Florida Department of Transportation

Trimble Business Center – Heavy Construction Edition (HCE)

Version 5.4

Version	Change	Made By	Date

Table of Contents

Introduction 4
Software Information 4
Software Download 4
System Requirements ..... **Error! Bookmark not defined.**
Software Updates 4
Opening the software 4
Licensing 4
Menu 7
Updating the Ribbon 7
Setting the Template Folder 8
Starting a New Project 10
Updating Project Settings 12
Importing Files 14
- Definition of Point/Breakline-based 15
- Definition of Triangle-based 15

Import Format Editor 17
- Example Survey file 17

Importing a .txt file 18
Naming Conventions 22
Viewing the Flags Pane 22
Calculating Surface to Surface Volumes (No Boundary) 23
- Definition of a Surface 23
- Example Earthwork Volume Report 26

Calculating Surface to Surface Volumes (with Boundary) 26
- Definition of Boundary 27
- Definition of Specify Individual Points 33
- Definition of Stream points 33

Viewing Cross Sections 33
Creating an Alignment 34
- Definition of Alignment 34
- Definition of Inscribe curves at PIs 35
- Definition of Define individual segments 35

Adding Station Labels to Alignment 35
Creating a Corridor 38
- Definition of Corridor 38

Generating a Corridor Earthwork Report (with Option for Subsection/ Between Stations) 42
- Example Corridor Earthwork Report 43

Additional Trimble Resources 44
FDOT Trimble Webpage 44
Trimble Help and Geospatial Community 44
Trimble YouTube 44
Tips and Tricks 44
- Designer Surfaces 44
- Field Survey Data 45

Introduction

The purpose of this document is to provide guidance on how to use basic functions of Trimble Business Center – HCE (Trimble) Version 5.4 to calculate earthwork quantities for Final Estimates purposes.

All graphics shown in the User Guide are from Trimble Version 5.4; however, the procedures to use these basic functions should be similar for all versions. It is the user's responsibility to learn the necessary functions for the applicable version which is being used. See the Additional Trimble Resources section for further guidance.

Software Information

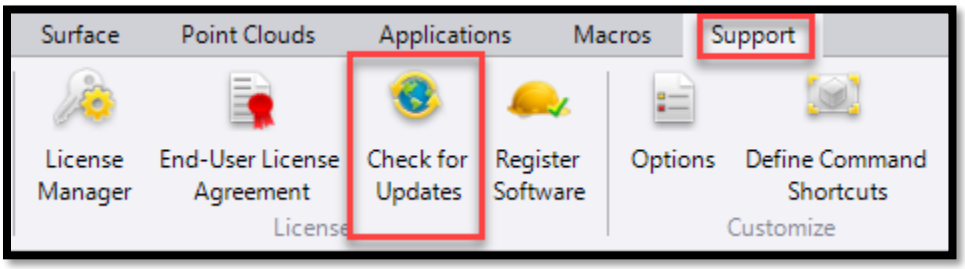
Software Download

1. FDOT Users: Submit an Information Resource Request to have Trimble 5.4 installed to your computer and contact the State Final Estimates Office to gain access to the license server.
2. Consultant Users: Contact a Trimble representative to discuss license options and purchase a license that suits your needs.

Software Updates

Updates to the software can be through the application directly (see below).

1. Select Support, then Check for Updates.



2. In the pop-up menu, check the box next to the appropriate update and select Install Updates. Follow the Instructions provided.

Opening the software

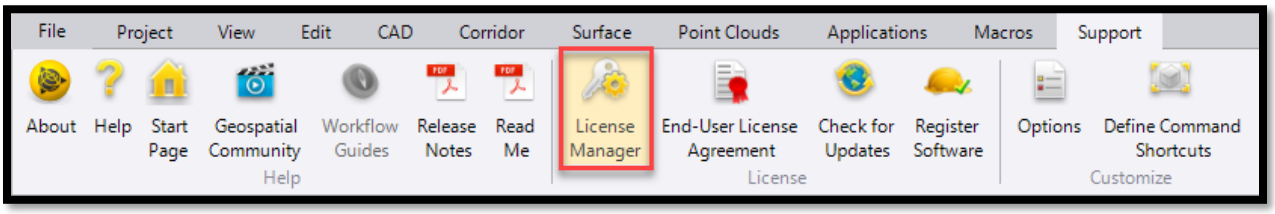
The software can be opened by double clicking the ***Business Center - HCE Powered by Trimble*** icon installed on your desktop.

Licensing

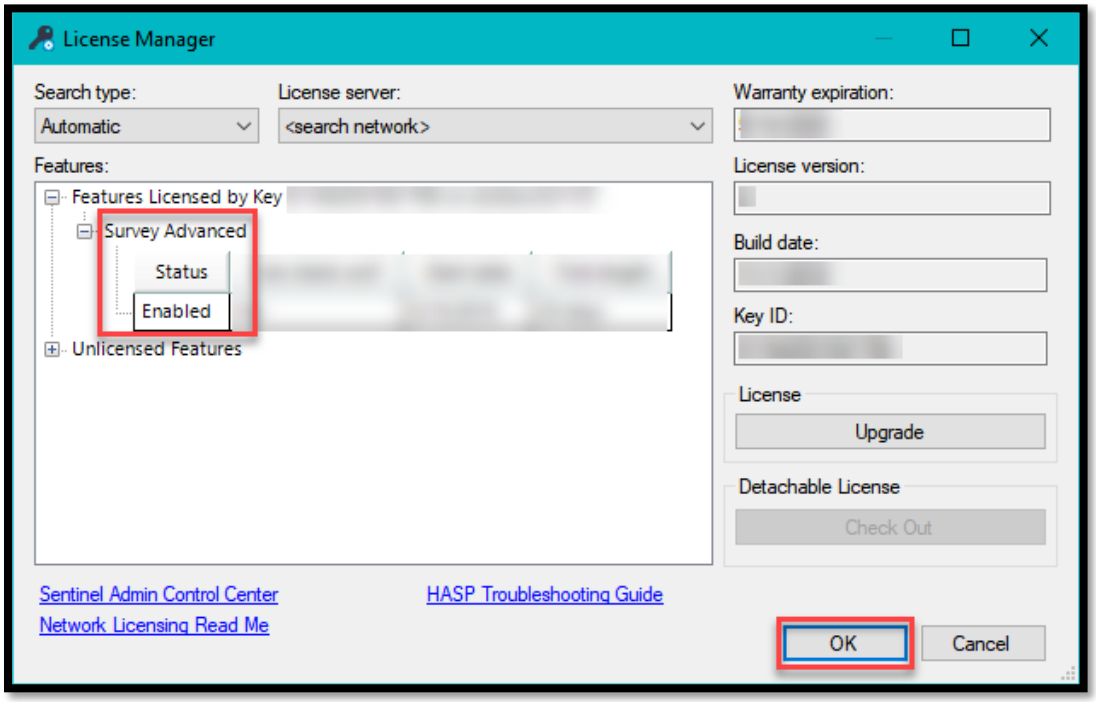
Consultant Users: See Software Download above.

FDOT Users: The State Construction Office has nine (9) licenses available for use across the state. When your Trimble software is installed, it will be pointed to the SCO license sever. Each time you open Trimble it will look at the server to determine if a

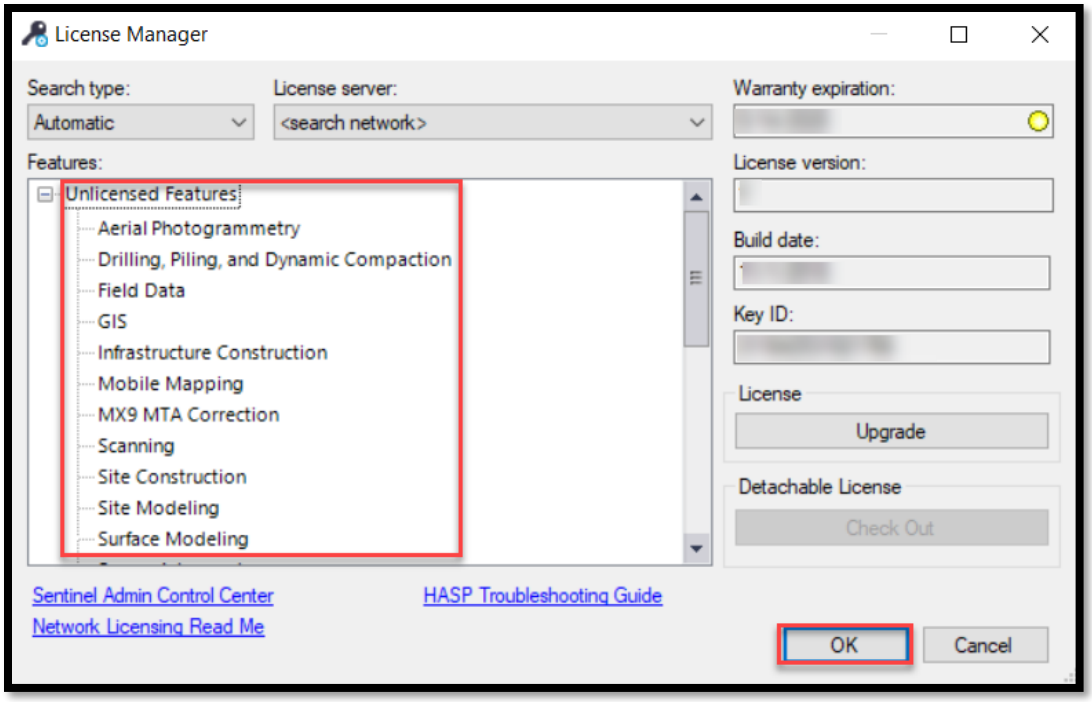
license is available. You can verify on the Support tab in the License Manager, whether you were assigned a license.



Assigned a license: system will identify Survey Advanced is enabled.



No licenses are available: system will identify the unlicensed features.



If no licenses are available, submit a Support Ticket for assistance.

Menu

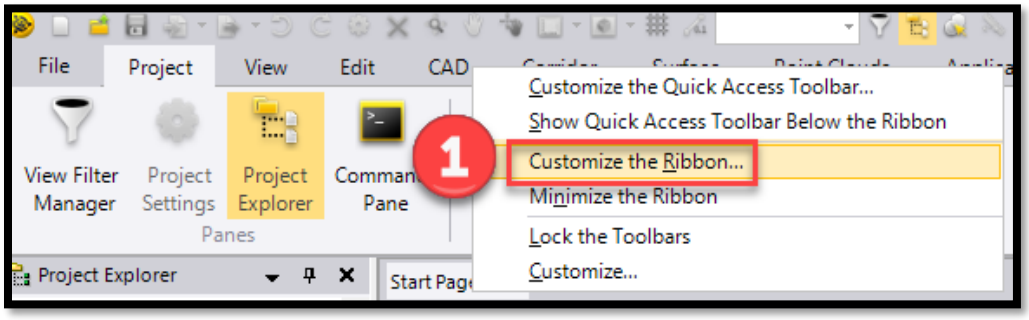
Updating the Ribbon

This step is optional and only needs to be done with the first load of each download/update.

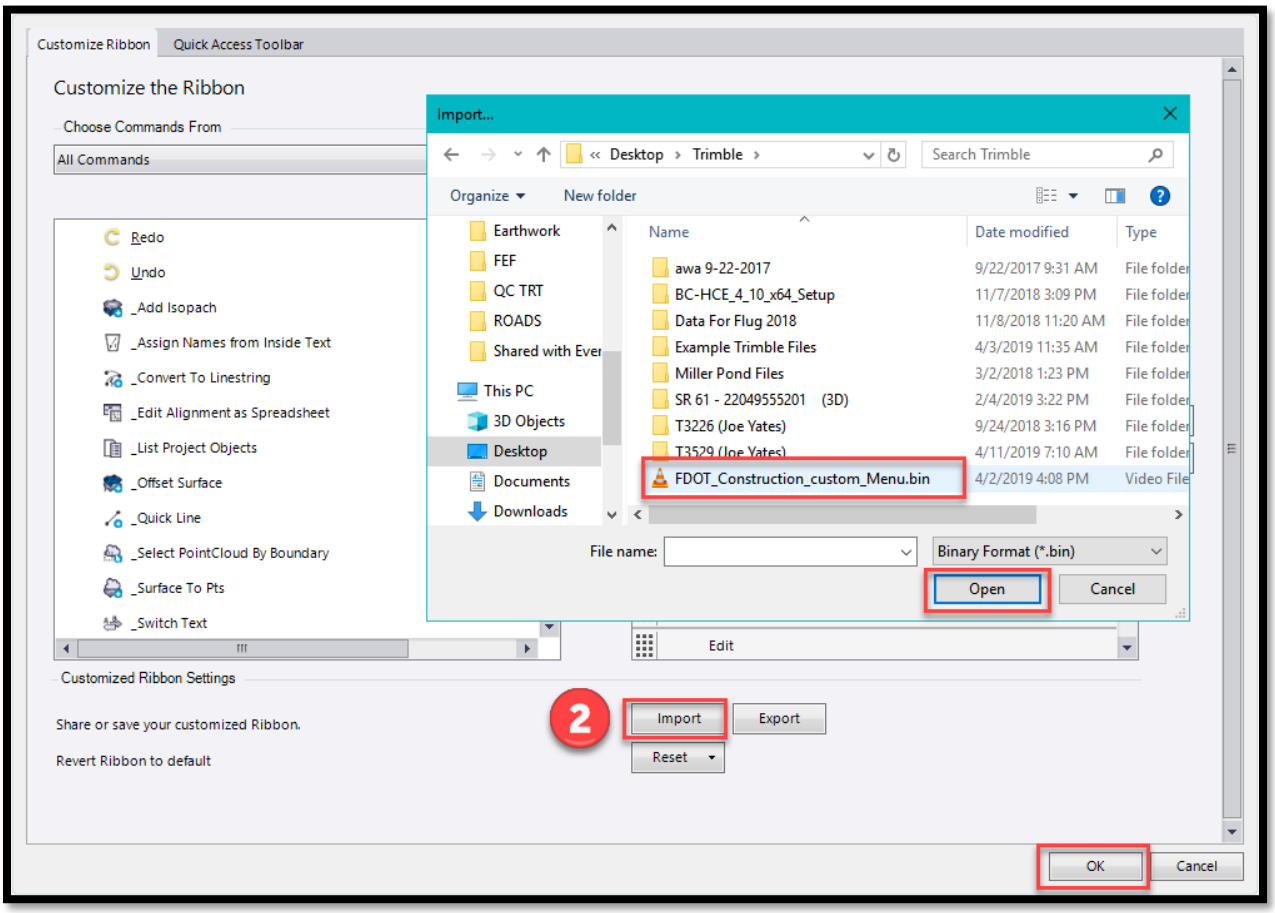
Trimble has an extensive array of licenses that can be purchased to perform many different functions. Many of the ribbon buttons are not necessary and will either be grayed out or, when clicked, will pop up with a box to purchase a new module.

In order to simplify the FDOT user experience, the Department has created a customized FDOT ribbon that can be downloaded from the FDOT Trimble Resource link and imported into Trimble. This will reduce the number of tabs available, leaving only the ones required to perform functions needed by FDOT.

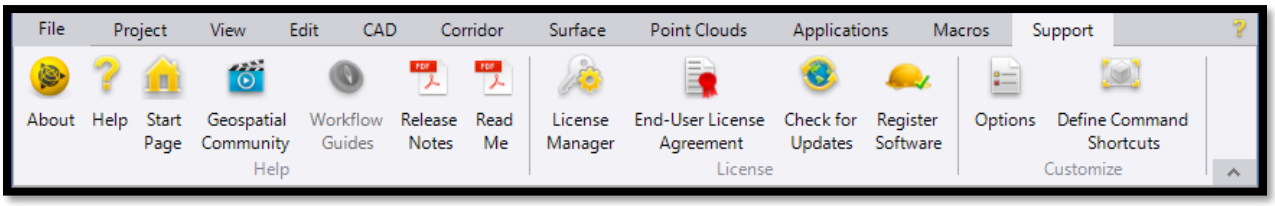
1. After downloading the FDOT Custom Menu file, right click anywhere on the ribbon, then select Customize the Ribbon.



2. Select Import, then navigate to and select the FDOT Custom Menu file and click Open, then OK.



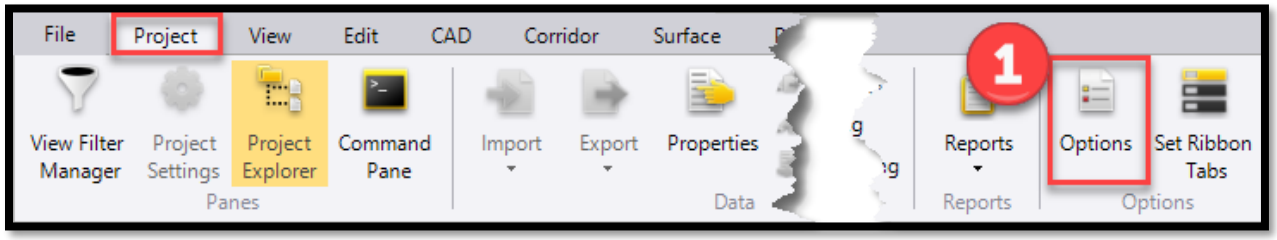
3. When imported, the menu should resemble the figure below.



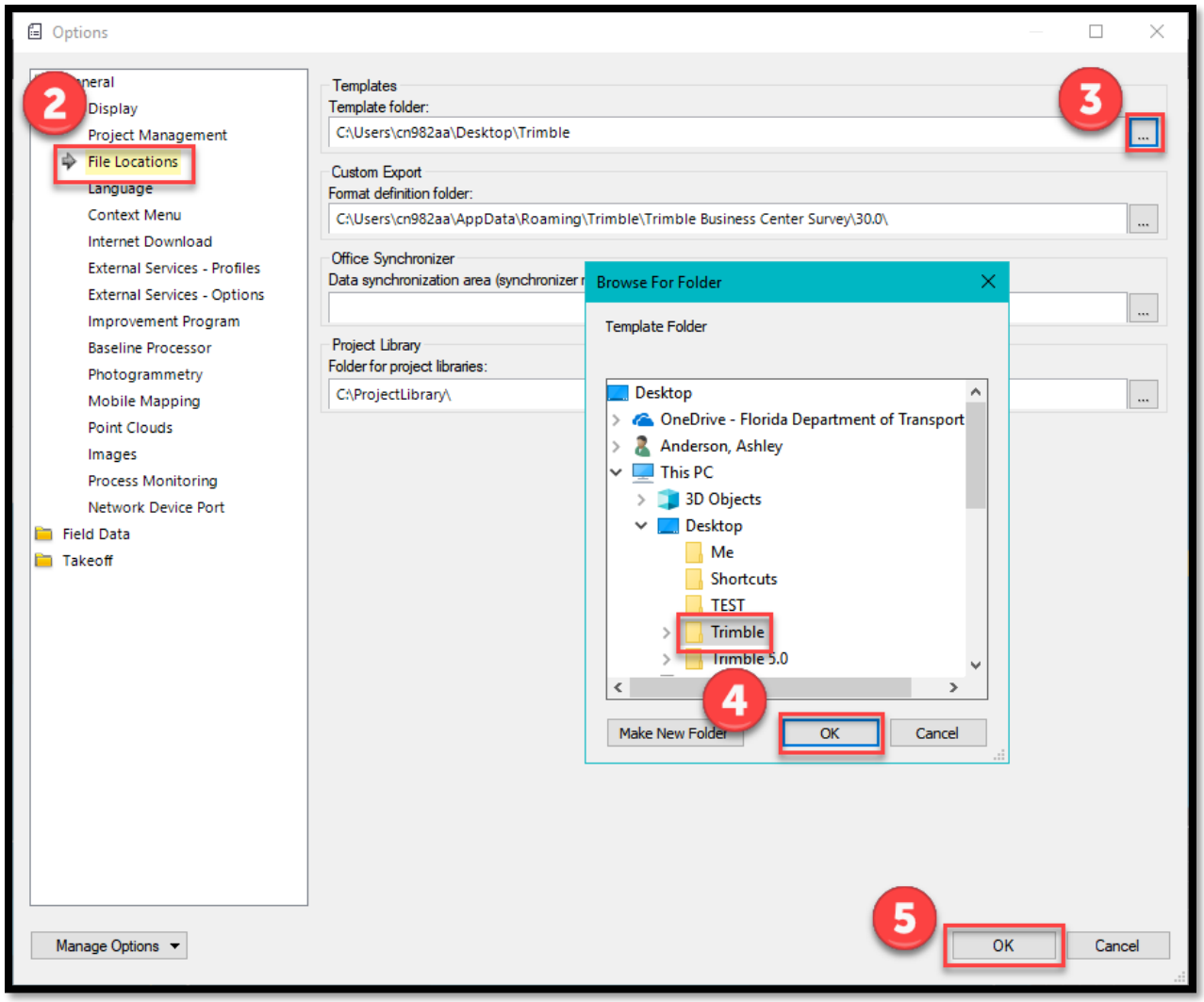
Setting the Template Folder

From the [FDOT Trimble Resource link], download the Florida Templates (East 901 Datum, West 902 Datum, and North 903 Datum). Extract from the zip files, as needed.

