

Refining a 2D Model with HEC-RAS

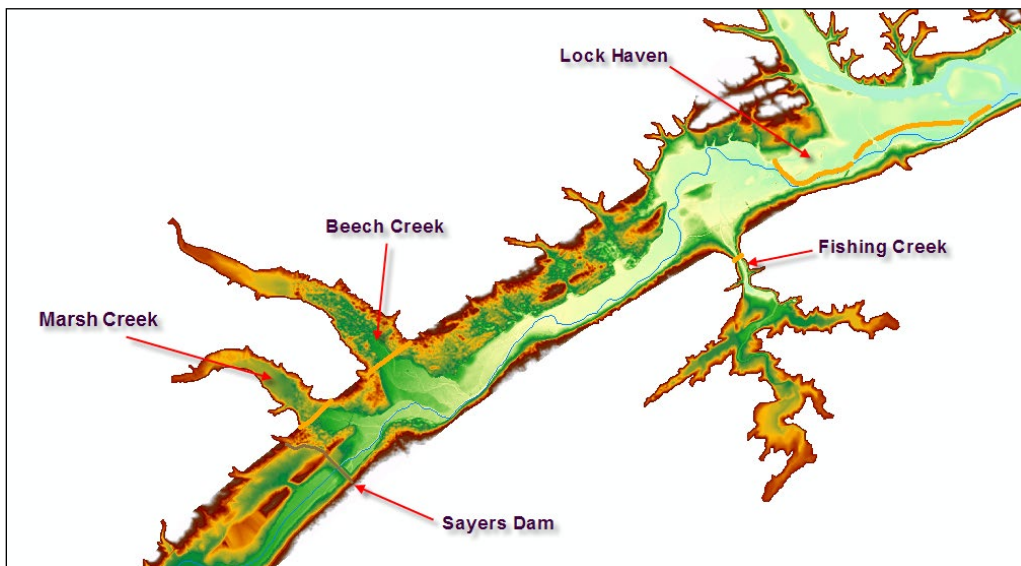
Workshop

1 Objective

In this workshop, you will learn how to improve a 2D model through mesh refinement and evaluation of computational time step.

2 Background

You will be working on Bald Eagle Creek near Lock Haven, PA. A rudimentary river hydraulics model has already been created for you to refine.



3 Open the Workshop

This part of the workshop will have you evaluate the importance of time step on the simulation results.

1. **Start HEC-RAS.**
2. **Open** the workshop "Refining a 2D Model".

Question: What time step is used for the base ("Initial Run") plan?

4 Grid Cell Size and Time Step

Evaluate alternative time steps and grid cell sizes to see how the model performs.

4.1 Time Step

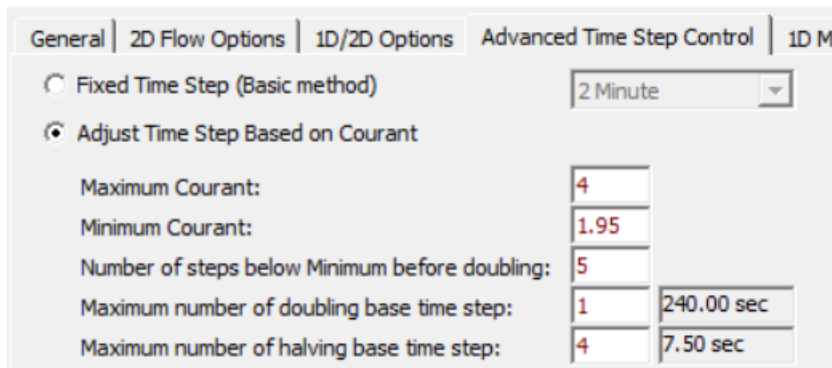
Let's test the sensitivity of the model to the time step by creating two additional Plans where we only changing the Computational Interval.

3. **Save** your current **Plan As** to a new name ("**2min**") and change the time step to **2 minutes**.
4. **Run** the "**2min**" plan.
5. **Save** your current **Plan As** to a new name ("**1min**") and change the time step to **2 minutes**.
6. **Run** the "**1min**" plan.

Question: What is the significance of the time step on the results? Evaluate by comparing the Stage or Depth hydrographs at several locations in the model from upstream to downstream, including the tributary areas.

Question: How is the town of Lock Haven impacted by the flood event?

