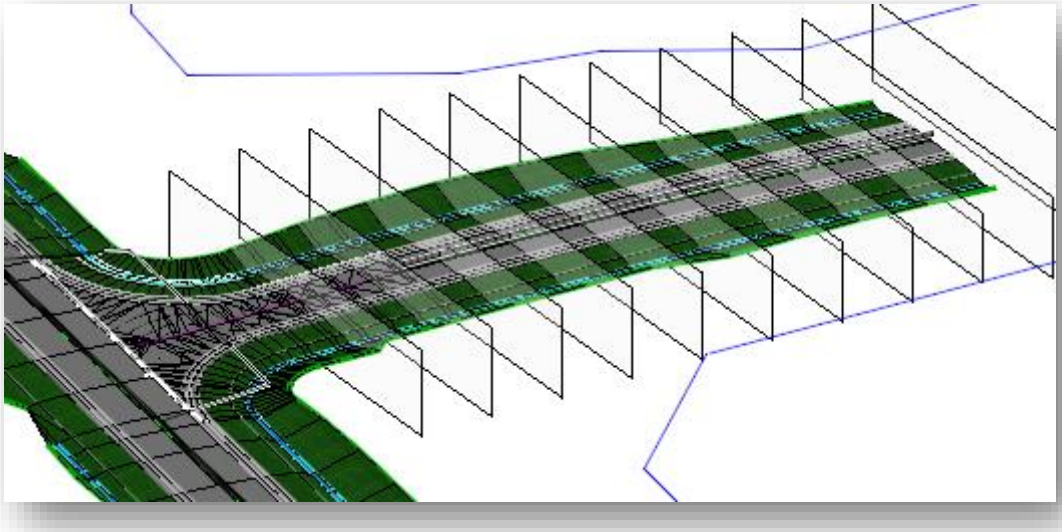
OpenRoads Designer: Cross-Section Sheets

Cross-Section Sheet Process Overview

The process to generate cross-section sheets is very similar to the plan and profile sheet process.

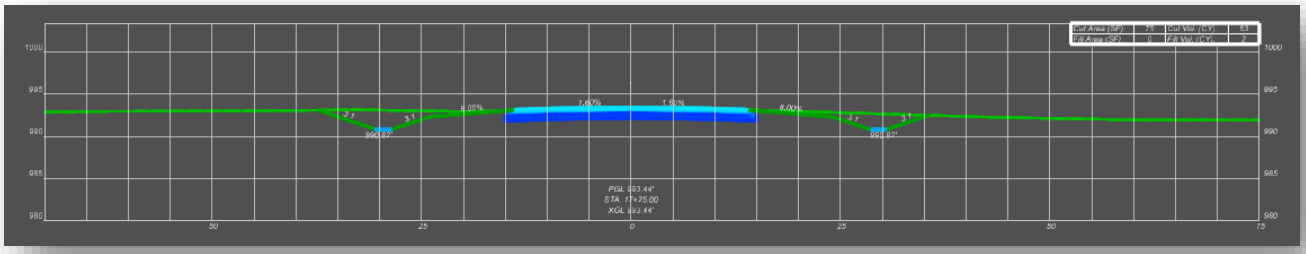
OpenRoads designer uses MicroStation **Named Boundaries** to define the cross section clipping areas. The named boundaries are placed in a **3D Design** model relative to a selected alignment.

The example below shows the 3D Named Boundaries placed relative to the St. Peter Road 3D model.

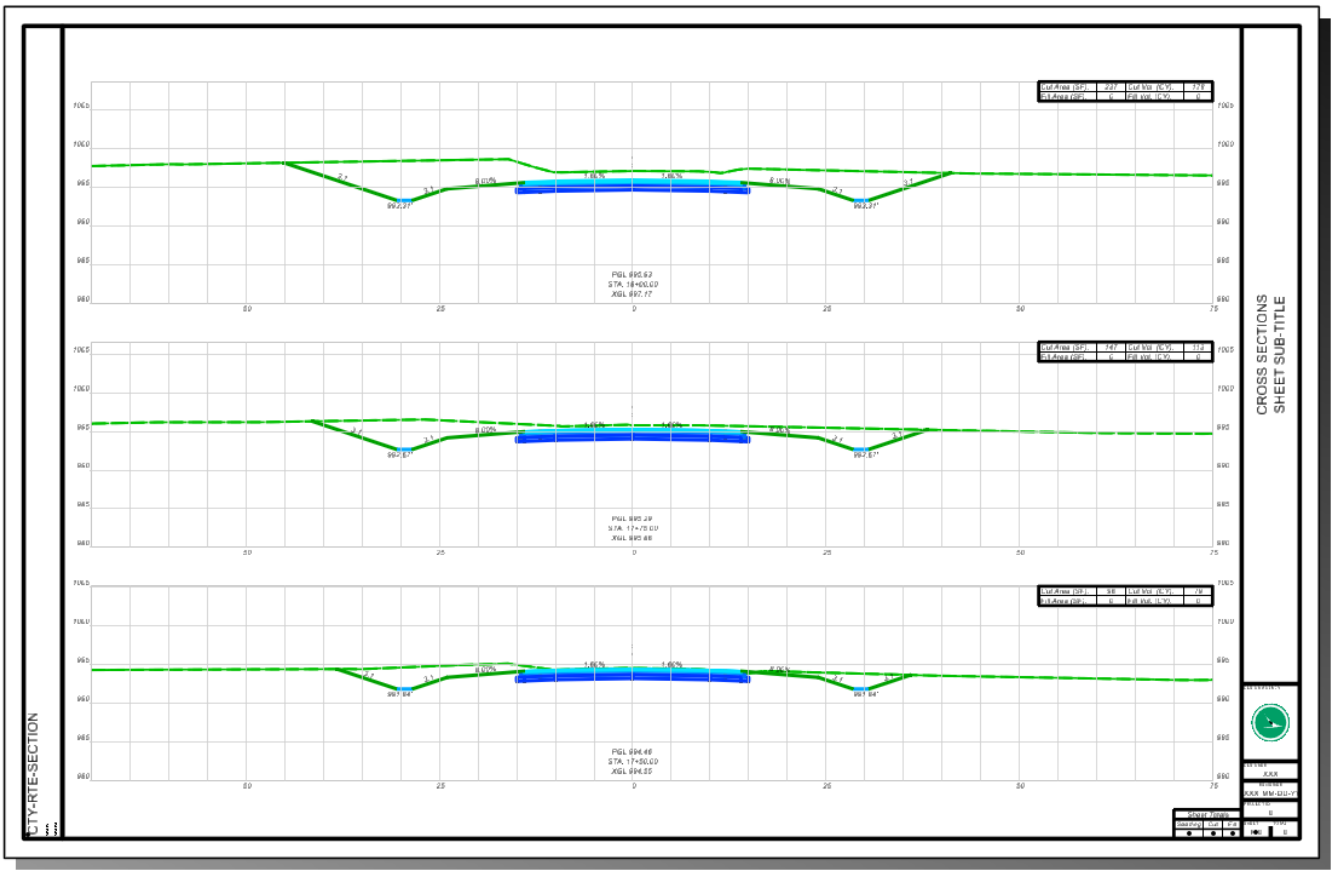


Before generating the named boundaries, a design file is created as a "container file" to attach references and place the named boundaries for the cross-section locations. The 3D model must be displayed in order to place the named boundaries. The cross section are cut from the 3D model. In the example above, the geometry, survey, and corridor model basemaps are attached to the plan view with the 3D model displayed. The named boundaries are placed in the 3D model relative to a selected alignment.

When the sheets are generated, the software creates a MicroStation drawing model for each named boundary. An example of the drawing model for a cross-section is shown below.



The drawing models are referenced to a sheet model with a sheet border to assemble the completed cross-section as shown in the example below.



The sheet model is intended for plotting or PDF generation. Most annotations should be placed in the various drawing models, not in the sheet models.

File Types and Usage

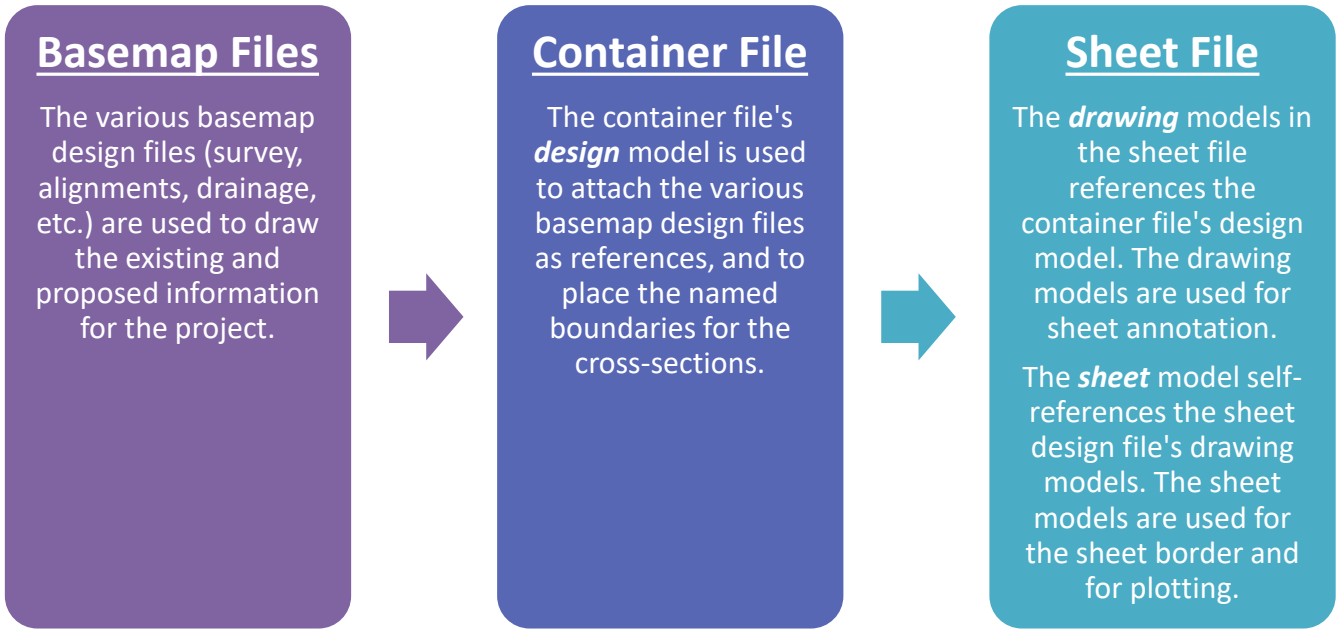
A "container file" is used to attach references for the information that will be shown in the cross sections as well as to place the named boundaries for the cross-section locations.

