Chapter 3

Creating and Managing Watersheds

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Chapter 3

Creating and Managing Watersheds

A watershed is a data set associated with a geographic region for which you may have configured multiple models and area coverages. A watershed may include all of the streams, projects (reservoir, levees, etc.), gage locations, impact areas, time-series locations, and hydrologic and hydraulic data for a specific area. All of these details together, once configured, form a watershed data set.

In the **Watershed Setup Module**, you will set up your watershed's *physical* arrangement including: background maps, the Stream Alignment, geo-extents, projects, and other geo-referenced data.

You define **Configurations** when you initially create a watershed. This should enable modelers to develop data explicitly for a specific configuration and reduce the possibility that incompatible model data sets will be used for multiple program applications (e.g., HEC-ResSim and HEC-FIA).

You can also use the Watershed Setup Module to define Projects and Computation Points associated with specific configurations in your watershed. Projects can include Reservoirs, Levees, Diversions, Channel Modifications, Off-Channel Storage Areas, and "Other" Projects. Computation Points are locations where time-series information is exchanged between models (e.g. ResSim and FIA).

3.1 Recognizing Watershed Setup Screen Components

The Watershed Setup Module provides tools for setting up your watershed's *physical* arrangement, including maps, the Stream Alignment, geo-extents, projects, and other geo-referenced data. Figure 3.1 shows the components of the Watershed Setup Module main window. Tools unique to this module are described in the following sections.

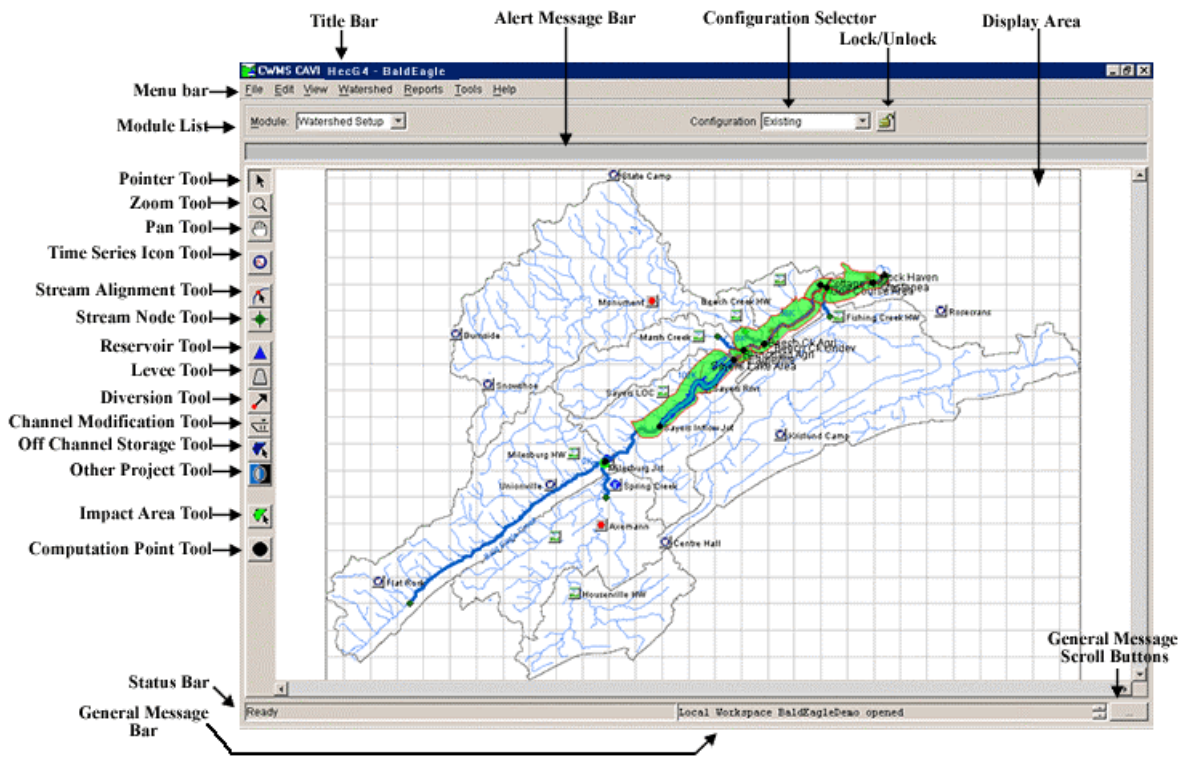

Figure 3.1 Watershed Setup Module Main Window

3.1.1 Menu Bar

The following is an overview of menus unique to the **Watershed Setup** Module. These tools will be described in more detail in the context of specific tasks later in this chapter.

