



Technical Documentation Version 7.3

Workspace



Center for Advanced Decision Support for
Water and Environmental Systems (CADSWES)

UNIVERSITY OF COLORADO **BOULDER**

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Workspace

1. Introduction

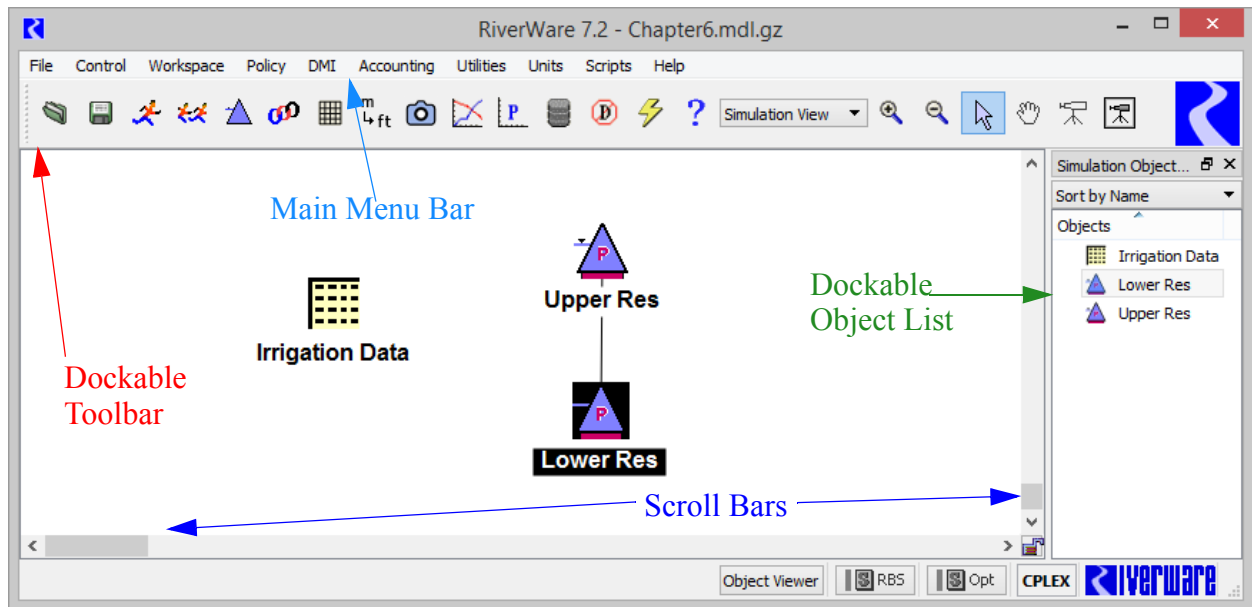
The RiverWare workspace is the main window and provides the primary view of the simulation space where models are built and modified. The workspace contains a menu bar and toolbar through which various RiverWare functions are accessed. In the workspace, a model is graphically represented as a network of objects with links connecting the objects. The workspace allows for exploration of the model through a number of viewing options:

1. A zooming interface.
2. Context sensitive pop-ups providing information about objects and links.
3. Scrolling bars to pan across the model.
4. The ability to select multiple objects by selecting a region of the workspace or to select single objects.
5. A dockable window displaying a list of all objects on the workspace.
6. The ability to resize the workspace to display a larger or smaller region of the model.

2. General Workspace Features

The workspace features a main menu bar in which the various functions of RiverWare are organized into pull-down menus. The workspace also contains a dockable toolbar featuring shortcut buttons to some key RiverWare functions and a dockable object listview window of all the objects on the workspace. The workspace is the entire RiverWare window.

- **Resizing:** The workspace can be resized by clicking on any of the corners and dragging the workspace to the desired size.
- **Scrolling:** The scroll bars can be used to view different regions of the workspace. The default locations of the scroll bars are the lower corners of the workspace.
- **Dockable Windows:** The dockable windows can be moved to new positions on the workspace or completely detached from the workspace by clicking on the raised grey lines (the handle) of the window and dragging it to a new position. If you undock and/or close the toolbar or object list, you can reshown them using the **Utilities ➤ Windows ➤ Show Simulation Object List, Toolbar, or Animation Controls** menus.



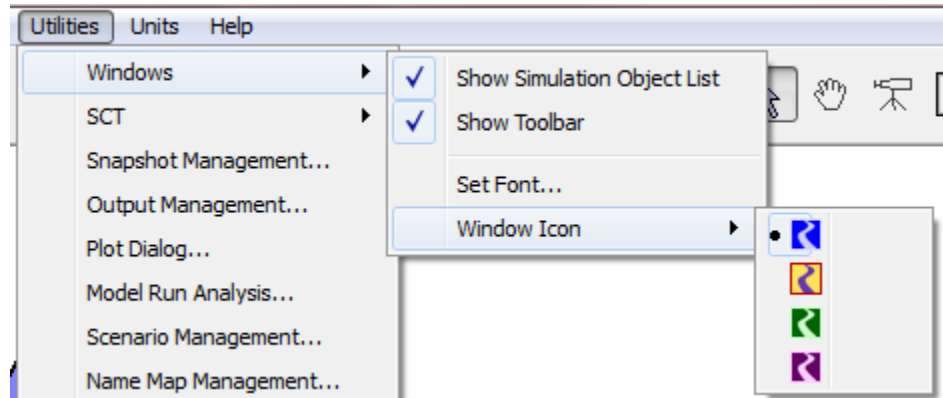
2.1 Font and Text Size

The font, size and style used for menus, lists and other text can be changed from the **Utilities** ➔ **Windows** ➔ **Set Font** menu. There are few limitations with this feature:

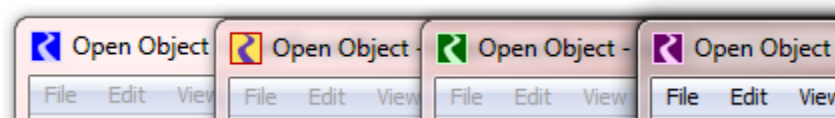
- The font setting is only changed during a single RiverWare session. It does not persist between sessions; this may be changed in the future.
- The font setting does not affect:
 - Workspace canvas text (i.e. object names) - Canvas fonts can be changed from the workspace canvas properties [HERE \(Section 4.1.1\)](#).
 - Existing SCT's - Fonts on the SCT can be changed in the SCT's configuration menu [HERE \(SCT.pdf, Section 3.4\)](#). New SCTs will inherit the font specified for the windows/dialogs.
 - RiverWare Policy Language expressions - Fonts for RPL expressions can be configured from the RPL Layout Editor [HERE \(RPLUserInterface.pdf, Section 6.2.2\)](#).
- Various fonts seem to work well in RiverWare if they are reasonably sized but some dialogs don't display extreme-sized fonts.

2.2 Icon Colors

You can select the icon that is shown on all windows associated with the RiverWare model. This is particularly useful when you are comparing two models in two separate sessions of RiverWare. Use the **Utilities** ➤ **Windows** ➤ **Window Icon** Menu to select from the four options:










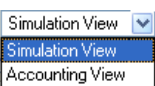

















Then, all windows and the task bar will use the selected icon. The selected icon color is saved in the model file. Below are four separate RiverWare sessions showing the four icons:



2.3 Toolbar and workspace buttons

The toolbar in RiverWare is dockable, meaning it can be moved from one side of the workspace to the other or exist as an independent dialog. The workspace has the following buttons:


Icon	Action	Icon	Action
	Load a model		Open the DMI manager
	Save a model		Open the Model Run Analysis tool
	Open the Run Control Dialog		Close Dialogs
	Open the Multiple Run Control Dialog		Open the Help file in Adobe Acrobat Reader
	Open the Object Palette		Switch between the Simulation View, Geospatial View and the Accounting View (if Accounting is enabled)


Icon	Action	Icon	Action
	Open the Smart Linker or Edit Links dialog		Zoom in
	Load a SCT		Zoom out
	Open the Unit Converter		Selection Mode
	Open the Snapshot Manager		Pan Mode - (Use the middle mouse button to temporarily enter pan model from Selection Mode)
	Open the Output Manager		In-view Locator Mode
	Open an empty plot dialog		Show Locator Window
	Show the Object Viewer, if populated		Show the loaded RBS ruleset
			Show the loaded optimization goal set;

2.4 Object Viewer button

The Object Viewer button allows for quick access to the Object Viewer with previously opened objects. It is disabled if there are no objects shown in the viewer. For more information, see [HERE \(ObjectDialogs.pdf, Section 1\)](#).

2.5 RPL Set buttons

The workspace has buttons on the bottom of the dialog to show the loaded RBS ruleset  or optimization goal set

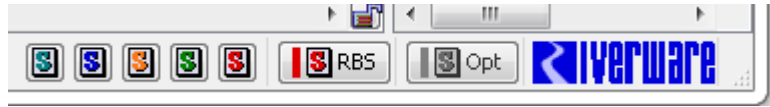
. The bar is colored (red for RBS, purple for Opt)

when there is a loaded set, grey when there isn't. So in the screenshot to the right, there IS a loaded RBS ruleset, but no loaded Opt goal set. Click one of the buttons (when loaded) to raise the loaded set to the top.

Also shown are color coded icons for any opened:



- Ruleset, goal set, or global function set opened from a file
- Embedded sets (OLAM, expression slots, Init rules, Iterative MRM) that contain at least one group

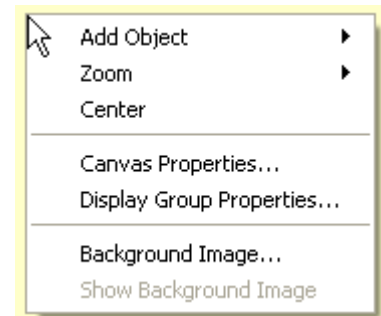


Mouse over any icon for a tool tip indicating the location or click to open that set. Also, the sets are still available through the **Policy** menu. For more information and the color code for sets, click [HERE \(RPLUserInterface.pdf, Section 1.1\)](#).

2.6 Context Menu - Right Click

The Simulation Workspace right click context menu (when not clicking on a simulation object icon) has the following options.

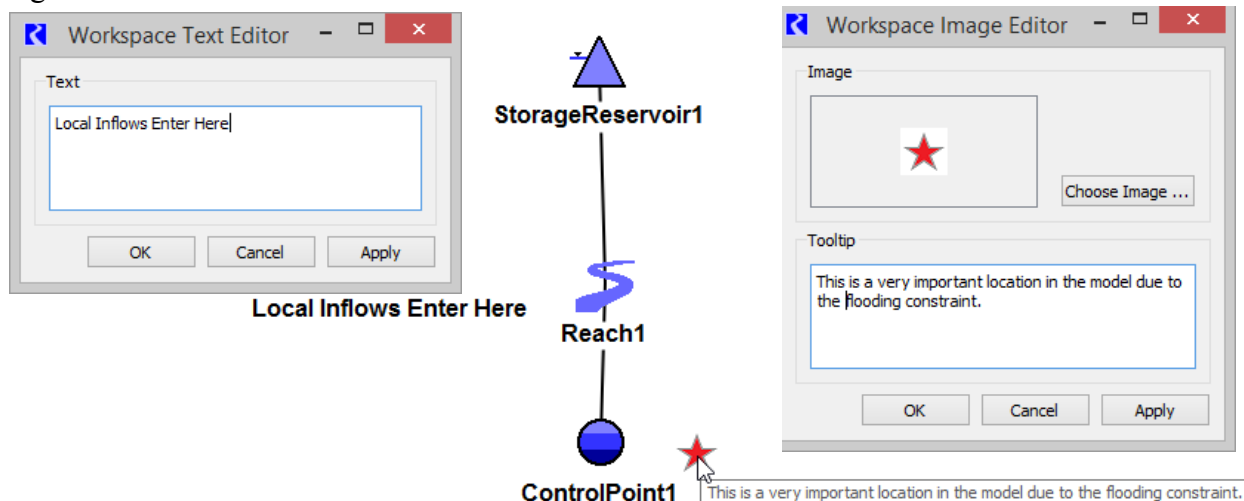
- **Add Object:** Add an object
- **Zoom:** Choose the desired zoom level
- **Center:** re-centers the visible Workspace area on the clicked point.
- **Canvas Properties...:** Click [HERE \(Section 4.1.1\)](#)
- **Display Group Properties...:** Click [HERE \(Section 7\)](#)
- **Add Text...** Add text to the workspace. Click [HERE \(Section 2.7\)](#).
- **Add Image...** Add an Image to the workspace. Click [HERE \(Section 2.7\)](#).
- **Background Image...:** brings up a new Background Image Configuration dialog. Click [HERE \(Section 4.1.2\)](#)
- **Show Background Image:** (a checkbox) either shows or hides the configured background image. This item is enabled only if a background image is configured. This checkbox state is also represented as a checkbox in the Background Image Configuration dialog. Click [HERE \(Section 4.1.2\)](#)
- **Object Coordinates:** (Geospatial view only) shows the geospatial coordinates for the objects on the workspace.



2.7 Add Text or Add Image

Often users find that they may wish to annotate their workspace with text or image files. To do so, use the right click context menu and choose **Add Text...** or **Add Image...** This opens a dialog where you can specify the text or an image, respectively. The image on the left shows the text editor and the resulting text below it. The image on the right shows the image editor with a small image shown. Also shown is

the tooltip for the specified text. This is the text you see when you hover the mouse arrow over the image.



Note, both text and images are not selectable on the workspace, but you can move them individually. Also, right-click the text/image to **Edit** and **Delete** or delete the item.

These are supported separately on the Simulation and Accounting views, but not the Geospatial view. Images are saved in the model file and will increase the model file size. GIF, PNG, or JPG images are supported.

2.8 Output Canvas Items and Animation Controls

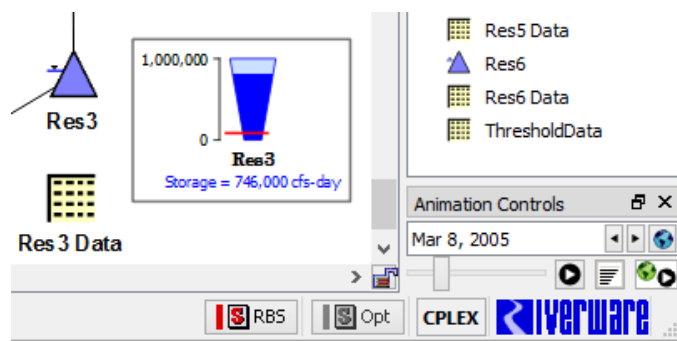
The Output Canvas allows you to create spatially distributed output visualization diagrams. You can show the following items from an Output Canvas directly on the Simulation and/or Geospatial Views.

- Teacups
- Charts
- Text
- Flow lines
- Canvas lines

This is described in detail [HERE \(Output.pdf, Section 6.7\)](#).

When items are shown on workspace views, an additional panel of **Animation Controls** is shown below the **Simulation Object List** as shown to the right. The controls in this panel are described [HERE \(Output.pdf, Section 6.6\)](#).

Like other dockable windows, this panel can be pulled off of the workspace to its own dialog, docked on the left side of the workspace or closed. To re-show the panel, use the **Utilities** ➤ **Windows** ➤ **Show Animation Controls** menu.

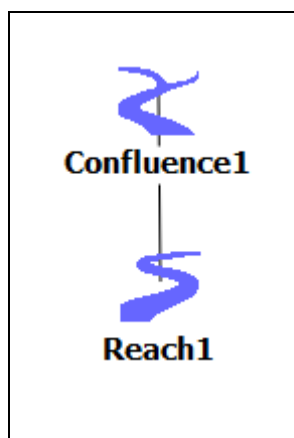


3. Model Navigation

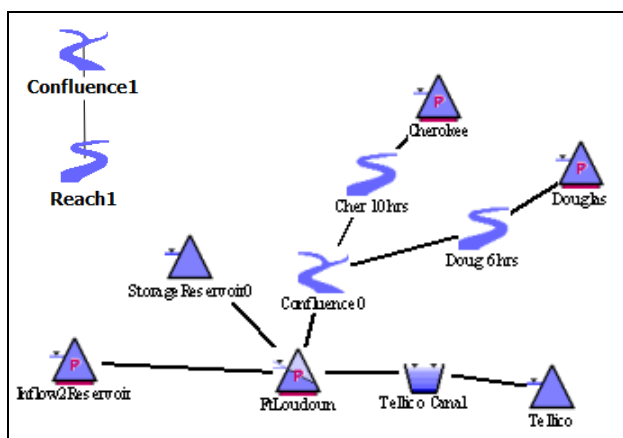
Large models can rarely be viewed in their entirety on the workspace, making it difficult to locate objects. There are, however, multiple ways of navigating through a model on the workspace or locating particular objects within a model. These methods are described in greater detail below.

3.1 Zooming on the Workspace

The zoom features can be accessed by clicking on the zoom buttons (see right) on the toolbar or by right clicking with the mouse on the workspace.



