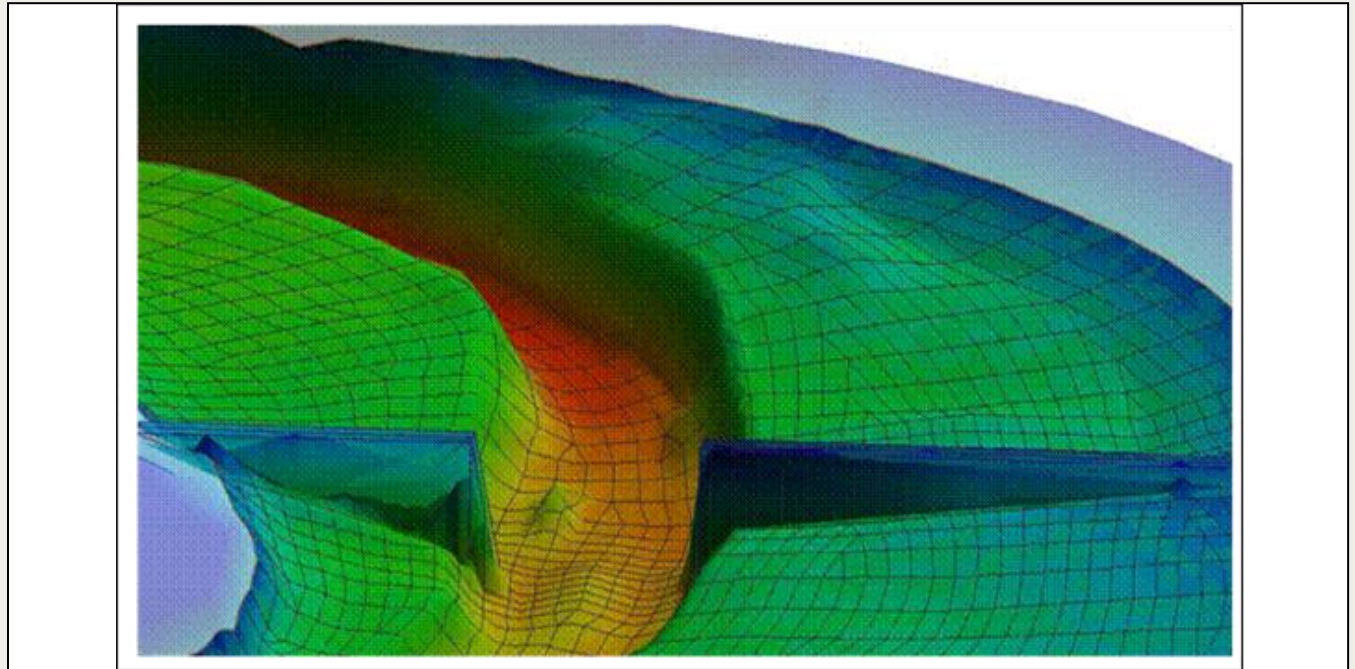*SMS 13.3 Tutorial*

Feature Stamping

Stamping features into a 2D mesh

Objectives

Learn how to use conceptual modeling techniques to create numerical models which incorporate flow control structures into existing bathymetry. The flow control structures that will be created are abutments for a proposed bridge over Double Pipe Creek near Detour, Maryland. This will be done using feature stamping.

Prerequisite Tutorials

- Overview
- Map Module

Required Components

- SMS Core

Time

- 30–45 minutes

AQUAVEO™

1   Introduction

To provide a base map and to help place the centerlines for the abutments of the proposed bridge, open the starting project containing an aerial photograph of Double Pipe Creek near Detour, Maryland.

To open the starting project:

1. If SMS is not running, launch SMS.

2. If SMS is already running, select *File* | **New** to ensure the program settings are restored to the default state. A dialog may appear asking to save changes. Click **Don't Save** to clear all data.

