

CI125383-L

Beyond Roads and Buildings: Point Cloud Feature Extraction While in InfraWorks

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Learning Objectives

- Learn how to create an .rcp within ReCap Pro
- Learn how to import an .rcp file into InfraWorks
- Learn how to create a surface from a Point Cloud
- Learn how to extract features from a Point Cloud

Description

Let's dive into the complete process of creating an .RCP file while in ReCap Pro software and importing the Point Cloud into InfraWorks software, and see the step-by-step process of creating both a usable InfraWorks surface but also extracting features from your Point Cloud using both the new Point Cloud terrain and Point Cloud modeling tools within InfraWorks. The Point Cloud modeling tool is like your description keys in AutoCAD Civil 3D software, but instead of 2D blocks you'll get 3D features like power poles and trees automatically inserted into your model. We'll take you step-by-step through the process to help save you time.

Speaker

William Neuhauser, PE, has been a civil applications engineer for Managed Design, Inc. out of Minneapolis, Minnesota, since the summer of 2005. Prior to this, he taught Civil Techs at Minnesota State Community and Technical College, and prior to that he worked for a few North Dakota and Minnesota civil consulting firms for about 10 years as an engineer, CADD guy, CADD manager, and supervisor better known as a “jack-of-all-trades”. He was also one of the first AutoCAD® Civil 3D® ICE certified experts (2005) and a certified FAA UAV pilot.


Recap and Recap Pro

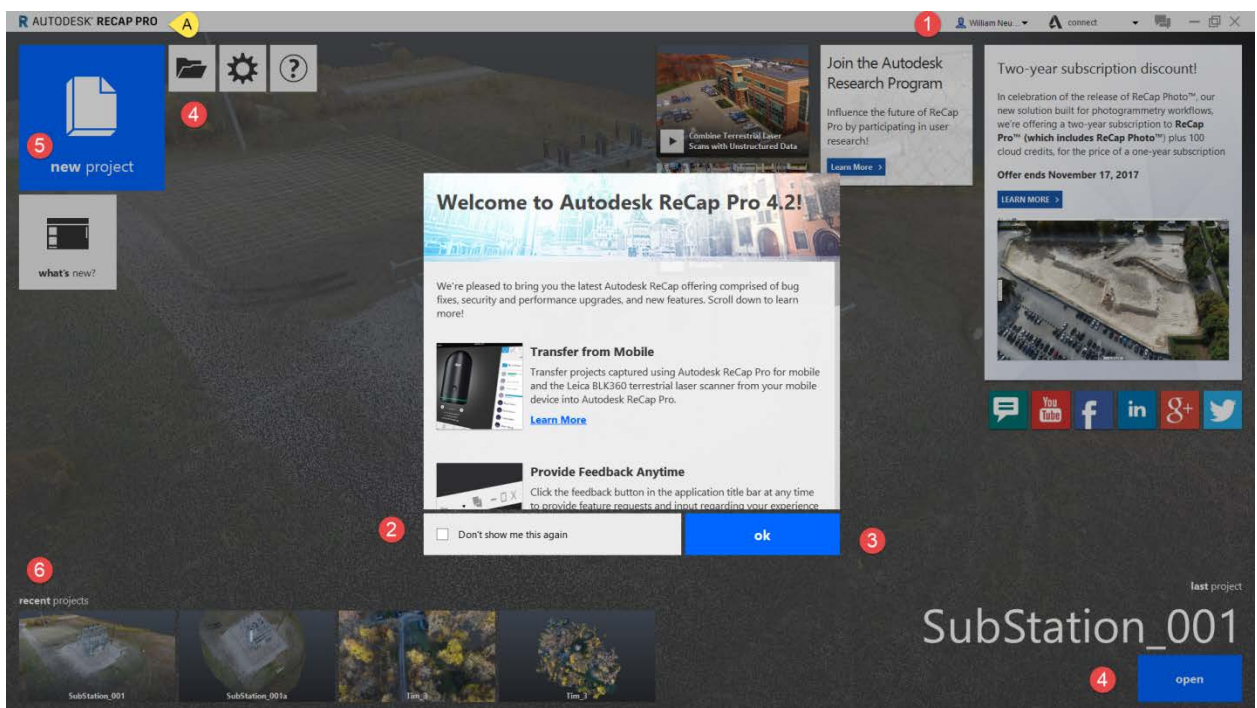
Creation of a Recap Project .RCP file

Part of the process to importing your Point Cloud data into Infraworks is to first process your RAW Point Cloud data or in our case, .LAS file(s), first in Recap. First let's understand that there are two versions of Recap, Recap and Recap Pro. For this class either version will work, but keep in mind you'll need Recap Pro if you want to do any real Point Cloud edits of your .LAS files, but have found most of these edits are only for Point Cloud that originated from a scanner and not a UAV.

All we require Recap for right now is to import your raw .LAS files (what is typically received from the surveyor/scanner/UAV) into Recap which will create .RCP file. Treat the RCP file as your Project file for your Point Cloud.

Recap and Recap Pro – Interface

Below is the Recap Pro startup screen; for reference the only way to tell if it is Recap or Recap Pro is the text 



The different areas of the startup screen.

- 1 This will show who is currently logged in to A360. (You must be logged in for Recap or Recap 360 to work.)
- 2 "What's new" area.
- 3 This will close the "What's new"
- 4 Open buttons
- 5 New Project
- 6 Recent Projects Preview area

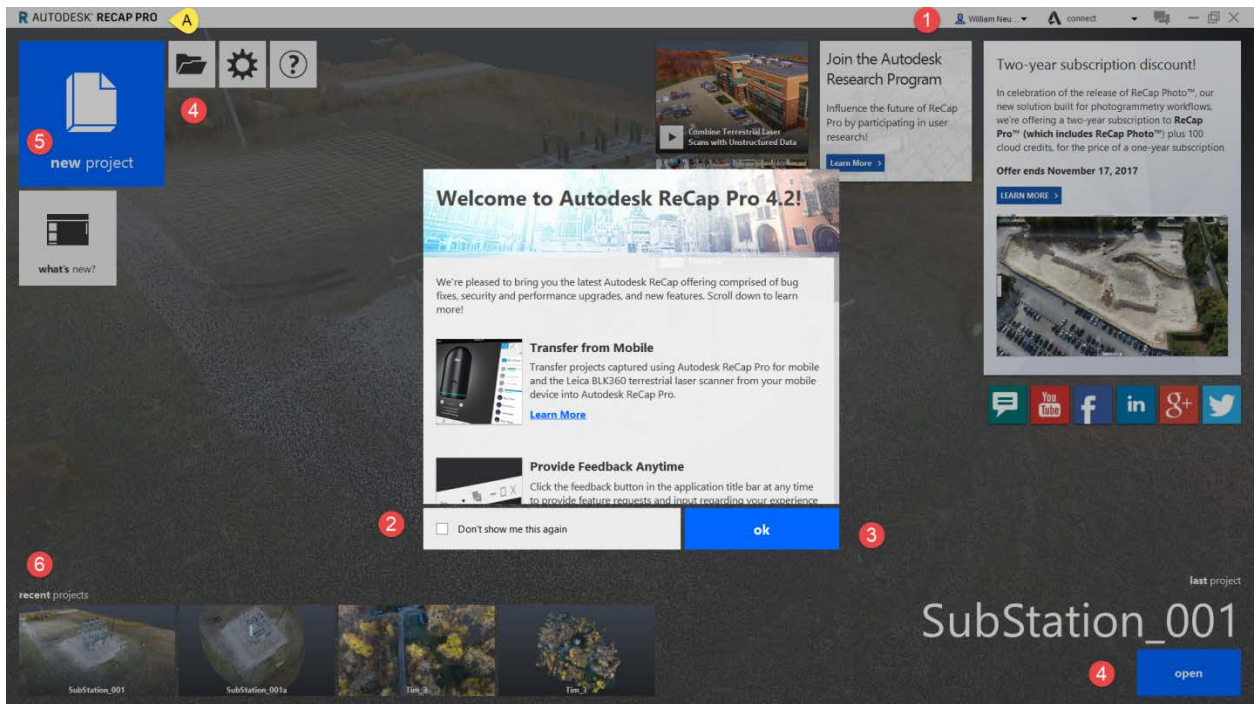
Recent files or projects you have viewed are listed at the bottom of the screen:

Importing and viewing of scan data is available in all tiers of RECAP. To open an individual scan or project file, simply use the “*open*” button:

The last document that you viewed is displayed in a noninvasive opacity as the application background, and can be opened by clicking anywhere on its preview image or on the “*open*” button next to the file name:

Recent projects are also available at any time through the application's main menu. Simply hover over the “home” button and proceed to the "Recent Projects" fly out. A list will be provided for you there to quickly switch between projects.

*Please note that you will not have full application functionality unless you are signed into the application with your Autodesk account.



We are going to now create a new project and import in our .LAS data that we received from a ground based scanner.

Lesson 1: Creating our .RCP file in Recap Pro

1. Startup Recap PRO

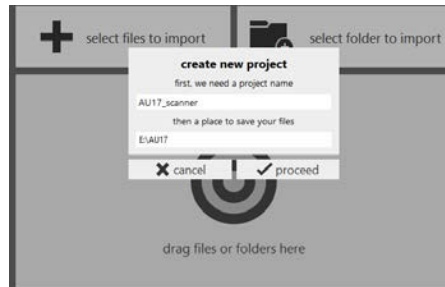
2. Click on New Project



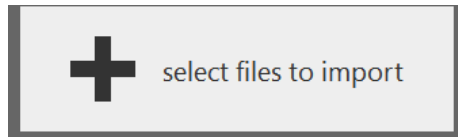
3. Import Point Cloud



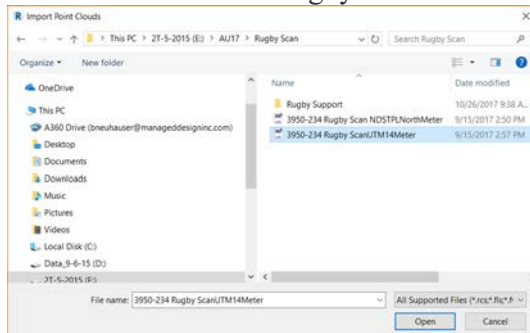
4. Fill in the "Create New Project" as shown here but change this to c:\AU17. Then click proceed.



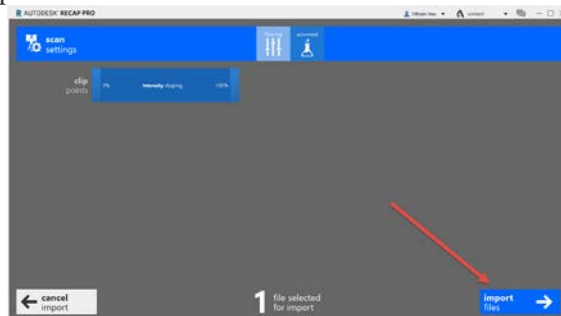
5. Now select Files to import.



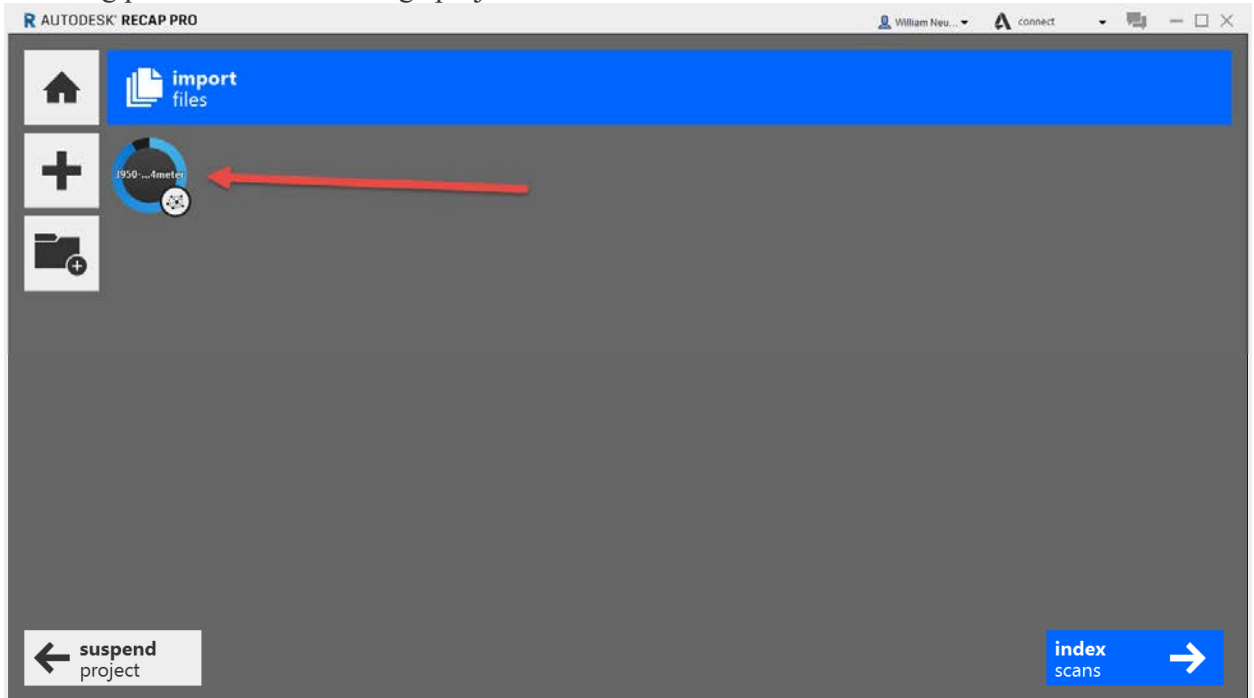
6. Choose the C:\AU17\Rugby Scan\3950-234 Rugby Scan USSF




7. Now you click on Import Files.



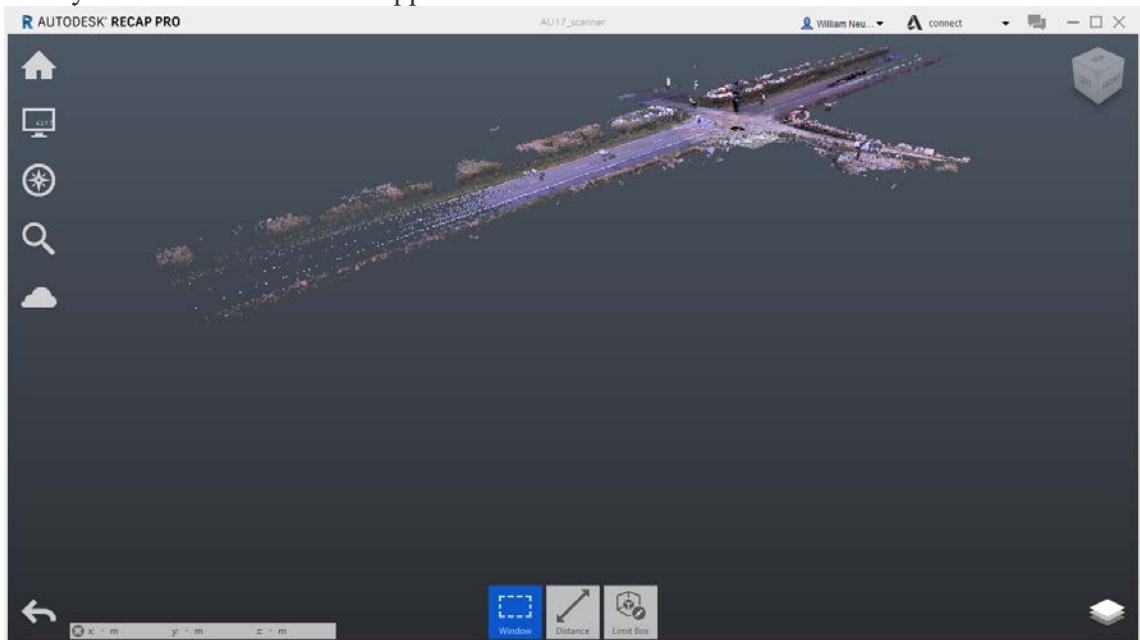
8. Now you wait! This can take a few minutes depending on the size of the files being imported. With our sample this should only take a minute or so. If you are importing in more than one file you will see them listed here with an hourglass type indicator as they are being processed. With a large project this could take 30 mins or more.



