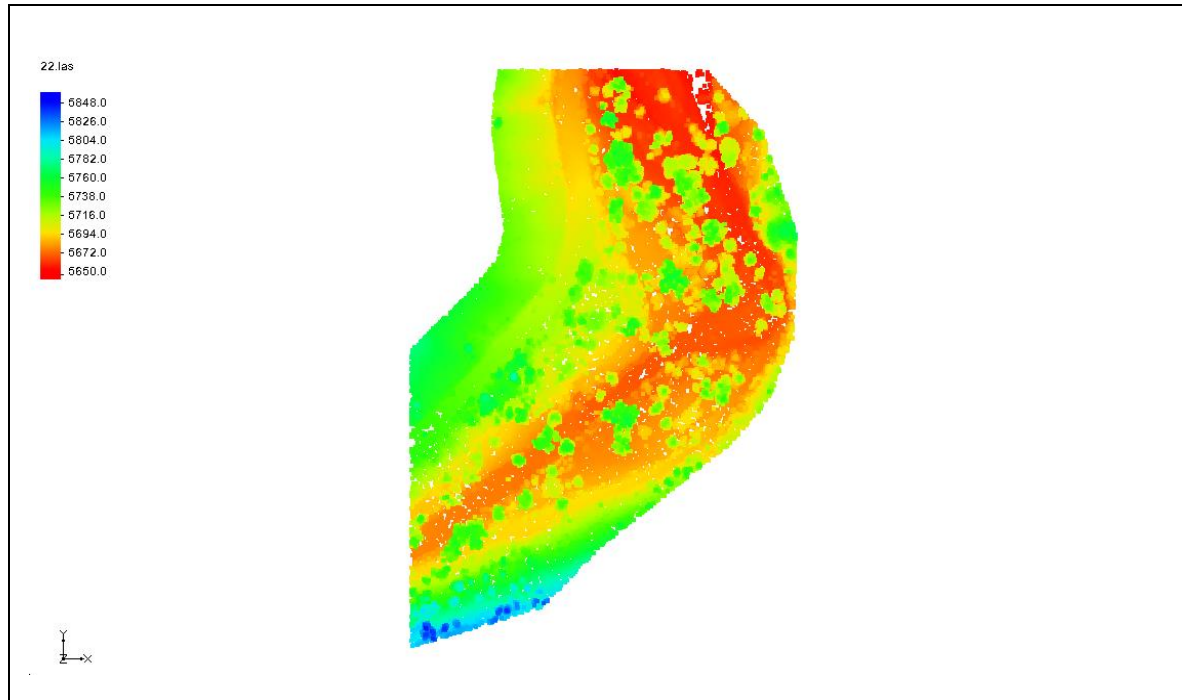


## SMS 13.0 Tutorial

### **Lidar**



### Objectives

This tutorial teaches how lidar data can be used in SMS for display and interpolation.

### Prerequisites

- Overview Tutorial

### Requirements

- GIS Module
- UGrid Module
- Scatter Module

### Time

- 10–20 minutes

**AQUAVEO™**

|          |   |           |
|----------|---|-----------|
| <b>1</b> | <b>Introduction .....</b>                 | <b>2</b>  |
| 1.1      | Getting Started.....                      | 2         |
| <b>2</b> | <b>Importing Lidar Data.....</b>          | <b>2</b>  |
| <b>3</b> | <b>Lidar Display Options.....</b>         | <b>4</b>  |
| 3.1      | Filtering Lidar.....                      | 5         |
| 3.2      | Contours .....                            | 6         |
| 3.3      | Color by classification.....              | 6         |
| 3.4      | Number of points displayed.....           | 7         |
| 3.5      | Bounding box .....                        | 7         |
| 3.6      | Trimming Lidar .....                      | 8         |
| <b>4</b> | <b>Exporting a Filtered Lidar.....</b>    | <b>9</b>  |
| <b>5</b> | <b>Converting Lidar to a Raster .....</b> | <b>10</b> |
| <b>6</b> | <b>Multiple Lidar Files.....</b>          | <b>11</b> |
| <b>7</b> | <b>Conclusion.....</b>                    | <b>11</b> |

## 1 Introduction

---

Lidar stands for Light Detection and Ranging. A lidar file contains many 3D points representing points detected by the lidar device. These generally include points on the Earth's surface, points on a water surface, the tops of vegetation, buildings, etc..

