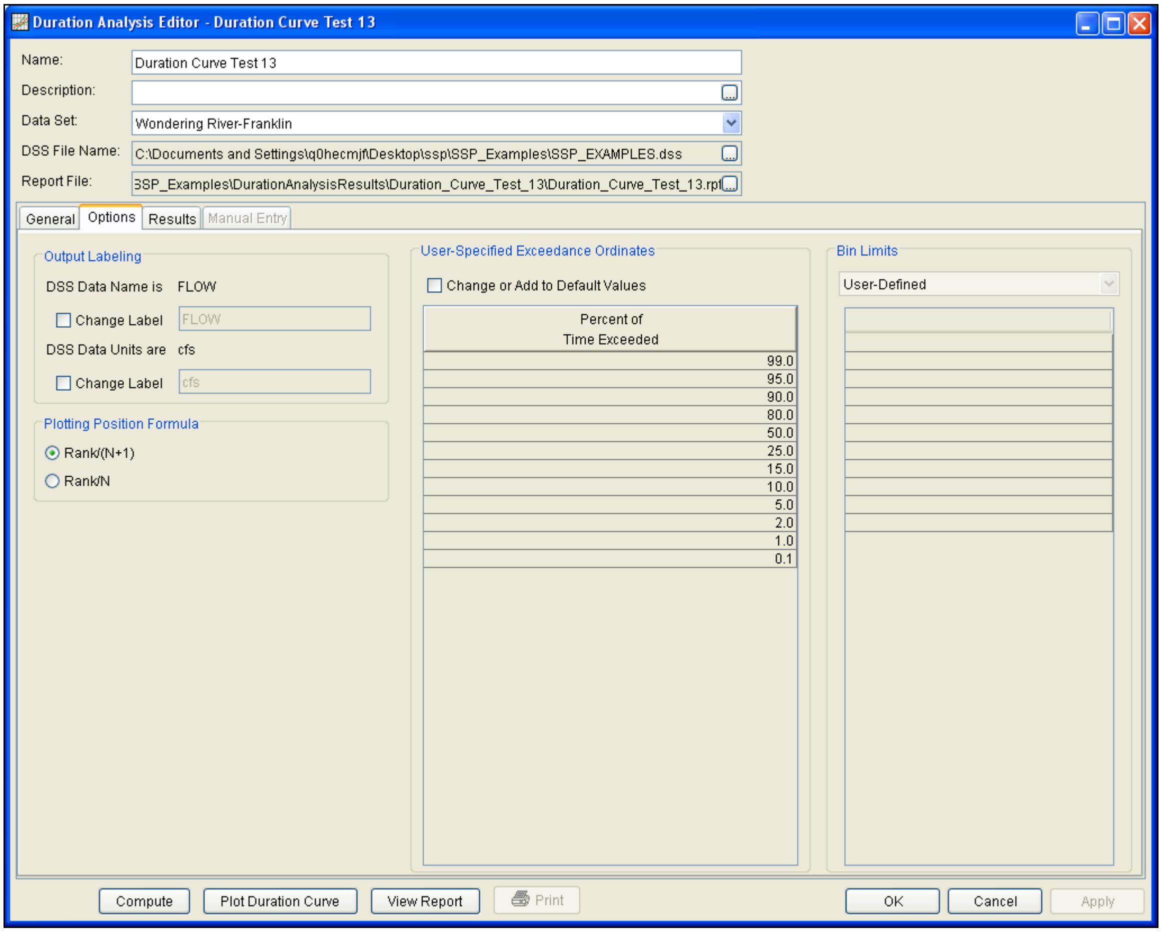


Figure B-98. Duration Analysis Editor with Options Tab Shown for Test Example 13.

Once all of the General and Optional settings are set or selected, the user can choose to compute the analysis by pressing the **Compute** button. Once the computations have been completed, a message window will open stating **Compute Complete.** Close this window and then select the **Results** tab, shown in Figure B-99.

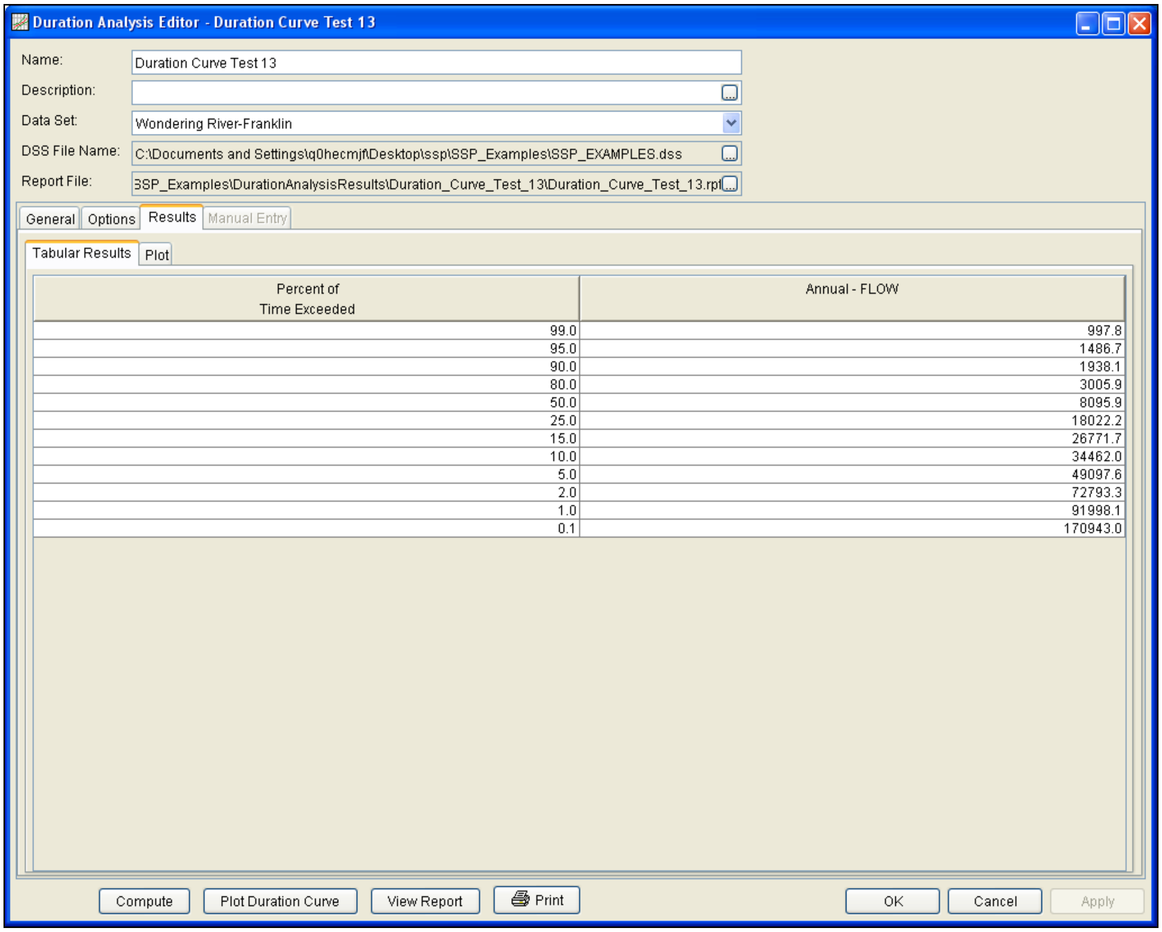


Figure B-99. The Results Tab for Test Example 13.

As shown in Figure B-99, the **Result** tab contains both tabular and graphical results. The **Tabular Results** tab contains a table of the duration curve interpolated to the percent of time exceeded ordinates defined on the Options tab. The **Plot** tab contains a graph of the duration curve. The plot includes the computed duration curve and the duration curve interpolated to the user-defined percent of time exceeded ordinates. The duration curve plot can also be opened by pressing the **Plot Duration Curve** button at the bottom of the analysis window, shown in Figure B-100.

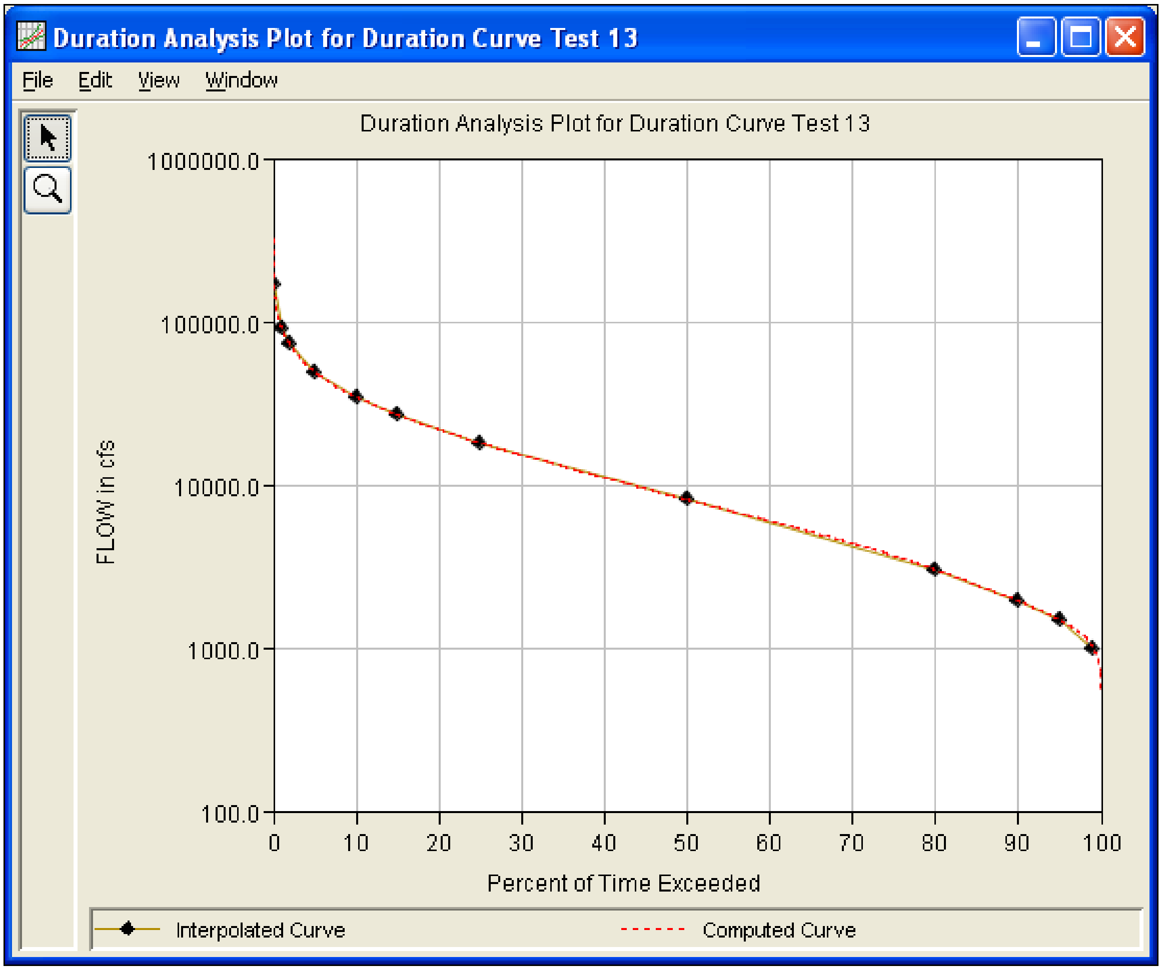
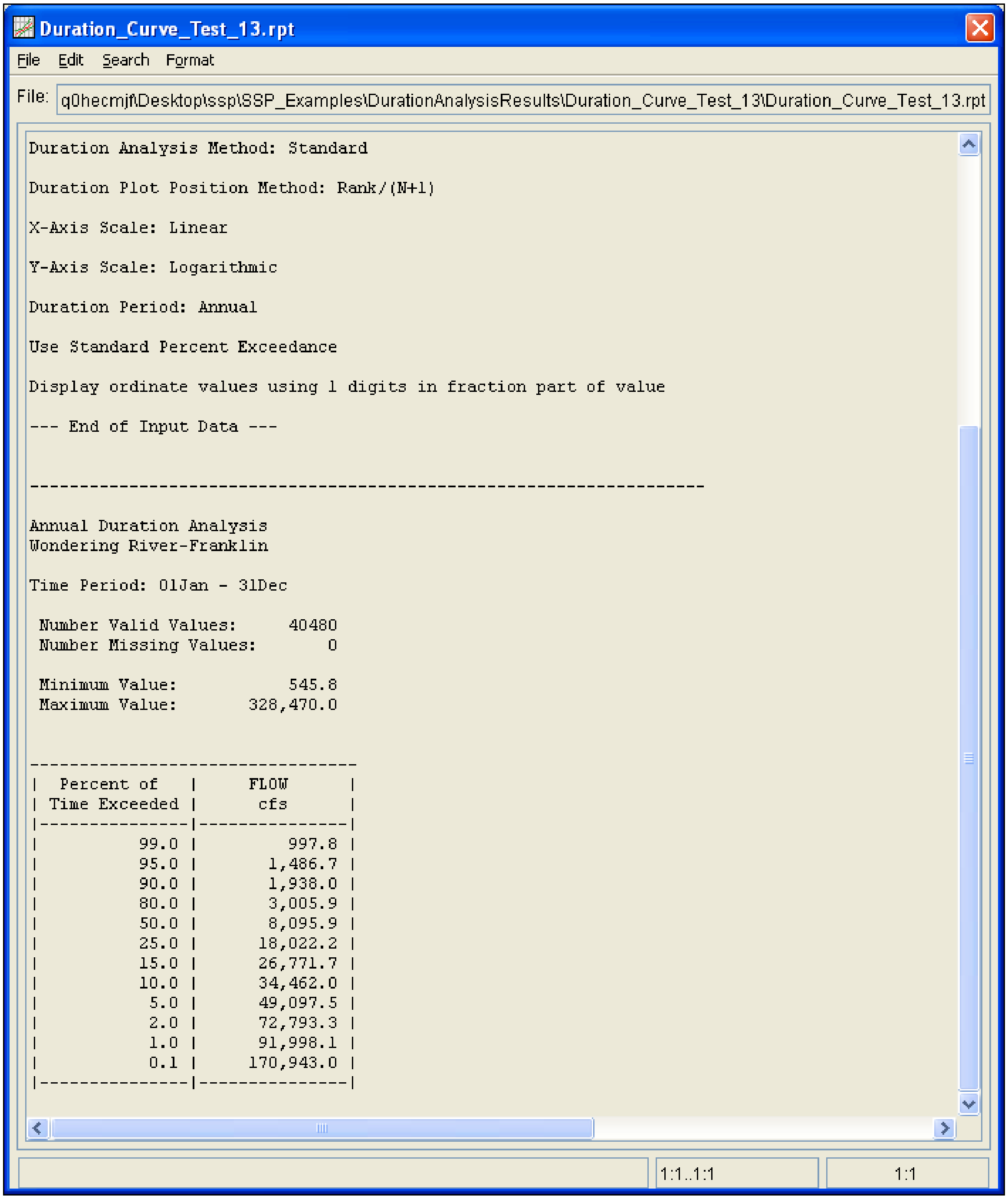


Figure B-100. Plot Tab for Test Example 13.

The tabular and graphical results can be sent to the printer or the windows clipboard for transfer into another piece of software. To print the tabular results, select **Print** from the bottom of the analysis window. To send the tabular results to the windows clipboard, highlight the data you want to send to the clipboard and then press the Control-C key sequence. To print the graphical results, first bring up the graphical plot and then select **Print** from the **File** menu. To send the graphic to the windows clipboard, select **Copy to Clipboard** from the **File** menu.

In addition to the tabular and graphical results, there is a report file that shows the input data and results for the analysis. To review the report file, press the **View Report** button at the bottom of the analysis window. When this button is selected a text viewer will open the report file and display it on the screen. Shown in Figure B-101 is the report file for Test Example 13.