3. Select *File* | **Open...** to bring up the *Open* dialog.

4. Select "All Files (*.*)" from the *Files of type* drop-down.

5. Browse to the *SMS_Feature_Stamping\SMS_Feature_Stamping\data files* folder and select "start.sms".

6. Click **Open** to import the image and exit the *Open* dialog.

SMS will display the initial project as seen in Figure 1. The starting project contains aerial photograph, a scatter set, a 2D mesh, and map coverages. The scatter set contains the imported elevation values used for the mesh and will be later used with the abutment features. The map coverages where used to generate the 2D mesh. To see the process of generating a 2D mesh, see the Mesh Generation tutorial.
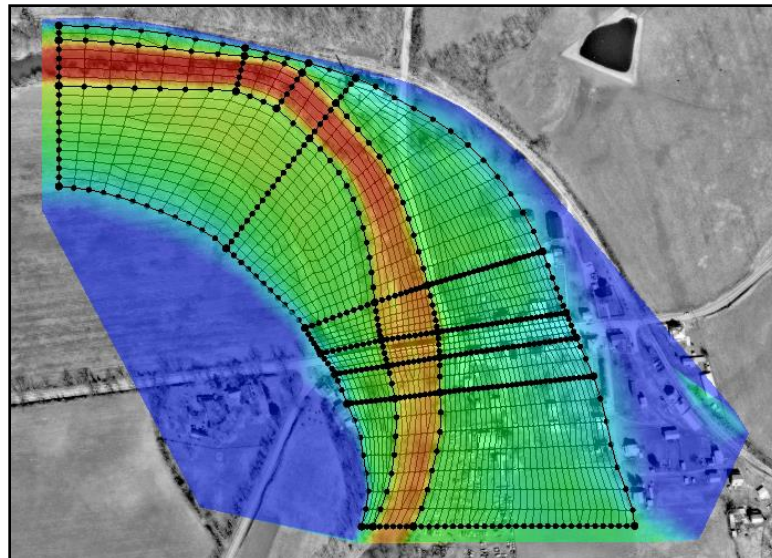
Figure 1   The initial project

2   Creating the Abutments

As mentioned above, the abutments of the proposed roadway will be created using feature stamping. The stamping of the abutments for the proposed bridge over Double Pipe Creek is presented in five processes.

2.1   Setting Up a Stamping Coverage

SMS includes a "stamping" coverage type. It is used for positioning and defining the geometry of features to be forced (or "stamped") into existing bathymetry. Set up the stamping coverage for this tutorial by doing the following:

1.   Right-click on " Map Data" in the Project Explorer and select **New Coverage** to bring up the *New Coverage* dialog.

2.   Select *Generic* | **Stamping** as the *Coverage Type* and enter "Feature Stamp" as the *Coverage Name.*

3.   Click **OK** to close the *New Coverage* dialog and bring up the *Stamping Coverage Attributes* dialog.

4.   In the *Underlying Geometry* section, turn on *Use cutoff*.

5.   Select the " Z" elevation dataset from the tree list.

6.   Select "Elevation" from the *Elevation type* drop-down.

This sets the elevation (Z) dataset of the detour scatter set as the bathymetry into which the stamped features will be forced. By setting the *Elevation type* as "Elevation," SMS knows that the selected dataset contains elevation values rather than depth values.

7.   Click **OK** to close the *Stamping Coverage Attributes* dialog.

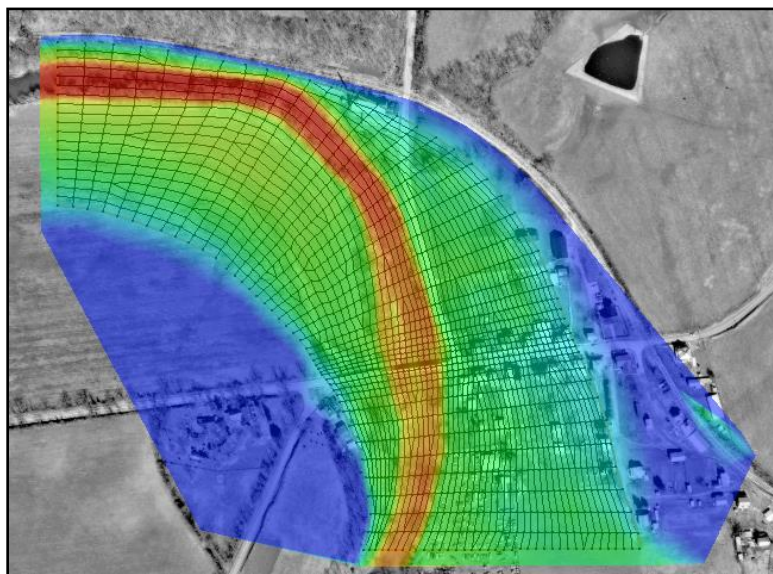The project should appear similar to Figure 2.