Lidar data can be used in SMS for display and interpolation to other objects. A number of features exist to efficiently handle the large amount of data that is typical in a lidar file or point cloud, such as options to display a subset of points and exclude points. To maintain efficiency, individual points cannot be selected or edited.

In this tutorial, a lidar file representing the area around Boulder, Colorado, will be imported and used in various ways. Topics covered include:

- Importing a lidar file
- Filtering lidar
- Changing the display options
- Exporting lidar

Creating a raster from a lidar file

### 1.1 Getting Started

---

Do the following to get started:

1. If necessary, launch SMS.
2. If SMS is already running, select *File / New* to ensure that the program settings are restored to their default state.

## 2 Importing Lidar Data

---

Start with opening a file containing lidar data. Lidar data is typically very dense and the files can be very large.

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

2. Browse to the *Tutorials\GIS\lidar* directory
3. Select “22.las”.
4. Click **Open** to close the *Open* dialog.

The Graphics Window should appear similar to Figure 1. This is a lidar point cloud of almost one million points located near Boulder, Colorado. Only 50,000 points are being displayed due to the current display options. The projection information was included in the lidar file and SMS set the display projection to match it. The projection can be examined by right-clicking on the “22.las” in the Project Explorer and selecting the **Projections** command. For more information on projections, refer to the “Projections” tutorial.

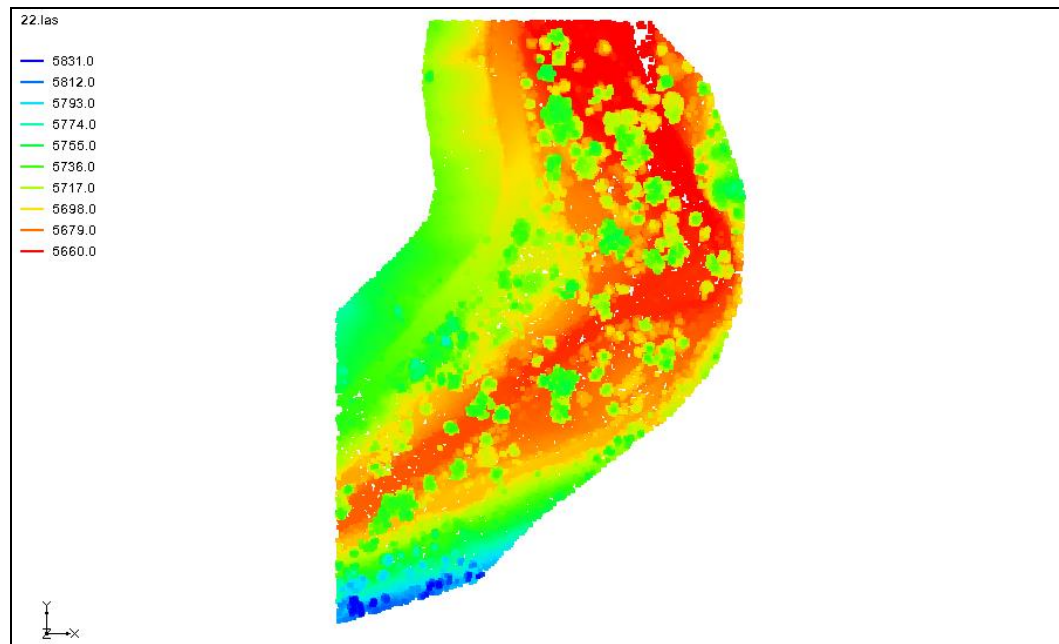




Figure 1 LiDAR data in SMS

5. Zoom in and out on the raster using the mouse wheel or **Zoom** . If zooming in far enough, individual points can be seen as in Figure 2.
6. When done zooming in, click on the **Frame**  macro.

