CONCEPTSTATION
OpenRoads

CONNECT Edition

TDOT

Roadway Design Division

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TN TDOT Department of Transportation

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Preface

Purpose & Need

The OpenRoads ***CONCEPTSTATION*** Manual is the seventh document in a series of **seven** training manuals released by the Tennessee Department of Transportation (TDOT). Bentley's OpenRoads Designer (ORD) software is being adopted and implemented statewide by TDOT as the new **3D modeling** design software, which will ultimately replace both MicroStation V8i and Geopak (SELECT Series 2). This manual provides an introduction to Bentley's 3D highway conceptual modeling software.

The first portion of this manual provides an introduction into creating conceptual models in the ConceptStation software. This includes roadways, intersections, roundabouts, ramps, bridges, culverts, pavement markings, and street furniture as well as generating quantities from the model and exporting the model elements. The second portion of the manual focuses on integrating the conceptual models into ORD, standard ORD plan production, and printing of deliverables.

Disclaimer

The ***CONCEPTSTATION*** Manual is developed based on OpenRoads ConceptStation CONNECT Edition Version **10.00.16.84**. The TDOT ConceptStation workspace consists of a single seed file (**seed_imperial_en.dgndb**) and complies with the latest CADD standards and should be used in conjunction with this manual. It can be downloaded on the TDOT CADD Support website under ORD Resources. If you have any technical issues or recommendations for this manual, please contact TDOT CADD Support at TDOT.ORD@tn.gov.

Revisions

The ***CONCEPTSTATION*** Manual will be revised over time as a result of future Bentley software releases and procedural & workspace updates. All revisions will be documented by WSP/TDOT and included on the **Revision History** page at the end of the manual. TDOT CADD support will announce updated manual versions when they become available via emailed announcements.

Chapter 1. Course Overview

Course Description and Objectives:

This course introduces users to OpenRoads ConceptStation CONNECT Edition software, which is Bentley's current conceptual civil design platform that is being adopted for use by TDOT.

At the conclusion of this course, participants will be able to:

1. Import terrain and aerial imagery into ConceptStation.
2. Create a roadway, ramp, intersection, and roundabout.
3. Create a bridge, tunnel, and culvert.
4. Place roadway furniture and pavement markings.
5. Develop high level quantity exports.
6. Understand the LumenRT Designer software.
7. Import a ConceptStation alignment, terrain, and model into ORD.
8. Create conceptual layout sheets and print to PDF.

The topics covered in this class are:

1. User Interface Customization
2. Creating a ConceptStation File
3. Backstage Menu
4. Understanding the Interface
5. Templates and Materials
6. Road Placement Tools
7. Structure and Drainage Tools
8. Furniture and Marking Tools
9. Miscellaneous Tools
10. Quantities and Costs
11. Exporting Outputs and Design Scenarios
12. Visualize with LumenRT Designer
13. Integration of ConceptStation Model with ORD Plans Production

Target Audience:

This course is designed for anyone who wants to create conceptual models, with the option and ability to incorporate the designs into functional plan drawings. Ideally, ConceptStation is used during **Stage 0: Planning** of TDOT's Project Delivery Network (PDN).

Prerequisites:

- Familiarity with TDOT's construction policies, procedures, and standards.
- A working knowledge of Windows 10.
- Completion and full comprehension of the Fundamentals (ORD) Manual.

Chapter 2. User Interface Customization

It is important to first understand the conceptual model workflow in ConceptStation and how it relates to the TDOT process. This chapter provides a broad view of the ConceptStation workflow and outlines how TDOT will develop plans based on the exported conceptual model.

2.1 Objectives

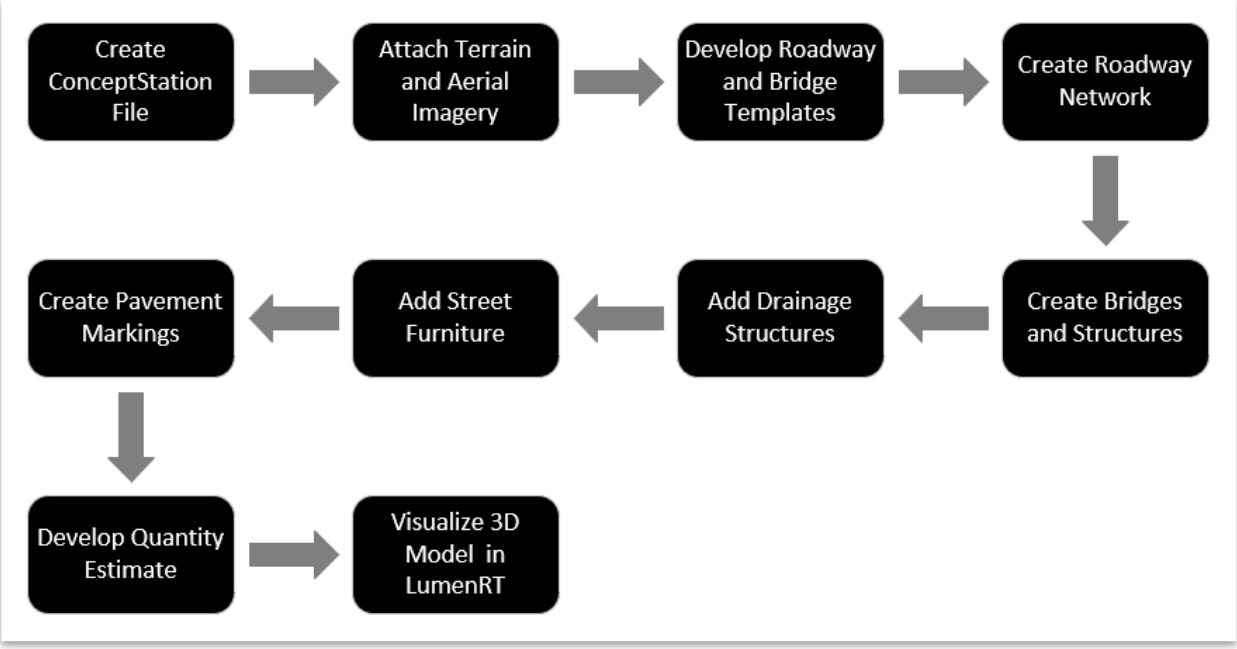
At the conclusion of this chapter, participants will be able to:

1. Know the overall workflow for conceptual models and plan production.
2. Update the ConceptStation default seed file to incorporate the TDOT templates and cost configuration.

2.2 Lecture: ConceptStation Workflow

The ConceptStation workflow allows the user to quickly develop conceptual roadway and bridge models and alternatives. The workflow diagram shown in Figure 1 highlights the design process to produce a 3D conceptual model with cost estimation and graphical visualization.

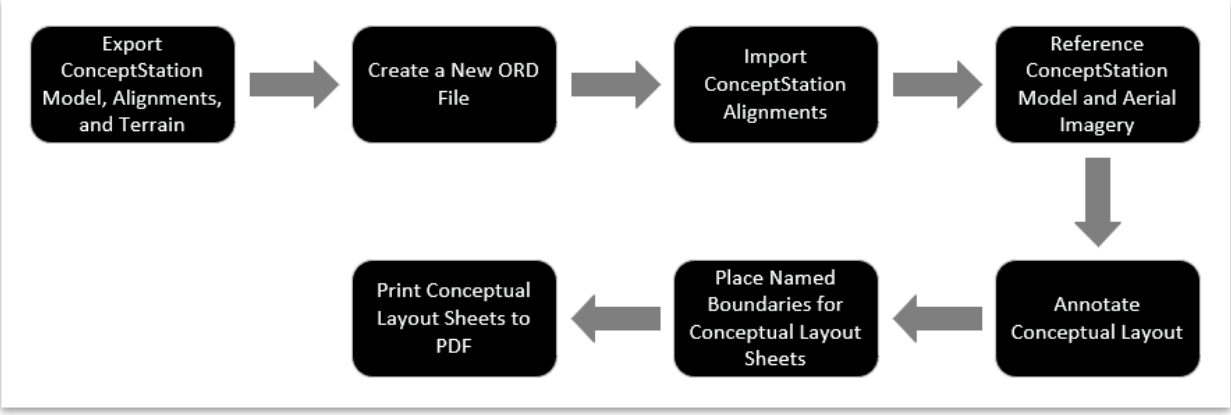
FIGURE 1. CONCEPTSTATION WORKFLOW



2.3 Lecture: TDOT Planning Workflow

The **TDOT Planning** workflow allows the user to export the conceptual model from ConceptStation and create plan sheets in ORD. The workflow diagram shown in Figure 2 highlights the process to create a plan set.

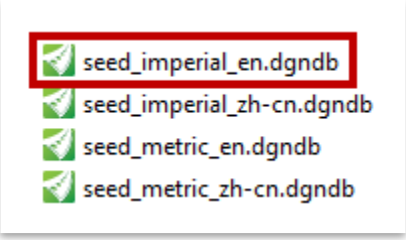
FIGURE 2. TDOT PLANNING WORKFLOW



2.4 Lecture: ConceptStation Seed File

To include the TDOT standard templates and custom cost configuration, the user will need to update the **seed_imperial_en.dgndb** file, which is located on the C drive: **C:\ProgramFiles\Bentley\OpenRoads ConceptStation CONNECT Edition\ConceptStation\Default\Seed** (Figure 3).

FIGURE 3. CONCEPTSTATION DEFAULT SEED FILES



TDOT will provide the highlighted seed file on the website, which only needs to be updated when Bentley releases a new version of ConceptStation. It is important to note that users **should not** edit any of the seed files.

Take Note!

*For **TDOT personnel**, replacing the seed file on your C drive will require an admin password. Consult with your regional IT staff or create a helpdesk ticket to perform this action.*

With the updated **seed_imperial_en.dgndb** file utilized, users will notice an additional Templates **TDOT** folder, which contains the standard TDOT roadway and bridge templates which will be discussed further in Exercise 6.2.1. (Figure 4). This file also contains the custom TDOT cost configuration (**zeroed out rates**) which will be discussed further in Lecture 11.2.2.

FIGURE 4. TDOT TEMPLATE FOLDER IN CONCEPTSTATION

2.4.1 Exercise: Updating the Default Seed File

In this exercise, we will perform the necessary steps to update the default seed file.

1. Within **File Explorer**, navigate to the default ConceptStation seed file folder: **C:\Program Files\Bentley\OpenRoads ConceptStation CONNECT Edition\ ConceptStation\Default\Seed**.
2. Replace the **seed_imperial_en.dgndb** with the provided TDOT version.

Take Note!

Make sure that the updated seed file is used when creating any new ConceptStation files. We will look further at the seed file definition in Exercise 3.2.

Chapter 3. Creating a ConceptStation File

This chapter will discuss the first step in the conceptual model process, where the designer will create a new file and import survey terrain, aerial imagery, and other existing objects such as roads, buildings, and hydrology.

3.1 Objectives

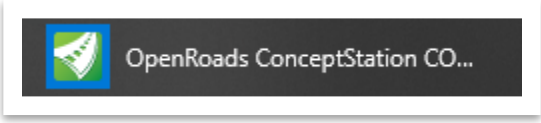
At the conclusion of this chapter, participants will be able to:

1. Create a new file in the TDOT coordinate system using the TDOT ConceptStation seed file.

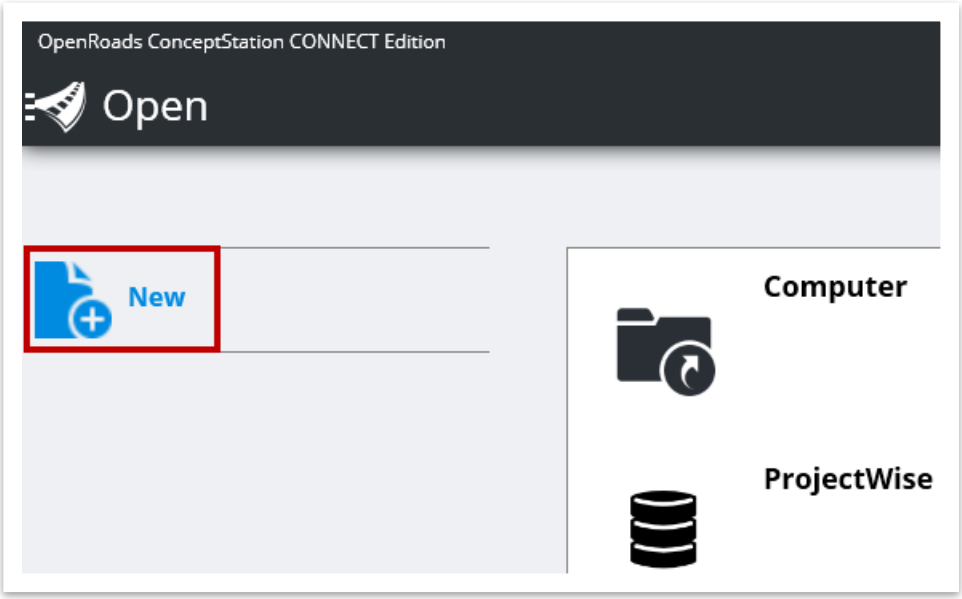
3.2 Exercise: Create a New File in OpenRoads ConceptStation

In this exercise, we will create a new ConceptStation file.

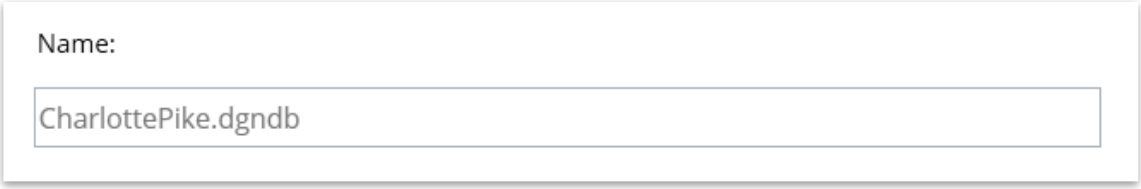
1. Make sure that you are signed into the **CONNECTION Client** and then launch **ConceptStation**. As a reminder, you should have a ConceptStation shortcut icon on the desktop. If not, open the Windows menu in the lower left of the desktop and look for the **Bentley** folder, which contains **OpenRoads ConceptStation CONNECT Edition** (green icon).



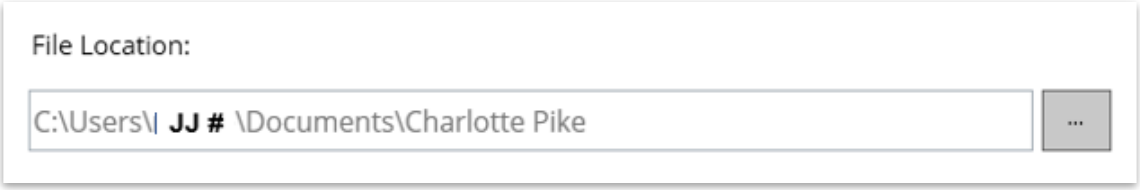
2. After launching ConceptStation, you will be taken to the **File Selection Manager**. Here, you can either create a new folder or open a file on your computer or ProjectWise. Let's go ahead and create a new file by clicking **New**.



3. Notice that the default file name will need to be changed. For this exercise, we will define the file **Name** as **CharlottePike.dgndb**. **Note:** This file will be utilized and built upon up through Chapter 13.

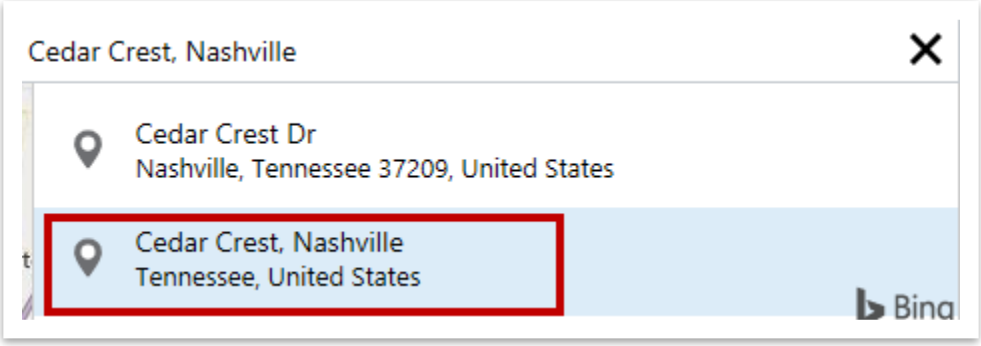


4. Next, create a folder named **Charlotte Pike** within the recommended **C:\Users\ JJ#\Documents** folder and assign it as the **File Location**. All supplemental files generated through ConceptStation will be located in this folder.



5. Notice that the **Seed File** is defined as **System seed will be used**. The system seed should link to the **Imperial** seed that was replaced on the C drive in Exercise 2.4.1. We can leave the linkage as-is. **Note:** As a reminder the seed file is updated and maintained by TDOT.

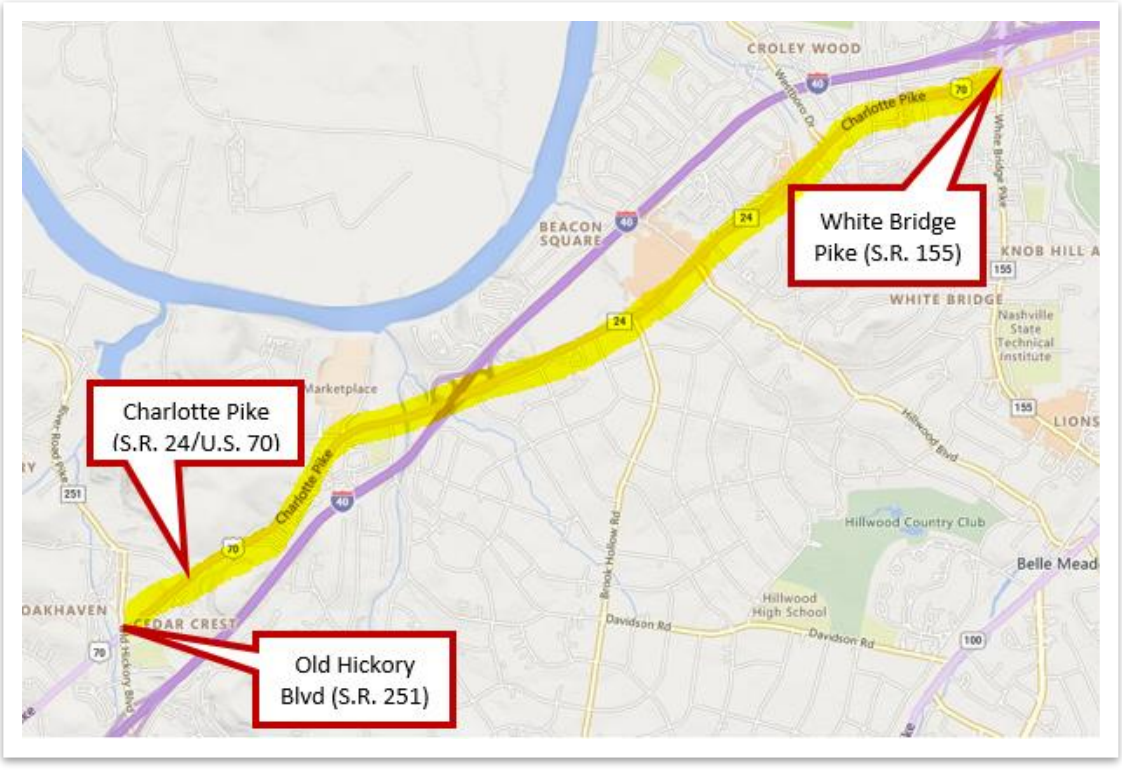
6. Before we can select the applicable **Coordinate system**, we need to define a **concept location** using the **Search** toolbar, which will update the available coordinate system options in that area to select from. For the exercises in this manual, we will be developing a project along **Charlotte Pike** (S.R. 24/U.S. 70) using most of the tools in ConceptStation. Key-in **Cedar Crest, Nashville** into the search toolbar and then select it.



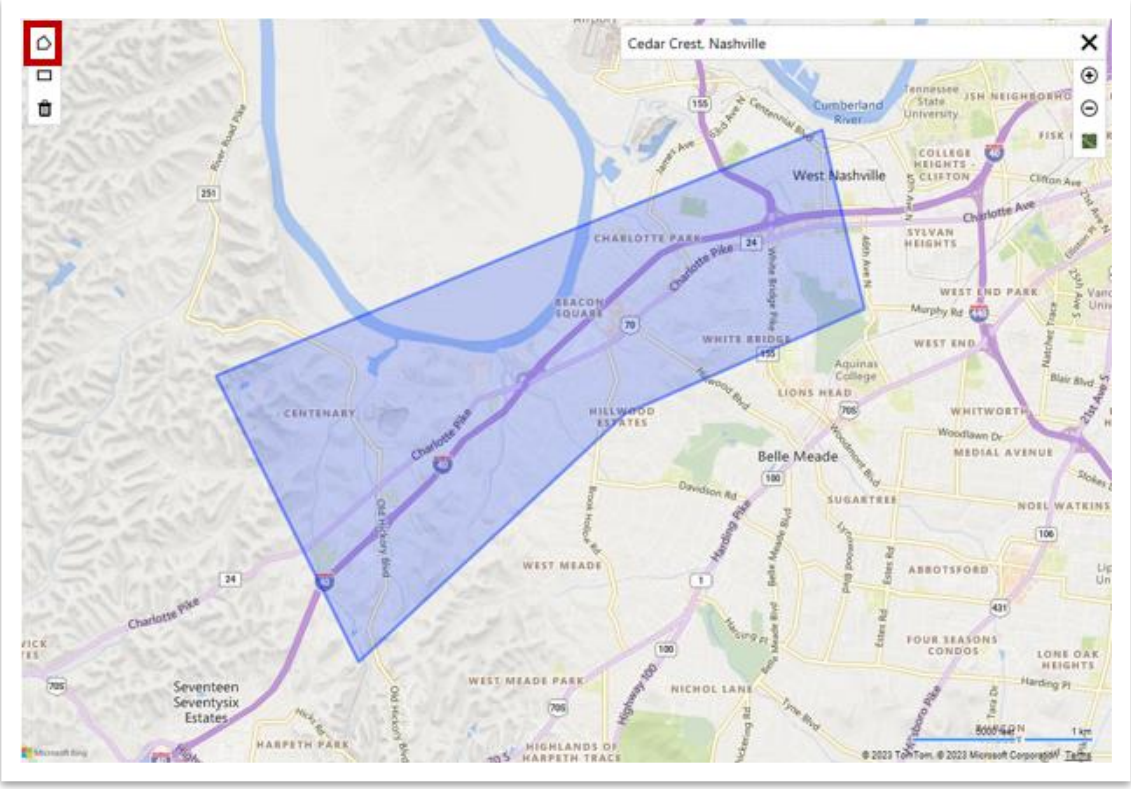
Take Note!

You should be able to type in any location near the project site to reach the relevant area. The search bar makes it easier to zoom in to the project area in comparison to scrolling or panning.

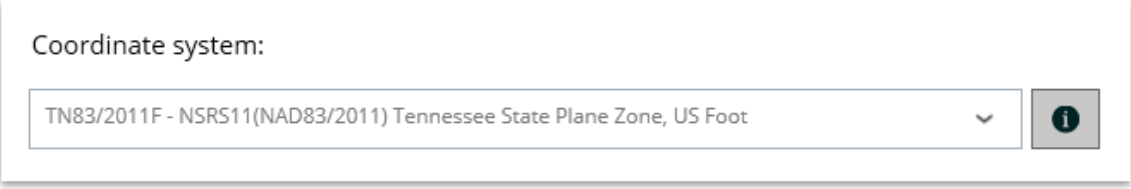
7. Now, zoom in to see the entire **Charlotte Pike** corridor (yellow highlighted path) from **Old Hickory Blvd** (S.R. 251) to **White Bridge Pike** (S.R. 155).



8. **Left** click on the **Define Concept Location** (irregular shape) icon to initiate the tool and then move the cursor in the direction of the line. **Left** click at each corner point to create the shape around the extent of the project location. If necessary, click on the trash can icon to delete the project extent and redraw. **Note:** The project extent does not need to match the image exactly.



9. Next, we will define the **Coordinate system**. Scroll through the coordinate system list and select **TN83/2011F - NSRS11 (NAD83/2011) Tennessee State Plane Zone, US Foot**. **Note:** Every Tennessee project should utilize this coordinate system. Also, it is necessary to define the concept location before assigning the coordinate system. If not, the coordinate system drop-down will not show any options to select from.

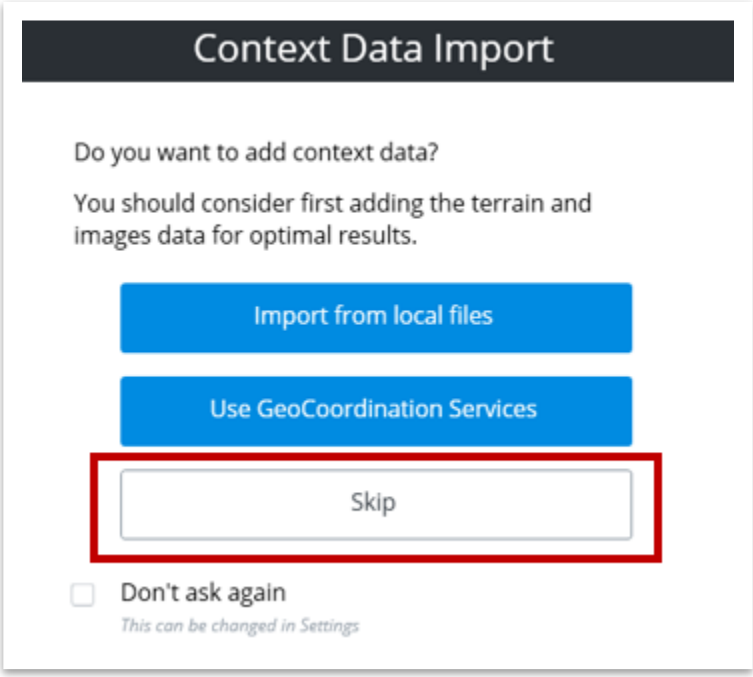


Take Note!

*The list also contains the **TN83F - NAD83 Tennessee State Plane Zone, US Foot** coordinate system, but keep scrolling until you reach the exact system shown above.*

10. Now that the coordinate system is set, click **Create**.

11. The **Context Data Import** window should automatically open. Click **Skip**. <u>This will create a blank new file without georeferenced data</u>.



Take Note!

*The **Context Data Import** window is used to import terrain, raster imagery and other data into the project. This data can come from local files or from an online **GeoCoordination Service** that is accessed through the CONNECTION Client. This data does not have to be imported when the project is first created. It can be imported later by using the **Backstage** menu.*

We will cover context data import options in the next chapter as there are a few different workflows that can be applied based on what data the user already has.

Chapter 4. Backstage Menu

This chapter will discuss the **backstage** menu and highlight key tools that will be utilized when creating and manipulating a conceptual model.

4.1 Objectives

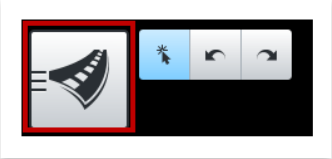
At the conclusion of this chapter, participants will be able to:

1. Locate and navigate the Backstage.
2. Utilize the Backstage menu to import, export and attach files.

4.2 Lecture: Backstage Menu

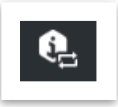
The **Backstage** menu can be found by clicking the large icon at the upper left of the screen (Figure 5). It contains a series of tools. The top six tools are **Conceptualize**, **Visualize**, **iTwin**, **Templates**, **Materials**, and **Quantities and Costs**.

FIGURE 5. BACKSTAGE ICON

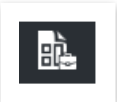


Conceptualize: Takes the user to the conceptual model. This tab will be used for most of the exercises.

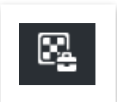
Visualize: Takes the user to **LumenRT Designer** to develop visualizations, which will be discussed further in Chapter 13.



iTwin: Allows the user to synchronize design data to iTwin using **iTwin Synchronizer**. This is a separate software interface and will not be covered in this manual.



Templates: Allows the user to create, edit and view the predefined templates saved in the seed file. Template creation will be discussed further in Lecture 6.3.

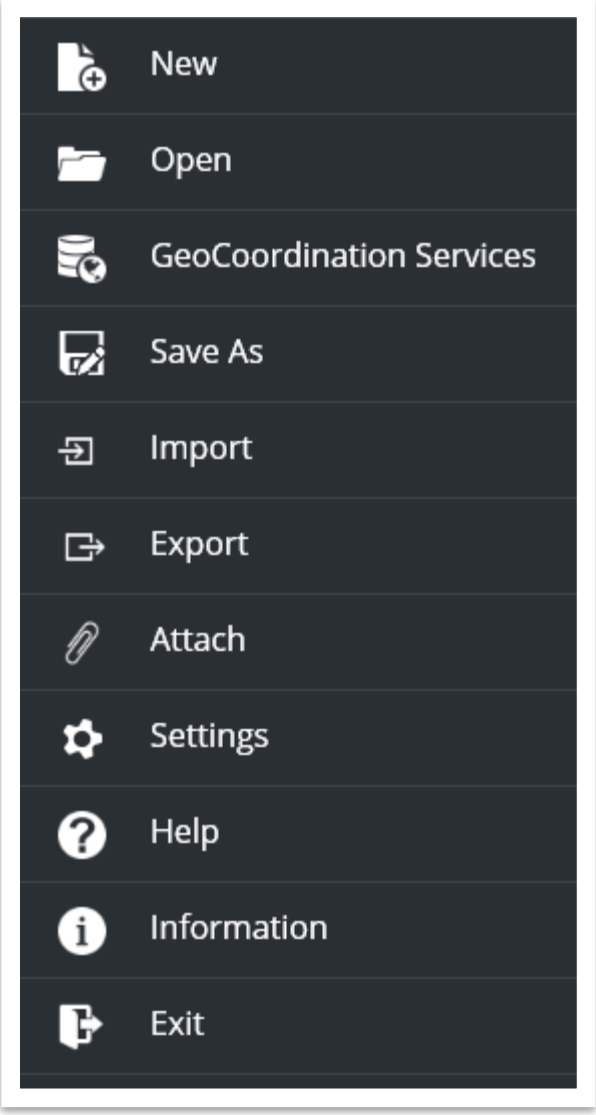


Materials: Allows the user to create and manage predefined or custom materials that can be applied to the templates, which will be discussed further in Lecture 6.4.

Quantities and Costs: Allows the user to view and modify the Quantities and Cost Report Configuration which will be discussed further in Lecture 11.2.

The remaining tools in the Backstage include options for creating a **New** dgndb file, **Opening** and **Saving** a dgndb file, accessing **GeoCoordination Services**, **Importing**, **Exporting**, **Attaching** data to a dgndb file, and the program **Settings** (Figure 6).

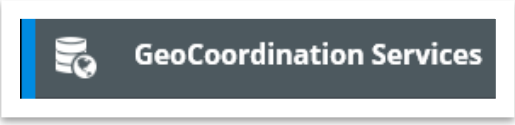
FIGURE 6. BACKSTAGE ADDITIONAL TOOLS



4.3 Lecture: GeoCoordination Services

The **GeoCoordination Services** utilize **USGS** and **OpenStreet Maps**, which allows the user to find, download and import georeferenced contextual information such as terrain, static imagery, existing roadways, buildings, and hydrology (Figure 7). To access the GeoCoordination Services, the user must be signed into the CONNECTION Client.

FIGURE 7. GEOCOORDINATION SERVICES TOOL



When creating a new file, the user will be prompted to access the GeoCoordination Services, or it can be accessed later in the Backstage. It is important to first open the **Settings** (Figure 8) and set the GeoCoordination Services download path prior to any downloads (Figure 9). The recommendation is to select the applicable project folder as the path.

FIGURE 8. SETTINGS

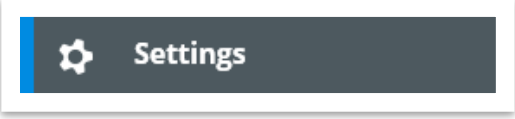
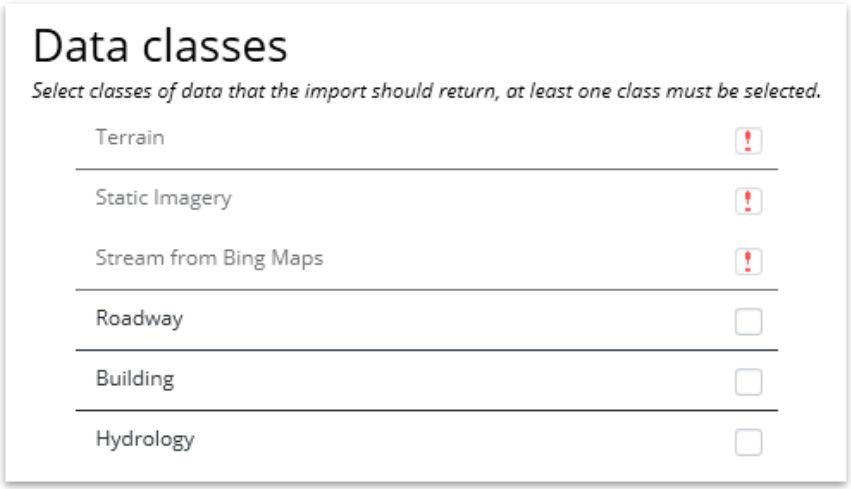


FIGURE 9. GEOCOORDINATION SERVICES – DOWNLOAD PATH

4.3.1 Download Options

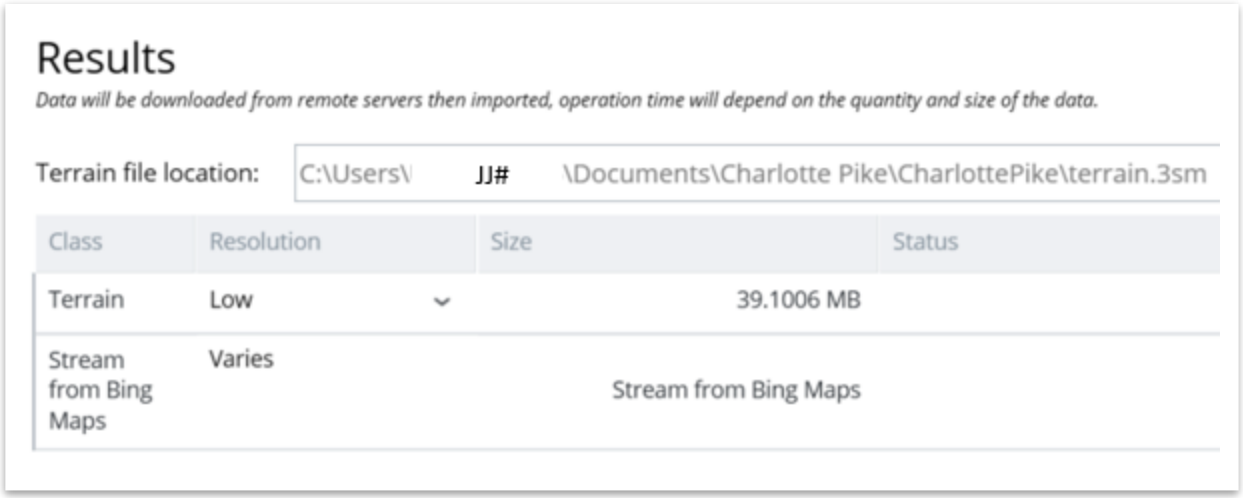
In the **GeoCoordination Services**, a selection of **Data classes** can be imported. If a data class has already been imported, there will be red exclamation point in the toggle box and the data class will be greyed out (Figure 10). To import one or more data classes, simply toggle on the box and click **Next**.

FIGURE 10. DATA CLASS CATEGORIES



Once the **GeoCoordination Services** have connected, the data **Resolution** can be chosen (**Low**, **Medium**, **High**) and the terrain file location can be defined (Figure 11). Once the variables have been set, the user can **Download and Import** the data. This may take some time depending on the resolution and size of the project area.

FIGURE 11. TERRAIN FILE LOCATION



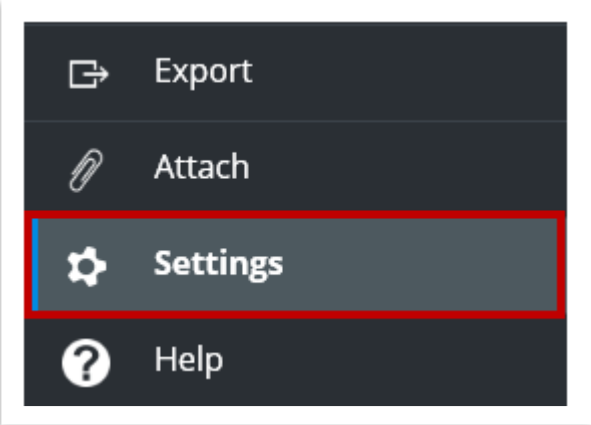
Take Note!

*Once a **Terrain** and **Static** Imagery is imported, you will be unable to import another terrain or aerial imagery.*

4.3.2 Exercise: Import Data From GeoCoordination Services

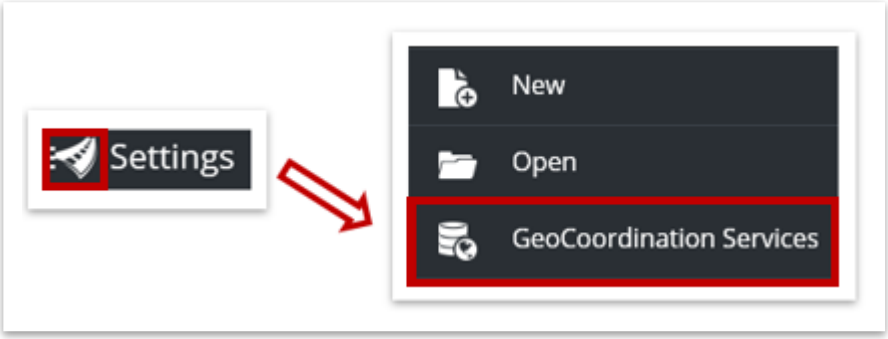
In this exercise, we will use the GeoCoordination Services to import aerial imagery and terrain data.

1. First, let's set the GeoCoordination Services **download path** so we can easily access the aerial imagery later in this manual. Select the **Settings** option within the **Backstage** menu.

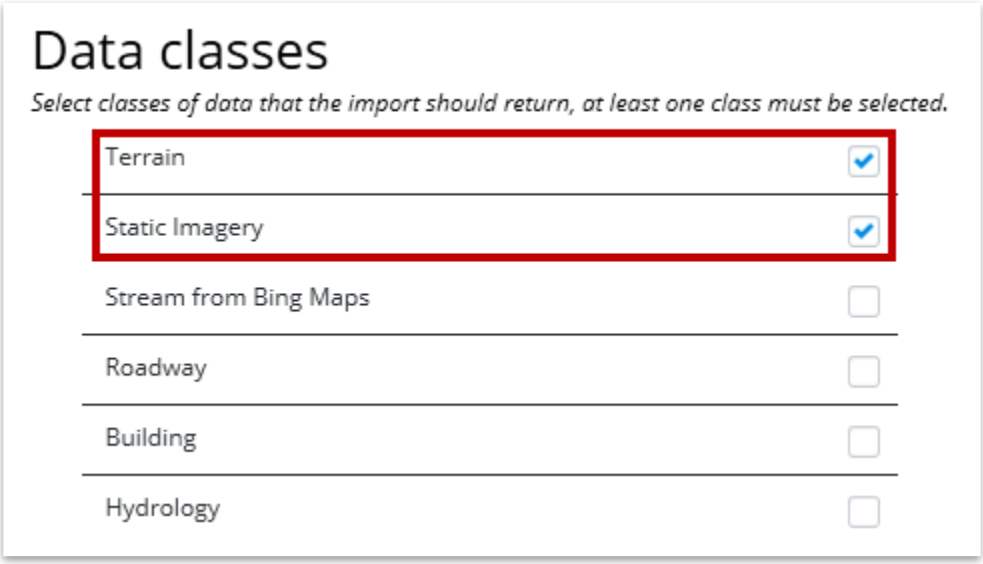


2. Within **GeoCoordination Services**, set the **Download path** to the same folder as your ConceptStation file: **C:\Users\(JJ#)\Documents\Charlotte Pike**.

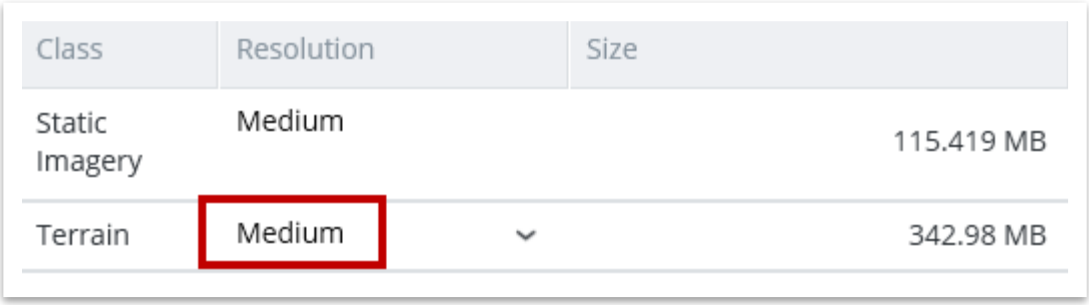
3. Next, open the **Backstage** menu again and select the **GeoCoordination Services** option. Notice that the project boundary is outlined.



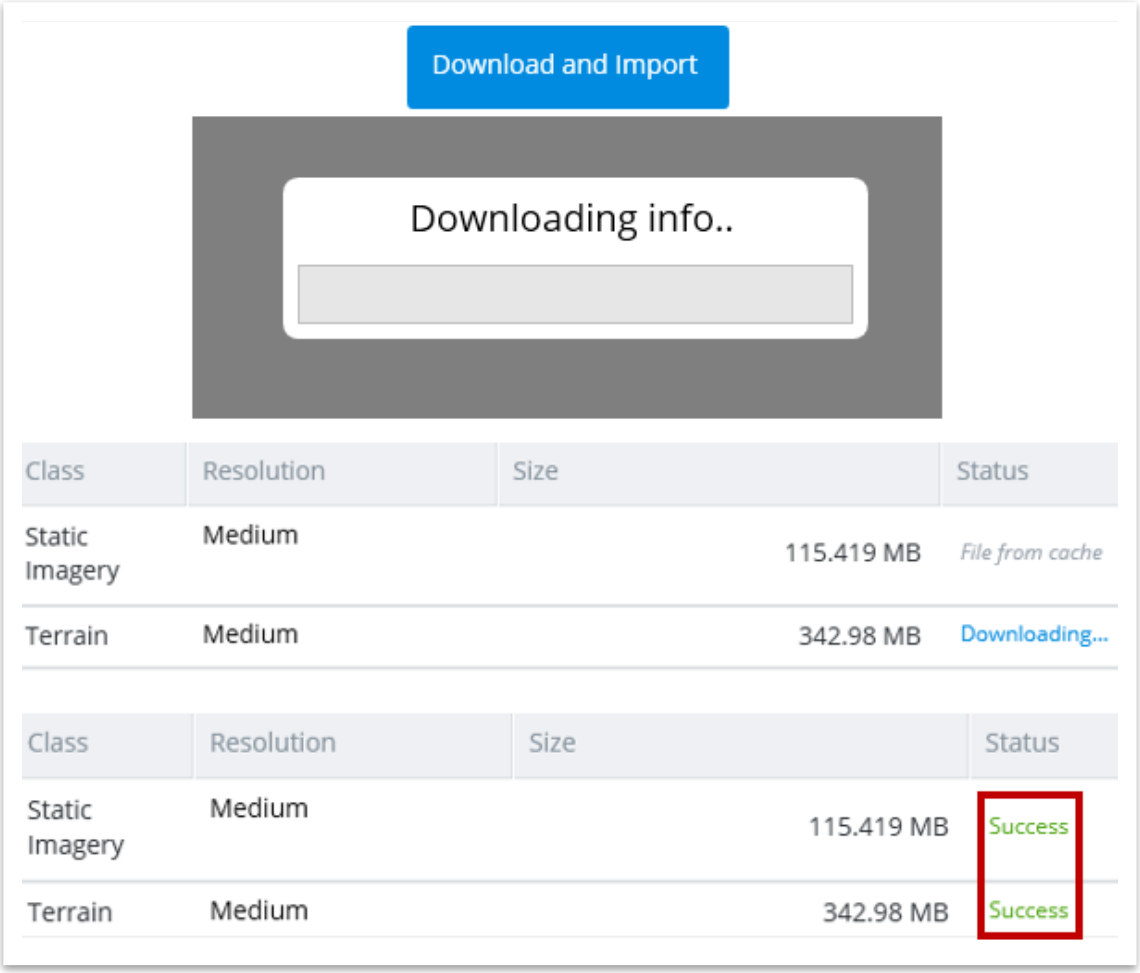
4. Toggle **On** the **Terrain** and **Static Imagery** Data classes and then click **Next**.



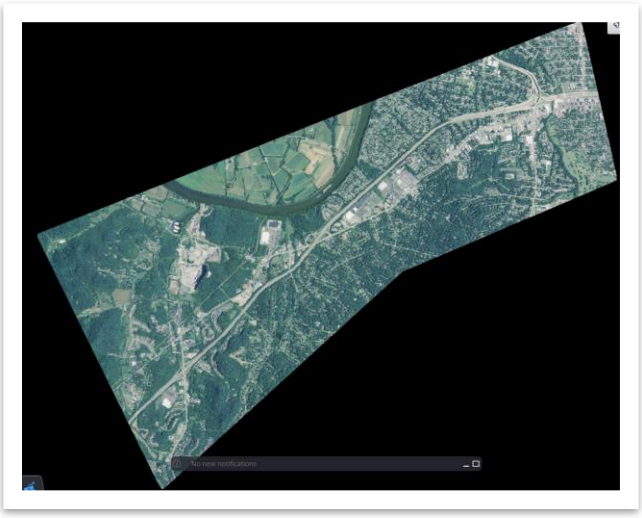
5. Now let's look at the **Resolution**. The **Static Imagery** resolution is already set and cannot be modified. For the **Terrain**, toggle through the resolution options to see the file size differences. For this exercise, select **Medium**. **Note:** Depending on your project extent, the file sizes may differ from the image below.



6. Click **Download and Import** and then wait for the **Status** of each **Class** to say **Success**. **Note:** This process will take a few minutes to complete.



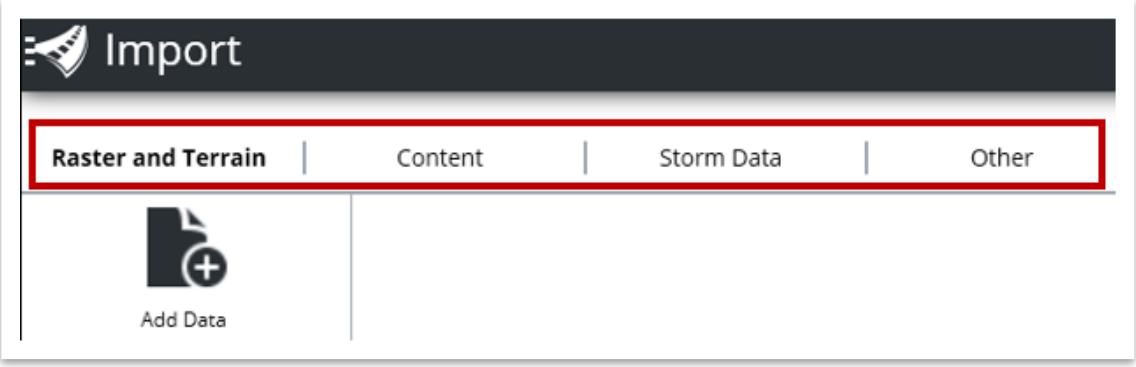
7. Click **Done** and review the terrain. **Note:** Your clip shape does not need to match exactly.



4.4 Lecture: Import

The **Import** option allows the user to import rasters, terrains, and other sources of data into the ConceptStation file (Figure 12).

FIGURE 12. IMPORT OPTIONS



Take Note!

The imported data must be in the same coordinate system that was applied when creating the ConceptStation dgndb file.

4.4.1 Raster and Terrain

The following **Raster** and **Terrain** file formats can be imported (Table 1). In some scenarios, the imported data might be more current that the GeoCoordination Services option.

TABLE 1. IMPORT FILE FORMATS

File Type	File Format	
Raster	• Ingr. TIFF / GEOTIFF (*.tif; *.tiff) • Internet TIFF and TIFF64 (*.Itiff; *.itiff64) • JPEG (*.jpg; *.jpeg; *.jpe; *.jfif) • JPEG 2000 (*.jp2; *.j2k; *.jpm)	• MrSID (*.sid) • ERMapper Compressed Wavelets (*.ecw) • Web Map Server (*.xwms)
Terrain	• TIN • IMG • DEM • DTM	• POD • TIF • HGT • XML

4.4.2 Content

Content from other **dgndb** files (templates, components, furniture, street markings, linear furniture, and transverse markings), **striping definition** files (.xml) and **speed table** files (.xml) can be imported. A summary of items will be displayed before importing.

4.4.3 Storm Data

Storm Data from **text** files (*.txt, *csv) and **InRoads IDF Data** files (*.IDF) can also be imported. This is beyond the scope of this manual and will not be covered.

4.4.4 Other

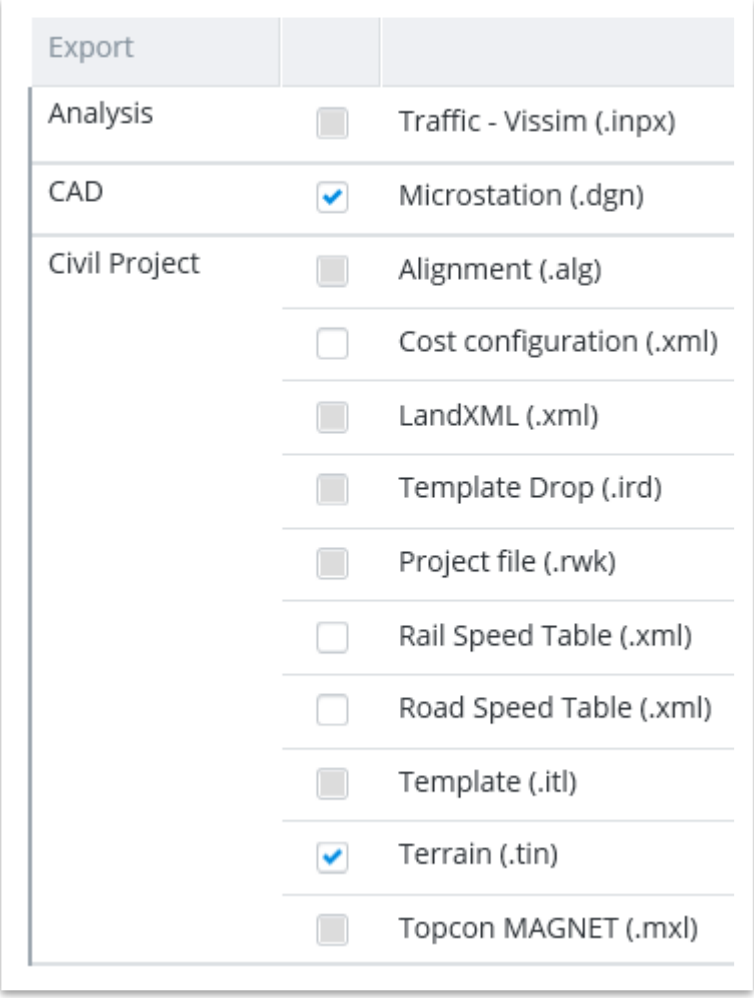
Additional **Other** files can be imported, which include the following formats:

- Open Street Map File (*.osm)
- Design File (*.dgn)
- ESRI Shapefile (*.shp)
- ESRI File Geodatabase (*.gdb)
- Civil Geometry File (*.alg)
- Custom Rules (.xml)
- LandXML File (*.xml)

4.5 Lecture: Export

The **Export** option allows the user to export specified information from the ConceptStation file file such as **Traffic - Vissim** data (.inpx), a **Microstation** file (.dgn), an **Alignment** (.alg), **Template** data (.ird, .itl), a **Project file** (.rwk), **Existing Terrain** (.tin) and **Topcon MAGNET** files (.mxl) (Figure 13). Additionally, the following information can be exported to .xml files: **Cost configuration**, **LandXML**, **Rail Speed Table**, and **Road Speed Table**.

FIGURE 13. EXPORT OPTIONS



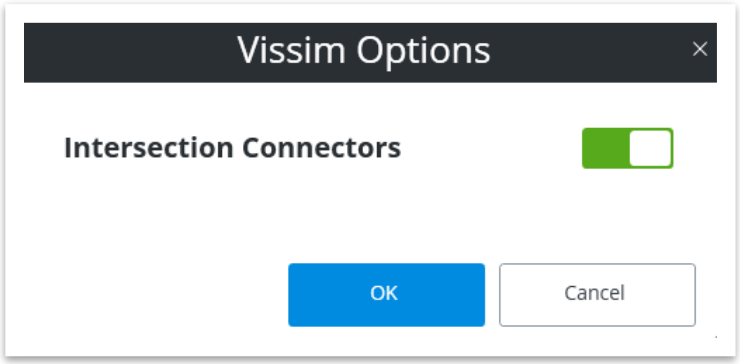
Take Note!

At this point in the manual, most options will be grayed out since we have not yet placed any features (roadway alignments, templates, etc.) in this file yet.

4.5.1 Traffic - VISSIM Export Options

For **Traffic - Vissim** (.inpx) exports, the user has the option to include **Intersection Connectors** using the toggle (Figure 14).

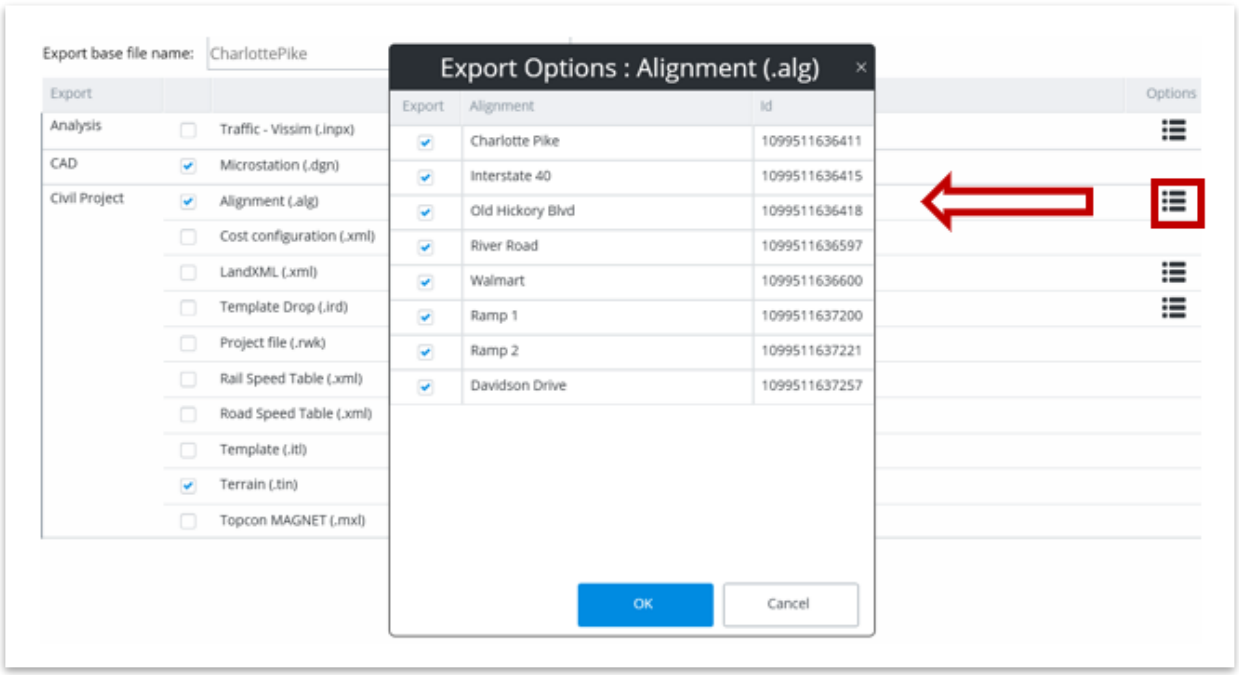
FIGURE 14. EXPORT OPTIONS – VISSIM



4.5.2 Alignment Export

For **Alignment** (.alg) exports, the user has the option to export specific alignments that are present in the model using the **Export** toggle (Figure 15).

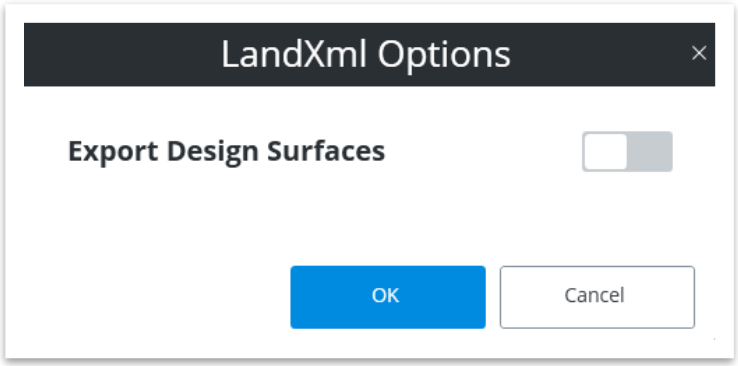
FIGURE 15. EXPORT OPTIONS – ALIGNMENT



4.5.3 LandXML Export

For **LandXML** (.xml) exports, the user has the option to **Export Design Surfaces** using the toggle (Figure 16).

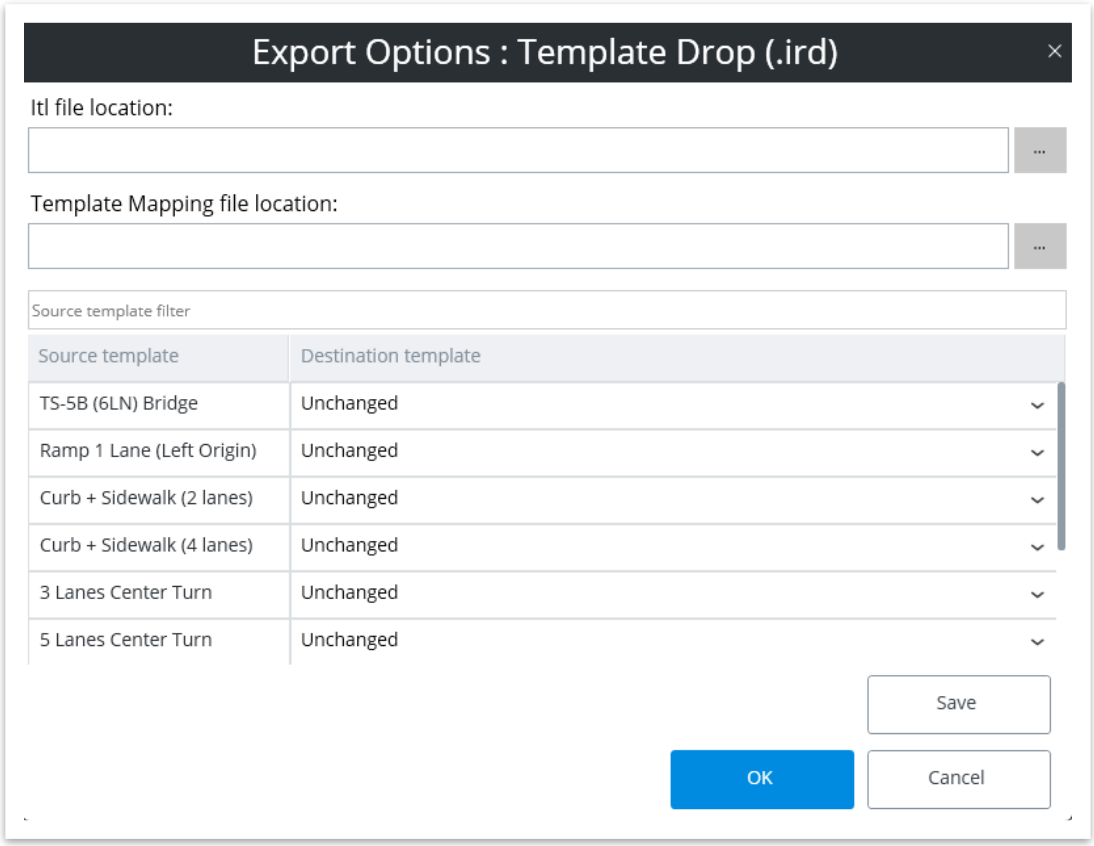
FIGURE 16. EXPORT OPTIONS – LANDXML



4.5.4 Template Drop Export

For **Template Drop** (.ird) exports, the user can map the templates placed in the ConceptStation model to an ORD template library (.itl) (Figure 17). The corridors created in ConceptStation can then be imported into ORD using the template mapper.

FIGURE 17. EXPORT OPTIONS – TEMPLATE DROP



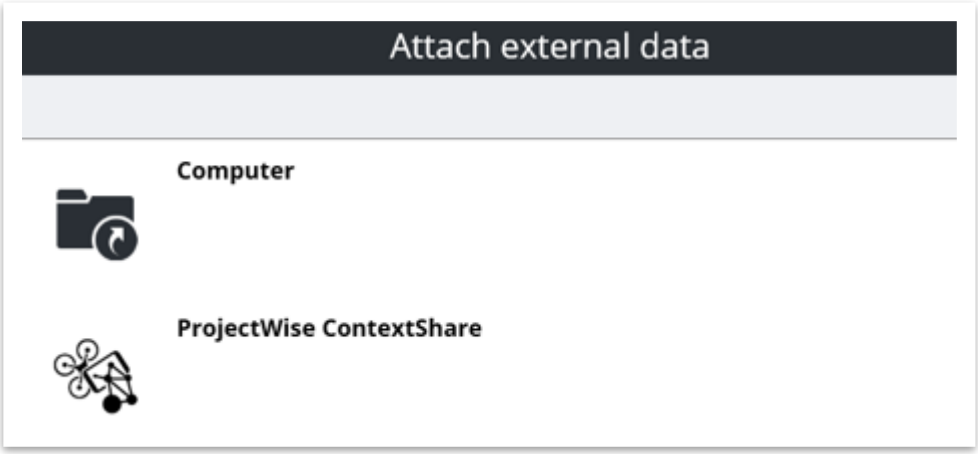
Take Note!

For more detailed design after the conceptual phase, it is recommended to utilize the ORD templates to build the roadway model rather than utilizing the simplified templates exported from ConceptStation. The ORD templates contain all the necessary components and pavement layers based on TDOT design standards.

4.6 Lecture: Attach

The **Attach** option allows the user to attach external data such as **Reality Mesh** files (.3sm, 3mx), **Vissim** animation files (.ani, .txt), and **Pointcloud** files (.pod). These files can be attached from the user's **Computer** or **ProjectWise ContextShare** (Figure 18). **Note:** The user must first assign a coordinate system and scale the point cloud with a survey adjustment factor in ORD prior to extracting the ground points and attaching in ConceptStation.

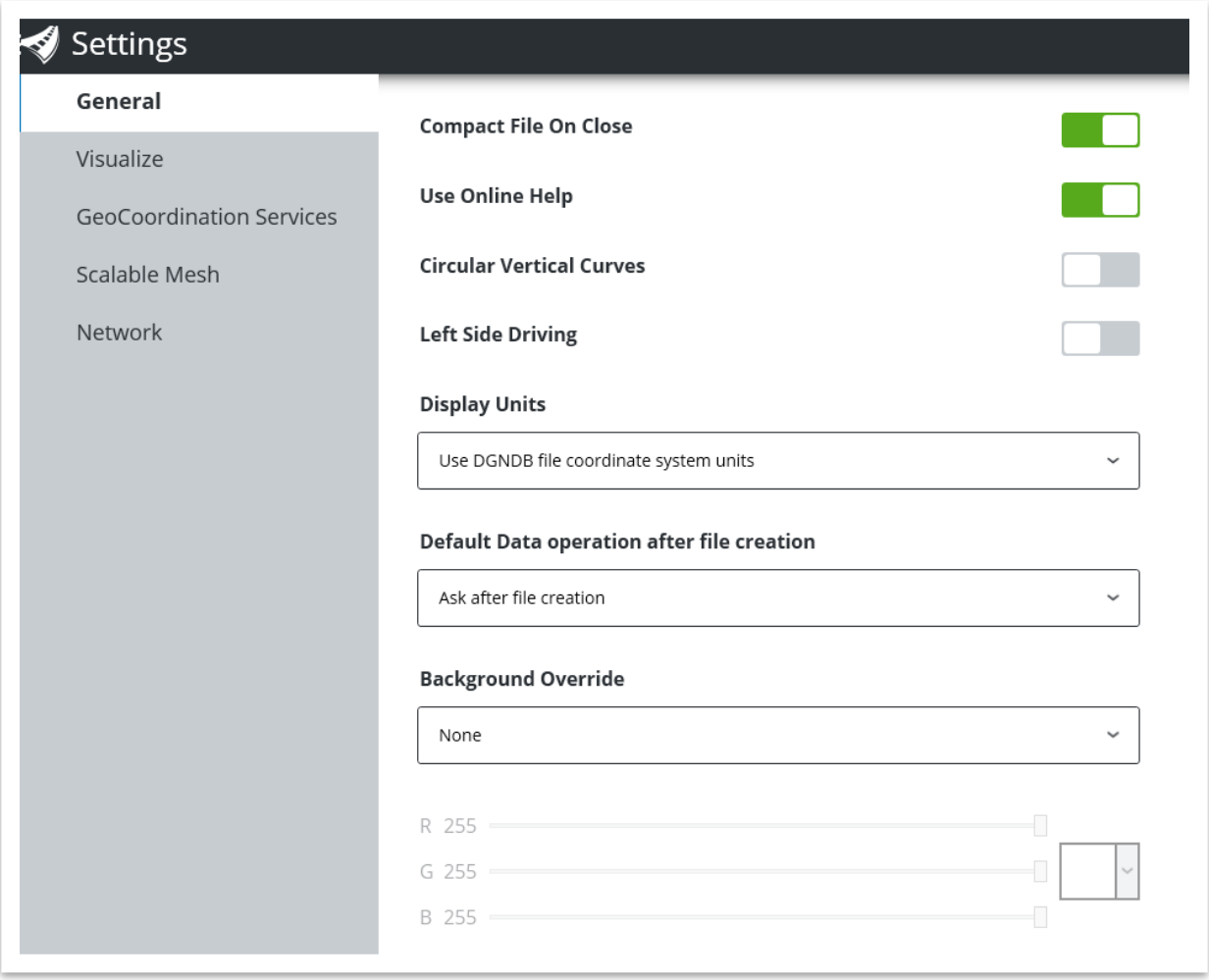
FIGURE 18. ATTACH OPTIONS FOR EXTERNAL DATA



4.7 Lecture: Additional Settings

The **Settings** option allows the user to change **General** settings of the dgndb file such as **Circular Vertical Curves**, **Left Side Driving**, and **Default Data operation after file creation** (Figure 19). These settings have been set for the standard TDOT files.

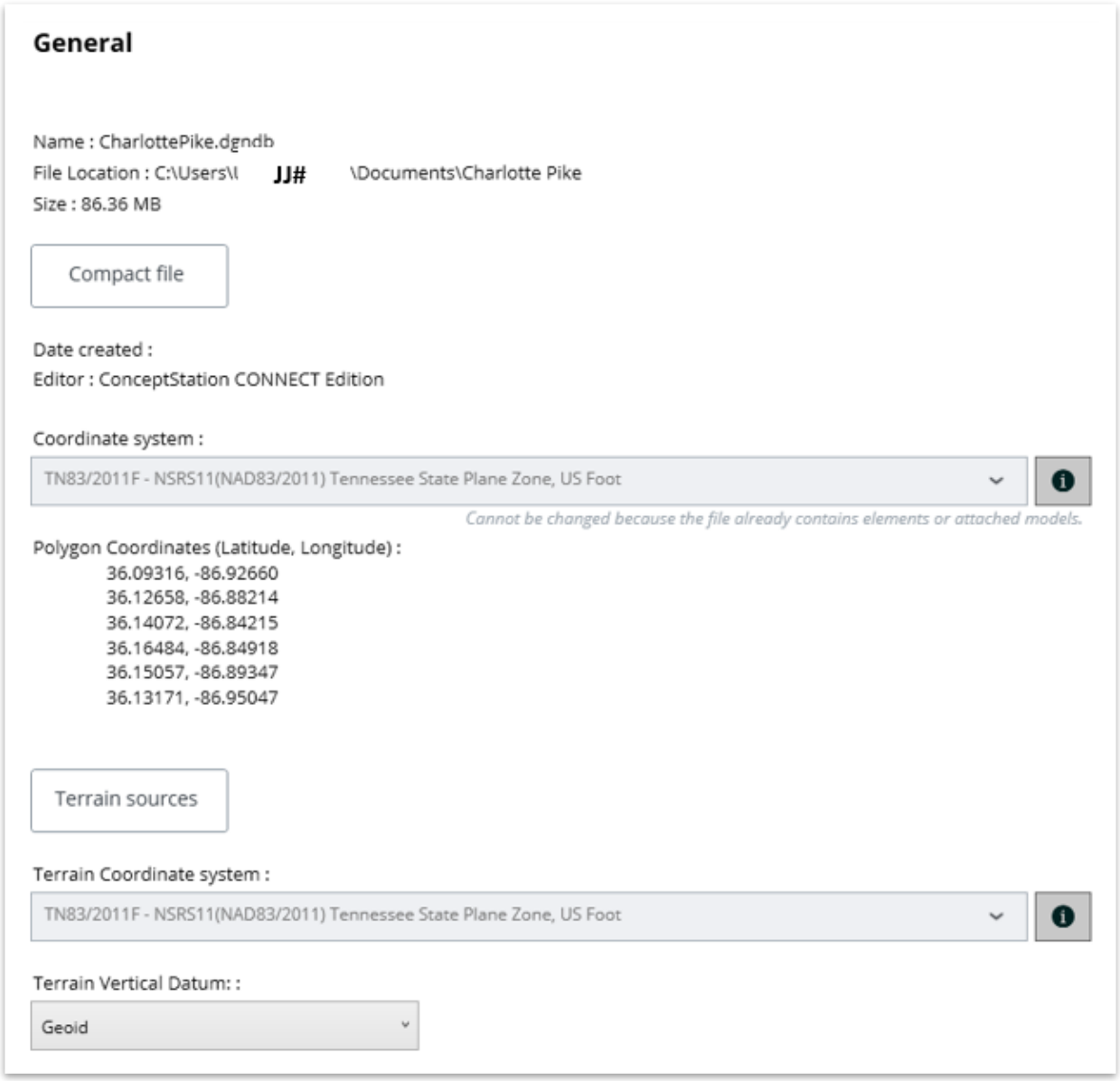
FIGURE 19. GENERAL SETTINGS



4.8 Lecture: Information

The **Information** option provides the information for the **dgndb** file. This includes the **File Name**, **Location**, and **Size**, plus the **Coordinate system**, **Polygon Coordinates**, and **Terrain sources** (Figure 20).

FIGURE 20. GENERAL FILE INFO



Chapter 5. Understanding the Interface

This chapter will discuss the ConceptStation window **interface** tools (general, navigation, viewing, etc.) and the action center.

5.1 Objectives

At the conclusion of this chapter, participants will be able to:

1. Locate and navigate the ConceptStation interface.
2. Navigate through the 3D model views.

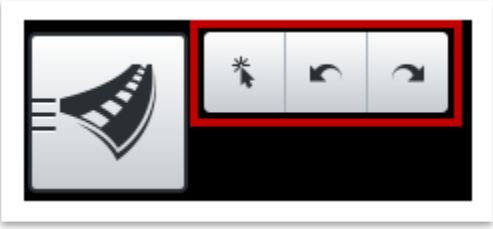
5.2 Lecture: Interface Tools

Within the main ConceptStation window, there are a series of interface tools along each side of the screen.

5.2.1 General Tools

The **Elements selection** and **Undo/Redo** tools are found to the right of the Backstage icon in the upper left along the top of the window (Figure 21). If the Elements selection tool is active, it will cancel the other tool options.

FIGURE 21. ELEMENTS SELECTION AND UNDO/REDO TOOLS



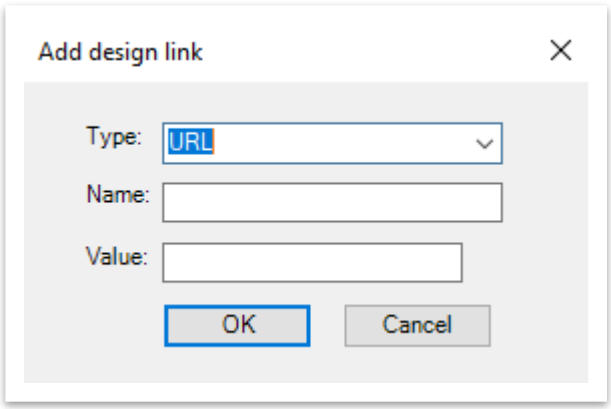
If an alignment is selected, the toolbar expands to provide additional options: **Clear Selection**, **Design Link tool**, **Hide Selected Items**, **Isolate Selected Items**, and **Elements deletion tool** (Figure 22).

FIGURE 22. EXPANDED TOOLBAR

5.2.1.1 Design Link Tool

This tool allows the user to add an external design link to elements in the model. The **Type** options include **External File**, **URL**, and **ProjectWise** (Figure 23 on next page). This tool could be utilized to attach links to standards, standard drawings, or photos/notes taken in the field at a particular location.

FIGURE 23. DESIGN LINK DIALOG BOX



5.2.2 Navigation Tools

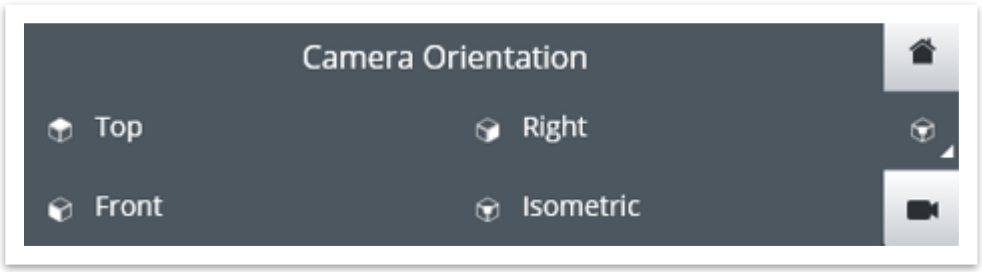
The **Navigation** tools are found in the upper right along the top the window. The user can **Rotate**, **Rotate 2 Points**, **Pan**, and **Fit**, plus zoom to a **Window Area**, and **View Previous** and **View Next** (Figure 24).

FIGURE 24. NAVIGATION TOOLS

5.2.3 View Tools

The **View** tools are found in the upper right along the right side of the window. The user can select between the **Home View** (isometric view), **Display camera orientation tools**, and **Toggle Camera** (Figure 25).

FIGURE 25. VIEW TOOLS

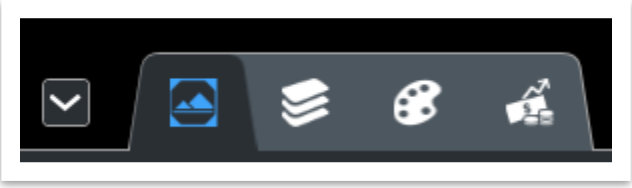


- **Camera orientation:** Rotates the view to either Top, Front, Right or Isometric.
- **Toggle camera:** Turns on/off the shadows within the view to allow for 2D graphic.

5.2.4 Action Center

The **Action Center** is found in the lower left along the bottom of the window (Figure 26). Clicking the up arrow will allow the user to access **Saved Views**, **Categories And Models**, **Symbology Override**, and **Quantities and Costs**. It will also display the **cross section** and **profile** views when an alignment is selected.

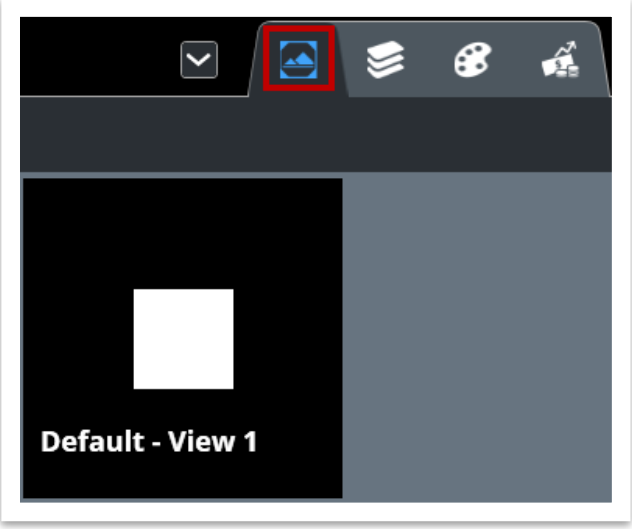
FIGURE 26. ACTION CENTER OPTIONS



5.2.4.1 Saved Views

The user can create and save any **stored views** of the model (Figure 27). The default model is set as the **Isometric** orientation. **Do not delete Default - View 1**.

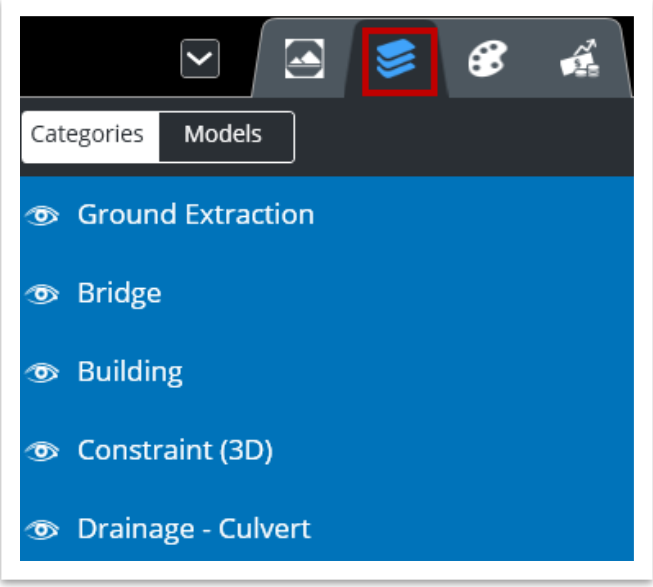
FIGURE 27. ACTION CENTER – SAVED VIEWS TAB



5.2.4.2 Categories And Models

The user can turn on and off model elements, including the terrain, bridges, buildings, roadways, and furniture (Figure 28).

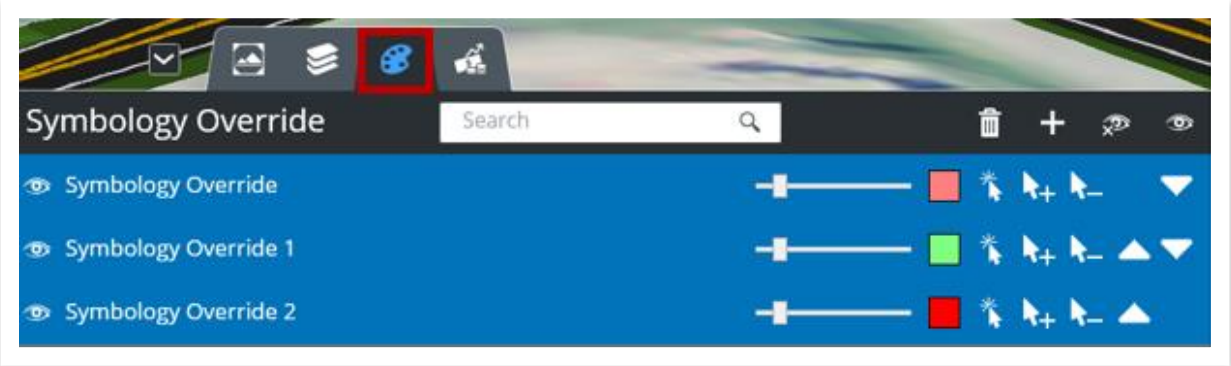
FIGURE 28. ACTION CENTER – CATEGORIES AND MODELS TAB



5.2.4.3 Symbology Override

Symbology overrides can be created to change the color or highlight specific selections (Figure 29). For example, the user can select all the existing roads and assign them a slight color tint to distinguish them from the proposed roads. The symbology override can be turned on or off and elements can be added or subtracted from a symbology.

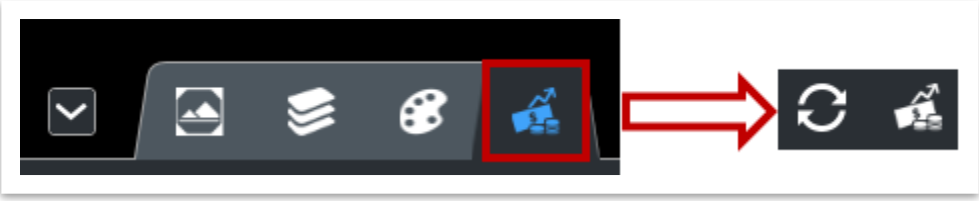
FIGURE 29. ACTION CENTER – SYMBOLOGY OVERRIDE TAB



5.2.4.4 Quantities and Costs

The conceptual **cost estimate** functionality allows the user to see a real time cost estimate of the proposed model. The **Calculate quantities and costs** tool would need to be clicked to recalculate and update the cost estimate when additional alignments and furniture are added to the model. The **Display detailed quantities and costs** tool will allow the user to export quantities, unit costs and categories of the conceptual model to an **.xlsx** file (Figure 30). Utilization of these tools will be covered in Lecture 11.3.

FIGURE 30. ACTION CENTER – QUANTITIES AND COSTS



Chapter 6. Templates and Materials

This chapter will discuss the default Bentley and TDOT **templates** that are provided in the TDOT ConceptStation workspace, as well as predefined and custom **materials** that can be applied to template components. The TDOT templates include roadway, ramp and bridge templates that align with the **TDOT RD11** standards.

Take Note!

For TDOT typical sections with ditch end conditions, the ConceptStation roadway templates have trapezoidal ditches instead of V-ditches as shown in the TDOT RD11 standards since trapezoidal ditches are more conservative for the expected roadway footprint.

6.1 Objectives

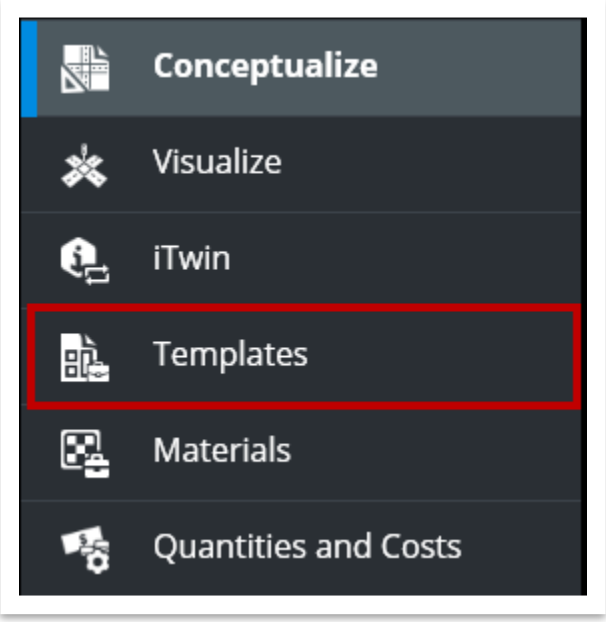
At the conclusion of this chapter, participants will be able to:

1. Review default Bentley and TDOT templates in the template library.
2. Create new templates and edit existing templates.

6.2 Lecture: Template Library Overview

The **Templates** option is found within the Backstage menu (Figure 31). It allows the user access to the **Template Manager**, which contains both default Bentley templates as well as TDOT specific templates.

FIGURE 31. BACKSTAGE MENU – TEMPLATES OPTION



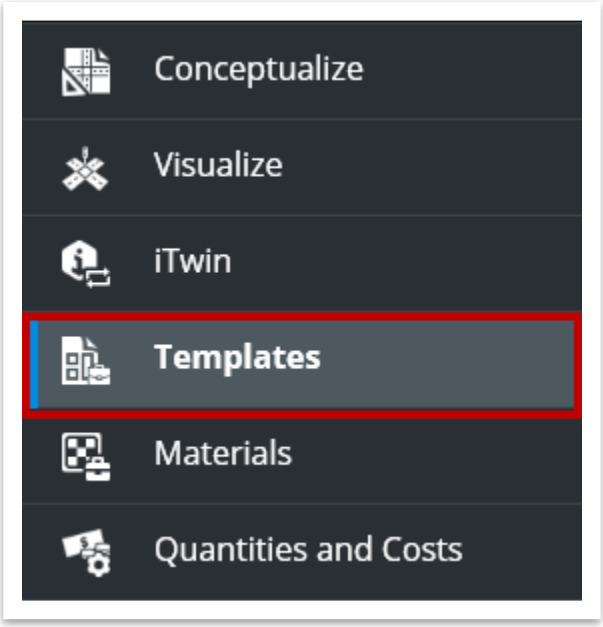
The **Rail** and **Road** folders are default Bentley, which include various rail track, roadway, and bridge templates. The **TDOT** folder contains roadway, ramp and bridge templates that align with the **RD11** standards (Figure 32). Essentially, they are simplified TDOT ORD templates. Once a file is created, templates can be imported from another **dgndb** file. Within the template manager, the user can review, create, or edit templates and add new folders and subfolders.

