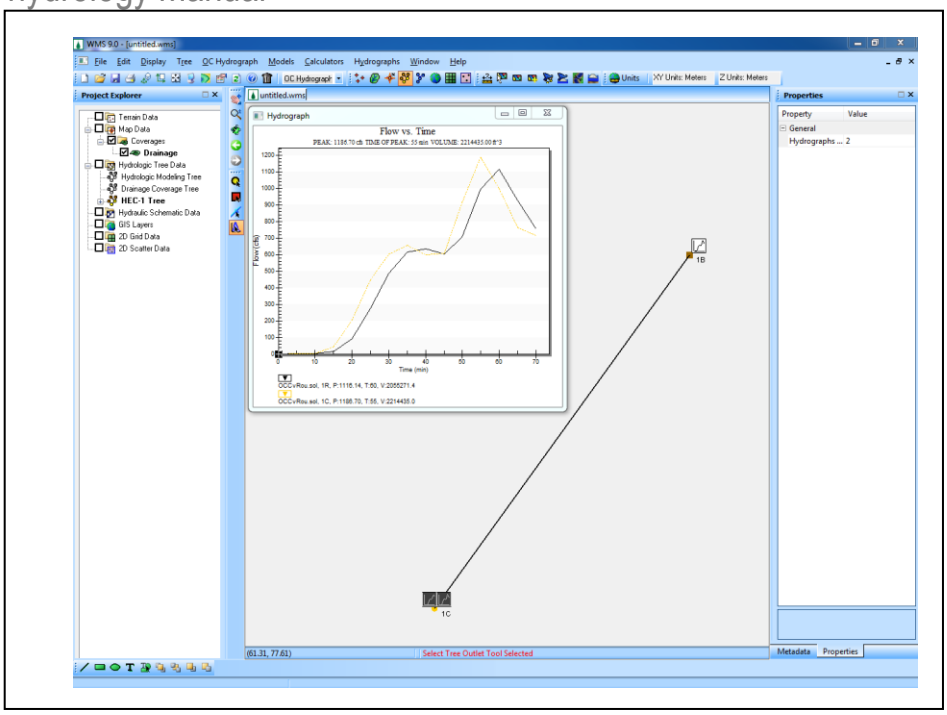
WMS

v. 10.1

WMS 10.1 Tutorial

Watershed Modeling – Orange County Unit Hydrograph

Build and run a unit hydrograph analysis based on methods in the Orange County (California) hydrology manual



Objectives

This tutorial shows how to define and run basic Orange County unit hydrograph models. Different options are explored for computing and routing hydrographs. This is based on the example problem on page E-26 of the Orange County Hydrology Manual.

Prerequisite Tutorials

- None

Required Components

- Hydrologic Models

Time

- 20-40 minutes

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1 Introduction

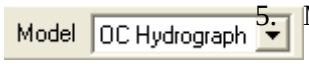
This exercise will cover the steps necessary to create a unit hydrograph analysis based on the example problem on page E-26 of the Orange County Hydrology Manual.

2 Orange County Hydrology Manual Example

2.1 Create Hydrologic Tree (Schematic) Model

1. Open WMS. If WMS is already open, select *File* | **New** and click **No** if prompted to save changes.
2. Switch to the **Hydrologic Modeling** module.
3. Select *Tree* | *Add* | **Outlet** (or press the O key on the keyboard).
4. Select *Tree* | *Add* | **Basin** (or press the B key on the keyboard).

This generates a basic schematic model representing a concentration point with one sub-area.



5. Make sure that the *Model* combo box is set to "OC Hydrograph".

2.2 Enter Job Control Parameters

1. Select *OC Hydrograph* | **Job Control…**

2. The *HEC-1 Job Control* dialog will appear. For the *Computational time interval* enter "5".
3. Set the *Number of hydrograph ordinates* to "350".

NOTE: The number of unit hydrograph ordinates should be enough to cover the duration for the storm event at the computational time interval. For example, if the computational time interval entered is 1 minute, then the number of hydrograph ordinates for a 1-day storm event should be at least 1,440.

4. Select **OK**.

2.3 Define the Storm Event

1. Select *OC Hydrograph* **| Define Storm…**
2. The *Orange County Storm* dialog will appear. Change the *Frequency* to "100" year.
3. Select **OK**.