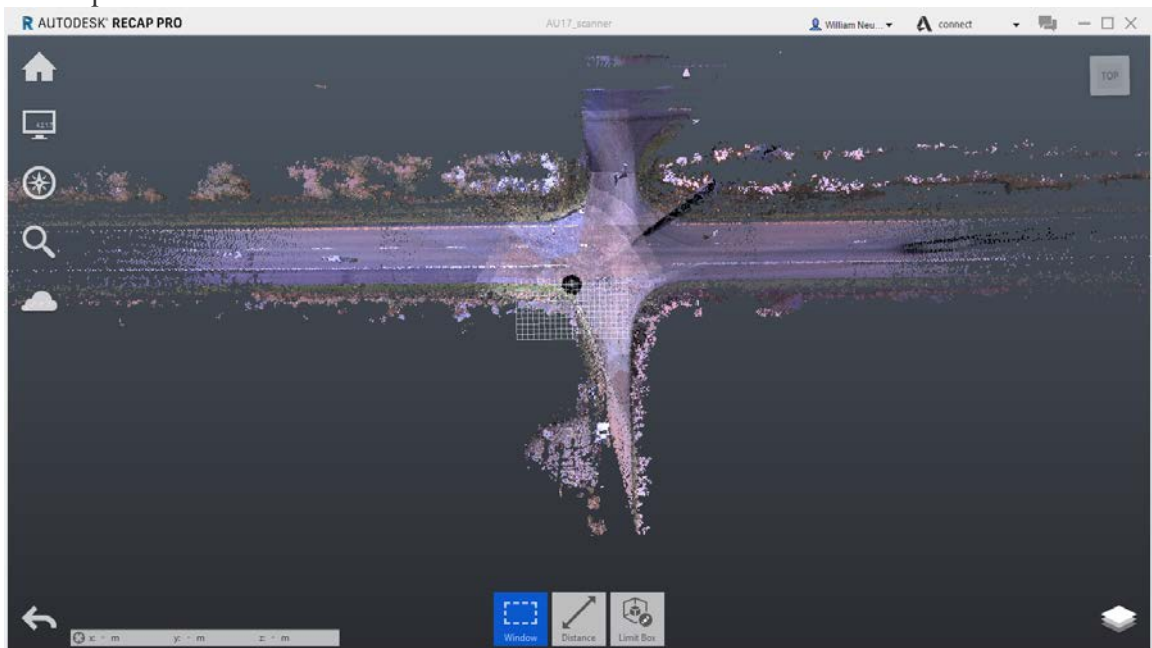
9. When completed the icon will now look like this.  Now click on the lower right "index scans". Wait just a bit and then click on the lower right "Launch Project"



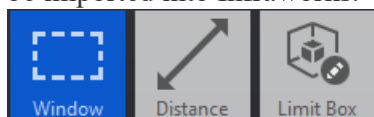
10. Now your Point Cloud should appear.



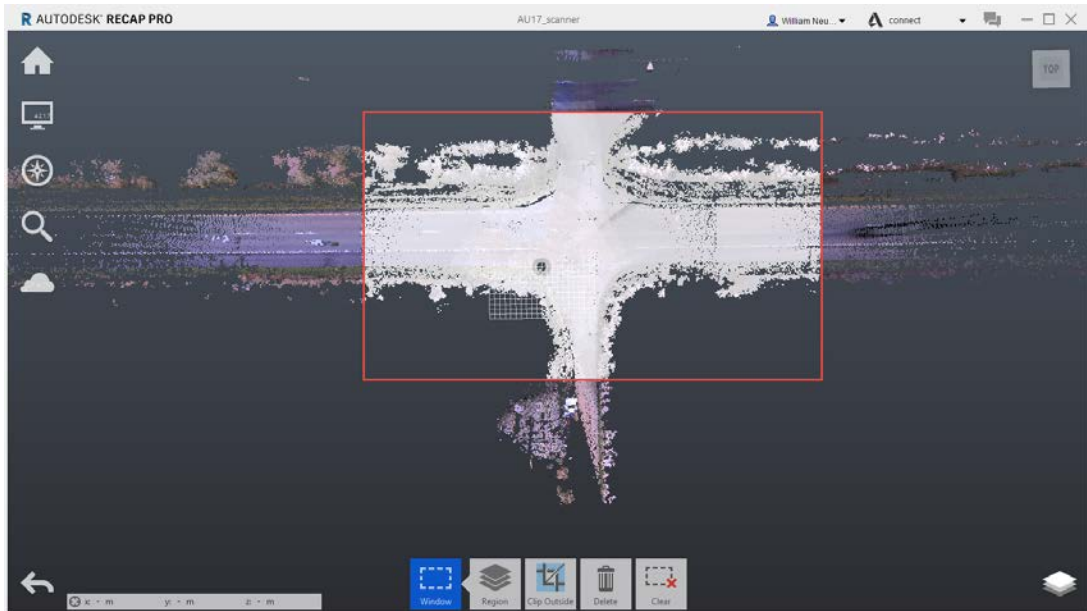
11. Now using standard mouse controls, position your view as shown below. More of a top-down view. From here we will create a window to limit the Point Cloud to only what we will require for Infraworks.



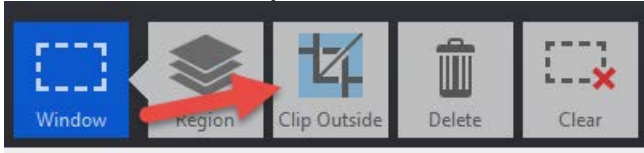
12. On the middle lower part of the screen you will see the “window” icon. We will use this window command to limit or exclude what we’ll export out to a .RCP file that will later be imported into Infraworks.



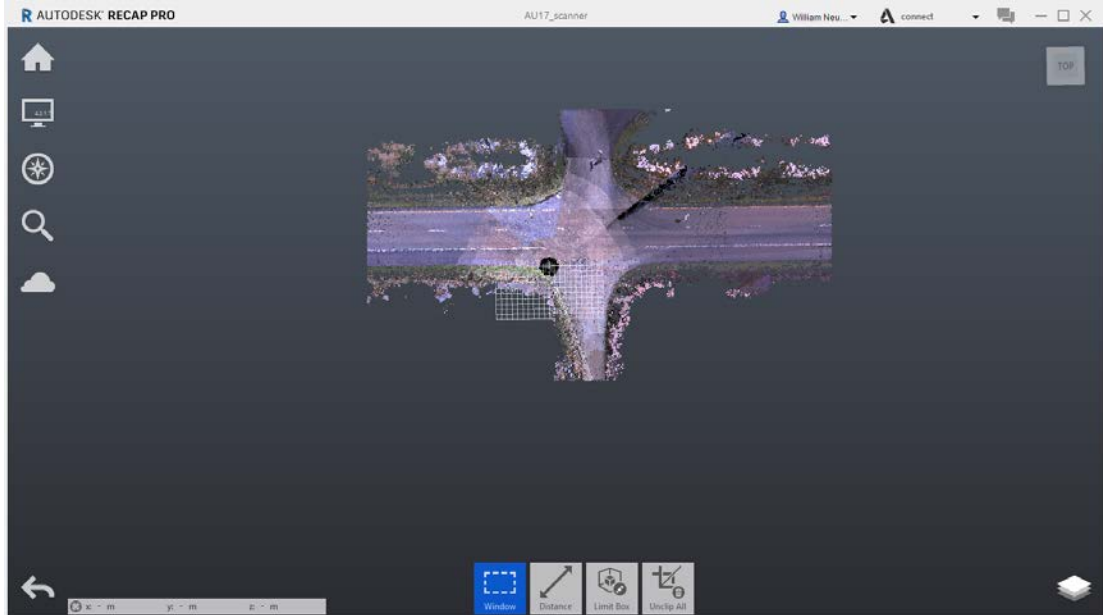
13. Click on this window icon and window similar to what is shown below.



14. Now click on the 'Clip Outside' icon as shown here.



15. Now a fly out will appear and choose "Clip Outside". Below is what we should now see:



16. Now click on the upper left ‘Home Icon’ and then the “Save” icon. And then again the “Save” icon to save this new clipped version of our LAS data.



This is all for which we will dive into Recap Pro. Next we will fire up Infracore and run thru the import process of this .RCP file we just created. You may now close Recap Pro.

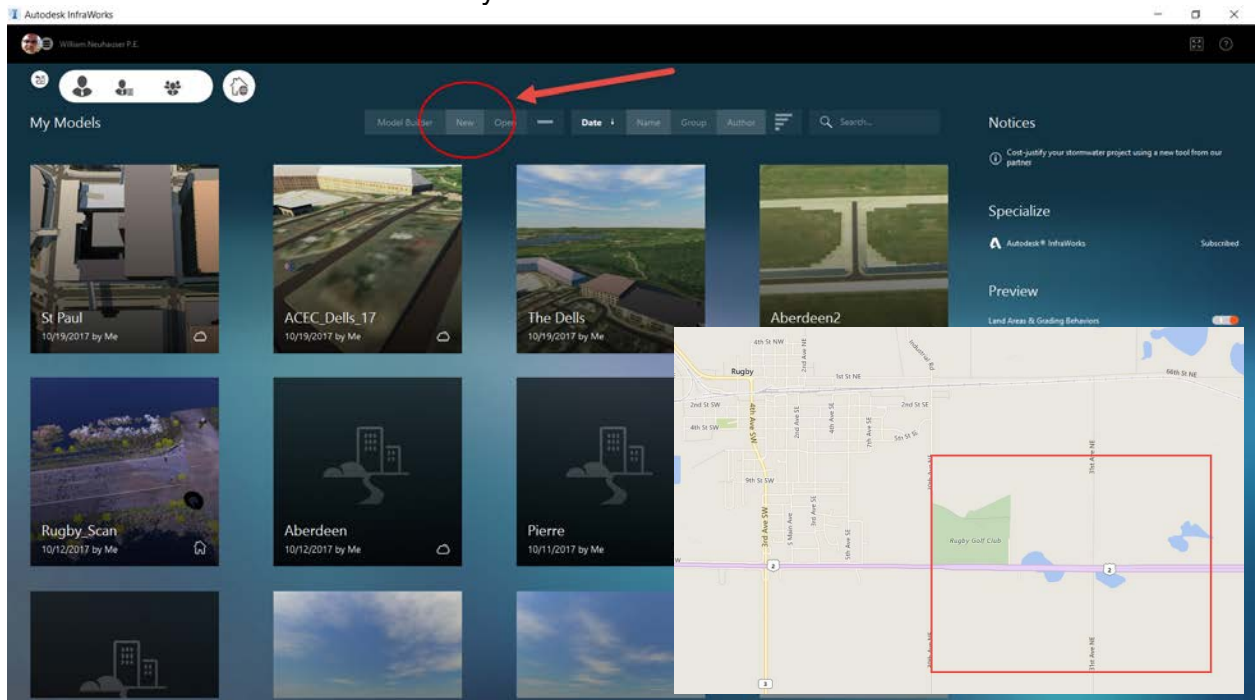
Now this is not meant to be a training class on basic Infracore (IW). We will assume from here that you know the basics of IW. From here just start a new project and the user will be responsible to set up the Project based on his location and whether or not they wish to also use other sources of base data, i.e. Model Builder data or other existing source data.

For our purposes we will just startup IW and start a new project with the IW defaults. Then we will run thru the process of importing the .RCP file just created.

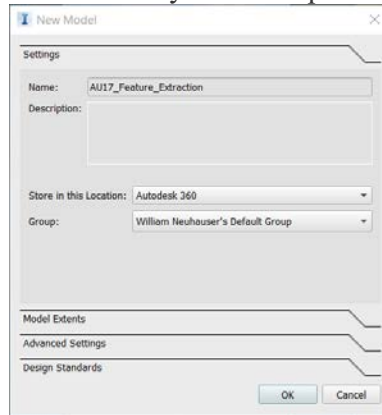
Lesson 2: Importing into Infracore





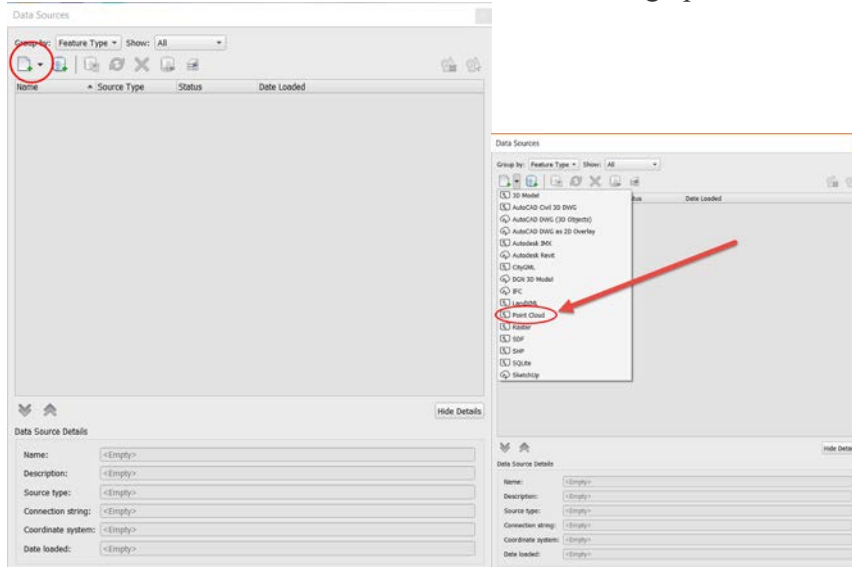
1. Startup Infracore
2. Now Click on “New”. Or you can use Model Builder and search for Rugby,ND and just to the east of the Golf Course on Hwy 10.



3. Enter in your project name and choose your corresponding Group. Then click “ok”



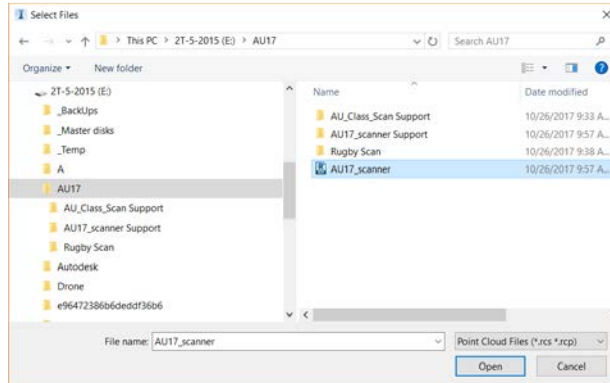
4. After a bit you should be greeted with the below “Data Sources” window. If not, then click on the , then the  cube icon. Then the below icons should be visible and now choose the “Data Sources” icon. This will bring up the below “Data Sources” icon.



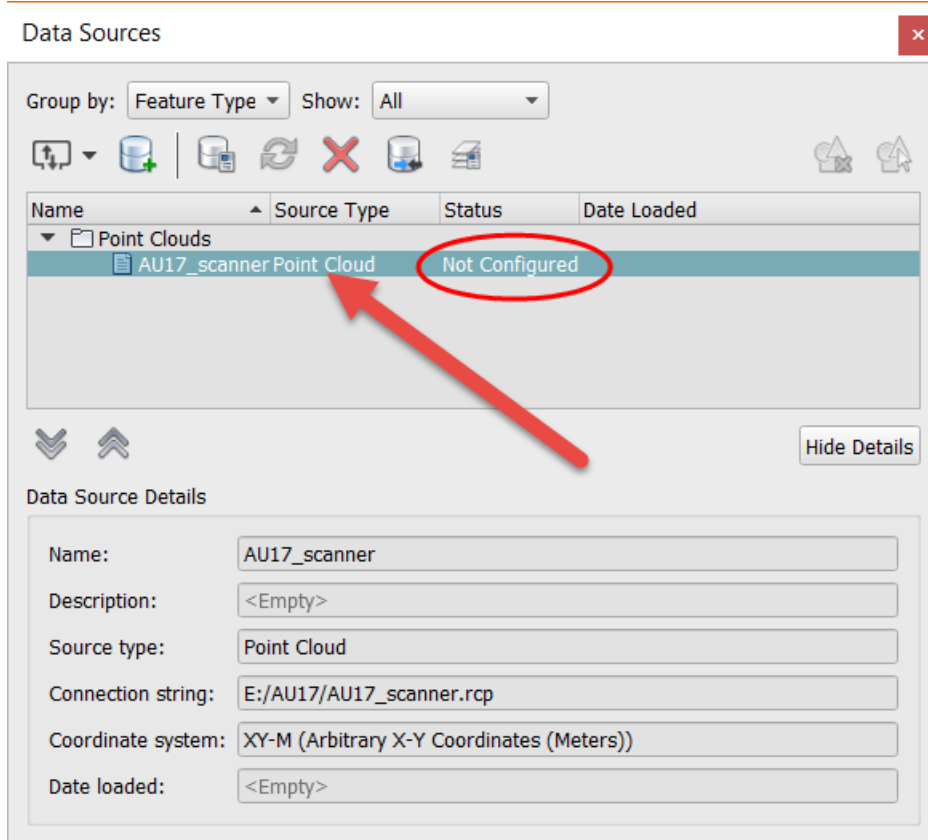
5. Now click on the  icon.

6. Choose this “Point Cloud” option.

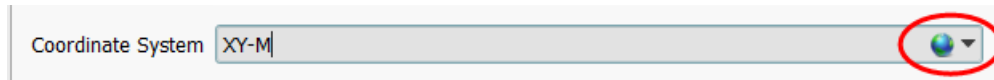
7. From here browse to our AU folder and choose the AU17_scanner.rcp file we've created earlier.



