

Earthwork

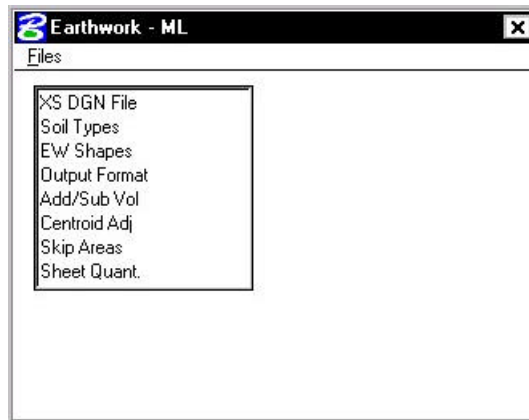
14.1 Introduction

Objectives	Learn the procedures for calculating earthwork quantities with GEOPAK Learn how to use Project Manager to set up and process an earthwork run.
Project Manager	Earthwork
Menu Bar Application	None, except batch processing of an input file.

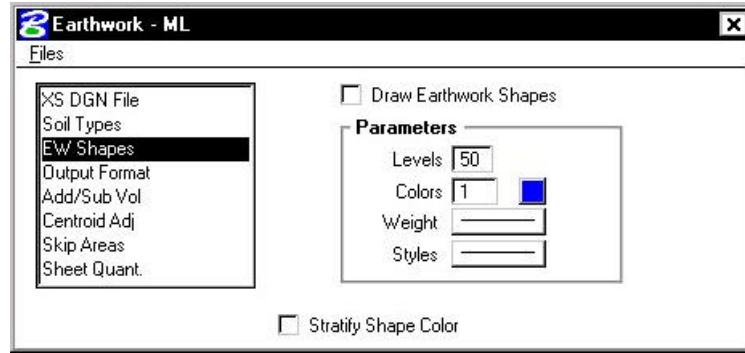
GEOPAK forms graphical earthwork shapes in a (MicroStation) cross section design file to represent the end areas used to calculate volumes by the end-area method. These shapes are created when the designer processes an earthwork run in which the existing ground, finished grade, base, etc. are identified by level, color, weight and type.

14.2 Accessing

To access the necessary dialog boxes needed to create and process an earthwork run, select **Project Manager > Earthwork**. Once the run is chosen or selected, the following dialog box appears.



The left side of the dialog box contains the list of parameters required to compute earthwork. When each parameter is selected, the dialog box changes the key-in fields to reflect the selection. For example, when **EW Shapes** is selected, the dialog box changes as illustrated below.

