Bentley Institute

Practice Workbook

This workbook is designed for use in Live instructor-led training and for OnDemand self study.
The explanations and demonstrations are provided by the instructor in the classroom, or in the OnDemand videos for this course available on the Bentley LEARN Server (*learn.bentley.com*).

This practice workbook is formatted for on-screen viewing using a PDF reader.
It is also available as a PDF document in the dataset for this course.

Cross Sections: Creating, Annotating, and Volumes

SELECTseries 4 (08.11.09.845) or newer

About this Practice Workbook...

- This PDF file includes bookmarks providing an overview of the document. Click on the bookmark to quickly jump to any section in the file. You may have to turn on the bookmark function in your PDF viewer.
- This dataset. Throughout this practice workbook Imperial values are specified first and the metric values second with the metric values enclosed in square brackets. For example: *12' [3.4m]*
- Having an appropriate workspace is very important when using the OpenRoads technology. The workspace contains the standards and other design specifications needed to complete your work.

This training uses the *Bentley-Civil* workshop delivered with the software. It is very important that you select the *Bentley-Civil* workspace when working the exercises in this course.

TRNC01611-1/0003

Exercise 1: Creating the Proposed Cross Sections

Description

In this exercise, we will learn how to create proposed cross sections using our 3D Design Model.

Skills Taught

- Create Cross Sections
- View Cross Sections with Cross Section Viewer

Open the DGN and Reference the Design

1. Start the software.
2. Select the workspace...

InRoads, GEOPAK, and PowerCivil Users

A. Select the User, Project, and Interface settings.

- User: *Examples*
- Project: *Bentley-Civil-Imperial* or *[Bentley-Civil-Metric]*
- Interface: *Bentley-Civil*

Continue with step 3

Help with the Workspace

If the *Bentley-Civil-Imperial* or *[Bentley-Civil-Metric]* projects are not listed, review the troubleshooting information in the Bentley Communities by clicking here or visiting communities.bentley.com and searching for “Civil Workspace”.

MX ROAD Users

A. On the MX Project Start Up window, click **New Project**.

B. Click **Browse** and select the folder where the training dataset is located.

C. Key in **Training** in the *Project Name* field.

D. Set the Default MX Project Settings to *UK_imperial [UK_metric]*.

E. Select the User, Project, and Interface settings.

- User: *Examples*
- Project: *Bentley-Civil-Imperial* or *[Bentley-Civil-Metric]*
- Interface: *Bentley-Civil*

F. Click **OK**. The MX project files are created and the software opens into a blank file named draw.dgn.

G. Select **File > Open** from the CAD menu.

Continue with step 3

3. Browse to the folder where you unzipped the dataset files and select the file **Proposed Cross Sections.dgn** *[Proposed Cross Sections - Metric.dgn]*.

4. Attach the existing terrain and corridor model as a reference.

a. Select the **References** tool.

b. In the References dialog choose **Attach**.

c. Select the **Complete Design_2D.dgn** *[Complete Design_2D - Metric.dgn]* file.

d. Set the *Attachment Method* to **Interactive**.

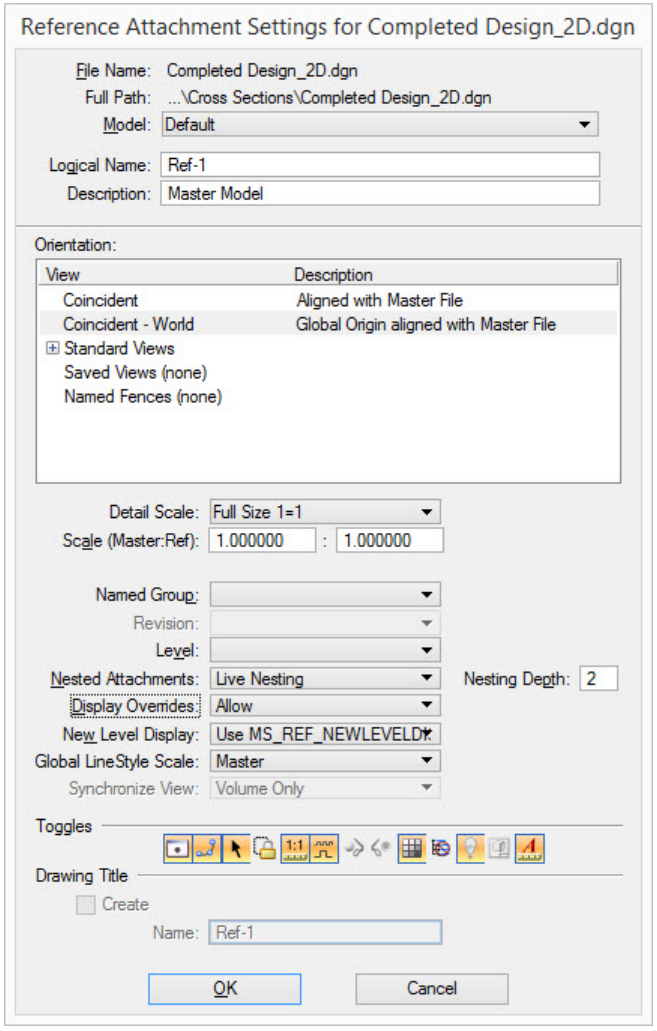
e. Click **Open** to activate the Reference Attachment Settings dialog.

f. Populate the Reference Attachment Settings as shown.

Orientation	**Coincident - World**
Nested Attachments	**Live Nesting**
Nesting Depth	**2**

Hint: Live nesting with a nesting depth of 2 will give access to both the 3D model and the existing terrain because the terrain is already referenced to the model.

