

# CEE3430 Engineering Hydrology HEC-HMS Bare Essentials Tutorial and Example

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April 2014

This tutorial provides some bare essentials step by step guidance on starting to use HEC-HMS. This is not intended to be comprehensive or to replace the HEC-HMS documentation; rather it is a getting started guide intended to get you through a first run using the program and provide the bare essential knowledge from which you can learn more by exploring the software and more comprehensive manuals.

## HEC HMS website and resources

- (a) Main HEC-HMS website: <http://www.hec.usace.army.mil/software/hec-hms/>
- (b) HEC-HMS , version 4.0 download: <http://www.hec.usace.army.mil/software/hec-hms/downloads.aspx>
- (c) User's Manual: [http://www.hec.usace.army.mil/software/hec-hms/documentation/HEC-HMS\\_Users\\_Manual\\_4.0.pdf](http://www.hec.usace.army.mil/software/hec-hms/documentation/HEC-HMS_Users_Manual_4.0.pdf)
- (d) Quick Start Guide(for new users and includes a tutorial): [http://www.hec.usace.army.mil/software/hec-hms/documentation/HEC-HMS\\_QuickStart\\_Guide\\_4.0.pdf](http://www.hec.usace.army.mil/software/hec-hms/documentation/HEC-HMS_QuickStart_Guide_4.0.pdf)

## 1. Steps for download and installation:

- On the "Download" page, under the "Windows" section, click on "**Download**"
- A "File Download – Security Warning" will appear with the question, "Do you want to run or save this file?"
- Click on "**Run**" to run HEC-HMS\_40\_Setup.exe
- Takes a few seconds to download
- Message appears: "Welcome to the InstallShield Wizard for HEC-HMS 4.0", click "**Next**"
- Read Terms and Conditions, and click "I agree to the above Terms and Conditions for Use", and click to step through the install selecting all the defaults.
- A final InstallShield message appears: click "**Finish**"

## 2. Running a simple case:

This follows Example 5.1, the “Small-Watershed Example,” from page 335 of Bedient et al. (2008)

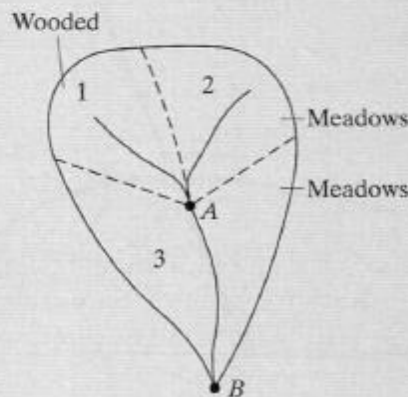
### SMALL-WATERSHED EXAMPLE (HEC-HMS)

A small undeveloped watershed has the parameters listed in the accompanying tables. A unit hydrograph and Muskingum routing coefficients are known for subbasin 3, shown in Fig. E5-1(a).  $TC$  and  $R$  values for subbasins 1 and 2 and associated SCS curve numbers (CN) are provided as shown. A 5-hr rainfall hyetograph in in./hr is shown in Fig. E5-1(b) for a storm event that occurred on June 19, 1983. Assume that the rain fell uniformly over the watershed. Use the information given to develop an HEC-HMS input data set to model this storm. Run the model to determine the predicted outflow at point  $B$ .

Subbasin Number	$TC$ (hr)	$R$ (hr)	SCS Curve Number	% Impervious (%)	Area (mi <sup>2</sup> )
1	2.5	5.5	66	0	2.5
2	2.8	7.5	58	0	2.7
3	—	—	58	0	3.3

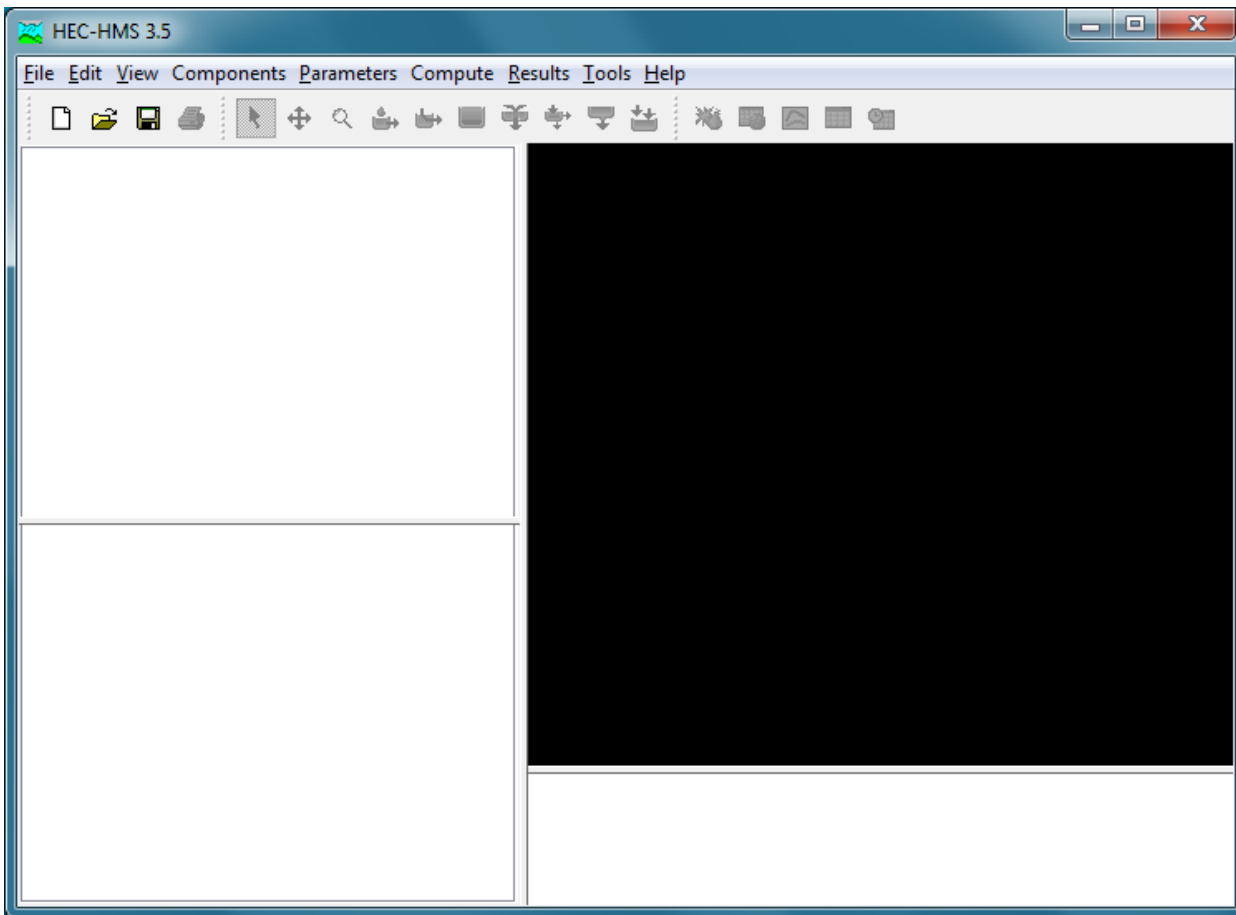
Input UH for	Time (hr)	0	1	2	3	4	5	6	7
Subbasin 3:	$U$ (cfs)	0	200	400	600	450	300	150	0

Muskingum coefficients:  $x = 0.15$ ,  $K = 3$  hr, area = 3.3 sq mi.