Sheets can be clipped into the container file itself, or clipped into multiple files, one sheet per design file, if desired.

Each container file is used to generate the sheets for a single alignment. For example, a project with three alignments would typically use three container files as detailed below:

Design File	Usage	Models Used
XS000	Container file for S.R. 185	Design
XS001, XS002, XS003…	Cross-section sheets for S.R. 185	Drawing and Sheet
XS100	Container file for St. Peter Road	Design
XS101, XS102, XS103…	Cross-section sheets for St. Peter Road	Drawing and Sheet
XS200	Container file for Jameson Road	Design
XS201, XS202, XS203…	Cross-section sheets for Jameson Road	Drawing and Sheet

The references are attached as illustrated below.



The container file is used to control the reference attachment and level display settings for all the sheets from one location. More information on level display can be found in the Level Management section of this document.

It is possible to put the named boundaries for multiple alignments in one container file if all the sheets will share the same reference attachments and level display settings.

End Area Volumes

End areas can be extracted from the 3D model for each named boundary and included on the completed sheets. This process requires 3D mesh elements for the cut and fill areas. The 3D mesh elements should be created in a separate design file. These 3D meshes are normally created before starting the sheet clipping process.

Cross-Section Sheet Summary

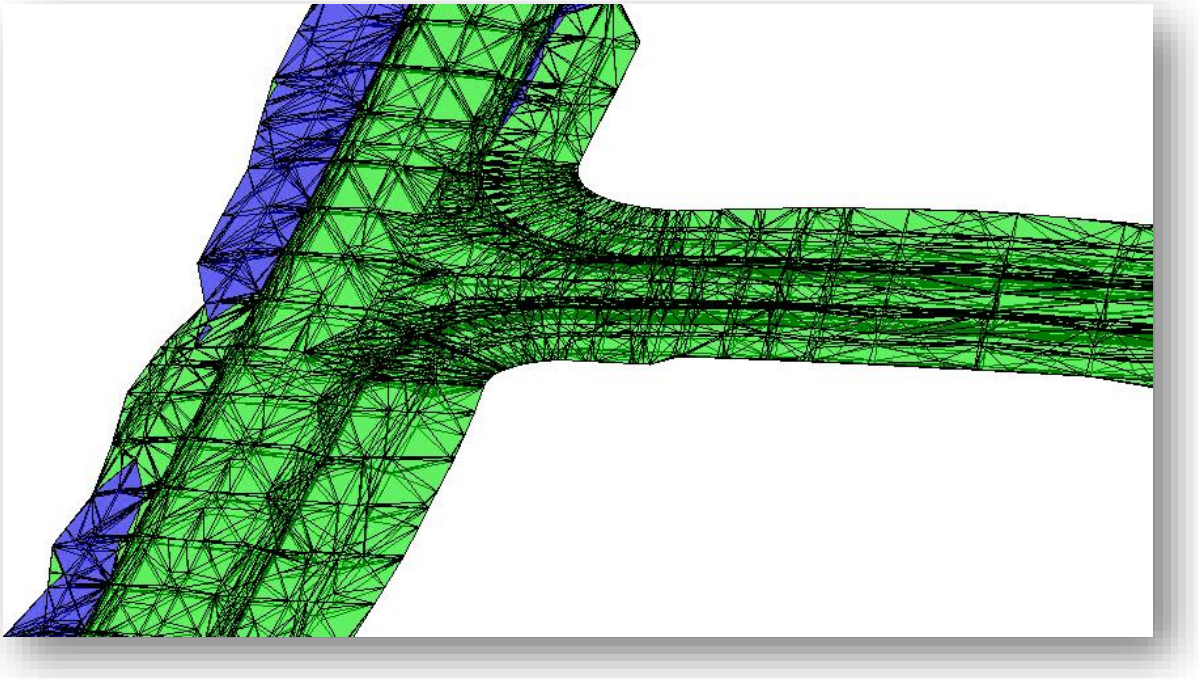
The steps to generate cross-section sheets are summarized below:

1. If end area quantities are to be displayed, create a design file to contain the 3D mesh elements and run the **Create Cut Fill Volumes** command
2. Create a design file to act as the container file
3. In the container file, take the following steps to prepare for clipping the cross-section sheets:
    a. Attach the various design files containing the 3D models and survey information, underground utilities, 3D right-of-way lines, etc. that will be shown on the cross-sections. Also attach the design file containing the 3D mesh volume elements
    b. Assign the existing ground terrain model as the active terrain
    c. Open a 3D view of the model
    d. Toggle on/off the Global Display of the levels in the Design-3D model that you wish to be displayed in the cross-sections.
    e. Create **Named Boundaries** for the cross-section locations, but do not create the sheets yet.
    f. If end area quantities are to be displayed, run the **End Area Volume** report. Each named boundary is tagged with the quantity values
4. Create the cross-section sheets. The sheets can be generated into the active design file (the container file) or into separate design files.

Create Cut and Fill 3D Meshes

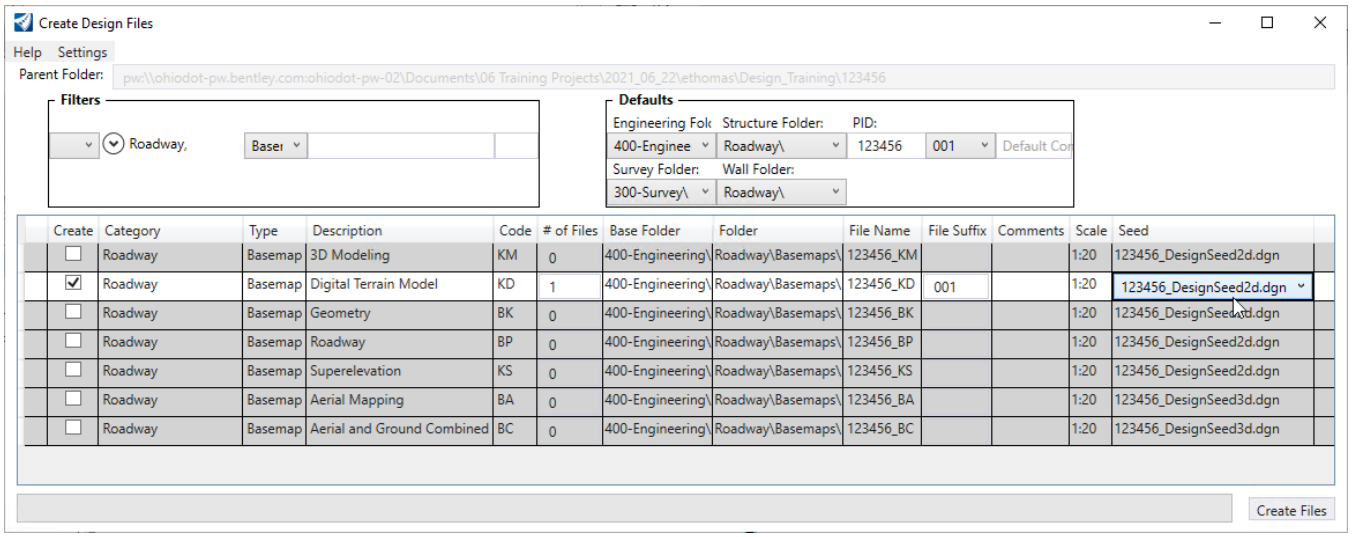
The **Create Cut Fill Volumes** command is used to generate 3D mesh elements for the cut and fill volumes. These elements are required to generate end area volumes for the cross-section sheets. This training guide will document the process to create simple cut/fill quantities.

An example of the 3D mesh elements is shown below.



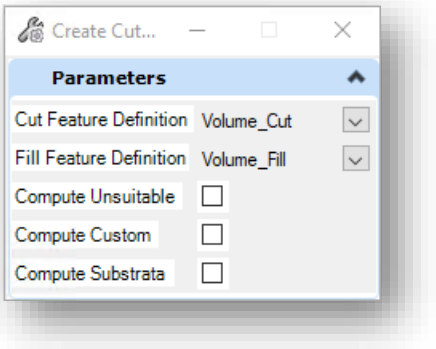
The 3D mesh elements are generated in the **Roadway Digital Terrain Model** file type.

When using the **OHDOT Create Design Files** application the **Seed** option will default to the **DesignSeed3d** file. Change this to the **DesignSeed2d** option as shown below.



After the file is created, the next step is to attach the design files as a reference that contain the existing ground terrain and the proposed corridor models.

The Create Cut Fill Volumes process will compare the lowest proposed component to the active terrain to generate 3D prismoidal volumes. Be sure to set the existing ground terrain as the active terrain before running the command. The command is accessed by selecting **OpenRoads Modeling > Home > Civil Analysis > Create Cut Fill Volumes**.



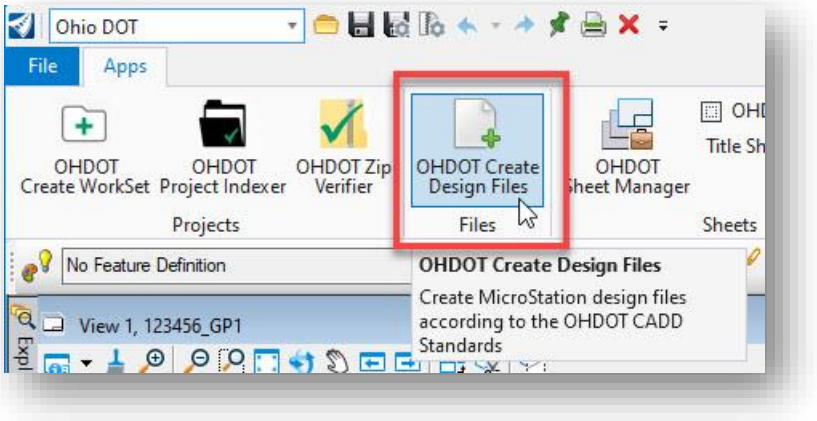
The tool settings for the command are shown at left.

Accept each option by issuing a left click as each option is presented on the cursor.

