WATERSHED DELINEATION

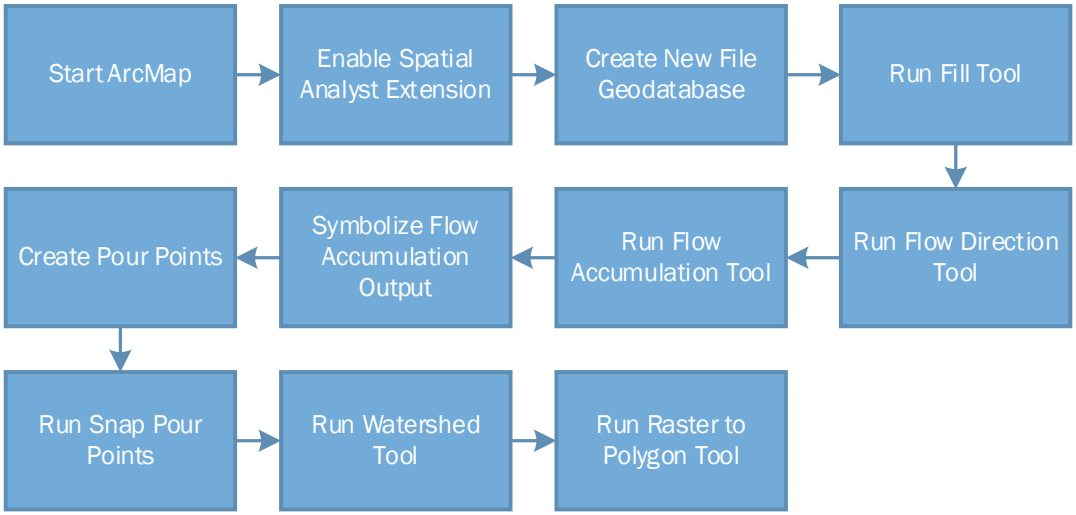
SUMMARY

A watershed, also known as basin or catchment, is an upslope area that contributes water flow to a common outlet. This area can be delineated from a digital elevation model (DEM) using the ArcGIS Hydrology toolset from the Spatial Analyst toolbox.

This guide assumes that you have basic working knowledge of ArcMap and have obtained the required data, which includes a digital elevation model (DEM) and stream network file for your area of interest.

PROCEDURE OVERVIEW

The flow chart below illustrates the sequence of actions and tools to execute to delineate watersheds. The chart does not include inputs and outputs.



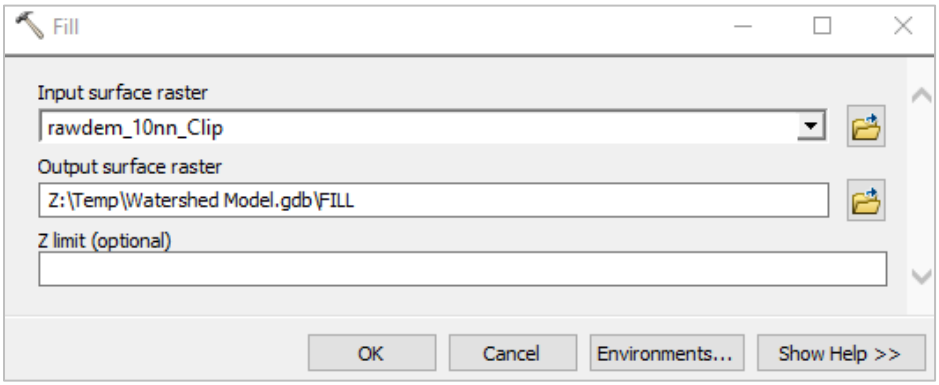
PROCEDURE

1. Setup Work Environment.
   A. Open ArcMap.
   B. Navigate to Customize (main ribbon) > Extensions > select Spatial Analyst to enable extension.
   C. Select Add Data.
   D. Navigate to the folder where you wish to save results.
   E. Select New File Geodatabase (GDB). Give the new GDB an appropriate name.
   F. Within the Add Data window, navigate to DEM and add to map document.

2. Run the Fill tool.

   Fills in sinks of a raster to remove small imperfections in the data. A sink is a cell with an undefined drainage direction; no cells surrounding it are lower.

