CONNECTICUT DEPARTMENT OF TRANSPORTATION

DIGITAL DESIGN ENVIRONMENT GUIDE

CONNECT EDITION

Volume 4 - OpenRoads Designer Survey

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Course Overview

This volume focuses on the OpenRoads Survey tools and covers the post-processing of field data. The main topics contained in this volume are the importing and editing of field data once brought into a design model and the creation and editing of the Terrain Model. This volume also introduces users to the custom CTDOT placement and drawing tools available on the Ribbon (this replaces the Custom Tasks used in V8i).

The underlying configuration that drives the survey engine has changed significantly since InRoads V8i SELLECTSeries 2. The Graphical engineering elements have become "intelligent" so have survey elements. There are no longer external database files (.dtm or .alg) to keep track of and sync with the graphical survey data as the survey information is stored within the graphical elements themselves in the design (.dgn) file. The elements keep track of how they were created (from what data files), what their terrain attributes are and how to display annotation. Modify the element's terrain attributes and the Terrain Model updates, change its point code and the graphics update. This now allows for single file to deliver as a final product (even terrain elements are now contained within the DGN file itself).

MODEL USES

WHAT IS A TERRAIN MODEL?

A terrain model is a set of triangles mathematically computed from point data collected from the surface being modeled. They are typically used to model highly irregular surfaces, like the surface of the earth. A terrain model is created from 3D features such as points, breaklines, and contours. Terrain models are also referred to as digital terrain models (DTMs), triangulated irregular networks (TINs), or triangulated surfaces. A terrain model is stored as a 3D mesh element in an OpenRoads/OpenRail Designer 3D design (.dgn) file, similar to what used to be stored in a GEOPAK TIN, InRoads DTM, or MX FIL file. When you select a terrain model in the design file, the Element Selection tool recognizes it as a Terrain Model, and the Properties and Explorer Windows will show it as a Terrain Model Element. The display of a terrain model in the product is controlled by using a Feature Definition and Element Template. Being an element stored in a 3D design file, terrain models are easily shared and used by anyone using any DGN based application like OpenBuildings Designer (formerly AECOsim Building Designer), OpenPlant Modeler, or MicroStation CONNECT Edition.

WORKING DIRECTORY

Before attempting to open or create DGN files users should make sure the following is in place:

- CTDOT users should have the CTDOT CONNECT DDE synced through SharePoint with the COMPASS Project Synced along with the CAD Configuration.
- Consultants should have CTDOT DDE properly installed or be syncing to the CTDOT DDE SharePoint/COMPASS system.

- Make note of the **Coordinate System** you will be working in.

There are two Sub-Modules to complete to properly set up the CTDOT CAD Environment:

- Syncing the SharePoint DDE – This is equivalent to the old network W Drive storage location for the CAD Workspace and when synced will show up under the Enterprise Icon.
- Syncing a COMPASS Project – This is equivalent to the old Network P and X Drive Project locations and when synced will show up under the Enterprise Icon.

The COMPASS Project is the working Directory. After Syncing there will be a **Design** folder available that has a sub-folder for each discipline.

- District Survey will work in the **SVY_District** folder.
- Central Survey will work in the **SVY_Central** folder.

When a file is ready for designer to reference, a copy of the file will be placed in the **Active_Survey** folder. Central Survey will notify the Design team to let them know it is available.

All edits will be made in the **SVY_District** or the **SVY_Central folders** and pushed up to **Active_Survey** as needed.

SEED FILES

Seed file is a term for a template. When a user selects File/New, the application makes a copy of the selected seed file, puts it in the desired folder, and the dgn is given a new name.
The CTDOT Survey seed file is set to
CT_Configuration|Organization|Seed|Survey|CT_SurveySeed.dgn
This is a file with a 3D Design Model that has been assigned a default Geographic Coordinate System (GCS) of NAD 1983 State Plane Connecticut with a North American Vertical Datum of 1988 to allow interaction with geospatial applications.

For more on Seed files and GSC, please see **Volume 2**.

Exercise 1 – Base Survey File Creation

In this module you will learn how to access OpenrRoads Designer to create a new DGN file.

Skills Taught

- Learn how to access the Application to get the proper workspace to appear.
- Learn how to create a DGN file from the proper seed file.
- Learn how to update the Geographic Coordinate System.

1.1 Startup

Before attempting to open or create DGN files users should make sure the following is in place:

1. CTDOT users should have the CTDOT CONNECT DDE synced through SharePoint with the COMPASS Project Synced along with the CAD Configuration.
2. Consultants should have CTDOT DDE properly installed or be syncing to the CTDOT DDE SharePoint/COMPASS system.
3. Make note of the **Coordinate System** you will be working in.
4. Log on to the CONNECTION Client.

   Bentley Connect licensing requires users to log into their Bentley account to secure a software license. CTDOT users should log in using your CTDOT email address and Bentley password.If you do not see the dialog box, select the ∧ icon on the bottom Windows Screen. Click on the Connection Client Icon and select **Open.**

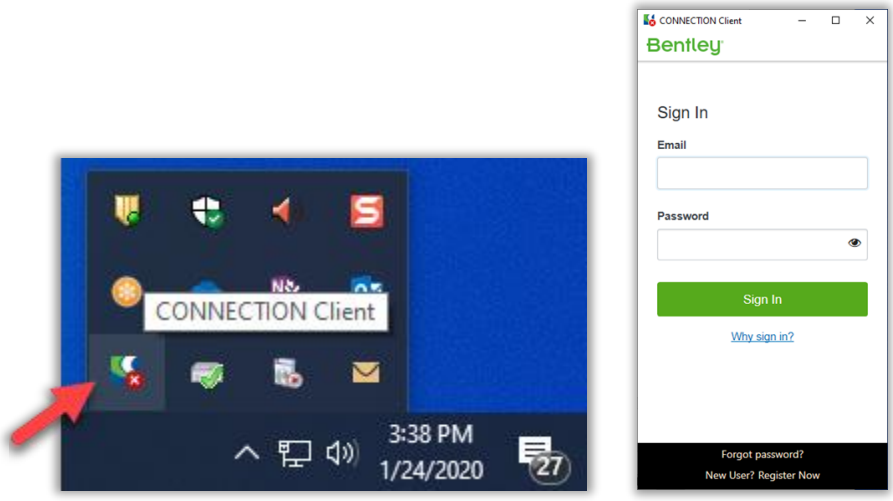


Figure 1 CONNECTION Client System tray

5. Launch the Application.
   - **Consultants**
     Start the software
     via an appropriate CTDOT DDE icon and skip to step 5.

Figure 2 ORD Icon

   - **CTDOT employees**
     On your desktop double click on the **CAD Accounting Icon**.

Figure 3 CAD Accounting Icon

6. On the CT DOT Accounting Menu there will be several applications to pick. Select ***Compass OpenRoads CE***.
7. In the ***Run Program*** field select the needed program, the ***Available Account*** (funding source) and ***Resource Type***. Click on the **Start** button to load the program.

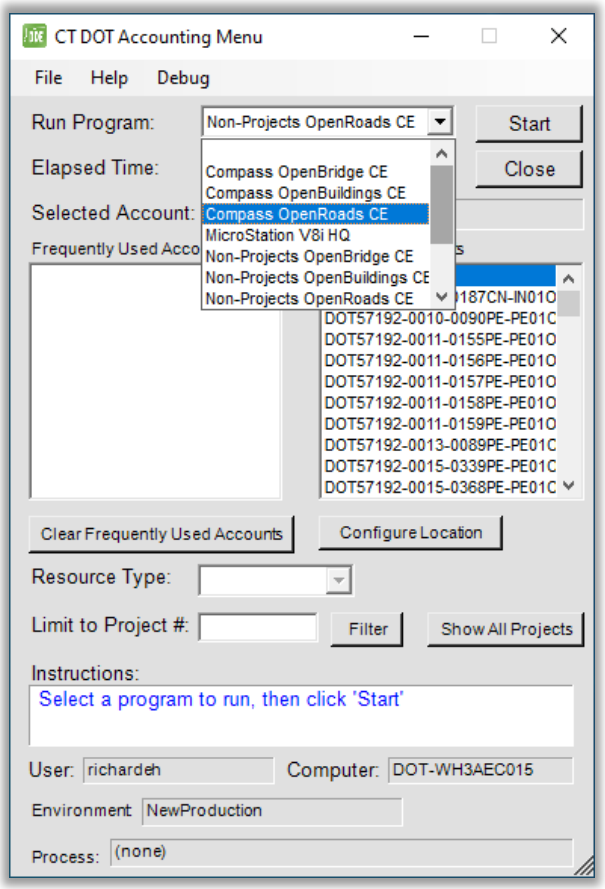


Figure 4 CAD Accounting dialog box

8. After launching the program, the following a Welcome Screen will appear.
9. Ensure you are using the **Custom Configuration** and **CT_WorkSpace**, then select the relevant **WorkSet** and **Role > *Survey***.

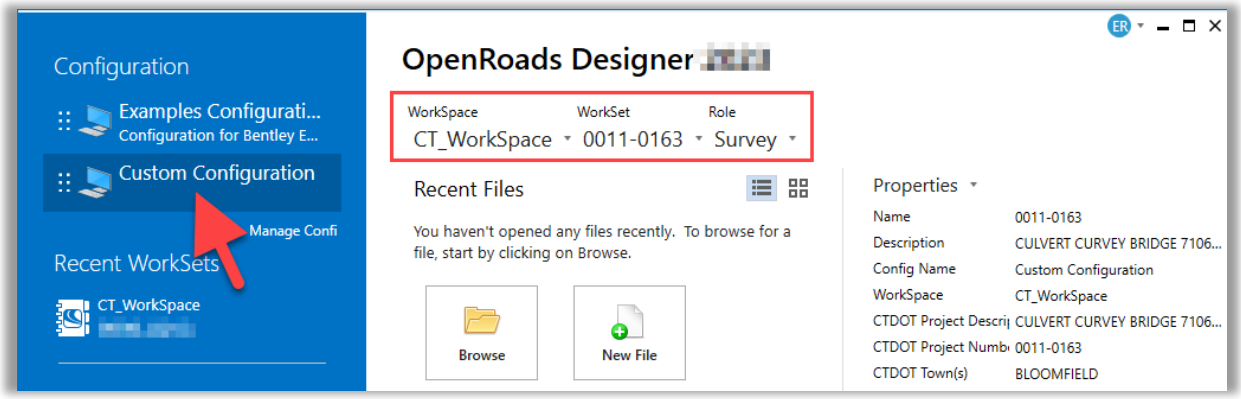


Figure 5 OpenRoads Welcome Splash Screen

If you do not see the Project Number listed, please request a Compass/CAD Setup using this link [New CAD Project Request]

1.2 Create a Design File

1. Select the **New File** Icon. In the New dialog box browse to the ***SVY_District*** folder.
2. The Seed file should be set to the Survey Workspace. If this is not the case, click on the **Browse** button to pick the seed file.

   To select a seed file browse to:

   CT_Configuration|Organization|Seed|Survey|

   and select: ***CT_SurveySeed.dgn***
3. *In the **File name** field enter a name for your file using the CTDOT File Naming structure.*

   Example: ***SV_D2_1234_1234_Ground TOPO - Terrain.dgn***
4. Select **Save** and the new file will open.

   ***Note:** Do not copy DGN files created with V8i SELECTseries or InRoads SS2, SS3, SS4, or SS10 to the new CTDOT CONNECT Project/WorkSet folders.*

5. After the DGN file is created open File Explorer and browse to the file, **right click** and select **View online**.

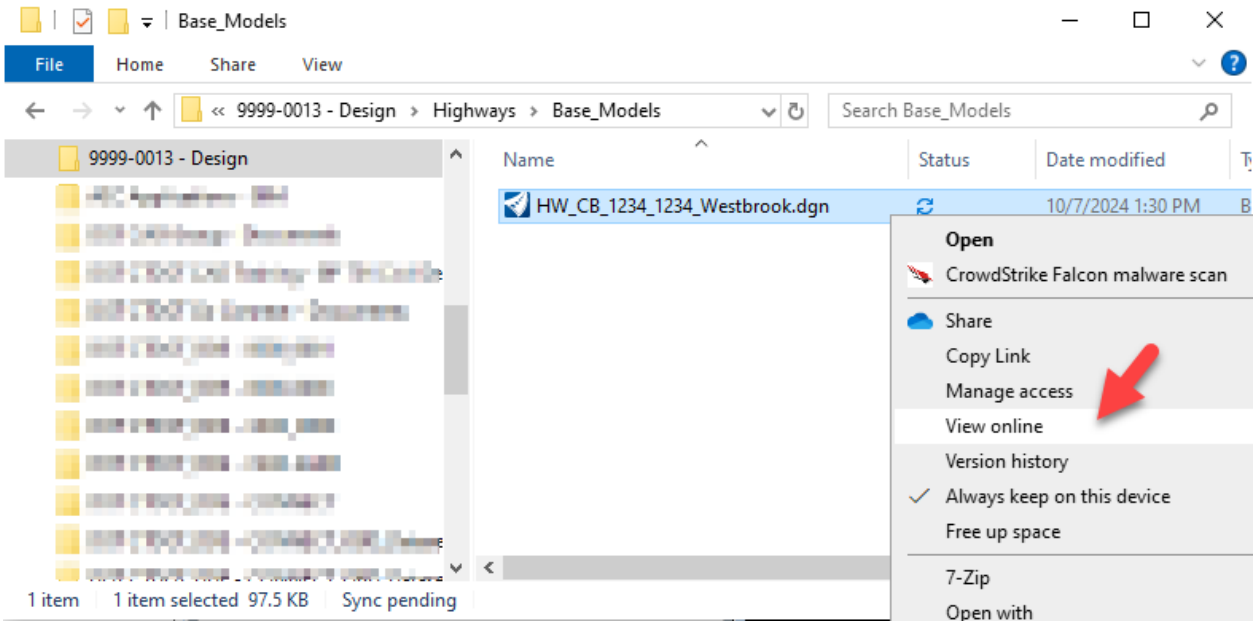


Figure 6 File Explorer View online tool

6. The Projects SharePoint site will open, sort by **Date**, click on the **three dots**, select ***More > Check Out***

   Note: *When you are done working on the DGN file, exit the program and go back to the SharePoint Site and* ***Check In*** *the file.*

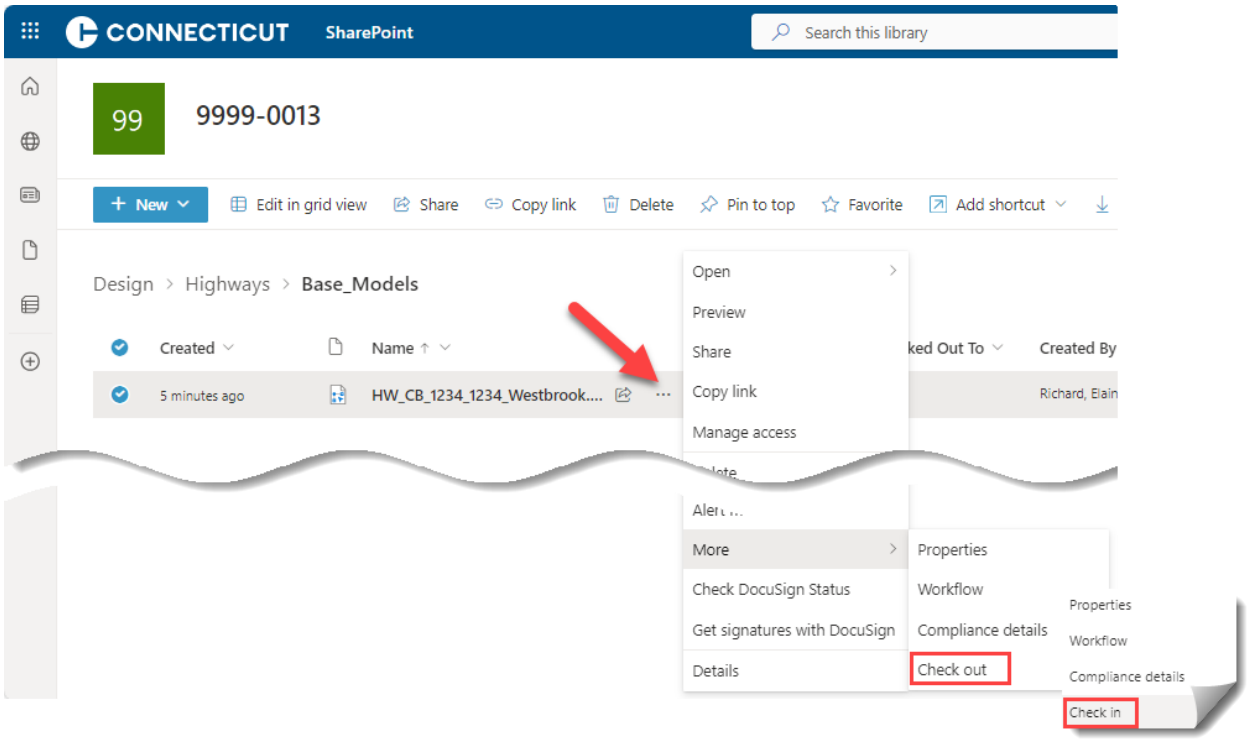


Figure 7 SharePoint Check out

Exercise 2 – Exploring the Interface

In this module you will learn how to review and navigate the new CONNECT Edition interface, the ribbon tool bars, and review User Preferences. In this module you will also explore the Standard Survey Feature Definitions that have been set up for CTDOT.

Skills Taught

- To become proficient finding needed tools in ORD.
- To become familiar with the custom CTDOT Ribbon.
- To gain a basic understanding how the User Preference Settings work.
- To become familiar with the CTDOT OpenRoads Survey Standards.

2.1 The CONNECT EDITION Interface

1. Continue in the file created in Module 1. On the pull-down menu on the top left next to the OpenRoads Icon select **Survey**, this is the Workflow Pick list.
   ORD and **MicroStation CONNECT** are ribbon based. The ribbon interface is driven by workflow picklists. Different workflows contain different tab options for the ribbon. Each tab exposes specific groups and tools.

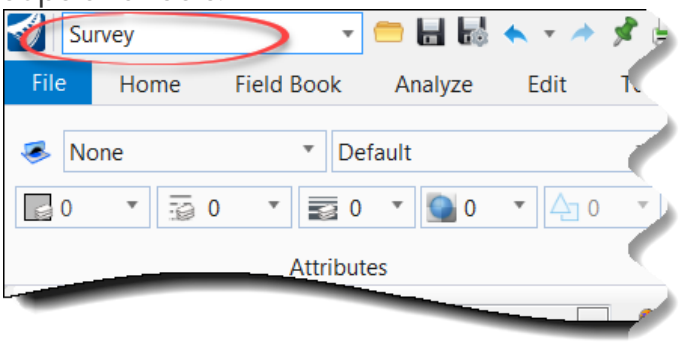


Figure 8

2. Select different **Tabs** and **Workflows** and notice the Ribbon change.
   These Tab sets replace the Tasks that were available in **V8i.** In the image below, the Survey workflow displays a Drawing tab. The Drawing tab contains the Placement group which includes Line and Arc tools.

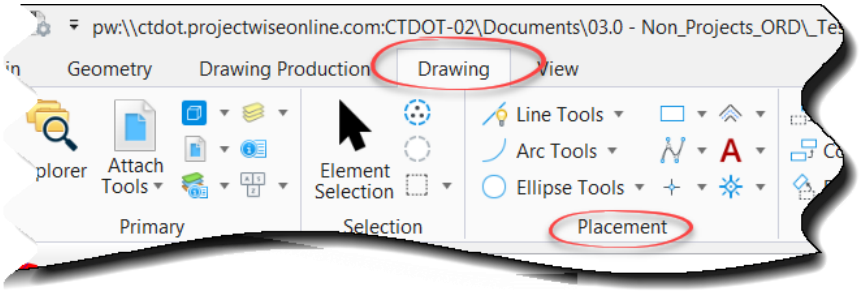


Figure 9

3. In **Search**, Type in a tool name or a portion of one and a list will pop up, select as needed. The **Search** function is very useful for initially finding dialogs, tools, etc.

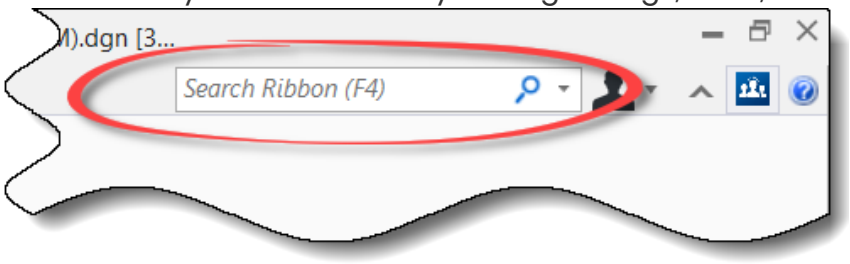


Figure 10

2.2 User Preferences

1. User settings have been moved to what is referred to as the Backstage. Access this through the main menu: ***File> Settings> User> Preferences*** to open the Preferences dialog box.

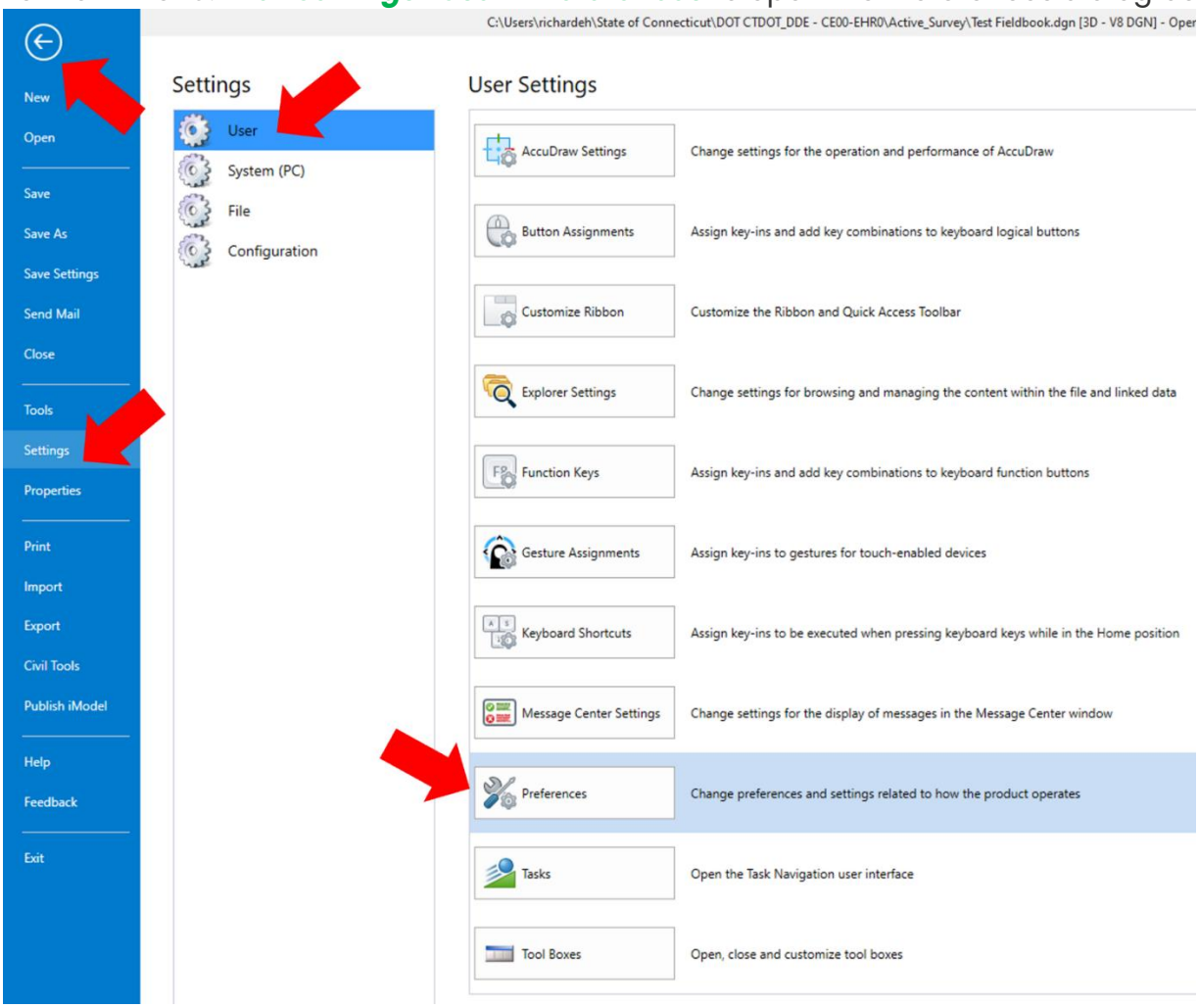


Figure 11

2. On the Preferences dialog box, select **View Options**. ***Check on*** Scroll Bars and turn ***Off*** Anti-alias Lines and Anti-alias Text.

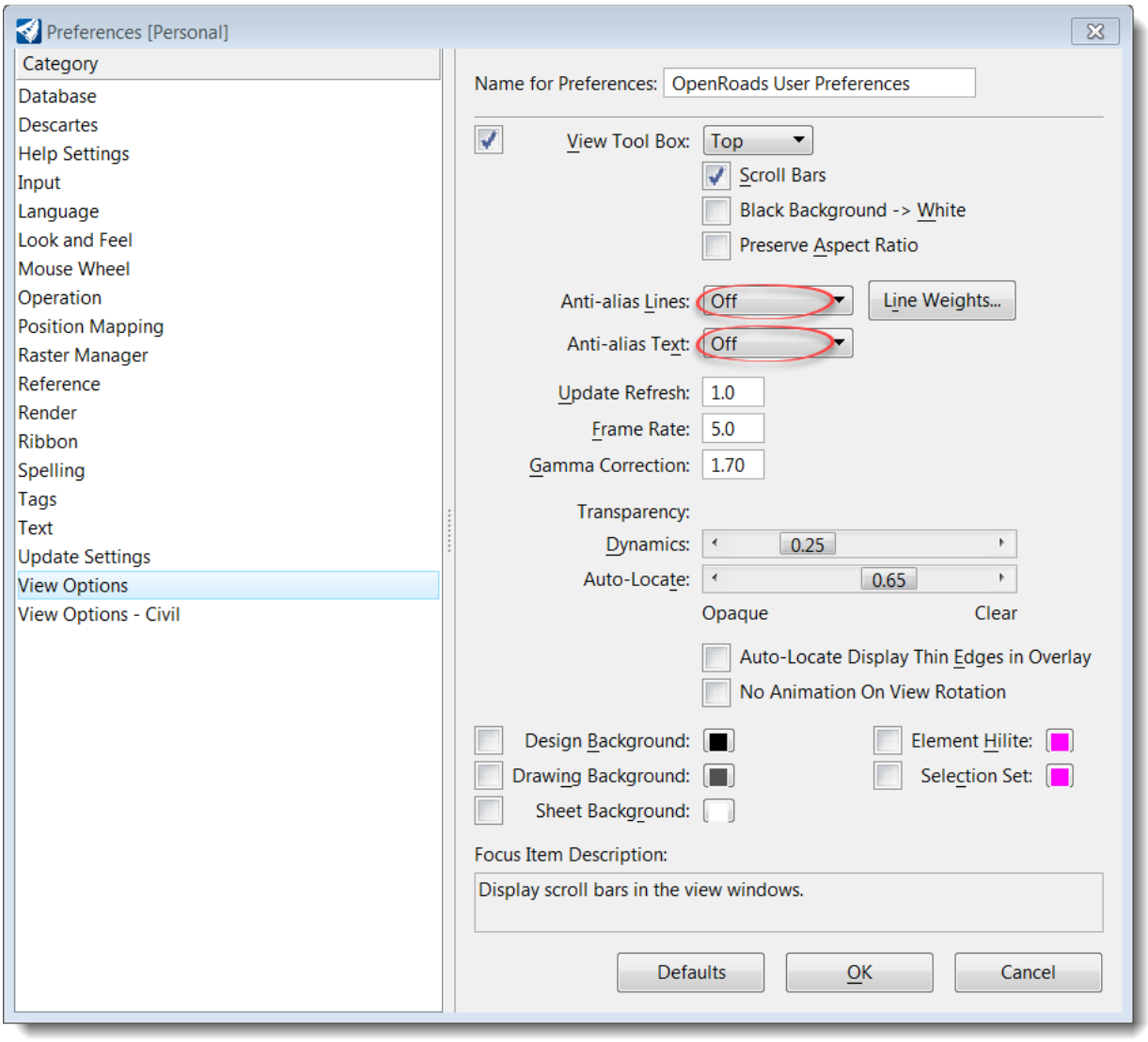


Figure 12

3. Explore **View Options – Civil** to view or change civil preferences. You can display and set point label preferences such as Number and Elevation under **Survey Decorators**.

   The intent here is to standardize and automate, these options don't need to be modified but it is important to be aware of the settings. **Survey Decorators** appear the same size regardless of zoom level; however, they will resize according to the size of the view window.

