Survey / Map Module Tutorial

Version 10

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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® Forestry and RoadEng® tasks.

Installation

The Survey Map module is installed as a part of either Terrain Tools Forestry or with RoadEng Forest Engineer.

The tutorial files referred to in the following examples can be installed from Softree's Support web site:

- Go to the *Support-Documentation Updates* page on Softree's web site: https://support.softree.com/product-updates/Documentation-Tutorials.
- Once *SoftreeTutorials.exe* has been successfully downloaded. *Double-click* on the file to begin installation.
- During the installation you will be prompted to select which content to install, we recommend installing **ALL** the available tutorial options.

Documents

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

C:\Users\Public\Documents\Softree\TrainingV10\SurveyMap

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 <**SurveyMap**> in the examples below.

Recommendation: To make accessing files easier as you work through the tutorial, we suggest pinning the <SurveyMap> folder to your Quick Access menu. To do so, open Windows Explorer, navigate to the folder <SurveyMap>. Right-click on the folder, select "Pin to Quick Access". This will now make the folder available on the left-hand side of Windows Explorer (see figure below).

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.
If a file gets modified, delete the files in the training folder. Then re-install the tutorial files (per the original steps).

C:\Users\Public\Documents\softree\trainingV10\SurveyMap

Defaults and Layouts

The setup and layout files are stored the folder below by default:

C:\ProgramData\Softree\RoadEng

It is possible to change this folder, so we will refer to it as **<Defaults and Layouts>** in the examples below. A folder containing training specific files has also been added to this location:

<Defaults and Layouts>

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

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

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.

Additional help is available through the Softree Knowledge Base:
https://www.support.softree.com/knowledge-base

Tutorial Units

Most examples in this tutorial are in metric units. To correctly follow the examples, ensure Metric Units are enabled. Select *Setup Tab* | *Module Setup* button and clicking on the *Units* tab. 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.

Conventions

The following conventions are used throughout the manual:

- Menu functions are delimited by a line "|". *File* | *Open* means to click on Survey/Map *File* button in the corner of 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. Functional Overview

Softree software solutions are sold as modular products. Depending on the product you have purchased, it could include up to three *modules*:

1. *Survey/Map*
2. *Terrain*
3. *Location*

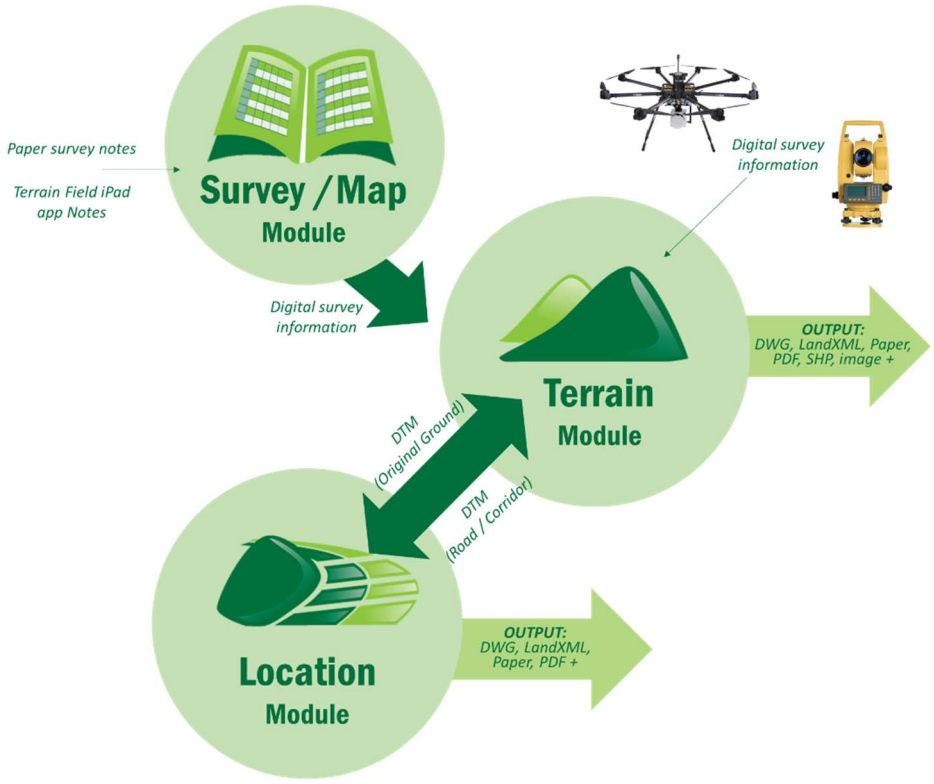


Figure 2-1: Relationship Between the Modules

Each of the modules can be started from the Windows Start menu, a desktop shortcut or from the *Setup* tab within either of the other modules.

Module Descriptions

Survey/Map Module

The Survey/Map module was developed for survey applications in the forest industry. It can be used with a variety of survey equipment and accuracy requirements, including clinometer/compass, theodolite, level, and EDM. GPS coordinates can also be included to geo-reference traverses and for coordinate adjustments.

This module is used primarily to type paper survey notes into the computer. Azimuths, distances and slopes are entered and reduced to coordinates. Facilities exist to add perpendicular side shots to a traverse so that a group of terrain, suitable for a road design, can be easily captured with basic survey instruments.

Survey/Map also contains tools for adjusting traverses with respect to each other or to known coordinates.

Terrain Module

The Terrain Module provides basic CAD facilities for assembling and manipulating 2D and 3D points and features. Information can be imported from external sources like survey files, CAD files and image files. Three dimensional coordinates can be incorporated into a digital terrain model (DTM).

DTMs can be used for:

- Contour generation
- Section and profile display
- Volume calculations
- Pad, pit and site design (grading)
- 3D viewing
- Original ground for road design (Location module)

The Terrain module is also a capable mapping tool with control of line types, colors, symbols, hatching and labelling styles.

Location Module

This is the module used to design road alignments. Location requires an original ground terrain (provided by the Survey/Map and/or Terrain modules). The designer controls cross section templates, alignment location and curves. Location provides real time feedback of volumes, mass haul, road footprint, cross sections, grades, etc.

Location can also export designed surfaces back to the terrain module where they can be merged into a composite surface. This is the most common way to prepare the original ground for an intersection design.

The Survey Map Screen

Survey/Map includes facilities for field note capture, adjustment and display. Two main screens are available for entering and manipulating survey data; a fully customizable spreadsheet for field note capture (*Traverse Screen*) and a fully customizable plan display window for displaying one or more traverses (*Map Screen*).

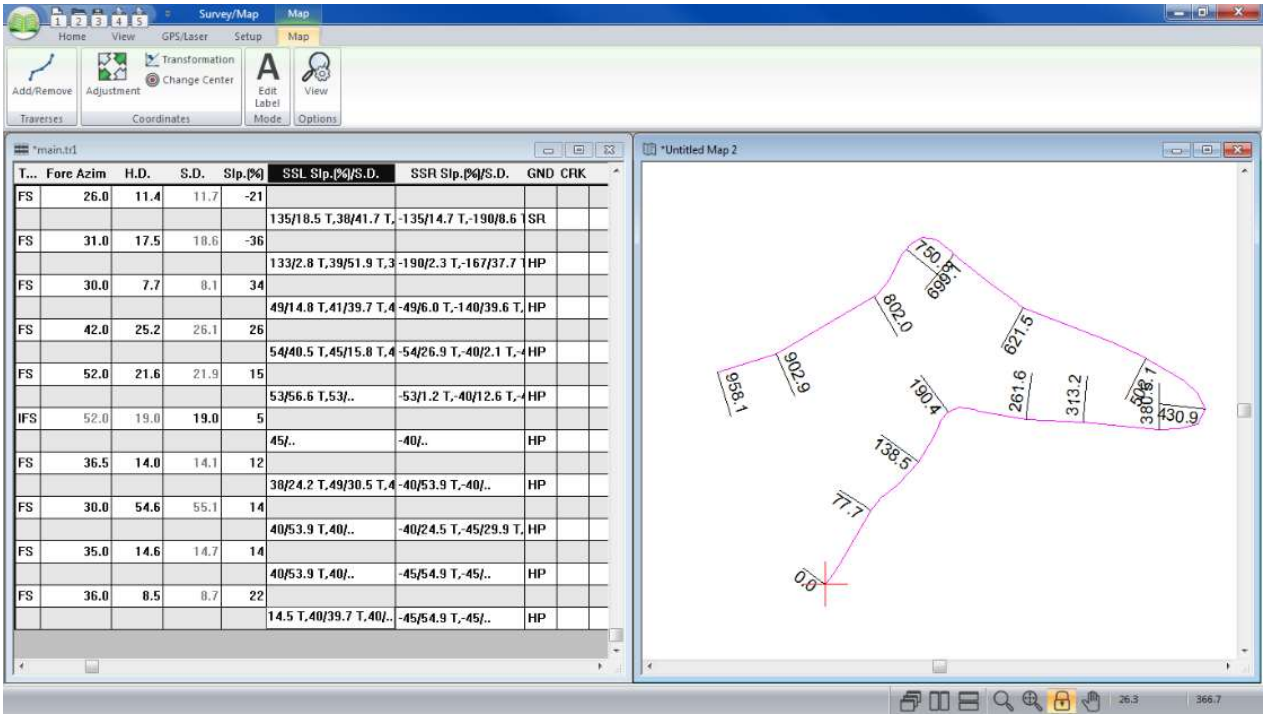


Figure 2-2: Survey/Map Screens

Shot Types

The following terminology is used in Survey / Map:

- *FS* **Foreshot** is a shot on the traverse centerline from current instrument position to the next instrument position.
- *BS* **Backshot** is a shot on the traverse centerline from current instrument position to previous instrument position. Matching FS and BS shots are averaged.
- *IFS* **Intermediate field shot** is a shot on the centerline which is not a turning point. The bearing of the IFS shot is assumed to be the same as the next FS which follows.

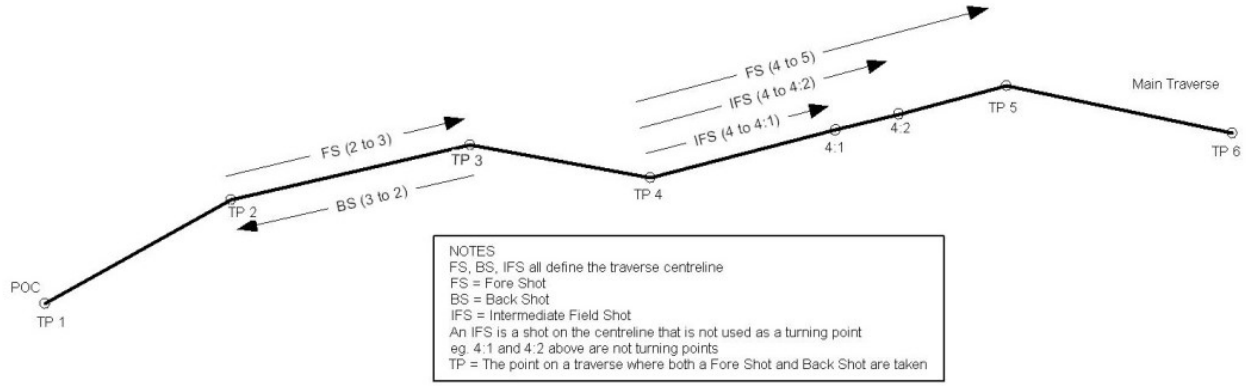


Figure 2-3: Centerline shots (FS, BS and IFS)

- *RS* **Radial shot** is a fore shot off the traverse at any orientation.

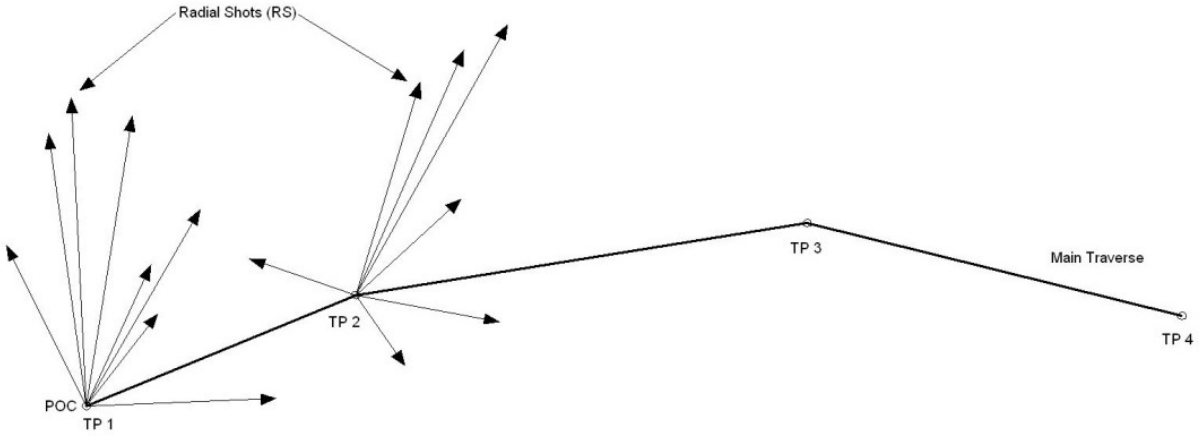


Figure 2-4: Radial shots (RS)

- *SSL (SSR)* **Side Slope Left (Right)** are shots assumed to be on a perpendicular bisector cross section to the main centerline.

There are two different types of Side Slope shots and can be used in conjunction with one another. They are:

- *SSL-FS (SSR-FS)* is a foreshot on the perpendicular bisector cross section. This point is considered a turning point
- *SSL-IFS(SSR-IFS)* is an intermediate field shot on the perpendicular bisector cross section. This point is not a turning point.

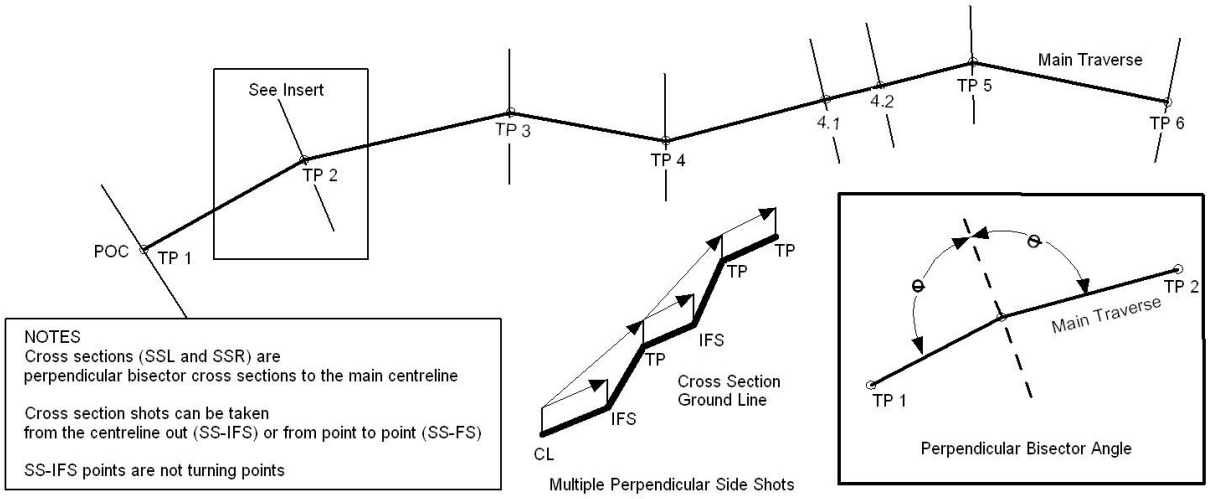


Figure 2-5: Cross Section Shots (SSL-FS, SSR-FS, SSL-IFS, SSR-IFS)

3. Entering and Closing a Boundary Traverse

This exercise demonstrates how to customize the notes entry options, enter survey notes for a boundary traverse, close the traverse and create a map.

