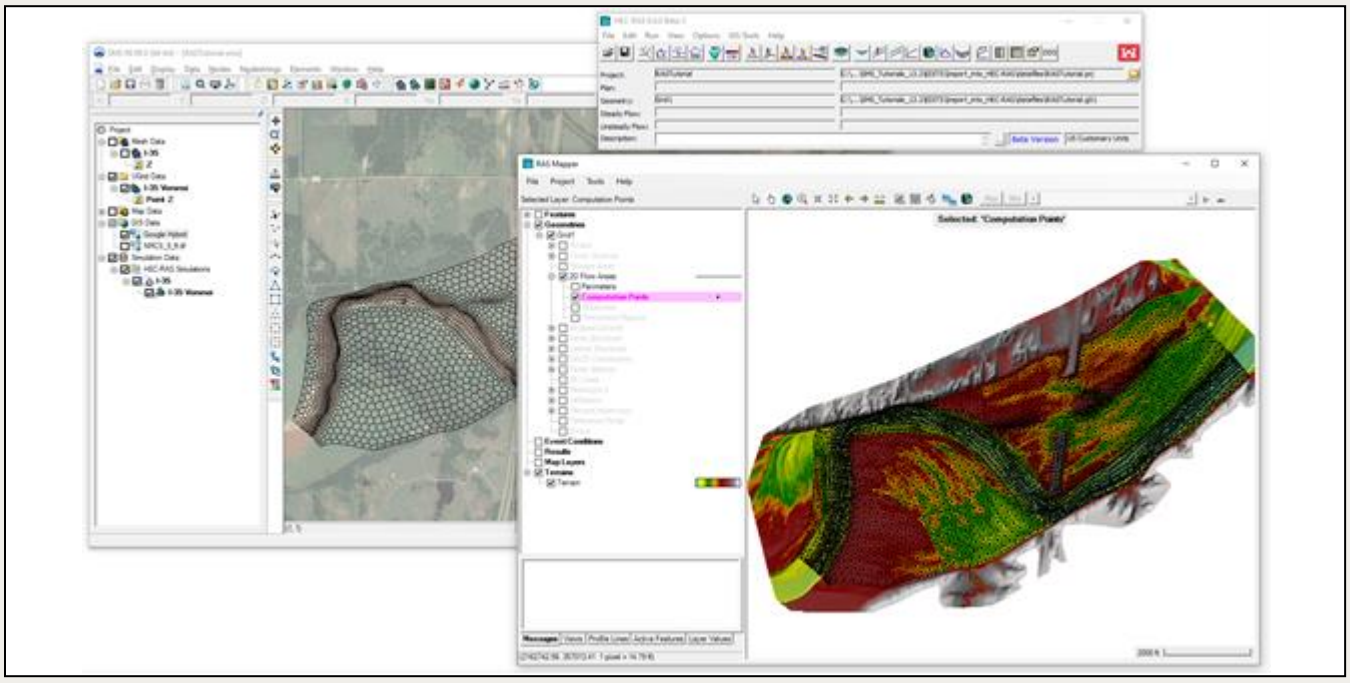
SMS 13.3 Tutorial

HEC-RAS

Using the HEC-RAS interface in SMS



Objectives

This tutorial introduces the HEC-RAS model interface in SMS and how it can be used to generate files for use with the HEC-RAS software.

Prerequisite Tutorials

- Overview
- Mesh Generation

Required Components

- SMS Core
- HEC-RAS 2D Geometry Import & Export

Time

- 10–25 minutes

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1 Introduction

The U.S. Army Corps of Engineers Institute for Water Resources 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. This tutorial focuses on the 2D functionality of the model. Specifically, it shows how to create and export geometric data (grids or meshes) as HEC-RAS input data and files. The “Importing into HEC-RAS” tutorial discusses importing these files into HEC-RAS.

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

2 Importing a Mesh

To save time, a triangle/quad mesh has been provided in an SMS project file. The process used to generate this mesh is shown in the “Mesh Generation” tutorials. Refer to these tutorials for more information about mesh generation.

Import the mesh by doing the following:

1. Start SMS.
2. Select *File* | **Open…** to bring up the *Open* dialog.
3. Select “Project Files (*.sms)” from the *Files of type* drop-down.
4. Browse to the *HEC-RAS\datafiles* folder and select “RASTutorial.sms”.
5. Click **Open** to import the project and exit the *Open* dialog.

The display should appear similar to Figure 1.

It is recommended to review the “ Materials” coverage which contains Manning’s n values associated with polygons and the “ NRCS_5_ft.tif” raster that were included in this project. These will be used by RAS as well. (Note: refer to the SRH-2D tutorial to review how the materials coverage is created.)