Refer to Chapter 2 for information about the **View**, **Tools,** and **Help** menus, which are common to all three modules.

The **File** menu (Figure 3.2) allows you to create a **New** watershed, **Open** an existing watershed, **Save** a watershed, **Save Map** (saves the display area) and **Exit** ResSim. Your most-recently-used watersheds are located at the bottom of the File menu.

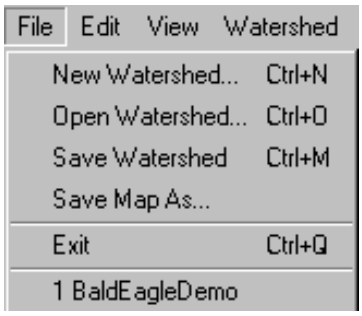

Figure 3.2 File Menu

Use the **Edit** menu (Figure 3.3) to access the following editors in the Watershed Setup Module: the **Watershed Data Editor**, **All Impact Areas Editor**, **Projects Editor**, and **Drawing Properties Editor**. You must select **Allow Editing** if you wish to make changes to your watershed (or toggle the Lock above the display area).

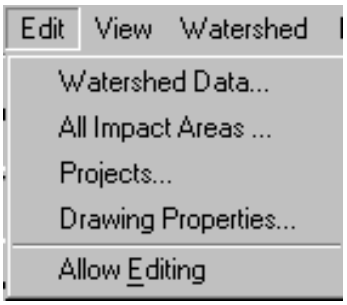

Figure 3.3 Edit Menu

Using the **Watershed** menu (Figure 3.4), you can create and edit **Configurations**, **Update Computation Points**, **Import** and **Export** Stream Alignments, and Impact Areas, and **Save Configurations**.

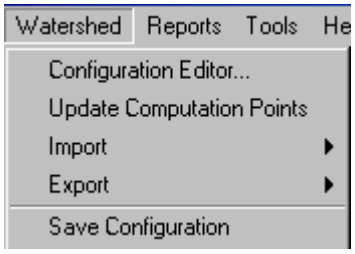

Figure 3.4 Watershed Menu

The **Reports** menu (Figure 3.5) gives you access to reports for your watershed. Reports include the **List of Streams**, **List of Impact Areas**, **List of All Configurations**, **List of Computation Points**, and **Projects** listings by project type.

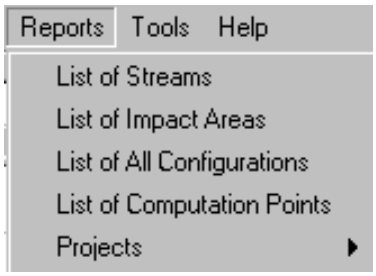

Figure 3.5 Reports Menu

3.1.2 Configuration Selector and Lock/Unlock

When you add a schematic element to the map display, you must choose its Configuration using the Configuration Selector. The default Configuration, Study, contains the entire set of all projects and Computation Points defined in the watershed. You can also associate projects with custom configurations.

Before you can add, remove, or edit schematic elements in your watershed, you must lock the Configuration by clicking on the symbol to the right of the Configuration Selector. When the

Configuration is locked, the symbol appears. If the Configuration is unlocked, the symbol appears.

3.1.3 Map (Mouse) Tools

In the Watershed Setup Module, Map (Mouse) Tools allow you to access and configure objects within your watershed. Project Tools help you to create and edit the various project types. After you have created a project, ResSim adds it to the active Configuration. The following are descriptions of the available tools:

Pointer Tool
Right-click with the Pointer Tool to select and access a shortcut menu for any schematic element in the watershed map display.

