REAL-TIME MAPPING ALERT SYSTEM: USER'S MANUAL

By Luis A. Torres

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ACRONYMS AND DEFINITIONS

ADAPS	Automated Data Processing System
AML	Arc Macro Language
ARC	A continuous string of x,y coordinate pairs (vertices) having length, direction, but no area. It represents line features, borders of area features, or both.
ARC/INFO	Registered software package of ESRI for handling GIS data. It uses a tabular database management system (INFO) for storage and manipulation of map feature attributes.
CPL	Command Procedure Language
DCP	Data Collection Platform
DG/UX	Data General UNIX Operating System
ESRI	Environmental Systems Research Institute
FTP	File Transfer Protocol program designed to send and retrieve files between computer systems by electronic means.
FORTRAN 77	Formula Translation Programming Language Standard 1977
GIS	Geographic Information System
PRIMOS	Prime Operating System
RTMAP	Real-Time Mapping
REAL-TIME	An actually occurring event.
UNIX	An operating system based on the C programming language that could be easily ported to different computer systems.
USGS	U.S. Geological Survey

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By Luis A. Torres

ABSTRACT

The U.S. Geological Survey has an extensive hydrologic network that records and transmits precipitation, stage, discharge, and other water-related data on a real-time basis to an automated data processing system. Data values are recorded on electronic data collection platforms at field monitoring sites. These values are transmitted by means of orbiting satellites to receiving ground stations, and by way of telecommunication lines to a U.S. Geological Survey office where they are processed on a computer system. Data that exceed predefined thresholds are identified as alert values. These alert values can help keep water-resource specialists informed of current hydrologic conditions. The current alert status at monitoring sites is of critical importance during floods, hurricanes, and other extreme hydrologic events where quick analysis of the situation is needed. This manual provides instructions for using the Real-Time Mapping software, a series of computer programs developed by the U.S. Geological Survey for quick analysis of hydrologic conditions, and guides users through a basic interactive session. The software provides interactive graphics display and query of real-time information in a map-based, menu-driven environment.

INTRODUCTION

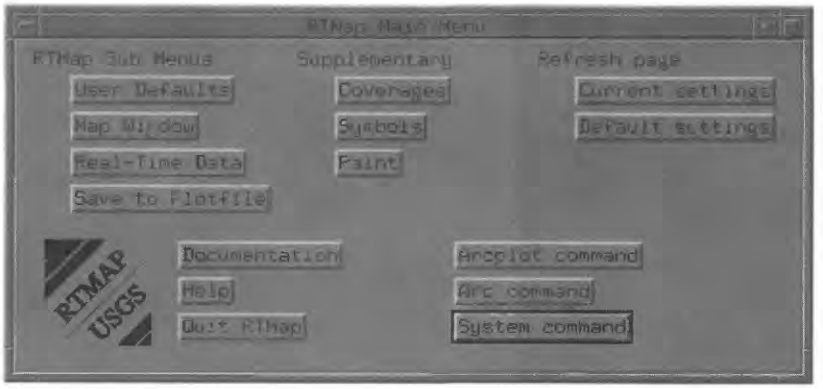
An extensive monitoring network is used by the U.S. Geological Survey (USGS) to collect and transmit hydrologic data to the Automated Data Processing System (ADAPS) that operates in a USGS minicomputer (Dempster, 1990). The hydrologic data are referenced by parameter codes that correspond to stage, discharge, precipitation, specific conductance, and other characteristics. Values that exceed predefined thresholds are flagged as alert values. Information on hydrologic events at monitoring sites within a state or region is of critical importance to government agencies. There is an increasing need for the USGS and other organizations to visualize hydrologic events as they are occurring (real-time). Public water and power utilities, civil defense, environmental protection, natural resource, county, regional, and local agencies can use this information for effective response to emergency situations. A Real-Time Mapping (RTMAP) alert system was developed to satisfy USGS requirements and to enhance the dissemination of hydrologic data.

The RTMAP alert system is a series of computer programs currently (1995) written in Command Procedure Language (CPL), Prime Fortran 77, ARC Macro Language (AML), and Green Hills Fortran-88000 that provide interactive graphics display of hydrologic data in a map-based and menu-driven environment. The primary purpose of RTMAP is to provide water-resources managers with a system to quickly analyze extreme hydrologic events such as floods, severe rainfall, severe drought, and water-quality conditions. Data about hydrologic events are viewed and analyzed by use of Geographic Information System (GIS) maps, time-based graphs, and icons displayed on a computer screen. The GIS maps show areas such as river basins, valleys, counties, states, or islands (fig. 1). The time-based graphs show data collected from monitoring sites in the field, such as stage, discharge, precipitation (rainfall), water temperature, specific conductance, and so forth (fig. 2). Icons are depicted on maps to indicate location of monitoring sites, the type of data being monitored, and the alert situation occurring at that moment (fig. 3). In addition, RTMAP provides a series of user-friendly menus to enable users to print the displayed screen; select and enlarge a map area; select icons representing sites monitoring one type of sensor at a time (discharge only, for instance); find out how many sites are in alert status and for what type of data, update GIS map files when sites are added, modified, or removed from the database; and execute computer commands.

Within the USGS, the RTMAP software has become useful for flood-alert systems, because it provides a visual display of data quickly and effectively. Each monitoring site in the field is equipped with a data collection platform (DCP), an automated microcomputer that electronically collects data from instruments such as rain gages, stage sensors, or weather sensors. The DCP's are usually programmed to collect data every 15 or 60 minutes for each connected sensor and transmit the data every 4 hours to a geostationary satellite linked to a receiving ground station. The received data are then transferred to a computer system where RTMAP resides (fig. 4). If extreme hydrologic events trigger alert thresholds already defined in each DCP, the transmission and receiving process described above is, in most cases, performed every 5 minutes or less until the alert situation is over. For practical purposes, DCP data transmitted and received every 5 minutes or less, either by satellite, radio, or telephone, are considered to be real-time data.

The data originating from monitoring sites are known as unit values. They are stored in a database file system that is accessed by RTMAP for retrieval (fig. 5). Other relevant data are accessed as well, such as name, location, USGS station identification number, and alert threshold values. Once retrieved, these data are merged into GIS coverages and relational database files (fig. 6). The RTMAP software relies on ARC/INFO to access and manage GIS data.

The purpose of this report is to explain how to use the RTMAP software. The report provides step by step instructions to be followed during the interactive session. The instructions are shown in outline format, but also have been grouped by title. This can help users to better understand and learn how to identify alert monitoring sites, plot maps and graphs, set up alert thresholds, and so forth. The report also provides illustrations that tell the user the input requests, screen displays, and printer outputs to expect. The scope of the report is confined to explaining the general steps needed by most computer users.



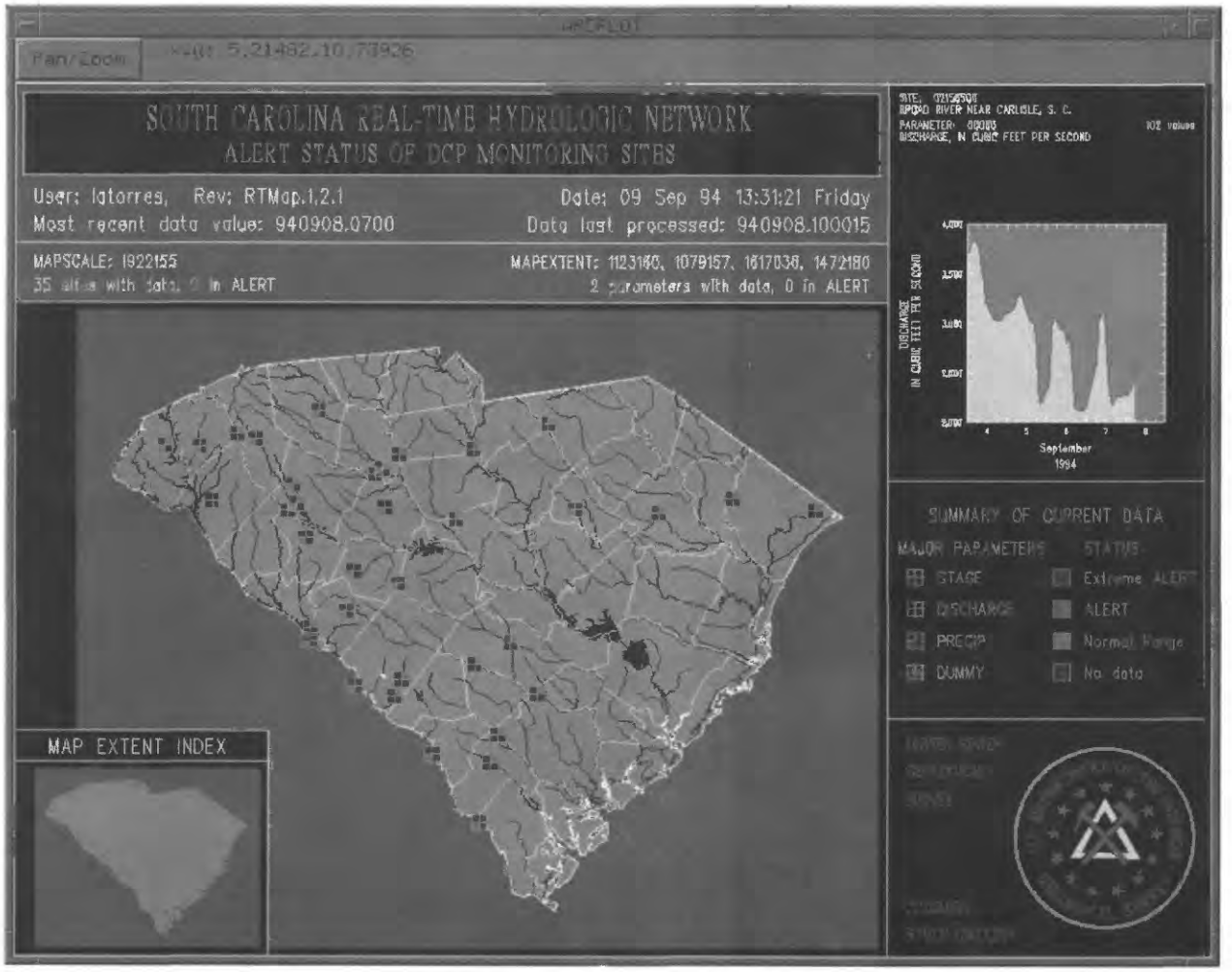


Figure 1. Example of the Real-Time Mapping software displaying a state map.

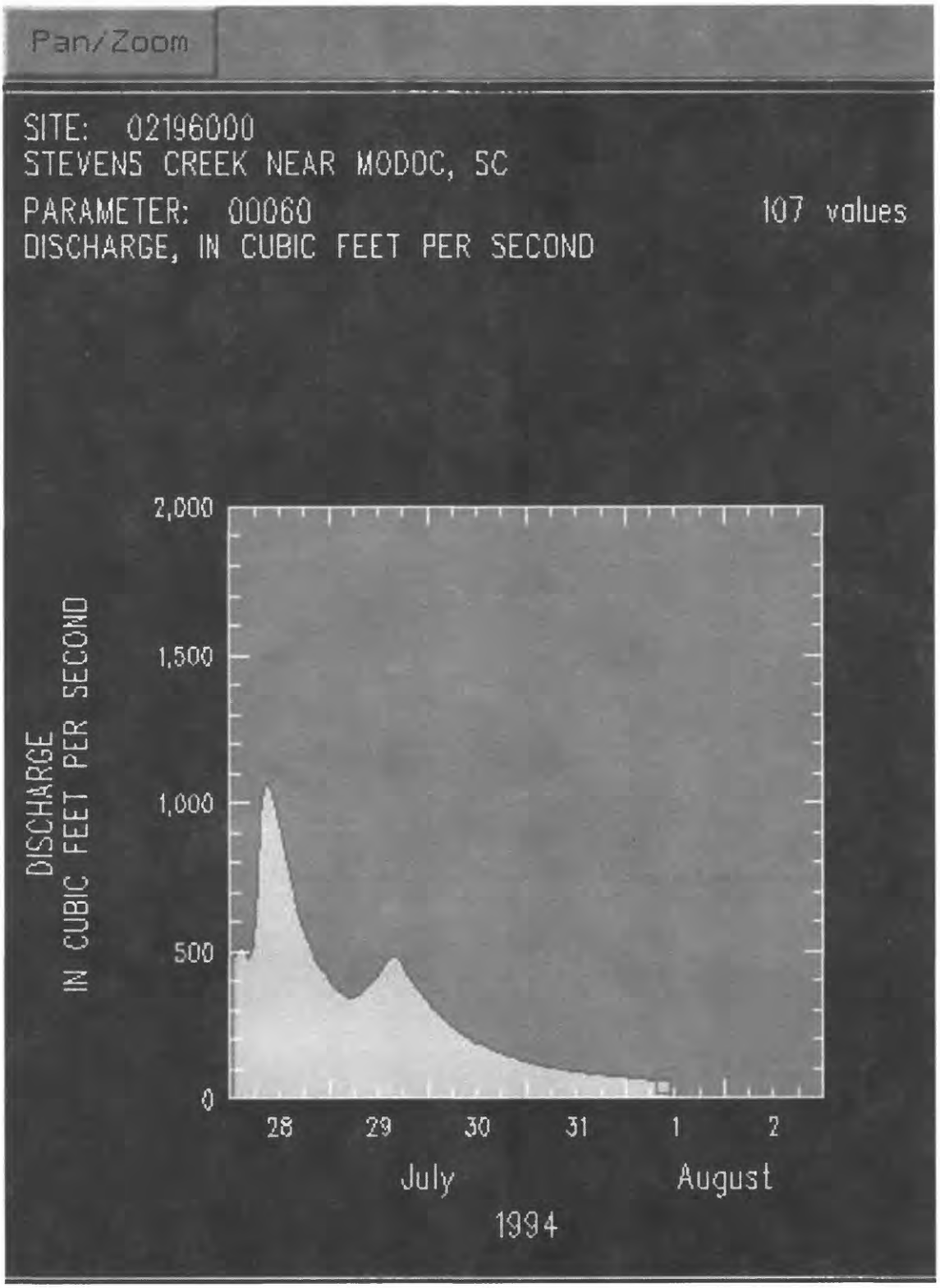


Figure 2. Example of a time-based graph generated by the Real-Time Mapping software.