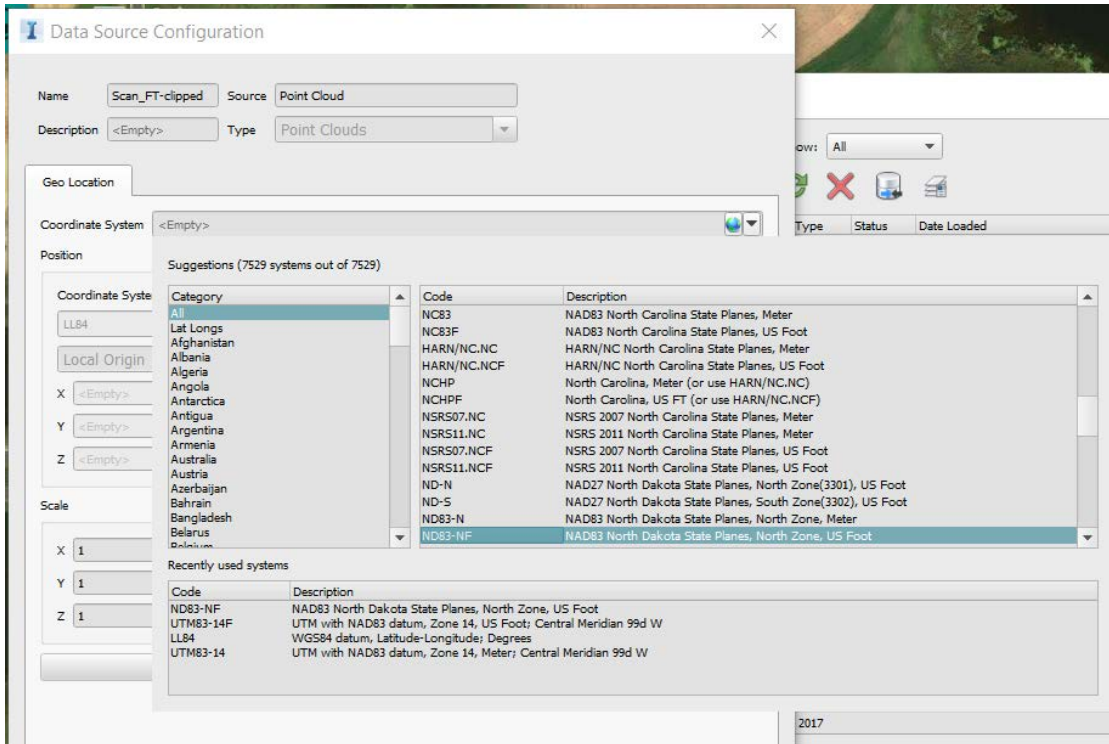
8. Like any other IW data we must first configure it before IW will actually import it. So double click on the file shown below.



9. Now choose the Earth icon and select

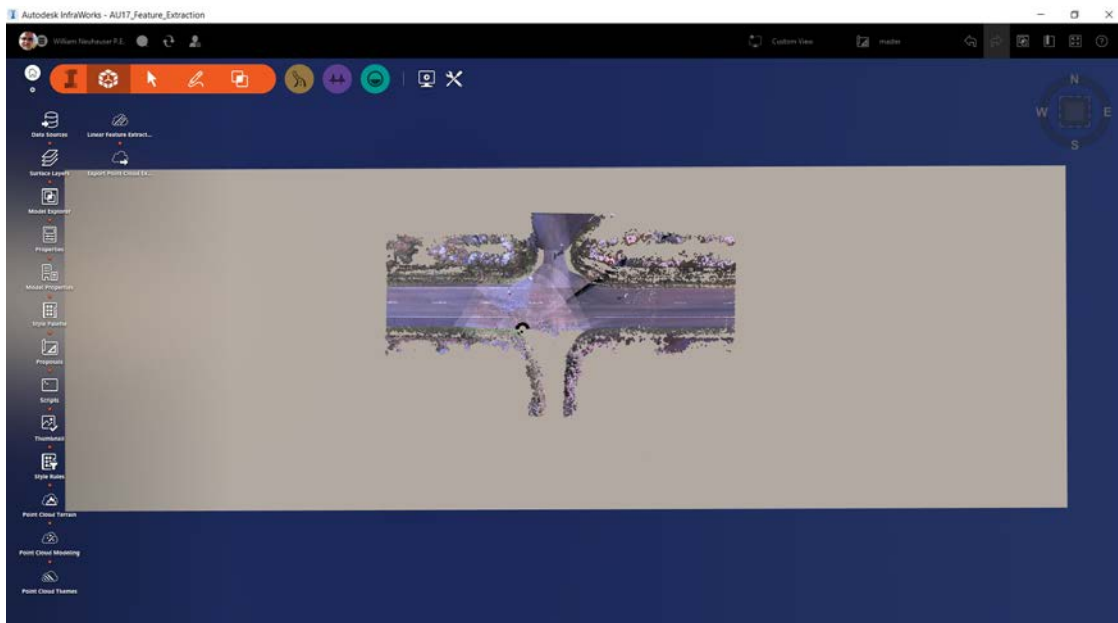


10. And select the ND83-NF US Foot zone for this .RCP data file. Click “OK”.

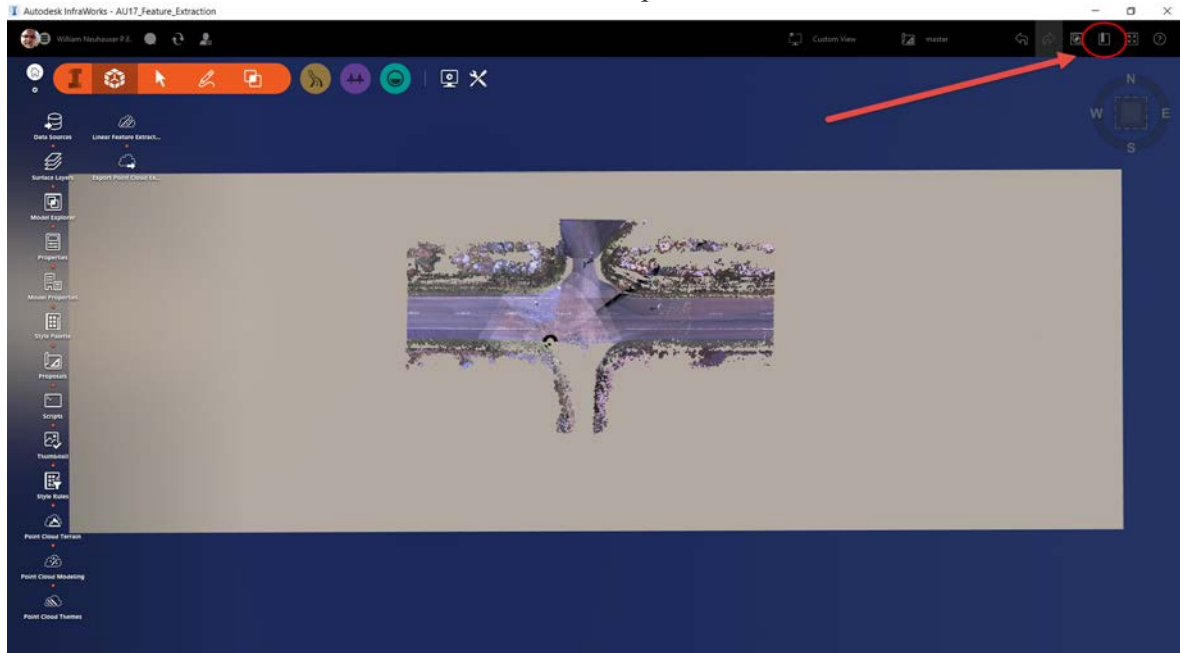


11. Now take the rest of the default settings, click on the lower “Close & Refresh” icon. (This will now change from greyed to a darker color).

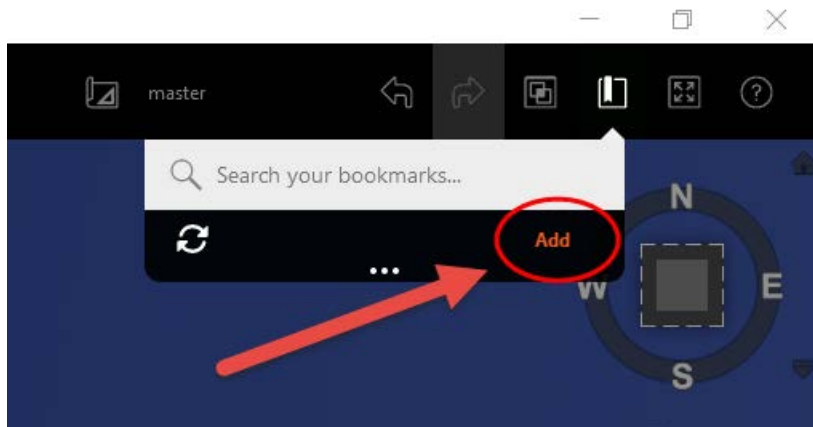
12. Close out the “Data Sources” window and you should now see your Point Cloud. Use your mouse now to zoom in closer.



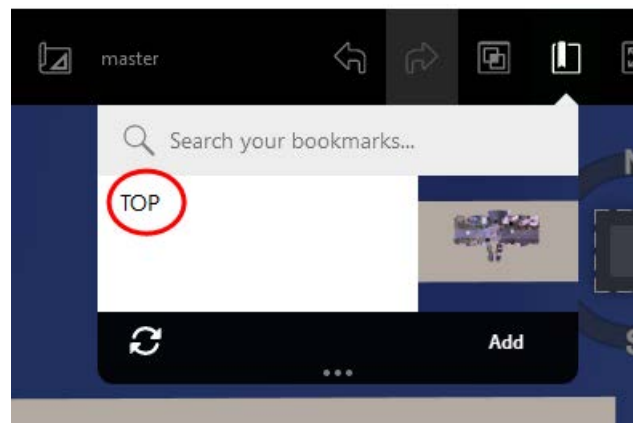
13. At this time we will save a Bookmark for this view point.



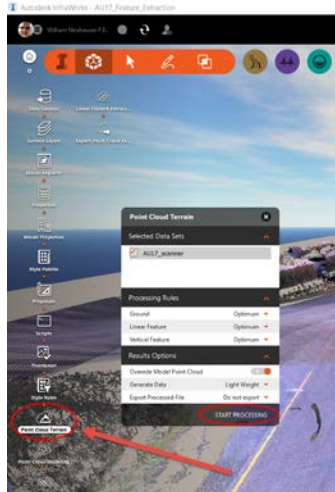
14. Now click on the “Add” button.



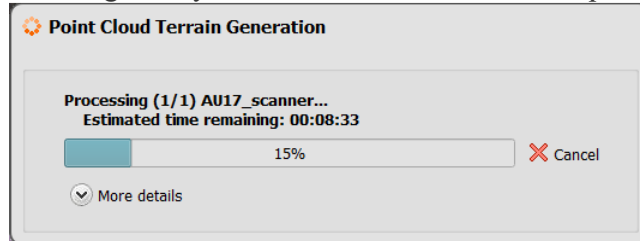
15. Change the name to “TOP”, then just move your mouse away from this fly out and it will collapse.



16. Next click on the “Point Cloud” Terrain button. Then this “Point Cloud Terrain” window will appear.

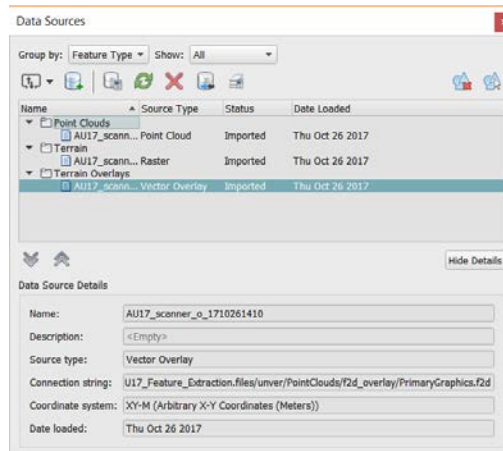


17. For now we will use the stock defaults. These seem to work well with most data sets. This can and will take a few minutes to finish processing. For some Point Cloud this can take a good hour or so. Even though it says “* minutes or so” this means pretty much nothing.



This just created your Point Cloud surface and prepared it for both the “Feature Extraction” and “Linear Feature Extraction” functions.

If you now have a look at the “Data Source” window you will see two newly added sets of data.



There is nothing else here to do within the Data Sources window, more or less just to show you what you should delete if you wish to start over.

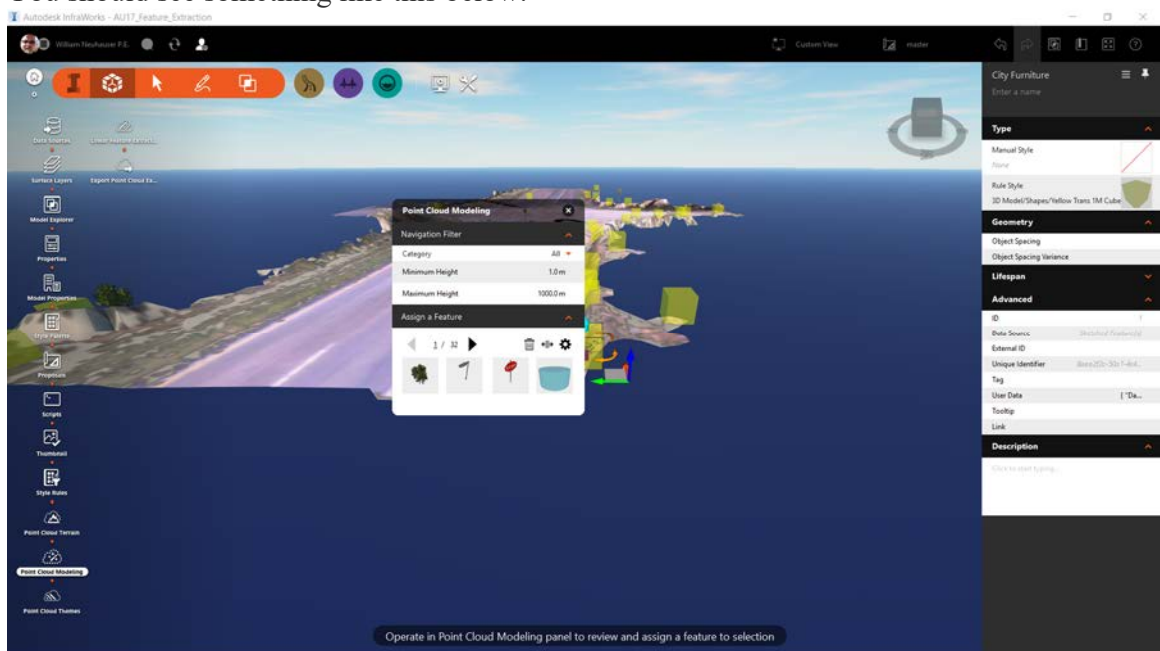
Now that we are finished waiting for the “Point Cloud Terrain” command, next we can extract out object/features from the Point Cloud like signs, trees and power poles.

Lesson 3: Extracting objects from our Point Cloud.

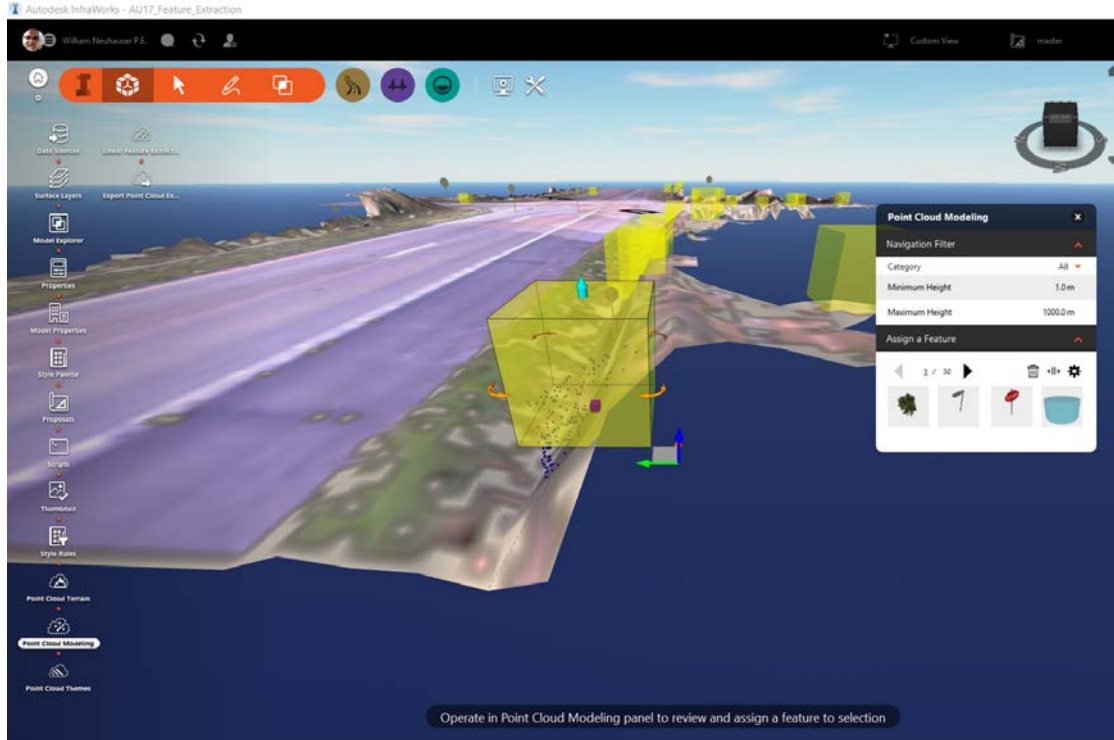
1. Click on the “Point Cloud Modeling” button.



