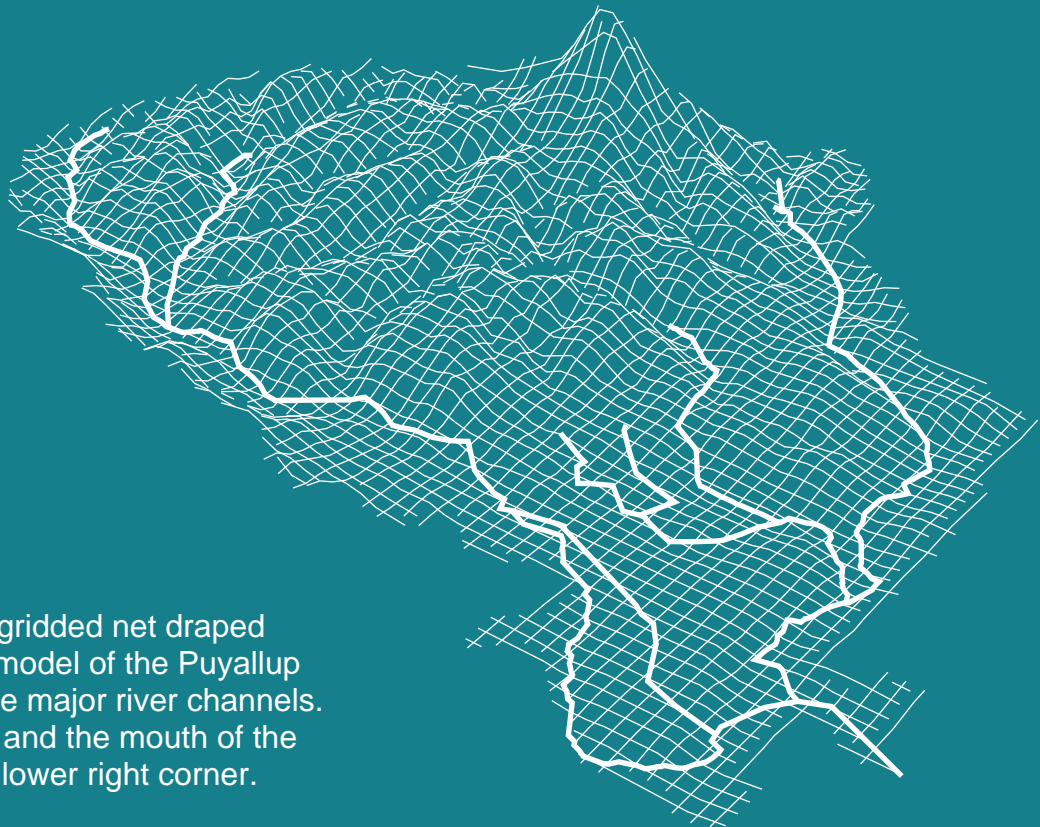


User's Guide to SSARRMENU

Open-File Report 01-439



A computer image of a gridded net draped over a digital elevation model of the Puyallup River Basin including the major river channels. Mt. Rainier is at the top and the mouth of the Puyallup River is at the lower right corner.

User's Guide to SSARRMENU

By M.C. Mastin and Thanh Le

U.S. GEOLOGICAL SURVEY

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U.S. GEOLOGICAL SURVEY
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ABSTRACT

The U.S. Geological Survey, in cooperation with Pierce County Department of Public Works, Washington, has developed an operational tool called the Puyallup Flood-Alert System to alert users of impending floods in the Puyallup River Basin. The system acquires and incorporates meteorological and hydrological data into the Streamflow Synthesis and Reservoir Regulation (SSARR) hydrologic flow-routing model to simulate floods in the Puyallup River Basin. SSARRMENU is the user-interactive graphical interface between the user, the input and output data, and the SSARR model. In a companion cooperative project with Pierce County, the SSARR model for the Puyallup River Basin was calibrated and validated. The calibrated model is accessed through SSARRMENU, which has been specifically programmed for the Puyallup River and the needs of Pierce County. SSARRMENU automates the retrieval of data from ADAPS (Automated DATA Processing System, the U.S. Geological Survey's real-time hydrologic database), formats the data for use with SSARR, initiates SSARR model runs, displays alerts for impending floods, and provides utilities to display the simulated and observed data. An on-screen map of the basin and a series of menu items provide the user with easy access to SSARRMENU's capabilities. SSARRMENU runs on a personal computer in a Windows NT™, version 4.0, operating environment that includes the U.S. Corps of Engineers' distributed SSARR program, companion data management and workfile utilities, and internet connection.

INTRODUCTION

A real-time flood-alert system has been developed for the Puyallup River Basin in Washington State by the U.S. Geological Survey (USGS), in cooperation with the Pierce County Department of Public Works. The major components of the system consist of a real-time network of streamflow and meteorologic gages operated by the USGS, a calibrated watershed and flow-routing model, a database, a data-communication network, and the user. SSARRMENU, the software program that ties all these components together, has two functions: (1) provide an interface between the user and the input, model, and output; and (2) display alerts of impending floods. A description of the watershed and flow-routing model, SSARR; how it was developed, calibrated, and validated; and an overview of the Puyallup Flood-Alert System (hereafter referred to as the Flood-Alert System) is described by Mastin (1999) in a separate report. This report is intended to provide the user with a practical guide for using the SSARRMENU (version 2K4.1) software to retrieve input data, make runoff simulations and view results, and provide a reference for system requirements and the many related files needed or generated by the program.

The roles of the Flood-Alert System and SSARRMENU are illustrated by the generalized flow paths of data from the gage sites to the Pierce County Department of Public Works and within the computer for the Flood-Alert System ([fig. 1](#)).

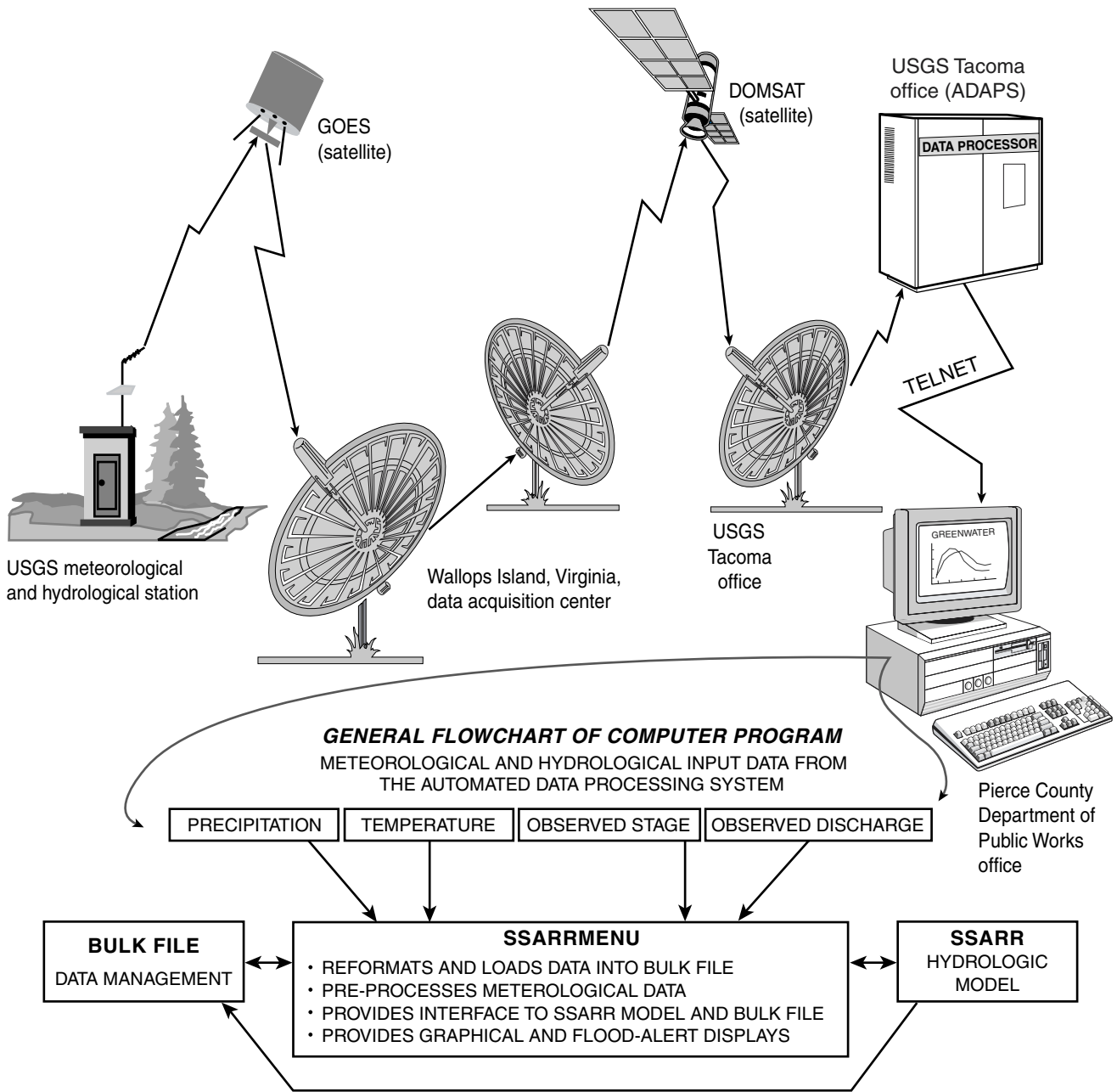


Figure 1. Generalized flowpath of meteorological and hydrological data from the gage sites to the Pierce County Department of Public Works office and within the computer for the Puyallup Flood-Alert System.

MANUAL OVERVIEW

This manual is intended to provide a guide to running SSARRMENU, a FORTRAN90-compiled executable program for the Windows NT™ operating system (version 4.0), and related watershed and flow-routing model files. It provides a summary of the watershed and flow-routing model (“Model Overview”), and outlines how to get started in SSARRMENU (“Getting Started”) and make runoff simulations (“Runoff Simulation”). The main screen for SSARRMENU that appears after initial start-up contains the Puyallup River Basin Flood-Alert Map and eight top-level menu items ([fig. 2](#)). Four of the top-level menu items (File, Edit, Window, and Help) are standard window-application program items that arrange the windows, save graphics to files, print windows, exit the program, and so forth. The other four top-level menu items (Retrieve Data, Model Runs, Basin Status, and Text Files) represent groups of actions specific to runoff simulations on the Puyallup River ([fig. 3](#)). Each of these four top-level menu items and subordinate menu options are described in the section titled “Modeling Options,” and the subheadings in this section match the titles for the menu options in SSARRMENU. The section “System Documentation” lists the directory structure and the files required to operate SSARRMENU. The final section, “Appendix A. Supplemental Information,” describes miscellaneous computer operations that may be useful for the user.

Model Overview

The watershed and flow-routing model used in the Puyallup Flood-Alert System is the Streamflow Synthesis and Reservoir Regulation (SSARR) hydrologic model. The SSARR model was developed and is distributed by the North Pacific Division, U.S. Army Corps of Engineers ([URL: http://www.nwd-wc.usace.army.mil/report/ssarr.htm](http://www.nwd-wc.usace.army.mil/report/ssarr.htm)). SSARRMENU is the user-interactive graphical interface between the user, the input and output data, and the SSARR model.

The SSARR model, as constructed for the Puyallup River Basin, contains seven subbasins. Each subbasin is divided into elevation zones or “snowbands” for the computation of snowmelt and accumulation. During a model run, the runoff and current hydrologic conditions (soil moisture,

interception storage, snow water equivalent, etc.) are computed for each subbasin at each time step. The subbasins, streams, and the network of streamflow and precipitation and temperature gages are shown on the map on [figure 4](#). Observed data from six precipitation gages, six temperature gages, eight stream stage gages, and nine discharge gages are input to the Puyallup River SSARR model.

Accurate simulation of flood peaks requires accurate averages of precipitation and temperature for each elevation zone (snowband), which rely on accurate point values measured at the gages. Subbasin precipitation and temperature at stations of known elevation are the two meteorological inputs to the SSARR model. Observed or forecasted precipitation at point locations is converted into a separate precipitation time series for each subbasin with a weighted average of two station records. The weight that is applied is the ratio of the subbasin mean annual precipitation determined from a mean annual isohyetal map for the State of Washington (Soil Conservation Service, 1965) to the station’s mean annual precipitation determined from station records. Observed or forecasted temperature data are adjusted for the difference between the station elevation and the mean elevation of each snowband with a computed temperature lapse rate calculated from pairs of observed temperature time series at stations with known elevation. The various time series and their SSARR code names are shown in [table 1](#).

The outflows from the subbasins are routed through simulated reaches, REACH1 through REACH5; added together at summation points, SUM1 through SUM6; and regulated at two simulated reservoirs, Lake Tapps (TAPPS) and Mud Mountain Lake (MMD). Lake Tapps outflow is regulated by the model to match the observed outflow discharge (Lake Tapps Diversion near Dieringer). Mud Mountain Lake outflow is regulated by the model to match either the observed stage (Mud Mountain Lake—forebay elevation) or the computed outflow near Buckley, which is derived by adding the observed discharge at White River at Buckley with the observed discharge at White River Canal at Buckley (MCQOBS). A schematic of the model representation of the Puyallup River Basin ([fig. 5](#)) shows all the components of the SSARR model and how they are connected.

