OpenRoads Designer User Manual

U.S. Department of Transportation
Federal Highway Administration

Chapter 22

PROPOSED TERRAIN MODEL CREATION

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Chapter 22 Proposed Terrain Model Creation

This chapter explains how to create Finished Grade and Subgrade Terrain Models from Corridors, Linear Templates, and/or Surface Templates. The resulting Terrain Model is commonly used for project deliverables or other design applications.

NOTE: Civil Cells are packaged set of Linear Templates and Surface Templates. The workflows shown in this chapter apply to Civil Cells models.

WARNING: Before creating proposed Terrain Models, change the Corridor Feature Definition to "Final" or "Final w/ Contours". See *9D.2 Corridor Feature Definition: Design and Final*. This setting increases the Template Drop Interval and "density" of the Corridor. ***BEST PRACTICE:*** To reduce the ORD File size, change the Corridor Feature Definition back to "Design" after the Terrain Model has been created.

NOTE: For creating a custom Terrain Model from User-drawn linework elements, see *11A.2 Surface Templates and Terrain Models – Process Overview*.

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22A – CREATE FINISHED AND SUB-GRADE TERRAIN MODELS

There are two methods for creating Finished Grade or Sub-Grade Terrain Models from Corridors, Linear Templates, and/or Surface Templates.

Terrain Model Creation Methods			
Method	**Description**	**Pros**	**Cons**
***Create Terrain Model from Design Meshes* tool** **PREFERRED AND EASIEST METHOD**	This tool creates a single, combined Terrain Model from **ALL** Corridors, Linear Templates, and Surface Templates referenced into the current ORD File.	This method is very quick because all modeling elements are selected **automatically**.	It is NOT possible to specifically select which Corridors, Linear Templates, and Surface Templates will form the Terrain Model. ORD File referencing and modeling data management must be considered because all modeling elements are automatically included. See the ***DISCUSSION**** below.
Select Mesh Elements to Create the Terrain Model (From Elements tool)	Top/Bottom Mesh elements***** and Surface Template Components are manually selected to create the Terrain Model. ***WARNING:*** This method is NOT advised. This method should only be used as a last resort to create separate Terrain Models from poorly-managed Design ORD File(s). See the ***DISCUSSION**** below.	Modeling elements are **manually** selected. With this method, an intermediate layer Terrain Model (i.e. top of aggregate, red tops) can be created from a **Surface Template**. See ***TIP*** below.	***WARNING:*** **Surface Templates do NOT produce Top/Bottom Mesh elements**. The top Template Component can be selected to create a **Finished Grade** Terrain Model. However, to create a **Sub-Grade** Terrain Model, the Surface Template requires re-configuration. ***WARNING:*** With this method, the resulting Terrain Model often requires additional manipulation and workarounds due to errant triangulation extending past the intended boundary.

TIP: The table above provides methods for creating Terrain Models from the TOP or BOTTOM of the proposed model. For creating Terrain Models from intermediate layers (i.e., top of aggregate, red tops), see *22B – Alternate Surface (Intermediate Layers)* [Corridors and Linear Templates ONLY]. For creating an intermediate layer Terrain Model from Surface Templates, see *22A.2.c Surface Templates with the From Elements tool*.

NOTE*: Top and Bottom Mesh elements are created by Corridors and Linear Templates and represent Finished Grade (Top Mesh) and Sub-Grade (Bottom Mesh). Surface Templates do NOT produce Top/Bottom Mesh elements. For more information, see *9I.1 Top and Bottom Meshes*.

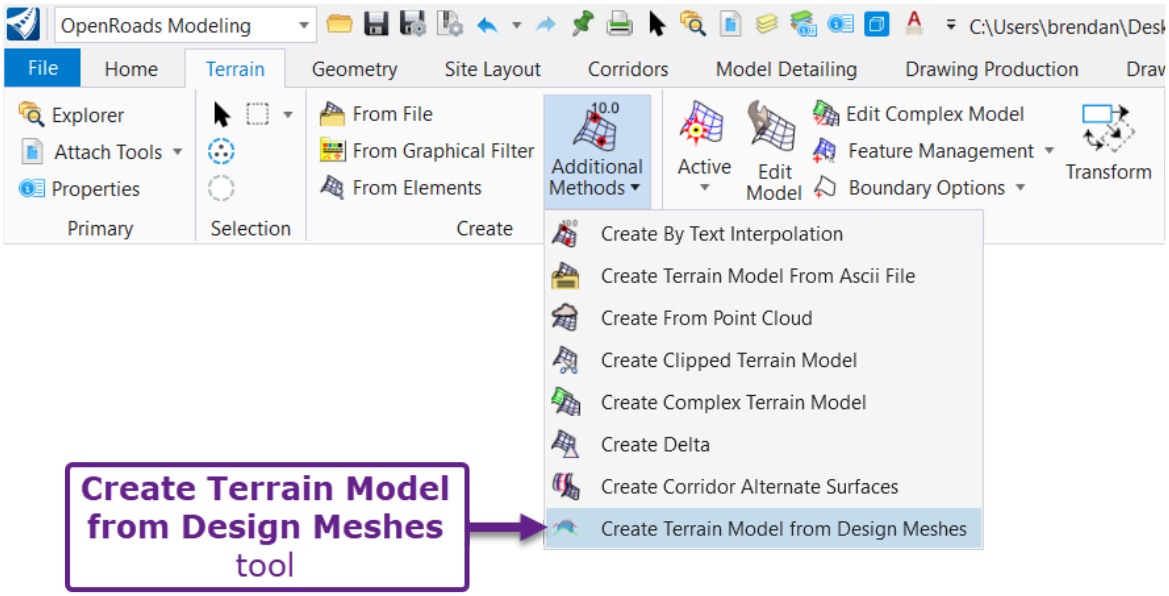
DISCUSSION**: It is ***BEST PRACTICE*** to create a new Design ORD File for each design feature type. For example, do NOT create and model the Mainline Road Corridor and an intersecting Side Road Corridor in the same Design ORD File. This configuration is problematic because the *Create Terrain Model From Design Meshes* tool creates a single Terrain Model for both the Mainline and intersecting Side Road.

22A.1 Create Terrain Model from Design Meshes tool

With the *Create Terrain Model From Design Meshes* tool, a Finished Grade or Sub-grade Terrain Model is created from **ALL** Corridors, Linear Templates, and Surface Templates **within** AND **referenced** into the current ORD File.

WARNING: Before creating a proposed Terrain Model, change the Corridor Feature Definition to "Final" or "Final w/ Contours". See *9D.2 Corridor Feature Definitions: Design and Final*. This setting increases the Template Drop Interval and "density" of the Corridor.

NOTE: Terrain Models created with this tool are NOT dynamic. If the design changes, then a new Terrain Model must be created.



The flow chart below details the process for creating a Proposed Terrain Model with the *Create Terrain Model from Design Meshes* tool:

Create a new Proposed Terrain Model ORD File

BEST PRACTICE: Use a **3D Seed File** when creating the new ORD File**.**

IMPORTANT: ONLY reference in the Design ORD Files that contain the desired Corridors, Linear Templates, and/or Surface Templates

22A.1.b Create a Proposed Terrain Model ORD File

↓

Use the *Create Terrain Model from Design Meshes* tool

22A.1.c Use the Create Terrain Model from Design Meshes tool

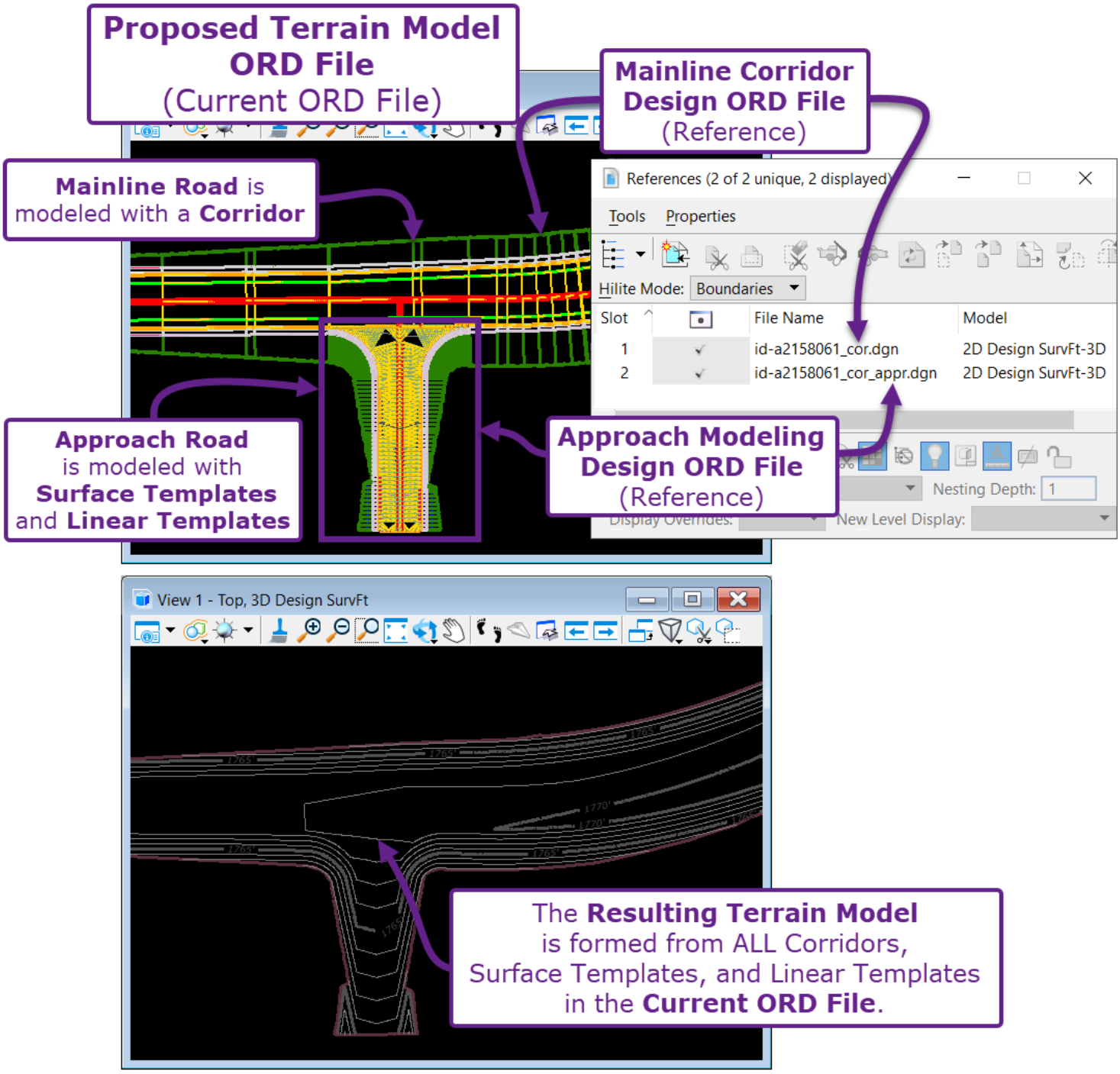
↓

Examine and Rename the Terrain Model

22A.1.d Examine and Rename the Terrain Model

22A.1.a Background Information

ALL Corridors, Linear Templates, and Surface Templates that are **referenced** into the current ORD File are included in the resulting Terrain Model.

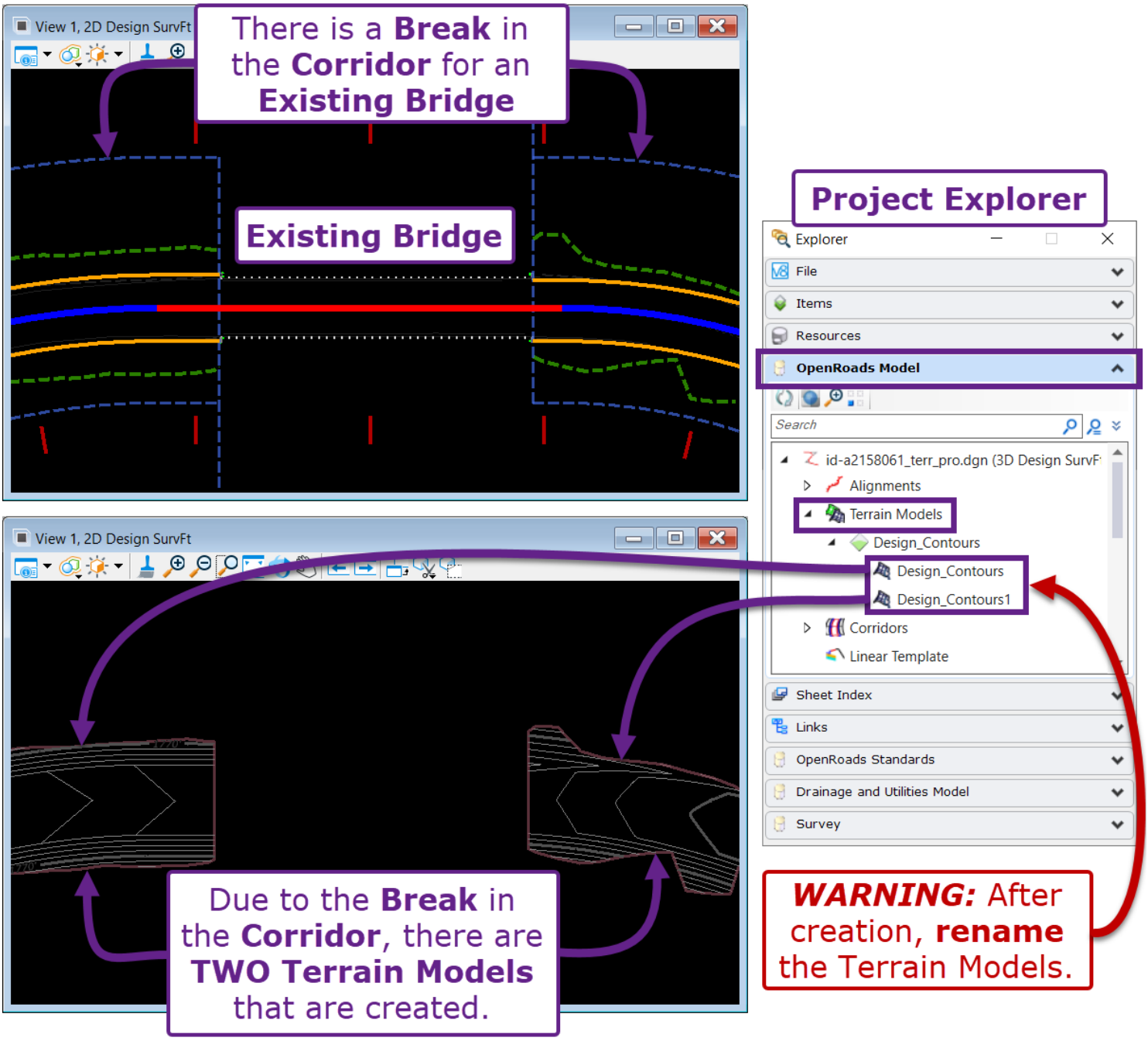


WARNING: Even if a Reference display is toggled OFF or clipped, all contained modeling elements are still included in the Terrain Model. Reference and File management must be considered to control which modeling elements are included in the Terrain Model.

TIP: To manually select which modeling elements are included in the Terrain Model, see *22A.2 Select Mesh Elements to Create the Terrain Model*. However, this process is more complicated and prone to error.

Multiple Terrain Model Creation: As shown on the previous page, all **adjacent** Corridors, Linear Templates, and/or Surface Templates are combined into a single Terrain Model.

IMPORTANT: If there is a **gap or break between modeling elements**, then separate Terrain Models are created. For example, if the Corridor contains a break for an existing bridge, then a Terrain Model is created on each side of the bridge break.



TIP: The resulting Terrain Models are listed in the Explorer under the **OpenRoads Model** drop-down.

WARNING: The *Create Terrain Model from Design Meshes* tool does NOT provide the option for **Naming** the resulting Terrain Model. Initially, the Terrain Model is named according to the Feature Definition specified in creation. After creation, re-name the Terrain Model appropriately. See *22A.1.d Examine and Rename the Terrain Model*.

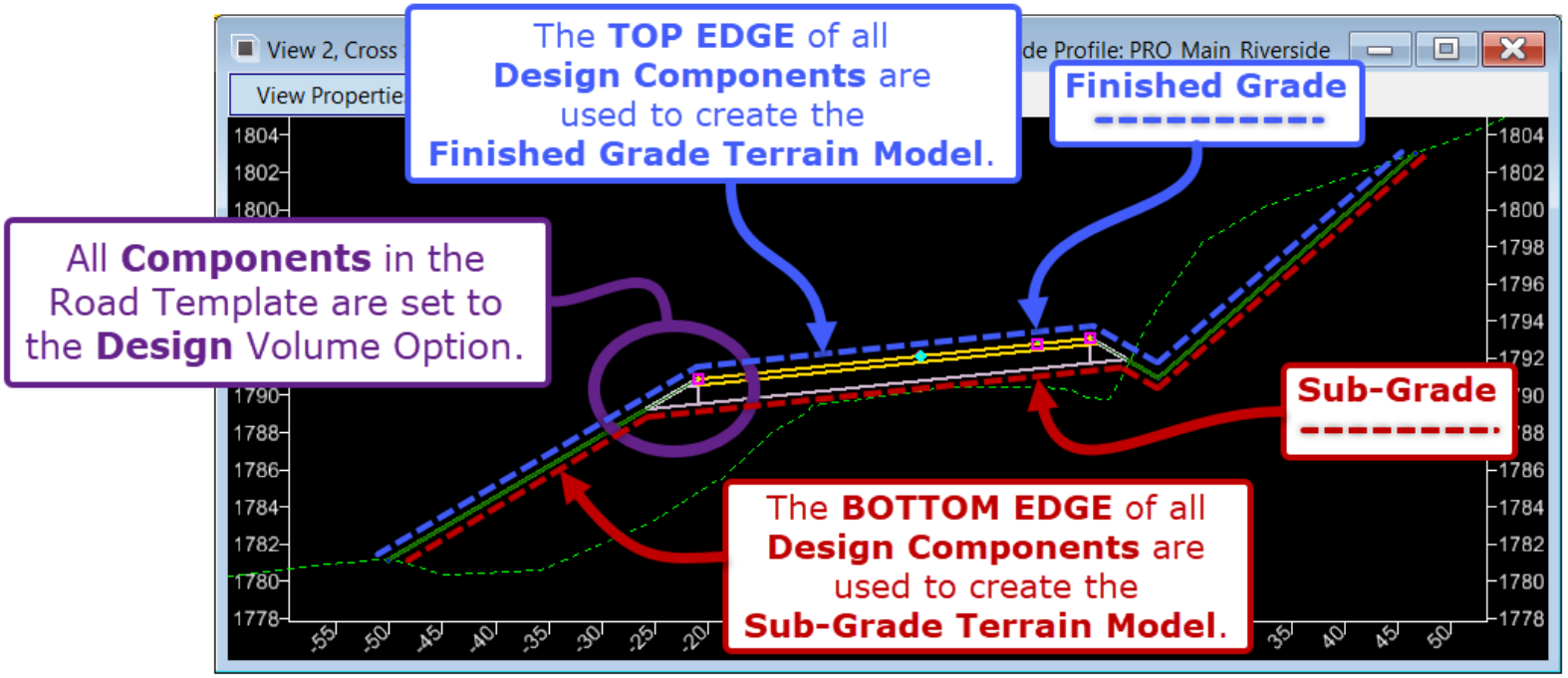
Volume Option: When the *Create Terrain Model from Design Meshes* tool is used, the *Volume Option* setting controls if a Template Component is incorporated into the Terrain Model.

> ***TIP:*** The *Volume Option* setting is accessed/viewed in the **Mesh** Feature Definition settings which are found in the Explorer . To locate this setting, see *22A.1.a.i Change the Volume Option for a Component - Workflow*.
>
> ***NOTE:*** The *Volume Option* setting also affects how earthwork volume quantities are calculated when the *Create Cut Fill Volumes* tool is used. See *20G – Advanced Information: Component Feature Definition and Volume Options*.

Design Volume Option: If the **Mesh** Feature Definition for the Template Component is set to **Design** Volume Option, then the Template Component will be considered for inclusion in the Terrain Model.

In the graphic shown below, ALL Template Components are assigned to the **Design** Volume Option.

> If a **Finished Grade** Terrain Model, then the **TOP EDGE** of all Components will form the Terrain Model.
>
> If a **Sub-Grade** Terrain Model is created, then the **BOTTOM EDGE** of all Components will form the Terrain Model.



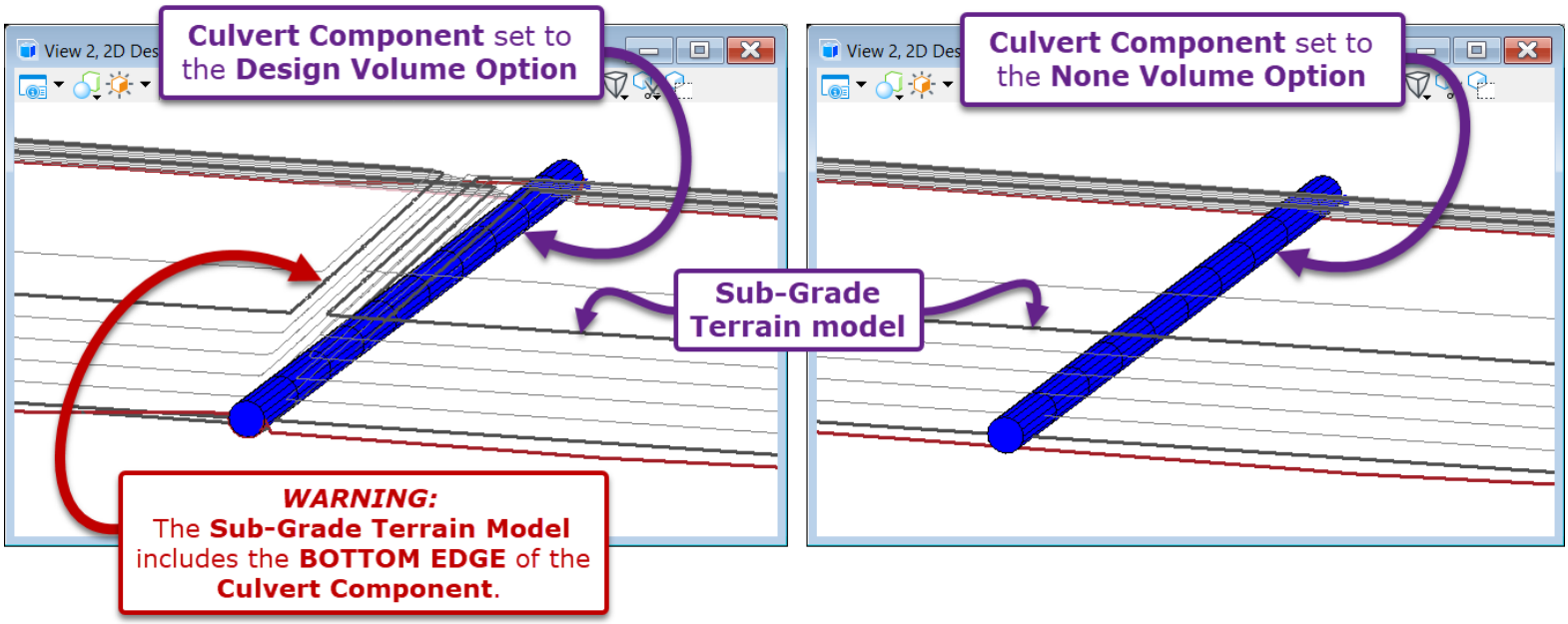
NOTE: In the FLH WorkSpace and Template Library, the settings for proposed Road Template Components are pre-configurated and assigned to the **Design** *Volume Option*. For more information on the **Design** *Volume Option*, see *20G.1 Design Volume Option*.