Duration_Curve_Test_13.rpt

File Edit Search Format

File: q0hecmjf\Desktop\ssp\SSP_Examples\DurationAnalysisResults\Duration_Curve_Test_13\Duration_Curve_Test_13.rpt

```
Duration Analysis Method: Standard

Duration Plot Position Method: Rank/(N+1)

X-Axis Scale: Linear

Y-Axis Scale: Logarithmic

Duration Period: Annual

Use Standard Percent Exceedance

Display ordinate values using 1 digits in fraction part of value

--- End of Input Data ---


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

Annual Duration Analysis
Wondering River-Franklin

Time Period: 01Jan - 31Dec

 Number Valid Values:      40480
 Number Missing Values:        0

 Minimum Value:            545.8
 Maximum Value:        328,470.0


---------------------------------
|  Percent of   |      FLOW      |
| Time Exceeded |       cfs      |
|---------------|---------------|
|          99.0 |          997.8 |
|          95.0 |        1,486.7 |
|          90.0 |        1,938.0 |
|          80.0 |        3,005.9 |
|          50.0 |        8,095.9 |
|          25.0 |       18,022.2 |
|          15.0 |       26,771.7 |
|          10.0 |       34,462.0 |
|           5.0 |       49,097.5 |
|           2.0 |       72,793.3 |
|           1.0 |       91,998.1 |
|           0.1 |      170,943.0 |
|---------------|---------------|
```

1:1..1:1 1:1

Figure B-101. Report File for Test Example 13.

Example 14: Duration Analysis, Manual Entry

This example demonstrates how to use the Duration analysis and enter the duration curve manually. To open the analysis editor for example 14, either double-click on the analysis labeled **Manual Duration Curve Test 14** from the study explorer, or from the **Analysis** menu select open, then select **Manual Duration Curve Test 14** from the list of available analyses. As shown in Figure B-102, the "None" data set was selected for this analysis. The **Manual Entry** tab becomes active when the "None" data set is selected (the **Result** tab will become inactive).

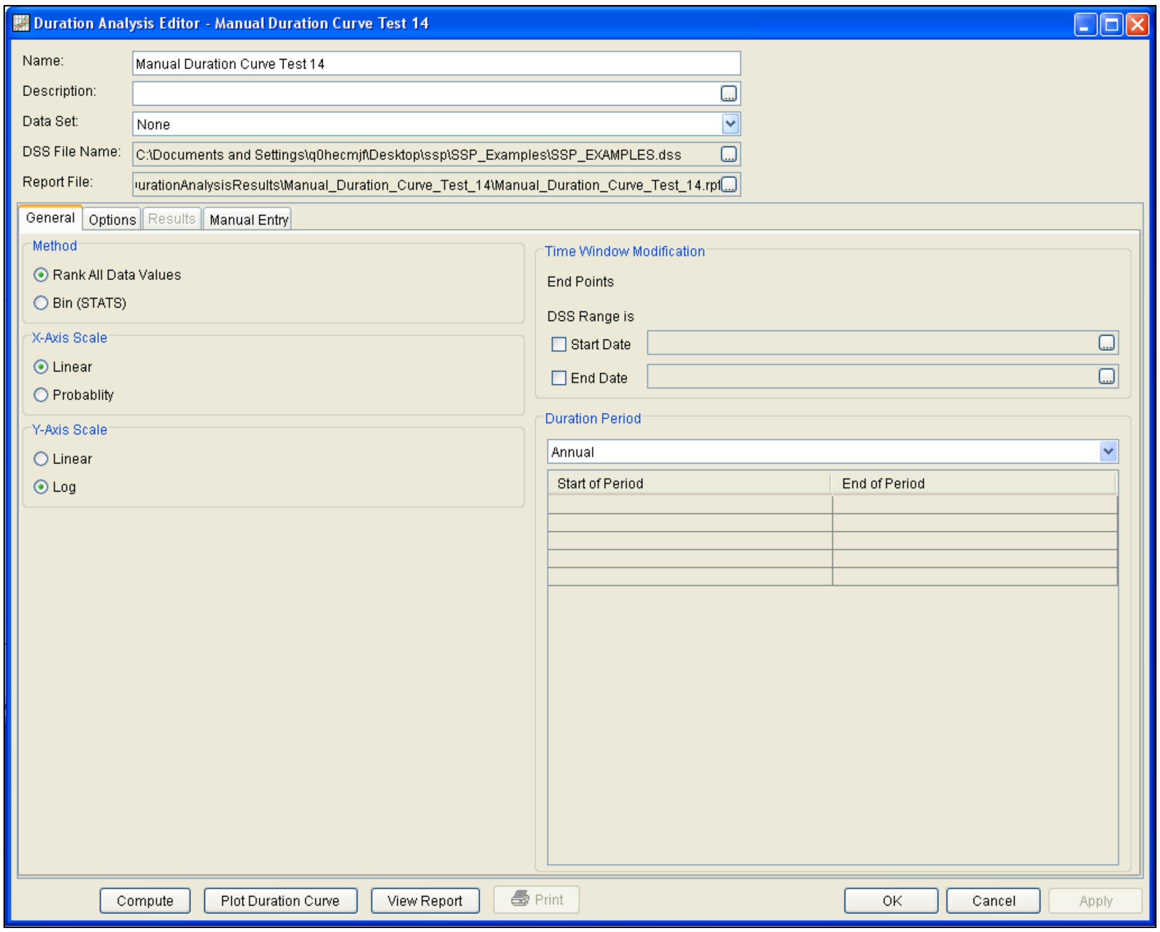


Figure B-102. Duration Analysis Editor for Test Example 14.

The y-axis scale was set to **Log** while all other default options were selected on the General and Options tabs. Figure B-103 shows the **Manual Entry** tab for Test Example 14. A variable name of "FLOW" and units of "cfs" were entered as well as the duration curve. The program will plot the duration curve when the **Compute** button is pressed.

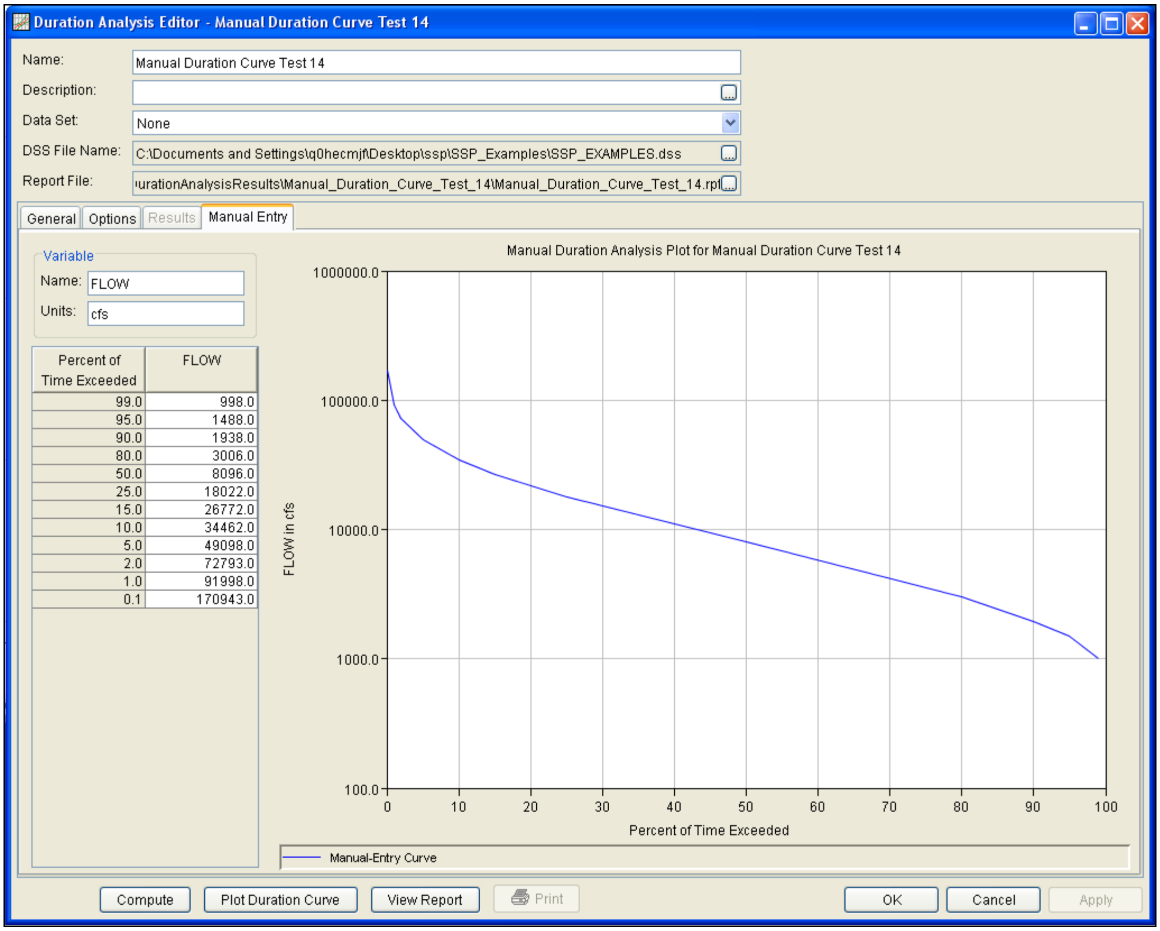


Figure B-103. Duration Analysis Editor with Options Tab Shown for Test Example 14.

The duration curve plot can also be opened by pressing the **Plot Duration Curve** button at the bottom of the analysis window, shown in Figure B-104.

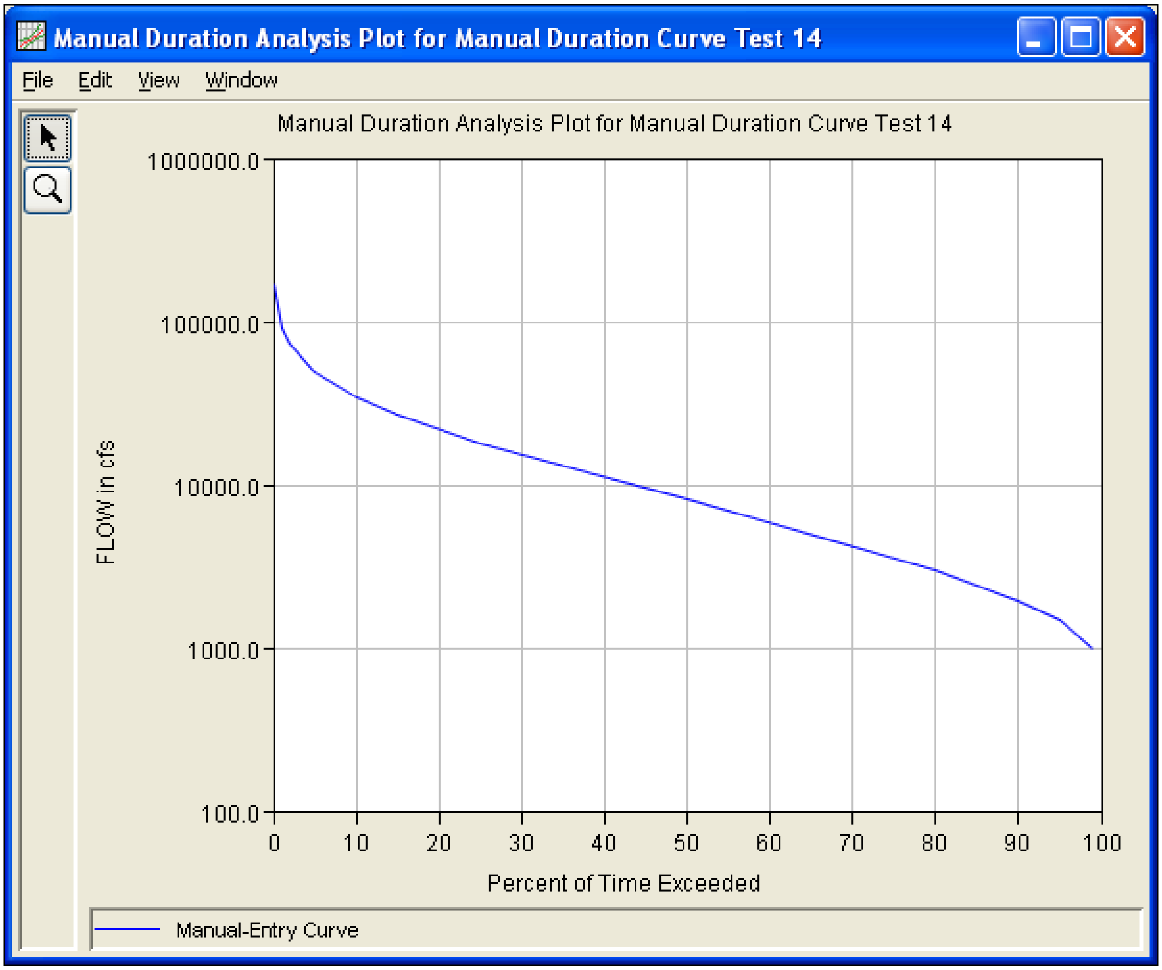


Figure B-104. Plot Tab for Test Example 14.

Example 15: Coincident Frequency Analysis, A and B can be Assumed Independent

This example demonstrates how to create a coincident frequency analysis. Figure B-105 illustrates the scenario for Example 15. The goal of this example is to develop a stage-frequency curve at a point along the tributary (variable C) given flows on the tributary (variable A) and flows in the mainstem (variable B). Large flows on the mainstem do cause backwater along the tributary and thus affect the stage at the point of interest. The data for this example comes from an existing flow frequency curve for Variable A and an existing flow duration curve for Variable B. An HEC-RAS model was used to simulate the response of Variable C (stage at the point of interest) for multiple combinations of flow on the tributary and flow in the mainstem.

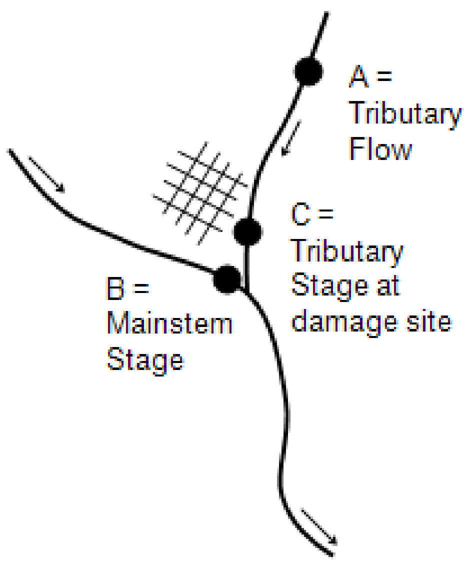


Figure B-105. Scenario for Example 15.

A Coincident Frequency analysis has been developed for this example. To open the Coincident Frequency Analysis editor for test example 15, either double-click on the analysis labeled **Coincident Freq Test 15** from the study explorer, or from the **Analysis** menu select open, then select **Coincident Freq Test 15** from the list of available analyses. When test 15 is opened, the Coincident Frequency Analysis editor will appear as shown in Figure B-106.

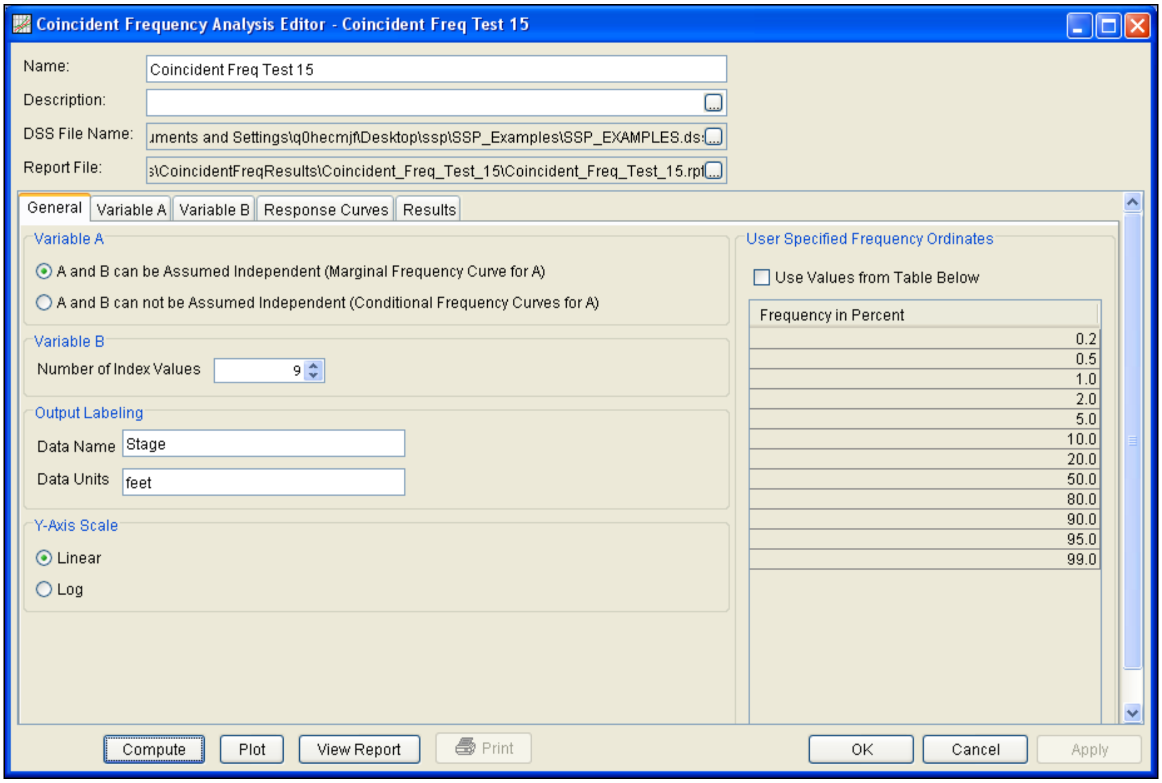


Figure B-106. General Tab Shown for Test Example 15.