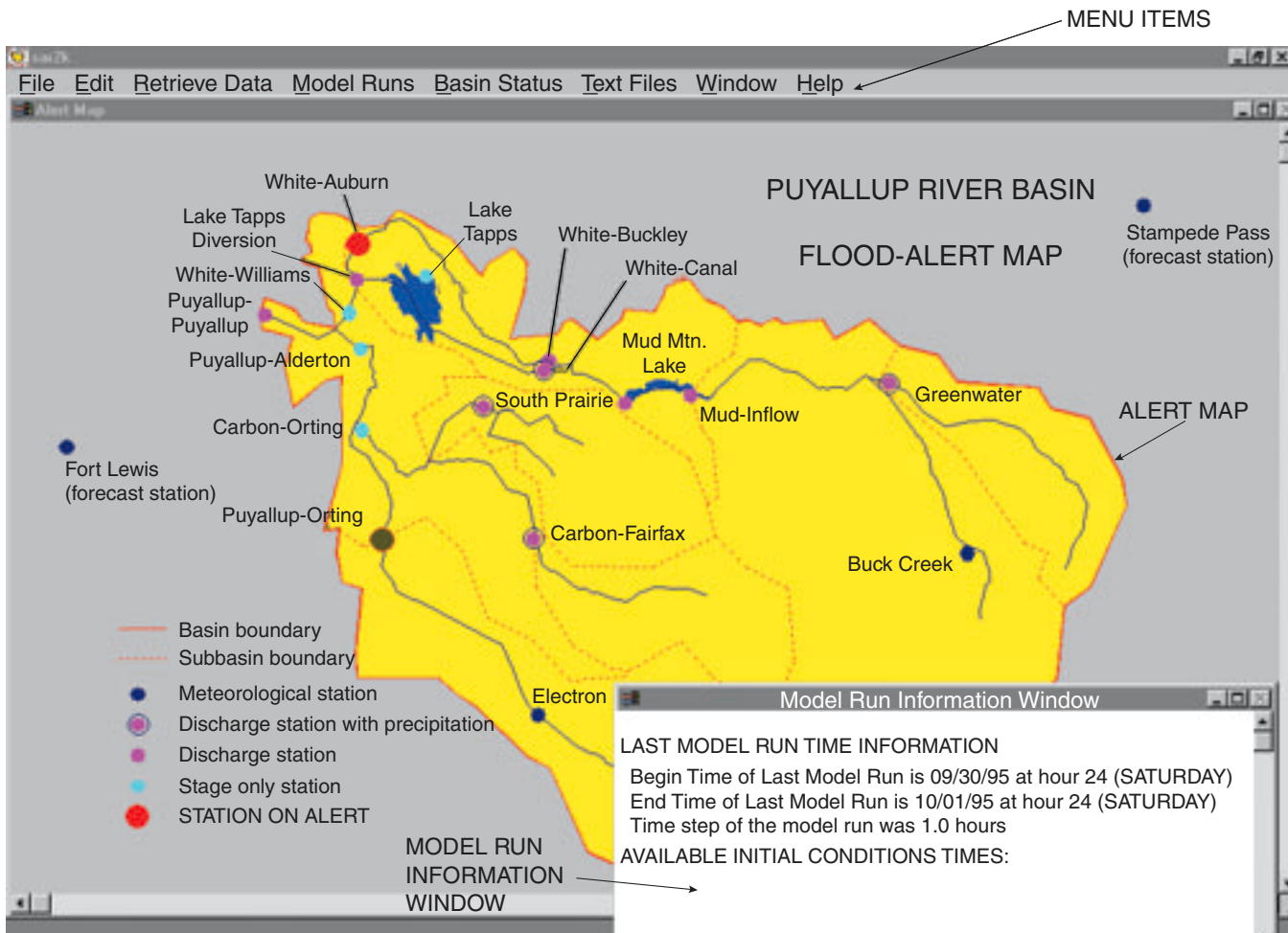
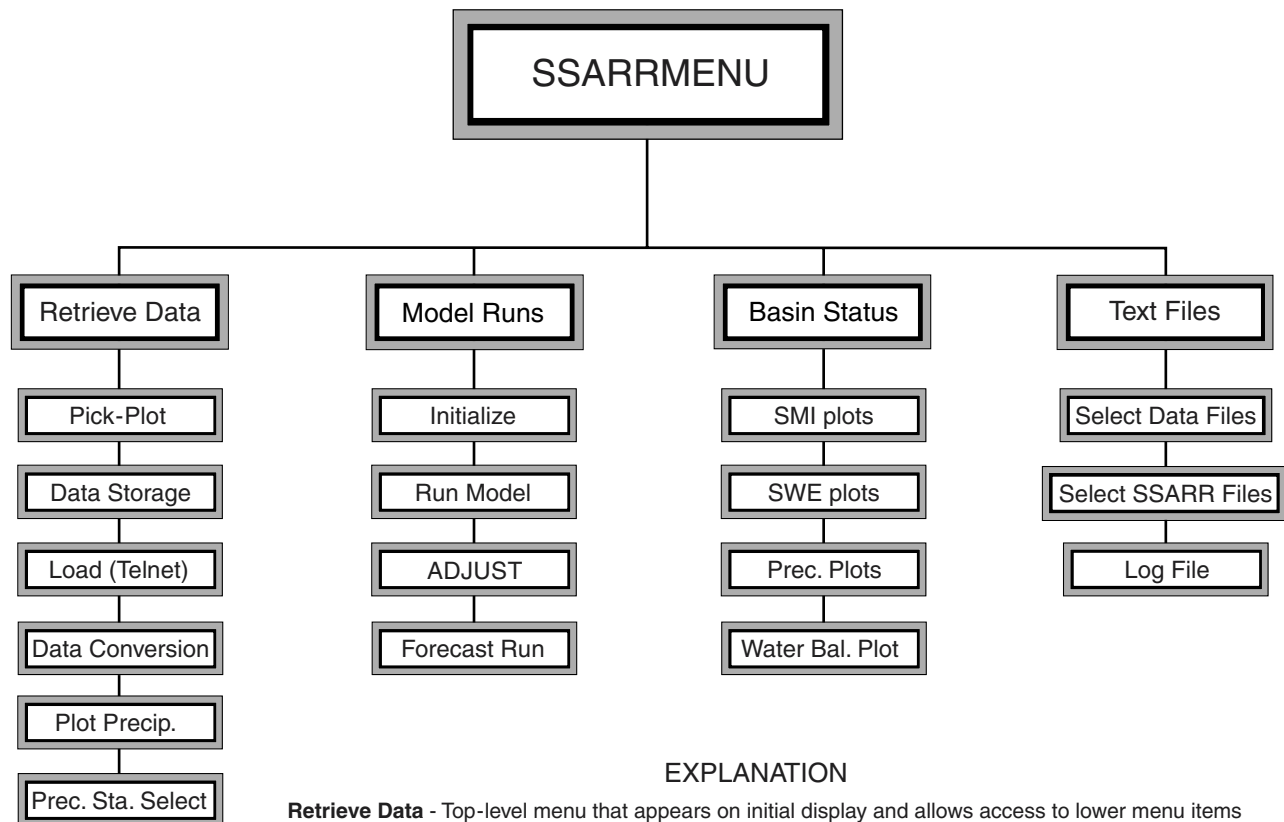


Figure 2. Computer screen display of the Puyallup River Basin, Washington, flood-alert map from the SSARRMENU program showing menu items, alert map, and model run information window.



EXPLANATION

Retrieve Data - Top-level menu that appears on initial display and allows access to lower menu items

Pick-Plot - allows the user to select a station by mouse input on the flood-alert map for making time-series plots of simulated and observed data

Data Storage - initiates the bulk2k.exe program to view the contents of the BULK file

Load (Telnet) - initiates the Telnet program to retrieve data from ADAPS

Data Conversion - converts WATSTORE-formatted data to SSARR-formatted data and loads them into the BULK file

Plot Precip. - plots precipitation data

Prec. Sta. Select - brings up a dialog box for user to select the precipitation stations to use in the current model run

Model Runs - Top-level menu that appears on initial display and allows access to lower menu items

Initialize - initializes the SSARR model at the beginning of the water year

Run Model - makes SSARR model run

ADJUST - makes automated adjustments of simulated discharge from observed discharge for the most recent model run

Forecast Run - makes a forecast model run

Basin Status - Top-level menu that appears on initial display and allows access to lower menu items

SMI Plots - plots soil moisture index for selected subbasins

SWE Plots - plots simulated snow-water equivalence for selected subbasins

Prec. Plots - plots mean annual precipitation or the 10-year, 24-hour precipitation frequency maps for the basin

Water Bal. Plot - plots selected simulated subbasin water-balance components of runoff for the last model run

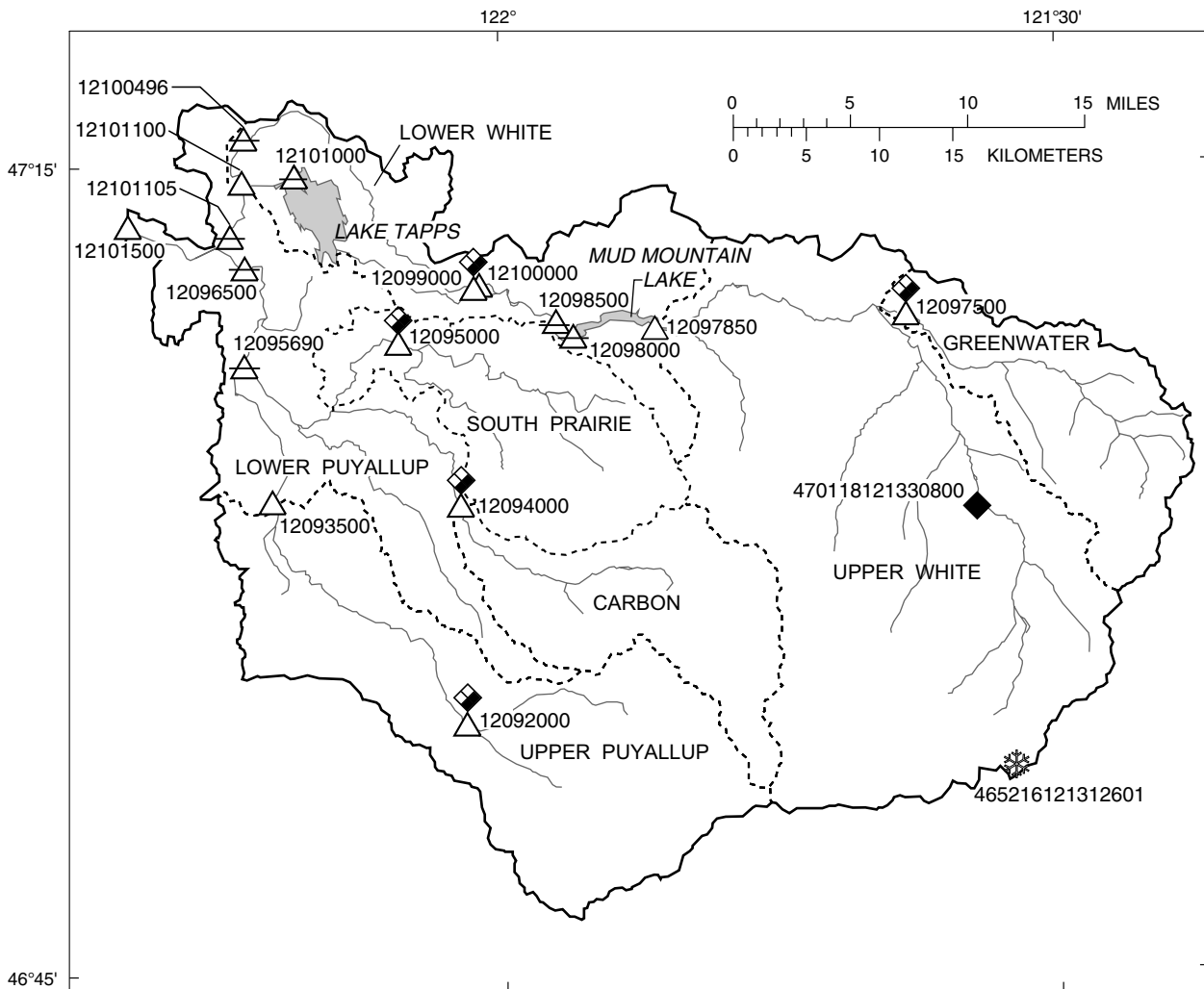
Text Files - Top-level menu that appears on initial display and allows access to lower menu items

Select Data Files - views hydrologic and meteorologic data files

Select SSARR Files - views SSARR-related files

Log File - views log file of model runs

Figure 3. Chart and description of menu items for SSARRMENU.



EXPLANATION	USGS Station Number	Station Name
—————	12092000	Puyallup River near Electron
	12093500	Puyallup River near Orting
	12094000	Carbon River near Fairfax
- - - - -	12095000	South Prairie Creek at South Prairie
CARBON	12095690	Carbon River at Orting
△	12096500	Puyallup River at Alderton
△	12097500	Greenwater River at Greenwater
△	12097850	White River below Clearwater River near Buckley
△	12098000	Mud Mountain Lake near Buckley
△	12098500	White River near Buckley
❄	12099000	White River Canal at Buckley
◆	12100000	White River at Buckley
	12100496	White River near Auburn
	12101000	Lake Tapps near Sumner
	12101100	Lake Tapps Diversion near Dieringer
	12101105	White River at Williams Bridge at Sumner
	12101500	Puyallup River at Puyallup
◆	470118121330800	Buck Creek Camp meteorological site near Greenwater
◆	465216121312601	Cayuse Pass snow course

Figure 4. Map showing Streamflow and meteorological network of U.S. Geological Survey-operated gages used by SSARRMENU in the Puyallup River Basin, Washington.