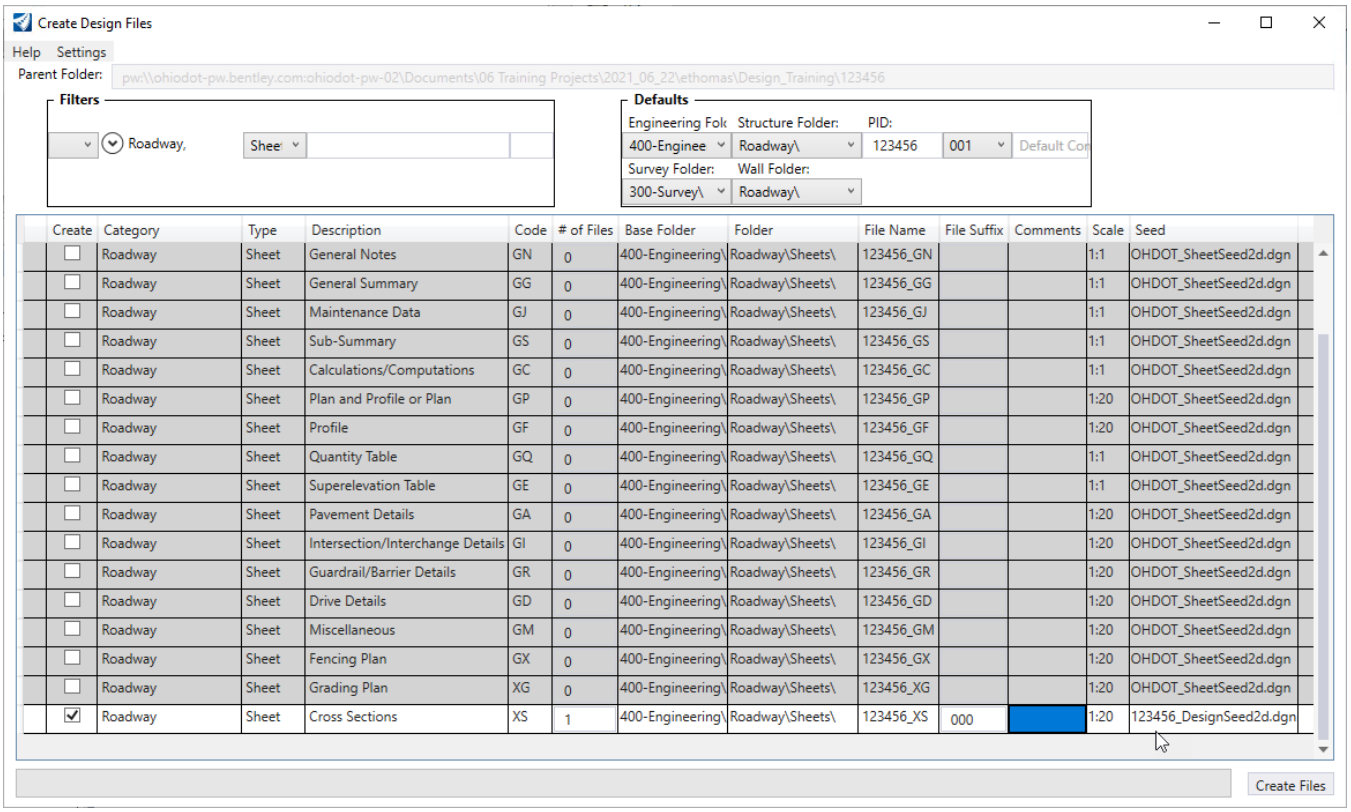
The 3D mesh elements for the cut and fill volumes are placed in the 3D model like the example shown on the previous page.

Creating the Container File

Design files are created using the **OHDOT Create Files** application. The application is accessed from the Ohio DOT WorkFlow by selecting the **New Design File** icon.



The application is opened as shown below.



In the example above, the file suffix of **000** has been entered for the **Cross Sections** sheet type. The application recognizes the 000, 100, 200, etc. series as container files and has automatically switched the **Seed** file to the appropriate design seed for the WorkSet.

Reference Attachments

After creating the new design file for the cross section named boundaries, attach the references necessary to generate the cross sections.

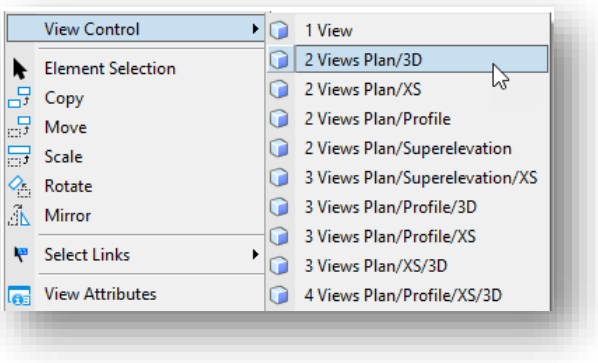
As a minimum, the following files will need to be attached:

- Survey basemap containing the existing ground terrain model.
    - **Note:** Be sure to set the existing ground as the active terrain after the file is attached. This will create a 3D model in the active cross section sheet design file
- Geometry basemap containing the alignments
- Corridor Modeling basemaps containg the applicable corridors

Several additional files may be included as attachments depending on the project:

- Any other files that contain 3D information (utilities, right-of-way, etc.) that is to be displayed on the cross sections
- The design file that contains the prismoidal volume areas, which is required to display end-area quantities on the sheets

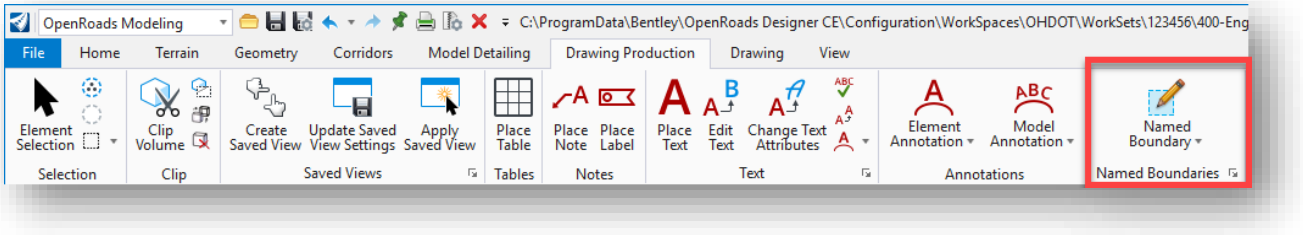
After the references are attached, it is necessary to configure the view windows to display both plan and 3D model information. Hold down the right mouse-button with the cursor positioned in a MicroStation view window until the pop-up menu appears. Select the **2 Views Plan/3D** option as shown below.



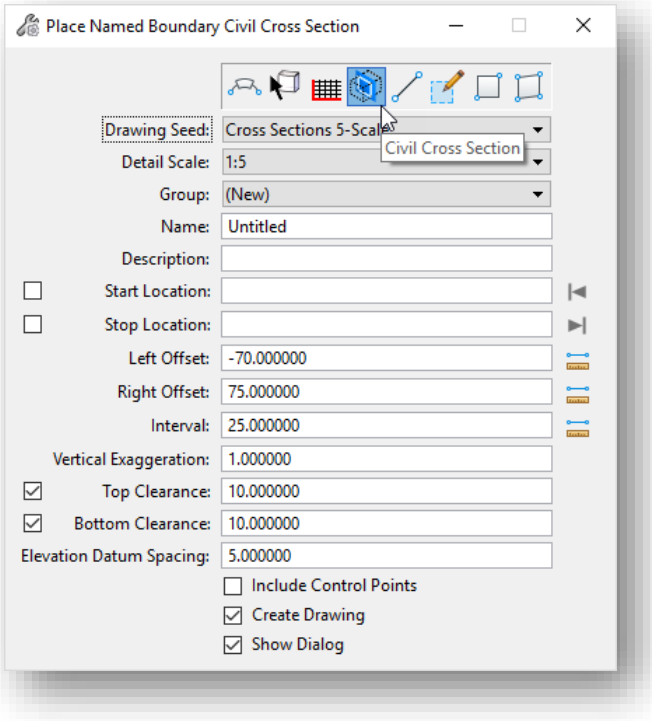
The graphics that will be displayed on the clipped cross sections are controlled by what is displayed in the 3D view. Toggle on/off the desired levels in the 3D view before proceeding.

Named Boundaries

Sheets are clipped using **Named Boundary** tool. From the **OpenRoads Modeling** workflow, select the **Drawing Production** tab to access the **Named Boundary** tool as shown below.



The *Place Named Boundary Civil Plan* dialog is opened as shown below.



The top of the dialog contains several icons to select the type of named boundary that you wish to place.

The following icons will be discussed in this document:

Civil Cross Section

Civil Cross Section 2 Points

Note: Toggle the **Create Drawing** option off if generating end area volume quantities to be displayed on the cross-section sheets. The Named Boundaries must be placed before running the **End Area Volumes Report**. See End Area Volume Report for more information.

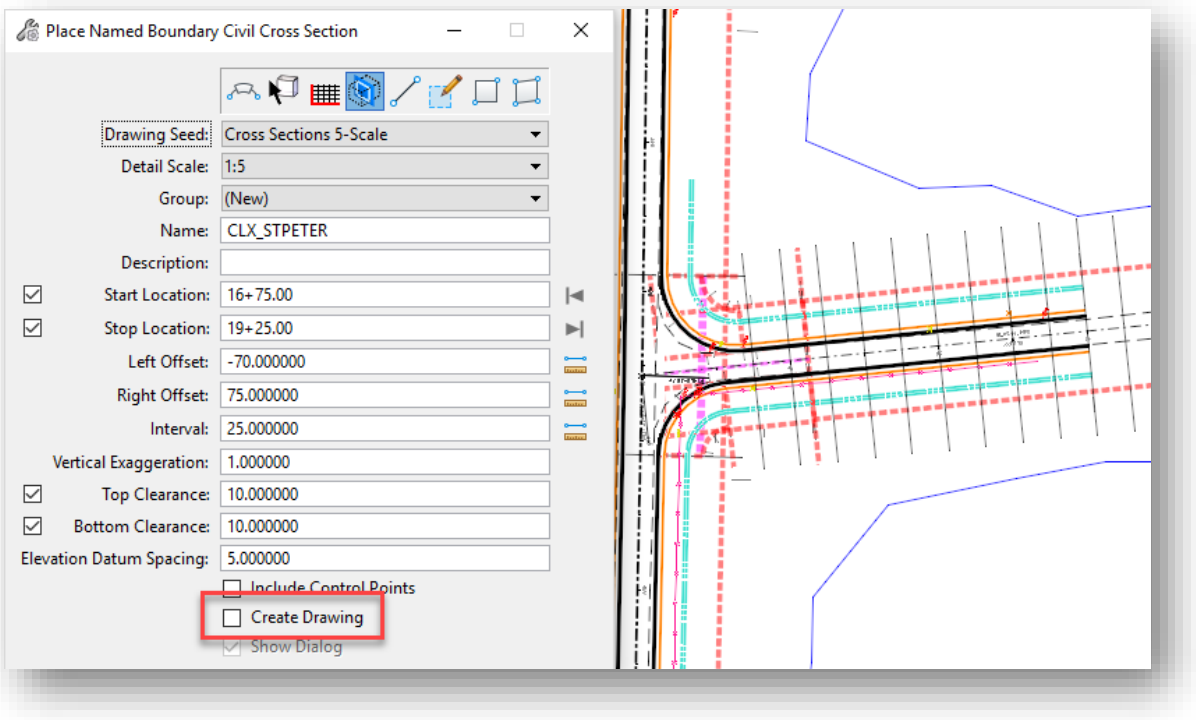
Select the fourth icon, **Civil Cross Section** to begin the process of placing the cross section named boundaries. The **Drawing Seed** item is used to select the configuration for placing cross section named boundaries. As of this writing, two options are available to define the named boundaries for cross section sheet clipping.