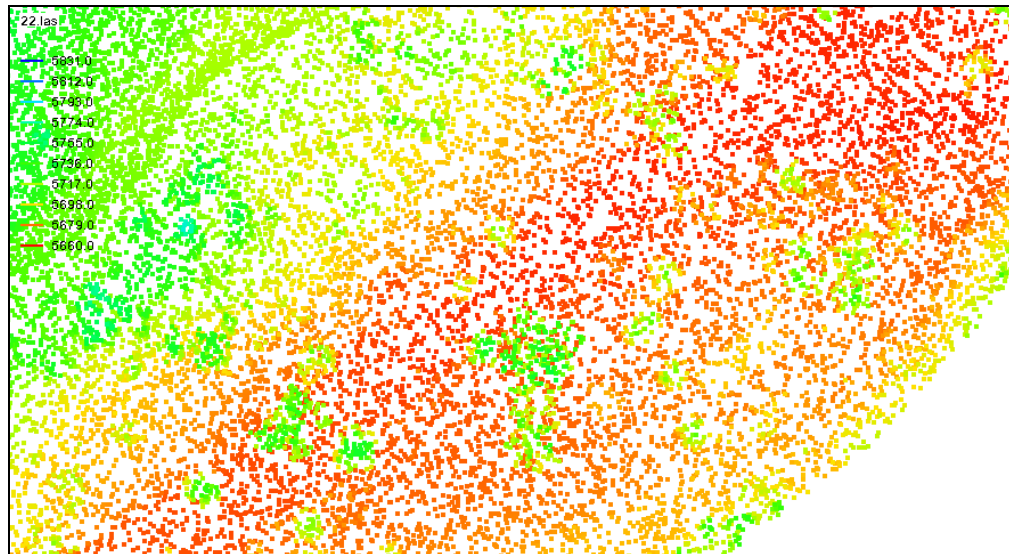


Figure 2 Lidar points

### 3 Lidar Display Options

Each lidar file has its own display options. This differs from how SMS works with most other objects. The lidar display options are accessed by right-clicking on the lidar items in the Project Explorer.