FIGURE 32. TDOT TEMPLATE FOLDER

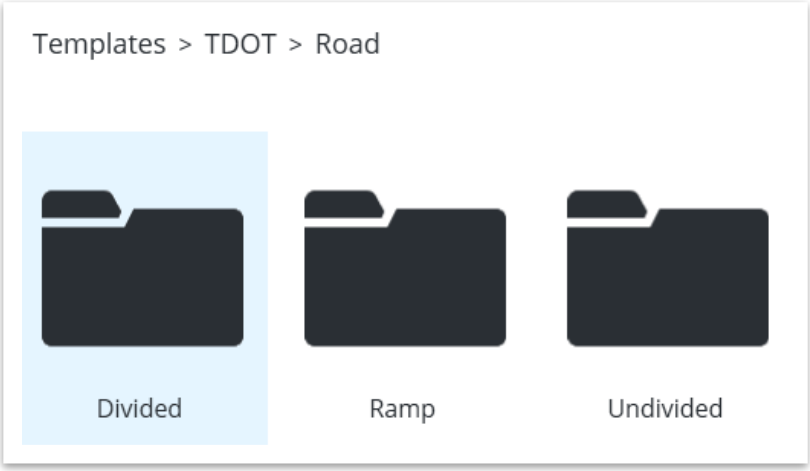
6.2.1 Exercise: Review Template Folders

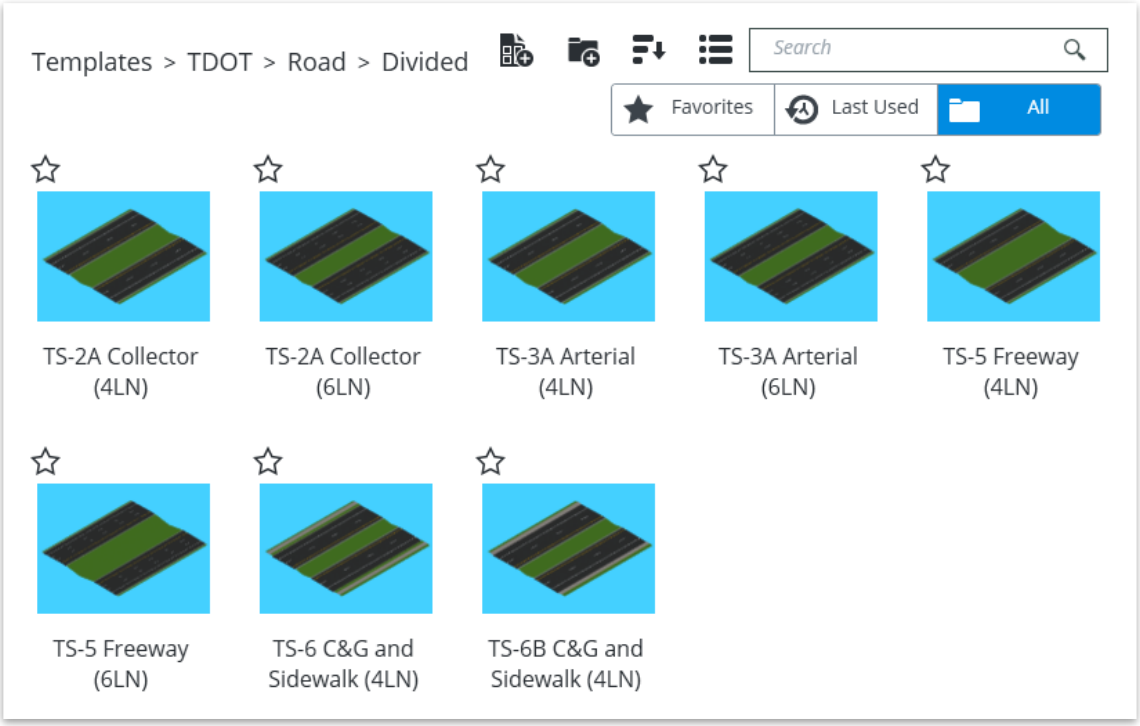
In this exercise, we will review the TDOT template folders and set several templates as a Favorite.

1. To review the folders provided by Bentley and TDOT, select the **Templates** option within the **Backstage** menu.



2. Select the **Templates >> TDOT >> Road** template folder and review the templates within the **three** subfolders. **Note:** The **Divided** subfolder is shown below.



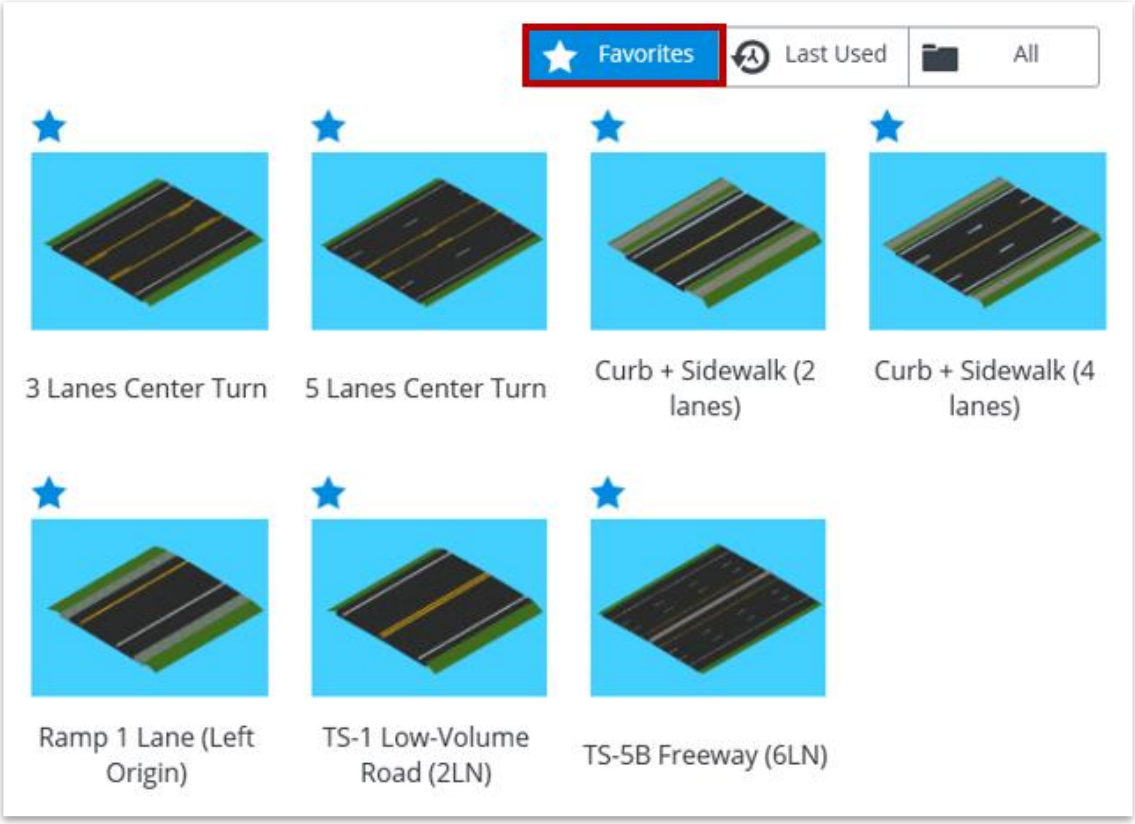


3. **Right** click on any template and notice the options: **Rename**, **Delete**, **Copy**, **Duplicate** and **Edit**. To return to a previous folder, click on the folder name above the templates.

4. Next, let's add **seven** templates to our **Favorites**, since we will utilize them later in the manual. Use the table below to search for and then set each template as a **Favorite** by clicking the **star** above each template.

Template Name	Template Path
3 Lanes Center Turn	Road
5 Lanes Center Turn	Road
Curb + Sidewalk (2 lanes)	Road >> 2 Lanes
Curb + Sidewalk (4 Lanes)	Road >> 4 Lanes
Ramp 1 Lane (Left Origin)	Road >> Ramp
TS-1 Low-Volume Road (2LN)	TDOT >> Road >> Undivided
TS-5B Freeway (6LN)	TDOT >> Road >> Undivided

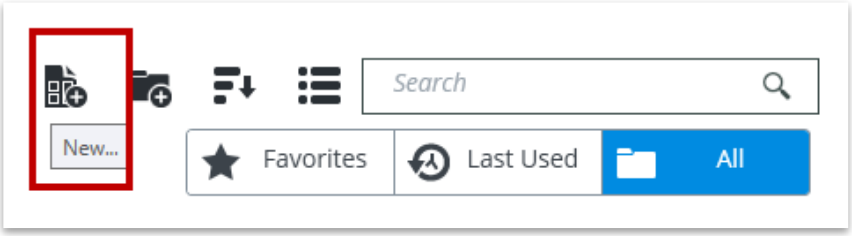
5. Once you have set all **seven** templates, click on the **Favorites** button in the upper right corner to view the list.



6.3 Lecture: Template Editor

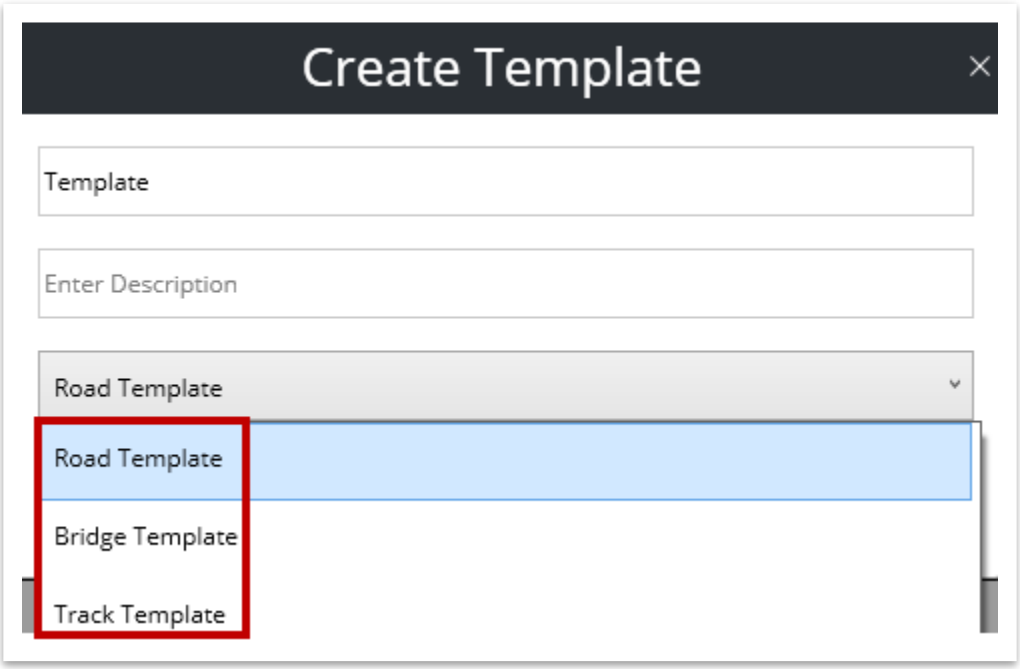
If a new roadway, ramp, bridge, or rail template is needed, the user can create one in the template manager by clicking on the **New…** icon (Figure 33) or by right clicking within the folder and selecting **New Template**.

FIGURE 33. NEW TEMPLATE ICON



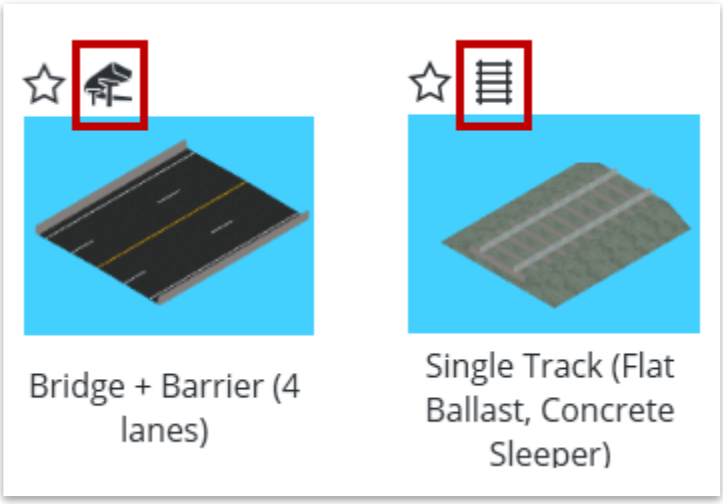
When creating a new template, it is imperative to identify the template type as either a **Road**, **Bridge** or **Track** template (Figure 34). You will be unable to change the type of template once it is created. Also, any new template created is not associated with the folder structure.

FIGURE 34. TEMPLATE TYPES



Bridge templates will have a **bridge** icon above the template and track templates will have a **track** icon about the template (Figure 35).

FIGURE 35. BRIDGE AND TRACK ICONS



Take Note!

If a ConceptStation template is modified after placement, the model will still dynamically update to reflect the changes.

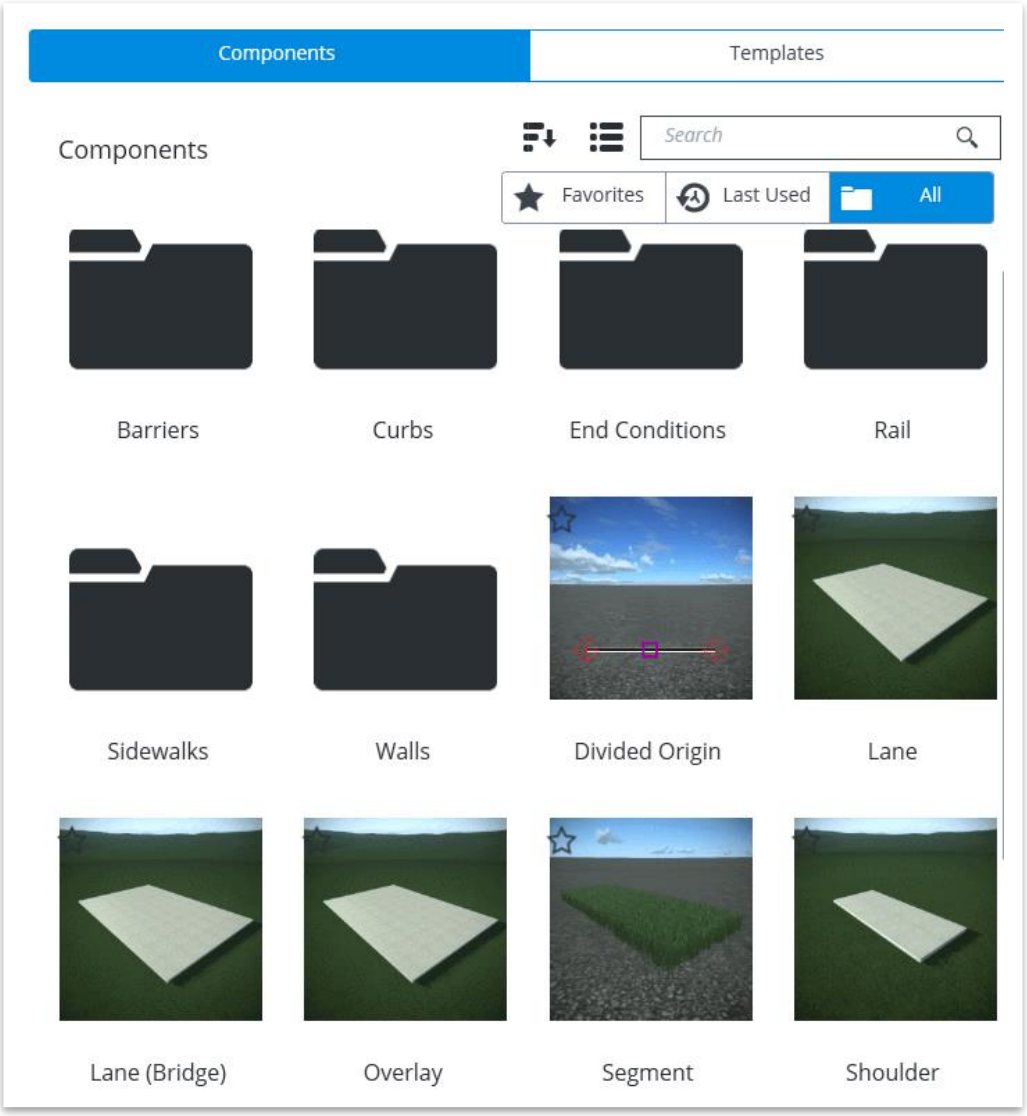
6.3.1 Template Components

New templates are built using predetermined components. The user can then define the **width**, **height**, and **slope** of the components once they are placed in the template. The components window provides folders for **Barriers**, **Curbs**, **End Conditions**, **Rail**, **Sidewalks**, and **Walls**. The basic components are listed for **Divided Origins**, **Lanes**, **Segments**, and **Shoulders** (Figure 36).

Take Note!

Currently, the user is not able to create new components or modify the predetermined components provided in the default library beyond the tools available in the editor once a component has been placed in a template. Bentley has logged this as a potential product enhancement for a future software release.

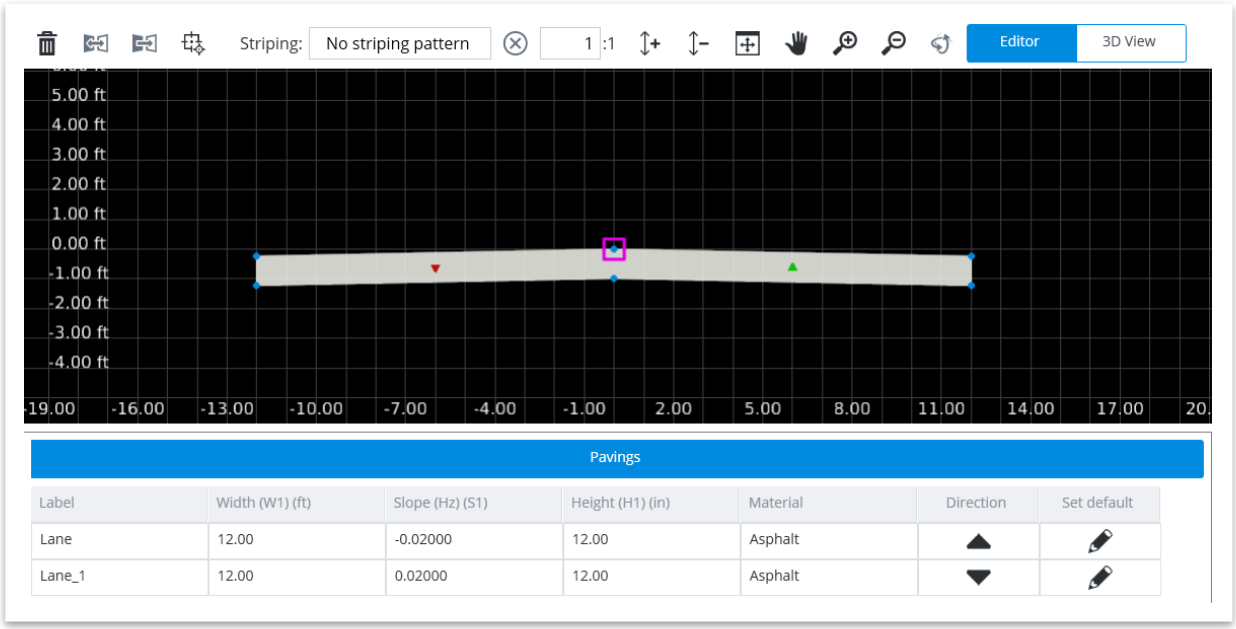
FIGURE 36. COMPONENTS WINDOW



6.3.2 Graphical Editor Window

To place a component in the template, the user must select one of the components and then use the **Graphical Editor** window to position it (Figure 37). Once placed, the user can left click to accept and then modify the template properties at the bottom of the window.

FIGURE 37. GRAPHICAL EDITOR WINDOW



The **Graphical Editor** tools allow for the rapid creation and editing of a template (Figure 38). The available editing tools are **Delete**, **Mirror Component**, **Reflect Component**, **Set Origin** and **Striping**. The navigation tools allow the user to **Modify Vertical Exaggeration**, **Fit**, **Pan**, **Zoom In/Out**, **Rotate View**, and **3D View**.

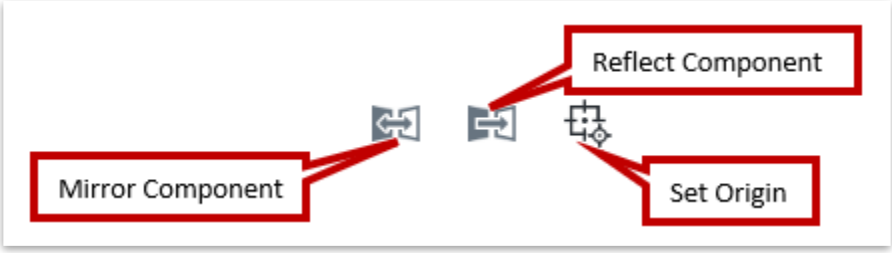
FIGURE 38. GRAPHICAL EDITOR TOOLS

6.3.2.1 Component Editing Tools

When using the **Graphical Editor** tools, the following options in the upper left are important when creating or editing a component (Figure 39).

- **Mirror Component:** Mirrors the component to place it correctly on both sides of the template at once.
- **Reflect Component:** Flips the component to place it correctly on one side of the template at a time.
- **Set Origin:** Used to define a new origin point for the component.

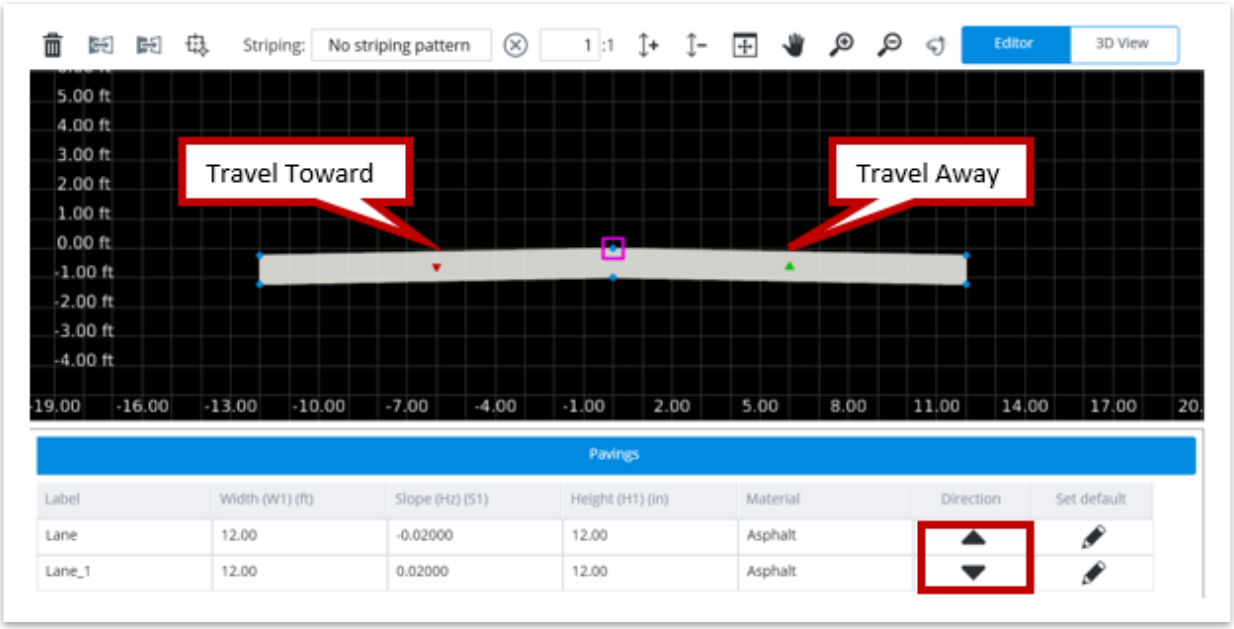
FIGURE 39. COMPONENT EDITING TOOLS



6.3.2.2 Component Direction Tool

The direction of travel for lane components can be modified in the **Graphical Editor** window. The **green** up arrow represents travel **away** from the user, and the **red** down arrow represents travel **towards** the user (Figure 40). This designation is especially important for the placement of the pavement centerline striping. The lane direction can be changed by toggling the up/down arrow for each component in the table at the bottom of the **Graphical Editing** window.

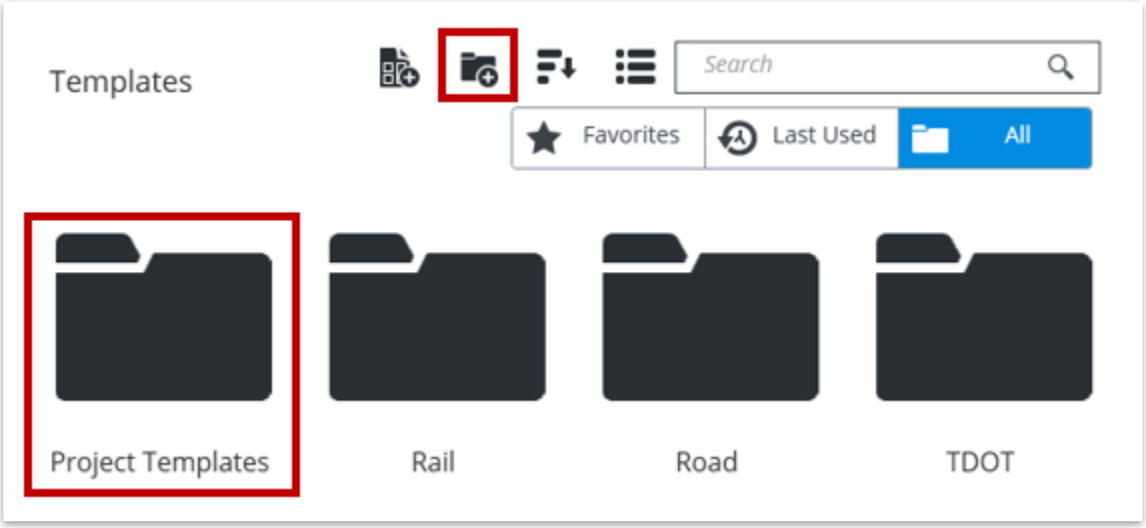
FIGURE 40. COMPONENT DIRECTION TOOL



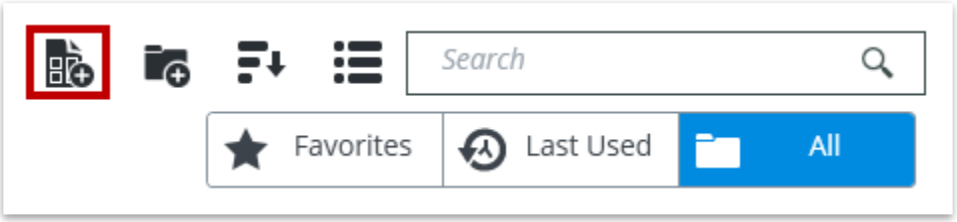
6.3.3 Exercise: Create a New Template

In this exercise, we will create a new template using the Template Editor.

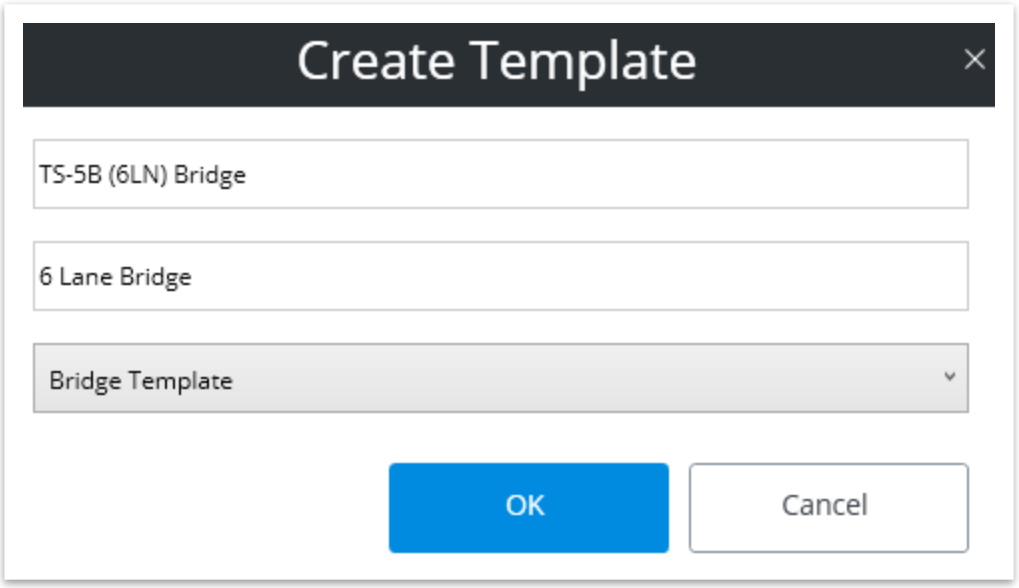
1. First, let's create a new template folder. Select the **Templates** option within the **Backstage** menu, if not already open. Click the **New Folder…** icon and name it **Project Templates**.



2. Next, open the **Project Templates** folder and click the **New…** icon. **Note:** You could also **right** click within the folder and select **New Template**.



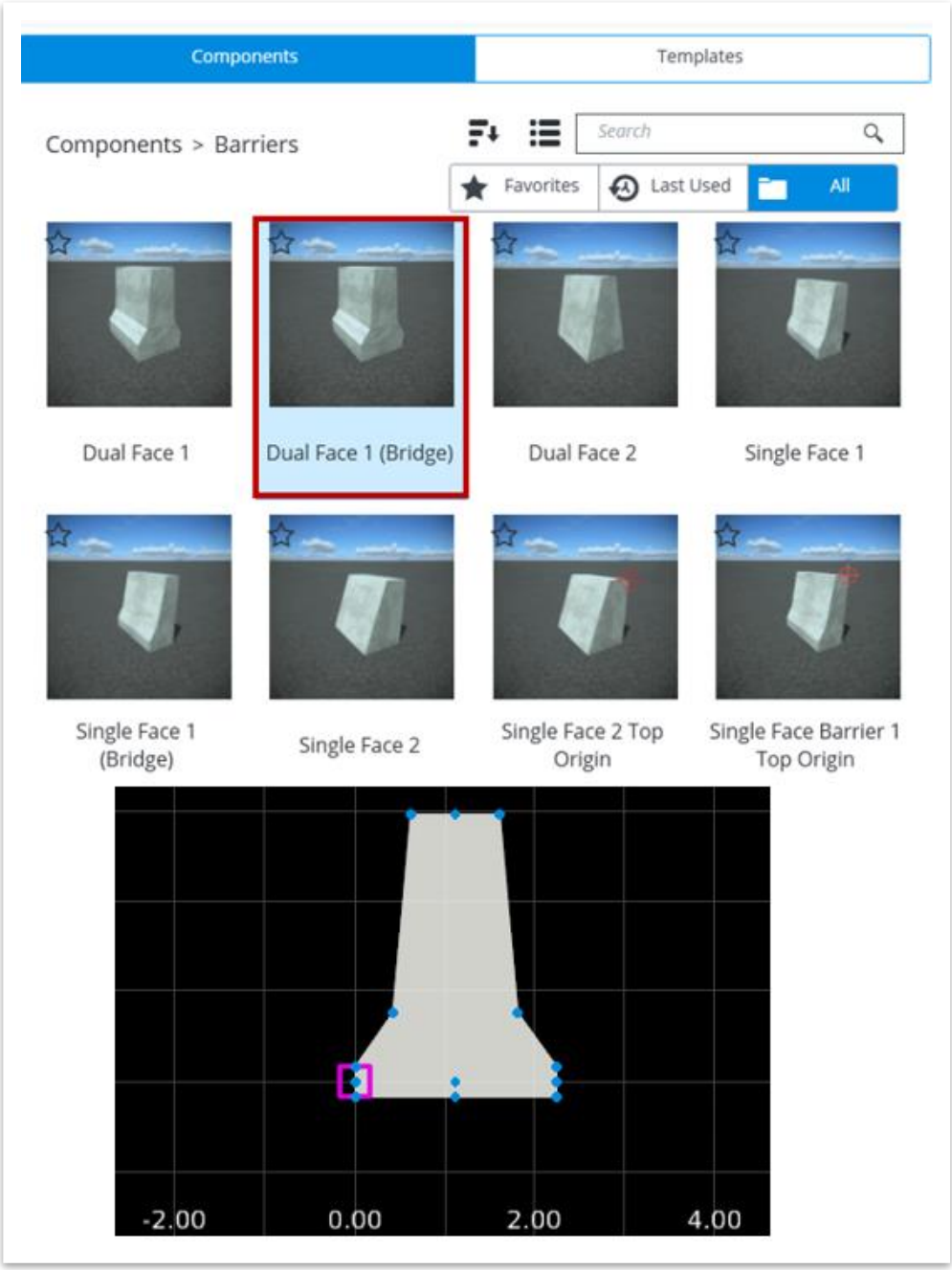
3. Within the **Create Template** dialog box, select the following settings, and then click **OK**.
    a. **Template Name:** TS-5B (6LN) Bridge
    b. **Enter Description:** 6 Lane Bridge
    c. **Template Type:** Bridge Template



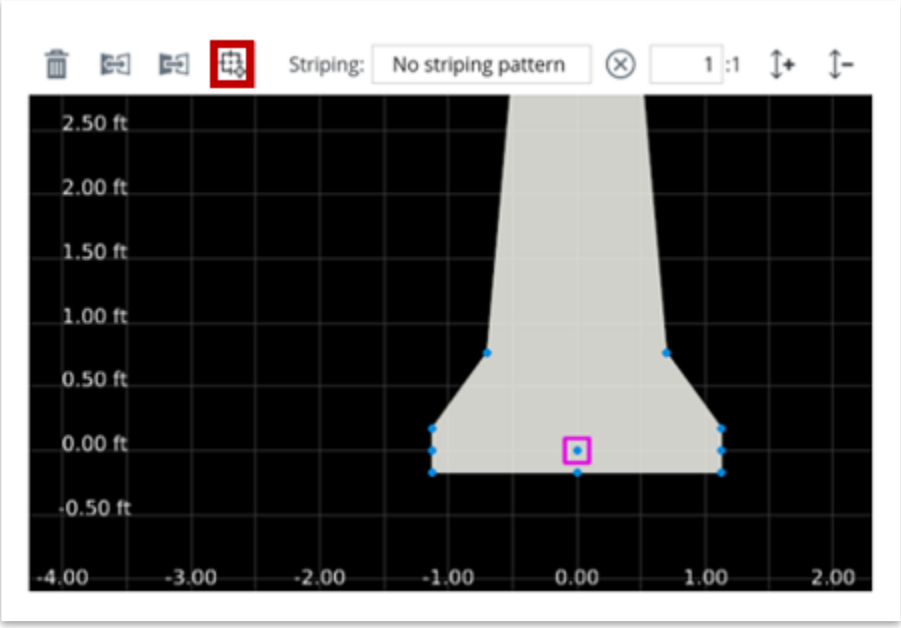
Take Note!

*Make sure you create a **Bridge** template and not a roadway template. You will be unable to change the type of template once it is created.*

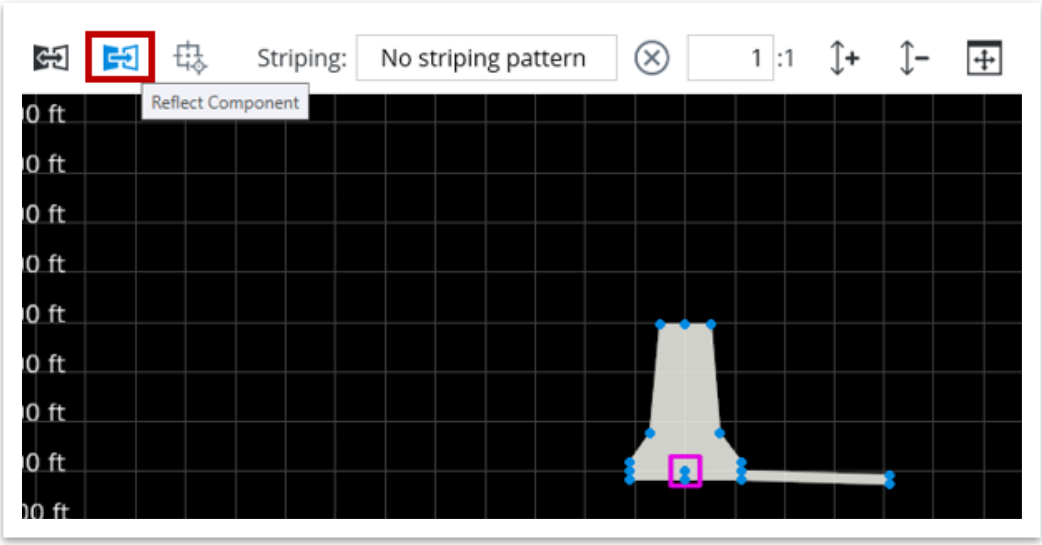
4. The **6 Lane Bridge** template will include a median barrier, inside shoulders, and outside shoulders with bridge barriers. First, let's place the median barrier component. On the left side of the screen, open the **Barriers** components folder and **left** click on the **Dual Face 1 (Bridge)** component. Within the black **Graphical Editor** window on the right, notice that the component is on the cursor. **Left** click in the **Graphical Editor** window to place it and then **right** click to clear the tool. **Note:** Since this is the first component placed in the template, it will automatically place at the grid origin (**0,0**).



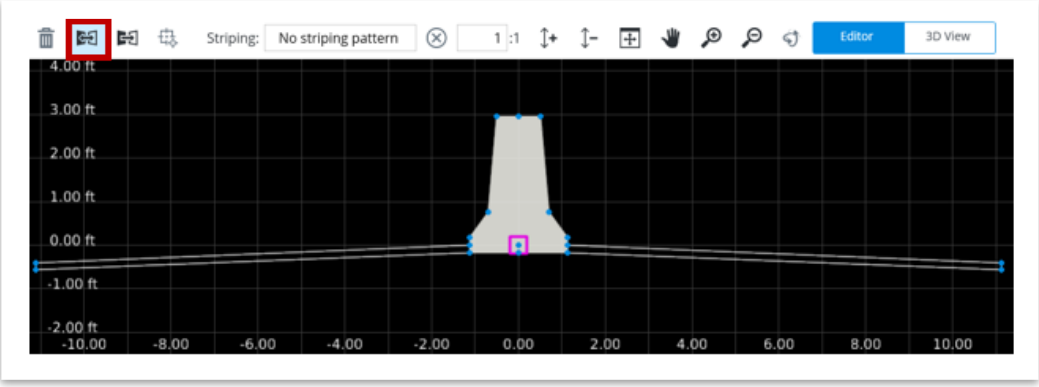
5. In the **Graphical Editor** window, open the **Set Origin** tool in the upper left and update the origin point to the **middle** point towards the bottom of the barrier.



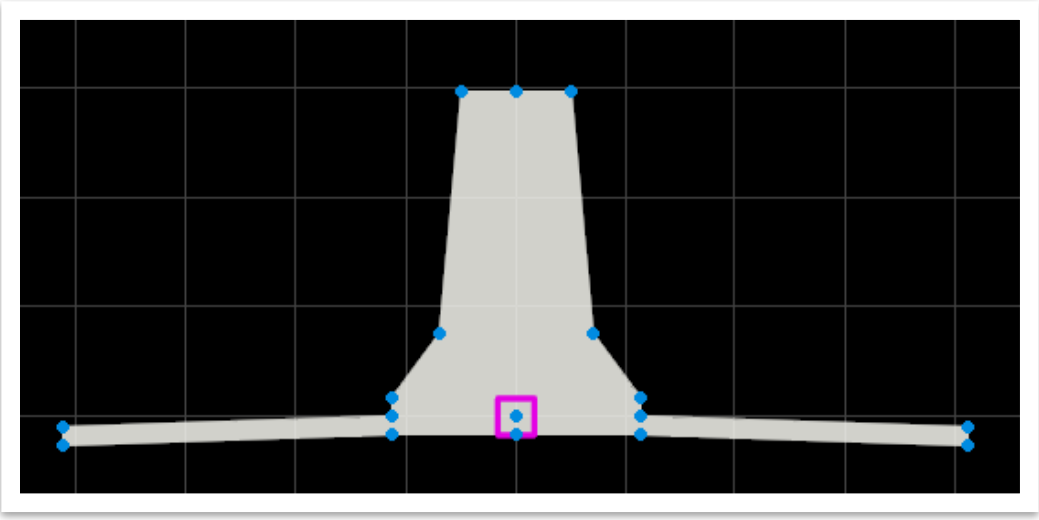
6. Now navigate back to the main components folder by clicking **Components** and scroll down to the **Shoulder (Bridge)** component. **Left** click on the component and move your cursor into the **Graphical Editor** window. There are two ways you can place the shoulder. Select **one** of the following ways:
    a. **<u>One component at a time</u>:** Place the component on the **right** side of the median barrier. Then, use the **Reflect Component** tool to place the component on the **left** side of the median barrier. **Right** click to clear the tool.



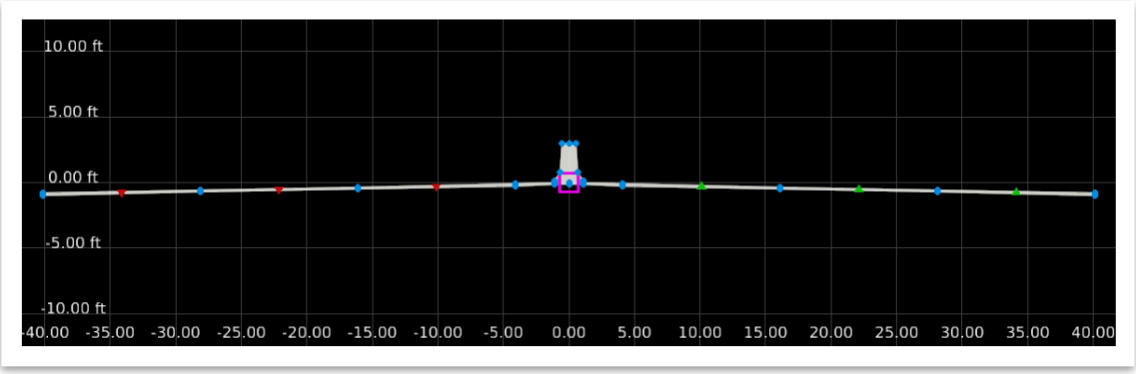
b. **<u>Mirrored</u>:** Use the **Mirror Component** tool and place the shoulders on both sides of the barrier at once. **Right** click to clear the tool.



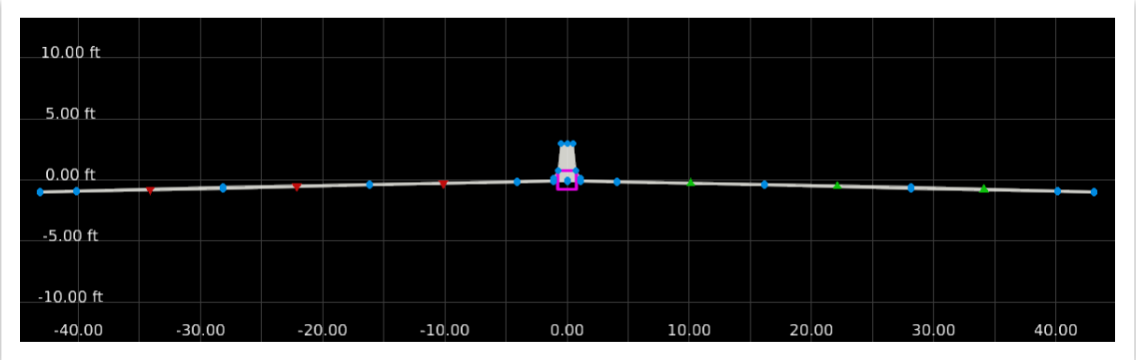
7. Once you have placed the **Shoulder (Bridge)** components, the template should look like the screenshot below. We will update the **widths** and **slopes** once all components have been placed.



8. Next, we will place **three** lanes on each side of the shoulders using the **Lane (Bridge)** component. Once again, you can use either the **Mirror Component** or **Reflect Component** tool to place the lanes. **Right** click to clear the tool once you are done. Notice the **green** and **red** arrows indicating direction of travel for each lane. The default directions are correct in this scenario so there is no need to modify them. **Note:** If you misplace a component, **left** click on it to select and then click the trash can to delete it.



9. Now let's place **one Shoulder (Bridge)** component on both sides and then **right** click to clear the tool.



10. Open the **Barriers** component folder and select the **Single Face 1 (Bridge)** component and place **one** on each end of the outside shoulders. **Note:** Use your mouse wheel to zoom in and out to make sure you place the barrier on the edge point.

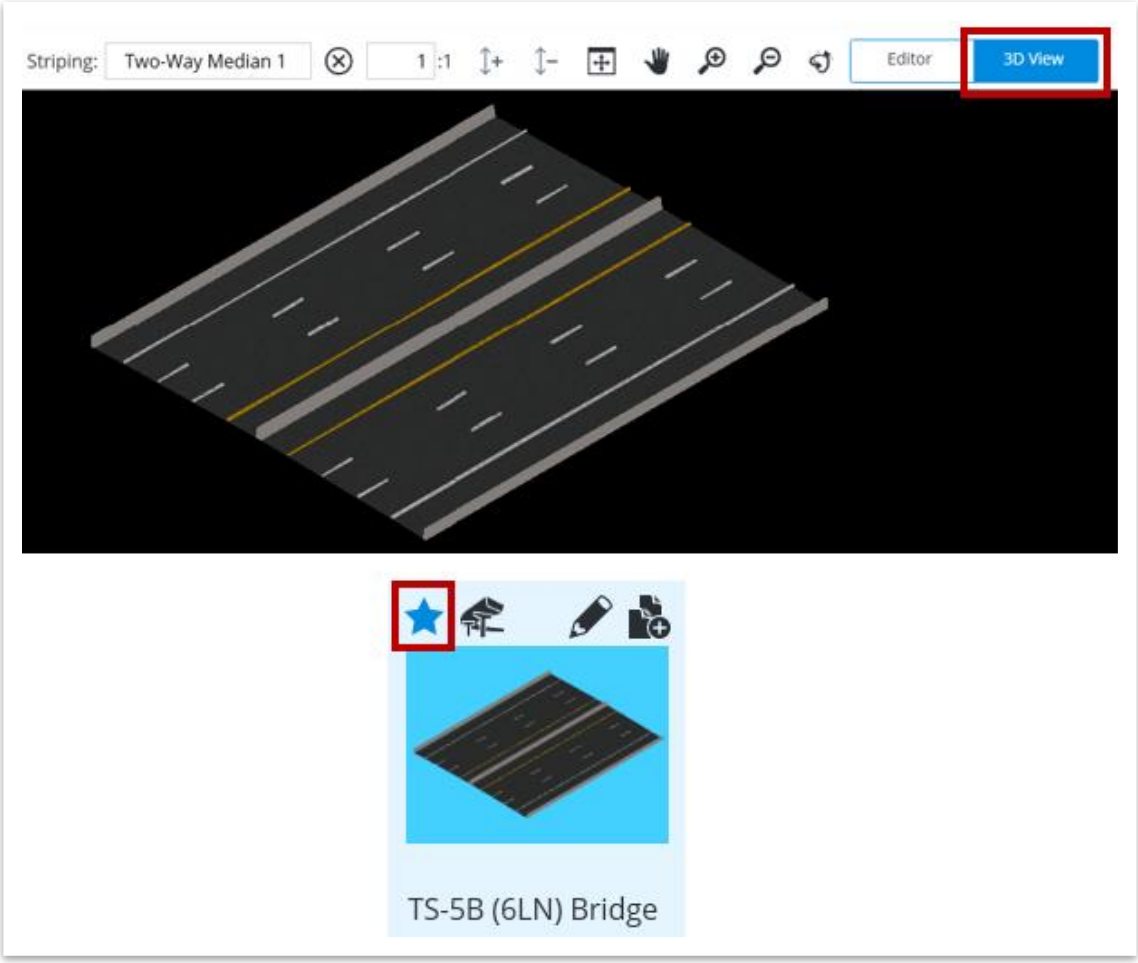
11. Next, we will edit the component variables. In the **Graphical Editor** window, click the **Buffers** tab. Click on the **shoulder** component name to see it highlighted. Update the shoulder components per the following settings. **Note:** The component order may be different depending on how you placed the components.
    a. **Inside Shoulders:** 12’ wide, 2% slope
    b. **Outside Shoulders:** 12’ wide, 4% slope

Barriers | Buffers

Label	Width (W1) (ft)	Slope (Hz) (S1)	Height (H1) (in)
Shoulder (Bridge)_IR	12.00	-0.02000	2.00
Shoulder (Bridge)_IL	12.00	0.02000	2.00
Shoulder (Bridge)_OR	12.00	-0.04000	2.00
Shoulder (Bridge)_OL	12.00	0.04000	2.00

12. Now that the shoulder component variables have been updated, let’s assign **Striping**. **Left** click the **Striping** box at the top of the **Graphical Editor** window and select **Two-Way Median 1**.

13. Lastly, click on the **3D View** button in the upper right corner to view the template. Once you are done reviewing, click **Save** and then **left** click on the star to **Add to Favorites**.

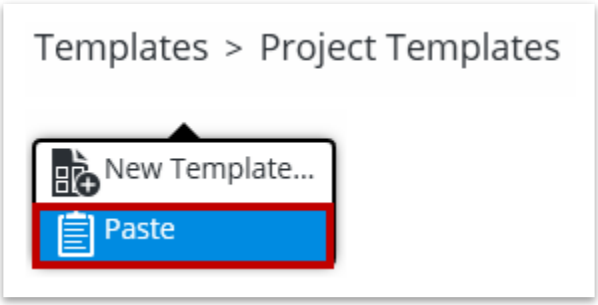


6.3.4 Exercise: Edit an Existing Template

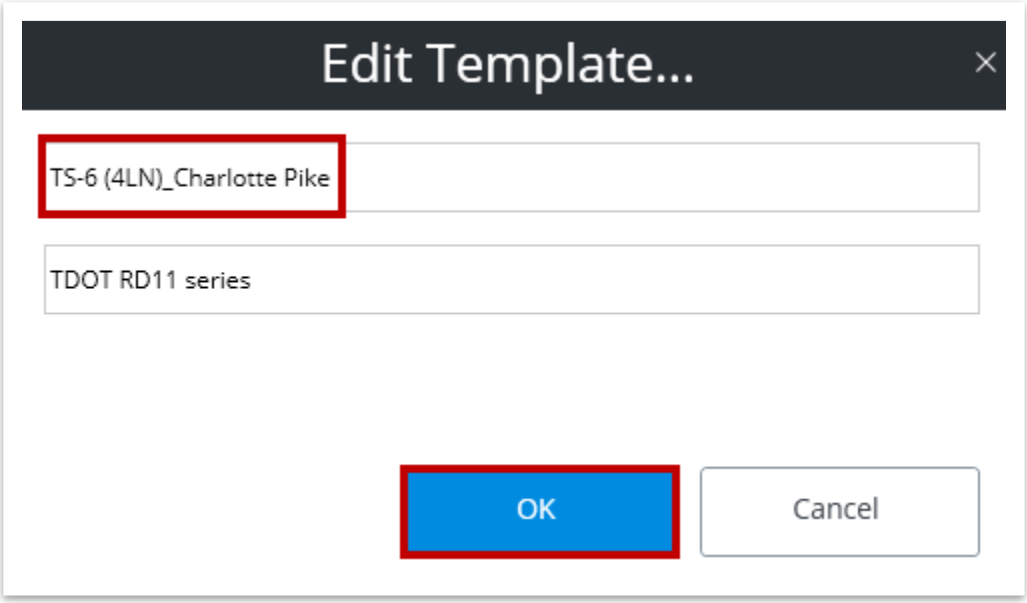
In this exercise, we will copy an existing template and modify it in the Template Editor.

1. Select the **Templates >> TDOT >> Road >> Undivided** template folder, and then **right** click on **TS-6 Median, C&G, and Sidewalk (4LN)** and select **Copy**.

2. Next, open the **Project Templates** folder. **Right** click and select **Paste**.

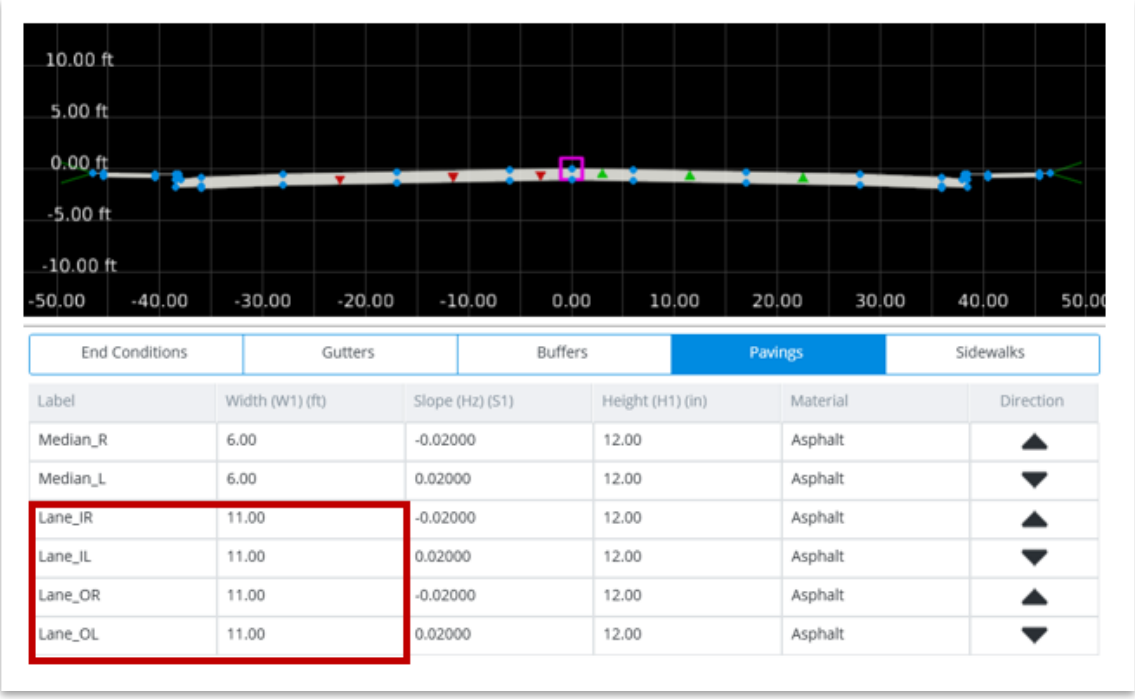


3. Now **right** click on the template and rename it to **TS-6 (4LN)_Charlotte Pike** and click **OK**.

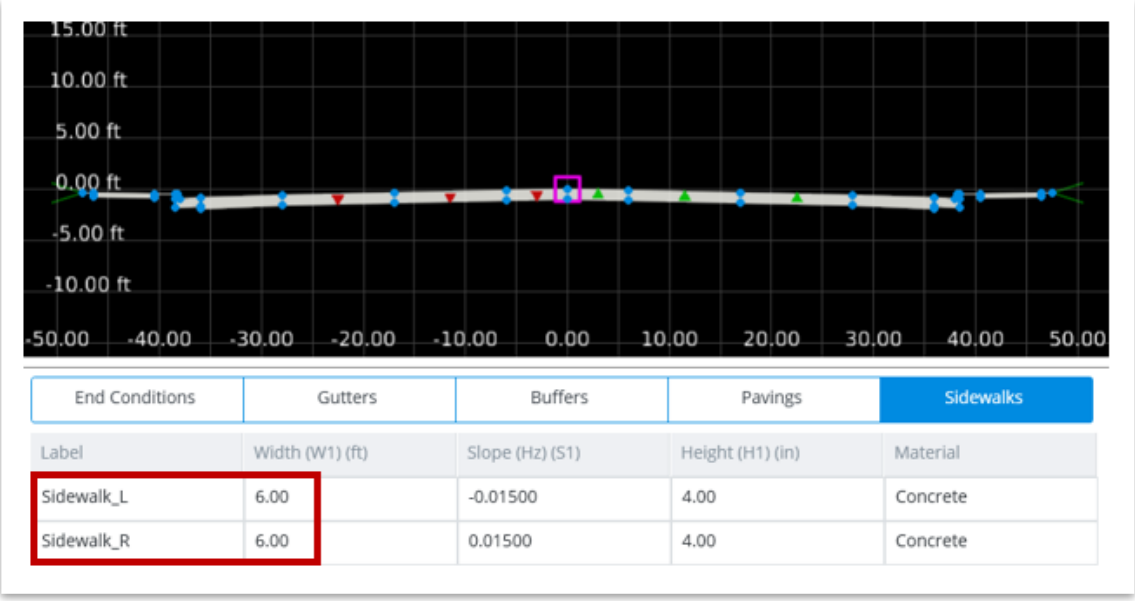


4. **Left** click on the template and select the **Edit Template…** tool.

5. Next, we will edit the right and left **lane widths**. In the **Graphical Editor** window, click the **Pavings** tab. Click on each of the four **Lane** components and update the **Width** to **11.00**.



6. Now we will edit the sidewalk width. In the **Graphical Editor** window, click the **Sidewalks** tab. Click on the **Sidewalk_L** and **Sidewalk_R** components and update the **Width** to **6.00**.

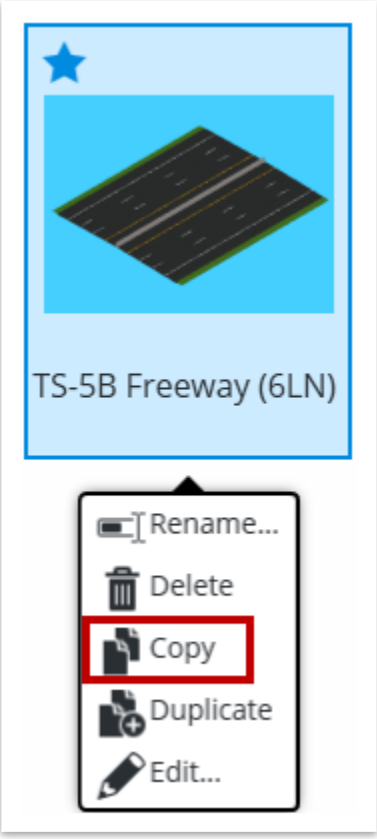


7. Once you are done updating, click **Save** and then **left** click on the star to **Add to Favorites**.

6.3.5 Exercise: Add Retaining Walls

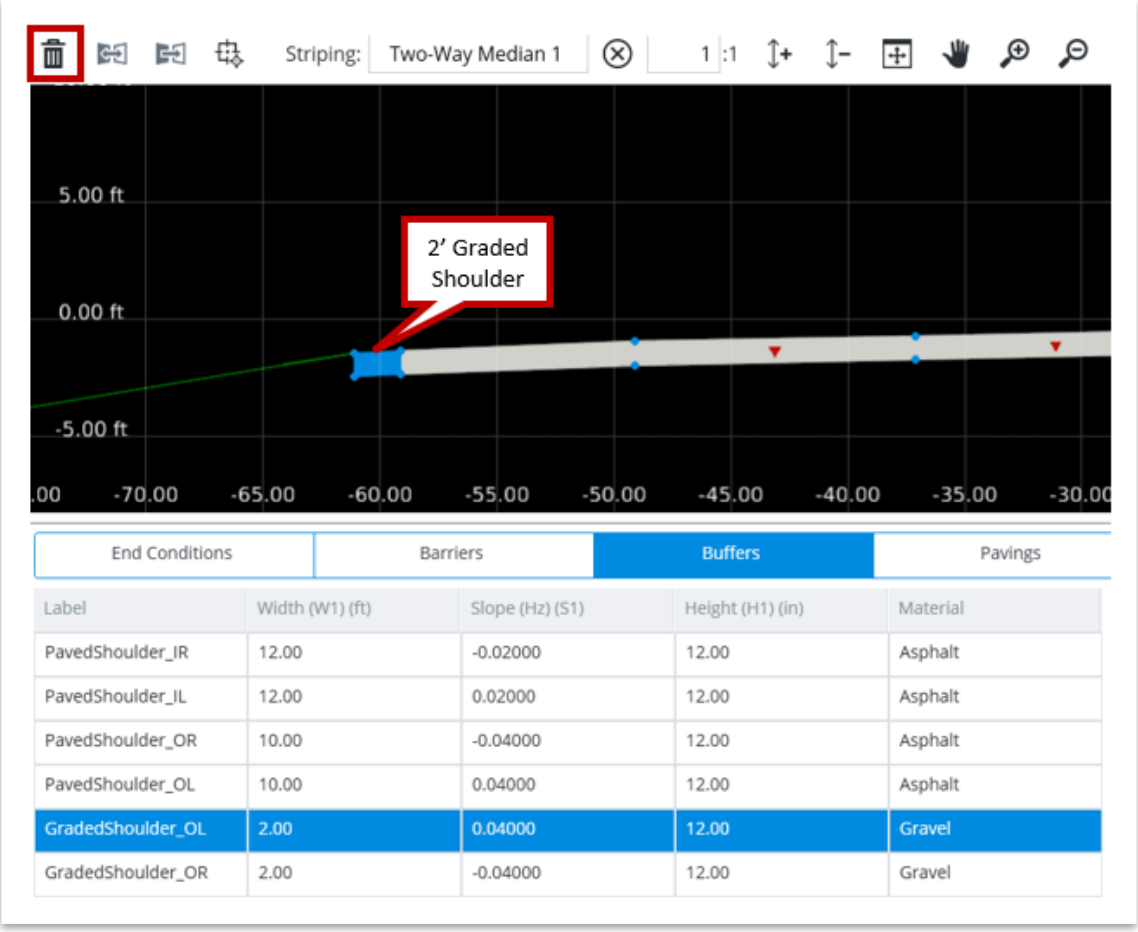
In this exercise, we will edit a template and add retaining walls instead of end conditions.

1. Within the **Favorites** folder, **right** click on **TS-5B Freeway (6LN)** and select **Copy**.



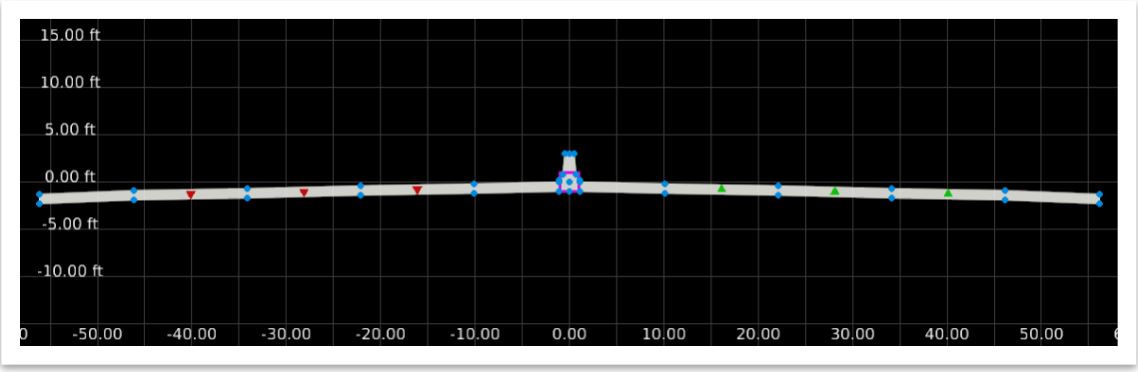
2. Next, open the **Project Templates** folder. **Right** click and select **Paste**. Then, **right** click on the template and rename it to **TS-5B (6LN) Retaining Wall** and click **OK**.

3. **Left** click on the template and select the **Edit Template…** tool. Zoom in to the **left** side of the template and **left** click on the **2' Graded Shoulder**. Then, click the trash can to remove the graded shoulder and ditch segment.

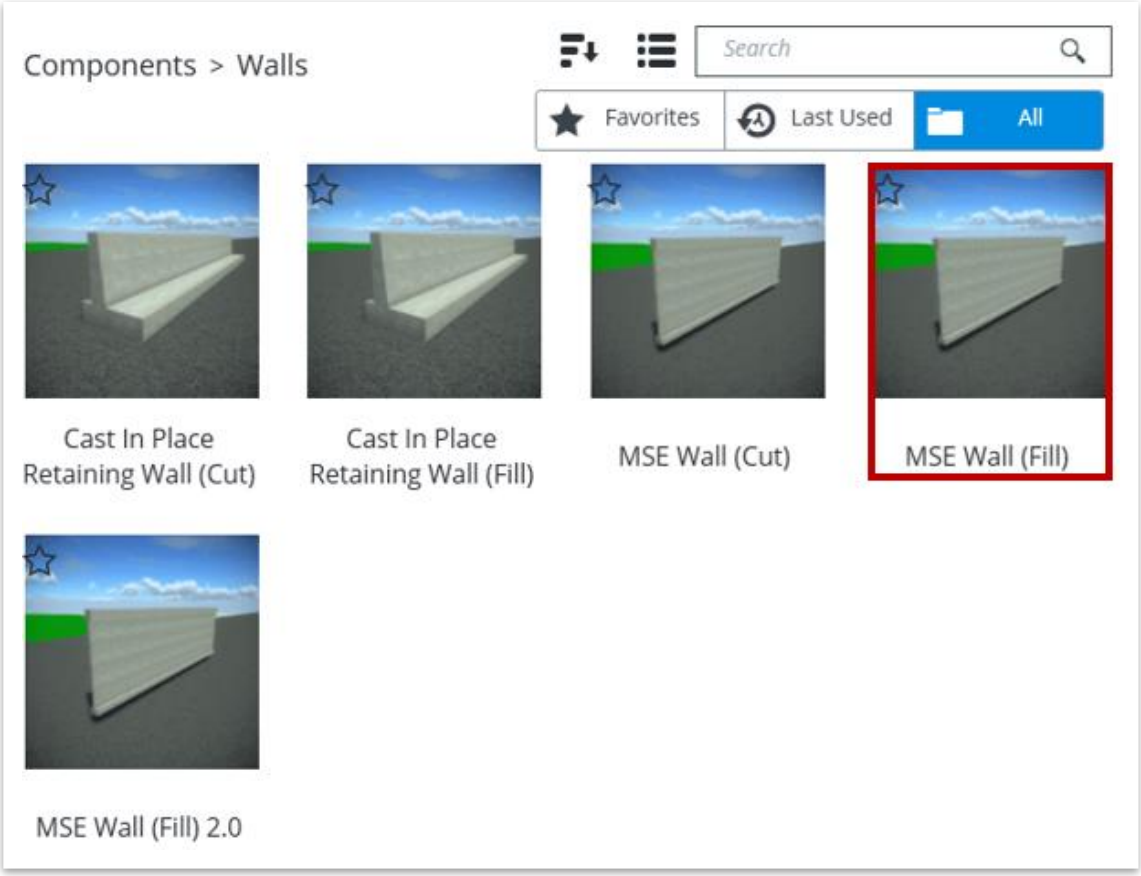


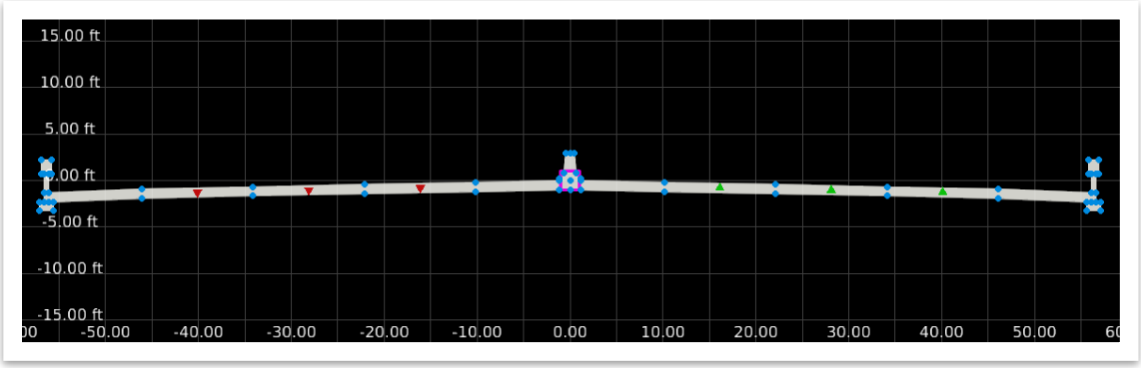
Label	Width (W1) (ft)	Slope (Hz) (S1)	Height (H1) (in)	Material
PavedShoulder_IR	12.00	-0.02000	12.00	Asphalt
PavedShoulder_IL	12.00	0.02000	12.00	Asphalt
PavedShoulder_OR	10.00	-0.04000	12.00	Asphalt
PavedShoulder_OL	10.00	0.04000	12.00	Asphalt
GradedShoulder_OL	2.00	0.04000	12.00	Gravel
GradedShoulder_OR	2.00	-0.04000	12.00	Gravel

4. Repeat the previous step on the <u>right</u> side of the template so that the template only has a **median barrier**, **shoulders**, and **lanes**.



5. Now open the **Walls** components folder and select the **MSE Wall (Fill)**. Place **one** wall on <u>both</u> sides of the template. Use the **Reflect Component** tool to flip the placement point of the wall. Once completed, click **Save**.

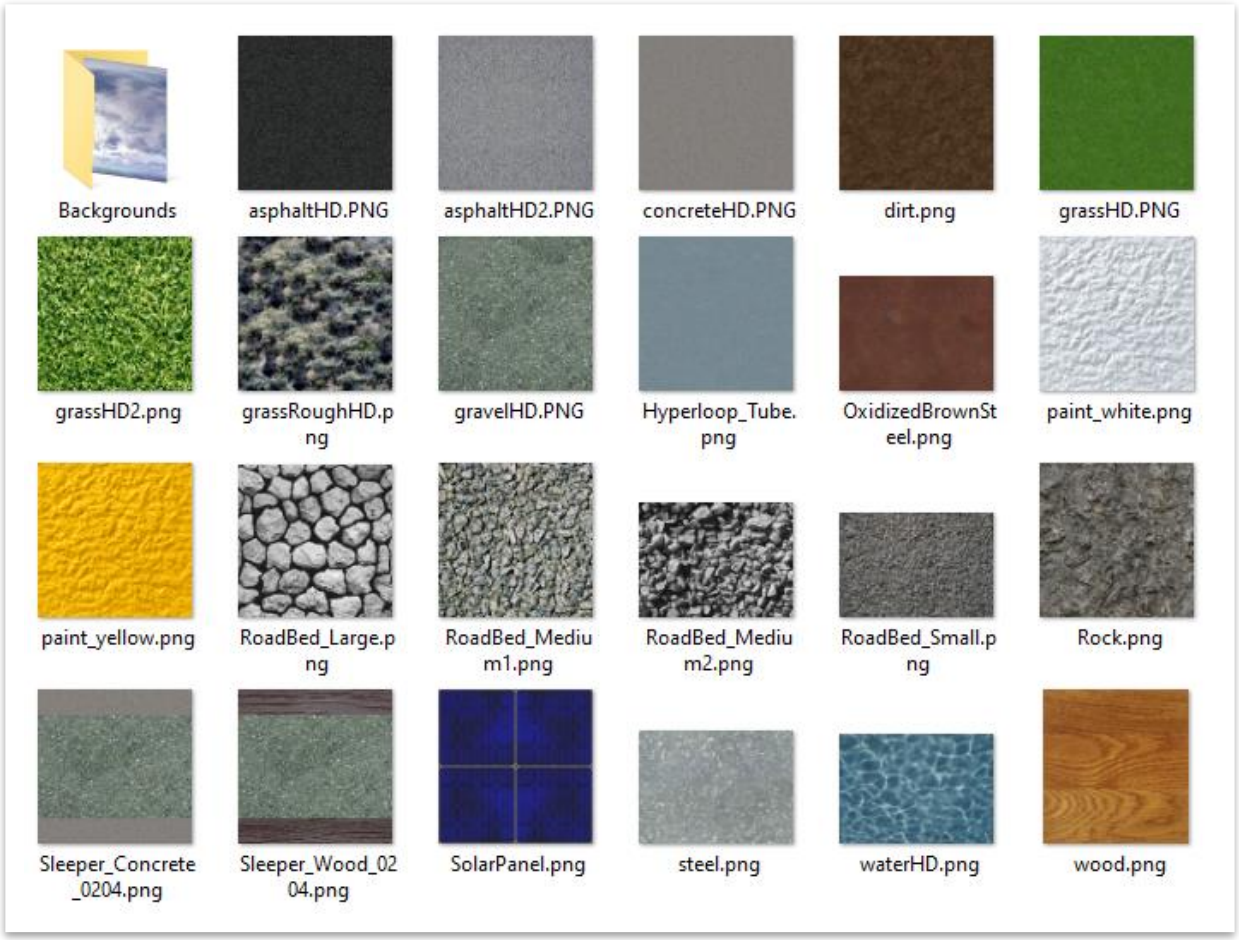




6.4 Lecture: Template Component Materials

Materials are image-based features in ConceptStation and are attached to template components to distinguish within the conceptual model and provide a realistic visualization. Additionally, the attached materials can be linked to a **cost code** (TDOT pay item) for quantification in the cost estimate. Bentley has provided a set of images for predefined materials that are included in the software installation and located in the following location: **C:\ProgramFiles\Bentley\OpenRoads Conceptstation CONNECT Edition\ConceptStation\Materials** (Figure 41).

FIGURE 41. DEFAULT MATERIALS



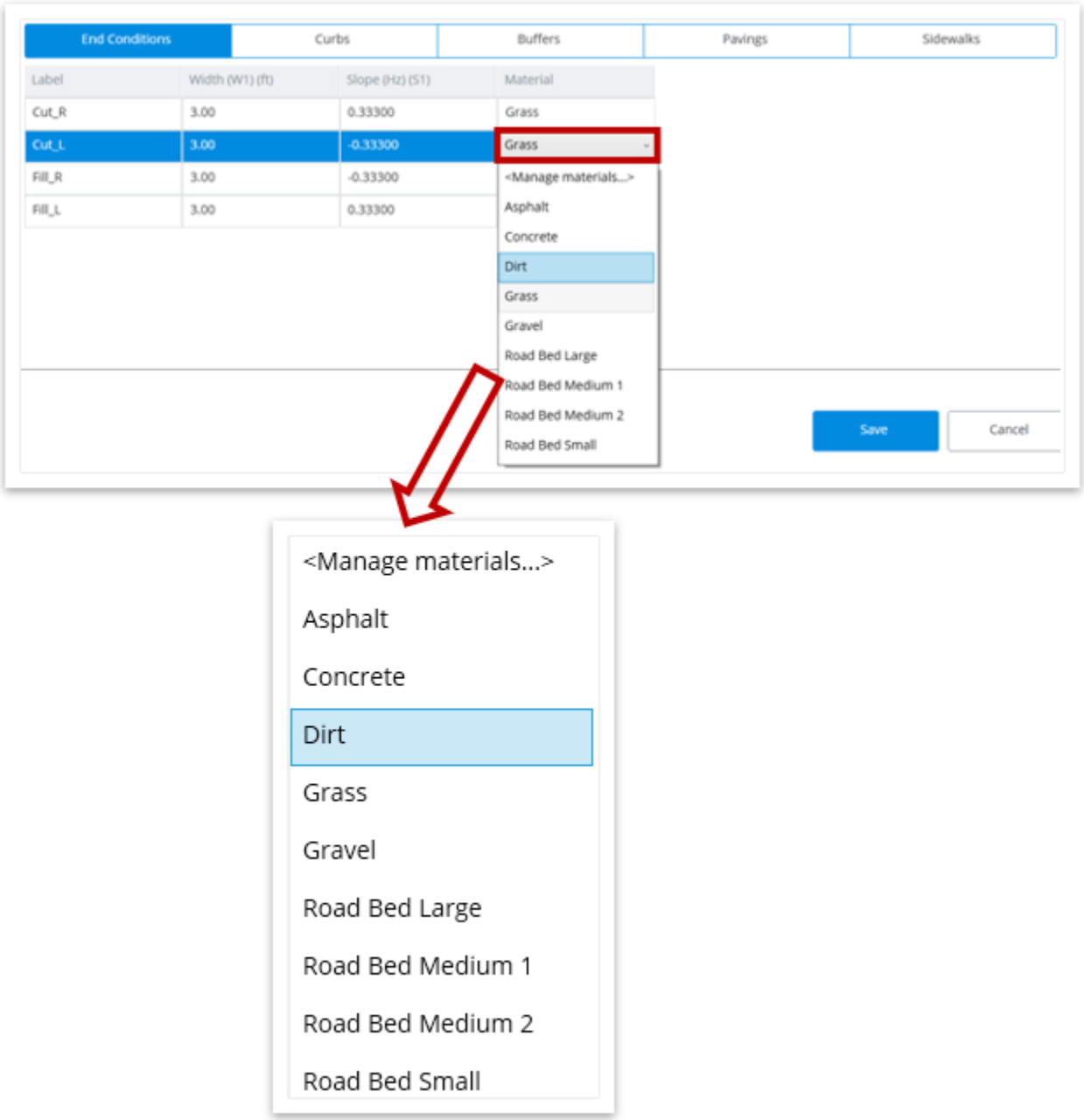
The **asphalt/concrete** material is for **lanes** and **shoulders**, the **white/yellow** paint is for **pavement striping**, and the **grass** is for **cut/fill end conditions** and **grass buffers**, etc. The material that is assigned to each template component can be viewed in the **Graphical Editor** window.

Take Note!

The material assignments are predefined during the initial setup of the template library and should not be modified in most cases.

However, if the user intends to modify the material attached to a template component, this can be done by updating the **Material** from the drop-down in the table at the bottom of the **Graphical Editing** window (Figure 42).

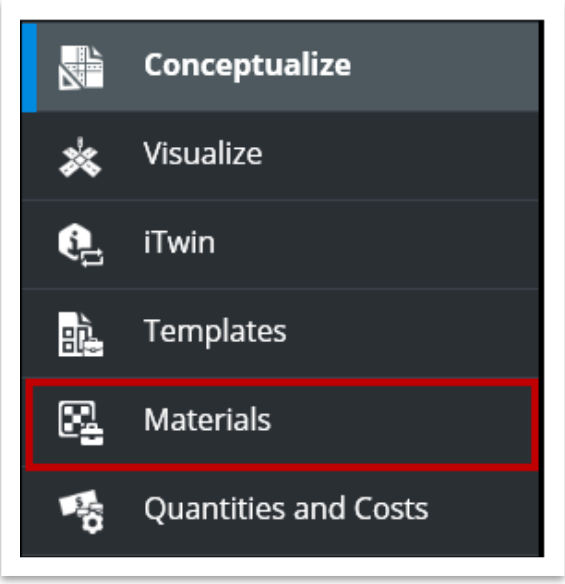
FIGURE 42. GRAPHICAL EDITOR WINDOW – MATERIAL DROP-DOWN



6.4.1 Custom Materials Manager

The **Materials** option is found within the Backstage menu (Figure 43). It allows the user access to the **Materials Manager**, which provides enhanced customization capabilities for materials in ConceptStation.

FIGURE 43. BACKSTAGE MENU – MATERIALS OPTION

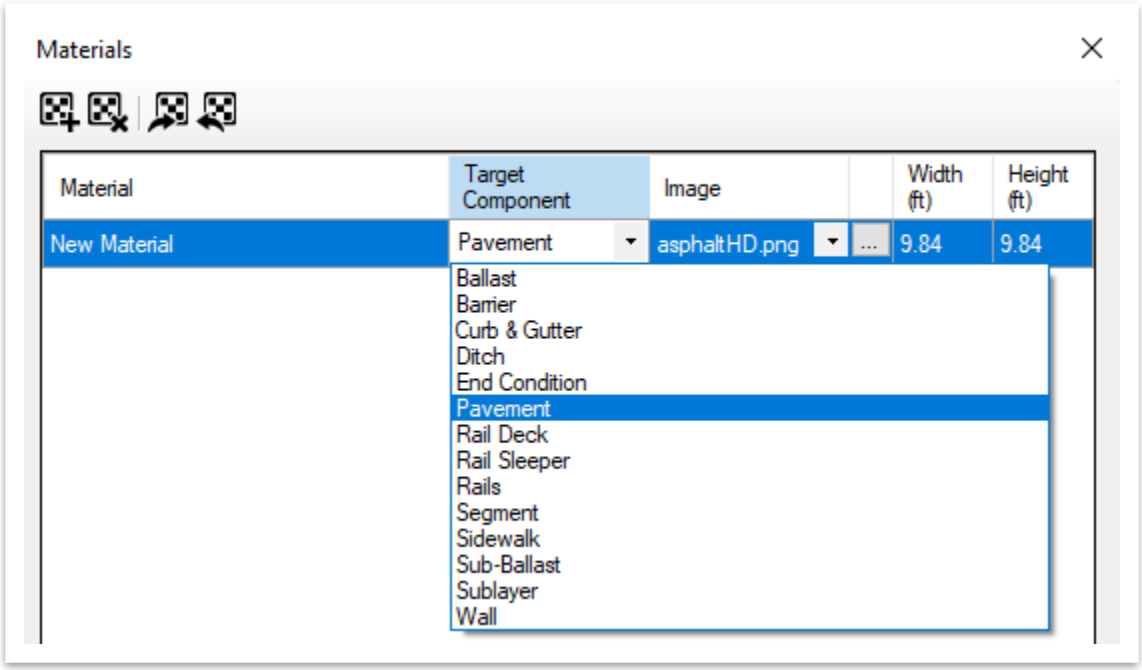


In the **Materials Manager**, the user can select from the following options: Define a **New** material, **Delete** a previously created material, and **Import/Export** materials in XML format (Figure 44).

FIGURE 44. MATERIALS MANAGER OPTIONS

Once a material is added, the user can define the **Name**, the **Target Component** to which the material can be attached, an **Image** (.png file) to attach to the material, and the **Width/ Height** of the image (Figure 45). Prior to creating the new material, the user can save custom images to the same folder location that contains the default Bentley images and then attach these images to created materials. This could be useful if a project has a specific feature for which a material does not previously exist in the library (e.g., brick pavers or cobblestone).

FIGURE 45. MATERIAL CUSTOMIZATION OPTIONS



Take Note!

For most cases in the TDOT workflow, it is not recommended for users to modify the materials that are attached to the predefined templates nor attach custom images to materials whether they be default Bentley templates or TDOT templates.

Chapter 7. Road Placement Tools

This chapter will discuss the **road placement** tools featured in ConceptStation, which includes new roads, divide roads, offset roads, intersections, roundabouts, and ramp connections, as well as existing rail tracks.

7.1 Objectives

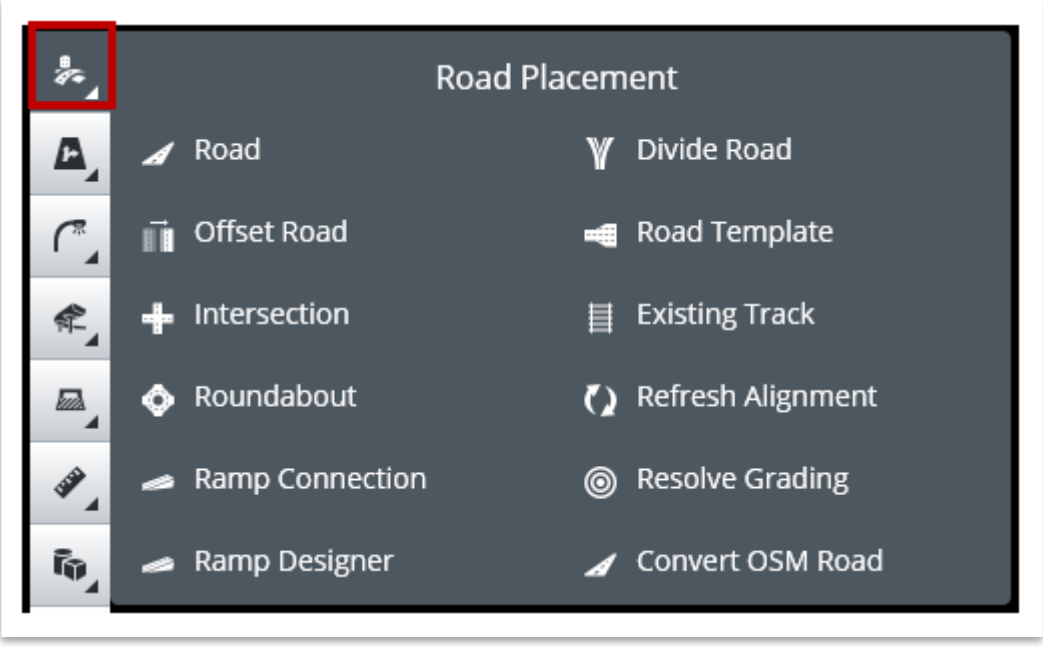
At the conclusion of this chapter, participants will be able to:

1. Utilize the road placement tools to create a new road with horizontal and vertical alignments.
2. Modify road templates.
3. Create intersections, roundabouts, and ramp connections.
4. Create offset roadways and divide roads.
5. Place existing rail tracks.

7.2 Lecture: Road Placement Tools Overview

Within the Backstage menu under **Conceptualize**, the **Road Placement** tools can be found under the first icon within the tool menu. There are **twelve** road placement tools (Figure 46). **Note:** The **Convert OSM Road** tool will be covered separately in Appendix A.1.

