Specifying Meteorological Data in HEC-RAS
Workshop

1 Objective

This workshop will help students learn how to specify meteorological data including precipitation, evapotranspiration, and wind. In addition, the workshop also includes how to setup infiltration. **This work was developed with HEC-RAS Version 6.2. However, the same steps should work for Versions 6.0 and 6.1.**

2 Base Plan

The terrain data (and a depth map) that was used in the HEC-RAS model for Bald Eagle Creek is show below. Evaluate the existing plan.

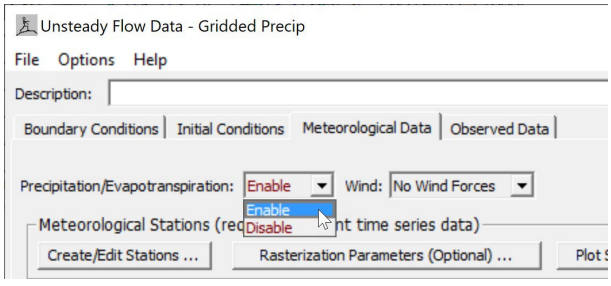
1. **Open** HEC-RAS and the "BaldEagleDamBrk.prj" project.
2. **Run** the "Single 2D Area" plan.
3. **Animate** the results in **RAS Mapper**.

Note the model setup including the geometry, dam, computational options and tolerances, and boundary conditions. Note where water is spilling into the town. The base plan is setup as a single 2D area with the dam modeled as an SA/2D Connection. The reservoir has a single inflow hydrograph. The dam as a Time-Series Controlled Gate Openings. The downstream boundary is a Normal Depth boundary condition.

3 Gridded Precipitation

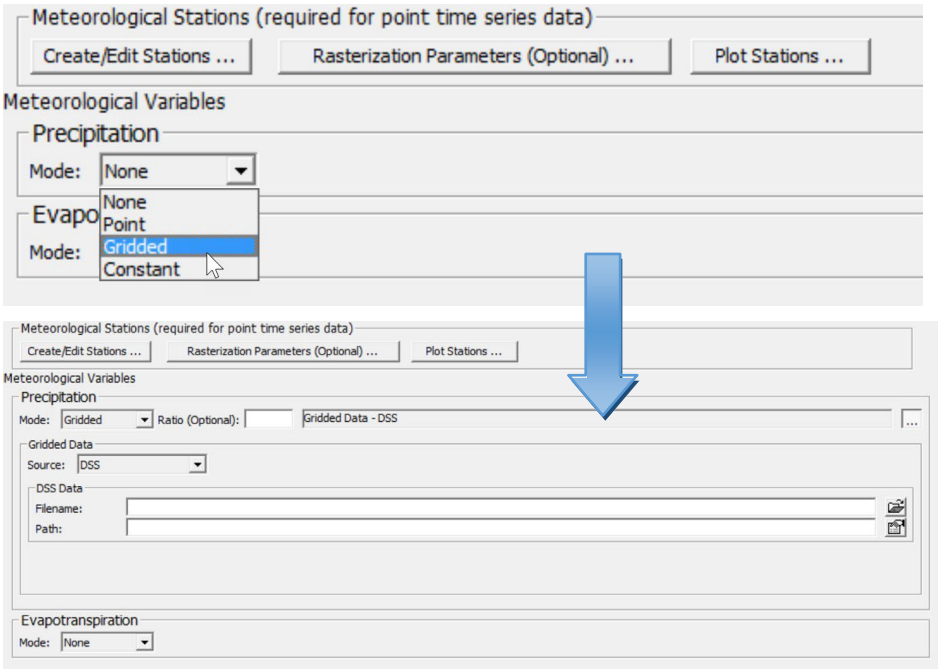
This task will add gridded precipitation to the base model plan. The gridded precipitation DSS file has already been created.

4. Create a new **Unsteady Flow Data** file and call it "Gridded Precip".
5. Within the **Meteorological Data** tab of the **Unsteady Flow Data** editor, click on the drop-down menu next to **Precipitation/Evapotranspiration** and select **Enable**.



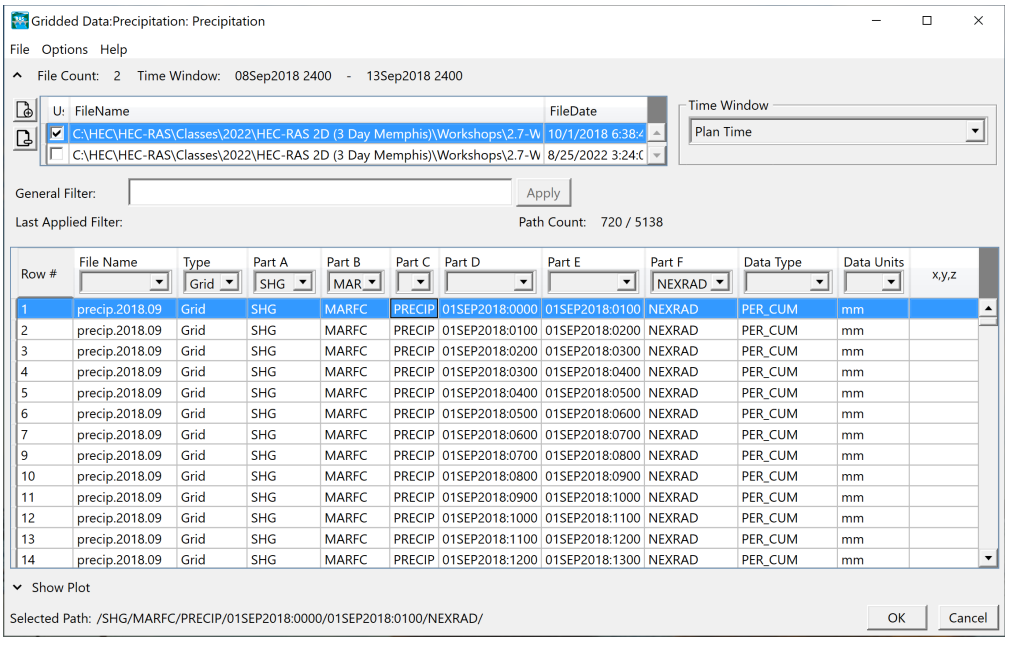
The **Precipitation** and **Evapotranspiration** fields will be enabled under **Meterological Variables**.

