RAS Mapper Dam Breach Geometry

Workshop

Objective

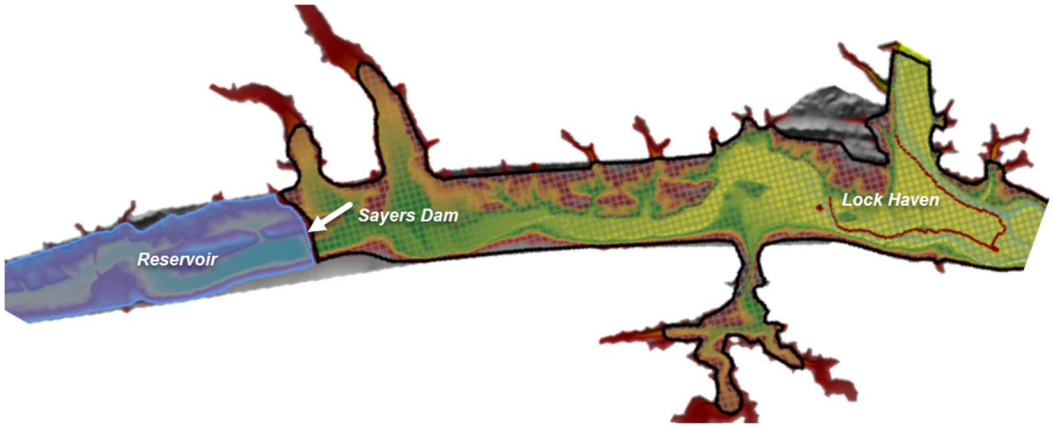
In this workshop, you will learn how to create an HEC-RAS model from a digital terrain model (DTM). The general process will teach you how to create geospatial data in RAS Mapper to represent the river system and floodplain area specifically for performing a dam breach analysis with HEC-RAS.

Once the geometric data has been created, you will identify data that requires correction and enter remaining data to complete the RAS model.

NOTE: While this data is from an actual river system, the model and results of this workshop do not represent current or future conditions of the river. The United States Army Corps of Engineers has granted access to the information in this model for instructional purposes only. Do not copy, forward, or release the information without United States Army Corps of Engineers approval.

Background

You will be working on Bald Eagle Creek near Lock Haven, PA. A flow hydrograph will be used to simulate inflows to into the reservoir behind Sayer's Dam. The water surfaces will then be used in the GIS to perform floodplain mapping.



This workshop is comprised of two parts: geometric data development using HEC-RAS Mapper; and completion of the data in the HEC-RAS Geometric Editor.

Work quickly, but thoughtfully, and be sure to read each part carefully. When you have questions, don't hesitate to ask! Lastly, don't get too carried away with being accurate – this is a workshop. It is intended to highlight the general use of using HEC-RAS Mapper for data development and editing.

1 Start a new HEC-RAS Project with Terrain

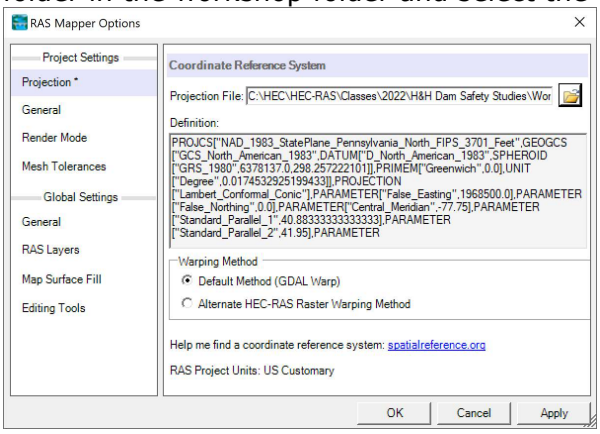
You will be starting from scratch with a new HEC-RAS project.