6. When done reviewing the mesh, return to **Plan View** .

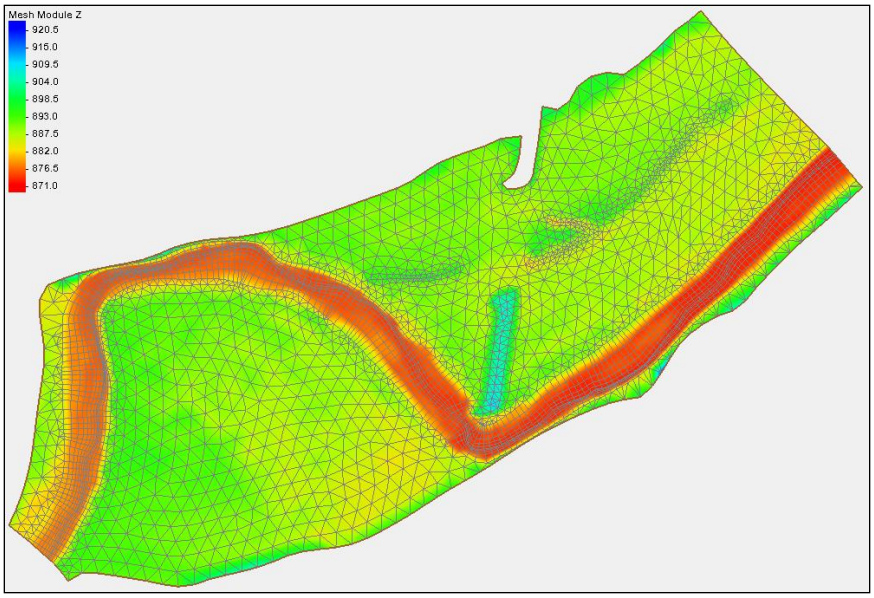

Figure 1 The imported mesh

3 Export SRH-2D Material Coverage to Shapefile

The material list and material zones defined in the "Materials" coverage can be used to in a RAS project. To do this, they must be converted to a shapefile.

1. Right-click on the "Materials" coverage and select **Export** to open the *Export Coverage* dialog.
2. For the *File name*, enter "CimarronMats" and set the *Save as type* to be "Feature Polygons to Polygon Shapefile".
3. Click **Save** to close the *Export Coverage* dialog and create a polygon shapefile.

This creates the four files associated with the shapefile.

4 Convert Tri/Quad UGrid to Voronoi

The mesh included in this project can be used directly as the computational basis of SHR-2D or a number of other hydraulic engines. However, HEC-RAS operates on Voronoi polygon cells. When a mesh is loaded into RAS from an external source, such as SMS, RAS computes a set of cells based on the cell centroids provided.

It is useful to see the computational domain being used. For this reason, SMS now includes a tool to convert a mesh or unstructured grid to its Voronoi dual. This approach utilizes the toolbox available in SMS. To do this:

1. Select the **Toolbox** macro to open the *Toolbox* dialog.
2. Expand *Unstructured Grids* folder to display a list of tools that operate on or create unstructured grids.
3. Double-click on the **Voronoi UGrid from UGrid** tool to open the *Voronoi UGrid from UGrid* tool dialog.

This tool allows for inputs on the left side with a link to a help article from the wiki on the right side of the tool.

4. For the *Input grid*, select “Mesh Data/I-35” mesh.
5. Enter an *Output grid name* of “I-35 Voronoi”.
6. Click **OK** to close the *Voronoi UGrid from UGrid* dialog and start the tool.

A progress dialog will appear providing feedback on what the tool is doing. A message saying “Successfully ran tool” should appear at the top of the dialog when the tool is finished running.

7. Click **OK** to close the *Voronoi UGrid from UGrid* tool dialog.
8. Click **Close** to exit the *Toolbox* dialog.
9. In the Project Explorer, turn off the “ I-35” mesh to review the created Voronoi UGrid.

5 Setting Up a HEC-RAS Simulation in SMS

The HEC-RAS interface in SMS makes use of simulation-based modeling. This allows creation of multiple scenarios in one SMS project. This project only uses one unstructured grid, but multiple meshes could be used create multiple simulations.

With the UGrid available, the HEC-RAS simulation needs to be created.

1. Right-click in an empty space in the Project Explorer and select *New Simulation* | **HEC-RAS** (Figure 2).

A new simulation titled “ Sim” should appear in the Project Explorer.

