

1 Quick SMS and TUFLOW FV Tutorial

1.1 A quick SMS tutorial – trapezoidal channel

The following example demonstrates the development of a very simple model mesh. Follow the steps performed here and expand upon them to develop more complex, real-world models.

The example is a trapezoidal channel, dimensions as shown:

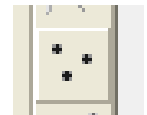
- Top width = 100 m
- Bottom width = 50 m
- Depth = 5 m
- Length of channel = 1,000 m
- Grade of channel = 1 in 1,000
- The model domain should have a resolution of 12.5 m across the channel and 25 m along the channel.

1 Map Coverage (points and arcs defining the model layout)

A The first step is to setup the SMS Map coverage. In this module the “outline”, or specific points and curves that describe the geometry to be meshed, is defined.



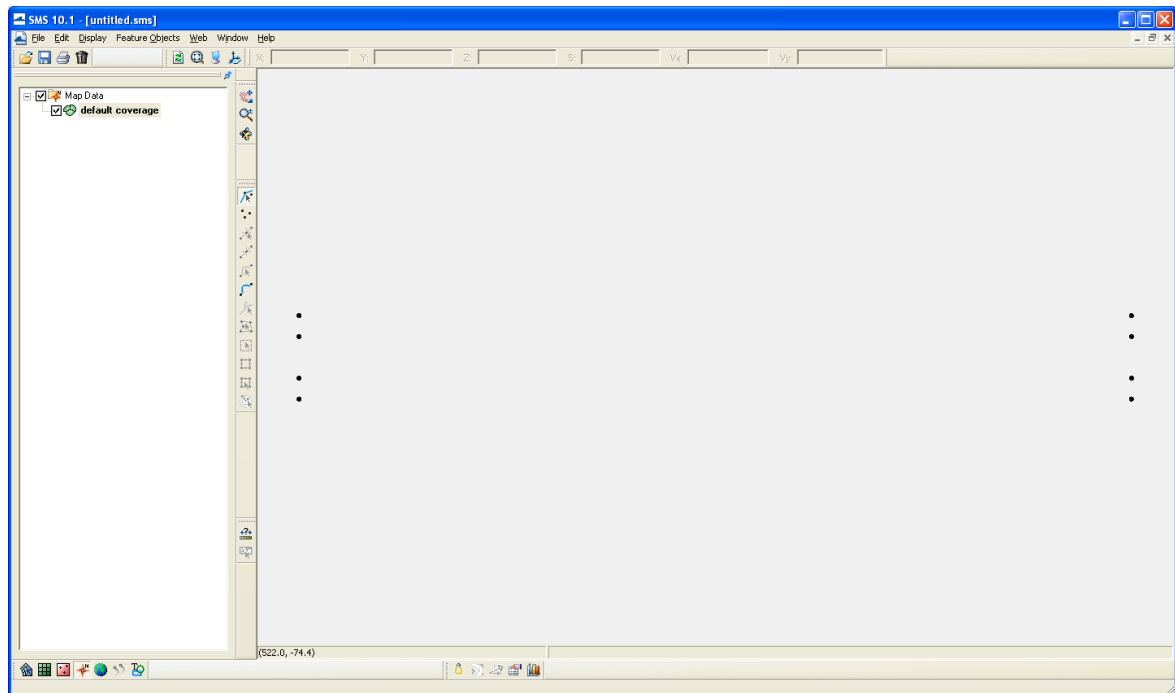
B The map coverage works in a plan view. Using the “create feature point” button, create the 8 points that define the channel.



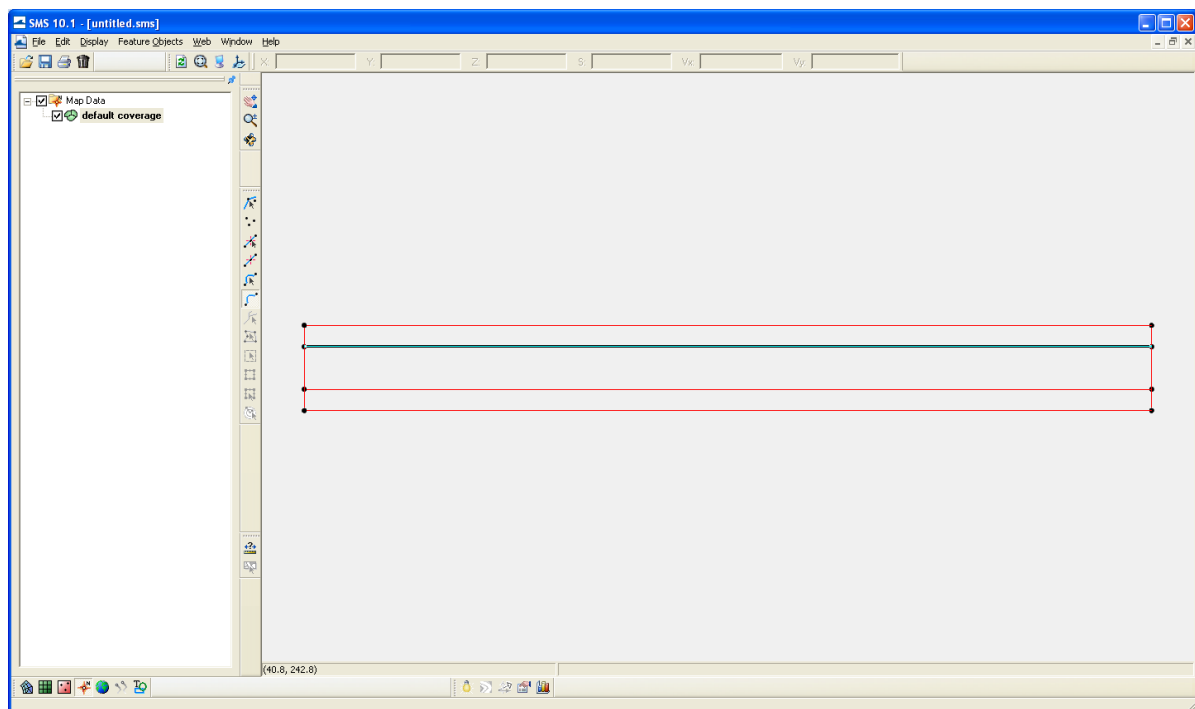
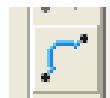
C As each feature point is created, use the coordinate boxes in the toolbar to specify the precise coordinates (x and y). Also insert the z value.