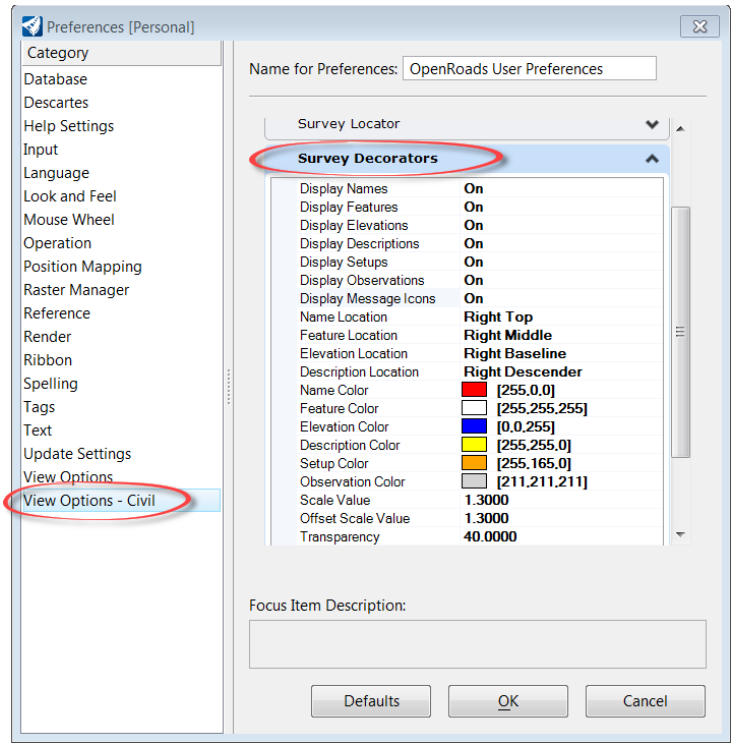


Figure 13

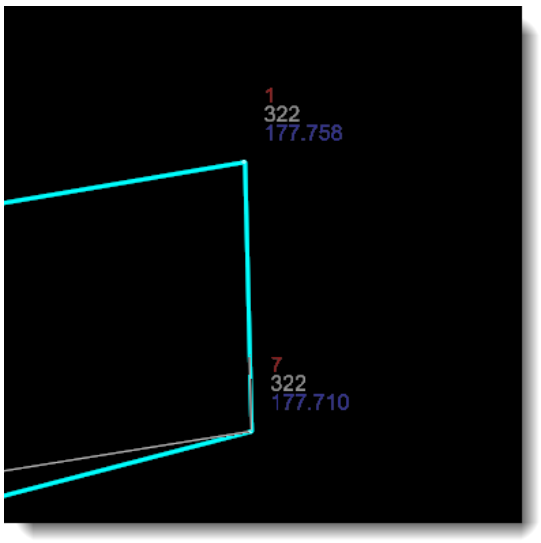


Figure 14

4. With the Preferences dialog still open, explore other Preferences such as **Survey Locator**.
5. Save settings if desired by choosing ***File> Save Settings***.
6. Return to the design file by clicking the **back arrow**.

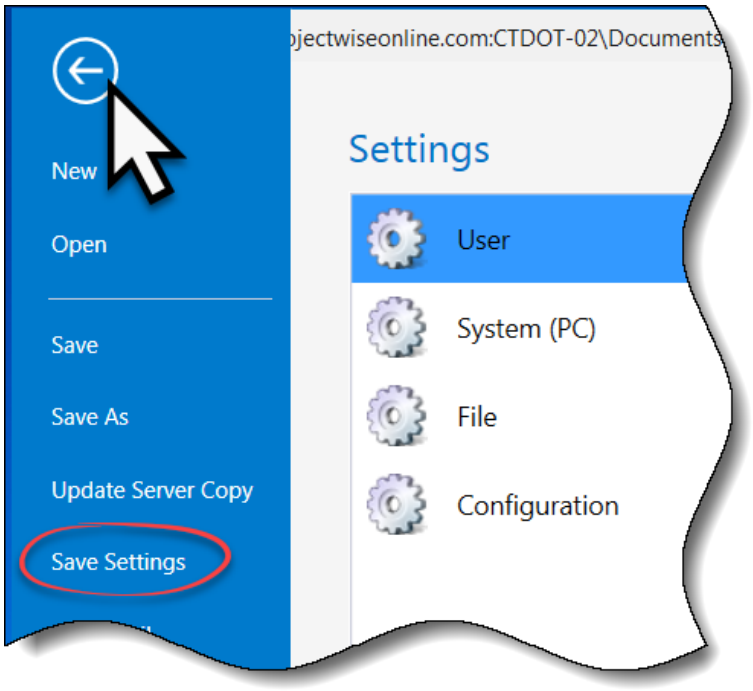


Figure 15

2.3 The Survey Ribbon

Familiarize yourself with the Survey Workflow, ensure that the ribbon Workflow is set to the **Survey.**

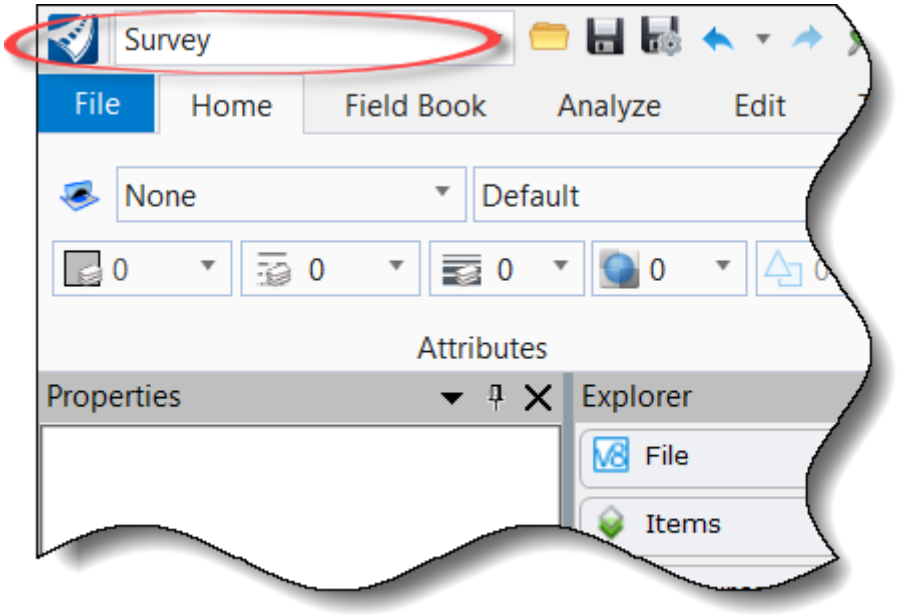


Figure 16

1. Open the Details dialog box.
   ① Click the **Field Book** tab [Note that the ribbon groups and tools are quite different from the **Home** tab].
   ② Click **Details** to toggle Survey Details.
   ③ Drag the Details dialog box and dock on the Screen as needed.

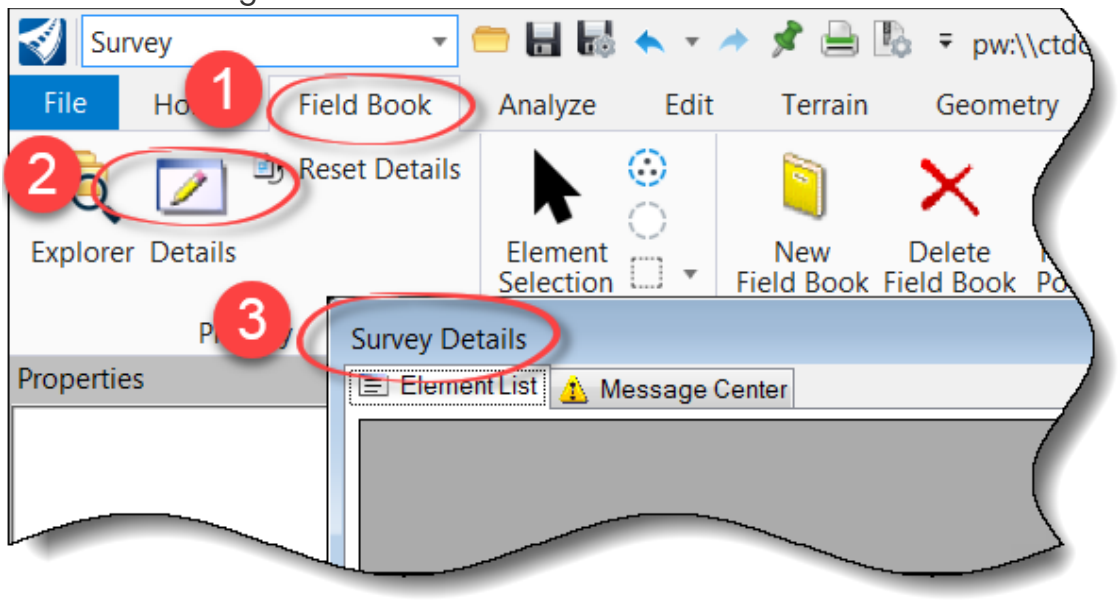


Figure 17

2. You may wish to open the Feature Definition toolbar.
   ① Begin by typing ***feature*** into the Ribbon Search.
   ② Hover over the ***Feature Definition Toolbar*** result.

③ Note the Survey workflow tip.

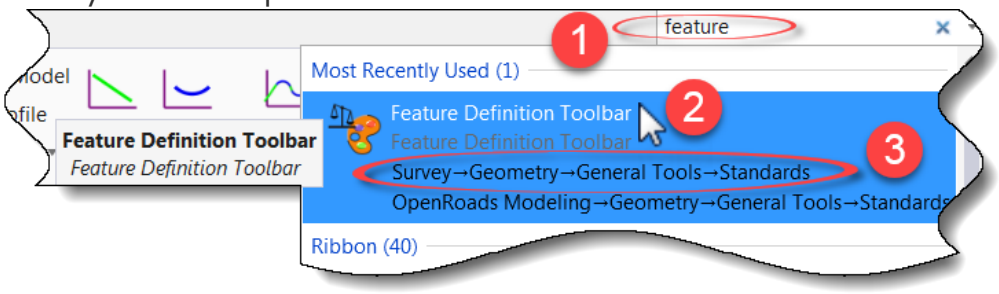


Figure 18

Options above are available to either click the ② *Feature Definition Toolbar* result or to follow the ③ interface tip.

3. You can also find this on the Ribbon, ①**Survey>** ②**Geometry>** ③**General Tools>** ④**Standards.**

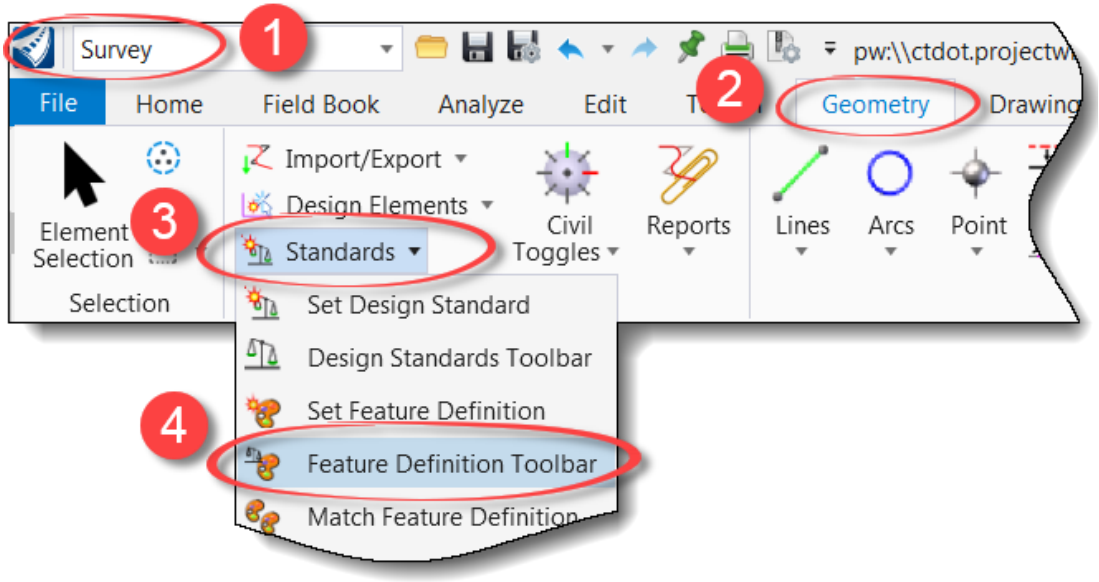


Figure 19

4. Dock the resulting ***Feature Definition Toolbar*** if desired.

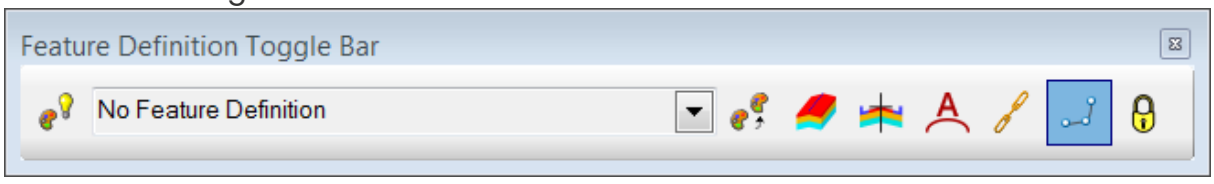


Figure 20

2.4 CTDOT OpenRoads Standards

Default resources are listed in the OpenRoads Standards group Libraries. If they have been changed by the user, they will become part of the design file.

1. From the **Explorer** interface, select the **OpenRoads Standards** group, expand **Standards**, and expand **Libraries.**
   This may take a moment since files need to be cached.

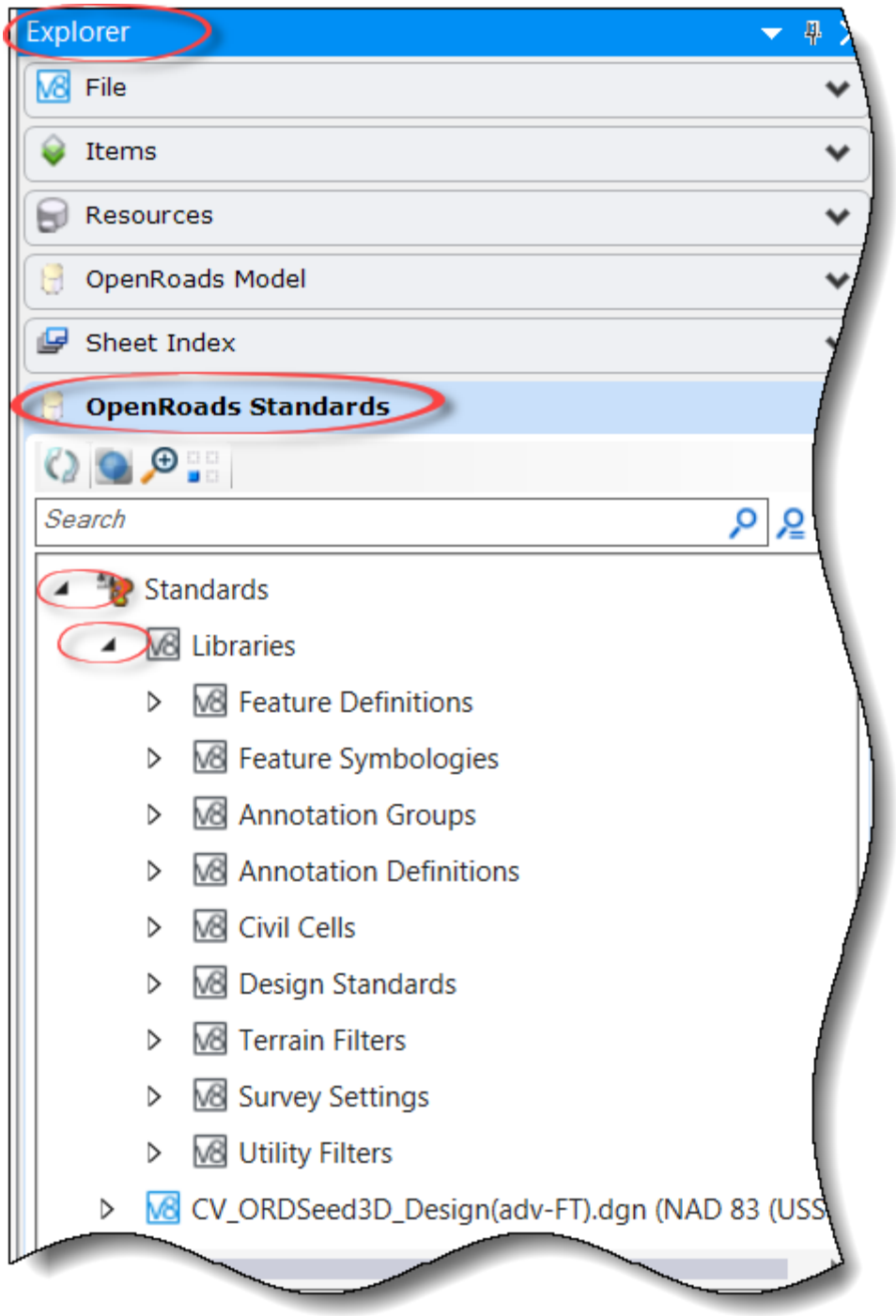


Figure 21

2. Explore ***Standards> Libraries> Feature Symbologies> Feature Symbology Model (CV_Survey_Feature_Definitions.dgnlib).***
   Note the Symbology names in the right pane.

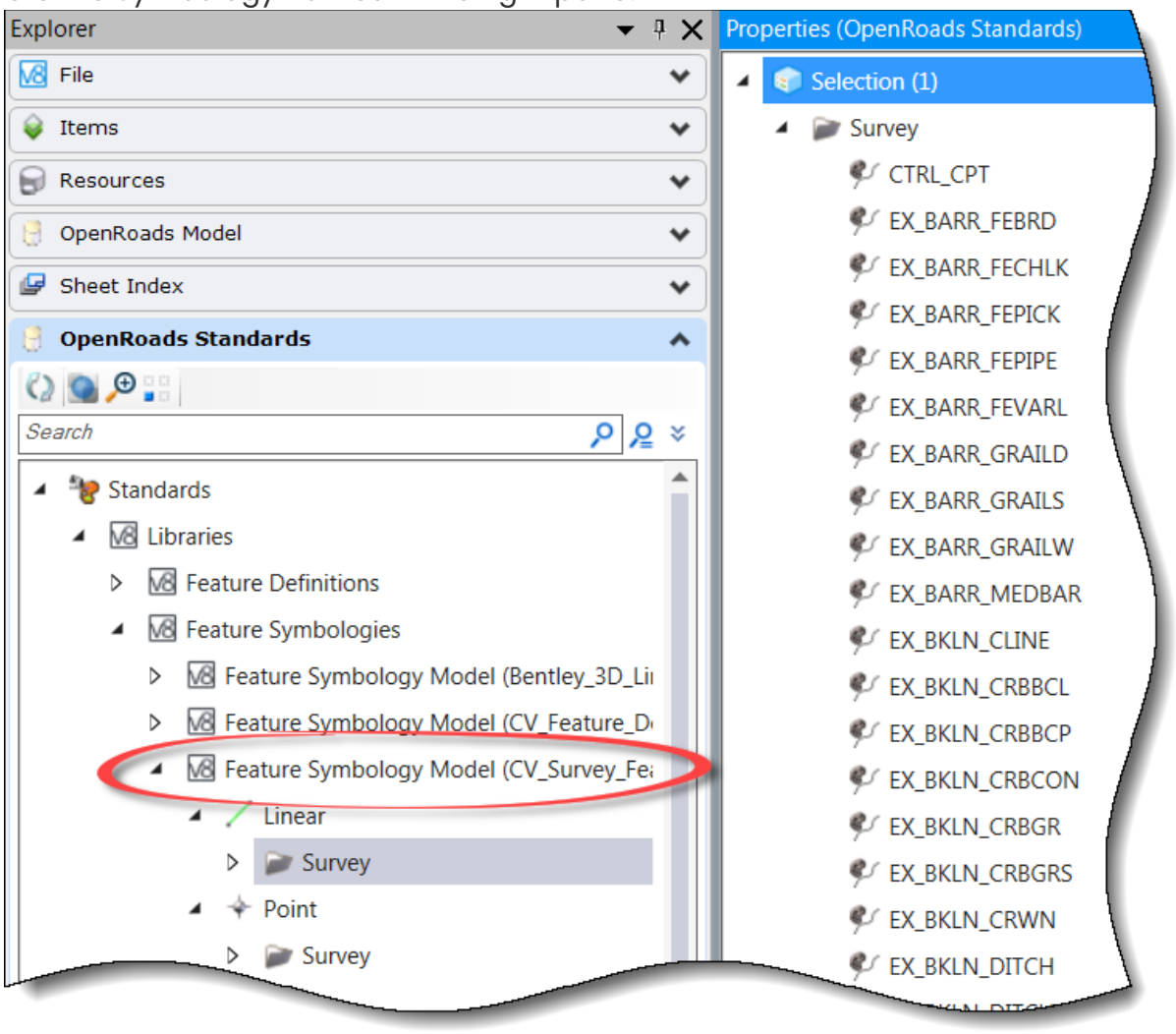


Figure 22

3. Expand **Survey Settings** to explore **Linking Codes**, etc. Please note, there are 2 separate sections where Survey Settings will appear. The greyed-out sections are showing the CTDOT preferred settings and cannot be changed. The Survey Settings section below the greyed-out section are copied to the DGN file upon creation of a field book. Those settings are able to be adjusted for project specific needs.
   [Linking Codes are further discussed in **Module 3**]

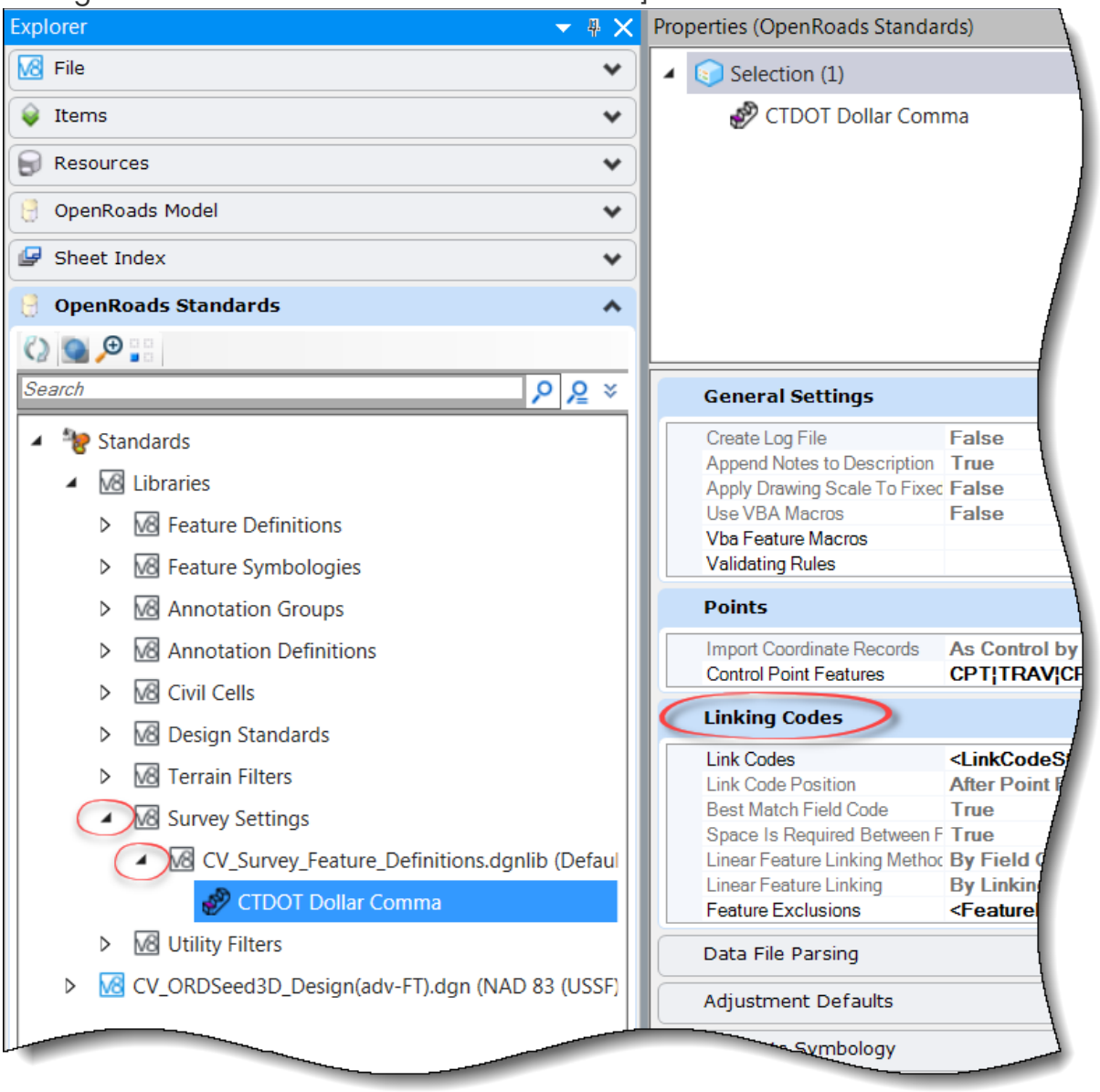


Figure 23

2.5 The CTDOT Ribbon

Tasks are no longer supported in CONNECT; therefore, AEC Applications has customized ORD with specific workflows for CTDOT users. The customized workflow is named **CTDOT**.

1. On the pull-down menu on the top left next to the OpenRoads Icon select **CTDOT**, this is the Workflow Pick list.

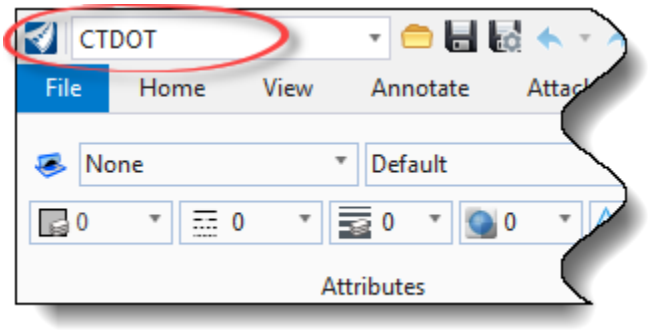


Figure 24

This Workflow contains the Tabs that will be useful for Survey:

- **CTDOT**
- **Prop Maps**
- **Survey**

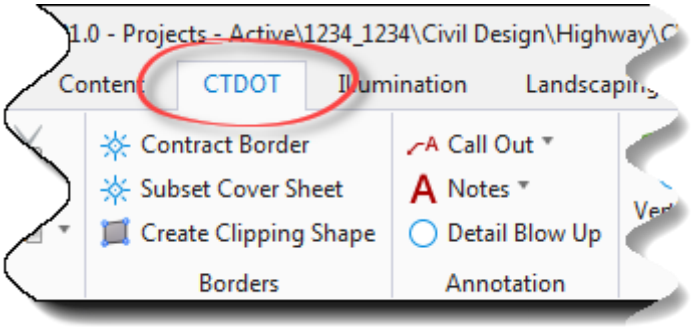


Figure 25

2. The **CTDOT** tab includes a **Publishing** group. The **Publishing** group includes ***Type,*** ***Color,*** and ***Print*** tools.

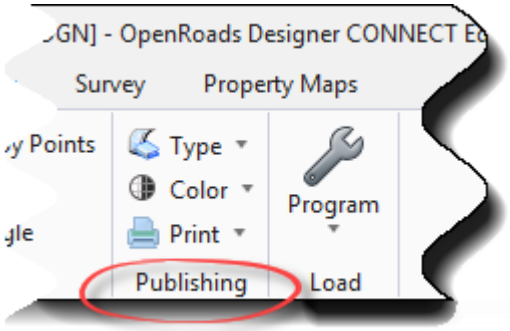


Figure 26

In this example, the *Print* tools are expanded.

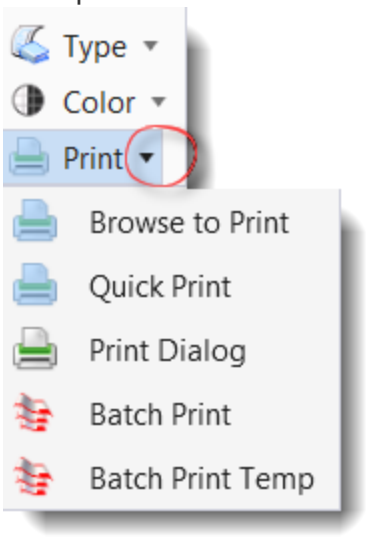


Figure 27

For further information on printing and publishing please visit CTDOT CONNECT DDE eBook Volume 014 - Publishing and Printing.

3. Select the ***Survey*** tab. The **Open** tools will open Cell Libraries. The **Pull Downs** will set Element Templates (Color, Weight, Line styles, and Levels) and trigger the Place Line command to activate.

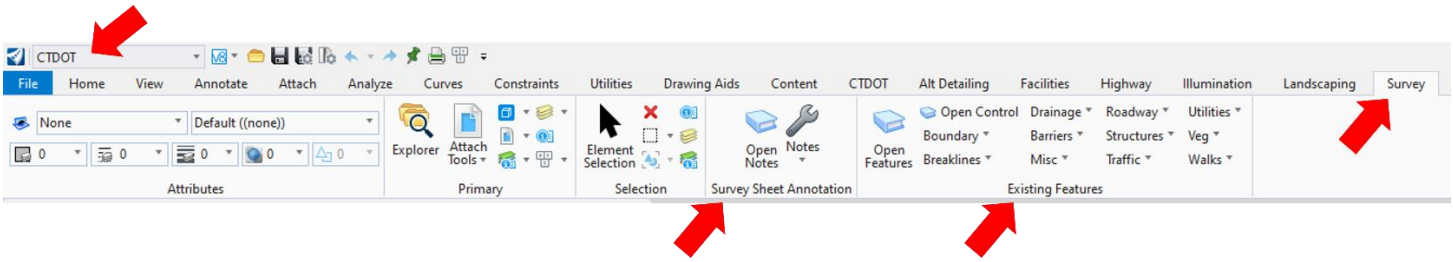


Figure 28

Exercise 3 – Base Survey File Set up

Once inside a MicroStation design file, there may be some initial verification/set up that could be performed for each file, such as: a default Cell Library, a default Text Style, and Drawing Scale.

