SMS 12.3 Tutorial
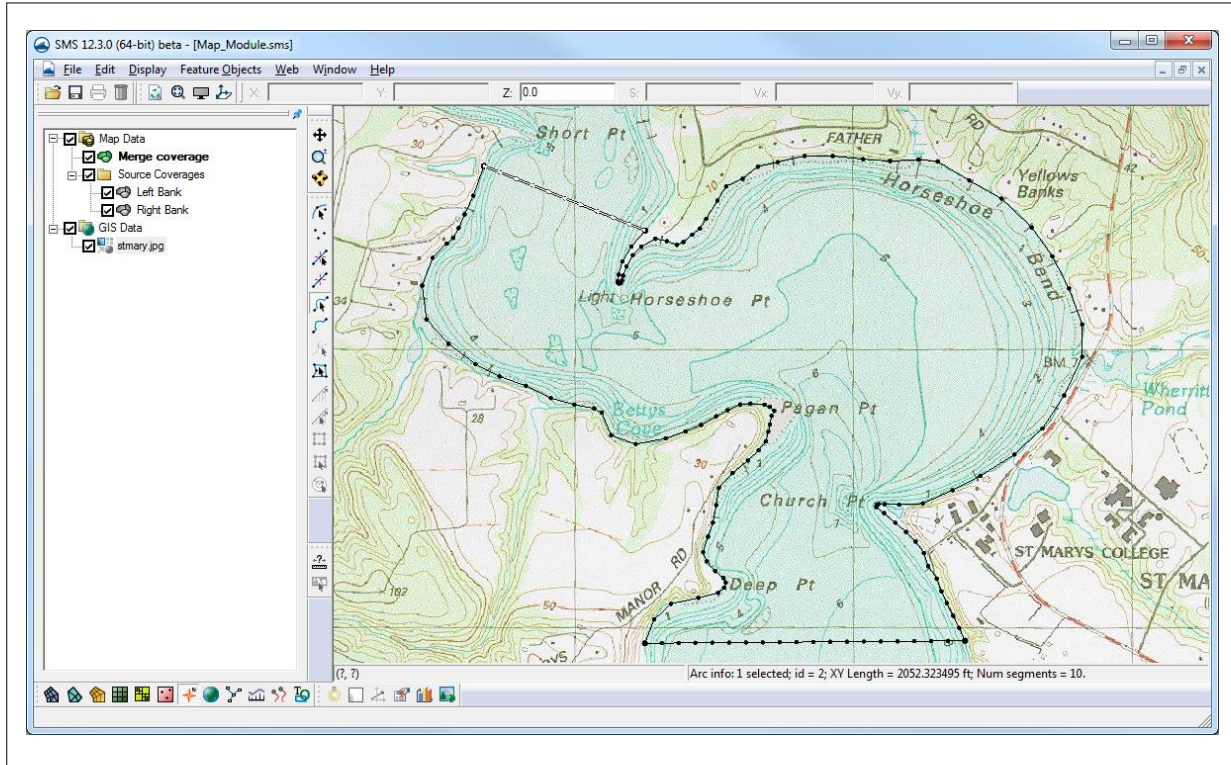# Map Module Operations

Objectives

This tutorial describes the fundamental tools in the Map module of the SMS. This tutorial provides information that is useful when constructing any type of geometric grid (unstructured grid or mesh, Cartesian grid, QuadTree, etc.).

Prerequisites	Requirements	Time
• SMS Overview	• Mesh Module • Scatter Module • Map Module	• 15–20 minutes

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1   Introduction

As mentioned in the "Overview" tutorial, the Map $\quad$ module is used to build a conceptual model consisting of a vector based representation (lines and curves) of the situation being modeled. The "SMS Overview" tutorial should be completed before this tutorial.