Shown in Figure B-106 are the general settings for this coincident frequency analysis. For this analysis, the **A and B can be Assumed Independent (Marginal Frequency Curve for A)** option was selected. This would be determined by performing a correlation analysis between variables A and B; little correlation would indicate that variables A and B could be assumed independent. The number of variable B index values was set to 9, the **Data Name** was set to “Stage” and the **Data Units** to “feet”, and the y-axis scale was set to **Linear**.

Shown in Figure B-107 is the Coincident Frequency Analysis editor with the **Variable A Tab** selected. The **Manual Entry** option was selected and a **Data Name** of “Flow” and **Data Units** of “cfs” were entered. The frequency curve values were manually entered into the **Variable A Frequency Curve** table.

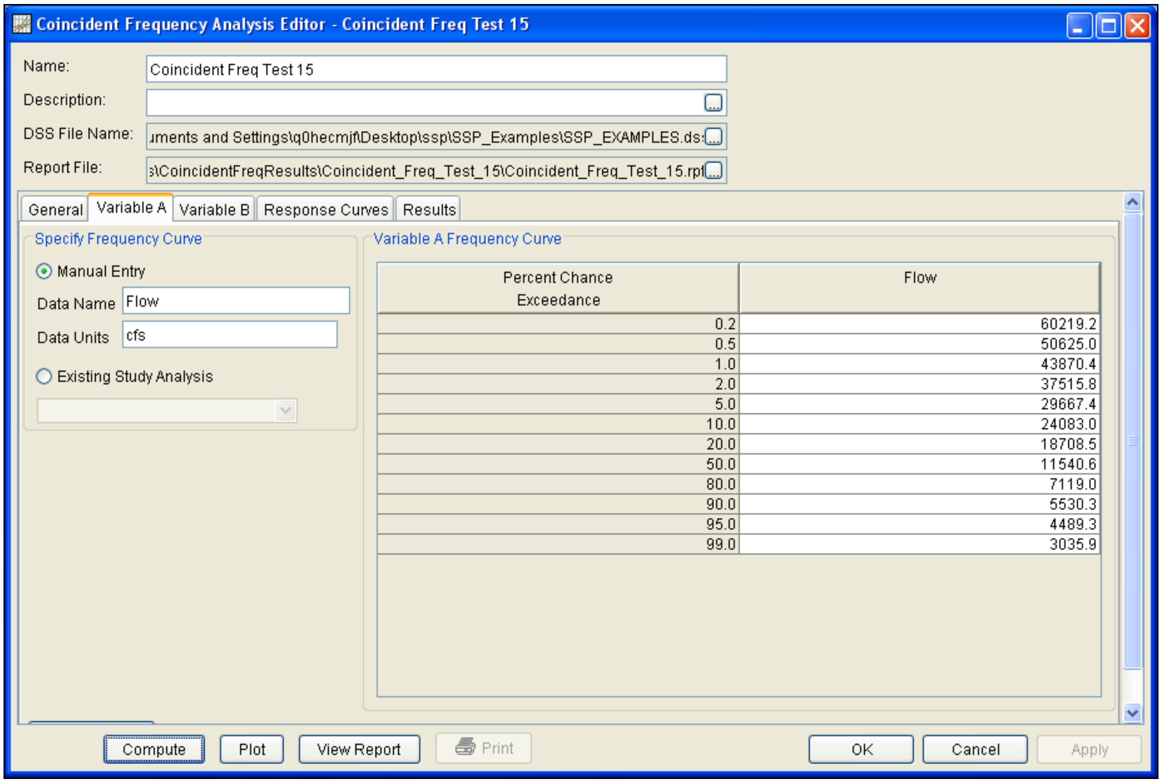


Figure B-107. Variable A Tab for Test Example 15.

Shown in Figure B-108 is the Coincident Frequency Analysis editor with the **Variable B** tab selected. The Duration Curve from Test 13 was selected in the drop-down list. Once selected, the duration curve table automatically fills with the computed ordinates from the duration curve. In the **Develop Probabilities from Duration Curve** panel, the **Define Automatically** option was selected. This option uses a predefined probability pattern to discretize the duration curve into index points. The **Generate Table** button was pressed in order activate the predefined probability pattern. In this example, the first index value is 3005.92 (cfs). This value is taken at the midpoint between percent of time exceeded values at 100 and 60 percent (from Duration Curve Test 13). This index value is assigned a probability of 40 percent; this flow value could be expected 40 percent of the time. The second index value is 8095.9. This value is taken at the midpoint between percent of time exceeded values at 60 and 40 percent and is assigned a probability of 20 percent.

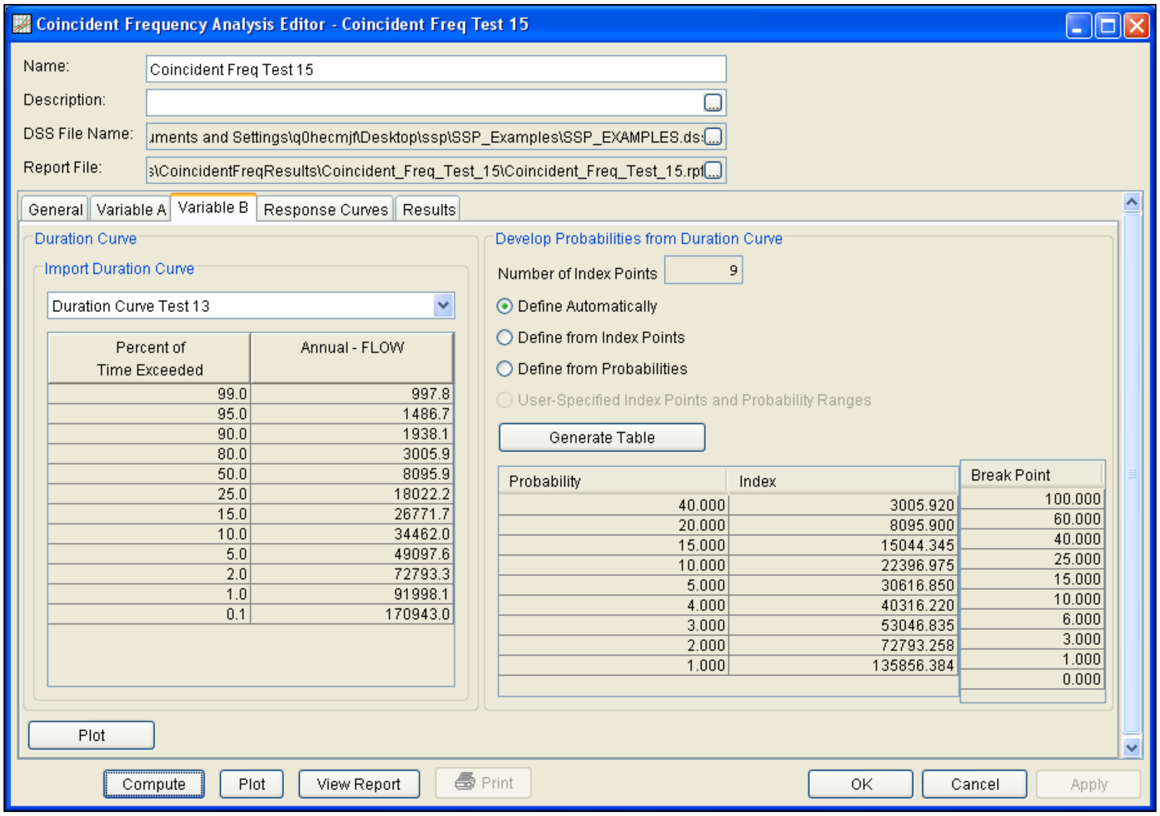
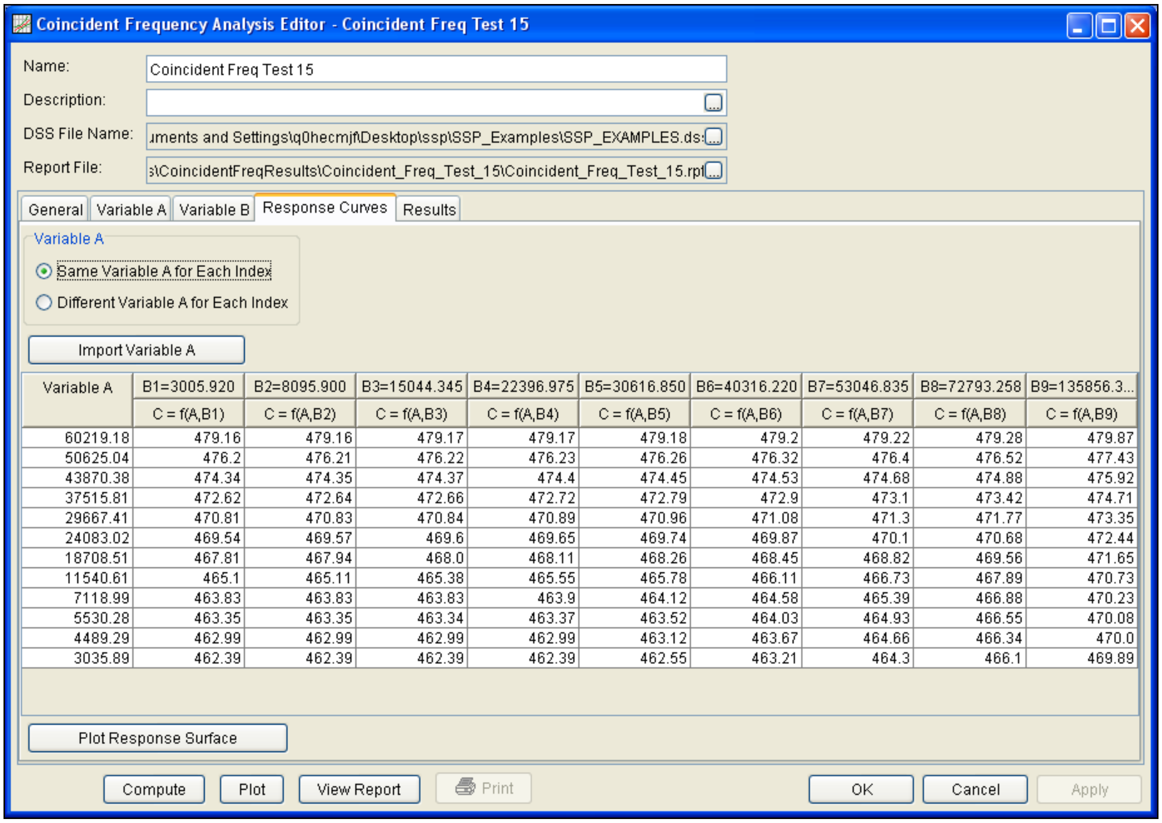


Figure B-108. Variable B Tab for Test Example 15.

Once the Variable A and Variable B tabs have been completed, the user can populate the response curves table. Figure B-109 shows the Response Curves tab for Test Example 15. The **Same Variable A for Each Index** option was selected and the **Import Variable A** button was pressed to automatically copy values from the Variable A tab and fill in the **Variable A** column. The remaining columns in the table were populated with results from a hydraulics model. For example, the first value in the second column is 479.16. This value is the stage at the point of interest given a flow of 60219.18 (cfs) on the tributary (variable A) and a flow of 3005.92 (cfs) on the mainstem (variable B). A total of 108 simulations were required from the hydraulics model to fill in the response curves table. Figure B-110 shows a plot of the response surface. The plot shows variable A (x-axis) and variable C (y-axis). For this example, the response surface shows that flows greater than 53000 (7th index point) on the mainstem affect the stage at the point of interest on the tributary. When the flow in the mainstem is below 53000 (cfs), only the flow on the tributary affects the stage at the point of interest.



Variable A	B1=3005.920	B2=8095.900	B3=15044.345	B4=22396.975	B5=30616.850	B6=40316.220	B7=53046.835	B8=72793.258	B9=135856.3...
	C = f(A,B1)	C = f(A,B2)	C = f(A,B3)	C = f(A,B4)	C = f(A,B5)	C = f(A,B6)	C = f(A,B7)	C = f(A,B8)	C = f(A,B9)
60219.18	479.16	479.16	479.17	479.17	479.18	479.2	479.22	479.28	479.87
50625.04	476.2	476.21	476.22	476.23	476.26	476.32	476.4	476.52	477.43
43870.38	474.34	474.35	474.37	474.4	474.45	474.53	474.68	474.88	475.92
37515.81	472.62	472.64	472.66	472.72	472.79	472.9	473.1	473.42	474.71
29667.41	470.81	470.83	470.84	470.89	470.96	471.08	471.3	471.77	473.35
24083.02	469.54	469.57	469.6	469.65	469.74	469.87	470.1	470.68	472.44
18708.51	467.81	467.94	468.0	468.11	468.26	468.45	468.82	469.56	471.65
11540.61	465.1	465.11	465.38	465.55	465.78	466.11	466.73	467.89	470.73
7118.99	463.83	463.83	463.83	463.9	464.12	464.58	465.39	466.88	470.23
5530.28	463.35	463.35	463.34	463.37	463.52	464.03	464.93	466.55	470.08
4489.29	462.99	462.99	462.99	462.99	463.12	463.67	464.66	466.34	470.0
3035.89	462.39	462.39	462.39	462.39	462.55	463.21	464.3	466.1	469.89

Figure B-109. Response Curves Tab for Example 15.

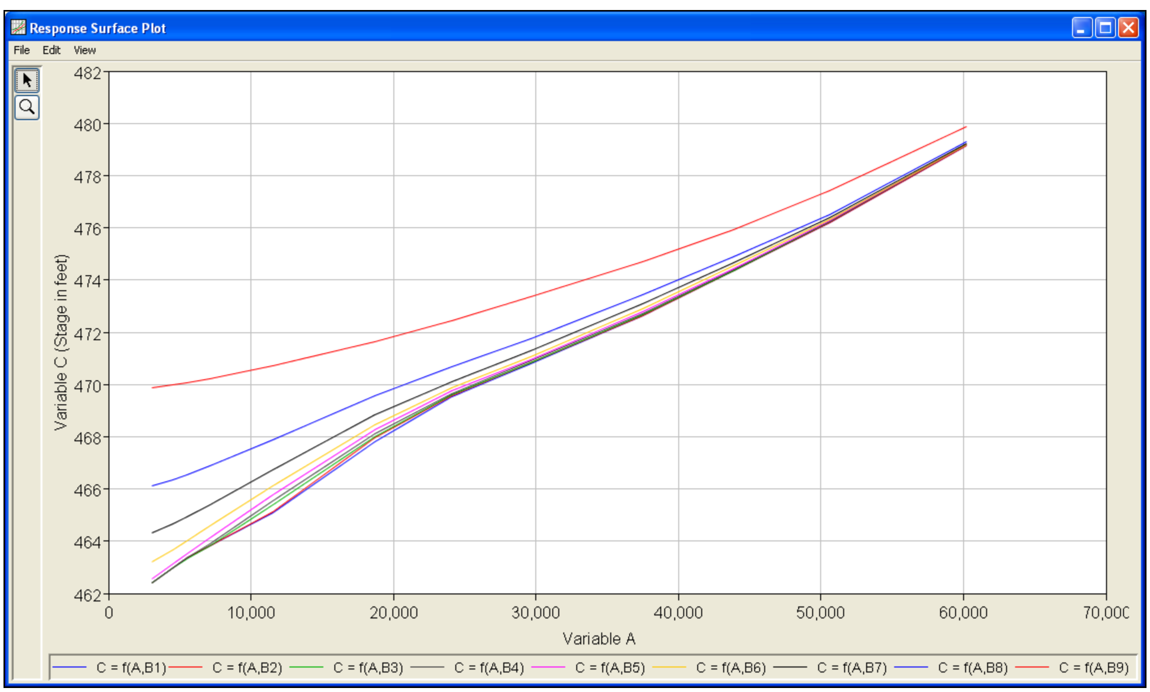


Figure B-110. Response Curves Plot for Example 15.

