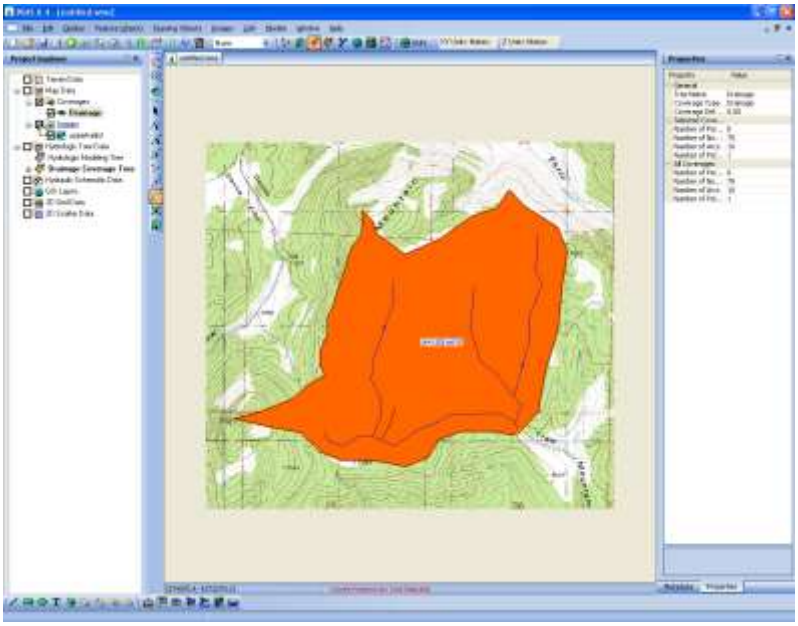
WMS

v. 10.0

WMS 10.0 Tutorial

Introduction – Advanced Feature Objects

Learn how to do advanced operations with feature objects



Objectives

Use feature object drainage coverages for manual watershed delineation. Import and edit CAD data to define a watershed.

Prerequisite Tutorials

- Introduction – Basic Feature Objects

Required Components

- Data
- Drainage
- Map
- Hydrology

Time

- 30-60 minutes

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1 Introduction

In a previous exercise (tutorial 3) users learned how feature points, lines, and polygons are created and organized into coverages. In this exercise users will continue to learn about the creation and editing of feature objects, with a focus on creating drainage coverages, the primary coverage used in WMS to develop watershed models.

2 Objectives

In this exercise users will learn the how to create and import feature objects and manage different coverages. This includes the following:

1. Using feature object drainage coverages for watershed delineation
2. Advanced feature object editing functions
3. Assigning appropriate feature object attributes
4. Importing and editing feature objects from CAD data

3 Defining a Watershed with Feature Objects

By using a combination of stream arcs, outlet nodes, and basin polygons, users can develop an entire watershed without the use of a digital terrain model. The watershed can be to scale or a schematic. Of course, if it were not to scale, polygon areas and stream lengths would not be valid for the hydrologic model.

In this section of the exercise, users will create the Aspen Grove watershed from an image of a scanned paper map with clearly marked streams and basin boundaries.

1. Close all instances of WMS.
2. Open WMS.
3. Switch to the **Map** module.
4. Select *File* | **Open**.

5. In the *Open* dialog, locate the "featureadv" folder in the files for this tutorial. If needed, download the tutorial files from www.aquaveo.com.
6. Open "aspentrc.img".

Users should see a portion of a USGS quad map with basin boundaries outlined in red and the stream network in black.

3.1 Creating Basin Boundaries

Users will begin by creating the basin boundaries, but it does not matter whether the basins or streams are created first.

1. Choose the **Create Feature Arc** tool.
2. Select *Feature Objects* | **Attributes**.
3. In the *Feature Arc Type* dialog, make sure that the arc type is *Generic* and Select **OK**.
4. Beginning at the outlet point (lower right) trace out the entire watershed boundary. Users do not need to follow every detail; take as much time as preferred.
5. Now create each of the three sub-basin boundary arcs on the interior of the watershed. Begin by clicking on a point near the junction in the center of the watershed and ending by clicking near the intersection of the arc previously created for the exterior boundary.