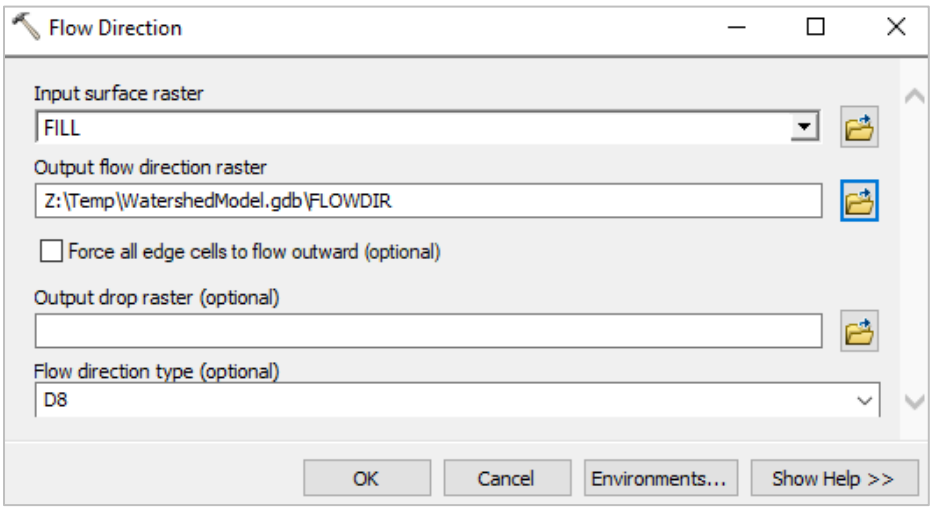
   A. Navigate to Fill tool.
   B. Use the DEM as the 'Input surface raster'.
   C. Verify the path name for the 'Output surface raster'.
   D. Click OK.



3. Run the Flow Direction tool.

   The Flow Direction tool determines the direction of flow from each cell to its steepest downslope neighbor.

   A. Navigate to Flow Direction tool.
   B. Use the DEM output from Step 2 as the 'Input surface raster'.
   C. Verify the path name for the 'Output flow direction raster'.
   D. Click OK.

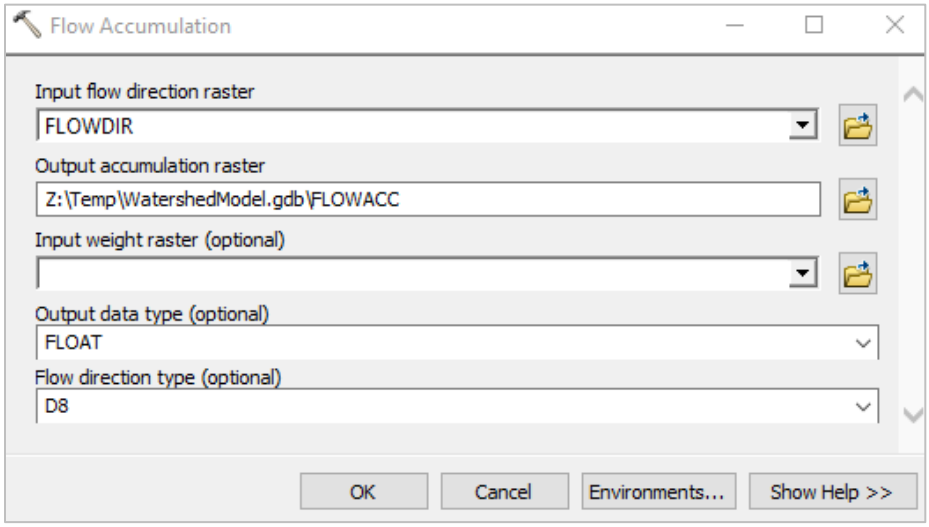


   When the tool has finished, the new flow direction grid will be added to the map document.

4. Run the Flow Accumulation tool.

   The Flow Accumulation tool calculates the accumulated flow to each cell, as determined by the accumulated weight of all cells that flow into each downslope cell.

