

Program Operation

The following discussion explains how, within the ArcGIS® environment, a CEDRA-AVland™ user can (a) define a horizontal alignment with random points, (b) extract cross-sections and profile data from contour strings and (c) create a fully annotated profile.

Configuring ArcMap® with the appropriate CEDRA-AVland™ toolbars

In order to perform the above mentioned work, within ArcMap, the user must first display the CEDRA-AVland menus and tools, to do so perform the following steps presented below:

- ▶ **1** Invoke ArcMap by **double-clicking** on the **ArcMap icon** displayed on the desktop, or by selecting the Start button in the task bar, then selecting the Programs menu item followed by selecting the ArcGIS menu, and finally selecting the ArcMap menu item.

- ▶ **2** Select the **radial button** to the left of the *A new empty map* label, and then **click** at the **OK** button (see Figure 1).

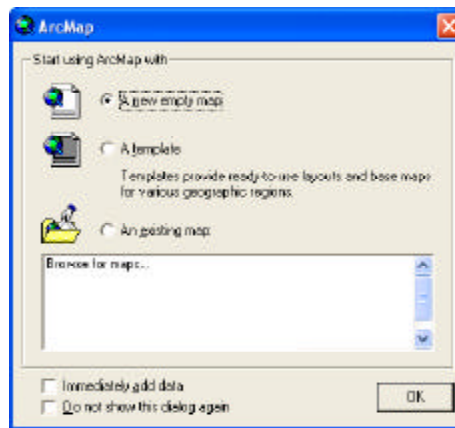


Figure 1 - Project Selection

- ▶ **3** Select the **Tools** menu item, and then select the **Customize...** sub menu item. Once the Customize form is displayed (see Figure 2) **make certain** the **Toolbars tab** is active, and select the following toolbars so that they are displayed.

- ☞ Editor
- ☞ CEDRA-AVlandHAlignment-Menus
- ☞ CEDRA-AVlandHAlignment-Tools
- ☞ CEDRA-AVlandVAlignment-Menus
- ☞ CEDRA-AVlandVAlignment-Tools
- ☞ CEDRA-AVland-CrossSections
- ☞ CEDRA-AVcad-Menus and then **click** at the **Close** button to close the Customize dialog box.

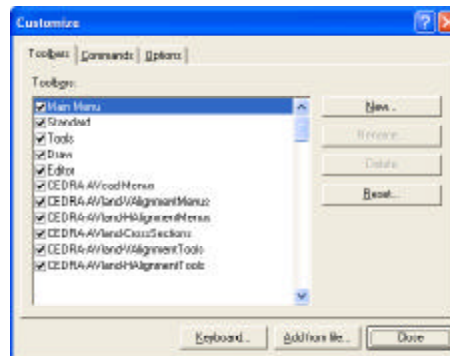


Figure 2 - Toolbar Selection

Any other CEDRA related toolbars can be added as desired. The other toolbars provide functionality which may prove useful for performing tasks other than those outlined at the beginning of this paper.

- 4 **Rearrange** the toolbars so that they are displayed as shown in Figure 3.

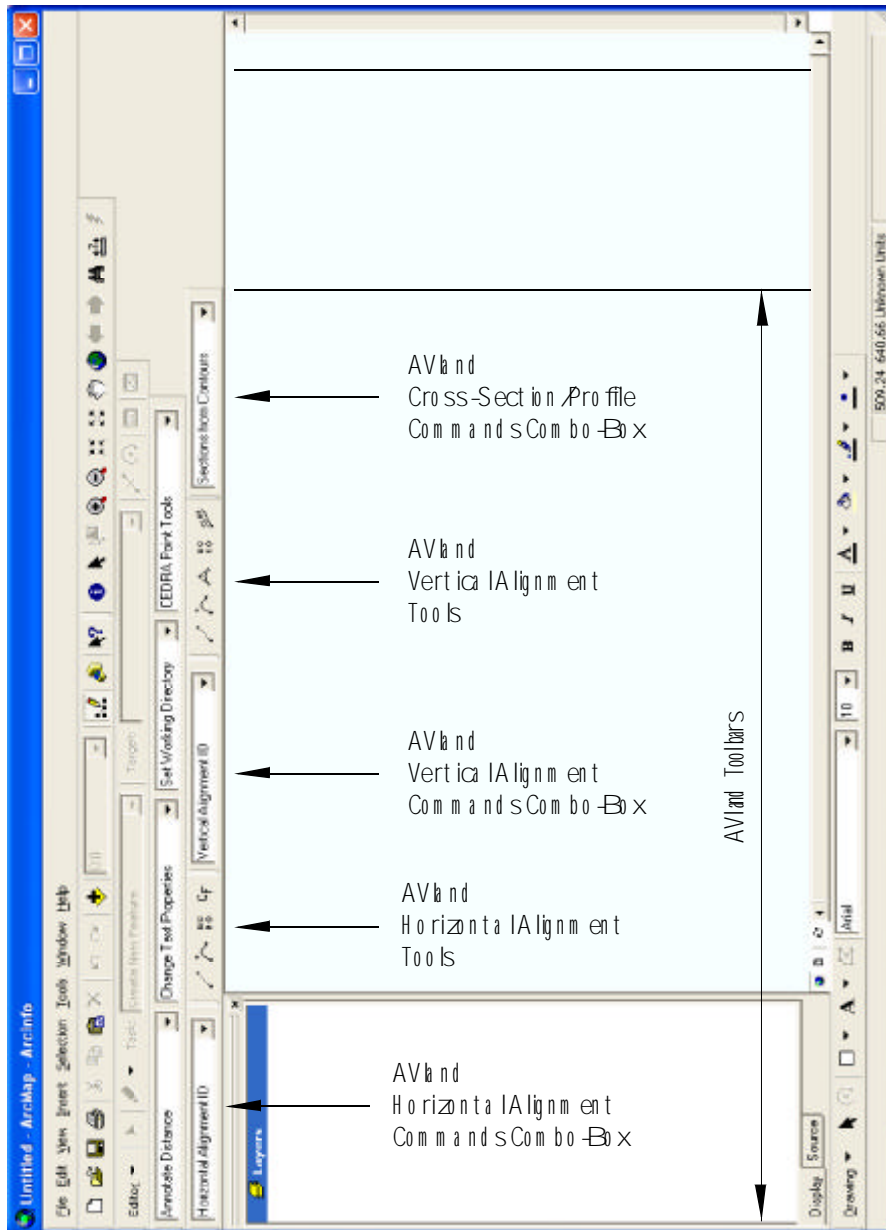
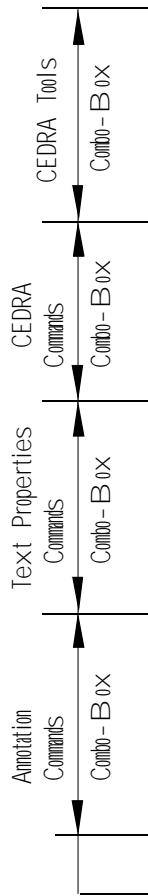




