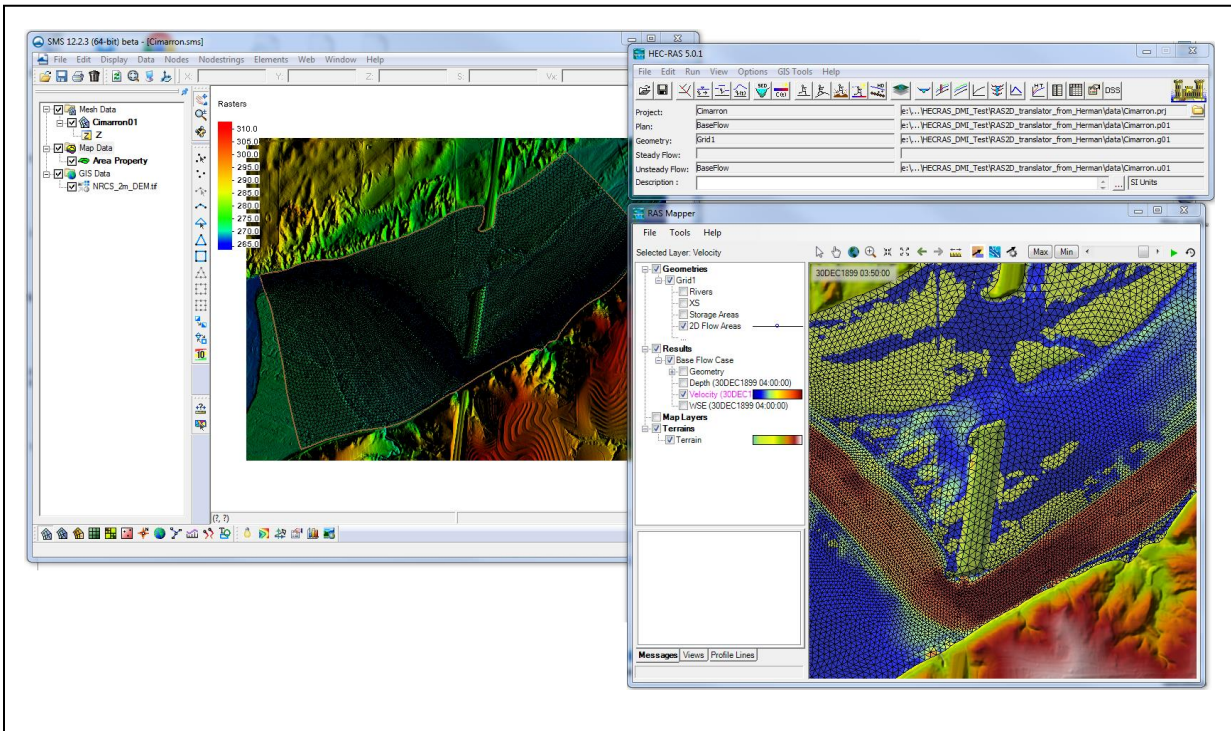


## SMS 13.0 Tutorial

### Importing into HEC-RAS



### Objectives

This tutorial demonstrates importing files into HEC-RAS that were exported from SMS.

### Prerequisites

- HEC-RAS

### Requirements

- HEC-RAS 5.0.3

### Time

- 15–25 minutes

<b>1</b>	<b>Introduction .....</b>	<b>2</b>
1.1	Disclaimer .....	2
<b>2</b>	<b>Opening the HEC-RAS project .....</b>	<b>2</b>
<b>3</b>	<b>Loading the Terrain .....</b>	<b>3</b>
<b>4</b>	<b>Setting up Boundary Conditions .....</b>	<b>4</b>
4.1	Defining the Location.....	4
4.2	Defining Boundary Condition Values .....	4
<b>5</b>	<b>Setting up the Plan.....</b>	<b>6</b>
<b>6</b>	<b>Running the HEC-RAS analysis.....</b>	<b>6</b>
<b>7</b>	<b>Viewing the results.....</b>	<b>6</b>
<b>8</b>	<b>Conclusion .....</b>	<b>8</b>

## 1 Introduction

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The Hydrologic Engineering Center's (CEIWR-HEC) River Analysis System (HEC-RAS) is a one- and two-dimensional model for computing water surface profiles for steady state or gradually varied flow. Two-dimensional capabilities were added to the program in version 5.0. HEC-RAS supports networks of channels and is capable of modeling subcritical, supercritical, and mixed flow regime profiles. HEC-RAS is able to model obstructions in the flow path.