X:	0.0	Y:	75.0	Z:	-5.0	S:
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The feature points should then look like:

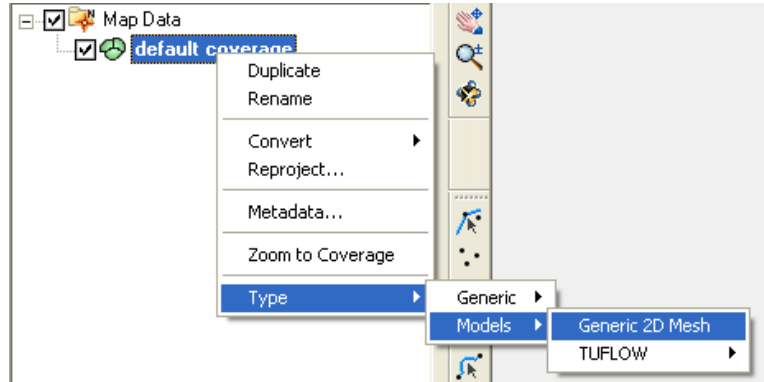


D Now use the “Create feature arc” button to join the dots together.



E At this point, it's a good idea to **SAVE**.

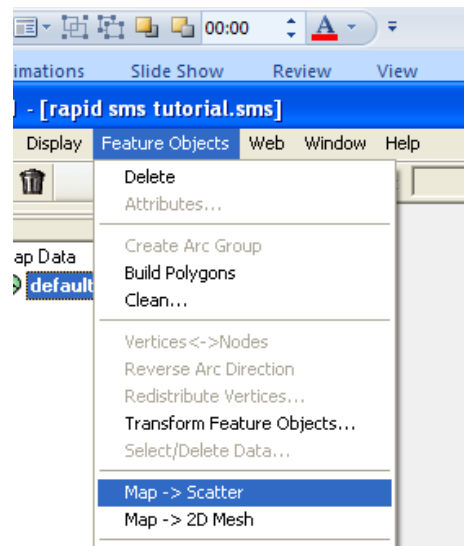
- F Also at this point (if not before), it is time to set the coverage type for the map data. The coverage type must be “Generic 2D Mesh”. Right click on the coverage label in the explorer bar as shown:



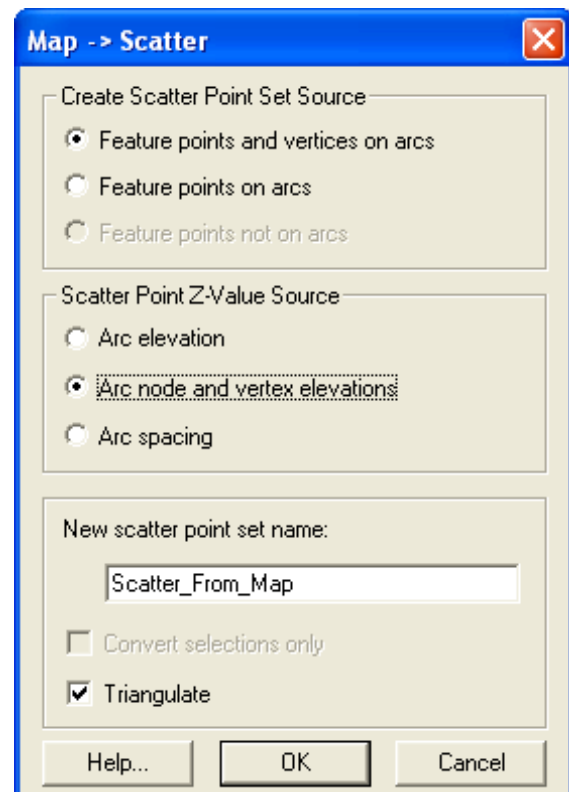
You have now created the basic map layout that will define the model geometry.