2.4 Edit Sub-area Parameters

1. Use the **Select Basin** tool to select the sub-area labeled 1B.
2. Select *OC Hydrograph* **| Edit Parameters…**
3. The *Edit Orange County Unit Hydrograph Parameters* dialog will appear. Click on the **Basin Data…** button.
4. In the *HEC-1 Basin Data* dialog, enter an *Area* of "5" sq. miles (3200 acres).
5. Toggle on *Enter base flow*.
6. In the *STRTQ* field enter "-10" to represent a base flow of 10 cfs/sq. mile.
7. Select **OK**.

2.5 Develop Effective Precipitation

1. Click on the **Effective Precipitation…** button.
2. The *Orange County Precipitation Wizard* will appear. Enter a *Fm* value of "0.19".
3. Enter a *Ybar* value of "0.337".
4. Click on the **Next** button to view the effective precipitation.
5. Click **Done**.

2.6 Define the Unit Hydrograph

1. Click on the **Unit Hydrograph Method…** button.
2. In the *Orange County Unit Hydrograph* dialog, enter a *Lag time* of "0.75".
3. Toggle on the *Valley developed* S-graph.

4. Set the *weight* for the Valley developed S-graph to "1.0".
5. Click the **Plot Unit Hydrograph** button.
6. Select **OK**.
7. Click the **Done** button on the *Edit Orange County Unit Hydrograph Parameters* dialog.

3 Running the Simulation

1. Select *OC Hydrograph* | **Run Simulation…**
2. Click the **browse** button next to the Input File.
3. The *Select HEC-1 Input File* dialog will appear. For the *File name* enter "ochme-26" and click **Save** (this specifies the file name but does not actually save it).
4. Verify that the *Save file before run* option is toggled on.
5. Select **OK**.
6. A new window will open where HEC-1 will run. Select **Close** once HEC-1 finishes running (this may take a few seconds to a minute or so).
7. Double-click either hydrograph icon.

View a plot of the average runoff hydrograph ordinates as shown in Figure 1. Draw a smooth curve in order to determine the peak discharge as outlined on page E-40 of the Orange County Hydrology Manual.

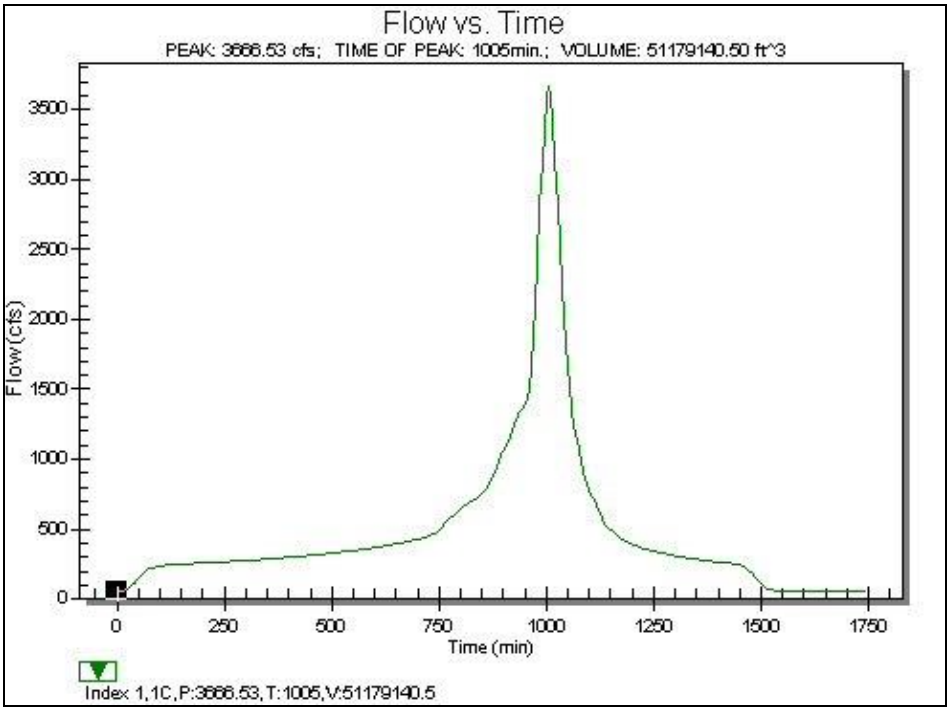


Figure 1 Runoff hydrograph

8. Click on the X to close the Plot Window.

4 Saving Files

1. Select *OC Hydrograph* | **Save HEC-1 File…**
2. The *Save* dialog will appear. Enter a file name and select the **Save** button to save a HEC-1 input file (*.hc1)

The HEC-1 input file contains all of the standard HEC-1 cards and parameters. It does not have any of the input parameters such as point precipitation values and S-graph data that are used to generate HEC-1 input.