Table 1. Time series used in the Puyallup River Flood Model and their SSARR code names

<u>Subbasins</u>		<u>Subbasin precipitation</u>	
UPPUY	Upper Puyallup River	UPPP	
LWPUY	Lower Puyallup River	LPUP	
UPWHT	Upper White River	UPWP	
LWWHT	Lower White River	LWHP	
SOPRE	South Prairie Creek	SOPP	
CARBON	Carbon River	CARP	
GRNWTR	Greenwater River	GRNP	
<u>Observed precipitation</u>		<u>Observed temperature</u>	
BUCP	Buck Creek Camp Meteorological Site Number 470118121330800	BUCT	Buck Creek Camp Met. Site
ELEP	Puyallup River near Electron, Station Number 12092000	ELET	Puyallup River at Electron
SOPR	South Prairie Creek, Station Number 12095000	SPRT	South Prairie Creek at South Prairie
CARB	Carbon River near Fairfax, Station Number 12094000	CAYU	Cayuse Pass Snow Pillows
WHTP	White River Canal, Station Number 12099000	GNWT	Greenwater River at Greenwater
GNWP	Greenwater River at Greenwater, Station Number 12097500	CART	Carbon River near Fairfax
<u>Forecasted temperature</u>			
STMP	Stampede Pass		
FTLT	Fort Lewis		
<u>Simulated discharge</u>		<u>Observed discharge</u>	
UPPUY	(basin outflow)	ORTOBS	Puyallup River near Orting, Station Number 12093500
CARBON	(basin outflow)	CRFOBS	Carbon River near Fairfax, Station Number 12094000
SOPRE	(basin outflow)	SOPOBS	South Prairie Creek at South Prairie, Station Number 12095000
GRNWTR	(basin outflow)	GRNOBS	Greenwater River at Greenwater, Station Number 12097500
SUM1Q	(summation point)	WBCOBS	White River below Clearwater, Station Number 12097850
MMDQ	(reservoir outflow)	WNBOBS	White River near Buckley (not available for real time)
CANAL	(CANALB outflow)	WCBOBS	White River Canal at Buckley, Station Number 12099000
SUM2Q	(summation point)	WBQOBS	White River at Buckley, Station Number 12100000
TAPPSQ	(reservoir outflow)	LTDOBS	Lake Tapps Diversion, Station Number 12101100
PUYSIM	(REACH5 outflow)	PUYOBS	Puyallup River at Puyallup, Station Number 12101500
PUYDIF	(PUYBAL–difference between PUYOBS and REACH5)	MCQOBS	addition of flows (Station No. 12099000 + No. 12100000)
		WCQOBS	subtraction of flows (Station No. 12097850 - No. 12097500)
<u>Simulated stage</u>		<u>Observed stage</u>	
ORSSIM	(ORSSTG rating)	ORSOBS	Puyallup River near Orting, Station Number 12093500
CRSSIM	(CRSSTG rating)	CRSOBS	Carbon River at Orting, Station Number 12095690
PASSIM	(PASSTG rating)	PASOBS	Puyallup River at Alderton, Station Number 12096500
MMDE		MMDOBS	Mud Mountain Lake, Station Number 12098000
WASSIM	(WASSTG rating)	WASOBS	White River near Auburn, Station Number 12100496
TAPPSE		TAPOBS	Lake Tapps near Sumner, Station Number 12101000
PUSSIM	(PUSSTG rating)	WWBOBS	White River at Williams Bridge, Station Number 12101105
		PUSOBS	Puyallup River at Puyallup, Station Number 12101500

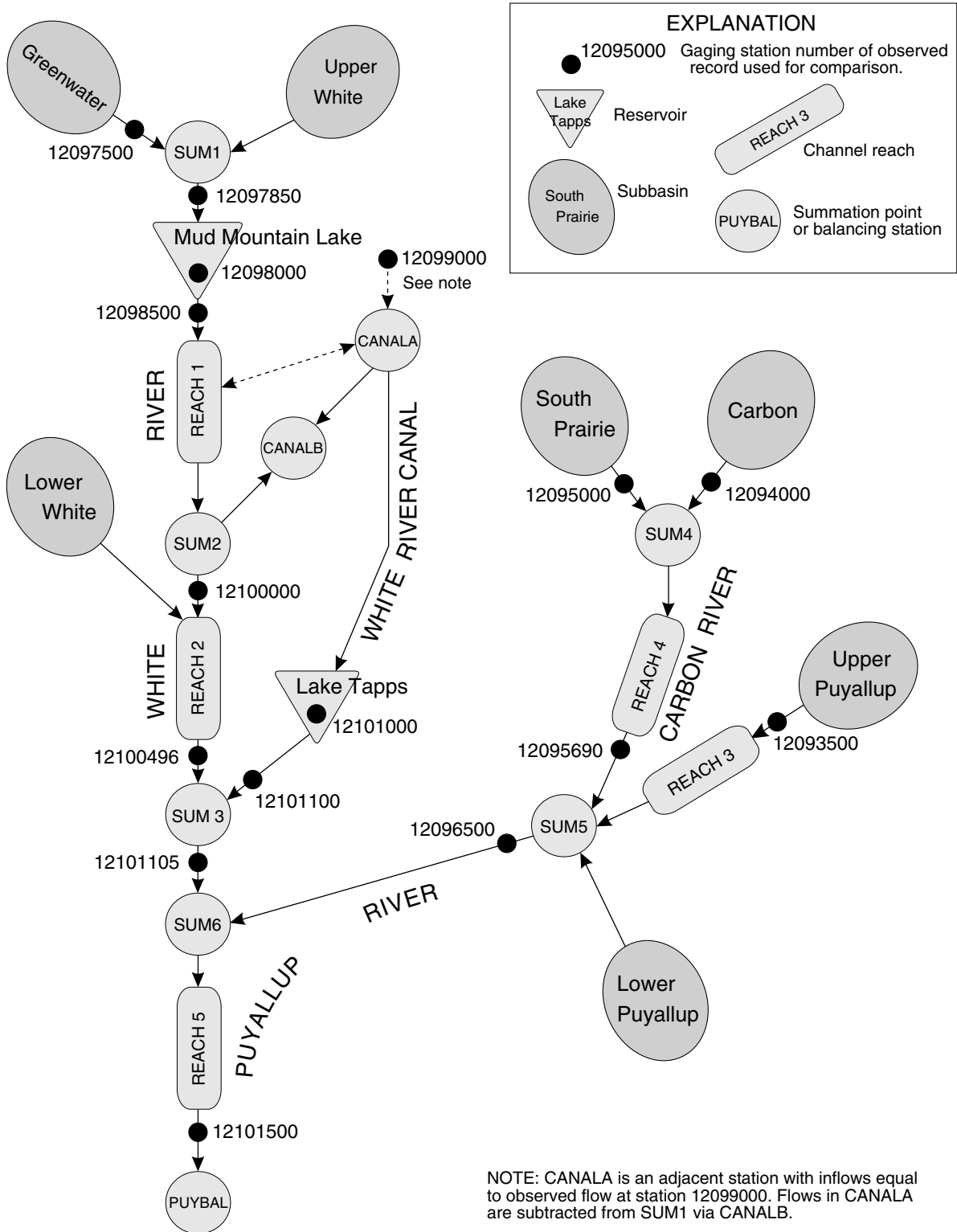


Figure 5. Schematic diagram of the network of subbasins, channel reaches, reservoirs, and summation points used in the Puyallup River Basin model, Washington.

GETTING STARTED

The executable program file, SSARRMENU.exe, can be located in any directory that a user chooses (henceforth called the root directory); however, there are three subdirectories, BASIN, DATA, and SSARR, that must be created under the root directory. For example, if the executable file is in the root directory C:\BRAKE\FLOODSIM, the three subdirectory pathnames will be C:\BRAKE\FLOODSIM\BASIN, C:\BRAKE\FLOODSIM\DATA, and C:\BRAKE\FLOODSIM\SSARR. In addition to the SSARRMENU executable file, three additional executable files from the SSARR model package and 21 supplementary files are needed in the root\SSARR directory. Also, eight supplementary files are needed in the root\BASIN directory and four supplementary files are needed in the root\DATA directory. See the “System Documentation” section for a complete list of files.

The color palette of the PC display should be set to 256 colors. This is accomplished by right clicking on the desktop and selecting the “Properties” option, which will open the “Display Properties” dialog box. Select the “Settings” tab. Under the “Color Palette” menu item, select 256 Colors, then select “OK.” Also, within the “Settings” menu, the “Desktop Area” should be set to 1024 by 768 pixels for best performance.

To start the SSARRMENU program, the user may double click with the mouse on the file name SSARRMENU.exe, located in the root directory if using the Windows NT™ Explorer program, or select (“select” or “selecting” refers to using the mouse to click on an item or button on the computer screen) an icon on the desktop if a shortcut has been created. After selecting the “OK to continue” button in the start-up screen, the main window will appear with the title “Puyallup River Basin Flood Alert-Map.”

Puyallup River Flood-Alert Map

The main window in SSARRMENU that appears when starting SSARRMENU is the alert map, titled “Puyallup River Basin Flood-Alert Map” (fig. 2). From this main window, all the standard window operations, modeling options, data retrievals, and data displays are launched. The circle symbols on the map represent gaging stations important to the Real-Time Flood-Alert System. By selecting these symbols, x-y time series

plots of observed and simulated data for the station can be displayed for a specified period using the Pick Plot option described later.

The flood-alert map also displays alerts for those stations where measurements have exceeded predefined threshold values. The most recently imported observed precipitation, stage, and discharge from the USGS database are scanned for values that exceed the threshold values. If a station’s observed value is exceeded, a large flashing red dot appears over the station location on the map to alert the user to high-water or high-precipitation conditions. If new data are retrieved, the program will automatically scan the new data for alert status. [Table 2](#) lists the stations and established thresholds. These thresholds can be changed by editing the alert.fil file in the root\DATA directory.

Runoff Simulation

SSARRMENU is designed to be run according to a set procedure, which is outlined in this section. Some of the normal flexibility of the SSARR model, such as selecting different time steps, recording initial conditions at multiple times during a model run, manual adjustment of initial conditions, and so forth, cannot be accomplished through the SSARRMENU interface. These options are not accommodated by SSARRMENU because they would increase the complexity of the programming, the data input and output, and the user operations. The model is intended to begin on October 1 of each water year with an empty Bulk file, the SSARR data-management file, and an empty Iodc file, the SSARR work file (see SSARR User Manual for more details, U.S. Army Corps of Engineers, 1991, p. 52). There are only two different time steps used—the 6-hour time step (backup mode) and the 1-hour time step (storm mode).

General Procedure for using SSARRMENU

The general order and procedures used to make model runs using SSARRMENU are outlined below (details of each procedure are provided later in the text).

Table 2. Threshold values for alert status for the Puyallup Flood-Alert System, Washington[ft³/s, cubic feet per second]

Variable	Station name	Threshold value ¹	
River stage	White River near Auburn	80.0	feet
River stage	Puyallup River at Alderton	53.0	feet
River discharge	Puyallup River at Puyallup	17,000	ft ³ /s
River discharge	Puyallup River near Orting	4,000	ft ³ /s
River stage	Carbon River at Orting	27.0	feet
River discharge	Carbon River near Fairfax	3,500	ft ³ /s
River discharge	White River below Clearwater River near Buckley	7,090	ft ³ /s
Lake stage	Mud Mountain Lake near Buckley	1,092.0	feet
River stage	White River at Williams Bridge at Sumner	47.8	feet
Creek discharge	South Prairie Creek at South Prairie	2,500	ft ³ /s
River stage	White River near Buckley	7.1	feet
River discharge	Greenwater River at Greenwater	1,300	ft ³ /s
24-hour precipitation	Buck Creek Camp Meteorological Site near Greenwater	3.0	inches
6-hour precipitation	Buck Creek Camp Meteorological Site near Greenwater	1.4	inches

¹ If this value is exceeded, the station is on alert.

1. Initialize the model with predefined watershed model characteristics and initial discharges in the simulated river reaches beginning on October 1 of the water year being modeled.
2. Retrieve data from the USGS computer in the Washington District office using the communications software Telnet. A Perl script is used to retrieve all the stage, discharge, temperature, and precipitation data from the ADAPS program as National **WATER** Data **STOR**age and **RE**trieval System (WATSTORE)-formatted files (Hutchison, 1975). The user is prompted for the start and end dates for the retrieval and whether to use a 1-hour time step (storm mode) or a 6-hour time step (back-up mode) between data values.
3. Convert the stage, discharge, precipitation, and temperature data from WATSTORE-formatted files to SSARR-formatted files and load into the Bulk file. The user is prompted by SSARRMENU to select one of two time series, Mud Mountain Lake stage or the combined discharge of White River at Buckley and White River Canal at Buckley, to simulate regulated outflow from Mud Mountain Lake. The program provides the option to produce time-series graphs of both sets of data for visual inspection of the data before the user needs to make a choice.
4. Select precipitation stations that are deemed unusable. These sets of data are eliminated from the computation of subbasin time series of precipitation. The subbasin time series of precipitation are converted into SSARR format and loaded into the Bulk file. A program menu item (Plot Precip.) is available for plotting the precipitation data for each station in order to assess its quality.
5. Make a SSARR model run. SSARRMENU uses dialog boxes to prompt the user for the begin time, end time, time step, and the temperature records that should be used. A plot of temperature records may be made to assess data quality. Records that appear unusable may be eliminated. All model runs made after the first model run of the water year must begin exactly at the end time of the previous model run for which the hydrologic state of the simulated watershed values and river reach discharges are saved by the SSARR model. These values and discharges are used as the initial conditions for the next model run.