To review, feature objects in SMS include points, nodes, arcs, and polygons, as shown in Figure 1. Feature objects are grouped into sets called "coverages." Only one coverage can be active at a time.
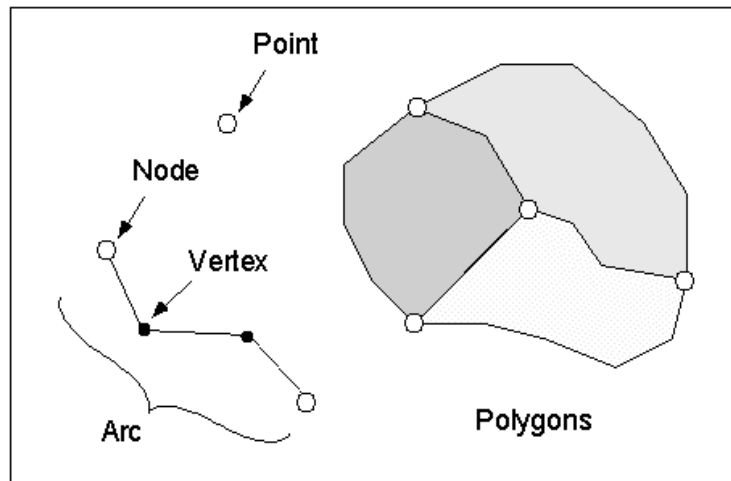

Figure 1   Feature objects

A feature point defines an (x, y) location in the conceptual model. It is a stand alone point and is not attached to any other objects.

A feature node is the same as a feature point, except that it is attached to at least one arc.

A feature arc is a sequence of line segments grouped together as a polyline entity. The two end points of an arc are called "feature nodes," and the intermediate points are called "feature vertices."

A feature polygon is constructed from a closed loop of feature arcs. A feature polygon can consist of a single feature arc or multiple feature arcs, as long as a closed loop is formed.

This tutorial covers some of the basics of working with feature objects using the Map module in SMS including:

- Importing map module data
- Creating feature objects
- Manipulating coverages
- Redistributing vertices
- Building polygons
- Saving map module data

All files for this tutorial are found in the "data files" folder within the "MapModule" folder.

2   Getting Started

This tutorial starts with importing an image file then importing a map file containing a map coverage and a feature arc.

1. Start SMS
2. If SMS is already open, select *File* | **Delete All**.
3. Click **Yes** to clear all data in SMS.

2.1   Opening a Background Image

Do the following to open the JPEG image in this example:

1. Select *File* | **Open**. This will bring up the *Open* dialog.
2. Select the file "stmary.jpg" from the "data files" folder in the "Map Module" folder.
3. Click **Open** to import the image file.

The image should be visible in the Graphics Window.

2.2   Opening an Existing Map Coverage

The "Overview" tutorial introduced the map module and how to digitize arcs over an image. Do the following to open a set of digitized arcs:

1. Select *File* | **Open** to bring up the *Open* dialog.
2. Select the file "LeftBank1.map" from the data files folder for this tutorial.
3. Click **Open** to import the map data.

A new coverage, called "🌐 Left Bank", will appear in the Project Explorer. The coverage contains a feature arc running along the left bank of the river as though looking downstream (right side of the Graphics Window).

4. To hide the coverage, uncheck ☐ the box next to "🌐 Left Bank" in the Project Explorer.

Notice how the feature arc in the Graphics Window disappears.

5. Check ☑ the box next to "🌐 Left Bank" to the data can be seen in the Graphics Window.

The Graphics Window should appear similar to Figure 2.
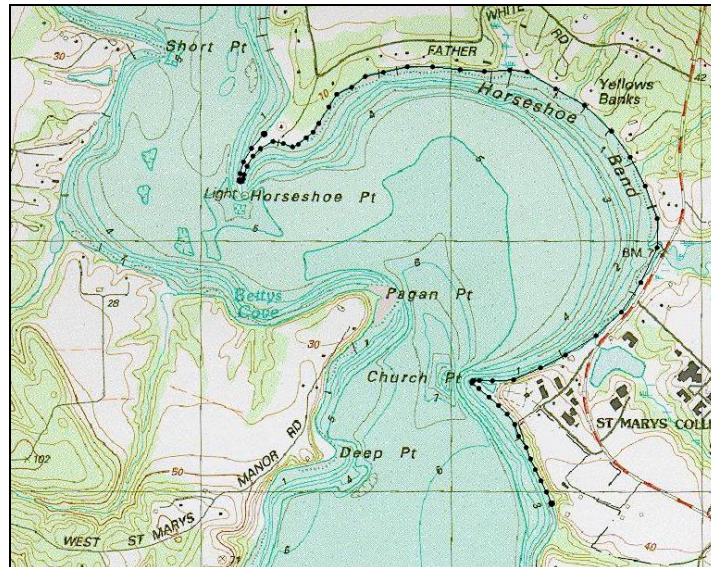

Figure 2   The stmary1.map feature object data

3   Merging/Splitting Arcs

Feature arcs exist in an SMS coverage to define a physical object. Examples of these objects include the edge of a computational domain, the boundary between two types of vegetation, the centerline of a channel or the shoulder of an embankment.