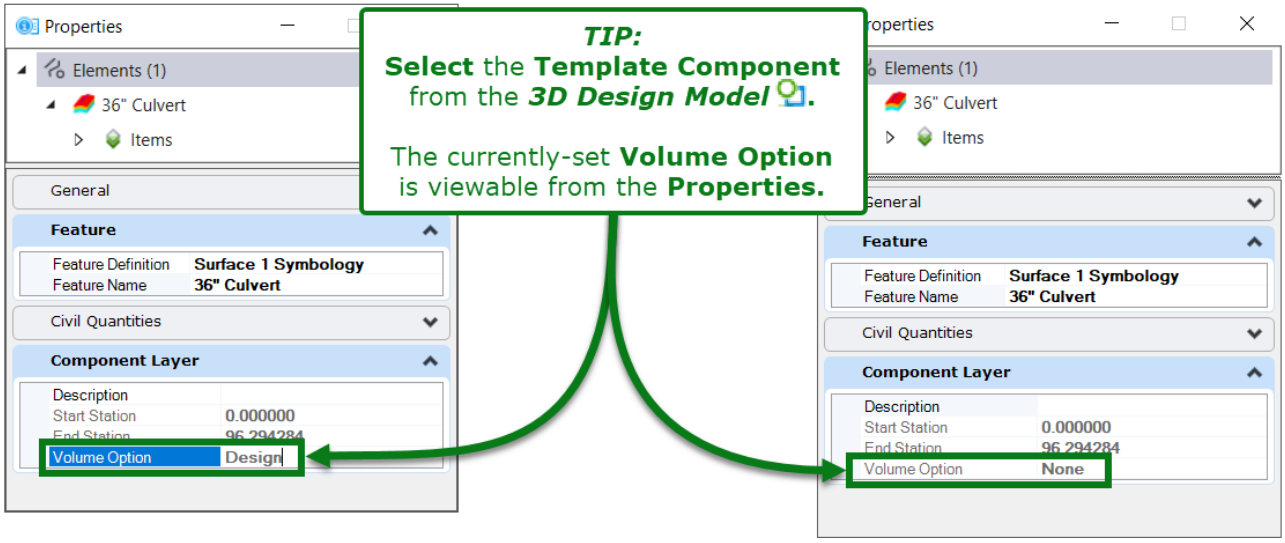
None Volume Option: If the **Mesh** Feature Definition is set to the **None** Volume Option, then the Template Component will NOT be included in the Terrain Model.

The graphic below illustrates the difference between the **Design** and **None** Volume Options when a Sub-Grade Terrain Model is created with the *Create Terrain Model from Design Meshes* tool.

If the Culvert Component is set to the **Design** Volume Option (left graphic), then the Sub-Grade Terrain Model includes the BOTTOM EDGE of the Culvert. The Road Sub-Grade Surface is interrupted by the Culvert Component.

If set to the **None** Volume Option (right-graphic), then the Sub-Grade Terrain Model does NOT seek out and include the Culvert Component.





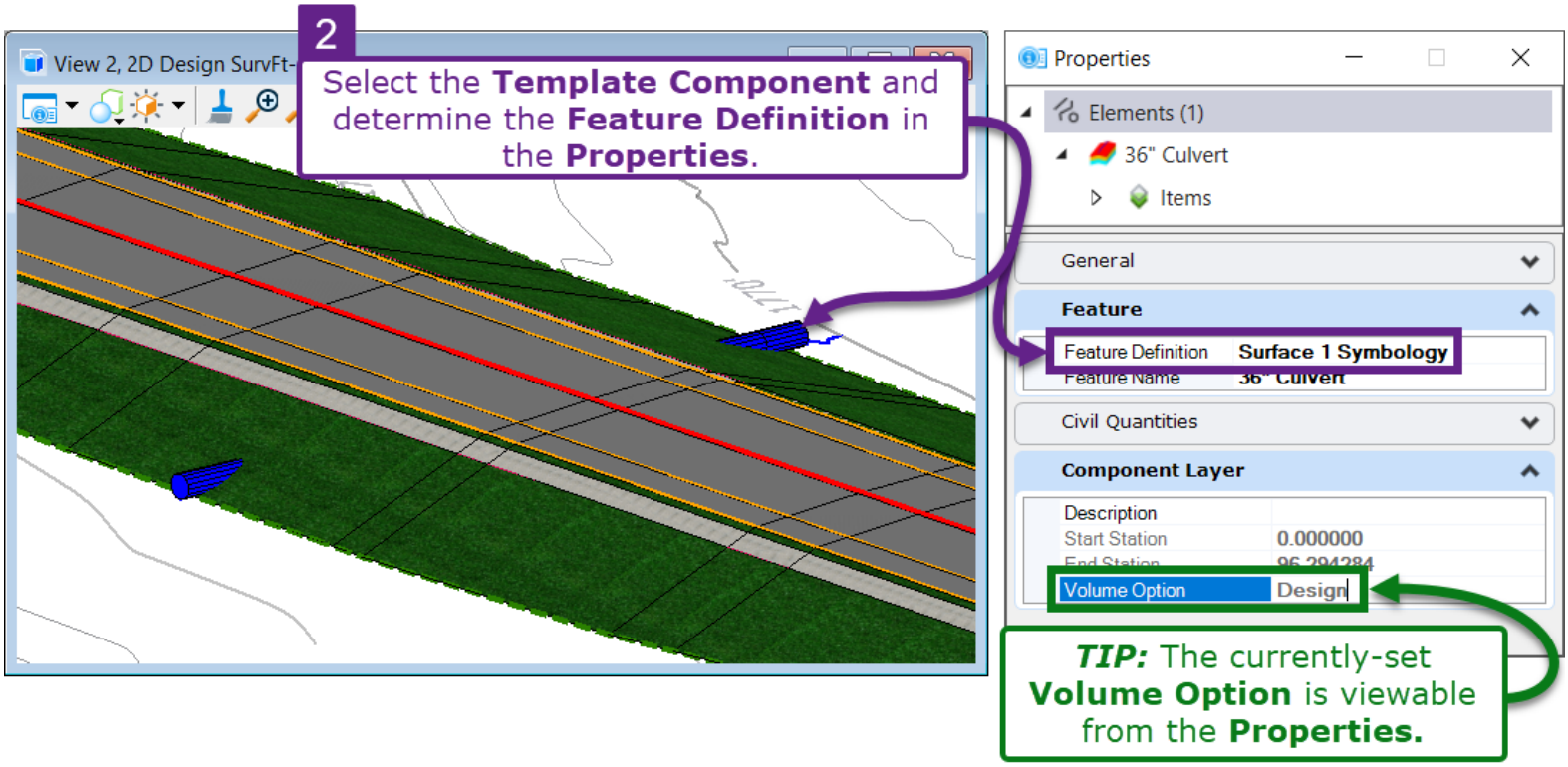
TIP: Selecting a Template Component in the *3D Design Model* reveals the currently-set *Volume Option* in the Properties box. However, the *Volume Option* is greyed out and CANNOT be changed from the Properties. The *Volume Option* must be changed from the Explorer menu.

22A.1.a.i Change the Volume Option for a Component - Workflow

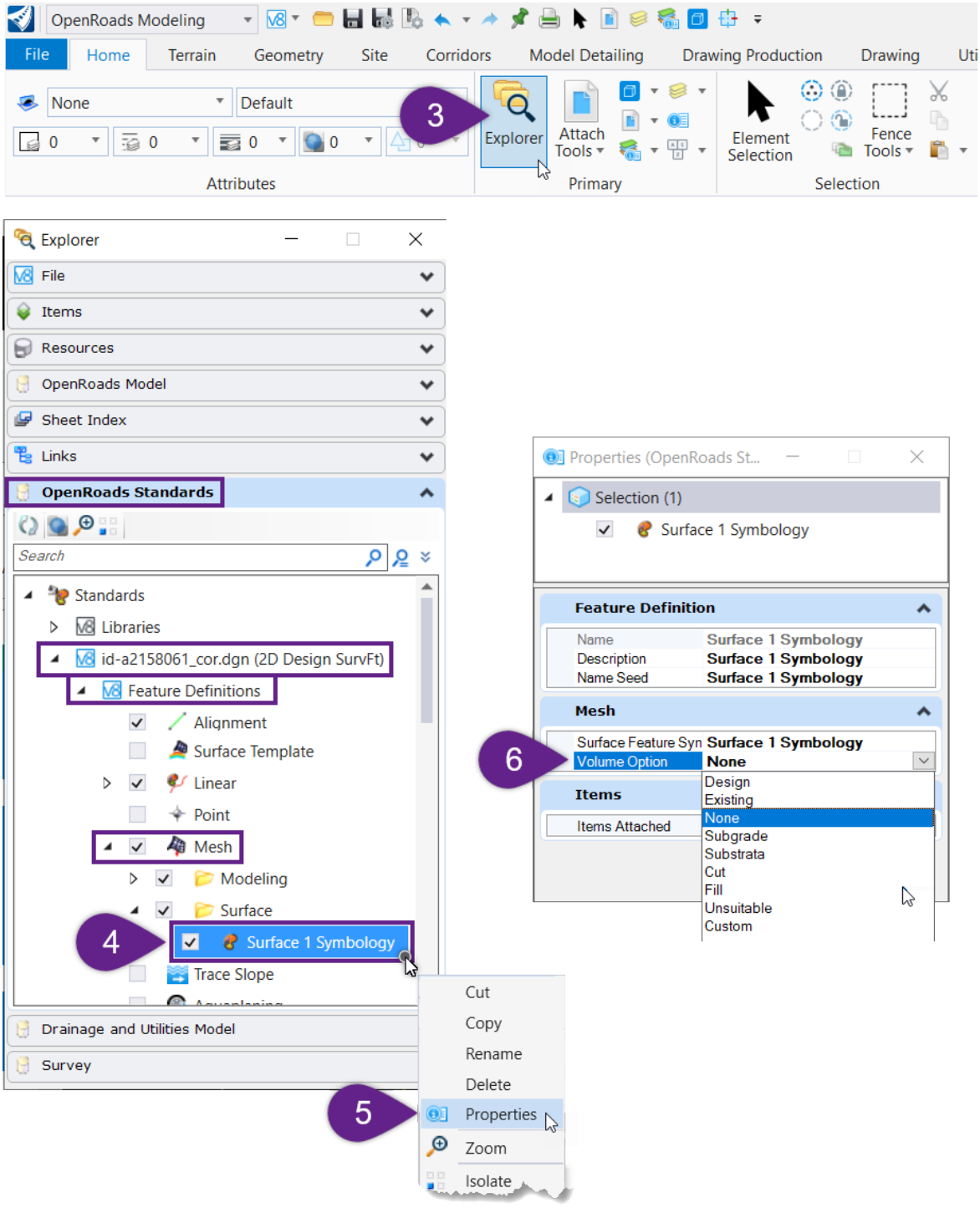
The *Volume Option* for a Template Component is accessed through the Explorer menu. The *Volume Option* is a **Mesh** Feature Definition setting.

This workflow demonstrates how to locate and change the *Volume Option* setting.

1	Open the Design ORD File that contains the Template Component. ***IMPORTANT:*** To take effect, the Volume Option setting must be changed from the ORD File that the Template Component was created in.
2	Determine the **Feature Definition** of the Template Component. In this case, the Culvert Template Component is set to the "Surface 1 Symbology" Feature Definition. ***TIP:*** Select the Template Component in the *3D Design Model* and examine the Properties to determine the Feature Definition.

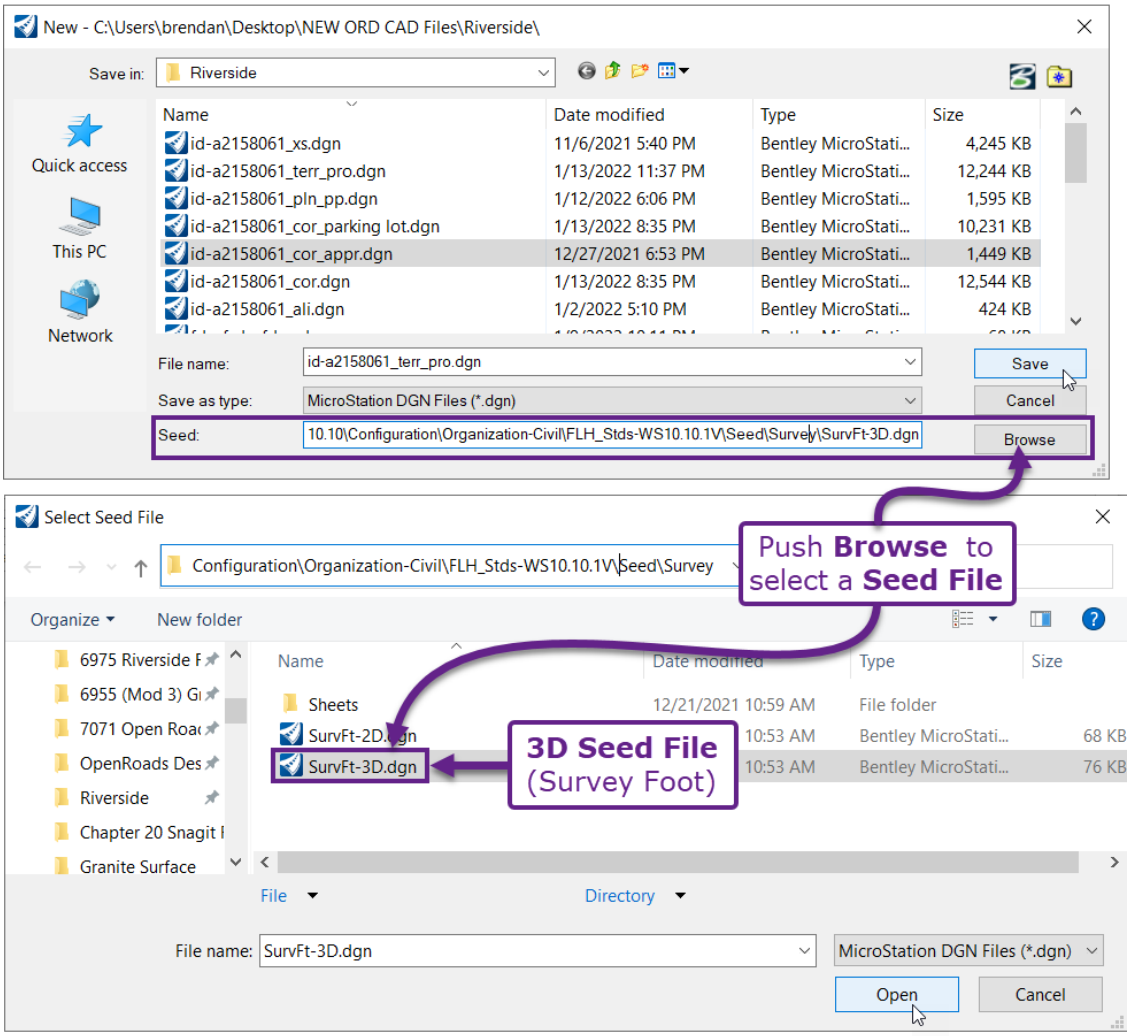


3	Open the **Explorer** menu.
4	Locate the **Feature Definition** in the Explorer. **Mesh** Feature Definition settings are located under: *OpenRoads Standards → Current DGN Name (Default) → Feature Definitions → Mesh*
5	Right-Click on the **Feature Definition** and select **Properties**.
6	Change the **Volume Option** as desired.



22A.1.b Create a Proposed Terrain Model ORD File

1	Create a new ORD File to contain the Proposed Terrain Model. ***BEST PRACTICE:*** Use a **3D Seed File** when creating the new ORD File. See the **2D Seed File vs 3D Seed File Discussion** below. For more information on Seed Files, see *3B.3 The Seed File*. Seed Files are found in the FLH WorkSpace at the following location: …\OpenRoads Designer CE 10.10\Configuration\Organization-Civil\FLH_Stds-WS10.10.1V\Seed

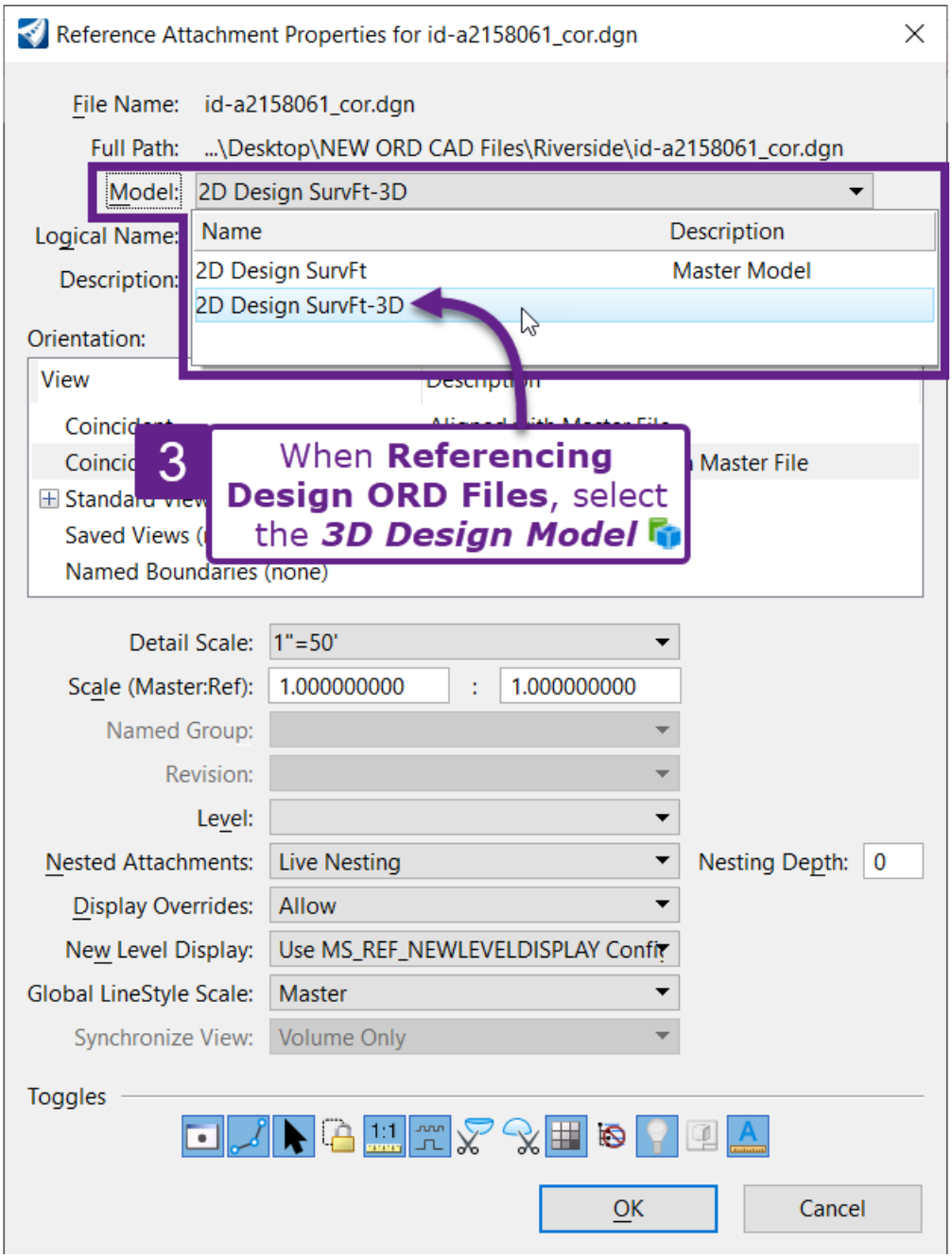


2D Seed File vs 3D Seed File Discussion: When a **3D Seed File** is used, the new ORD File ONLY contains a *3D Design Model*. Proposed Terrain Models are 3D entities and reside in the *3D Design Model*. For Proposed Terrain Model creation, typically the *2D Design Model* is NOT necessary.

However, if the Proposed Terrain Model requires troubleshooting or manipulation after initial creation, then a *2D Design Model* is needed.

BEST PRACTICE: Create the Proposed Terrain Model using a **3D Seed File**. Examine the Proposed Terrain Model for inconsistencies and erroneous triangulation. If the Proposed Terrain Model needs troubleshooting or manipulation, then re-create the ORD File using a **2D Seed File**. Troubleshooting a Terrain Model must be done from the *2D Design Model*. For Terrain Model troubleshooting procedures, proceed to *22C – Troubleshooting and Manipulating the Terrain Model*.

2	In the new ORD File, set the appropriate **Coordinate System**. See *3D.1 Set the Coordinate System*.
3	In the new ORD File, **reference** in Design ORD Files that contain the desired Corridors, Linear Templates, and Surface Templates. ***IMPORTANT:*** If using a **3D Seed File**, reference the ***3D Design Model*** of the Design ORD File. The *3D Design Model* is selectable through the *Reference Attachment Properties*.



22A.1.c Use the Create Terrain Model from Design Meshes tool

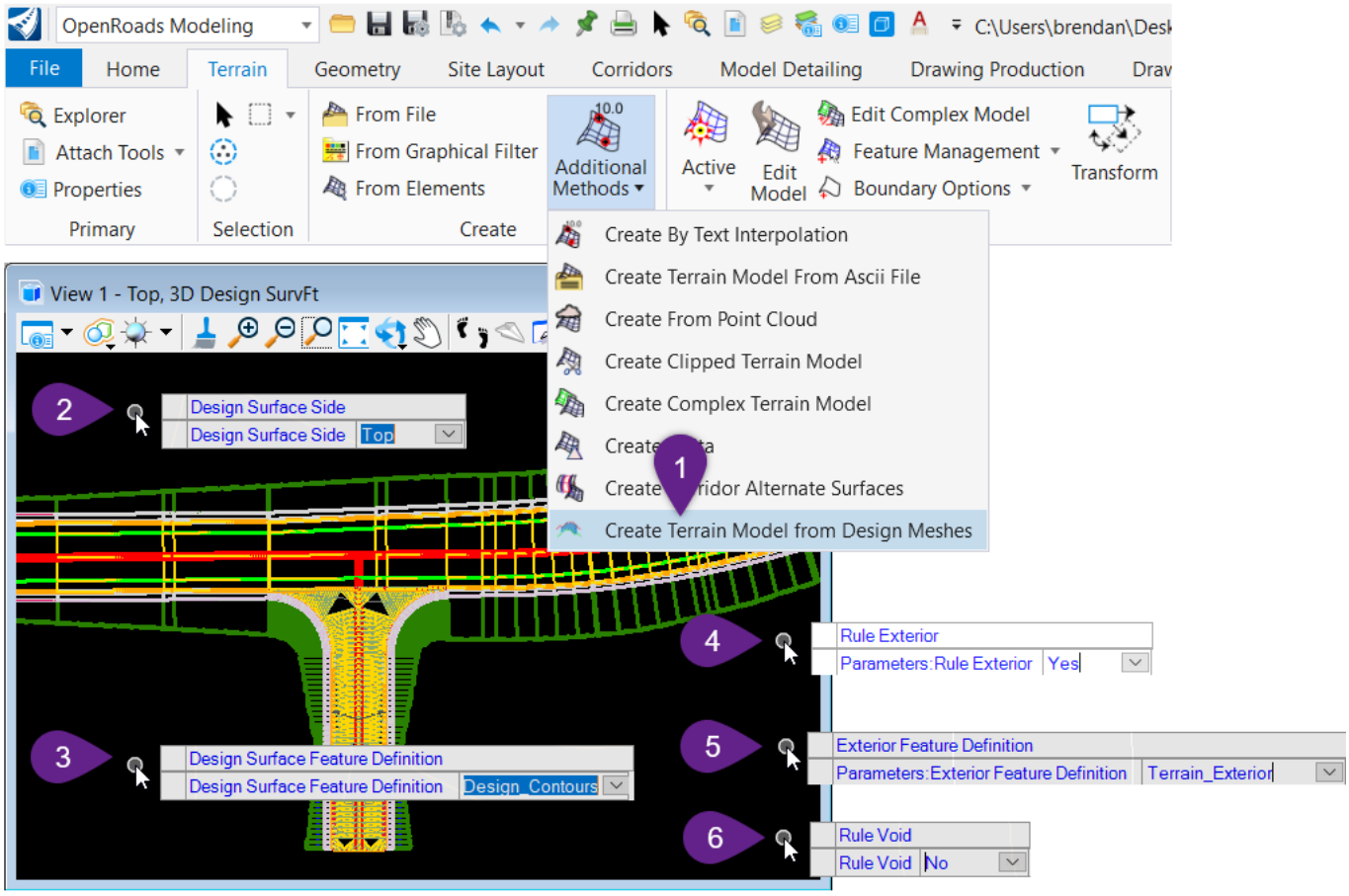
In step 2, the User is prompted to select the *Design Surface Side*:

TOP: If the **TOP** option is used, then a **Finished Grade Terrain Model** is created.

BOTTOM: If the **BOTTOM** option is used, then a **Sub-Grade Terrain Model** is created.

In step 4, the *Rule Exterior* (YES or NO) prompt is shown. If YES is selected, then a 3D Linear Element is created around the Boundary of the resulting Terrain Model. This Boundary element is useful for the following applications:

- The Boundary element can be used for troubleshooting and manipulating the resulting Terrain Model.
- The Boundary element represents the perimeter of the Corridor. This Boundary element has applications in quantity calculations and plan production:
  - The Boundary element represents the Total Area of Disturbance. Copy the Boundary element into the *2D Design Model* and measure the area.
  - The Boundary element can be copied, trimmed, and offset to create the Construction Limits for the project.



