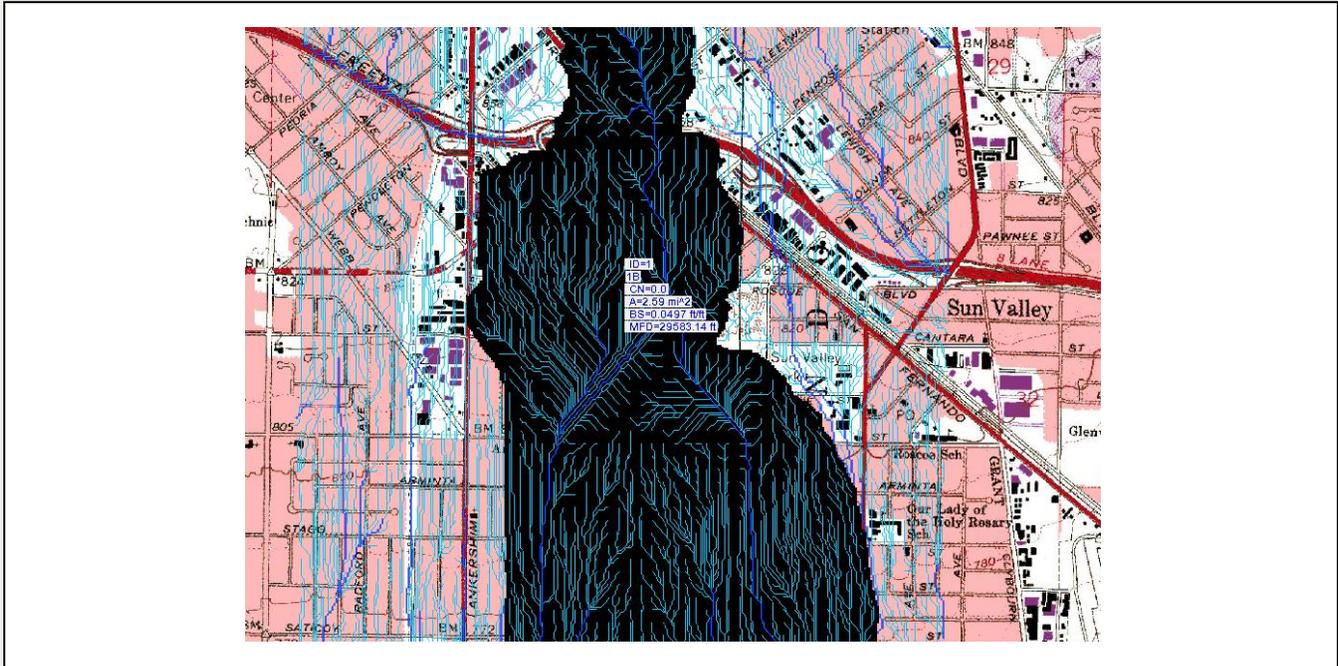




WMS 11.4 Tutorial

DEM Delineation – Stream Arcs

Model man-made and natural drainage arcs



Objectives

Learn to manipulate the default watershed boundaries by assigning map features such as road embankments, gutters, and known watershed boundaries to watershed delineations.

Prerequisite Tutorials

- DEM Delineation

Required Components

- Data
- Drainage
- Map

Time

- 15–20 minutes

1	Introduction	2
2	Getting Started	2
3	Running TOPAZ	3
4	Basin Delineation.....	4
5	Displaying Flow Directions.....	5
6	Adding Stream Arcs along Railroad	6
7	Basin Delineation with the New Stream	7
8	Conclusion	9

1 Introduction

Some terrain features are not well represented in DEMs, especially if the DEM resolution is coarse. This can lead to erroneous automated watershed delineation. In addition, it may be desirable to evaluate future alterations in terrain that result from development scenarios. WMS has tools for manipulating DEM delineation results in order to accurately represent the actual watershed drainage basins.