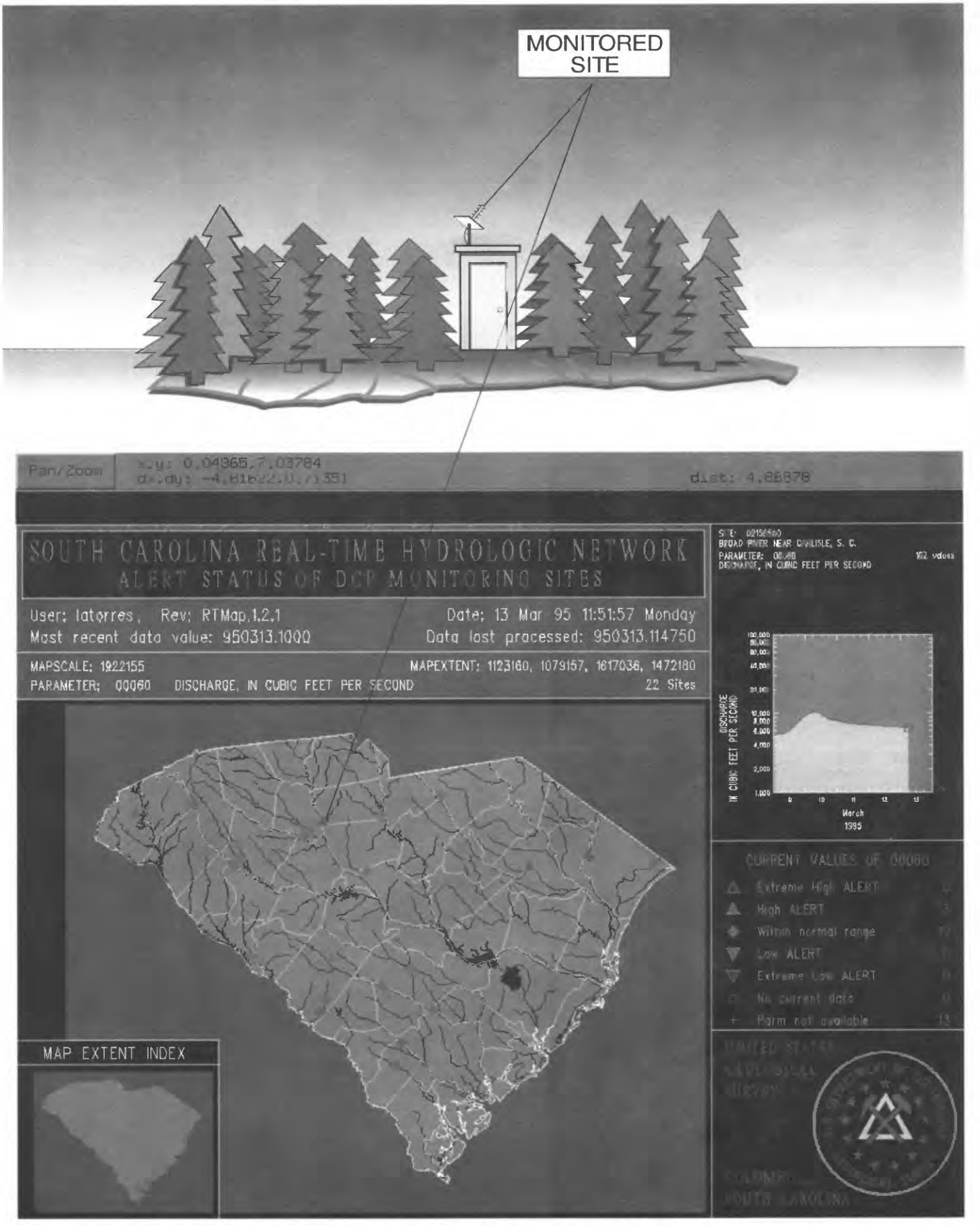


Figure 3. Example of icons that represent name and location of monitoring sites, type of data being monitored, and the alert status.

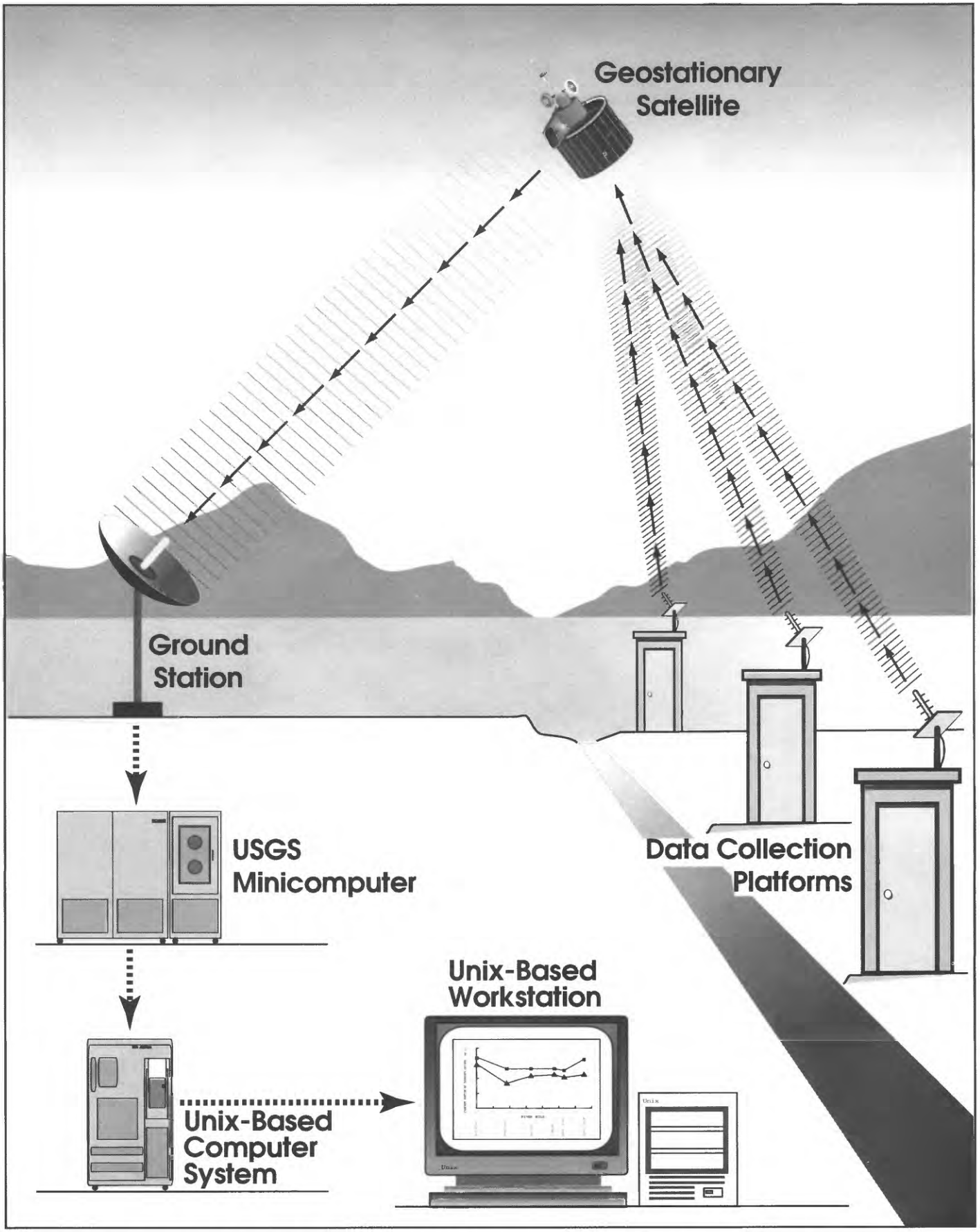


Figure 4. Path of data from monitoring sites to a computer system where the Real-Time Mapping software resides.

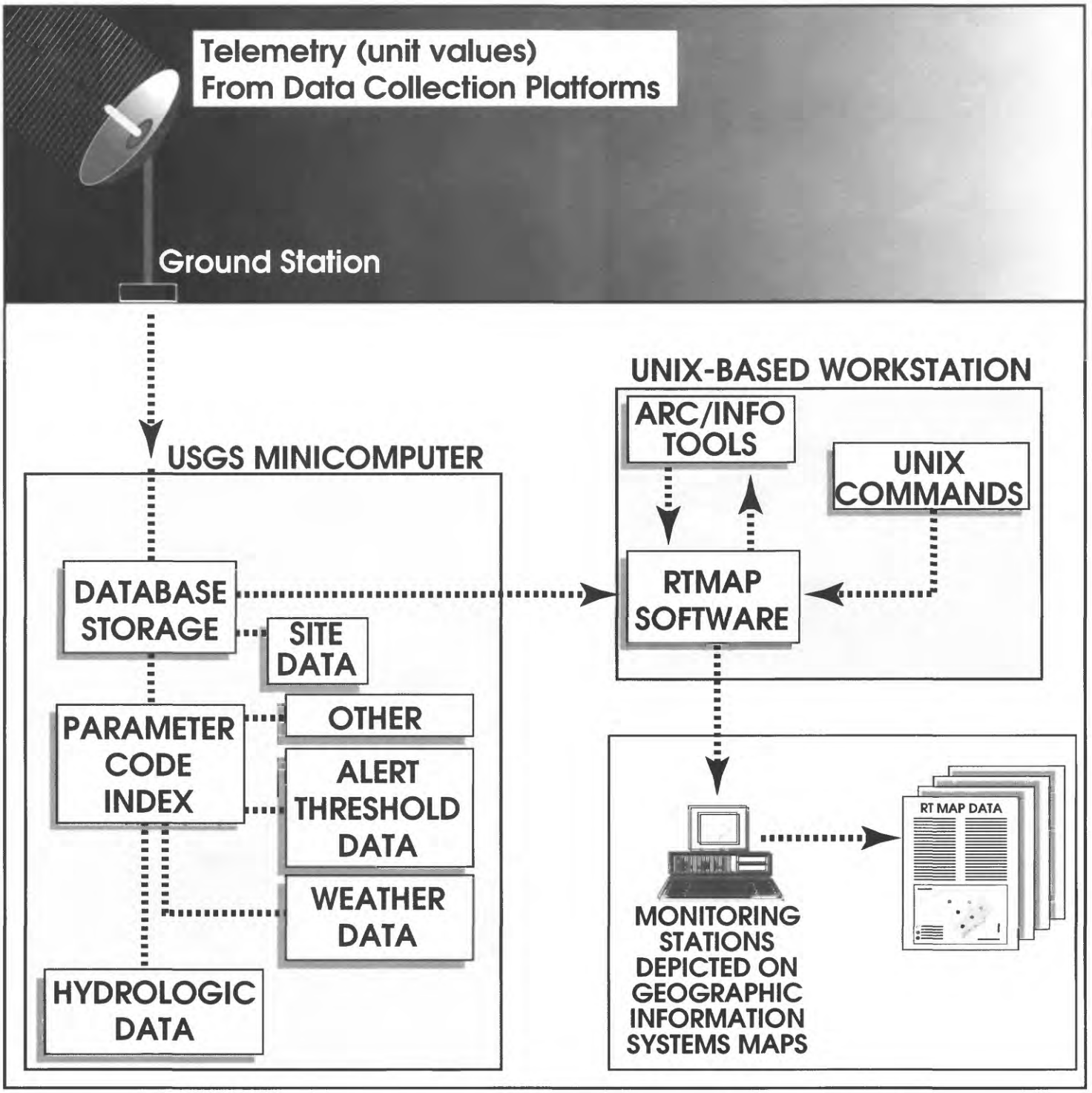


Figure 5. Database file system containing telemetry and other relevant data to be accessed by the Real-Time Mapping software for retrieval.

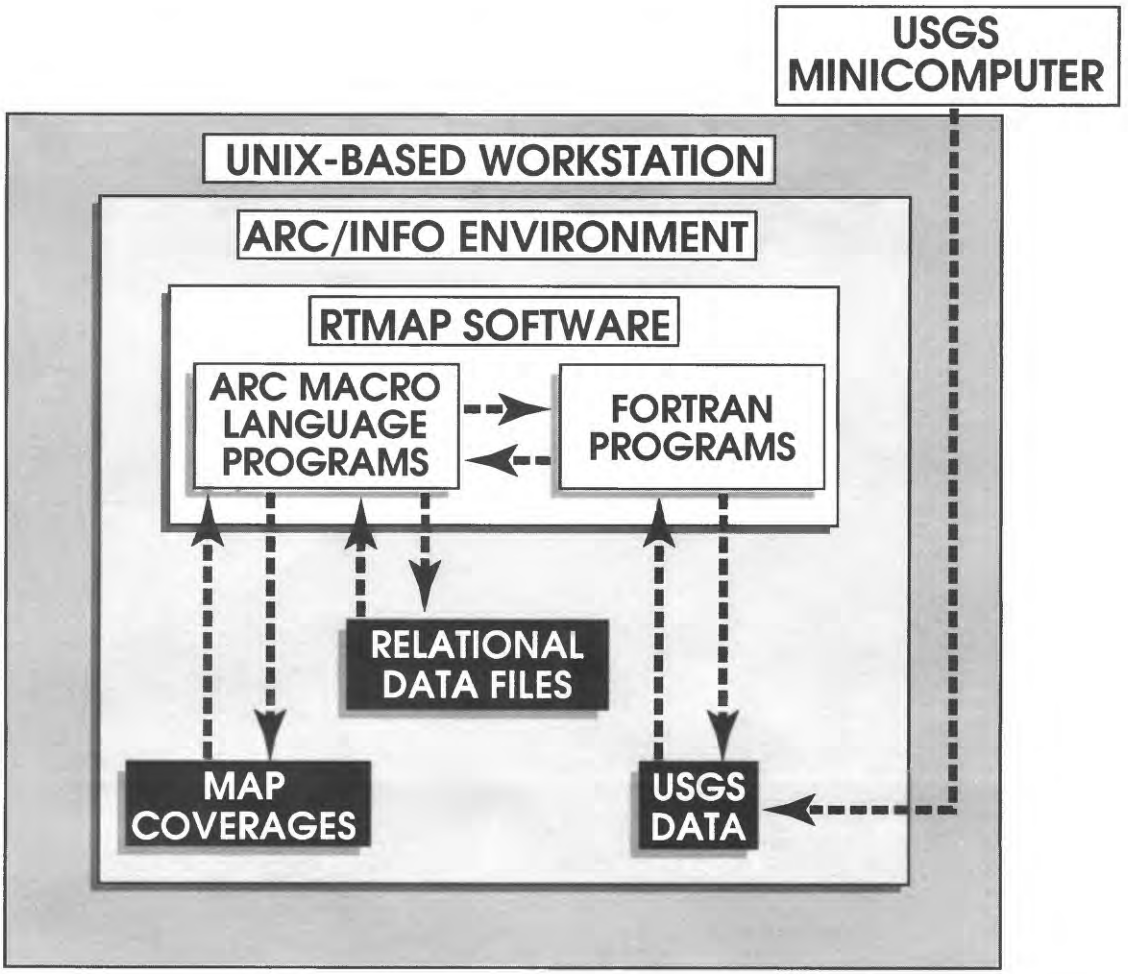


Figure 6. Data from the U.S. Geological Survey minicomputer are merged into Geographic Information System coverages and relational database files.

USING THE REAL-TIME MAPPING SOFTWARE ON THE U.S. GEOLOGICAL SURVEY MINICOMPUTER

The USGS minicomputer contains the data needed by the RTMAP software for processing. The data are stored by the ADAPS software developed by the USGS. This is why the retrieval part of the RTMAP software resides in the USGS minicomputer. The USGS minicomputer is currently (1995) a PRIME 50 series running the PRIME Operating System (PRIMOS) that retrieves and transfers data to one or more UNIX-based workstations connected through a telecommunications network. The retrieval and transfer process is set up by the systems administrator, and runs automatically on regular time intervals. The user, however, can manually retrieve and transfer data by following the procedures below.

> NOTE: Special computer access rights are needed to follow the procedures below. If error messages appear or computer processing ends abnormally, please consult with either the database administrator, or the systems administrator at the nearest USGS office supporting the RTMAP alert system.

A. **Login** to the USGS minicomputer.

B. To manually retrieve and transfer the name and location of monitoring sites, complete the following steps:

   1. Enter **RESUME RTMAP>RUN>RTSITE.** (If available, enter local PRIMOS command **RTSITE** instead.)

   2. If run successfully, the screen display should end with **RTSITE ended normally.**

C. To manually retrieve and transfer the most recent unit values and alert flags, complete the following steps:

   1. Enter **RESUME RTMAP>RUN>MAPDAT.** (If available, enter local PRIMOS command **MAPDAT** instead.)

   2. If run successfully, the screen display should end with **MAPDAT ended normally.**

D. To manually retrieve and transfer unit values for the last 5 days, complete the following steps:

   1. Enter **RESUME RTMAP>RUN>MAPDAT5.** (If available, enter local PRIMOS command **MAPDAT5** instead.)

   2. If run successfully, the screen display should end with **MAPDAT5 ended normally.**

NOTE: Procedure E below is optional. It retrieves and transfers the current alert thresholds assigned by the USGS for each monitoring site displayed by the RTMAP software. Non-USGS users may change the alert thresholds to satisfy their own needs. Once the USGS thresholds arrive at a UNIX-based workstation, the user may change them through a text editor. This is explained in the section titled, **USING THE REAL-TIME MAPPING SOFTWARE ON THE UNIX-BASED WORKSTATION.**

E. To manually retrieve and transfer USGS alert thresholds, complete the following steps:

1. Enter **RESUME RTMAP>RUN>RTHRESH**. (If available, enter local PRIMOS command **RTHRESH** instead.)

2. If run successfully, the screen display should end with **RTHRESH ended normally**.

F. During hydrologic alert conditions, the unit values can be retrieved and transferred on a continuous basis using the steps below. However, these steps are optional and can only be used if the additional software needed has been installed.