As these arcs are used for various purposes in the modeling process, it may become necessary to split an arc into two arcs. There are two basic methods of splitting an arc into two. These include:

• Creating a new arc that starts or ends at a point in the interior of an existing arc.

• Converting a feature vertex in the interior of an existing arc to feature node.

To illustrate the first splitting process:

1. Click on the **Create Feature Arc** ∫ tool to make it active.

2. Click somewhere on the existing bank arc to begin creating a new arc.

Note: if this click is on a vertex the vertex is converted to a feature node. If the click is just on the arc, a new node is created at that location.

3. Move the cursor away from the arc towards the middle of the channel.

As the cursor moves, SMS displays a line from the starting point to the cursor. SMS has inserted a new feature node on the existing arc, splitting that arc into two arcs.

4. Double-click away from the arc to terminate the new arc.

The coverage now contains three arcs.

Reversing this splitting process requires the deletion of the new arc and a command to merge the bank back to a single arc. To do this:

1. Select the **Select Feature Arc** 🖈 tool to make it active.

2. Click on the new arc that was created attached to the left bank. SMS will highlight this arc.

3. Press the *Delete* key on the keyboard or click on the **Delete** 🗑 macro in the tool bar beneath the *Display* menu. SMS will ask for confirmation to delete the arc.

4. Click **Yes** to delete the new arc.

5. Select the **Select Feature Point** 🖈 tool to make it active.

This tool is used for selecting both feature points and feature nodes.

6. Click on node that was the end point of the arc that was just deleted. This is the node that joins two (and only two) arcs.

7. With a feature node selected, right-click and select **Convert to Vertex**.

SMS converts the node to a vertex, merging the two arcs back into one.

Note: if three or more arcs come together at a node, the **Convert to Vertex** command has no effect because that node cannot be converted.

If the creation of the arc was not on an existing vertex, the arc still has a vertex that did not exist before the new arc was created. If this is the case:

8. Use the **Select Feature Vertex** 🖈 tool, select the extra vertex and press the *Delete* key.

9. Click **Yes** to delete the extra vertex.

To illustrate the second splitting process:

1. Click on the **Select Feature Vertex** 🖈 tool to make it active.

2. Click on one of the vertices on the existing bank arc (the end point are feature nodes so they cannot be selected with this tool active).

3. With a feature vertex selected, right-click with the mouse and select **Convert to Node**. SMS converts the vertex to a node, splitting the arc into two arcs that join at the selected location.

To reverse the splitting process, merging two arcs into a single arc:

1. Using the **Select Feature Point** ⟋ᐟ tool, click on node that was created in the previous sequence—this is the node that joins two (and only two) arcs.

2. With a feature node selected, right-click with the mouse and select **Convert to Vertex**.

SMS converts the node to a vertex, merging the two arcs back into one.

4   Manipulating Coverages

When a set of feature objects is opened from a file, one or more new coverages are created. The last coverage opened becomes active. Any creation or editing of feature objects occurs in the active coverage. Feature objects on inactive coverages can be displayed in a separate color (blue-gray by default) or not displayed at all depending on the display option settings.

Each coverage is also represented by an entry on the Project Explorer. A project commonly includes many coverages defining various options in a design or various historical conditions.

4.1   Merging and Copying Coverages

Feature points, arcs and polygons may come from digitization, a CAD file, GIS data or a variety of other sources. SMS includes tools to combine data from multiple sources or create copies for modification.

The following steps illustrate the process of combining coverages:

1. Select *File* / **Open** to bring up the *Open* dialog.

2. Select the file "RightBank1.map" from the "data files" folder for this tutorial.

3. Click **Open** to import the map data.

A new coverage, called "🌐 Right Bank", will appear in the Project Explorer.