Skills Taught

- Learn how to open navigate through the interface to Activate a Cell Library, set a Text Style and the Drawing Scale.
- Get familiar with the CTDOT OpenRoads Survey Standards.

3.1 Activate Cell Library

From the **CTDOT** workflow, select the **Survey** tab, in the **Existing Features** section select **Open Features**. The Cell Library ***CTDOT_ORD_Features_Existing.cel*** will open.

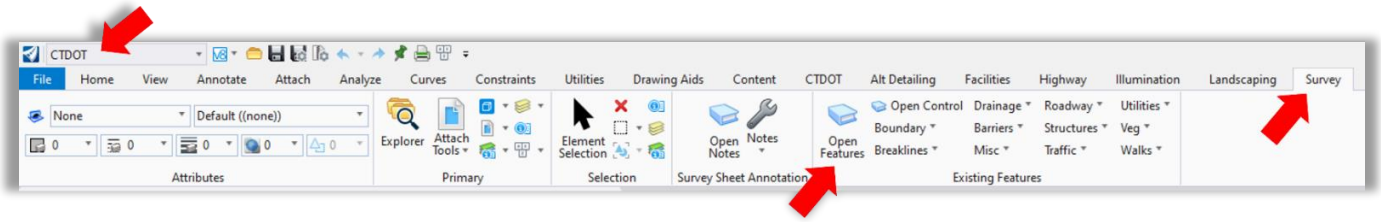


Figure 29

3.2 Set Text Style

You may wish to set a default text style of ***CTDOT_100*** for annotation. ***Note:*** *This is no longer critical since ORD decorator text for nodes is now set in preferences.*
Choose Text Styles through ***Survey› Drawing Production› Text› Text Styles***, double click the ***CTDOT_100*** Text Style to activate it.

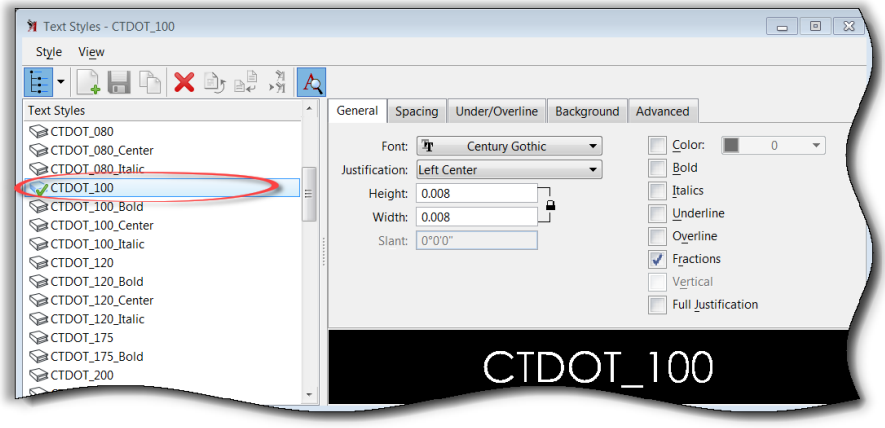


Figure 30

3.3 Set the Drawing Scale

Drawing Scale can be set so that annotation is visually pleasing. It can be changed at any time.

Set the ④ Drawing Scale dialog box through ①**Survey**› ②**Drawing**› ③**Drawing Scales**.

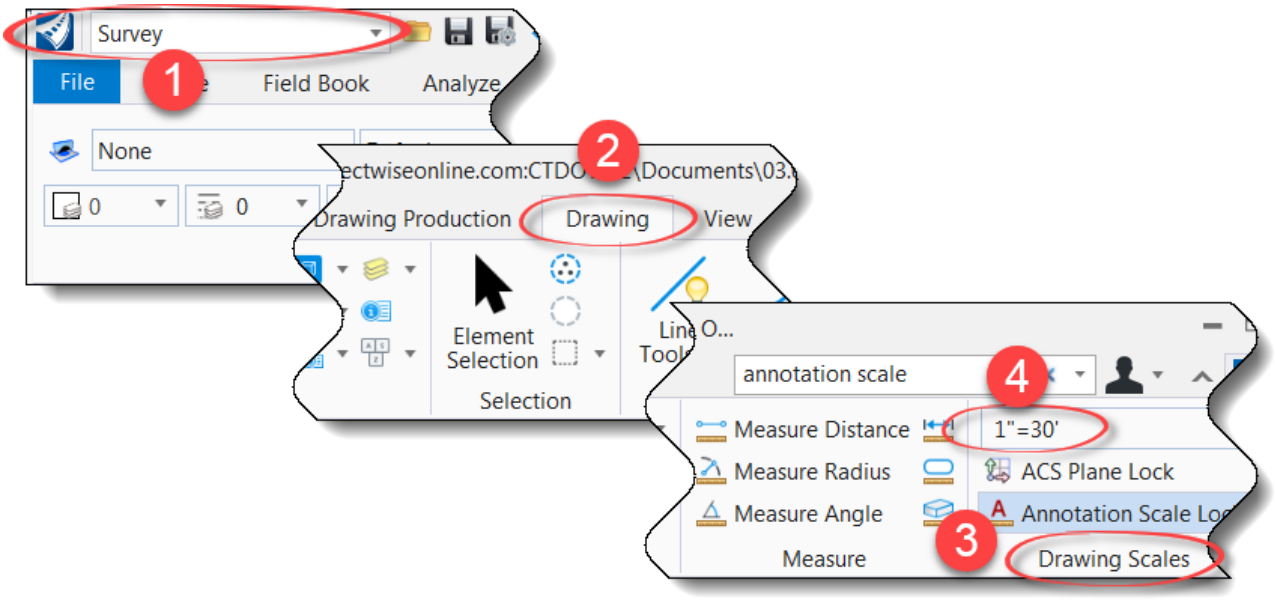


Figure 31

Exercise 4 – Processing Survey Data

In this Module, you will learn how to import an ASCII survey data file and edit the imported data.

Skills Taught

- Learn how to Import Field Data (ASCII data file).
- To become familiar with the available tools and dialog boxes.
- To become proficient editing the imported field data.

4.1 Review and Edit Data Files

Raw data (usually in the form of *.rw5) and coordinate files (usually in the form of *.txt) should be reviewed and can be edited before the import in to OpenRoads. One option is to edit field files via a text editor before loading them into the field book.
Numerical order is irrelevant. The important thing is the order in how link codes define the shape.

```
620,173843.2148,600877.0856,167.5436,915 st pc
630,173845.5708,600877.1773,167.4586,915
640,173847.6977,600878.1849,167.4179,915 pt
650,173847.1816,600878.9791,167.4399,915 pc
660,173845.3573,600878.3830,167.4752,915
610,173843.6326,600878.1825,167.5270,915 pt cl
```

Figure 32

Additional points (i.e. Stored Points) can be entered, but ensure that they stand out from actual shots taken (i.e. Observation Points.) ORD will resolve double link codes by using an underbar and number suffix (e.g. **1018_1**) so a good practice is to use a letter suffix.

```
SS,OP745,FP1014,AR351.162010,ZE89.002180,SD107.065926,--915 ST PC
SS,OP745,FP1015,AR351.114632,ZE88.585606,SD103.331517,--915
SS,OP745,FP1016,AR351.334338,ZE88.561748,SD99.367252,--915 PT
SS,OP745,FP1017,AR350.492982,ZE88.524054,SD99.078636,--915 PC
SS,OP745,FP1018,AR350.383858,ZE88.575453,SD103.593130,--915
SS,OP745,FP1018A,AR350.411248,ZE89.002503,SD107.368222,--915 PT CL
```

Figure 33

String Substitutions - ORD no longer uses multiple Linking Codes; however, double coded shots such as "**st pc**" are automatically converted through String Substitutions (e.g. "**startPC**".) CTDOT has added "**pt cl**" to simply "**cl**" behind the scenes. This allows field personnel to continue using familiar InRoads coding for the time being.

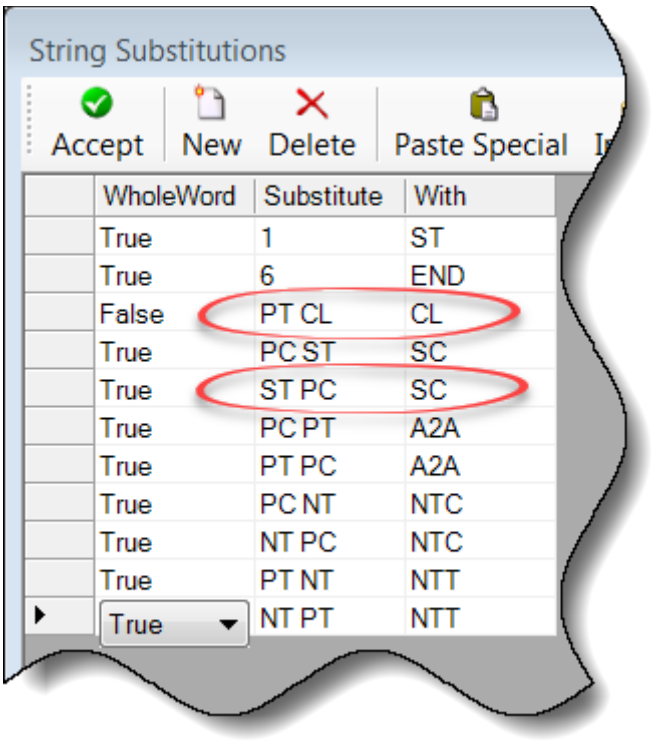


Figure 34

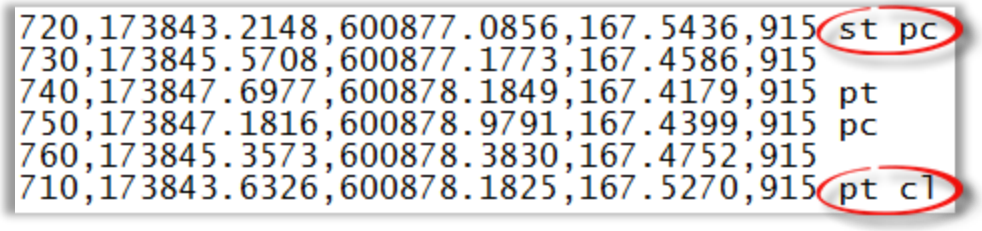
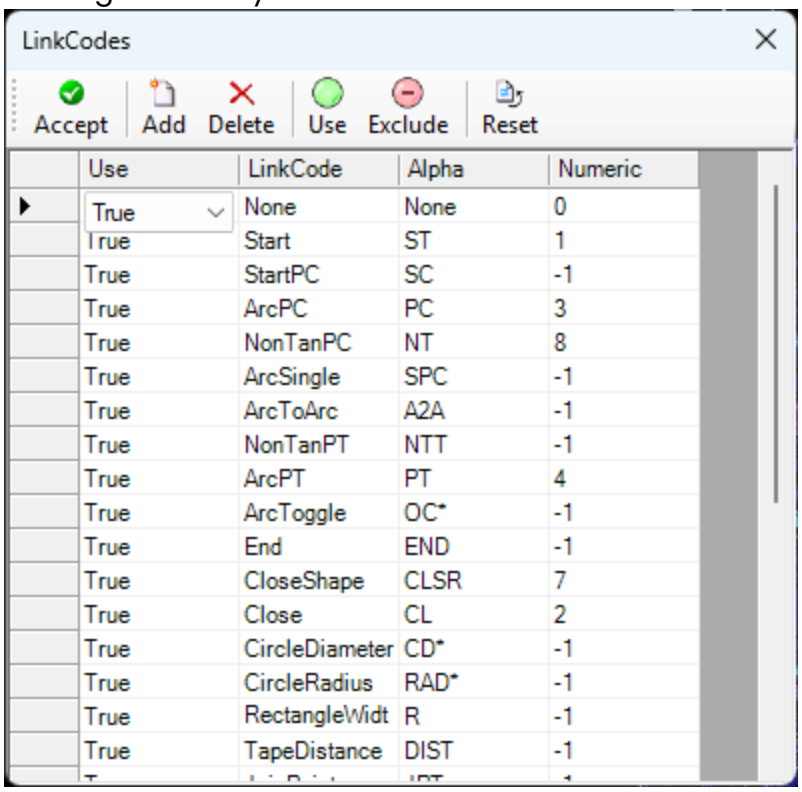


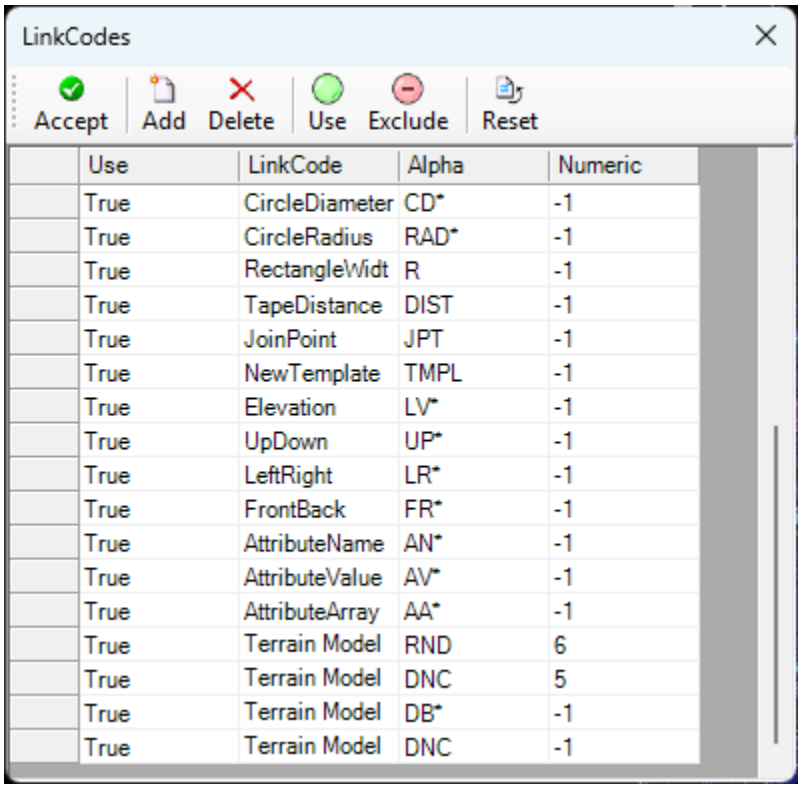
Figure 35

See the next 2 pages for examples of Linking Codes, Substitute Strings, and Control Survey Codes.



Use	LinkCode	Alpha	Numeric
True	None	None	0
True	Start	ST	1
True	StartPC	SC	-1
True	ArcPC	PC	3
True	NonTanPC	NT	8
True	ArcSingle	SPC	-1
True	ArcToArc	A2A	-1
True	NonTanPT	NTT	-1
True	ArcPT	PT	4
True	ArcToggle	OC*	-1
True	End	END	-1
True	CloseShape	CLSR	7
True	Close	CL	2
True	CircleDiameter	CD*	-1
True	CircleRadius	RAD*	-1
True	RectangleWidt	R	-1
True	TapeDistance	DIST	-1

Figure 36A



Use	LinkCode	Alpha	Numeric
True	CircleDiameter	CD*	-1
True	CircleRadius	RAD*	-1
True	RectangleWidt	R	-1
True	TapeDistance	DIST	-1
True	JoinPoint	JPT	-1
True	NewTemplate	TMPL	-1
True	Elevation	LV*	-1
True	UpDown	UP*	-1
True	LeftRight	LR*	-1
True	FrontBack	FR*	-1
True	AttributeName	AN*	-1
True	AttributeValue	AV*	-1
True	AttributeArray	AA*	-1
True	Terrain Model	RND	6
True	Terrain Model	DNC	5
True	Terrain Model	DB*	-1
True	Terrain Model	DNC	-1

Figure 37B

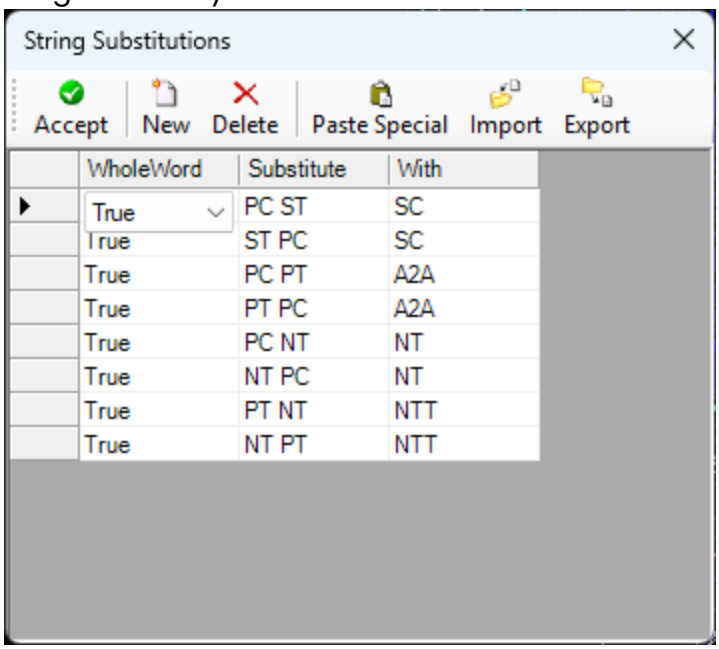


Figure 38C

Figure 39D

For more information on Linking Codes and Control Survey Codes, see Section 4.7.4 of this guide.

4.2 Create Field Book

1. From the **Explorer** interface, select the **Survey** group. ***Note:*** *The model name, "**Default**" is listed as the default under Survey Data – not the design file name. This could be renamed to something more relevant such as: Terrain, Ground File, Annotation, etc.* The current Survey See File (CT SurveySeed.dgn) will create a Model with the name of Existing Ground Survey.

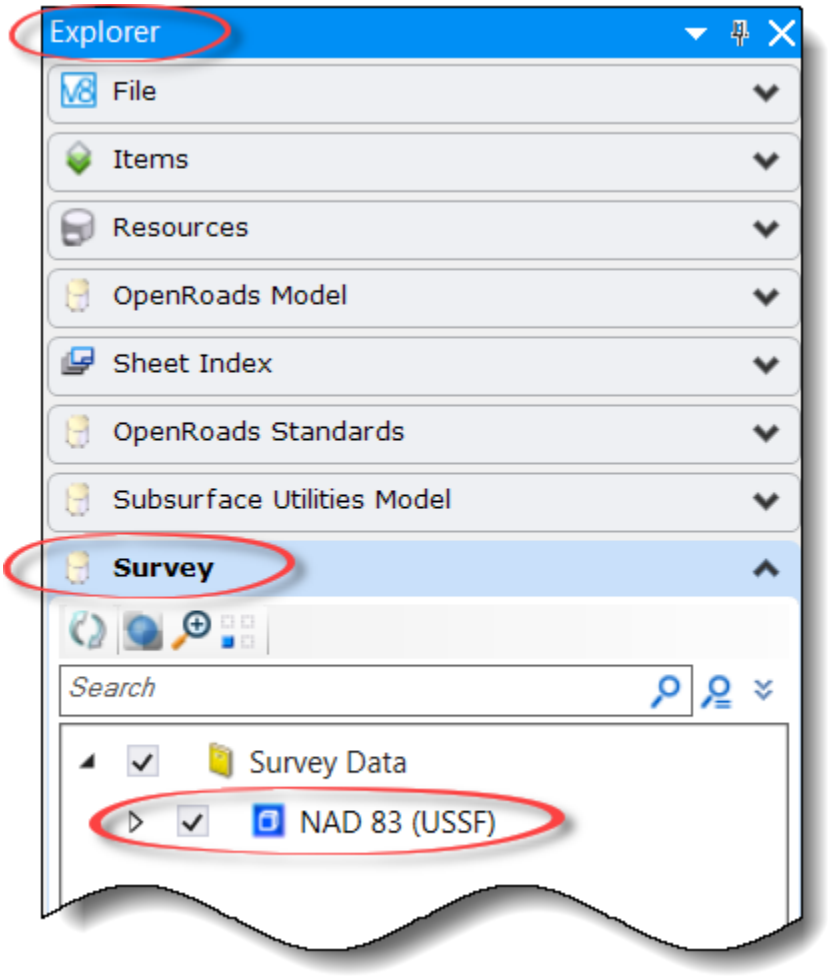


Figure 40

2. Expand the model tree.
3. **Right-click** on ***Field Books*** to review the menu options.
   - **Create Terrain Model From Field** Book Selection Set Depending on your system configuration Terrain Models can be created dynamically. The benefit to this is you can see how edits affect the Terrain Model in real time (we will use this functionality later in this course). Also any additional data collected is added to the Terrain Model automatically. If you elect to turn this functionality off however, it's a simple matter to create a Terrain Model using this menu choice. You may also notice that it will use a

selection set, this might be highly useful if you need a specialized Terrain Model made from certain data types or Feature Codes.

- **New** This menu choice creates a new Field Book. As noted before it's entirely up to you how many (or few) Field Books you utilize in your projects.
- **Properties** Properties will display all of the properties of a survey feature.
- **Zoom** Zoom will allow you to zoom into a specific area of data in your project. Within a large project (with several Field Books) it may be beneficial to be able to Zoom into a specific data collection session.
- **Isolate and Clear Isolate** This will modify the display to highlight specific collection sessions. Useful if you have several Field Books.

4. In the Survey panel, **right-click** on **Field Books** and select **New...**
5. On the Selecting Settings dialog select **Accept**. Note that a new drop-down arrow appears as a Field Book is added.

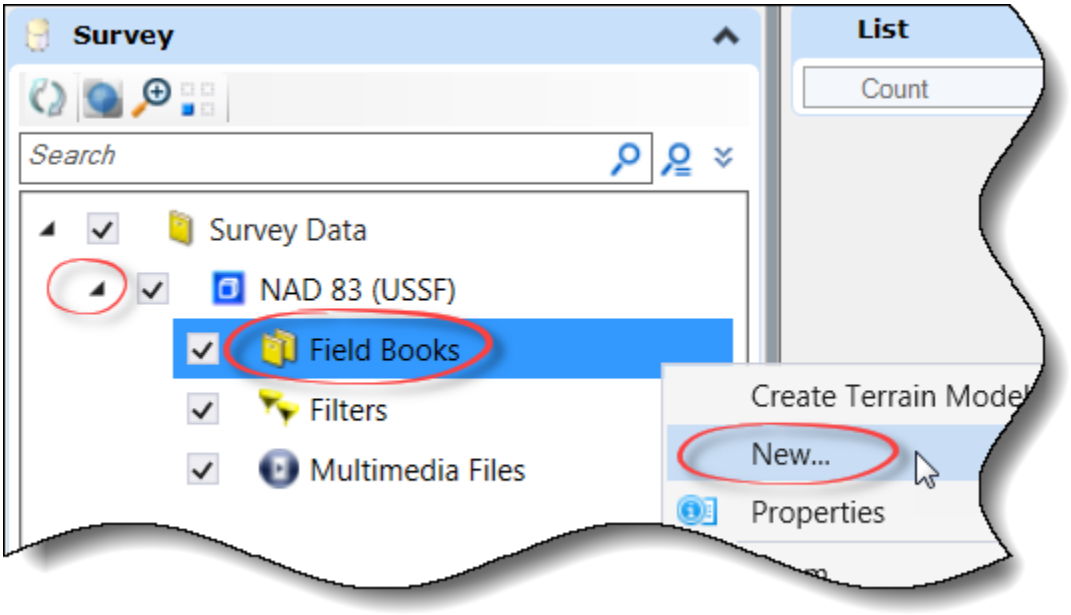


Figure 41

6. Expand **Field Books**.

When a new Field Book is created, it will be created under the Field Books folder with a default name of Field Book 1. To view the newly created field book you must expand the Field Books folder using the drop-down arrow next to Field Books in the Survey pane

7. Expand the newly created **Field Book 1**, additional Survey information will appear once data has been imported.

Under Field Books is where the survey data you import is stored. You can create the data structure to fit your operational needs.

- Do you need a single “Job” where all the collected field data is stored? You can do that.
- Do you need to separate each and every collection into it’s own book? That’s easy as well.

Basically, it is up to you to decide what a “Field Book” contains.

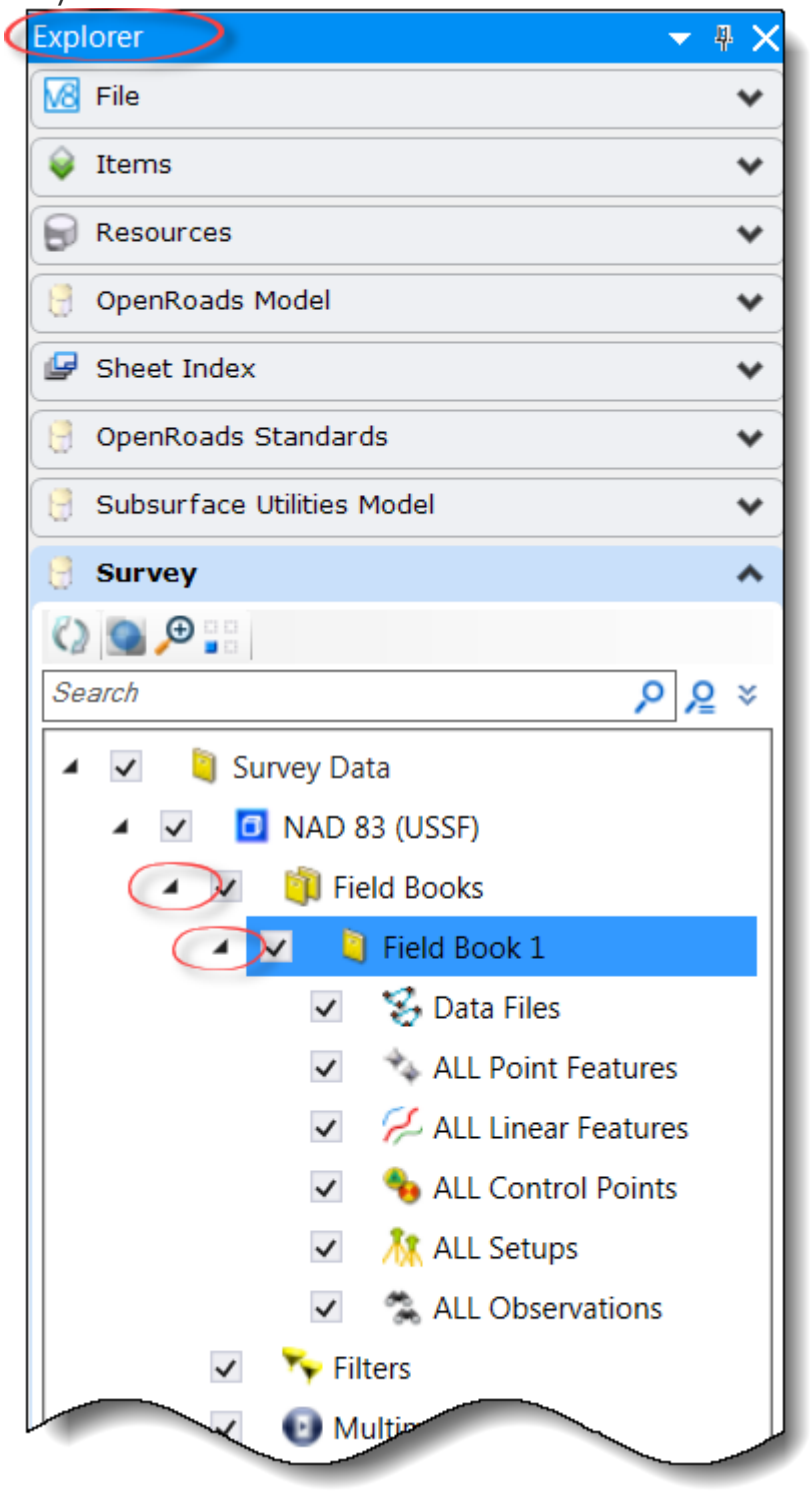


Figure 42

4.3 Rename the Field Book

1. Click **Field Book 1** in **Explorer** to select its properties as shown in the previous image.
2. Using the Properties (Survey) interface, rename **Field Book 1** to something more appropriate if desired.

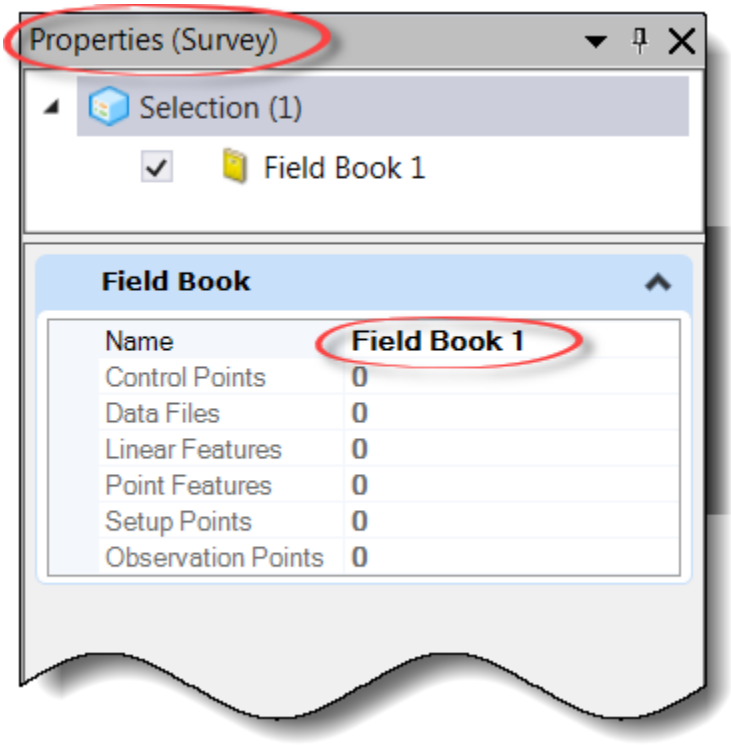


Figure 43

4.4 Import Field Data

All project field data should be stored in the COMPASS Project folder. OpenRoads can import multiple files at once. The 2 main types of survey data files used at CTDOT are *.rw5 and *.txt. RW5 files contain raw survey data meaning setups, backsights, rod heights, angles, and slope distances. TXT files contain survey data that has already been reduced in software other than OpenRoads into coordinate locations.