1. Enter **CPL RTMAP>RUN>RTMAP UP**. (If available, enter local PRIMOS command **RTMAP UP** instead.)

2. If running successfully, the screen display should say:

   RTMAP UP PROCEDURE.
   RTMAP IS NOW RUNNING.
   ISSUING STATUS MESSAGES EVERY 5 MINUTES UNTIL DEACTIVATED.

3. If the situation is no longer occurring, enter **CPL RTMAP>RUN>RTMAP DOWN**. (If available, enter PRIMOS command **RTMAP DOWN** instead.)

4. If running successfully, the screen display should be like the example below:

   STOPPING RTMAP. PLEASE STANDBY.
   RTMAP DOWN PROCEDURE COMPLETED.
   PROGRAM TERMINATED ON 95-05-08.09.20.30.Mon.

USING THE REAL-TIME MAPPING SOFTWARE ON THE UNIX-BASED WORKSTATION

Use the following procedures to process data sent by the USGS minicomputer to the UNIX-based workstation. The processing part of the RTMAP software is currently (1995) on the Data General AViiON workstation running the Data General UNIX Operating System (DG/UX). Consult with your systems administrator if error messages appear or computer processing ends abnormally.

A. **Login** to a UNIX-based workstation.

> NOTE: Procedure B assumes that file **rthresh**, containing USGS alert thresholds, was sent by the USGS minicomputer. Special access rights are needed to follow the procedure below. If error messages appear or computer processing ends abnormally, please consult with either the database administrator, or the systems administrator at the nearest USGS office supporting the RTMAP alert system. **General RTMAP users should skip to procedure C at this time.**

Setting Up Local Thresholds

B. If needed, set up local alert thresholds as follows:

1. At the UNIX prompt, point to the directory where the files sent by the USGS minicomputer are stored (example, enter **cd /project/rtmap-sc/data**).

2. Invoke a text editor in order to edit file **rthresh** (example, **emacs rthresh**).

3. The contents of the **rthresh** file should be similar in structure to the example in figure 7. Notice that each record contains a USGS station number, followed by a parameter code (00060 for discharge, for instance), followed by 4 numbers respectively indicating extreme low, low, high, and extreme high alert thresholds. Undefined alert thresholds are indicated with number -99.99.

4. Point to the desired record and change the alert thresholds accordingly. Make sure the edited numbers are properly aligned with the rest of the threshold records. Repeat as needed.

5. Save the modified **rthresh** file and **exit** the text editor. Then enter UNIX command, **cp rthresh mapthresh**. The RTMAP software will be able to generate its own alert flags based on the alert thresholds defined in the **mapthresh** file.

6. Edit the contents of the **mapthresh** file when needed.

USGS STATION NUMBER	PARAMETER CODE	EXTREME LOW ALERT	LOW ALERT	HIGH ALERT	EXTREME HIGH ALERT
02110500	00060	16.00	36.00	4000.00	7000.00
02110500	00065	00.00	0.50	13.00	14.00
02110730	00095	60.00	20.00	50000.00	60000.00
02110755	00095	60.00	20.00	1000.00	15000.00
02110770	00095	60.00	20.00	15000.00	20000.00
02110770	00095	-99.99	-99.99	-99.99	-99.99
02132000	00065	-99.99	-99.99	-99.99	18.28

Figure 7. Example of the contents of the alert thresholds file used by the Real-Time Mapping software.

Starting the Real-Time Mapping Software

C. Run ARC/INFO by entering **arc** at the computer prompt. The ARC/INFO software will output an **ARC/INFO** window. Move the **ARC/INFO** window to the bottom of the computer screen; this makes ARC/INFO messages, such as input requests, warnings, or programming error messages, visible to the user. If while following the steps below, you notice that RTMAP does not respond to the mouse, or shows a clock symbol, check to see if there is a window waiting to be closed. Also, look in the **ARC/INFO** window to see if it is waiting for you to respond. It may be behind the **ARCPLOT** window.

D. At the **Arc:** prompt, point to the directory where the AML programs are located (example, enter **&WORKSPACE /project/rtmap-sc/amls**). Notice the following:

1. If either program **RTMAP>RUN>RTSITE** or **RTMAP>RUN>RTHRESH** was just run on the USGS minicomputer, RTMAP has received information on new or updated monitoring sites. Therefore, you must process this information first by entering **&r gen_rtsite**. The name, location, and configuration of monitoring sites depicted on GIS maps will be properly updated before they are displayed on screen.

2. If either program, **RTMAP>RUN>MAPDAT** or **RTMAP>RUN>MAPDAT5**, was just run on the USGS minicomputer, RTMAP has received the most current instrument readings from alert monitoring sites. Therefore, you must process this information by entering **&r proc_rtsite**

   a) Data files received from the USGS minicomputer will be converted into ARC/INFO compatible input files.

   b) Alert flags depicted on GIS maps will be properly updated before they are displayed on screen.

   c) Run this AML program whenever you want the most current data.

Running the Main Program

E. At the **Arc:** prompt point to the directory where the RTMAP software is located (example, enter **&WORKSPACE /project/rtmap-sc/amls**). Then enter **&r rtmap** to begin execution.

1. An initial popup display describing the RTMAP system should appear similar to the example in figure 8. To close the display, click on the **QUIT** field located on the lower right of the display. You may avoid the initial popup display by entering **&r rtmap notitle** instead.

2. A default graphics window titled **ARCPLOT**, showing a state or regional map is displayed (fig. 9). Notice the following:

   a) Area boundaries, hydrographic features, and monitoring sites are shown on the map.

   b) Squared icons represent monitoring sites. Each icon is divided into four sub-squares. Each sub-square represents an instrument sensor (parameter).

      (1) Stations with unit values are represented with green, orange, or red sub-squares.

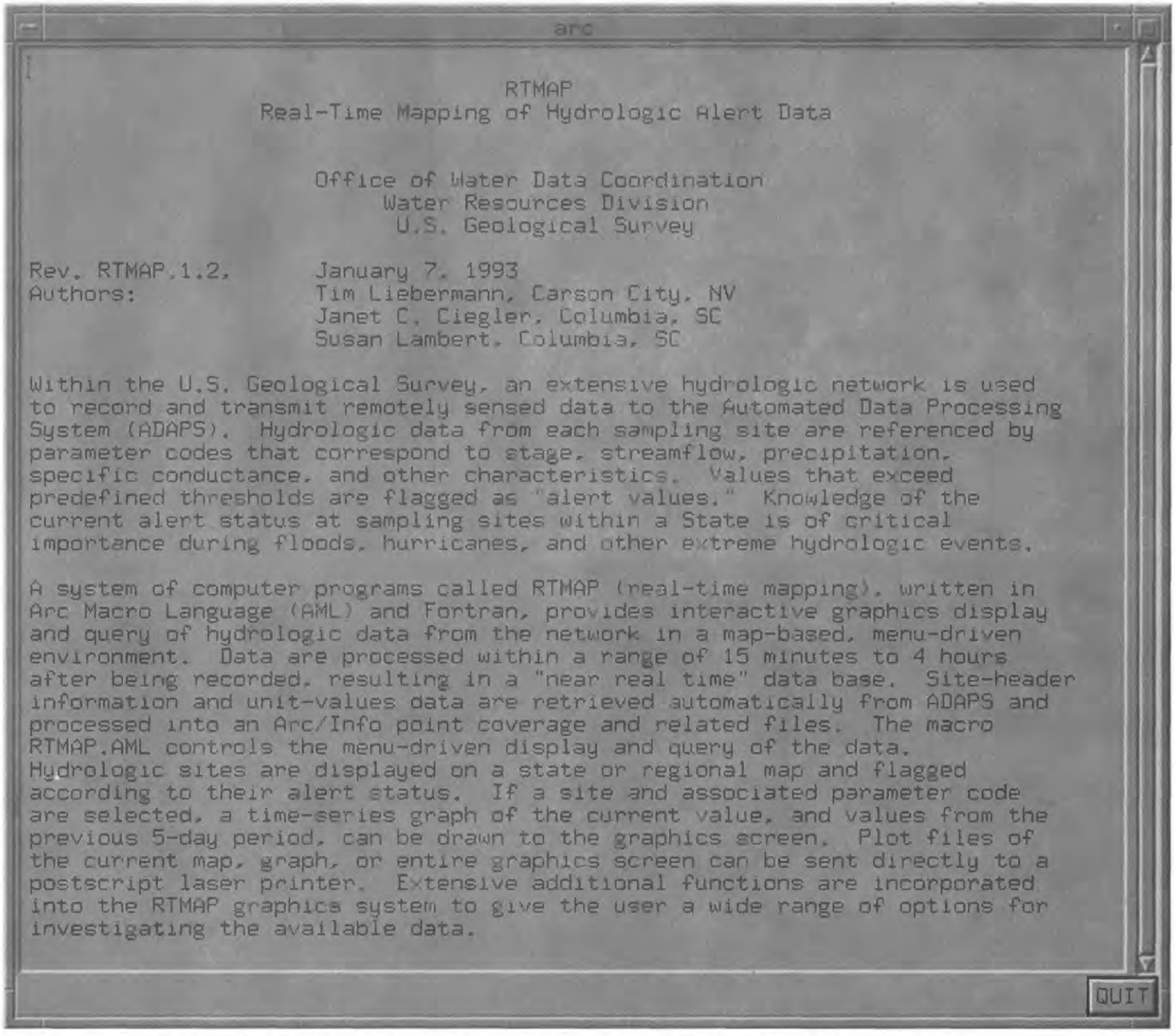


Figure 8. Initial popup display describing the Real-Time Mapping system.

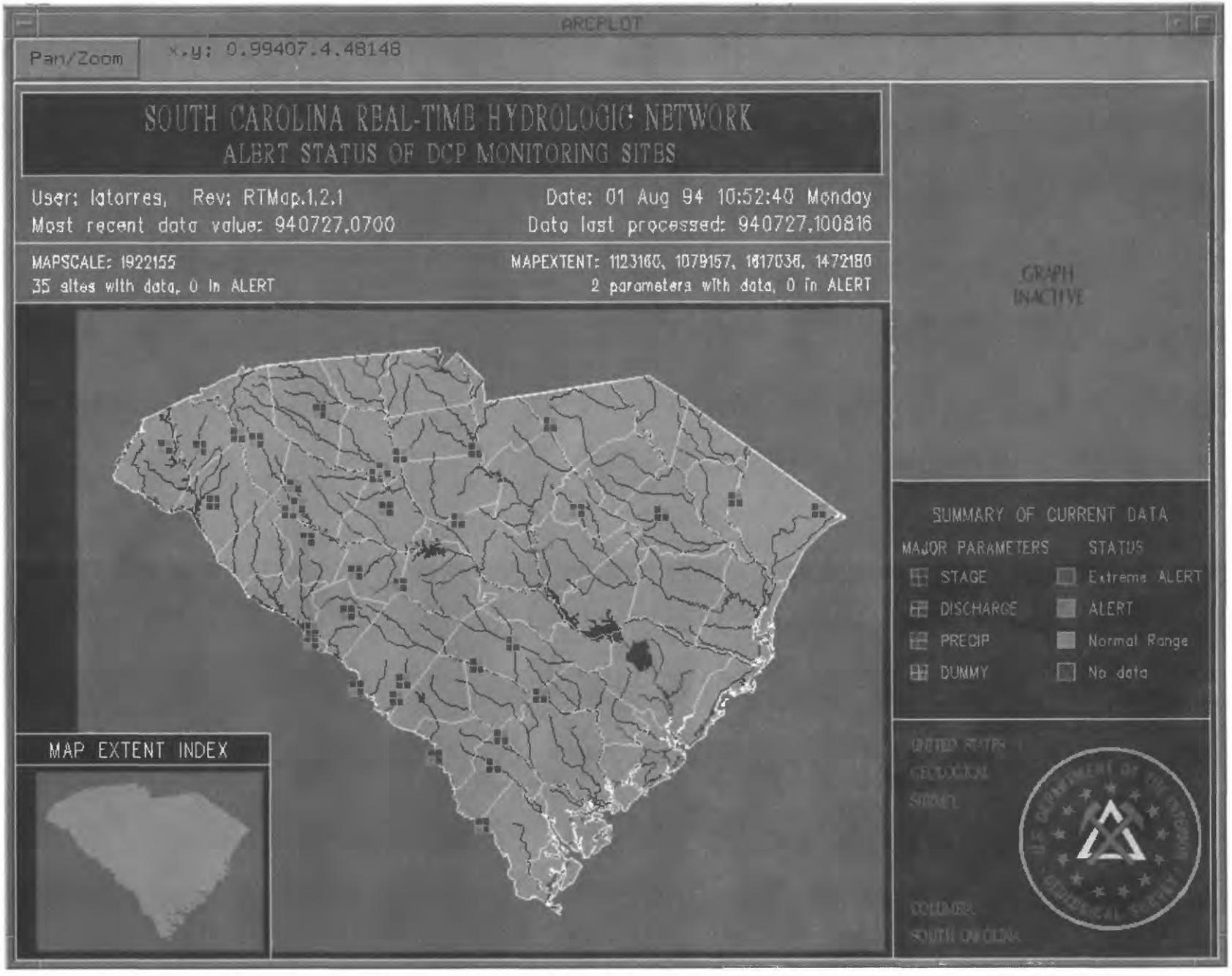


Figure 9. Example of the default ARCPLOT graphics window generated by the Real-Time Mapping software.

(2) A green sub-square indicates normal conditions for the represented parameter.

(3) An orange or red sub-square indicates that the alert threshold for the represented parameter has been exceeded. An orange color indicates a high or low condition, and a red color indicates a very high or very low condition.

(4) A sub-square that is not colored green, orange, or red indicates that no unit values exist for the represented parameter at that site.

