Terrain 3D Tutorial

TerrainTools®

Version 7

Softree Technical Systems Inc.

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1. Getting Started

This manual is formatted as a hands-on tutorial, which can be used by novice or experienced users. Step by step examples use prepared documents and data files to illustrate tools needed for common Terrain Tools® 3D and RoadEng® tasks.

Files

The Terrain module can be installed as a standalone program (Terrain 3D) or installed with RoadEng Civil Engineer.

The tutorial files referred to in the following examples can be installed from the RoadEng or Terrain 3D install CD/Flash Drive or from the Softree's web site:

CD or Flash Drive
An Auto-run screen should appear when the install medium is inserted. (If Auto-run is disabled, view the device in Windows Explorer and run the executable manually). Select *Install the Tutorial Files*.

Web Go to the *Support-Documentation Updates* page on Softree's web site: http://www.softree.com/Support/Support_Documentation.aspx .

Terrain 3D (standalone) in the *Surveying and Mapping* section, click the link to download the *Tutorial Files and Documentation* installer. Open this file to install.

RoadEng Civil Engineer in the *Civil Engineering* section, click the link to download the *Tutorial Files and Documentation* installer. Open this file to install.

Documents

The tutorial files (data sets) will be installed in the folder below by default:

C:\Users\Public\Documents\Softree\Training70\Terrain

It is possible to change this folder at install time; you can also copy it to a new location afterwards if you wish. We will refer to the install folder as **<Terrain>** in the examples below.

Defaults and Layouts

The setup and layout files required for the examples are saved in the folder below:

<Defaults and Layouts>\Training

Where **<Defaults and Layouts>** depends on your operating system and application install. The common location for **<Defaults and Layouts>** is shown below**:**

XP:	**C:\Documents and Settings\All Users\Application Data\Softree\Terrain**
Vista	**C:\ProgramData\Softree\Terrain**
Windows7, 8, 8.1:	**C:\ProgramData\Softree\Terrain**

If you have RoadEng® installed the **<Defaults and Layouts>** folder will be in a folder named **RoadEng** not **Terrain**.

Note: You can always determine the actual **<Defaults and Layouts>** folder by running the Terrain Module, selecting menu *Module* | *Setup* and clicking on the *Install* tab.

Don't save files (in most cases)

Most of the following examples end with the phrase: "… do not save changes". If you modify the tutorial files, they will no longer work with the steps in the exercise; this will prevent you, or someone else, coming back and doing the exercise again. In the event that the files do get modified, you can always delete and re-install the tutorial files.

Function Groups

Some Terrain Tools® (and RoadEng ®) products have certain features disabled (*Terrain Recreational* for example); we classify these optional features by *function group*.

If you don't have a password or key, then only a few Terrain Module *function groups* are permitted without entering *Demonstration Mode*. To view or change the enabled function groups:

1. Select *Module* | *Setup* from the menu bar; an Options Dialogue box appears. Click on the *General* tab.
2. Click on the *Menus* button to open the Menu Customization Dialogue box.

Function group items with a red circle (see figure below) before them are permitted in *Demonstration Mode* only. A checkmark beside an item indicates it has been enabled.

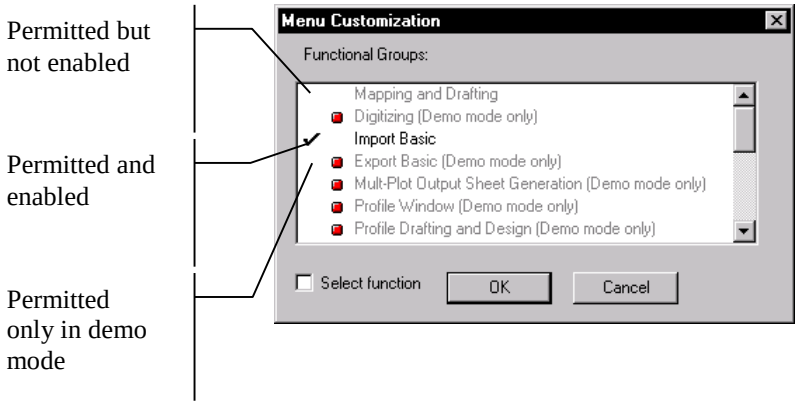


Figure 1.1: Function groups displayed in the menu customization dialogue

Function Groups Required for Examples
All required function groups are listed prior to each example in this manual. If you do not have permission to use all the required function groups, you may wish to skip the example. Also note that some function groups may be disabled even if *you* have permission to use them – this is so users with a lesser license can still do the example.

If you attempt to open a tutorial file containing function groups that are not permitted in your licensed software you will be prompted with the message box below.

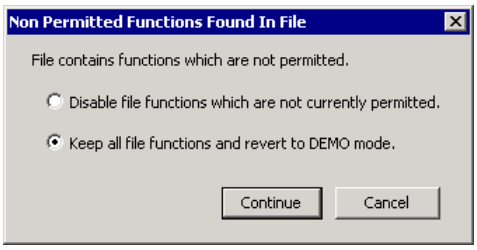


Figure 1.2: Function groups not permitted prompt

To continue the example you must respond *"Keep all file functions and revert to demo mode"*. In demo mode printing and saving are disabled.

On-line Help

Help information is available by choosing the *Help* menu or pressing F1. The On-line Help includes detailed technical information about menus, dialogue boxes, and operation of the program.

It may be useful to refer to the On-line Help while working through the examples in this manual.

Tutorial Units

Most examples in this tutorial are in metric units. To correctly follow the examples ensure Metric Units are enabled. Select *Module* | *Setup* before starting. If other units are used they will be specified at the start of the example. The procedures and concepts described apply to all unit systems.

Checkpoints

Checkpoints identified by a checkmark indicate the beginning of an example. All files required to start from a checkpoint are included in Tutorial install.

Conventions

The following conventions are used throughout the manual:

- Menu functions are delimited by a line "|". *File* | *Open* means to click on *File* in the menu bar and then select *Open* from the drop down menu.
- Dialogue box control (like buttons) and heading names are *italicized*.

- The symbols “< >” contain keyboard functions. For example < shift-enter> means: hold down the *Shift* key and press the *Enter* key.
- File names and path names are bold.

2. Basic Concepts

The Terrain Module provides you with the facilities for assembling and manipulating topographic and other map features. Information can be entered from a paper map using a digitizing tablet, from an external file or on the screen using the mouse.

The Terrain Module provides 8 windows: Profile, Plan, Status, Points, Features, 3D, and Multi-Plot. The number and type of windows available depends on the *Function Groups* you have enabled. The figure below shows a typical window arrangement.

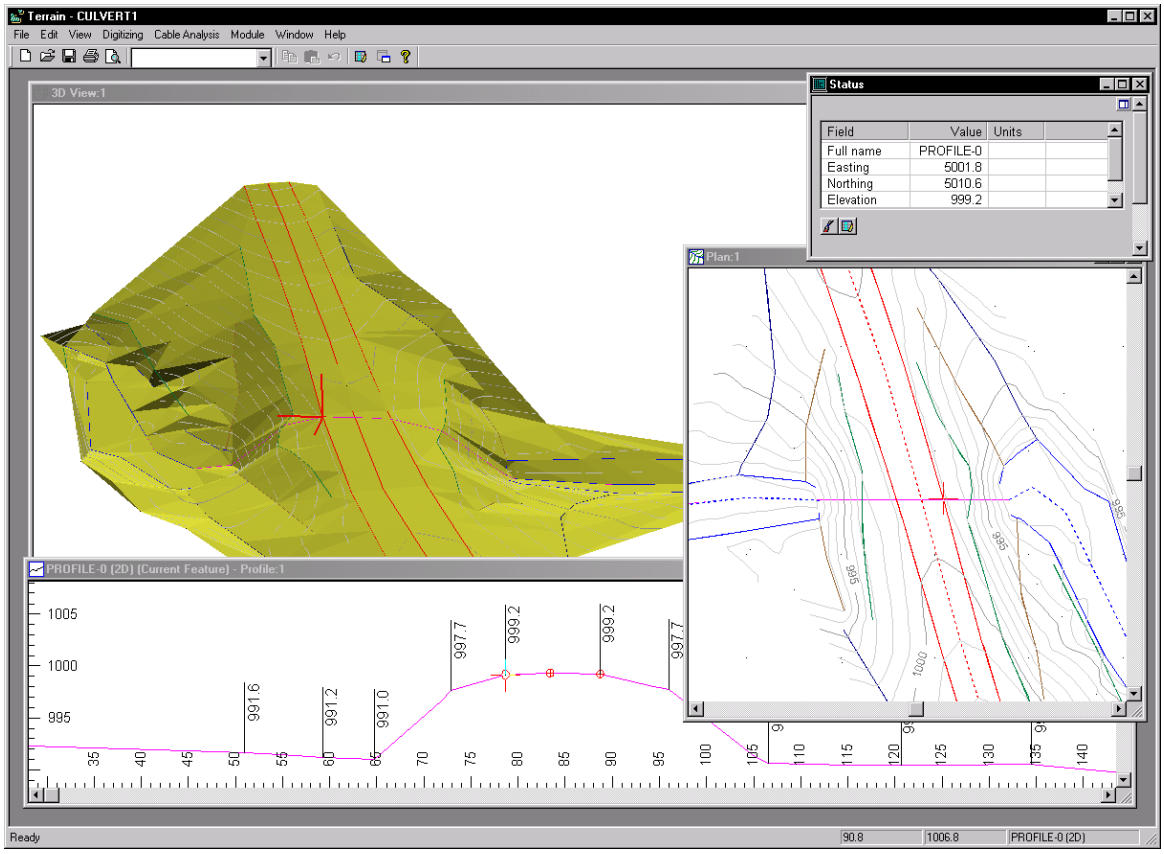


Figure 2.1: Terrain windows

Window Types

Plan Window displays a plan View. It is used to display and edit features.

Profile Window displays a profile view of one or more selected features. This window requires that the Profile Window function group be enabled.

Status Window displays numeric information about the current feature and point. It can be used as a floating window or as a docked panel window on the right-hand side of the screen.

Points Window is used to report and/or modify attribute information about the current point. It can be used as a floating window or as a docked panel window on the right-hand side of the screen.

Features Window is used to report and/or modify attribute information about the current feature. It can be used as a floating window or as a docked panel window on the right-hand side of the screen.

3D Window displays the features in a 3 dimensional view.

Multi-plot Window is used to create an output sheet containing plans, profiles, legends, scale bar, images etc. This window requires that the Multi-plot function group be enabled.

Each window has its own menu. These menus are available when the window is active. The active Window title bar will be highlighted and the menu *Window*|<*active window name*> will have a checkmark beside it.

Each window can be sized, moved, maximized and minimized in the standard Microsoft fashion. All windows can be configured from the menu *View*|*Active Window* (<name>) Options.

Text Windows such as *Features*, *Points*, and *Status* can be floating or docked to the right side of the screen. To dock a floating window, click the dock icon  on the upper right side of the window. To float a docked window, click the float icon  on the upper right side of the docked window.

Customizing Terrain using Screen Layouts

Options for all windows can be saved in a configuration file called a *Screen Layout*. To change the default configuration for Terrain:

1) Arrange the screen positioning of windows, scales, labels etc.
2) *File* | *Save Screen Layout* and specify **Normal.ilt** (other layout names can be used for creating layouts for different applications**. Normal.ilt** is the default).

The *screen layout* drop down control can be found in the Standard toolbar in all modules (figure below).

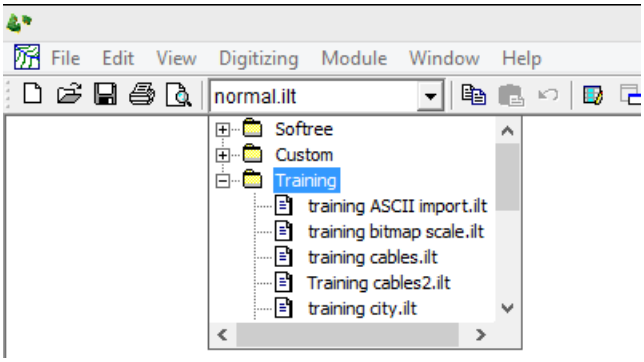


Figure 2.2: Screen layouts *drop down control in the* Standard *toolbar.*

To retrieve a layout, open the control by clicking on the down arrow, then scroll down and select the desired file. Screen layouts used in the tutorials are all in the *training* folder.

Note: Layout files will be used extensively in the examples and are extremely valuable for saving and retrieving the large number of options available.

Tool Bars

Tool Bars display buttons or icons that are used to activate common functions. The function name appears when the cursor hovers over the icon. The Active buttons in the Tool Bar are dependent on the window selected. The various toolbars can be shown or hidden by selecting menu *View*|*Toolbar* or by right clicking on any currently visible toolbar. Toolbars can be floating or docked to the edge of the screen.

Screen Layouts can also specify which Tools options are displayed. For example, Standard Tools, Window Tools, Zoom Tools, Mode Tools and Navigation Tools are pre-set in **normal.ilt**.

Points, Features, Attributes, and Feature Properties

Features

A feature is a collection of points such as a contour line, a lake boundary or a spot elevation point. Bitmap images are also considered to be features (in this case the corners are the points). Many operations in Terrain apply to features or groups of features such as formatting, moving, deleting etc. Feature attributes can be assigned to the features.

Points

Features consist of 1 or more xyz coordinate points. Point attributes can be assigned to individual points.

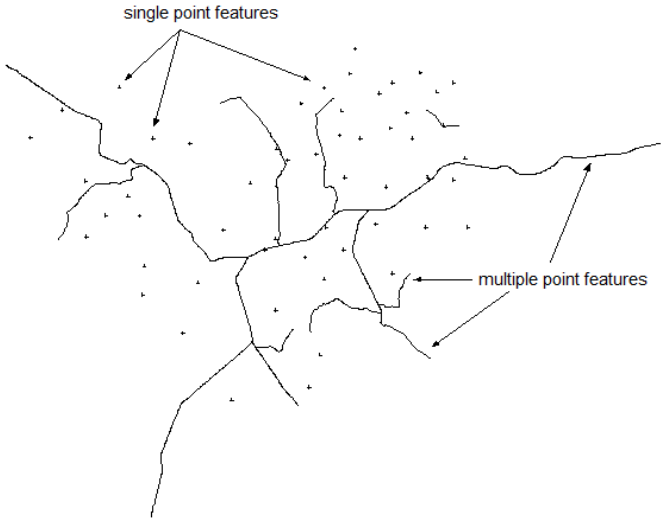


Figure 2.3: Single and multiple point features

Attributes

Attributes are the properties of a particular object. They can be things like line type and color, which are editable feature attributes, or things like the number of features in a file which is a read-only attribute.

Attributes can be viewed through the Status Window, the Features Window or the Points Window. There are three broad classifications of attributes and they are as follows:

- Point Attributes - properties of a point on a feature.
- Feature Attributes - properties of a feature.
- File Attributes - properties of all the features and the file as a whole.

Attributes are grouped together in categories. Many categories are pre-defined, but you can create your own attribute definitions by adding a new category using the Attributes Setup Dialogue. An example of a pre-defined category is Format. The Format category contains feature attributes such as line type, color, and hatch. These attributes are not read-only, so you can modify them in the Features Window.

Fixed Feature Attributes (Feature Properties)

Every feature has a set of fixed attributes (additional attributes are optional). These attributes are saved in a feature header.

The following properties are saved with every feature:

Feature Name	Each feature has a unique name consisting of a 50 character Alphanumeric Id portion and a Numeric Id. It is possible to have more than 1 feature with the same Alphanumeric ID e.g. STREAM-1, STREAM-2 etc. The feature name is not case sensitive i.e. " RightOfWay11" = " RIGHTOFWAY11".

Line-type, Color, Symbol and Hatchtype -	Drawing format
Displayed	Visibility e.g. displayed or hidden
Connected	Feature points are connected by lines or isolated (refer to Figure 2.4)
Elevation	Feature points have elevations
Modeled	Feature points will be included in the TIN model
Breakline	Feature is a breakline (TIN modeling)
Negative Area	Feature represents a hole with negative area. This option can be used with *TIN Boundary* below.
TIN Boundary	Feature is a TIN boundary
Surface Volume Boundary	Feature is used as a polygon to accumulate volumes in the volume calculations.

Note: When working with very large data sets it is not a good idea to use single point features because the memory overhead for the feature header can be significant. If possible, make sure that data are grouped into features containing a number of points (1000+).

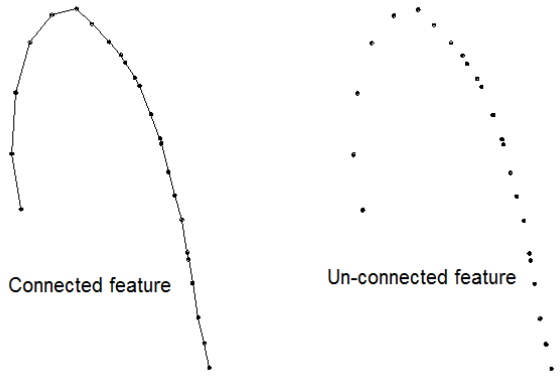


Figure 2.4: Connected and unconnected feature property

Current Feature and Point

In the Terrain module it is possible to *select* multiple features; selected features are the target of most operations (delete, move, change line-type, change properties, etc.). Often the concept of current point and current feature is used. At least one feature must be selected

- There is no current point or feature if no features are *selected*. *Selected* features are always displayed with color magenta.

- The *Current Point* is displayed in the plan and profile windows with a red cross.
- The *Current Feature* is the *selected* feature containing the *Current Point*.
- Most of the information displayed in the Status window relates to the *Current Feature* and *Current Point*.
- Selecting with the mouse (in selection mode) is a common and simple way to change the *Current Feature* and *Current Point*.

3. Basic Mapping and Drafting

This section is intended to provide the user with an introduction to the Terrain Module mapping and drafting functions. No special knowledge of surveying or mapping is required other than some basic familiarity with scales and coordinates.

To do the examples in this section the *Mapping and Drafting, Import Basic and Export Basic* function groups must be enabled (See *Function Groups* in the On-line help for more information).

Scaling Maps

Park Map Example

Note: See Getting Started section for file install folders **<Terrain>** and **<Defaults and Layouts>**)

1. *File* | *Open* <Terrain>\Cad\park map.ter.

Note: Terrain Recreational users may get the message "Non Permitted Functions Found in File". If this message appears choose "Keep all functions and revert to DEMO Mode".

2. The Terrain Module works with *natural scales*. A natural scale of 1:5000 indicates 1 unit on the paper drawing = 5000 units on the ground. If working with mixed unit scale such as 1" = 200', then it must be converted to a natural scale before using it with Terrain (1":200' is the same as 1": 2400" i.e., a natural scale of 2400).
3. Activate the Plan Window by clicking on the Title Bar. The scale is set to **15000** in the *Scale Box* in the Toolbar. Change the scale to **25000** and press Enter.

Notice the change in the screen view.

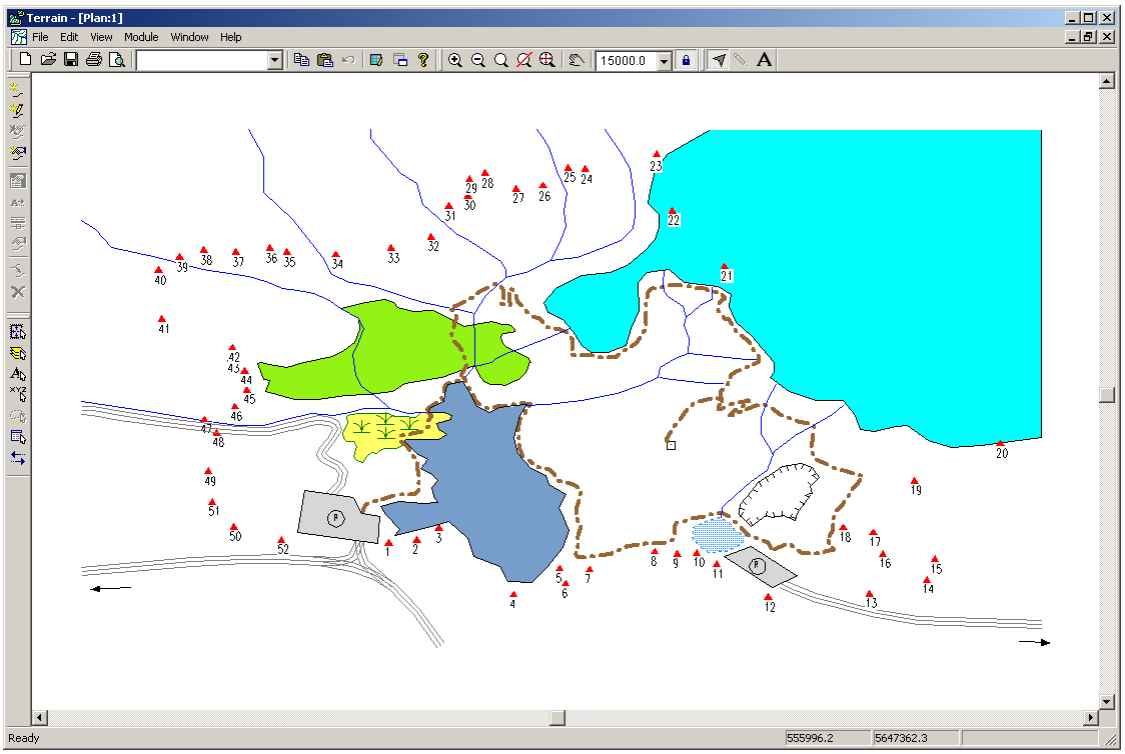


Figure 3.1: ***Park map.ter***

4. Choose menu *View* | *Active Window (Plan) Options* and select the *General* tab. Change the scale back to **15000**. Enable *labels* checkbox and press OK.

5. Change the scale back to **25000** in the toolbar. Notice the label sizes have remained the same but the map features have become smaller. Change the scale back to **15000** in the toolbar.

Note: Changing scales adjusts the size of map features. Labels, line-types and symbols are not adjusted and remain the same size. When creating a drawing, it is important to set the scale to the required output scale before making adjustments to label positions.

Note: Zooming functions magnify (or shrink) the entire drawing including labels, symbols and line-types when the *lock scale* button is depressed or locked. When it is not depressed the scale will change but the labels, symbols and line-types will stay the same size.

6. With the *lock scale* button depressed, click on the *Magnification Double* and *Magnification Half* buttons several times. Notice that the label and line sizes change but the scale remains the same.

7. Turn off the *Lock Scale* button Repeat the above step. Notice that with *Magnification Double* the scale halves and with *Magnification Half* the scale doubles. Labels and line-types stay the same size as the scale changes.

8. *File* | *New* to close **park map.ter** and continue to the next example or *File* | *Exit* to leave program. Do not save any changes.

Drawing Features

Drawing Features Using the Mouse – Method One

There are three modes used to create and edit points on a feature.

Entry mode – New points are inserted at either end of the current feature.

Insert mode+ - New points are inserted in between existing points.

Edit mode- Existing points are edited.

This example demonstrates basic drawing operations using the mouse. Edit  and entry modes  will be used to draw and modify a feature.

9. *File*|*Open* <Terrain>\Cad\drawing.ter.

Note: Terrain Recreational users may get the message “Non Permitted Functions Found in File”. If this message appears choose “Keep all file functions and revert to DEMO Mode”.

Your screen should look similar to the figure below.

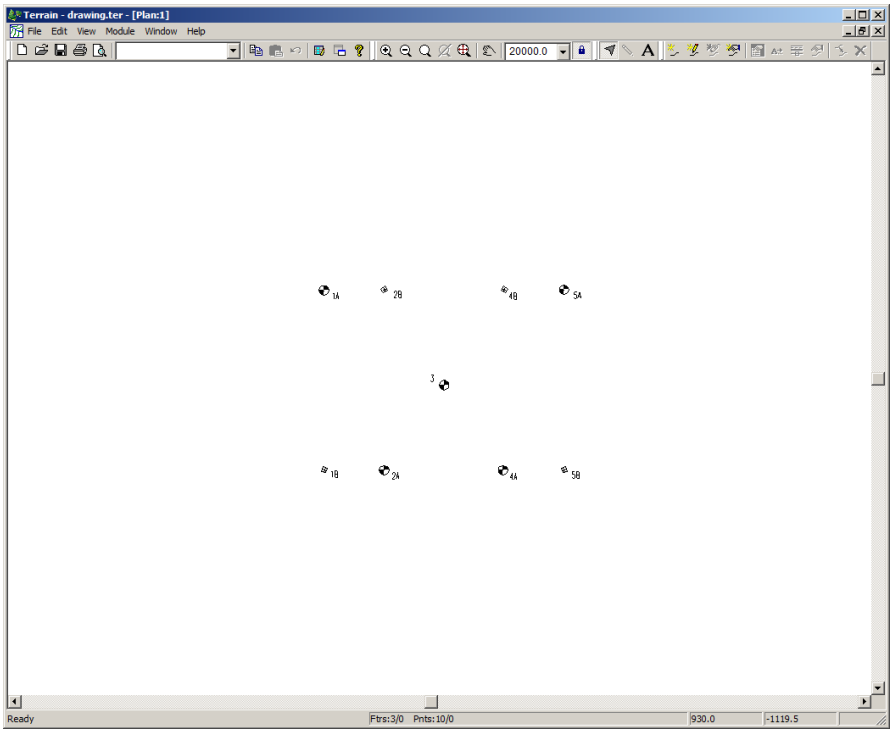


Figure 3.2: ***Drawing.ter***

10. Press the *Draw New Feature* button from the tool bar.

The Entry mode cursor appears in the Plan Window indicating that a mouse click will create the first point of your new feature. The menu *Edit-New Feature* provides an alternate method.

11. Left click (mouse down/up) anywhere in the Plan window.

A new point is created and the cursor changes to a cross. The red cross-hair representing the position of the new point is tied to the mouse – we say the point is *captured*.

12. Locate the symbol labeled "1A"; move your mouse cursor over it.

Notice that the snap cursor appears. Snap options are available in the Plan window options, *General* tab (right click select menu *Active Window (Plan) Options*).

13. Left click again to snap to "1A" and to *anchor* the point.

Now we have a feature with one point; it is the *selected* feature and the *current point* (red cross).

14. Create another point and snap to "2A":
15. Left click anywhere in the Plan window (except on the current point).
16. Locate the symbol labeled "2A", and left click once in the middle of the symbol. This will attach point "1A" to the cursor by a rubber band line.

17. Left click again and the cross-hairs will anchor to the symbol labeled “2A”. This is now the current point of the current feature. The current feature is the line segment that attaches “1A” and “2A”.

Note: To undo any point, select *Edit* | *Undo Add Point*

18. Locate the symbol labeled “4A”. Left click once in the middle of the symbol.

Your screen should now look like the figure below.

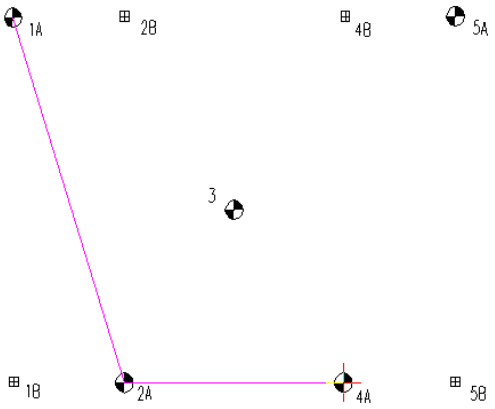


Figure 3.3: Drawing with the mouse

19. Move the cursor over the line segment between 2A and 4A. Notice the cursor changes to the insert cursor

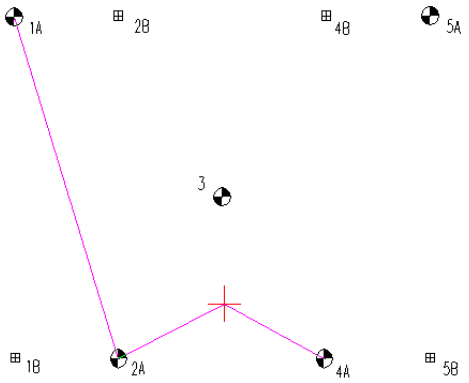


Figure 3.4: Inserting a Point at the End of a Segment

20. Left click on the line segment between 2A and 4A. Drag to point 3, and left click to anchor the new point.

21. Move the cursor over the point labeled 5A and left click twice to add a new point.

You should now see a 'W' as shown in the figure below.

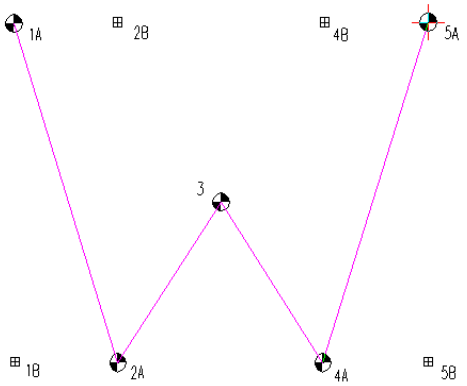


Figure 3.5: Completed W

22. Move the Entry mode cursor over "1A". The entry mode cursor changes to edit point mode and the Edit cursor now appears over 1A.
23. Left click over symbol "1A", the cursor will attach to the line segment.
24. Move the Edit cursor over symbol "1B" and left click again. This will attach the line segment to this point.
25. Repeat the above steps moving points "2A to 2B, 4A to 4B, and 5A to 5B.

The W has changed to an M as shown in the figure below.

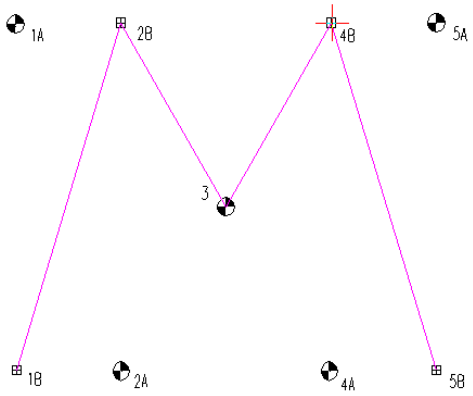


Figure 3.6: Completed M

26. *File*| *New* to continue to the next tutorial or *File* | *Exit* to leave the program. Do not save changes

Note: When a point is captured it can be released by pressing the <Esc> key and deleted by pressing the <Delete> key. If the point is anchored and the <delete> key is pressed the entire feature will be deleted.

Drawing Features Using the Mouse and Keyboard – Method Two

This example demonstrates an easier method to draw a new feature using the mouse.

1. *File* | *Open* **<Terrain>\Cad\park map.ter**. Click on the *maximize* button in the upper right corner of the Plan:1 Window.

Note: Terrain Recreational users may get the message "Non Permitted Functions Found in File". If this message appears choose "Keep all functions and revert to DEMO Mode".

The Plan Window now displays triangular symbols with index stations 1 to 54. These index stations are surveyed points along the boundary. The following steps demonstrate how to trace the park boundary by "connecting the dots".

Note: If *Snap to Point/line* is selected (View | Active Window (Plan) Options | General Tab) when a new point is created or an existing point is edited, the nearest point on an adjacent feature is also selected provided that it is within a minimum distance (2 mm).

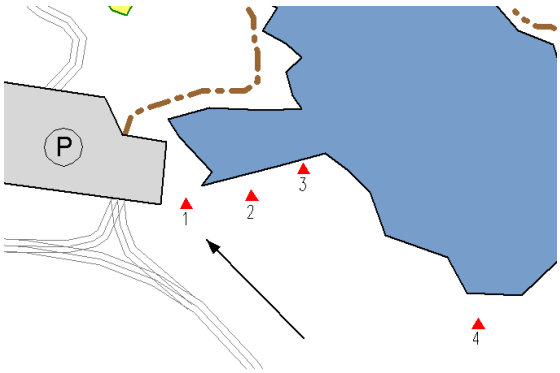


Figure 3.7: Boundary starting point

2. Press the *Draw New Feature* button. Position the cursor over the center of station 1 (indicated with the arrow in the figure above) and press the number 5 key on the number pad or if your computer does not have a number pad use the letter S. A new point should be created at the cursor position. If this does not happen, check that *Num Lock* on the keyboard is on.
3. Move the cursor to Station 2 and press the 5 key on the number pad (or S Key). A new point will be created at the cursor position. Continue adding points around the boundary until it is closed. In case of a mistake use the edit function as described below to correct the problem.

Note: To change the location of an anchored point, move the entry cursor over the desired point until the cursor changes to the edit cursor and left click. Once the point is captured press the <Delete> key to delete the point. Pressing the <Esc> key will restore the point to its previous location provided that the new point has not already been anchored. If the point needs to restored even after anchoring, use the Edit | Undo function

If you have created a new feature with elevations (Edit | New Feature – elevations selected), it is possible to enter elevations using the following key definitions.

5 or S	Same elevation as previous point. This may be overridden by Snap To Point including Z.
8 or U	Up 1 contour interval. This may be overridden by Snap To Point including Z.
2 or D	Down one contour interval. This may be overridden by Snap To Point including Z.
Ins or E	Manually enter co-ordinates including elevation

4. *File* | *New*. Do not save changes.

Selecting Features

A feature is a collection of points such as a contour line, a lake boundary or a single spot elevation point. Bitmap images are also considered to be features (in this case the corners of the bitmap are the feature points).

A *Terrain document* is a collection of features. Each feature has a unique name consisting of an 8 character *Alphanumeric Id* portion and a *Numeric Id* example ROAD-21. It is possible to have more than 1 feature with the same Alphanumeric ID such as STREAM-1, STREAM-2 etc.

Note: Feature names are not case sensitive "F1" = "f1".

The next several examples demonstrate how to select features by layer, name, range, property, boundary, or by using the mouse.

Selecting Individual Features with the Mouse

1. File | *Open* <Terrain>\Cad\park map.ter. Press open.

Note: Terrain Recreational users may get the message “Non Permitted Functions Found in File”. If this message appears choose “Keep all functions and revert to DEMO Mode”.

2. Move the Selection cursor , over one of the stream features in the Plan Window and left click with the mouse. The stream feature should change color from blue to magenta (indicating that it is selected). Notice in the lower right corner the Name of the feature is displayed (STREAMCx-xx).
3. Select another feature. Notice when a new feature is selected, the previous feature is de-selected. The information in the Status window also changes to reflect that of the new feature.

Selecting Groups of Features with the Mouse

4. Hold down the <Shift key> and left click on a new feature. Notice that the previous feature remains selected. Use this technique to select several more features.

5. With several features selected, press the delete key on the keyboard or press the *Delete* button. The features are deleted and disappear. Press Edit | Undo Delete and the features reappear.
6. Left mouse click in any blank area on screen to de-select all features.
7. Depress the left mouse button and move the mouse any direction. Notice a rectangle is formed from the position where the mouse was first clicked. Release the left button. All features inside (or crossing) the rectangle are now selected.
8. Hold down the <Shift key> and left click on one of the selected features. This feature is de-selected and the other features remain selected.
9. Left mouse click in any blank area on screen to de-select all features.

Selecting All Features

10. *Edit*|*Select Feature(s)*|*All* or press the *Select All* button. All features are now selected (magenta).

Inverting Selection

11. Hold the <shift> key down and de-select one of the features
12. Select *Edit*|*Select Feature(s)*|*Invert Selection* or press the *Invert Selection* button, feature(s) previously selected are now un-selected and all feature(s) previously un-selected are now selected. In this case one feature will be selected and the rest will be de-selected.
13. Proceed to Step #2 in Selecting by Layer or exit the program by selecting *File*| *Exit*. Do not save any changes

Note: One of the selected features contains a red cross-hair. This indicates the *current point.* The feature containing the *current point* is the *current feature.* Information about the current feature and current point are displayed in the Status Window.

Note: Most operations in the Terrain Module apply to a selected set of features or points such as formatting, moving, deleting etc.

Selecting Features By Name

14. *File* | *Open* <Terrain>\Cad\park map.ter.

Note: Terrain Recreational users may get the message "Non Permitted Functions Found in File". If this message appears choose "Keep all functions and revert to DEMO Mode".

If you are continuing from the previous example, select Edit | Undo Delete. Left click in any blank area to de-select all features.

15. Edit | Select Feature(s) |B y Name or press the Select By Name button.
16. Press the *Advanced* button. Type "SURVEY" in the *Select Matching Names* area as shown below. Press the *Select* button in the *Select Matching Names* area. Press OK.

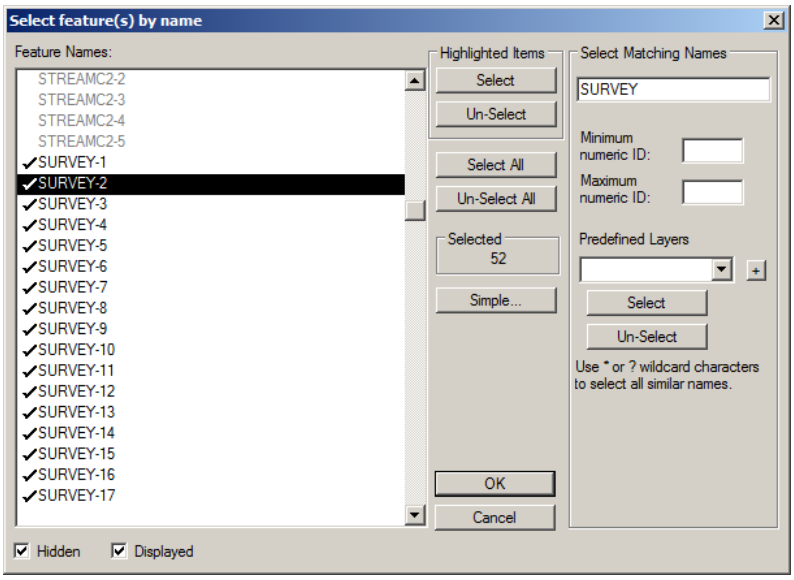


Figure 3.8: Select feature(s) by name dialogue

A number of triangle features are selected and highlighted in magenta. All of these features have the name SURVEY. See figure below.

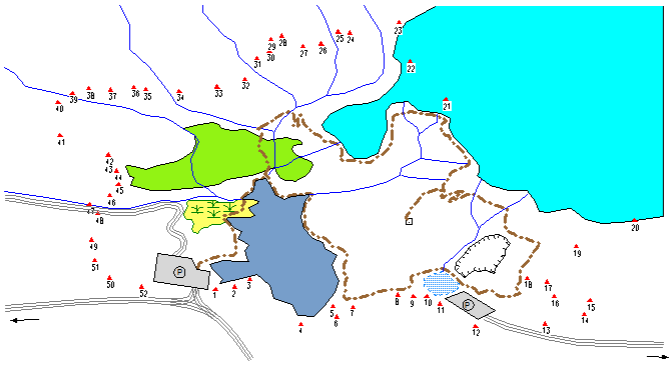


Figure 3.9: Triangle features highlighted in magenta

17. *File* | *New*. Do not save any changes.

Selecting Features by Layer

Each feature has a unique ID. This name can be used to organize a map into different layers. For instance, in Park Map all Class 1 streams have been named STREAMC1 and Class 2 streams as STREAMC2. These names can be quickly used to select all Class 1 streams, Class 2 streams, or all streams.

1. *File*|*Open* <Terrain>\Cad\park map.ter.

Note: Terrain Recreational users may get the message "Non Permitted Functions Found in File". If this message appears choose "Keep all functions and revert to DEMO Mode".

2. Edit | Select Feature(s) | By Layer or press the Select By Layer button to open the Select Features by Layer dialogue box.

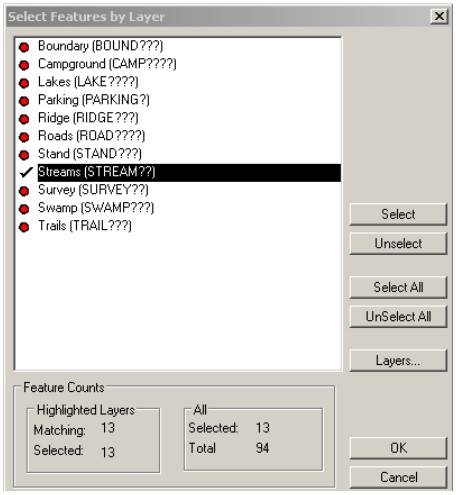


Figure 3.10: Select features by layer *dialogue*

3. Press the *Un-Select All* button to de-select all features.
4. Select *Streams* in the list-box and then press the *Select* button. The information in the *Feature Counts* changes indicating that 13 of the 94 features are streams. Press OK to return to the main screen. The 13 selected streams are highlighted in magenta.

Note: Features can also be selected or de-selected by double clicking with the left mouse when the cursor is over the feature name in the dialogue box.

5. To create a new layer for the Class 1 streams, press the *Select By Layer* button or *Edit | Select Features | By Layer* to activate the S*elect Features by Layer* Dialogue Box. Click on the *Layers* button to activate the *Layers* dialogue box.

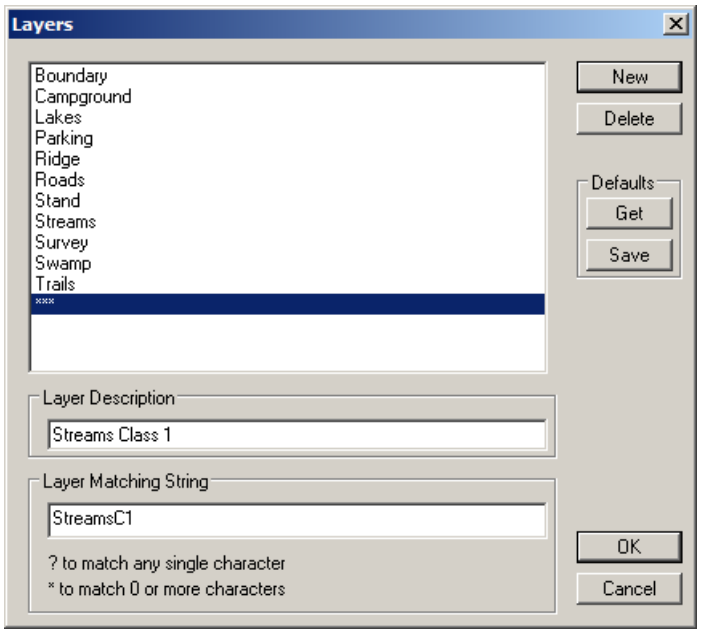


Figure 3.11: Add/Remove layers dialogue

6. Press the *New* button. Type in the *Layer Description* field "Stream Class 1". Type in STREAMC1 into the *Layer Matching String*. Press OK to return to the *Select Features by Layer dialogue*. Note that the new Layer Stream Class 1 has been added

7. Press the *Un-Select All* button to de-select all features. Select *Streams Class 1* in the list-box and press the *Select* button to select all Class 1 stream features. Look at the Streams item. Note the grey check mark beside Streams. This indicates that only part of the STREAM layer has been selected. Press OK to return to the main screen.

The following steps demonstrate how to turn off the display of all features except the STREAMS.

8. *Edit* | *Select Features* | *By Layer* or press the *Select By Layer* button to activate the S*elect Features by Layer Dialogue Box*. Press the *Unselect All* button to un-select all features. Highlight *Streams* in the list-box and press the *Select* button to select them. Press OK.

9. *Edit* | *Select Features* | *Invert Selection*. This will this will switch the selected and unselected features so that all features are now selected except the streams features.

10. *Edit* | *Modify Selected Feature(s)* | *Properties* or press the *Properties* button in the toolbar. Turn off the *Displayed check box.* Press OK to return to the main screen.

Note: All the features are still displayed. Click on a blank area of the screen (where there are no features) to de-select all features.

11. If the highlighted features still remain, press the *Refresh* button to redraw the entire screen (removes the highlighted features). Notice that only the streams are displayed. If the *Refresh* button is not visible, select *View* | *Toolbar* | *Navigation Tools* and the Refresh button will become visible.

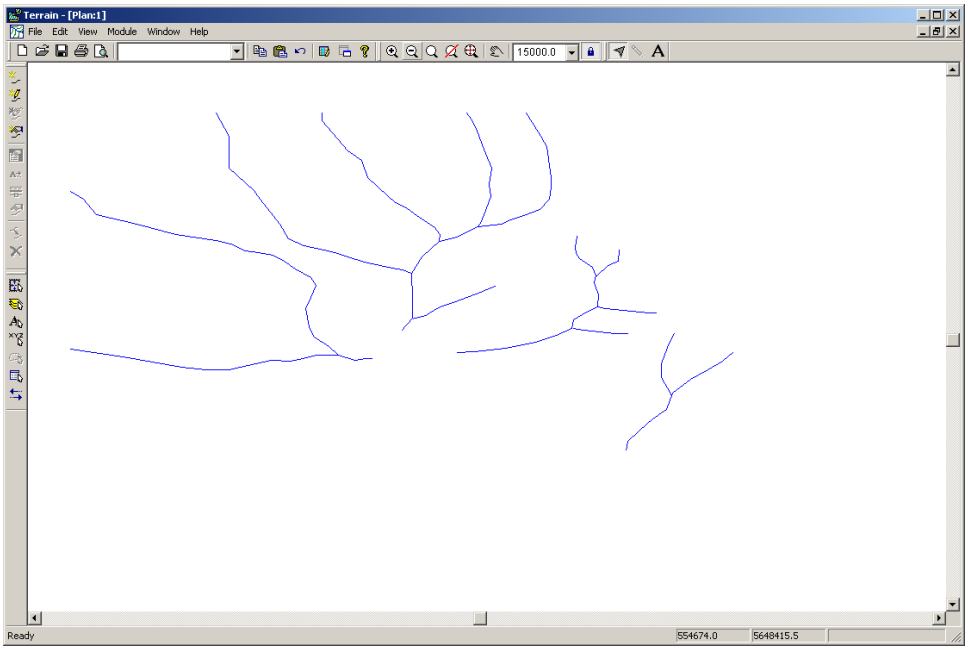


Figure 3.12: Streams layer

12. *File* | *New*. Do not save any changes.

Line-types

1. *File*|*Open* **<Terrain>\Cad\park map.ter**. Click on the *maximize* button in the upper right corner of the Plan:1 Window.

Note: Terrain Recreational users may get the message "Non Permitted Functions Found in File". If this message appears choose "Keep all functions and revert to DEMO Mode".

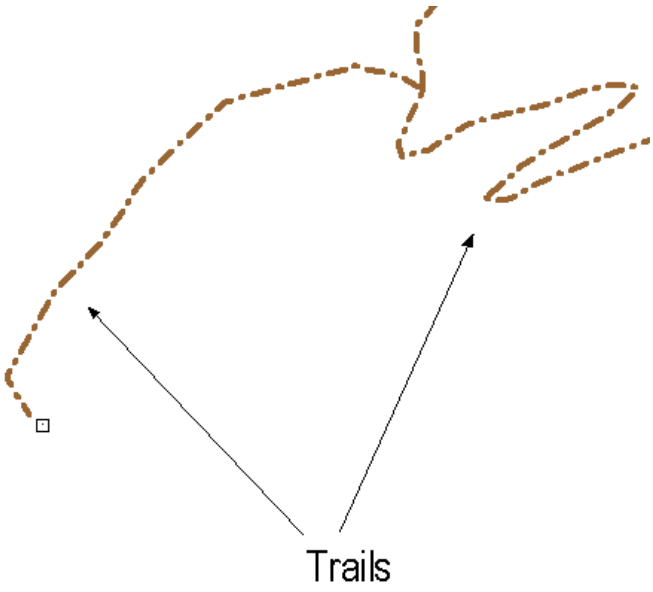


Figure 3.13: ***park map.ter***

2. Dashed lines identify the trails in Park Map (see figure above). Hold down the <Shift> key, then with the *Select* cursor left click on each of the trails. Use zoom and screen scrolling to see all of the trails.

If a wrong feature is accidentally selected, de-select by clicking again on the same feature with the shift key still depressed. To start again left click in a blank area to de-select all features.

The trails could also have been selected by either pressing the *Select By Name* button or selecting menu *Edit* | *Select Feature(s)* | *By Name*.

3. *Edit*|*Modify Selected Feature(s)*/*Line-types, Symbols* or press the *Line style* button to activate the *Plan Window Feature Formatting* dialogue box as shown in the figure below.

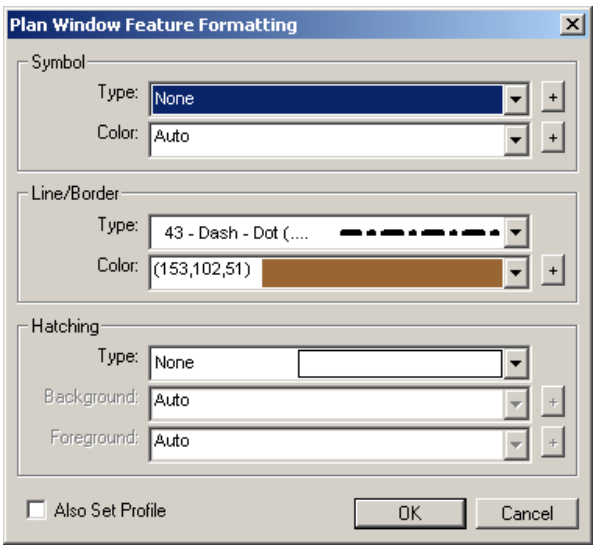


Figure 3.14: Line-types and symbols dialogue

4. Change the line-type: from 43 Dash Dot to 44 - Dash x 2 (narrow). Press OK. Left click anywhere in the Plan Window to de-select trails.

5. Proceed to step #2 in Adding Symbols *or* *File*|*New* to exit the program. Do not save changes.

Symbols

Park Map Example

1. *File*|*Open* **<Terrain>\Cad\park map.ter**. Click on the *maximize* button in the upper right corner of the Plan: 1 Window. If continuing from the previous example, left click in a blank area to de-select all features.

Note: Terrain Recreational users may get the message "Non Permitted Functions Found in File". If this message appears choose "Keep all functions and revert to DEMO Mode".

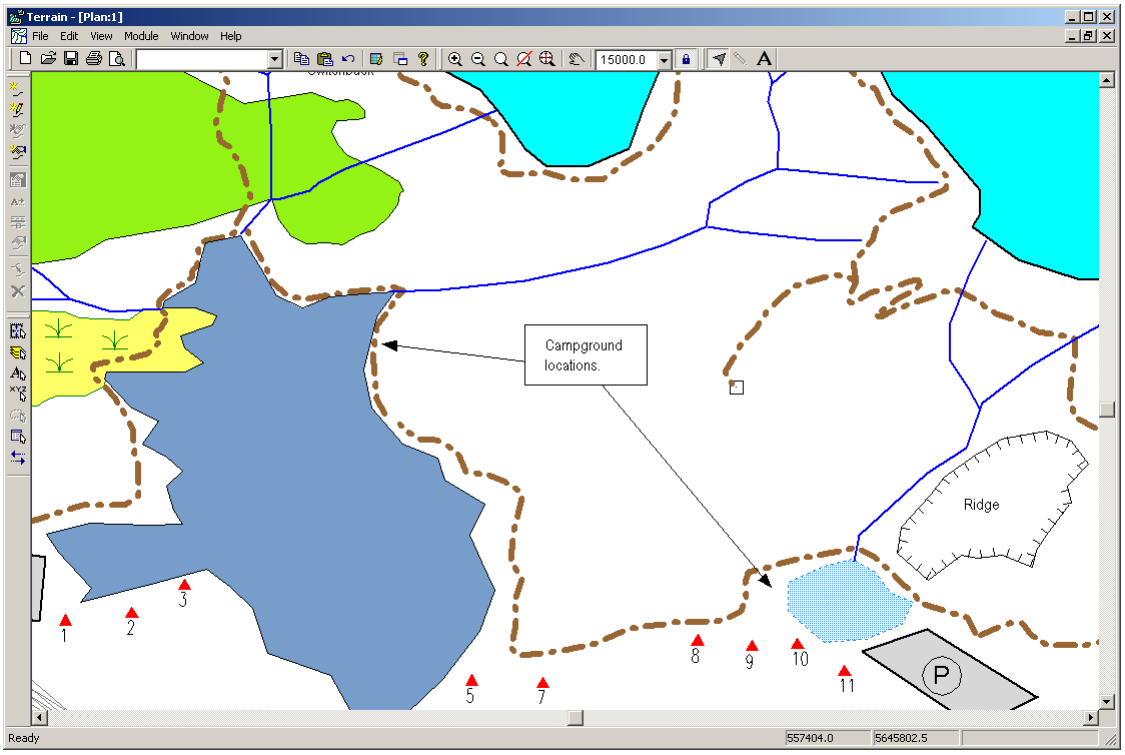


Figure 3.15: Campground locations

2. *Edit* | *New Feature* to activate the *Feature Properties* dialogue box. Select CAMP from the *Name drop down box*. Turn off *Elevations* and *Modeled* as shown in the figure below. Press the *Mouse* button.