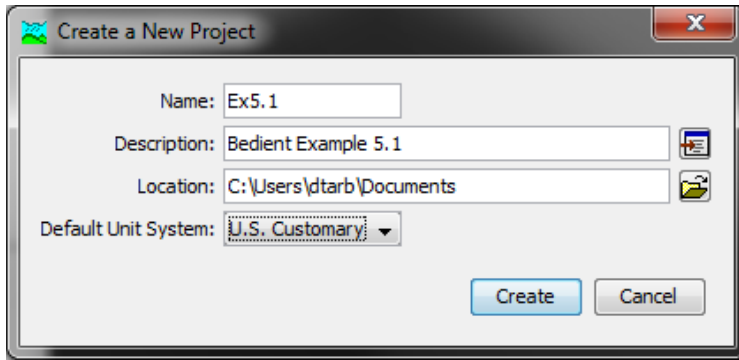


Steps:

- a. Double click on the HEC-HMS 4.0 icon to Open Hec-HMS. You may need to scroll to the bottom and agree to the terms and conditions of use. The program screen, similar to the picture below, appears

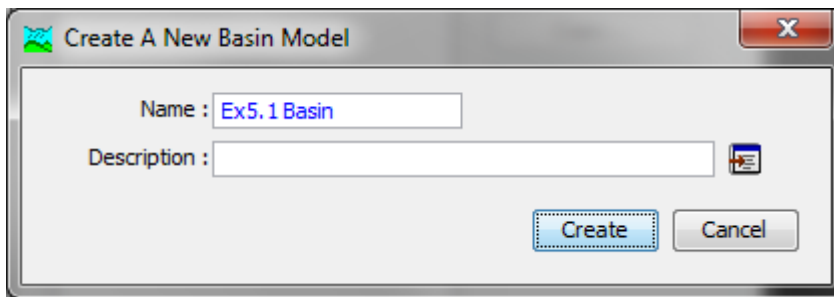


- b. On the menu bar, click on "File"
  - For new projects, click on "New"
  - For existing projects, click on "Open" and select from existing projects.
- c. The "New" project will be the setup in Example 5.1
  - Create a project name (I chose "Ex5.1"),
  - Select where the project work will be stored,
  - Provide a description, and
  - Select the units to use (U.S. Customary for the example above).
  - Click "Create"

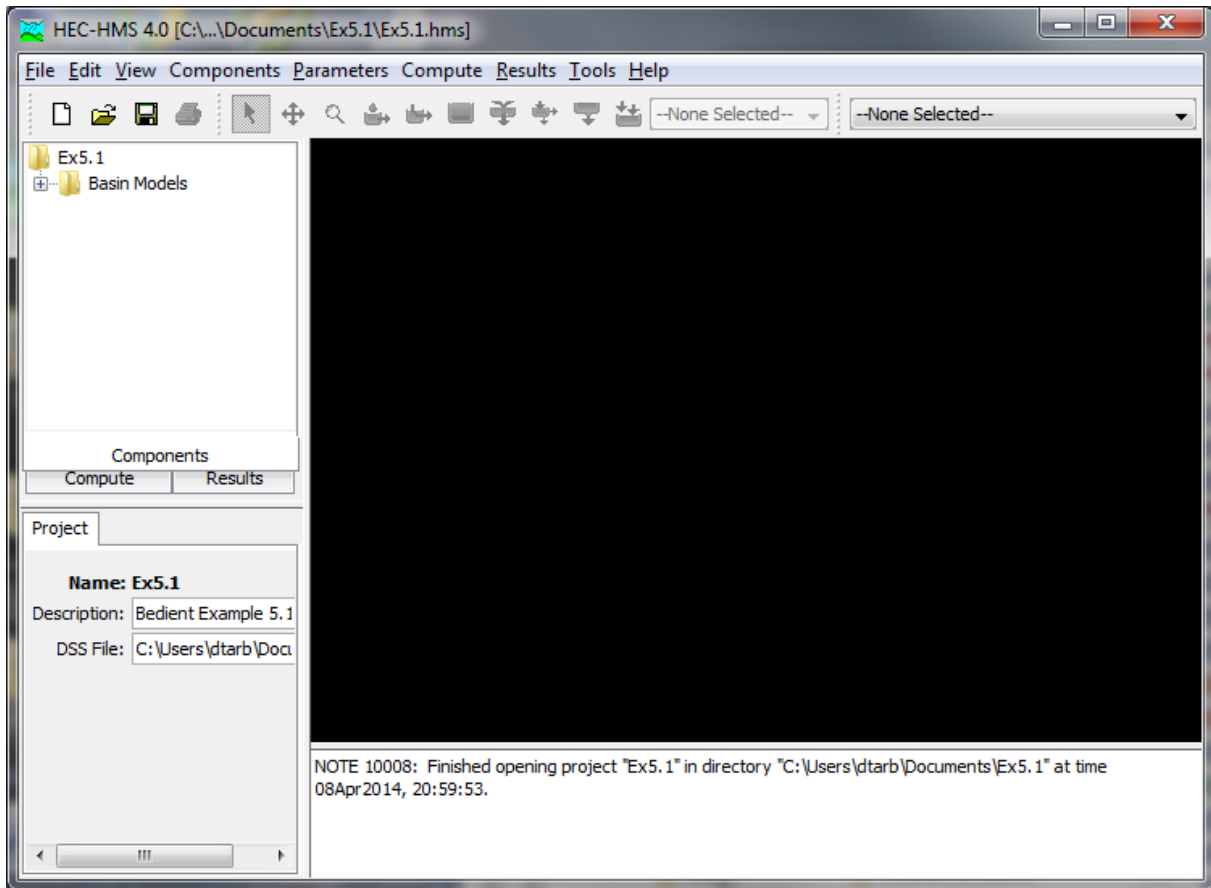


d. Begin to set up the basin

- At the top on the menu bar, select “Components”
- Select “Basin Model Manager” and click on “New”
  - Provide a basin name and description
  - Click on “Create”