3. The **RTMap Main Menu** window appears above the **ARCPLOT** window (fig. 10).

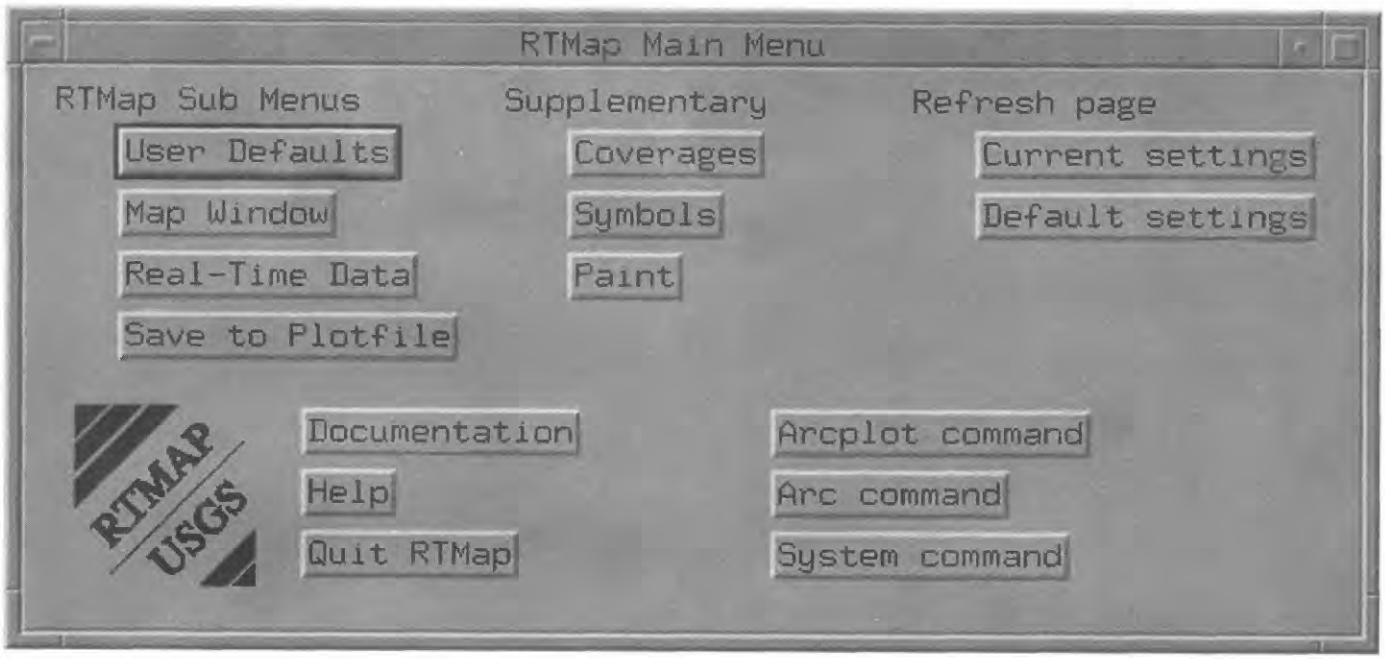


Figure 10. RTMap Main Menu window appearing on top of the ARCPLOT graphics window.

Starting the Interactive Graphics Session

F. Interact with RTMAP by performing the following steps:

1. Using the mouse button, click on the **Map Window** option in the **RTMAP Main Menu** window. A **Map Window SubMenu** window will appear (fig. 11).

   NOTE: On mouse drivers connected to Data General AViiON workstations, use the left click button to make selections.

2. Select **Point-n-click** from **Change Map Extent** options. Notice that the mouse cursor turns into a small clock symbol. This indicates RTMAP is waiting for you to respond. Notice the **Enter 2 points:** and **Define the box** messages appearing on the bottom of the **ARC/INFO** window.

3. Move the mouse cursor into the map area in the "ARCPLOT" window. Notice the perpendicular axes moving as the mouse cursor moves. The mouse cursor is at the point where both axes intersect.

4. Determine a quadrangular area within the displayed map, making sure that monitoring sites of interest are included within that area. **Select** a point of origin by pressing and releasing the mouse button. Then move the mouse cursor opposite the origin (for example, from northwest to southeast). Notice the quadrangular perimeter being formed (fig. 12). Press and release the mouse button again. The RTMAP software will change the map extent based on the quadrangular area of interest (fig. 13). Notice the **Map Extent Index** shown on the lower left corner of the **ARCPLOT** window indicating the part of the map being examined.

5. Move the mouse cursor back to the **Map Window SubMenu** window and click on the **Close this menu** option. The window will disappear.

6. Move the mouse cursor back to the **RTMap Main Menu** and click on the **Real-Time Data** option. A **Real-Time Data Sub** window will appear

7. **Click** on **Change parameter** from the **General** options. A **Popup** window will appear (fig. 15). Notice the items listed describe the type of data available for display.

8. Move the mouse cursor inside the **Popup** window. **Click** on a parameter other than **MAJOR PARMS**. The **Popup** window will disappear and a small **ARC/INFO** window containing statistical data based on the parameter selected will appear (fig. 16). Move the mouse cursor to the **QUIT** field, and **click** to remove the window.

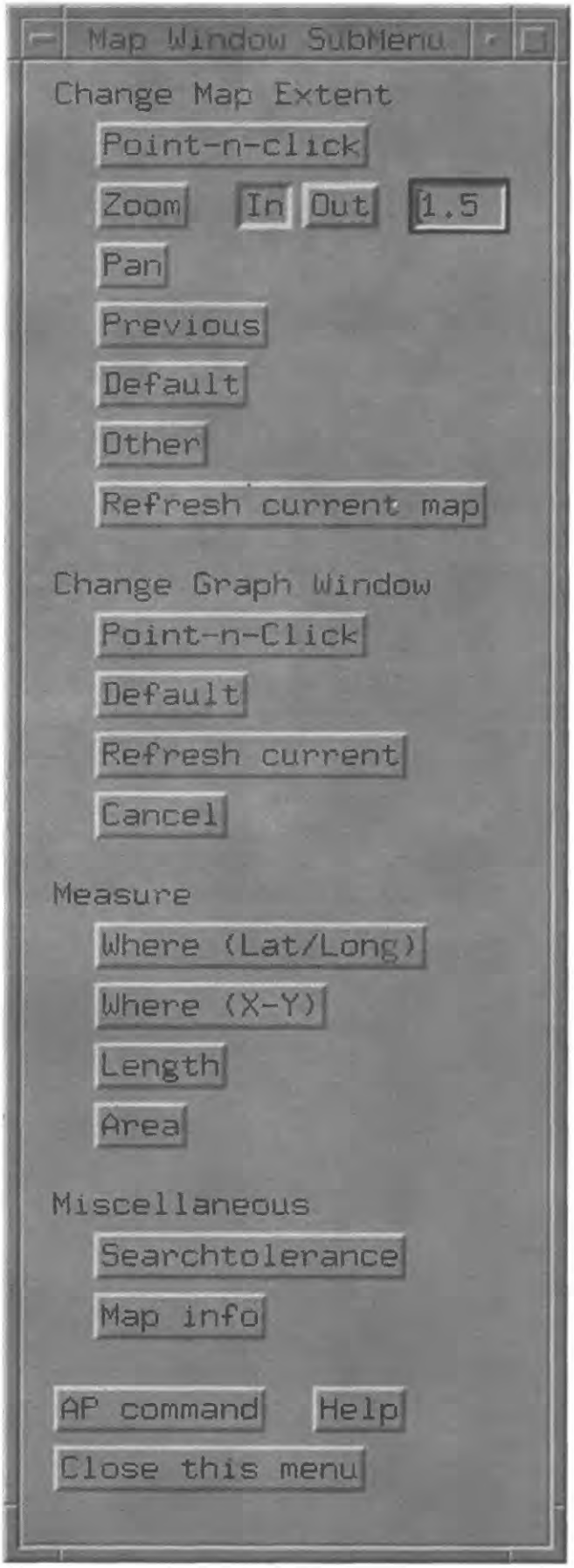


Figure 11. Map Window SubMenu window generated by the Real-Time Mapping software.

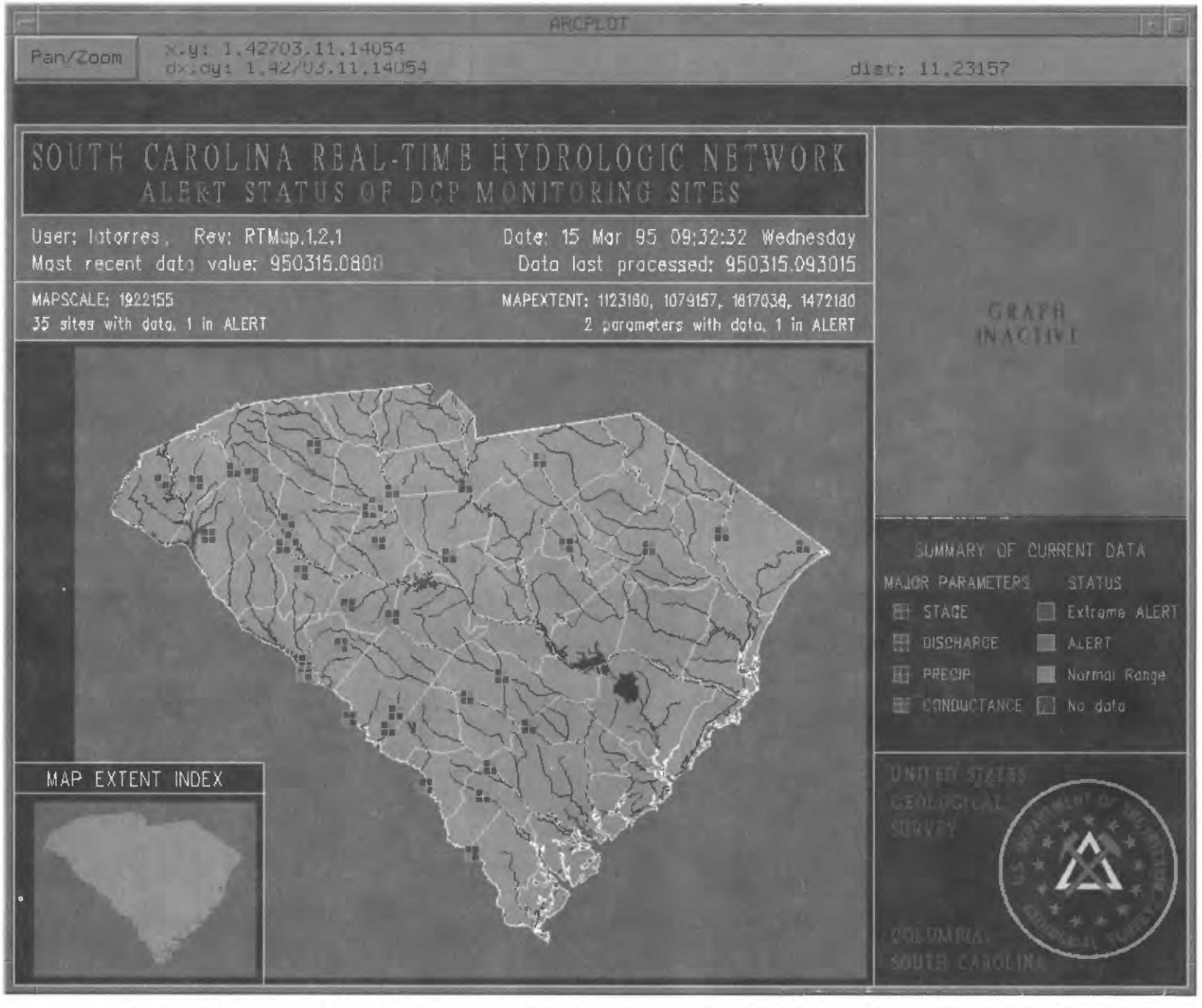


Figure 12. Example of a quadrangular area of interest formed after clicking on the mouse.

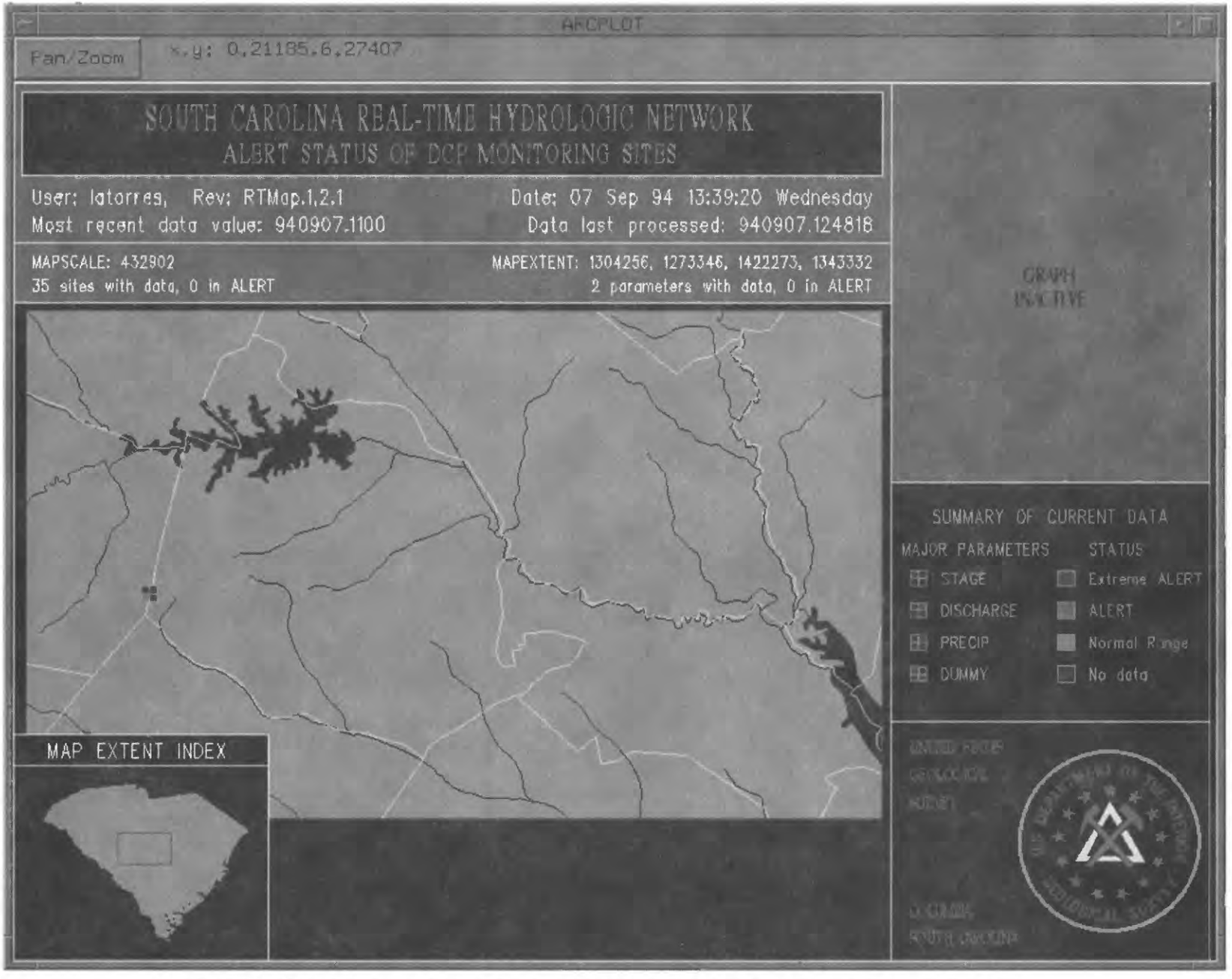


Figure 13. Changed map extent based on the quadrangular area of interest.

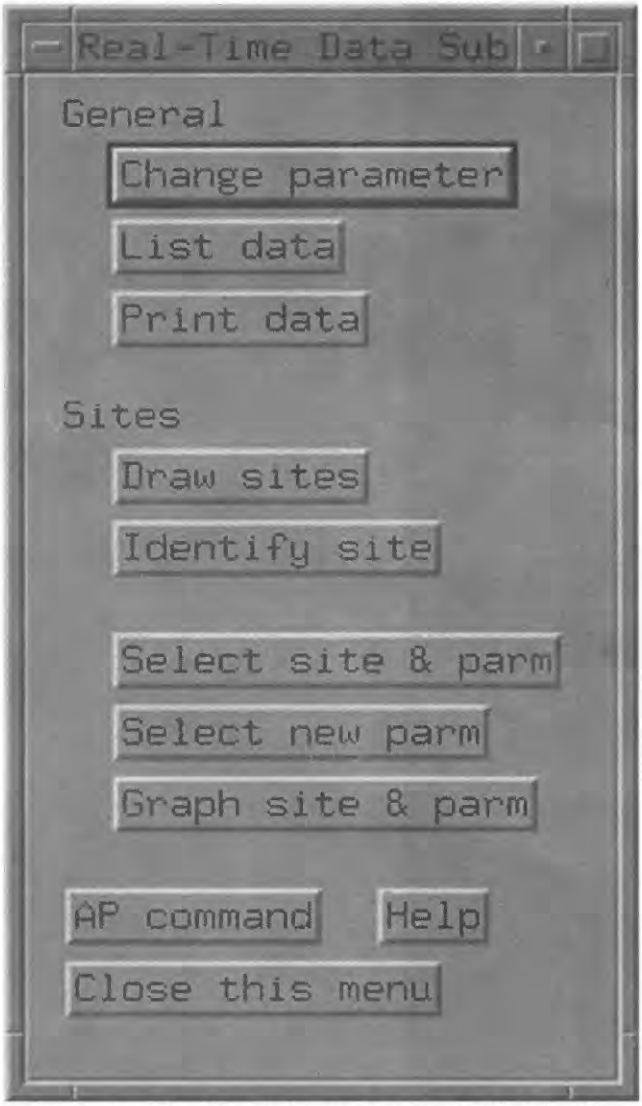


Figure 14. Real-Time Data Sub window generated by the Real-Time Mapping software.