Figure 2   After the stamping coverage is set up

2.2   Positioning the Abutments

The next process is to position the abutments by creating feature arcs along their centerlines. The accuracy in how the abutments intersect the existing bathymetry depends on how many vertices are distributed along the centerline arcs. For this tutorial, it is necessary to distribute the vertices so they are closer together where the slope of the bathymetry changes rapidly near the banks of the creek and further apart where the slope is nearly flat in the floodplain.

To create the centerline arcs for the abutments, do the following:

1.   Select "🔴 Feature Stamp" to make it active.

2.   Turn off "🔷 Mesh" to make it easier to see the abutment.

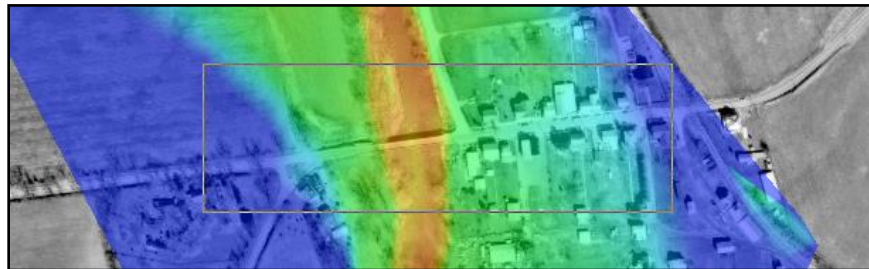3.   **Zoom** 🔍 in to the area in the rectangle in Figure 3.

Figure 3   Zoom in to this area

4.   Using the **Create Feature Arc** 🖊 tool, create two arcs representing the centerlines of the two abutments (east and west) as shown in Figure 4. Start the arcs at the point farthest from the bridge and end them at the bridge.
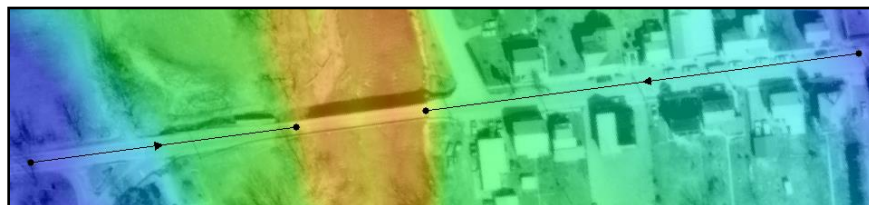

Figure 4   Abutment centerline arcs

Use the roadway in the aerial photograph to help position the centerline arcs and line them up with each other.

5.   Using the **Select Feature Arc** 🖊 tool, select the centerline arc for the west abutment.

6.   Select *Feature Objects* | **Redistribute Vertices…** to bring up the *Redistribute Vertices* dialog.

7.   Select "Number of segments" from the *Specify* drop-down.

8.   Enter "20" as the *Number of segments*.

9.   Enter "0.1" as the *Bias*.

The *Bias* positions the vertices so that the distance between the last two vertices is 0.1 times the distance between the first two vertices.

10.   Click **OK** to close the *Redistribute Vertices* dialog.

11. Repeat steps 5–10 for the east abutment centerline, entering "30" as the *Number of segments* and "0.1" as the *Bias*.

The abutment centerline arcs should appear similar to those in Figure 5.
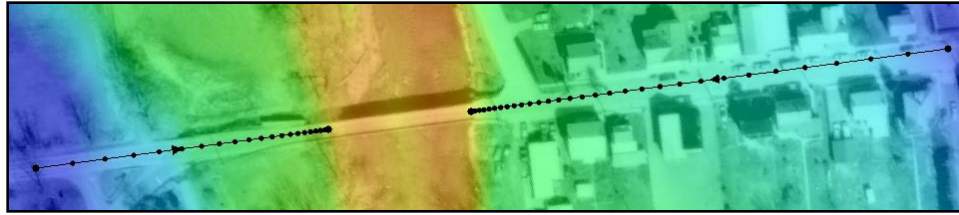

Figure 5   Abutment centerlines with redistributed vertices

2.3   Specifying the Geometry of the Abutments

Now that the abutments have been positioned with centerline arcs, specify their geometry by doing the following:

1. Using the **Select Feature Arc** tool, double-click on the west abutment centerline arc to bring up the *Stamping Arc Attributes* dialog.

