

# HEC-ResSim Reservoir System Simulation



## **Quick Start Guide**

Version 3.3 February 2021

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# HEC-ResSim Reservoir System Simulation

**Quick Start Guide** 

Version 3.3 February 2021

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## **Table of Contents**

Introducti	ion	1
Starting	g the Program	1
Exiting	g the Program	1
First, Son	ne Terminology	2
What is	s a Watershed?	2
What a	are Watershed Locations?	2
What a	are Modules?	
А.	Watershed Setup Module	
В.	Reservoir Network Module	6
C.	Simulation Module	
Some (	Other Useful Terms	9
Getting D	Down to Business	10
Steps for	for Developing a Reservoir Model	10
Â.	Set Up the Watershed	11
В.	Develop a Reservoir Network	
C.	Define Alternatives	
Steps for	for Performing a Simulation	
Â.	Create/Open a Simulation.	
B.	Set Alternative to be Active.	
C.	Compute	

### **List of Figures**

Figure 1: Tools Menu, Options Editor, Watershed Locations	. 2
Figure 2: Add Watershed Location	. 3
Figure 3: ResSim Module Concepts	. 3
Figure 4: Watershed Setup Module, Opening Window	. 4
Figure 5: Watershed Setup Module, Opened Watershed, HayesBasin	. 6
Figure 6: Reservoir Network Module, HayesBasin	. 7
Figure 7: Simulation Module, HayesBasin	. 8
Figure 8: New Watershed	12
Figure 9: Allow Layer Editing	12
Figure 10: Drawing a Stream Alignment	13
Figure 11: Configuration Editor	15
Figure 12: Rename Computation Point	16
Figure 13: A Simple Configuration, StandardConfig	17
Figure 14 Import Network Wizard - Step 1 of 6 Select Watershed from which to Import	18
Figure 15 Import Network Wizard - Step 2 of 6 Select Network from which to Import	18
Figure 16 Import Network Wizard - Step 3 of 6 Define New Network Name and Description	19
Figure 17 Import Network Wizard - Step 4 of 6 Assign Stream Names	19
Figure 18 Import Network Wizard - Step 5 of (Resolve Network Computation Points)	20
Figure 19 Import Network Wizard – Step 6 of 6 (Import Summary)	20
Figure 20: Create New Reservoir	21
Figure 21: New Network Based on Configuration StandardConfig	21
Figure 22: Drawing Routing Reaches	22
Figure 23: Junction Editor	23
Figure 24: Reach Editor	24

Figure 25: Reservoir Editor, Pool Data	25
Figure 26: Reservoir Editor, Rename Dam	26
Figure 27: Reservoir Editor, Gated Outlet	27
Figure 28: Reservoir Editor, Uncontrolled Outlet (Spillway)	27
Figure 29: New Operation Set	28
Figure 30: New Operating Rule	29
Figure 31: Zones and Rules Panel	31
Figure 32: Observed Data Tab	32
Figure 33: Alternative Editor, Create New Alternative	33
Figure 34: Alternative Editor, Run Control Tab	34
Figure 35: Alternative Editor, Operations Tab	35
Figure 36: Alternative Editor, Lookback Tab	35
Figure 37: Alternative Editor, Time-Series Tab (for Mapping Data)	36
Figure 38: DSS Time-Series Record Selector	36
Figure 39: Alternative Editor, Hotstart Tab	37
Figure 40: Simulation Period	38
Figure 41: Overrides Editor	41

## Introduction

Welcome to the HEC-ResSim Quick Start Guide. This document will take you through the steps needed to develop a reservoir simulation model using HEC-ResSim. Use this document to get a quick overview of the program and its basic features. For more detailed information, refer to the HEC-ResSim User's Manual [references to the HEC-ResSim User's Manual are given in this type of formatted text to provide you with a cross reference for locating additional information]. This guide provides basic steps for using the Graphical User Interface (GUI) to enter data, run simulations and view results. "New" features (from Version 3.1 to Version 3.3) are indicated as highlighted text.

## **Starting the Program**

Once HEC-ResSim has been installed on your PC, start the program as follows:

#### From Microsoft Windows -



On your desktop, double-click on the HEC-ResSim icon or, from the Start menu, select All Programs  $\rightarrow$  HEC  $\rightarrow$  HEC-ResSim  $\rightarrow$  HEC-ResSim 3.3.

When you first start the program, you will see an introductory screen containing the version and contact information. This screen will disappear after a few moments. However, the same information is available from ResSim's **Help** menu by selecting the **About** option.



## **Exiting the Program**

To exit the program, from the **File** menu on the Main Window, select **Exit**. The program will prompt you to save all files.

## First, Some Terminology...

### What is a Watershed?

In HEC-ResSim terminology, a **Watershed** is a collection of data associated with a particular reservoir system or study [*Chapter 2*]. Types of data include Watershed Setup (Configurations) [*Chapter 3*], Reservoir Networks (including Operation Sets [*Chapter 10*] and Alternatives [*Chapter 14*]), and Simulations [*Chapter 15*]. After performing a Simulation, which will include one or more Alternatives, you can view and print results in both graphical and tabular form [*Chapters 16 & 17 and Appendix E*].

## What are Watershed Locations?

A **Watershed Location** is the place on disk where you can store watersheds; also called a **Shortcut**, model directory, or working directory [Section 3.2.1]. You can have multiple watershed locations, although a given watershed cannot span multiple locations. Each watershed location should be given a descriptive name, such as My Watersheds or General Projects, and a path specification that identifies the directory where you want to create and edit your watershed data.

		1	
General Fonts	Simulation	Advanced	ResSim Compute
Shortcuts	Compute Dis	splay	Debug Levels
Shortcuts			
Name		Location	
Add Shortcut	Remove	Shortcut	Edit Shortcut

Figure 1. Tools Menu, Options Editor, Watershed Locations

Before you can create or open a watershed, you must define at least one watershed location. Do so by selecting **Options** from the **Tools** menu. The Options Editor will appear as shown in Figure 1. The **Shortcuts** tab of the Options editor is used to define Watershed Locations. To add a new location to the list, press the **Add Shortcut**... button. The **Add Shortcut** dialog will appear (Figure 2). In the **Location** field, you can enter the full path to the working directory or you can **Browse** to the area on disk where you want to build your watershed. Next, enter the name you are giving this location in the **Name** field and press **OK**.

Add Shortcut	X
Name:	
Location:	Browse
	OK Cancel

Figure 2. Add Shortcut (Watershed Location) dialog

## What are Modules?

The ResSim program is divided into separate sets of functions called **modules** *[Section 2.2]*. Each module provides access to specific types and directories of data within the watershed data tree. The three modules within the ResSim program are:

- Watershed Setup [Section 2.2.1 Chapters 3-5]
- Reservoir Network [Section 2.2.2 and Chapters 6–14]
- Simulation [Section 2.2.3 and Chapter 15]

Figure 3 provides a graphical illustration of concepts and typical workflow through the three modules that make up HEC-ResSim. Refer back to this figure as you learn more about the function of each module to help keep the concepts organized.



Figure 3. ResSim Module Concepts

#### A. Watershed Setup Module

The opening window of the **Watershed Setup Module** is shown in Figure 4. As you can see, most menus and tools are inactive (grayed-out). They will remain so until a watershed is created or opened, which can be done by selecting **New Watershed** or **Open Watershed** from the **File** menu in the Watershed Setup Module. When a watershed is created, ResSim constructs a directory tree where

all files pertaining to the watershed will be stored. Those files specific to the ResSim model (and not shared by other models like HMS, FIA, etc.) are stored in the watershed directory tree in a subdirectory named **rss**.



