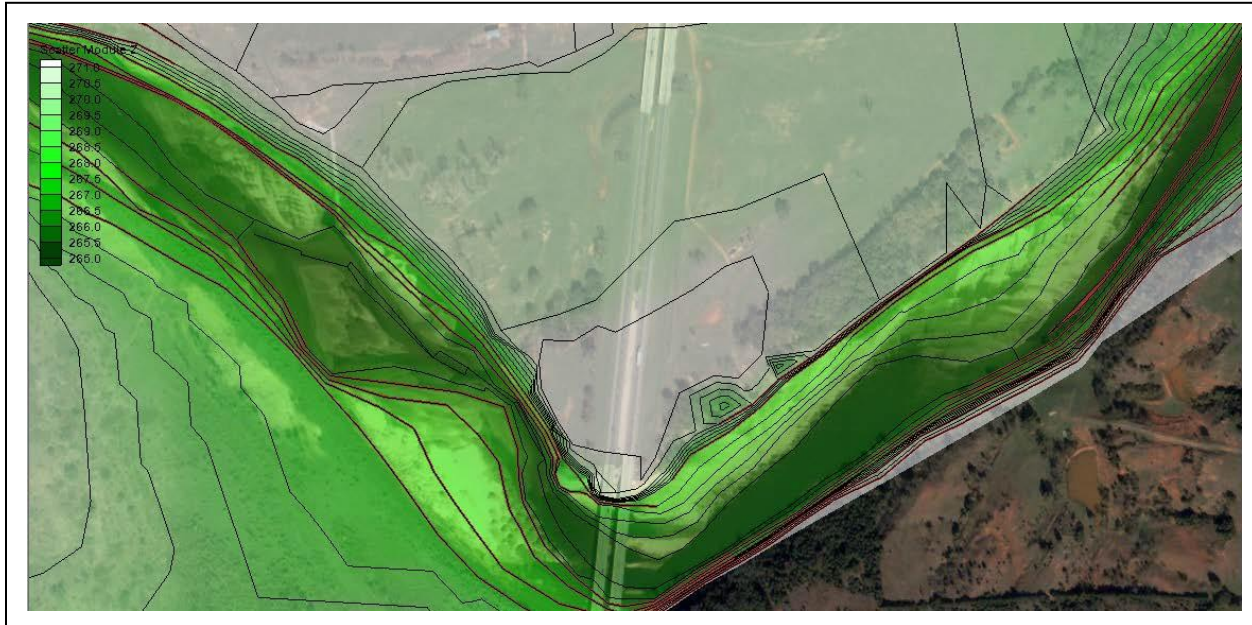*SMS 12.3 Tutorial*
Scatter Data – TINs

Objectives

This tutorial covers the basics of working with TINs (triangulated irregular networks) using the scatter module of SMS, including: importing TIN data, editing and filtering data, and exporting TIN data.

Prerequisites	Requirements	Time
• None	• Scatter Module • Map Module	• 45–60 minutes

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1   Importing Topographic Data

A common method of obtaining data points for two-dimensional hydrodynamic modeling is from scattered survey points or cross sections. SMS can import delimited text files which can then be triangulated. The data used in this most of this tutorial is from where I-35 crosses the Cimarron River in Oklahoma in the United States.

Start by importing data from a tab-delimited text file by doing the following:

1. Select File | **Open…** to bring up the *Open* dialog.

2. Browse to the *data files* folder for this tutorial.

3. Select "cimarron_survey_tab.txt" and click **Open** to exit the *Open* dialog and bring up the *Step 1 of 2* page of the *File Import Wizard* dialog.

This dialog provides options to specify delimiters and a starting point for importing delimited data.

4. In the *File import options* section, turn on *space* under *Set the column delimiters*.

5. Below the *File import options* section, enter "2" as the *Start import at row* and turn off *Heading row*.

6. Click **Next** to accept the other defaults and go to the *Step 2 of 2* page of the *File Import Wizard* dialog.

7. Select "Scatter Set" from the *SMS data type* drop-down.

This tells SMS to import the delimited data as scatter points.

8. In the *Mapping* section, make sure *Triangulate data* is turned on.

This tells SMS to triangulate the points into a TIN.

9. Click **Finish** to close the *File Import Wizard* dialog and import the data.

10. Select *Display* | **Display Options…** to bring up the *Display Options* dialog.

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

12. On the *Scatter* tab, turn on *Points*.

13. Click **OK** to close the *Display Options* dialog.

14. **Frame** 🔍 the project.

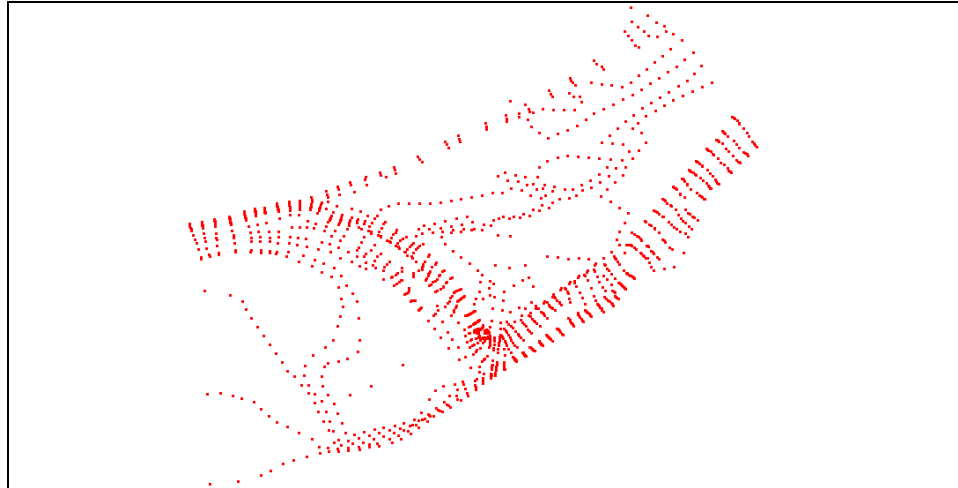The project should appear similar to Figure 1.

Figure 1   Imported delimited data displayed as a scatter set

Now adjust the display settings to see the TIN triangles and the surface contour data.

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

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

17. On the *Scatter* tab, turn on *Triangles* and *Contours*.

18. On the *Contours* tab, in the *Contour Method* section, select "Color Fill" from the first drop-down.

19. Click **OK** to exit the *Display Options* dialog.

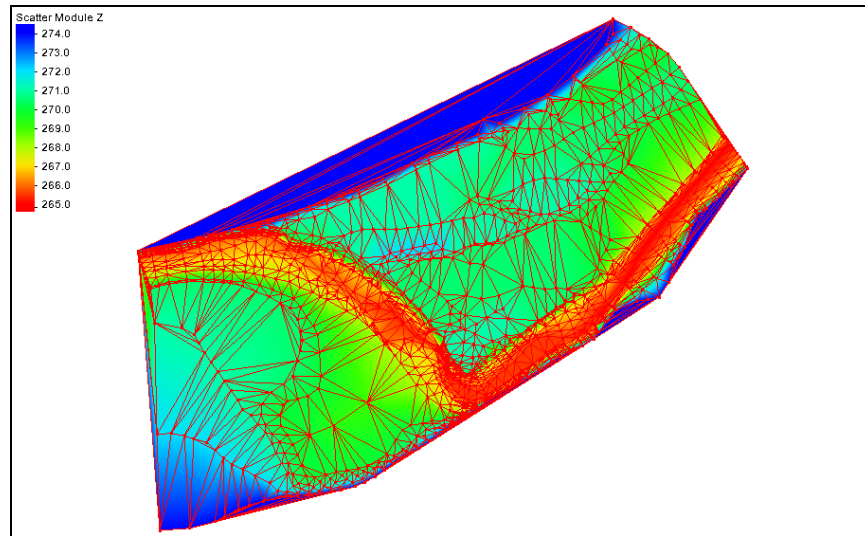The project should appear similar to Figure 2.

Figure 2   Triangulated and contoured data points

2   Editing TIN Data

Edit the TIN data by deleting boundary triangles and resolving triangulation issues.

2.1 Deleting Boundary Triangles

The triangulation process creates triangles from all the points in the set using a boundary called a convex hull. This results in areas being included in the surface that are not really represented well by the points.

For example, if the survey includes cross sections around a bend of a river, but does not have data points on the inside overbank, the surface will cover the inside overbank, but will not represent any data in that region. In a similar fashion, long skinny triangles may be formed around the edge of the surface that connect points that are a long ways from each other, and don't represent the surface.

To make the surface better represent the conditions being modeled, these extra triangles can be deleted in different ways. A common and intuitive method is to select (or click on) a triangle and then delete it. However, this method can be time consuming if a very large dataset is being used.