Zoom level: 100%



Zoom level: 50%



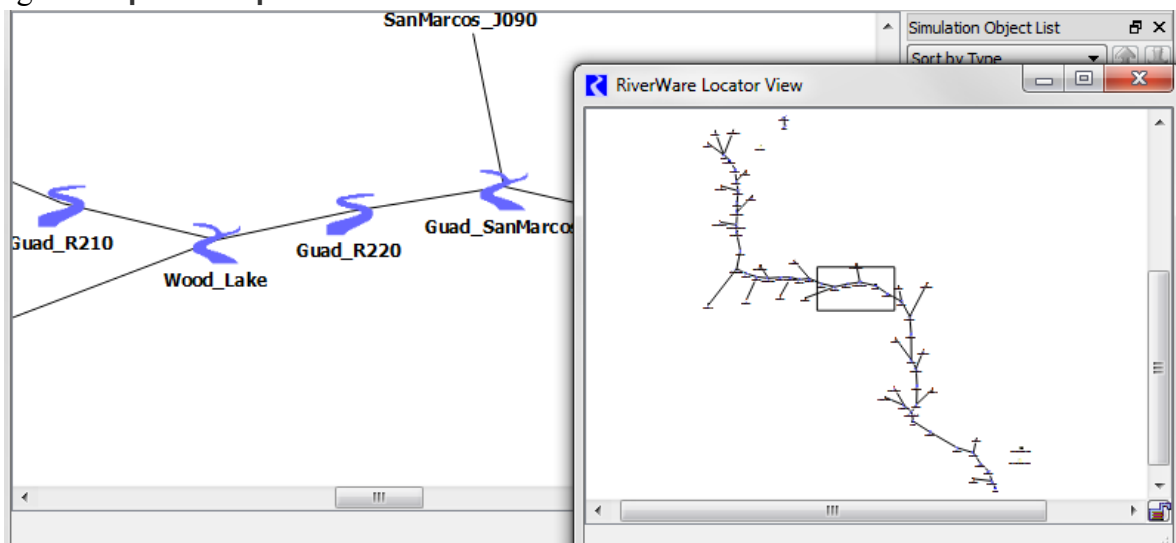
At 100% zoom level, object icons are shown in their natural size of 40x40 pixels. When zooming out, e.g. to 50%, to expose a broader area of the workspace, the object icons and labels are also zoomed out and their size is reduced. When zooming in beyond the 100%, icons, labels and links remain their natural size (100%) instead of becoming larger (or thicker links). This allows you to expose more detail

of background images around closely clustered objects without showing large icons. This implementation of “smart zooming” effects only the Simulation and Geospatial views.

3.2 The Locator View

An overview of a model can be accessed with the locator view. The locator view displays the entire workspace on a miniature scale. The locator view is accessed by:

- Selecting the locator button from the workspace toolbar
- Selecting **Workspace** ➔ **Open Locator** from the menu bar.



The rectangle represents the current displayed portion of the workspace. Dragging the rectangle to different regions of the model in the locator view will cause that region to be displayed on the workspace.

A status bar shows the name of the Simulation Object near the mouse cursor. (*See the bottom of the image*). This functions even while dragging the inscribed rectangle.

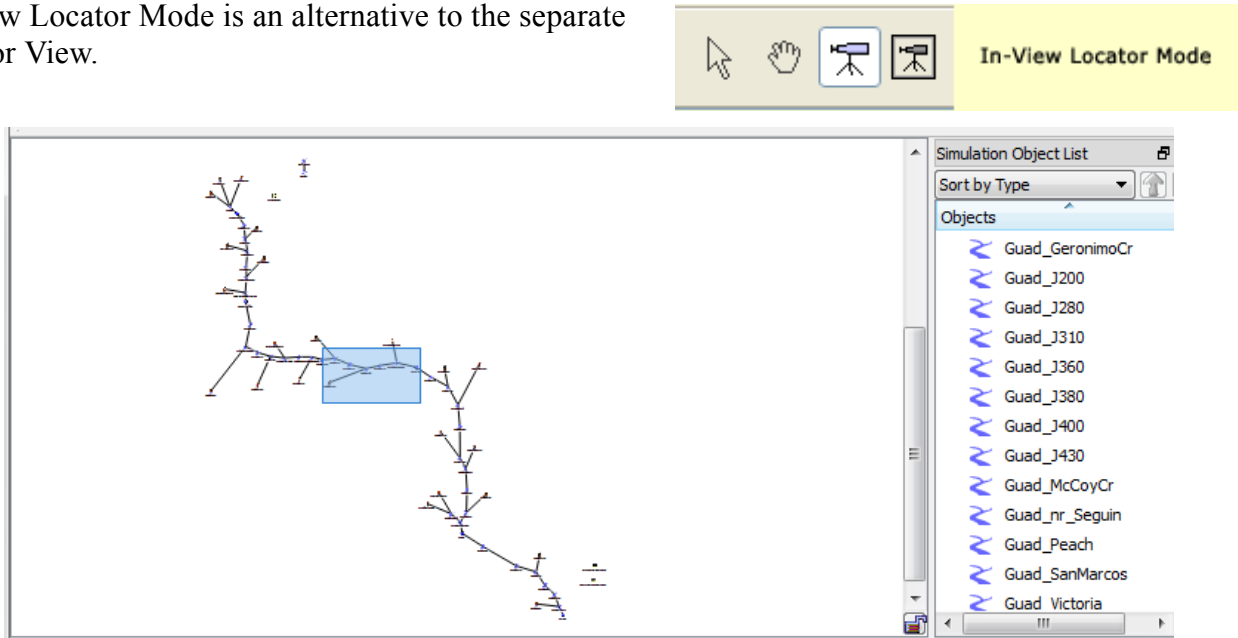
The Locator View implements a Context Menu (right-click) having these two operations:

- **Center.** This re-centers the inscribed rectangle at the clicked position. This is useful especially if the inscribed rectangle (representing the visible area of the workspace) is not visible within the Locator View -- that would occur if the workspace is currently scrolled to an area which doesn't contain any Simulation Object icons.
- **Rescale:** Recomputes the Locator View scale, e.g. if Simulation Objects have been added to the Workspace.

Note: There is a known limitation of the Locator Window. When the workspace view is zoomed in beyond 100%, object icons and their associated text labels, are unconditionally drawn at their normal size. This is unfortunately true also of those features, as they appear in the Locator Window and therefore look much larger than they should.

3.3 In-View Locator

In-View Locator Mode is an alternative to the separate Locator View.



Selecting this mode causes the workspace to temporarily rescale to show the scope of all of the simulation objects on the workspace. The rectangular region of the normally visible area (at the currently set zoom level) is shown as a shaded rectangle. Drag the shaded rectangle to a new area and upon releasing the mouse button, the workspace is positioned at the new area at the previous zoom level. This allows you to quickly snap to a different area in your model.

3.4 Scrolling

If a model is not particularly large or is familiar, it is possible to move to the desired region of the model using the scroll bars. By default, the scroll bars are located in the lower corners of the workspace. Adjusting the scroll bars will pan the model to the desired location. Also, you can use the middle mouse button to temporarily enter Pan Mode to pan through the workspace.

3.5 The Simulation Object List

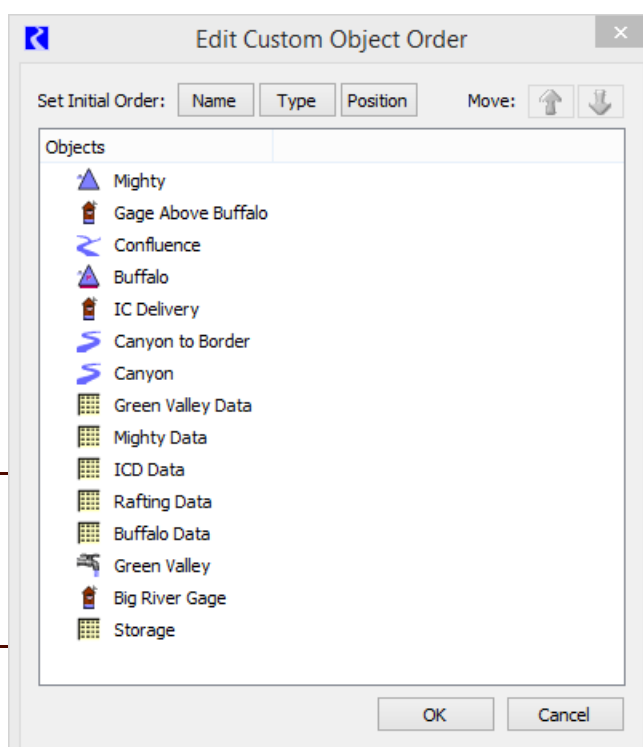
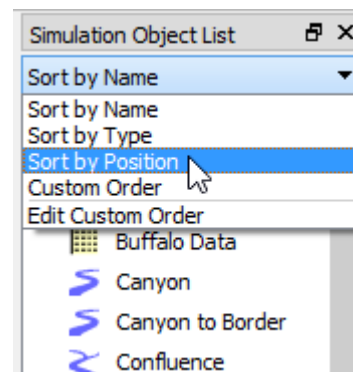
The dockable object list window provides the most comprehensive means of locating a specific object within a model. The object list window can be detached from the workspace and be positioned at a desired location. If you undock and/or close the object list, you can show it using the **Utilities** ➤ **Windows** ➤ **Show Simulation Object List** menu. Clicking the desired object in the listview window automatically selects the object on the workspace. Right-clicking on an object allows you to open the object without scrolling the workspace.

Objects in the list window can be organized by **Name**, **Type**, **Position** or a **Custom Order**. Objects are further organized in ascending or descending order by clicking on the column label.

The Custom Order is defined using the **Edit Custom Order** menu. The following dialog is shown:

Set an initial order using the **Name**, **Type**, or **Position** buttons. Then select one or more objects by clicking on an object and then using Shift or Ctrl key and clicking on another object. Drag and drop or use the up and down arrow buttons to rearrange. When you click OK, this order is preserved as the custom order and is shown on the Object List.

Note: This custom order can be used in the **Model Run Analysis** utility [HERE \(ModelRunAnalysis, Section 1.1.1\)](#) and **Object Coordinate** utility [HERE \(Workspace.pdf, Section 4.3.3\)](#). In those dialogs, choose the “Custom from Workspace” sort order.



3.6 Initial Workspace Appearance

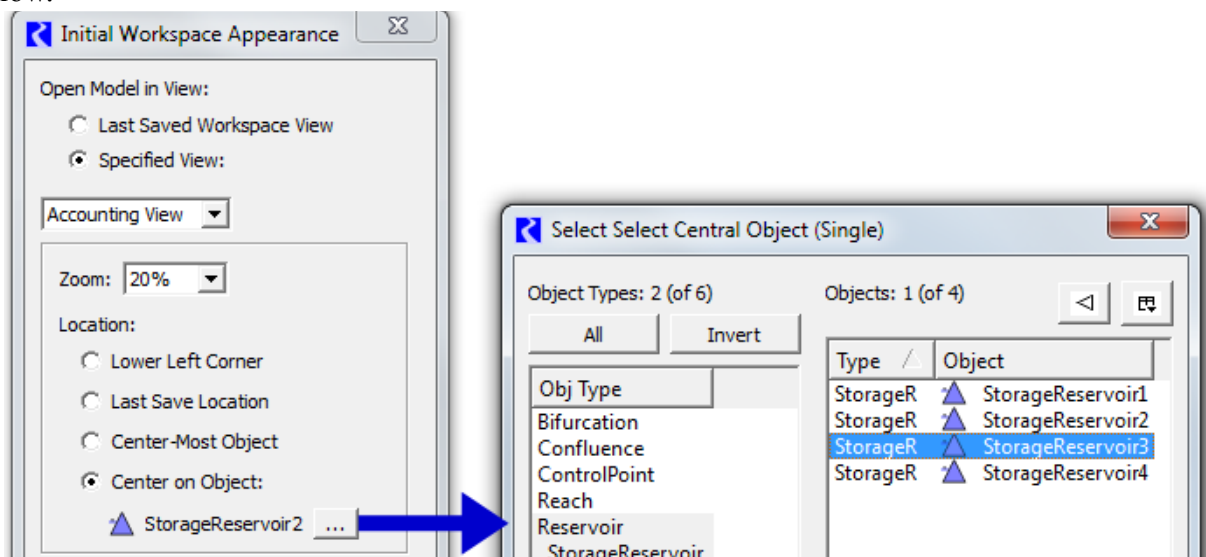
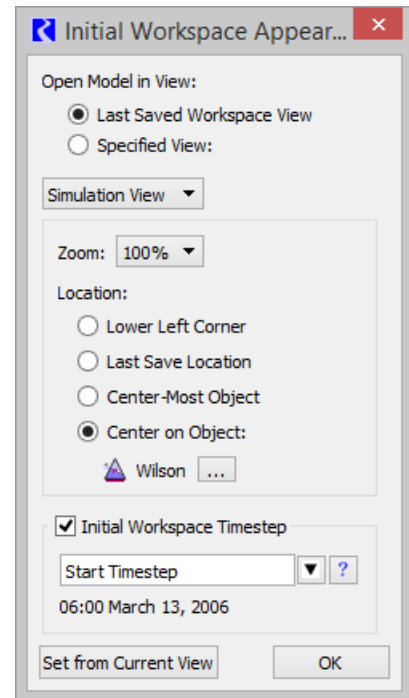
You can configure the workspace appearance when the model is first opened in terms of the view, zoom, and scroll location. On the workspace, use the **Workspace** ➔ **Initial Appearance...** menu. The **Initial Workspace Appearance** dialog shown to the right opens.

First, choose either:

- **Last Saved Workspace View:** (default). The view at the time of the last model save is shown on model load.
- **Specified View:** Specify a particular view to show when the model is opened.

Then, for each of the three workspace views, **Simulation**, **Accounting** (when enabled), and **Geospatial**, specify the zoom level and scroll location to use. Each view maintains these settings separately. For the location, select between these four ways to specify where to scroll:

- **Lower Left Corner:** Initially scroll to the lower left corner.
- **Last Save Location:** Initially scroll to the workspace coordinates (center of the visible area) as last saved. Note that the size of the workspace window remains as is and is not affected by these options.
- **Center-Most Object:** Scroll to the center of the workspace objects, that is, the object which is closest to the average workspace view location of all object icons.
- **Center on Object:** Scroll so a specified object is at the center of the workspace. When this option is selected, use the button to bring up the object selector to specify the center object. See the image below.

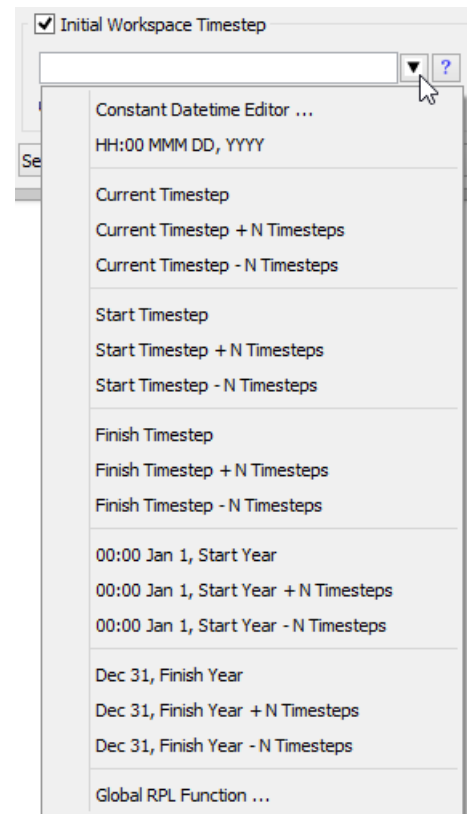
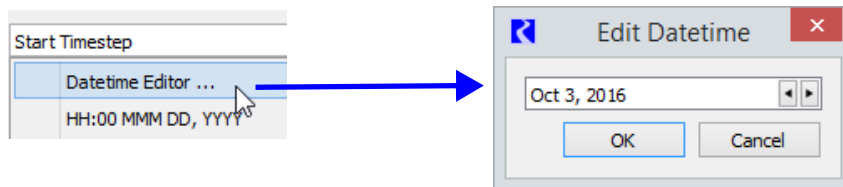


Note: When centering on an object, if the object is near one of the edges, the view is scrolled such that the object is visible, but not actually centered.

Initial Workspace Timestep: The last option is the **Initial Workspace Timestep**. Define a constant or symbolic datetime to which the model should scroll when first opened. When loading a model file containing this specification, the date is evaluated and all windows are Global Time Scrolled to that date.

The Datetime can be specified explicitly or symbolically as RPL DATETIMES as described [HERE \(RPLTypesPalette.pdf, Section 1.3\)](#). Text below the editor field indicates the actual datetime of the entered symbolic time text (if it is valid), or the status if it is not valid. You can also use the drop-down menu to specify one of the common datetimes. Some of these are expressions which must be edited to become valid, e.g. by replacing “N” with a nonnegative integer and the **HH:00 MMM DD, YYYY** formula, where you substitute the hour, month, day and year.

The **Datetime Editor...** option opens a separate dialog to specify the datetime using a selector configured for the model's timestep size.