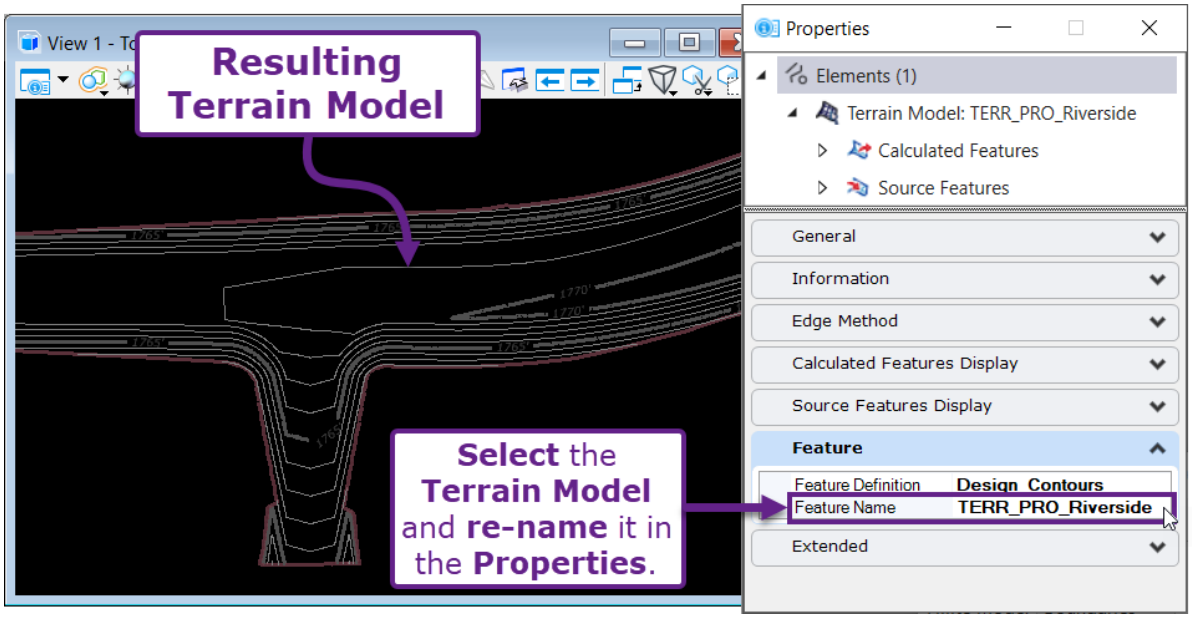
1	From the Ribbon, select the *Create Terrain Model from Design Meshes* tool: [***OpenRoads Modeling*** → ***Terrain*** → ***Create*** → ***Additional Methods***].

2	*Prompt: Design Surface Side* – Select **Top** to create a **Finished Grade Terrain Model**. Select **Bottom** to create a **Sub-grade Terrain Model**.
3	*Prompt: Design Surface Feature Definition* – Select the "**Design_Contours**" Feature Definition for the resulting Terrain Model. This Feature Definition will show the Contours of the resulting Terrain Model.
4	*Prompt*: *Rule Exterior* – Select *Yes* to create a separate Boundary element. ***BEST PRACTICE:*** Select YES. As stated on the previous page, the Boundary element can be useful for various applications.
5	*Prompt: Exterior Feature Definition* – The Boundary element will be placed on the Feature Definition specified in this step. ***TIP:*** Use the Linear → Terrain Features → "**Terrain_Exterior**" Feature Definition.
6	*Prompt*: *Rule Void* – Select *Yes* to create **Interior** Boundary elements for each Void or Hole present in the model. ***TIP:*** Use the Linear → Terrain Features → "**Terrain_Interior**" Feature Definition. ***WARNING:*** For the 2021 Release 1 - Update 10 (10.10.01.03) version of the ORD Software, this option is does NOT function. For accommodating void areas in a Terrain Model, see *22C.1 Create Gaps in the Terrain Model*.

22A.1.d Examine and Rename the Terrain Model

Examine the Proposed Terrain Model: Look for inconsistencies and erroneous triangulation in the Terrain Model. If the Proposed Terrain Model needs troubleshooting or manipulation, then proceed to *22C – Troubleshooting and Manipulating the Terrain Model*.

Rename the Proposed Terrain Model: The *Create Terrain Model from Design Meshes* tool automatically assigns the Terrain Model a default name. Rename the Terrain Model in accordance with FLH Naming conventions. See *3F - Naming Convention for Proposed ORD File*.



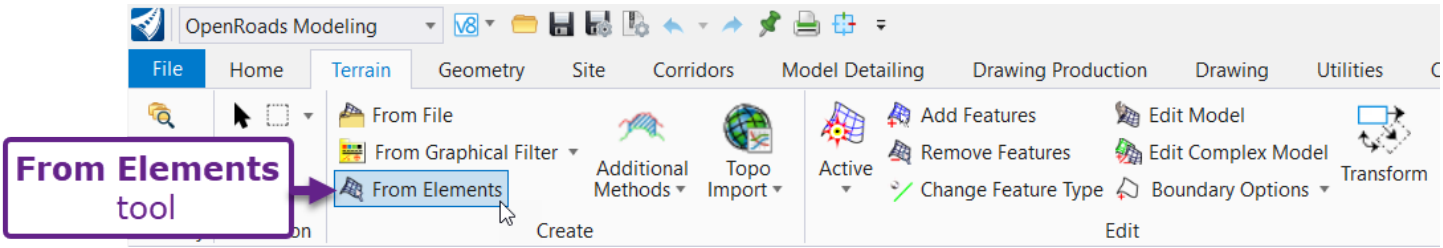
22A.2 Select Mesh Elements to Create the Terrain Model

This is an alternate method for creating a Terrain Model. In this method, modeling elements are manually selected with the *From Elements*. The types of modeling elements that are typically selected are:

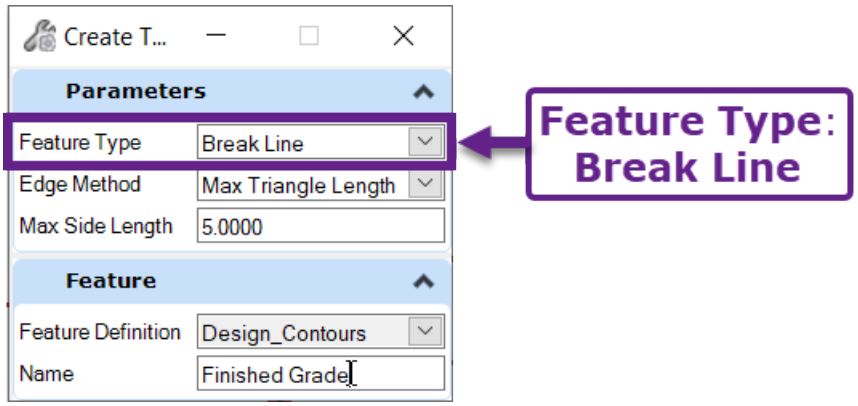
- Top and Bottom Mesh elements – which are produced by Corridors and Linear Templates
- Surface Template Components (i.e., Pavement Layer 1).

The *From Elements* tool can be found in the Ribbon in the following location:

OpenRoads Modeling workflow → **Terrain** tab → **Create** panel



TIP: When using the *From Elements* tool, set the **Feature Type** to **Break Line**.



Edge Method and **Max Side Length** can be edited after creation of the Terrain Model. If the resulting Terrain Model extends past the boundary of the modeling elements, editing these Properties settings may adjust the Terrain Model Boundary as desired.

TIP: Typically, the **Max Edge Length** with a **Max Side Length** value of **5.0000**' produces acceptable results. If this combination does NOT work, try increasing the **Max Side Length** value by increments of 2.5'. To locate this Property setting for the resulting Terrain Model, see *22C.2 Terrain Model Extends Past Proposed Terrain Model*.

22A.2.a Create a Proposed Terrain Model ORD File

Create a new ORD File to contain the Proposed Terrain Model. This procedure is shown in *22A.1.b Create a Proposed Terrain Model ORD File*.

BEST PRACTICE: When using modeling elements to create the Proposed Terrain Model, use a **2D Seed File**. The resulting Terrain Model will likely require manipulation from the *2D Design Model* .

In the new ORD File, reference in the following Files:

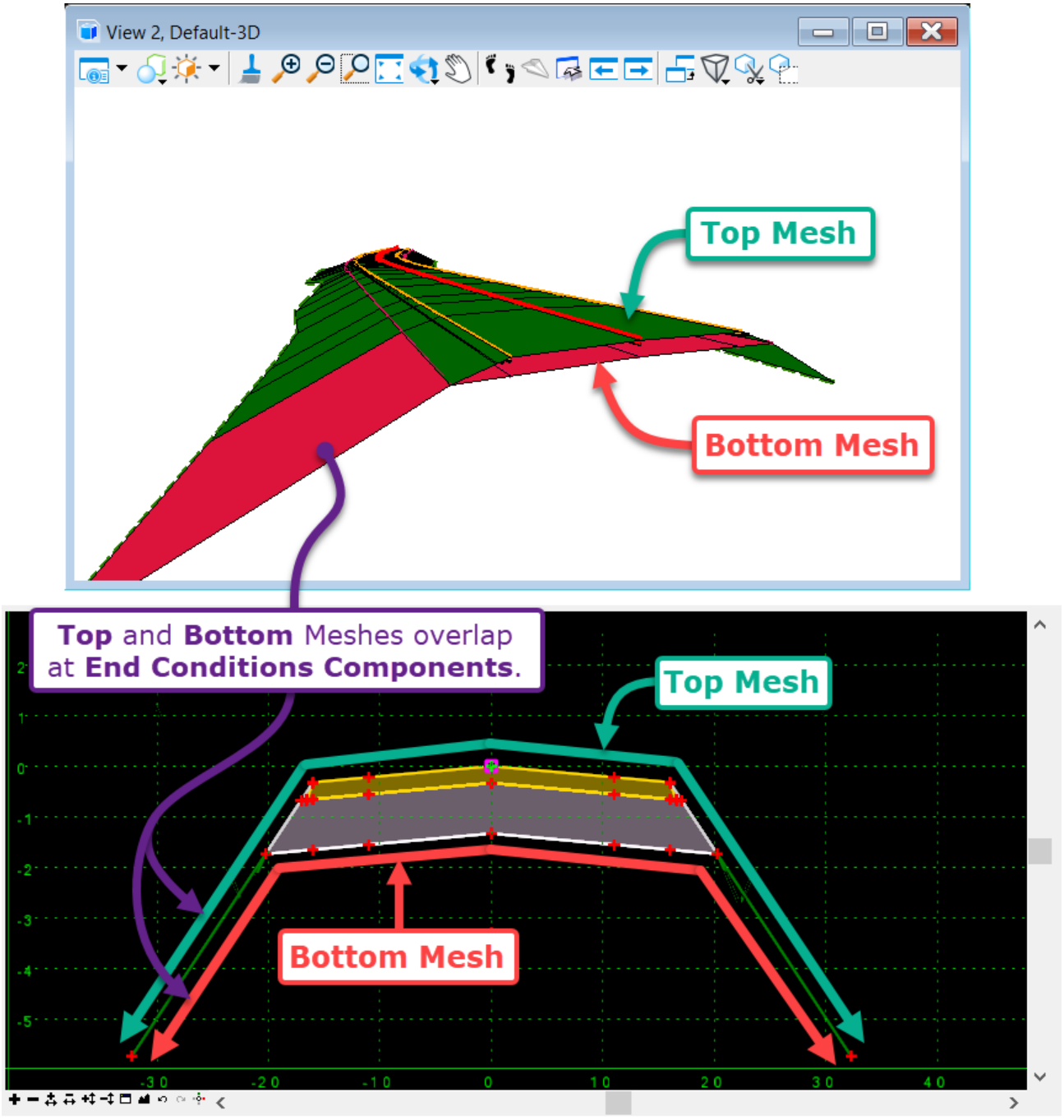
Existing Ground Terrain Model ORD File: To access the *3D Design Model* for the new ORD File, the Existing Ground Terrain Model needs to be referenced and *Activated*.

Design ORD Files: Reference in the Design ORD Files that contain the desired modeling elements to be included in the Terrain Model.

22A.2.b Corridors and Linear Templates (Top/Bottom Mesh Elements)

Corridors and Linear Templates produce Top and Bottom Mesh elements. As shown below, the **Top Mesh** elements represents **Finished Grade**. The **Bottom Mesh** element represents **Sub-Grade**.

NOTE: Initially, Top and Bottom Mesh elements are hidden. Corridor/Linear Template Feature Definition settings must be edited to display the Top and Bottom Mesh elements.



WARNING: Surface Templates do NOT produce Top/Bottom Meshes. The process for selecting Surface Templates with the *From Elements* tool is shown in *22A.2.c Surface Templates with the From Elements tool*.

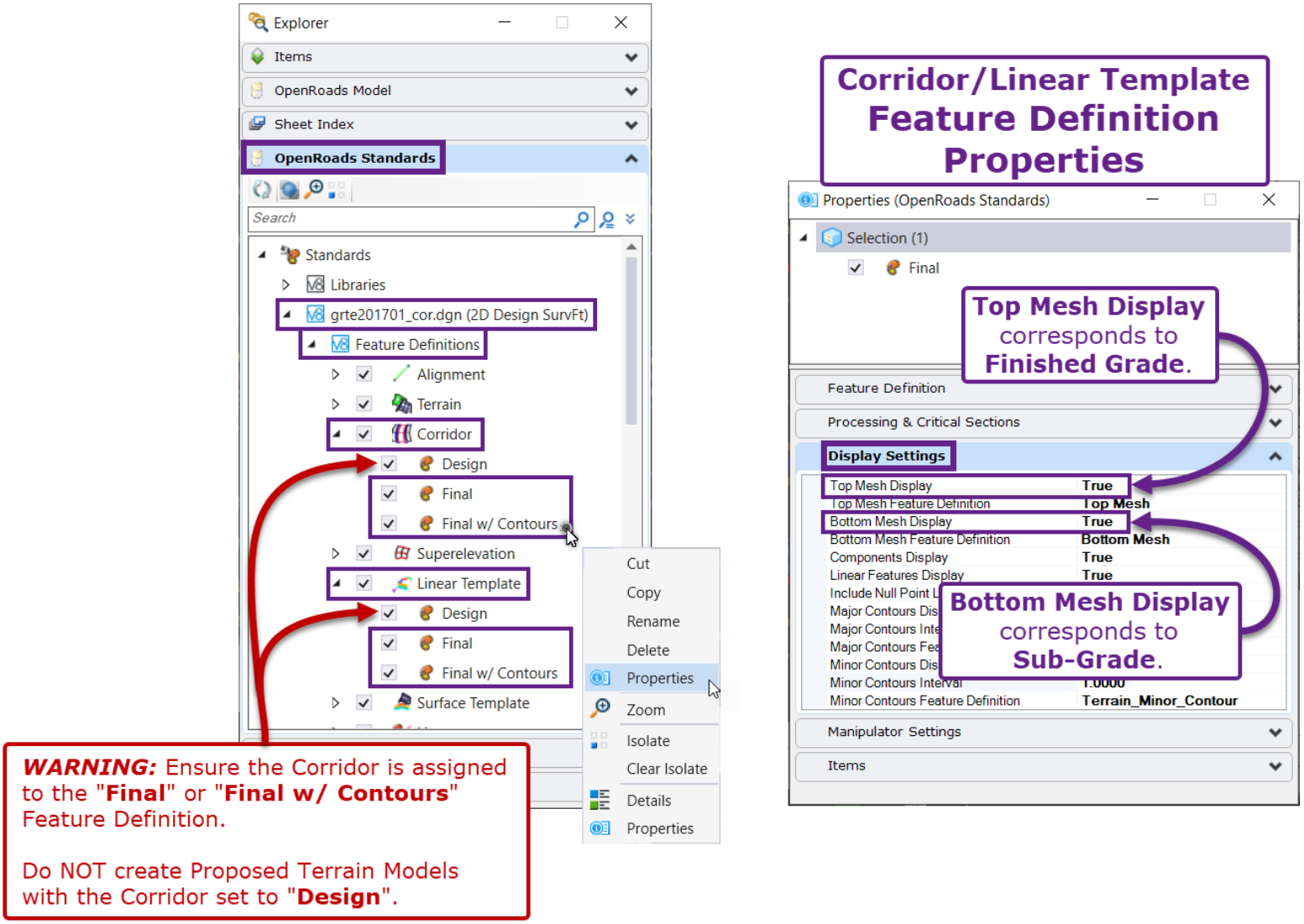
22A.2.b.i Display Top and Bottom Meshes

Initially, Top and Bottom Mesh elements are NOT selectable or displayed in the *3D Design Model* . Corridor and Linear Template **Feature Definition Properties** have to be re-configured to display Top/Bottom Meshes.

Corridor and Linear Template **Feature Definition Properties** are edited through the Project Explorer in the following location:

OpenRoads Standards > *Current DGN Name (Default)* > *Feature Definitions* > *Corridor* or *Linear Template*

The *Top Mesh Display* and *Bottom Mesh Display* must be changed from *False* to *True.*



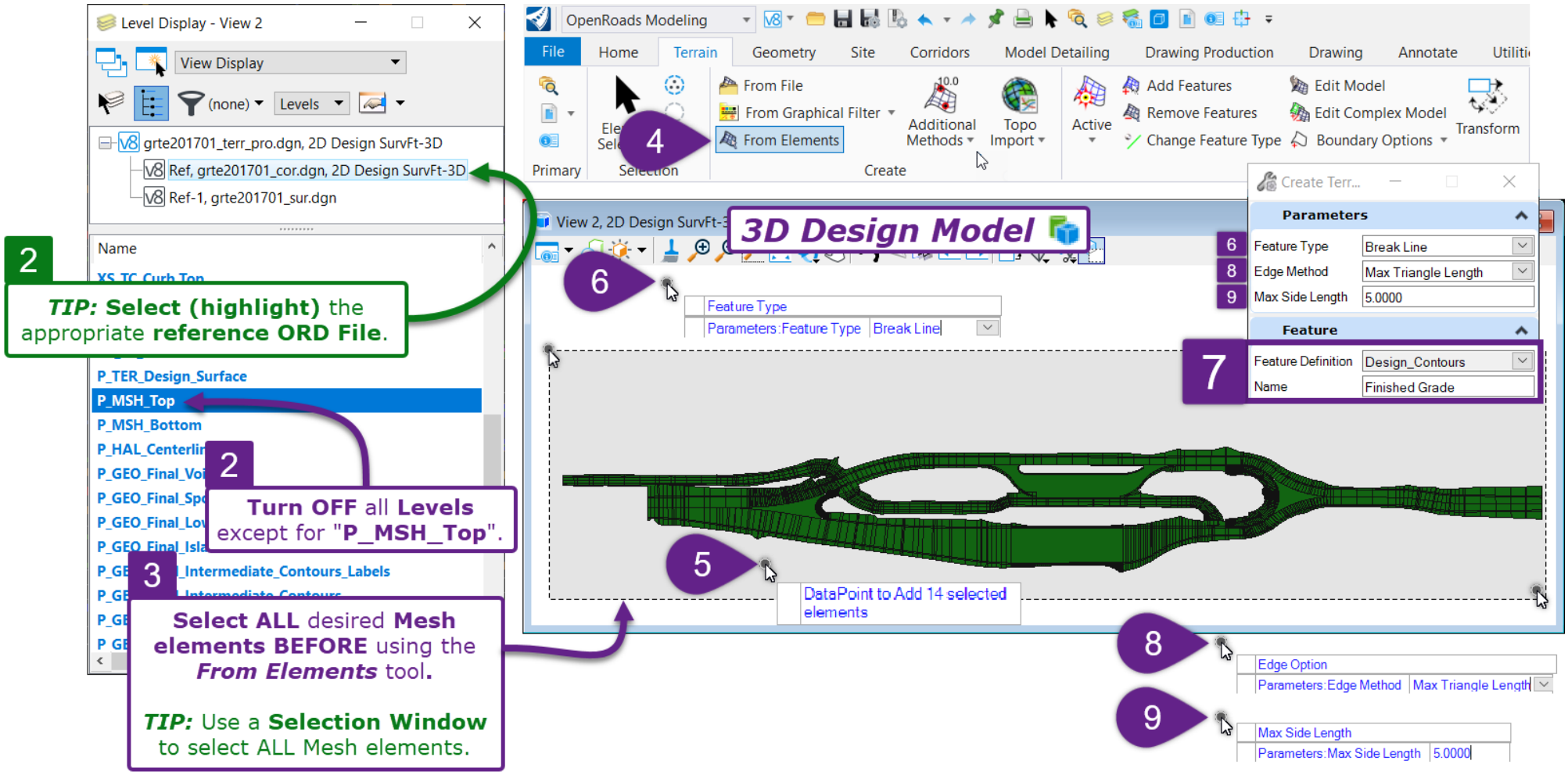
IMPORTANT: After Feature Definition Properties are edited, ALL Corridors and Linear Templates must be re-processed for the Top and Bottom Mesh to be displayed. See *9H.1 Locking and Processing the Corridor*.

22A.2.b.ii Select Top or Bottom Mesh elements with the From Elements tool

When using the *From Elements* tool, Top or Bottom Mesh elements must be selected from *3D Design Model*.

TIP: A combination of Top or Bottom Mesh elements [Corridors and Linear Templates] and **Surface Templates Components** can be selected when using this tool. See *22A.2.c Surface Templates with the From Elements tool*.

BEST PRACTICE: Select the desired modeling elements BEFORE using the *From Elements* tool. Isolate and turn off levels to decongest the *3D Design Model*.



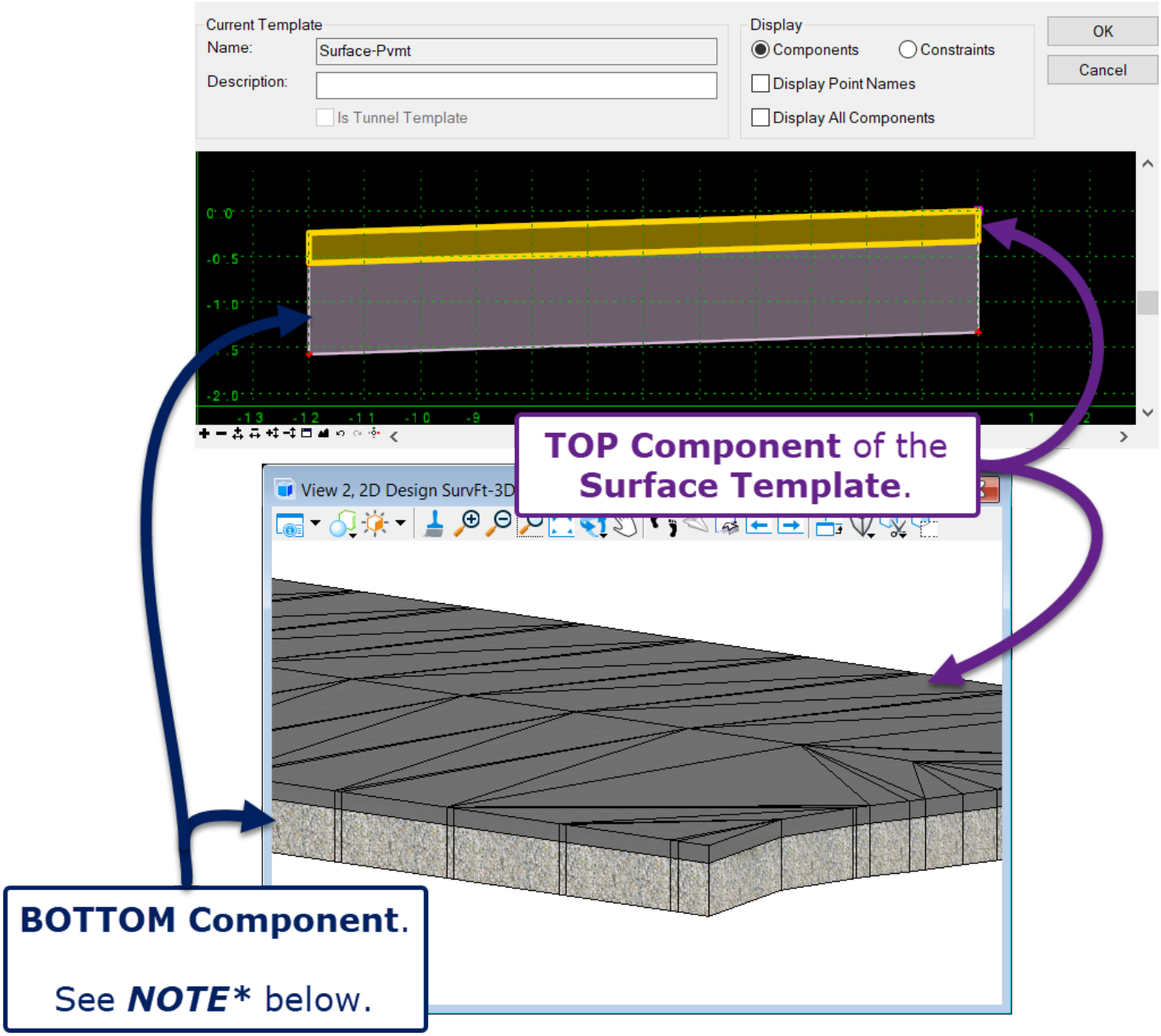
1	In the new Proposed Terrain Model ORD File, open the *3D Design Model* view. ***NOTE:*** If the new ORD File does NOT contain a *3D Design Model*, then the Existing Grade Terrain Model has NOT been *Activated*.
2	Turn OFF all Levels except for "P_MSH_Top" (Finished Grade) or "P_MSH_Bottom" (Sub-Grade). ***TIP:*** Select (highlight) the appropriate reference ORD File from the list in the top portion of the Level Display menu.
3	Select the desired Top/Bottom Mesh elements. ***TIP:*** To select all Top or Bottom Mesh elements, zoom out and use a *Selection Window* to
4	From the Ribbon, select the *From Elements* tool: [***OpenRoads Modeling*** → ***Terrain*** → ***Create*** → ***From Elements***].
5	*Prompt: DataPoint to Add X selected elements* **–** Left-Click (data point) in the *View* to accept the current selection of Mesh Elements
6	*Prompt: Feature Type:* **Break Lines**. To create the Terrain Model, the Mesh Elements must be added as **Break Lines**.
7	***IMPORTANT:*** Before advancing further, assign the Terrain Model a **Feature Definition** and **Name** in the *Dialogue Box*. When creating a **Finished Grade** Terrain Model (Top Mesh elements), select a Feature Definition from the **Terrain** → **Design** folder (i.e., "Design_Contours" or "Design_Triangles"). For **Sub-Grade** Terrain Models (Bottom Mesh elements), select a Feature Definition from the **Terrain** → **Subgrade** folder (i.e., "Subgrade_Contours" or "Subgrade_Triangles").
8	*Prompt: Edge Option:* **Max Triangle Length**. ***NOTE:*** *Edge Options* are discussed in *11B.5 Edge Methods for Terrain Model Triangulation and Troubleshooting*. Edge Options affect the overall triangulation for the Terrain Model. For initial creation of the Terrain Model, use the **Max Triangle Length** with the **Max Side Length** set to **5.0000**.
9	*Prompt: Max Side Length:* **5.0000**.