SMS includes a utility called the *Process Boundary Triangles* function. This utility speeds up the process of identifying and possibly removing unwanted boundary triangles. It selects boundary triangles that have an edge ratio higher than a user specified value. The edge ratio of a triangle is calculated by dividing the length of the triangle edge on the boundary by the length of the smallest triangle edge.

If desired, contours can be turned off by doing the following in order to make the selected triangles easier to see:

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

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

3. On the *Scatter* tab, turn off *Contours* and click **OK** to close the *Display Options* dialog.

To delete unwanted boundary triangles:

1. Select *Triangles* / **Process Boundary Triangles...** to bring up the *Process Boundary Triangles* dialog.

2. In the *Boundary Triangle Options* section, enter "1.00" as the *Aspect ratio* and click **Preview**.

The best edge ratio can be found by trial and error. The Graphic Window display will update, highlighting the triangles that are connected to the boundary with an edge ratio greater than "1.00". In this case, "connected" means all triangles between any scatter point and the boundary that have an edge ratio greater than 1.

Note that a large portion of the surface is selected. The utility can't distinguish between skinny triangles that actually represent the surveyed region, and undesirable boundary triangles. Care must be used to when selecting an edge ratio. If desired, try a few different values and use **Preview** to see how many triangles would be affected.

3. For consistency in this tutorial, enter "36.00" as the *Aspect ratio* and click **Preview**.

This value for the edge ratio selects mostly undesirable thin triangles. However, there are some triangles on the bottom that are selected just because of the high resolution of the cross section sampling. These triangles need to be unselected before deleting.

4. Select the *Select* option and click **OK** to close the *Process Boundary Triangles* dialog.

5. **Zoom** $\mathcal{Q}$ in to the area indicated at the bottom of the dataset (Figure 3).
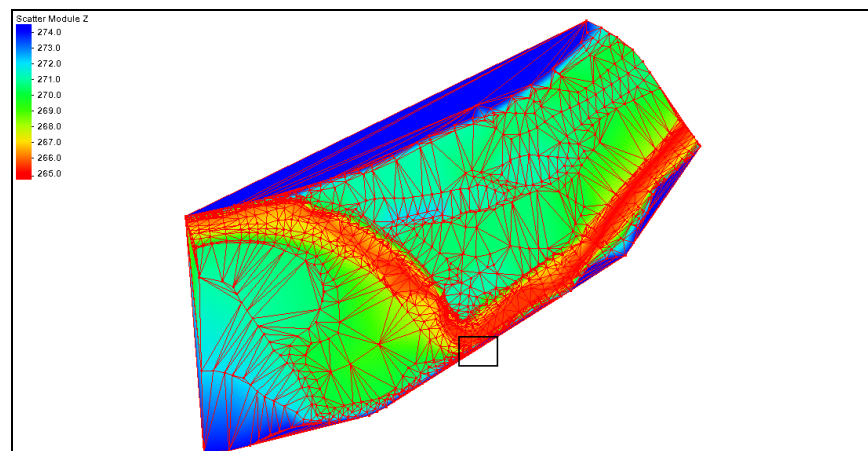

Figure 3   Zoom in to this area

The Graphics Window should appear similar to Figure 4.
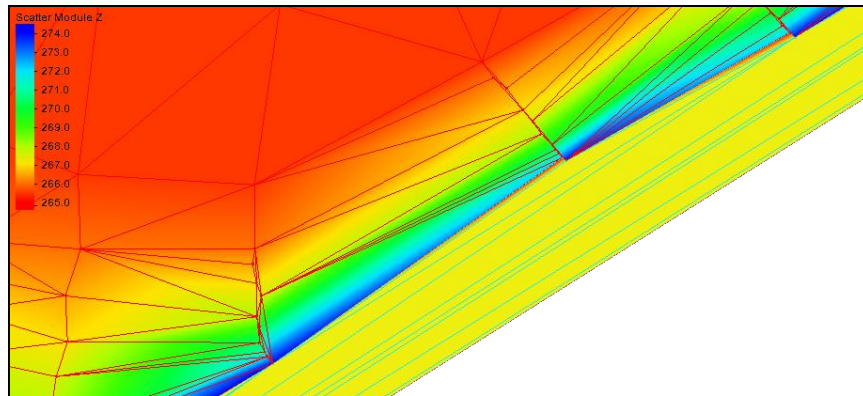
Figure 4   Area once zoomed in

SMS provides several modifier keys that can be used in connection with the graphical selection tools to make it easy to perform a number of selection related tasks. If the *Shift* key is pressed, newly selected items are added to the selection and previously selected items are removed from the selection. If the *Alt* key is pressed, newly selected items are selected if they were not previously selected (nothing is unselected). If both the *Alt* and *Shift* are pressed, newly selected items are removed from selection list (nothing is added).

6. Using the **Select Triangle** tool while holding down both *Alt* and *Shift*, drag a box around the triangles to deselect (Figure 5).
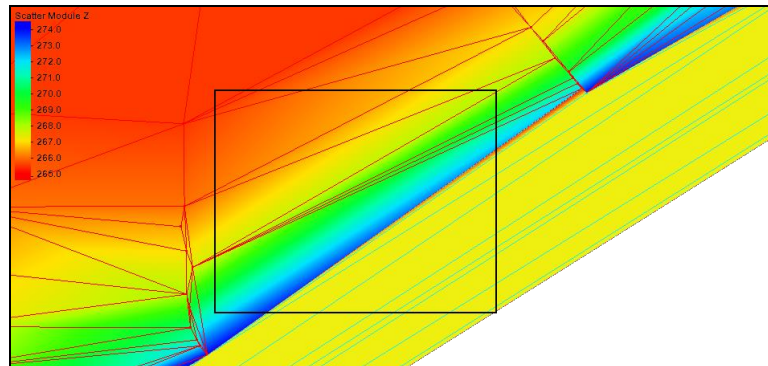

Figure 5   Area to select

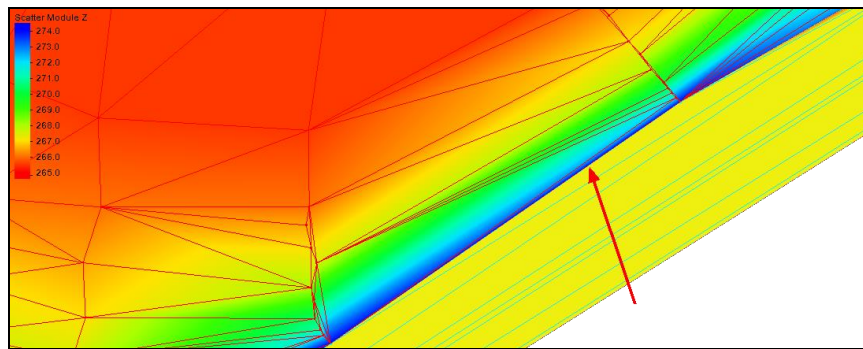All selected triangles whose centroid lies inside this box will be deselected (Figure 6).

Figure 6   Deselected triangles indicated by arrow

7. Press the *Delete* key to delete the selected triangles.

8. If prompted to confirm deleting these triangles, click **Yes**.

This process does not remove all undesirable boundary triangles. Manual selection and deletion of boundary triangles, or applying this process with multiple edge ratios or after some manual removal may be required.

In this situation, both the upstream and downstream ends of the river still have long skinny triangles that must be deleted manually because the survey data is so dense. It is not necessary to delete these triangles to complete the tutorial, but this should normally be done.

2.2 Solving Triangulation Issues

SMS builds a triangulation that conforms to the Delaunay criterion which is intended to create triangles that are as close to equilateral triangles as the data sampling will allow. In general, this avoids skinny triangles. While this is a good general triangulation strategy, it doesn't always represent the surface well.

This section will go step-by-step on how to swap edges to improve surface definition. A numerical model cannot represent a set of physical conditions if the surface it is based on is incorrect. Care should be taken to ensure the TIN is accurate.

How vertices are connected into triangles has a large effect on the surface that is represented. Connecting vertices differently will give different surfaces.