SMS can be used to create geometric data (grids or meshes) for the HEC-RAS 2D software. This tutorial does not provide thorough coverage of all of the capabilities of the HEC-RAS software. Instead, it focuses on importing into HEC-RAS 2D files created in SMS.

The HEC-RAS software can be downloaded for free,<sup>1</sup> and version 5.0.3 is required to complete this tutorial. If this version of the software cannot be obtained or installed, this tutorial cannot be completed.

This tutorial uses a mesh generated from data gathered for a portion of the Cimarron River in Oklahoma.

### 1.1 Disclaimer

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HEC-RAS was created by the U.S. Army Corps of Engineers Hydrologic Engineering Center. Questions about how the HEC-RAS software operates cannot be answered by Aquaveo, and Aquaveo does not provide technical support for the software. The steps provided in this tutorial are for convenience only. Please refer to the HEC-RAS Support Policy<sup>2</sup> for assistance regarding use of the HEC-RAS software.

## 2 Opening the HEC-RAS project

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This tutorial illustrates how to import, set up, and run a simple 2D HEC-RAS simulation using files exported from SMS.

<sup>1</sup> Download the HEC-RAS software at <http://www.hec.usace.army.mil/software/hec-ras/>

<sup>2</sup> HEC-RAS Support Policy: [http://www.hec.usace.army.mil/software/support\\_policy.aspx](http://www.hec.usace.army.mil/software/support_policy.aspx)

To use these files with HEC-RAS, do the following:

1. Launch the HEC-RAS software.
2. In HEC-RAS, select *File* | **Open Project...** to bring up the *Open Project* dialog.
3. Browse to the *Import\_into\_HEC-RAS\datafiles* directory.
4. Select “Cimarron.prj” and click **OK** to import the file into HEC-RAS.


With the geometry from SMS loaded, the HEC-RAS simulation requires the following steps in order to run:

- Load/create a terrain model.
- Set up the boundary conditions.
- Set up the plan.


### 3 Loading the Terrain

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The HEC-RAS engine requires a terrain definition based on a digital elevation map. To create the terrain, do the following:

1. Click on the  icon to open the *RAS Mapper* dialog.
2. Turn on the “2D Flow Areas” to see the extents of the domain.
3. Right-click on “Terrains” object and select **Create a new terrain ....**

HEC-RAS will bring up a notification that a projection is desired.

4. Click **Yes** to bring up the *Spatial Reference Projection File* dialog.
5. Click **Open**  to bring up the *Browse for the spatial reference projection file for this project* dialog.
6. Select “Cimarron01\_projection.prj” and click **Open** to import the file into HEC-RAS and close the *Browse for the spatial reference projection file for this project* dialog.

HEC-RAS may give an error message that the projection does not appear valid.


7. Ignore this message and click **OK** to close the *Spatial Reference Projection File* dialog and open the *New Terrain Layer* dialog.
8. In the *Input Terrain Files* section, click  to open the *Browse for Terrain raster files* dialog.

This dialog allows for selecting a new digital elevation map.

9. Browse to the *datafiles* directory for this project and select “NRCS\_2m\_DEM.tif”.
10. Click **Open** to exit the *Browse for Terrain raster files* dialog.

11. Click **Create** to exit the *New Terrain Layer* dialog and bring up the *Creating Terrain 'Terrain'* dialog.

This dialog shows the progress of processing the DEM.

12. When it is complete, click **Close** to exit the *Creating Terrain 'Terrain'* dialog.
13. Turn on “Terrains” in the *RAS Mapper* dialog to display the terrains and make the image appear.
14. **Close**  the *RAS Mapper* dialog for now.

HEC-RAS has now created a “Terrain” folder in the project directory and copied the DEM into that folder. It has also created the files “Terrain.hdf”, “Terrain.vrt”, and “Cimarron.rasmap” for use with this project.