WARNING: After creation, examine the resulting Terrain Model for consistency with the Proposed Model. Commonly, Terrain Model extends past the Proposed Model as shown in *22C.2 Terrain Model Extends Past Proposed Model*.

22A.2.c Surface Templates with the From Elements tool

Surface Template Components can be included in the selection set to create a Terrain Model with the *From Elements* tool.

The Terrain Model will follow the top surface of the Surface Template Component. A **Finished Grade** Terrain Model can be created directly from the **TOP Component**.



NOTE: If the BOTTOM Component is selected, then the resulting Terrain Model follows the top surface of the BOTTOM Component.

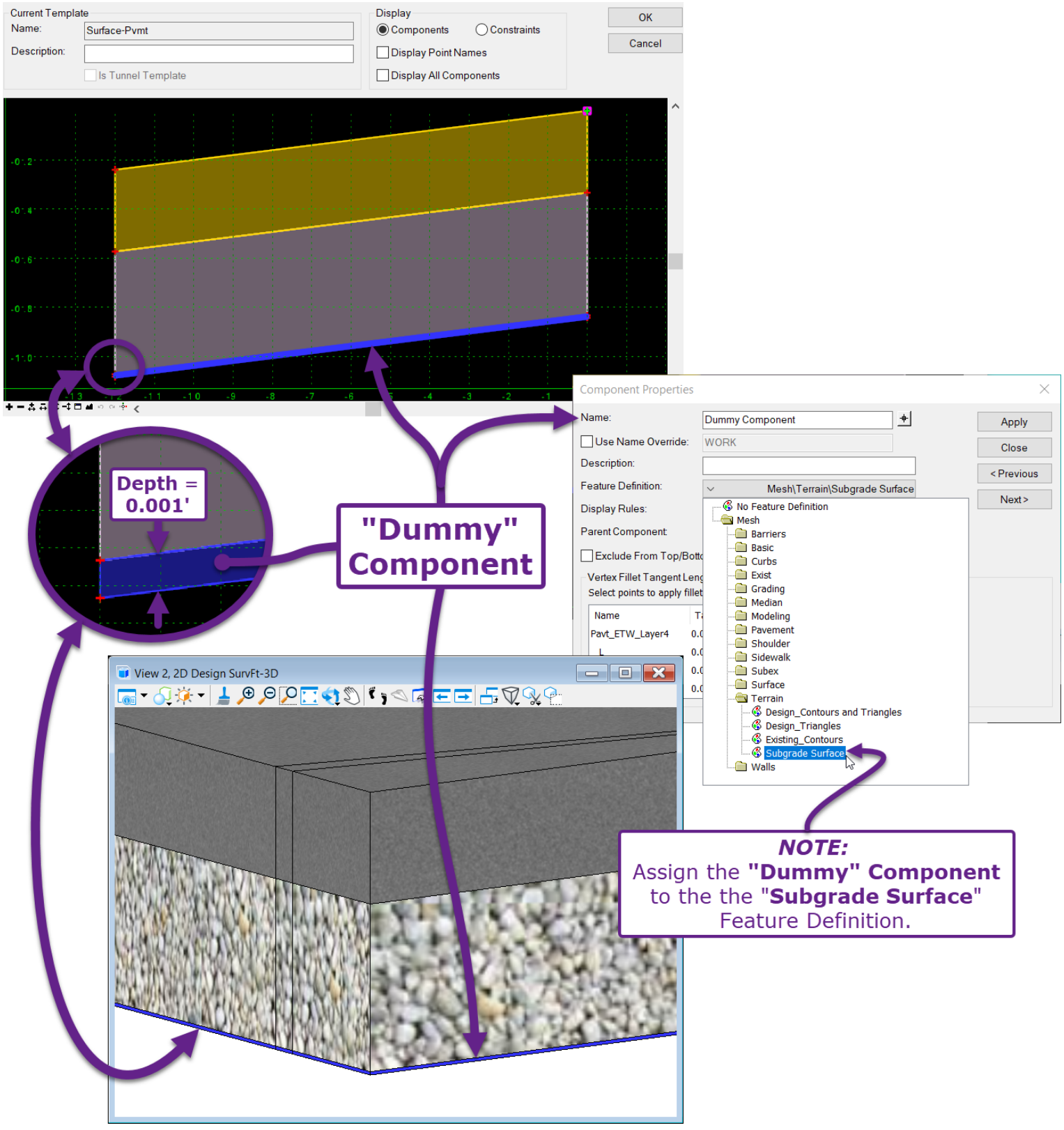
WARNING: Selecting the Bottom Component does NOT create a Sub-Grade Terrain Model. As shown on the next page, a "DUMMY" Component added to the Surface Template to create a Sub-Grade Terrain Model.

TIP: Select the **BOTTOM COMPONENT** to create a "top of aggregate" or "red-tops" Terrain Model from a Surface Template.

To create a **Sub-Grade** Terrain Model, an additional, "DUMMY" Component must be created at the bottom of Surface Template.

The "DUMMY" Component must be volumetric and have a depth. The "DUMMY" Component CANNOT be a single planar layer. As shown below, the "DUMMY" Component has a vertical depth of 0.001'.

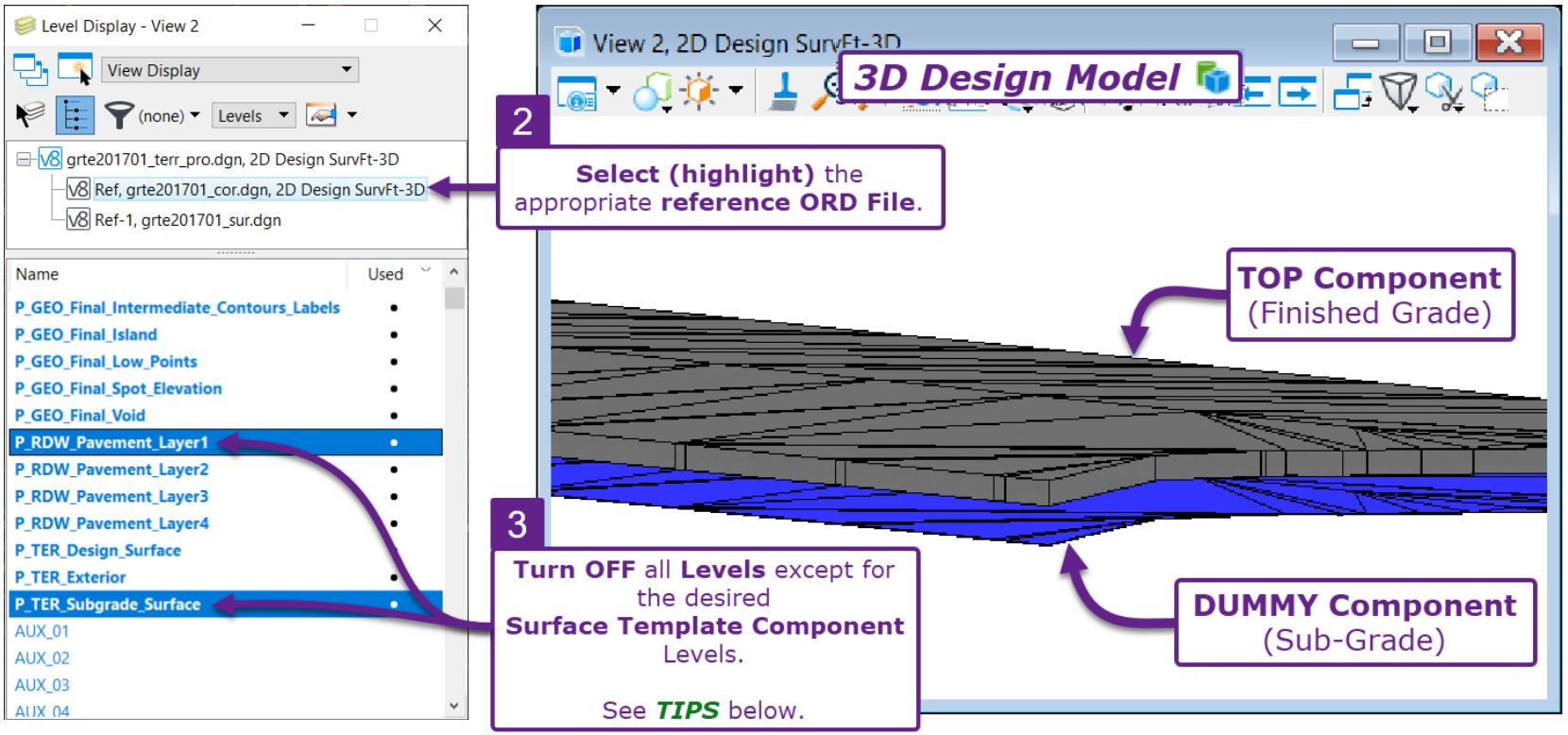
To create a Surface Template Component, see *8H.3 Create a Surface Template - Workflow*.



22A.2.c.i Select Surface Template Components with the *From Elements* tool

When using the *From Elements* tool, Surface Template Components must be selected from *3D Design Model* .

For more detailed information on the *From Elements* tool, see *22A.2.b.ii Select Top or Bottom Mesh elements with the From Elements tool*.
The workflow below shows how to isolate and select Surface Template Components as a preliminary procedure for the *From Elements* tool



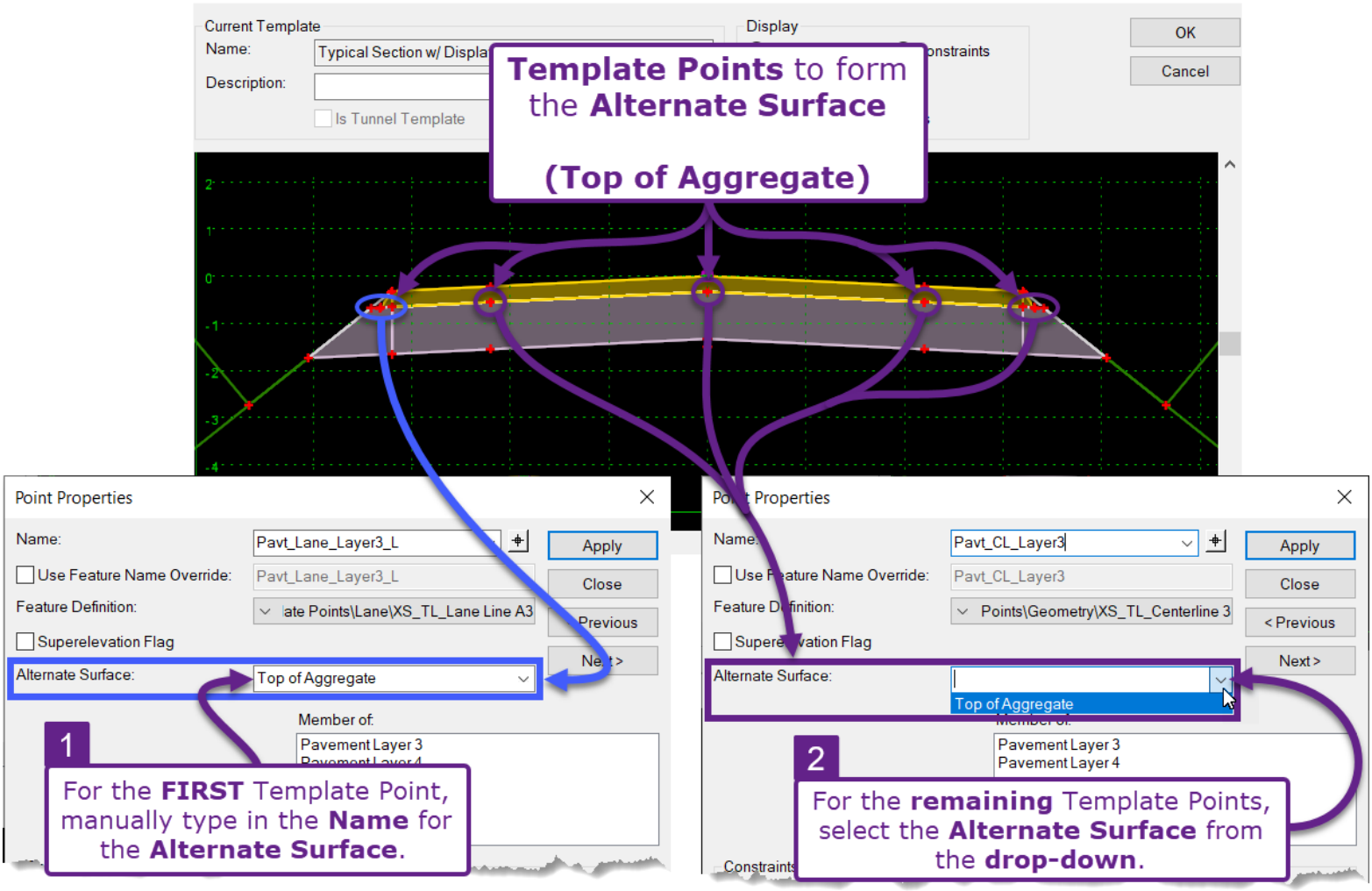
1	Open the *3D Design Model* view. ***NOTE:*** If the new ORD File does NOT contain a *3D Design Model* , then the Existing Grade Terrain Model has NOT been *Activated*.
2	Select (highlight) the appropriate reference ORD File from the list in the top portion of the Level Display menu.
3	Turn OFF all Levels except for the Level(s) that correspond with the desired Surface Template Components. ***TIP:*** If selecting the **TOP Component** for a **Finished Grade Terrain Model**, isolate the "P_RDW_Pavement_Layer1" Level. ***TIP:*** If selecting the **DUMMY Component** for a **Sub-Grade Terrain Model**, isolate the "P_RDW_Subgrade" Level.

22B – ALTERNATE SURFACES (INTERMEDIATE LAYERS)

An **Alternate Surface** is a Terrain Model created from a User-defined intermediate layer (i.e., top of aggregate, red tops) of a Corridor or Linear Template.

> ***WARNING:*** Surface Templates CANNOT generate an Alternate Surface with this method. To create an intermediate layer Terrain Model from a Surface Template, see *22A.2.c Surface Templates with the From Elements tool*.

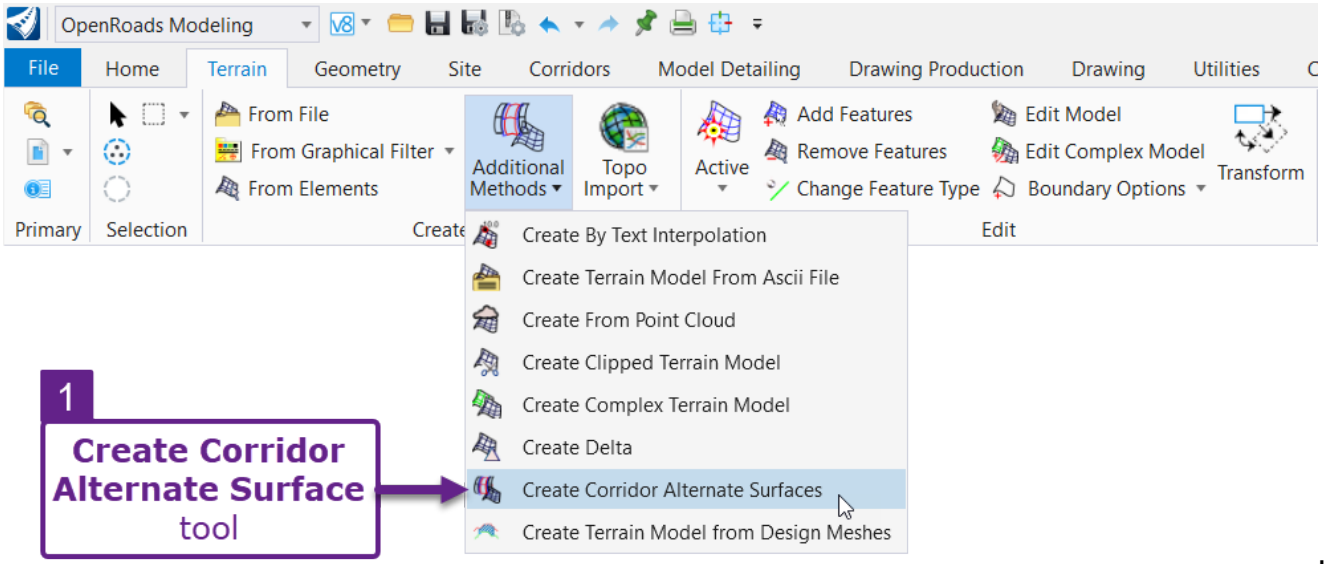
In the Template Editor, each Point that forms the intermediate layer must be set to the same Alternate Surface property. For more information on Alternate Surface point property, see *8C.4 Alternate Surface*.



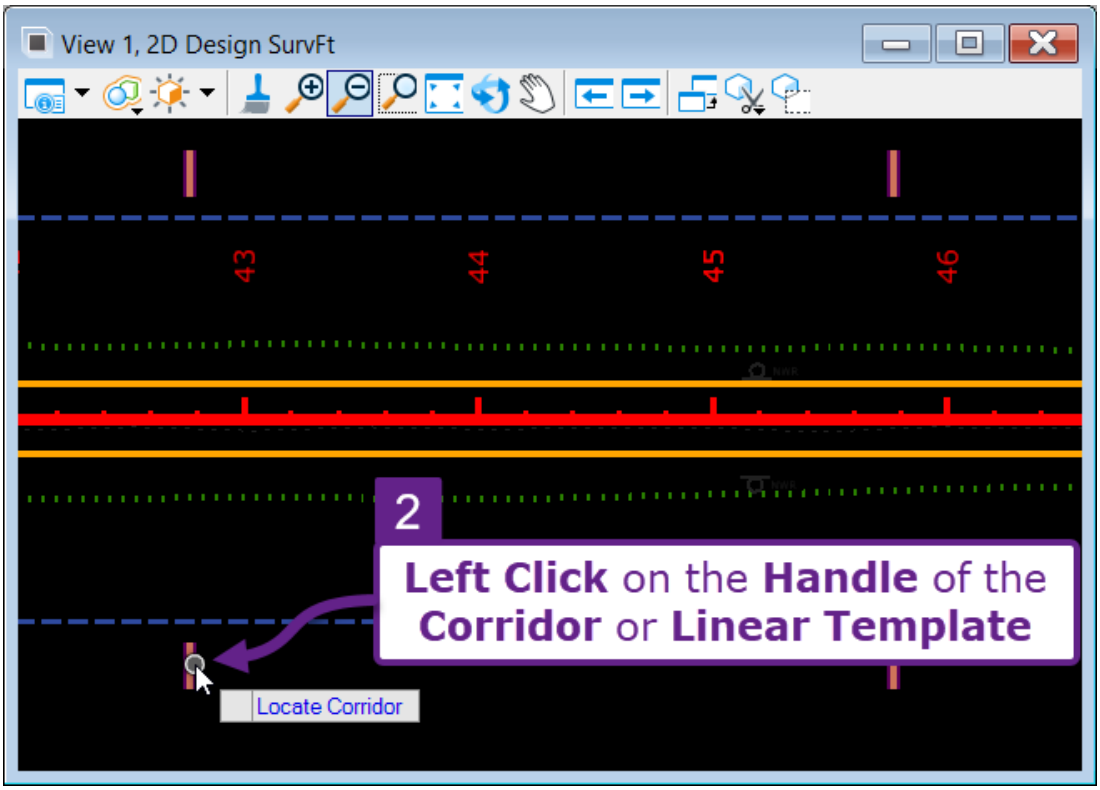
NOTE: After the Alternate Surface is defined in the Template Point properties, the edited Template must be "synced" with the Corridor or Linear Template. Use the *Synchronize Library* tool to accomplish this task. See *9E.8 Synchronize with Library tool*.

The *Create Corridor Alternate Surface* tool is used to create the Terrain Model. This tool can be found in the Ribbon in the following location:

OpenRoads Modeling workflow → **Terrain** tab → **Create** panel → **Additional Methods** drop-down



1	From the Ribbon, select the *Create Corridor Alternate Surfaces* tool: [***OpenRoads Modeling*** → ***Terrain*** → ***Create*** → ***Additional Methods***].
2	*Prompt: Locate Corridor* – Left-Click on the **Handle** of the Corridor or Linear Template. After this step the Alternate Surface Terrain Model will be created.

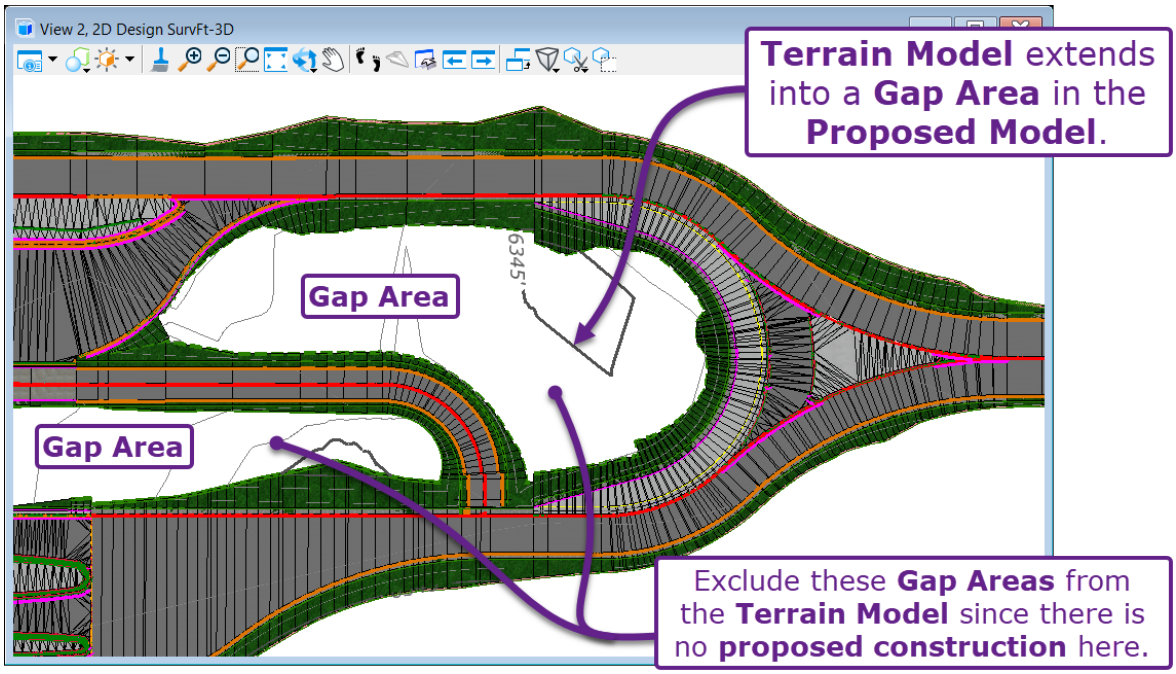


NOTE: The *Create Corridor Alternate Surfaces* can ONLY be used on a single Corridor and Linear Template at a time. Use the *Create Complex Terrain Model* tool to merge multiple Alternate Surfaces into a single Terrain Model.