Figure 4. Watershed Setup Module, Opening Window

The Watershed Setup Module main window has the following menus:

File	This menu will appear in all modules and most editors. In the main window, it always includes the options <b>Open Watershed</b> , <b>Save</b> <b>Watershed</b> , <b>Save Map As</b> , and <b>Exit</b> . In the Watershed Setup Module, the option <b>New Watershed</b> is also included. These options relate to the overall watershed data.
Edit	This menu will appear in all modules and most editors. This menu is module specific. The edit options will be relevant to data elements currently available for modification. The edit options available in the Watershed Setup module include: <b>Watershed</b> <b>Data</b> , <b>All Impact Areas</b> , <b>Projects</b> , <b>Drawing Properties</b> , <b>and</b> <b>Allow Editing</b> .
View	View options relate to all modules. Options include adding <b>Layers</b> that are displayed in the map region, selecting the <b>Unit</b>

**System** for *viewing*, and selecting whether or not to show the **Grid Lines** in the map region.

- Watershed This menu is only available in the Watershed Setup Module.
   Watershed options relate to the entire watershed, as well as to the individual configurations and the stream alignment. Options include Configuration Editor, Update Computation Points, Import and Export (of Stream Alignment), and Save Configuration.
- **Reports** Predefined reports and tables are listed in this menu. This menu appears in all modules, but its content is module specific. In the Watershed Setup and Reservoir Network Modules, most of the reports detail input data. In the Simulation Module, the reports detail simulation results.
- ToolsUser setting options, properties, and extended tools such as HEC-<br/>DSSVue and scripting are found here.
- HelpThis menu provides access to the user documentation in pdf form.<br/>It also allows for the installation of example watersheds, after a<br/>watershed location has been defined [Section 3.2.1]. This option<br/>also gives the ResSim version information.

Figure 5 shows the main window of the **Watershed Setup Module** after opening an existing watershed (HayesBasin). A map region occupies the majority of this window, where the user must place the project elements (e.g., reservoirs) onto the stream alignment (all configurations that will be defined for this watershed will be on this alignment). A background map can be added (but is not required) to the map region to help identify the streams for the alignment.



Figure 5. Watershed Setup Module, Opened Watershed, HayesBasin

#### **B.** Reservoir Network Module

The **Reservoir Network Module** is used for editing element (e.g., reservoir, computation point, and routing reach) data and placing additional elements onto the stream alignment. Figure 6 shows an example of the Reservoir Network Module window for HayesBasin. This example shows a Network named "NormalNetwork2" which was created by selecting **New** from the **Network** menu and selecting "StandardConfig" from the Configuration list. A map region occupies the majority of this window, where the user must place Routing Reaches (required for connectivity) and Diverted Outlets (if appropriate) onto the stream alignment.



Figure 6. Reservoir Network Module, HayesBasin

Element data is edited within the Reservoir Network Module. First, select the appropriate tool from the tool bar on the left side of the window, then right-click on the element. A shortcut menu appears with options to edit data defining the element. Alternatively, select the general pointer tool room the top of the toolbar on the left side and right-click on any element to view the shortcut menu.

The menus that are new or unique to the **Reservoir Network Module** are listed and described below:

- EditThis menu will appear in all modules and most editors. The edit<br/>options available for reservoir networks include: Reservoirs,<br/>Reaches, Junctions, Diversions, and Reservoir Systems, State<br/>Variables, Import Element Properties, and Allow Network<br/>Editing.
- NetworkNetwork options are used in defining the network and<br/>configuration to be used. Options include New, Open, Edit, Save,<br/>Save As, and Rename. Also included are the Update Network<br/>from Configuration, Import Network, and Delete Networks<br/>options.

- Alternative The only option in this menu is Edit. This opens the Alternative Editor, which will enable you to create, edit, and save alternatives.
- ReportsPredefined reports and tables are listed in this menu. Options<br/>include Reservoir List, Reach List, Junction List, and Diversion<br/>List. An Advanced option is also available that shows a summary<br/>table of the Network elements and their connectivity, as well as a<br/>listing of Nodes in the network.

#### C. Simulation Module

The **Simulation Module** is designed to facilitate the analysis phase of reservoir modeling. In this module you will create and run Simulations. Each Simulation is a combination of the time window and Alternatives that you want to analyze.

A view of the Simulation Module is shown in Figure 7. This view shows an open Simulation (Oct\_1999\_Event) with one of the Alternatives (StandNorm2) of the Simulation set as active (bolded alternative).



Figure 7. Simulation Module, HayesBasin

The checkmark on the left side of the Alternative indicates that the user requests that the results are to be shown (plots, tables, etc.). Results for multiple alternatives can be shown for comparison purposes by checking all alternatives of interest. However, only one alternative can be set to **active** (**bold**) at a time and that alternative's data is reflected in the map region and is, therefore, available for editing.

The menus that are new or unique to the **Simulation Module** are listed and described below:

- Edit This menu will appear in all modules and most editors. The edit options available for the Simulation Module include: Script List selection, Set Active Alternative, and editors for Reservoirs, Reaches, Junctions, Diversions, Reservoir Systems and State Variables. Also available is the Run editor for the active alternative.
- Simulation Simulation options are provided for creating, opening, editing, saving, and running simulations. Options include New, Open, Re-Open, Close, Simulation List, Replace from Base, Edit, Save, Delete, Info, and Run Manager. Also, Release Overrides can be defined from this menu.
- Alternative The only option in this menu is Edit. This opens the Alternative Editor, which will enable you to edit and save alternatives.
- ReportsPredefined reports and tables are listed in this menu. Options<br/>include Reservoir Summary, Flow Summary, Power Summary,<br/>Gates Summary, Stage Summary and Release Decision report.<br/>Also available from this menu are User Reports, Compute logs,<br/>and Network Element Lists (Reservoir, Reach, Junction, and<br/>Diversion, as well as the Advanced Network Connectivity<br/>Summary).

### **Some Other Useful Terms**

The following is a list of terminology commonly used throughout the ResSim Quick Start Guide. This page may be useful as you progress through the manual.

Alternative An alternative is a specific composition of watershed system characteristics and necessary data to perform a scenario-based simulation.

Component	In ResSim, a component, or element, refers to a piece of the watershed model, such as a reservoir, tributary, stream node, junction, or computation point and the associated physical data.
Computation Point	ResSim allows the user to add computation points on the stream alignment. These are placed at locations where the model will need information that is not generated by the placement of projects. Examples include stream gage locations, control points, confluences, and inflow points.
Configuration	In brief, a <b>Configuration</b> is the identification of a "set" of projects within your watershed that you want to model in your watershed. If more than one set of projects will be considered in a study, then more than one Configuration will be needed. While you add projects to your Configurations, a special "superset" (named Study) is developed by the program to contain all projects from all Configurations in the watershed. If multiple programs (e.g., HEC- HMS, HEC-FIA, HEC-RAS, etc) are going to be applied to your watershed, then Configurations should be developed by the modeling team before the models for an individual program are prepared.
<b>Operation Set</b>	In ResSim, an <b>Operation Set</b> is the operation plan or scheme upon which a reservoir bases its decisions regarding how much water to release at each time step of a simulation run <i>[Chapter 10]</i> . Key elements of an Operation Set include reservoir zones, Guide Curve selection, and rules. A reservoir can have more than one Operation set, but only one can be active within an alternative.
Projects	Within ResSim, a project primarily refers to a reservoir. However, a levee is also considered a project. A configuration reflects a collection ("set") of projects.
Simulation	In ResSim, a simulation is where the computations are performed for alternatives within a user-defined time window. Results of alternatives are available in a simulation.

## **Getting Down to Business...**

The basic steps for developing a reservoir model are outlined below. These steps are illustrated in the sections that follow.

### **Steps for Developing a Reservoir Model**

Developing a ResSim model entails the following steps:

#### A. Set Up the Watershed

- 1. Create/Open a Watershed [Sections 3.2 and 1.3]
- 2. Add Map files [Section 3.3 and Appendix B]

- 3. Draw a Stream Alignment [Chapter 4]
- 4. Create a Configuration [Section 3.4]
- 5. Place Project Elements into the Configuration [Section 3.4.3]

#### B. Develop a Reservoir Network

- 1. Import/Create/Open a Network [Sections 6.2 and 12.9]
- 2. Add Routing Reaches [Section 7.2]
- 3. Edit Junction Properties [Section 7.1]
- 4. Edit Reach Properties [Section 972]
- 5. Edit Reservoir Properties
  - a. Physical Data [Chapter 9]
  - b. Operations Data [Chapters 10 and 11]
  - c. Observed Data [Sections 8.3 and 14.10]

#### C. Define Alternatives

- 1. Create an Alternative [Section 14.3]
- 2. Define the Run Control Specifications [Section 14.4]
- 3. Select the Operation Scheme(s) [Section 14.5]
- 4. Specify Lookback Conditions [Section 14.8]
- 5. Identify Time-Series data records from DSS [Sections 14.9 and 14.10]
- 6. (Optional) Define Hotstart Options [Sections 14.11]

#### **D.** Perform a Simulation

- 1. Create/Open a Simulation [Sections 15.2 and 15.3]
- 2. Select/Activate Alternatives [Section 15.4.1]
- 3. Compute [Section 15.4]
- 4. View Results [Chapters 16 & 17 and Appendix E]
- 5. (Optional) Specify Overrides [Section 15.7.3]
- 6. Manage Simulation Data [Section 15.8]

#### A. Set Up the Watershed

#### 1. Create/Open a Watershed

In the **Watershed Setup Module**, choose **New Watershed** from **File** menu. The new watershed screen will appear, as illustrated in Figure 8. Enter a name for your watershed and a detailed description in the appropriate fields. From the **Location** list, select where you want your watershed stored. If the **Location** list is empty, press **Cancel**, and go back to page 2 to see how to add a Watershed Location. Use the **Units** list to select the unit system that the watershed will use when storing its data. The available unit systems are English and SI (i.e., US Customary and International System of Units). Then select a **Time Zone**. The watershed time zone is always specified as some offset from GMT, which does

Name:	1		
Description:			
Location:		Select Location	
Units:	English	⊚ SI	
		Time Zones	

NOT recognize Daylight Savings Time. When you have completed all fields, press **OK**.