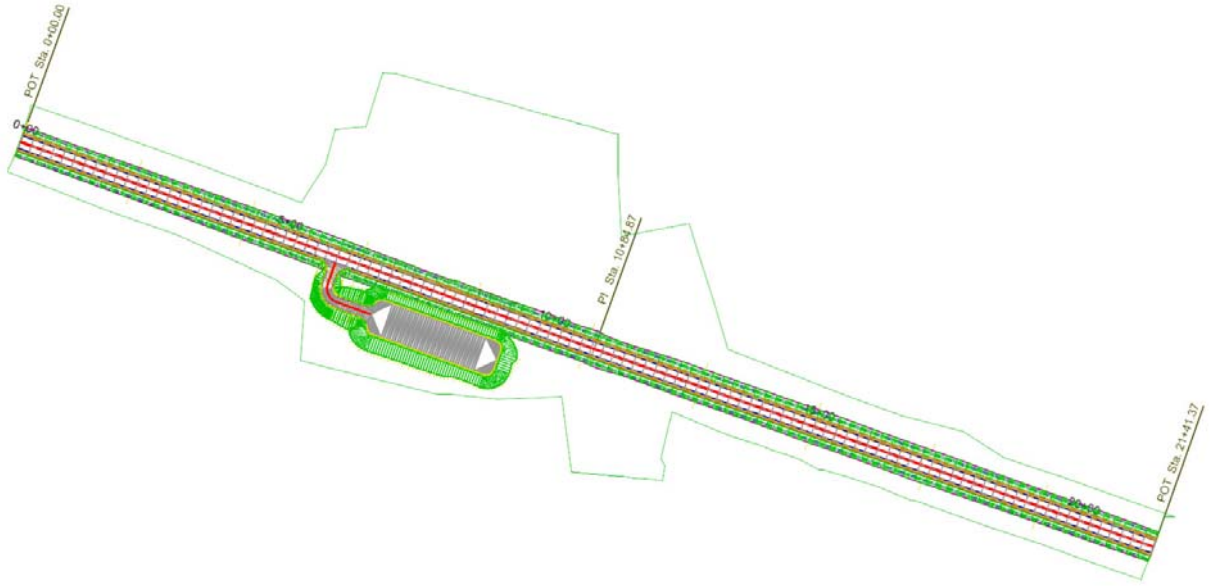
g. Select **OK** to attach the reference file and dismiss the References dialog.



Create the Proposed Cross Sections

1. **Fit** View to review the project location.

   Hint: Pressing the F8 Function Key will toggle black background to white and toggle on the level override symbology. This is setup as part of the Bentley-Civil workspace. Pressing F8 again will revert back to original settings.



2. In the MicroStation pull down menu choose **File > Save Settings** to save how the view is currently setup.

3. Open the **Level Display Dialog** and verify all levels are enabled.

   Turning off a level at this stage will also turn it off in the created cross section Design Model. For a component to be displayed in the proposed cross section Design Model, the level must be turned on in the 3D model before creating the sections.

   If any level settings are changed, it is important to select **File > Save Settings** so the changes will be remembered when cross sections are created.

4. Select the **Create Cross Sections** tool from the *Corridor Modeling* task menu.

5. Following the heads-up prompt, locate the alignment by selecting the **GeomCL** element (red centerline alignment graphic).

6. Select the preference to layout cross sections in sheets without a grid.

   a. Select **Preferences** button from the bottom of the *Create Cross Section* dialog.

   b. In the Preferences dialog select the preference named **Sheet - w/o Grid**.

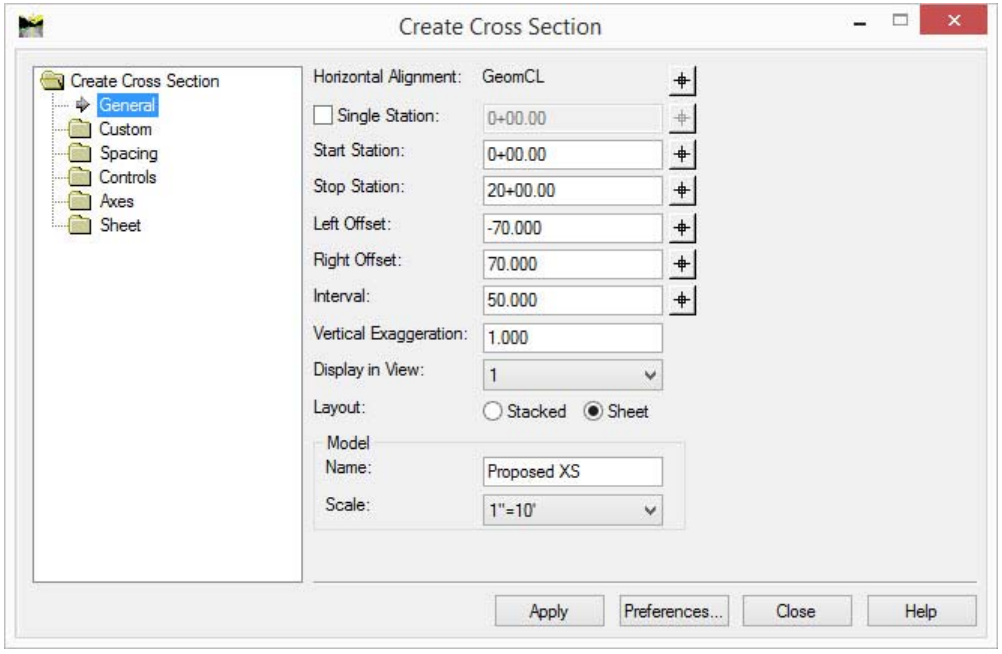
   c. Select **Load**.

      Preferences are predefined settings stored in the active XIN settings file for all three products (GEOPAK, InRoads, and MX). These preferences are used for creating, annotating and computing end area volumes on proposed cross sections.

   d. **Close** the Preferences dialog.