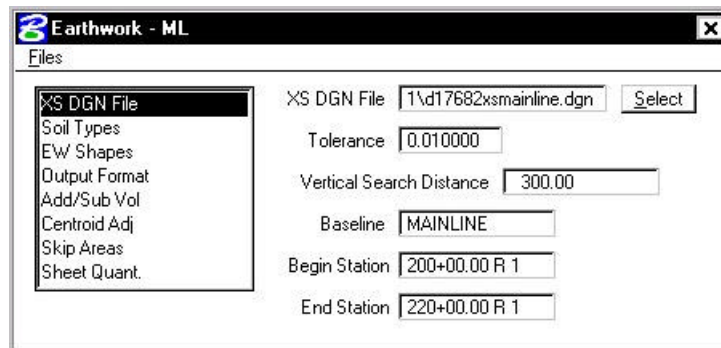


14.3 Earthwork Dialog Box

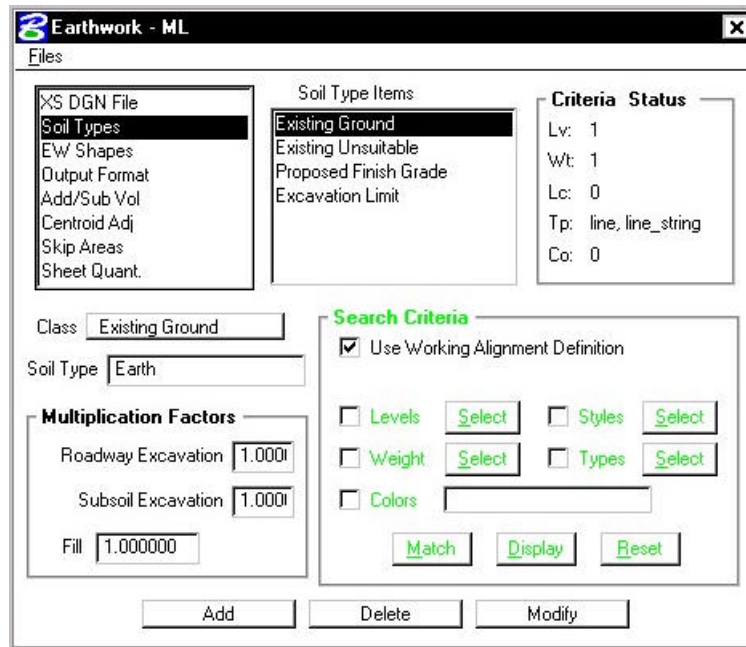
In **XS DGN File** the user can specify the file name in which to find the cross-sections. **Tolerance** specifies the maximum distances between two elements (in a cross section) to be considered as adjoining. **Vertical Search Distance** specifies the distance above and below the cross-section to look for elements pertaining to that cross-section. **Baseline** specifies the GEOPAK COGO chain the cross-sections are based from. **Begin/End Station** specifies the beginning and ending stations to perform the earthwork calculations.



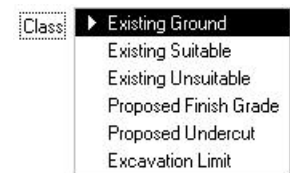
As noted in section 12.1.1, it is important that the **Tolerance** value be set to **0.01** to ensure proper cross section and earthwork processing.



The **Soil Types** dialog box requires the user to define the symbology and shrinkage/swell factors to be used.



The user must first select the **Class** of the soil type, displayed in the exploded view below and detailed in the table.



Existing Ground	Identifies the surface of the existing ground. This classification is required to calculate earthwork. It also defines the default excavation material.
Proposed Finish Grade	Surface of the proposed roadway. This classification is required to calculate earthwork and defines the default fill material.
Existing Suitable	Material between excavation limits that is to be removed only when it encroaches on the proposed design. For example, if the proposed design is in fill, therefore above the existing suitable, it is not removed.
Existing Unsuitable	Material between excavation limits that is to be removed in all circumstances.
Proposed Undercut	Proposed layers that are not part of the finish grade, i.e. pavement layers, shoulder layers.
Excavation Limit	Pairs of vertical lines drawn in the cross-sections to demarcate the limits of removal for any existing suitable or unsuitable material. Can also be used to isolate earthwork computations between any pair of lines

Once the **Classification** is chosen, a **Soil Type**, the element symbology of the material, and the shrinkage/swell factors need to be entered. A **Classification**, except **Existing Ground**, can be listed multiple times. The **Soil Type** determines how the cut and fill are calculated. For example, a user creates an earthwork run with a classification of Existing Ground with a soil type of Existing, classification of Proposed Finish Grade with a soil type of Suitable_Grading, and a classification of Proposed Undercut with a soil type of Pavement. The output from the run would look as follows.

Material Name Station	End Areas	Unadjusted Volumes	Adjusted Volumes	Mult Factor	Mass Ordinate
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	(square ft)	(cubic ft)	(cubic ft)		

287+00					
SUITABLE_GRADING					
Excavation	0.00	0	0	1.00	
Fill	12.32	336	336	1.00	2887
EXISTING					
Excavation	25.88	654	654	1.00	
Fill	0.00	0	0	1.00	3541

In the same example, if both classifications of Existing Ground and Proposed Finish Grade had the soil type of Suitable_Grading, then the output would look as follows.