Press the **Compute** button to perform the analysis. Once the computations have been completed, a message window will open stating **Compute Complete.** Close this window and then select the **Results** tab. The results tab should look Figure B-111. The left portion of the results tab contains the computed variable C frequency curve and the right portion of the results tab contains a plot of the computed variable C frequency curve.

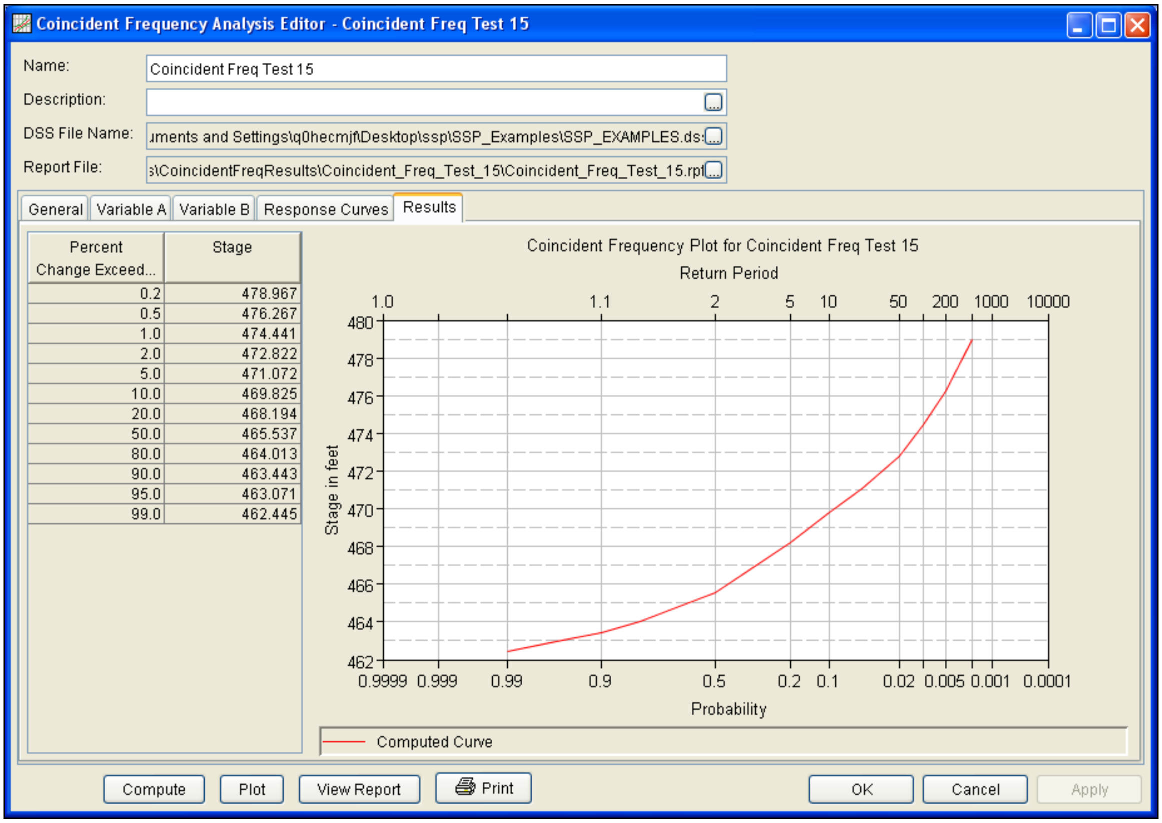
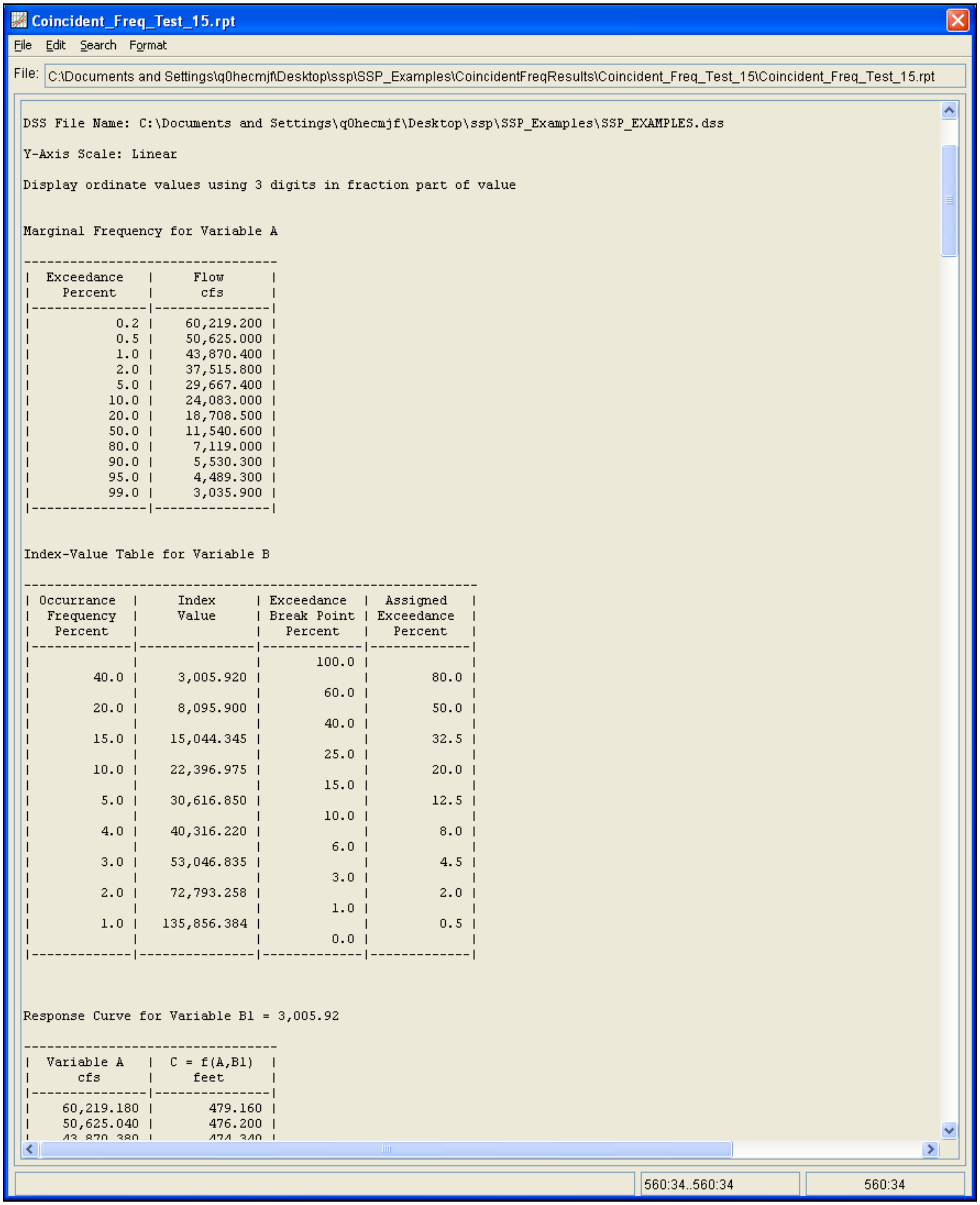


Figure B-111. Results Tab for Test Example 15.

The tabular and graphical results can be sent to the printer or the windows clipboard for transfer into another piece of software. To print the tabular results, select **Print** from the bottom of the analysis window. To send the tabular results to the windows clipboard, highlight the data you want to send to the clipboard and then press the Control-C key sequence. To print the graphical results, first bring up the graphical plot by pressing the **Plot** button from the bottom of the analysis. Then select **Print** from the **File** menu. To send the graphic to the windows clipboard, select **Copy to Clipboard** from the **File** menu.

In addition to the tabular and graphical results, there is a report file that shows input data and results. To review the report file, press the **View Report** button at the bottom of the analysis window. When this button is selected a text viewer will open the report file and display it on the screen. Shown in Figure B-112 is the report file for Test Example 15.



Coincident_Freq_Test_15.rpt

File Edit Search Format

File: C:\Documents and Settings\q0hecmjf\Desktop\ssp\SSP_Examples\CoincidentFreqResults\Coincident_Freq_Test_15\Coincident_Freq_Test_15.rpt

DSS File Name: C:\Documents and Settings\q0hecmjf\Desktop\ssp\SSP_Examples\SSP_EXAMPLES.dss

Y-Axis Scale: Linear

Display ordinate values using 3 digits in fraction part of value

Marginal Frequency for Variable A

Exceedance Percent	Flow cfs
0.2	60,219.200
0.5	50,625.000
1.0	43,870.400
2.0	37,515.800
5.0	29,667.400
10.0	24,083.000
20.0	18,708.500
50.0	11,540.600
80.0	7,119.000
90.0	5,530.300
95.0	4,489.300
99.0	3,035.900

Index-Value Table for Variable B

Occurrance Frequency Percent	Index Value	Exceedance Break Point Percent	Assigned Exceedance Percent
		100.0	
40.0	3,005.920		80.0
		60.0	
20.0	8,095.900		50.0
		40.0	
15.0	15,044.345		32.5
		25.0	
10.0	22,396.975		20.0
		15.0	
5.0	30,616.850		12.5
		10.0	
4.0	40,316.220		8.0
		6.0	
3.0	53,046.835		4.5
		3.0	
2.0	72,793.258		2.0
		1.0	
1.0	135,856.384		0.5
		0.0	

Response Curve for Variable B1 = 3,005.92

Variable A cfs	C = f(A,B1) feet
60,219.180	479.160
50,625.040	476.200
43,870.380	474.340

560:34..560:34 560:34

Figure B-112. Report File for Test Example 15.

Example 16: Coincident Frequency Analysis, A and B can not be Assumed Independent

This example demonstrates how to create a coincident frequency analysis when variables A and B are not independent. Figure B-113 illustrates the scenario for Example 16. The goal of this example is to develop a stage-frequency curve at a point along the tributary (variable C) given flows on the tributary (variable A) and flows in the mainstem (variable B). Large flows on the mainstem do cause backwater along the tributary and thus affect the stage at the point of interest. The data for this example comes from existing conditional flow frequency curves for Variable A and an existing flow duration curve for variable B. An HEC-RAS model was used to simulate the response of variable C (stage at the point of interest) for multiple combinations of flow on the tributary and flow in the mainstem.

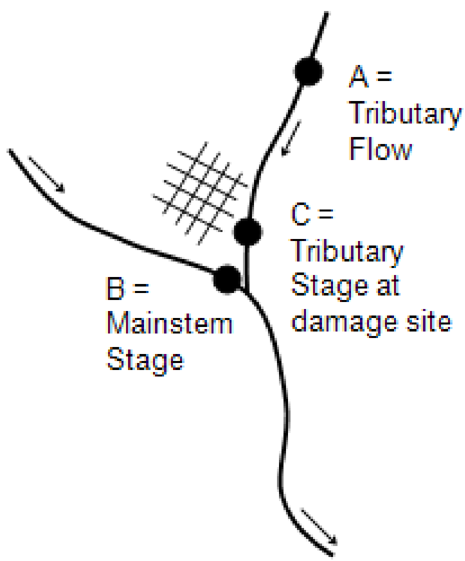


Figure B-113. Scenario for Example 16.

A Coincident Frequency analysis has been developed for this example. To open the Coincident Frequency analysis editor for test example 16, either double-click on the analysis labeled **Coincident Freq Test 16** from the study explorer, or from the **Analysis** menu select open, then select **Coincident Freq Test 16** from the list of available analyses. When test 16 is opened, the Coincident Frequency analysis editor will appear as shown in Figure B-114.

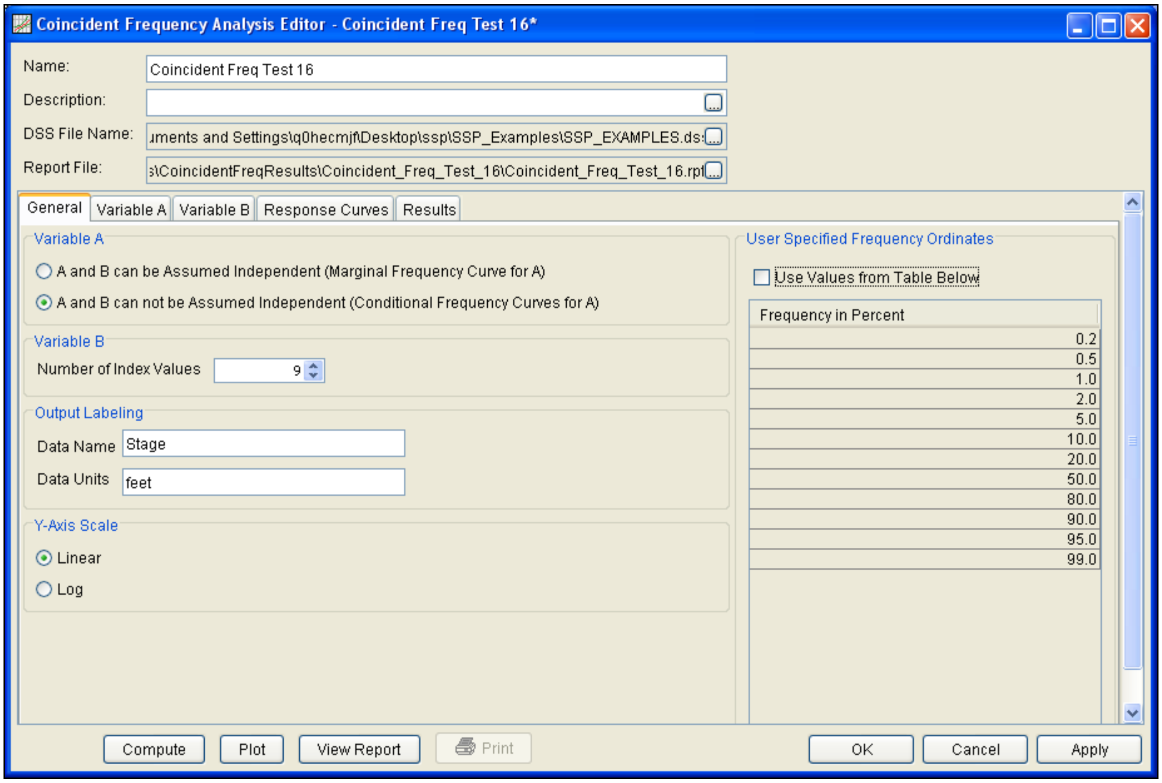
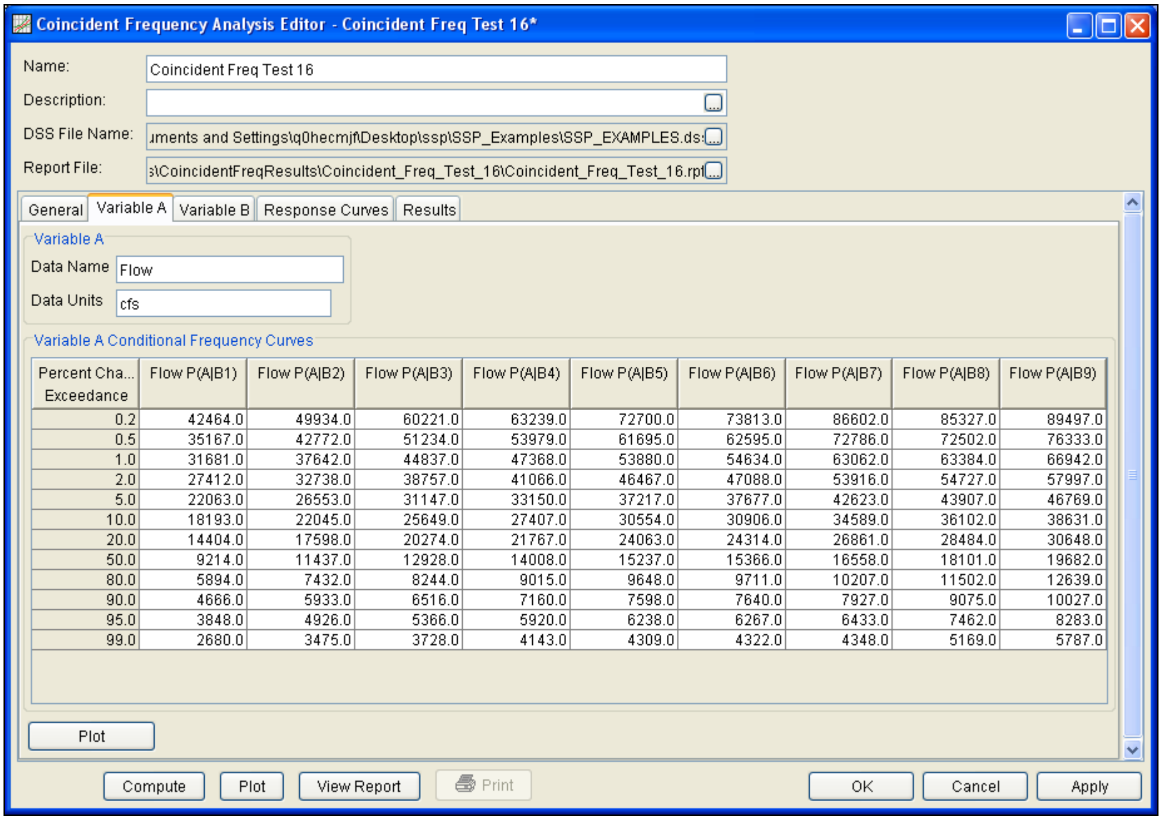


Figure B-114. General Tab Shown for Test Example 16.

