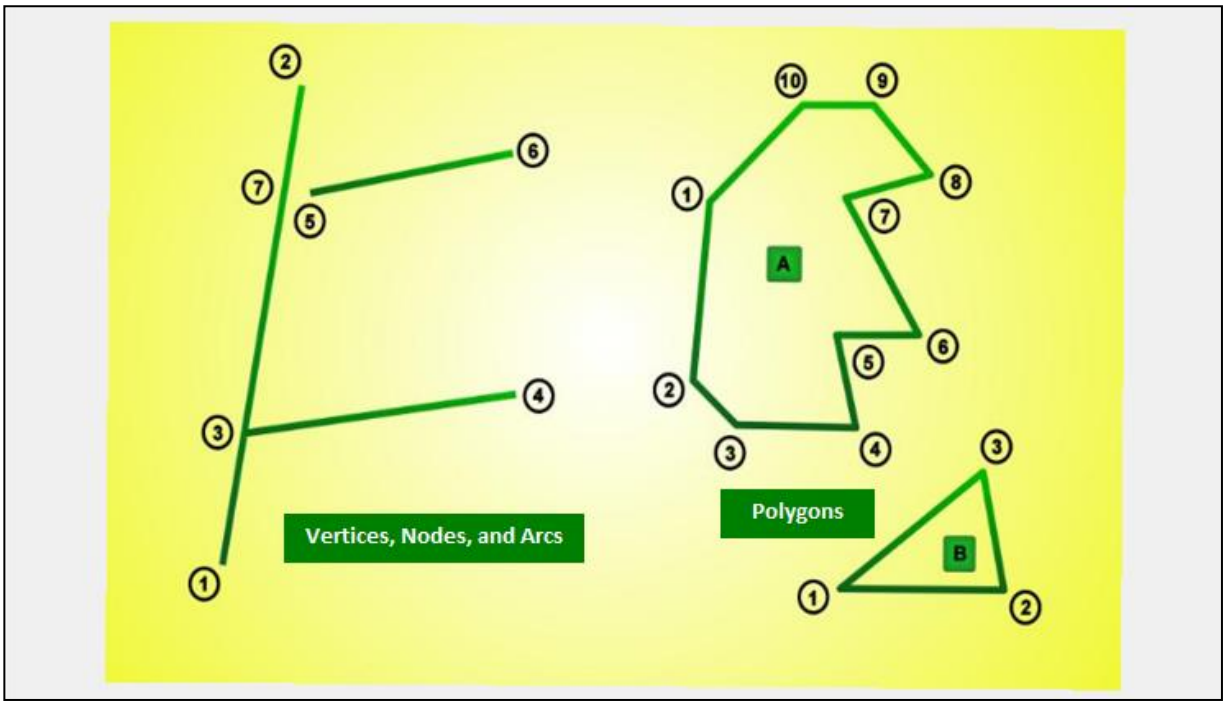
WMS

v. 11.0

WMS 11.0 Tutorial

Introduction – Basic Feature Objects

Learn about, create, edit, and manage feature objects in WMS, and import and use GIS data



Objectives

Define the term "Feature Objects". Create, edit, and manage feature objects and coverages in WMS. Import GIS data and convert the data to feature objects in the map module. Use images to create feature objects from scratch.

Prerequisite Tutorials

- None

Required Components

- Data
- Map

Time

- 30–60 minutes

AQUAVEO™

1		**Introduction**	**2**
2		**Getting Started**	**3**
3		**Creating and Editing Feature Objects**	**3**
	3.1	Creating Feature Arcs	4
	3.2	Inserting Vertices and Snapping Arcs	4
	3.3	Deleting an Arc	5
	3.4	Converting Vertices to Nodes	5
	3.5	Converting Nodes to Vertices	6
	3.6	Building Polygons	6
	3.7	Assigning Attributes	7
4		**Using Shapefiles to Create Feature Objects**	**8**
	4.1	Importing a Shapefile and Mapping to Feature Objects	9
5		**Using Background Images to Create Feature Objects**	**10**
	5.1	Create a New Coverage	11
	5.2	Importing Images	11
	5.3	Manually Digitizing Feature Objects	11
	5.4	Assigning Feature Polygon Attributes	13
6		**Display Options**	**14**
7		**Conclusion**	**15**

1 Introduction

Feature objects are points, lines, and polygons organized in coverages by different attribute sets such as drainage features, land use, soils, travel time paths, cross sections, and so on. The primary coverage in WMS is the drainage coverage, which holds drainage boundary polygons, stream lines, and outlet nodes. Most of the other coverages are secondary to the drainage coverage and are used to "map" other hydrologic parameters such as travel time or curve numbers.