Consider the simple triangulation shown in Figure 7. When the surface is viewed from an oblique angle, Figure 8 can be seen. Notice how the triangulation creates a trough or channel.
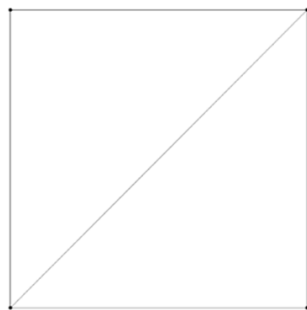

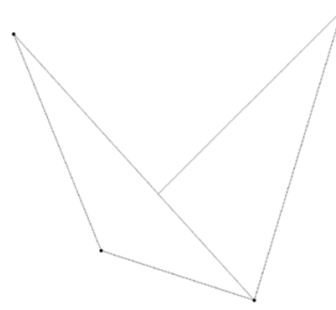*Figure 7   Simple triangulation*

Figure 8   Showing triangles

Figure 9 shows the same set of points after the common triangle edge (diagonal of the quadrilateral) is swapped. When viewed from an oblique angle (Figure 10), instead of the trough that was formed in Figure 8, a ridge or dam is formed.
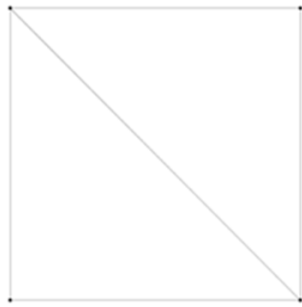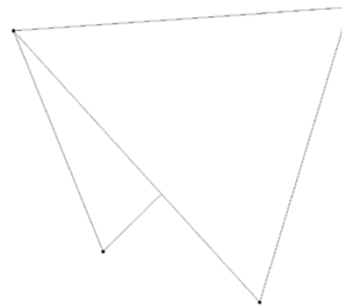
Figure 9   After swapping edges   *Figure 10   After swapping edges*

This simple example illustrates that the direction of the triangles edges can drastically change the surface created by the triangulation. This shows why the **Swap Edge** ⬔ tool is very important and has to be used carefully to better define channels, etc.

2.3 Manually Swapping Edges

The first editing tool is a manual edge swap. This method is usually straightforward, but may involve a lot of effort. It is illustrated here because many situations require manual clean up and the process is the basis for all of the TIN editing techniques.

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

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

3. On the *Scatter* tab, turn on *Contours*.

4. On the *Contours* tab, in the *Contour Method* section, select "Color Fill and Linear" from the first drop-down.

5. Click **Line color** ▭ to bring up the *Line Attributes* dialog.

6. Enter "2.0" as the *Width* and click **OK** to close the *Line Attributes* dialog.

7. Click **Color Ramp…** to bring up the *Color Options* dialog

8. In the *Palette Method* section, select *Intensity Ramp*.

9. In the *Current Palette* section, move the arrow on the left out of the black range into dark green (Figure 11).
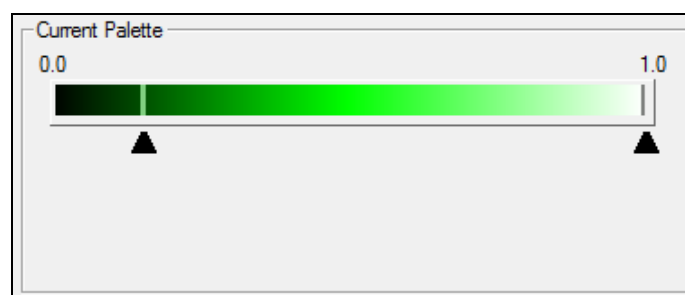

Figure 11   Current Palette section

10. Click **OK** to exit the *Color Options* dialog.

11. In the *Data range* section, turn on *Specify a range*.

12. Enter "265.0" as the *Min* and "271.0" as the *Max.*

13. In the *Contour interval* section, enter "13" in the field to the right of the drop-down.

14. Click **OK** to close the *Display Options* dialog.

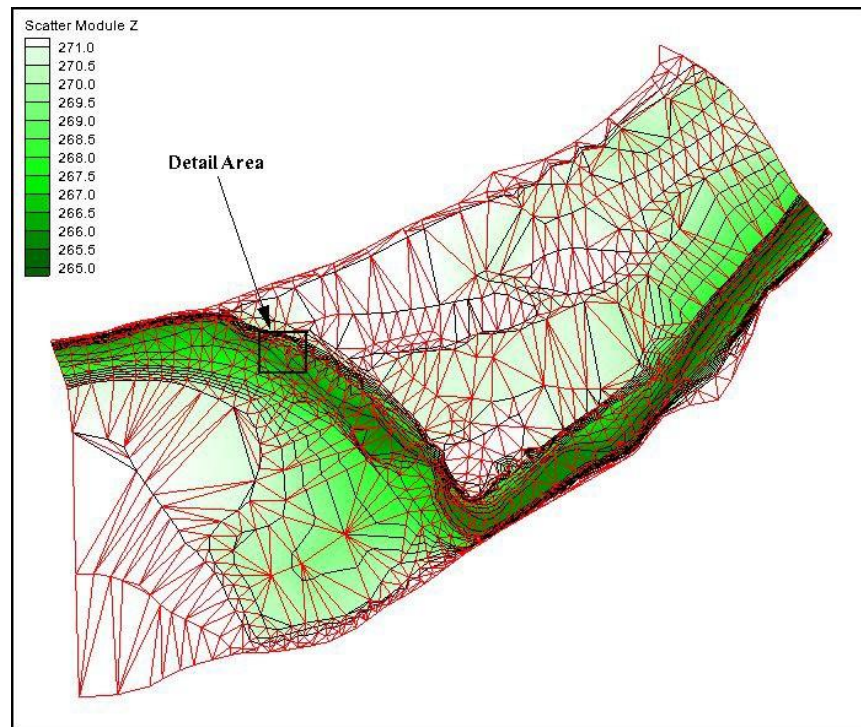15. **Zoom** in to the detail area as shown in Figure 12.

Figure 12   Manual swap detail area

After zooming, the screen should look like Figure 13. Note the linear contour around the edges to be swapped. It is not smooth or straight. In fact, two contours actually converge to a single line. This is possible if a vertical cliff exists, but is not likely in this situation. Natural contours tend to be smooth. A good guideline is to swap edges so that linear contours are smooth.
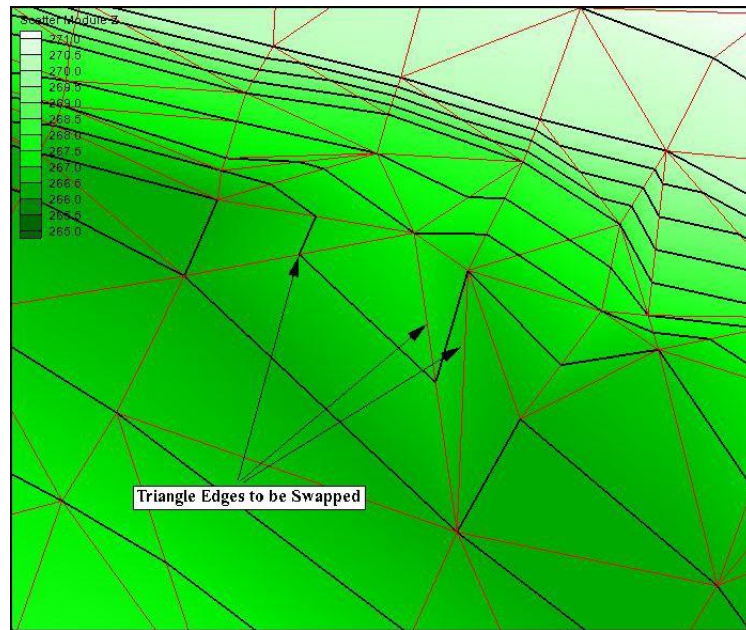
Figure 13 Zoomed out area showing triangle edges to be swapped

To fix triangles:

16. Using the **Swap Edge** tool, select one of the three edges identified in Figure 13.

17. Repeat step 16 for each of the other two edges identified in .

The TIN should appear similar to Figure 14. Notice how the two contours are now distinct and much smoother.