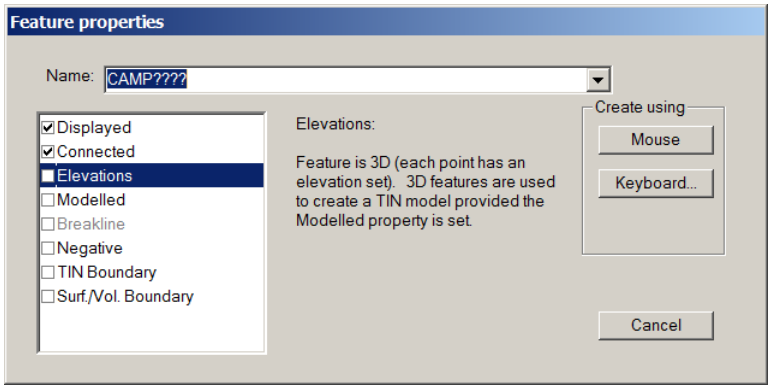


Figure 3.16: New feature properties *dialogue*

3. Move the cursor to one of the campground locations as indicated by the two arrowheads in Figure 3.15 and press the left mouse once to create (and capture) a new point. Left click again to anchor the new point.
4. *Edit* | *Modify Current Point(s)* | *Symbols* and choose *Campground* for the symbol. Press OK to return to the main window.

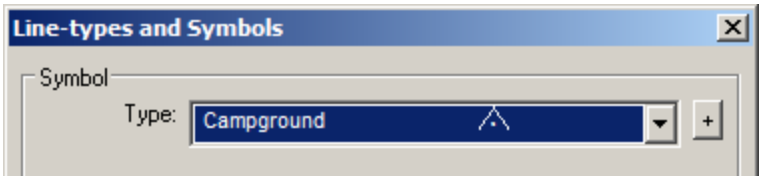


Figure 3.17: Campground symbol selection dialogue

5. Press the *Refresh* button to redraw the entire screen.

A campground symbol has now been created. The following steps will duplicate this symbol at the other campground locations.

6. With the campground symbol still selected, press <Ctrl +C> or press the *Copy* button to copy it. These are shortcuts for menu Edit | Copy.
7. Press <Ctrl +V> or press the *Paste* button to paste the symbol.
8. Press <Ctrl +M> or select *Edit* | *Modify Selected Feature(s)* | *Move/Size* and a rectangle should appear around the campground symbol.
9. Move the cursor inside the rectangle. The cursor should change its' shape to a 4 sided arrow. Left click and drag the copied symbol to the other location.
10. Press the *Refresh* button to redraw the entire screen.

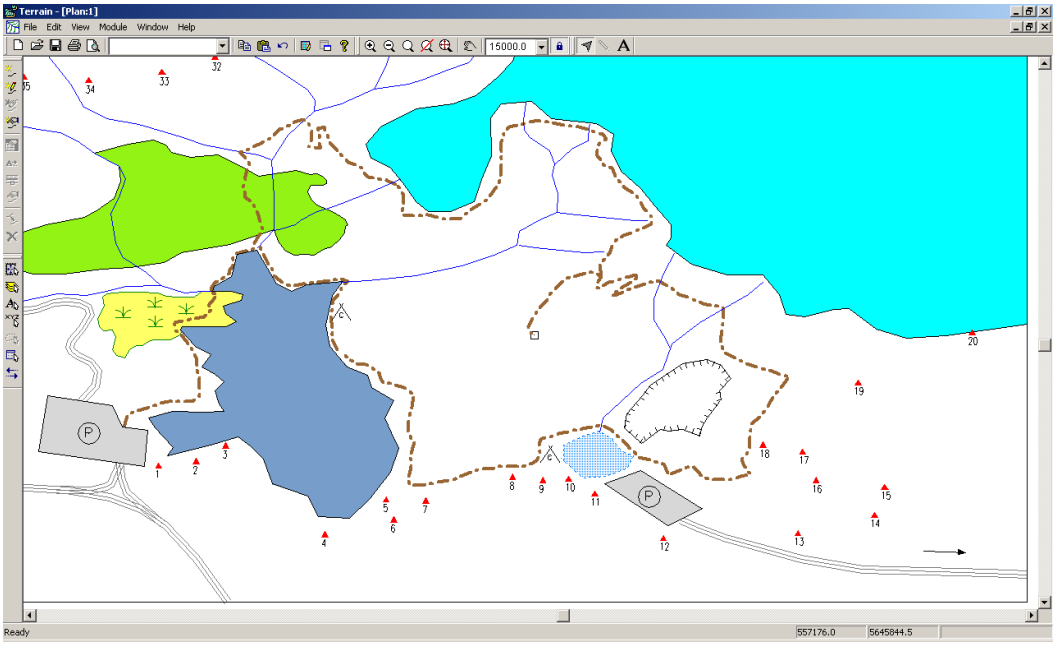


Figure 3.18: Park example with campground symbols

11. Proceed to Step #2 of the next example or exit the program by selecting *File*|*New*. Do not save changes

Creating a Boundary Polygon

To do this example the *Mapping and Drafting, Import Basic and Export Basic Enhanced Mapping and Drafting* must be enabled. See *Function Groups* in the On-line help for more information

1. *File*|*Open* **<Terrain>\ Cad \park map.ter**. If continuing from the previous example, left mouse click in a blank screen area to de-select campgrounds.

Note: Terrain Recreational users may get the message "Non Permitted Functions Found in File". If this message appears choose "Keep all functions and revert to DEMO Mode".

2. Edit|Select Feature(s)|By Name or press the Select By Name button.

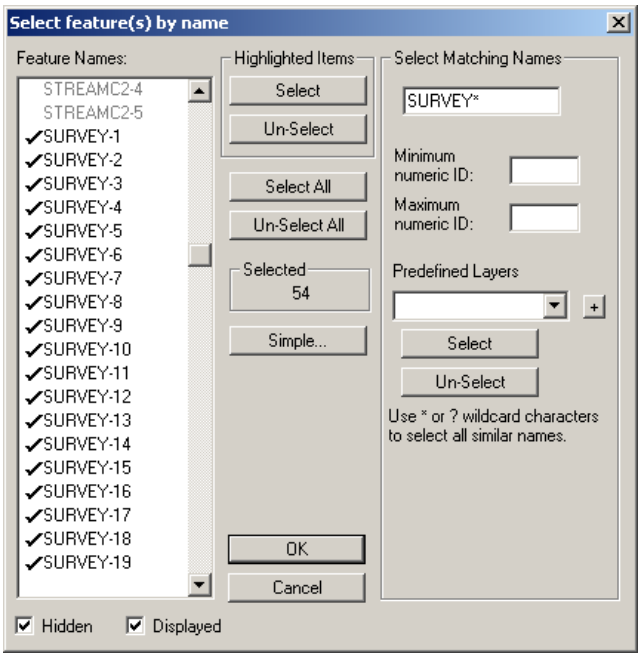


Figure 3.19: Select feature(s) by name *dialogue*

3. Press the *Advanced* button and type **SURVEY*** into the *Select Matching Names* area as shown in the figure above. Press the *Select* button in the *Select Matching Names* area. Press OK. A number of triangle features are selected. All of these features have the name SURVEY.

4. Press the *Properties*  button in the toolbar or *Edit* | *Modify Selected Feature(s)* | *Properties*. Turn *Connected* on. Press OK.

5. *Edit*|*Modify Selected Feature(s)*|*Join*. All the selected features will be joined.

6. Press the *Line style*  button to activate the *Plan Window Feature Formatting* dialogue box. Change the *Line-type* to *5-thick (medium*) and change the Symbol to *None.* Press OK

7. *Edit*|*Modify Selected Feature(s)*|*Close*. The boundary will close and the map should look like the figure below.

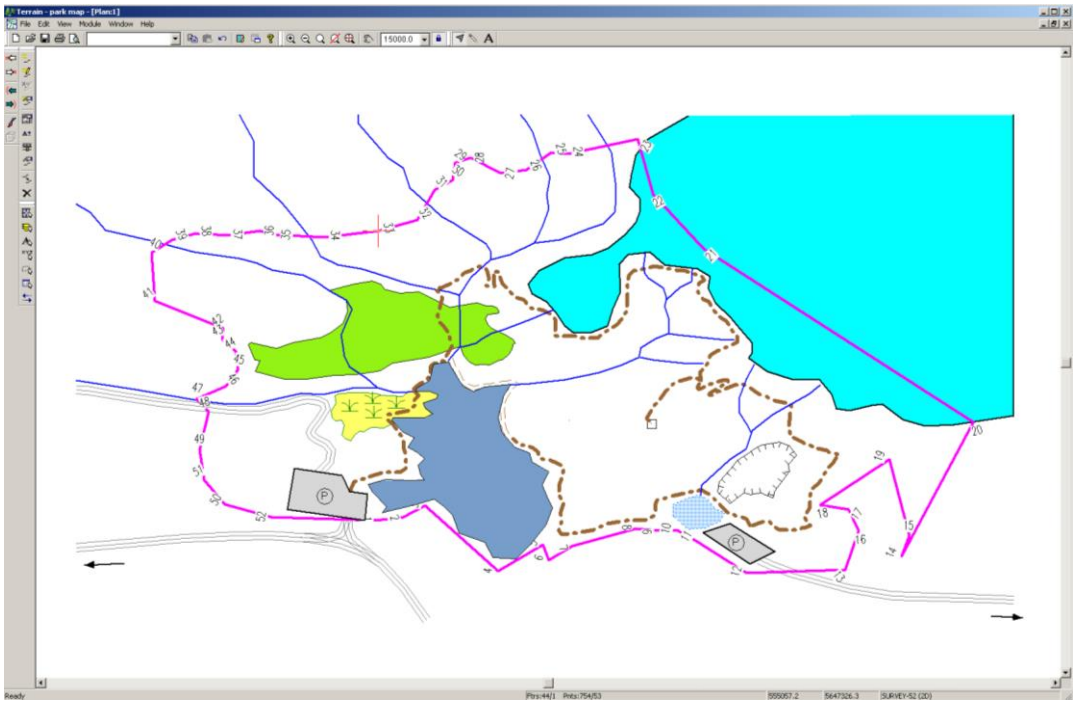


Figure 3.20: Park Boundary

Labels

There are two types of labels used in the Terrain Module, *Automatic labels* and *Floating Labels*.

> ***Feature Labels*** are labels associated with a feature. *Elevation*, *Azimuth*, and *Distance* are all examples of automatic labels. Point or feature attributes such as *Comments*, *Date*, *Point Numbers* etc. are Feature Labels. Whenever a feature is edited or deleted feature labels are modified accordingly.
>
> ***Floating Labels*** are simply user-defined text. They do not depend on any feature and can be placed anywhere and modified directly.

The default characteristics (position, font, size, orientation etc.) for each label class is controlled by window type (Plan, Profile etc.). For the Plan Window these defaults are set in menu *View | Active Window (Plan) Options* dialogue box, *Labels* tab .

8. *View | Active Window (Plan) Options | Label* tab. Turn on *Floating Labels (not attached to a feature)* by double clicking on it in the list box or by highlighting *Floating Labels (not attached to a feature)* and turning on the Display check box (See Figure 3.21 below). Press *OK* to return to the main screen. The Plan Window will now look like Figure 3.22 below.

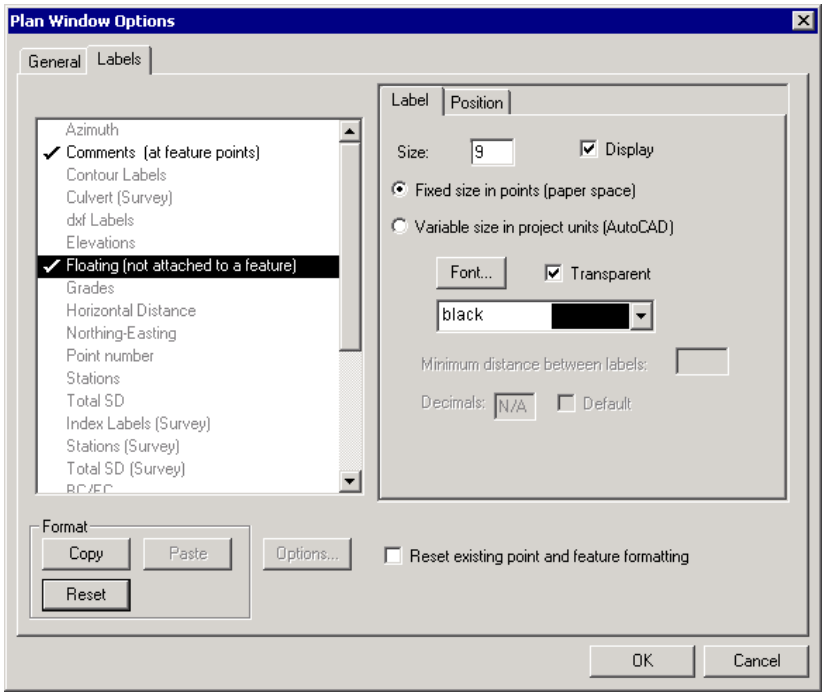


Figure 3.21: Plan window options- default label format

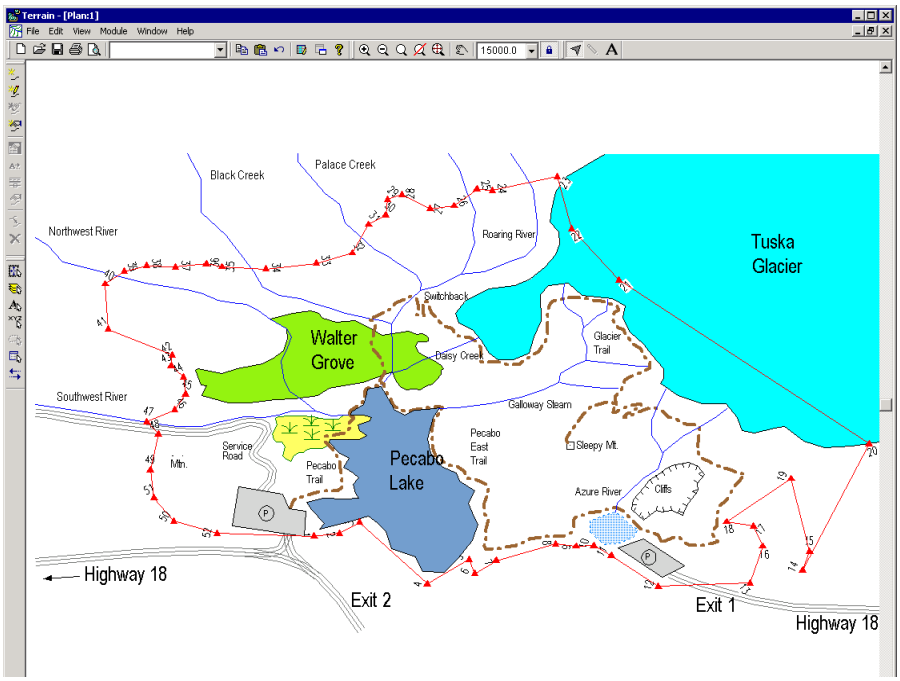


Figure 3.22: Plan window with floating labels

It is often useful to override the default label positioning for individual features. For instance you may wish to turn on or off a certain class of labels for a specific feature. Label control of individual features is done using menu *Edit | Modify Selected Features | Labels*. We will use this function to turn off the labels in our boundary.

9. Highlight the park boundary with the Selection cursor.
10. *Edit | Modify Selected Features | Labels*. Turn off the display of *Comments (at feature points)* by double clicking in the list box or turning off the check box adjacent to Display.
11. Click the *Reset all existing point and feature formatting* checkbox. Press OK and answer "Yes" to the prompt "Do you wish to reset point formatting?"

We will now add a floating label to our park map.

12. Click on the *Label Edit* button to initiate *Label Edit mode*.
13. With the cursor click on upper left corner of the map and enter the text ("Park Boundary"). See figure below.

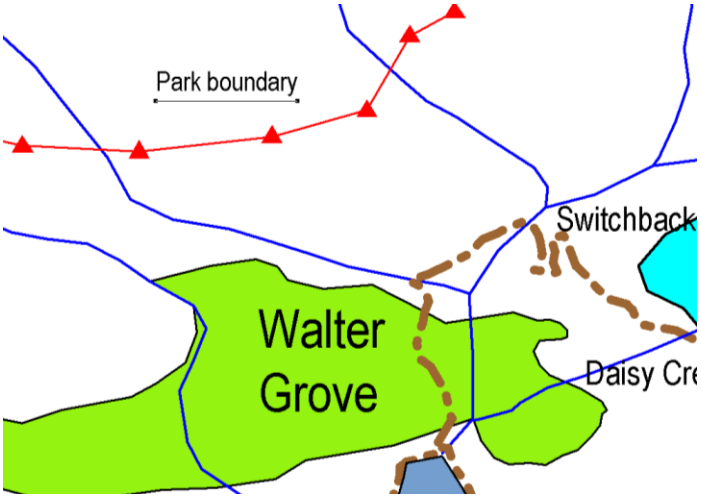


Figure 3.23: Plan window feature formatting dialogue box

Note: The is referred to as the *Orientation handle* and the , is referred to as the *Position Handle.*

To move the position of a label, move the cursor over the *Position Handle* (or any part of the label). Left click and drag the label to a new location and release.

To rotate a label, move the cursor over the *Orientation Handle*. Left click and pivot the label to the preferred position and release the left mouse when in the correct position.

Hatching

To complete the example hatching will be used to shade the park area.

14. Highlight the park boundary with the Selection cursor.

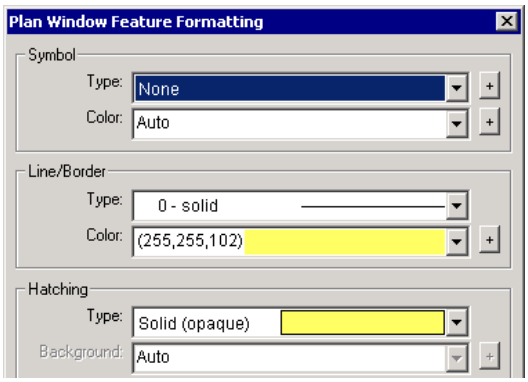


Figure 3.24: Plan window feature formatting dialog box.

15. Edit | Modify Selected Feature(s) | Line-types, Symbols.
    - Set Symbols to None,
    - Line/Border color to Yellow (255,255,102)
    - Hatching to Solid (opaque). Press OK.

Note: (*255,255,102*) is a notation for Red, Green, Blue values. It is possible to create any color (supported by a graphics card) by clicking on the + button beside the color combo box and entering an RGB value.

16. With the boundary still selected, choose menu Edit | Modify Selected Feature(s) | Shuffle Display Order | Shuffle to back.

At this point your map should look similar to the figure below. You may need to refresh or move your center wheel to see the changes.

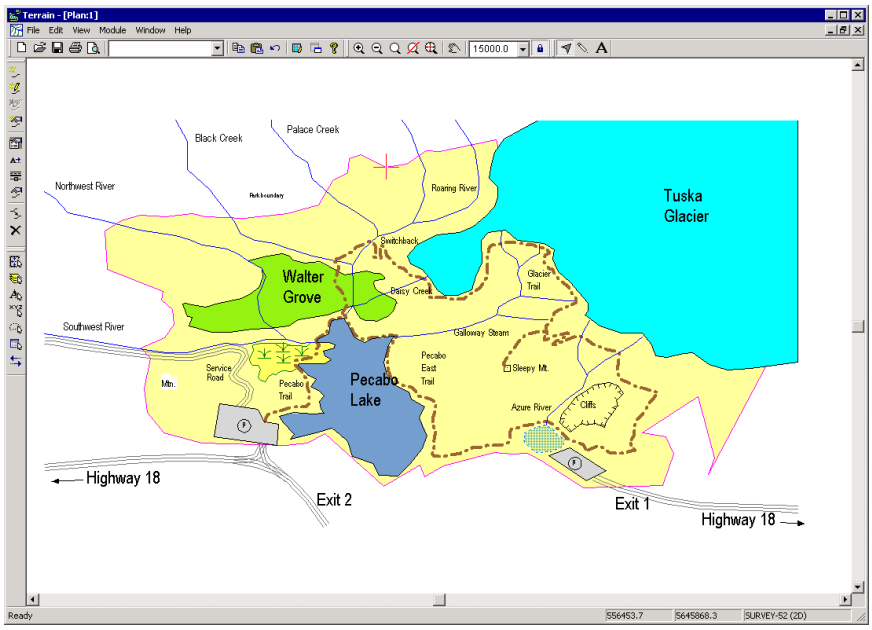


Figure 3.25: Map with shaded boundary polygon

17. *File*| *New*. Do not save changes.

Creating an Output Sheet

Park Map Example

This example is intended to familiarize you with the Multi-plot functions for creating an output sheet.

1. *File* | *Open*. Select **<Terrain>\Cad\park map II.ter**. Press Open.

Note: Terrain Recreational users may get the message "Non Permitted Functions Found in File". If this message appears choose "Keep all functions and revert to DEMO Mode".

2. Go to *File*|*Printer Setup*. Ensure the printer is setup for letter size (21.59 x 27.94 cm or 8.5 x 11 in) and Orientation is Landscape.

Note: The Multi-Plot output setup depends on the paper size of your default printer.

3. *Window*| *New Window*|*Multi-Plot*, a blank multi-plot page will appear. Click on the *maximize* button in the upper right corner of the Multi-Plot Window.
4. Right click and select M*ulti-plot Options*. Check *Snap to grid* and *Show Grid* and set the *Spacing* to 5.00 as in the4 figure below. Press OK.

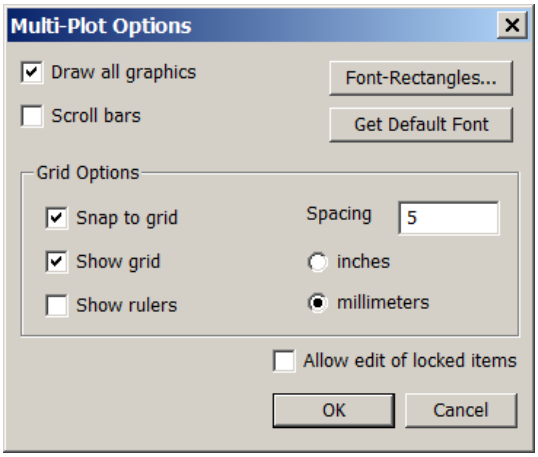


Figure 3.26: Multi-plot Options

A Multi-plot sheet consists of a series of *Sub-views* such as plans, profiles, legends, images, title blocks etc.

5. *Edit*|*New Sub-View*| *Plan: 1*. A Plan Sub-View will appear in the middle of your multi-plot sheet.

Notice that there are 8 handles that you can click and drag to change the size of the Sub-View. Click and drag anywhere else on the Plan Sub-View to move it. The <Delete> key will remove the selected Sub-View(s).

6. Resize and reposition the Plan Sub-View until it appears approximately in the top 2/3 of the output sheet (see Figure 3.28 below).

7. To center the map in the Plan Window, press <Shift + left arrow >. A prompt as shown in Figure 3.27 will appear. Press OK and continue manually controlling the position of the Plan window using the <Shift + arrow> keys.

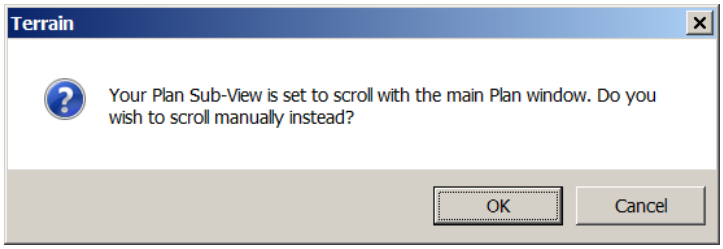


Figure 3.27: Plan Window Sub-view Manual Scrolling Prompt

Note: Positioning the map inside the Plan Window can be done using the <Shift + arrow> keys. By default, the Plan Sub-View scrolls with the main Plan Window (menu Plan:1).

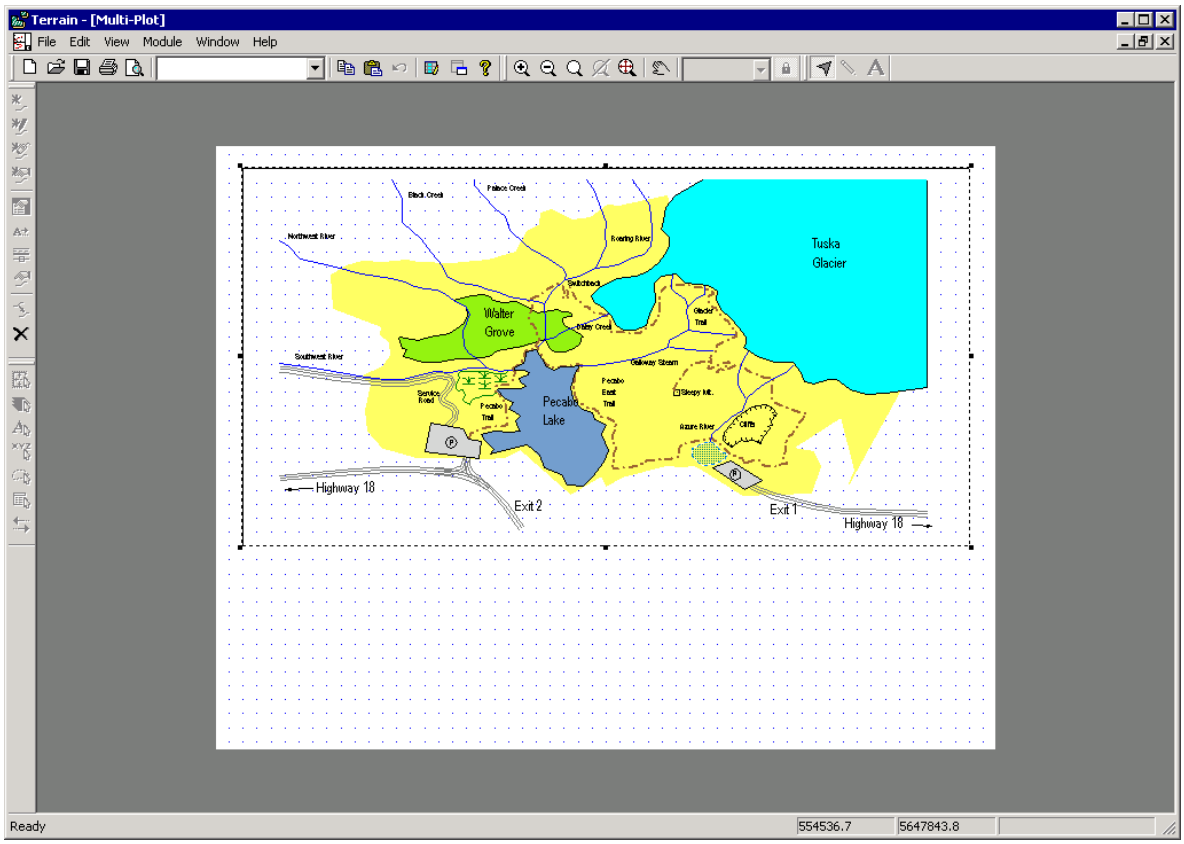


*Figure 3.28: Multi-Plot plan sub-view of **plan1.ter***

Adding a Legend and Scale Bar

8. *Edit*|*New Sub-View*|*Legend*. A legend will appear in the middle of your multi-plot sheet.
9. *View*|*Multi-Plot Sub-View Options*, to activate the Legend Sub-view Options dialogue box or double click on the Legend sub-view will also activate this dialogue box.

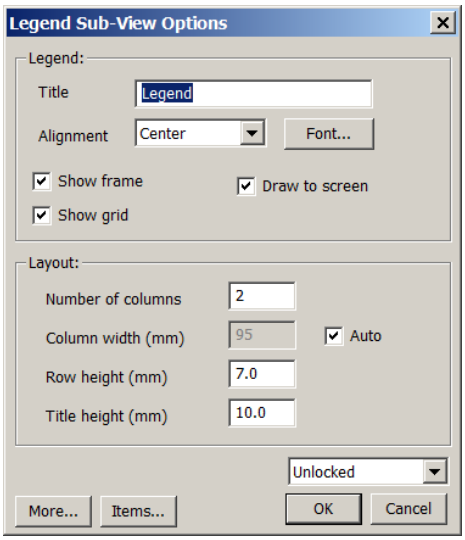


Figure 3.29: Legend sub-view options *dialogue*

Note: When the *Auto* check box is enabled, the window frame size determines the width of the column. The frame can be made smaller or larger by clicking and dragging on any of the eight handles. If you disable the *Auto* option, the column width can be changed manually.

10. Configure the Legend Sub-view Options dialogue box as shown in the figure above.

Note: When the Legend Sub-view is created, the current file is searched to find all distinct symbols, line-types, and hatch types. These items are included in the default legend along with their associated feature name.

11. To modify the legend entries, press the Items button. Delete all line-types that do not appear in the figure below. Change the descriptions to match the items on the right. Do this by clicking on the desired list item and then changing the Description in the Current item area. Press OK to close dialogue boxes.

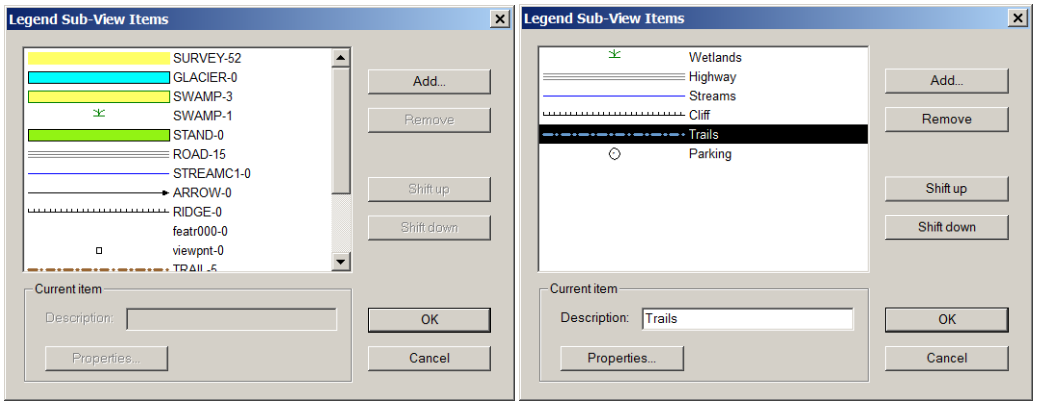


Figure 3.30: Legend sub-view options dialogue

12. Re-size and re-position the legend directly below the plan sub-view and on the left side of the page as shown in Figure 3.32.

13. *Edit*|*New Sub-View*|*Scale Bar*, a scale bar will appear in the middle of your multi-plot sheet.

14. *View | Multi-Plot Sub-View Options* or double click on the scale bar to activate the Scale Bar Sub-view options dialogue box.

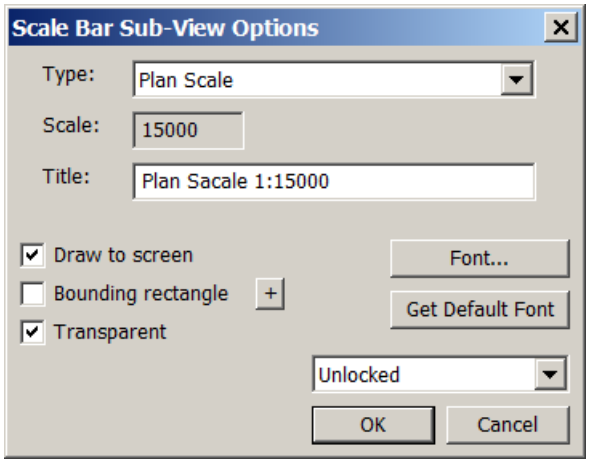


Figure 3.31: Scale bar sub-view options dialogue

15. Type in the *Title:* **Plan Scale 1:15000** as shown above and press OK.

16. Re-size and re-position the scale bar inside the Plan sub-view. If you click on the Plan Sub-View by mistake the scale bar will be shuffled to the back and you will no longer be able to move or size it with the mouse; use the *Edit /Shuffle Front To Back* menu to correct this or use Ctrl +K.

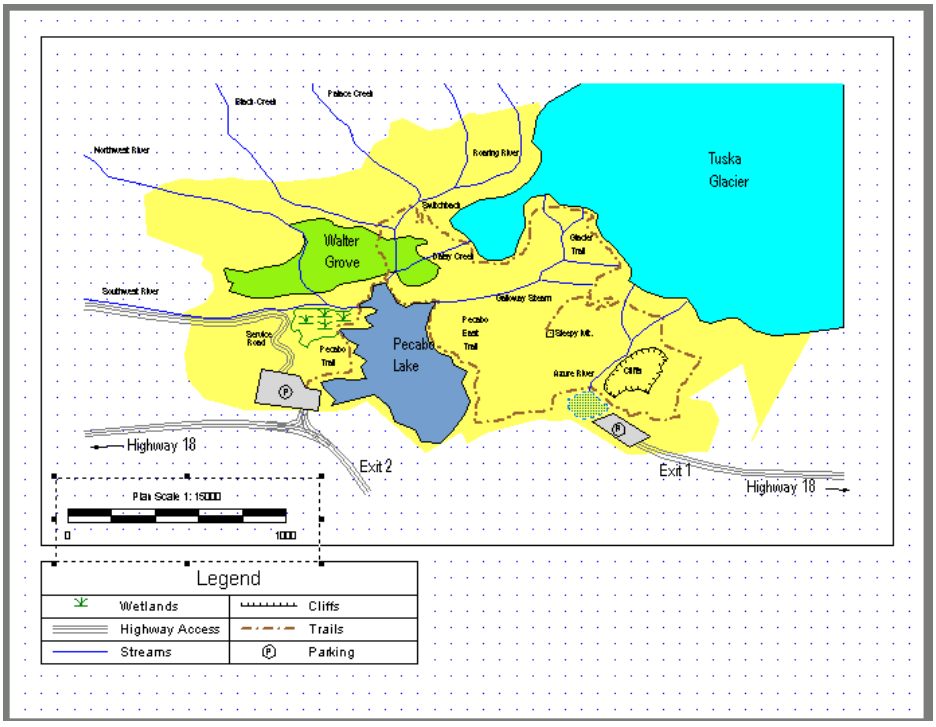


Figure 3.32: Final multi-plot output

17. Select *Edit | New Sub-view | Rectangle*. Under User-defined, type in the Text "Park Map Example" and change font size to 18 and bold. Press OK and position the sub-view as shown in the figure below.

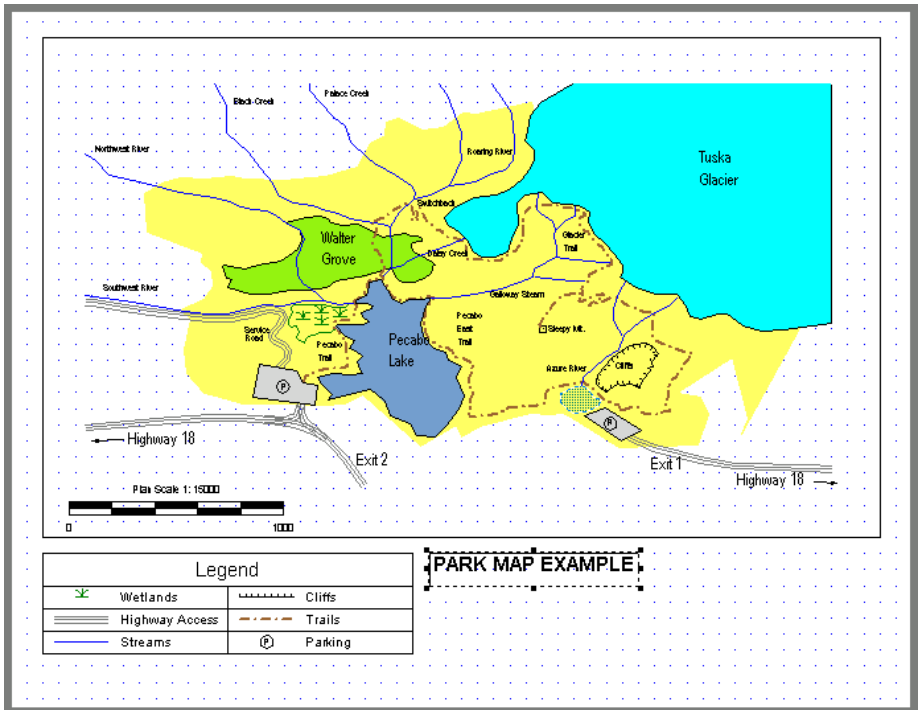


Figure 3.33: Multi-plot rectangle

18. Repeat the procedure from step 17, create and position several rectangles as shown in the figure below. Enter any text you wish.

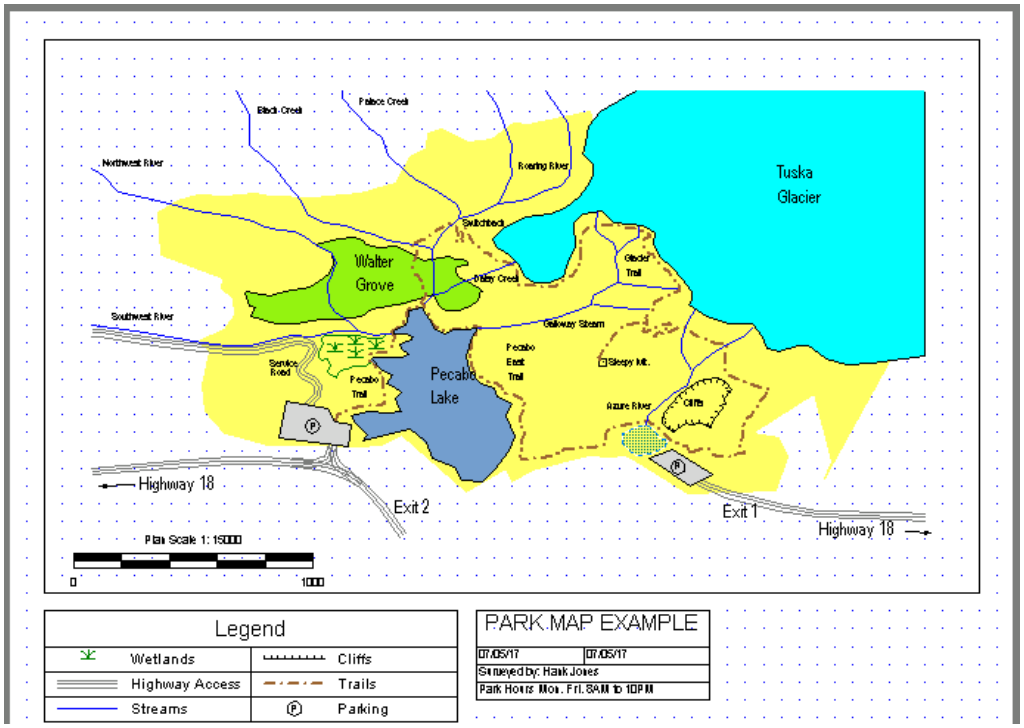


Figure 3.34: Multi-plot with rectangle

19. *File*|*New*. Do not save changes.

4. Images

Digital images (or bitmaps) can be used to enhance the visual impact of a map or drawing. They can also be used to extract and/or represent geometric information. The Terrain Module allows you to import bitmap images in various standard formats such as BMP, JPG or TIF. In order to use images for mapping they must be *georeferenced*.

In GIS terminology *Georeferenced* means 'tied to a specific geographic location on the earth'. A georeferenced image is one that has been scaled, rotated and stretched into position to correlate to a map projection. It may be an aerial photograph, a scanned paper map or a satellite image. What makes a georeferenced image distinct from other raster images is the inclusion of coordinate data used to locate its exact geographic position. This additional coordinate information can either be encoded in the image (e.g. Geotif), or as a separate "world" file (e.g. *.tfw).

Standard images (*.bmp, *.jpg etc) do not contain georeference information. However, images from mapping or GIS sources contain this information. If an image is not georeferenced, Terrain Tools can be used to create this information. This example will explore several methods for georeferencing an image.

To do this example *Mapping and Drafting, Import Basic and Export Basic* function groups must be enabled. See *Function Groups* in the on-line help for additional information.

Scaling an Image

Real-estate Areas Example

In this example we will measure a feature of known length on the image. The image will then be scaled (by setting the pixel size) so that the feature has the correct length. The image is not corrected for position and rotation.

We will provide options for both metric and English (feet) units. Use menu *Module* | *Setup, Units* tab, if you want to change units.

Note: See Getting Started section for file install folders (**<Terrain>** and **<Defaults and Layouts>**)

1. Select menu *File*|*Retrieve Screen Layout* <Defaults and Layouts>\Training\training bitmap scale.ilt.

Note: Terrain Recreational users may get the message "Non Permitted Functions Found in File". If this message appears choose "Keep all functions and revert to DEMO Mode".

This screen layout sets options such as Plan Window location and scale. To check which options have been set in the Plan Window, right click in the plan window select *Active Window (Plan) Options.*

2. Select menu *File* | *Insert File* to open the *Insert File* dialogue box.

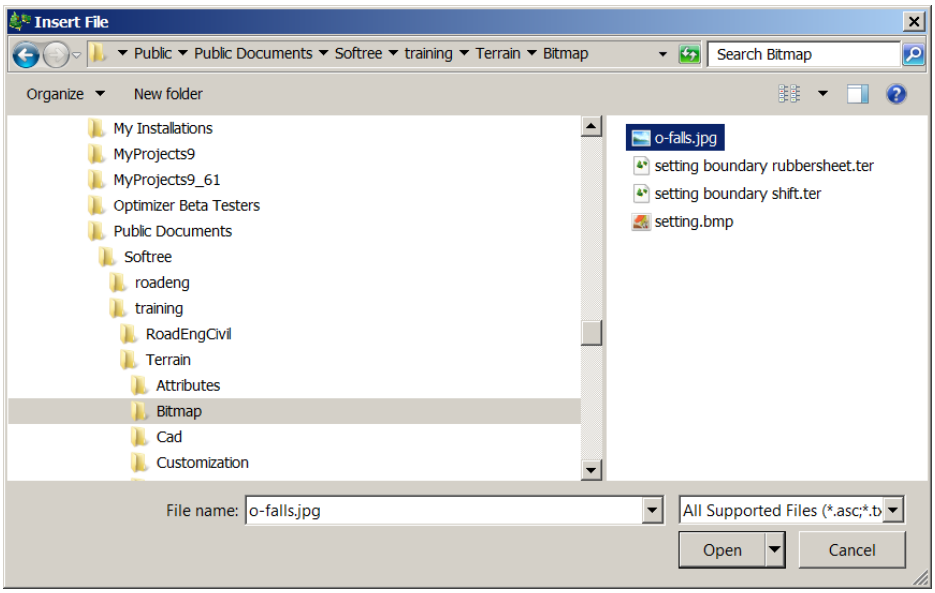


Figure 4.1: Insert File Dialogue

3. Set Files of type to either All Supported Files or Image Files (*.asc,*.txt, …) as in the figure above.
4. Select <Terrain>\ Bitmap\o-falls.jpg. Press *Open.*

You will be presented with the *Import Options* dialogue box as shown below.

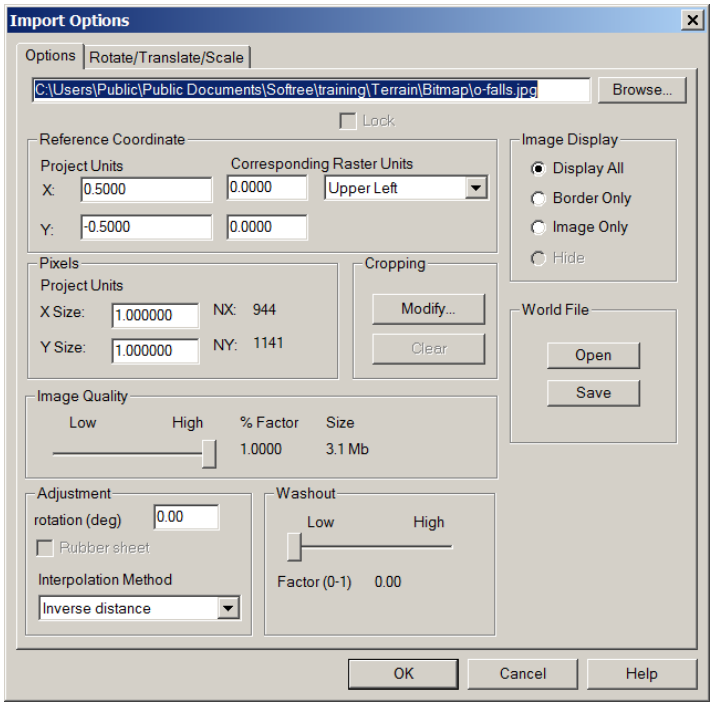


Figure 4.2: Image Import Options *dialogue (used to geo-reference and scale bitmaps).*

The *Pixels* area is used for scaling the image.

Note: If the natural scale and the dots per inch (dpi) are known then the pixel size can be calculated using the following formula:

An image was scanned at 200dpi (dots per inch) and the natural scale is 1:12000. Hence:

$$\text{Pixel size} = \frac{1\text{map-inch}}{200\text{pixel}} * \frac{12000\text{inch}}{1\text{map-inch}} * \frac{25.4\text{mm}}{1\text{inch}} * \frac{1.0\text{m}}{1000\text{mm}}$$

$$= 1.524\text{m/pixel}$$

We won't change any of the import options – we'll determine pixel size later.

5. Press *OK* to import the image.

The newly inserted image is selected; when an image is selected, the rectangle is hatched magenta.

6. Click outside the image to de-select.
7. Zoom extents.

The Plan window now displays the imported bitmap as shown in figure below.

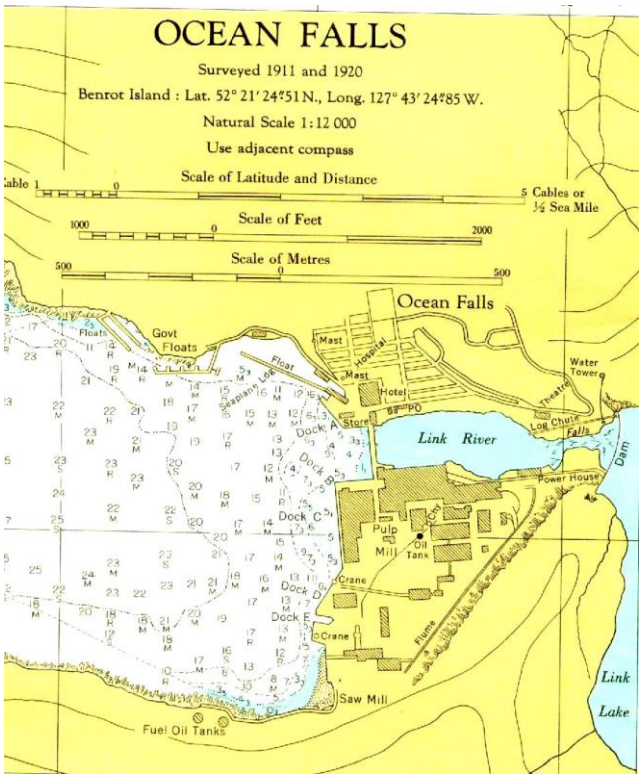


Figure 4.3: Imported bitmap

8. Zoom in so the scale bars are clearly visible.

In this example the natural scale is known, but the dots per inch are not. By measuring the scale bar, you will be able calculate the pixel size. This map has three scale bars. If you are working in meters, measure "Scale of Meters"; if you are working in feet, measure "Scale of Feet".

9. Measure the scale bar:
    a. With the cursor in the Plan Window, right-click and choose *Measure Tool (length, area)* from the menu.
    b. Move the mouse until the cross-hair is over one end of the scale bar and left-click.
    c. Move the mouse over to the other end of the scale bar and hover.

You can observe the length in two ways:

- The tooltip window (hover tip).
- The *Measure Tool* toolbar (this appeared at the lower left of your screen when you entered measure mode).

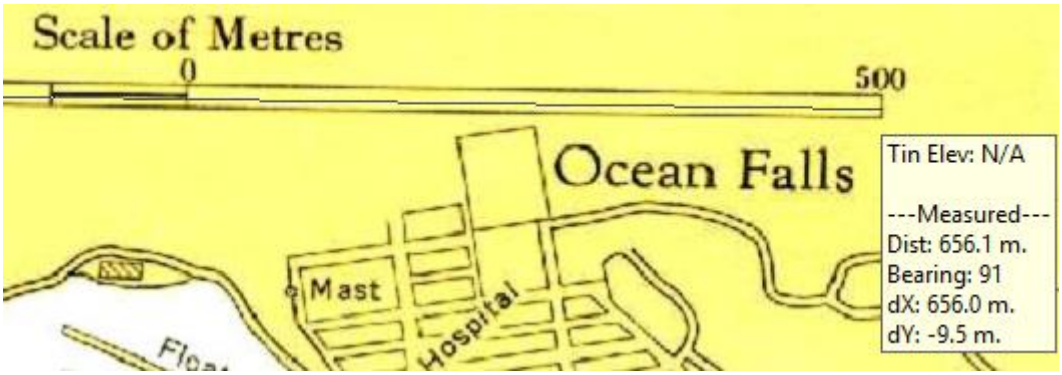


Figure 4.4: Measure Tool *hover tip.*

Figure 4.5: Measure Tool *toolbar.*

The *"Scale of Metres"* bar should be approximately **656**m long. This length is clearly incorrect; it should be 1000m, so the image must be re-scaled.

If you were working in feet, you would find that the *"Scale of Feet"* scale bar is 600**f**t long; similarly, this should be 3000feet, so image must be re-scaled.

    d. Right click, select *Stop Measuring* (or just type <escape>) to get out of measure mode.

Note: The *Measure Tool* does not disable editing with the mouse; this can be useful but most of the time you will want to be in selection mode before you use the *Measure Tool*.

10. Re-Scale the image by changing the pixel size:

a. Left click on the bitmap select it.

b. Select menu *Edit*|*Modify Selected Feature(s)*/*Properties* or press the *Properties* button in the toolbar to open the *Bitmap Options* dialogue box (Figure 4.2 above).

The current pixel size is set to 1.0. Scale it by multiplying by the true scale bar length divided by the measured scale bar length:

New Pixel Size (m) = 1.0m * 1000.0m/656m = **1.524**m

New Pixel Size (ft) = 1.0ft * 3000.0ft/597.8ft = **5.000**ft

c. Type the appropriate pixel size (**1.524m** or **5.000**ft) into both the *X size* and *Y size*.

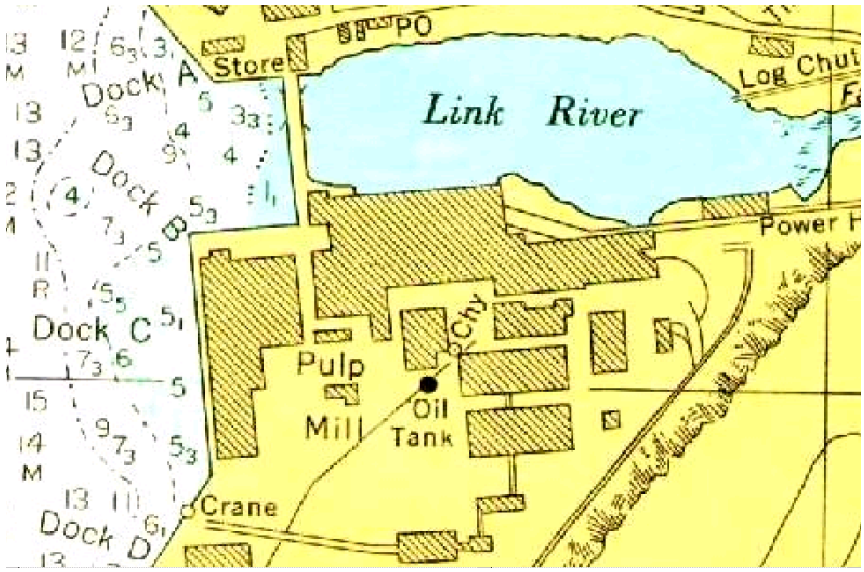
d. Press *OK* to close the dialogue box.

The image is scaled correctly. If the image were distorted then the process should be repeated using a vertical feature of known length to calculate the *Y size.*

If desired, verify the image is scaled correctly by measuring the scale bar again.

Tracing Image Features

The following steps demonstrate how to trace features in the image and use them to calculate their area.