4. Click on the new "🌐 Right Bank" coverage to make sure it is active.

5. Hold down the *Shift* key and click on the "🌐 Left Bank" coverage.

6. Right-click on either selected coverage and select **Merge Coverages** from the pop up menu. A dialog will appear asking "Do you want to delete the coverages used to make the merged coverage?"

7. Click **No** to keep the individual coverages.

8. Click on the new "🌐 Merge coverage" to display the combined arcs.

When editing and adjusting the data in a coverage, it is useful to have a backup both for comparison and for safety. To copy a coverage:

1. Right-click on "🌐 Merge coverage" and select **Duplicate**.

SMS creates a new coverage named "🌐 Merge coverage (2)".

4.2   Organizing Coverages

When there are many coverages being drawn, the display can become cluttered.

Individual coverages may be turned off by unchecking the box next to the coverage name in the Project Explorer as show in Section 2.2.

If a coverage is no longer desired, it can be deleted.

1.   Right-click on "⊕ Merge coverage (2)" in the Project Explorer and select **Delete**.

2.   Click **Yes** to confirm the deletion.

     Note: SMS requires at least one coverage to exist, so the right-click menu does not include a delete command if only one coverage exists.

Coverages can also be organized into folders.

1.   Right-clicking on the "🗺 Map Data" item and select **New Folder**.

2.   Enter the name "Source Coverages" and press *Enter* to name the folder.

3.   Click and drag the "⊕ Left Bank" coverage to be under the "📁 Source Coverages" folder.

4.   Repeat step for the "⊕ Right Bank" coverage.

The Project Explorer should now resemble Figure 3. The folder can be turned on or off to show or hide all coverages in the folder.
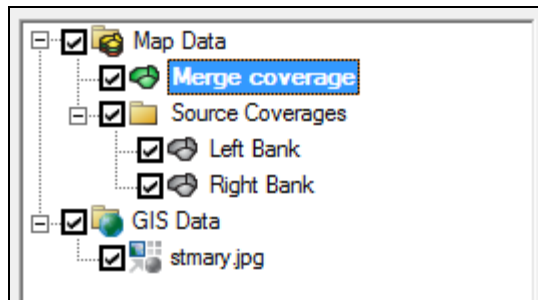

Figure 3   Coverages organized into a folder

5   Defining Polygons

Feature arcs are the building blocks of a conceptual model, but many applications require full two dimensional objects rather than just the linear features. The Map module uses feature polygons for this purpose. Before polygons can exist, feature arcs must be connected to end to end to form one or more closed loops.

To form these closed loops:

1.   Select "⊕ Merge coverage" to make it the active coverage.

2. Using the **Create Feature Arc** ∫ tool, click on the node at the top of the right bank arc (in the upper left side of the image) to start creating an arc on the upstream end of the channel.

3. To finish the arc, click on the node at the top of the left bank arc (across the channel) to close the upstream end.

4. Repeat steps 2–3 above to close off the downstream end of the channel.

> *Note:* The order or direction of the arcs is not important at this point. The enclosing arcs can be created starting at either side of the channel.

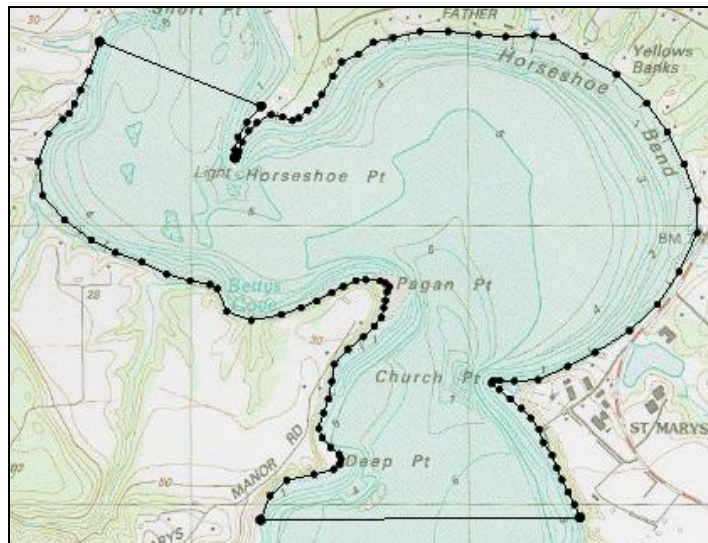Now the arcs enclose an area, or form a loop, as seen in Figure 4.

