RiverWare

Technical Documentation Version 7.3

Model Building

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

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Introduction: In general, building a RiverWare model consists of the following steps. Some models require additional steps and others do not require all of these steps. This document describes these steps and provides links to documents with more information:

1. Define your desired Unit Scheme.

2. Select the Simulation Controller and set Run Times for a simulation run.

3. Pull objects off the Palette.

4. Select user methods on the objects.

5. Set timeseries ranges, enter, import, and export slot data.

6. Link objects together to define the basin topology.

1. Defining Units

RiverWare stores all slot values in RiverWare internal units and performs calculations in these units (except where the algorithms do explicit conversions). You can display values in any **User Unit** that you wish. You define the user units, scale, precision and format by setting up a Unit Scheme. More information on features of Unit Schemes may be found in the reference located **HERE (Units.pdf, Section 2)**.

2. Selecting the Controller and setting Run Times

The next step in building a model is to select the controller and specify the run times and timestep for the run. These actions are performed from the **Run Control** dialog.

• Selecting **Control ➡ Run Control Panel** or clicking the Run Control toolbar icon, brings up the **Run Control** dialog.
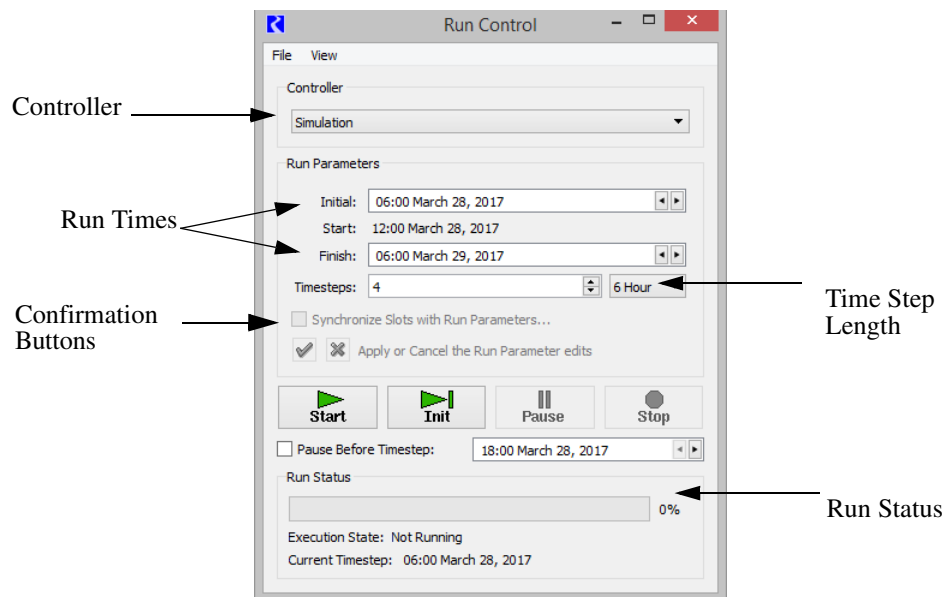
- From this dialog, specify:
  - Controller
  - Timestep length
  - Initial date
  - Finish date or number of timesteps.

For a detailed description of this dialog and the various pieces click **HERE (RunControl.pdf, Section 1)** to go to the Run Control documentation.

3. Objects on the Workspace

A model can be created on a blank workspace by selecting desired objects from the object palette and placing them on the workspace. 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.

3.1 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.** Mousing over the "add object" option opens a list of all objects. Clicking on the desired object will place it on the workspace.