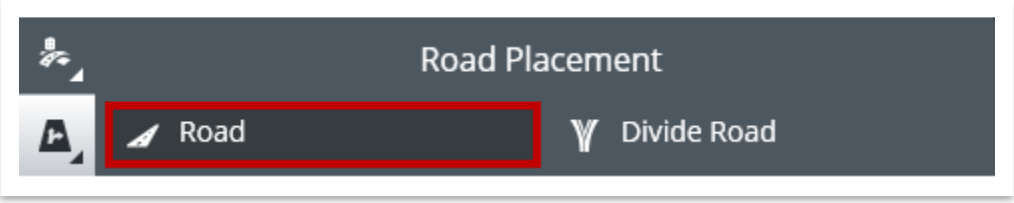
FIGURE 46. ROAD PLACEMENT TOOLS



7.3 Lecture: Road Tool

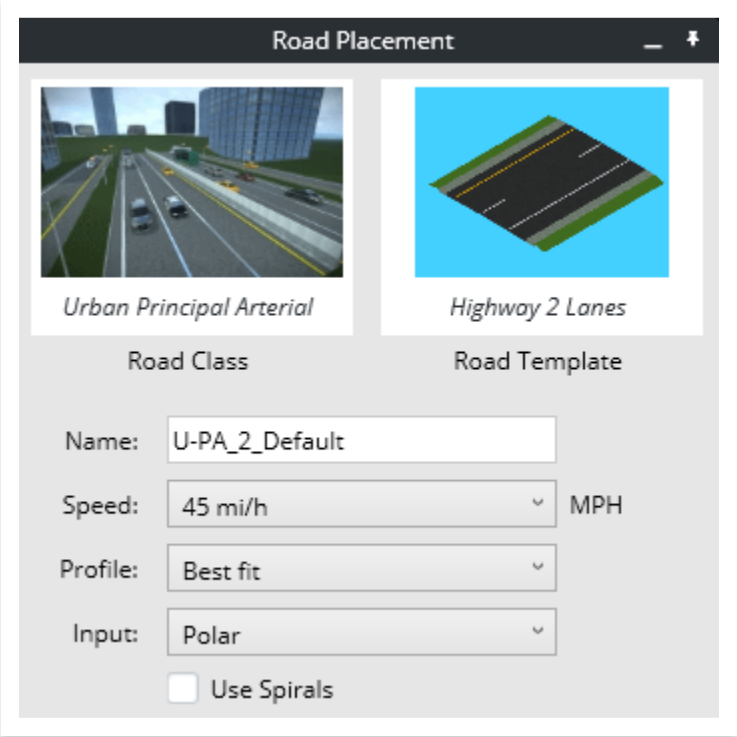
The **Road** tool is found within the **Road Placement** tools (Figure 47). It allows the user to place a road corridor as a starting point for the conceptual model.

FIGURE 47. ROAD TOOL



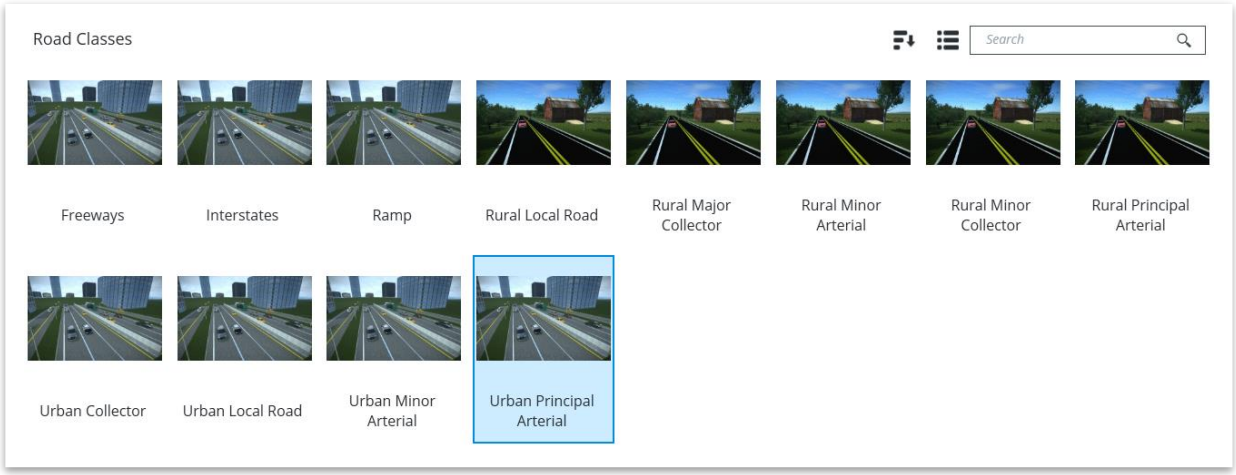
Within the dialog box, the user can select various inputs, including **Road Class**, **Road Template** (as discussed in Lecture 6.2, and **Speed** (Figure 48). The alignment **Name**, **Profile** (**Best fit** or **Straight**), and **Input** (**Polar** or **Cartesian** coordinates) can also be set. If spirals are necessary, toggle on **Use Spirals**.

FIGURE 48. ROAD PLACEMENT DIALOG BOX



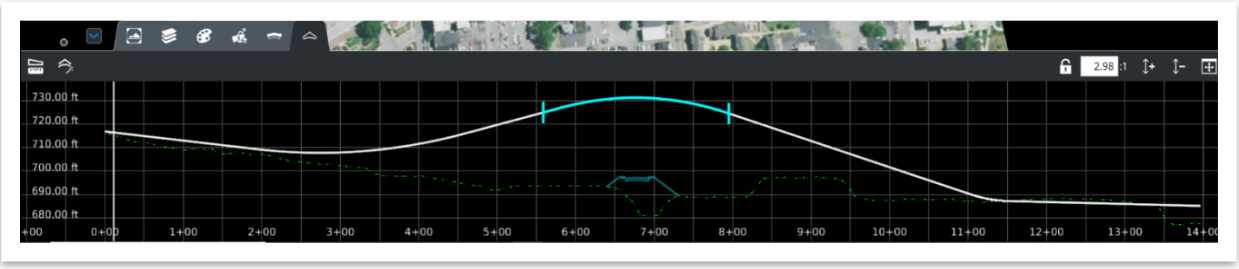
The **Road Classes** are set to the **AASHTO** standard classes (Figure 49), which include **Freeways**, **Interstates**, **Ramps**, and various **Rural** and **Urban** options. By selecting a road class and speed, ConceptStation uses the AASHTO standard design tables for minimum horizontal and vertical curves when creating the roadway alignments and profiles.

FIGURE 49. ROAD CLASSES



Once a road is placed, a vertical alignment is created (Figure 50). The user can then edit the profile through the **Action Center** at the bottom of the window. Such edits can involve inserting or deleting **PVI's** by right clicking in the profile. The minimum vertical curve length will be placed, which can then be edited using the manipulators, or by entering the desired vertical curve length.

FIGURE 50. VERTICAL ALIGNMENT WINDOW



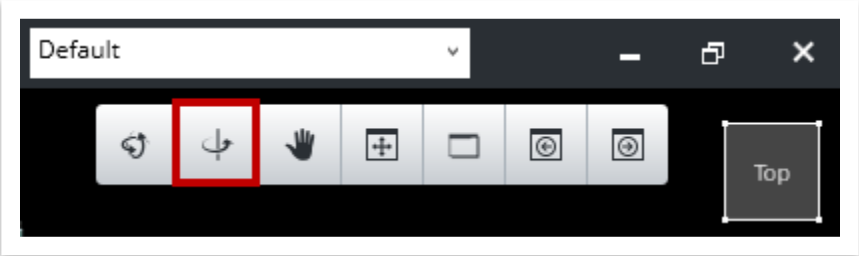
Take Note!

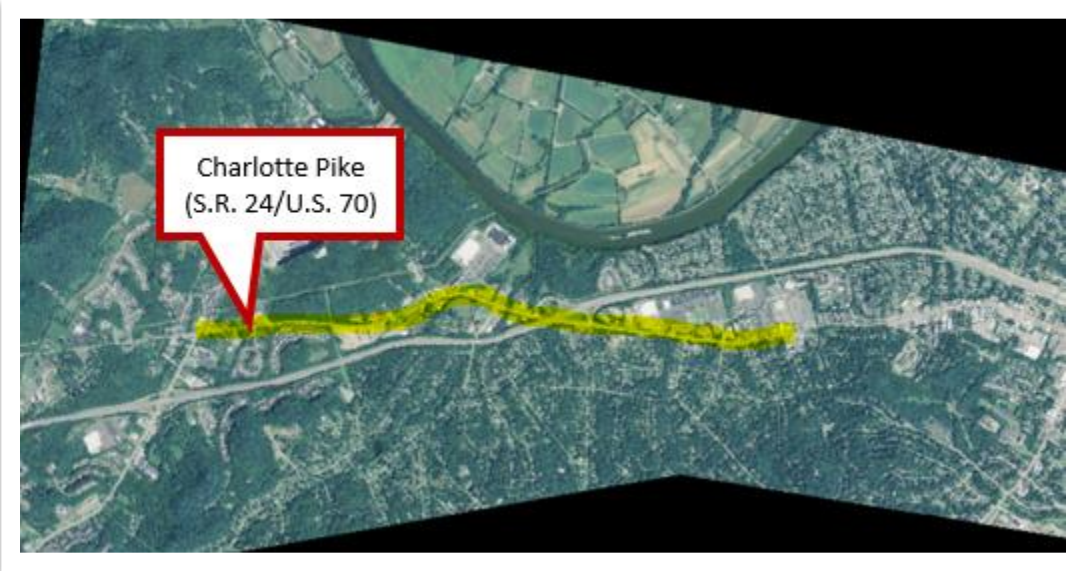
*To keep the **Action Center** or **Information** tab from popping up when selecting an element, click the arrow key next to the tab to hide it.*

7.3.1 Exercise: Create a Road

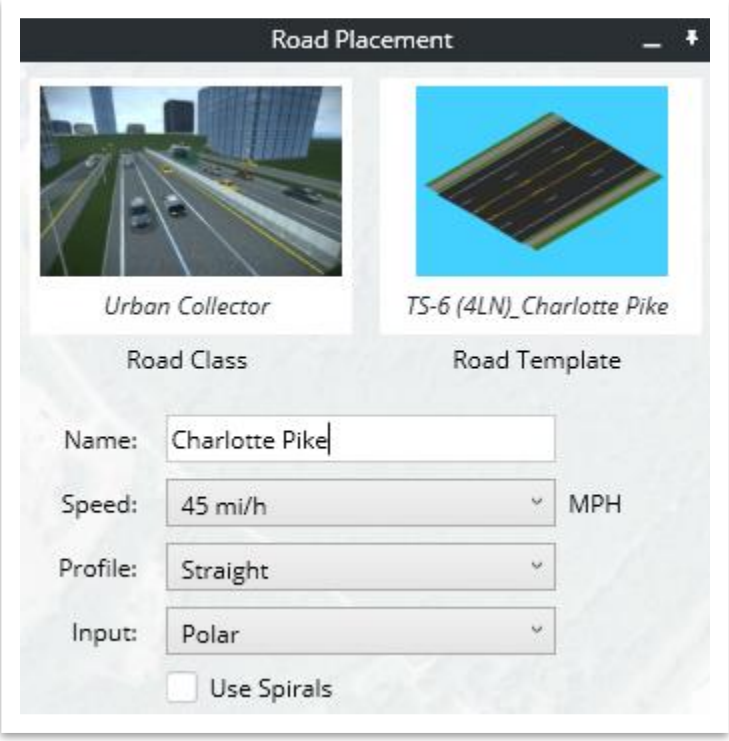
In this exercise, we will create multiple roadway alignments (horizontal and vertical) within the project extent, and then make the necessary geometrical adjustments. In subsequent exercises, we will create additional alignments and connections.

1. Select the **Conceptualize** option within the **Backstage** menu. Rotate the view to align with the **Charlotte Pike** (S.R. 24/U.S. 70) corridor using the **Rotate 2 Points** tool in the **Navigation Tools**. **Note:** All screenshots will be rotated to this view for the remaining exercises. The only exception is for 3D/isometric views.

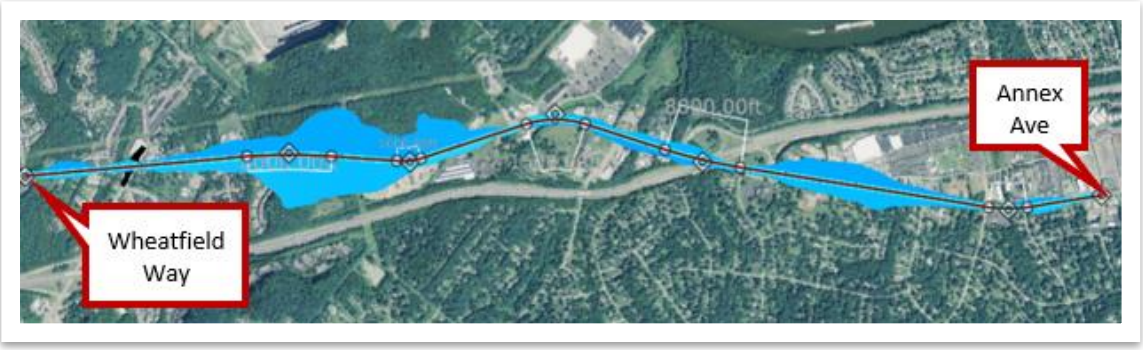




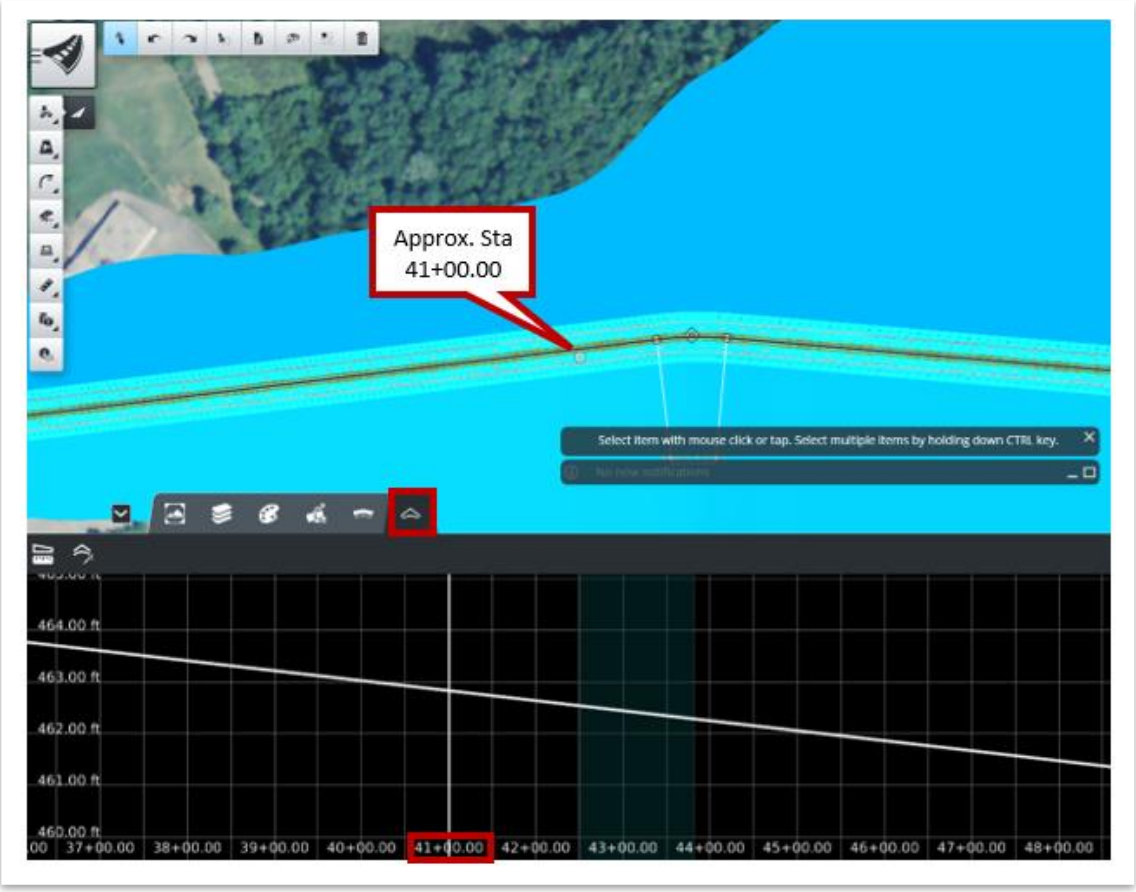
2. Next, we will create the **Charlotte Pike** (S.R. 24/U.S. 70) alignment between **Wheatfield Way** and **Annex Ave**. Open the **Road** tool (**Backstage >> Conceptualize >> Road Placement**) and select the following settings.
    a. **Road Class:** Urban Collector
    b. **Road Template:** TS-6 (4LN)_Charlotte Pike (select from **Favorites** for quicker navigation)
    c. **Name:** Charlotte Pike
    d. **Speed:** 45 mi/h
    e. **Profile:** Straight
    f. **Input:** Polar
    g. **Use Spirals:** Toggle off



3. Notice the prompt: **Enter first PI**. **Left** click to set the point at **Wheatfield Way**, and then **left** click to place additional **PI** points along the existing **Charlotte Pike** (S.R. 24/U.S. 70) alignment until you get to **Annex Ave**. **Right** click to accept placement and then click on the **Elements selection** tool to reset. **Note:** Your roadway geometry does not need to match exactly.

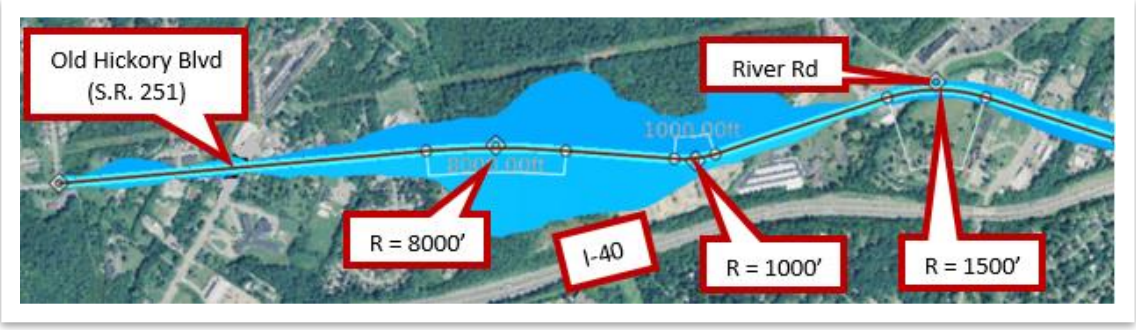


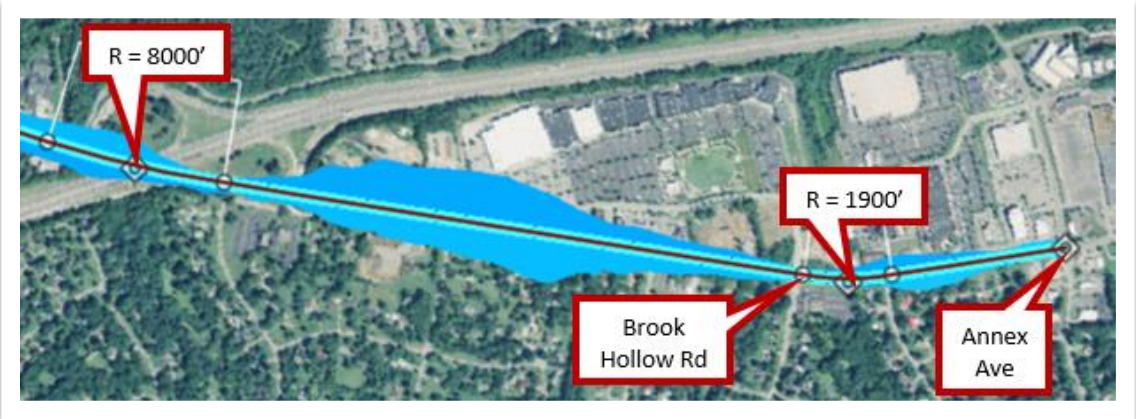
4. Now we will modify the horizontal curves going left to right. First, however, select the alignment and open the **profile view** within the **Action Center** so that you can easily pinpoint the stationing along the alignment. You can then use the white guideline to navigate along the alignment stationing, as shown below.



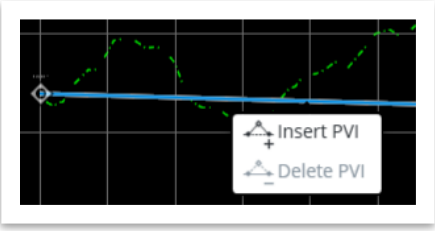
5. To **Insert** (or Delete) a **PI**, select the corridor and then **right** click on the alignment. To edit the radii, you can adjust via the manipulators or key-in a specific radius. Go ahead and update the alignment based on the table below. The images below the table provide a visual for the overall radii updates.

PI Approximate Station	Radius
41+00.00	8000’
60+00.00	1000’
84+00.00	1500’
107+00.00	8000’
155+00.00	1900’



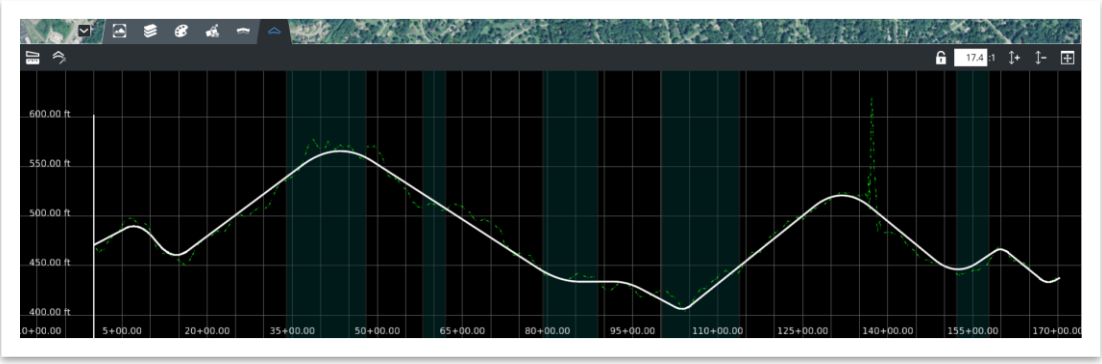


6. Next, we will edit the **Charlotte Pike** (S.R. 24/U.S. 70) vertical alignment (profile) to approximately follow the existing ground. Since we placed the road using the **Straight** profile method, **right** click on the profile and **Insert** the **PVI's** based on the table below. Drag the PVI manipulator either up or down to meet the existing ground at the defined PVI station, and then modify the curve lengths based on the table below. **Note:** Your profile may vary, but the goal is to match the existing ground as closely as possible.

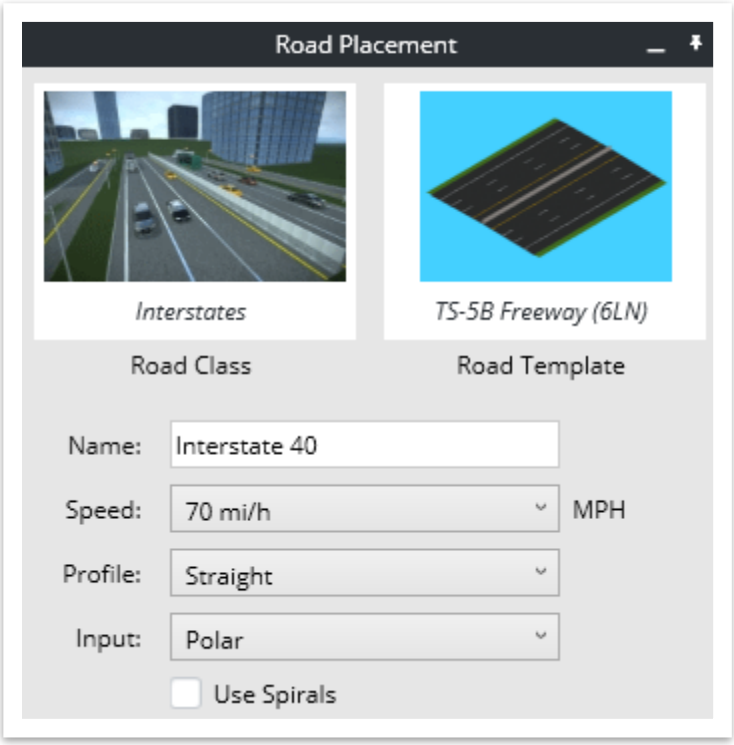


PVI Approximate Station	Curve Length
8+00.00	500'
14+00.00	500'
43+00.00	1250'
82+00.00	750'
94+00.00	500'
104+00.00	250'
132+00.00	1000'
152+00.00	750'
160+00.00	250'
168+00.00	250'

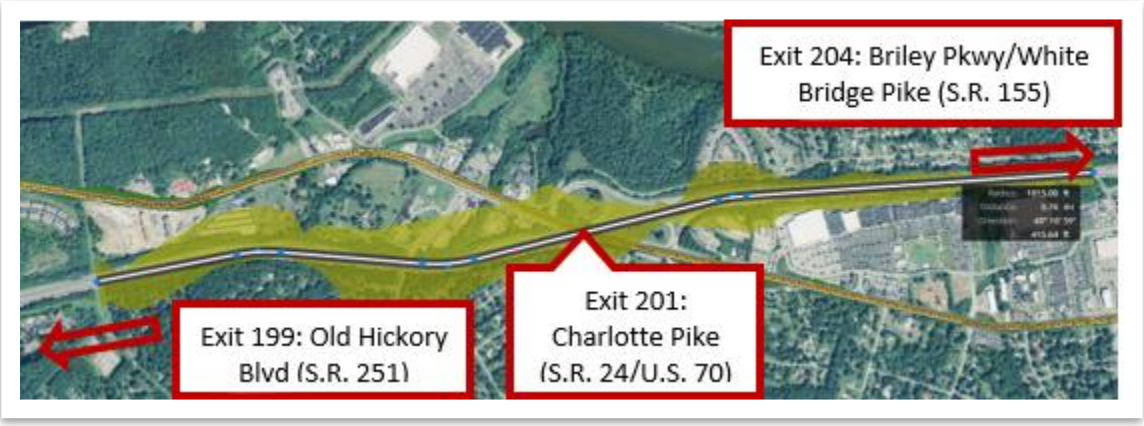
7. Once you've added the PVI points and adjusted the vertical curve lengths, your **Charlotte Pike** (S.R. 24/U.S. 70) profile should look similar to what's shown below.



8. Next, we will create the **Interstate 40** alignment. Open the **Road** tool (**Backstage >> Conceptualize >> Road Placement**) and select the following settings.
   a. **Road Class:** Interstates
   b. **Road Template:** TS-5B Freeway (6LN) (select from **Favorites** for quicker navigation)
   c. **Name:** Interstate 40
   d. **Speed:** 70 mi/h
   e. **Profile:** Straight
   f. **Input:** Polar
   g. **Use Spirals:** Toggle off

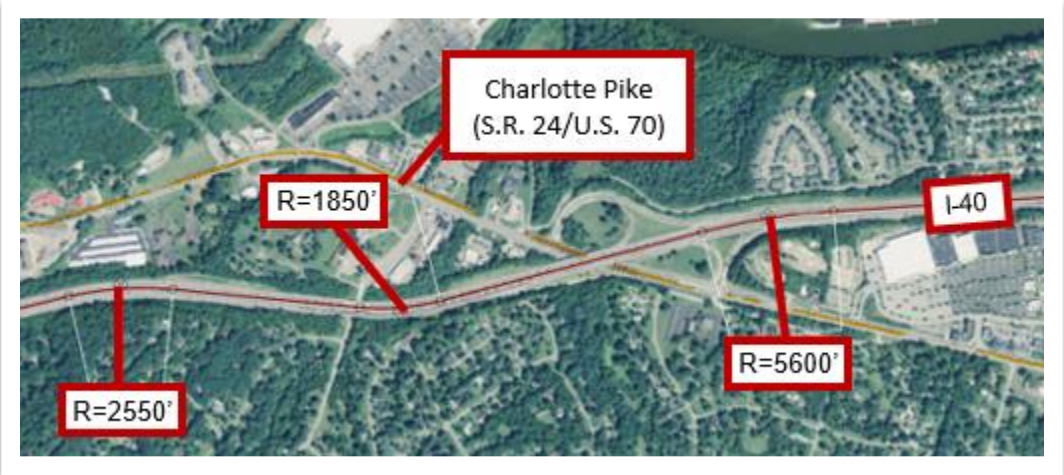


9. Notice the prompt: **Enter first PI**. **Left** click to set the **beginning** point between **Exit 199 – Old Hickory Blvd** (S.R. 251) and **Exit 201 – Charlotte Pike** (S.R. 24/U.S. 70). Then, **left** click to place additional **PI** points along the existing **I-40** (yellow highlighted path) until you get between **Exit 201 – Charlotte Pike** (S.R. 24/U.S. 70) and **Exit 204 – Briley Parkway/White Bridge Pike** (S.R. 155). **Right** click to accept placement and then click on the **Elements selection** tool to reset. **Note:** Your roadway geometry does not need to match exactly.

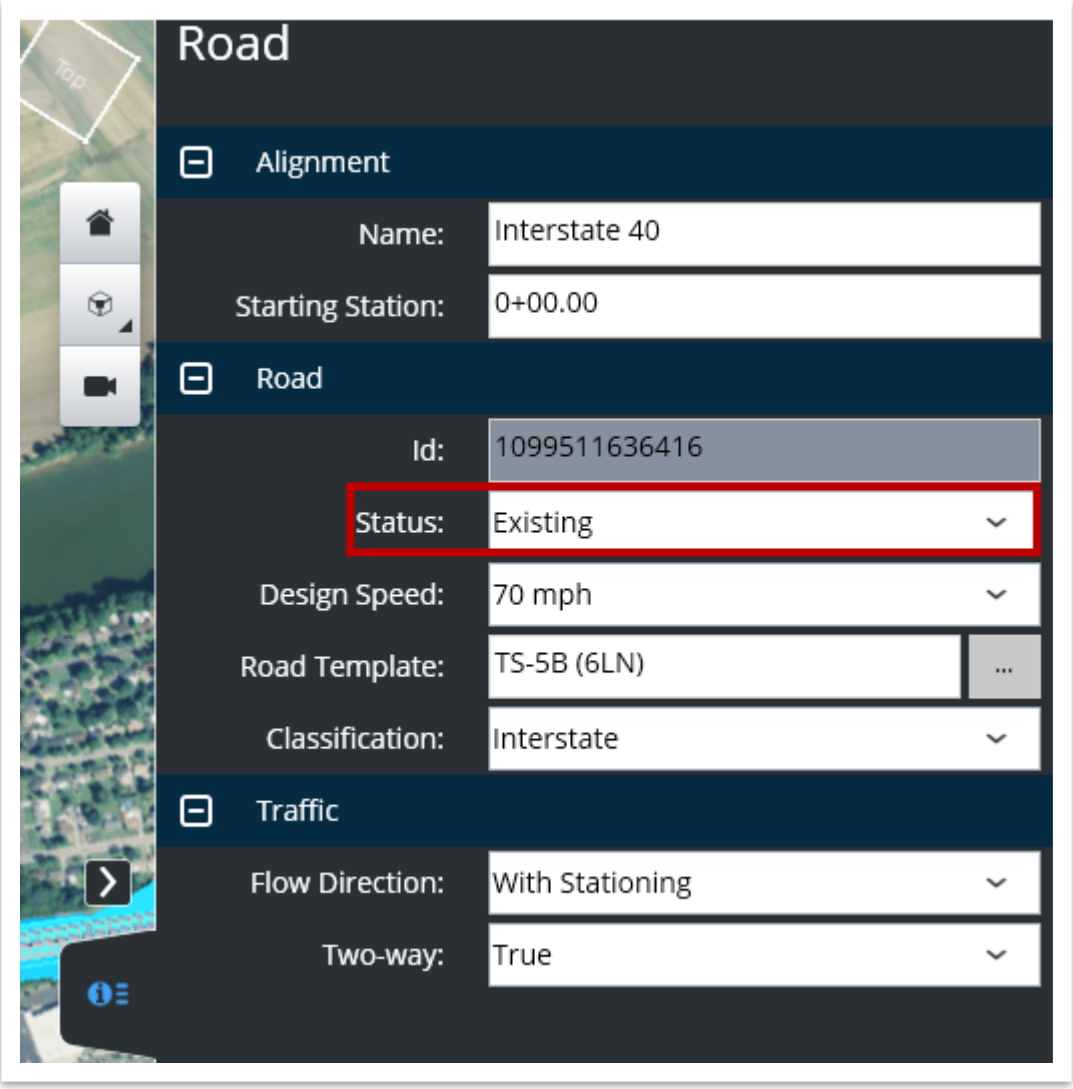


10. Go ahead and modify the horizontal curve radii based on the table below. The image provides a visual for the overall radii updates. **Note:** As a reminder, you can navigate the stationing in the alignment profile view within the **Action Center**.

PI Approximate Station	Radius
18+00.00	2550’
39+00.00	1850’
71+00.00	5600’

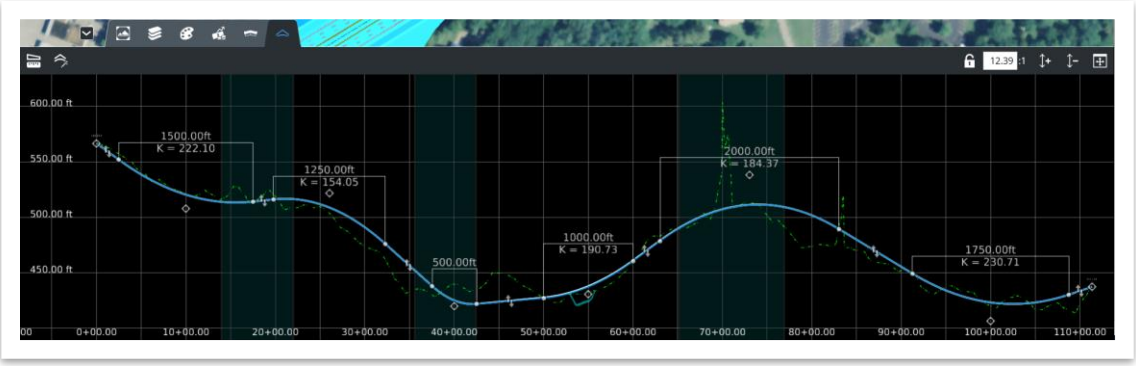


11. With the **I-40** alignment still selected, open the **Information** tab on the right side of the window and update the **Status** to **Existing**. This update will omit **I-40** in the overall quantities calculation, which will be run in Exercise 11.3.1.



12. Now we will edit the **I-40** vertical alignment (profile) to approximately follow the existing ground. Select the alignment and open the **profile view** within the **Action Center**. **Insert** the **PVI's** and then modify the curve lengths based on the table below. **Note:** As a reminder, your profile may vary, but the goal is to match the existing ground as closely as possible.

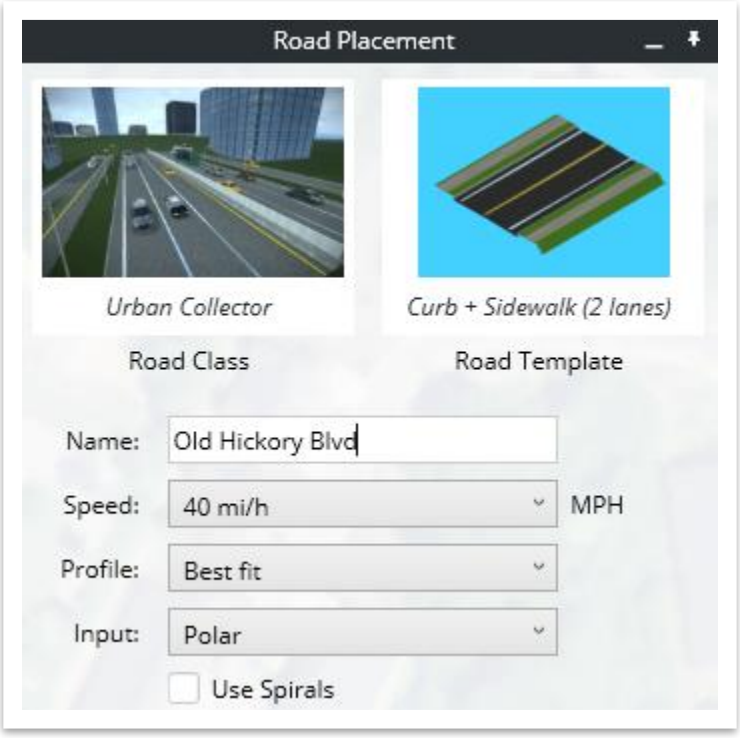
PVI Approximate Station	Curve Length
10+00.00	1500'
26+00.00	1250'
40+00.00	500'
55+00.00	1000'
73+00.00	2000'
100+00.00	1750'



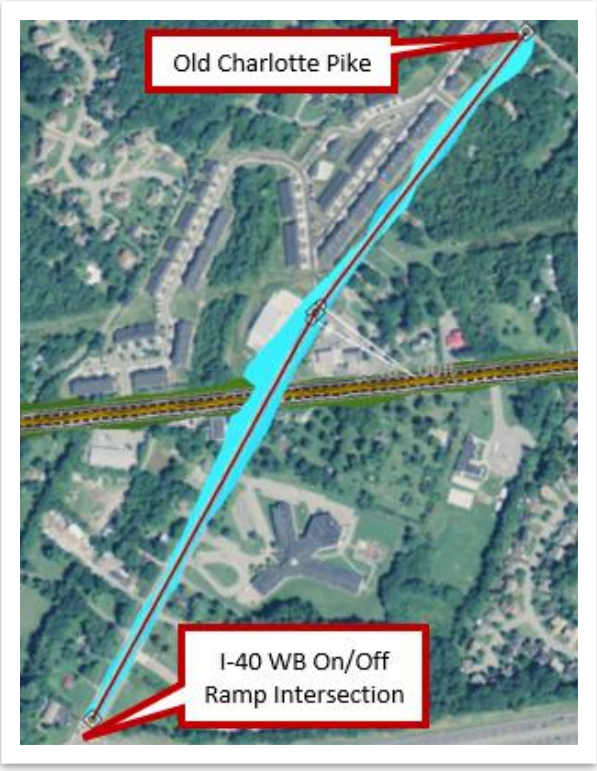
13. Once you have completed the **I-40** profile, zoom out to view the model.

14. Next, we will create the **Old Hickory Blvd** (S.R. 251) alignment. Zoom in towards the beginning of **Charlotte Pike** (S.R. 24/U.S. 70) on the west side of the corridor.

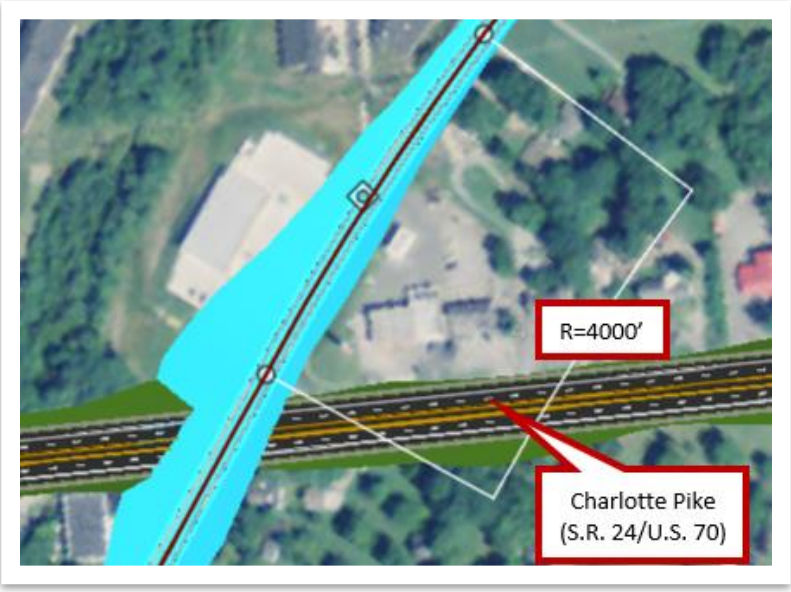
15. Open the **Road** tool (**Backstage >> Conceptualize >> Road Placement**) and select the following settings.
    a. **Road Class:** Urban Collector
    b. **Road Template:** Curb + Sidewalk (2 lanes) (select from **Favorites** for quicker navigation)
    c. **Name:** Old Hickory Blvd
    d. **Speed:** 40 mi/h
    e. **Profile:** Best fit
    f. **Input:** Polar
    g. **Use Spirals:** Toggle off



16. Notice the prompt: **Enter first PI**. **Left** click to set the point at **Old Charlotte Pike** and then **left** click to place additional **PI** points along the existing **Old Hickory Blvd** (S.R. 251) alignment until you get to the intersection of the **I-40** WB on/off ramps. **Right** click to accept placement and then click on the **Elements selection** tool to reset. **Note:** Your roadway geometry does not need to match exactly.

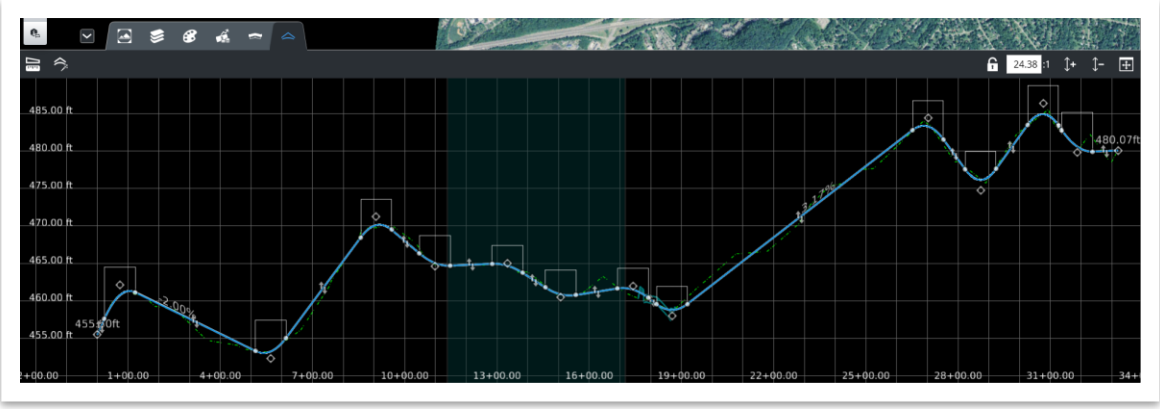


17. Now modify the horizontal curve just north of the **Charlotte Pike** (S.R. 24/U.S. 70) intersection to have a **4000'** radius.

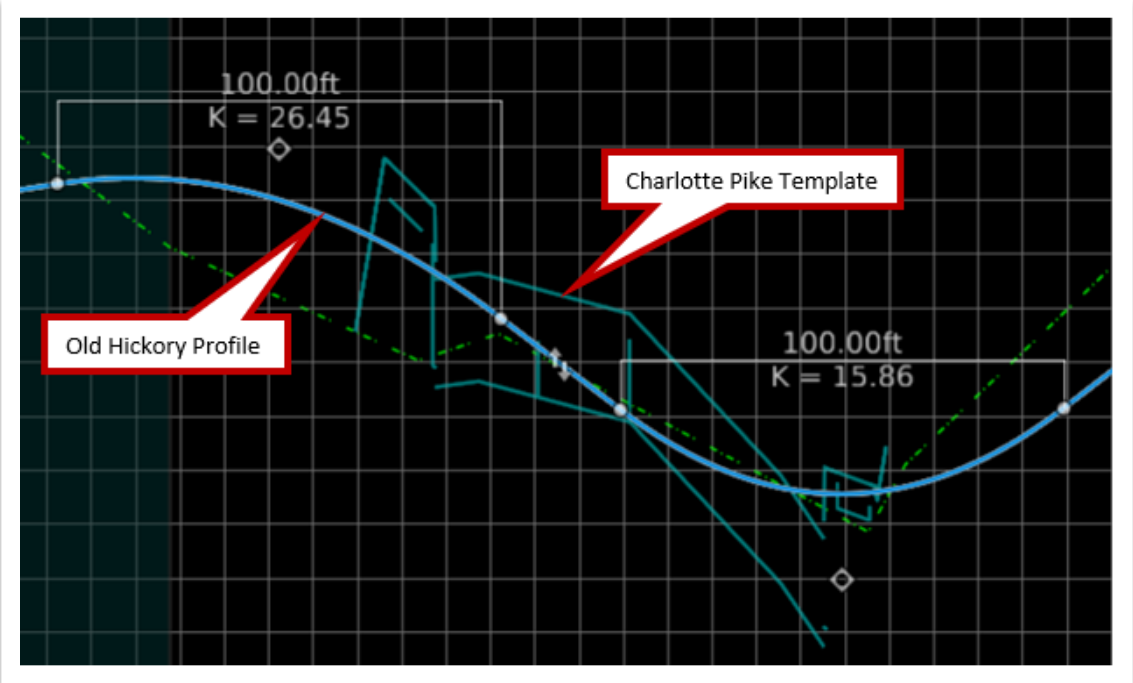


18. Lastly, we will edit the **Old Hickory Blvd** (S.R. 251) vertical alignment (profile) to approximately follow the existing ground. Select the alignment and open the **profile view** within the **Action Center**. Insert/modify the **PVI's** and then modify the curve lengths based on the table below. **Note:** As a reminder, your profile may vary, but the goal is to match the existing ground as closely as possible.

PVI Approximate Station	Curve Length
0+75.00	100'
5+50.00	100'
9+00.00	100'
11+00.00	100'
13+25.00	100'
15+00.00	100
17+50.00	100'
18+75.00	100'
27+00.00	100'
29+00.00	100'
30+75.00	100'
32+00.00	100'



19. Notice that the **Charlotte Pike** (S.R. 24/U.S. 70) template is displayed on the **Old Hickory Blvd** (S.R. 251) profile where the two alignments cross (approximately between Station **17+00.00** and **20+00.00**). Since we will be placing an intersection at this location later in the manual, make sure that the **Old Hickory Blvd** (S.R. 251) profile is at roughly the same elevation as the **Charlotte Pike** (S.R. 24/U.S. 70) template at the crossing location so that the intersection will form correctly.



7.4 Lecture: Road Template Tool

The **Road Template** tool is found within the **Road Placement** tools (Figure 51). It allows the user to modify the template of a road section (Figure 52) and applies a template transition between the main template and the additional road section.

FIGURE 51. ROAD TEMPLATE TOOL

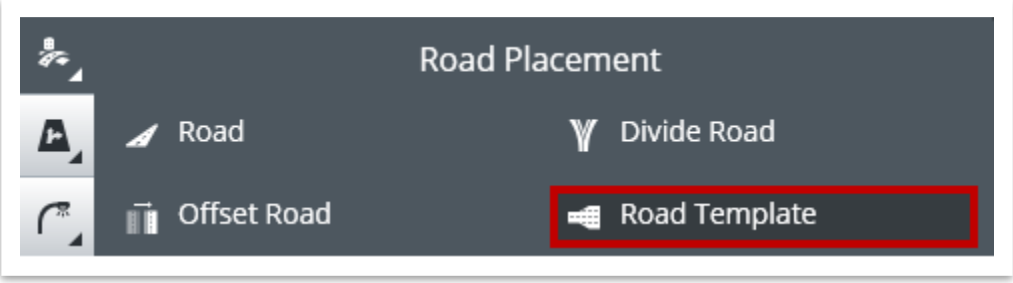


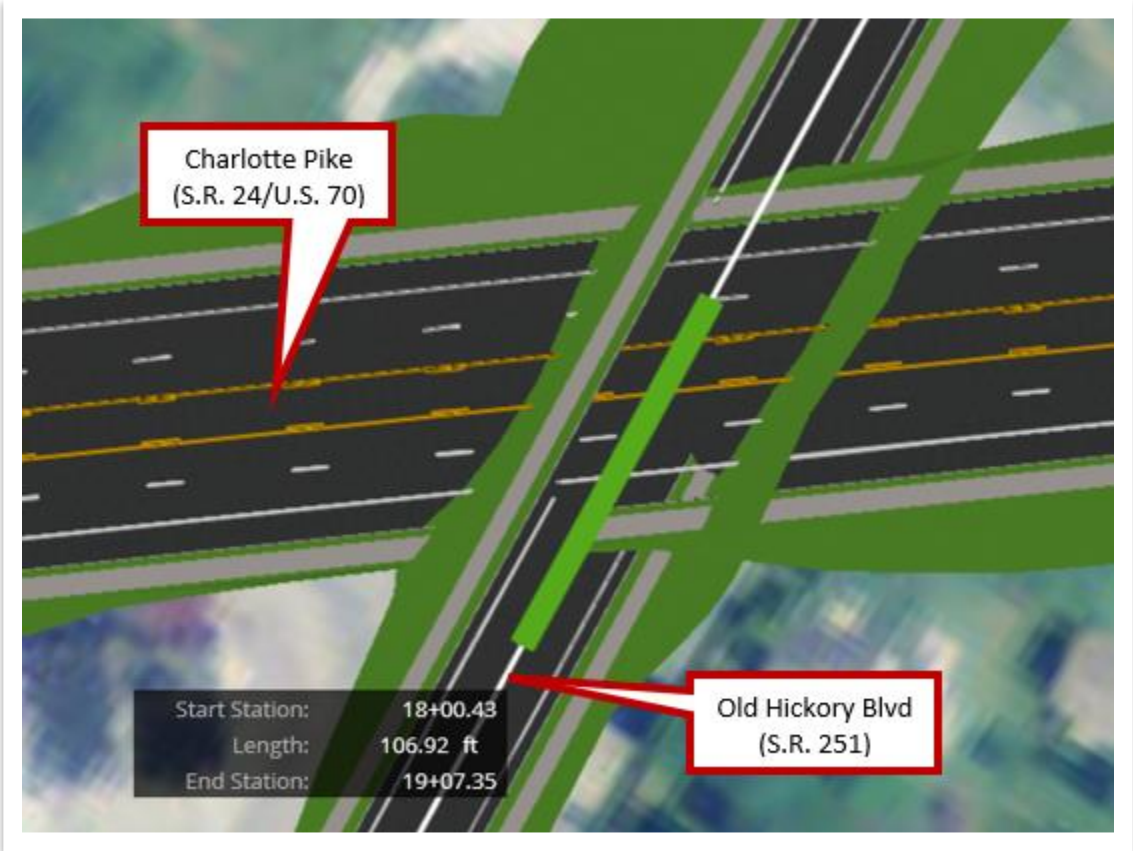
FIGURE 52. MODIFY ROAD TEMPLATE

Once the roadway has been modified with an additional template drop, the user can edit the **transition length** with the manipulator arrows. To add or subtract lanes from the inside with the roadway striping, the user can left click twice using the **Elements selection** tool and then left click the center transition.

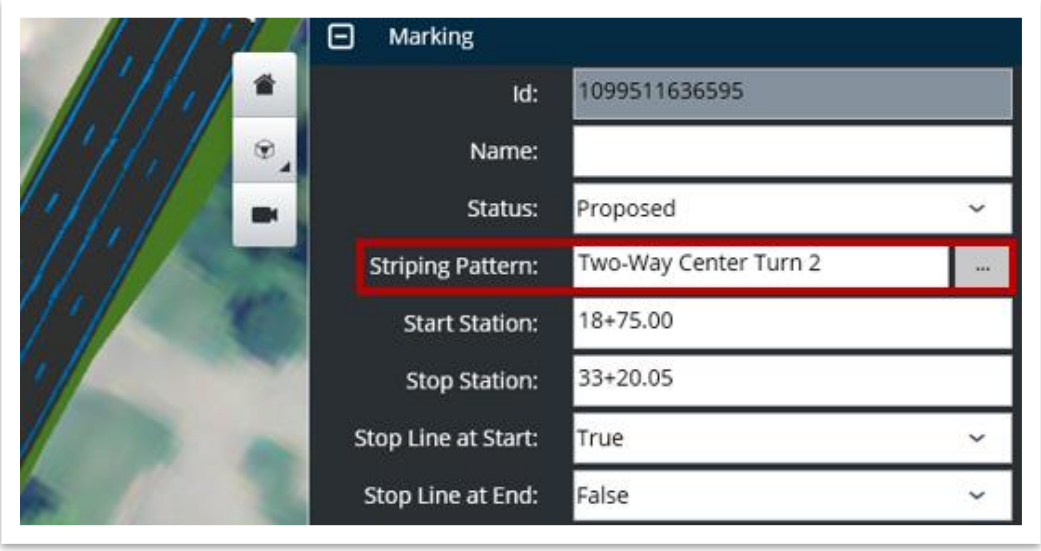
7.4.1 Exercise: Modify Road Template

In this exercise, we will modify a portion of the **Charlotte Pike** (S.R. 24/U.S. 70) and **Old Hickory Blvd** (S.R. 251) roadway templates.

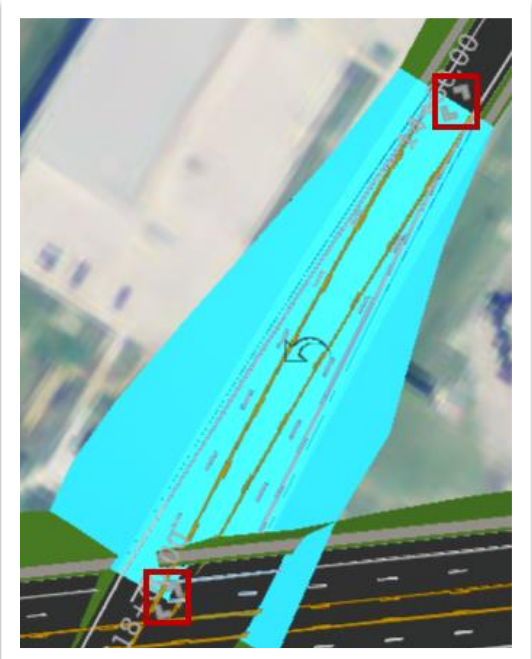
1. First, we will modify a portion of **Old Hickory Blvd** (S.R. 251). Open the **Road Template** tool (**Backstage >> Conceptualize >> Road Placement**) and select **5 Lanes Center Turn** (select from **Favorites** for quicker navigation).
2. Notice the prompt: **Enter first point**. **Left** click on the **Old Hickory Blvd** (S.R. 251) alignment near the intersection of **Old Hickory Blvd** (S.R. 251) and **Charlotte Pike** (S.R. 24/U.S. 70) to set the point.



3. Notice the next prompt: **Enter second point**. Drag your mouse to the end of the **Old Hickory Blvd** (S.R. 251) alignment just north of the intersection of the **I-40** WB on/off ramps, and then **left** click to set the point. Then, click on the **Elements selection** tool to reset.
4. Next, select the pavement striping within this segment and open the **Information tab**. Update the **Striping Pattern** to **Two-Way Center Turn 2**.



5. Zoom back into the intersection and **left** click twice on the **transition**. Notice the manipulator arrows now appear (highlighted in red) allowing you to shift the transition. **Note:** The double solid yellow line (**DSYL**) has disappeared on the 2-lane segment of **Old Hickory Blvd** (S.R. 251), but we will modify the striping in Exercise 9.3.1.1.

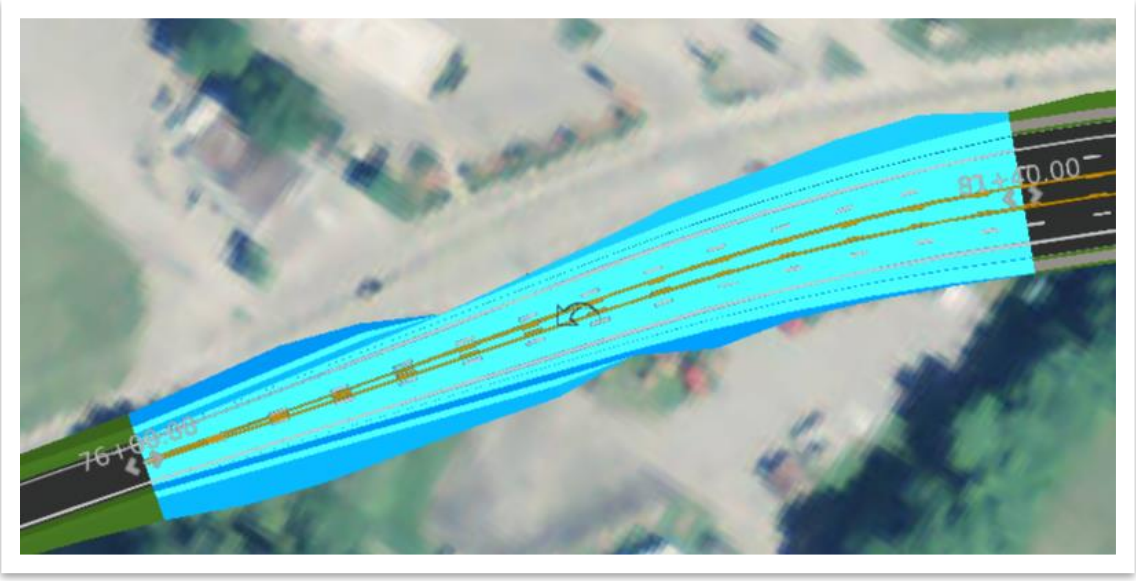


6. Click the lower manipulator arrows at the bottom and **lengthen** the transition to be below the intersection. The stationing can be approximate (Station **20+03.94** in the screenshot) since we will edit these transitions later in the manual. **Left** click on the curved arrow to **reverse** the direction of the lane transition markings so that the striping tapers off the **centerline** instead of the pavement edges.

7. Now we will modify the beginning of **Charlotte Pike** (S.R. 24/U.S. 70). Open the **Road Template** tool (**Backstage >> Conceptualize >> Road Placement**) and select **TS-1 Low-Volume Road (2LN)** (select from **Favorites** for quicker navigation).

8. Notice the prompt: **Enter first point**. **Left** click on the **Charlotte Pike** (S.R. 24/U.S. 70) alignment at the **Wheatfield Way** intersection to set the point. Notice the next prompt: **Enter second point**. Drag your mouse along the **Charlotte Pike** (S.R. 24/U.S. 70) alignment until the developments just before the **River Road** intersection (approximate Station **76+00.00**), and then **left** click to set the point. Then, click on the **Elements selection** tool to reset. **Note:** The DSYL will most likely disappear, but we will modify the striping in Exercise 9.3.1.1.

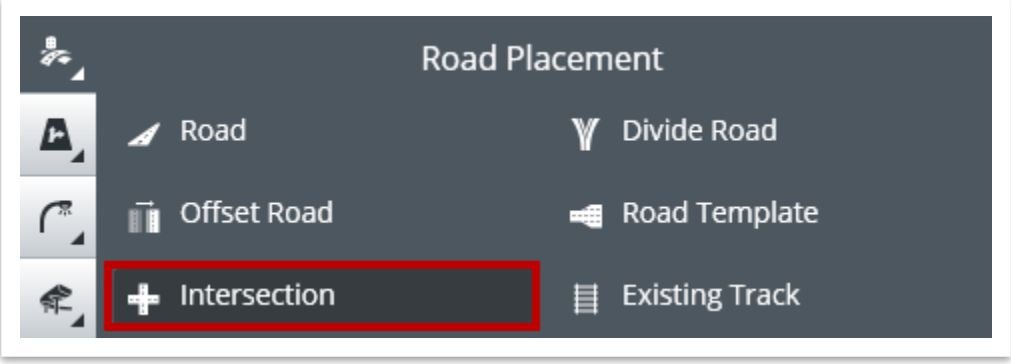
9. Lastly, **left** click twice on the **transition** just before the **River Road** intersection. **Left** click on the curved arrow to **reverse** the direction of the lane transition markings so that the striping tapers off the **centerline** instead of the pavement edges.



7.5 Lecture: Intersection Tool

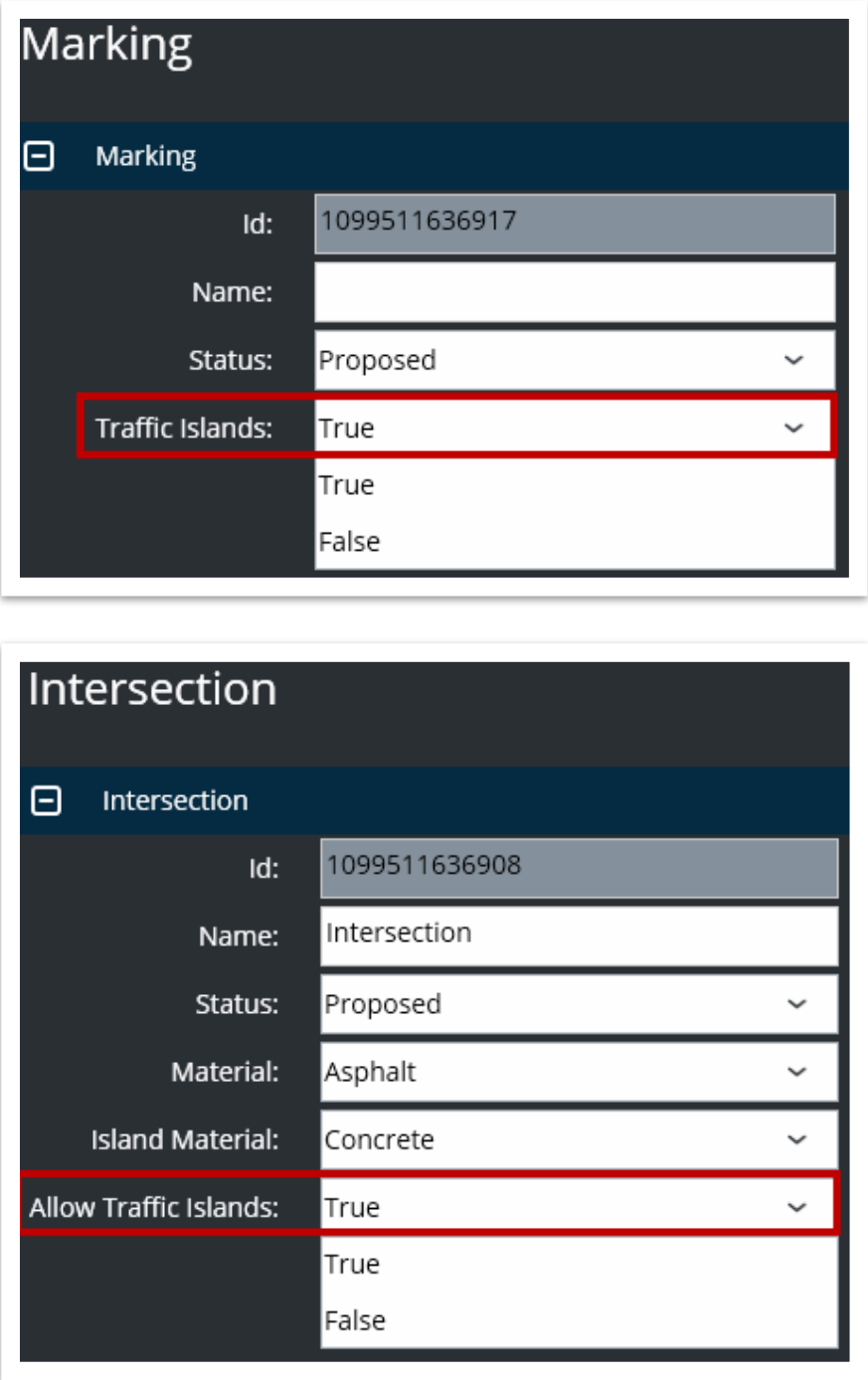
The **Intersection** tool is found within the **Road Placement** tools (Figure 53). It allows the user to build an intersection with two or more crossing roads (or a T). When placing an intersection, the two horizontal alignments need to cross each other, and the vertical profiles should be at roughly the same elevation at the crossing location. Once an intersection is placed, the user can update each **leg template** and modify the turning radius.

FIGURE 53. PLACE INTERSECTION TOOL



The **Information** tab provides enhanced customization capabilities for intersections including the ability to turn **Traffic Islands** (and **Traffic Island Striping**) on/off using **True/False** toggles (Figure 54). **Note:** An intersection or intersection striping must be created or applied in order to make these changes in the **Information** tab.

FIGURE 54. INTERSECTION MARKING MODIFICATION – INFORMATION TAB

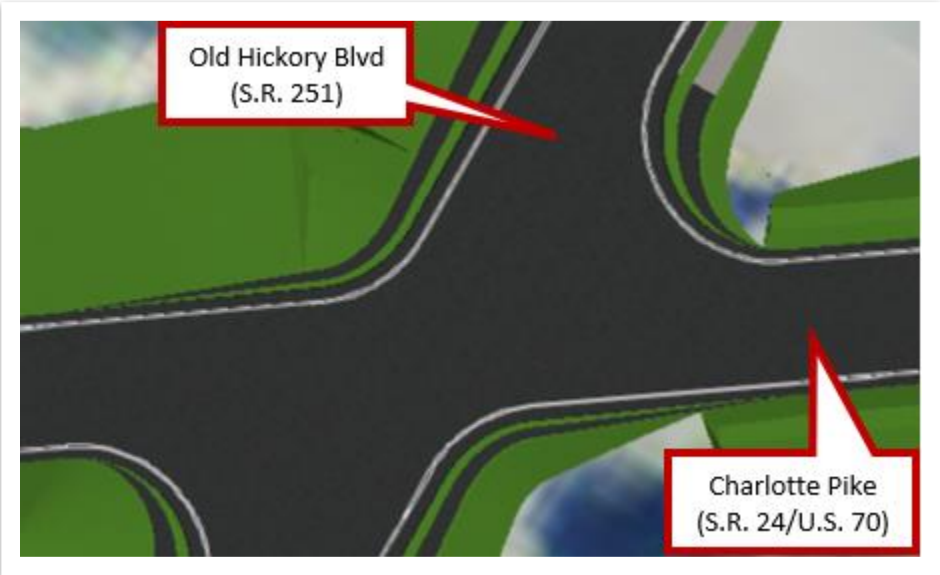


7.5.1 Exercise: Create an Intersection

In this exercise, we will create an intersection at **Charlotte Pike** (S.R. 24/U.S. 70) and **Old Hickory Boulevard** (S.R. 251).

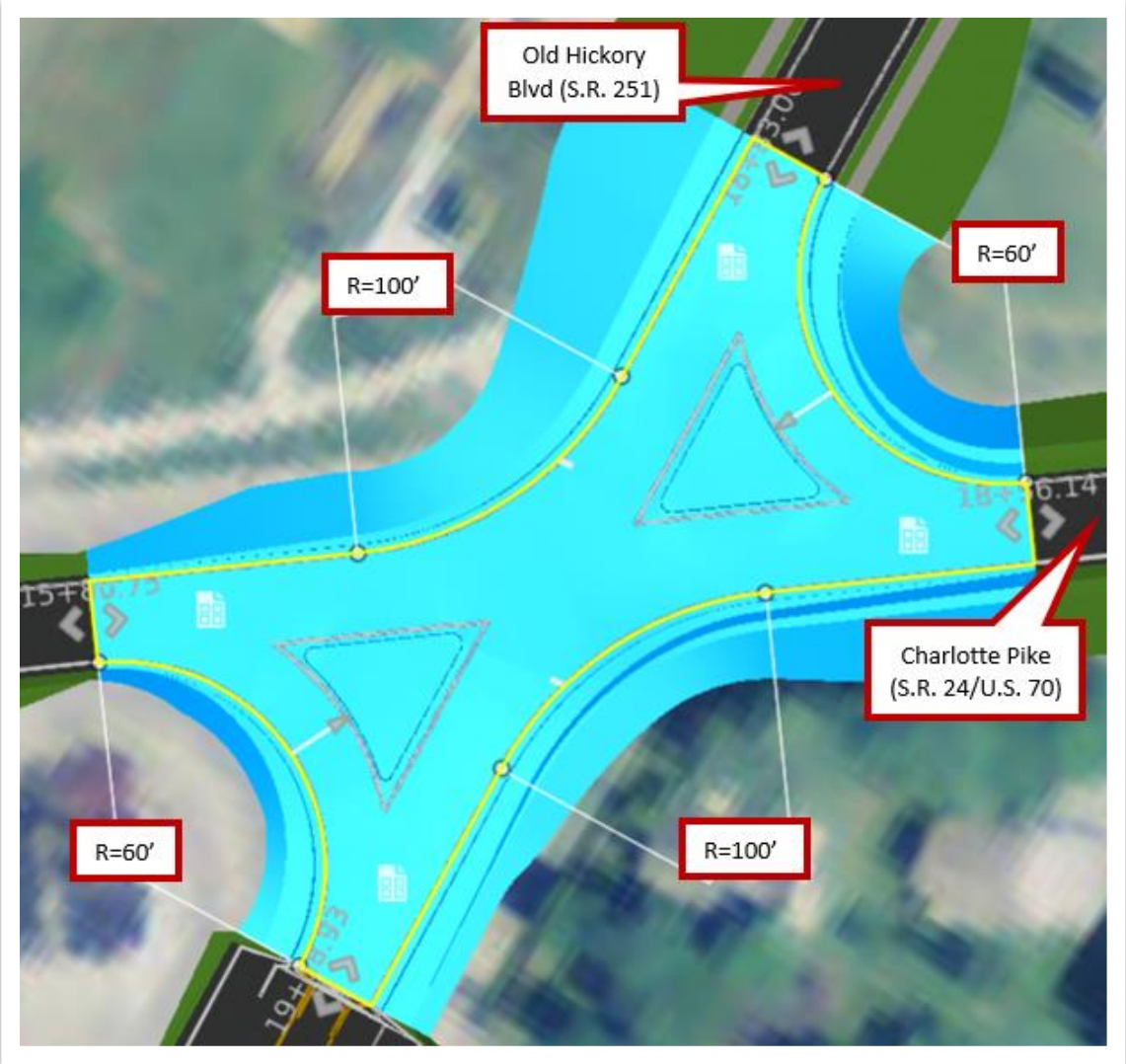
1. To create the intersection, open the **Intersection** tool (**Backstage >> Conceptualize >> Road Placement**). Notice the prompt: **Select primary road**. Select the **Charlotte Pike** (S.R. 24/U.S. 70) alignment. Notice the second prompt: **Select secondary road**. Select the **Old Hickory Boulevard** (S.R. 251) alignment. There should be a green outline of the intersection, which indicates the extent.

2. Notice the next prompt: **Select next secondary road or right click to accept**. **Right** click to accept and the intersection should be created. Then, click on the **Elements selection** tool to reset.

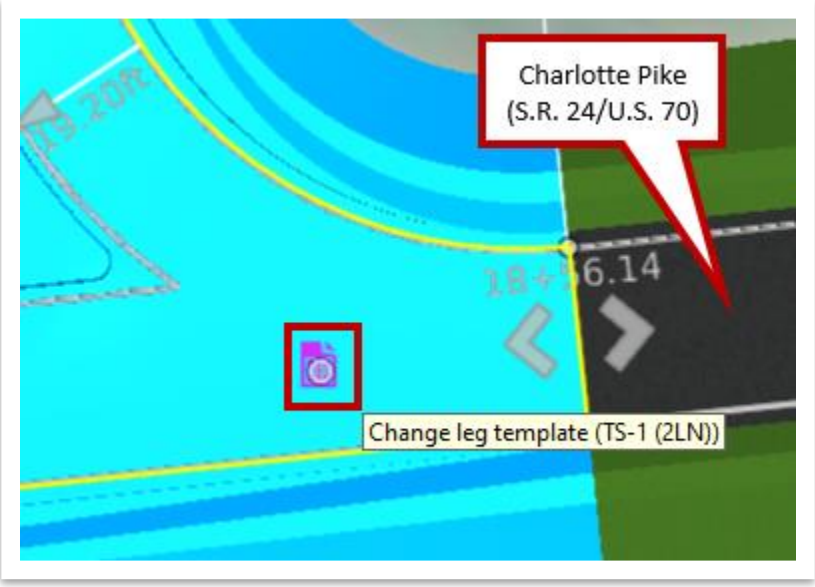


3. Next, **left** click on the intersection and edit the **curb return** radii based on the table below. The image provides a visual for the overall radii updates.

Curb Return Location	Radius
NE	60’
SE	100’
SW	60’
NW	100’

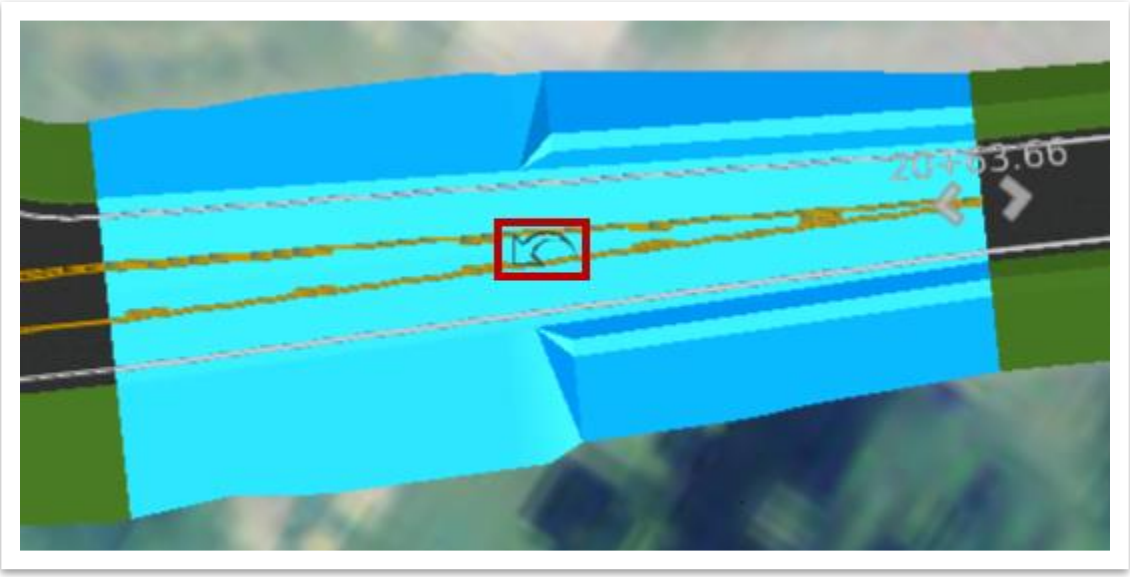


4. Now we will edit the leg template on all four legs. For the **East** leg along **Charlotte Pike** (S.R. 24/U.S. 70), **left** click the **Change leg template (TS-1 (2LN))** icon and select **3 Lanes Center Turn** (select from **Favorites** for quicker navigation).

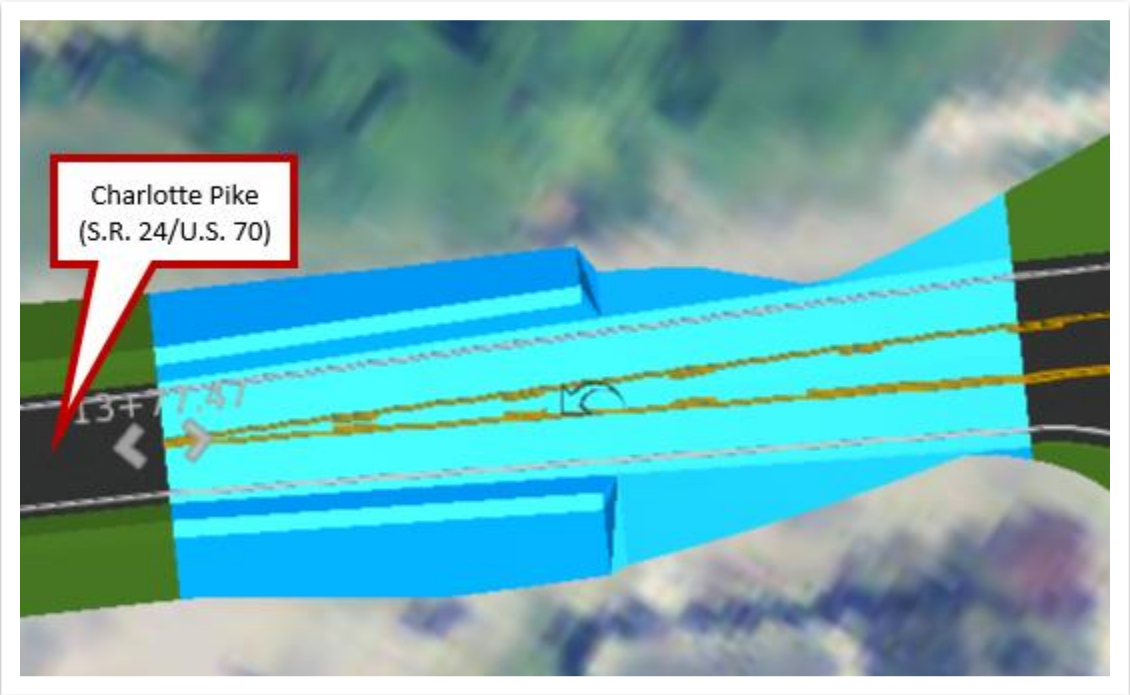


5. Next, we will **lengthen** the transition length. **Left** click on the small **transition** and use the manipulator arrows to drag the length an additonal **200** feet. **Note:** It may be necessary to **left** click on the lane twice to display the manipulator arrows. You may get a **Click again to show other controls** prompt after the first click.

6. Now let's **left** click on the curved arrow to **reverse** the direction of the lane transition markings so that the turn lane now widens from the **centerline** instead of the edge of traveled way.



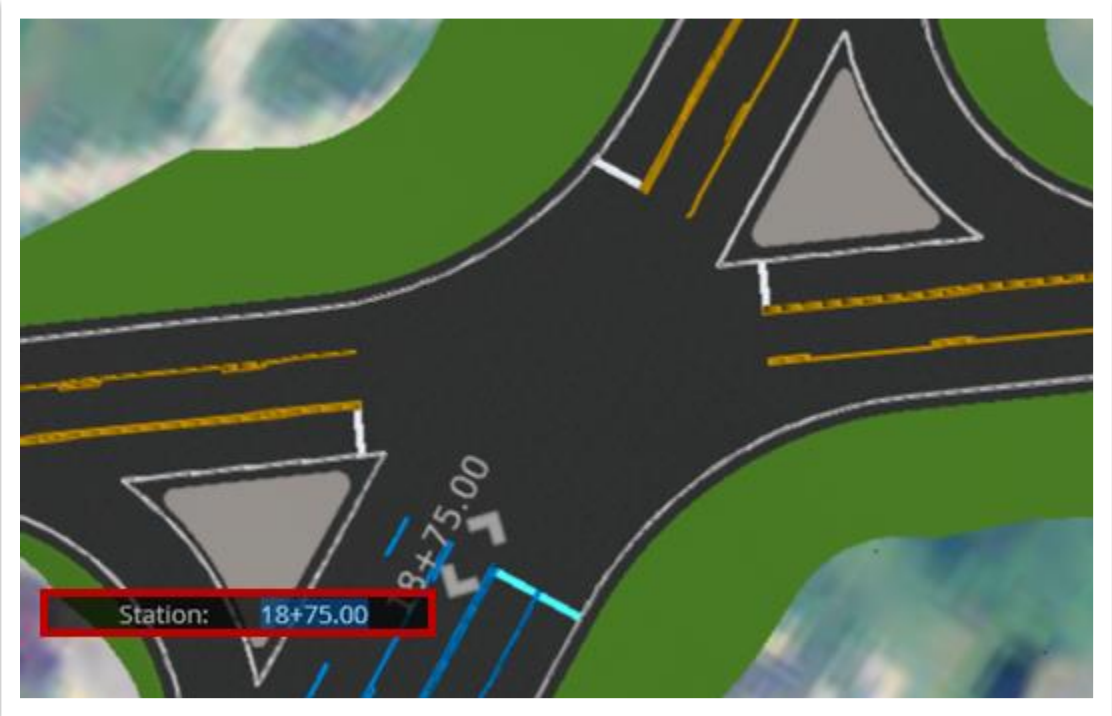
7. Repeat Steps 4-6 for the **West** leg along **Charlotte Pike** (S.R. 24/U.S. 70).



8. Next, let's edit the **North** leg along **Old Hickory Boulevard** (S.R. 251). **Left** click the **Change leg template (TS-1 Low-Volume Road (2LN))** icon and select **3 Lanes Center Turn** (select from **Favorites** for quicker navigation).

9. Now let's edit the **South** leg along **Old Hickory Boulevard** (S.R. 251). **Left** click the **Change leg template (TS-1 Low-Volume Road (2LN))** icon and select **5 Lanes Center Turn** (select from **Favorites** for quicker navigation).

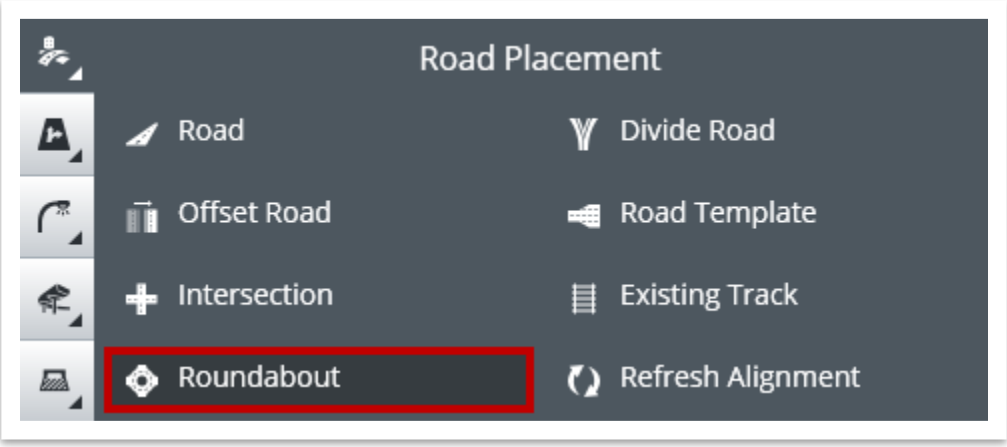
10. Lastly, we will adjust the **stop bars** on all four legs. For each leg, **left** click on the pavement markings and drag the manipulator arrows backwards away from the intersection to edit the station where the lane markings start and stop.



7.6 Lecture: Roundabout Tool

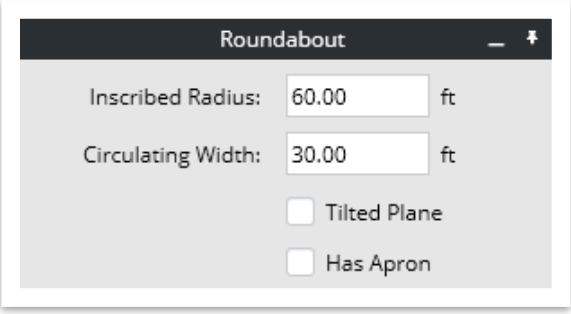
The **Roundabout** tool is found within the **Road Placement** tools (Figure 55). It allows the user to create a roundabout using two or more road alignments. Like the **Intersection** tool, the horizontal alignments need to cross each other, and the vertical profiles should be at roughly the same elevation at the crossing location.

FIGURE 55. ROUNDABOUT TOOL



Within the dialog box, the user can define the **Inscribed Radius**, **Circulating Width**, and whether the roundabout will have a **Tilted Plane** and/or an **Apron** (Figure 56).

FIGURE 56. ROUNDABOUT DIALOG BOX



- **Inscribed Radius:** Refers to the radius from the center of the roundabout to the outside edge of the drivable surface.
- **Circulating Width:** Refers to the drivable surface width or roadway width.
- **Tilted Plane:** Forces the central island to have a single high and low point on the roundabout profile.
- **Has Apron:** Places a traversable but raised paver strip inside the circulating width.

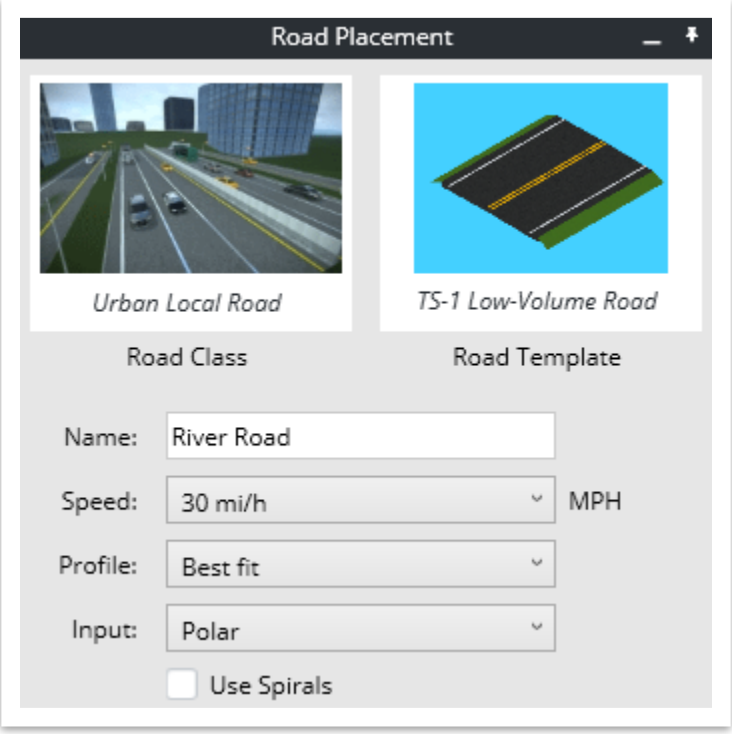
Once the roundabout is placed, the user can modify the properties of the **Central Island** and **Island Apron** in the **Information** tab. Like **Intersections**, the user can also manipulate the **Traffic Islands** (and **Traffic Island Striping**) on the leg templates.