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

Setting up the Traverse Entry Screen

1. Open the Survey/Map Module. Select *Setup* | *Module Setup*.
2. On the *Units* tab check that the *Units* are in *metric*. If correct press *Cancel*.
3. *File* | *New*, select *Traverse Document*. Press *OK*.

The Starting Coordinate dialogue box will open. If you enter a start coordinate in a known coordinate system (UTM, Albers, State Plane, etc.), the traverse will be geo-referenced. This is useful for exporting to GIS systems or Google Earth (see Terrain module). If you are not concerned where the traverse is located geographically you can accept the default coordinate which is (0,0,100).

4. For this example, we will accept the default. Press *OK*.

The following steps demonstrate how layout files can be used to quickly change the screen format.

5. *View* | *Screen Layout* dropdown, expand the *Training* folder, select **training block.slt**. Notice how the columns change after this screen layout is read in. Change back to the default screen layout, by selecting **normal.slt** from the *Screen Layouts* box.

Note: Commonly used screen layout files are saved in the **<Defaults and Layouts>** directory allowing them to be accessed from the *Screen Layouts* box. See Getting Started. Layout files are useful for personalizing the Survey/Map module screen. Window options such as scales, columns, tab/enter sequence etc. can be setup and saved in a layout file for future use. The default layout screen for a new traverse is **normal.slt.**

6. To customize the traverse entry screen and create a personalized layout file, choose *Traverse* | *Traverse Entry* or double click on any gray area of the traverse notes to pop up the *Traverse Entry Options* dialogue box shown in the figure below.

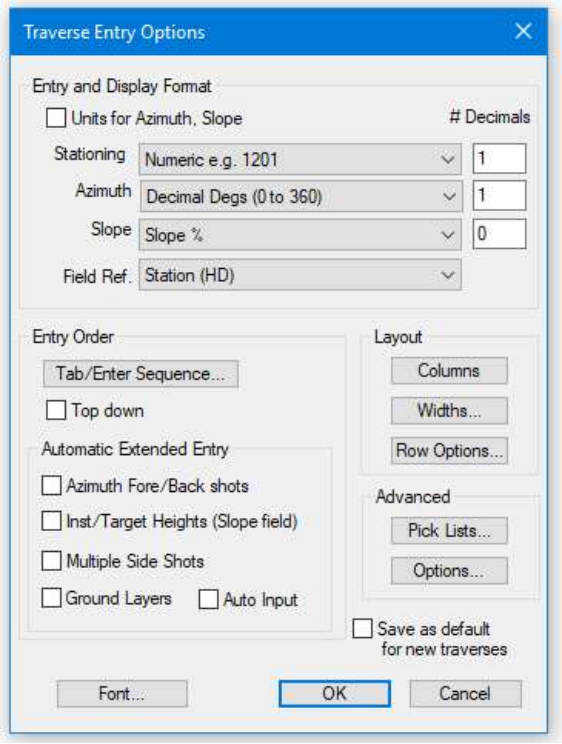


Figure 3-1: Traverse Entry Options Dialogue Box

7. To add or remove columns, press the *Columns* button to open *Columns Select* dialogue box as shown below.

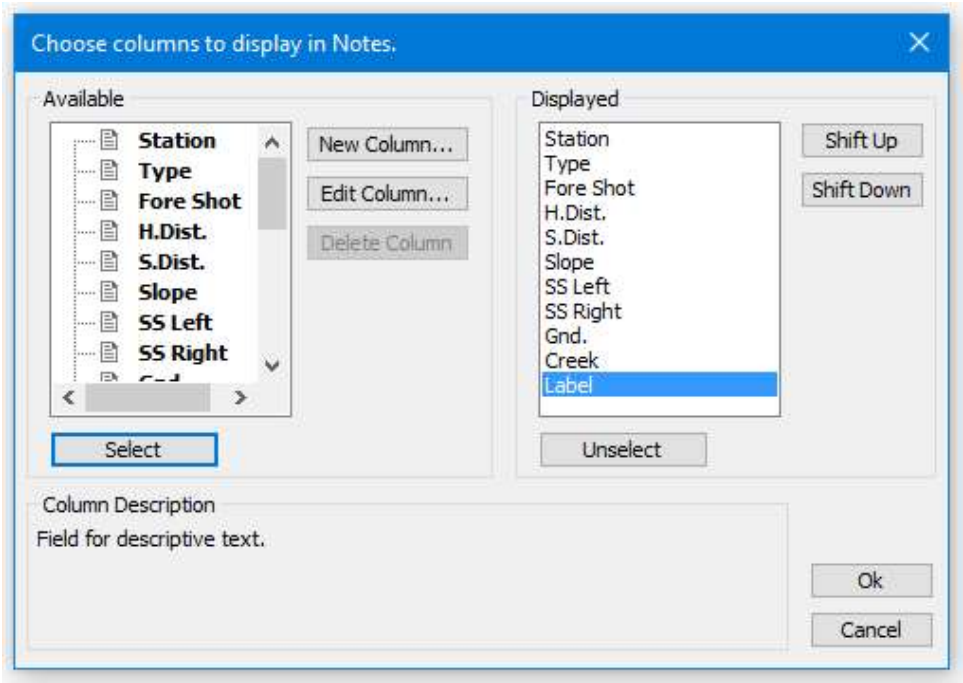


Figure 3-2: Columns Select Dialogue Box

8. Change the items in the *Displayed* list to match the *Displayed* list in the figure above.
    - To remove an item from the *Displayed* list, highlight it and press the *Unselect* button.

- To add an item to the *Displayed* list, highlight it under *Available* and press the *Select* button. The new item will appear at the bottom of the *Displayed* list.
- Use the *Shift Up* or *Shift Down* buttons to move item positions in the list. When done, press *OK*.

9. Click on the *Tab/Enter Sequence* button to open a similar dialogue box to Figure 3-2. Using the same procedure as above, list in order *Label, Type, Fore Shot, Slope* and *S.Dist*. in the *Selected* list. Press *OK* twice to close both dialogue boxes.

Note: To enter horizontal distance, use *Traverse | Traverse Entry* button, and select the *Tab/Enter Sequence* option then add *H. Dist*. At the same time remove *S.Dist*.

10. *View | Save.* Save the layout as *unit* in the <Defaults and Layouts>\Training**training unit**
11. A Softree Prompt appears stating "To make the layout available in your tool bar it must end in **.dlt** (Location), **.ilt** (Terrain), **.slt** or **.mlt** (Survey/Map)." Press *OK*.

The new customizations are now saved (along with the rest of the Traverse Entry Options), so that they can be retrieved at another time without having to re-customize. The screen layout will be saved with the given name and the extension ***.slt**. If you save a screen layout to the **\RoadEng** directory, it will appear in the Screen Layouts Box in the tool bar for quick access.

Entering Survey Notes

In the steps above, we have set up the columns and entry mode to allow us to enter a sample set of notes with the minimum number of key strokes.

Note: Our sample notes are recorded from the bottom up; if you work the other way, set the *Top Down* check box in the *Entry Order* area of the *Traverse Entry Options* dialogue box (Figure 3-1).

12. Start entering the Block 1 traverse notes shown below:

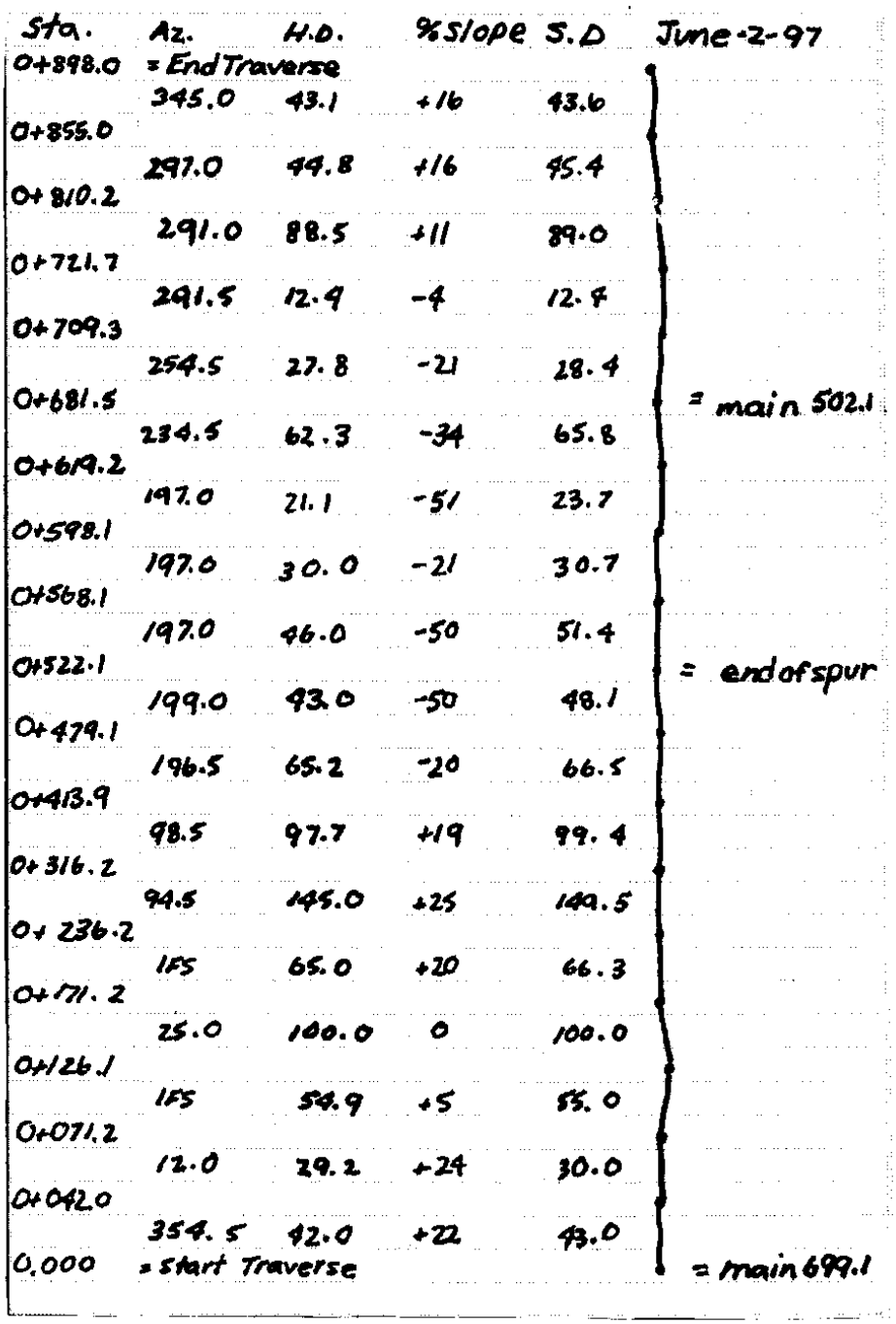


Figure 3-3: Block1 Traverse Notes

13. Place your cursor in the *label* field at the bottom of the screen and type *main 699.1* then press <Enter> to move to the *Type* field.

The <Enter> or <Tab> key will move between the fields selected in the Tab/Enter Sequence; <Shift +Enter> or <Shift +Tab> will reverse the direction.

14. Press <Enter> again to accept the default *FS* indicating that this is a normal foreshot.

15. Type 354.5 under the *Fore Azim* column <Enter>.

16. Type **22** under the *Slp%* column <Enter>.
17. Type **43** under the *S.D.* column <Enter>, and <Enter> again to bypass the *Labels* column.

Note that:

The Station is calculated and displayed.
The cursor skips over the *HD* column to the *Slp%* column.
Horizontal distance is automatically calculated from the slope distance and the percent slope.

18. Press <Enter> to indicate that the 2nd line of the traverse is an *FS* type shot and continue to enter the notes in the figure above.

At Station **71.2** (the 3rd line of the traverse) the *Type* of the next shot is not FS.

19. When you reach station 71.2, *Type* field, type **IFS** or select *IFS* from the drop menu and press <Enter>. This indicates that this shot will be an IFS (Intermediate Foreshot).

Note: IFS shots (Intermediate Foreshots) differ from Foreshots (FS Type) in a number of ways. Foreshots have an azimuth while IFS shots do not. An IFS shot has the same azimuth as the next FS type shot. Secondly, IFS shots always start at the last station or hub. A number of IFS shots in a row will all start at the last turning point and all distances will reference back to that station.

When and why are IFS shots used instead of Foreshots or FS shots?
IFS shots are used when approaching a location where topography is important but creating a hub is not (such as a gully or stream crossing). IFS shots are used rather than FS shots because the total chainage does not increase and hence neither does the error that can build up with excessive FS type entry.

Radial Shots (RS type shots) like IFS shots always start at the last station hub or turning point but unlike IFS shots have their own azimuth and hence do not define the centerline of the survey. They are used as reference (tie) stations or for topography.

20. Press <Enter>.The program will correct the IFS azimuth later when it is defined. In this case it will be the bearing of the subsequent shot (25.0 degrees).

This traverse has been saved as <SurveyMap>\Notes**block1.tr1.**

21. Click the close button on block1.tr1. Do not save changes.

Creating a Map Document

A Map Document is a collection of traverse names. Traverses can be added or removed from the map without affecting the traverse documents.
In this section a map of the boundary traverse entered in the previous section will be created.

1. *File* | *Open* <SurveyMap>\Notes**block1.tr1**.
2. To create a map from an open traverse, select *Traverse* | *Quick Map* or *Home* | *Quick Map*. A Map will open that has the name Untitled Map 1. Alternatively, <right-click> and select *Quick Map*.
3. *File* | *Save* the Untitled Map 1 as <SurveyMap>\Notes**block1.map** (*block1.map* already exists. Press Yes when prompted to overwrite the existing file).

4. Arrange the map and traverse screens side by side, with *View* | *Tile Vertically*. To view the Station column in **block1.tr1** slide the bottom scroll bar to the far left

Note: Clicking on the title bar of a document will activate it. Menu functions and toolbar buttons will change depending on which type of document is active.

5. Click on **block1.map** title bar.
6. Select *Map* | *View* button to open the *Map View Options* dialogue box as shown in the figure below.

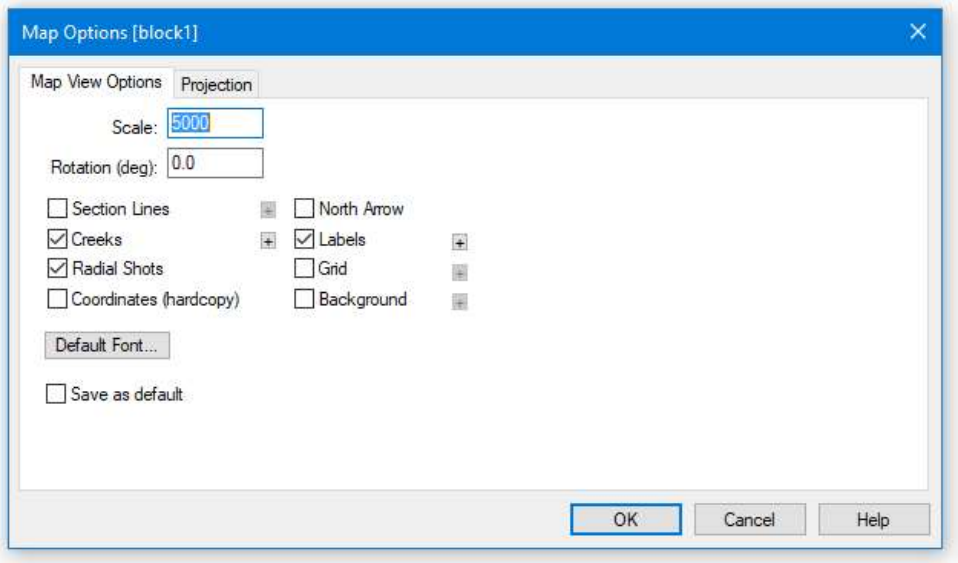


Figure 3-4: Map View Options Dialogue Box

7. Select *Labels*. A check mark will appear beside word *Labels*. Press the adjacent ⊞ button that highlights as soon as *Labels* is selected. The dialogue box shown below will appear.