6. In the section called **Precipitation**, select **Gridded** in the **Mode** drop-down menu as shown below.

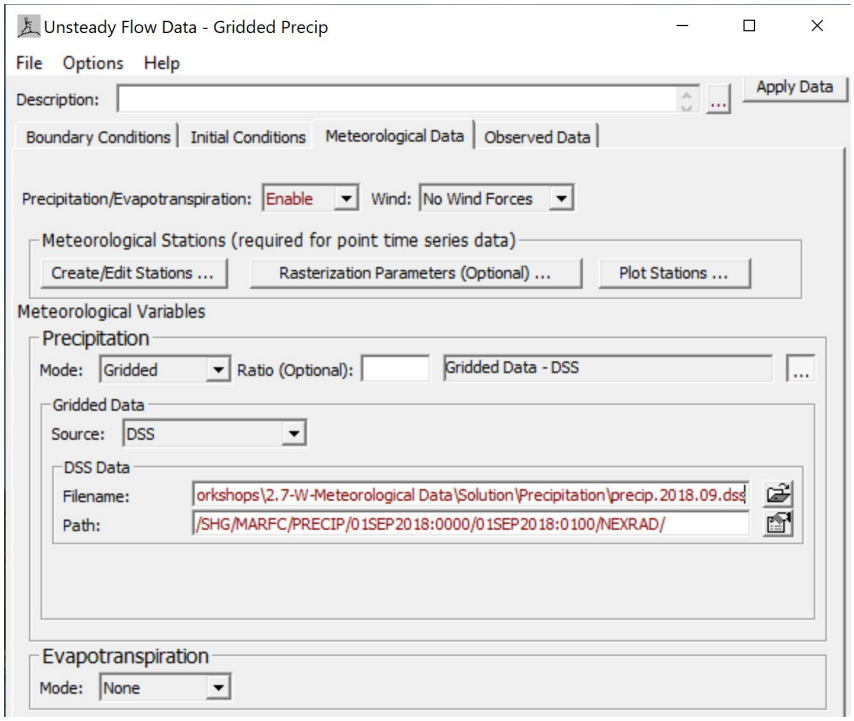


7. Make sure the **Source** drop-down menu is set to **DSS**.

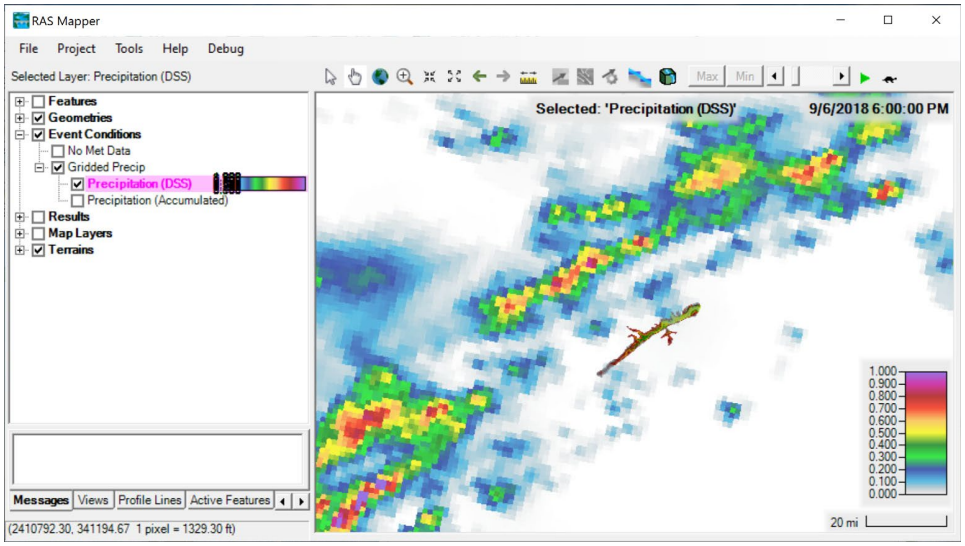
8. In the section **DSS Data** click on the open icon  and select the DSS file called "precip.2018.09.dss" located in the **Precipitation** folder of the project folder. The **HEC-RAS DSS Viewer** will open. Set the DSS path parts as shown in the figure below. Then double-click on any of the rows to set the path and click on the **OK** button.



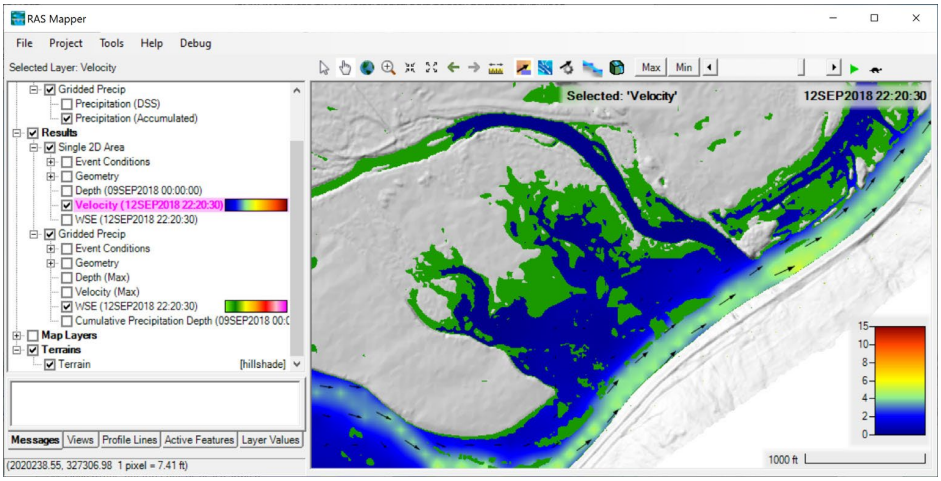
The **Unsteady Flow Data** editor should look something like the figure below.



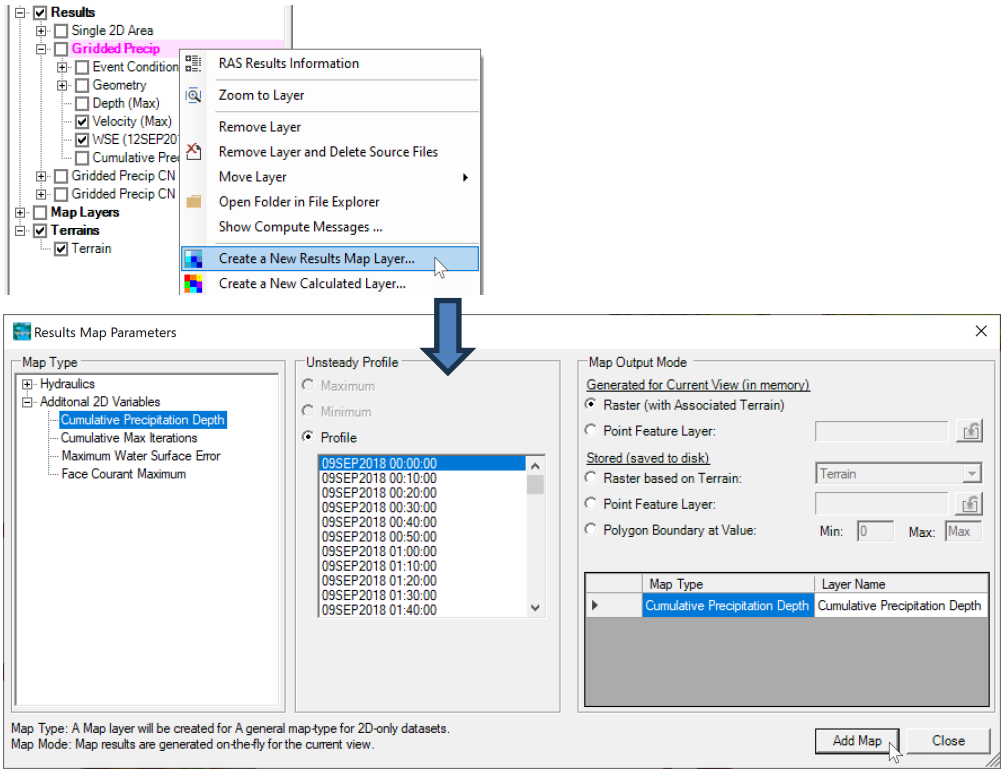
9. **Save** and close the **Unsteady Flow Data** editor.
10. Create a new plan called "Gridded Precip" with the new unsteady flow data and run it.
11. Before inspecting the results, inspect the gridded precipitation in **RAS Mapper**. Open **RAS Mapper** and select the **Gridded Precip** layer under the **Event Conditions** layer. For the precipitation to display properly it will be necessary to adjust the surface colormap. Animate the precipitation. The gridded precipitation should look something like the figure below.



12. Inspect the HEC-RAS results and compare to the plans with and without precipitation. Use a different colormap for the water surface elevations highlight the differences or compare the extents of the water surface and velocity layers. See the example below.



13. Add the **Cumulative Precipitation Depth** result in **RAS Mapper** by right-clicking on the "Gridded Precip" plan and selecting **Create a New Results Map Layer…** from the menu. In the Results Map Parameters editor, select **Cumulative Precipitation Depth** under the **Additional 2D Variables** layer, click on **Add Map**, and **Close** the editor.



14. Adjust the colormap and inspect the spatial distribution of the precipitation.
15. Compare the results with and without precipitation by plotting time-series and spatial maps in **RAS Mapper**.

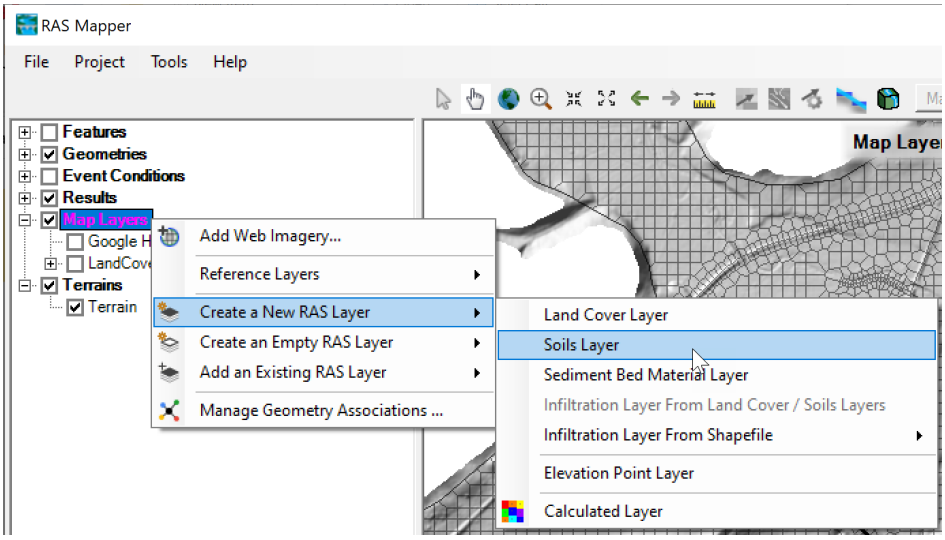
4 Infiltration

The SCS Curve Number method can be parameterized using a combination of both Land Cover and Hydrologic Soils data or only one of those datasets. In this workshop both the Land Cover and Hydrologic Soils data are utilized. First, a **Soils Layer** is created based on the USDA gSSURGO database (https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/geo/?cid=nrcs142p2_053628). Then, an **SCS Curve Number Infiltration Layer** is created based on both the **Soils Layer** and the **Land Cover** classification layers.