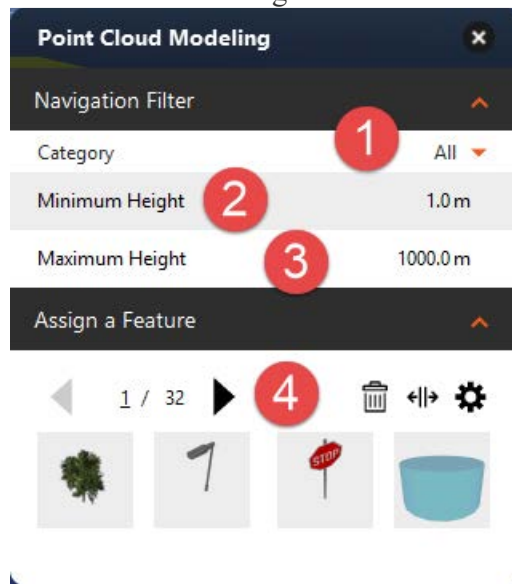
2. You should see something like this below.



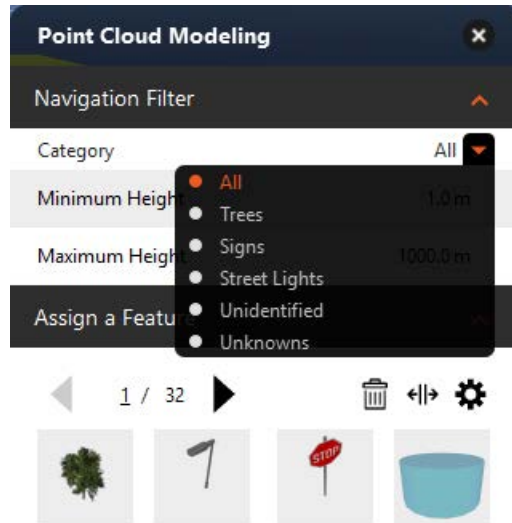
- You can use your mouse to move the “Point Cloud Modeling” window to the side and then zoom in to see the first object that IF wants to replace.




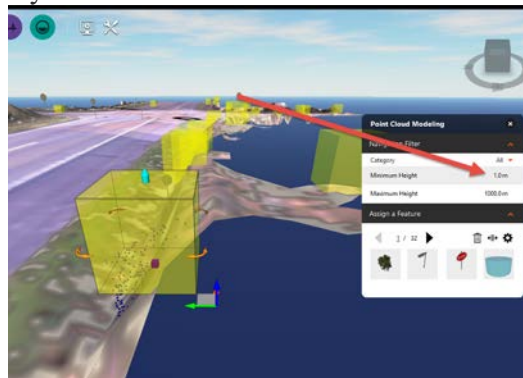
- Let's first talk about this “Point Cloud Modeling” Window.




- If you click on the down arrow here you will see a list of “Categories” to pick from. If you leave it set to “All” then as you click on the Arrow **4** IW will then jump around your Point Cloud randomly choosing area of points it sees as a potential object. If you were to set this as one of the below items i.e. Tree, then IW will only jump to areas it thinks are trees. It is up to the user to decide what they may think is a more efficient method for their particular data.

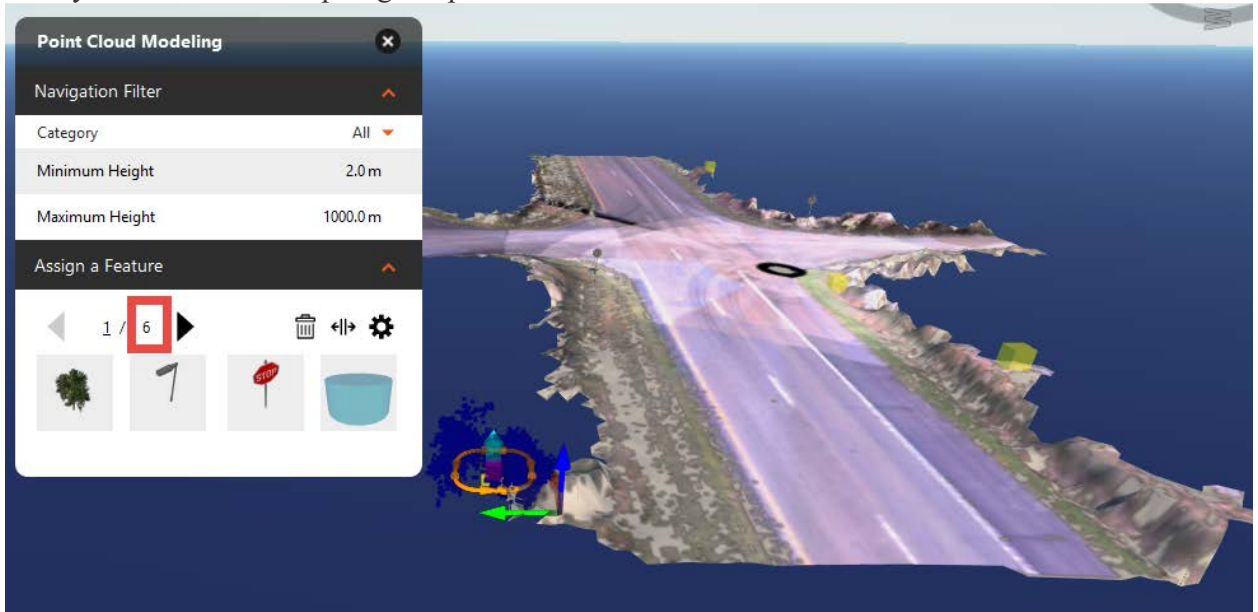


6. Here it has stopped and is asking for user input on what this clump of pts might be. You the user now can either pick on either a tree, pole, sign or you can skip this area with the black arrow . Or you can change the “Minimum Height” options and raise this value to now skip any clump less than say 2m.

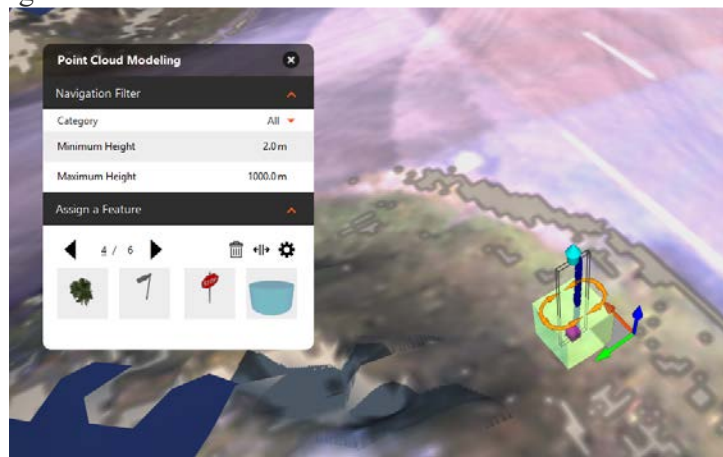



7. When you change this to 2m you’ll notice the software jumps you somewhere else and highlights a whole new clump. And at the same time the total objects drops from 32 to now 6 (This will all depend on the size of your original Point Cloud you created in step 2).

8. Click on the lower left “Tree” icon. Next click on the  IF will now jump around and ask you to choose a object for the remaining 5 clumps. Go ahead now and run thru this and pick what you think each clump might represent.



9. I have stopped at what looks to be a street sign. Now due to its location in the intersection, I doubt this particular sign is a stop sign, but I will go ahead and pick the stop sign. Keep in mind that you can always later open up the IW “Styles Palette” and then manually drag and drop the correct sign over this.



10. Spend some time now and process thru the list applying with your best judgement. If you come to an unrecongnizable clump you can decide to delete  the clump and move on.

11. Now when you are down you still might have a few clumps that IW can't decide what they are and either can you. If this is the case just manually pick each of the Green boxes and delete them.

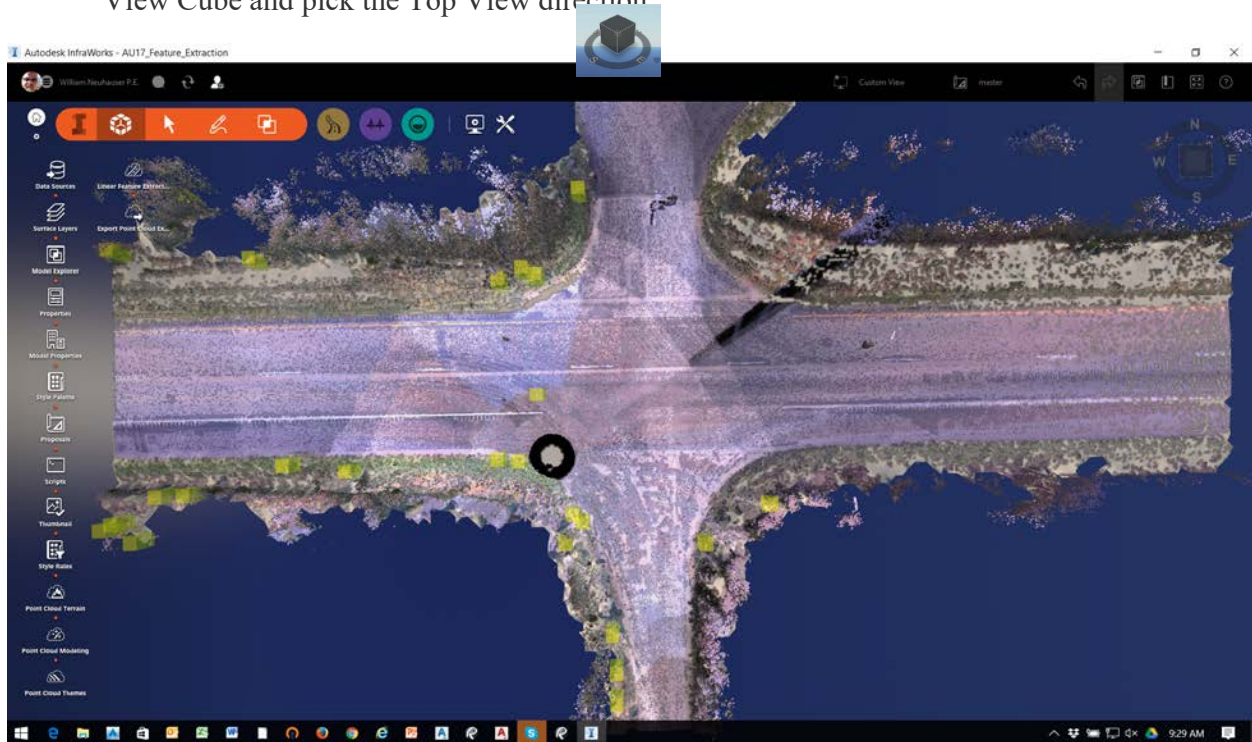


Lesson 4: Linear Feature Extraction

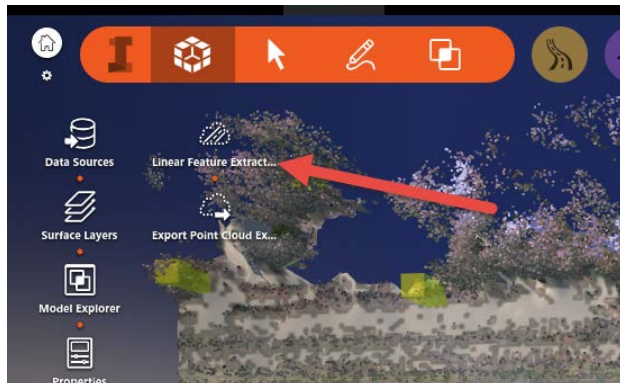
This lesson we will learn the new “Linear Feature Extraction”. This new tool will ultimately help extract out only what you really need from your Point Cloud and this will then reduce say at 15 million point Point Cloud down to say 20 thousand points.

What we learned in Lesson 3 gave us the ability to separate out physical objects from the Point Cloud that will later be exported out of IW and then imported into Civil3D as pts. With combination of these points and Civil 3D description keys we will now be able to show these as their corresponding objects in Civil 3D. i.e. Trees, signs and light poles. Now what we are going to do here in this Lesson 4 is extract out both EG points and breaklines as ASCII files and ESRI shapes files. These will then be imported directly into Civil 3D and be used to create our existing ground surface and topo.

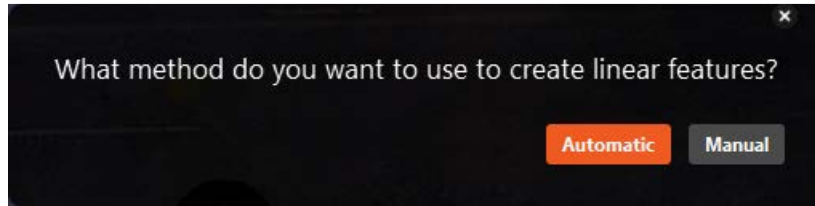
1. Now let's reset our view to a “Top” looking down view as you see here. Just click on the View Cube and pick the Top View direction.



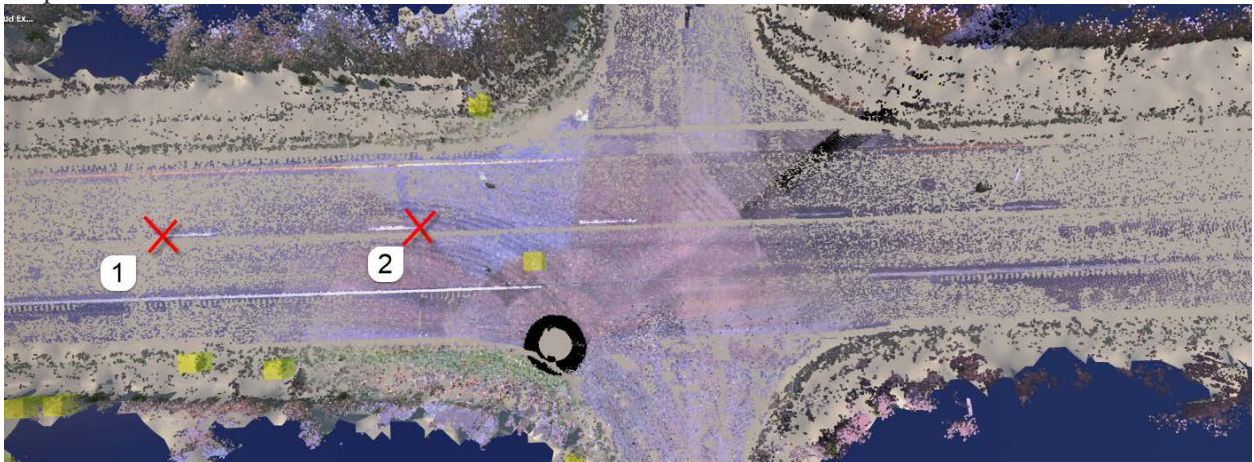
2. Now click on the Linear Feature Extract tool.



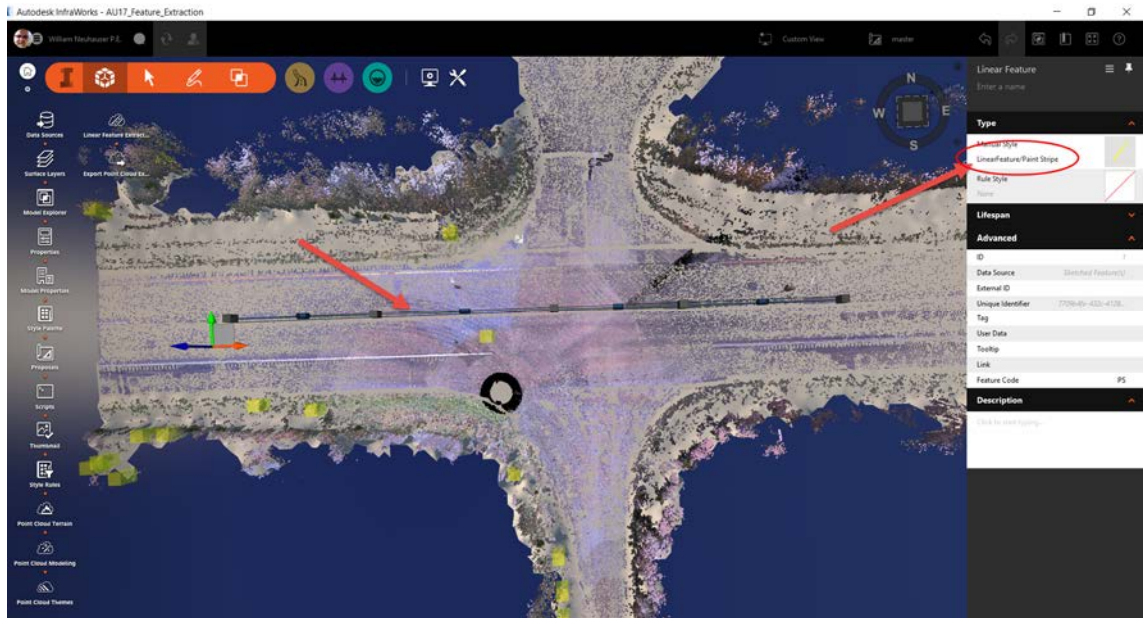
3. You will now see this menu. We can either choose the **Automatic** method or the **Manual** method. Keep in mind as of right now the Automatic method only works on Lidar Point Clouds that have an “Intensity” classification. This will not work with photogrammetry data as in your typical UAV data. You will need to use the “Manual” method for any “non-intensity” classified Point Clouds.