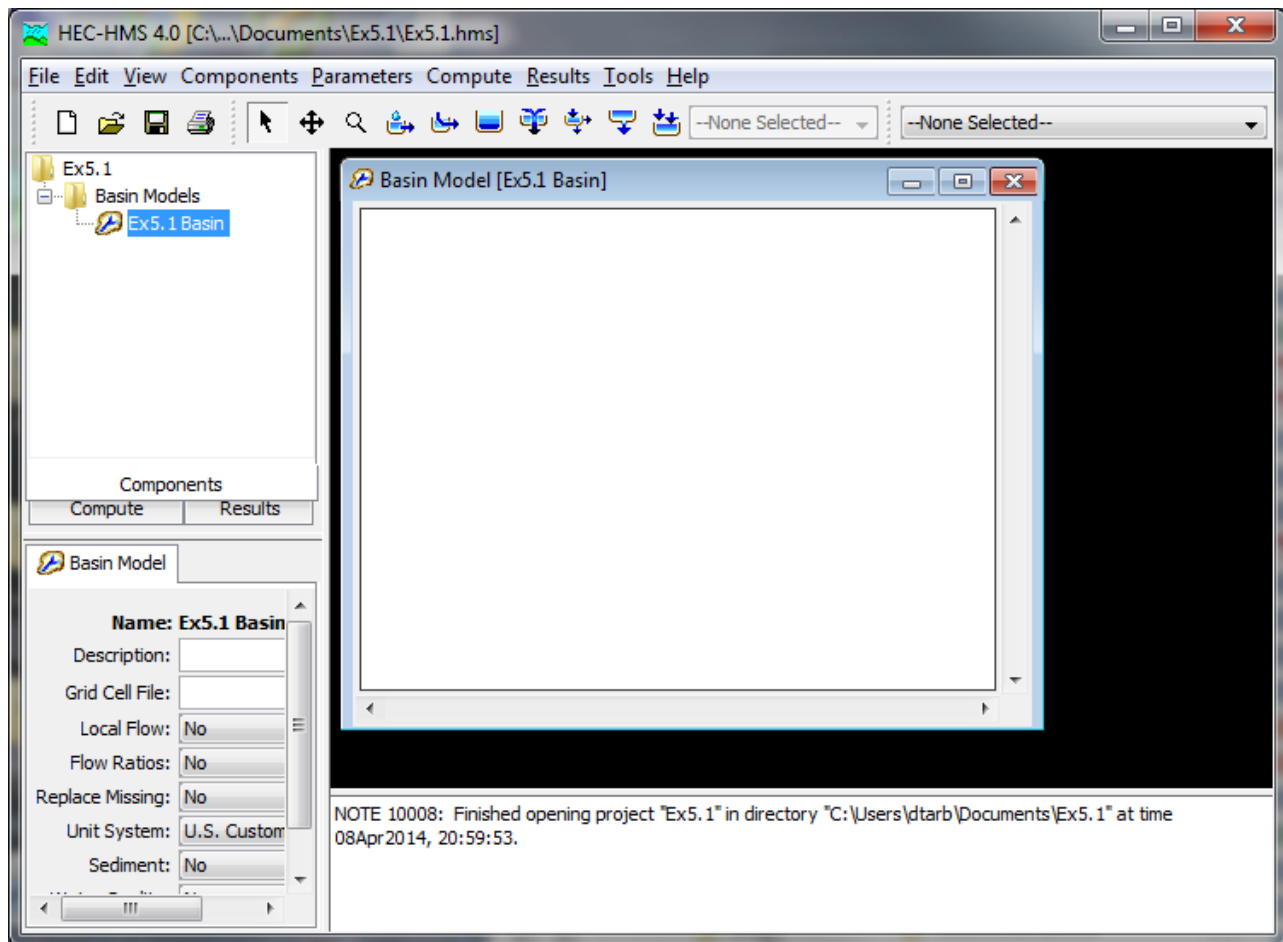


- The folder, “Basin Models,” appears in the Watershed Explorer (on left of screen) under the project name, Ex5.1
- Close the Basin Manager (click X)

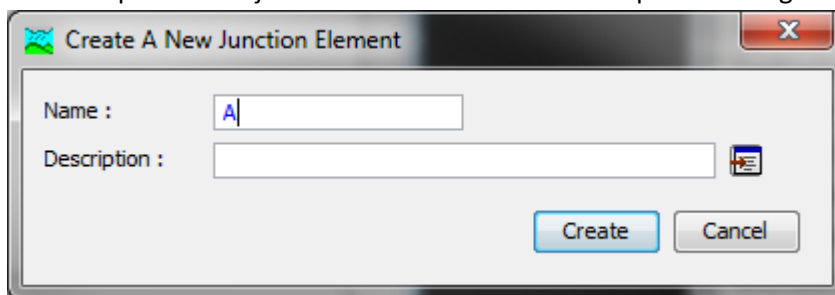


e. Set up basin details

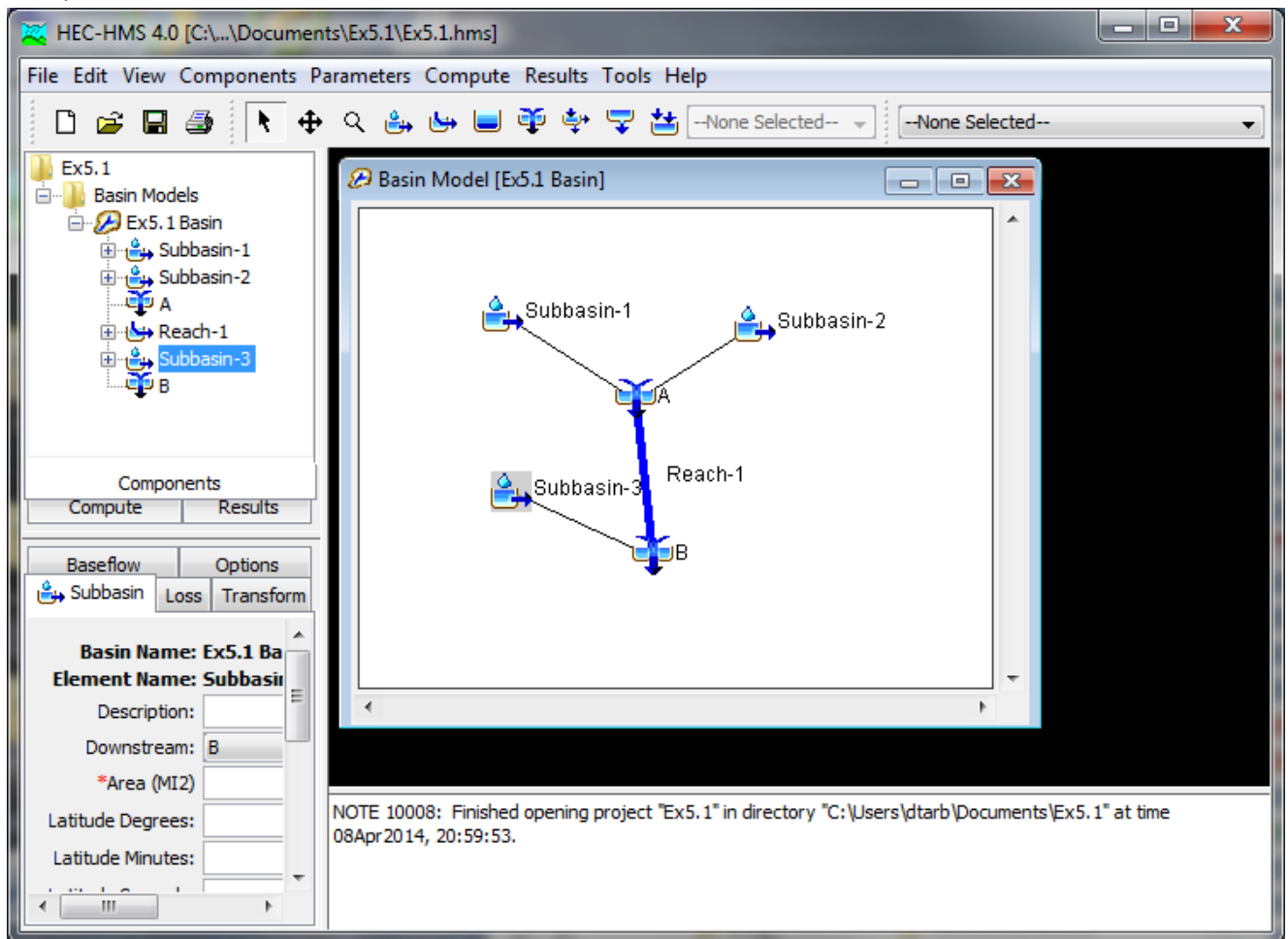
- Double click on (or expand) the folder, “Basin Models,” and a small watershed icon appears, as shown below, labeled with the name you gave it (Ex5.1 Basin)
- Click on the watershed icon. This results in 3 changes on the screen: (i) it will make active the watershed creation tools under the menu bar (to the right of the magnifying glass: Subbasin, Reach, Reservoir, Junction, Diversion, Source, and Sink creation tools); (ii) in the lower left corner in the Component Editor, information may be input to the Basin Model; and (iii) the Basin Model template appears in the Desktop area. It is in this space that the basin model will be set up with the Watershed Creation tools.



- Refer to Example 5.1 for details about the watershed.
- HMS is flexible on how you may prefer to organize steps in creating a model, so the steps below are one way to create a project watershed and enter information and data.
  - Adding 3 subbasins: Click on the Subbasin Creation tool. Move the cursor over to the desktop area, and the pointer cursor should turn to a crosshairs for placement of the subbasin. Click on the desktop area to place the subbasin, and a popup will appear in which a subbasin name and description may be input. Click “Create” when finished. A subbasin feature appears on the basin template. Repeat the steps for the 2 remaining subbasins.
  - Location of the features added to the watershed with the creation tools may be changed by selecting the arrow tool, left-clicking on the object and dragging it to a different location.
  - Adding the 2 junctions: Click on the “Junction Creation tool” and move the cursor over to the Desktop area and place the 2 junctions on the watershed template naming them A and B.