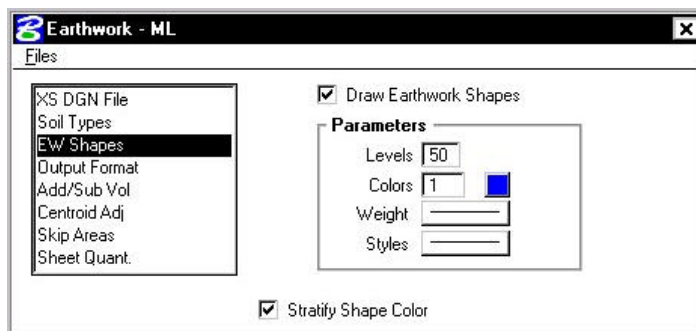
Material Name Station	End Areas (square ft)	Unadjusted Volumes (cubic ft)	Adjusted Volumes (cubic ft)	Mult Factor	Mass Ordinate

287+00					
SUITABLE_GRADING					
Excavation	25.88	654	654	1.00	
Fill	12.32	336	336	1.00	3541

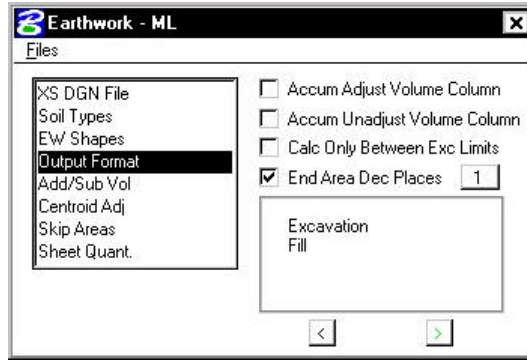
As can be seen from the above examples, when the soil types for the Existing Ground and Proposed Finish Grade classifications were named differently, both soil types appeared in the output. When the soil types for the Existing Ground and Proposed Finish Grade classifications were named the same, the quantities for each classification were combined into one soil type. By paying close attention to the soil types, the user can specify when material can be re-used and exactly where a specific soil type should be placed.

Once the **Classification** and **Soil Type** are chosen, the user can select the **Element Symbology** to define that particular **Soil Type** and the **Multiplication Factors** for the **Soil Type**. The **Match** button can be used to select the **Element Symbology**. Once the **Match** button is selected, the user can select the elements in the MicroStation view. The symbology of that element will be added to the symbology list used to define the **Soil Type**.

EW Shapes enables the earthwork shapes to be drawn and the associated symbology. The colors of the earthwork shapes can be stratified, so that cut and fill or each soil type are different.



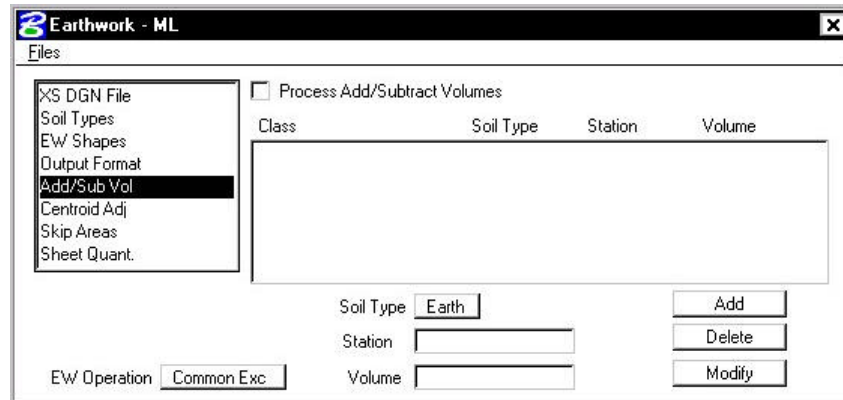
Output Format enables the user to specify any additional columns for the report in addition to what combination of earthwork classifications to show in the earthwork report. Users also can control the number of decimal places for end area calculations. **Calc Only Between Exc. Limits** instructs the software to calculate quantities between each pair of excavation limits as defined in the soil types category.