1. Right-click on “ 22.las”, and then select **Display Options** to bring up the *Lidar Display Options* dialog.

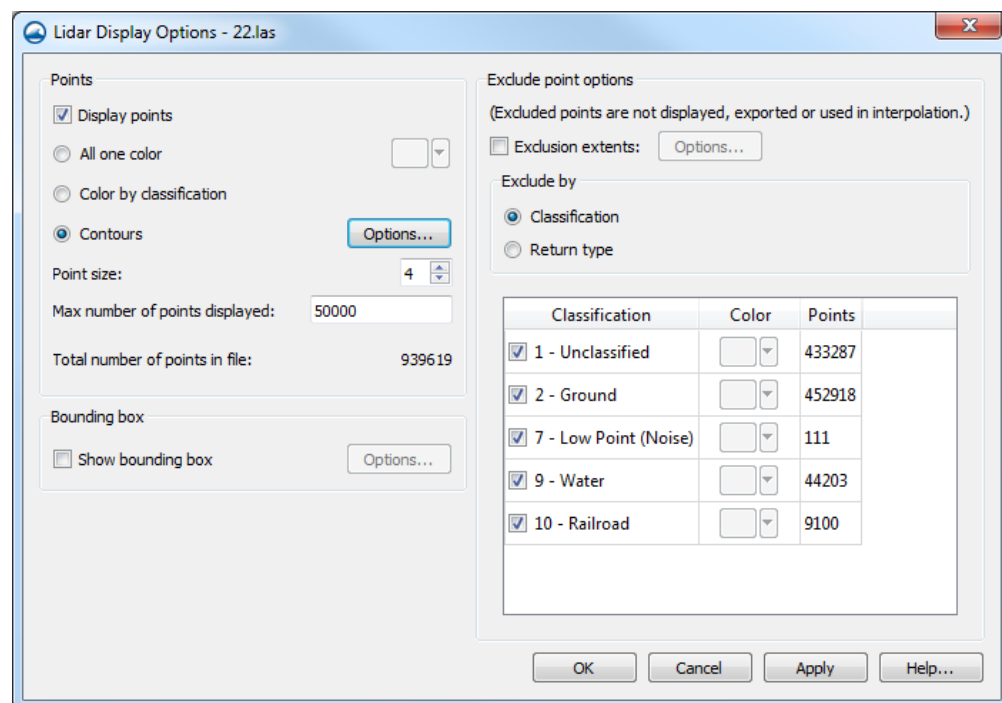



Figure 3 Display options dialog

### 3.1 Filtering Lidar

Lidar use classifications and return types for each point, signifying a possible trait the points have. The classifications have been given a name based on possible terrain types, however they may not actually represent the given name. It is possible to filter out points from the display that do not meet certain criteria. On the right side of the dialog, there is an *Exclude by* section. Notice that it currently has *Classification* selected. Below this section is a table listing each existing classification. Notice that each classification is currently checked.

1. Check “Low Point (Noise)”.
2. Click **Apply**. If necessary, move the dialog to the side so the graphics window can be seen.

The display should now look something like Figure 4. Notice that by including the extreme values the contour coloring provides a less interesting picture. Note that by turning off the “Low Point (Noise)” points they will not be used if interpolating from “22.las” . By default, extreme values are not displayed when import a lidar file.



Filtering affects the points that are used when interpolating from lidar.



Figure 4 LiDAR data filtering out one classification

3. Uncheck “Low Point (Noise)” to return to the previous display options.
4. In the *Exclude by* section, click *Return Type*. Notice that the table below changes.
5. Check *Second but not-last* then click **Apply**.

The display should now look similar to Figure 5.

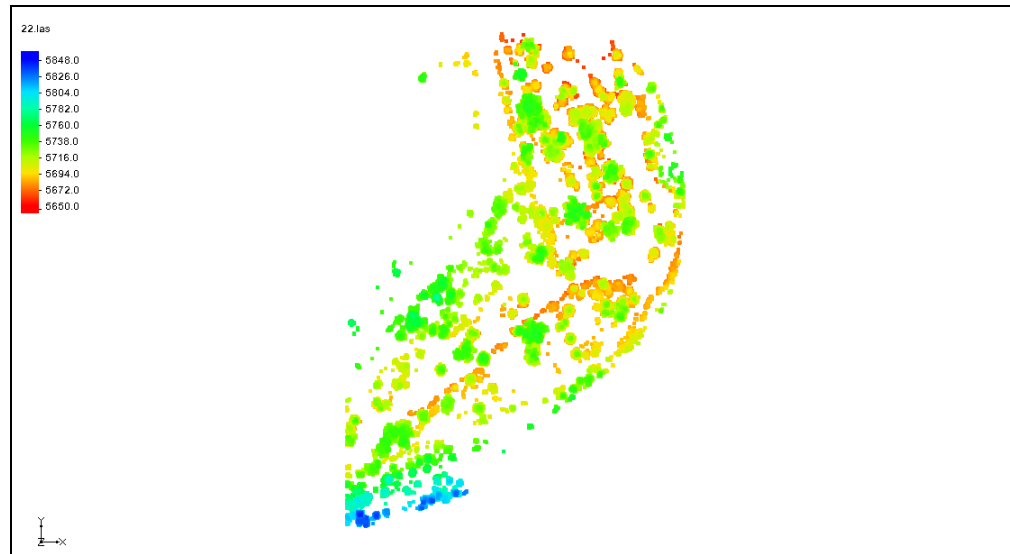


Figure 5 LiDAR data filtered by a return type

6. Change the filter back to *Classification* and click **Apply**.

### 3.2 Contours

1. In the *Points* section, make sure that *Contours* is selected.
2. Click the **Options...** button next to *Contours* to open the *Dataset Contour Options* dialog.