2. Right-click on “ Sim” and select **Rename**.
3. Enter “I-35” and press *Enter* to set the new name.

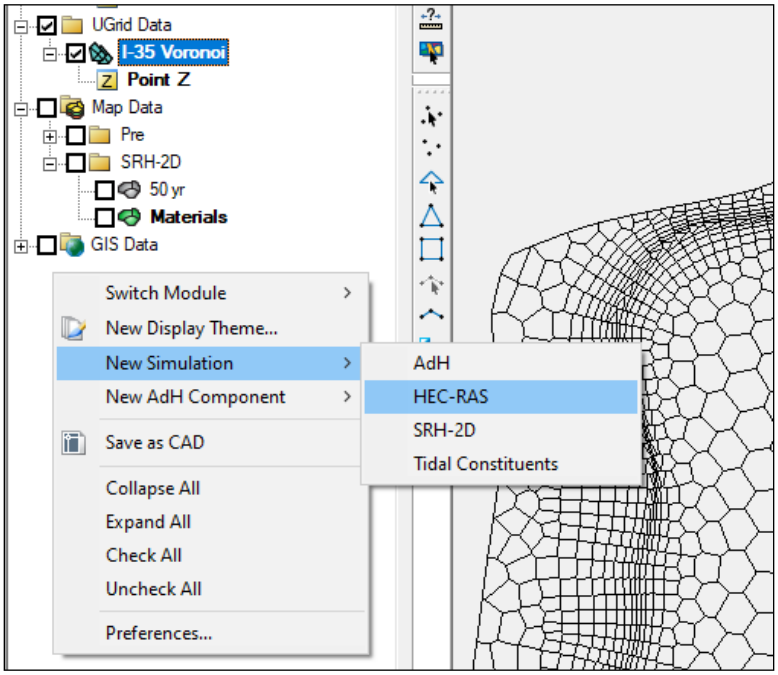

Figure 2 Creating a new HEC-RAS simulation

The "I-35" simulation currently contains no properties or data. Components need to be added to the simulation before the simulation can be launched. The same components can be added to multiple simulations. Changes made to a component will be automatically updated in all simulations where it is used. Currently, for a HEC-RAS simulation, the only component needed is a 2D UGrid.

To link the UGrid to the simulation, do the following:

4. Right-click on "I-35 Voronoi" and select *Apply to* | **HEC-RAS Simulations → I-35**.

The simulation should now appear similar to the one at the bottom of Figure 3.

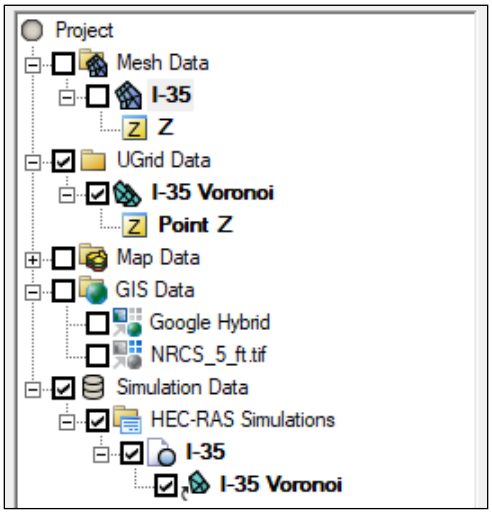

Figure 3 The HEC-RAS simulation in the Project Explorer

6 Save the Project and Export the HEC-RAS Input Files

SMS only generates a geometric grid or mesh. In future versions the interface will include specification of boundary conditions, material zones with roughness values or land use rasters, background DEMs, and model parameters. For now, these components will be linked into the RAS simulation in the RAS GUI.

To generate the input files needed for use in HEC-RAS:

1. Right-click on "I-35" simulation and select **Save Project and Simulation**.

This command first saves all the work just completed on the project, then generates four input files for the simulation in the *RASTutorial_models/HEC-RAS/I-35* folder:

- "RASTutorial.g01" – HEC-RAS geometry file
- "RASTutorial.g01.hdf" – HEC-RAS 2D geometry file
- "RASTutorial.prj" – HEC-RAS project file
- "I-35 Voronoi_projection.prj" – coordinate system projection file

Note that both the HEC-RAS project file and the HEC-RAS projection filenames end with the "*.prj" extension. However, they are not the same type of file.

With the HEC-RAS files successfully exported from SMS, these files are now ready to be imported into the HEC-RAS application. This process is not discussed in this tutorial.

7 Conclusion

This concludes the “HEC-RAS” tutorial. This tutorial demonstrated and discussed the following:

- Creating a HEC-RAS simulation in SMS.
- Exporting a mesh file from SMS for use in HEC-RAS 2D.