Feature objects are equivalent to GIS vector data. Importing from GIS databases is one way to create coverages in WMS. Feature object coverages can also be digitized directly from the screen, using a georeferenced image in the background as a guide. This tutorial demonstrates both methods, focusing on using various tools and assigning attributes.

This tutorial teaches the basics of creating and importing feature objects and managing different coverages. It discusses and demonstrates:

- Creating and editing feature objects
- Defining feature object attributes
- Creating coverages
- Specifying attribute sets
- Using shapefiles
- Using images to create feature objects
- Managing multiple coverages

 © Aquaveo 2018

2 Getting Started

Launching WMS 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 *Ctrl-N* or select *File* | **New…** to ensure that the program settings are restored to their default state.
3. A dialog may appear asking to save changes. Click **Don't Save** to clear all data.

The graphics window of WMS should refresh to show an empty space.

4. Switch to the **Map** module.
5. Click **Open** to bring up the *Open* dialog.
6. Browse to the *feature\feature* folder and select "FeatureObjects.jpg".
7. Click **Open** to import the image and exit the *Open* dialog.

An image similar to Figure 1 will appear in the Main Graphics Window. This image depicts different examples of feature objects. This tutorial will use them to trace and create feature objects.

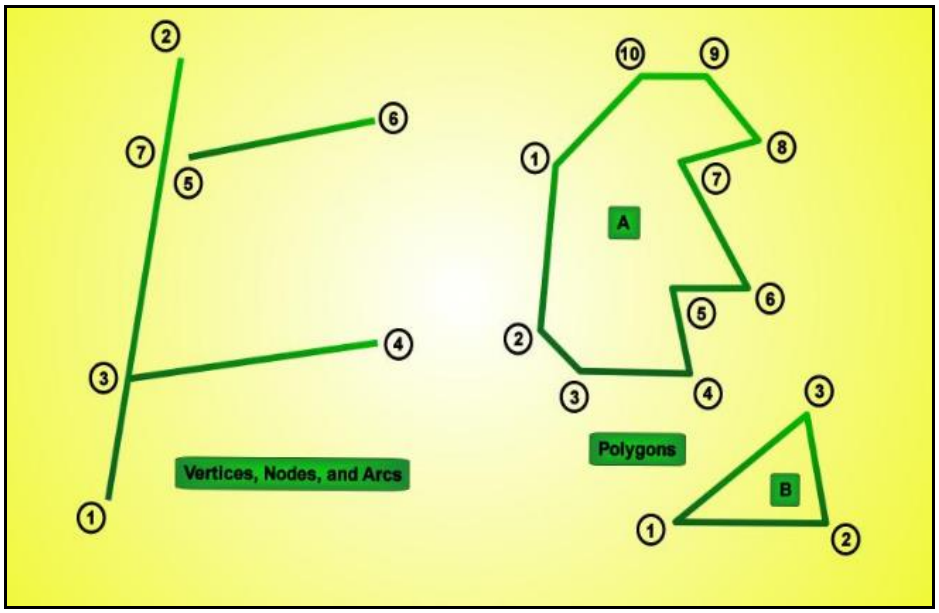


Figure 1 Example feature objects depicted in the imported image

3 Creating and Editing Feature Objects

The **Terrain Data**, **Drainage**, and **Map** modules are where the feature objects are created and manipulated. All feature objects are made from a set of points and the lines (arcs) connecting the points. There are three main types of feature objects: points, arcs, and polygons. The following sections show how to create and edit the different types of feature objects.

© Aquaveo 2018

3.1 Creating Feature Arcs

Use the "Vertices, Nodes, and Arcs" section of Figure 1for sections 3.1 through 3.5. While creating a feature arc, press *Esc* to cancel, *Backspace* to back up one vertex, *Enter* or single-click to make a vertex, and double-click to end the arc. When WMS creates an arc, each end is a node and all points in the middle are vertices.

1. Select "Drainage" in the Project Explorer to make the coverage active.
2. Using the **Create Feature Arc** tool, click on the image near point "1".
3. Double-click on the image near point "2" to end the arc.
4. Click at point "3", directly on top of the newly created arc.
5. Double-click at point "4" to end the arc.

Notice how WMS automatically links the new arc to the existing arc and creates a node at the point of intersection, splitting the existing arc into two arcs.