The lidar contour options are the same contour options that are used throughout SMS, although some things are disabled.

3. Click **Color Ramp...** to open the *Color Options* dialog.
4. Click the **Reverse** button.
5. Click **OK** to close the *Color Options* dialog.
6. Click **OK** to close the *Dataset Contour Options* dialog.
7. Click **Apply**.

Notice that the contours are still visible, but now red is used for the maximum value instead of the minimum value.

### 3.3 Color by classification

Now to look at assigning classification specific colors.

1. Select *Color by classification*.
2. In the table on the right of the dialog, change the color of “Unclassified” to green, “Ground” to brown, and “Water” to blue.
3. Click **Apply**.

The display should now look similar to Figure 6. This display illustrates that perhaps the “Unclassified” points, displayed as green could represent vegetation growing above the ground.

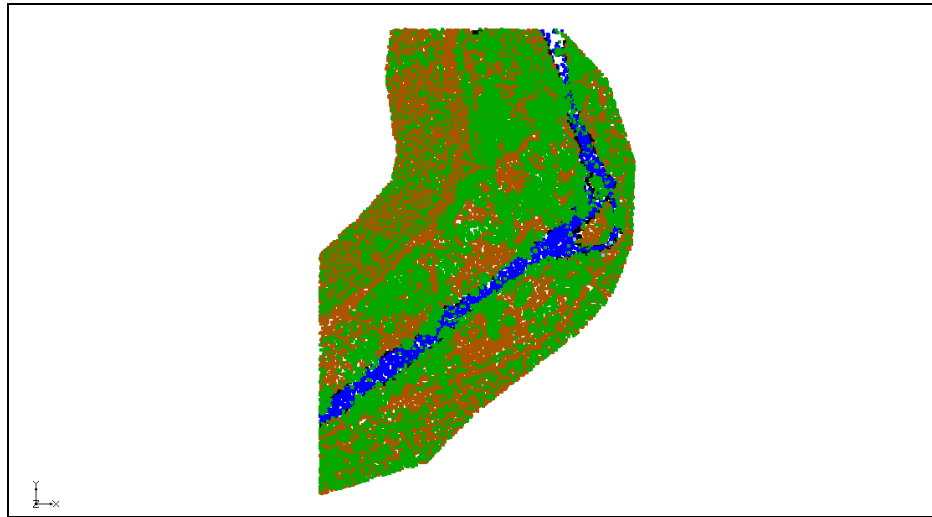


Figure 6 Points colored by classification.

### 3.4 Number of points displayed

Notice that the *Total number of points in file* is more than the *Number of points displayed*. Because lidar files typically have a lot of points, SMS only displays the number of points specified in order to speed up the display of the lidar file. However, when the lidar is used as an interpolation source, SMS uses all the points in the file, not just those being displayed.



The number of points displayed does NOT affect the points used when interpolating from lidar.

1. Change the *Max number of points displayed* to 100,000 and click **Apply**.

Notice there are more points being displayed.

### 3.5 Bounding box

With some files, it can be hard to identify the extents of the lidar. To resolve this issue:

1. Check the box marked *Show bounding box*.
2. Click **OK** to close the *Lidar Display Options* dialog.
3. Select the *Display / View | Oblique* menu command.

Notice that this created a box around the extents of the lidar. The box style can be changed by clicking the **Options...** button next to the *Show bounding box* option.





### 3.6 Trimming Lidar

Sometimes the lidar covers an area much larger than the area of interest. We can trim the lidar to the area of interest. Note that when a trimmed lidar is used as an interpolation source, only the trimmed area is used.