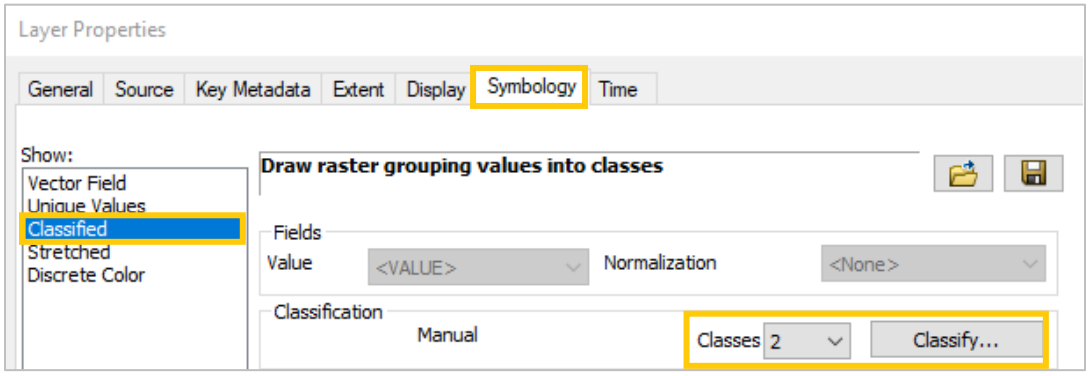
   A. Navigate to Flow Accumulation tool.
   B. Use the output raster from Step 3 as the 'Input flow direction raster'.
   C. Verify the path name for the 'Output accumulation raster'.
   D. Click OK.



   The new flow accumulation raster will be added to your map document.

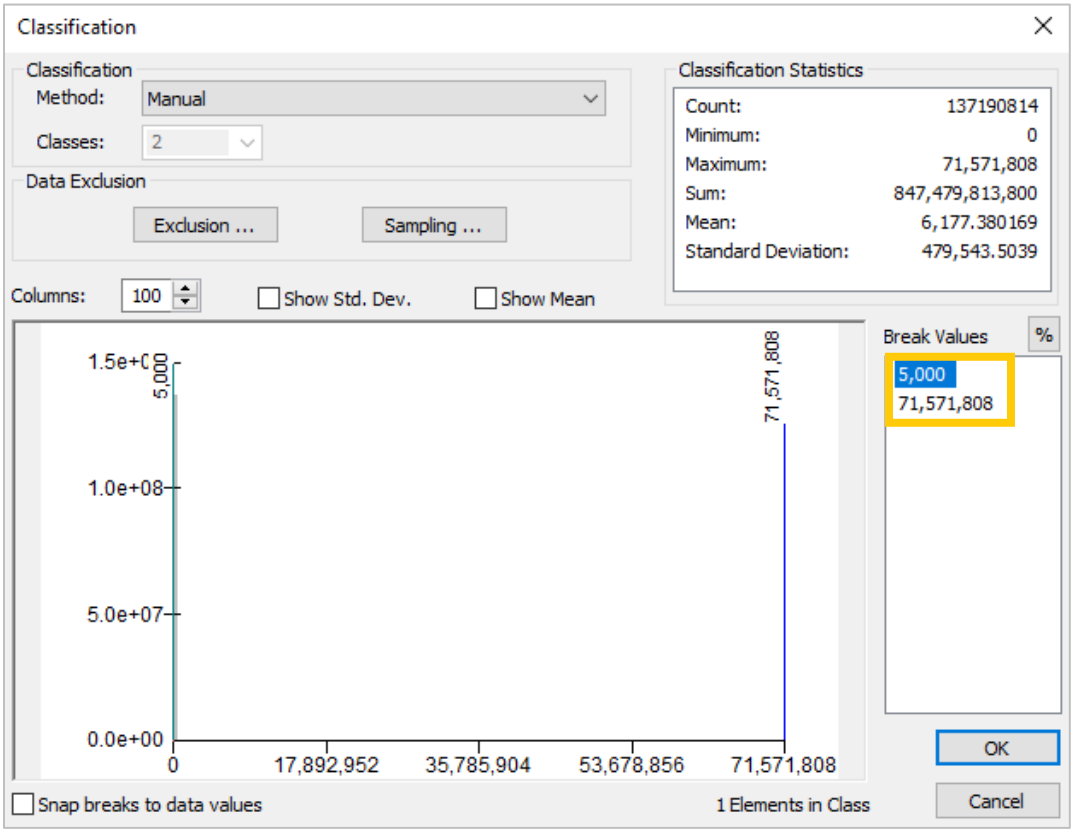
5. Symbolize the Flow Accumulation Output.