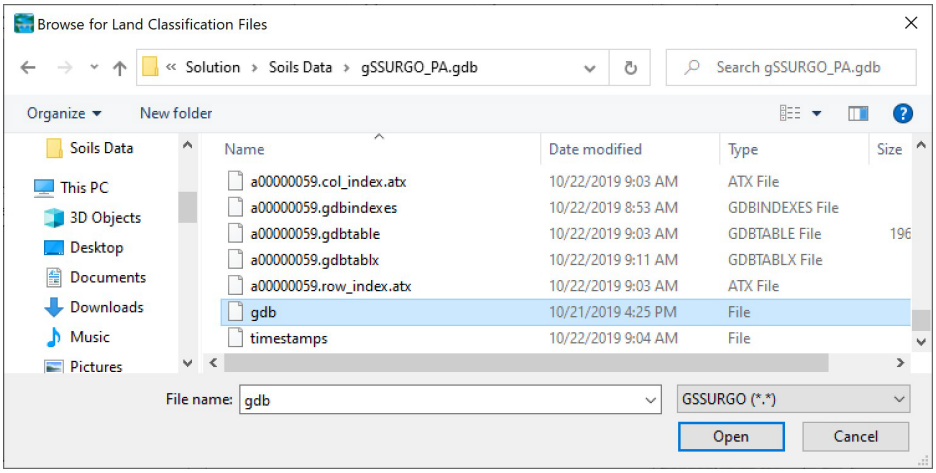
4.1 Soils Layer

This section covers how to create or load an existing Soils Layer in RAS Mapper.

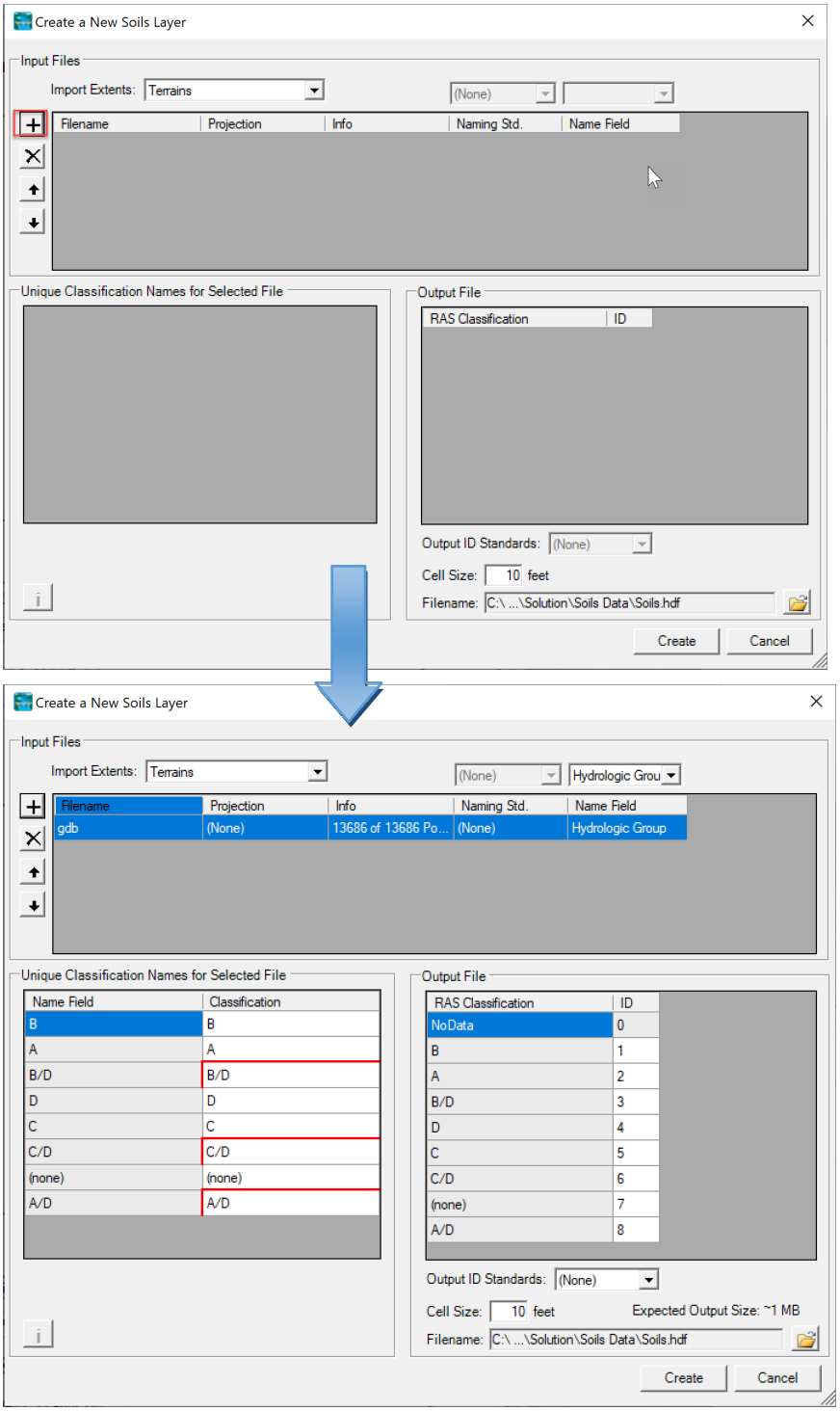
16. Create a **Soils Layer** by right-clicking on **Map Layers** and selecting **Create a New RAS Layer**.



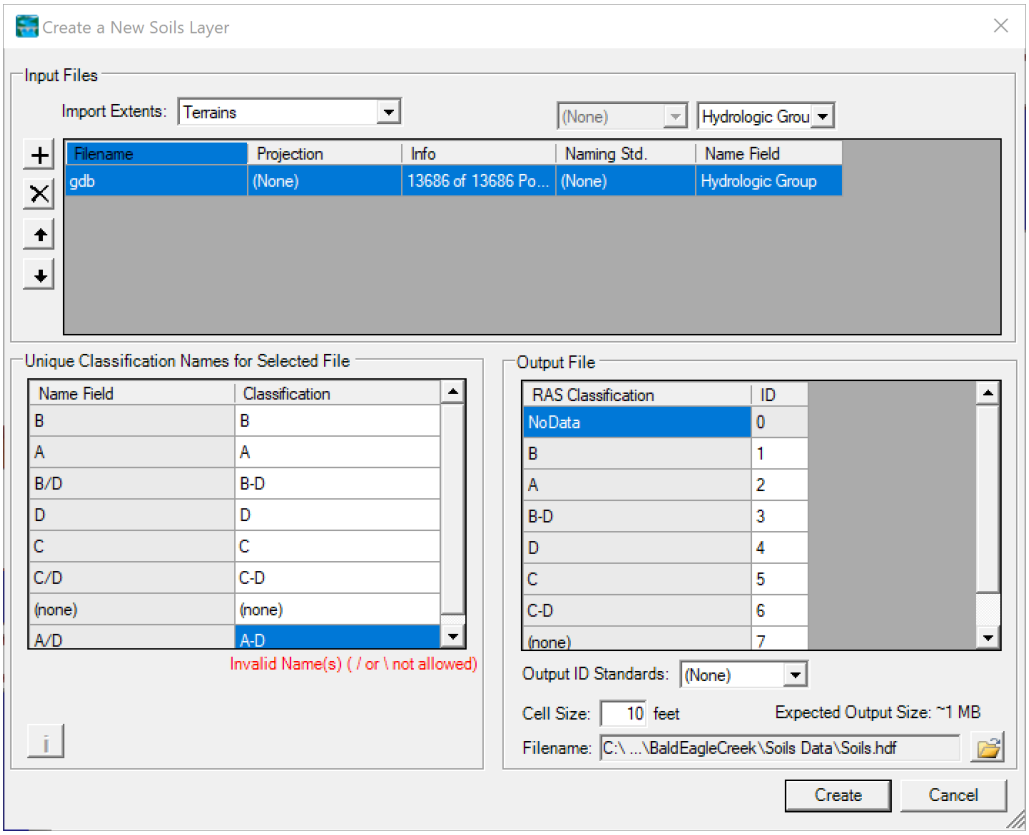
17. In the **Browse for Land Classification Files** window, select the GSSURGO folder called gSSURGO_PA.gdb in the Soils Data folder in the main project directory.