The **Global RPL Function...** option opens a Function Selector to select a RPL function in the Expression Slot or Global Function Set. **The selected function must have a return type of DATETIME, and must not have any arguments.**

Click the Help Button (question mark icon button) on the right side of the symbolic datetime editor to show a description of symbolic datetime representations.

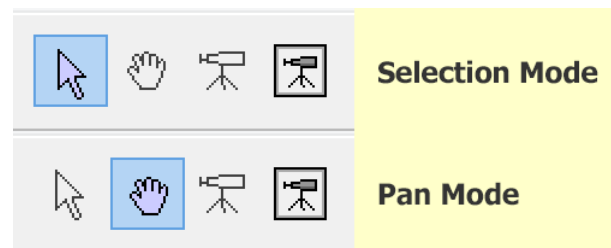
Set from Current View: Use the **Set from Current View** button to use the current workspace's setting. This has the following effects:

- The view selection combo box is set to the workspace's current view.
- The **Zoom** box is set the current view's zoom level.
- The **Location** setting is set to **Last Save Location**.

Click the OK button to apply changes and close the dialog. Shift-click the OK button to apply the currently shown settings in this dialog to the workspace.

3.7 Workspace Cursor Modes: Selection / Pan

The Workspace has two cursor selection modes. These define the effect of clicking and dragging the mouse on the workspace.



3.7.1 Selection Mode

Selection Mode is used for selecting and repositioning Simulation Object icons on the workspace.

Multiple icons can be selected by dragging a rectangle over the icons (with the mouse drag operation started *off of* any icon). Clicking an icon while holding down the Control key toggles the icon in or out of the selected set.

A set of selected icons can be moved together by starting the icon drag *on* one of the selected icons. An icon move operation can be aborted by hitting the Esc (escape) key *before* releasing the mouse button.


3.7.2 Pan Mode

Pan Mode allows the user to move or pan the workspace canvas within the visible workspace area.

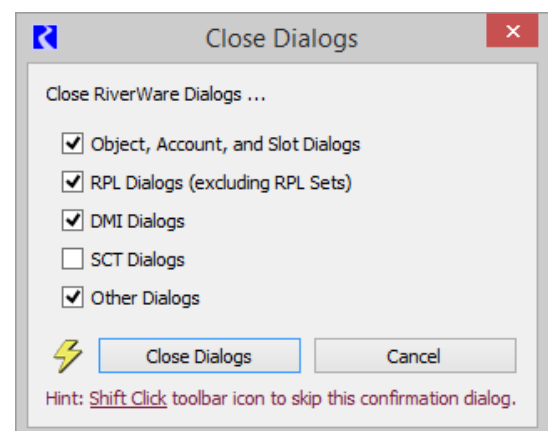
Use the middle mouse button to temporary enter Pan Mode from Selection Mode.

3.8 Closing all Dialogs

All opened dialogs can be closed at once using the Close

Dialogs feature.  When this button is clicked, the dialog shown to the right opens. The dialog allows the user to select the types of dialogs that should be closed (all are selected by default) including


- Object, Account, and Slots
- RPL Dialogs (the highest RPL Set editors do not close)
- DMI Dialogs
- SCT Dialogs
- Other Dialogs



Then the **Close Dialogs** button closes the selected types. This utility never closes the **Workspace**. In addition, two types of dialogs are just minimized instead of being closed:

- **RPL Set editors**. Actually closing those dialogs would also remove the RPL Sets from the RiverWare session.

- **SCTs** not yet associated with (i.e. saved as) an SCT file.

As the text in the dialog shows, the user can also Shift-Click on the  button and it will close all the dialogs without first seeing the **Close Dialogs** window.

Hint: This tool is particularly useful when the user has opened many slot, object, or account dialogs and they wish to close all of them. If the user cannot even find the workspace in order to do this action, there is a menu option on most of those dialogs to **File ➤ Show Workspace....** Once the workspace is shown, the lightning bolt can be used to close all the dialogs.



Workspace

4. The Canvas or Workspace Views

The canvas is the region within the workspace in which models are built and displayed. There are three versions of the canvas which display different “Views” of the objects and connection. The Simulation View displays a schematic of the basin; objects are linked together to form a network. The Accounting View (when accounting is enabled) shows a similar schematic, but each object is displayed as a rectangle which contains all the accounts on that object. The third view, the Geospatial View, displays objects at their actual locations on a georeferenced background map. Because of the differences in how the network is displayed in each view, there are different configuration options for each canvas. The following sections describe each canvas and the configuration options.

Note: Each canvas is configured separately. Although the configuration dialogs are the same for the Simulation and Accounting Views, their settings are not shared. Thus, you can configure each independently.

4.1 Simulation View

The Simulation View displays a schematic of the basin; objects are represented by icons and are linked together to form a network. Note, the Simulation View was the original view in RiverWare. As such, most of the screenshots in the RiverWare documentation reference this view when describing models.

4.1.1 Canvas Properties

The canvas properties dialog is accessed:

- from the menu: **Workspace ➤ Canvas Properties**
- by right click on the workspace and then select **Canvas Properties**.

This dialog allows you to change the following attributes of the canvas:

- **Canvas Width:** number of pixels
- **Canvas Height:** number of pixels
- **Set Background Color:** The selected color is saved in the model file.
- **Set Text Color**
- **Set Canvas Font** including the style and size

4.1.2 Background Image

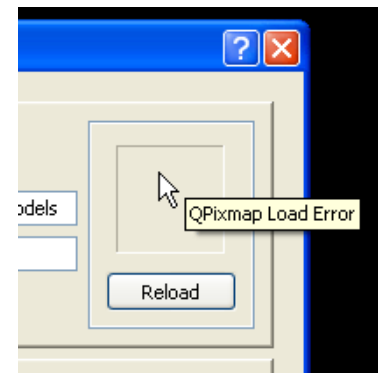
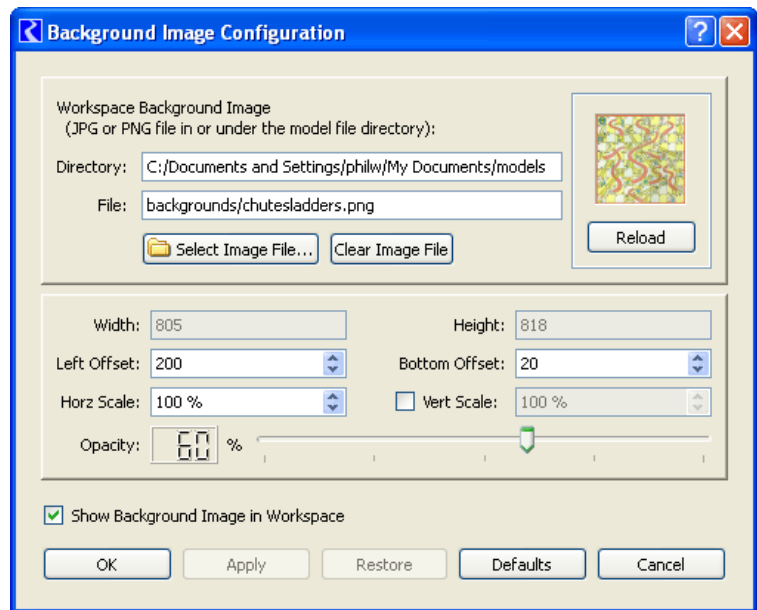
The Simulation Workspace supports the ability to show an image loaded from an image file (JPEG or PNG) as the background. The utility is accessed by right-clicking on the workspace and choosing **Background Image...**

The path of the selected image is preserved in the model file (if the model file is saved after configuring the background image). When loading a model with a configured background image file, if the background image file does not actually exist at the recorded path, the model loads without a problem, and the currently-invalid image file path is retained.

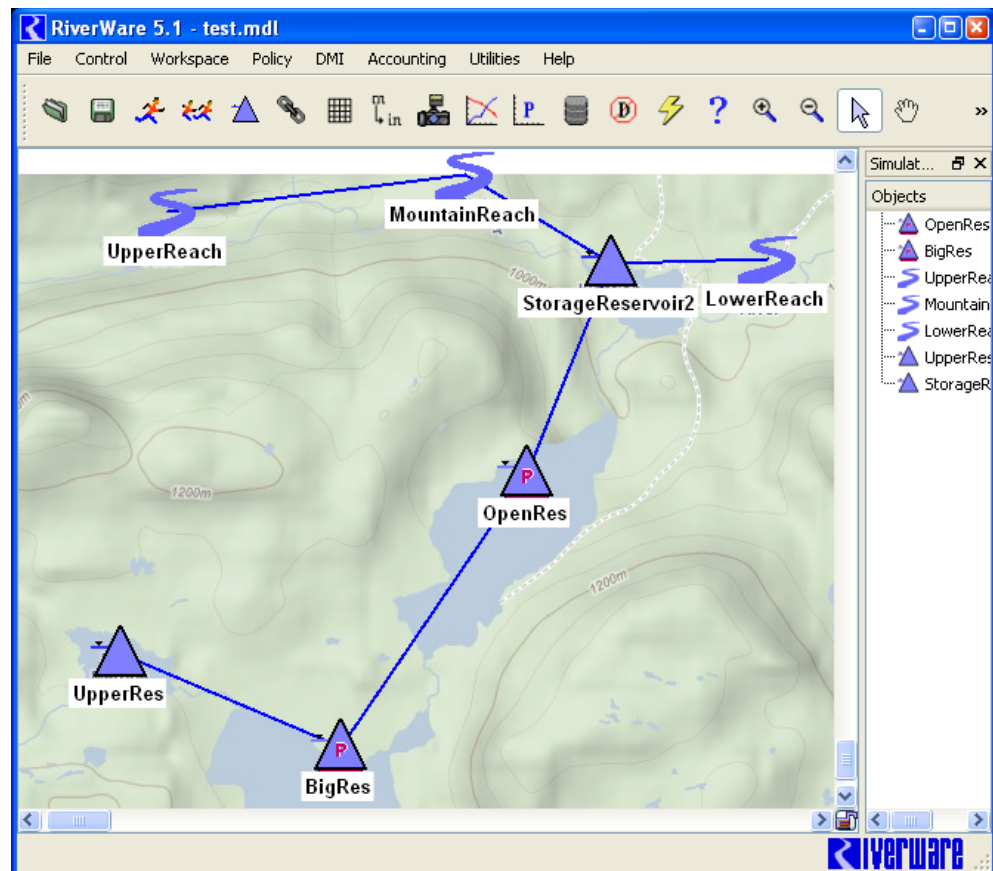
If the selected image file does not represent a valid, supported image file format, the thumbnail (small image preview) will be blank, and the Tooltip on the thumbnail will indicate an error. *See the image to the right.*

Configurable background image properties include:

- The image file path (to a JPG or PNG image file).
- The left offset of the image -- number of pixels from the left side of the workspace.
- The bottom offset of the image -- the number of pixels from the bottom of the workspace.
- The horizontal scale. (100% represents full image scale).
- An optionally independent vertical scale. (100% represents full image scale). If an independent vertical scale is not specified, the configured horizontal scale is used also for the vertical dimension.
- An opacity factor, as a percentage. Zero percent is completely transparent (invisible). 100% is complete opacity -- which generally is too opaque unless the actual image is already “faded”.
- A toggle indicating whether or not the background image should actually be shown. This has the same state as the similar toggle in the workspace’s context menu. *See the prior section.*



A typical use of a background image is a map. This works well if you can reasonably position the icons at approximate positions and/or you do not have or wish to use geospatial coordinate data. But, georeferencing is available on the Geospatial View [HERE \(Section 4.3\)](#).



4.2 Accounting View

If accounting is enabled, the accounting network is displayed in the **Accounting View**, and can be selected by the option menu on the toolbar. The accounting view provides a representation of the physical objects, as well as, the accounts on those objects where the network can be displayed without occluding or modifying the original physical network.

General configuration of the accounting view is identical to the Simulation View [HERE \(Section 4.1.1\)](#), but remember, the settings are not shared but are independent.

More information on the Workspace Accounting View, please see the Accounting Documentation [HERE \(Accounting.pdf\)](#).

4.3 Geospatial view

The Geospatial View of the workspace provides a spatially coherent display of the modeled basin by associating a map projection and its cartesian coordinate system with the view. Users locate objects and a background map image in this coordinate system, allowing RiverWare to display a schematic view of the modeled basin overlaid in registry with the map. That is, RiverWare objects are displayed at their

location on the map. By providing an intuitive and information-rich view of a basin, the Geospatial view complements the Simulation and Accounting views of the workspace.

The key features of the Geospatial View are:

- The Geospatial canvas has an associated map projection and location (rectangular extent) within the projection's coordinate system.
- A map image with a known location in the coordinate system can be displayed in the background layer of the view.
- Images can be georeferenced interactively or automatically via metadata contained within the image file or an accompanying world file.
- The background image (map) can be changed to another with the same projection without requiring any change to the spatial locations (geospatial view coordinates) of the objects.
- Objects are georeferenced (given spatial coordinates) and displayed at that location.
- A distinction is made between an object's *display* and *actual* spatial coordinates.
- Object coordinates can be shared between models and external GIS applications.
- Additional control over the schematic view is provided including sizing and labelling of the icons.
- The coordinates of the mouse in the map projection are continuously presented in the status bar. When available, geographic coordinates (lat/long) are displayed as well.

4.3.1 Introduction to GIS concepts

Graphical information systems (GISs) support storage, analysis, and display of spatial data. This section introduces some basic GIS terminology and concepts which are relevant to the Geospatial View.

Locations on the spherical earth are most often represented as a pair of coordinates representing latitude and longitude. For some applications, a third coordinate representing an elevation relative to mean sea level is also used. To display a part of the curved surface of the earth on a flat surface necessarily requires a projection, and GIS systems typically represent flat display locations as cartesian coordinates in a plane onto which the surface of the globe has been projected.

Several standards have been developed to provide agreed-upon coordinate systems for a given area. These standard coordinate systems define a set of map projections which together cover the target area. One common coordinate system which covers the globe is the Universal Transverse Mercator (UTM) coordinate system. This system defines a projection for the northern and southern areas of each of 60 longitudinal zones spanning the globe. For example, in the projection UTM Zone 11 North, the coordinates eastings = 397,800 m, northings = 4,922,900 m, corresponds to a location in central Oregon, USA.

Another standard coordinate system is the State Plane coordinate system which defines a set of projections for the United States. In this system, each state is divided into one or more zones, so a location is specified by a state, zone designation, and x, y coordinates.

Note that a standard coordinate system defines a mathematical coordinate system corresponding to each projection of a set of projections; when these two uses of the term “coordinate system” would be

confusing, we use the term to refer to the standard, and use the term “projection” or “map projection” for the component (mathematical) coordinate systems.

Coordinates, whether they be geographic (latitude and longitude) or correspond to a map projection, are specific to a datum. A datum is a reference surface and surveyed coordinates for a set of actual points and lines. Examples of common datums include the North American Datum of 1983 (NAD83) and the World Geodetic System of 1984 (WGS84).

The Geospatial View has a map projection associated with it, and everything displayed in that view (e.g., object icons, background image) needs to be displayed in that projection. Because RiverWare assumes that a single projection is shared between the Geospatial View, the object coordinates, and the map, RiverWare does not need to know the mathematical details of that projection. However, if these details are provided to RiverWare (typically by providing a background image which contains metadata describing the image’s projection), then RiverWare can translate projected coordinates to geographic coordinates, and display these coordinates where appropriate.

4.3.2 The Geospatial Canvas Configuration Dialog

The Geospatial View is most useful when a basin map exists which can be located (georeferenced) in a known projection system. If this information is not available, consider using the Simulation View with a background image.

The Geospatial Canvas Configuration Dialog allows you to specify information about your georeferenced image and how it relates to the RiverWare workspace. It is accessed by:

- right clicking on the geospatial workspace and choosing **Canvas Properties**.
- using the **Workspace ➤ Canvas Properties** menu when the Geospatial View is shown.

We will discuss each of the Geospatial Canvas Configuration Dialog’s three tabs in turn.

4.3.2.1 The Image & Coordinate System Tab

This portion of the dialog describes the background image and the projected and geographic coordinate systems associated with that image (and the Geospatial View in general).

Background Image:

Image files are specified by full path names with environment variable expansion. Environment variables are specified using the \$PATH syntax. If the image changes outside of RiverWare you may need to **Reload** it using the button.