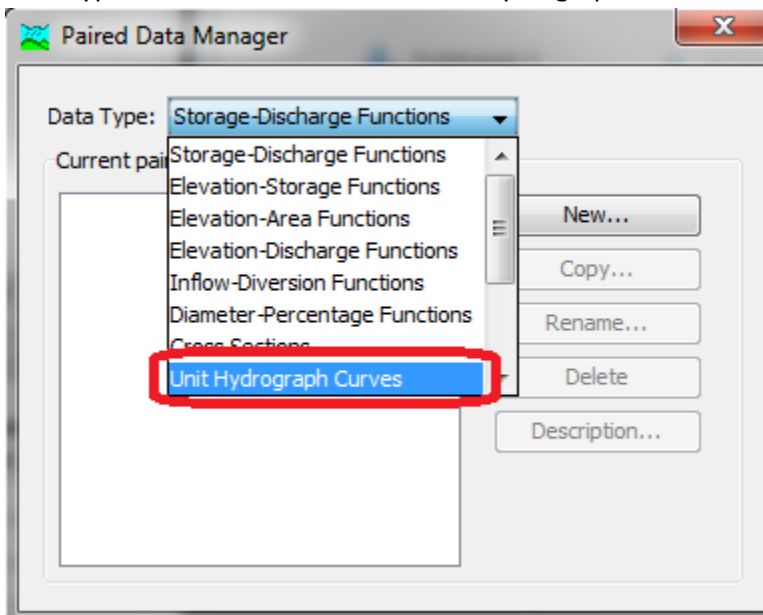
- Add a channel reach for the reach from A to B. Click on the “Reach Creation Tool” and place a reach in your basin model desktop area by clicking at the point where you want the reach to start then clicking at its end.
- At this point you have the necessary components, but they need to be connected. Specifically subbasins 1 & 2 should be connected to Junction-A and Subbasin-3 to Junction-B. Junction A needs to be connected to the reach and the reach to junction B. Connecting the features is done by selecting the arrow pointer and right-clicking on the upstream object (e.g., Subbasin-1); from the menu, select “Connect Downstream”; the cursor turns to crosshairs and connect Subbasin-1 to Junction-A downstream by clicking on the junction. Similarly, connect the other 2 subbasins and the reach to the appropriate junctions, and junction A to the reach. Once this is done the “reach” should be a thicker blue line and the connections should be thinner black lines as indicated. You can move the objects around the screen and by clicking on the labels, move them to arrange the layout nicely



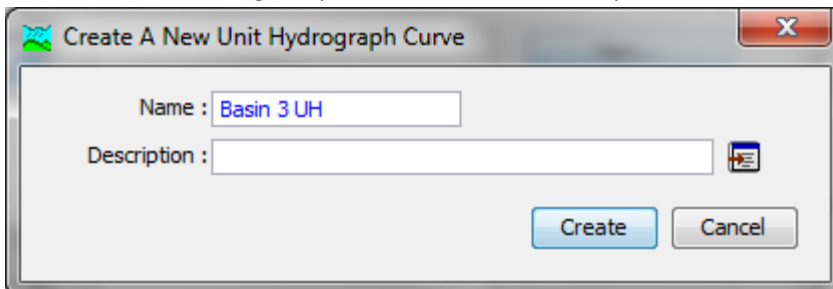
- Input basin information to elements of the watershed:

To input information for an element of the watershed, click on the element either in the conceptual basin created in the Desktop area or in the Watershed Explorer. The appropriate information input fields for the particular feature appear in the Component Editor in the lower left corner

- Click on Subbasin-1. Initially, there are 5 tabs in the Component Editor (Left-hand corner): Subbasin, Loss, Transform, Baseflow and Options. Depending on the methods selected these tabs will appear/disappear.
  - Subbasin tab: The “downstream” point is already filled, in since the connection was made in the Desktop area but may also be entered or edited here. Enter the area. Change the loss method to curve number. Change the baseflow method to none. Check that the transformation method is Clark Unit Hydrograph.
  - Click on the loss tab and input SCS curve number.
  - Click on transform tab and Input TC and R.
- Similarly, enter data for Subbasin 2.
  - Subbasin-3: Enter the area and set baseflow method to none. Set loss method and CN. This subbasin has a user-specified Unit Hydrograph, so set this for the Transform Method. Until the hydrograph information has been input, cells of the Transform tab are not active.
  - Input Unit Hydrograph for Subbasin-3:
    - Go to Components on the main menu at the top, select “Paired Data Manager,”
    - Data Type: Scroll down and select “Unit Hydrograph Curves”



- Click “New” on the right—provide name and description; then click “Create”



- In the Watershed Explorer, the folder, “Paired Data” was created; double click to expand to the folder “Unit Hydrograph Curves,” and double click on the “Unit Hydrograph Curves folder to get the UH icon with the name it was given (eg, Basin 3 UH). Click on the Unit Hydrograph icon to get the Paired Data Component Editor. Set the units and duration. Switch to the “Table” tab and enter the Unit Hydrograph data for Subbasin 3.



The screenshot shows the HEC-HMS 4.0 software interface. The main window displays a basin model diagram with three subbasins (Subbasin-1, Subbasin-2, and Subbasin-3) connected by a reach (Reach-1). The reach is highlighted in blue. The left sidebar shows the project structure, including the basin models and paired data. Below the sidebar is a table showing discharge data over time.

Time (HH:mm)	Discharge (CFS)
00:00	0
01:00	200
02:00	400
03:00	600
04:00	450
05:00	300
06:00	150
07:00	0
08:00	

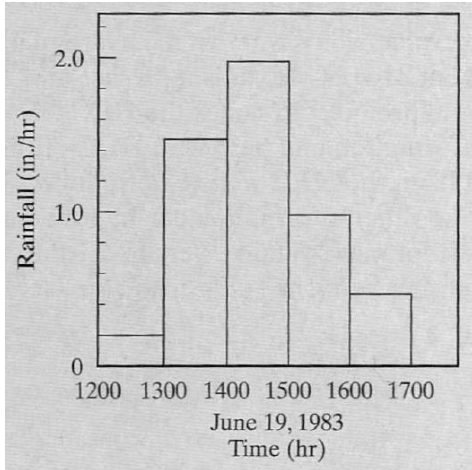
NOTE 10008: Finished opening project "Ex5.1" in directory "C:\Users\dtarb\Documents\Ex5.1" at time 08Apr2014, 20:59:53.

- Note the data entered are colored **blue**, indicating that the data are not saved. Save the file ("File, Save" at the main menu), and the data turn from blue to **black**, indicating that they are now saved.
- Select Subbasin-3 in the Watershed Manager: Under the Transform tab in the Component Editor, select the UH pattern (eg, Basin 3 UH) to use for Subbasin-3 in simulations.
- Reach-1:
  - Reach tab: Input information for Muskingum Routing
  - Routing tab: Muskingum K and x, and 2 subreaches (The number of subreaches should be chosen based on the routing parameters to ensure numerical stability).
- Input Hyetograph:
  - In Components on the main menu at the top, select "Time Series Data Manager",
  - Data Type: Select "Precipitation gage", click on "New," provide name and description, and click "Create." And close.

The screenshot shows a dialog box titled "Create A New Precipitation Gage". It has two input fields: "Name" and "Description". The "Name" field contains the text "Gage 1". There are "Create" and "Cancel" buttons at the bottom of the dialog box.

- A folder, "Time Series Data," is added to the Watershed Manager.

