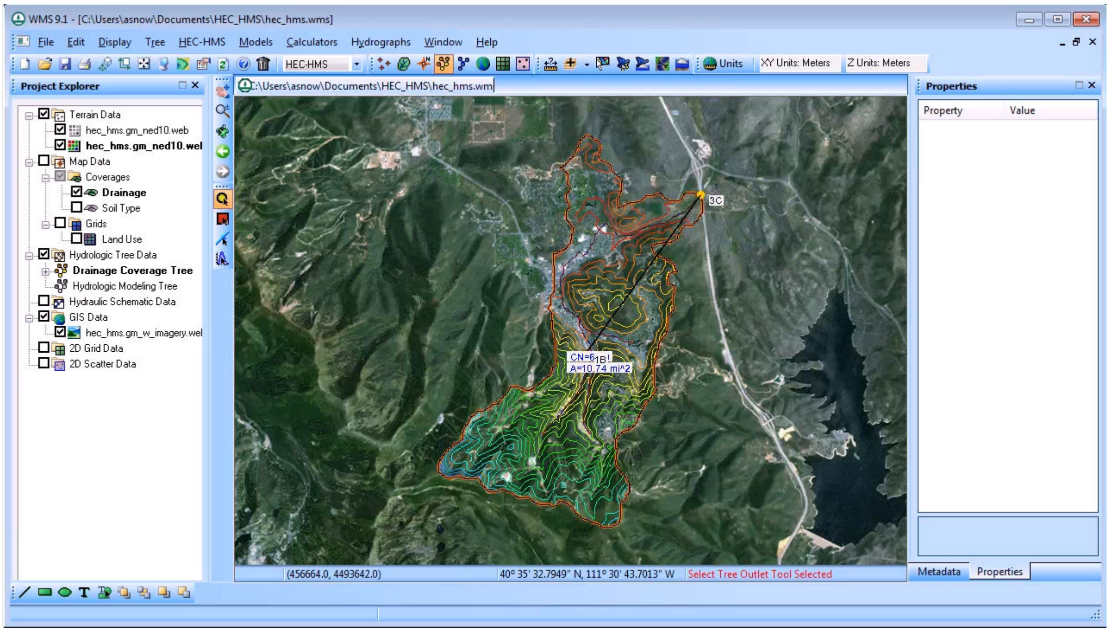
WMS

v. 10.0

WMS 10.0 Tutorial

Watershed Modeling — Using Online Spatial Data to Create an HEC-HMS Model

Learn how to setup an HEC-HMS model using WMS online spatial data



Objectives

This tutorial shows how simple it is to use WMS to gather data and create an HMS model of a watershed near Park City, Utah. This tutorial describes how to use the WMS Hydrologic Modeling Wizard to download data and automatically build an HMS model. After the model is built using WMS, you will export it to an HMS file and run the model in the HMS interface.

Prerequisite Tutorials

- Watershed Modeling – DEM Delineation

Required Components

- Data
- Drainage
- Map
- Hydrology
- Hydrologic Models

Time

- 15-30 minutes

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1 Contents

2 Introduction

WMS has unparalleled tools that allow you to easily download and use spatial data for hydrologic modeling. After downloading the necessary data, you can use built-in tools to compute and extract all the parameters necessary for building an HMS hydrologic model, save the necessary HMS model files, run HMS, and view the HMS output.

3 Objectives

This tutorial shows how to use WMS to gather online data and create an HMS model of a watershed near Park City, Utah. You will use the WMS Hydrologic Modeling Wizard to download data and to automatically build an HMS model. After the model is built using WMS, you will export it to an HMS file and run the model in the HMS interface

4 Hydrologic Modeling Wizard

Bring up the hydrologic modeling wizard and step through it to download DEM and topographic data and delineate a watershed near Park City, UT.

1. Close all instances of WMS
2. Open WMS
3. Click on the *Hydrologic Modeling Wizard* 

4.1 Project Filename

The first step in defining an HMS model is to define your project filename.

1. Click the *Open* button within the wizard 
2. Select a location and filename for your project file and select *Save*
3. Select *Save* in the wizard.
4. Select *Next*

4.2 Define Project Bounds

After you have defined a project filename, you can define a coordinate projection to use in your project and then define the boundary of your model area. For this project, you will use the UTM Projection with metric units. You can use the Virtual Earth Map Locator window to locate and then define your project boundary. For this tutorial, we will select a watershed in Park City, Utah as the project area.