1. Select Project, then Options.

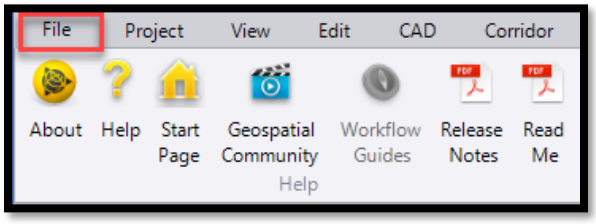


2. Select File Locations
3. Select the ellipsis next to Template folder.
4. Navigate to the folder where you stored the template files, select OK.
5. Select OK again.



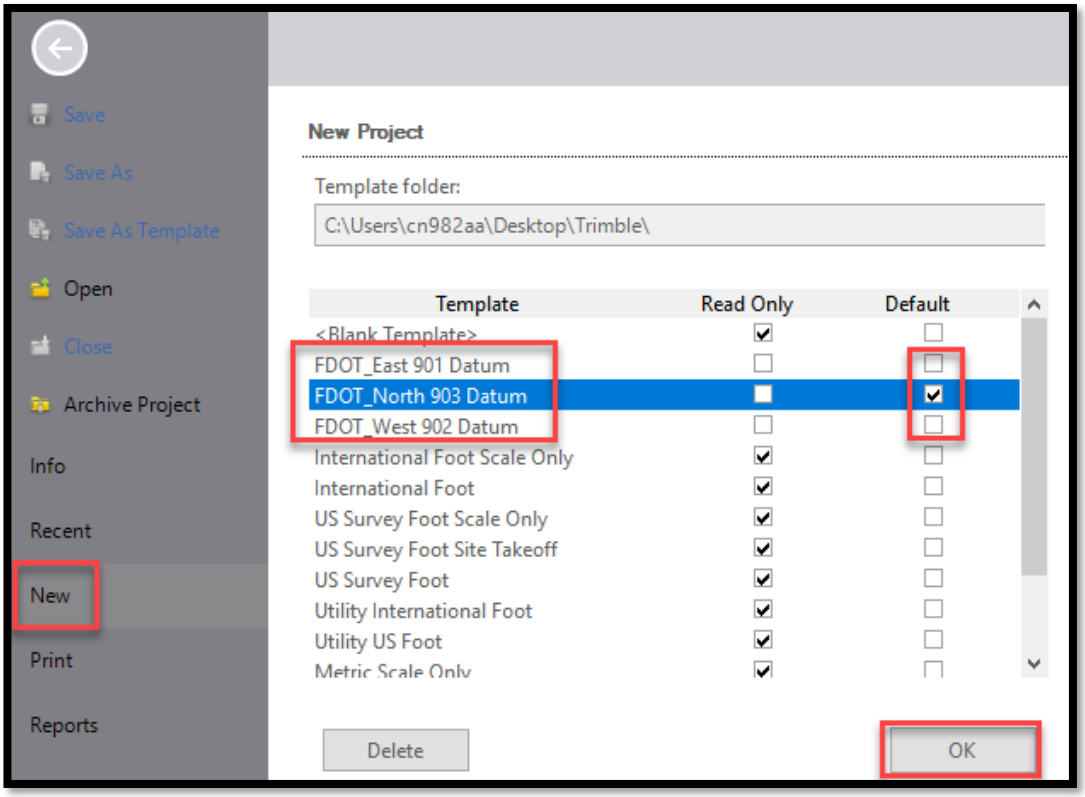
Starting a New Project

1. Select File.

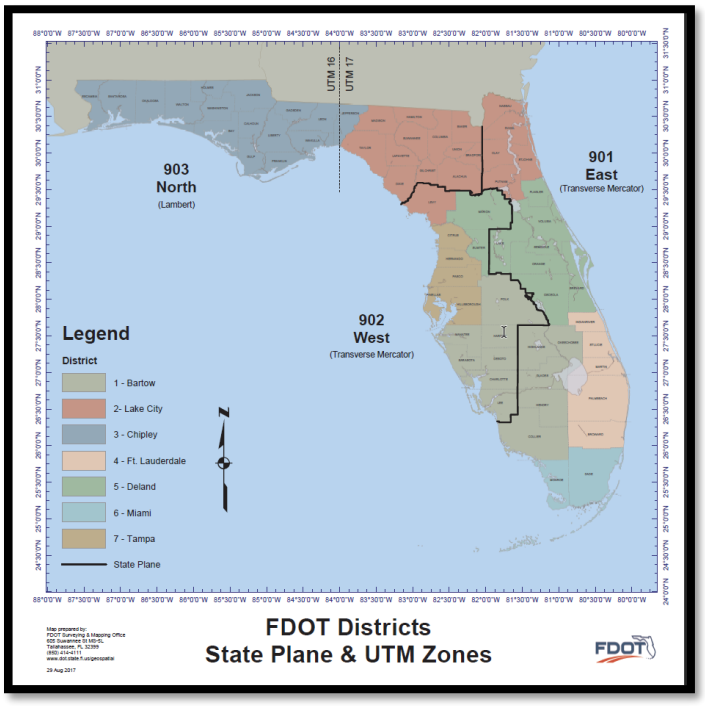


2. Select New. If you don't see the template you need in the list, refer to Setting the Template Folder. Select the appropriate Datum Template for your project, then select OK.

   NOTE: Multiple Templates will appear in the selection list. It is recommended to identify one of the FDOT Templates as the Default.



NOTE: Check the map below to ensure you are using the correct Datum. Datums run along county lines. (Click map for larger view.)

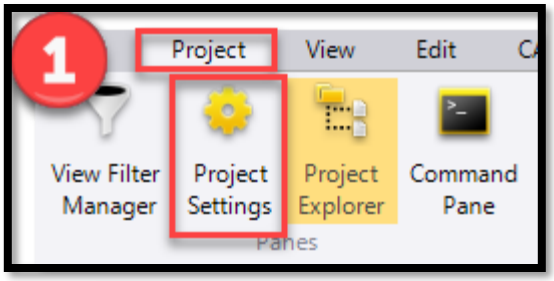


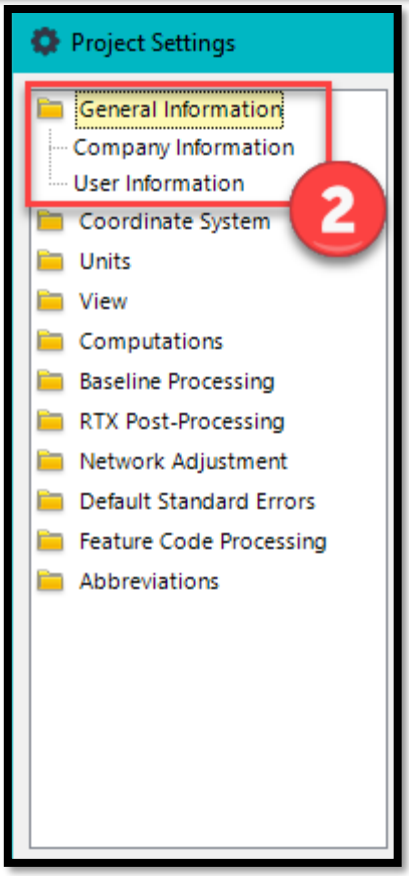
Updating Project Settings

Modifying the Project Settings will help with identifying projects and reports

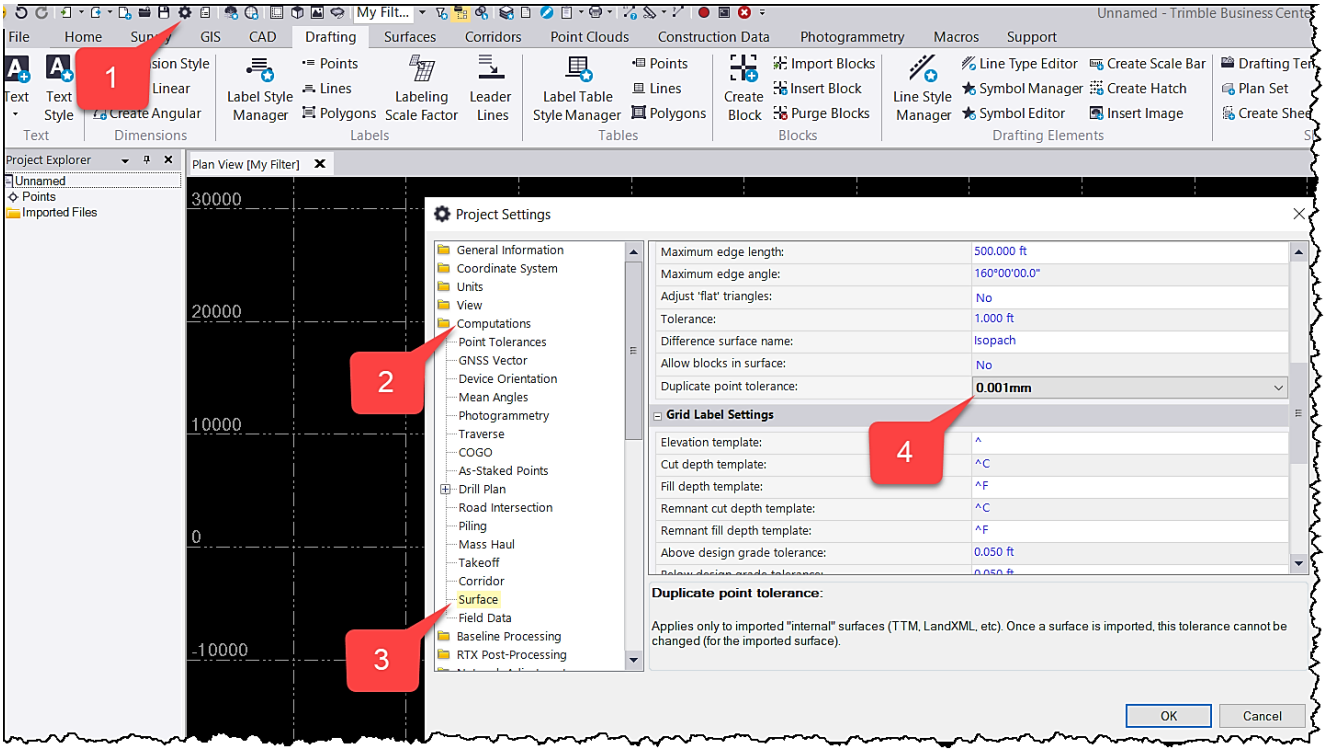
1. Select Project, Project Settings.

2. Update the General Information (Reference Number [Contract/Project Number(s)], Project Name, Description), Company Information, and User Information.

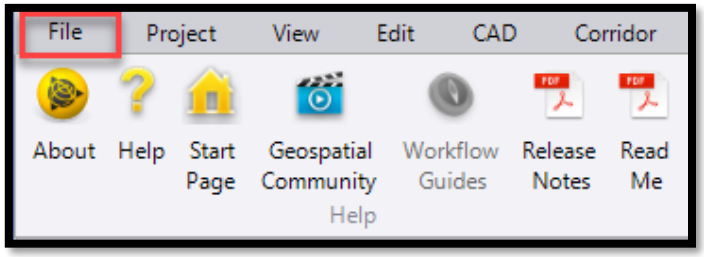


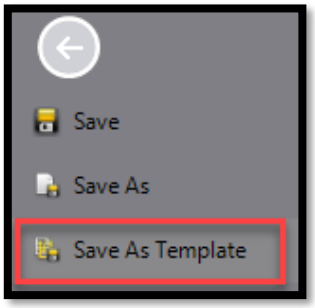


3. If the FDOT templates are <u>not used</u>, review the other project settings to ensure the units are correct and align with the survey information to be imported into the file.
    a. Make sure the duplicate point tolerance is set at the smallest spacing option at 0.001mm. This setting can be changed by following the screenshot below.



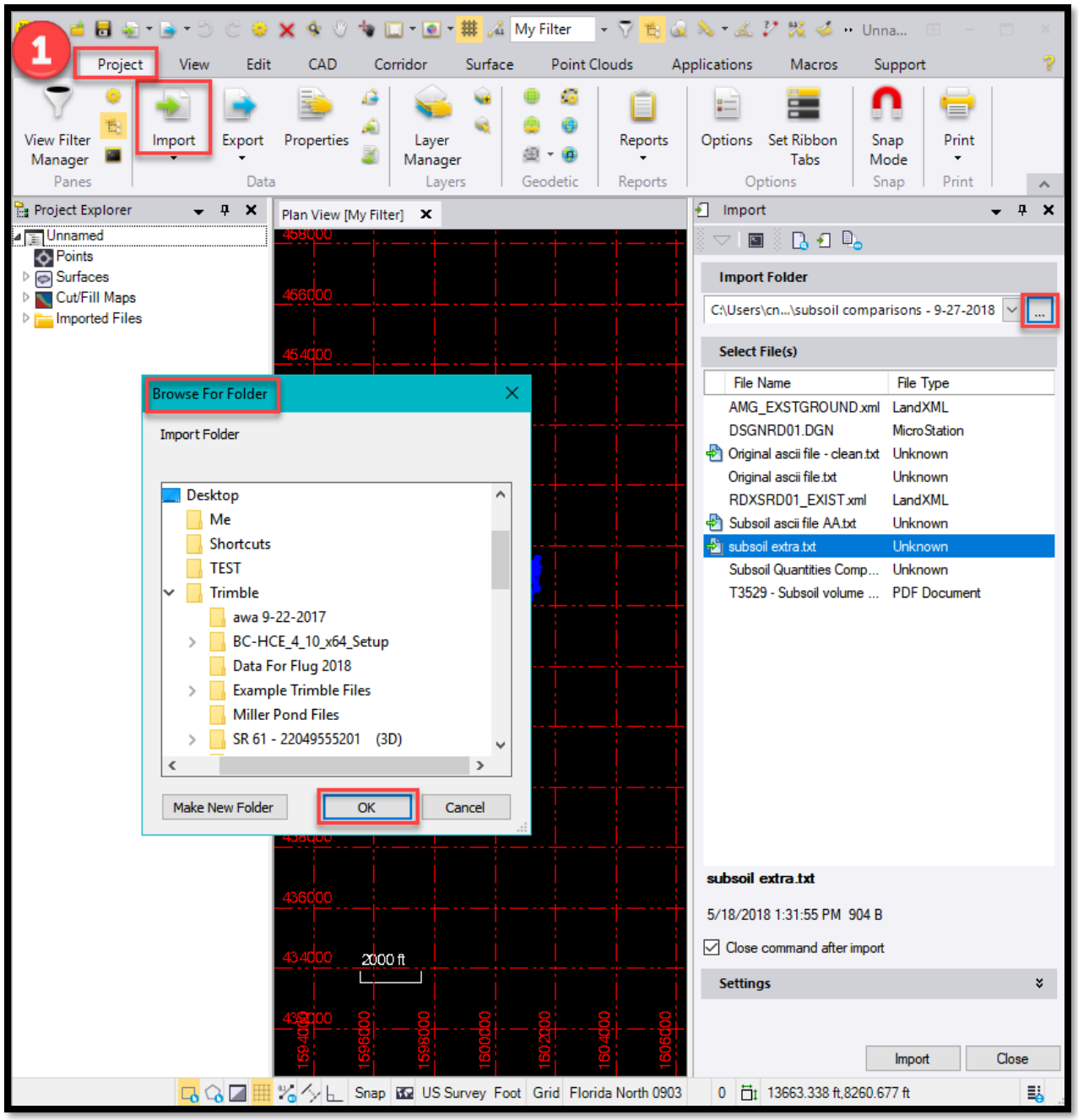
NOTE: Once your information is added to the project settings, you can save the template as your own by selecting File > Save Project As Template to avoid entering in this information each time you start a new project.





Importing Files

1. On the Project tab, select Import. Under Import Folder, select the ellipsis […] next to the folder location box. Navigate to the folder where your project files are located, then select OK.



2. On the Import tab, select the files to import, then select Import.

   NOTE: Use only LandXML Format, if possible. If .txt or .xyz files are needed for field data, use the Import Format Editor to create a new format specific to the file.

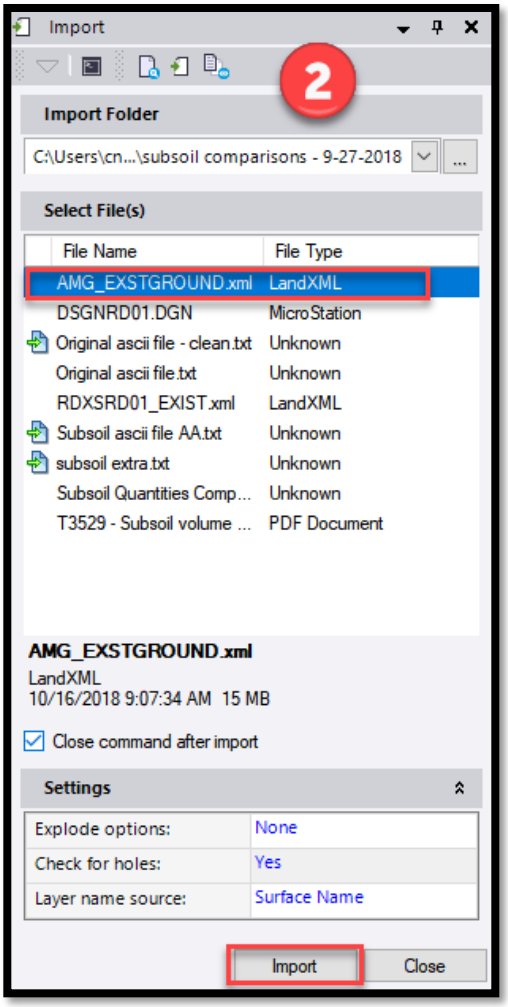
3. On the Import Conflicts screen, select Triangle-based definition, then Import.