3.2 Creating the Stream Network

The stream network is created in much the same way the basin boundaries were. The only thing to note is that in the upper basin the basin boundary comes very close to the stream. Users will need to zoom in on this region in order to avoid conflicts with the snapping tolerance.

1. Select *Feature Objects* | **Attributes**.
2. Choose the *Stream* feature arc type.
3. Select **OK**.
4. Create the main channel from the outlet of the watershed to the outlet point for the two upper basins. Begin by clicking near enough to the boundary arc at the outlet in the bottom right corner, so that it snaps to it and end by clicking on the basin junction point.
5. Create the two branches of the lower basin by clicking on a point near the stream arc just created and double-clicking at the most upstream point of the branches in the image.

NOTE: As users create new vertices on stream arcs they should always do so from downstream to upstream.

6. Choose the **Zoom**.
7. Zoom in on the region shown in Figure 3

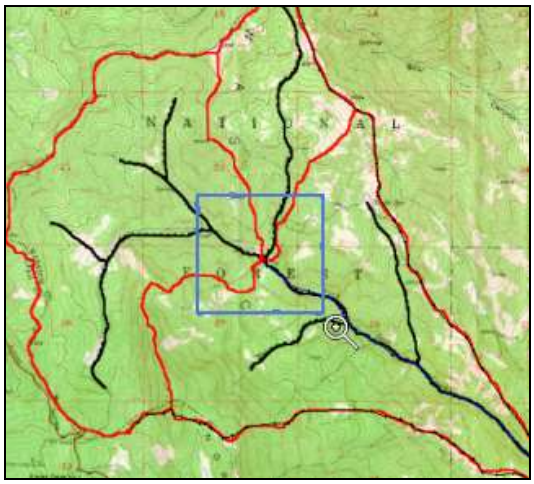


Figure 3 Junction of Main Channel in Aspen Grove Watershed

8. Choose the **Create Feature Arc** .
9. Create the initial portion of each stream by clicking on the junction point (intersection of red boundary lines in the image) and going as far upstream as is possible on the zoomed image. End by double-clicking.

The user needed to zoom in order to avoid conflicts with the auto-snapping feature. However, if users click too close to an existing arc, they will get a message that the stream is illegal and they will need to try again.

Users can end the stream at one location and then continue defining after zooming out by beginning at the point where they left off.

10. Select *Display* | *View* | **Previous View** or use the **Previous View** button.
11. Finish defining each branch. Begin the branch by clicking near the point the user left off with and ending by double-clicking at the terminal point of the stream.

In order to define separate basins at the junction point users will need to convert the node at the junction to an outlet node.

12. Choose the **Select Feature Point/Node** tool.
13. Select the junction point in the center of the watershed corresponding to the intersection of the streams and the sub-basin boundary arcs that were just created.
14. Select *Feature Objects* | **Attributes**.
15. Set the attribute to *Drainage outlet.*
16. Select **OK**.

3.3 Building Polygons

At this point the watershed boundaries are only arcs. In order for them to become polygons users must create the polygon topology.

1. Right-click on the "Drainage" coverage in the Project Explorer and select **Build Polygon**.
2. Select **OK** when asked whether to use all the arcs to build the polygon (WMS excludes the stream arcs when building polygons).
3. Choose the **Select Feature Polygon** tool, double click on each basin polygon, and change the type to *Drainage Boundary*.

3.4 Updating Geometric Parameters

1. Right-click on the "Drainage" coverage in the Project Explorer and select **Display Options** on the pop-up menu.
2. In the *Display Options* dialog, select "Map Data" from the menu on the left and turn on the *Color fill polygons* option.
3. Select **OK**.

In order to transfer the basin area and stream lengths and to compute them in appropriate units for hydrologic modeling, users need to compute the basin data. This will make it possible to use the polygon area in any of the hydrologic modeling interfaces.