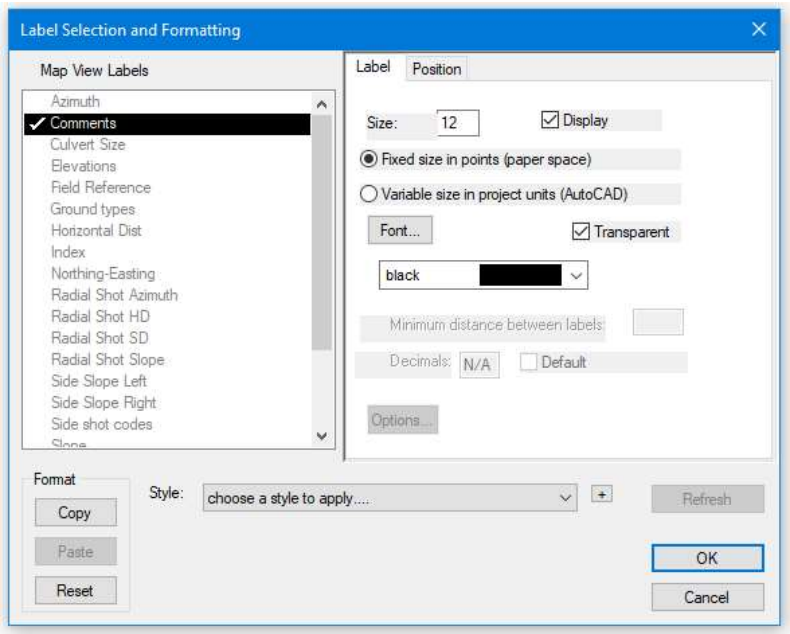


Figure 3-5: Label Selection and Formatting Dialogue Box

8. If necessary, activate the *Comments* label by selecting or highlighting *Comments*, and check the *Display* box. A check mark will appear beside the word *Display*, and in front of the label name. A double click on the label name will also activate and de-activate the label. Press OK twice to return to main screen.

Map View now displays the 3 comments in the Label column, (main 699.1, end spur and main 502.1).

Select a station in the traverse notes and the cross-hair will move to the corresponding station in the map.

9. Hover the arrow cursor over the boundary line of the block in the *block1.map* window, a text box will appear with the name of the traverse and the station that you are closest to.
10. Click on the top right corner of the boundary. Two things have happened, the cross-hair moved to that station in the map and to the corresponding station in the traverse notes.

Note: Double-clicking on a traverse in a map document will open the corresponding traverse notes

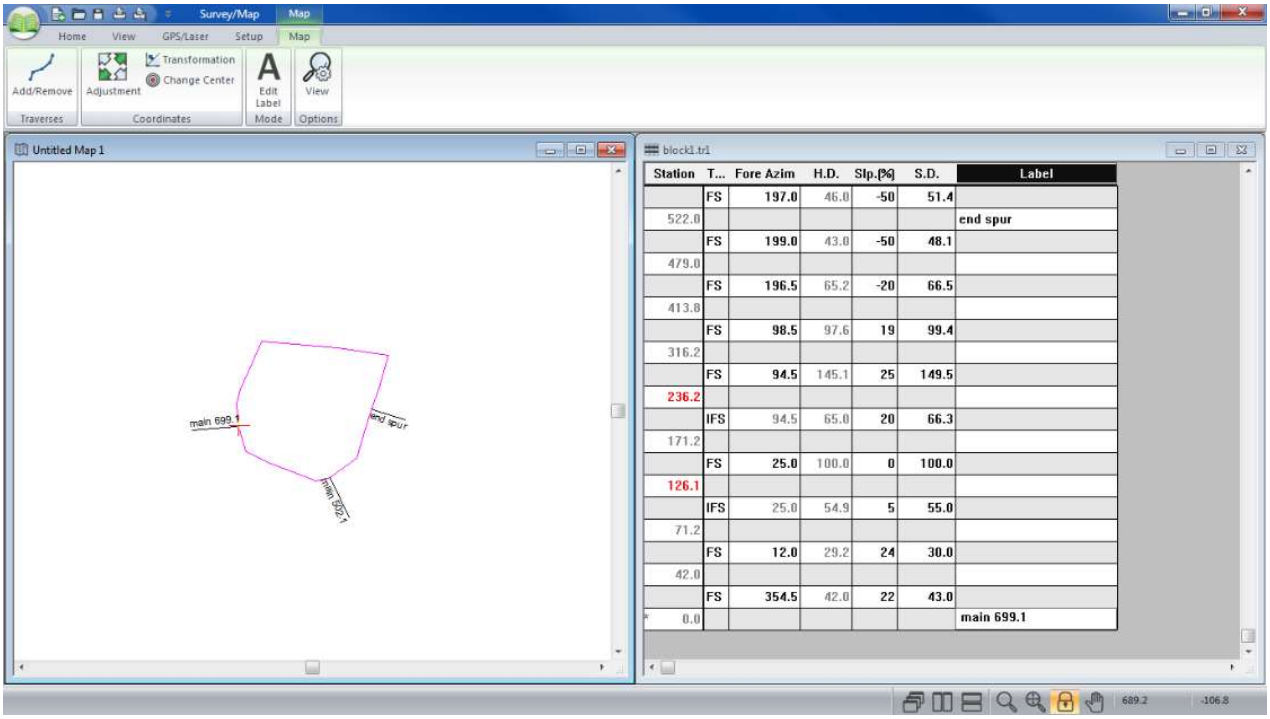


Figure 3-6: Final Traverse and Map Documents

Closing the Boundary Traverse

This example illustrates how to close a boundary by determining its area and the closing error.

1. If the previous exercise was not completed, then *File* | *Open* <SurveyMap>\Notes**block1.tr1** and <SurveyMap>\Notes**block1.map**.
2. Use *View* | *Tile Vertically* to arrange the map and traverse documents side by side

There is a small gap between the first and last station. See the figure above.

3. Click on the Traverse Document title bar (titled **block1.tr1**).
4. Select *Traverse* | *Close Traverse*. A confirmation prompt will appear asking whether you want to close the traverse. Press OK.

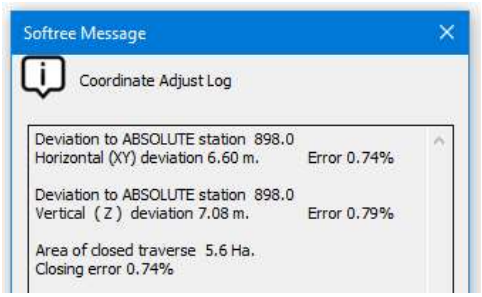


Figure 3-7: Coordinate Adjust Log

5. Another dialogue box will appear called *Coordinate Adjust Log*. It states that there is a Horizontal (XY) and a Vertical (Z) deviation to Absolute Station 898.0. Area of closed traverse 5.6 Ha and a closure error of 0.74%. Press *OK*.

Note: Scroll the traverse notes so that the last shot is visible. Station 898.0 now has an asterisk beside it (indicating an absolute coordinate). This means that station 898.0 has fixed X, Y, and Z coordinates, in this case the same as station 0.0. The coordinates of the first station in a traverse are always absolute. The coordinates between absolute stations are determined using the Compass Rule.

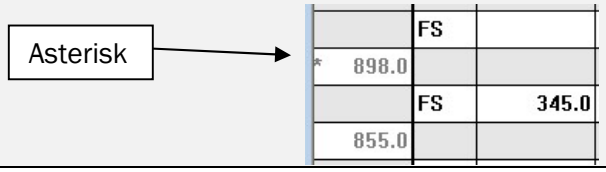


Figure 3-8: Asterisk Displaying Absolute Coordinates

6. Click the *Close* button on both map and traverse. Do not save changes.

4. Road P-Line Traverse with Cross Sections

Entering traverse notes without using the mouse is a faster method for the experienced user. All functions for entering traverse notes can be accomplished with keystrokes. The following example demonstrates some techniques using keystrokes to minimize data entry time.

Customizing the Traverse Screen for a P-Line Survey

Unlike the previous boundary example, the P-line traverse in this example includes perpendicular side slopes, creek crossings, and ground types. To accommodate this additional information, you will configure your entry screen and save it as a new layout.

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

1. *File | New*; select *Traverse Document*; press *OK*. You will be prompted for the start coordinates; press *OK* to take the defaults.
2. Maximize the window by clicking the maximize button on the top right of the traverse document window.

The columns, entry order and other options currently reflect the settings in your default screen layout (<Defaults and Layouts>**Normal.slt**). For consistency, we will start this exercise from a screen layout provided with the tutorial.

3. *View | Screen Layout* dropdown, expand the *Training* folder, select **training block.slt**.
4. Change the columns displayed:
    - Select *Traverse | Traverse Entry* button or right mouse click and select *Traverse Entry Options* to open the dialogue box.
    - Press the *Columns* button to open the column selection dialogue box (Figure 3-2 above).
    - In the *Displayed* list, select in order (use the *Shift Up/Down* buttons if necessary):
        i. *Station*
        ii. *Type*
        iii. *Fore Shot*
        iv. *Back Shot*
        v. *Slope*
        vi. *S.Dist*
        vii. *SS Left*
        viii. *SS Right*
        ix. *Gnd*
        x. *Creek*
        xi. *Label.*
    - Press *OK*.
5. Change the entry order:
    - Press the *Tab/Enter Sequence* button.
    - Ensure the *Selected* list displays, in order:
        i. *SS Left*
        ii. *SS Right*
        iii. *Gnd*
        iv. *Creek*

v. *Label*
vi. *Type*
vii. *Foreshot*
viii. *Backshot*
ix. *Slope*
x. *S.Dist.*

- Press *OK*.

6. Enable the *Multiple Side Shots* in the *Automatic Extended Entry* area.
7. Press OK to exit the Traverse Entry Options dialogue box.
8. Save your customized traverse screen layout by *View* | *Save*. Save as <Defaults and Layouts>\Training**pline.slt**.

You can later retrieve this layout using menu *Screen Layout drop down*.

9. Optional: if you had trouble with the previous step, *View* | *Screen Layout* dropdown, expand the *Training* folder, select **Training pline.slt**.

Note: If a layout is saved in the RoadEng directory, *<Defaults and Layouts>* or *<Defaults and Layouts>\training*, it will be available through the *Screen Layouts* toolbar dropdown. You can also create your own screen layouts folders; right click on the Softree folder in the *Screen Layouts* toolbar dropdown.

10. *File* | *Save*, as <SurveyMap>\Notes**spur2.tr1**.

Entering a Traverse with Side Shots

11. Select *Traverse* | *Current Field* to open the *Extended Side Shot Edit* dialogue box (figure below). The *Extended Side Shot Edit* dialogue box allows perpendicular side shots (cross section shots) to be entered.

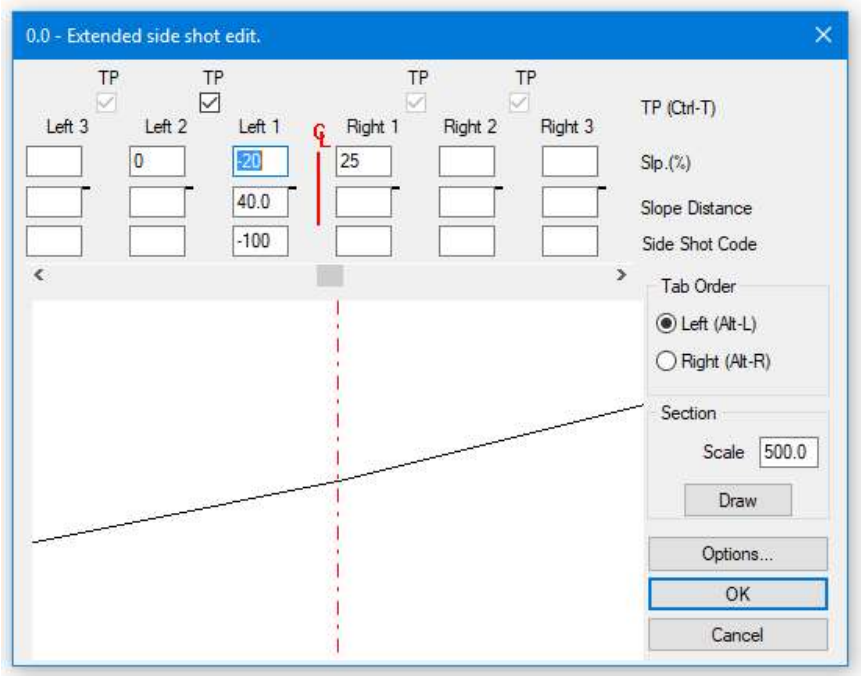


Figure 4-1: Extended Side Shot edit Dialogue Box

Note: Pressing the <Tab> key moves the cursor from field to field within dialogue boxes. Pressing <Shift + Tab> reverses the direction. In the *Extended Side Shot Edit* dialogue box, <Page Up> mimics <Shift + Tab> and <Page Down> mimics <Tab>; this allows one-handed entry from the keyboard.

Referring to the Traverse notes in the figure below:

12. Type the first left slope **-20,** press <Page Down>.
13. Type slope distance **40**, press <Page Down>.
14. Type final left slope **–100**. Press <Enter> or click *OK*.

The dialogue box will re-fresh. The cursor will be positioned to enter the shots right of the centerline (<Alt + R> will also jump to the right-hand side).