The coordinates of the objects on the workspace are saved with the model so that objects will remain in position.
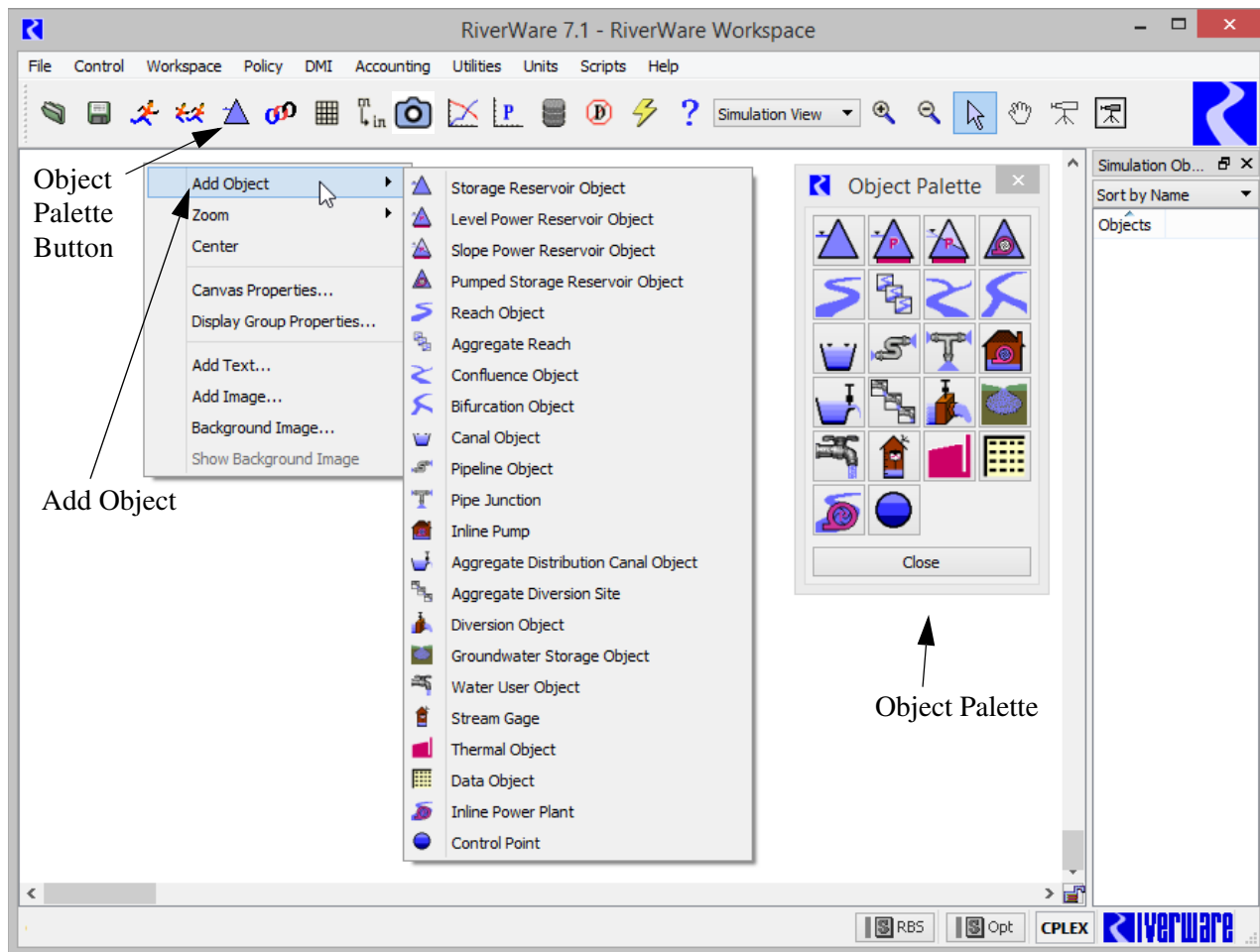
3.2 Pulling Objects Off The Palette

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, default attributes are defined by several sources. The first timestep and timestep size in SeriesSlots are matched to the **Run Control** run time settings. Display units and other slot configurations will conform to the currently 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)**

For more information on managing objects including, selecting, importing, exporting, deleting, and clearing the workspace, click **HERE (Workspace.pdf, Section 5)** to view the workspace documentation.

4. Configuring Objects

Objects are configured from the Object Viewer (or Open Object) dialog. More information on this dialog is presented **HERE (ObjectDialogs.pdf, Section 1)**. The general steps to necessary to configure the objects are as follows:

- Name the object: **HERE (ObjectDialogs.pdf, Section 2.1)**
- Select User Methods: **HERE (ObjectDialogs.pdf, Section 2.3.1)** Note, the **Multi-Object Method Selector** can be used to select methods on multiple objects in one action. This feature is described in detail **HERE (ObjectDialogs.pdf, Section 4)**.