   - **Definition of Point/Breakline-based**

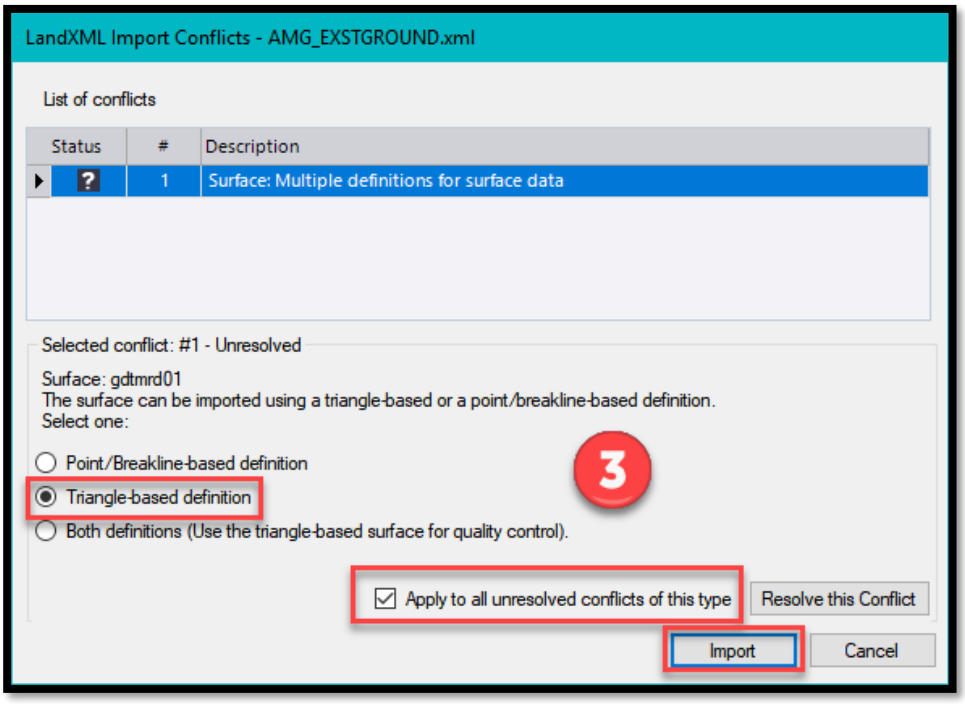
     Point/Breakline-based means the points, breaklines, boundaries, and contours in the LandXML file are used by Trimble to create the surface. This data defines the surface, but the data can be modified, if needed.

   - **Definition of Triangle-based**

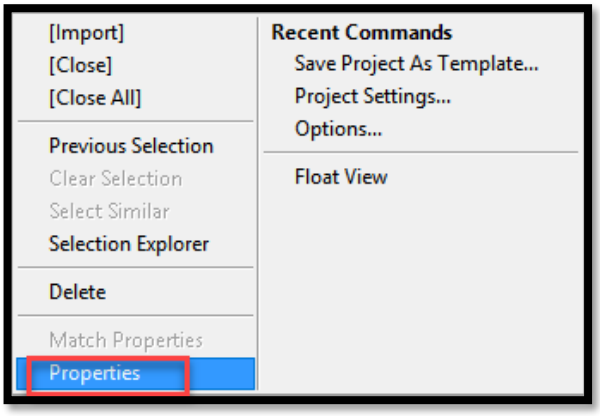
     Triangle-based means only the triangles used to define the surface are imported. This data becomes the surface and it can no longer be edited. This method can be used as a quality control, if the "Both definitions" option is chosen.

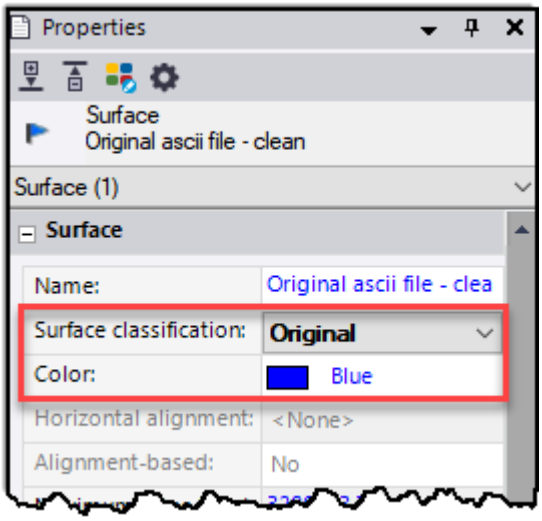


NOTE: It is recommended to use the Triangle-based option to ensure the same triangles the Engineer of Record used to determine quantities are used in Trimble. Allowing Trimble to create triangles with the Point/Breakline-based option opens the data up for potential for errors and conflicts.



4. Select the surface, then right click the surface, then select properties. On the Properties pane, set the classification appropriately (Design, Original, As-built, etc.). This will ensure Trimble calculates cut and fill correctly. Optionally, set a surface color to help distinguish surfaces in your project





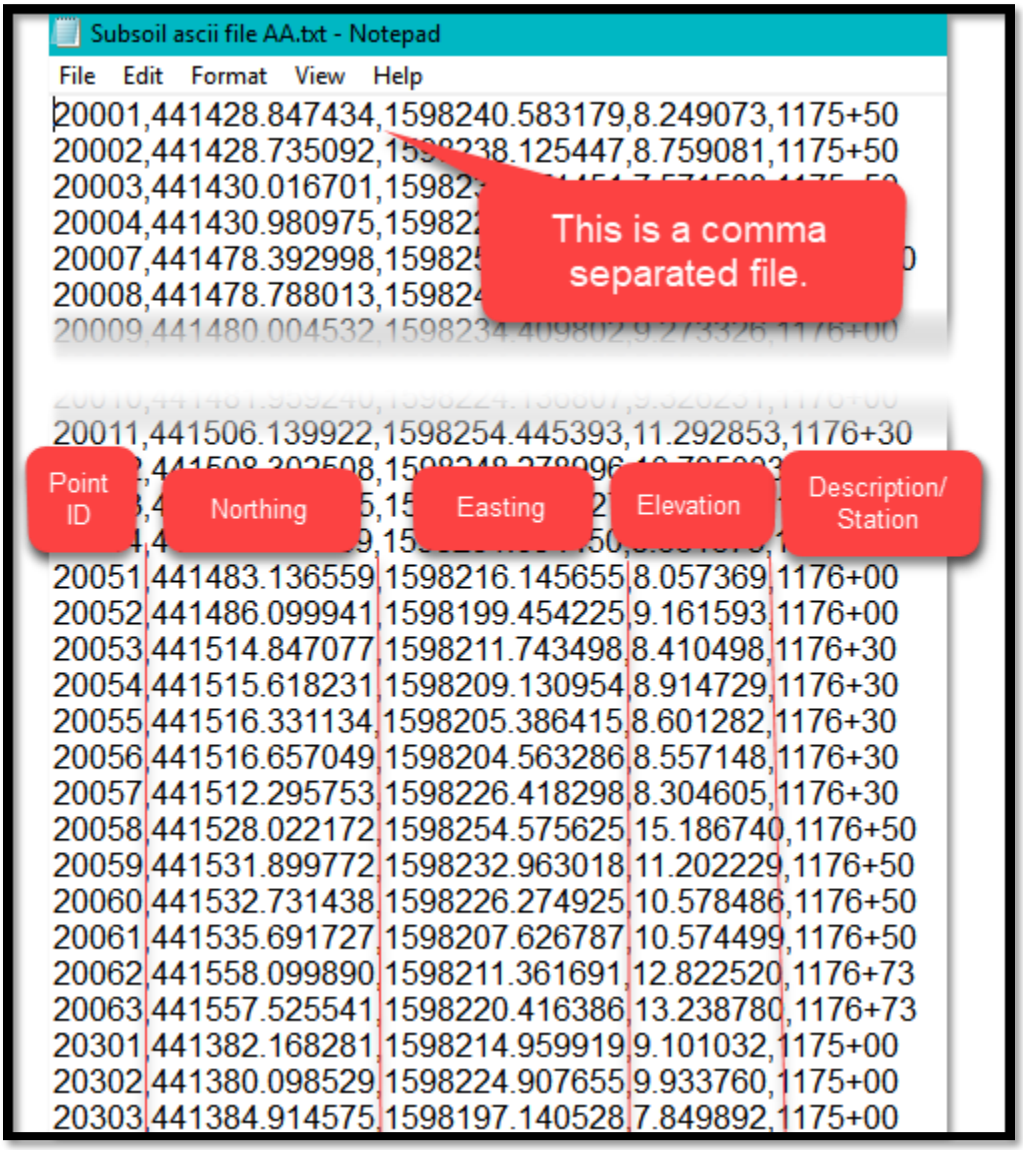
5. Repeat as necessary to import all pertinent files.

Import Format Editor

The import editor is used when you need to define how Trimble reads a file.

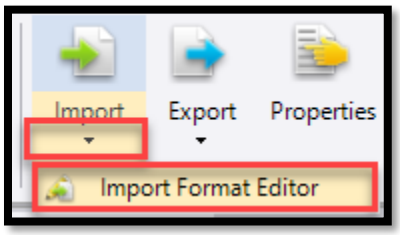
NOTE: GPS survey data collected in the field is typically provided in txt files that require you to understand the format and data included in the file before importing into Trimble. You need to know how the data is delimited (separated). Common separators are spaces, commas, or tabs. You also need to know what data is included. Typically, there is a Point ID, which is information to help identify where the point is located, as well as the Northing, Easting, and elevation for each point. The Northing, Easting, and elevation give the XYZ coordinate for each point, so that it can be located geographically. Sometimes the Easting comes first, so you need to know your dataset to import it correctly. Switching the northing and easting columns will orient your project incorrectly, which is a clear indicator you imported your file inaccurately.

- **Example Survey file**

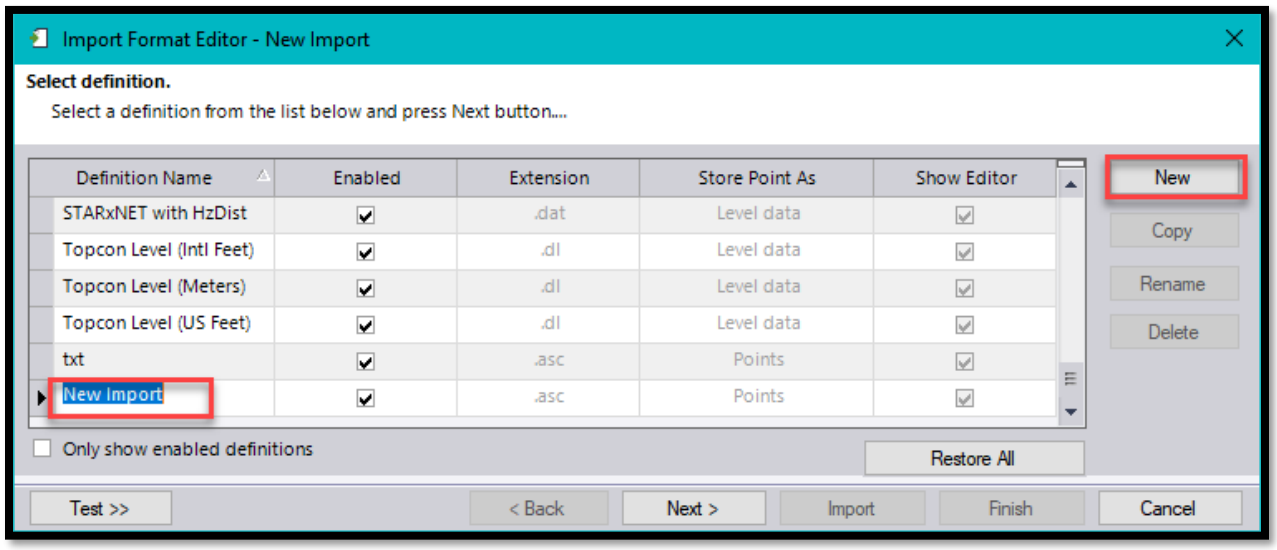


Importing a .txt file

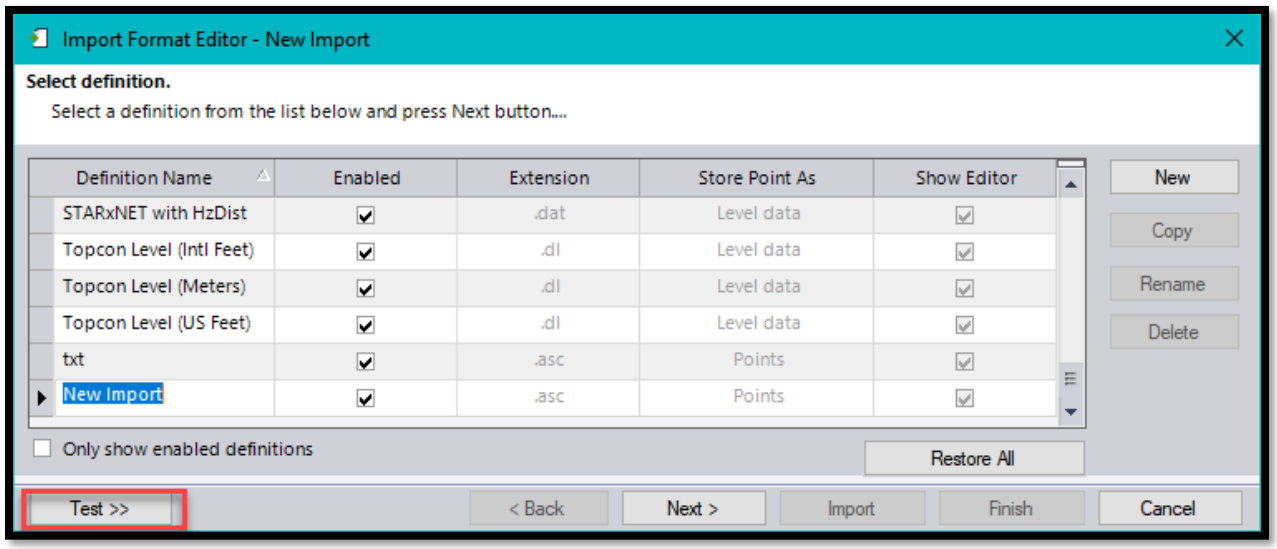
1. Select the down arrow below Import and select Import Format Editor



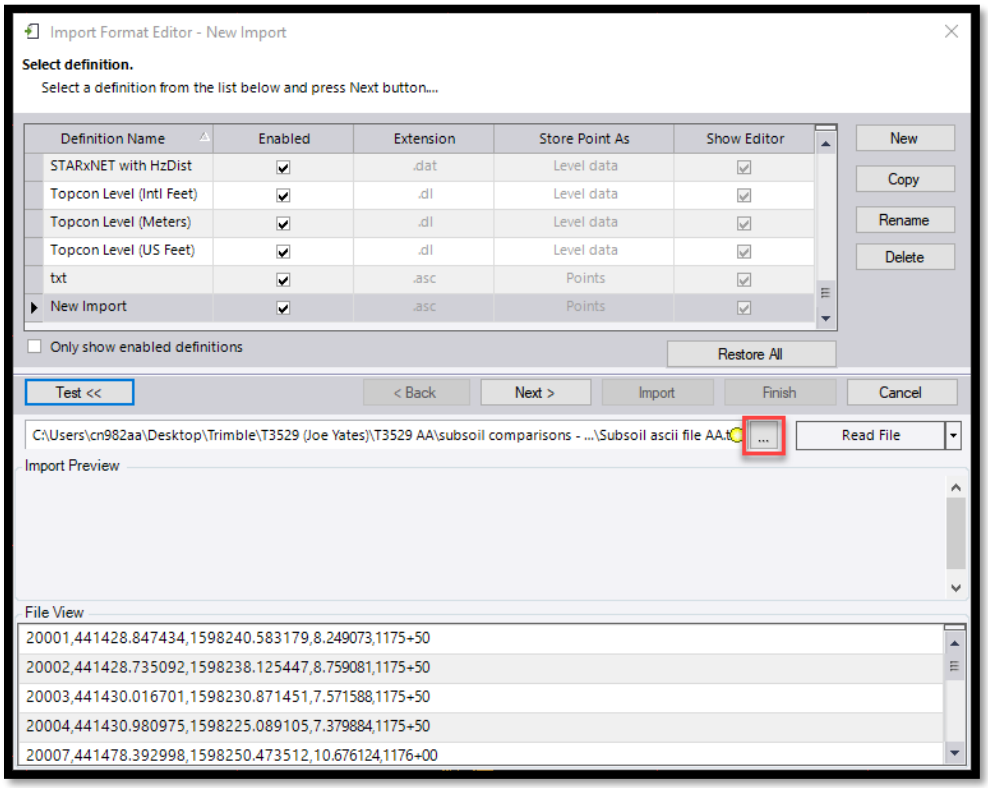
2. On this screen, select New and name your Definition.



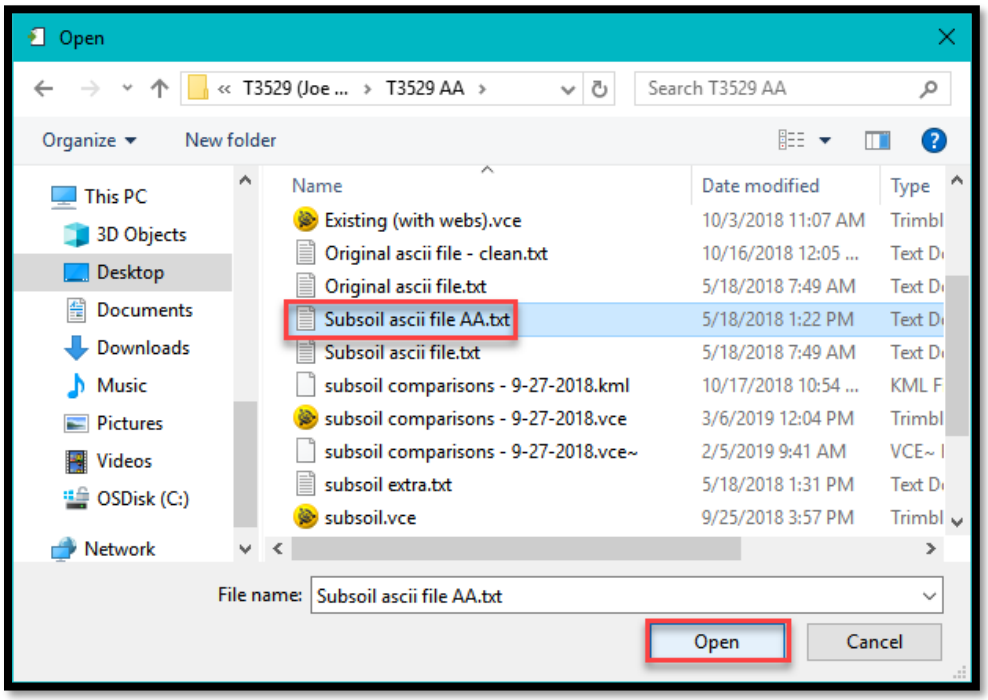
3. Select Test to open the import preview. This will help you see your formatting applied to your data.