## 4 Setting up Boundary Conditions



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The boundary conditions for the 2D hydraulic regions are specified in two steps: defining the location of the lines, then setting the values.

### 4.1 Defining the Location

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To define the location, do the following:

1. Click **View/Edit Geographic Data**  to open the *Geometric Data* dialog.
2. Using the **SA/2D Area BC Lines**  tool, digitize the boundary condition location by creating a line near the left edge of the domain. It does not need to be precise. It is recommended to just click two points near the two left corners. Double-click on the last point in the line to end the line and bring up the *HEC-RAS* dialog

In this dialog, HEC-RAS asks for a name for this boundary condition line.

3. Enter “Inflow” in the provided text field and click **OK** to close the HEC-RAS dialog.


HEC-RAS will snap the line to the edge of the domain.

4. Repeat steps 2–3 to create a boundary condition arc on the right side of the domain named “Outflow”.
5. Select *File* | **Save Geometry Data** to update the “g01” and “g01.hdf” files.
6. **Close**  the *Geometric Data* dialog.

### 4.2 Defining Boundary Condition Values

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To define the boundary condition values, do the following:

1. Click **View/Edit Unsteady Flow Data**  to open the *Unsteady Flow Data* dialog.
2. On the *Boundary Conditions* tab, in the spreadsheet near the bottom, on the “BCLine: Outflow” line, select the blank field in the *Boundary Condition* column.

In this case, a stage hydrograph will define the outflow boundary, so do the following:

3. In the *Boundary Condition Types* section, click **Stage Hydrograph** to open the *Stage Hydrograph* dialog.
4. Select “4 Hour” from the *Data time interval* drop-down.
5. In the *Select/Enter the Data’s Starting Time Reference* section, on the *Fixed Start Time* row, enter “0” as the *Time*.
6. In the *Hydrograph Data* section, enter “271” on both rows 1 and 2 in the *Stage* column.
7. Click **OK** to close the *Stage Hydrograph* dialog.
8. Select the blank field in the *Boundary Condition* column on the “BCLine: Inflow” line.

In this case, a flow hydrograph will define the inflow boundary, so do the following:

9. In the *Boundary Condition Types* section, click **Flow Hydrograph** to open the *Flow Hydrograph* dialog.
10. Select “4 Hour” from the *Data time interval* drop-down.
11. In the *Select/Enter the Data’s Starting Time Reference* section, on the *Fixed Start Time* row, enter “0” as the *Time*.
12. In the *Hydrograph Data* section, enter “1000” on both rows 1 and 2 in the *Flow* column.
13. At the bottom of the dialog, enter “0.001” as the *EG Slope for distributing flow along BC Line*.
14. Click **OK** to close the *Flow Hydrograph* dialog.
15. Select *File* | **Save Unsteady Flow Data** to bring up the *Save Unsteady Flow Data As* dialog.
16. Enter “Q100” as the *Title* and click **OK** to close the *Save Unsteady Flow Data As* dialog.


HEC-RAS will save a file named “Cimarron.u01” containing this unsteady flow data.

17. Click **Close**  the *Unsteady Flow Data* dialog.

## 5 Setting up the Plan

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The final step in setting up the simulation is to define a plan. To do this:

1. Click **Perform an unsteady flow simulation**  to open the *Unsteady Flow Analysis* dialog.
2. In the *Programs to Run* section, turn on *Geometry Preprocessor*, *Unsteady Flow Simulation*, *Post Processor*, and *Floodplain Mapping*.
3. In the *Simulation Time Window* section, enter “0” as the *Starting Time* and “4” as the *Ending Time*.
4. In the *Computation Settings* section, select “30 Second” from the *Computation Interval* drop-down.
5. Select “10 Minute” from the *Mapping Output Interval* drop-down.
6. Select “10 Minute” from the *Hydrograph Output Interval* drop-down.
7. Select “10 Minute” from the *Detailed Output Interval* drop-down.
8. Select *File* | **Save Plan** to bring up the *Save Plan Data As* dialog.
9. Enter “Q100” as the *Title* and click **OK** to close the *Save Plan Data As* dialog and bring up the *HEC-RAS* dialog.

This dialog asks for a short plan Identifier between 16 and 64 characters in length.