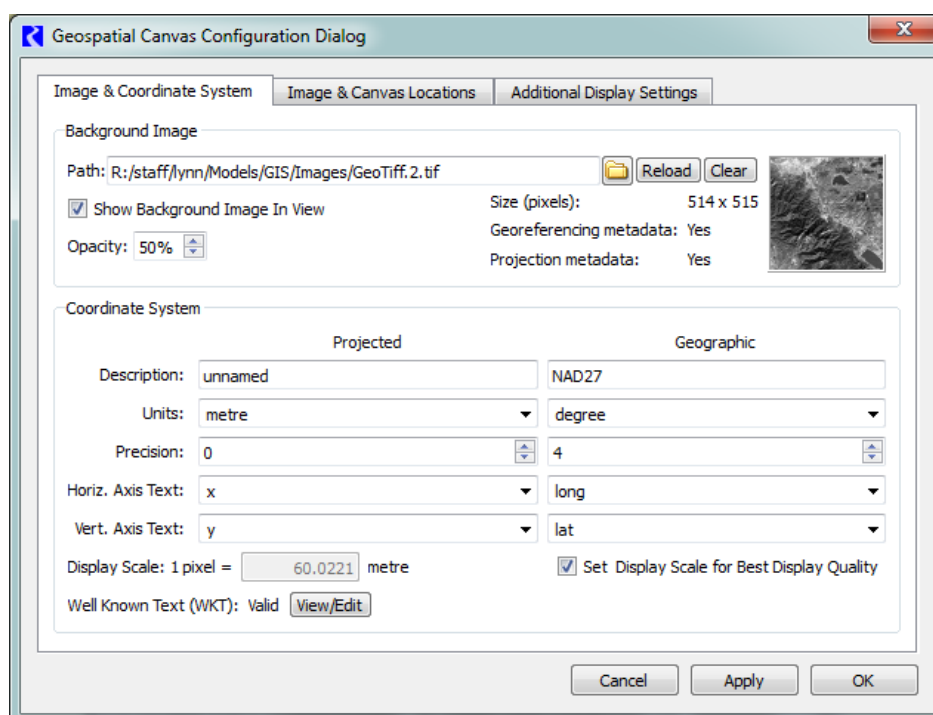


Figure 1: The Geospatial View's Image and Coordinate System Tab

Of the many image formats supported by RiverWare¹, the most common are JPEG, PNG, JPEG 2000, GeoTIFF, and MrSID. When an image is loaded, RiverWare checks for the presence of two type of useful metadata:

- Georeference: the location of the image in its projection.
- Projection: a description of the projection in WKT (well known text) format.

If present, these data are used to set appropriate aspects of the configuration. Some image formats support the embedding of these metadata in the image file itself (e.g., GeoTIFF, JPEG 2000, and MrSID), but RiverWare also checks for a co-located file with a suffix indicating that it contains image metadata. For example, RiverWare will look for an associated file in the world file format, a plain text file format developed by ESRI for georeferencing raster map images.

A valid world file contains 6 lines, each containing a floating point value, denoted here by the letters A-F. These values define an affine transformation from pixel coordinates to projection coordinates in the form:

$$x_1 = Ax + By + C$$

$$y_1 = Dx + Ey + F$$

1. RiverWare uses the GDAL open source library to read image files. This library supports over 100 raster data formats, though many of these formats are not suitable for background images because they do not contain color rendering information.

where

x_1 = calculated x-coordinate of the projection location

y_1 = calculated y-coordinate of the projection location

x = column number of a pixel in the image

y = row number of a pixel in the image

A = x-scale; dimension of a pixel in map units in x direction

B, D = rotation terms

C, F = translation terms; x, y map coordinates of the center of the upper left pixel

E = negative of y-scale; dimension of a pixel in map units in y direction

For many GIS applications, creating an image with a world file is relatively straightforward. For example, to do this in ArcMap 10.0, select File->Export Map..., then check the “Write World File” checkbox option within the subsequent dialog. On the other hand, when this is not possible, the world file format is simple enough that it can be created by hand with a text editor.

The Geospatial View currently supports only images with unrotated, square pixels, thus not all map images can be displayed as background images. If metadata indicate that these assumptions are violated, RiverWare will notify the user at image load time.

Additional controls and information contained in this section of the dialog:

- Checkbox indicating whether or not to **Show Background Image in View**.
- Integer indicating the percent **Opacity** with which to display the image
- Labels indicating the presence or absence of georeference and projection image metadata.

Coordinate System: This panel displays information about the projected and geographic coordinate systems associated with the Geospatial View:

- **Description:** textual description of the coordinate system. This could include a technical description of the coordinate system such as “UTM NAD83 Zone 11N”, but RiverWare will not make any assumptions about the description contents.
- **Units:** text describing the units of the coordinate system. These are not limited to the units supported for slot values because these are used for display purposes only.
- **Precision:** number of digits to the right of the decimal point with which to display coordinates.
- **Horiz. Axis:** label associated with the horizontal dimension of the coordinate system. For the projected coordinate system, this is usually “x” or “Easting” but you can also select <custom> and enter your own text. For geographic coordinate systems, this is usually “long” or “longitude”.
- **Vert. Axis:** label associated with the vertical dimension of the coordinate system. It is usually “y” or “Northing” but you can also select <custom> and enter your own text.
- **Display Scale:** the projection units per pixel used for displaying the canvas on the screen at a zoom factor of 100%. This setting relates the projection to the screen display of the canvas. When the **Set Display Scale for Best Quality Display** box is checked, RiverWare sets this automatically, usually

using the display scale which leads one pixel in the background image to be displayed as one pixel on the screen. Note that RiverWare uses a single display scale for both vertical and horizontal dimensions.

- **Well Known Text (WKT):** indicates whether or not full projection information is available in the WKT format and allows this text to be view and edited. Typically this description will be set automatically from image metadata, but if the image does not contain this information, it can be provided interactively.

You can either set these fields interactively or, if the appropriate image projection metadata is present, RiverWare will set them automatically. Note that in the latter case it is possible to override the values set from metadata, but they will be re-set if the image (and metadata) is re-loaded. A preferable approach would be to correct the metadata to contain the desired information.

The geographic coordinate system portion of this panel is only relevant when full projection information is present, typically part of the projection metadata. When this information is not present, this portion of the panel is disabled.

4.3.2.2 Image & Canvas Locations Tab

This panels displays information about the locations of the background image and canvas in the projected coordinate system.

Background Image Rectangle Location: In order to display the background image at the proper location on the canvas, RiverWare needs to know its location in the projected coordinate system (i.e., the image must be georeferenced). There are two alternatives for providing this information if RiverWare did find it

when the image was loaded. One is to click on the **Set from: World File** button. RiverWare will then present a file chooser dialog for specifying the world file containing the image's georeferencing information. This option is appropriate when an appropriate world file exists, but it is either not co-located with the image or has an unusual name that prevents RiverWare from discovering it.

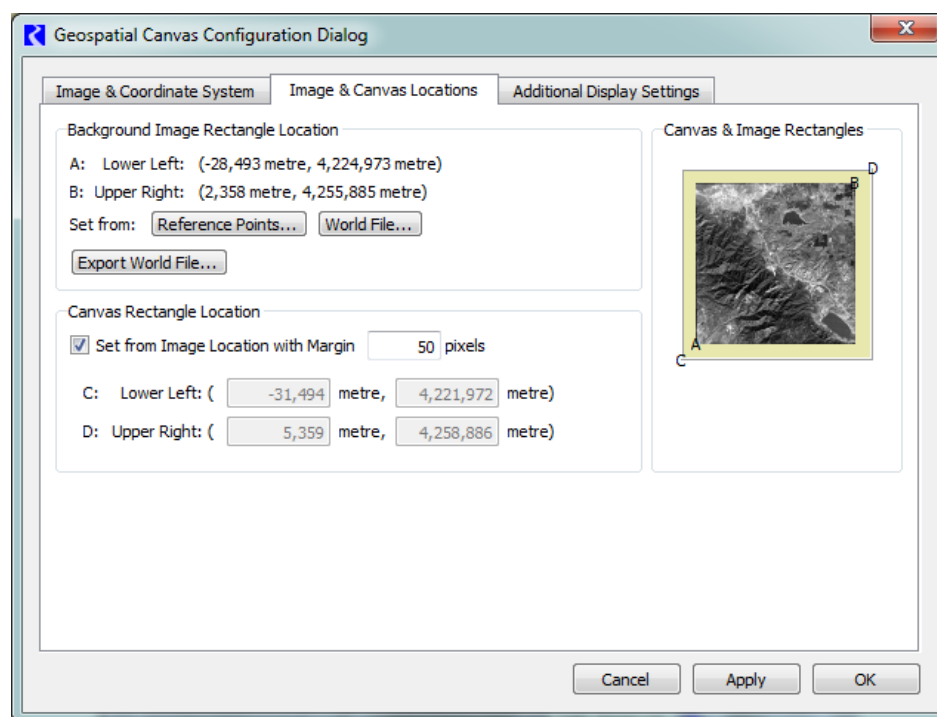


Figure 2: The Geospatial View's Image and Canvas Location Tab

If no metadata is available, then another option is to provide coordinates for two specific locations in the map, in which case RiverWare will use these reference point coordinates to compute projection coordinates for the full image. To provide this information to RiverWare, select the **Set from: Reference Points** button. This opens the **Image Location Dialog** which displays a view of your image. For this utility, a reference point is a location for which you know the coordinates and you can locate in the image. Only 2 reference points are needed to locate the image in the projection coordinate system. As shown in the image, you do three steps

- Step 1:

Locate a reference points in the image. Use the zooming tools to get as close as possible to the first reference location. Click on the




button and then click in the image to locate the first reference point one. Zoom/Scroll to the 2nd reference location. Click on the second button




and click in the image to locate the second reference point.

- Step 2:

For the first reference point corresponding to , enter the coordinates in the dialog.

- Step 3:

For the second reference point corresponding to , enter either the x or y coordinate; the other coordinate will be computed by RiverWare.

Click **OK** to confirm the entry and close the dialog.

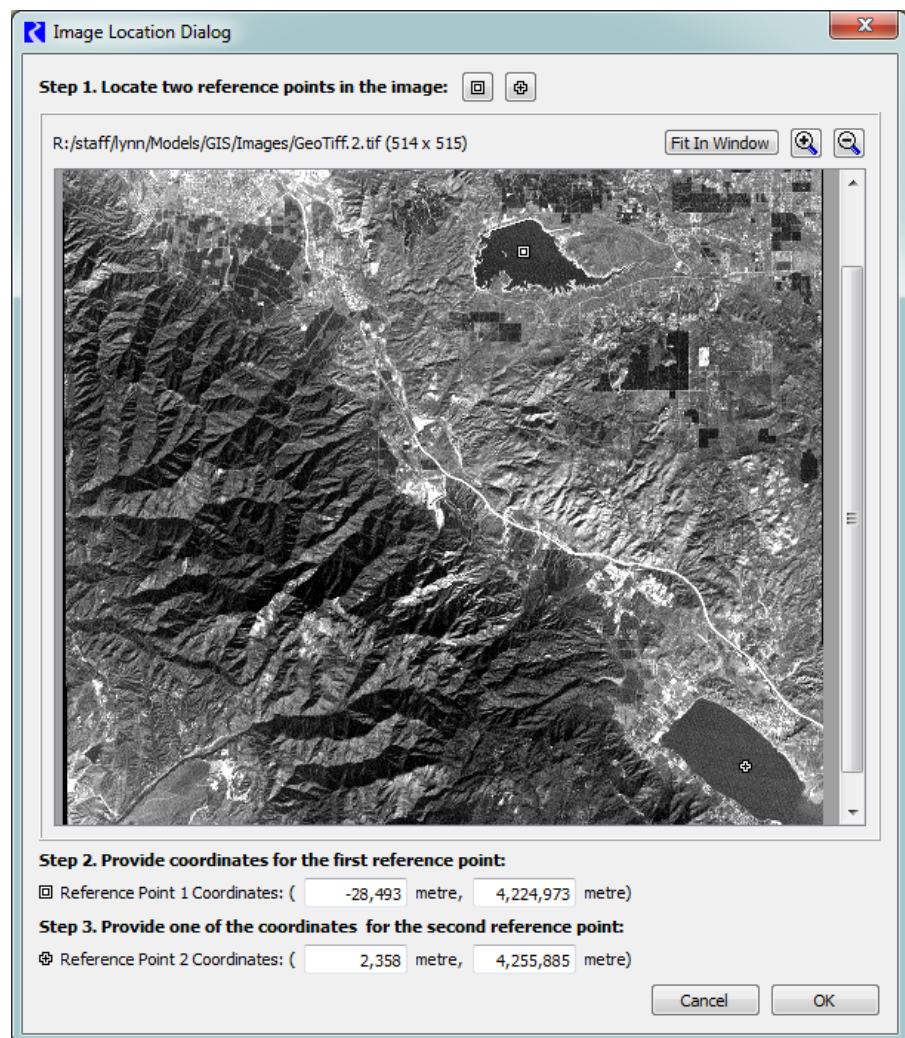


Figure 3: The Geospatial View's Image Location Dialog

If you have set the background image rectangle location interactively, you can export the corresponding georeferencing information by selecting the **Export World File** button. RiverWare will allow you to select a file name and write the background image's georeferencing information to that file in the world file format. This file can then be used to automatically register the image within other RiverWare models or with any application that can supports the world file format.

Canvas Rectangle Location: In the Canvas Rectangle Location area, you specify where the canvas rectangle lies in the projection's coordinate system, by giving the coordinates of the lower left and upper right corners of that rectangle. Checking the **Set from Background Image with Margin** checkbox will cause RiverWare to automatically compute the canvas location to be that of the Background Image with an optional margin added to each side. Unchecking this box allows you to interactively enter three coordinates of the canvas location (the remaining coordinate will be computed by RiverWare based on the other three). Care should be taken here to enter a canvas location that includes that of the image.

Canvas & Image Rectangles: This panel provides a high-level view of the canvas and image rectangles, drawn as rectangles whose size and relationship to each other matches that defined in the Background Image Rectangle Location and Canvas Rectangle Location panels. The locations of each coordinate (A, B, C, and D) are shown in the thumbnail.

4.3.2.3 Additional Display Settings Tab

In this tab, you can specify additional display settings for the geospatial workspace:

- **Canvas Background Color:** Click the button to bring up a color chooser.
- **Icon Size:** Enter a new value for the RiverWare icon size at 100% zoom factor. Note, the standard size is 40 pixels. Currently, this setting is "global" for the geospatial canvas. In the future, this may be changed to a per-object setting.

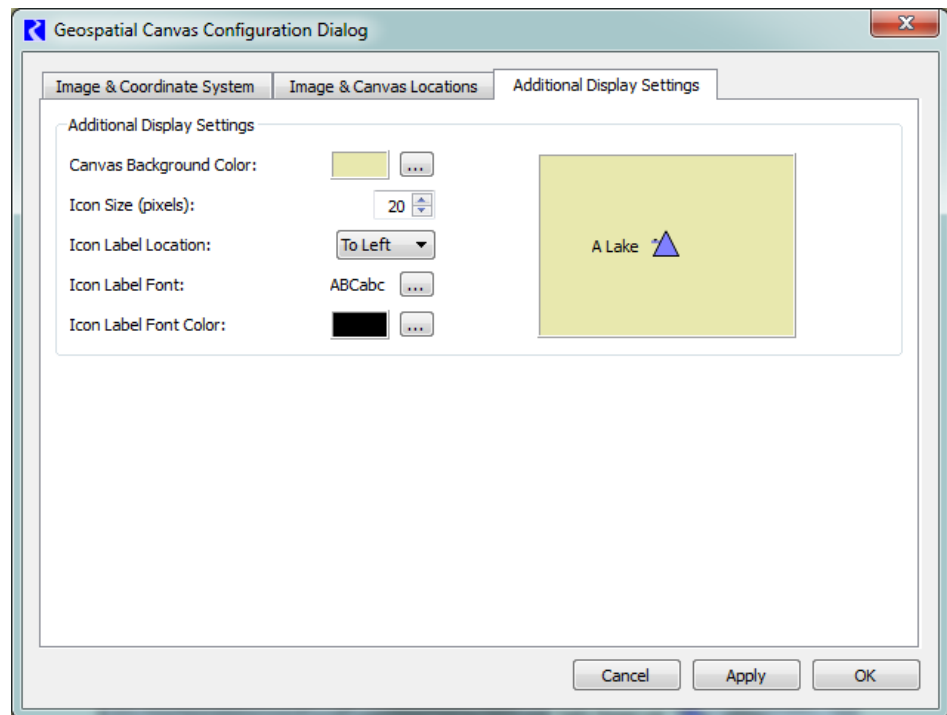
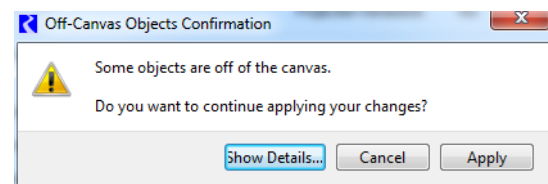


Figure 4: The Geospatial View's Additional Display Settings

- **Icon Label Location:** choose the location of the label: below, above, left, right of the object. Note that **No Label** is an option. Currently, this setting is “global” for the geospatial canvas. In the future, this may be changed to a per-object setting.
- **Icon Label Font:** Provide a font and size for the label text.
- **Icon Label Font Color:** Choose a color for the object label text.

All selections in this frame are applied to the sample reservoir icon immediately, but are applied to your workspace when the **OK** or **Apply** button are clicked.