Figure 15. Popup window listing the type of data available for display from a selected monitoring site.

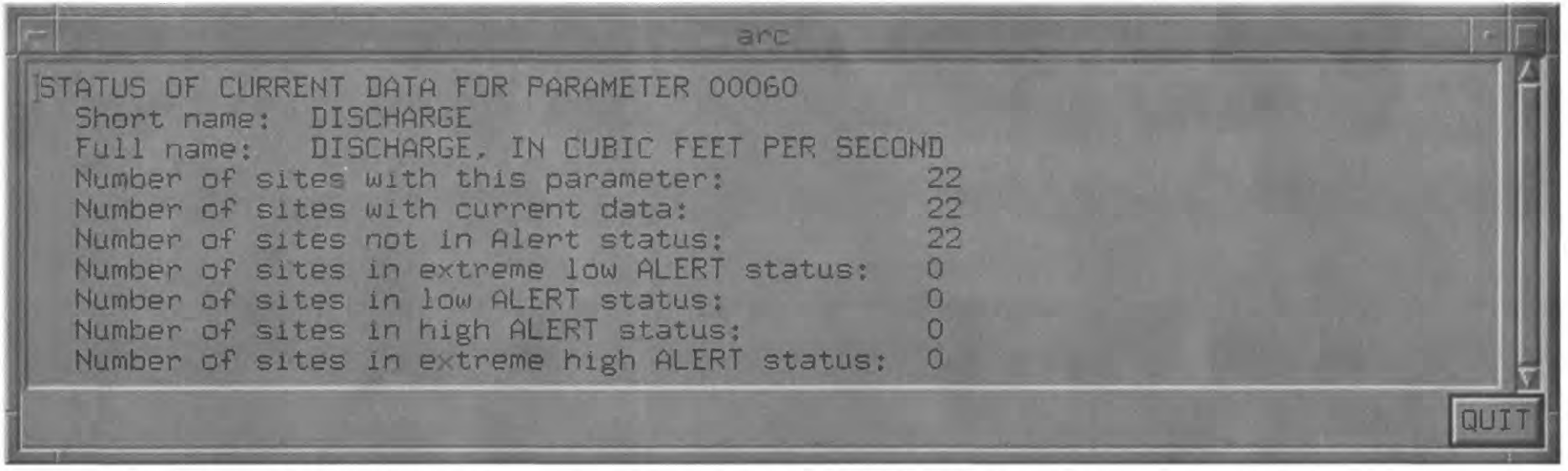


Figure 16. ARC/INFO window containing statistical data based on the parameter selected.

9. Notice the **Use 'Refresh' or 'Map Extent' to see any changes...** message appearing on the bottom of the **ARC/INFO** window. Move the mouse cursor back to the **RTMap Main Menu** window and click on **Current Settings** from the **Refresh page** options. RTMAP redraws the map in the **ARCPLOT** window, showing only monitoring sites that provide data based on the selected parameter (**PRECIP**, **STAGE**, or **LAKE ELEV**, for example). Refer to the example in figure 17.

10. Notice the symbols reference list shown on the middle right side of the **ARCPLOT** window. It should be specific to the parameter previously selected. The identification number assigned for the parameter (that is, **00060** for water discharge, or **00045** for precipitation) is shown on top. The symbols used are as follows:

    a) A colored triangle indicates current data values are available. A green diamond indicates normal conditions. Orange and red triangles indicate that alert thresholds have been exceeded.

    b) A small orange quadrangle indicates that no data are available.

    c) A light-blue "plus" (+) icon indicates the monitoring site was not configured to collect data matching the parameter being examined.

11. Move the mouse cursor back into the **Real-Time Data Sub** window. Click on **List data** from the **General** options. An **ARC/INFO** window similar to the example in figure 18 appears. The data shown come from the **rt_map.dat** file. Notice each record listed includes the USGS station identification number, latest date and time when data were received from the field, and the unit value for the parameter being examined. The time tags shown are consistent with the ADAPS database within the USGS minicomputer. Notice that values -99.99 indicate that no unit values are available for the time period specified. Move the mouse cursor to the **QUIT** field and click to remove the window.

12. If a printed copy is desired, move the mouse cursor back into the **Real-Time Data Sub** window and click on **Print data** from the **General** options. Notice the next message appearing on the bottom of the **ARC/INFO** window. If successful, the contents of file **rt_map.dat** are sent to your local printer. If an error message appears, consult your system administrator.

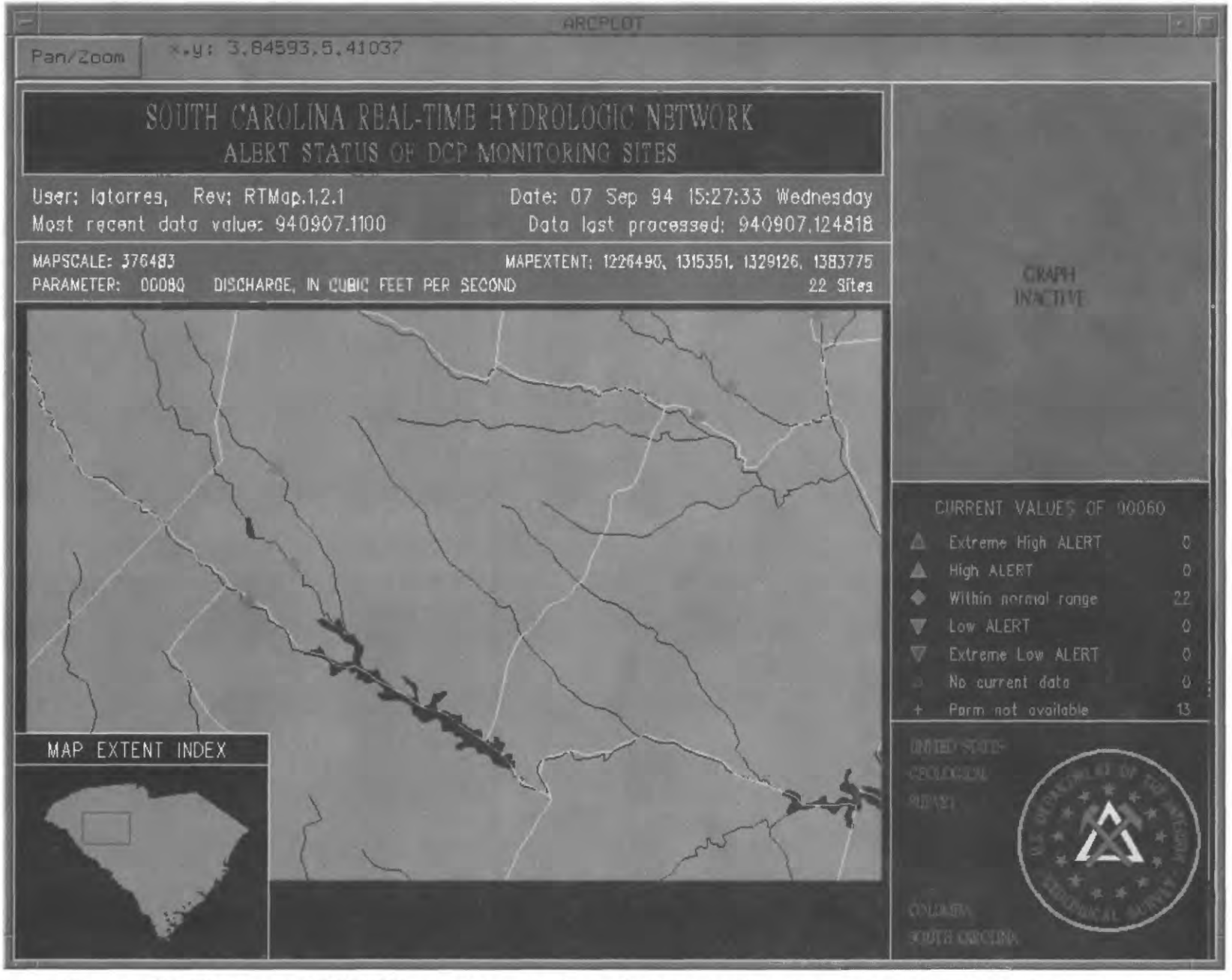


Figure 17. Redrawn ARCPLOT graphics window displaying sites monitoring a selected parameter.

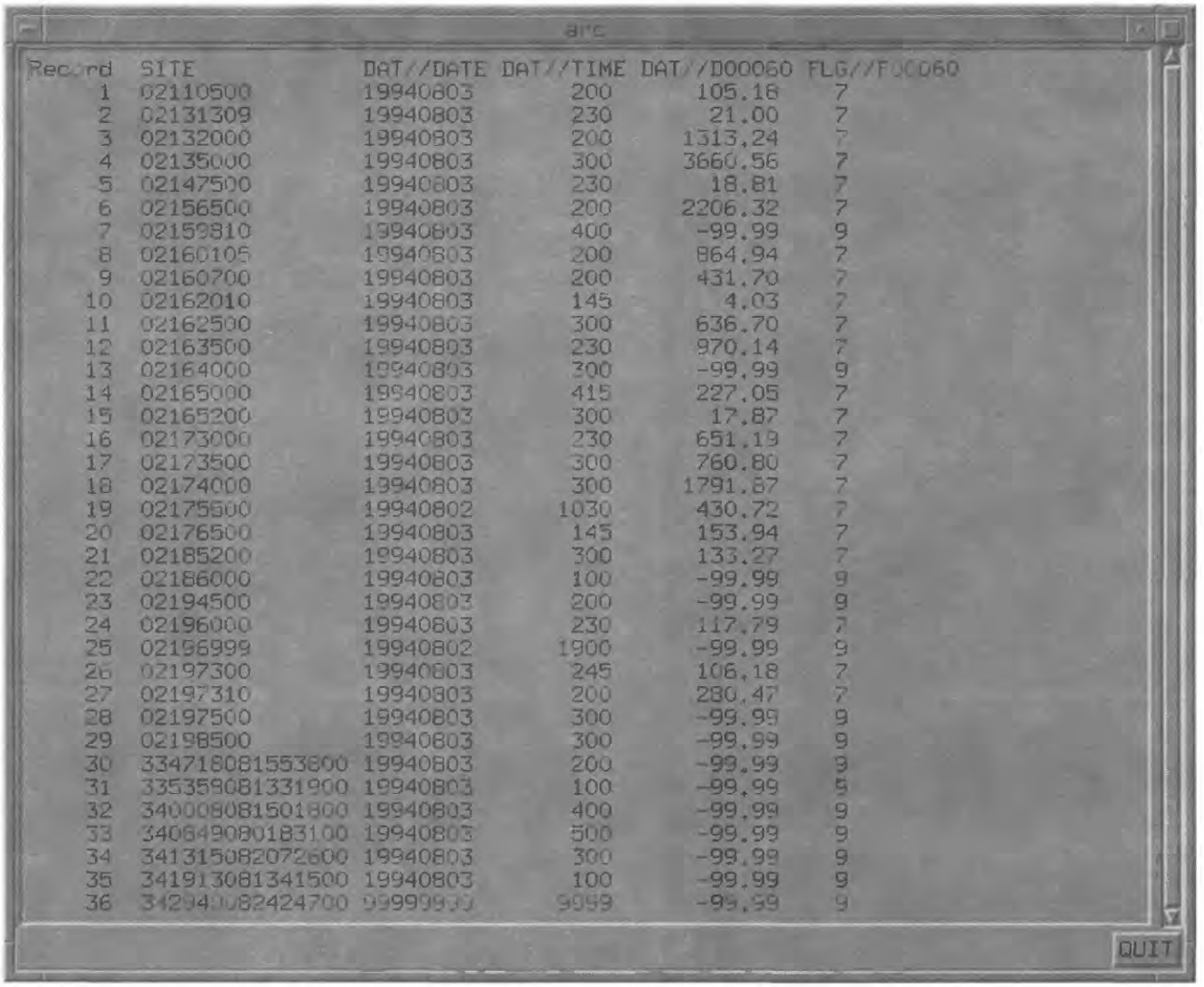


Figure 18. ARC/INFO window listing unit values.

Identifying Alert Monitoring Sites

13. To determine the names and locations of individual sites shown on the map, move the mouse cursor back into the **Real-Time Data Sub** window, and select **Identify sites** from the **Sites** options. Notice that the mouse cursor turns into a small clock symbol, and the message **Point to site: Enter point** appear on the bottom **ARC/INFO** window. This indicates that RTMAP is waiting for you to respond. Move the mouse cursor into the map area in the **ARCPLOT** window. Notice the perpendicular axes moving as the mouse cursor moves. The mouse cursor has become the intersection point. Move the intersection point to the center of any monitoring site icon, and press and release the mouse button. An **ARC/INFO** window will appear (fig. 19) displaying a table of data about the site. Notice that values -99.99 indicate no unit values are available for the specified time period. Move the mouse cursor to the **QUIT** field, and click to remove that window.

14. If the monitoring site icon being identified becomes distorted by the intersection point, move the mouse cursor into the **Real-Time Data Sub** window and click on **Draw sites** from the **Sites** options. The displayed icons and the symbols reference list are redrawn within the **ARCPLOT** window.

15. If desired, identify other sites displayed on the map by repeating the previous steps as many times as needed.

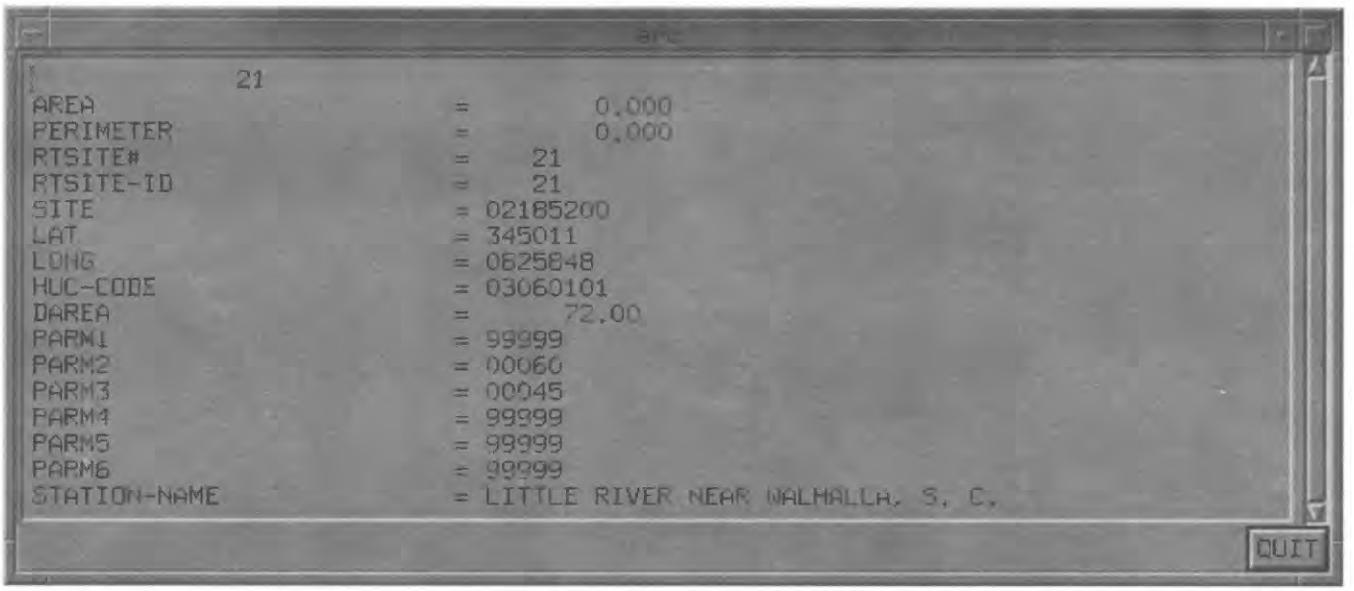


Figure 19. ARC/INFO window displaying Geographic Information System data about the selected site.