11. Activate the Plan Window by clicking on the title bar and select menu *View* | *Active Window (Plan) Options*. Change the scale to **5000** if working in metric units (or **1000** if working in feet units).
12. Scroll and zoom the Plan window so that the pulp mill buildings are visible as in figure below.
13. 

14. *Figure 4.6: Ocean Falls buildings*

If you have already done the *Drawing Features* exercise in the *Basic Mapping and Drafting* chapter above, then you should have no problem with the next step. Otherwise, the sub-steps (a, b, c) should help.

15. Trace around the boundary of three of the buildings using the mouse (like in the figure below).

    a. Press the *Draw New Feature* toolbar button to begin drawing a new feature.

    b. Left click anywhere to create a new point.

    c. Position the cursor over one of the corners of a building and left click again to anchor the point.

    d. Left click away from the first point to create another point (note the line joining the new point to the old).

    e. Position the cursor over the next corner and left click again to anchor the point.

    f. Repeat until the building is outlined.

    g. Click the *Draw New Feature* button to begin a tracing a new building.

Note: The mouse can be used to edit existing points and insert points ; see the *Basic Mapping and Drafting* chapter.

Don't forget about *Edit | Undo*, <Ctrl-Z>.

If you have a number pad on your keyboard, there is a digitizing feature you might want to try; move your mouse cursor over a point of interest and type the <**5**> key on the number pad. This will create a new feature point in one step.

Figure 4.7: Traced buildings

    h. When you are finished, use the right mouse to change back to *select with mouse* mode.

Determine the area of each building:

16. Select each building perimeter with the mouse and look at the Status window.

13. Format the perimeter features and then determine the total area:

a. Select all the traced buildings, by holding down the <Shift> key and left clicking on each of the building's traced boundaries.

b. Select menu Edit | Modify Selected Feature(s) | Line-types, Symbols (or type <Ctrl-L>).

c. Select Line/Border Type 6-thick (heavy).

d. Change the color to *blue*.

e. Press *OK*.

View the Status Window (figure below) to see the area of the selected features: *Area Subtot*. If working in metric units, the area of the buildings should be approximately 2.9 Ha. (Imperial units the area should be approximately 7.0 acres).

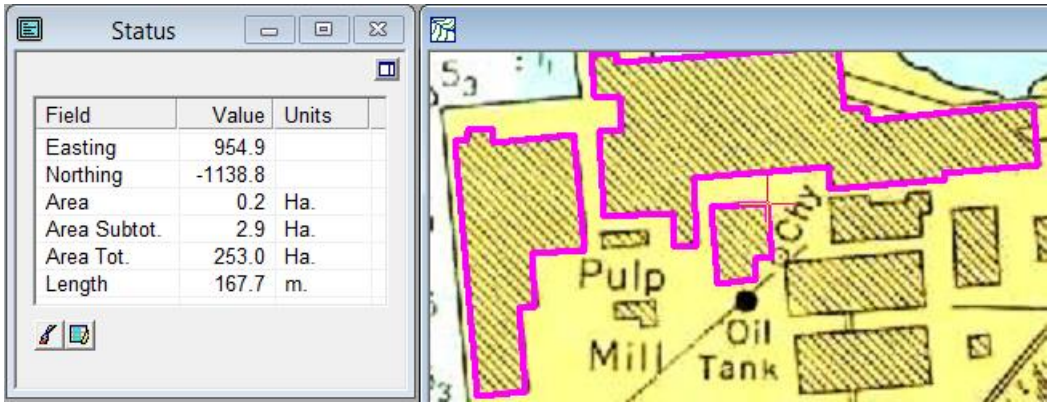


Figure 4.8: Selected buildings with area reported in the status window

The total area (*Area tot.*) includes the bitmap boundary; the *Area* field shows only the area for the current feature (containing the red cross).

Note: The Status window options allow you to display areas in square meters (square feet) for the current feature. Add item *Sq. Units* found in the *Geometry* category.

17. Click outside the image to de-select all.

Now you can see the true color of your perimeter features.

Note: Images are opaque. Use the menu *Edit* | *Modify Selected Feature(s)* | *Shuffle Display Order* to make sure the features you want to see are in *Front* and visible.

18. *File*|*New*. Do not save changes.

Adjusting an Image

Forestry Cut Block Layout Example

This example requires *Mapping and Drafting, Import Basic and Export Basic* function groups enabled (see *Function Groups* in the On-line help for more information).

Moving and Resizing

This example demonstrates how to overlay a series of traverses on a scanned contour map. These traverses were entered in the Survey Module; however they could have come from other sources.

1. *File | Open*. Change *Files of Type to (All Supported Files *.asc; *.ter; …).*
   Select **<Terrain>\ Bitmap\setting boundary shift.ter**.

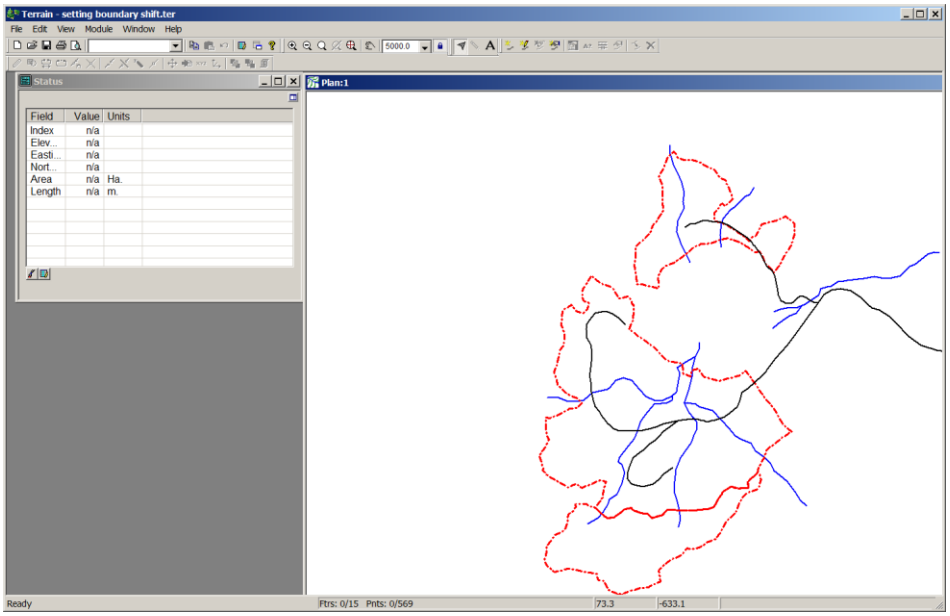


Figure 4.9: ***Setting boundary shift.ter*** *- surveyed traverses*

The terrain file **setting boundary shift.ter** includes several block boundaries, roads and streams. Notice that the traverses are in correct positions with respect to each other. These traverses were entered and adjusted in the Survey/Map Module.

2. *File | Insert File*. Change Files of type to Image Files (*.tif: *.jpg; *.bmp; *.sid; *.jp2; *.png;*.ecw; *.doq;….).
   Select File Name: **<Terrain>\Bitmap\setting.BMP**. Press Open.
3. The Import Options dialogue box appears. Ensure that the default settings are set (X and Y are set to **0.0** for Project Units and the X and Y are set to **1.0** for the Pixels) as shown in below. Press OK to insert the bitmap.

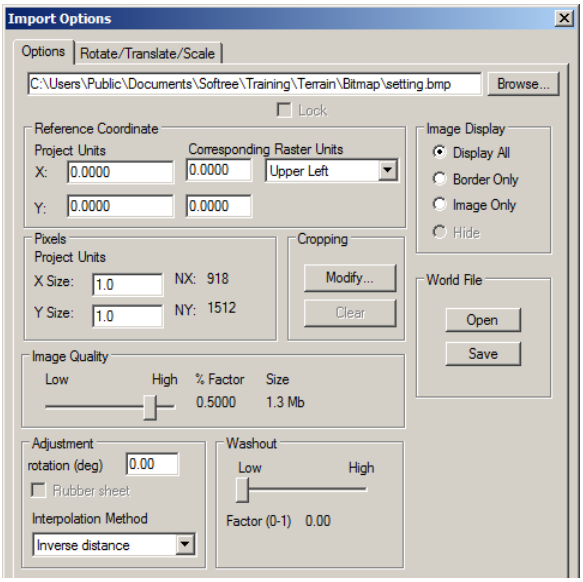


Figure 4.10: Import options dialogue box

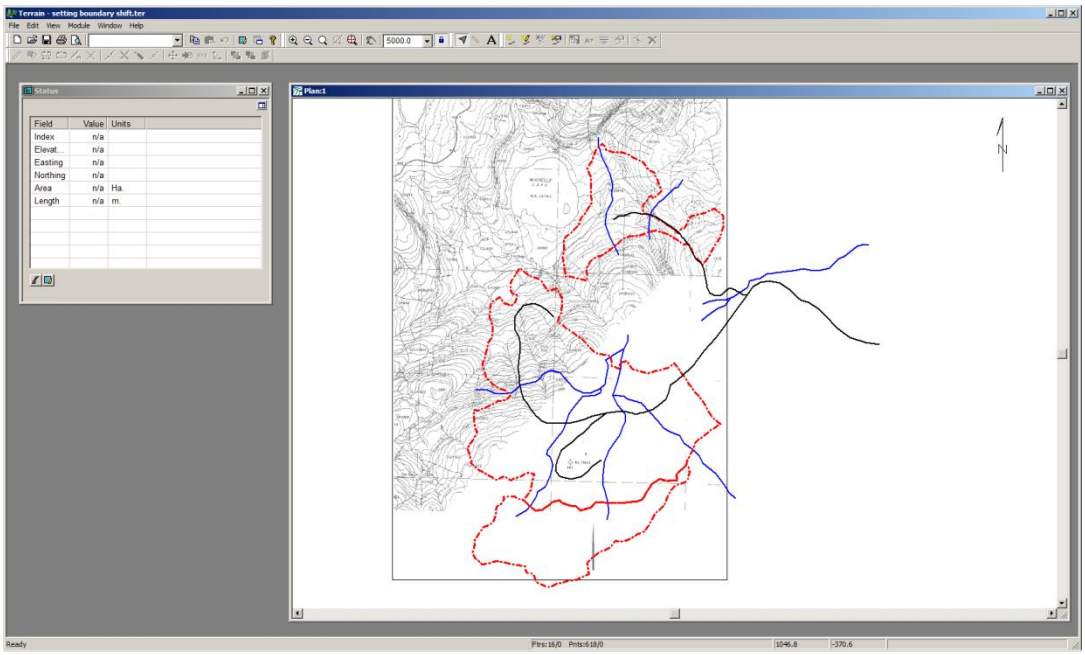


*Figure 4.11: Plan window after adding **setting.bmp***

The bitmap file was created from a 1:5000 topographic map. The image was scanned and saved as a Windows Bitmap (*.bmp) using external software.

The bitmap is not correctly positioned with respect to the traverses (MICHELLE LAKE is offset) (See figure above). The size of the bitmap image is also incorrect. The next steps show how to adjust the position and size of the bitmap by trial and error (although it is possible to be more analytical if you know the pixel size and the coordinates of one corner of the scanned image).

Using the lakeshore to tie into the traversed streams:

4. Select the bitmap by left clicking its boundary with the Selection cursor .

5. *Edit*|*Modify Selected Feature(s)*|*Move/Size* or press the *Move/Size* button. This activates Move/Size mode with the bitmap selected. The cursor changes to the Move cursor when it is inside the image. Zoom out several times to see the handles.

6. With the Move cursor displayed, left click and drag to position MICHELLE LAKE so that the stream traverses line up with the lakeshore. Release the left mouse key to redraw the screen.

The bitmap image is too large to match with the traverses. The next step will reduce the size of the bitmap.

7. Still in Move/Size mode, hold down the <Ctrl> and press the <Down Arrow> on the keyboard. Notice that when the screen refreshes the bitmap image is smaller. Pressing the <Ctrl + Up Arrow> will expand the image, and <Shift + Ctrl + Arrow keys> allows for fine adjustments.

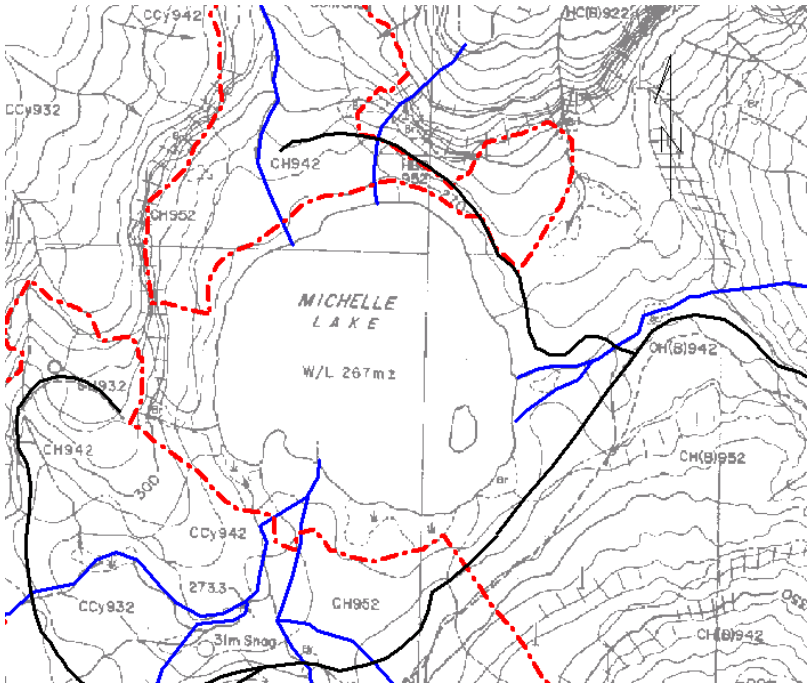


Figure 4.12: Lining up Michelle Lake with streams by trial and error

8. Repeat the above two steps until the lakeshore lines up with the traversed streams as in the figure above. This procedure involves some trial and error to adjust both the size and position of the bitmap. The Zoom In/Out buttons are useful in this process.

Information about the bitmap can be displayed and modified. This can be useful for rotating, scaling and positioning a bitmap using explicit coordinates.

9. With the bitmap still selected, activate the Image Options Dialogue box by choosing *Edit*|*Modify Selected Feature(s)*|*Properties* or pressing the *Properties* button in the toolbar.

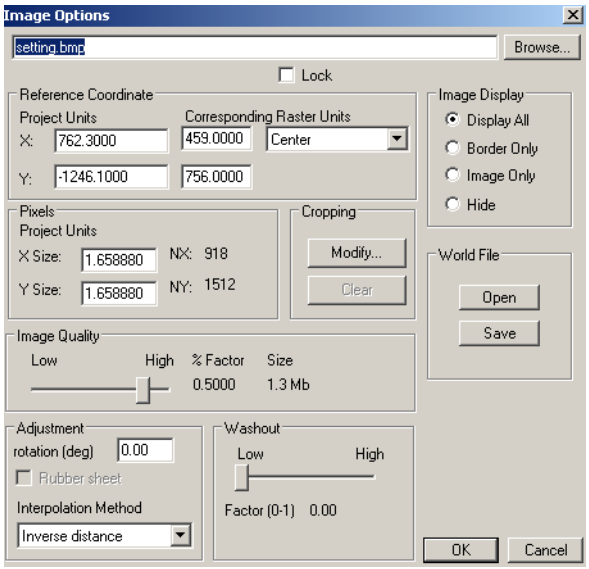


Figure 4.13: Bitmap options dialogue

Note: The X and Y pixel sizes. The default size of bitmap pixels is 1. The coordinates of the upper left corner are 0,0. These defaults were changed when the bitmap was moved and sized in the previous example. This dialogue box can be used to explicitly set the rotation, size and position of a bitmap.

10. Press Cancel. *File* | *New*. Do not save changes.

5. Features, Coordinates and Attributes

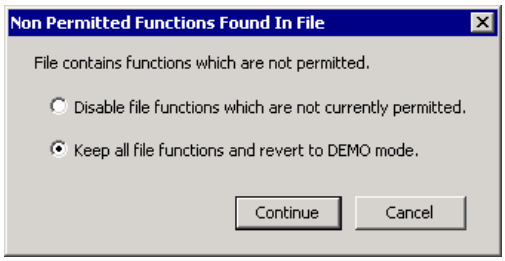
A feature is a collection of xyz coordinates. Features and coordinates can have attributes. Coordinates can be entered directly by typing them into a dialogue box, traced from an existing map using the mouse or a digitizer or by importing them from an external file.

This section of the documentation will familiarize you with some of the methods for creating features by importing coordinates from external files and for entering coordinates via the keyboard.

Note: Terrain works with Cartesian xyz coordinates such as UTM, Albers, State Plane Etc. Cartesian coordinates allow you to measure lengths and areas in the usual way. If you have non Cartesian coordinates, such as Lat/Lon, it is recommended you convert them to a Cartesian coordinate system when you import them.

To follow the examples in this section the *Mapping and Drafting*, *Import Basic*, *and Import Extended* function groups must be enabled. See *Function Groups* in the On-line help for more information.

If your software license does not include a required Function Group, when you open a file or screen layout you will be prompted:



Choose “Keep all the functions and revert to DEMO mode”. Examples in this section can be completed in Demonstration Mode. Contact Softree to upgrade your license to permit more functions.

Importing DWG or DXF Files

Cadastral Survey Example

The Terrain Module will read basic geometric information from DWG files (some 'esoteric' drafting entities such as text leaders are ignored -- a log file indicates entities that are ignored). More information about the technical aspects of DWG files can be found in the On-line help.

Note: See Getting Started section for file install folders (<**Terrain**> and <**Defaults and Layouts**>)

1. *File*|*Open File*. Change *Files of type to Autocad DWG (*.dwg).*
   Select <**Terrain**>**\Import\municipal.dwg**. Press Open.

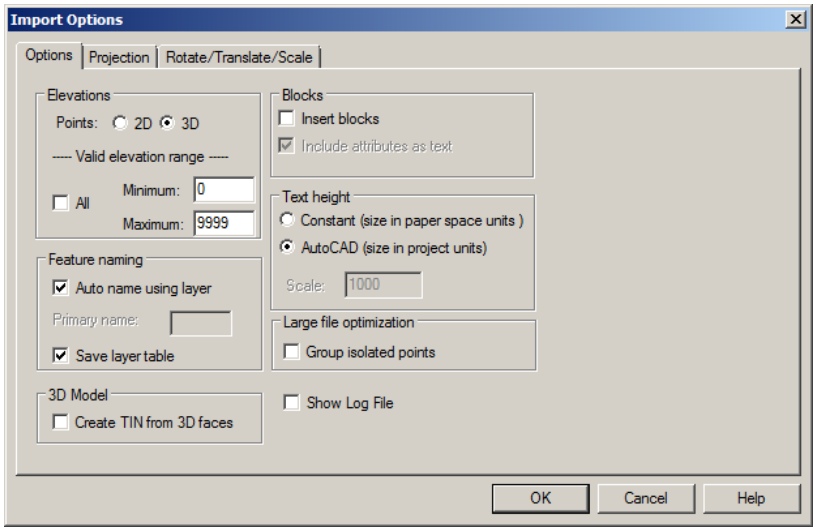


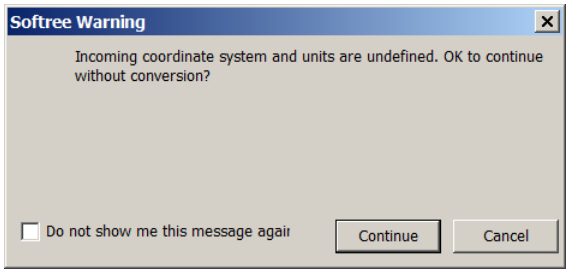
Figure 5.1: Import options *dialogue*

For on-line help descriptions for each of the dialogue box items, press F1 while the *Import DWG/DXF Options* dialogue is still active.

The options in the *Text Height* group box allow you to control the text size when importing the DWG file.

- If *Constant* is selected, the text size is based on the drawing scale entered in the *Scale* field.
- If *AutoCAD* is selected, the text size is determined by the scale of the drawing. Changing the scale will resize the text. This is the best option to correctly size text.

2. Set the dialogue options to match those shown in Figure 5.1 and press OK. You will get the following warning. Press Continue.



3. After the import process is complete press the *Zoom extents*  button. A city map with all the features selected will appear. De-select all features by clicking in a blank area of the Plan Window.

4. Zoom in with the Magnify  button to examine the details of the legal plans as shown in the figure below.

Note: If *Primary Name* (from the *DWG Import Options dialogue box*) is left blank, the incoming features will have their Alphanumeric ID set to the 1st 8 characters of the DWG layer name. The Numeric ID will be automatically generated.

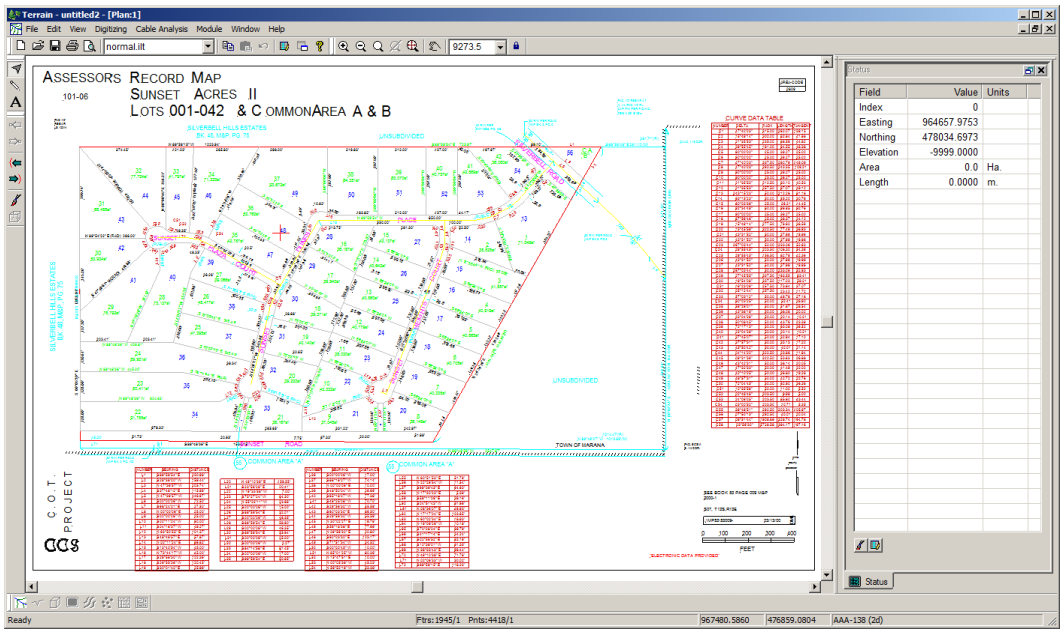


Figure 5.2: Imported DWG file

Note: 2D vs. 3D DWG Files

DWG files are often only 2D and thus they can't be used to create 3D models. This is the case with **municipal.dwg**. If you click on a feature in the Plan window you will notice in the Status window the Elevation is reported as -9999, indicating that it has no elevations. Sometimes DWG files contain a mixture of 2D and 3D entities. If these files are to be used for 3D modeling, the different feature types must be selected and their property set to 2D or 3D accordingly.

5. *File* | *New*. Do not save the changes.

Importing Shape Files

Contour Map Example

Another common file format used is shape files. The Terrain Module will read (and write) Shape files including attributes.

1. *File* | *Open File*. Change *Files of type to ArcView Shape (*.shp)*.
   Select **<Terrain>\ Import\topo.shp**. Press Open.
2. Set the *Import Options* dialogue box to match those shown in the figure below and press *OK*.

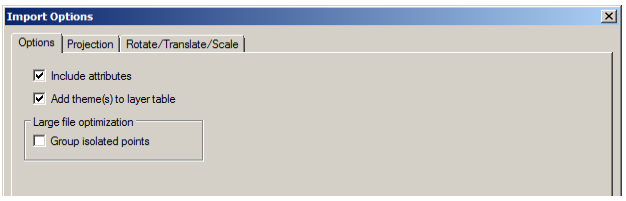


Figure 5.3: Shape import options dialogue

After the import is complete the Plan window should appear as shown in the figure below.

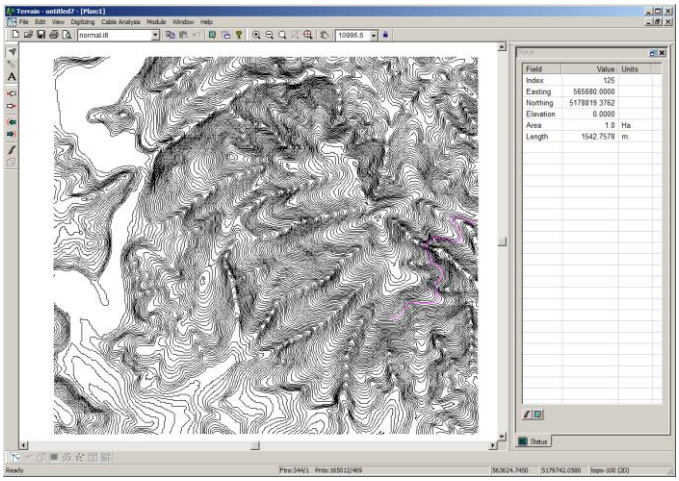


Figure 5.4: ***Imported Topo.Shp***

Note: If you click on any of the contour lines, the Status Window shows an elevation of 0.0. The elevation information has been saved in a separate attribute. Some Shape files save the elevation information with the coordinates; others (as in this case) save elevations in an attribute..

The next steps will show how to extract the elevations from an attribute and assign them to the contours so they can be used to create a TIN model

3. Click on the Options Button  located at the bottom of the Status Window. Click on the *Add/Remove* button. Scroll down to the bottom of the list on the left hand side and locate the folder call "topo". From this folder add the item *Contour*. Press Ok twice to return to the main screen

Note: If you click on any of the contour lines the Status Window now shows an elevation beside CONTOUR. See figure below.

In order to use this file to create a TIN model the elevation in attribute CONTOUR must be assigned to Elevation (Z-value). This can be done using menu *Edit* | *Modify Selected Features* | *Assign*.

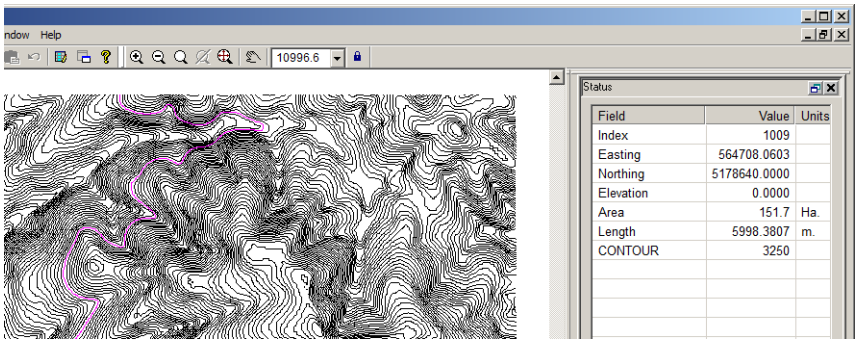


Figure 5.5: CONTOUR attribute

4. *File* | *New* to start next example *or File* | *Exit* to close program. Do not save changes.

Importing ASCII Files

Topographic Survey Example

The Terrain Module will accept a variety of different ASCII files by allowing the user to configure the import format. This example illustrates the use of the import functions to read a topographic survey file created by a total station data collector.

A Typical Data File

The file (excerpt below) consists of a *sequence number*, *X*, *Y*, *Z* and *code* separated by tabs.

501	100005.519	669380.4079	374.3334144	SIGN
502	100005.4794	669377.6708	378.4704648	TOB
503	100005.455	669381.2522	373.6119528	DITCH
504	100005.5069	669382.2581	373.6689504	SHOULDER!
505	100005.5678	669383.4834	373.6997352	EP!
506	100004.9978	669360.2576	381.6608064	SPOT
507	100006.4914	669386.827	373.7369208	CLP!
508	100004.7662	669349.7755	383.6218896	SPOT
509	100024.0052	669385.6383	373.5726336	CLP
510	100021.4448	669349.0349	382.406652	SPOT
511	100023.7247	669382.4074	373.5458112	EP
512	100023.9594	669381.0297	373.482108	SHOULDER
513	100023.9625	669380.2037	373.415052	DITCH
514	100022.8043	669363.6653	379.8536472	SPOT
515	100041.7689	669378.9815	373.1014128	DITCH
516	100023.7491	669376.4882	377.8693992	TOB
517	100041.6561	669379.9873	373.180356	SHOULDER
518	100041.2203	669375.9365	376.1890368	TOB
519	100041.6409	669381.3284	373.2388776	EP
520	100042.0036	669384.5227	373.2394872	CLP

Figure 5.6: Excerpt from ***Survey1.txt***

Setting up an Import Format

1. Open the Terrain Module. Select menu *Module* | *Setup*, and click on the *Units* tab. Select *Imperial (ft)* units if not already set to *Imperial (ft)* since this example is in Imperial measure.

Note: Import software cannot detect units from the information in an ASCII file.

2. Click on the *Import* tab and press the *Open* button. Browse to find the import options file **<Defaults and Layouts>\Training\training Normal.iop** (See figure below). Press *Open* to read the file.

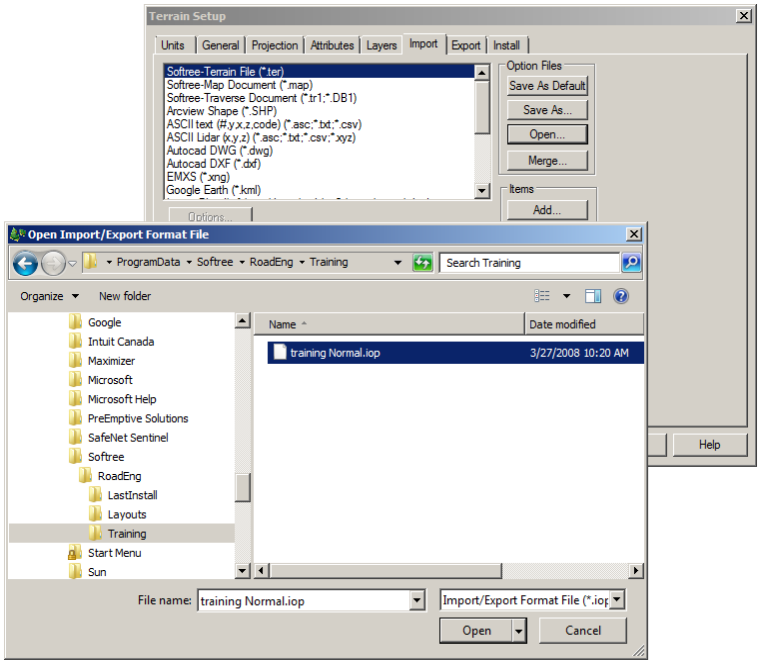


Figure 5.7: Opening an import/export format file from Terrain setup.

Note: the default import/export formats are read from Normal.iop (found in your Layouts and Settings folder). Modify Normal.iop to change your defaults.

3. Select the format called "ASCII (x,y,z,code) [*.asc,*.txt,*.csv] ", then press the *Add* button to open the *Define New File Format Options* dialogue as shown in the figure below.

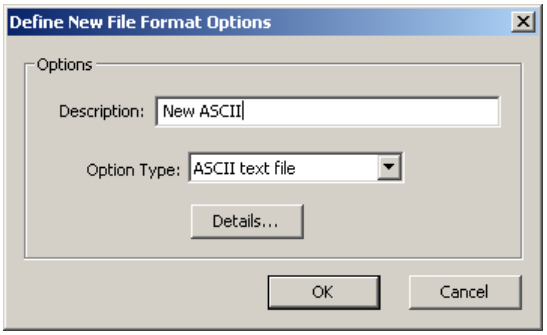


Figure 5.8: Define new file format options dialogue

Note: When you create a new import format, it will initially be a copy of the one selected when you press the *Add* button ("ASCII (x,y,z,code) [*.asc,*.txt,*.csv] ", in this case).

4. Type "New ASCII" in the *Description* field and then click on the *Details* button to open the *Import ASCII Options* Dialogue box shown below.

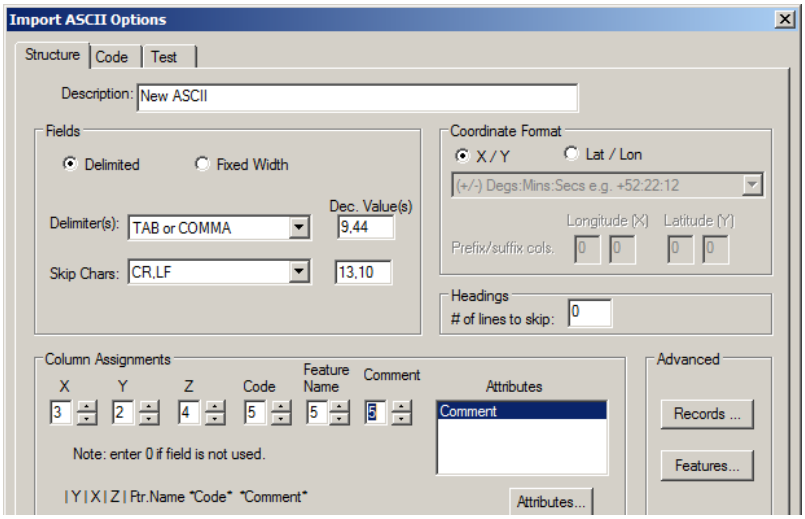


Figure 5.9: Import ASCII options dialogue – structure tab

The *Import ASCII Options* dialogue box allows you to describe the format of external files. Several options are available to identify, select and format incoming coordinate data. Detailed descriptions of the options in this dialogue box are available by pressing <F1>.

5. Change the *Column Assignments* in the dialogue box to match the figure above ($X = 3$, $Y = 2$, $Z = 4$, *Code* = 5, *Feature Name* =5 and *Comment* = 5). Our file contains [point #, Y, X, Z, code] in each line.

You have now set up the import format to read data from the correct columns in the file.

6. Go to the top of the *Import ASCII Options* dialogue box and select the *Code* tab. Here you can assign properties, symbols and line-types to the incoming points.

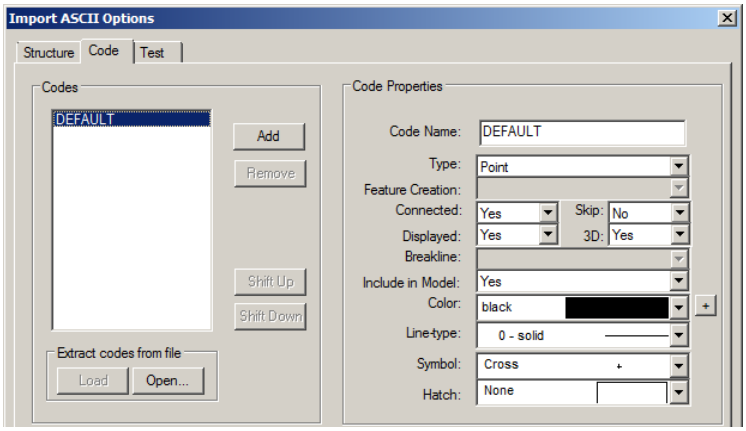


Figure 5.10: Import ASCII Options Dialogue box – Code Tab

7. Change your default code properties to match those shown in the figure above. 3D points Black cross symbol.
8. Press the *Open* button. Select **<Terrain>\ASCII Import\survey1.txt**. Press *Open*. This will extract all of the codes found in the file.

9. Select the **CONTROL** code found in the codes list. Note that the options initially are the same as DEFAULT.
   Change *Color* to **navy**
   Change *Symbol* to **Circle with cross**.

10. Select **EP** (Edge Pavement) in the code list and type in * beside EP in the Code Name. The "*" is a wild card – any code starting with "EP" will fall into this category.
    Change *Type* to **Polyline**.
    Change *Feature Creation* to **Connect All by Code**.
    Change *Breakline* to **Yes**.
    Change *Color* to **Blue**.
    Change *Symbol* to **None**.

Points with the EP code will be connected together (in the order found in the file) and made into a blue breakline. The Connect All by Code property ensures that codes like EPL and EPR form separate features even though they both fit the EP* specification.

11. Select code name **CLP** (Center Line Pavement) in the code list.
    Change *Type* to **Polyline**.
    Change *Feature Creation* to **Connect All**.
    Change *Breakline* to **Yes**.
    Change *Color* to **Red**, *Line-type* to **dash-dot**.

12. Go to the top of the *Import ASCII Options* dialogue box and select the *Structure* tab again. Press the *Features* button in the *Advanced* section on the lower right. The *Feature Detection Method* dialogue box shown below will appear.

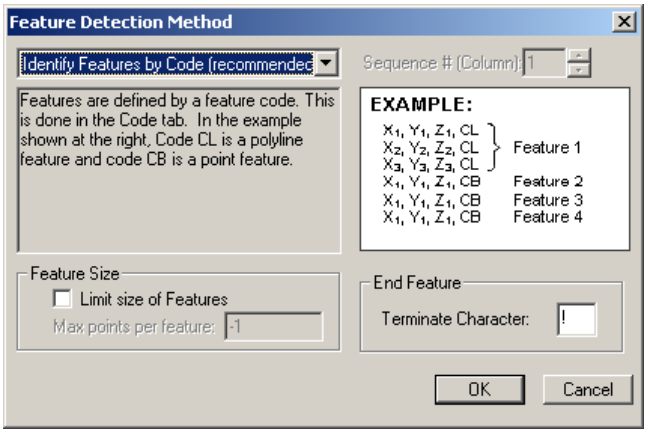


Figure 5.11: The feature detection method *dialogue box*

The Feature Detection Method dialogue box allows you to limit the length of **polyline** features by defining a termination character to be found in the point code.

An exclamation point, "!", is defined as the termination character in the *Feature Detection Method* dialogue box. If you refer to the **Survey1.txt** (see Figure 5.6 at the start of this exercise), you will see many of the point codes end with "!"; this means that a connected feature breaks after this point and a new feature will be created when the next point of this type is encountered. The *EP* polyline code (defined above) will import as two breaklines (left and right) because of a strategically placed "!" in the survey point codes.

13. Press Cancel to exit the *Feature Detection Method* dialogue box.
14. To test the specification, go to the *Test* tab (see figure below).

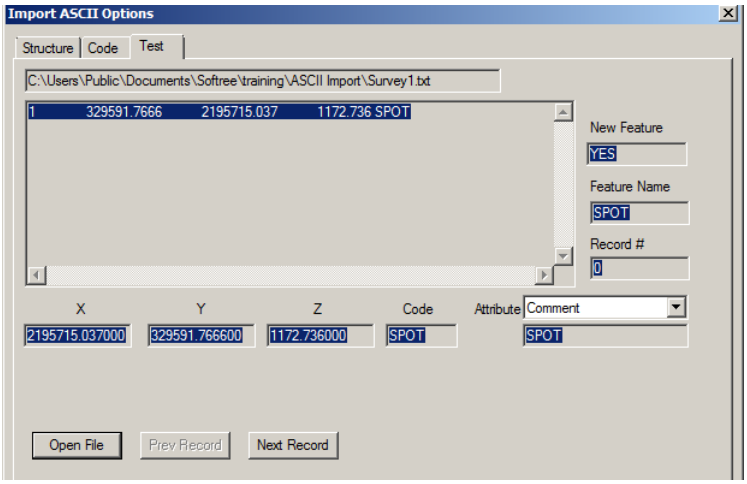


Figure 5.12: Import ASCII options *dialogue – test tab*

15. Press the *Open File* button and choose **Survey1.txt** and press O*pen***.**
16. Press the *Next Record* button several times. At the bottom of the dialogue box the values of X,Y,Z and comment are displayed. Confirm that the incoming fields are being correctly interpreted; if not return to the other tabs to modify the format.
17. When satisfied, press *OK* to return to the *Define New File Format* dialogue and *OK* again to add the new format to the list.
18. To save the new import specifications for future use, press the *Save-As* button. Normally, you would choose **Normal.IOP** and write over it (to update your default settings) – do this only if you are working on a computer used for training only, otherwise save as **training.iop** or ***Cancel*** to avoid changing your defaults.
19. Press OK to close the *Terrain Setup* dialogue box.

Now we'll use the import format we've created to open the survey data file.

20. *File* | *Open*. Change *Files of type* to *New ASCI I* (at the bottom of the list). Open **Survey1.txt**. You will be presented with the *Import Options* dialogue box to allow last minute changes. Press *OK* to import the file.
21. Use the layouts drop down in the standard toolbar (or menu *File* | *Retrieve Screen Layout*) to open **training ASCII import.ilt**.

This will set up your options and windows to look like the figure below.

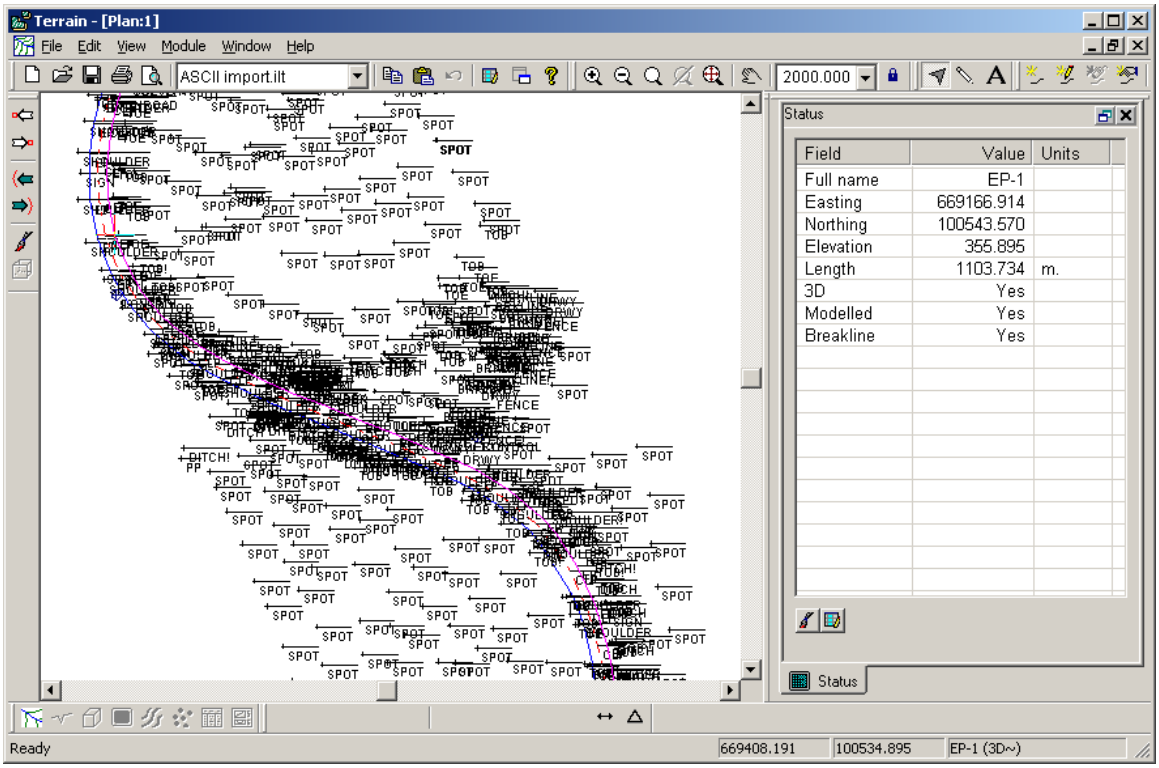


Figure 5.13: Plan window after importing ***Survey1.txt****.*

Note: The right **EP** feature is selected (note the properties displayed in the status window). There are many point codes that have not been formatted or connected to form breaklines. In the next steps, we will re-read the same data with a prepared import format.

22. *File | Open*. Change *Files of type* to *ASCII 2 (#,y,x,z,code)*. Open **Survey1.txt**. When prompted to save changes, choose *No*.
23. You will then be presented with the *Import Options* dialogue; click on the *Code* tab to see the extra codes defined – no changes are required. Press *OK* to import the file.
24. Use the layouts drop down in the standard toolbar (or menu *File | Retrieve Screen Layout*) to open **training Normal.ilt**. This will set up your options and windows to look like the figure below.

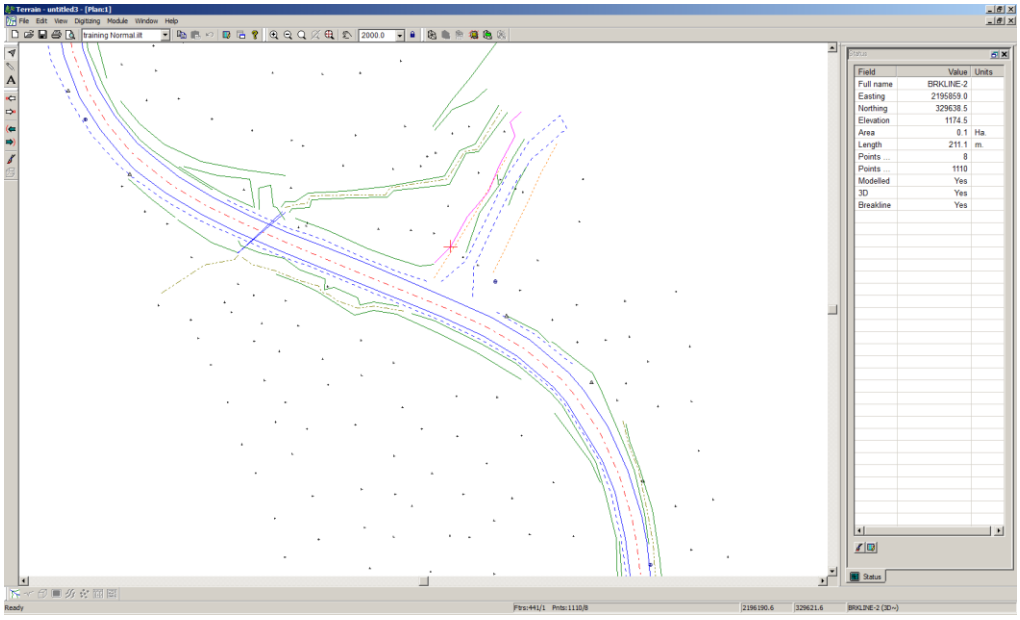


Figure 5.14: ***Survey1.txt*** *imported with more point codes defined.*

You may wish to select features with the mouse to see what properties are displayed in the *Status* area.

25. *File* | *New*. Do not save changes

Keyboard Coordinate Entry

Legal Survey Example

To follow the examples in this section, the *Mapping and Drafting*, *Import Basic*, *Import Extended*, and *Enhanced Mapping and Drafting* function groups must be enabled. See *Function Groups* in the On-line help for more information.

The Terrain Module allows you to create a feature and enter its coordinates directly from a dialogue box. This example will demonstrate this procedure by creating a plat (cadastral) boundary from the following legal description.

> *Beginning at the Northeast corner of Lot 23, Block 1, "Plat of Williams Beach";*
> *thence S 30º 15' E a distance of 403 feet of the Point of Beginning;*
> *thence S 43º 42' W a distance of 446 feet;*
> *thence N 67º 47' W a distance of 368 feet;*
> *thence N 3º 18' E a distance of 317.5 feet;*
> *thence along a curve to the right having a radius of 200 feet, a chord bearing of N 46º 16' E, and a chord distance of 272.66 feet;*
> *thence N 83º 37' E a distance of 231.97 feet to the Point of Beginning*

1. Set up units and angle format:

a. Choose menu Module | Setup, Units tab.

b. Choose *Imperial (Ft)* for Units.

c. Change Direction format to Quadrant Deg:Mins N32:16W.

d. Change *Slopes* and *Cut/Fill Slope* to ***Slope %*** (if necessary).

e. Press *OK*.

2. Use menu *File* | *Retrieve Screen Layout* or the *Screen Layouts* dropdown in the standard toolbar to select **<Defaults and Layouts>\Training\training deed.ilt**.

Note: Terrain Recreational users may get the message "Non Permitted Functions Found in File". If this message appears choose "Keep all functions and revert to DEMO Mode".

Enter the Main Boundary

The following steps can be time consuming; you can jump ahead at any time to Enter the Easement Boundary below.

3. Create a new 2D feature:

a. Choose menu *Edit* | *New Feature* to open the *Feature properties* dialogue box.

b. Enter *Name* **Lot 23**.

c. Disable *Elevations* and *Modeled* (as below).

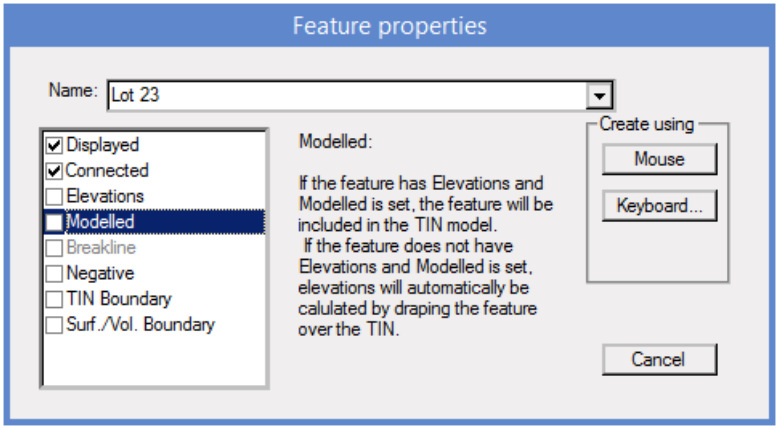


Figure 5.15: Feature properties dialogue

d. Press the *Keyboard* button to close *Feature properties* and open the *Feature Coordinates* dialogue box.

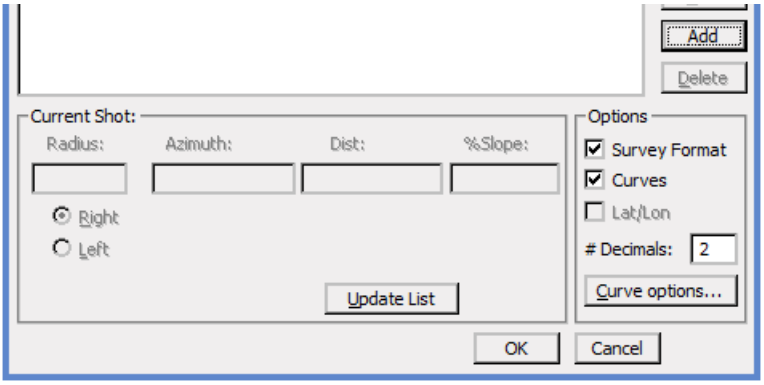


Figure 5.16: Feature Coordinates *dialogue box set up for survey entry*.

The *Feature Coordinates* dialogue box can be used for entering or modifying XYZ coordinates or survey information. In this case the *Survey Format* and *Curves* options are checked (figure above), so you can enter the survey information.

4. Add a shot:
    a. Press the *Add* button.

A new shot is added with default values in the fields; the cursor is in the *Radius* field in the *Current Shot* area.

    b. Leave the radius blank and type <TAB> to move to the next field
    c. Enter *Azimuth* **s30.15e**, <TAB>.

Note: For azimuth, data entry, a period (or decimal) is OK to separate degrees and minutes and capitals are unimportant.

    d. Enter a distance of **403**, <TAB>.
    e. Enter % *Slope* **0**, <Enter> (or press *Add*) to accept the fields and add a new shot.

5. Repeat for the next three shots:
    a. S 43º 42' W, 446 feet
    b. N 67º 47' W, 368 feet
    c. N 3º 18' E, 317.5 feet

6. Now enter the curve:
    a. Enter a Radius of **200,** <TAB>.
    b. Use the <arrow> keys to select ***Right*** and <TAB> (of course you can also use the mouse for this).

Notice the headings change, after entering the radius, to *Chord Az*. and *Chord Dist*. Additional options for entering curve data are available by pressing *Curve Options* (see On-line help <F1> for more information).

    c. Enter a chord azimuth of **N46.16E**, <TAB>.

d. Enter a chord distance of **272.66**, <TAB>.

e. Enter slope **0**, as usual, press <Enter>.

7. Enter the final shot: **N83.37E**, **231.97** feet. After entering the **0** slope, press the *Update List* button. (Do not press enter or add).

The *Feature Coordinates* dialogue box should now look like the figure below.