1.1 Create a new HEC-RAS Project

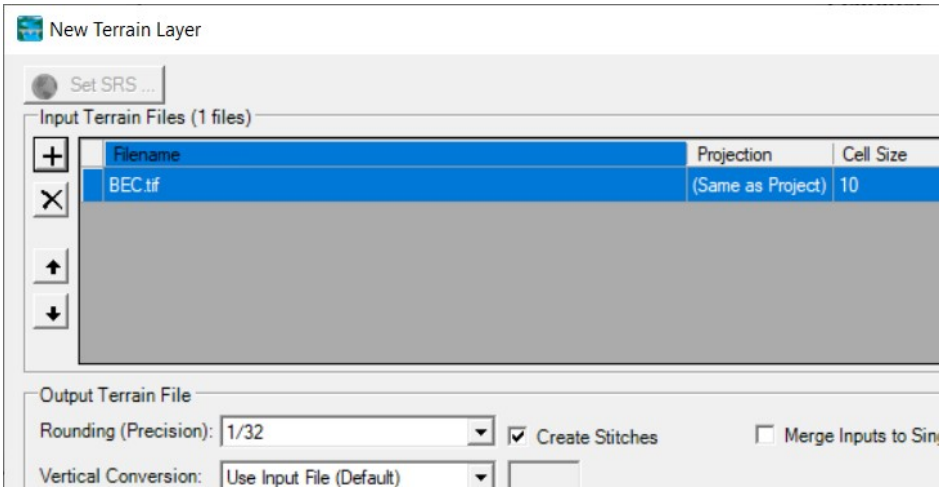
1. Create a **NEW** HEC-RAS project and give it a Name.
2. Go to the Geometric Data Editor and select **File | New Geometry Data**. Provide a name and press **OK**.

1.2 Import the Terrain Model

3. Open **RAS Mapper** and set the Projection for the project, using the **Tools | Set Projection for Project** menu item. Browse to the "**GISData**" folder in the workshop folder and select the "**projection.prj**" file.



4. Create a new terrain model using the **Tools | New Terrain** menu item.
5. Click to **+** button to add the terrain file. Use the "**BEC.tif**" file located in the "**GISData**" folder.



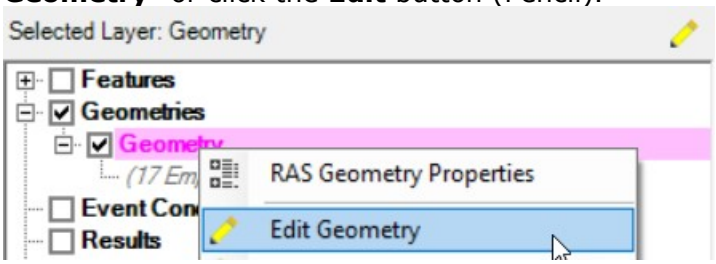
6. Press the **Create** button to import the terrain data.

7. **Close** the dialog once the Terrain has been created.

2 Geometry Development

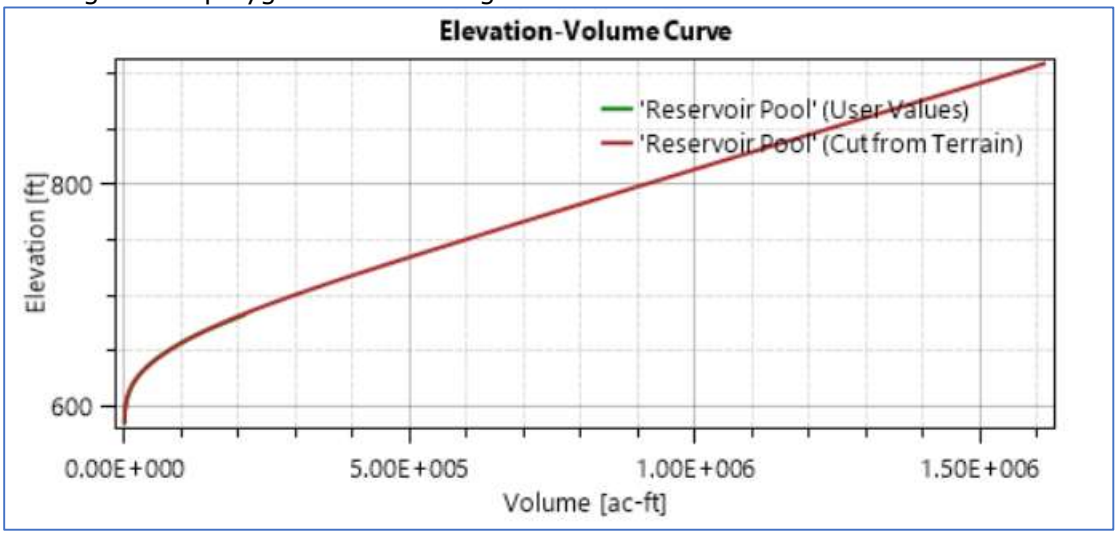
Use the RAS Mapper Editing Tools to create a 1D RAS model geometry. Pay attention to using the correct tool to **Add New** versus **Select / Edit** on the **selected layer**. Open the Geometry for Editing