Shown in Figure B-114 are the general settings for this coincident frequency analysis. For this analysis, the **A and B can not be Assumed Independent (Conditional Frequency Curve for A)** option was selected. This would be determined by performing a correlation analysis between variables A and B; a correlation coefficient in the range of 0.3 – 0.7 would indicate that variables A and B could not be assumed independent. The number of variable B index values was set to 9, the **Data Name** was set to "Stage" and the **Data Units** to "feet", and the Y-Axis scale was set to **Linear**.

Shown in Figure B-115 is the Coincident Frequency Analysis editor with the **Variable A Tab** selected. A **Data Name** of "Flow" and **Data Units** of "cfs" were entered. A separate frequency curve for variable A was developed for each index value defined on the Variable B tab. For example, the frequency curve in the "Flow P(A|B1)" column is the variable A frequency curve for the 1st variable B index value. The variable B tab shows the 1st index value, 3005.92, is assigned a proportion of time of 40 percent. Therefore, the 1st variable A frequency curve was developed using annual peak flows on the tributary when flows in the mainstem were in the range of the 1st variable B index value. For this example, a multivariate lognormal random number generator was used to develop a large enough data set so that variable A frequency curves could be computed for each variable B index value. The random numbers were generated using statistics from the annual peak flows occurring on the tributary, statistics from the coincident (same day) flows occurring on the main stem, and the covariance between the two datasets.



Percent Cha... Exceedance	Flow P(A|B1)	Flow P(A|B2)	Flow P(A|B3)	Flow P(A|B4)	Flow P(A|B5)	Flow P(A|B6)	Flow P(A|B7)	Flow P(A|B8)	Flow P(A|B9)
0.2	42464.0	49934.0	60221.0	63239.0	72700.0	73813.0	86602.0	85327.0	89497.0
0.5	35167.0	42772.0	51234.0	53979.0	61695.0	62595.0	72786.0	72502.0	76333.0
1.0	31681.0	37642.0	44837.0	47368.0	53880.0	54634.0	63062.0	63384.0	66942.0
2.0	27412.0	32738.0	38757.0	41066.0	46467.0	47088.0	53916.0	54727.0	57997.0
5.0	22063.0	26553.0	31147.0	33150.0	37217.0	37677.0	42623.0	43907.0	46769.0
10.0	18193.0	22045.0	25649.0	27407.0	30554.0	30906.0	34589.0	36102.0	38631.0
20.0	14404.0	17598.0	20274.0	21767.0	24063.0	24314.0	26861.0	28484.0	30648.0
50.0	9214.0	11437.0	12928.0	14008.0	15237.0	15366.0	16558.0	18101.0	19682.0
80.0	5894.0	7432.0	8244.0	9015.0	9648.0	9711.0	10207.0	11502.0	12639.0
90.0	4666.0	5933.0	6516.0	7160.0	7598.0	7640.0	7927.0	9075.0	10027.0
95.0	3848.0	4926.0	5366.0	5920.0	6238.0	6267.0	6433.0	7462.0	8283.0
99.0	2680.0	3475.0	3728.0	4143.0	4309.0	4322.0	4348.0	5169.0	5787.0

Figure B-115. Variable A Tab for Test Example 16.

Shown in Figure B-116 is the Coincident Frequency analysis editor with the **Variable B Tab** selected. No duration curve was selected for this example. In the **Develop Probabilities from Duration Curve** panel, the **User-Specified Index Points and Probability Ranges** option was selected. The probabilities and index values were defined manually and the Generate Table button was pressed in order to compute the Break Points.

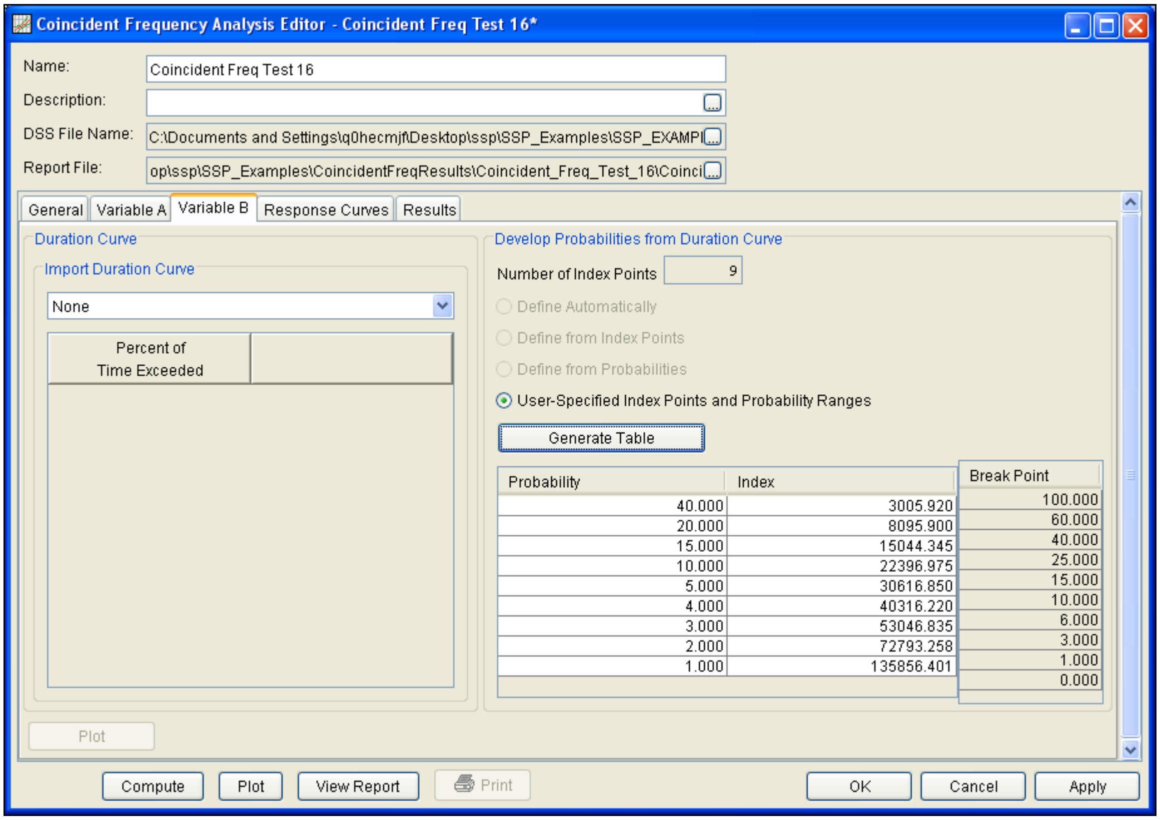


Figure B-116. Variable B Tab for Test Example 16.

Once the Variable A and Variable B tabs have been completed, the user can populate the response curves table. Figure B-117 shows the Response Curves tab for Test Example 16. The **Different Variable A for Each Index** option was selected. When selected, a separate Variable A column is added for each variable B index value. For example, the first Variable A column is linked to the C = f(A,B1) column. The second variable A column is lined to the C = f(A,B2), and so on. The **Import Variable A** button was pressed to automatically copy values from the Variable A tab to fill in appropriate **Variable A** column. The remaining columns in the table were populated with results from the hydraulics model. For example, the first value in the second column is 473.95. This value is the stage at the point of interest given a flow of 42464 (cfs) on the tributary (variable A) and a flow of 3005.92 (cfs) on the mainstem (variable B). A total of 108 simulations were required from the hydraulics model to fill in the response curves table.

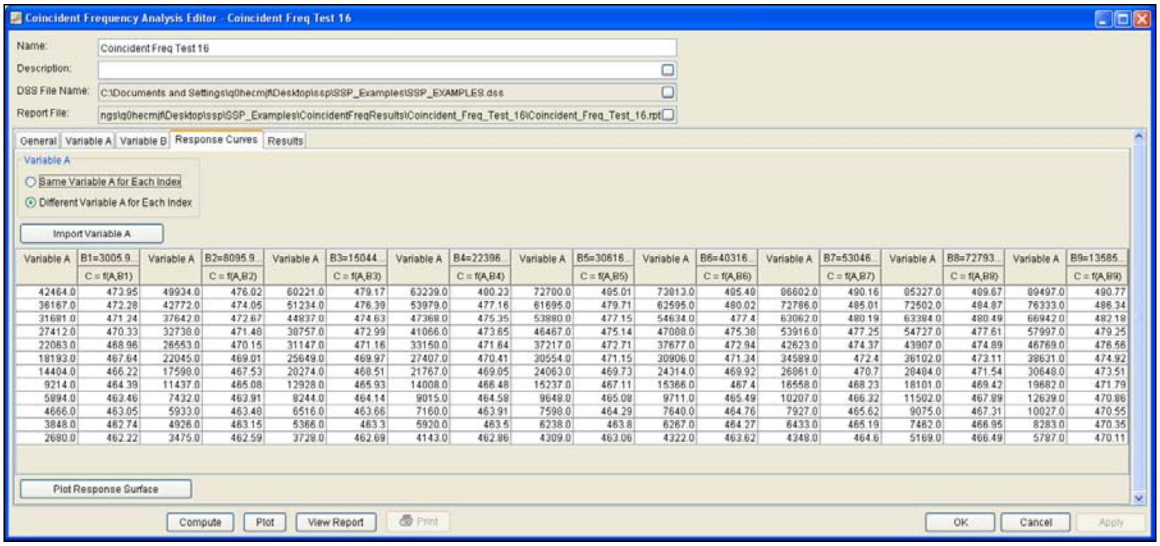


Figure B-117. Response Curves Tab for Example 16.

Press the **Compute** button to perform the analysis. Once the computations have been completed, a message window will open stating **Compute Complete.** Close this window and then select the **Results** tab. The **Results** tab should look Figure B-118. The left portion of the results tab contains the computed variable C frequency curve and the right portion of the results tab contains a plot of the computed variable C frequency curve.

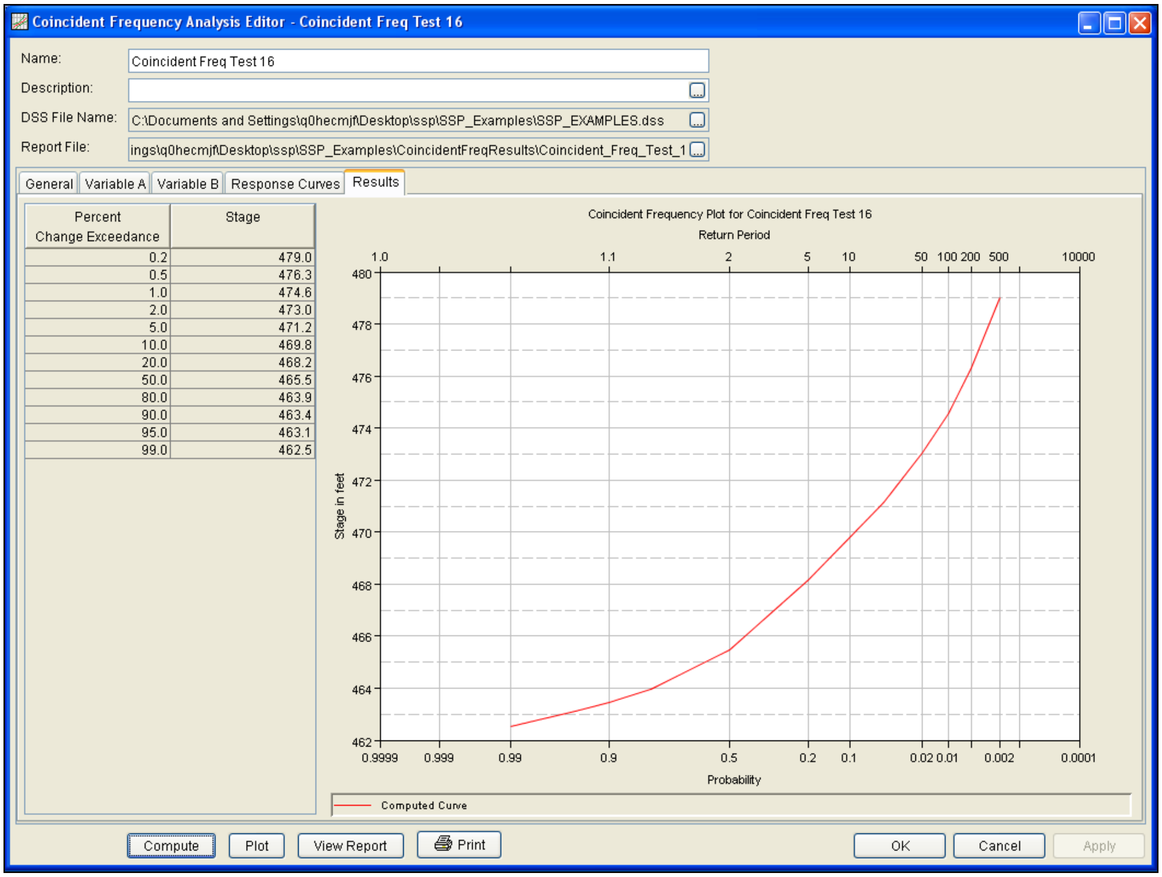
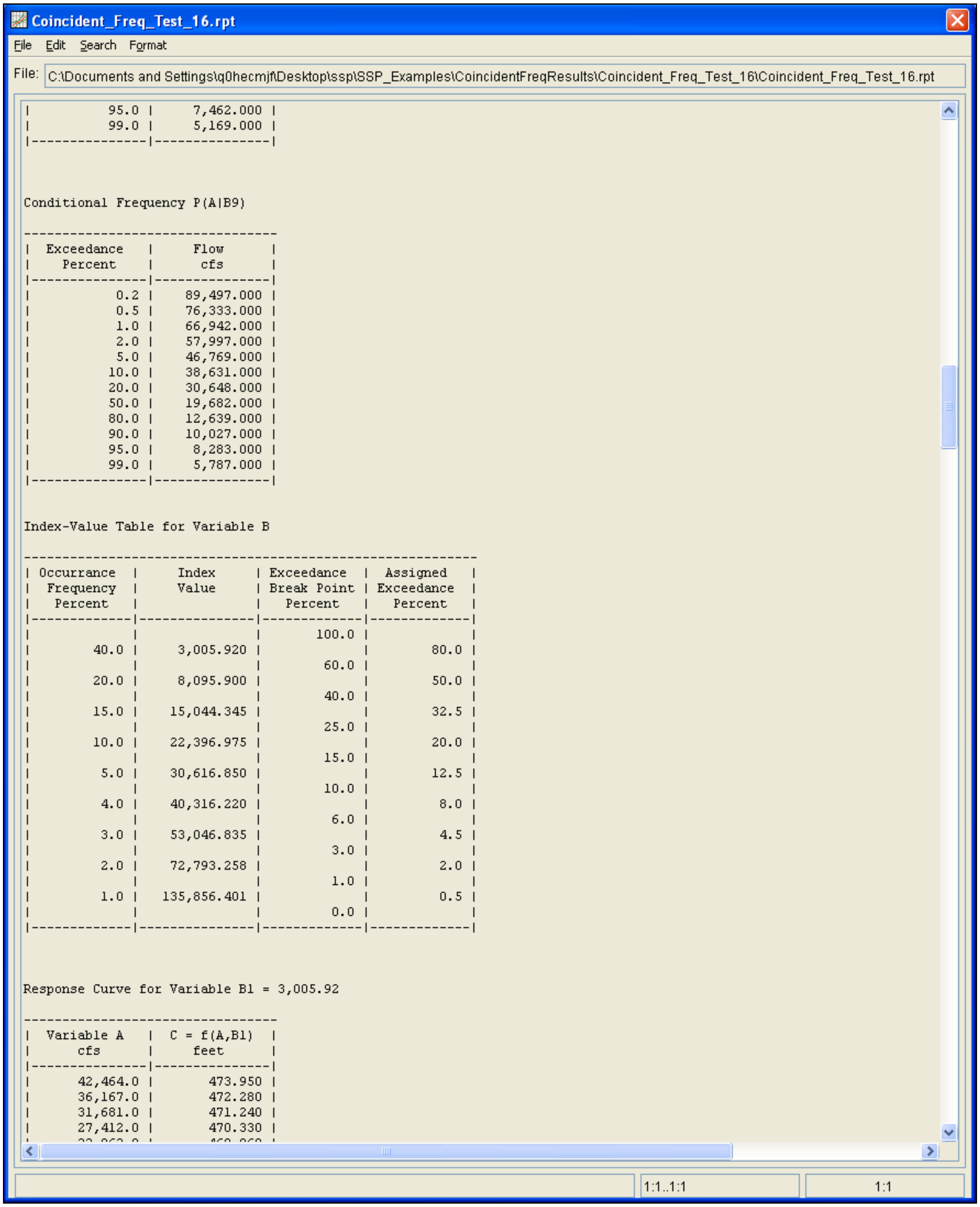


Figure B-118. Results Tab for Test Example 16.