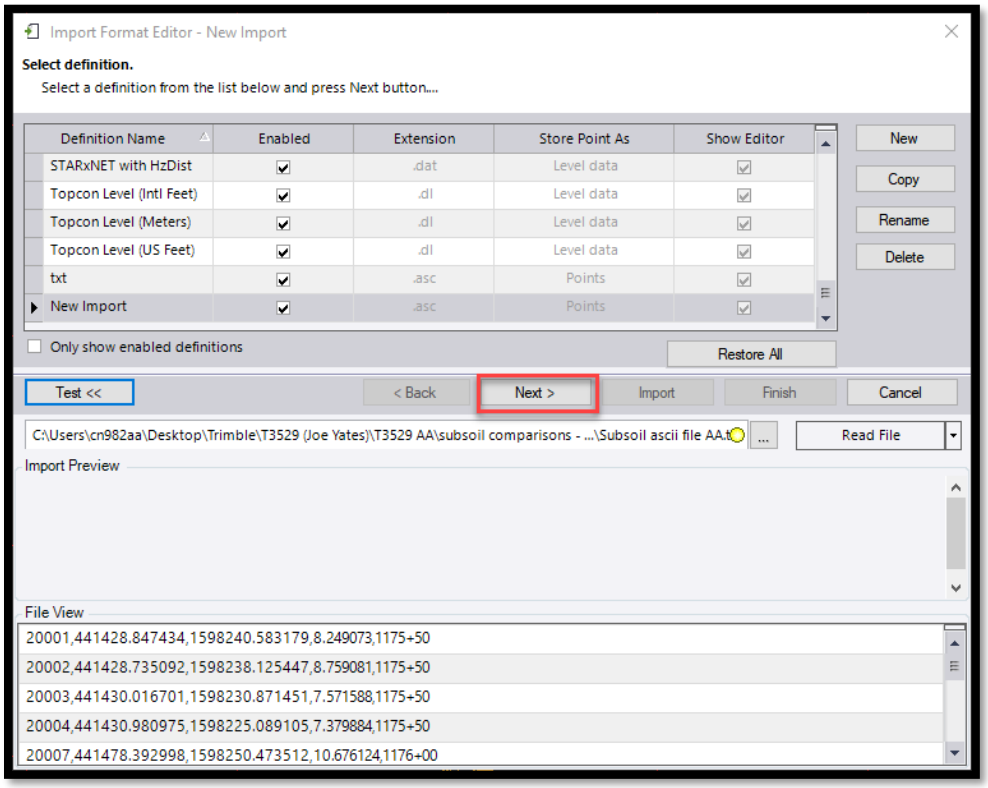
4. Select the ellipsis […] to select your file.



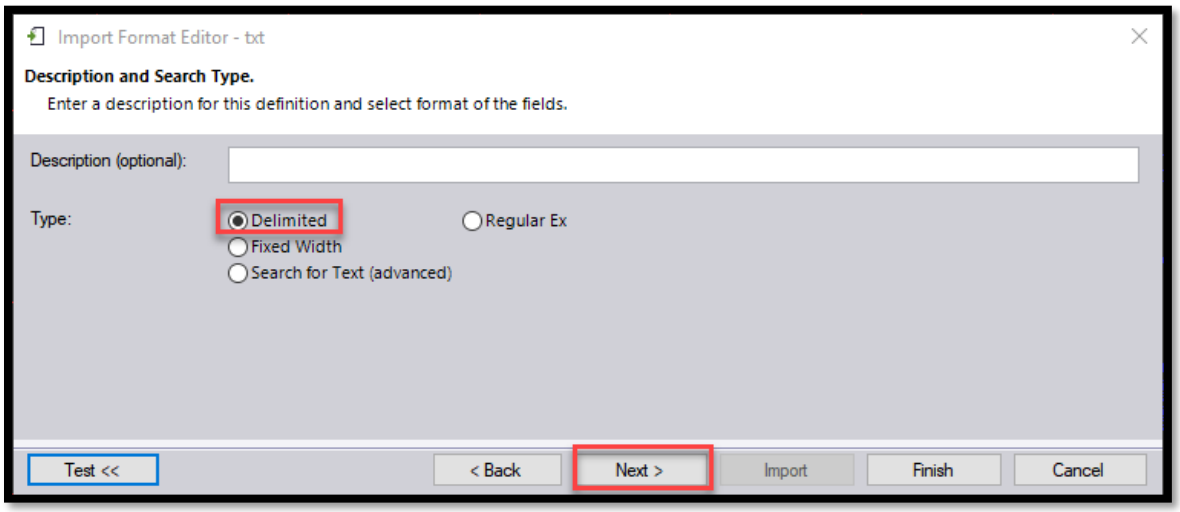
5. Navigate to your file location, select your file and select open.



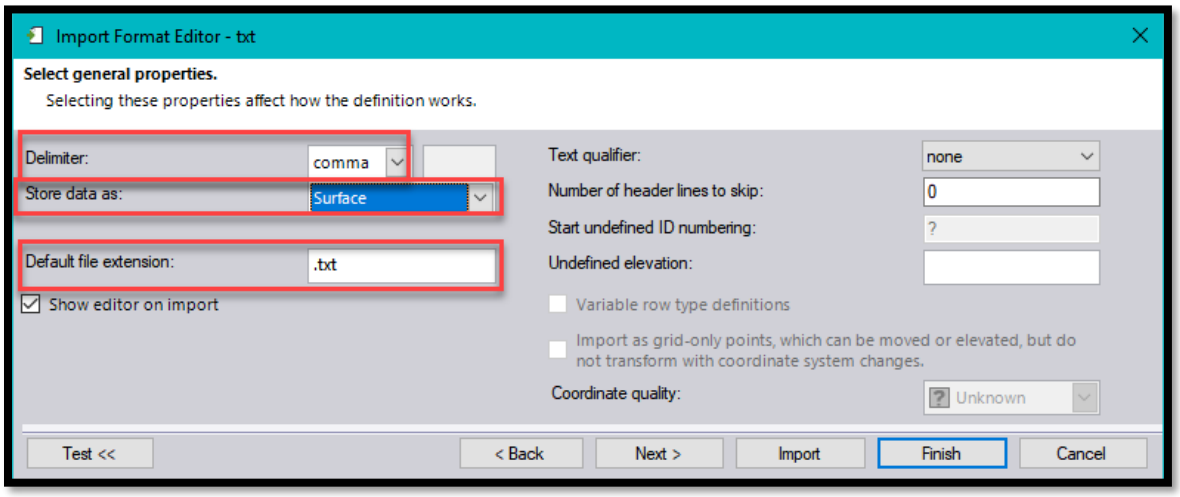
6. Then select Next.



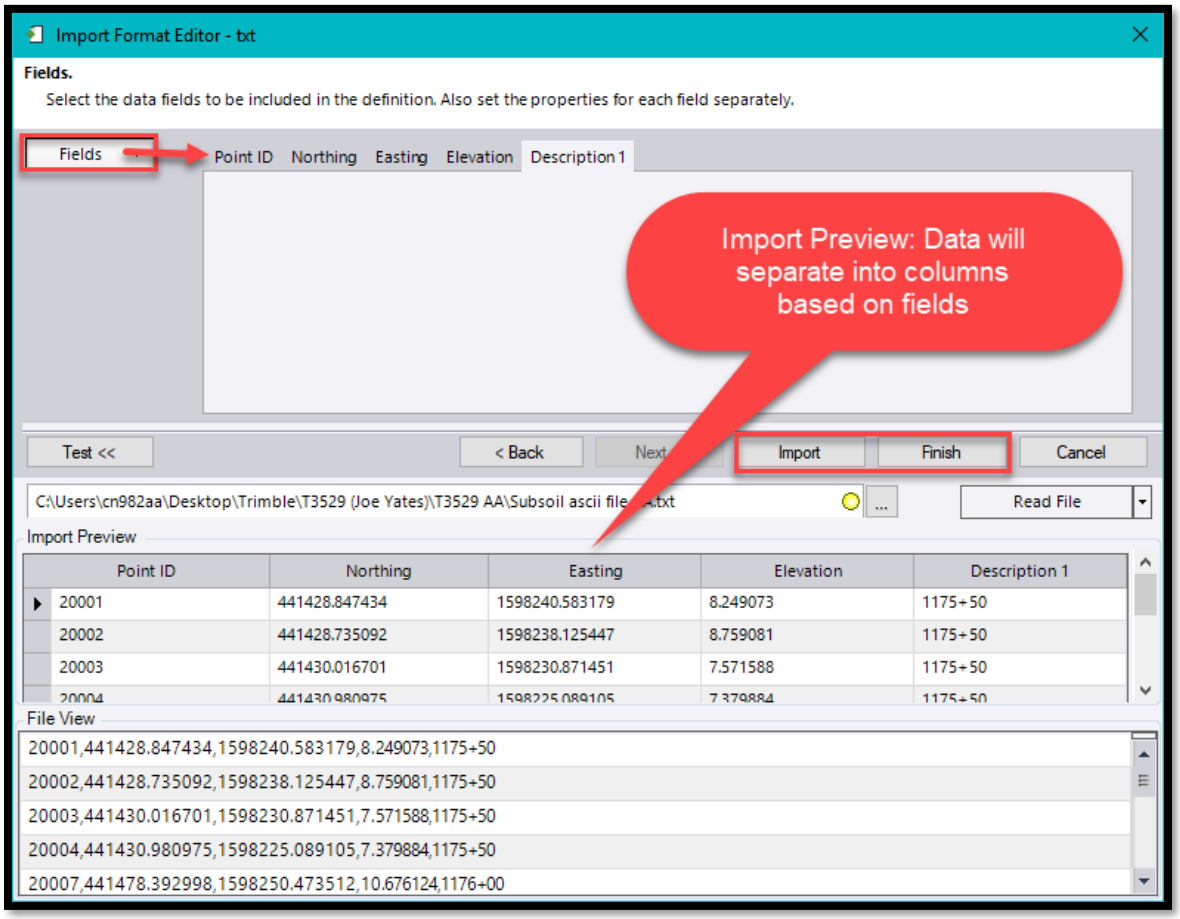
7. Select Delimited, then Next.



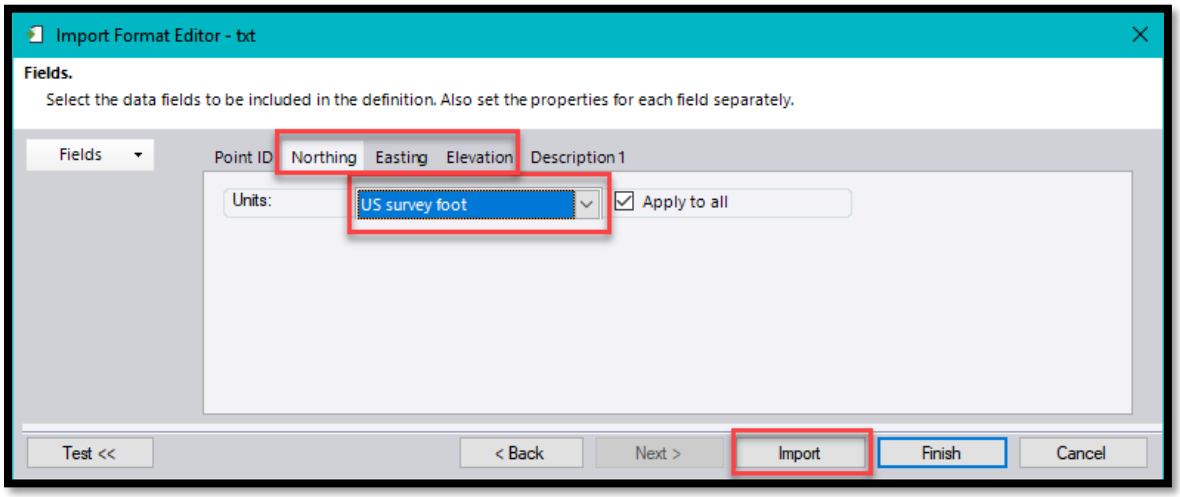
8. Select the option for how your file is delimited and select the option to store the data as a surface. Optionally, identify the default file extension that will use this import format, then select Next.



9. On this screen, add the fields for your dataset (i.e. Point ID, Northing, Easting, Elevation) in the order they are in your file. Repeat until your fields are correct. Use the import preview to verify your selections.



10. Then Select the units - US Survey Foot, then Select Import.



11. Trimble will ask if you want to save the changes to this definition after import. Select Yes. That will leave your definition as an option for you to choose next time you need to import similar data.

Naming Conventions

Ensure all Trimble files and new features (surfaces, corridors, layers, etc.) within Trimble have descriptive titles (subsoil, final, intermediate, etc.) along with the Contract Number and Financial Project Number.

Example Trimble File Submittal Naming Convention: T1234_987651-1-52-01.vce

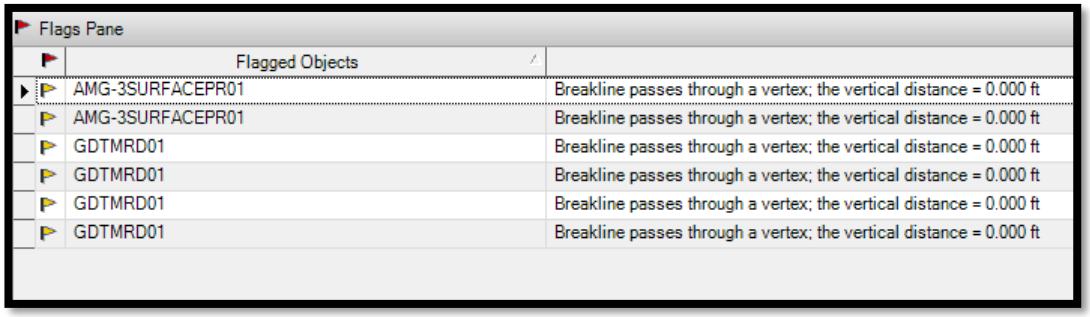
Example Surface Naming Convention: T1234_987654-1-52-01_Subsoil_Final.xml

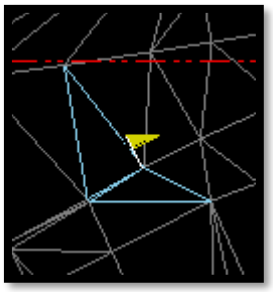
Example Layer Name: Subsoil_Final

Viewing the Flags Pane

The Flags Pane shows import or computation errors. Flagged objects should be analyzed to see why the objects were flagged and if it warrants further attention.

To view the Flags Pane, click the icon in the status bar across the bottom of the screen.





When reviewing the Flags pane, double click on any line item and it will take you to where the error is located in the model. Flags within your project will identify the location of each error as well.

NOTE: The Flag pane only shows the top 100 flags for each surface in the model. As you resolve flags, more flags may appear until you eliminate all the flags. Typical flags will be found where two surface breaklines cross but have different elevations for the same location. Trimble will form a surface model and assume that one of the two options is correct and will flag the difference. Trimble may assume that the wrong one is correct, so it is the user's responsibility to ensure that the model is correct.

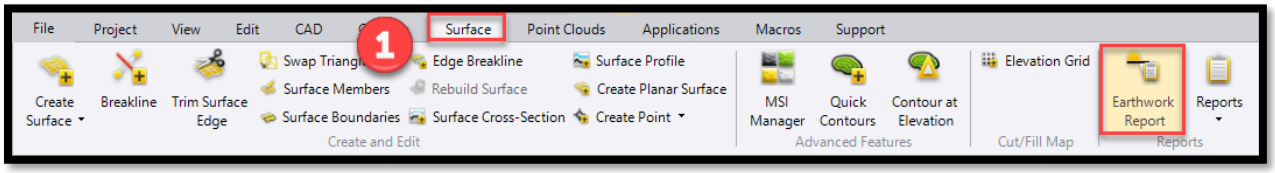
Calculating Surface to Surface Volumes (No Boundary)

This method of generating an Earthwork Report will calculate earthwork quantities without a user defined boundary; thereby making the default boundary limits equal to the limits of the outer boundaries of the surfaces being compared.

- **Definition of a Surface**

  A surface is generated by connecting data points into triangles to create a 3D model.

1. Select Surface, then Earthwork Report.



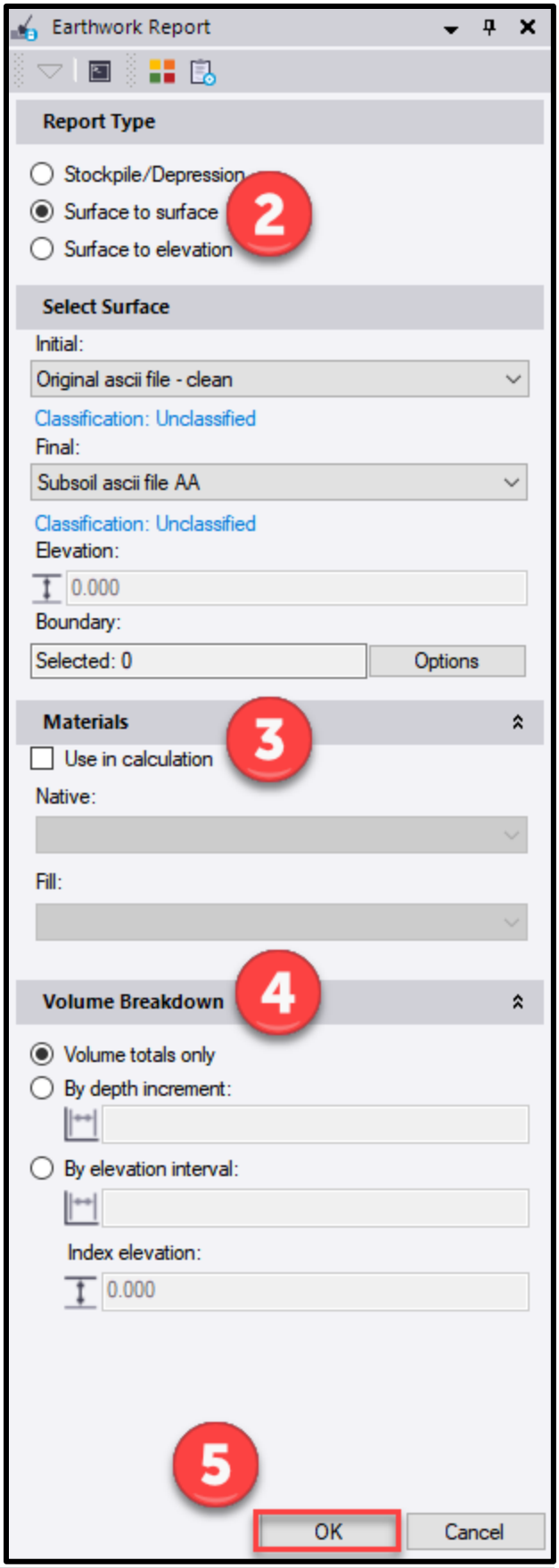
2. On the Earthwork Report tab, select Surface to Surface, select the initial and final surfaces (i.e. the 2 surfaces to compare).

   NOTE: The surface names that appear under 'Initial' and 'Final' are the actual names of the surfaces (within the surface files) and not necessarily the names of the surface files that were imported.

   a. Typically, you will be comparing the design files to your pre-construction survey, or your design files to your post-construction survey.
   b. In the case of subsoil, you will be comparing the bottom of subsoil excavation to the top of fill. You will also need to compare the bottom of subsoil to the design files to see if the tolerances in ***Specifications Section 120-4.1*** were exceeded and compare the top of fill to the finished grading template, as defined in ***Specifications Section 120-2.3***. Use the 1:2 control line shown in ***Design Standard Index 500*** to determine the limit for removal.