Zoom Tool
Use the Zoom Tool to zoom in and out of the display area. To zoom in, hold the left mouse button down and outline the area you want to zoom in on. To zoom out, right-click in the display area.

Pan Tool
Use the Pan Tool to move the display area while you are zoomed in.

Time-Series Icon Tool
Use the Time-Series Icon tools to create, delete, and rename time-series icons that are used for plotting and tabulating time-series data. To create, select the **Time-Series Icon Tool**, hold down the **CTRL** key and click. To access the available commands, select the **Time-Series Icon Tool**, right-click on a time-series icon, and the commands are available from the shortcut menu.

Stream Alignment Tool
Use the Stream Alignment Tool to draw the multi-segmented lines that comprise a Stream Alignment representing river systems in the map display.

Stream Node Tool
The Stream Node Tool allows you to create and edit stream nodes and junctions, two of the primary components of a Stream Alignment.

Reservoir Tool
Use the Reservoir Tool to select and add reservoir projects to the map display and access editors for reservoirs.

Levee Tool
Use the Levee Tool to select and add levee projects to the map display panel and access editors for levees. In the Watershed Setup Module, only the name and description can be edited.

Diversion Tool
Use the Diversion Tool to select and add diversions to the map display and access editors for Diversions.

Channel Modification Tool
Use the Channel Modification Tool to select and add channel modifications (such as channel straightening, concrete walls, dredging, and widening) to the map display and access editors for Diversions.

Off Channel Storage Tool
Use the Off-Channel Storage Areas Tool to select and create Off-Channel Storage Area polygons in the map display and edit their properties.

"Other" Project Tool
Use the "Other" Projects Tool to place icons representing "other" projects, such as pump stations and gages, etc., and edit their properties.

Impact Area Tool
Use the Impact Area Tool to create and edit impact areas representing regions in the watershed where flood damages will be evaluated.

Computation Point Tool
Use the Computation Point Tool to create and edit Computation Points. Computation Points are locations in the watershed where individual models will share information. Typically one model will produce results at a Computation Point that another model will use as input.

3.2 Using Shortcut Menus

Shortcut menu commands vary according to the schematic elements with which they are associated. Figure 3.6 shows the shortcut menu for a reservoir named "Sayers".

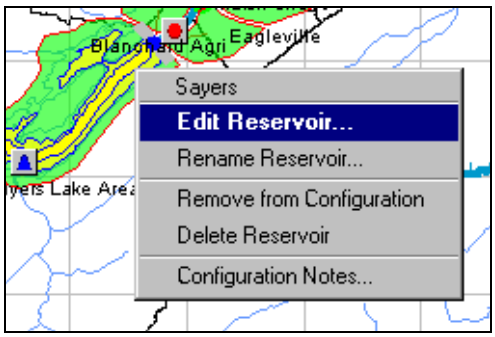

Figure 3.6 Reservoir Shortcut Menu

If your watershed is locked, the shortcut menu will allow you to edit, rename, and delete the object (depending on the object type), as well as view its properties. If your watershed is unlocked, some of the options will be unavailable.

3.3 Watershed Creation

The first thing you must do to create a new watershed is to specify its directory location, give it a name and description, and establish the Units of Measure and Time Zone. Once you have created your new watershed, ResSim generates a new directory hierarchy in the "base" working directory. Your new watershed becomes active in the main window and the tools needed to create the watershed data become available. At this point you may continue to configure the new watershed by adding layers and schematic elements, setting preferences for the map display, etc., as described later in this chapter.

3.3.1 Defining a Watershed Location

A **Watershed Location** is your working directory--the place on disk where you create and edit your watershed data. You can have multiple watershed locations, although an individual watershed cannot span multiple locations. Each watershed location should have a logical name, such as *CWMS* or *General Projects*.