2. Enter "West Abutment" as the *Feature Name*.

3. Select "Fill Feature" from the *Stamping Type* drop-down.

This is because the abutment will be increasing the elevation of the existing bathymetry.

4. In the *Centerline (CL) Profile* section, click **Constant → Elevation** to bring up the *Constant → Elevation* dialog.

5. Enter "332.0" (Feet) in the *Enter constant elevation* field and click **OK** to close the *Constant → Elevation* dialog.

This sets the elevation at each of the points along the centerline arc to 332.0 feet. The elevations for the points along the centerline can also be set individually using the spreadsheet in the *Centerline (CL) Profile* section.

Notice that in that spreadsheet, the first point along the centerline is marked with an arrow ▶ to identify the point currently selected. Selecting any other row will move the arrow to that row.

The *Cross-sections (CS)* section of the *Stamping Arc Attributes* dialog displays for viewing and editing the cross section of the current point. The views in the *Cross-sections (CS)* section update to display the cross section of the currently selected point.

To specify the cross sections at each point along the centerline, do the following:

6. In the *Centerline (CL) Profile* section, select the first row.

7. In the *Cross-sections (CS)* section, click **Specify Top Width and Single Side Slopes** to bring up the *Top Width and Side Slopes* dialog.

8. Enter "25.0" (ft) as the *Top Width*, and "-1.0" (Vert./Horiz. (ft)) as both the *Left Slope* and *Right Slope*.

9. Click **OK** to close the *Top Width and Side Slopes* dialog.

A simple cross section has now been specified.

10. To ensure these cross sections intersect the bathymetry when being stamped, enter "35.0" (Feet) as the *Maximum Distance from CL* for both the *Left Side* and *Right Side* subsections.

Now to copy this cross section to the remaining centerline points by doing the following:

11. At the bottom of the *Cross-sections (CS)* section, click **Current CS → All CS**.

12. When asked if cross sections should be adjusted based on centerline elevation, click **Yes**.

Next to specify a slope on the end of the abutment by doing the following:

13. Click **Last End Cap…** to bring up the *Last End Cap* dialog.

14. Select "Sloped Abutment" from the *Type of end cap* drop-down.

15. Enter "0.0" as the *Angle.*

16. In the *Slope* section, enter "1.0" on the blank row in the *Distance from CS (ft)* column.

17. Enter "331.0" in the *Elevation (ft)* column.

18. To ensure the sloped abutment intersects the bathymetry, enter "25.0" (ft) as the *Maximum Distance from CS*.

19. Click **OK** to exit the *Last End Cap* dialog.

20. Click **OK** to close the *Stamping Arc Attributes* dialog.

21. Repeat steps 1–20 for the east abutment, entering "East Abutment" as the *Feature Name*.

The geometry for both the abutments has now been specified. For this tutorial, fairly simple features are being created to force into the existing bathymetry. The feature stamping interface inside SMS has been designed to create simple features quickly while allowing for the creation of more complex features. The definitions are now ready to stamp the abutments and add them to the conceptual model.

2.4   Stamping the Abutments

To maintain the integrity of the conceptual model and the existing bathymetry, feature stamping creates a new coverage and a new scatter set for each stamped feature. If the conceptual model or the existing bathymetry becomes corrupted, it can be difficult to test multiple scenarios for the placement and geometric design of features being stamped.

To stamp the abutments into the existing bathymetry:

1. Select *Feature Objects |* **Stamp Features...** to bring up the *Stamp Features* dialog.

2. In the *Stamping Options* section, select "Mesh Generator" from the *Coverage Type* drop-down.

3. Click **Stamp** to stamp the features and close the *Stamp Features* dialog.

Notice that both a coverage and scatter set are added to the Project Explorer for each abutment. The Project Explorer should appear similar to Figure 6.
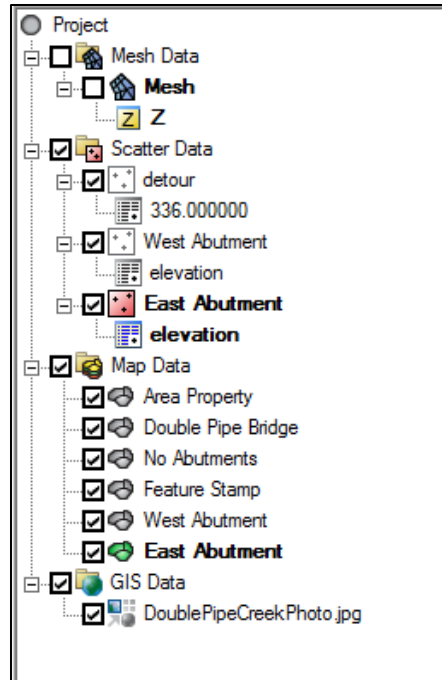
Figure 6   Project Explorer