5. Importing/Entering Data into slots

The next step in model building is to enter data into slots. This topic is described in detail in the Slots section of the online help **HERE (Slots.pdf, Section 2.1.1)**.

6. Linking Slots on Objects

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. Links are bidirectional in general, but in a pure simulation run, if values propagate in both directions during a single timestep, the model is overdetermined, and the run aborts.

A slot may be linked to more than one other slot. Also, several links may exist between different slots on two objects, but only one line is represented on the workspace.

6.1 Viewing Existing Links on the Workspace

In models with many links, it can be difficult to determine which objects and slots a particular link is connecting. By hovering over the link with the mouse cursor, all the connected objects and slots associated with that link are displayed in a tool-tip pop-up window as shown. The link name is also shown in the workspace status bar (lower left corner). This can be useful because as long as the mouse is over the link, the name is shown in the status bar. Tool tips only show the name for a few second.
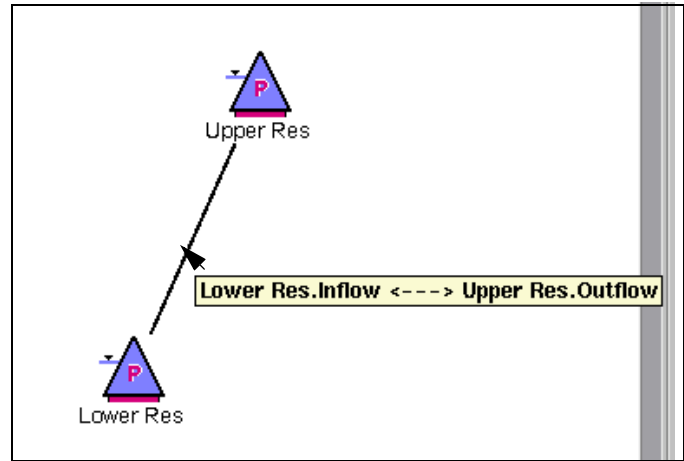
Also, in the **Object Viewer** (or **Open Object**),

Slots tab, linked slots are marked with a ⬜.

Right clicking on a linked slot brings up a context menu. Highlighting **Linked Slots** displays a list of all slots linked to the selected slot. Clicking a slot on this context menu will open that slot.

6.2 Editing Links

There are three utilities for viewing, creating, and deleting links:

- Context Menus - Create links between any two slots on the workspace using the context menus. Delete any existing link from the workspace.
- Smart Linker - Create recommended links between two objects. Delete existing multiple links between two objects in one operation.
- Edit Links dialog - Create a links between any two slots. Delete any existing link.

These three approaches are described in the following sections:

6.2.1 Context menu

On the workspace, right-click context menus can be used to create or delete links as follows:

Creating Links: Use the right-click context menu **Link Slots** to link any two slots. Create links by first right-clicking on an object. A context menu dialog appears. Select **Link Slots** then choose the slot you wish to link. A link is started. Then, right click on another object to which the link will end. Choose **Link Slots** and select the slot on that object. The link is created. Note, you can link any two dispatch slots in the model regardless if the link makes physical sense.

Deleting Links: Delete links between objects by hovering over the link and right click. In the context menu, choose **Delete Link** and select a link from the list. The link will be deleted.

6.2.2 Smart Linker

The **Smart Linker** simplifies the process of linking slots by recommending a set of links between two selected objects based on the **type of object**, their **method selections**, and the **relationship** between the two objects.

For example, if you select a reach and a groundwater object, and you have the Head Based Seepage method selected on the reach and the Head Based Groundwater Grid method selected on the groundwater object, the Smart Linker proposes the links: **Reach.Previous Water Table Elevation** to **Groundwater.Elevation Previous** and **Reach.Seepage** to **Groundwater.Inflow from Surface Area**. If you are also modeling evaporation or salinity, another set of links are proposed.

> **Note:** The recommended links have been defined by CADSWES based on common modeling practices, experience, and existing models. It is possible that there are other slots that you may wish to link.