Before you can create or open a watershed, you must define at least one watershed location. To define a Watershed Location:

1. From the **Tools** menu, select **Options**. The **HEC-ResSim Options** dialog box (Figure 3.7) will open.

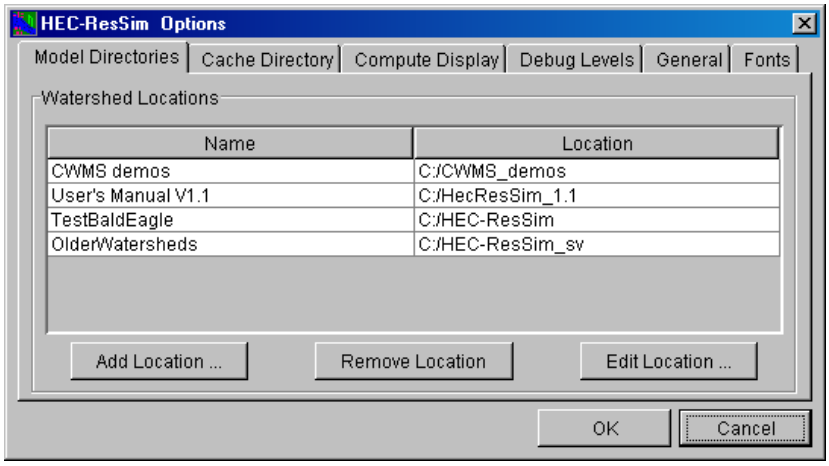

Figure 3.7 HEC-ResSim Options Dialog Box

2. Select the **Model Directories** tab. The **Name** and **Location** of any watershed locations you have previously defined will display in the list.
3. To add a new location to the list, click the **Add Location**…button. The **Add Watershed Location** dialog box will open (Figure 3.8).

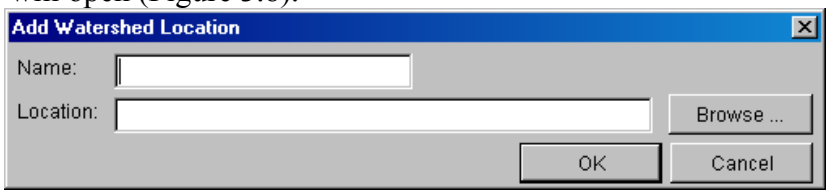

Figure 3.8 Add Watershed Location Dialog Box

4. Enter a logical **Name** for the new location, then click the **Browse…** button to select the area on disk where you want to build your watershed. This directory is the "holder" of the "base" directory and the "base" directory is the "holder" of your watershed. In other words, the Watershed Location contains a directory named **base**, which contains the directory(s) for your watershed(s).
5. Click **OK** to close the Add Watershed Location dialog box.

The new location will now appear in the list of watershed locations on the **Model Directories** tab.

Refer to Appendix A for information about other options available in the **Options** dialog box.

3.3.2 Creating a New Watershed

Once you have established the working directory, you can create a new watershed.

To create a new watershed:

1. Select **New Watershed** from the **File** menu. The **Create New Watershed** dialog box (Figure 3.9) opens.

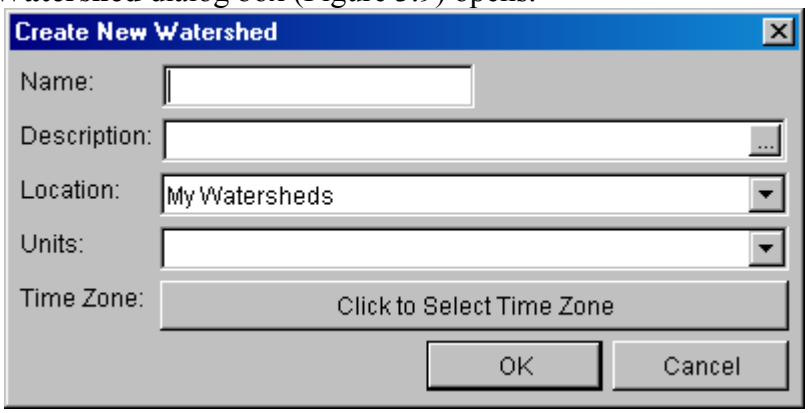

Figure 3.9 Create New Watershed Dialog Box

2. Type a **Name** for the new watershed. The watershed name must be less than 32 characters and cannot contain any of the following characters: | / : * ? ” < > - \ .
3. Type a **Description** for the new watershed that clearly explains what it is.
4. Select a **Location** (working directory) for the new watershed's directory from your list of available locations.
5. Specify either **English** (U.S. customary units) or **SI** (System International) as the **Units of Measure**. You will not be able to change this after you click **OK** (see Specifying Units of Measure, below, for more information).
6. Specify the **Time Zone** of the new watershed by selecting from the list of standard time zones. Note that the *watershed* Time Zone does not recognize Daylight Savings Time (see Section 3.3.4, Specifying Time Zone, for more information).
7. Click **OK** to close the Create New Watershed dialog box.

3.3.3 Specifying Units of Measure

All modeling data, time-series data, geometric and reservoir information, model parameters, and flow-, elevation- and stage-time-series data must use the same unit system when saved. Therefore, it is crucial that you specify either **English** or **SI** as the Units of Measure for your watershed when you set it up. NOTE: You *cannot change the watershed units of measure* once the watershed setup is complete, but you can at any time customize the *display of data* using the **View** menu.

3.3.4 Specifying Time Zone

When a new watershed is created, the user must select the appropriate time zone for the watershed. This typically would be the time zone for the outlet or major portion of the watershed. Internally, ResSim will store all time-series data using the fixed "standard time offset from GMT" for the selected watershed time zone. Thus, internally, the data will be held in standard time only.

*You **cannot change the Watershed Units of Measure or the Time Zone** once the watershed setup is complete.*

3.4 Setting Up New Map Layers

Layers in ResSim are like transparencies laid one on top of the other, with static physical images such as roads, county and state boundaries, rivers, subbasins, etc., layered in the display as color pictures. Each of these images, along with its associated data, is a map layer. Access to the Layers Selector is available from the **View** menu. Refer to Chapter 4 for a more detailed description of Map Layers.

3.4.1 Importing Maps into ResSim

The background maps you will use in your watershed will come from sources outside of ResSim. To import a map file for use in your watershed, copy the appropriate map files to the "maps" directory of your watershed (see Appendix A for information about the ResSim directory structure). ResSim does not perform coordinate transformation for background maps. Therefore, all of the map layers you use in a watershed should be referenced to the same coordinate system (see Appendix B for more information on coordinate systems). Table 3.1 shows the file formats ResSim supports and each format is described in the paragraphs that follow. Appendix C describes how to access the map editors for configuring each type of map format.

Table 3.1 Map Layer Formats Supported by ResSim

Description	Common **File** Name **Extension**
ArcView® Shapefile	.shp
AutoCAD® DXF	.dxf
Raster image	.img, .gif, .jpg
USGS* Digital Line Graph	.dlg
USGS* Digital Elevation Model	.dem
ASCII NET TIN	.net
ArcInfo® DEM	.asc
*US Geological Survey	

Arc Shapefiles (.shp)
This layer type is the native data structure for the ArcView® GIS program. Shapefiles store non-topological geometry and attribute information for the spatial features of a data set. Usually there are three files: *.dbf, *.shp, and *.shx. The .shp file contains the shapes (point, polylines, or polygons) that display in the layer. Each shape has a record in the .dbf file containing descriptive data called "attributes." The .shx file contains an index that links each shape to its record in the .dbf file.

AutoCAD® DXF (.dxf)
A Drawing Interchange file (.dxf) is created by a Computer-Aided Design (CAD) package, AutoCAD®. This format is a tagged data representation of an AutoCad® drawing file. In tagged data, a group code precedes each data element. A group code is an integer number indicating the type of data element. The file created is a vector-based graphic. The DXF format is commonly used for data exported from other CAD and GIS programs.