1. Click *Define…* under Project projection
2. Make sure *Global Projection* is selected
3. Select *Set Projection…*
4. Set *Projection* to *UTM*, *Datum* to *NAD83*, *Planar Units* to *METERS*, and *Zone* to *12 (114°W - 108°W – Northern Hemisphere)*
5. Select *OK*
6. Set the Vertical *Projection* to *NAVD 88(US)* and the vertical units to *Meters* (See Figure 4-1)

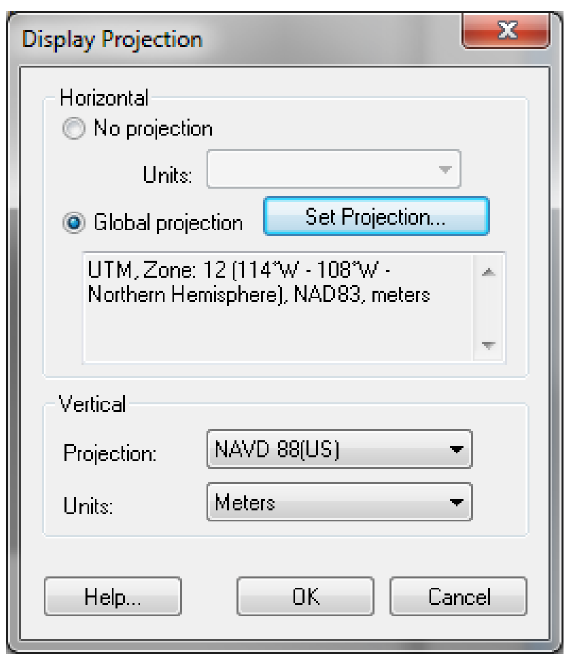


Figure 4-1: Display Projection

7. Select *OK*

8. Select *Define…* under Project boundary
9. Select the *Locator tool* and type in *"Park City, UT"* in the *Where* box
10. Select *OK*
11. Select *Next*

4.3 Watershed Data/Download Data (Web Services)

Using WMS, you can download all the necessary data to delineate your watershed and compute hydrologic and geometric parameters from online data sources. There are tools to download elevation data, land cover data, aerial photographs, maps and other images, vector-based land use and soil data, and other data that is useful in watershed modeling. WMS downloads, imports, and displays all the selected data for the model area you select.

1. Make sure the *Use web services* option is checked
2. Select *Next*
3. Select the following: *United States Elevation Data (NED) (10m Resolution), NLCD 2006 (US National Land Cover Database) (30m Resolution), World Imagery,* and *Ssurgo Soil Type Shapefile (US Only)*
4. Select *Download Data From Web*
5. Select *OK* to accept the defaults for downloading the various data
6. Select *Yes* if asked if you would like to generate image pyramids
7. Select *Next*

After downloading the data, it should look similar to Figure 4-2.

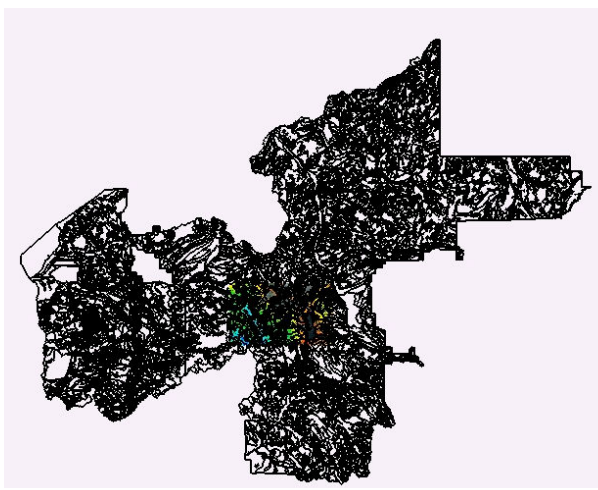


Figure 4-2: Downloaded Data

4.4 Compute Flow Directions and Accumulations

WMS uses a model called TOPAZ to compute the flow patterns in your watershed. This model is used to determine high flow accumulation areas where streams may form.

1. Click *Compute TOPAZ*
2. Select *Close* when TOPAZ finishes running
3. Enter a *Min flow accumulation threshold* of **1.0** and select *Apply to Display*
4. Click *Next*

4.5 Choose Outlet Locations

After you have computed the flow accumulation locations using TOPAZ, select one or more outlet locations for your watershed model. In this model, we will define an outlet near a bridge passing over one of the streams. By doing this, we can use HMS to compute the hydrograph under this bridge during a large storm.