22C – TROUBLESHOOTING AND MANIPULATING THE TERRAIN MODEL

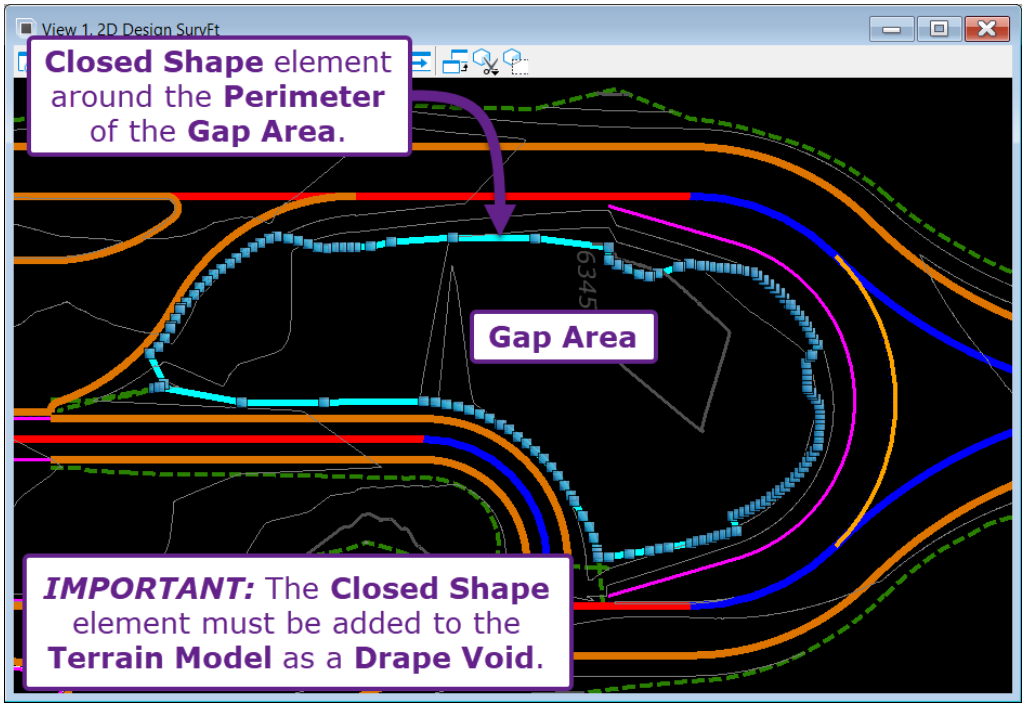
22C.1 Create Gaps in the Terrain Model

As shown below; if a Proposed Model contains a Gap Area, then the Terrain Model may errantly extend into this interior area. A Gap Area refers to an area that requires NO proposed construction and is located within the limits of the Proposed Model.



To remove the Gap Areas from the Terrain Model, follow the procedures listed below:

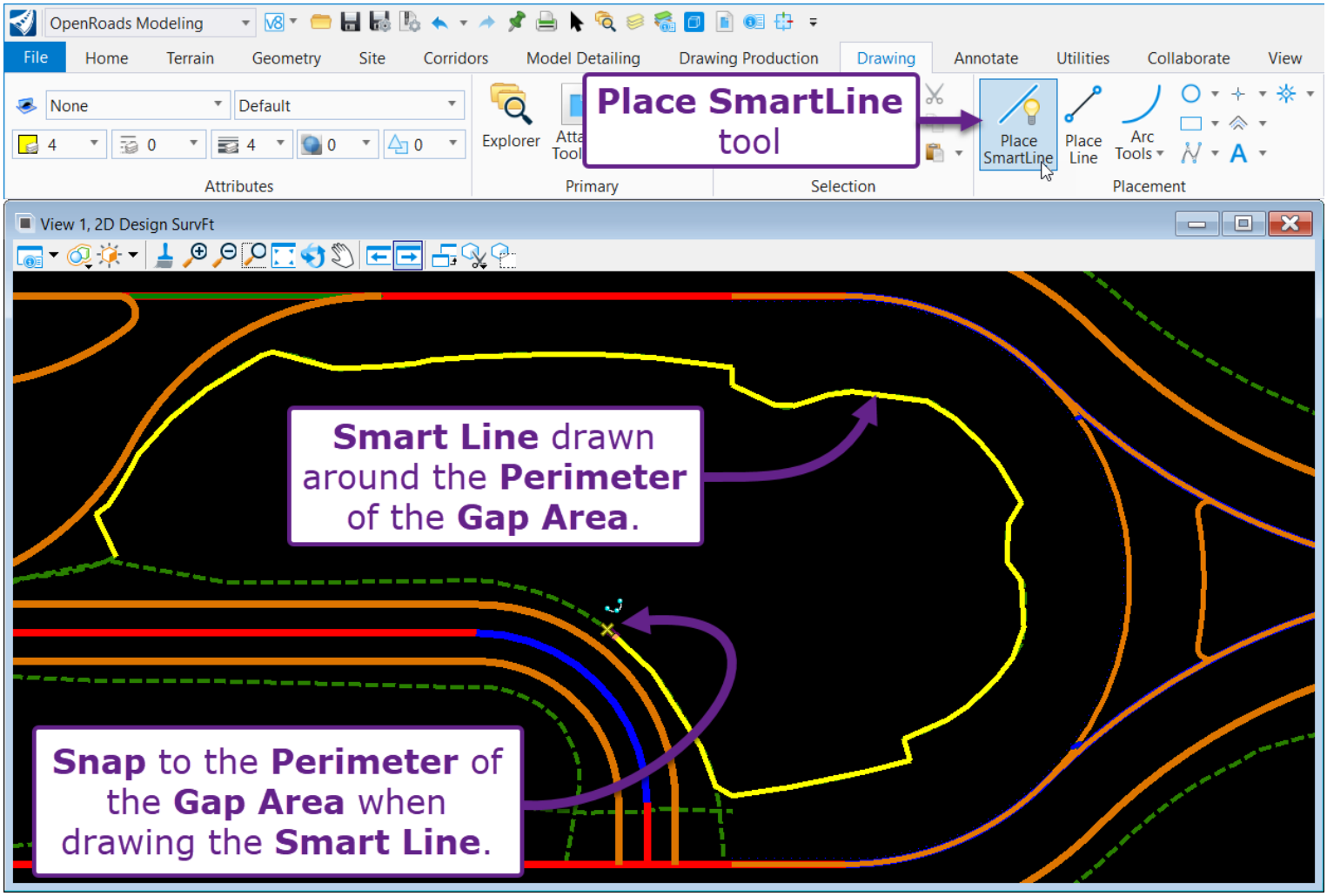
- In the *2D Design Model* , create a continuous **Closed Shape** element around the perimeter of the Gap Area. See *22C.1.a Create a Closed Shape element around the Perimeter*.
- With the Add Features tool, add the Closed Shape to Terrain Model as a **Drape Void**. See *22C.1.b Add the Closed Shape element to the Terrain Model as Drape Void*.



22C.1.a Create a Closed Shape element around the Perimeter

Create a Closed Shape element in the *2D Design Model* . There are two recommended strategies for creating the Closed Shape element:

Strategy 1: Create the Closed Shape element with a **Smart Line**. Trace the trace the perimeter of the Gap Area with a single Smart Line. ***BEST PRACTICE:*** Assign the Smart Line to the "P_GEO_Void" Level.



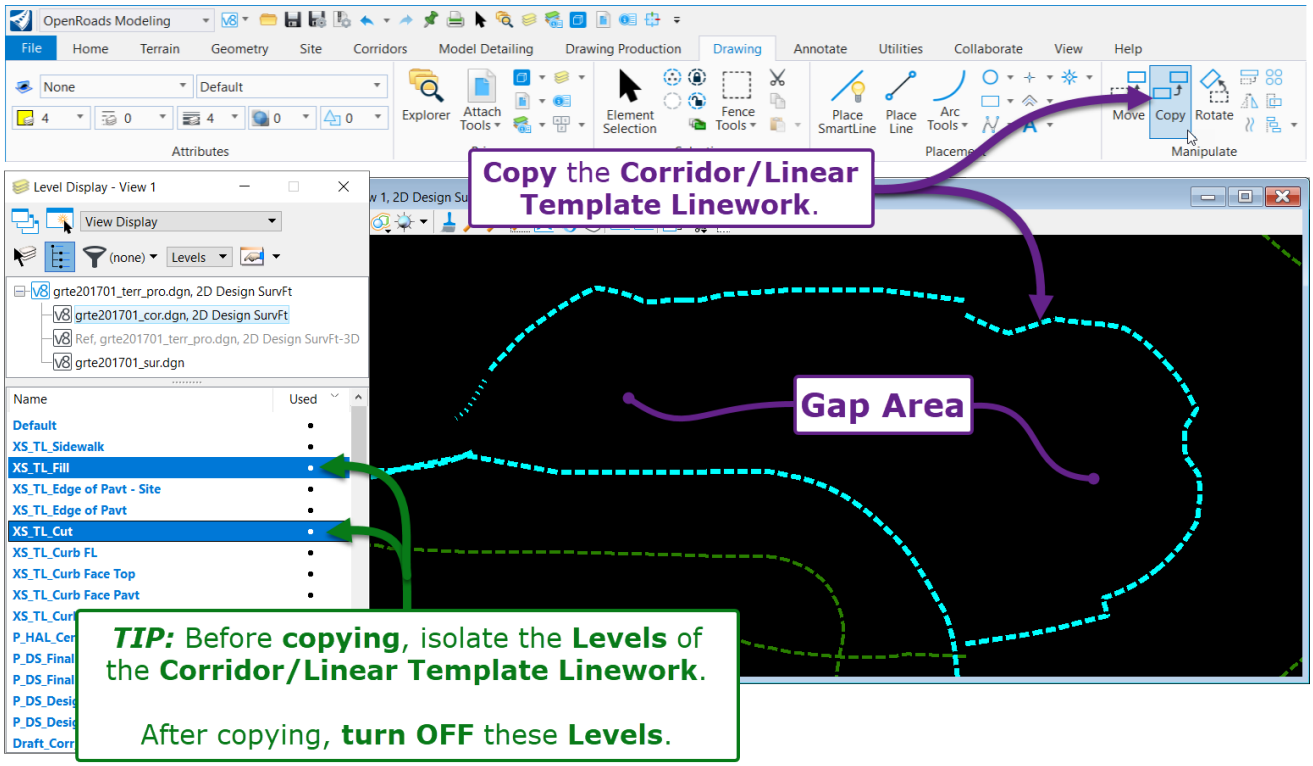
TIP: While drawing the Smart Line; if a vertex is accidentally skipped, press CTRL+Z or the Undo button to undo the last segment of the Smart Line. Do NOT abort the Smart Line command while undoing.

Strategy 2: Copy Corridor/Linear Template linework elements and manipulate/join them into a single Closed Shape element with the *Create Complex Shape* tool or *Create Region* tool.

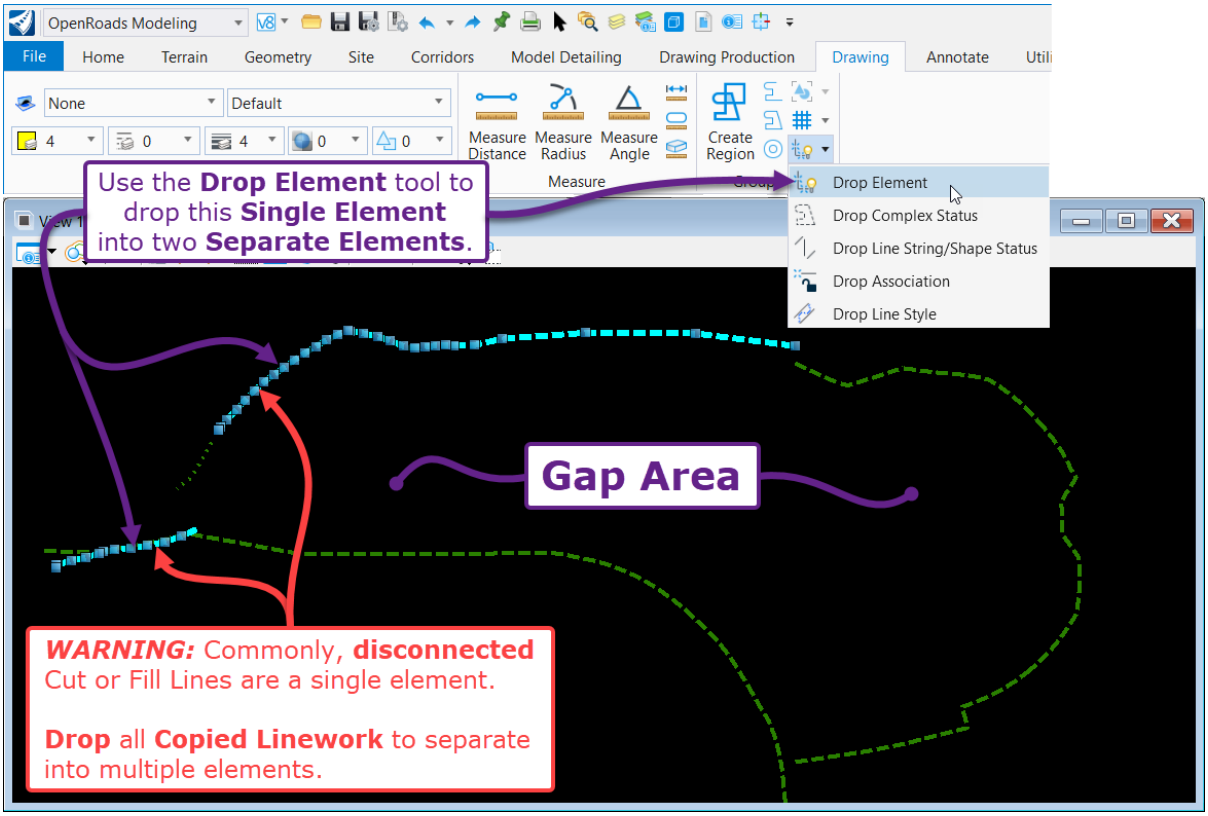
For this strategy, the following processes are required:

- **Copy** the linework that constitutes the perimeter of the Gap Area.
- Use the **Drop Element** tool on the copied linework.
- **Manipulate** the copied linework into a continuous perimeter.
- Use the **Create Complex Shape** tool or the **Create Region** tool to join the perimeter into a single Closed Shape element.

Copy the Perimeter Linework: Select and Copy all Corridor/Linear Template Linework that constitutes the perimeter of the Gap Area. In this case, the perimeter of the Gap Area is comprised of Cut and Fill Limits.

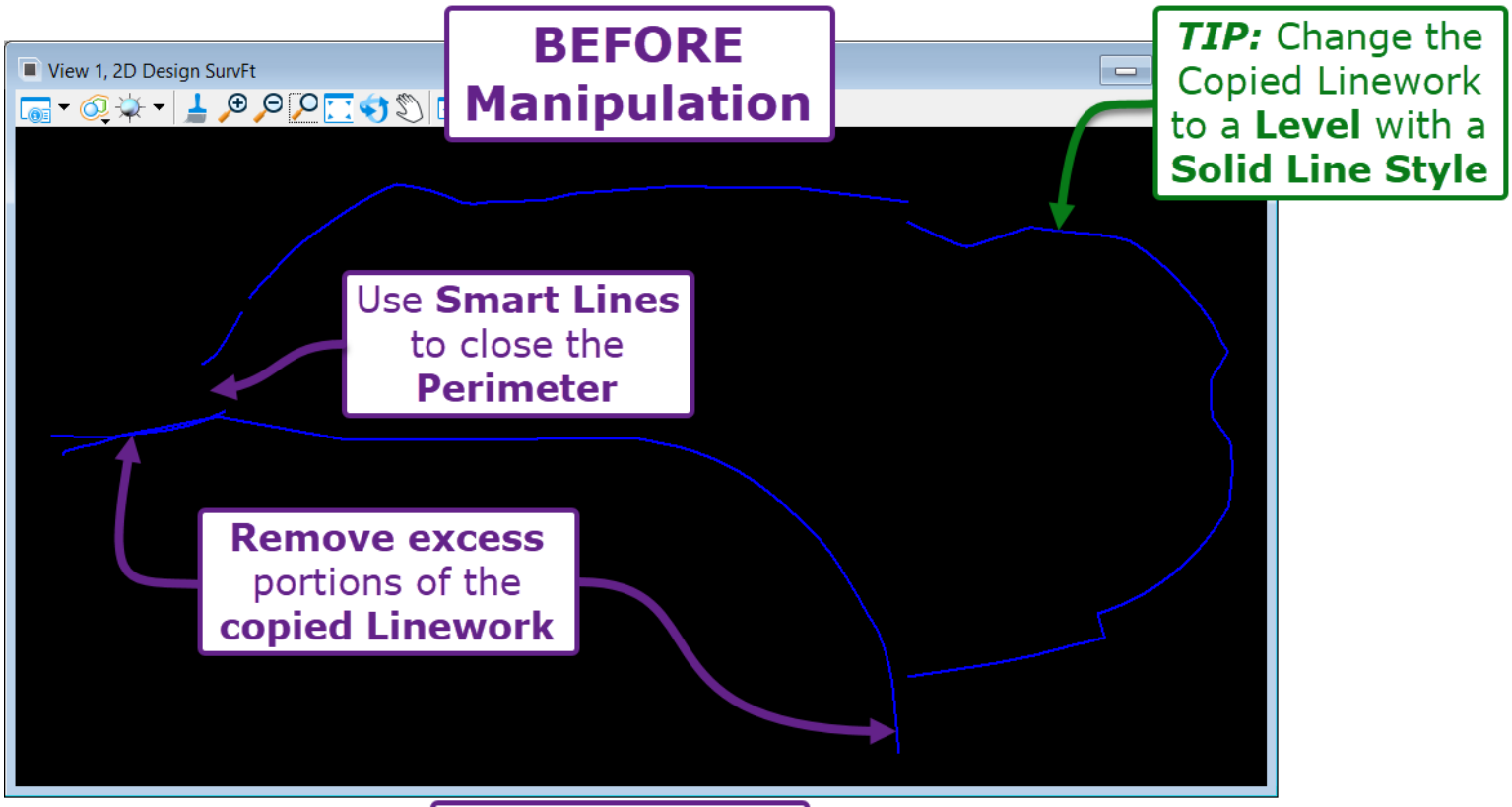


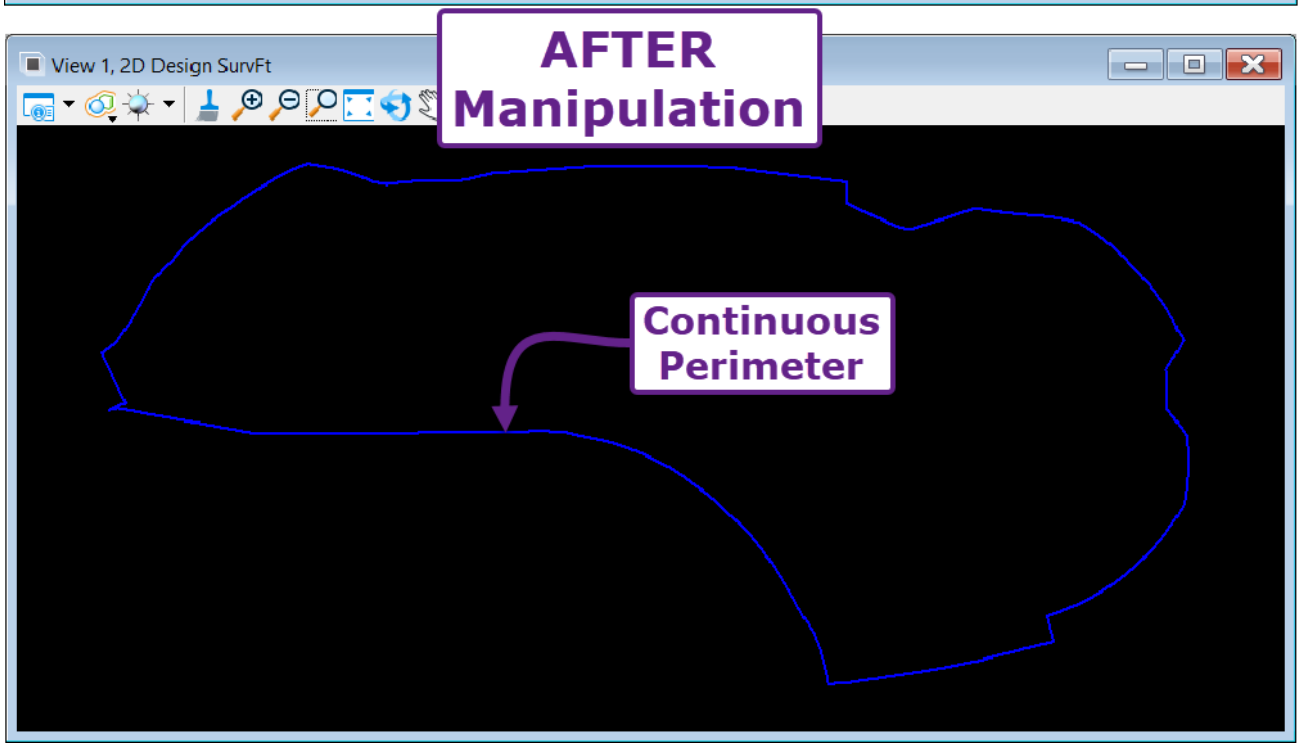
Drop the Copied Linework: Select all the copied Linework and use the *Drop Element* tool. This process is necessary because Corridor/Linear Template linework may appear disconnected but is actually multiple disjointed line strings that make up a single element.



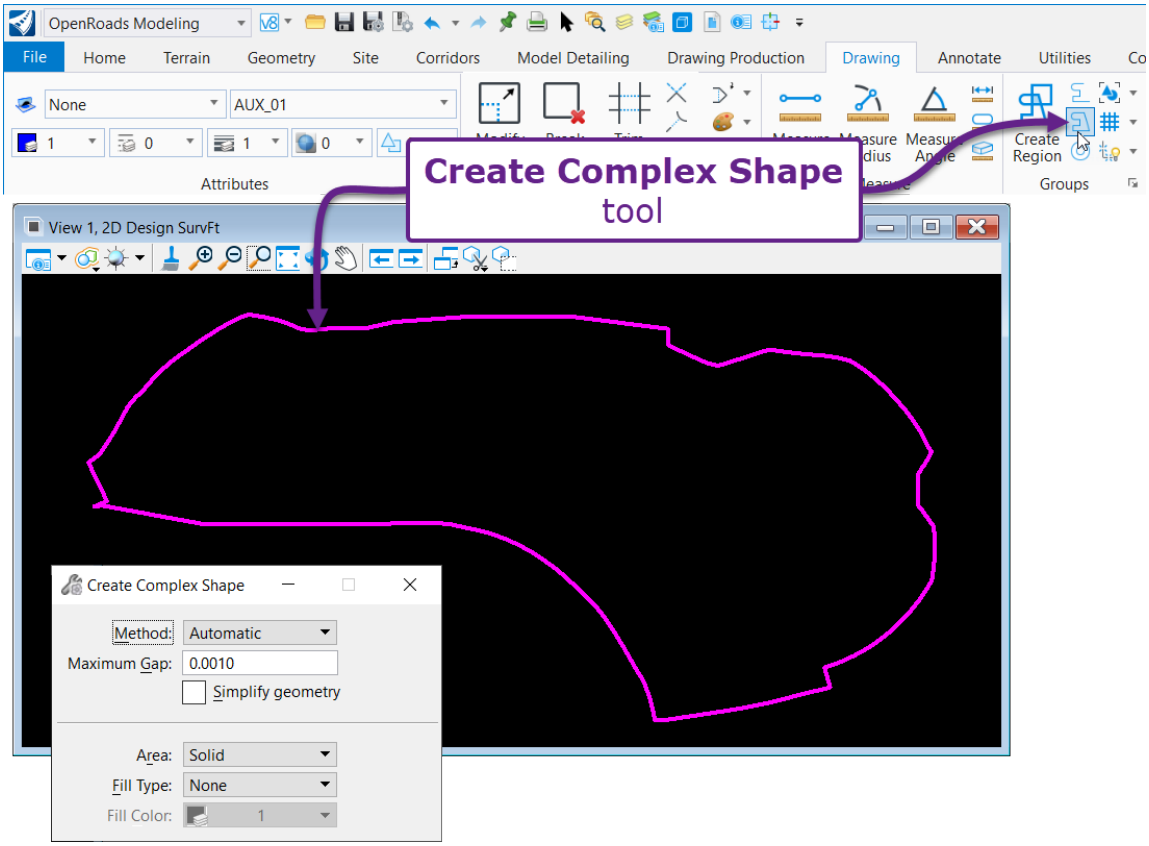
Manipulate the Copied Linework into a Continuous Perimeter: Using the *Trim Element* and *Break Element* tools, remove excess portions of the copied Linework. Draw *Smart Lines* to close openings in the perimeter.