Figure 3 - ArcMap Project Layout Window

Loading the Digital Terrain Model Themes

Once the appropriate toolbars have been displayed and positioned, the base map data including the digital terrain themes (layers) should be added to ArcMap. To do so, perform the following:

- ▶ **5** Select the Add Data  button, **navigate** to the appropriate directory and **select** the digital terrain themes (layers) and then **select** the **Open** button to add these themes (layers) to the map.
- ▶ **6** Select the **View** menu item followed by **selecting** the **Data Frame Properties...** sub menu item. See Figure 4. It is important to set the Map and Display units prior to performing any analytical work. Therefore, in the drop-downs to the right of the Map and Display labels, within the Units frame under the General tab, **select** the appropriate units (typically feet or meters), then **select** the **OK** button.
- ▶ **7** Select the Full Extent  button to zoom to the full extent of the digital terrain model.
- ▶ **8** Select the **File** menu item, then **select** the **Save As...** sub menu item, navigate to the directory where the work is to be stored, **enter** a desired document filename and **select** the **Save** button to save the work done to this point.

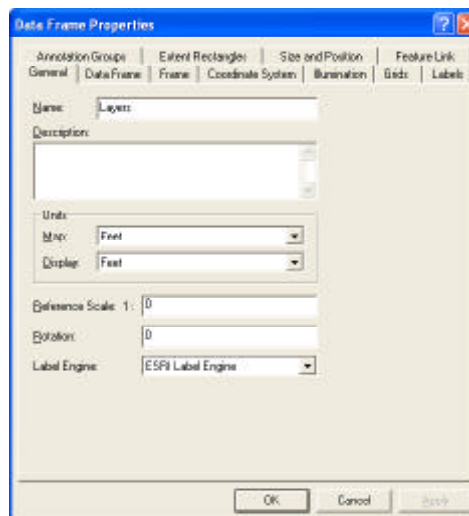


Figure 4 - Data Frame Properties

Defining the Current Working Directory

Prior to performing any work with the CEDRA-AVland software, the directory where any new information will be stored should be specified. This location is referred to as the current working directory. Any new files that are created by CEDRA software are stored in the current working directory. This includes shapefiles, text files and personal geodatabases.

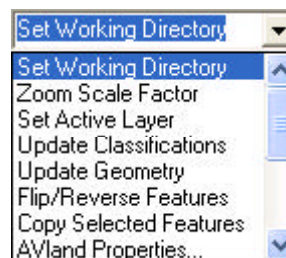


Figure 5 - Set Working Directory

Any other data can be added to the map, if desired. This includes the layer containing the lines which represent the horizontal alignments.

- 9 From the CEDRA Commands combo-box **select** the **Set Working Directory** menu item. **Navigate** to the folder where any new data is to be stored and **select** the folder. Once this is done, **select** the **Select** button. In the low left corner of the application window, the command will display the pathname of the current working directory in the low left corner of the application window.
- 10 Depending upon the map units which are being used, the user may need to specify the units of measure for the CEDRA-AVland properties. To do so, from the CEDRA Commands combo-box **select** the **AVland Properties...** menu item. The dialog box of Figure 6 is displayed. If the map units are set to Meters, then **select** the **radial button** to the left of the SI label in the Data Storage Units and Data Entry Units frames at the top of the properties dialog box. Once this is done **select** the **OK** button.