4. Right-click on the "Drainage" coverage in the Project Explorer and select **Compute Basin Data**. This command computes areas, perimeters, and centroids for each of the sub-basins and assigns these values to the hydrologic modeling tree.
5. In the *Units* dialog, select the **Current Projection...** button.
6. In the *Display Projection* dialog, make sure the *Horizontal* and *Vertical units* are "Meters" (the base units were UTM meters).
7. Select **OK**. The *Display Projection* dialog will close.
8. In the *Units* dialog, set the *Basin Areas* units to "Square miles".
9. Set the *Distances* units to "Feet".
10. Select **OK** to compute the sub-basin data.

4 More Basin Delineation

Now that users have the basics of digitizing a watershed from a topographic map and developing the correct topology for the watershed, they can try it again without the "burned" in lines on the image or the step by step outline.

4.1 Single Basin Delineation

For the first part of this exercise users will delineate the entire watershed as a single basin.

1. Select *File* | **New**.
2. Select **No** when asked to save changes.

3. Select *File* | **Open** .
4. In the *Open* dialog, locate and open “uppertrailmt.jpg”.

Users should have a portion of a scanned topographic map that has already been georeferenced. Users should now delineate the watershed as a single basin, including the streams as indicated by the blue lines. The final watershed should look similar to Figure with an area of about 1.5 square miles. Step by step procedures will not be given this time, but users can refer back to previous sections for help and to the Figure . The following are a list of things users will want to remember:

1. Start by digitizing the streams and remember to make sure the feature arc attribute type is set to stream and that were digitized from downstream to upstream. Users did this earlier in this tutorial in steps 1-3 of section 3.2.
2. Digitize the boundary with arcs that are set to the generic attribute. Users did this in section 3.1, steps 1-3.
3. Build polygons once users have created the arcs that form the boundary. Users did this in section 3.3.
4. Compute the basin data when done and make sure that the model units are meters. Users did this in section 3.4.