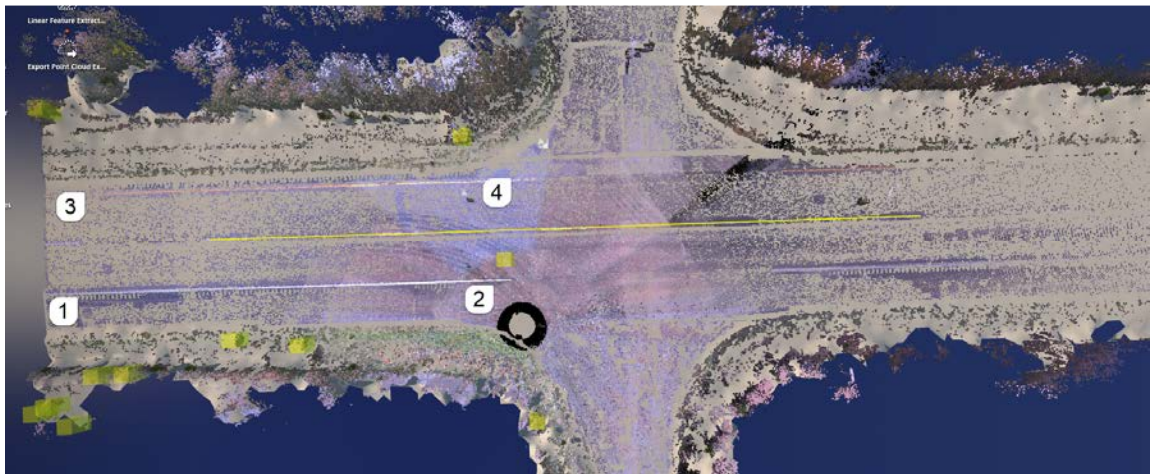
4. Let's choose the “Automatic” method since this data does have “Intensity” classifications imbedded in the Point Cloud data. We are going to pick the left end of the centerline strip **1** and then “DOUBLE” click on approximately the right end of the next centerline strip **2** as shown below. As you will see, IW will then “Automatically” connect all of the centerline strips with this new line.



- You will now see a longer line that now should look like below. Here on the right is a window that should a popup. This popup will let the user change the style being applied. In this case it is a Paint Strip and the software as you can see does infact recongize it as so.

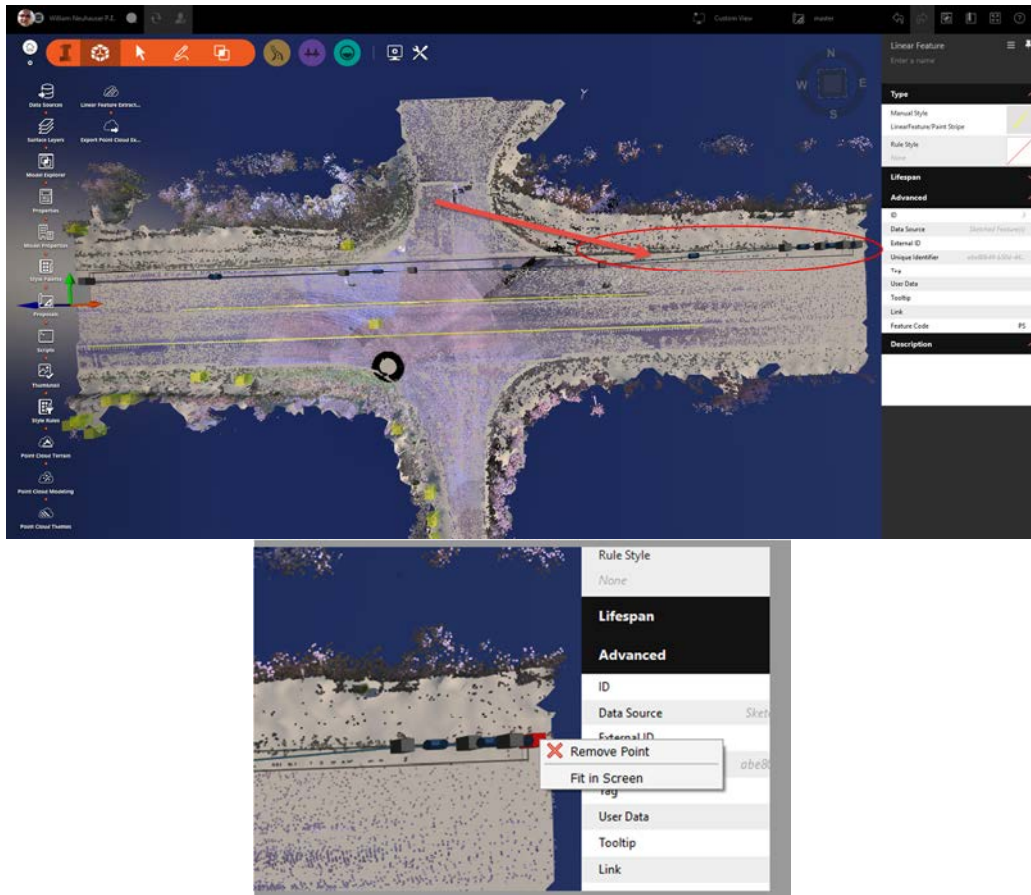


- Lets now repeat this same process but for the shoulder white lines.



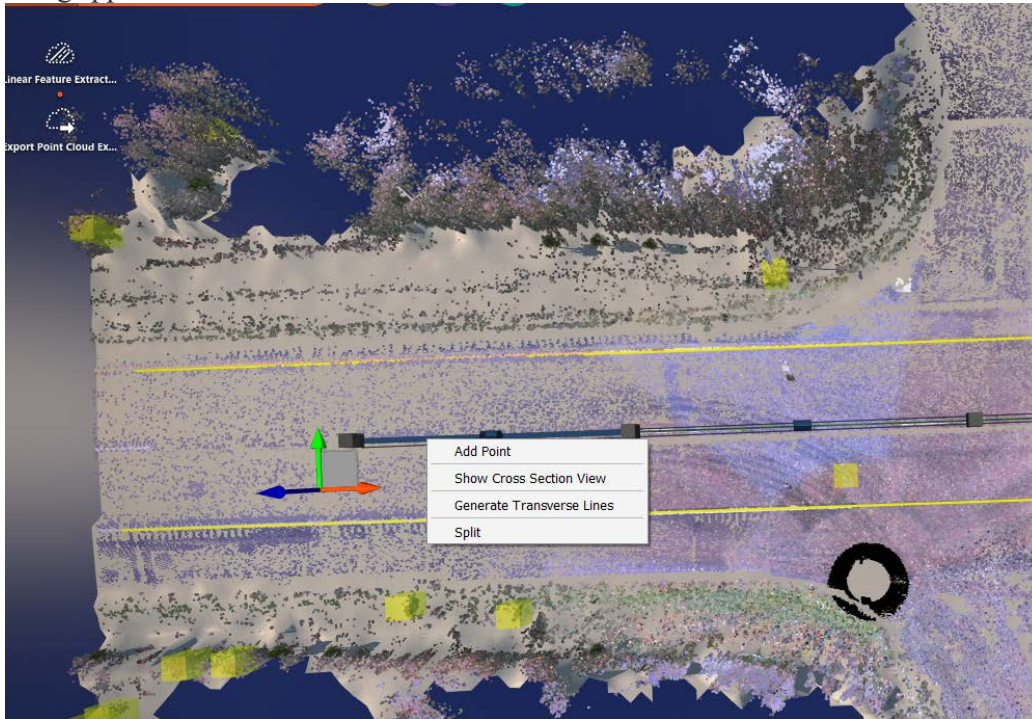
- Repeat Step 5. By choosing **1** and then double clicking on **2**. Then again repeat for the north white line **3** and **4**. When you do this you may get a segment of the line that doesn't follow exactly where you think it should. Not a big deal, all you do is grip each vertex and manually adjust the line.

8. Or you can right click on any vertex and remove them one at a time, your choice.

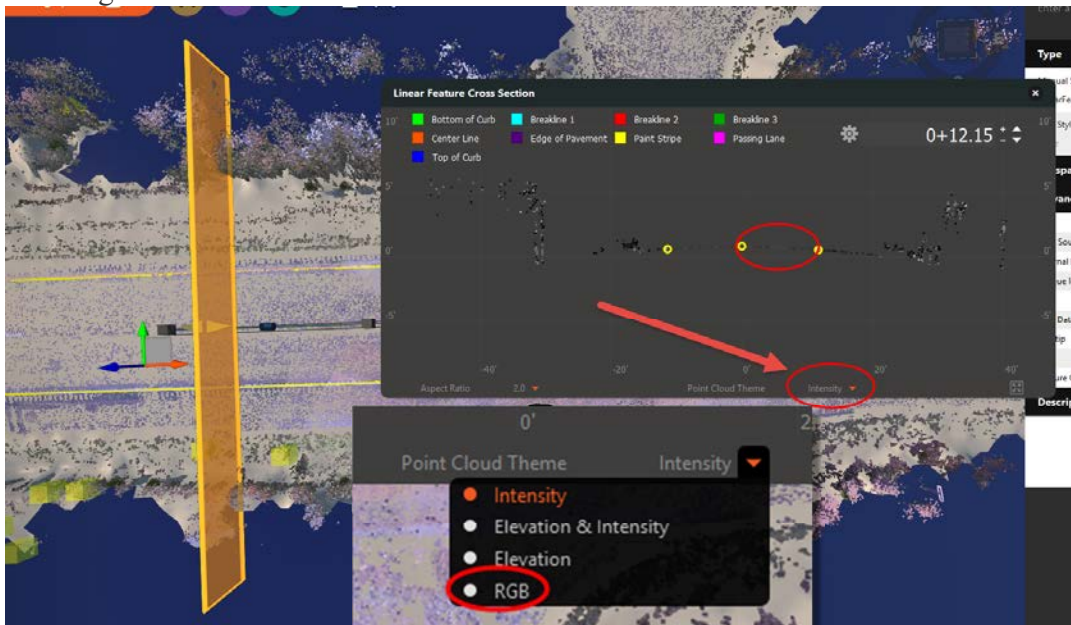


9. Keep in mind these newly created lines are just being draped onto of the PT Cloud surface IW created.
10. The next part of the Linear Creation tool is the ability to show a cross section view at each vertex. This will help you decide if the location of this line is in the correct spot. This will prove to be more helpful if the area of interest is something like a Curb and Gutter section.

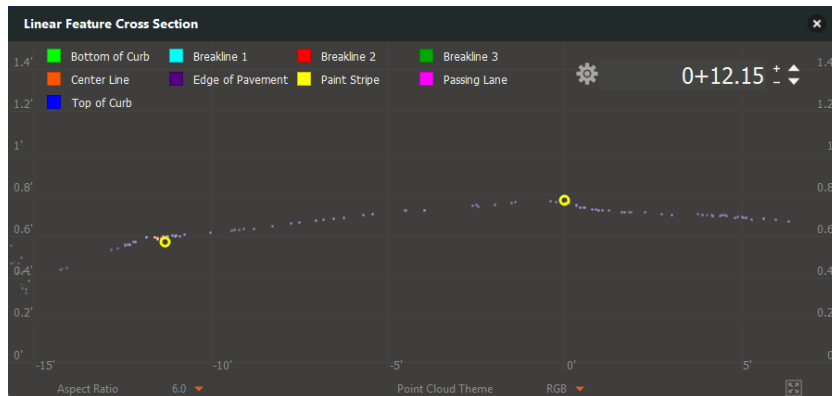
11. Let's now grip select the original Centerline feature we just created in Step 5. Right click on this gripped line and choose "Show Cross Section View".




12. You should see something like below. The Cross Section View might default to the Intensity View and therefore the actual Point Cloud data in the cross section might be hard to view. If so change this to RGB.

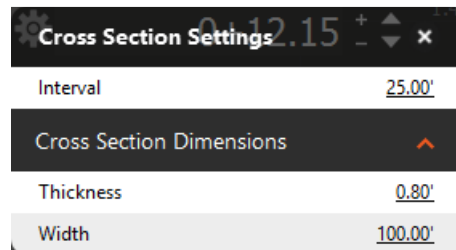


13. You can now play with a few of the other settings to your liking. i.e. the Aspect Ratio and Zoom Factor.

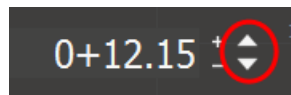


14. The top bar is the Legend for all of the default line styles that could be used. You should notice that since we only so far have used Paint Stripes that is all we can see here as yellow circles. Since we originally chose the centerline feature that is shown here with a yellow circle located at the zero offset. The other yellow circle shown at the approximate 12' left offset was our second grid shoulder white line we created in Step 8. From this cross section view one can manually grip on any of these yellow circles and adjust their locations. Very handy if this was a Point Cloud representing a C&G section and you wanted to make sure you were getting the real gutter location.

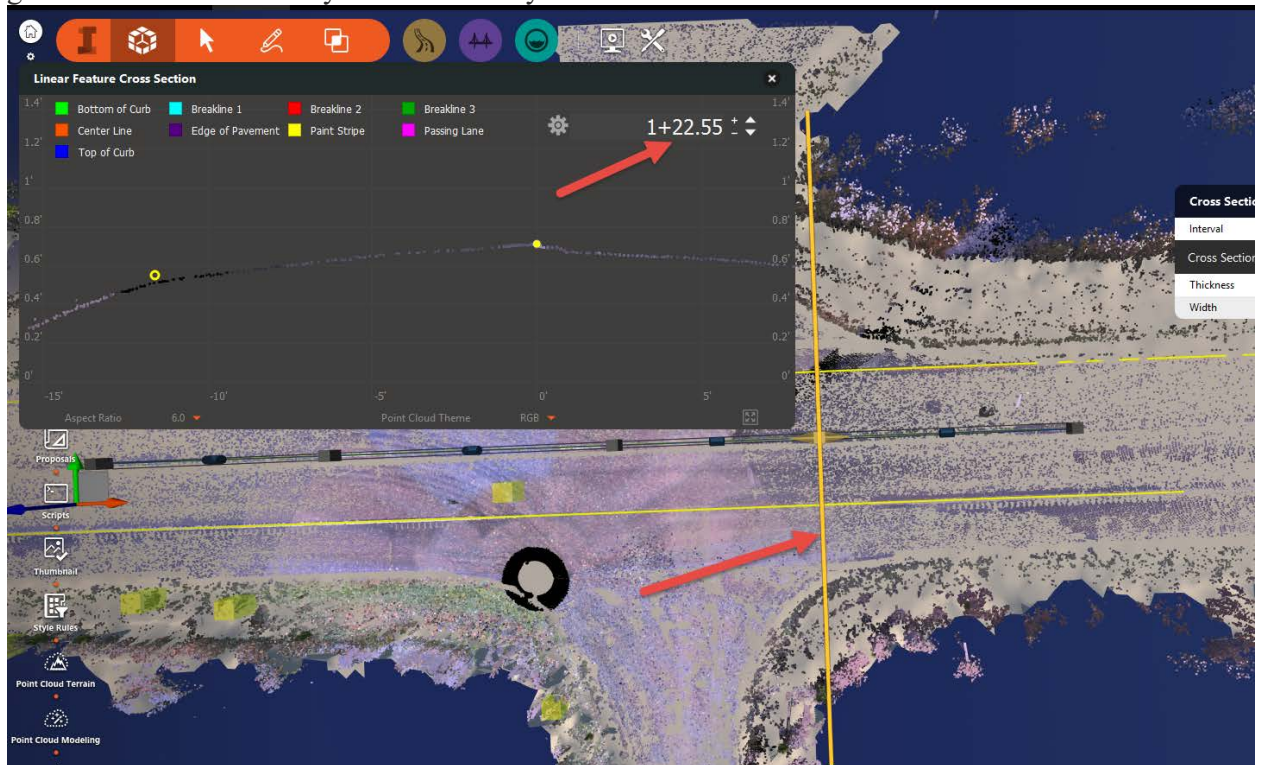
15. On the upper right side of this section view you will see a . This will open up the settings menu as shown below. This is where you can change the sample interval, thickness and width of these section views.



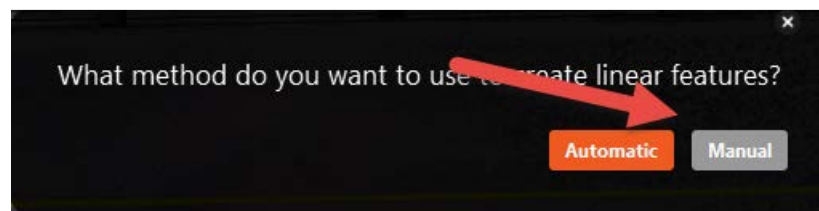
16. To the right of this settings icon you'll see the station location of this section view. You can now change this by clicking on the up or down arrows shown here.