7. **Save** your current **Plan As** to a new name ("**Adaptive Time Step**") and change the base time step to **2 minutes**.
8. Use the **Advance Time Step Control** using the specification below.
HEC-RAS Unsteady Computation Options and Tolerances



The screenshot shows the 'Advanced Time Step Control' dialog box in HEC-RAS. It has tabs for 'General', '2D Flow Options', '1D/2D Options', 'Advanced Time Step Control', and '1D Model'. The 'Advanced Time Step Control' tab is active. There are two radio buttons: 'Fixed Time Step (Basic method)' and 'Adjust Time Step Based on Courant'. The 'Adjust Time Step Based on Courant' option is selected. A dropdown menu next to it shows '2 Minute'. Below this are several input fields: 'Maximum Courant' (4), 'Minimum Courant' (1.95), 'Number of steps below Minimum before doubling' (5), 'Maximum number of doubling base time step' (1) with a secondary field '240.00 sec', and 'Maximum number of halving base time step' (4) with a secondary field '7.50 sec'.

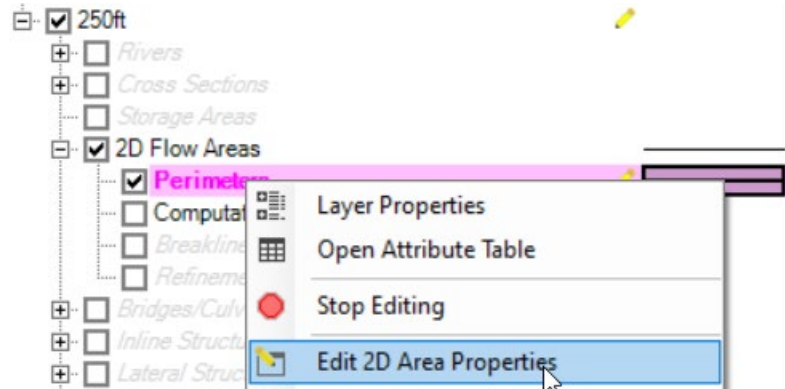
9. **Run** the "**Adaptive Time Step**" plan.

Question: What time step did HEC-RAS choose to use?

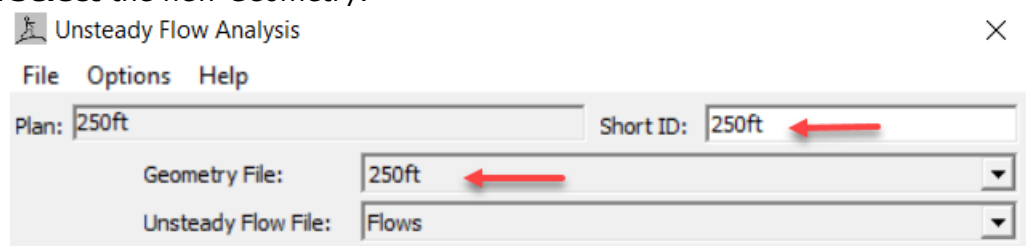
4.2 Grid Cell Size

Evaluate the significance in the grid cell size. Make a copy of the Geometry.

10. Open RAS Mapper
11. Right click on the **Simple Geometry** Layer and select **Save Geometry As**. Enter a name for the new geometry (i.e. "250ft").
12. **Start Editing** the new geometry layer (250ft),
13. Right click on the 2D Flow Areas' **Perimeter** layer and select **2D Flow Area Editor**.



14. Create **Computation Points with All Breaklines** using a spacing of **250 ft**. (Click **Yes** when prompted.)
15. Verify the mesh.
16. **Stop Editing** to SAVE the data.
17. **Close** RAS Mapper.
18. **Save** the Adaptive Time Step plan to a new Plan ("250ft").
19. **Select** the new Geometry.



20. Pick a **new base time step**.
21. **Run** the new plan.
22. **Compare Results**

Question: What is the significance of the grid-cell size on model results?

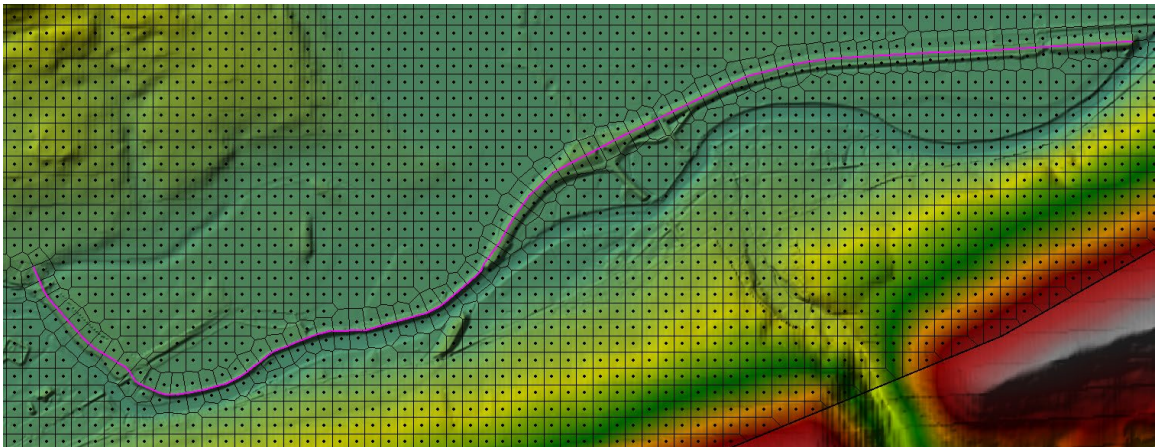
Question: Did the smaller cell size result in differences at the town of Lock Haven? What is geometrically significant about the Lock Haven area? How could we best model this area?