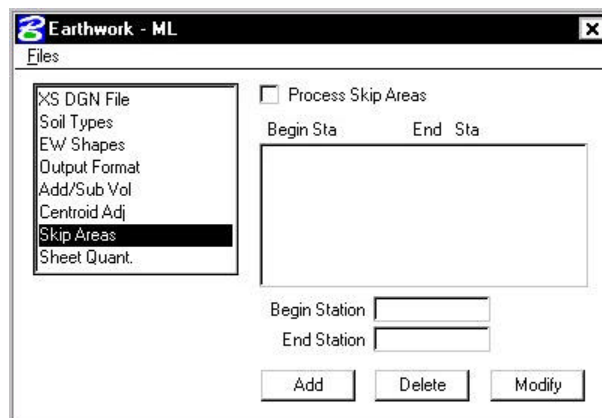
With this command, any combination of the three classifications of excavation volumes can be formulated. For example, if the user desires to combine all three into an earthwork listing of simply cut and fill, press the < or > arrows until the desired option is displayed. Options include:

- ? Common Exc, Subgrade Exc, Subsoil Exc, and Fill
- ? Excavation (Common and Subgrade), Subsoil Exc, and Fill
- ? Excavation (Common and Subsoil), Subgrade Exc, and Fill
- ? Excavation (Subgrade and Subsoil), Common Exc, and Fill
- ? Excavation (all types) and Fill

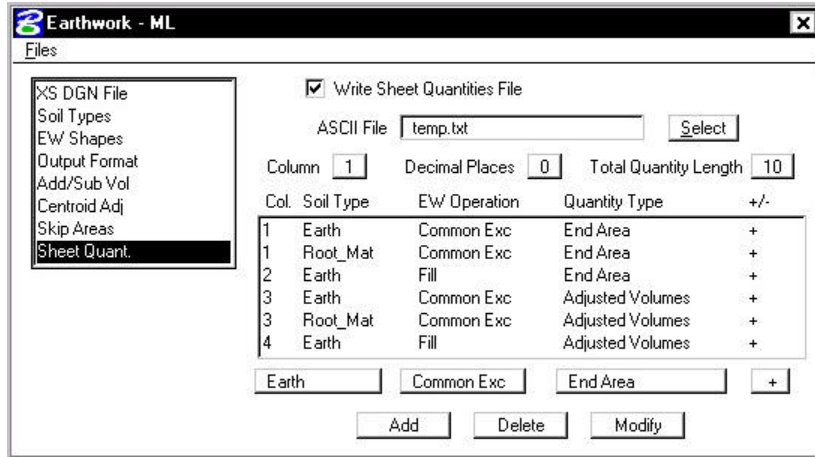
Add/Sub Volumes allows the user to enter volumes to be added or subtracted from the total earthwork calculated from the available sections. The user can specify whether to add excavation or fill, the soil type, the station, and the volume to be added.



Skip Areas enable the user to specify an area in which to not calculate earthwork volumes.



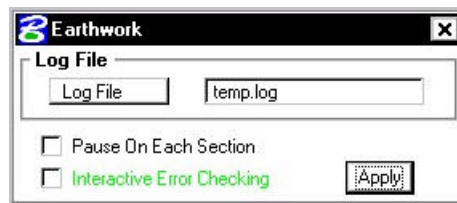
Sheet Quantities allows a user to write an earthwork quantity file to be used when plotting the cross-section sheets. The name of the ASCII file can be chosen or entered. The user then selects the columns in which to place the quantity, the number of decimal places, the total column width, the soil type, the earthwork operation, and the type of quantity. This information is written to the ASCII file, and can be used to plot the quantities on the cross-section sheets.