7. Complete the General settings as shown.

Start Station	**0+00**
Stop Station	**20+00** *[0+600]*
Left Offset	**-70.0** *[-30.0]*
Right Offset	**70.0** *[30.0]*
Interval	**50.0** *[20]*
Vertical Exaggeration	**1.0**
Layout	**Sheet**
Model Name	**Proposed XS**
Scale	**1” = 10’** *[1:100]*



Note: Once the predefined Preferences are loaded, you should only need to modify items in the General tab to define the range, width, and spacing of cross sections. If the project requires custom cross section locations, the Custom tab is used to define additional single cross section locations, ranges of cross sections and skewed cross sections.

8. Select **Apply** to create the cross sections. They will but created in a a new drawing Model entitled *Proposed XS*.

   It will take a few seconds for the cross sections to be created. A status bar appears in the lower right corner showing the progress.

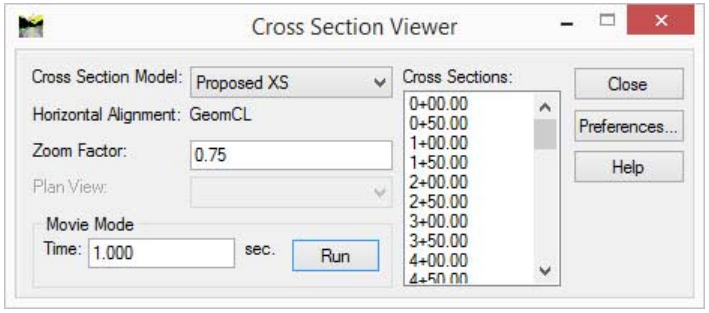
9. Close the *Create Cross Section* dialog.

Viewing the Cross Sections

In this section, you will learn how to use the Cross Section Viewer.

1. Select the **Cross Section Viewer** tool from the *Corridor Modeling* task menu.
2. Verify that **Proposed XS** is the active *Cross Section Model*.
3. Set the *Zoom Factor* to **0.75**.
4. Set the *Movie Mode Time* to **1.0** sec.
5. Select **Run** to automatically scan through the cross sections.

   Press the **Esc** key on your keyboard to exit the movie mode.



6. Select Cross Section **9+00** *[0+280]* by clicking on it in the list and notice how the view updates to the selected cross section.

   The cross sections automatically include all objects in the model. At this location the parking area next to the road is also visible. Other objects such as buildings and pipes can just as easily be included on cross sections simply by drawing or referencing them into the model.

7. Press the **Up** and **Down** Arrow keys on your keyboard to step through the Cross sections in the list.
8. Close the Cross Section Viewer application.

Exercise 2: Annotating the Proposed Cross Sections

Description

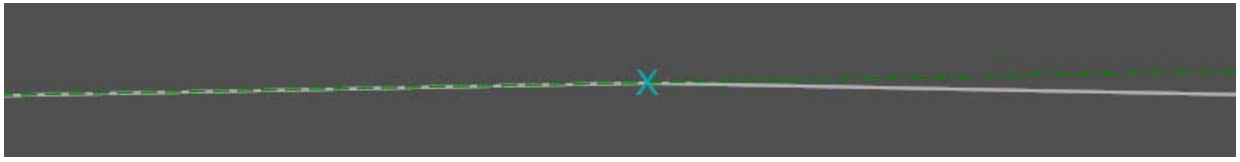
In this exercise we will learn how to annotate proposed cross section offsets, elevations, and slopes.

Skills Taught

- Annotate Cross Section Offsets, Elevations, and Slopes

Annotating the Proposed Cross Sections

1. Zoom in very close to the centerline on one of the cross sections.

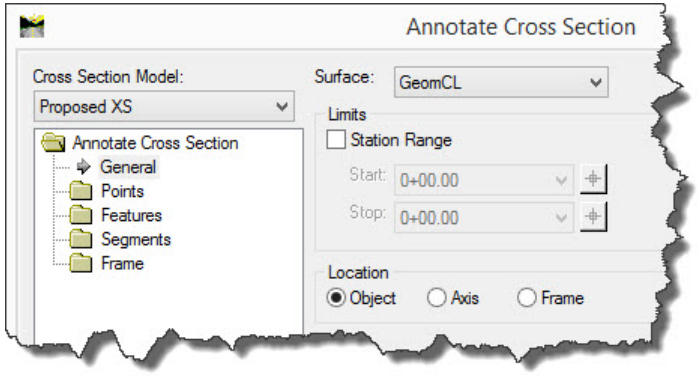


Notice that an 'X' is displayed here and at each of the crossing features such as the Centerline and the Edge of Pavement. The features must be displayed for them to be annotated, but they can be displayed at a small size as we see here so they are not easily visible when viewing the cross sections.

2. Select the **Annotate Cross Sections** tool from the *Corridor Modeling* task menu.
3. Load the Offset Elevation Slope annotation preference.
   a. Select **Preferences**.
   b. Select the preference entitled **Object - Off/Elev/Slope**.
   c. Select **Load**, to utilize the selected preference.
   d. Close the Preferences selection dialog.
4. In the Annotate Cross Section dialog, define the *General* settings.
   a. Set *Surface* to **GeomCL.**

      Cross sections may include many difference surfaces. Selecting the correct surface for the features to be annotated is very important. This set of cross sections for example has seven different surfaces including the existing ground, the GeomCL roadway surface, and several surfaces associated with the parking area adjacent to the road corridor.

   b. Set the *Location* to **Object**.