Figure 8: New Watershed

#### 2. Add a Map

When a watershed is created, ResSim constructs a whole directory tree. One of the subdirectories in the watershed tree is the **maps** directory. Using a file system viewer (like Windows Explorer), copy the files you will use as background maps into the maps directory of your watershed:

<watershed location>\base\<watershed name>\maps

The supported types of map files include DLG (USGS Digital Line Graphs), SHP (ArcView® shapefiles), DXF (Autocad® Digital Exchange Format), DEM (USGS Digital Elevation Models), IMG (Raster Image), ASC (ArcInfo® ASCII grid), and NET (ASCII NetTIN) [Appendix B].

To display a map in the watershed, go to **View**, **Layers...** This will open the Layers Editor. First, make the layers editable by selecting **Allow Layer Editing** from the **Edit** menu. This is illustrated in Figure 9. Then, from the **Maps** menu, select **Add Map Layer**. This will open another window from which you can select the map file you want to view. You can select and deselect maps by un-checking the checkbox next to the map name.

👿 Layer Sel	ector - HayesBasin	• ×
Layers Edit	Maps View	
	Move to Top	
	Move Up	
	Move Down	
÷ 🛛	Move to Bottom	
	Properties	
🖪	Add Toolbar Button	
	Reload Default Button	
	Allow Layer Editing	
ОК	Cancel	Apply

Figure 9: Allow Layer Editing

Note that it is not necessary to display a map. However, it is convenient to have the map as a guide when creating stream alignments [*Chapter 4*].

**Zoom**. To zoom in or out on the map area, select the zoom tool  $\bigcirc$  on the left side of the window. To zoom in, click and drag over the desired viewing area. To zoom out, right-click until the desired viewing area is visible. Alternately, to zoom out to the original display, go to **View**, **Zoom to All**.

#### 3. Draw a Stream Alignment

The next step is to create a stream alignment on which stream reaches and reservoirs can later be located. First, ensure that you are working in the Watershed Setup Module. If you aren't, then be sure to select Watershed Setup from the Module list. Second, from the **Edit** menu, activate **Allow Editing** (a check mark will appear to the left and the "yellow lock" in the upper right portion of the window will lock to indicate that you are in the edit mode). Alternately, the yellow lock are pressed to allow editing.



Figure 10: Drawing a Stream Alignment

• Create a Stream Alignment Element. The Stream Alignment must be created *from upstream to downstream*. Select the stream alignment tool from the tool bar along the left side of the map region. Hold down the control (CTRL) key and click to place successive points along the stream alignment. To terminate the stream element, release the CTRL key and click to place the last point of the stream. As shown in Figure

10, a tributary may be connected to a stream by following the same procedure as above and terminating the stream at the point of connection to the existing stream.

- Edit a Stream Element. Select the stream alignment tool 🔊 and double click on the stream element to be edited. The stream will change color, and points will appear where each stream point is defined. These points can be moved to realign the stream by positioning the cursor over them and holding down the left mouse button and dragging. New points are added to a stream by clicking on the stream while holding down the CTRL key. Remove points from a stream by clicking over an existing point while holding down both the SHIFT and CTRL keys. An entire stream can be deleted by right-clicking on it and selecting Delete Stream Element from the shortcut menu. Streams can be renamed by right-clicking on the stream Element.
- Define Stationing. The green dots at the end of each stream in the alignment are Stream Nodes. Their purpose is to define the stationing along the stream. By default, the most downstream node will get a stream station of zero, and the node at the upstream end will get a stream station value determined by the length of the stream line in the coordinate system of the map region. However, these default values can be changed to more accurately describe the stream. Using the stream node tool 🖈 right-click on a stream node and select Edit Node. In the editor that appears, uncheck the "Use Default Stationing" box then update the value of the station to represent the appropriate real world station value of that representative point. If you change the stationing of the upstream node, then you may need to edit the most downstream node to reset its station to zero (0.0). Stationing along a stream will be determined proportionally based on the station values of the bounding nodes. Interior stream nodes can be added to a stream to more accurately define distances along a stream and to locate known river station landmarks. To do so, select the stream node tool, then while holding down the CTRL key, click those locations on a stream where you want to place a stream node.

#### 4. Create a Configuration.

Before adding reservoirs and computation points, a Configuration must be defined [Section 3.4]. In brief, a Configuration is the identification of a "set" of projects that you want to model in your watershed. If more than one set of projects will be considered in a study, then more than one Configuration will be needed. While you add projects to your Configurations, a special "superset" (named Study) is developed by the program to contain all projects from all Configurations in the watershed. If multiple programs (e.g., HEC-HMS, HEC-FIA, HEC-RAS, etc) are going to be applied to your watershed, then

Configurations should be developed by the modeling team before the models for an individual program are produced.

- Make the Configuration Editable. Before you can create or modify a Configuration, you must make it editable. To do so, select Allow Editing from the Edit menu (or click the "unlocked" g yellow lock, which "locks" the configuration (allowing you to perform editing). In other words, this option turns on (or off) the ability to make changes to the Configuration.
- Create the Configuration. From the Watershed menu, select Configuration Editor. From the Configuration menu in the Configuration Editor that has opened (Figure 11), select New. In the new configuration window, enter a Name and Description for the Configuration and select a time step from the Time Step list and press OK. Then, click OK in the Configuration Editor.

🟹 Configuratio	on Ed	litor		×
Configuration	Edit	Projects		
Name:				•
Description:				
Base Date:				
Time Step:				
Projects GI	S			
Project			Project	
Name		Project Notes	Туре	Existing
L		ОК	Cancel	Apply

Figure 11: Configuration Editor

#### 5. Place Project Elements into the Configuration.

The next step is to place projects into the watershed. The projects you place will be added to the current Configuration as identified in the Configuration field at the top of the window.

• **Draw Project Elements**. Verify that you have selected the appropriate configuration to which you will be adding projects. Select the appropriate tool to add projects. Each project, when placed, will create one or more computation points. When using the Reservoir Tool loce to place reservoirs, hold down the **CTRL** key to place the

*upstream* point(s) of the reservoir, then release the **CTRL** key and place the *downstream* point. A **Name New Reservoir** window will appear so that you can name the reservoir.

Another useful tool is the Computation Point Tool . Use this tool to place additional computation points by holding down the **CTRL** key and clicking on additional locations as needed. As you place additional computation points, you will be prompted to name them (when placed at the junction of two or more streams, you will need to select which stream the computation point should be placed on). Placing reservoirs on the stream alignment also creates computation points at the upstream and downstream extents of the reservoir using automatically generated names. Be sure to rename each of these points so it can be easily identified from a list when the map region is not visible. To do so, right-click on the computation point, select **Rename Computation Point** from the shortcut menu and enter a new name in the window as shown in Figure 12.

Rename Comp	utation Point
Name:	CP1
Description:	
	OK Cancel Help

Figure 12: Rename Computation Point

• Save the Configuration. When you are finished adding elements to the Configuration, be sure to save it and turn off editing. Select Save Configuration from the Watershed menu to save, then "unlock" the Configuration lock (yellow lock button) to toggle off the editability of the Configuration. A fairly simple Configuration (named StandardConfig) is shown in Figure 13.