3. It is not recommended to use the Materials option as it isn't needed for final estimate payment. This option can be useful for Contractors when determining if material is usable in other locations on the project.

4. Under Volume Breakdown, select your preferred reporting option. (See next page for options.)



a. Volume totals only – report will give you the amount of cut, fill, and excess/shortage.
(Example below)

Bank Volumes Based on Surface Geometry Alone	
Cut material:	264.0 yd³
Fill material:	5.2 yd³
Excess:	258.8 yd³

b. By depth increment – report will give cut and fill based on the depth increment entered, along with the volume totals.
(Example below is depth increment = 5)

Volumes by Depth Range

Depth range	Cut (yd³)	Fill (yd³)
-5.000 > 0.000	264.0	0.0
0.000 > 5.000	0.0	5.2

c. By elevation interval, report will give you cut and fill based on the elevation interval and index elevation entered, along with the volume totals.
(Example below is elevation range = 1 and index elevation = 0.)

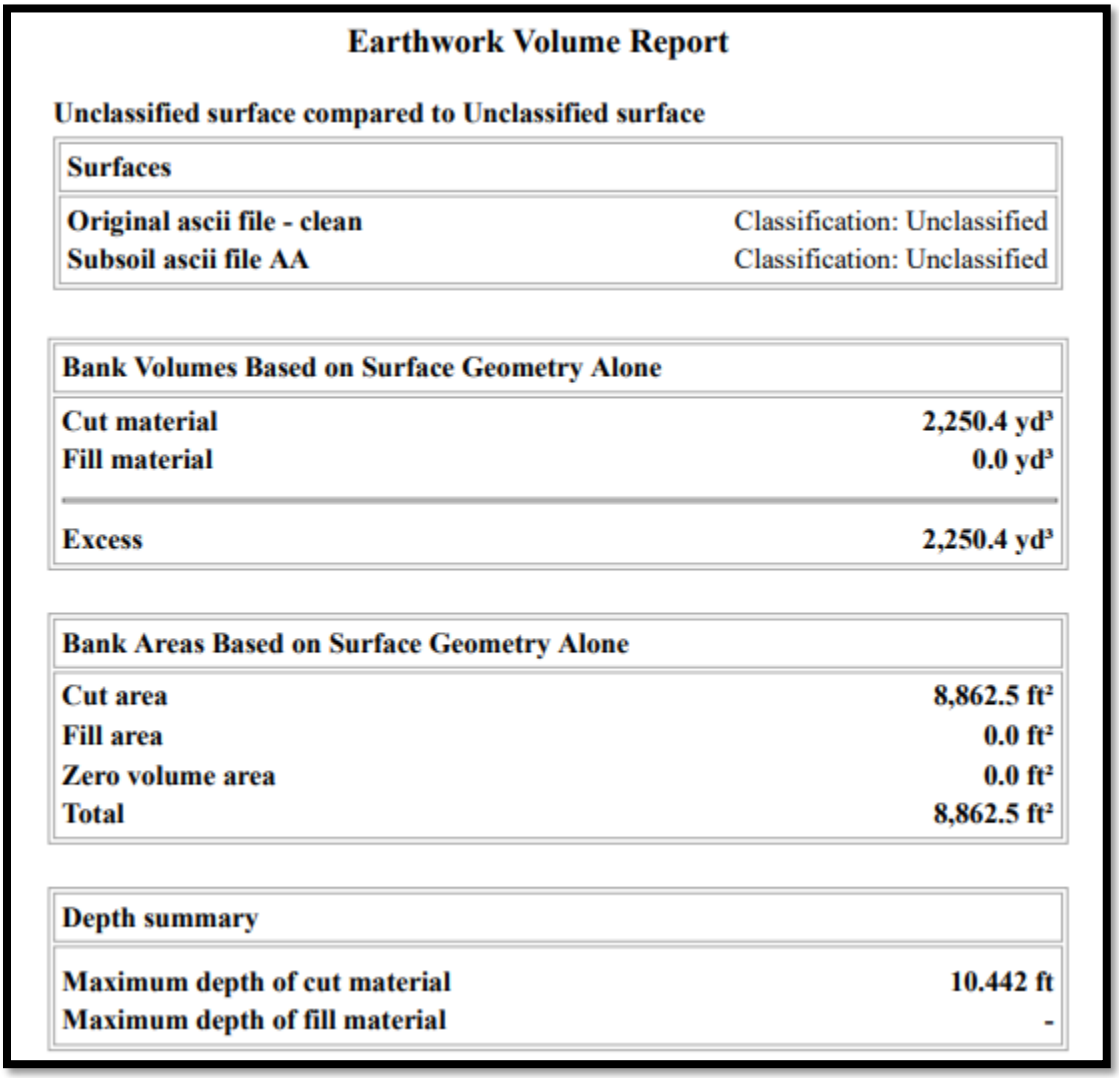
Volumes by Depth Range

Elevation range	Cut (yd³)	Fill (yd³)
109.859 > 110.000	0.0	0.0
110.000 > 111.000	0.0	0.1
111.000 > 112.000	11.4	0.2
112.000 > 113.000	43.9	0.4
113.000 > 114.000	69.8	4.6
114.000 > 115.000	80.3	0.0
115.000 > 116.000	49.8	0.0
116.000 > 116.666	8.8	0.0

5. Click OK to generate the Earthwork Report based on your preferred option for volume breakdown.

NOTE: Always review the surfaces and surface classifications being compared to ensure that the Cut / Fill quantities are reported correctly.

- **Example Earthwork Volume Report**



Earthwork Volume Report

Unclassified surface compared to Unclassified surface

Surfaces	
Original ascii file - clean	Classification: Unclassified
Subsoil ascii file AA	Classification: Unclassified

Bank Volumes Based on Surface Geometry Alone	
Cut material	2,250.4 yd³
Fill material	0.0 yd³
Excess	2,250.4 yd³

Bank Areas Based on Surface Geometry Alone	
Cut area	8,862.5 ft²
Fill area	0.0 ft²
Zero volume area	0.0 ft²
Total	8,862.5 ft²

Depth summary	
Maximum depth of cut material	10.442 ft
Maximum depth of fill material	-

Calculating Surface to Surface Volumes (with Boundary)

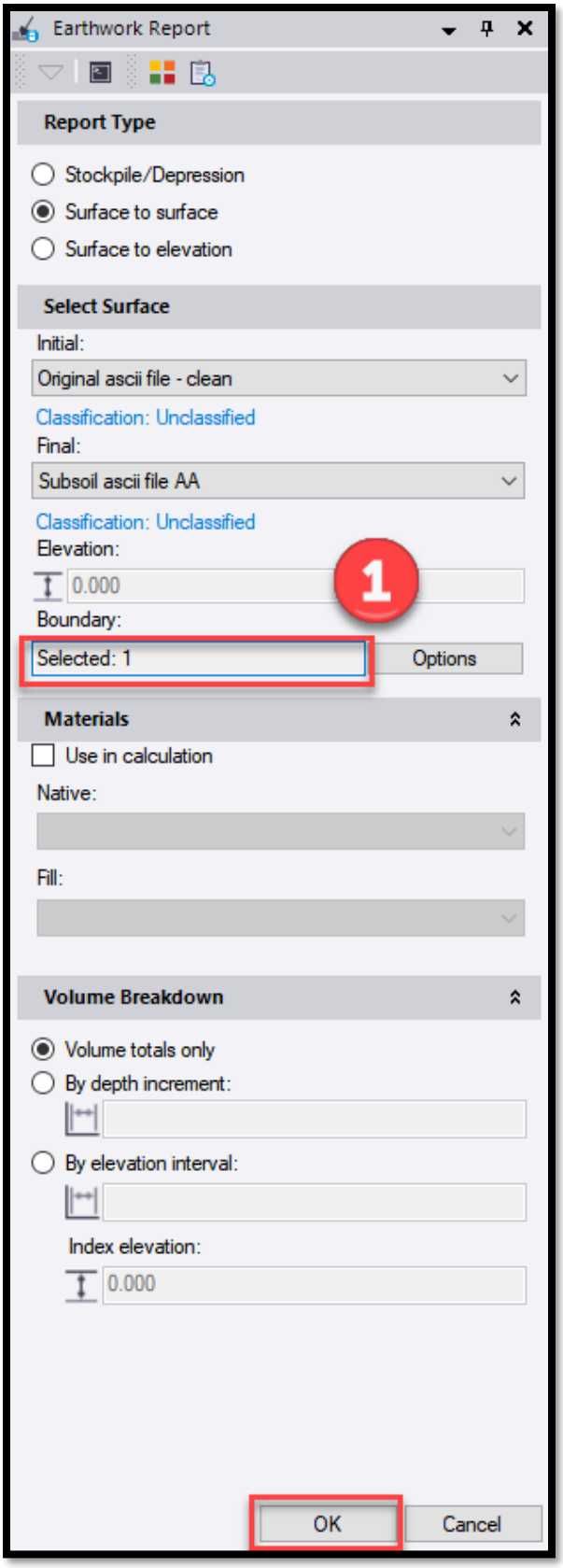
It may be beneficial or necessary to generate an earthwork report within isolated areas on the project.

- **Definition of Boundary**

  A boundary delineates a portion of a surface to limit the calculation to a specific area or section of the surface. Boundaries can be defined by creating/using shapes, polylines, or corridors within the project limits.

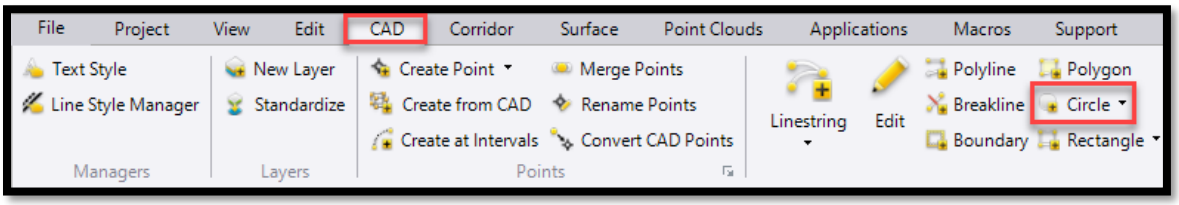
1. Follow the steps for Calculating Surface to Surface Volumes, but in the Boundary cell, select the boundary line to limit your calculation, then select OK.

NOTE: The boundary can be various shapes (see Create a Circle, Create a Rectangle, and Create a Polyline. The boundary must be a closed shape to limit the calculation correctly. Also, boundaries only need to be in 2-D (no elevation required). Be aware however, that “no elevation” is like 0 elevation, so the boundary will be at a different elevation as the surface when viewing in 3-D. A boundary acts as a “cookie cutter” through the selected surfaces and limits the volumes computed to that which fall inside of the boundary.

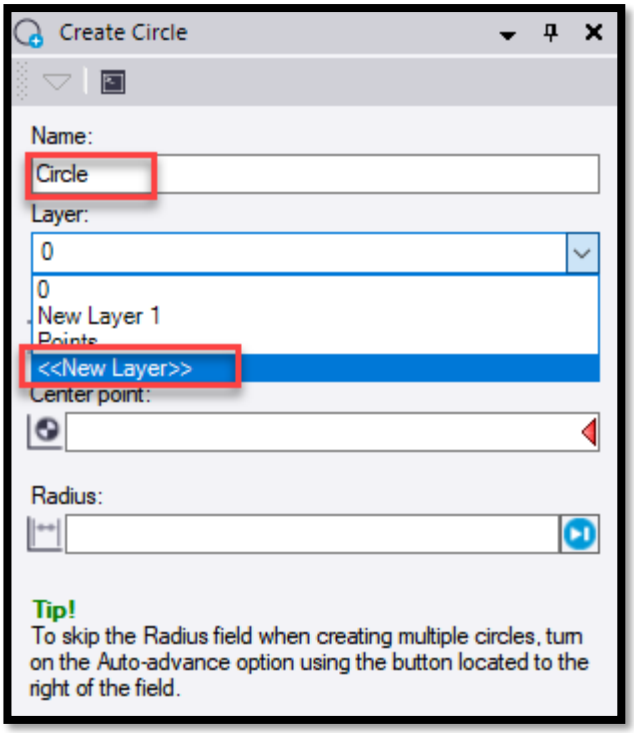


Creating a Circle (for use as a Boundary)

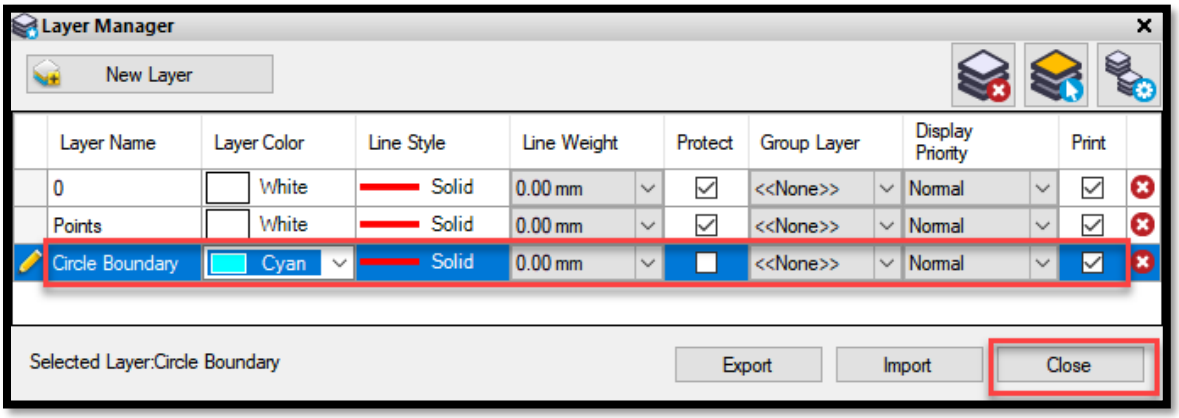
1. On the CAD tab, select Circle.



2. On the Create Circle tab, name the circle, and assign it to a new layer.



3. In the Layer Manager window, enter a layer name, and select the layer color, line style, and line weight, then select Close.

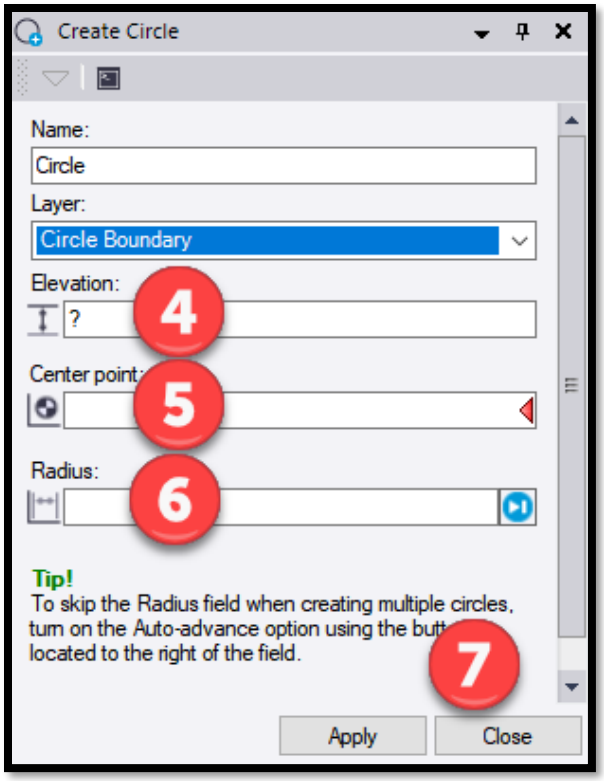


4. Optional: Enter the circle Elevation or snap to any 3d object to specify the elevation. (See Definition of Boundary – elevation is not required.)

5. Enter a coordinate or select a point on the surface as the Center point of the circle.

6. Enter the radius or select a point on the surface to specify the circle size.

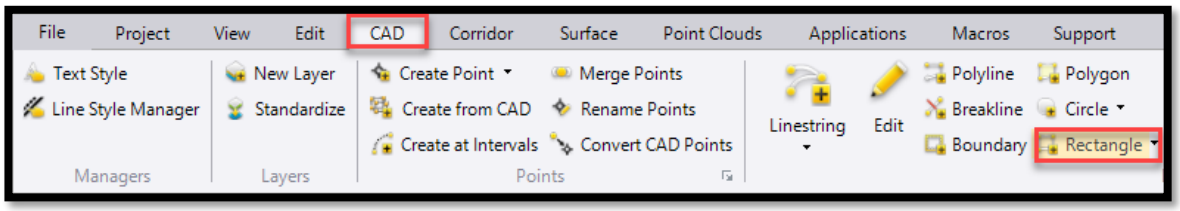
7. Once a radius is selected, the Create Circle tab is ready to make a new circle. If you are done making a circle, select Close. If you need another circle, repeat the Create Circle steps above.



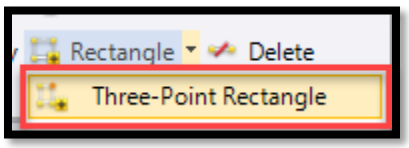
NOTE: Once a boundary is created, it can be used to generate a surface to surface volume report.

Creating a Rectangle (for use as a Boundary)

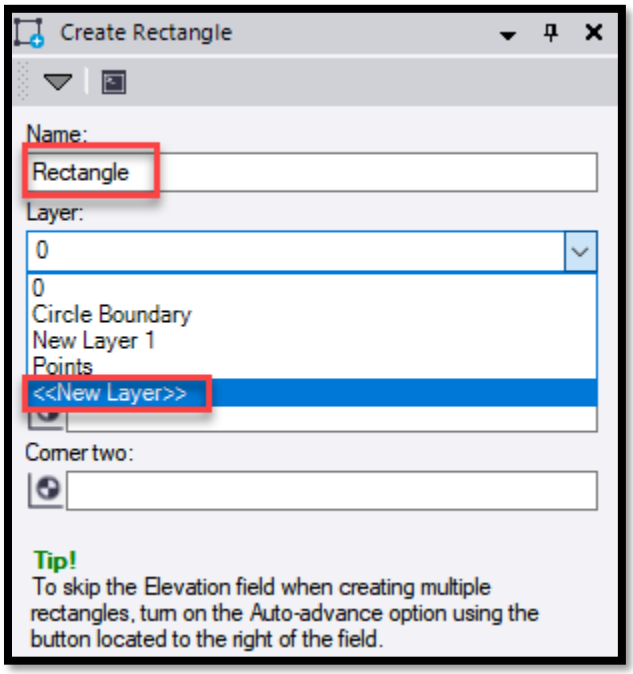
1. On the CAD tab, select Rectangle.