7.6.1 Exercise: Create a Roundabout

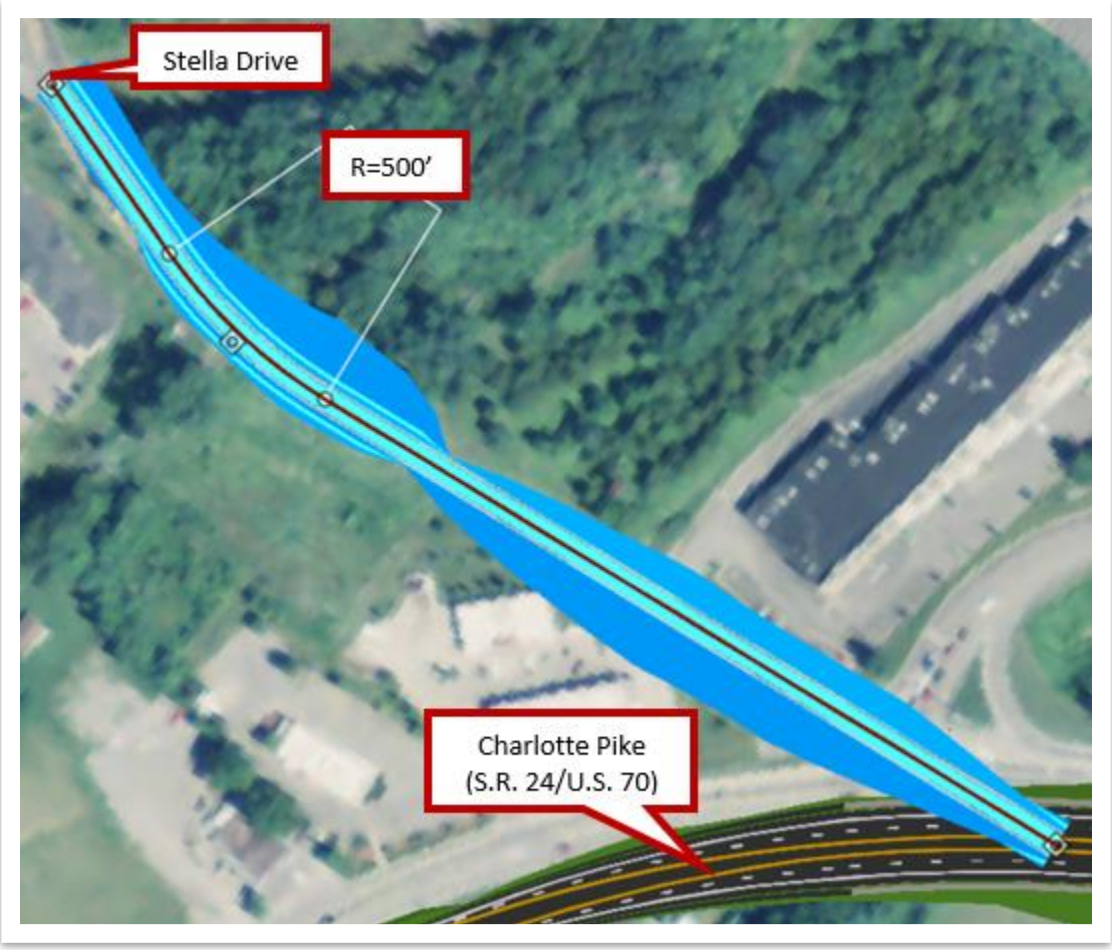
In this exercise, we will create a roundabout at the **Charlotte Pike** (S.R. 24/U.S. 70), **River Road** and **Walmart** shopping center intersection.

1. Zoom in to the **Charlotte Pike** (S.R. 24/U.S. 70), **River Road** and **Walmart** shopping center intersection. As a reminder, in Exercise 7.4.1, we modified the road template, which created a transition just before this intersection. Since the transition is in the middle of the intersection, go ahead and move it back using the manipulator arrows.

2. Next, we will create the **River Road** alignment. Open the **Road** tool (**Backstage >> Conceptualize >> Road Placement**) and select the following settings.
    a. **Road Class:** Urban Local Road
    b. **Road Template:** TS-1 Low-Volume Road (2LN) (select from **Favorites** for quicker navigation)
    c. **Name:** River Road
    d. **Speed:** 30 mi/h
    e. **Profile:** Best fit
    f. **Use Spirals:** Toggle off



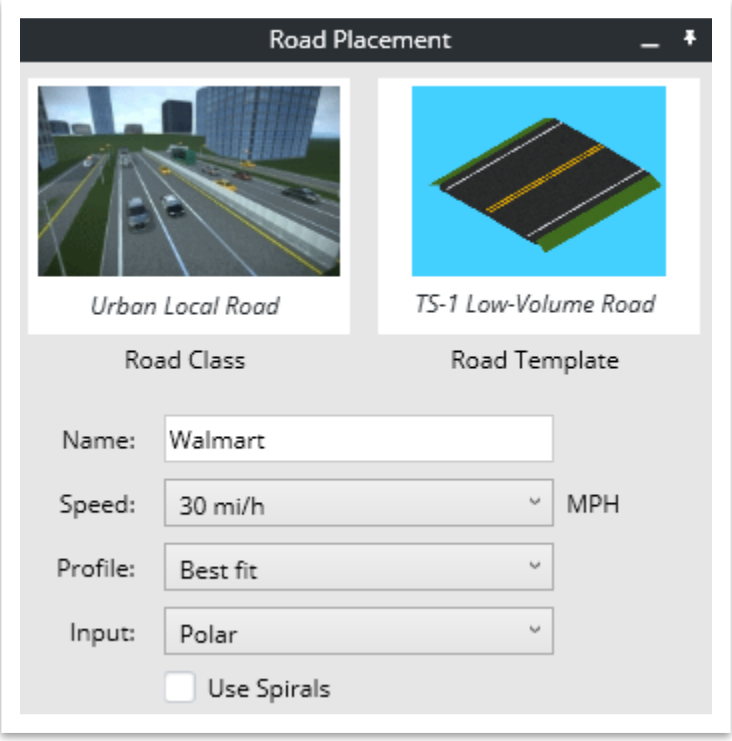
3. Notice the prompt: **Enter first PI**. **Left** click to set the beginning point at the **Stella Drive** intersection, and then **left** click to place additional **PI** points along the existing **River Road** alignment until you get to **Charlotte Pike** (S.R. 24/U.S. 70). **Right** click to accept placement and then click on the **Elements selection** tool to reset. Use a **500** ft radius at approximate Station **3+00.00**. **Note:** Make sure the **River Road** alignment crosses into **Charlotte Pike** (S.R. 24/U.S. 70). **Note:** As a reminder, you can navigate the stationing in the alignment profile view within the **Action Center**.



4. Now we will edit the **River Road** vertical alignment (profile) to approximately follow the existing ground. Select the alignment and open the **profile view** within the **Action Center**. Insert/modify the **PVI's** and then modify the curve lengths based on the table below. **Note:** The end of the profile should be on top of the **Charlotte Pike** (S.R. 24/U.S. 70) template. Also, your profile may vary, but the goal is to match the existing ground as closely as possible.

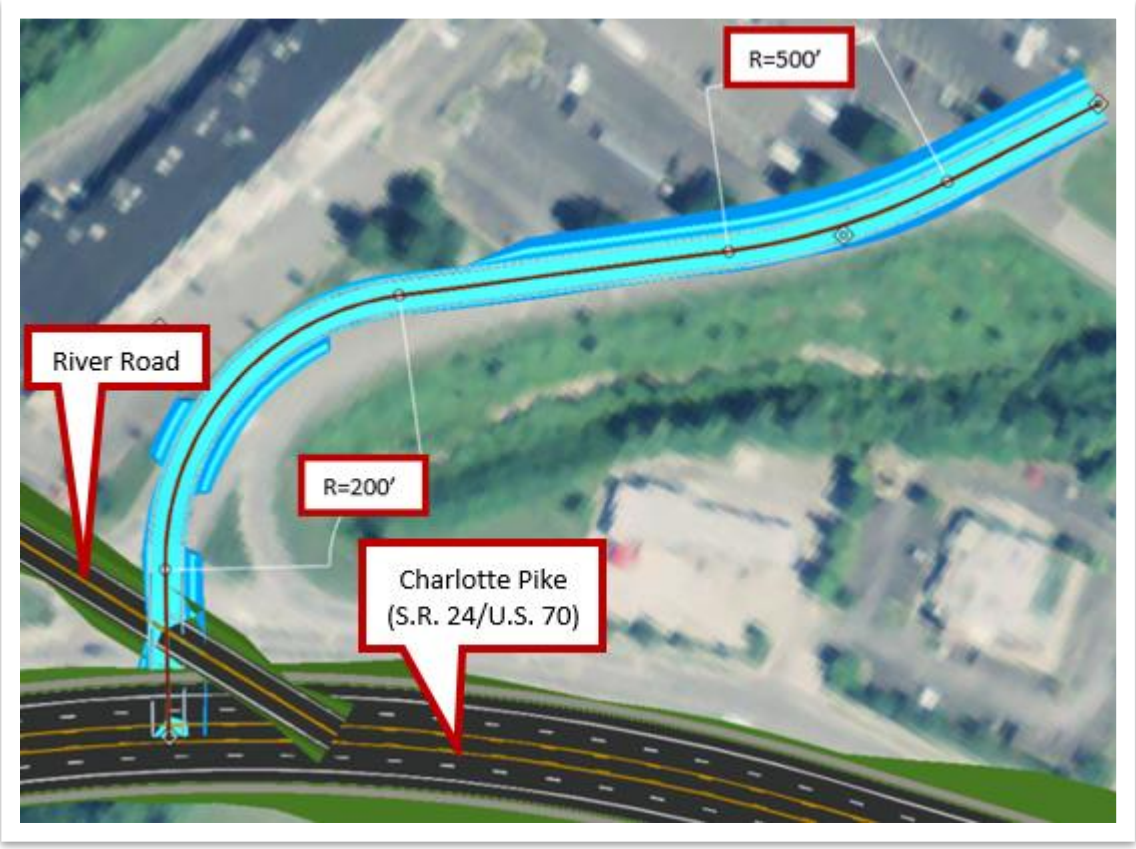
PVI Approximate Station	Curve Length
1+00.00	200'
4+00.00	200'
7+00.00	200'
10+00.00	200'

5. Next, we will create the **Walmart** shopping center road. Open the **Road** tool (**Backstage >> Conceptualize >> Road Placement**) and select the following settings.
    a. **Road Class:** Urban Local Road
    b. **Road Template:** TS-1 Low-Volume Road (2LN) (select from **Favorites** for quicker navigation)
    c. **Name:** Walmart
    d. **Speed:** 30 mi/h
    e. **Profile:** Best fit
    f. **Input:** Polar
    g. **Use Spirals:** Toggle off



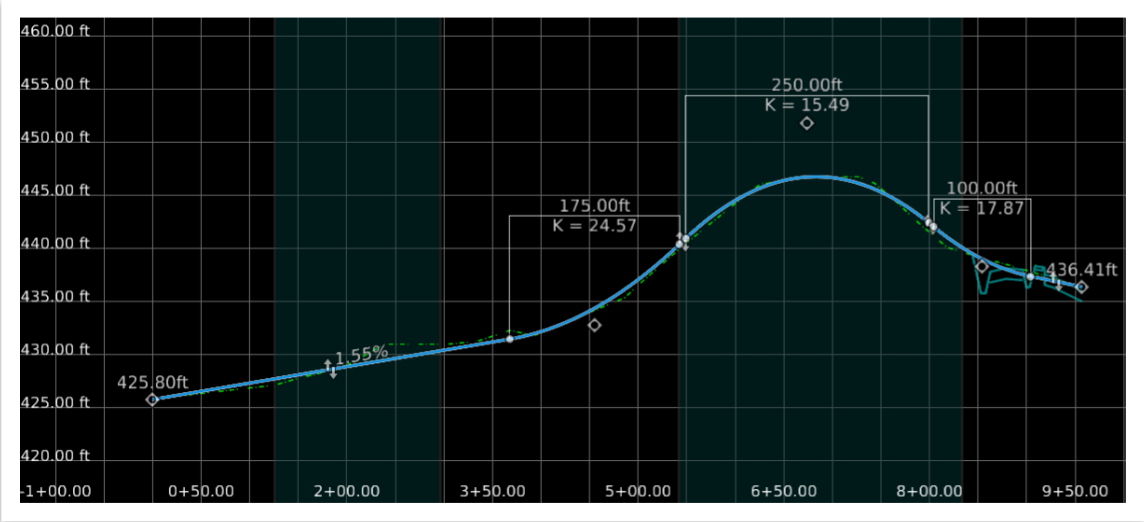
6. Notice the prompt: **Enter first PI**. **Left** click to set the **beginning** point within the **Walmart** parking lot, and then **left** click to place additional **PI** points along the existing **Walmart** road alignment until you get to **Charlotte Pike** (S.R. 24/U.S. 70). **Right** click to accept placement and then click on the **Elements selection** tool to reset. Go ahead and modify the horizontal curve radii based on the table below. The image provides a visual for the overall radii updates. **Note:** Make sure the **Walmart** road alignment crosses into **Charlotte Pike** (S.R. 24/U.S. 70) at a **90-degree** angle. **Note:** As a reminder, you can navigate the stationing in the alignment profile view within the **Action Center**.

PI Approximate Station	Radius
2+00.00	500’
7+00.00	200’



7. Now we will edit the **Walmart** road vertical alignment (profile) to approximately follow the existing ground. Select the alignment and open the **profile view** within the **Action Center**. Insert/modify the **PVI's** and then modify the curve lengths based on the table below. **Note:** The end of the profile should cross **Charlotte Pike** (S.R. 24/U.S. 70). Also, your profile may vary, but the goal is to match the existing ground as closely as possible.

PVI Approximate Station	Curve Length
5+00.00	175'
7+00.00	250'
9+00.00	100'

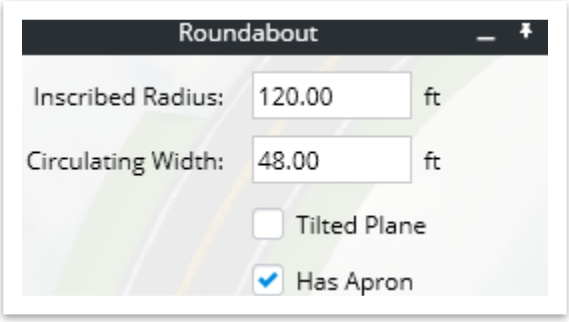


8. Since the **Charlotte Pike** (S.R. 24/U.S. 70) typical section has a turning lane, we need to update to a **4-lane** section. Open the **Road Template** tool (**Backstage >> Conceptualize >> Road Placement**) and select **Curb + Sidewalk (4 lanes)** (select from **Favorites** for quicker navigation).

9. Notice the prompt: **Select alignment**. Select the **Charlotte Pike** (S.R. 24/U.S. 70) alignment. Notice the next prompt: **Enter first point**. **Left** click on the **Charlotte Pike** (S.R. 24/U.S. 70) alignment before the intersection to set the point.

10. Notice the next prompt: **Enter second point**. Drag your mouse along **Charlotte Pike** (S.R. 24/U.S. 70) to a point after the **River Road** crossing, and then **left** click to set the point. Then, click on the **Elements selection** tool to reset. **Note:** As a reminder, the striping does not update when using the **Road Template** tool. The striping will look incorrect, but we will modify it in Exercise 9.3.1.1.

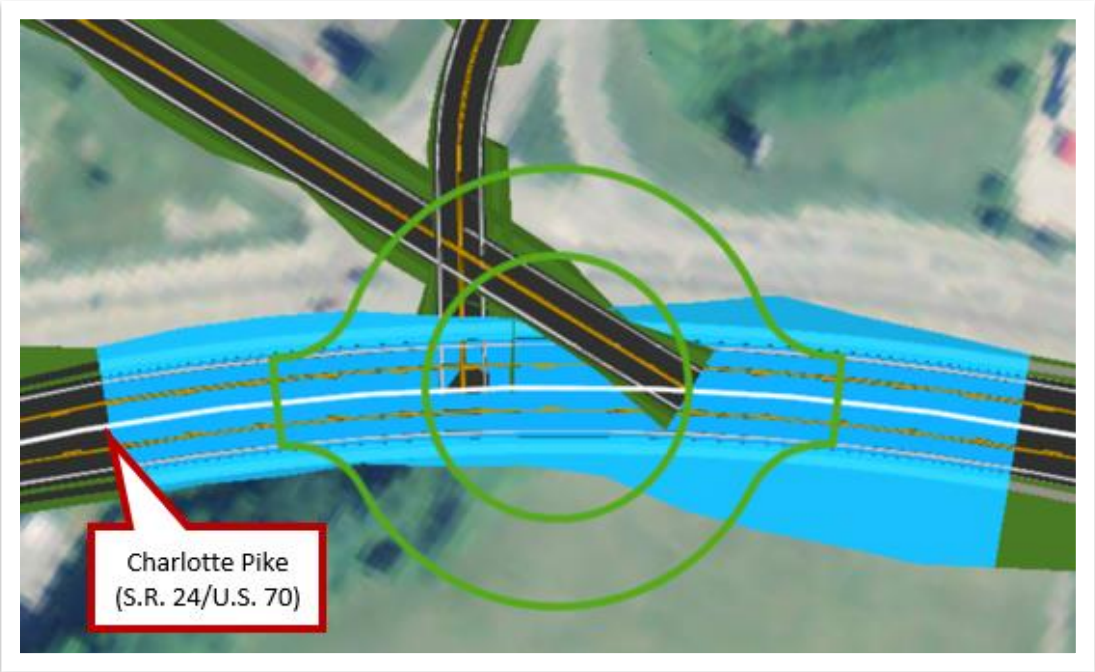
11. To create a roundabout, open the **Roundabout** tool (**Backstage >> Conceptualize >> Road Placement**) and select the following settings.
    a. **Inscribed Radius:** 120.00
    b. **Circulating Width:** 48.00
    c. **Tilted Plane:** Toggle off
    d. **Has Apron:** Toggle on



Take Note!

*Once the Roundabout has been placed, you can go back and edit the **inscribed radius** and **circulating width**.*

12. Notice the prompt: **Select primary road**. Select **Charlotte Pike** (S.R. 24/U.S. 70).



13. Notice the next prompt: **Select secondary road or right click to place roundabout at current location**. Select the **Walmart** road. **Note:** Do not right click after selecting the **Walmart** road since we still need to select **River Road**.

14. Notice the next prompt: **Select next secondary road or right click to accept**. Select **River Road**. **Note:** If the software does not allow you to select the roadway, it means the alignments are too close together and the horizontal alignment needs to be adjusted.

15. **Right** click to accept and notice the 4-leg roundabout has been created. Then, click on the **Elements selection** tool to reset.

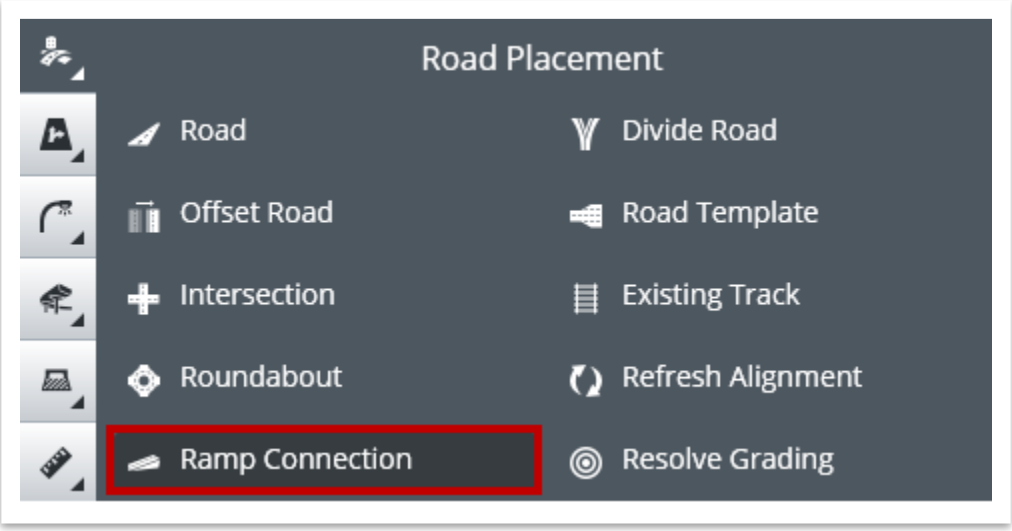
16. Next, we need to edit the pavement **striping** on the roundabout legs. For the **West** leg along **Charlotte Pike** (S.R. 24/U.S. 70), select the pavement striping and open the **Information** tab. Update the **Striping Pattern** to **Two-Way Double**.

17. Review both the **River Road** and **Walmart** road legs to ensure that the pavement striping is connected. If not, go ahead and select the pavement striping and use the manipulator arrows to close the gaps.
18. For the **East** leg along **Charlotte Pike** (S.R. 24/U.S. 70), **left** click on the curved arrow on the transition to **reverse** the direction of the lane transition markings. **Note:** Since the striping on this leg is connected to the entire **Charlotte Pike** (S.R. 24/U.S. 70) segment from the roundabout to the eastern limit (**Annex Avenue**), we cannot open the **Information** tab and update the pavement striping like we did for the **West** leg. We will modify this striping with the **Marking** tools in Exercise 9.3.1.1.

7.7 Lecture: Ramp Connection Tool

The **Ramp Connection** tool is found within the **Road Placement** tools (Figure 57). It allows the user to connect two intersecting road alignments with a ramp. Like the **Intersection** and **Roundabout** tools, the horizontal alignments need to cross each other, and the vertical profiles should be at roughly the same elevation at the crossing location.

FIGURE 57. RAMP CONNECTION TOOL



Within the dialog box, the user can select from two **Ramp Terminals** (**Parallel** or **Tapered**) plus set the **Design Radius** for the entry and exit of the ramp (Figure 58). Once the ramp is placed, the user can adjust the radius with the text manipulator field or the manipulator arrows. The **gore radius**, **auxiliary lane width** (parallel ramp terminal), and the **taper length** can also be modified.

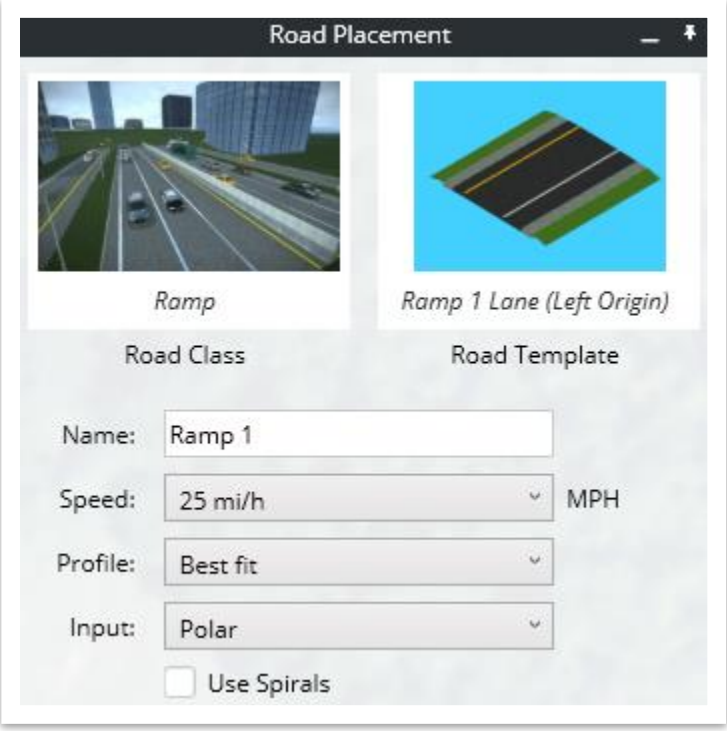
FIGURE 58. RAMP CONNECTION DIALOG BOX – PARALLEL AND TAPERED RAMP TERMINALS

7.7.1 Exercise: Create a Ramp Connection

In this exercise, we will add a ramp connection at the **Interstate 40** and **Charlotte Pike** (S.R. 24/U.S. 70) interchange (Exit 201).

1. Zoom in to **Exit 201** (I-40 WB off-ramp). We first need to create a road alignment (**Ramp 1**) along the **off-ramp**.

2. Open the **Road** tool (**Backstage >> Conceptualize >> Road Placement**) and select the following settings.
    a. **Road Class:** Ramp
    b. **Road Template:** Ramp 1 Lane (Left Origin) (select from **Favorites** for quicker navigation)
    c. **Name:** Ramp 1
    d. **Speed:** 25 mi/h
    e. **Profile:** Best fit
    f. **Use Spirals:** Toggle off



3. Notice the prompt: **Enter first PI**. **Left** click to set the **beginning** point at **I-40**, and then **left** click to place additional **PI** points along the existing **off-ramp** alignment until you get to **Charlotte Pike** (S.R. 24/U.S. 70). **Right** click to accept placement and then click on the **Elements selection** tool to reset. Go ahead and modify the horizontal curve radii based on the table below. The image provides a visual for the overall radii updates. **Note:** Make sure both extents of the off-ramp (**Ramp 1**) alignment cross the intersecting baselines. **Note:** As a reminder, you can navigate the stationing in the alignment profile view within the **Action Center**.

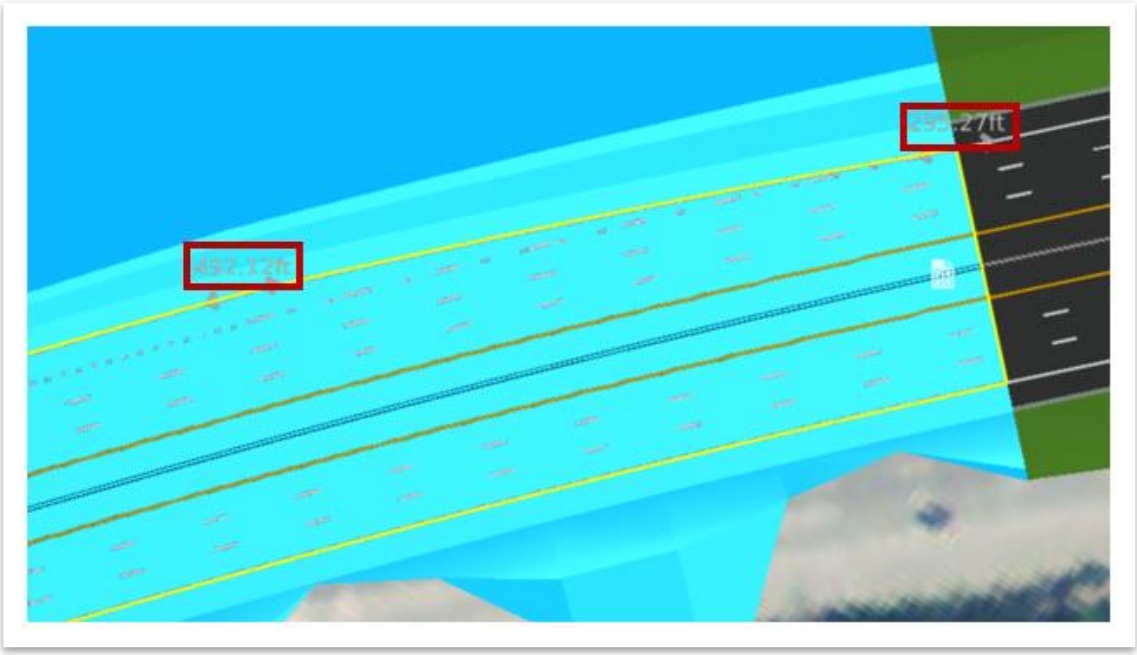
PI Approximate Station	Radius
5+00.00	750’
12+00.00	300’
14+00.00	300’

4. Next, open the **Ramp Connection** tool (**Backstage >> Conceptualize >> Road Placement**) and select the following settings.
    a. **Ramp Terminal:** Parallel
    b. **Design Radius:** 250.00

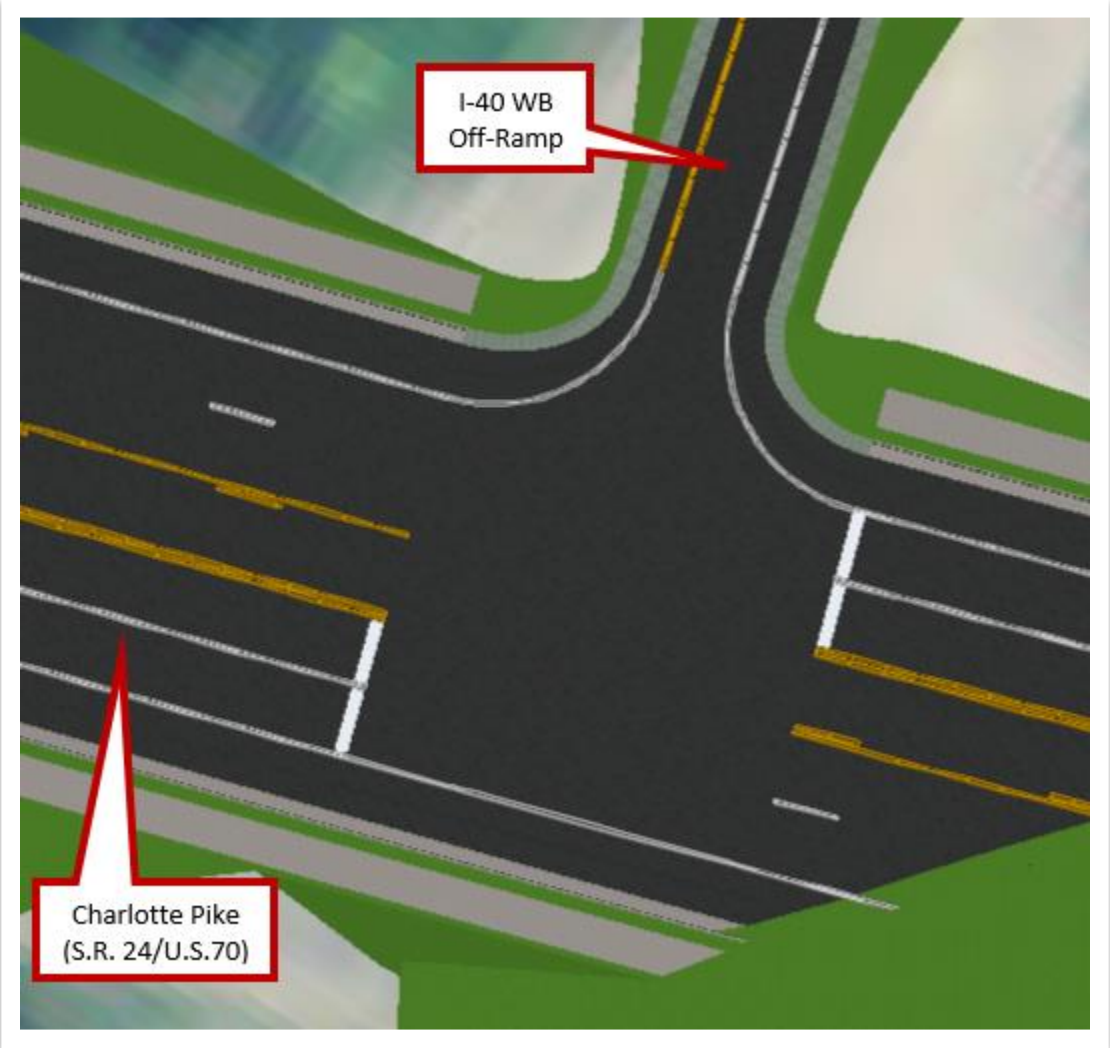
5. Notice the prompt: **Select primary road**. Select **I-40**.

6. Notice the next prompt: **Select secondary road**. Select the off-ramp (**Ramp 1**). There should be a green outline of the ramp, which indicates the extent. **Right** click to accept the ramp connection. Then, click on the **Elements selection** tool to reset.

7. Now **left** click on the off-ramp **transition** and zoom in to the **lane taper**. This is where you can edit the **taper** and **auxiliary lane** lengths. For this exercise, we will leave the default transition as-is.



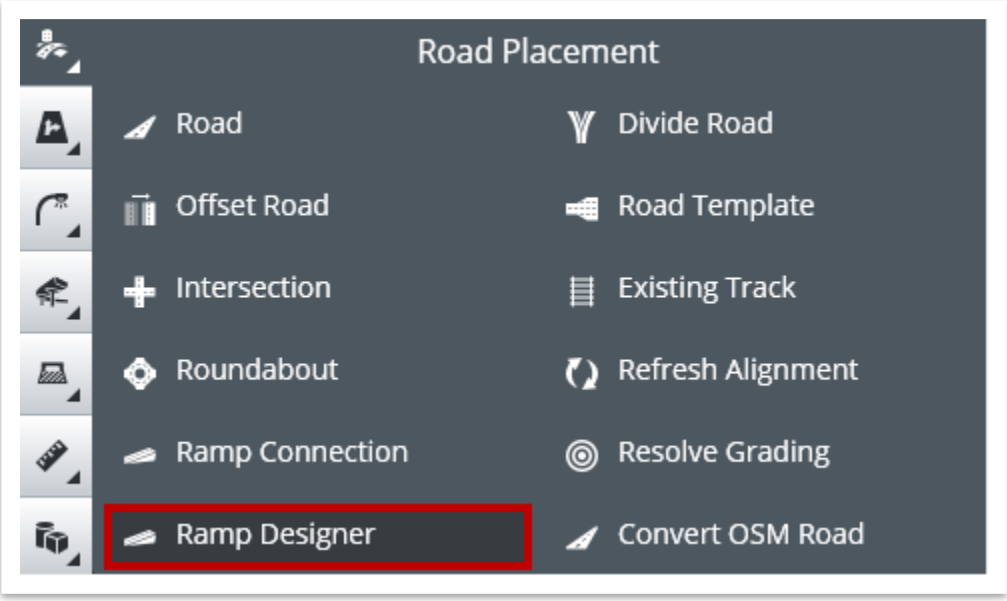
8. Lastly, we will create an **intersection** at the end of the off-ramp (**Ramp 1**). Open the **Intersection** tool (**Backstage >> Conceptualize >> Road Placement**). Notice the prompt: **Select primary road**. Select **Charlotte Pike** (S.R. 24/U.S. 70). Notice the next prompt: **Select secondary road**. Select the off-ramp (**Ramp 1**). **Right** click to accept and the intersection should be created. Then, click on the **Elements selection** tool to reset. **Note:** If the fill slope from I-40 is obstructing this intersection, modify the **I-40** profile so that it matches the existing ground more closely in this area and thus brings in the fill slope. We will be removing the I-40 side slope end conditions in this area when we place a bridge over **Charlotte Pike** in Exercise 8.2.1.1.



7.8 Lecture: Ramp Designer Tool

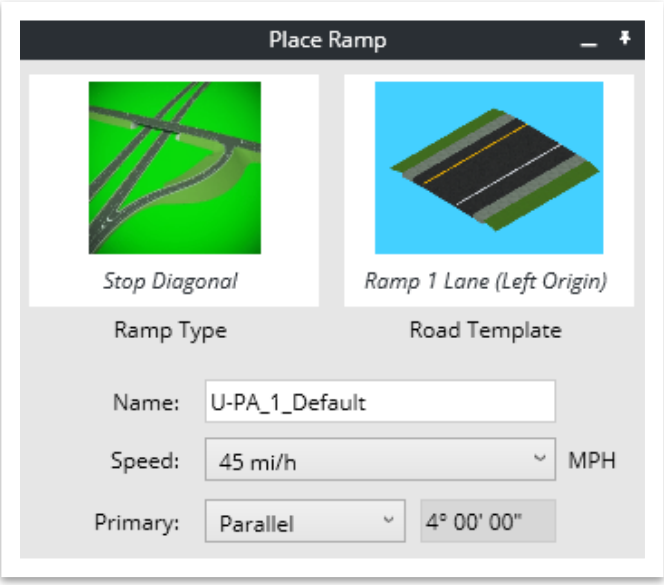
The **Ramp Designer** tool is found within the **Road Placement** tools (Figure 59). It allows the user to identify two roadway alignments and place a connecting ramp, based off **four** ramp selection types.

FIGURE 59. RAMP DESIGNER TOOL



Within the dialog box, the user can select a **Ramp Type**, a **Road Template**, and whether it is a **Parallel** or **Tapered** ramp (Figure 60). The **four** ramp types are **Free Loop**, **Simple Direct**, **Stop Diagonal** and **Stop Loop**. Once the ramp is placed, the user can edit the leg templates and the curve radii.

FIGURE 60. PLACE RAMP DIALOG BOX

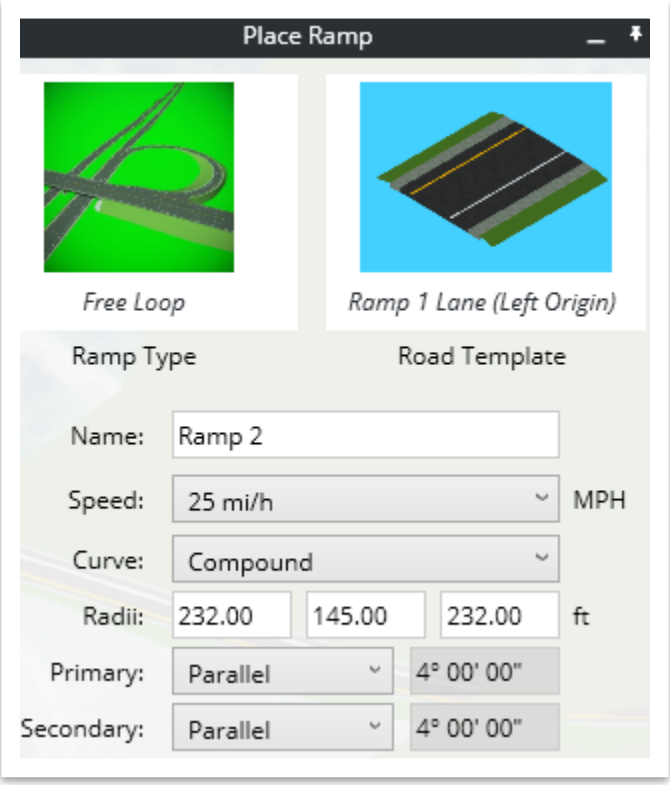


7.8.1 Exercise: Design a Ramp

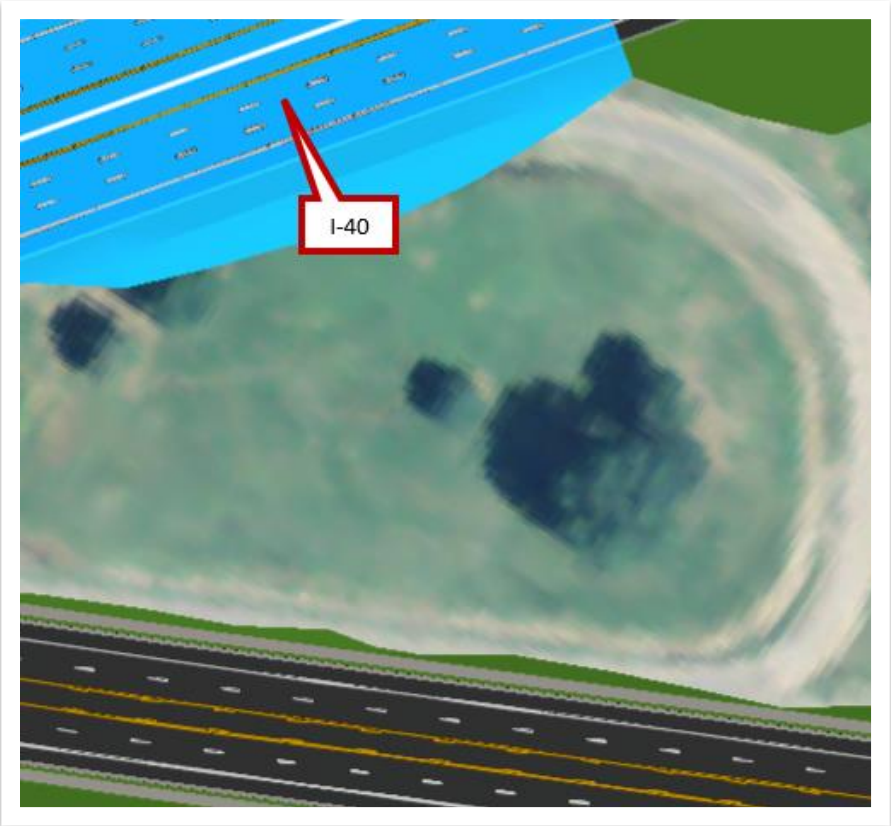
In this exercise, we will design a free loop ramp at the **Interstate 40** and **Charlotte Pike** (S.R. 24/U.S. 70) interchange (Exit 201).

1. Zoom in to **Exit 201** (I-40 EB off-ramp). We first need to design a free loop (**Ramp 2**) along the **off-ramp**.

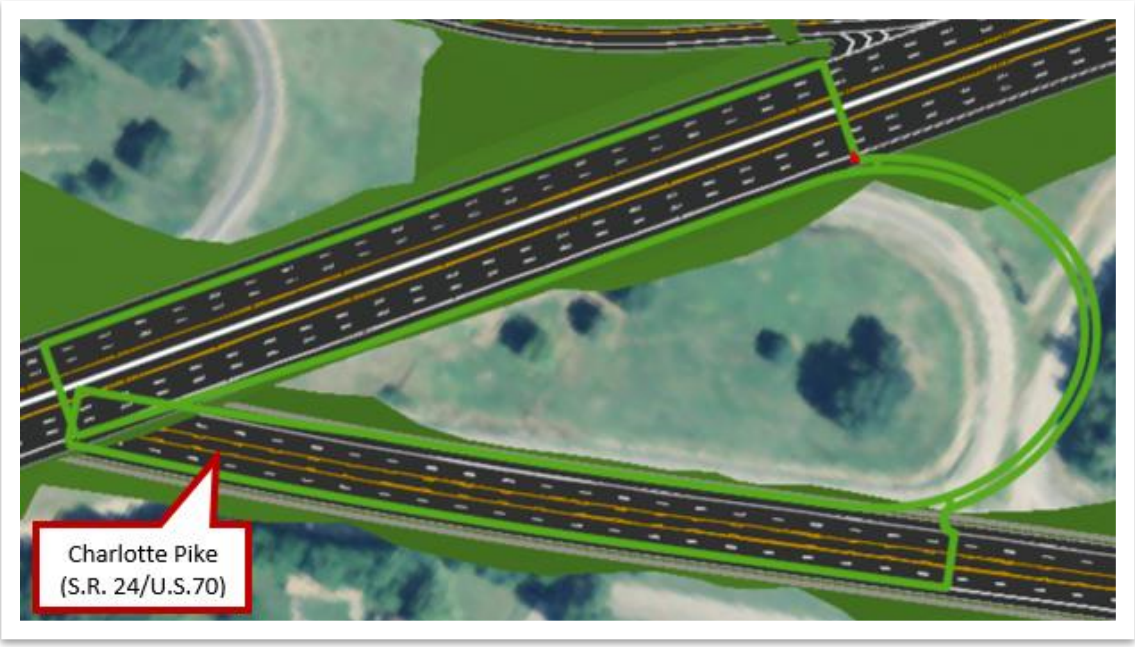
2. Open the **Ramp Designer** tool (**Backstage >> Conceptualize >> Road Placement**) and select the following settings.
    a. **Ramp Type:** Free Loop
    b. **Road Template:** Ramp 1 Lane (Left Origin)
    c. **Name:** Ramp 2
    d. **Speed:** 25 mi/h
    e. **Curve:** Compound
    f. **Radii:** 232.00, 145.00, 232.00
    g. **Primary:** Parallel
    h. **Secondary:** Parallel



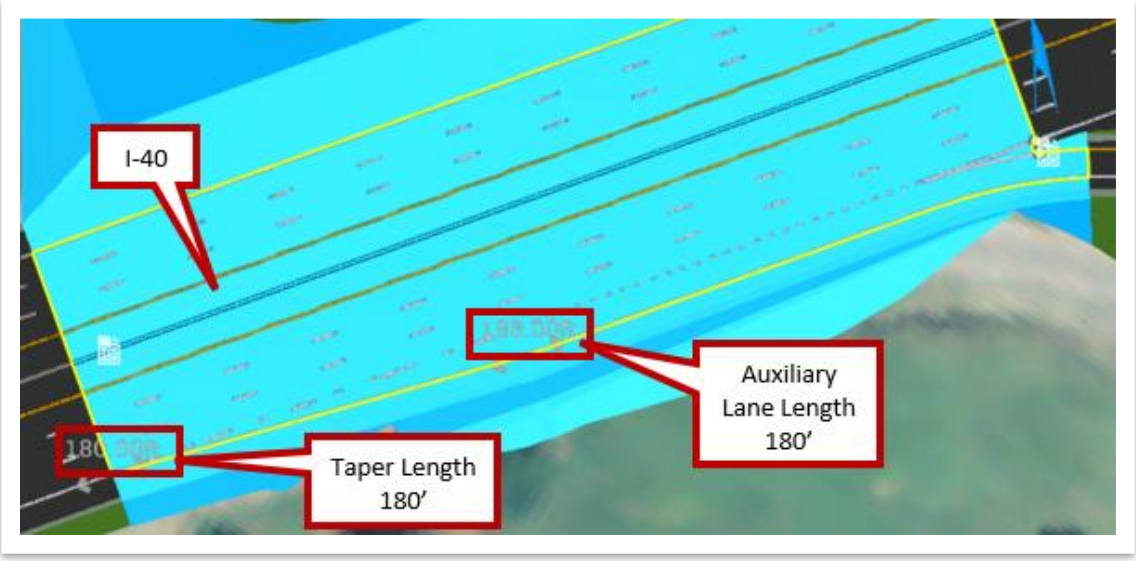
3. Notice the prompt: **Select primary road**. Select **I-40**.



4. Notice the next prompt: **Select secondary road**. Select **Charlotte Pike** (S.R. 24/U.S. 70). **Right** click to accept and the loop ramp should be created. Then, click on the **Elements selection** tool to reset.



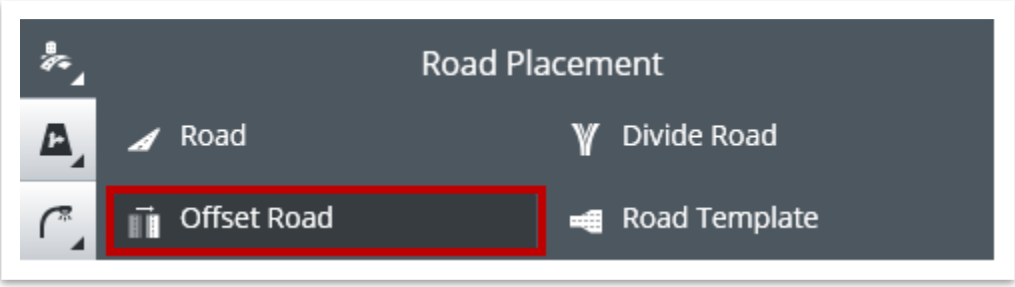
5. Lastly, we will edit the **taper** and **auxiliary lane** lengths. **Left** click on **I-40** and edit the taper and auxiliary lane lengths to both be **180'**. We will adjust the ramp transition location before we place the bridge in Exercise 8.2.1.1.



7.9 Lecture: Offset Road Tool

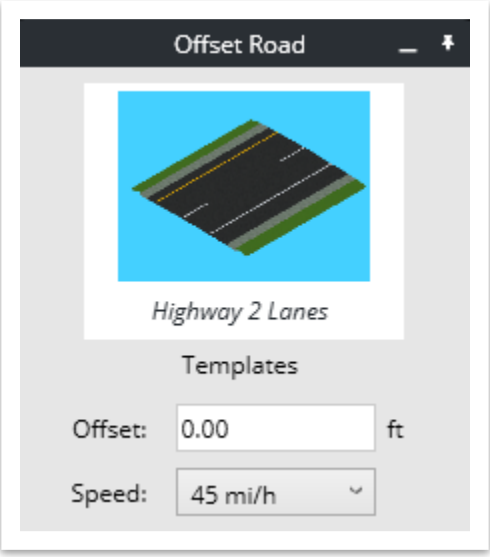
The **Offset Road** tool is found within the **Road Placement** tools (Figure 61). It allows the user to create another road alignment such as a **side road**, **bike path** or **multi use path** along an existing alignment.

FIGURE 61. OFFSET ROAD TOOL



Within the dialog box, the user can select a road **Template** and define the **Offset** distance between the two roads (Figure 62). The distance is measured between **template origin points**. A negative offset will place the road on the **left** of the alignment. The **Speed** defines the **design speed** for the offset road. Once an offset road is placed, the user can edit the alignment, add inflection points, and edit the profile.

FIGURE 62. OFFSET ROAD DIALOG BOX



7.10 Lecture: Divide Road Tool

The **Divide Road** tool is found within the **Road Placement** tools (Figure 63). It allows the user to divide an existing road with differing **Left** and **Right Road Templates** (Figure 64). The **Alignment Spacing** defines the distance between the **template origins** of the two selected templates. Once the divide road is placed, the user can edit the leg templates and the curve radii.

FIGURE 63. DIVIDE ROAD TOOL

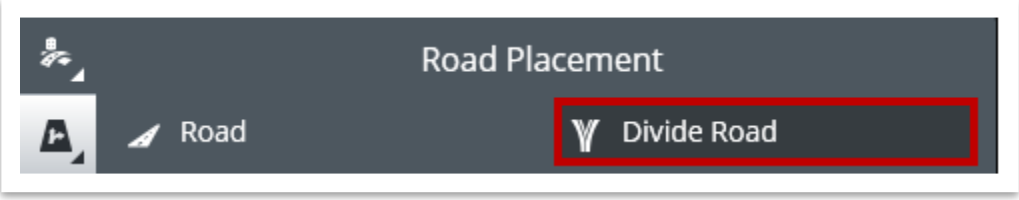
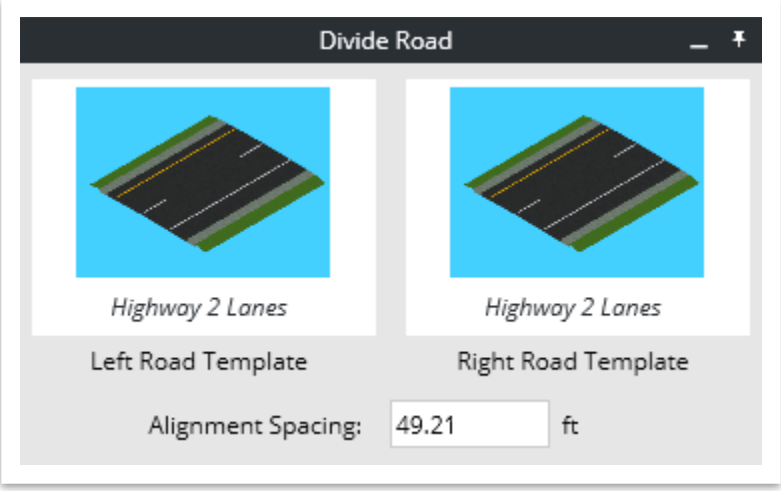


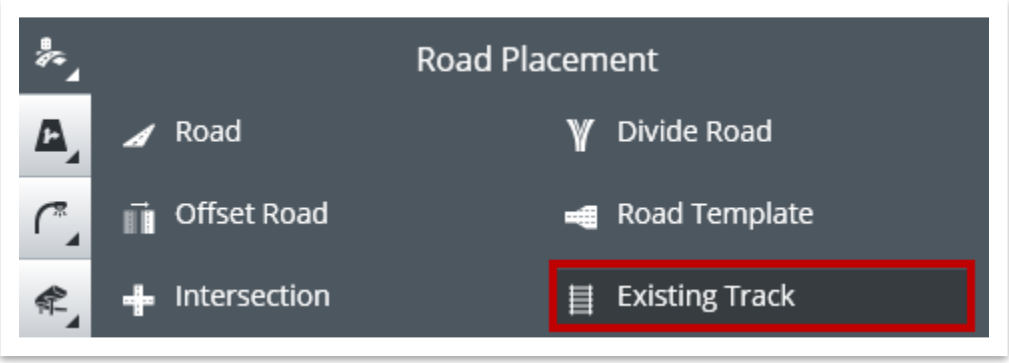
FIGURE 64. DIVIDE ROAD DIALOG BOX



7.11 Lecture: Existing Track Tool

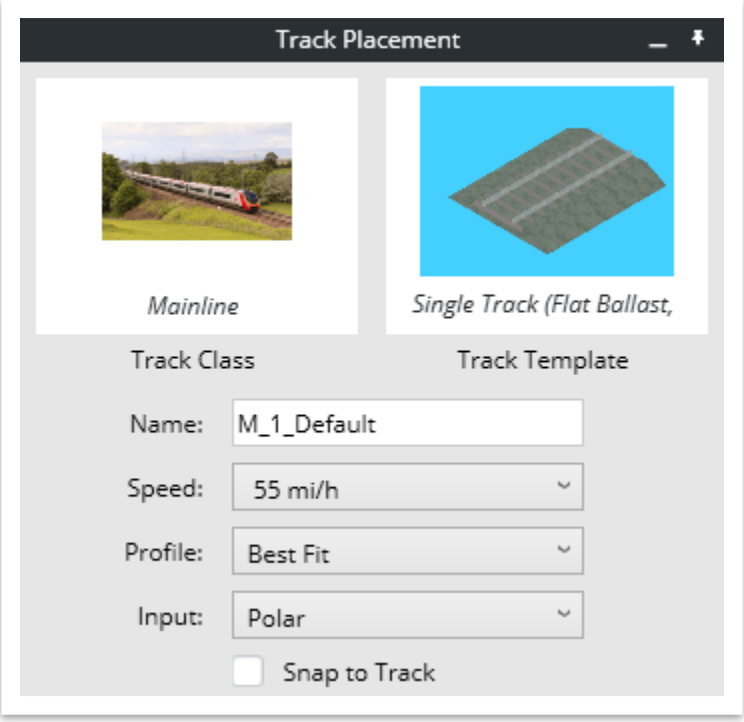
The **Existing Track** tool is found within the **Road Placement** tools (Figure 65). It allows the user to place an existing track and **will not** be counted in the cost estimate.

FIGURE 65. EXISTING TRACK TOOL



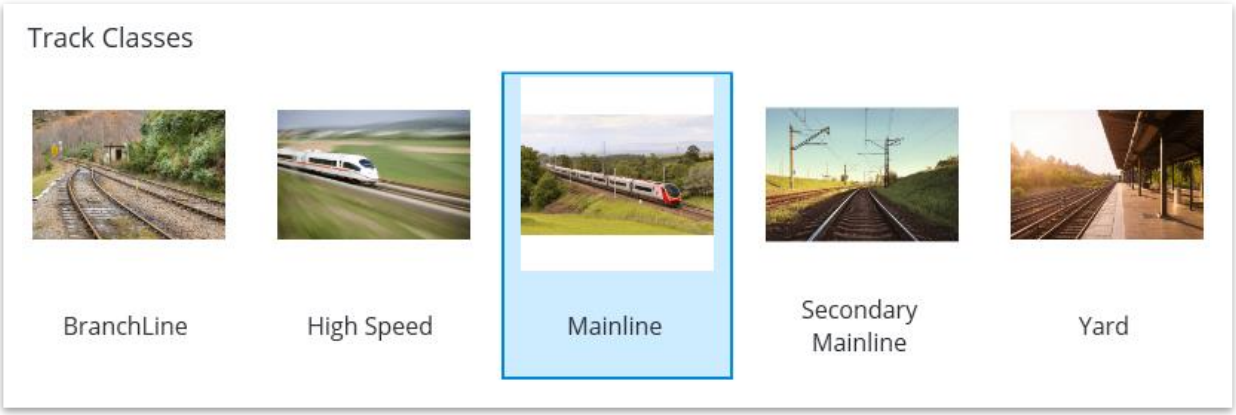
Within the dialog box, the user can select a **Track Class**, **Track Template**, track design **Speed**, **Profile** type (**Straight** or **Best Fit**), **Input** type (**Polar** or **Cartesian**), and the option to toggle **Snap to Track** (Figure 66).

FIGURE 66. TRACK PLACEMENT DIALOG BOX



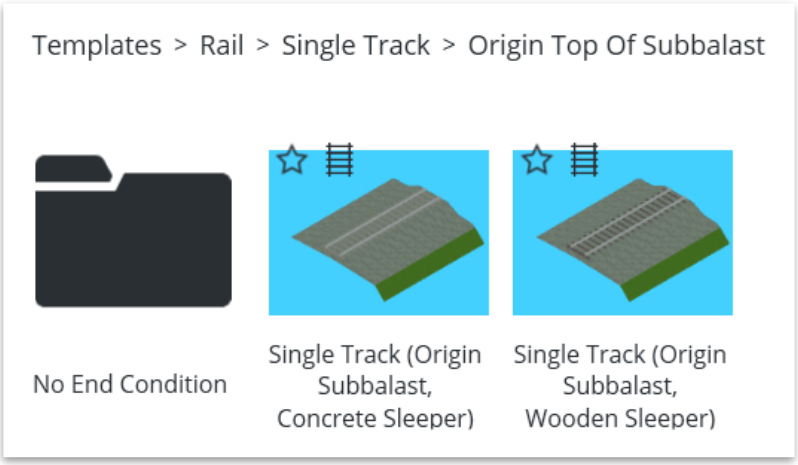
The **five** track classes include **BranchLine**, **High Speed**, **Mainline**, **Secondary Mainline** and **Yard** (Figure 67).

FIGURE 67. TRACK CLASSES



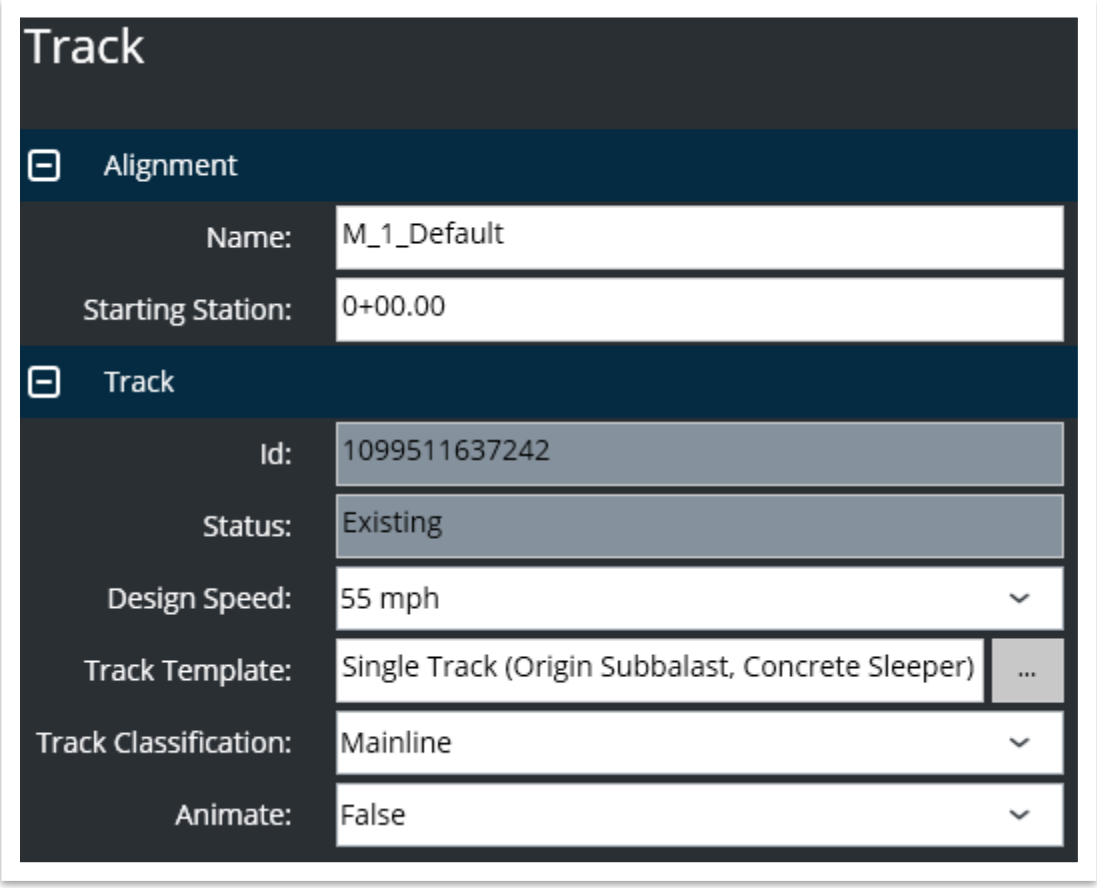
Bentley has provided several existing track templates to select from within the **Templates >> Rail** folder (Figure 68). There are **three** subfolders: **Bridge**, **Multi Track** and **Single Track**.

FIGURE 68. TRACK TEMPLATES



Once the track is placed, the user can modify the track properties in the **Information** tab (Figure 69).

FIGURE 69. TRACK MODIFICATION – INFORMATION TAB



Chapter 8. Structure and Drainage Tools

This chapter will discuss the **structure** and **drainage** placement tools featured in ConceptStation, which includes bridges, bridge ramps, tunnels, and culverts. **Note:** This manual will not cover the **Hyperloop** tool (Structure) or the **Drainage Network** tool (Drainage).

8.1 Objectives

At the conclusion of this chapter, participants will be able to:

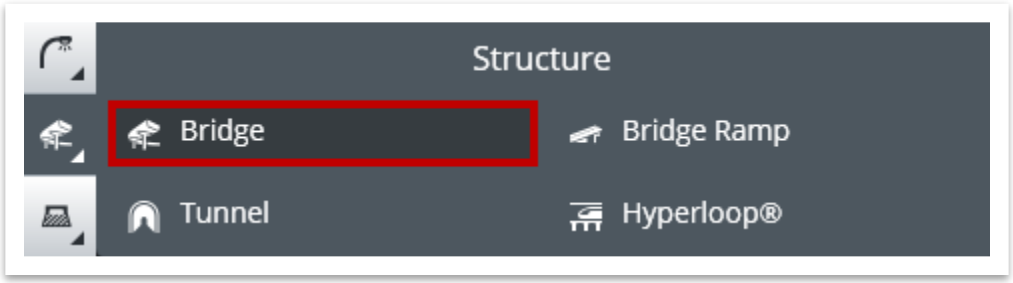
1. Utilize the bridge placement tools to create a new bridge with horizontal and vertical alignments.
2. Create a bridge ramp and tunnel.
3. Utilize the culvert placement tools to create and modify a culvert.

8.2 Lecture: Structure Tools

8.2.1 Bridge Tool

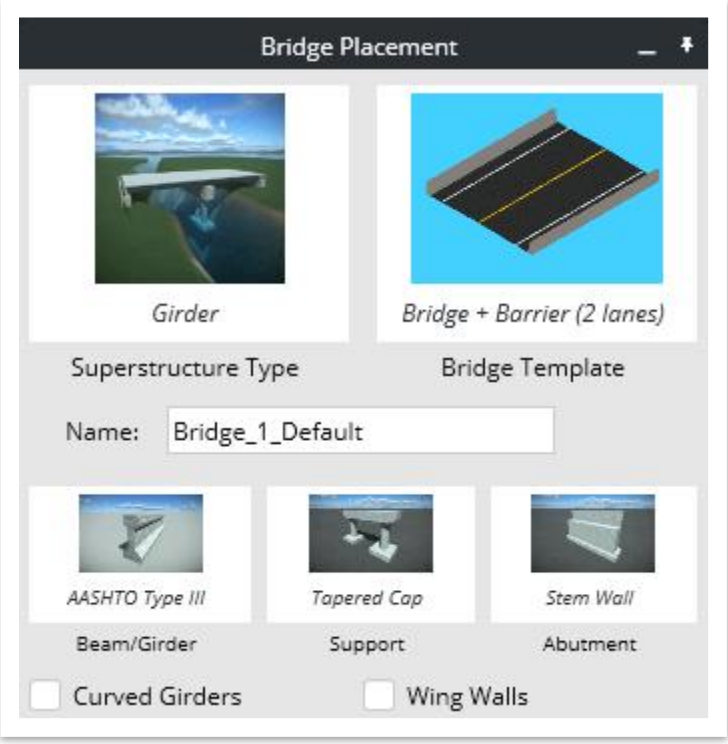
The **Bridge** tool is found within the **Structure** tools (Figure 70). It allows the user to place a bridge on an existing road alignment. After placement, the user can adjust the vertical alignment.

FIGURE 70. BRIDGE TOOL



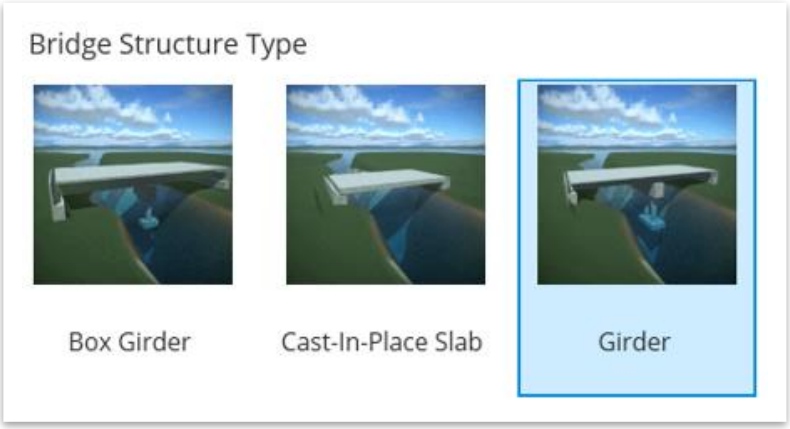
Within the dialog box, the user can select a **Superstructure Type**, **Bridge Template**, **Beam/Girder**, **Support**, and **Abutment** (Figure 71).

FIGURE 71. BRIDGE PLACEMENT DIALOG BOX



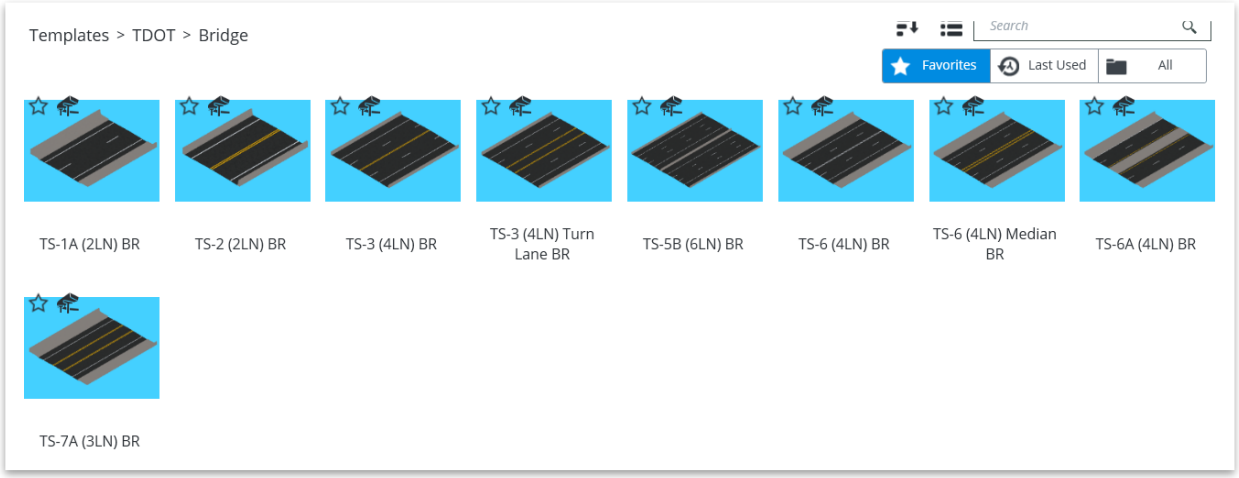
There are **three** superstructure types: **Box Girder**, **Cast-In-Place Slab**, and **Girder** (Figure 72).

FIGURE 72. BRIDGE STRUCTURE TYPES



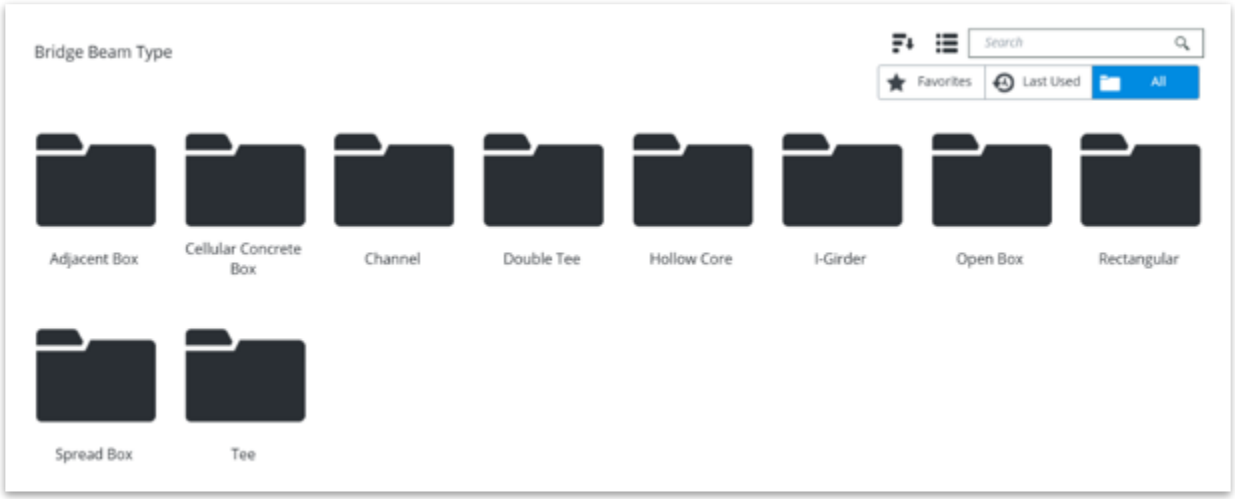
Several **TDOT** bridge templates have been created in accordance with TDOT standards and are in the **Templates >> TDOT >> Bridge** folder (Figure 73). The Bentley provided bridge templates are available in the **Templates >> Road >> Bridge** folder.

FIGURE 73. TDOT BRIDGE TEMPLATES



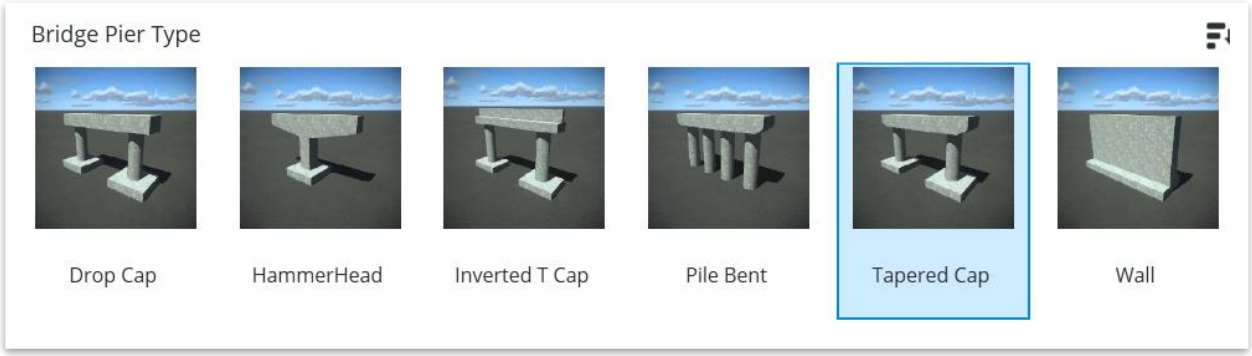
There are a variety of **bridge beam type** folders that can be found when clicking on **Beam/Girder** (Figure 74). Each folder contains multiple beam types based on client requirements.

FIGURE 74. BRIDGE BEAM TYPES



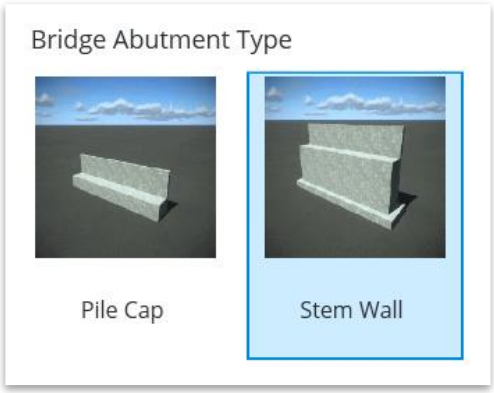
Once a bridge beam type is selected, the user can pick from **six** bridge pier types (**Support** options): **Drop Cap**, **HammerHead**, **Inverted T Cap**, **Pile Bent**, **Tapered Cap** and **Wall** (Figure 75).

FIGURE 75. BRIDGE PIER TYPES



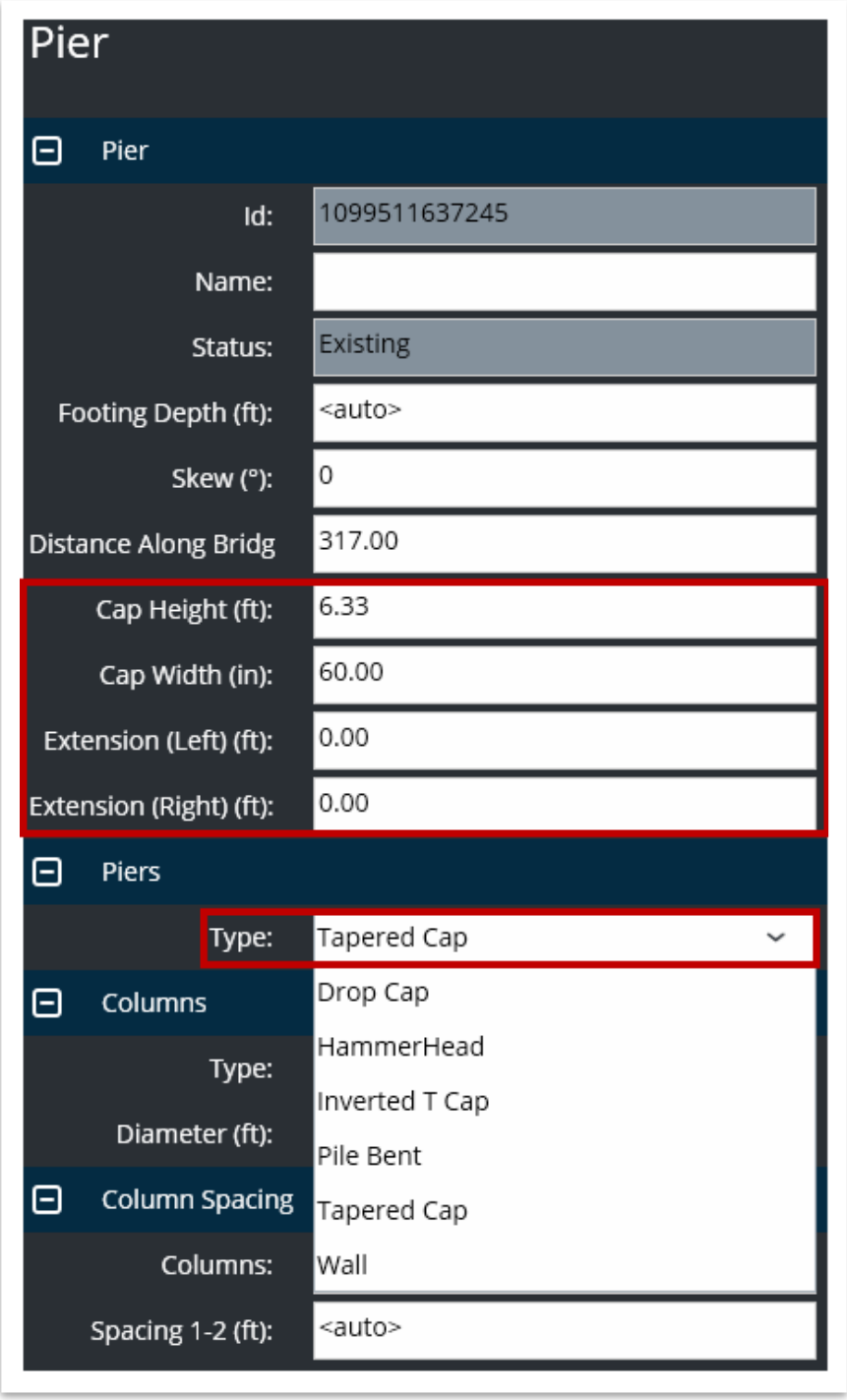
The user can also select between two bridge **Abutment** types: **Pile Cap** and **Stem Wall** (Figure 76). When creating a bridge on a curve, the user should toggle on **Curved Girders.** The user can also toggle **Wing Walls** on/off in front of the bridge abutments.

FIGURE 76. BRIDGE ABUTMENT TYPES



The **Information** tab provides enhanced capabilities for modification of piers once a bridge has been placed. When a pier is selected in the model, the following properties can be modified: **Cap Height/Width**, **Extension** (**Left/Right**) of the bridge centerline, and **Pier Type** (Figure 77).

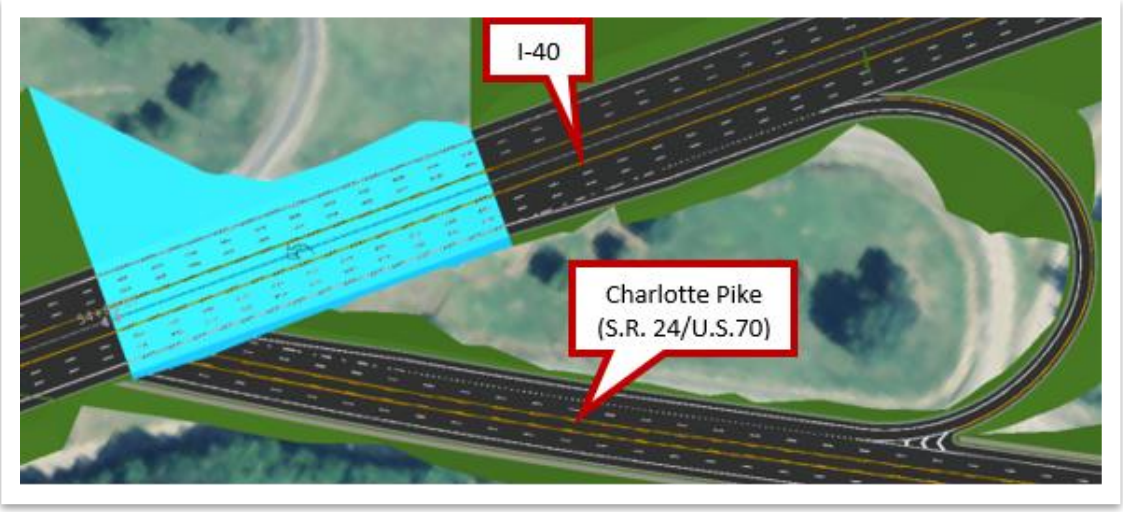
FIGURE 77. PIER MODIFICATION – INFORMATION TAB



8.2.1.1 Exercise: Place a Bridge

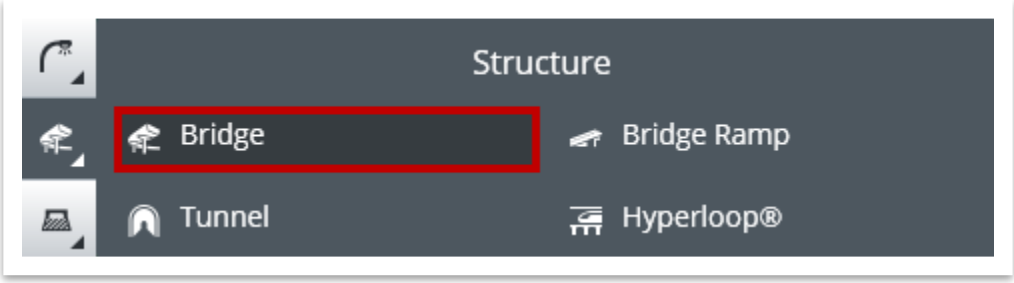
In this exercise, we will place a bridge at the **Interstate 40** and **Charlotte Pike** (S.R. 24/U.S. 70) interchange (Exit 201).

1. Since the software does not allow a bridge to be placed in a transition, we need to make sure that the previously created ramp transitions are moved outside of the bridge location. To edit the transition, zoom in to the interchange and **left** click on the **transition** just west of the free loop (**Ramp 2**).

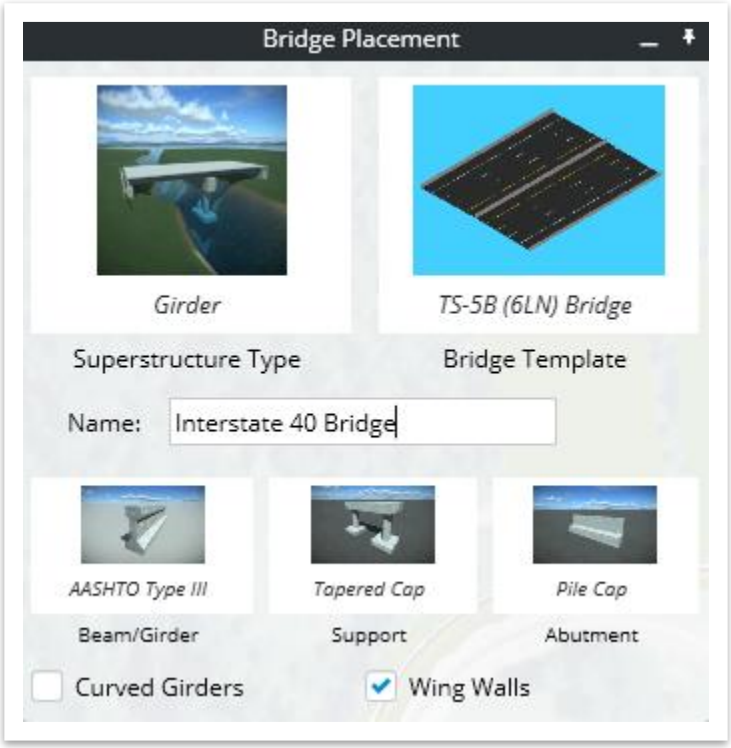


2. Use the manipulator arrows to make the transition shorter and outside of the bridge location.

3. Next, we will place the **I-40** bridge over **Charlotte Pike** (S.R. 24/U.S. 70). Open the **Bridge** tool (**Backstage >> Conceptualize >> Structure**) and select the following settings.