Figure 4   Arc forming an enclosed loop

Polygons are created from each group of arcs that form a closed loop. Each polygon is used to define a specific attributes such as meshing type or material zone.

In SMS, polygons are not automatically created when arcs form a closed loop. A single command instructs SMS to create the polygons for a coverage. To have SMS build polygons out of the arcs, do the following:

1. Select *Feature Objects* | **Build Polygons**.

Although nothing appears to have changed in the display, polygons have been built from the arcs. The one evidence of this is that the **Select Polygon** 🔲 tool becomes available (un-dimed). The polygons in this example are for defining the material zones as well as aiding in creating a better quality mesh.

6   Redistributing Vertices

As noted above, feature arcs may come from a variety of sources. The spacing of the vertices along the arc is from this previous operation and does not necessarily reflect the

desired resolution in SMS. Typically, the resolution of the vertices in the arcs is determined so as to be fine enough to define the desired shape and position.

In addition, the element density in an unstructured grid created from feature objects matches the density of vertices along the feature arcs, so it may be desirable to adjust the node distribution. The vertices in a feature arc can be redistributed at a desired spacing.

To redistribute vertices, follow these steps:

1. Using the **Select Feature Arc** 🏹 tool, click on the arc on the bottom of the channel.

2. Hold the *Shift* key down and click on the arc at the inflow (top) of the channel.

3. Select *Feature Objects* | **Redistribute Vertices** to open the *Redistribute Vertices* dialog.

The dialog shows information about the feature arc segments and vertex spacing. There are many options for redistributing the vertices on an arc. Refer to the help document to get details on each.

4. Make sure the "Specified spacing" option is selected for *Specify* and enter a value of "200" for *Average spacing*.

This tells SMS to create vertices 200 feet apart from each other (or 200 meter apart if working in metric units).

5. Click **OK** to close the *Redistribute Vertices* dialog and redistribute the vertices along the arc.

The arcs will still be highlighted, because they are still selected. Notice vertices have been added and evenly spaced along the arcs.
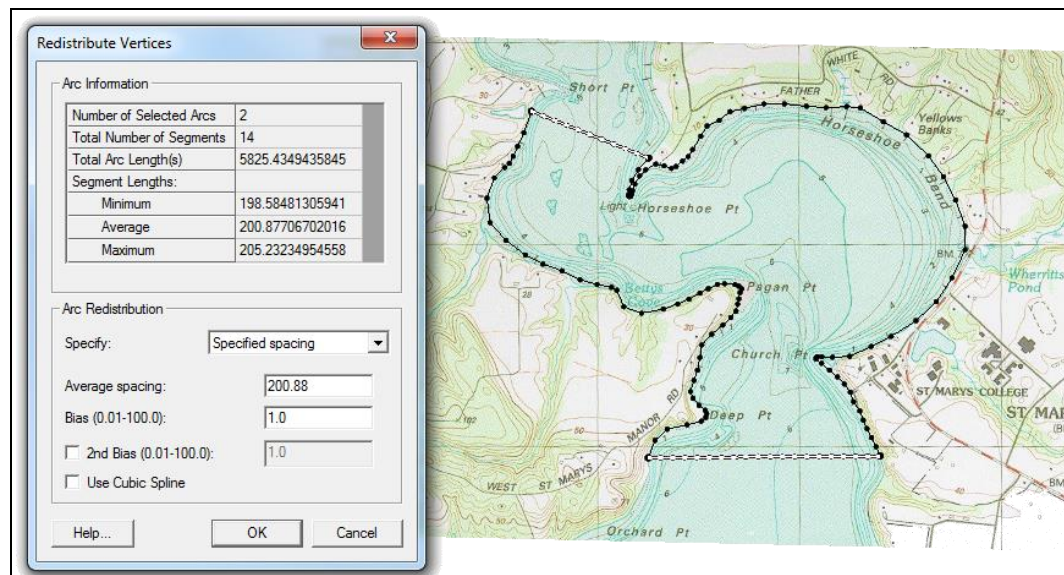

Figure 5   Redistribution of vertices along arcs

6. Right-click on any of the selected arcs and select **Redistribute Vertices…**.

This is another way to get to the redistribute tool without using the menu. Notice that the average length is now 200.8, the minimum length is 198.58 and the maximum is 205.2. In an unconstrained situation, all of these values would be 200 since that was the requested distribution. However, this is as close to 200 as SMS could get with the constraints of arc lengths.