Raster Image
ResSim supports JPEG (.jpg) and Graphics Interchange (.gif) raster image formats. Before ResSim can access these file types, you must first create an .img (ASCII text) file containing the following lines:

```
Image West=2051443.
Image North=355443.
Image East=2054925.6
Image South=351947.4
```

These are image boundaries that are determined by the user and usually calculated using a program such as ArcInfo®.

```
Image URL  = path and filename of raster image
             (i.e., maps/lh_2m.gif)
```

The raster image boundaries must match the easting and northing parameters stated in the Geographic Region Dialog (see Section 3.4.3, "Specifying the Geographic Referencing and Coordinate System").

USGS Digital Line Graph (.dlg)
USGS Digital Line Graph (DLG) files are created from two sources using manual and automated digitizing methods. The two sources are aerial photographs and cartographic sources. DLG files are vector representations of the data. When ResSim interacts with a .dlg file, it automatically creates a .dlgbin file, which is a binary representation of the ASCII .dlg file.

USGS Digital Elevation Model (.dem)
The USGS Geological Survey publishes the raster file format USGS Digital Elevation Model (DEM). DEM files usually contain terrain elevations, but the file format can be used for representing any surface. The format, published by the USGS, allows internal documentation of coordinate system, date of publication, etc.

ASCII NetTin (.net)
This is an ASCII file format used to represent a Triangulated Irregular Network (TIN). The TIN data is stored in a simple format that defines the nodes, edges, and triangles contained in the TIN. This format is common for transferring TIN data between software packages.

ArcInfo® DEM (.asc)
This is an ASCII file format representation of a grid generated by ArcInfo®. The file consists of keywords followed by values defining the number of columns, number of rows, lower left corner, cell size, no data value, and each cell value.

3.4.2 Adding a New Map Layer

To make map files accessible in the watershed, first make sure that the map files are in the "maps" directory of the watershed, as previously described in Section 3.4.1. Also, ensure all maps you add to a watershed share the same coordinate system before you add them to the watershed.

To add a map layer to your watershed:

1. Select **Layers** from the View menu. The **Layer Selector** dialog box will appear (Figure 3.10).
2. From the **Edit** menu, select **Allow Layer Editing**.
3. Next, from the **Maps** menu, select **Add Map Layer**. The **Open File** dialog box (Figure 3.11) will open.