Note: Be very cautious when using the **Swap Edge** tool. If the wrong edge is selected, the quality of the surface can suffer. While swapping edges, make sure that the surface is being defined accurately.
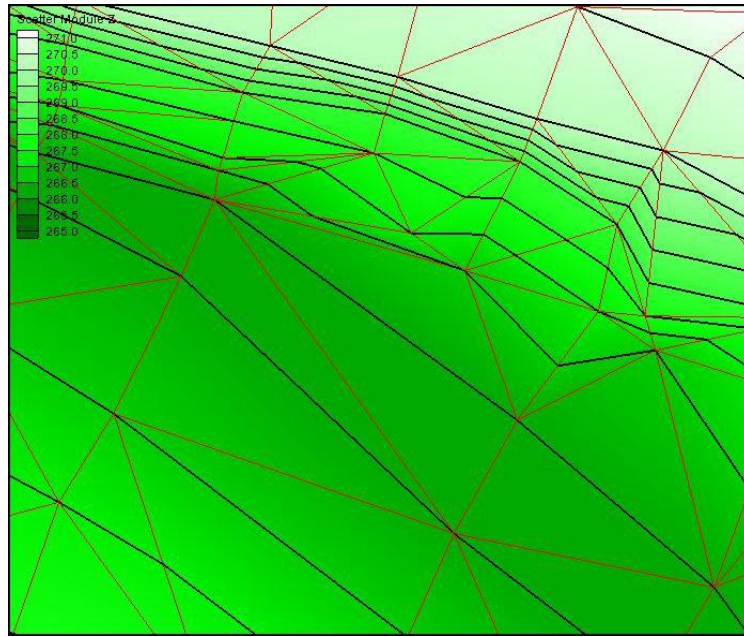
Figure 14   Triangles after edge has been swapped

2.4 Adding Breaklines to Smooth Contours

While it is always possible to get the desired surface by swapping edges, it is often time consuming and may be impractical. When wanting a feature represented in a TIN—such as the bottom of a channel, bank, or man-made feature—it might be time consuming to determine all the right edges to swap to connect the feature. Breaklines can be used in these cases to force triangle boundaries along a feature. Breaklines can be imported in various formats as part of the scattered data (from the surveyor), and SMS includes the capability to create breaklines from CAD or GIS data.

As noted above, an easy way to spot triangulation problems is to look for jagged contour lines. Breaklines can be used to connect vertices of similar elevations to prevent jagged contours. The following steps illustrate how to use breaklines to edit the TIN.

When not working directly with the edges, it helps to turn them off. This unclutters the display and simplifies interaction with the scattered data points. It is also useful to use 3D views to understand the shape of the surface by rotating the view and experimenting with the surface. In this case, a view will be specified as an illustration.

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

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

3. On the *Scatter* tab, turn on *Points* and turn off *Triangles*.

4. Click on the ▣ button to bring up the *Symbol Attributes* dialog.

5. Enter "4" as the *Size*.

6. Click **OK** to close the *Symbol Attributes* dialog.

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

8. On the *General* tab, turn off *Auto z-mag* and enter "10.0" as the *Z magnification*.

9. On the *View* tab, select *View angle* and enter "30.0" as the *Bearing* and "50.0" as the *Dip*.

10. Under *Looking at point*, enter "648700.0" for *X*, "3984000.0" as *Y*.

11. Enter "2675.0" as *Z*, and "800.0" as the *Width*.

12. Click **OK** to exit the *Display Options* dialog.

13. Select *Display* | **Oblique**.

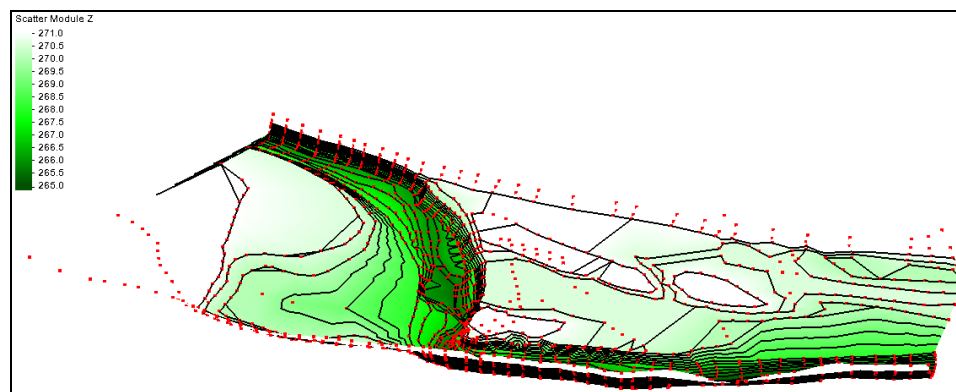The project should appear similar to Figure 15.

Figure 15   Angle (oblique) view of contours and points

Note how the contours tend to connect the vertices of common elevation. However, they connect with very crooked lines. A breakline, connecting vertices with straight lines, can force the triangulation to follow those straight lines.
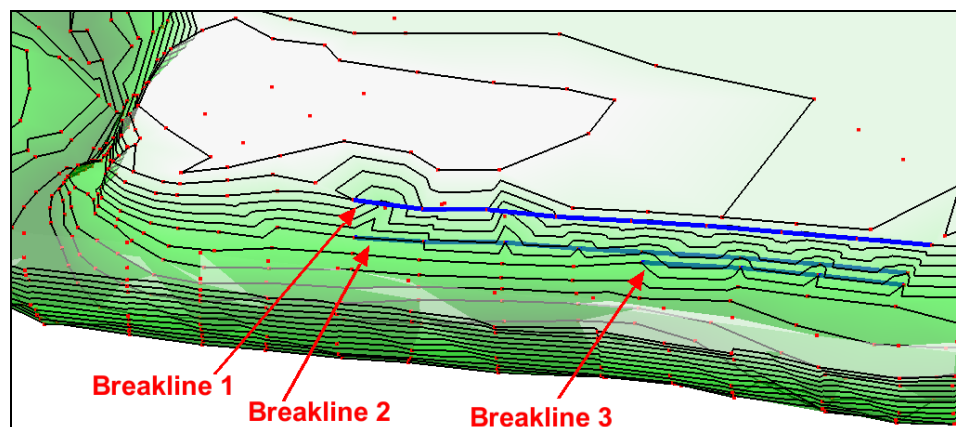

Figure 16   Connectivity for breaklines on the bank

14. **Zoom** in to the detail area just to the right of the sharp turn on the river (Figure 16).

15. Using the **Create Breakline** ⌢ tool, add the first breakline as shown in Figure 16. Click on each vertex along the line and double-click on the last one to end the breakline.

16. Repeat step 15 to create the second and third breaklines.

17. Using the **Select Breakline** ⫩ tool while holding down the Shift key, select all three breaklines.

18. Right-click and select **Force Breakline.**

After forcing the breaklines, the breaklines can be deleted.

19. Right-click and select **Delete Selected**.

20. When asked to confirm the deletion of the selected breaklines, click **Yes**.

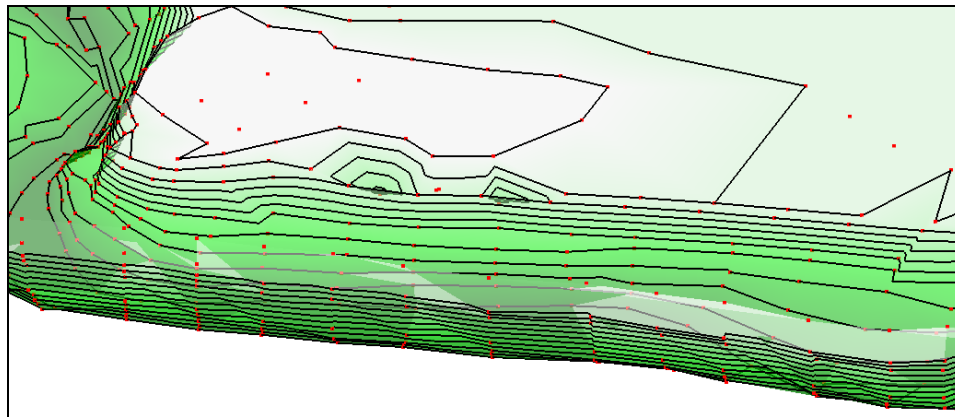Notice how the contours are much smoother now (Figure 17).

Figure 17   TIN with breaklines forced

These breaklines smoothed out one section of the bank. If desired, experiment with the 3D view to get a better impression of the surface. More breaklines can be added around the scatter set to force the triangulation in other areas.

Even with the ability to force breaklines, cleaning up an entire survey can still be very time consuming. An updated and cleaned up file of the scatter set has been provided.

To view the updated surface, do the following:

21. Click **Open** 📂 to bring up the *Open* dialog.

22. Select "cimarron_updated.sms" and click **Open** to exit the Open dialog and import the new project.

23. If asked to confirm deletion of the existing data, click **Yes.**

The imported project should appear similar to Figure 18. Twenty-six breaklines were used to smooth and force the triangulation. Feel free to **Zoom** 🔍 in to review how the breaklines were used.
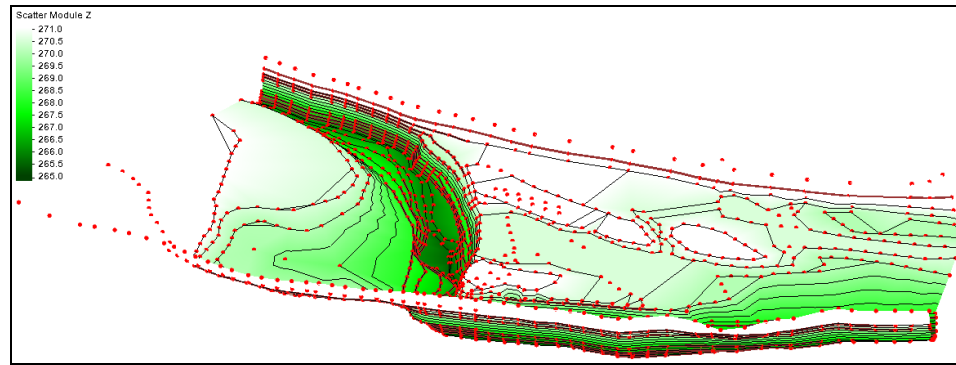
Figure 18   Clean TIN of the Cimarron River

3   Modifying Scatter Sets

Scatter sets may not represent all the features or the area being modeled and therefore need enhancement. Verifying the TIN with another data source, such as an aerial photo or topographic map can ensure the adequacy of the surface for modeling purposes.