6. Click at point "5".
7. Double-click at point "6".

3.2 Inserting Vertices and Snapping Arcs

If two arcs very close to each other should share a common node, WMS has a tool to snap these nodes together.

1. Click **Display Options** to bring up the *Display Options* dialog.
2. Select "Map Data" from the list on the left.
3. On the *Map* tab, turn on *Vertices* and click on the button to the right of the check box to bring up the *Point Properties* dialog.
4. Enter "5" as the *Radius*.
5. Click **OK** to close the *Point Properties* dialog.
6. Click **OK** to close the *Display Options* dialog.
7. Using the **Create Feature Vertex** tool, click on the first arc next to where it is labeled "7".

A vertex is inserted here, making it possible for the "5-6" arc to be "snapped" to this location.

8. Using the **Select Feature Point/Node** tool, right-click on node "5" and select **Clean…** to bring up the *Clean Options* dialog.
9. Turn on *Snap selected nodes*.
10. Click **OK** to close the *Clean Options* dialog.

At the bottom left of the WMS screen, notice the prompting to "Select a snapping point…" (Figure 2).

11. Select the newly created vertex "7".

© Aquaveo 2018

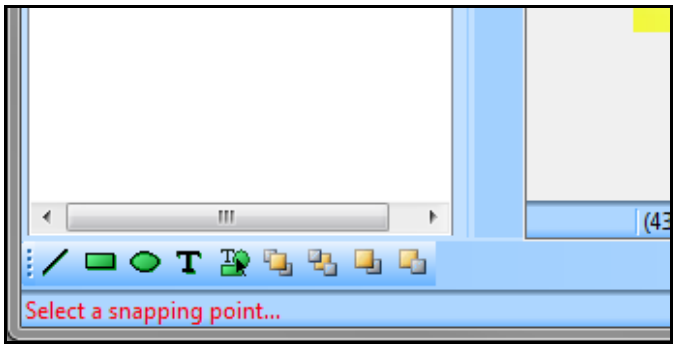


Figure 2 Select a snapping point

WMS snaps the two arcs together and changes vertex "7" to a node (Figure 3).

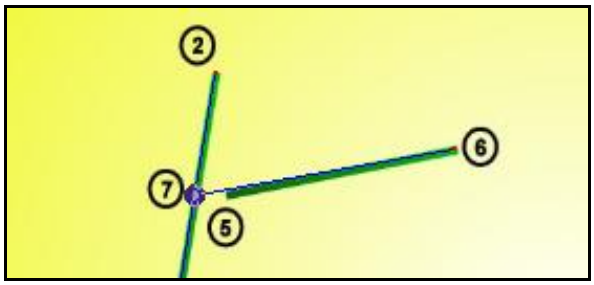


Figure 3 Vertex 7 becomes Node 7 after snapping Node 5 to it

3.3 Deleting an Arc

Now that the main arc has two nodes along its length, delete the center arc only.

1. Using the **Select Feature Arc** tool, select the arc between nodes "3" and "7".

Notice that WMS highlights the selected arc.

2. Press the *Delete* key—or right-click and select **Delete** —to delete the arc.
3. If asked to confirm deleting the arc, click **OK** .

Arcs can be created between two existing nodes by doing the following:

4. Using the **Create Feature Arc** tool, click on node "3".
5. Click on node "7" to re-form the arc.

3.4 Converting Vertices to Nodes

WMS uses vertices and nodes for different purposes. For example, nodes can have attributes while vertices simply define the shape or position of the arc. Changing a vertex to a node—or a node to a vertex—is sometimes necessary.

1. Using the **Create Feature Vertex** tool, click on the 3–7 arc anywhere between nodes "3" and "7".

A dot should appear, indicating the location of the new vertex.

2. Using the **Select Feature Vertex** tool, right-click on the new vertex and select **Vertex → Node**.

 © Aquaveo 2018

A red node should appear at this location (Figure 4). The 3–7 arc is now broken in half. It is now possible to define attributes (e.g., a drainage outlet) at this location.