15. Type **25** in the SSR Slp. (%) S.D. box.
16. Press <Enter> to exit the *Extended Side Shot Editor*.

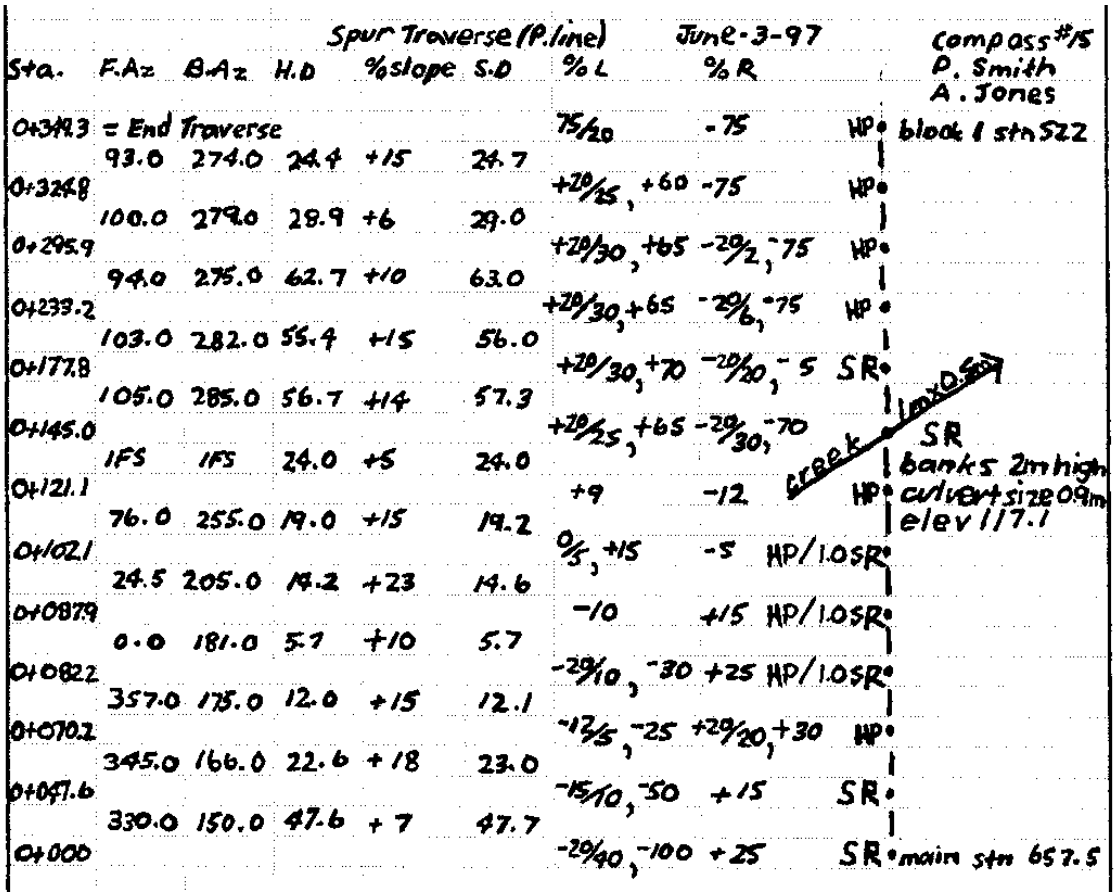


Figure 4-2: Spur Traverse Notes

Note: The extended side shots defined in the dialogue box will be displayed in the *SSL* and *SSR* fields as one line of text (-20/40.0 T,-100/..). It is possible to directly type extended side shots in the *SSL* and *SSR* fields once the syntax is known. The "T" stands for turning point and represents a check in the corresponding *TP* box in the dialogue box. A slash, "/", can be typed instead of a comma between shots if desired.

17. The cursor should be positioned in the *GND* column. Type *SR* (Solid Rock), under the *GND* column. Press <Enter> to skip the *CRK* column.

Note: Ground types are used to determine engineering properties, such as cut/fill angles for road design. It is important to record them in the field correctly. If using the traverse for road design, check to see that the cut/fill angles and ground types are pertinent to the geographic location. Changing the ground types can be done using *Traverse | Types* or *Layers by Range* buttons.

18. The cursor should now be in the *Label* column, type *Main Stn* **657.5**, press <Enter>.
19. Press <Enter> again, to accept the default shot type *FS* (Foreshot).
20. Type **330.0** in *Fore Azimuth* column, press <Enter>. Type **150** in *Back Azimuth* column, press <Enter>.
21. Type **7** in the *Slp%* column, press <Enter>.
22. Type **47.7** in the *S.D.* column, press <Enter>.
23. The *Extended Side Shot Edit* dialogue box will appear again. Type **–15** <Page Down> type **10** <Page Down> type **–50** <Enter>; and for the right type *15* <Enter>.
24. Press <Enter> again to indicate that *SR* will also apply to the second survey station, and <Enter>, <Enter> to skip *Creeks* and *Labels* entry fields.
25. Use *Traverse | Traverse Entry | Tab/Enter Sequence* to remove any columns infrequently used (such as *Creeks* and *Labels*) from the entry sequence; these fields can always be selected with the mouse or use <Control + Arrow keys> to move the cursor to the field to input data.
26. Continue entering notes in Figure 4-2 until station 82.2 *GND* field. The ground type at station 82.2 indicates a *1.0* m layer of HP on top of SR.
27. At station 82.2, with the cursor in the *GND* column, <double-click> or press <Control + O> to open the *Ground Layers* dialogue box (figure below).

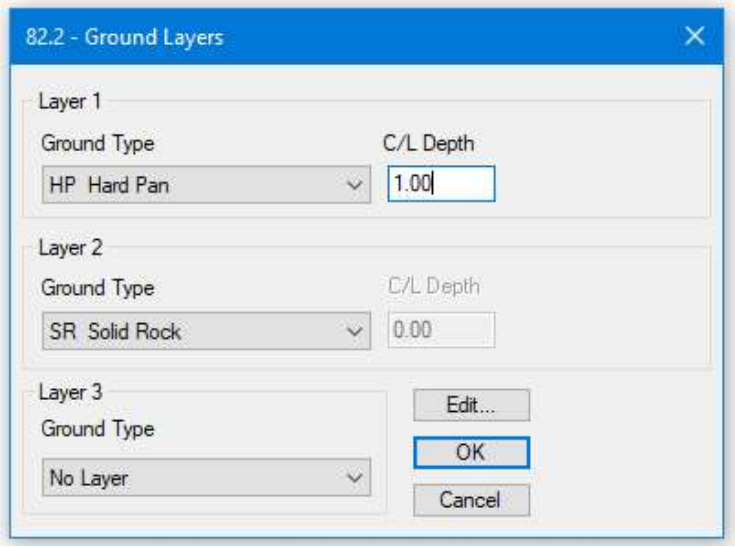


Figure 4-3: Ground Layers Dialogue Box

28. Select *HP Hard Pan* depth **1.00** for *Layer1*; select *SR Solid Rock* for *Layer2*.

Note: the depth for *Layer 1* cannot be entered until a ground type for *Layer 2* is selected. Layer 2 depth is ignored unless there is a third layer. Press OK.

For the next two stations, the program will automatically default to the previous ground type. Ground types only have to be entered when the ground type changes. Don't forget to change the ground type to HP at station 121.1.

Note: Extended depths and ground types can be entered by double clicking in the *GND* column, or by <Control + O> when the cursor is in the *GND* column and entering the data into the *Ground Layers Dialogue Box*. The materials and layer depths can also be typed directly in the *GND* field (i.e. *HP/1/SR*). Layers are displayed in the cross section of the *Extended Side Shot Edit* dialogue box.

29. Continue entering notes in Figure 4-2 until station *349.3*.

Note: For IFS (Intermediate Foreshots) shots, type '**I**' under the *Type* column or select IFS from the drop box and skip the *Azimuth* column(s). The azimuth of the IFS will automatically be determined from the azimuth of the next non-IFS shot.

For culvert dimensions, type the pipe diameter in mm in the *CRK* column. <Control + O> or a double click in the CRK field will provide more options for entering creek/culvert information.

30. Close the window. Do not save changes.

5. Survey Adjustments

Surveys may be adjusted for a number of reasons.

- Traverses may tie to other traverses as well as to features on the ground or to GPS coordinates.
- Alternate routes for a part of a road traverse may be considered. Instead of re-traversing the entire road, a traverse segment may be inserted at the location of the alternate route
- Files may be joined and closed to determine the area enclosed by a number of traverses.
- Traverses may be corrected in areas with magnetic anomalies.

Making a Map with Multiple Traverses

The next example demonstrates how to display several traverses on the same map and adjust the positions of the traverses with respect to each other.

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

1. *File* | *Open* <SurveyMap>\Adjust**block1.map**.
2. Maximize the window by clicking the maximize button on the top right of the traverse document window.
3. *Map* | *Add/Remove* button, the *Map traverses* dialogue box, shown in below will appear.

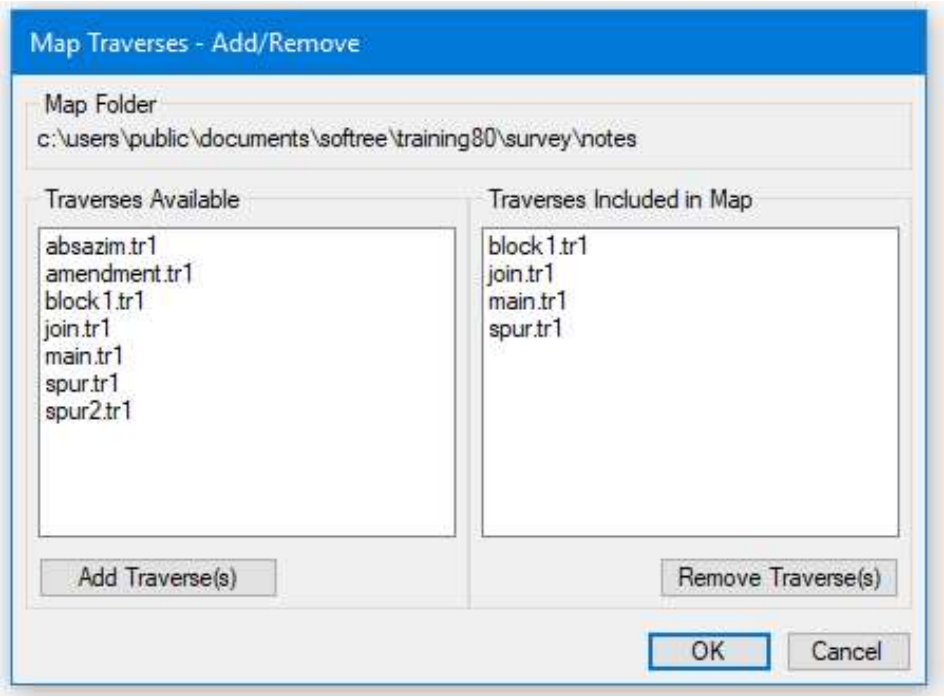


Figure 5-1: Add/Remove Traverses Dialogue Box

4. Select ***spur.tr1*** and press the *Add Traverse(s)* button. *spur.tr1* appears in the *Traverse Included in Map* list box. Do the same with ***join.tr1*** and ***main.tr1*** Press *OK*.
5. *View* | *Screen Layout* dropdown, expand the *Training* folder, select **block1.mlt**.

Note: The same map can be also be created by selecting menu *File* | *New*, choosing Map Document, and then selecting the four traverses **block1.tr1**, **spur.tr1**, **join.tr1** and **main.tr1** with the mouse, while holding the <Control> key.

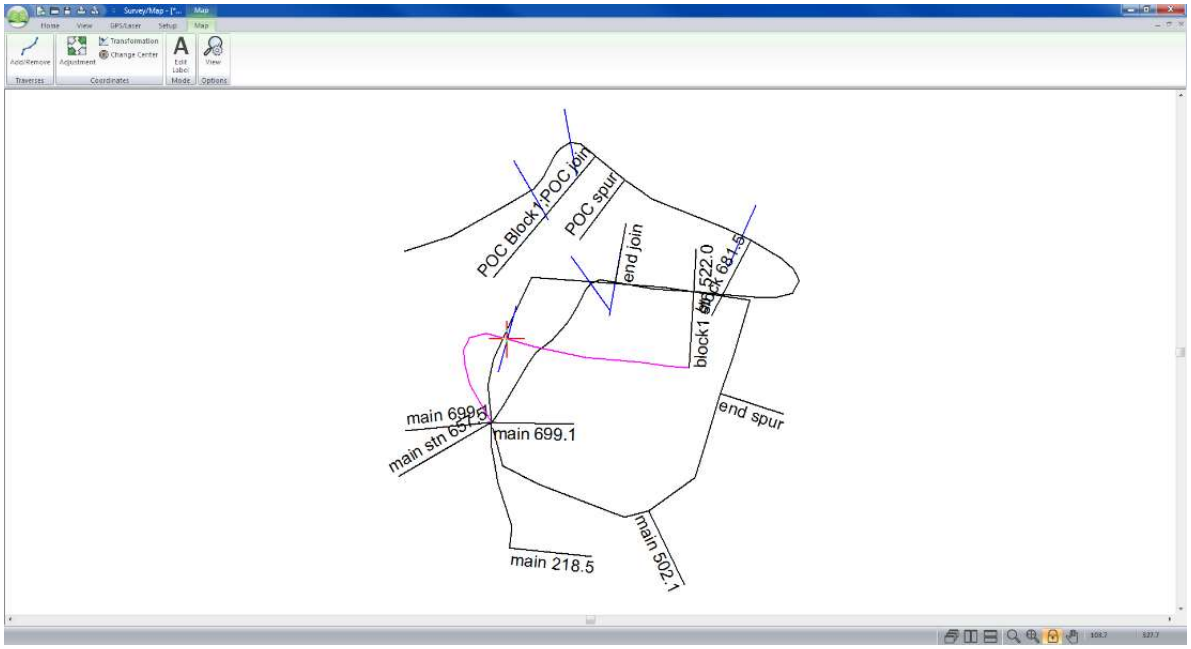


Figure 5-2: Map View after adding Additional Traverses

6. <*Double-click*> on any of the traverses in block1.map and the corresponding traverse notes will open.
7. Close the *Untitled Map* window. Do not save changes.

Absolute Coordinates

All traverses start from an absolute coordinate. By default, all other coordinates are calculated from this starting point. Arbitrarily, the value (0, 0, 100) is assigned for the X, Y, and Z coordinate of the first station. If these coordinates are changed the entire traverse is shifted (provided no other absolute coordinates have been set).

Other coordinates within the traverse can be set absolute by using the *Traverse* | *Set/Get XYZ Coordinates* menu (Traverse Document), *Traverse* | *Close Traverse* menu (Traverse Document), or the *Map* /*Coordinate Adjustment* menu (Map Document). The traverse is stretched or shrunk, using the Compass Rule, to fit between two or more absolute coordinates, as shown in the figure below.

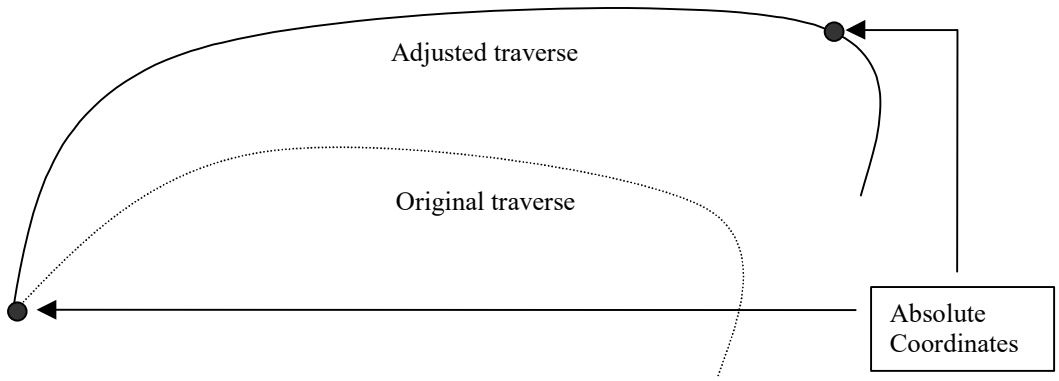


Figure 5-3: Adjusted Traverse and Original Traverse

Shifting, Joining, and Adjusting Traverses

Method 1 demonstrates how to make a coordinate adjustment in the *Traverse Document*. Method 2 shows how to modify traverses from the Map Document. In both cases the coordinate changes are saved with the Traverse Document. Raw field data (bearings, distances etc.) remain unchanged.

Method 1 -Setting Absolute Coordinates in the Traverse Document

1. *File* | *Open* <SurveyMap>\Adjust**method1.map**.

There are two traverses in this map, *main.tr1* and *block1.tr1*; see figure below.