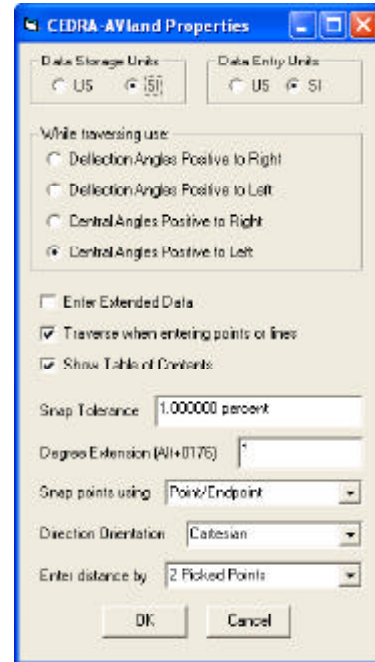


Figure 6 - AVland Properties

Verifying the Digital Terrain Model

In order to extract cross-sections and profile data from contour strings, the layer which contains the contour strings must have an attribute (field), called either Z or ELEVATION, which contains the elevation value of the contours. *The reader should examine the attributes of the contour string layer and verify that a field containing either of these two names exists.*

If this attribute does not exist, the following steps can be performed to create the required field.

- 11 **Right-click** in the TOC on the name of the layer that contains the contour strings to display the command options of Figure 7, and **select** the **Open Attribute Table** command. The table of said layer is now displayed as shown in Figure 8.
- 12 **Click** at the **Options** button in the low right corner of Figure 8 to display the available operations shown in Figure 9.

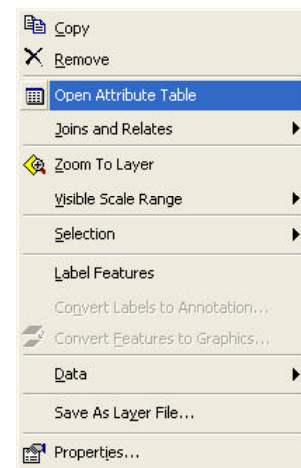


Figure 7

| FID | Shape* | ID | CONTOUR |
|-----|----------|----|---------|
| 0 | Polyline | 1 | 10 |
| 1 | Polyline | 2 | 5 |
| 2 | Polyline | 3 | 15 |
| 3 | Polyline | 4 | 15 |
| 4 | Polyline | 5 | 15 |
| 5 | Polyline | 6 | 15 |
| 6 | Polyline | 7 | 25 |
| 7 | Polyline | 8 | 20 |
| 8 | Polyline | 9 | 50 |

Figure 8 - Table of the Contours Layer

- 13 Select the **Add Field...** option to display the dialog box of Figure 10.

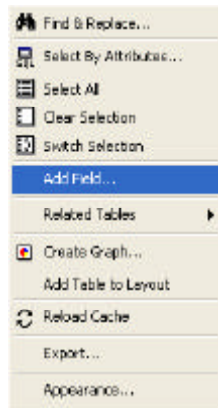


Figure 9

Figure 10

- 14 In said dialog box:
 - Enter **Z** in the data field to the right of the **Name:** label,
 - Scroll in the **Type:** datafield, and select the **Double** option (note the slight change in the window,
 - Enter **18** to the right of the Precision data field,
 - Enter **6** to the right of the Scale data field, and then
 - Click at the **OK** button to create the new attribute (field).

Double option (note the slight change in

| FID | Shape* | ID | CONTOUR | Z |
|-----|----------|----|---------|---|
| 0 | Polyline | 1 | 10 | |
| 1 | Polyline | 2 | 5 | |
| 2 | Polyline | 3 | 15 | |
| 3 | Polyline | 4 | 15 | |
| 4 | Polyline | 5 | 15 | |
| 5 | Polyline | 6 | 15 | |
| 6 | Polyline | 7 | 25 | |
| 7 | Polyline | 8 | 20 | |
| 8 | Polyline | 9 | 50 | |

Figure 11

The Z field has now been added to the table as shown in Figure 11. We will now transfer the values from the Contour field into the Z field. Note that the command options shown on the right side of Figure 11 will not be displayed at this time.

- ▶ **15 Right-click** on top of the data field heading **Z** in the table of the contour strings, to display the command options shown in Figure 11. Depending upon various factors, the positioning of this command options window may not be that as shown in Figure 11. The message box of Figure 12 is now displayed

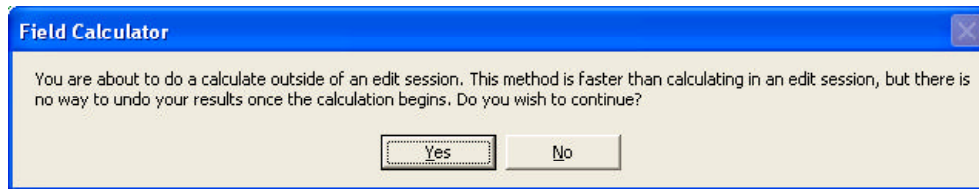


Figure 12 - Table Calculate Command Warning Message

- ▶ **16 Click** at the **Yes** button. The dialog box of Figure 13 is now displayed.
- ▶ **17 Double-click** on the **CONTOUR** field name in the upper left frame labeled **Fields**. This field name is now displayed within brackets in the low left frame labeled **Z =** of Figure 13. **Click** at the **OK** button.
- ▶ **18 Close** the table of the layer that contains the contour strings.