   A. Right-click the Flow Accumulation raster > select Properties.
   B. In the Layer Properties window, select Symbology > select Classified. Set the number of classes to 2 and select Classify.

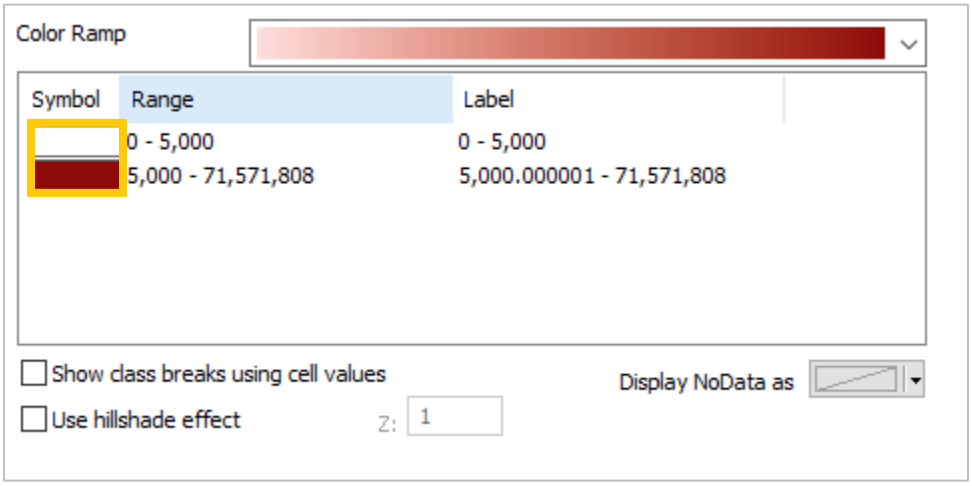


   C. Set the first break value to a threshold number that will assist with delineating channels. This value will be based on your data, and is really up to the analyst.

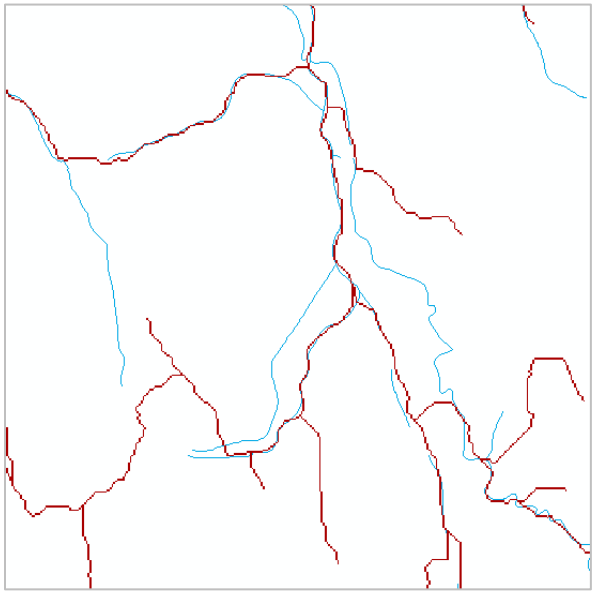
For this example we have used 5000 as a threshold, which means that cells that have less than 5000 upstream cells flowing into them will be symbolized differently than cells with more than 5000 upstream cells. Leave the second value as the maximum value in the grid. Click OK.



D. Within the Symbology Properties window, change the symbology by double-clicking the colour swatches under Symbol. Select No color for the first class (0-5000) and a red colour for the second class (5000+). Click OK to apply the changes and close the window.



E. Add the stream network layer to the map document to visually compare the flow accumulation data with the actual stream network. Note that the two data sets will not line up perfectly, but the flow accumulation grid should correspond closely with the watercourse data as shown below.