1. From the Explorer Survey group, right click the new field book to ***Import› File…***

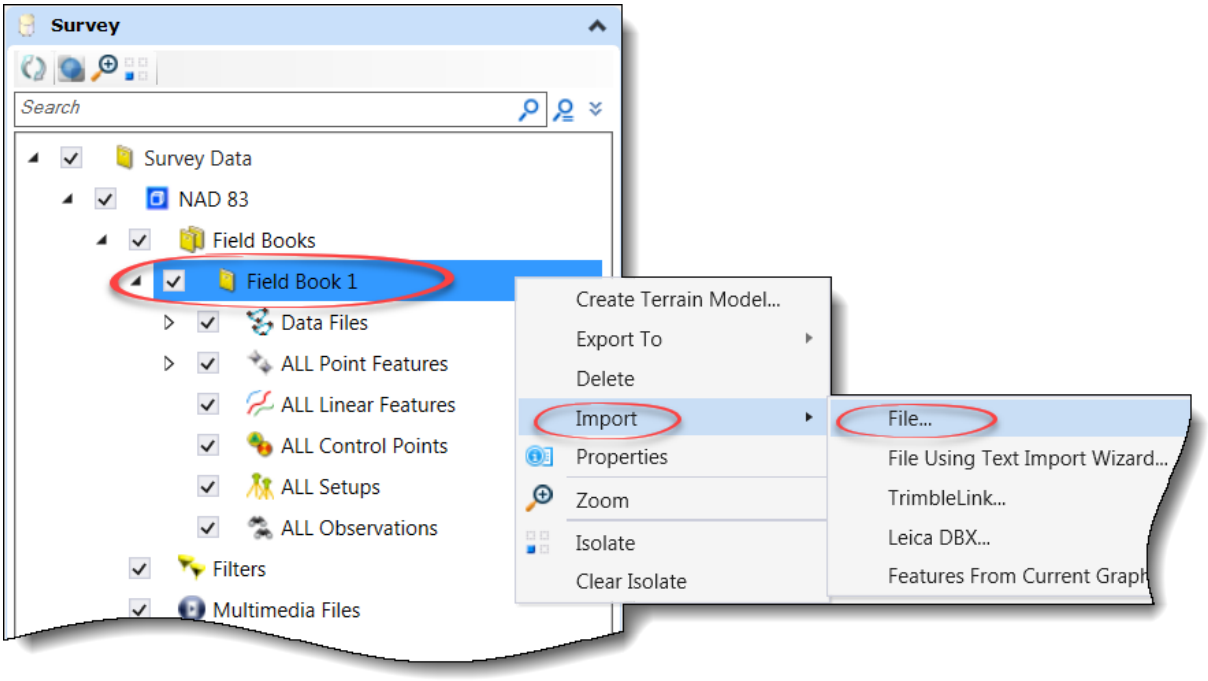


Figure 44

Browse to the field data folder in your COMPASS Project. If using this as a training document, browse to the location of the CTDOT_SURVEY_ALL_DATA.RW5 file (available from CTDOT AEC).

2. First select a control file if present. Control is already present in the CTDOT_SURVEY_ALL_DATA.RW5 file.
3. Click **OK**. Files with an asc extension will not work.

   When importing text files, pick the one of the top 2 options ("…code or …code, code").

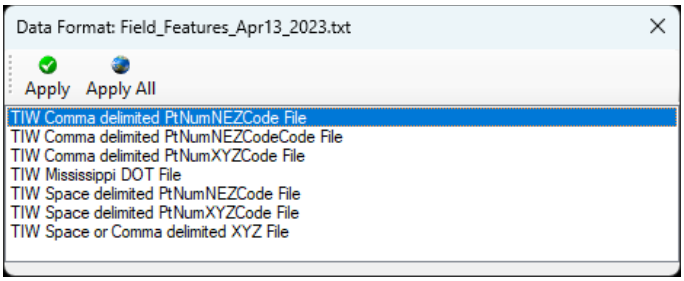


Figure 45A

4. Continue to import multiple field files to **Field Book 1**. You can **Add** them or simply click **OK**.

   If using this as a training document, the CTDOT_SURVEY_ALL_DATA.RW5 file is the only file to be imported.

   At this point it's important to mention that all of the resulting survey data is contained within the DGN file. There are no external files and no need to ensure synchronization between the "data" and the resulting graphics or terrain. The resulting graphic elements contain the "intelligence" and "know" certain survey properties such as Terrain Model attribute (Spot, Break, None) how they should display and other properties that used to be controlled by multiple external files. As you will shortly see this is very powerful and makes editing data very intuitive and the resulting changes are seen in real-time as the graphics update. However, sometimes this does necessitate a different mindset. Such as, to make changes to the Terrain Model best practice would be to edit the terrain properties of the point rather than the resulting "Triangles".

5. Review the imported survey data. Use the **Fit** View tool to see the results.

4.5 Address Duplicate Points

Address duplicate points using the ①"Differences" tab if necessary.
NOTE: Most of the time selecting the ② "Skip" option will be the correct choice, but this may vary depending on the project needs. In this example shown below, the Control file information was brought in first and should take precedence.
③ Apply All.

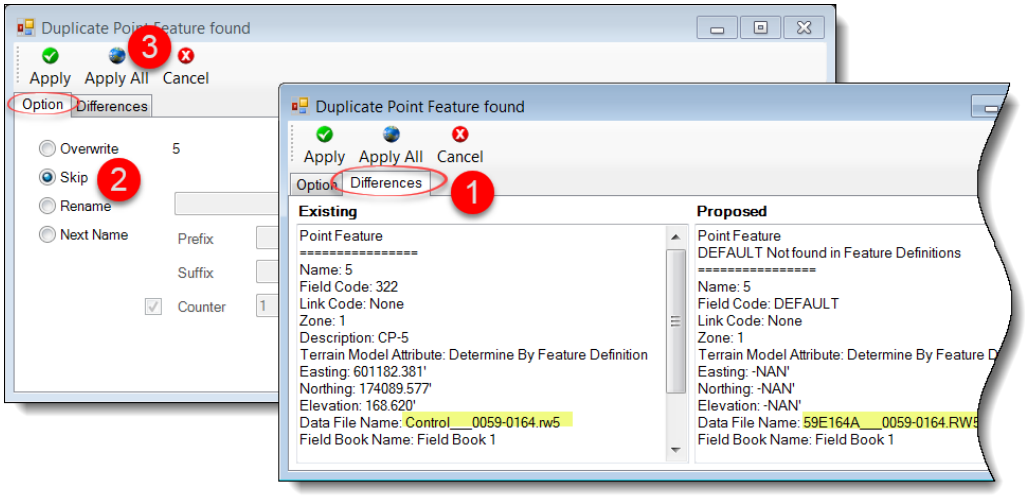


Figure 46

The field book tree is now populated.

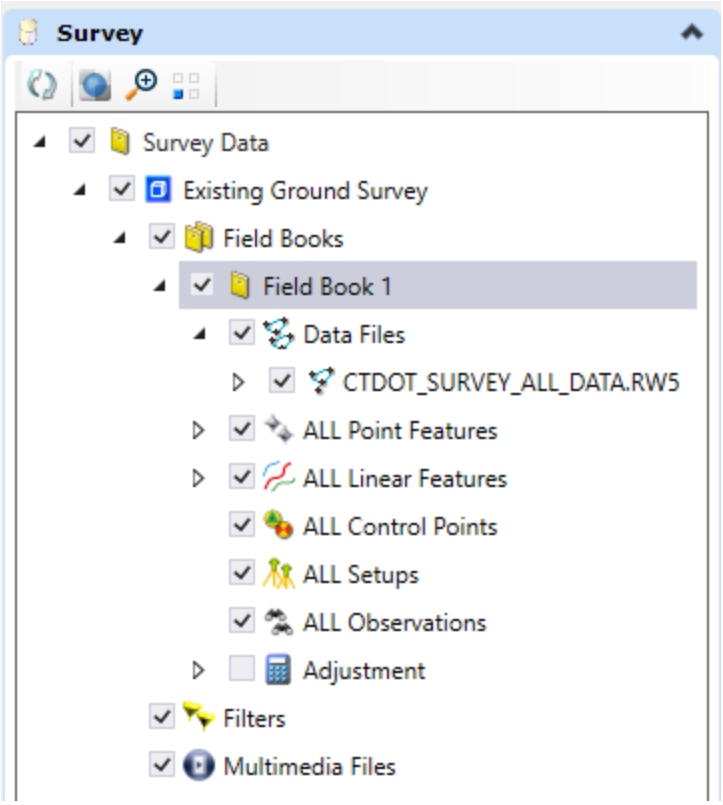

Survey
Survey Data
Existing Ground Survey
Field Books
Field Book 1
Data Files
CTDOT_SURVEY_ALL_DATA.RW5
ALL Point Features
ALL Linear Features
ALL Control Points
ALL Setups
ALL Observations
Adjustment
Filters
Multimedia Files

Figure 47

4.6 View Options

4.6.1 Examine Survey Features

In this section, you will examine Survey Features.

1. Fit View. **All Observations** and **Triangles** are displayed by default.

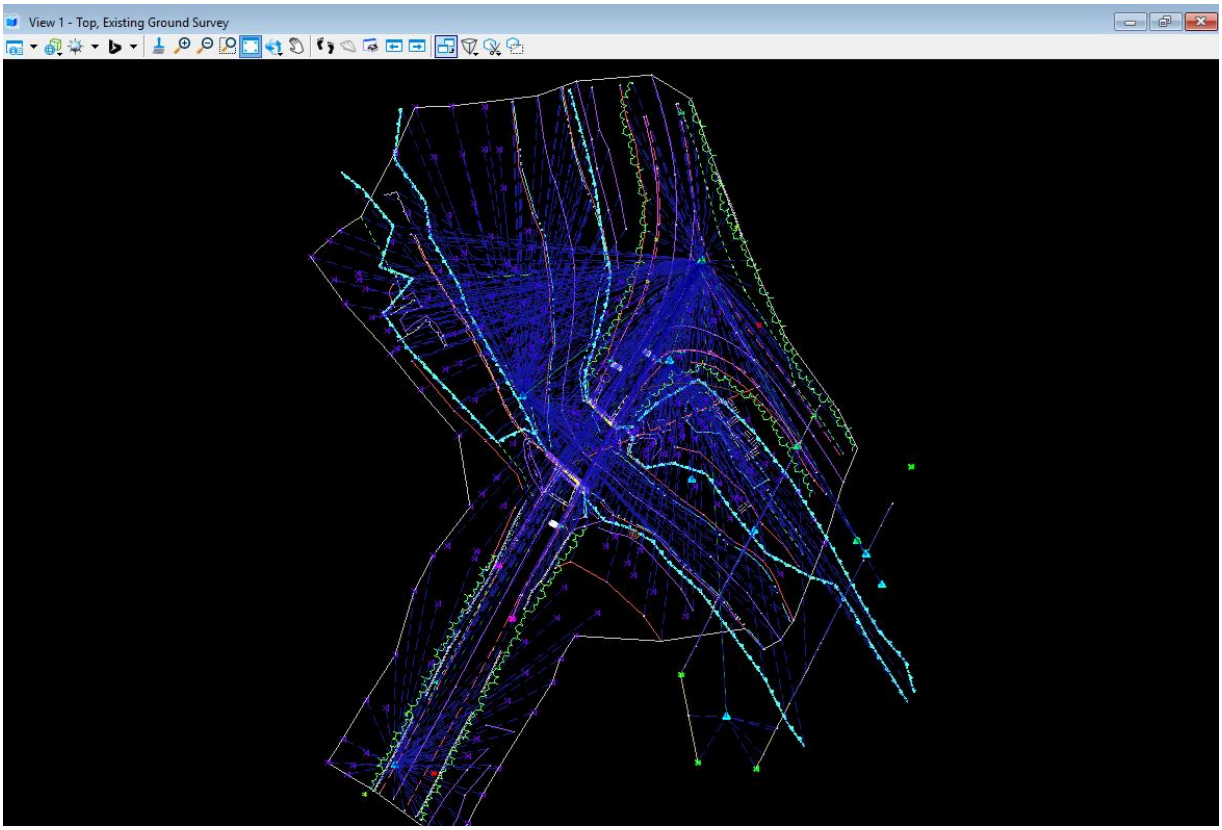


Figure 48

2. You may toggle off **All Observations** through Explorer if desired. NOTE: TXT files will not have Setups or Observations as those have already been processed in software other than OpenRoads.

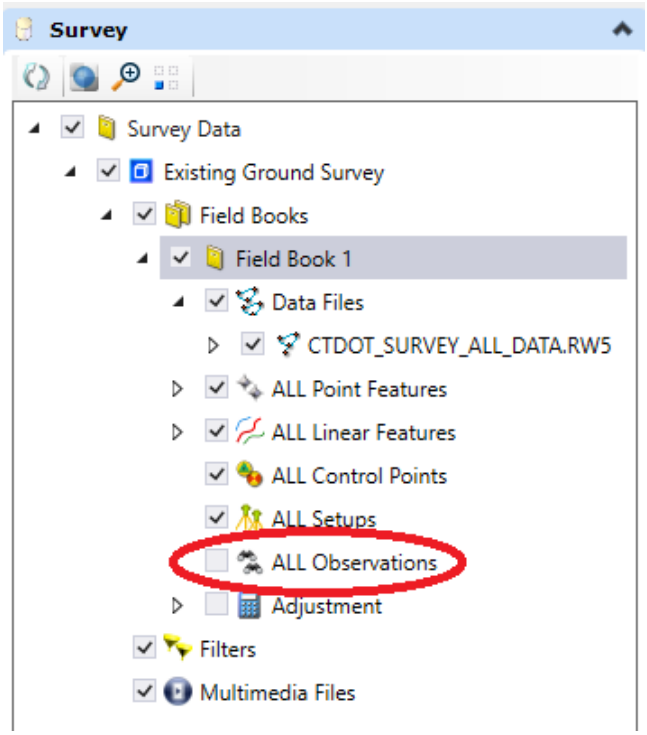


Figure 49

3. Zoom into the view. Use Element Selection to click and highlight the Terrain Model outer boundary.

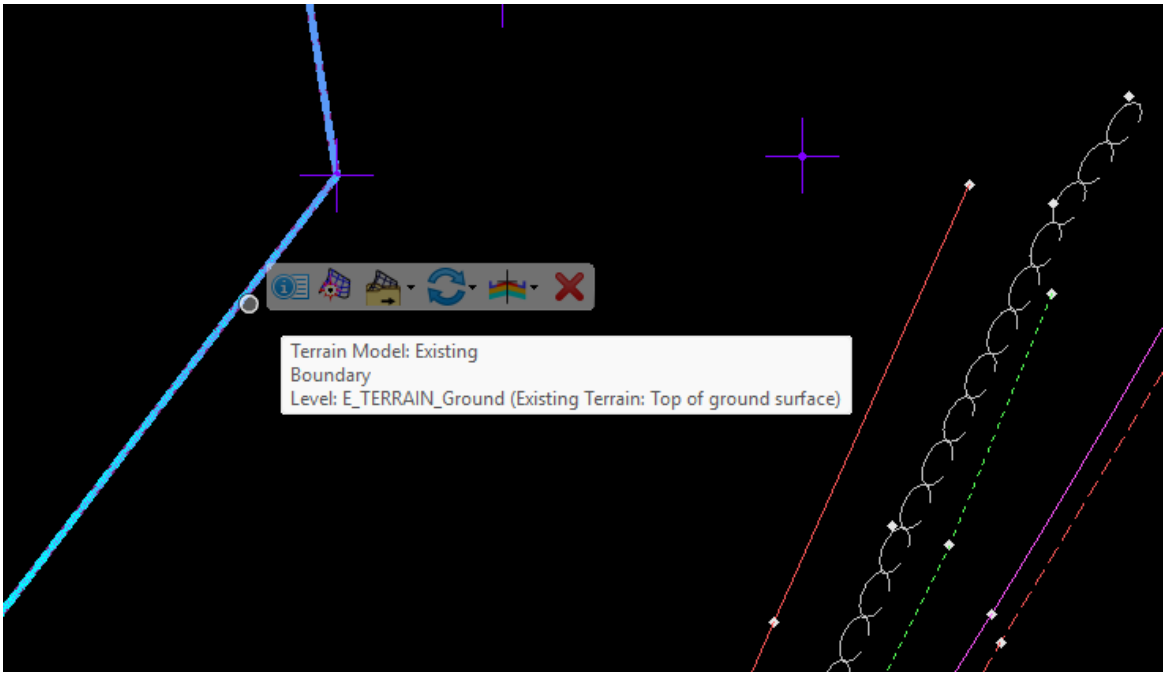


Figure 50

4. Toggle displays such as Triangles by double clicking the **Off** or **On** through **Properties**. The display immediately changes.

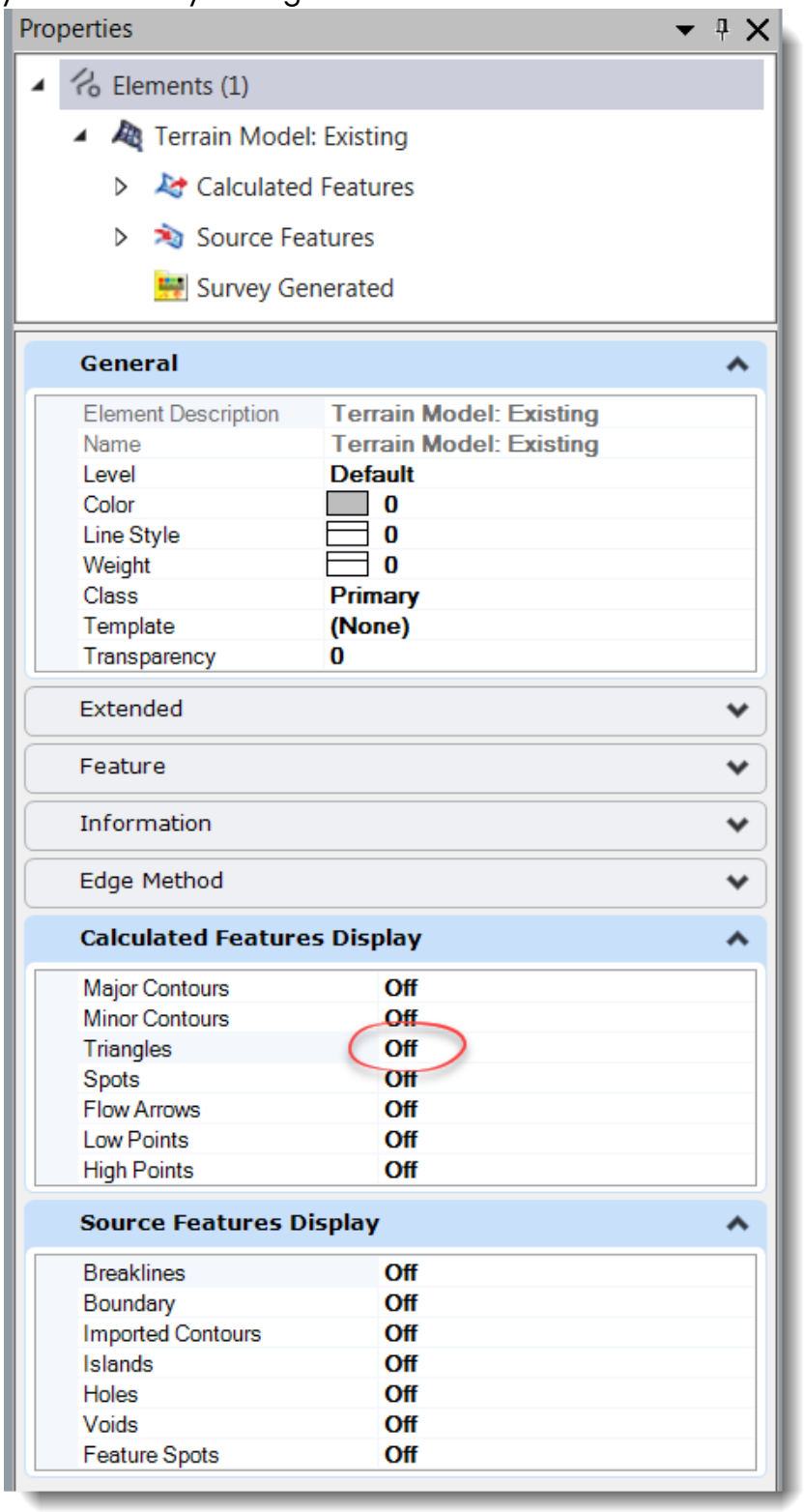


Figure 51

4.6.2 Decorations

In this section, you will become familiar with decorations. Decorations provide surveyors a quick display tool to access vital survey point information. They can be utilized during the quality control process and differ from the annotation tools which place permanent labels in the project.

1. Change the active tab from Home to **Analyze**.

   Note the Decorations section of the menu, these tools control the display of survey data such as the survey point Names, Field Codes, Elevations, Descriptions, Setups, Observations and Icons. All of these tools function as **ON/OFF** display toggles.

2. In the **Decorations** section of the ribbon, ***left-click*** on the Names tool and notice that the point names disappear. ***Left-click*** on Names again and the display returns.

3. Display the Field Codes and Elevations.

   In the **Decorations** section of the ribbon, ***left-click*** **Field Codes** to display the feature codes.
   Left-click **Elevations**, to display the elevations of the survey points.
   The display properties of the Decorations can be configured from the Back Stage view.

4. Select **File** to get to the back stage and then select ***Settings > User > Preferences > View Options - Civil > Survey Decorators***. The Colors have been set up to follow standards and should not be changed.

   Click **OK** to accept any changes and return to the drawing view and note the changes.

4.7 Process Survey Data

Be aware that any editing after this point will become self-contained in the MicroStation file, and there presently is not an option to export the edited field book from OpenRoads.

4.7.1 Survey Details Reminder and Usage

The **Survey Details** panel will show whatever Point Features or Linear Features are highlighted in **Explorer**.

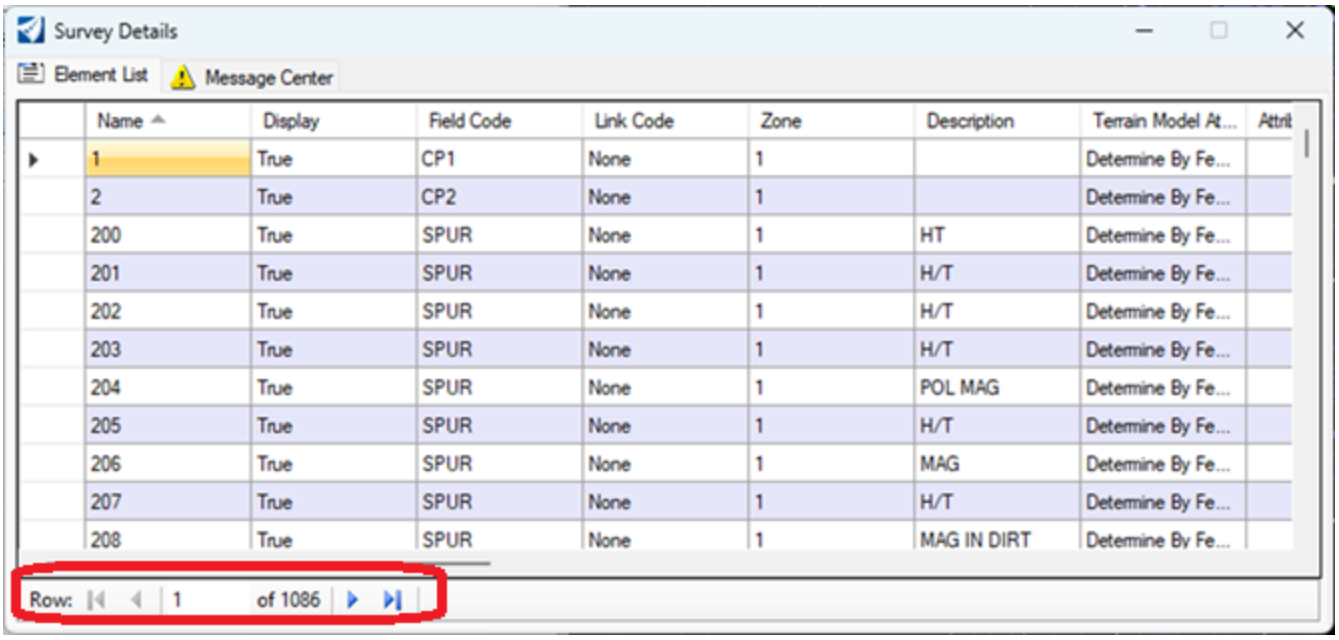


Figure 52A

As Point and Linear Features are chosen in **Explorer**, the numbers in the bottom left of the **Survey Details** will change to reflect the number of items chosen in **Explorer**.

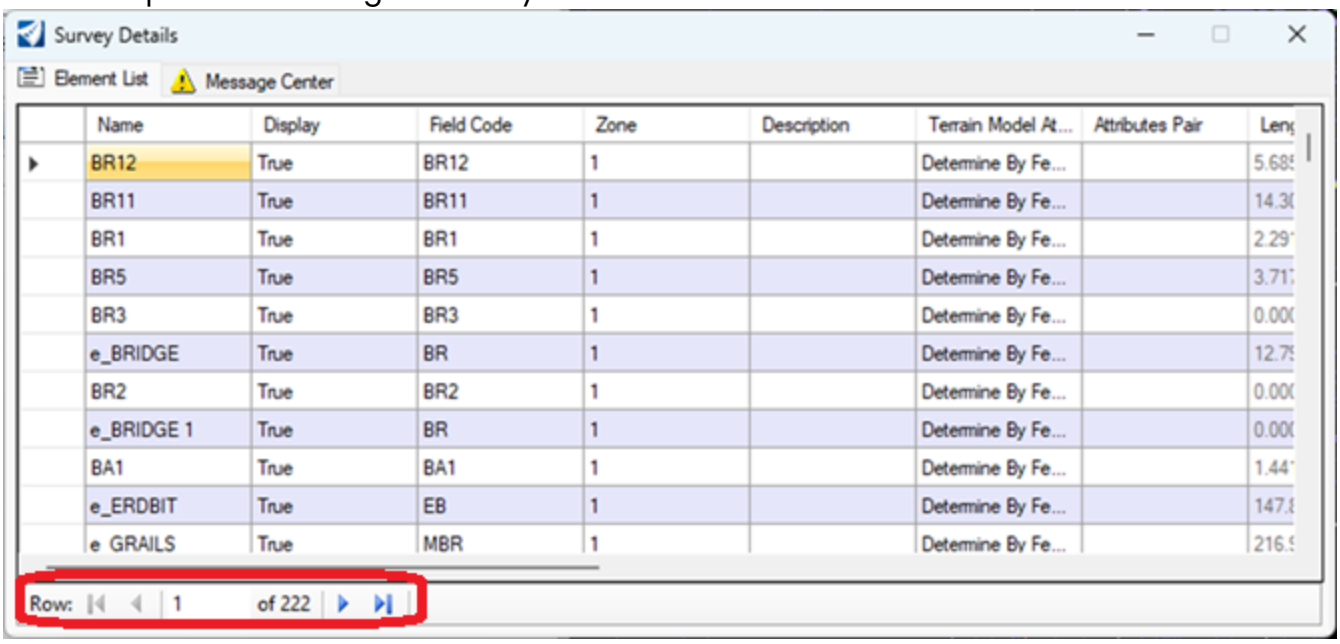


Figure 53B

The columns can be sorted by various methods and the columns shown can be customized as needed to eliminate the display of any redundant or unneeded data.