Sometimes it is necessary to add stream arcs to a basin to represent water that accumulates along, in, or behind man-made objects such as roads, canals, dams, dikes, or levees. These often disrupt the natural flow of watersheds, acting as a barrier that collects water, creating a man-made stream or collection pond. The water collected in these locations needs to be added into the watershed in order to properly model the hydrology. Stream arcs can be used to edit flow directions associated with the DEM, routing water into the proper drainage basins.

This tutorial teaches how to manipulate DEM data for more accurate drainage analysis by discussing and demonstrating how to use stream arcs to manipulate basin delineation.

2 Getting Started

Starting WMS new at the beginning of each tutorial is recommended. This resets the data, display options, and other WMS settings to their defaults. To do this:

1. If necessary, launch WMS.
2. If WMS is already running, press the **Ctrl-N** key combination or from the *Menu* bar, select the *File | New* menu item to ensure that the program settings are restored to their default state.
3. A dialog may appear asking to save changes. Click the **Don't Save** button to clear all data.

The Graphics Window of WMS should refresh to show an empty space.

Next, open the starting project file containing a DEM data file and background image. Complete this by doing the following:

4. Click the **Open**  macro to bring up the *Open* dialog.
5. Browse to the *demdel-stream-arcs\demdel-stream-arcs* directory.
6. Select the "start.wms" file.
7. Click the **Open** button to exit the *Open* dialog and import the project.

The Graphics Window should appear similar to Figure 1.

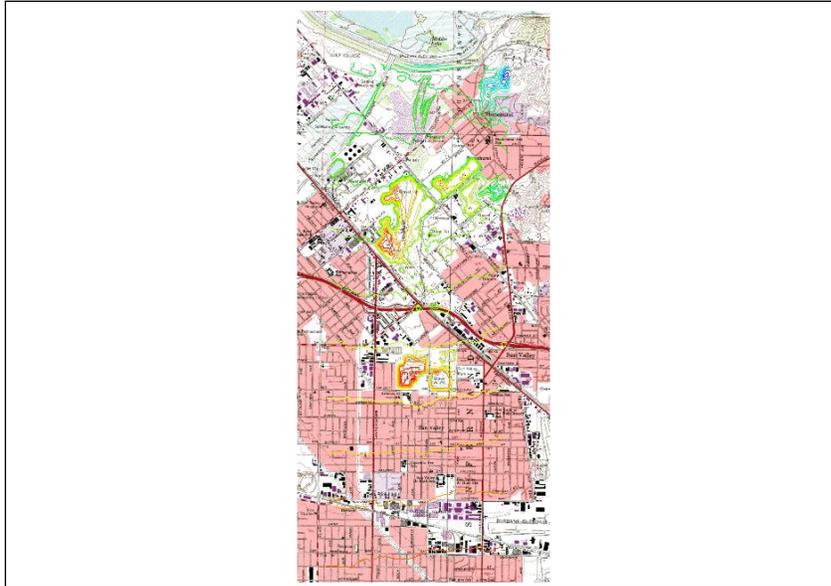


Figure 1: With topo map background

3 Running TOPAZ

Run TOPAZ to compute flow direction and accumulation grids.

1. From the *Modules* bar, switch to the **Drainage**  module.
2. From the *Menu* bar, click on the **DEM | Compute Flow Direction/Accumulation...** menu item to bring up the *Flow Direction/Accumulation Run Options* dialog.
3. Click the **OK** button to accept the defaults, close the *Flow Direction/Accumulation Run Options* dialog and open the *Units* dialog.
4. In the *Parameter units* section, from the *Basin Areas* drop-down, select “Square miles”.
5. Click the **OK** button to close the *Units* dialog and open the *Model Wrapper* dialog.
6. Once TOPAZ finishes running, turn on the *Read solution on exit* checkbox and click the **Close** button to exit the *Model Wrapper* dialog.
7. In the *Project Explorer*, right-click on the “ 86666671 (Converted)” terrain data coverage and select the **Display Options...** context menu item to bring up the *Display Options* dialog.
8. From the list on the left, select “DEM Data”.
9. On the *DEM* tab on the right, as the *Minimum Accumulation For Display*, enter “0.04”.
10. Click the **OK** button to close the *Display Options* dialog.