17. As you change the stations, the view will automatically be updated as shown below. As you go from station to station you can now do your final edits to the locations of each vertex.



18. Next let's create "manual" feature lines to represent the edge of our asphalt in our intersection. We will later use these feature lines to help better define these areas in Civil 3D as break line data. Choose the Manual option this time and zoom in to the SW curb return area of our intersection.

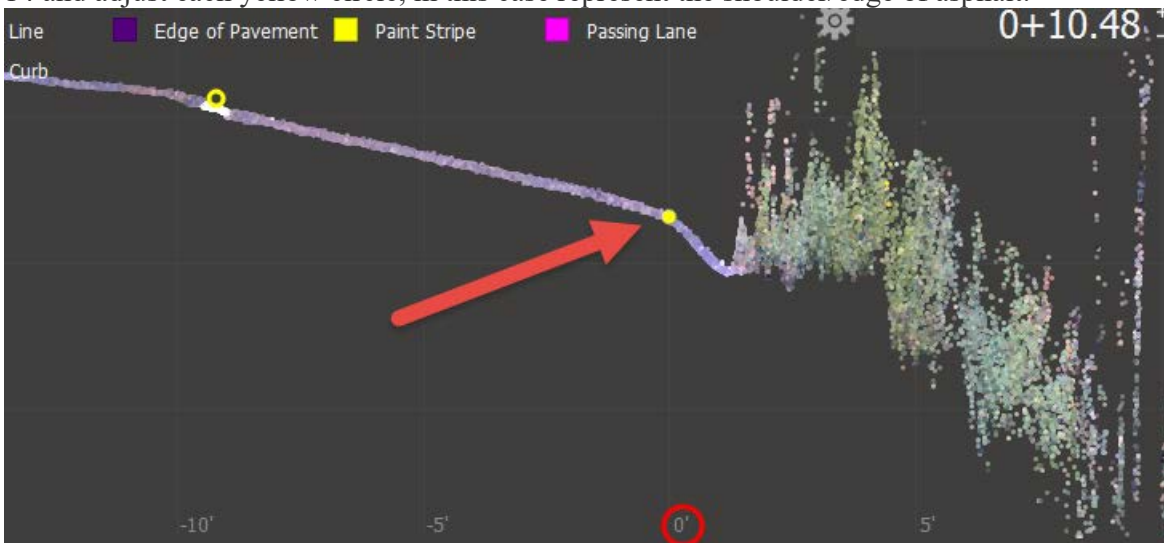


19. Now with the command active start tracing nearest as possible the location of the edge of asphalt as shown here. You don't need to be exact with your picks and clicks, we can fine tune these in the section editor. Make sure to double click on the last vertex location to

complete the line. Should now look something like below:



20. Now like in Step 11, right click and choose “Show Cross Section View” like you did in Step 14 and adjust each yellow circle, in this case represent the shoulder/edge of asphalt.

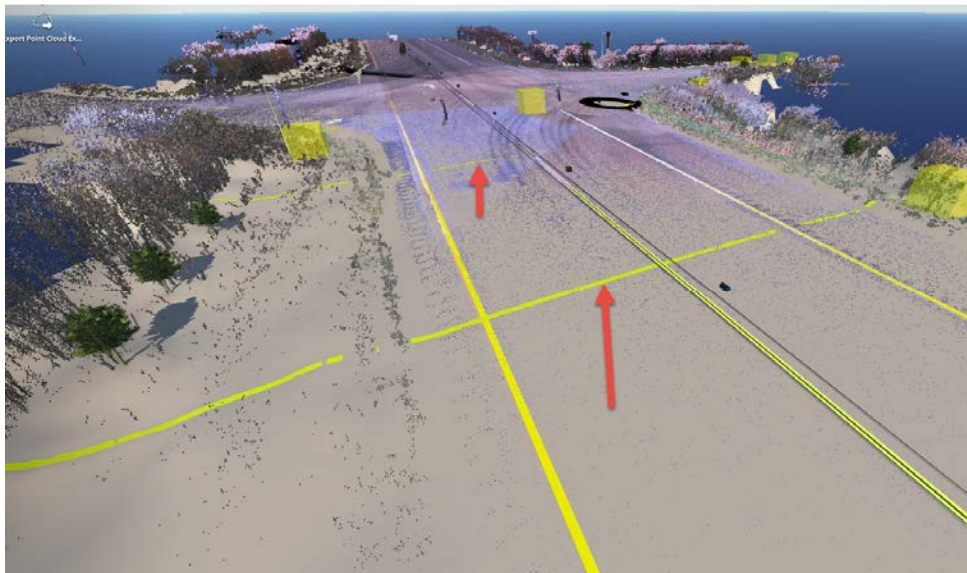


Lesson 5: Generate Transverse Lines

This lesson we will learn from these new linear features we can now create points on the Point Cloud surface perpendicular to these feature lines. These new points can then be exported out in ASCII file to later be imported into Civil 3D. While in IW these points are just lines perpendicular to our centerline and are represented as just lines draped on the Point Cloud surface.

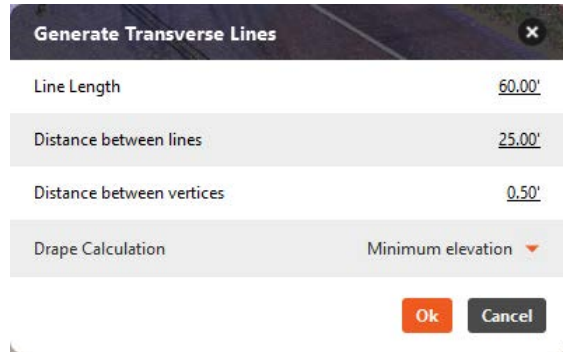


In 3D to see these new transverse lines:



We will walk you thru the creation of these transverse lines.

1. Now changed to a more 3D view of our Point Cloud as shown below. Grip on the centerline feature line as shown and right click. Now choose “Generate Transverse Lines”. On this new menu you have four settings: Line Length, Distance between lines, Distance between vertices and Drape Calculation.



Generate Transverse Lines	
Line Length	60.00'
Distance between lines	25.00'
Distance between vertices	0.50'
Drape Calculation	Minimum elevation ▾

Ok Cancel

2. Line Length = the swatch width of the section. (Max. 200ft)
3. Distance between lines is the sample rate or stationing.
4. Distance between vertices is the sample rate along the transverse line.

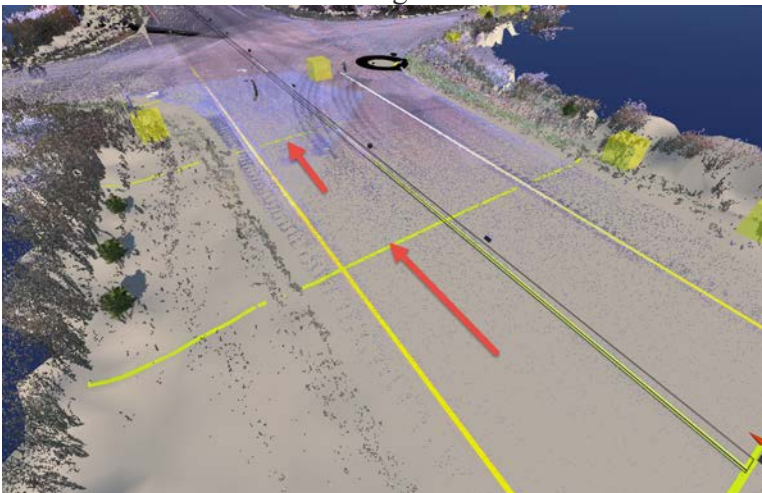


Generate Transverse Lines	
Line Length	60.00'
Distance between lines	25.00'
Distance between vertices	0.50'
Drape Calculation	Minimum elevation ▾

- Minimum elevation
- Maximum elevation
- Average elevation

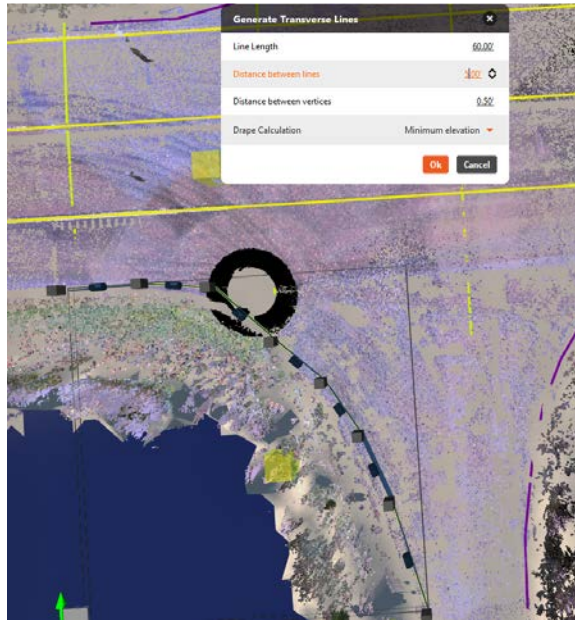
Ok Cancel

5. And Drape Calculation is either min, max or average elevation at each sample spot.
6. Click “ok” and use the defaults given.



7. In combination with the feature lines one could use this in tight areas to better the surface in civil 3D.

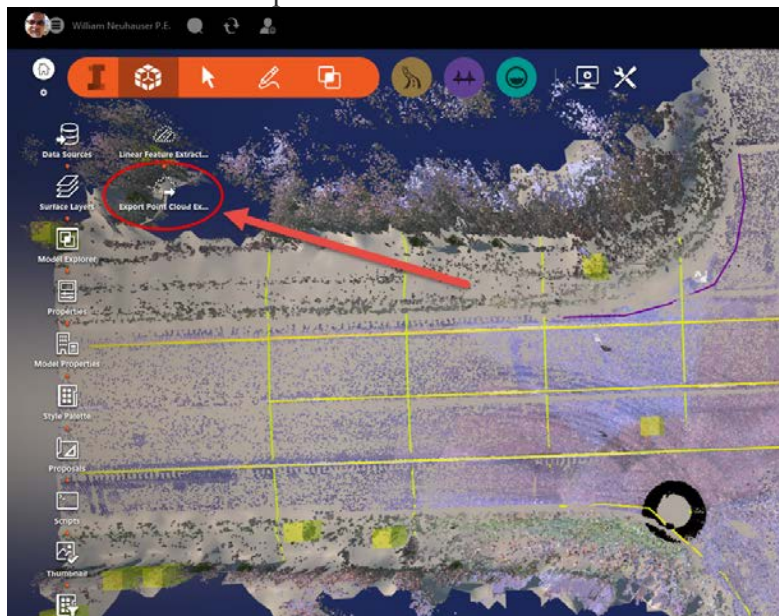
- Take your time now and experiment some. Go around the intersection and first create a feature line for each curb return and then “Generate Transverse Lines” with the listed settings.



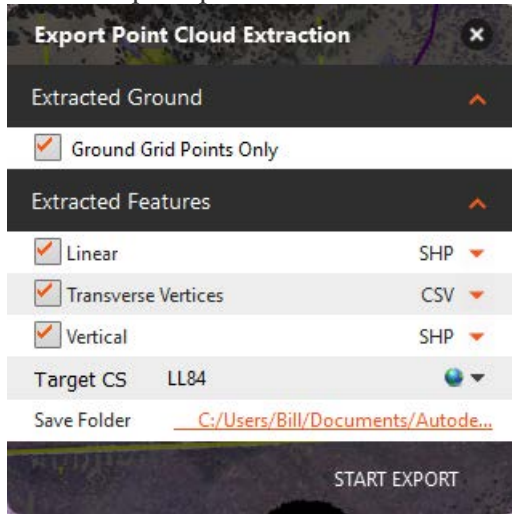
Lesson 6: Exporting and Importing into Civil 3D 2018

This lesson we will first export out objects from Lesson 3 and both the feature lines of their corresponding transverse points from the last two lessons. Then we will startup Civil 3D and run thru the import process of the above items.

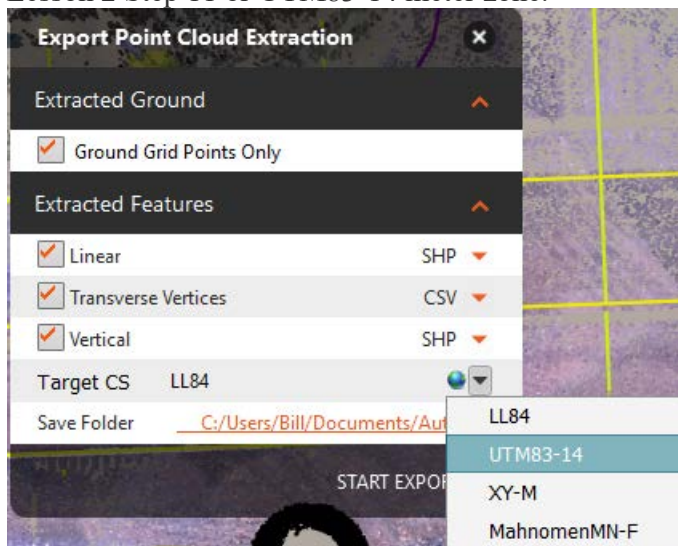
- Now click on the “Export Point Cloud Extraction” icon.



2.) This will open up this menu.



3.) Two big settings to pay attention to are the “Target CS” and the “Save Folder”. In our case let’s set the Target CS to the same coordinate system we used for this IW model in Lesson 2 Step 11 or UTM83-14 meter zone.



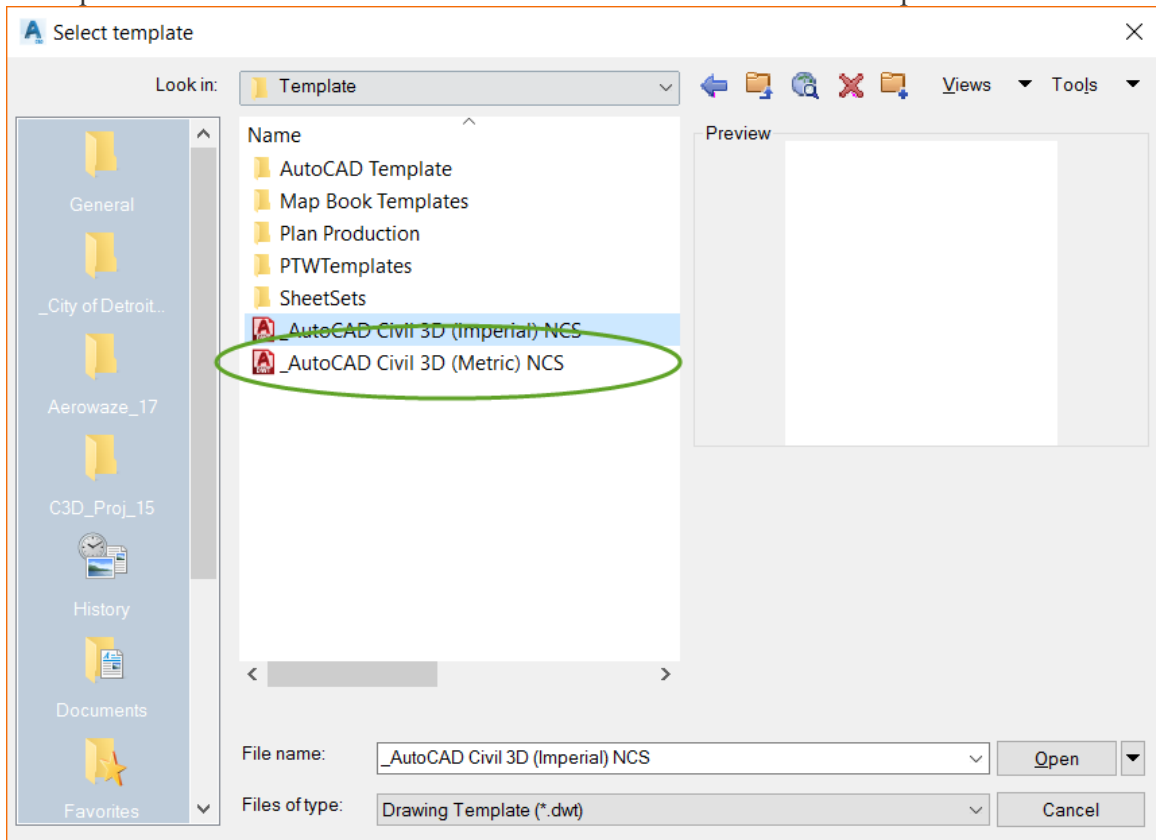
4.) And then verify the location of the Saved Folder. For everything else we will just use the defaults for now and click “ok”

5.) In the folder you extracted to it should look something like below.