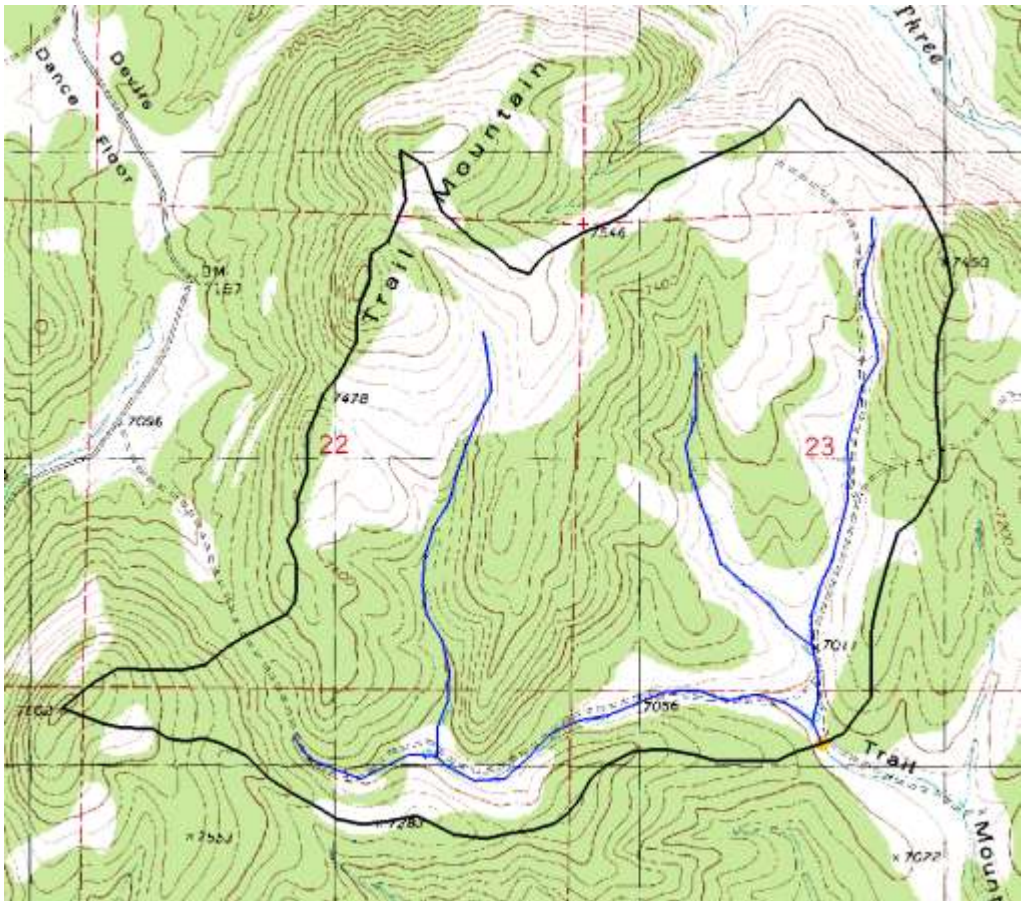


Figure 2 Delineated Upper Trail Mountain Watershed as a single basin

4.2 Adding Sub-basins

Once users have successfully digitized the watershed as a single basin, add two interior outlets as indicated in Figure and digitize the sub-basin boundaries. Note in Figure that the sub basin on the left side is defined by converting the vertex just below the junction of the stream to an outlet, thus treating that branch as a single basin, whereas the outlet for the right sub basins is placed on the node that defines the junction of the streams, thus creating a separate basin for each upstream branch. Some important considerations are:

1. For the left side basin users will need to convert a vertex to a node. This is done first by choosing the **Create Feature Vertex** tool and clicking on the arc to create a new vertex. If there's already a vertex the user wishes to convert skip to step 2.
2. Choose the **Select Feature Vertex** tool.
3. Right-click on the new vertex and select **Vertex → Node** on the pop-up menu.

The user should now see a red node at this location.

4. Be sure to change the attribute of the node defining the outlets to type *outlet*. Do this by double-clicking on the node and selecting *outlet* from the pop up *Drainage Feature Point Type* window.
5. Digitize the sub-basin boundaries with generic arcs and rebuild the basin polygons when done. The full instructions on how to do this are found in sections 3.1-3.3 of this tutorial.
6. Finally, to compute basin data, follow the instructions in section 3.4 of this tutorial.