Trimming affects the points that are used when interpolating from lidar.

1. Switch to **Plan View** .
2. **Zoom**  in on the right side of the points as shown in Figure 7

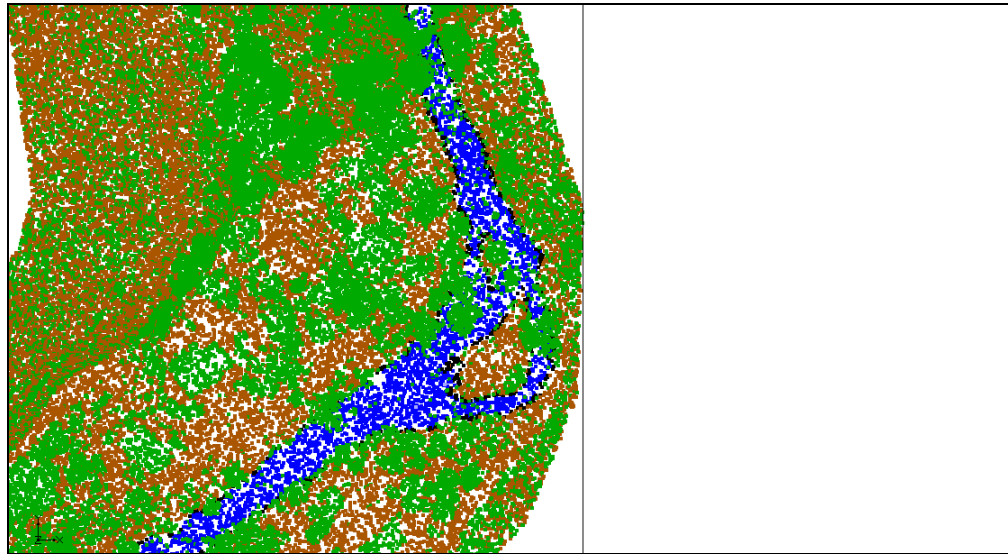



Figure 7 Zoomed in on right side.

3. Return to the *Lidar Display Options* dialog by right-clicking on “ 22.las” in the Project Explorer and selecting the **Display Options** command.
4. In the upper-right corner, check *Exclusion extents*, then click the **Options...** button next to it to bring up the *Lidar Exclusion Extents* dialog.
5. Check on the *X/Y* option.
6. Click the **Update** button. This sets the *Min* and *Max* values in the table.

The **Update** button gets the X and Y extents of the current view and updates the values in the table below. For the **Update** button to work, the display must be in plan view. The min and max X,Y and Z values can also be edited manually if desired.

7. Click **OK** to close the *Lidar Exclusions Extents* dialog.
8. Click **OK** to close the *Lidar Display Options* dialog.
9. Select the *Display / View | Oblique* menu command.

Notice the lidar extents have been trimmed and the display should look something like Figure 8.