4 Basin Delineation

Define a watershed basin.

1. From the *Static* tool bar, using the **Zoom**  tool, zoom into the area near the bottom of the project as indicated in Figure 2.



Figure 2: Zoom area

2. From the *Modules* bar, switch to the **Drainage**  module.
3. From the *Dynamic* tool bar, using the **Create outlet point**  tool, click anywhere on the DEM to create an outlet.
4. If a message appears stating that the outlet is not located in a flow accumulation cell, click the **OK** button.
5. In the *Properties* window on the right side of the *Graphics Window*, for *Feature Point X*, enter “373777.7” and for *Feature Point Y*, enter “3784742.5”.

This moves the outlet location to the new coordinates near the lower right of the area selected in step 1.

6. From the *Menu* bar, select the **DEM | Delineate Basins Wizard** menu item to bring up the *Stream Feature Arc Options* dialog.
7. To accept the defaults, close the *Stream Feature Arc Options* dialog and bring up the *Units* dialog, click the **OK** button.

This runs the WMS menu commands **DEM → Stream Arcs..., Define Basins, Basins → Polygons**, and **Compute Basin Data**.

8. Click the **OK** button to close the *Units* dialog.
9. From the *Macro* bar, click the **Display Options**  macro to bring up the *Display Options* dialog.
10. From the list on the left, select the “DEM Data” item.
11. On the *DEM* tab on the right, turn off the *Fill Basin Boundary Only* checkbox.
12. From the list on the left, select the “Map Data” item.
13. On the *Map* tab, in the spreadsheet, on the *Color Fill Polygons* row, click the **Drainage Basin Display Options** button to bring up the *Drainage Basin Display Options* dialog.

14. Under *Pattern* on the right, click the  *Color Picker* button, select “Lime” from the list of colors.
15. Click the **OK** button to close the *Drainage Basin Display Options* dialog and return to the *Display Options* dialog.
16. From the list on the left, select the “Drainage Data” item.
17. On the *Drainage Data* tab on the right, turn on the *Basin Names*, *Show Units*, *Basin Areas*, *Basin Slopes*, and *Max Flow Distance* checkboxes.
18. Click the **OK** button to close the *Display Options* dialog.

The DEM cells assigned to the delineated drainage basin are now color-filled and should appear similar to Figure 3.

The results do not quite look like what might be expected in an urban area. Even though the drainage basin was delineated using ~10 meter elevation data, there are still many features of the urban terrain that are not well represented in the DEM data. One example is the railroad running diagonally across the lower portion of Figure 3 along which the outlet point is located.

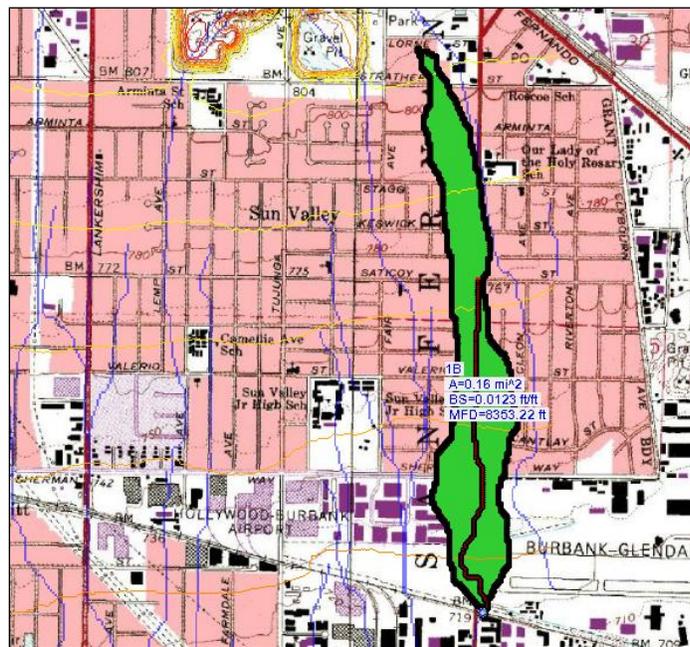


Figure 3: Initial delineation results

5 Displaying Flow Directions

The DEM flow directions will show water flowing right across the railroad tracks instead of collecting along the tracks.