18. In the Create a **New Soils Layer** editor, click on the add button as shown in the figure below and select the file in the **Soils Data** folder in the main project directory.

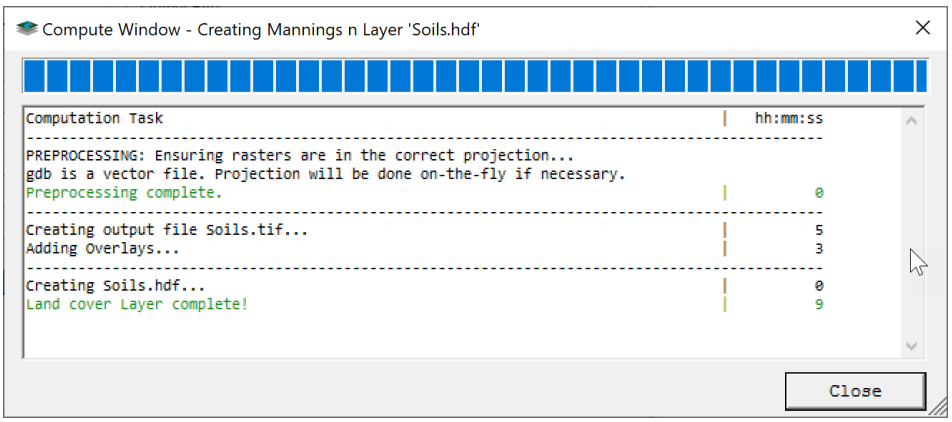


19. Replace "/" with "-" and "(none)" with "NoData" in the Classifications to dashes as shown in the figure below.

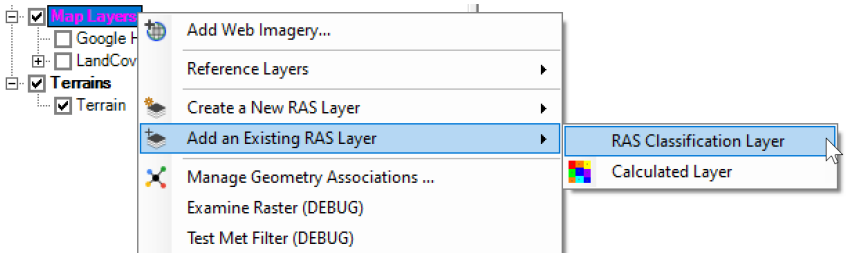


20. Click on the **Open Folder** icon and save the **Filename** as "Soils.hdf" in the **Soils Data** folder in the main project directory.

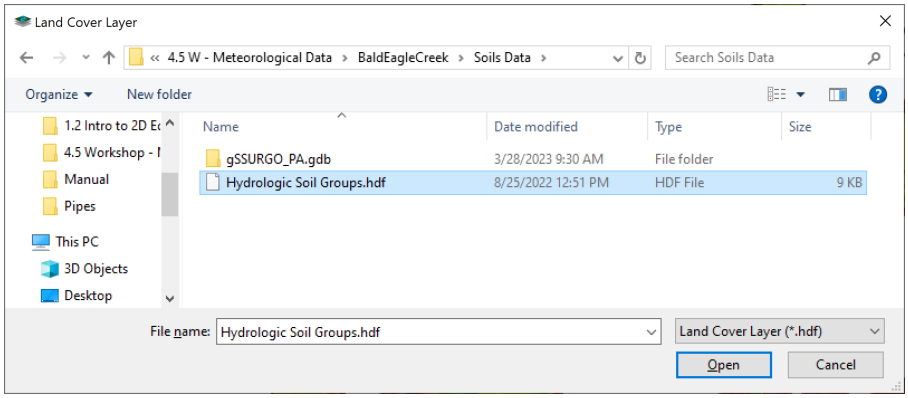
21. In the **Create a New Soils Layer** window shown above, click **Create** and then **Close** in the **Compute Window** below.



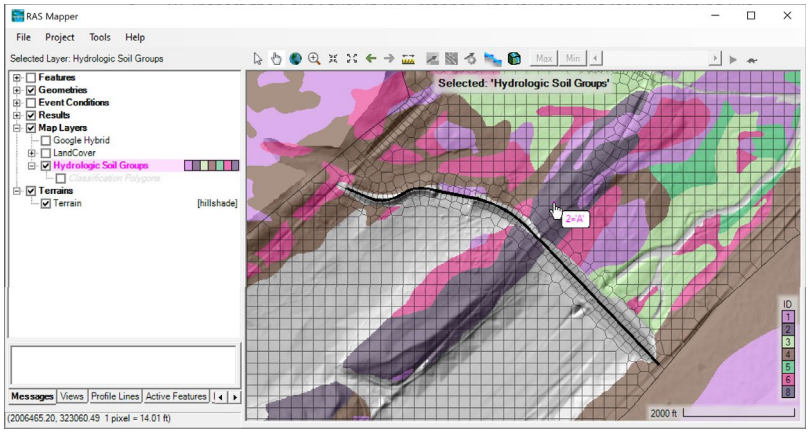
22. To demonstrate how to load an existing **Soils Layer** and to prevent any issues with the previously created **Soils Layer**, an existing **Soils Layer** is loaded and used in the workshop. First remove the Soils layer from RAS Mapper. To add an existing Soils Layer open **RAS Mapper**, right-click on the **Map Layers**, and select **Add Existing RAS Layer | RAS Classification Layer** as shown in the figure below.



23. Select the **Soils Data** layer called "Hydrologic Soil Groups.hdf" in the folder called "Soils Data" in the BaldEagleCreek folder as shown below and select **Open**.



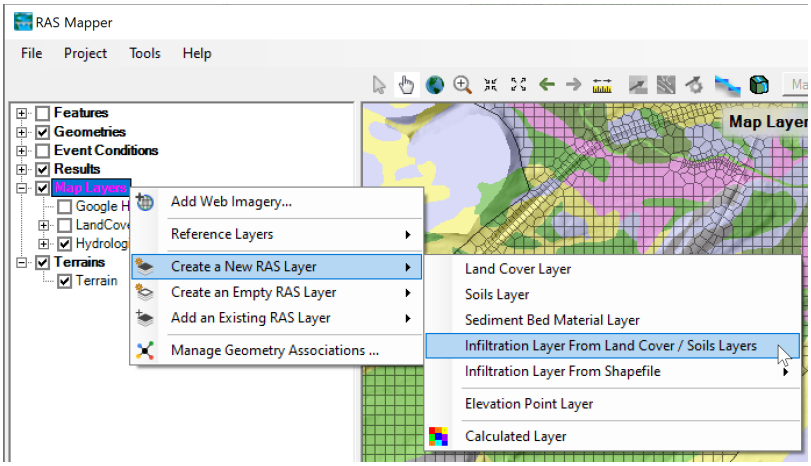
24. Inspect the **Soils Layer** in **RAS Mapper**. The layer should look something like the figure below.



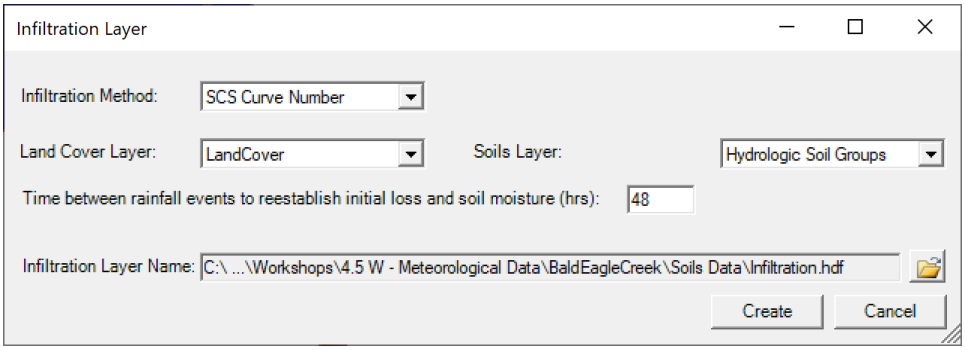
4.2 Infiltration Layer

This section describes how to create or add an existing infiltration layer. In order to avoid any issues with the created infiltration layer, the workshop will continue with a previously created infiltration layer.