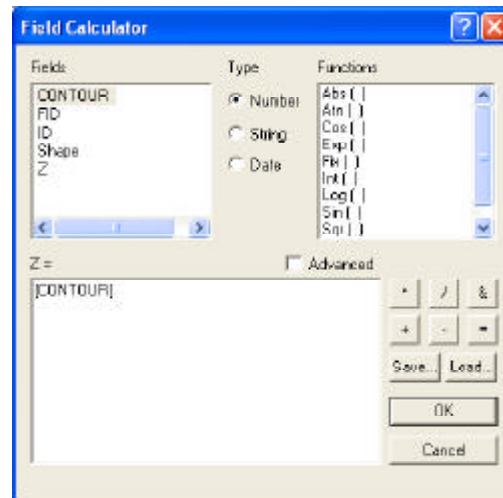


Figure 13 - Field Calculator Dialog Box

We now have a contour string layer that can be used for extracting cross-sections and profile data.

Subdividing the Digital Terrain Model

For improved processing performance, we will now select the group of contours to be exported into a new, smaller, layer. This will expedite the work to be done, since we will not have to parse through all contours of the overall project. We will work with only those contours within the immediate area of the horizontal alignment to be processed.

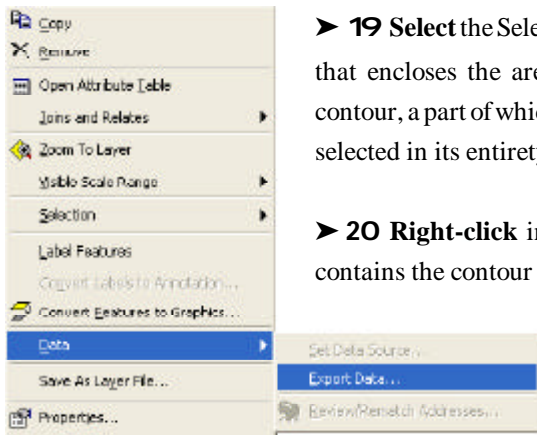



Figure 14 - Data Export Command

► **19** Select the Select Features  tool, and **define** a rectangle that encloses the area of immediate interest. Note that any contour, a part of which is contained within this rectangle will be selected in its entirety.

► **20** **Right-click** in the TOC on the name of the layer that contains the contour strings to display the command options of

Figure 14, **select** the **Data** command option to display the additional sub-commands of Figure 14, and then **select** the **Export Data** option to display the dialog box of Figure 15.

Depending upon the digital terrain model, the subdivided models can apply to more than one horizontal alignment. That is, a subdivided digital terrain model does not need to be created for each horizontal alignment.

► **21** Enter in the **Output shapefile or feature class**: data field the **pathname** shown in this data field in Figure 15, or any other desired pathname, and then **click** at the **OK** button to display the confirmation message box of Figure 16.

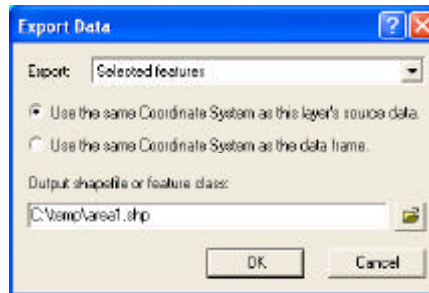
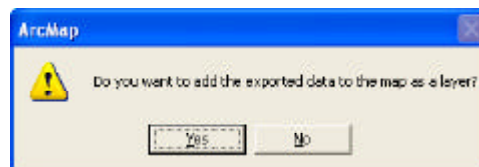


Figure 15 - Export Data

If another existing pathname is desired, you may click at the browse button to the right of the **Output shapefile or feature class**: data field, and select the desired pathname. The query message box of Figure 16 is now displayed.



**Figure 16
Confirmation to Add Exported Data**

► **22** **Click** at the **Yes** button to confirm the addition of the new layer.

A new layer, the name of which is that entered in Figure 15, has now been added to the TOC. This will be the contour string layer used for cross-section/profile extraction.

Defining the Horizontal Alignment and Random Points

CEDRA-AVland provides two modes for defining a horizontal alignment. The first is by defining the alignment's start and end points and then introducing its horizontal curves. The second mode is by converting an existing line feature into a horizontal alignment. This paper discusses the second mode of alignment generation.

Existing line/ polyline features can be converted into horizontal alignments, thereby saving the user the time to manually define the alignment's start and end points as well as it's PI's.

Define the current active horizontal alignment.

Define the current active horizontal alignment's parameters.

Select the point features that are to be treated as random points for the current active horizontal alignment.

➤ **23** Click at the Convert Feature  tool in the Horizontal Alignment tool bar.

➤ **24** Click in the view at the line representing the alignment of the new roadway. The Yes/No/Cancel message box of Figure 17 is displayed.

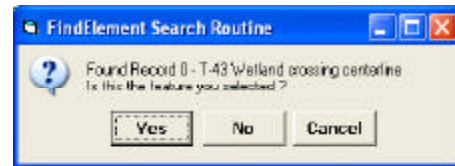


Figure 17 - Convert to HA Confirmation Message Box

➤ **25** Click at the Yes button to confirm.