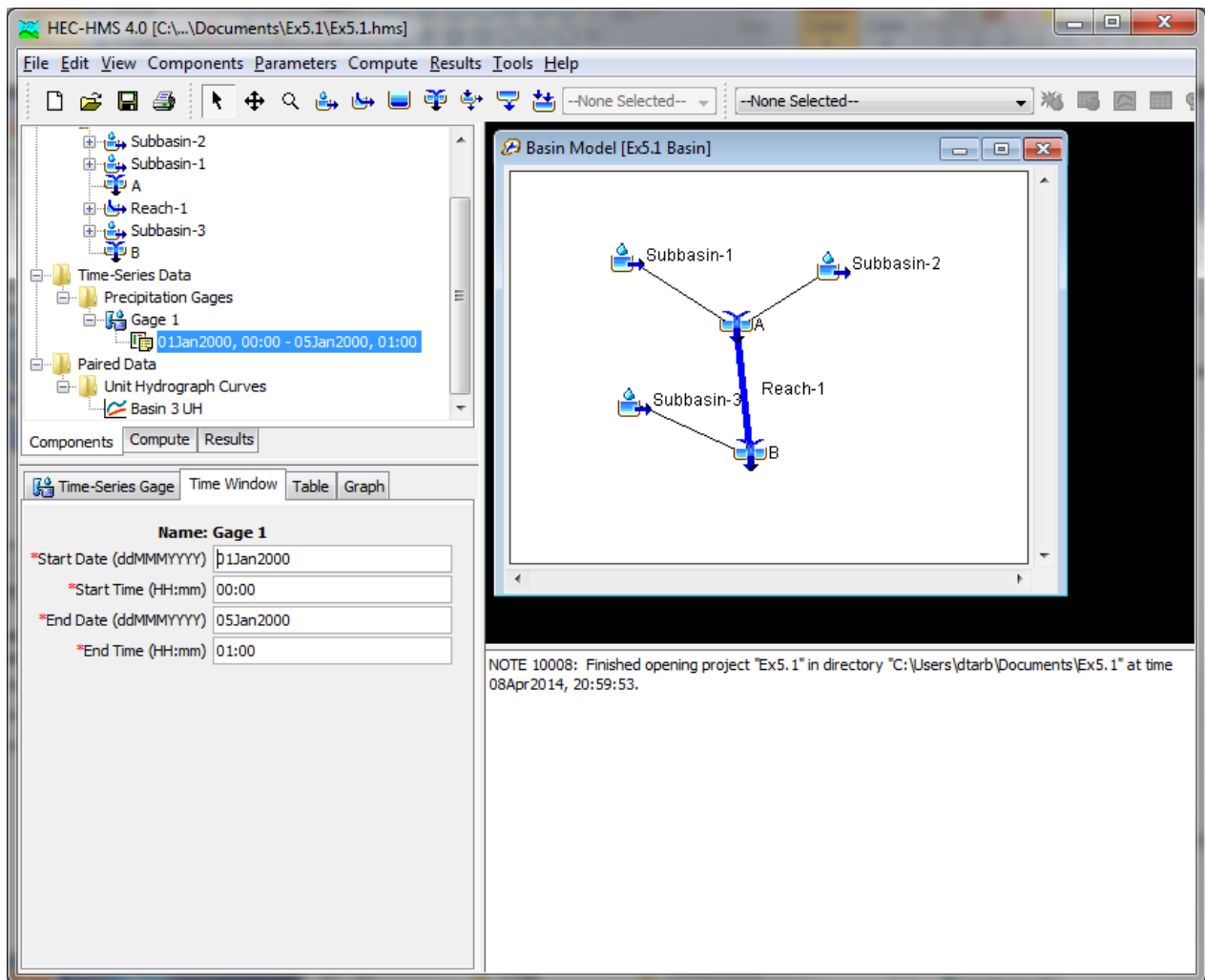
- Expand in sequence to “Precipitation Gages,” then “Gage 1,”
- Under “Gage 1” is a storm event with a generic date. Click on the storm event to enter hyetograph data and information.
- Fill in information on the following tabs: Time-Series Gage, Time Window, and Table
- Time-Series Gage tab: Units = Incremental inches, and Time Interval = 1 Hr
- Time Window: define the time window to include time for the precipitation event.
- Table tab: Hourly time increments should be on the left side of the table for the period defined under the Time Window tab. Enter hourly precipitation increments interpreted from the precipitation plot below



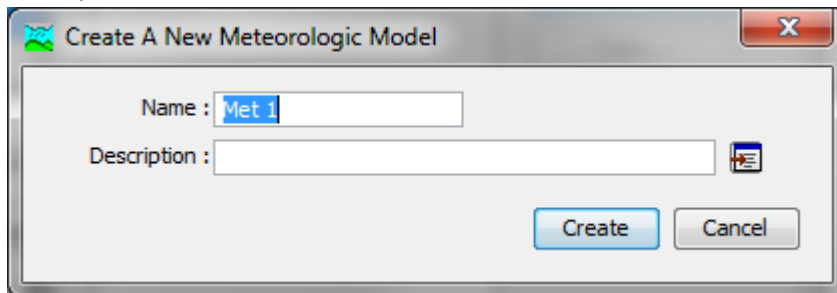
- At the end of the precipitation event, input zeroes for the remaining time increments. Select multiple rows, right click and use Fill to add multiple 0's at once.

Time (ddMMYYYY, HH:mm)	Precipitation (IN)
01Jan2000, 00:00	
01Jan2000, 01:00	0.2
01Jan2000, 02:00	1.5
01Jan2000, 03:00	2.0
01Jan2000, 04:00	1.0
01Jan2000, 05:00	0.4
01Jan2000, 06:00	0.0
01Jan2000, 07:00	0.0
01Jan2000, 08:00	0.0
01Jan2000, 09:00	0.0
01Jan2000, 10:00	0.0
01Jan2000, 11:00	0.0
01Jan2000, 12:00	0.0
01Jan2000, 13:00	0.0
01Jan2000, 14:00	0.0

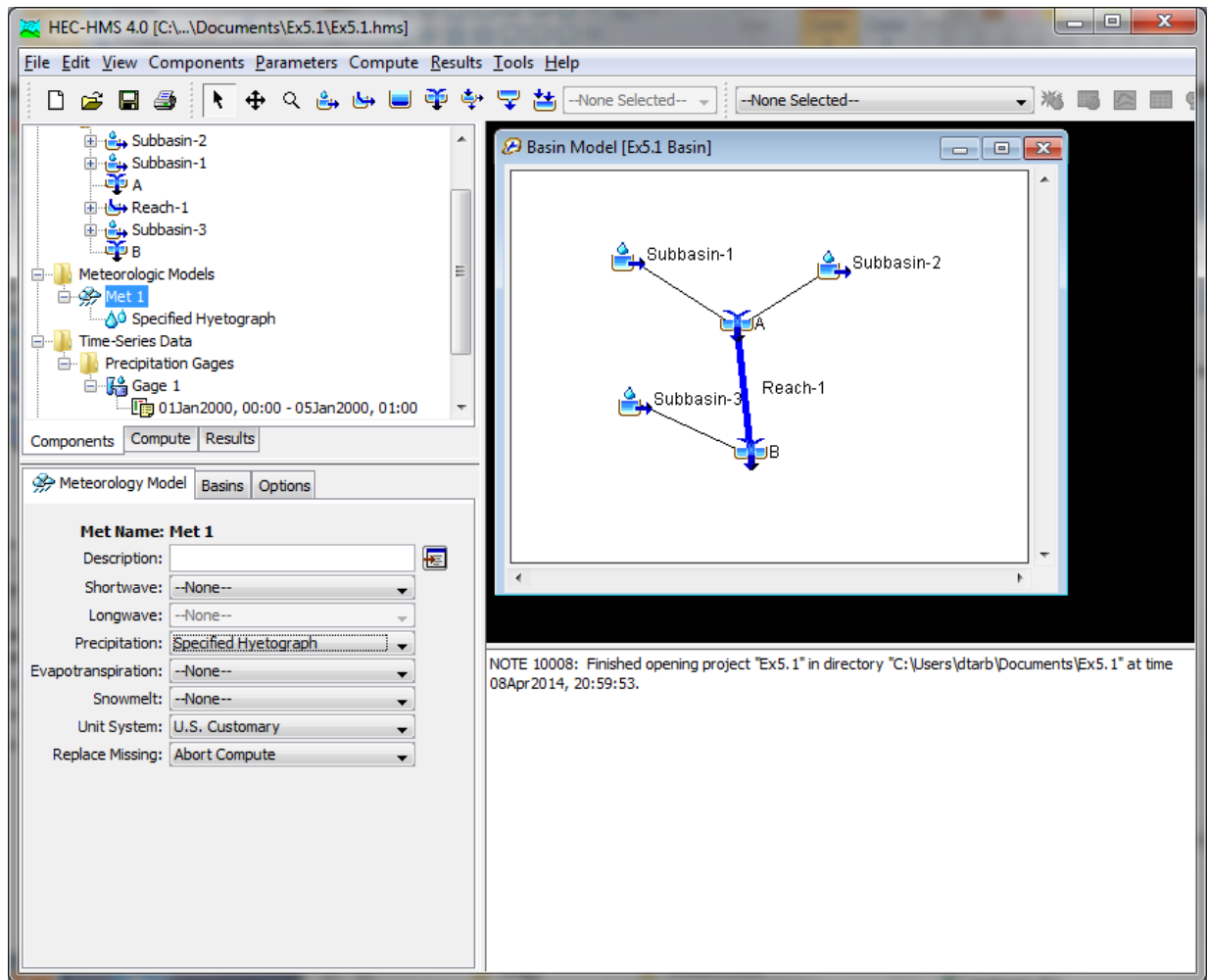
- Save the file.