2 Create Scatter points (from which bed levels will be interpolated from)

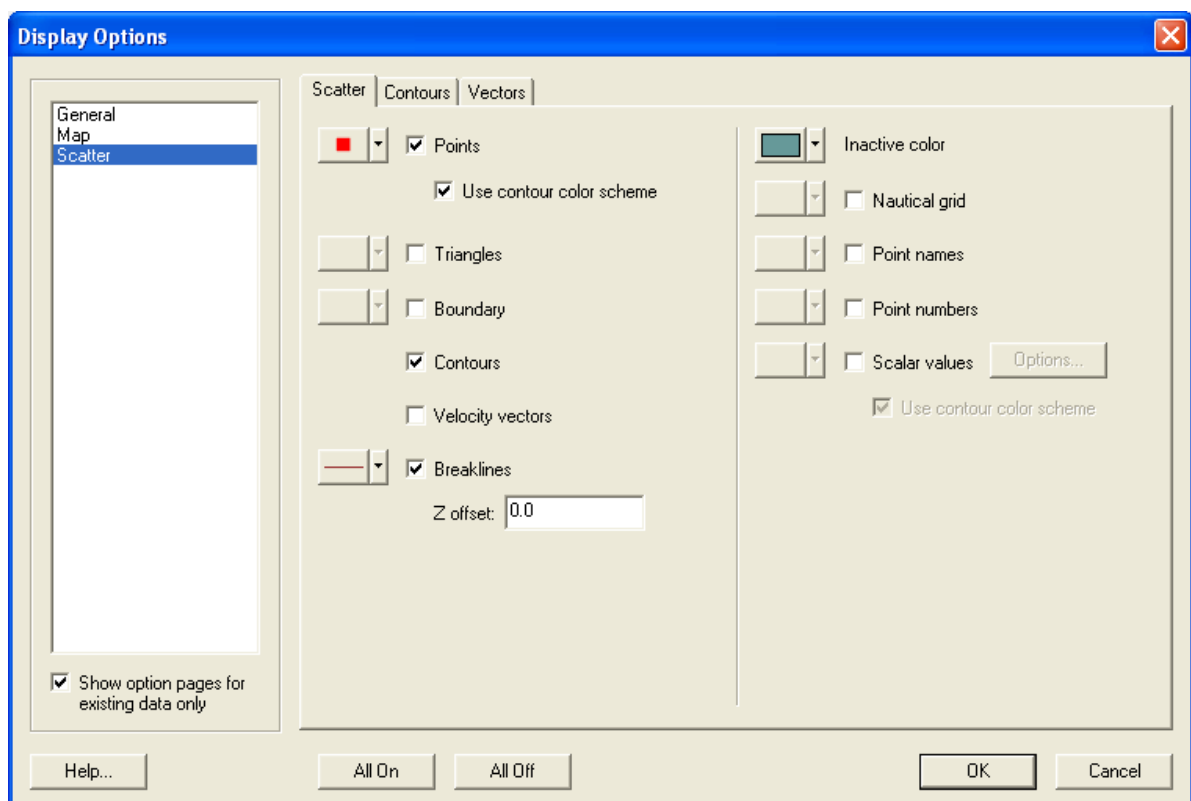
- A If you have entered “z” values you can also specify the bathymetry to be used in the model. Do this from the menu “Feature objects” – “Map -> Scatter”.



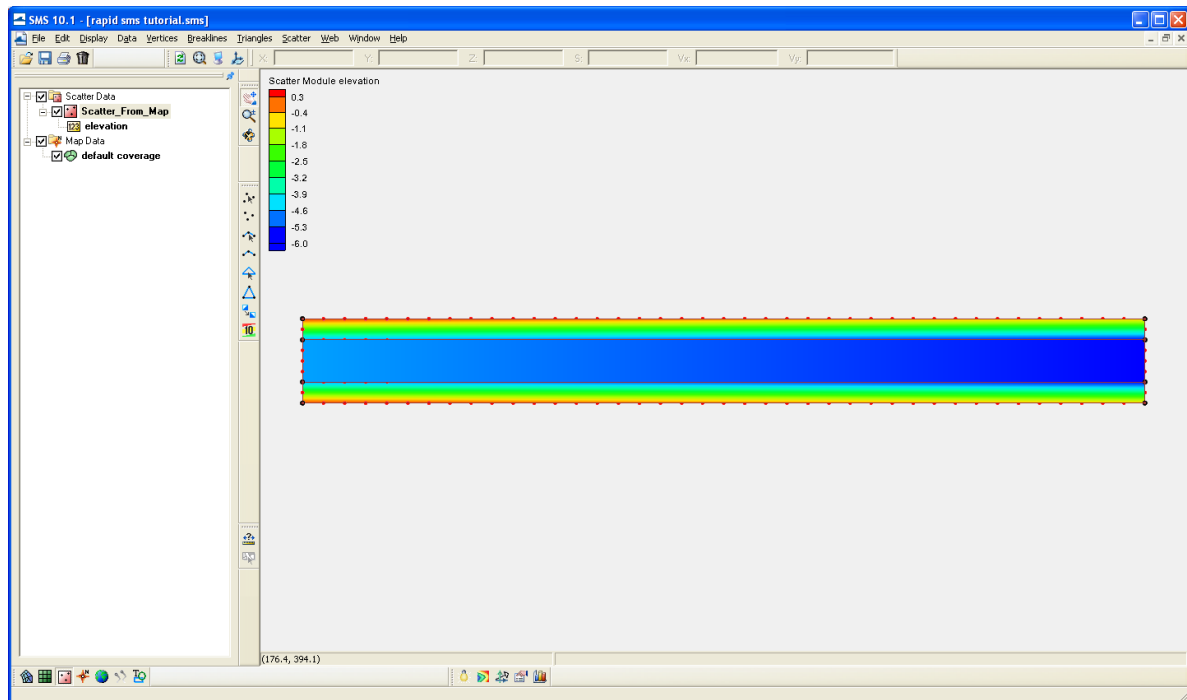
- B Make sure you specify the z value source from the “Arc node and vertex elevations” in the dialog box:



- C To see your handiwork, use the display button to turn on contours in the scatter data module:



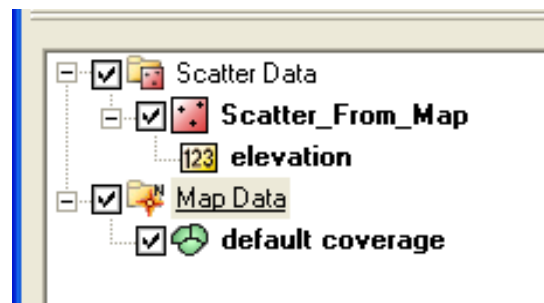
Then the shaded z values are then visible:



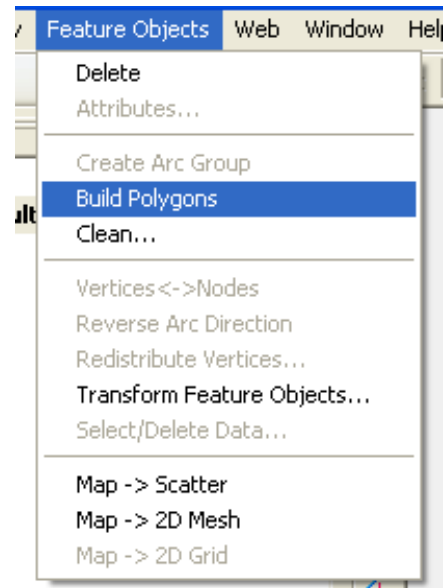
These steps (1 and 2) have replaced the often complex steps associated with inputting GIS layers, scatter datasets, etc to create the base geometry for the model. The approach demonstrated is fine for a simple test case, but real world applications are often more complex and contain a variety of data sources, etc. This can be done in SMS in a more rigorous manner (discussed in the SMS manuals) but is also done using other software such as GIS and CAD.

3 Build polygons

- A Back to the mesh module – click on the “Map Data” entry in the explorer window to do this.



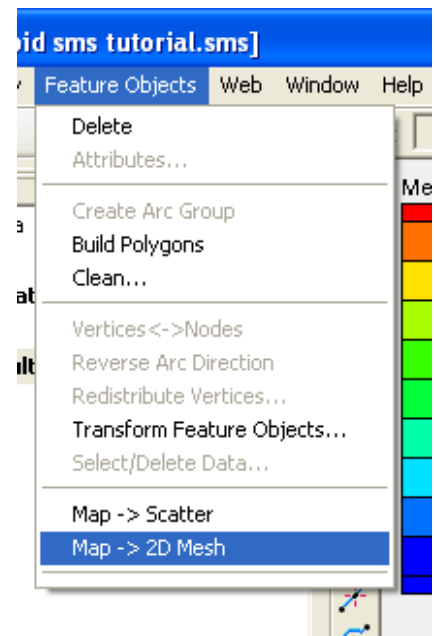
- B The next step is to build polygons, which is done from the menu “Feature objects” – “Build polygons”.



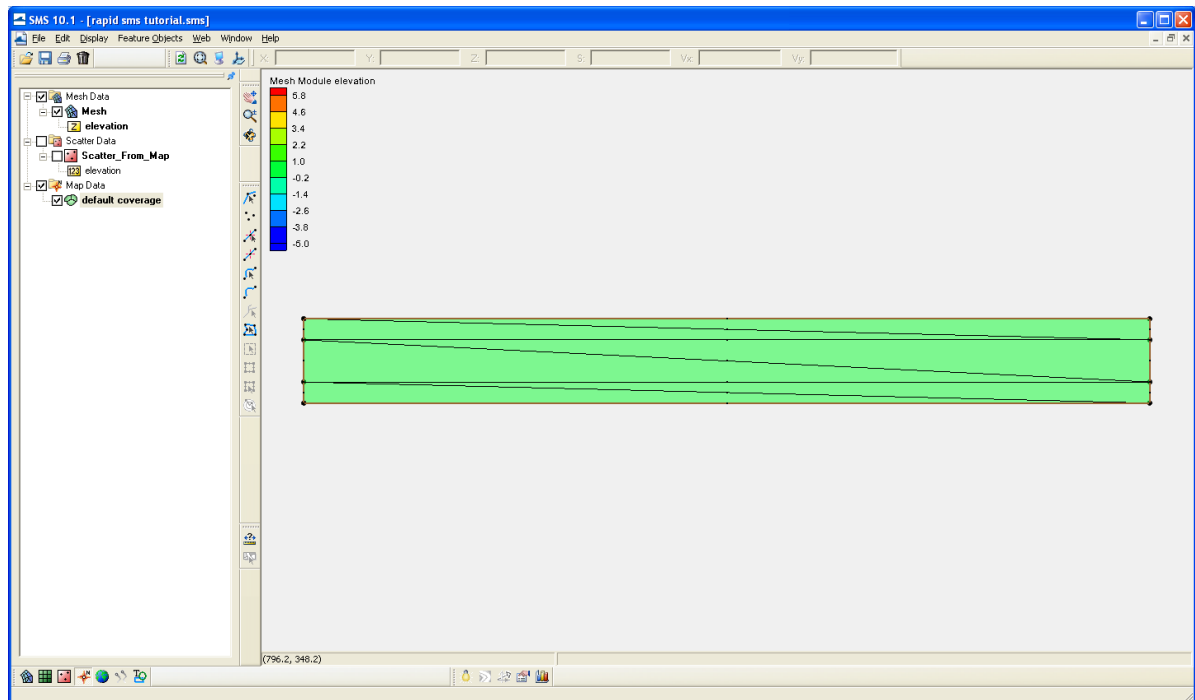
This takes the feature arcs and creates a series of polygons. It is these polygons that we can now individually investigate and specify mesh properties for.

4 Build the mesh (but need to go back and increase vertex resolution!)

- A Now we can build a mesh. To build the mesh, use the menu commands “Feature objects” – “Map -> 2D Mesh”.