7. Click **Cancel** to exit the *Redistribute Vertices* dialog without changing the vertices.

8. Click somewhere else on the display.

The selection will clear and the effects of redistribution can be seen more clearly.

When creating conceptual models, this redistribution would be done for each arc until the vertex spacing matches what is wanted in each area. If the spacing is the same for multiple arcs, multiple arcs can be selected and redistributed at the same time.

7   Additional Operations on Arcs

SMS includes several other operations that can be performed on an arc. To access these functions:

1. Choose the **Select Feature Arc** tool from the toolbox.

2. Select any of the arcs in the coverage.

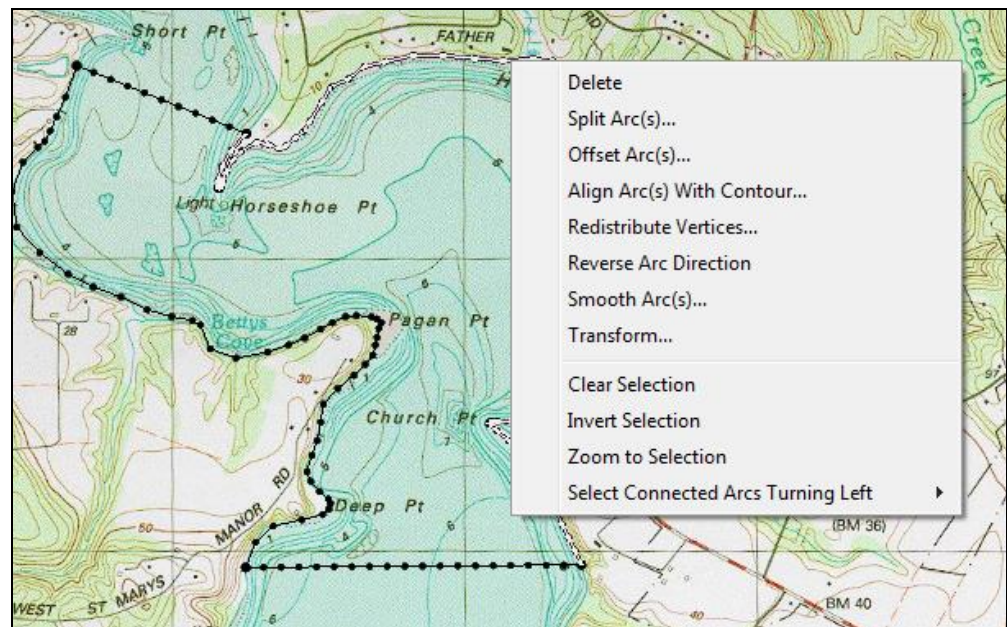3. Right-click and the menu of available operations appear.

Figure 6   Additional operations on arcs

The operations include:

- Delete – deletes the selected arc.

- Split Arc(s) – splits the arc into multiple arcs based on a maximum length or at sharp corners.

- Offset Arc(s) – creates offset arcs to either or both sides of the arc at a specified distance.

- Align Arc(s) With Contour… – allows the selection of a surface (TIN) and dataset, then prompts for a contour value. If the arc is close to this contour value SMS will move the arc to align with the contour.

- Redistribute Vertices… – discussed in previous section.

- Reverse Arc Direction – reverses the arc direction which can be required for special applications.

- Smooth Arc(s)… – this applies a moving average to the vertices of the arcs to smooth the shape.

- Transform – applies a transformation to the arc(s).

Spend whatever time is desired exploring these operations. They are illustrated in later tutorials where applicable.

8   Conclusion

This concludes the "Map Module Operations" tutorial. Continue to experiment with the SMS interface or quit the program.