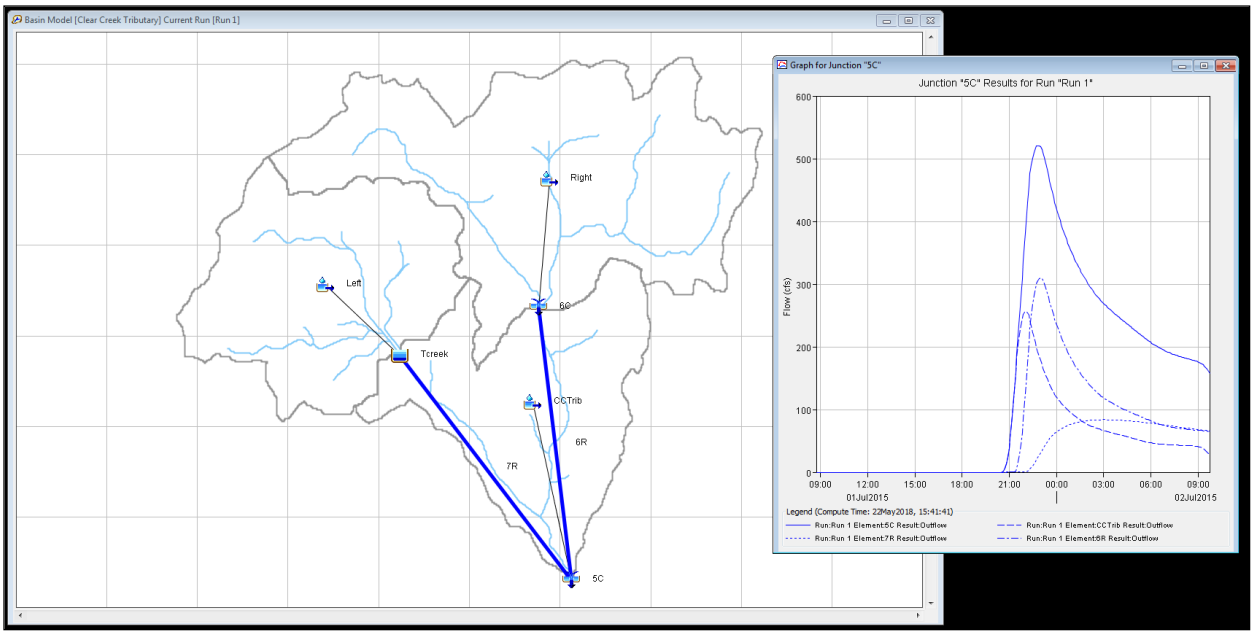
WMS

v. 11.0

WMS 11.0 Tutorial

Modeling Reservoirs in HEC-HMS

Learn how to route a hydrograph through a reservoir in HEC-HMS.



Objectives

Using a previously delineated watershed, learn how to create a reservoir in WMS and how to use HEC-HMS to route a hydrograph through a reservoir.

Prerequisite Tutorials

- DEM Delineation
- HEC-HMS Modeling

Required Components

- Data
- Drainage
- Map
- Hydrology
- Hydrologic Models
- HEC-HMS

Time

- 15–30 minutes

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1 Introduction

Oftentimes it is useful to model the effects of a reservoir either for design purposes or to see how a current reservoir affects the outlet flow of a watershed. A reservoir will attenuate flow in the watershed, and will therefore flatten the peak of the hydrograph, allowing for more controlled flow. This tutorial demonstrates how to model reservoir routing in HEC-HMS.

2 Getting Started

Starting WMS new at the beginning of each tutorial is recommended. This resets the data, display options, and other WMS settings to their defaults. To do this:

1. If necessary, launch WMS.
2. If WMS is already running, press *Ctrl-N* or select *File* | **New…** to ensure that the program settings are restored to their default state.
3. A dialog may appear asking to save changes. Click **No** to clear all data.

The graphics window of WMS should refresh to show an empty space.

4. Click **Open** to bring up the *Open* dialog.
5. Change the *Files of type* to "WMS XMDF Project File (*.wms)".
6. Navigate to*reservoir**reservoir*\ and select "hec-1_SingleWatershed.wms" and select **Open** to close the *Open* dialog and import the project file.

3 Modeling a Reservoir in HEC-HMS

A small reservoir exists at the outlet of the upper left basin. It has a storage capacity of 1000 ac-ft at the spillway level and 1540 ac-ft at the dam crest.