8. Open **RAS Mapper**.
9. In RAS Mapper, Select the new Geometry layer, right-click and choose "**Edit Geometry**" or click the **Edit** button (Pencil).



2.1 Create the Storage Area for the Reservoir

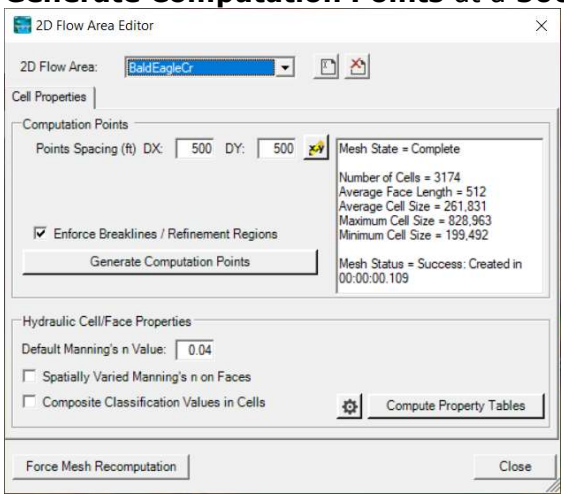
10. Click on the **Storage Areas** layer.
11. Draw a polygon representing the reservoir (you don't have to be precise).
12. Provide a **Name**.
13. The Elevation-Volume relationship will be automatically extracted from the terrain.
14. You can plot the Elevation-Volume relationship for the polygon but right-clicking on the polygon and choosing **Plot Elevation-Volume Curve**.



*Typically, you would want to override the Elevation-Volume relationship with pre-dam survey information, as most likely, the terrain in the reservoir pool is not correct.

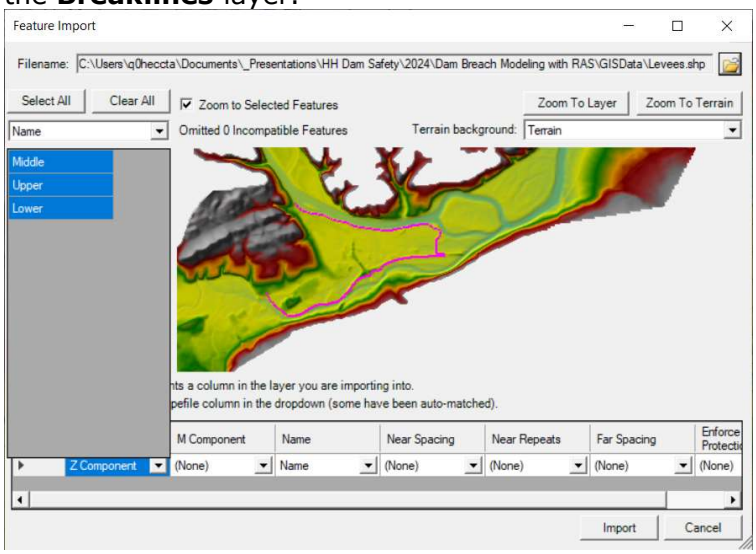
2.2 Create the 2D Flow Area Downstream of Sayers Dam

15. Expand the **2D Flow Areas** layer to see sub layers.
16. Click on the **Perimeters** layer
17. Draw a polygon representing the area downstream from the dam downstream past Lock Haven.
18. From the **2D Flow Area Editor**…
    a. Set the Manning's n value for the 2D Area to **0.06**.
    b. **Generate Computation Points** at a **500ft** spacing