Figure 13: A Simple Configuration, StandardConfig

#### **B.** Develop a Reservoir Network

With a stream alignment in place and one or more configurations defined, a network of reservoirs and stream routing reaches can be created. A summary of the basic steps is presented in the following paragraphs. From the **Module** list, select **Reservoir Network**.

#### 1. Import a Reservoir Network.

To use the Import Network Wizard, perform the following steps:

• From the Network menu in the Reservoir Network module, select Import Network.... The Import Network Wizard – Step 1 of 6 will appear. Select the Watershed that contains the network *from which* you would like to import the entire network physical and operational data. The box on the left side of the dialog contains names of Watershed Locations that have been specified as Model Directories. The box on the right side of the dialog contains all the watersheds that can be found in each Watershed Location.

🖥 Import Network Wizard - S	tep 1 of 6	<b>X</b>
Select the Watershed		
Watershed Locations		Watersheds
M ResSim	Name	Description
My Watersheds	BaldEagle_V3.1	Demonstration watershed for ResSim distributi
	HayesBasin_V3.1	
		< Back Next > Cancel

Figure 14 Import Network Wizard – Step 1 of 6 Select Watershed from which to Import

• Select Next and Import Network Wizard – Step 2 of 6 will appear. Select the network *from which* you would like to import all elements by highlighting the Network Name.

Timport Net	twork Wizard - Step 2 of 6	X
Select the N	etwork to Import Elements from	
Watershed:	HayesBasin_V3.1	
Available Ne	tworks	
Name		Description
NormalNetv	work2	
		< Back Next > Cancel

Figure 15 Import Network Wizard – Step 2 of 6 Select Network from which to Import

• Select Next to continue and the Import Network Wizard – Step 3 of 6 will appear. Enter a New Reservoir Network Name and Description.

🟹 Import Network Wizard - Step 3 o	of 6	×
Set New Network Name and Desc	ription	
Watershed: HayesBasin_V3.1		
Existing Reservoir Networks		
Name	Description	
NormalNetwork2		*
		-
New Reservoir Network		
Name: NormalNetwork2_	Import	
Description:		
	< Back Next >	Cancel

Figure 16 Import Network Wizard – Step 3 of 6 Define New Network Name and Description

 Select Next to continue and the Import Network Wizard – Step 4 of 6 will appear. Assign Stream Names by drop-down menu one at a time, or all at once by selecting the Assign Stream Names button. Care is required in determining the connection of the Imported Element to the Stream. If Imported Elements are associated with streams that are not connected, it is possible there will be erroneous downstream control rules added to upstream junctions.

Import Network Wizard	- Step 4	of 6				23
Watershed: HayesBasi	n_V3.1					
New Network: NormalN	etwork2_	Import		Import	From Network:	NormalNetwork2
Imported Element	Eleme	nt Type	From St	ream	To Stream	n
CP10	junction	n	Hayes R	liver	Hayes Riv	er 👻 🔺
CP13	junctior	ı	Hayes R	liver	Hayes Riv	er 👻
CP12	juncti	🟹 Select Stream	Name	-	×	<b></b>
CP11	juncti	-				
CP9	juncti	From Stream		To Stream	ı	<b>•</b>
CP8	juncti	Burnham Creek	k (Burnham Cre		Creek 🚽	⊧k 👻
CP7	juncti	Hayes River	Hayes River		er 👻	
CP5	iuncti	John's Creek	John's Creek		eek 👻	<b>_</b>
CP6	juncti	Bonner Creek	Bonner Creek		eek 🗸	ek 👻
CP3	juncti					-
Reservoir B-Dam at H				ок	Cancel	-
CP1	juncti					k 👻
Reservoir A-Dam at B			Bonner	Creek	Bonner Cr	reek 👻
CP2	junctior	junction		Bonner Creek		eek 👻
CP4	iunction	1	Haves River		Haves Riv	er 🗸 🔻
		Assign St	ream Na	mes		
				< Ba	ack Next >	Cancel

Figure 17 Import Network Wizard – Step 4 of 6 Assign Stream Names

• Select Next to continue and the Import Network Wizard – Step 5 of 6 will appear. Assign the network elements to their corresponding

watershed computation points by use of a drop-down menu for each imported element.

Mark Vetwork V	Wizard - S	tep 5 of 6		X				
Resolve Network (	Computat	tion Points						
Watershed: Ha	Watershed: HayesBasin_V3.1							
Configuration: St	andardC	onfig		•				
New Network: No	rmalNetw	ork2_Import	Selected Network: NormalNetwo	ork2				
Imported Elemen	nt Name	Element Type	Watershed Computation Point					
CP10		junction	CP10 -					
CP13		junction	CP13 -					
CP12		junction	CP12 -					
CP11		junction	CP11 -					
CP9		junction	CP9 -	-				
			< Back Next > Car	ncel				

Figure 18 Import Network Wizard – Step 5 of (Resolve Network Computation Points)

• Select Next to continue and the Import Network Wizard – Step 6 of 6 will appear. Review all of the information in the import summary. Check to ensure that all physical and operational data was successfully imported by reviewing the Import Summary and by viewing the various network element editors in the Reservoir Network module.



Figure 19 Import Network Wizard – Step 6 of 6 (Import Summary)

#### 2. Create/Open a Reservoir Network.

As an alternative to Importing a reservoir network, you may also create a new network. From the **Network** menu, select **New**. The **Create New Reservoir Network** window will appear (Figure 14). Specify a name and description for the network. Then, select the Configuration on which this network will be based and click **New** [Section 6.2].

Create New Reservoir Netwo	ork 🛛 🗶
Watershed: Test Existing Reservoir Networks	
Name	Description
	*
New Reservoir Network	
Name:	
Description:	
Configuration:	•
	New Cancel

Figure 20: Create New Reservoir

Reservoirs and computation points that were part of the selected configuration will automatically be created as elements in the Reservoir Network. Reservoirs transfer directly. Computation points appear as Junctions. This is depicted in Figure 15.



Figure 21: New Network Based on Configuration StandardConfig

**Make the Network Editable**. Before you can begin editing, you must ensure the network is editable. To do so, select **Allow Network Editing** from the **Edit** menu (or press the "yellow lock" button in ). This option turns on (or off) the ability to make changes to the network.

#### 3. Add Routing Reaches, etc.

Draw the additional elements needed to complete the connectivity of the reservoir network schematic [Section 7.2].

**Draw Routing Reaches**. Select the Routing Reach Tool  $\checkmark$ . Hold down the **CTRL** key and click anywhere on the stream to place the upstream end of the reach. Release the **CTRL** key and move the mouse along the stream and click again at a lower station on the stream to place the downstream end, as shown in Figure 16. Routing reaches must be connected to an existing junction. If you start or end a reach where there is no junction a junction will be created, and you will be prompted to first name the new junction and then name the new reach. (Note: tributaries cannot connect to the middle of a reach; they must connect to a junction.)



Figure 22: Drawing Routing Reaches

#### 4. Edit Junction and Reach Properties.

With a reservoir network schematic complete, the data for the model elements can be entered and saved.

**Edit Junction Properties**. With the pointer tool  $\blacktriangleright$  or the junction tool  $\bigcirc$  selected, right-click on desired junction and select **Edit Junction Properties**. The Junction Editor will appear. Select the **Local Flow** tab and input a name and factor for each external flow entering the junction (as shown in Figure 17). The name entered will appear during the Alternative definition to identify the local flow for time-series mapping. Therefore, the name given on the Local Flow tab should be recognizable during the time-series mapping. Flows *must* be supplied to headwater junctions and are optional at other junctions.

👿 Junction	Editor - Network: River Basin Network	X
Name	CP6	✓ K ④ 9 of 13 ▷ N
Description		
Info Loca	I Flow Rating Curve Observed Data	1
Name		Factor
	ОК	Cancel Apply

Figure 23: Junction Editor

To edit junction properties for other junctions without exiting this window, click **Apply** and then select another junction from the **Name** list or use the navigator buttons located in the upper right portion of the window. Alternately, click **OK**, then right-click and **Edit** another junction.



For each junction where you specify **Local Flows**, you will see a "halo" around the Junction element. This provides you with a visual reference for ensuring local flows have been indicated for the appropriate locations in your watershed.