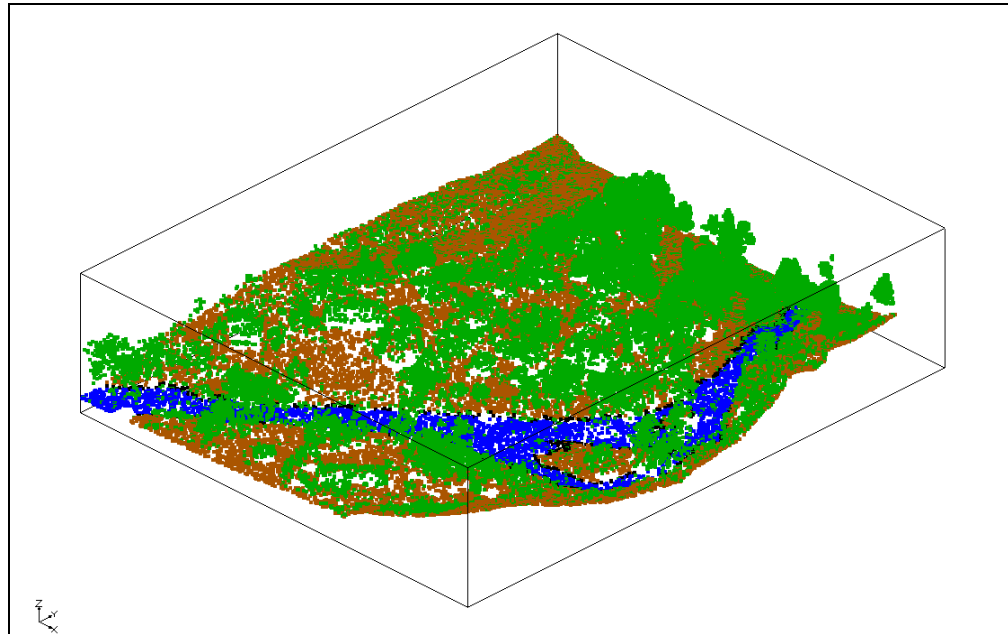





Figure 8 Trimmed lidar.

## 4 Exporting a Filtered Lidar

SMS can export a filtered lidar file. The exported file will only include the filtered points.

1. Right-click on “ 22.las”, and click **Export...** to open the *Lidar File* dialog.
2. Enter “22\_filtered” for the *File Name*.
3. Click **Save** to close the *Lidar File* dialog and export the lidar file.

If desired, the file could be changed this using the drop-down menu, and saved as a \*.laz file (compressed). A \*.laz file is the same as a \*.las file but compressed.

4. Click the **New**  macro.
5. Select **Don’t Save** at the prompt.
6. Click **Open**  to bring up the *Open* dialog.
7. Select the “22\_filtered.las” file and click **Open**.

The display should appear similar to Figure 9.

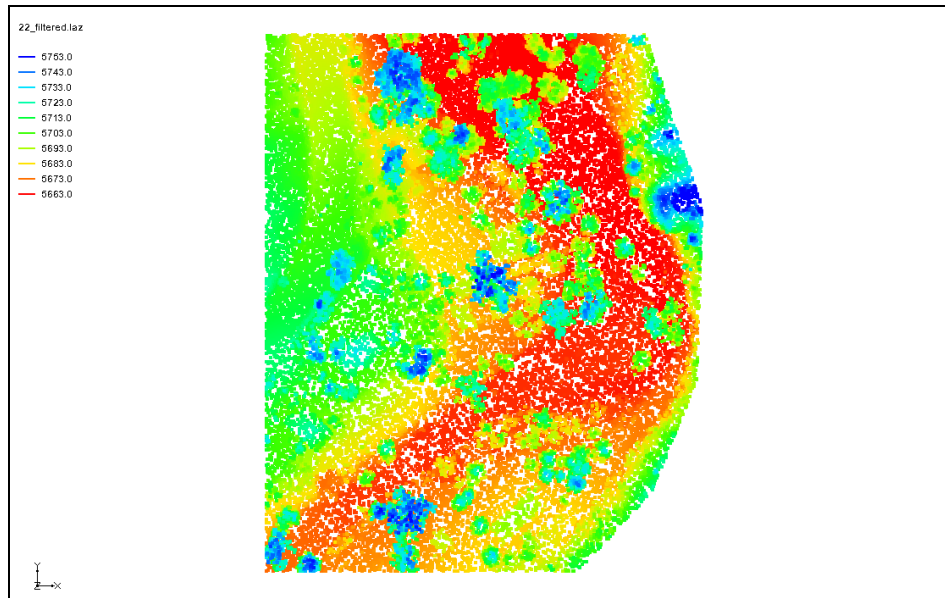



Figure 9 Filtered lidar

8. Right-click on “ 22\_filtered.las”, and then select **Display Options** to bring up the *Lidar Display Options* dialog.