Accessing the Smart Linker: The **Smarts Linker** dialog is accessed by selecting two objects on the workspace, then either:

- Right clicking and choosing **Smart Linker...**
- Clicking the Link icon on the workspace and choosing **Smart Linker**.
- Choosing **Workspace ➡ Smart Linker...** menu on the workspace.

If there are 0, 1, 3, 4... objects selected on the workspace, a warning box opens. You should select exactly two objects.

If the two selected object do not have any recommended links defined, a warning dialog opens. If you wish to link slots on these objects, use either the Link Slots context menu or the Link Editor.
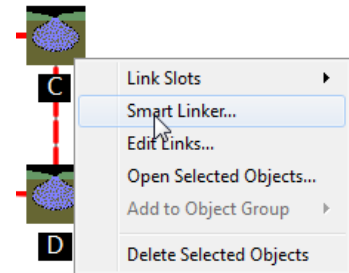
Overview: Following is screenshot of the Smart Linker tool followed by an overview of the tool.
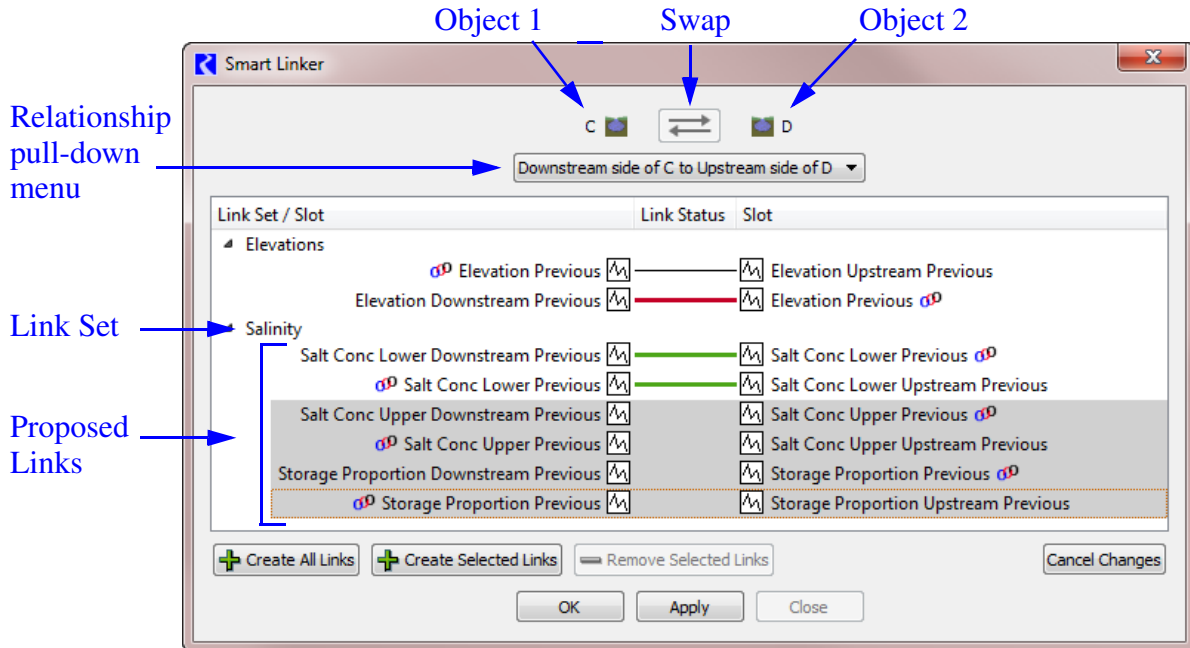
The dialog shows the two selected objects at the top. The double-arrow button ⇄ swaps the two objects in the dialog (left to right). It is disabled when there are any un-applied link additions or removals, or if the reversed order is not supported.

The pull-down menu shows the available spatial relationships between the two selected objects. Use this pull down to indicate the relative position or relationship of the two objects. For example, is Object 1 upstream or downstream of Object 2. Possible examples include upstream / downstream, left / right, diverts from / diverts to, returns from / returns to. The selected relationship will lead to different recommended links.

Listed in the body of the dialog are sets of recommended links in a treeview with the specific slots shown.