10. Enter “Q100 Flow Case” and click **OK** to close the *HEC-RAS* dialog.


## 6 Running the HEC-RAS analysis

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The simulation is now ready to run. To do this:

1. Click **Compute** to bring up the *HEC-RAS Computations* dialog.

At this point, HEC-RAS processes the geometry and runs the simulation. The *HEC-RAS Computations* dialog reports the analysis progress and other notifications. It should take only a few minutes to run the 4 hours simulation


2. When the process is complete, click **Close** to exit the *HEC-RAS Computations* dialog.
3. **Close**  the *Unsteady Flow Analysis* dialog.

## 7 Viewing the results

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To view the solution:




1. Click **Open RAS Mapper to view maps and data spatially**  to open the *RAS Mapper* dialog.


There should now be items in the “Results” section.

2. Turn on “Velocity (Max)”.

The inundated area at the active time will be filled with a blue color in the graphic display.

3. At the upper right of the *RAS Mapper* dialog, drag the scroll bar slider  all the way to the right (4 hours). Notice the change in the inundated areas.
4. Double-click on the “Velocity” dataset to bring up the *velocity – Layer Properties* dialog.

This dialog allows the setting of the display options.

5. Click in the color ramp on the left side to bring up the *Select Surface Fill* dialog.
6. In the *Surface Symbol* section, enter “1.5” as the *Max* and click **Create** to redistribute the colors.
7. Click **Apply** to close the *Select Surface Fill* dialog.
8. **Close**  the *Layer Properties* dialog.

The velocity magnitudes will now be clearly visible in the graphic display (Figure 1).

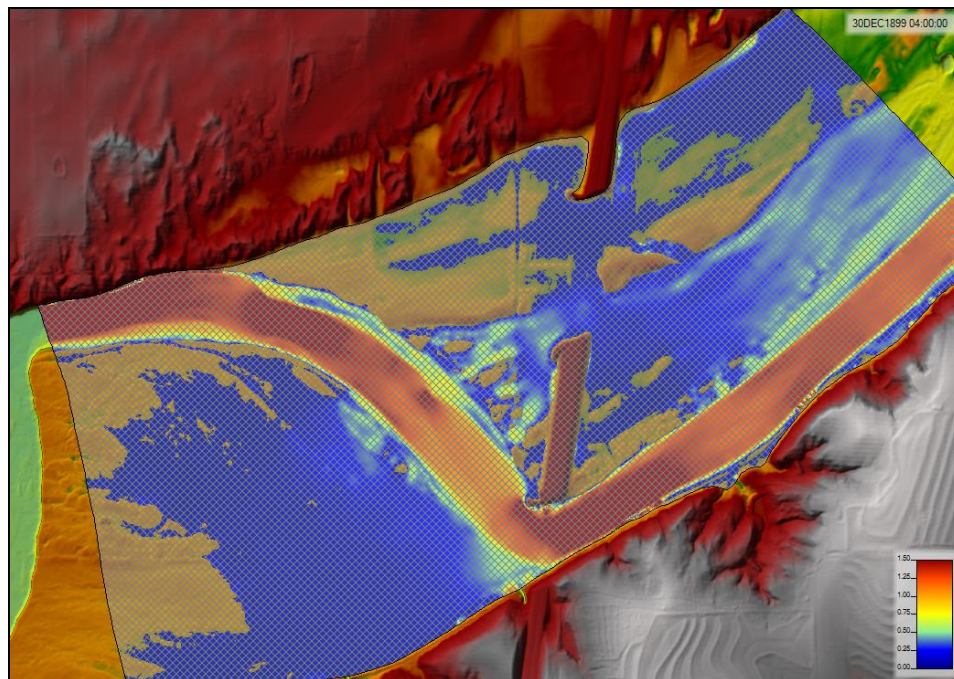


Figure 1 Velocity magnitude dataset

Explore the solution by changing which dataset is displayed and which time step is selected. The buttons at the top also allow for display of vectors.

## **8 Conclusion**

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This concludes the “Importing into HEC-RAS” tutorial. The following key concepts were discussed and demonstrated:

- Importing files exported from SMS for use in HEC-RAS 2D.
- Using HEC-RAS 5.0 with the files prepared in SMS.

If desired, experiment further with the HEC-RAS simulation. When done, exit the program.