Applying Configuration Changes: When you are satisfied with the configuration and would like to apply it to the Geospatial View, click **OK** or **Apply** at the bottom of the dialog. This will apply changes from all tabs of the dialog (**OK** will also close the dialog). If the current spatial coordinates of one or more object do not fall within the configured canvas boundaries, you will be prompted with



the warning dialog shown. A detailed explanation can be shown, basically explaining that RiverWare expects all objects to be displayed on the canvas, and that continuing the apply operation will cause RiverWare to automatically reposition those objects so that they are on the canvas. This is a reasonable thing to do if this is the first time an image and coordinate system information has been configured for this view. Once the new configuration has been applied the Geospatial View, you can then refine the positions of the object (by direct manipulation with the workspace or using the **Object Coordinate Manager**, described below). On the other hand, the objects could have correct coordinates for the coordinates system but are off of the canvas due to unintended changes to the canvas location, in which case you should cancel the apply operation and correct any problems.

Following are some strategies for dealing with overlapping icons which is sometimes called “icon clustering.”

- Use smaller icons and place labels to one side or the other.
- Give clustered objects **display** spatial coordinates that allow for a clear display, deviating somewhat from their **actual** coordinates as necessary.

4.3.3 Object Coordinates

To support the Geospatial View of the workspace, RiverWare associates coordinates in the view’s projected coordinates system with each object on the workspace. To provide more flexibility for the user, RiverWare supports both **Actual** and **Display** spatial coordinates. Actual coordinates are the static coordinates of the object which may come from other sources. The display coordinates are the location where the object is shown on the geospatial view. Often the display coordinates differ from the actual coordinates because the object was moved slightly for less icon clustering or better display.

When an object is created, it is placed at the point of creation in the current view and given locations in the other two views based on its location in the current view. Objects can be moved in any view, and in

the Geospatial View this will change the display spatial coordinates. This view also provides the following additional mechanisms to edit or specify spatial coordinates:

- The **Object Coordinate Manager** dialog displays spatial coordinates for all objects in a single dialog. This dialog supports editing of individual values as well as cut/paste/copy (see section below for more details). This also provide a mechanism to facilitate reconciliation of an object's actual and display spatial coordinates.
- Import the **Actual Coordinates** from an ESRI shape file.

Following is a description of the Object Coordinate Manager Dialog which is used to edit/view object coordinates. The **Object Coordinate Manager** is non-modal and accessed by right-clicking on the main workspace (in the Geospatial View) and then selecting **Object Coordinates...**

The **Object Coordinate Manager** dialog displays both the display and actual spatial coordinates for all workspace objects. This dialog supports editing of individual fields as well as cut/paste/copy. For each object, both the display and actual spatial coordinates are displayed. Following are operations that you can perform through the dialog:

- **Select Coordinate system:** Coordinates are displayed for either the projected or geographic coordinate system. If the canvas has not been configured with full projection information, then RiverWare can not convert to geographic coordinates and this option is disabled.
- **Sort:** Objects in the table can be sorted using the Sort menu. There are options to sort by **Object Type**, **Object Name**, **Display X** or **Y**, **Actual X** or **Y**, **Custom** and **Custom from Workspace**. To use the Custom sort, highlight one or more objects and use the blue up and down arrows to sort the objects. The **Custom from Workspace** sort option is defined on the workspace's **Object List** as described [HERE \(Workspace.pdf, Section 3.5\)](#).
- **Editing:** Values in the dialog are only editable when the appropriate **Enable Editing** toggle is selected. Then, double click on a value and type in a new number.
- **Show Data Objects:** The Show Data Objects toggle allows you to specify whether you wish to see data objects.
- **Show on Workspace:** Select one or more objects, then right-click and select **Show on Workspace** to highlight and select the objects on the workspace.

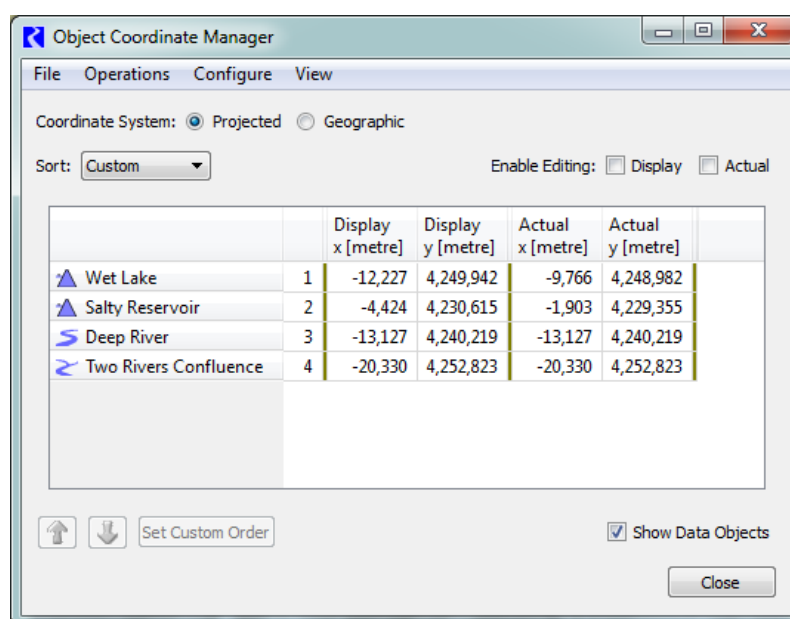


Figure 5: The Object Coordinate Manager Dialog

- **Copy Display/Actual Coordinates to the other:** The **Operations** menu has options to **Copy Display Coordinates to Actual Coordinates** and **Copy Actual Coordinates to Display Coordinates**. This allows you to move coordinates easily between the display and actual. Note, these operations copy ALL values in the column, not the selected ones. When you do this operation, it may overwrite data. Thus, a warning dialog is provided for you to confirm or cancel the operation.
- **Export Copy/Import Paste Values:** You can copy or paste any value(s) to/from the system clipboard and then to/from external text or Excel files or back to this dialog. This gives you a lot of flexibility in how you move data. Notes, when you copy/paste values, it is operating on the selected values in the sort order as it is displayed. There is also an option to **Export Copy with the Object Names** to also export the RiverWare object name. These operations are available from the right click context menu.
- **Importing/Exporting Coordinates:** Import and export spatial coordinates through the ESRI shape file format. In this context, the shape file format is a collection of three files with different suffixes:
 - .shp - objects represented as points.
 - .shx - indices into .shp file
 - .dbf - object attributes (initially object name and object type)

RiverWare supports export of the spatial coordinates of all or selected objects. When coordinates are imported, the user will be warned that the existing coordinates will be overwritten and notified when coordinates for unknown objects are encountered. Note that both export and import use the projected coordinate system.

Following is a diagram of the possible movement of coordinate data within RiverWare. Note, any operation using the system clipboard involves a Copy/Cut/Paste which involves Export Copy and Import Paste within RiverWare.

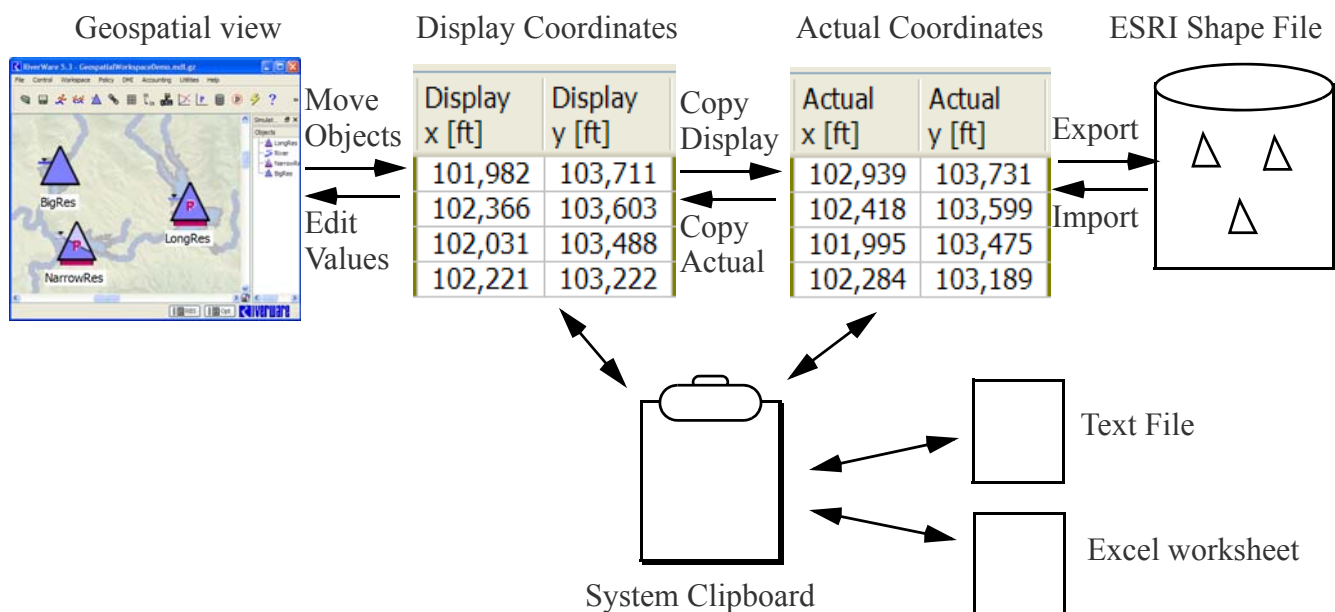


Figure 6: Data Operations in the Object Coordinate Manager Dialog

4.3.4 Getting Started with the Geospatial View

This section describes how you might begin to use the Geospatial View with an existing model which to this point has made use of only the Simulation and/or Accounting Views. Figure 7 shows the workspace Simulation View for the model we will be using to illustrate this process.

Step 1 - Acquire a map of the basin: As discussed above, the Geospatial View is most useful when you have a basin map with projection information. Such maps can be exported from a GIS application or acquired from a map provider. For example, one can download maps for the U.S.A. in a variety of formats from the USGS National Map web site (<http://nationalmap.gov>).

Step 2- Switch to the Geospatial View:

Initially the positions of the objects in this view will be based on their original placement in another view. Also, at this point, the canvas will have a default configuration and the object coordinates in the default coordinate system (which equates one unit of distance with one display pixel) will likely be orders of magnitude off of their true coordinates in any actual coordinate system. In our example, the southernmost reservoir (Salty Reservoir) is at the northernmost position, and object coordinates are in the range 100-400.

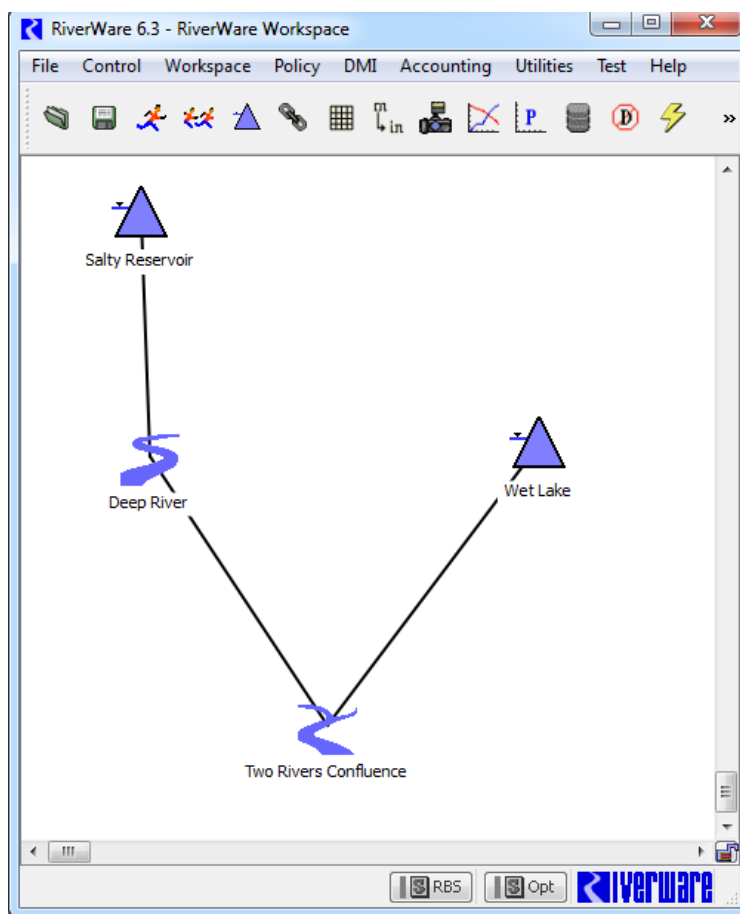


Figure 7: Simulation View of Example Model

Step 3 - Load the map:

Continuing with our example, open the **Geospatial Canvas Configuration** dialog and select a GeoTIFF image.

Note: There are many supported formats but common ones include GeoTIFF, JPG2000, and MrSID.

As illustrated in Figure 8, this is a 514 x 515 pixel image with projection metadata. While the projected coordinate system is not named in the metadata, the geographic coordinate system (datum) on which the projection is based, is NAD27.

Step 4 - Adjust the Canvas:

By clicking on the **Image & Canvas Locations** tab, we see the location of the image in the projected coordinate system, and we can adjust the canvas size if necessary. By default the canvas is automatically sized to be slightly bigger than the image, which works well for this model.

Step 5 - Apply changes:

At this point you have established the basics of the configuration and can apply your changes by clicking on **OK**. Since the default object coordinates are in the hundreds but the image rectangle y coordinates are in the 4000 km range, the objects are not on the canvas as we it is newly configured. Figure 10 illustrates the Geospatial View after apply our changes and letting RiverWare automatically place the objects on the

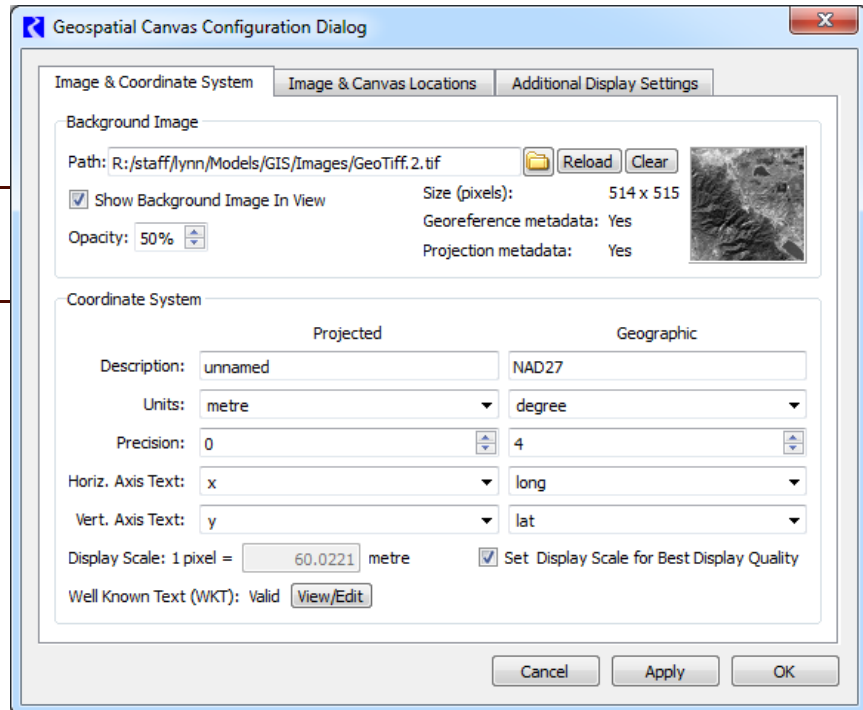


Figure 8: Geospatial config. dialog for sample model

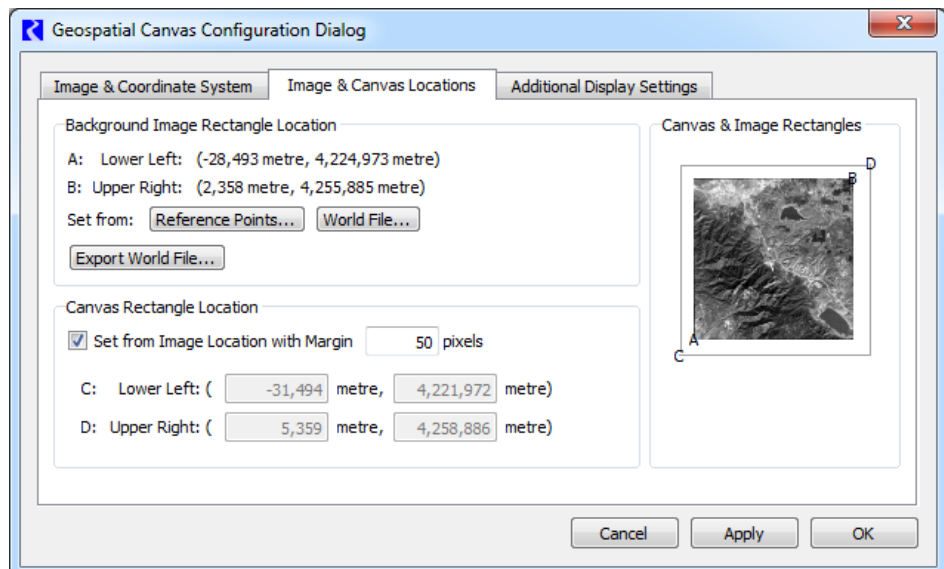


Figure 9: Geospatial configuration dialog for sample model

canvas. Note that the status text in the lower left corner of the dialog now shows the location of the cursor coordinates in both the projected and geographic coordinate systems.