A horizontal line in the **Link Status** column indicates the following:

| Image	Color	Description
——————	Thin black	An existing link.
——————	Thick Green	A tentatively added link.
——————	Thick Red	A tentatively removed link

Buttons along the bottom allows you to create or delete selected links. These changes are made tentatively; choose **OK** or **Apply** complete the operation or **Cancel Changes** to cancel the changes.

Aggregate/Element Objects: Aggregate objects are handled a little differently. Because the **Smart Linker** is opened by choosing two objects on the workspace, there is no way to select an element, so the selection of the element is made in the **Smart Linker**.

When an aggregate object is shown in the **Smart Linker**, a toggle box labeled **Element** is shown. Leave it unchecked to link the aggregate object. Check the box and select the element to link the element object. For example, on the screenshot shown to the right, a reach element Reach0 will be linked to the aggregate diversion site.

Creating Links: To link the slots shown in a row, highlight the row and click **Create Selected Links**. Alternatively click the **Create All Links** button to create all the recommended links. The **Link Status** for that row turns to a green line. Click **OK** or **Apply** to actually create the links.
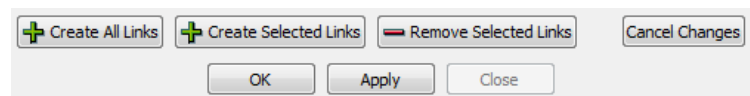
Deleting Links: Any existing link can be deleted by highlighting the row and clicking the **Remove Selected Links**. The **Link Status** for that row turns to a red line. Click **OK** or **Apply** to actually delete the link.

Using the Smart Linker: Following are basic steps to use the **Smart Linker** to create all the recommended links between two objects:

1. Select two objects on the workspace that you wish to link. Right click and choose **Smart Linker...**

2. In the **Smart Linker**, orient the two objects as desired using the swap button.

3. If applicable, use the pull-down menu to specify the relation ship of the two objects. After each change, a different set of slots will be listed as recommended links.

4. Create all of the recommended links by clicking on the **Create All Links** button.

5. Click **OK** to create the links and close the dialog.

6.2.3 Link Editor

Sometimes the above links operations do not provide enough flexibility to view, create or edit links. In this situation the **Edit Links** dialog provides a comprehensive location to view, create, and delete links.

From the workspace, selecting **Workspace ➥ Edit Links...** or clicking on the Link Editor toolbar icon, and choose Edit Links. The utility is shown in the following dialog.