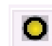
1. In the Project Explorer, turn off all GIS Data except for the image (<*image_filename*>.gm_w_imagery.web.tif)
2. Select *Create outlet point* in the wizard 
3. Push your middle mouse wheel down to drag and scroll the wheel to zoom in at the top right corner until you can see the road and create an outlet point as shown in Figure 4-3

Figure 4-3: Outlet point location

4. Select *Next*

4.6 Delineate the Watershed

After defining the outlet point, delineate the watershed by clicking on the Delineate Watershed button. When delineating the watershed, WMS computes all the geometric parameters necessary to run your HMS model.

1. Select *Delineate Watershed*
2. Select *Next*

The delineated watershed should look similar to Figure 4-4.

Figure 4-4: Delineated Watershed

4.7 Select Model

Select HEC-HMS as the desired model and initialize the model data.

1. Select *HEC-HMS* as the desired model
2. Select *Initialize Model Data*
3. Select *Next*

4.8 Job Control

Define a start and end time for your model simulation. This model will run for two days with a 10-minute time increment.

1. Set the starting date to **9/1/2008** and the ending date to **9/3/2008**
2. Set the starting and ending times to **12:00:00 AM**
3. Set the Time interval to **10** minutes
4. Select *Set Job Control Data*
5. Select *Next*

4.9 Define Land Use and Soil Data

WMS downloaded a land use grid and soil polygons. This spatial data will be used to compute a composite curve number for the watershed. Before computing the curve number, we must first join tables containing soil-specific information with each of the polygons in the soil layers and convert the polygons intersecting the watershed to WMS polygons in a soil type coverage that can be used for computing the curve number.

1. Next to the first shapefile, select *Join NRCS*...
2. Check the *Fill Blank Values* box as well as the *Compute hydraulic conductivity using equivalent conductance equation*

3. Select *OK*
4. Repeat steps 1-3 for each Shapefile in the list
5. Select *Create Coverages…*
6. Select *Next*
7. Select *Next*
8. Select *Finish*
9. Select *Next*

4.10 Hydrologic Computations

You can compute the curve number and other hydrologic parameters using the Compute GIS Attributes dialog. This dialog combines the information in the soil type coverage and the land use grid to determine an area-averaged curve number value for your watershed. Comma-delimited tables are available for download from Aquaveo's help pages on http://www.xmswiki.com that relate land use ID's to curve number values for various soil types. After the composite curve number is computed, WMS displays a report file that shows the various land use and soil combinations in your watershed with the details of the curve number computation.

Another important hydrologic parameter computed by WMS is the Time of Concentration or the Lag Time. You can select from WMS' extensive library of equations or you can define your own equation for computing the necessary time parameters for hydrologic modeling in your watershed. You can also assign equations to polylines representing the longest flow path in your watershed and use these equations to compute the watershed time parameters. We will select the SCS method for computing the Lag Time in this model.

After you have defined your watershed Curve Number and Lag Time, you can finish setting up your HMS model by applying the SCS Curve Number loss method and the SCS transform to your HMS model.

1. Download the NLCD 2006 data table on the following wiki page: http://www.xmswiki.com/xms/WMS:Compute_GIS_Attributes#NRCS_Curve_Numbers_.28CN.29
2. Select *Compute GIS Attributes*
3. Select *Import*
4. Select *OK* if the dialog warns you about overwriting the current land use table.
5. Select the downloaded file *NLCD2006LuCodes.txt* and click *Open*
6. Select OK
7. A window will open that displays the CN computation results. Select *OK* if prompted to select an editor to view the data file. Note how the weighted CN is calculated along with its value and then close the window.
8. Select *Using Basin Data…* under the Compute Tc column
9. Select *Compute Lag Time* under the *Computation type*.
10. Select the *SCS Method* under the *Method* drop-down.

11. Select *OK*
12. Select *Edit Parameters…*
13. Select *Loss Rate Method* under Display options in the Display column,
14. Select *SCS Curve Number* under the Show Column
15. Scroll down and select *Transform* under the Display column
16. Select *SCS* under the Show column
17. Make sure *SCS Curve Number* is selected for the Loss Rate Method and that *SCS* is selected for the Transform Method.
18. Select *OK*
19. Select *Next*

4.11 Define Precipitation

We will build our model using an SCS, type 2, 100-year, 24-hour storm. The standard design curve associated with this storm is included with WMS. You can use NOAA Atlas 14 to get the 100-year, 24-hour precipitation value of 3.13 inches for this watershed in Park City, Utah. Fill in the precipitation depth in the HMS Meteorological Model window.