- Cross Sections 5-Scale
- Cross Sections 10-Scale

Issue a left mouse-click in the **Start Location** Field. And then select the desired alignment that will be used as the centerline for the cross-section clipping. The **Start Location** value will dynamically change as the cursor is moved within the view window. Note that the second **Name** field will change from "Untitled", as shown above, to the name of the selected alignment.

- Identify the desired **Start Location** by issuing a data-point within the view, by keying in a station value, or by selecting the icon to the right of the **Start Location** field to lock the starting location to the beginning of the selected alignment.

After the **Start Location** has been established, identify the desired **Stop Location**. As the cursor is moved, the **Stop Location** will track the station value relative to the cursor position. Clipping borders are dynamically displayed as the cursor is moved. The stop location can be entered by issuing a right-mouse click in the view, keying in the desired station, or by selecting the icon to the right of the **Stop Location** field to lock the ending location to the end of the selected alignment. An example is shown below.



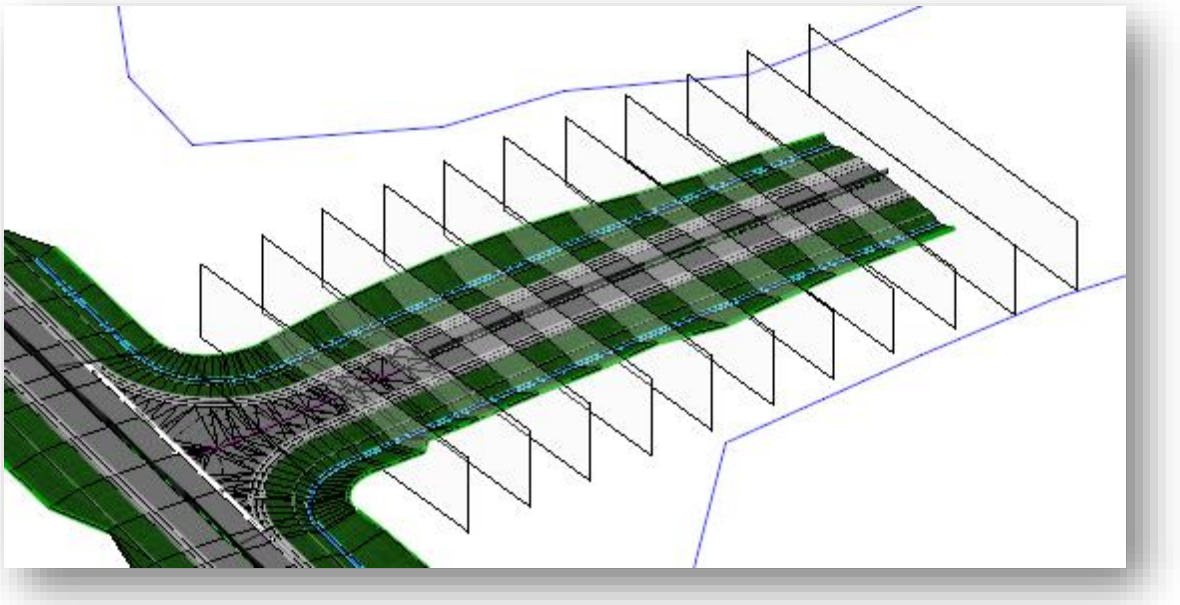
Create Drawing
This option is used to initiate the process to create the sheets after the named boundaries are placed.

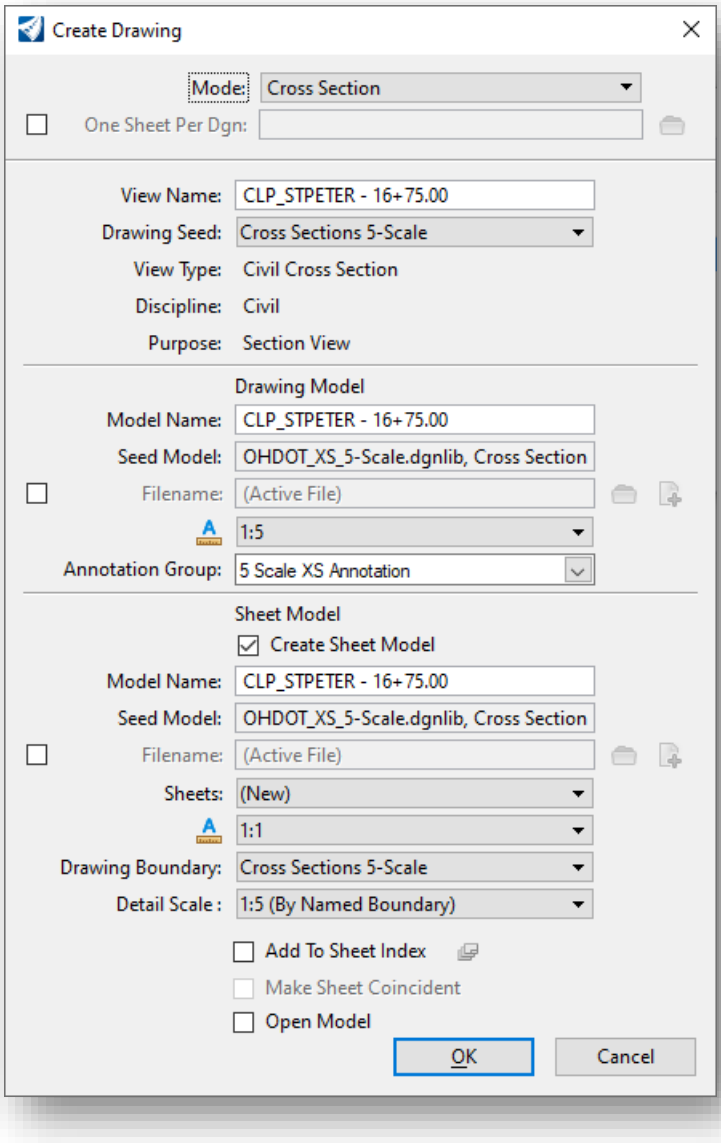
- Turn this option **OFF** if you want to update the named boundaries with the end area quantities before generating the sheets. See the End Area Volume Report section.
- Turn this option **ON** to generate the sheets without any end area values. The end areas can be updated later as detailed below.

Placing the Named Boundaries

After the parameters in the ***Place Named Boundaries*** dialog has been defined, it takes two left-mouse clicks to initiate the named boundary placement.

- Issue a left mouse-click to accept the **Start** and **Stop Location** values
- Issue another left mouse-click to accept the named boundary placement. Named boundaries are drawn in the 3D view representing the clipping limits for each cross section as shown below





If the **Create Drawing** and **Show Dialog** options are toggled on, the ***Create Drawing*** dialog, shown at left, is opened.

Toggle in the **One Sheet Per DGN** option if desired and set the path for the new cross-section sheets. When this option is selected, the **Sheet Model** > **Model Name** parameter is used to specify the name of the cross-section sheet design files.

Check to ensure that the **Drawing Model** annotation scale and **Sheet Model Detail Scale** parameters are set properly for the corresponding cross-sections.

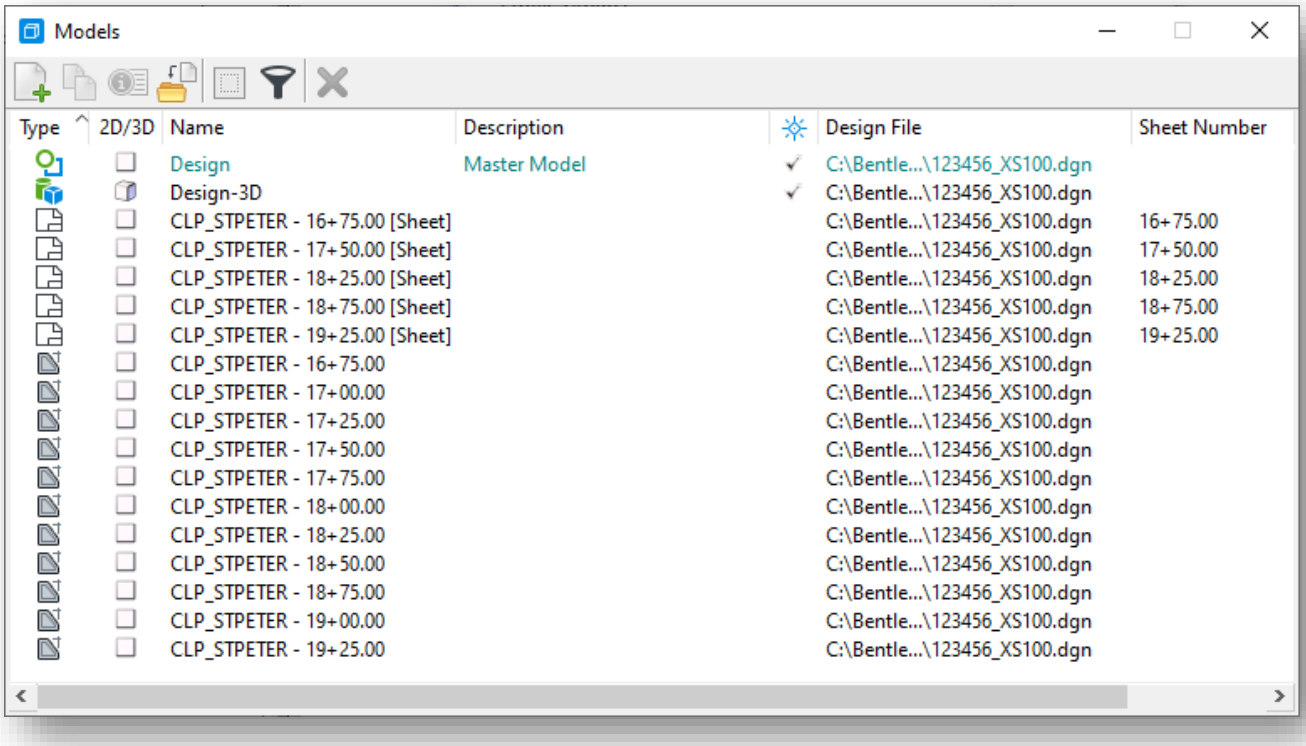
Always set the **Sheet Model** annotation scale parameter to 1:1 as shown at left.