**Edit Reach Properties**. With the reach tool  $\checkmark$  or the pointer tool  $\blacktriangleright$  selected, right-click on the desired reach and select **Edit Reach\_Properties**. Select the routing method from the **Method** list (as shown in Figure 18) and fill in the

necessary parameters for the selected routing method. The default routing method is **Null Routing** (no route).

📷 Reach E	ditor - Network: River Basin Network	×
Reach Na Descriptio	on CP7 to CP9	
Routing	Losses Observed Data	
Method	Null Routing	-
	Null Routing	
	Coef. Routing	
	Muskingum	
	Muskingum-Cunge 8-pt Channel	E
	Muskingum-Cunge Prismatic Channel	A I
	Modified Puls	
	SSARR Routing	
	Working R&D	Ŧ
		OK Cancel Apply

Figure 24: Reach Editor

The **Coefficient Routing** method can be used to mimic most linear routing methods by representing the method as a series of coefficients for each time step of the routing extent. Specifying a coefficient of 1.0 in the first row of the Coefficient table is the same as specifying a null routing.

To edit another reach without exiting this window, click **Apply** then select another reach from the **Reach Name** list or use the navigator buttons to select another reach. Alternately, click **OK**, then right-click and **Edit** another reach *[Section 7.2]*.

#### 5. Edit Reservoir Physical Properties.

With the reservoir tool  $\blacktriangle$  or the pointer tool  $\blacktriangleright$  selected, right-click on a reservoir, select Edit Reservoir Properties and the Reservoir Editor window will appear as shown in Figure 19. This editor has a tab panel with three tabs: Physical tab [Chapter 9], Operations tab [Chapters 10 and 11], and Observed Data tab [Section 8.3].

• On the **Physical** tab, a *tree* appears in the left panel of the window. Initially, two *branches* of the tree are shown: **Pool** and **Dam**. The Pool reflects characteristics of the reservoir storage while the Dam reflects the reservoir dam.

💘 Reservoir Editor - Network: River Ba	in Network
Reservoir Edit	
Reservoir A 🗸	Description
Physical Operations Observed Da	
Pool Dam at Bonner Creek	Composite Release Capacity
	Elevatio Controll Uncontr Total (cfs)
	2 4 6 8 10
	Flow (cts)
	Label Position: NORTH V
	OK Cancel Apply

Figure 25: Reservoir Editor, Pool Data

- Enter Pool Properties. Click on Pool to enter the Elevation vs. Storage vs. Area data (as shown in Figure 19). At least two rows are required for Elevation, Storage and Area data, with values increasing down the columns (no duplicate values). The maximum elevation should not exceed the Elevation at top of dam, which is input when Dam is selected. Pool losses can be specified by right-clicking on Pool and selecting Add Pool Evaporation and/or Add Pool Seepage [Section 9.3.1].
- Enter Dam Properties. Click on Dam in the reservoir tree. The data area to the right of the reservoir tree will change to allow you to enter the data needed to define the dam [Section 9.4]. Before proceeding, take a look at the name of the dam. The name is probably something like "Dam at My Main River." This is the default name the program gives to the dam. It identifies the dam based on the name of the underlying stream upon which the dam was placed. This enables the program to uniquely identify more than one dam within a reservoir. It is a rare case when a reservoir has more than one dam, so feel free to rename the dam by right-clicking on the dam name and selecting **Rename** (as shown in Figure 20). One suggestion is to name it *Dam* by removing the stream name. Another possibility is to name the dam by its actual name (many reservoirs have a name for the pool and a different name for the dam; ResSim provides the ability to name each part individually).

• Enter the elevation and length of the dam in the relevant fields. The composite release capacity table is not editable. This table is informational and will be filled automatically as you add outlets to the dam.

🟹 Reservoir Edito	or - Network: River Ba	in Netw	ork					×
Reservoir Edit Dam								
Reservoir Rese	Reservoir Reservoir A   Description   Md_1of2  Md							
Physical Oper	ations Observed Da	ta						
A Reservoir A		Reserv	oir A-Dam	at Bonner Cr	eek			
Dam a	Add Tailwater Eleva	ation	on at top	of dam (ft)				
Ex Ex	Add Forebay Head	Loss	at top of	dam (ft)				
( ) Č	Add Leakage		osite Re	lease Capacit	y			
	Add Controlled Ou	tlet	vation	Controlled	Uncontrolled	Total	1	0
	Add Uncontrolled	Outlet	(ft)	(cfs)	(cfs)	(cfs)		8
	Add Outlet Group						19 atio	6
/	Add Power Plant						E C	4
Æ	Add Pump							<sup>2</sup>
	Pulse Flow Options	;						2 4 6 8 10
	Rename							Flow
								(03)
	OK Cancel Apply							

Figure 26: Reservoir Editor, Rename Dam

• Add Outlets. Physical Outlets can be added to the Dam by rightclicking on the Dam. Figure 20 illustrates the dam's shortcut menu. Select Controlled Outlet to add a gate or other control structure to the dam [Sections 9.4.2 and 9.6]. You can rename the outlet by rightclicking on the outlet and selecting Rename.

A simple controlled outlet can be defined by entering a maximum release capacity curve for the outlet. If a more detailed outlet definition is desired, press the **Edit Gate Settings** button. The Gate Settings Editor will allow you to define a set of gate openings with Elevation vs. Maximum Capacity (flow) data. When finished, the release capacity table will show several more columns (as shown in Figure 21), one for each gate opening in the set you defined.



Figure 27: Reservoir Editor, Gated Outlet

Select Uncontrolled Outlet to add an ungated emergency spillway to the dam [Section 9.9]. For an Uncontrolled Outlet, the spillway length and elevation are entered along with either a Weir Coefficient or an Elevation vs. Outflow relationship. The spillway elevation must be at or below the Elevation at top of dam and above the minimum storage elevation. Figure 22 shows the window for entering data for an Uncontrolled Outlet.

🟹 Reservoir Editor - Network: River Ba	asin Network			×
Reservoir Edit Spillway				
Reservoir A	Description			
Physical Operations Observed Da	ata			
Reservoir A	Reservoir A-Dam at Bonne	er Creek-Uncontrolled Outlet		
Dam at Bonner Creek	Outlet Elevation (ft)		657	
Uncontrolled Outlet	O Weir Coef.		0.0	
	Length (ft)			
	elevation vs. Outflow			
	Elev	vation (ft)	Outflow (cfs)	685
		657	0	680
		658.0	2500.0	€ 675
		659.0	6000.0	5 670
		660.0	12000.0	5 0/0
		661.0	16000.0	<u>à</u> 665
		663.0	29000.0	<sup>W</sup> 660 /
		665.0	46000.0	655
	l	667.0	64000.0	0 150.000 300.000
	l	669.0	85000.0	Outflow (ofo)
		670.0	96000.0	Outilow (cis)
		672.0	120000.0	
		675.0	170000.0	
		678.0	2000.0	
		679.0	216000.0	
		680.0	232000.0	
		683.0	280000 0	
			ОК	Cancel Apply

Figure 28: Reservoir Editor, Uncontrolled Outlet (Spillway)

In addition to Controlled and Uncontrolled Outlets, the following components can also be added to the Dam:

Leakage [Section 9.4.5], Outlet Group [Section 9.4.6], Tailwater Elevation [Section 9.4.7], Power Plant [Section 9.7], and Pump [Section 9.8].

In addition to adding physical components to the Dam, there is an advanced option for specifying **Pulse Flow Options** [Section 11.3.5].

#### 6. Edit Reservoir Operational Properties.

After adding the reservoir physical properties, add the operational information via the **Operations** tab of the Reservoir Editor. When the **Operations** tab is initially chosen, a screen similar to Figure 29 will appear. A new operation data set must be created before operations data can be entered [Section 10.2.1].

🟹 Reservoir Editor - Network: River Basin Network		22
Reservoir Edit Operations Zone Rule IF_Block		
Reservoir A		
Physical Operations Observed Data		
Operation Set	▼ Description	
Zone-Rules Rel. Alloc. Outages Stor. Credit. D	c. Sched. Projected Elev	
Storage Zone	Description	
Function of	New Operation Set	Define
	Name: Description: CK Cancel Help	
Zone Sort Elevation		
	ОК	Cancel Apply



- Create an Operation Set. Select New from the Operations menu and give the new operation set a name (as illustrated in Figure 23). An **Operation Set** is the operation plan or scheme upon which a reservoir bases its decisions regarding how much water to release at each time step of a simulation run [Section 10.2].
- **Operation Zones**. Once an Operation Set is created, then a set of "default" reservoir zones is generated: **Flood Control**, **Conservation**, and **Inactive**. Additional zones (e.g., Top of Dam) can be added by

selecting **New** from the **Zone** menu. Top of zone curves must be entered, as no default values are available [*Section 10.3*].