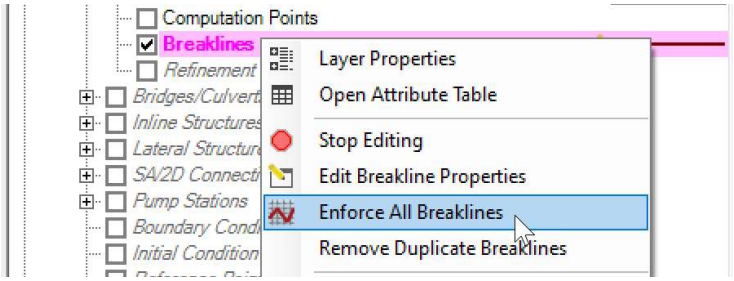


2. **Create Breaklines** along the levees by importing them from shapefile
    a. Expand the 2D Flow Areas node
    b. Right-click on the Breaklines layer and choose **Import Features**
    c. Select the

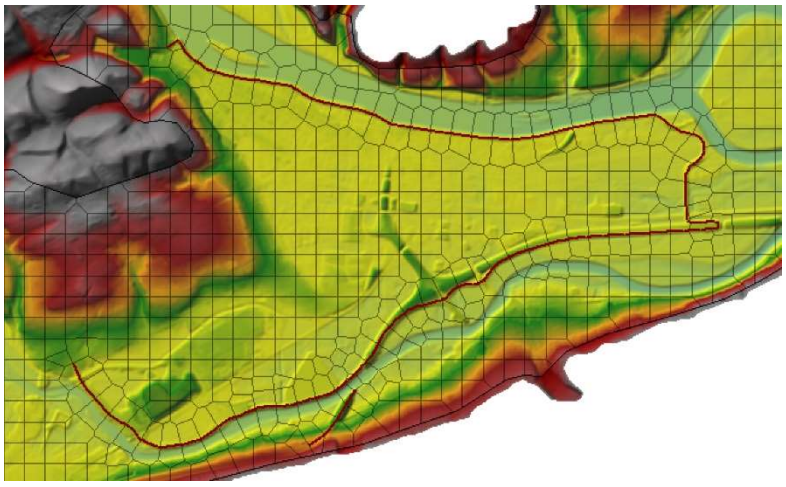
d. Import the **Levee** shapefile for the upper, middle, and lower levee to the **Breaklines** layer.



e. **Right-click** on the **Breaklines** layer and choose **Enforce All Breaklines** to modify the mesh.



The mesh should look similar to the figure below.



2.3 Create the Additional Breaklines (as appropriate)

19. Select the **Breakline** layer

20. Create additional breaklines where appropriate to align cell faces!
    Note: looks for roads and other high ground that directs flow.

21. **Enforce** all breaklines (make sure the mesh computes)

2.4 Create Boundary Conditions

22. Click on the **Boundary Conditions Lines** layer.

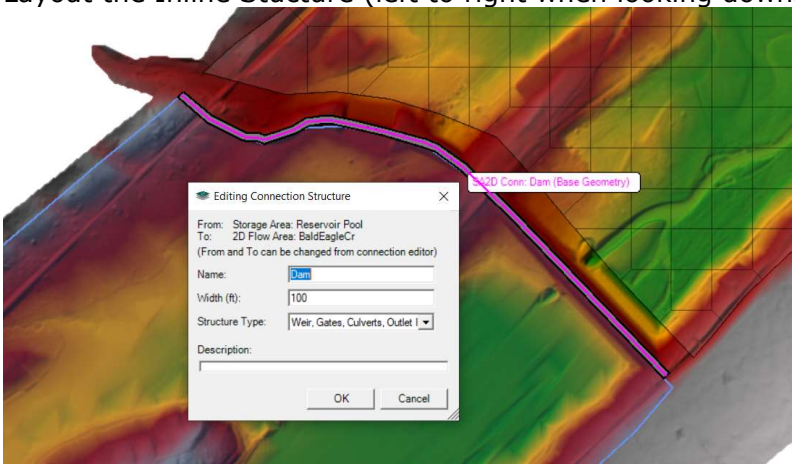
23. Navigate to the most downstream end of the 2D Area and create a **BC Line** at the end of the 2D area on the outside of the 2D Area.