BEST PRACTICE: Select the copied Linework and change the Level to "P_GEO_Void". The "P_GEO_Void" Level has a solid Line Styles, which assists in identifying openings in the perimeter.

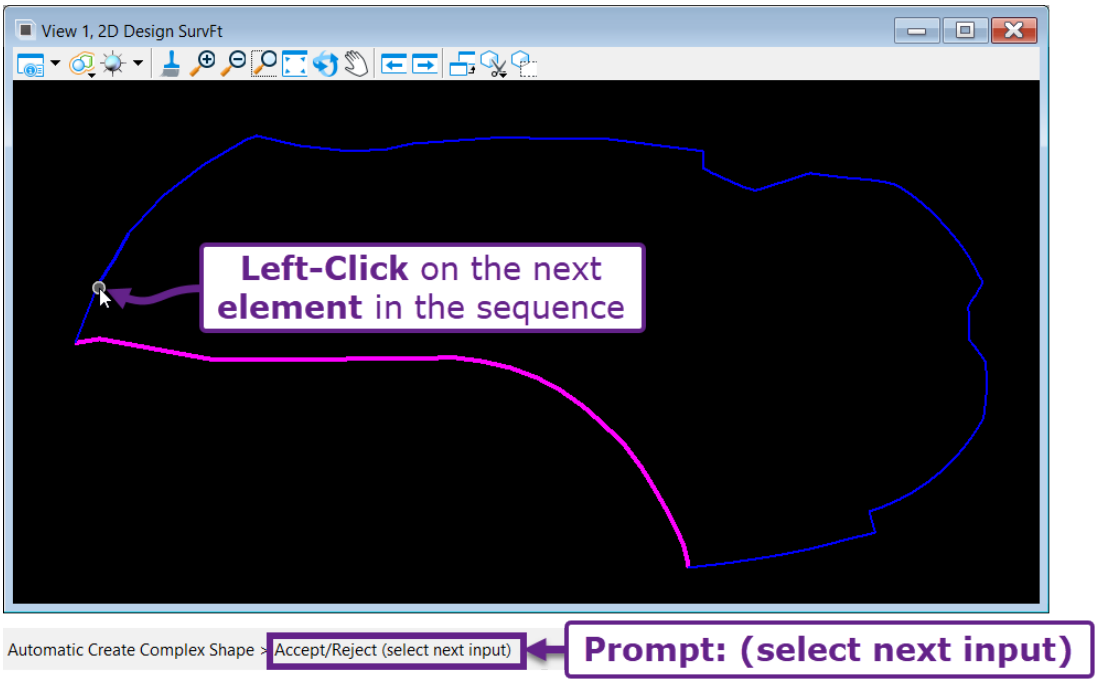




Join Perimeter Elements into a Closed Shape with the Create Complex Shape tool Using the *Create Complex Shape* tool with the Method set to **Automatic**, join the perimeter into a single Closed Shape element. ***NOTE:*** The *Create Region* tool (method set to Flood) could also be used to create the Closed Shape element. However, this tool frequently has difficulty finding the enclosed shape.

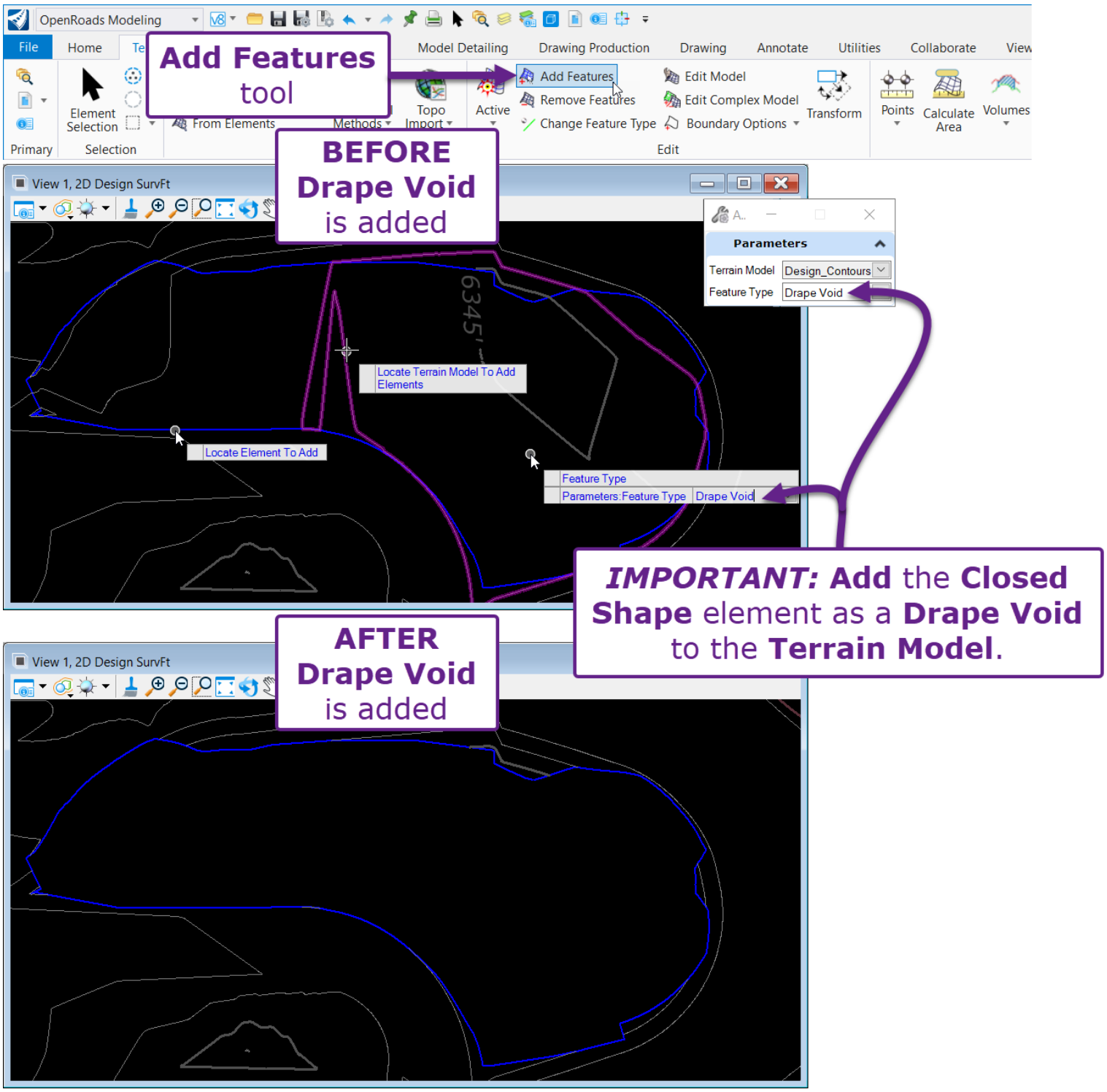


TIP: When using the *Create Complex Shape* tool, pay close attention to the **Prompts** shown in the bottom-left corner of the ORD Software window. As shown below, it may be required to manually select the next element in the *Create Complex Shape* sequence.



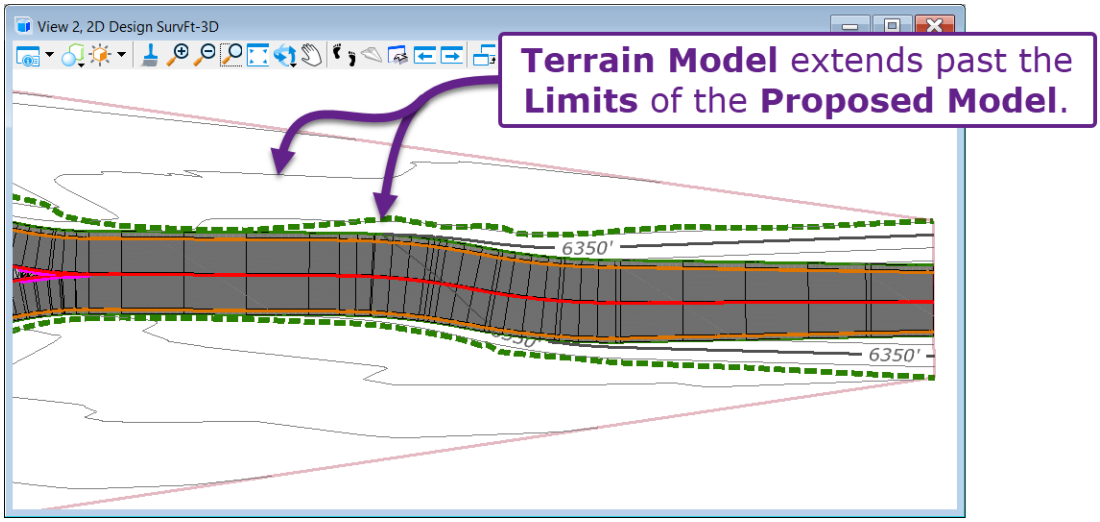
22C.1.b Add the Closed Shape element to the Terrain Model as a Drape Void

Using the *Add Features* tool, add the Closed Shape element to the Terrain Model as a **Drape Void**. A detailed workflow for this process is shown in *11C.4.a.iii Add the 3D Linear Element to the Terrain Model to create the Void*.



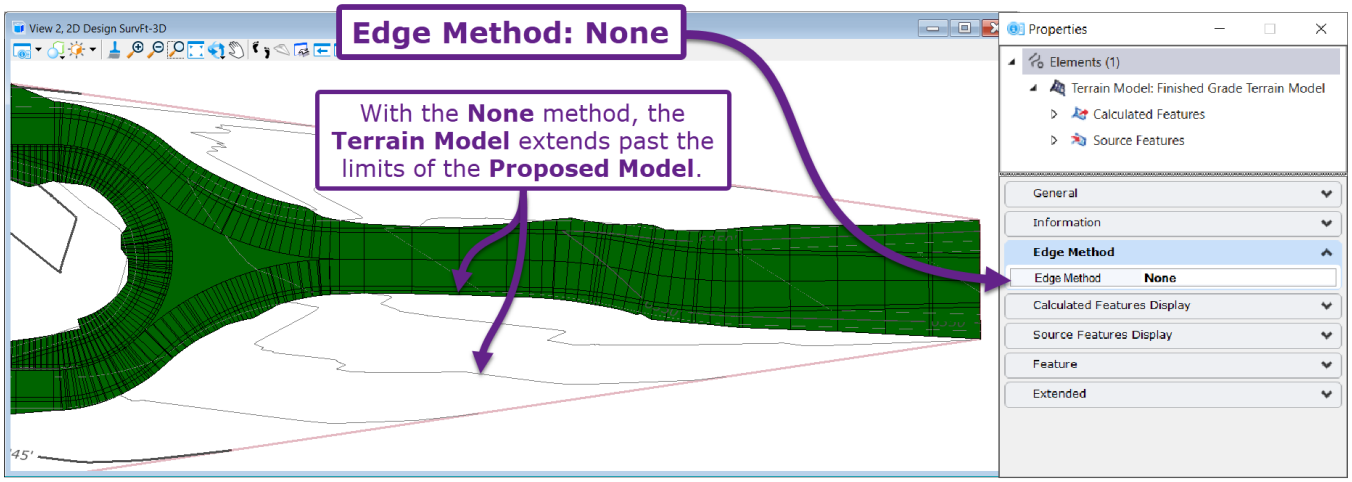
22C.2 Terrain Model Extends Past Proposed Model

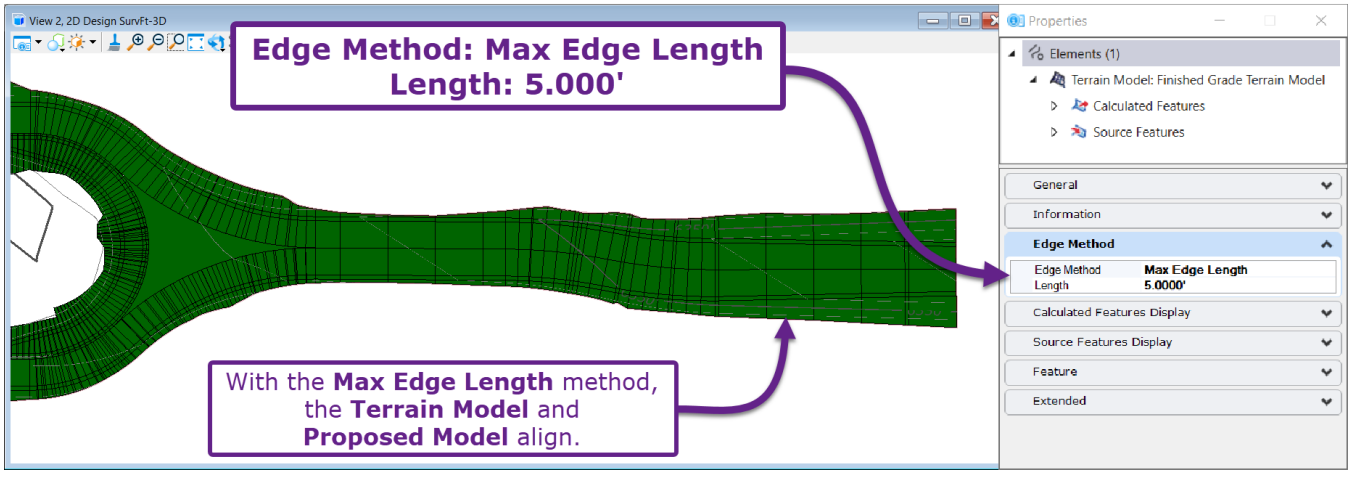
When Top and Bottom Meshes are used to create the Terrain Model, a common issue is the resulting Terrain Model extending past the Limits of the Proposed Model.



IMPORTANT: Before attempting to re-apply the Boundary (as shown on the next page), try changing the **Edge Method** setting in the Properties of the Terrain Model.

Typically, the **Max Edge Length** with a **Length** value of 5.0000’ produces acceptable results. If this combination does NOT work, try increasing the **Length** value by increments of 2.5’.



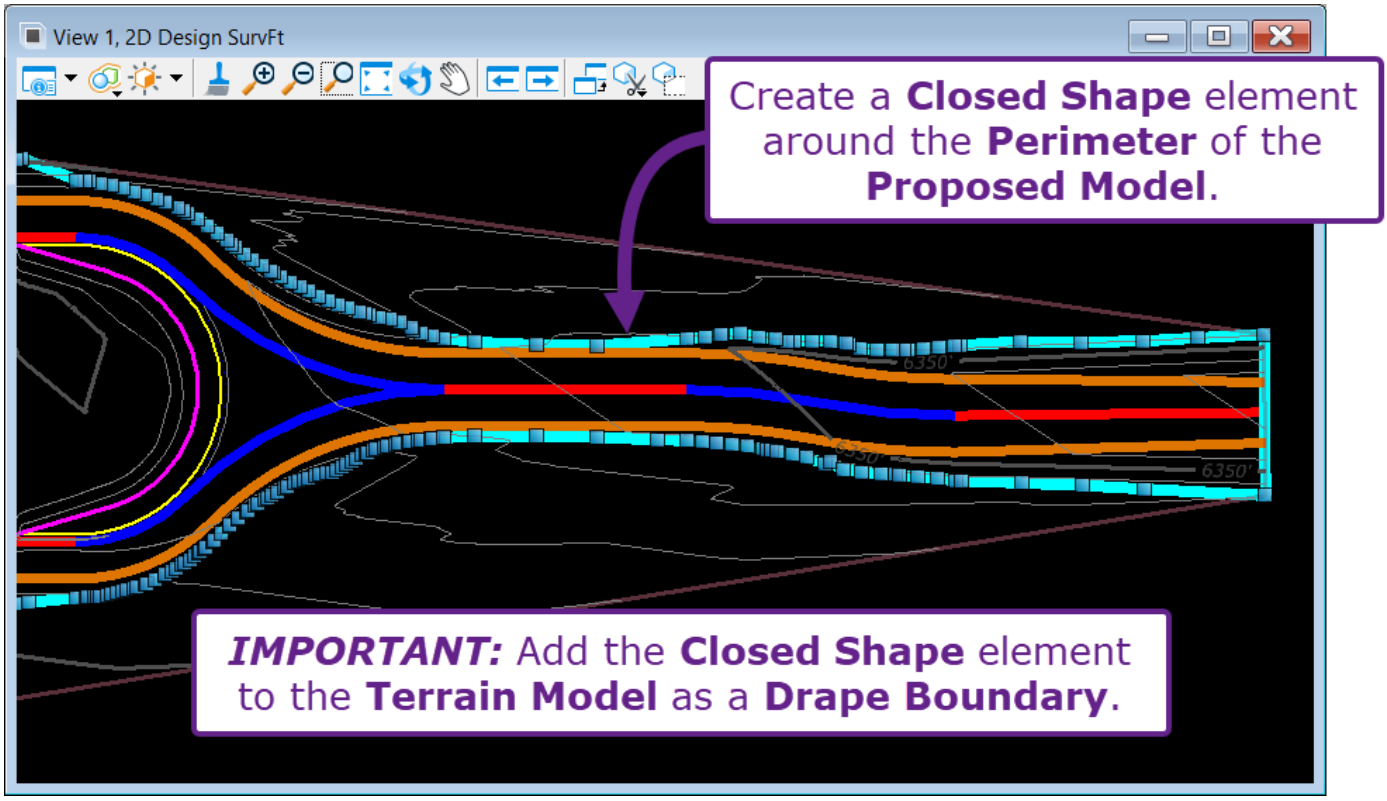


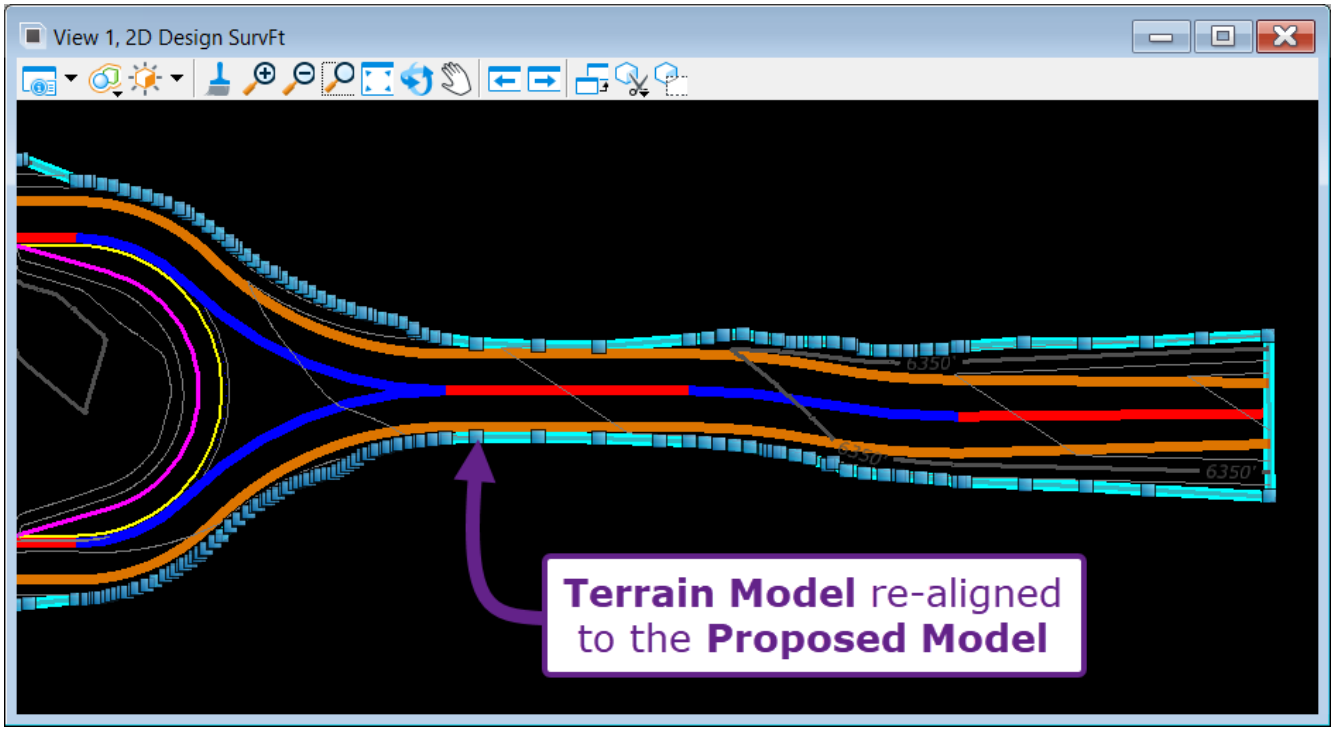
To manually align the Limits of the Proposed Model with the Terrain Model, follow the procedures below:

- In the *2D Design Model* , create a continuous **Closed Shape** element around the Limits (Boundary) of the Proposed Model.

  This can be performed by Copying, Manipulating, and Joining the Proposed Model Boundary elements. See **Strategy 2** of *22C.1.a Create a Closed Shape element around the Perimeter*.

- With the Add Features tool, add the Closed Shape to Terrain Model as a **Drape Boundary**. See *22C.1.b Add the Closed Shape element to the Terrain Model as Drape Void*.

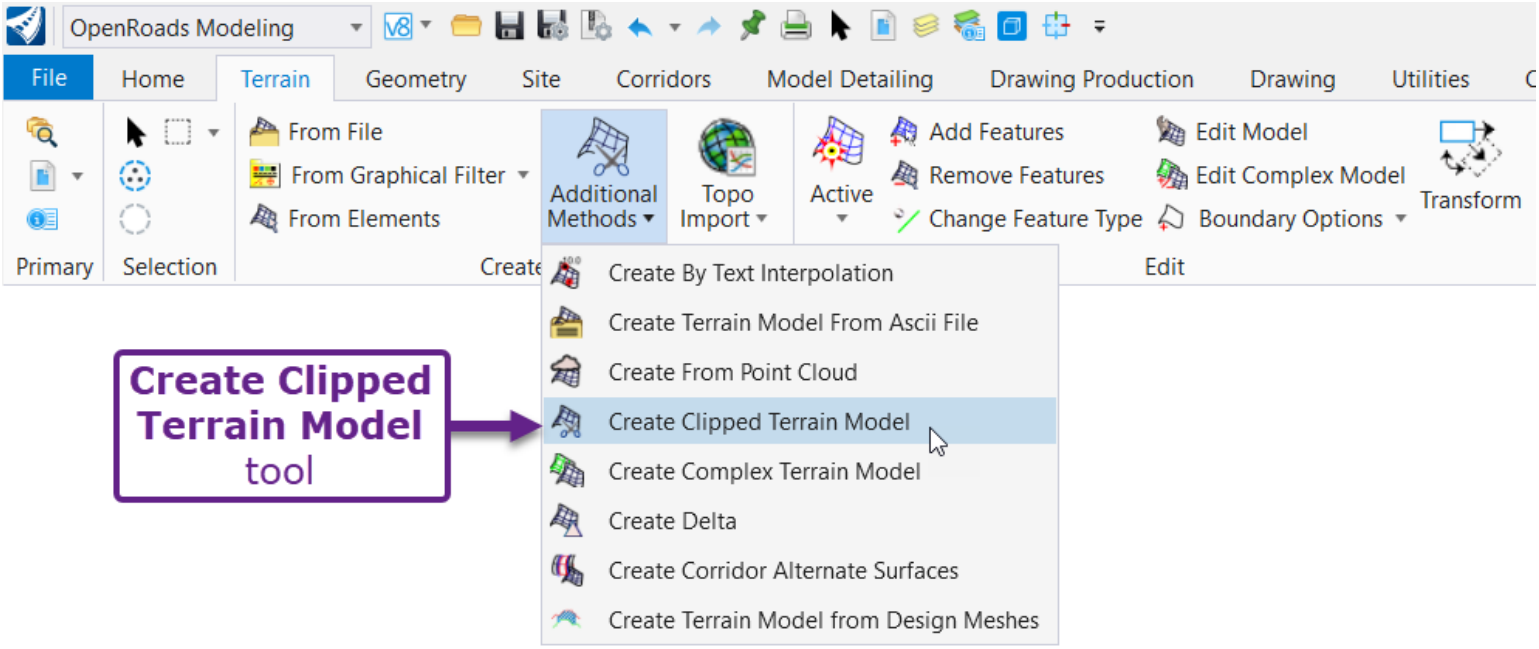




22D – CREATE A CLIPPED TERRAIN MODEL

The *Create Clipped Terrain Model* tool is used to remove an area of a Terrain Model. This tool can be found in the Ribbon in the following location:

OpenRoads Modeling workflow → **Terrain** tab → **Create** panel → **Additional Methods** drop-down



With this tool a **Reference Terrain Model** and one or more **Clipping Elements** is selected. The overlapping area between the Reference Terrain Model and Clipping Element(s) is removed in the resulting Clipped Terrain Model.