3. Select *File* | **Save As…**
4. In the *Save As* dialog, enter a file name and select the **Save** button to save a WMS project file (*.wms).

The WMS project file stores all of the HEC-1 input data for each sub-area and concentration point as well as the data used to generate the HEC-1 input.

5 Flow-through Routing

Flow-through routing is also known as storage routing using the Modified-Puls method. Open a HEC-1 file that already has the inflow and job control parameters defined for the flow-through routing example on page F-9 of the Orange County Hydrology Manual. Enter the routing parameters and view the routed hydrograph after running the simulation.

5.1 Open Unit Hydrograph File

1. Select *File* | **New** .
2. Select **No** if prompted to save changes to the project.
3. Switch to the **Hydrologic Modeling** module. Make sure that "OC Hydrograph" is selected from the *Models* window.
4. Select *OC Hydrograph* | **Open HEC-1 File…**
5. Locate the "OrangeCounty\UnitHydro" folder in the files for this tutorial. If needed, download the tutorial files from www.aquaveo.com.
6. Open "OCHMFlowThru.hc1".

5.2 Define Routing

1. Use the **Select Outlet** tool to select the concentration point labeled 1C.
2. Select *OC Hydrograph* | **Edit Parameters…**
3. In the *Edit Orange County Unit Hydrograph Parameters* dialog, click the **Routing Data…** button.
4. In the *HEC-1 Routing Data* dialog, change *Routing type* to "Storage (RS)".

5. Choose *Reservoir* and click on the **Define** button.
6. The *HEC-1 Reservoir Routing Options* dialog will appear. In the *Outflow* section of the dialog choose *Known outflow*.
7. Toggle on *SE* and click on the **Define** button.
8. The *XY Series Editor* will open up. Enter the values in the *Elevation* column of Table 1.

Table 1: Elevation, storage, and discharge data

Elevation (SE)	Outflow (SQ)	Volume (SV)
0.0	0.0	0.0
1.0	4.2	14.4
2.0	12.0	28.8
3.0	51.7	43.2
4.0	114.7	57.6
5.0	186.8	72.0
6.0	263.2	86.4

9. Select the remaining cells in the column and hit the **DELETE** key on the keyboard so that the cells are blank.
10. Select **OK**.
11. Toggle on *SQ* and click on the **Define** button
12. In the *XY Series Editor*, enter the values in the *Outflow* column of Table 1.
13. Select the remaining cells in the column and hit the **DELETE** key on the keyboard so that the cells are blank.
14. Select **OK**.
15. In the *Volume* section of the dialog choose *Known volume*.
16. Toggle on *SE* and click on the **Define** button.
17. The *XY Series Editor* will reappear. Change the *Selected curve* to "1C Outflow elev".
18. Select **OK**.
19. Toggle on *SV* and click on the **Define** button.
20. In the *XY Series Editor*, enter the values in the *Volume* column of Table 1.
21. Select the remaining cells in the column and hit the **DELETE** key on the keyboard so that the cells are blank.
22. Select **OK**.
23. Select **OK** in the *HEC-1 Reservoir Routing Options* dialog.
24. Select **OK** in the *HEC-1 Routing Data* dialog.
25. Select **Done** in the *Edit Orange County Unit Hydrograph Parameters* dialog.

5.3 Run the Simulation

1. Select *OC Hydrograph* | **Run Simulation…**
2. In the *HEC-1 Run Options* dialog, click the **browse** button next to the Input File.
3. The *Select HEC-1 Input File* dialog will appear. For the file name enter "OCHMFlowThruRoute" and click **Save** (this specifies the file name but does not actually save it).
4. Verify that the *Save file before run* option is toggled on.
5. Select **OK**.
6. Select **Close** in the new window once HEC-1 finishes running (this may take a few seconds to a minute or so).
7. Select one of the two hydrograph icons displayed at the concentration point labeled 1C.
8. Hold the **SHIFT** key down and double-click on the other hydrograph icon.

Figure 2 shows the inflow and the routed outflow hydrographs.