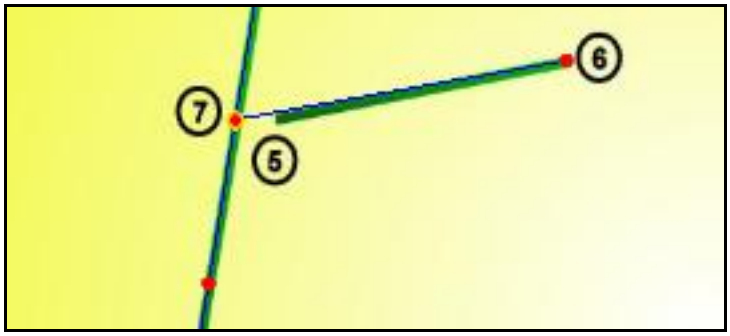


Figure 4 The new node appears as a red dot below Node 7

3.5 Converting Nodes to Vertices

Just as vertices can be changed to nodes, nodes can be changed to vertices. Doing so can leave the project with a cleaner representation of its feature arcs. For example, instead of managing and assigning attributes to two arcs, converting a node to a vertex merges the two arcs together.

1. Using the **Select Feature Point/Node** tool, right-click on the new node and select **Node → Vertex**.

The node has been changed back to a vertex.

3.6 Building Polygons

For this section, use the "Polygons" section on the imported image.

1. Using the **Create Feature Arc** tool, click on point "1" of polygon "A".
2. Click on points "2" through "10" and then click again on point "1" to close the arc.
3. Click **Yes** if a warning appears asking to convert the arc to a generic feature arc.
4. Do the same for points "1" through "3" on polygon "B".

Now there are two closed arcs. To change them into polygons, do the following:

5. Right-click on the " Drainage" coverage in the Project Explorer and select **Build Polygon**.
6. Click **OK** when asked to use all arcs.

The two polygons should now be drawn with a thicker line instead of the thinner arc lines (Figure 5). Polygons are built from their constituent arcs. The appropriate topology is established when the polygon is built.

 © Aquaveo 2018

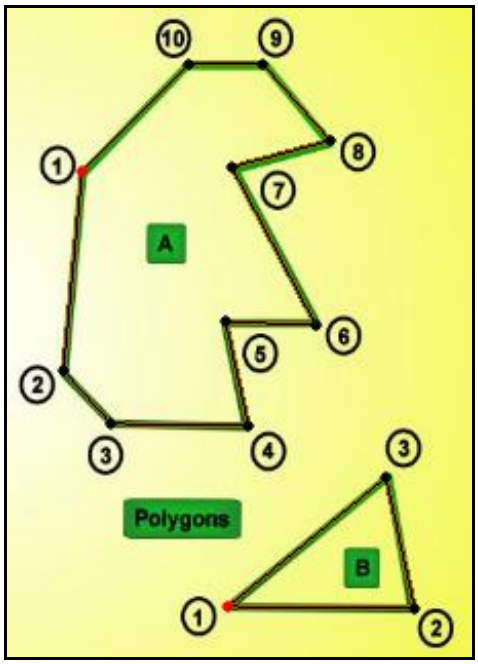


Figure 5 The polygons have thicker lines

3.7 Assigning Attributes

Each of the nodes, arcs, and polygons were created with default properties or attributes. WMS allows changing the attributes of feature objects.

1. Using the **Select Feature Arc** tool, hold down the *Shift* key and select all five arcs in the "Vertices, Nodes, and Arcs" section of the image.
2. Select *Feature Objects* | **Attributes…** to bring up the *Feature Arc Type* dialog.

This dialog allows choosing the type of arc for the selected arc(s).

3. Select *Stream* and click **OK** to close the *Feature Arc Type* dialog.
4. Turn off "FeatureObjects.jpg" in the Project Explorer.
5. Click anywhere outside of the feature objects to deselect all of them.
6. Click **Display Options** to bring up the *Display Options* dialog.
7. Select "Map Data" from the list on the left.
8. On the *Map* tab, scroll to the bottom of the list below the *Coverage type* drop-down and turn on *Stream Arrows*.
9. Click **OK** to close the *Display Options* dialog.

Notice that the arcs are now colored blue. Each arc portion should have a blue arrow indicating flow direction for the stream. The original direction in which the arc was created determines the way the stream flows (though the flow direction can be reversed). It is best practice to create stream arcs from downstream to upstream.

Notice that the lower node on the arc looks different now. WMS has automatically changed it to a drainage outlet instead of a generic node.

 © Aquaveo 2018

10. Using the **Select Feature Point/Node** tool, double-click on the lower outlet node (Feature Point ID "2C") to bring up the *Drainage Feature Point Type* dialog.

Notice that in the *Type* section, *Drainage outlet* is selected. This dialog can be accessed by selecting any feature object (point, line, or arc) and then selecting *Feature Objects* | **Attributes…** or by double-clicking on the object.

11. Click **OK** to close the *Drainage Feature Point Type* dialog.

Just as the attributes of arcs and nodes can be changed, the attributes of polygons can be changed.