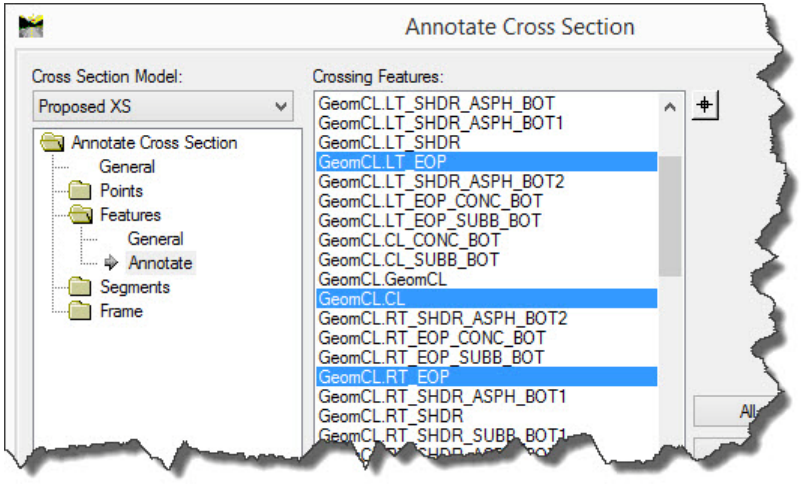
5. Expand the **Features** folder and select **Annotate** on the left hand side of the dialog.
6. Using the **Ctrl** key on your keyboard, select the following *Crossing Features*.

   GeomCL.LT_EOP

   GeomCL.CL

   GeomCL.RT_EOP

   The selected features will be annotated with their offset and elevation as defined on the Features > General leaf.



7. Expand the **Segments** folder and select **Annotate** on the left hand side of the dialog.
8. Select the following *Crossing Features* so that they will be annotated on the cross sections as shown below.

   GeomCL.LT_Construction Limit

   GeomCL.LT_DITCH_BACKSLOPE

   GeomCL.LT_DITCH_FORESLOPE

   GeomCL.LT_FILL_TOP

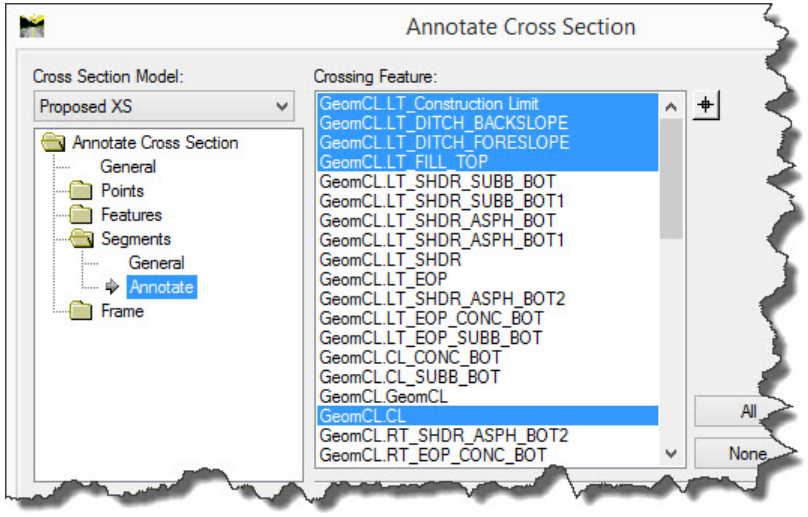
   GeomCL.CL

   GeomCL.RT_FILL_TOP

   GeomCL.RT_DITCH_FORESLOPE

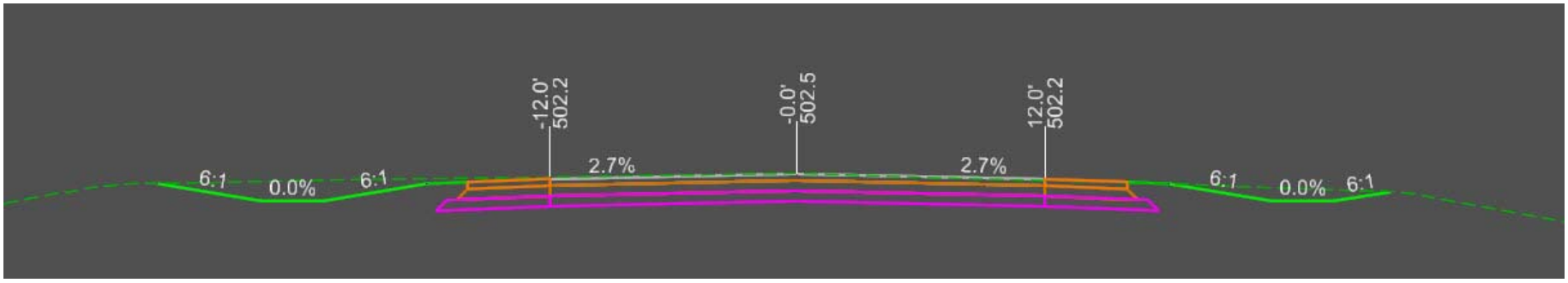
   GeomCL.RT_DITCH_BACKSLOPE

   GeomCL.RT_Construction Limit



These segments will be annotated with their slope as defined on the Segments > General leaf.

9. Select **Apply** to annotate the cross sections.



Hint: The cross section annotation labels are automatically made part of a MicroStation Graphic Group. Additionally, only the selected Features are labeled.

10. **Close** the Annotate Cross Section dialog.
11. Zoom in and review the labeling on a cross section.
12. Select **Settings > Drawing Scale**.
13. Change the setting to **1"=20'** *[1:200]*.

    The text size is increased.
14. Return the setting back to the original setting of **1"=10'** *[1:100]*.

Exercise 3: Computing End Area Volumes

Description

This exercise teaches how to compute the proposed cross section end-area volumes and generate a mass haul diagram.