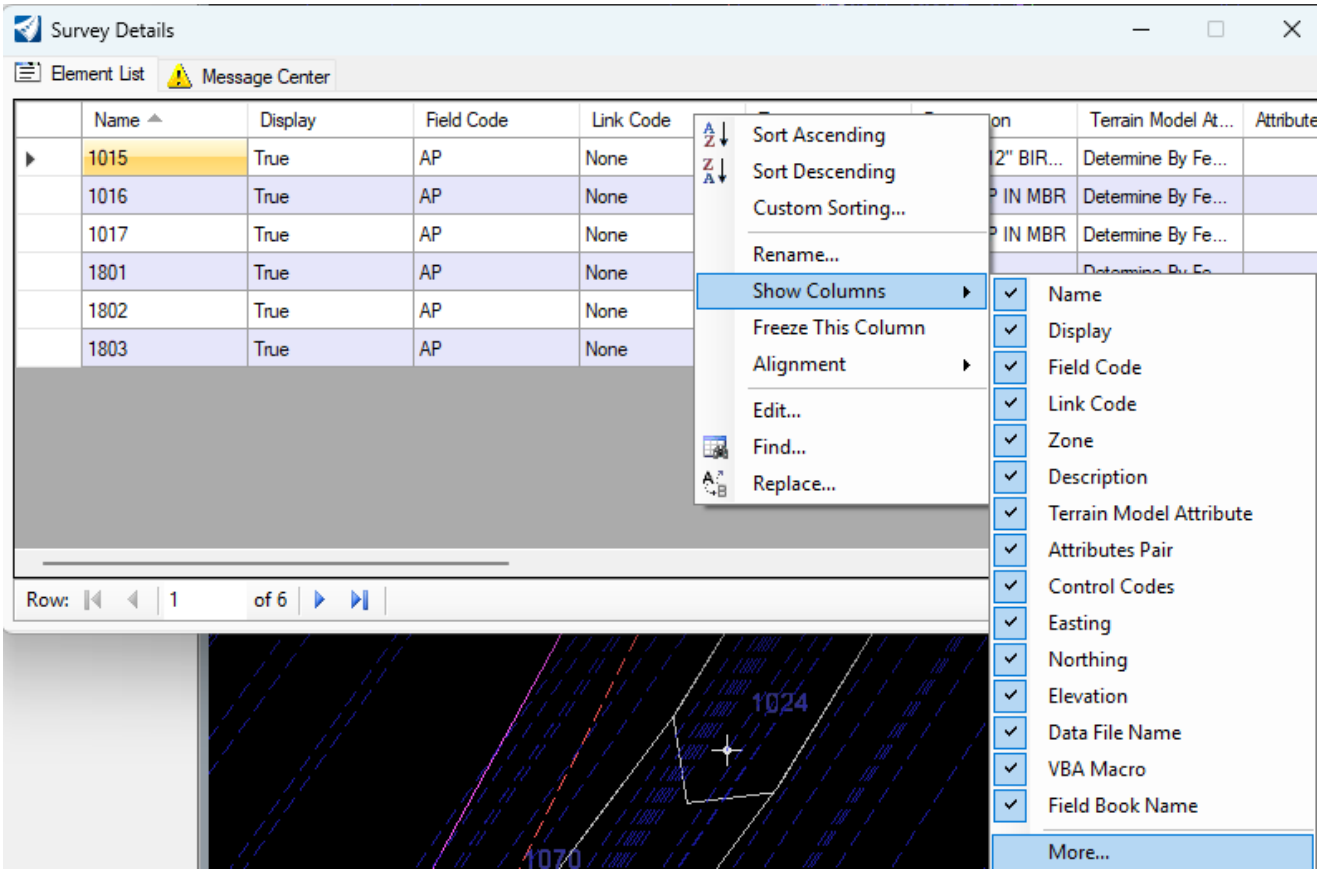


Figure 54C

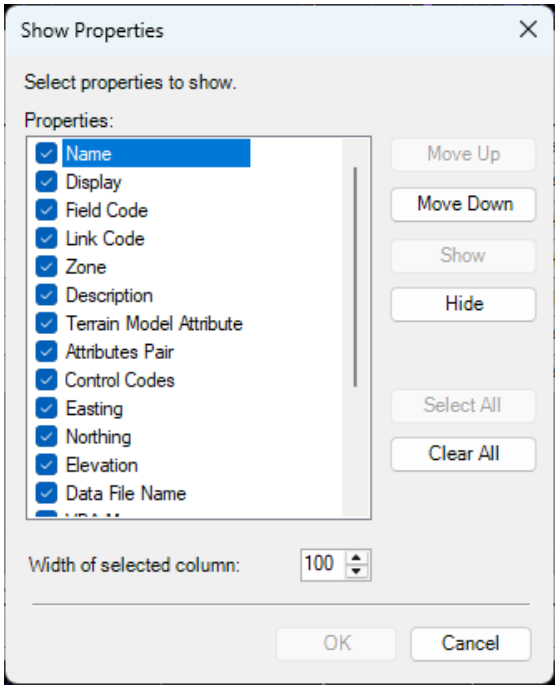


Figure 55D

1. Display **Survey Details** if not already shown.
2. Click **All Observations** to list them.

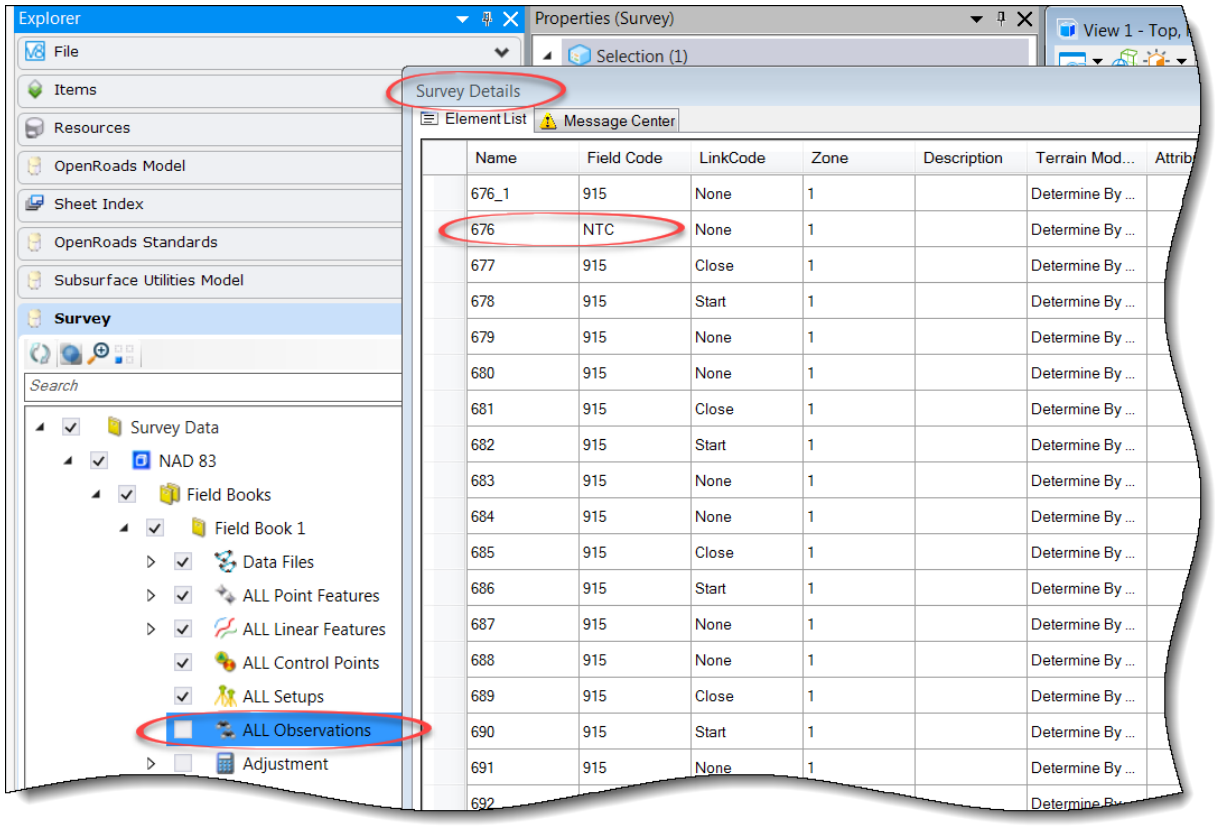


Figure 56

4.7.2 Review Flags and Messages

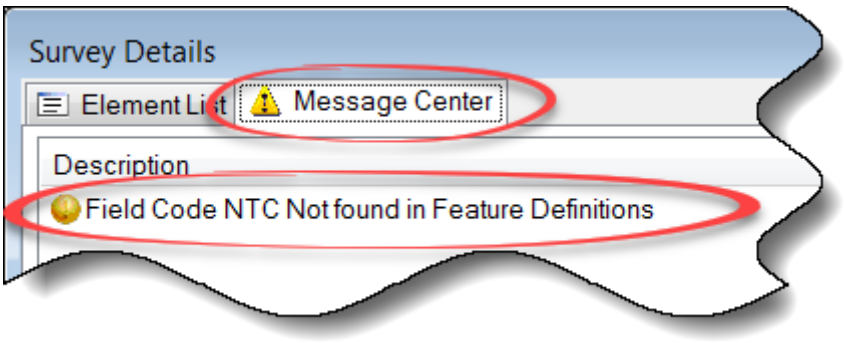


Figure 57

Any Points or Linear Features with incorrect field coding will show in **RED** in the ***Explorer Dialog***.

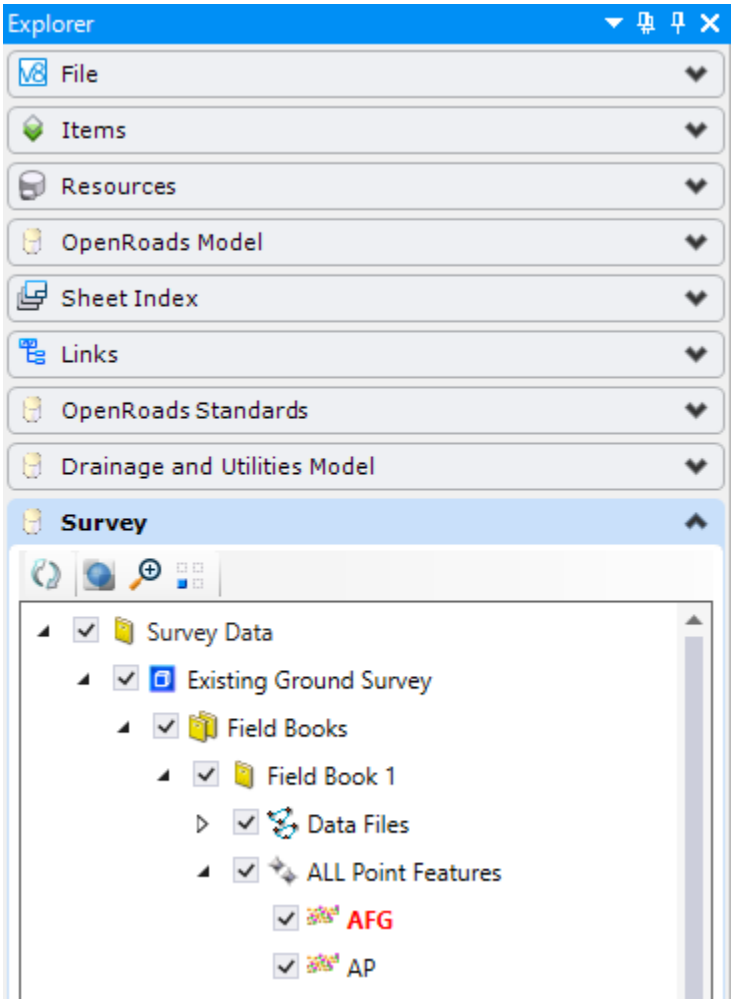
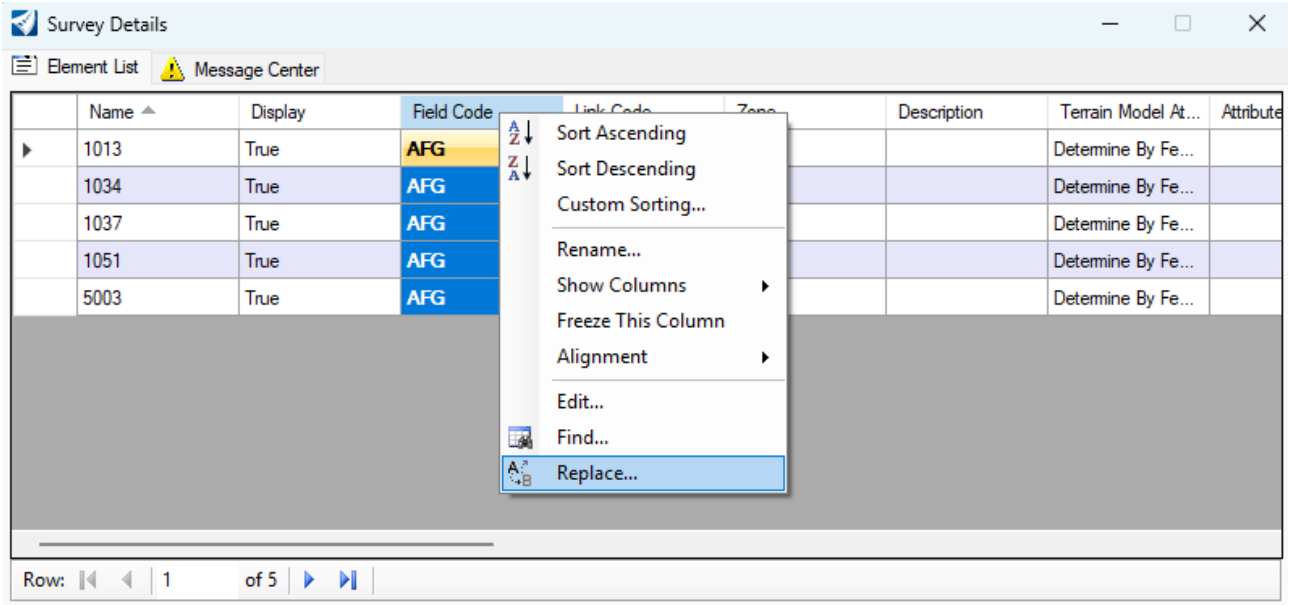
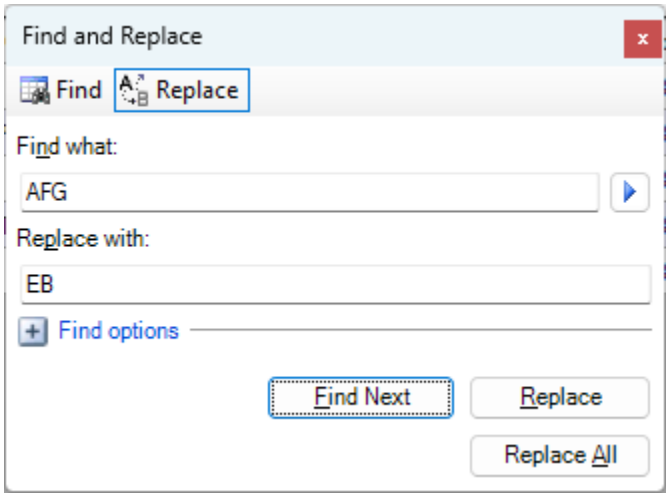


Figure 58

1. Before doing any editing of Survey Features, it is a good idea to choose the Set Mark Icon from the Quick Access Toolbar.  This will allow undoing of the DGN back to the time of clicking the Set Mark Icon.
2. Click on the "AFG" Point Feature shown in **RED**.
3. If necessary, open the Survey Details Panel. The Survey Details Panel will display any set of Point or Linear Features that are highlighted in the Explorer Dialog. CTRL and SHIFT can be used in such selections just like File Explorer in Windows.
4. ***Right-click*** the top of the ***Field Code Column*** and choose Replace.



5. Replace the incorrect Field Code of "AFG" with the correct Field Code of "EB".



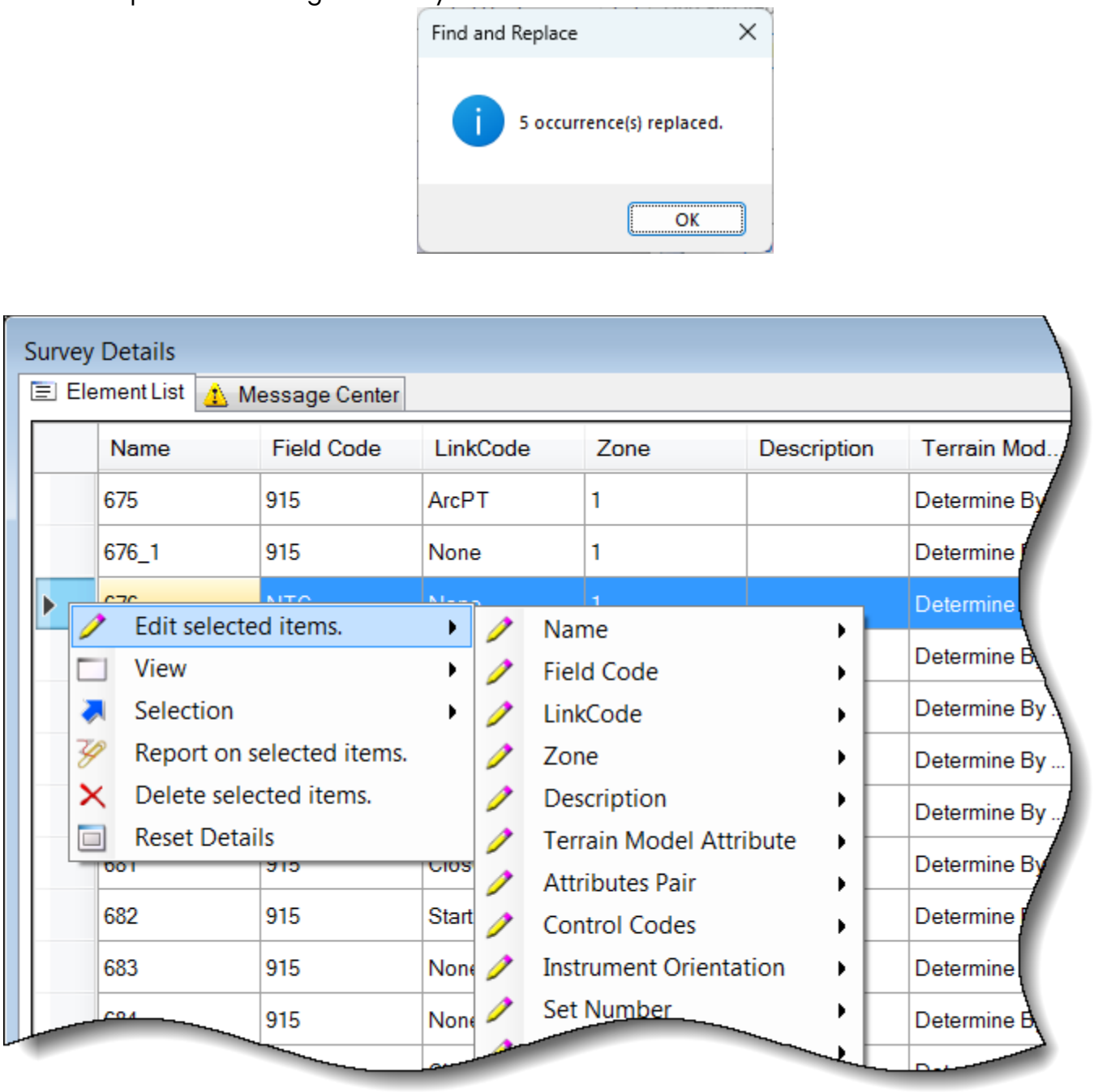

Find and Replace
5 occurrence(s) replaced.
OK
Survey Details
Element List
Message Center
Name
Field Code
LinkCode
Zone
Description
Terrain Mod...
675
915
ArcPT
1
Determine By
676_1
915
None
1
Determine
Edit selected items.
View
Selection
Report on selected items.
Delete selected items.
Reset Details
Name
Field Code
LinkCode
Zone
Description
Terrain Model Attribute
Attributes Pair
Control Codes
Instrument Orientation
Set Number

Figure 59

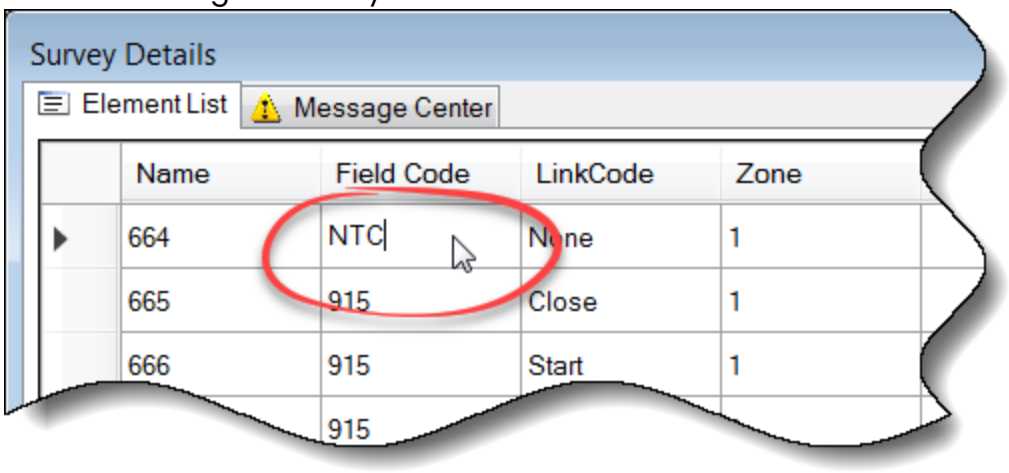

Survey Details
Element List
Message Center
Name
Field Code
LinkCode
Zone
664
NTC
None
1
665
915
Close
1
666
915
Start
1
915

Figure 60

4.7.3 Heads-Up Editing

1. Use **Element Selection** to select feature.
2. Hover over the selection for the **Heads-up Tools** to appear.

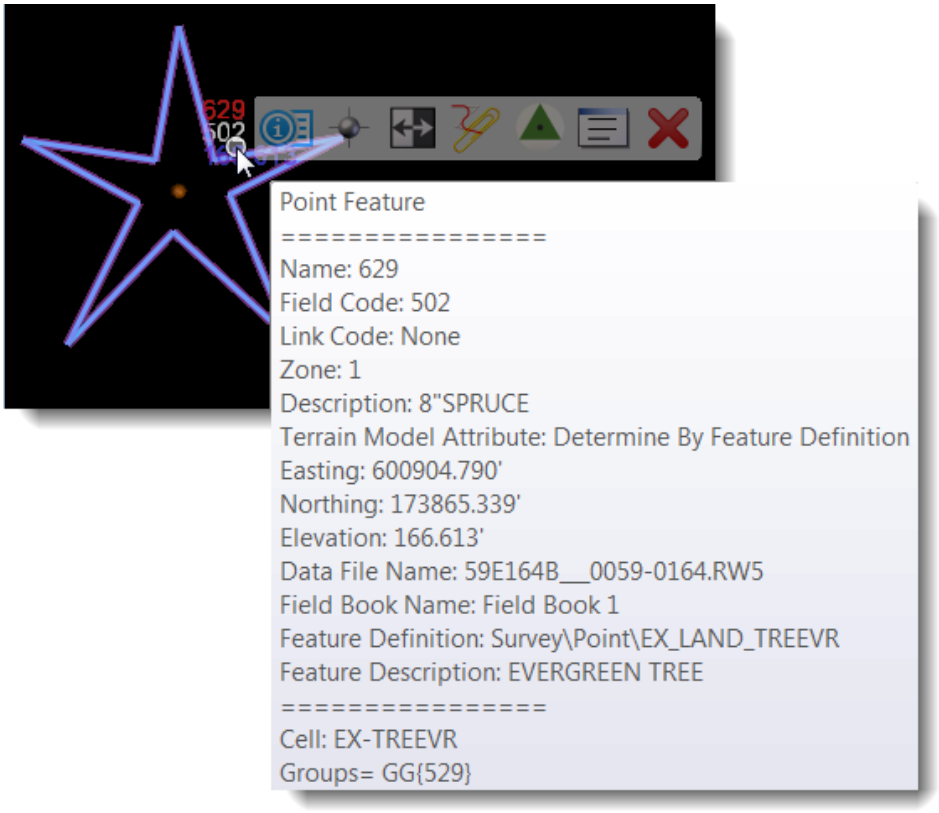


Figure 61

3. Move the cursor over the **Heads-up Tools** to select a tool.

   Point feature tool choices are as follows:

Figure 62

1. Properties
2. New Point Feature
3. Turn on/off All Annotations
4. Report
5. Create Control Point
6. Edit Observations
7. Delete

Linear feature tool choices are as follows:

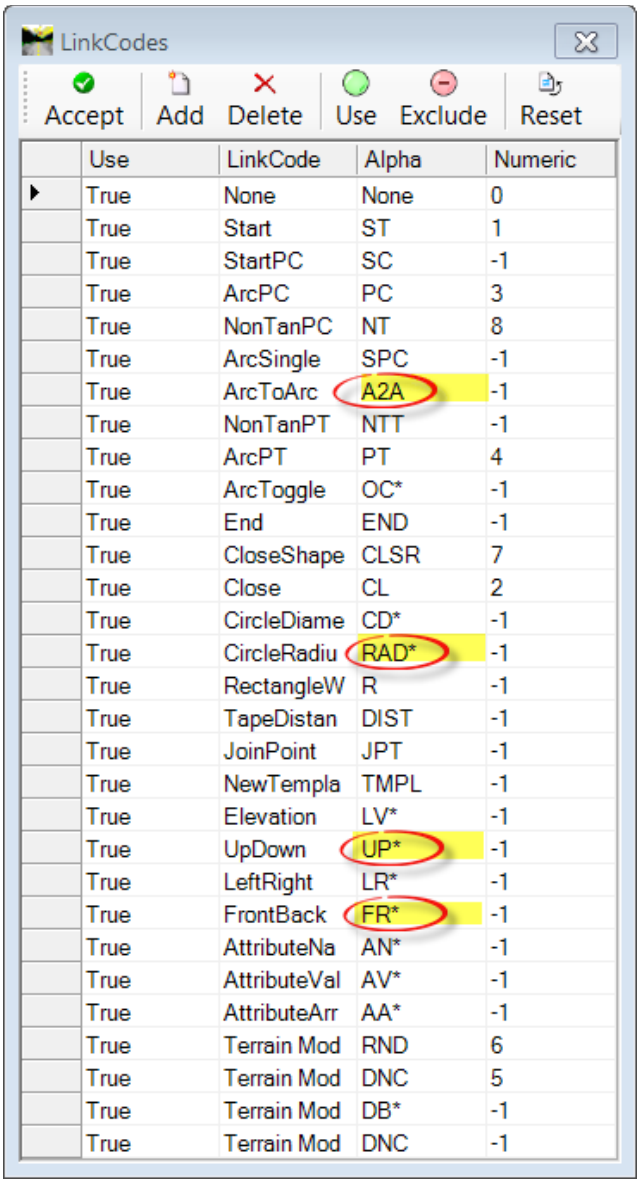
Figure 63

1. Properties
2. Append Point In Linear Feature
3. Move Point Along Linear Feature
4. Insert Point In Linear Feature
5. Close Linear Feature
6. Break Linear Feature
7. Transpose Linear Feature – Changes linestyle direction
8. Move Linear Feature
9. Report
10. Convert to Point List Linear Feature
11. Manage Point List
12. Edit Point Features
13. Delete

4. Use the Explorer Dialog in conjunction with the Survey Details Panel to edit any Survey Points or Survey Linear Features that need adjusting.

4.7.4 Survey Codes

Linking Codes – Linking Codes is a way to connect features in the field. They are placed after Feature Codes. Some have been customized to avoid conflicts with feature codes.



Use	LinkCode	Alpha	Numeric
True	None	None	0
True	Start	ST	1
True	StartPC	SC	-1
True	ArcPC	PC	3
True	NonTanPC	NT	8
True	ArcSingle	SPC	-1
True	ArcToArc	A2A	-1
True	NonTanPT	NTT	-1
True	ArcPT	PT	4
True	ArcToggle	OC*	-1
True	End	END	-1
True	CloseShape	CLSR	7
True	Close	CL	2
True	CircleDiame	CD*	-1
True	CircleRadiu	RAD*	-1
True	RectangleW	R	-1
True	TapeDistan	DIST	-1
True	JoinPoint	JPT	-1
True	NewTempla	TMPL	-1
True	Elevation	LV*	-1
True	UpDown	UP*	-1
True	LeftRight	LR*	-1
True	FrontBack	FR*	-1
True	AttributeNa	AN*	-1
True	AttributeVal	AV*	-1
True	AttributeArr	AA*	-1
True	Terrain Mod	RND	6
True	Terrain Mod	DNC	5
True	Terrain Mod	DB*	-1
True	Terrain Mod	DNC	-1

Figure 64

Figure 65

Control Codes – Control Codes can be used to draw additional planimetrics for circles, rectangles, and lines; and can also modify a location.

Control Codes	Alpha	Description
CircleDiameter	**CD***	draws a circle of specified diameter around this point (must be within Linear Feature)
CircleRadius	**CR***	draws a circle with specified radius around this point (must be within Linear Feature)
RectangleWidth	**RECT**	draws a rectangle from two points and specified width (must be within Linear Feature)
TapeDistance	**DIST**	applies field measured distances to the Linear Feature. All measurements are applied 90 degrees from previous segment. Positive values turn right, and negative values turn left. (must be within Linear Feature)
JoinPoint	**JPT**	joins this point to specified point name (does NOT have to be in linear feature)
NewTemplate	**TMPL**	same as InRoads TMPL Consecutive Start codes will get this linear feature paralleled and translated based off of initial points
Elevation	**LV***	sets the Elevation of this point
UpDown	**UD***	changes final elevation coordinate of point by value entered
LeftRight	**LR***	changes final coordinate of point by adjusting left (-) or right (+) of measured observation by value entered
FrontBack	**FB***	changes final coordinate of point by adding or subtracting a distance from the measured distance
AttributeName	**AN***	one method of getting attributes for a point (pairs with Value)
AttributeValue	**AV***	one method of getting attributes for a point (pairs with Name)
AttributeArray		one method of getting attributes for a point (Names and Value in array)
TerrainSpot	**DS***	include in DTM as spot
TerrainNoSpot	**DB***	do not Include in DTM
TerrainBreak	**DX***	include in DTM as break
TerrainNoBreak	**DNC**	do not include in DTM

Figure 66

You are able to use a JPT code **from a line** see below.

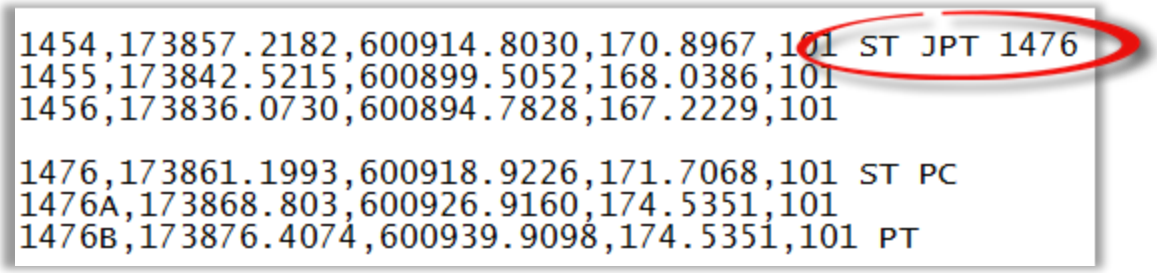


Figure 67

You are able to use a JPT code **from a line** but **not from a pc** see below.