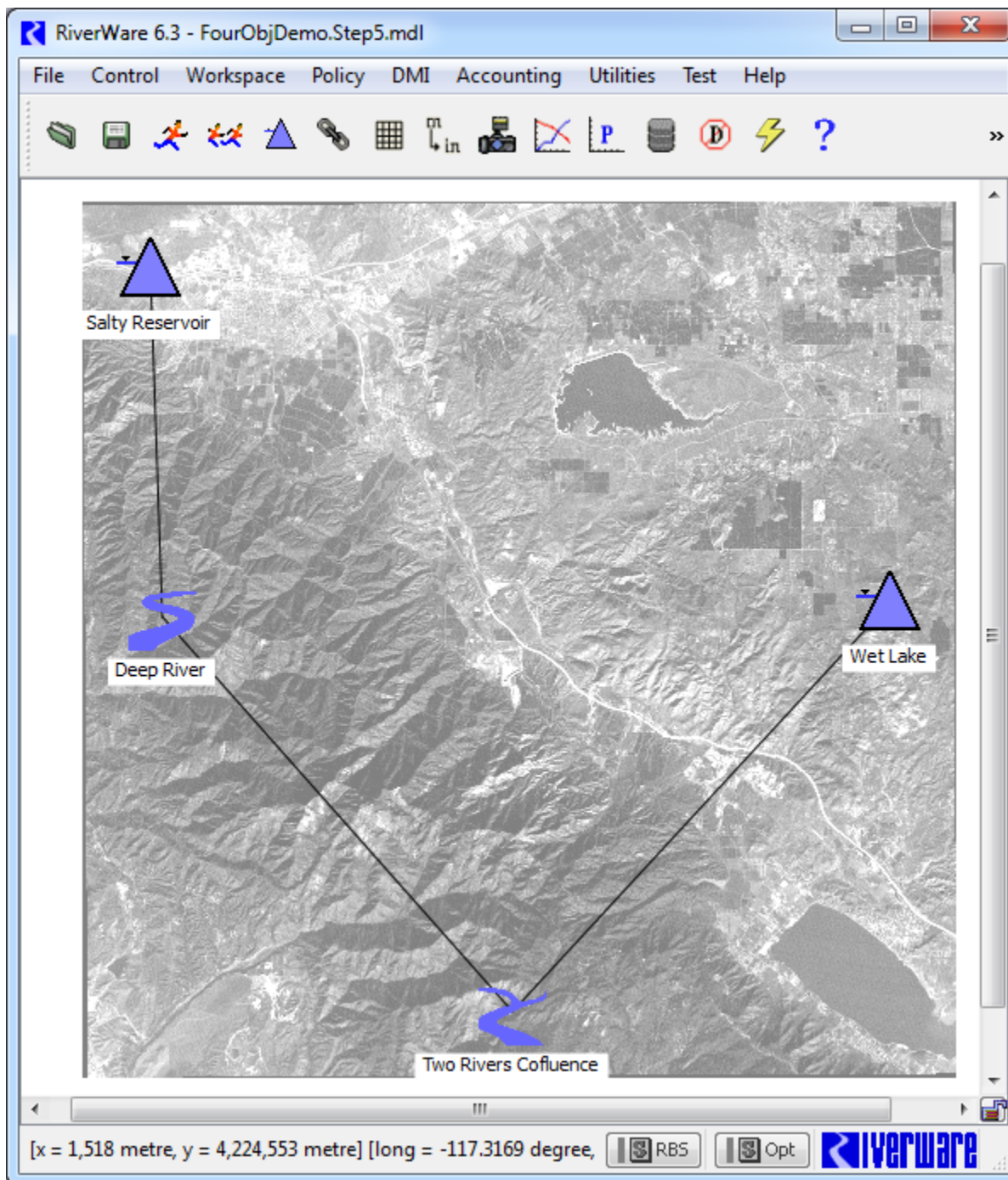


Figure 10: Geospatial canvas after importing image

Step 6 - Position the objects: All of the objects are on the canvas, but they are not at their true locations. If you knew their coordinates in the projected coordinate system, you could use the **Object Coordinate Manager** to place them, but for most purposes, placing them by hand in the workspace is adequate. Figure 11 shows the workspace after placing the objects at their approximate locations on the map.

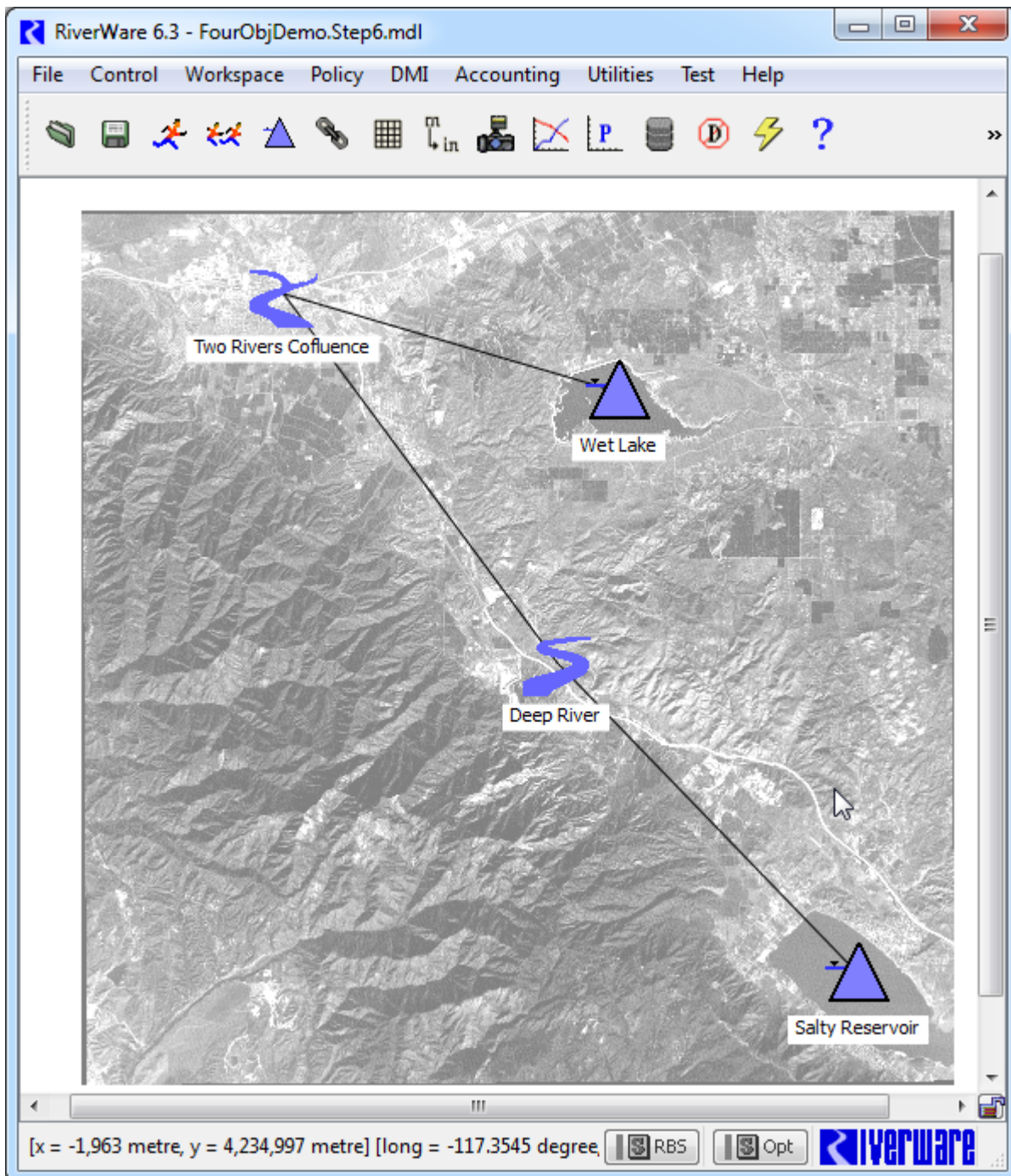


Figure 11: Geospatial canvas after moving objects

Step 7 - Refine the Configuration: For this small, low resolution image, the RiverWare icons tend to obscure the map. To improve the display, you can return to the canvas configuration dialog and adjust controls in the **Additional Display Settings** tab. Figure 12 shows the workspace after tinkering with the background color, font, and label orientation, and then adjusting the icon positions further.

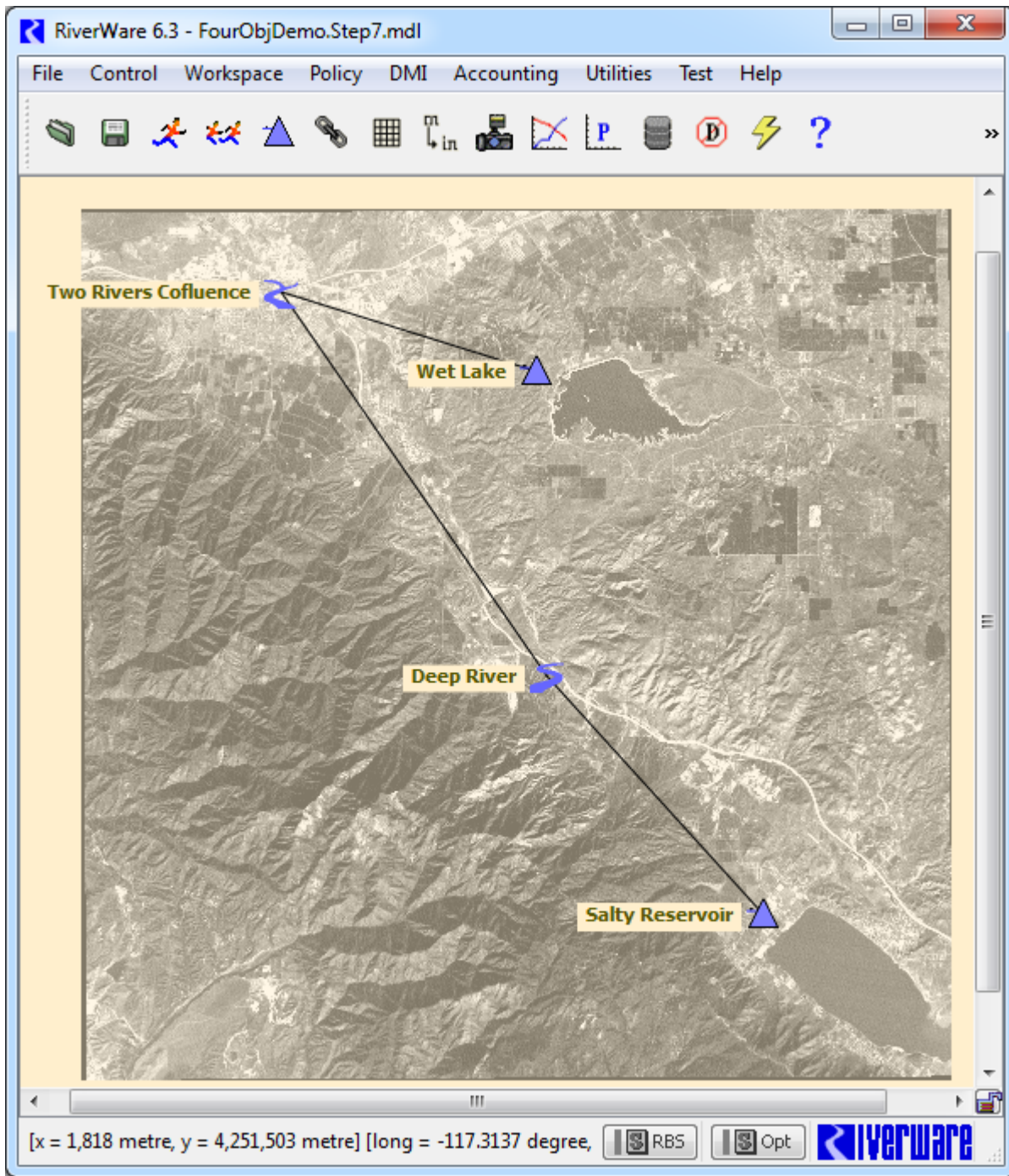


Figure 12: Geospatial canvas after adjusting settings


Workspace

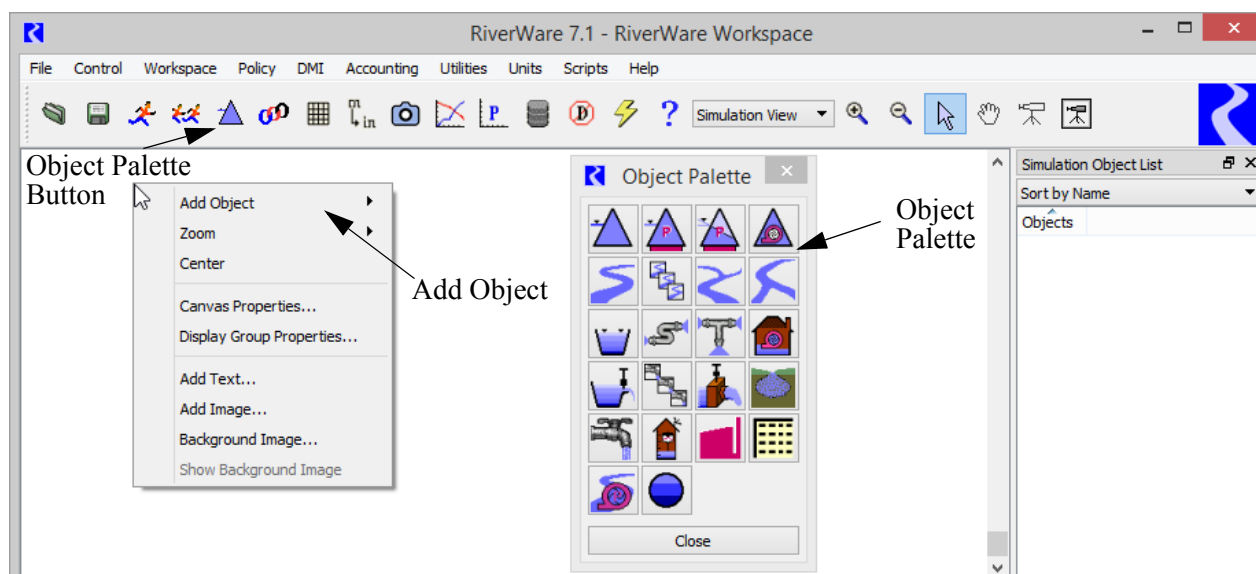
5. Objects on the Workspace

The workspace displays the objects representing features in the basin. The object icons are a convenient way to visualize the physical layout of a modeled system. These objects also contain the data and the physical process algorithms that drive the simulation. This section describes how to manage objects on the workspace.

5.1 The Object Palette

Objects are added to the workspace using the object palette. The **Palette** contains all of the available object types used to represent features of a river basin. It is the source from which objects are instantiated on the workspace. To place objects on the workspace, drag them off the object palette and place them in the desired location on the workspace. The object palette is accessed:

- by clicking on the object palette selector button on the main toolbar. 
- selecting **Workspace** ➤ **Objects** ➤ **Object Palette from the menu bar**.
- by right clicking with the mouse on the workspace. This will bring up a small window with the option to **Add Object**. Selecting the “add object” option opens a list of all objects. Clicking on the desired object will place it on the workspace.



5.2 Pulling Objects off the Palette

An object is created by clicking on its icon and dragging it off the **Palette** onto the workspace. At the time an object is created, the first timestep and timestep size in Series Slots are matched to the **Run Control** run time settings. The slots show display attributes (Units, Scale, Precision, and Format) as defined in the active Unit Scheme, [HERE \(Units.pdf, Section 2\)](#). Default user methods are also selected for new objects. Slots associated with the selected controller and Methods are allocated in memory. For more information on each type of object, click [HERE \(Objects.pdf\)](#).

5.3 Opening an Object

To open an object to see its slots, method selections, accounts, and description:

- Double click the icon on the workspace, or
- Double click on the object icon in the workspace object list.

This displays the Object Viewer. More information can be found [HERE \(ObjectDialogs.pdf, Section 1\)](#).

5.4 Selecting Objects

Objects can be selected for various reasons such as moving them, deleting them, or adding them to a subbasin. Once an object or group of objects has been selected, it will be highlighted both on the workspace and in the dockable list window.

The following are ways to select an object on the workspace:

- Single clicking on the object's icon.

- Drawing a rectangle around the object. To select multiple objects at the same time, draw a rectangle around a group of objects.
- Control clicking an object toggles the object in and out of the selection
- Shift clicking and dragging a rectangle adds objects to the selection.
- Right-clicking an object (to show its context menu) also adds the object to the selection.
- Single clicking on the object in the object list. Control and Shift Clicking allows selection of multiple objects in the list window.