The resulting mesh, as shown, doesn't look very good. But it is a mesh! A mesh has been created using 6 triangular elements (pave), connected by the nodes which, in this case, are the 8 points used to define the extents of the trapezoidal channel.



Note in the image that the scatter data set has been “unticked” in the explorer window – this hides the scatter data in the display, which makes the other information easier to see. Also unclick the mesh data set to better inspect the mesh module information.

This model geometry is not good enough; we require a much higher resolution than this. To make it better we need to go back to the mesh module and adjust the polygons to create more vertices and hence more elements.

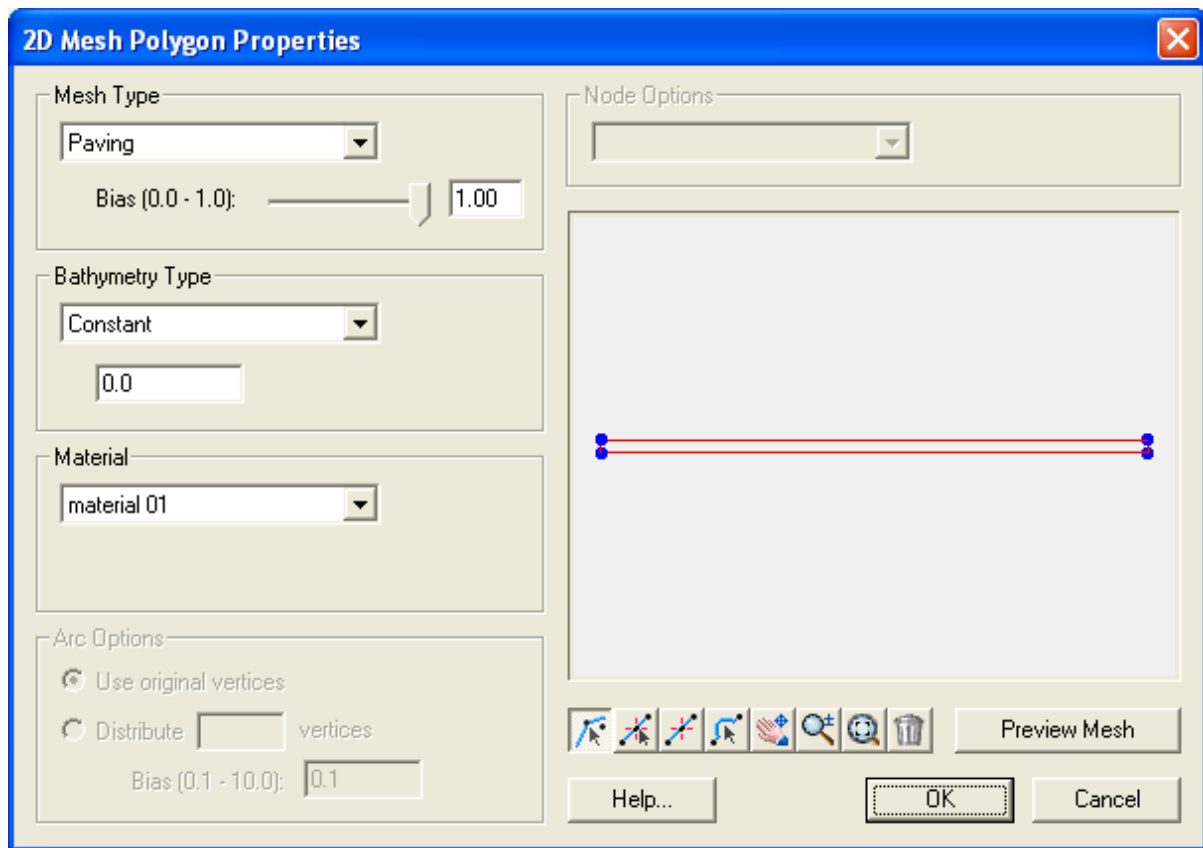
Note: more vertices along the polygon arcs = higher mesh resolution.

5 Modify polygons

- A Using the “select feature polygon” button, double click on each of the polygons.



A dialog box will appear with many options. Check out the SMS manual for a better description, or try a few different options and see what happens.



Some of the key options worth noting are:

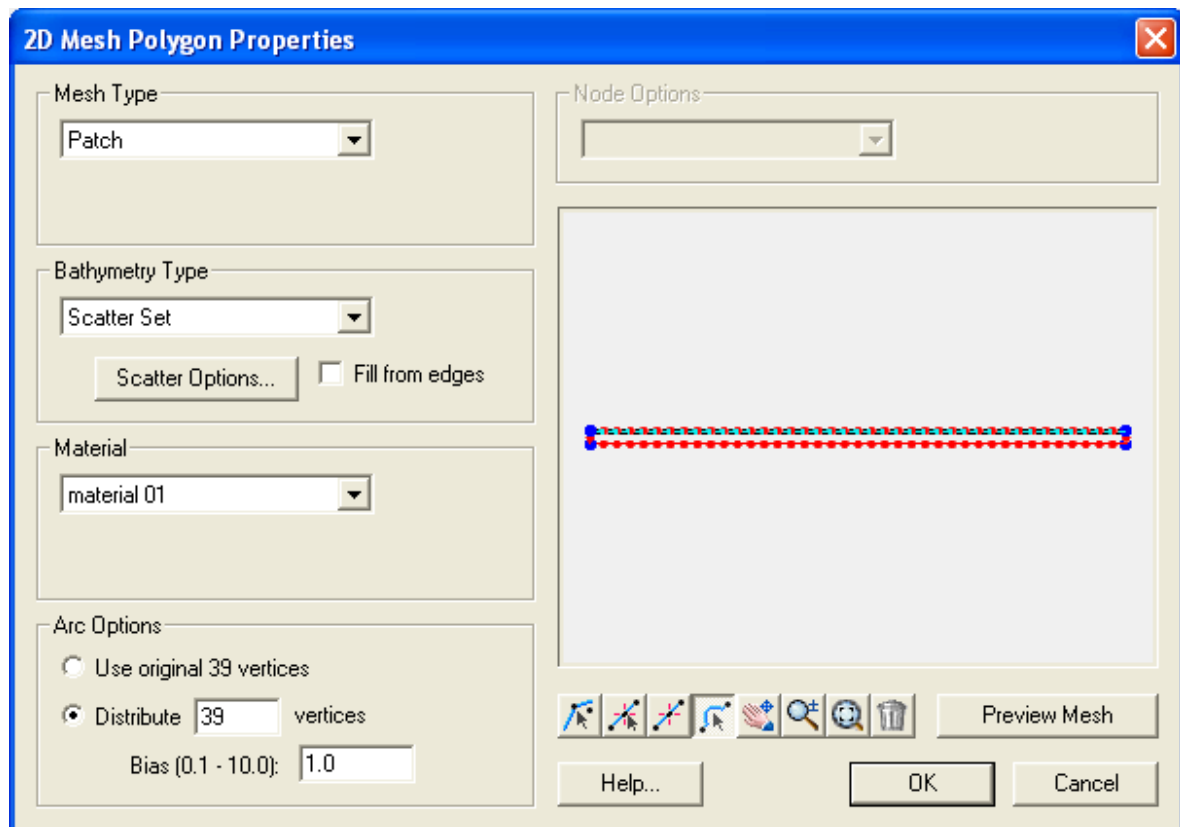
- Mesh type:
 - Paving is the classic triangular mesh, where triangles are used to fill the polygon area.
 - Patch fills the polygon area with a patch of quadrilateral (rectangular) elements. There are some limitations to using this mesh type (like having 4 arcs defining the polygon).
- Bathymetry Type:
 - Scatter Set will use the scatter data we have created in step ? to set the z values in the mesh
- Preview Mesh:
 - Use this to see how your mesh design looks for this polygon area.

Along the bottom of the display image is a series of buttons which let you adjust arc lines and the vertices that define them.

- B For this model example we should adopt a resolution of 5 m across the channel and 25 m along the channel. Using the “Select Feature Arc” button, select the top arc.



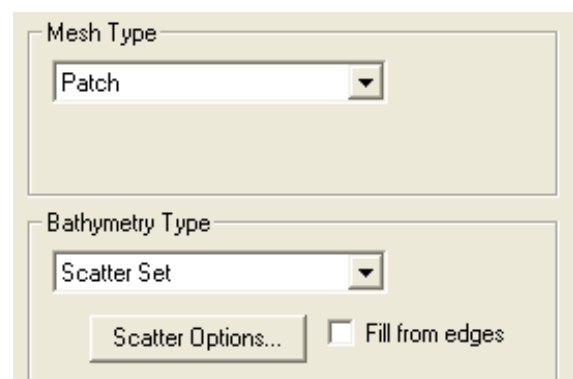
Then, adjust the number of vertices (the “Arc options” buttons) to suit the desired mesh resolution. In this instance, there should be $1,000 / 25 - 1 = 39$ vertices. Repeat this for the bottom arc.



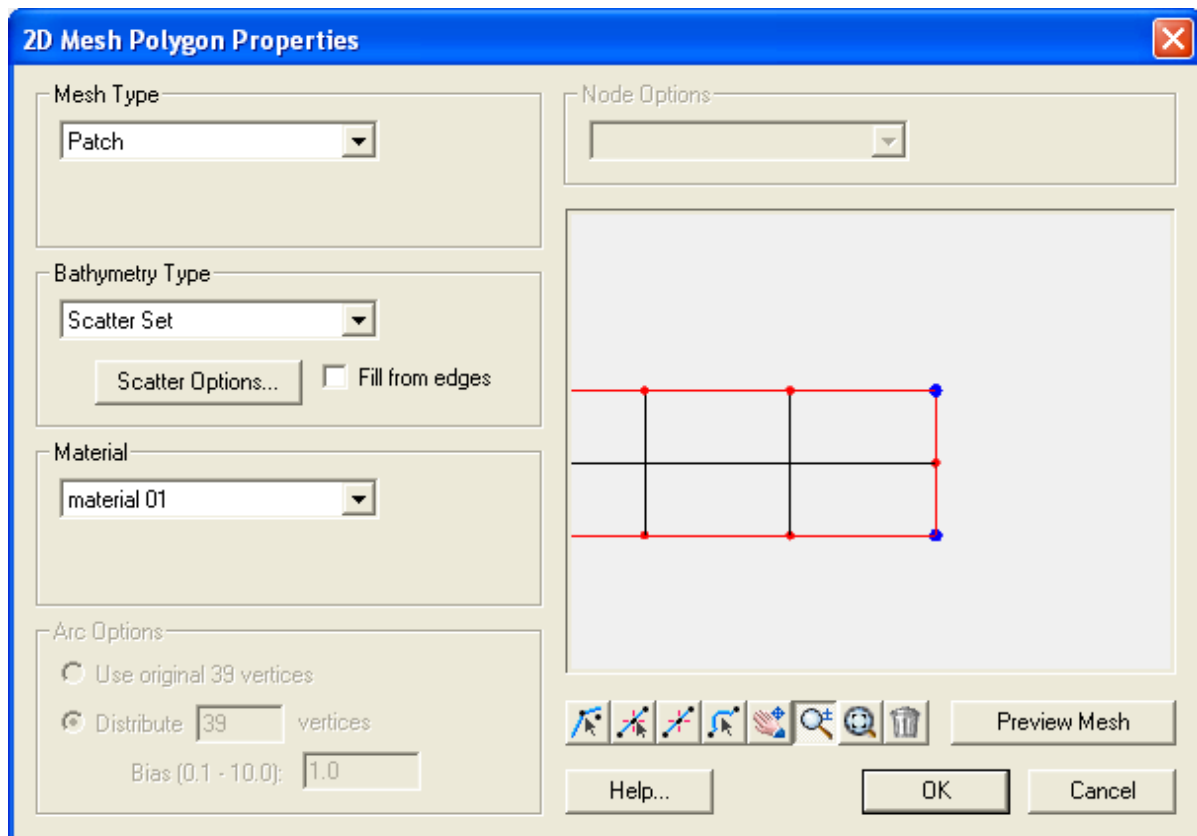
- C Repeat for the left and right arcs, which will have $25 / 12.5 - 1 = 1$ vertices. You may need to use the “zoom” button to assist with arc selection.