From the **Files** menu, the **Run** option processes all parameters that have been set in the **Earthwork** dialog box. The **Save Settings** option saves all information in the **Earthwork** dialog box to the current run. The **Export** option saves the parameters in the **Earthwork** dialog box as an ASCII input file. The **Exit** option exits the **Earthwork** dialog box.



After all necessary information has been entered, the user has two options. The preferred method of running the earthwork is to select the **Run** option. The following dialog box appears and the user may proceed by entering a log file name, choosing the **Pause On Each Section** option and then selecting the **Apply** button. The second method is to export the information as an ASCII input file, then use the **Process Cross Sections** tool.

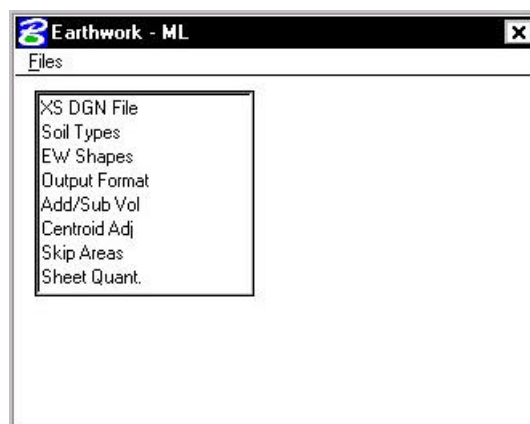


The earthwork quantities are written to the bottom of the log file and can be reviewed in any standard ASCII text editor. Therefore it is recommended that the user create a log file of a user selected name for printing or reviewing at a later time.

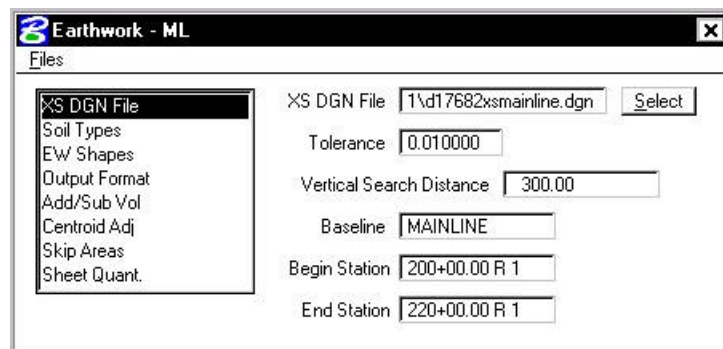
LAB 14: Earthwork

14.1 Basic Earthwork Computations

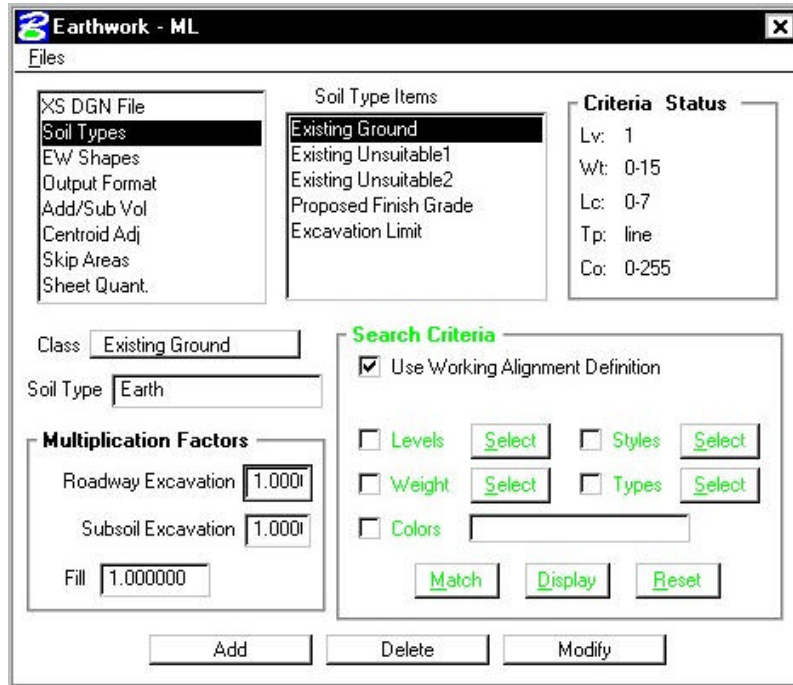
- Step 1.** Execute C:\data\geo\VDOT\road1\LAB14.EXE.
- Step 2.** Open the MicroStation file: c:\data\geo\VDOT\road1\d17682xsmainline.dgn.
- Step 3.** Access **Project Manager**. It should automatically access the Road workflow dialog box since we “remembered” the options in Exercise 2.
- Step 4.** Click **Earthwork** from the Project Manager dialog box and create a new run named **ML**. Open the new run.