Some features may be too small to have been captured in the survey, but still have significant impact on the hydrodynamics of the region. Other features—such as man-made structures (such as embankments or levees)—may not have existed at the time of the survey. Remember that features change over time, so verification must include data from the appropriate time period.

Do the following to import the image file:

1.   Click **Open** to bring up the *Open* dialog.

2.   Select "ge_highres.jpg" and click **Open** to import the background image and exit the Open dialog.

3.   Switch to **Plan View** .

The image will only be visible in plan view. Once the image is loaded, adjust the scatter data display to see the road by doing the following:

4.   Click **Display Options** to bring up the *Display Options* dialog.

5.   Select *Scatter* from the list on the left.

6.   On the *Scatter* tab, turn off *Points* and turn on *Triangles*.

7.   On the *Contours* tab, enter "70" as the *Transparency*.

8.   Click **OK** to exit the *Display Options* dialog.

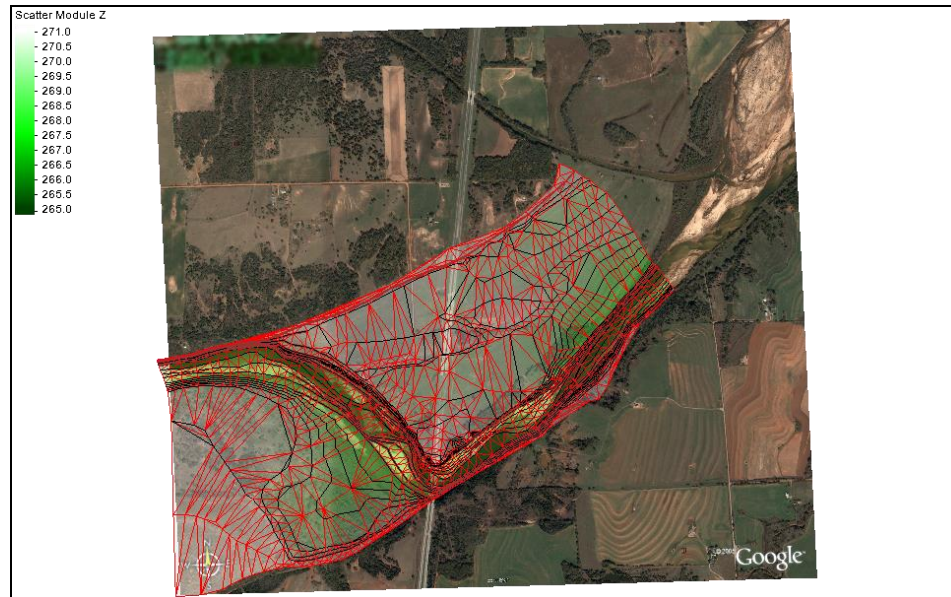The Graphics Window should appear similar to Figure 19.

Figure 19   TIN with background image

The aerial photo reveals that a roadway cuts through this domain. The survey and TIN surface do not represent the roadway embankment. This may have been intentional, if the study was intended to compare preconstruction conditions to post-construction or if a modified structure is desired. The TIN would require modification to accurately represent the flood plain and the roadway with its embankment. There are several methods available for incorporating a feature into a TIN.

These include:

- Using the stamped feature option in SMS (refer to the "Feature Stamping" tutorial for details on this process).

- Merge another TIN into the current surface.

- Add vertices at specified points or along feature lines.

The first two options are illustrated in the "Feature Stamping" tutorial and will not be discussed in this tutorial.

3.1   Adding and Editing TIN Vertices

Digitization to add points to a scatter set functions in SMS after a surface is created just as when starting out. Using the **Create Scatter point** ⋮ tool, new scatter vertices can be placed at any location simply by clicking at that location. The elevation of the point defaults to the current elevation. Changing the elevation of a newly created point, using the *Z* edit field, changes the current elevation.

Vertices can also be moved interactively by dragging the individual entities. To prevent accidental edits to scattered vertex locations, SMS includes an option to lock the vertices in the *Vertices* menu.

When adding a structure, such as a roadway embankment, it may be tedious to insert each vertex one at a time. An alternative is to use a feature line. The feature line is an arc in a coverage in the Map module. SMS includes features to convert CAD files or GIS files to feature arcs. Refer to *Overview*, *GIS* and *Observation* tutorials as well as to the section at the end of this tutorial for more description of these processes.

For this tutorial, the roadway is a straight line with a constant elevation, so create the feature arcs interactively.

To do this:

1. **Zoom** $\mathbb{Q}$ in to the area shown in Figure 20.

2. Select "$\bigcirc$Area Property" in the Project Explorer to make it active and switch to the **Map** $\clubsuit$ module.

3. Using the **Create Feature Arc** $\int$ tool, create two arcs as shown in Figure 20. No intermediate vertices are required at this time.

4. Using the **Select Feature Arc** $\cancel{\mathbb{K}}$ tool while holding down the *Shift* key, select the two arcs.

5. Select *Feature Objects* | **Transform Feature Objects…** to bring up the *Transform Feature Objects* dialog.

6. Select *Scale* and enter "273.0" for *Z*.

This changes the arc elevations.

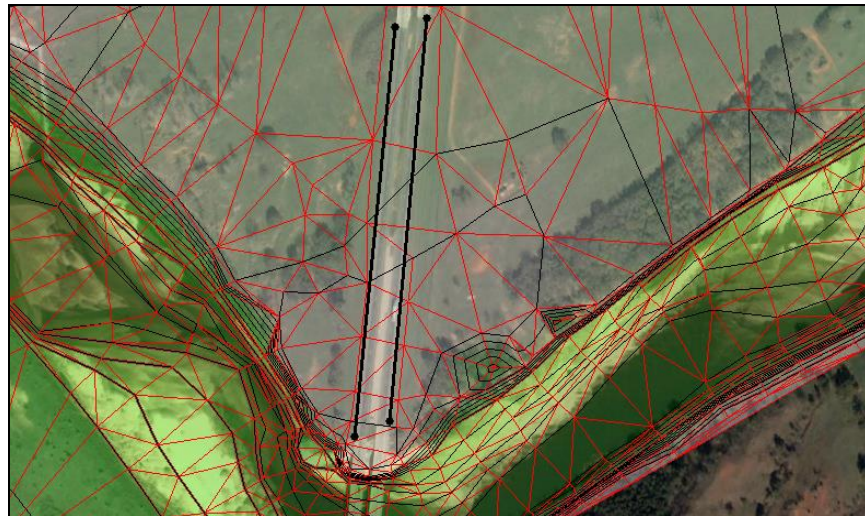7. Click **OK** to close the *Transform Feature Objects* dialog.

Figure 20   Arcs along embankment edges of the road

8. With both arcs still selected, right-click on either and select **Redistribute Vertices…** to bring up the *Redistribute Vertices* dialog.

9. In the *Arc Redistribution* section, select "Specified spacing" from the *Specify* drop-down.

10. Enter "50.0" as the *Average spacing*.

This is the approximate spacing of the vertices in the TIN. It is useful to be consistent with spacing when possible and it is not excessive.