Selecting a Site by Station Number

16. To select a site by station number, move the mouse cursor back into the **Real-Time Data Sub** window. Click on **Select site & parm** from the **Sites** options. A **Popup** window appears similar to the example in figure 20. Move the mouse cursor to the methods listed in that window and click on **Site number**. The **Popup** window will disappear and another one similar to the example in figure 21 will appear. Notice the site numbers listed are USGS station identification numbers. Point the mouse cursor within the browsing band shown on the right of the displayed list. (To find and select a site, pinpoint the mouse cursor underneath the level indicator, press and release the mouse button, and watch the station numbers shifting upward. Pinpoint the mouse cursor over the level indicator, press and release the mouse button, and watch the station numbers shifting downward.) After browsing up and down, select a station number by moving the cursor to it, and click. The **Popup** window will disappear, and another small **Popup** window similar to the example in figure 22 will appear, listing the parameters that the selected monitoring site can provide. Select one of the listed parameters. The **Popup** window will disappear.

17. An **ARC/INFO** window appears, showing statistical data similar to the example in figure 23. Move the mouse cursor to the **QUIT** field, and click the mouse button. That window will disappear. Another **ARC/INFO** window appears showing statistical data covering up to 5 days similar to the example in figure 24. Move the mouse cursor to the **QUIT** field and click to remove that window.

Figure 20. Popup window listing additional methods for site search.

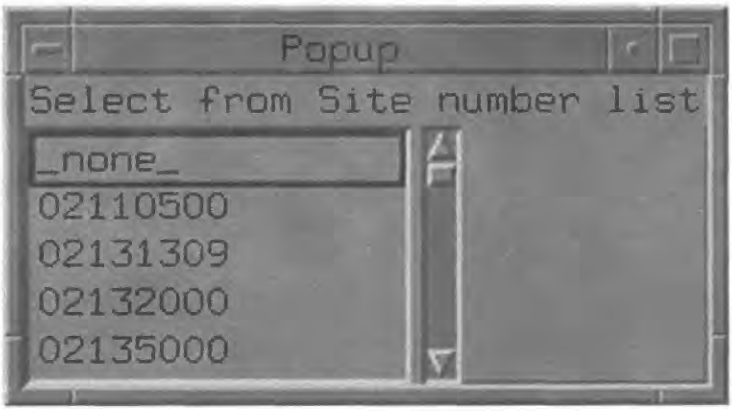


Figure 21. Popup window listing U.S. Geological Survey identification numbers to select.

Figure 22. Popup window listing parameters to select for a given site.

Figure 23. ARC/INFO window displaying statistical data from a selected site.

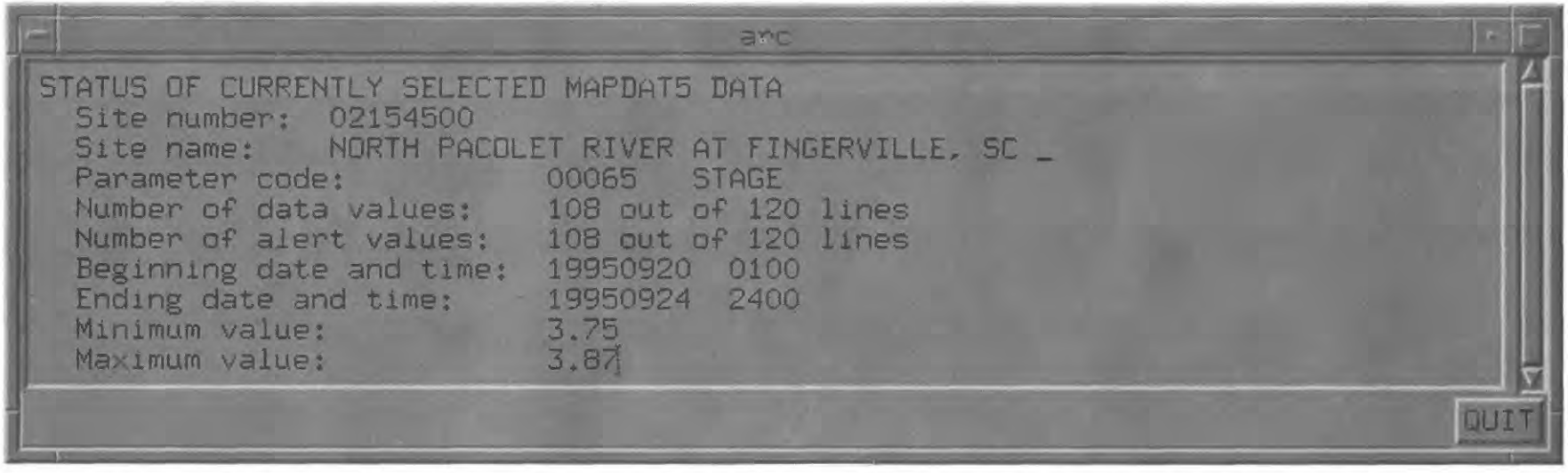


Figure 24. ARC/INFO window displaying statistical data covering up to 5 days for a selected station.

18. If you noticed that the station picked in step 15 had more than one parameter available, move the mouse cursor back to the **Real-Time Data Sub** window, click on **Select new parm** from the **Sites** options. Notice the windows described in step 17 apply here also. Repeat step 17and proceed to following step below.

Generating Time-Based Graphs

19. Move the mouse cursor back into the **Real-Time Data Sub** window. Select **Graph site & parm** from the **Sites** options. A window titled **RTData Time Series** similar to the example in figure 25 will appear. Notice the statistical data and site information still refers to the same monitoring site selected in steps above.

20. Move the cursor into the **RTData Time Series** window. Click on the squares under **Graph Characteristics** to select or deselect the available options. Click on **Log** axis when examining logarithmic data such as water discharge. Click on **Linear** axis when examining other non-logarithmic data such as precipitation, lake elevation from sea level, or river stage. Move the mouse cursor to the **OK, make graph** option. Notice the mouse cursor becomes a clock symbol while RTMAP plots the graph. Notice also the message **Plotting... Please wait until menu clears...** appearing on the bottom of the **Arc** window. When plotting is done, the **RTData Time Series** window will disappear and the **ARCPLOT** window should look similar to the example in figure 26.

21. Move the mouse cursor back into the **Real-Time Data Sub** window. Click on **Graph site & parm** from the **Sites** options. The **RTData Time Series** window similar to the example in figure 25 will reappear. Notice the statistical data and site information still refer to the same monitoring site selected in previous steps.

Selecting a Site by Name

22. To select a site by name, move the mouse cursor back into the **Real-Time Data Sub** window. Click on **Select site & parm** from the **Sites** options. A **Popup** window appears similar to the example in figure 20. Move the mouse cursor to the methods listed in that window and click on **Site name**. The **Popup** window will disappear and another one similar to the example in figure 27 will appear. With the exception of monitoring sites being selected by name instead of by USGS station number, steps for identifying sites and plotting data are the same as in steps 15 through 20. Selecting Sites and Parameters by Point-and-Click

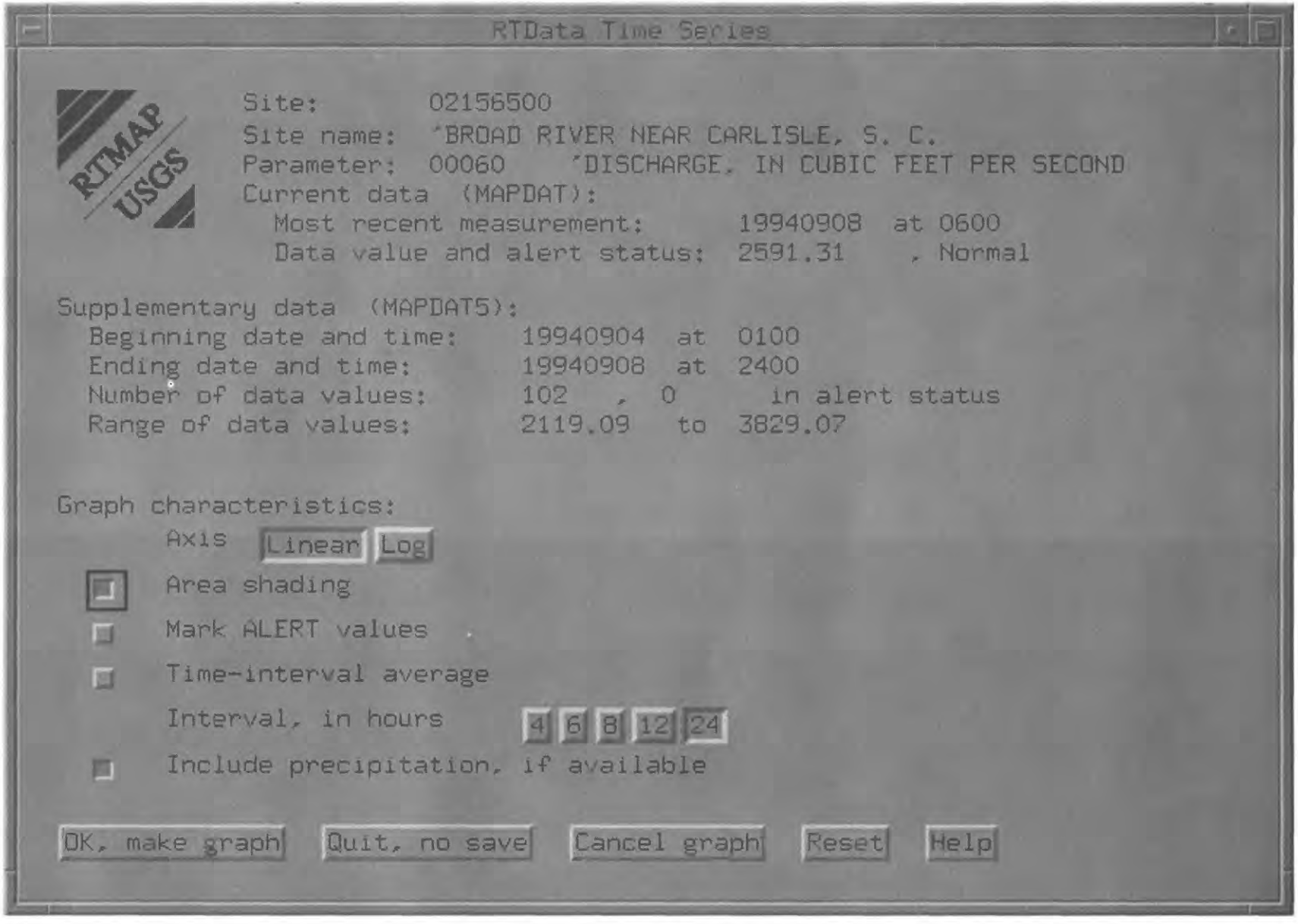


Figure 25. RTData Time Series window displaying statistical data and site information.

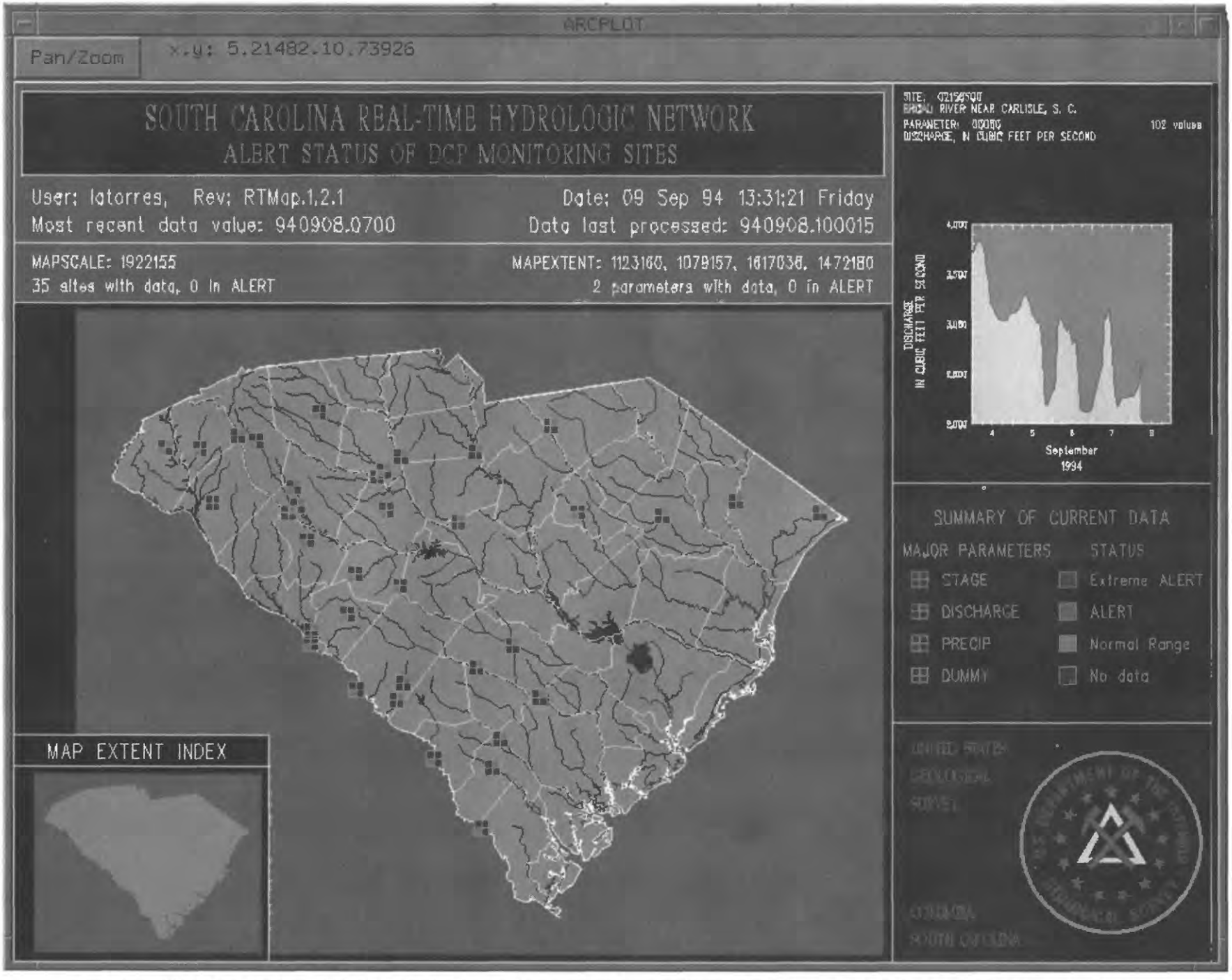


Figure 26. Redrawn ARCPLOT window after selecting options from the RTData Time Series window.

