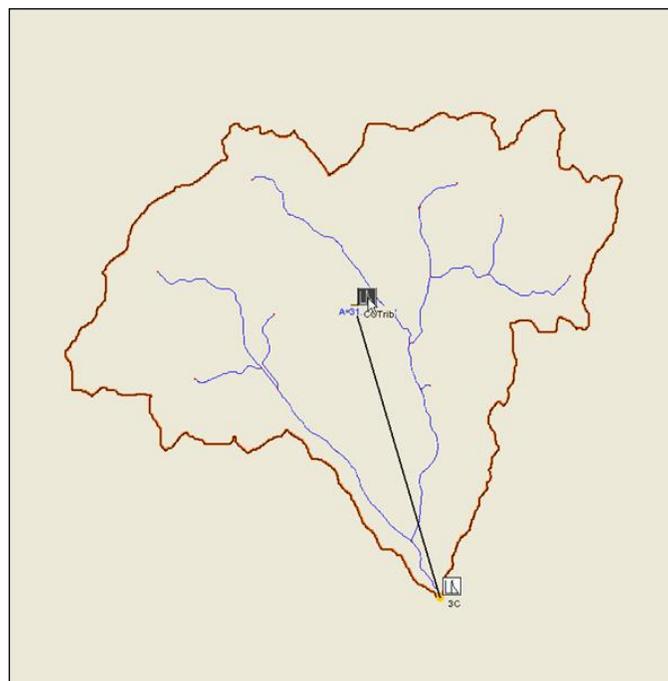


## WMS 11.0 Tutorial

### **HEC-1 Modeling**

Learn how to setup a basic HEC-1 model using WMS



#### Objectives

Build a basic HEC-1 model using a DEM, land use, and soil data. Compute the geometric and hydrologic parameters required to run a HEC-1 model.

#### Prerequisite Tutorials

- DEM Delineation

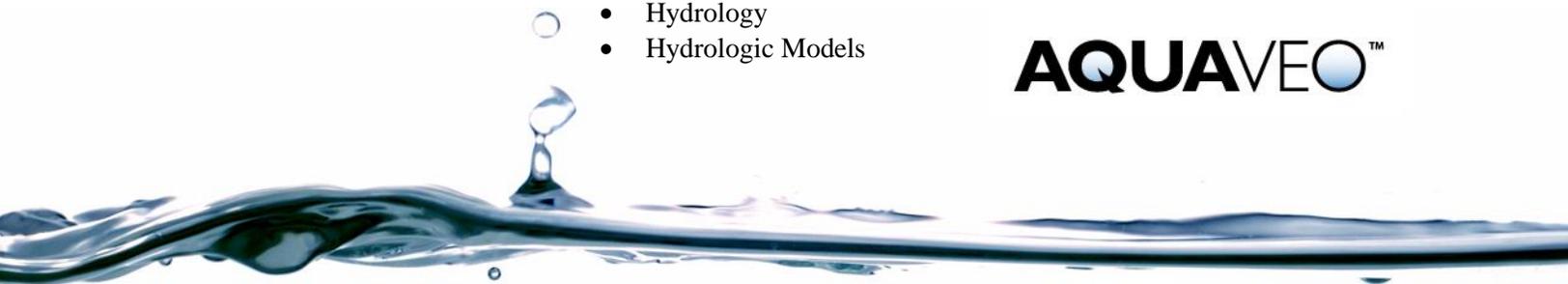
#### Required Components

- Data
- Drainage
- Map
- Hydrology
- Hydrologic Models

#### Time

- 30–60 minutes

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## 1 Introduction

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WMS includes a graphical interface to HEC-1. Geometric attributes such as areas, lengths, and slopes are computed automatically from the digital watershed. Parameters such as loss rates, base flow, unit hydrograph method, and routing data are entered through a series of interactive dialog boxes.

Once the parameters needed to define an HEC-1 model have been entered, an input file with the proper format for HEC-1 can be written automatically. Since only parts of the HEC-1 input file are defined in this chapter, feel free to explore the different available options of each dialog, being sure to select the given method and values before exiting the dialog.

The US Army Corps of Engineers now supports HMS rather than HEC-1, but the hydrologic calculations for the options within HEC-1 have not changed. Results of the two models will be identical.