➤ **26** Scroll down in the Horizontal Alignment menu combo box (see Figure 18), and select the **Horizontal Alignment ID** command. The dialog box of Figure 19 is displayed.

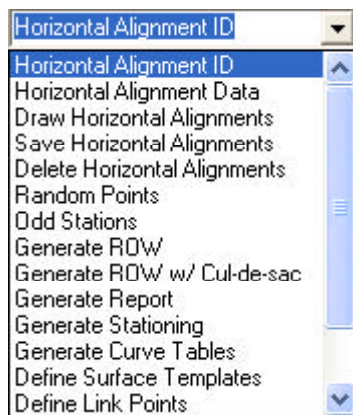


Figure 18 - Horizontal Alignment Combo-Box

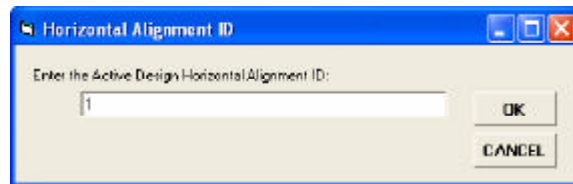


Figure 19 - Horizontal Alignment ID Entry

➤ **27** Enter in the data field the horizontal alignment ID number, in this case **1**, and then click at the **OK** button.

➤ **28** Scroll down in the Horizontal Alignment menu combo box (see Figure 18), and select the **Horizontal Alignment Data** command. The dialog box of Figure 20 is displayed.

➤ **29** Enter in, and scroll down and select from the various data fields of the displayed dialog box the data and options shown in the corresponding data fields in Figure 20, and then click at the **OK** button.

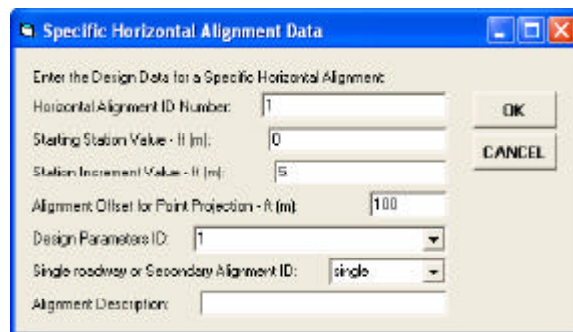



Figure 20 - Horizontal Alignment Data Entry

➤ **30** Select the Select Features  tool, click on top of one of the two points, hold the keyboard shift key down, and then click on top of the other point. These two points are to represent random points.

- **31** Scroll down in the Horizontal Alignment menu combo box (see Figure 18), and select the **Random Points** command. The message *2 points added* is displayed in the status bar at the bottom of the ArcMap window.

Extracting Cross-Sections and Profile Data

- **32** Click in the TOC on top of the name of the layer containing the contours that were exported previously.

- **33** Scroll down in the Cross-Section/Profile menu combo box (see Figure 21), and select the **Sections from Contours** command. The dialog box of Figure 22 is displayed.

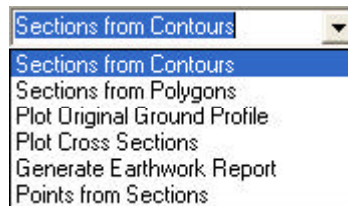


Figure 21 - Cross-Section Profile Menu Combo-Box

- **34** Enter in, and scroll down and select from the various data fields of the displayed dialog box the data and options shown in the corresponding data fields in Figure 22, and then click at the **OK** button.

The program now begins to strip the cross-section at the previously specified station increment, and for the previously specified offset limits to the left and right of the alignment. Cross-sections have also been stripped at the two random points that were previously selected. These cross-section lines are shown in Figure 23.

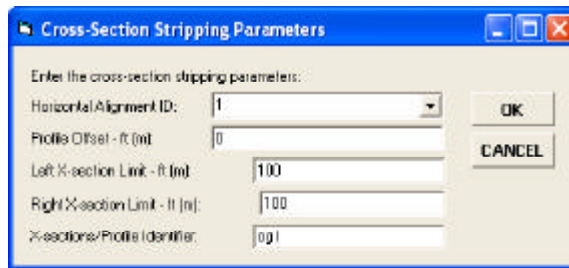


Figure 22 Cross-section Stripping Parameters

- **35** Click at **View** menu in the ArcMap menu bar, and from the displayed command options select the **Data Frame Properties...** option to display the Data Frame Properties dialog box.
- **36** Make certain that the **Annotation Group** tag is active, click at the **og1-pln** name, click at the **Remove Group** button, and then click at the **OK** button to close the Data Frame Properties dialog box.

A table called RANOMPNTSdata will be added to the map containing the random points. Random points can be used for extracting cross-section and profile data at a specific location.

Cross-Sections and Profile data are extracted from the current active layer.

The profile offset is the distance from the horizontal alignment where the profile is to be taken. A value of zero denotes that the profile is to be taken along the horizontal alignment itself. The left and right x-section limits represent the distances to the left and right for cross-section extraction.

These values should be large enough such that a cross-section intersects at least one contour string.