Select **OK** to initiate the sheet clipping process.

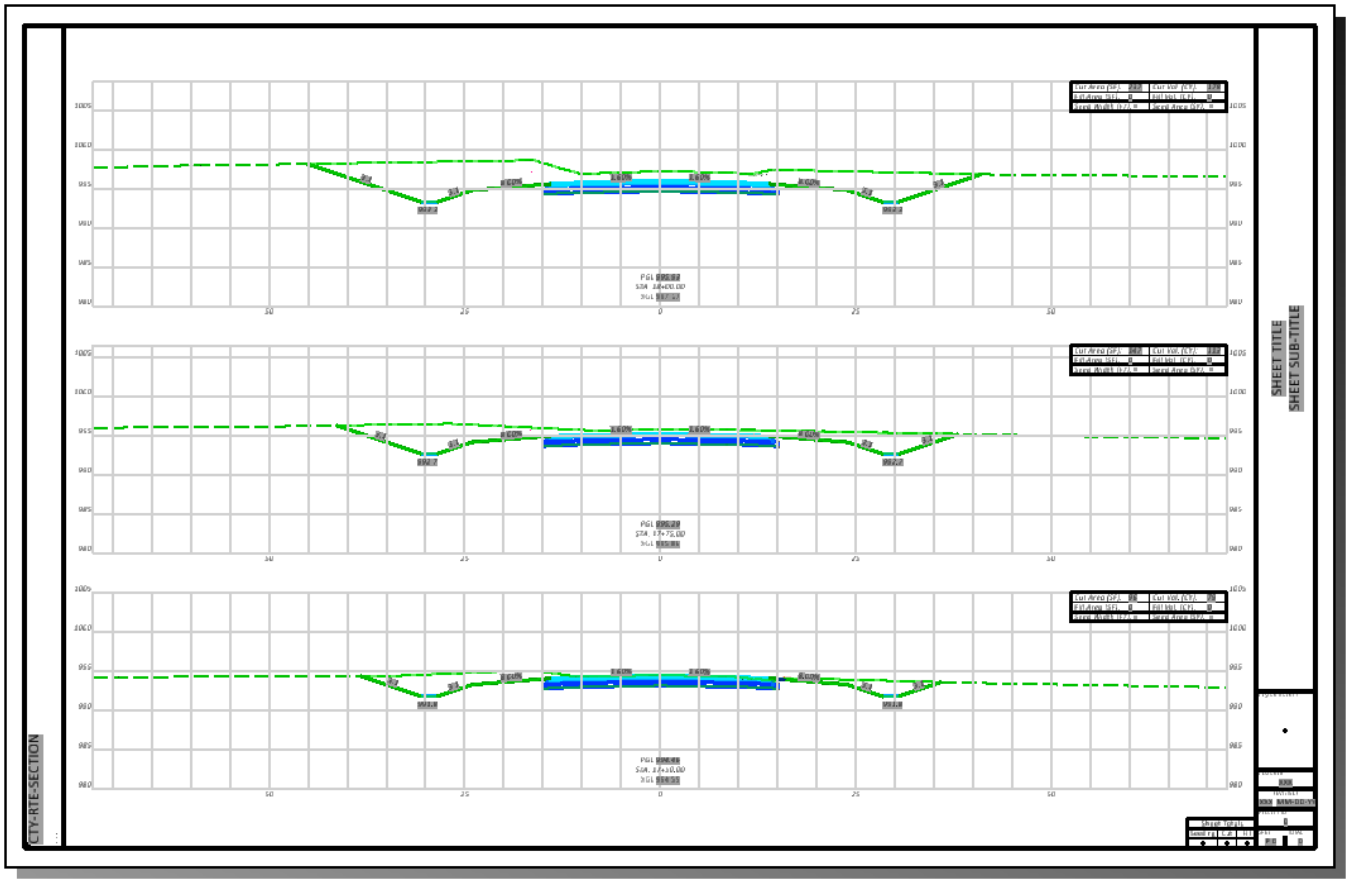
The software creates a drawing model and a named view for each cross-section.

Sheet models are created with the sheet borders. The drawing models are referenced to the sheet models.

The **Models** dialog (**Home > Models**) can be used to review each of the newly created model, as shown below.



The software will attempt to place as many cross sections as possible on the sheets.



Note that the spacing above and below each cross section, within the grid lines, is set in the *Place Named Boundary* dialog by setting the **Top Clearance** and **Bottom Clearance** values. The default values for the bottom clearance have been set to account for the presence of underground utilities, however, the value represents a default setting and may not be appropriate for all cases.

The spacing between the cross sections is set by a configuration variable.

Drawing Model vs. Sheet Model Usage

Each cross-section is displayed in a drawing model. The various drawing models are referenced to the sheets. Each sheet is contained in its own sheet model. The models are intended to be used as follows:

Drawing Models

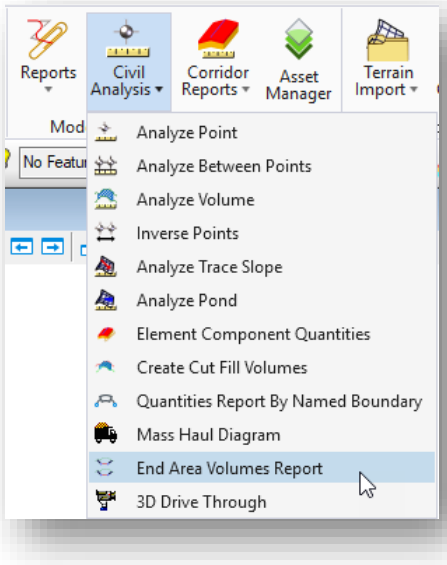
All annotation placed in the cross-sections should be placed in the drawing model. The cross-section grid area represents the clipping limits of the cross-section on the sheets; therefore, anything drawn outside of the grid will not be displayed on the cross-section sheets.

Sheet Models

The sheet model is intended the be used for printing. All annotation, other than the sheet border information, should be placed in the various drawing models.

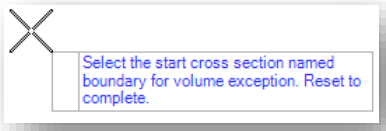
End Area Volume Report

Quantities can be extracted from the 3D mesh elements (see Create Cut and Fill 3D Meshes) using a previously placed set of cross section named boundaries using the **End Area Volume Report**, shown below. When the command is process, the named boundaries are tagged with the end area quantity values, which can then be used for cross-section annotation.

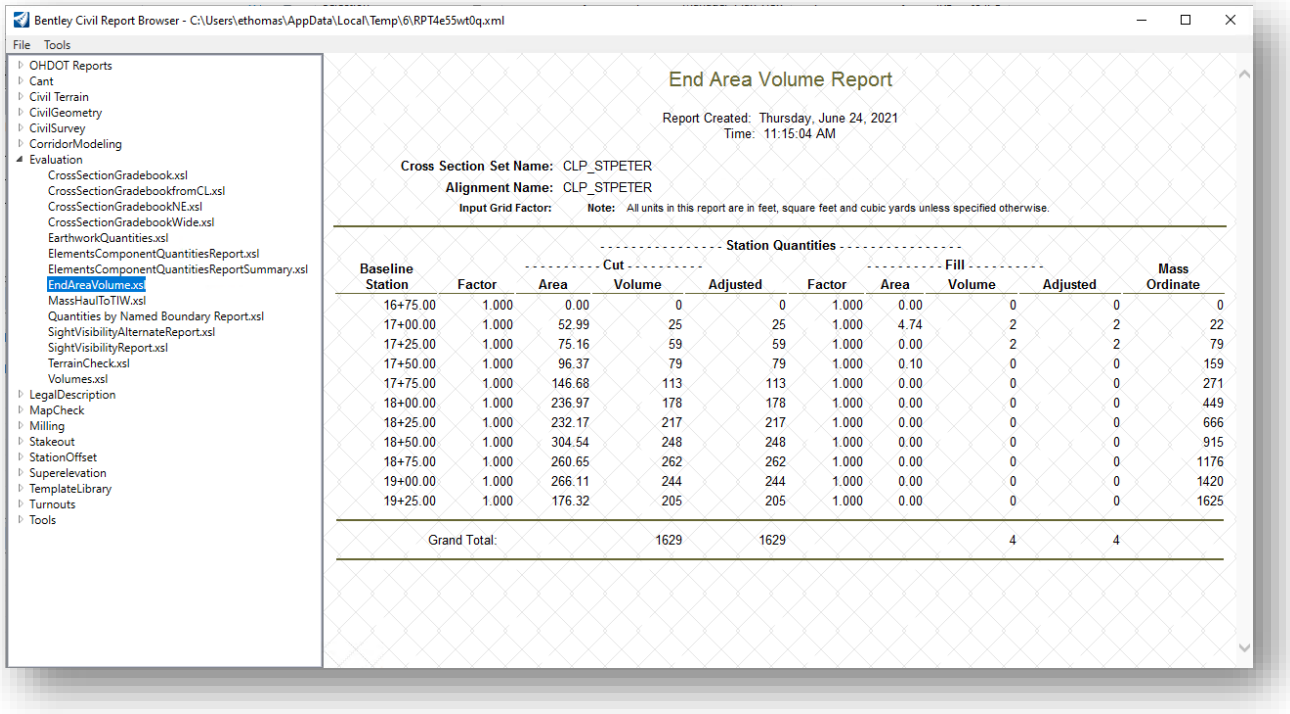


After selecting the command, choose the named boundary group that will be tagged with the quantity information.

When prompted, select any named boundaries that you wish to exclude from the process. Right-click (reset) when complete.