1. Click the **Display Options**  macro to bring up the *Display Options* dialog.
2. From the list on the left, select “DEM Data”.
3. On the *DEM* tab, for the *Point Display Step*, enter “5”.
4. Turn on the *Flow Direction* and *Points* checkboxes.
5. Click the **OK** button to close the *Display Options* dialog.

Notice that flow direction arrows for DEM points are visible. Because the display of flow directions is adaptive, not every DEM point has a flow direction arrow visible. More flow directions are displayed when zooming in and fewer flow directions are visible when zooming out.

6. From the *Static* tool bar, use the **Zoom**  tool to zoom in along the railroad tracks until the DEM flow directions for each DEM point are visible.

Notice that flow goes right over the railroad tracks.

7. Select the *Display* | **Display Options...** menu item to bring up the *Display Options* dialog.
8. From the list on the left, select “DEM Data”.
9. On the *DEM* tab, turn off *Flow Direction* and *Points*.
10. Click the **OK** button to close the *Display Options* dialog.
11. In the *Project Explorer*, right-click on the “ Drainage” map data coverage and select the **Zoom To Layer** context menu item.

6 Adding Stream Arcs along Railroad

In WMS, a stream arc can be used to conceptually model runoff collecting along the railroad tracks.

1. Using the **Zoom**  static tool, zoom into the outlet point for the delineated drainage basin.
2. Switch to the **Map**  module.
3. Select the **Create Feature Arc**  dynamic tool.
4. Select the *Feature Objects* | **Attributes...** menu item to bring up the *Feature Arc Type* dialog.
5. In the *Type* section, select the *Stream* radio button
6. Click the **OK** button to close the *Feature Arc Type* dialog.
7. Using Figure 4 as a guide, begin a new stream arc attached to the existing stream arc by clicking on the vertex just upstream of the outlet point.

Click far enough away from the outlet point that WMS does not snap to the outlet point.



Figure 4: Start point for the railroad stream arc

8. Using Figure 5 as a guide, create the arc along the railroad, double-clicking to end the arc at the location shown by the blue arrow (the orange arrow indicates where the arc started, just to the right of the outlet point).

Use the scroll wheel button on the mouse to zoom and pan while creating the arc.



Figure 5: Start (orange) and end (blue) points of the railroad stream

7 Basin Delineation with the New Stream

When the basin is defined, WMS will change flow directions for DEM cells under the stream arc so that they are aligned with the stream arc. The basin definition will then include all areas which have flow paths intercepted by the stream arc.

The **DEM → Stream Arcs...** and **Delineate Basins Wizard** menu commands for delineating drainage basins should not generally be used once the automated delineation results are manually manipulated—in this case, by adding a stream arc to collect runoff along the railroad tracks. This is because WMS will delete all existing feature data except for outlet points when these tasks are performed, removing the stream arcs added for manual manipulation as well. Instead, use the **Define Basins** and **Basins → Polygons** commands to update the delineation.

1. Switch to the **Drainage**  module.
2. Select the **DEM | Define Basins** menu item.

Notice that the basin area has expanded significantly.

3. Select the **DEM | Basins → Polygons** menu item.

Notice that the polygon boundary has shifted to encompass the expanded area of the drainage basin (Figure 6).

4. Select the *DEM* | **Compute Basin Data** menu item to bring up the *Units* dialog.
5. Click the **OK** button to accept the defaults and close the *Units* dialog.
6. In the *Project Explorer*, right-click on the “ Drainage” map data coverage and select the **Zoom To Layer** context menu item.