In this tutorial, a watershed will be delineated from a DEM. A simple, single basin model will be developed using the delineated watershed to derive many of the parameters. Land use and soil shapefiles (downloaded from the Internet) will be used to develop a SCS curve number (CN) value.

## 2 Getting Started

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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.

## 3 Single Basin Analysis

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The simulation will be defined for a single basin by entering the Job Control parameters as well as the rainfall event, loss method, and unit hydrograph method parameters.

### 3.1 Setting up the Job Control

Most of the parameters required for a HEC-1 model are defined for basins, outlets, and reaches. However, there are many “global” parameters that control the overall simulation and are not specific to any basin or reach in the model. These parameters are defined in the WMS interface using the Job Control dialog.

1. Select **File / Open...** to bring up the *Open* dialog.
2. Select “WMS XMDF Project File (\*.wms)” from the *Files of type* drop-down.
3. Browse to the *hec-1\hec-1\* directory and select “hec-1\_SingleWatershed.wms”.
4. Click **Open** to import the project file and close the *Open* dialog.

The project in the Main Graphics Window should appear similar to Figure 1.

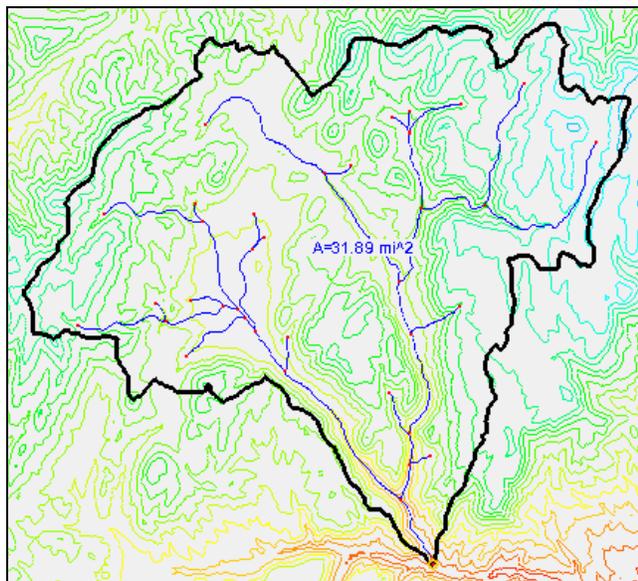


Figure 1 The drainage basin used in this tutorial

5. Switch to the **Hydrologic Modeling Module** .
6. Select “HEC-1” from the Model list drop-down (Figure 2).

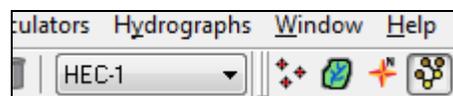


Figure 2 Model list drop-down

7. Select **HEC-1 / Job Control...** to bring up the *HEC-1 Job Control* dialog.

The first three lines are displayed at the top of the HEC-1 input file that will be created. The first line already has information indicating that the input file is generated by WMS. The other two lines can contain any desired information to help identify the project when reviewing the HEC-1 input file. The **Add Row** and **Delete Row** buttons can be used to add and delete rows as needed for additional information to be displayed at the top of the input file.

For this tutorial, do the following:

8. Enter “Clear Creek Tributary Watershed” on the second ID line.

9. Enter your name and the current date on the third line.
10. In the second section, leave the default values in the *Day*, *Month*, and *Year* fields.

HEC-1 allows a date to be entered here. In this tutorial, a hypothetical storm (rather than an actual storm) will be simulated. If these values are changed, be sure these fields match the beginning storm date in the *XY Series Editor* dialog (discussed later in this tutorial).

11. Enter “5” as the *Computational time interval*.
12. Enter “300” as the *Number of hydrograph ordinates*.

HEC-1 simulations run for a length of time equal to the time step multiplied by the number of ordinates. If simulating a 24-hour storm, but the simulation is run for only 12 hours, the full hydrograph will not be captured. Conversely, running a 24-hour simulation for 96 hours will generally produce a lot of runoff ordinates equal to 0 at the end. In this case, the simulation is running for 1500 minutes (slightly more than 24 hours) with an ordinate on the hydrograph being computed for every 5 minutes.

13. In the fourth section, select *English units* as the *Computation units*.

Setting the computation units does not cause any units conversion to take place. This simply tells HEC-1 that input units in English units will be provided (square miles for area, inches for rain, feet/miles for length) and to expect the results of the computations to be in English units (cfs). If selecting Metric, ensure that input units are also metric (square kilometers, mm for rain, meters/kilometers for length) so the results will be metric (cms).