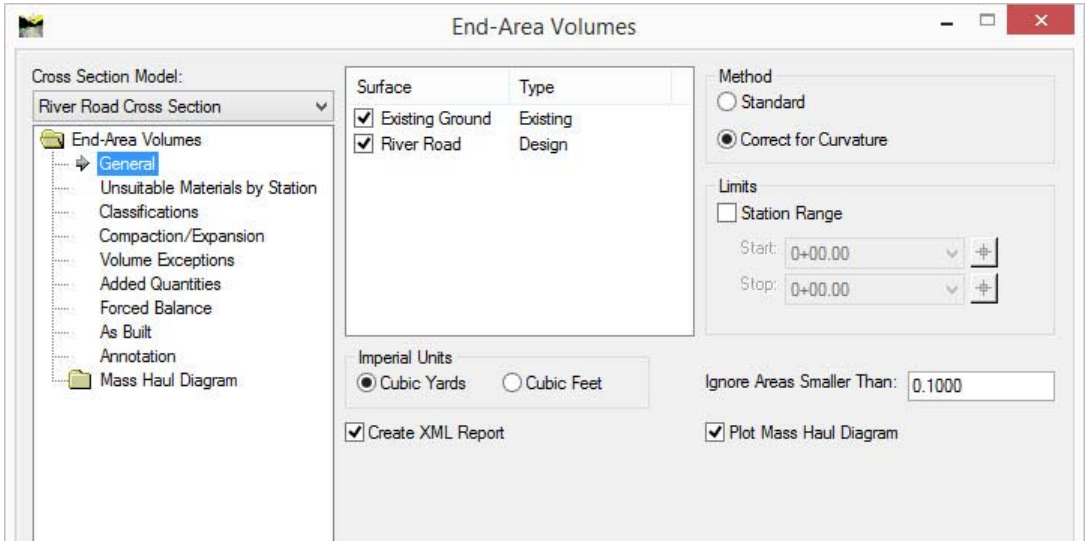
Skills Taught

- Compute End Area Volumes
- Define Unsuitable Material
- Define Compaction/Expansion Factors
- Define Exception Station Ranges
- Define Added Quantities

Computing End Area Volumes

1. Open the *End Area Volume.dgn [End Area Volume - Metric.dgn]* file.
2. Set the active *Model* to **River Road Cross Section**.

3. Select the **End Area Volume** tool from the *Corridor Modeling* task menu
4. Select the predefined Earthwork preferences.
   a. Select **Preferences**.
   b. Select the preference named **Earthwork**.
   c. Select **Load**.
   d. **Close** the Preferences dialog.
5. Define the surfaces used for computing end area volumes.
   a. Select the **General** leaf settings.
   b. Select the **Existing Ground** and **River Road** surfaces.
   c. Enable the **Create XML Report** option.
   d. Enable the **Plot Mass Haul Diagram** option.
   e. Set *Ignore Areas Smaller Than* to **0.100**.



6. Define unsuitable material for a depth of 0.5 feet *[0.15 m]* along the entirety of the project.

   This unsuitable material definition is being used to account for topsoil stripping. This volume of material will be removed between the limits of construction and because it is classified as unsuitable this material will not be used as fill material.

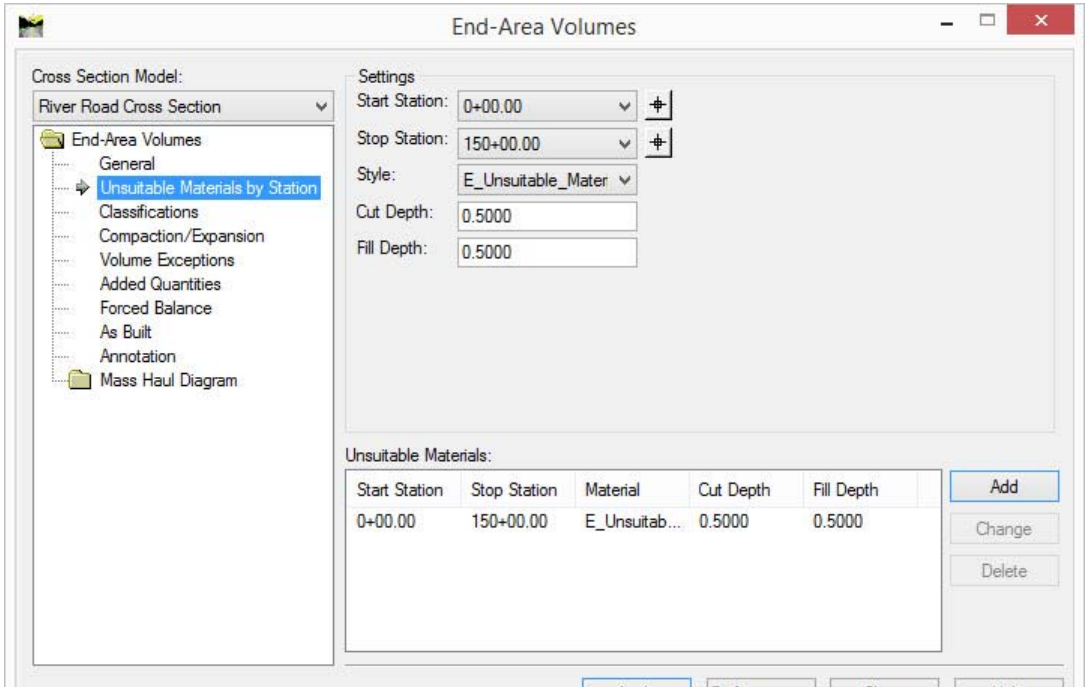
   a. Select **Unsuitable Materials by Station** leaf settings on the left of the dialog.

   b. Set the following values for the unsuitable materials.

Start Station	**0+00.00** *[0+000]*
Stop Station	**150+00.00** *[4+627.201]*
Style	**E_Unsuitable_Material**
Cut Depth	**0.50** *[0.15]*
Fill Depth	**0.50** *[0.15]*

   c. Click **Add**.

   The unsuitable material definition is added to the table at the bottom of the dialog.



7. Define the soil classifications and cut/fill factors for each terrain and components that are displayed on the cross sections.