- Step 5.** Populate the **XS DGN File** section of the dialog box as shown below:



Step 6. In the Soil Types section of the dialog box, create the following classifications and soil types utilizing the parameters detailed in the table below.

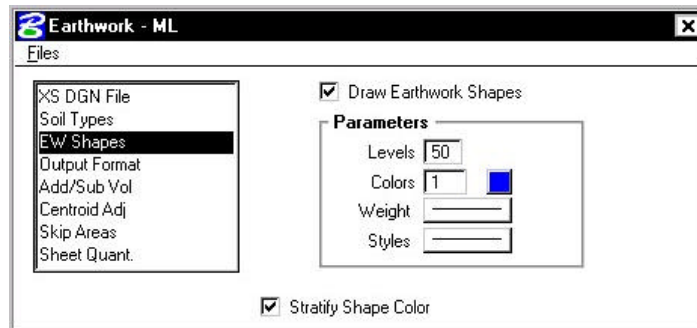


Class	Soil Type	Search Criteria
Existing Ground	Earth	Working Alignment Definition
Proposed Finish Grade	Earth	Working Alignment Definition
Existing Unsuitable	RootMat_Cut	LV=29, WT=8, LC=0, CO=3, TYPE=Line
Existing Unsuitable	RootMat_Fill	LV=29, WT=8, LC=0, CO=7, TYPE=Line
Excavation Limit	None	LV=25, WT=0, LC=0, CO=55, TYPE=Line

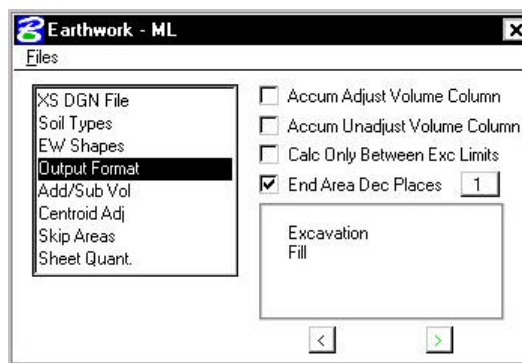
You can manually define the symbologies using the settings in the Search Criteria portion of the dialog box. When using these settings, there are also three additional buttons to help you.

- Match** Prompts you to identify an element. Once you do, it will fill in the symbology settings with the symbology of the identified element.
- Display/Undisplay** Highlights all elements in the design file matching the set symbology.
- Reset** Clears all symbology settings.

Step 7. In the **EW Shapes** section of the dialog box, toggle on **Draw Earthwork Shapes** and **Stratify Shape Color**. Populate the dialog box with the parameters as shown below.