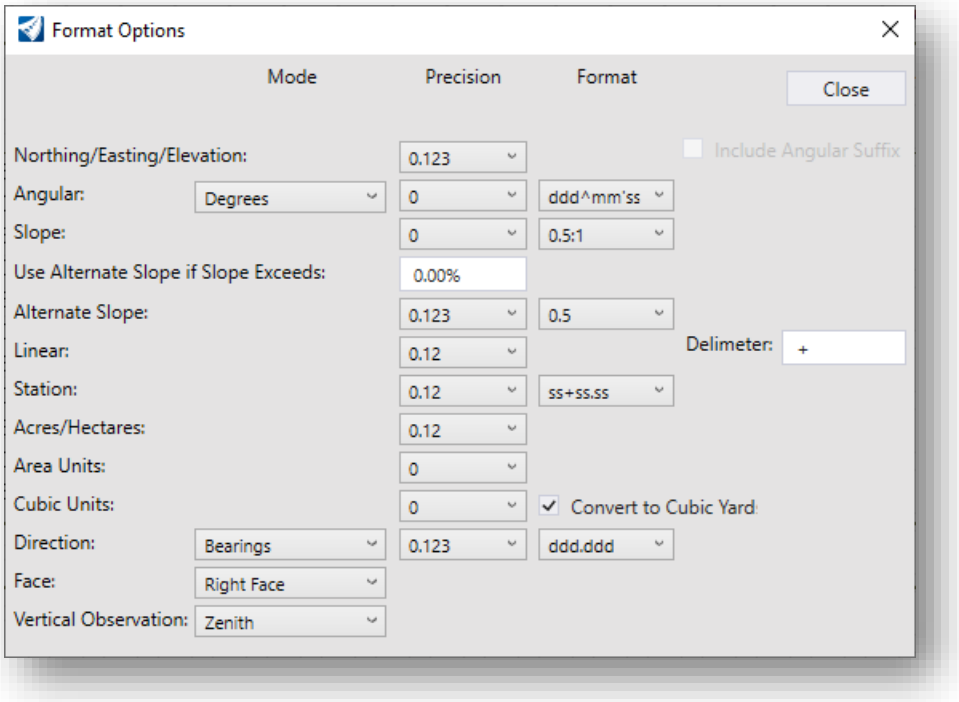


After processing the **End Area Volume Report** is displayed as shown below.



Each named boundary is tagged with the quantity information.

By default, the End Area Volume Report shows cut and fill volumes in Cubic Feet. From the ***Civil Report Browser*** dialog, select **Tools > Format Options** to access the dialog shown below.

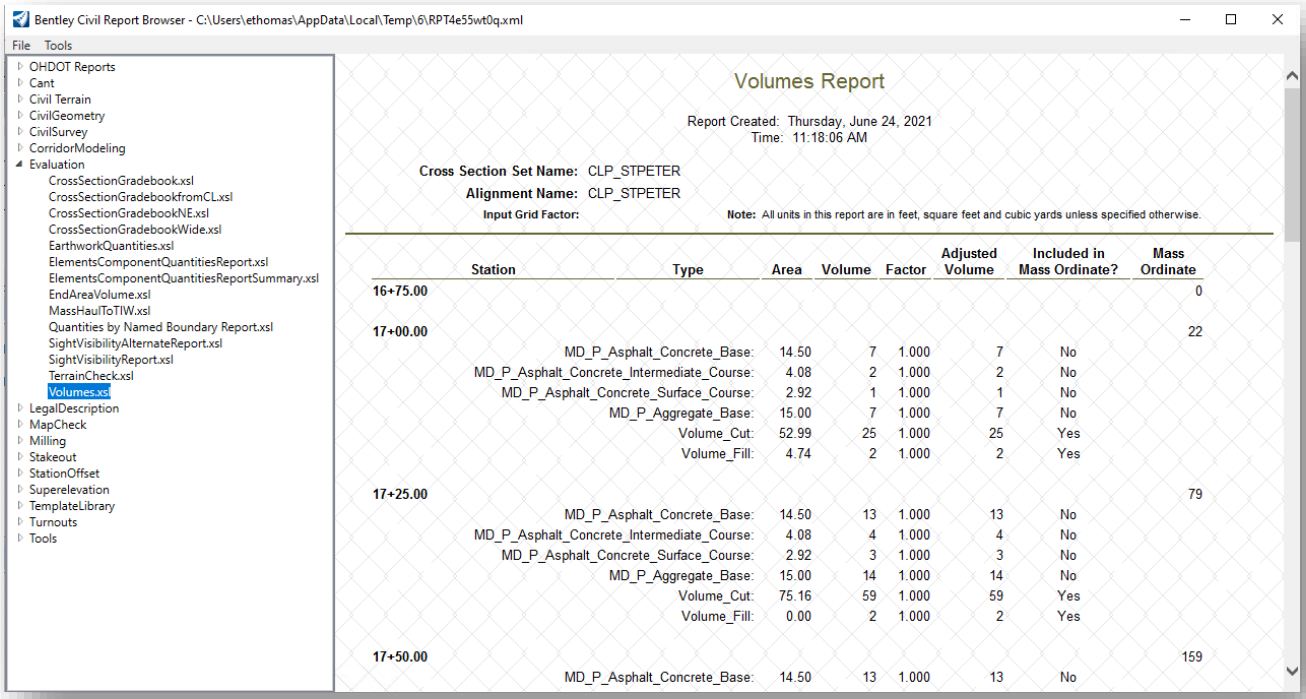


For ODOT projects, toggle on the **Convert to Cubic Yard** option as shown at left.

Select **Close** to apply the changes. Changes in format are applied to the current report values.

Various reports are available as shown on the previous page. It is good practice to save this report by choosing the **File > Save As** option.

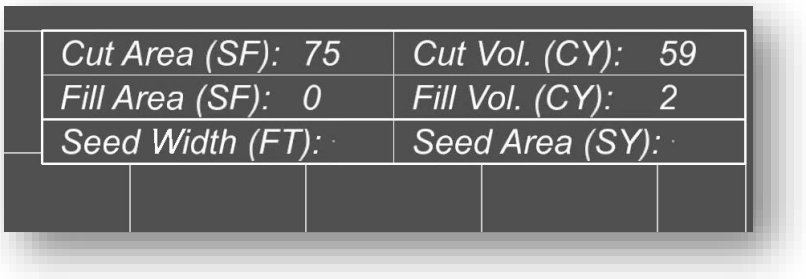
Another report you may want to consider saving is the **Volumes** report, shown below. This report shows the quantities for each component.



Station	Type	Area	Volume	Factor	Adjusted Volume	Included in Mass Ordinate?	Mass Ordinate
16+75.00							0
17+00.00							22
	MD_P_Asphalt_Concrete_Base:	14.50	7	1.000	7	No	
	MD_P_Asphalt_Concrete_Intermediate_Course:	4.08	2	1.000	2	No	
	MD_P_Asphalt_Concrete_Surface_Course:	2.92	1	1.000	1	No	
	MD_P_Aggregate_Base:	15.00	7	1.000	7	No	
	Volume_Cut:	52.99	25	1.000	25	Yes	
	Volume_Fill:	4.74	2	1.000	2	Yes	
17+25.00							79
	MD_P_Asphalt_Concrete_Base:	14.50	13	1.000	13	No	
	MD_P_Asphalt_Concrete_Intermediate_Course:	4.08	4	1.000	4	No	
	MD_P_Asphalt_Concrete_Surface_Course:	2.92	3	1.000	3	No	
	MD_P_Aggregate_Base:	15.00	14	1.000	14	No	
	Volume_Cut:	75.16	59	1.000	59	Yes	
	Volume_Fill:	0.00	2	1.000	2	Yes	
17+50.00							159
	MD_P_Asphalt_Concrete_Base:	14.50	13	1.000	13	No	

Displaying End Area Quantities

End area volumes are annotated in a table in the drawing model for each cross section as shown below.



The table is placed as part of the cross-section annotation. The table uses ORD Civil Fields for the end area quantities. These fields are automatically updated using the current values assigned to the named boundary when the drawing model is opened.

Notes:

- The table is placed only if a 3D line string is encountered in the 3D model generated by a point named "PGL" or "EX_Table" in the template that was used to generate the corridor model.
- The Seeding quantities are not computed by ORD. These entries are included in the table for use to manually place seeding quantities in the table.

Updating the End Area Quantities

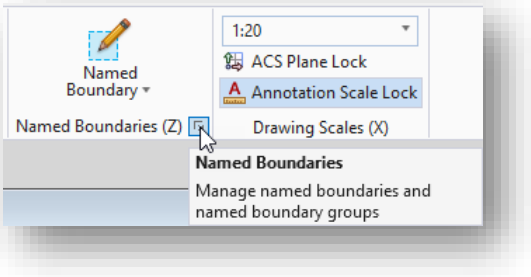
If changes are made to the model, the 3D mesh prismoidal cut and fill elements must be regenerated, and the end area volume report must be reprocessed. Take the following steps to update the quantities if changes are made to the model:

1. Open the DGN file containing the 3D mesh prismoidal volume elements
2. Delete the previously created prismoidal volume cut and fill elements
3. Run the **Home > Civil Analysis > Create Cut Fill Volumes** command
4. Open the cross-section container DGN file
5. Run the **Home > Civil Analysis > End Area Volume Report** command
6. Open each cross-section drawing model. The quantity fields are automatically synchronized with the earthwork quantity values that have been assigned to the named boundaries as each cross-section drawing model is opened

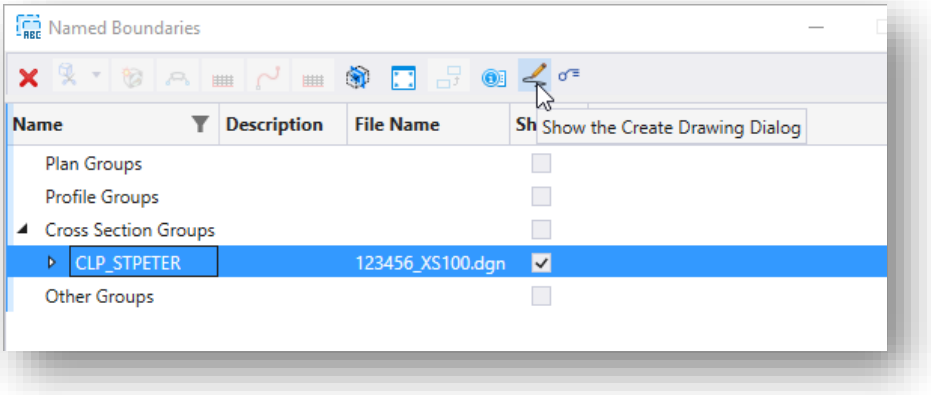
Processing Sheets from Previously Generated Named Boundaries

If the named boundaries were generated without creating the sheets, as is the case when running the **End Area Volume Report** after generating the named boundaries, the sheets can be generated from the named boundaries with the following steps:

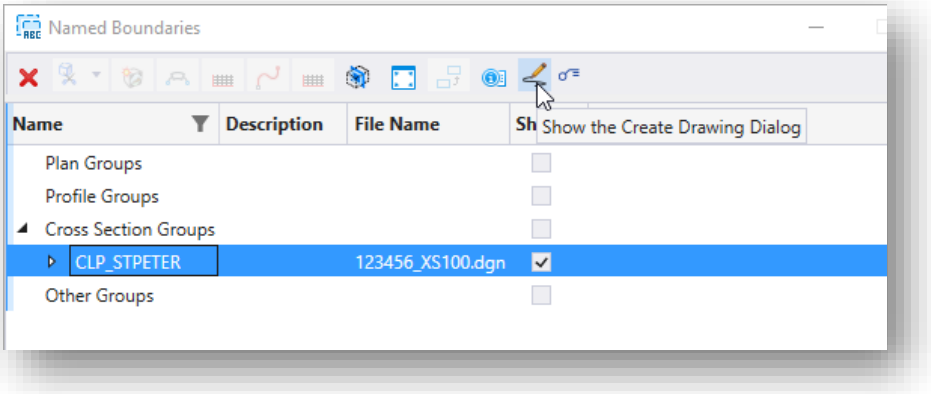
1. From the **Drawing Production** tab, select the icon at the lower left of the **Named Boundaries** group as shown below. The ***Named Boundaries*** dialog is opened.