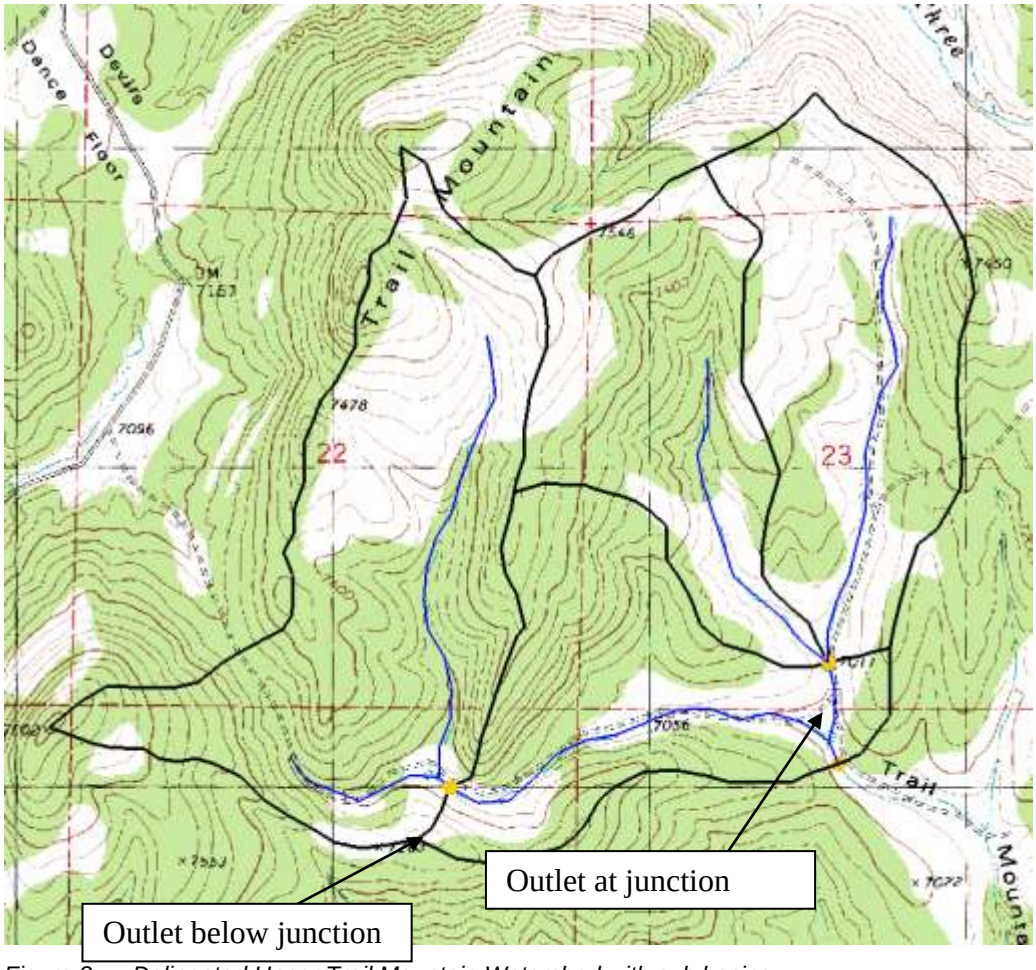


Figure 3 Delineated Upper Trail Mountain Watershed with sub basins

5 Feature Objects from CAD Data

Users may have CAD data available (or shape files which would follow a similar process). DWG and DXF data can be automatically converted to feature objects in WMS.

1. Select *File* | **New** .
2. Select **No** if asked to save changes.
3. Ensure that the **Map** module is selected.
4. Select *File* | **Open** .
5. In the *Open* dialog, locate and open "af.dwg".
6. Select *CAD* | **CAD → Feature Objects**.

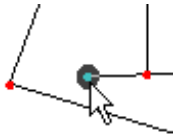
The *CAD → Feature Objects* dialog that opens shows a check mark for each layer that will be converted to feature objects. Users will convert all layers and accept the default coverage type (which should be "Drainage") and name (which should be "CAD layers").

7. Select **OK**.
8. In the new *Clean Options* dialog, select **OK**.

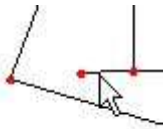
9. In the *Coverage Properties* dialog, select **OK** to accept the coverage type and name.
10. Select *CAD* **| Display Options**.
11. In the *CAD Display Options* dialog, toggle off the check box at the top labeled *Display CAD data*.
12. Select **OK**.

Because these lines were created in AutoCAD, users cannot be sure that the streams were created using the WMS conventions for direction (and in most cases they will not be). In order to fix any such problems users can use the Reorder Streams command. By selecting the most downstream node in a stream network and invoking the Reorder Streams command, users tell WMS to ensure that all arcs are ordered downstream to upstream from the selected point.

13. Choose the **Select Feature Point/Node** tool.



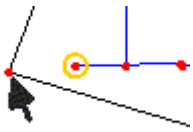
14. Right-click on the left-most node in the interior of the basin (the left-most node on the portion that forms a network inside of the arcs forming a boundary) and select **Reorder Streams** on the pop-up menu.
15. Choose the **Select Feature Line Branch** tool.



16. Select the arc attached to the left-most node (the node that was just used to reorder streams)
17. Select *Feature Objects* **| Attributes**.
18. In the *Feature Arc Type* dialog, select the *Stream* type and select **OK**.

Each stream now flows the proper direction, toward the one drainage outlet at the left of the stream network. This outlet needs to be snapped to the basin boundary.

19. Choose the **Select Feature Point/Node** tool.
20. Right-click on the drainage outlet and select **Clean** on the pop-up menu.
21. Make sure *Snap selected nodes* is checked.
22. Select **OK**.



23. Choose the node on the basin boundary closest to the drainage outlet.
24. Right-click on the "CAD layers" coverage in the Project Explorer and select **Build Polygon**.
25. Select **OK** if asked to use all arcs.

This set of streams and basins is now properly ordered and connected and is ready to be used for hydrologic analysis.

6 Conclusion

In this exercise users should have learned how to do the following:

1. Use feature object drainage coverages for watershed delineation
2. Advanced feature object editing functions

3. Assign appropriate feature object attributes
4. Import and edit feature objects from CAD data