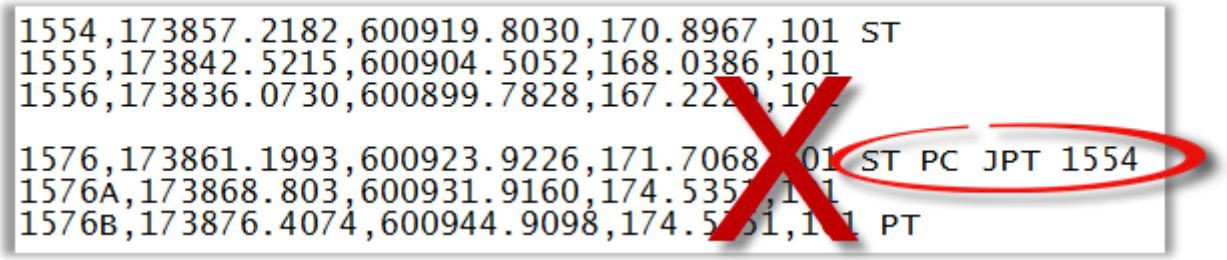


Figure 68

The following demonstrates results from each of these examples:

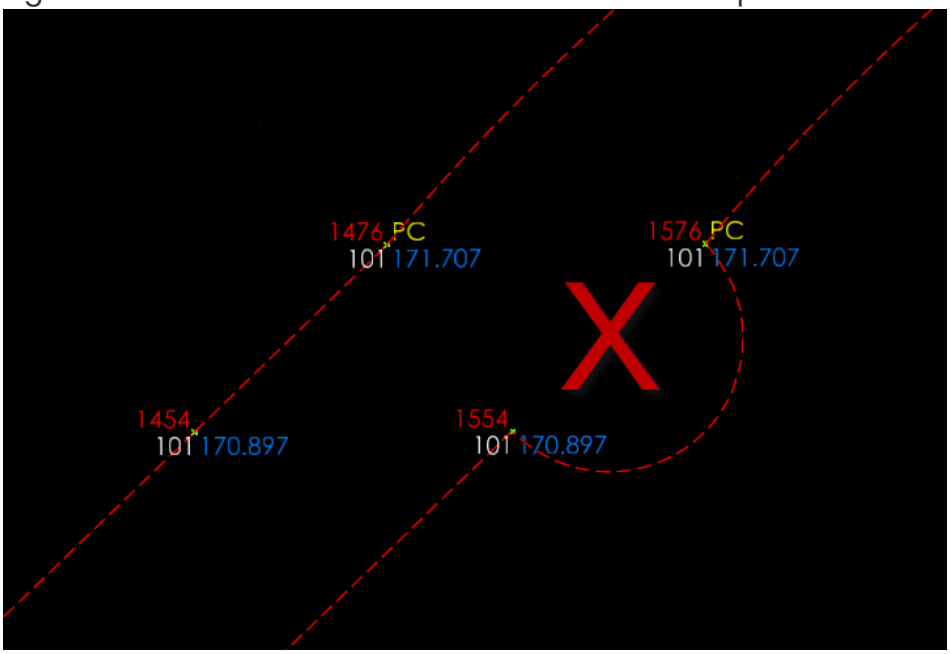


Figure 69

Exercise 5 – Processing Terrain Data

In this module you will learn how to view element that make up a terrain. You will also learn how to edit the terrain, by adding brake lines, void regions and an exterior boundary.

Skills Taught

- To become proficient with the terrain viewing and editing tools and option.
- To become familiar with the CTDOT Standards set up for Terrains.

Terrain Attribute Descriptions

- **Not Set –** Not included in the terrain model.
- **Determine By Feature Definition –** Whether the feature is included in the terrain model is determined by the DTM Attribute that was set when the Feature Definition was created.
- **Do Not Include –** Not included in the terrain model.
- **Break Line -** Breaks are used to designate linear features such as edges of pavement, ditch bottoms, ridges, etc. where an abrupt change of slope occurs. Any longitudinal element may be defined as a break line. Triangles will not cross a break line in the terrain model.
- **Soft Break Line -** A soft break line is a break line; however, if it crosses a break line, it will not affect the triangulation and is ignored.
- **Boundary -** The external boundary of the surface.
- **Drape Boundary -** A surface boundary that determines its elevations by draping on the underlying surface.
- **Void -** An area defined by a closed shape that demarcates a region of missing data or obscure areas. No point or break data located within the void area is utilized and no triangles are created inside the void areas. The Void coordinates are included in the triangulation and void lines between successive void coordinates are inserted as drape lines on the surface; therefore, they do not change the slope or elevations of the surface.
- **Drape Void -** An area defined by a closed shape that demarcates a region of missing data or obscure areas. No point or break data located within the void area is utilized and no triangles are created inside the void areas. In the drape void, the void coordinates are not included in the triangulation. Voids are inserted post triangulation. The void coordinates and lines are draped on the terrain model surface. Even though a user must provide an elevation for Drape Void vertices, the user elevations are changed to the elevation of the terrain model surface at the XY Drape Void coordinate position.
- **Break Void -** An area defined by a closed shape that demarcates a region of missing data or obscure areas. No point or break data located within the void area is utilized and no

triangles are created inside the void areas. It differs from Voids and Drape Voids in that it utilizes the vertex elevations of the graphical element, while the void lines between successive void coordinates are inserted as break lines; therefore, break voids change the slope and elevations of the surface.

- **Island –** An area defined by a closed shape that demarcates a region of data wholly within a void. Example, islands in the middle of rivers, lakes, etcetera.
- **Contour –** Element or set of elements of the same elevation. Contours may be used as source data to generate a terrain model or may be computed (drawn based on terrain model). Contour interval is the elevation difference between two adjacent contours.
- **Hole –** An area defined by a closed shape that demarcates a region where the current terrain is ignored, and the underlying terrain is utilized.

5.1 View Settings: Triangles/Contours

Breaklines and points can be edited to change their terrain model attributes; however, terrain commands such as deleting triangles will not work until Survey Processing Rules are deactivated.
Contour and triangle appearances are set by a template. To change their appearance to the familiar orange triangles:

1. Select the Boundary element using Element Selection.
2. From the Properties dialog, click **Terrain Model: Existing Template.**
3. Choose ***Template> Existing Terrain> Existing Contours and Triangles.***

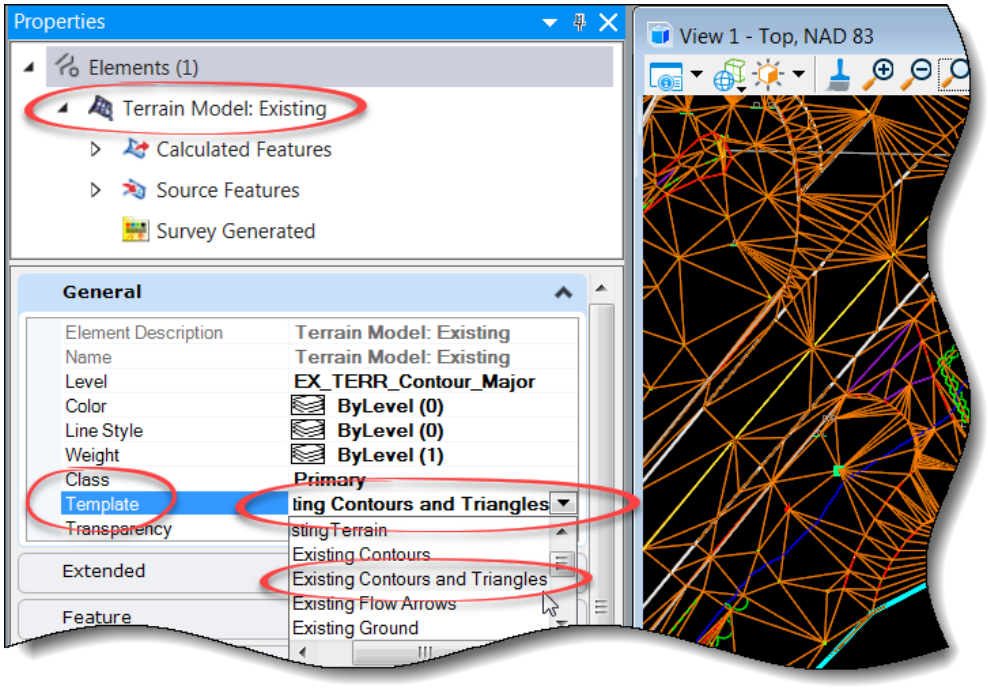


Figure 70

4. CTDOT will add more predefined choices based on District Survey input; however, the contour interval in the active file can be changed. Choose ***Template› Existing Terrain› Existing Contours and Triangles› Manage Templates.***

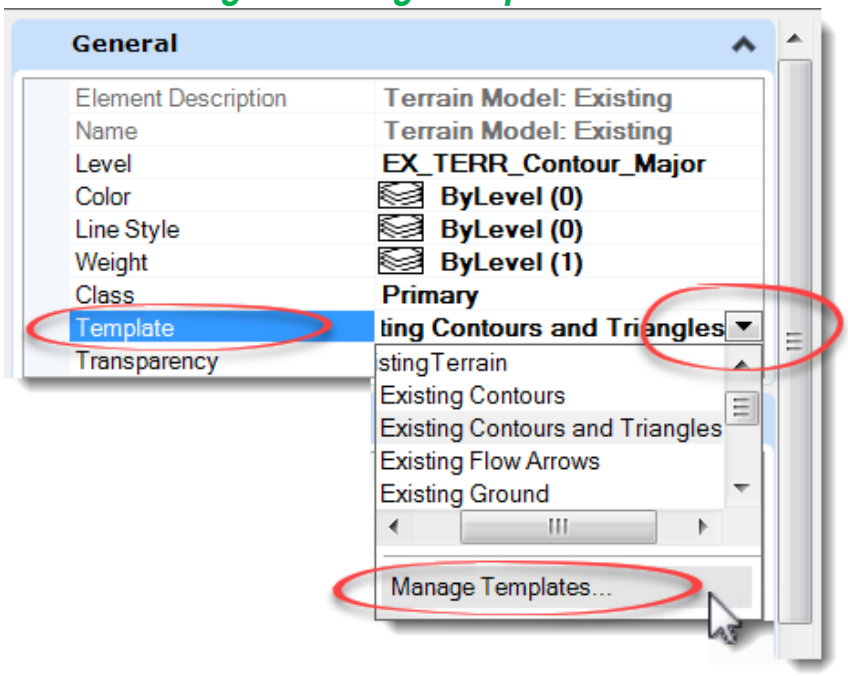


Figure 71

5. Click the **active file**.
6. Expand **Existing Terrain**.
7. Click **Existing Contours and Triangles**.

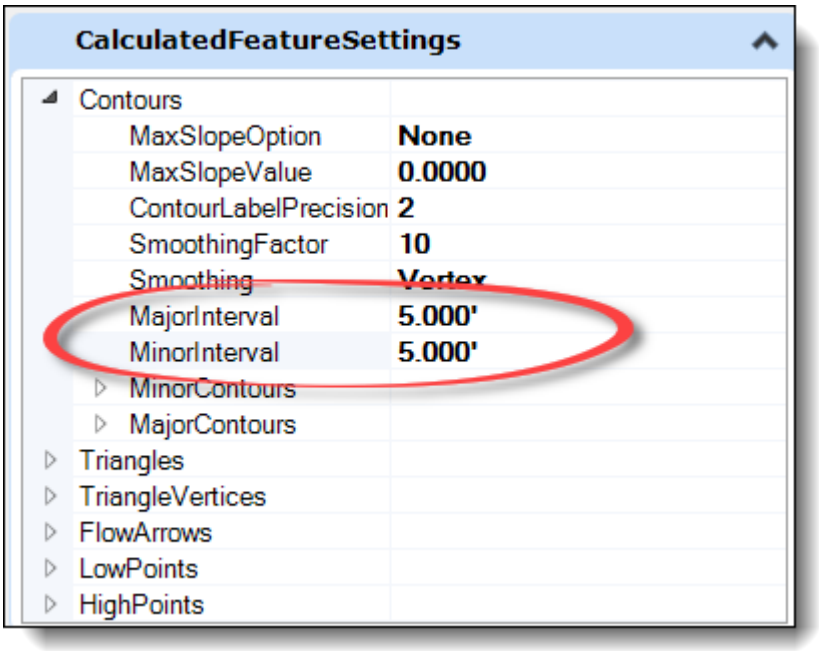


Figure 72

8. It the default Minor Interval of **"5"** is not desirable double click the value of **"5"** and enter **"1"**

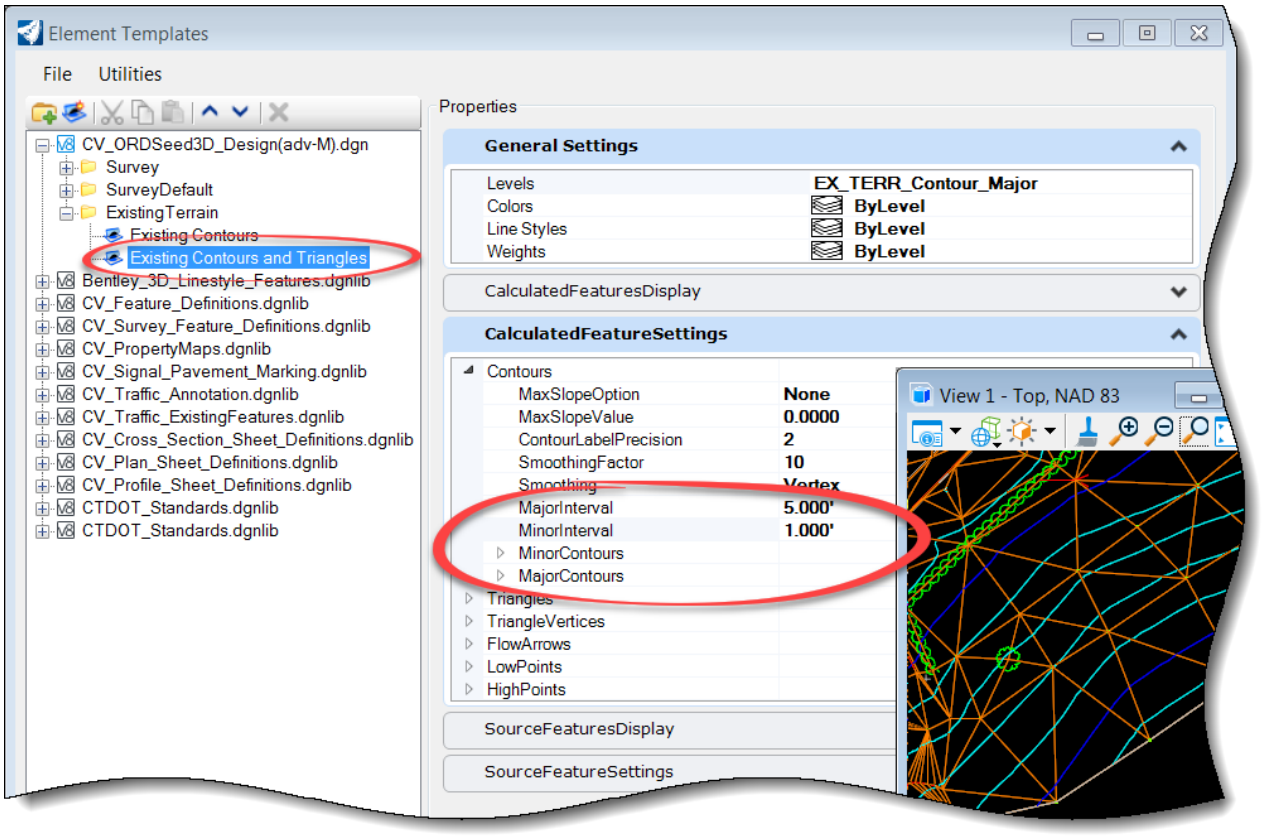


Figure 73

If contours do not appear correct, Choose ***Existing Terrain> Existing Contours*** and delete.

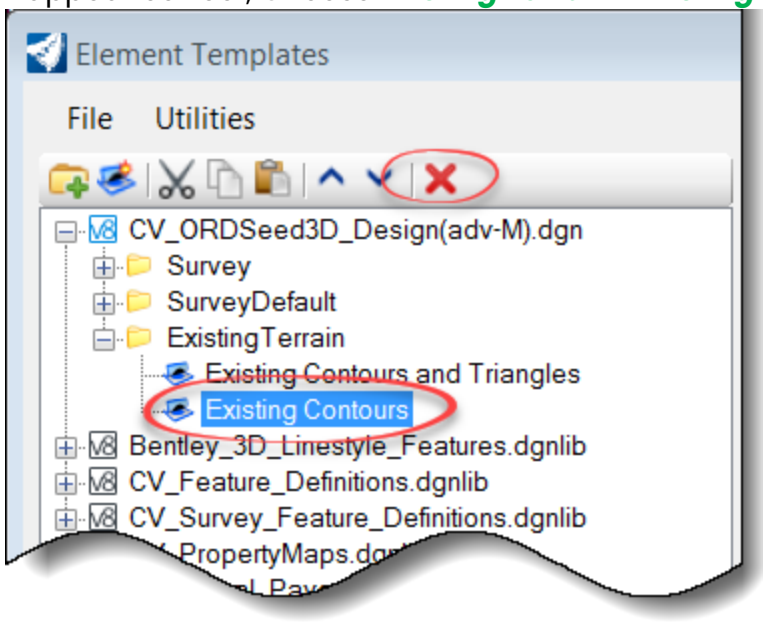


Figure 74

5.2 Inspect Contours

5.2.1 Top View Hi Spots or Depressions

1. Visually inspect for abnormalities in top view.

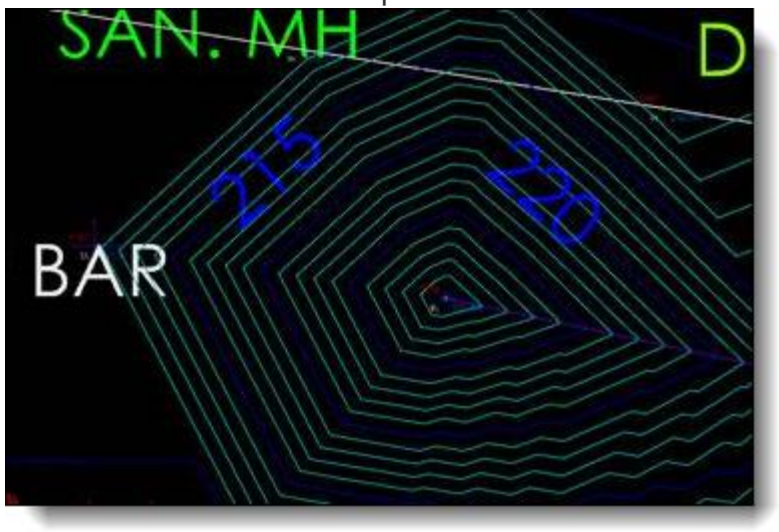


Figure 75

2. Use the tools at the top of the view window to zoom, fit, and pan.

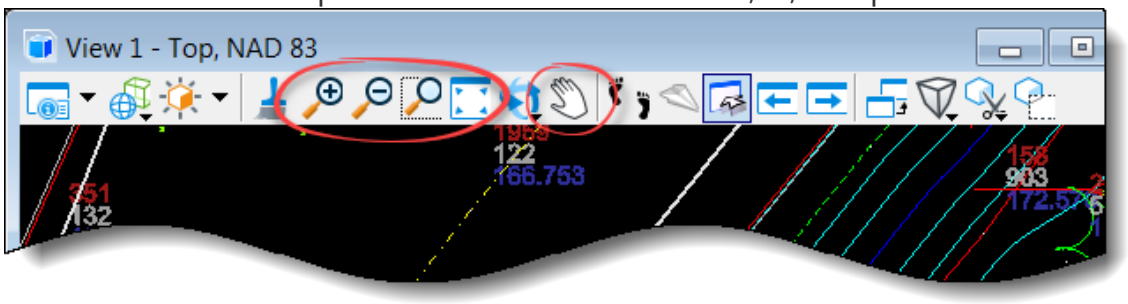


Figure 76

3. Edit features if necessary, through Survey Details.

5.2.2 Front View Spikes

1. Visually inspect for vertical abnormalities in front view. Rotate the view using the View Rotation tool.

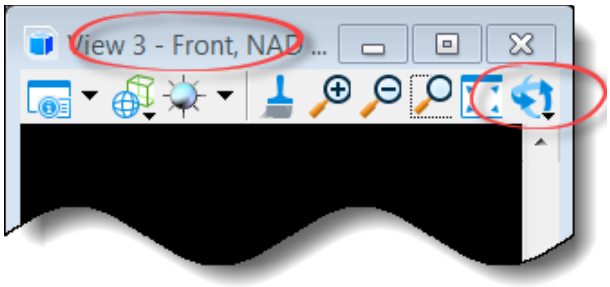


Figure 77

2. Render the view through View Attributes. Try different Display Styles such as Smooth: Modeling or Thematic: Height.

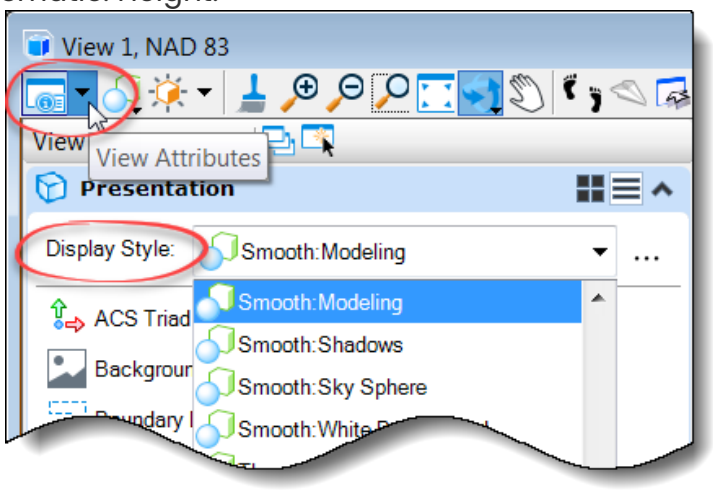


Figure 78

3. You can also use isometric views for inspection.

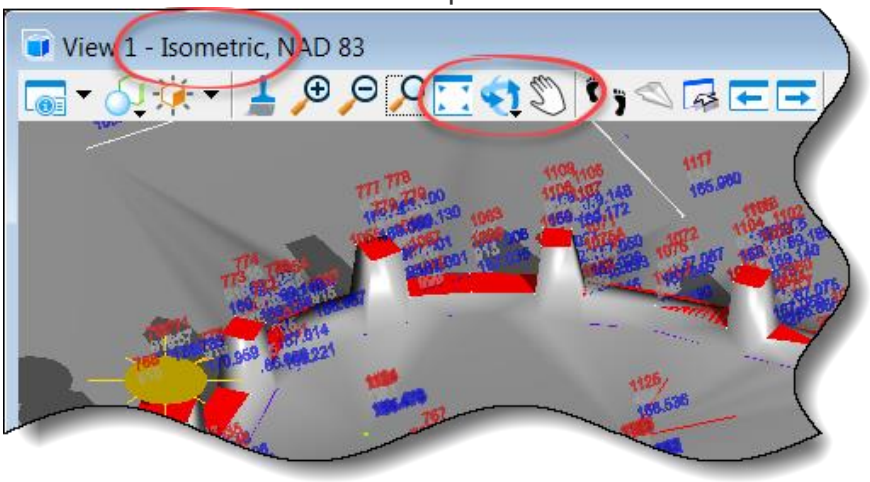


Figure 79

5.3 Process Terrain Features

5.3.1 Edit Terrain Model Attributes

Change the Terrain Model Attributes of an existing feature. In this example, we will modify a linear feature since it contains both a line and point elements.

1. Use Element Selection to select a linear feature.

Figure 80

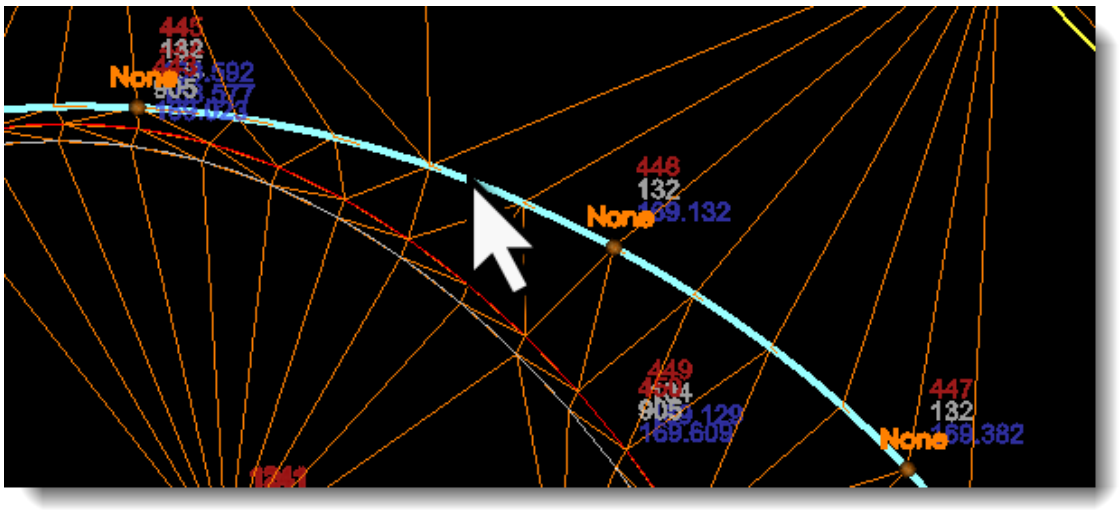


Figure 81

2. Use the **Heads-up tool** to click **Edit Point Features**.

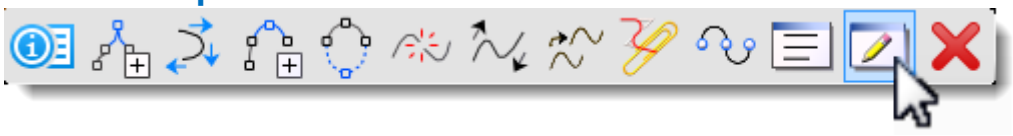


Figure 82

Survey Details now reflects the elements of the selected Linear Feature.

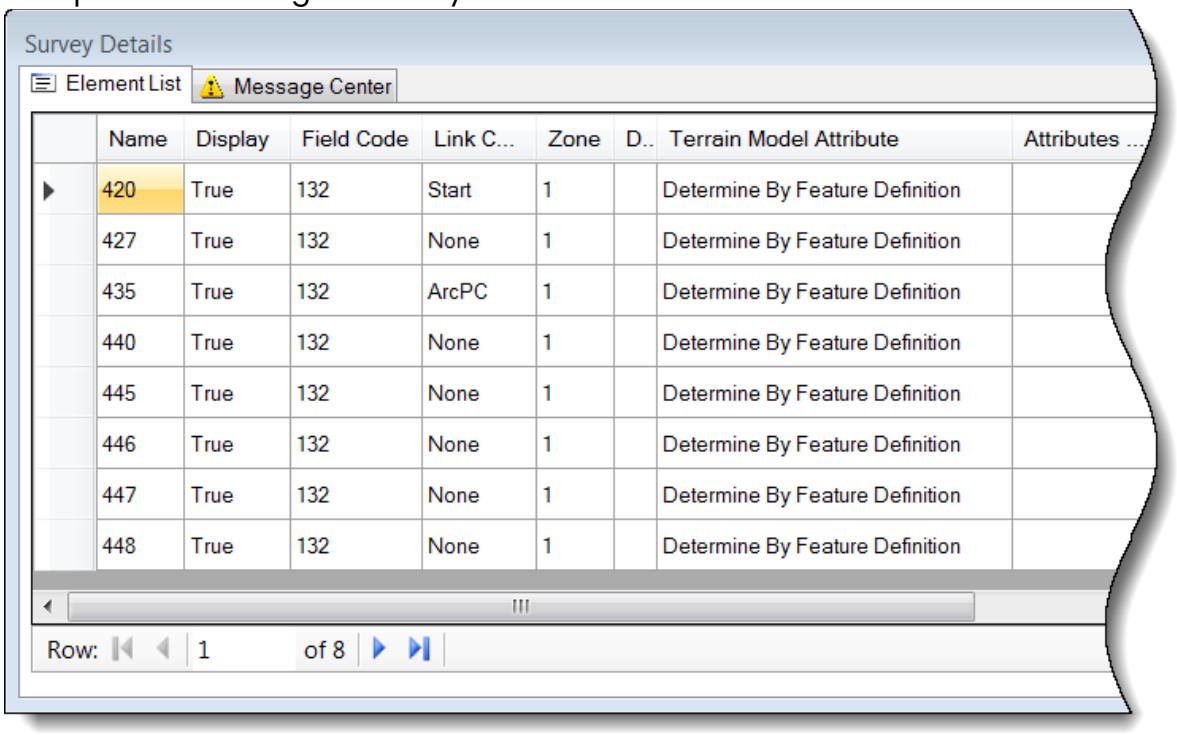


Figure 83

3. Click the **Terrain Model Attribute** column header.
4. Right Click to **Edit**.

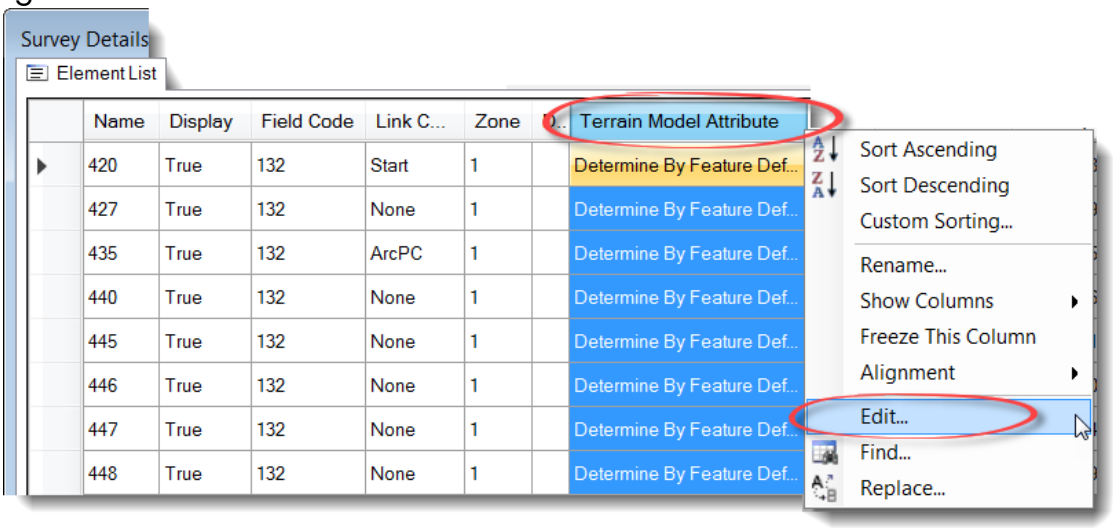


Figure 84

5. Choose the desired property value (in this case, Do Not Include) from the drop-down list and click **OK.** This changes all Point Features that made up the line, but not the Linear Feature itself.