• **Operation Rules**. To add a rule to a zone, highlight the appropriate zone and select **New** from the **Rule** menu. In the new rule window (Figure 24), enter a name for the rule, then select the pool, dam, outlet, or outlet group for which the rule will apply (**Operates Release From**), then select the rule type from the **Rule Type** list, and then click **OK** [*Chapter 11*].

Rule New Operating Rule	
Rule Name:	
Operates Release From:	<b></b>
Rule Type:	<b></b>
	OK Cancel

Figure 30: New Operating Rule

**Rule types** differ depending on where the rule is applied (pool, dam, or outlet) [Section 11.1.1]. The rules that apply to the Reservoir Pool, are typically relevant to *Storage* or *Elevation*, whereas the rules that apply to a Dam or an Outlet are relevant to *Flow*.

Rules that apply to <u>Reservoir Pool</u>, <u>Reservoir Dam</u>, <u>Controlled Outlets</u>, <u>Outlet Groups</u>, and <u>Diverted Outlets</u> (i.e., all 'Operates Release From' elements, except Pumps)

- Release Function, Maximum, Minimum or Specified Release as a function of Date, Date and Time, Model Variable, or External Variable [Section 11.2].
- Flow Rate of Change Limit, Allowable change when increasing or decreasing release values [Section 11.5].
- Script, User-defined scripting available that dramatically increases the flexibility of reservoir operations. [Section 12.3].

Rules only for the **<u>Reservoir Pool</u>** include the following:

- Downstream Control Function, Minimum or Maximum Flow or Stage target or constraint (at a downstream location) as a function of Date, Date and Time, Model Variable, or External Variable [Section 11.3].
- Induced Surcharge, Special flood control operation using gate regulation parameters [Section 11.4].
- Elevation Rate of Change Limit, Allowable change when increasing or decreasing pool elevation values [Section 11.6].
- Tandem Operation, Release based on balancing pool with a downstream reservoir [Section 11.9].

Rules only for the **<u>Power Plant</u>** include the following:

- Hydropower Power Guide Curve, Energy Requirement (expressed as % Plant Factor) is dependent on the available power storage. Optional Daily and Hourly distributions can be specified [Section 11.7.1].
- Hydropower Schedule, Monthly Firm Energy Requirements (specified as Monthly MWH or % Plant Factor) with optional Daily and Hourly distributions [Section 11.7.2].
- Hydropower System Schedule, same requirements as above except with additional options for specifying the power generation pattern and for identifying reservoirs whose power generation can be used to meet system requirement [Section 11.7.3].
- Hydropower Time Series Schedule, Energy Requirement as defined by user-supplied time-series data [Section 11.7.4].

Rules only for **<u>Pumps</u>** include the following single rule:

 Pump Schedule, Pumpback storage operation using user defined schedule [Section 11.8].

Depending on the rule type, you will need to enter data to define the rule. A screen will open in the editor to allow you to enter the required data for each rule. The rules and storage zones are displayed in a tree on the left side of the window (as shown in Figure 25). Once a rule has been defined, it can be included in more than one zone by selecting **Use Existing** from the **Rule** menu. Similarly, a rule can be removed from a zone by selecting **Remove from Zone**. A rule can be deleted from the operation set by selecting **Delete**. However, when a rule is Deleted, then it is no longer available to any of the zones; therefore, *caution should be used when actually deleting a rule*.



Figure 31: Zones and Rules Panel

When finished entering data for a reservoir, click **OK**. To edit a different reservoir without exiting the reservoir editor, click **Apply** and select another reservoir from the **Reservoir** list.

- The **Observed Data** tab is used to indicate that observed data is available for comparison purposes [Section 10.23]. If the **Observed** box is "checked" in the table (as shown in Figure 26), then there will be a corresponding entry in the Observed Time-Series mapping table when an Alternative is created [Section 13.9].
- 5. Save the Reservoir's Physical and Operations data, Junction information, Routing criteria, etc... From the Network menu select Save. *It is a good idea to do this <u>frequently</u>.*

👿 Reservoir Editor - Network: NormalNetwor	k2	×
Reservoir Edit		
	Scription Most Linstream Reservoir on Bon	
reserven A		
Physical Operations Observed Data		
Select Locations that display Observed data	a in output reports and plots	
Location	Variable	Observed
Reservoir A-Pool	Elev	
Reservoir A-Pool	Stor	
Reservoir A-Pool	Flow-IN	
Reservoir A-Pool	Flow-IN NET	
Reservoir A-Pool	Flow-EVAP	
Reservoir A-Pool	Flow-SEEPAGE	
Reservoir A-Pool	Area-Reservoir	
Reservoir A-Pool	Flow-OUT	
Reservoir A-Dam at Bonner Creek Tailw	Flow	<b>V</b>
Reservoir A-Dam at Bonner Creek Tailw	Flow-IN	
Reservoir A-Dam at Bonner Creek L&O	Flow	
Reservoir A-Controlled Outlet	Flow	
Reservoir A-Uncontrolled Spillway	Flow	
	OF	Cancel Apply

Figure 32: Observed Data Tab

#### C. Define Alternatives

**Create an Alternative.** An Alternative consists of a Reservoir Network, an Operation Set for each reservoir in the network, a definition of initial conditions, and a mapping all time-series records to identified local inflows, etc. To create an alternative:

1. From the Alternative menu (in the Reservoir Network module) select Edit [Section 13.2].

Alternative Edit...

- 2. In the Alternative editor, ensure that the appropriate **Configuration** name is displayed from the list of available configurations. Then, from the **Alternative** menu, select **New** (as shown in Figure 27).
- 3. In the New Alternative editor, enter a name for the Alternative in the **Name** box and a description in the **Description** box. Select a **Reservoir Network** from the list and click **OK**.

All of the relevant fields in the Alternative Editor will become active [Section 13.3].

mative				
New	Ctrl+N	dConfig		
Save	Ctrl+S			
Save As		Descri	ption	Network Network
Delete	Ctrl+D	Typical	(Dav-to-Dav) operatio	ns. NormalNetwork2
Close			(,,,,	NormalNetwork2
		No rule	suse "Guide Curve (	D  NormalNetwork2
lame:				
escription:				
Reservoir N	etwork			
Observed	Data	Hotstart Yield A	Analysis DSS Out	put Ensemble Monte Carl
Run C	ontrol	Operatio	ons Looki	oack Time-Series
Time Step:		- A	Iternative Type	
			Standard	
Flow Con	nputation	Method	<ul> <li>Viald Analysia</li> </ul>	
Progra	am Deteri	mined	<ul> <li>Meid Analysis</li> </ul>	
Period	d Average		Ensemble	
Instan	itaneous		Monte Carlo	
Compu	ite Unreg	ulated Flows		
Compu	ite Holdor	uts		
Log Level:	1 -			
	<u> </u>			

Figure 33: Alternative Editor, Create New Alternative

4. The **Run Control** tab (Figure 28) allows you to specify the **Time Step** and **Flow Computation Method** to be used in your simulation(s) [Section 13.4].

ternative					
Configuration: StandardC	Config			•	
Name	Description	1	Vetwork		
StandNorm2	Turisel (Dawle D	N	lormalNetwork	2	
Alt2	Typical (Day-to-D	ay) operations. IN	IormalNetwork	2	
GC-only	No rulesuse "G	uide Curve O N	lormalNetwork	2	
Name: TypOps Description: Typical (Day	/-to-Day) operations.				
Reservoir Network Norn	nalNetwork2				
Observed Data Ho Run Control	start Yield Analysis Operations	DSS Output Lookback	Ensemble Tim	Monte Carlo ne-Series	
Time Step: 1 Hour	Alternative     Standa	Type ard			
<ul> <li>Program Determin</li> </ul>	ed 💿 Yield A	nalysis			
<ul> <li>Period Average</li> <li>Instantaneous</li> </ul>	<ul> <li>Ensen</li> <li>Monte</li> </ul>	Ensemble     Monte Carlo			
Compute Unregulat	ed Flows				

Figure 34: Alternative Editor, Run Control Tab

5. In the Alternative editor, select an Alternative. On the **Operations** tab, select an **Operation Set** for each reservoir [*Section 13.5*]. This can be accomplished in the Operation Set column by selecting (for each Reservoir) the operation set from the list, as shown in Figure 29.

ternative					
Configuration: StandardCo	nfig				
Name	Description		Network		
StandNorm2		1	VormalNetwork	2	
TypOps	Typical (Day-to-D	)ay) operations. N	NormalNetwork	2	
Alt2		1	NormalNetwork	2	
Name: TypOps			]		
Description: Typical (Day-to	o-Day) operations.		]		
Reservoir Network Norma	INetwork2		]		
Observed Data Hotst	art Yield Analysis	DSS Output	Ensemble	Monte Carlo	
Run Control	Operations	Lookback	Tir	ne-Series	
Reservoir		Operation Set			
Reservoir A		Day-to-Day Opera	erations 🚽		
				¥	
Water Account Set Select	ion				

Figure 35: Alternative Editor, Operations Tab

6. On the Lookback tab [Section 13.7], select the initial conditions Type (Times-Series or Constant) from the list for each Location listed, as shown in Figure 30. This is similar to selecting the operation set per reservoir. For Variables defined as Constants, enter a constant Value for the Elevation or Release.