12. Using the **Select Feature Polygon** tool, double-click anywhere inside polygon "A" to bring up the *Drainage Feature Polygon Type* dialog.
13. In the *Type* section, select "Drainage boundary" and click **OK** to close the *Drainage Feature Polygon Type* dialog.

The boundary of polygon "A" should remain a thick colored line (Figure 6).

14. Double-click anywhere inside polygon "B" (the triangle) to bring up the *Drainage Feature Polygon Type* dialog.
15. In the *Type* section, select *Lake/Reservoir* and click **OK** to close the *Drainage Feature Polygon Type* dialog.
16. Click outside either polygon to deselect all polygons.

Polygon "B" should have a light blue border (Figure 6).

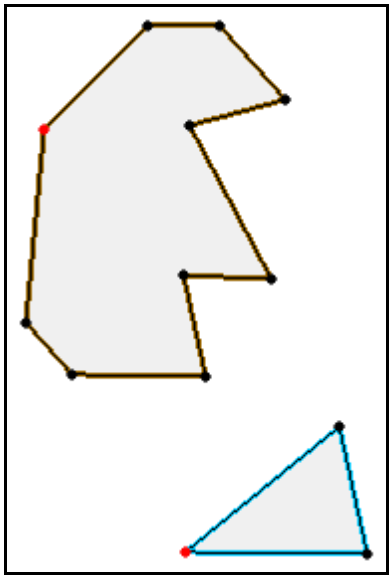


Figure 6 Polygons after the type attribute is set

4 Using Shapefiles to Create Feature Objects

One of the most important features of WMS is the ability to automatically create feature objects using shapefiles. Importing shapefile data can be done in different ways.

© Aquaveo 2018

Additional options may be available, depending on which external software (e.g., ArcGIS) is installed.

Before proceeding, reset to a blank project.

1. Click **New** .
2. Click **Don't Save** when asked to save changes.

4.1 Importing a Shapefile and Mapping to Feature Objects

1. Switch to the **GIS** module.
2. Right-click on " GIS Data" in the Project Explorer and select **Add Shapefile Data...** to bring up the *Select shapefile* dialog.
3. Select "streams.shp" and click **Open** to import the shapefile and close the *Select shapefile* dialog.

The shapefile should appear similar to Figure 7. Note that the DBF and SHX files (in this case, "streams.dbf" and "streams.shx") must always be in the same directory as the SHP file or the shapefile will not work properly.

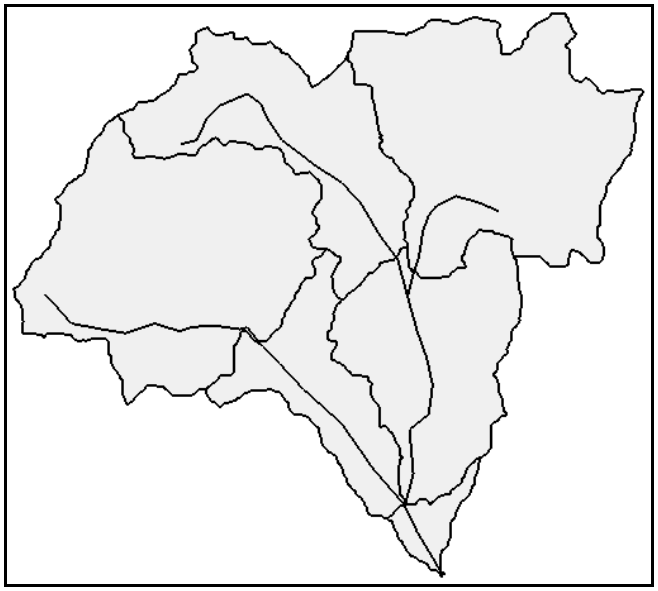


Figure 7 The imported shapefile showing the drainage basin

4. Using the **Select Shapes** tool, click and drag a box around all the shapes to select them all.
5. Select *Mapping* | **Shapes → Feature Objects** to bring up the *Step 1 of 3* page of the *GIS to Feature Objects Wizard* dialog.

This dialog is used to map shapefile data to feature objects in WMS.

6. Click **Next** to go to the *Step 2 of 3* page of the *GIS to Feature Objects Wizard* dialog.

The spreadsheet shows each shapefile attribute in capitalized letters (e.g., *DRAINTYPE*, *LENGTH*, *SLOPE*, and so on). Underneath each attribute is a drop-down containing the WMS attributes available to map to the shapefile attributes.