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

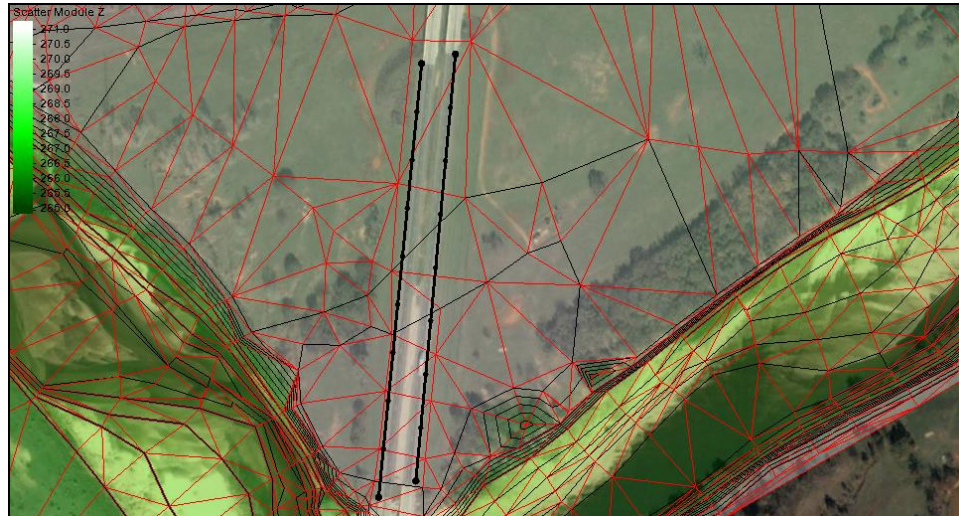The resulting arcs, with their distributed vertices should appear similar to Figure 21.

Figure 21   Redistributed vertices along embankment arcs

9. Right-click on "🌐 Area Property" and select *Convert* | **Map → 2D Scatter** to bring up the *Map → Scatter* dialog.

10. In the *Scatter Point Z-Value Source* section, select *Arc elevation*.

11. Click **OK** to accept all other default settings and exit the *Map → Scatter* dialog.

SMS creates a new scatter set, with breaklines along the arcs. There are other options to provide *z* values for the newly created points. This gives more flexibility.

12. Select "📌 Area Property Scatter" in the Project Explorer to make it active.

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

14. In the *Select scatter sets to merge* section, check both boxes in the *Merge* column of the spreadsheet.

15. Click **OK** to merge the scatter sets, close the *Merge Scatter Sets* dialog, and bring up the *Merge Report* dialog.

A new scatter set is created that includes points and breaklines along the edges of the roadway embankment. The "Feature Stamping" tutorial explains more about the merging options.

16. After reviewing the merge report, click **Close** to close the *Merge Report* dialog.

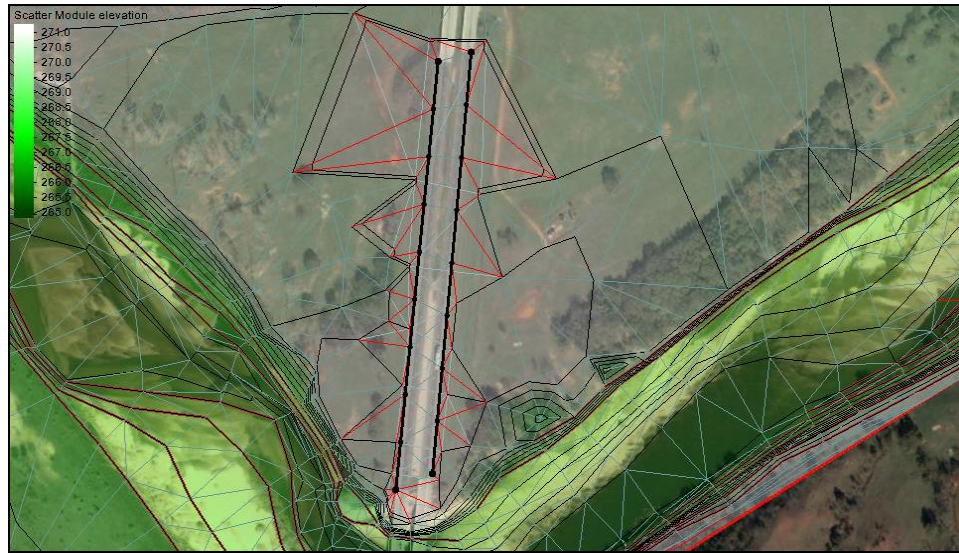The project should appear similar to Figure 22.

Figure 22 TIN with additional inserted points after merging the scatter sets

4 Exporting to Tabular Data

TIN data can be exported into a tabular format from SMS for use in other software. To export the existing data:

1. Select *File* | **Save As…** to bring up the *Save As* dialog.

2. Select "Tabular Data Files (*.txt)" from the *Save as type* drop-down.

3. Enter "cimarron_updated_tabular2.txt" as the *File Name*.

4. Click **Save** to close the *Save As* dialog and open the *Export Tabular File* dialog.

5. In the *Options* section, enter "4" as the *Number of Columns*.

6. In the spreadsheet, in column *1*, click **Data…** in the *Data* row to open the *Format Column Data* dialog.

7. In the *Data Type* section, select "Vertex Id" and click **OK** to close the *Format Column Data* dialog.

8. In column *2*, on the *Data* row, click **Data…** button to open the *Format Column Data* dialog.

9. In the *Dataset to Export* section, select "x location" from the tree list and click **OK** to close the *Format Column Data* dialog.

10. Repeat steps *8–9* for columns *3* and *4*, selecting "y location" and "elevation", respectively.

11. Turn on *Column Headings*.

12. Enter "Vertex ID" on the *Heading* row in column *1*.

13. Repeat step 12 for columns *2*, *3*, and *4*, entering "X", "Y", and "Elevation", respectively.

14. Click **OK** to exit the *Export Tabular File* dialog and save the file.

5   Filtering Data in Large Files

Sometimes available data can be rather large, which can result in time consuming processing. In the case where the available data is too large to effectively process, SMS provides different ways to filter certain data points that are not important for later simulations.

For this part of the tutorial, a set of evenly distributed cross section data points defined in the file "Raster-in.xyz" will be imported into SMS using two types of filter options.

5.1   File Import Filter Options

Input date files can be large. They may have higher resolution that is needed or cover a larger area that is needed for a specific project. In those situations, it is useful to limit the data imported into SMS. SMS provides options to perform this filtering.

Before importing the file, change the display options to show the points by doing the following:

1. Select *File |* **Delete All** to clear out the data in SMS.

2. When asked to confirm deletion of all data, click **Yes.**

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

4. At the bottom of the list on the left, turn off *Show option pages for existing data only*.

5. Select *Scatter* from the list on the left.

6. Turn on *Points* and *Use contour Color Scheme* .

7. Turn off *Triangles*.

8. Click on the ▪ button to bring up the *Symbol Attributes* dialog.

9. Enter "8" as the *Size* and select the circle icon from the section on the right.

10. Click **OK** to exit the *Symbol Attributes* dialog.

11. Click the 🔲 button to the left of *Inactive color* to bring up the *Color* dialog.

12. Select a purple or magenta color and click **OK** to close the *Color* dialog.

13. Click **OK** to exit the *Display Options* dialog.

The "Raster-in.xyz" file will be imported multiple times to illustrate the options. Start by importing the entire file:

1. Click **Open** 📂 to bring up the *Open* dialog.

2. Select "Raster-in.xyz" and click **Open** to exit the *Open* dialog and bring up the *Step 1 of 2* page of the *File Import Wizard*.

The first page gives the option to specify delimiters and a starting point for importing.

3. In the *Set the column delimiters* section, turn on *Space*.

4. Click **Next** to accept the remaining defaults and go to the *Step 2 of 2* page of the *File Import Wizard* dialog.

5. Select "Scatter Set" from the *SMS data type* drop-down.

This tells SMS to import these points as scatter points.

6. In the *Mapping options* section, turn off *Triangulate data*. Triangulation is not needed for this tutorial.

7. Click **Finish** to close the *File Import Wizard* and import the scatter points.

SMS imports the raster data and converts each point to a scattered vertex (Figure 23). This may take a few minutes because there are over 561,000 points in this dataset.
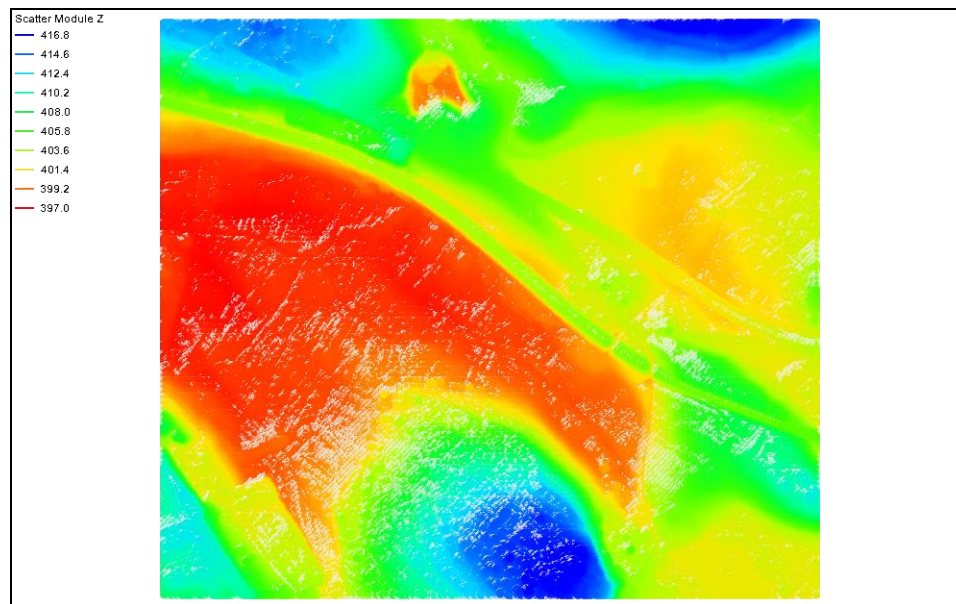

Figure 23   Imported scatter dataset

Now import the file again, but this time with filtering. This allows the resulting scatter sets to be compared in order to understand the differences made by filtering.