Figure 27. Popup window listing names of monitoring sites to select.

Selecting Sites and Parameters by Point-and-Click

23. To select sites and parameters by point-and-click, move the mouse cursor back into the **Real-Time Data Sub** window. Click on **Select site & parm** from the **Sites** options. A **Popup** window appears similar to the example in figure 20. Move the mouse cursor to the methods listed in that window and click on **Point-n-click**. Notice the mouse cursor turns into a clock symbol, signaling RTMAP is waiting for you to respond, and that the message **Point to the site (1 to Select, any other key to Quit)...** appears on the bottom of the **ARC/INFO** window. Move the mouse cursor into the map area in the **ARCPLOT** window. Notice the perpendicular axes moving as the mouse cursor moves. The mouse cursor is at the point where both axes intersect. Move the intersection point to any monitoring site icon, and press and release the mouse button. An **ARC/INFO** window similar to the example in figure 28 will appear. Move the mouse cursor to that window and select **OK, Continue** option. Notice that the steps for identifying sites and plotting data are the same as in steps 15 through 20.

24. To remove the window, move the mouse cursor back into the **Real-Time Data Sub** window. Click on the **Close this menu** option.

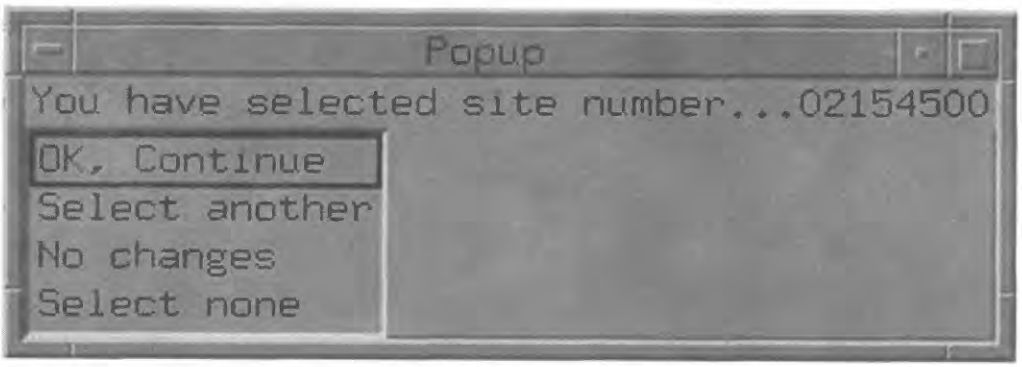


Figure 28. Popup window indentifying the monitoring site selected.

Changing User Defaults

24. To change user defaults, move the mouse cursor back into the **RTMap Main Menu** window. Click on the **User Defaults** option. A **User Defaults SubMenu** window will appear (fig. 29).

25. Move the cursor into the **User Defaults SubMenu** window. Click on the button indicator located left of each option under **Data Display**. Button indicators enable you to select or deselect the available map coverages to be displayed (for example, counties, streams, highways, railroads). Pushed-in buttons indicate selected options. Pushed-out buttons indicate deselected options. Notice that if you click on the **OK save** option, the selected and deselected map coverage options will be saved and used the next time RTMAP is restarted. The contrary will happen if you click on the **Quit, no save** option. If you click on **Reset**, the button indicators will return to default settings. Click on either **OK save**, or **Quit, no save** option at this time. The **User Defaults SubMenu** window must disappear.

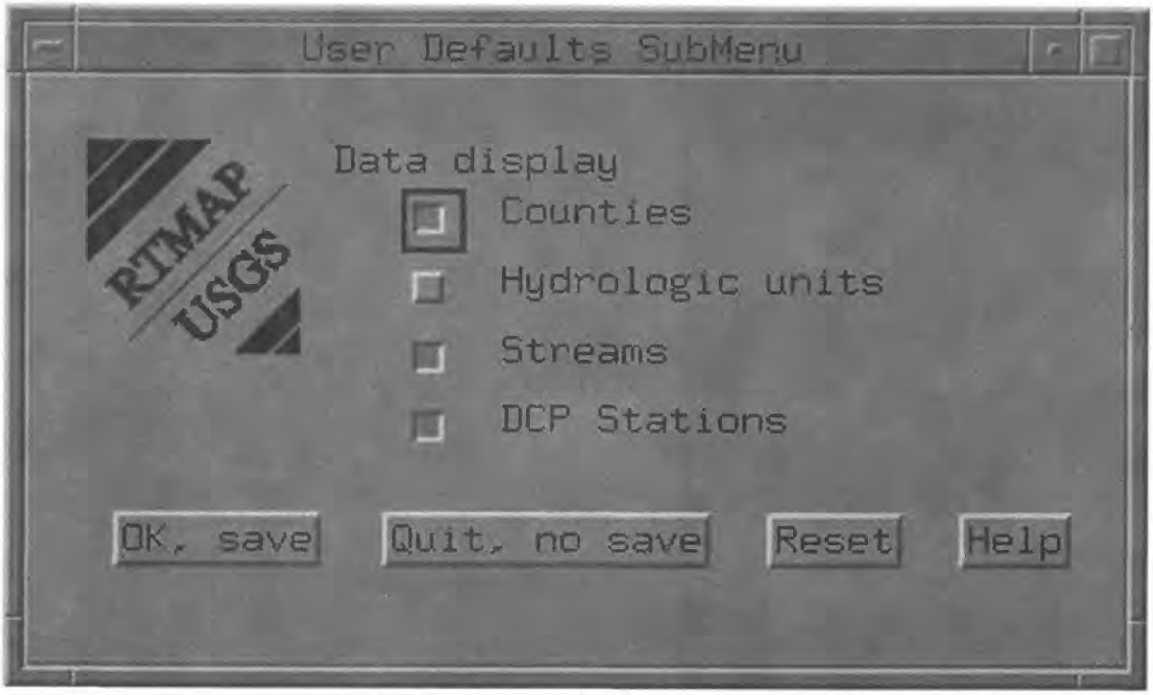


Figure 29. User Defaults SubMenu window listing map coverage options.

26. To redraw the map with different defaults, move the mouse cursor back into the **RTMap Main Menu** window. Click on **Current Settings** from **Refresh Page** options. RTMAP will redraw the **ARCPLOT** window according to the **Data Display** options selected above. If desired, click on **Default Settings** from **Refresh Page** options. The RTMAP software redraws the entire map according to the new default settings, similar to the example in figure 9. Notice that some map features previously shown were removed and that new features are displayed.

    NOTE: Steps 27 through 40 are optional and detail how to generate and save plotfiles of the displayed map only, the displayed graph only, or the entire page within the **ARCPLOT** window. Options for generating postscript files for printing are included as well. If desired, skip to step 42. Otherwise continue with step 27.

Plotting Maps and Graphs through the Postscript Laser Printer

27. Move the mouse cursor back into the **RTMap Main Menu** window. Click on the **Save to Plotfile** option. A window titled **Plotfile SubMenu** will appear (fig. 30).

28. Move the mouse cursor into the **Plotfile SubMenu** window. Click on **Entire-Page** from **Type of plotfile output** options.

29. Click on **Convert plots to Postscript** from **Printing options.**

30. Print the plotfile output selected by clicking on **Save to plotfile**. The type of plotfile selected (either **Map, Graph** or **Entire page)** is generated and sent to your local laser postscript printer for output. Notice the mouse cursor becomes a clock symbol while postscript printing is in progress. Notice also the ARC/INFO and ARCPLOT messages displayed on the bottom of the **ARC/INFO** window, similar to the example in figure 31.

31. Repeat steps 28 through 30, but click on **Graph** from **Type of plotfile output** options at this time.

32. Repeat steps 28 through 30, but click on **Map** from **Type of plotfile output** options at this time.

Saving Maps and Graphs into Plotfiles

33. With the mouse cursor still within the **Plotfile SubMenu** window, click on **Save Map** from **Save to Map Composition** options. A **Response** window will appear (fig. 32). Enter a name as requested, then click on the **OK** field.

    NOTE: Provided the default selections in the **Plotfile Submenu** window were not changed, RTMAP will not create a file, but a directory carrying the name entered at the **Response** window. Notice that under such directory, a series of plotfiles similar to the example in figure 33 are stored. The same applies to graph compositions specified in the next step below. These directories are treated as coverages by the ARC/INFO software, and can be used by GIS personnel for detailed scientific analysis and the research and development of more coverages.

34. With the mouse cursor still within the **Plotfile SubMenu** window, click on **Save Graph** from **Save to Map Composition** options. A **Response** window will appear (fig. 34). Enter a name as requested. Then click on the **OK** field.

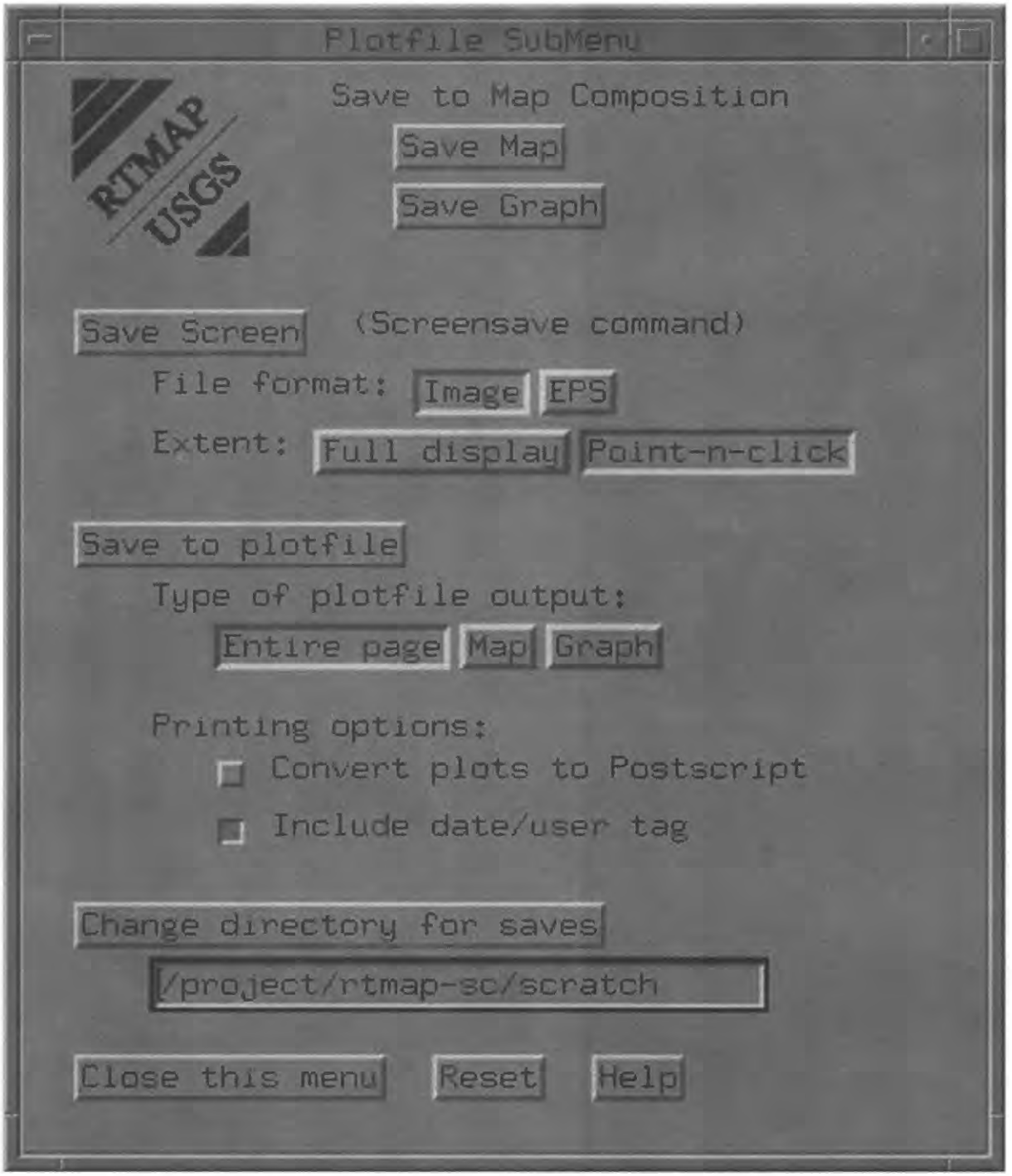


Figure 30. Plotfile SubMenu window listing plot storage options.

Figure 31. Window displaying ARC/INFO and ARCPLOT messages.

Figure 32. Response window requesting a filename for the map composition to be saved.

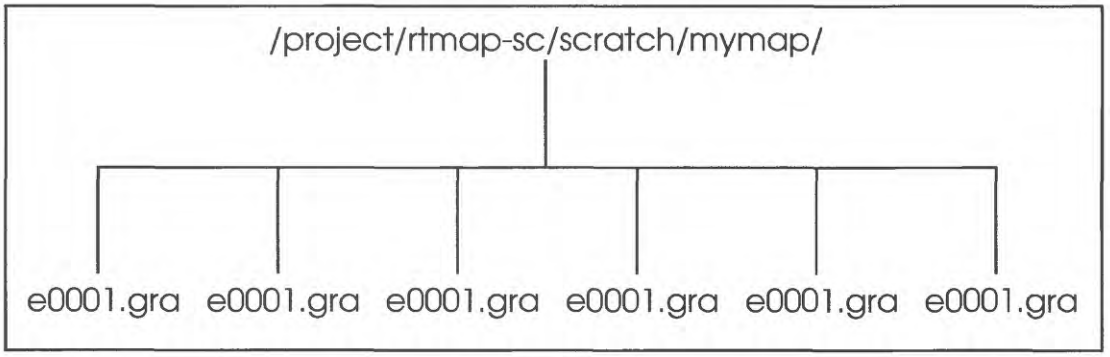


Figure 33. Structure of the composition file "mymap", as stored by the Real-Time Mapping software.

Figure 34. Response window requesting a filename for the screen graphics to be saved.

35. Notice the options under **Save Screen (Screensave command)**. They are listed below.

    a) **File format: [Image] [EPS]**

    b) **Extent: [Full display] [Point-n-click]**

36. Click on the **Image** option. The quadrangle surrounding **Image** will appear as a pushed-in button. Then click on the **Save Screen** option. A **Response** window will appear (fig. 34). Enter the file name requested, and **click** on the **OK** field. The window will disappear.

    NOTE: The **Image** file format option enables the user to save the contents of the **ARCPLOT** window in a raster image format. Notice that when using the **Save Screen** option, a screen display to be saved in **Image** format is stored in two files; one contains binary data representing the screen display itself (that is, **myimage**), the other contains area coordinates needed by the ARC/INFO software in order to properly redisplay the image (for example, **myimagew**). This file is known as the **world** file.

37. Click on the **EPS** option. The quadrangle surrounding **EPS** will appear as a pushed-in button. Then **click** on the **Save Screen** option. A **Response** window will appear (fig. 34). Enter the file name requested, and **click** on the **OK** field. The window will disappear.

    NOTE: The **EPS** file format enables the user to save the contents of the **ARCPLOT** window in an encapsulated postscript format developed by the Adobe Corporation. A screen display saved in **EPS** format requires only one file (that is, **myplot**). This is contrary to saving a screen display in **Image** format, which requires two files.

38. Click on the **Full display** option. The quadrangle surrounding **Full display** will seem like a pushed-in button. Then click on the **Save Screen** option. A **Response** window will appear (fig. 34). Enter the file name requested, and click on the **OK** field. The window will disappear.

    NOTE: Depending on the selected file format (as specified on steps 36 and 37), the entire contents of the **ARCPLOT** window are saved.