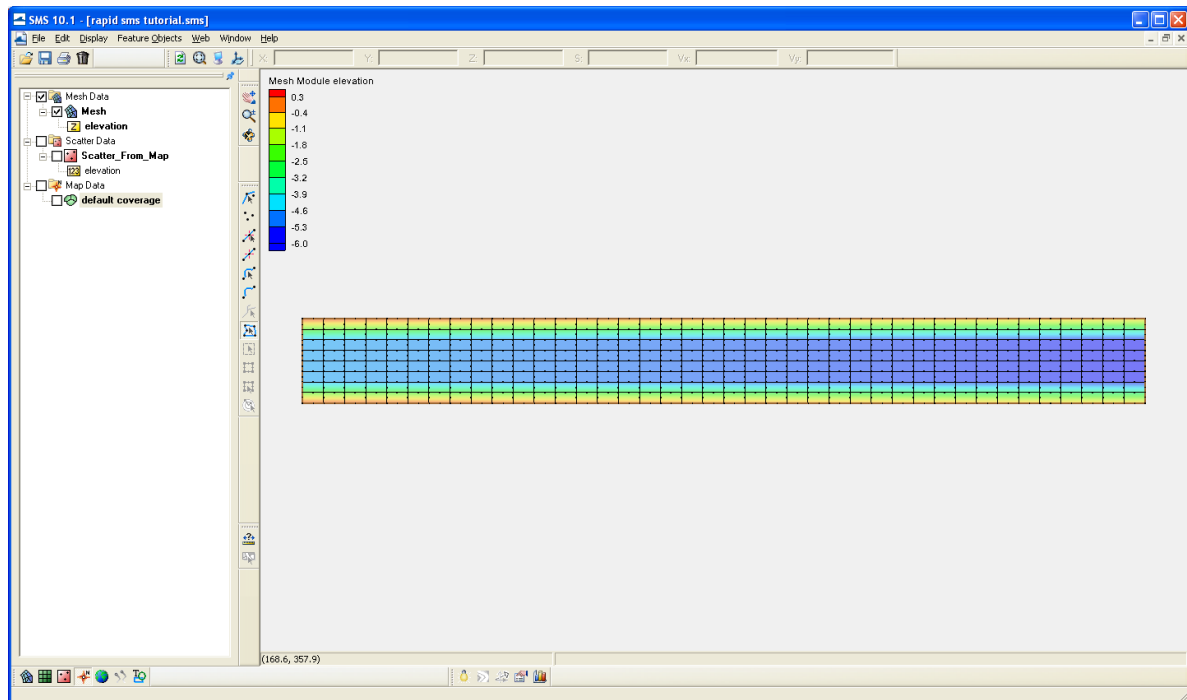
- D Once this is done, check the “Bathymetry type” to be “scatter set”. This will ensure that the z values previously entered into the scatter data will be interpolated onto the final mesh. For a straight trapezoidal channel such as this, a patch mesh type is the most efficient. For more information on this, see Section s?.



- E Use the “Preview Mesh” to see what the mesh looks like. Use the zoom function to see the finer details.



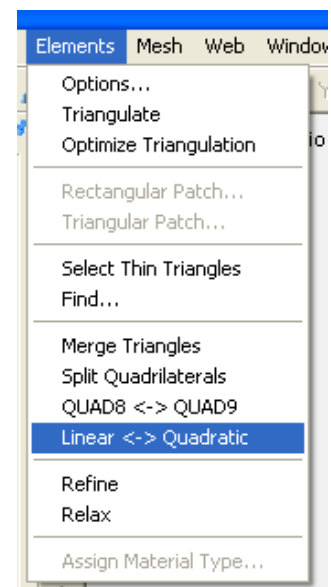
- F Once happy with the layout the mesh within this specific polygon, repeat with the remaining polygons. The middle polygon has $50 / 12.5 - 1 = 3$ vertices across the channel and $1,000 / 25 - 1 = 39$ vertices along the channel. The lower polygon has the same vertex count as the top polygon. Note that as each polygon is edited, the arc vertices are updated – this highlights how the mesh generator tracks each polygon to ensure that the overall mesh is consistent.
- G Now repeat step ?, using the menu commands “Feature objects” – “Map -> 2D Mesh”, to create the mesh. This time, a reasonable looking mesh should appear.