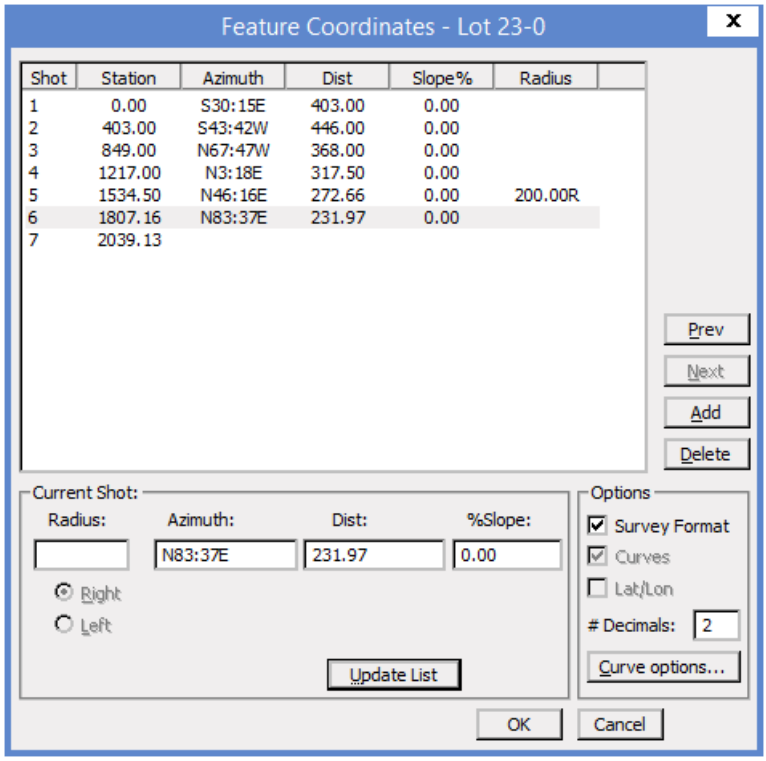


Figure 5.17: Feature coordinates *dialogue after survey entry.*

8. Check the entered bearings and distances against those in the figure above and then press *OK*.

The screen should now look like the figure below.

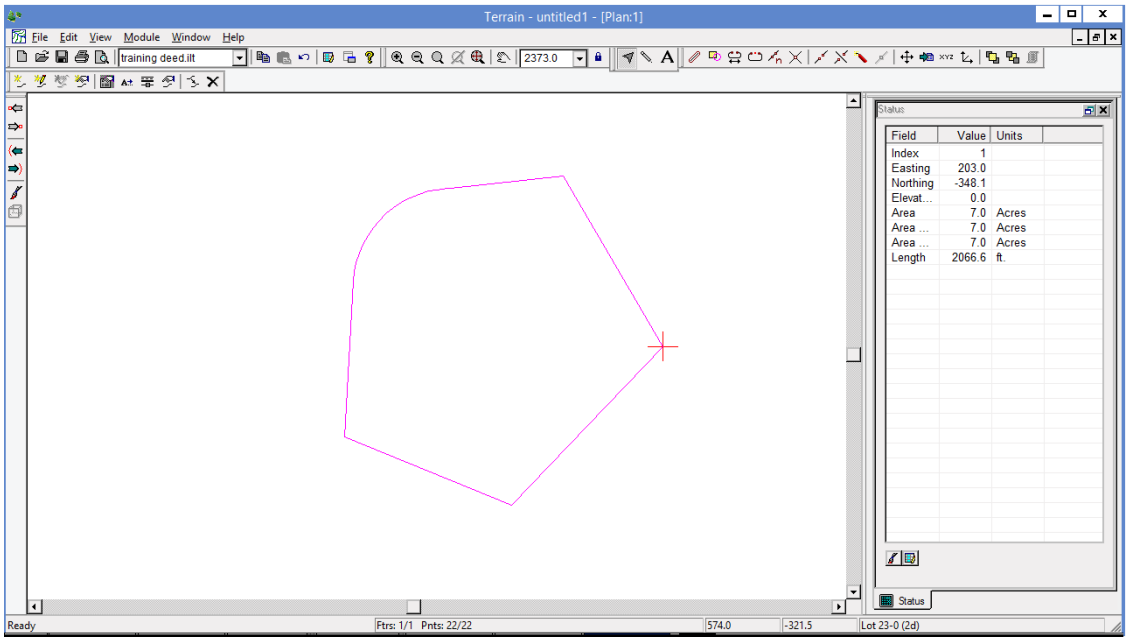


Figure 5.18: Lot boundary

9. Using the selection cursor , click on the second lot corner, identified by the red cross-hair in the figure above.

The Status Window reports the X, Y coordinate for the current point is **203.0** (Easting), **-348.1** (Northing). This is the starting point for the next boundary.

Enter the Easement Boundary

10. (Optional) If you did not finish the steps above, **File | Open <Terrain>\Enter\deed.ter**.
11. Create a new feature (properties will be inherited from the current feature):
    a. Choose menu *Edit* | *New Feature* to open the *Feature properties* dialogue box.
    b. Enter *Name* **Easement**.
    c. Set the *Negative* check box; this will allow us to subtract the enclosed area later.
    d. Press the *Keyboard* button to close *Feature properties* and open the *Feature Coordinates* dialogue box.

Note: *Negative* features create a hole or void. Their area will be subtracted when total areas are reported and the TIN will exclude these areas if *TIN Boundary* is also selected.

12. Define start coordinates (we did not do this for our first feature):
    a. In the *Options area* clear the *Survey Format* check box.

Note that the starting X, Y coordinates have automatically been set to the corner point (**203.0**, **-348.1**) that we selected above. If they were not correct, you could modify the coordinates now.

b. Set back to *Survey Format*.

13. Enter the *Easement Survey* traverse as shown in the figure below (use the save procedure as the previous exercise).

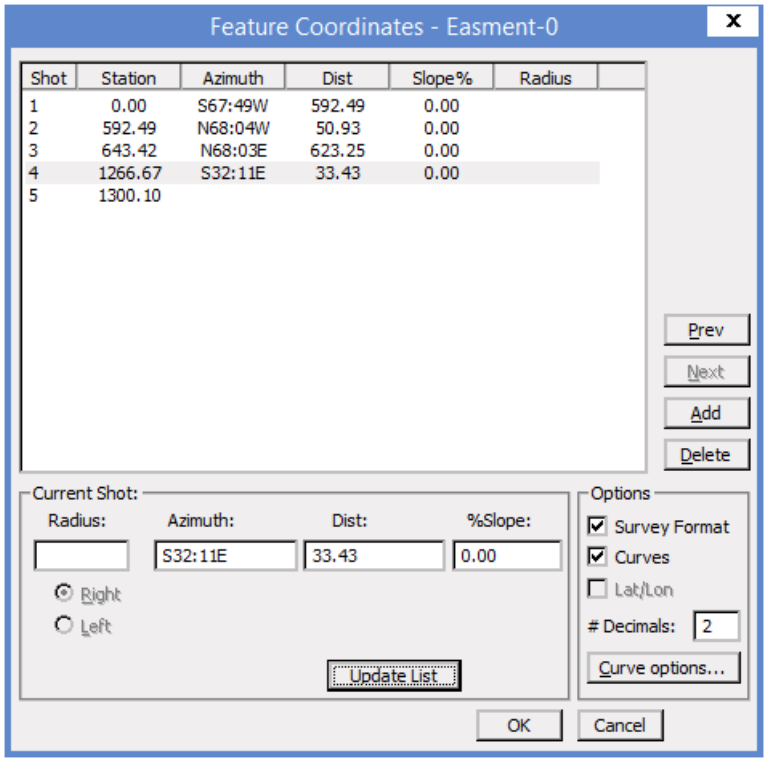


Figure 5.19: Easement survey

14. After entering the last slope, press *OK* to close the *Feature Coordinates* dialogue box.

The plan should now display *Lot 23* and *Easement* as in the figure below. Notice the negative area in the status window for the selected easement and total area of 6.5 Acres (7.0 - .5).

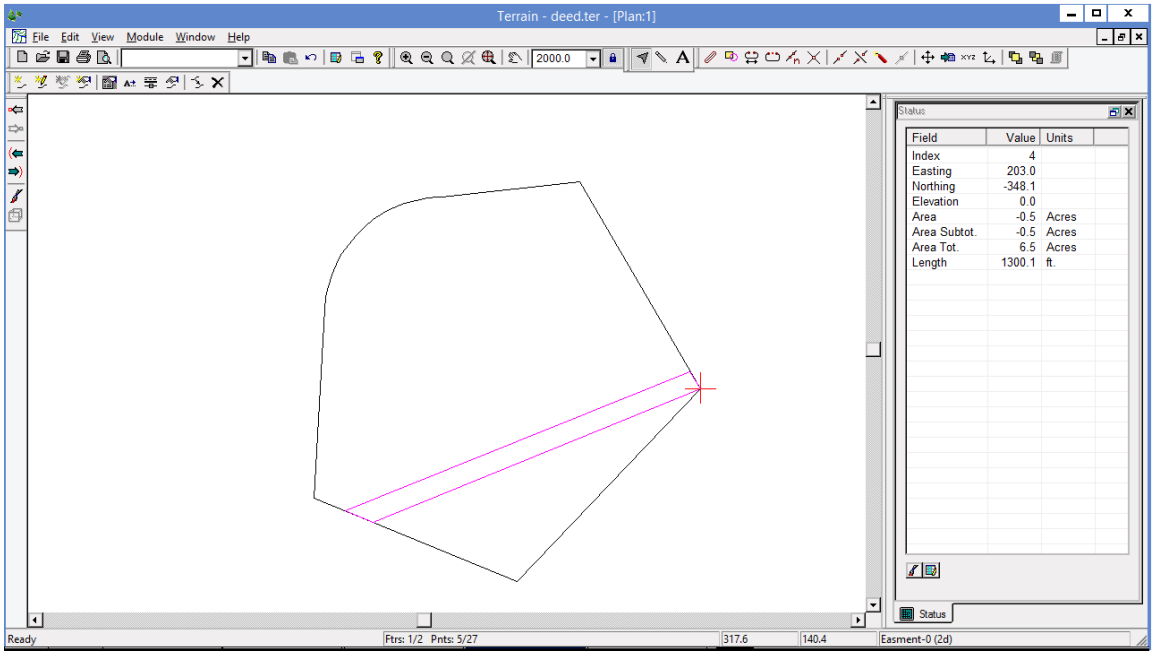


Figure 5.20: Lot Boundary and Easement

The survey entry is complete. The step below will turn on labels for the Lot 23 boundary only; this is called *Feature Formatting*.

15. Display survey information labels for Lot 23:

    a. Select the *Lot 23* boundary .

    b. Choose menu *Edit* | *Modify Selected Feature(s)* | *Labels*.

    c. Turn on *Azimuth*, *Horizontal Distance*, *Horz. IP at Curves* (Curve Information) and *Area* labels (double click on the items in the list-box).

    d. Press *OK*.

The selected feature labels are now displayed in the Plan Window (figure below).

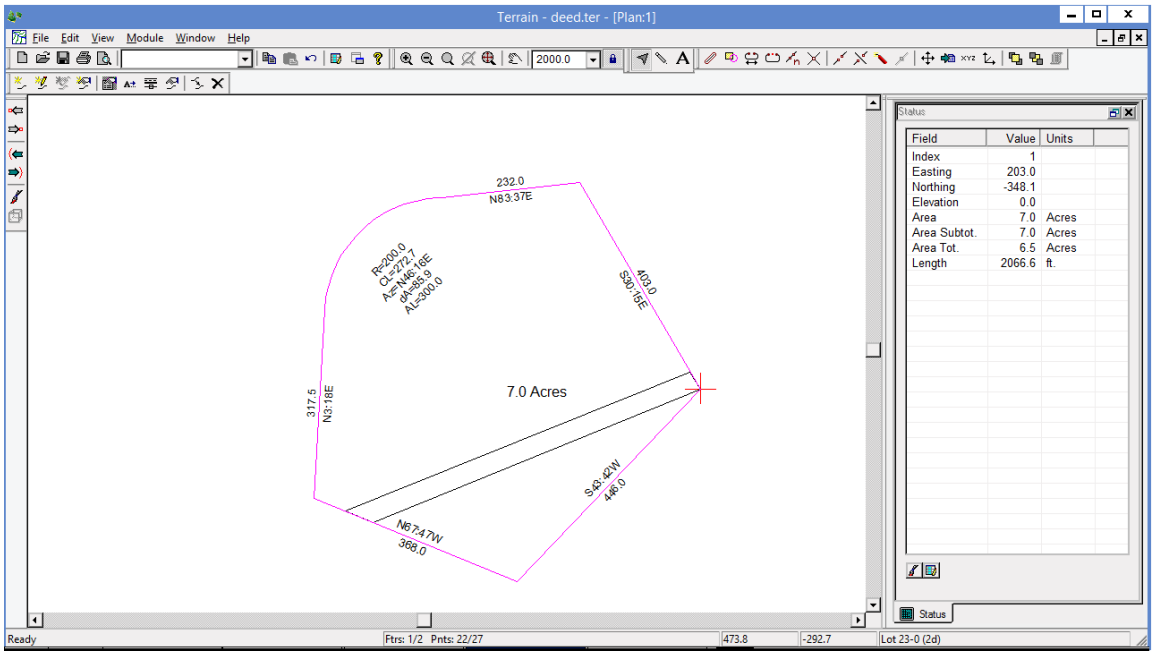


Figure 5.21: Annotated Lot Boundary and Easement

16. *File* | *New*. Do not save the changes.

Coordinate Systems and Map Projections

Defining a coordinates system (map projection) allows you to place points at the correct location on the earth's surface. It also allows you to display Latitude and Longitude (Lat/Lon). This is called *geo-referencing*. For more information about coordinate systems please refer to an introductory textbook on mapping.

Terrain doesn't strictly need to work in a defined coordinate system or map projection. However if you are importing and exporting data to external geo-referenced sources such as GPS or GIS you will want to work in a well-defined coordinate system. Some common coordinate systems include UTM, Albers, and State Plane.

Note: Terrain works in Cartesian coordinates (a system where coordinates are distances measured to perpendicular lines); usually, X=Easting, Y=Northing. Using Lat/Lon (Geographic Coordinates) as your X/Y coordinates is not recommended because distances, angles and areas are not well defined.

Many file types such as Shape, DEM, KML, TIF, TER etc. include geo-reference information. When these files are read into Terrain (using File | Open) the coordinate system is set to match the file. Other file types such as ASCII do not have geo-reference information. To geo-reference these you need manually set the coordinate system.

Note: If you do not need to import/export from/to a different coordinate system and you do not need to see Lat/Lon values, you do not need to define your coordinate system.

Setting Up a Coordinate System

1. *File* | *Open* <Terrain>**Import\roads_a.ter**.

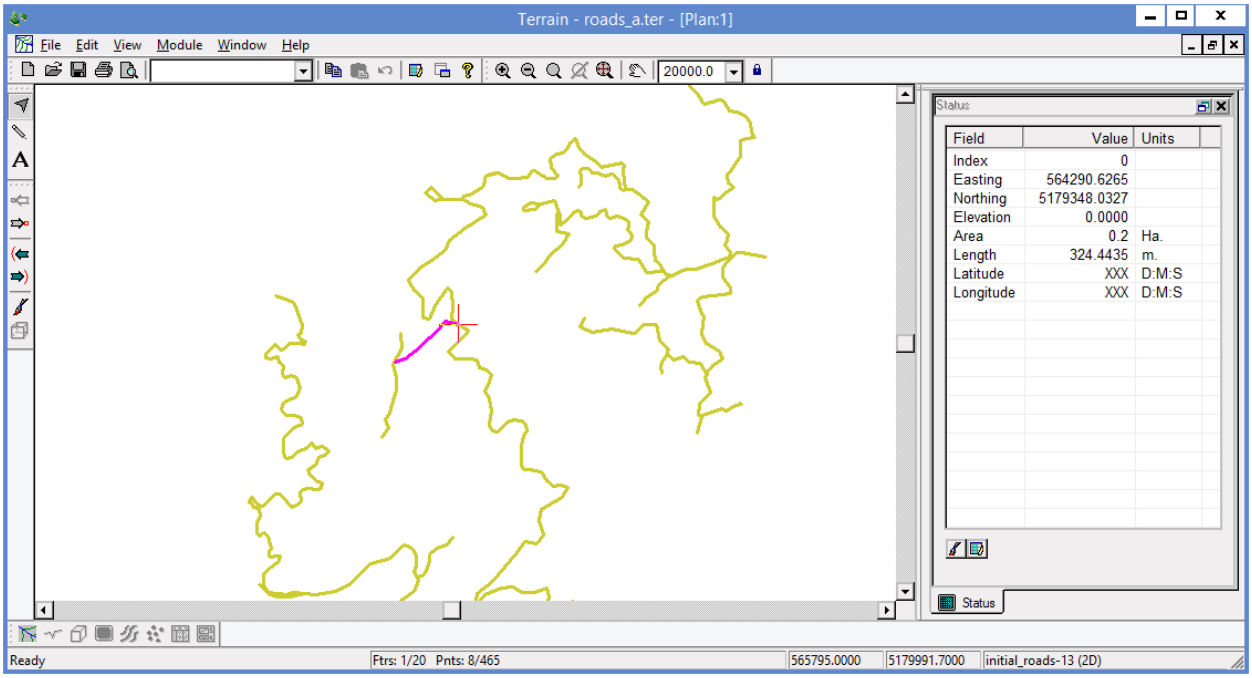


*Figure 5.22: **roads_a.ter** before the projection is defined.*

Notice that the Status window displays coordinates (*Easting* and *Northing*) but *Latitude* and *Longitude* are undefined (figure above).

roads_a.ter does not have any coordinate information attached to it but it is known to be in **UTM Zone 11 NAD 83** coordinates. If we setup the coordinate system in Terrain, the file will be geo-referenced.

2. Define the UTM projection:
3. Select menu Module | Setup, Projection tab.
4. Change the *Projection* settings to those shown in the figure below.
5. Press *OK*.

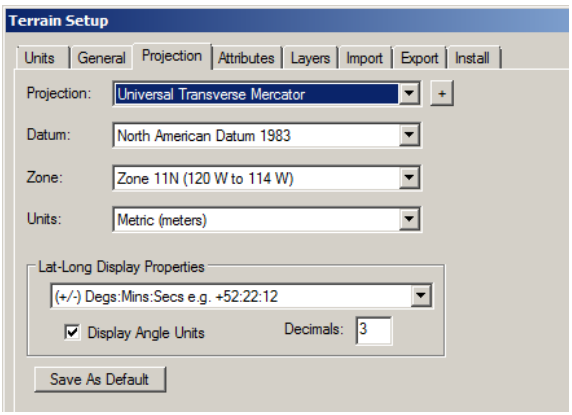


Figure 5.23: Projection settings

Notice that the Status window now displays *Latitude* and *Longitude*.

Verifying a Coordinate System using Google Earth

A quick and easy way to check that a file is correctly geo-referenced, is to export it to *Google Earth*. Google Earth is a free web based 3D mapping software (see www.google.com/earth for more information).

To complete the following steps you will need to have Google Earth installed.

First we will make sure you have a Google Earth export specification (KMZ); this depends on the **Normal.iop** file in your **<Defaults and Layouts>** folder.

6. Open Export Options and check for Google Earth:
7. Select menu *Module* | *Setup*, *Export* tab (figure below).
8. Scroll down and look for *Google Earth (*.kmz).*
9. If you find it, *Cancel* and continue to the step .

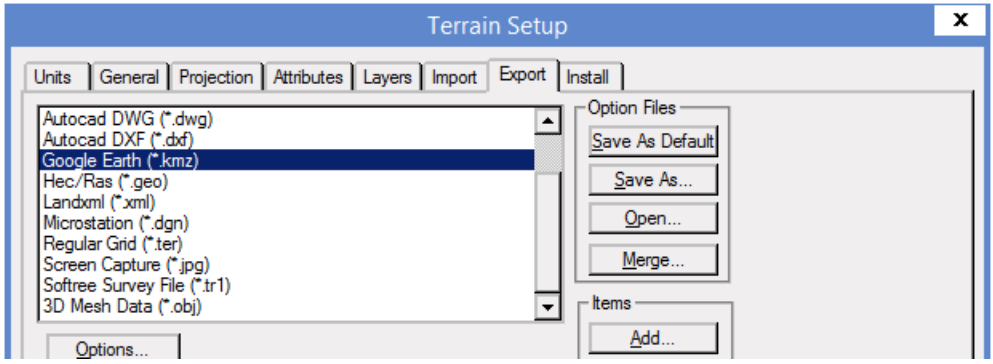


Figure 5.24: Export specifications

10. If the *Google Earth* export format does not exist, press the *Add* button to open the dialogue box below.

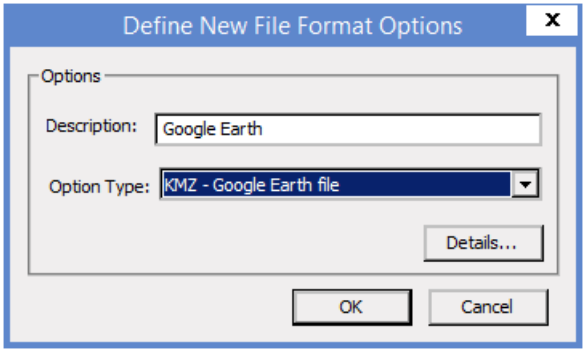


Figure 5.25: New export format options setup for Google Earth.

a. Set up the *Description* and select the *Option type* as shown above.
b. Press *OK* to close the *New File Format Options* dialogue box.
c. Press the *Save As Default* button to save this export format for future use.
d. Press *OK*, to close the *Module* | *Setup* dialogue box.

You should now be ready to check the coordinate system by exporting to Google Earth.

11. Select File | Save As and choose Google Earth (.kmz) from the Save as type pull-down.
12. Enter a *File name* e.g. **roads_a.** Press *Save*.

The *Export Options* dialogue box will now open (figure below).

13. Make sure that *All* Features and *Open in Google Earth* are selected, as shown below. Press *OK*.

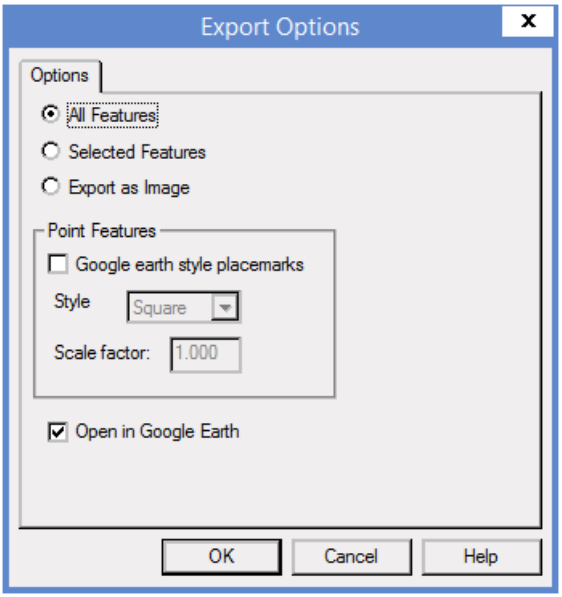


Figure 5.26: Google Earth *export specification*

This should run Google Earth and place your roads at the correct geographical position as shown in the figure below.

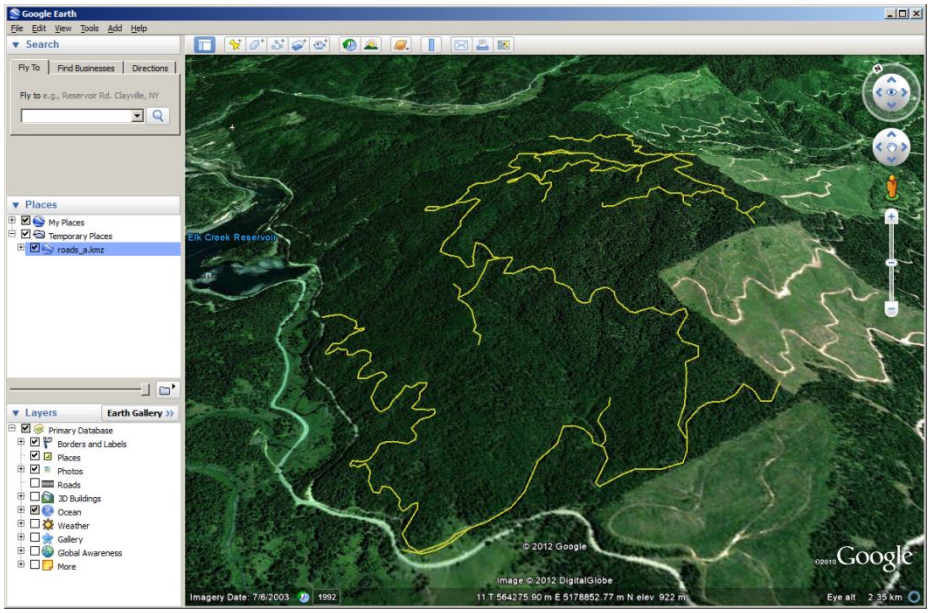


Figure 5.27: Google earth export

14. *Close* Google Earth
15. *File* | *New* to continue to the next example. *File* | *Exit* to close Terrain module. Do not save the changes.

6. Working with LiDAR

LiDAR (**Li**ght **D**irection **A**nd **R**anging) surveys produce very large amounts of relatively accurate three dimensional point data. The data includes points representing laser light scattered from the ground (bare earth), foliage, buildings, transmission lines and other objects. This data is usually broken into tiles, each containing a few million points.

Size and Accuracy Considerations

- The 32 bit version of Terrain is limited to approximately 5 million points.
- Interpolating the LiDAR into regular grid format is not recommended, because this creates additional points by interpolation (lost accuracy). For accuracy purposes it is better to work with the raw data points.
- When importing LiDAR data it is very important to group points together instead of making each point an individual feature. Doing this saves memory, because if a feature is attached to many individual points, you will end up with thousands of features, and this will take a long time to load. By grouping points into features, the memory used for that feature is 'shared' by many points.

It is not uncommon to have data sets with hundreds of millions of points (well exceeding the recommended maximum of 5 million points). This limitation is generally not a problem for most corridor projects, if points outside the area of interest are thinned. Consider a relatively large road project say 20 kilometers (~ 12 miles). Assume that your LiDAR horizontal resolution is 1 meter (3 feet) and that you have identified a corridor that is 200 meters (~656 ft.) wide along a preliminary alignment. This yields about 4 million data points.

Importing LiDAR in ASCII format

Large data sets need to be loaded in such a way that they use the least amount of memory possible. In the next section, you will load a prepared LiDAR import format from an **IOP** (Input/Output Parameters) file.

Note: If your data is in LAS format, many of the steps in the next section are not required. However, the corridor thinning technique is required for both formats. LAS format is the preferred format for LiDAR, as it is compact and loads fast.

1. Open the *Terrain* module.
2. Open the **<Terrain>\ LiDAR \Empty.ter** file provided with this example.
3. Choose the *Module-Setup* menu to open the *Terrain Setup* dialog box.
    a) Select the *Import* tab.
    b) Press the *Merge* button and browse to find the import options file. **<Terrain>\LIDAR \Lidar2.iop**. See figure below.

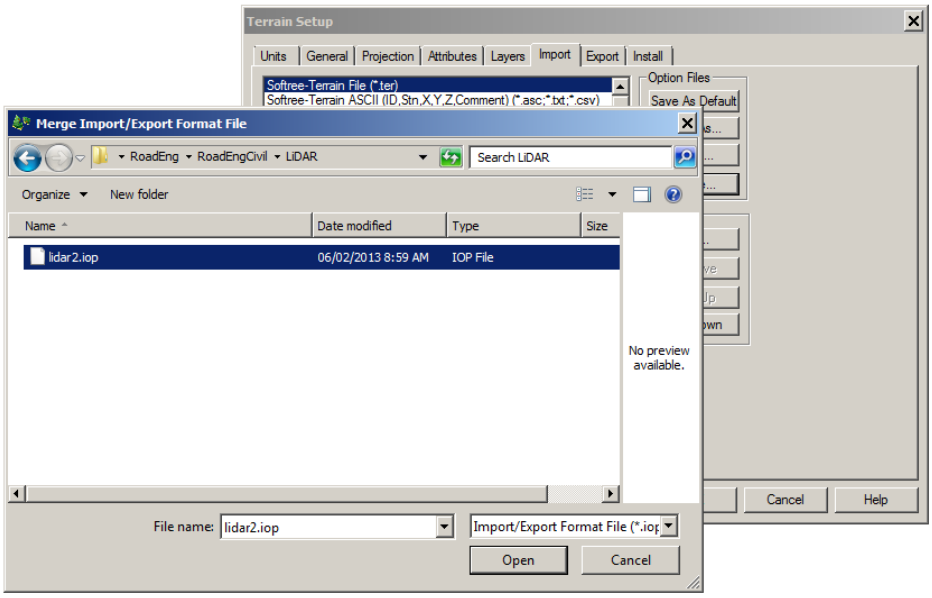


Figure 6.1: Changing import options by opening an IOP file.

c) Press *Open* to read the options (including *ASCII Lidar*, *Image* and *Arcview Shape*).

4. Press *OK* to close the *Module Setup* dialog box.

Setting up a Linear Corridor Feature

Now you will read in a proposed center line and later use it to create an area of interest.

5. Select menu File | Insert File.

   e. Select *Files of type*: **Shape (Arc) (*.shp)** at the bottom of the list (the one we added when we *Merged* **Lidar2.iop**).

   f. Browse for file <Terrain>\LiDAR\ ProposedAlignment.shp.

   g. Press *Open.* The Import options dialog box below appears. Press OK.

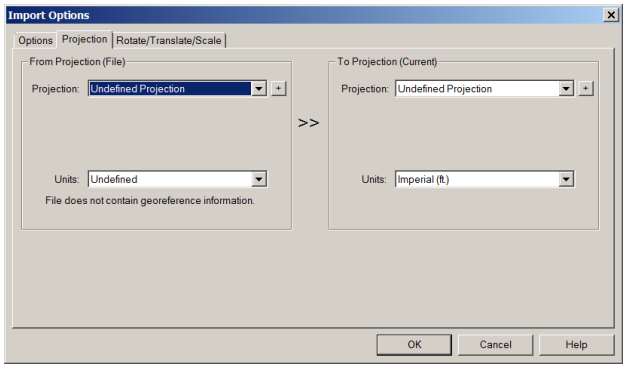


Figure 6.2: Import Options dialog box.

6. *Softree Warning* stating incoming coordinate system and unit are undefined appears. The coordinate system and units in **empty.ter** are correct. Enable *Do not show this message again*. Press OK to continue to load the proposed center line shown below.

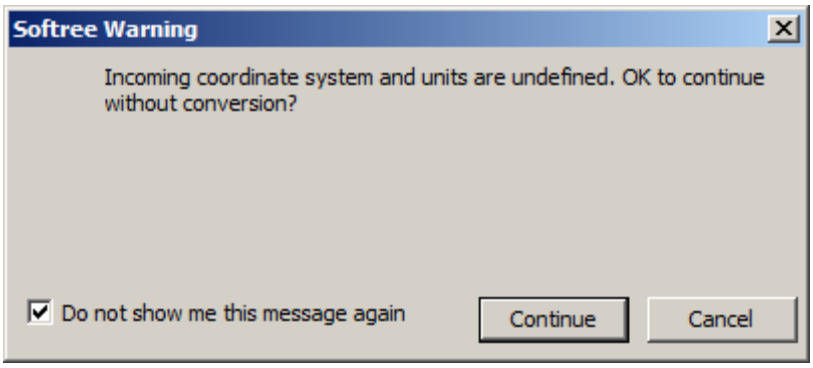


Figure 6.3: Softree warning.

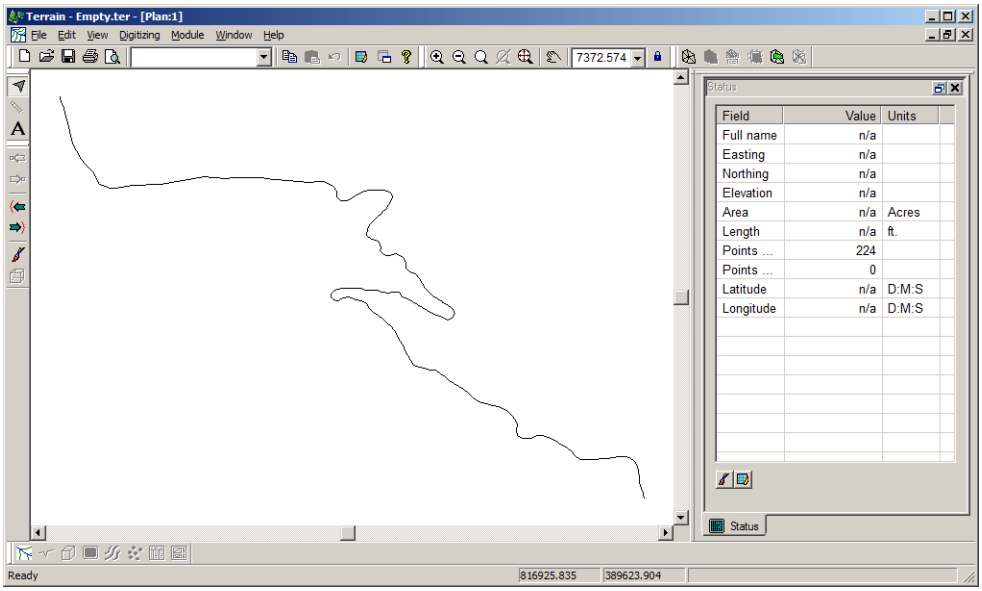


Figure 6.4: Proposed road center line.

This example only contains approximately 700,000 points to save download and file read time.

In the following steps we will read in the data at full resolution in the area of interest (AOI) and skip some points outside this area. In addition we will follow some important guidelines to prevent slow draw times and memory overload.

7. Use menu *File* | *Insert File* to display the *Insert File* dialog box.
    h. Select ASCII Lidar (x,y,z) in the Files of Type drop down.
    i. Select both **TXT** files included with this example.

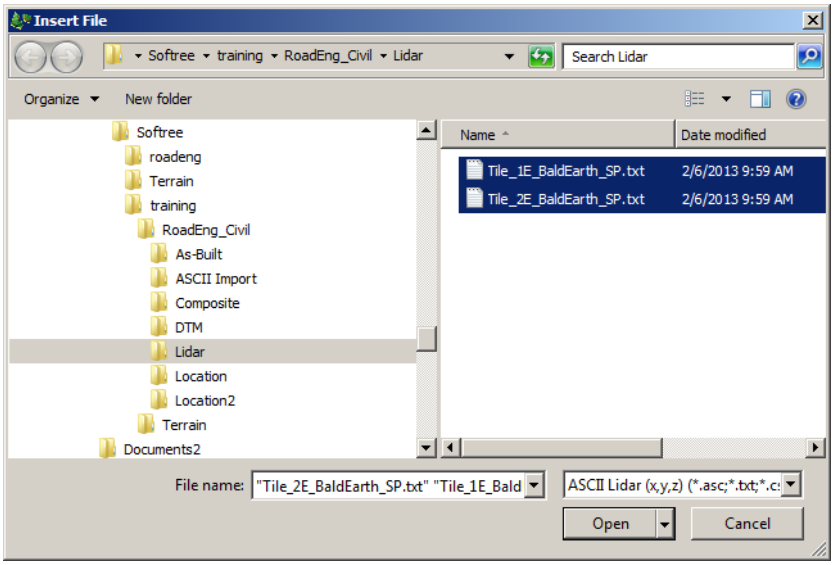


Figure 6.5: Inserting Multiple LiDAR files.

Note: *File* | *Insert* unlike *File* | *Open* allows you to select multiple files at once and does not clear existing features from your Terrain.

You will now be presented with the import options (in case you want to make last minute changes).

8. Click on the *Test* tab then on the *Next Record* button a few times to see what the file looks like.

Note that the *X, Y, Z* fields are showing the correct values (figure below). This indicates that the options set in the *Structure* tab are working correctly.

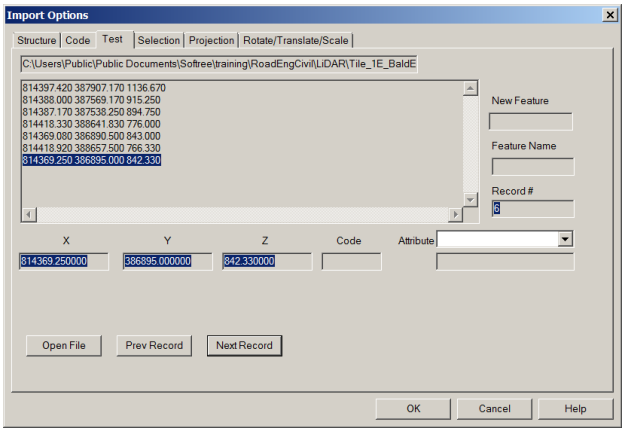


Figure 9.6.6: The Test *tab after pressing the* Next Record *button a few times.*

Memory Usage / Display Speed Guidelines

Other *Import Options* have been setup to avoid using more memory than necessary and to make the resulting Terrain display manageable. The following rules are necessary when importing large data sets:

a) Do not attach comments or other attributes to every point.

b) Do not allow very large numbers of points in features.

c) Do not make every point into a separate feature.

d) Do not attach symbols to every point.

e) Do not turn on labels (such as Elevation) that will display at every point.

If you use the standard LiDAR import options these guidelines will be taken care of for you.

9. Click on the *Structure* tab. Notice that there are no *Attributes* defined in the *Column Assignment* section (Rule **A**).

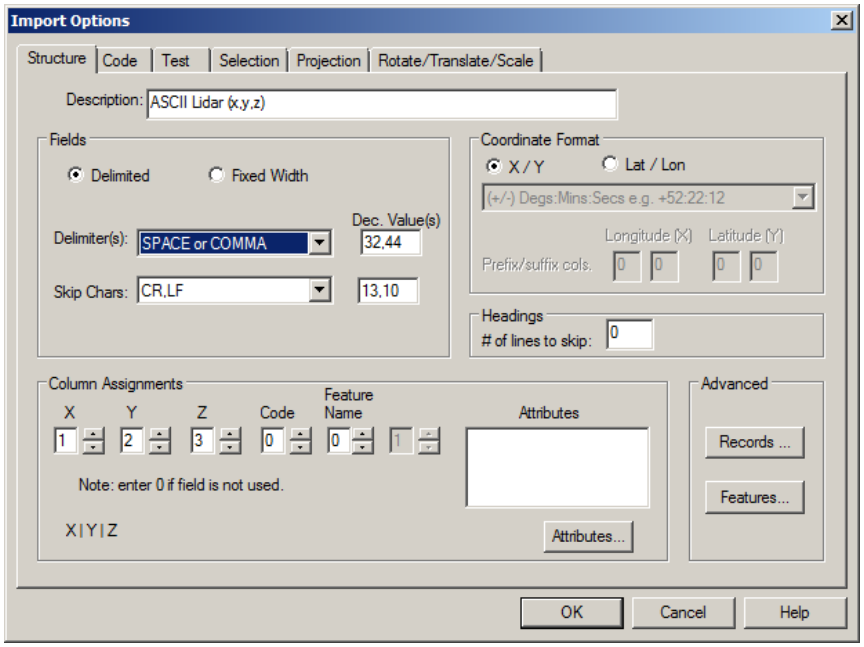


Figure 6.7: The structure tab defines the location of the X,Y,Z coordinates.

10. Press the *Features* button in the *Advanced* section of the *Structure* tab (lower right). Note that the *Feature Size* has been limited to 1024 points (Rule ***B***) as shown below. *Cancel* to close.

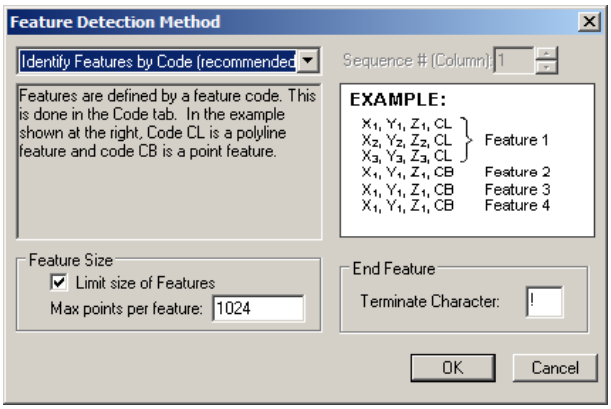


Figure 6.8: Feature size is limited to 1024 points.

11. Click on the *Code* tab. Note that all points are combined *Polylines*, *Connect All*. (Rule ***C***). The resulting features will appear as points, because the *Connected* property is turned off.

    Also note that no symbol is defined (rule ***D*** above). In some cases it makes sense to turn off the *Displayed* property, to speed draw time later.

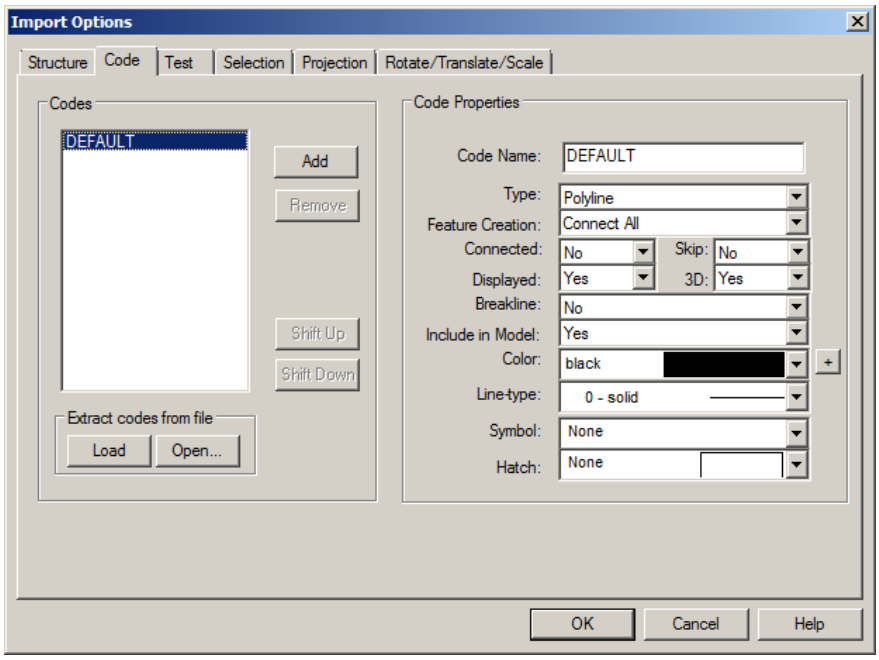


Figure 6.9: Point code properties suitable for large data set import.

Trim the tile to the area of interest

12. Click on the *Selection* tab to show the options below:

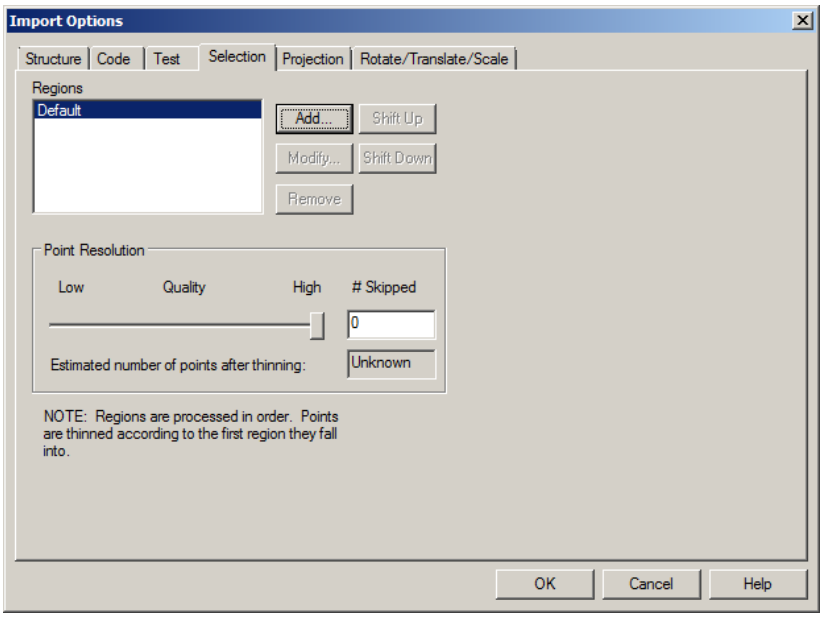


Figure 6.10: Selection *options.*

13. Press the *Add* button and to open the *Filtering Region* options as shown below.

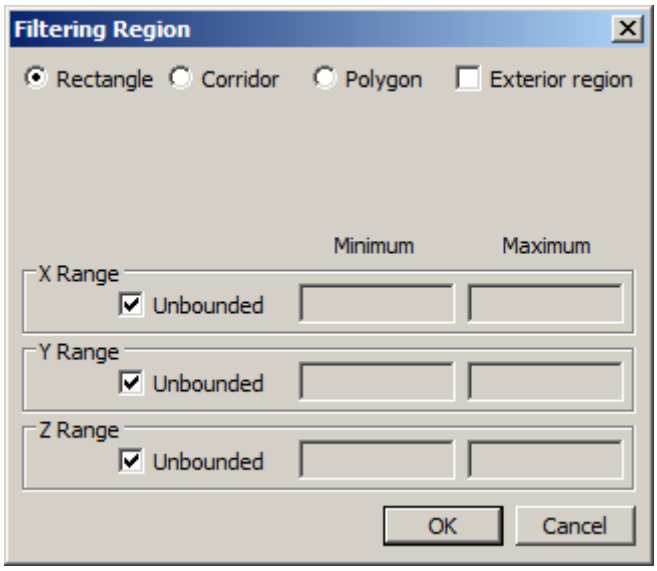


Figure 6.11: Filtering *options.*

14. Set the *Corridor* radio button as shown below.

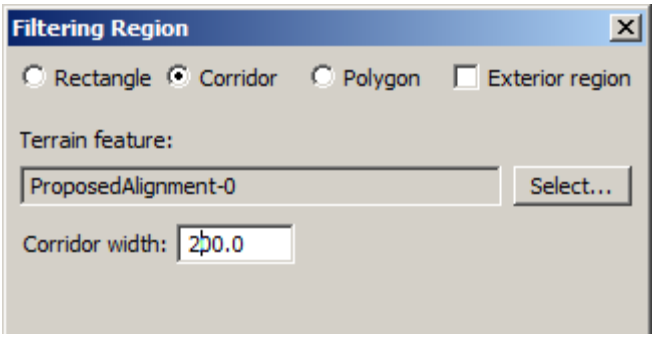


Figure 6.12: Filtering *option with Corridor selected.*

15. Press the *Select* button. Double click on the alignment feature. Press OK. Change the *Corridor width* to 200.

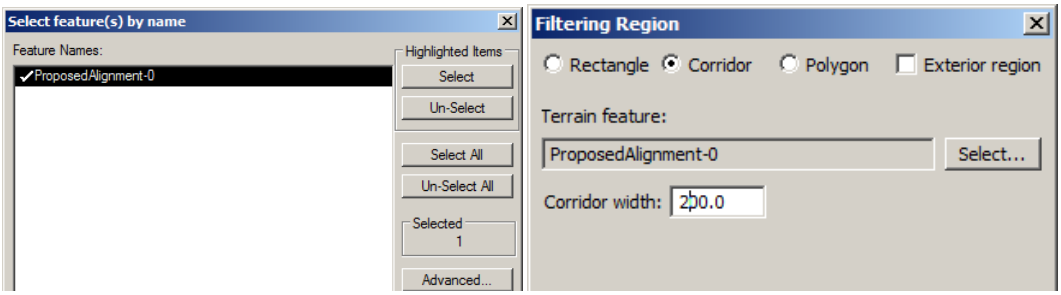


Figure 6.13: Defining a corridor with a linear feature.

16. Press OK to close the *Filtering Region* dialog box.
17. Select the *Default Region* in the list and slide the *Point Resolution* to 9 out of 10 points skipped (see figure below).

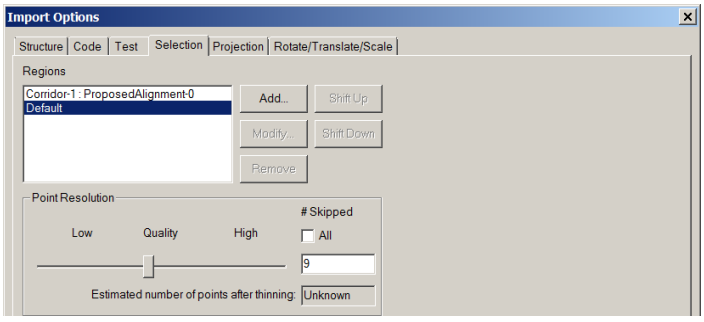


Figure 6.14: These options will skip most points outside of Corridor-1.

18. Now press the *OK* button to read the data.

It will take a couple of minutes to import about 69,000 points out of the 680,000 available.

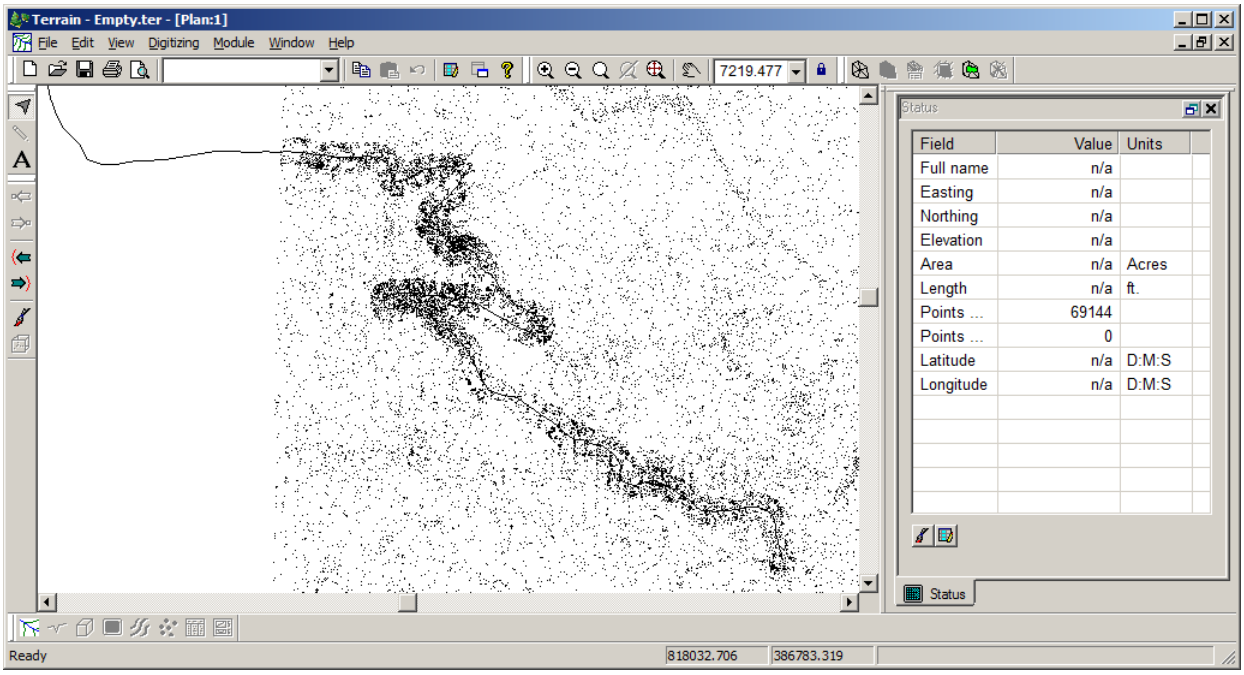


Figure 6.15: Full point density along a corridor, reduced density outside.

7. Digital Terrain Modeling

A TIN (Triangular Irregular Network) Model is a 3 dimensional surface which can be used to generate contours and profiles. Each triangle is a planar facet with vertices at the known elevation points.

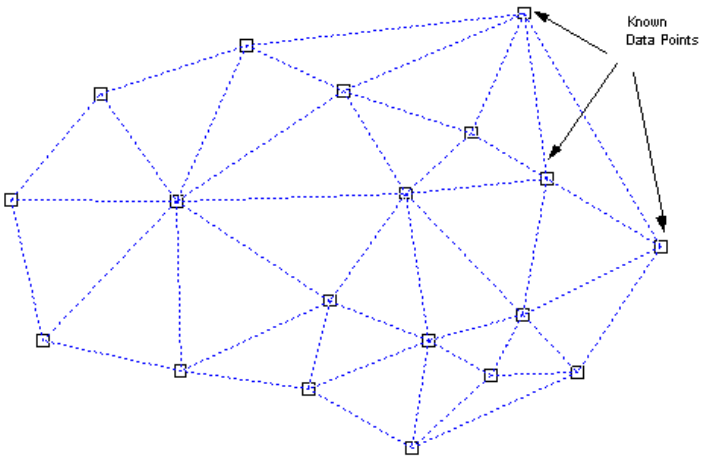
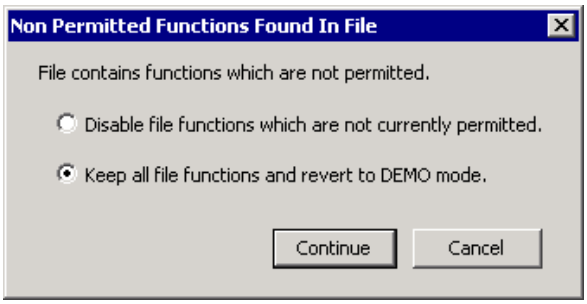


Figure 7.1: Triangle model

Once a TIN model has been created, the program can rapidly determine the elevation of a new point using the known elevations of the surrounding triangle. This allows contours and profiles to be generated.