 © Aquaveo 2018

7. In the *Mapping Preview* section on the *Mapping* row of the spreadsheet, select "Drainage Arc type" from the drop-down in the *DRAINTYPE* column.
8. Select "Stream Length" from the *LENGTH* drop-down.
9. Select "Stream slope" from the *SLOPE* drop-down.
10. Select "Not mapped" from the *DMANNINGS* drop-down.

This attribute cannot be mapped because there is not a corresponding WMS attribute available to map it to because it is not an attribute of a feature object in WMS.

11. Select "Stream basin id" from the *BASINID* drop-down.

Review the values assigned to each attribute for each shape in the spreadsheet.

12. Click **Next** to go to the *Step 3 of 3 (Finished)* page of the *GIS to Feature Objects Wizard* dialog.
13. Click **Finish** to close the *GIS to Feature Objects Wizard* dialog.
14. Turn off "streams.shp" in the Project Explorer.

The shapefile containing streams and basins has been imported, with all the shapes converted to WMS feature objects. The data from the original shapefile has been mapped to WMS attributes (Figure 8).

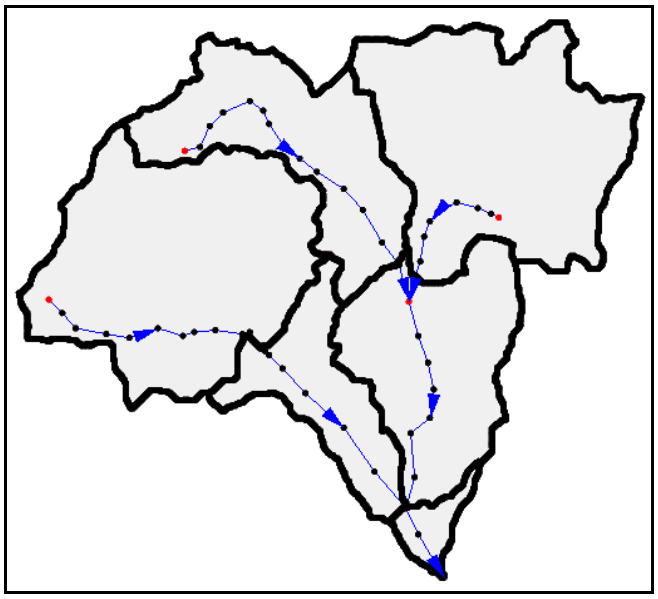


Figure 8 Shapefile mapped to feature objects

5 Using Background Images to Create Feature Objects

WMS enables the creation of feature objects using background images as guides—for instance, importing a soil use map into WMS.

Before proceeding, reset to a blank project.

1. Click **New**.
2. Click **Don't Save** when asked to save changes.

© Aquaveo 2018

5.1 Create a New Coverage

Notice the default coverage, "Drainage", listed under the "Map Data" folder in the Project Explorer. This is the default coverage automatically created in any new project in WMS. The Project Explorer enables management the default coverage, the ability to make new coverages, delete coverages, edit coverage properties, and change the active coverage.

1. Right-click on "Drainage" and select **Rename**.
2. Enter "PracticeDrainage" and press *Enter* to set the new name.
3. Right-click on "Coverages" and select **New Coverage** to bring up the *Properties* dialog.
4. Select "Soil Type" from the drop-down on the *Coverage type* row in the *Value* column.

Notice that the *Coverage name* in the field below automatically changes to "Soil Type".

5. Click **OK** to close the *Properties* dialog and create the new coverage.
6. Select the "Soil Type" coverage to make it active.

5.2 Importing Images

Now that a soil type coverage has been added, import the soils image.

1. Click **Open** to bring up the *Open* dialog.
2. Select "Image Files (*.img)" from the *Files of type* drop-down.
3. Select "soils.img" and click **Open** to import the image and exit the *Open* dialog.

A soils image similar to Figure 9 should appear.