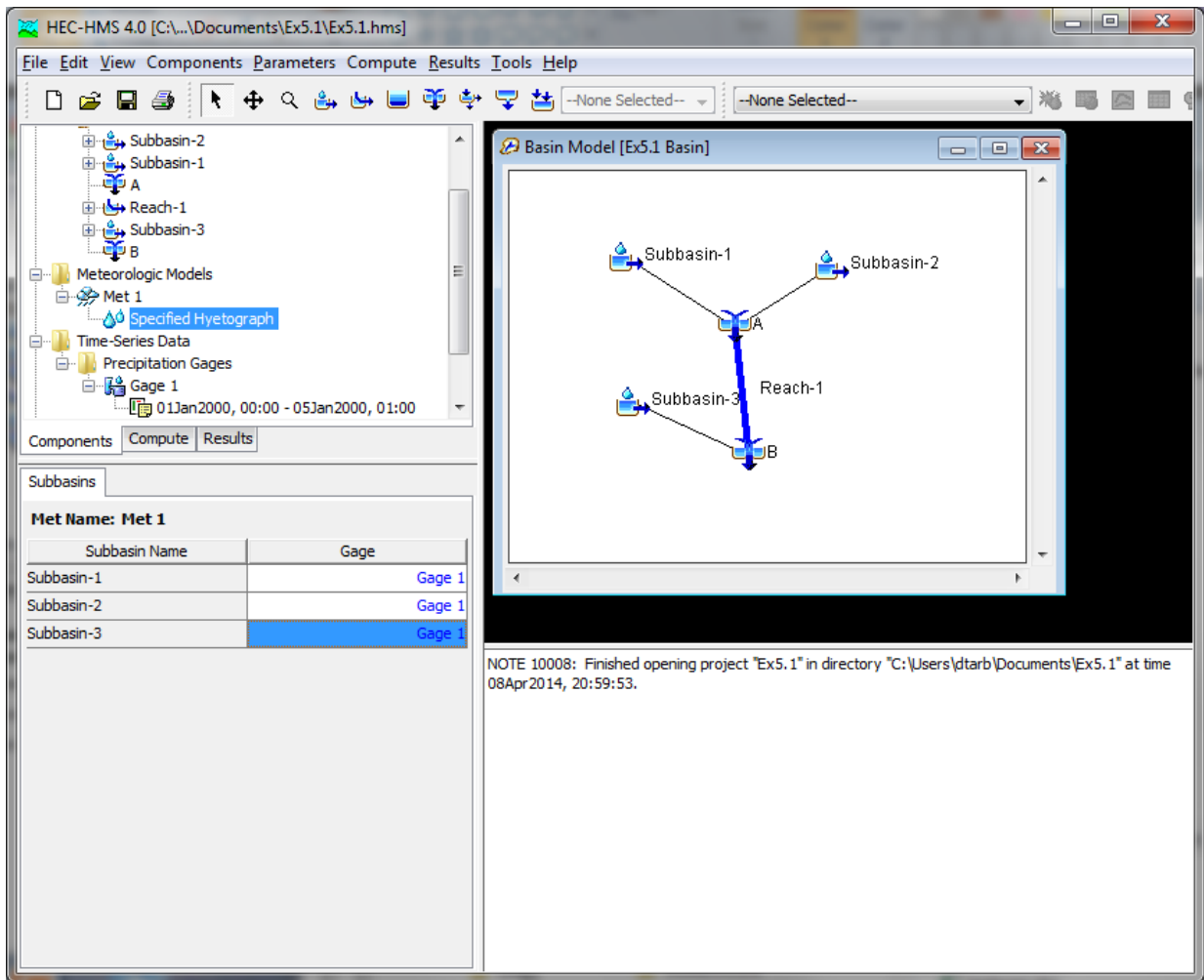
- Under Component on the Main menu , select “Meteorologic Model Manager,” click “New;” fill in name and description, and click “Create.”



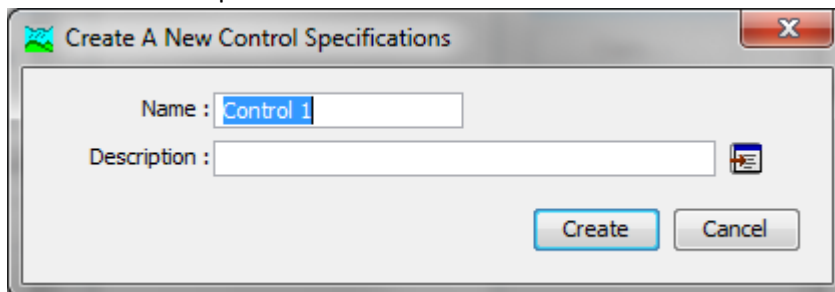
- As before, a folder, “Meteorologic Models” is added to the Basin-1 schematic in the Watershed Explorer.
- Expand the folder out to “Met 1”
- In the Component editor, under the Meteorology Model tab,
- Under Precipitation, select “Specified Hyetograph”
- Under “Units System,” select the units to be used.



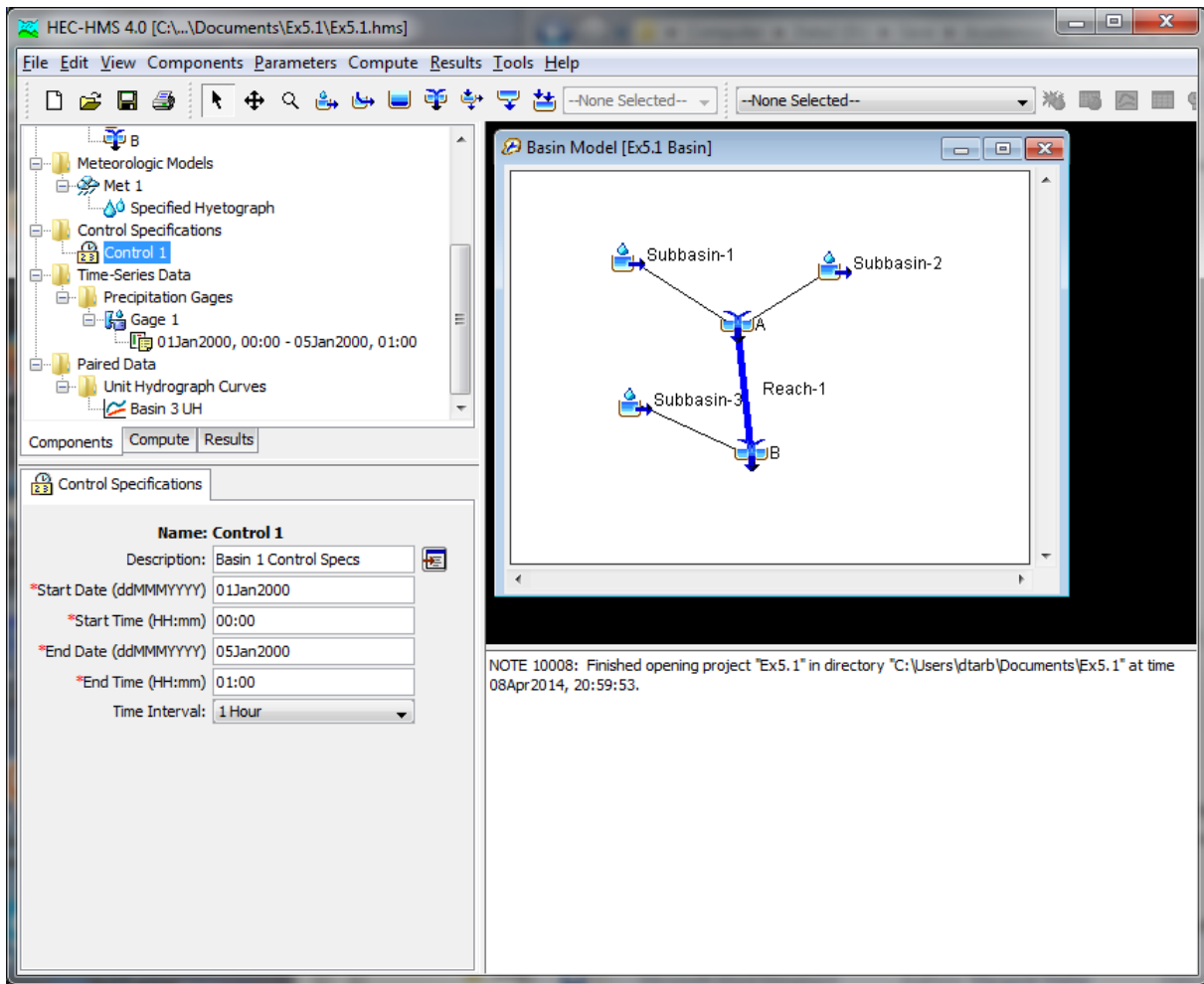
- Basins tab: the basin model to be used should already be identified on the left side of the table, and on the right, under the column heading, “Include Subbasins,” select “Yes,” since it is assumed that precipitation is distributed uniformly over the basin.
- From “Met 1” in the Watershed Explorer, click on the raindrops icon for “Specified Hyetograph” and assign a precipitation gage to each subbasin (in this case, the same one to the 3 subbasins).
- Save the project, since it’s a good habit.