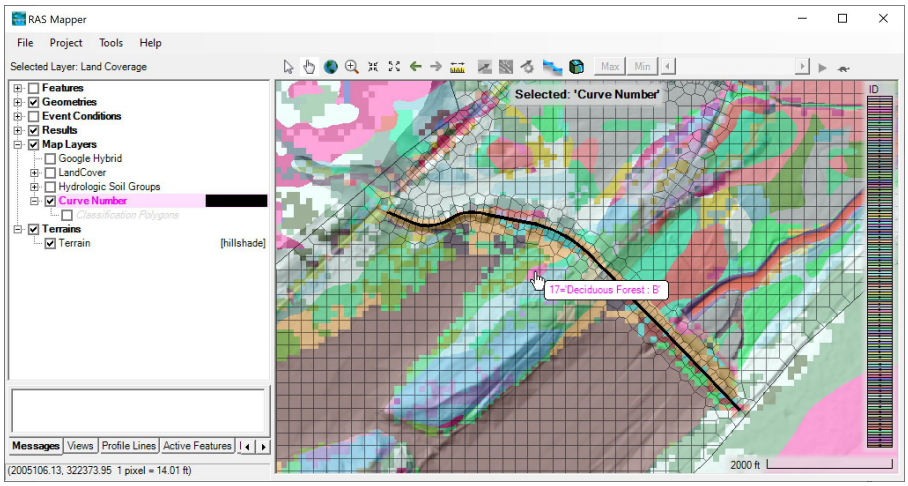
25. Create an **Infiltration Layer** by right-clicking on the **Map Layer** and selecting **Create a New RAS Layer** | **Infiltration Layer From Land Cover / Soils Layers** as shown in the figure below.



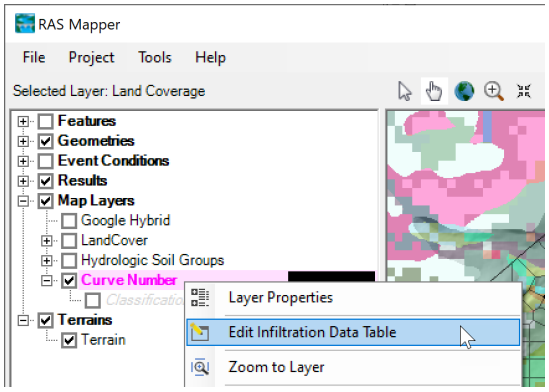
26. In the **Infiltration Layer** window, set the options as shown in the figure below and click **Create**. As mentioned previously, it is not necessary to utility both the **Land Cover** and **Soils Layers** for the **SCS Curve Number** method, but more accurate to do so.



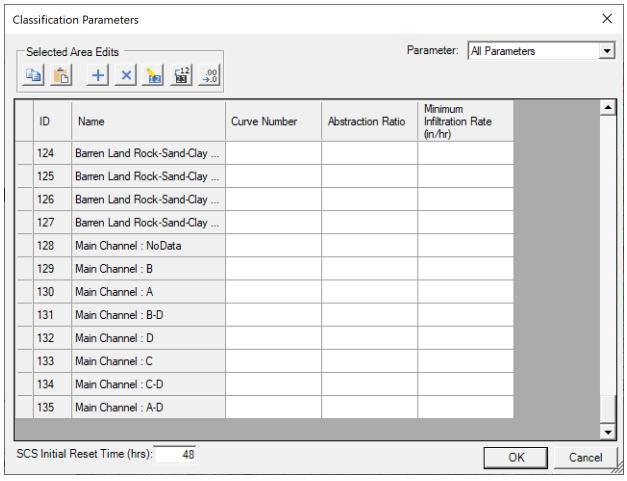
27. Inspect the Infiltration Layer in RAS Mapper. The layer should look something like the figure below.



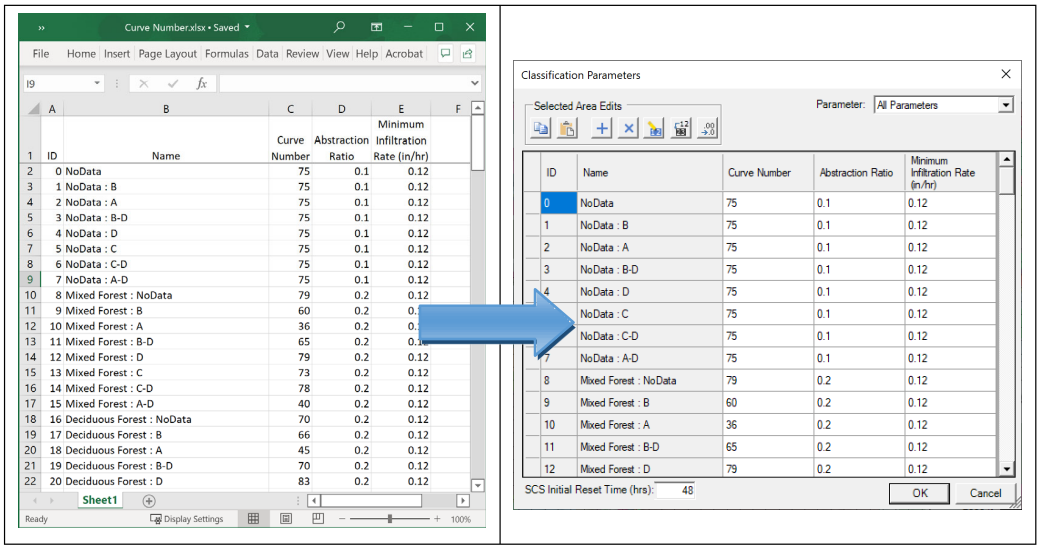
28. Right-click on the **SCS Curve Number Infiltration Layer** and select **Edit Infiltration Data Table**.



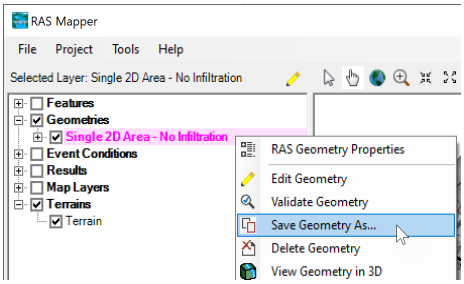
29. The **Classification Parameters** window will appear. The table contains all the land classifications which need to be assigned SCS Curve Number infiltration parameters.



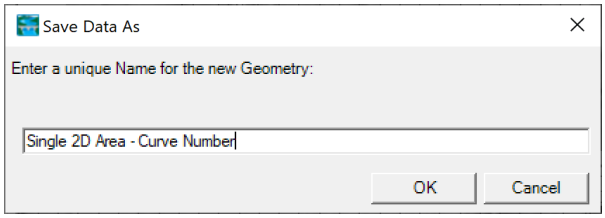
30. For the purposes of the workshop, an Excel spreadsheet has been provided with the SCS Curve Number parameters. Open the spreadsheet called "Curve Number.xlsx" located in the **Infiltration** folder of the main project directory and copy the values to the **Classification Parameters** window. Then Click **OK** to accept the values in the table.



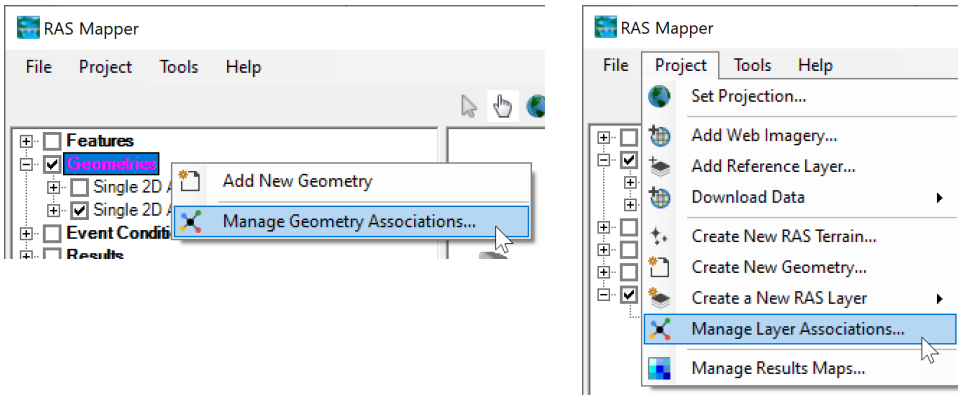
31. To demonstrate how to load an existing **Infiltration Layer** and to prevent any issues with the previously created **Infiltration Layer**, an existing **Infiltration Layer** is loaded and used in the workshop. First, open **RAS Mapper** and remove the previously created **Infiltration Layer**. Then right-click on the **Map layer** and select **Add Existing RAS Layer | RAS Classification Layer**. Select the **Infiltration Layer** called "Curve Number.pdf" located in the folder "Infiltration" folder and select **Open**.
32. To utilize the infiltration parameters, the **Infiltration Layer** needs to be "associated" with a geometry. Preserve the existing geometry without infiltration calculation, and create a new one by right-clicking on the geometry and selecting **Save Geometry As…**