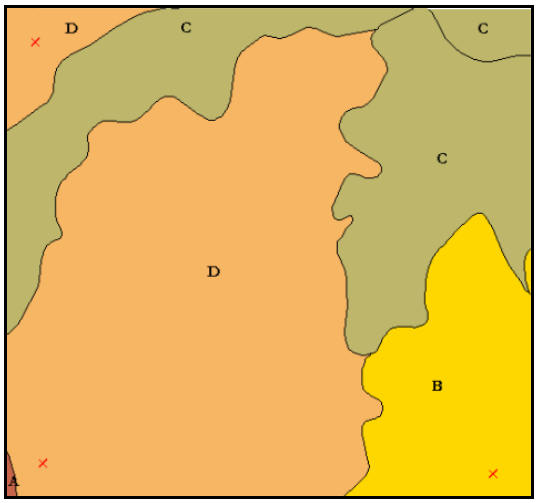


Figure 9 Soils image showing different soil types

5.3 Manually Digitizing Feature Objects

1. Select the "Soil Type" coverage to make it active.

© Aquaveo 2018

2. Using the **Create Feature Arc** tool,
3. Starting anywhere on the border of the large orange area (labeled "D"), outline with an arc the entire region.
4. Create arcs for all the other soil type areas, being careful to not create arcs on top of previously defined borders.

Zoom in to get a closer view of the image if needed. End an arc by double-clicking in order to be able to select any other tools, such as **Zoom**, **Pan**, or show all. When outlining each soil region, simply start on a previously created arc and proceed around each border, ending when another previously created border is reached. When clicking near an existing vertex or arc, WMS automatically snaps the new arc to the existing one.

The resulting arcs should appear similar to Figure 10.

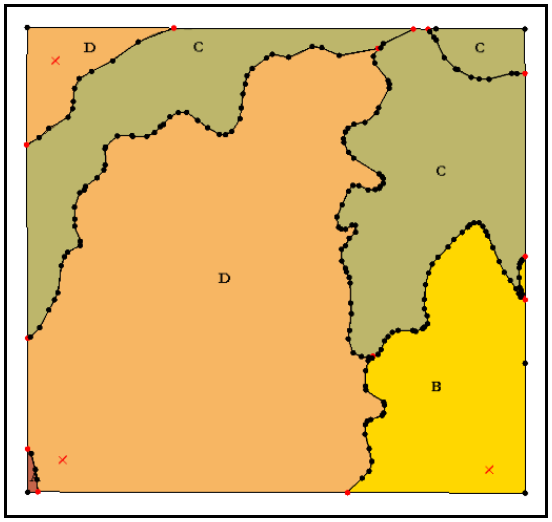


Figure 10 All of the soil areas defined with closed arcs

5. Right-click on the "Soil Type" coverage and select **Build Polygon**.
6. Click **OK** to use all the arcs.

Check to make sure that each soil use polygon is completely outlined. If one or more polygons do not build correctly, check to be sure that the arcs surrounding the polygons are completely closed. The resulting polygons should appear similar to Figure 11. Notice how the polygon borders are thicker than the closed arcs.

© Aquaveo 2018

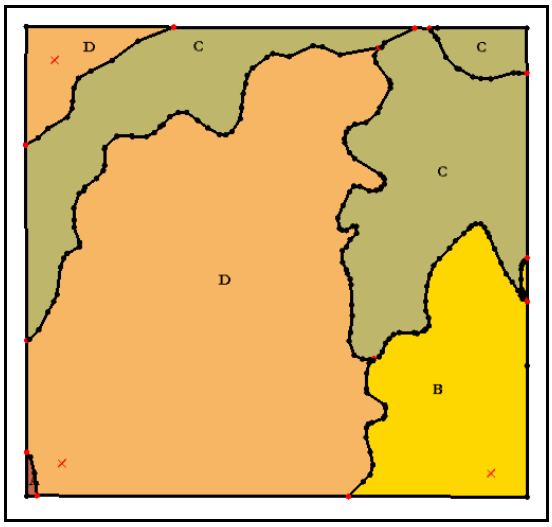


Figure 11 After the polygons are built

5.4 Assigning Feature Polygon Attributes

Now that the soil use polygons have been created, assign the soil use attributes to the correct polygons.

1. Using the **Select Feature Polygon** tool, double-click on the largest yellow polygon labeled "B" to bring up the *Soil type mapping* dialog.

Double-clicking on a feature object brings up a dialog allowing the selection or editing of its attributes. Because a "Soil Type" coverage is being used, the automatic attribute for a polygon is "Soil Type".

2. In the *WMS soil ID* section, click **Add soil ID** to list to create a new entry in the list above the button.
3. Repeat step 2 until there are four entries in the list above the button.

Now assign soil types to the WMS Soil IDs.