To follow the examples and procedures in this section, the *Mapping and Drafting, Import Basic, Import Extended, Surface Generation and Contouring,* function groups need to be enabled. The last example also requires the *Volume Calculation and Reporting* function group. See *Function Groups* in the On-line help for more information.

If your software license does not include the required Function Groups, when you open a file or screen layout you will be prompted:



Choose “Keep all the functions and revert to DEMO mode”. Examples in this section can be completed in Demonstration Mode. Contact Softree to upgrade your license to permit more functions.

Creating a Contour Map

Road Design Example

In this example a DXF file containing a section of designed road will be imported. Although the file was created in the Softree - Location Module (by exporting the road edges, slope stakes and right of way lines), the concepts can be applied to coordinate data files generated by other methods (surveying, digitizing, GIS, GPS etc.).

Generating Contours

Note: See Getting Started section for file install folders (**<Terrain>** and **<Defaults and Layouts>**)

1. *File | Retrieve Screen Layout*, **<Defaults and Layouts>\Training\training model.ilt**
2. Select *File | Insert File*. From the *Files of Type AutoCAD DXF (*dxf)* Open **<Terrain>\DTM\design1.dxf**.

The *Import DWG/DXF Options* dialogue will appear as shown in the figure below. Although it is not relevant to this example, the *Import DWG/DXF Options* dialogue contains several useful options. To find out more press the F1 key while this dialogue is displayed to access On-line Help.

3. Set the Import Options dialogue box Options tab to match those shown below. Press OK.

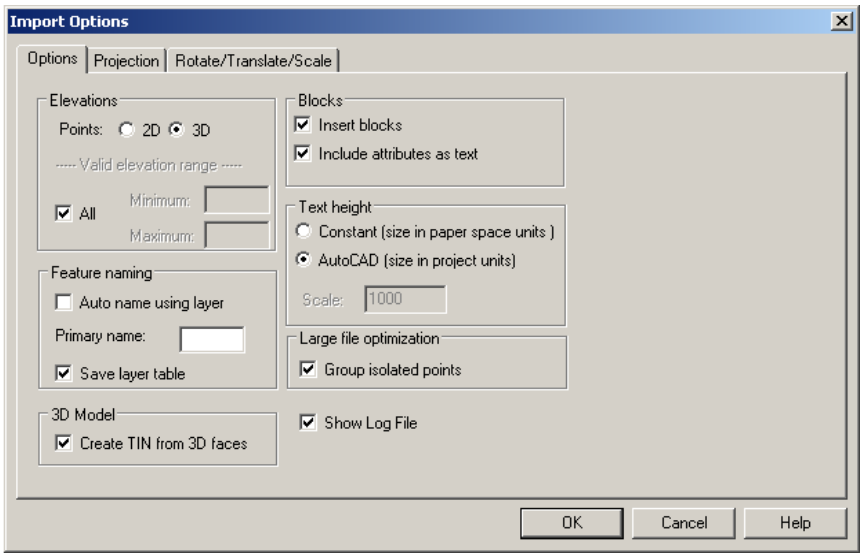
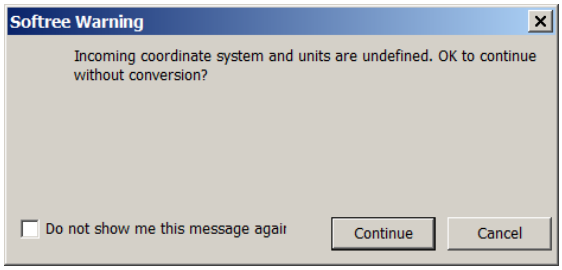


Figure 7.2: Import DWG/DXF Options Dialogue box Options Tab



4. Softree warning appears – press continue

5. Press the *Zoom extents* button.

The Plan Window now displays the Imported Features with Road Edges, Slope Stakes and Right of Way shown in the figure below.

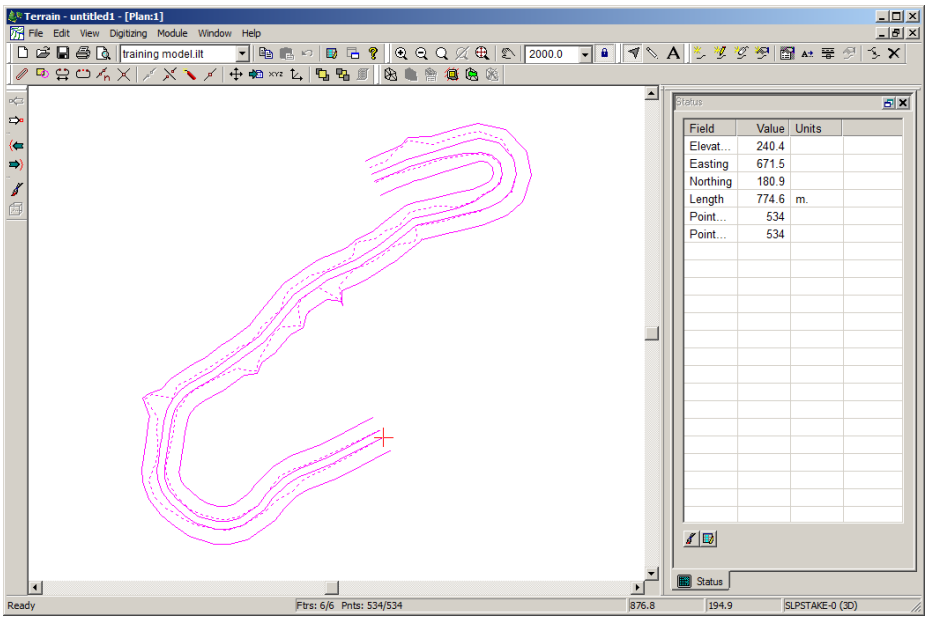


Figure 7.3: Imported features (road edges, slope stakes and right of way)

6. Press the *Generate TIN* button or *Edit*| *Terrain Modeling*| *Calculate Terrain Model* to open the *Terrain Calculation* dialogue box shown below.

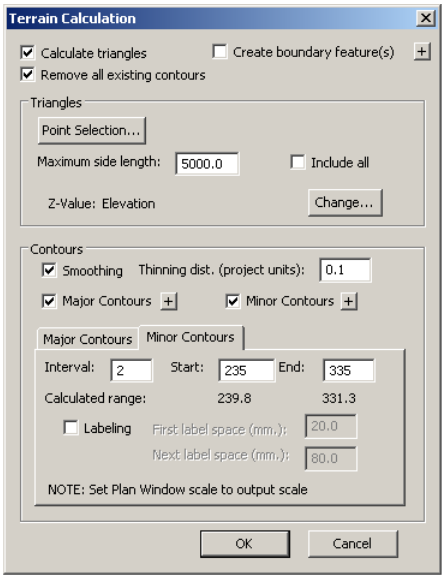


Figure 7.4: Terrain calculation *dialogue*

7. Change your dialogue box so it displays the same information as above. Note that *Major Contour* and *Minor Contours* are two separate tabs.
8. Select the *Major Contours* tab and change the *Interval* to **10** and turn on labeling.
9. To specify color and line-type, press the button beside *Major Contours.* Change the color to *Green* and the line-type to *Thick (Medium)*. Press OK.
10. Press the button beside *Minor Contours* and change the color and line-type to *Green* and 0-*Solid* respectively. Press OK.

Once the TIN model has been generated, contours are formed by creating a straight-line segment across each triangle.

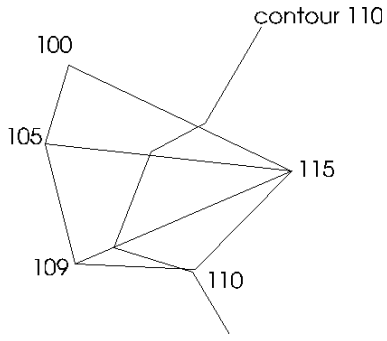


Figure 7.5: Example contour formation

If contour smoothing has been enabled, the resulting line segments are joined together and thinned to remove any points that are close together. The spacing is controlled by the *Thinning Distance* parameter (see *Example contour formation* in the figure above). This step effectively removes any small sharp bends in the contour. The resulting contour is then fitted with a mathematical (spline) curve.

11. Press OK to calculate triangles and contours.

The screen should now display the Contours as shown in the figure below. The Major Contours are thick and labelled. The Minor contours are thin and un-labelled.

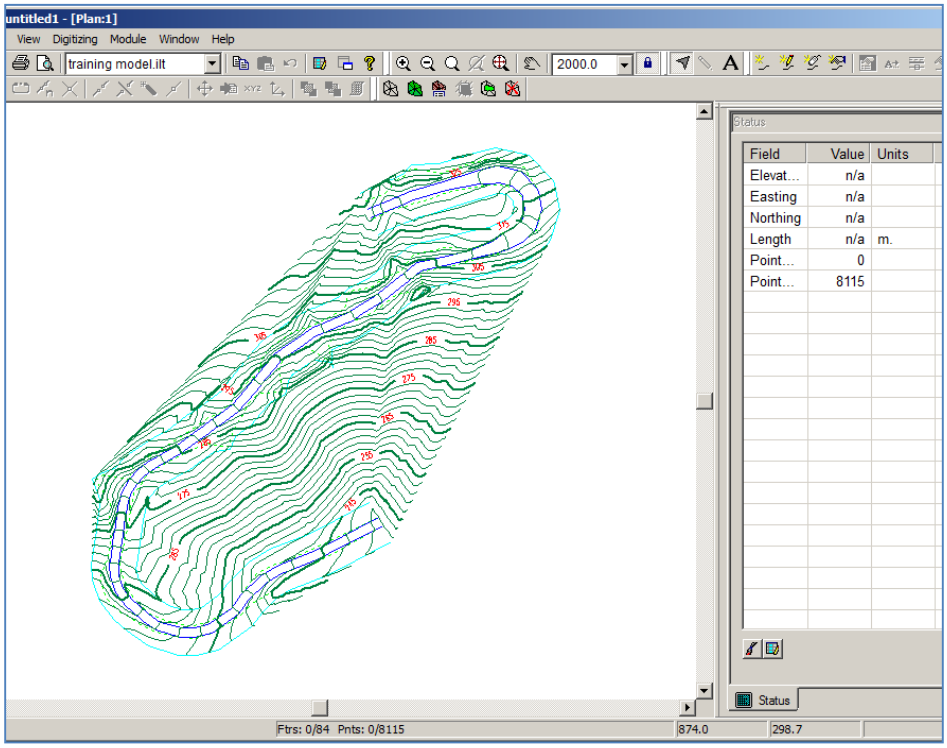


Figure 7.6: Contours - 2-meter interval

Removing Void Areas

The contours extend outside of the road corridor, due to the formation of large triangles, which interpolate between widely spaced data points. These contours are not accurate because they are too far from the known data points. There are two methods to resolve this problem. Either method can be used. This example demonstrates both methods:

Method 1	Limiting the side length of the triangle.
Method 2	Defining a TIN Boundary

Method 1: Limiting the length of the triangle

12. Edit | Terrain Modeling | Calculate Terrain Model or press the Generate TIN button to activate the Terrain Calculation dialogue box. Select Calculate Triangles, de-select Include all and change the Maximum side length to **50**. Press OK.

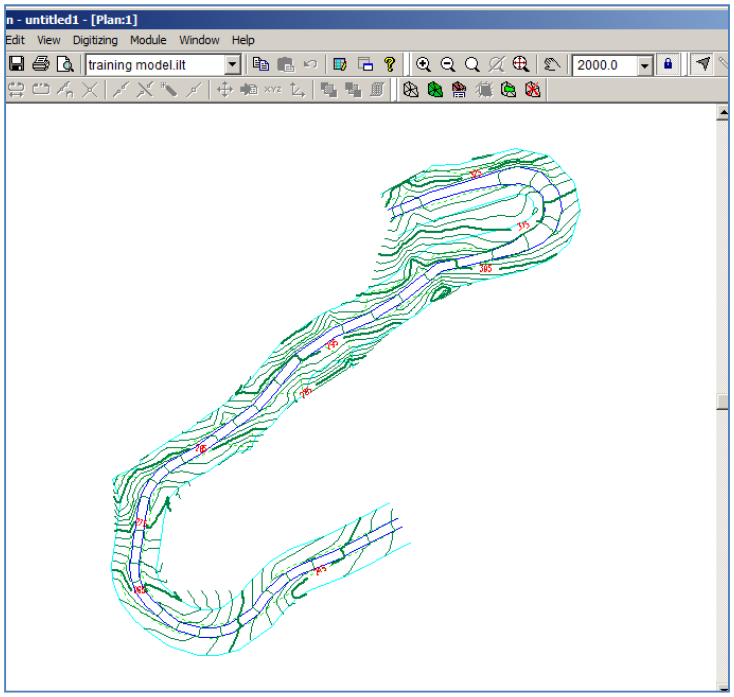


Figure 7.7: Contours generated with side length control

The contours now follow the road corridor; however, they still extend outside the road corridor particularly in the upper right corner.

Method 2 – Defining a TIN Boundary

The next step uses an explicit boundary feature to control the creation of triangles.

13. Edit | Select Feature(s) | By Name. Press the Un-Select All button inside the Select feature(s) by name dialogue box as shown below.

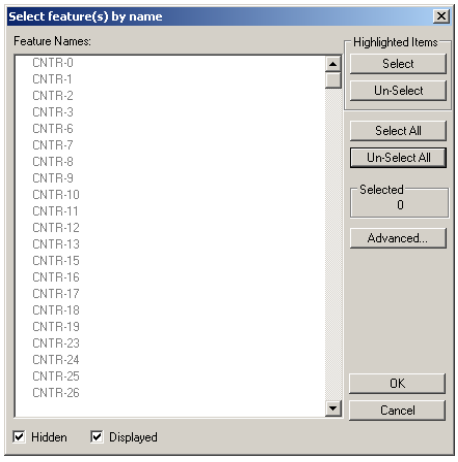


Figure 7.8: Select feature(s) by name dialogue box

14. Press the *Advanced* button and the *Select Feature(s) by Name* dialogue box will change and look as in the figure below, then select *ROW* in the *Predefined Layers* drop box and then press *Select.* Press OK.

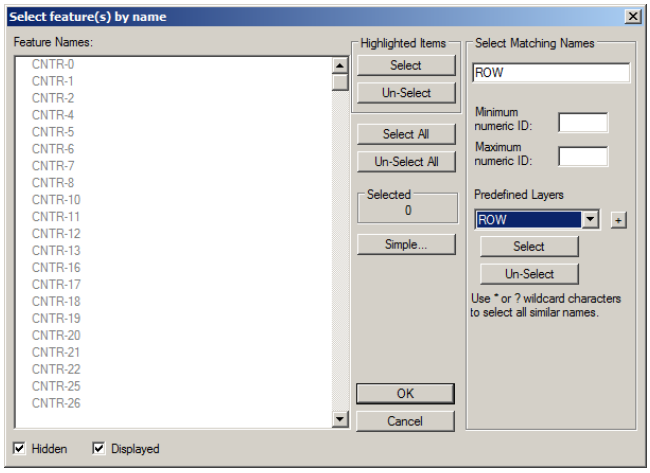


Figure 7.9: Select feature(s) by name dialogue box with advanced section

15. Press the *Join* button or select *Edit* | *Modify Selected Feature(s)* | *Join*. (If this menu is disabled, then a minimum of two features have not been selected.) You will be prompted "Warning existing triangles will be cleared". Respond "OK". One of the ends will be joined.

16. With the joined feature still selected, press the *Properties* button or Edit | Modify Selected Feature(s) | Properties to activate the *Feature Properties* dialogue box.

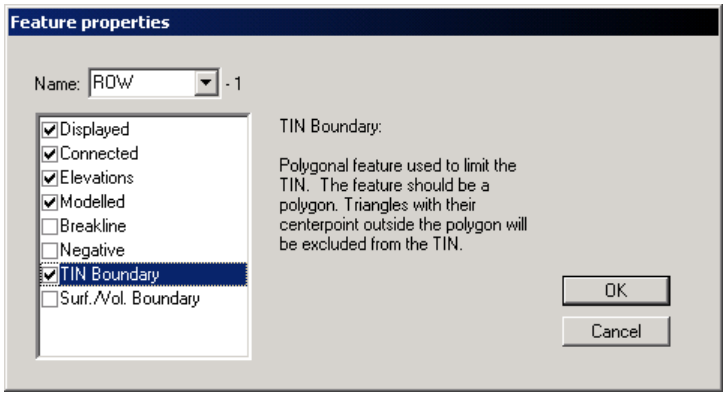


Figure 7.10: Tin boundary feature set in properties dialogue

17. Enable *TIN Boundary* and press OK.

When triangles are created, features with *TIN Boundary* activated are used to limit the extent of the triangulation. All triangles with their center point inside the TIN Boundary will be retained. If the TIN Boundary feature has the "Negative Area" property set then its area will be excluded.

18. *Edit* | *Terrain Modeling* | *Calculate Terrain Model* or press the *Generate TIN* button. Make sure that *Major Contours* and *Minor Contours* are selected and press OK. The contours now fall completely inside the right of way boundary.

The following steps will demonstrate how to remove triangles inside a TIN Boundary polygon. In this case, they will be removed from the road surface.

19. *Edit* | *Select Feature(s)* | *By Name*. Press the *Un-Select All* button. *Select* the features called REDGE-0 and REDGE-1. Press OK.
20. Select *Modify Selected Feature(s)*| *Join* (if this menu is disabled, then you have not selected two features) or press the *Join*  button. You will be prompted "Warning existing triangles will be cleared. Respond "OK".
21. With the joined feature still selected, *Edit* | *Modify Selected Feature(s)* | *Properties* or press the *Properties*  button in the toolbar. Change Feature Properties so that Negative and TIN Boundary are enabled (see figure below). Press OK.

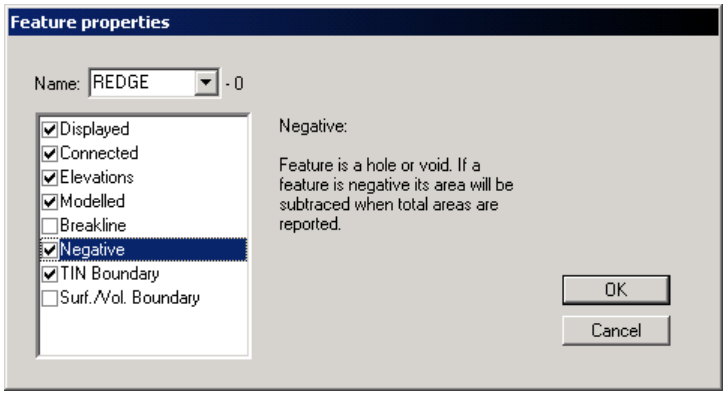


Figure 7.11: Negative area set for a TIN boundary feature

22. Edit | Terrain Modeling | Calculate Terrain Model. Make sure that Major Contours and Minor Contours are selected and press OK. (see figure below).

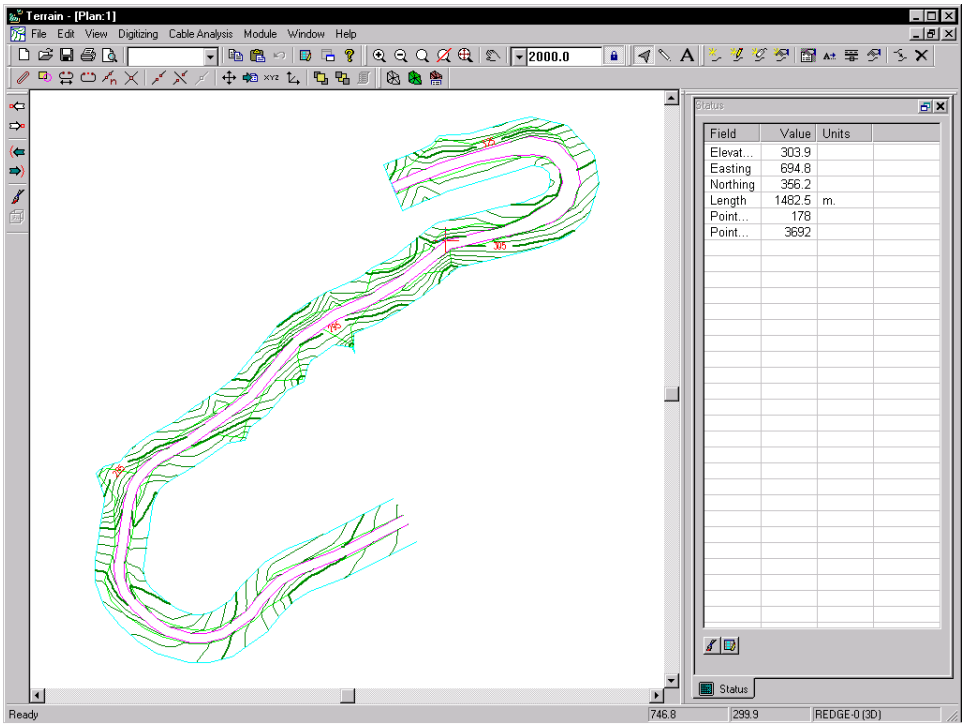


Figure 7.12: Contours generated with road surface excluded

23. *File*|*New*. Do not save changes.

Improving Contouring with Breaklines

Site Survey Example

Identifying and modeling breaklines can significantly improve the accuracy of a TIN model and associated contours. Breaklines are sharp changes in ground slope such as a creek bank, an edge of a road, an edge of ditch or a rock bluff.

Triangles should not be allowed to form across these features, since doing so would flatten the slope across the break. Features in the Terrain Module will be used as breaklines when their *Breakline* property is enabled. Triangle link lines will not cross *Breakline* features.

This breakline example uses a topographic survey around a creek. The data was created and adjusted in the Survey/Map module. See Survey/Map Tutorial - *Making a Map with Multiple Traverses* for more information.

1. *File* | *Open*. Change Files of Type to Softree-Terrain File (*.TER).
2. Select **<Terrain>\DTM\breakline.ter.** Press *Open*.
3. Press the Generate TIN button or Edit | Calculate Terrain Model to activate the Terrain Calculation dialogue box.
4. Turn on Major Contours, Minor Contours and Smoothing.

5. Under Triangles, change the *Maximum Side Length* to **60** (there are no void areas in this model).
6. Select the *Minor Contours* tab and change the *Interval* to **1.0.**
7. Select the *Major Contours* tab and change the *Interval* to **5** and turn on *Labeling*. Press OK.

Once the calculation is complete, a model of a creek with poorly generated contours will be displayed.

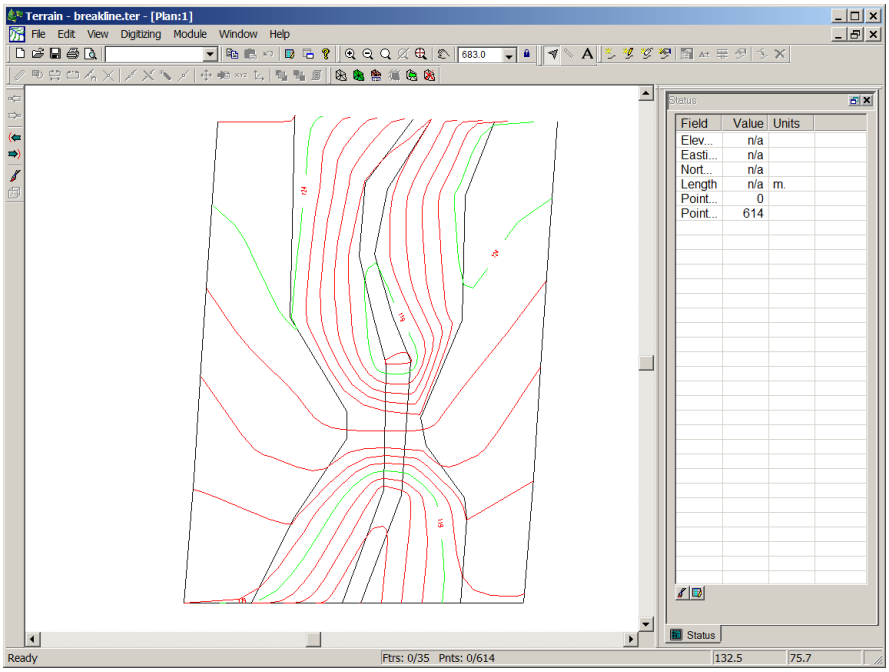


Figure 7.13: Model of creek with poorly generated contours

As an optional exercise, *use View | Active Window (Plan) Options | Surface Tab.* Enable the display of triangles. After looking at the triangles that represent the TIN model, turn the display off again for the rest of this example

The plan view in the figure above has contours that show the creek bottom rising up to the same elevation as the top of the banks (scarp 1, 2). This is due to triangles being formed between the scarp features and crossing over the creek features. To correct this, the defining features are made into breaklines.

8. *Edit | Select Feature(s) | By Name*. Press *Un-Select All* then *Select* features as shown in the figure below by double clicking on them in the *Select feature (s) by name* window. Press OK.

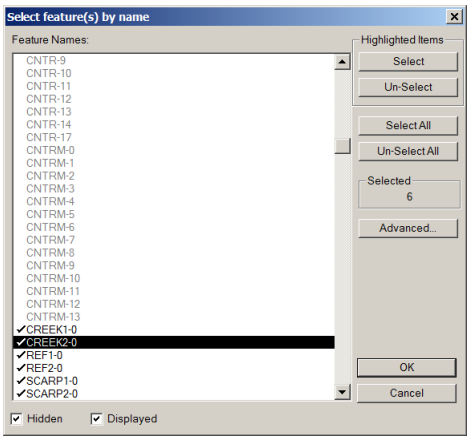


Figure 7.14: Select feature(s) by name dialogue

9. Press the *Properties*  or *Edit* | *Modify Selected Feature(s)* | *Properties*. Enable Breakline. As shown in figure below. Press OK.

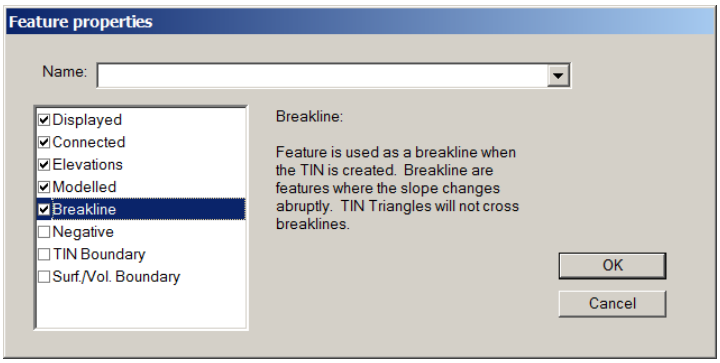


Figure 7.15: Modify feature properties dialogue

10. Press the *Generate TIN*  button. Press *OK*.

After re-calculating, the contour lines now indicate a continuous gully as shown in the figure below.

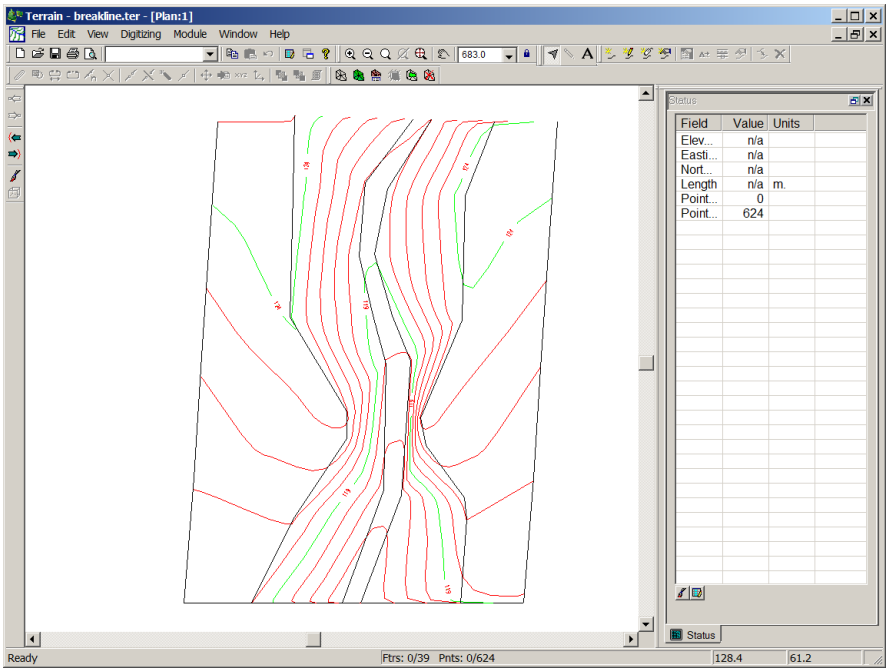


Figure 7.16: Contours after breaklines have been set

11. *File* | *New*. Do not save changes.

Calculating Volumes

This example requires *Mapping and Drafting*, *Import Basic*, *Surface Generation and Contouring and Volume Calculation and Reporting* function groups enabled. See *Function Groups* in the On-line help for more information.

This example cannot be completed without the required function groups. Contact Softree to upgrade your license to permit more functions if required.

Cut and fill quantities can be computed between any two triangulated surfaces or one surface and a TIN Boundary (another polygonal boundary can also be included to restrict the calculation to a specific area). Applications of this facility are numerous and include site design, stockpile and as-built quantities. To illustrate the concept, a rock quarry and a stockpile example will be done. The rock quarry example demonstrates volumes of material excavated using two surfaces and the stockpile example demonstrates volumes using only one surface.

Calculating Volumes Using Two Surfaces

Rock Quarry Example

1. *File*|*Open* <Terrain>\DTM\original ground.ter.

original ground.ter was created from a total station survey of a rock quarry. The XYZ coordinate points were imported, a triangulated surface and corresponding contours were generated and saved in a Terrain file (**original ground.ter)**

After the rock was removed from the quarry, another survey was done and again imported, triangulated and saved in a second Terrain file (**excavation.ter**).

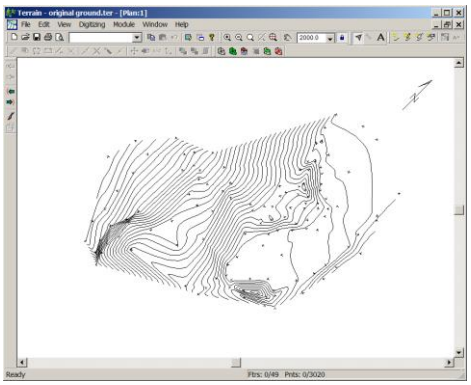


Figure 7.17:Original surface (original ground.ter)

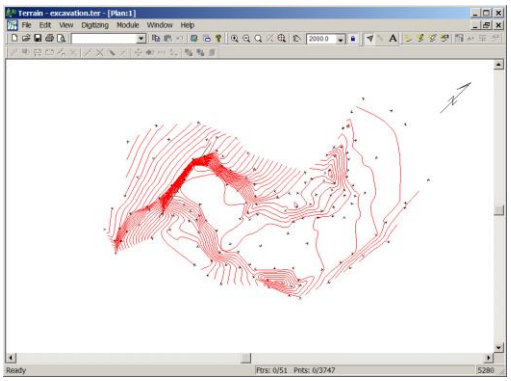


Figure 7.18: Surface after excavation (*excavation.ter)*

2. Press the *Calculate Volumes* button or select *Edit* | *Terrain Modeling* | *Calculate Volumes/Surf. Properties* to activate the dialogue box below.

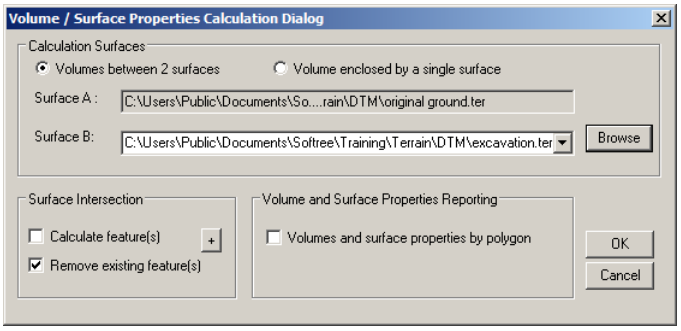


Figure 7.19: Volume / surface properties calculation *dialogue*

Note: In order to calculate volumes via this method, you must have created 2 terrain models and saved them in separate files. The first terrain model (surface A) is always the current Terrain.

The *Edit* | *Terrain Modeling* | *Calculate Volumes* menu is disabled if the current file does not have a terrain model. The user specifies the other surface (surface B) in the *Volume / Surface Properties Calculation dialogue box*.

3. Press the *Browse* button opposite *Surface B.* Select **<Terrain>\DTM\excavation.ter.** Press OK. Surface A should be set to **original ground.ter** and surface B should be set to **excavation.ter**. The order of these surfaces is not important as you will see later.

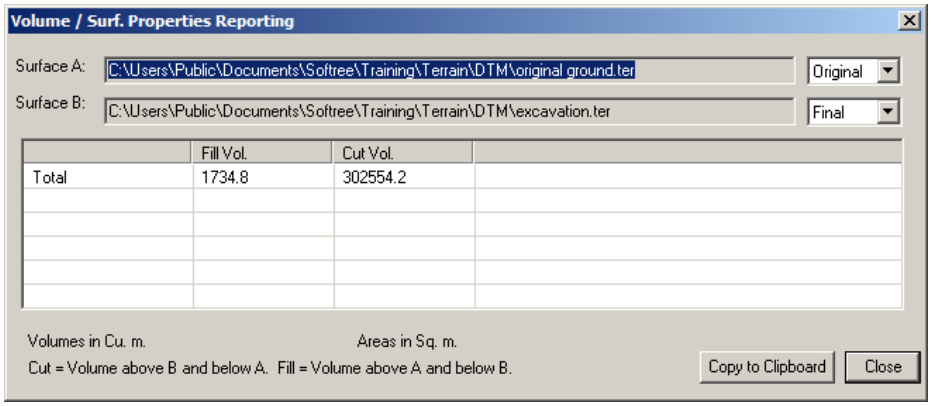


Figure 7.20: Volume / surf. properties reporting dialogue

4. Press the *Close* button.

The following steps demonstrate how to include two polygonal boundaries and calculate the volume inside each one.

5. *File* | *Insert File*. Select and open **<Terrain>\DTM\boundary.ter.** The *Import Options Dialogue box* appears. Press *OK*.

Two boundary polygons should now be visible in the Plan Window as in the figure below. If not visible press the *Zoom Out* button on the tool bar.

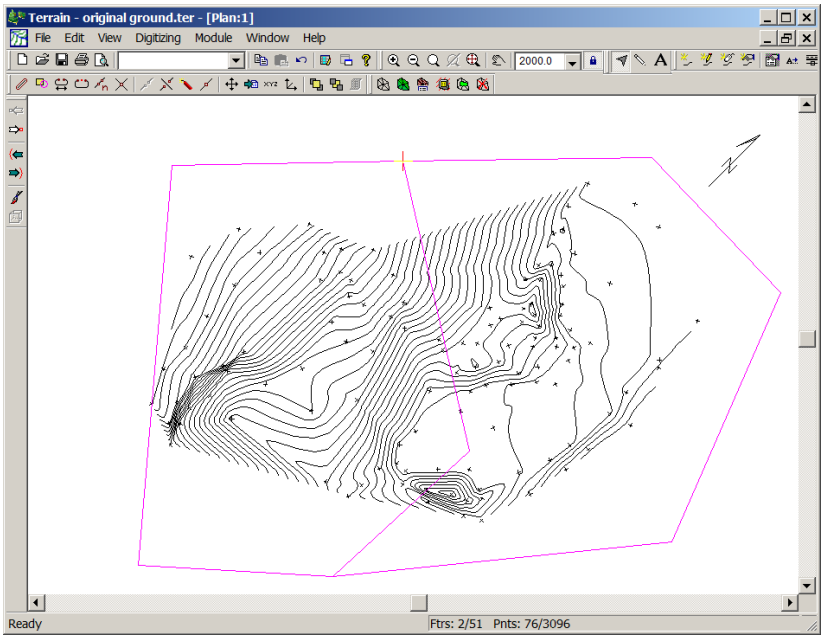


Figure 7.21: *Original topography with boundary polygons*

6. Press the Properties or select Edit | Modify Selected Feature(s) | Properties. Enable Surf/Vol. Boundary. Press OK.

Note: When a feature has surface / volume boundary set volumes, surface area, slope and slope direction will be calculated and assigned to the feature as attributes.

7. Press the Calculate Volumes button to open the Volume / Surface Properties Calculation dialogue box shown in below.

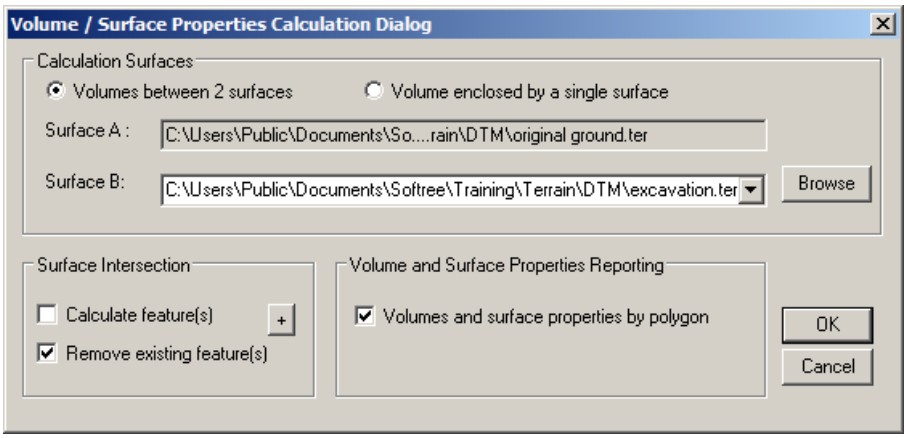


Figure 7.22: *Volume / surface properties calculation dialogue - volumes by polygon*

8. Select *Volumes and surface properties by polygon* and ensure all other selections are as indicated in the figure above. Press *OK* to begin the volume computation.

When completed, the *Volume/ Surf. Properties Reporting dialogue box* will appear (figure below). If you are working in imperial units (feet) the volumes will be reported in cubic yards.

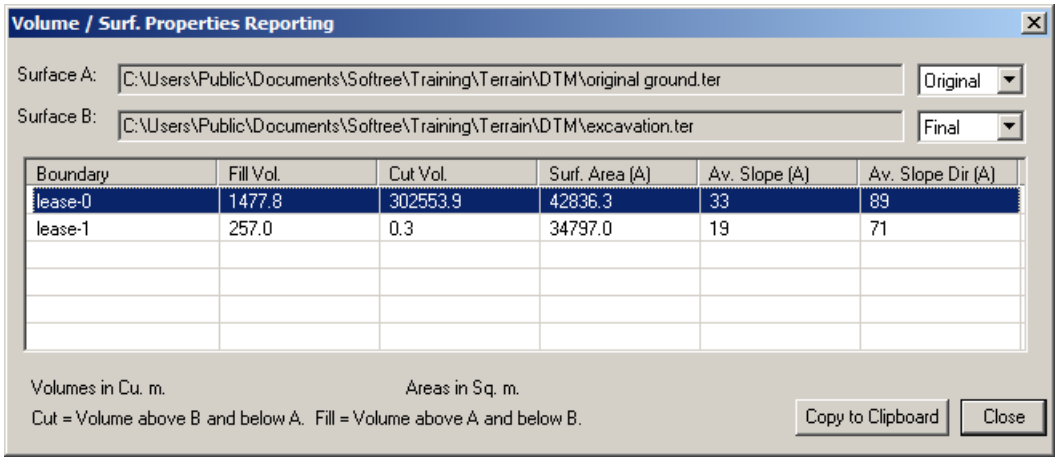


Figure 7.23: Volumes/Surf. Properties by Polygon

Note the cut, fill quantities and surface properties are reported for the 2 polygons (lease-0 and lease-1).

9. Press *Close*. To view the values, create a status window by *Window* | *New Window*|*Text*|*Status*.

Note: Text Windows can be floating or docked to the right side of the screen. To dock a floating window, click the dock icon on the upper right side of the window. To float a docked window, click the float icon on the upper right side of the docked window

10. Ensure the Status window is selected *then View* | *Active Window (Status) Options*. Press the *Add/Remove* button. Change the Selected items list to include only *Area*, *Vol. above* and *Vol. below* (the latter two can be found in the *Surface Properties* folder).

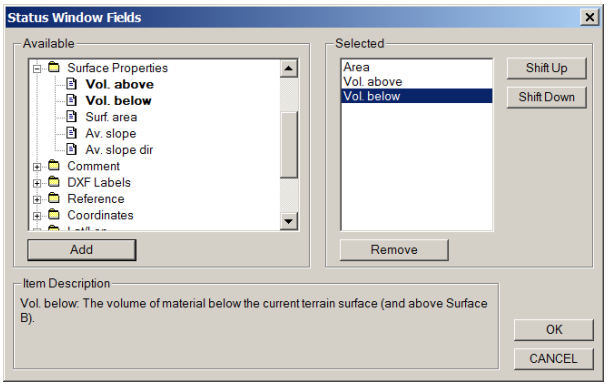


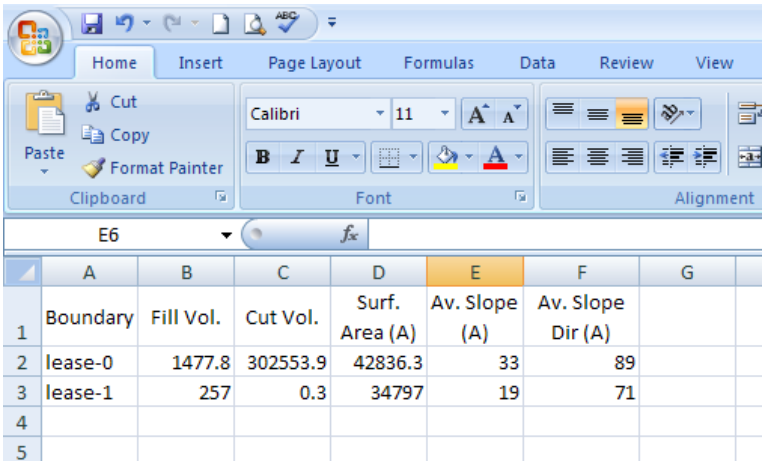
Figure 7.24: *Add/remove items to* Status window

11. Press OK twice to return to the main screen. Size and move the Status window to make the values visible and to expose the Plan window.
12. The Status Window displays the volumes associated with each *lease* feature. Select each *lease* feature and see how the volume changes. Select each lease feature by selecting *Edit* | *Select Feature(s)* | *By Name* then selecting either lease-0 or lease-1.

Note: To finish this example the results will be exported to a Microsoft Excel® spreadsheet using the Windows Clipboard. If you do not have a similar spreadsheet you can skip the next 2 steps.

13. *Edit* | *Terrain Modeling* | *Display Volumes/Surf. Properties*. The Volume/Surf. Properties Reporting dialogue box will appear, then press *Copy to Clipboard*.
14. Open Microsoft Excel® and create a new document. With the cursor positioned in the first cell select menu Edit | Paste.

The volume information should appear as in the figure below.



	A	B	C	D	E	F	G
1	Boundary	Fill Vol.	Cut Vol.	Surf. Area (A)	Av. Slope (A)	Av. Slope Dir (A)	
2	lease-0	1477.8	302553.9	42836.3	33	89	
3	lease-1	257	0.3	34797	19	71	
4							
5							

Figure 7.25: *Volume report exported to Microsoft Excel®*

15. Close your spreadsheet. Press Close to Close the *Volume / Surf. Properties Reporting* dialogue box.
16. *File* | *New*. Do not save the changes.

Calculating Volumes using a Single Surface

Stockpile Example

This example demonstrates how to quickly calculate pile or excavation volumes using the TIN boundary to define the lower surface. For most piles with simple convex boundaries this technique is appropriate and can save time since only one TIN surface is required.

This method can be applied to any earthwork calculation where the surface is defined by the toe of the pile (or crest of the excavation), and is an accurate representation of the original surface.

1. *File* | *Open* <Terrain>\DTM\stockpile.ter.

2. Press the Calculate Volumes button to open the *Volume / Surface Properties Calculation* dialogue box

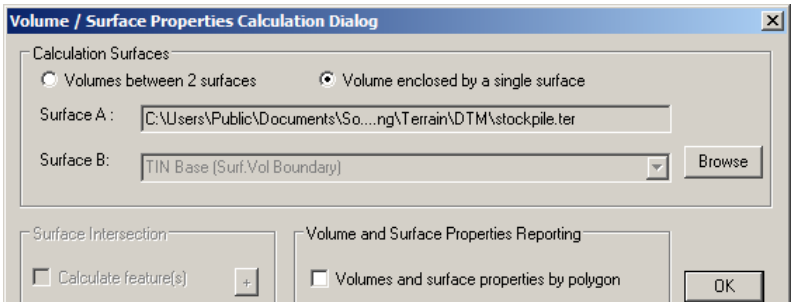


Figure 7.26: *Volumes / surface properties dialogue box*

3. Ensure the Volume enclosed by a single surface is enabled. Press OK.

Note: When Volume *enclosed by a single surface* is checked, the *Volume and surface properties by polygon* is automatically selected and disabled. This causes a boundary polygon to be automatically created but not shown.

4. Once the calculation is complete, the *Volume / Surf. Properties Reporting* dialogue box will display the cut and fill volumes.

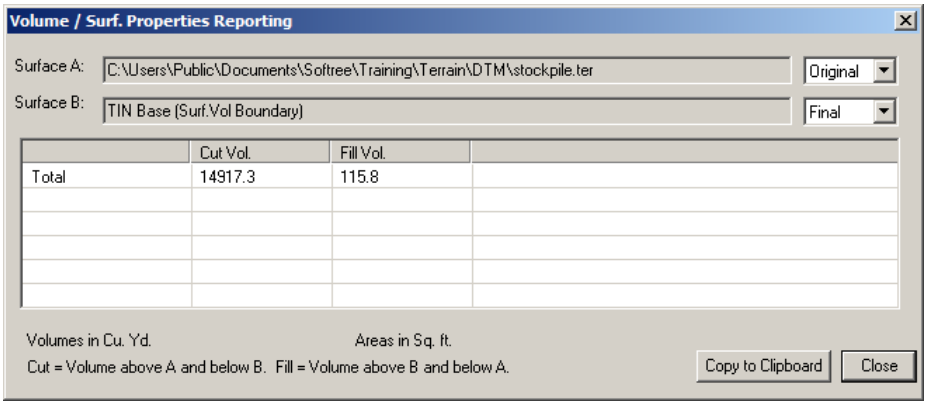


Figure 7.27: *Display of cut and fill volumes.*

Note: The fill volume (small compared to the cut), is because the toe of the pile is not flat. If the initial surface is not planar, it is more accurate to use the 2 surface technique (described in the previous section) to calculate volumes.

5. *File* | *New*. Do not save changes.

Surface Display

Surface displays of the TIN model may be an important aid to design. Features such as Slope Vectors, Shading and 3D visualization can all simplify the design process.

Plan Displays

1. *File* | *Open* <Terrain>\Attributes\theme17_sw.ter
2. *File* | *Insert File* **<Terrain>\DTM\surface display.ter**. Choose the default conversion as shown in the figure below. Press *OK*.

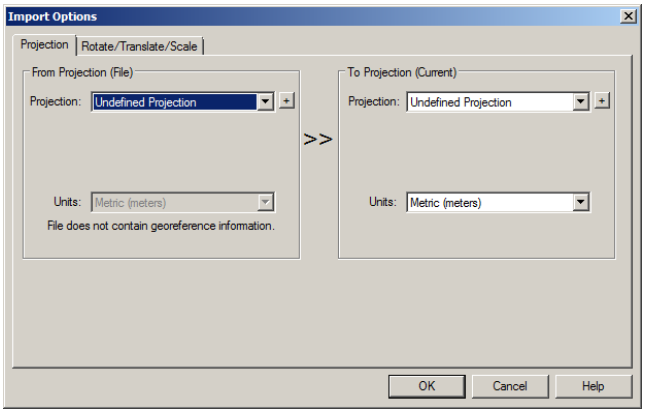


Figure 7.28: Import options *dialogue box - projection tab*

3. *Edit* | *Terrain Modeling* | *Calculate Terrain Model* to activate the Terrain Calculation dialogue box. Turn off all options except *Include All* as shown in the figure below. Press *OK*.

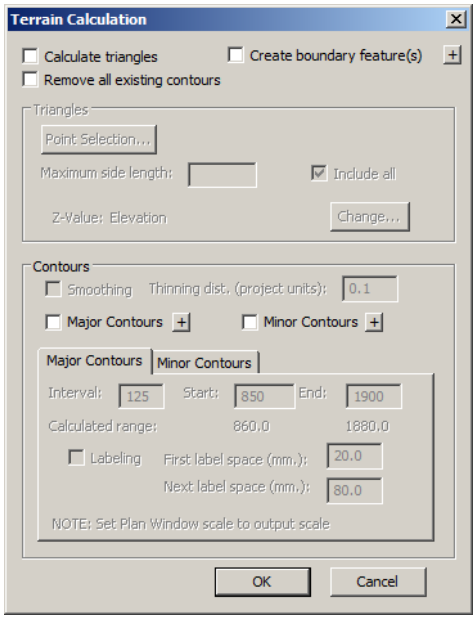


Figure 7.29: Terrain calculation *dialogue box*

Slope Vectors

4. Press the Active Window Options button on the main tools bar or right click in the Plan Window. Select *Active Window Options*. Select the *Surface* tab.
5. Turn on *Slope Vectors* and press the + sign beside *Slope Vectors* and the *TIN Slope Vector Options* dialogue box will open as in the figure below.

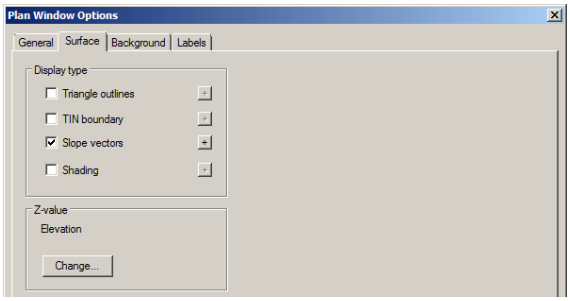


Figure 7.30: Plan windows options *dialogue box – surface tab*

6. In the *TIN Slope Vector* dialogue box Turn off *Fixed size.*
   Turn on *Auto size.*
   Change *Maximum length (mm)* to **50.**
   Turn on *Display at grid locations* and type in a Spacing for both X and Y of **200** as shown below.
   Press OK twice

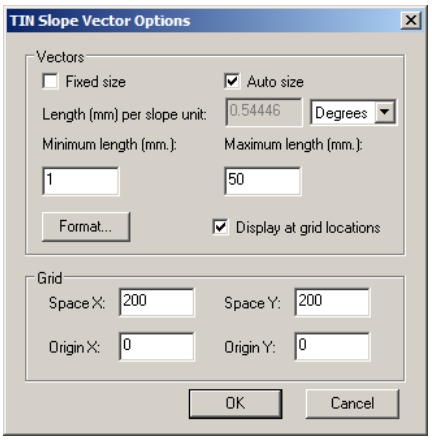


Figure 7.31: TIN slope vector options *dialogue*

7. Zoom in on any location to view the directional arrows close up. Notice all these arrows point in the down slope direction and the length of the arrows is directly proportional to the slope. The steeper the slope the longer the arrow as shown in the figure below.