The cross-sections are stored in a table called *ogl_xsc*, while the profile is stored in a table called *ogl_pro*.

The interval at which cross-sections are extracted is controlled by the alignment's *Station Increment Value* parameter.

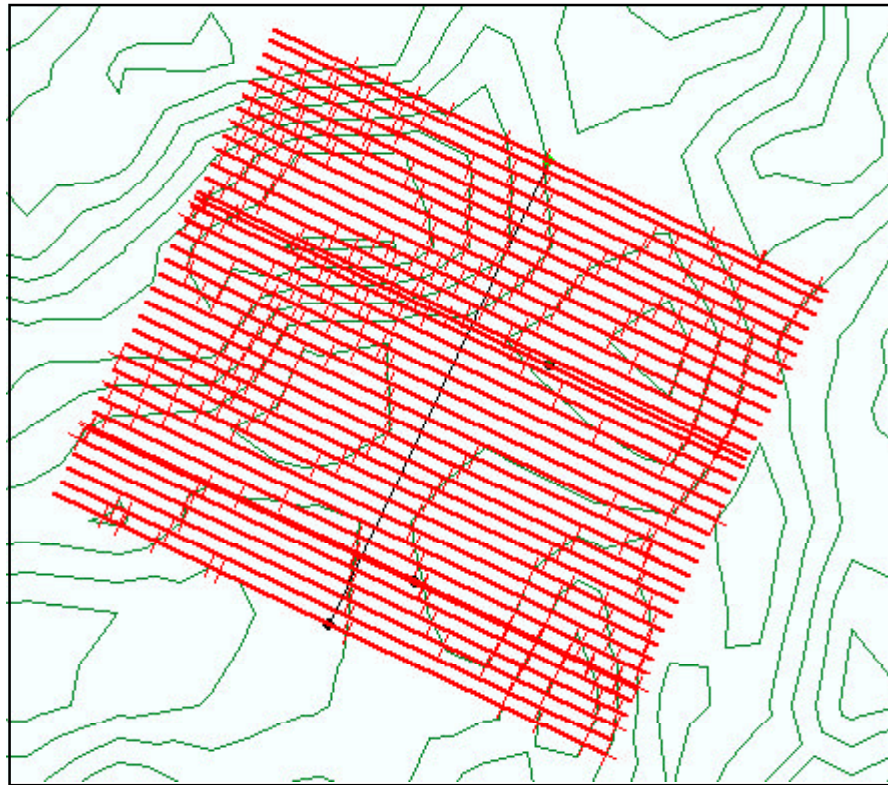


Figure 23 - Stripped Cross-Section Lines Along the Alignment

Profile Plotting and Original Ground Surface Annotation Generation

Prior to plotting a profile, the user should set the size of the text that is to be used in the profile plotting. Depending upon user specifications any desired text size value can be entered.

- **37** Scroll down in Text Properties commands menu combo-box, and select the **Change Text Properties** command to display the dialog box of Figure 24.
- **38** Enter **2** in the Text Size (points): data field, accept all other data, and then click at the **OK** button.

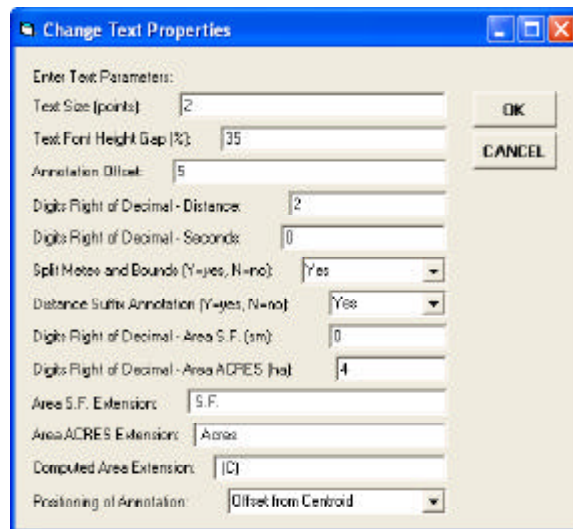


Figure 24 - Text Properties Dialog Box

► **39** Scroll down in the Cross-Section/Profile menu combo-box (see Figure 21), and select the **Plot Original Ground Profile** command. The dialog box of Figure 25 is displayed.

► **40** Scroll down in the

- *Profile Table*: data field and select the **og1_pro** option,
- *for Alignment*: data field and select the **1** option, and then click at the **OK** button. A dialog box similar to that of Figure 26 is displayed, but with different data.

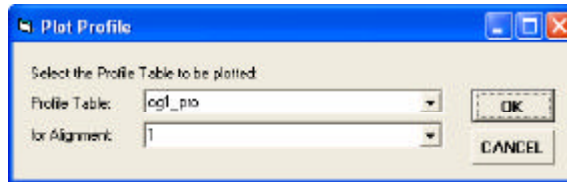




Figure 25
Alignment Selection for Profile Plot

► **41** Enter in, and scroll down and select from the various data fields of the displayed dialog box the data and options shown in the corresponding data fields in Figure 26, and then click at the **OK** button. The profile is generated (See Figure 27).

► **42** Click at the zoom-in  tool, and then make a rectangle about the profile.