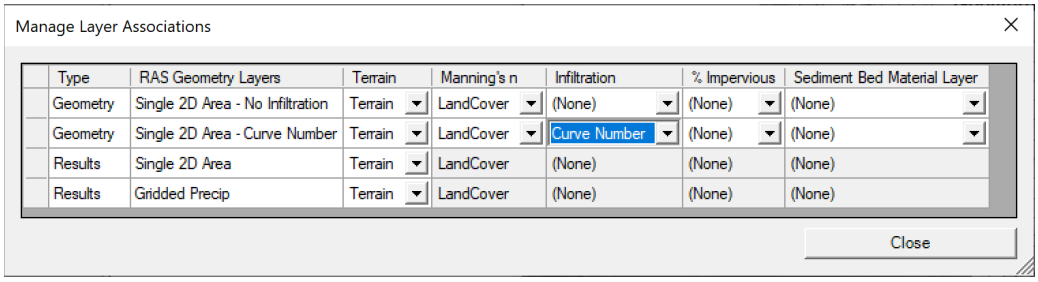
33. In the **Save Data As** window, save the new Geometry as "Single 2D Area – Curve Number".



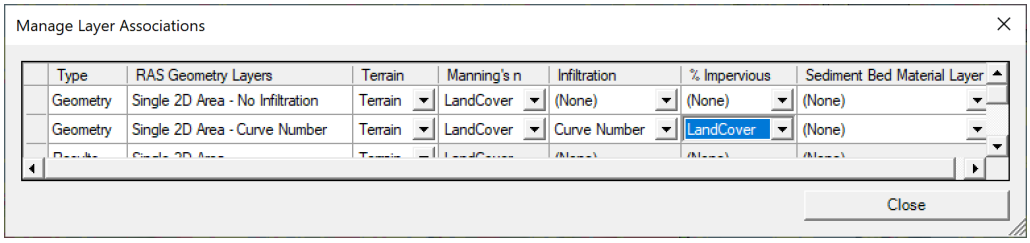
34. Right-click on the root **Geometry** node in **RAS Mapper** and select **Manage Geometry Associations** or go click on the menu **Project | Manage Layer Associations...** as shown below.



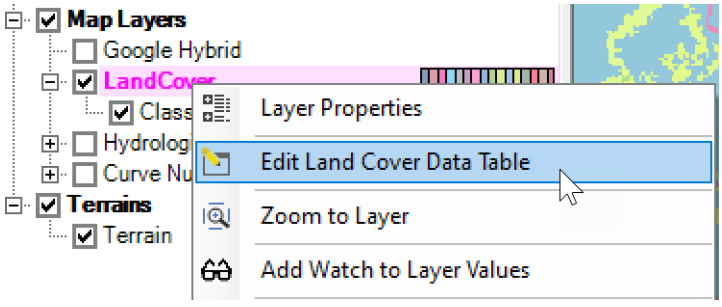
35. Set the **Infiltration** layer to **Curve Number** for the corresponding **Geometry** as shown in the figure below.



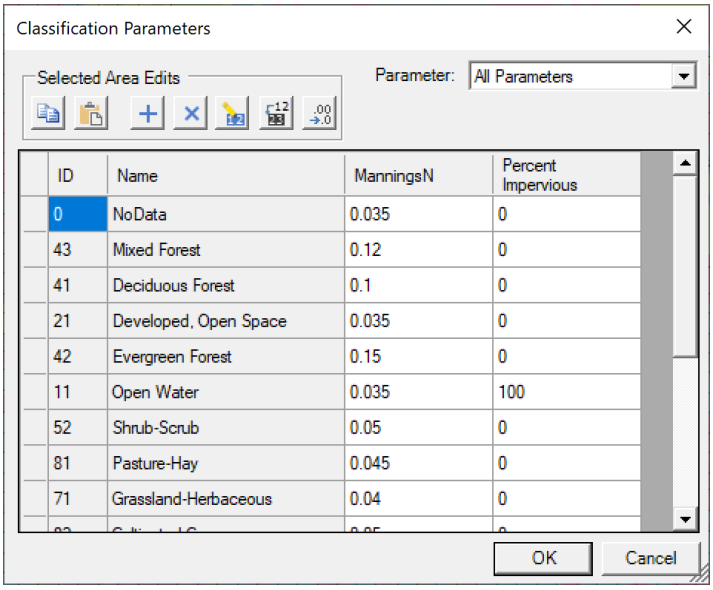
36. Set the **% Impervious Layer** to **Land Cover** for the corresponding Geometry as shown in the figure below and click **Close**.



37. Right-click on the **Land Cover** layer and select **Edit Land Cover Data Table**.

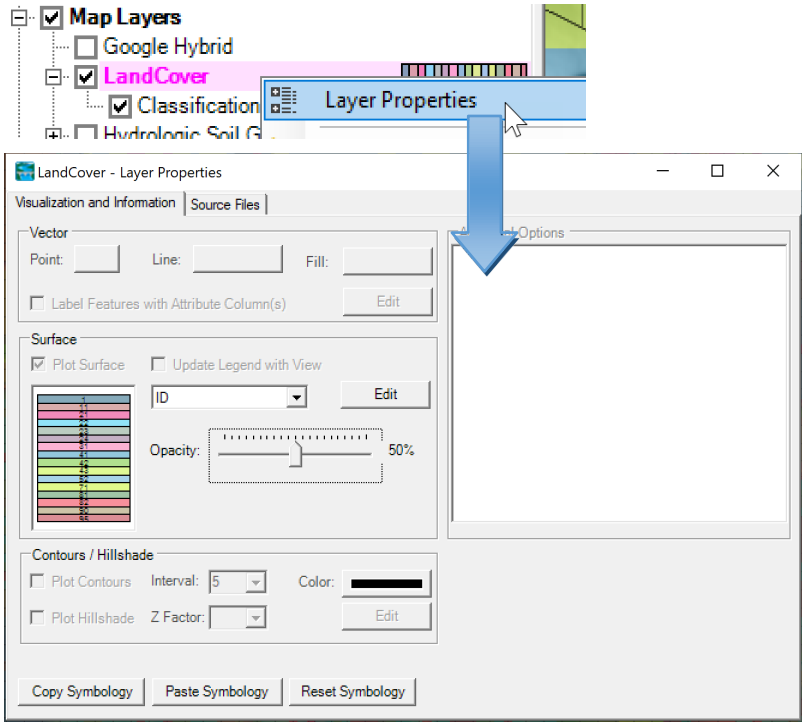


38. The **% Impervious** values have already been filled. Inspect the values.

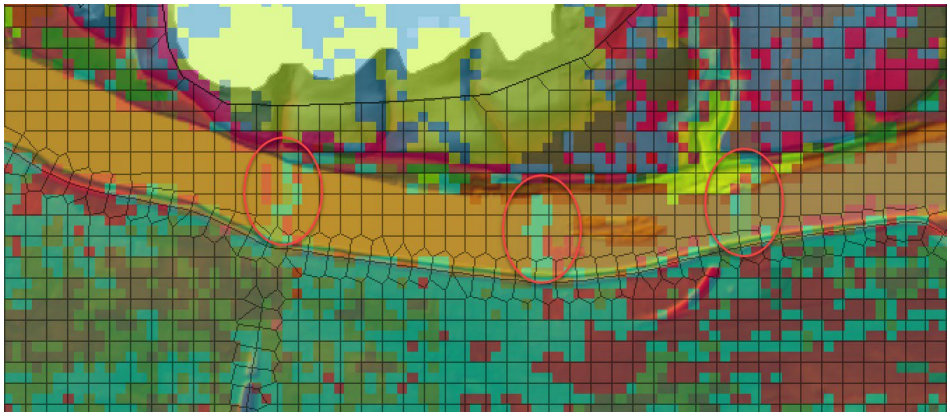


<u>Question</u>: Why are the impervious values set to 100 for open water?