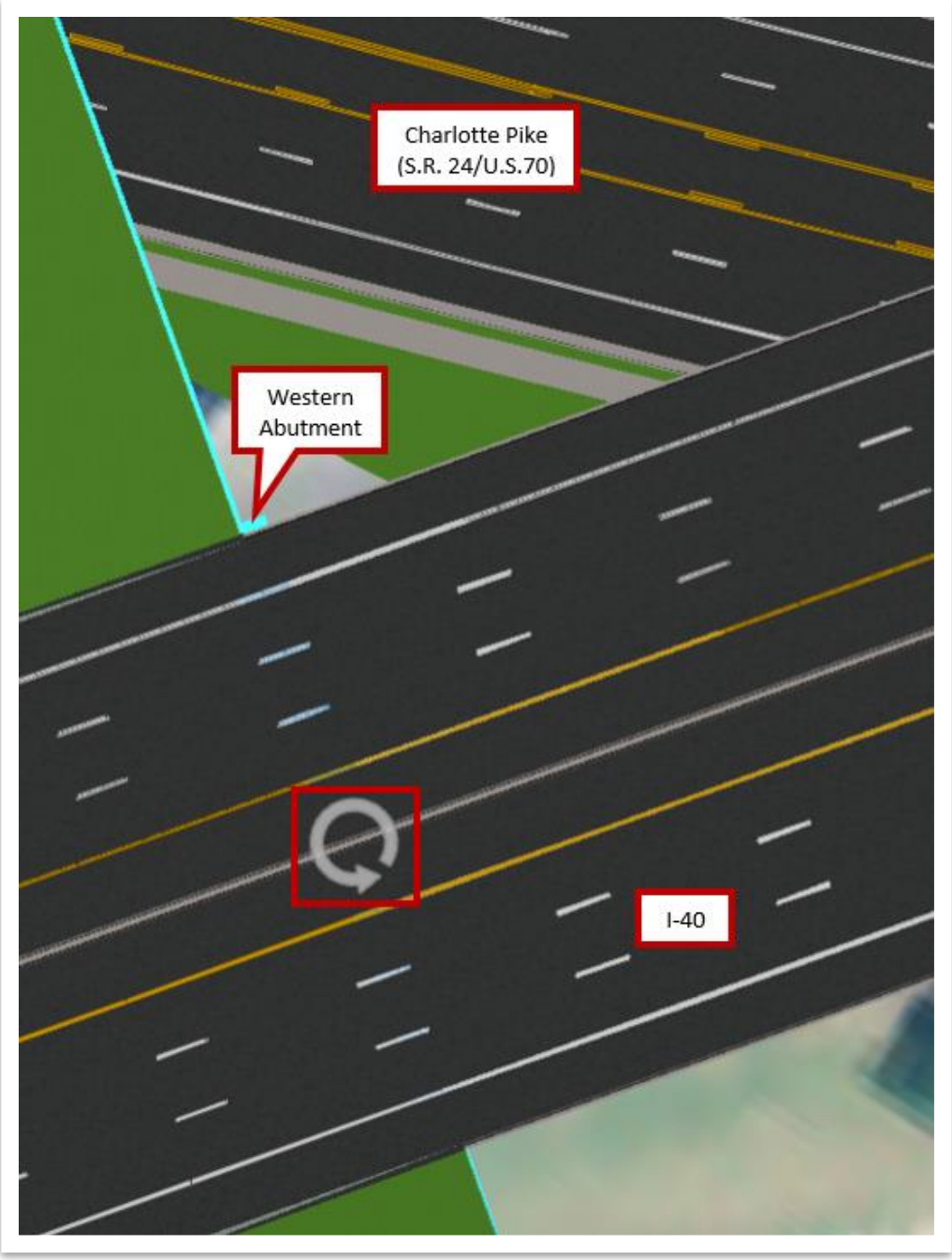
   a. **Superstructure Type:** Girder
   b. **Bridge Template:** TS-5B (6LN) Bridge (select from **Favorites** for quicker navigation)
   c. **Name:** Interstate 40 Bridge
   d. **Beam/Girder:** AASHTO Type III (**Bridge Beam Type >> I-Girder**)
   e. **Support:** Tapered Cap
   f. **Abutment:** Pile Cap
   g. **Curved Girders:** Toggle off
   h. **Wing Walls:** Toggle on



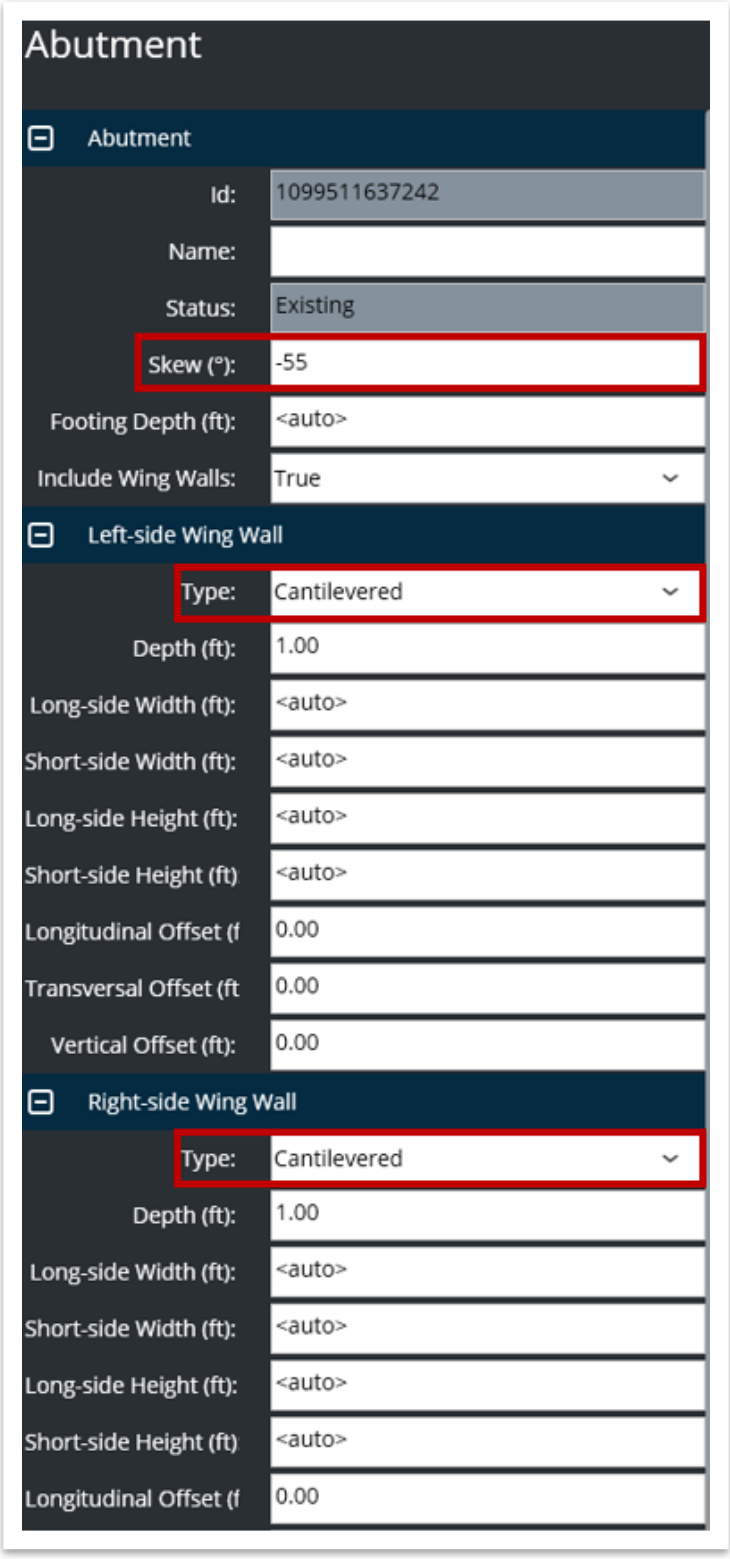
4. Notice the prompt: **Select alignment**. Select the **I-40** alignment. Notice the next prompt: **Enter first point**. **Left** click to set the point at approximate Station **52+00.00**. Notice the next prompt: **Enter second point**. Drag your mouse along the **I-40** alignment to approximate Station **58+00.00**, and then **left** click to set the point.

5. Within that station range, the template end conditions should now be removed, and the bridge placed. Click on the **Elements selection** tool to reset.

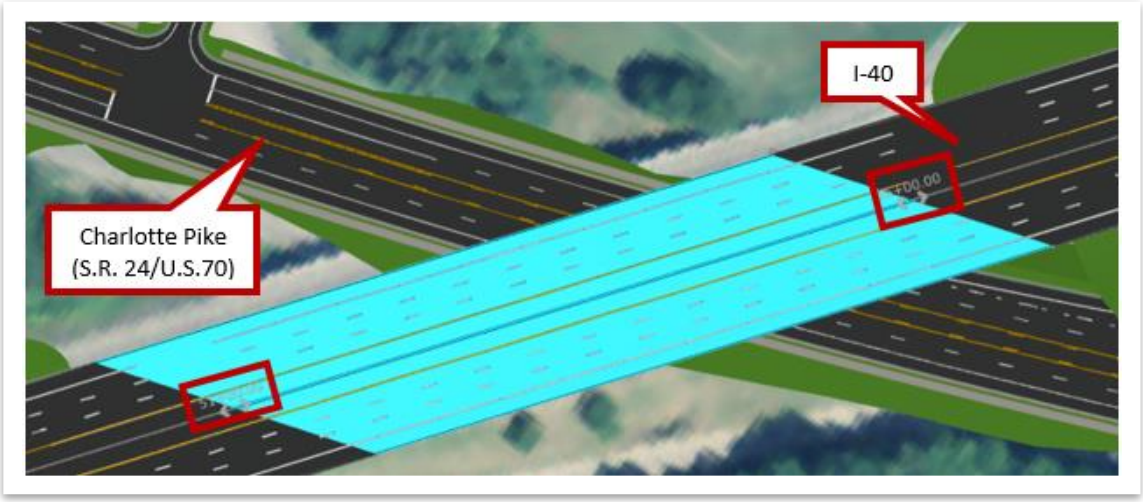
6. Now we will **skew** the wing walls that are going through **Charlotte Pike** (S.R. 24/U.S. 70). Zoom in to the **western** end of the bridge and select the thin gray **abutment**. Once selected, a **rotation** manipulator arrow should appear. You can either use this tool to skew the abutment angle manually or key-in a particular angle within the **Information** tab (which we will do in the next step).



7. With the western **abutment** still selected, go ahead and open the **Information** tab. Update the **Skew (°)** to **-55** and the **Left-side** and **Right-side Wing Walls** to **Cantilevered**. Repeat this for the eastern **abutment** as well.

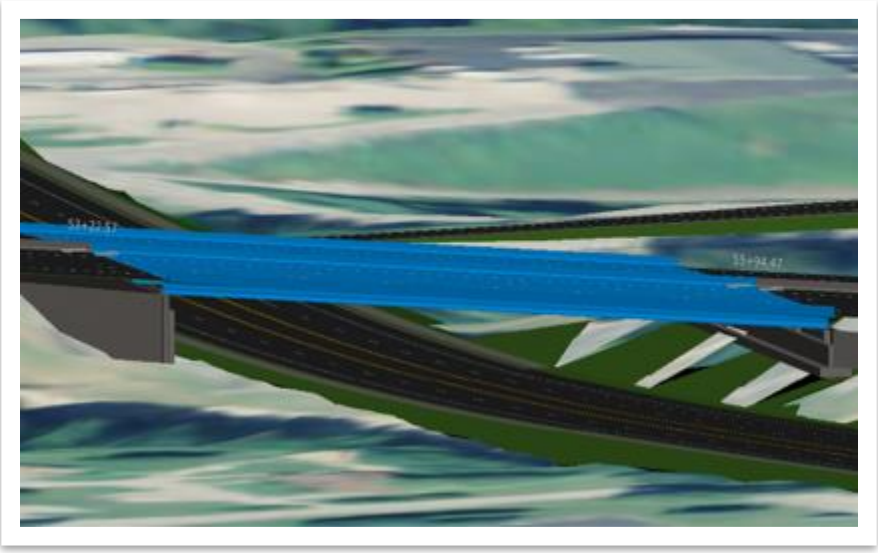


8. Now that the abutments have been skewed, **left** click twice on the bridge and use the manipulator arrows to extend the bridge limits so that the abutments and side slopes are outside the Charlotte Pike roadway. **Note:** If you have issues extending the bridge limits, move the I-40 transition segments further out.

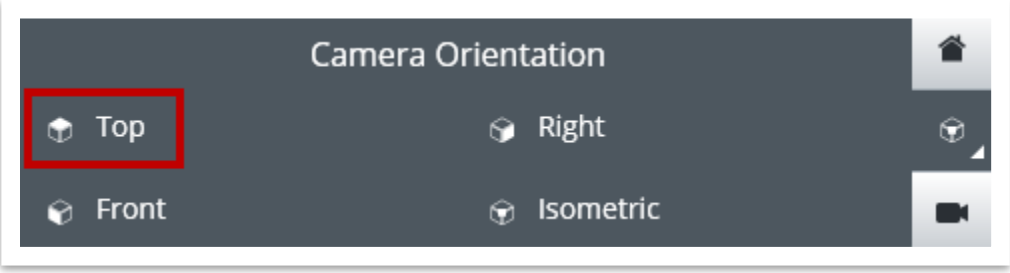


9. Next, use the **Rotate** tool to the view the bridge in 3D. Your bridge length will determine the number of spans and piers. **Note:** Your bridge does not need to match exactly.

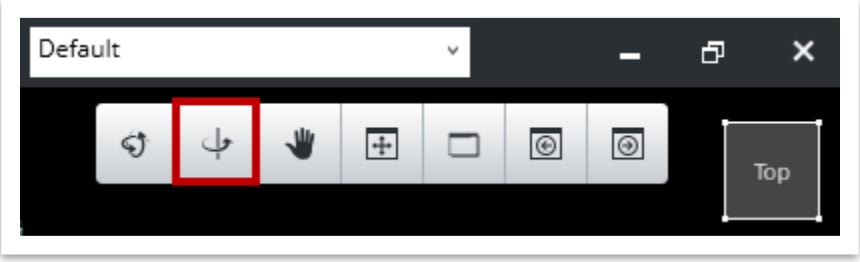
10. Select the bridge and open the **Information** tab. Update the number of **Spans** to **1**. This will remove the piers in the middle of the road.



11. Once you are done reviewing, revert the **Camera Orientation** back to **Top**.



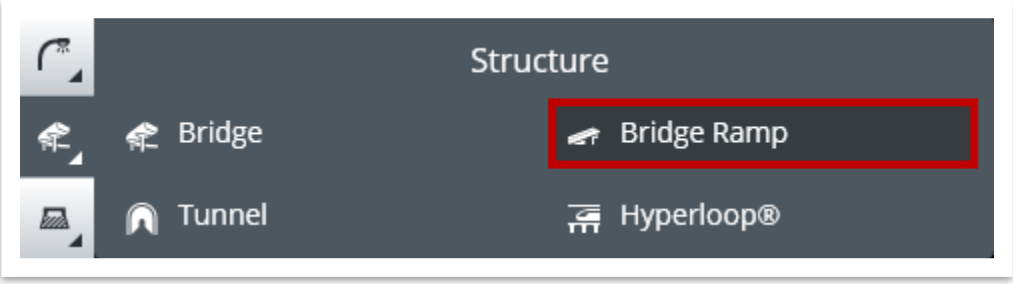
12. Lastly, rotate the view back to the **Charlotte Pike** (S.R. 24/U.S. 70) corridor using the **Rotate 2 Points** tool.



8.2.2 Bridge Ramp Tool

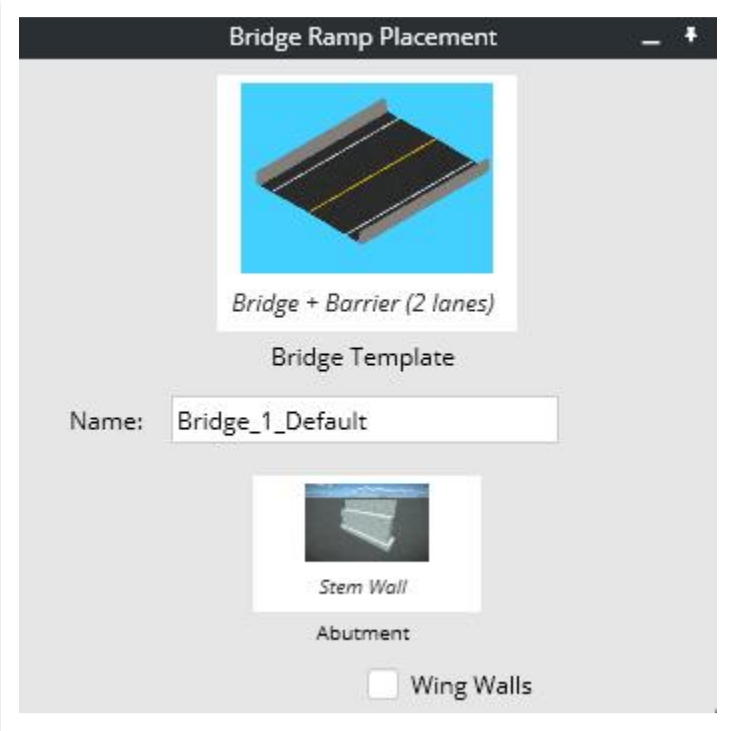
The **Bridge Ramp** tool is found within the **Structure** tools (Figure 78). It allows the user to connect a road alignment with a bridge and an intersecting road, which both need to be created before using the tool. It is recommended to adjust the vertical alignments of both alignments before creating the ramp.

FIGURE 78. BRIDGE RAMP TOOL



Within the dialog box, the user can select the **Bridge Template**, **Abutment** (**Pile Cap** or **Stem Wall**), and toggle **Wing Walls** on/off (Figure 79).

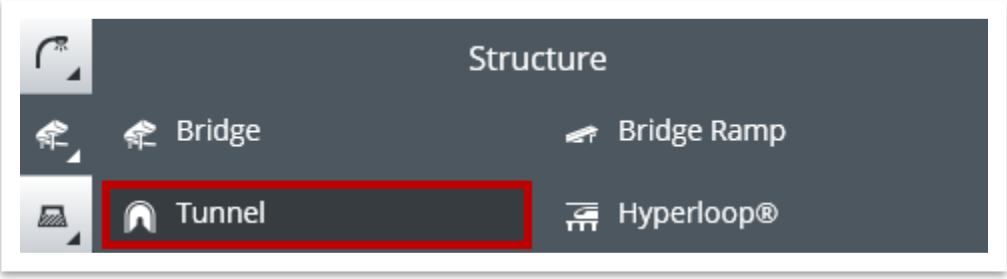
FIGURE 79. BRIDGE RAMP PLACEMENT DIALOG BOX



8.2.3 Tunnel Tool

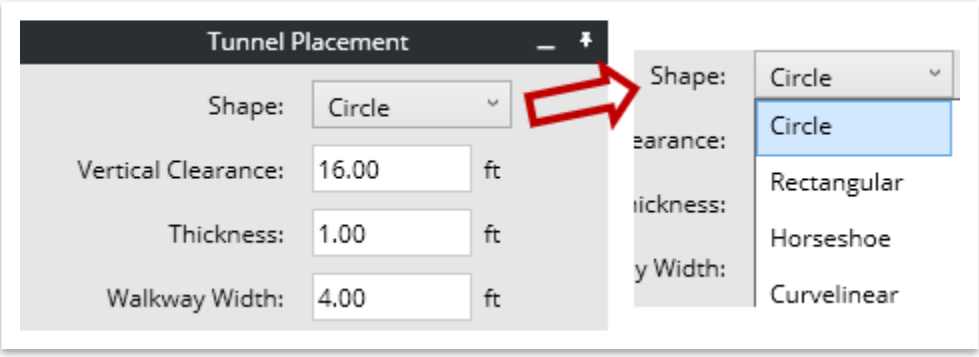
The **Tunnel** tool is found within the **Structure** tools (Figure 80). It allows the user to place a tunnel using an existing alignment.

FIGURE 80. TUNNEL TOOL



Within the dialog box, the user can select from **four** tunnel shapes: **Circle**, **Rectangular**, **Horseshoe** and **Curvelinear**. The tunnel **Vertical Clearance**, **Thickness**, and **Walkway Width** can also be defined (Figure 81).

FIGURE 81. TUNNEL PLACEMENT DIALOG BOX – SHAPE OPTIONS

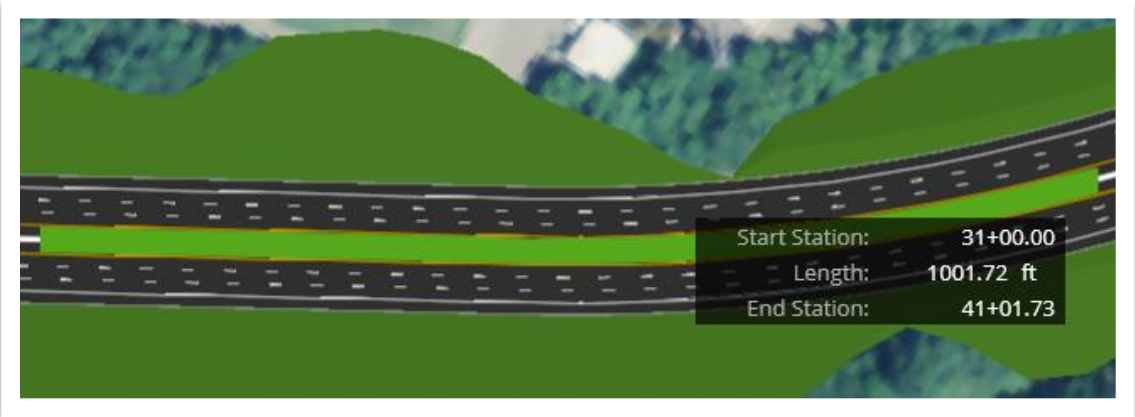


8.2.3.1 Exercise: Place a Tunnel

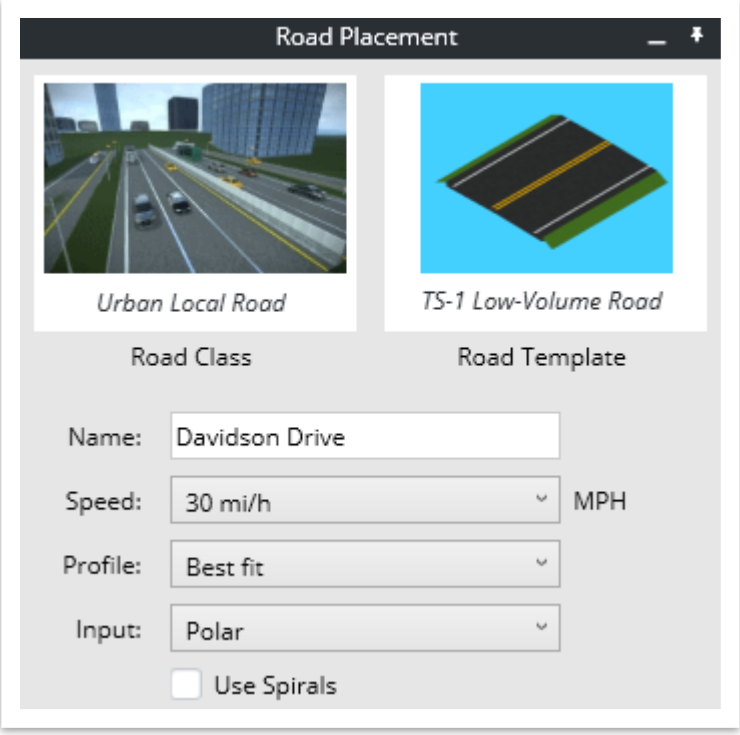
In this exercise, we will place a tunnel under **Interstate 40** along **Davidson Drive** and place the retaining wall template along Interstate 40.

1. We will use the **retaining wall** template created in Exercise 6.3.5. Open the **Road Template** tool (**Backstage >> Conceptualize >> Road Placement**) and select **TS-5B (6LN) Retaining Wall** (select from **Favorites** for quicker navigation)

2. Notice the prompt: **Enter first point**. **Left** click on the **I-40** alignment (approximate Station **31+00.00**) to set the point. Notice the next prompt: **Enter second point**. Drag your mouse along the I**-40** alignment to approximate Station **41+00.00**, and then **left** click to set the point.

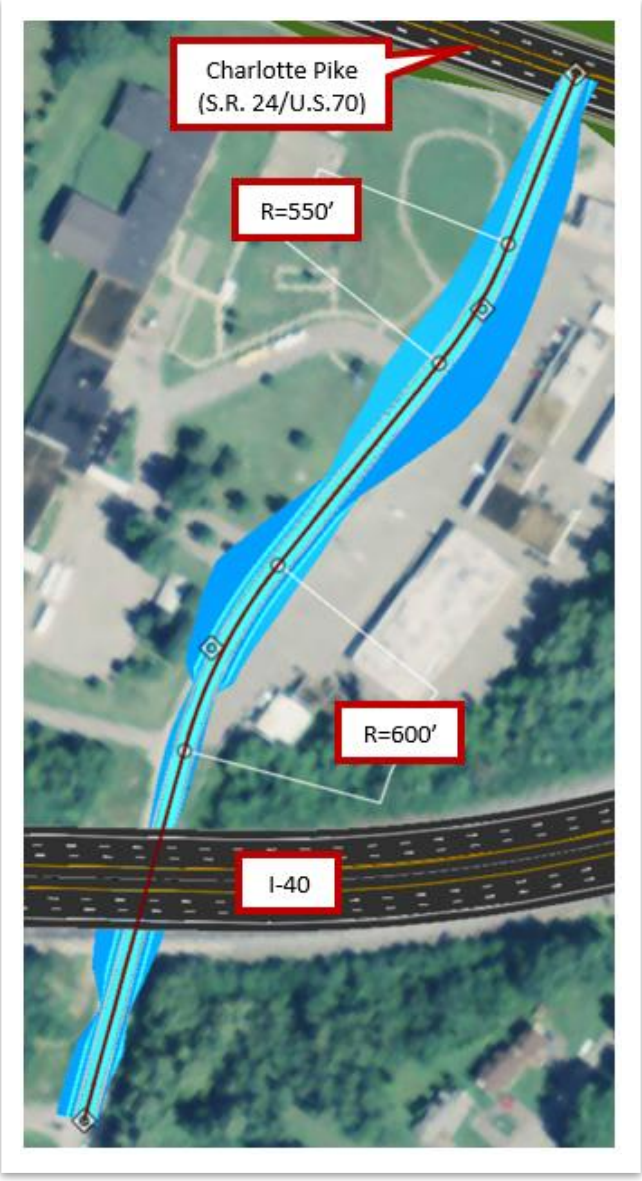


3. Next, we will add the **Davidson Drive** alignment. Open the **Road** tool (**Backstage >> Conceptualize >> Road Placement**) and select the following settings.
    a. **Road Class:** Urban Local Road
    b. **Road Template:** TS-1 Low-Volume Road (2LN) (select from **Favorites** for quicker navigation) **Note:** The full template name is too long for the extent below.
    c. **Name:** Davidson Drive
    d. **Speed:** 30 mi/h
    e. **Profile:** Best fit (**Note:** This method will automatically create a profile that follows the existing ground.)
    f. **Input:** Polar
    g. **Use Spirals:** Toggled off

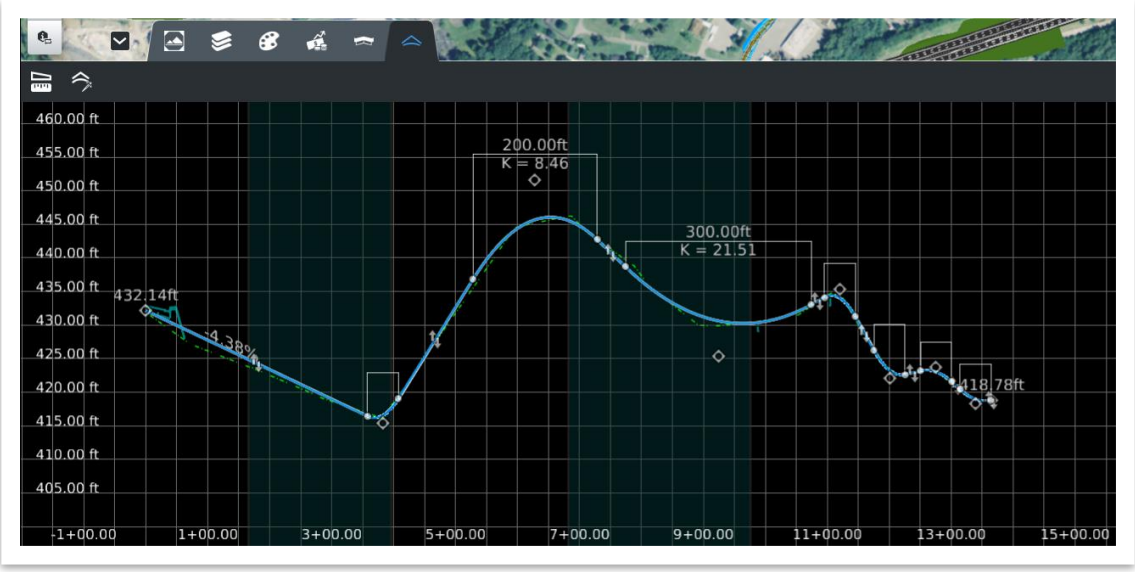


4. Notice the prompt: **Enter first PI**. **Left** click to set the **beginning** point at **Charlotte Pike** (S.R. 24/U.S. 70) and then **left** click to place additional **PI** points along the existing **Davidson Drive** until you get just south of **I-40**. **Right** click to accept placement and then click on the **Elements selection** tool to reset. Go ahead and modify the horizontal curve radii based on the table below. The image provides a visual for the overall radii updates. **Note:** As a reminder, you can navigate the stationing in the alignment profile view within the **Action Center**.

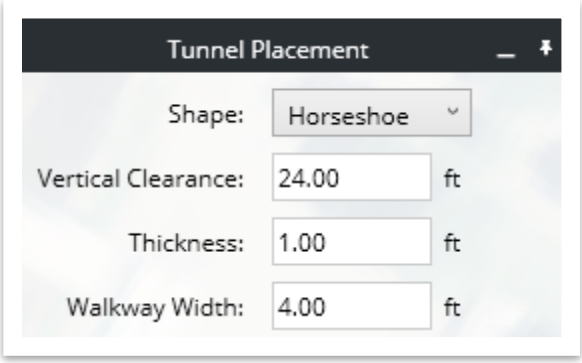
PI Approximate Station	Radius
3+00.00	550’
8+00.00	600’



5. Now we will edit the **Davidson Drive** vertical alignment (profile) so that it meets the proposed **Charlotte Pike** (S.R. 24/U.S. 70) template at the start of the alignment and has a linear profile to match the existing ground at the end of the alignment.

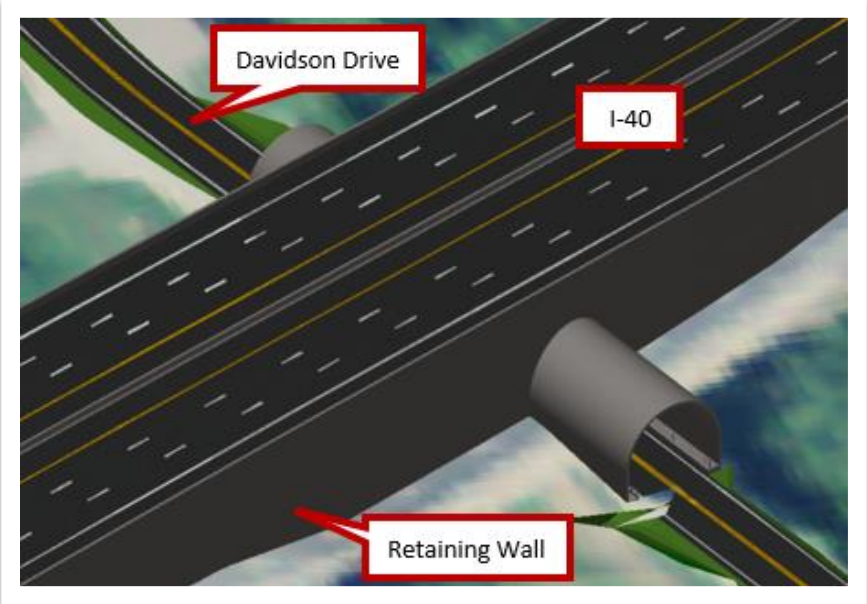


6. Next, we will place the **tunnel**. Open the **Tunnel** tool (**Backstage >> Conceptualize >> Structure**) and select the following settings.
   a. **Shape:** Horseshoe
   b. **Vertical Clearance:** 24.00
   c. **Thickness:** 1.00
   d. **Walkway Width:** 4.00

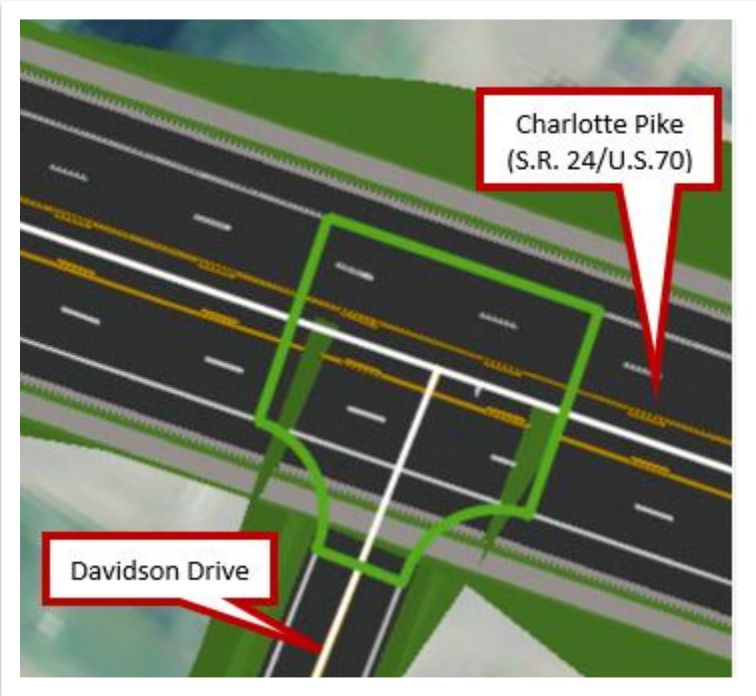


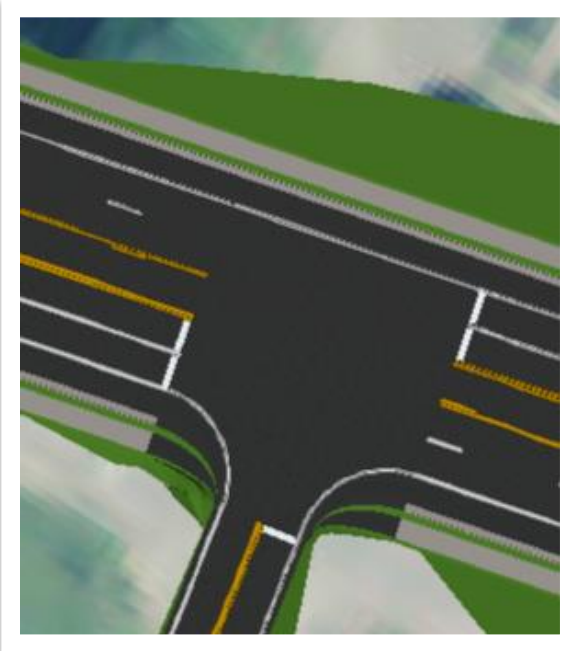
7. Notice the prompt: **Select alignment**. Select the **Davidson Drive** alignment. Notice the next prompt: **Enter first point**. **Left** click to set the point just before the **I-40** intersection (approximate Station **9+50.00**). Notice the next prompt: **Enter second point**. Drag your mouse along the **Davidson Drive** alignment to just past the I-40 intersection (approximate Station **11+50.00**). Then, click on the **Elements selection** tool to reset.

8. Use the **Rotate** tool to the view the tunnel in 3D. Once you are done reviewing, revert the **Camera Orientation** back to **Top** and rotate the view back to the **Charlotte Pike** (S.R. 24/U.S. 70) corridor.



9. Lastly, we will create an intersection at **Charlotte Pike** (S.R. 24/U.S. 70) and **Davidson Drive**. Open the **Intersection** tool (**Backstage >> Conceptualize >> Road Placement**). Notice the prompt: **Select primary road**. Select the **Charlotte Pike** (S.R. 24/U.S. 70) alignment. Notice the second prompt: **Select secondary road**. Select the **Davidson Drive** alignment. **Right** click to accept. **Note:** As a reminder, if you are unable to create the intersection, make sure that both roadway profiles are at roughly the same elevation at the crossing location.



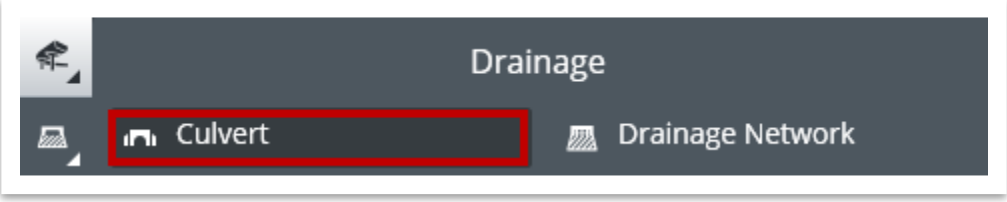


8.3 Lecture: Drainage Tools

8.3.1 Culvert Tool

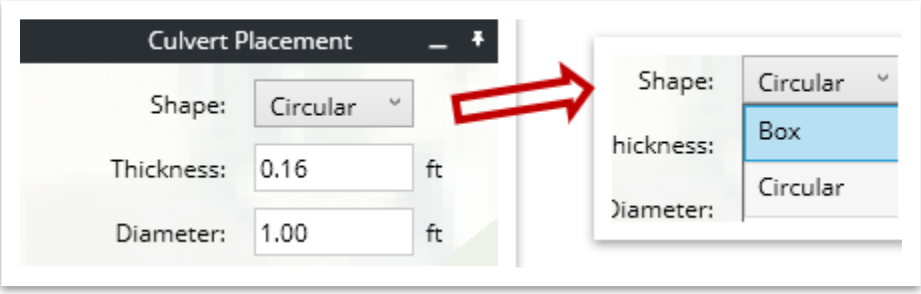
The **Culvert** tool is found within the **Drainage** tools (Figure 82). It allows the user to place a culvert crossing on an existing road alignment. The user can define the culvert **skew** relative to the roadway alignment.

FIGURE 82. CULVERT TOOL



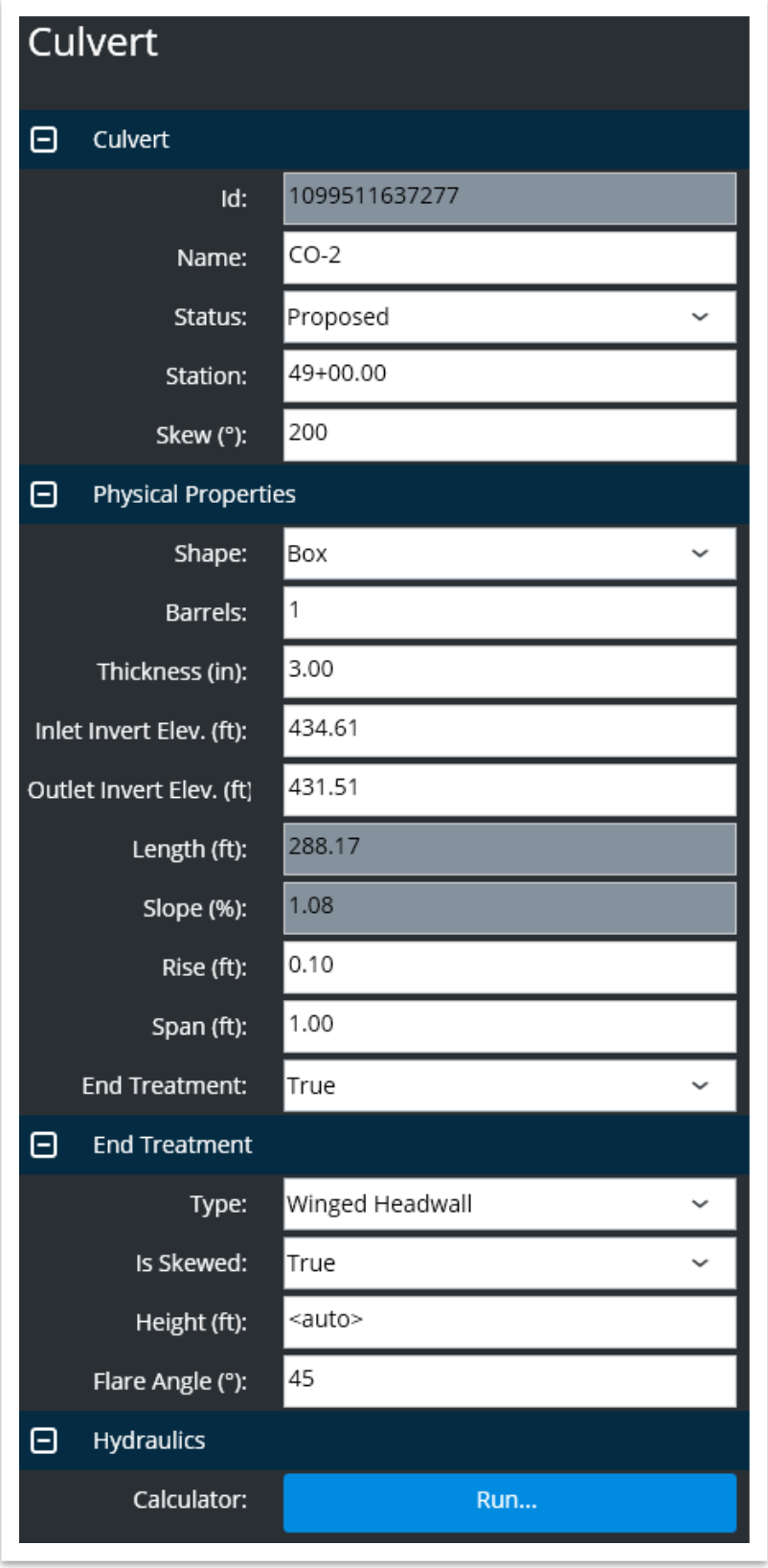
Within the dialog box, the user can select a culvert **Shape** (**Box** or **Circular**) and define the culvert **Thickness** and **Diameter** (Figure 83).

FIGURE 83. CULVERT PLACEMENT DIALOG BOX – SHAPE OPTIONS



The **Information** tab provides enhanced culvert modification capabilities including number of **Barrels**, **End Treatment** presence, **End Treatment Type** (**Winged Headwall** or **Headwall**), and the **Skew**, **Height**, and **Flare Angle** of the end treatment (Figure 84 on next page). Additionally, the hydraulic analysis can be run but this is beyond the level of detail for a TDOT conceptual model and will not be covered in this manual.

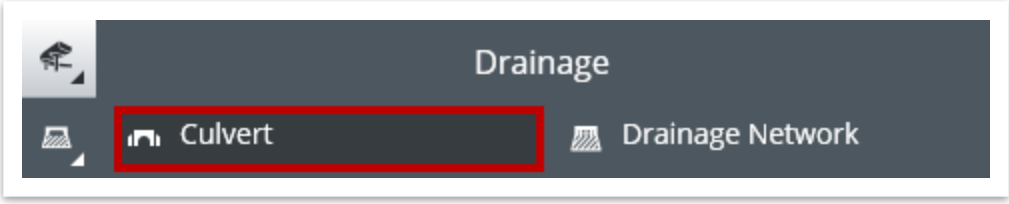
FIGURE 84. CULVERT MODIFICATION – INFORMATION TAB



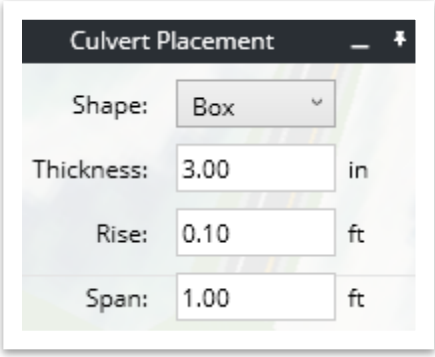
8.3.1.1 Exercise: Place a Culvert

In this exercise, we will place a box culvert under **Interstate 40** near the western bridge abutment.

1. To place a box culvert under **I-40**, open the **Culvert** tool (**Backstage >> Conceptualize >> Drainage**) and select the following settings.

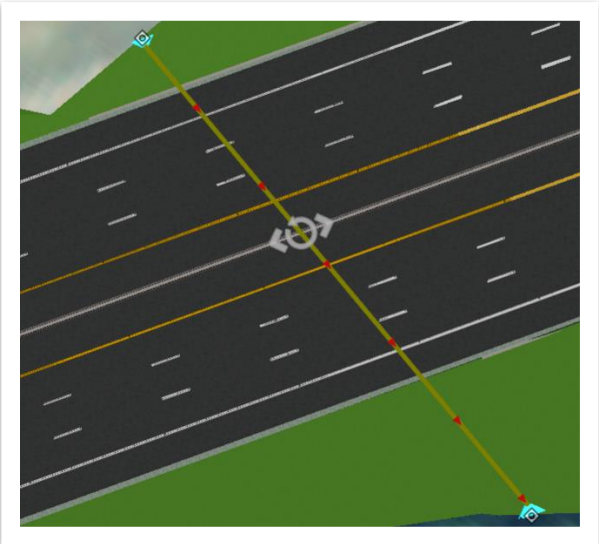


   a. **Shape:** Box
   b. **Thickness:** 3.00
   c. **Rise:** 0.10
   d. **Span:** 1.00



2. Notice the prompt: **Select alignment**. Select the **I-40** alignment (the roadway that the box culvert will cross). Notice the next prompt: **Select culvert stationing**. Move your mouse along the **I-40** alignment and select a culvert crossing location that is **yellow** and not red (approximate Station **49+00.00**). **Left** click to select the stationing.

3. Notice the next prompt: **Select culvert skew**. Move your mouse around and **left** click to accept a **200°** skew. Notice the next prompt: **Click to confirm placement and create culvert**. **Left** click again to confirm the culvert placement and give the software a minute to process. Then, click the **Elements selection** tool to reset.



Chapter 9. Furniture and Marking Tools

This chapter will discuss the roadway **furniture** and **pavement marking** tools featured in ConceptStation. This includes placement of city furniture, signals, signs, lights, guardrail, fence, sound barriers, lane striping, street markings and transverse markings.

9.1 Objectives

At the conclusion of this chapter, participants will be able to:

1. Place roadway furniture as single objects or linear features.
2. Place and update lane striping and linear markings.
3. Place street markings and transverse markings.

9.2 Lecture: Furniture Tools

9.2.1 Furniture Tool

The **Furniture** tool is found within the **Furniture** tools (Figure 85). It allows the user to place individual roadway furniture anywhere in the model.

FIGURE 85. FURNITURE TOOL

Within the dialog box, the user can define the furniture **Angle** relative to an alignment (Figure 86). Once any furniture is placed, the user can use the manipulators to move and rotate the object.

FIGURE 86. FURNITURE DIALOG BOX

The user can select from **five** furniture categories: **City Furniture** (benches, bus shelters, fire hydrants, traffic barrels/cones), **Rail Signals** (advance warning indicators, permanent speed restrictions, route indicators), **Road Signs**, **Street Lights**, and **Traffic Signals** (mast and post mounted) (Figure 87).

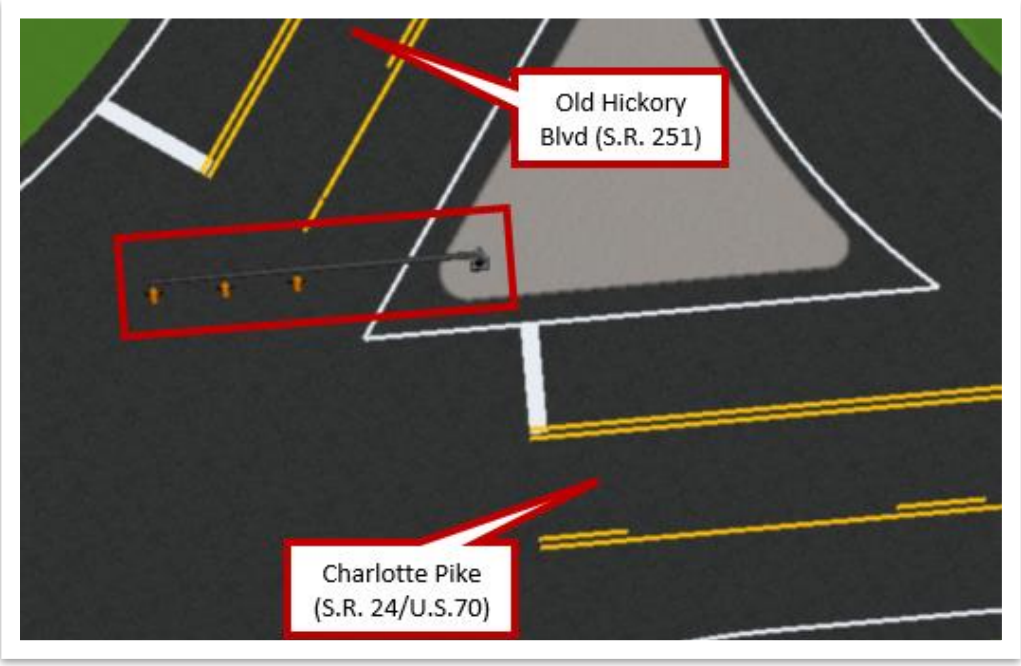
FIGURE 87. FURNITURE CATEGORIES

9.2.1.1 Exercise: Place Furniture

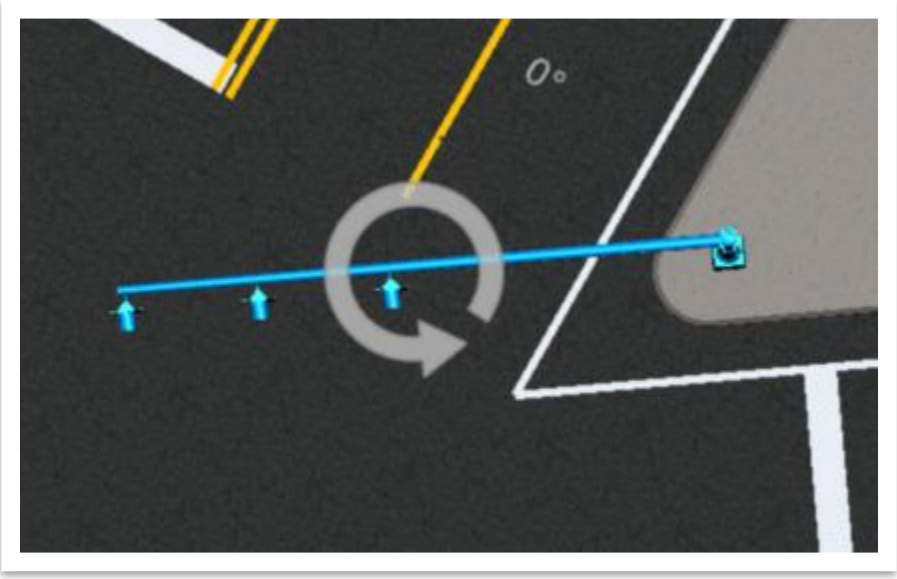
In this exercise, we will place a **traffic signal** at the southern leg of the intersection of **Charlotte Pike** (S.R. 24/U.S. 70) and **Old Hickory Boulevard** (S.R. 251).

1. Zoom in to the intersection. Open the **Furniture** tool (**Backstage >> Conceptualize >> Furniture**) and select the following settings.
    a. **Furniture:** Traffic Signal (35ft) (**Furniture >> Furniture >> Traffic Signals >> Mast Mounted Vertical**)
    b. **Angle From Alignment:** 0

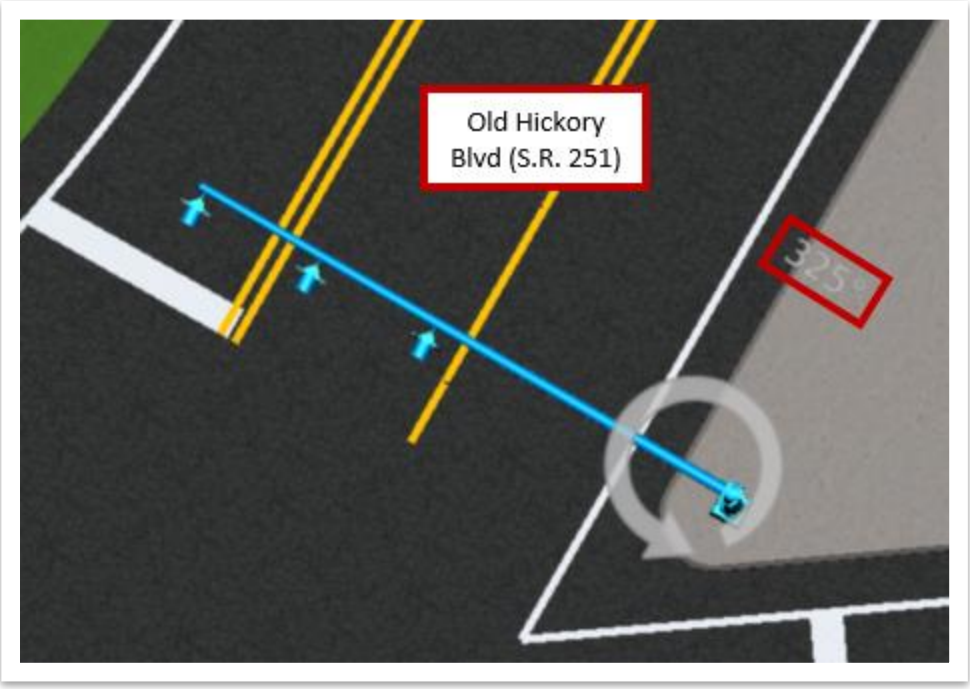
2. Hover over the **concrete island** on the **north** side of the intersection and **left** click to place the traffic signal.



3. Next, click the **Elements selection** tool to reset and then click on the traffic signal several times to cycle through the manipulation options until the **rotation arrow** appears.



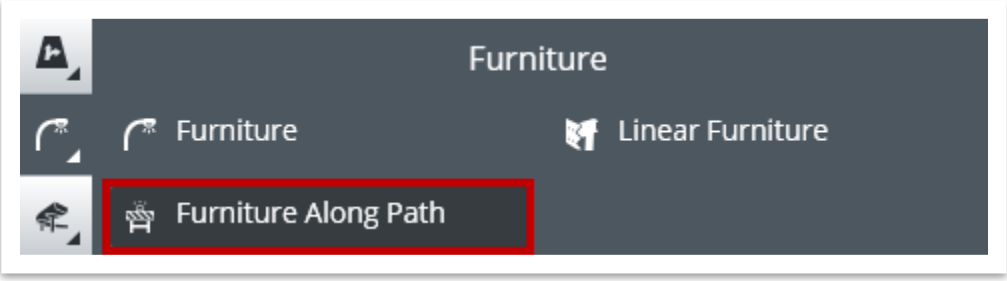
4. Rotate the traffic signal approximately **325°** to the **Old Hickory Blvd** (S.R. 251) alignment. **Note:** You can either key-in the angle or use the manipulator to manually rotate the signal to the alignment.



9.2.2 Furniture Along Path Tool

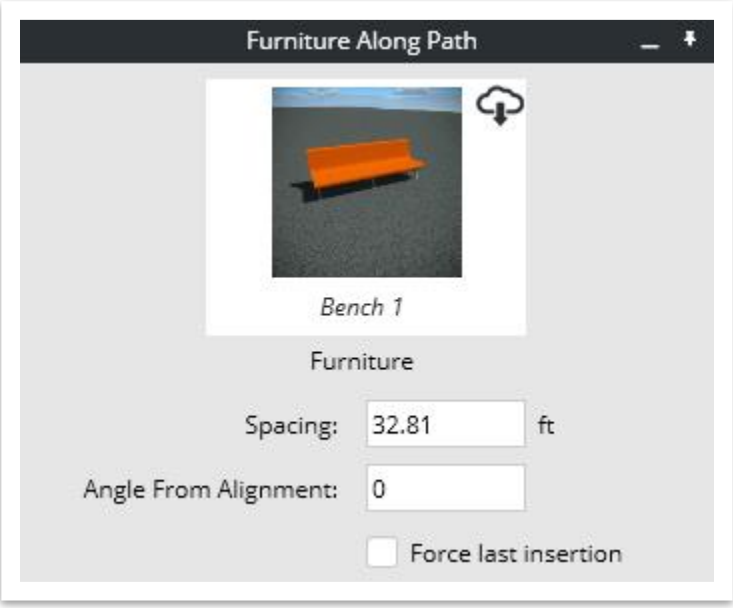
The **Furniture Along Path** tool is found within the **Furniture** tools (Figure 88). It allows the user to place furniture along a path.

FIGURE 88. FURNITURE ALONG PATH TOOL



Within the dialog box, the user can define the furniture **Spacing** and **Angle** relative to an alignment (Figure 89). If **Force last insertion** is toggled **on**, the tool will place the selected furniture at the endpoint of the path regardless of whether the minimum spacing to the previous furniture is met. The user can select from the same furniture options that are available in the other furniture tools.

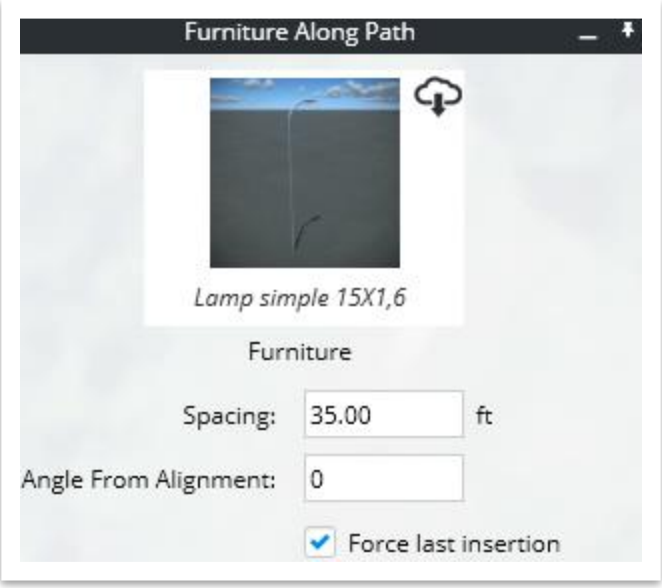
FIGURE 89. FURNITURE ALONG PATH DIALOG BOX



9.2.2.1 Exercise: Place Furniture Along Path

In this exercise, we will place lighting along **Ramp 1** at the **Interstate 40** and **Charlotte Pike** (S.R. 24/U.S. 70) interchange (Exit 201).

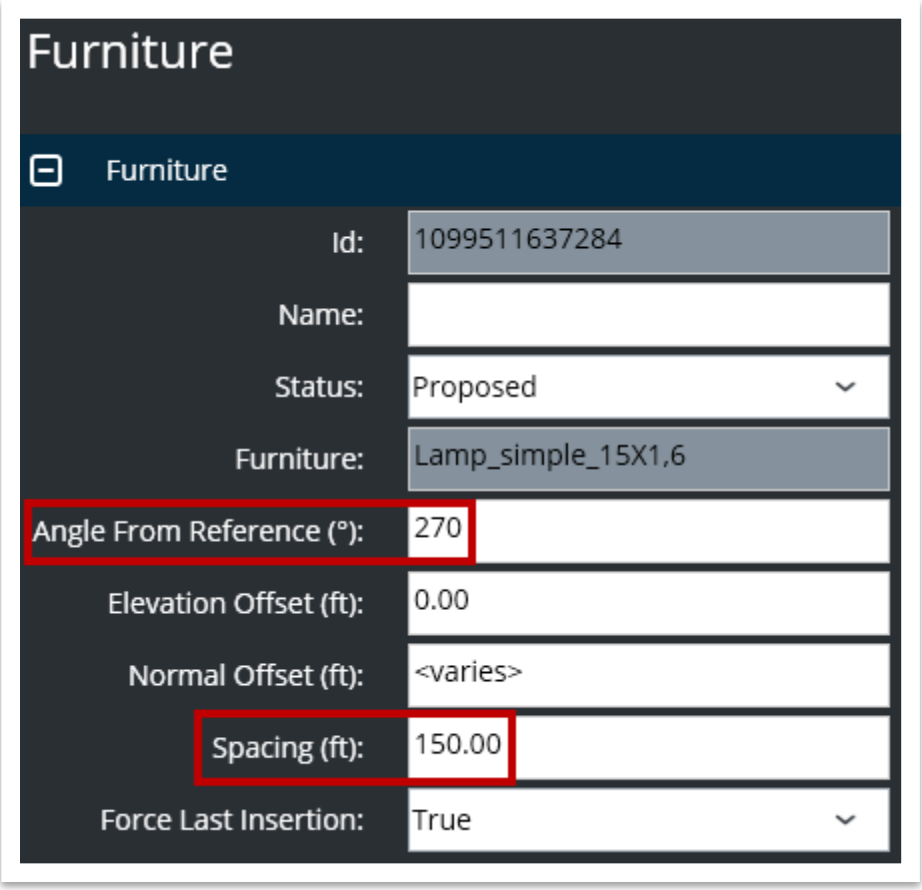
1. Zoom in to **Ramp 1** (I-40 WB off-ramp) on the **western** side of the interchange. Open the **Furniture Along Path** tool (**Backstage >> Conceptualize >> Furniture**) and select the following settings.
    a. **Furniture:** Lamp simple 15X1,6 (**Furniture >> Street Lights**)
    b. **Spacing:** 35.00 ft
    c. **Angle From Alignment:** 0
    d. **Force last insertion:** Toggled on



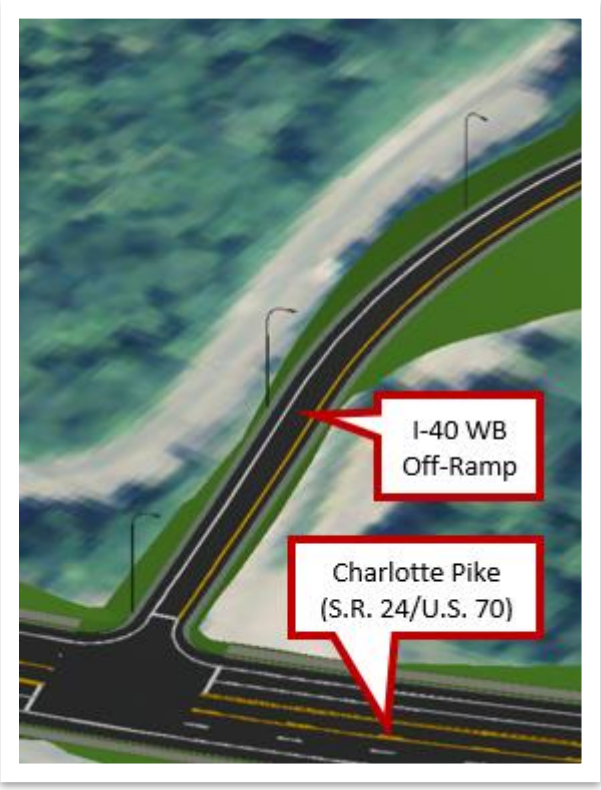
2. Notice the prompt: **Enter first control point**. **Left** click at the intersection of **Ramp 1** and **Charlotte Pike** (S.R. 24/U.S. 70).

3. Notice the next prompt: **Enter second control point**. Move your mouse to the **beginning** of the I-40 ramp and hover until you get the **green** path to follow the outside edge of the ramp. Then, **left** click to set the point and **right** click to accept.

4. The lamps should now be placed along the outside edge of the ramp. **Left** click on the lamps to open the **Information** tab. Update the **Angle From Reference (°)** from 0 to **270** degrees and the **Spacing (ft)** from 35.00 ft to **150.00** ft.



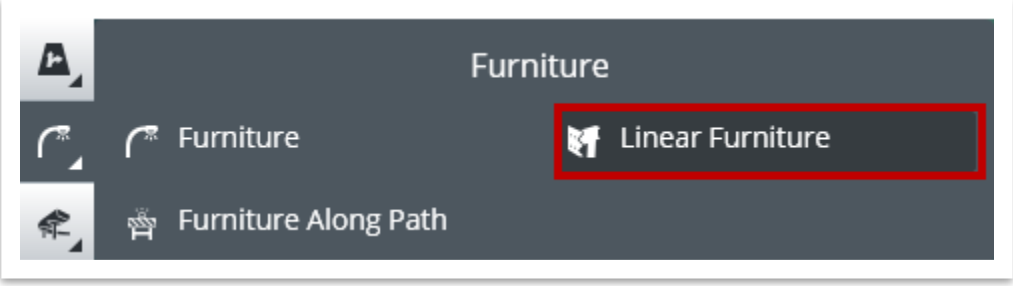
5. Use the **Rotate** tool to view the lamps placed along the ramp in 3D. Once you are done reviewing, revert the **Camera Orientation** back to **Top** and rotate the view back to the **Charlotte Pike** (S.R. 24/U.S. 70) corridor.



9.2.3 Linear Furniture Tool

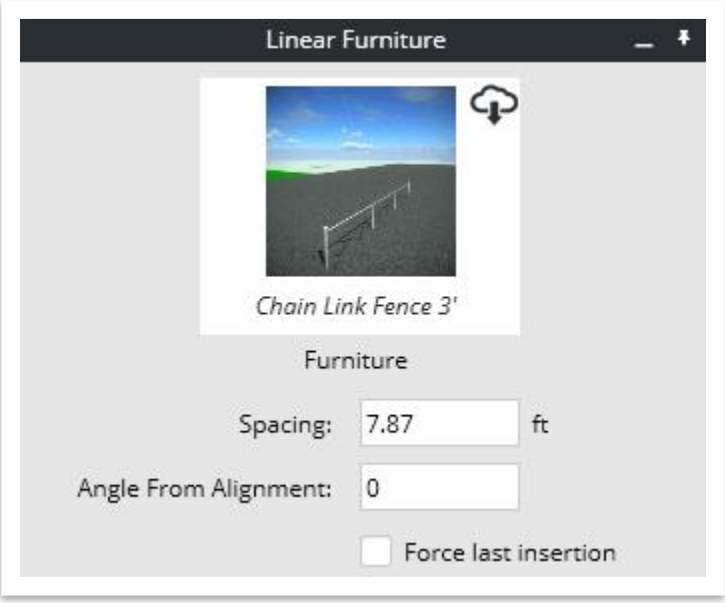
The **Linear Furniture** tool is found within the **Furniture** tools (Figure 90). It allows the user to place linear furniture.

FIGURE 90. LINEAR FURNITURE TOOL



Within the dialog box, the user can define the linear furniture **Spacing** and **Angle** relative to an alignment (Figure 91). If **Force last insertion** is toggled **on**, the tool will place the selected furniture at the endpoint of the path regardless of whether the minimum spacing to the previous furniture is met.

FIGURE 91. LINEAR FURNITURE DIALOG BOX



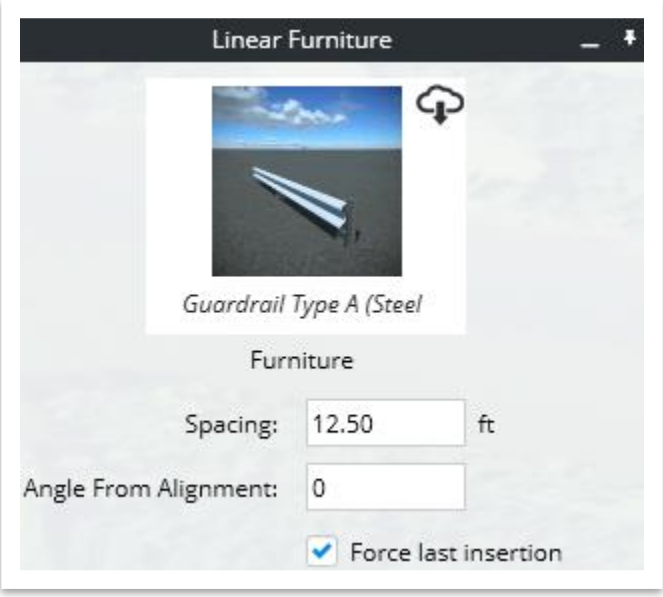
The user can select from three linear furniture categories: **Fence** (chain link), **Guardrails** (Bridge, Type A, Type B, Type BD) and **Sound Barrier** (Acrylic and Masonry) (Figure 92).

FIGURE 92. LINEAR FURNITURE CATEGORIES

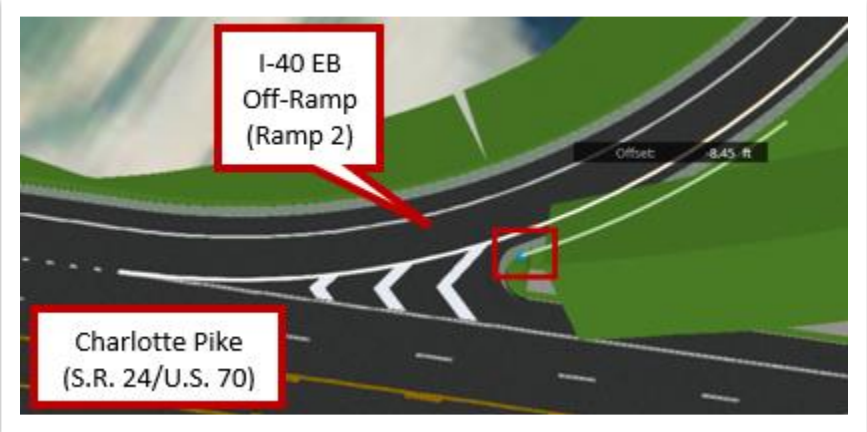
9.2.3.1 Exercise: Place Linear Furniture

In this exercise, we will place **guardrail** along **Ramp 2** at the **Interstate 40** and **Charlotte Pike** (S.R. 24/U.S. 70) interchange (Exit 201).

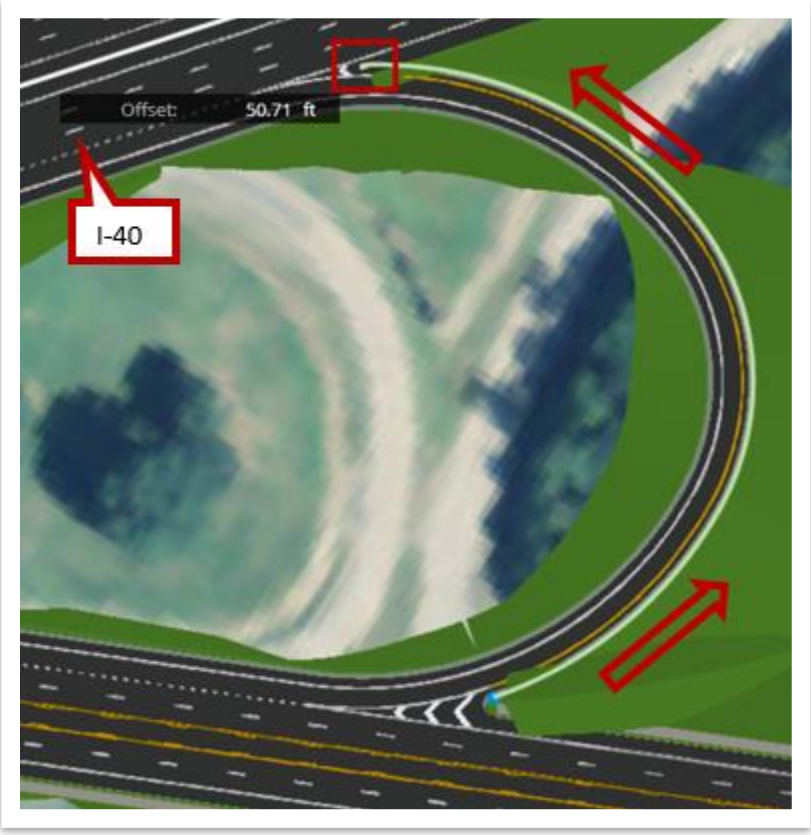
1. Zoom in to the free loop ramp (I-40 EB off-ramp) (**Ramp 2**) on the **eastern** side of the interchange. Open the **Linear Furniture** tool (**Backstage >> Conceptualize >> Furniture**) and select the following settings.
    a. **Furniture:** Guardrail Type A (Steel Post) (**Furniture >> Guardrail >> Guardrails**)
    b. **Spacing:** 12.50 ft
    c. **Angle From Alignment:** 0
    d. **Force Last Insertion:** Toggled on



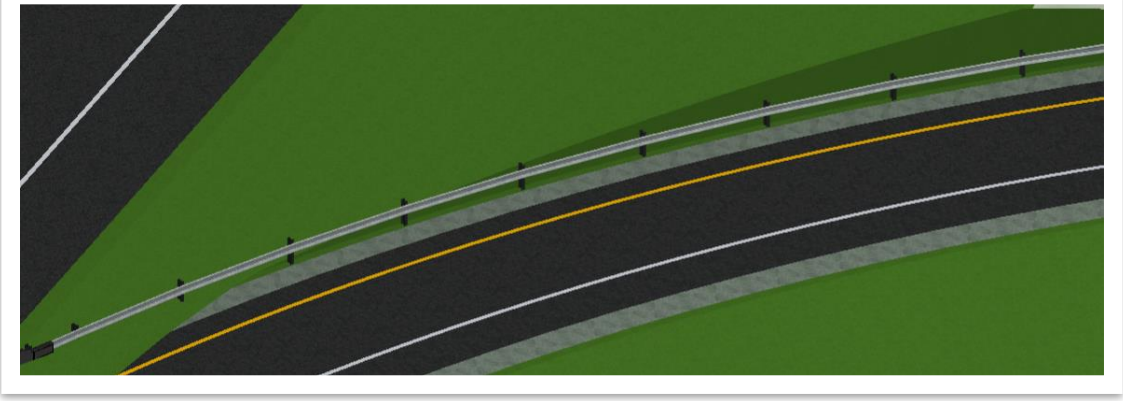
2. Notice the prompt: **Enter first control point**. **Left** click at the **gore** of **Ramp 2** at **Charlotte Pike** (S.R. 24/U.S. 70).



3. Notice the next prompt: **Enter second control point**. Move your mouse along the **outside** of the I-40 ramp and hover until you get the **green** path to follow the outside edge of the ramp. Then, **left** click to set the point just before the gore of the ramp and **right** click to accept.



4. Use the **Rotate** tool to view the guardrail placed along the ramp in 3D. Once you are done reviewing, revert the **Camera Orientation** back to **Top** and rotate the view to back to the **Charlotte Pike** (S.R. 24/U.S. 70) corridor.

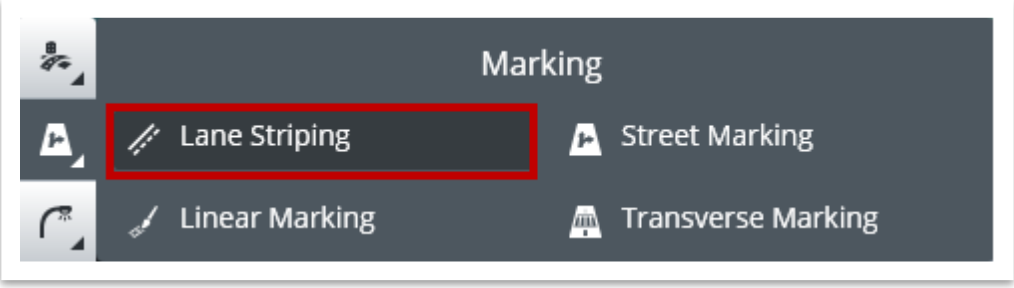


9.3 Lecture: Marking Tools

9.3.1 Lane Striping Tool

The **Lane Striping** tool is found within the **Marking** tools (Figure 93). It allows the user to modify the lane striping for a section of the road.

FIGURE 93. LANE STRIPING TOOL



Within the dialog box (Figure 94), the user can select from **25** different types of lane striping **Patterns**, which include both one-way and two-way options (Figure 95 on next page).

FIGURE 94. LANE STRIPING DIALOG BOX

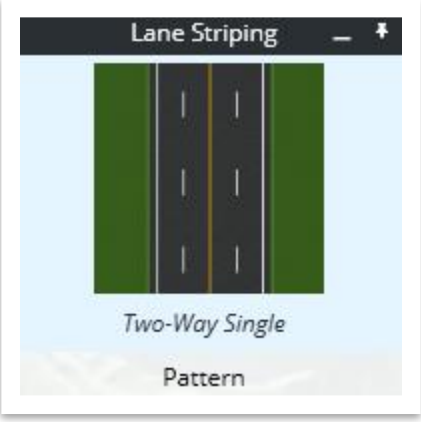
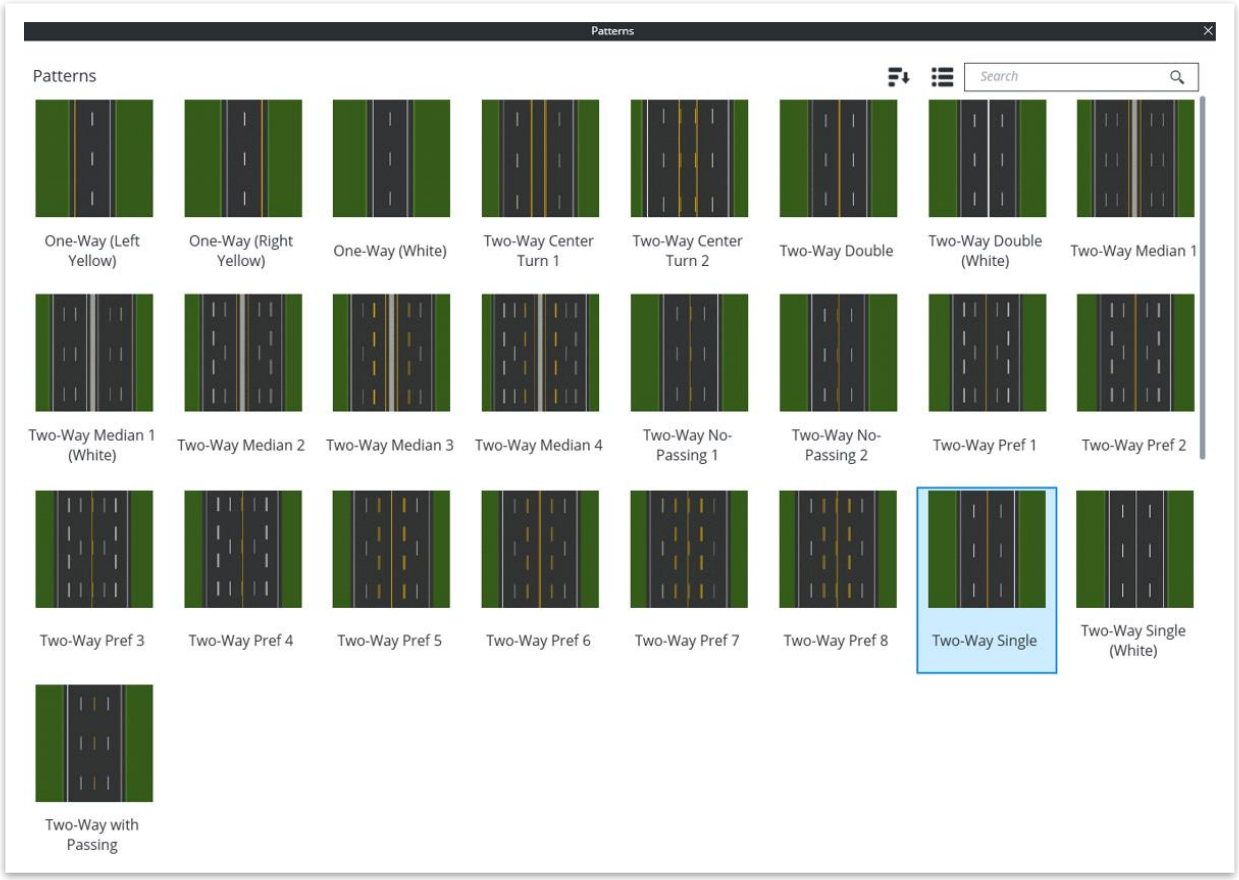


FIGURE 95. LANE STRIPING OPTIONS



9.3.1.1 Exercise: Modify Lane Striping

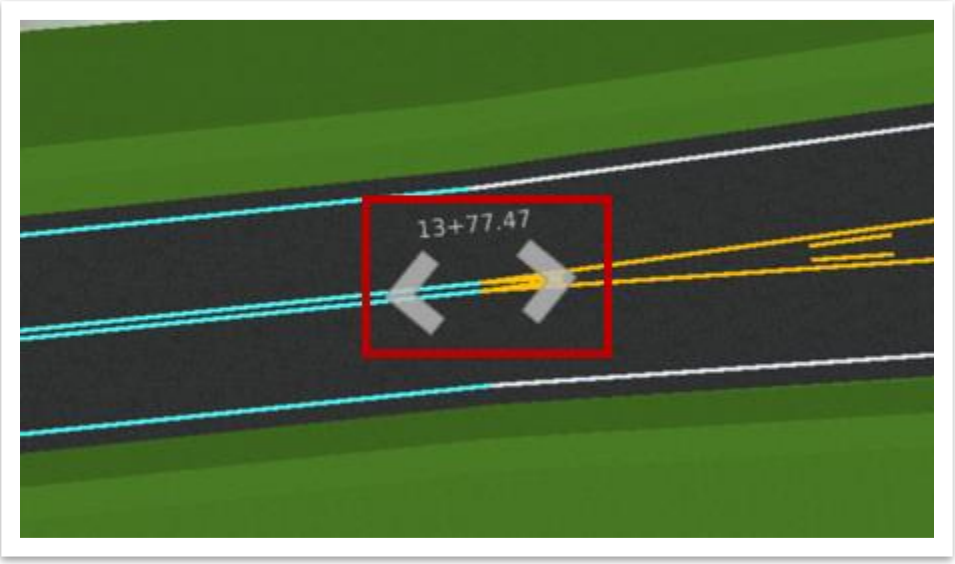
In this exercise, we will be modifying the lane striping at several locations where the striping template is incorrect. **Note:** As mentioned in Exercise 7.4.1 the **Modify Road Template** tool does not update striping in the sections with the updated templates. Bentley has logged a defect for this issue, and the workaround is to use the **Modify Lane Striping** tool to fix the striping in these sections.

1. Zoom in to the **Charlotte Pike** (S.R. 24/U.S. 70) segment **west** of the **Old Hickory Blvd** (S.R. 251) intersection. Notice how the **DSYL** striping is missing along the centerline.

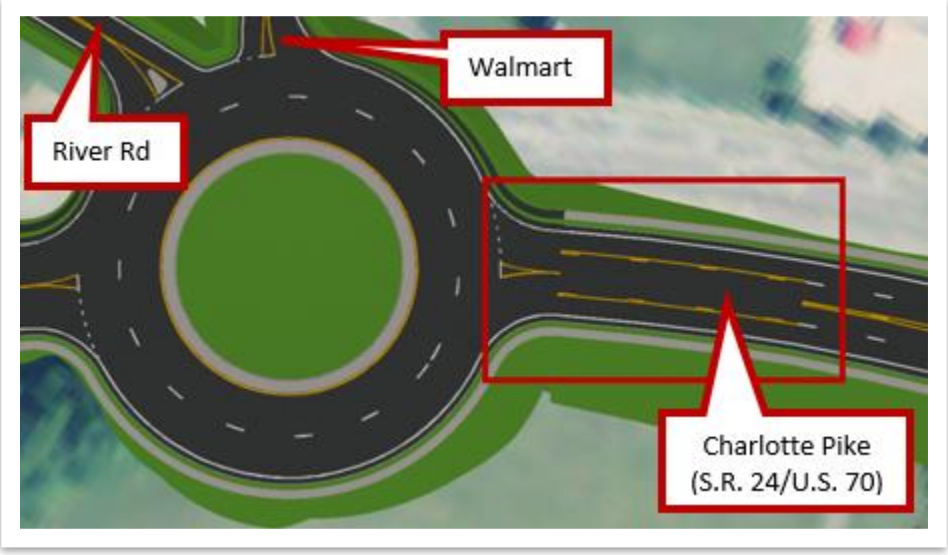
2. Open the **Lane Striping** tool (**Backstage >> Conceptualize >> Marking**) and select the **Two-Way Double** pattern.

3. Notice the prompt: **Select road alignment**. Select the **Charlotte Pike** (S.R. 24/U.S. 70) alignment. Notice the next prompt: **Enter first point**. **Left** click to set the point at the **beginning** of the alignment. Notice the next prompt: **Enter second point**. **Left** click to set the point before the **turn lane taper**.

4. Once the striping has been placed, you can select the striping and change the extents using the manipulator arrows, if necessary.

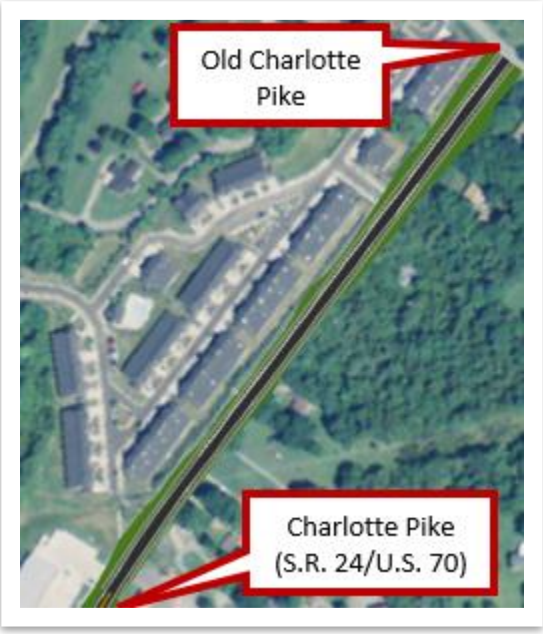


5. Next, zoom in to the **Charlotte Pike** (S.R. 24/U.S. 70) segment just **east** of the roundabout with **River Road** and **Walmart**.



6. With the **Lane Striping** tool (**Two-Way Double** pattern) still active, select the **Charlotte Pike** (S.R. 24/U.S. 70) alignment. **Left** click to set the first point at the tip of the roundabout **gore** and then **left** click to set the second point at the start of the **taper** for the center turn lane.

7. Now zoom in to the **Old Hickory Blvd** (S.R. 251) segment between **Old Charlotte Pike** and **Charlotte Pike** (S.R. 24/U.S. 70).

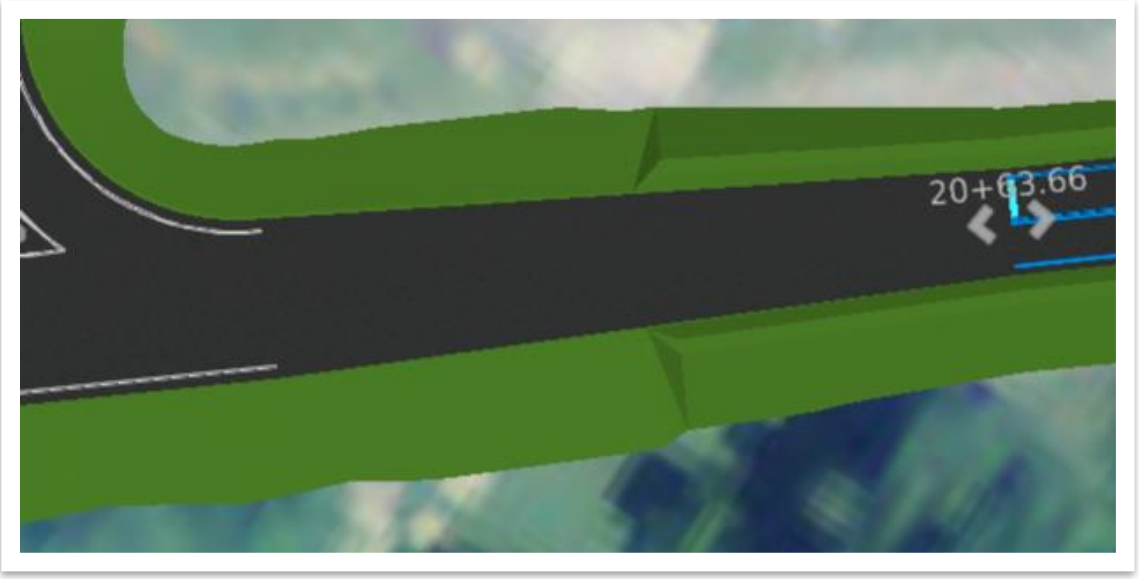


8. With the **Lane Striping** tool (**Two-Way Double** pattern) still active, select the **Old Hickory Blvd** (S.R. 251) alignment. **Left** click to set the first point at the **beginning** of the alignment and then **left** click to set the second point at the start of the **taper** for the center turn lane.