Notice in the *Classification* table “Low Point (Noise)” is no longer present, because when exporting the previous lidar file, “Low Point (Noise)” was filtered out.

9. Click **Cancel** to close the *Lidar Display Options* dialog.

## 5 Converting Lidar to a Raster

Lidar data can be converted into a raster. Unlike lidar, rasters are uniformly gridded data. Since rasters can also be used as a source of interpolation, it can be useful to convert the lidar to a raster that has fewer data points and then use the raster for interpolation thereafter. In this case, the raster would use less memory and would draw faster than the lidar.


Convert a lidar to a raster by doing the following:

1. Right-click on “ 22\_filtered.las”, then click **Interpolate to Raster** to open the *Interpolate Lidar to Raster* dialog.
2. Change the *Cell size* to “2”.

Notice that the cells (w x h) boxes changed their values to fit the *Cell size*.



The cell size should not be specified smaller than the average spacing between lidar points. Doing so could result in raster cells which do not contain any lidar points, and could therefore have no data. SMS applies some filling techniques to approximate values for holes, but these don't catch all cases. In fact, the data that is filled in should not be trusted.

3. Click **OK** to close the *Interpolate Lidar to Raster* dialog and open the *Raster File* dialog.
4. Click **Save** to close the *Raster File* dialog without changing the default filename.
5. Uncheck “ 22\_filtered.las” in the Project Explorer.

The raster now in the display should look similar to Figure 10.

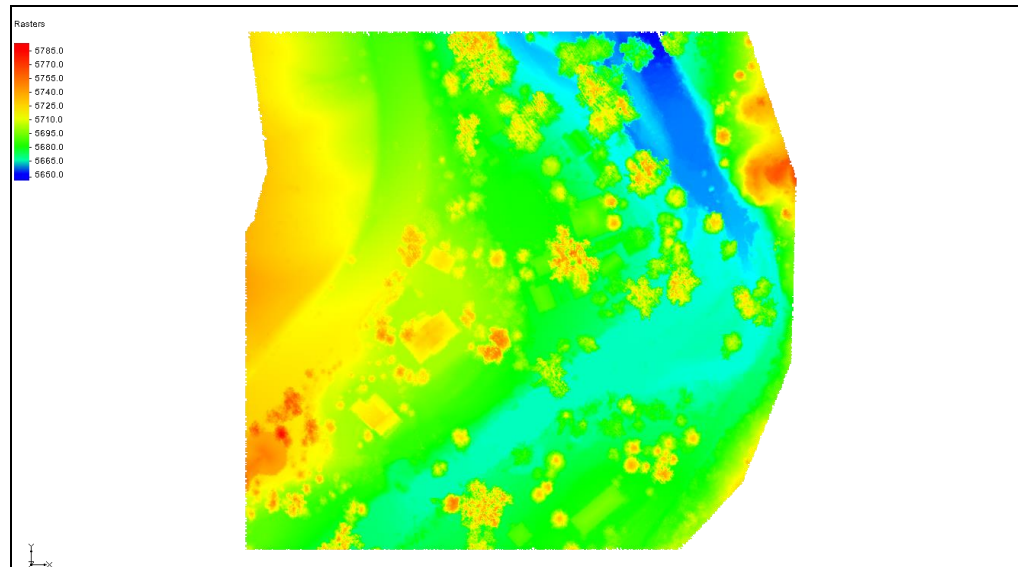


Figure 10 Raster converted from Lidar

## 6 Multiple Lidar Files

Multiple lidar files can be used when creating rasters. This is demonstrated in the “Lidar with Multiple Files” tutorial.

## 7 Conclusion

This concludes the SMS “Lidar” tutorial. The following topics were discussed and demonstrated:

- Lidar are images with elevation data.
- Lidar can be filtered and trimmed to show data desired.
- Lidar can be exported.
- Lidar can be converted to rasters.