4. In the *Soil type properties* section, select "Type A" from the drop-down in the *Soil ID 1* column.
5. Select "Type B" from the drop-down in the *Soil ID 2* column.
6. Select "Type C" from the drop-down in the *Soil ID 3* column.
7. Select "Type D" from the drop-down in the *Soil ID 4* column.
8. Since the polygon selected was Type B (and was therefore labeled "B" on the imported image), select "Soil ID 2" from the *WMS soil ID* list and click **Apply**.
9. Double-click on the smaller yellow polygon on the right edge of the image and repeat steps1 and 8.
10. Double-click on the polygon labeled "A" and repeat steps1 and 8, instead assigning "Soil ID 1".
11. Repeat steps1 and 8 for the three polygons labeled "C", assigning "Soil ID 3".
12. Repeat steps1 and 8 for the two polygons labeled "D", assigning "Soil ID 4".

 © Aquaveo 2018

It is recommended to recheck the soil types to make sure they have been entered correctly, especially on larger projects with many different types.

6 Display Options

WMS has many display options to help tailor the look of a project. It is possible to change options such as polygon colors, presence of nodes and vertices, and legends using the Display Options command.

1. Right-click on the "Soil Type" coverage and select **Display Options…** to bring up the *Display Options* dialog.
2. Select "Map Data" from the list on the left.
3. On the *Map* tab, turn on *Color Fill Polygons* and *Soil Type Legends*.
4. Turn off *Points/Nodes* and *Vertices*.
5. Click **Soil Type Display Options** to bring up the *Soil Type Display Options* dialog.
6. Select "Soil ID 1" from the list on the left and click the **Pattern** button.
7. Select "Red" from the list of colors.
8. Repeat steps 6–7 for "Soil ID 2", "Soil ID 3", and "Soil ID 4", setting them to "Blue", "Green", and Yellow", respectively.
9. Click **OK** to close the *Soil Type Display Options* dialog.
10. Click OK to exit the *Display Options* dialog.
11. Turn off "soils.tif" in the Project Explorer.

The Graphics Window should appear similar to Figure 12.

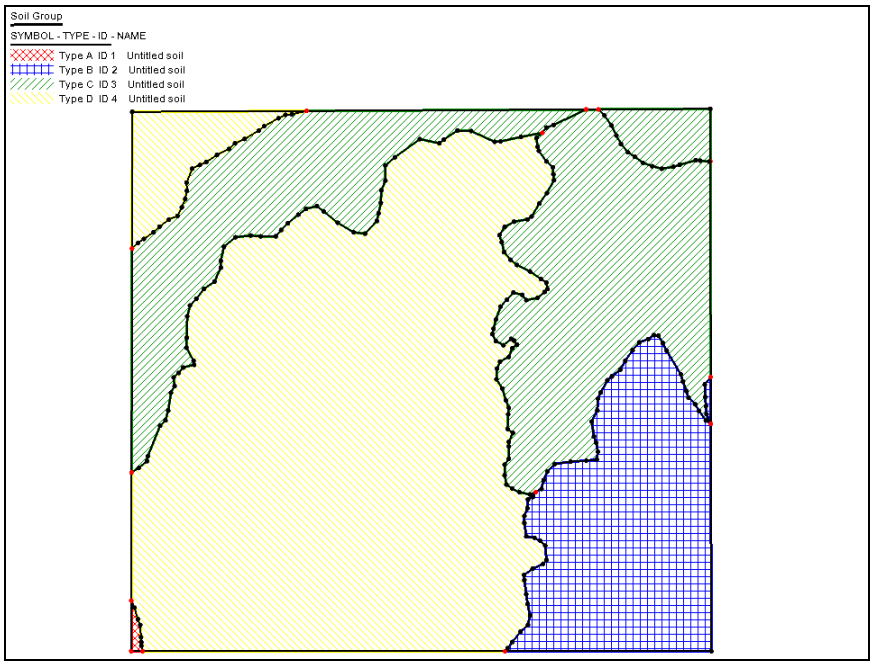


Figure 12 Soil types with new display colors

© Aquaveo 2018

Feel free to continue to exploring the display options. To assign new colors to the land uses, select the "Land Use" coverage before opening the *Display Options* dialog, or select "Land Use" from the *Coverage type* drop-down on the *Map* tab of the *Display Options* dialog.

7 Conclusion

This concludes the "Introduction – Basic Feature Objects" tutorial. The basics for creating and importing feature objects and managing different coverages were covered. Both these concepts are central to an understanding of WMS.

The following key concepts were also discussed and demonstrated:

- Create and edit feature objects
- Set feature object attributes
- Create coverages and specify coverage attribute sets
- Import shapefiles
- Use images to create feature objects
- Manage multiple coverages

© Aquaveo 2018