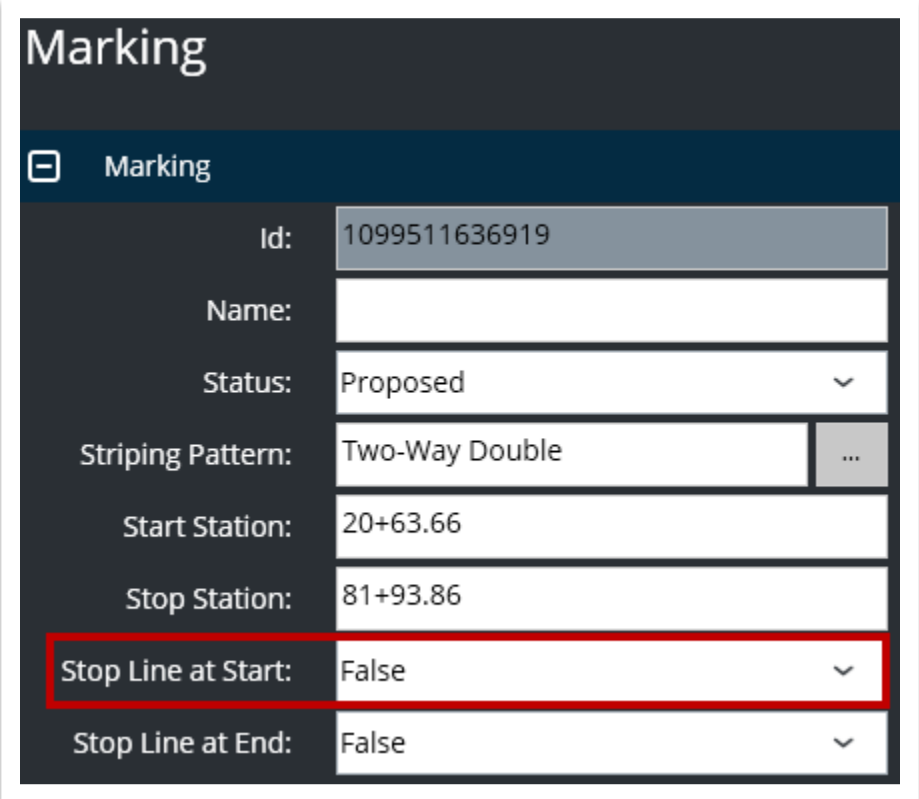
9. Once the striping has been placed, you can select the striping and change the extents using the manipulator arrows, if necessary.

10. Lastly, zoom in to the **Charlotte Pike** (S.R. 24/U.S. 70) segment just **east** of the **Old Hickory Blvd** (S.R. 251) intersection.

11. Select the striping and use the manipulator arrows to move the extent back to where the pavement starts transitioning for the added lane.

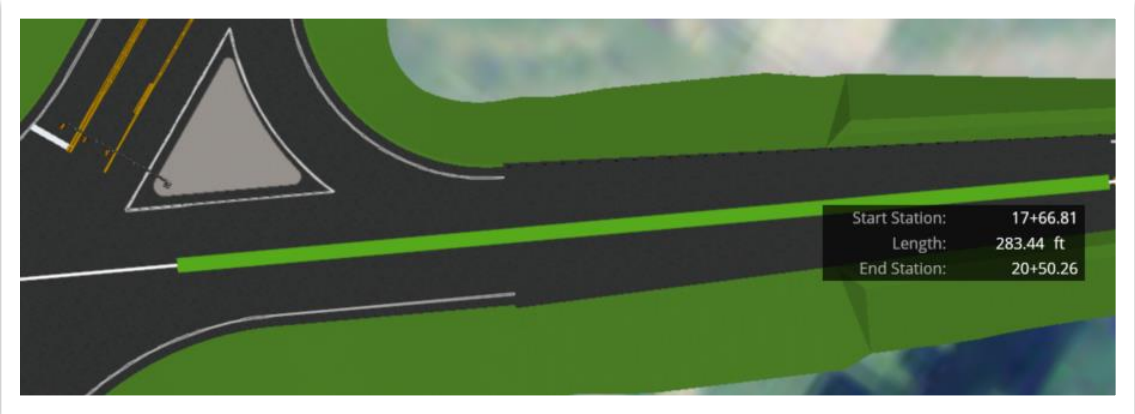


12. With the striping still selected, update the **Stop Line at Start** setting to **False** in the **Information** tab.

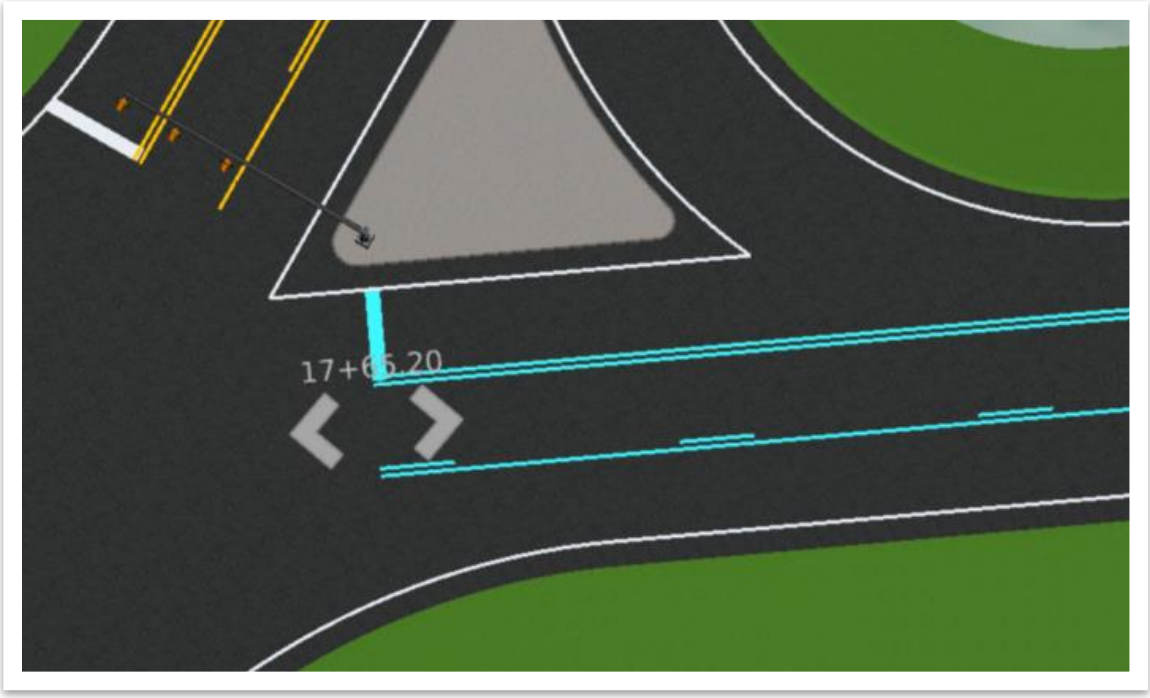


13. Open the **Lane Striping** tool (**Backstage >> Conceptualize >> Marking**) and select the **Two-Way Center Turn 2** pattern.

14. Select the **Charlotte Pike** (S.R. 24/U.S. 70) alignment. **Left** click to set the first point towards the left point of the **traffic island** and then **left** click to set the second point at the start of the **pavement transition** for the added lane (to meet the striping that was pulled back in Step 11).



15. Select the striping and use the manipulator arrows to extend the striping to the left point of the traffic island.



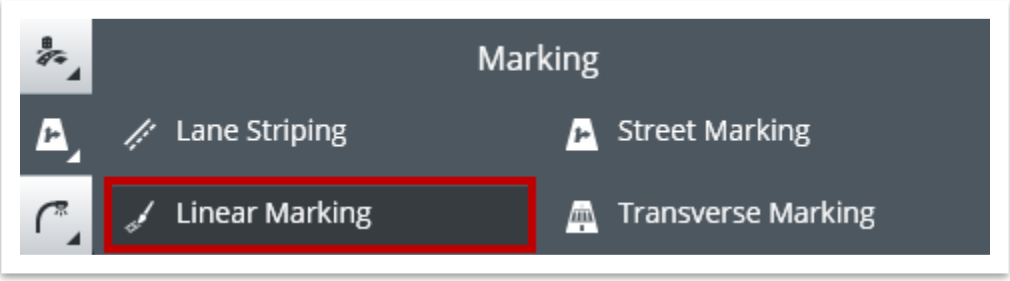
Take Note!

Notice that the intersection striping (turn lanes, approaches, etc.) is still not correct in the model. Since pavement striping in ConceptStation is tied to roadway templates, there is limited customization capabilities, particularly at intersections where the striping may not follow a predefined striping style from the library within ConceptStation. The current workaround to refine the intersection striping is to pull back the striping template out of the intersection and manually draw the lane striping using the ***Linear Marking*** *tool described in the next section (Lecture 9.3.2). The predefined striping styles are set within a striping definition* ***.xml*** *file. As described in Lecture 4.4.2, custom striping style files can be imported into ConceptStation to offer more custom options for intersection striping.*

9.3.2 Linear Marking Tool

The **Linear Marking** tool is found within the **Marking** tools (Figure 96). It allows the user to place linear striping along the roadway.

FIGURE 96. LINEAR MARKING TOOL



Within the dialog box (Figure 97), the user can select from **nine** different types of **Stripes**, which include both yellow and white options (Figure 98).

FIGURE 97. LINEAR MARKING DIALOG BOX

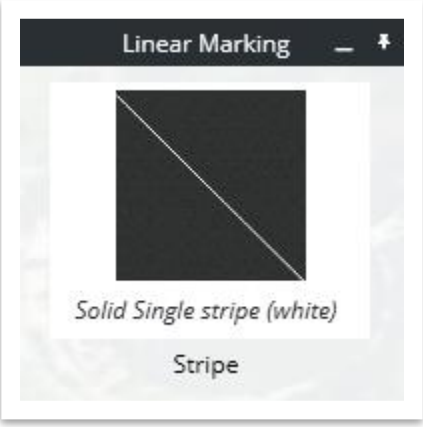
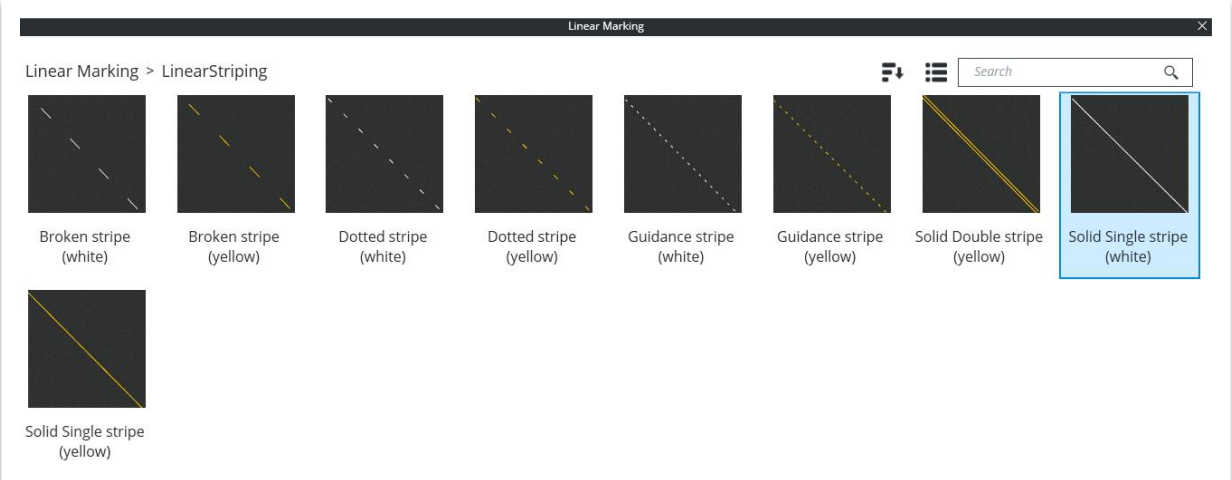


FIGURE 98. LINEAR MARKING OPTIONS

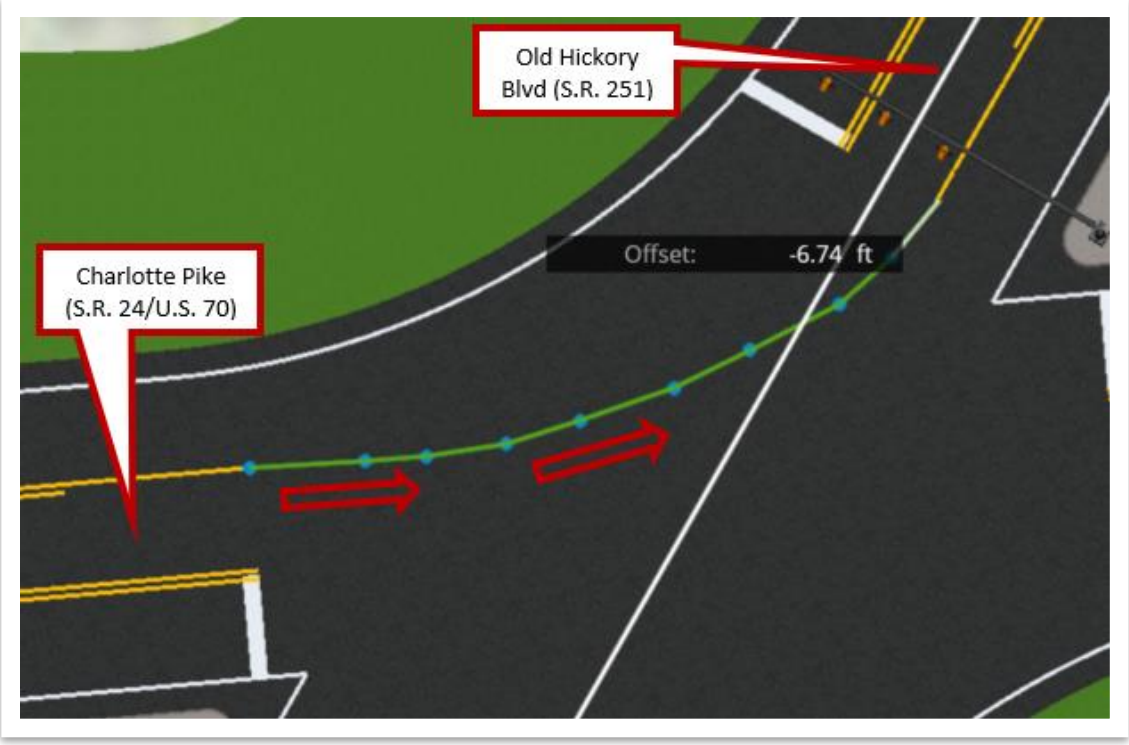


9.3.2.1 Exercise: Place Linear Marking

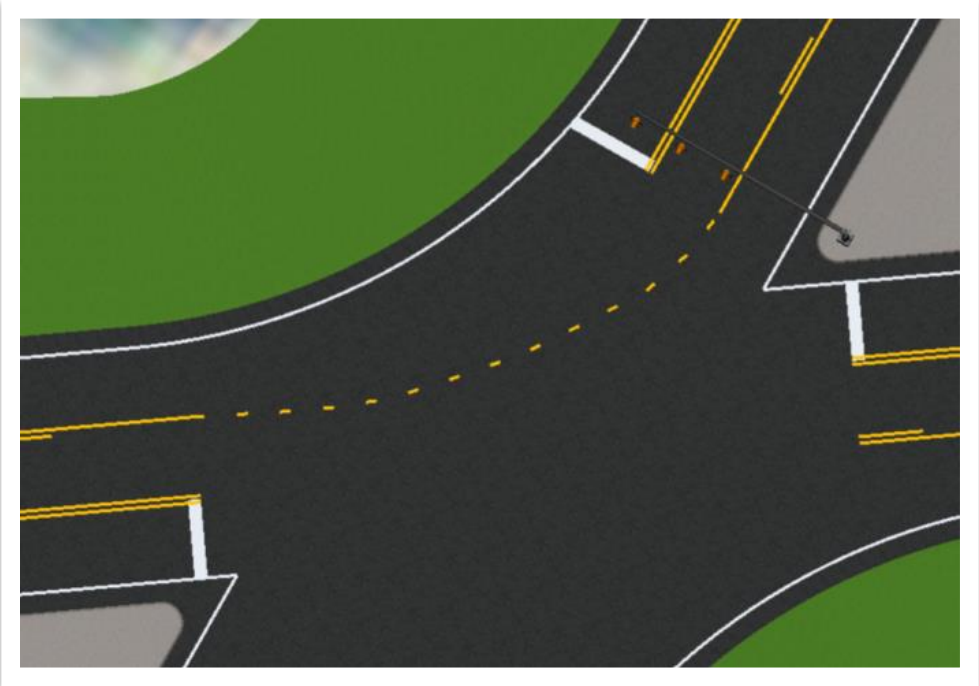
In this exercise, we will place **yellow guidance striping** for the **Charlotte Pike** (S.R. 24/U.S. 70) left turn lanes at the **Old Hickory Boulevard** (S.R. 251) intersection.

1. Open the **Linear Marking** tool (**Backstage >> Conceptualize >> Marking**) and select the **Guidance stripe (yellow)** stripe.

2. Notice the prompt: **Enter first control point**. **Left** click to set the point at the **left turn lane** on the western leg. Continue to **left** click to add more control points to connect to the northbound lane of the northern leg.



3. **Right** click to accept and notice the **guidance stripe** for the turning lane has been placed. You can select the striping and edit the **control points** using the manipulator arrows, if necessary.

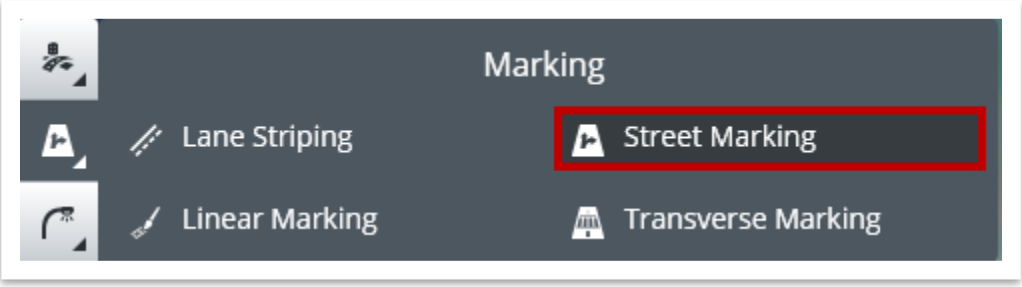


4. Repeat the same process for the **left turn lane** on the eastern leg, as shown below.

9.3.3 Street Marking Tool

The **Street Marking** tool is found within the **Marking** tools (Figure 99). It allows the user to place street markings on the roadway.

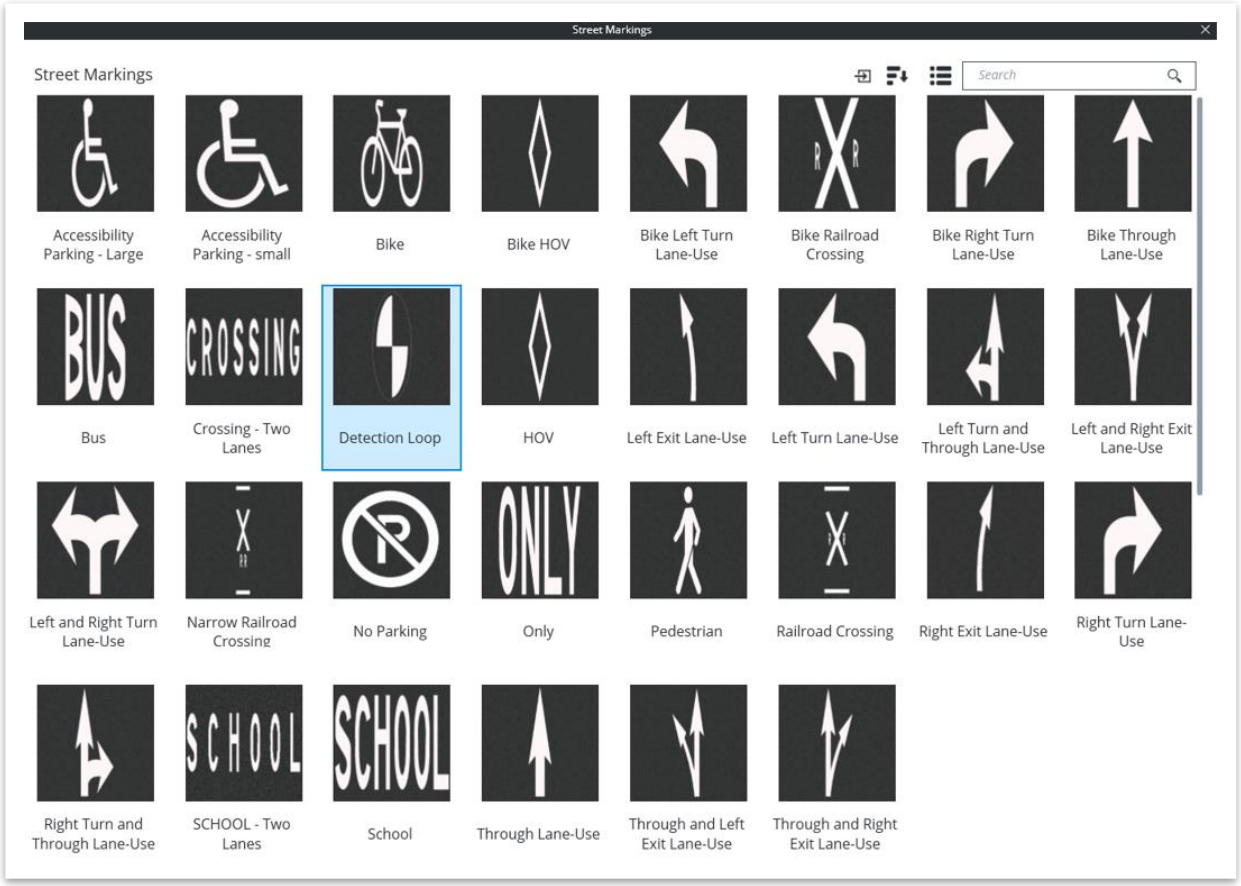
FIGURE 99. STREET MARKING TOOL



Within the dialog box (Figure 100), the user can select from **30** different types of **Markings**, which include symbols, arrows, and words (Figure 101 on next page). Once any markings are placed, the user can use the manipulators to edit the placement and move the marking along the alignment or perpendicular.

FIGURE 100. STREET MARKING DIALOG BOX

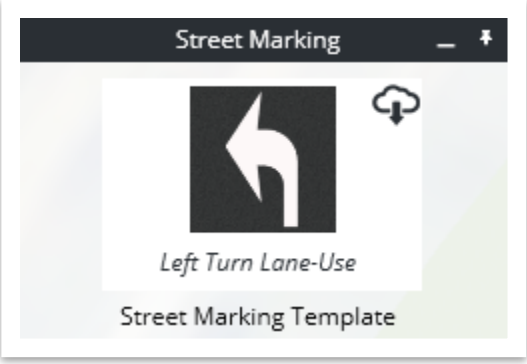
FIGURE 101. STREET MARKING OPTIONS



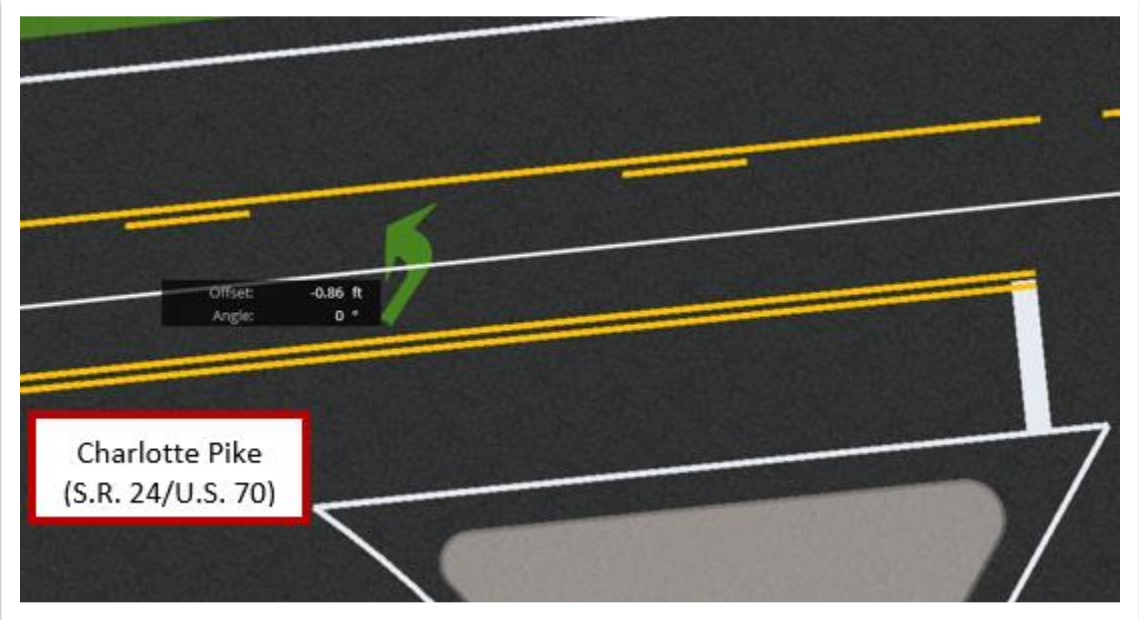
9.3.3.1 Exercise: Place Street Marking

In this exercise, we will be placing **left turn arrows** for the **Charlotte Pike** (S.R. 24/U.S. 70) left turn lanes at the **Old Hickory Boulevard** (S.R. 251) intersection.

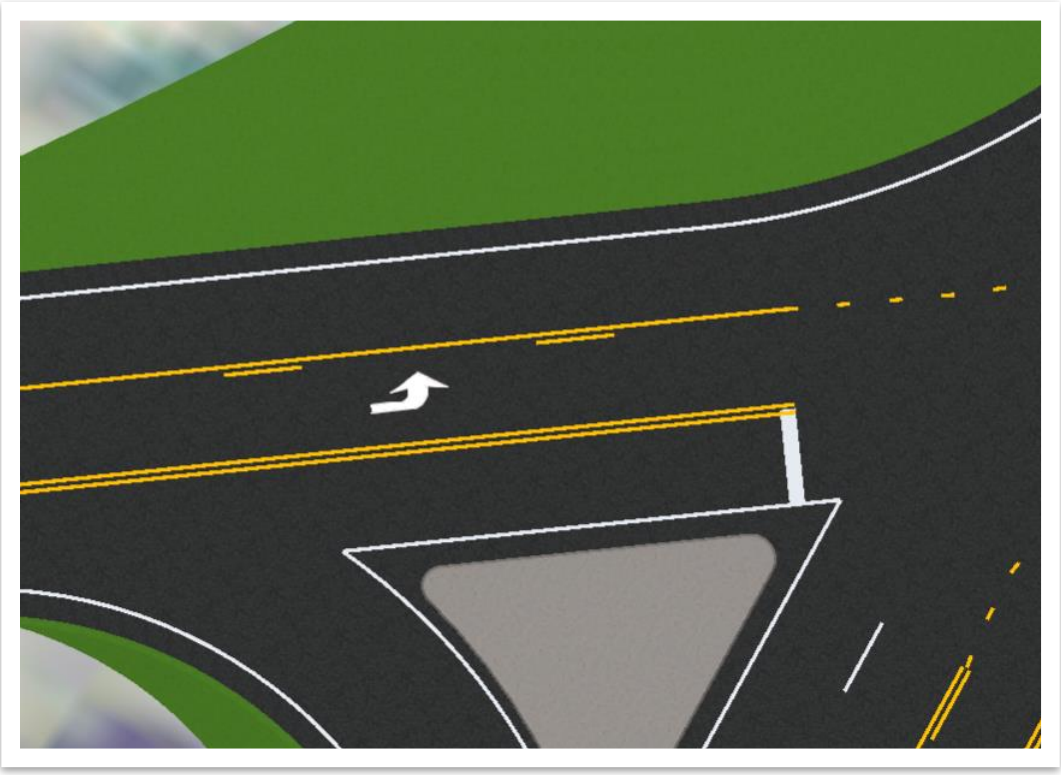
1. Open the **Street Marking** tool (**Backstage >> Conceptualize >> Marking**) and select the **Left Turn Lane-Use** street marking template.



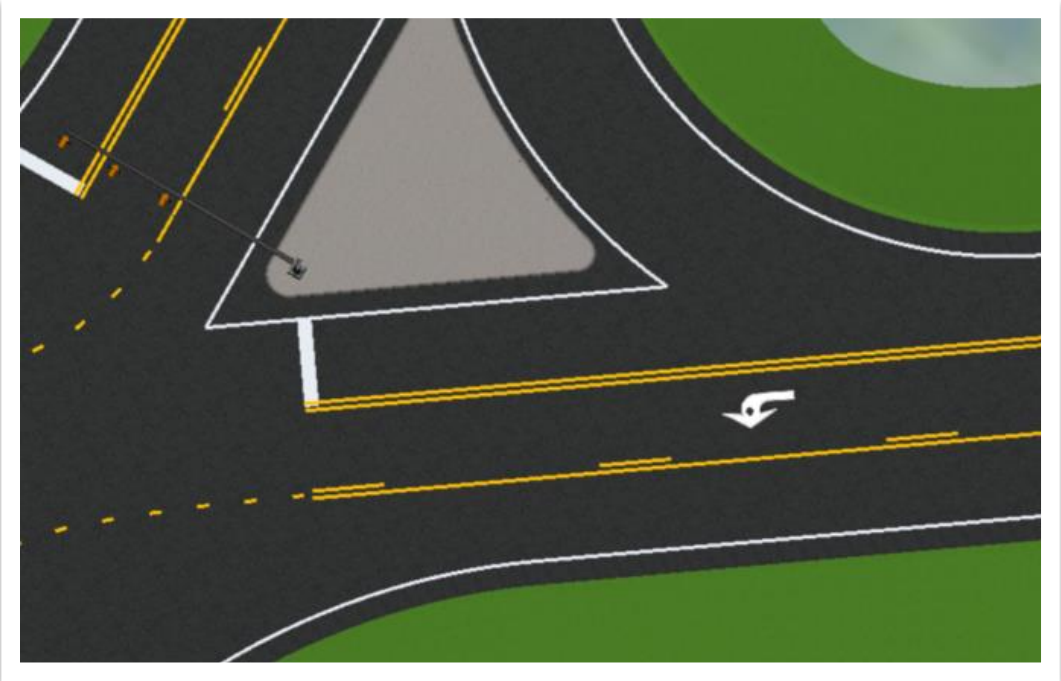
2. Notice the prompt: **Pick a roadway element to position the geometry**. **Left** click in the **left turn lane** on the western leg of the intersection.



3. Notice the next prompt: **Move around geometry and click to set its orientation**. Move your cursor around and notice the different orientations of the arrow. Once oriented correctly, **left** click to place.



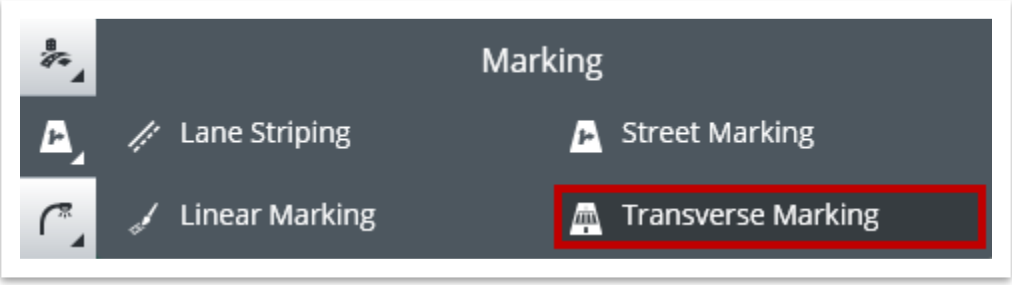
4. Repeat the same process for the **left turn lane** on the eastern leg, as shown below.



9.3.4 Transverse Marking Tool

The **Transverse Marking** tool is found within the **Marking** tools (Figure 102). It allows the user to place transverse pavement markings for pedestrian crossings.

FIGURE 102. TRANSVERSE MARKING TOOL



Within the dialog box (Figure 103), the user can select from **six** different types of **Markings**, which include transverse pedestrian/bike crossings and a stop line (Figure 104).

FIGURE 103. TRANSVERSE MARKING DIALOG BOX

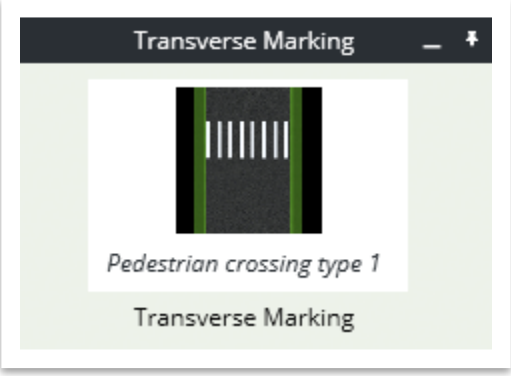
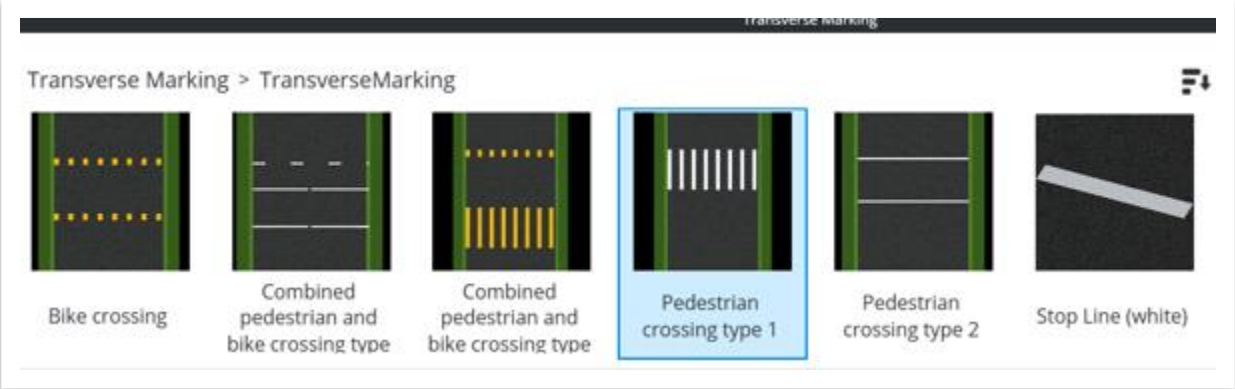


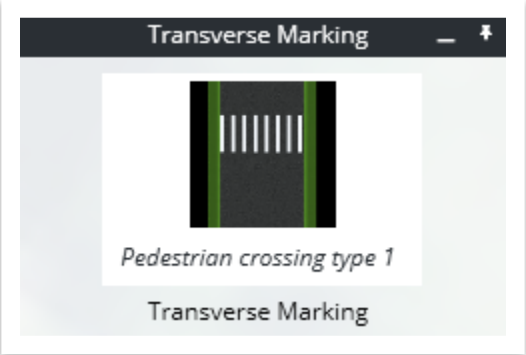
FIGURE 104. TRANSVERSE MARKING OPTIONS



9.3.4.1 Exercise: Place Traverse Pavement Marking

In this exercise, we will place a **crosswalk** at the intersection of **Charlotte Pike** (S.R. 24/U.S. 70) and **Davidson Drive**.

1. Zoom in to the intersection. Open the **Transverse Marking** tool (**Backstage >> Conceptualize >> Marking**) and select the **Pedestrian crossing type 1** transverse marking.



2. Notice the prompt: **Select alignment**. Select the **Charlotte Pike** (S.R. 24/U.S. 70) alignment. Notice the next prompt: **Enter first control point**. **Left** click to set the point on the western leg of the intersection.

3. Notice the next prompt: **Enter second control point**. **Left** click to set the point on the eastern leg of the intersection to complete the crossing.

Chapter 10. Miscellaneous Tools

This chapter will discuss the **miscellaneous tools** featured in ConceptStation, which include Cad modeling, measure, and grading tools.

10.1 Objectives

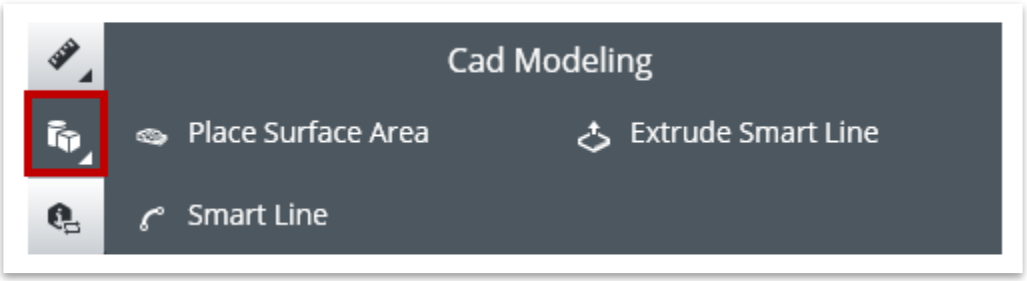
At the conclusion of this chapter, participants will be able to:

1. Place surface areas in the conceptual model.
2. Place and extrude smart lines in the conceptual model.
3. Measure distance, location, areas, and bridge clearances of existing and proposed roadways.
4. Apply grading tools to roadway corridors and optimize cut/fill volumes.

10.2 Lecture: CAD Modeling Tools

Within the Backstage under **Conceptualize**, the **Cad Modeling** tools can be found under the seventh icon within the tool menu. There are **three** cad modeling tools (Figure 105). These tools will mainly be used to supplement the transportation elements (roads, bridges, etc.) that are placed with the tools covered in the preceding chapters. They can be helpful for visualization and public outreach to display non-transportation elements in 3D, such as buildings, fences, ponds, etc. that are adjacent to the corridors.

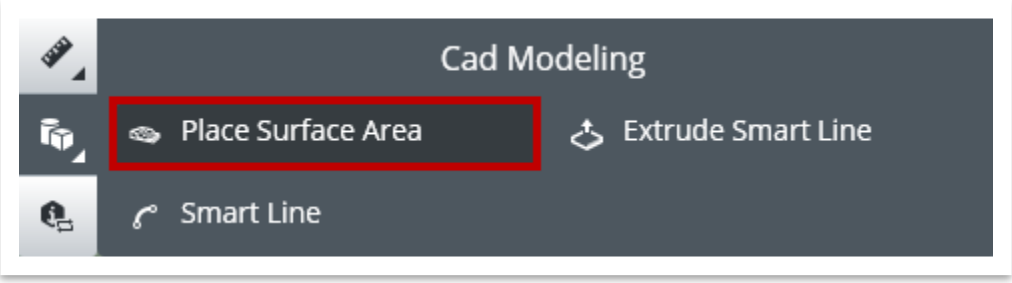
FIGURE 105. CAD MODELING TOOLS



10.2.1 Place Surface Area Tool

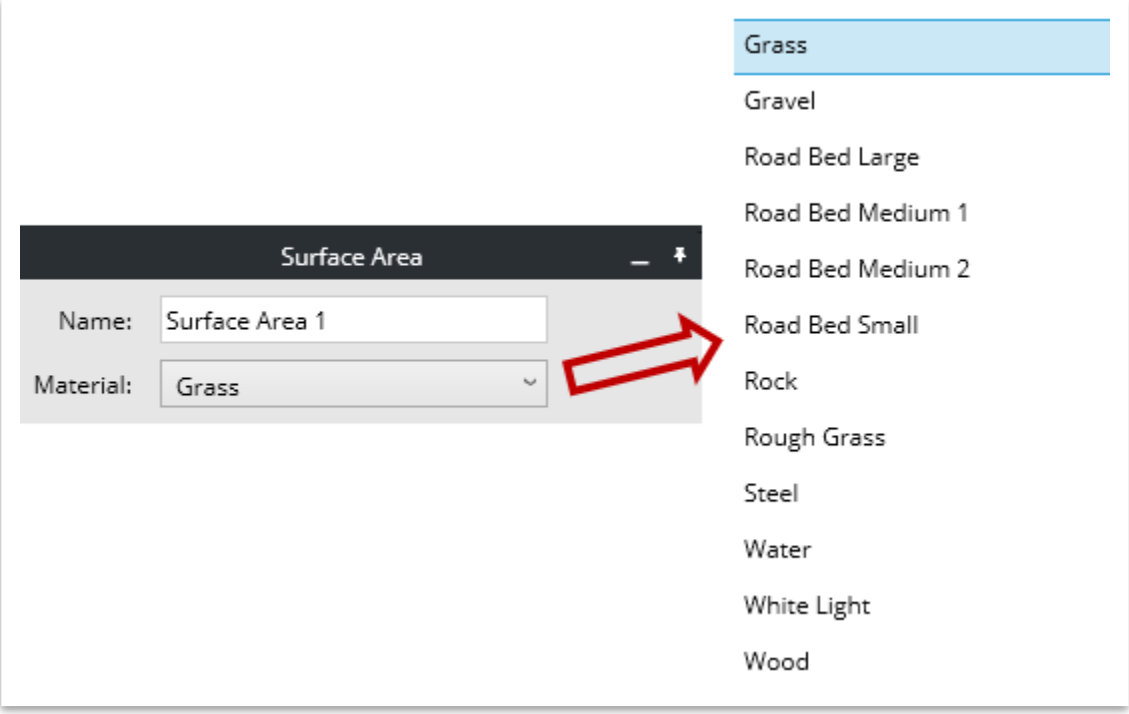
The **Place Surface Area** tool is found within the **Cad Modeling** tools (Figure 106). It allows the user to place a 2D area on top of the terrain imagery and attach a material to the area.

FIGURE 106. PLACE SURFACE AREA TOOL



Within the dialog box, the user can name the surface area and select from **twelve** different types of **Materials** (Figure 107).

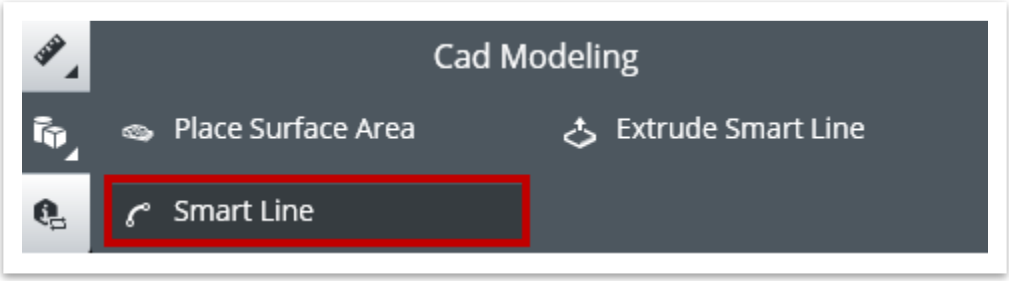
FIGURE 107. SURFACE AREA DIALOG BOX – MATERIAL OPTIONS



10.2.2 Smart Line Tool

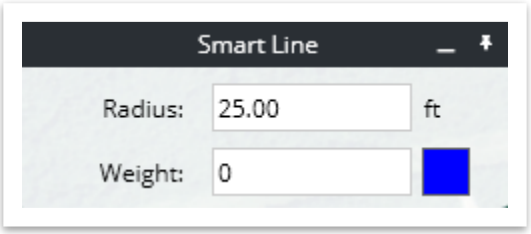
The **Smart Line** tool is found within the **Cad Modeling** tools (Figure 108). It allows the user to place a smart line as a linear element or a closed 2D shape.

FIGURE 108. SMART LINE TOOL



Within the dialog box, the user can define a color for the line or shape, as well as the radii if curves need to be added to the element (Figure 109). Once placed, the smart line can be draped on the terrain or proposed roadway. Additionally, closed shapes can be filled and a material can be assigned to them to override the previously defined color. These changes can be made in the **Information** tab once the smart line is selected.

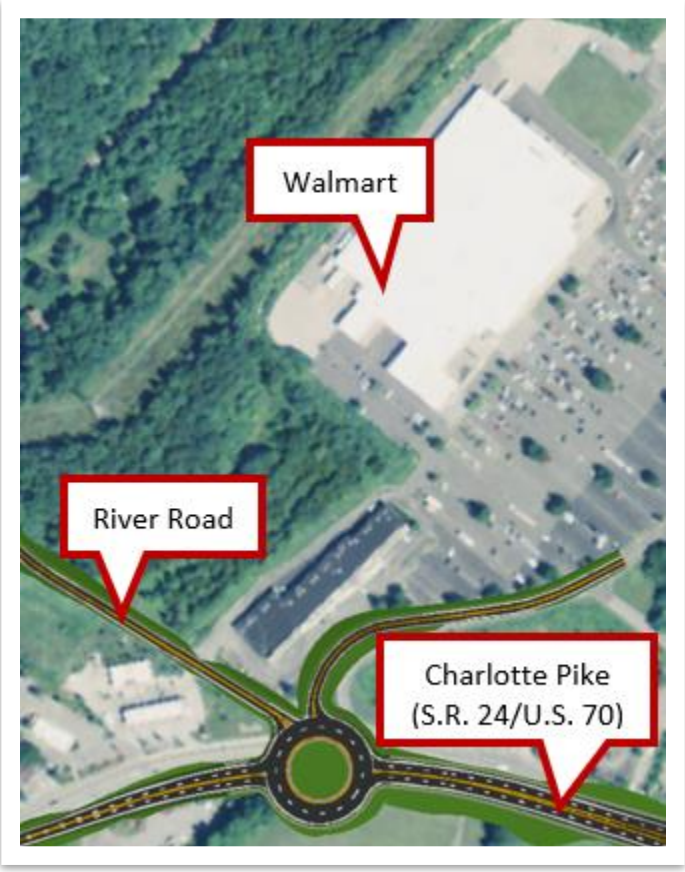
FIGURE 109. SMART LINE DIALOG BOX



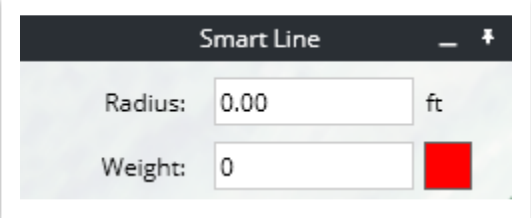
10.2.2.1 Exercise: Place Smart Line

In this exercise, we will place a closed shape to represent the **Walmart** near the roundabout.

1. Zoom in to the **Walmart** building north of the roundabout.

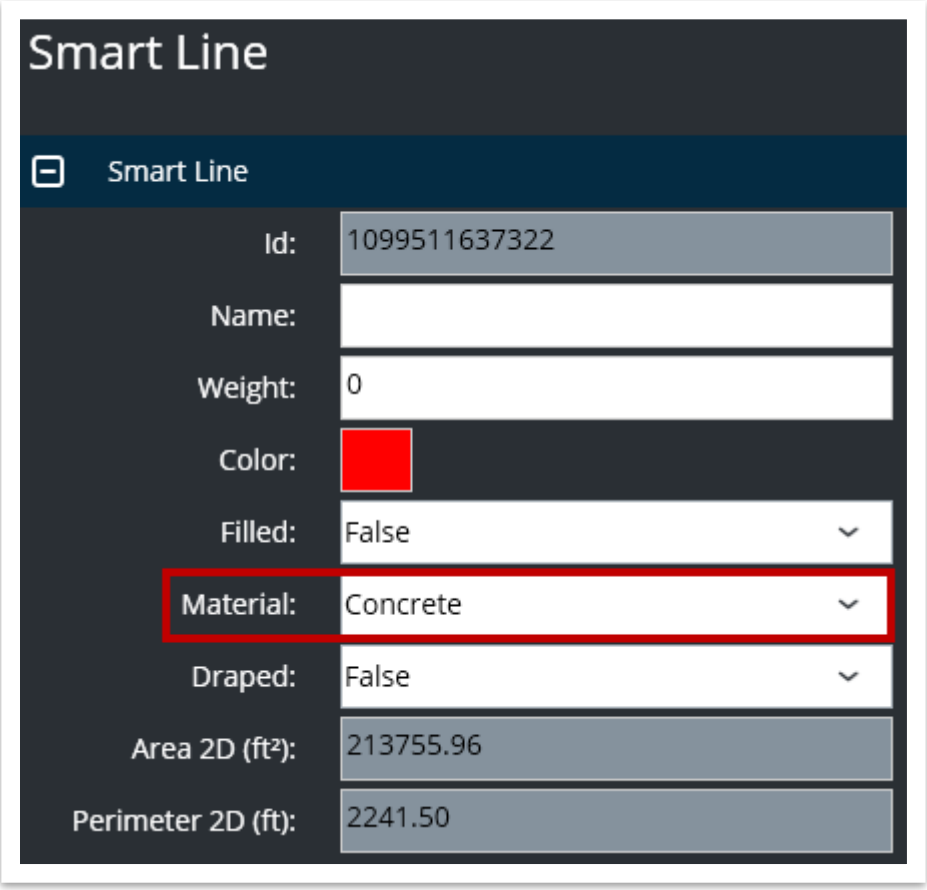


2. Open the **Smart Line** tool (**Backstage >> Conceptualize >> Cad Modeling**). Set the **Radius** to **0.00** ft and click on the color box to change the color to **red**, if not already selected.



3. Notice the prompt: **Enter first point. Left** click along the corners of the building shown in the aerial imagery to create a closed shape. **Note:** Although the drawn shape appears incomplete, it is correct. Since it is drawn at a constant elevation, some areas within the shape are below the terrain (white) whereas other areas are draped on top of the terrain (pink).

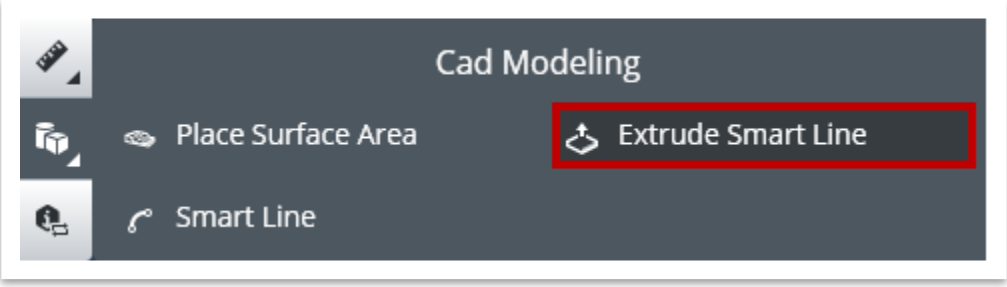
4. Select the shape to open the **Information** tab. Update the **Material** to **Concrete**. **Note:** If you update **Draped** to **True**, the entire shape will drape over the terrain.



10.2.3 Extrude Smart Line Tool

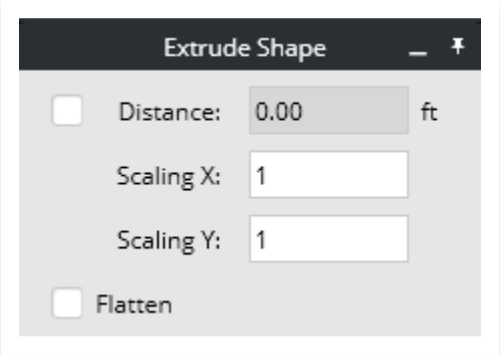
The **Extrude Smart Line** tool is found within the **Cad Modeling** tools (Figure 110). It allows the user to extrude a smart line linear element or closed shape by a specified distance.

FIGURE 110. EXTRUDE SMART LINE TOOL



Within the dialog box, the user can key-in a **Distance**: **positive** distance will extrude the element **up**, while **negative** distance will extrude the element **down** (Figure 111). A **Scaling** factor can also be applied to **chamfer** the extrusion as opposed to a perpendicular extension. In the **Information** tab, the extrusion can be further modified to **drape** on the terrain or proposed roadway or to add/remove the **cap** on the **top/base** of the shape.

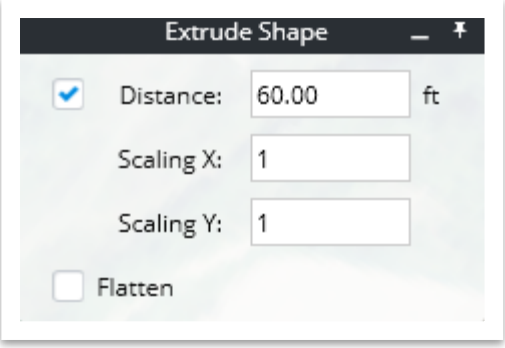
FIGURE 111. EXTRUDE SMART LINE DIALOG BOX



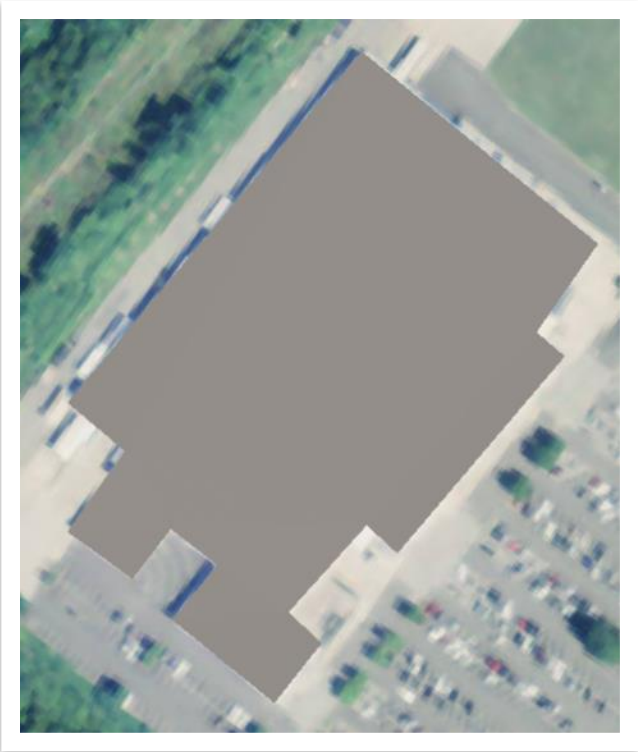
10.2.3.1 Exercise: Extrude Smart Line

In this exercise, we will extrude the shape placed in the previous exercise to create the 3D building representation for Walmart.

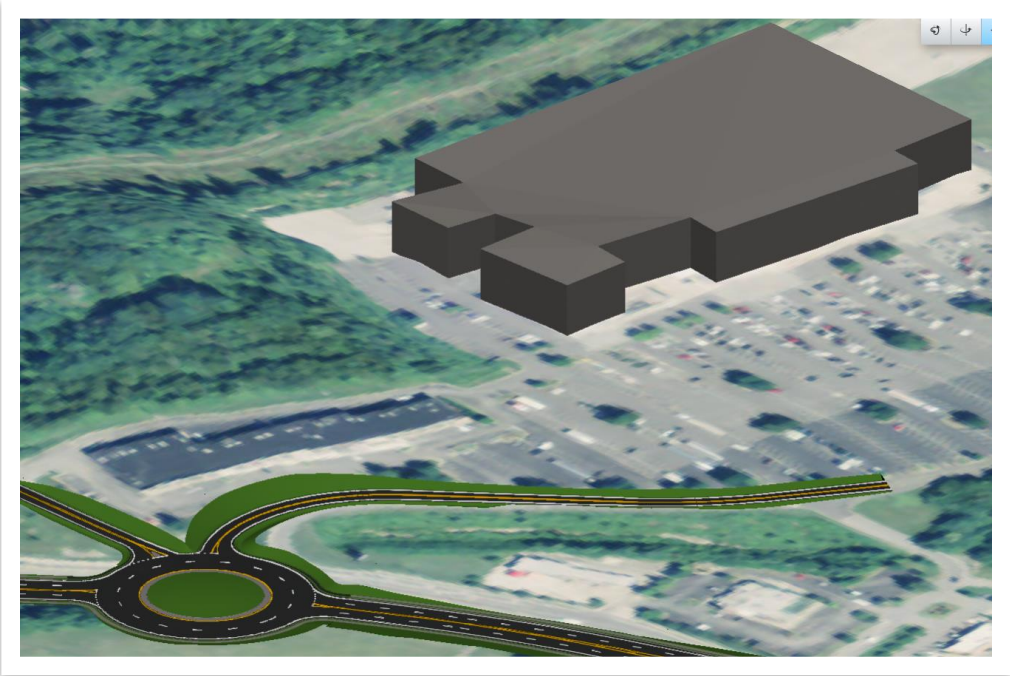
1. Open the **Extrude Smart Line** tool (**Backstage >> Conceptualize >> Cad Modeling**). Set the **Distance** to **60.00** ft and leave the **Scaling** factors as-is.



2. Notice the prompt: **Select a smart line. Left** click on the **2D** building shape. Notice the next prompt: **Define distance**. **Left** click in space to accept the distance and then open the **Elements selection** tool to clear the tool.



3. Using the **Rotate** tool, you can now view the extruded building shape in **3D**. Once you are done viewing, revert the **Camera Orientation** back to **Top** and then orient the view back to the **Charlotte Pike** (S.R. 24/U.S. 70) corridor.

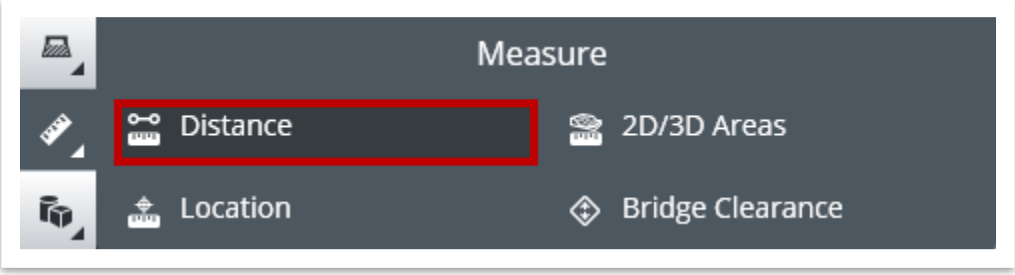


10.3 Lecture: Measure Tools

10.3.1 Distance Tool

The **Distance** tool is found within the **Measure** tools (Figure 112). It allows the user to measure linear distances between two specified points in the model. Once a measurement is made, the output is shown in the **Information** tab for each measured segment, as well as the **Cumulative Distance**.

FIGURE 112. DISTANCE TOOL



10.3.2 Location Tool

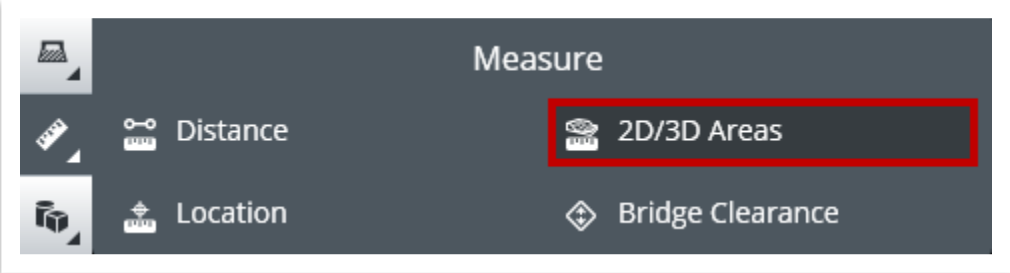
The **Location** tool is found within the **Measure** tools (Figure 113). It allows the user to retrieve the location coordinates of specified data points in the model. Once a point is selected, the output is shown in the **Information** tab in **(X,Y,Z) (m)** and **(Lat/Long)** coordinates.

FIGURE 113. LOCATION TOOL

10.3.3 2D/3D Areas Tool

The **2D/3D Areas** tool is found within the **Measure** tools (Figure 114). It allows the user to measure the area and the perimeter of a polygon. Once a polygon is drawn, the output is shown in the **Information** tab for **Area on existing ground** (3D), **Area XY plane** (2D) and **Perimeter XY plane** (2D).

FIGURE 114. 2D/3D AREAS TOOL



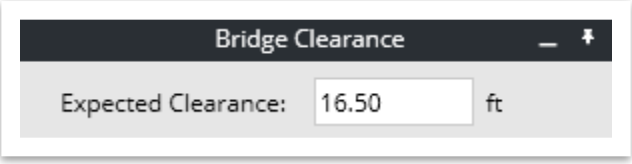
10.3.4 Bridge Clearance Tool

The **Bridge Clearance** tool is found within the **Measure** tools (Figure 115). It allows the user to measure the clearance between a bridge and roadway. The tool forms an **envelope** between the two corridors and displays the **lowest clearance** based on the profiles, templates and superelevation that is applied from the design standards.

FIGURE 115. BRIDGE CLEARANCE TOOL

The **default** expected clearance is set to **16.50** ft, which can be edited based on the design standards (Figure 116). A **green** envelope is displayed when the actual bridge clearance is greater than the expected clearance. A **red** envelope is displayed when the actual bridge clearance is less than the expected clearance. If the latter occurs, the user can edit either the bridge or roadway profile while the **Bridge Clearance** tool is still active. The bridge clearance will then update accordingly.

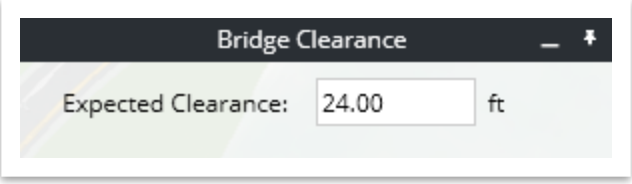
FIGURE 116. BRIDGE CLEARANCE DIALOG BOX



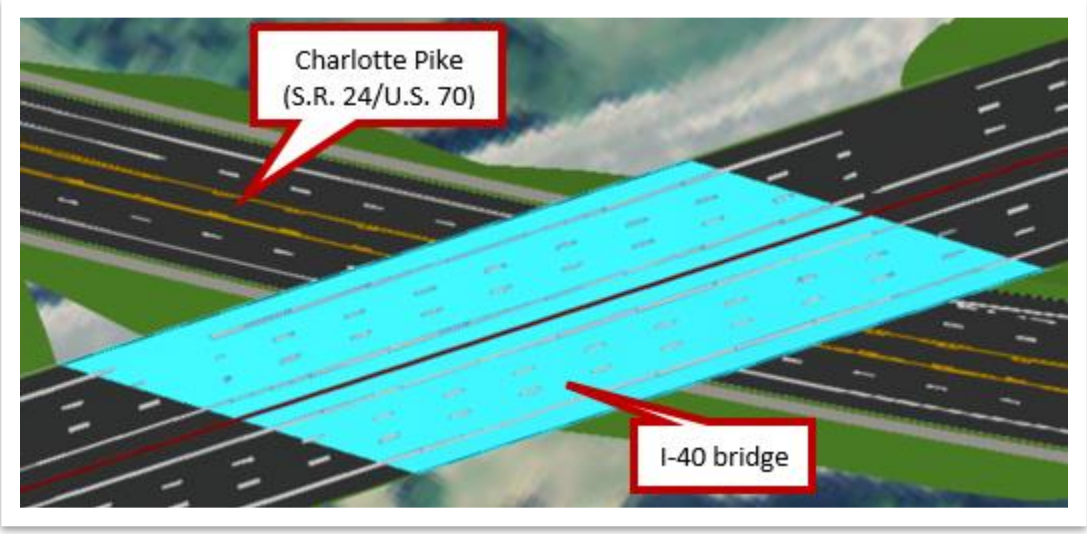
10.3.4.1 Exercise: Measure Bridge Clearance

In this exercise, we will measure the bridge clearance of the **Interstate 40** bridge over **Charlotte Pike** (S.R. 24/U.S. 70) that was placed in Exercise 8.2.1.1.

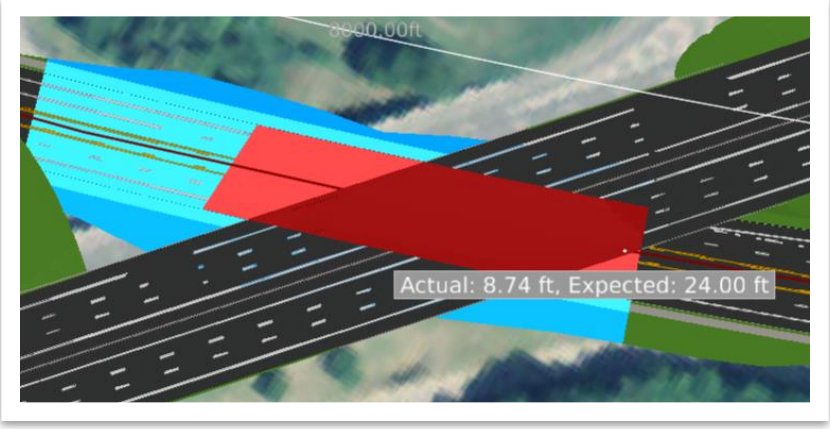
1. Open the **Bridge Clearance** tool (**Backstage >> Conceptualize >> Measure**). Set the **Expected Clearance** to **24.00** ft.



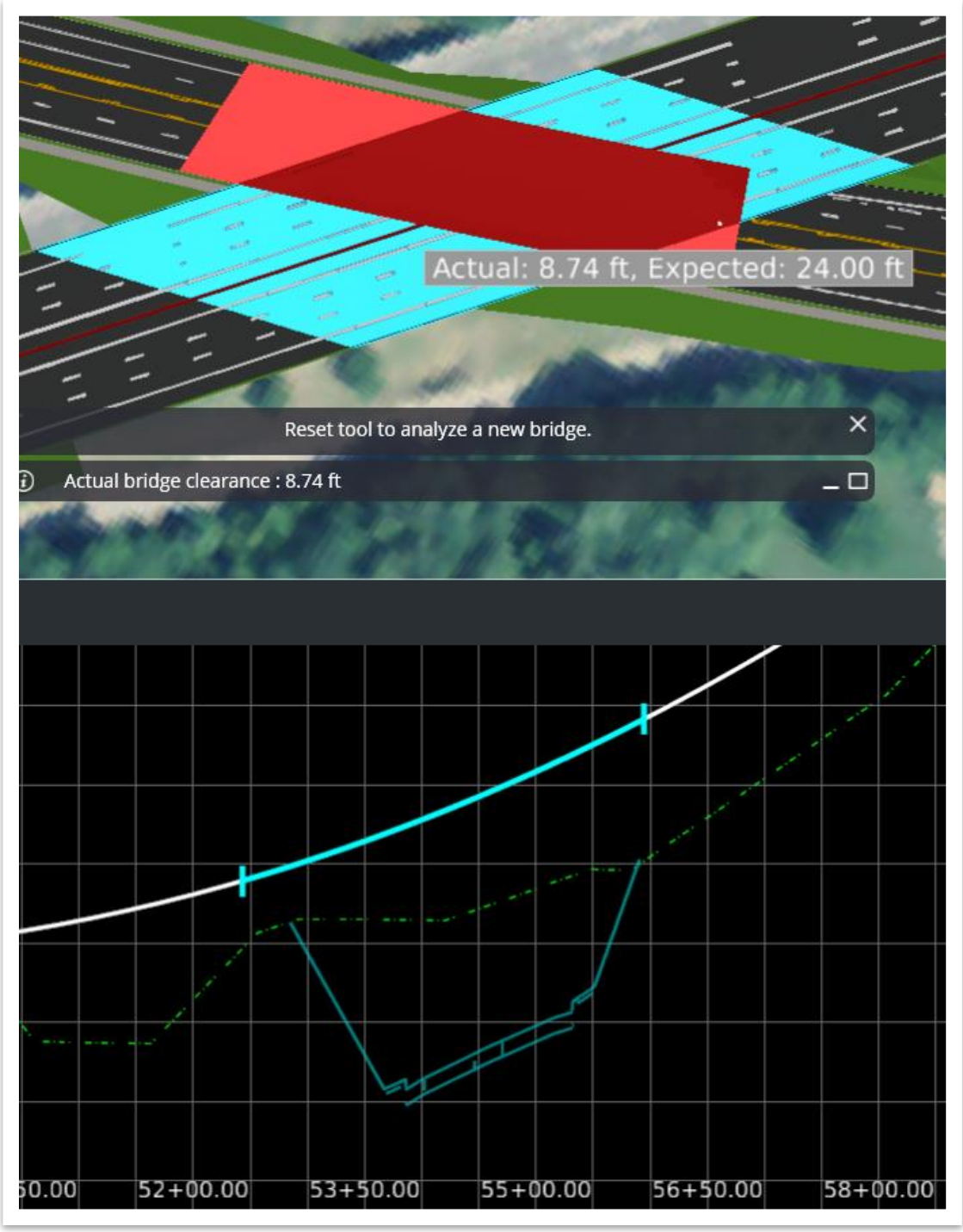
2. Notice the prompt: **Select bridge segment to analyze**. Select the **I-40** bridge.



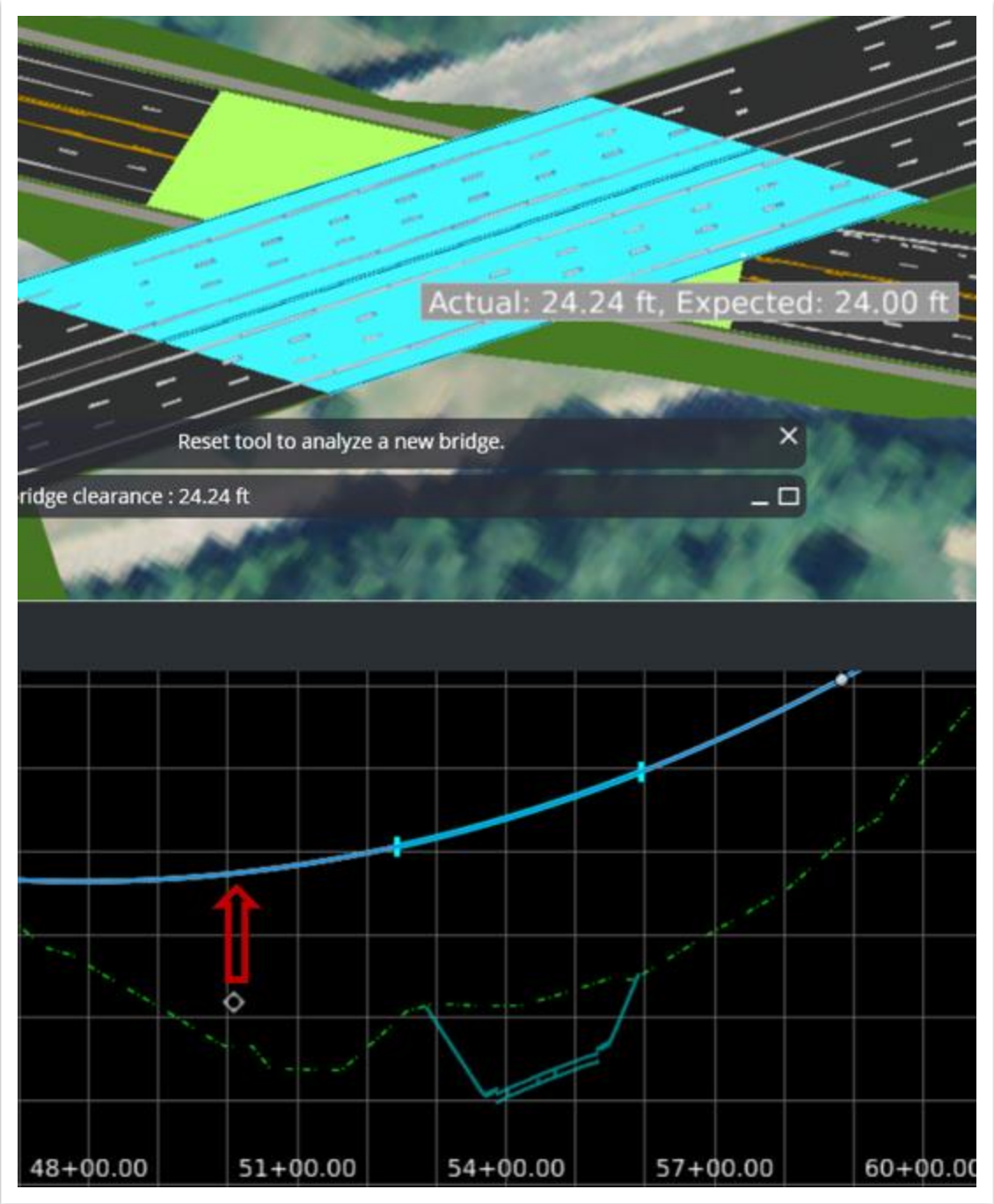
3. Notice the next prompt: **Select object below bridge to compare or reset to analyze a new**. Select the **Charlotte Pike** (S.R. 24/U.S. 70) corridor, which will then show the **Actual** and **Expected** clearance values. Notice that the actual clearance is less than **24.00** ft and is shown in **red**.



4. Next, we will edit the **bridge** profile so that the expected clearance will be met. With the **Bridge Clearance** tool still active, select the **I-40** bridge and open its profile.



5. Select the proposed **I-40** profile line and use the manipulators to **raise** the profile of the roadway until the expected clearance is met. At that point, the red shape will turn to **green** in plan view. **Right** click to clear the tool once updated. **Note:** Since the clearance is dynamically updating as the profile is being raised, this process may take a minute to load each time the profile changes.

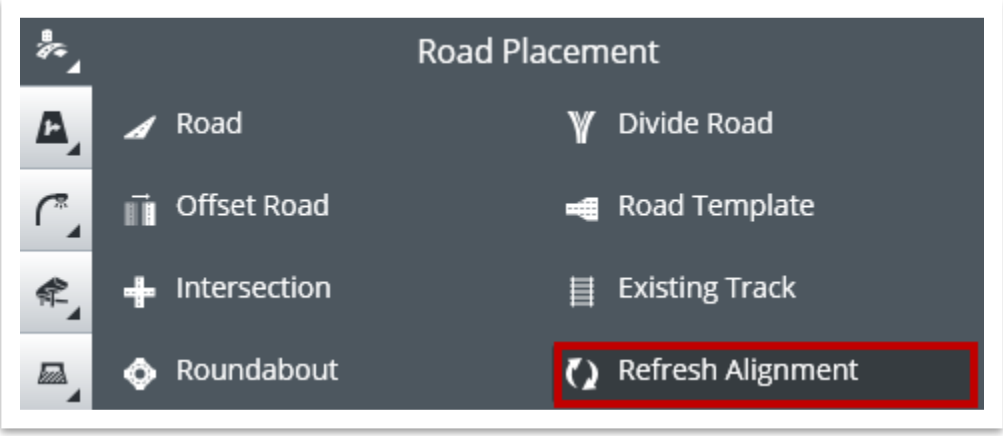


10.4 Lecture: Grading Tools

10.4.1 Refresh Alignment Tool

The **Refresh Alignment** tool is found within the **Road Placement** tools (Figure 117). It allows the user to refresh an alignment, recalculate, and clip to the terrain.

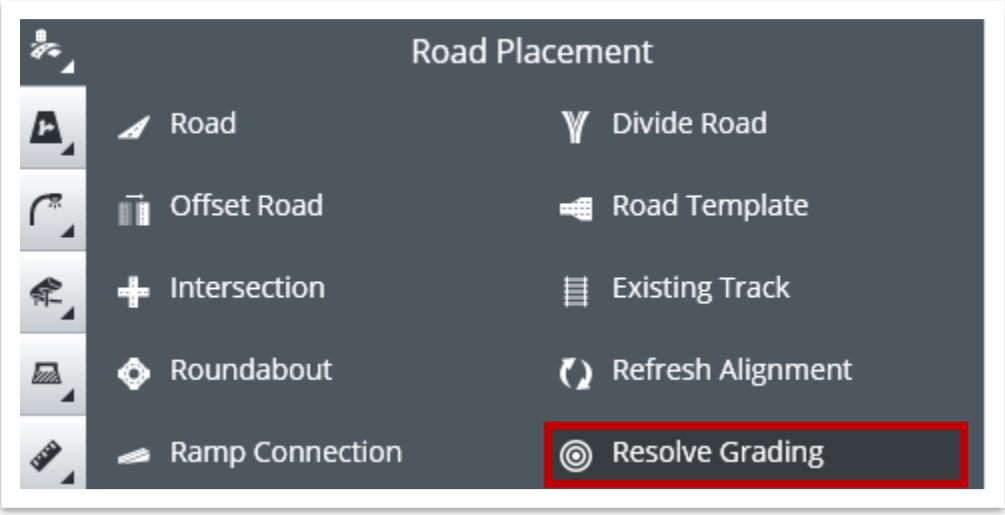
FIGURE 117. REFRESH ALIGNMENT TOOL



10.4.2 Resolve Grading Tool

The **Resolve Grading** tool is found within the **Road Placement** tools (Figure 118). It allows the user to resolve grading between **two or more** corridors with **overlapping end conditions**. This tool only works in all **Fill** or all **Cut** and merges overlapping end conditions. The changes of the grading are only temporary and will reset if edits to the corridor are made.

FIGURE 118. RESOLVE GRADING TOOL



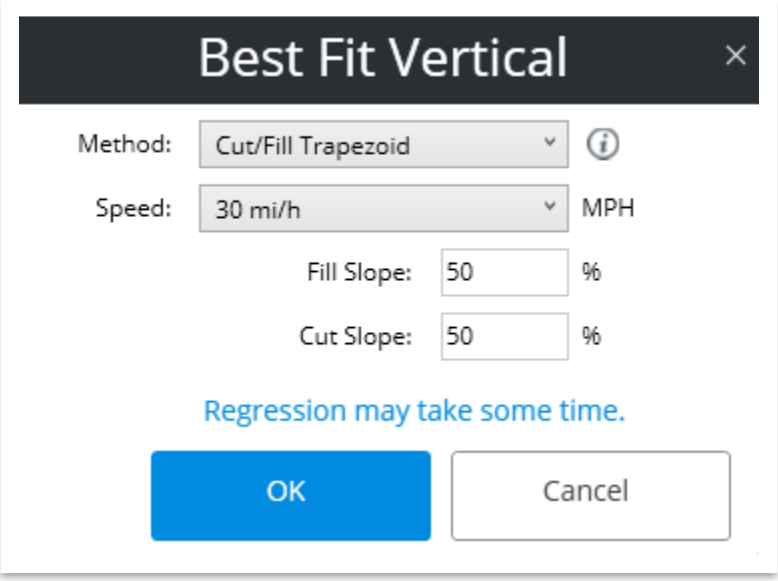
10.4.3 Best Fit Vertical Tool

The **Best Fit Vertical** tool is found within the profile view when an alignment is selected (Figure 119). This feature creates a best fit profile for the selected roadway alignment which optimizes the corridor cut/fill volumes.

FIGURE 119. BEST FIT VERTICAL TOOL

Within the dialog box (Figure 120), the user can select between the two best fit **Methods**, which are detailed on the next page.

FIGURE 120. BEST FIT VERTICAL TOOL DIALOG BOX



- **Absolute Difference:** Fits a profile as close as possible to the draped profile of the existing terrain at the centerline of the roadway. It calculates the difference between the terrain and the profile at regular intervals along the alignment and totals the difference ignoring the sign. This means it's an estimate of the absolute difference between the terrain and the profile. This does not consider the width of the roadway or any cut and fill slopes.
    - Roadway **Speed** can be defined.
- **Cut/Fill Trapezoid:** Tries to minimize the cut and fill while at the same time balancing them. It does this by calculating a trapezoid shape between the roadway plateau and an approximated tie-in. The width of the roadway plateau is inferred from the template, while the fill and cut slopes can be changed by the user. To make the evaluation fast enough, it is assumed that the existing terrain has the same elevation perpendicular to the roadway and that the same road width and slopes are applied along the entire roadway. This method then calculates an estimated total cut and total fill and tries to minimize the total and total difference. This method has the potential to give more realistic optimized results compared to just the absolute difference.
    - Roadway **Speed** and **Cut/Fill Slope** percentages can be defined.

Chapter 11. Quantities and Costs

This chapter will discuss the high-level **quantity estimation** associated with the conceptual bridge and roadway models.

11.1 Objectives

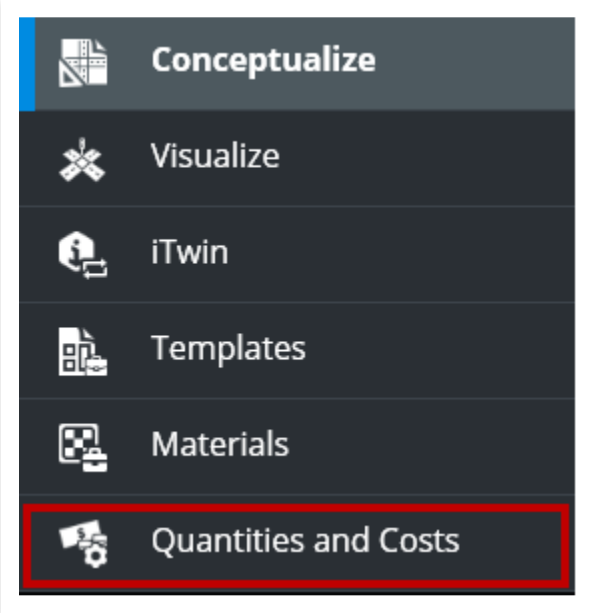
At the conclusion of this chapter, participants will be able to:

1. Review the quantities and cost report configuration.
2. Export the quantity estimate to excel.
3. Update the quantity estimate for the conceptual model.
4. Incorporate the exported quantities into the TDOT Planning Level Cost Estimate tool.

11.2 Lecture: Quantities and Cost Report Configuration

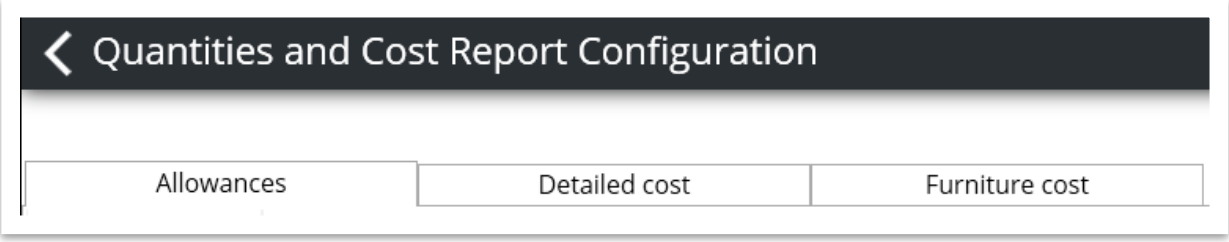
The **Quantities and Costs** option is found within the Backstage menu (Figure 121). It allows the user to open the **Quantities and Costs Report Configuration**, which provides a detailed summation for the conceptual model.

FIGURE 121. QUANTITIES AND COSTS



Within the report, there are **three** tabs: **Allowances**, **Detailed cost**, and **Furniture cost** (Figure 122).

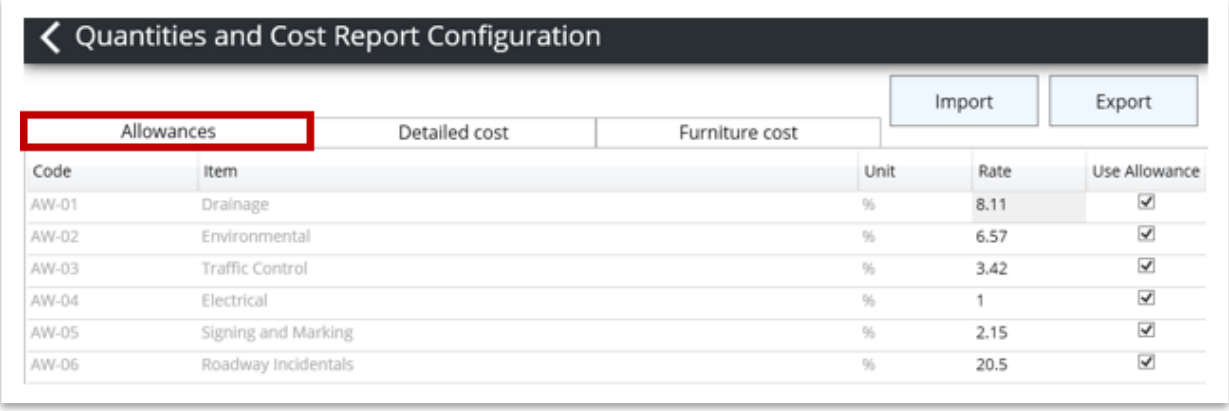
FIGURE 122. QUANTITIES AND COST REPORT CONFIGURATION TABS



11.2.1 Allowances

An **allowance** is a planned deviation from the nominal or theoretical value. It is intentionally introduced in the cost calculation to account for potential increases in cost that may arise as part of the detailed design process or during the construction period (due to change orders). Within the **Allowances** tab, **Rates** can be set for the following estimate categories: **Drainage**, **Environmental**, **Traffic Control**, **Electrical**, **Signing and Marking**, and **Roadway Incidentals** (Figure 123). These rates can be modified or toggled on or off.