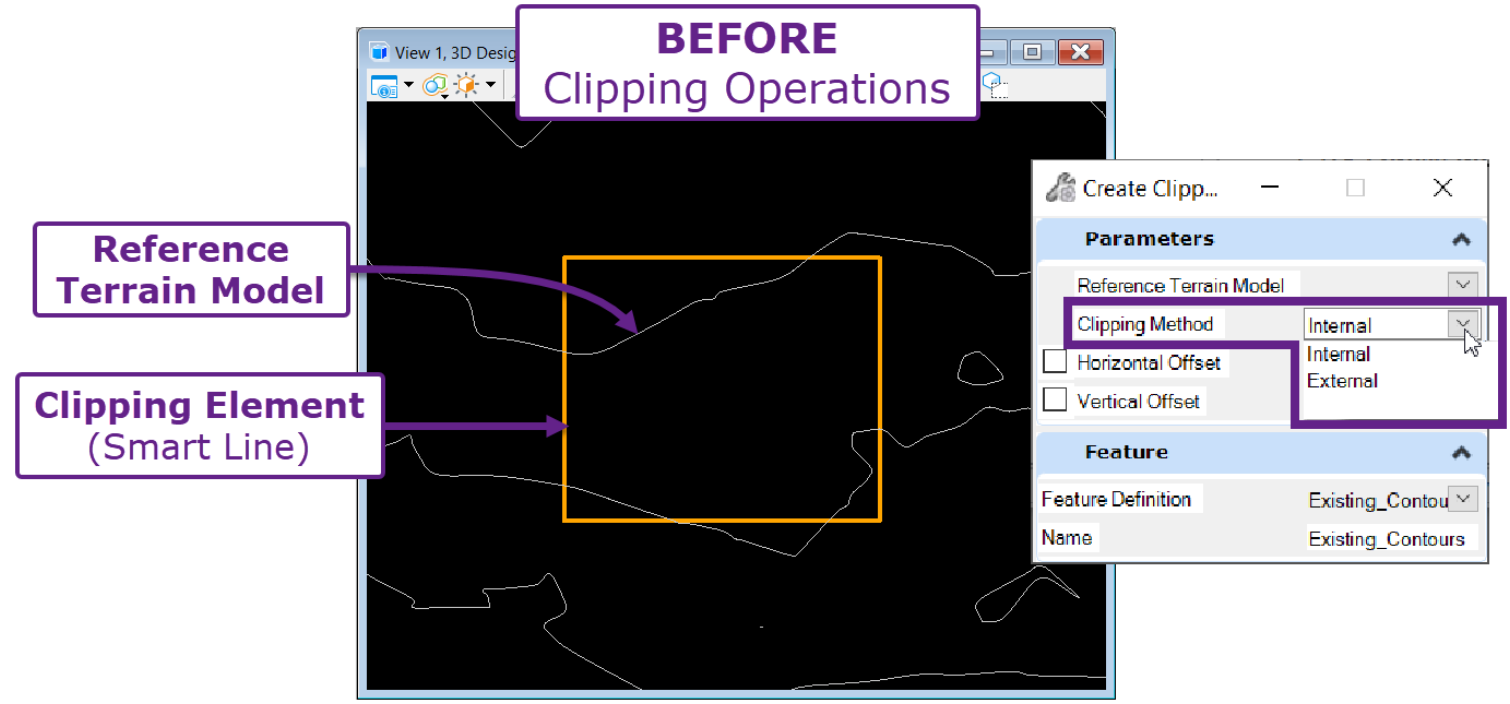
The **Clipping Element** can be any of the following element types:

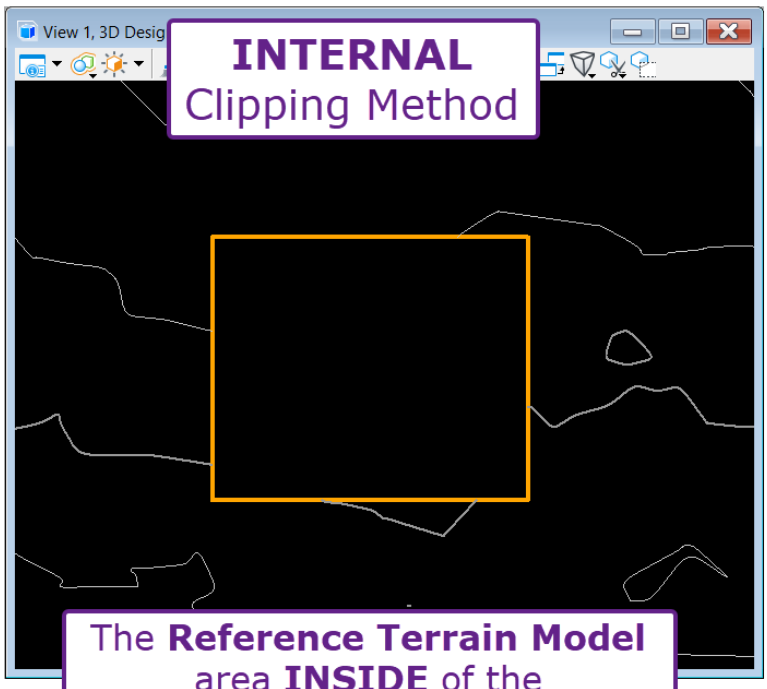
- A different Terrain Model. The overlapping area between the Reference Terrain Model and the **Clipping Terrain Model** is removed. This **Clipping Element Type** is demonstrated in the *22D.1 Create a Clipped Terrain Model – Workflow*. This method can be used to clip out Existing Ground contours when they overlap with Finished Ground contours.
- An enclosed shape element (i.e., an enclosed SmartLine, Complex Shape, enclosed Complex Element). Draw an enclosed SmartLine to denote the area to be removed from the Reference Terrain Model. This procedure is demonstrated on the next page.
- A Corridor, Linear Template, or Surface Template. For example, the Existing Ground Terrain Model can be selected as the **Reference Terrain Model** and the mainline Corridor can be selected as the **Clipping Element**. The overlapping mainline Corridor area is then removed from the Reference Terrain Model. This method can be used to clip out Existing Ground contours when they overlap with Finished Ground contours.

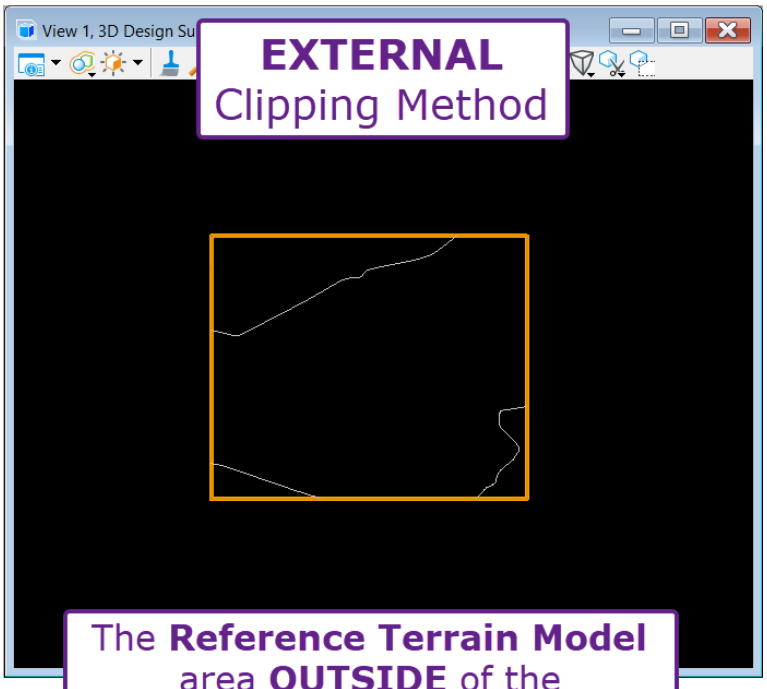
Clipping Method: The *Clipping Method* determines the direction of clipping, relative to the **Clipping Element**.

Internal – The Reference Terrain Model area **inside** of the Clipping Element is removed.

External – The Reference Terrain Model area **outside** of the Clipping Element is removed.





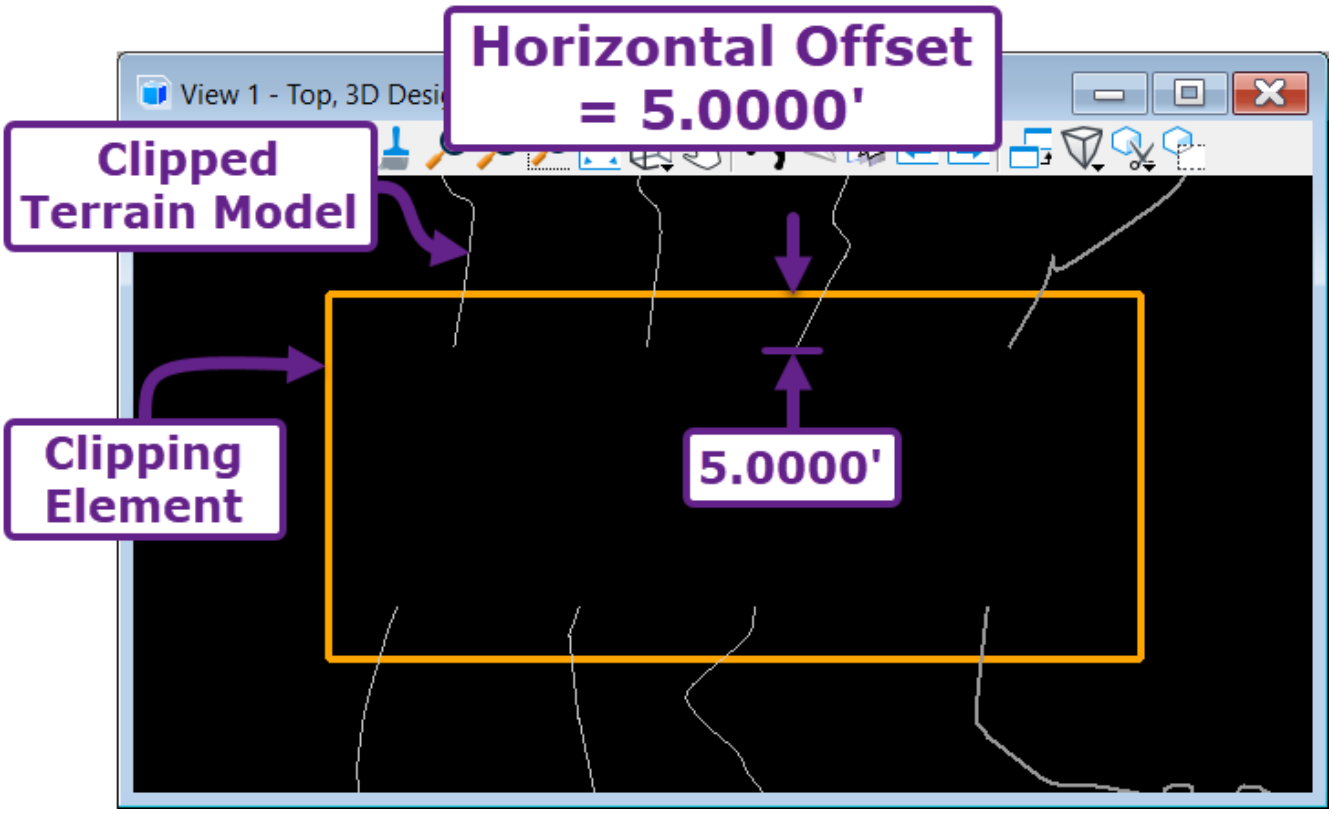


Horizontal and Vertical Offset: By specifying a Horizontal or Vertical Offset, the resulting Clipped Terrain Model is shifted.

Horizontal Offset: The Terrain Model is clipped at an Offset relative to the **Clipping Element**.

As shown below, the Horizontal Offset is set to 5.0000'. The Clipped Terrain Model contours extend 5.0000' into the **Clipping Element**.

NOTE: The Horizontal Offset value CANNOT be set to a negative value.



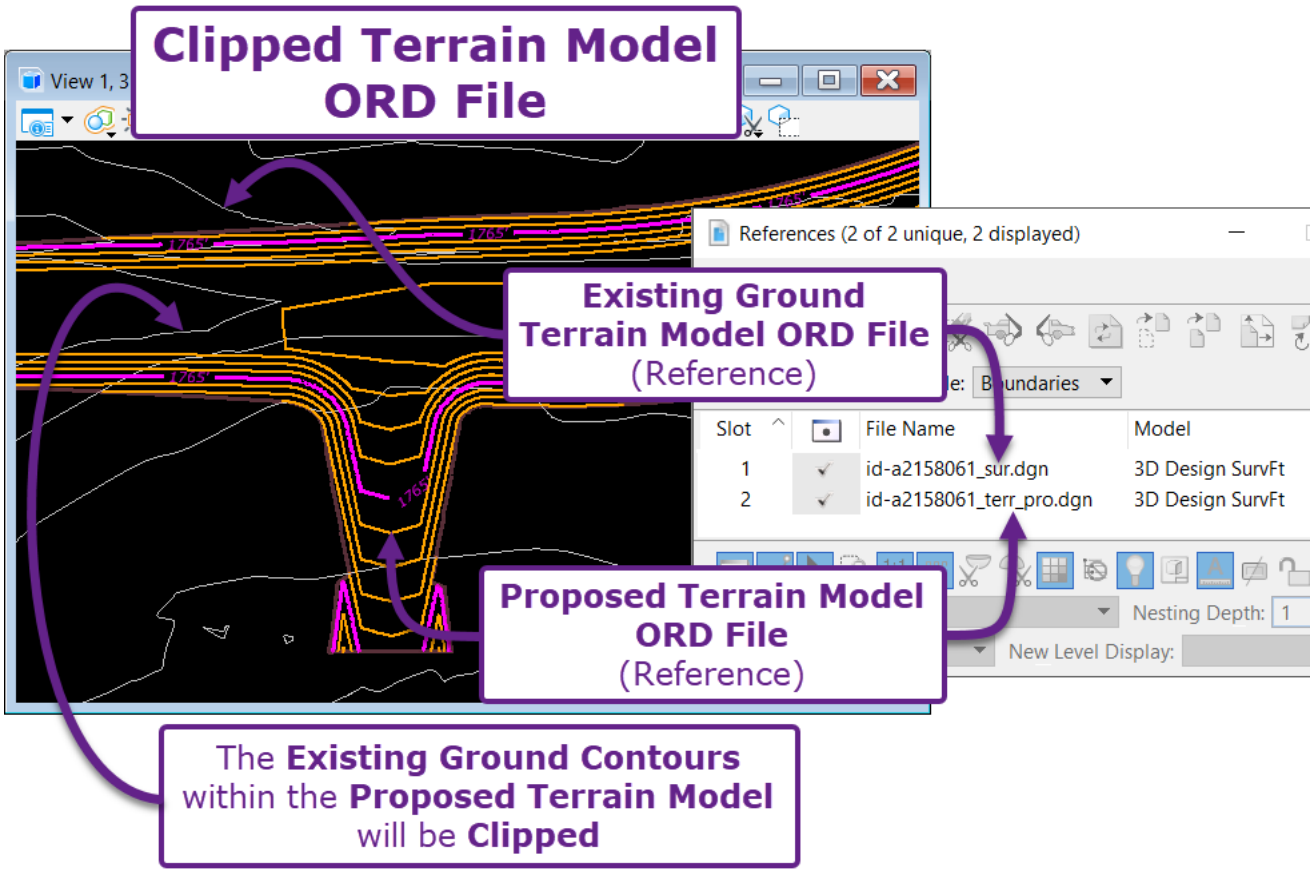
Vertical Offset: The resulting Clipped Terrain Model is shifted upwards (for a positive value) or downwards (for a negative value).

22D.1 Create a Clipped Terrain Model - Workflow

In this workflow, the Proposed Terrain Model area is clipped out of the Existing Ground Terrain Model.

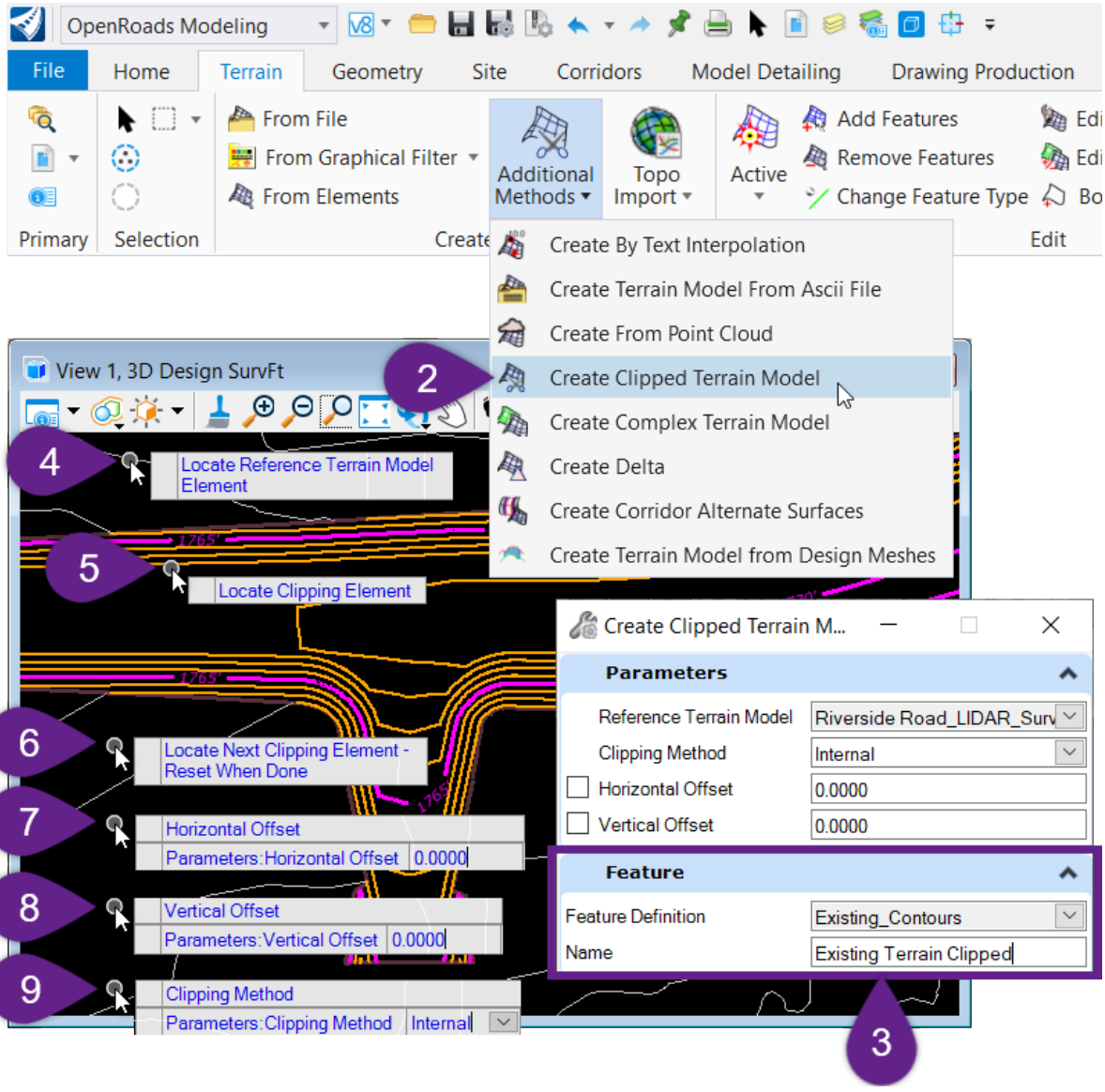
TIP: This workflow is commonly used to create Soil Erosion and Sediment Control sheets. In these sheets, both the Finished Grade and Existing Ground contours are shown. However, the Existing Ground contours must be clipped so they do NOT overlap with the Finished Grade contours.

1	Create a new ORD File to contain the Clipped Terrain Model. See *22A.1.b Create a Proposed Terrain Model*. ***BEST PRACTICE:*** Use a **3D Seed File** to create the Clipped Terrain Model ORD File. In the new ORD File, reference in the following: • **Existing Ground Terrain Model ORD File** • **Proposed Terrain Model ORD File** ***NOTE:*** When using a **3D Seed File**, select the *3D Design Model* of the reference ORD Files. See **STEP 3** of *22A.1.b Create a Proposed Terrain Model* for referencing a *3D Design Model*

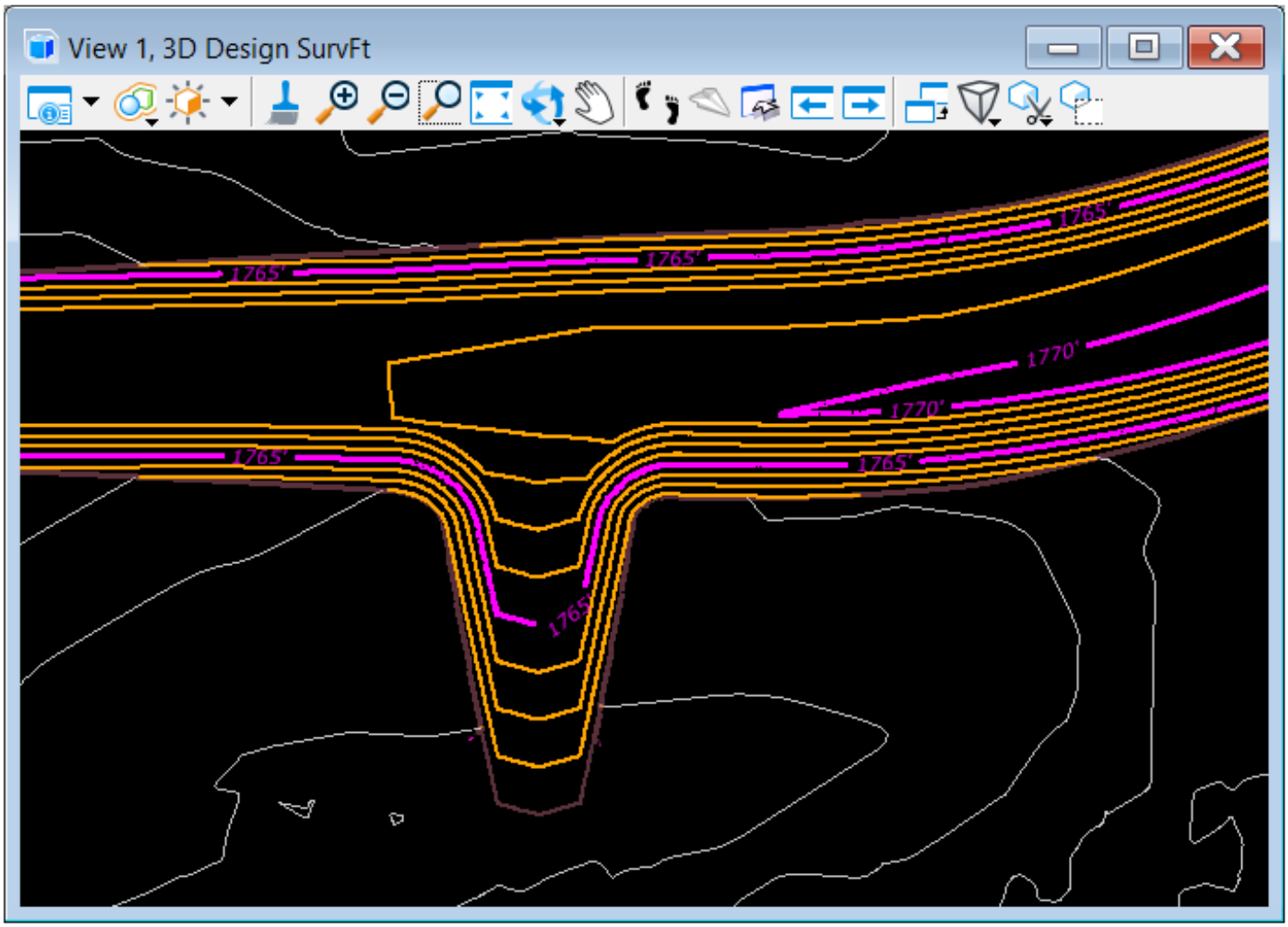


2	From the Ribbon, select the *Create Clipped Terrain Model* tool: [***OpenRoads Modeling*** → ***Terrain*** → ***Create*** → ***Additional Methods***].
3	Before advancing through the *Prompts*, assign the Clipped Terrain Model a **Name** and **Feature Definition**. ***TIP:*** For existing features, assign the Clipped Terrain Model to the "Existing_Contours" Feature Definition.