24. Provide a **Name**.

2.5 Create a SA/2D Connection for the Dam

25. Click on the **SA/2D Connections** structure layer

26. Layout the Inline Stucture (left to right when looking downstream).



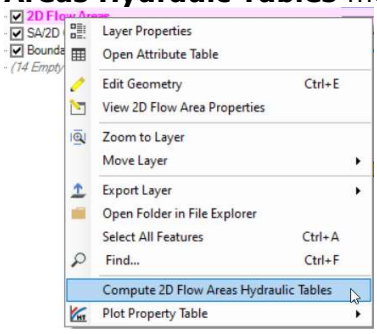
*You may need to override the weir profile for the Structure from the SA/2D Connection editor in the Geometric Editor. Breach information is also accessed from the SA/2D Connection editor.

2.6 Manning's n Values - We are skipping the detail version of this today.

2.7 Compute Hydraulic Property Tables

27. Click on the **2D Flow Areas** layer

28. Right-click on the 2D Flow Areas layer and choose the **Compute 2D Flow Areas Hydraulc Tables** menu item



2.8 Stop Editing

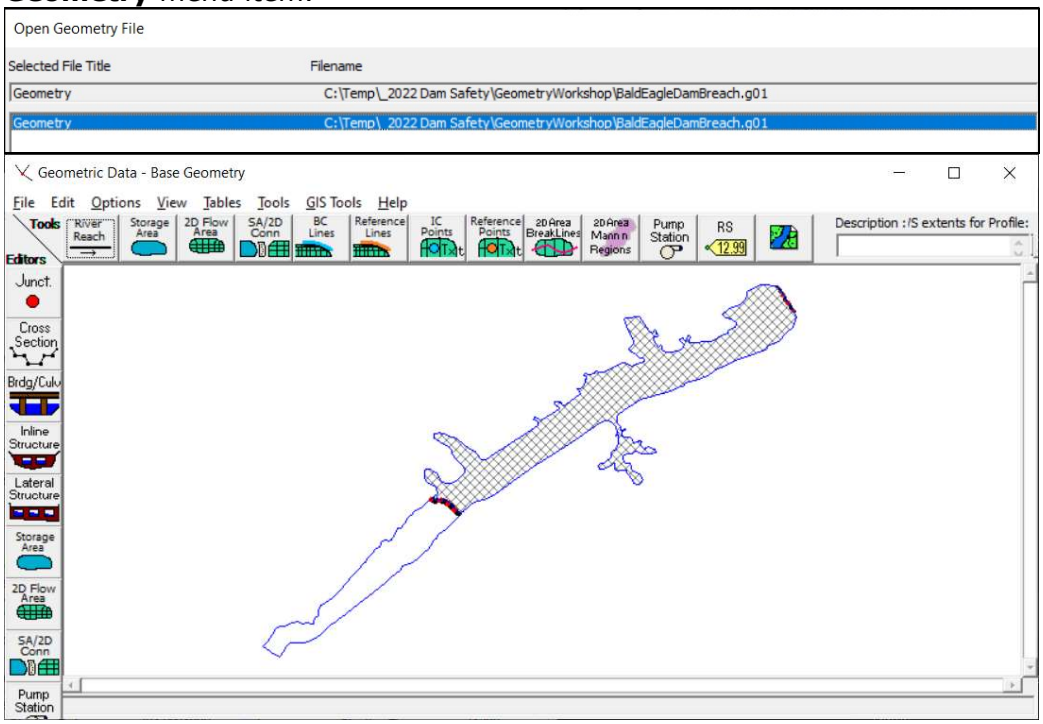
29. When **FINISHED** created features, select the **Geometries Node | Stop Editing** menu item.

30. **Close RAS Mapper**.