5.5 Deleting Objects from the Workspace

Deleting objects from the workspace by selecting one or more objects, then right-clicking one of them. Select **Delete Object** from the menu. A confirmation dialog appears to inform that the selected objects will be removed from workspace.

This deletion can also be accomplished by selecting one or more objects and pushing the **Delete** key or by selecting the objects and using the main menus: **Workspace ➤ Objects ➤ Delete Selected Object(s)**. In both cases, confirmation is still required.

5.6 Moving Objects on the Workspace

An object can be moved by selecting it and holding down the mouse button while dragging the object to the desired location. This will readjust the links to the object as well. A set of selected objects can be moved while maintaining their relative positions. The selected objects remain visible on the workspace during the move. Moving objects will change the **Display Coordinates** on the Geospatial view but will not change the **Actual Coordinates** described [HERE \(Section 4.3.3\)](#).

5.7 Lock Icon Positions Controls

The moving of Simulation Object icons on the Workspace can be disabled by locking icon positions as follows:

- The Lock Icon Button in the corner between the two Workspace scrollbars.
- The menu **Workspace ➤ Lock Object Positions**



5.8 Show Commas in Numbers

RiverWare provides the option to show commas as a thousands separator in slot values (slot dialogs, SCT, accounts, and exchanges) and numeric values entered into a RPL expressions. Commas are shown by default but can be turned off by clicking on the **Workspace ➤ Show Commas in Numbers** option. When the option is selected, all values will update automatically.

5.9 Slot Cache

The Slot Cache provides a temporary copy of series slot values. The cache is created from the **Workspace ➤ Create Slot Cache** menu. Within the run range, all visible series slots (except those on Data Objects that are not optimization variables, exchanges, supplies, and those slots with different step size than the run) are copied to the cache when this menu is operated. These values can be accessed using RPL predefined functions **SlotCacheValue** and **SlotCacheValueByCol**. They are typically used during an optimization run for certain “Seed Method” parameters. The cache values are not saved in the model file.

Manually clear the Slot Cache using the **Workspace ➤ Clear Slot Cache** option.

Note, the slot cache is under development. Please contact riverware-support@colorado.edu for more information and the current status of this feature.

5.10 Clearing the Workspace

All objects can be cleared from the workspace using the following action: **Workspace ➤ Clear Workspace**. A confirmation dialog appears warning that all objects on workspace will be removed. All rulesets will also be cleared and any unsaved changes will be lost.

5.11 Importing and Exporting Objects

Objects can be exported to a file and then imported into the same or another model. Exporting one or more objects includes exporting slot data, method selections and optionally links, accounts and supplies. Objects can be imported and exported to and from the workspace as follows:

5.11.1 Export

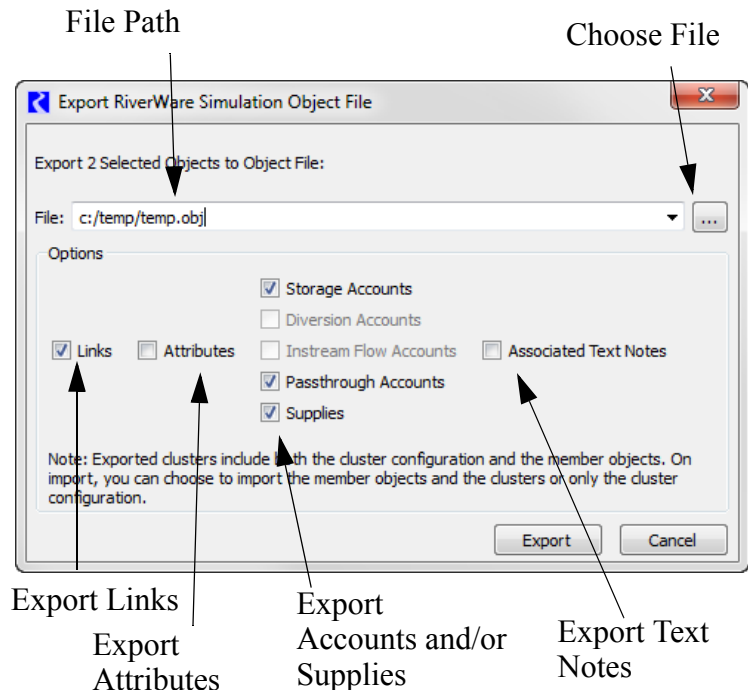
To **export**, first select, one or more objects. Then select **Workspace** ➤ **Objects** ➤ **Export Object** from the main workspace. The user is then presented with a dialog used to specify how the object(s) should be exported and to which file the object(s) should be written.

The following options are available for exporting depending on the model and possibly the selected objects' components.

- **Links:** Specify whether to write **Links** between slots.
- **Attributes:** Object attributes defined on the Attributes Manager and selected on the object's Attributes tab can be optionally exported.
- **Accounts:** In an accounting model, select the type of accounts to export: **Storage**, **Diversion**, **Instream Flow**, and/or **Passthrough** accounts.
- **Supplies:** In an accounting model, specify whether supplies should be exported.
- **Text Notes:** Specify whether to write **Associated Text Notes** - Click [HERE \(Slots.pdf, Section 6\)](#) for more information on text notes.
- As the note says, when the objects are part of an Object Clusters, both the cluster configuration and member objects are exported. When you import, you can choose whether to import objects and configuration or just the cluster configuration. This is described in the import section [HERE \(Section 5.11.2\)](#).

When exporting objects and links, only those links between exported objects will be written. Similarly, only those supplies between exported accounts will be written. In addition, the following are not exported:

- Subbasin membership of exported objects
- Computational subbasins
- Workspace display groups including Link, Object, Supply, and Account Groups
- Accounting exchanges including paybacks
- Accounting user defined object level methods - These may be exported separately from the RPL set. Note that method selection is exported on objects. It is important to export/import the object level accounting methods first as imported objects cannot reference methods that do not exist in the model

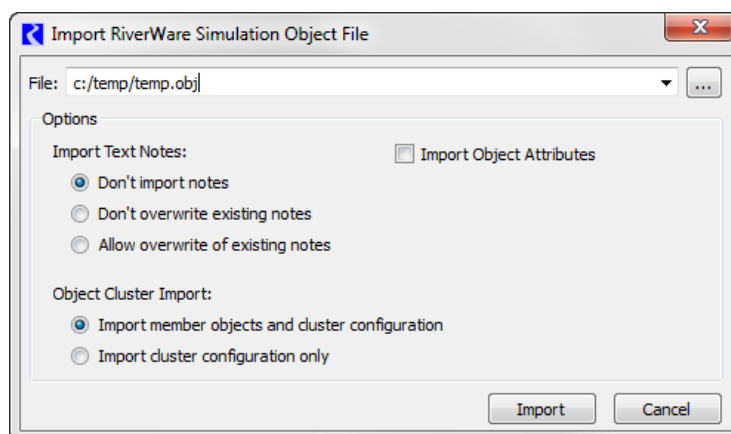


- For snapshots data objects, the reference to the original slot. When plotting slots and their snapshots from the output manager, the output manager cannot automatically plot a slot and its imported snapshots.

5.11.2 Import

To **import**, use the **Workspace** ➤ **Objects** ➤ **Import Object** menu from the RiverWare workspace. On import, the objects will have the same name as the original object unless an object by the same name already exists in the model. In this case, an integer is added to the object's name. The following options are available on import.

- Specify whether text notes should be imported as follows (Click [HERE \(Slots.pdf, Section 6\)](#) for more information on text notes):
 - **Don't import notes**
 - Import but **Don't overwrite existing notes**
 - Import and **Allow overwrite of existing notes**
- Specify a selection for **Object Cluster Import**:
 - Import member objects and cluster configuration
 - Import cluster configuration only
- Specify whether or not to **Import Object Attributes**



Imported objects are automatically selected (highlighted). Typically the user will then move all of the imported objects immediately to the desired location by dragging them on the workspace. This is especially true if they are on top of other objects. While the objects are still selected, it may be useful to create a subbasin of these objects so they may be easily selected later. Click [HERE \(Subbasins.pdf, Section 2\)](#) for information on how to create a subbasin from the selected objects.

Following are the limitations when importing objects. Objects are similar to model files, they can only be imported in models that have the same or higher version number, e.g. an object exported from a 5.0 model can only be imported into RiverWare 5.0, 5.1, etc.

On import, the objects will be placed at the same coordinates as the objects in the model from which they were exported in both the simulation and accounting views. If the workspace is too small to accommodate these new objects, the workspace will grow to exactly fit the imported objects (including a small border). Note, before RiverWare before 5.0, the coordinates of the objects on the accounting workspace were not exported. Therefore, if these objects are imported, they will be placed in the default location.

When an object or supply is imported and the name already exists in the model, the newly imported objects will be renamed by adding a number to the end of the name. The supplies will then be renamed using the default supply naming convention, “Object# Account to Object# Account”. A warning message is posted. If this new name is not available, because of multiple supplies between the same two accounts, the word “DUPL” is added to the end of the supply name to make it unique. These supply names can be changed from the account configuration. Accounts should not need to be renamed as account names are not unique only the object names are.

5.11.3 Export/Import Tips

There are a number of scenarios in which import/export of objects could be useful. One such example is when a team of modelers wish to break up a model and have various people work on different components. Following are some tips for this process.

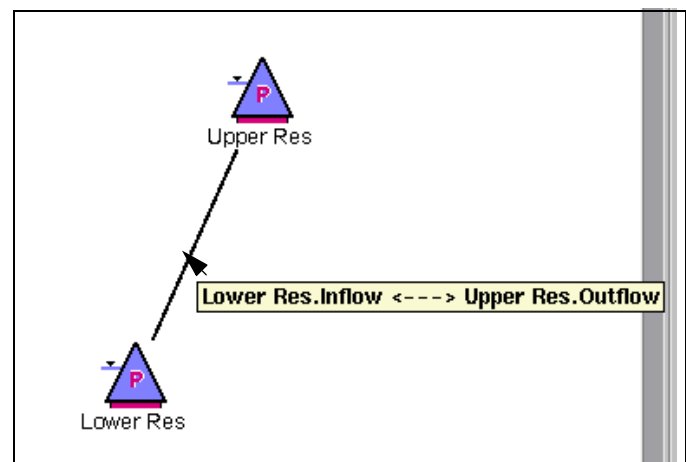
Each team member would take the full model and then pare it down to the desired objects, do the modeling work and then re-combine the pieces into one model. To pare down a model, it is typically better to delete unused objects than to export and re-import the desired objects into another model. By deleting objects, the Run Control parameters--run range, timestep length, controller, settings--are preserved. Also, the output devices, DMI's, object level accounting methods are then available in the pared down model.

To then re-combine the model with the original, it is best to delete the objects from the original model and then import the new objects from the pared down version(s). This prevents naming conflicts and having to re-name newly imported objects.

6. Links on the Workspace

Links are the connections between slots on objects which pass information during a simulation run. They propagate a value from a slot on one object to a slot on a different object. Several links may exist between different slots on two objects, but only one line is represented on the workspace. By hovering over the link with the mouse, all the linked slots are displayed in a tool-tip pop-up window as shown.

There are three utilities for viewing, creating and deleting links: Context Menus, the **Smart Linker**, and the **Edit Links** dialog. All three are described [HERE \(ModelBuilding.pdf, Section 6.2\)](#),

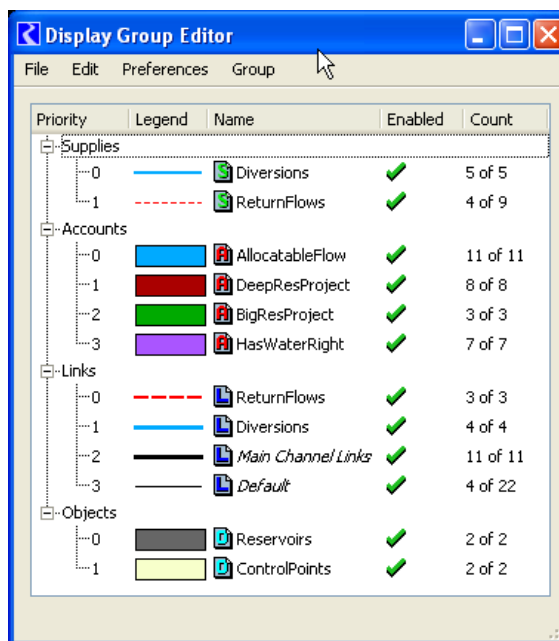


7. Display Groups

The appearance of links, objects, accounts, and supplies on the workspace can be manipulated using the Display Group Editor. The dialog is accessed by:

- Selecting **Workspace ➔ Display Group Properties** or
- right clicking with the mouse on the workspace and choosing **Display Group Properties**.

This brings up a window with the option to select **Display Group Properties**. The Display Group Editor provides the ability to create groups of links, groups of objects, and if accounting is enabled, groups of supplies and groups of accounts. The display properties and the membership of a group can be changed by double-clicking on that group. The membership of the groups need not be mutually exclusive. The groups are prioritized. For example, if two link groups contain the same link, the group highest in the list (lowest priority number) will be used to set the display properties of that link. Display groups can be enabled and disabled by clicking on the checkmark in the **Enabled** column.



The **Count** column provides information on the number of items in the group of the form XX of YY

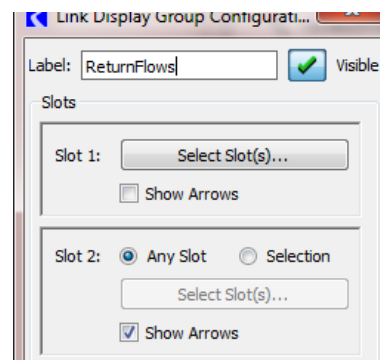
where YY is the number of items in the group's set selection, and XX is the number of those items which are governed by that group (i.e. not currently governed by an enabled, superior group).

Note: The counts are not automatically updated if you delete objects, accounts, links, or supplies. The counts can be updated manually with the **Groups ➔ Update Item Counts** menu item. They are also updated when the Display Group Editor dialog box is reshown.

7.1 Link Groups

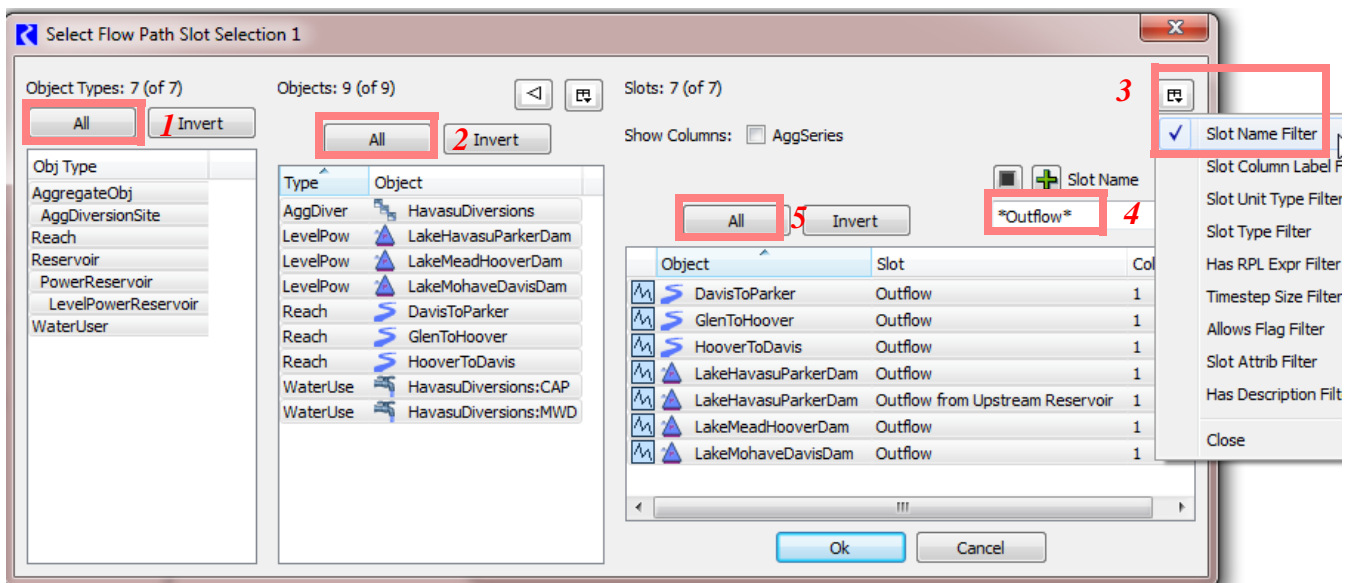
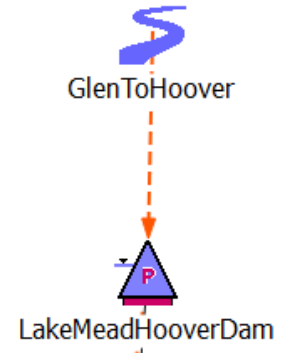
A link group can be created by selecting **Group ➔ Add Link Group** in the Display Group Editor. Double-clicking on the new link group entry will bring up the **Link Display Group Configuration** dialog. Provide a name that will be shown in the Link Group Editor.