6. Review the results of the simulation by making plots of the simulated data against available observed data or as text files of stage and discharge.
7. Back-up model runs (6-hour time step) are run periodically to keep the model current and prepared for quickly making storm-mode model runs (1-hour time step) and forecast model runs.
8. Adjust the simulated discharge values, if needed, to more closely agree with observed discharge values prior to making a forecast model run. Typically, the begin time of the “ADJUST” model run is a day or two before the start time of the forecast model run and the model run ends exactly on the start time of the forecast model run. It adjusts the precipitation amounts (and if snow is present in the snowband, it adjusts lapse rates and temperature) until the simulated runoff matches the observed runoff; then the forecast hydrograph can begin at a time when the observed and simulated runoff agrees. SSARRMENU prompts the user to choose between (1) adjusting the simulated runoff from one to five of the gaged subbasins or (2) adjusting the simulated discharge from the lower stream reach of the Puyallup River. After this choice is made, a procedure begins to automatically adjust the simulated discharge hydrograph to closely match the observed hydrograph. At the end of the subbasin ADJUST model run, the hydrologic conditions of the basin are saved for use as the initial conditions for the forecast model run.
9. Download the quantitative precipitation forecasts from the National Weather Service (NWS) and the temperature forecast from the Ohio State University weather data server. These data are given at a 6-hour time step for 54 hours into the future. SSARRMENU reformats these data, adjusts the model parameter file for a forecast model run, and makes the run. Results are presented as time-series graphs of resulting simulated hydrographs and as text files of discharge and stage.

Modeling Options

The modeling options presented in this section represent the four top-level, drop-down menu items, Retrieve Data, Model Runs, Basin Status, and Text Files (fig. 3), that are specific to flood simulations on the Puyallup River, and they are discussed in that order. In SSARRMENU, their drop-down options (subheadings in this section) are accessed by selecting the top-level menu items in the main window. To make runoff simulations, the menu items under “Retrieve Data” and “Model Runs” should generally be completed in the order they are listed. The remaining menu items, “Basin Status” and “Text Files,” are provided to view model information at any time during the simulation process.

Retrieve Data

This top-level menu has six drop-down options, numbered 1 through 6 below. This set of options retrieves stream stage, stream discharge, precipitation, and temperature data from selected sites from the USGS database, ADAPS, using the program Telnet (option 3) as WATSTORE unit value B-card-formatted files. This is generally the first option that needs to be completed before making a SSARR-model run. The retrieved data are automatically sent to the root\DATA directory as files with an “.out” extension to the file name. It is important for the user to review the data, and SSARRMENU has several graphical features to facilitate the review of the data for erroneous or missing values.

1. Pick-Plot

The Pick-Plot option of the Retrieve Data drop-down menu item allows the user to select a station from the Puyallup Flood-Alert Map (main screen of SSARRMENU) and make a plot of the available data. Pick-Plot is initiated by selecting on the Retrieve Data top-level menu item and then selecting the Pick-Plot option. At this point, the program is waiting for the user to select a station by selecting a circular station symbol on the Flood-Alert Map.

After a station is selected, a message box appears to verify the station selection with its name, and then the Plotting Time Period dialog box allows the user to select the data type and enter the begin and end times (fig. 6). After the information is entered into the dialog box, a time-series plot of the simulated and observed data (stage, discharge, precipitation, or temperature) is generated. The plot window can be iconified and instantly reopened by double-clicking the icon. All plot windows are listed under the main menu option “File” and may be reopened by selecting from the drop-down list.

Keyboard hint: To facilitate entering data in this and all the other dialog boxes, the tab key may be used to move the cursor from one dialog-box window to the next.

2. Data Storage

Data storage is a menu option that initiates the program bulk2K.exe, which accesses the Bulk file, the SSARR data-management file that contains all the observed and simulated data. This option is provided in SSARRMENU so that a user can create a new Bulk file at the beginning of a water year (use the INITIALIZE command) and view the contents of the file to see what is currently in the data-management file. After selecting this option, a DOS window named

“bulk2k.exe” appears and the program waits for keyboard input by the user. Entering a “?” command from the keyboard will show a brief listing of the seven commands that are available. The “Q” command quits the program, and the window disappears. A useful command to view all of the data that has been stored in the Bulk file is “LA”, which lists the entire contents. The first column of data displayed is the SSARR code of the time series as shown in table 1, and the last six are the begin and end times. A “Q” must be entered to end the bulk2K.exe program and return control of the program back to the main screen.

3. Load (Telnet)

The Load menu option involves the use of the Telnet application, as well as the File Transfer Protocol (FTP) function. Telnet is an application found in the “Accessories” program group of computer applications installed with the Windows NT™ operating systems that include Transmission Control Protocol/Internet Protocol (TCP/IP) connectivity utilities.

When the user selects the “Load” option, a telnet window is opened. From the telnet window, the user selects the drop-down menu “Connect.” Next, the user selects or specifies the IP address of the USGS Washington District National Water Information System (NWIS) server, which is 130.118.134.96.

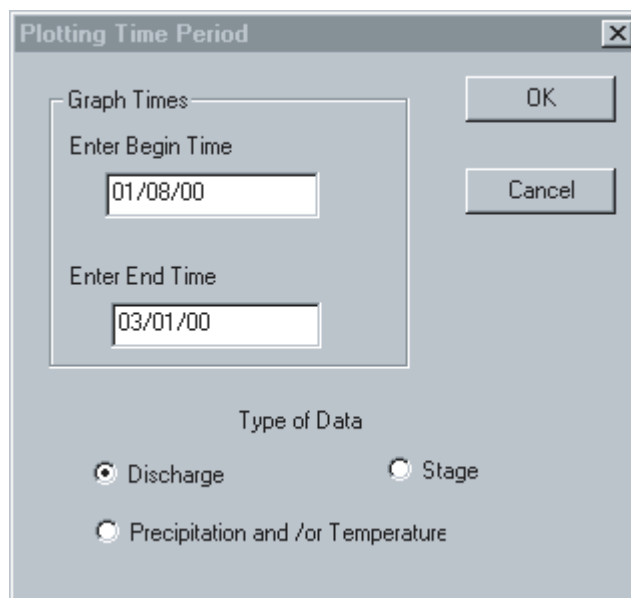


Figure 6. Image showing Plotting Time Period dialog box.

This will allow the user's computer to connect to the Washington District NWIS server. Previous arrangements must have been made with a member of the Washington District Computer Applications Section to allow access for connection. Once connected, the Washington District server will prompt the user for a user name at the "login:" prompt. The user name assigned to SSARRMENU is "ssar." The server will then prompt the user for a password. The password for the user name, ssar, is provided by a member of the Computer Applications Section of the USGS Washington District to Pierce County.

Once successfully logged on, the user types "getsardata.pl." The Perl script, getsardata.pl, was written to retrieve data from the USGS's ADAPS database. The script prompts the user for the parameter codes to use in its retrieval. The parameter codes for retrieval are: 65 for stage data, 60 for discharge data, 45 for precipitation data, 20 for temperature data, and 99 for all the parameter codes mentioned. Next, the user will be prompted for the starting date of the retrieval. The format of the date is YYYYMMDD (YYYY representing year, MM representing month, and DD representing the day). The user is prompted to enter the ending date of the retrieval period in the same YYYYMMDD format. The final parameter prompt is whether the user wants a 1-hour or 6-hour time step for the data retrieval. The script retrieves the data as ASCII. Once the retrieval is complete, the user types "exit" to disconnect from the server. This causes the telnet window to close and allows the transfer of the files to the user's computer by way of FTP (File Transfer Protocol), a connectivity tool that allows the transfer of files to and from computers running the FTP service. After the retrieval, the SSARRMENU program returns control to the main SSARRMENU window, the Flood-Alert Map.

4. Data Conversion

Data Conversion is the next step to be completed after the Load (Telnet) option. The Data Conversion program searches the root\DATA directory first for the file Prec1hr.out, a precipitation data file from ADAPS that, if present, indicates that the last data retrieval was for a 1-hour time step (storm mode) model run. If the file does not exist, the program searches for the file Prec6hr.out, indicating that the last data retrieval was for a 6-hour time step (backup mode) model run. In order for this option to be fully functional, three other files are needed. In backup mode, the other three files

(table 3) are: Stage6hr.out (stage), Q6hr.out (discharge), and Temp6hr.out (temperature). The data are scanned for values that exceed an established threshold, and the Flood-Alert Map (main window) is updated. If a threshold is exceeded, a large red flashing dot appears over the station location. The data in the four files are then converted from a WATSTORE B-card format to SSARR format, and finally are loaded into the Bulk file.

During this conversion process, the user is prompted with the Mud Mountain Regulation Time-Series dialog box (fig. 7) to select between two sets of time series of data that can be used to simulate regulation of Mud Mountain Lake outflows. This option was added after the November 1995 storms when it was realized that the Mud Mountain Lake stage gage was not reliable. The effects of regulation of streamflow by the Mud Mountain Dam are critical to the model's ability to accurately simulate flooding downstream of the dam. The user should first assess the accuracy of the stage record for Mud Mountain Lake before making a selection by selecting the "Plot Data" button, which makes a plot of observed stage and discharge at Buckley (time-series code MCQOBS, calculated by the addition of observed discharge at the White River at Buckley and the White River Canal at Buckley gages). These gages are located approximately 6.4 miles downstream of the dam, and therefore the flow is not entirely accurate because of travel times and inclusion of inflows between the gages and the dam. If the Mud Mountain Lake stage record is deemed accurate, it should be the first choice.

Table 3. Data file name, type, and time step retrieved from ADAPS

File names	Type of data	Time step
Stage1hr.out	stage	1 hour
Stage6hr.out	stage	6 hour
Q1hr.out	discharge	1 hour
Q6hr.out	discharge	6 hour
Prec1hr.out	precipitation	1 hour
Prec6hr.out	precipitation	6 hour
Temp1hr.out	temperature	1 hour
Temp6hr.out	temperature	6 hour

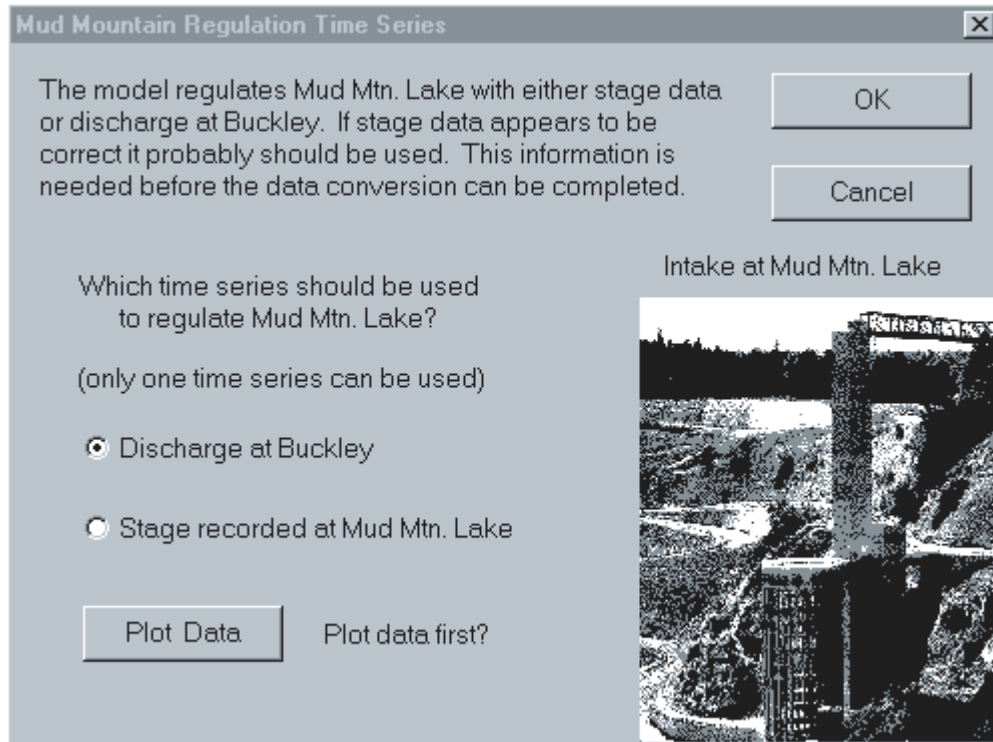


Figure 7. Image showing Mud Mountain Regulation Time-Series dialog box.

5. Plot Precipitation

This option makes plots of the observed data for the six precipitation stations in the network ([fig. 4](#)). It is strongly recommended that these plots be made and closely reviewed for accuracy before going on to the next option, Precipitation Station Select. A listing of the cumulative total precipitation and maximum 24-hour precipitation for the period of the data retrieval for the six precipitation sites is shown above the plots to provide a quick comparison of the data. If one station shows considerably less or more precipitation than the other stations, it might contain erroneous or missing data. Also, the maximum daily precipitation comparison provides the user with an indication of a storm's intensity, and thereby the potential for producing floods. The 10-year, 24-hour precipitation-intensity map ([fig. 8](#)) can be viewed through SSARRMENU from the Basin Status/Precipitation Plots option to provide a measure of a storm's intensity. Isolines on this map are estimates of the precipitation that have a statistical probability of being equaled or exceeded 10 times in 100 years on the average, or a 10-percent chance of being equaled or exceeded in any one year.

6. Precipitation Station Select

The final option in the Retrieve Data group allows the user to select which precipitation time series records are to be used in the model run for the period for which data have been retrieved. After selecting this option, a dialog box appears with all of the six precipitation stations preselected. The user may press the OK button or deselect certain stations by selecting their names in the list and then pressing the OK button. A minimum of two stations are needed to make a model run. After the selections are made, the program automatically uses two pre-selected station precipitation records to compute a weighted average precipitation record for each subbasin. These records will then be used as input to the model. If one of the precipitation records was rejected by the user, another station is automatically selected, based on a priority table embedded in the program code.

It should be noted that any missing data in the data files are interpreted as zero values in the reformatting routines and by the SSARR model.