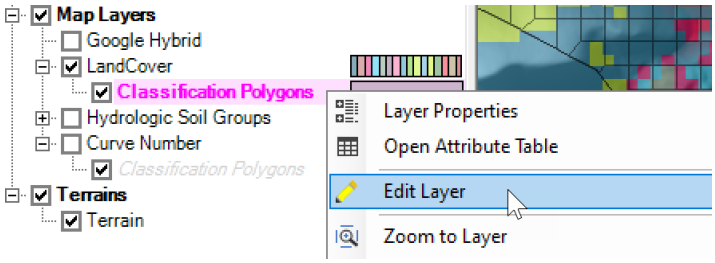
39. Inspect the **Land Cover** layer by setting the opacity/transparency to 50% and overlaying the layer the Terrain. Do this by right-clicking on the layer and selecting **Layer Properties**. Then close the Layer Properties window.



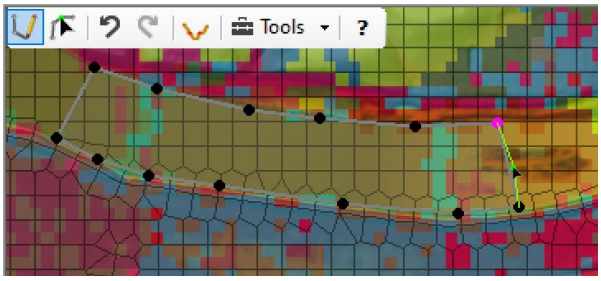
40. Find areas in the channels that do not correspond to Open Water (see examples in figure below).

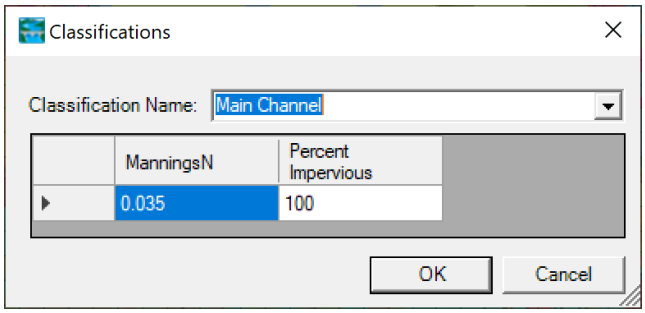


41. Practice fixing areas like this using **Classification Polygons**. Right-click on **Classification Polygons** and select **Edit Layer**. Then click on the **Add New Feature** tool  .

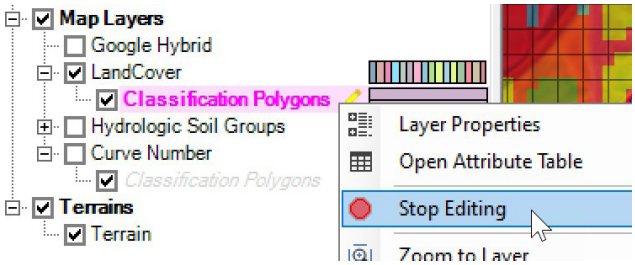


42. Draw polygons over the areas which need to corrected. After each polygon is drawn, an editor will appear to select the **Classification** for each polygon. Select the **Main Channel** classification and clock **OK**.

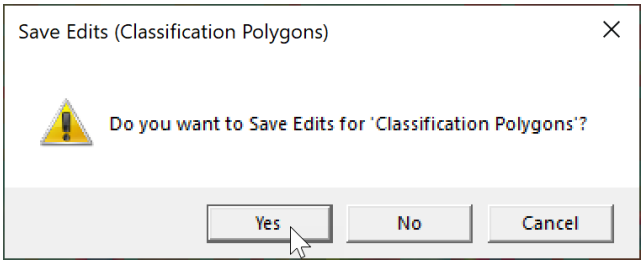




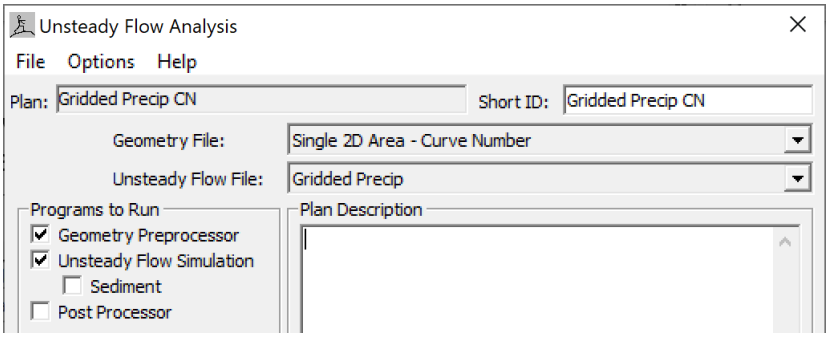
43. After creating a few polygons, right-click again on the **Classification Polygons** layer, and select **Stop Editing**.



44. The window below will appear. Click on **Yes** to save the edits.



45. Create a new plan called "Gridded Precip CN" with the new **Geometry** called "Single 2D Area – Curve Number" and run it.



46. Inspect the results and compare to the previous plans using profile and time-series plots in **RAS Mapper**.

<u>Questions</u>: How do the water level time-series compare between the three plans? Which water levels are higher and where the largest differences?

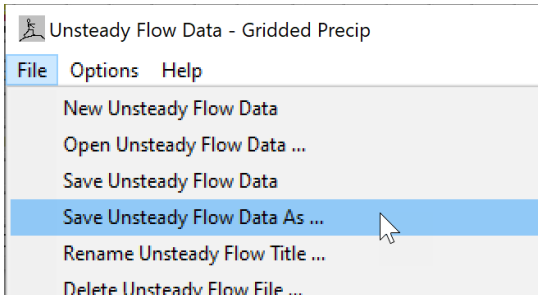
<u>Questions</u>: Why is there no infiltration in the channels?

<u>Questions</u>: Animate the Cumulative Infiltration Depth. Why does it reset to zero at some point during the simulation?

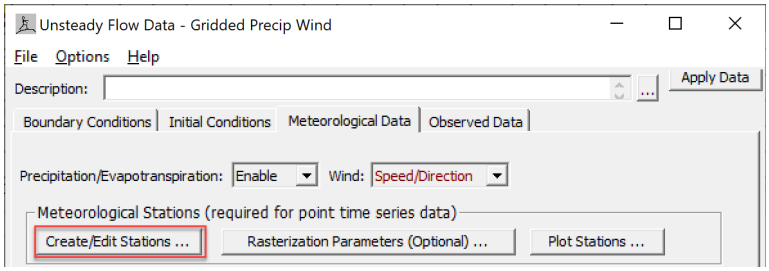
5 Potential Evapotranspiration

In this section, a time-series of potential evapotranspiration is added. The time-series is specified at a single meteorological station.

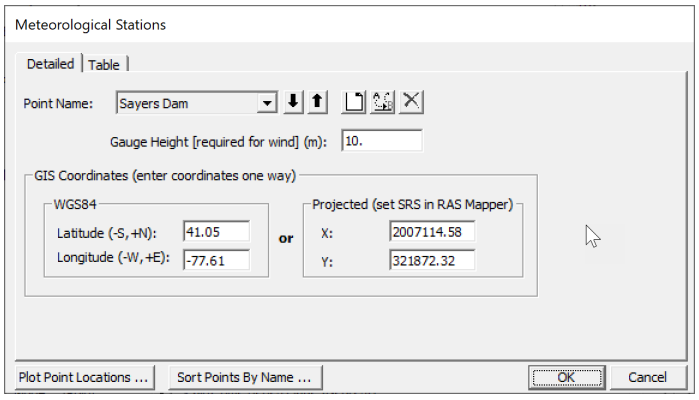
47. Create a new **Unsteady Flow Data** file called "Gridded Precip Evap".