4	*Prompt: Locate Reference Terrain Model Element* – Select the **Reference Terrain Model** to be clipped. In this case, the Existing Ground Terrain Model is selected.
5	*Prompt: Locate Clipping Element* – Select the **Clipping Element**. In this case, the Proposed Terrain Model is selected.
6	*Prompt: Locate Next Clipping Element – Reset When Done* – If multiple **Clipping Elements** are to be used, then select another element. If NO other Clipping Elements are to be used, then **Right-Click to advance to the next prompt**.
7	*Prompt: Horizontal Offset* – In this case, no Horizontal Offset is used for the Clipped Terrain Model.
8	*Prompt: Vertical Offset* – In this case, no Vertical Offset is used for the Clipped Terrain Model.
9	*Prompt: Clipping Method* – In this case, **Internal** is selected.



As shown below, the resulting Clipped Terrain Model does NOT extend into the Proposed Terrain Model (Clipping Element) area.



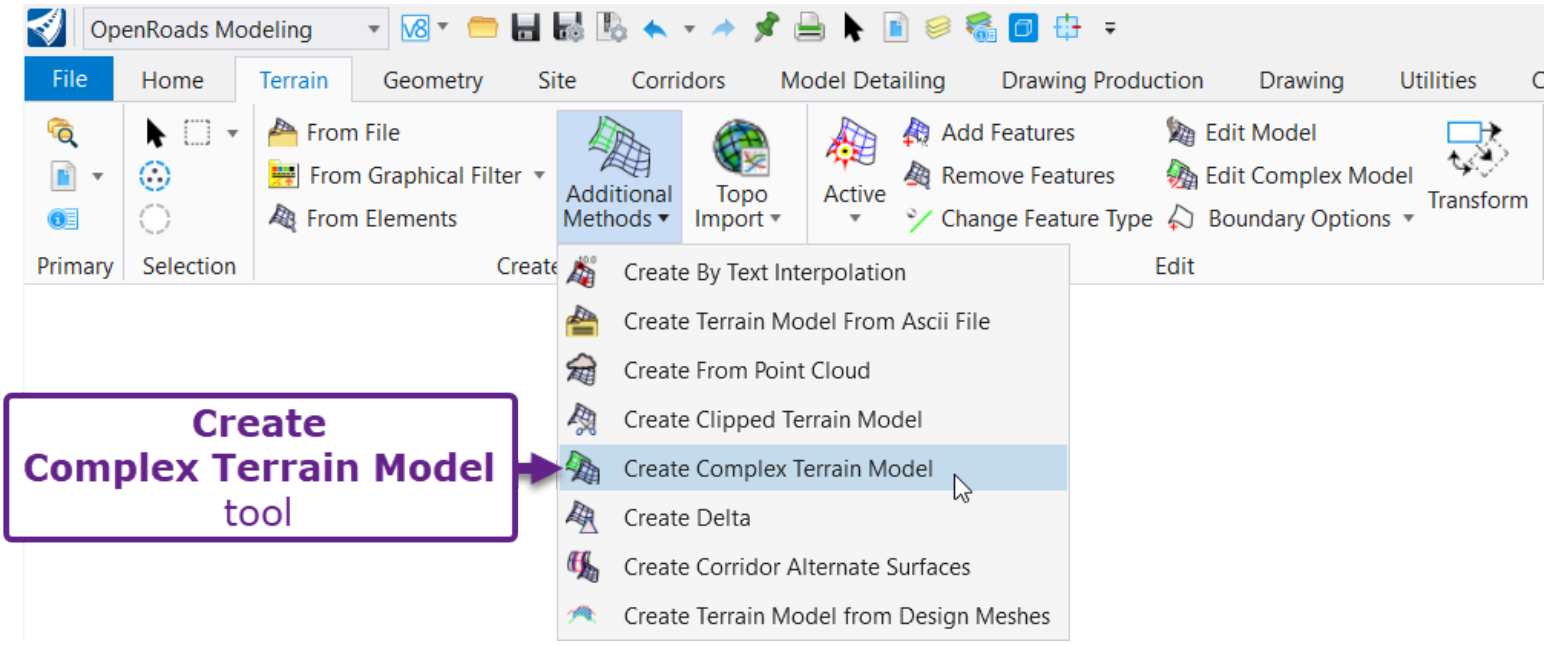
22E – MERGE TERRAIN MODELS

A **Complex Terrain Model** is created by combining (merging) two or more Terrain Models.

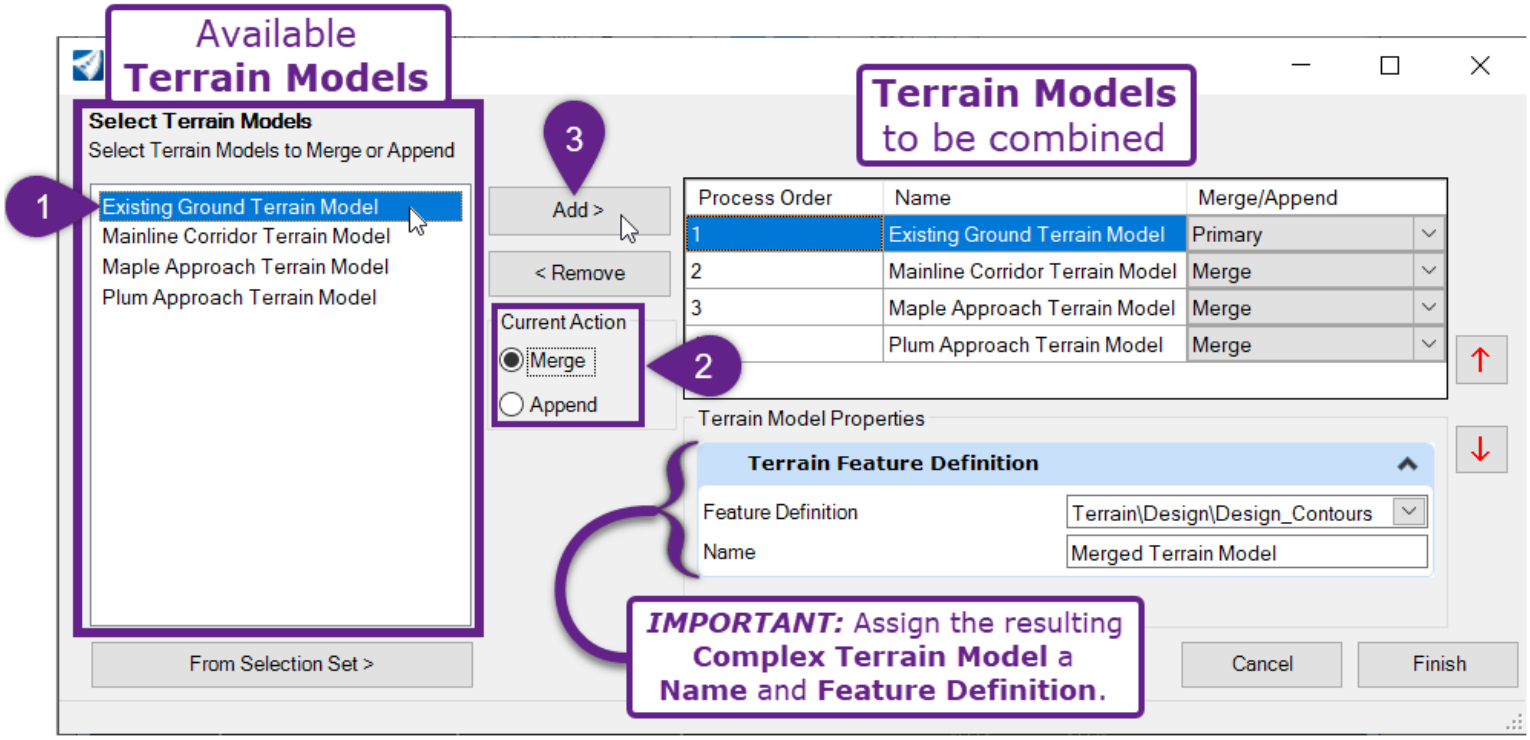
> **Real-World Example:** Merged Terrain Models are commonly used when construction requires phasing. For example, **Phase 2** construction may be built on top of the **Phase 1** and **Existing Ground** surfaces. In this situation, a **Complex Terrain Model** is created to merge the **Phase 1** and **Existing Ground** Terrain Models.

Complex Terrain Models are created with the *Create Complex Terrain Model* tool. This tool can be found in the Ribbon in the following location:

OpenRoads Modeling workflow → **Terrain** tab → **Create** panel → **Additional Methods** drop-down



The general operation of the *Create Complex Terrain Model* menu and workflow for creating a Complex Terrain is shown below.



1	All Terrain Models that were created or are referenced into the current ORD File are shown on the left. Select (highlight) a Terrain Model for inclusion in the Complex Terrain Model.
2	**Current Action:** Select either **Merge** or **Append**. These settings are explained on the next page. ***TIP:*** When in doubt, use the **Merge** setting. The **Append** setting commonly produces unpredictable results.
3	When the **Add >** button is pushed, the selected Terrain Model is moved to the list of Terrain Models to be combined on the right.

22E.1 Create Complex Terrain Model Settings

The following settings control how the Complex Terrain Model is triangulated and formed.

Merge vs Append: The Merge and Append settings control how overlapping Terrain Models interact.

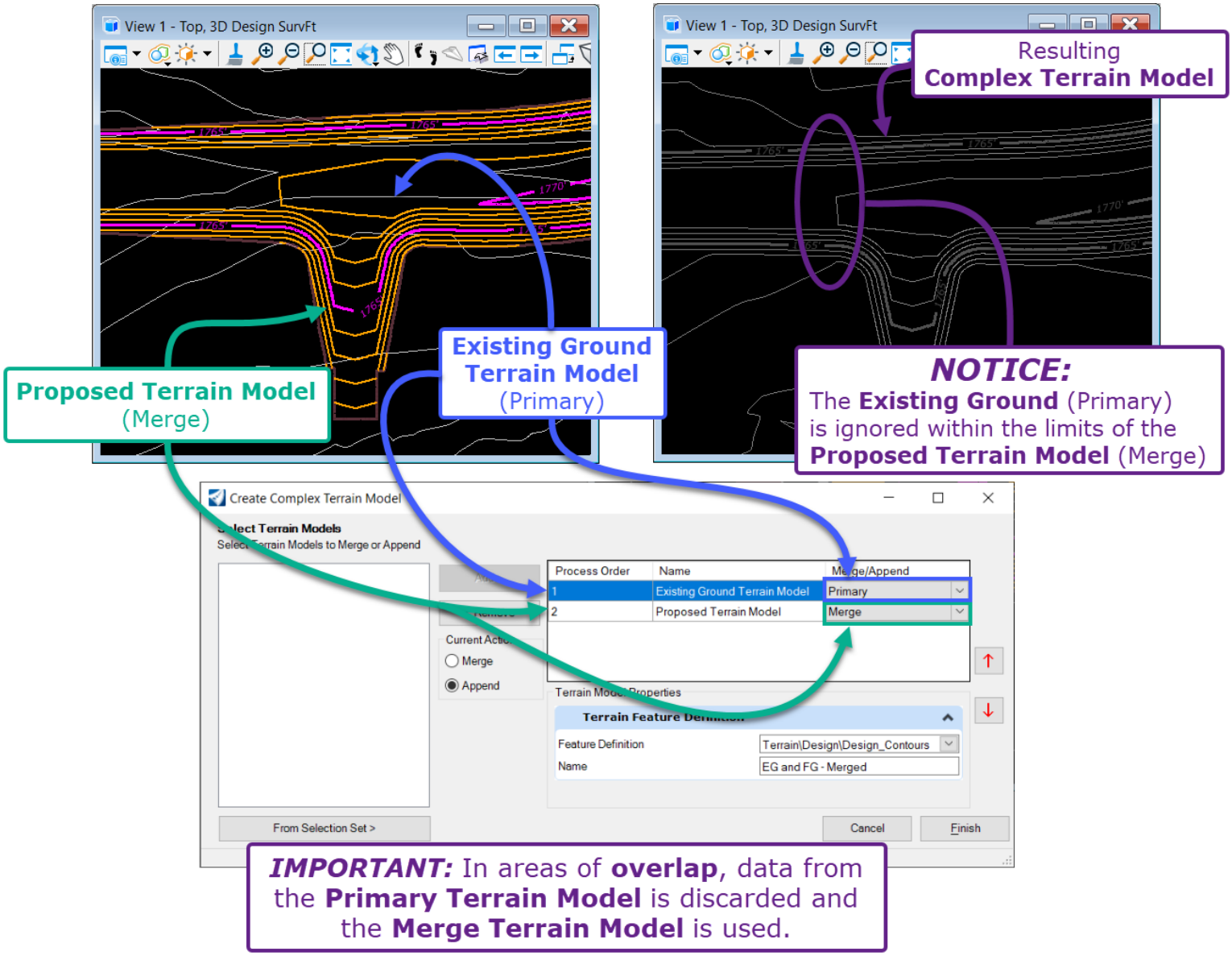
Merge: When Terrain Models overlap, then the **Primary** Terrain Model is ignored in the overlapping area. The **Merge** Terrain Model data is used in overlapping areas.

For example, to create a Complex Terrain Model that combines Existing and Proposed contours:

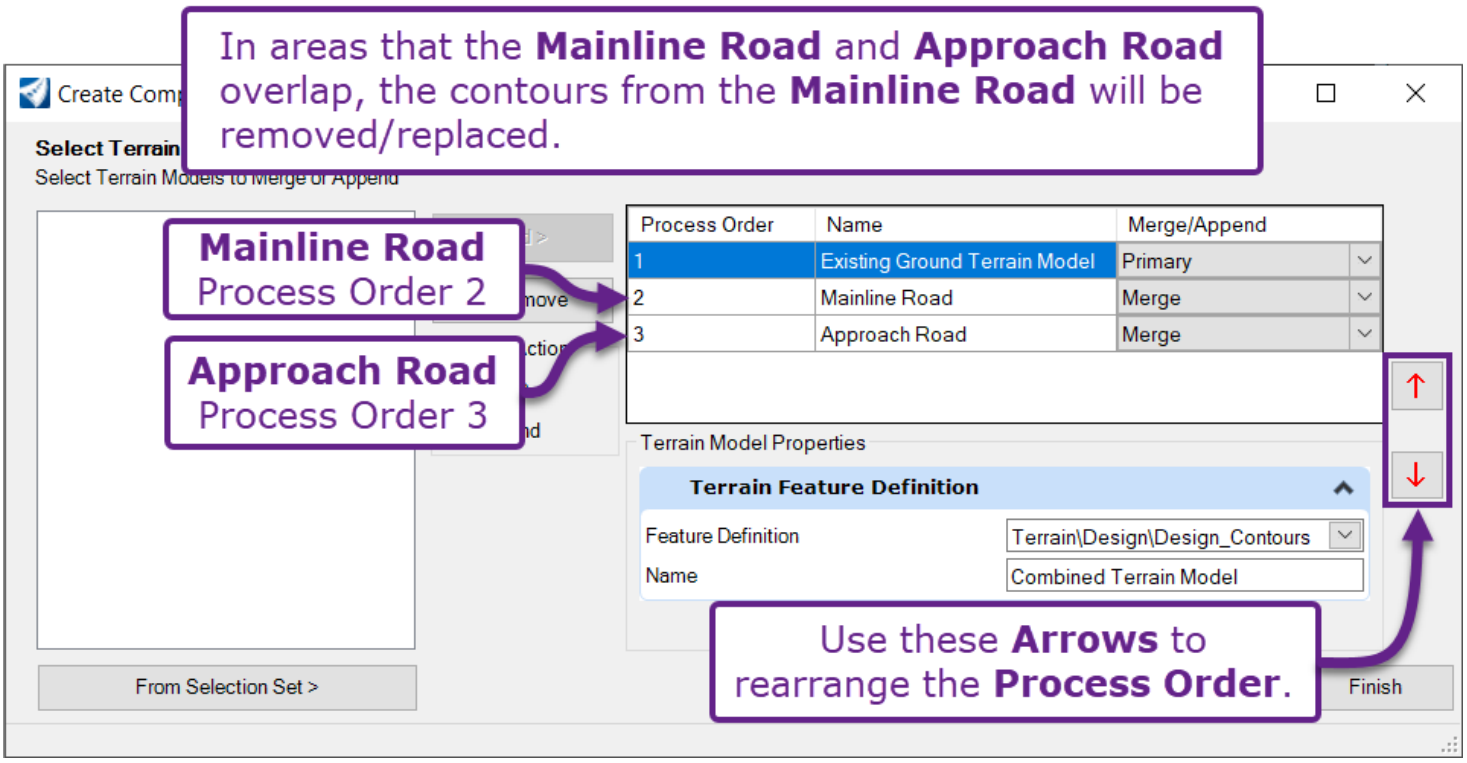
Existing Ground Terrain Model is designated as **Primary**.

Proposed Terrain Model is designated as **Merge**.

With this configuration, the Existing Ground contours are removed/replaced in the area that overlaps with the Proposed Terrain Model. The Terrain Model designated as **Merge** will NOT have its contours removed.



Process Order: If two or more Terrain Models are designated as **Merge**, then the **Process Order** determines which contours are remove/replaced. In areas where multiple Terrain Models overlap, the LAST Terrain Model in the **Process Order** will take priority. The LAST Terrain Model in the **Process Order** will NEVER have its contours removed/replaced.



NOTE: The **Process Order** is inconsequential when the **Append** option is used.

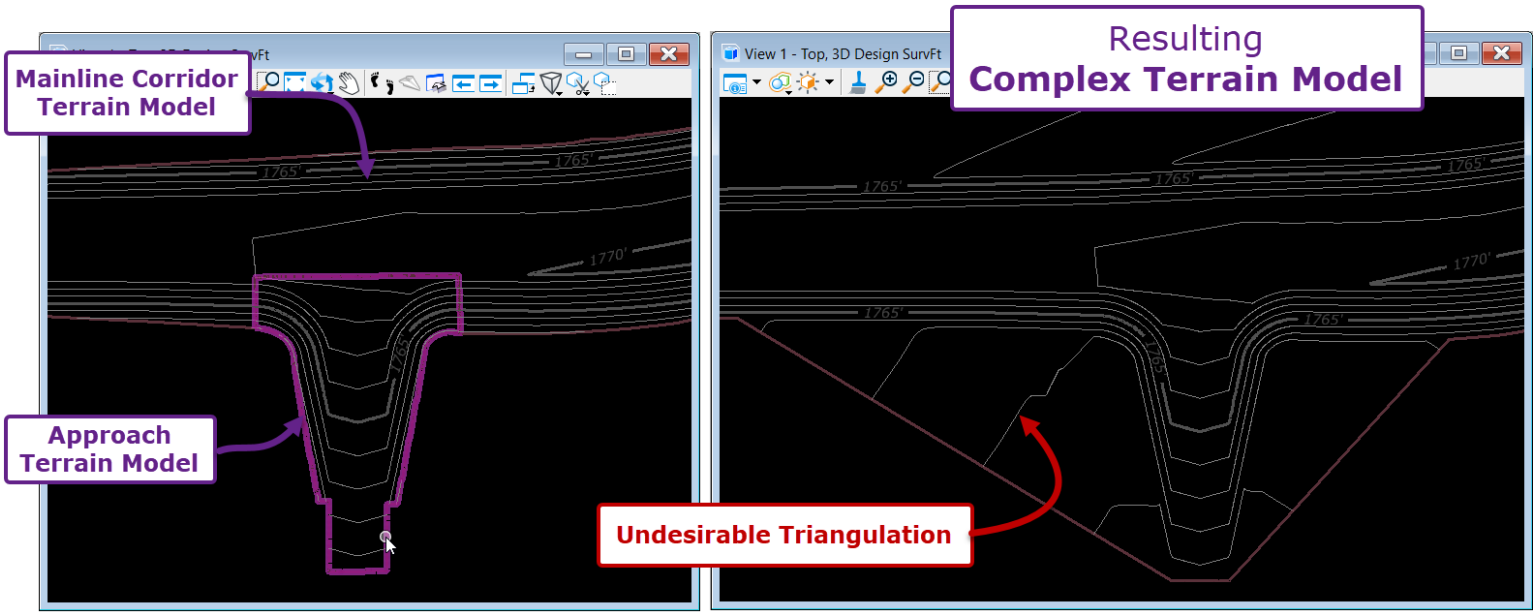
Append: When two Terrain Models overlap, elevation data from BOTH Terrain Models is used to triangulate the Complex Terrain Model.

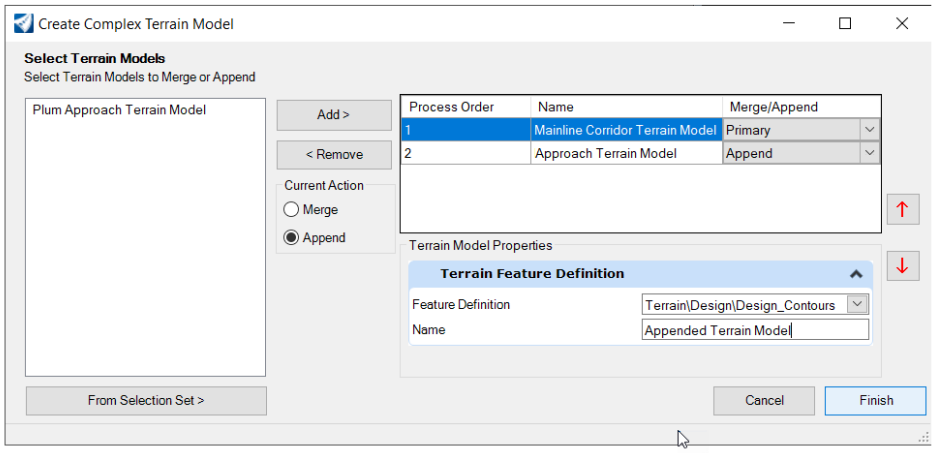
> ***WARNING:*** The **Append** option produces very unpredictable results if Terrain Models are overlapping. The resulting Complex Terrain Model attempts to use data from all constituent Terrain Models, which produces jagged and inaccurate contours.

The **Append** option is typically used when Terrain Models are adjacently positioned, but do NOT overlap. However, this configuration may produce errant triangulation.

NOTE: The **Process Order** is inconsequential when the **Append** option is used.

In the example shown below, the **Mainline Corridor Terrain Model** and the **Approach Terrain Model** are adjacently positioned, but do NOT overlap. The Terrain Models are combined with the **Append** option. However, the **Append** option produces undesirable triangulation, with the resulting Complex Terrain Model extending past the boundary of both constituent Terrain Models.





TIP: Using the **Merge** option for adjacently positioned Terrain Models typically yields acceptable results.

22E.1.a Edit a Complex Terrain Model after Creation

If the Complex Terrain Model does NOT produce desired results after creation, then *Edit Complex Model* tool can be used to re-configure the **Processing Order** and **Merge/Append** options.