39. Click on the **Point-n-click**. The quadrangle surrounding **Point-n-click** will appear as a pushed-in button. Click on the **Save Screen** option and do as follows:

    a) A **Response** window will appear (fig. 34). Enter the file name requested and click on the **OK** field. The window will disappear.

b) Move the mouse cursor into the map area in the **ARCPLOT** window. Notice the perpendicular axes moving as the mouse cursor moves. The mouse cursor is at the point where both axes intersect.

c) Determine a quadrangular area of interest within the displayed map. Select a point of origin by pressing and releasing the mouse button. Then move the mouse cursor opposite the origin (for example, from northeast to southwest). Notice the quadrangular perimeter being formed. See the example in figure 12. Press and release the mouse button again. Depending on the selected file format (as specified on steps 36 and 37), the contents within the quadrangular area of the **ARCPLOT** window are saved.

40. Move the mouse cursor back into the **Plotfile SubMenu** window. Click on the **Close this menu** option and the window will disappear.

Ending the Real-Time Mapping Software

41. Move the mouse cursor back into the **RTMap Main Menu** window. You have completed a basic interactive session with RTMAP. To examine other options, please refer to the **Additional Real-Time Mapping Windows** section in this report. When done, click on the **Quit RTMap** option. Except for the **ARC/INFO** window, all windows generated by RTMAP will disappear. Notice the prompt message, **Delete default map compositions from session?** showing on the bottom of the **ARC/INFO** window. Enter **yes**. The RTMAP software terminates, and the **Arc:** prompt reappears.

42. At the **Arc:** prompt, enter **quit** to exit from the ARC/INFO software.

G. When done, **log off** the UNIX-based workstation.

Additional Real-Time Mapping Windows

Steps for using additional RTMAP window options previously were not discussed, because most are designed for computer specialists, system administrators, and ARC/INFO users specializing in GIS. A brief explanation of these options are provided below.

On the **RTMap Main Menu** window options (fig. 10), notice the three options located on the lower right are listed as follows:

1. **Arcplot command**, to manually enter an ARCPLOT command.

2. **Arc command**, to manually enter an ARC command.

3. **System command**, to manually enter a UNIX Operating System command.

When selecting one of the three options listed above, the user is able to enter commands not included in the RTMAP menus. For example, to change the line color of the county boundaries, the user could click on **Arcplot command** and then enter the appropriate ARCPLOT syntax to change the line color. To change the value of an AML variable, the user could click on **Arc command** and then enter the appropriate ARC/INFO syntax. To run the file transfer protocol (FTP) program, the user could click on the **System command** and enter, for example, **ftp dsccmb.er.usgs.gov**. A **Response** window for each one of the three options is used; although only one command at a time can be entered.

However, if the command happens to be an AML program, all commands within that program plus any nested sub-commands will be executed. To execute the command, click on the **OK** field. To look at the result of the command just entered, always refer to the **ARC/INFO** window that displays the status of AML statements being executed (usually hidden behind the **ARCPLOT** window). When executing commands that require user interaction, RTMAP will remain in waiting mode (with the mouse cursor turning into a clock symbol when moved into the **RTMap Main Menu window**) until the entered command has been completely executed. If running an interactive UNIX command, such as **telnet**, or **ftp**, follow the proper login and logout procedures. If running an application (such as a Fortran program), make sure it completes its task, so that RTMAP regains control.

The **Documentation** option in the **RTMap Main Menu** window displays a **Doc SubMenu** window (fig. 35). Each option listed under **Real-Time Data, Main programs**, and **System Info** displays explanation windows similar to the example in figure 36. You may print a copy of these explanation files by clicking on the **Print an explanation** option. You can also click on **Print the title page**, which displays the same introductory popup window that appears when running RTMAP (fig. 8). Notice the **AP command** option. It is useful when entering help requests on ARCPLOT commands. Click on **Close this menu** and the **Doc SubMenu** window will disappear.

On the **RTMap Main Menu** window options (fig. 10), notice the three supplementary options located on the upper center are listed as follows:

1. **Coverages**
2. **Symbols**
3. **Paint**

The **Coverages** option displays a **Coverages Submenu** window (fig. 37). The **Symbols** option displays a **Symbols SubMenu** window (fig. 38). The **Paint** option displays a **Paint SubMenu** window (fig. 39). Each of these windows contain ARC/INFO command options familiar to GIS specialists. General computer users do not need to use these supplementary options.

Figure 35. Doc SubMenu window listing available documentation on the Real-Time Mapping software in the UNIX-based workstation.

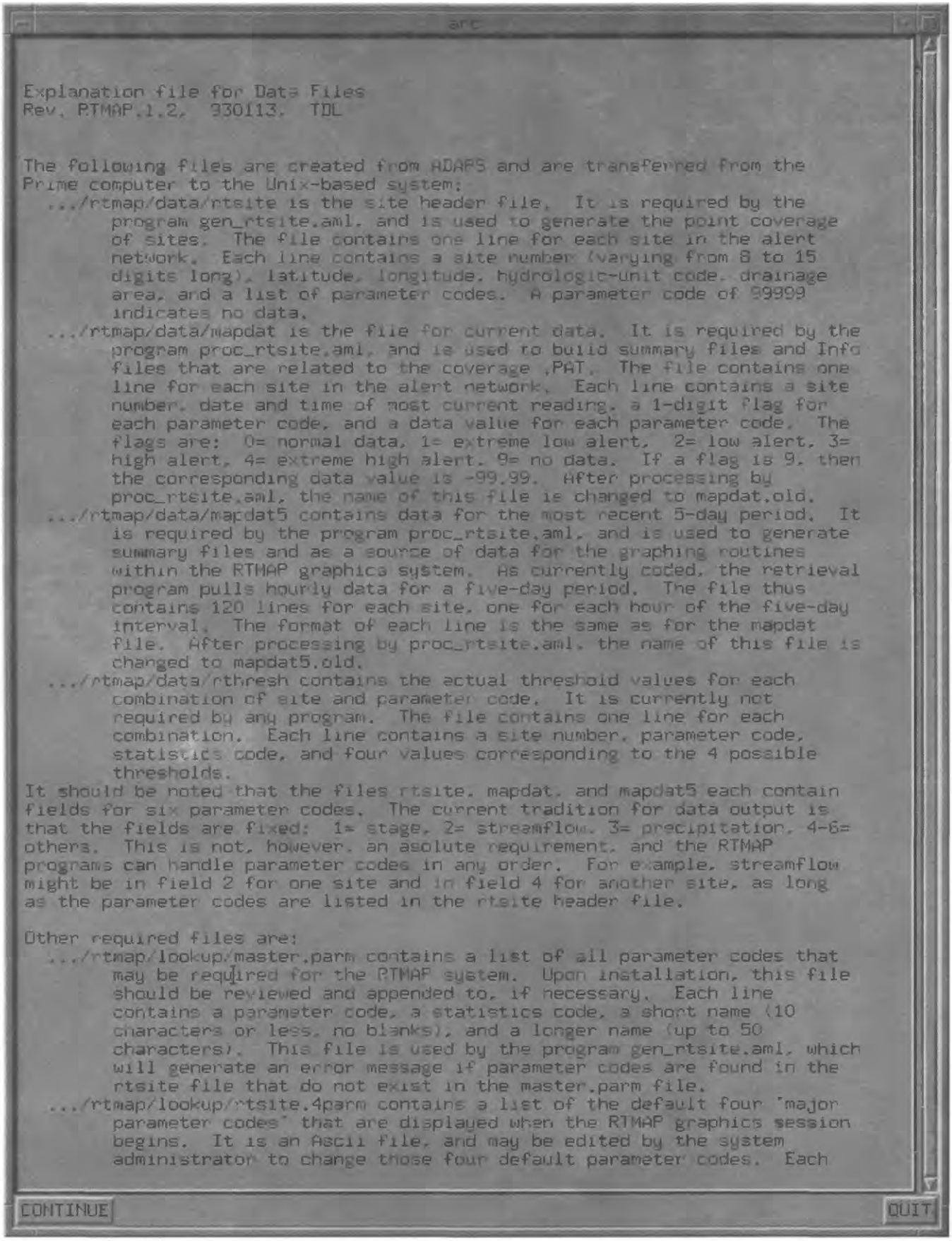


Figure 36. Text window generated when clicking on an option in the Doc SubMenu window.

Figure 37. Coverages SubMenu window listing ARC/INFO options.

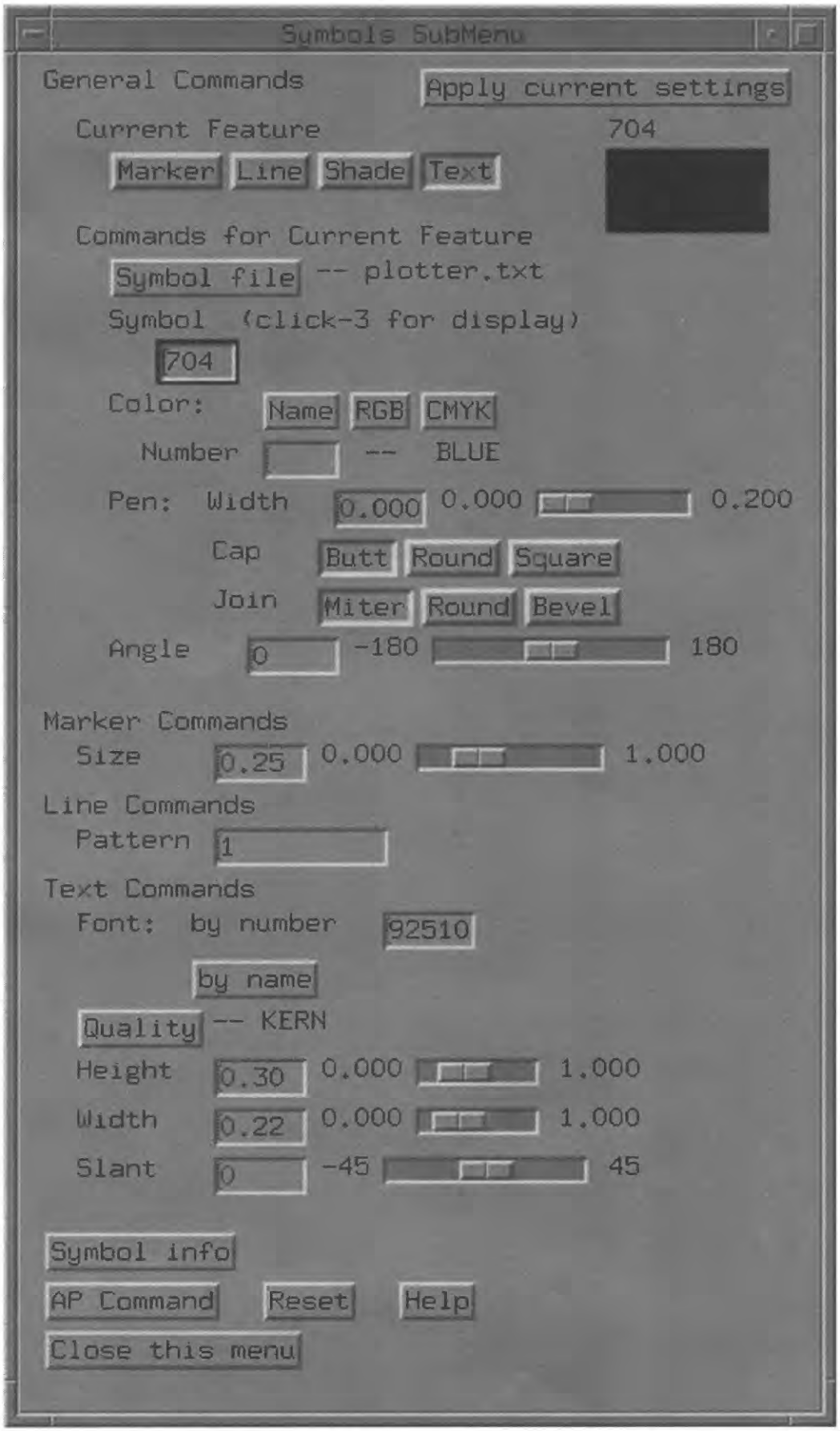


Figure 38. Symbols SubMenu window listing ARC/INFO options.

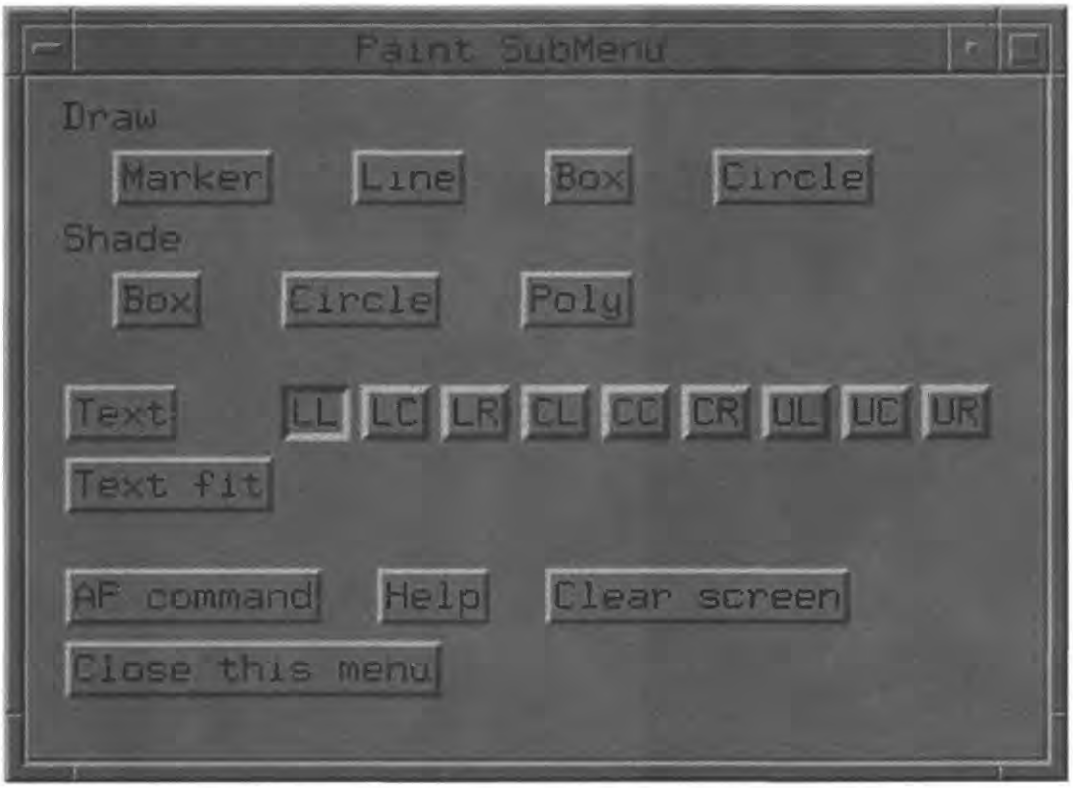


Figure 39. Paint SubMenu window listing ARC/INFO options.

SUMMARY

The Real-Time Mapping (RTMAP) software is a series of computer programs developed as a management tool, designed to display information on hydrologic events monitored by an alert network. The hydrologic data come from sites equipped with electronic data collection platforms, are transmitted by satellite to receiving ground stations, and are sent to a two-component computer system where the RTMAP software resides. The first component of this computer system retrieves real-time data at regular intervals. The second component processes the retrieved data, and provides an interactive graphics display of hydrologic data in a map-based and menu-driven environment. Monitoring sites are identified on a state or regional map and highlighted according to their alert status. The displayed maps and graphs can also be printed. The RTMAP software is written in CPL, Prime Fortran 77, AML, Green Hills Fortran-88000. It provides users with a wide range of options for display, query, and output of hydrologic data.

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