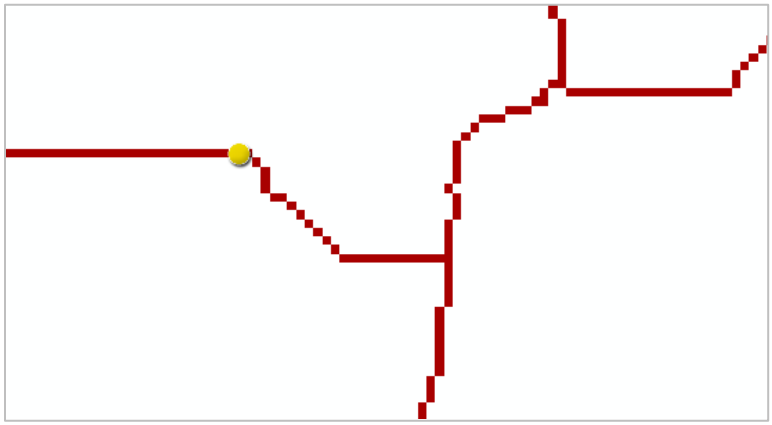


6. Create Pour Points (through visual inspection).

Pour points are points at which water flows out of an area, usually the outlet or re-entrant locations from the flow accumulation.

A. Create a new point feature class in your working directory/GDB.
B. Give the file an appropriate name and apply the appropriate coordinate system for your data.
C. Add the new point layer to the map document.
D. Add point(s), centre of cell, by starting an editing session (Editor > Start Editing).

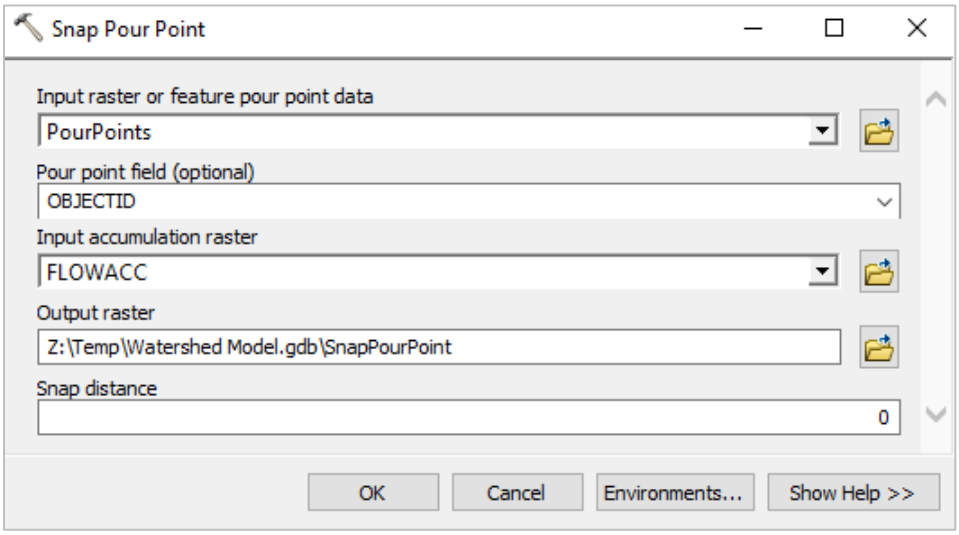
The chosen pour point must be on the high flow accumulation path, and should be a natural outlet for the upstream cells. Your choice essentially determines the 'end' of your catchment area; everything upstream from the point that you create will define a single watershed.



E. Save your edits and stop the editing session.

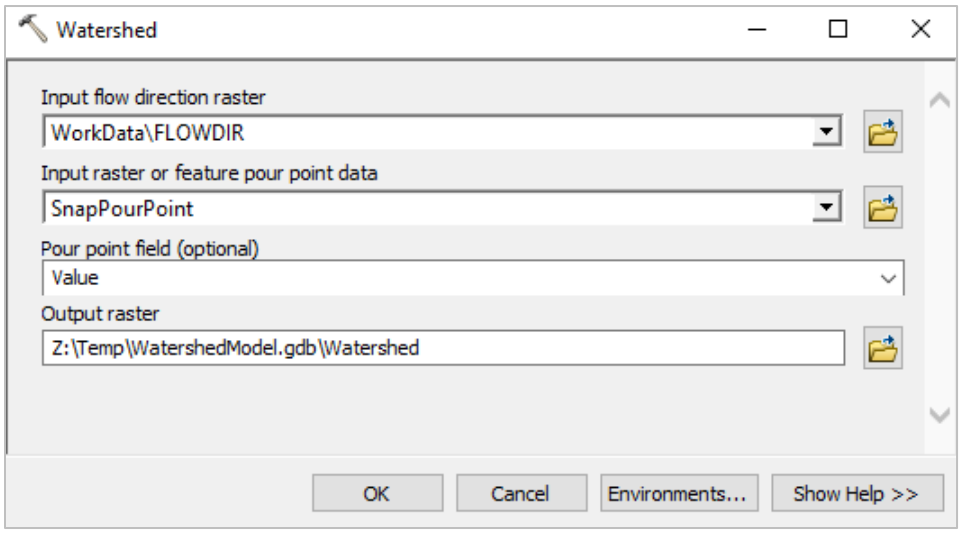
7. Run the Snap Pour Point tool to snap the pour points to cells of high accumulated flow.