0	bserved Data	Ho	tstart	Yield Analysis	DSS Outp	ut	Ens	emble	Monte Carlo
	Run Control			Operations	Lookb	ack		Tir	ne-Series
							_		
	Location			Variable	Туре	е		De	fault Value
Re	servoir B-Pool		Lookb	ack Elevation	Constant		-		1430.0
Re	servoir B-Pool		Lookb	ack Storage	Computed		-		
Re	servoir B-Contro	lle	Lookb	ack Release	Constant		-		155.0
Re	servoir B-Uncont	tro	Lookb	ack Spill	Constant		T.		0.0
Re	servoir A-Pool		Lookb	ack Elevation	Constant		T.		1450.0
Re	servoir A-Pool		Lookb	ack Storage	Computed		-		
Re	servoir A-Control	lle	Lookb	ack Release	Constant		-		122.0
Re	servoir A-Uncont	ro	Lookb	ack Spill	Constant		-		0.0
					Constant				
					Time-Series				

Figure 36: Alternative Editor, Lookback Tab

7. On the **Time-Series** tab *[Section 13.8]* select a row in the time-series mapping table (as shown in Figure 31). Each row in the table represents a *required input* for a local flow location (specified in the Local Flow tab within the Junction editor), an element/parameter you have defined on the Lookback tab as Time Series, or a Time Series that is referenced in the Operation rules. To attach a time-series record to the selected location, press the **Select DSS Path** button.

Observed D	ata	Hot	start	Yie	ld Analysis	DSS Out	put	Enser	nble	Monte Carlo
Run Co	ontrol		Operations Lookback		back		e-Series			
						_				
Location	Varia	ble	DSSI	File	Part A	Part B	Part C	F	Part E	Part F
RESERVOI	Know	n Flow	share	d\Ha		RANDOLP	FLOW	1	HOUR	2B
RESERVOI	Know	n Flow	share	d\Ha		SAVAGE I	FLOW	1	HOUR	2B
CP5 Local	Know	n Flow	share	d/Ha		CUMBER	FLOW	1	HOUR	2B
CP7 Local	Know	n Flow	share	d/Ha		FRANKLI	FLOW	1	HOUR	2B
CP9 Local	Know	n Flow	share	d/Ha		KEYSER	FLOW	1	HOUR	2B
CP10 Local	Know	n Flow	share	d/Ha		LUKE LOC	FLOW	1	HOUR	2B
CP12 Local	Know	n Flow	share	d/Ha		PINTO LOC	FLOW	1	HOUR	2B
CP11 Local	Know	n Flow	share	d/Ha		MYLOC	FLOW	1	HOUR	2B
CP6(CP7X	Know	n Flow	share	d\Ha		FRANKLI	FLOW	1	HOUR	2B
CP8(CP9X2)	Know	n Flow	share	d\Ha		KEYSER	FLOW	1	HOUR	2B
CP13 Local	Know	n Flow	share	d/Ha		YOURLOC	FLOW	1	HOUR	2B
Plot	Tabula	ate		Inflo	v Multipliers.				Selec	ct DSS Path

Figure 37: Alternative Editor, Time-Series Tab (for Mapping Data)

The DSS path selector window will appear as shown in Figure 32. Open a DSS file, use the parts filters to organize the catalog listing, and select a record. To get the selected record to map back to the alternative editor, press the button labeled **Set Pathname**.

<b>A</b>						x
File View Display Groups (	Collections Advance	d				
🖻 🔟 🏗  🛛						
File Name: C:/Programs/H	EC-ResSim-3 3 1 66	/Evamples/base/k	JavesBasin V3 1/shared/Hav			1
Dathagman Chause 44	baarraa Calaatadi 0	Detheoree is File	14 Ella Ciraci COO KR Ell	- Versies: CMD Like	and Manajana wea	-
Patinames Shown. 14 Pat	innames Selected. U	Patrinames in File.	14 File Size, 699 KD File	e version. 6-MP Libr	ary version. xo4	
Search A:		▼ C:	•	E:		•
By Parts: D		- D:		E.		
В.		• 0.	•	r		•
Number Part A	Part B	Part C	Part D / range	Part E	Part F	
1	CUMBERLAND LOC	FLOW	170ct1999 - 210ct1999	1HOUR	2B	
2	FRANKLIN HW	FLOW	170ct1999 - 210ct1999	1HOUR	2B	
3	KEYSER HW	FLOW	170ct1999 - 210ct1999	1HOUR	2B	
4	LUKE LOC	FLOW	170ct1999 - 210ct1999	1HOUR	2B	
5	MYLOC	FLOW	170ct1999 - 210ct1999	1HOUR	2B	
6	PINTO LOC	FLOW	170ct1999 - 210ct1999	1HOUR	2B	Ξ
7	RANDOLPH INFLO	FLOW	170ct1999 - 210ct1999	1HOUR	2B	
8	SAVAGE INFLOW	FLOW	170ct1999 - 210ct1999	1HOUR	2B	
9	WILLS CK LOC	FLOW	170ct1999 - 210ct1999	1HOUR	2B	
10	YOURLOC	FLOW	170ct1999 - 210ct1999	1HOUR	2B	
11 NPOT	BARNU	FLOW	170ct1999 - 200ct1999	1HOUR	OBS	
12 NPOT	DSSAV	FLOW	17Oct1999 - 20Oct1999	1HOUR	OBS	-
		Set P	athname		, 	
▲ No time window set.; T	ime zone: GMT-08:00	)				

Figure 38: DSS Time-Series Record Selector

- 8. On the **Observed Data** tab *[Section 13.9]*, using the same procedure as the Time-Series mapping described above, select *optional* time-series records for use in comparing with computed results.
- 9. Typically, the Lookback period is used for *warming-up* the state (i.e., setting initial conditions) of the watershed for an alternative. However, instead of using the Lookback period and associated data for determining the system state, you can save (and subsequently use) the data from one simulation to another simulation by using the *optional* Hotstart options (Figure 33). Use the Hotstart as a way of assigning a previously simulated watershed state to another simulation. In order to use the Hotstart option, the user must first run a simulation that saves system state data to "Hotstart" files [Section 13.10].

ResSim Alternative Editor*				×
Alternative				
Configuration: StandardConfig				•
Name	Description		Network	
StandNorm2			NormalNetwork	2
TypOps Alt2	Typical (Day-to-D	ay) operations.	NormalNetwork	2
GC-only	No rulesuse "G	uide Curve O	NormalNetwork	2
Name: TypOps				
Description: Typical (Day-to-D	ay) operations.		]	
Reservoir Network NormalNe	work2			~
Run Control	Operations	Lookback	Tir	me-Series
Observed Data Hotstart	Yield Analysis	DSS Output	Ensemble	Monte Carlo
Number of Hours to Save (for	Rule Lookback):		1.0	
Save Hotstart File at Er	id of Simulation ate/Time:			
Date:	Time:			
Save Hotstart File at Int	erval:			
Interval: 1 Hour -	Starting at Date:		Time:	
Read Hotstart File				
🔲 Load Hotstart File				
Alternative Name:				~

Figure 39: Alternative Editor, Hotstart Tab

## **Steps for Performing a Simulation**

Once the reservoir system data are entered, the model can be configured for a Simulation. From the **Module** list, select **Simulation**. Model elements of a Reservoir Network will not display in the map region until a Simulation is created or opened and an Alternative has been made active.