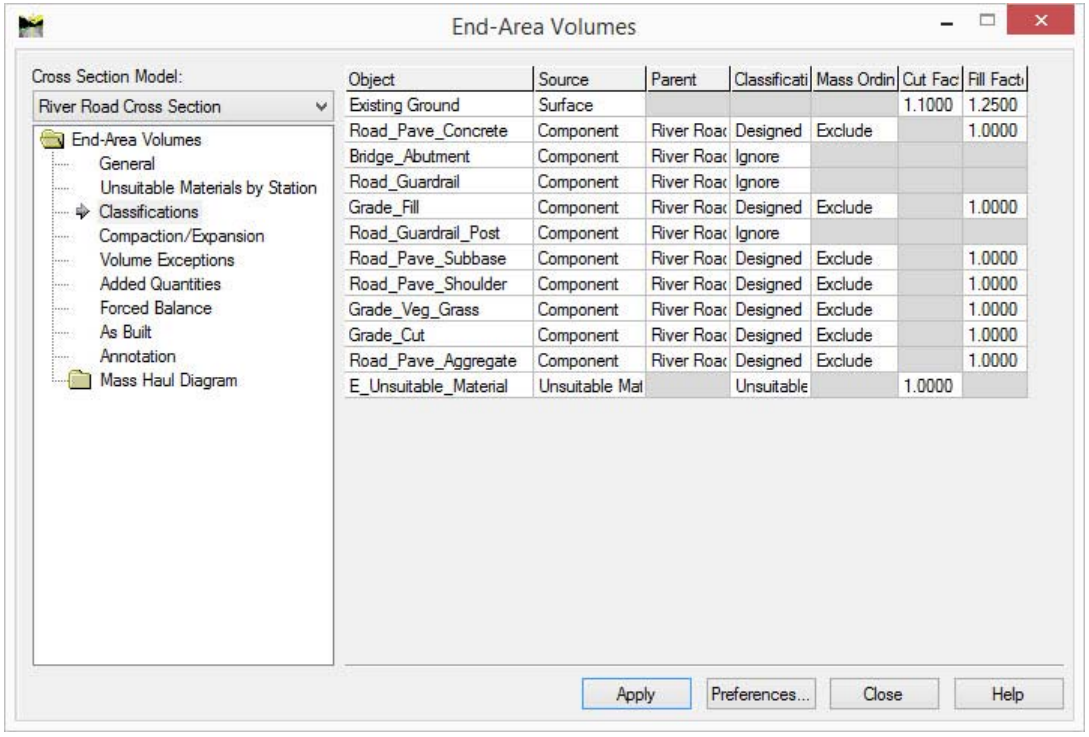
   These settings control how volumes are calculated and reported. The classification defines which group the volumes are reported; Unclassified, Unsuitable, Rock, Designed, and MDC. When the Classification is set to Ignore, volumes are not computed for the object.

   a. Select **Classifications** leaf settings on the left of the dialog.

      Notice that the E_Unsuitable_Material in the previous steps is included in the table and is classified as Unsuitable material.

   b. Set the *Classification* for the following Objects to **Ignore** to exclude them from the volume calculations.

      - **Bridge_Abutment**
      - **Road_Guardrail**
      - **Road_Guardrail_Post**



Earthwork material expands when removed from the ground (cut) and compact when placed in an embankment (fill). The Cut and Fill factors adjust the computed cut and fill volumes to account for this swelling and shrinking in volume to get an accurate volume and mass haul calculation.

Cut and fill factors can be set for individual objects/materials as part of the classifications. The cut and fill factor for the existing ground can also be defined by station range using the Compaction/Expansion leaf settings. Station range values on the Compaction/Expansion leaf override factors defined on the classifications.

   c. Set the *Existing Ground Cut Factor* to **1.10**.

   d. Set the *Existing Ground Fill Factor* to **1.25**.

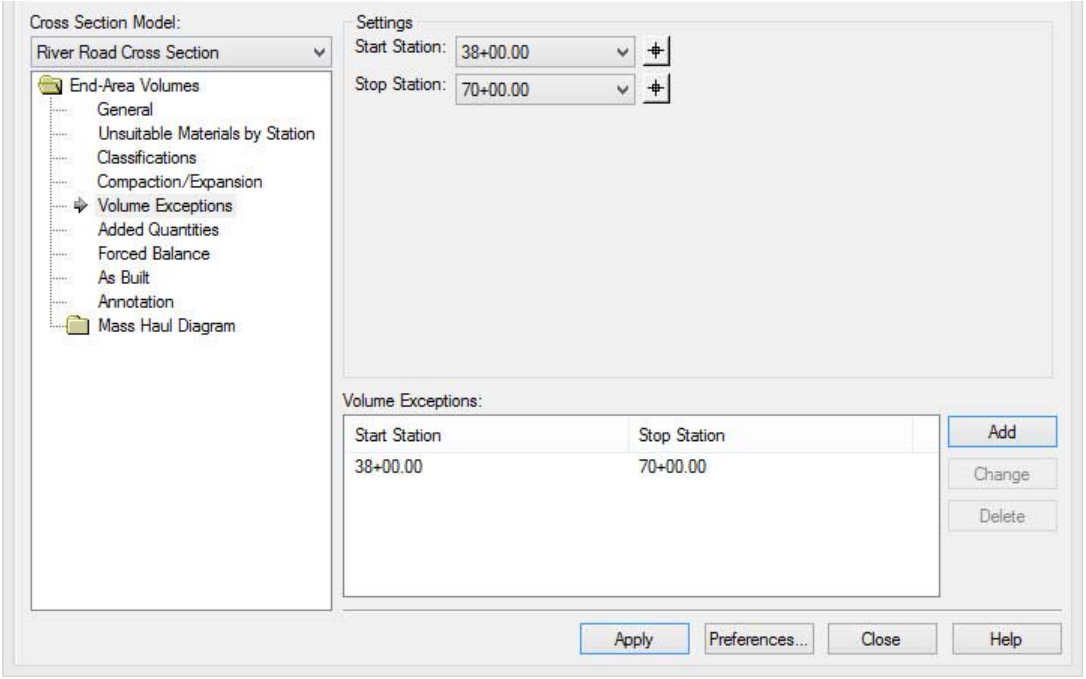
8. Define a volume exception so quantities are not computed through the bridge span between stations 38+00 *[1+158]* and 70+00 *[2+134]*.

   a. Select **Volume Exceptions** leaf.

   b. Set the *Start Station* to **38+00** *[1+158]*.

   c. Set the *End Station* to **70+00** *[2+134]*.

   d. Click **Add**.