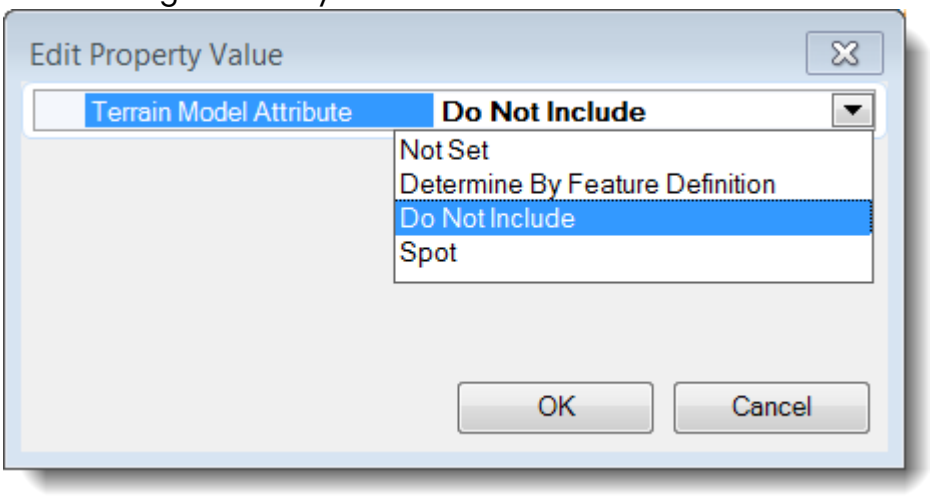


Figure 85

6. To change the **Terrain Model Attribute** of the Linear Feature, use the **Properties** dialog. From **Terrain Model** Attribute, choose **Do Not Include** from drop down.

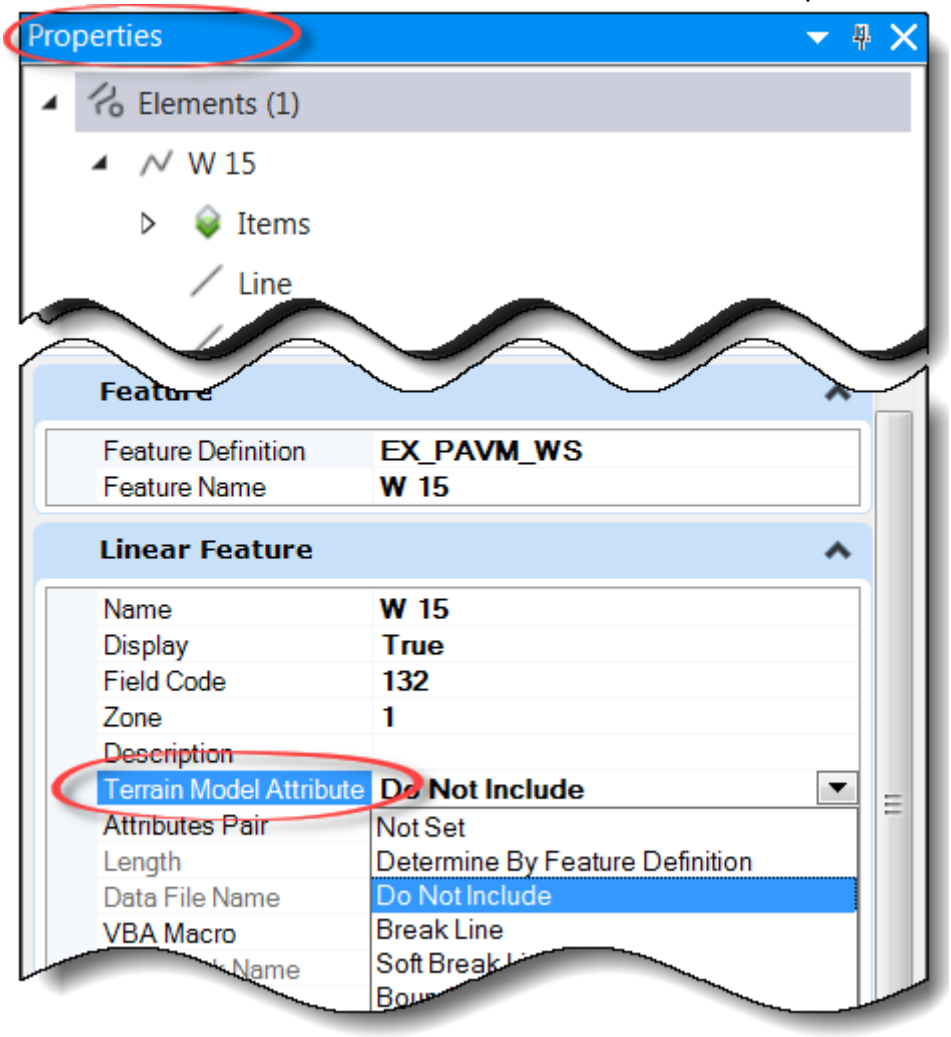


Figure 86

Triangles no longer include the edited Linear Feature.

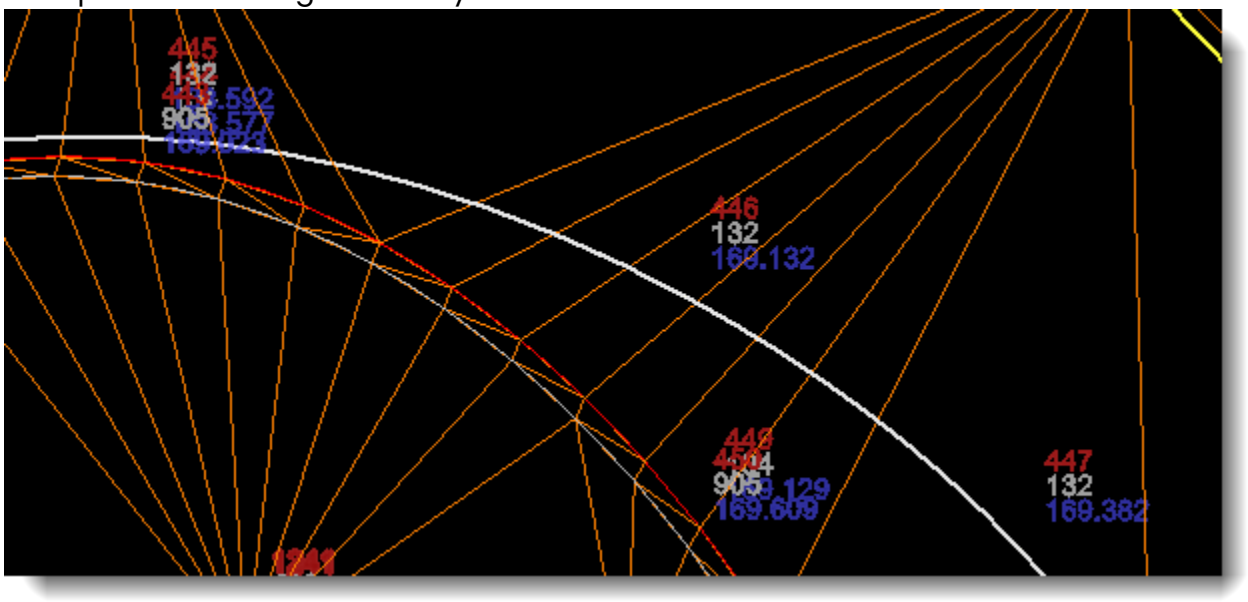


Figure 87

5.4 Add Break Lines

5.4.1 Add newly drawn 3D Linear Feature

One way to add a new breakline is to draw a 3D MicroStation line or line string and then convert it to a Graphic Linear Feature.

1. Draw the line or line string that is to be added to the Survey Data as a Graphic Linear Feature.
2. To covert the newly drawn 3D Linear Feature as a Break Line. Choose ***Explorer› Survey› All Linear Features***
3. Right click to **Add Graphic Linear feature**.

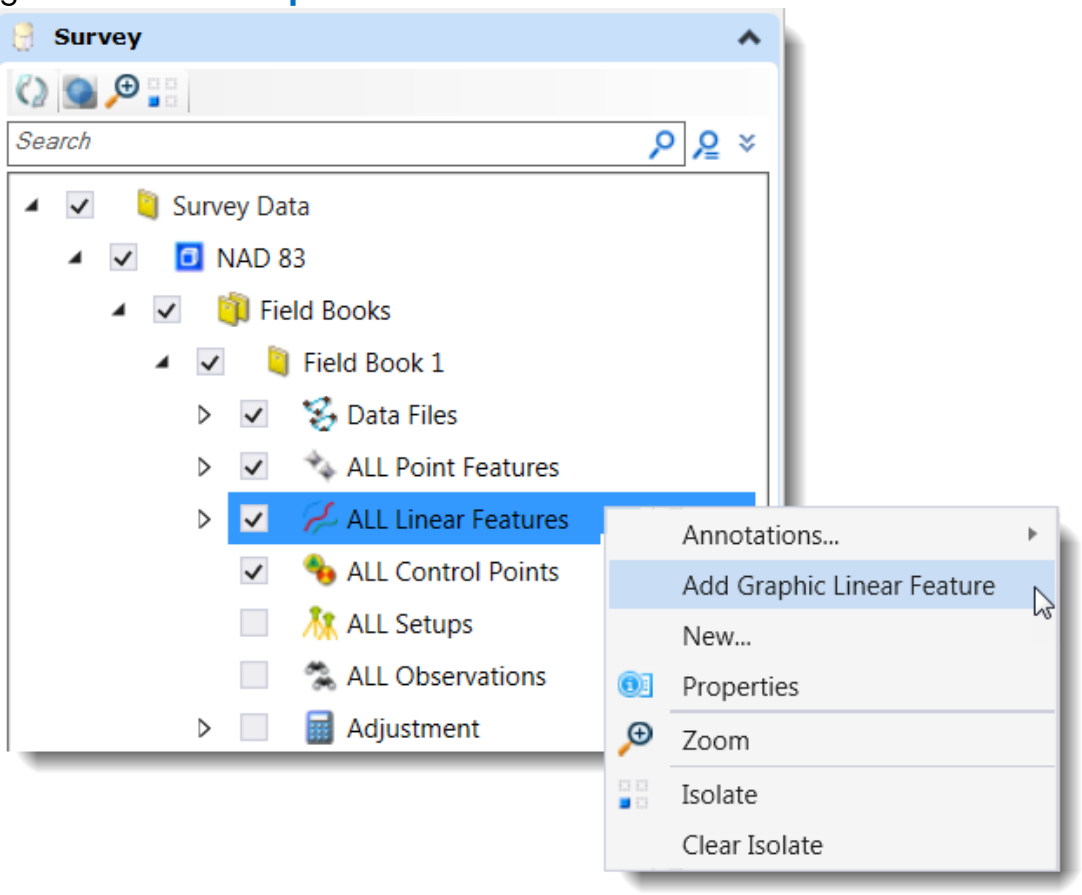


Figure 88

4. Select the newly drawn line when prompted.
5. Accept it and the re-triangulated view automatically refreshes.

6. From the model tree, click the newly added line, named Default. This is listed at the bottom of All Linear Features.

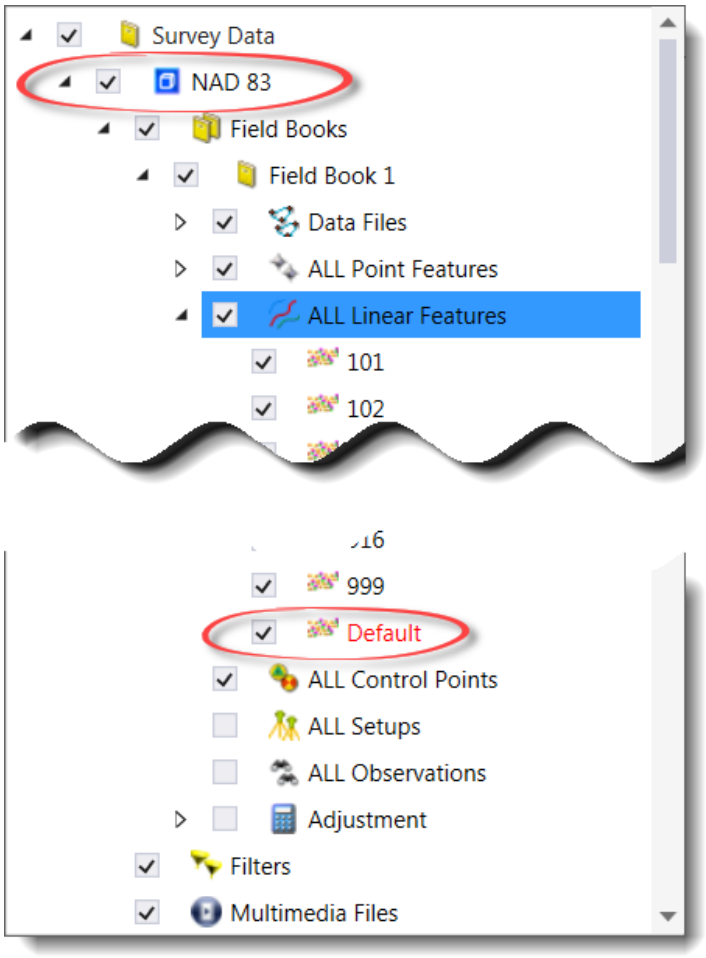


Figure 89

7. Change the field code in Survey Details.

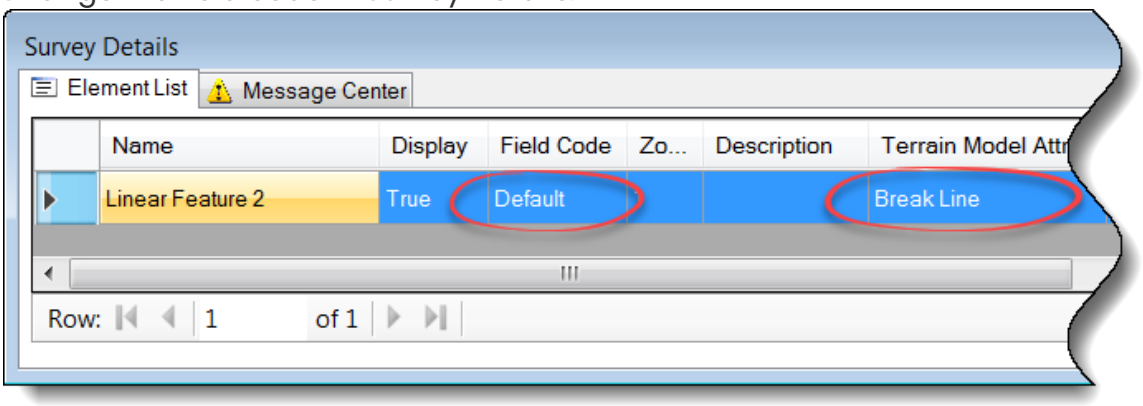


Figure 90

8. Change the Terrain Model Attribute to Determine by Feature Definition.

5.4.2 Delete Break Lines

1. To physically delete an existing linear feature. Select the feature using Element Selection.
2. Select all rows of the feature from Survey Detail to confirm.
3. Right click **Delete selected items**. Note: The deletion of Survey Linear Features (and Survey Points) can also be done individually using the **Heads-up Tools**.

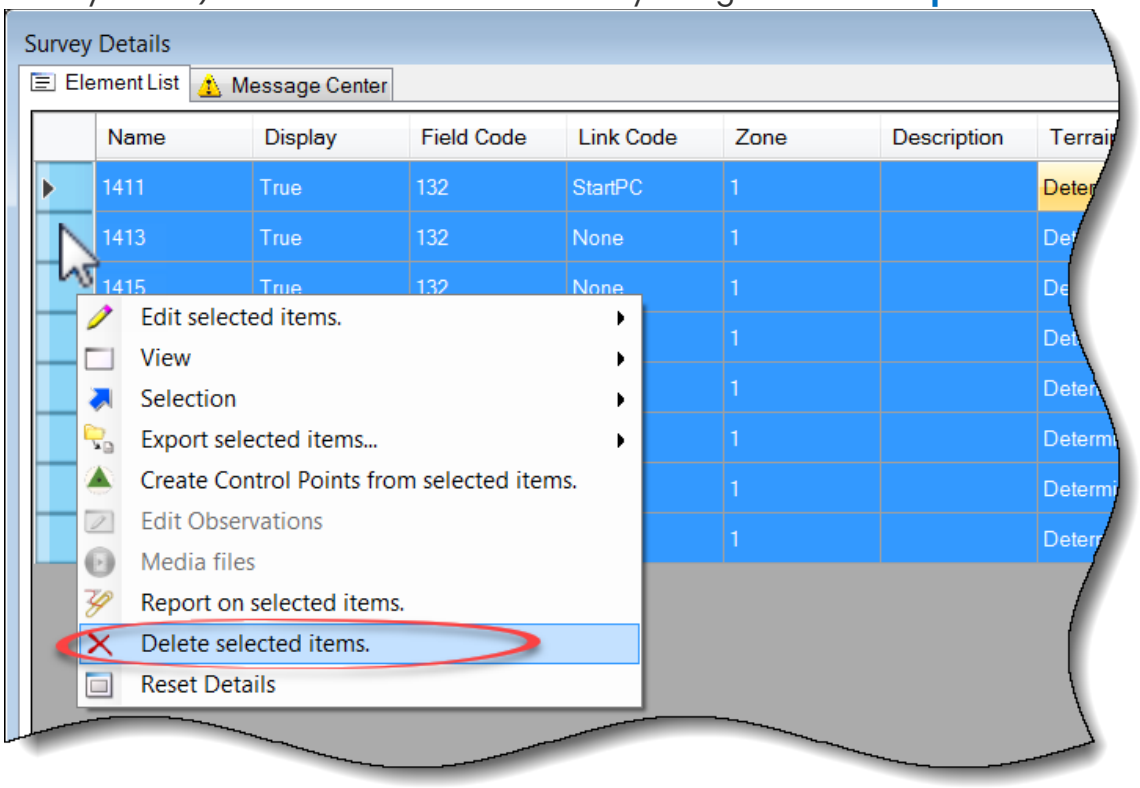


Figure 91

5.5 Add or Delete Void Regions

To add or delete a void region, or to change the Terrain Model Attribute, follow the same process for Break Lines. At the beginning of this chapter is a listing of Terrain Model Attributes and their descriptions that show after clicking the Properties Icon shown below.

Figure 92

5.6 Fix Crossing Break Lines

Crossing break lines can be checked each time individual raw data file are processed. Choose the Report Crossing Features tool.

①Survey› ②Terrain› ③Analysis› ④Reporting

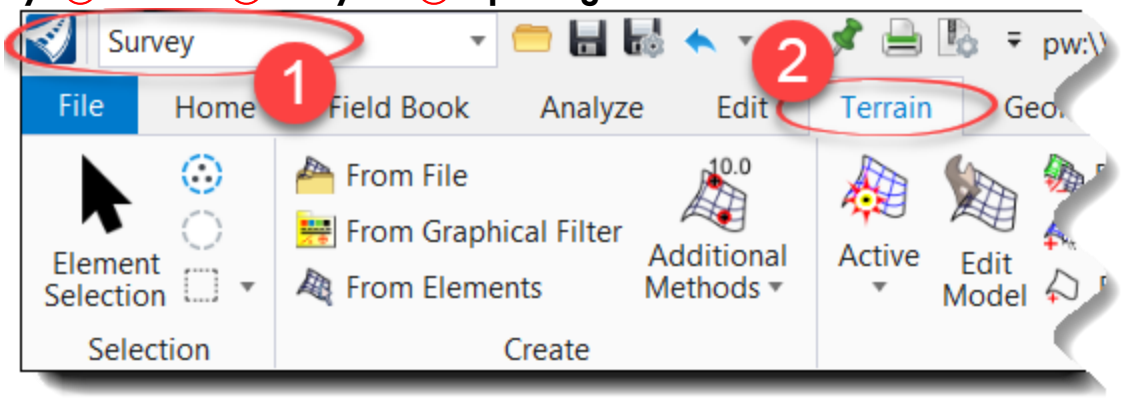


Figure 93

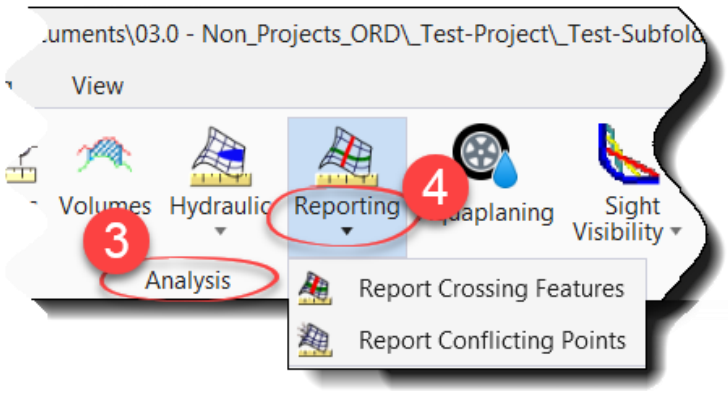


Figure 94

5.7 Edit Triangles

In order to edit triangles, etc., the terrain model must be made editable. This is done by deactivating survey processing through the **Survey** tree - not through the **OpenRoads Model** tree.

5.7.1 Deactivate Survey Processing

1. Choose ***Explorer> Survey> active model*** *(e.g. NAD 83).*
2. Right click the ***active model*** to **Deactivate Survey Processing Rules.**

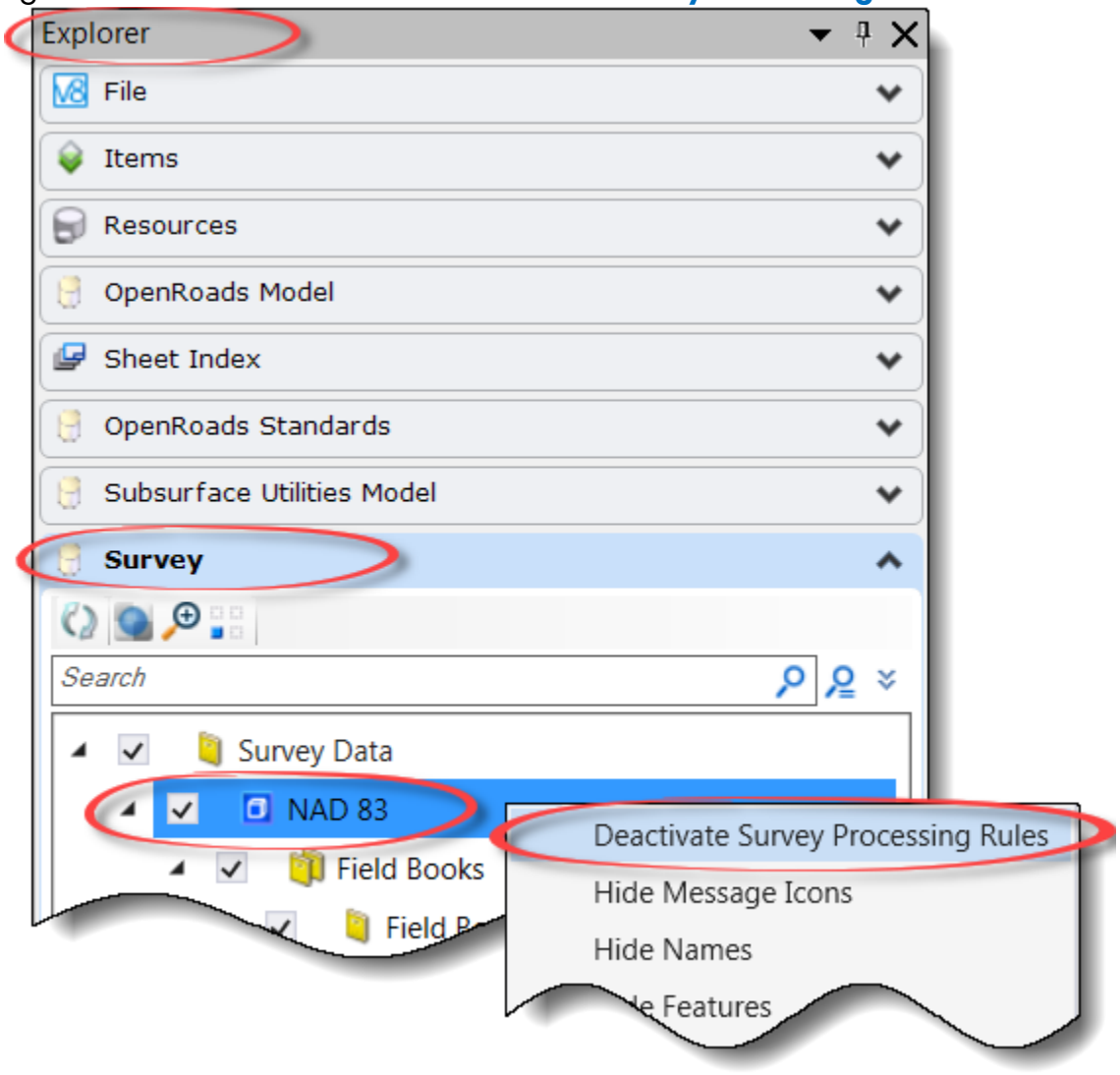


Figure 95

5.7.2 Edit Triangle Tools

1. Use **Element Selection** to select the Terrain Model.
2. From the ribbon, choose ***Survey> Terrain> Edit Model***, the **Edit Terrain Model** tools appear.

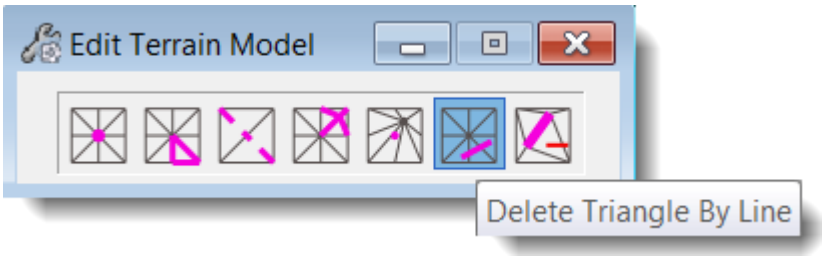


Figure 96

3. **Edit Terrain Model** choices are as follows:

   It is recommended that when using Delete Triangle By Line, the user delete the outermost segment of the triangle and begin drawing the line from the outside of the perimeter inward.

Figure 97

5.8 Create Outer Boundary

1. The displayed boundary is not really an exterior boundary - it's merely a perimeter. Select the **perimeter** to highlight and verify it.