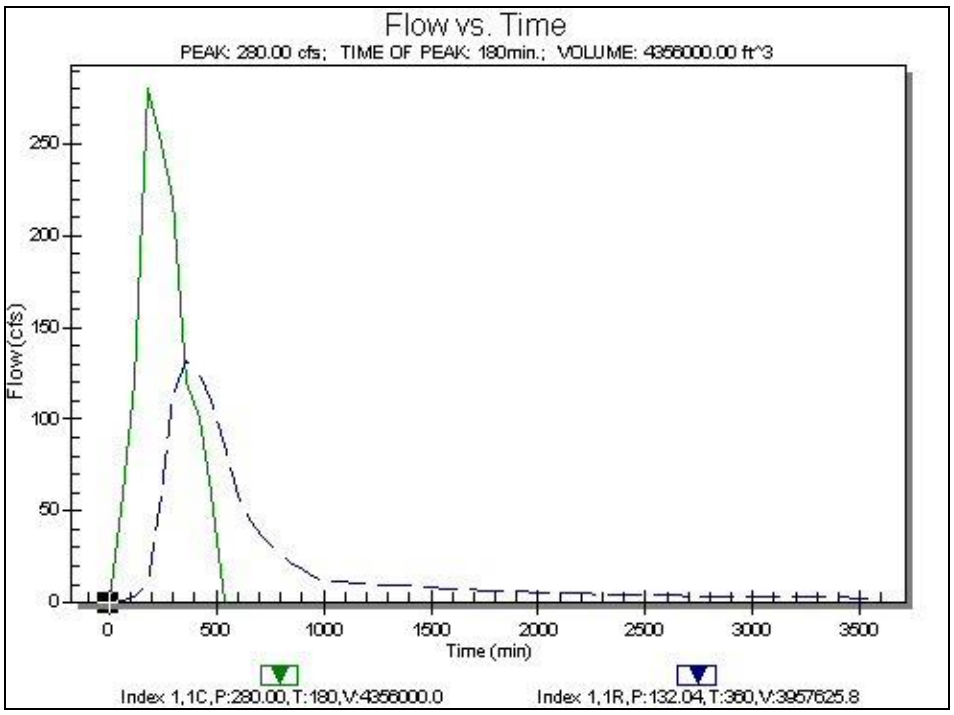


Figure 2 Inflow and routed outflow hydrographs for flow-through routing

9. Click on the X to close the plot window.

6 Flow-by Routing

6.1 Open Unit Hydrograph File

1. Select *File* | **New** .
2. Select **No** if prompted to save changes to the project.
3. Switch to the **Hydrologic Modeling** module.
4. Select *OC Hydrograph* | **Open HEC-1 File…**
5. Open "OCFlowBy.hc1".

6.2 Define Routing (Constant Diverted Flow)

1. Use the **Select Outlet** tool to select the concentration point labeled 1-14C.
2. Select *Tree* | *Add* | **Diversion**.
3. Use the **Select Diversion** tool to select the newly created diversion, labeled D1.
4. Select *OC Hydrograph* | **Edit Parameters…**
5. The *Edit Orange County Unit Hydrograph Parameters* dialog will reappear. Click on the **Diversion Data…** button.
6. In the *HEC-1 Diversion Data* dialog, click on the **Define DI** button to define the inflow portion of a rating curve for flow into concentration point 1-14C.
7. The *XY Series Editor* will reappear. On the first row enter "0.0".
8. On each succeeding row increment the value by 100.0 so that the value on the last row is "1900.0".
9. Select **OK**.
10. In the *HEC-1 Diversion Data* dialog, click on the **Define DQ** button to open the *XY Series Editor* and define the diverted flow portion of the rating curve.
11. In the *XY Series Editor*, enter a constant diverted flow of "50.0" in all rows.
12. Select **OK**.
13. Select **OK**.
14. Select **Done**.

6.3 Run the Simulation

1. Select *OC Hydrograph* | **Run Simulation…**
2. In the *HEC-1 Run Options* dialog, click the **browse** button next to the Input File.
3. For the file name enter "OCHMFlowByRoute" and click **Save** (this specifies the file name but does not actually save it).
4. Verify that *Save file before run* is toggled on.

5. Select **OK**.
6. Select **Close** once HEC-1 finishes running (this may take a few seconds to a minute or so).
7. Select the hydrograph icon displayed at the concentration point labeled 1-14C.
8. Hold the **SHIFT** key down and double-click on the hydrograph icon labeled 1-14R.
9. Click on the X to close the plot window.