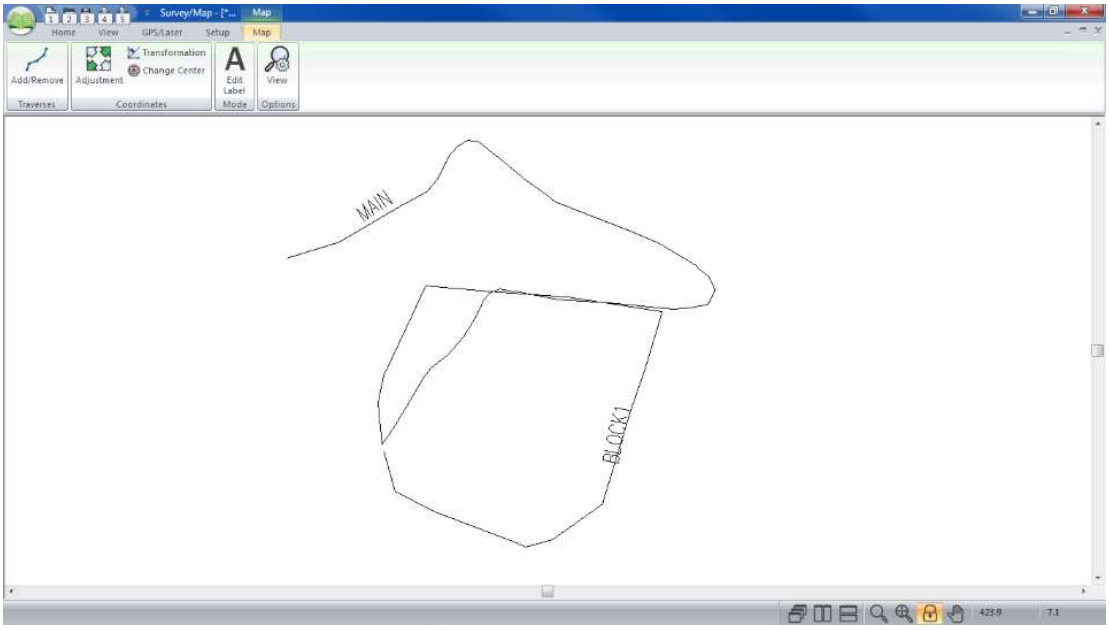


Figure 5-4: *Method1.map* prior to Adjustments

2. Double-click on each traverse (one at a time) in the Map Window to open the corresponding traverse document. The selected traverse will turn magenta. Select *View* |*Tile Vertically* after opening each traverse document to arrange the windows.
3. Click on the **BLOCK1.tr1** title bar. From menu *View* | *Tile Vertically* button.

This screen layout displays stations, corresponding labels and XYZ coordinates.

In this example, Block1 will be adjusted with respect to Main because Main is more accurate.

4. Highlight **MAIN.tr1**. Scroll to find *POC block1* in the *Label* column (station 699.1). Note the X, Y, and Z coordinates (this is the "Point of Commencement" of block1).
5. Highlight **BLOCK1.tr1**, and select Station 0.0.
6. From menu *Traverse | Set/Get XYZ Coordinates*, change Station 0.0 coordinates of **BLOCK1.tr1** to the same coordinates at **MAIN.tr1** station 699.1 Type *114.9* for X, *294.2* for Y and *193.0* for Z. Press *OK*.
7. Close ***BLOCK1*** by selecting *Traverse | Close Traverse*. Press *OK* to confirm closing of the traverse.

Alternatively, to close the Block1 traverse, you could have scrolled to the last station (898.0) in **BLOCK1.tr1.** Selected Coordinates | Set/Get XYZ Coordinates. Turned on *XY Absolute* and *Z Absolute* and changed the coordinates to equal those of station 0.0. (X= *114.9*, Y= *294.2* and Z= *193.0*)

Note: In addition to opening the Coordinate box by selecting *Traverse | Set/Get XYZ Coordinates* the Coordinate box can also be opened by left clicking in the x, y, or z field.

8. A *Coordinate Adjust Log* dialogue box appears, indicating the deviation to Absolute station 898.00, area of the closed traverse of 5.6Ha and a closure error of 0.74%. Press *OK*.
9. Find label "block 681.5" (station 502.1) in the *Label* column of **MAIN.tr1**. Make note of the coordinates (286.8, 201.4 and 174.9). This corresponds to station 681.5 in **BLOCK1.tr1**.
10. Highlight **BLOCK1.tr1**. Scroll to find "main 502.1" in the *label* column (Station 681.5).
11. Choose *Traverse | Set/Get XYZ Coordinates*, turn on *XY Absolute* and *Z Absolute* and change the coordinates to equal those of Station 502.1 in **MAIN.tr1**. Type *286.8* for X, *201.4* for Y, *174.9* for Z. Press *OK.*

A *Coordinate Adjust Log* dialogue box appears as shown below. It lists the (XY) and (Z) adjustments, area of the closed traverse and a closing error.

12. Press *OK*.

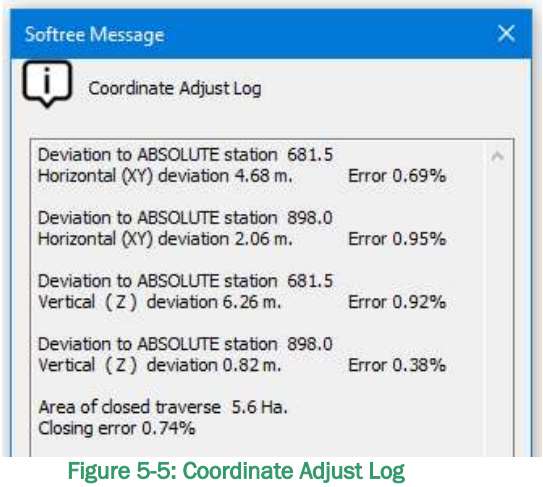


Figure 5-5: Coordinate Adjust Log

BLOCK1.tr1 is now closed and adjusted to match the two stations intersecting **MAIN.tr1**. The figure below shows **method1.map** before and after the final adjustments.

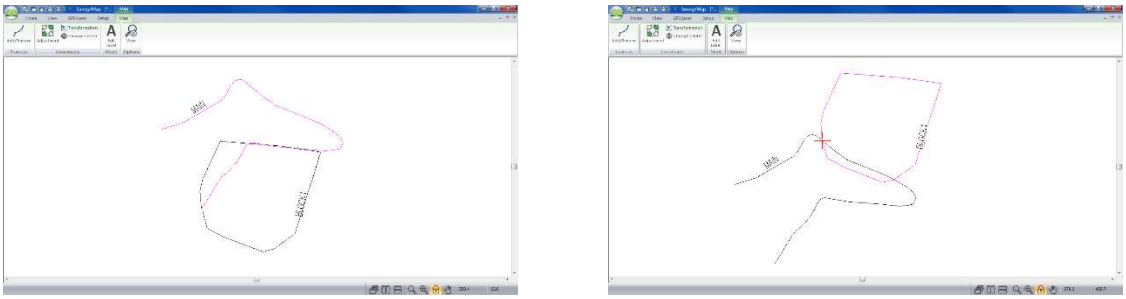


Figure 5-6: *Method1.map* Before (left) and After (right) Final Adjustment

13. *File* | *Close* both the Traverse and Map Documents. Do not save the changes.

Method 2 - Adjusting in the Map Screen

The map display (Method 2) provides a simpler method of implementing, undoing shifts and other adjustment functions. It demonstrates how to do adjustments without modifying the Traverse Document coordinates.
Method 2 has the following advantages over Method 1:

- Opening of multiple Traverse Documents not required.
- Direct feedback on whether the adjustment worked or not, as the user is viewing the map rather than coordinates within Traverse Documents.
- The last adjustment can be undone using the *Delete* key in the Traverse Adjustments dialogue.

1. *File* | *Open* <SurveyMap>\Adjust**method2.map.** Unlock Lock Scale by ensuring the button is not highlighted and press the *Zoom Extents* button.

The map shown in the figure below will appear.

2. Maximize the window by clicking the *maximize* button on the top right of the Traverse Document window.

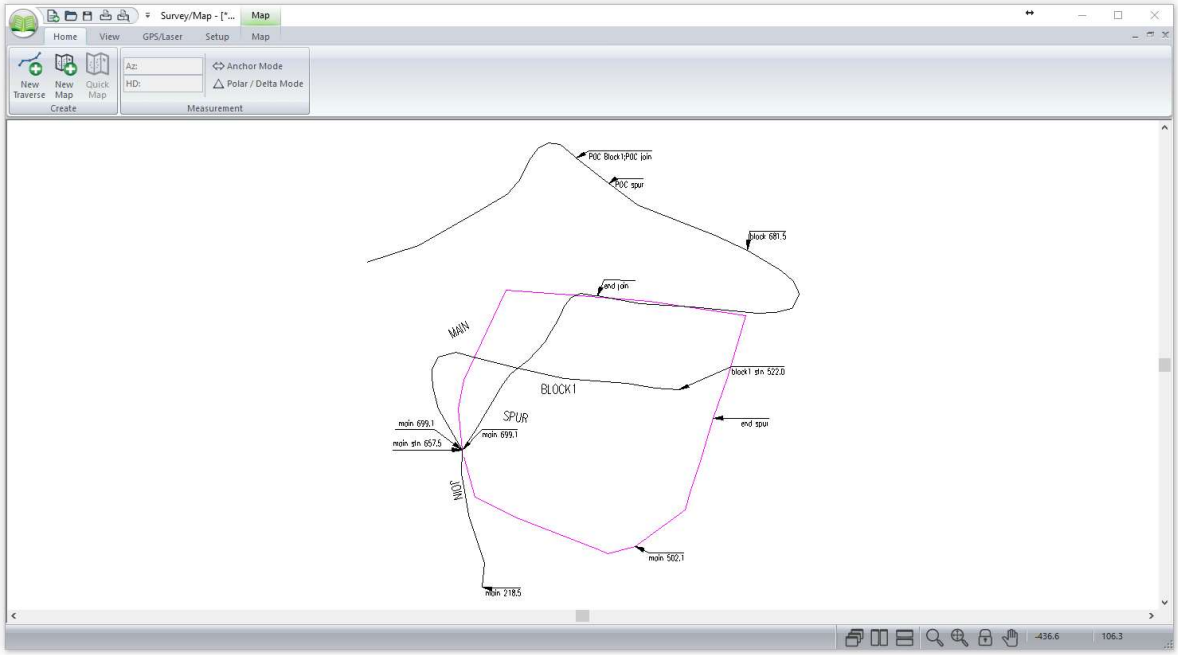


Figure 5-7: Map Document of method2.map

This example includes four traverses *main, block1, spur* and *join*.

3. Select *Map* | *Coordinates Adjustment* to open the Traverse Adjustments dialogue box shown below.

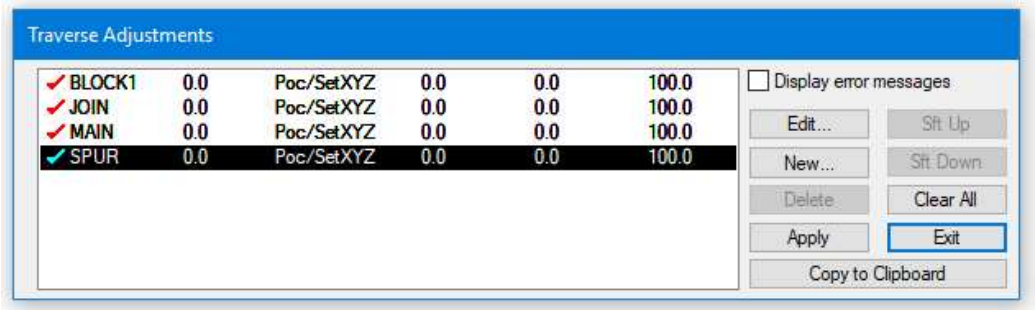


Figure 5-8: Traverse Adjustment Dialogue Box

4. Press the *New...* button, and change the information in the dialogue box to match the figure 5.9. Note that both *Shift* and *Set absolute XY* is checked. Press *OK* and then press *Apply*.

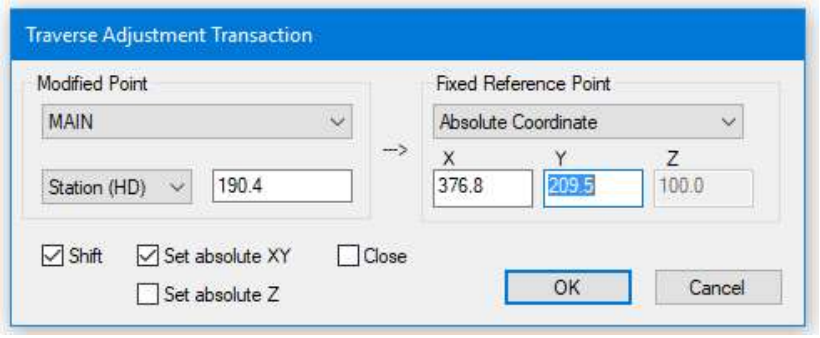


Figure 5-9: Traverse Adjustment Transaction Dialogue Box

Note that main traverse has been shifted to the set of coordinates on the *Fixed Reference Point* side. You may need to click on the Traverse Adjustment title bar and drag the dialogue box down and sideways to see the map changes.

Note: The absolute coordinates used in this example are local coordinates. UTM or any other coordinate system can be used.

5. Within the Traverse Adjustments Dialogue Box (Figure 5.10)

   - Press the *New…* button.
   - Change the *Modified Point* to *Main* and Enter Modified Point Station to **9999**. (9999 is end station).
   - Change the Fixed Reference Point to Absolute Coordinate
   - Change Fixed Reference Point X to **172.6** and Fixed Reference Point Y to **246.0**.
   - Ensure *Set absolute XY* is the only box selected.
   - Press *OK*.

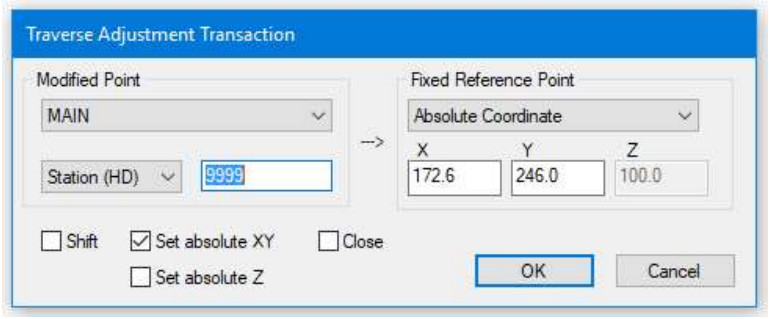


Figure 5-10: Traverse Adjustment Transaction Dialogue Box

6. A Softree Prompt "Station not found. Press *YES* to use nearest station (958.1). The *Modified Point Station* will automatically change to 958.1. Press *Apply.* A checkmark will appear in front of that adjustment in the adjustment list. The traverse was stretched to fit between the two sets of local coordinates.

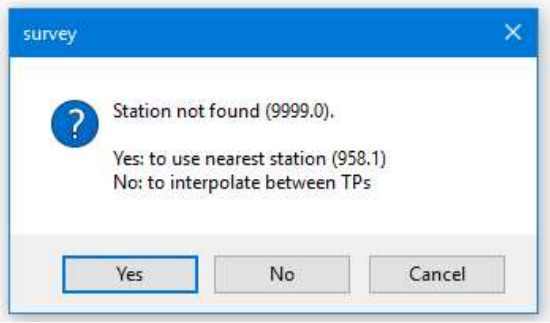


Figure 5-11: Traverse Adjustment Transaction Dialogue Box

7. Make another Traverse Adjustment (Figure 5.12):

   - Press *New…* button within Traverse Adjustments
   - Change Modified Point to *BLOCK1*
   - Enter *Station (HD)* to *0.0*.
   - Change the Fixed Reference Point to *Main*
   - With *Station (HD)* set change it to *699.1*
   - Make sure *Shift* and *Set AbsoluteXY* are selected.