FIGURE 123. QUANTITIES AND COST REPORT CONIGURATION – ALLOWANCES TAB



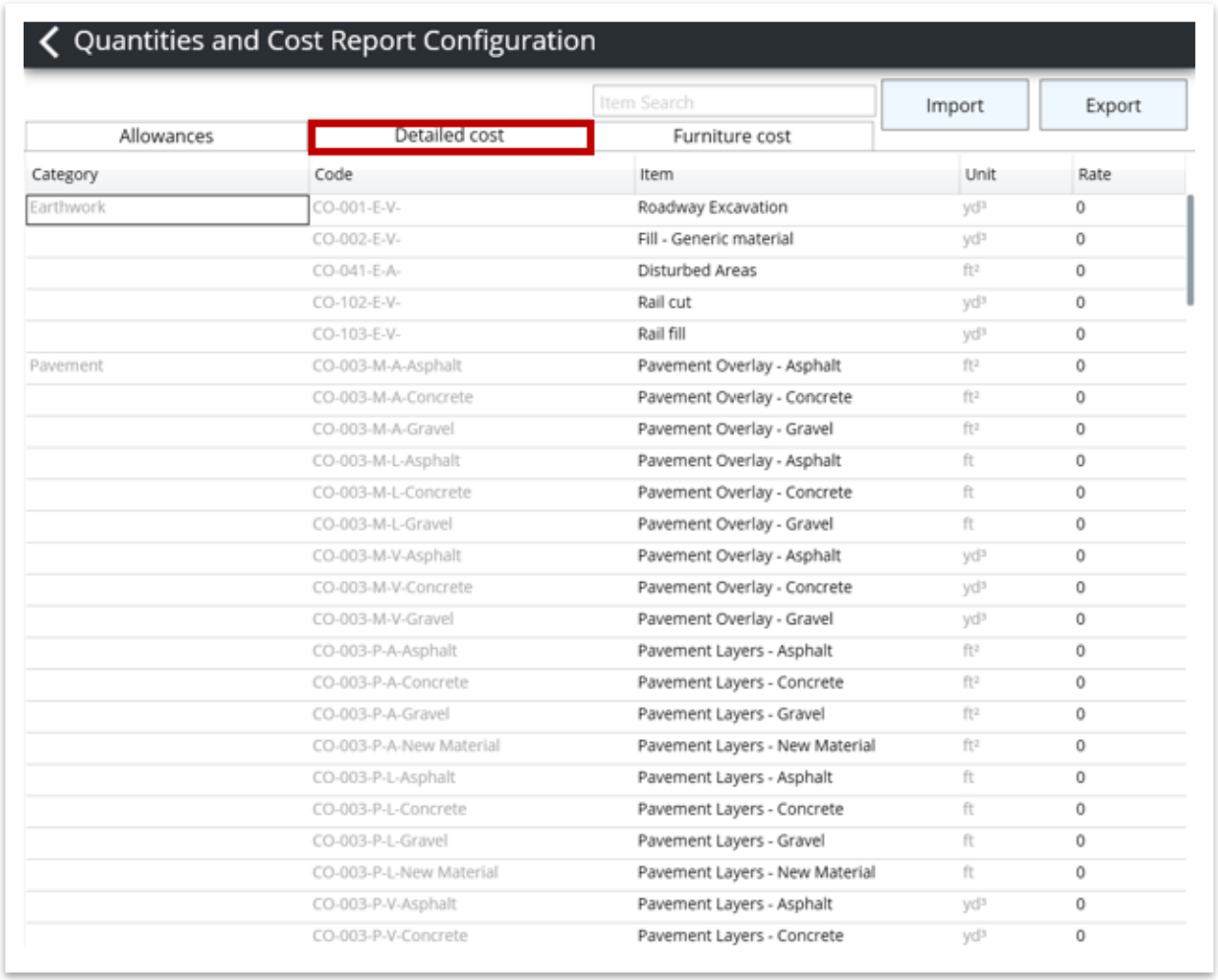
Take Note!

The allowance rates will be ignored since they are only applied to cost rates and do not affect the quantities.

11.2.2 Detailed Cost

Within the **Detailed cost** tab, **Rates** can be set for the following estimate categories: **Earthwork**, **Pavement**, **Rail**, **Retaining Wall**, and **Structure** (Figure 124). The **Units** are either **Metric** or **English**, depending on the values set in the **Settings**. The **Item** and **Rate** fields can be modified.

FIGURE 124. QUANTITIES AND COST REPORT CONFIGURATION – DETAILED COST TAB



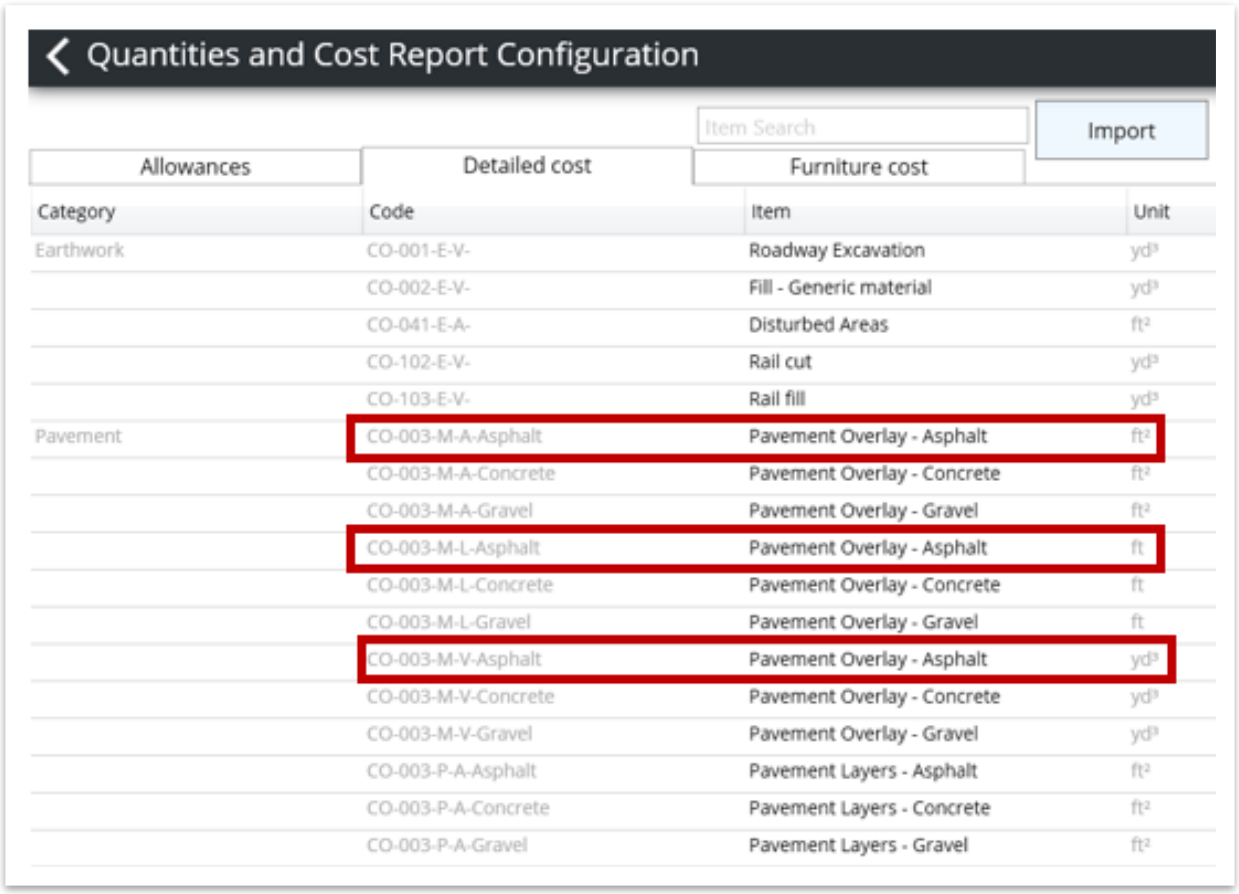
Category	Code	Item	Unit	Rate
Earthwork	CO-001-E-V-	Roadway Excavation	yd³	0
	CO-002-E-V-	Fill - Generic material	yd³	0
	CO-041-E-A-	Disturbed Areas	ft²	0
	CO-102-E-V-	Rail cut	yd³	0
	CO-103-E-V-	Rail fill	yd³	0
Pavement	CO-003-M-A-Asphalt	Pavement Overlay - Asphalt	ft²	0
	CO-003-M-A-Concrete	Pavement Overlay - Concrete	ft²	0
	CO-003-M-A-Gravel	Pavement Overlay - Gravel	ft²	0
	CO-003-M-L-Asphalt	Pavement Overlay - Asphalt	ft	0
	CO-003-M-L-Concrete	Pavement Overlay - Concrete	ft	0
	CO-003-M-L-Gravel	Pavement Overlay - Gravel	ft	0
	CO-003-M-V-Asphalt	Pavement Overlay - Asphalt	yd³	0
	CO-003-M-V-Concrete	Pavement Overlay - Concrete	yd³	0
	CO-003-M-V-Gravel	Pavement Overlay - Gravel	yd³	0
	CO-003-P-A-Asphalt	Pavement Layers - Asphalt	ft²	0
	CO-003-P-A-Concrete	Pavement Layers - Concrete	ft²	0
	CO-003-P-A-Gravel	Pavement Layers - Gravel	ft²	0
	CO-003-P-A-New Material	Pavement Layers - New Material	ft²	0
	CO-003-P-L-Asphalt	Pavement Layers - Asphalt	ft	0
	CO-003-P-L-Concrete	Pavement Layers - Concrete	ft	0
	CO-003-P-L-Gravel	Pavement Layers - Gravel	ft	0
	CO-003-P-L-New Material	Pavement Layers - New Material	ft	0
	CO-003-P-V-Asphalt	Pavement Layers - Asphalt	yd³	0
	CO-003-P-V-Concrete	Pavement Layers - Concrete	yd³	0

Take Note!

*For the TDOT conceptual workflow, all unit cost **Rates** are set to **0** by default. The estimate within ConceptStation should be used solely for quantities. The user can then either input their typical section design or input specific quantities from ConceptStation corresponding to TDOT pay items into the **TDOT Planning Level Cost Estimate Tool**, which is where TDOT maintains their unit costs. Integration of this tool with ConceptStation quantities will be discussed further in Lecture 11.4.*

Notice how each **Item** is listed multiple times (Figure 125). To account for varying units used for pay items, ConceptStation provides each **Item** with a **length (L)**, **area (A)**, and **volume (V)** quantity denoted by letter in the cost **Code** column. When retrieving the quantities from the exported report, it is important that the user not sum up multiple quantity types for each item, but instead make sure to use the applicable quantity for the unit of measure needed for the estimate. For example, TDOT has three different pay items for **Cold Planing Bituminous Pavement** to account for weight, area, and volume measurements, but only one would be used in an estimate.

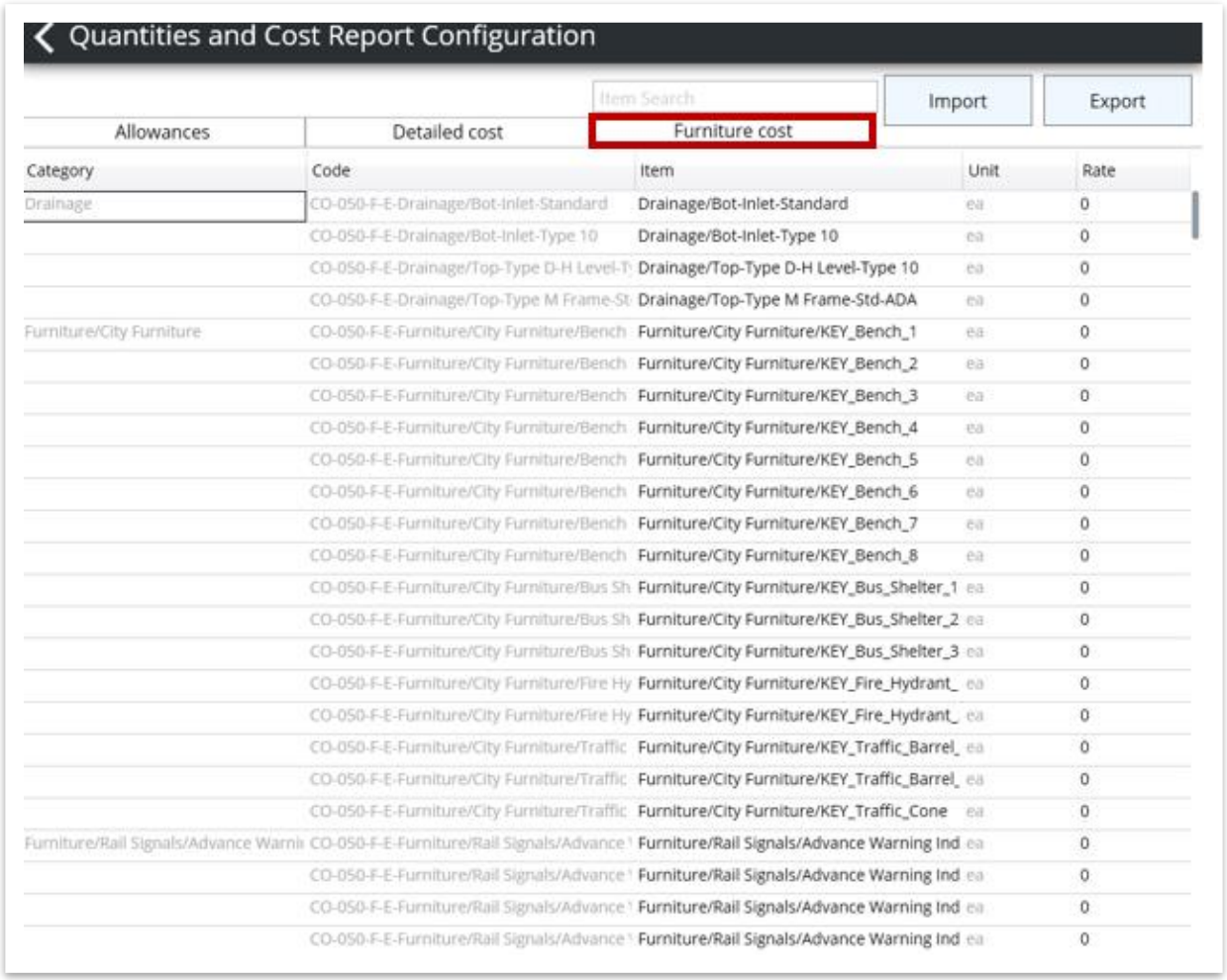
FIGURE 125. QUANTITIES AND COST REPORT CONFIGURATION – ITEM UNIT OPTIONS



11.2.3 Furniture Cost

Within the **Furniture cost** tab, the user can modify the **Item** and **Rate** fields (Figure 126). Once again, the rates have been zeroed out by default.

FIGURE 126. QUANTITIES AND COST REPORT CONFIGURATION – FURNITURE COST TAB



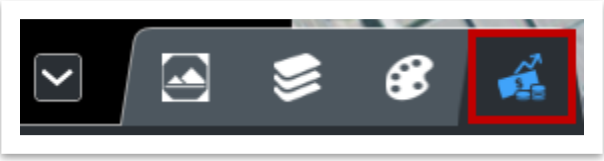
11.2.4 Import/Export

The **Import/Export** buttons in the upper right corner of the report configuration can be used to **Import** a cost configuration **xml** file or **Export** the current cost configuration to an **xml** file.

11.3 Lecture: Quantities and Costs

The **Quantities and Costs** tool can be accessed in the **Action Center** at the bottom of the window (Figure 127). If rates are entered, the user would see the **cost estimate** for the conceptual model, along with a **summary**.

FIGURE 127. ACTION CENTER – QUANTITIES AND COST TOOL

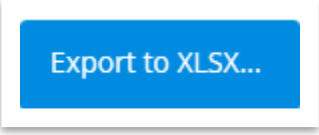


Once a new design element is placed, the user would need to click the **Calculate quantities and costs** (refresh) tool to recalculate and update the cost estimate (Figure 128). As previously mentioned, the user can set the status of any design element to either **Existing**, **Proposed** or **Construction**. All elements that are set to **Proposed** will be calculated in the cost estimate, including the furniture elements.

FIGURE 128. CALCULATE QUANTITIES AND COSTS TOOL

The **Display detailed quantities and costs** tool will allow the user to export the **quantities**, **unit costs** and **categories** of the conceptual model to a **.xlsx** file, which can then be formatted (Figure 129).

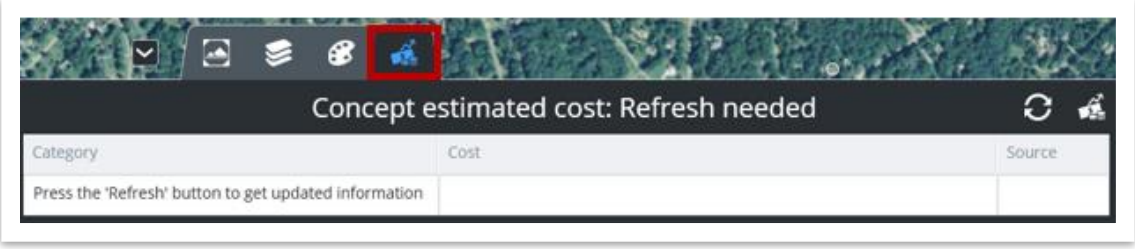
FIGURE 129. EXPORT TO XLSX TOOL



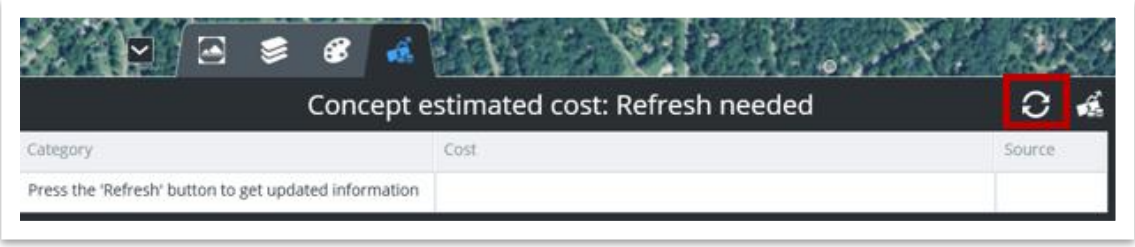
11.3.1 Exercise: Calculate Quantities and Costs

In this exercise, we will refresh the conceptual model cost estimate in the action center and export the detailed quantities and costs report as an excel file.

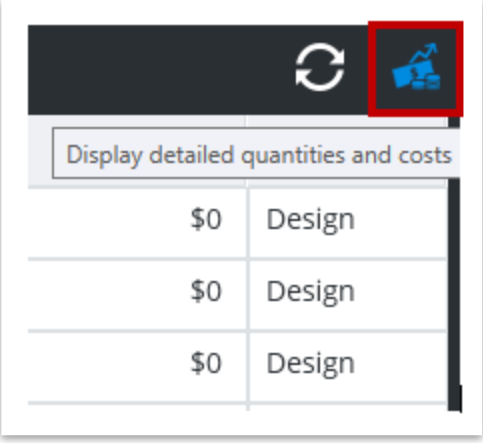
1. Within the **Action Center**, click the **Quantities and Costs** tool.



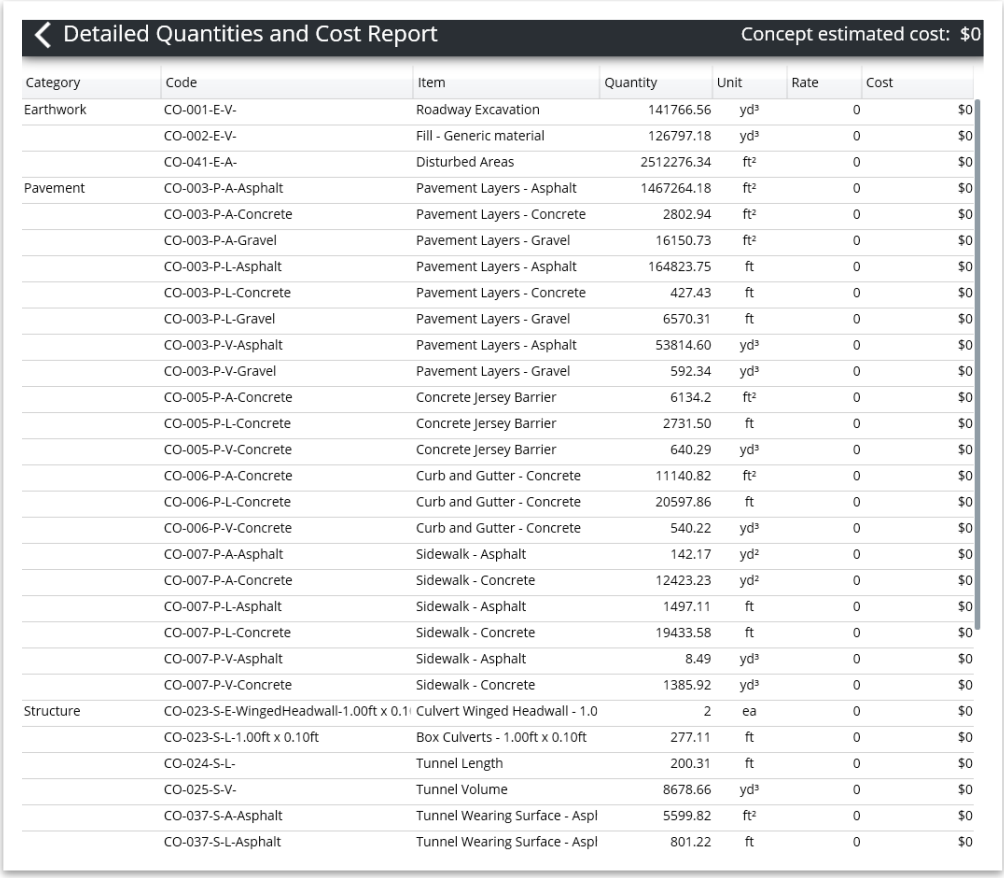
2. In the upper right corner, click the **Calculate quantities and costs** tool to refresh the estimate. **Note:** The software does not automatically calculate quantities as the model is developed, so it is necessary to use this tool to initiate. Give the software a minute to calculate the quantities.



3. Next, click the **Display detailed quantities and costs** tool.



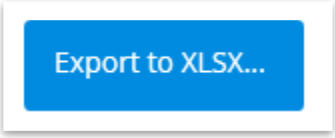
4. Within the **Detailed Quantities and Cost Report**, go ahead and review the quantities.



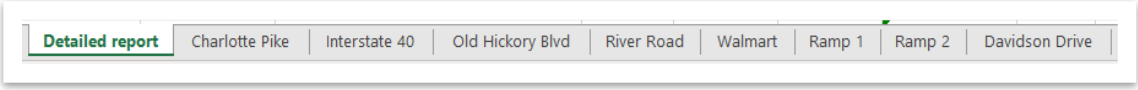
Detailed Quantities and Cost Report — Concept estimated cost: $0

Category	Code	Item	Quantity	Unit	Rate	Cost
Earthwork	CO-001-E-V-	Roadway Excavation	141766.56	yd³	0	$0
	CO-002-E-V-	Fill - Generic material	126797.18	yd³	0	$0
	CO-041-E-A-	Disturbed Areas	2512276.34	ft²	0	$0
Pavement	CO-003-P-A-Asphalt	Pavement Layers - Asphalt	1467264.18	ft²	0	$0
	CO-003-P-A-Concrete	Pavement Layers - Concrete	2802.94	ft²	0	$0
	CO-003-P-A-Gravel	Pavement Layers - Gravel	16150.73	ft²	0	$0
	CO-003-P-L-Asphalt	Pavement Layers - Asphalt	164823.75	ft	0	$0
	CO-003-P-L-Concrete	Pavement Layers - Concrete	427.43	ft	0	$0
	CO-003-P-L-Gravel	Pavement Layers - Gravel	6570.31	ft	0	$0
	CO-003-P-V-Asphalt	Pavement Layers - Asphalt	53814.60	yd³	0	$0
	CO-003-P-V-Gravel	Pavement Layers - Gravel	592.34	yd³	0	$0
	CO-005-P-A-Concrete	Concrete Jersey Barrier	6134.2	ft²	0	$0
	CO-005-P-L-Concrete	Concrete Jersey Barrier	2731.50	ft	0	$0
	CO-005-P-V-Concrete	Concrete Jersey Barrier	640.29	yd³	0	$0
	CO-006-P-A-Concrete	Curb and Gutter - Concrete	11140.82	ft²	0	$0
	CO-006-P-L-Concrete	Curb and Gutter - Concrete	20597.86	ft	0	$0
	CO-006-P-V-Concrete	Curb and Gutter - Concrete	540.22	yd³	0	$0
	CO-007-P-A-Asphalt	Sidewalk - Asphalt	142.17	yd²	0	$0
	CO-007-P-A-Concrete	Sidewalk - Concrete	12423.23	yd²	0	$0
	CO-007-P-L-Asphalt	Sidewalk - Asphalt	1497.11	ft	0	$0
	CO-007-P-L-Concrete	Sidewalk - Concrete	19433.58	ft	0	$0
	CO-007-P-V-Asphalt	Sidewalk - Asphalt	8.49	yd³	0	$0
	CO-007-P-V-Concrete	Sidewalk - Concrete	1385.92	yd³	0	$0
Structure	CO-023-S-E-WingedHeadwall-1.00ft x 0.1	Culvert Winged Headwall - 1.0	2	ea	0	$0
	CO-023-S-L-1.00ft x 0.10ft	Box Culverts - 1.00ft x 0.10ft	277.11	ft	0	$0
	CO-024-S-L-	Tunnel Length	200.31	ft	0	$0
	CO-025-S-V-	Tunnel Volume	8678.66	yd³	0	$0
	CO-037-S-A-Asphalt	Tunnel Wearing Surface - Aspl	5599.82	ft²	0	$0
	CO-037-S-L-Asphalt	Tunnel Wearing Surface - Aspl	801.22	ft	0	$0

5. Once reviewed, click **Export to XLSX…** to export the data. Save the file to your desktop and then open to review the data.



6. Within the excel file, the first tab (**Detailed report**) will be the overall summary. The remaining tabs are broken up based on **roadway name**.



7. Additionally, the data for each roadway is further separated within a given tab by different segments (transition sections, intersections, roundabouts, etc.). Looking at the **Charlotte Pike** tab, you'll notice the segment separation. Also, notice the length, area, and volume quantity options for each item, if applicable, as described earlier in the chapter. **Note:** Your quantities do not need to match exactly.

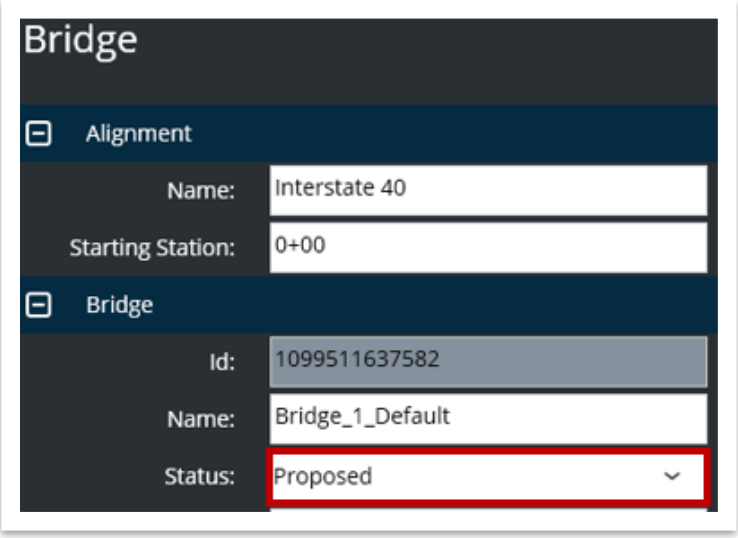
Road 0+00.00 - 13+77.47	**TS-1 (2LN)**					
Earthwork	CO-041-E-A-	Disturbed Areas	77718.73	ft²	0	$0
Pavement	CO-003-P-V-Asphalt	Pavement Layers - Asphalt	1428.49	yd³	0	$0
Pavement	CO-003-P-A-Asphalt	Pavement Layers - Asphalt	38569.31	ft²	0	$0
Pavement	CO-003-P-L-Asphalt	Pavement Layers - Asphalt	5517.33	ft	0	$0
Transition 13+77.47 - 15+54.70						
Earthwork	CO-001-E-V-	Roadway Excavation	1614.24	yd³	0	$0
Earthwork	CO-002-E-V-	Fill - Generic material	3.35	yd³	0	$0
Pavement	CO-003-P-V-Asphalt	Pavement Layers - Asphalt	190.36	yd³	0	$0
Pavement	CO-003-P-A-Asphalt	Pavement Layers - Asphalt	6203.16	ft²	0	$0
Pavement	CO-003-P-L-Asphalt	Pavement Layers - Asphalt	1064.01	ft	0	$0
Intersection 15+54.70 - 18+67.74						
Earthwork	CO-041-E-A-	Disturbed Areas	52607.33	ft²	0	$0
Pavement	CO-006-P-V-Concrete	Curb and Gutter - Concrete	0	yd³	0	$0
Pavement	CO-006-P-A-Concrete	Curb and Gutter - Concrete	183.91	ft²	0	$0
Pavement	CO-006-P-L-Concrete	Curb and Gutter - Concrete	270.41	ft	0	$0
Pavement	CO-003-P-V-Asphalt	Pavement Layers - Asphalt	1158.64	yd³	0	$0
Pavement	CO-003-P-A-Asphalt	Pavement Layers - Asphalt	31283.29	ft²	0	$0
Pavement	CO-003-P-L-Asphalt	Pavement Layers - Asphalt	814.23	ft	0	$0
Transition 18+67.74 - 20+63.66						
Earthwork	CO-001-E-V-	Roadway Excavation	2772.51	yd³	0	$0
Pavement	CO-003-P-V-Asphalt	Pavement Layers - Asphalt	253.98	yd³	0	$0
Pavement	CO-003-P-A-Asphalt	Pavement Layers - Asphalt	6857.26	ft²	0	$0
Pavement	CO-003-P-L-Asphalt	Pavement Layers - Asphalt	1177.37	ft	0	$0
Road 20+63.66 - 76+00.00	**TS-1 (2LN)**					
Earthwork	CO-041-E-A-	Disturbed Areas	374572.9	ft²	0	$0
Pavement	CO-003-P-V-Asphalt	Pavement Layers - Asphalt	5741.35	yd³	0	$0
Pavement	CO-003-P-A-Asphalt	Pavement Layers - Asphalt	155016.29	ft²	0	$0
Pavement	CO-003-P-L-Asphalt	Pavement Layers - Asphalt	22162.37	ft	0	$0
Transition 76+00.00 - 81+40.00						
Earthwork	CO-001-E-V-	Roadway Excavation	2507.31	yd³	0	$0
Earthwork	CO-002-E-V-	Fill - Generic material	1183.76	yd³	0	$0
Pavement	CO-003-P-V-Asphalt	Pavement Layers - Asphalt	580.19	yd³	0	$0

Detailed report | **Charlotte Pike** | Interstate 40 | Old Hickory Blvd | River Road | Walmart | Ramp

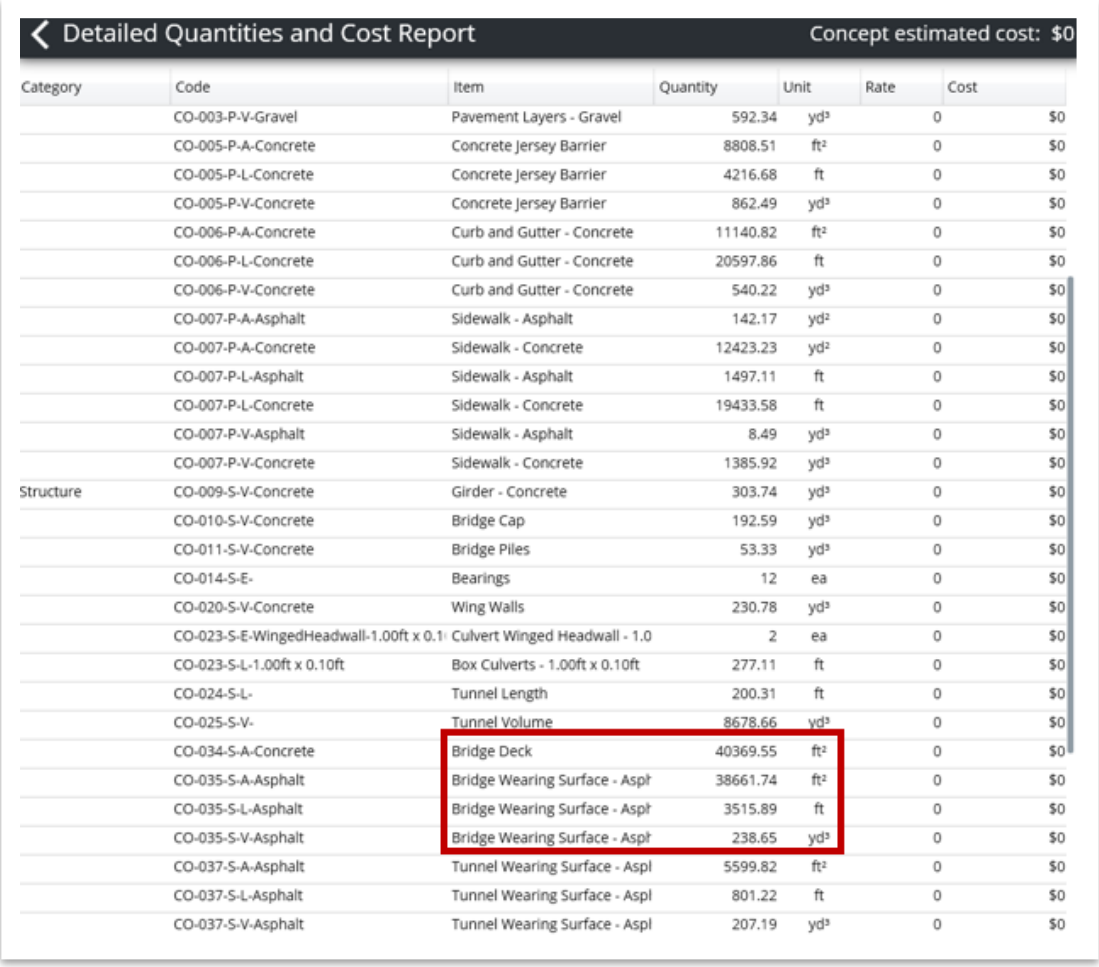
Take Note!

*For scenarios where one or more alignments come together (intersections, roundabouts, etc.), the intersection/roundabout data will only be quantified under the roadway that was selected as the **primary** alignment when the feature was created, to prevent redundancy.*

8. Notice that there are no **bridge** quantities. This is because we had set the **Status** of **I-40** to **Existing**. To update the cost estimate, first select the bridge component in the model. Within the **Information** tab, update the **Status** to **Proposed**.



9. Repeat Steps 2-4 to see the updated cost estimate with the proposed bridge.

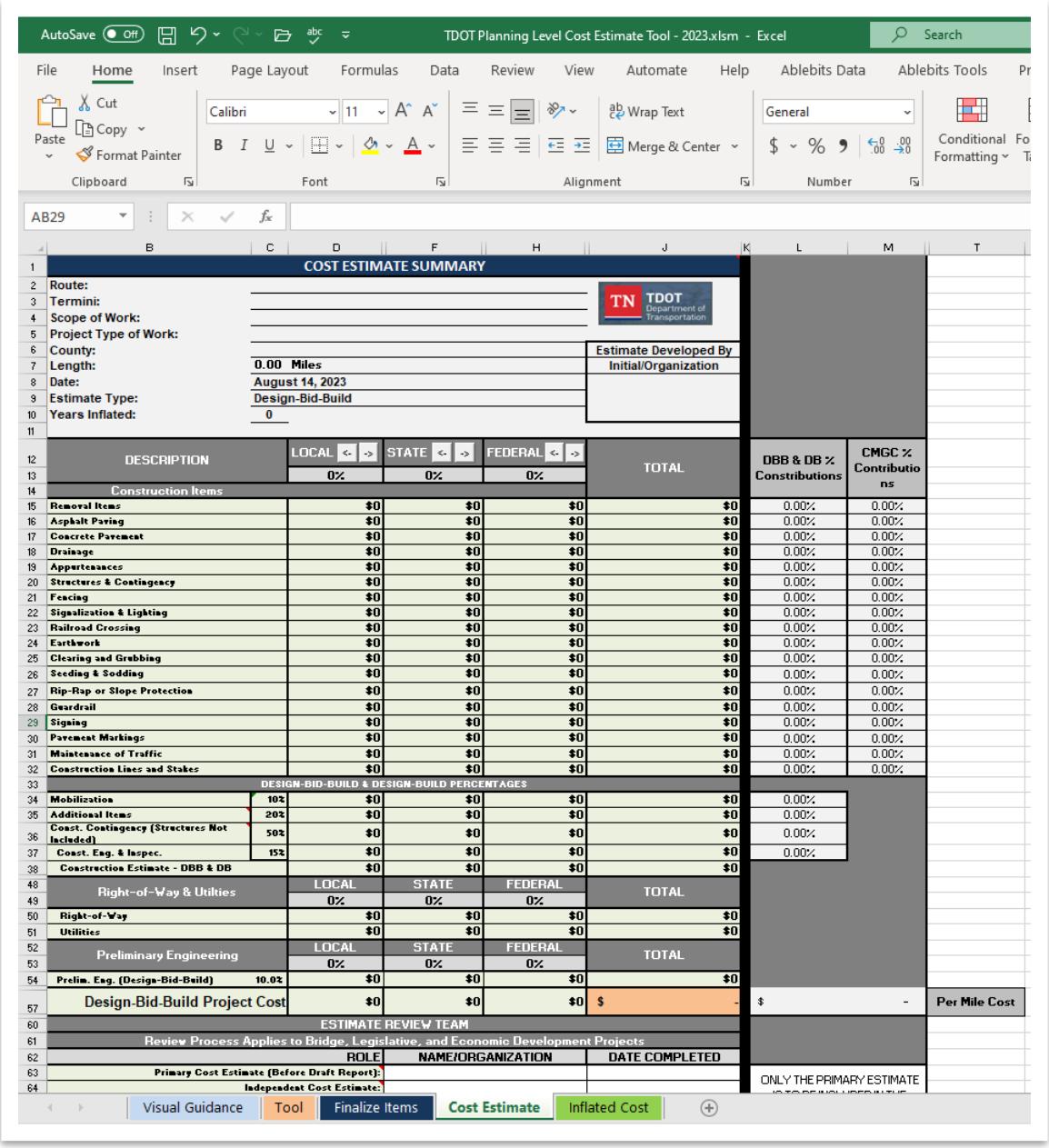


Category	Code	Item	Quantity	Unit	Rate	Cost
	CO-003-P-V-Gravel	Pavement Layers - Gravel	592.34	yd³	0	$0
	CO-005-P-A-Concrete	Concrete Jersey Barrier	8808.51	ft²	0	$0
	CO-005-P-L-Concrete	Concrete Jersey Barrier	4216.68	ft	0	$0
	CO-005-P-V-Concrete	Concrete Jersey Barrier	862.49	yd³	0	$0
	CO-006-P-A-Concrete	Curb and Gutter - Concrete	11140.82	ft²	0	$0
	CO-006-P-L-Concrete	Curb and Gutter - Concrete	20597.86	ft	0	$0
	CO-006-P-V-Concrete	Curb and Gutter - Concrete	540.22	yd³	0	$0
	CO-007-P-A-Asphalt	Sidewalk - Asphalt	142.17	yd²	0	$0
	CO-007-P-A-Concrete	Sidewalk - Concrete	12423.23	yd²	0	$0
	CO-007-P-L-Asphalt	Sidewalk - Asphalt	1497.11	ft	0	$0
	CO-007-P-L-Concrete	Sidewalk - Concrete	19433.58	ft	0	$0
	CO-007-P-V-Asphalt	Sidewalk - Asphalt	8.49	yd³	0	$0
	CO-007-P-V-Concrete	Sidewalk - Concrete	1385.92	yd³	0	$0
Structure	CO-009-S-V-Concrete	Girder - Concrete	303.74	yd³	0	$0
	CO-010-S-V-Concrete	Bridge Cap	192.59	yd³	0	$0
	CO-011-S-V-Concrete	Bridge Piles	53.33	yd³	0	$0
	CO-014-S-E-	Bearings	12	ea	0	$0
	CO-020-S-V-Concrete	Wing Walls	230.78	yd³	0	$0
	CO-023-S-E-WingedHeadwall-1.00ft x 0.1	Culvert Winged Headwall - 1.0	2	ea	0	$0
	CO-023-S-L-1.00ft x 0.10ft	Box Culverts - 1.00ft x 0.10ft	277.11	ft	0	$0
	CO-024-S-L-	Tunnel Length	200.31	ft	0	$0
	CO-025-S-V-	Tunnel Volume	8678.66	yd³	0	$0
	CO-034-S-A-Concrete	Bridge Deck	40369.55	ft²	0	$0
	CO-035-S-A-Asphalt	Bridge Wearing Surface - Aspl	38661.74	ft²	0	$0
	CO-035-S-L-Asphalt	Bridge Wearing Surface - Aspl	3515.89	ft	0	$0
	CO-035-S-V-Asphalt	Bridge Wearing Surface - Aspl	238.65	yd³	0	$0
	CO-037-S-A-Asphalt	Tunnel Wearing Surface - Aspl	5599.82	ft²	0	$0
	CO-037-S-L-Asphalt	Tunnel Wearing Surface - Aspl	801.22	ft	0	$0
	CO-037-S-V-Asphalt	Tunnel Wearing Surface - Aspl	207.19	yd³	0	$0

11.4 Lecture: Incorporating ConceptStation Quantities into TDOT Planning Level Cost Estimate Tool

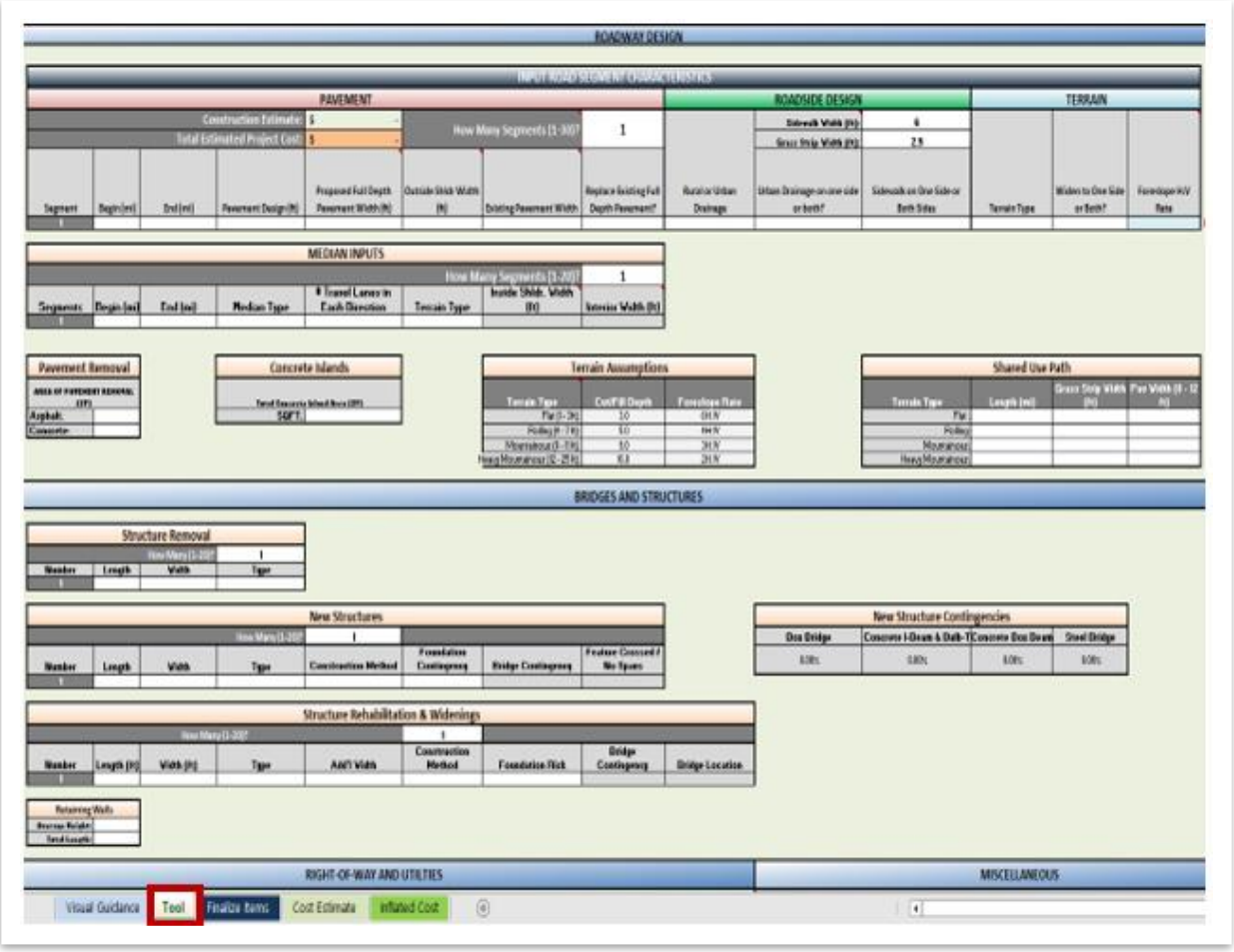
As part of the TDOT planning workflow, ConceptStation should be used solely for quantities and not for cost estimation since TDOT unit costs are not built into the software. The user can then either input their typical section design or input specific quantities from ConceptStation corresponding to TDOT pay items into the **TDOT Planning Level Cost Estimate Tool** (Figure 130).

FIGURE 130. TDOT PLANNING LEVEL COST ESTIMATE TOOL



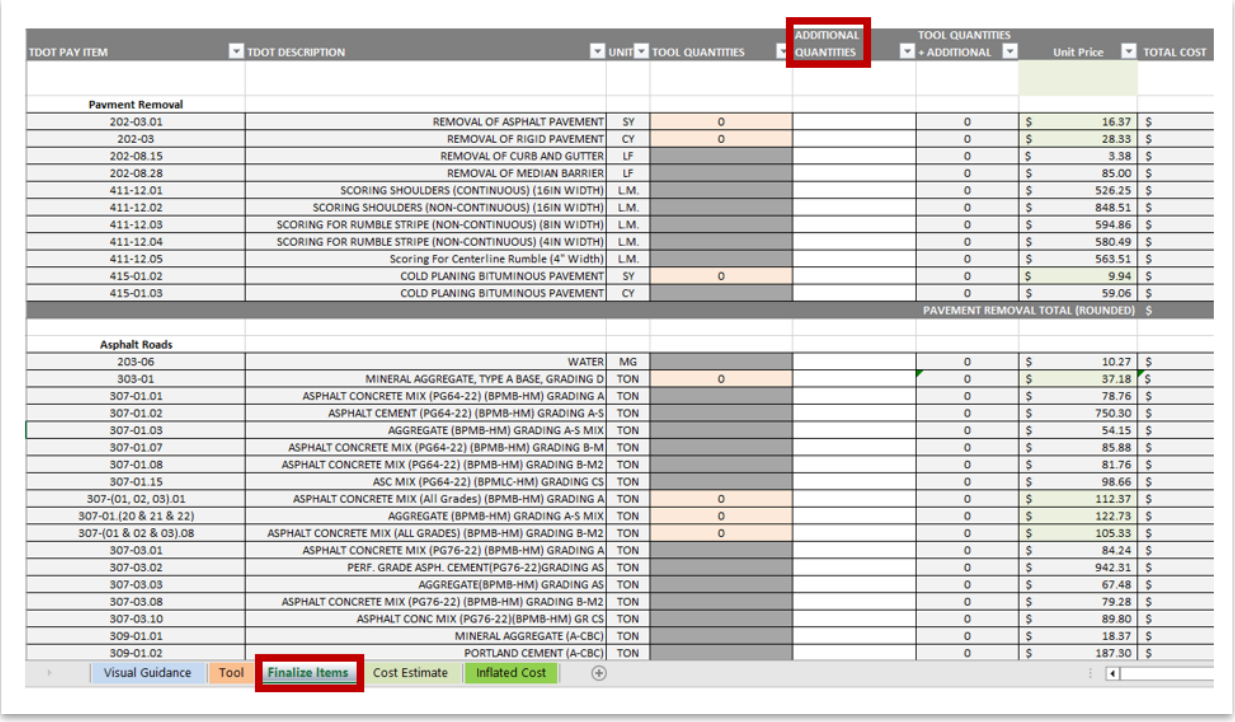
TDOT unit costs and pay items are embedded in this excel workbook to calculate a planning-level cost estimate. Due to limitations with the customization of predefined template components in ConceptStation as well as embedded TDOT standard conversion factors in the TDOT Planning Level Cost Estimate Tool, there is some discrepancy with how quantities are calculated between the two sources, particularly with **volume** and **area** quantities. Additionally, the ConceptStation roadway templates are somewhat simplified and only consist of a single pavement layer, as opposed to the TDOT tool which assumes a standard pavement design and breaks down the quantities/costs by multiple layers. As a result, it is recommended that the user input the **linear quantities** from the ConceptStation model into the **Tool** tab (Roadway Design/Bridges and Structures), which includes all facilities, such as sidewalks, shared use paths, medians, bridges, urban/rural drainage, etc. (Figure 131).

FIGURE 131. TDOT PLANNING LEVEL COST ESTIMATE TOOL – TOOL TAB



However, there are a few scenarios in which the **non-linear** ConceptStation model quantities may be more accurate for the estimate, including **earthwork**, **drainage items**, and **pavement arrows/symbols**. The earthwork quantities generated in ConceptStation are calculated based on the roadway profiles / existing ground in the model as opposed to the TDOT Planning Level Cost Estimate Tool which does not take into consideration the vertical alignment. Additionally, the TDOT tool assumes quantities for drainage structures and pavement markings based on the length of the roadway segment and is not as detailed in quantifying specific pay items. In these scenarios, it is recommended that the user find the applicable TDOT pay items and then input the ConceptStation model quantities into the **Additional Quantities** column within the **Finalize Items** tab (Figure 132).

FIGURE 132. TDOT PLANNING LEVEL COST ESTIMATE TOOL – FINALIZE ITEMS TAB



TDOT PAY ITEM	TDOT DESCRIPTION	UNIT	TOOL QUANTITIES	ADDITIONAL QUANTITIES	TOOL QUANTITIES + ADDITIONAL	Unit Price	TOTAL COST
Pavment Removal							
202-03.01	REMOVAL OF ASPHALT PAVEMENT	SY	0		0	$ 16.37	$
202-03	REMOVAL OF RIGID PAVEMENT	CY	0		0	$ 28.33	$
202-08.15	REMOVAL OF CURB AND GUTTER	LF			0	$ 3.38	$
202-08.28	REMOVAL OF MEDIAN BARRIER	LF			0	$ 85.00	$
411-12.01	SCORING SHOULDERS (CONTINUOUS) (16IN WIDTH)	L.M.			0	$ 526.25	$
411-12.02	SCORING SHOULDERS (NON-CONTINUOUS) (16IN WIDTH)	L.M.			0	$ 848.51	$
411-12.03	SCORING FOR RUMBLE STRIPE (NON-CONTINUOUS) (8IN WIDTH)	L.M.			0	$ 594.86	$
411-12.04	SCORING FOR RUMBLE STRIPE (NON-CONTINUOUS) (4IN WIDTH)	L.M.			0	$ 580.49	$
411-12.05	Scoring For Centerline Rumble (4" Width)	L.M.			0	$ 563.51	$
415-01.02	COLD PLANING BITUMINOUS PAVEMENT	SY	0		0	$ 9.94	$
415-01.03	COLD PLANING BITUMINOUS PAVEMENT	CY			0	$ 59.06	$
					PAVEMENT REMOVAL TOTAL (ROUNDED)		$
Asphalt Roads							
203-06	WATER	MG			0	$ 10.27	$
303-01	MINERAL AGGREGATE, TYPE A BASE, GRADING D	TON	0		0	$ 37.18	$
307-01.01	ASPHALT CONCRETE MIX (PG64-22) (BPMB-HM) GRADING A	TON			0	$ 78.76	$
307-01.02	ASPHALT CEMENT (PG64-22) (BPMB-HM) GRADING A-S	TON			0	$ 750.30	$
307-01.03	AGGREGATE (BPMB-HM) GRADING A-S MIX	TON			0	$ 54.15	$
307-01.07	ASPHALT CONCRETE MIX (PG64-22) (BPMB-HM) GRADING B-M	TON			0	$ 85.88	$
307-01.08	ASPHALT CONCRETE MIX (PG64-22) (BPMB-HM) GRADING B-M2	TON			0	$ 81.76	$
307-01.15	ASC MIX (PG64-22) (BPMLC-HM) GRADING CS	TON			0	$ 98.66	$
307-(01, 02, 03).01	ASPHALT CONCRETE MIX (All Grades) (BPMB-HM) GRADING A	TON	0		0	$ 112.37	$
307-01.(20 & 21 & 22)	AGGREGATE (BPMB-HM) GRADING A-S MIX	TON	0		0	$ 122.73	$
307-(01 & 02 & 03).08	ASPHALT CONCRETE MIX (ALL GRADES) (BPMB-HM) GRADING B-M2	TON	0		0	$ 105.33	$
307-03.01	ASPHALT CONCRETE MIX (PG76-22) (BPMB-HM) GRADING A	TON			0	$ 84.24	$
307-03.02	PERF. GRADE ASPH. CEMENT(PG76-22)GRADING AS	TON			0	$ 942.31	$
307-03.03	AGGREGATE(BPMB-HM) GRADING AS	TON			0	$ 67.48	$
307-03.08	ASPHALT CONCRETE MIX (PG76-22) (BPMB-HM) GRADING B-M2	TON			0	$ 79.28	$
307-03.10	ASPHALT CONC MIX (PG76-22)(BPMB-HM) GR CS	TON			0	$ 89.80	$
309-01.01	MINERAL AGGREGATE (A-CBC)	TON			0	$ 18.37	$
309-01.02	PORTLAND CEMENT (A-CBC)	TON			0	$ 187.30	$

Take Note!

*ConceptStation does not tabulate quantities for **linear** or **transverse** striping (guidance lines, crosswalks, stop bars, etc.) or **lane** striping associated with proposed roadway templates. These items should be manually measured / estimated in the model and directly input into the **Finalize Items** tab in the **TDOT Planning Level Cost Estimate Tool**. Bentley has logged this as a potential product enhancement for a future software release.*

The quantity approach will likely differ on a project-by-project basis and will require user judgement. At this stage, the quantity differences should be minor. Regardless, the TDOT tool has built-in contingency to account for unknown factors and variables.

Chapter 12. Exporting Outputs and Design Scenarios

This chapter will discuss the process for **exporting** the ConceptStation model files, which will then be imported into **ORD** in Exercise 14.2. In addition, we will look at the process for creating additional design scenarios for different conceptual alternatives.

12.1 Objectives

At the conclusion of this chapter, participants will be able to:

1. Export the necessary ConceptStation files for utilization in ORD.
2. Create additional design scenarios.

12.2 Lecture: Exporting Outputs

To utilize the conceptual model in ORD for plan production, the user will need to use the **Export** option found within the Backstage menu. The necessary outputs are:

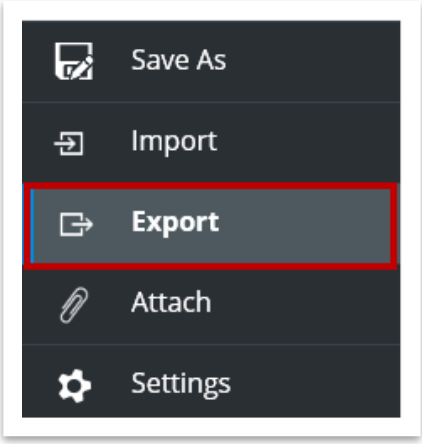
- **Microstation (.dgn)** (*conceptual model file*)
- **Alignment (.alg)**
- **Terrain (.tin)**

The user can also export the **Template (.itl)** and **Template Drop (.ird)** for further design development in the ORD corridor modeler, but this method is not a recommended workflow for TDOT design. **Note:** The aerial imagery was already exported to a subfolder within the project folder in Exercise 4.3.2 when ConceptStation loaded the imported files from the GeoCoordination Services.

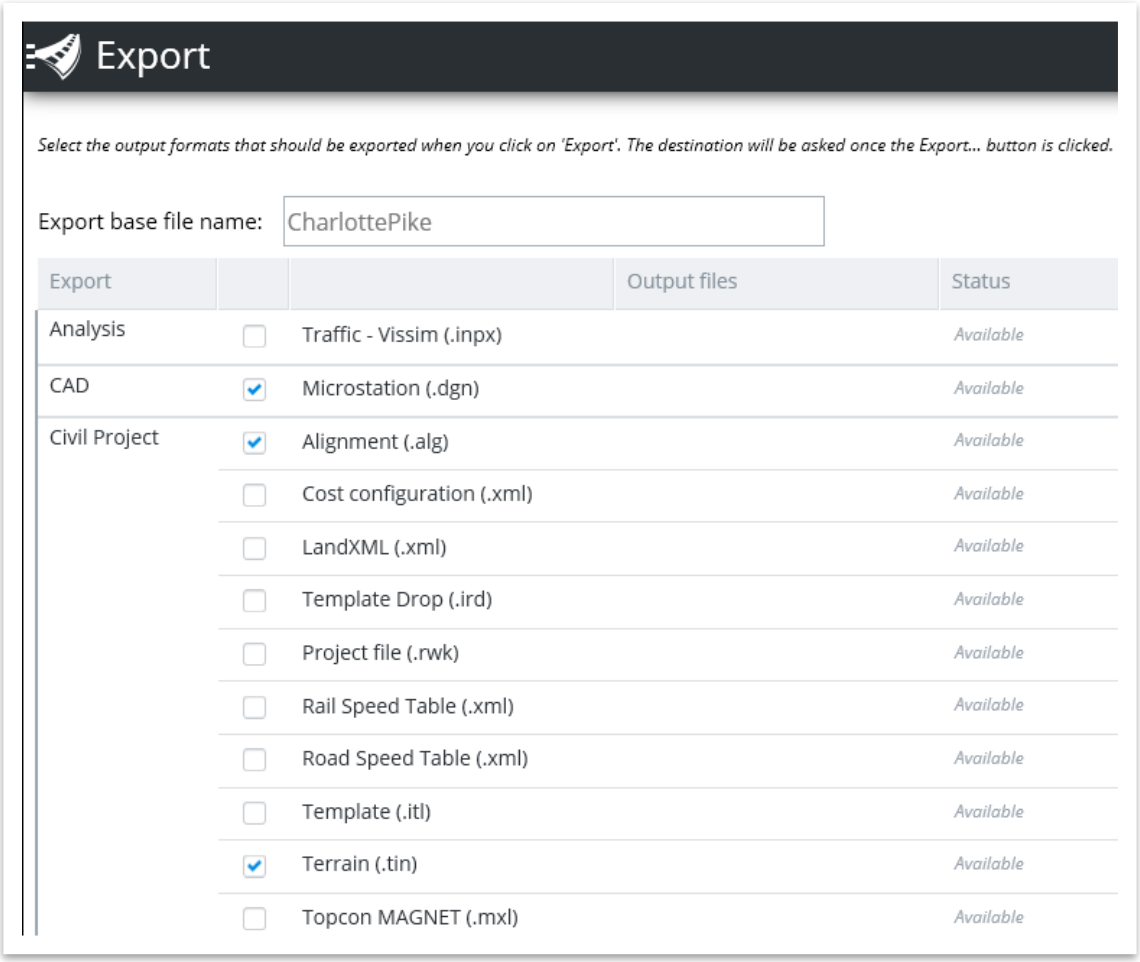
12.2.1 Exercise: Exporting Files

In this exercise, we will export the necessary ConceptStation files for utilization in ORD.

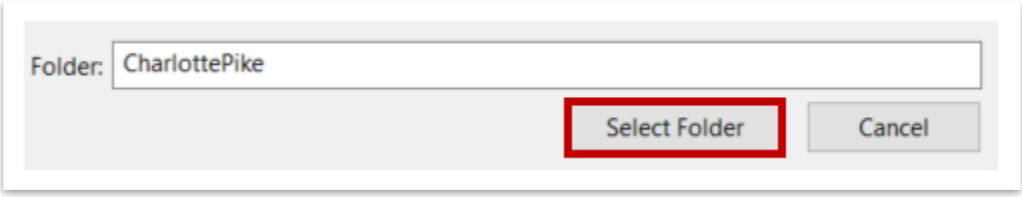
1. Open the **Export** option found within the Backstage menu.



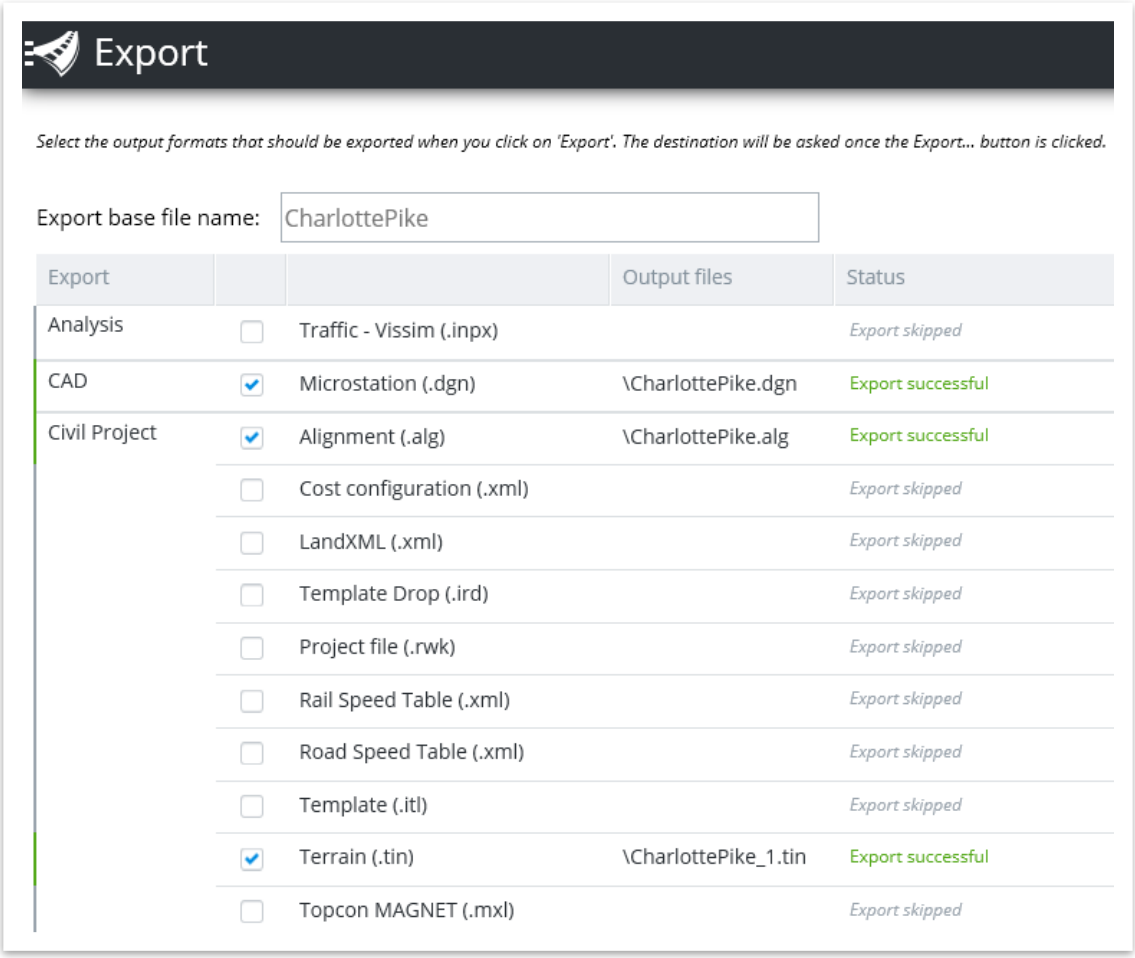
2. Toggle on the following files to export: **Microstation (.dgn)**, **Alignment (.alg)**, and **Terrain (.tin)**. Then, click **Export** at the bottom of the window.



3. Save the files to the same **Charlotte Pike** folder utilized throughout this manual.



4. Give the software a minute to process. Once complete, you should see **Export successful** in **green** under the **Status** column for all three files. Click **Close**. We will use these files in ORD in Exercise 14.2.

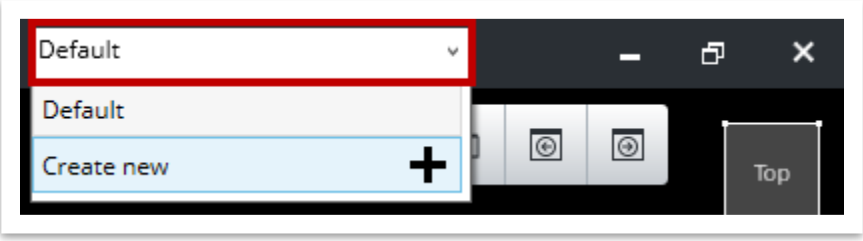


12.3 Lecture: Design Scenarios

The first conceptual model created is the **Default** design scenario. Additional scenarios can be created as copies of the original default concept. This process can expedite the creation of different conceptual alternatives, especially if each alternative is essentially a copy of each other with only small differences between them. The purpose of design scenarios is to enable the user to create multiple conceptual alternatives with corresponding quantity estimates for comparison, which is common during the planning stage. Each design scenario can be exported separately.

Design scenarios are created by using the drop-down in the upper right corner of the ConceptStation window (Figure 133). The default scenario cannot be renamed. The new scenario will be a copy of the Default scenario including all elements (raster, alignments, corridors, terrain, etc.).

FIGURE 133. DESIGN SCENARIOS DROP-DOWN

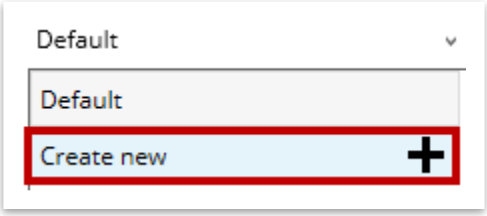


All typical data types (alignments, terrains, etc.) can also be imported into each additional design scenario. The user has control on which scenario(s) the data types are imported into within the ConceptStation file. It is important to note that when importing data into a particular scenario, the data will only import into the **Active Design Scenario** (the scenario that is currently open on screen). If the user needs to apply the data to multiple scenarios, they must import into each scenario separately.

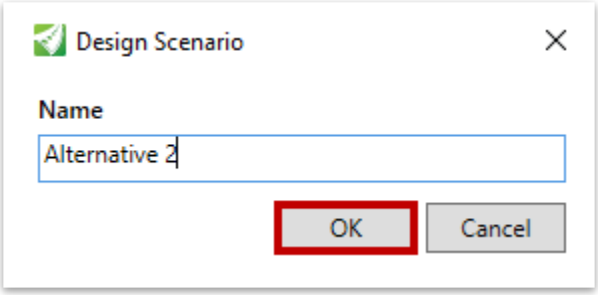
12.3.1 Exercise: Create an Additional Design Scenario

In this exercise, we will create an additional design scenario for the conceptual model we've created thus far. In the new scenario, we will modify the intersection of **Charlotte Pike** (S.R. 24/U.S. 70) and **Davidson Drive** to be a roundabout.

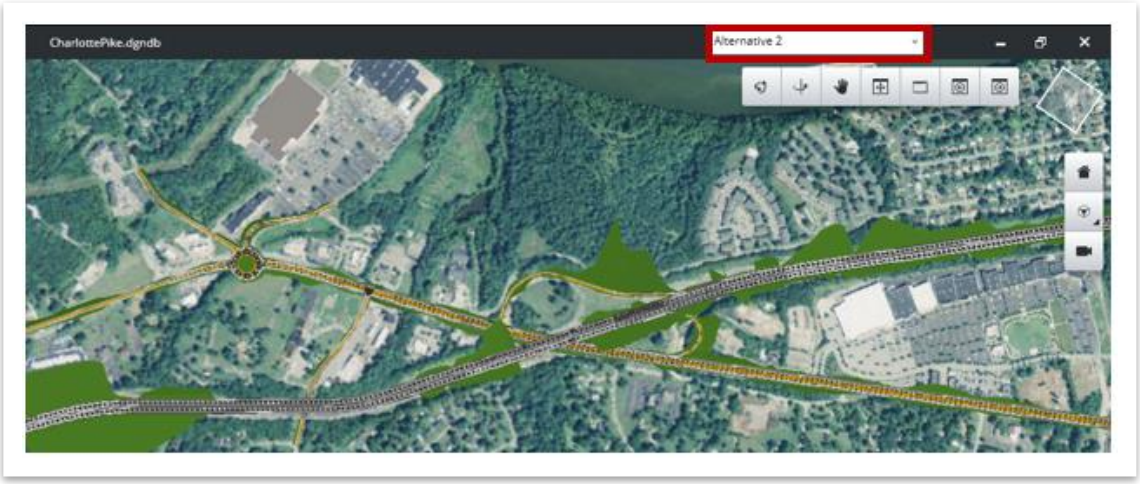
1. Using the design scenario drop-down in the upper right corner of the Concept Station window, click **Create new**.



2. In the **Design Scenario** dialog box, key-in in **Alternative 2** and then click **OK**.



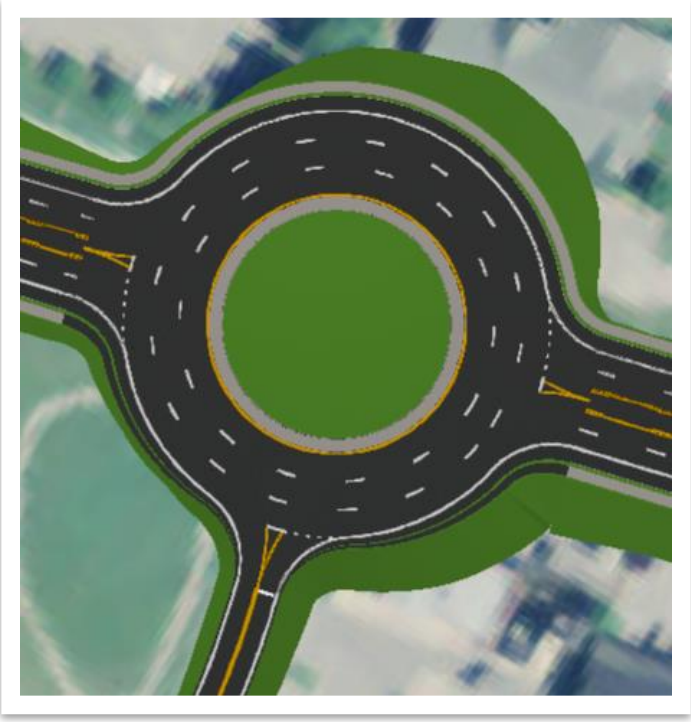
3. Notice that the design scenarios box in the upper right corner now shows **Alternative 2** and that all elements from the **Default** model are still present.



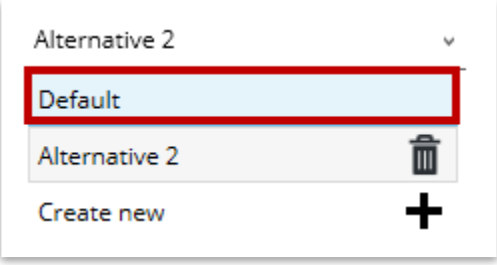
4. Zoom in to the intersection of **Charlotte Pike** (S.R. 24/U.S. 70) and **Davidson Drive**. We will now convert the intersection to a roundabout.

5. Select the intersection and hit **Delete** so we can create the roundabout.

6. Next, open the **Roundabout** tool (**Backstage >> Conceptualize >> Road Placement**) and leave the default settings as-is. Notice the prompt: **Select primary road**. Select the **Charlotte Pike** (S.R. 24/U.S. 70) alignment. Notice the next prompt: **Select secondary road or right click to place roundabout at current location**. Select the **Davidson Drive** alignment. Then, **right** click to accept placement.



7. Open the **Elements selection** tool to clear the tool and then select the **Default** model from the design scenarios drop-down in the upper right corner of the ConceptStation window. Zoom in to the same intersection and notice that the T-intersection is still present in this model.



Chapter 13. Visualize with LumenRT Designer

This chapter will discuss how to access **LumenRT Designer** to **Visualize** the model. While these tools are not part of the TDOT workflow, they can still be accessed to produce photorealistic renderings and videos.

13.1 Objectives

At the conclusion of this chapter, participants will be able to:

1. Utilize the Visualize option within ConceptStation to access LumenRT Designer and understand the functionality between the two.
2. Understand the tools within LumenRT Designer.
3. Understand the outputs from LumenRT Designer.

13.2 Lecture: Visualize

The **Visualize** option is found within the Backstage menu. It allows the user to automatically export the contents of the ConceptStation model into the **LumenRT Designer** product (Figure 134).

FIGURE 134. VISUALIZE OPTION + LUMENRT DESIGNER

This will open the **LiveCube** containing the optimized **LumenRT scene**, which is created from the conceptual model. It may take the a few minutes for the software to process and open. Once the scene is saved and closed, the user can edit the ConceptStation model and then **re-export** it back into LumenRT Designer to add additional objects and animations. Even if the ConceptStation model is substantially changed, the original saved scene features will still be retained when re-opening the model in LumenRT Designer.

All **3D geometry** and **associated materials** and **textures** in the conceptual model will be exported as elements in LumenRT Designer. 2D geometry and non-mesh geometry such as lines, are not exported into LumenRT Designer.

13.3 Lecture: LumenRT Designer Tools

The **LiveCube** has **navigation** controls on the bottom of the window and **material** and **animation** tools on the left of the window (Figure 135).

FIGURE 135. LUMENRT NAVIGATION CONTROLS

Clicking **F1** will show the keys for the different **navigation** modes such as **Animation**, **Walk-thru**, **Fly-thru**, and **Orbit**. The tools on the left of the window include the **File** options (file creation/saving), **Selection** tools (manipulate items in the model), **Setup** tools (modify visualization settings), **Sun & Atmosphere Settings** (time of day, season, weather), **Terrain & Ocean** settings, **Add Plants**, **Character**, and **Vehicle**, **Photo**, and **Movie Editor**.

Users can import objects and rapidly create traffic flows for animation. Users can also create photos, renderings, and videos, plus publish LiveCubes. Once the user has finished visualizing the model in LumenRT Designer, exiting the file will save the scene and the user will be able to edit the ConceptStation model again.

Figure 136 shows a photorealistic close-up of the intersection of **Charlotte Pike** (S.R. 24 /U.S. 70) and **Old Hickory Blvd** (S.R. 251) in the **LumenRT Designer** 3D environment.

FIGURE 136. LUMENRT – 3D VIEW OF INTERSECTION

Chapter 14. Integration of ConceptStation Model with ORD Plans Production

This chapter will discuss the **import** process of ConceptStation (conceptual) models into **ORD**, which then allows for the creation of layout sheets showing the photorealistic conceptual model overlayed on aerial imagery.

14.1 Objectives

At the conclusion of this chapter, participants will be able to:

1. Create a new ORD file.
2. Import the ConceptStation alignments, corridors, and aerial imagery into ORD.
3. Create conceptual layout sheets in ORD.
4. Print a conceptual layout sheet in ORD.

14.2 Exercise: Creating an ORD File and Importing the ConceptStation Model

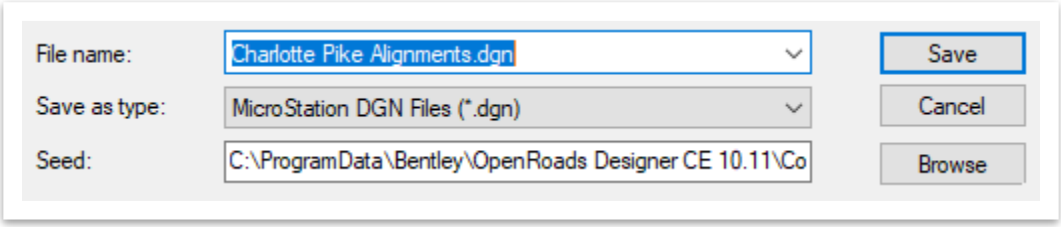
In this exercise, we will create a new ORD file and then import the ConceptStation alignments and attach the ConceptStation model as a reference.

Take Note!

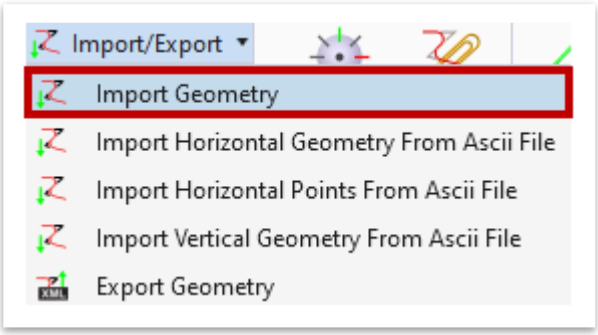
*On an actual project, remember to use the TDOT ORD naming convention when creating **all** design files. The file names used in this manual serve as general guidance for training purposes only. The procedures are intended to teach the necessary tools and TDOT's ORD workspace. For more information, refer to the TDOT ORD File Naming Convention Standards document.*

1. Launch **ORD CE – 2022 Release 1** and make sure the **TDOT_Standards** workspace is active. Select the **123456.00_INITIALS** workset. **Note:** If you do not have this workset as an option in the drop-down, refer to Exercise 2.3.3 in the Fundamentals (ORD) Manual for how to create the workset.

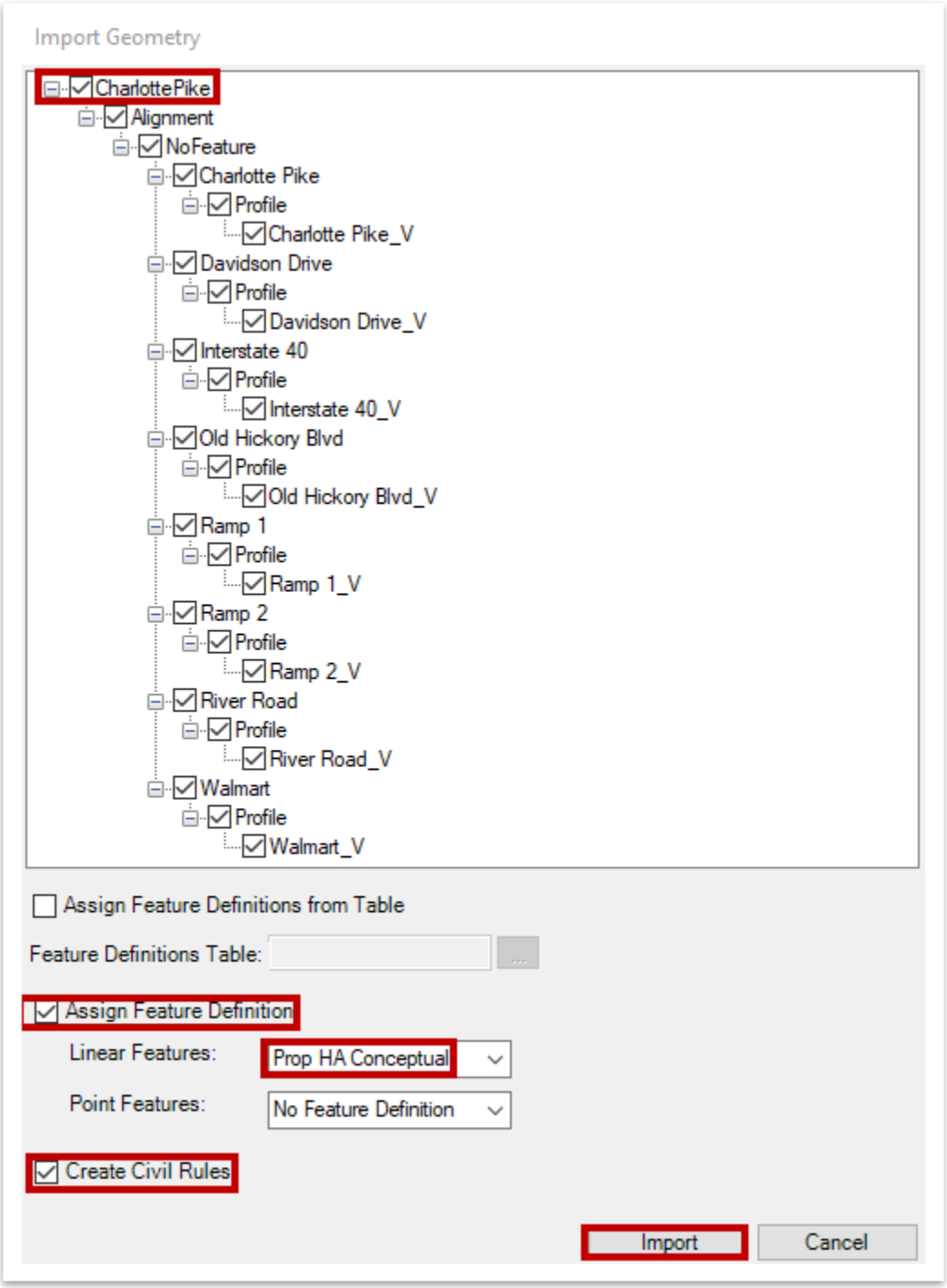
2. Create a new file and name it **Charlotte Pike Alignments**. Select the **TDOTSeed 2D.dgn** and click **Save**.



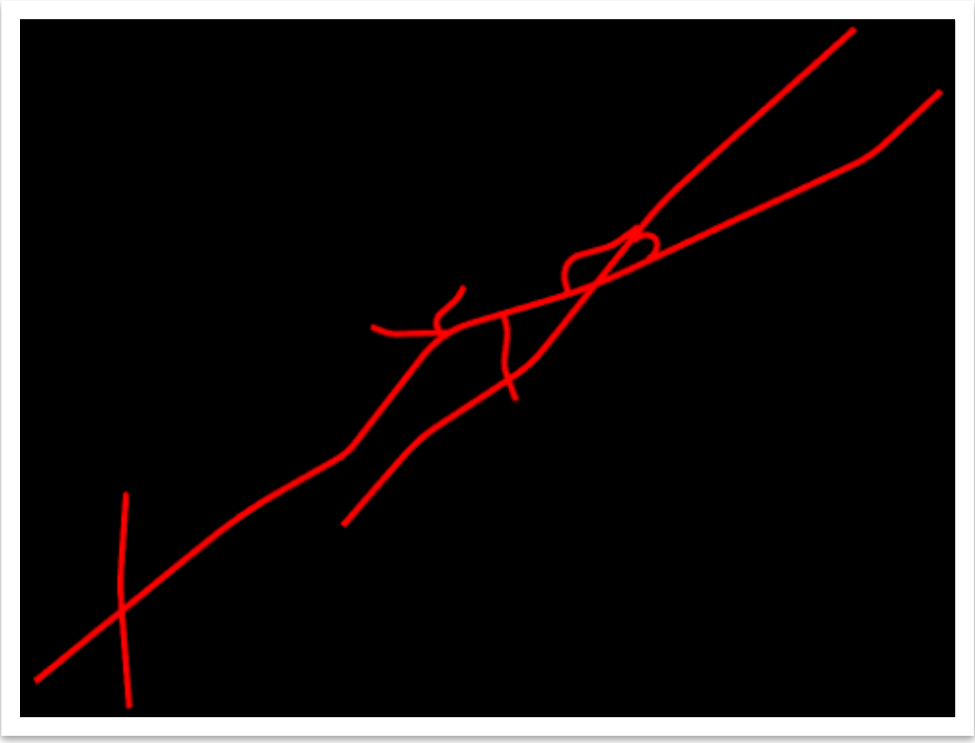
3. Go ahead and move the exported ConceptStation files that were created in Exercise 12.2.1 to the following location: **C:\ProgramData\Bentley\OpenRoads Designer CE 10.11\Configuration\WorkSpaces\TDOT_Standards\WorkSets\123456.00_INITIALS\dgn**. We will utilize them later in this chapter.
4. Now we will import the ConceptStation alignments from the exported .**alg** file. Open the **Import Geometry** tool (**OpenRoads Modeling >> Geometry >> General Tools >> Import/Export**).



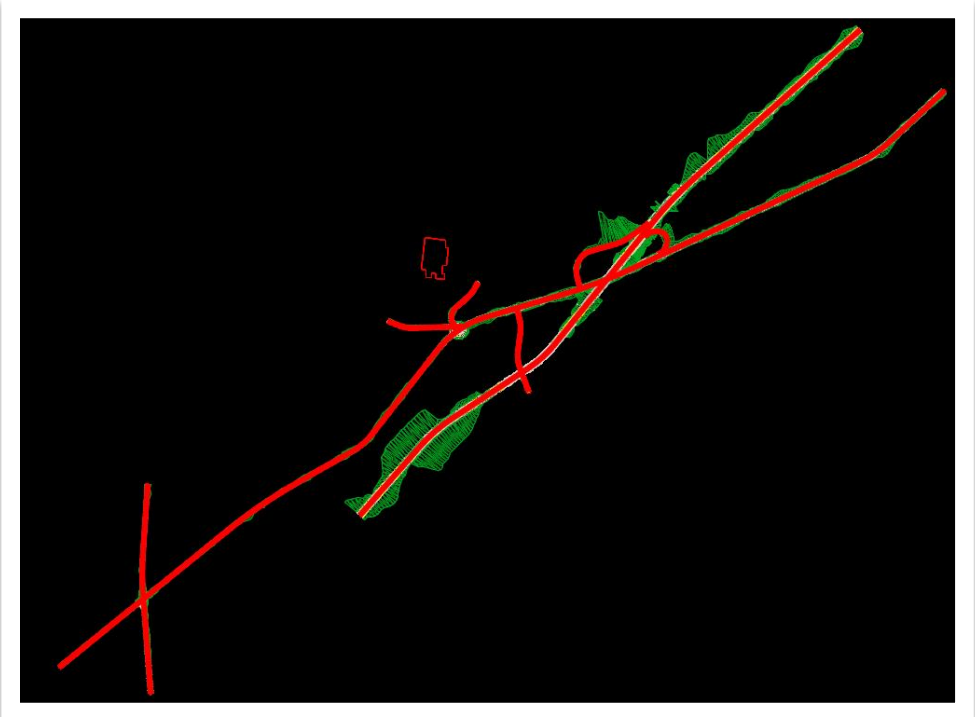
5. Select the **CharlottePike.alg** file within the **123456.00_INITIALS** workset dgn subfolder and click **Open**. Within the **Import Geometry** dialog box, toggle on **Charlotte Pike** so that all horizontal alignments and their corresponding profiles will be imported. At the bottom of the dialog box, toggle on **Assign Feature Definition** and **Create Civil Rules**. Set the **Linear Features** to **Alignment >> Prop HA Conceptual**. Then, click **Import** and give it a second to process.