8. Repeat steps 1–5, then click **Filter Options** to bring up the *File Import Filter Options* dialog.

The different options allow for only certain sections of the data to be imported into SMS. There are three options in the *Filter Type* section:

- *nth Point*: Allows only the *nth* points to be selected, *n* being any positive whole number. The whole area will be imported into SMS, but will be less dense and easier to work with when working with very large files.

- *Area:* Used when only a section of the data is needed. A rectangle of data will be selected with specified *X* and *Y* coordinates.

- *Grid:* Similar to the filtering by *nth* point, but done on a grid basis.

Continue by doing the following:

9. In the *Filter Type* section, turn on *nth Point* and enter "4" in the field below the *Filter Type* section.

10. Click **OK** to exit the *File Import Filter Options* dialog.

11. Click **Finish** to close the *File Import Wizard* dialog.

12. Turn off "⊞ Raster-in" in the Project Explorer.

A new "⊞ Raster-in (2)" dataset will appear in the Project Explorer, and the dataset appear almost identical to the other one (Figure 24). It may be necessary to hide the file which was first imported.
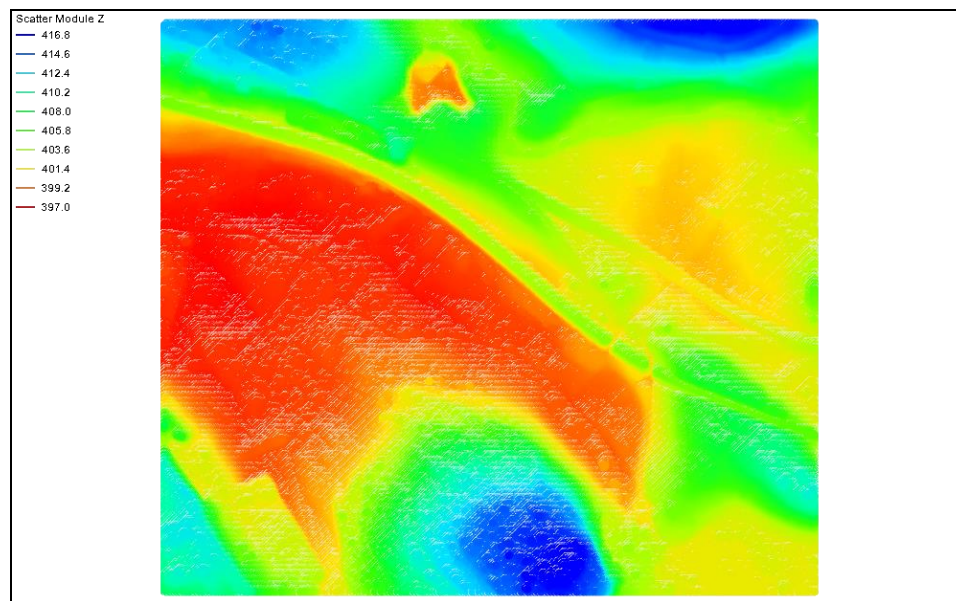

Figure 24   Filtered scatter set for raster data

13. Turn on both "⊞ Raster-in" and "⊞ Raster-in (2)".

14. Select "⊞ Raster-in" to make it active.

15. **Zoom** 🔍 in to the top left corner of the dataset.

The purple or magenta points are the filtered data. Only those exist in the filtered set. The unfiltered scattered dataset includes all of the points.

5.2   Filtering Based on Angle

Now investigate another filtering option that is available after a file has been imported into SMS. These filtering options operate on the TIN and therefore require triangulation.

1.   Turn off "⬛ Raster-in (2)".

2.   Select "⬛ Raster-in" to make it active.

3.   **Frame** 🔍 the project.

4.   Select *Triangles* | **Triangulate**.

This method involves the removal of redundant data because this data does not add any details to the TIN surface. For example, when a point lies in the plane of all the surrounding points, no new features are represented and that point is superfluous.

This filtering option allows the user to specify a tolerance angle. Each data point is checked to see if it is within that tolerance of being flat. (Note: a dot product of the "normal vectors" is used to determine this - see Figure 25). Vertices that are deemed to be redundant are deleted.
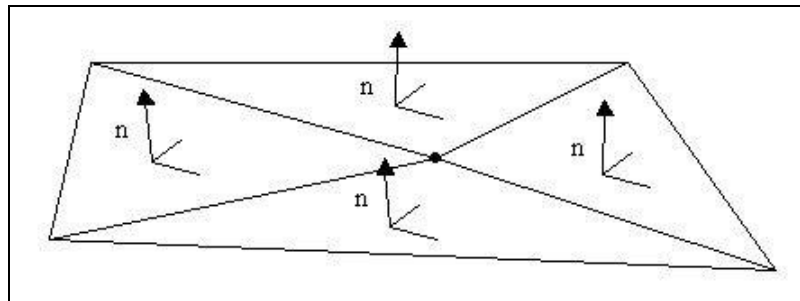

Figure 25   Triangles with relatively same normals

It is recommended to create a copy of the dataset prior to filtering by doing the following:

1.   Right-click on "⬛ Raster-in" and select **Duplicate**.

This creates a new "⬛ Scatter" dataset.

2.   Right-click on "⬛ Scatter" and select **Rename.**

3.   Enter "Raster-in -2 degree filter" and press *Enter* to set the new name.

4.   Select *Data* | **Filter…** to bring up the *Filter Options* dialog.

5.   Enter "2" as the *Filter angle*.

6.   Click **OK** to close the *Filter Options* dialog and bring up the *Filter Report* dialog.

Depending on the speed of the computer being used, this may take a few minutes. There are around 50,000 points to be deleted, or about 9% of the total points. Note that SMS retriangulates the remaining points, so any editing of the TIN performed on the original will be lost.

7. Click **Close** after viewing the report to close the *Filter Report* dialog.

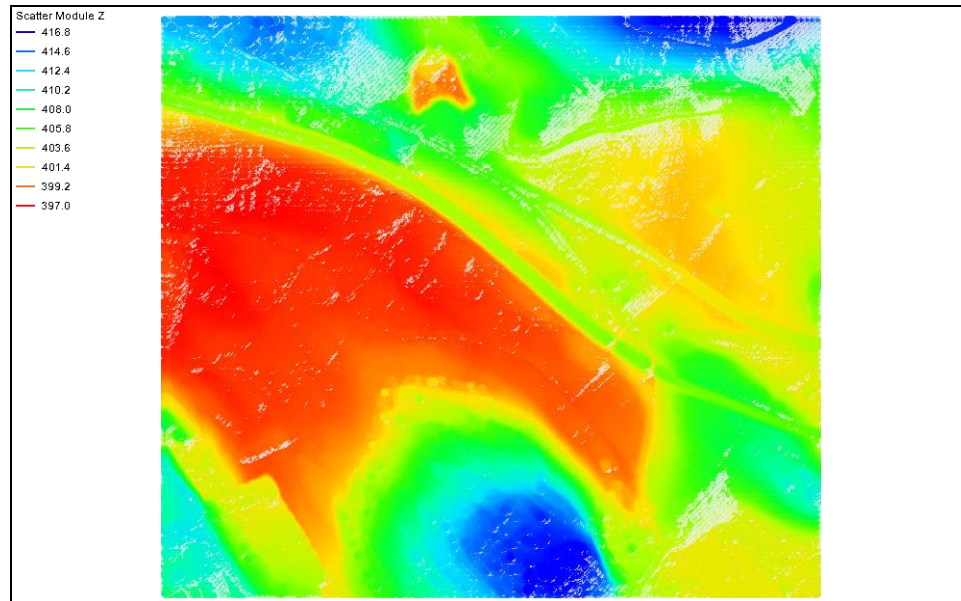The screen should appear similar to Figure 26. Notice the blank spaces where the data has been deleted.