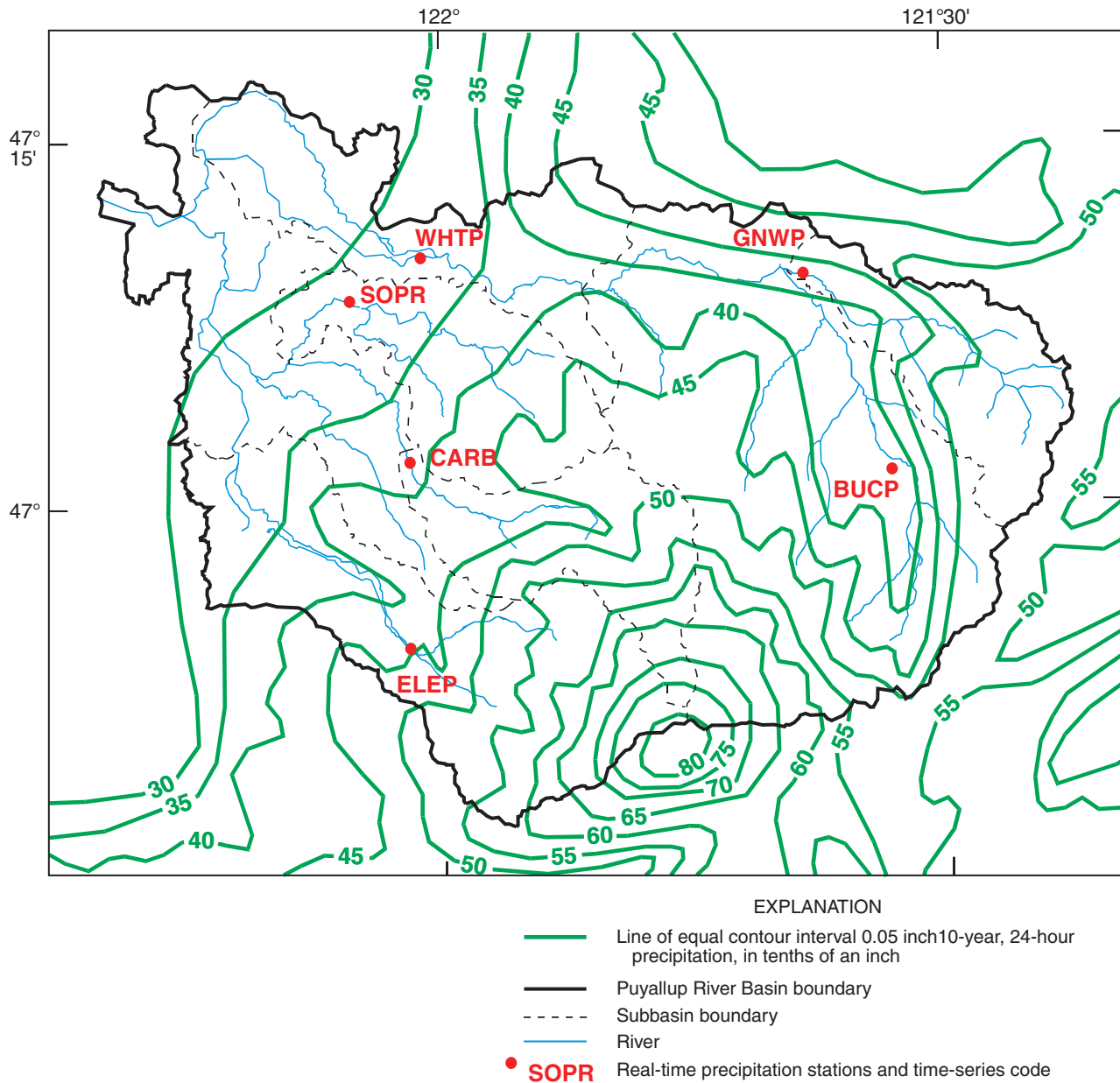


Figure 8. Map showing Network of precipitation gages used by SSARMENU and 10-year, 24-hour precipitation for the Puyallup River Basin, Washington.

Model Runs

This top-level menu item has four drop-down options, numbered 1 through 4 below. The menu items should generally be completed in the order they are listed. The “Initialize” model feature is generally made only once at the beginning of each water year. After this feature has been run, the standard back-up or

storm-mode model runs are made with the “Run Model” option. Prior to making a forecast model run, an “ADJUST” model run may be needed to adjust the beginning discharge of the forecast model run to the observed discharge. The “Forecast Run” option is used to make a flood forecast using forecasted precipitation and temperature from the National Weather Service.

1. Initialize

After selecting the Initialize drop-down menu option, an Initialize Main Menu dialog box appears and the user is given the choices “Initialize Model?” or “Initialize Mud Mountain Lake?” The Initialize Model suboption is generally made before any model run of the new water year has been made. The Initialize Mud Mountain Lake suboption is provided to the user to specify the stage of Mud Mountain Lake at the beginning of a model run. This suboption was added to the functionality of SSARRMENU because the SSARR model often becomes unstable when trying to simulate the outflow and stage of Mud Mountain Lake; it will simulate unreasonably high or low stage values. By specifying a stage of the lake at the beginning of a model run, much of the instability can be avoided.

Initialize Model

This option sets up the model runs for the water year by loading the model parameter files (RT.CHR and RT.TBL files) into a binary-formatted SSARR workfile called Iodc in the root/SSARR directory. This sets the initial conditions of the reaches to average values observed in the past on October 1 (beginning of the water year) and sets the initial conditions of the subbasins to the same values as those used during the start up of the calibration model runs. October 1 is generally a time of relatively dry soil conditions and low flows in the reaches. If rainfall has been high just prior to October 1, the model may under-simulate the runoff for the first few days, but it should match the actual conditions within a short time.

This option first checks the root\SSARR directory to make sure that a Bulk file exists before it continues. If the file does not exist, a warning is given and the user should use the bulk2k.exe programs to create a new and empty Bulk file. (See Appendix A. Supplemental Information about creating the Bulk file.) A new, empty Iodc file is automatically created by the Initialize Model option.

The “Initialize” dialog box appears to prompt the user to enter the water year for which the runoff simulations will be made and choose whether a new log file should be created or the existing log file should be appended. After entering this information, the SSARR model run is executed to initialize the model with the model parameter files and initial variables for October 1 of the water year indicated by the user. The user is now ready to make a back-up or storm-mode model run.

Initialize Mud Mountain Lake

This option allows the user to specify the simulated stage of Mud Mountain Lake at a specific time—usually a start or end time of a model run. Selecting this option opens the file root/SSARR/initmud.sar with the Notepad, an operating system text editor, and allows the user to edit the time and stage for the stage correction. The file initmud.sar contains one line of SSARR-formatted input called a “2L card” (see SSARR User Manual for more details, U.S. Army Corps of Engineers, 1991, p. B-80) that is distinguished from the remainder of the text in the file by having a character in the first column. The SSARR model only reads lines of input that have a character in the first column. It is critical that the user edit the values in the correct columns, otherwise the model will misinterpret the information. Some guidelines are given in the file to direct the user to properly edit the file. After editing the file, the user must exit Notepad by selecting the “File” menu item and then the “Exit” menu option.

2. Run Model

When the Run Model menu option is invoked, SSARRMENU redisplay the Model Run Information Window ([fig. 9](#)) near the center of the screen and opens the Model Run Times dialog box ([fig. 10](#)). Before entering the model run times, the user should carefully check the Model Run Information Window for an appropriate “initial condition time” for the begin time of the next model run. All model runs must start on an available initial condition time. An initial condition time is a time at which reach volumes and watershed hydrologic values have been stored in the Iodc file. These values are stored at the end of each model run and at October 1 of the specified water year.

After entering the start time that agrees with an initial conditions time, the user enters an end time and picks either the 1-hour or 6-hour time step. If a 6-hour time step is used, the end hour on a particular day should be a multiple of six plus the begin hour. For example, if the begin hour is 08 hours, the end hour should be 08, 14, 20, or 02 hours.

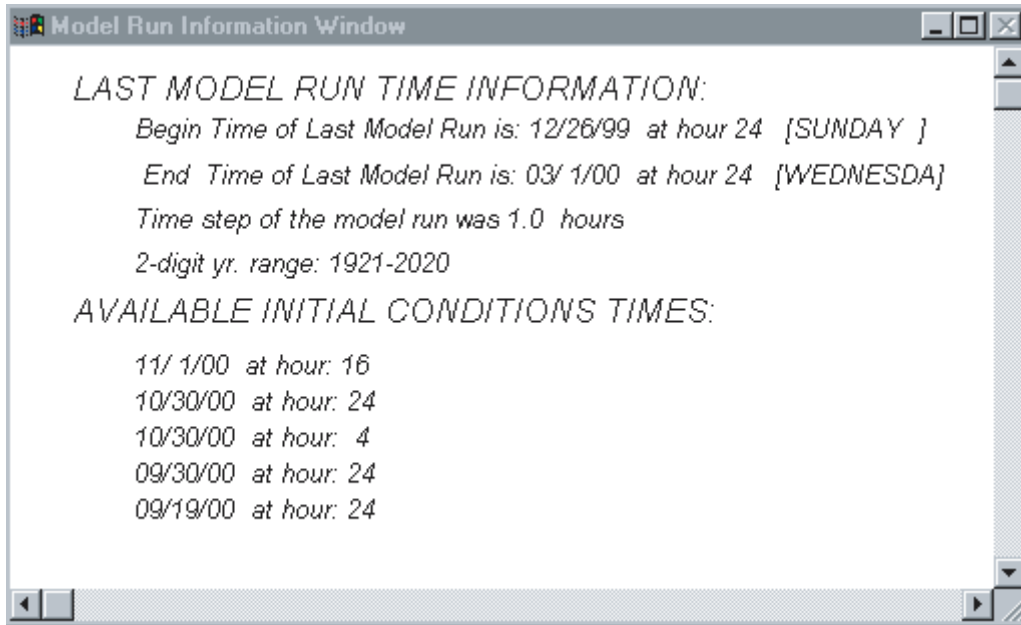


Figure 9. Image showing Model Run Information window.

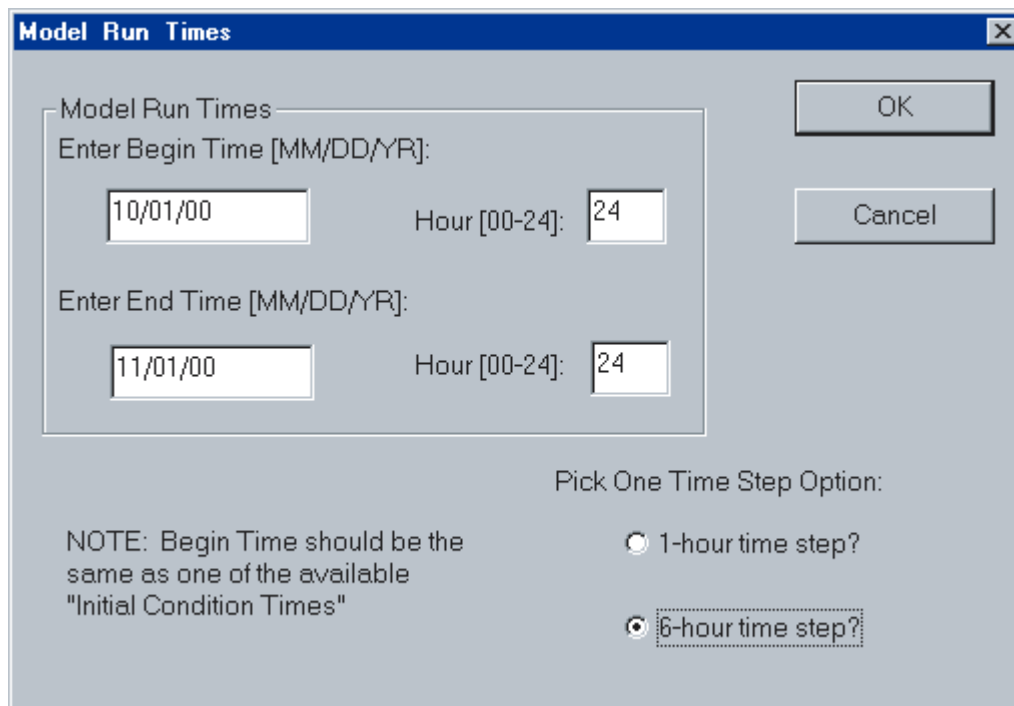


Figure 10. Image showing Model Run Time dialog box.

The next dialog box that appears is the Temperature Station Selection dialog box (fig. 11). This dialog box allows the user to select which temperature records to use in a model run, because not all temperature records may be complete and have good values. A minimum of two temperature records are needed to compute lapse rates of change in temperature with elevation, and a minimum of one temperature record is needed to make a model run, in which case the default lapse rate of 3.3 degrees Fahrenheit per 1,000 feet is used. An option to make a temperature graph for the indicated model run times is provided to check the data visually.

After making the temperature station selections, the Mud Mountain Regulation dialog box (fig. 12) appears to verify that the correct method for simulating regulation at Mud Mountain Dam is used. The user's choice should agree with that made during the data-conversion process. A user may check the log file with the Text Files/ Log File menu option if in doubt. When the OK button is pressed, the model run is started. The user is notified with an information box when the model run has finished, and in the Model Run Information Window (fig. 9) the start, end, and elapse times of the model run are given. Results of the model runs can be viewed graphically by using the Retrieve Data/Pick Plot menu option or viewed as text files with the Text Files/ Select SSARR Files menu option. The text files, which are overwritten after each model run, include Outputb.out, which contains most of the simulated stage and discharge values; Outputa.out, which contains monthly summaries of simulated results for the subbasin; and Rtsys.out, which contains simulated results for each time step for each subbasin.

Note that a model run can be aborted by selecting the Cancel button (located under the OK button) on the Model Run Times dialog box (fig. 10), the Temperature Station Selection dialog box (fig. 11), or the Mud Mountain Regulation dialog box (fig. 12).