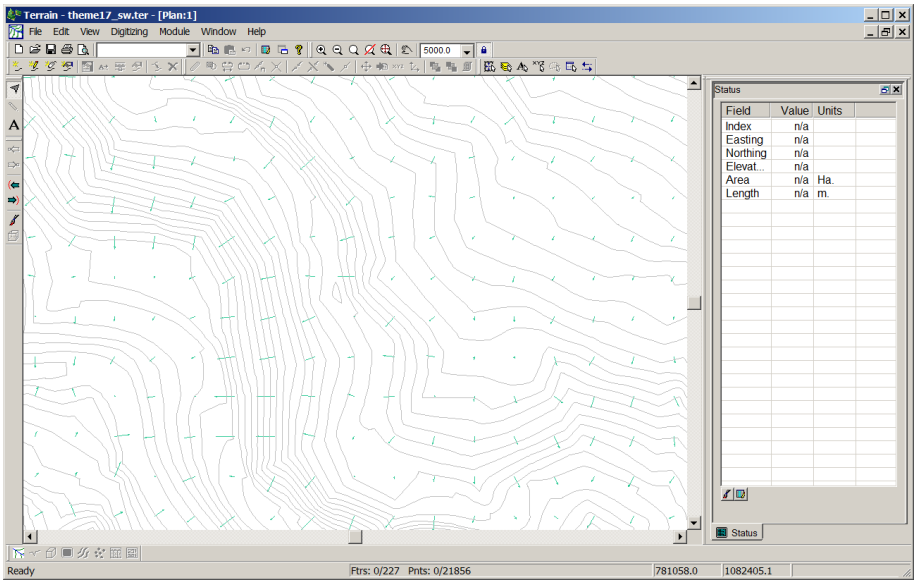


Figure 7.32: *Slope directional arrows*

Shading

8. Right click in the Plan Window. Select *Active Window (Plan) Options*. Turn off *Slope vectors* under the *Surfaces* tab and turn on *Shading*. Press the + button beside *Shading*. Select *Slope* and *Degrees* as the shading type.

9. Press the *Autogen* button and set the parameters as shown in the figure below. Press *OK*.

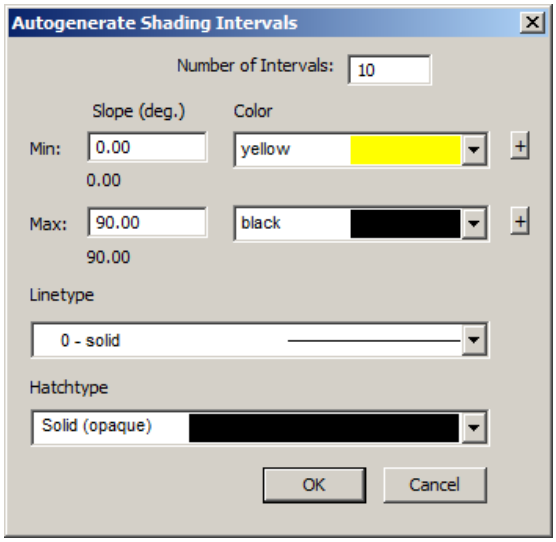


Figure 7.33: *Autogenerate shading intervals dialogue box*

Notice that there are 10 *Shading ranges* created. In this example only *Slope* is used. Try some of the other shading attributes to see what they do. They will not be explained in this example.

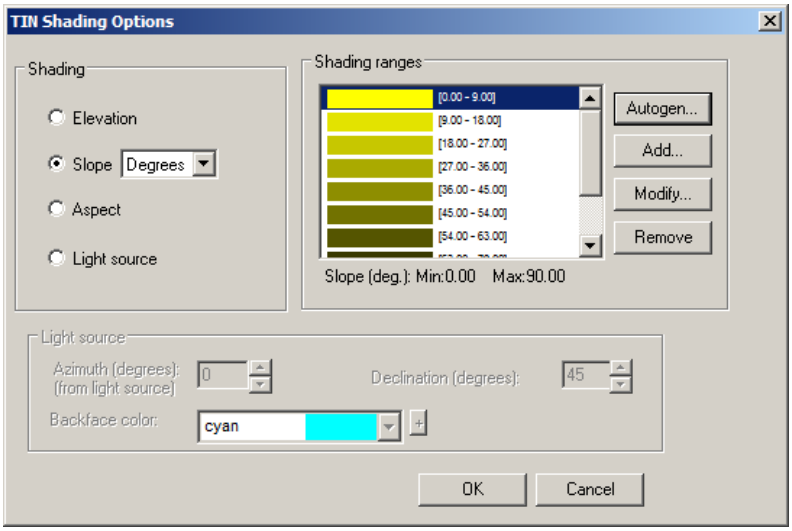


Figure 7.34: *Tin shading options dialogue*

10. Change the *TIN Shading Options* to those in the figure above. Press *OK*.

Notice the slope coloration. The steeper the slope the darker the color. The flatter the area the lighter the color (see figure below).

Note: *Number of shading intervals:* In this example there are 10 shading intervals between yellow and black. The greater the shading intervals the smoother the transition from one color to the next.

Number of legend intervals: If this map is printed in a multi-plot window and a legend is created, the legend would show a color with an interval of slope breaking the total slope into 10 equal intervals.

Min/Max shading ranges: If *Auto* is checked min and max slopes will be determined from the maximum and minimum slopes in the file. If unchecked a limit to the shading slope range can be entered. All other slopes that are outside of the range will remain white.

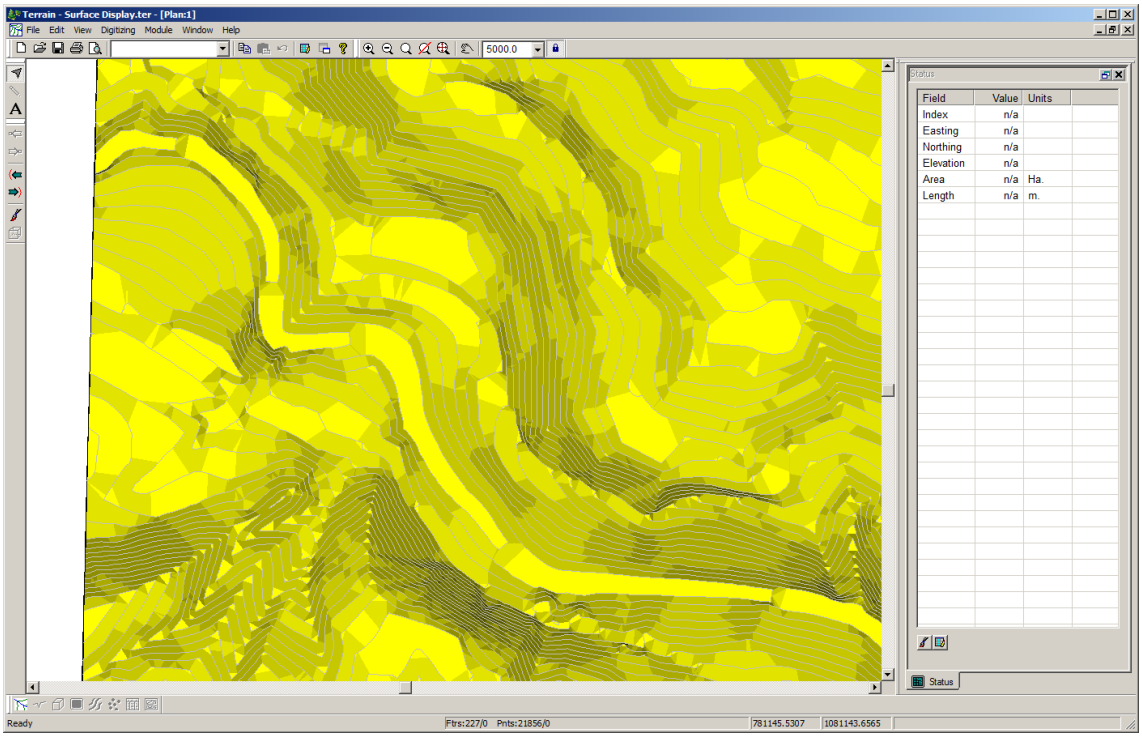


Figure 7.35: *Shaded TIN model*

3D Displays

Another method of visualizing the TIN is with a 3D Window.

11. Press the Active Window Options button  or right click in the Plan Window. Select *Active Window (Plan) Options* and turn off *Shading* found in the *Surface* tab. Press OK.
12. Select menu *Window*|*New Window*|*Graphics*|*3D* and a 3D window will appear on your screen.
13. *View*|*Active Window (3D*) Options. Change your *3D options* to match those shown in the figure below. There are two tabs, *Content* and *View*. Press *OK*.

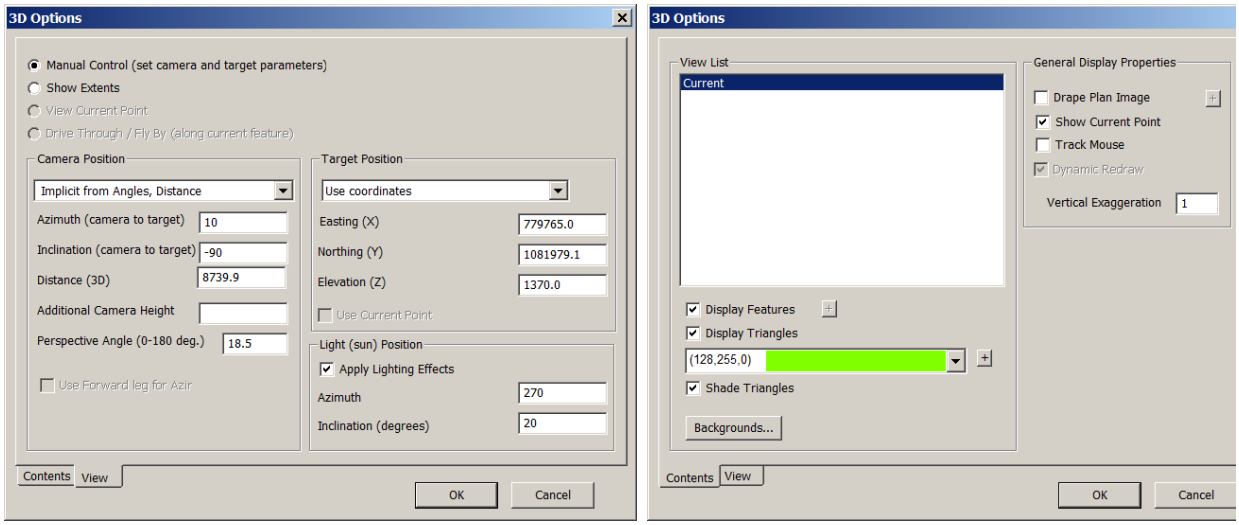


Figure 7.36: 3D options *dialogue,* View *(left) and* Contents *(right) tabs.*

Note:

Show Extents: Shows the entire View

Camera Position – Use Coordinates: Allows entry of the coordinates at which the camera will be placed and the *Perspective Angle*. The *Perspective Angle* is the view angle. The larger the angle the larger the view. If *Use Current Point* is checked the coordinates will be grayed out and the current point in the plan window will be used.

Camera Position - Implicit from Angles, Distance: Allows entry of the *Azimuth*, *Inclination,* and *Distance* to the target (which is a set of coordinates or the current point) entered in by the user in the *Target Position* area. If *Use Forward leg for Azim.* is checked then the camera will always face the direction of travel.

Light (sun) Position: The direction and angle of sun in the sky.

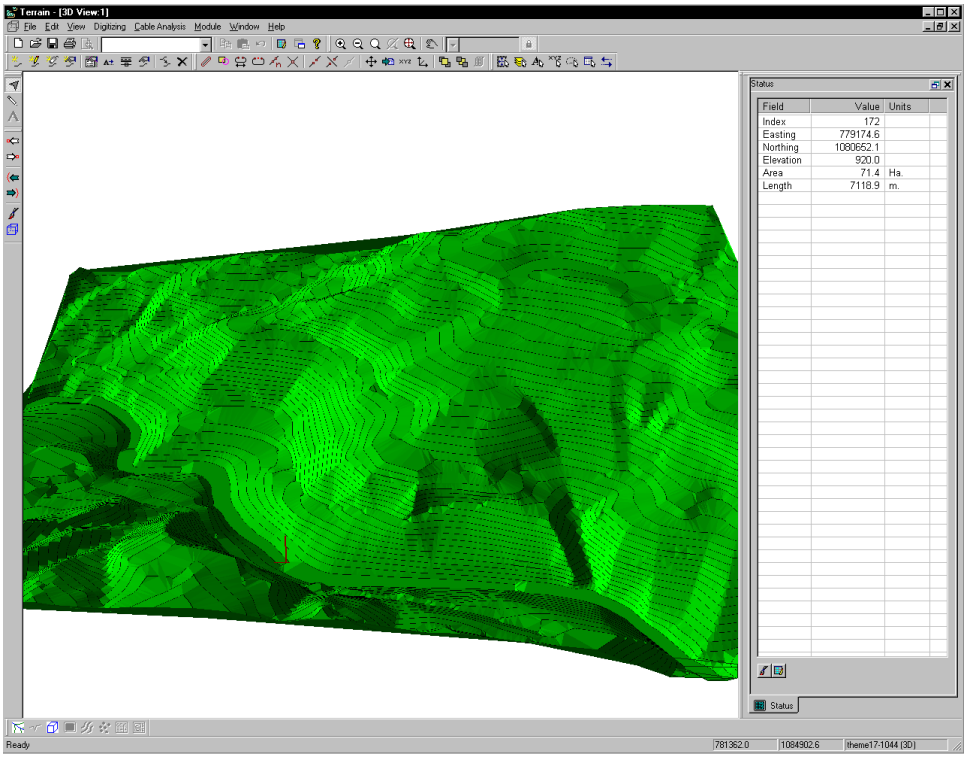


Figure 7.37: *3D view from GIS contour data*

Zooming and P*anning* allow you to navigate the 3D image. The Zoom Tools toolbar allows you to zoom or pan once after selecting a function. If you have a mouse with a middle button and a roller you can zoom and pan at any time.

14. Click the *Pan* button in the Zoom Tools toolbar, move your cursor over the 3D window. Click and drag with the left mouse button.

Note: The view moves with your mouse. When you release the mouse the cursor changes back into its previous shape; you must click the *Pan* button again to initiate a second pan.

15. If you have a middle mouse (even if it is a roller), move your cursor over the 3D window, depress and hold the middle mouse button and note that the cursor changes to the Pan hand. Continue holding the middle mouse and drag to perform a Pan operation

16. *File* | *New*. Do not save changes.

8. Profiles and Draped Features

The Terrain module allows you to display and edit features in profile (or cross section) and to drape features onto a surface. This section will provide you with an overview of these functions.

To follow the examples in this section the *Mapping and Drafting, Enhanced Mapping and Drafting, Surface Generation and Contouring, Profile Window,* and *Profile Drafting and Design* function groups must be enabled. See *Function Groups* in the On-line help for more information. Some examples will have additional requirements.

Note: Terrain Recreational users may get the message "Non Permitted Functions Found in File". If this message appears choose "Keep all functions and revert to DEMO Mode".

Creating a Profile

Stream Survey Example

This example demonstrates how to create a profile, set scales and display properties.

A profile is created by assigning a *fence section feature* to a *Profile Window*. The horizontal axis in the *Profile Window* is the distance (horizontal) along the fence section feature. The vertical axis is elevation.

Any feature can be a *fence section* (even closed loops or features which cross themselves). If the fence section consists of two points the profile becomes a standard cross section.

Note: See Getting Started section for file install folders (<**Terrain**> and <**Defaults and Layouts**>)

1. In the Terrain module, *File* | *Open* <**Terrain**>**\Profile\topograph.ter**.

You will see the features shown in the figure below.

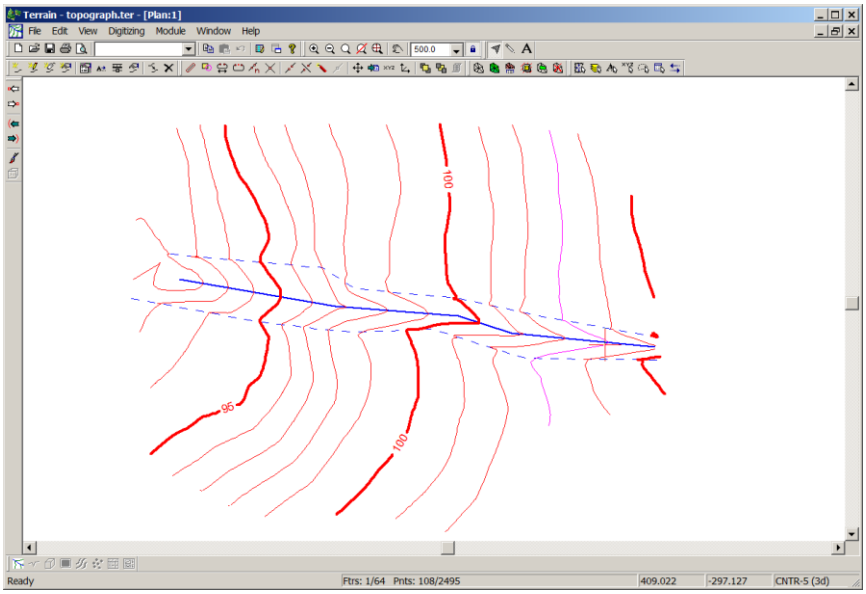


*Figure 8.1: Stream survey (**topograph.ter**)*

The Terrain feature representing the stream is a three dimensional polyline that is used to define the surface (and indirectly, to define the contours). In the steps below, you will view this feature in a Profile window.

2. Create a Profile window using the stream feature as you fence section:
3. Select *Stream-2* (the thick blue feature running across the middle) by clicking on it with the selection cursor .
4. Select menu Window | New Window | Graphics | Profile.

The new Profile window uses the current feature as the fence section; the feature name is part of the Profile title bar (figure below).

5. Select menu *Window* | *Tile Vertically* to show Profile and Plan windows side by side (figure below).

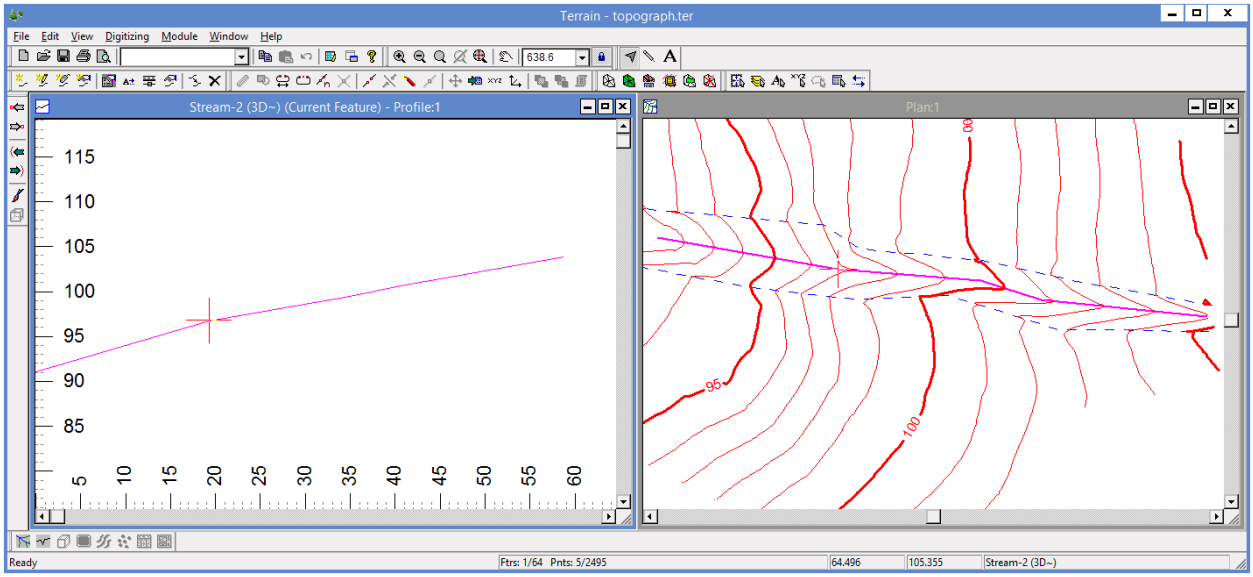


Figure 8.2: Profile with Stream-2 *as fence.*

Notice that the Plan and Profile windows both show the stream feature as selected (magenta in color) and both windows show the current point as a red cross. Sometimes it is not obvious how the profile view relates to the plan; the current point can help and there is a shadow cursor displayed in the widows that do not contain the mouse.

6. Using key strokes <Ctrl-N> and <Ctrl-B> move the *current point* forward and backward on the *current feature*.
7. Move your mouse around in the *Plan* window (don't click any mouse keys!) and watch the shadow cursor ⊕ in the *Profile* window.
8. Similarly, move your mouse around in the *Profile* window and watch the shadow cursor ⊕ in the *Plan* window.

The scale in the Profile is automatic, so the feature fills the window.

9. Use the Profile window options to define an explicit scale with distortion:
10. Right click the Profile window and select context menu *Active Window (Profile) Options.*

This will open *Profile Window Options* dialogue box (figure below). Notice the *Scale* is set to *Auto Scale*.

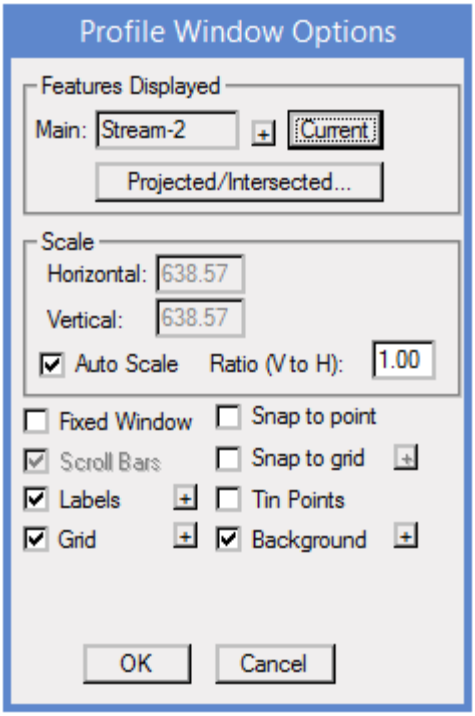


Figure 8.3: Profile Windows Options *dialogue box.*

11. Clear the *Auto Scale* check box and change the *Horizontal* and *Vertical* scales to **1000** and **500** respectively.

Notice the other controls in the *Profile Windows Options* dialogue box; you can change the fence feature (*Main*) at the top of the dialogue box.

12. Press *OK* to close the dialogue box.

The Profile Window has a new scale with 2:1 vertical distortion.

Now we'll display some automatic labels in the Profile.

13. Turn on *Elevations* and *Grades* labels:
14. Again, right click the Profile window and select context menu *Active Window (Profile) Options* to open thew *Profile Window Options* dialogue box (figure above).
15. Push the plus button ⊞ beside *Labels* to open the *Profile Window Labels* dialogue box.
16. Turn on *Elevations* and *Grades* by double clicking on them in the list-box.
17. Press *OK* twice to return to the main screen.

The screen should now look like the figure below.

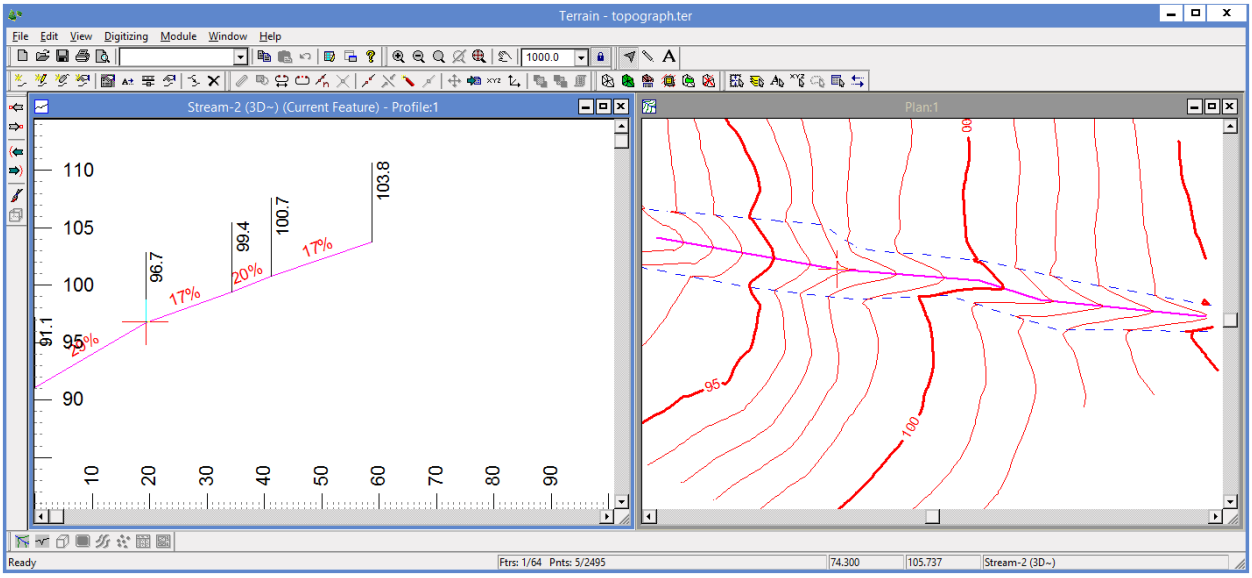


Figure 8.4: Stream profile with elevations and grades

18. Reverse the direction of the stream feature:
19. Make sure the stream feature is still selected.
20. Choose menu *Edit* | *Modify Selected Feature(s)* | *Reverse* or press the *Reverse*  button in the toolbar.
21. Press *OK* when warned about clearing the surface triangles.

Notice that the labels update automatically.

22. *File* | *New*. Do not save the changes.

2D and 3D Features

Stream Survey Example

A 3D feature has elevation (Z) values explicitly defined at each point (X, Y). A 2D feature, on the other hand, does not contain elevation data.

There two kinds of 3D feature:

- *3D modelled* (**3D**): Points contain elevation values that are used by Terrain to create the DTM surface (for example ground survey points).
- *3D not modelled* (**3d**): Elevations are defined but *not* used in the surface model (for example the bridge deck points).

There are also two kinds of 2D features:

- *2D draped* (**2D**): The feature points can pick up the elevation of the DTM surface. If there is no surface under a point it will have an undefined elevation (-9999). A draped feature will create a profile (or cross section) of the surface wherever it is placed.
- *2D not draped* (**2d**): Elevations are always undefined (-9999).

The concept of 2D versus 3D features is simple but has several subtleties with important consequences. The next example investigates the properties of 2D and 3D features.

To follow the example the *Mapping and Drafting, Surface Generation and Contouring, Profile Window,* and *Profile Drafting and Design* function groups must be enabled.

1. *File* | *Open* <Terrain>\Profile\topograph.ter

This is the same example used in the previous exercise, see Figure 8.1 above.

2. Select the thick blue feature (*Stream-2*) by clicking on it with the selection cursor .

The name and type of the current selected feature is displayed in the lower right corner of the screen: Stream-2 (3D~). This indicates that the current feature is *3D modelled*; it is incorporated into the surface. The ~ symbol indicates the feature is a breakline. (See Digital Terrain Modeling for information about breaklines).

3. Press the *Properties* toolbar button or select menu *Edit* | *Modify Selected Feature(s)* | *Properties*; there is also a speed key: <Ctrl-E>.

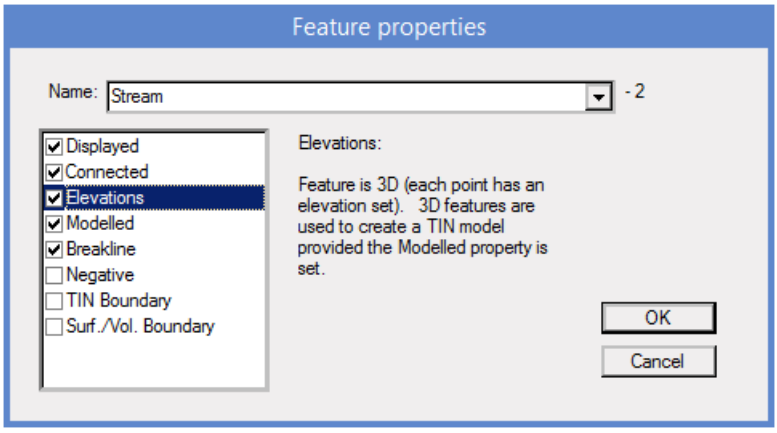


Figure 8.5: 3D~ Feature properties

The *Feature Properties* dialogue box (above) allows you to modify all properties (including the feature *Name*). Notice that both the *Elevations* and *Modelled* checkboxes are selected.

4. Press *Cancel* to close the dialogue box.

Now we will create a draped feature for cross section display.

5. Create new draped feature:

6. Press the *Create New Feature* toolbar button or select menu *Edit* | *New Feature*.

This opens the same feature properties dialogue box shown in the figure above.

Note: If there is a feature selected, the feature created with *Edit* | *New Feature* will inherit the current feature properties.

7. Change the *Name* to **Cross Section**.
8. Clear the *Elevation* check box (this also clears the *Breakline* property).
9. Press the *Mouse* button to close the dialogue box and begin creating points with the mouse.
10. Draw a feature with two points perpendicular to the stream (similar to that shown in *the figure below*).

For more information about drawing a feature please refer to the Basic Mapping and Drafting section of this manual.

11. Right mouse click and choose mode *Select with Mouse*.

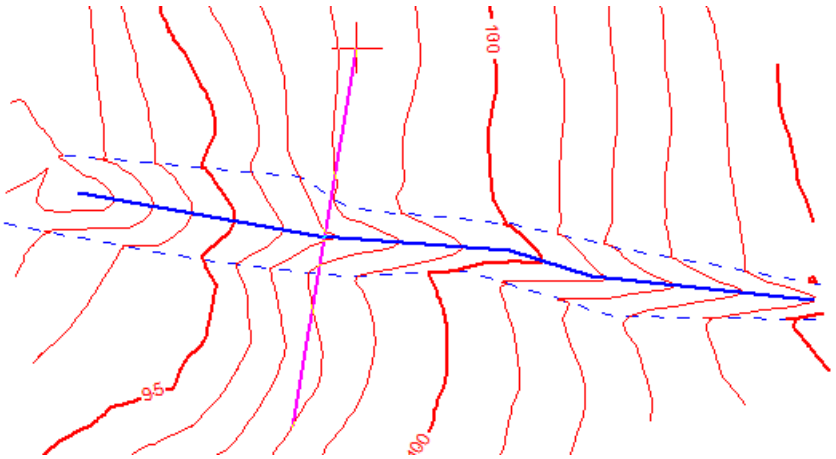


Figure 8.6: 2D feature across the stream

12. Select menu *Window* | *New Window* | *Graphics* | *Profile* to view a fence section of the feature.

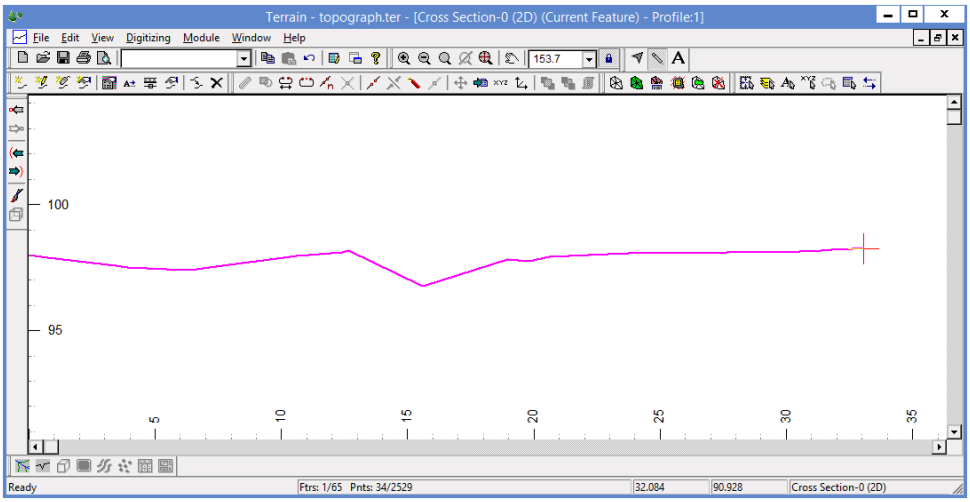


Figure 8.7: 2D draped *feature shows the ground elevation.*

Notice that the Profile window shows the ground surface between the two end points. These new points are called *TIN points* and they show the elevation of the underlying DTM. They are automatically inserted in 2D *draped* features wherever a triangle side is crossed.

Note: *TIN points* cannot be edited. They can, however, be labeled if you set the *TIN Points* check box in the Profile window options.

Stream Survey Example Continued

It is possible to drape a feature on multiple DTM surfaces. To do this, one or more Digital Terrain Models (DTM's) must have been created in separate terrain files. These files can be then displayed as *background terrains* in the Plan and Profile Windows.

For this example two DTM's have been prepared, **overburden.ter** and **overburden1.ter** (separating two overburden layers). These surfaces will be set as background terrains and the profile will be draped on them.

13. Add background files:
14. Choose menu *View | Active Window (Profile) Options* (also available in the right click context menu) to open the *Profile Window Options* dialogue box.
15. Ensure *Background* is enabled and press the button to open the *Background Display Files* dialogue box (figure below).
16. Press *Add* and choose **<Terrain>\Profile\overburden.ter** and press *Open***.**
17. Repeat for <Terrain>\Profile\overburden1.ter.

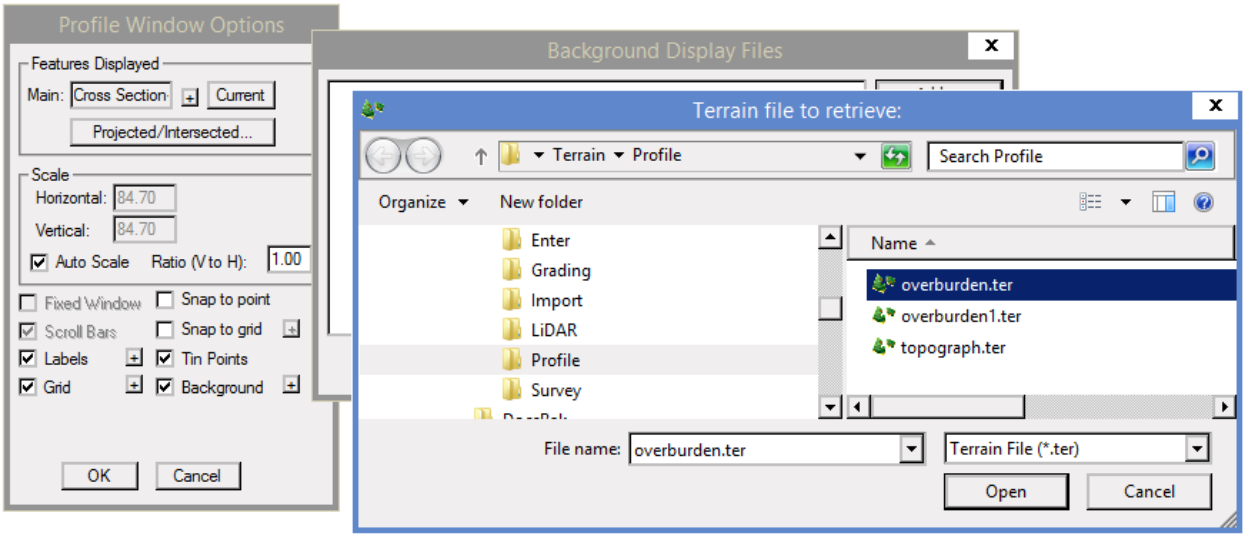


Figure 8.8: Opening a background file

You should still be in the *Background Display Files* dialogue box. The next two steps set the color and hatching for each layer.

18. Select file **overburden.ter** and press the *Properties* button.
19. Press *Profile Feature Format* and set the color to *green* and hatch type to *dots 2* (figure below).

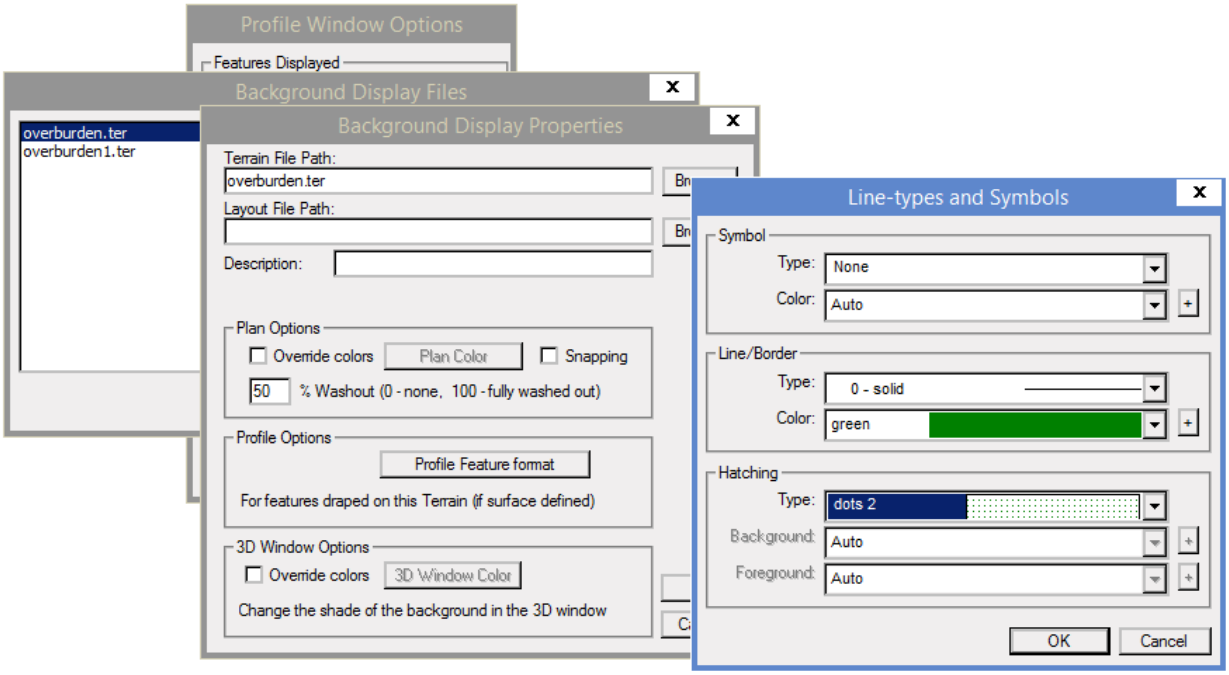


Figure 8.9: Configuring background surface format.

20. Press *OK* twice.

21. Repeat for **overburden1.ter** (choose your own color and hatch type).
22. Press *OK* until you have returned to the main screen.

Your Profile Window should now appear similar to the figure below.

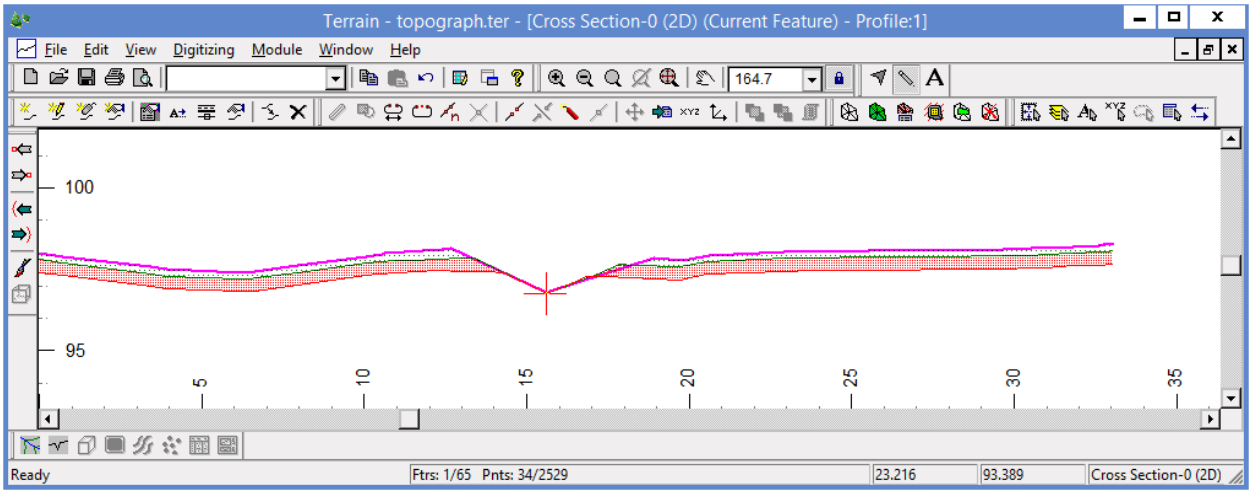


Figure 8.10: Profile window with multiple layers

23. *File* | *New*. Do not save the changes.

Modifying Features in the Profile Window

Stream Survey Example

To follow this example, have the *Mapping and Drafting*, *Surface Generation and Contouring*, *Profile Window* and *Profile Window Drafting and Design* function groups enabled.

1. *File* | *Open* <Terrain>\Profile\topograph.ter.

This is the same example used in the previous exercise, see Figure 8.1 above.

2. Select the thick blue feature (*Stream-2*) by clicking on it with the selection cursor .
3. Choose menu *Window*|*New Window*|*Graphics*|*Profile* to view this feature in a Profile window.

Note: Editing a feature with *Auto Scale* set is confusing, because after each edit the screen redraws at a new scale.

4. Turn off auto-scaling by doing either of the following:
5. Choose menu *View* | *Active Window (Profile) Options* to open the *Profile Window Options* dialogue box. De-select *Auto Scale* and set the horizontal and vertical scales. Press *OK*.
6. Attempt a zoom function; you will be prompted "OK to turn off auto-scale?" Choose *OK*.
7. Zoom and scroll to center the stream profile.
8. Right click in the Profile window and choose mode *Edit/Insert Points with mouse* .

9. Add a point at the end of the feature:
10. Click to the right of the last point; respond *OK* to the warning.
11. Move your mouse around observing the captured point and connecting segment.
12. Click a second time to anchor the new point.
13. Edit an existing point:
14. Move your mouse over one of the vertex points in the feature, note that the mouse changes to the edit cursor . (The first point of a *fence* feature, however, is not editable.)
15. Click on a vertex and capture the point.
16. Move your mouse around observing the captured point and connecting segments.
17. Left click again to anchor the point in a new position.
18. Select menu *Window* | *Tile Vertically* to show Profile and Plan windows side by side (similar to Figure 8.2 in the previous exercise above).

Because you have just modified one of the features in the model, your contours will be out of date.

19. Recalculate the surface and contours:
20. Choose menu Edit | Terrain Modelling | Calculate Terrain Model, or press the toolbar button .
21. Press *OK* to re-calculate with the previous settings.
22. *File*| *New*. Do not save the changes.

Profile Window Design and Drafting

Culvert Design Example

This example illustrates profile window design and display using multiple features and multiple Profile Windows. The concept of *projected* and *intersected* features is also covered.

1. *File*|*Open* <**Terrain**>**Profile\topograph.ter**. Using the Selection cursor select the thick blue feature running down the center of the creek (STREAM-2) as shown in the figure below. It will turn magenta when selected.

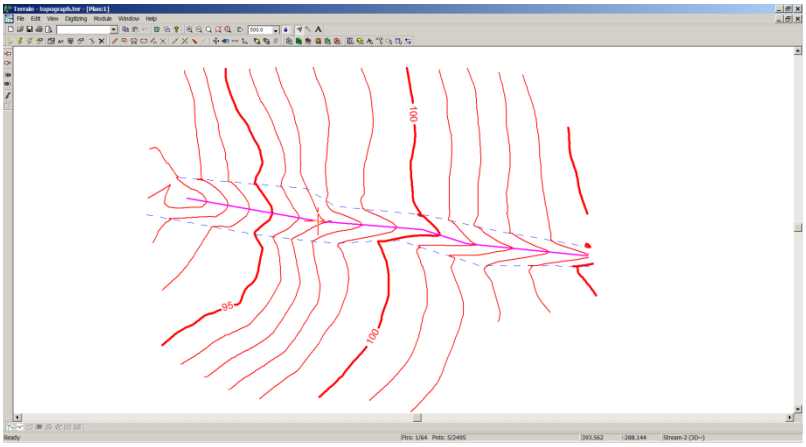


Figure 8.11: ***topograph.ter*** *screen dump*

2. *Window* | *New Window* | *Graphics*|*Profile*. This opens a Profile Window with the feature name, STREAM-2. Press the *Maximize* button on the profile window.

Note: To activate the Plan Window, press the *Plan* button. To activate the Profile Window, press the *Profile* button. The icons are located at the bottom of the screen.

3. Using the Selection cursor in the Plan Window, select the upper stream bank feature (STREAM-0). Switch to the Profile Window. Note the feature in the Profile Window remains the same (STREAM-2) but it is no longer the current feature (no longer highlighted in magenta).
4. *View* | *Current Feature To Profile* (F5). The Profile Window should now display STREAM-0.

Current Feature to Profile changes the Profile Window to display the current feature (this function changes the active Profile Window).

5. Switch back to the Plan Window. Left mouse click in an empty area to deselect all features.

Note: When a new feature is created it inherits the formatting (line-type and color) of the currently selected feature. By deselecting all features, the new feature will not inherit any formatting.

The next several steps involve entering the coordinates of the road centerline as it crosses the stream and then profiling the road centerline.

6. *Edit* | *New Feature* or press the *Create New Feature* button. Change the feature name to **ROADCL** and Make sure *Displayed, Connected,* and *Modeled* are on. All other properties should be off. Press the *Keyboard* button. You may get the following warning as shown below. Press OK

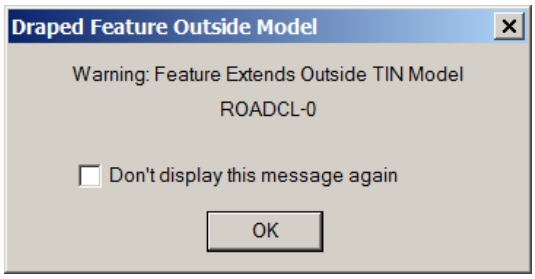


Figure 8.12: Draped feature outside model error message

7. Enter the following X, Y coordinates:

   399.2 <Tab > **-276.8** <Enter >
   399.4 <Tab > **-288.7** <Enter >
   399.4 <Tab > **-296.0** <Enter >
   398.8 <Tab > **-310.6** <Tab >

Do not press <Enter > after the last coordinate (if you accidentally do, use the *Delete* button to remove the last 0,0 coordinate).

8. Press the *Update List* button to accept the last coordinate.
9. Check the above coordinates if satisfied they are correct, press OK. Notice the Plan Window now displays the new ROADCL feature.

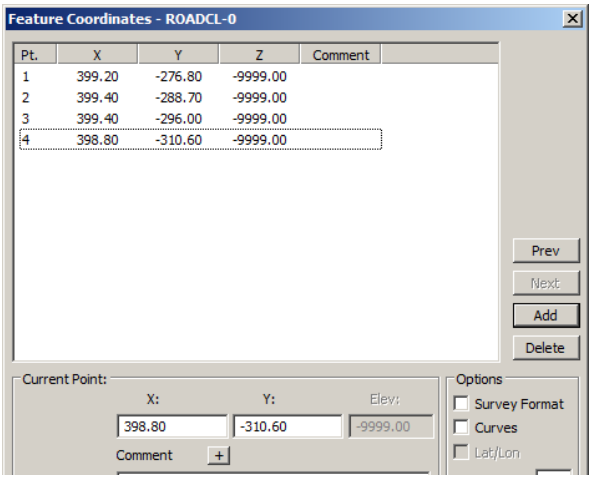


Figure 8.13: Feature coordinates *dialogue box*

10. Switch back to the Profile Window. Select menu *View | Current Feature To Profile*. Notice that the Profile now displays ROADCL (as shown in the figure below) provided that the *Ratio (V to H)* is set to **10** (*View | Active Window (profile) Options*).

Note: Turning on *Auto-Scale* in the Profile Window display options will re-scale the view so that the profile line will fit to the extents of the profile view.

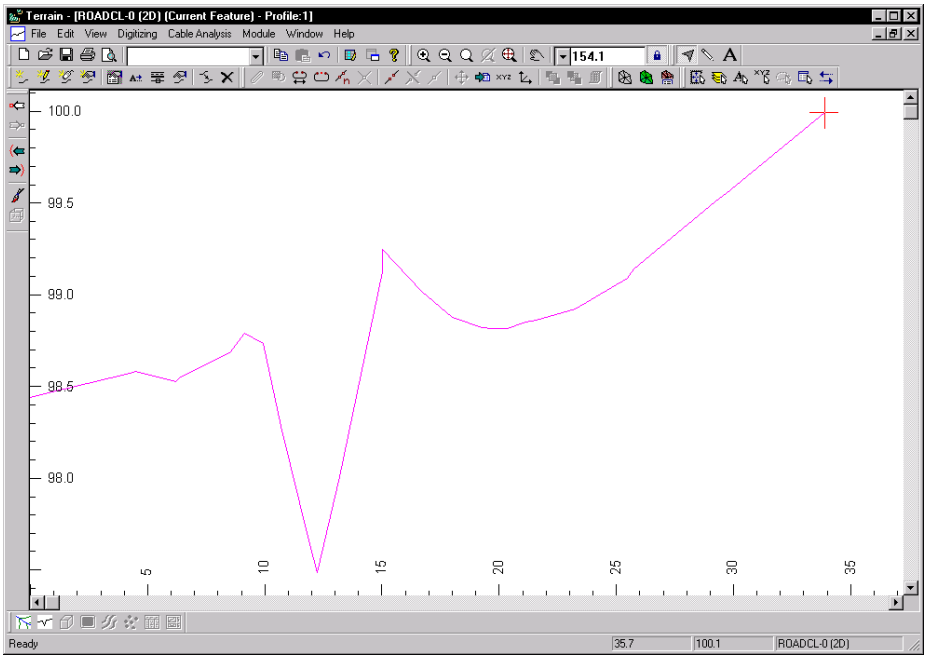


Figure 8.14: ROADCL profile

11. To create a cross section parallel to the creek, select *menu Edit | New Feature* or press the *Create New Feature* button. Change the feature name to **SECTION.** Make sure *Displayed, Connected,* and *Modeled* are on. All other properties should be off. Press the *Keyboard* button and enter the following X, Y coordinates:

    382.4 <Tab > **-287.1** <Enter >.
    421.7 <Tab > **-291.7** <Tab >.

12. Do **not** press <Enter > after the last coordinate. Press the *Update List* button. Press OK provided the *Feature Coordinates - Section -0* dialogue box looks like the figure below.

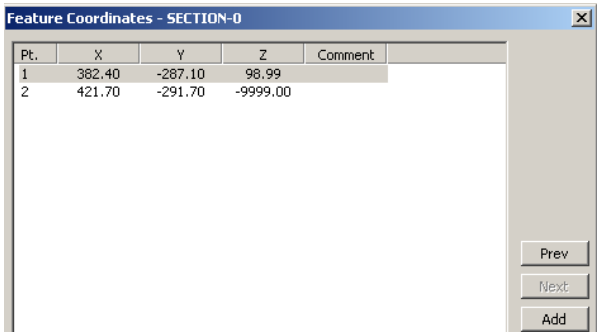


Figure 8.15: Feature coordinates - section -0 *dialogue box*

13. Select *Window | New Window | Graphics| Profile*. A Profile Window appears with the feature name, SECTION-0, in the title bar.

Notice there is another feature in the Profile Window. This is feature STREAM-2 projected onto the SECTION-0 profile. See figure below.

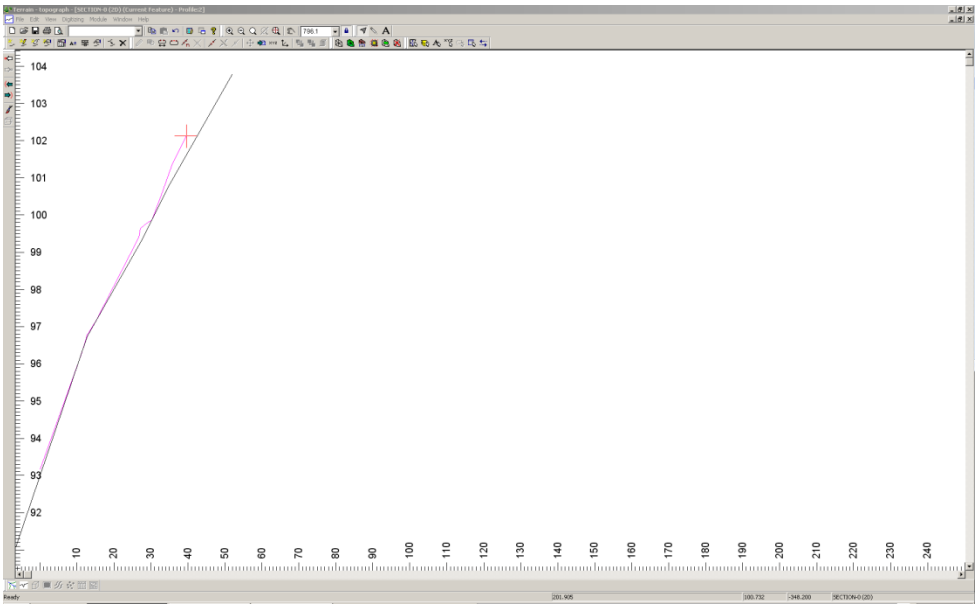


Figure 8.16: Screen shot of STREAM-2 and SECTION-0 profile

Intersected and Projected Features

Each Profile Window is based on a feature called the *Fence Section Feature*. It is possible to display additional *projected* or *intersected* features in a Profile Window.