5 Modify Computation Mesh with Break Lines and Refinement Region

As time allows, evaluate importance in modifying the computational mesh using break lines and refinement regions.

5.1 Break Lines

23. From RAS Mapper, right click on the 250ft geometry layer and select **Save Geometry As**, to create a new geometry. Use the name "250ft+Breaklines".
24. In RAS Mapper, Zoom into the Lock Haven area at the downstream end of the model and note the town is protected by a levee. As shown previously, the levee is **Not** being honored in the 2D mesh and flooding is occurring. Add a break line to modify the computational mesh to force the cell faces to follow the terrain.
25. **Start Editing** and edit the **Break Lines** Layer to add a breakline along high ground.
26. Double-click to finish and provide a name ("**Levee**").
Note that the mesh is warping to snap to the line; however, the faces do not all align with the break line.
27. Right-click on the breakline and choose the **Enforce Breakline** option. This will ensure the cell faces follow the break line.

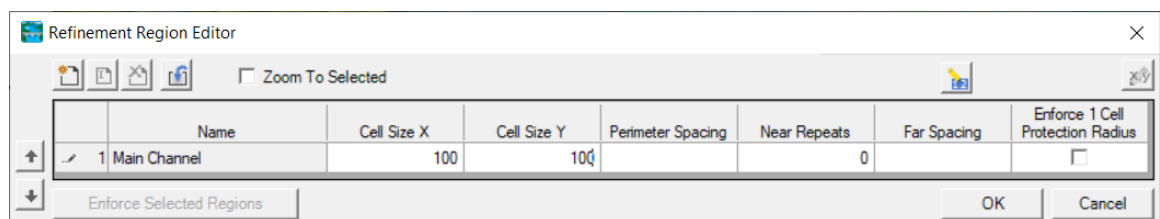


28. **Stop Editing** to save the geometry.
29. Create a new Plan and Simulate.

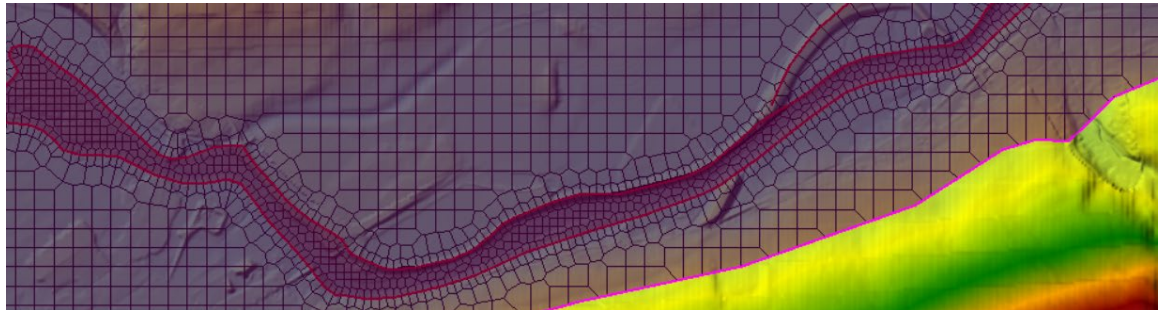
Question: What is the effect of incorporating the levee on model results? What do you think of the results?

5.2 Refinement Regions

30. From RAS Mapper, right click on the 250ft+Breaklines geometry layer and select **Save Geometry As**, to create a new geometry. Use the name "250ft+Refinement".
31. **Start Editing** and edit the **Refinement Regions** Layer to add the channel area.
32. **EDIT the Breaklines layer where the levee and refinement region overlap!**
33. **Edit the Refinement Region properties and use a 50ft cell size.**



34. Use the 2D Area Properties and **Generate the Computation Points with All Breaklines** (this uses the refinement regions, also).



35. **Stop Editing** to save the geometry.
36. Create a new Plan and Simulate.

Question: What is the effect of using the refinement region?