3.1 Defining a Reservoir in Combination with Routing

One of the routing methods available in HEC-HMS is storage routing, which can be used to define reservoir routing. In this case, Muskingum-Cunge routing is already being used to move the hydrograph through the reach connecting the upper left basin to the watershed outlet. The outlet must be defined as a reservoir in order to route the hydrograph through the reservoir before routing it downstream.

1. Switch to the **Hydrologic Modeling Module** .

2. Using the **Select Outlet** tool, select the outlet of the upper left basin.
3. Right-click on the outlet and select *Add* | **Reservoir**.

The icon will change color and become a triangle.

3.2 Setting up the Reservoir Routing Parameters

In order to define reservoir routing with HEC-HMS, elevation vs. storage (storage capacity curve) and elevation vs. discharge rating curves must be defined. Values can be entered directly or computed based on hydraulic structures. In this tutorial, values will be entered directly, using the same elevation values for both curves.

In this case, there should be no outflow until the elevation in the reservoir reaches the spillway. Since HEC-HMS linearly interpolates between consecutive points on the elevation-discharge and elevation-volume curves, two points on the curves at almost the same elevation (6821.99 ft and 6822 ft) will be entered. The first will have no outflow and the second will have the discharge over the spillway (640 cfs) as defined for the dam.

The initial conditions of the reservoir need to be entered to define the reservoir routing. These can be defined as an elevation, a discharge, or a volume. For this tutorial, the initial condition is set to an elevation four feet below the top of the spillway (the spillway corresponds to an elevation of 6822).

1. Select "HEC-HMS" from the model drop down above the project window.
2. Using the **Select Outlet** tool, double-click on the reservoir outlet point to bring up the *HMS Properties* dialog.
3. In the *Properties* section, change the value in the *Name* column to "Tcreek".
4. On the "Tcreek" row, from the *Method* drop-down, select "Elevation-Storage-Discharge".
5. Select "Elevation (ft)" from the *Initial* drop-down.
6. Enter "6818.0" in the *Initial Value* column.
7. Click **Define…** in the *Elevation-Storage* column to bring up the *XY Series Editor* dialog.
8. Click **New** and enter "Elevation-Storage" as the *Curve Name*.
9. In an external spreadsheet program, open the "reservoir-hms.xls" file found in the *reservoir\reservoir* directory.
10. Copy the numbered contents in the "Elevation" column.
11. In WMS in the *XY Series Editor* dialog, right-click in the empty cell under the *Elevation (ft)* column and select **Paste**.
12. In the external spreadsheet program, copy the numbered contents in the "Storage" column.
13. In WMS in the *XY Series Editor* dialog, right-click in the empty cell under the *Storage (ac-ft)* column and select **Paste**.
14. Click **OK** to close the *XY Series Editor* dialog.

15. Click the **Define…** button in the *Storage-Discharge* column to bring up the *XY Series Editor* dialog.
16. Click **New** and enter "Storage-Discharge" in the *Curve Name* field.
17. In the external spreadsheet program, copy the numbered contents in the "Storage" column.
18. In WMS in the *XY Series Editor* dialog, right-click in the empty cell under the *Volume (ac-ft)* column and select **Paste**.
19. In the external spreadsheet program, copy the numbered contents in the "Discharge" column.
20. In WMS in the *XY Series Editor* dialog, right-click in the empty cell under the *Discharge (cfs)* column and select **Paste**.
21. Click **OK** to close the *XY Series Editor* dialog.
22. Click **OK** to close the *HMS Properties* dialog.

3.3 Running HEC-HMS

Everything is now defined to run a three-basin HEC-HMS analysis that includes routing the upper basins through the reaches connecting them to the watershed outlet.

1. Right click on "Drainage Coverage Tree" in the Project Explorer and select **Save HMS File…** to bring up the *Save HMS File* dialog.
2. Select "HMS File (*.hms)" from the *Save as type* drop-down.
3. Enter "CCTribReservoir.hms" as the *File name*.
4. Click **Save** to save the HMS file and close the *Save HMS File* dialog.

HEC-HMS will be used to do additional calculations:

5. Locate and launch "HEC-HMS.exe" on the computer being used.
6. Once in HEC-HMS, select *File* | **Open…** to bring up the *Open an Existing Project* dialog.
7. Click **Browse** to bring up the *Select Project File* dialog.
8. Browse to the *reservoir\reservoir* directory and select "CCTribReservoir.hms".
9. Click **Select** to open the file and close the *Select Project File* dialog.
10. If asked to convert the file to the current version of HEC-HMS, click **Convert Project**.
11. The *Open File Format* dialog may appear. If so, in the *Open file as* section, select "HMS Basin Files" from the drop-down and click **OK** to close the *Open File Format* dialog.
12. In the HEC-HMS Project Explorer, expand the "Basin Models", "Meteorologic Models", "Control Specifications", and "Paired Data" folders.
13. Select "Clear Creek Tributary" to expand it.