Intersected features penetrate the vertical plane of the profile. These intersection points can be displayed with a symbol of your choice.

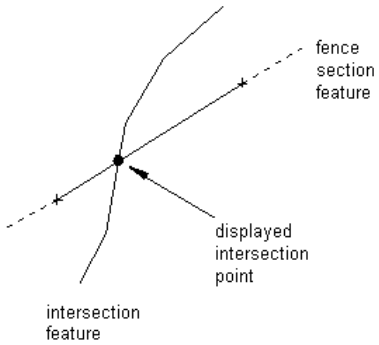


Figure 8.17: Intersected feature (Plan View)

Projected features are displayed on the profile by projecting perpendicularly onto the fence section.

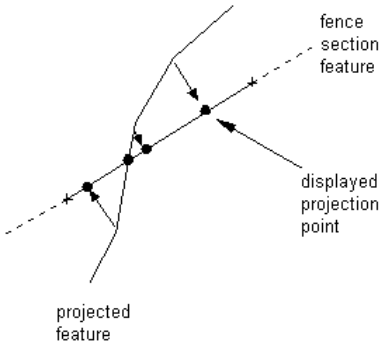


Figure 8.18: Projected feature (Plan View)

Projected features are often on (or near) the fence section. If you draw features (other than the fence section) in a Profile Window they are automatically added to that windows list of Projected features.

A user configurable list of intersected and projected features is stored with each profile. This list can be accessed from the *Active Window (Profile) Options dialogue box.*

To display the intersection of ROADCL on the creek section (SECTION-0):

14. Select Window SECTION-0. With the cursor positioned in the Profile window, right mouse click and select *Active Window (Profile) Options.* Click on the *Projected/ Intersected* button. In the *Intersected Features* group box, press the *Select* button. Find and *Select* ROADCL-0. (figure below) Press OK until you have returned to the main screen.

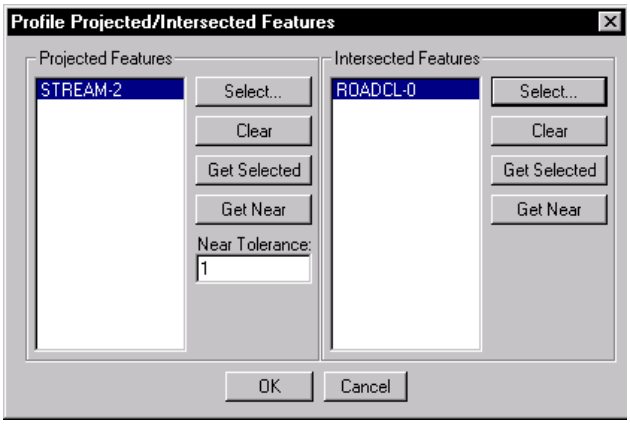


Figure 8.19: Profile projected /intersected *features*

15. Select *Edit | Select Feature(s) /by Name*. Press the *Un-select All* button and select the *ROADCL-0* from the list with a double click. Press OK to return to the main screen.
16. Right mouse click in the Profile Window, and select *Modify Selected Feature(s) | Line-types, Symbols*. Select symbol *Triangle (Large).* Press OK. A large triangle is now in the center of the creek profile indicating the position of the road centerline feature. Use Zoom extents or Pan the view if the road centerline is not visible.

Note the elevation of the road centerline lies on the streambed. This is because the road centerline feature has been 'draped' over the TIN model.

Design in the Profile Window

17. To position the culvert pipe in the stream, activate the road centerline profile ROADCL-0 by pressing the Profile icon until the ROADCL-0 title appears in the Profile Window title bar.
18. Position the cursor in the Profile Window, right mouse click and select *Active Window (Profile) Options*. Deselect the *Autoscale* checkbox and set both horizontal and vertical scales to **200**.
19. Select *Snap to Grid* and press the button to set the grid space (*SpaceX* and *SpaceY*) to **1.8m** (to create an 1800 mm diameter pipe). Press OK. Return to the main screen.
20. Press the *Draw New Feature* button. Draw a horizontal line in the Profile window one grid space wide (1.8m). Each point requires two left clicks. See *Drawing and Editing a Feature* in the On-line help for more information.
21. Right mouse click and select *Modify Selected Feature(s)* | *Shape* or press the *Shape* button. Choose *Diameter to circle* from the list box. Press OK.
22. Again right mouse click, this time select *Modify Selected Feature(s)* | *Properties* or press the *Properties* button in the toolbar. Change the name to **PIPE**. Press OK.
23. While holding down the <Ctrl > press the <M> key to enter *move/size mode* or press the *Move/Size* button. Move the cursor inside the circle. Note it changes shape to a four headed arrow.
24. Left click and drag the circle to a reasonable position in the creek. Release the left mouse and right click. Select menu *Select with mouse* to exit move/size mode.

At this point your Profile Window should look similar to the screen capture in the figure below.

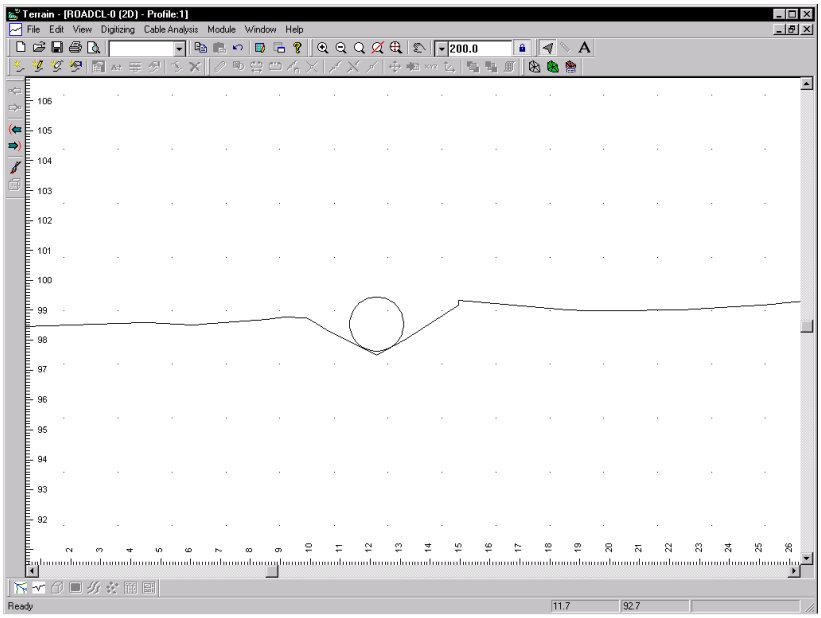


Figure 8.20: 1800mm pipe displayed in road centerline profile

25. Click on the Profile Window button until SECTION-0 is displayed.
26. Select *Active Window (Profile) Options.* First, de-select the *Autoscale* checkbox and set both horizontal and vertical scales to **200.**
27. Click on the *Projected Intersected* button. In the *Projected Features* group box, press the *Clear* button and then the *Select* button. Scroll down the list and double click on **PIPE-0**. Press OK three times to return to the main screen.

You should now be able to see the projection of the culvert on the stream cross section. Use Zoom extents or Pan the view if the cross section is not visible. The projected pipe is displayed as a very thin oval shape (if the cross section was exactly perpendicular to the centerline it would be displayed as a vertical line).

The next step is to draw a road template on the cross section.

28. Press the *Draw New Feature* button. This will create a new feature with *Displayed, Connected, Elevation* and *Modeled* turned on.
29. Left click once over the profile window
30. With the cursor positioned in the Profile Window right mouse click and select menu Modify Selected Feature(s) | Labels. Turn on the display of the *dLength [length change]* and *Grades* labels by finding them in the list box and double clicking. Make sure all other labels are turned off. Press OK when they are selected.

The *dLength* label will display the 3D length of a segment. *Grades* label will display the slope % (rise/run *100%).

31. With the length and grades displayed, draw a road prism for a 10 m wide road similar to the one shown below.

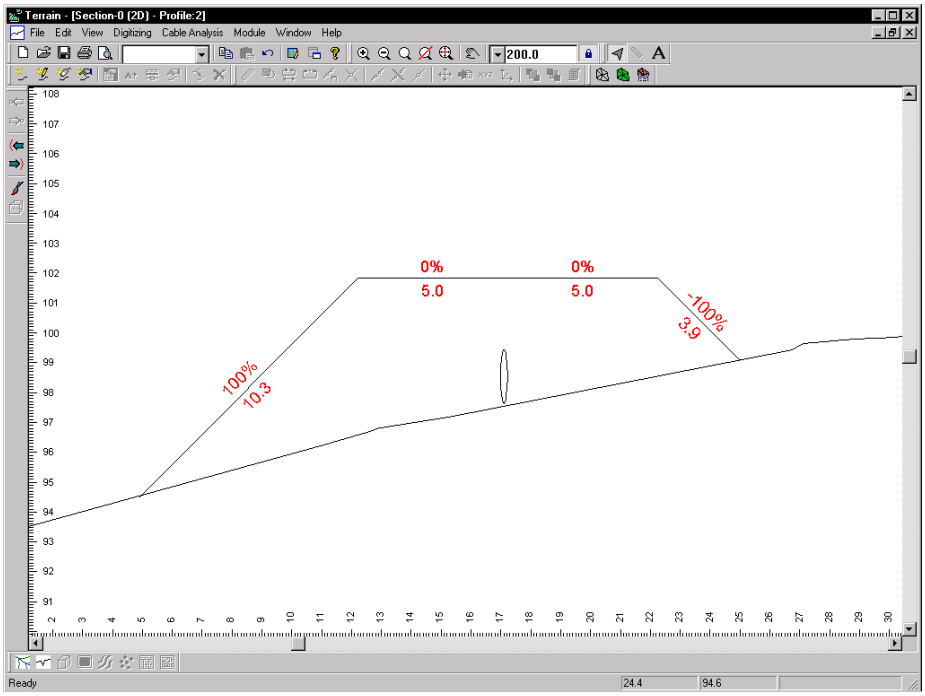


Figure 8.21: Cross section with road template

32. Repeat the process to draw the top of the pipe. Press the *Draw New Feature* button  . Left Click once over the Profile Window.

33. Keeping the cursor positioned in the Profile Window right mouse click and select menu *Modify Selected Feature(s)* | *Labels*. In the list box find and enable the display of the *dLength* and *Grades* labels. Press OK.

34. Draw the top of the pipe line from one side of the road to the other as shown in below.

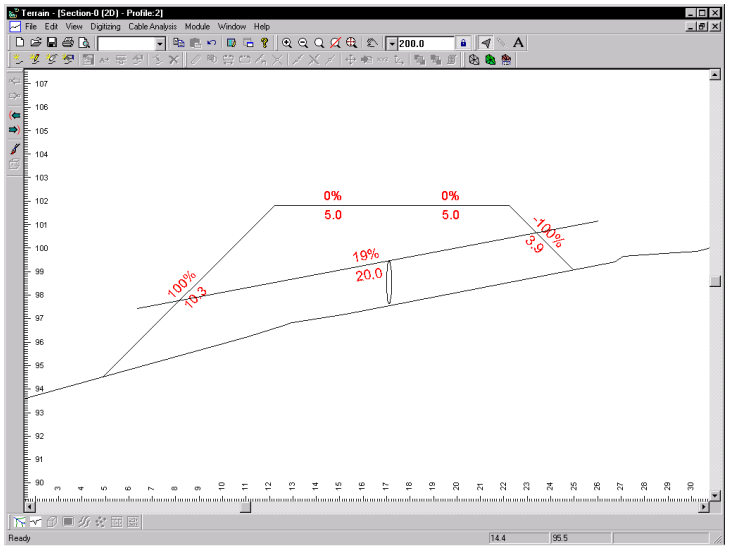


Figure 8.22: Cross section with preliminary culvert position

35. Using the selection cursor select the top of the pipe feature. While holding down <Ctrl > press the <D> key (or press the *Duplicate* button) to duplicate it. Move the cursor inside the new feature. Click and drag to move it to the bottom of the circular pipe feature.

36. Select the circular pipe feature in the center of the Profile Window. Duplicate it by holding down <Ctrl-key> press the <D> key or press the *Duplicate* button. Move the cursor inside the new feature. Click and drag to move it to a new position at the end of the pipe on the right side. Repeat this procedure for the left. The result will be as shown in below.

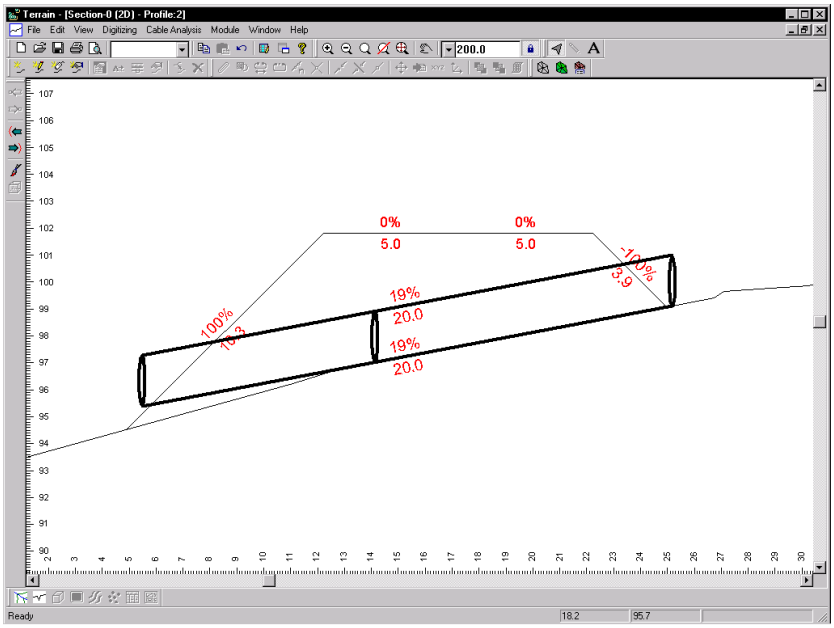


Figure 8.23: Cross section with culvert position

Changing line-types makes it easier to identify the culvert features in the Plan Window.

37. Using the selection cursor depress <shift>, select the top of the pipe, the bottom of the pipe, and the circular elements. Right mouse click and choose menu *Modify Selected Feature(s)* | *Line-types, Symbols*. Choose Line-type *5-thick (medium)* and check *Also Set Plan* indicating that changes will also affect the Plan Window. Press OK.

38. Activate the Plan Window by pressing the *Plan* icon. Your screen should be similar to the figure below.

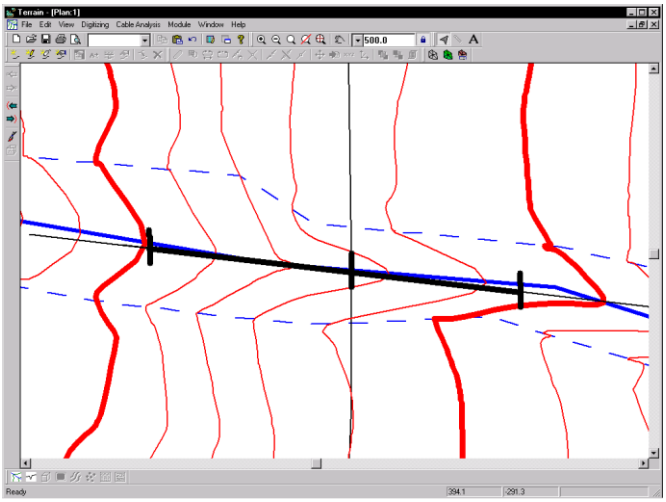


Figure 8.24: Plan Window with Culvert Position

39. *File* | *New*. Do not save the changes.

9. Grading

The Grading functions in Terrain are useful for designing polygonal shaped objects such pits, ponds and pads. It can also be used to design linear objects such as roads, channels and walls etc. although the RoadEng Location module is better suited for this purpose.

Note: Terrain Recreational users may get the message "Non Permitted Functions Found in File". If this message appears choose "Keep all functions and revert to DEMO Mode".

To illustrate the concepts of grading we will design a platform.

Grading Concepts

Platform Example

In this example a platform outline (polygon) will be created using the mouse. We will then iteratively adjust the elevation of the pad to balance the cut and fill quantities.

Note: See Getting Started section for file install folders (<**Terrain**> and <**Defaults and Layouts**>)

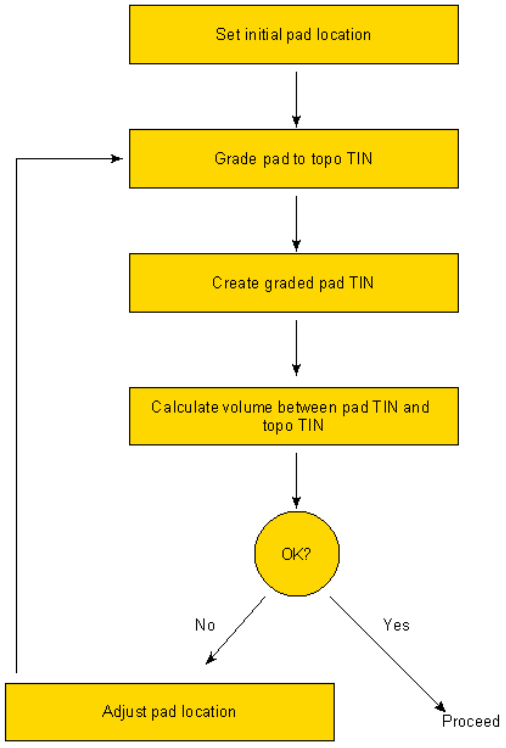


Figure 9.1: Procedure for balancing cut and fill

Platform Design

The following steps will demonstrate how to set the initial pad location by entering its coordinates. The initial pad location could also be established by drawing it with the mouse or importing it from an external file (shape, dxf etc.).

Before the pad is created we will place the topo contours ("**OriginalGroundGrading.ter**") in the background for reference.

1. Open the Terrain module and choose menu *View* | *Active Window Plan Options* | *Background*. Press the Add button and browse for **<Terrain>\Grading\OriginalGroundGrading.ter**.
2. Press OK. Use Zoom extents or Pan the view if the background is not visible.
3. Select *Edit* | *New Feature*, the *Feature Properties* dialogue box will appear. Type in the name "**Platform**" and keep the default properties (*displayed, connected, elevations, modeled*) as shown in the figure below.

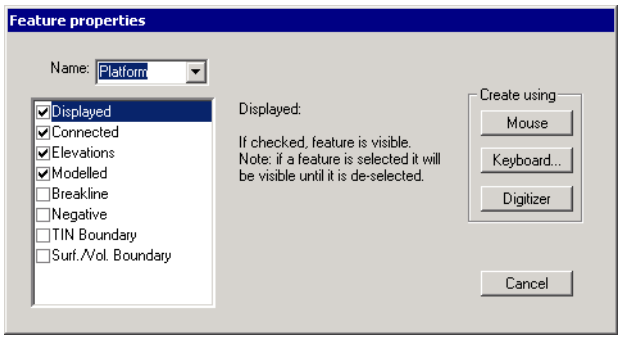


Figure 9.2: Feature properties *dialogue*

Press the Keyboard button, and the *Feature Coordinates* dialogue box for the new feature called "Platform-0" will appear (minus the *xyz coordinates*) as shown in the figure below.

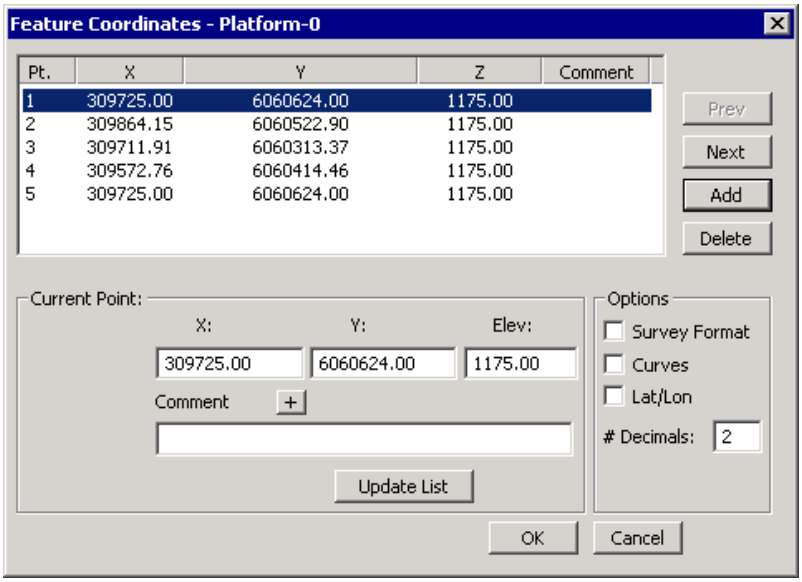


Figure 9.3: Feature coordinates *dialogue*

4. With *Survey Format* option unchecked, type in the **X: 309725**, **Y: 6060624**, **Elev: 1175** and press the *Add* button.

5. Continue entering coordinates as shown in the figure above, pressing *Add* after each entry. For the last coordinate press the *Update List* button. Do not press the *Add* button. Once you are complete, press OK (your screen should be similar to the figure below).

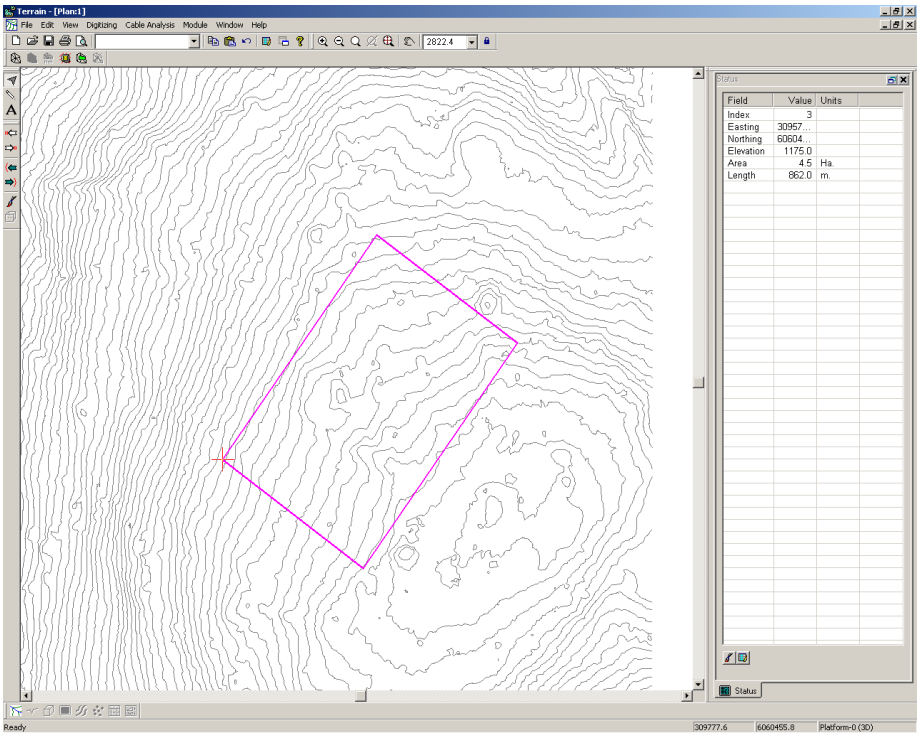


Figure 9.4: Initial pad location overlaid on topo contours.

Grading the Platform

The Grading option projects a feature at user specified cut/fill angles to a 'Target surface'. Slope lines are created at each feature point and at user specified interpolated points. The daylight line is also calculated as shown in the figure below.

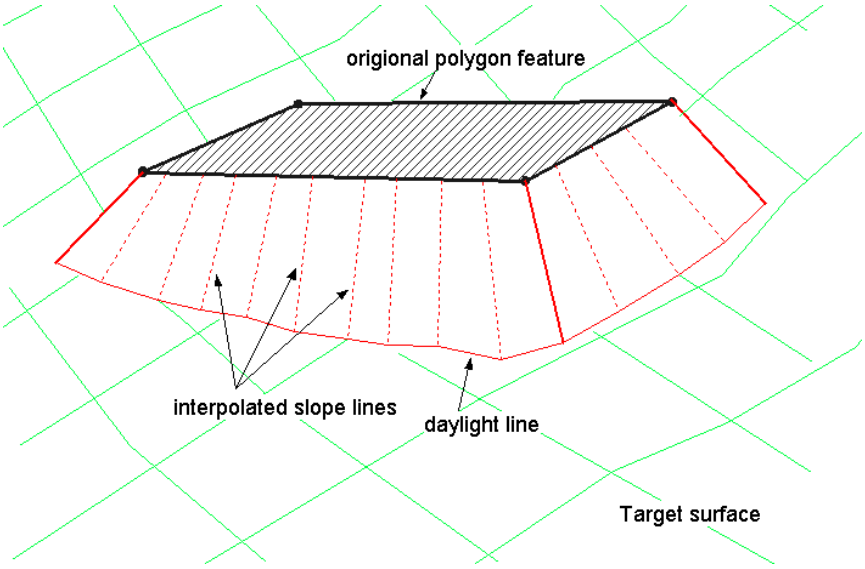


Figure 9.5: Grading a polygon to a target surface

In this Platform Design example we will assume the platform is in a good plan location (if this is not the case, the pad can be easily dragged to a new location using Ctrl-M). We will grade the platform top to a topo surface.

1. Open the *Grading* Dialogue box by selecting menu *Edit* | *Terrain Modeling* | *Grading* or by selecting the  icon from the TIN toolbar.

The *Grading* Dialogue box shown in the figure below will appear.

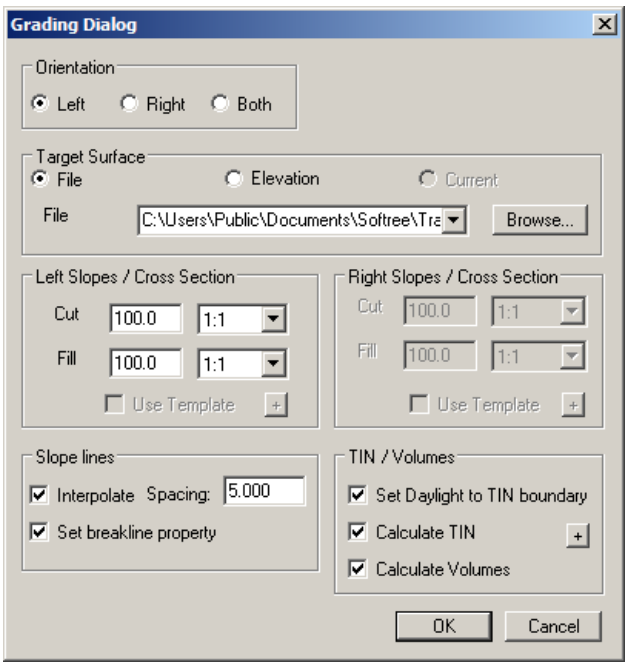


Figure 9.6: Grading dialogue box

The *Grading Dialogue* box controls how the slope is projected (*Orientation*), the elevation or surface (*Target Surface)* the *Slopes* from the pad to the surface, and the spacing (*Slope line interpolation spacing*) of the projected slope lines. The dialogue also allows you to calculate the TIN model as well as volumes after the grading calculation operation is complete.

2. Press the *Browse* button and select file **<Terrain>\Grading\OriginalGroundGrading.ter**. Press *Open*. Change the other fields to match those shown in the figure above. Press *OK*.
3. After a few seconds the grading calculation will complete and the *Volume / Surf. Properties Reporting* dialogue box will appear. Notice that there is a considerable amount of fill indicated in the *Volume / Surf. Properties Reporting* dialogue box. Press Close.

Note: Ensure that the **OriginalGroundGrading.ter** file is designated as "Original" and the Untitled.ter file is designated as "Final" otherwise the cut and fills will be reversed. (Refer to the figure below).

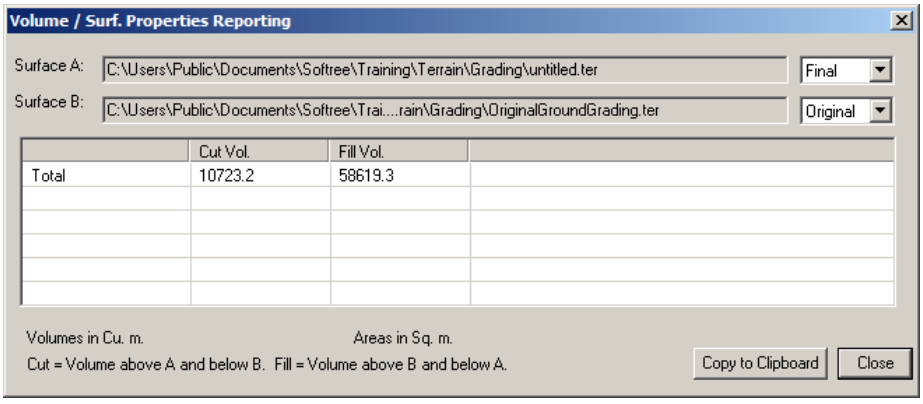


Figure 9.7: Volume/Surf. properties reporting dialogue box

4. In order to balance the cut and fills, let's try dropping the pad by 1-meter increments. First of all we have to select the pad if it is not already selected. Select the pad top by using the selection cursor . It is not necessary to select the slope and daylight lines. (Refer to the figure below)

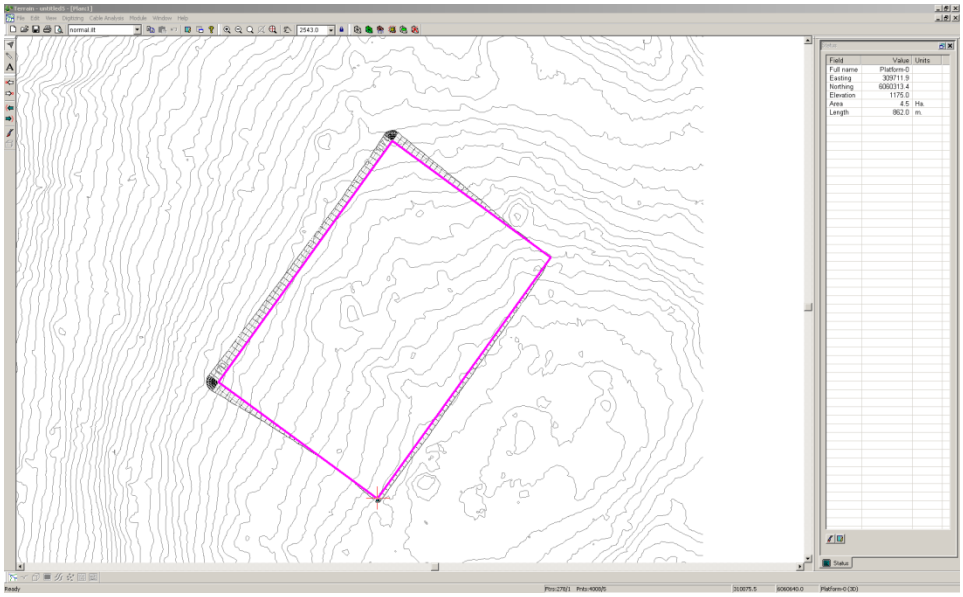


Figure 9.8: Screen shoot with pad top selected

5. Edit | Modify Selected Features | Coordinate Transformation | Rotate/Translate/Scale Tab. Disable the Disable (no coordinate adjustment) button. You may get a Terrain warning dialogue box may open as shown in the figure below. Press OK.

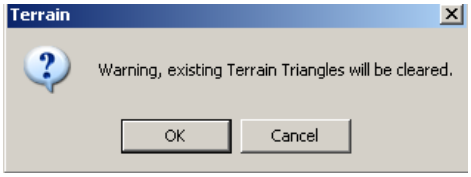


Figure 9.9: Terrain warning dialogue box.

6. Change the *Shift Offset* Z to **–1** as shown below. Press OK.

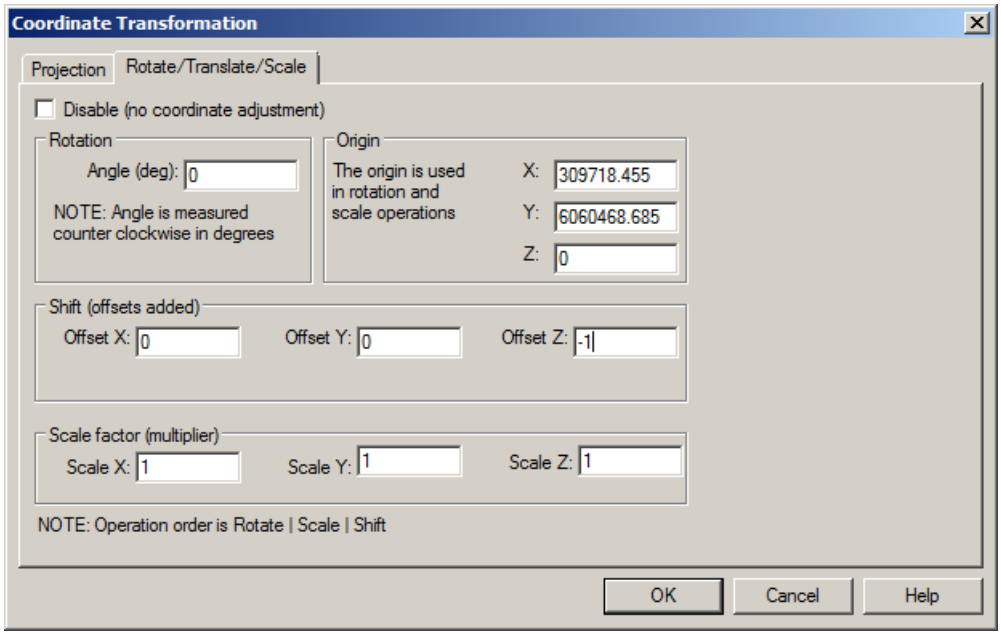


Figure 9.10: Coordinate Transformation Dialogue box

7. *Select Edit | Terrain Modeling | Grading* or by selecting the  icon from the TIN toolbar. Press OK.

You should see the elevation of the platform decrease from 1175 to 1174 in the status window. The new volumes are reported as below

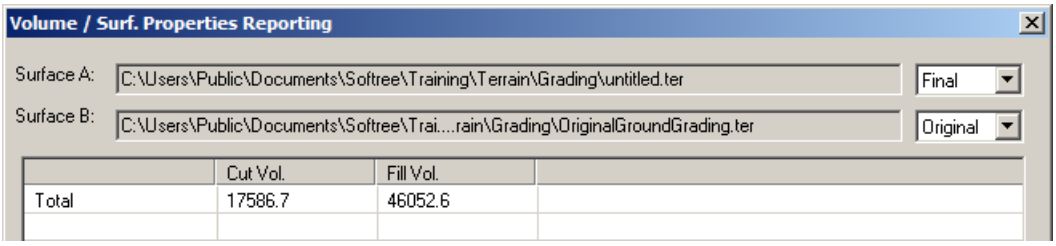


Figure 9.11: Volumes after dropping the pad by 1-meter

8. Repeat the above grading, TIN and volume calculation as in Steps 5 through 8. Press OK. Once the grading calculation has completed you will notice that there is still too much fill.
9. This time select *Edit | Modify Selected Features | Shift*. Change *Z* to **1172.51** as shown in the figure below. Press *OK*.

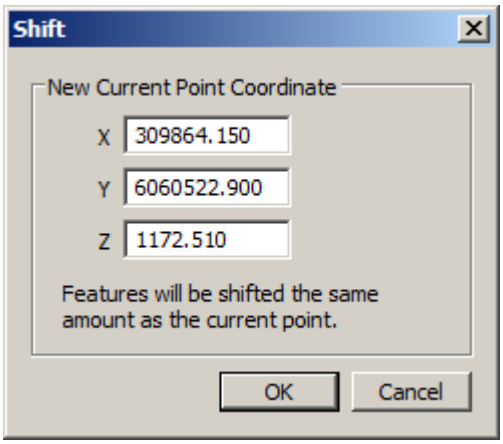


Figure 9.12: Using Shift to change elevation of "Platform"

10. *Select Edit | Terrain Modeling | Grading* or by selecting the  icon from the TIN toolbar. Press OK.

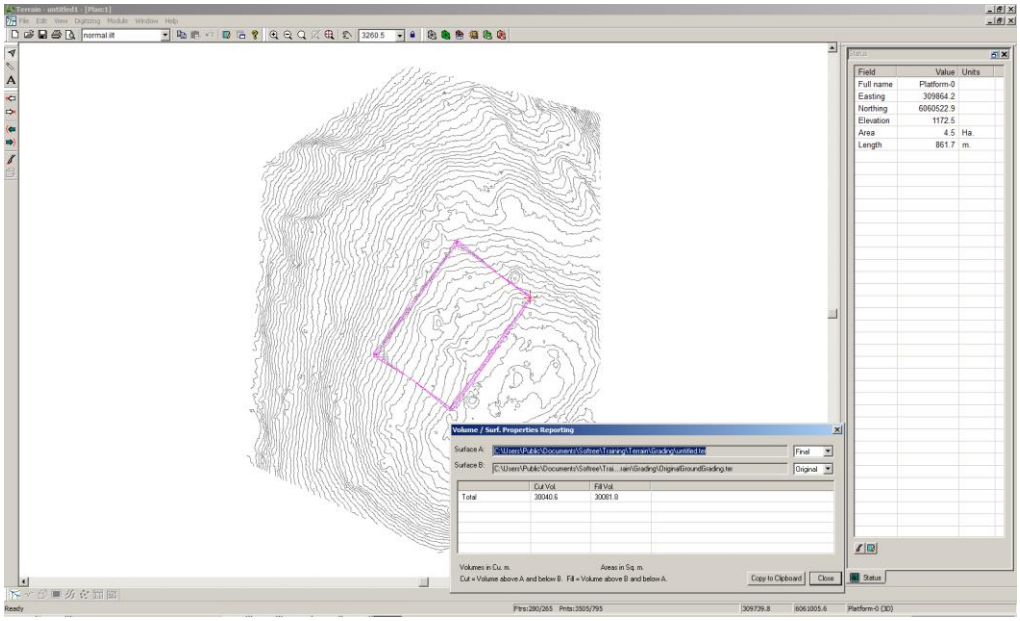


Figure 9.13: Screen shot of final cut and fill slopes

11. You can see that we have balanced cut and fill. (See figure above).
12. *File | New*. Do not save changes.

Merging Terrains

The next few steps to will describe how to merge the pad with the **OriginalGroundGrading** file contours.

1. *File* | *Open* <**Terrain**>**\Grading\OriginalGroundGrading.ter** A contour file will appear on your screen.

Next we will merge the pad terrain into this terrain file. This is done with menu *Edit* | *Terrain Modeling* | *Merge or* with the Merge Terrain icon located in the TIN toolbar.

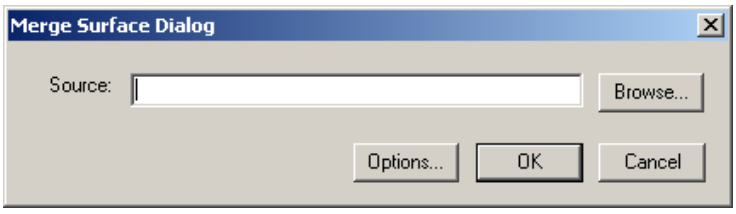


Figure 9.14: Merge Surface

2. Press the Browse button. Select <Terrain>\Grading\ pad-grading after volume calc.ter.
3. Before we continue, we have to make sure that the slope stakes on the pad form a distinct boundary. This is done by pressing the Options button and selecting Include inside stitching (source) breakline in the *TIN Merge Options* dialogue box as in the figure below. Press OK twice.

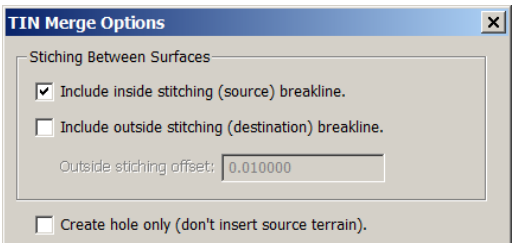


Figure 9.15: Merge Surface

4. A "Warning No Space for Undo" message box may pop up (figure below). Press *OK*.

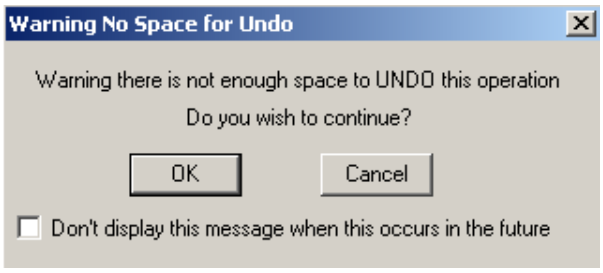


Figure 9.16: Warning no space for undo dialogue box

After a few seconds, the screen should now look like the figure below. Notice that the pad is now merged into the original ground surface.

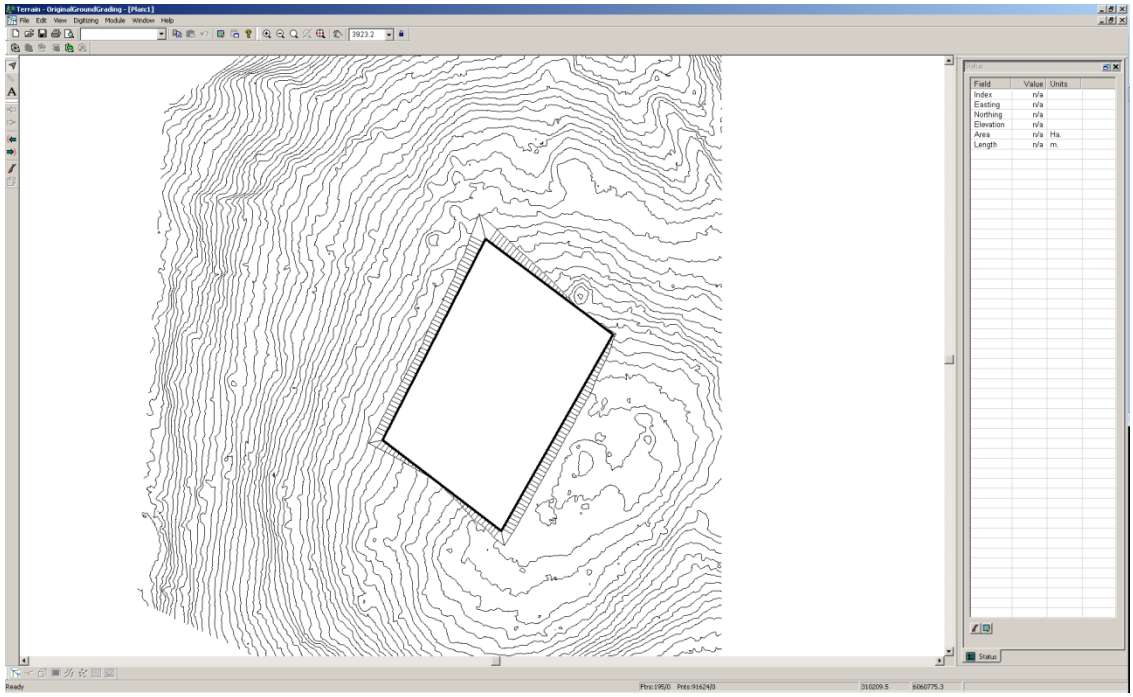


*Figure 9.17: Platform merged into **OriginalGroundGrading.ter***

5. *Edit | Terrain Modeling | Calculate Terrain Model*. Set the parameters as shown in the *Terrain Calculation* dialogue box below and press OK to re-triangulate the surface.

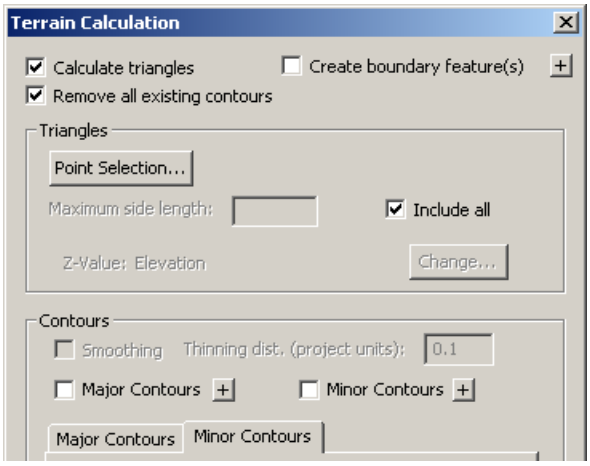


Figure 9.18: Terrain calculation dialogue box

6. To view the platform file merged into the **OrignalGroundGrarding.ter** contours let us look at it in 3D. Select menu *Window | New Window | Graphics | 3D* and rotate as required and you can see that the two files have been merged.

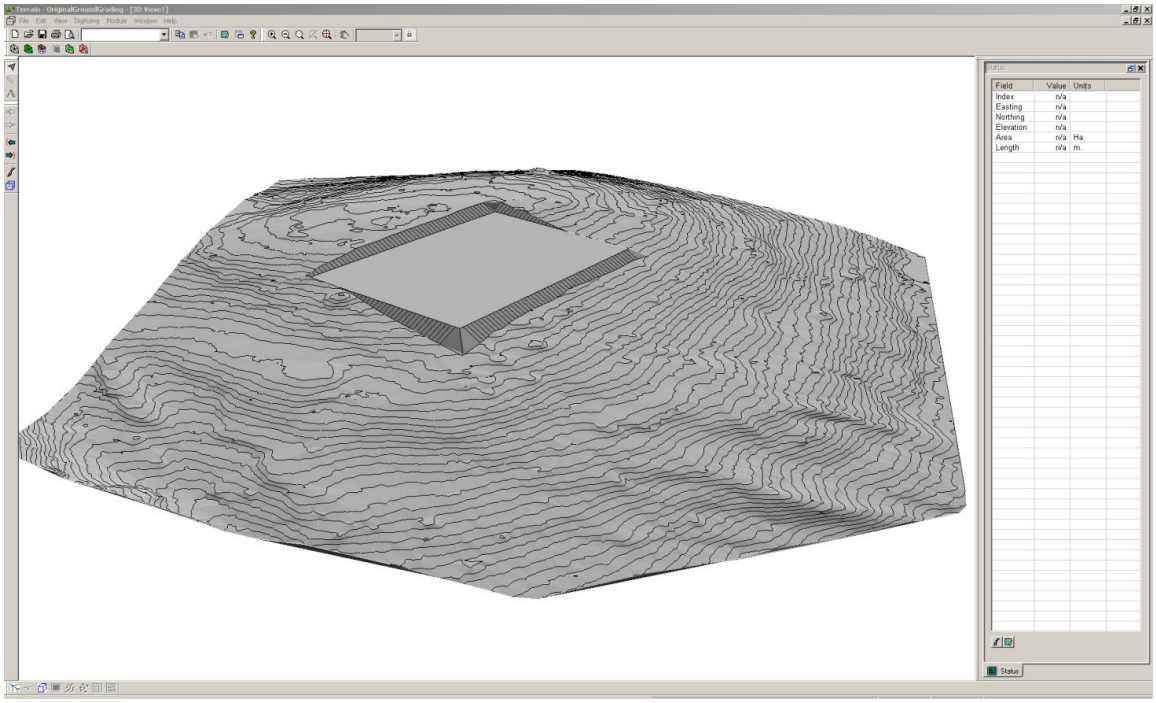


*Figure 9.19: 3D image of merged files (**Platform and OriginalGroundGrading.ter**)*

7. *File | New*. Do not save changes.

10. Traverse Data

The Terrain Module imports and exports traverse files used by the Survey/ Map and Location modules. This section will describe the procedures for working with traverses.

To follow the examples and procedures in this section the *Mapping and Drafting, Import Basic, Export Basic, Import Enhanced, Export Enhanced, Profile Window,* and *Surface Generation and Contouring* function groups must be enabled. See Function Groups in the On-line help for more information.

Note: Terrain Recreational users may get the message "Non Permitted Functions Found in File". If this message appears choose "Keep all functions and revert to DEMO Mode".

Creating a Profile from a Traverse

Road Design Example

A traverse document has been entered into the Survey/Map Module. This example will demonstrate how to display a profile of the traverse.

Note: See Getting Started section for file install folders (<**Terrain**> and <**Defaults and Layouts**>)

1. File | Retrieve Screen Layout <**Defaults and Layouts**>**\Training\training terrain profile.ilt**
   This screen layout has Scroll Bars, TIN, Labels, Grid, North Arrow and Background enabled.
2. File | Insert File. From the Files of Type pull-down choose Softree Traverse Document (*.TR1,*.DB1). Select <**Terrain**>**\Survey\road.tr1.**

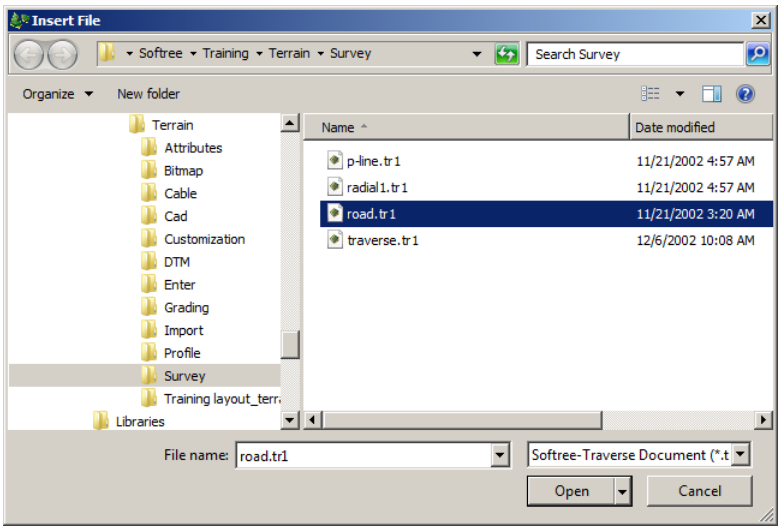


Figure 10.1: Insert file – *Softree traverse document*

3. Press *Open* and OK to bypass the *Import Options* dialogue box.
4. From the Windows drop down menu, select **ROAD-0 (3D)(Current Feature) -Profile:1**

The ground profile, shown in the figure below, will appear in the Profile Window. If the profile does not match the profile shown in below, then right click in the Profile Window to open the *Profile Window Options* dialog box. Change *Ratio (V to H)* to 10.0

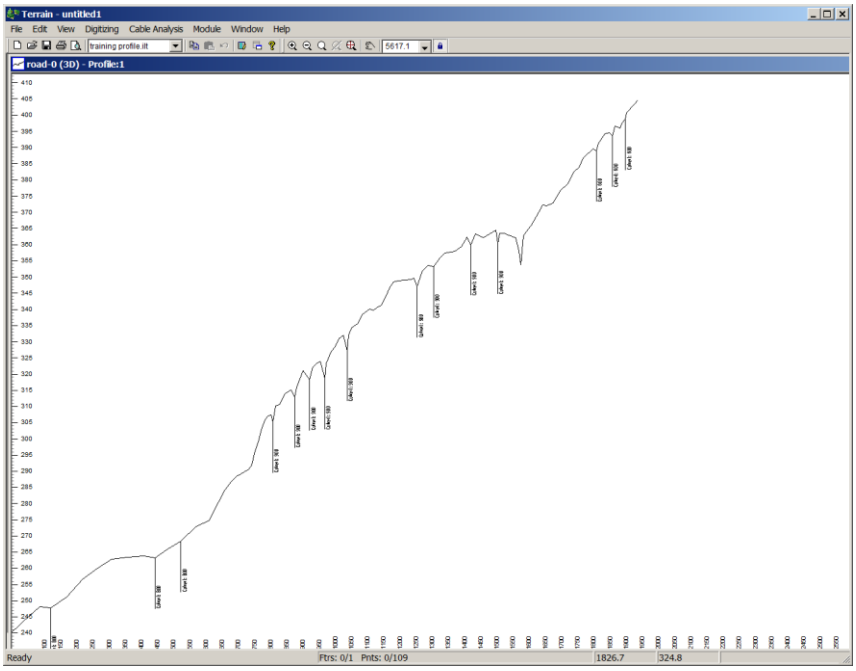


Figure 10.2: Profile of a survey/map traverse document

5. The scale has automatically been set to fit the entire traverse into the Profile Window. To change the scale: activate the Profile Window. Press the *Active Window Options* button or select menu *View*|*Active Window (Profile) Options* to open the *Profile Windows Options* dialogue box as shown in the figure below.