The **Edit Links** dialog is divided into two areas, one for Existing Links and one for Link Creation.
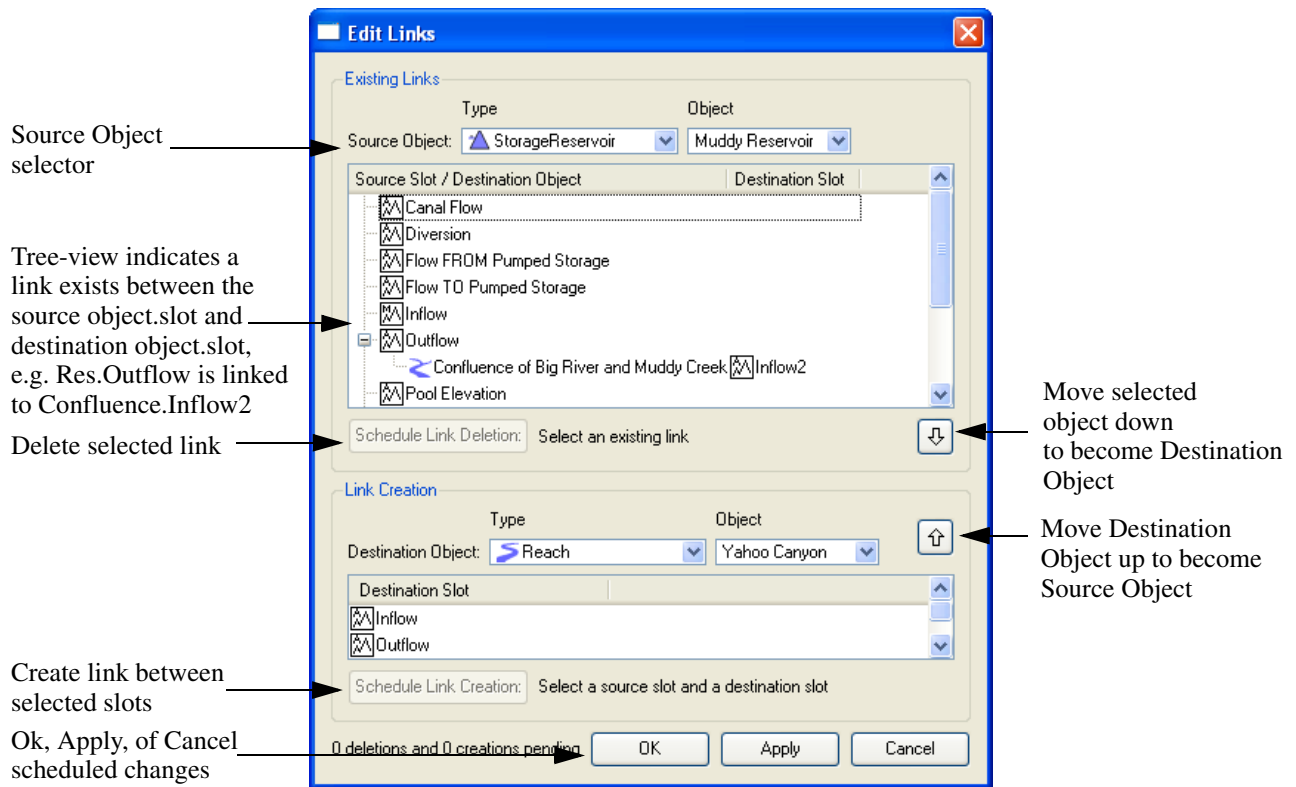
Existing Links - Viewing and deleting: The upper portion of the dialog is used to view and delete existing links. A list of slots is generated by selecting a **Source Object: Type** and an **Object**. The list of all linkable slots on that object appears in the **Source Slots** tree-view list. Aggregate Objects show the upper level aggregate and each element with a "**+**" symbol to display the member slots, similar to the Object Viewer (or Open Object) dialog.

A slot in this dialog has a link if it has a "**+**" symbol to the left of its name. Clicking on the "**+**" expands the tree view and shows all of the slots linked to the given slot by displaying the **Destination Object** and **Destination Slot**.

When the you highlight a row containing a **Destination Object** and **Destination Slot**, the **Schedule Link Deletion** button becomes active. Clicking this button will "schedule" the link for deletion; the link is actually deleted when the Ok or Apply button is clicked. When a link is scheduled for deletion, the text is displayed with a strike through its name and a note next to the button.

Note, you can create a link between two slots, then change methods on one or both of the objects such that the linked slots are no longer visible or in use. The link will remain on the workspace and in the **Edit Links** dialog, the **Source Slot** will be shown in *italics* to indicate that it is not currently visible in the model. You are prevented from creating links between non-visible slots, but links between non-visible slots can be deleted and viewed.

Creating Links: Both the upper and lower portion of the dialog are used to create new links. First select a **Source Object: Type** and **Object** in the upper portion of the dialog. Then select a **Destination**

Object: Type and **Object** in the lower portion. Highlight the desired slot in the upper and lower lists and click the **Schedule Link Creation** button to "schedule" the link for creation; the link will actually be created when the OK or Apply button is clicked. A link scheduled for creation is shown as green text and the tree view is automatically expanded.

Links can be created between any pair of slots when one slot is listed in the top half and the other slot is listed in the bottom half. These links may not all make physical sense, but any combination can be defined.

Moving the Destination Object to become the Source Object: Often when using this dialog, you are creating a series of links in a specified order, say upstream to downstream. To accommodate this, the up

arrow button ⬆ can move the **Destination Object** in the link creation area up to become the **Source**

Object. Similarly, the down arrow ⬇ can be used to move the **Source Object** down to become the **Destination Object**. When using this button, the object in the selected row is moved down; thus, you can either select a slot (or make no selection) and the **Source Object** will move down. Or, you can highlight the linked **Destination Object** and **Destination Slot** row (via the tree-view) and clicking the down arrow will move the selected destination object down to become the object selected in the link creation area.