#### A. Create/Open a Simulation.

To create a Simulation, from the **Simulation** menu select **New.** The window illustrated in Figure 34 will open [*Sections 14.2 and 14.3*].

🟹 Simulati	on Peri	bd			×			
Name	2016	2016.09.15-1000						
Description	n 📃				)			
Simulatio	n Time	s						
Start Dat	е	15	5Sep2016 Time		1000			
Lookbac	k Date	15	5Sep2016 Time		1000			
End Date	e	15	5Sep2016 Time		1000			
Altornativ	00		[√] Run I	New Extract				
Select	Name		Description	Time Step	Network			
	Stand	Vorm2		1Hour	NormalNe			
	ТурОр	S	Typical (Day-to-Day	1Hour	NormalNe			
	Alt2			1Hour	NormalNe			
	GC-on	ly	No rulesuse "Gui	1Hour	NormalNe			
				ОК	Cancel			

Figure 40: Simulation Period

- Enter a Start Date & Time, a Lookback Date & Time, and an End Date & Time.
- Enter a name for the Simulation in the **Name** box. A default name is generated based on the Start Date and Time. You can use the default name or you can change it to a more meaningful name. You can also enter a Simulation Description.
- Select a **Time Step** from the list.
- Select one or more applicable Alternatives for the Simulation and click OK.

#### **B.** Set Alternative to be Active.

In the "tree list" of alternatives for the simulation (on the right side of the screen), right-click on the desired alternative and select **Set as Active**. At this point, the model elements of the Reservoir Network will be displayed in the map region reflecting the active (notice **bolded name**) alternative [*Section 14.4.1*].

#### C. Compute.

After all data and parameters have been input as desired, click on the **Compute "Name of Alternative"** button in the control panel of the Simulation Module's main window to perform the computations [Section 14.4.2].

A compute window will appear showing status messages and program progress. When the computation is finished, a "Compute Complete" message will appear and the status bar will read 100%. Click **Close** to close this



window. Note: You can stop the compute process before the compute is complete by clicking on **Stop Compute**.

#### 7. View Results.

Model results can be reviewed from three different approaches [Section 14.5 and Appendices E & F].

• **Plots.** On the model schematic you can rightclick on a model element to get a menu list. Included on the list will be one or more plot options. Select the option by clicking on it. The default plot will display. The plotted results can be tabulated by selecting **Tabulate** from the plot's **File** menu [Section 14.5.2].



• Summary Reports. From the Reports menu in the Simulation module, there is a list of Summary Reports for the model simulation [Section 14.5.3]. The Reservoir, Flow, Power, Gates, and Stage reports provide Average, Maximum and Minimum values for the simulation. The Release Decision summary report provides the current zone and limiting operating rule for each reservoir for all time periods of the simulation.

 DSS Viewer. When HEC-DSSVue is selected from the Tools menu, a DSS file is opened that contains the results of the simulation [Section 14.8 and Appendix E]. A list of pathnames is provided but a screened list can be obtained by selecting a pathname part from the lists in the Search by Parts section of the window. To select records to be displayed, highlight the pathnames and click



on the **Select** button. After one or more records are selected, the buttons for plot and tabulate become active. Click either button to generate the associated output.

#### 8. Specify Overrides.

Once you have completed a simulation, you can override model results by specifying either the reservoir Elevation Target, or Releases (per outlet), or Capacity Factors (per outlet), or Storage (or Elevation) values for some (or all) of the time steps [Section 14.6.3]. ResSim will use the values you specify for Elevation Target and Release Overrides, within the physical limits of the reservoir (i.e., the physical rate-of-change, the release capacity and the amount of water available in the reservoir may preclude ResSim from using your



override values). To specify the override values, select **Overrides** from the **Simulation** menu in the Simulation module for the desired alternative; or, you can select the **Overrides** button by right-clicking on the "Active Alternative" and selecting **Edit**  $\rightarrow$  **ResSim** from the shortcut menu and then click on the **Overrides** button. The Overrides Editor will open (Figure 35).

Elevation Target Release	Conacity Storage			
Date	Time	Elevation Target (ft)		
19Oct1999	0900	1,429,58		Unspecify
19Oct1999	1000	1,429,60		
19Oct1999	1100	1,429,62		Unspecily All
19Oct1999	1200	1,429,64		Import
19Oct1999	1300	1,429.66		impore
19Oct1999	1400	1,429.68	Ξ	1 490
19Oct1999	1500	1,429.69		1,400
19Oct1999	1600	1,429.71		1,470
19Oct1999	1700	1,429.73		4.400
19Oct1999	1800	1,429.74		1,460-
19Oct1999	1900	1,429.76		€ 1.450
19Oct1999	2000	1,429.78		
19Oct1999	2100	1,429.79		ш 1,440-
19Oct1999	2200	1,429.81		1 420
19Oct1999	2300	1,429.82		1,430
20Oct1999	0000	1,429.84		00:00 00:00
20Oct1999	0100	1,429.85		
20Oct1999	0200	1,429.86		1 1
20Oct1999	0300	1,429.88		
20Oct1999	0400	1,429.89		
20Oct1999	0500	1,429.90		
20Oct1999	0600	1,429.92		
20Oct1999	0700	1,429,93		

#### Figure 41: Overrides Editor

To specify override values for the "selected reservoir" (see Reservoir list at top of Overrides editor), do the following:

- Select either the Elevation Target or Release or Capacity or Storage overrides tab.
- To revise a *single* value, double-click in the cell you want to revise and enter the new value.
- To revise *multiple* adjacent values:
  - 1. Point and click on the first cell, then drag your mouse or shift-click to highlight the cells to be revised.
  - 2. Right-click on the highlighted cells, and select **Fill** from the shortcut menu. The Table Fill Options dialog box will open.





- 3. Select the appropriate fill option in the **Table Fill Options** dialog box, then click **OK**. The revised values will reflect the fill option you selected. Also, the color of the revised values changes from black to blue and the mini-plot shows the revised values as a red line.
  - For those time steps where you do not specify override values, ResSim uses the reservoir rules to determine the reservoir release values. After running a simulation using your override values, you may decide to no longer use some, or all, of your override values. If so, you can use the **Unspecify** and

**Unspecify All** buttons to indicate that you want ResSim to determine the release values during the next compute.

- Use the Unspecify button when you want release values to be based on the reservoir rules for some of the override values you have specified. Highlight the cells where you have specified override values (they are green in the Release Overrides table), then press the Unspecify button.
- Use the Unspecify All button when you want all of the release values to be based on the reservoir rules and not have any overrides specified.
- Use the **Import** button when you want to use a Time Series of override values. The **Import Overrides Time Series** dialog box will open, which functions exactly like the **Select Time Series Path** dialog box used to select time-series records for an Alternative.

#### 9. Manage Simulation Data.

There are two operations involved in managing Simulation data [Section 14.7]. You can *save* your data *to* the base directory to make it available for other Simulations, and you can *replace* data in a Simulation for a specific Alternative with data *from* the base directory. See Appendix A of the ResSim User's Manual for an overview of the ResSim directory structure, including a discussion of the base and simulation directories.

- Simulation: 19 Oct 1999, 0800 Lookback: 18 Oct 1999, 0800 End: 21 Oct 1999, 2300 Compute Edit Run Set As InActive New Trial... Replace From Base Directory... Save to Base Directory...
- Save Data *to* the Base Directory. When you edit model data from the Simulation Module, your changes apply only to an individual Alternative that is saved in your Simulation

directory. If you want your changes to be available for subsequent Simulations, you will need to *save* the data *back to* the **Base** directory [Section 14.7.1]. This can be done by right-clicking on the Alternative in the Simulation Control menu, set the Alternative as Active, and then select Save to Base Directory. This will make your changes to physical and operational data available in the Reservoir Network Module.

• Replace Data *from* the Base Directory. If, while editing data in the Simulation Module, you need to revert to the original Alternative data from the Network Module, you can *replace* the changed data in your Simulation directory with data *from* the Base directory. [Section 14.7.2] This will make your original data (from the Reservoir Network Module) available in the Simulation Module, overwriting any changes you made to the selected alternative within the Simulation Module.