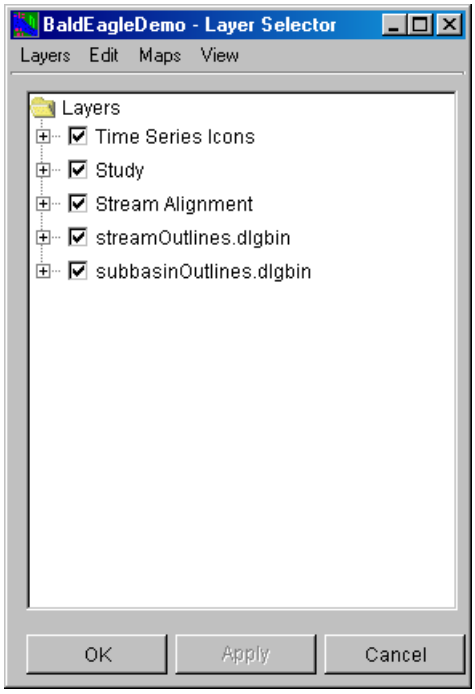

Figure 3.10 Layer Selector Dialog Box

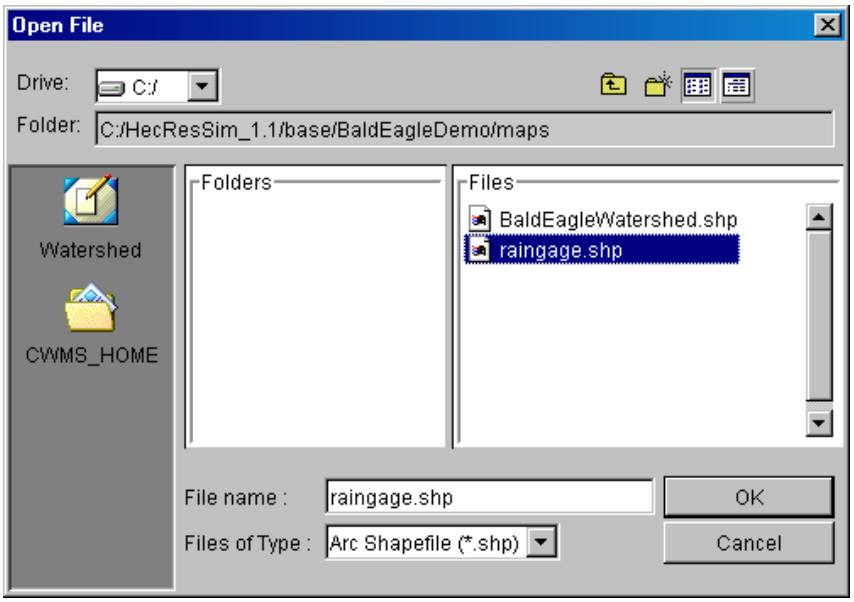

Figure 3.11 Open File Dialog Box to Add Map Layer

4. Locate the map file you wish to use on your local computer (for example, "raingage.shp").
5. After you have selected the map you wish to use, click **OK**. The new map will now appear in the Layer Selector dialog box.

3.4.3 Specifying the Geographic Referencing and Coordinate System

To maintain a geographic reference, you must specify a coordinate system for each watershed. To establish the grid size and coordinate system:

1. Select **Layers** from the **View** menu to open the **Layer Selector** dialog box.
2. From the **Maps** menu, select **Map Display Coordinates** to open the **Geographic Region** dialog box (Figure 3.12).

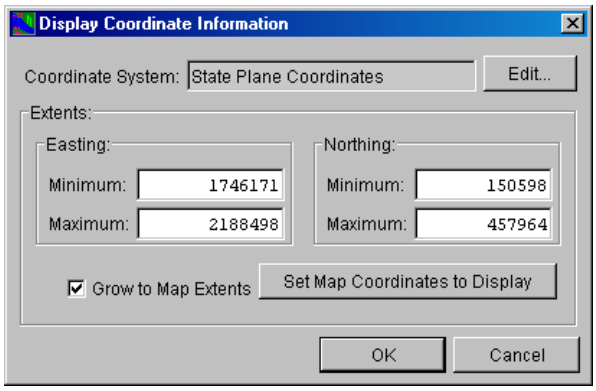

Figure 3.12 Geographic Region Dialog Box

The **Geographic Region** dialog box includes the following information:

Coordinate System
This box identifies the coordinate system established for the watershed. The coordinate system can be edited, but remember that all maps and data must exist in one unified coordinate system. Therefore, some layers or data might require the use of a GIS program to transform coordinate system information. For additional information about editing the Coordinate System, see "Editing the Coordinate System" below.

Extents
The values of **Easting Min**, **Easting Max**, **Northing Min**, and **Northing Max** indicate the location of the left, right, bottom and top borders (respectively) of the grid in the display area. ResSim displays coordinates in the Status Bar as you move the cursor within the map display panel.

Grow to Map Extents
When you check this box, ResSim automatically sets the geographic region to define the smallest rectangle that encompasses all of the

objects (maps, icons, alignments, etc.) in the display area. If you add any objects to the watershed that lie outside the geographic region, ResSim automatically updates the extents to include the new objects.

You must select the geographic extents of your watershed carefully to ensure that all layers in your watershed setup are included. The extents you specify and the coordinate system you use must be consistent for all layers in the watershed. You should use GIS tools to transform layers from one coordinate system to another before you use them in ResSim.

Setting Map Coordinates to Display

You can automatically set the geographic extents to the coordinates in your current view. First, zoom in or out in the display area to determine a preferred geographic region, then open the **Geographic Region** dialog box and click **Set Map Coordinates to Display**. ResSim will set the extents to the current view in your map display. Objects beyond the geographic extents remain in the watershed, but they are not included in the grid of the display area.

Editing the Coordinate System

You can edit the Coordinate System of the Watershed by selecting **Edit** in the **Geographic Region** dialog box. This opens the **Map Coordinate Information** dialog box, where you can configure the System, Units, Spheroid, and other system-specific data. See Appendix B for more information on configuring map coordinate information.