In the top part of the dialog, you specify the slots on either end of the links. Click on **Select Slot(s)...** in the **Slot 1** area to specify the first set of slots. You can use filters and other selection mechanisms to quickly choose a large number of slots. This is describe in the **Selector** help



[HERE \(Selector.pdf, Section 1\)](#) with an example shown below. Either leave the **Slot 2** as **Any Slot** or specify slots using the selector.

You can then choose to show arrow heads on either end of the links using the **Show Arrows** option. Note that the ordering of the slot selections is important if want to show arrows. For example, if you wanted to show arrows from all Outflows to all Inflows (i.e. the flow path), you could choose as shown in the following figure, for Slot 1: **All Object Types** (1), **All Objects** (2), and use a slot name filter (3) and enter *Outflow* (4). Then click the **All** button (5). Then click **Ok**. Use the **Any Slot** option or choose only Inflow slots.

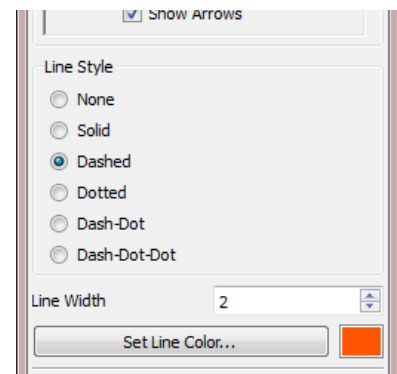


In the bottom portion of the dialog, you can control the **Line Style**, **Line Width**, and **Line Color** of the links.

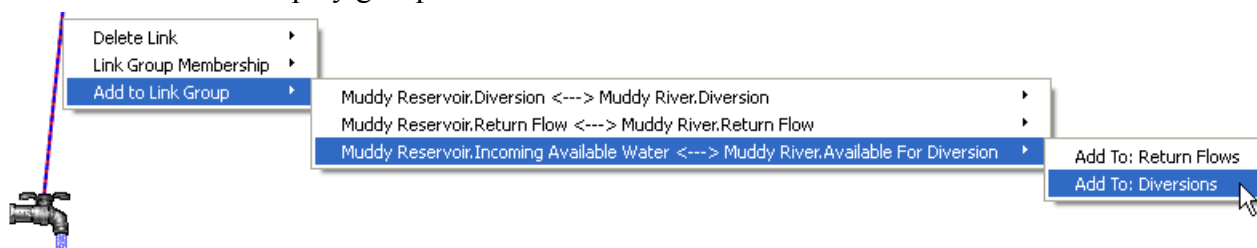
7.1.1 Selecting Links

From the Workspace, a link can be added to link group by right-clicking on the link(s) between two objects, mousing over the **Add to Link Group** option, mousing over the desired link (there can be multiple links on the same “line” between two objects), and selecting the desired **Add to: <link group>**.

Equivalently, links can be added to a link group within the Display Group Editor. This approach allows multiple links to be added to a link group at once. By double-clicking on the desired link group, the Link Display Group Configuration window is opened. The slot



on one end of the link is selected by clicking Select Slot(s) in the **Slot 1** field. If the **Any Slot** toggle is selected in the **Slot 2** field then all links to any of the slots listed in the **Slot 1** field will be associated with the display group. While the Link Display Group Configuration dialog does not display the links associated with a particular group, the slot selector dialog “remembers” the selected links. Therefore, the user can view the links associated with a group by clicking on the **Select Slots(s)...** button. To make a more specific selection of links, slots can be selected in the **Slot 2** field if the **Selection** toggle is enabled. Only those links that are connected to a slot in the **Slot 1** field AND the **Slot 2** field will be associated with the display group.

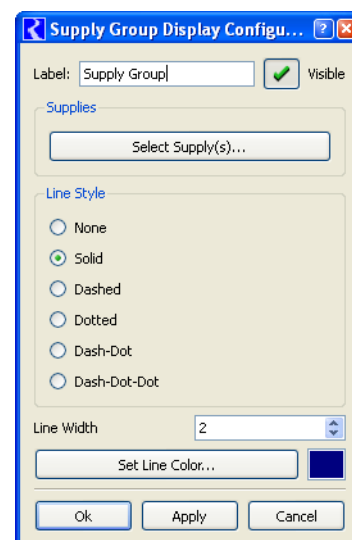


7.1.2 Predefined Link Groups

Two predefined link groups are provided for all models: *Main Channel Links*, and *Default*. The *Main Channel Links* group contains all links between main channel upstream slots and main channel downstream slots. The *Default* link group contains all links on the workspace.

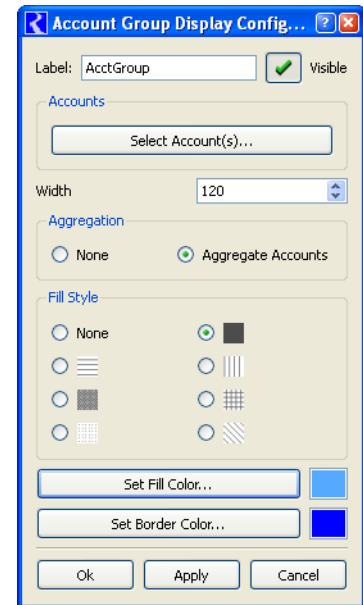
7.2 Supply Groups

Supply groups are active only if accounting is enabled. A supply group can be created by selecting **Group ➤ Add Supply Group** in the Display Group Editor. Double-clicking on the new supply group entry will bring up the Supply Display Group Configuration dialog. The membership of the group and the line style, color, and width of the group members can be set with this dialog. The membership of the group is controlled by pressing the **Select Supply(s)...** button. More information on Supply Groups is given [HERE \(Accounting.pdf\)](#).



7.3 Account Groups

Account groups are active only if accounting is enabled. An account group can be created by selecting **Group ➤ Add Account Group** in the Display Group Editor. Double-clicking on the new account group entry will bring up the Account Display Group Configuration dialog. The membership of the group and the fill style, fill color, account width, account aggregation, and border color of the group members can be set with this dialog. The membership of the group is controlled by pressing the **Select Account(s)...** button. If account aggregation is selected, the selected accounts, on a particular simulation object, will be collapsed into one icon. The icon will appear as a “stacked” group of accounts to indicate the presence of more than one account. An account can also be added to an Account Display Group by right-clicking on the account on the workspace, mousing over **Add to Account Group**, and clicking on the desired Account Display Group. If the account is already a member of an Account Display Group, this option will be replaced with **Account Group Membership**. Mousing over this option will show the display group to which the account belongs. More information on Account Groups is given [HERE \(Accounting.pdf\)](#).

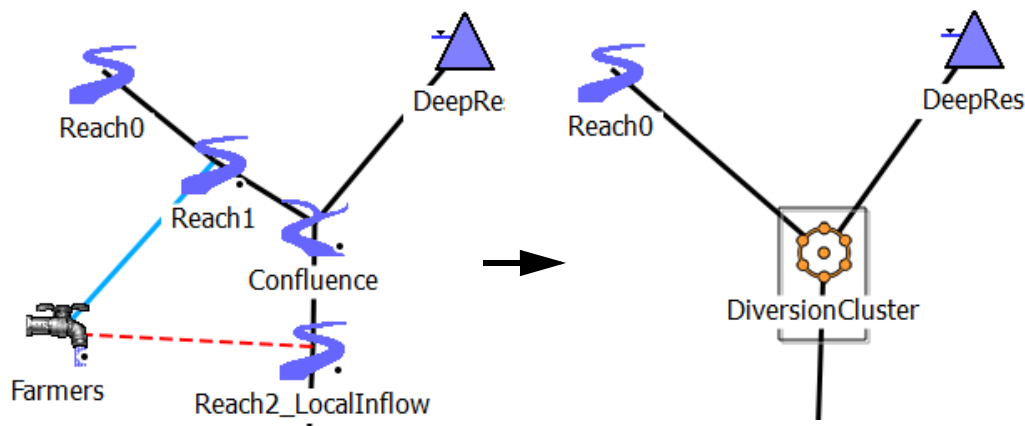


7.4 Object Groups

The display options associated with object groups apply to both the Simulation View and the Accounting View of the RiverWare workspace (some options apply only to accounting). An object group can be created by selecting **Group ➤ Add Object Group** in the Display Group Editor. Double-clicking on the new object group entry will bring up the Object Display Group Configuration dialog. The membership of the group and the fill style, fill color, visibility, drawing layer, and border color of the group members can be set with this dialog. The membership of the group is controlled by pressing the **Select Objects(s)...** button. An object can also be added to an Object Display Group by right-clicking on the object on the workspace, mousing over **Add to Object Group**, and clicking on the desired Object Display Group. If the object is already a member of an Object Display Group, this option will be replaced with **Object Group Membership**. Mousing over this option will show the display group to which the object belongs. The fill style, fill color, and border color apply only to objects in the Accounting View as indicated in the Object Display Group Configuration dialog. The Drawing Layer option is useful when simulation objects are stacked on top of each other on the workspace. The user can control the order of the layering or stacking by specifying the Drawing Layer. Objects with a higher priority Drawing Layer (lower numerical value) will be displayed on top of objects with a lower priority Drawing Layer.

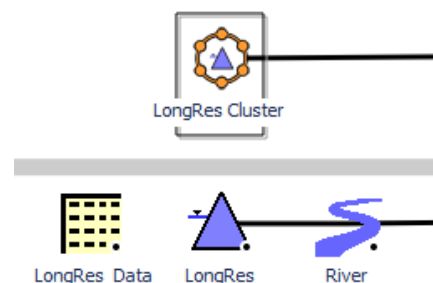
8. Object Clusters

Object Clusters allow you to group together simulation objects on the workspace and show only a single icon.



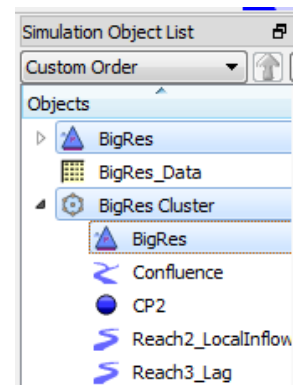
Clusters have the following properties:

- Clusters are display-only; they have no effect on the model solution.
- Clusters are supported on the Simulation and Geospatial Views. They are not supported in the Accounting View.
- Clusters can contain any simulation objects which appear on the workspace, except other clusters.
- A simulation object can be a member of only one cluster.
- Adding a simulation object to a cluster does not effect the object's locations within any of the workspace views.
- For any cluster, you can switch between:
 - Displaying the cluster icon with either the default orange dot or the icon for any member object. See image to the right.
 - Displaying the individual member objects' icons with a black dot in the bottom-right area of the icon indicating it is part of a cluster.
- When the cluster icon is shown, links between objects in the cluster and objects outside of the cluster are drawn to the cluster icon.
- Cluster settings are independent between the Simulation and Geospatial view. For example, a cluster can be shown with a cluster icon in the Geospatial View and with individual member object icons in the Simulation View.



- An item for each cluster appears as a top-level item in the **Simulation Object List**. Each cluster item has a tree view showing each of its member simulation objects. A particular object can appear twice in the list. In the image to the right, notice that “BigRes” (a level power reservoir) appears twice.
- On the workspace, hover over the cluster to see a tool tip with a list of the member objects.

Following is more information on how to create and use Clusters.



8.1 Creating a Cluster

To create a new cluster, select one or more simulation object icons on the Simulation or Geospatial workspace and either:

- Right-click on one of those selected object icons and choose **Add to Object Cluster ➤ New** menu
- Use the **Workspace ➤ Object Clusters ➤ Add to Object Cluster ➤ New** menu on the workspace

If any of the selected simulation objects are already in a cluster, the **Add to Object Cluster** context operation is instead presented as **Move to Object Cluster**. This operation is used to move objects from one cluster to another. Note, an object can be in only one cluster.

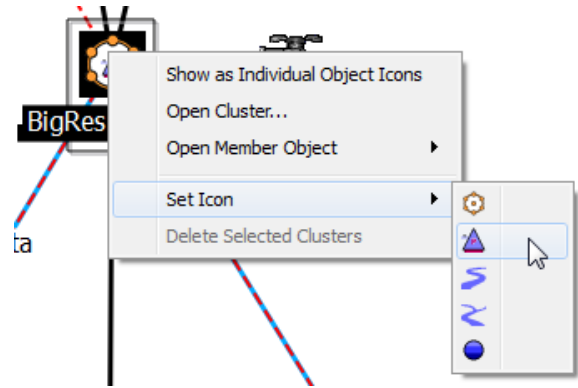
8.2 Operations on a Cluster

In general, to modify a cluster you can either right-click on the cluster on the workspace, right-click on the cluster in the Object List, or select the cluster and use the **Workspace ➤ Object Cluster** menu.

Following explains the various options, depending on the selection and the menu chosen:

- **Show as Individual Object Icons** Shows the member object icons and hide the cluster icon. Each object will show a black dot in the lower right indicating it is part of a cluster.
- **Show as Single Icon** or **Show as Object Cluster**: Shows the cluster icon and hides the member object icons.
- **Open...** or **Open Cluster...** Shows the Open Object Cluster dialog; see the next section [HERE \(Section 8.3\)](#).
- **Open Member Object** shows a submenu of the member objects. Clicking on one of those objects opens that object's Open Object Dialog.

- **Set Icon:** Choose the icon to use in the center of the cluster's icon. A cluster's context menu's **Set Icon** submenu presents each of the member objects' icon as shown in the screenshot. Click one of these items to set the small icon in the middle of the cluster icon.
- **Delete Cluster / Delete Selected Cluster:** Delete the cluster, showing the individual members' icons. The member objects are displayed in their original positions with their icons displayed. You must confirm this operation.
- **Remove (Selected Objects) From Cluster:** Remove the selected member objects from their containing cluster. Their icons will be shown on the workspace as usual.
- **Add Selected Objects to Cluster:** From the **Workspace** ➔ **Object Cluster** menu, you can choose this option to add the selected objects to the specified cluster.



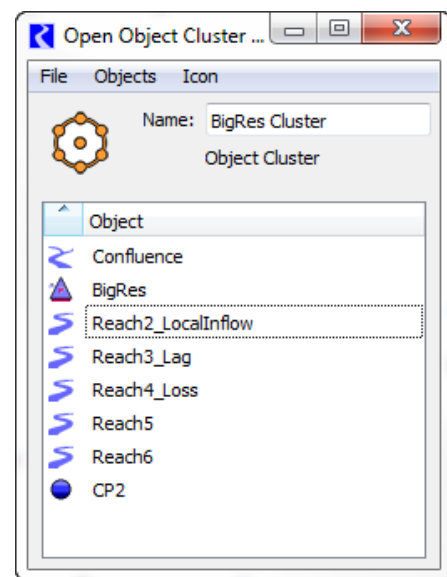
8.3 Opening a Cluster

To see a list of the objects in a cluster, open the cluster by:

- Double clicking on a cluster's workspace icon.
- Double clicking on a cluster's **Simulation Object List** item
- Clicking **Open Cluster...** in a cluster's workspace icon context menu.
- Clicking **Open...** in a cluster's Workspace Object List item context menu.

The **Open Cluster Dialog** shows the member objects in a list. Sort by object type or object name by clicking in the column header. From this dialog, you can:

- Rename the cluster using the **Name:** field.
- Use the **Objects** menu, to open the selected object.
- Use the **Objects** menu, to add simulation objects to the cluster using the object selector dialog.
- Use the **Objects** menu to remove selected member objects from the cluster.
- Use the **Icon** menu to set the cluster's icon to the default cluster icon (shown to the right) or a cluster icon containing a small version of the selected object.
- Open any of the member objects by double clicking them.



Most of these operations are also available by right clicking an object/cluster in the Simulation Object List.

9. Exporting and Printing Model Images

It is possible to export or print an image of the workspace for use in presentations or other graphic applications.

9.1 Exporting Model Images

Selecting **File ➤ Export Workspace** Image brings up the options to export the entire workspace image or only the visible portion of the workspace. The image can be saved in the following formats: PNG, BMP, JPG, PMB, PGM, PPM, XMP, or XMB. It is also possible to specify image resolution, width, and height in the export dialog.

In general, users will get the best results if they use PNG instead of JPG. PNG is very much like GIF, but has an open specification. (GIF is proprietary). JPG is lossy, but best for images with a lot of continuous variation. GIF and PNG are non-lossy for images with a limited number of colors (no more than 256 colors, which is the case with riverware workspace images, for the most part) -- and they compress really well for images with large blocks of solid color (also an attribute of the workspace). Also, GIF and PNG are much cleaner for the purpose of workspace and plot images. With JPEG, the user may see “wiggles” on edges.

9.2 Printing Model Images

The print option prints the entire workspace image. To print the workspace, select **File ➤ Print**, which brings up the Setup Printer dialog. In this dialog, various printing options can be selected.