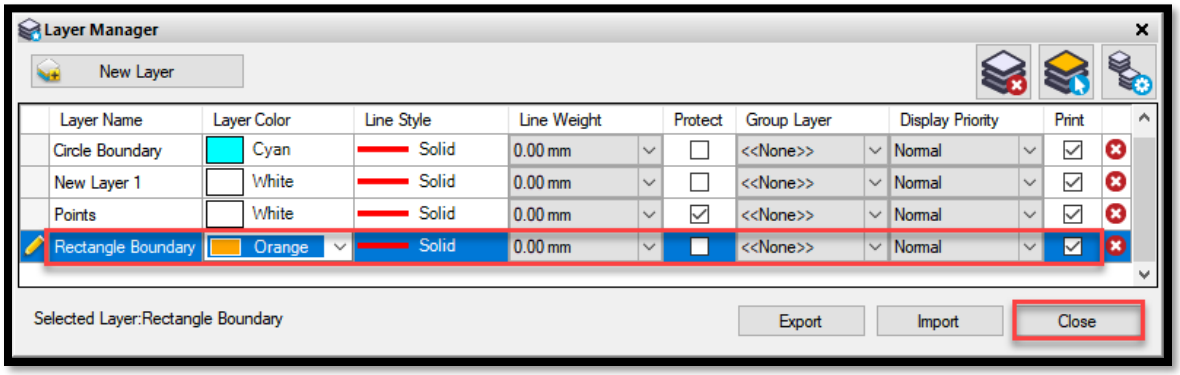
NOTE: The rectangle command creates a rectangle in the N-S, E-W orientation. To skew a rectangle, use the pull down on the icon and select 3-point rectangle. This allows selection of two points and a width to define the rectangle (See Step 8).



2. On the Create Rectangle tab, name the rectangle, and assign it to a new layer.



3. In the Layer Manager window, enter a layer name, and select the layer color, line style, and line weight, then select Close.

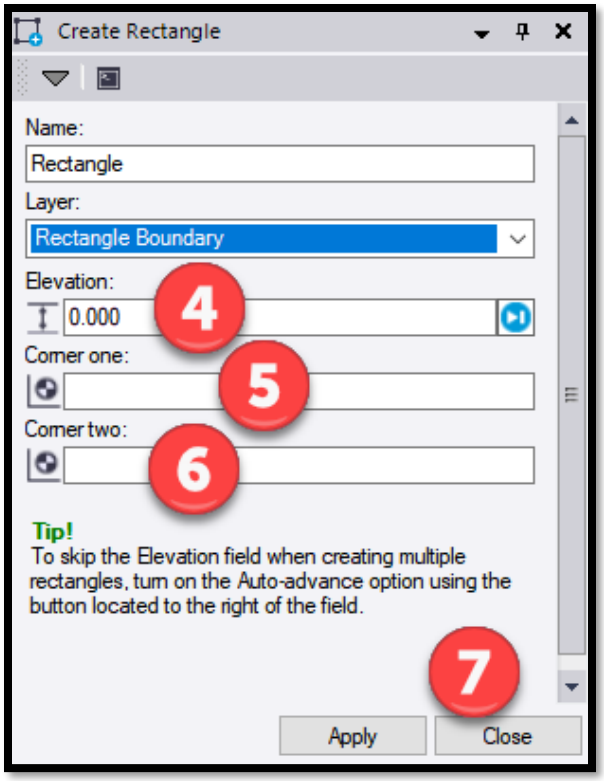


4. Optional: Enter the rectangle Elevation or snap to any 3d object to specify the elevation. (See Definition of Boundary – elevation is not necessary).

5. Enter a coordinate or select a point on the surface as Corner one.

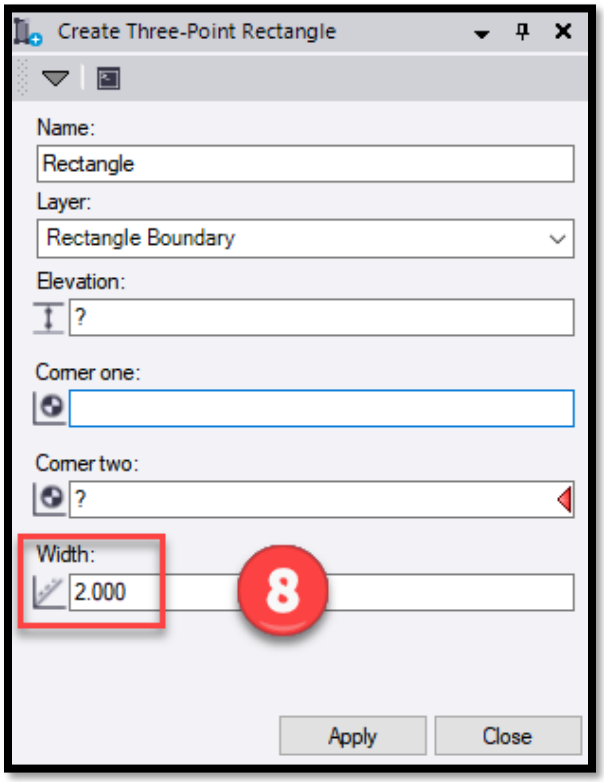
6. Enter a coordinate or select a point on the surface as Corner two.

7. Once Corner two is selected, the Create Rectangle tab is ready to make a new rectangle. If you are done making a rectangle, select Close. If you need another rectangle, repeat the Create Rectangle steps above.



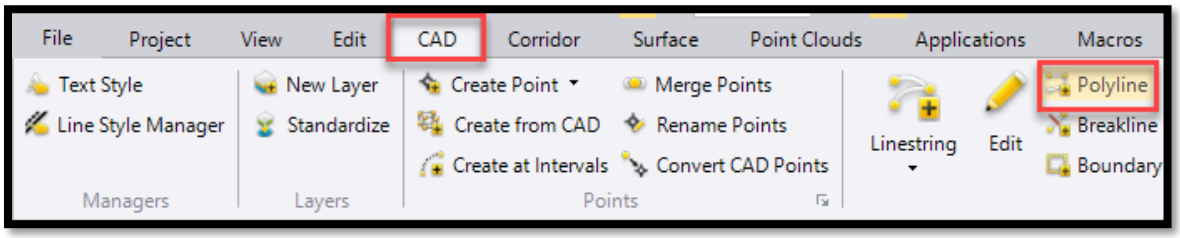
8. For a Three-Point Rectangle, select the width and then Close.

NOTE: Once a boundary is created, it can be used to generate a surface to surface volume report.

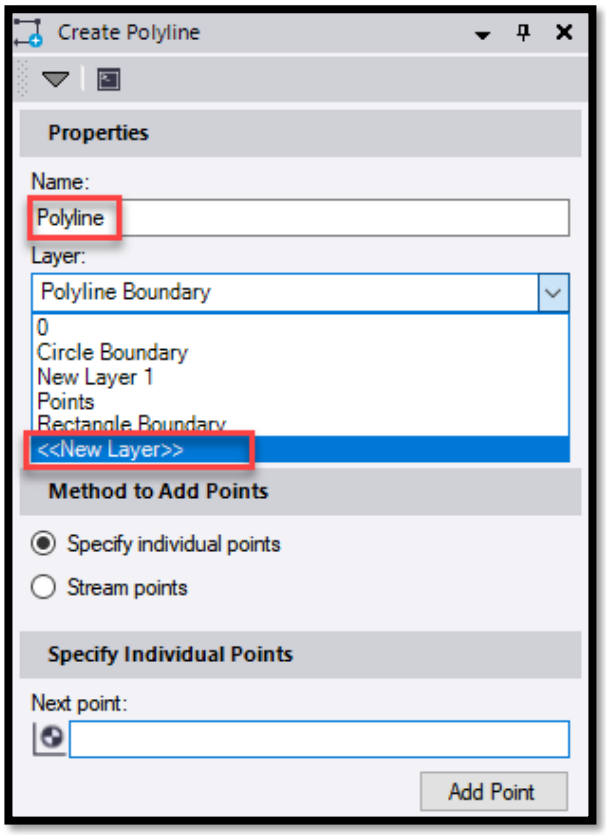


Creating a Polyline (for use as a Boundary)

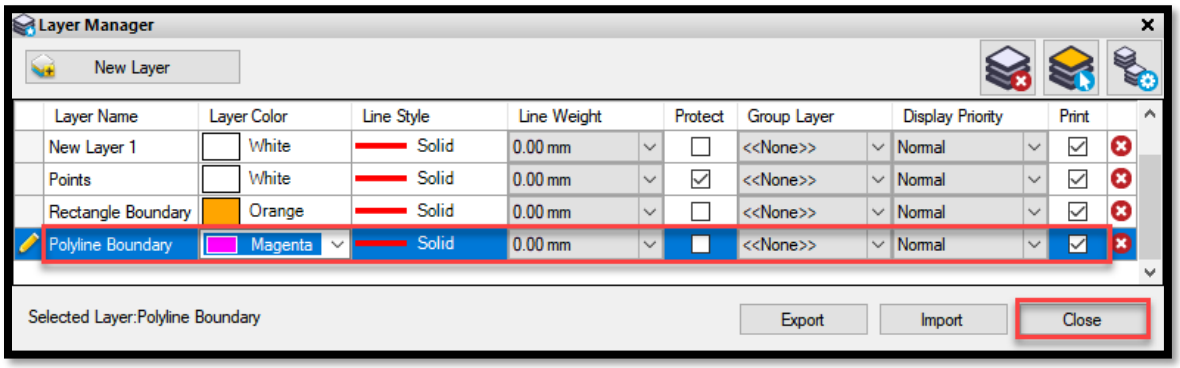
1. On the CAD tab, select Polyline.



2. On the Create Polyline tab, name the polyline and assign it to a new layer.



3. In the Layer Manager window, enter a layer name, and select the layer color, line style, and line weight, then select Close.



4. Select Always to automatically close by connecting ends, since the boundary needs to be closed.

5. Select the appropriate Method to Add Points.

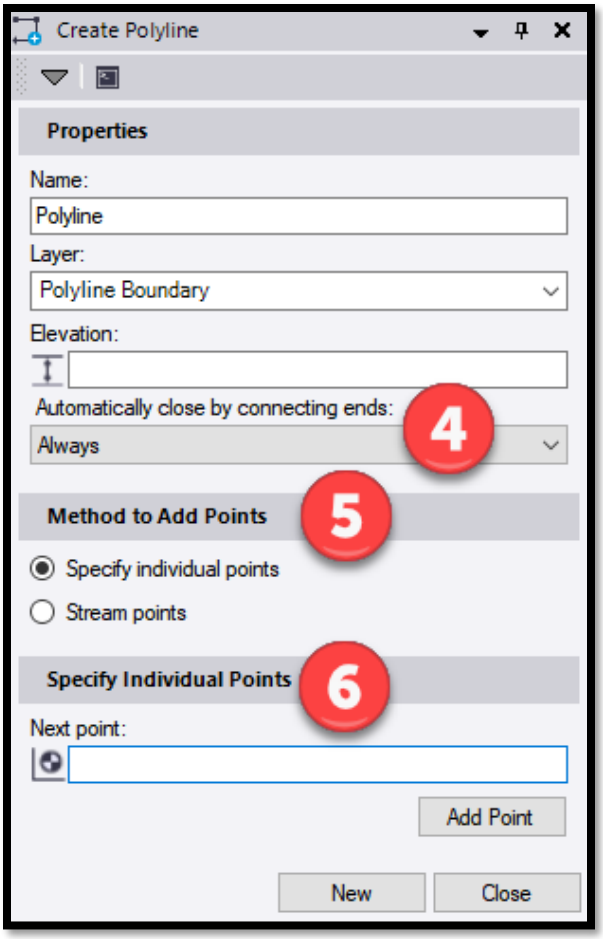
- **Definition of Specify Individual Points**

  The start and end points for each segment can be selected.

- **Definition of Stream points**

  The first point of the polyline can be selected, then points are selected as you move along the path with the mouse button down based on the filter settings.

6. The last option of the Create Polyline tab is dependent upon the selection for Method to Add Points. Add points and then Close.

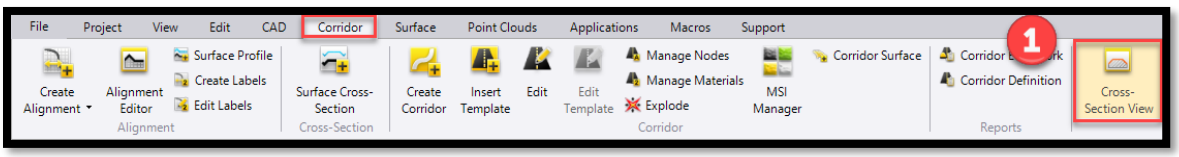


NOTE: Once a boundary is created, it can be used to [generate a surface to surface volume report.]

Viewing Cross Sections

First, you must have a corridor with an alignment to create cross sections. Design files will come with a corridor and alignment already defined. If you have a project that does not have a corridor and alignment, you will need to create them (See [Creating an Alignment] and [Creating a Corridor]).

1. Select Corridor, then Cross-Section View. You must have an alignment selected for the Cross-Section View icon to be selectable.



2. At the bottom of the screen, type in the station value or move the slider to the station to view. Use the yellow wheel icon, to change the station interval.

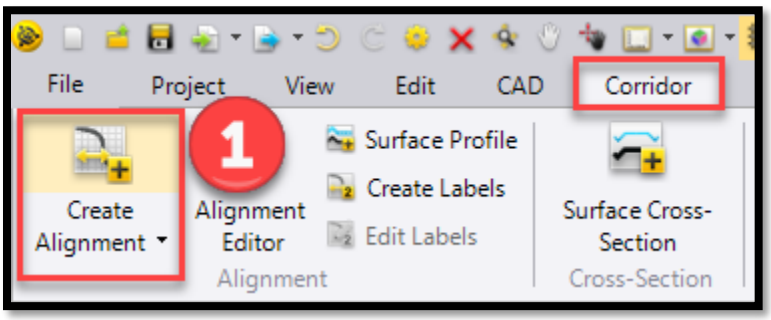
Creating an Alignment

- **Definition of Alignment**

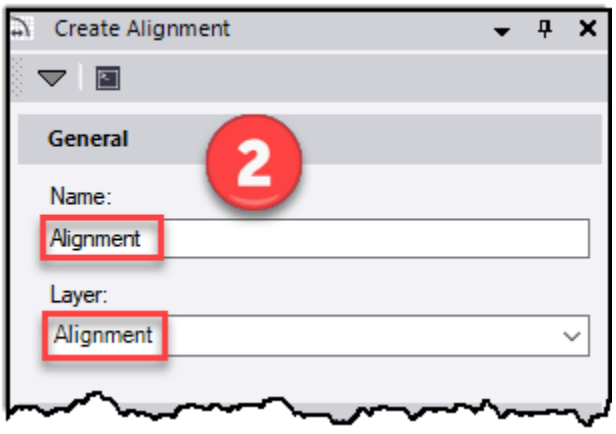
  An Alignment defines the path or route of a road based on a series of tangents and curves. There are two alignments for every road – the horizontal alignment and the vertical alignment. The horizontal alignment typically follows the centerline of the road. The vertical alignment follows the horizontal alignment, but indicates the elevation to show whether you are going up or down a hill.

  If the designer provided an Alignment file in the CADD.zip file, you don't need to create an alignment. Skip this step and use the Import instructions to add it to your Trimble project.

1. Select Corridor, Create Alignment.



2. Enter the name of the alignment and select the layer on the Create Alignment tab.



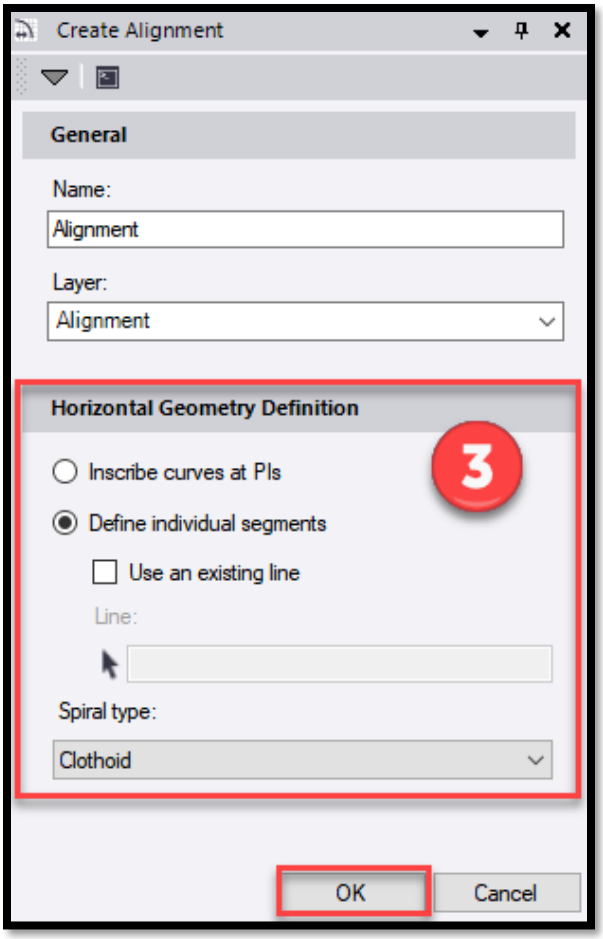
3. Select the applicable Horizontal Geometry Definition, then select OK.

- **Definition of Inscribe curves at PIs**

  This option builds the alignment from data with values for curves at consecutive Points of Intersection (PIs).

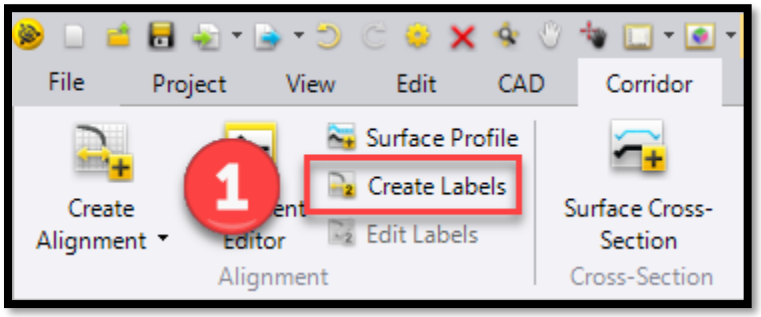
- **Definition of Define individual segments**

  This option builds the alignment from data with values for consecutive line, arc, and spiral segments or to build an alignment based on the geometry of an existing line.

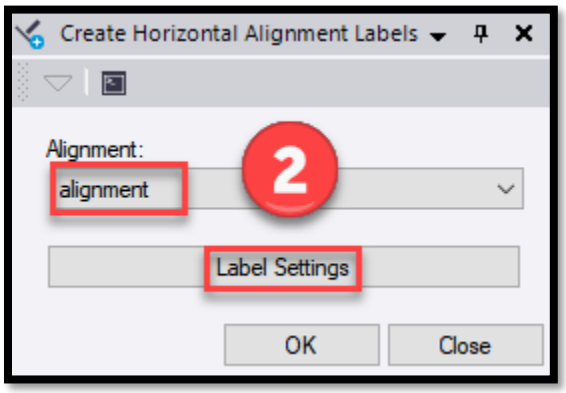


Adding Station Labels to Alignment

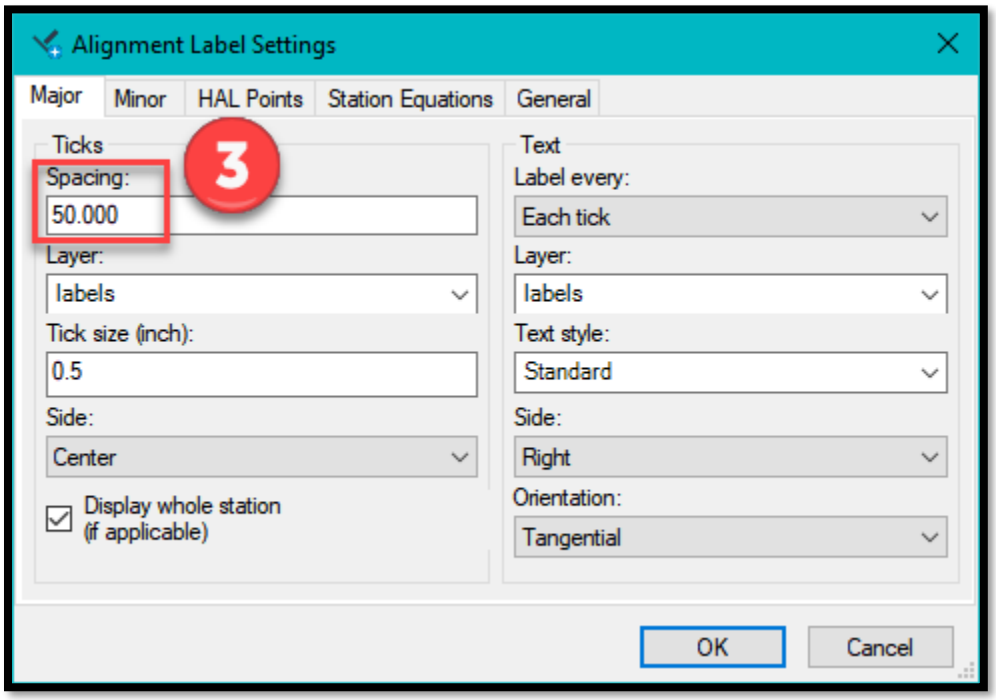
1. On the Corridor tab, select Create Labels.