2. In the ***Named Boundaries*** dialog, select the cross-section group from the list. Toggle the **Show the Create Drawing Dialog** option on as shown below.



3. Choose the **Create Cross Section Drawing** command. The ***Create Drawing*** dialog, previously described, is opened. Complete the ***Create Drawing*** dialog to generate the cross-section sheets.



Adding Cross Sections at Specific Stations

The initial cross section named boundary placement is defined by selecting an alignment and specifying an interval. Additional named boundaries for specific locations such as a driveway or a drainage structure can be inserted using the **Civil Cross Section 2 Points** option.

Additional cross section locations may be defined prior to, or after generating the initial sheets. Each workflow is summarized below.

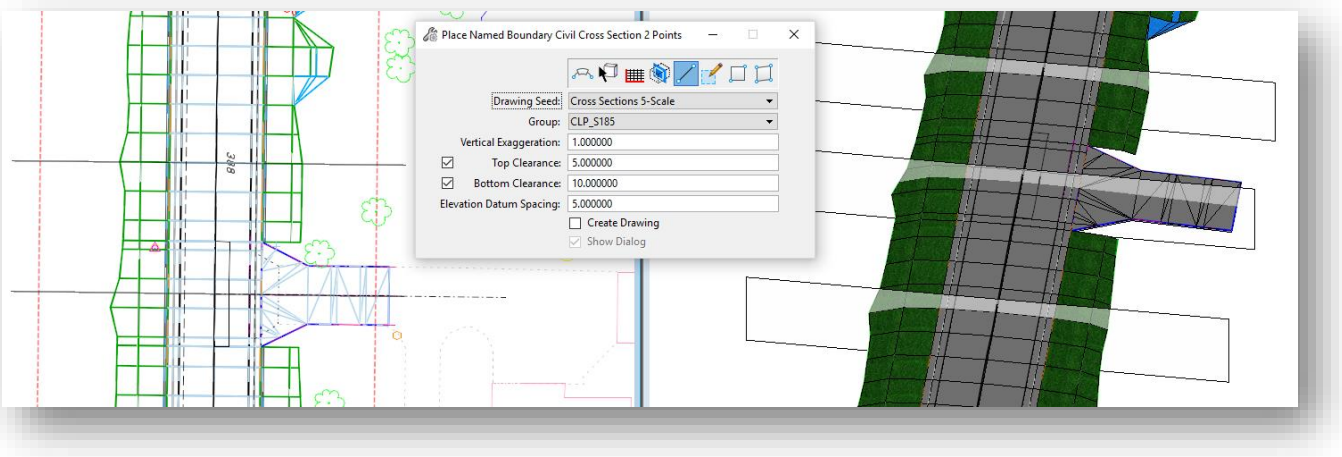
Adding Named Boundary Locations Before Generating the Initial Sheets

When the initial set of named boundaries is defined for the cross sections, be sure to toggle the **Create Drawing** option OFF. This allows the user the opportunity to define additional named boundaries at specific locations not covered by the initial named boundary interval placement.

Take the following steps to define additional cross section named boundary locations:

- From the **OpenRoads Modeling** WorkFlow, select **Drawing Production > Named Boundary** to initiate the process. The ***Place Named Boundary*** dialog is opened.
- If multiple locations are to be defined, toggle the **Create Drawing** option OFF
- Select the fifth icon, **Civil Cross Section 2 Points** to begin the process of placing the cross section named boundaries
- Select the desired **Drawing Seed** for the cross section named boundaries.
- Select the **Group**. The drop-down list will include any previously defined cross section groups.
- Select the alignment for the named boundaries
- After the alignment has been identified, enter data points for the start and end of the named boundary location. A third data point is required to accept the named boundary placement
- To define additional named boundary locations, the path element (alignment) must be identified each time. Follow the prompts in the lower left corner of the MicroStation window.

In the example below, a named boundary has been added at a driveway location.



Tip: For best results, create any additional named boundaries using Civil AccuDraw to define the station and offset values for the boundary. Use the same offset values as the primary cross-sections.

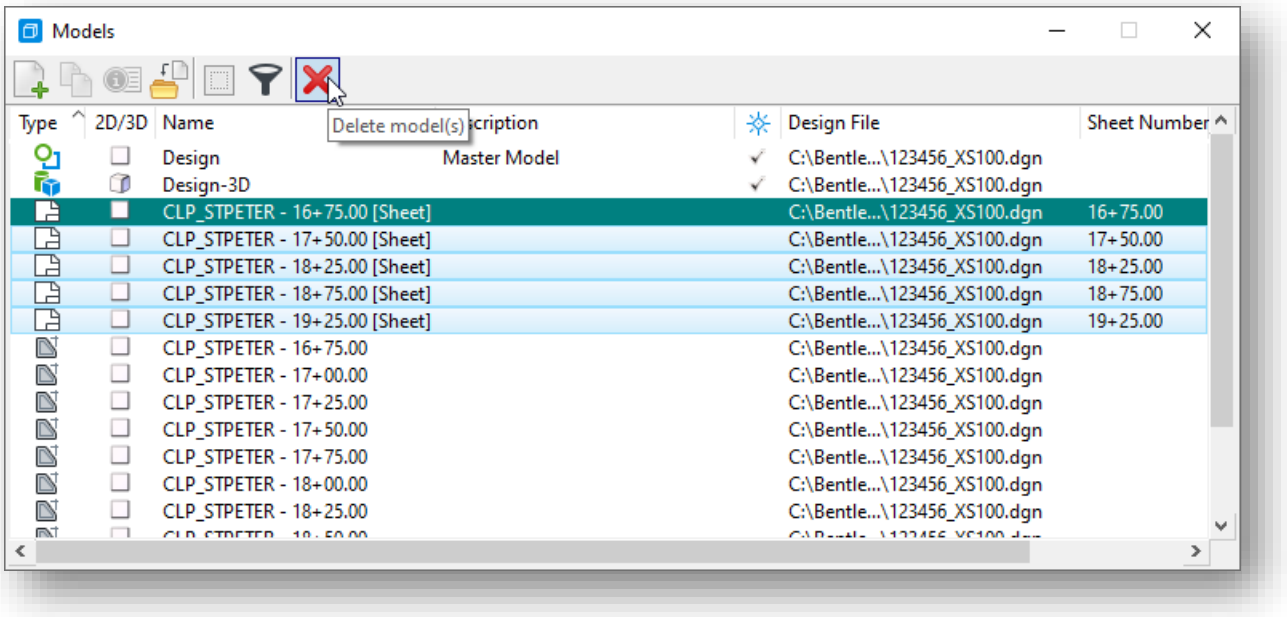
- Toggle on the **Create Drawing** option ON prior to defining the last boundary to launch the ***Create Drawing*** dialog.

  If you forget to toggle this option back on, the ***Create Drawing*** dialog can be accessed from the ***Named Boundaries*** dialog. See Processing Sheets from Previously Generated Named Boundaries, for more information.

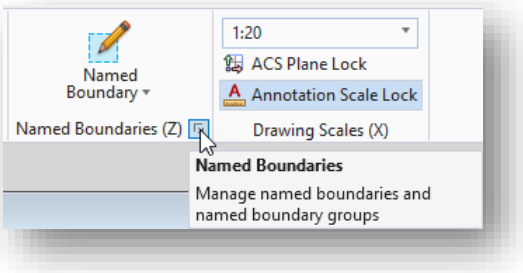
Adding Named Boundary Locations to Previously Generated Sheets

Occasionally it is necessary to add a cross-section location after the initial sheets have been generated. OpenRoads version 10.10 provides functionality to generate new sheet models while retaining previously generated cross-section drawing models.

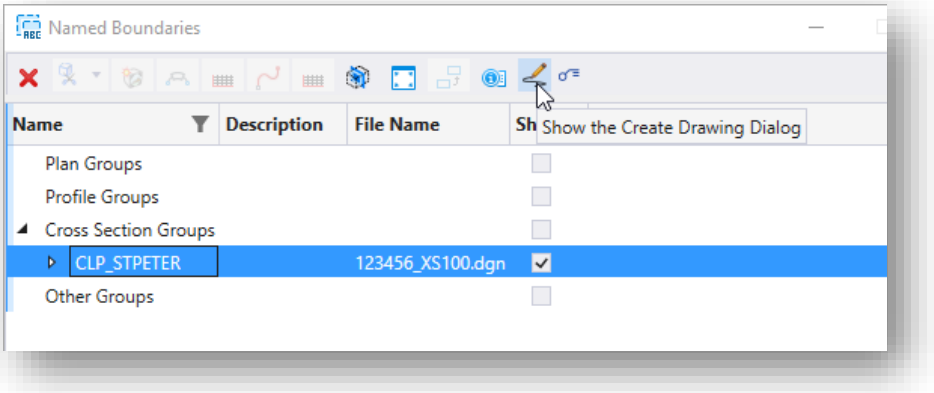
Before processing a new set of cross-section sheets, it is necessary to manually delete previously generated sheet models. Open the Models dialog from one of the OpenRoads WorkFlows by selecting the **Models** icon on the **Home** tab. Select the sheet models to be deleted, and then choose the **Delete Model(s)** icon like the example below.