3. ADJUST

There are two suboptions in the ADJUST menu option—REACH5 or the subbasin adjustment. The user can only pick one option at a time. The ADJUST procedure is generally used at the beginning of a forecast model run if the simulated discharge values are significantly different from the observed values at the time when the forecast model run will begin. In order for the forecast model run to begin with reasonable

accuracy, the simulated values need to be corrected to the observed values. Rather than simply changing the last simulated value of the pre-forecast model run to agree with the observed value, the subbasin adjust procedure reruns the subbasin simulations with slight increases or decreases to the precipitation inputs. If snow is present in a snowband, temperature and lapse rate inputs are also adjusted to more gradually correct the simulated hydrograph to agree with the observed hydrograph. Thereby, the model will simulate more hydrologically correct conditions in the subbasins for the begin time of the forecast model run (for more details, see Mastin, 1999, p. 23). For these reasons, if significant errors exist between the simulated subbasin outflow and observed subbasin outflow, the subbasin adjust routine should be completed before using the REACH5 adjust routine, described below.

It should be noted that the subbasin procedure can only be used where observed discharge records are available for comparison with simulated streamflow. This limits the procedure to only the Upper Puyallup, South Prairie, Carbon, Upper White, and Greenwater subbasins and only when these observed records are complete and without bad values.

Subbasin Adjustment

The subbasin ADJUST procedure is built into the SSARR program. The subbasin ADJUST procedure, as it is used in SSARMENU, is run on either a 1- or 6-hour time step, can only be used at the beginning of a previous model end time, and can be used for a period when observed discharge data are available. The adjustment algorithm first computes the differences between the observed and simulated subbasin outflows and weighs the differences according to an attribute table of time versus accumulated percentage of runoff, which is analogous to a cumulative unit hydrograph. This table, ATTR1, is found as a card image in the file Rt.tbl. The table was generated from a simulated hydrograph for a 24-hour period for South Prairie Creek Basin. Therefore, to effectively use the ADJUST routine, the period for the adjustments should be at or close to 24 hours. Before running the subbasin ADJUST procedure, a model run is made and the simulated and observed discharges are compared by the user at the mouths of the subbasins (subbasins UPPUY, CARBON, GRNWTR, SOPRAIR, and UPWHT).

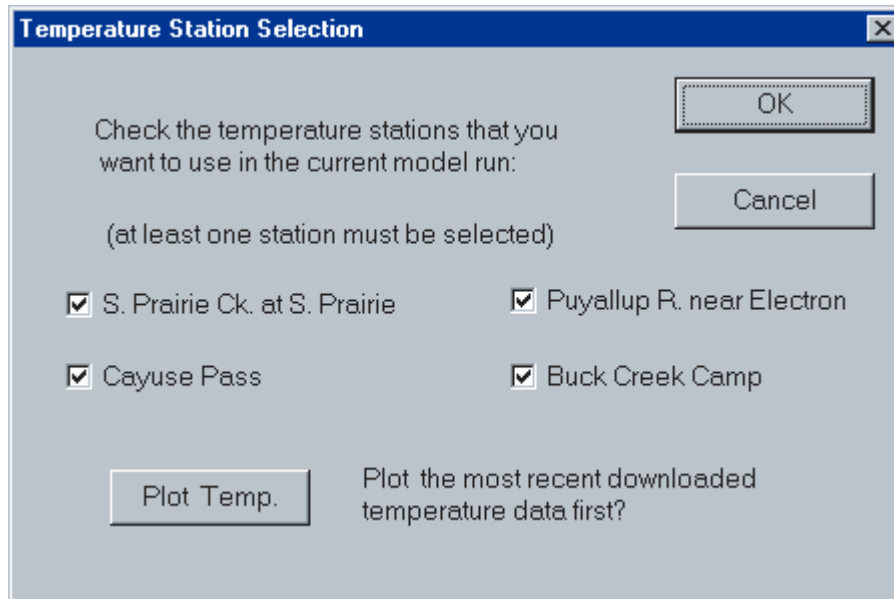


Figure 11. Image showing Temperature Station Selection dialog box.

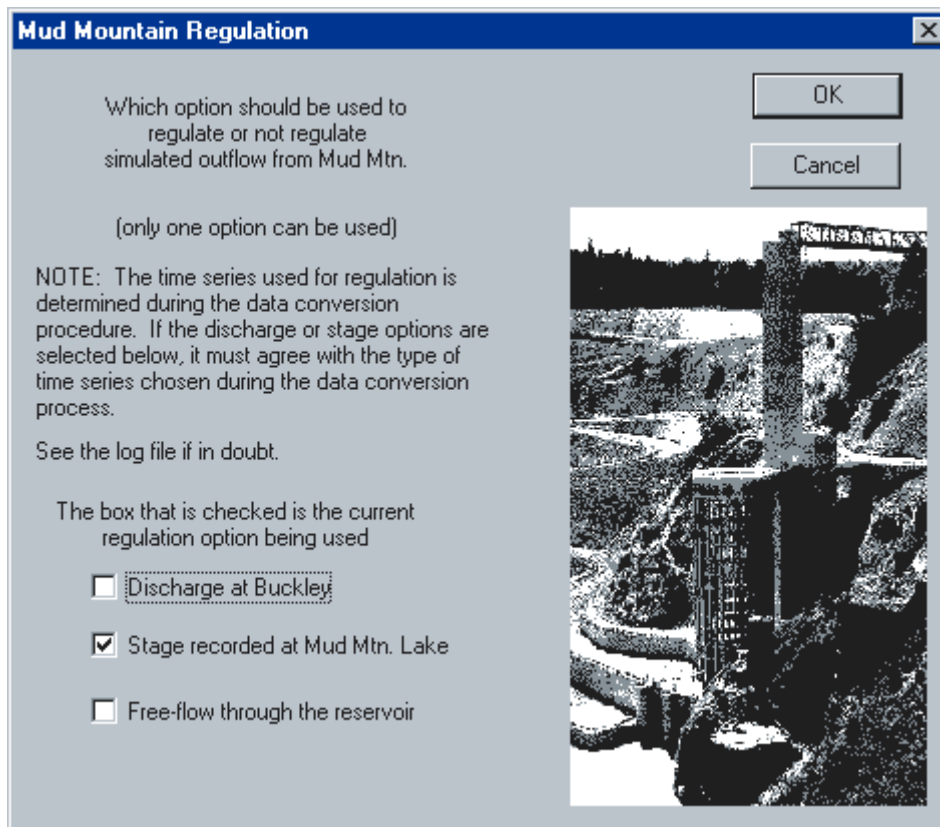


Figure 12. Image showing Mud Mountain Regulation dialog box.

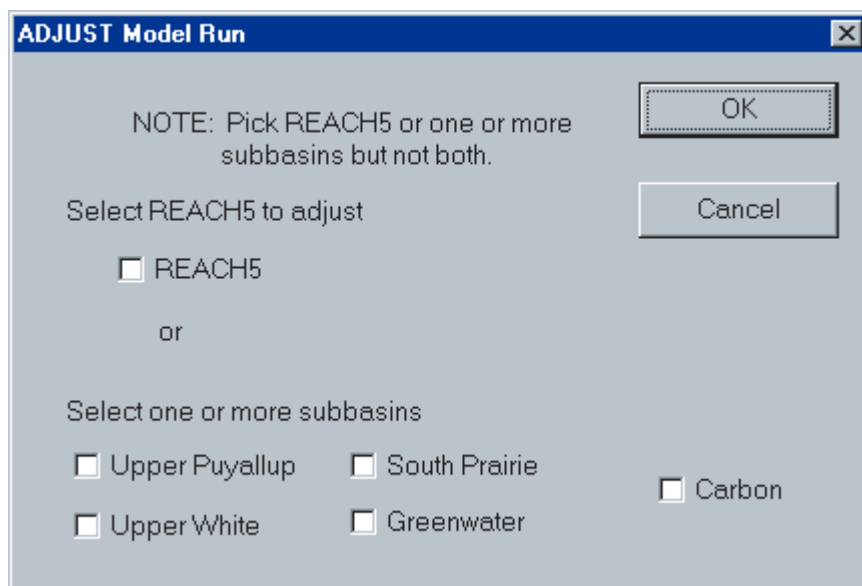


Figure 13. Image showing ADJUST Model Run dialog box.

Subbasins for which the simulated discharge significantly departs from the observed discharge should be adjusted by the use of the ADJUST Model Run dialog box (fig. 13). The Model Run Times dialog box will appear next, and after the user enters the begin and end times, the ADJUST model run will be made. The ADJUST procedure will iterate a maximum of 10 times to adjust lapse rates, temperature, and precipitation within specified tolerances. Large differences may not be completely resolved with this procedure. It may be necessary to manually correct the initial conditions at the beginning of the ADJUST period to more closely match observed conditions. (See Appendix A. “Supplemental Information” at the end of this manual.)

REACH5 Adjustment

REACH5 refers to the lower Puyallup River channel reach along River Road in Puyallup in the SSARR model, which is monitored by the gaging station named Puyallup River at Puyallup, numbered 12101500. Sometimes, the simulated hydrograph may diverge significantly from the observed hydrograph. To correct this condition, the REACH5 ADJUST procedure may be used to match the simulated hydrograph to the observed discharge hydrograph. During regular model runs, a time series of the differences between simulated discharge at REACH5

and observed discharge at station 12101500 is computed as time series PUYDIF. When the REACH5 ADJUST procedure is selected, the Model Run Times dialog box will appear, the user enters begin and end times, and a model run will be made that adds the PUYDIF values to the simulated discharge values, PUYSIM, resulting in a new, corrected time series, PUYSIM, that should match the observed time series.

4. Forecast Run

Before selecting the Forecast Run menu option, the necessary temperature and precipitation forecast data must be manually downloaded by the user from the Internet and stored in the root\DATA directory as three specific files. The quantitative precipitation forecast (QPF) data are provided by the Seattle National Weather Service (NWS) office at 6-hour time steps and the forecasted temperatures are from the statistical modeling program called NGM-based MOS Guidance (Nested Grid Model, Model Output Statistics) for making surface meteorological forecasts at 3-hour time steps. Experience, corroborated by advice from Charles Orwig, Senior Hydrologist with the National Weather Service (written commun., December 1996), has shown that the QPFs from the Seattle NWS meteorologists are more accurate than the NGM-MOS QPFs.

The Seattle NWS meteorologists, however, do not forecast 6-hour temperature data; therefore, the NGM-MOS forecasts for temperature are used. The forecast model runs are made for a period of 54 hours, which is the length of time for the temperature forecasts.

The QPFs for Enumclaw, Stampede Pass, and Ohanapecosh are three NWS forecast points in or near the Puyallup River Basin that are used by SSARRMENU to compute subbasin precipitation during forecasts. They can be downloaded from a restricted access Internet site (access has been obtained for the Pierce County Department of Public Works) on the Seattle NWS Internet home page under the heading “QPS-most recent (restricted)” (location: <http://www.wrh.noaa.gov/Seattle/forecast02.html>).

After selecting this site, the data must be saved to a file with the name SEA.QPF in the root\DATA directory. An example of a SEA.QPF file can be found in [table 4](#).

The temperature forecast data are located at the Ohio State University weather data server at <http://twister.sbs.ohio-state.edu/>. The data for two sites used by SSARRMENU, Fort Lewis and Stampede Pass, are accessed by selecting “Weather by State” in the left frame, selecting the State of Washington with the mouse on a U.S. national map, selecting “Forecasts” on the top of the right frame, and then selecting “Fort Lewis” under the heading of “Model Text.” This data file should be saved as GRF.WMO (GRF is the NGM code name for Fort Lewis) in the root/Data directory. (See [table 4](#) for an example of a GRF.WMO file.) Hit the BACK key, select “Stampede Pass,” and save the data file as “SMP.WMO” (SMP is the code name for Stampede Pass) in the root/Data directory.

After the three data files, SEA.QPF, GRF.WMO, and SMP.WMO, have been created in the root\DATA directory and the Forecast Run menu option has been selected, SSARRMENU checks the starting time of the three files. If they are not the same, an error message is shown and the model run is aborted. If the start times are the same, the Forecast Model Run Information dialog box ([fig. 14](#)) appears with the begin time corrected for local time. This dialog box gives the user the opportunity to check the begin time and assure that it agrees with one of the initial condition times displayed in the Model Run Information Window. Otherwise, the user should press the Cancel button and abort the model run. When the OK button is pressed, SSARRMENU reformats the QPF and WMO data

files, adjusts the model parameter file for the Puyallup River model, and makes the forecast run. Results can be viewed as time-series graphs of simulated hydrographs or as text files of discharge and stage (file: root\SSARR\Forouta.out).

Basin Status

This top-level drop-down menu contains several options to allow the user to view several different types of key hydrologic data related to the flood potential in the Puyallup River Basin. The user can view the data as plots to compare with observed data or simply view the current and recent conditions.

SMI and SWE Plots

These two plotting routines are similar in their programming, user interaction, and relevance to flooding, therefore their descriptions are grouped together in this section.

SMI is the Soil Moisture Index, an index to the amount of water, in inches, in the soil that is simulated by the SSARR model. In most cases, significant flooding occurs only after the soil has become sufficiently “wet.” Observing the SMI plots and comparing the values to past levels will give the user a sense of when the basin is becoming primed for a flood.

If the SMI is high for a subbasin and more rain is predicted, the user should be aware of the potential for flooding.

SWE (Snow-Water Equivalent) is a measure of the amount of water in the snow, in inches, averaged for each snowband in a subbasin. Large amounts of snow, represented by large values of SWE, especially in the lower elevations, can dramatically add to the flooding potential of the basin if a relatively warm rain storm is approaching. The snow may melt quickly and contribute to the flooding. Thus, it is important for the user to monitor the simulated SWE, and if observed values of SWE are available, the SWE plots can be used to compare simulated values with observed values to see if the snow simulations are reasonable. If the simulated SWE values need to be changed, the values for individual snowbands for each subbasin may be edited by the user at any of the initial condition times (see “Changing Values for Initial Condition of Snow-Water Equivalent Outside of SSARRMENU” in Appendix A at the end of this guide).