1. Select *Define Precipitation…*
2. Select *User Hyetograph* under *Precipitation Method*
3. In the Total Depth (in) column, type **3.13**
4. Select *XY Series…* under the Hyetograph column
5. Select *typeII-24hour* under *Selected Curve*
6. Select *OK* twice
7. Select *Next*

4.12 Clean Up Model

The "Clean Up Model" button runs some common tasks that are often performed to clean up your display and check your model before running it. When your model is cleaned up, no errors should be detected in the HMS model.

1. Select *Clean Up Model*
2. Set Spacing to *"30"*
3. Select *OK*
4. Select *Done*
5. Select *Save* to save your WMS project file
6. Select *Next*
7. Select Finish

Your model should appear similar to Figure 4-5.

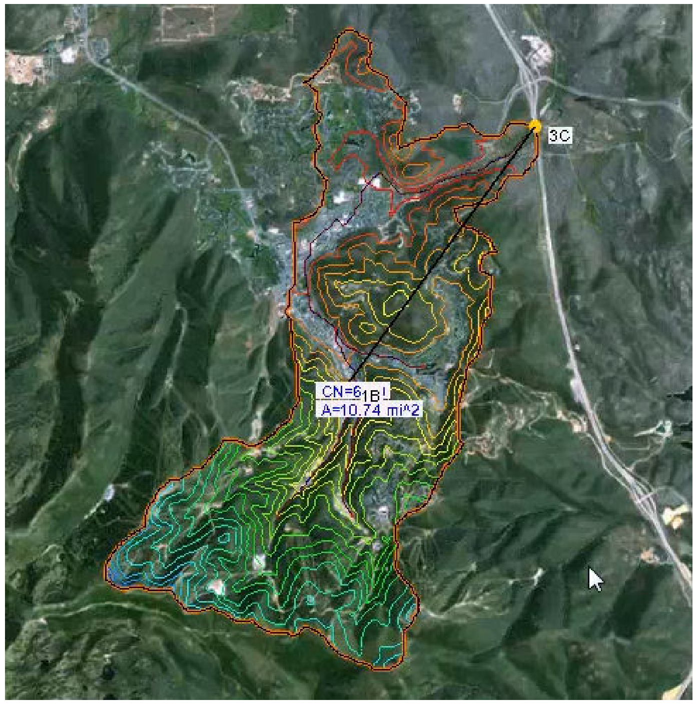


Figure 4-5: Finished Model Set Up

5 Running HEC-HMS

5.1 Save HMS Model and Start HMS

After completing the hydrologic model, you can save your HMS model and import your model into the HMS interface.

1. Select ***HEC-HMS* | *Save HMS File…*** or right click on *Drainage Coverage Tree* in the Project Explorer and select ***Save HMS File***
2. Name the HMS project file *ParkCity.hms* and *Save*
3. Start HEC-HMS on your computer

5.2 Run Model in HMS

Once you have imported your model into HMS, you can view or edit your model data and compute the results from your WMS model. HMS has a rich set of tools for viewing the hydrograph and other output from your hydrologic model.

1. Select ***File* | *Open*** 
2. Select the *Browse* button and browse to the location where you just saved your HMS Project from WMS.
3. Select the *ParkCity.hms* project file
4. From the HEC-HMS project explorer expand Basin Models then click on *WMS Watershed*

5. Select 1B to view the watershed data values exported from WMS.
6. Select the *Compute* tab at the bottom of the HEC-HMS project window.
7. Expand Simulation Runs and select *Run 1*
8. Select the Compute Current Run macro 
9. When finished computing select *Close*
10. Select the *Results* tab at the bottom of the HEC-HMS project window.
11. Select Simulation Runs from the project window, then Run 1. Select different elements (basins, junctions, and the Global Summary) and view results, especially the hydrograph graph, the hyetograph (rainfall/loss) graph, and the Time-Series Table for the watershed basin.

6 Conclusion

WMS has a wizard that steps you through the process of downloading all the required data, computing necessary geometric and hydrologic parameters, and saving an HMS model. After saving an HMS model, you can easily bring your model into HMS, run the model, and view the results.