   A. Navigate to Snap Pour Points tool.
   B. Either input a point feature class or a raster as the 'Input raster or feature pour point data'.
   C. Use the output raster from Step 4 as the 'Input accumulation raster'.
   D. Verify the path name for the 'Output raster'.
   E. Click OK.



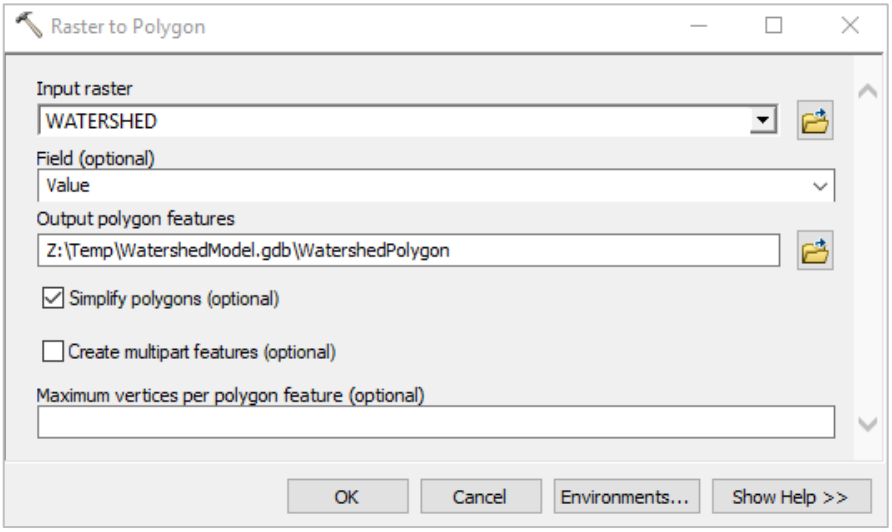
8. Run the Watershed tool.

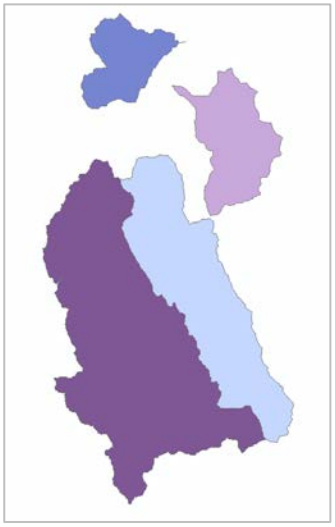
   A. Navigate to Watershed tool.
   B. Use the output raster from Step 2 as the 'Input flow direction raster'.
   C. Use the output from Step 7 as the 'Input raster or feature pour point data'.
   D. Verify the path name for the 'Output raster'.
   E. Click OK.



9. Run the 'Raster to Polygon' tool to create polygon features from the watershed raster.

   A. Navigate to Raster to Polygon tool.
   B. Use the output from Step 8 as the 'Input raster'.
   C. Verify the path name for the 'Output polygon features'.
   D. Click OK.





RELATED INFORMATION

- ArcGIS Help: How Fill works
- ArcGIS Help: How Flow Direction works
- ArcGIS Help: How Flow Accumulation works
- ArcGIS Help: Snap Pour Point (Spatial Analyst)
- ArcGIS Help: How Watershed works
- ArcGIS Help: An overview of the Hydrology toolset
- FAQ: What is the difference between the Basin and Watershed tools from the Spatial Analyst toolbox?
- ArcGIS Help: How To: Create a watershed model using the Hydrology toolset
- Trent University: Watershed Delineation with ArcGIS 10.2.x