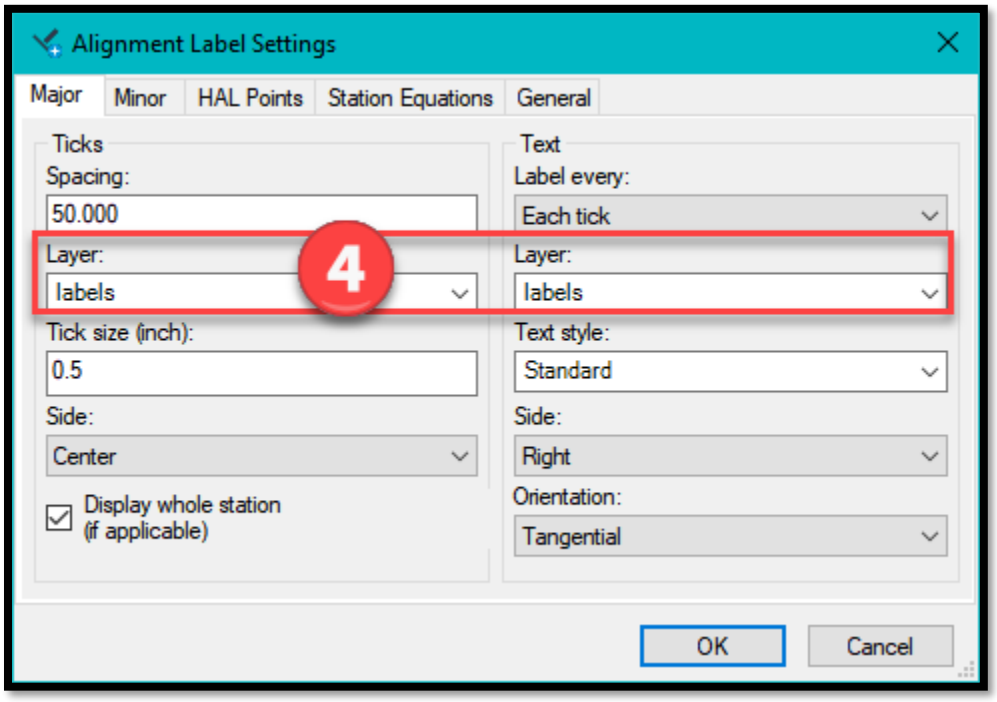
2. On the Create Horizontal Alignment Labels, select the alignment, then select Label Settings.



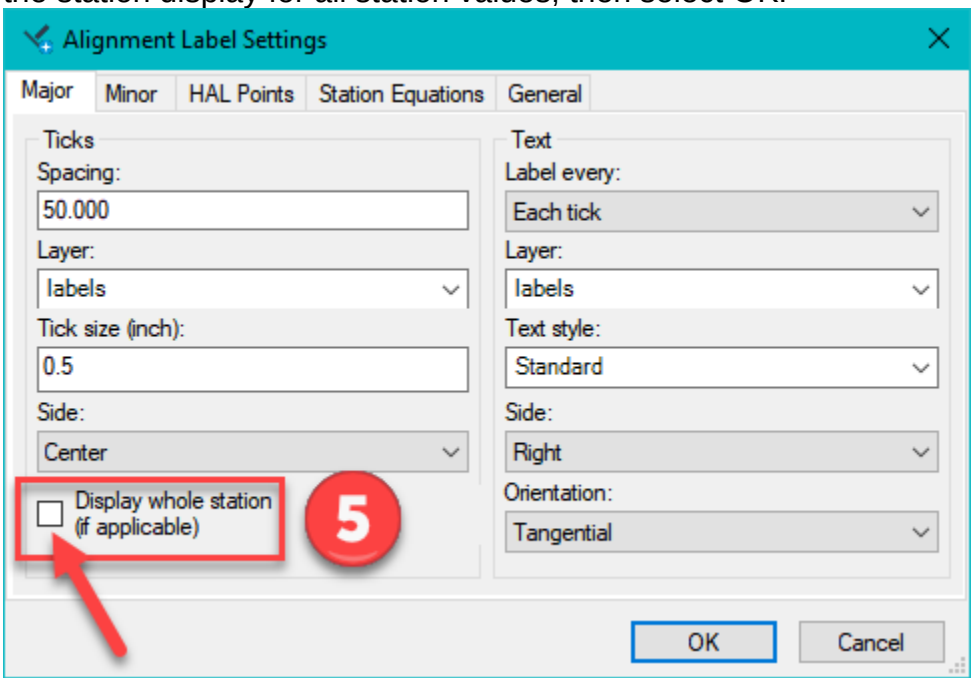
3. Identify your tick mark spacing.



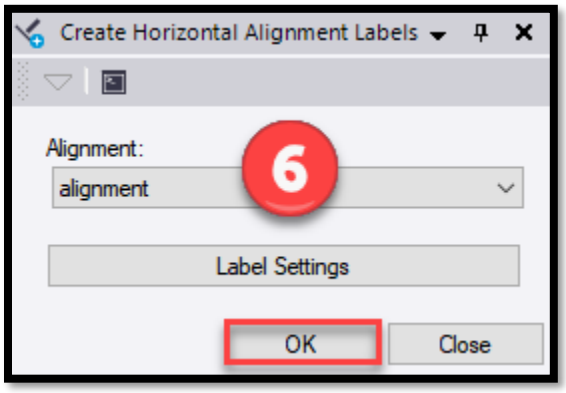
4. Choose/Create a layer for both the Ticks and the Text, then select OK.



5. Un-select the Display whole station (if applicable) box to ensure the + is shown in the station display for all station values, then select OK.



6. Select OK.



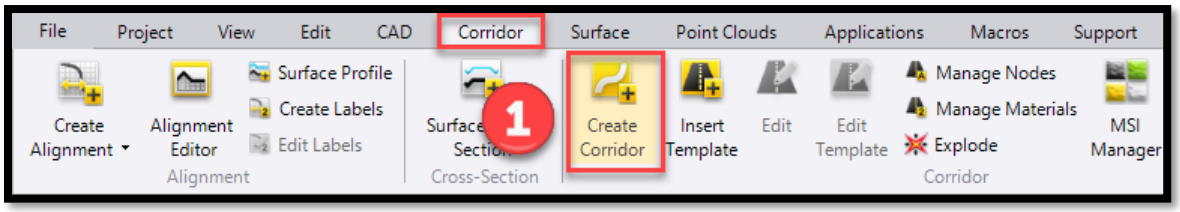
NOTE: If need adjust other settings so text is appropriate size and font.

Creating a Corridor

- **Definition of Corridor**

  A Corridor is a 3D model of a road based on the horizontal and vertical alignments identified.

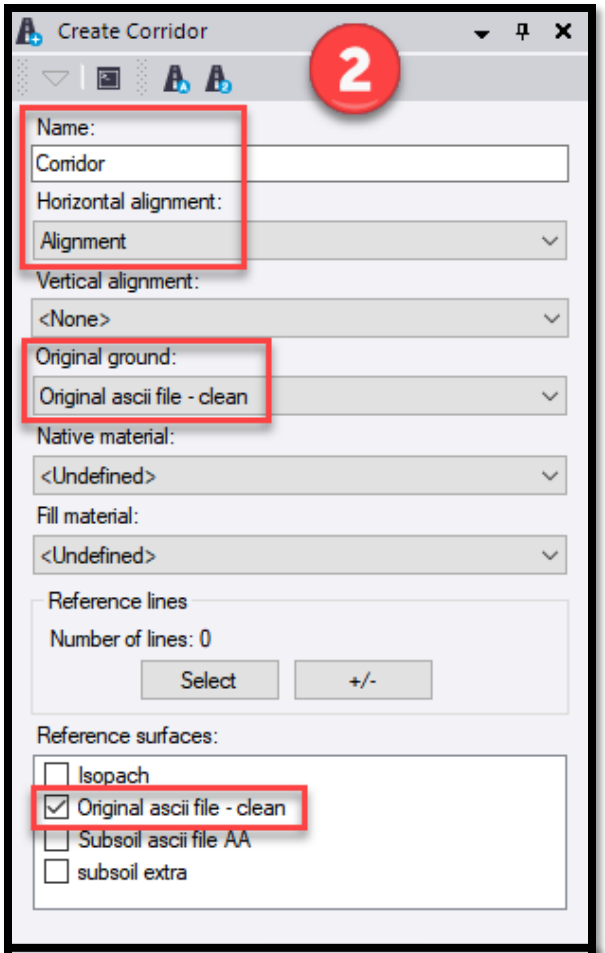
1. On the Corridor tab, select Create Corridor.



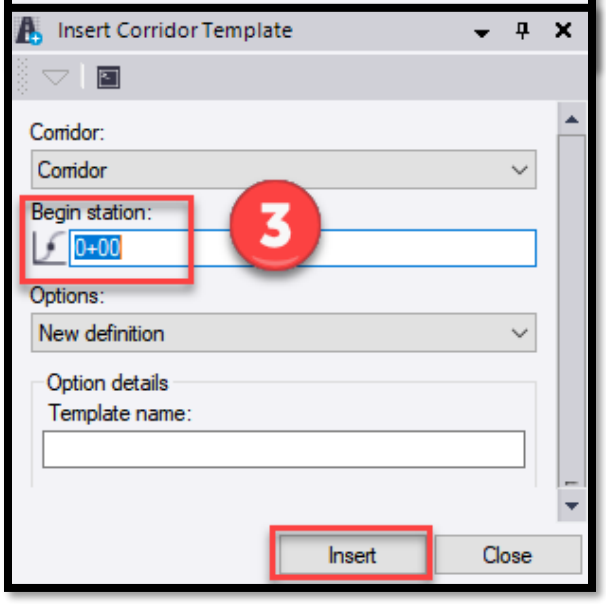
2. On the Create Corridor tab, name the corridor and select the horizontal alignment. Select the appropriate original ground file and check the same original

ground file in the “reference surfaces” section at the bottom of the window, click OK.

NOTE: It is not required to select a vertical alignment or native and fill materials.



3. On the Insert Corridor Template tab, select a beginning station for the new corridor and click Insert.

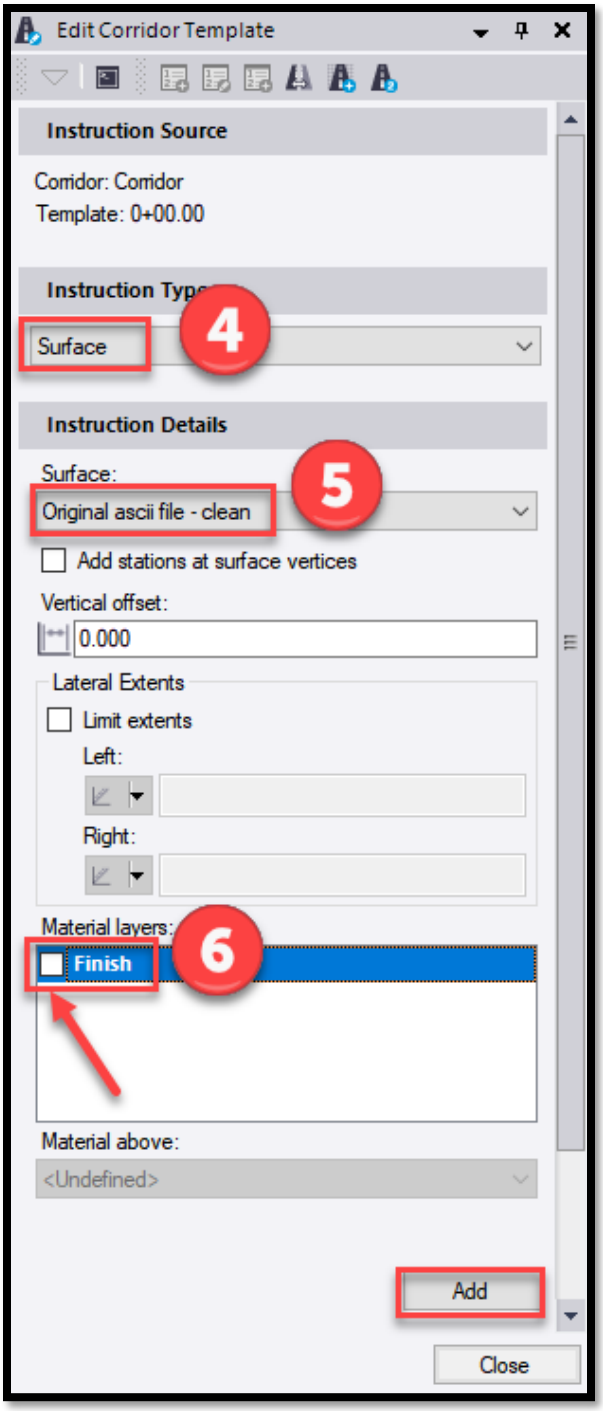


4. On the next tab, under Instruction Type, select Surface.

5. Under Instruction Details, select the surface.

    a. Typically it is the Original Ground/Existing surface, however, if you want to compare volumes between Last Month and This Month, then Last Month can be selected as the existing and This Month set as the finish surface.

6. Under Material layers, ensure the Finish box is <u>not</u> checked, and select Add.



7. On the next tab, under Instruction Details, select the surface to compare with the original ground.

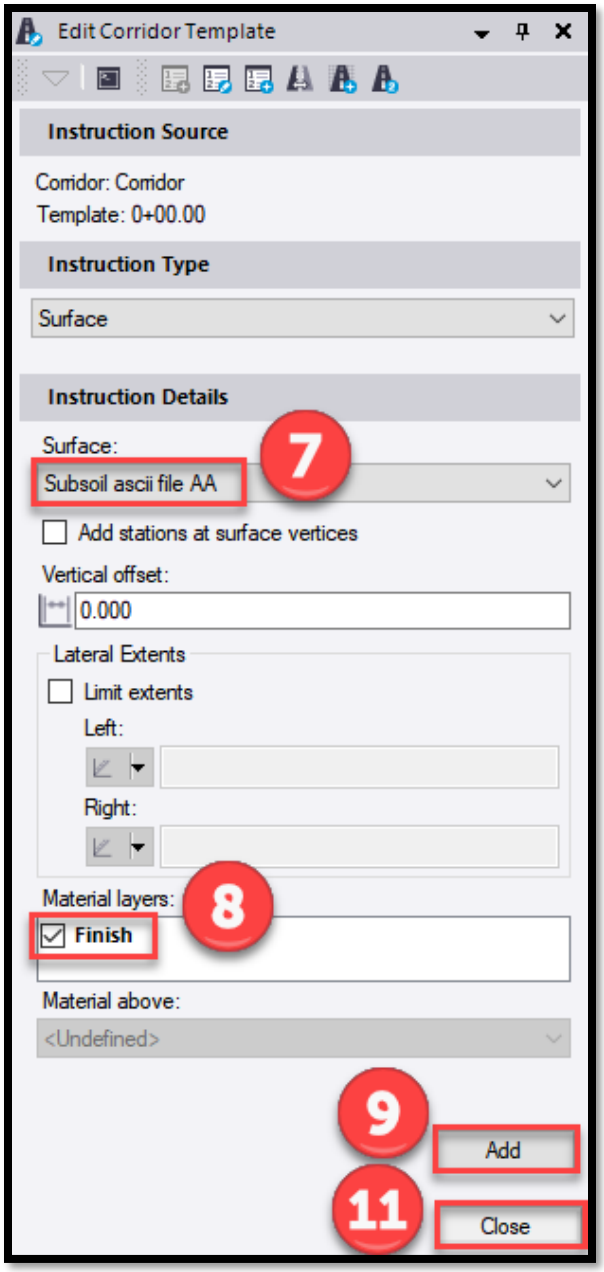
8. Under Material Layers, select the Finish box.

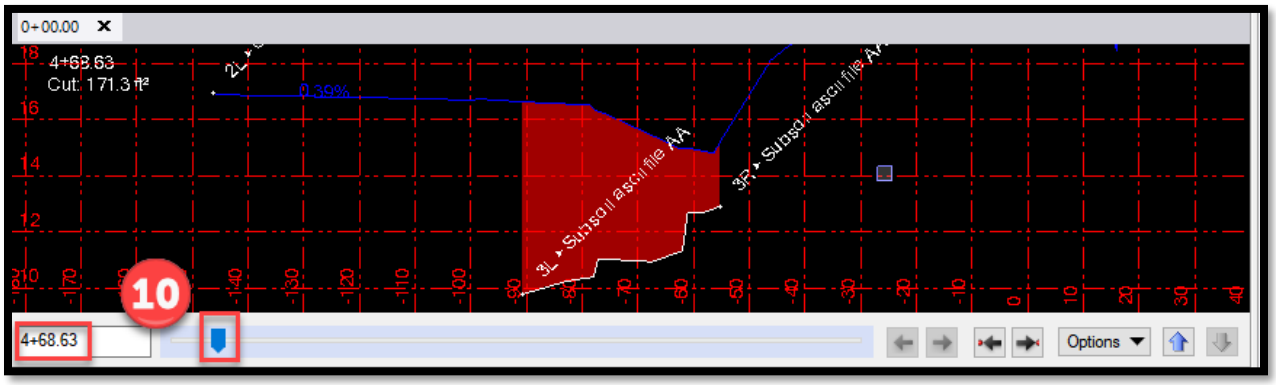
9. Click Add, then Close.

10. Type in a station or move the slider along the corridor to see cross-sections. Cut and Fill areas will be identified.

11. Click Close. Once the Edit Corridor Template is closed, the station slider will also close.

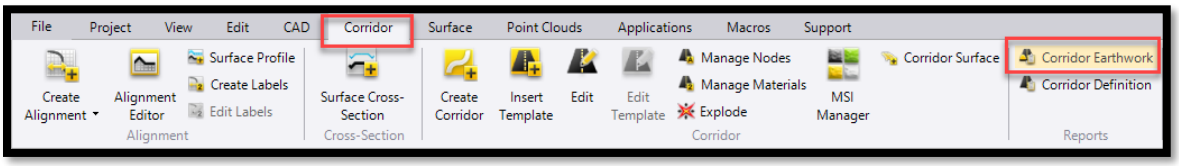
NOTE: It is now possible to generate Corridor Earthwork Reports along the corridor.