The tabular and graphical results can be sent to the printer or the windows clipboard for transfer into another piece of software. To print the tabular results, select **Print** from the bottom of the analysis window. To send the tabular results to the windows clipboard, highlight the data you want to send to the clipboard and then press the Control-C key sequence. To print the graphical results, first bring up the graphical plot by pressing the **Plot** button from the bottom of the analysis. Then select **Print** from the **File** menu. To send the graphic to the windows clipboard, select **Copy to Clipboard** from the **File** menu.

In addition to the tabular and graphical results, there is a report file that shows input data and results. To review the report file, press the **View Report** button at the bottom of the analysis window. When this button is selected a text viewer will open the report file and display it on the screen. Shown in Figure B-119 is the report file for Test Example 16.



Coincident_Freq_Test_16.rpt

File Edit Search Format

File: C:\Documents and Settings\q0hecmjf\Desktop\ssp\SSP_Examples\CoincidentFreqResults\Coincident_Freq_Test_16\Coincident_Freq_Test_16.rpt

```
|          95.0 |      7,462.000 |
|          99.0 |      5,169.000 |
|---------------|---------------|



Conditional Frequency P(A|B9)

---------------------------------
|  Exceedance   |      Flow     |
|    Percent    |      cfs      |
|---------------|---------------|
|           0.2 |     89,497.000 |
|           0.5 |     76,333.000 |
|           1.0 |     66,942.000 |
|           2.0 |     57,997.000 |
|           5.0 |     46,769.000 |
|          10.0 |     38,631.000 |
|          20.0 |     30,648.000 |
|          50.0 |     19,682.000 |
|          80.0 |     12,639.000 |
|          90.0 |     10,027.000 |
|          95.0 |      8,283.000 |
|          99.0 |      5,787.000 |
|---------------|---------------|


Index-Value Table for Variable B

-----------------------------------------------------------
| Occurrance  |     Index      | Exceedance  |  Assigned   |
|  Frequency  |     Value      | Break Point | Exceedance  |
|   Percent   |                |   Percent   |   Percent   |
|-------------|----------------|-------------|-------------|
|             |                |       100.0 |             |
|        40.0 |      3,005.920 |             |        80.0 |
|             |                |        60.0 |             |
|        20.0 |      8,095.900 |             |        50.0 |
|             |                |        40.0 |             |
|        15.0 |     15,044.345 |             |        32.5 |
|             |                |        25.0 |             |
|        10.0 |     22,396.975 |             |        20.0 |
|             |                |        15.0 |             |
|         5.0 |     30,616.850 |             |        12.5 |
|             |                |        10.0 |             |
|         4.0 |     40,316.220 |             |         8.0 |
|             |                |         6.0 |             |
|         3.0 |     53,046.835 |             |         4.5 |
|             |                |         3.0 |             |
|         2.0 |     72,793.258 |             |         2.0 |
|             |                |         1.0 |             |
|         1.0 |    135,856.401 |             |         0.5 |
|             |                |         0.0 |             |
|-------------|----------------|-------------|-------------|



Response Curve for Variable B1 = 3,005.92

---------------------------------
|  Variable A   |  C = f(A,B1)  |
|     cfs       |     feet      |
|---------------|---------------|
|      42,464.0 |       473.950 |
|      36,167.0 |       472.280 |
|      31,681.0 |       471.240 |
|      27,412.0 |       470.330 |
```

1:1..1:1   1:1

Figure B-119. Report File for Test Example 16.

Example 17: Curve Combination Analysis, Combine Flow Frequency Curves

This example demonstrates how to create a curve combination analysis to combine multiple flow frequency curves. In this example, a flow frequency curve from a log-Pearson III analysis will be combined with information from a hydrology model, frequency precipitation applied to a calibrated rainfall-runoff model, and an estimate of the PMF. The frequency of the PMF is set to 0.00737 percent for this example.

A Curve Combination analysis has been developed for this example. To open the Curve Combination Analysis editor for test example 17, either double-click on the analysis labeled **Curve Combination Test 17** from the study explorer, or from the **Analysis** menu select open, then select **Curve Combination Test 17** from the list of available analyses. When test 17 is opened, the Curve Combination Analysis editor will appear as shown in Figure B-120.

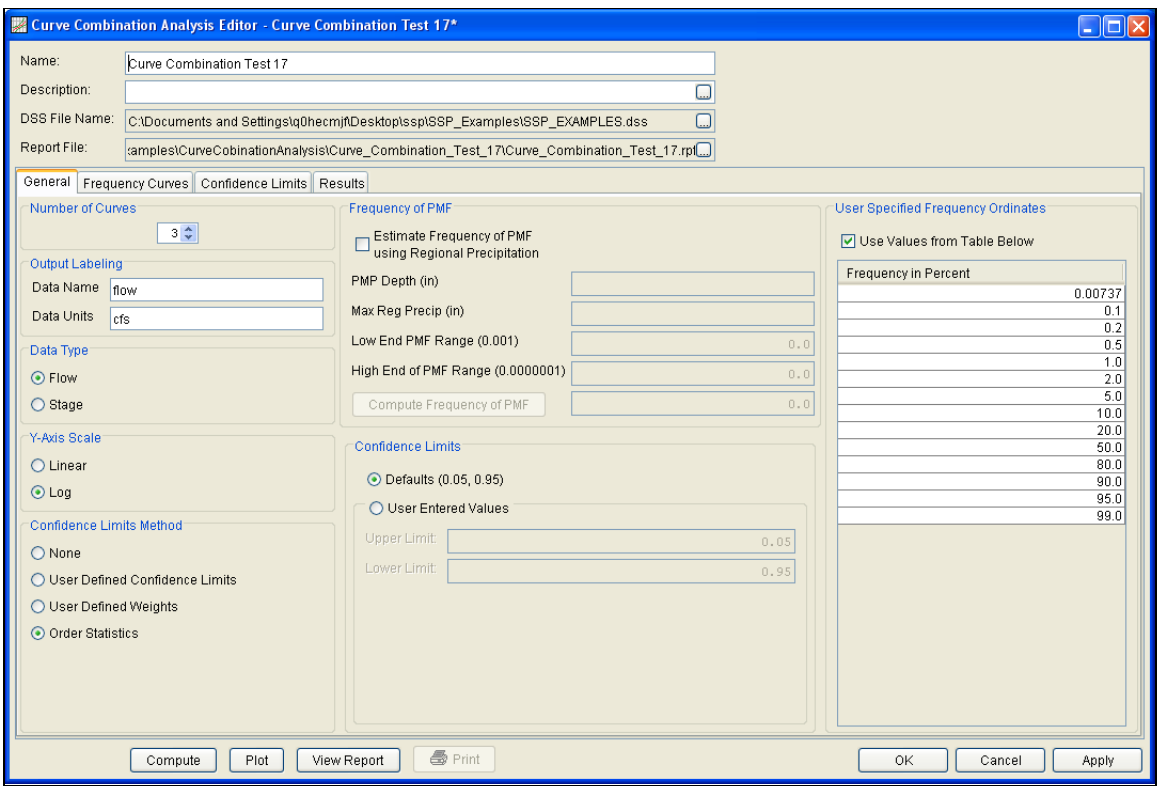


Figure B-120. General Tab Shown for Test Example 17.

Shown in Figure B-120 are the general settings for this curve combination analysis. The number of curves to combine was set to 3, “flow” was entered as the **Data Name**, and “cfs” was entered as the **Data Units**. The **Data Type** of “Flow” and **Y-Axis Scale** of “Log” were selected. “Order Statistics” was selected as the **Confidence Limits Method**. Finally, a frequency of 0.00737 was added to the **User Specified Frequency Ordinates table**.

Shown in Figure B-121 is the Curve Combination analysis editor with the **Frequency Curves** tab selected. Frequency curve 1 was imported from an existing Bulletin 17B analysis. The **Existing Study Analysis** option was selected and then the Bulletin 17B analysis named “Reservoir Inflows” was selected. The second frequency curve was entered manually using output from a hydrology model. The third frequency curve contains an estimate of the PMF. After the frequency curves were defined, a weight was specified for each ordinate in the frequency curves. The program uses these weights when computing the combined frequency curve.

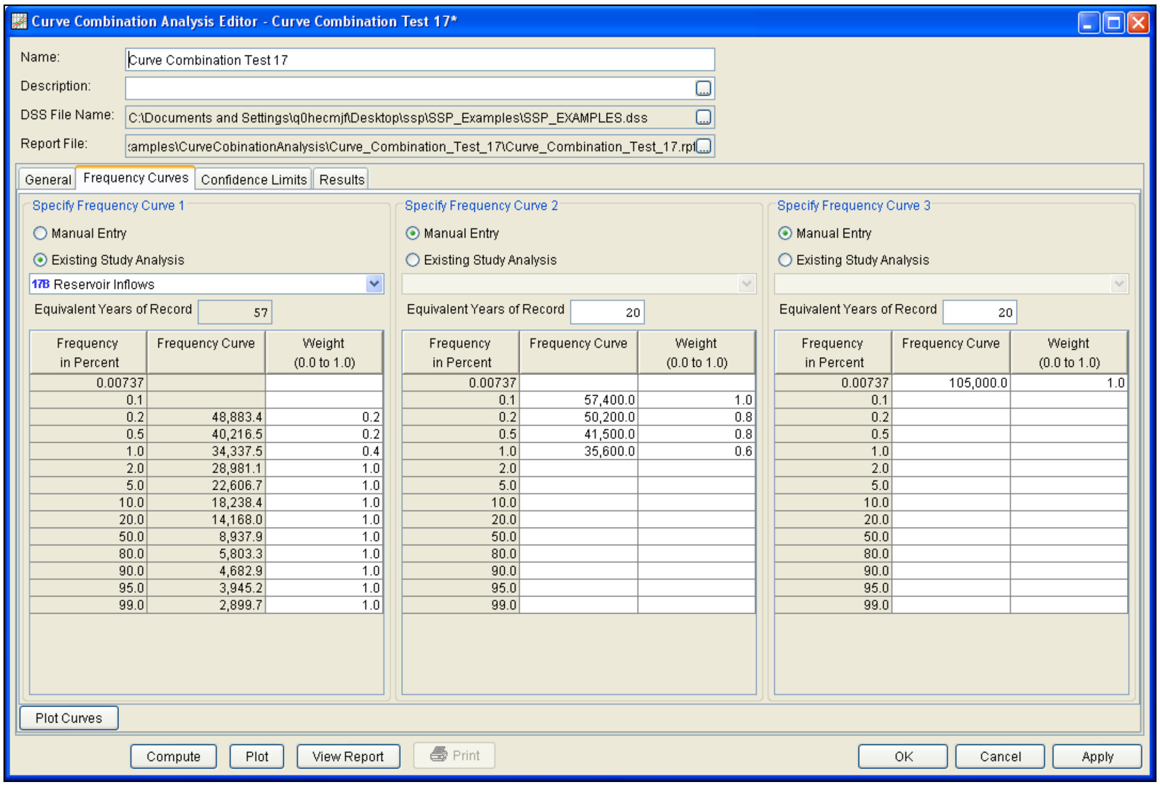


Figure B-121. Frequency Curves Tab for Test Example 17.

Shown in Figure B-122 is the Curve Combination analysis editor with the **Confidence Limits** tab selected. Since the Order Statistics method was selected as the confidence limits method, the user must define an equivalent years of record for each frequency curve ordinate. The program uses the equivalent years of record when computing the confidence limits using the order statistics method. When the **Compute Confidence Limits** button is selected, the program will first compute the combined frequency curve and then compute the confidence limits around the computed frequency curve using the order statistics method.

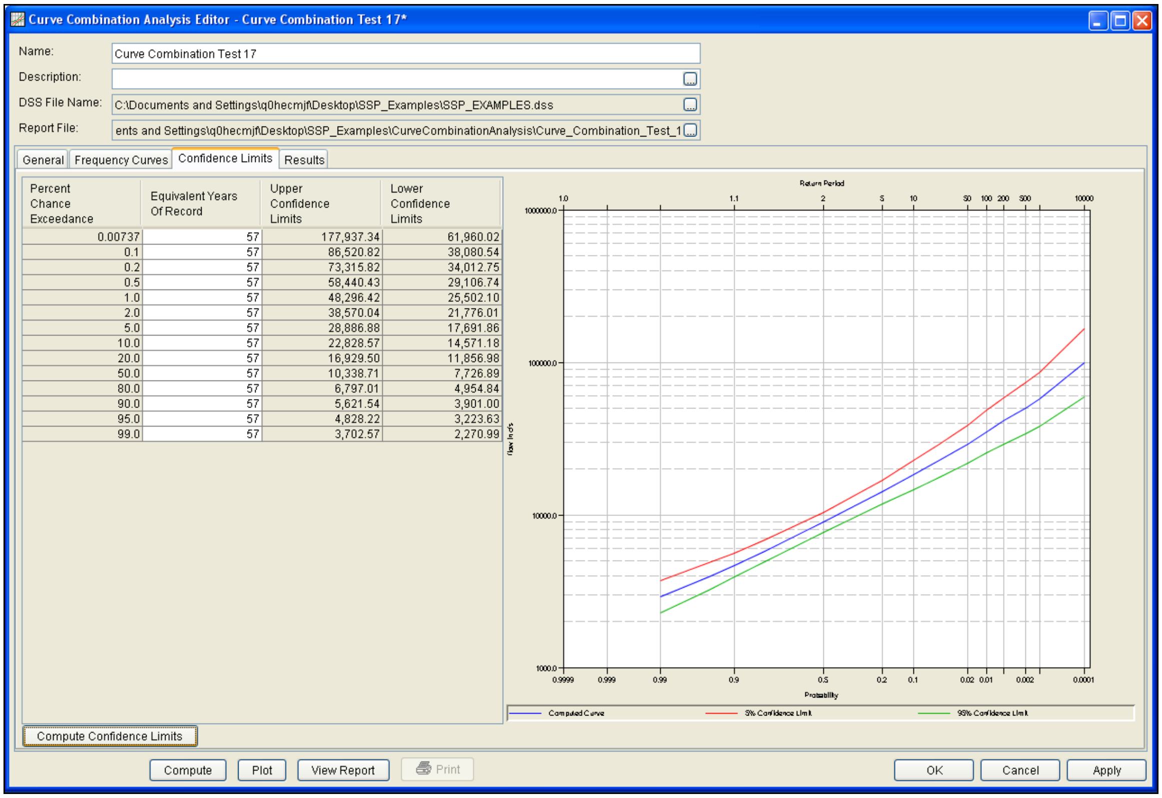


Figure B-122. Confidence Limits Tab for Test Example 17.

Press the **Compute** button to perform the analysis. Once the computations have been completed, a message window will open stating **Compute Complete.** Close this window and then select the **Results** tab. The results tab should look Figure B-123. The left portion of the results tab contains the computed frequency curve with confidence limits and the right portion of the results tab contains a plot of the computed combined frequency curve.