- Press *OK* and then *Apply.*

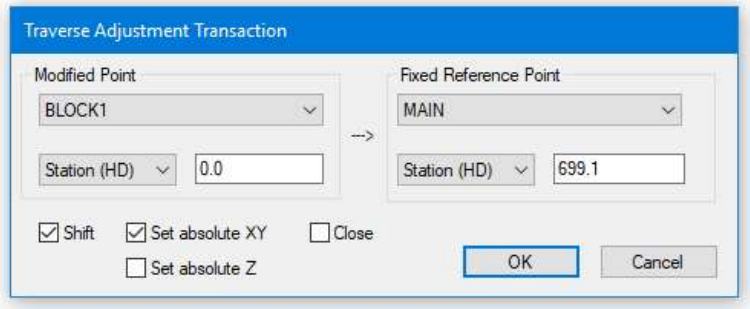


Figure 5-12: Traverse Adjustment Transaction Dialogue Box

The start of **main.tr1** identified by labels "POC Block1, POC join" now coincides with the start of **block1.tr1**.

	Action	Modified traverse	Modified Station	Fixed Traverse	Fixed Station	Result
1	Shift and Set Absolute XY	Main	190.4	376.8 X and 209.5 Y	0.0	Puts main in correct position with respect to Absolute set of coordinates
2	Set Absolute XY	Main	End	172.6 X and 246 Y	End	Accommodate second absolute set of coordinates (main is stretched). Note that "9999"is used for end station. Main is now tied to the 2 Absolute points.
3	Shift and Set Absolute	Block 1	0.0	Main	699.1	Shifts Block1 to Main.
4	Close					Close Block1.
5	Set Absolute XY	Block 1	681.5	Main	502.1	Shift Block to position on Main
6	Shift and Set Absolute	Spur	0.0	Main	657.5	Shift Spur to position on Main.
7	Set Absolute XY	Spur	End	Block 1	522.0	Attach Spur to Block1.

Table 5-1: Table Depicting Adjustment Steps

8. This step coincides with Step 4 of Figure 5.13. Press *New* and make sure that *Close* is checked. Press *OK* then *Apply*. The **Block1** traverse will close.
9. Zoom in. Note that the "block 681.5" and "main 502.1" do not coincide. Block1 needs to tie to main at this point.

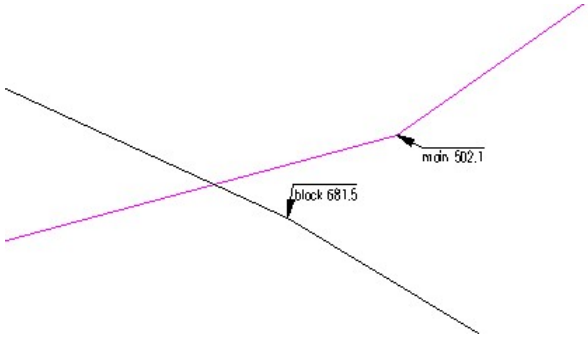


Figure 5.14: Point 681.5 and 502.1 not Coinciding

10. Adjust Traverse to make points coincide:

- Press *New…* and *turn off* Close option.
- Change the Modified Point Traverse to ***BLOCK1*** and *Station (HD)* to **681.5.**
- Change the Fixed Reference Point Traverse to ***MAIN*** and the *Station (HD)* to **502.1.**
- Make sure that Shift is *not checked* and Absolute XY is *checked*. Press *OK* and then *Apply*.
- "block 681.5" and "main 502.1" now coincide.

11. Follow the above procedure to complete steps 6 and 7 of Table 5-1. The two figures below should provide some guidance.

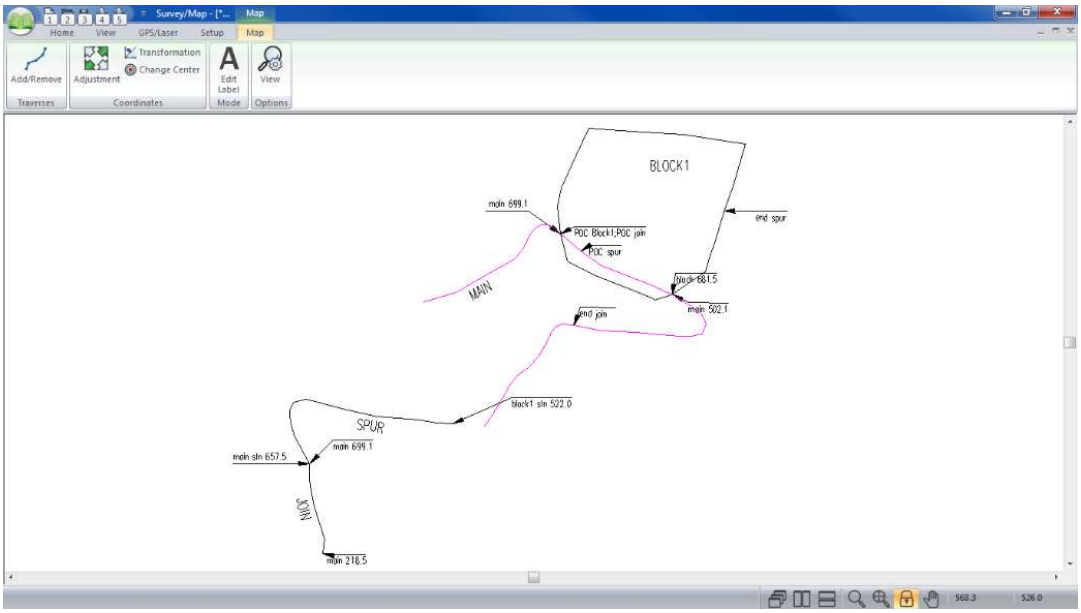


Figure 5-13: *Method2.map* before Adjusting *spur.tr1*

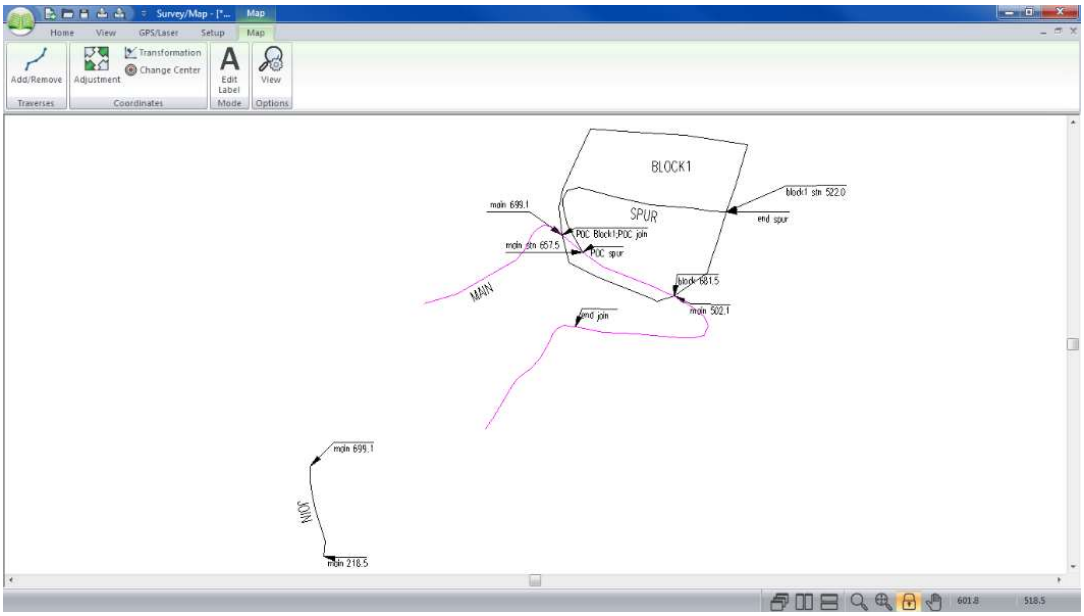


Figure 5-14: *Method2.map* after Adjusting *spur.tr1*

At this point all traverses except join have been adjusted. This operation is similar to that for **spur**. Keep in mind the final position of **join** in shown below.

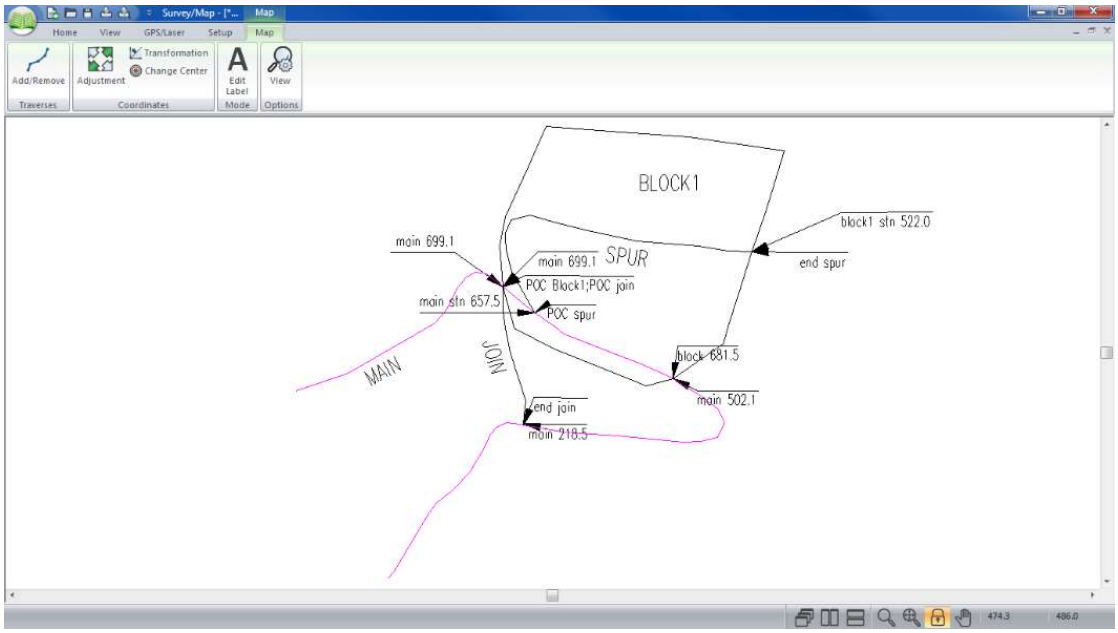


Figure 5-15: *method2.map* after Adjusting *join.tr1*

Note: Only coordinates and absolute points are modified by adjustments. Raw traverse data (*Azimuth, Distance, Slope*, etc....) are unaffected. All adjustments can be removed by pressing the *Delete* or *Clear All* buttons in the Traverse Adjustment dialogue box (see Figure 5-8).

Adjustments can be independent or dependent on previous adjustments. It all depends on the order of operations. The last operation in the list supersedes previous operations for that traverse. For example, move the end of **main** to a different location.

12. Add New Traverse:
    - Press *New...*
    - Change the Modified Point to *MAIN* and station to *958.1*.
    - Change the Fixed Reference Point Traverse to *Absolute Coordinate* and the Fixed Reference Point Station to X = *376.8* and Y = *209.5*.
    - Make sure that Shift is *checked* and press *OK* and then *Apply*.

You will notice that **main** has moved without affecting other traverses and that last operation on traverse **main** supersedes the previous operations.
To move other traverses with **main** simply change the hierarchy of the last operation.

13. Using the *Shift up* button, move last operation so that it is just above the operation:
    block1 0.0 Shift/Set XY main 699.1
14. Press *Apply.*
15. Now press the *Delete* button and press *Apply*. The final adjustment will now look like Figure 5-15, because the previous main adjustments in the list now take effect.

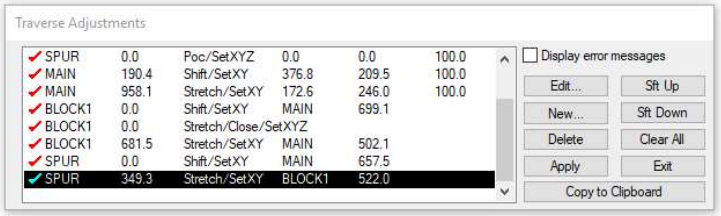


Figure 5-16: *Traverse Adjustment*

Note: All adjustments in this example were with reference to the XY direction (2D) only. 3D adjustments can also be done by turning on *Absolute Z* in the Traverse Adjustment Transaction dialogue box.

16. Close the **method2.map** window. Do not save changes.

Inserting a File

This example demonstrates how to extract a section of a traverse from one document and insert it into another.

In the figure below, the entire traverse amendment is inserted into a section of *main* from stations 430.9 to 720.1

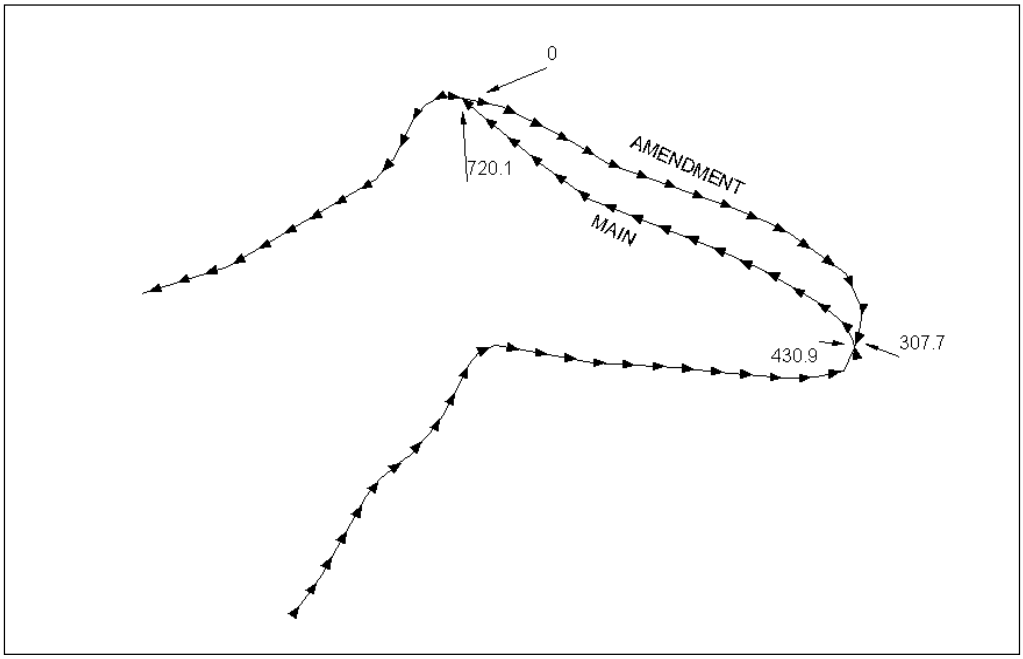


Figure 5-17: Original Traverse and Amendment.

1. *File* | *New*. Select *Traverse Document*. Press *OK*.
2. When prompted for *Starting Coordinate*, press *OK* to take the default.
3. Place the cursor at station *0.0* of the new traverse. *Choose Traverse* | *Insert File* Button, select and open <SurveyMap>\Adjust**main.tr1**.