Generating a Corridor Earthwork Report (with Option for Subsection/ Between Stations)

1. On the Corridor tab, select Corridor Earthwork.



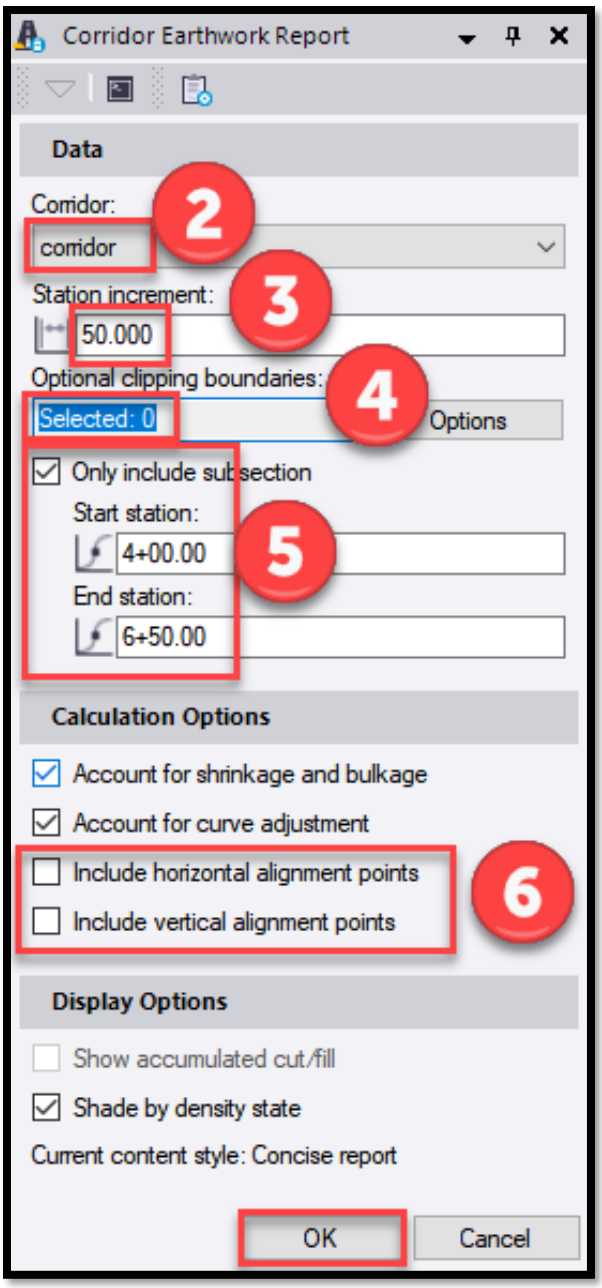
2. Choose appropriate corridor for analysis.

3. Specify station increment.

4. Optional Clipping Boundaries will be automatically set to “Selected: 1”. Ensure it is set to “Selected: 0”.

5. ***To produce the Corridor Earthwork Report for a specific section of the project***, enter the start and end station values for the section to be analyzed.

6. Uncheck the horizontal and vertical points to produce earthwork quantities only for the specified increments, and click OK.



7. A new screen will open, and the Corridor Earthwork Report will be generated.

- **Example Corridor Earthwork Report**

Corridor Earthwork Report

Corridor name:	corridor
Native material:	<Undefined>
Fill material:	<Undefined>

Start station:	4+00.00
End station:	6+50.00
Account for curve adjustment:	Yes
Account for shrinkage/bulkage:	Yes

Mass Earthwork

	Volume (yd³)
Total available bank cut	1,839.0
Total fill supplied	1,839.0
Total fill required	0.0
Total excess (yd³)	**1,839.0**

Cut Quantities

Material	Volume (yd³)
<Undefined>	1,839.0
Total	**1,839.0**

Station	Area (ft²)		Volume (yd³)				Accumulated Volume (yd³)
	Available Bank Cut	Fill Required	Available Bank Cut	Fill Supplied	Fill Required	Excess/Deficit	Excess/Deficit
4+00.00	156.9						
			503.9	503.9		503.9	503.9
4+50.00	387.3						
			693.8	693.8		693.8	1,197.6
5+00.00	362.0						
			641.4	641.4		641.4	1,839.0
5+50.00	330.7						
						0.0	1,839.0
6+00.00							
						0.0	1,839.0
6+50.00							

Density State Color Legend		
Bank density		A Shrinkage
Loose density		B Hauling Bulkage
Compacted density		C Hauling Compaction

Additional Trimble Resources

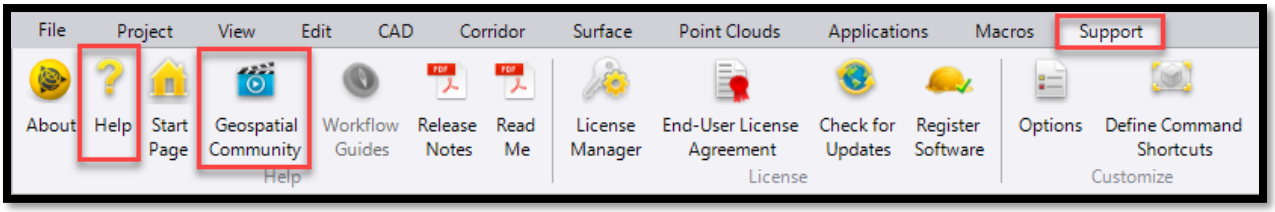
FDOT Trimble Webpage

http://www.fdot.gov/construction/eConstruction/Trimble.shtm

This link is the FDOT Trimble webpage. Additional information and Frequently Asked Questions will be posted here.

Trimble Help and Geospatial Community

It is recommended to take advantage of the built-in Help menu and Geospatial Community. These resources are great for more information on how to perform functions in Trimble.



Trimble YouTube

Trimble also has detailed videos posted on their YouTube channel: https://www.youtube.com/user/TrimbleHelpBCHCE

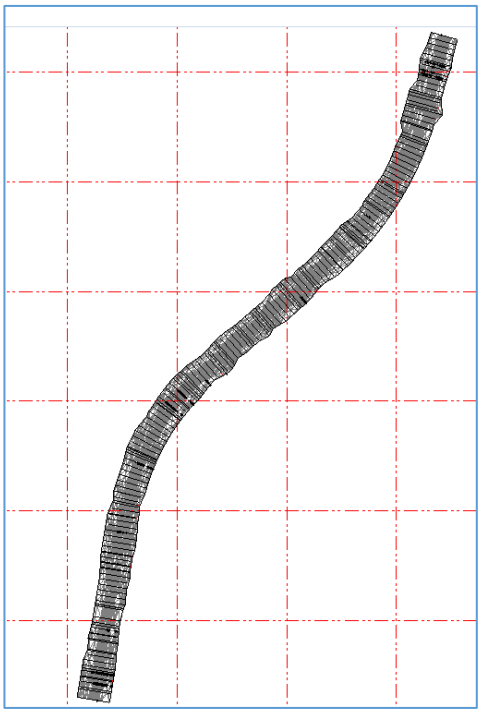
Tips and Tricks

- **Designer Surfaces**

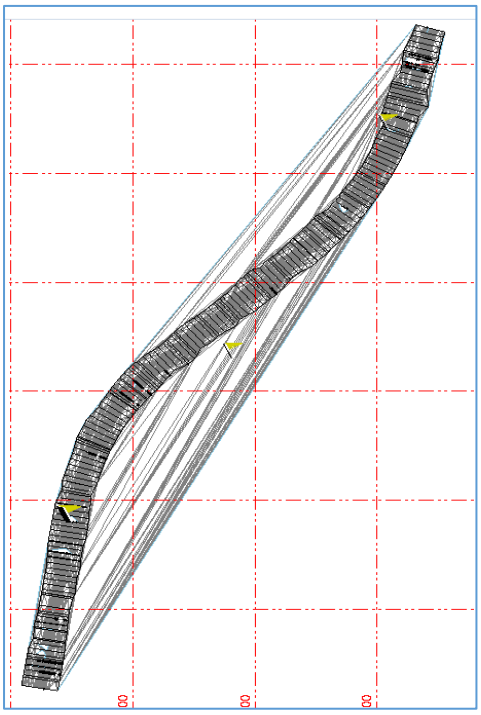
Surfaces with Poor Quality

Designers are required to provided 3D files per the CADD Manual and should create them using the FDOT Roadway Design and 3D Modeling User Training Manual (Chapter 10). If you receive 3D files that have extraneous triangles (webs) from the designer, send the files back to the designer for correction immediately. The examples below show what clean and poor-quality surfaces look like:

Surface without webs (clean, break lines)



Surface with webs (poor, no break lines)



Surfaces Not provided

If you don't receive surfaces for your project, contact the designer immediately. The designer must provide 3D files (per the current CADD Manual) or GEN files (per the old CADD manual).

- **Field Survey Data**

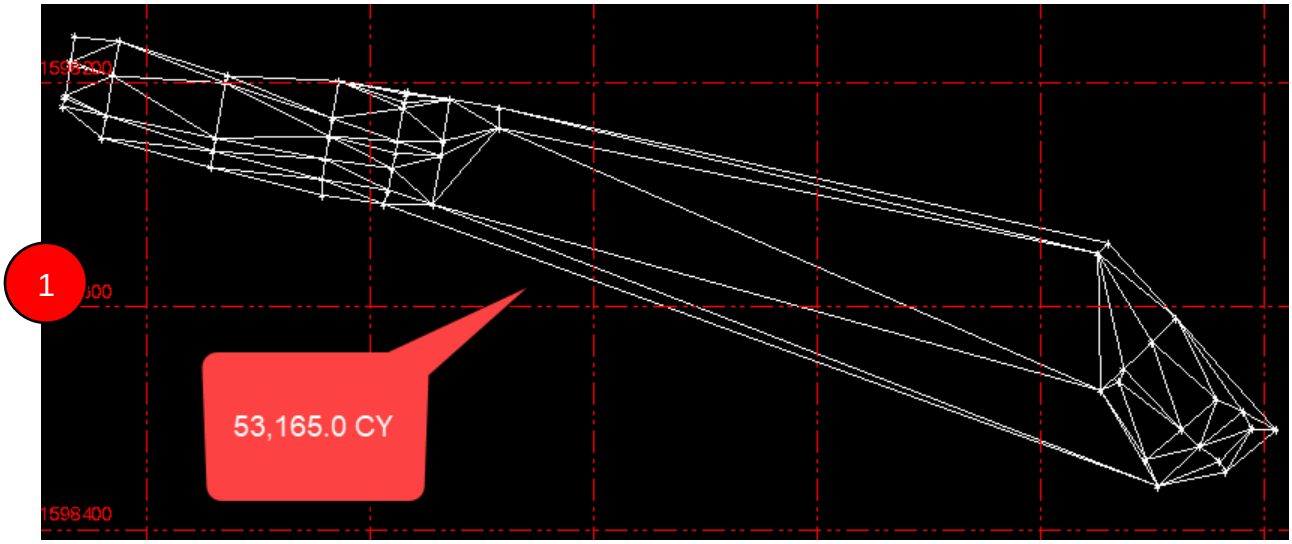
It is very important to understand and know your field survey data. Before you use your field survey data in calculation of earthwork quantities, be sure to review the data. You must investigate why Trimble created triangles/web between your data points.

Individual Areas

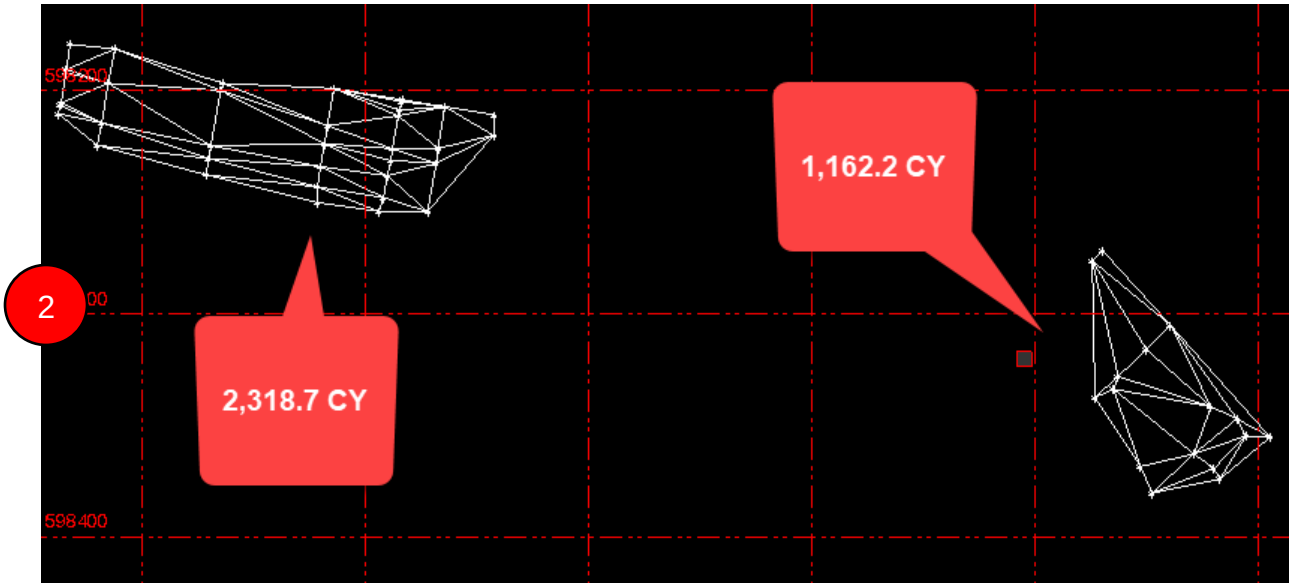
It is recommended to make separate files for each subsoil area (or each isolated survey area if not subsoil), so Trimble does not create triangles/web between unconnected areas.

Example

The picture 1 below shows 2 subsoil areas in one surface file. Trimble interpolates triangles between these areas, which will thereby calculate volumes between them as well. Leaving the 2 areas together generates a volume of 53,165.0 CY.

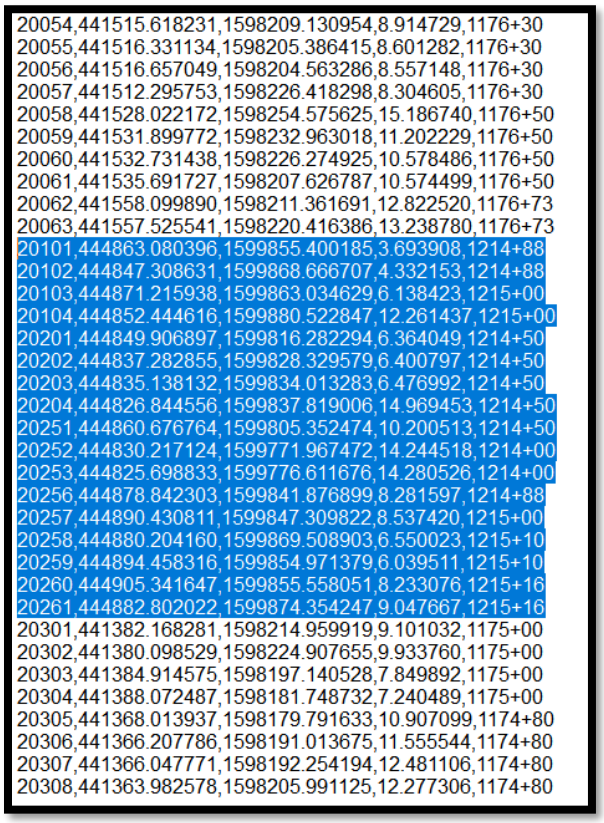


Whereas separating each area into its own file like picture 2 and adding each volume together generates a volume of 3,480.9 CY.



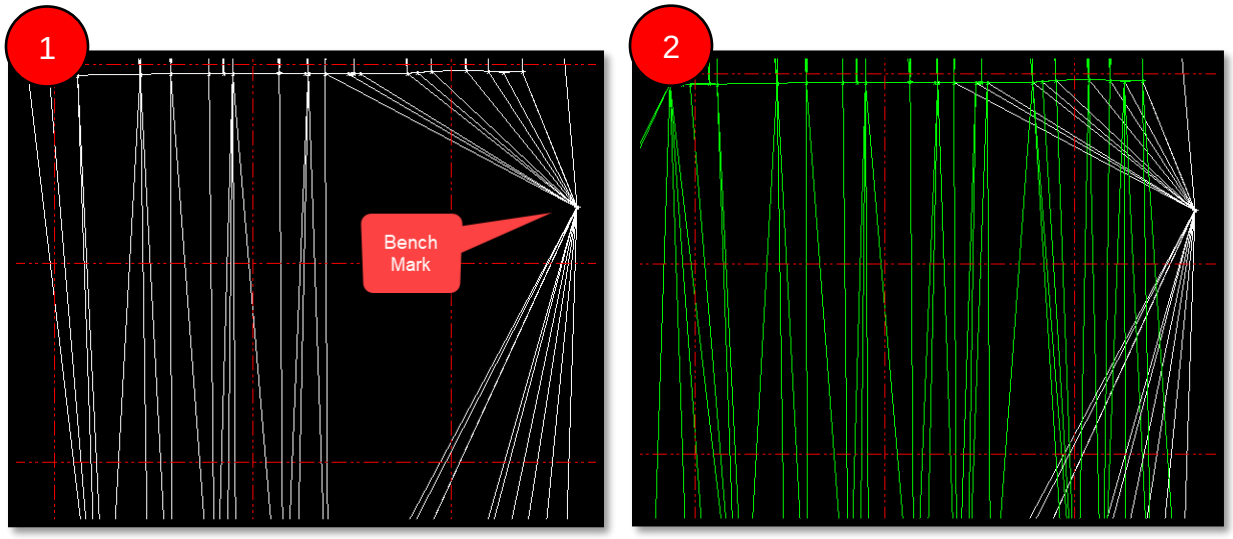
NOTE: Another option would be to create a new layer boundary for each area and generating the earthwork report using that layer, as the boundary option. This method however, would require choosing the correct boundary points in order to generate accurate volumes. (See Definition of a Boundary, in this Handbook for more information.)

If your surveyor provides your survey data for multiple areas within a single file (as shown below), you can manually separate the data. Note the stationing is the last data entry in the rows. By looking at the stationing, it can be determined that the blue area is near Station 1215+00 whereas the remaining survey data is near Station 1174+80 to 1176+73. Analyze your data to identify the separate areas (blue highlight vs remaining points), then copy and paste each area into its own file. Import the separate files into Trimble.



Bench Marks

Bench Marks are very important for validating your survey, but they do not need to become part of your surface. As you can see in picture 1, the survey was tied to a bench mark, which caused Trimble to create triangles/web (white) to that point. This skewed the surface out at that point, adding area that wasn't part of the surface.

When the bench mark was removed from the from the survey data in picture 2, Trimble was able to create the correct triangles/web (green) for the surface.

Clean up such as this is required to produce accurate volumes. If your surface "doesn't look right," it probably isn't. Use common sense and your gut to validate the surface data. Coordinate with your surveyor on any areas that seem "off." The closer you do this to the actual survey the more accurate your surface will be. Delayed analysis can result in questions that can't be answered when the surveyor has forgotten the details of the area surveyed.