Figure 26   Scatter set after filtering by angles

6   Converting DXF Files to Scatter Data

SMS can import many file types generated by other software in their native format. One of the file types that can be imported are DXF files. These are vector drawing data files created by AutoCAD and used for background display or for conversion to feature objects.

6.1 Importing a DXF File

For this part of the tutorial, the a DXF file will be imported into SMS as a scatter dataset by doing the following:

1. Select *File* | **Delete All** to clear out the data in SMS.

2. When asked to confirm deletion of all data, click **Yes**.

3. Click **Open** 📂 to bring up the *Open* dialog.

4. Select the file "stmary.dxf" and click **Open**.

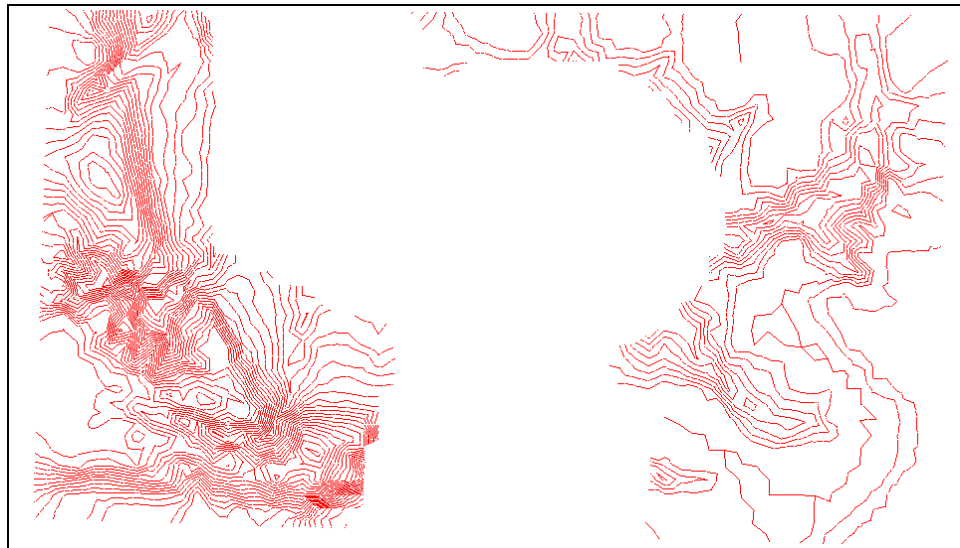After the file is imported, notice that there is a "🗐 CAD Data" folder in the Project Explorer with a set of contours. The Main Graphics window displays those contours (Figure 27).

Figure 27   Imported CAD contours

In order to convert CAD data to scatter data, it needs to be changed to map data by doing the following:

5. Right-click on "🗐 stmary.dxf" under "🗐 CAD Data" in the Project Explorer and select *Convert* | **CAD → Map** to bring up the *Clean Options* dialog.

6. Click **OK** to accept the defaults and close the *Clean Options* dialog.

The project should appear similar to Figure 28.

Figure 28   Converted CAD data

7. Select the new "⬔ CAD" coverage to make the **Map** ✛ module active.

8. Right-click on "⬔ CAD" and select *Convert | **Map → 2D Scatter** to bring up the *Map → Scatter* dialog.

9. Click **OK** to accept the defaults and close the *Map → Scatter* dialog.

SMS does a duplicate point check as it creates the scattered dataset. The spacing of the points along the contours in the CAD data is fairly high resolution, so this process may take a few minutes (depending on the speed of the computer being used).

10. Turn off "⬔ CAD" to make the scatter set more visible.

11. **Zoom** 🔍 in to the top west part of the scatter set in order to better see scatter points and scatter breaklines (Figure 29).
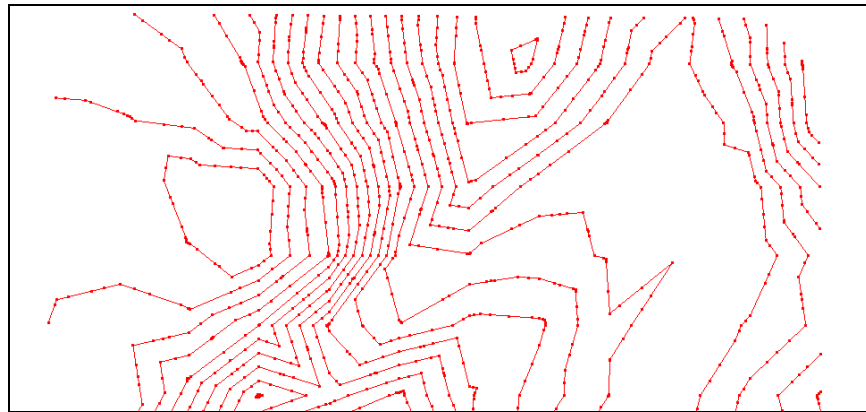

Figure 29   Scatter points and breaklines

6.2 Importing a Scatter Dataset from a CSV

In some situations, agencies provide data that includes scatter breakline information. Since these breaklines generally improve surface representation, SMS supports a few standard file formats for breaklines. This section illustrates how to import this data.

For this part of the tutorial, a CSV file will be imported into SMS as a scatter dataset by doing the following:

1. Click **Open** 📂 to bring up the *Open* dialog.

2. Select "stmary.csv" and click **Open** to exit the *Open* dialog and bring up the *Open File Format* dialog.

Since this is a comma separated values (CSV) file, it may be interpreted in a variety of ways.

3. Select *Use Import Wizard* and click **OK** to close the *Open File Format* dialog and bring up the *Step 1 of 2* page of the *File Import Wizard* dialog.

4. Click **Next** to accept the defaults and go to the *Step 2 of 2* page of the *File Import Wizard* dialog.

5. Select "Scatter Set" from the *SMS data type* drop-down.

6. In the *File preview* section, in the fourth column on the *Type* row, select "Breakline" to bring up the *Scatter Breakline Options* dialog.

7. In the *Breakline Delimiters* section, select *Tags*, then turn on *Continue* and *End*.

8. Enter "1.0" for *Start*.

9. Enter "2.0" for *Continue*.

10. Enter "4.0" for End.

Note: There are other options for defining breaklines in tabular data. These include named breaklines, for which each breakline has a specific name. When the name changes, SMS starts a new breakline. If the name is blank, the vertex will not be in a breakline.

11. Click **OK** to close the *Scatter Breakline Options* dialog.

12. Click **Finish** to close the *File Import Wizard* and import the file.

When SMS imports the survey CSV file, it creates a new scattered dataset that could be combined with the scattered dataset from the CAD file. Both sets include breaklines to ensure the TIN surface is true to the original surface. The project should appear similar to Figure 30.
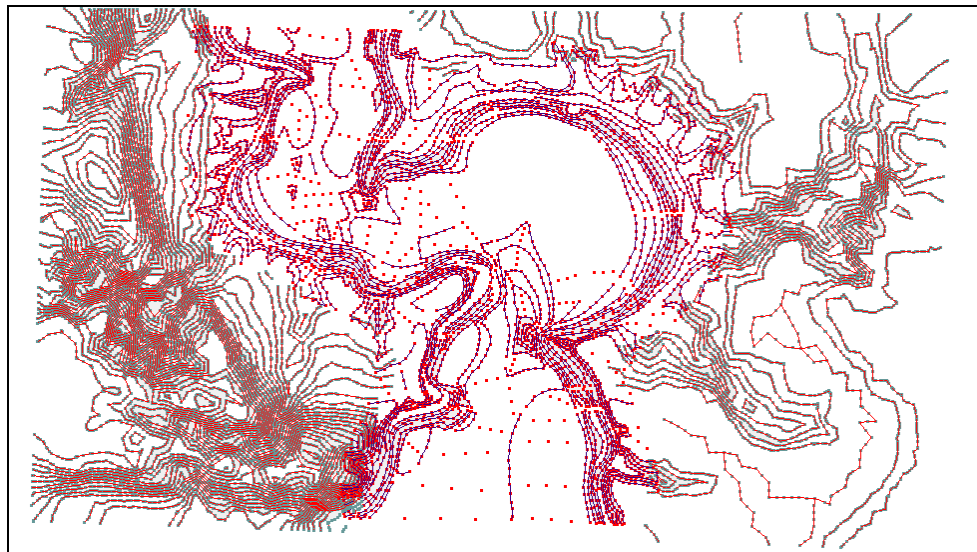

Figure 30   After importing the CSV survey data

7   Conclusion

This concludes the "Scatter Data – TINs" tutorial. It reviewed some of the features that SMS provides for importing and editing TIN data. Feel free to continue experimenting with the interface, or exit the program.