Table 4. Example portion of the quantitative precipitation file, SEA.QPF, and temperature forecast file, GRF.WMO, used in the Puyallup River Flood-Alert System, Washington

SEA.QPF:

```
ZCZC SEAQPSSEA
ATTAA00 KSEA 071249
:FN 10:
:.....INTERNAL NWS PRODUCT FOR GUIDANCE PURPOSES ONLY.....
:
.B SEA 1107 DC110712
.B1 /DH18/PPQFZ /DRH+06/PPQFZ/DRH+12/PPQFZ/DRH+18/PPQFZ
.B2 /DRH+24/PPQFZ/DRH+30/PPQFZ/DRH+36/PPQFZ/DRH+42/PPQFZ
.B3 /DRH+48/PPQFZ/DRH+54/PPQFZ/DRH+60/PPQFZ/DRH+66/PPQFZ :
:.....FORECAST PRECIPITATION (INCHES).....:
:
:**UPDATES- LEAVE PAST DATA AS ORIGINALLY FORECAST. :
:
DAY1-----> DAY2-----> DAY3----->:
      206Z 12Z 18Z 00Z 06Z 12Z 18Z 00Z 06Z 12Z 18Z 00Z
UIL .00/ .00/ .00/ .00/ .00/ .00/ .00/ .00/ .00/ .00/ .00/ .00
ABEW1 .00/ .00/ .00/ .00/ .00/ .00/ .00/ .00/ .00/ .00/ .00/ .00
FRW1 .00/ .00/ .00/ .00/ .00/ .00/ .00/ .00/ .00/ .00/ .00/ .00
GLAW1 .05/ .05/ .00/ .00/ .00/ .00/ .00/ .00/ .00/ .00/ .00/ .00
MARW1 .10/ .10/ .00/ .00/ .00/ .00/ .00/ .00/ .00/ .00/ .00/ .00
VERW1 .05/ .05/ .00/ .00/ .00/ .00/ .00/ .00/ .00/ .00/ .00/ .00
SKYW1 .05/ .05/ .00/ .00/ .00/ .00/ .00/ .00/ .00/ .00/ .00/ .00
SEA .05/ .00/ .00/ .00/ .00/ .00/ .00/ .00/ .00/ .00/ .00/ .00
ENUW13.05/ .75/ .75/ .60/ .20/ .00/ .00/ .00/ .00/ .00/ .00/ .00
SMP4 .10/ .75/ .75/ .75/ .18/ .00/ .00/ .00/ .00/ .00/ .00/ .00
OHAW15.10/ .80/ .70/ .80/ .30/ .00/ .00/ .00/ .00/ .00/ .00/ .00
CINW1 .10/ .05/ .05/ .00/ .00/ .00/ .00/ .00/ .00/ .00/ .00/ .00
```

GRF.WMO:

```
FOUS14 KWBC 071200
GRF6 W NGM MOS GUIDANCE 11/07/97 0000 UTC
DAY /NOV 7 /NOV 8 /NOV 9 /
HOUR 206 09 12 15 18 21 00 03 06 09 12 15 18 21 00 03 18 21
MN/MX 41 53 34 58
TEMP7 50 51 51 49 47 48 49 47 45 43 42 39 43 47 48 39 34 32 31
DEWPT 46 45 46 46 44 43 42 41 44 44 42 40 37 36 34 34 40 39 37
CLDS OV OV OV BK OV OV OV BK SC SC CL CL CL CL CL CL CL CL
WDIR 18 23 32 00 14 00 00 00 00 02 00 00 00 00 00 00 00 00 00
WSPD 03 05 04 00 01 00 00 00 00 01 00 00 00 00 00 00 00 00 00
POP06 40 37 23 13 0 0 0 0
POP12 42 10 0 0
QPF 0/ 0/ 0/0 0/ 0/0 0/ 0/0 0/ 0/0
TSV06 5/0 1/0 0/1 0/0 0/2 0/0 0/0 0/0 0/0
TSV12 5/0 0/0 0/0 0/2 0/0 1/0
PTYPE R R R R R R R R R R R R R R R R R R R
POSN 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0
SNOW 0/ 0/ 0/0 0/ 0/0 0/ 0/0 0/ 0/0
CIG 4 4 5 5 5 5 4 3 7 7 7 7 7 7 7 7 7 7
VIS 4 5 5 5 4 4 4 3 5 5 5 5 5 5 5 5 5 5
OBVIS F N N N F F F F N N N N N N N N
```

¹Start date.
²O6Z or 06= 6:00 am (Greenwich Mean Time).
³ENUW1= quantitative precipitation forecast for Enumclaw.
⁴SMP = quantitative precipitation forecast for Stampede Pass.
⁵OHAW1 = quantitative precipitation forecast for Ohanapecohsh.
⁶GRF = station code for Fort Lewis.
⁷TEMP = forecasted air temperatures.

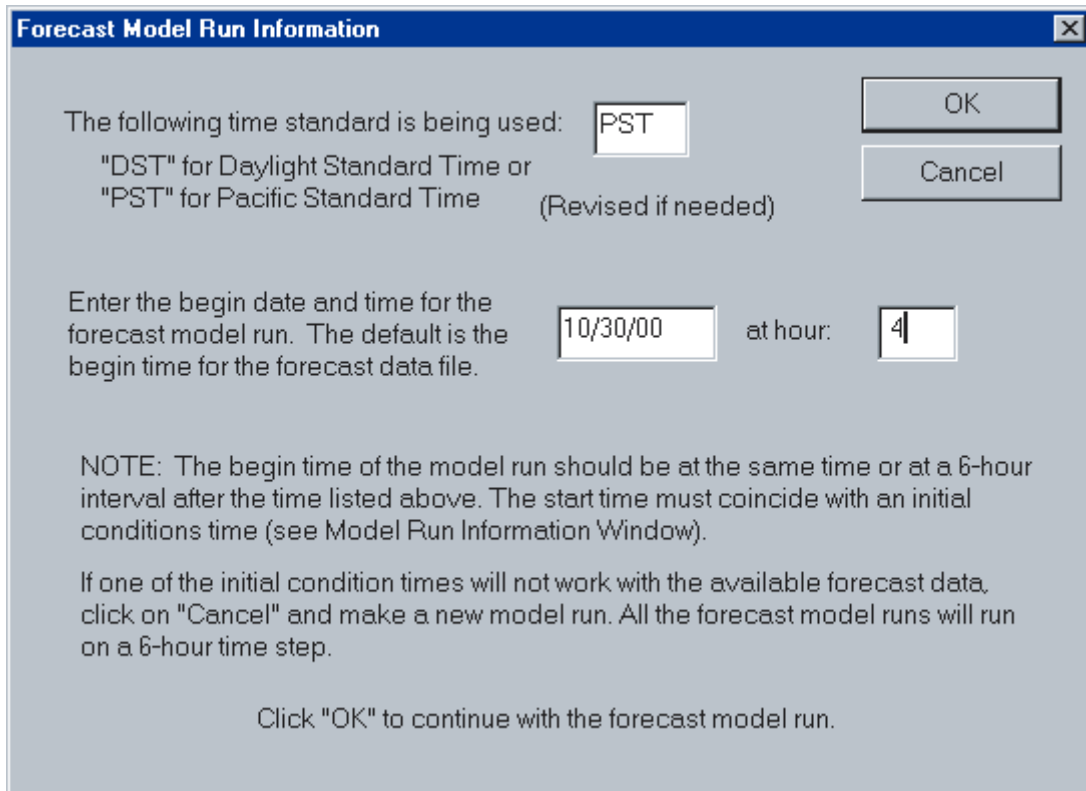


Figure 14. Image showing Forecast Model Run Information dialog box.

Selecting the SMI or SWE plot option brings up the SMI or SWE Plot Date dialog box (fig. 15) that queries the user for a date for which to generate the plot. A special SSARR model run must be made to produce an output file, root/SSARR/Zonesys.out, that contains all the subbasin SMI and SWE information for each snowband. This special model run is initiated in the same way as a regular model run. First, the SMI or SWE Plot Date dialog box appears and the user enters the plot date for the SMI or SWE data. Next a Model Run Time dialog box prompts the user for a begin time that is before the day specified in the first dialog box (plot date) and that coincides with an available initial condition time. Next, the user enters an end time after the day specified in the first dialog box, and, finally, selects the appropriate temperature records in the Temperature Station Selection dialog box. After the user presses OK on the Temperature Station Selection dialog box, the plot is generated in a window titled "Basin Status Graph," with either the daily average SMI or SWE on the x-axis and elevation on the y-axis. A separate line is plotted for each subbasin.

Precipitation Plots

This menu option simply provides the user with a choice of displaying one of two precipitation maps of the Puyallup River Basin. After selecting the Prec. Plots menu option, the Precipitation Plots dialog box appears and offers the user a choice between displaying a map of the mean annual precipitation (Soil Conservation Service, 1965) or a map of the 10-year, 24-hour-frequency precipitation totals (U.S. Department of Commerce, 1973). (The 10-year, 24-hour precipitation is the rainfall total over a 24-hour period that is exceeded on average only once in every 10 years; see fig. 8.) These maps are provided to the user as a static reference. They are not dynamically generated.

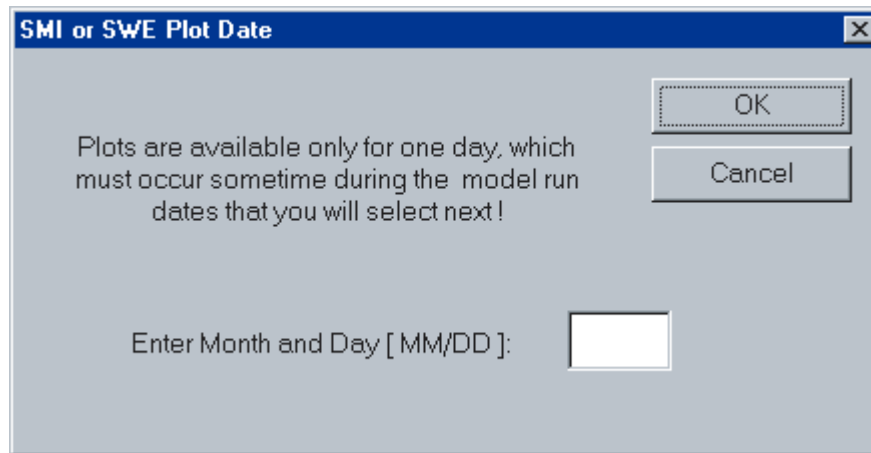


Figure 15. Image showing SMI or SWE Plot Date dialog box.

Water-Balance Plots

This menu option displays a map of the subbasins and plots selected simulated water-balance components accumulated by subbasin for the last SSARR model run. Specifically, the total subbasin precipitation, incremental snow-water equivalence, incremental soil-moisture index, and runoff are shown in seven grouped histograms, one for each subbasin.

Text Files

This top-level, drop-down menu has three options: Select Data Files, Select SSARR Files, and Log File. All three options use the standard MS Windows operating-system text editor, Notepad, to view or edit selected files. The “Select Data Files” option causes a dialog box to appear with a list of selected files located in the DATA directory. After the user selects a file, it is loaded into Notepad and displayed. After viewing and(or) editing the file, select the File/Exit menu option in Notepad to exit and return to an activated main screen. Note that once the user has started Notepad with SSARRMENU, all the menu items and options are deactivated, and can only be activated by dismissing Notepad. The “Select SSARR Files” option works the same way by opening a dialog box with a list of selected files in the SSARR directory.

The “Log File” option immediately opens the log file that contains a listing of all the SSARR-model-related actions made by the user. This file continues to append information to the file unless the “Start new log file” option is chosen when initializing the model. A short description of the files can be found in the following section, “System Documentation.”

SYSTEM DOCUMENTATION

The following documentation is simply a list of (1) required files to run the program, (2) a list of output files generated when running SSARRMENU, and (3) the program files used in the building and compiling of the SSARRMENU executable file. The files are arranged by the directory in which they are found (in bold type).

Required Files

Below is a list of the required files to run SSARRMENU, version 2K4.1. They are listed by a directory structure that contains the listed files relative to the directory containing the SSARRMENU.EXE file (“root” directory in this documentation).

C:\.\root\SSARRMENU.EXE

C:\.\root\SSARR

bulk2K.exe		These three programs are distributed by the North Pacific Division of the U.S. Army Corps of Engineers
finit2K.exe		
ssarr2K.exe		

Adj.job	It.sar
Adj.sar	Mud.sar
Adj5.sar	Ratings.chr
Adj5.mod	Rt.chr
Bulk	Rt.job
Forecast.chr	Rt.sar
Forrum.sar	Rt.tbl
Fortemp.chr	Store.sar
Initial.sar	Strprec.sar
initmud.sar	tempplot.sar
inmudrun.sar	Zones.sar
Iodc	

C:\.\root\BASIN

Basin.lst	str.lst
Gage.lst	subbasin.BMP
lake.lst	subbasin.lst
meanprec.BMP	ten24.BMP

C:\.\root\DATA

Alert.fil	Log.ftp
Alert.lst	threshld.fil

Output and Data Files

Several of the output and data files produced during model runs contain information that may be of interest. These files and remarks about their content are listed below.

root\SSARR directory:

Rtsys.out	Produced after each model run. It is a large file that contains a summary listing of results for each time step for each subbasin (see U.S. Army Corps of Engineers, 1991, p. D-26, for a description of the summary codes).
ADJSYS.out	Same as Rtsys.out, except this is for ADJUST runs.
Forsys.out	Same as Rtsys.out, except this is for forecast runs.
Outputa.out	Produced after each model run. It contains monthly summary information for each subbasin.
Forouta.out	Same as Outputa.out, except this is for forecast model runs.
Outputb.out	Produced after each model run. It is an ASCII file listing of simulated discharge or stage for 10 selected sites in SSARR card-6 format (U.S. Army Corps of Engineers, 1991, p. B-95).
Foroutb.out	Same as Outputb.out, except this is for forecast model runs.

root\DATA directory:

Q1hr.out	<input type="checkbox"/>	Observed discharge data in WATSTORE B-card format retrieved from ADAPS in 1-hour time steps (Q1hr.out) or 6-hour time steps (Q6hr.out). These data could be edited manually to correct missing values or erroneous data before the "Prec. Sta. Select" option in SSARRMENU is executed.
Q6hr.out		
Prec1hr.out	<input type="checkbox"/>	The same as Q1hr.out or Q6hr.out, except it contains observed precipitation data.
Prec6hr.out		
Stage1hr.out	<input type="checkbox"/>	The same as Q1hr.out or Q6hr.out, except it contains observed stage data.
Stage6hr.out		
Temp1hr.out	<input type="checkbox"/>	The same as Q1hr.out or Q6hr.out, except it contains observed temperature data.
Temp6hr.out		

The following data files may also appear in the DATA directory.