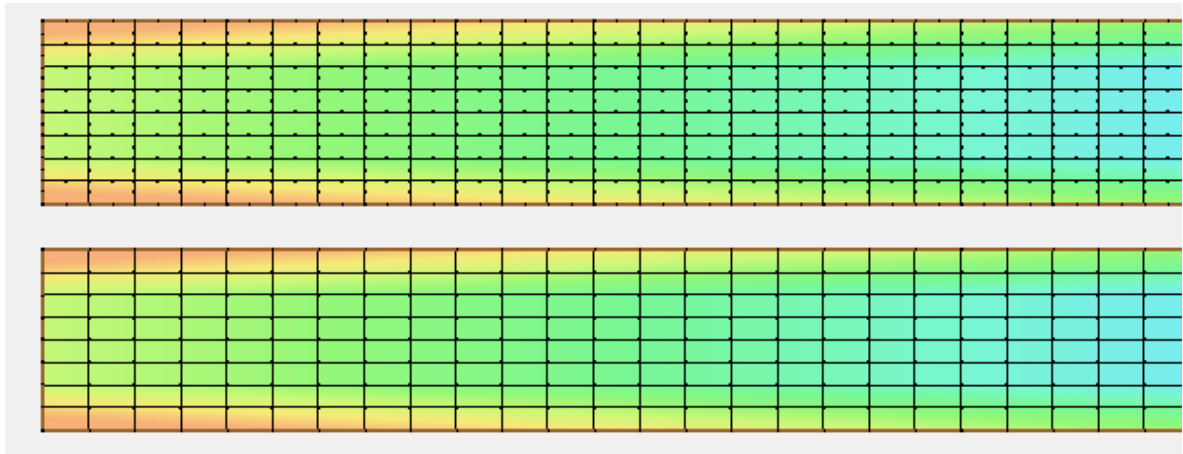
6 Linear elements

There are some final adjustments to be made prior to finishing the mesh creation.

- A The first is to switch the elements to be linear, rather than quadratic. Quadratic elements (not used by TUFLOW FV) are for finite element models that use mid-side nodes (such as RMA). Press the menu command “Elements” – “Linear <-> Quadratic” to remove the mid-side nodes.



The difference between linear and quadratic can be seen in the mesh display.



7 Nodestrings (boundary conditions)

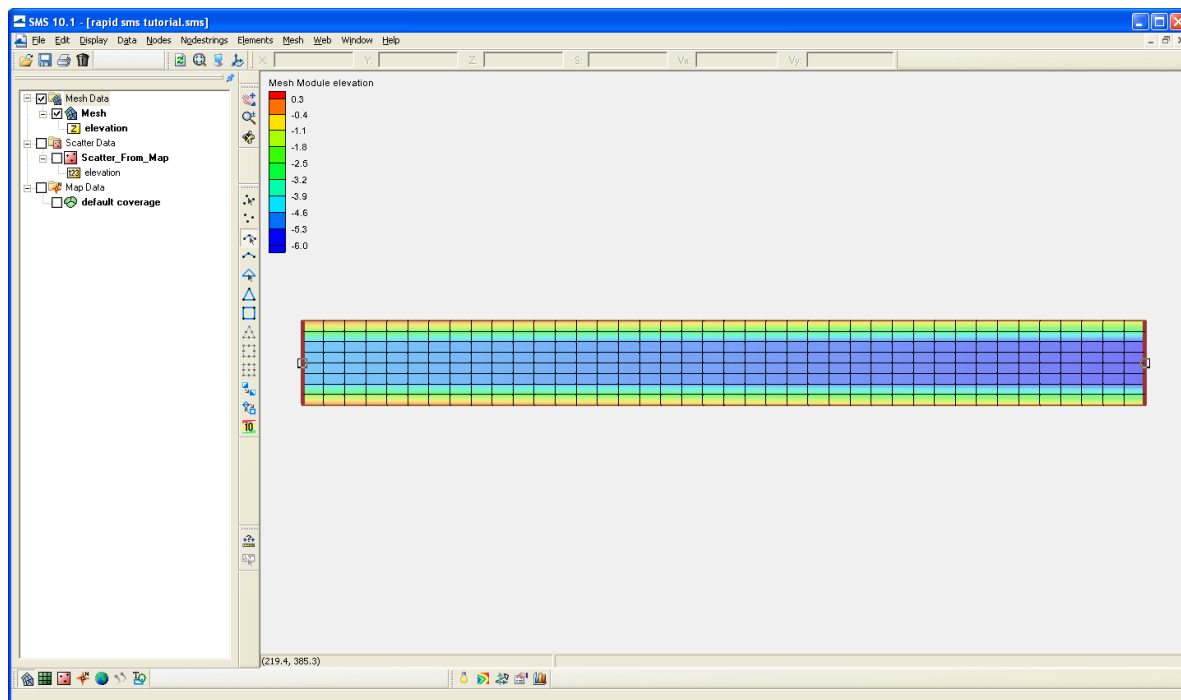
The last step is to insert nodestrings. Nodestrings are a string of nodes that can be used to define boundary conditions in TUFLOW FV (in SMS the nodestrings have a number of other functions not used by TUFLOW FV). For this example, there will be an upstream and a downstream boundary condition applied (ie along the left and right edges of the model domain).



- A Press the “Create nodestring” button, then click along the nodes that make up the left edge of the mesh. Then create a second nodestring along the right edge of the mesh.

Hint – hold the “shift” button down to select all nodes between first clicked and second clicked nodes.

These nodestrings are used to specify boundary conditions at a later time (see Section **Error! Reference source not found.**).



Save now. You have completed the construction of a mesh, congratulations.