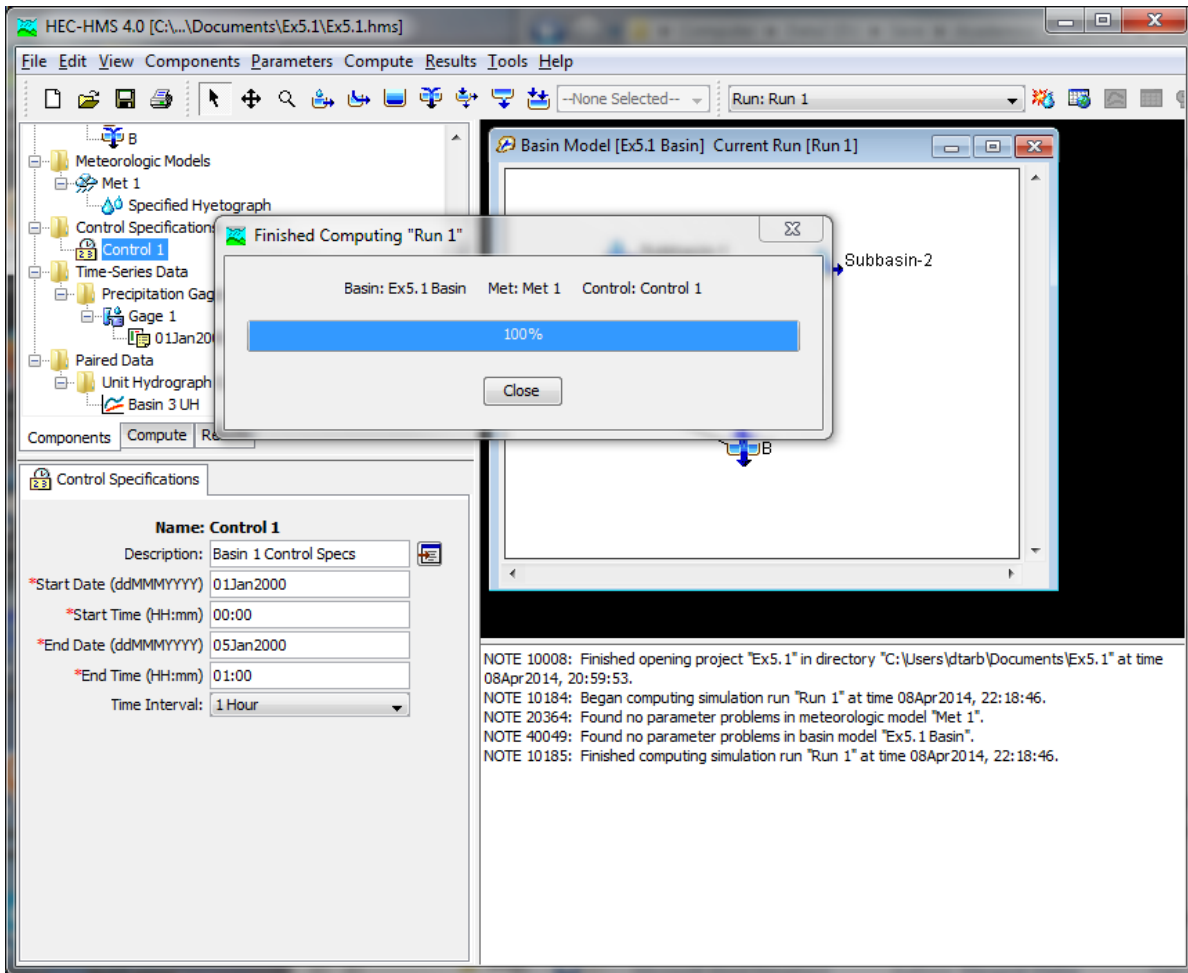
- Model Control Specifications:
  - Under Components, select "Control Specifications Manager," and click "New." Add name and description, and click "Create." A folder, "Control Specifications" is added to the Basin-1 schematic in the Watershed Explorer.



- Expand the folder out to "Control 1," click on it, and fill in the information in the Component Editor area.
- Define the time window to include time for the rainfall as well as the runoff response (I went for the same period as the rainfall and set the time interval to 1 hour).