<u>Root file names:</u>	<u>Possible extension</u>	<u>Type of data</u>
prec1hr prec6hr	*.sar *.sar	SSARR-formatted files after Prec. Sta. Select menu option has been completed.
q1hr,q6hr stage1hr,stage6hr temp1hr,temp6hr	*.sar *.sar *.sar	SSARR-formatted files after Data Conversion menu option has been completed.
Prec1hr,Prec6hr Q1hr,Q6hr Stage1hr,Stage6hr Temp1hr,Temp6hr	*.bak *.bak *.bak *.bak	Previous SSARR-formatted files created when converting new data files to SSARR-formatted files.

Program Files

The SSARRMENU executable was compiled and built using the following files and Microsoft Fortran PowerStation™ version 4.0 using the QuickWin™ run-time library

Source Files

basstat.for
dataconv.for
drawmap.for
floodmap.for
graph.for
graphdlg.for
gui_menu.for
letter.for
modtimdlg.for
modules.for

Source Files

mudplot.for
picksta.for
preconv.for
preplot.for
sarprogs.for
scandata.for
telnet.for
tempbad.for

Image Files

fishnet3.bmp
initialize.bmp
mudintake3.bmp
icon2.ico
icon3.ico
icon4.ico

Include Files

resource.h
resource.fd

Definition File

gui.def

Resource Files

script1.rc
tempplot.for
text.for

REFERENCES CITED

- Hutchison, N.E., comp., 1975, WATSTORE user's guide: U.S. Geological Survey Open-File Report 75-426, v. 1-6.
- Mastin, M.C., 1999, Real-time flood alert and simulation of river flood discharges in the Puyallup River Basin, Washington: U.S. Geological Survey Water-Resources Investigations Report 98-4226, 70 p.
- Miller, J.F., Frederick, R.H., and Tracey, R.J., 1973, Precipitation-frequency atlas of the western United States, V. IX-Washington: U.S. Department of Commerce, NOAA Atlas 2, 37 p.
- Soil Conservation Service [now National Resource Conservation Service], 1965, [Map of] mean annual precipitation 1930-1957 State of Washington: Portland, Oregon, Soil Conservation Service, 1 p.
- 1991, User manual SSARR model streamflow synthesis and reservoir regulation: Portland, Oreg., North Pacific Division, U.S. Army Corps of Engineers, [variously paged].
- U.S. Department of Commerce, 1973, Precipitation-frequency atlas of the western United States, Volume D-Washington: Silver Springs, Maryland, National Oceanic and Atmospheric Administration, NOAA Atlas 2, 43 p.

APPENDIX A. Supplemental Information

APPENDIX A. SUPPLEMENTAL INFORMATION

Several examples of user interaction with the SSARR model outside of SSARRMENU are given below. In these examples the keystrokes entered by the user are in **bold** and the computer prompts or information are *italicized*.

Changing Values for Initial Conditions of Snow-Water Equivalent Outside of SSARRMENU

The following procedure outlines the steps needed to change the initial conditions values of snow-water equivalent (SWE) of a subsequent model run if the simulated values of SWE in a subbasin are in error.

It is best to end a model run on the date that the changes will be made, so that the next model run uses the changed values as initial conditions.

The following is a list of keystrokes that are made after entering the SSARR program. The program has an interactive initial-conditions processor that changes the stored initial conditions in the SSARR work file, Iodc.

While in Windows Explorer™, double click on ssarr2k.exe in the SSARR directory to initiate the SSARR program. The * prompt should appear.

*

IC

Enters the initial-conditionsinteractive processor.

IC COMMAND?

?

(Optional) for help on IC commands

LT

For listing of current IC start time. This is the time that changes will take effect.

IC START TIME IS 24.0 25NOV94

IC COMMAND?

If a new IC start time is needed:

T

ENTER NEW IC START TIME AS:

HOUR, DDMMYY (6A.M. IS ENTERED AS 6 OR 6.)

24.0, 251194

for 11/25/94 at 24 hours or 11/26/94 at 0 hours

Once the correct IC start time has been entered, a list of the SWE values for a particular subbasin can be shown. In this example, the South Prairie Subbasin, SSARR code—SOPRE, is shown.

IC COMMAND?

IC SOPRE SWE L

IC for initial conditions, SOPRE for South Prairie subbasin, SWE for snow-water equivalent, and L for listing. The values of SWE are under the column “WE” by zone (snowband).

SOPRE		(24.0 25NOV94)						
ZONE	CC	LIQW	ATIMR	ATICC	WE	SMI	BII	TINT
1	.00	.0	0.	32.	.0	6.0	.1	.20
2	.00	.0	0.	32.	.0	6.3	.1	.20
3	.00	.0	0.	32.	.2	6.7	.1	.20
4	.00	.0	13.	32.	1.0	7.0	.1	.20
5	.00	.1	31.	31.	1.9	7.3	.1	.20
6	.00	.1	9.	30.	3.2	7.3	.0	.20
7	.00	.1	4.	30.	4.6	7.1	.1	.20
8	.00	.1	1.	28.	6.4	6.7	.0	.20
9	.00	.1	0.	27.	7.3	6.4	.0	.20
10	.00	.1	0.	26.	9.4	5.8	.0	.20
11	.00	.1	0.	24.	11.5	4.8	.0	.20
SURFACE		6.0	6.0	12.0				
SUBSURF		8.0	12.0	14.0				
BASEFLOW		115.0	113.0					
LOWERZN		.0	.0					

To change SWE values:

IC COMMAND?

IC SOPRE SWE

Enter the new value for initial conditions of SWE for each elevation zone, starting with zone 1, with each value separated by commas. For example, change the SWE values in the South Prairie Subbasin to 1.0 inch for each of the first two zones and then add another inch at every other higher zone:

1.0,1.0,2.0,2.0,3.0,3.0,4.0,4.0,5.0,5.0,6.0

The new values will be displayed as shown below.

<i>SOPRE</i>		<i>(24.0 25NOV94)</i>						
<i>ZONE</i>	<i>CC</i>	<i>LIQW</i>	<i>ATIMR</i>	<i>ATICC</i>	<i>WE</i>	<i>SMI</i>	<i>BII</i>	<i>TINT</i>
1	.00	.0	0.	32.	1.0	6.0	.1	.20
2	.00	.0	0.	32.	1.0	6.3	.1	.20
3	.00	.0	0.	32.	2.0	6.7	.1	.20
4	.00	.0	13.	32.	2.0	7.0	.1	.20
5	.00	.1	31.	31.	3.0	7.3	.1	.20
6	.00	.1	9.	30.	3.0	7.3	.0	.20
7	.00	.1	4.	30.	4.0	7.1	.1	.20
8	.00	.1	1.	28.	4.0	6.7	.0	.20
9	.00	.1	0.	27.	5.0	6.4	.0	.20
10	.00	.1	0.	26.	5.0	5.8	.0	.20
11	.00	.1	0.	24.	6.0	4.8	.0	.20
<i>SURFACE</i>		6.0	6.0	12.0				
<i>SUBSURF</i>		8.0	12.0	14.0				
<i>BASEFLOW</i>		115.0	113.0					
<i>LOWERZN</i>		.0	.0					

IC COMMAND?

Q To quit the IC processor.

*

by To quit SSARR.

Adjusting Subbasin Outflows with Specified Discharges

If the ADJUST option in SSARRMENU is not working, specific outflows may be entered for the surface, subsurface, baseflows, and lower zone flow from a specific subbasin using the SSARR model input processor. The format of the input is the station name, time-date (HHHDDMMYY), and flow values for each routing phase in cubic feet per second (CFS). See SSARR User Manual for more details (U.S. Army Corps of Engineers, 1991, p. B-41). Entering the Z2B

card (“card” refers to one line of input with specific arguments separated by spaces) with the proper format specifies the discharges for baseflow from the specified subbasin. Using the same format, the Z2S card adjusts surface outflow, the Z2SS card adjusts the subsurface outflow, and the Z2LZ card adjusts the lower zone outflows. From the previous example, the IC processor showed three phases of flow for the surface outflow from subbasin SOPRE for 11/24/94 at 2400 hours (coded as 240) to be 6, 6, and 12 cfs. To change the three phases of flow to 20, 20, and 40 cfs, the user may do the following.

*

Z2S SOPRE 240270200 12 12 40

Z2S card format

IA

Return to interactive prompt

*

IC

Enter initial conditions processor

IC SOPRE Q L

List initial conditions

<i>SOPRE</i>		<i>(24.0 25NOV94)</i>						
<i>ZONE</i>	<i>CC</i>	<i>LIQW</i>	<i>ATIMR</i>	<i>ATICC</i>	<i>WE</i>	<i>SMI</i>	<i>BII</i>	<i>TINT</i>
1	.00	.0	0.	32.	1.0	6.0	.1	.20
2	.00	.0	0.	32.	1.0	6.3	.1	.20
3	.00	.0	0.	32.	2.0	6.7	.1	.20
4	.00	.0	13.	32.	2.0	7.0	.1	.20
5	.00	.1	31.	31.	3.0	7.3	.1	.20
6	.00	.1	9.	30.	3.0	7.3	.0	.20
7	.00	.1	4.	30.	4.0	7.1	.1	.20
8	.00	.1	1.	28.	4.0	6.7	.0	.20
9	.00	.1	0.	27.	5.0	6.4	.0	.20
10	.00	.1	0.	26.	5.0	5.8	.0	.20
11	.00	.1	0.	24.	6.0	4.8	.0	.20
<i>SURFACE</i>		<i>12.0</i>	<i>12.0</i>	<i>40.0</i>				
<i>SUBSURF</i>		<i>8.0</i>	<i>12.0</i>	<i>14.0</i>				
<i>BASEFLOW</i>		<i>115.0</i>	<i>113.0</i>					
<i>LOWERZN</i>		<i>.0</i>	<i>.0</i>					

IC COMMAND?

Q

To quit the IC processor

*

by

To quit SSARR

Working with the Bulk File

The Bulk file stores input and output to and from the model. It is necessary to have the file present in the root/SSARR directory in order for SSARRMENU to operate. Using the executable root/SSARR/bulk2k.exe, two common operations with the Bulk file are creating a new Bulk file and compressing an existing Bulk file.

Creation of a New Bulk File

Outside of SSARRMENU, start the root/SSARR/bulk2k.exe program. A DOS window with the title “bulkmain” will appear and read:

*ENTER “INITIALIZE” TO EMPTY AND RESET THE FILE OR
ENTER L,LA,LS,S,R,C,Q OR ?*

The user should enter: **INITIALIZE**

The program will respond:

*ENTER THE NUMBER OF SEGMENTS CAPACITY IN THE NEW
FILE. EACH SEGMENT TAKES 2960 BYTES*

The user should enter: 2000

This is the number that was frequently used in trial runs of SSARRMENU. Any higher number would work also, but lower numbers might create too small a Bulk file that would fill too quickly and cause errors at some point during the modeling process.

The program will respond: *ENTER L, LA, LS, S, R, C, Q OR ?*

The user should enter: **Q** (Quit the program)

Compression of the Bulk File

Over the course of many model runs during the water year, the size of the Bulk file may become cumbersome. The user may want to compress the file to save disk space. A simple utility in bulk2k.exe will compress the Bulk file without any change to the data. This is easily done outside of SSARRMENU by first starting the bulk2k.exe program and following the commands listed below.

The first prompt will be

*ENTER “INITIALIZE” TO EMPTY AND RESET THE FILE OR
ENTER L, LA, LS, S, R, C, Q OR ?*

The user should enter: **C**

The program will respond:

THE OLD FILE HAS CAPACITY FOR 2000 SEGMENTS.

ENTER BLANK LINE IF COMPRESSED FILE IS TO HAVE THE SAME CAPACITY

ENTER THE CAPACITY (IN SEGMENTS) OF THE COMPRESSED FILE,

IF IT IS TO BE DIFFERENT THAN THE OLD FILE.

<enter> The user should enter a blank line

The program will respond:

COMPRESSED BULK FILE CLOSED. THERE WERE 56 WRITES, DIRECTORY IS
225 WORDS LONG (MAX IS 740), AND FILE HAS 136 SEGMENTS USED (MAX IS 3000).

ENTER L, LA, LS, S, R, C, Q, OR ?

Q Quit the program.

A file called Newbulk will be created that is the compressed version of the Bulk file. The file Bulk can be deleted, and the file Newbulk can be renamed to Bulk. If SSARRMENU is restarted, it will read the new Bulk file (the compressed version) just the same as the old Bulk file without any loss of data.



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USER'S GUIDE TO SSARRMENU

USGS OPEN-FILE REPORT 01-439