3   Incorporating the Abutments into a Numerical Model

There are several ways to incorporate a stamped feature into a numerical model. Two methods will be illustrated in this tutorial. The first method uses the existing mesh elements and applies the stamped elevations to the nodes of the mesh. The second method creates a new mesh that uses the stamped elevations. The new mesh also has a different configuration of elements than the original mesh.

Both methods described here require a new scatter set that includes the stamped elevations. The second method also requires a new conceptual model. In general, the second method is the preferred approach to set up the elements to match the updated bathymetry.

3.1   Merging Scatter Sets

To use the new scatter sets in the numeric model, combine them with the original data by doing the following:

1. Select "⬛ Scatter Data" to switch to the ⬛ **Scatter Module**.

2. Select *Scatter* | **Merge Sets** to bring up the *Merge Scatter Sets* dialog.

3. In the Overlapping region options section, select Merge all scatter points.

4. In the *Select scatter sets to merge* section, click **Select All**.

This indicates that all available scatter sets should be merged.

5. Click **OK** to close the *Merge Scatter Sets* dialog and bring up the *Merge Report* dialog.

SMS triangulates the new set of merged scatter points at this point.

6. When done reviewing the report, click **Close** to exit the *Merge Report* dialog.

7. Turn off everything except "⊞ Merged" in the Project Explorer.

8. Right-click on "⊞ Merged" and select **Zoom to Scatter**.

Note that, in some cases, the merged scatter set (or TIN) may exceed the original stamped feature boundaries. If this happens, the TIN may need to be manually edited to more accurately represent the combined surface. This should not be the case in this tutorial.

The project should appear similar to Figure 7.
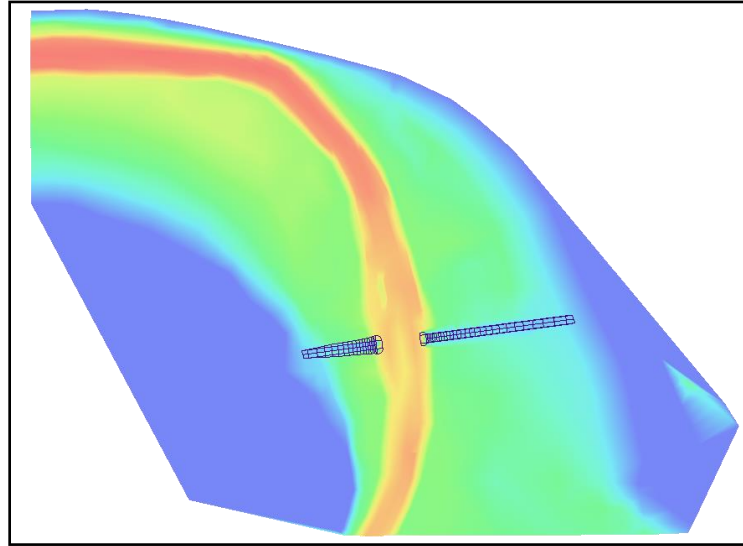
Figure 7   Merged scatter set

3.2   Interpolating to the Mesh

To integrate the abutments into a numerical model using this method:

1. Select "⊞ Merged" in the Project Explorer to switch to the ⊞ **Scatter Module**.

2. Select *Scatter |* **Interpolate to…** to bring up the *Interpolation Options* dialog.

3. In the *Interpolate from* section, under "⊞ Merged", turn on the dataset "▦ elevation".

4. Turn on the *Map Z* option.

5. In the *Interpolate to* section, select the "⬧ Mesh" mesh item.

6. Click **OK** to close the *Interpolation Options* dialog.

7. Click **OK** at the message saying the Z values will be replaced.

3.3   Viewing the Results

In some cases, the differences in elevations are not noticeable. This can be adjusted via the *Display Options* dialog.