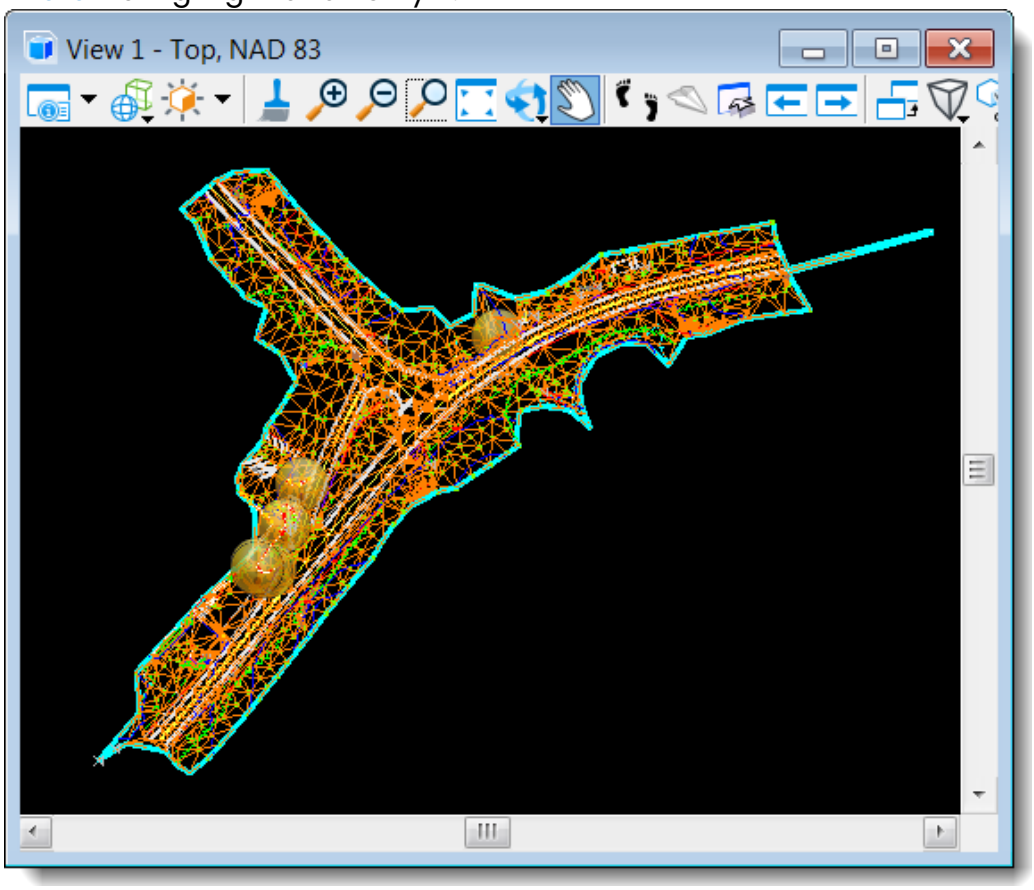


Figure 98

2. Create a graphic element to represent current triangulation limits. From the **Survey** workflow, choose ***Terrain> Boundary Options> Add Boundary.***

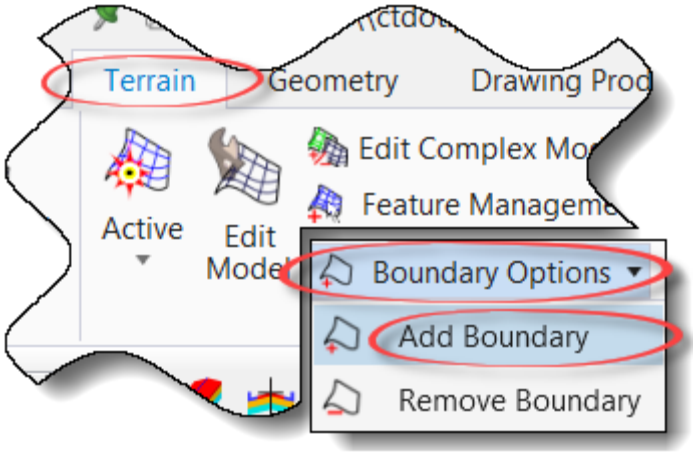


Figure 99

- Delete Vertex
- Delete Edge Triangle
- Swap Line
- Insert Vertex
- Move Vertex
- Delete Triangle By Line
- Delete Feature

3. Select the perimeter when prompted to Locate a Terrain Model.

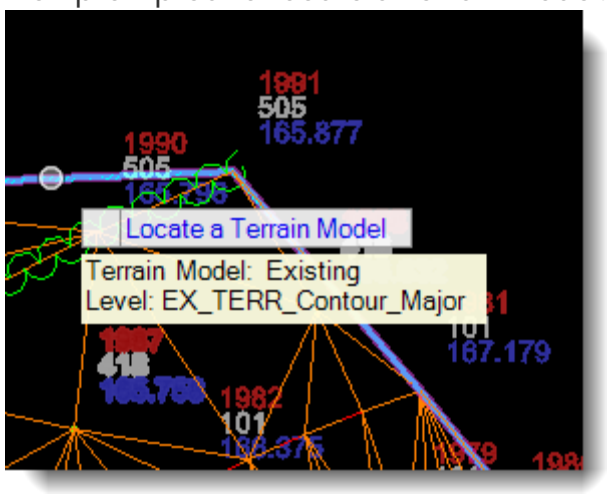


Figure 100

4. Keep the default Method of Extract Graphic.

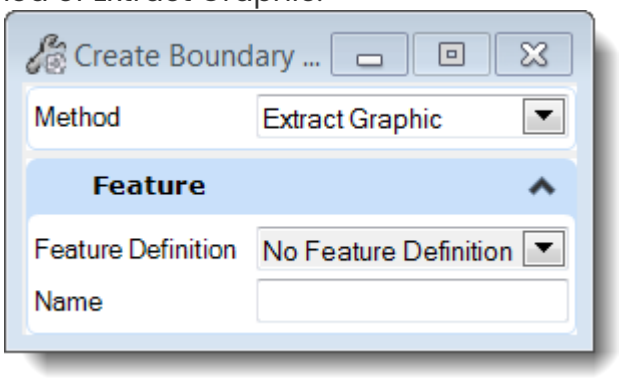


Figure 101

5. Click any blank spot in the view to accept the choice.

5.9 Import Boundary

1. Add the newly created graphic to the Field Book. Reactivate Survey Processing Rules, click **Yes** to confirm.

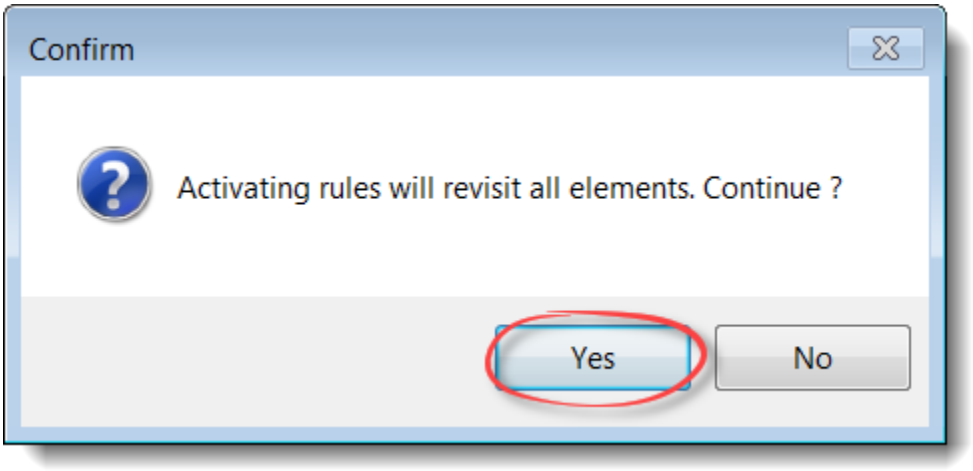


Figure 102

2. Right click **All Linear Features** to **Add Graphic Linear Feature**.

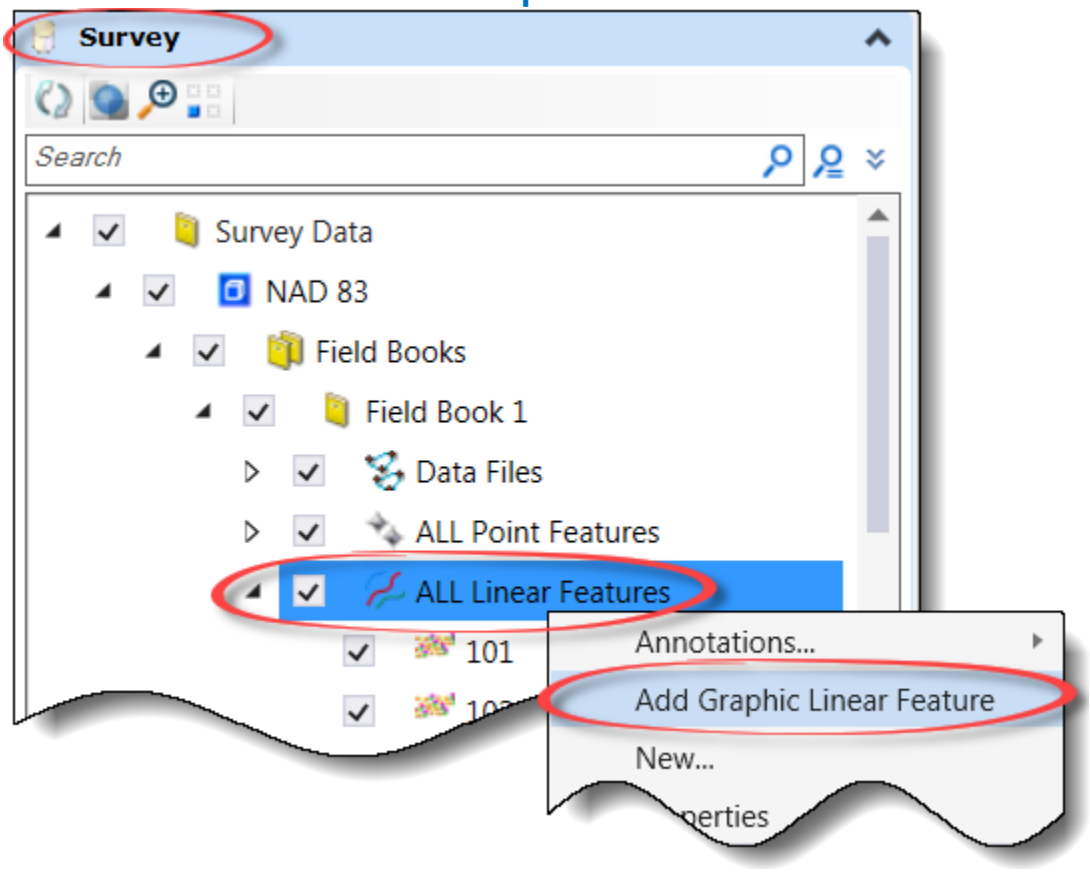


Figure 103

3. Select the element when prompted Accept it.
   - Ensure that **Survey Details** is open
   - Expand **All Linear Features**
   - Scroll to the bottom of the list and click **Default**

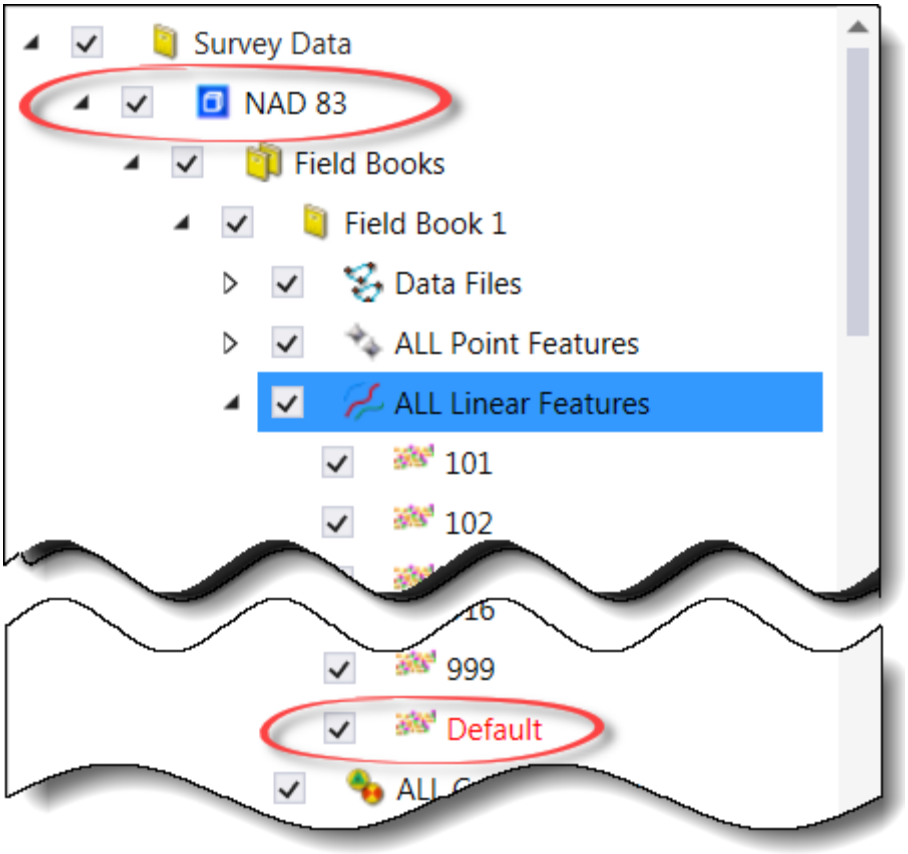


Figure 104

4. Survey Details refreshes with the new linear feature. The default Terrain Model Attribute is Break Line. Change **Break Line** to **Boundary**.

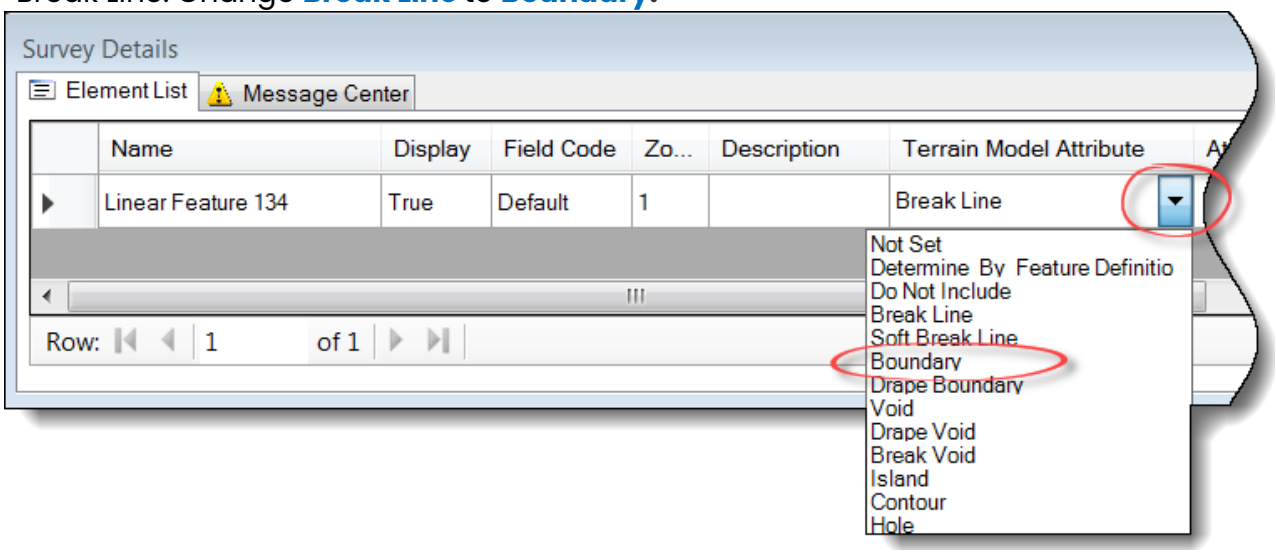


Figure 105

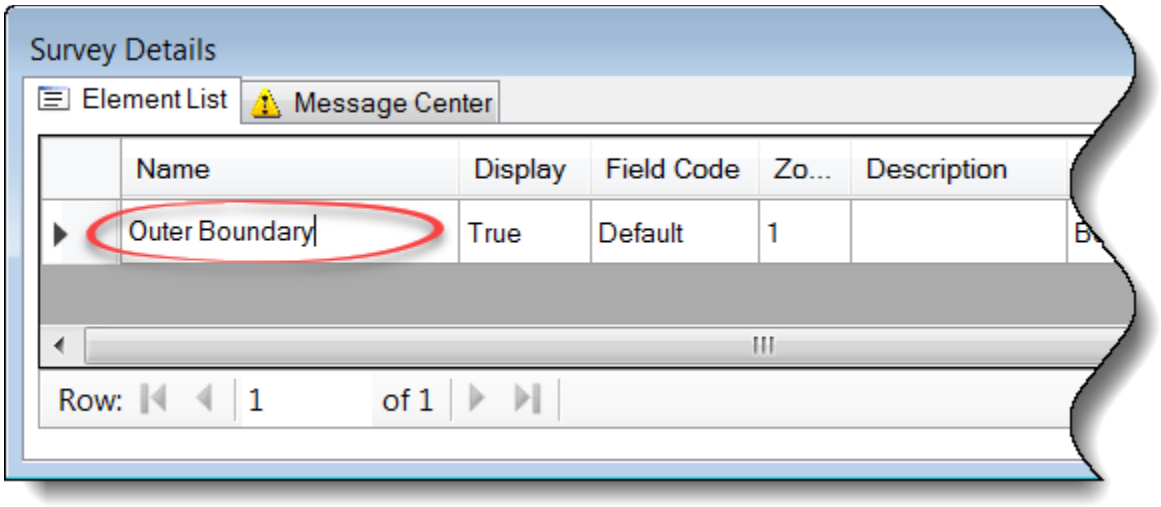


Figure 106

5. Rename the Linear Feature if desired.

Exercise 6 - Drawing Production

Coming Soon

Skills Taught

- Coming Soon

6.1 Border and Title Block

Coming Soon

6.2 Annotation

Coming Soon

6.3 Cells

Coming Soon

6.4 Additional Line Work

Coming Soon

6.5 Grids Ticks and Lines

Coming Soon

Exercise 7 - Deliverables

Coming Soon

Skills Taught

- Create and understand Null Terrain Model usage.
- Creation of a Complex Terrain Model that can easily accommodate updated / additional survey information.
- Save the Complex Terrain Model for use by Highways.

7.1 Create New 3D File

1. Open OpenRoads using the CTDOT WorkSpace and create a new 3D file using the CT_SurveySeed.dgn Seed File. Create the file in the Active_Survey folder for your project.

7.2 Attach Survey Terrain Model as Reference

1. Attach the Existing Terrain Model as a reference to the file you created in the previous section.
2. Select *Home* > *Primary* > *Attach Tools* > **References**.
3. Select **Tools > Attach**, browse to the location of the Existing Terrain Model file and select the file with the Existing Survey Terrain Model.
4. Select **Open** to attach the Existing Terrain Model DGN to the newly created 3D DGN.
5. Set *Attachment Method* as **Coincident World**.

7.3 Create Delta Terrain Model

1. Go to *Terrain*> *Create* > *Additional Methods* **> Create Delta**.
2. The **Create Delta Terrain Model** dialog will appear, make changes to as
3. shown below:
    a. *Delta Method*: **Terrain Model to Plane**
    b. *Feature Definition*: **Terrain \ Existing \ Existing Boundary**
    c. *Name*: ***SV_D2_1234_1234_*Null** (or similar name for your purposes)
4. For *Locate First Terrain Model* prompt **Left-click** on the outline of the *Existing Terrain* boundary.
5. *Parameters to Plane* > **0.000**
   Left-click to accept *Enter Plane Parameters*: *To Plane*. The *Delta Terrain* was created.

6. Hit **<Esc>** to *Exit Command*.
7. The boundary of the Delta Terrain will be shown.

7.4 Create New 3D File w/ References

1. Select **New File** to create a 3D file using the CT_SurveySeed.dgn Seed File. Create the file in the Active_Survey folder for your project.

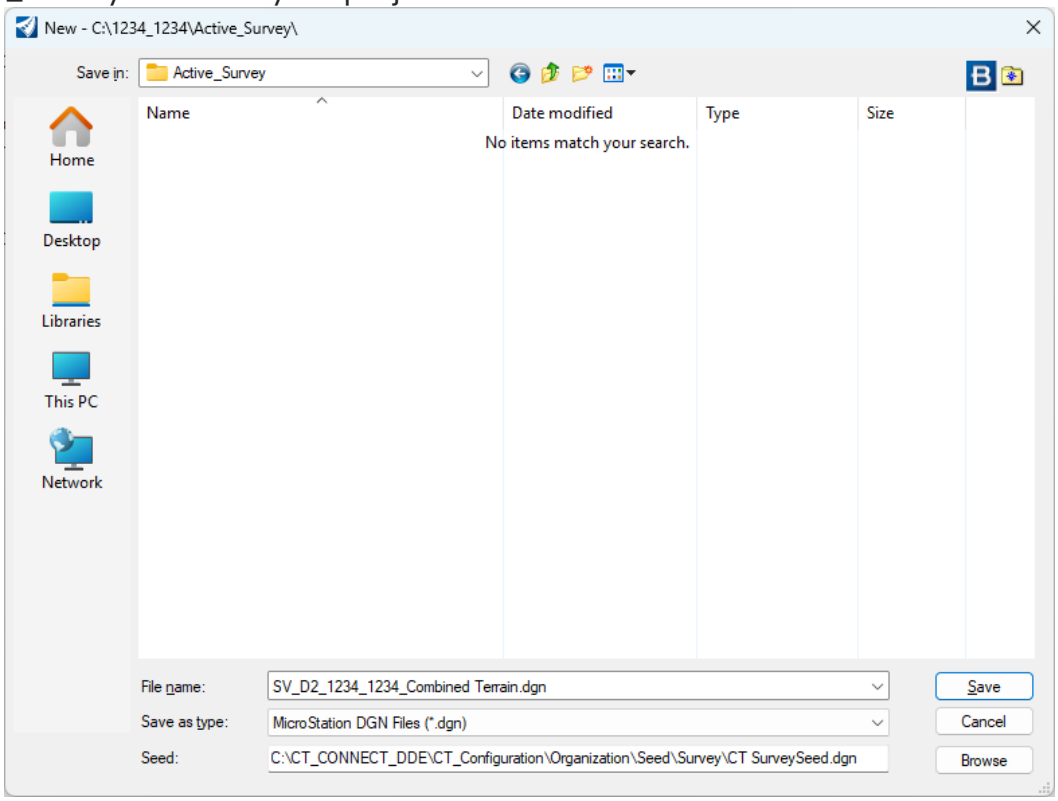
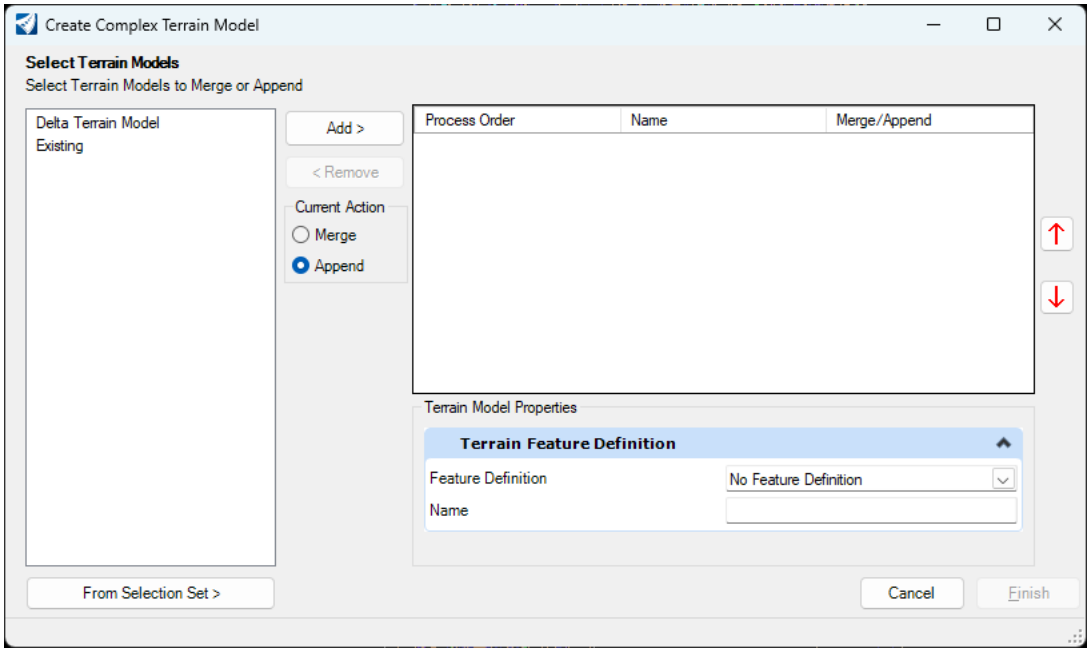


Figure 107

2. Once inside the new 3D DGN File, select *Home* > *Primary* > *Attach Tools* > **References**.
3. Select *Tools* > **Attach**, browse to the location of Existing Terrain Model DGN and select the DGN containing the Existing Terrain Model.
4. Set *Attachment Method* as **Coincident World**.
5. Attach Delta Terrain Model reference file.
6. Select *Tools* > **Attach**, browse to the location of the training files and select the file containing the Delta Terrain Model.
7. Select **Open** to attach the survey terrain file.
8. Set *Attachment Method* as **Coincident World**.

7.5 Create Complex Terrain Model

1. Go to *Terrain> Create > Additional Methods >* **Create Complex Terrain Model**.
2. The **Create Complex Terrain Model** dialog will appear, This tool will read both the terrain attached as highlighted below:



3. **Left-click** on *Existing* on the left hand pane.
4. **Left-click** on **Add >** button which you can see in between the two panes.
5. Now **Left-click** on *Delta Terrain Model* on the left hand pane.
6. Select *Current Action*: **Append**.
   NOTE: The **Append** action defines that if the terrain models overlap the data from both terrain models is retained.The Merge action will discard data from the Primary terrain and only keep the data from the merged terrain.

7. **Left-click** on **Add >** button.

8. Set the Terrain Model Properties as shown below:
   a. *Feature Definition*: **Terrain \ Existing \ Existing Triangles**
   b. *Name*: **Existing Ground**
   c. **Left-click** on **Finish** button at the end.

9. Edit the complex terrain model as desired and add a boundary if preferred.

10. When updated or additional survey data is acquired, the following steps will add the new survey data to the complex terrain model:
    a. Process the new survey data into a terrain model as usual.
    b. Reference the new terrain model into the DGN containing the complex terrain model.
    c. Remove the delta terrain model from the complex terrain model.
    d. Add the new terrain model into the complex terrain model using the Merge option.

7.6 Export Graphics File

Coming Soon

7.7 Drainage Requests

Coming Soon
Additional 3D Pipe file
Copy elements into both exported files

7.8 Import (SS2 DTMs)

This process will be used to convert to an OpenRoads terrain from an old DTM SS2 Survey. The designer will request that an existing terrain DGN file be created from Survey using the DTM SS2 file. Survey will use the ORD Create from File tool to convert the existing DTM to a Terrain. In this case the delivered survey information will be in two or more files: the ORD Terrain (from the DTM) and the V8i Ground File(s) Topo. Below are the basic steps:

1. Create a new 3D Design Model to house the existing Terrain.
2. In the task menu select the **OpenRoads Workflow > Terrain > from File**.
3. Browse to the location of the DTM file to import.
4. The Import Terrain Model(s) dialog will appear, fill out the fields as shown:
    - Feature definition: ***Terrain/ Existing Ground***
    - Import Options: ***Import Terrain Only***
5. Click **Import**.
6. Repeat for 2nd
7. Create Complex using merge
8. (3 results: new + 2 originals) Delete originals
9. Add feature definition for Existing triangles
10. **Save**

Reference (ORD)

Original is Primary, not updated topo. Be sure to 1st rename these original terrains: General>Name & Feature> Feature Name

- Open Blank file
- Reference (orig & updated topo)
- Create Complex Terrain Model
- Set Current Action to Merge
- Load & Set Primary (orig) & Merge (Updated Topo) TM info
- Set Feature Definition (EX_TERR_Ground)
- Set name (Existing)
- Finish

Note: *If an Import Failed error appears, continue with the following DTM procedure.*

a. *Open the DTM using an old version of InRoads.*
b. *On the InRoads Explorer dialog box open the DTM.*
c. *Right click on the DTM and select Properties.*
d. *Toggle on Use Extended Data Checks and Lock Triangulation, click Apply and Close.*
e. *Right click on the DTM and select Save.*
f. *Right click on the DTM and select Properties.*
g. *Toggle off Use Extended Data Checks and Lock Triangulation , click Apply and Close.*
h. *Right click on the DTM and select Save. Right click on the DTM and select Close.*
i. *Repeat Steps 3 & 4.Select Fit View tool and the terrain should appear in the file.*

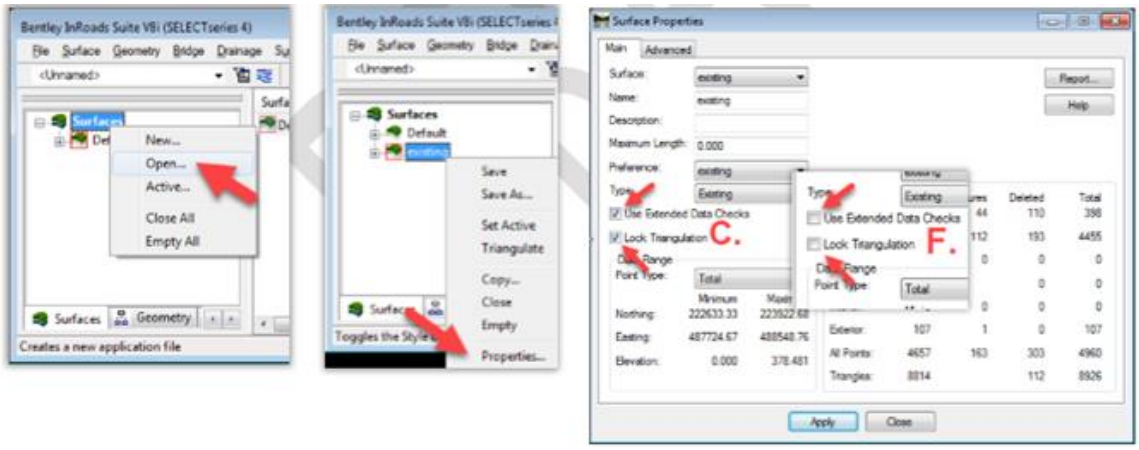


Figure 107 Old InRoads DTM Setting

Exercise 8 - Best Practices

Coming Soon

Skills Taught

- Best Practices for Reviewing and Editing Survey Data

8.1 Checking for Empty Northing, Easting, and/or Elevations