Name	Type	Size
gridpoints_2017-11-01_10-34-31	Autodesk ReCap Scan	212 KB
linearfeature_2017-11-01_10-34-34.cpg	CPG File	1 KB
linearfeature_2017-11-01_10-34-34.dbf	DBF File	17 KB
linearfeature_2017-11-01_10-34-34.idx	IDX File	2 KB
linearfeature_2017-11-01_10-34-34.prj	PRJ File	1 KB
linearfeature_2017-11-01_10-34-34	AutoCAD Shape Source	2 KB
linearfeature_2017-11-01_10-34-34	AutoCAD Compiled Shape	1 KB
transversepoints_2017-11-01_10-34-34	Microsoft Excel Comma Separated Values File	55 KB
verticalfeature_2017-11-01_10-34-34.cpg	CPG File	1 KB
verticalfeature_2017-11-01_10-34-34.dbf	DBF File	400 KB
verticalfeature_2017-11-01_10-34-34.idx	IDX File	6 KB
verticalfeature_2017-11-01_10-34-34.prj	PRJ File	1 KB
verticalfeature_2017-11-01_10-34-34	AutoCAD Shape Source	5 KB
verticalfeature_2017-11-01_10-34-34	AutoCAD Compiled Shape	1 KB

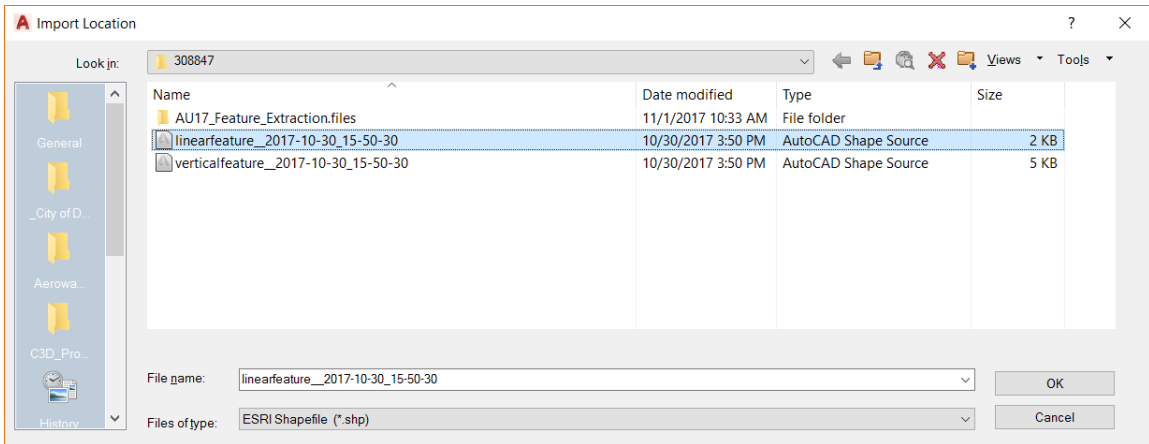
6.) From this above list we will import both the Linearfeature and VerticalFeature shape files and the Transversepoints.csv file.

7.) Startup Civil 3D and make sure to start with the stock Civil 3D NCS template.

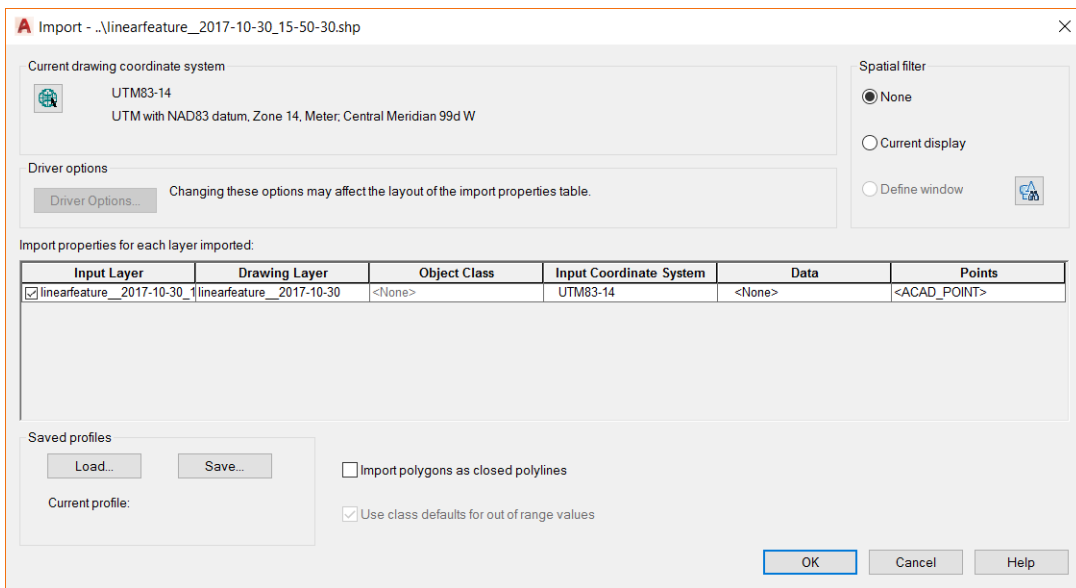


8.) Make sure to set the coordinate system to match your data.

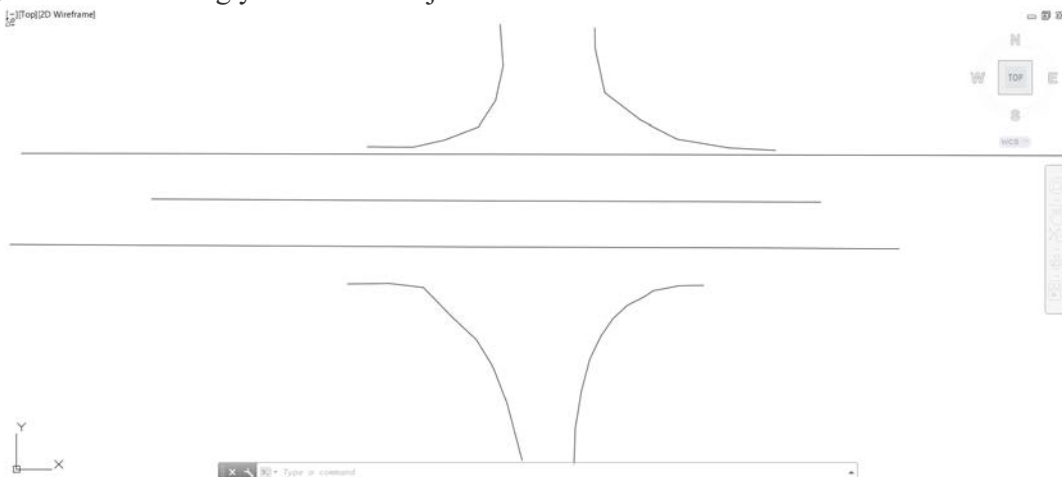
9.) Now in this new dwg run the MAPIMPORT command and select the Linearfeature SHP file shown below. Click “ok”.



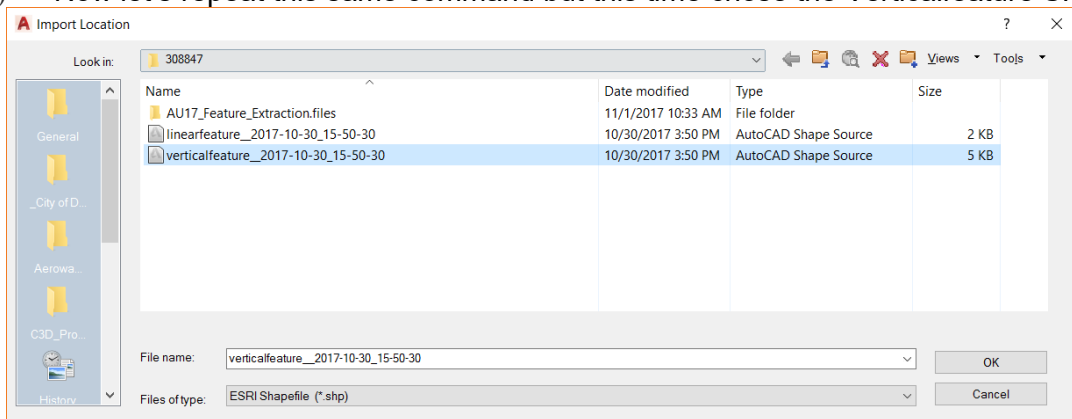
9. Verify that the coordinate systems match, and then click “ok”.



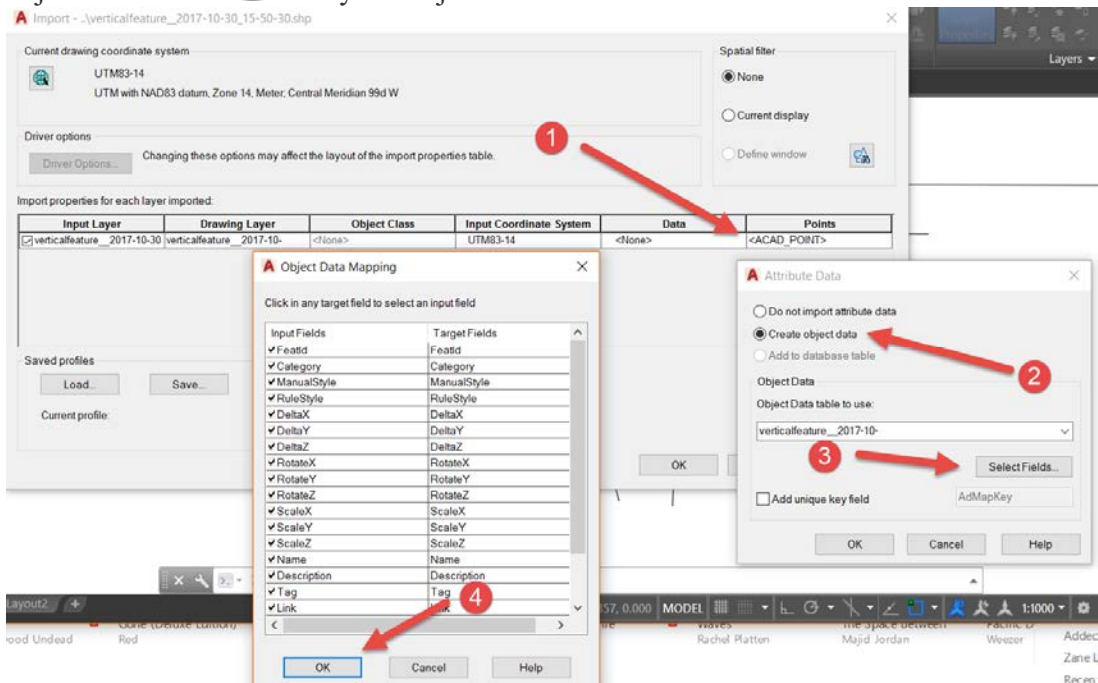
10.) In the drawing you should see just the feature lines that were earlier created in Infraworks.



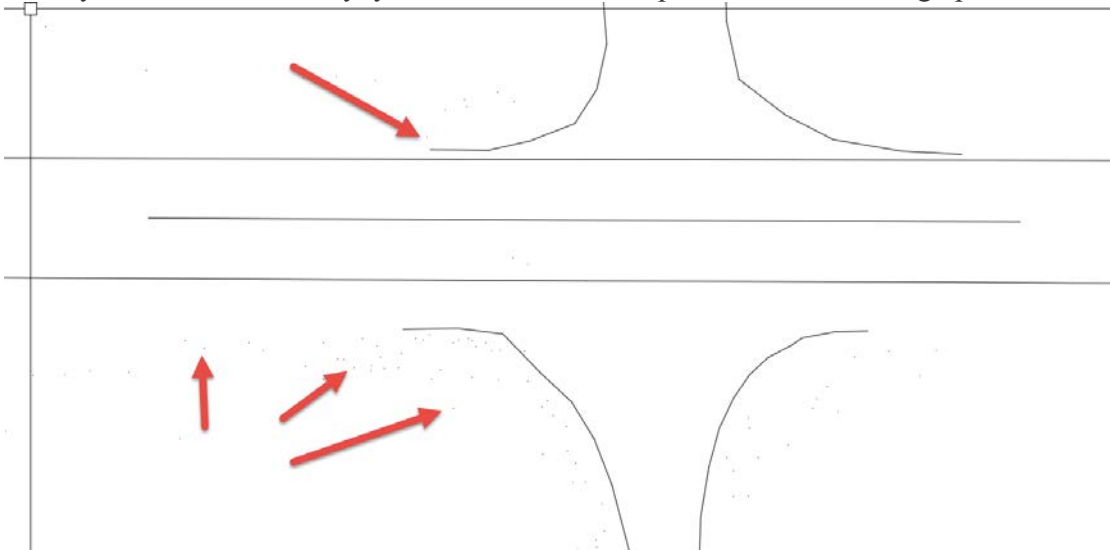
11.) Now let's repeat this same command but this time chose the Verticalfeature SHP file.



12.) Again verify the coordinate system, but this time we must use Map to get the descriptions into a useable format. So first **1** choose the **<None>**, then **2**, then toggle **3** “create object data”. Last **4** verify the object data and click “ok”.

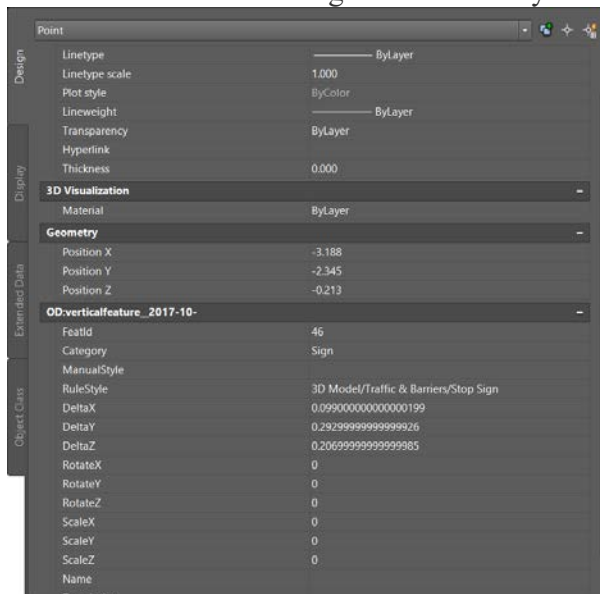


- 13.) If you look real carefully, you'll see the Autocad points, not civil3d cogo points, I'm afraid!

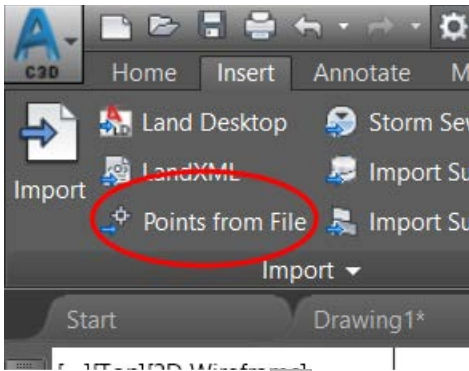


But

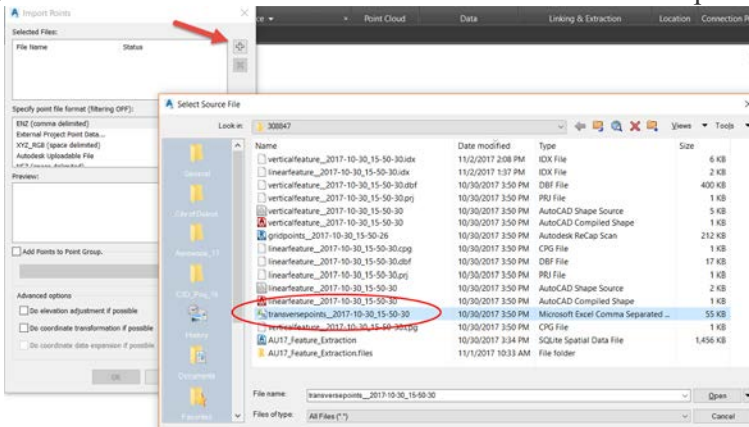
First let's verify that the Category data was added to the points. Grip on one of these new points and right click and bring up the properties window. You should see a category with Sign, Tree or Pole. But a lot of these may not show anything, these are the cubes we didn't delete while in Infraworks. We never assigned a feature/style to these so therefore their object data is blank.



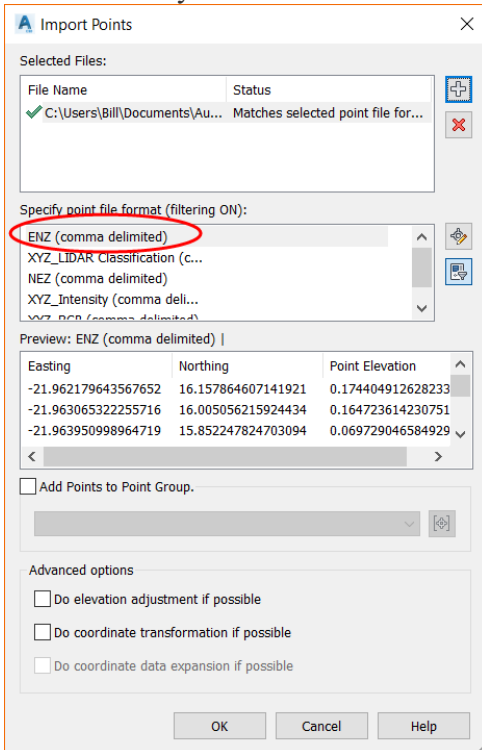
- 14.) Even though these are convertible AutoCAD points, the text was embedded in the object properties and not in the Autocad point. Before we show you how to convert this to usable Civil 3D points we will first import the Transverse points we created earlier. Good news is that Infraworks this time did create a simple ASCII file.
- 15.) So we will just use the standard Points> Import points since points were exported in a normal ASCII CSV file.