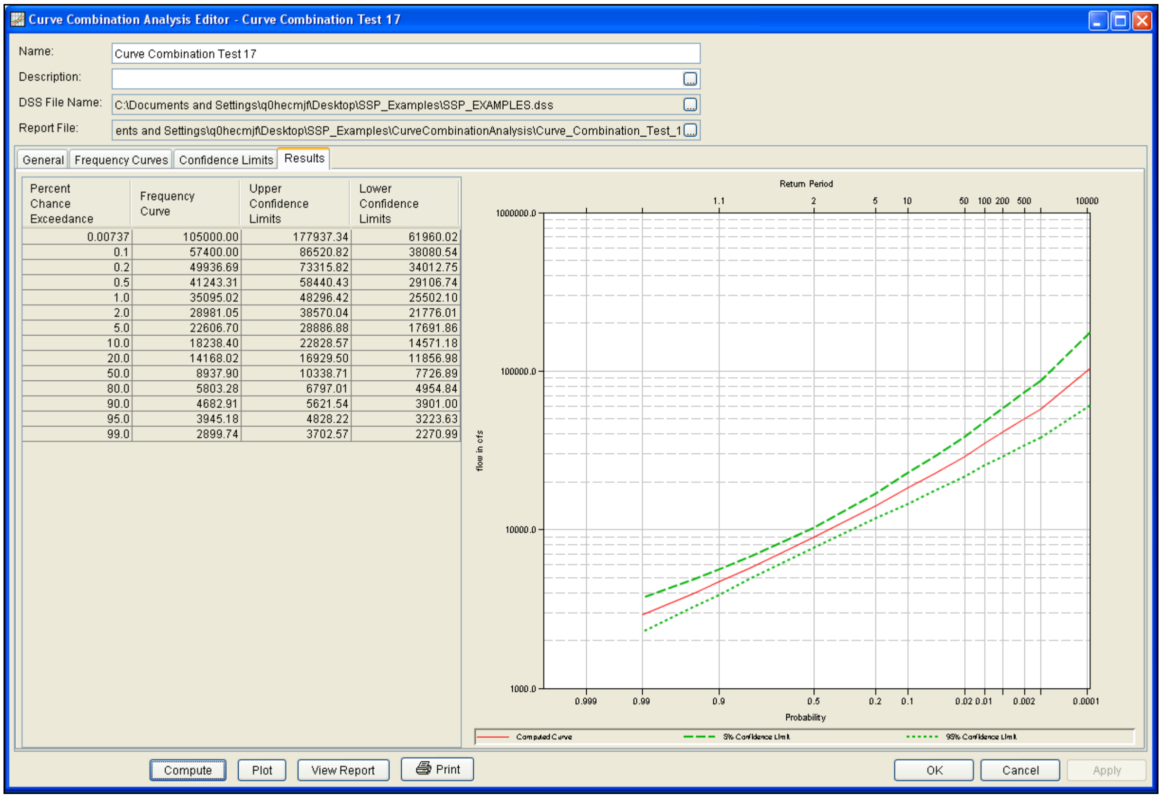
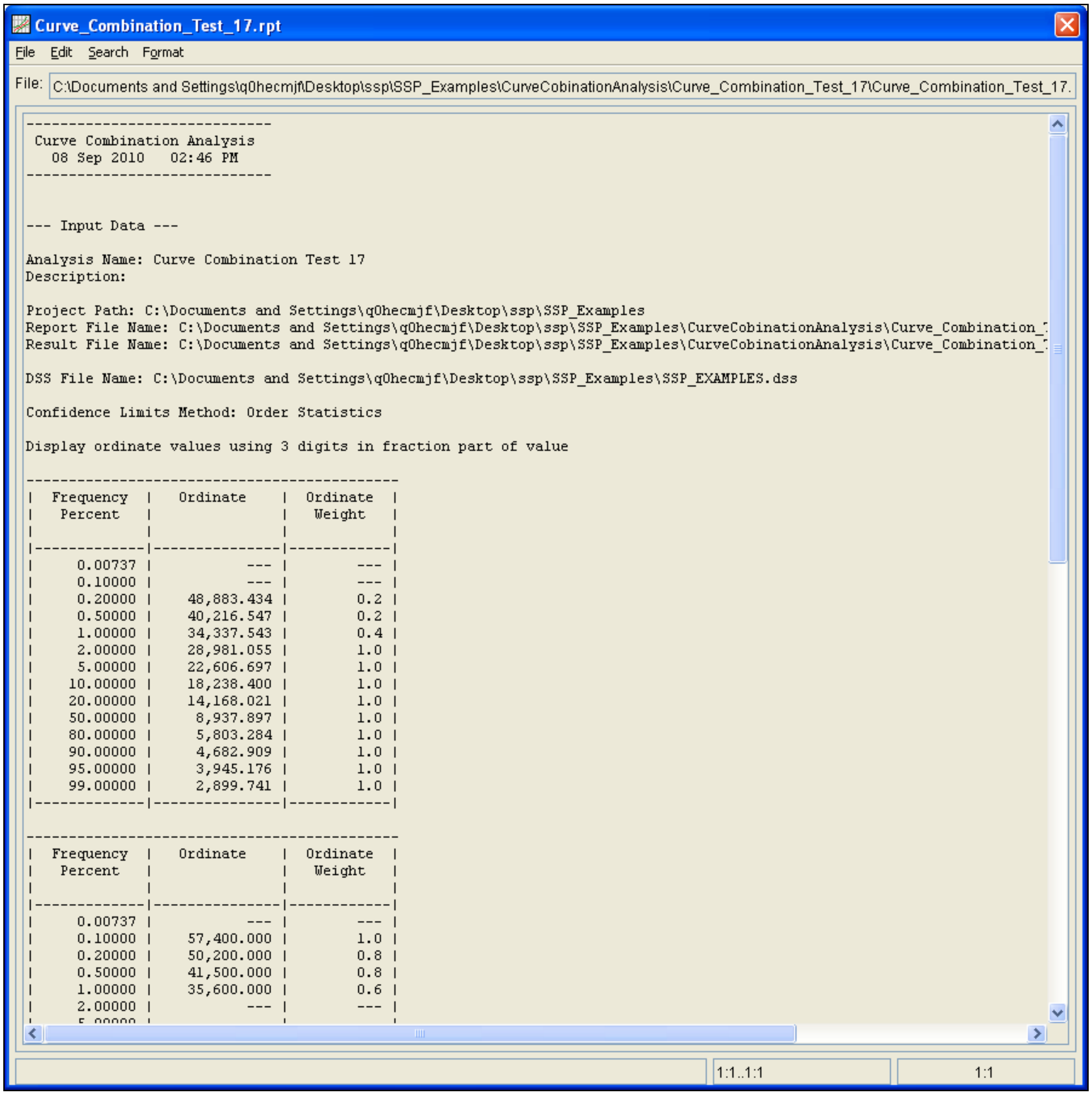


Figure B-123. Results Tab for Test Example 17.

The tabular and graphical results can be sent to the printer or the windows clipboard for transfer into another piece of software. To print the tabular results, select **Print** from the bottom of the analysis window. To send the tabular results to the windows clipboard, highlight the data you want to send to the clipboard and then press the Control-C key sequence. To print the graphical results, first bring up the graphical plot by pressing the **Plot** button from the bottom of the analysis. Then select **Print** from the **File** menu. To send the graphic to the windows clipboard, select **Copy to Clipboard** from the **File** menu.

In addition to the tabular and graphical results, there is a report file that shows input data and results. To review the report file, press the **View Report** button at the bottom of the analysis window. When this button is selected a text viewer will open the report file and display it on the screen. Shown in Figure B-124 is the report file for Test Example 17.



Curve_Combination_Test_17.rpt

File Edit Search Format

File: C:\Documents and Settings\q0hecmjf\Desktop\ssp\SSP_Examples\CurveCobinationAnalysis\Curve_Combination_Test_17\Curve_Combination_Test_17.

```
----------------------------
 Curve Combination Analysis
   08 Sep 2010   02:46 PM
----------------------------


--- Input Data ---

Analysis Name: Curve Combination Test 17
Description:

Project Path: C:\Documents and Settings\q0hecmjf\Desktop\ssp\SSP_Examples
Report File Name: C:\Documents and Settings\q0hecmjf\Desktop\ssp\SSP_Examples\CurveCobinationAnalysis\Curve_Combination_T
Result File Name: C:\Documents and Settings\q0hecmjf\Desktop\ssp\SSP_Examples\CurveCobinationAnalysis\Curve_Combination_T

DSS File Name: C:\Documents and Settings\q0hecmjf\Desktop\ssp\SSP_Examples\SSP_EXAMPLES.dss

Confidence Limits Method: Order Statistics

Display ordinate values using 3 digits in fraction part of value

--------------------------------------------
| Frequency  |   Ordinate     |  Ordinate  |
|  Percent   |                |   Weight   |
|            |                |            |
|------------|----------------|------------|
|    0.00737 |            --- |        --- |
|    0.10000 |            --- |        --- |
|    0.20000 |     48,883.434 |        0.2 |
|    0.50000 |     40,216.547 |        0.2 |
|    1.00000 |     34,337.543 |        0.4 |
|    2.00000 |     28,981.055 |        1.0 |
|    5.00000 |     22,606.697 |        1.0 |
|   10.00000 |     18,238.400 |        1.0 |
|   20.00000 |     14,168.021 |        1.0 |
|   50.00000 |      8,937.897 |        1.0 |
|   80.00000 |      5,803.284 |        1.0 |
|   90.00000 |      4,682.909 |        1.0 |
|   95.00000 |      3,945.176 |        1.0 |
|   99.00000 |      2,899.741 |        1.0 |
|------------|----------------|------------|

--------------------------------------------
| Frequency  |   Ordinate     |  Ordinate  |
|  Percent   |                |   Weight   |
|            |                |            |
|------------|----------------|------------|
|    0.00737 |            --- |        --- |
|    0.10000 |     57,400.000 |        1.0 |
|    0.20000 |     50,200.000 |        0.8 |
|    0.50000 |     41,500.000 |        0.8 |
|    1.00000 |     35,600.000 |        0.6 |
|    2.00000 |            --- |        --- |
```

1:1..1:1 1:1

Figure B-124. Report File for Test Example 17.

Example 18: Curve Combination Analysis, Combine Stage Frequency Curves

This example demonstrates how to create a curve combination analysis to combine multiple stage frequency curves. In this example, a stage frequency curve that was fit graphically to observed annual maximum stage data will be combined with information from a hydrology model, frequency precipitation applied to a calibrated rainfall-runoff model, and the maximum stage from the probable maximum flood simulation.

A Curve Combination analysis has been developed for this example. To open the Curve Combination Analysis editor for test example 18, either double-click on the analysis labeled **Curve Combination Test 18** from the study explorer, or from the **Analysis** menu select open, then select **Curve Combination Test 18** from the list of available analyses. When test 18 is opened, the Curve Combination Analysis editor will appear as shown in Figure B-125.

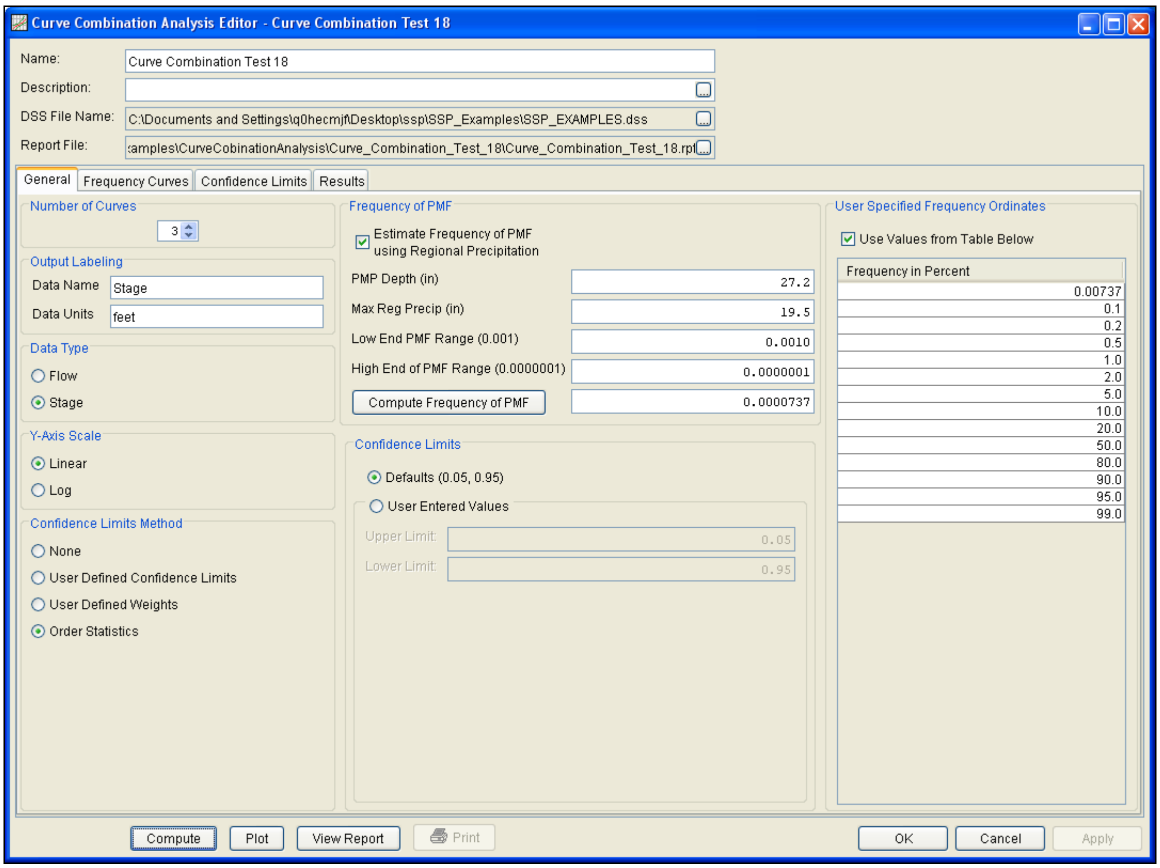


Figure B-125. General Tab Shown for Test Example 18.

Shown in Figure B-125 are the general settings for this curve combination analysis. The number of curves to combine was set to 3, "Stage" was entered as the **Data Name**, and "feet" was entered as the **Data Units**. The **Data Type** of "Stage" and **Y-Axis Scale** of "Linear" were selected. "Order Statistics" was selected as the **Confidence Limits Method**. The Frequency of PMF panel was used to estimate the frequency of the PMF event using observed regional maximum precipitation. The 72-hour PMP for a storm of 450 square miles was 29.2 inches and the greatest regional 72-hour observed precipitation for a 450 square mile storm was 19.5 inches. The recommended values for the low and high range of the PMF were entered and the **Compute Frequency of PMF** button was pressed. This resulted in an estimated probability for the PMF of 0.0000737 or 0.00737 percent. This value was added to the **User Specified Frequency Ordinates** table.

Shown in Figure B-126 is the Curve Combination analysis editor with the **Frequency Curves** tab selected. Frequency curve 1 was entered manually by copying the graphical frequency curve from the Reservoir Inflows general frequency analysis. The second frequency curve was entered manually using output from a hydrology model. The third frequency curve contains an estimate of the maximum stage from the PMF. After the frequency curves were defined, a weight was specified for each ordinate in the frequency curves. The program uses these weights when computing the combined frequency curve.

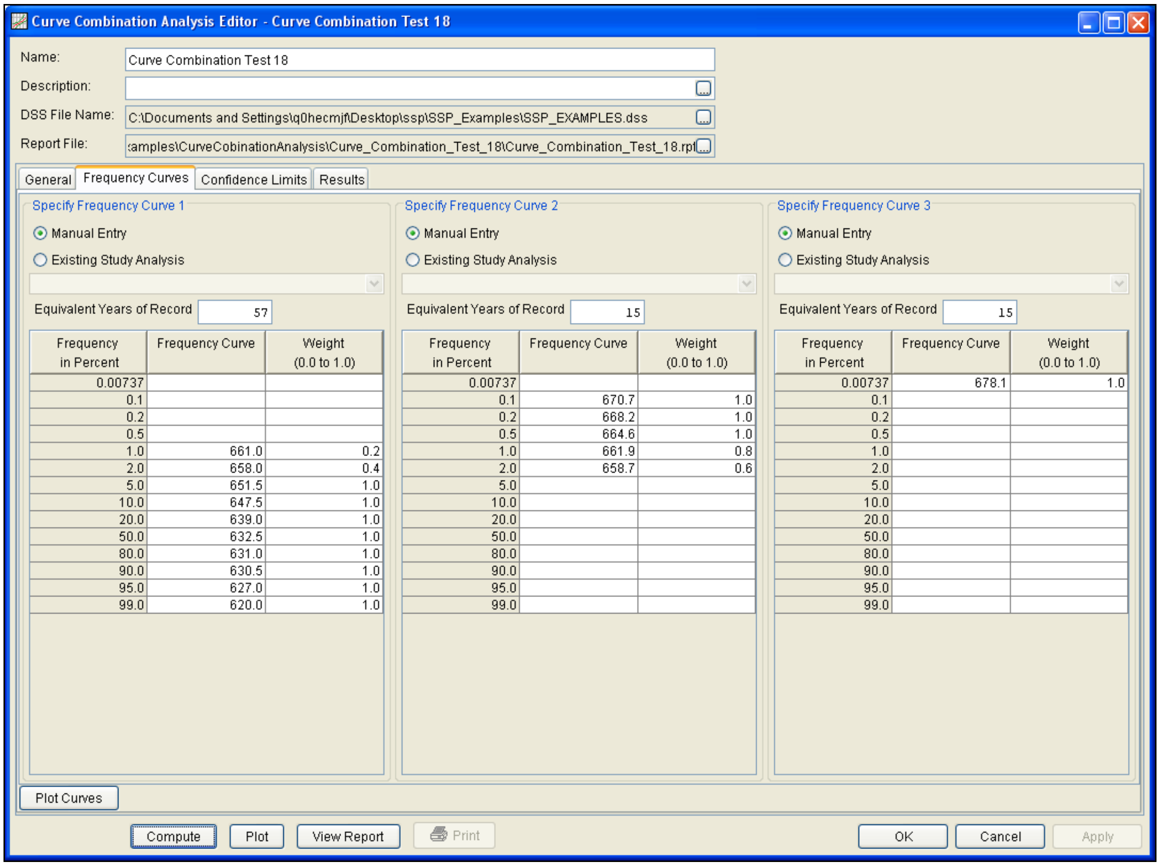


Figure B-126. Frequency Curves Tab for Test Example 18.