For now, the other *HEC-1 Job Control* dialog settings will be left at their default values.

14. Click **OK** to close the *HEC-1 Job Control* dialog.

### 3.2 Setting up the Basin Data Parameters

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1. Using the **Select Basin**  tool, double-click on the brown basin icon labeled 1B to bring up the *Edit HEC-1 Parameters* dialog.

The brown basin icon may be partially hidden behind the basin labels near the center of the basin. Double-clicking on a basin or outlet icon always brings up the parameter editor dialog for the current model (in this case HEC-1).

2. In the *Basin HEC-1 Cards* section, click **Basin Data...** to bring up the *HEC-1 Basin Data* dialog.

Notice that the *Area* has been calculated. If metric units were being used, the *Area* would show in square kilometers.

3. In the top section, enter “CCTrib” as the *Basin name*.

HEC-1 only uses the first six characters entered, so it is not recommended to use basin or outlet names longer than six characters.

4. Click **OK** to close the *HEC-1 Basin Data* dialog.
5. Click **Precipitation...** to bring up the *HEC-1 Precipitation* dialog.
6. Select *Basin average (PB)* and enter “1.8” as the *Average precipitation*.
7. Click **Define Series** to bring up the *XY Series Editor* dialog.

In order to simulate a rainfall event, enter both a rainfall depth and a temporal distribution. The NRCS uses standard time distributions for different areas of the U.S. These are stored in WMS. Additionally, a series can be defined based on an actual storm or on a design from a regulating agency.

8. On the lower right, select “typeII-24hour” from the *Selected Curve* drop-down.
9. Click **OK** to close the *XY Series Editor* dialog.
10. Click **OK** to close the *HEC-1 Precipitation* dialog.
11. Click **Loss Method...** to bring up the *HEC-1 Loss Methods* dialog.
12. Enter “70.0” as the *CRVNBR* and click **OK** to close the *HEC-1 Loss Method* dialog.
13. Click **Unit Hydrograph Method...** to bring up the *HEC-1 Unit Hydrograph Methods* dialog.
14. Select *SCS dimensionless (UD)* and click **Compute Parameters - Basin Data** to bring up the *Basin Time Computation* dialog.
15. Select “Compute Lag Time” from the *Computation type* drop-down.
16. Select “SCS Method” from the *Method* drop-down and click **OK** to close the *Basin Time Computation* dialog.

Notice that the computed lag time for the *SCS dimensionless (UD)* has been updated (the number in the *TLAG* field).

17. Click **OK** to close the *HEC-1 Unit Hydrograph Methods* dialog.
18. Click **Done** to close the *Edit HEC-1 Parameters* dialog.

Now all of the parameters needed to run a single basin analysis have been entered.

### 3.3 Running HEC-1

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Whenever running a HEC-1 simulation, WMS will first save a standard HEC-1 input file. An output file and a solutions file will need to have names specified. The output file is the standard text output file generated by HEC-1 and the solution file is an HEC-1 TAPE22 file (a plot file) containing the hydrographs formatted to make it easy for WMS to read and plot.

1. Select *HEC-1 / Run Simulation...* to bring up the *HEC-1 Run Options* dialog.
2. Below *Input file*, click  to bring up the *Select HEC-1 Input File* dialog.
3. Enter “CCTrib.hc1” as the *File name* and click **Save** to set the file name and close the *Select HEC-1 Input File* dialog.

Notice that the file name specified in step 3 now appears to the right of *Input file*. This specifies the file name but does not actually save it yet.

4. Turn on *Save file before run*.
5. Click **OK** to close the *HEC-1 Run Options* dialog and bring up the *Model Wrapper* dialog.
6. Once HEC-1 finished, turn on *Read solution on exit*.
7. Click **Close** to import the solutions and close the *Model Wrapper* dialog.

A small hydrograph plot icon will appear by the basin icon.

8. Using the **Select Hydrograph**  tool, double-click on the hydrograph icon to open the *Hydrograph* dialog.

The dialog should display a hydrograph similar to Figure 3. Notice that the hydrograph suddenly stops at 1500 minutes (the duration of the simulation as established in the *Job Control* dialog), but the simulation has not run to completion. Run the simulation again with additional hydrograph ordinates to capture the entire storm.