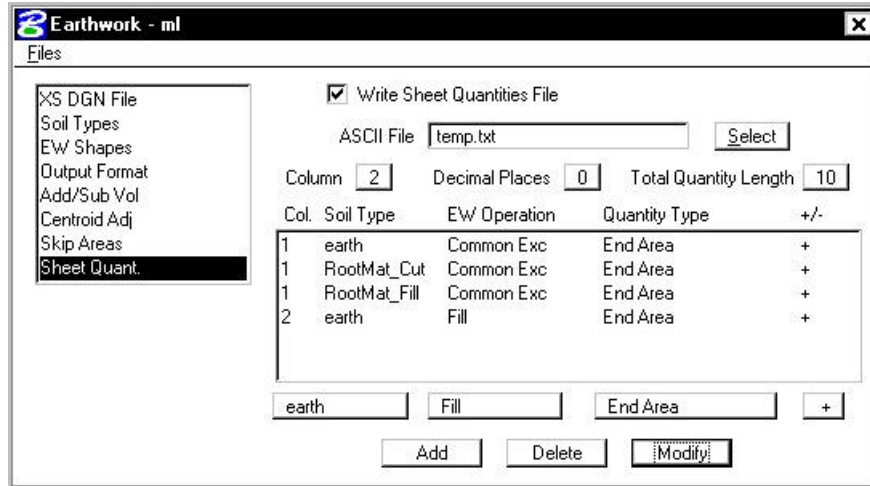
Step 8. Change the Output Format as shown below.



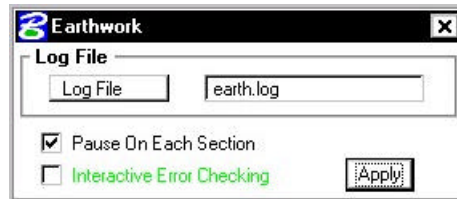
NOTE: Use the arrows (< or >) to change the format to **Excavation** and **Fill**.

Step 9. In the Sheet Quantities section, toggle on the Write Sheet Quantities File. Name the file temp.txt. Add the following columns to the file with Decimal Places = 0 and Total Quantity Length = 10:

Col.	Soil Type	EW Operation	Quantity Type	+/-
1	Earth	Common Exc	End Area	+
1	RootMat_Cut	Common Exc	End Area	+
1	RootMat_Fill	Common Exc.	End Area	+
2	Earth	Fill	End Area	+



Step 10. Using the **Files > Run** pulldown, run the earthwork for the proposed cross sections. Place your output into a log file as shown in the dialog box below and **Pause on Each Section**.



Step 11. Review the file **earth.log** using the GEOPAK editor.

Step 12. Exit the Earthwork dialog box and save your run.

Step 13. Review your cross sections using XS Navigator. Notice that GEOPAK has placed shapes onto your cross sections representative of the calculated earthwork areas. These shape areas can be measured to verify earthwork areas if desired.

14.2 Modify The Earthwork Text File

Step 1. Open Design and Computation Manager. Double click item **Location & Design>Special Applications>EW Labels**.

Step 2. Populate the dialog box as show below. Click **OK**.

Earthwork Text Labels

Earthwork Text File

Earthwork Text File to be Created

Warning: Prefixes and Suffixes cannot contain a space.

Column 1 Prefix	<input type="text" value="C-"/>	Suffix	<input type="text"/>
Column 2 Prefix	<input type="text" value="F-"/>	Suffix	<input type="text"/>
Column 3 Prefix	<input type="text"/>	Suffix	<input type="text"/>
Column 4 Prefix	<input type="text"/>	Suffix	<input type="text"/>
Column 5 Prefix	<input type="text"/>	Suffix	<input type="text"/>
Column 6 Prefix	<input type="text"/>	Suffix	<input type="text"/>
Column 7 Prefix	<input type="text"/>	Suffix	<input type="text"/>
Column 8 Prefix	<input type="text"/>	Suffix	<input type="text"/>
Column 9 Prefix	<input type="text"/>	Suffix	<input type="text"/>

Step 3. Review the file **earth.txt** using the GEOPAK editor. **C-** should be added to all quantities in Column 1 and **F-** should be added to all quantities in Column 2.

Step 4. Exit MicroStation.