The drainage basin data has been recalculated (Figure 6).



Figure 6: New drainage basin area with basin data

7. In the *Project Explorer*, right-click on the “ 86666671 (Converted)” terrain data coverage and select the **Display Options...** context menu item to bring up the *Display Options* dialog.
8. From the list on the left, select the “DEM Data” item.
9. On the *DEM* tab on the right, turn on the *Flow Direction* and *Points* and turn off the *Stream*, *Flow Accumulation*, and *Color Fill Drainage Basins* checkboxes.
10. Click the **OK** button to close the *Display Options* dialog.
11. **Zoom**  into the stream arc along the railroad track until flow directions for each DEM point are visible.

Notice that the flow directions are now aligned with the stream arc so that flow no longer crosses the railroad tracks. When zoomed out to the extents of the project, the Graphics Window should appear similar to Figure 7.

12. Right-click on the “ 86666671 (Converted)” terrain data coverage and select the **Display Options...** context menu item to bring up the *Display Options* dialog.
13. From the list on the left, select the “DEM Data” item.

14. On the *DEM* tab on the right, turn off the *Flow Direction* and turn on the *Stream*, *Flow Accumulation*, *Color Fill Drainage Basins*, and *Fill Basin Boundary Only* checkboxes.
15. Click the **OK** button to close the *Display Options* dialog.
16. In the *Project Explorer*, right-click on “ Drainage” map data coverage and select the **Zoom to Layer** context menu item.

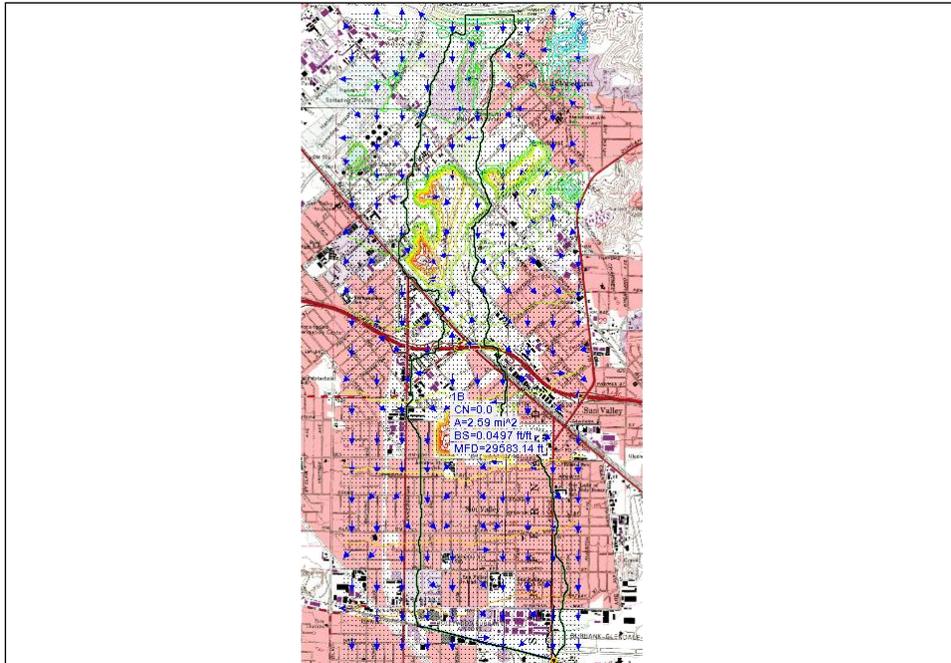


Figure 7: The drainage basin delineated with the railroad stream

8 Conclusion

This concludes the “DEM Delineation – Stream Arcs” WMS tutorial. These tools can be used for many different scenarios where the automated delineation does not yield the expected results.

The following basin delineation features were discussed and demonstrated:

- Using stream arcs to manipulate basin delineation
- Mapping polygons representing drainage basins to the DEMs

Feel free to continue to experiment with these tools or exit the program.