When a project has excess earthwork material that needs to be hauled off the project site or requires additional material be hauled in the volume is accounted for as an added quantity. That quantity (cut or fill) is included in volume reports and mass ordinate calculations at the specified station.

9. Define the removal of 5,000 cubic yards *[1700 cubic meters]* of material to be hauled away from the project at station 135+00 *[4+100]*.

   a. Select **Added Quantities** leaf.

   b. Set the *Start Station* to **135+00** *[4+100]*.

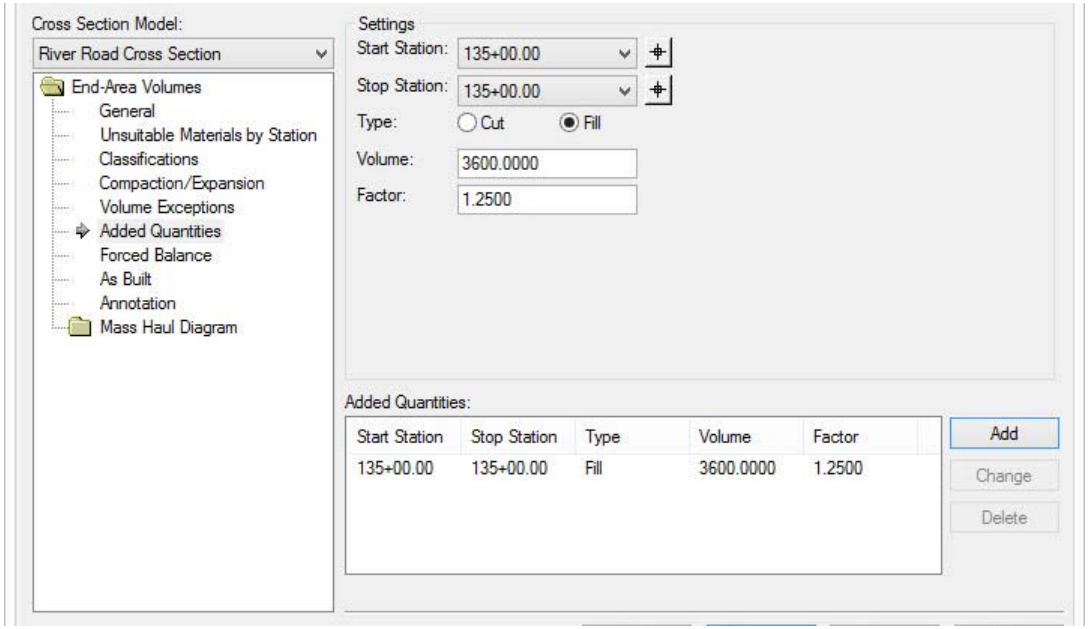
   c. Set the *End Station* to **135+00** *[4+100]*.

   d. Set the *Type* to **Fill** *[Cut]*.

   e. Enter a *Volume* of **5000** *[1400]*.

   f. Enter a *Factor* of **1.25**.

   g. Click **Add**.



10. Select **Apply** to compute the end area volumes.

    This will complete the following five tasks when processing.

    - Compute end areas.
    - Compute volumes between sections.
    - Label cross sections with computed values.
    - Display cut and fill areas on the cross sections.
    - Generate a quantities report that can be formated with Style Sheets.
    - Create the Mass Haul diagram.

    Note: When the volumes computations are complete, the Bentley Civil report browser opens (if the Create XML Report option on the General leaf is enabled). The report browser allows the designer to review the end areas as well as computed volumes for all surfaces.

11. Review the End Area Volume Report

    a. In the *Bentley Civil Report Browser*, select **Tools > Format Options**.

    b. Change the *Station Format* to match your desired readout.

    c. Change the *Precision* of *Linear* and *Area Units* to **0.12** to round each of these values in the report to 2 decimal places.

    d. Change the *Cubic Units* precision to **0**.

    e. Close the Format Options window.

12. In the report Browser, change to the **Volumes.xsl** report format.

    The end area volumes are updated to a new report format that shows detailed object/material volumes.

13. Scroll to station **135+00** *[4+100]* in the report and notice the added fill.

14. Close the Bentley Civil Report Browser and the End-Area Volumes dialog.

15. Pan over to the right side of the cross sections to locate the generated Mass Haul diagram.

    You can delete the previous annotations and Mass Haul Diagram as they are placed on 2 distinct graphic groups. This will need to be done before running the End-Area volumes tool again.

Exercise 4: Volumes including Substratum

Description

In this exercise an additional existing surface is included. This additional surface is a limestone substratum layer. Separate end area volumes need to be computed when cutting into this rock.