3 Finish Entering Geometric Data

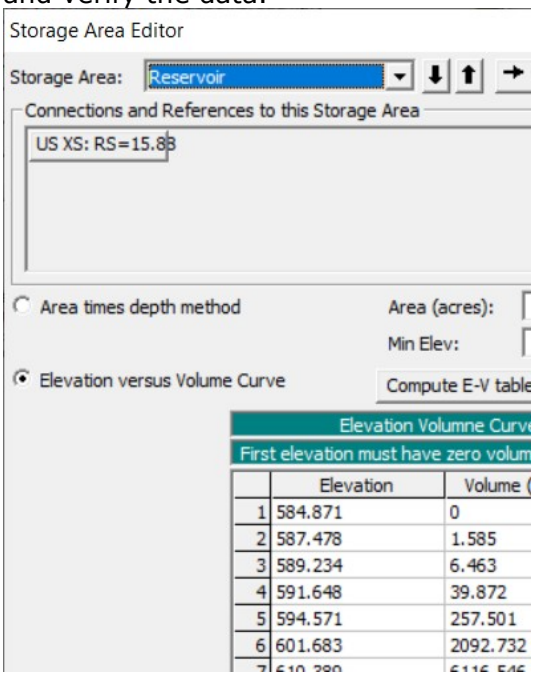
If you haven't already, close RAS Mapper and open the **Geometric Schematic**. Your geometry will not be loaded automatically.

31. **Open** the geometry you created using RAS Mapper using the **File | Open Geometry** menu item.



3.1 Storage Areas

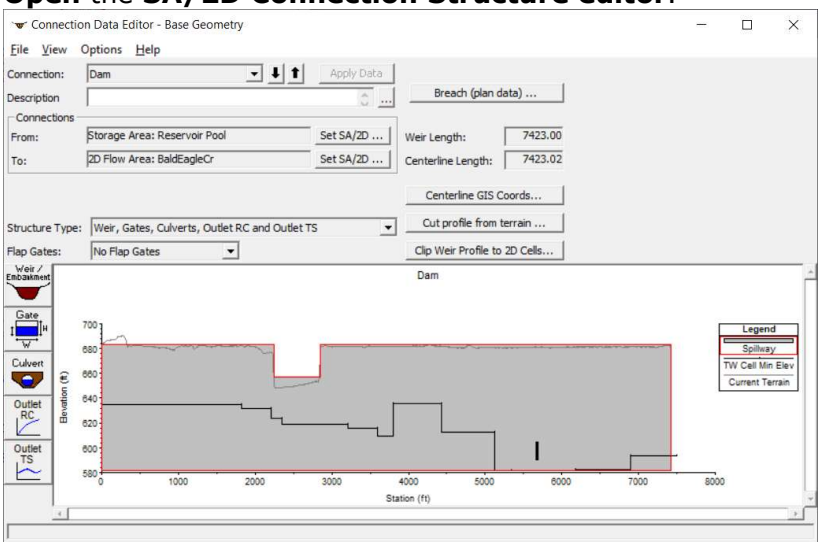
32. Select the **Elevation versus Volume Curve** method for the storage areas and verify the data.



33. You may also want to **filter** the points or replace with survey data.

3.2 SA/2D Connection Structure

34. **Open** the **SA/2D Connection Structure editor**.



35. **Override** the **Weir** information.

    a. **Dam Crest @ 683 ft**.

b. **500-ft wide Auxiliary Spillway @ 657 ft** (on the left embankment)

	Station	Elevation
1	0	683
2	2250	683
3	2250	657
4	2850	657
5	2850	683
6	7423	683

c. Provide a Weir coefficient of **2.6** for the auxiliary spillway.

36. Add a **low-level outlet** - locate it in the channel.

    a. **Invert Elevation @ 590 ft**.

    b. Use a **circular culvert** with **2 ft** diameter.

37. Consider what other geometry-related things have we not done?

-----Bonus – If time allows----------

If you have time, create an unsteady flow simulation and try to run the model. This will allow you to see if the geometry has been input properly!

4 Flow Data

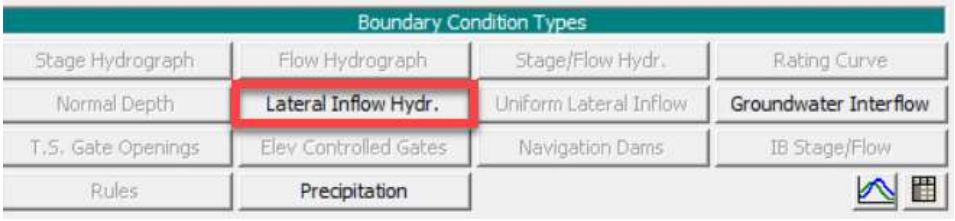
After you have created the Geometry, add flow data to the RAS project.