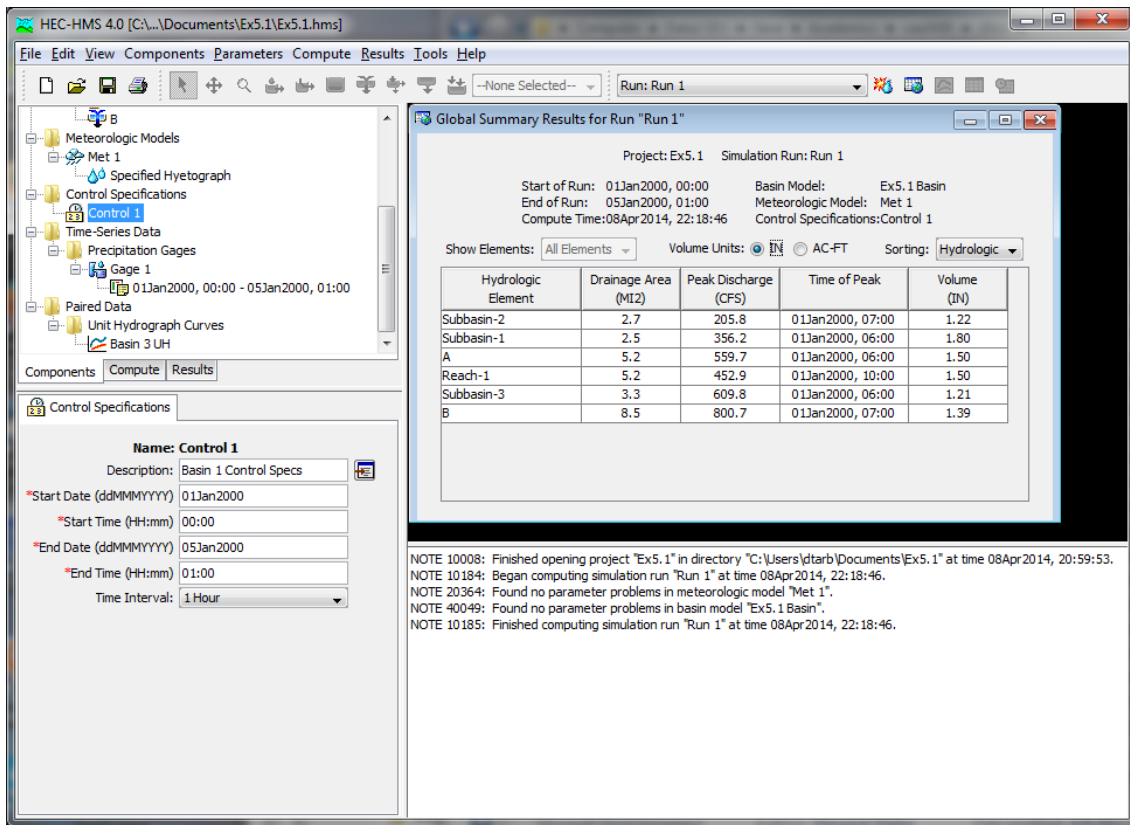


- Save the project.
- Running Simulations and Viewing Results:
  - Main Menu: Select “Compute”, then select “Create Compute” > “Simulation Run”
  - Create a simulation run with a name, which can be described after it is created; there are 4 steps:
    - 1<sup>st</sup> step: the name, click “Next”
    - 2<sup>nd</sup> step: select the basin model, then click “Next”
    - 3<sup>rd</sup> step: select a meteorological model, then click “Next”
    - 4<sup>th</sup> step: lastly, select a control specifications model, and click “Finish”
  - Below the Main Menu, right of the component creation tools, is a button with a raindrop next to a red & yellow sun (the “compute current run” button). Click it to run the simulation.
  - A message box appears saying that HEC-HMS is finished computing your simulation run; close the message box.
  - Errors in model runs, as well in building the basin model, appear in the message area below the Desktop area.

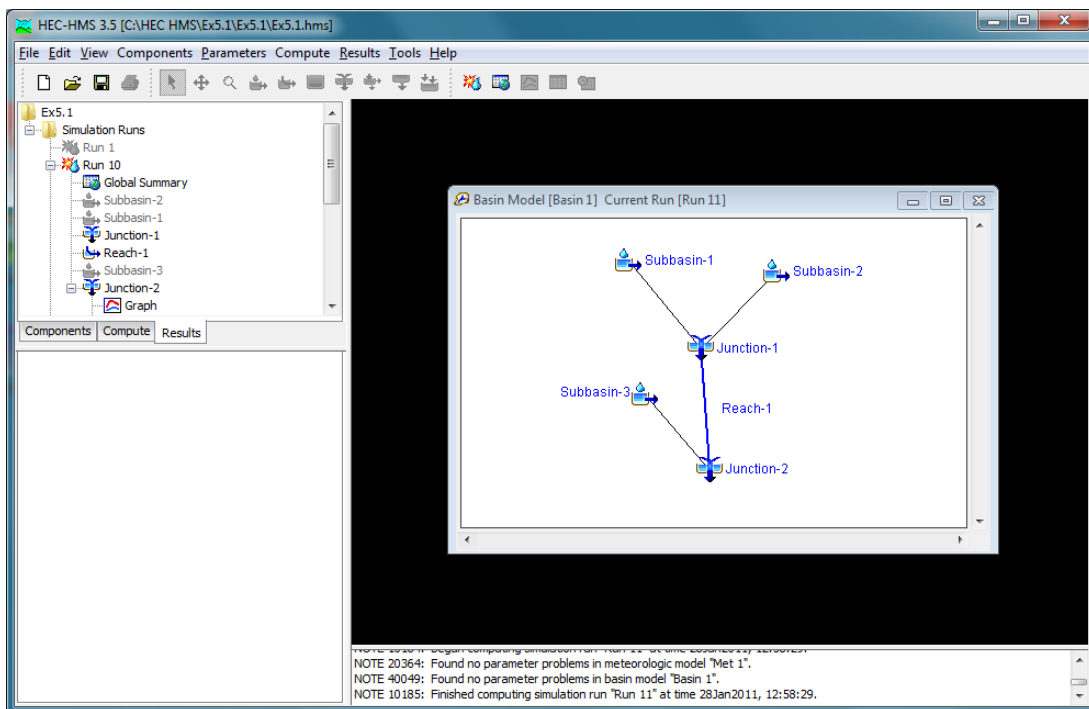


- Viewing Results:

- Right of the "Run Simulation" button, is a button table with a global, the "Global Summary" button. Click it to view a summary of simulation results.

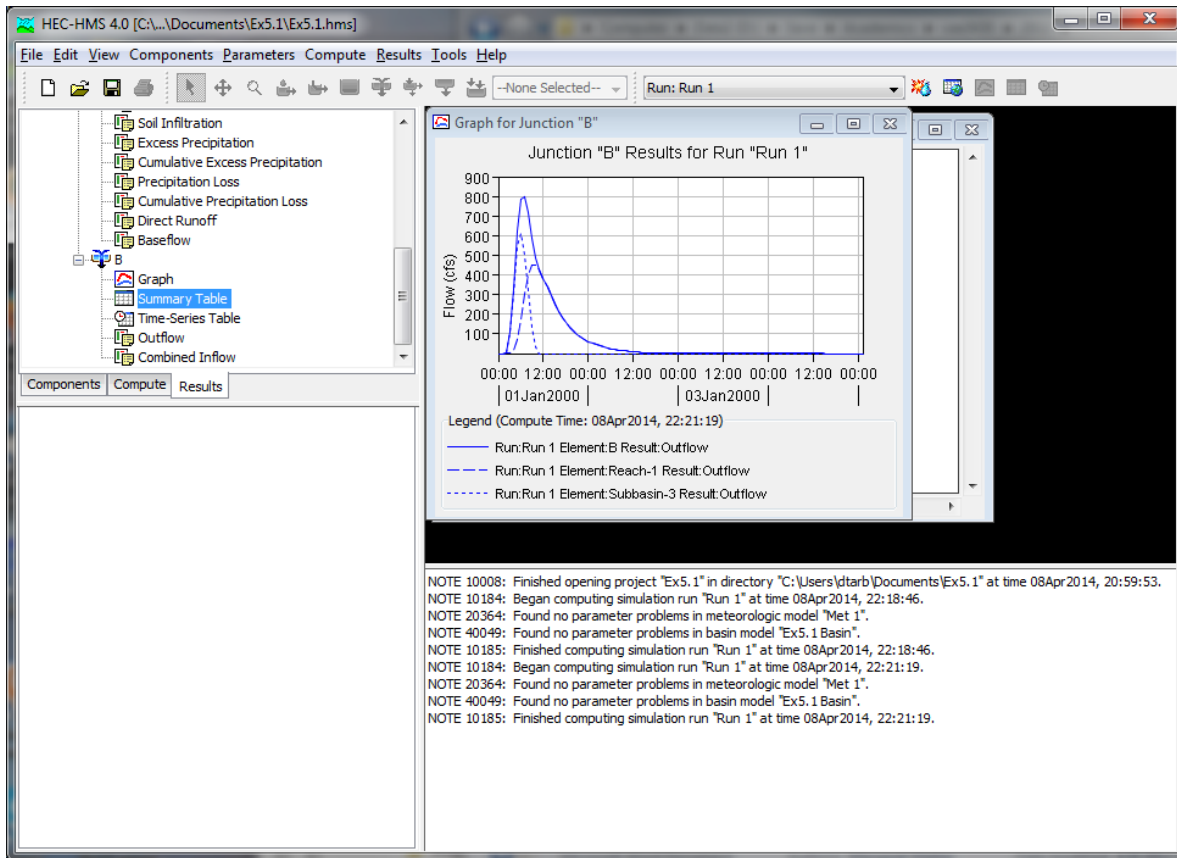


- To view graphical and tabular results, go to the Watershed Explorer area and click on the "Results" tab.



- Select the Run # for which you want to review the results
  - Output for any component of the basin (eg, Subbasin-2, Reach-1, Junction-2) may be observed by clicking on the component & selecting the output format type.





## Reference

Bedient, P. B., W. C. Huber and B. E. Vieux, (2008), Hydrology and Floodplain Analysis, 4th Edition, Prentice Hall, 795 p.