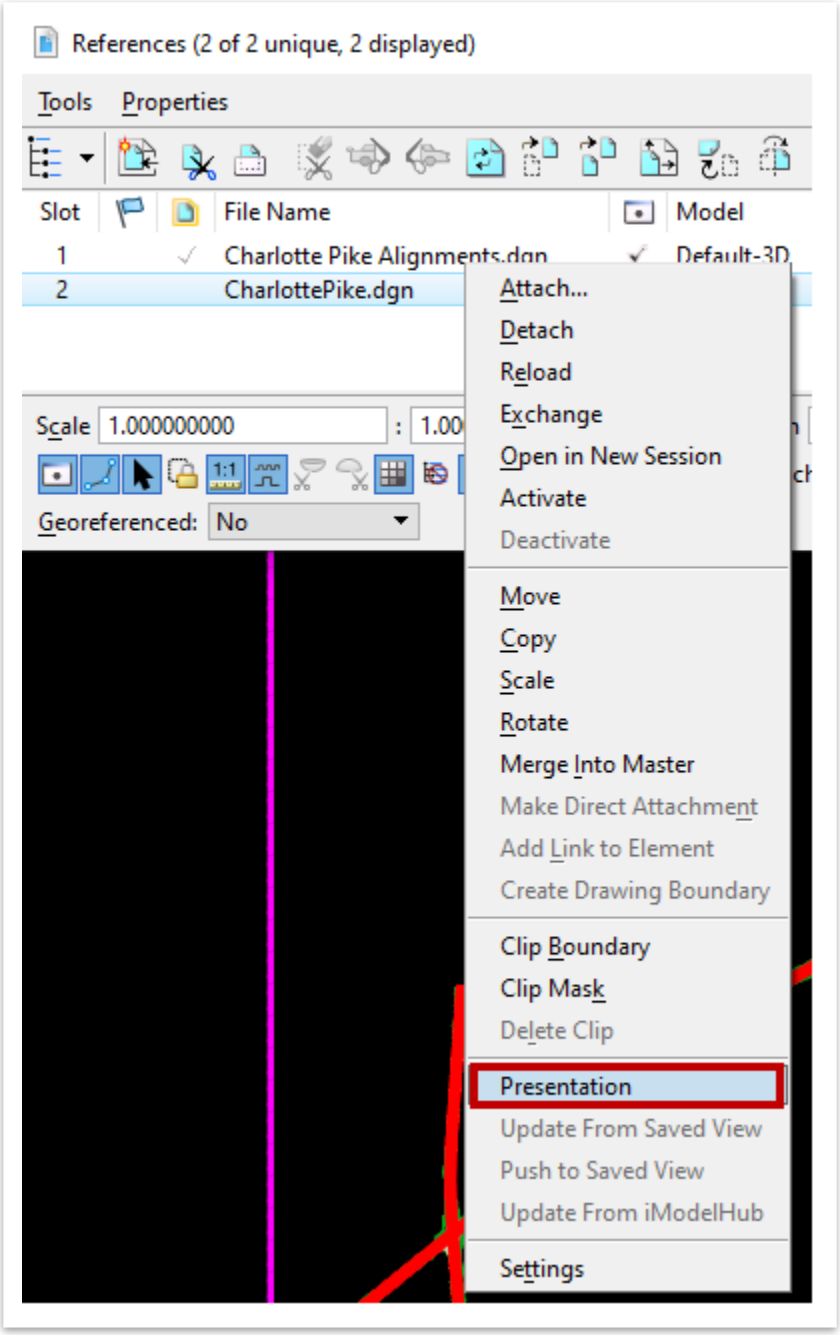
6. Click **Fit View** and notice the imported alignments.



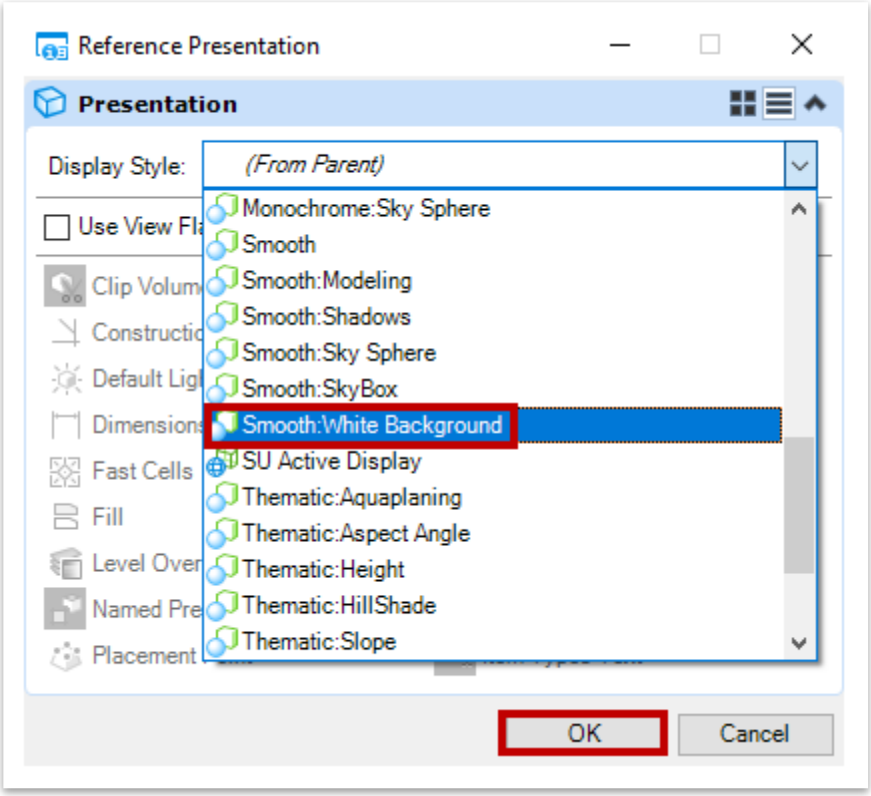
7. Next, attach the **CharlottePike.dgn** file (export from ConceptStation) as a reference file using the **Coincident World** attachment method. Notice that the ConceptStation model is now showing along the imported alignments.



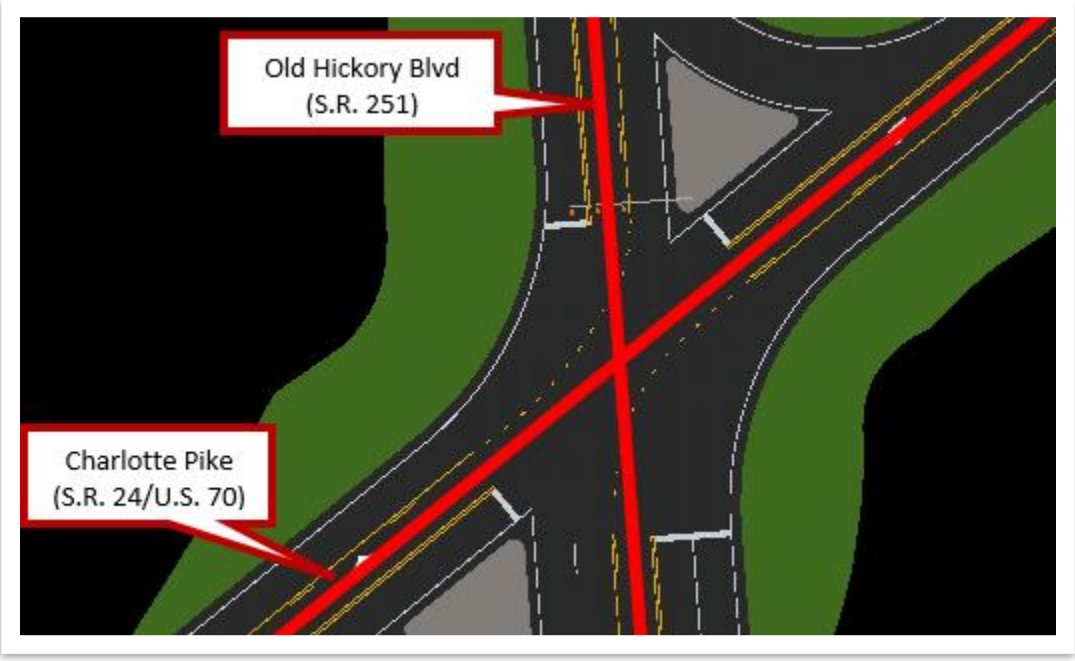
8. In the **References** window, **right** click on the **CharlottePike.dgn** reference file and select **Presentation**.



9. In the **Reference Presentation** window, select **Smooth:White Background** as the **Display Style**. Then, click **OK**.



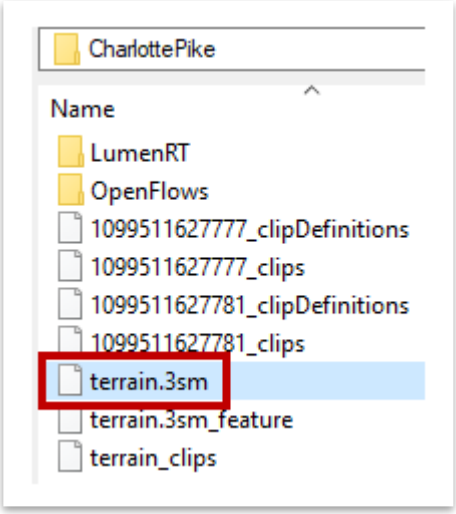
10. Zoom in to the **Charlotte Pike** (S.R. 24/U.S. 70) – **Old Hickory Blvd** (S.R. 251) intersection and notice that the model now displays like in ConceptStation.



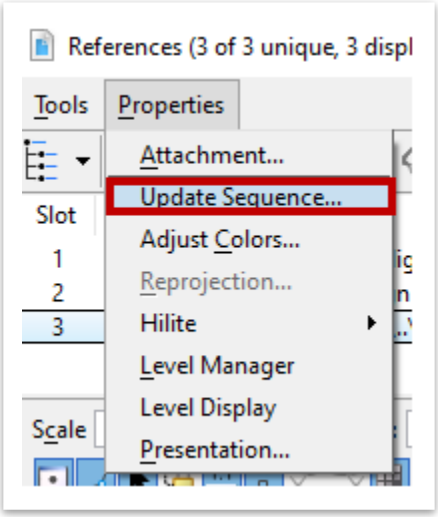
14.3 Exercise: Importing ConceptStation Aerial Imagery into ORD

In this exercise, we will attach the terrain.3sm file from the ConceptStation Geo Coordination Services download into the ORD file to display the aerial imagery clip like in ConceptStation.

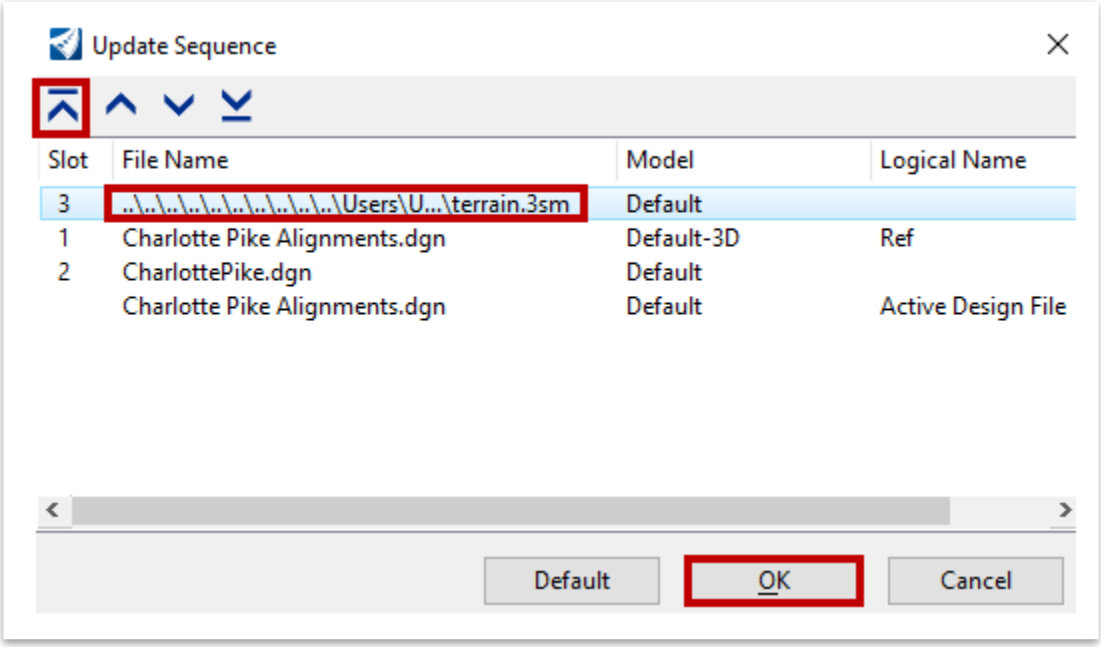
1. First, let's attach the **terrain.3sm** file using the **Coincident World** attachment method. **Note:** You will need to browse to the **Charlotte Pike** subfolder created earlier in the manual to locate the file (**C:\Users\(JJ#)\Documents\Charlotte Pike**).



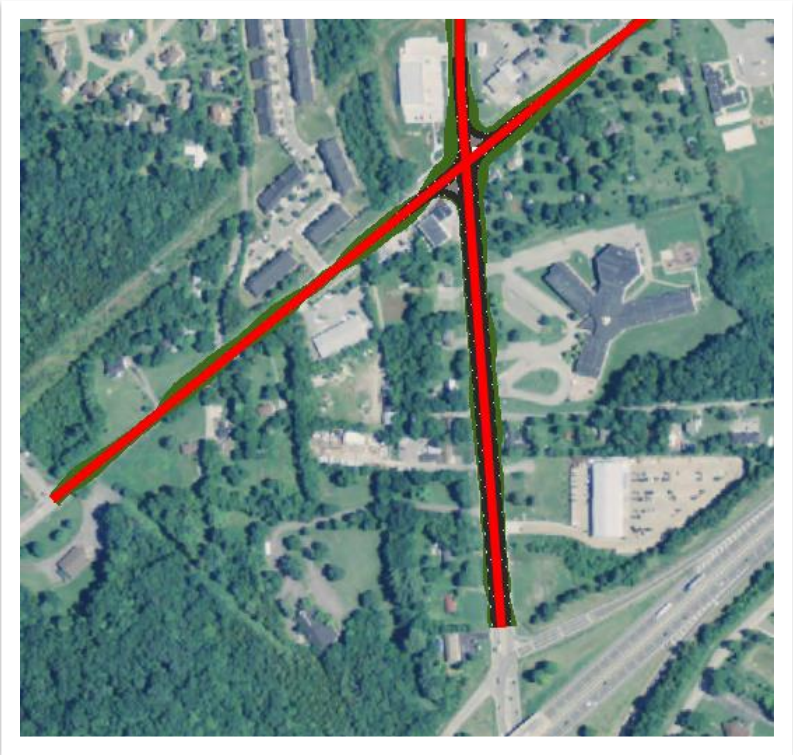
2. In the **References** window, **right** click on the **terrain.3sm** reference file and select **Presentation**. In the **Reference Presentation** window, select **Smooth:White Background** as the **Display Style**. Then, click **OK**.
3. Staying in the **References** window, go to **Properties >> Update Sequence**.



4. In the **Update Sequence** window, select the **terrain.3sm** file and move it to the **top** of the list so that the aerial will be behind the referenced ConceptStation alignments and model in the active file. Then, click **OK**.



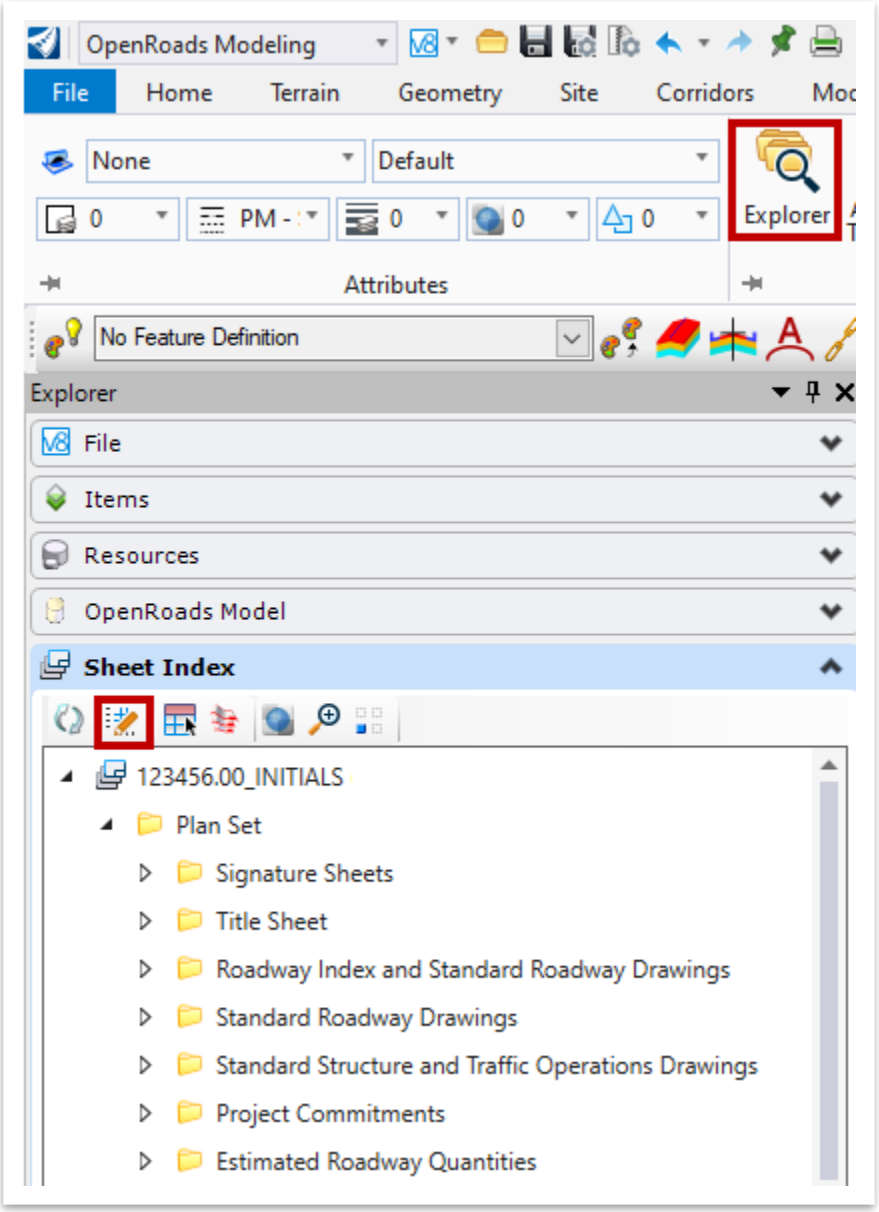
5. Zoom in and notice the aerial overlay, which should be underneath the Concept Station alignments and model.



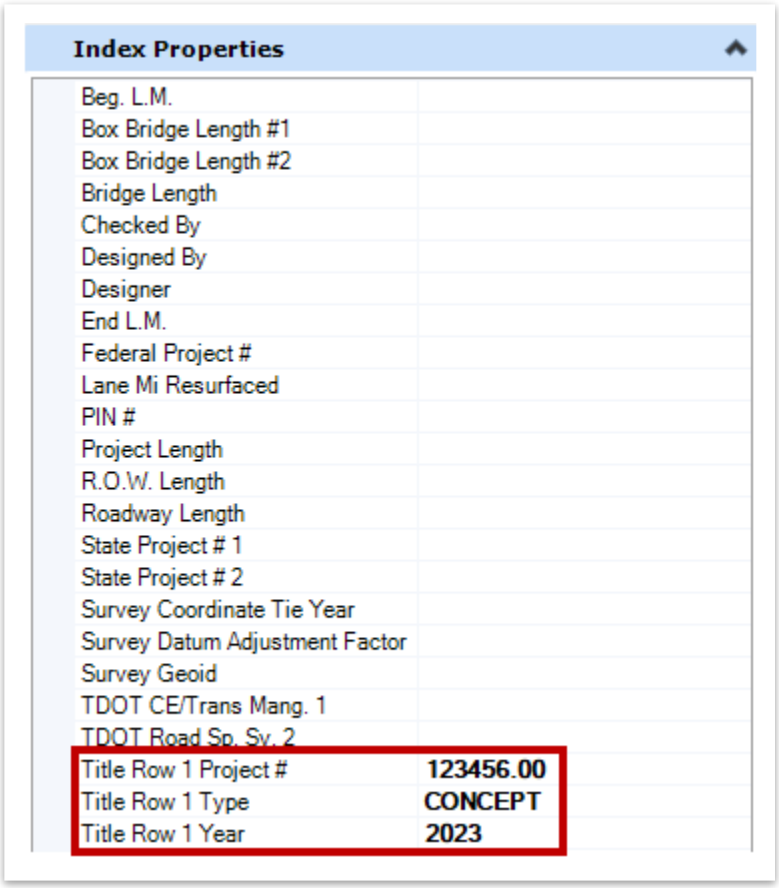
14.4 Exercise: Creating Conceptual Layout Sheets in ORD

In this exercise, we will modify the sheet index properties as well as create conceptual layout sheets for the imported ConceptStation model.

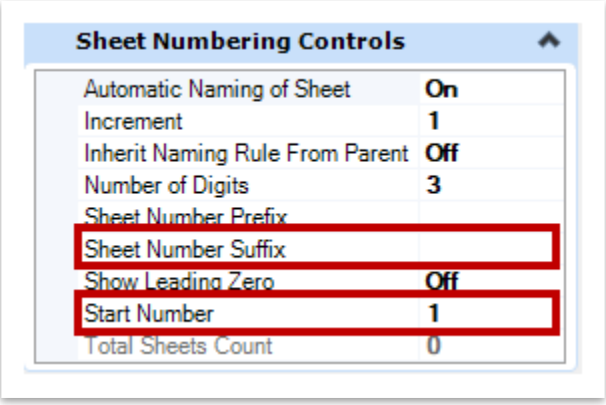
1. Within the **Explorer** under the **Sheet Index** tab, click on the **Open Sheet Index for Edit** icon so we can modify the index properties, which will populate in the title blocks once the sheets have been created.



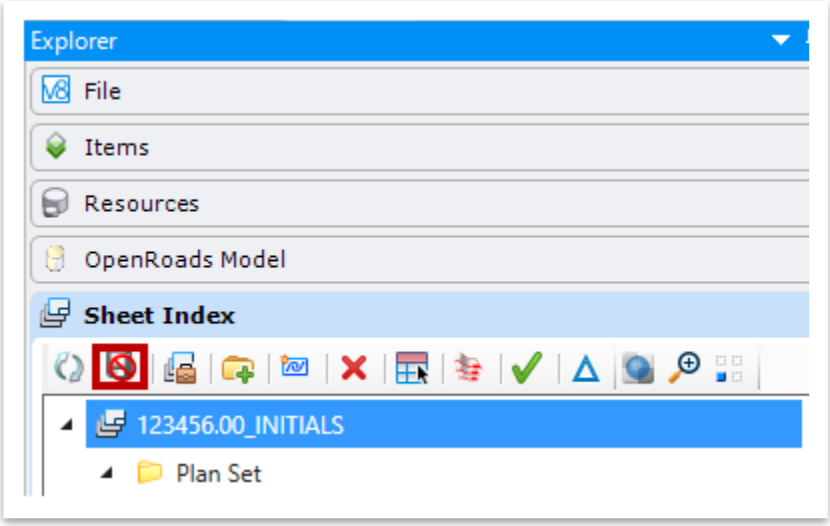
2. Next, highlight the **123456.00_INITIALS** workset in the **Sheet Index**. Within the **Index Properties**, fill in the **3** fields as shown below:
    a. **Title Row 1 Project #:** 123456.00
    b. **Title Row 1 Type:** CONCEPT
    c. **Title Row 1 Year:** 2023



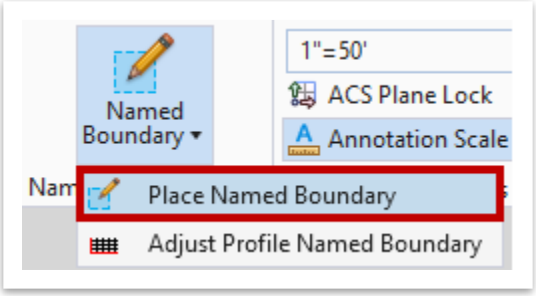
3. Now highlight the **Proposed Layout(s)** folder in the **Sheet Index**. Within the **Sheet Numbering Controls**, update the **2** fields as shown below:
    a. **Sheet Number Suffix:** Remove “B”
    b. **Start Number:** 1



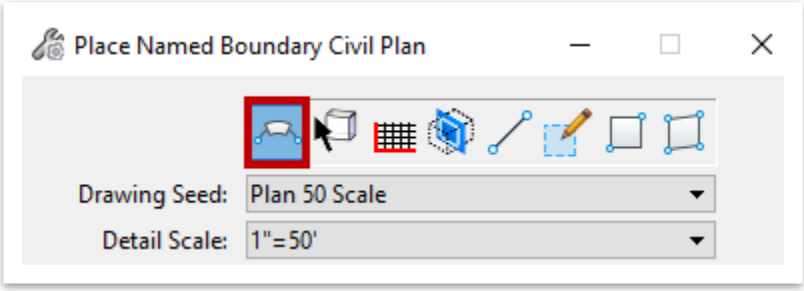
4. Once completed, click on the **Make Sheet Index Read Only** icon in the **Sheet Index** to close the sheet index for editing.



5. Next, open the **Place Named Boundary** tool (**OpenRoads Modeling >> Drawing Production >> Named Boundaries >> Named Boundary**).

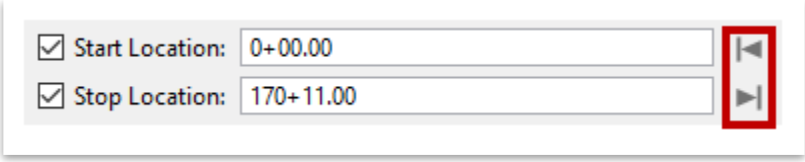


6. Make sure that the **Civil Plan** option is toggled on. Select **Plan 50 Scale** for the Drawing Seed.

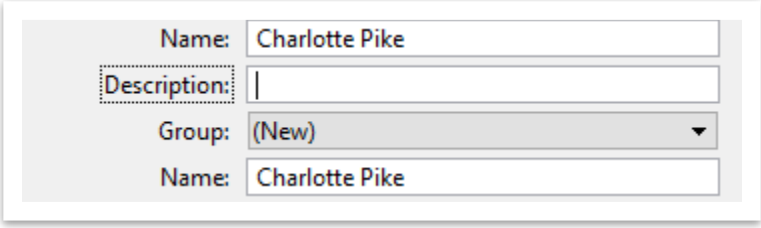


7. Follow the prompts in the lower left corner of the ORD window. Identify the path element (**Charlotte Pike** alignment) by selecting it.

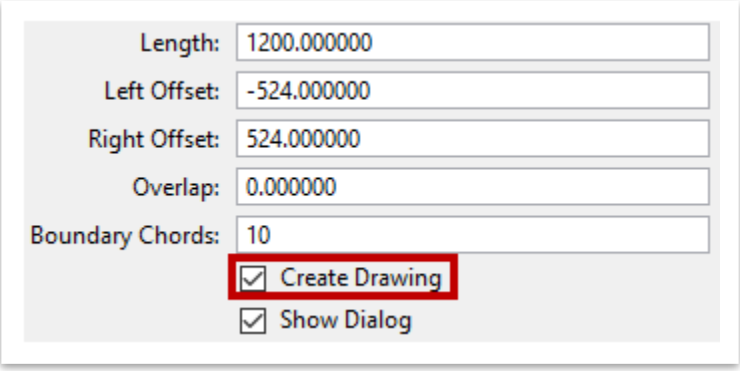
8. Since we will be creating sheets along the entire alignment, click **Lock to Start** and **Lock to End**. **Note:** The **Stop Location** may differ depending on the length of the alignment originally drawn and does not need to match exactly.



9. Key-in **Charlotte Pike** for both the Named Boundary name and the Group name.

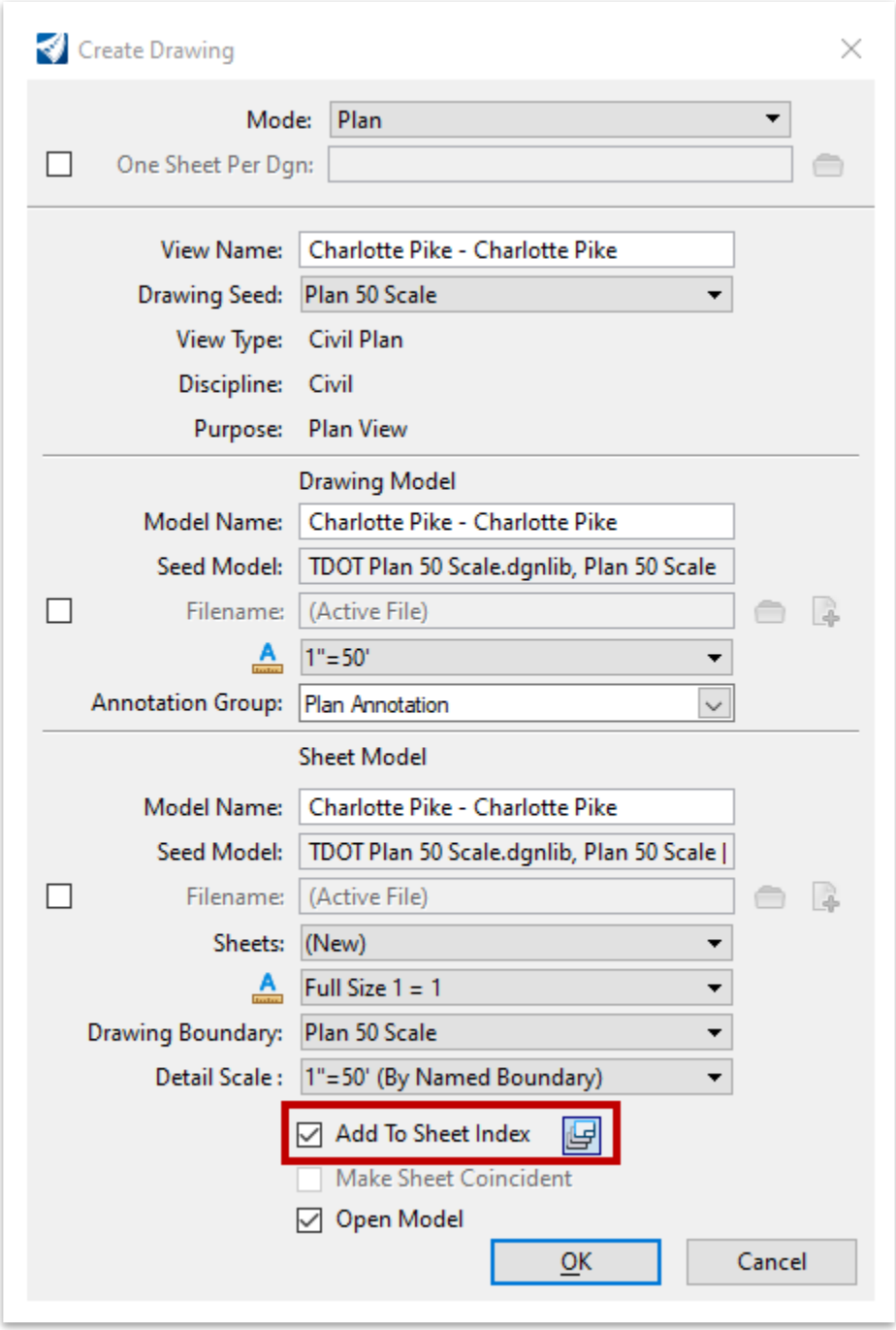


10. Make sure that **Create Drawing** is toggled on and leave everything else as-is.

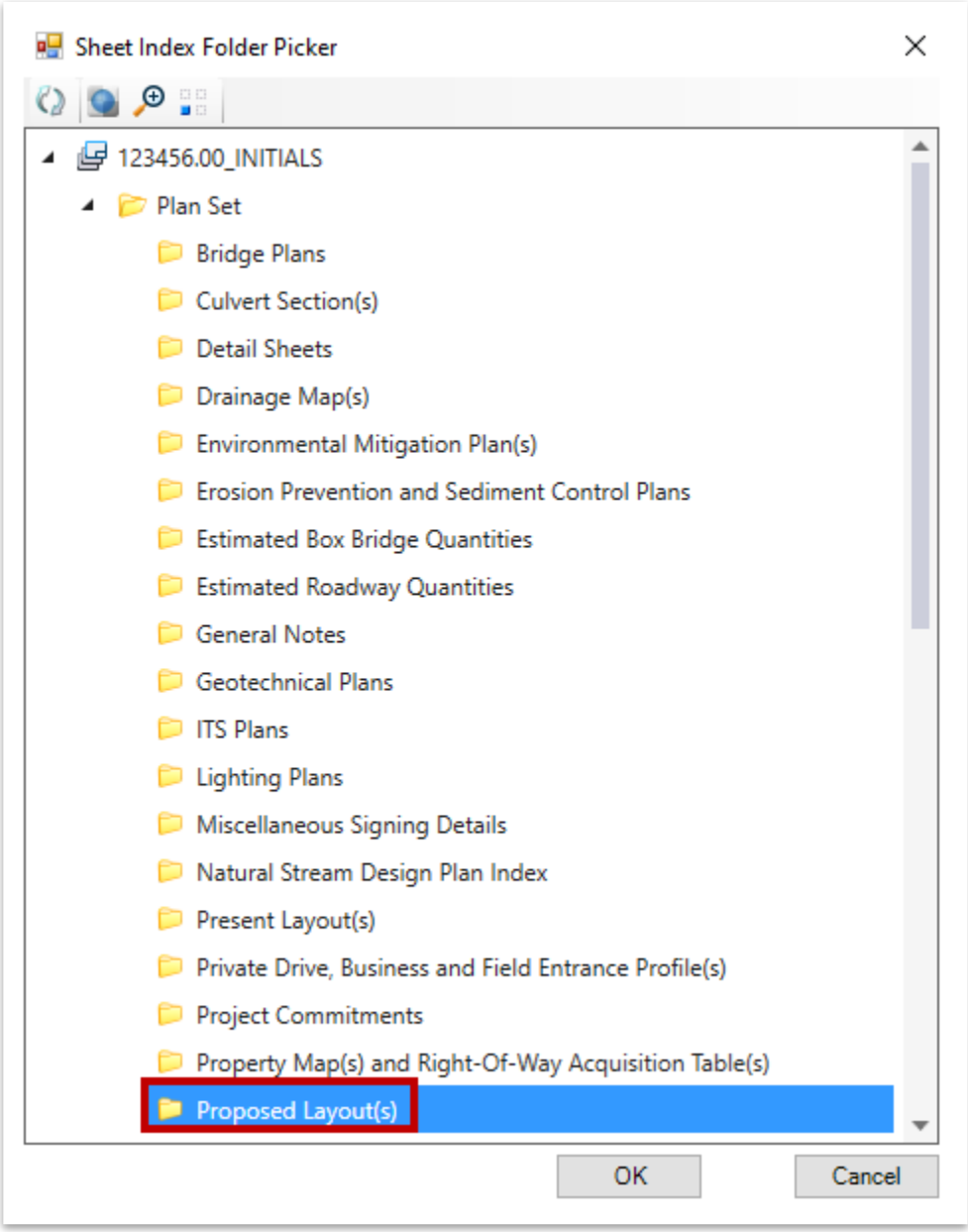


11. **Left** click out in space **3 times** to accept the settings and notice the **15** white clip shapes are drawn in the file.

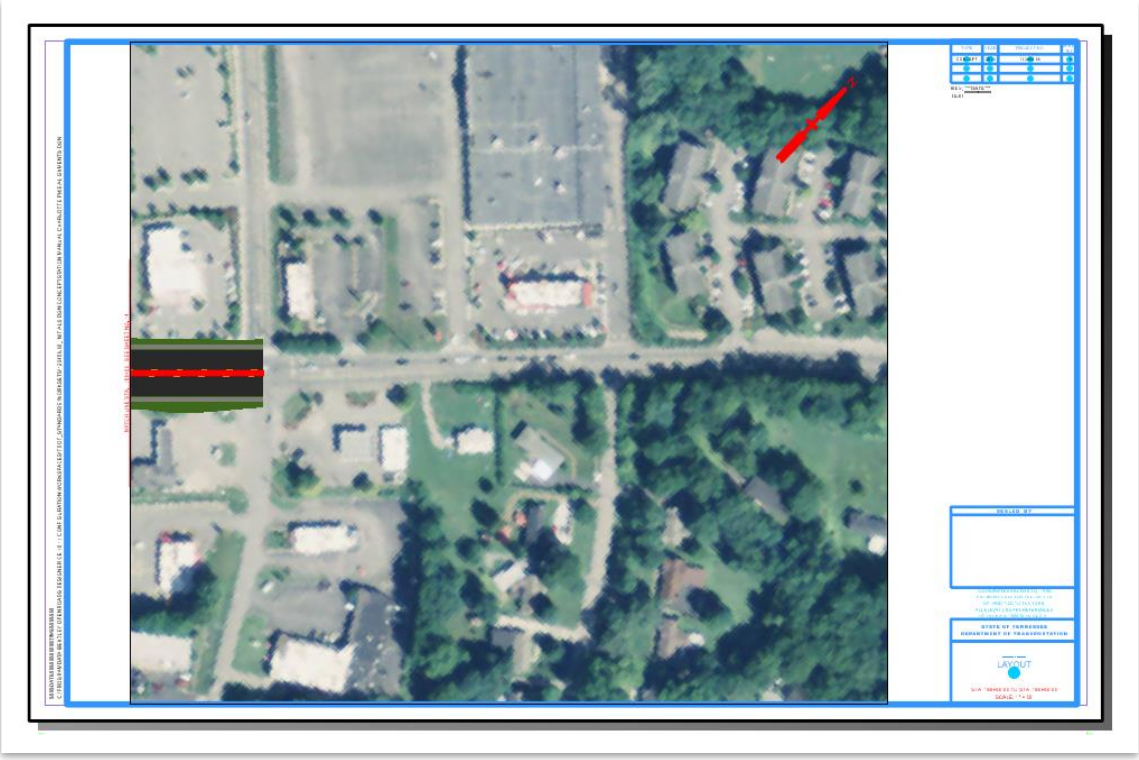
12. The **Create Drawing** window will appear automatically after creating the named boundary shapes. Make sure that **Add to Sheet Index** is toggled on and then click on the browse button.



13. Select the **Plan Set >> Proposed Layout(s)** folder for the layout sheets to be inserted into. Then, click **OK** to close the Sheet Index Folder Picker and **OK** to accept the Create Drawing window.



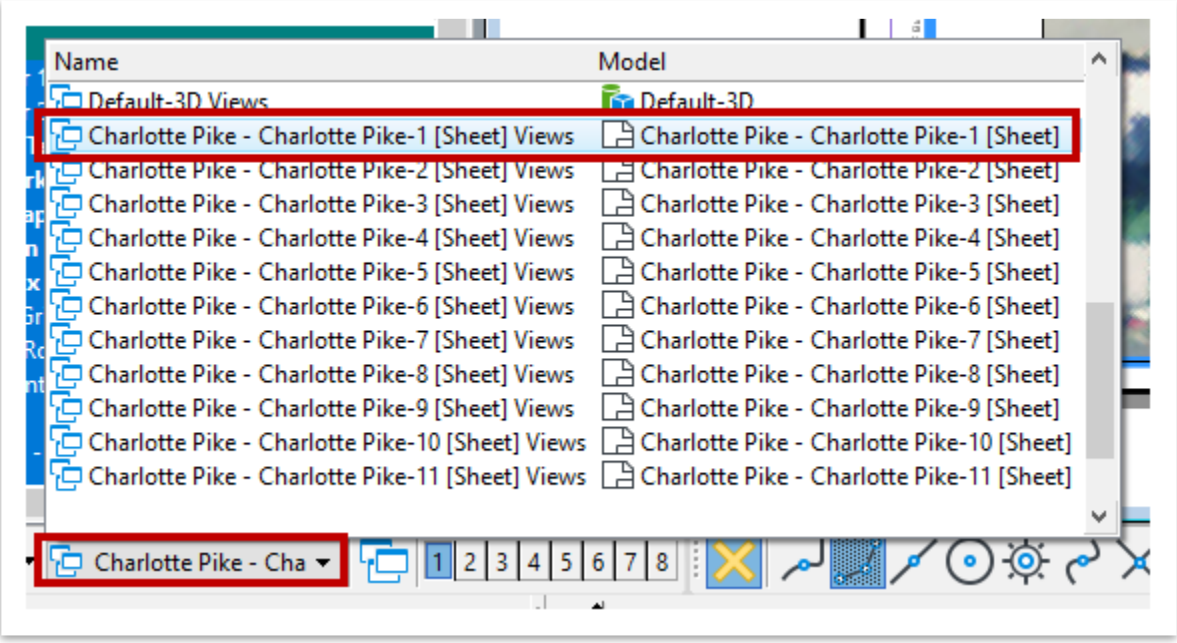
14. Give the software a minute to generate the 50 scale layout sheets along the Charlotte Pike alignment. Once the software is done processing, it will open to the last sheet in the series.



14.5 Exercise: Printing Conceptual Layout Sheets in ORD

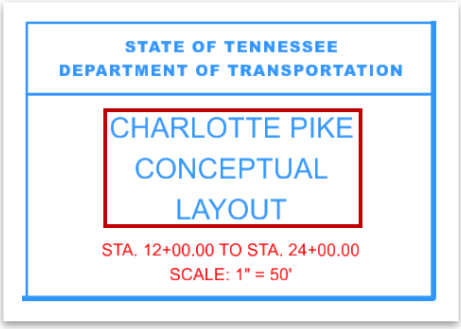
In this exercise, we will be printing a single conceptual layout sheet showing the Concept Station model and aerial imagery in ORD. When there are multiple sheets in a set, it is recommended to use the **Print Organizer** to print the sheets in the Sheet Index. In the previous exercise, we went ahead and added the sheets, but that is only a placeholder. Currently, ConceptStation aerial imagery is not visible when printing via the Print Organizer. Bentley has logged a defect for this issue, which is not yet resolved. The workaround is to print single sheets via the **Print** function in ORD.

1. Open the **Active View Groups** drop-down in the lower left corner of the ORD window and open the **Charlotte Pike - Charlotte Pike-1 [Sheet] Views** model.

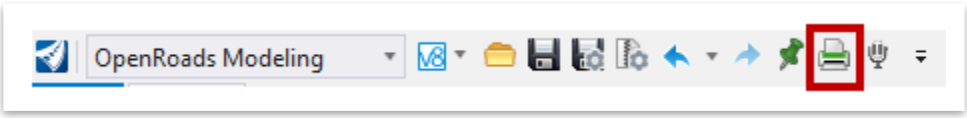


2. Turn off the following levels in the active sheet model (**Charlotte Pike Alignments.dgn, Charlotte Pike - Charlotte Pike-1 [Sheet]**):
   - **DES - SCRATCH - User 1**
   - **DES - SCRATCH - User 2**
   - **DES - SHEET - Plot Shape**
   - **DES - SHEET - Revision Text**

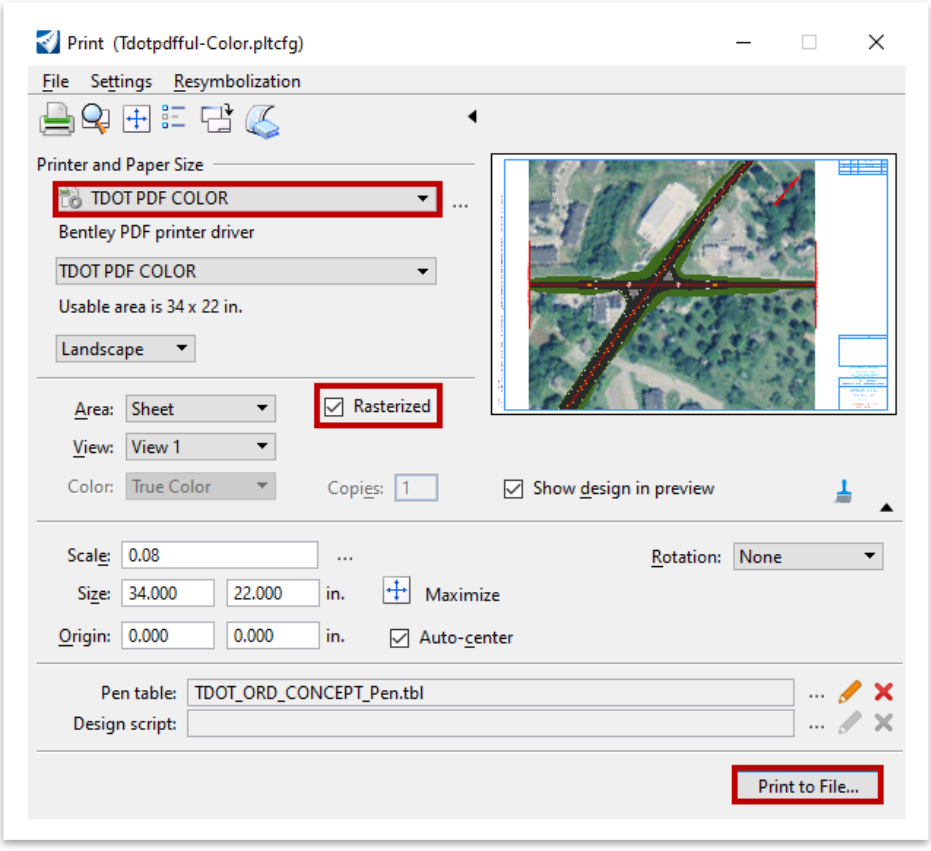
3. In the title block in the lower right corner of the sheet, change the sheet title to **CHARLOTTE PIKE CONCEPTUAL LAYOUT**.



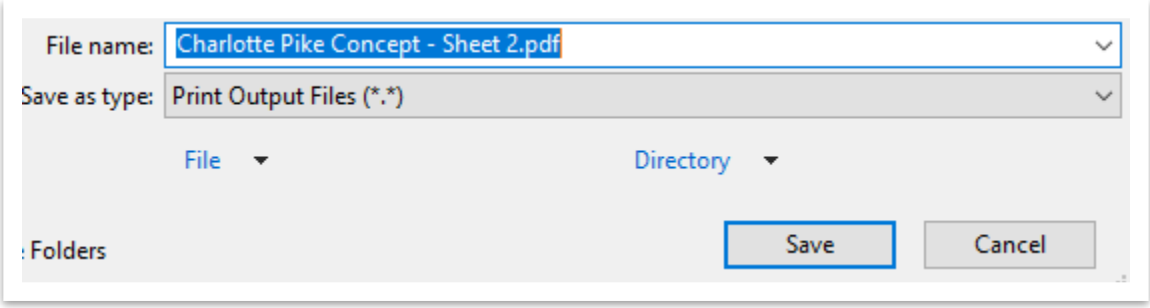
4. Now we are ready to print the sheet. Go ahead and click on the **Print** icon in the upper left corner of the ORD window.



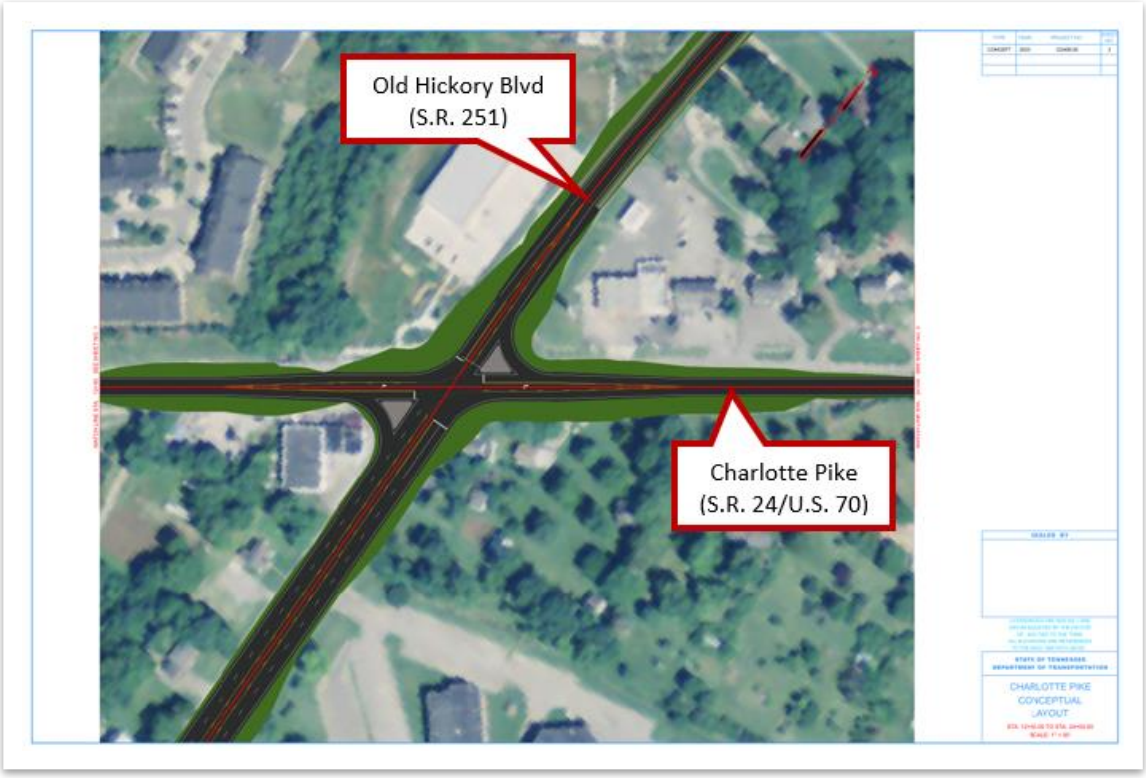
5. In the **Print** window, select the **TDOT PDF Color** print driver, and make sure that **Rasterized** is toggle on. Then, click **Print to File**. **Note:** If Rasterized is not turned on, the print will not show the aerial imagery, and the ConceptStation model will show in Wireframe.



6. Name the file **Charlotte Pike Concept - Sheet 2.pdf** and save it in the ORD project workset folder: **C:\ProgramData\Bentley\OpenRoads Designer CE 10.11\Configuration\WorkSpaces\TDOT_Standards\WorkSets\123456.00_INITIALS\dgn**.



7. Give the software a minute to generate the pdf print. Once completed, open the file to view the conceptual layout sheet. Notice that the ORD print shows the ConceptStation model (alignments, corridor, pavement markings, aerial imagery, and furniture (signal)) at the **Charlotte Pike** (S.R. 24/U.S. 70) – **Old Hickory Blvd** (S.R. 251) intersection.



8. Repeat Steps 1-7 to print the remaining 14 sheets in the set.

Revision History

DATE (MONTH/YEAR)	AUTHOR/EDITOR	IB #	SECTIONS MODIFIED

Appendix A. Additional ConceptStation Features

A.1 Lecture: Integration with OpenStreetMap in ConceptStation

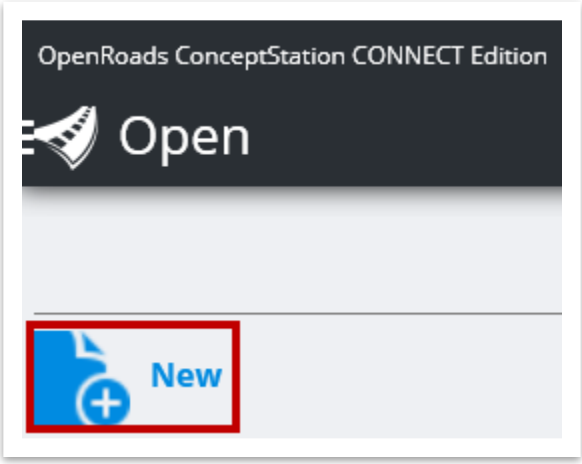
OpenStreetMap (OSM) is an open-source platform that provides geolocated roadway imagery for mapping. OSM imagery can be accessed through ConceptStation's GeoCoordination Services in the Backstage menu. Toggling on the **Roadway** Data class will initiate the import of the OSM roads into the ConceptStation file. It is also important to toggle on the **Terrain** and **Static Imagery** Data classes when importing OSM roads to provide the aerial imagery overlay for context. Since the terrain is imported as well, the user can view the profiles of the OSM roads within the project extent. When using OSM roads, there are several limitations:

- Since GeoCoordination Services will import all paved areas within the project extent, it is recommended to use a small area so that the processing of the OSM roads will be quicker. This is especially crucial in more developed areas that have a higher density of roadways, parking lots, business entrances, etc. If the project extent is too large, the processing time may be lengthy.
- The pavement markings on the imported OSM roads may not be entirely accurate when compared to the actual pavement marking configuration in the field. As a result, it will be necessary to convert the OSM road segments into ConceptStation roads and then edit the templates to ensure the pavement markings are corrected.
- This tool is mainly applicable for existing roadway modification since it will only import existing road segments. For new alignments, it is recommended to place the roads directly in ConceptStation using the tools described earlier in the manual.

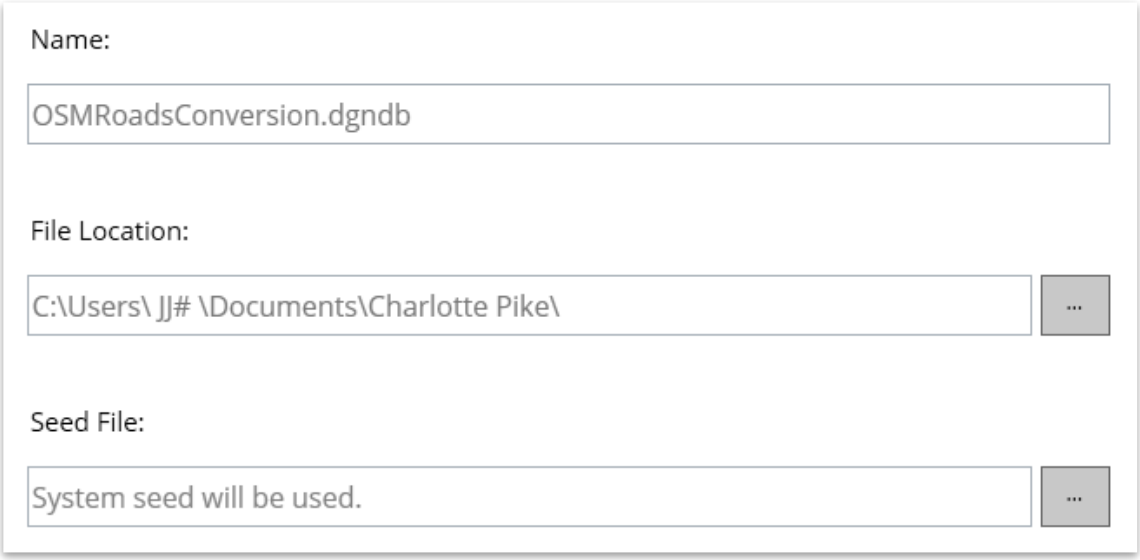
A.1.1 Exercise: Converting OSM Roads to ConceptStation Roads

In this exercise, we will convert an imported OSM road to a ConceptStation road, which will have the same functionality as roads that are directly placed using ConceptStation tools.

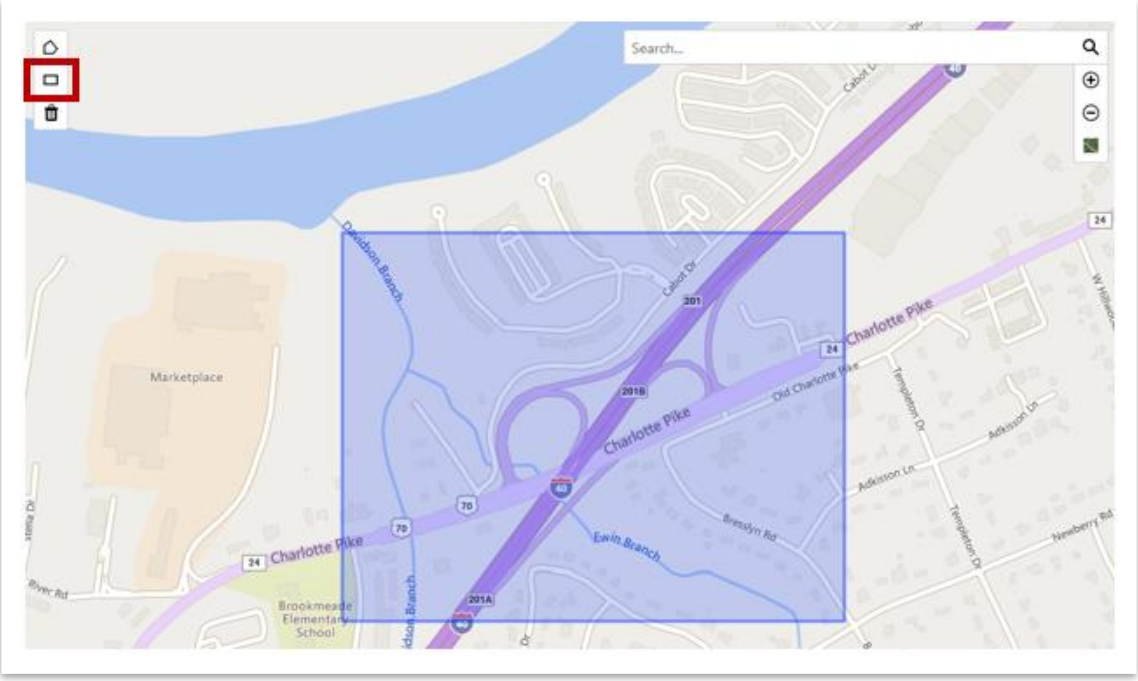
1. Launch **ConceptStation**, if not already opened, and create a new file by clicking **New**.



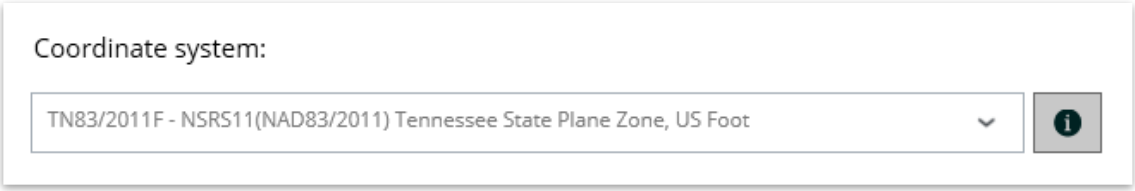
2. For this exercise, we will define the file **Name** as **OSMRoadsConversion.dgndb**. Set the **File Location** to the same **Charlotte Pike** folder created earlier in the manual (**C:\Users\(JJ#)\Documents**). Notice that the **Seed File** is defined as **System seed will be used**. We can leave the linkage as-is.



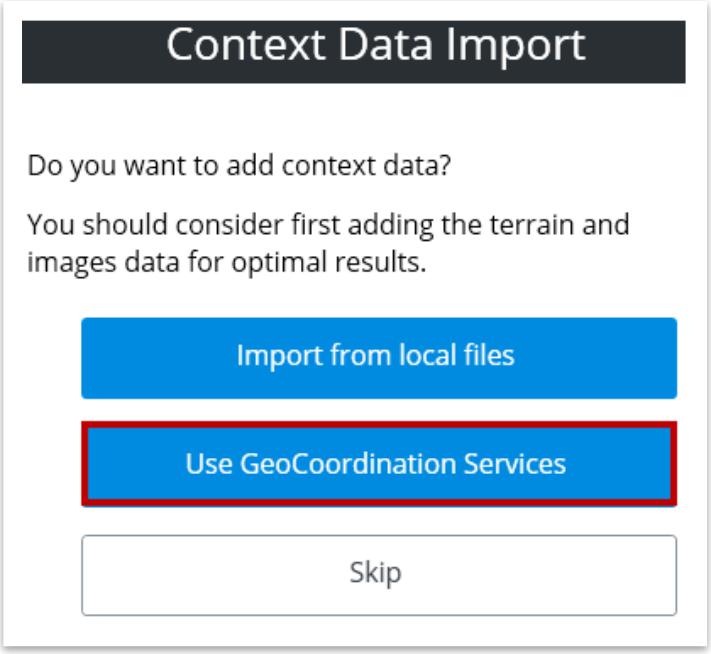
3. Before we can select the applicable **Coordinate system**, we need to define a **concept location**. Zoom in to the **Interstate 40** and **Charlotte Pike** (S.R. 24/U.S. 70) interchange (Exit 201). **Left** click on the **Define Concept Location** (rectangular shape) icon to initiate the tool and then move the cursor to draw a rectangular shape around the extent of the interchange. If necessary, click on the trash can icon to delete the project extent and redraw. **Note:** As a reminder, it is recommended to use a smaller area for OSM road imports relative to the project extent. The focus of this exercise is the interchange area.



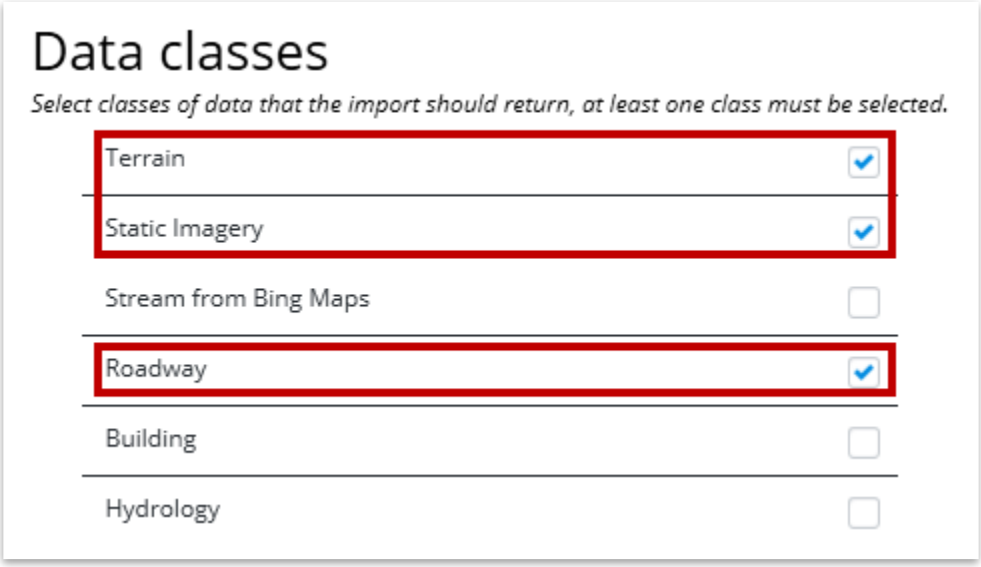
4. Next, we will define the **Coordinate system**. Scroll through the coordinate system list and select **TN83/2011F - NSRS11 (NAD83/2011) Tennessee State Plane Zone, US Foot**. **Note:** As a reminder, it is necessary to define the concept location before assigning the coordinate system. The drop-down search menu for the coordinate system will not return any results if a concept location is not first defined.



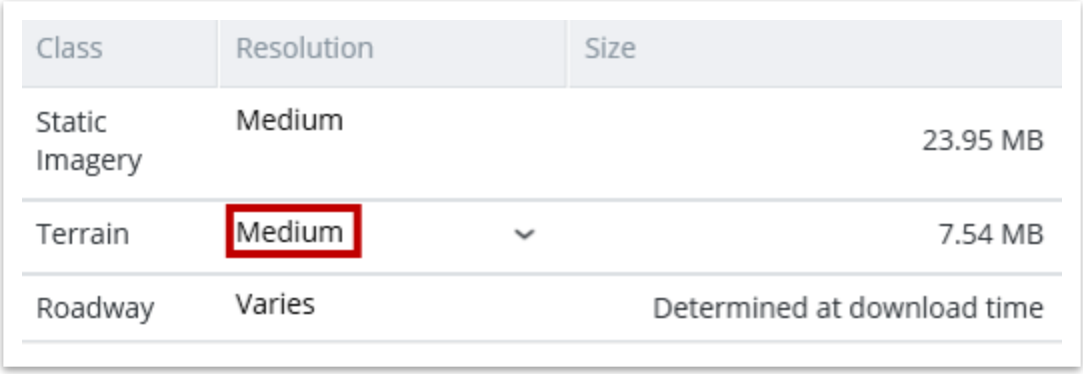
5. Go ahead and click **Create**, and then the **Context Data Import** window should automatically open. Click **Use Geo Coordination Services** to be able to import the geolocated references for the newly created file. **Note:** You could also click **Skip** to go ahead and create the file without importing any geolocated references. You would then be able to access GeoCoordination Services from the Backstage menu and follow the same process that is covered in the upcoming steps.



6. Toggle **On** the **Terrain**, **Static Imagery**, and **Roadway** Data classes and then click **Next**. As mentioned in the lecture, toggling on Roadway is what will initiate the import of the OSM roads into the file. The Terrain and Static Imagery will be imported to provide the aerial imagery context for the imported OSM roads.

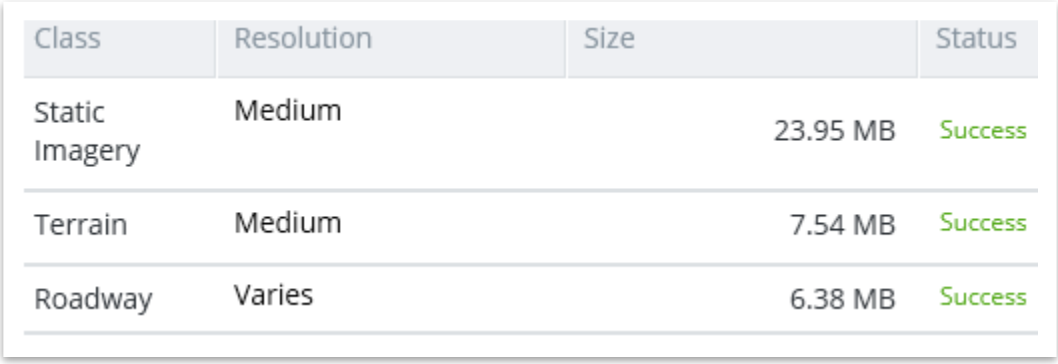


7. Now let's look at the **Resolution**. The **Static Imagery** resolution is already set and cannot be modified. For the **Terrain**, select **Medium** to match the Static Imagery resolution. The **Roadway** resolution will vary based on the download and cannot be modified. **Note:** Depending on your project extent, the file sizes may differ from the image below.



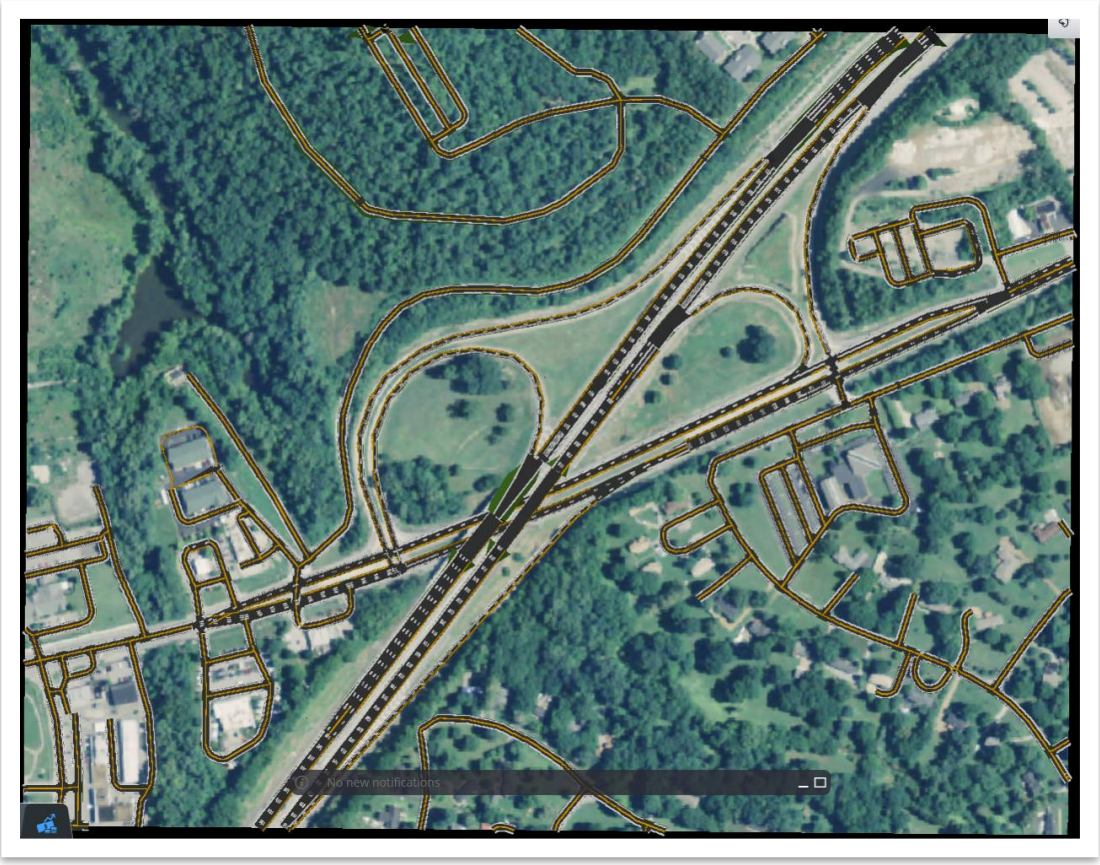
Class	Resolution	Size
Static Imagery	Medium	23.95 MB
Terrain	Medium	7.54 MB
Roadway	Varies	Determined at download time

8. Click **Download and Import** and then wait for the **Status** of each **Class** to say **Success**. **Note:** This process will take a few minutes to complete.

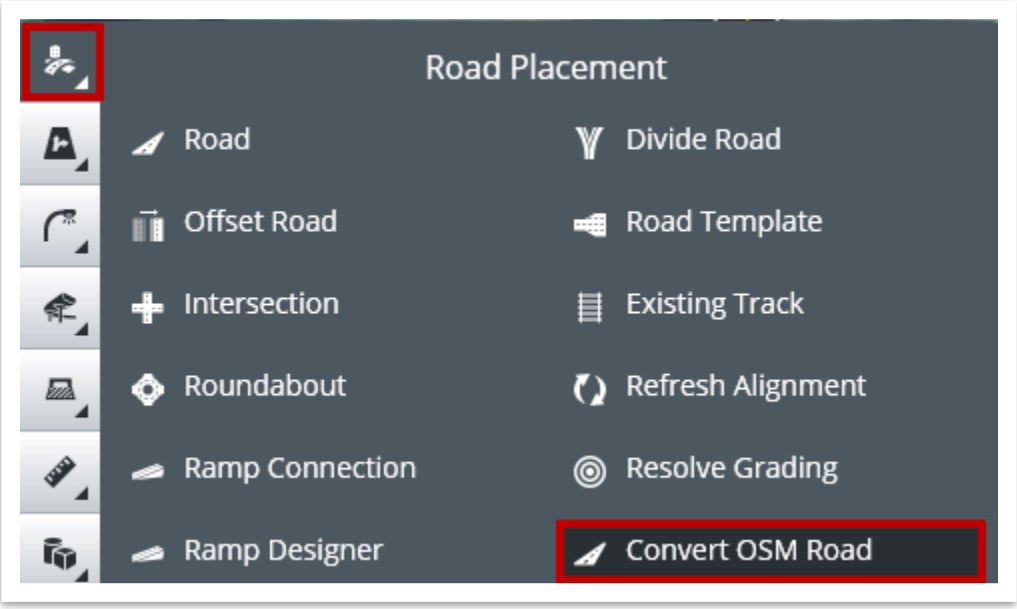


Class	Resolution	Size	Status
Static Imagery	Medium	23.95 MB	Success
Terrain	Medium	7.54 MB	Success
Roadway	Varies	6.38 MB	Success

9. Click **Done** and review the imported OSM roads and background aerial imagery. **Note:** Your clip shape does not need to match exactly.



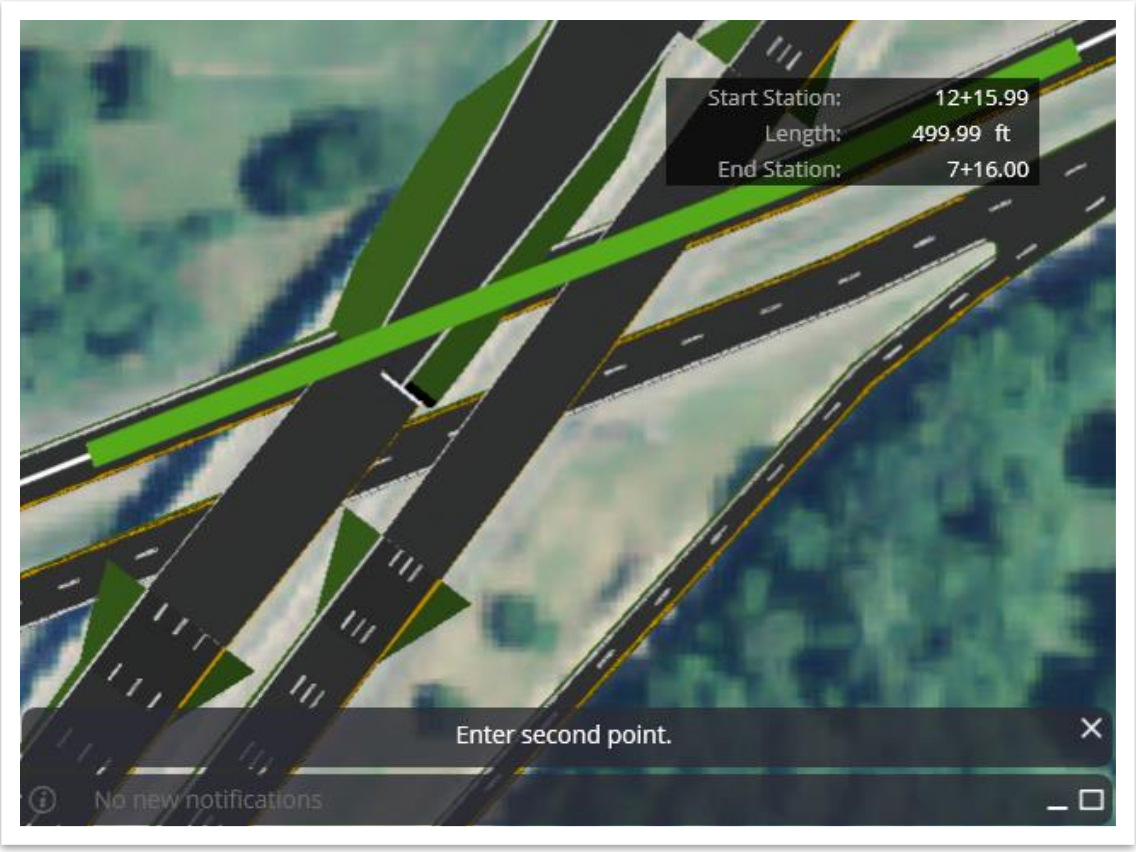
10. Next, open the **Convert OSM Road** tool (**Backstage >> Conceptualize >> Road Placement**).



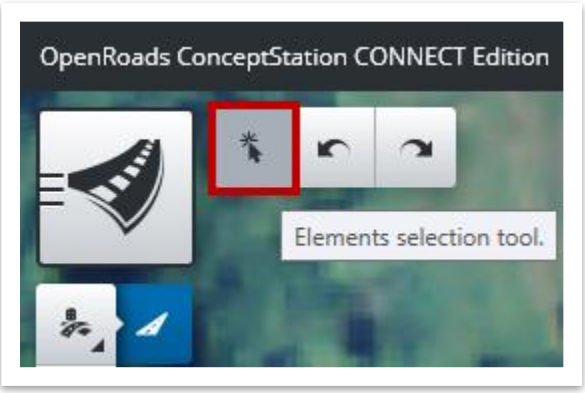
11. Notice the prompt: **Select OpenStreetMap Road**. Zoom in to the I-40 bridges over Charlotte Pike and select the <u>westbound</u> segment of **Charlotte Pike** going under the bridge.

12. Notice the next prompt: **Enter first point**. A white line should now show along the selected roadway centerline. **Left** click on the centerline just west of the I-40 bridges (approximate Station **12+16.00**) to begin the segment.

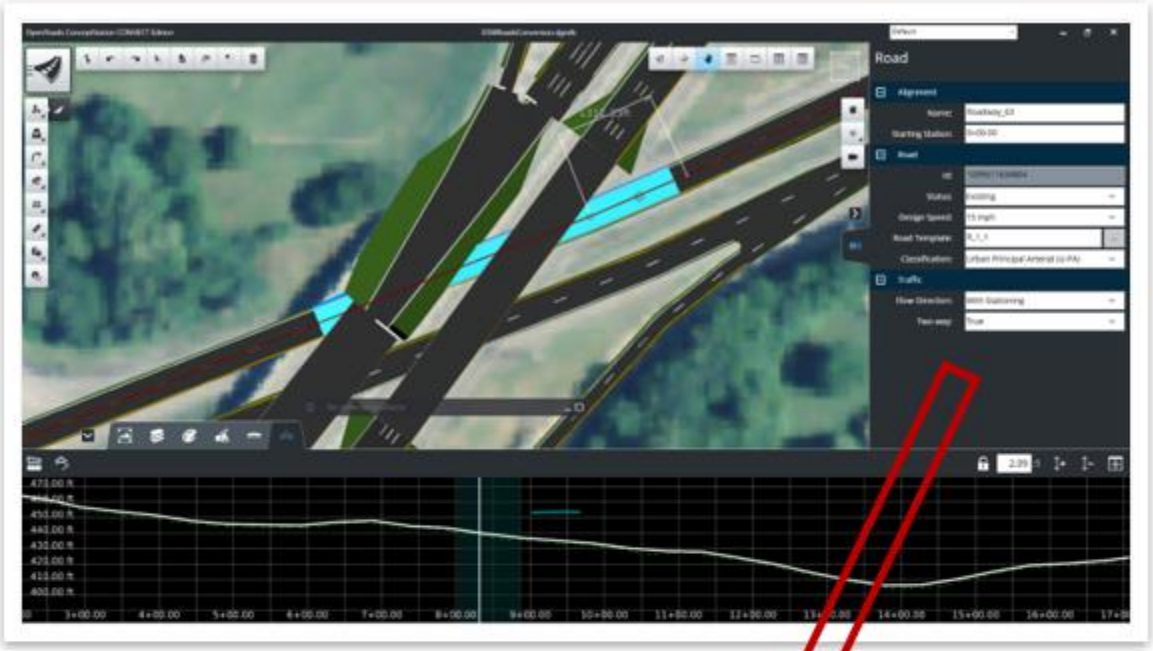
13. Now move your cursor eastbound along the centerline and a green line will appear over the centerline to highlight the selected segment. Notice the next prompt: **Enter second point**. **Left** click just east of the I-40 bridges to end the segment (approximate Station **7+16.00**) and then **right** click to clear the tool. **Note:** For this exercise, your extents do not need to match exactly.

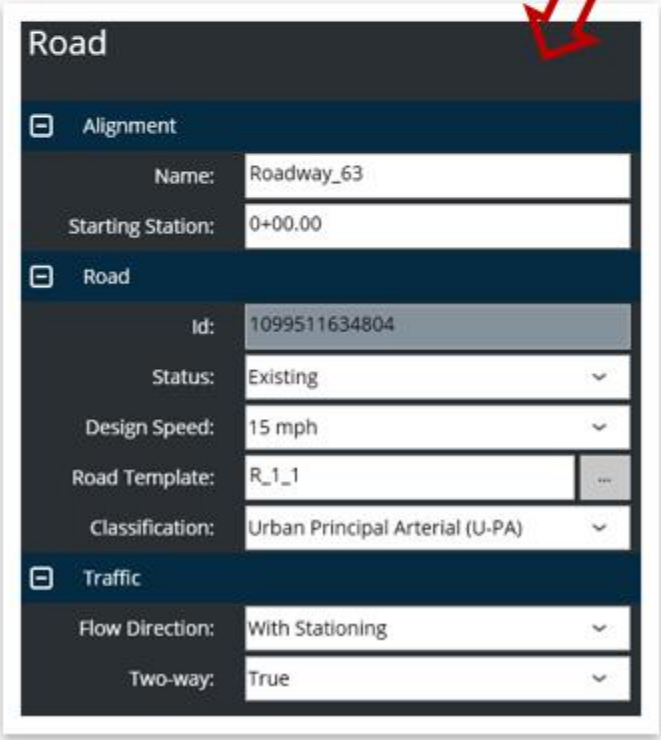


14. Next, open the **Elements selection** tool.



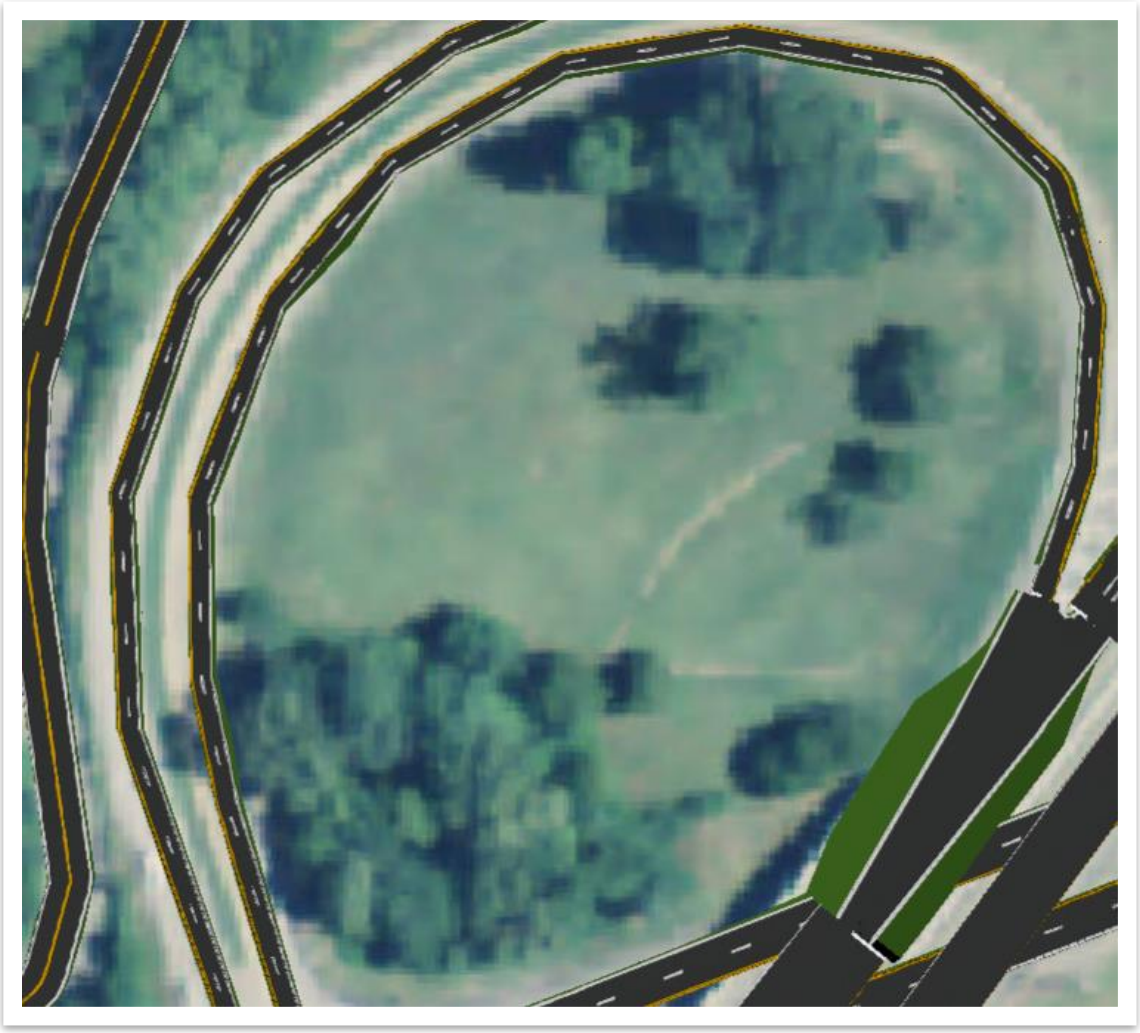
15. **Left** click on the **Charlotte Pike** segment below the I-40 bridges, which should now be converted to a ConceptStation road. Notice that the horizontal alignment geometry now shows in the plan view and the vertical alignment geometry shows in the profile view, like the roads placed earlier in the manual with the Concept Station tools. **Note:** Feel free to use the **Convert OSM Road** tool on any other road segments within the extent of the import area.





16. Lastly, we will visualize the pavement marking limitations in the OSM road import. Notice how GeoCoordination Services imported all paved areas within the selected import area as **OSM** roads. Zoom in to the **I-40 loop ramps** on the west side of the Charlotte Pike interchange. Notice how the OSM roads show a **single broken white line** pavement marking along the centerline of both loop ramps. A comparison of the same location in Google Earth on the next page shows that these pavement markings do not accurately match the configuration in the field.

OSM Roads in ConceptStation:



Google Earth Aerial Imagery:

17. Once the OSM road segments are converted to ConceptStation roads, it will be necessary to edit the templates to ensure the pavement markings are corrected.