► **43** Click at the Select Elements Tool  and select one of the text labels in the profile.

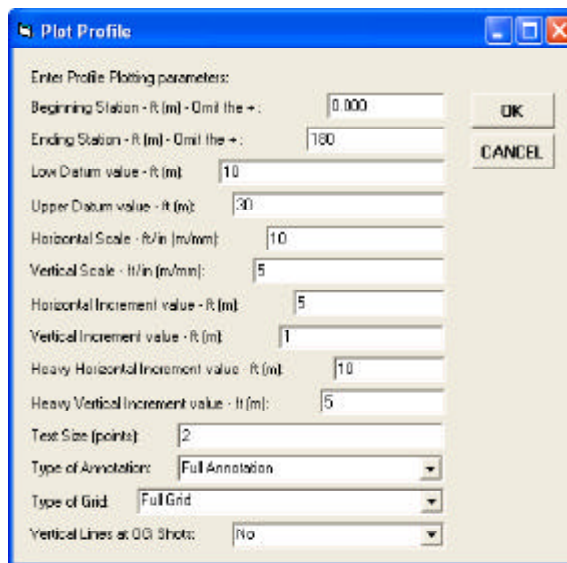


Figure 26 - Profile Parameters Dialog Box

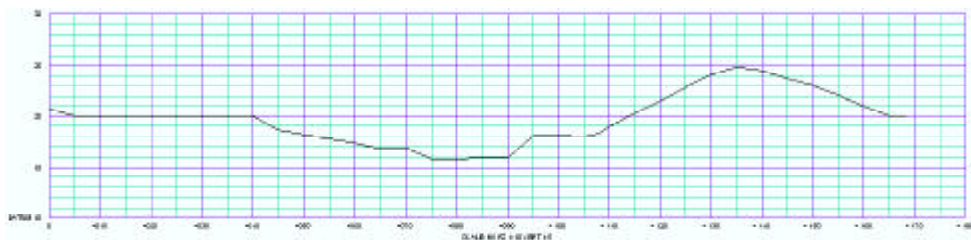


Figure 27 - The Profile

The user needs to specify which original ground profile is to be plotted and which horizontal alignment the profile is associated with.

The default values displayed in Figure 26 represent the actual limits of the original ground profile. These values are altered by rounding up or down. Depending upon user specifications any other values can be entered.

It is possible to define the text size to be used in creating new annotation by pointing at an existing annotation and then using the Set Text Size command.

The profile is stored in the Personal GeoDatabase, algX.mdb, where X is the horizontal alignment ID

- 44 Scroll down in Text Properties commands menu combo-box (see Figure 28), and select the **Set Text Size** command. The message box of Figure 29 is displayed identifying the size of the selected text. Click at the **OK** button to acknowledge the new text size.

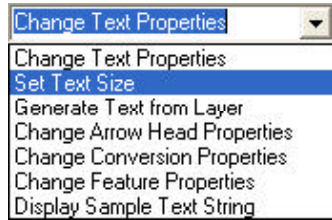


Figure 28
Text Properties
Menu Combo-Box



Figure 29 - Text Size



Figure 30
Vertical Alignment
Menu Combo-Box

- 45 Scroll down in the Vertical Alignment menu combo-box (see Figure 30), and select the **Annotate Surface Elevations** command. The dialog box of Figure 31 is displayed.

- 46 Enter the data shown in Figure 31 in response to the various annotation parameters presented in the annotate surface elevations dialog box and then click at the **OK** button.

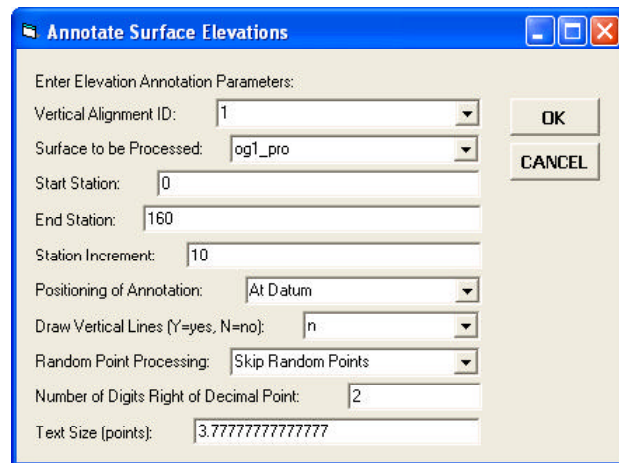


Figure 31
Annotate Original Ground Parameters

The command will then generate along the datum of the profile annotation representing the elevation at a specific station value on the original ground profile (see Figure 32).

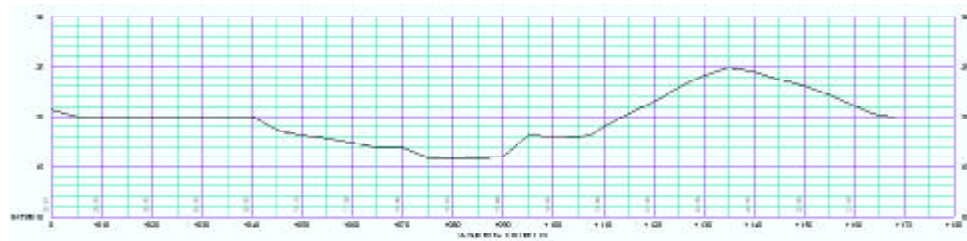


Figure 32
Original Ground Annotation along Profile Datum

We will now generate text which represents the elevation of the original ground at specific station values. The user has the option of placing this annotation at the profile datum, below the datum or along the surface of the original ground profile.