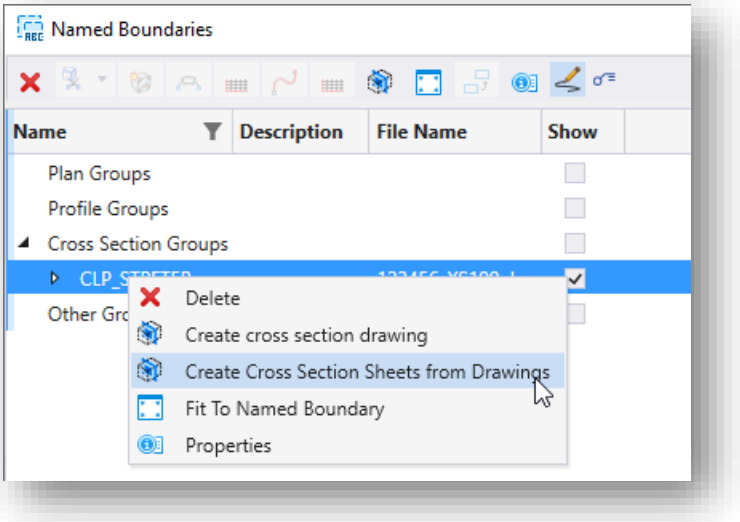
1. From the **Drawing Production** tab, select the icon at the lower left of the **Named Boundaries** group as shown below. The ***Named Boundaries*** dialog is opened.



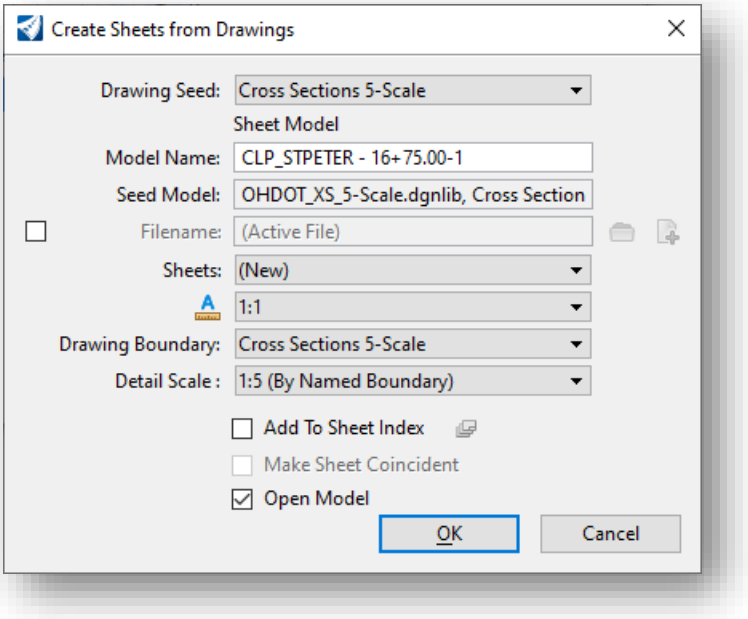
2. In the ***Named Boundaries*** dialog, select the cross-section group from the list. Toggle the **Show the Create Drawing Dialog** option on as shown below.



3. Right click on the named boundary group name and choose the **Create Cross Sections from Drawings** option.

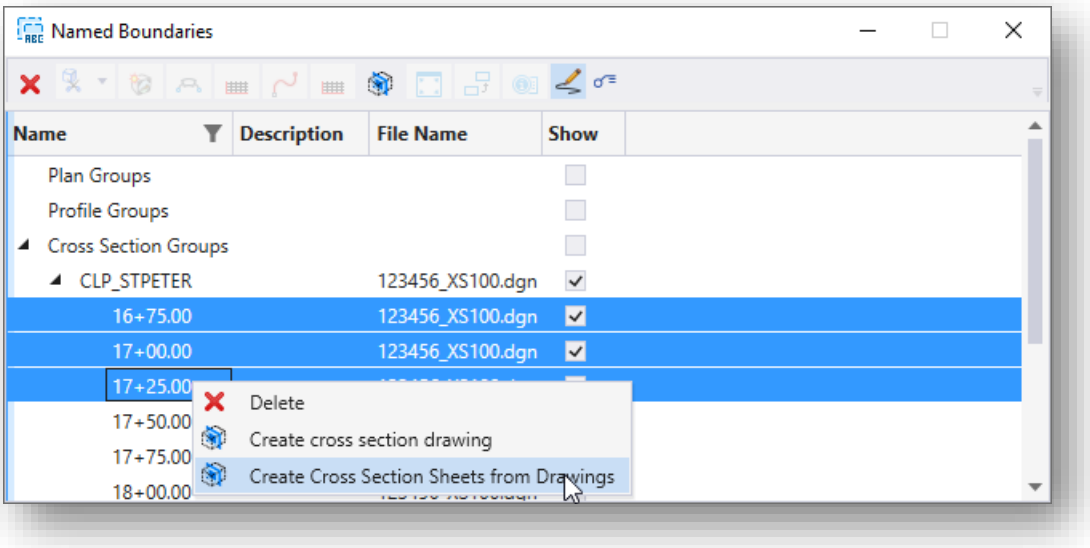


4. The ***Create Sheets from Drawings*** dialog is opened as shown below.



Select **OK** to initiate the process.

It is also possible to create new sheets from specifically selected named boundaries as shown below.



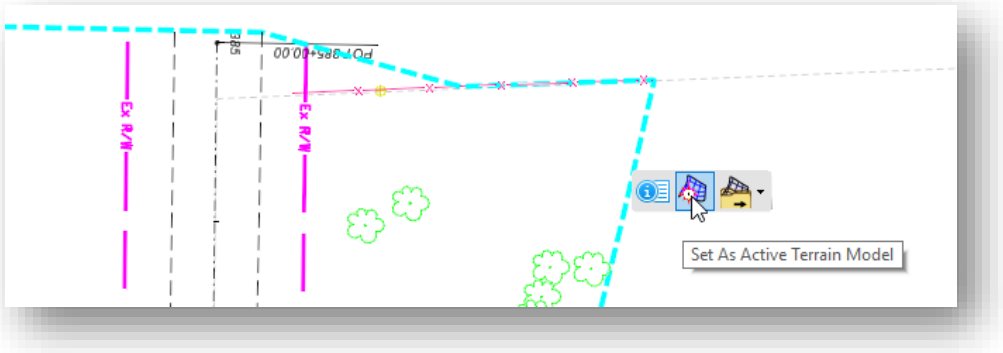
Displaying Right-of-Way on Cross-Sections

The location of both the existing and proposed the Right-of-Way lines can be displayed in a dynamic cross-section view and on the cross-section sheets like the example shown below:

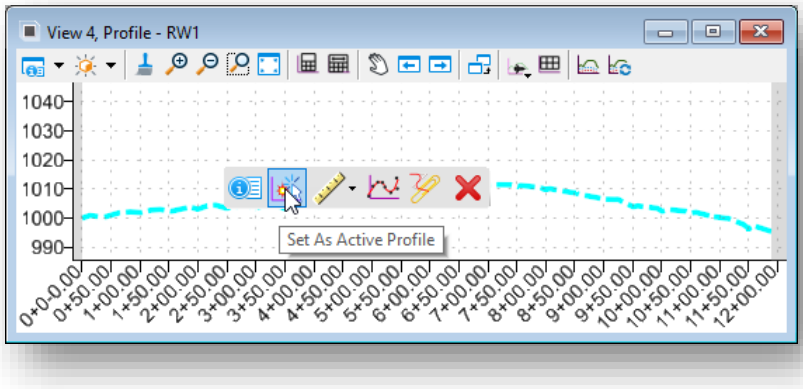
To display the Right-of-Way lines on the cross-sections, each Right-of-Way line must have an existing profile defined. This is accomplished by opening a profile view for each Right-of-Way line and defining the exiting ground profile as the active profile. When the profile is defined for right-of-way lines, a 3D line string is created in the 3D model for the line.

The workflow to assign a profile to the right-of-way lines is as follows:

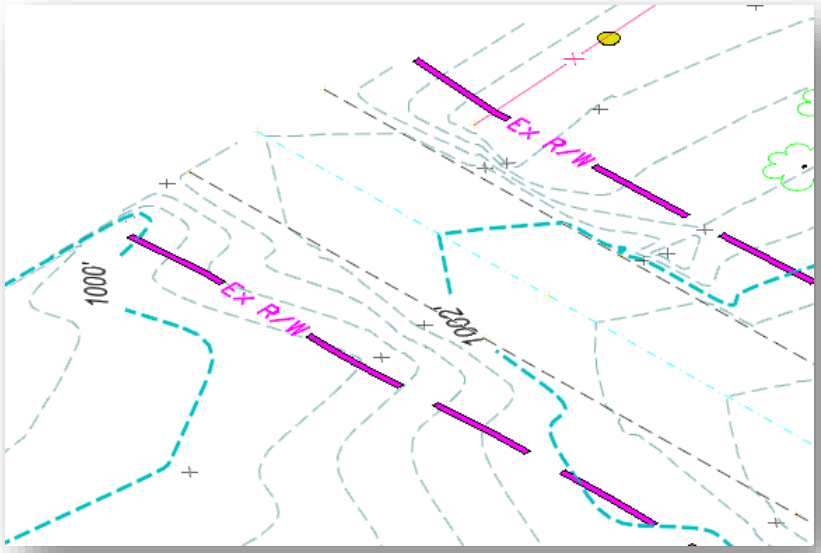
- In the right-of-way basemap design file (BR), attach the design file containing the existing terrain
- Set the referenced terrain model as the active terrain by selecting the terrain and choosing the **Set As Active** Terrain option from the pop-up menu



- Open a profile model for each right-of-way line, either by selecting the element and choosing the Open **Profile Model** option, or by holding down the right-mouse button and choosing **View Control > 2 Views Plan/Profile** from the pop-up menu.
- Select the ground line in the profile window and choose the **Set As Active Profile** option from the pop-up menu



A 3D element is generated in the 3D model like the example below.



When cross sections are generated, if the cross section intersects a 3D Right-of-Way line in the 3D model, a cell is placed in the cross section at the right-of-way line offset and elevation.

OpenRoads Software Version

This document was prepared using the following software version:

OpenRoads Designer CONNECT Edition – 2021 Release 1 Update 10 – Version 10.10.01.03

Contacts

For any questions, suggestions, or problems with this document please contact the ODOT Office of CADD and Mapping Services by use of the following form on the ODOT website:

https://odot.formstack.com/forms/cadd_servicerequest