38. **Open** the **Unsteady Flow** data editor

39. Choose the Add SA/2D Flow Area button

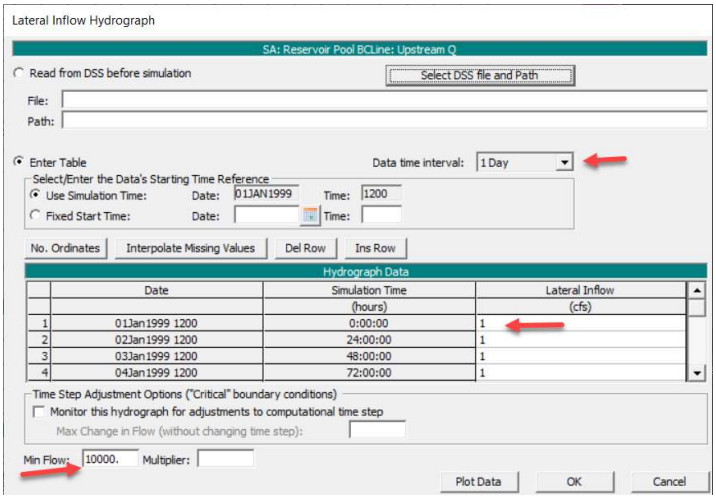
40. Add the **Reservoir** Storage Area Boundary Condition location

41. Add the **Lateral Inflow Hydrograph** boundary condition



42. Enter a **Lateral Flow Hydrograph** for the **Reservoir**.

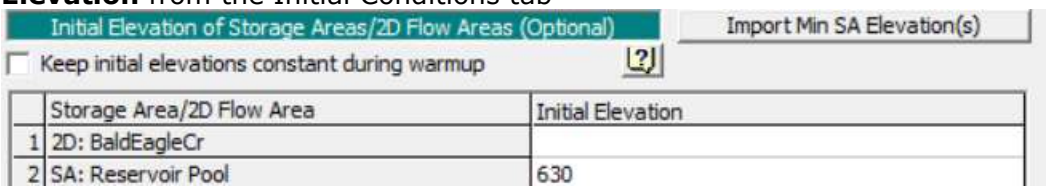
    f. Enter a time series of data



    g. Put in a **Min Flow** of **10,000** cfs for a steady profile.

43. Enter a **Normal Depth** boundary condition with a slope, **S=0.0004**.

44. Set the Reservoir Storage Area **Initial Conditions** to an appropriate **Elevation** from the Initial Conditions tab



45. **Save** the flow data.

5 Simulate

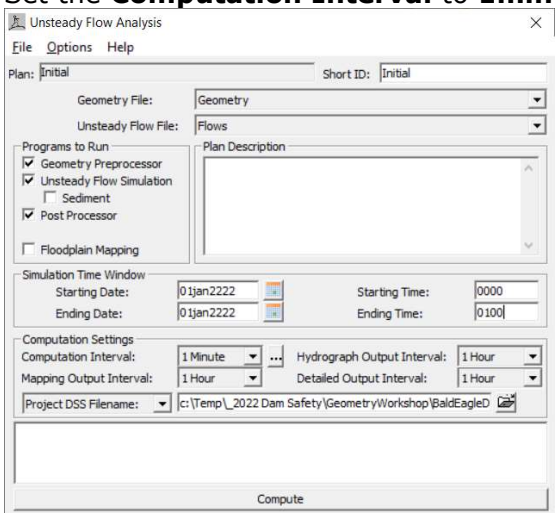
Run the steady-flow simulation.

46. Open the **Unsteady Flow** simulation dialog.

47. Create a new **Plan** with a name and Short ID.

    h. Set the **Simulation Time Window** to run for an hour.

    i. Set the **Computation Interval** to **1min**



48. **Compute** a water surface.

!!! Read the error messages and work through data deficiencies !!!

!!! HEC-RAS will provide warnings if the data are incomplete !!!

49. If the simulation runs, it means you successfully satisfied the data development requirements and flow data entry.