6.4 Define Routing (Varying Diverted Flow)

1. Use the **Select Diversion** tool to select the diversion.
2. Select *OC Hydrograph* | **Edit Parameters…**
3. In the *Edit Orange County Unit Hydrograph Parameters* dialog, click on the **Diversion Data**… button.
4. In the *HEC-1 Diversion Data* dialog, click on the **Define DQ** button to define the diverted flow portion of the rating curve.
5. The *XY Series Editor* will appear. On the first row enter "0.0".
6. On each succeeding row increment the value by 50.0 so that the value on the last row is "950.0".
7. Select **OK**.
8. Select **OK**.
9. Select **Done**.
10. Select *Hydrographs* | **Delete All**.
11. Follow the steps in Section 6.3 to run the simulation again and view the results.

7 Convex Routing

7.1 Open Unit Hydrograph File

1. Select *File* | **New** .
2. Select **No** if prompted to save changes to the project
3. Switch to the **Hydrologic Modeling** module.
4. Select *OC Hydrograph* | **Open HEC-1 File…**
5. From the *Open* dialog, open "OCHMConvex.hc1".

7.2 Define Routing

1. Use the **Select Outlet** tool to select the concentration point labeled 1C.
2. Select *OC Hydrograph* | **Edit Parameters…**

3. In the *Edit Orange County Unit Hydrograph Parameters* dialog, click the **Routing Data…** button.
4. In the *HEC-1 Routing Data* dialog, change *Routing type* to "Convex (RV)".
5. Enter a *L* value of "3000".
6. Enter a *S* value of "0.005".
7. Enter a *N* value of "0.015".
8. Enter a *WD* value of "10".
9. Select **OK**.
10. Select **Done**.

7.3 Run the Simulation

1. Select *OC Hydrograph* **| Run Simulation…**
2. In the *HEC-1 Run Options* dialog, click the **browse** button next to the Input File.
3. For the file name enter "OCHMConvexRoute" and click **Save** (this specifies the file name but does not actually save it)/
4. Verify that *Save file before run* is toggled on.
5. Select **OK**.
6. Select **Close** once HEC-1 finishes running (this may take a few seconds to a minute or so).
7. Select one of the two hydrograph icons displayed at the concentration point labeled 1C.
8. Hold the **SHIFT** key down and double-click on the other hydrograph icon.

Figure 3 shows the inflow and the routed outflow hydrographs.

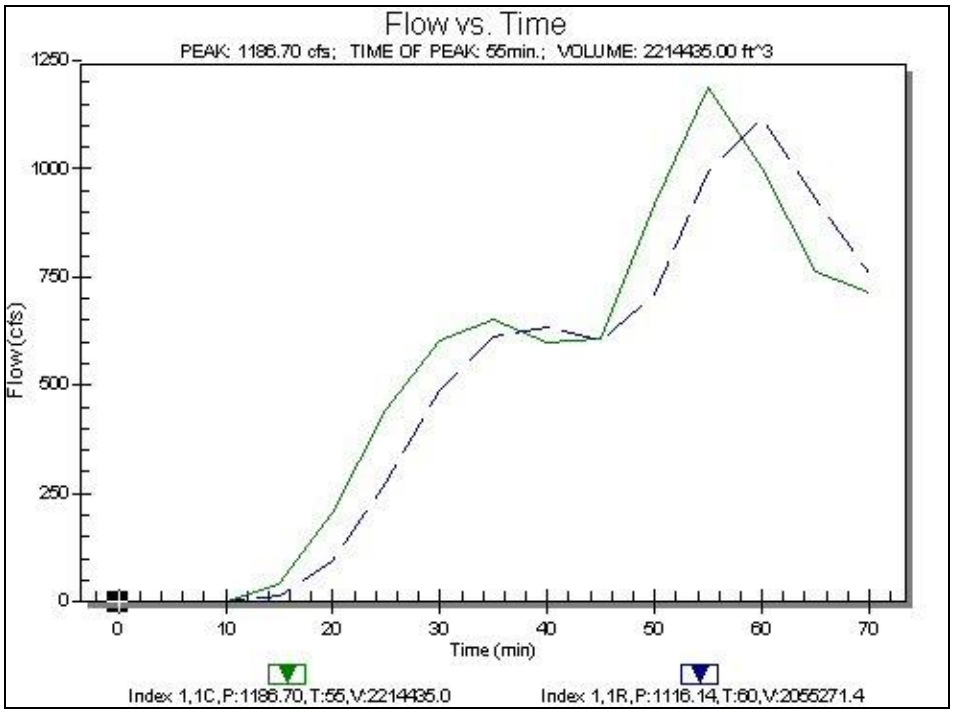


Figure 3 Inflow and routed outflow hydrographs for convex routing

9. Click on the X to close the plot window.

8 Conclusion

This tutorial demonstrated the steps necessary to create a unit hydrograph analysis.