The annotation created will be the same text size as the profile grid text.

- **47** Scroll down in the Vertical Alignment menu combo-box (see Figure 30), and select the **Annotate Surface Elevations** command. The dialog box of Figure 31 is displayed.

- **48** Enter the data shown in Figure 33 and then click at the **OK** button.

- **49** Click at the **No** button, as shown in Figure 34, to indicate that the annotation which is to be created is to be added to the existing annotation.

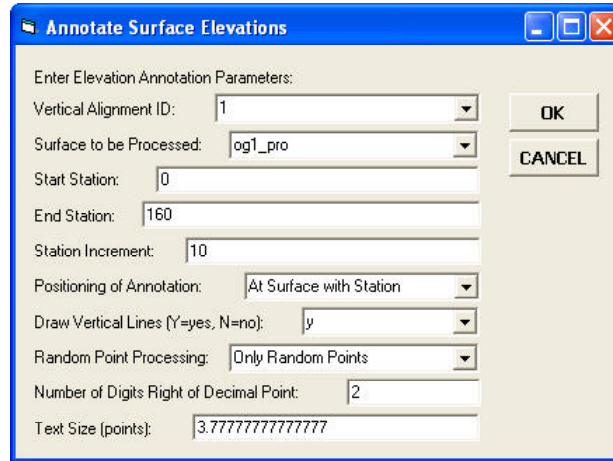


Figure 33
Annotate Original Ground Parameters

The command will then generate along the surface of the original ground profile (see Figure 35) annotation representing the station and elevation of the random points that are associated with the current active horizontal alignment. Figure 36 is a "blowup" of the annotation created by the Annotate Surface Elevation command.

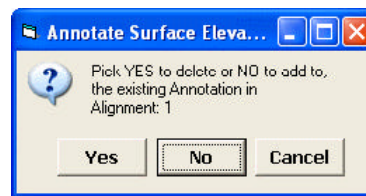


Figure 34
Annotate Original Ground Parameters

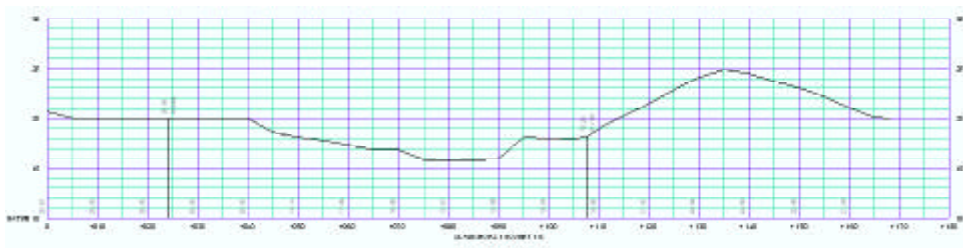


Figure 35
Annotate Original Ground Parameters

- **50** Select the **Editor** button, select the **Stop Editing** menu item, and then click the **Yes** button in the displayed query box. All edits performed so far are now saved to disk.

We will now annotate the station and elevation values of the random points which are associated with the current active horizontal alignment.

The profile annotation is stored in the Personal GeoDatabase, algX.mdb, where X is the horizontal alignment ID.

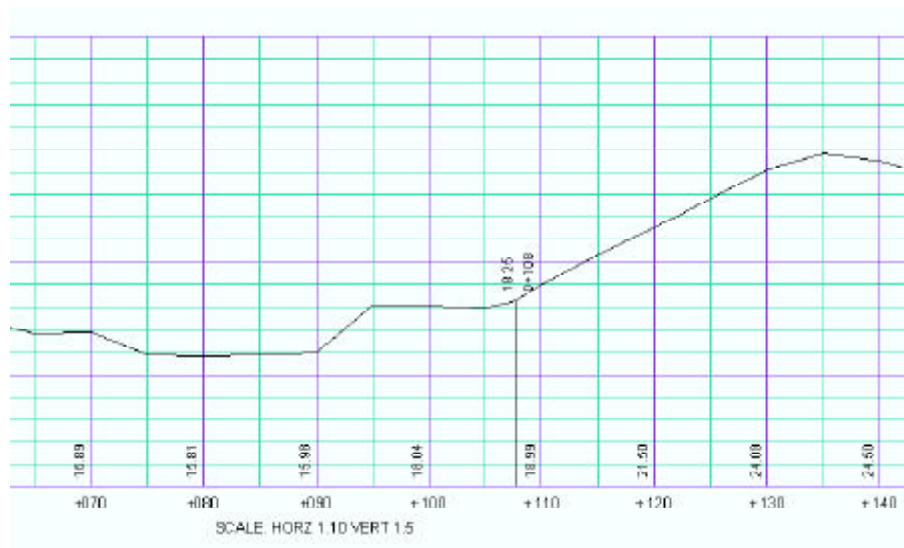


Figure 36
Annotate Original Ground Parameters