Skills Taught

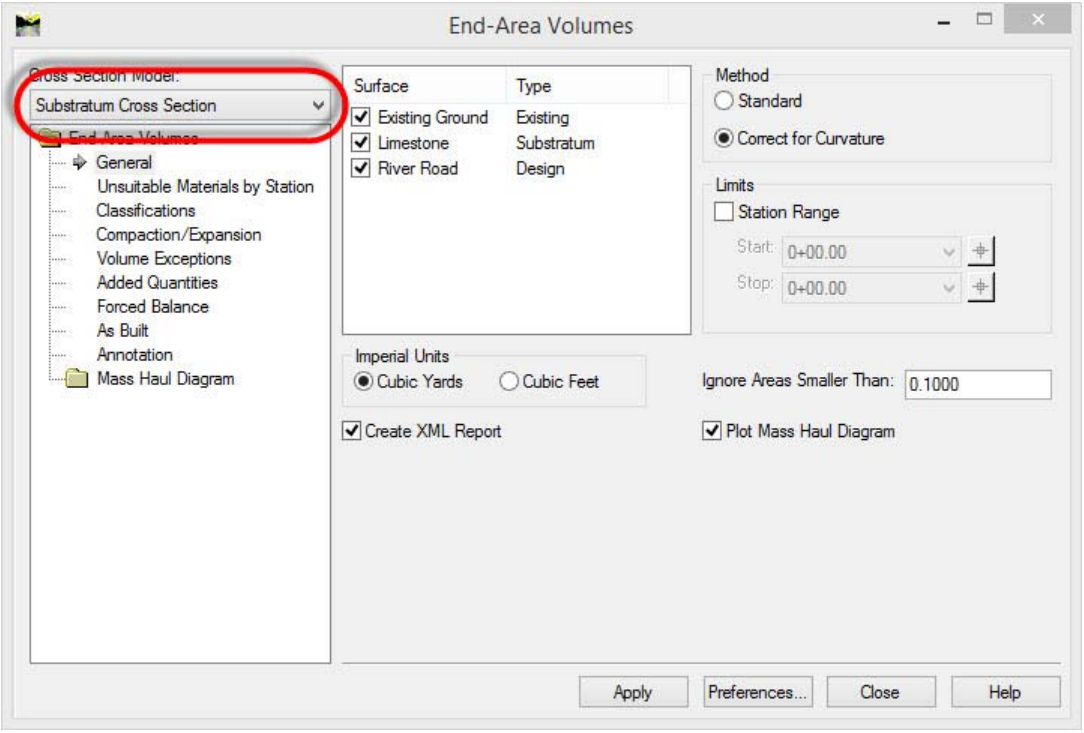
- End Area Volumes
- Substratum Volumes

Volumes including Substratum

1. Continuing in the *End Area Volume.dgn* file, set the active *Model* to **Substratum Cross Section**.

2. Select the **End Area Volume** tool from the *Corridor Modeling* task menu.

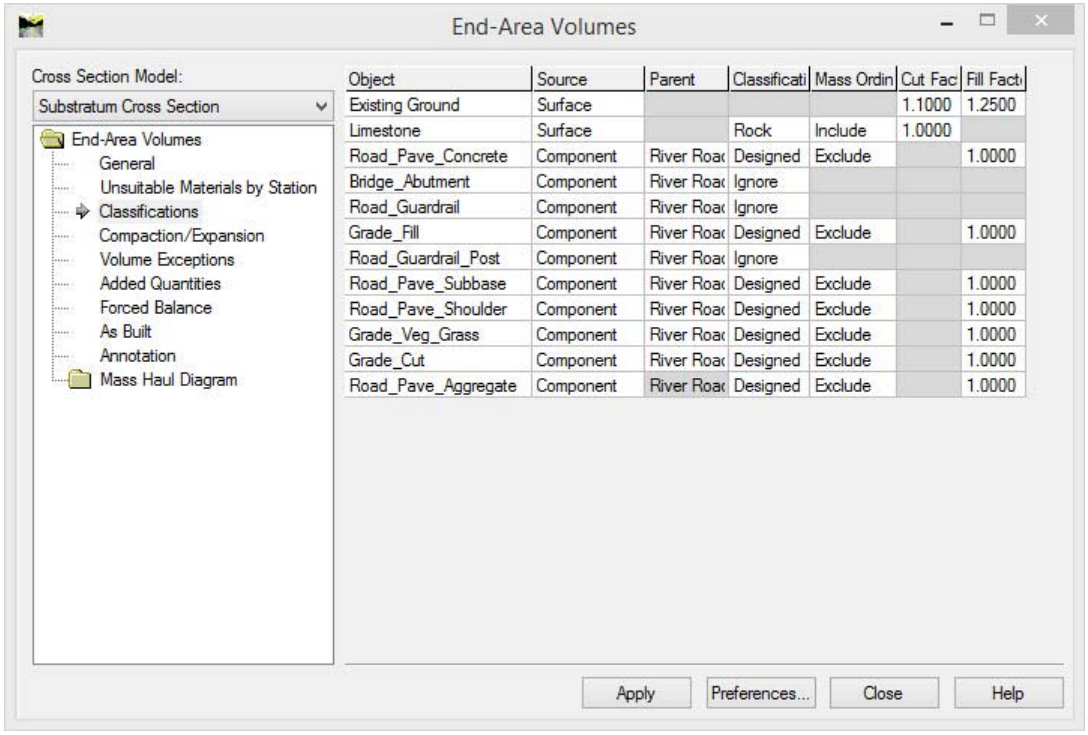
3. Make sure to set active the *Cross Section Model* to **Substratum Cross Section** on the End-Area Volumes dialog.



4. Ensure that all 3 surfaces (**Existing Ground**, **Limestone**, and **River Road**) are enabled.

   Why is it that the Substratum Cross Section includes a Limestone surface and the River Road Cross Section does not? The model containing the Limestone surface was referenced to the End Area Volumes.dgn after the River Road Cross Sections were created and before the Substratum Cross Sections were created.

5. Select the **Classification** settings and set the *Limestone Surface* as a **Rock** Classification.



6. Click **Apply** on the End-Area Volumes dialog to create an XML Report.
7. Select the **Volumes.xsl** report format.
8. Scroll to stations **121+00** *[3+700]* through **123+00** *[3+740]* where the proposed design cuts into the Limestone surface. Notice how quantities are included for both the Limestone and Normal Cut (existing ground surface).
9. Examine the Cross Sections in the same station range.