Shown in Figure B-127 is the Curve Combination Analysis editor with the **Confidence Limits** tab selected. Since the Order Statistics method was selected as the confidence limits method, the user must define an equivalent years of record for each frequency curve ordinate. The program uses the equivalent years of record when computing the confidence limits using the order statistics method. When the **Compute Confidence Limits** button is selected, the program will first compute the combined frequency curve and then compute the confidence limits around the computed frequency curve using the order statistics method.

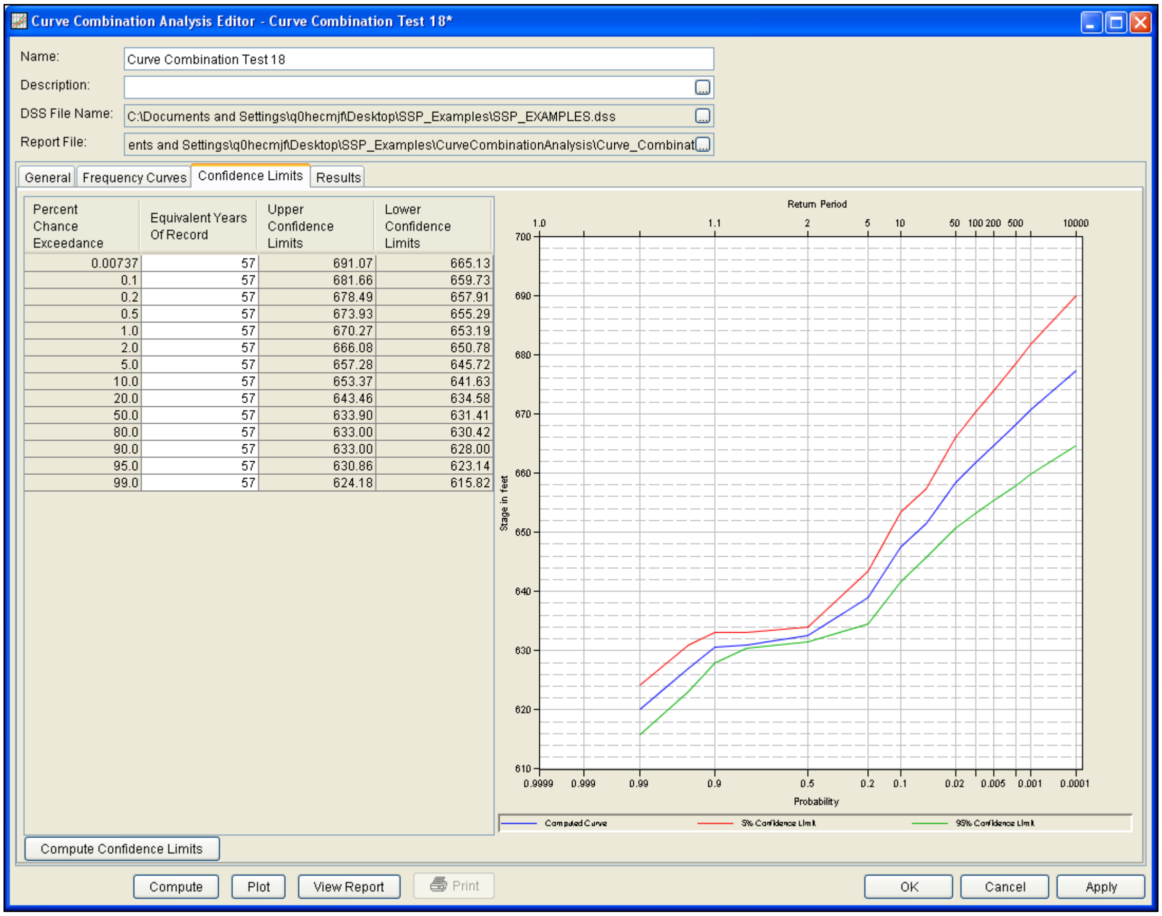
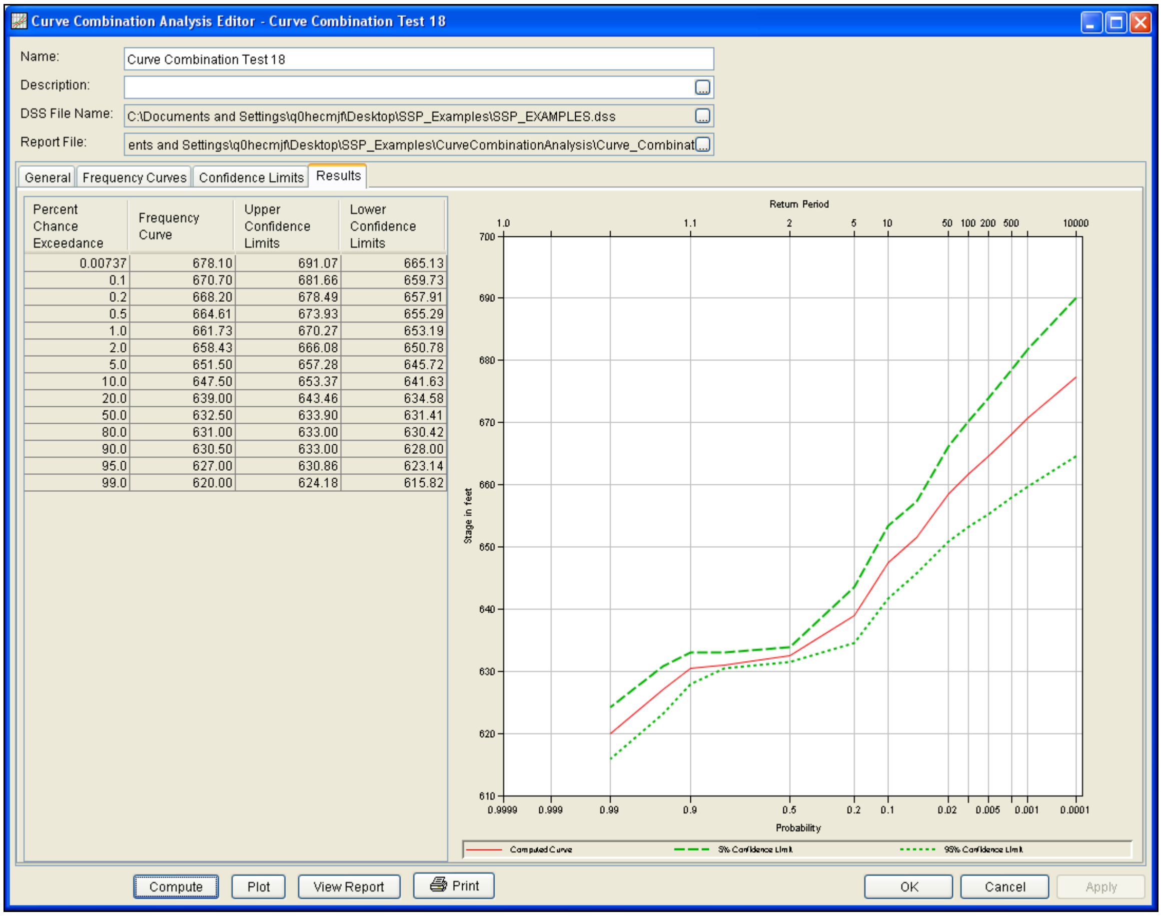


Figure B-127. Confidence Limits Tab for Test Example 18.

Press the **Compute** button to perform the analysis. Once the computations have been completed, a message window will open stating **Compute Complete.** Close this window and then select the **Results** tab. The results tab should look like Figure B-128. The left portion of the results tab contains the computed frequency curve with confidence limits and the right portion of the results tab contains a plot of the computed combined frequency curve.

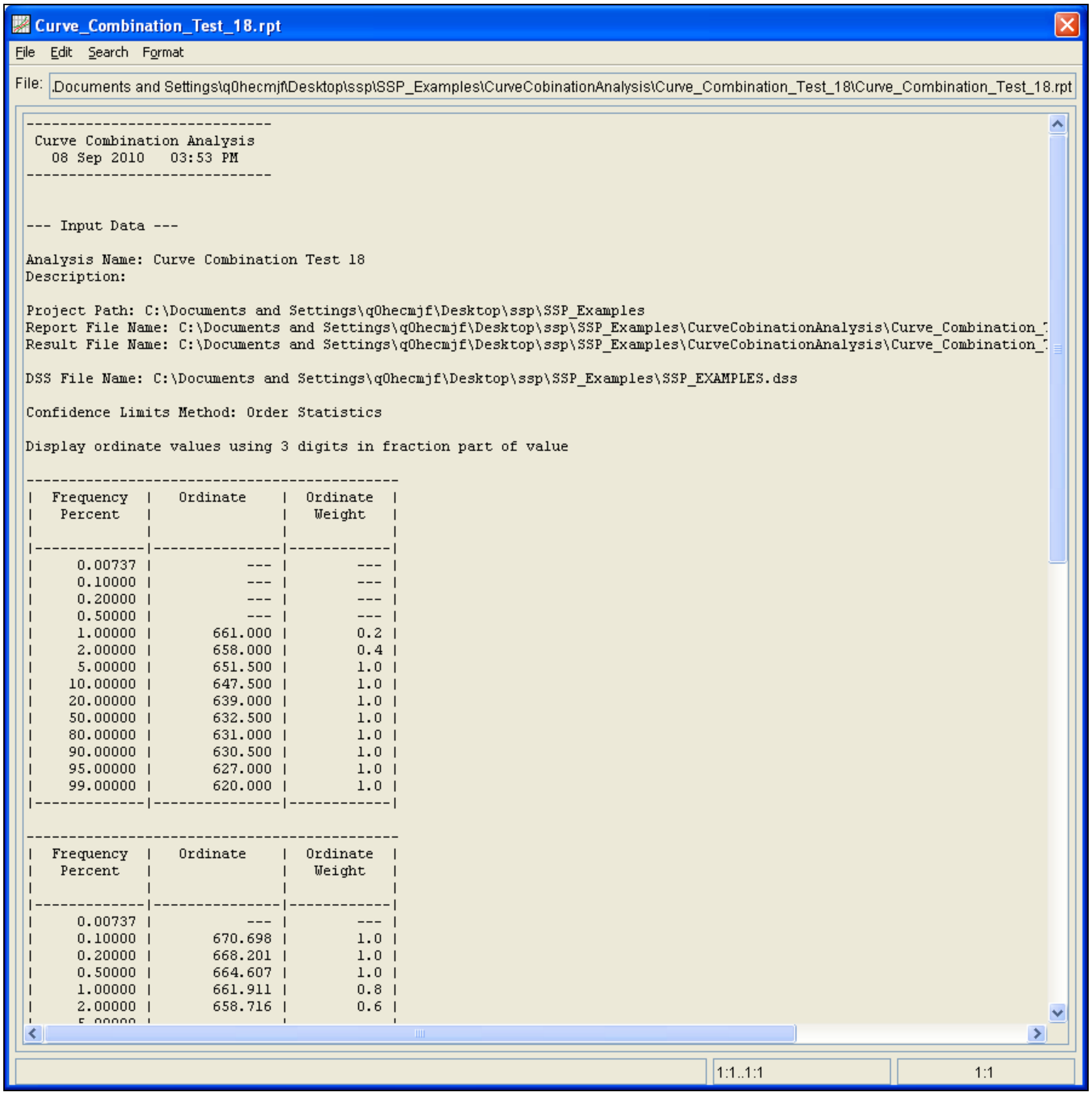


Percent Chance Exceedance	Frequency Curve	Upper Confidence Limits	Lower Confidence Limits
0.00737	678.10	691.07	665.13
0.1	670.70	681.66	659.73
0.2	668.20	678.49	657.91
0.5	664.61	673.93	655.29
1.0	661.73	670.27	653.19
2.0	658.43	666.08	650.78
5.0	651.50	657.28	645.72
10.0	647.50	653.37	641.63
20.0	639.00	643.46	634.58
50.0	632.50	633.90	631.41
80.0	631.00	633.00	630.42
90.0	630.50	633.00	628.00
95.0	627.00	630.86	623.14
99.0	620.00	624.18	615.82

Figure B-128. Results Tab for Test Example 18.

The tabular and graphical results can be sent to the printer or the windows clipboard for transfer into another piece of software. To print the tabular results, select **Print** from the bottom of the analysis window. To send the tabular results to the windows clipboard, highlight the data you want to send to the clipboard and then press the Control-C key sequence. To print the graphical results, first bring up the graphical plot by pressing the **Plot** button from the bottom of the analysis. Then select **Print** from the **File** menu. To send the graphic to the windows clipboard, select **Copy to Clipboard** from the **File** menu.

In addition to the tabular and graphical results, there is a report file that shows input data and results. To review the report file, press the **View Report** button at the bottom of the analysis window. When this button is selected a text viewer will open the report file and display it on the screen. Shown in Figure B-129 is the report file for Test Example 18.



Curve_Combination_Test_18.rpt

File Edit Search Format

File: .Documents and Settings\q0hecmjf\Desktop\ssp\SSP_Examples\CurveCobinationAnalysis\Curve_Combination_Test_18\Curve_Combination_Test_18.rpt

```
-----------------------------
 Curve Combination Analysis
   08 Sep 2010   03:53 PM
-----------------------------


--- Input Data ---

Analysis Name: Curve Combination Test 18
Description:

Project Path: C:\Documents and Settings\q0hecmjf\Desktop\ssp\SSP_Examples
Report File Name: C:\Documents and Settings\q0hecmjf\Desktop\ssp\SSP_Examples\CurveCobinationAnalysis\Curve_Combination_
Result File Name: C:\Documents and Settings\q0hecmjf\Desktop\ssp\SSP_Examples\CurveCobinationAnalysis\Curve_Combination_

DSS File Name: C:\Documents and Settings\q0hecmjf\Desktop\ssp\SSP_Examples\SSP_EXAMPLES.dss

Confidence Limits Method: Order Statistics

Display ordinate values using 3 digits in fraction part of value

--------------------------------------------
|  Frequency  |   Ordinate    |  Ordinate  |
|   Percent   |               |   Weight   |
|             |               |            |
|-------------|---------------|------------|
|     0.00737 |           --- |        --- |
|     0.10000 |           --- |        --- |
|     0.20000 |           --- |        --- |
|     0.50000 |           --- |        --- |
|     1.00000 |       661.000 |        0.2 |
|     2.00000 |       658.000 |        0.4 |
|     5.00000 |       651.500 |        1.0 |
|    10.00000 |       647.500 |        1.0 |
|    20.00000 |       639.000 |        1.0 |
|    50.00000 |       632.500 |        1.0 |
|    80.00000 |       631.000 |        1.0 |
|    90.00000 |       630.500 |        1.0 |
|    95.00000 |       627.000 |        1.0 |
|    99.00000 |       620.000 |        1.0 |
|-------------|---------------|------------|

--------------------------------------------
|  Frequency  |   Ordinate    |  Ordinate  |
|   Percent   |               |   Weight   |
|             |               |            |
|-------------|---------------|------------|
|     0.00737 |           --- |        --- |
|     0.10000 |       670.698 |        1.0 |
|     0.20000 |       668.201 |        1.0 |
|     0.50000 |       664.607 |        1.0 |
|     1.00000 |       661.911 |        0.8 |
|     2.00000 |       658.716 |        0.6 |
```

1:1..1:1 1:1

Figure B-129. Report File for Test Example 18.