The *Insert File* dialogue box shown below will appear:

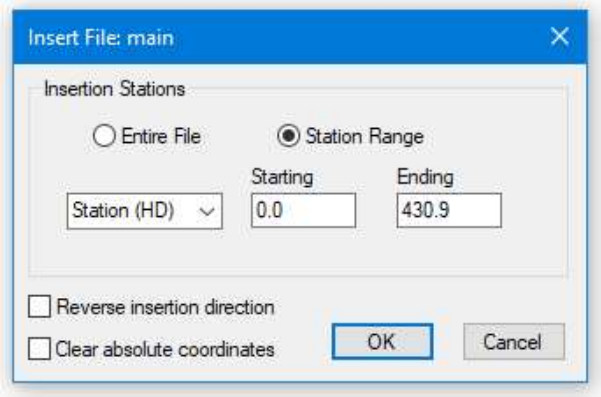


Figure 5-18: File Insert Dialogue Box

4. Configure the dialogue box so that we are only inserting up to station *430.9*, as shown above. Ensure *Clear Absolute Coordinates* is not checked. Press *OK*. A prompt appears "Insert file at Station 0.0?'; press *OK* to confirm

All Stations from 0 to 430.9 appear in the new traverse. A "+" sign appears in the *Station* column signifying the stations which were added.
The next step is to insert the entire traverse called **amendment**. Notice in Figure 5-17, that **amendment** is running in the opposite direction to **main** and must be inserted in the reverse direction.

5. Place the cursor at Station 430.9 in the *Station* column of the untitled traverse.
6. *Traverse*| *Insert File* button, select <SurveyMap>\Adjust**amendment.tr1**. Press *Open*.
7. In the *Insert File* dialogue box, *Entire File* and *Reverse Insertion Survey Direction* should be selected. Press OK.
8. Again, press *OK* to confirm.

Stations 0 to 307.7 appear above station 430.9 as Stations 436.2 to 738.5.

9. Place the cursor Station 738.5 in the *Station* column.
10. Select *Traverse*| *Insert File* button, choose <SurveyMap>\Adjust**main.tr1**. Press Open.
11. Configure the dialogue box so that it appears as shown in the figure below. Be sure that *Clear Absolute Coordinates* is not checked. Press *OK*.

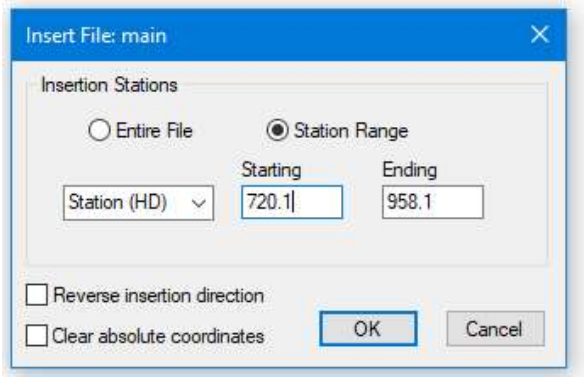


Figure 5-19: File Insert Dialogue Box

12. A Softree Prompt appears "Insert file at Station 738.5?" Press *OK* to confirm

13. *File* | *Save*. Type **new main2.tr1.** Press Save.
14. Select *Traverse* | *Quick Map* button. The map displays creeks. To turn off the Creek display, *right click*. Select Map Options. *Disable* Creek. Press *OK* to return to map view.
15. To verify the changes made select *Map* | *Add/Remove Traverses*. Highlight **main.tr1** on the left. Press the *Add Traverse* button. **main.tr1** now appears on the right. Press *OK*.

The map now resembles the original traverse and amendment as shown in Figure 5-17.

16. Close the **Untitled Map 1** and **main2.tr1** window. Do not save changes.

Correcting a Traverse using Station Equations

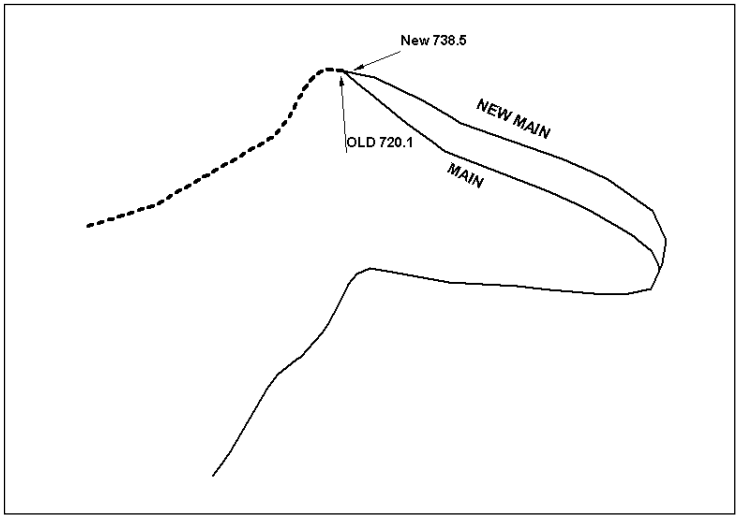


Figure 5-20: Old Route (main) and New Route (new main)

Note the discrepancy between the stations of **main** (old route) and **new main** (new route) in the figure above. If the stationing is left as is, the stations after 720.1 in the field would be different than the stations in the traverse module. To correct this a *Field Reference* column is added to the new main traverse notes.

1. *File* | *Open* <SurveyMap>\Adjust**main.tr1** and <SurveyMap>Adjust**new main.tr1**.
2. Place the Traverses side by side using *View* | *Tile Vertically*.
3. Highlight **main.tr1** and scroll up to station 720.1. Highlight **new main.tr1** scroll up to station 738.5.
4. To add a *Field Reference* column to **new main.tr1**. Select *Traverse* |*Traverse Entry* Button. Press the *Columns* button and add *Field Ref*. from the *Available* side to the *Displayed* side. Press the *Shift Up* button until *Field Ref* is just below *Station* on the *Displayed* Side. Press OK twice.
5. Select *Traverse* | *Current Field* button in the Survey Information Dialogue Box press the *Stn. Equations* button.
6. Press the *Add* button in the resulting dialogue box.
7. Type **738.5** in the *Backwards* frame, and **720.1** in the *Forwards* frame. Press OK to close all dialogue boxes.

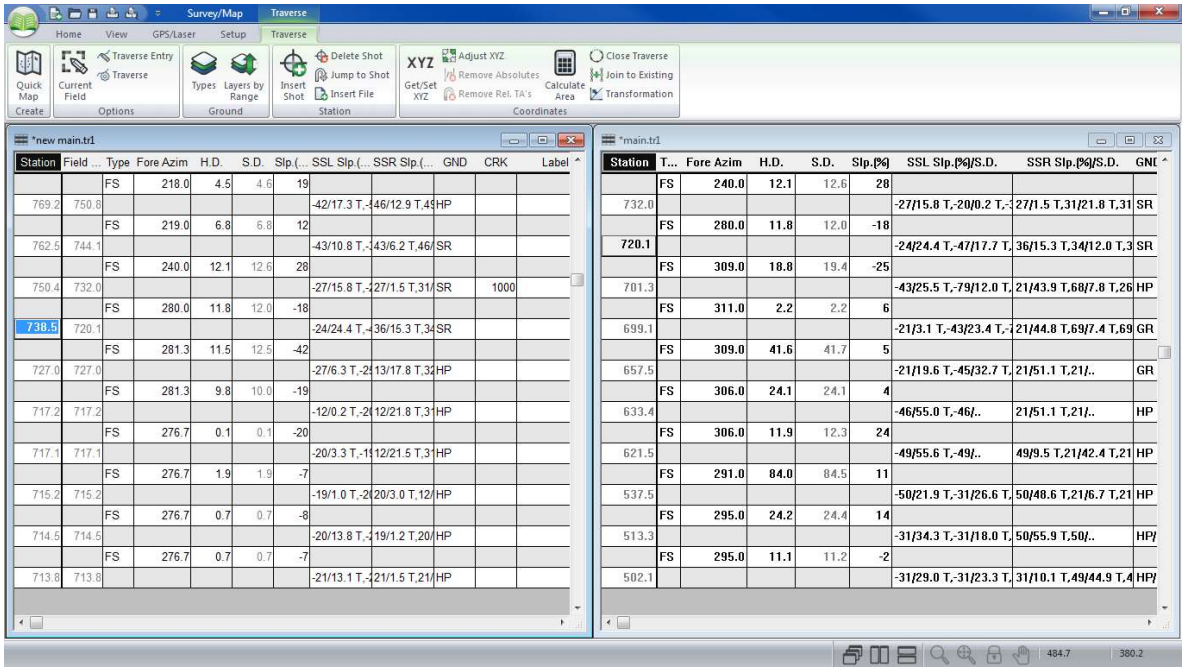


Figure 5-21: new main.tr1 with Field Reference to main.tr1

The *Field Ref* column opposite station 738.5 of **new main.tr1** reads 738.5 = 720.1. Notice that in the *Field Ref* column of **New Main.tr1** above station 738.5 corresponds to the stations in **main.tr1** above station 720.1.

8. Close both **new main.tr1** and **main.tr1**. Do not save changes.

Adjusting for Magnetic Anomalies

Certain geographic locations have problems with magnetic fields that may disturb compass readings. If the foreshot to next station and the backshot from next station differ significantly, magnetic anomalies may be the problem. This example will demonstrate how to correct this problem.

1. File | Open <SurveyMap>\Adjust**absazim.map** and \Adjust**absazim.tr1**.
2. Select View | Tile Vertically.

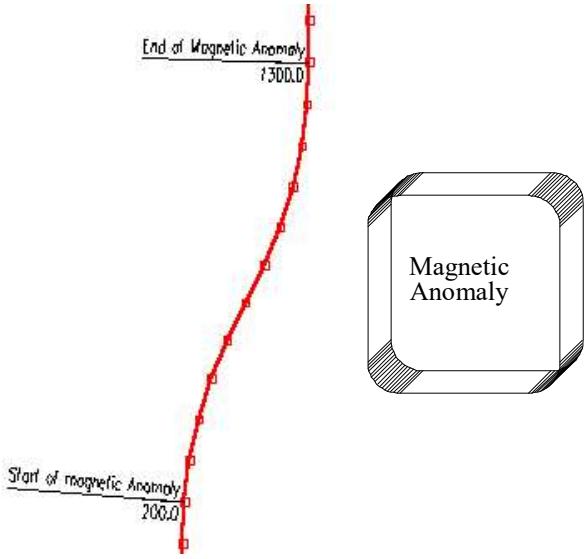


Figure 5-22: Compass Errors from Magnetic Anomalies

The traverse should have been a straight line at a bearing of 0, but due to a magnetic anomaly, the traverse is skewed. The traverse is correct up to station 200. After station 200, the foreshot and corresponding backshot start to differ. Once the traverse proceeds beyond the anomaly (Station 1300), it reverts back to the initial bearing. There is a simple way of fixing this problem.

3. Select the *Traverse Document* title bar.
4. *Traverse* | *Traverse Entry* button, choose the *Options…* button and select the *Automatic Magnetic Anomaly Adjustment* check box. Press *OK* twice.

This automatically enables the *Foreshot/Backshot Tolerance (degrees)* option and the default setting of 1.00. This means that when the foreshot and corresponding backshot differ by more than 1.00 degree, there will be an adjustment to correct for the magnetic anomaly.

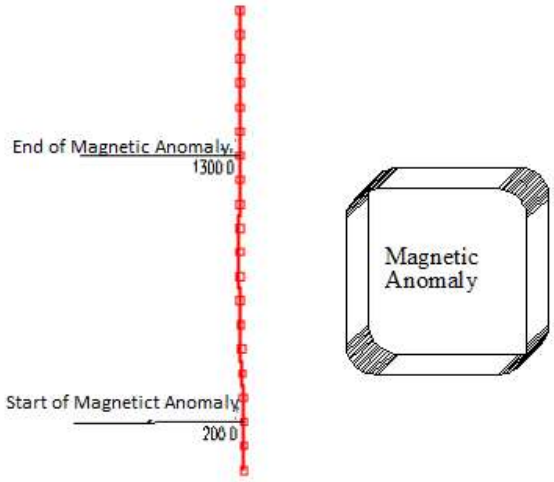


Figure 5-23: Corrected Traverse

Note: Magnetic Anomalies are corrected by using foreshot and backshot to calculate relative changes in angle (turning angles). These turning angles are used to calculate each azimuth from the previous one (similar to a theodolite survey). This works because the deflection error from the anomaly is the same for both the foreshot and the backshot taken from the same point.

5. Highlight the traverse document. *Traverse | Adjust XYZ*. The *Coordinate Adjust Log,* as shown below, appears. Press *OK*.

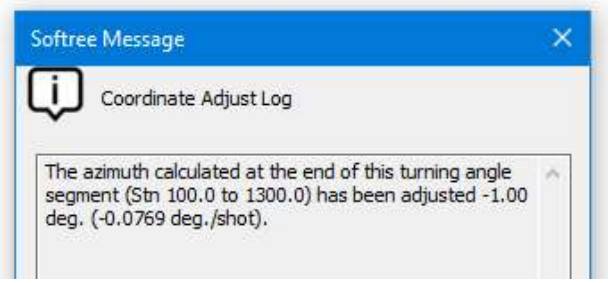


Figure 5-24: Turning Angle Adjustment Message

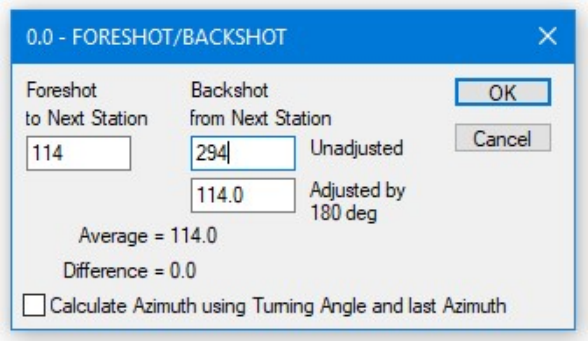
This dialogue box identifies the azimuth error adjustments, when a calculated azimuth at the end of a relative segment is reconciled with an absolute azimuth. In this case the azimuth was adjusted 1.0 degree.

The symbol " ~ " appears in the *Station* column, indicating the stations which were calculated using turning angles.

Warning: You might at some point find that the difference between foreshot and corresponding backshot = zero "0.0", when you pass through an anomaly, as shown in the Foreshot/Backshot dialogue box below. In this case the magnetic anomaly may not be corrected automatically, and a manual adjustment of the offending station may be required.

To manually adjust a magnetic anomaly, double click on the Foreshot field to display this dialogue box shown below. Enable the *Calculate Azimuth using Turning Angle and last Azimuth* option.

You can also set up the Traverse Entry Options to automatically display the dialogue box by selecting *Traverse | Traverse Entry Options* and enable Azimuth Fore/Back shots under Automatic Extended Entry.



6. *Close* both documents. Do <u>not</u> save changes.

6. Survey Formats and Customization

This section demonstrates several features such as instrument and target height, initial backshot angle, and vertical angle formats to allow entry of theodolite and leveling surveys.

Transit Survey (An Example of a Block Boundary)

Transit surveys are conducted by taking an initial backshot, and a series of foreshots that are calculated using turning angles. The horizontal angle is measured by turning right (clockwise) from the backshot to the foreshot.

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

1. *File* |*New*, select *Traverse Document*. Press *OK* to create a new traverse.

The *Starting Coordinate* dialogue box below will open with default values (0.0, 0.0, 100.0).