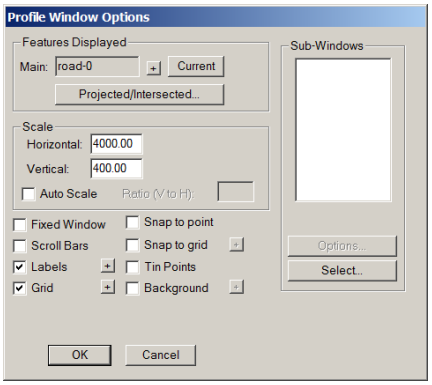


Figure 10.3: Profile window options *dialogue*

6. De-select *Auto Scale*. Set the *Horizontal scale* to **4000**, the *Vertical scale* to **400** (as shown above. Press OK.

7. At this point the Profile Window may be blank. Press the <Ctrl + N> key; the traverse should come into view.

Note: The <Ctrl + N> and <Ctrl + B> keys will change the current point (N=Next and B=Back).

8. To examine the profile near the proposed culvert at station 522. Using <Ctrl + N> and <Ctrl + B> move the current point to station 522 (as shown below).

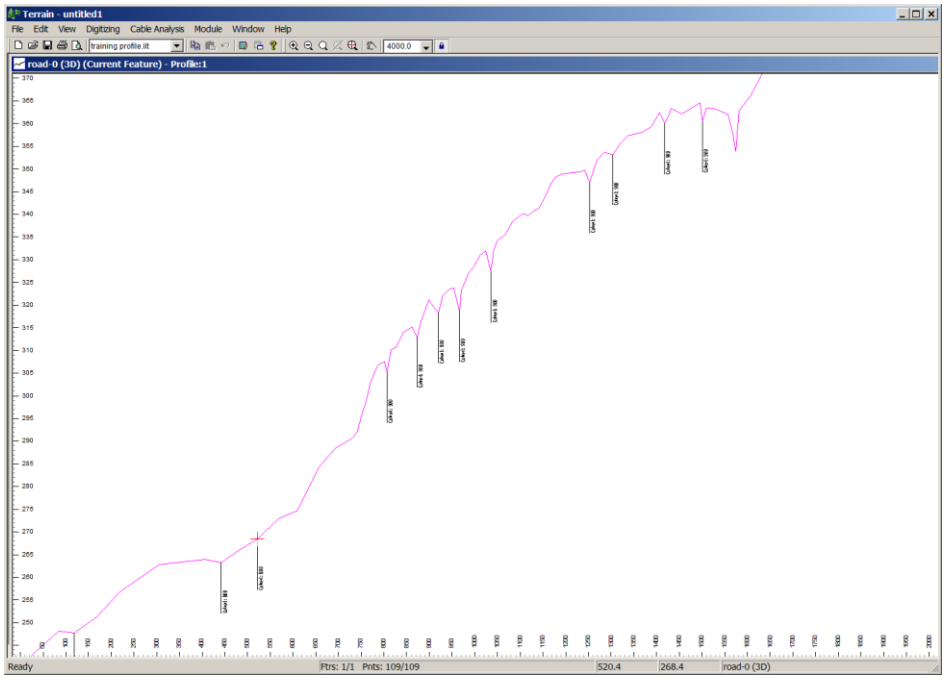


Figure 10.4: Profile with current station at 522

To display the station numbers, press the Active Window Options button. Press the button next to Labels. Double click to select Stations. Press OK to return to main screen. The Station numbers are now displayed.

9. *File*|*New*. Do not save changes.

Creating a DTM from a Radial Survey

Site Survey Example

The following example imports a *map document* containing a site survey. This example demonstrates how to import a map, format the points and create a DTM with contours.

The map consists of a radial survey taken from a single setup (See Survey/Map Tutorial - *Radial Surveys* for more information) and a road P-Line traverse.

1. *File*|*Open*. Select *Softree-Map Document (*.MAP)* from the *Files of Type* pull-down. *Open* **<Terrain>\Survey\site.map**
2. Make sure that *Include Side Shots* is **not** checked in the Import Options dialogue box. Press OK.
3. File|Retrieve Screen Layout **<Defaults and Layouts>\Training\training site.ilt**
4. Press the *Zoom Extents* button.

Your screen should resemble the figure below.

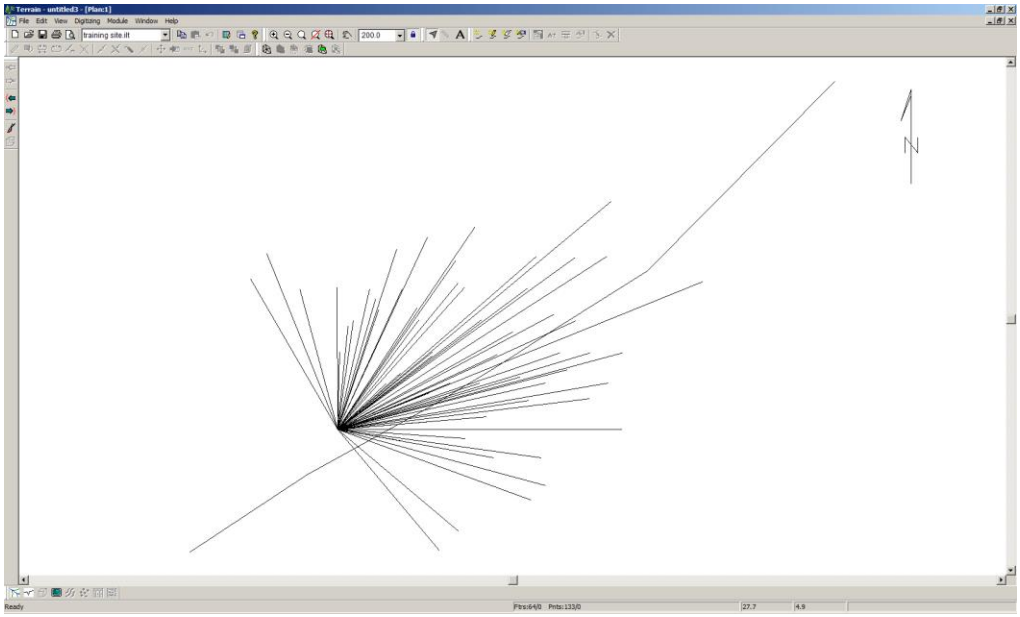


*Figure 10.5: Imported **site.map***

5. For presentation purposes the imported survey information will be re-formatted and 'cleaned up'. Select *Edit* | *Select Feature(s)* | *By Name*

6. Press the *Un-select All* button. Click on the *Advanced* button and type **RADIAL*** in the *Select Matching Names* area as shown in the figure below. Press the *Select* button in the *Select Matching Names* area. Press *OK*. The selected features are displayed in magenta.

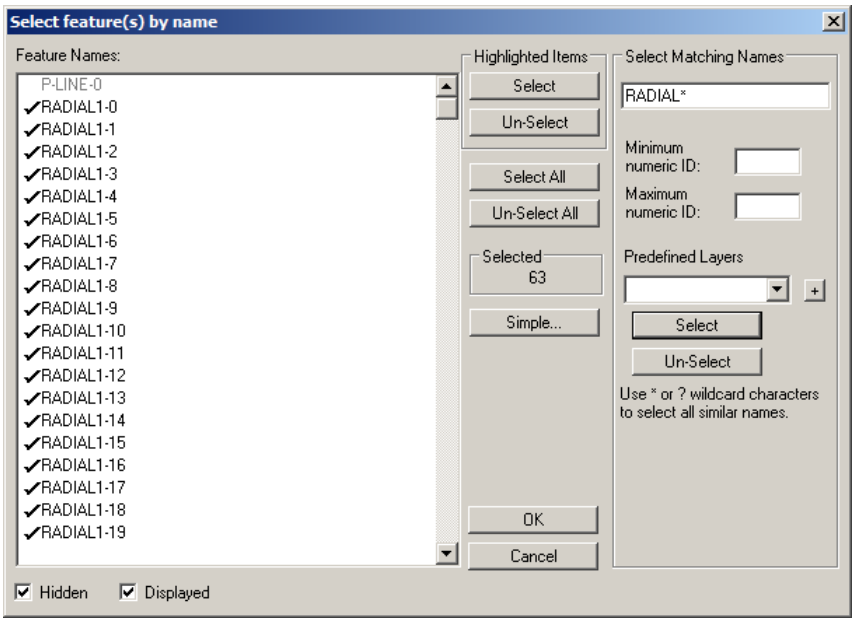


Figure 10.6: Select features by name *dialogue*

Note: The *Select Matching Options* names fields in the *Advanced* section of the *Select feature(s) by name* dialogue box allows you to enter a character in each field you wish to match. "?" matches all characters, "*" matches all following characters and an empty field matches nothing.
For Example
"?ABC????" or "?ABC*" will match:
1ABC
1ABCXYZ
AABC
It will not match:
ABC
1AB2
Minimum and maximum numeric ID's allow you to select by a features numeric ID (for more information about feature naming see *Features* in the On-line Help).

7. Press the *Line Style* button. Set symbols to *Cross*. See figure below. Press OK.

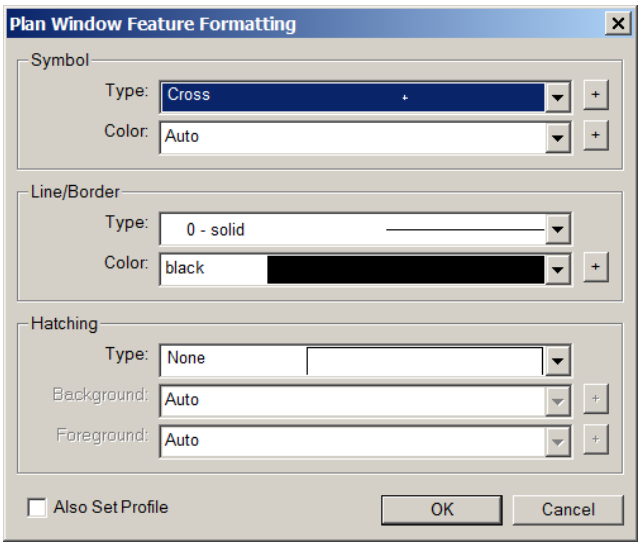


Figure 10.7: Line-types and symbols dialogue

8. Press the *Properties* button and de-select the *Connected* property option. Press OK.

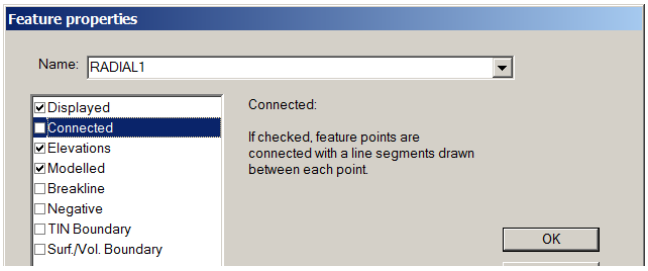


Figure 10.8: Feature properties *dialogue*

9. Select the P-Line traverse (the only remaining linear feature) by clicking on it with the Selection Cursor .

8. *Edit | Modify Selected Feature(s) | Labels* or press the Labels button. In addition to what is already selected, select *Stations (Survey)* by double clicking on the list box entry or enabling the Display checkbox. Press OK.

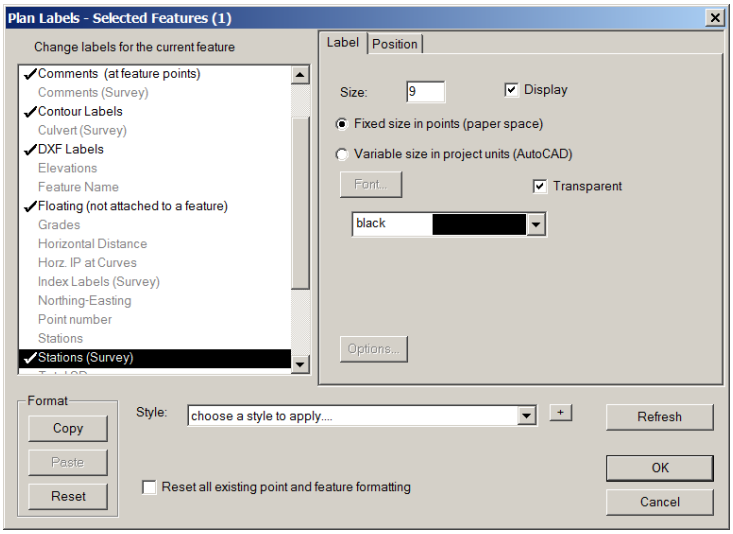


Figure 10.9: Label selection and formatting *dialogue*

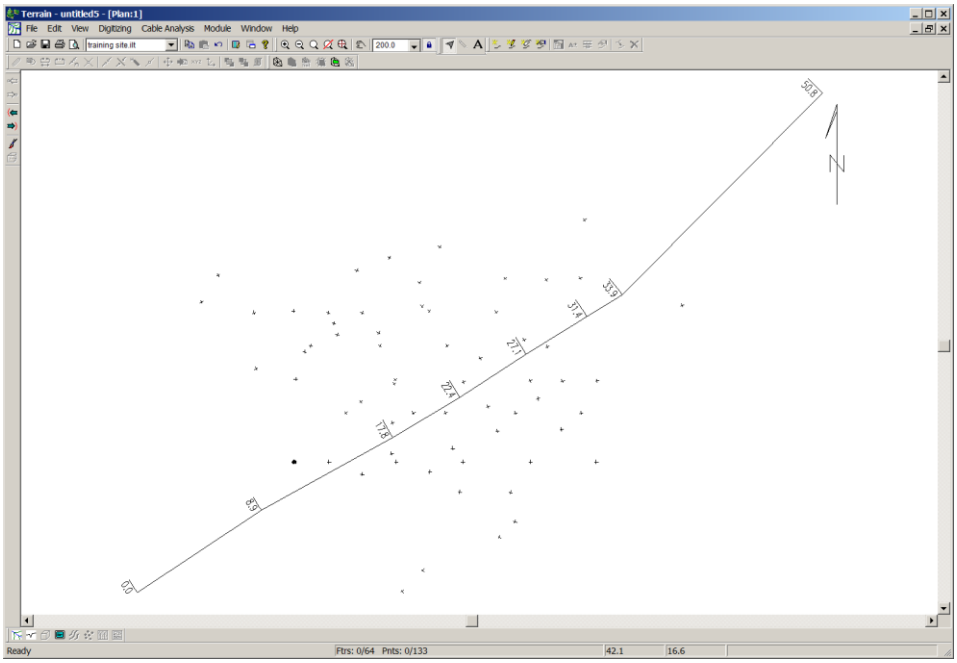


Figure 10.10: Site plan after formatting

10. Press the *Generate TIN* button to create a digital terrain model (DTM) and calculate contours. Set the parameters as shown in the figure below. Press *OK*

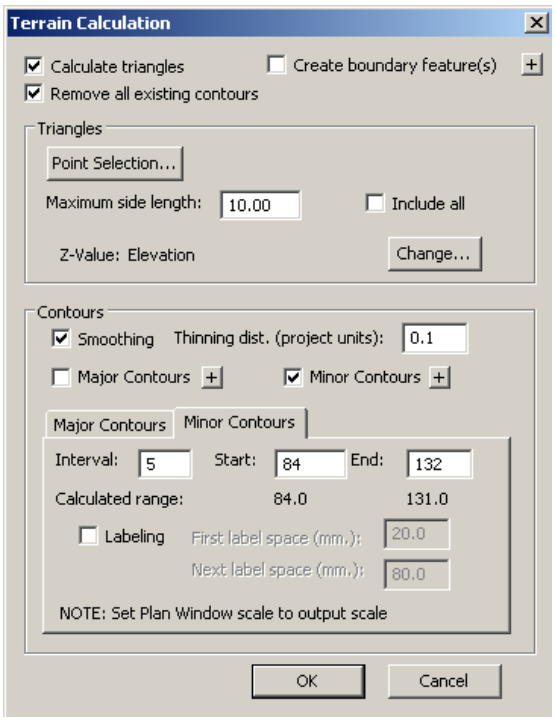


Figure 10.11: Terrain calculation dialogue

Your screen should now display contours of the stream crossing as shown in the figure below.

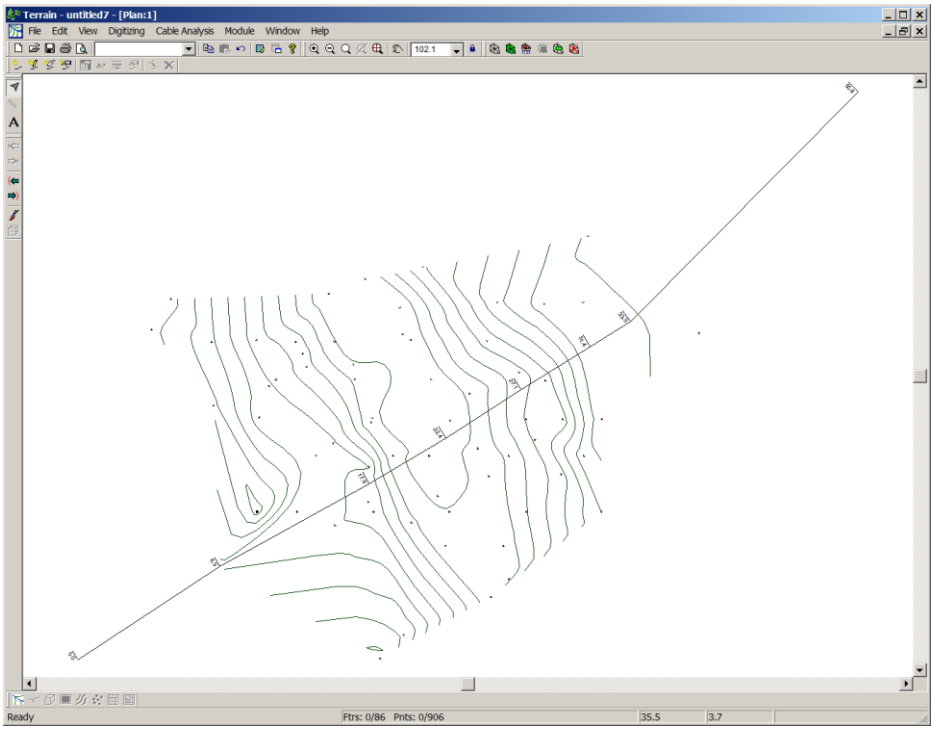


Figure 10.12: Site plan with contours

11. *File*| *New*. Do not save changes.

11. Creating Custom Symbols and Line-types

In this section new symbols and line-types will be created. Tables of symbols and line-types are stored together in TRF files. The default symbol and line table file is **<Defaults and Layouts>\normal.trf**.

Note: RoadEng does not write over your **<Defaults and Layouts>** files during an update; customizations you made in the past will not be overwritten. If you want to see the latest version of **normal.trf** (or any other setup file) look in **<Defaults and Layouts>\LastInstall.**

Terrain and Location documents have private symbol/line tables stored in their files (extension **.te1** for Terrain and **.ds3** for Location). Survey/Map documents always use the defaults in **normal.trf**.

Creating Symbols

In this example we will examine the tools for creating and editing symbols.

Note: See Getting Started section for file install folders (**<Terrain>** and **<Defaults and Layouts>**)

1. Open the Terrain module and select menu *Module*|*Setup*. Choose the *General* tab.

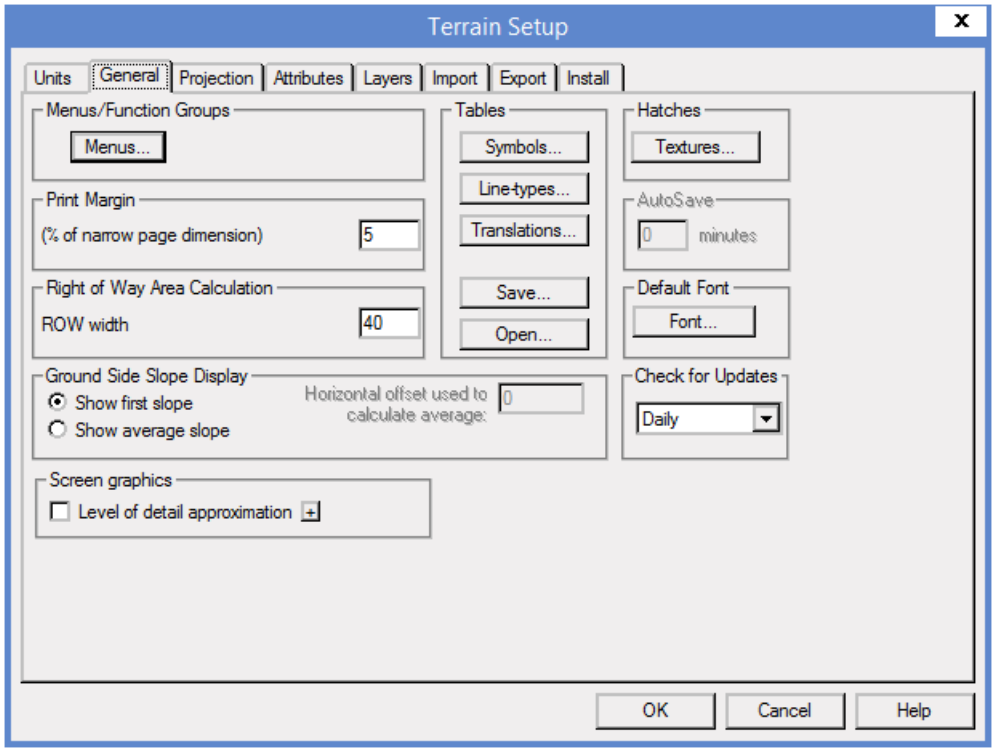


Figure 11.1: Module/Setup, General *tab.*

The tables on your computer may have been customized; the step below will open a Line/Symbol table suitable for this exercise.

2. Press the *Open* button in the *Tables* group, and browse for **<Defaults and Layouts>\Training\training normal.trf**. Press *Open*.
3. Press the *Symbols* button to open the *Edit Symbols* dialogue box (figure below).

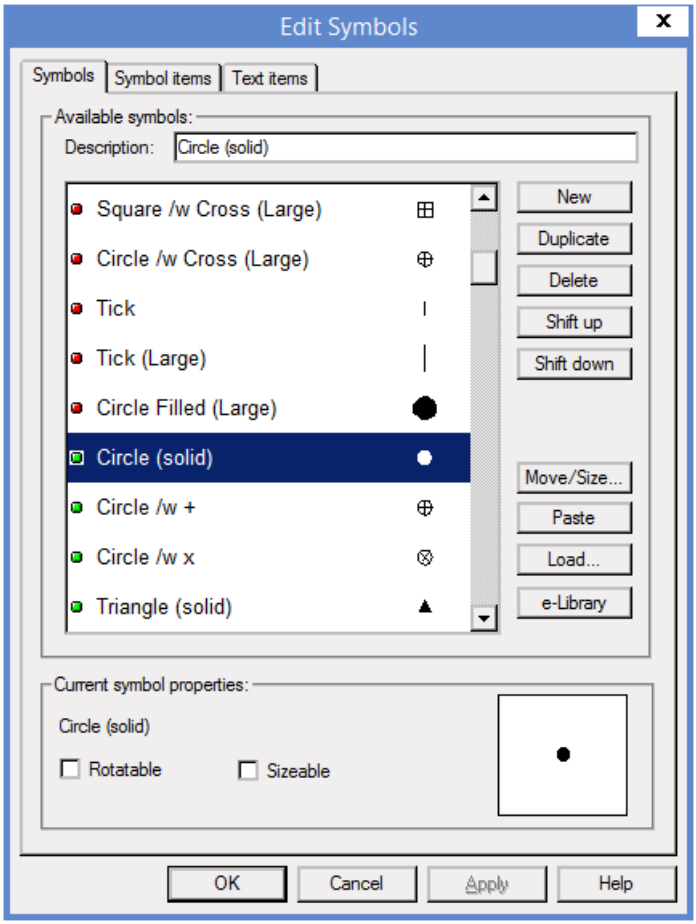


Figure 11.2: Edit Symbols *dialogue box,* Symbols *tab.*

The *Symbols* tab shows the same list you would see if you were changing the formatting of a Terrain or Location feature. The items preceded with the green dot ■ are modifiable, those with a red dot ■ are not.

A Symbol consists of *Symbol Items* and *Text Items*. Symbol items are a series of line segments; text items are characters with font information. When you select a modifiable symbol, you can click on the other two tabs to modify the selected symbol.

Load external Symbols

While it is possible to create *New* symbols from scratch, it is usually easier to *Load* (import) from an external source.

Note: Symbols and line-types can be loaded from Translation Files (extension TRF, TE1, or DS3), old-style symbol or line-type files (SYM or LIN), or from AutoCAD DWG files.

4. Scroll to the bottom of the list.

Notice that the last item in the list is *open arrow*.

5. Load a version 3.1 symbol table:
6. Press the *Load* button.
7. Set the Files of Type from the drop down menu to Softree V3.1 Symbols (*.sym).
8. Brows for <Defaults and Layouts>\Training\training example.sym.
9. Press Open.

This will open the *Selective Load* dialogue box shown below.

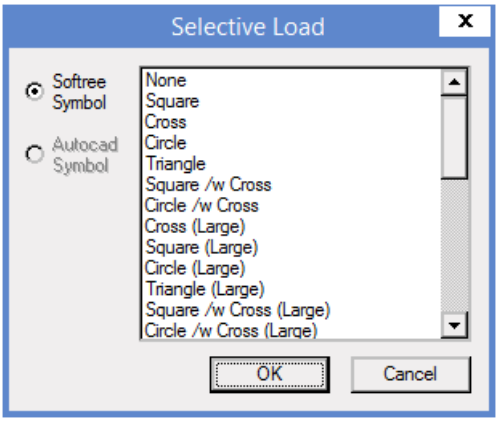


Figure 11.3: Selective load *dialogue box for symbols.*

10. Select all of the symbols in the list:
    a. Click on the first item in the list.
    b. Scroll down to the bottom of the list.
    c. Hold down the <shift> key, and click on the last item.
11. Press *OK* to load all selected symbols.

You will be prompted with the dialogue box shown below.

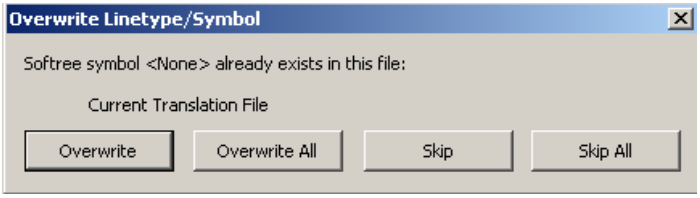


Figure 11.4: Overwrite line-type/symbol *dialogue box*

12. Press Skip *All*. Do not overwrite the existing symbols.

You will now see six new symbols at the end of the list.

Create a new Symbol

13. Press the *New* button.

A new symbol *xxx* will appear at the bottom of the *Available symbols* list.

14. Change the *Description* from *xxx* symbol to ***Tree*.**
15. Click on the *Symbol items* tab.

The *Edit Symbols* dialogue box will appear as shown below.

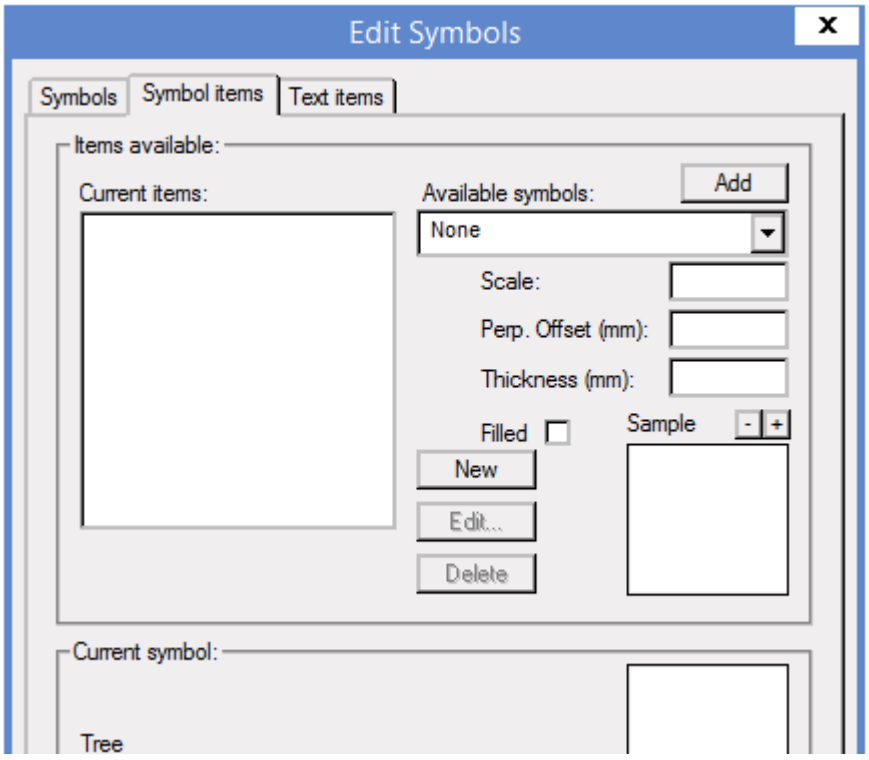


Figure 11.5: Edit Symbols *dialogue box,* Symbol items *tab*

16. Press the *New* button.

You are ready to draw a new symbol. Notice that the main drawing surface is composed of a grid, and that the *Snap To Grid* and *Add* options are set as in Figure 11.6 below.

2. Press the Zoom button until you have zoomed to **x8**.
3. Move the cursor around the drawing area and notice that the *Pointer position* is dynamically updated.

Note: The *Pointer position* is in units of 1/10mm. The symbol below will be **6**mm on your screen (if not scaled).

4. Draw a vertical line:
    a. Select *Add* mode (if it is not selected).

b. Move your mouse pointer above the center point (red cross-hair) until the *Pointer position* is roughly (**0, 300**).

c. Click and drag with the mouse until you draw a straight line that ends the same distance below the center. Watch the *Pointer position for* (**0, -300**).

d. Release the mouse button to finish the segment.

e. If you need to edit the line, select *Edit* mode, and click and drag an end point.

5. Repeat the step above to draw a horizontal line: (**300, 0**) to **(-300, 0**).

6. Draw two more lines that run diagonally as shown in the figure below: (**225, 225**) to (**-225, -225**) and (**-225, 225**) to (**225, -225**).

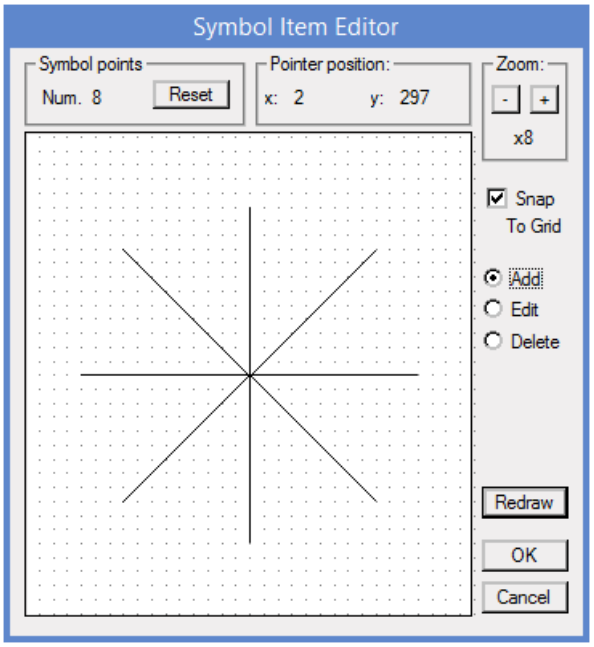


Figure 11.6: Symbol item *editor*

Note: This dialogue box contains some other useful features. The *Reset* button will clear the whole drawing, so that you can redraw the symbol. Activating the *Edit* or the *Delete* options will allow you to edit or delete a line segment by clicking on a point. The *Redraw* button refreshes the drawing surface. If you do not want the lines to attach to grid points, turn off the *Snap To Grid* option. Up to 20 points can be added to an item.

7. Once you are done press *OK*.

If the symbol is more complex than the one just drawn (i.e. more than 20 points) you will have to add portions of the symbol as separate items. You can also add *Available symbols* to the *Current items* list by selecting a symbol in the pull down box and pressing the *Add* button.

A Symbol is a collection of items. Each item can be controlled individually:

- Fill an item by setting the *Filled* check box (do this *after* you have drawn the item).
- Change the *Scale* to something other than the default value of 1.00.
- Offset the item (perpendicular from the line it is assigned to) by changing the *Perp Offset* option.
- Change the thickness of the segments in the item.

8. Select the *Symbols* tab. Don't press *OK* it closes the whole dialogue box!.

The new symbol *Tree* appears in the *Available Symbols* list and the *sample* box (figure below).

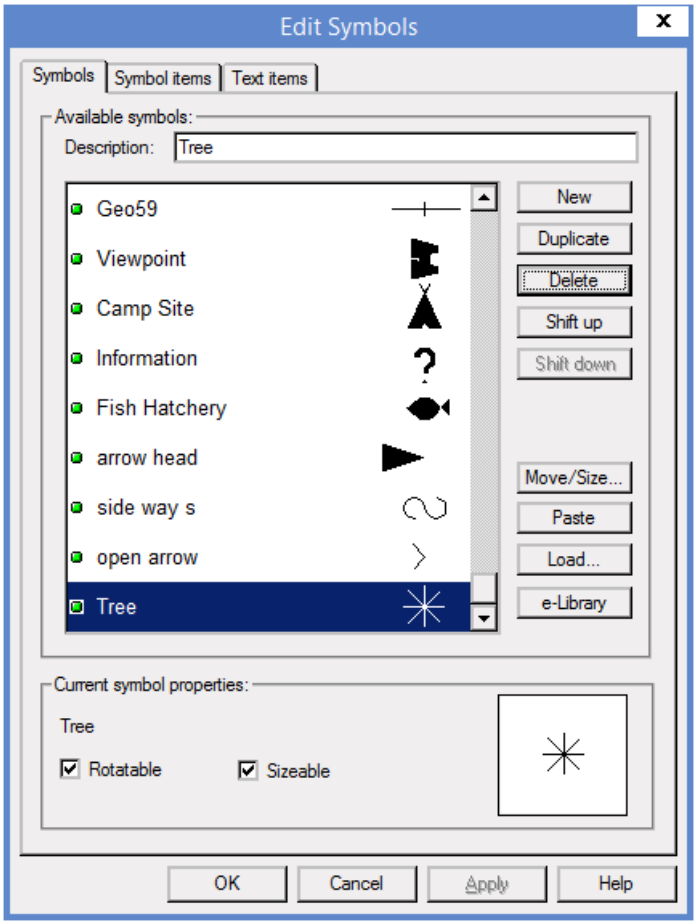


Figure 11.7: Creating a new symbol

It is also possible to create symbols from characters and fonts. Or, to make a compound symbol with one or more characters combined with one or more graphic items.

Let's make a new symbol from a character with a special font.

9. Again, press the *New* button.
10. Change the *Description* from "xxx" to **Omega.**
11. Click on the *Text items* tab.

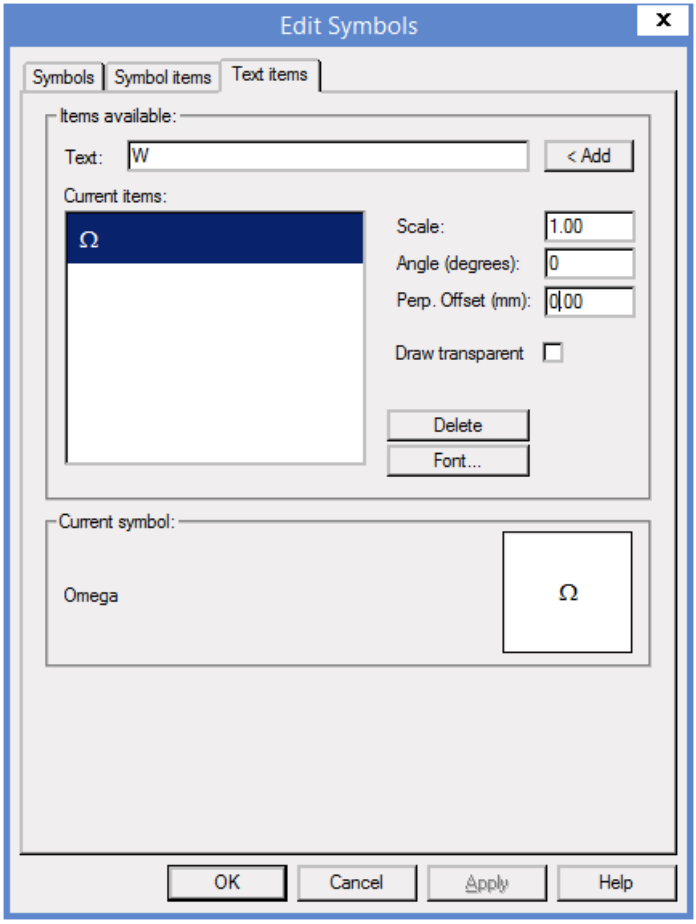


Figure 11.8: Symbol editor dialogue - text items tab

12. Type **W** in the *Text* field and press the *Add* button.
13. Press the *Font* button to open the *Font Selection* dialogue box. Select *Symbol* font, if available. Press *OK*.

The "W" is now rendered as the Greek character omega (figure above).

Note: It is possible to create symbols from other specialized fonts as shown in the figure below. Fonts are not provided with the Terrain Module (use the Internet to locate specialized font sets).

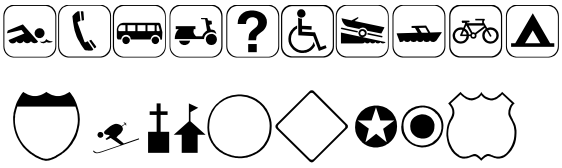


Figure 11.9: Symbols created using specialized fonts

Fonts are not provided with the Terrain Module (use the Internet to locate specialized font sets).

14. Select the *Symbols* tab again.

The new symbol *Omega* appears at the bottom of the list.

17. Press *OK*, to close the *Edit Symbols* dialogue box.
18. Press *Save* in the *Tables* section of the *Terrain Setup* dialogue box.

You are prompted with the *File Save* dialogue box to save this table. You could save over your **normal.trf** file to modify your defaults, or you could save to another file.

19. Press *Cancel*. We do not want to save this example table.
20. Continue to step 3 in Creating Line-types below or Cancel to close.

Creating Line-types

Line-types can contain periodic symbols and text as well as lines. In this exercise we will load lines from an external table and create a new line type from scratch.

1. Open the Terrain module and select menu *Module*|*Setup*. Choose the *General* tab.

You will be presented with the dialogue box shown in Figure 11.1 above.

The tables on your computer may have been customized; the step below will open a Line/Symbol table suitable for this exercise.

2. Press the *Open* button in the *Tables* group, and browse for **<Defaults and Layouts>\Training\training normal.trf**. Press *Open*.
3. Press the *Line-types* button in the *Tables* group to open the *Edit Line Types* dialogue box (figure below).

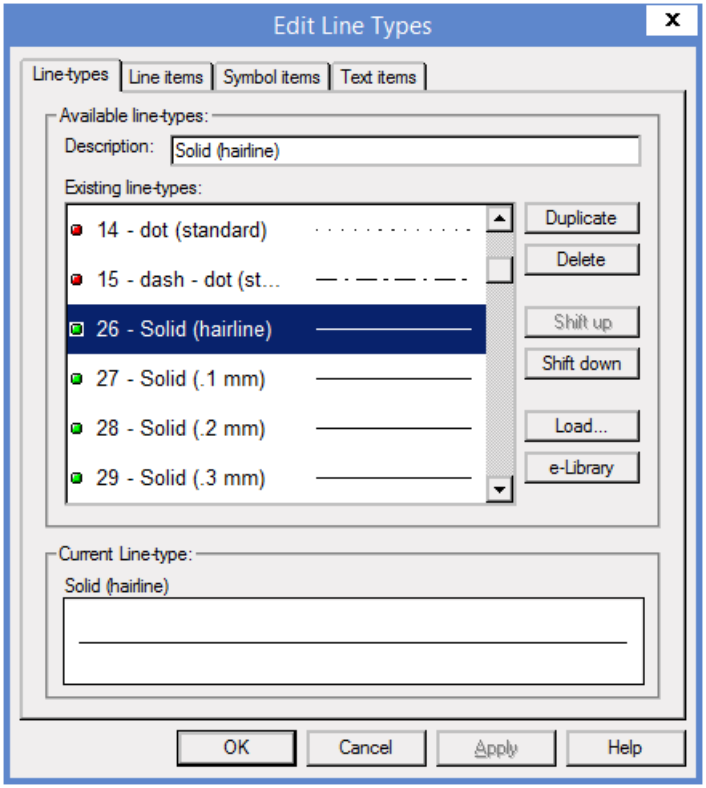


Figure 11.10: Edit line types *dialogue box*

The *Line-types* tab shows the same list you would see if you were changing the formatting of a Terrain or Location feature. The items preceded with the green dot ■ are modifiable, those with a red dot ■ are not.

A Line-type consists of *Line-Items*, *Symbol Items* and *Text Items*. *Line items* are linear patterns that may or may not be offset. *Symbol items* and *Text items* can be included at regular intervals or on the line vertex points. When you select a modifiable line-type, you can click on the other tabs to modify it.

Load External Lines

While it is possible to create *New* line-types from scratch, it is also possible to *Load* (import) from an external source.

Note: Symbols and line-types can be loaded from Translation Files (extension TRF, TE1, or DS3), old-style symbol or line-type files (SYM or LIN), or from AutoCAD DWG files.

4. Scroll to the bottom of the *Existing line-types* list.

Notice that the last item in the list is *ZIGZAG*.

5. Load a version 3.1 line table:
6. Press the *Load* button.
7. Set the *Files of Type* from the drop down menu to *Softree V3.1 Lines (*.lin*).
8. Browse for <Defaults and Layouts>\Training\training example.lin.

9. Press *Open*.

This will open the *Selective Load* dialogue box shown below.

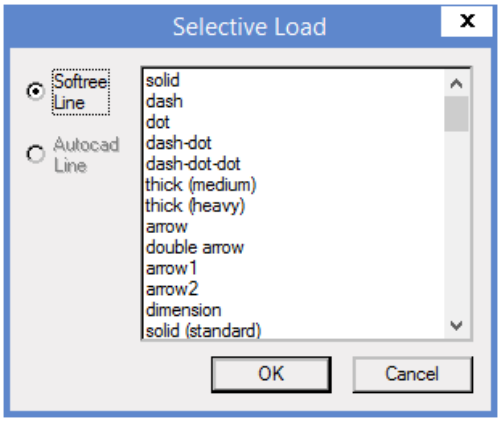


Figure 11.11: Selective load *dialogue box for line-types*

10. Select all of the line-types in the list:
    a. Click on the first item in the list.
    b. Scroll down to the bottom of the list.
    c. Hold down the <shift> key, and click on the last item.
11. Press *OK* to load all selected symbols.

You will be prompted with the dialogue box shown below.

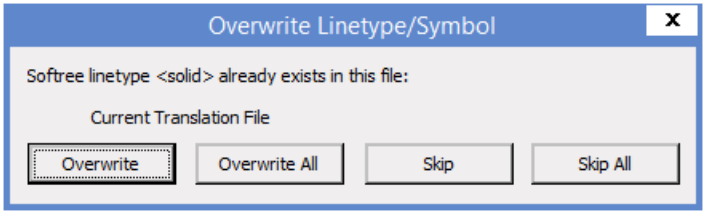


Figure 11.12: Overwrite line-type/symbol *dialogue box*

12. Press Skip *All*. Do not overwrite the existing line-types.

You will now see six new line-types at the end of the list.

Create a new Line-type

We will now create a new line-type by duplicating an existing one.

13. Duplicate Solid (.3 mm):
14. Scroll until you find *29 - Solid (.3 mm)* and select it.
15. Press the *Duplicate* button.

The line-type will be duplicated and placed at the end of the list.

16. Change the *Description:* to **Gully with S6 stream**.

The line type is OK for our purposes. You may want to look in the *Line items* tab to see what options are set.

17. Add the *open arrow* symbol every 5mm:
18. Select the *Symbol items* tab.

The *Edit Line Types* dialogue box will change to look like the figure below.

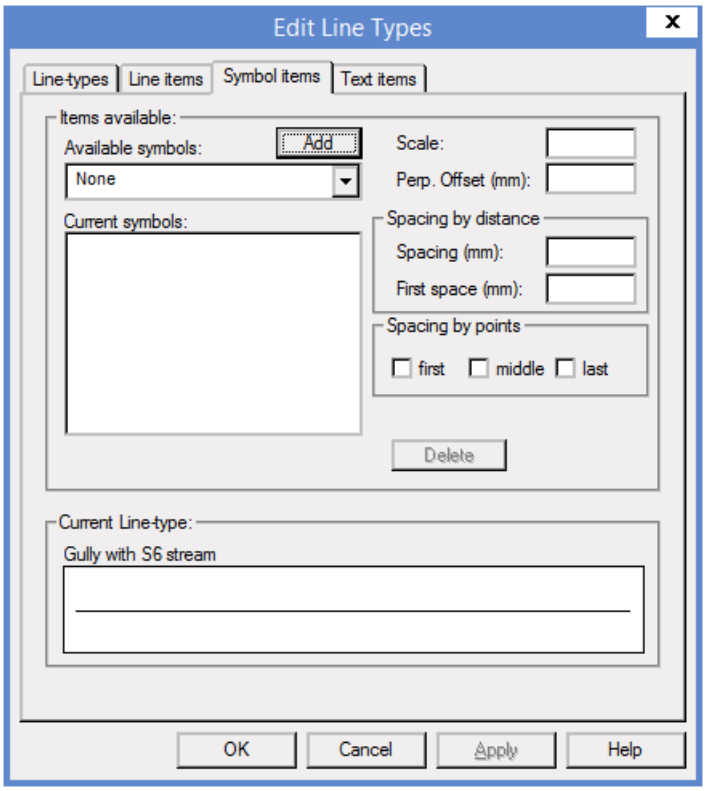


Figure 11.13: Edit Line Types Dialogue box - Symbol Items Tab

19. Scroll through the *Available symbols* list until you find a symbol called *open arrow* (near the end of the list). Select this symbol.
20. Press the *Add* button.

The arrow symbol will be added to the *Current symbols* list, and you will see it at the start of the *Current Line-type* graphic at the bottom of the dialogue box.

21. Clear the *first* check box under *Spacing by points*.

The symbol is now *Spacing by distance*; every 10mm by default.

22. Change the spacing to **5**mm.
23. Add an arrow symbol at the end of the line:
24. Again scroll through the *Available symbols* list select the symbol called *Arrow R1*.

25. Press the *Add* button.
26. Clear *first* and select *last* in the *Spacing by points* section.

The arrowhead is now at the end of the line and should look like the *Current Line-type* in figure below

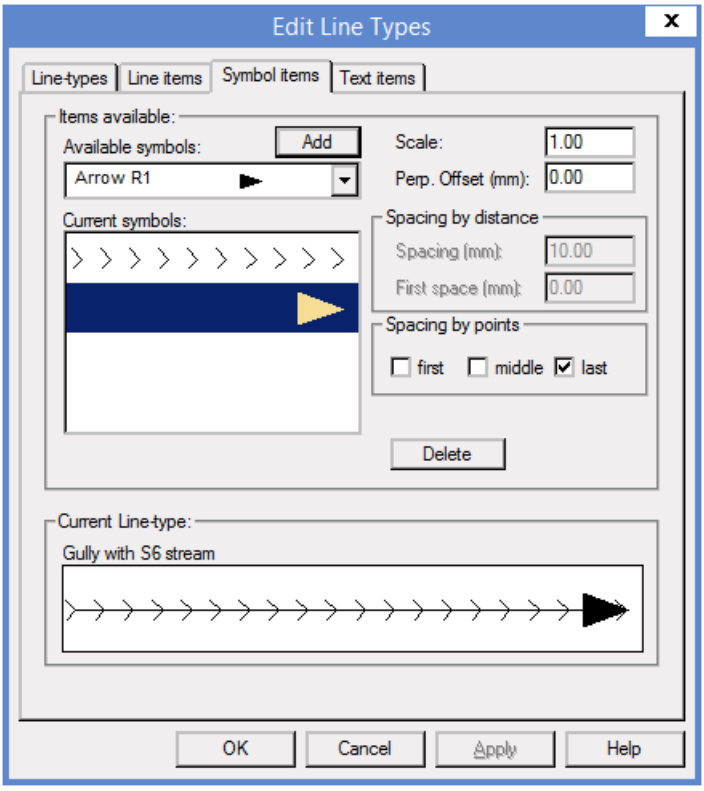


Figure 11.14: Edit Line Types *dialogue box* - Symbol items *tab*

27. Add “S6” text along the line:
28. Press the *Text items* tab.

The dialogue box now looks like the figure below.

29. Type **S6** in the *Text* field.
30. Press the *Add* button.
31. Change the *Spacing* to **20**mm.
32. Turn off the *Draw transparent* option.

The result will be as displayed in the *Current Line-type* box below.

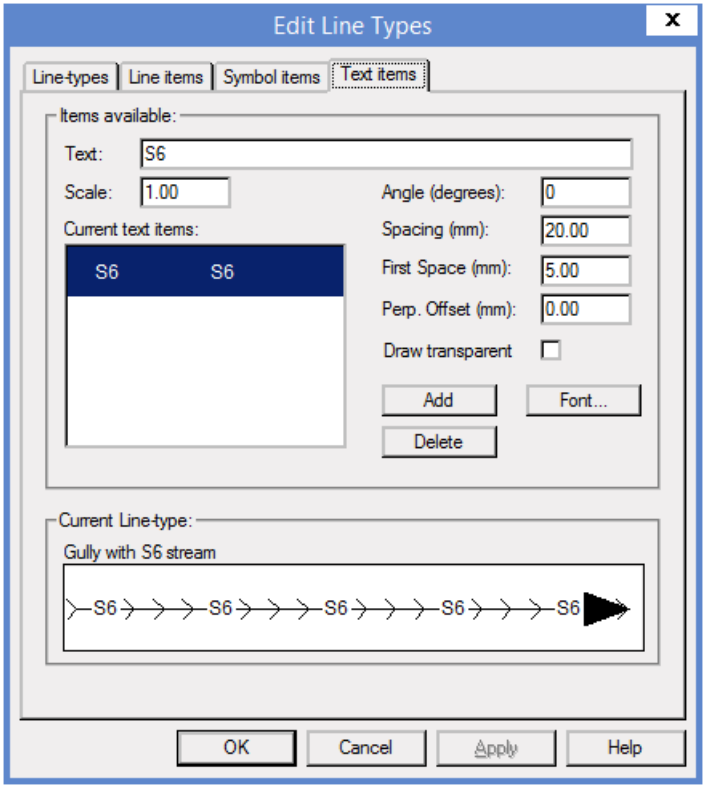


Figure 11.15: Edit Line Types *dialogue box* - Text items *tab*

33. Click *OK* to return to the Terrain *Setup* dialogue box.
34. Press *Save* in the Tables section of the Terrain Setup dialogue box.

You are prompted with the file *Save As* dialogue box. If you write over **<Defaults and Layouts>\Normal.trf**, you will update your defaults for Terrain and Location modules.

35. Press *Cancel*. Do not save this example table.

Any TRF file you create is available from the *Open* button. If you open an existing Terrain document and then change Line/Symbol table, the lines and symbols you have applied will change. Only the non-modifiable ■ symbols and lines are guaranteed to remain unchanged.

Note: Symbols and Line-types are referenced by table index (not name). If you open an existing Terrain document and then insert lines or symbols near the beginning of the table, all features containing lines or symbols after the insertion point will change.

Note: Terrain documents can be created with different line/symbol tables. If you insert or paste features from one Terrain document into another, the line/symbol formatting may change.

36. Press *Cancel* again to exit the *Terrain Setup* dialogue box.

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