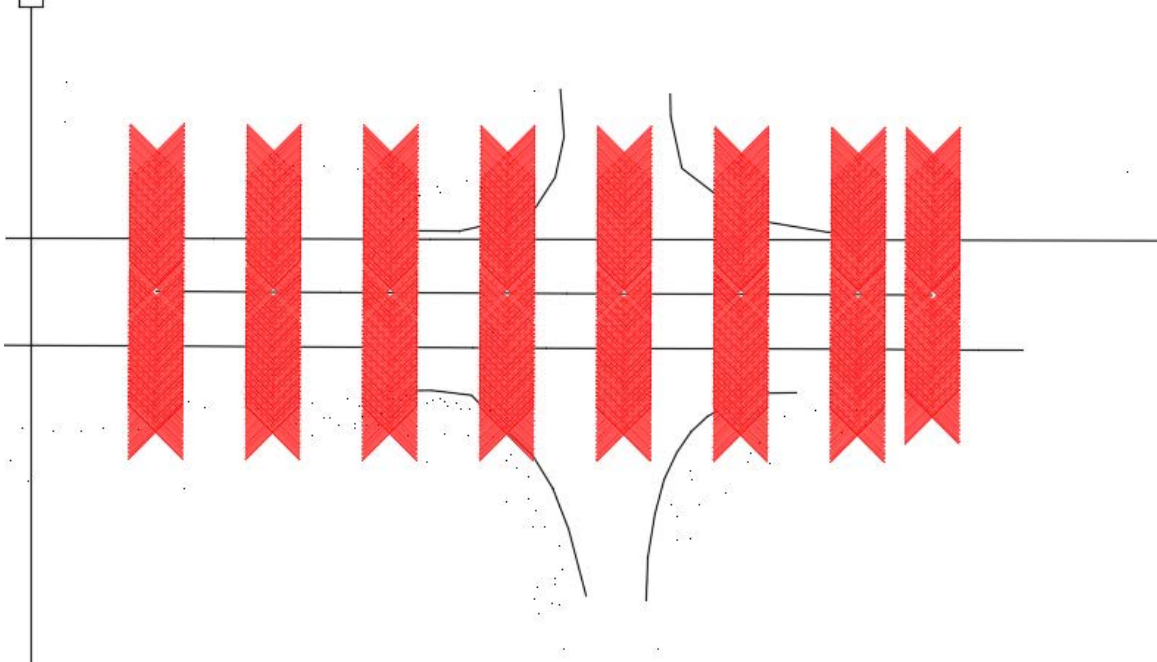
16.) Now click on the  and then choose the transversepoints CSV file listed and click open.



17.) Now verify that ENZ has been chosen as the Format and then click on “ok”.



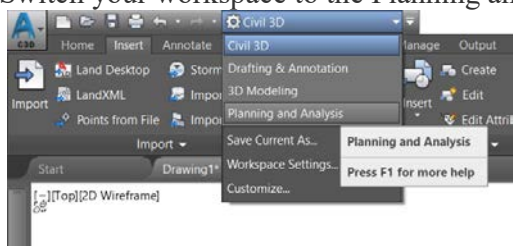
- 18.) You should now see something ugly like this. The points come in using the stock point setting in your Civil 3D template. So the point markers in this case are quite large.



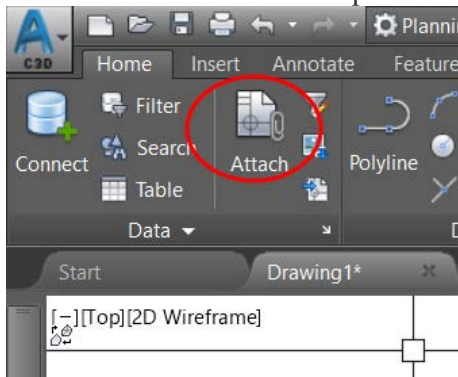
- 19.) From here one can now use both these points and the Linear Features imported to create your existing ground surface. The vertical features are not necessary for this, but if one wishes you can use the next few steps to convert these what I'll call Infracad Points into usable Civil 3D points with the combination of a description key can now import in these as visible blocks i.e. Trees, Poles and Signs.
- 20.) Now save this drawing to be used in the next steps in the conversion process. Essentially you will now use Map to query this new dwg and create a Report that is a CSV file of these AutoCAD points but now with their Categories will be as point descriptions.

Added section to do on your own time if time permitting.

- 1.) Start a new dwg and make sure to set the Zone again to UTM NAD83 – Zone 14 M
- 2.) Switch your workspace to the Planning and Analysis.

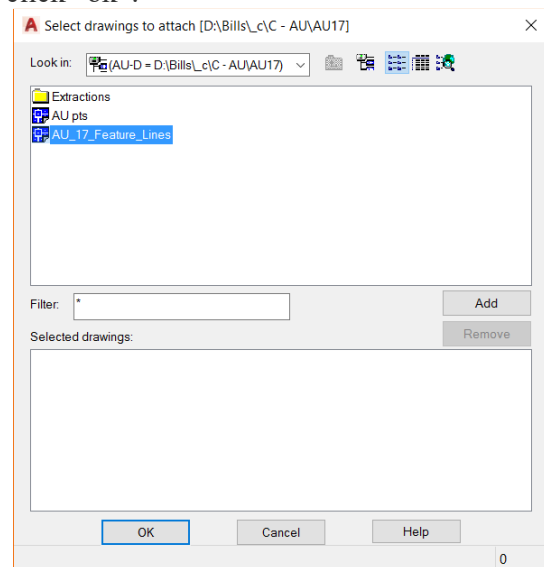


3.) On the Home Ribbon>Data portion click on the Attach Icon.



Attaching the drawing:

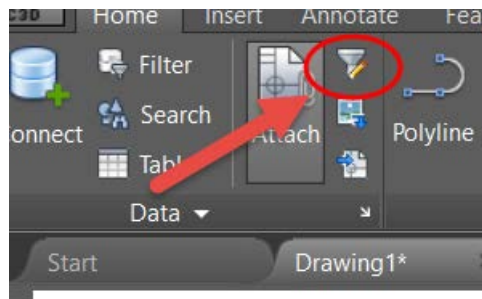
1.) Attach the AU_17_Feature_Lines drawing we just made in steps 11-19 and click add and then click “ok”.



2.) You will see your drawing listed as Attached and Active. Click “OK”.

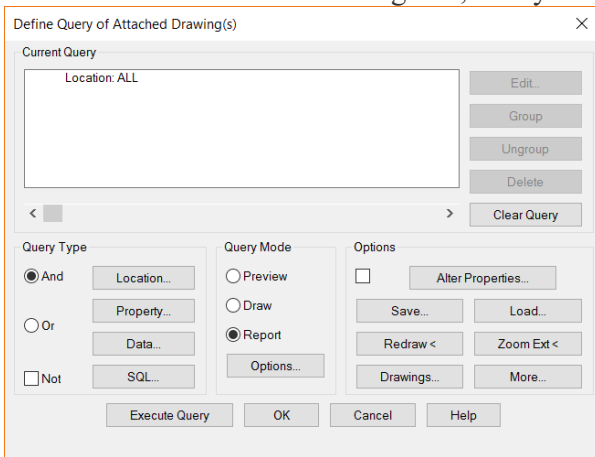
Defining the query:

3.) On the Map menu, click Query > Define Query.

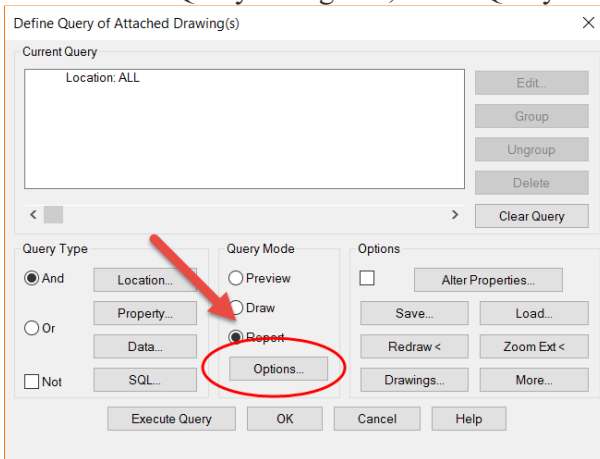


4.) In the Define Query dialog box, click Location.

5.) In the Location Condition dialog box, verify that 'All' is selected and click "OK".

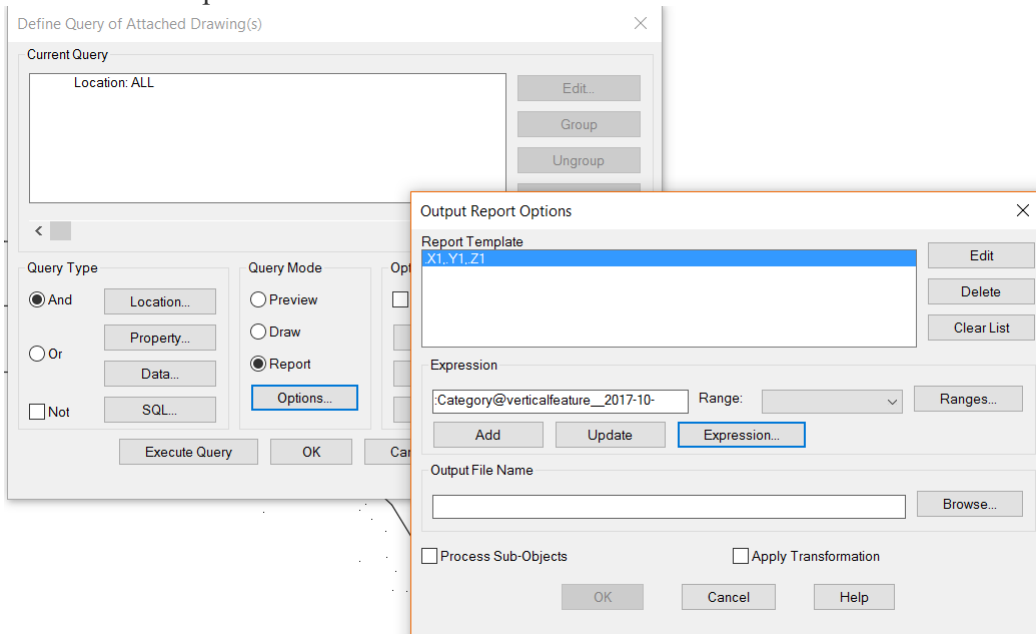


6.) In the Define Query dialog box, under Query Mode, select Report and click Options.



7.) In the Output Report Options dialog box, click Expression.

8.) In the Report Template Expression dialog box, select the Object Data field you would like to include in the report and click "OK".



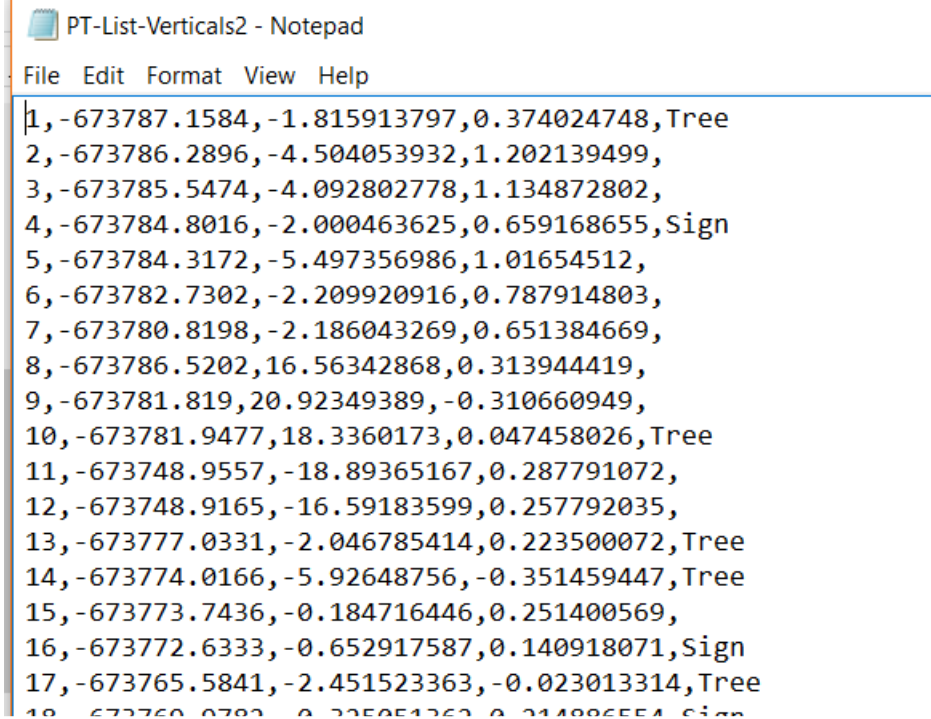
- 9.) The expression will be created. Click Add to add it to the Report Template list. Follow the same procedure for any other fields you want to include in the report. The fields will be separated by commas.
- 10.) Add the fields shown.
- 11.) Once the Report Template is created, click the Browse button and navigate to the folder where you would like to create the file. Click “OK”.

The screenshot shows the 'Output Report Options' dialog box. It has a title bar with a close button (X). The main area is divided into several sections:

- Report Template:** A list box containing two entries: '.X1..Y1..Z1' and '.Category@verticalfeature__2017-10-'. The second entry is highlighted in blue. To the right of the list are three buttons: 'Edit', 'Delete', and 'Clear List'.
- Expression:** A section with a text input field, a 'Range:' dropdown menu, and a 'Ranges...' button. Below these are three buttons: 'Add', 'Update', and 'Expression...'.
- Output File Name:** A section with a text input field containing the path 'D:\Bills_c\C - AU\AU17\PT_Verts.txt' and a 'Browse...' button.
- Options:** Two checkboxes: 'Process Sub-Objects' and 'Apply Transformation', both of which are currently unchecked.
- Buttons:** Three buttons at the bottom: 'OK', 'Cancel', and 'Help'.

- 12.) In the Define Query dialog box, select Execute Query. The file will be created in the directory you selected.

13.) Open Excel, then open the txt file. Edit as necessary and save as CSV. Below is what you can now import into Civil 3D.



```
PT-List-Verticals2 - Notepad
File Edit Format View Help
1, -673787.1584, -1.815913797, 0.374024748, Tree
2, -673786.2896, -4.504053932, 1.202139499,
3, -673785.5474, -4.092802778, 1.134872802,
4, -673784.8016, -2.000463625, 0.659168655, Sign
5, -673784.3172, -5.497356986, 1.01654512,
6, -673782.7302, -2.209920916, 0.787914803,
7, -673780.8198, -2.186043269, 0.651384669,
8, -673786.5202, 16.56342868, 0.313944419,
9, -673781.819, 20.92349389, -0.310660949,
10, -673781.9477, 18.3360173, 0.047458026, Tree
11, -673748.9557, -18.89365167, 0.287791072,
12, -673748.9165, -16.59183599, 0.257792035,
13, -673777.0331, -2.046785414, 0.223500072, Tree
14, -673774.0166, -5.92648756, -0.351459447, Tree
15, -673773.7436, -0.184716446, 0.251400569,
16, -673772.6333, -0.652917587, 0.140918071, Sign
17, -673765.5841, -2.451523363, -0.023013314, Tree
18, -673760.0782, 0.225051262, 0.214886554, Sign
```

14.) END!

Import formats	Export formats
CL3 (Topcon)	E57
CLR (Topcon)	PTS
E57	PCG
FLS (Faro)	RCP/RCS
FWS (Faro)	Note: ReCap 360 support exporting to the structured E57 format (individual scans, with row/column info, including registration transforms). The structured E57 export does not apply any deletions or clips created in the project; it is a complete export of all data.
LSPROJ (Faro)	
LAS	
PCG	
PRJ (Leica)	
PTG (Leica)	
PTS	
PTX	
RCS	
RDS (3D only; Riegl)	
TXT	
XYB	
XYZ	
ZFS (Zoller+Fröhlich)	
ZFPRJ (Zoller+Fröhlich)	

Import formats	Export formats
CL3 (Topcon)	E57
CLR (Topcon)	PTS
E57	PCG
FLS (Faro)	RCP/RCS
FWS (Faro)	Note: ReCap 360 support exporting to the structured E57 format (individual scans, with row/column info, including registration transforms). The structured E57 export does not apply any deletions or clips created in the project; it is a complete export of all data.
LSPROJ (Faro)	
LAS	
PCG	
PRJ (Leica)	
PTG (Leica)	
PTS	
PTX	
RCS	
RDS (3D only; Riegl)	
TXT	
XYB	
XYZ	
ZFS (Zoller+Fröhlich)	
ZFPRJ (Zoller+Fröhlich)	

Insert AU caption.