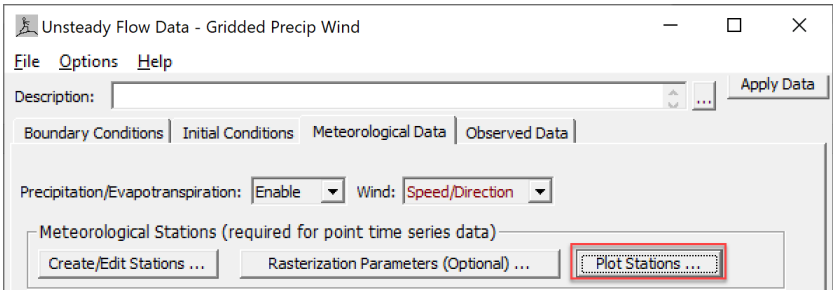
48. Next, create a **Meteorological Station**, by clicking on the button labeled **Create/Edit Stations...**

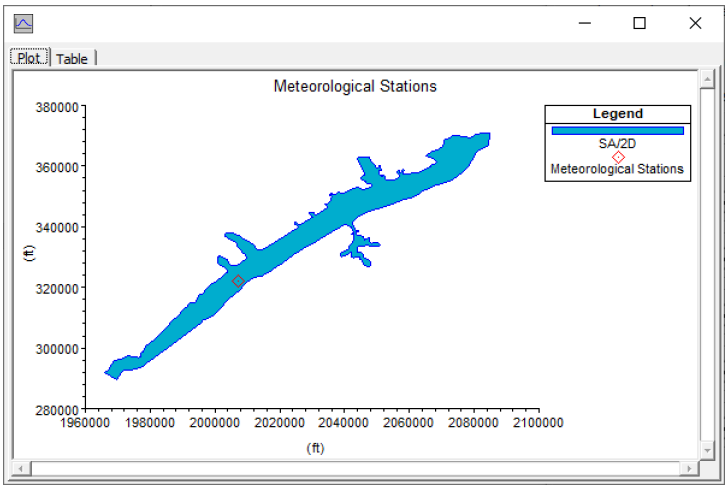


49. In the **Meteorological Stations** editor, click on the new button, call it Sayers Dam, and enter either the WGS84 or projected coordinates shown below.

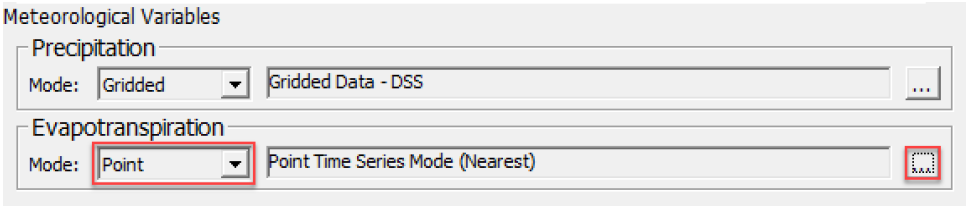


50. Click on the **Plot Stations** button.

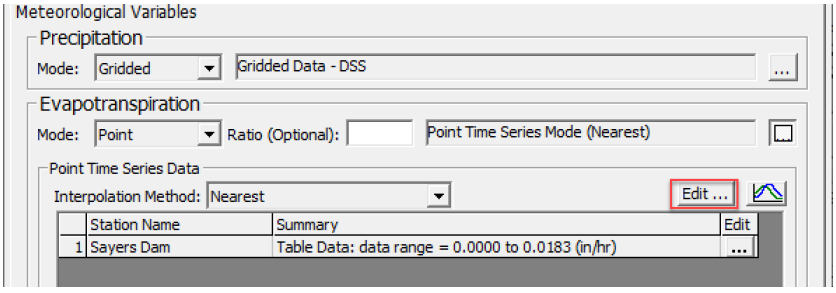




51. In the **Evapotranspiration** section, set the **Mode** is set to **Point**, and click on the … button to expand the section as shown below.

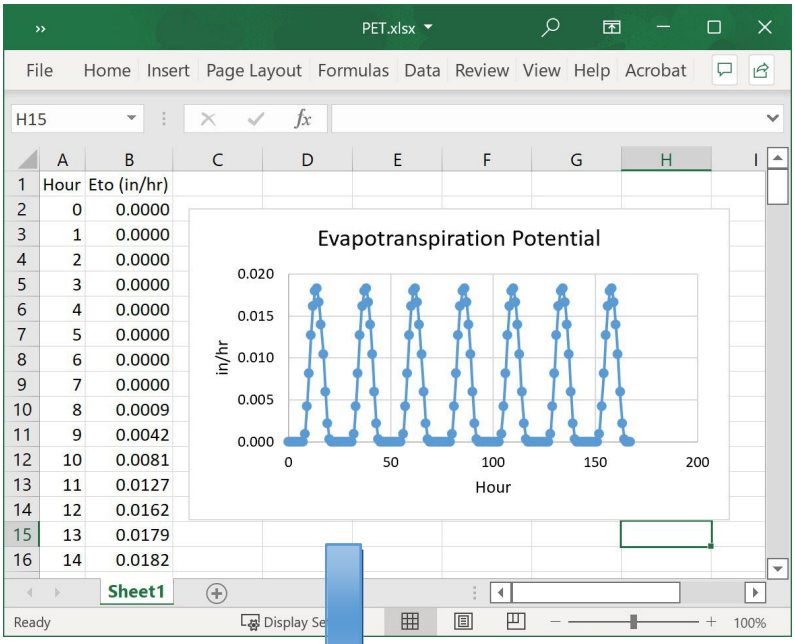


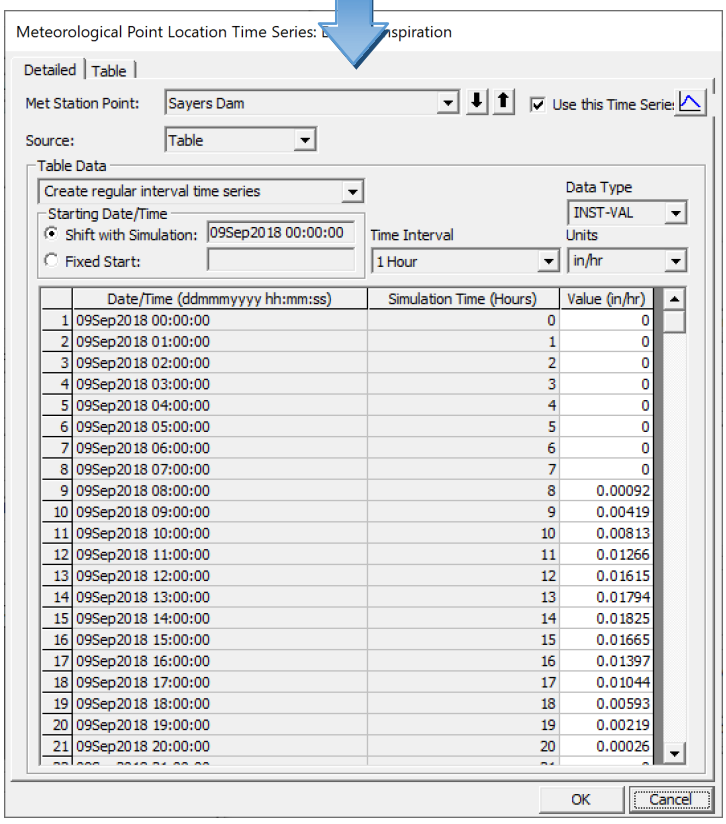
52. Click on the **Edit** button shown below.



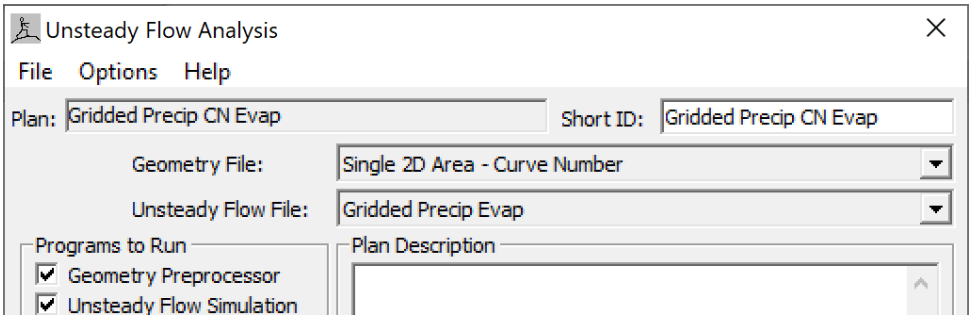
Notes: In Version 6.2, the time-series plots of Meterological Variables does not work. In addition the **Ratio** option does not work. Both of these issues have been fixed in Version 6.3.

53. In the **Meteorological Point Location Time Series** window, enter the hourly potential evapotranspiration data for **Sayers Dam** as shown in the figure below. The data has been provided in an Excel spreadsheet called "PET.xlsx" located in the **Potential Evapotranspiration** folder of the main project directory. Once all the data is entered click on the **OK** button.





54. Open the **Unsteady Flow Analysis** editor and create a new **Plan** called "Gridded Precip CN Evap".



55. **Save** the plan and run it.

56. Compare the results with the previous plans in **RAS Mapper**. Specifically, plot the **Cumulative Evapotranspiration Depth** at various points.

    Questions: How do the water level time-series compare between the plans with and without evapotranspiration?