1. Click 🖥 **Display Options** to bring up the *Display Options* dialog.

2. Select "General" from the list on the left.

3. On the *General* tab, turn off *Auto z-mag* and enter "5.0" as the *Z magnification*.

4. Select "Scatter" from the list on the left.

5. On the *Contours tab,* set the *Transparency* to "0" (%) and click **OK** to close the *Display Options* dialog.

6. Turn on "🔷 Mesh" in the Project Explorer.

The **Rotate** 🔶 tool can be used to view the project from any angle, including the one in Figure 8. This allows the contours of the area in the project to be more easily seen.
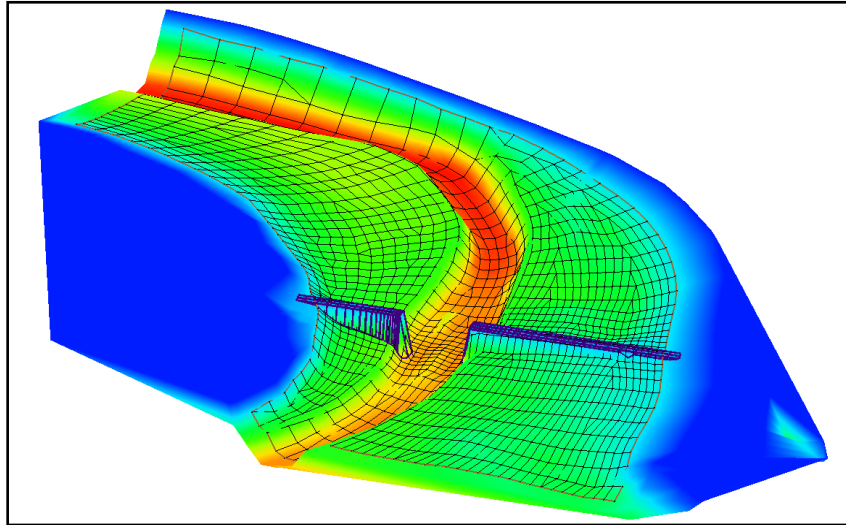

Figure 8   Rotated view with mesh turned on

7. Turn off "🔷 Mesh" in the Project Explorer.

Break lines are automatically created when using feature stamping. They force the contours to follow the abutment once triangulation is finished. The break lines outlining the abutment are more easily seen with the mesh turned off (Figure 9).
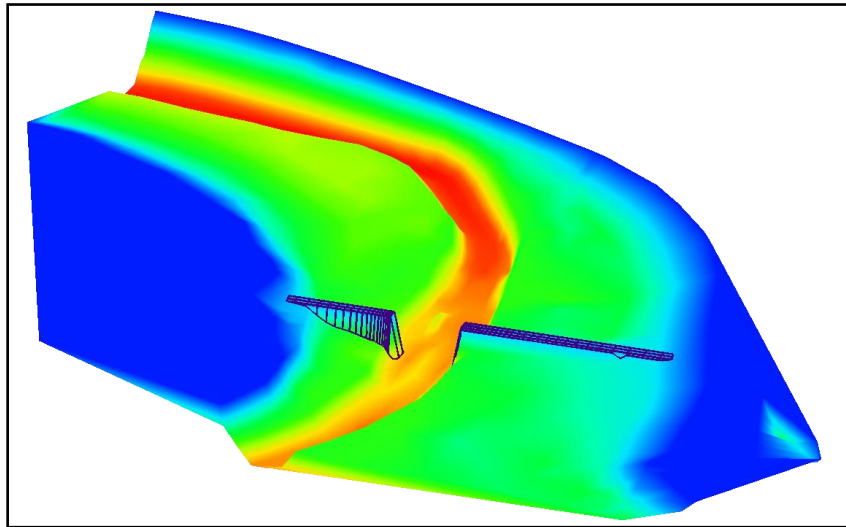

Figure 9   Rotated view with mesh turned off

4   Conclusion

This concludes the "Feature Stamping" tutorial. The following key concepts were discussed and demonstrated:

- Importing bathymetric data as a scatter set

- Creating a conceptual model to use for mapping

- Creating the mesh without the abutments

- Creating abutments by using a stamping coverage

The same process can be used to create channels, pits, or mounds. If desired, experiment with some of these other options.