To run the simulation, do the following in HEC-HMS:

1. Switch to the *Compute* tab in the HEC-HMS Project Explorer.
2. Select "Run 1" under the " Simulation Runs" folder under " CCTribReservoir".
3. Select *Compute* | **Compute Run [Run 1]** to bring up a progress dialog.
4. Click **Close** when HEC-HMS finishes computing to close the progress dialog.
5. At the bottom of the HEC-HMS Project Explorer, select the *Results* tab.
6. Expand the " Simulation Runs" folder and select "Run 1" to expand the results.
7. Select "Global Summary" to review the peak flows.
8. Select "Graph" below the entry for the junction for the entire basin to view the hydrograph for the entire basin.

Notice that there are four hydrograph curves in the plot (Figure 1). One represents the discharge from the CCTrib basin, one represents routed flow from the right basin, one represents routed flow from the left basin, and the curve with the largest peak represents the superimposed composite of the other three curves.

Feel free to explore and review the graphs and charts in each entry below the "Global Summary". Selecting each will cause the results to appear.

13. When finished, close and exit HEC-HMS by selecting *File* | **Exit.**
14. Click **Yes** if prompted to save the project.
15. Return to WMS.

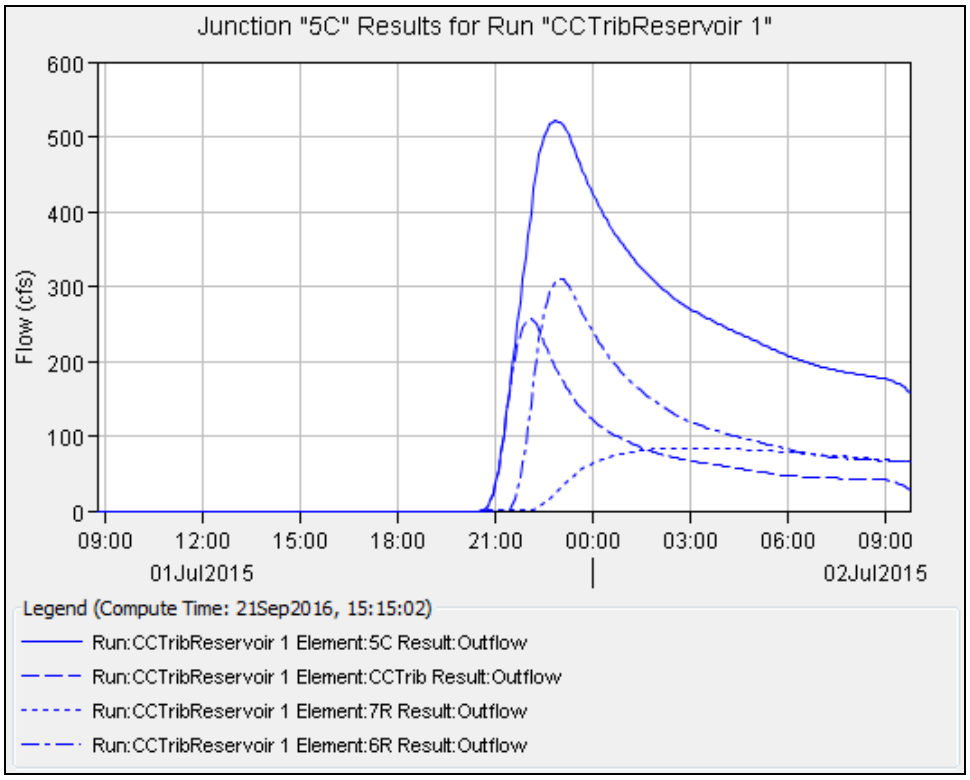

Figure 1 Hydrograph for entire basin with reservoir, including all three sub-basins

4 Conclusion

This concludes the "Modeling Reservoirs in HEC-HMS" tutorial. The key concepts discussed and demonstrated include:

- Performing a watershed analysis
- Defining routing parameters
- Routing a hydrograph through a reservoir
- Saving and running HEC-HMS simulations