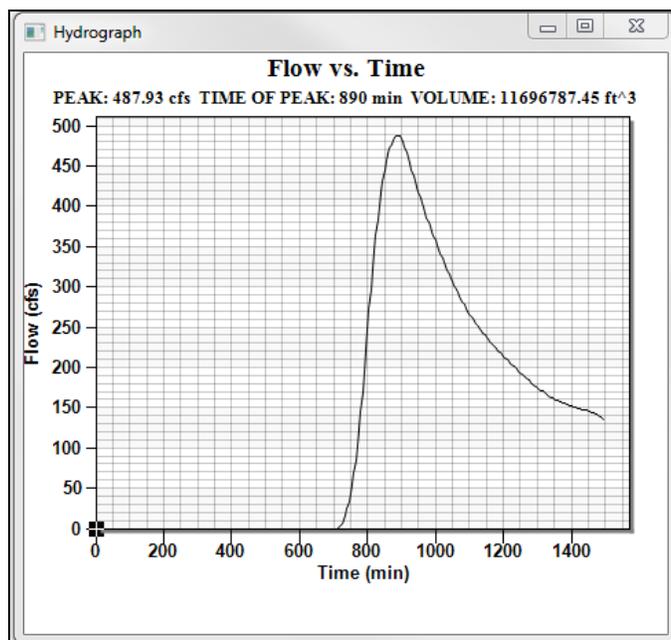


Figure 3 Hydrograph after first HEC-1 run

9. Close the *Hydrograph* dialog by clicking  in the upper right corner of the window.
10. Select *Hydrographs / Delete All* to remove the hydrograph.
11. Select *HEC-1 / Job Control...* to bring up the *HEC-1 Job Control* dialog.
12. Enter "400" as the *Number of hydrograph ordinates* and click **OK** to close the *HEC-1 Job Control* dialog.
13. Select *HEC-1 / Run Simulation...* to bring up the *HEC-1 Run Options* dialog.
14. Click **OK** to close the *HEC-1 Run Options* dialog and bring up the *Model Wrapper* dialog.

This overwrites the previous files, which is acceptable because the hydrograph was incomplete.

15. Once HEC-1 finishes, turn on *Read solution on exit* and click **Close** to exit the *Model Wrapper* dialog.
16. Using the **Select Hydrograph**  tool, double-click on the hydrograph icon next to the basin icon to bring up the *Hydrograph* dialog.

The HEC-1 simulation has now been completed for a single basin and the resulting hydrograph should appear similar to Figure 4.

17. Close the *Hydrograph* dialog by clicking  in the upper right corner of the window.

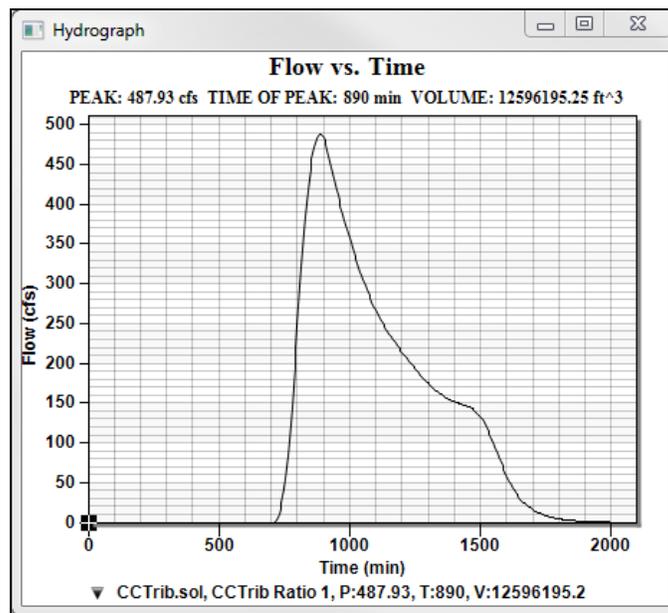


Figure 4 Solution hydrograph for HEC-1 Simulation

## 4 Conclusion

This concludes the “HEC-1 Modeling” tutorial. The key concepts discussed and demonstrated include:

- Entering job control parameters
- Defining basin parameters such as loss rates, precipitation, and hydrograph methodology.
- Saving HEC-1 input files
- Reading hydrograph results