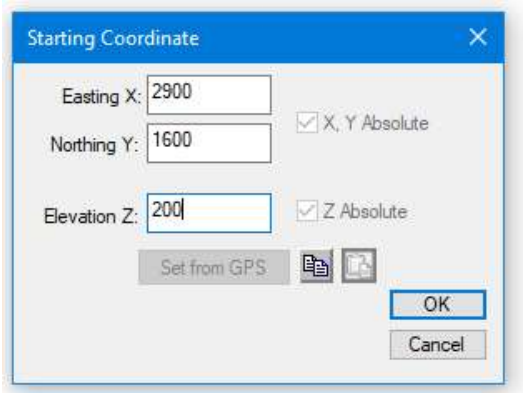


Figure 6-1: Starting Coordinate Dialogue Box after Setting Initial Position.

2. Set the coordinates as shown above: type *2900.0* for *Easting* (X), *1600.0* for *Northing* (Y) and *200.0* for Elevation (Z). Press *OK*.

The notes entry table is now set up according to the contents of your default screen layout (**Normal.slt**). We need to change to accommodate theodolite data.

3. *View* | *Screen Layout* dropdown, expand the *Training* folder, select **training transit.slt**.
4. <Double-click> in any gray area to access the Traverse Entry Options Dialogue box (this is also available from the *right click* context menu).

The screen layout **training transit.slt** has been configured for entry of *Azimuth* in *Deg:Mins:Secs (0 to 360)*, and *Slope* in *Zenith deg:min:sec (0 to 180)* angle.

5. Press the *Options...* button; note that the horizontal angles will be calculated using *turning angles*. Press *Cancel*, and *Cancel* again, to return to main screen.
6. <Right-click> in any gray area on the Traverse screen; select *Traverse Options...* (at the bottom of the context menu) to open the dialogue box shown below (or you can select *Traverse* | *Traverse Options* from the main menu). Select the *Survey Information* tab.

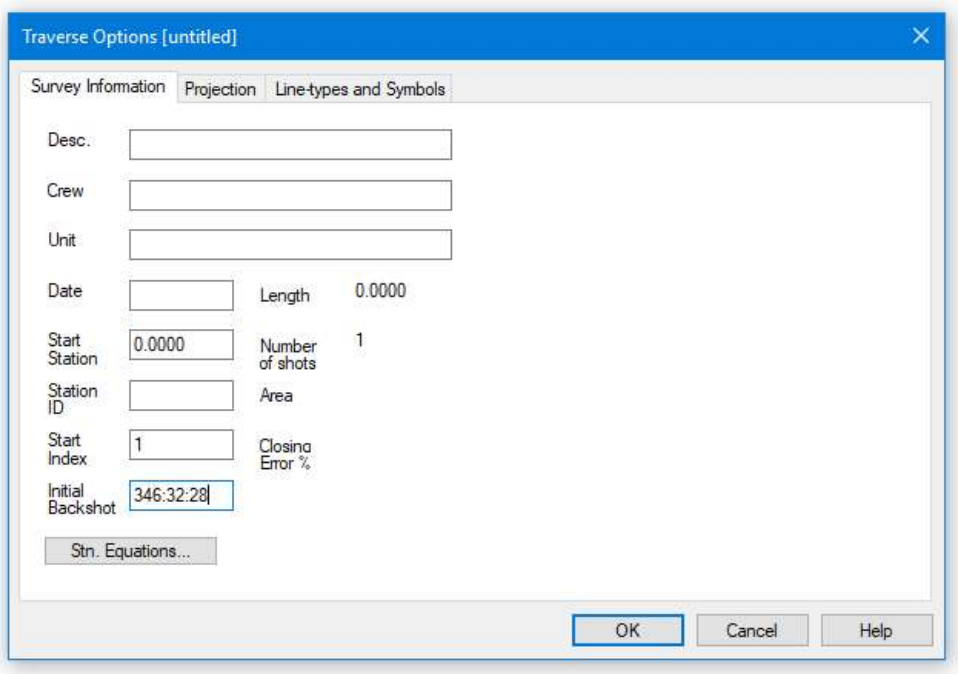


Figure 6-2: Survey Information Dialogue Box

7. Type in the *Initial Backshot* **346:32:28** as shown above.
8. Click on the *Projection* tab and change *Units* to *Imperial (ft.)* (if necessary). Press *OK*.
9. Place the cursor in the *Label* column at Station 0.00. Type in **BM** (short for bench mark) as the first label. Press <Enter>.
10. Refer to the Theodolite Survey notes in Figure 6-3 below. In the *Fore Right* field (HORZ ∠) for Pt # 2 type **106.4409**. Press <Enter>.

An error prompt appears, stating "Invalid value (minutes and seconds must be from 0 to 60)". The format used in the paper notes (ddd.mmss) is not supported.

11. Press *OK* to close the message box.
12. Type **106.44.09** instead. Press <Enter**>**.

Note: Type all Horizontal angles (*Fore Right*) and Vertical angles (*Zenith*) as *deg.min.sec* or *deg:min:sec*, for example 106.44.09 or 106:44:09 **not** 106.4409.

With the exception of labels, the notes can be entered using the number pad only. Use decimal point delimited fields for ease of entry. The values will be displayed with the colon delimiter.

13. In *S.D.* (Foresight slope distance) type **137.33.** Press <Enter>.
14. For *Zenith* (VERT ∠) type **89.12.20.** (See Note above) Press <Enter>.
15. Type in the *Inst. Height* (HI) of **5.2**. Press <Enter>.
16. Type in the *Target Height* (Rod Ht.) of **5.2**. Press <Enter>.

Notice that the instrument and target heights have been copied into the next record. Any changes can be typed in, otherwise <Enter> will accept the previous value.

17. Enter the remaining notes from Figure 6-3, continuing from PT # 3.

PT	HORZ ∠	S.D.	VERT <	ROD HT
SET UP ON		PT #1	NORTHING :	1600
			EASTING :	2900
			ELEVATION :	200
		BS PT #9	= 346.32	2.8
			H.I. = 5.2	
PT #2	106.4409	137.33	89.1720	5.2
SET UP ON PT #2			H.I. = 5.2	
PT #3	180.0000	1034.91	89.1220	6.3
SET UP ON PT #3			H.I. = 5.2	
PT #4	104.4347	60.08	90.3030	5.2
SET UP ON PT #4			H.I. = 5.2	
PT #5	180.0000	615.06	91.3000	5.2
SET UP ON PT #5			H.I. = 5.2	
PT #6	109.4501	349.813	90.5040	6.12
SET UP ON PT #6			H.I. = 5.2	
PT #7	94.0409	451.038	89.4515	5.2
SET UP ON PT #7			H.I. = 5.2	
PT #8	225.1929	560.387	89.3010	6.5
SET UP ON PT #8			H.I. = 5.2	
PT #9	180.0000	340.04	89.2012	6.0
SET UP ON PT #9			H.I. = 5.2	
PT #1	79.2325	419.80	89.4008	8.4

Figure 6-3: Theodolite Survey Notes

18. **Optional**: If you did not complete the notes entry, open <SurveyMap>\Other**transit.tr1** and skip the following step.

19. *File | Save*. Save as <SurveyMap>\Other**transit2.tr1**.

This traverse represents a closed polygon. However, due to an imperfect survey, the end point is not coincident with the start.

20. *Traverse | Close Traverse Coordinates*. Press *OK* to confirm closing of traverse. A *Coordinate Adjust Log* appears reporting a closure error and area of closed traverse. Press *OK*.

Notice that an asterisk, *, appears next to the final station to indicate that it is an absolute station (coordinates are set to match the start).

21. Double click on any of the stations in the *station* column to open the *Survey Information* dialogue box (figure below). Closure error is 0.002%, Area 16.73 Acres, and the length of the traverse is 3968.0391 meters. Press *OK*.

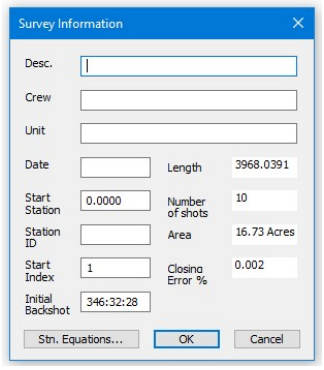


Figure 6-4: Survey Information Dialogue Box

22. Select *Traverse* | *Quick Map* to open a map of the current Traverse.
23. *View* | *Screen Layout* dropdown, expand the *Training* folder, select **training transit.mlt**.
24. Arrange windows side by side with menu *View* | *Tile Vertically.*

The screen should now appear as shown in the figure below:

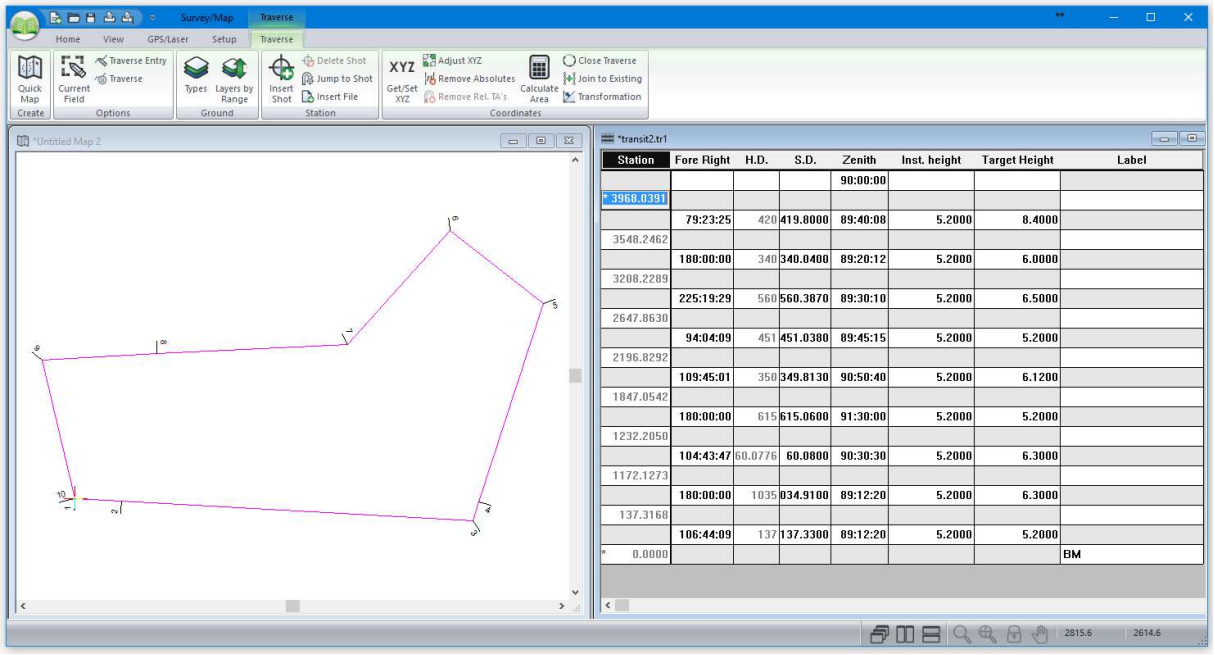


Figure 6-5: Final Closed Block Boundary

Note: If you select a shot in the Traverse window, the Map window will indicate the selected shot with a red cross.

25. *Close* both the Traverse and Map Documents. Do not save changes.

Level Survey

This example will demonstrate how to enter a level survey with radial shots. The main survey is created using *Backshots* and *Foreshots* at station hubs; multiple elevation shots originate from these hubs. We will work from the notes in Figure 6-7.

1. *File* | *New*, select *Traverse Document*. Press *OK*.

The *Starting Coordinate* dialogue box below will open with default values (0.0, 0.0, 100.0).

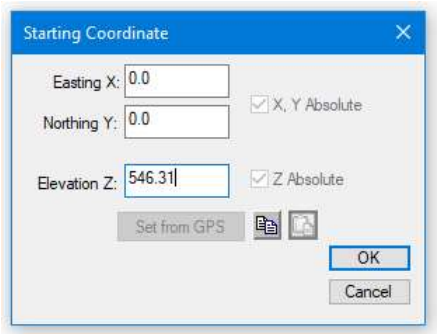


Figure 6-6: Starting Coordinate Dialogue Box after Setting Initial Position.

2. Type in the *Elevation Z of* **564.31**; we will keep the default *Easting X*, and *Northing Y* values. Press *OK*.

The notes entry table is now set up according to the contents of your default screen layout (**Normal.slt**). We need to change to accommodate level survey data.

3. *View* | *Screen Layout* dropdown, expand the *Training* folder, select **training level.slt**.
4. <Double-click> on any gray area in the traverse document to open the *Traverse Entry Options* dialogue box. Notice that the screen layout, **training level.slt** has been configured for entry of *Azimuth* in *Quadrants* (e.g. N32W), and slope in *Level (elevation)*. Press *Cancel* to close.

At this point, your traverse is set to use your default units (meters or feet). This exercise works in any units, but if you want to change them, choose menu *Edit* | *Traverse Options* and select the *Projections* tab.
Now we will create the first radial shot (RS) from the first station.

5. Press <Enter> to move to the *Type* column. Type **RS** (**r** is sufficient) or select *RS* from the drop down. Press <Enter>.
6. Type **E** (due East) under the *Fore Bearing* column. Press <Enter>.
7. Type **10** under the *S.D.* (slope distance) column. Press <Enter>.
8. Type **565.17** under the *Next Z* (elevation) column. Press <Enter>.

	Bearing	S.D.	BS	HI	RS	FS	ELEV	dZ
BM28			1.56	565.87			564.31	
605	E	10.0			0.70		565.17	+.86
606	N45W	20.0			2.90		562.97	-1.34
607	S50W	10.0			3.50		562.37	-1.94
608	S20E	15.0			6.70		559.17	-5.14
609	N25E	15.0			11.90		553.97	-10.34
TP.2	N10E	20.0	0.41	554.65		11.63	554.24	-10.07
610	N45E	10.0			3.20		551.45	-2.79
611	N10W	10.0			8.60		546.05	-8.19
612	S30W	10.0			9.00		545.65	-8.59
613	S40E	20.0			12.20		542.45	-11.79
614	S20E	10.0			9.30		545.35	-8.89
615	N60W	10.0			8.40		546.25	-7.99
616	S85E	10.0			7.10		547.55	-6.69
617	N15E	20.0			8.40		546.25	-7.99
618	N25W	20.0			7.00		547.65	-6.59
619	N65E	10.0			4.10		550.55	-3.69
TP.3	N	25.0	8.02	559.98		2.73	551.92	-2.32
			9.99					
					564.31	14.36		
					559.98	9.99		
				check	4.37=	4.37	✓ OK.	

Figure 6-7: Level Survey Notes

Before you enter the rest of the shots, note that only *Type*, *Bearing, S.D.* and *Elevation* fields are required. Also note that **TP.2** and **TP.3** are foreshots (**FS** in the *Type* column). All other shots are radial shots (**RS** in the *Type* column).

9. Enter the rest of the traverse notes above, continuing from point 606.
10. **Optional**: If you did not complete the notes entry, open <SurveyMap>\Other**level.tr1** and skip the following step.
11. *File* | *Save* the Traverse Document as <SurveyMap>\Other**level2.tr1**
12. Select *Traverse* | *Quick Map* Create to open a new Map Document.
13. *View* | *Screen Layout* dropdown, expand the *Training* folder, select **normal.mlt>**
14. Arrange windows side by side with menu *View* | *Tile Vertically.*
15. Press the *Zoom Extents* button to scale appropriately.
16. Right click in the map document. Select menu *Map Options* and enable *Radial Shots*. Press *OK*.

Your screen should look similar to the figure below.

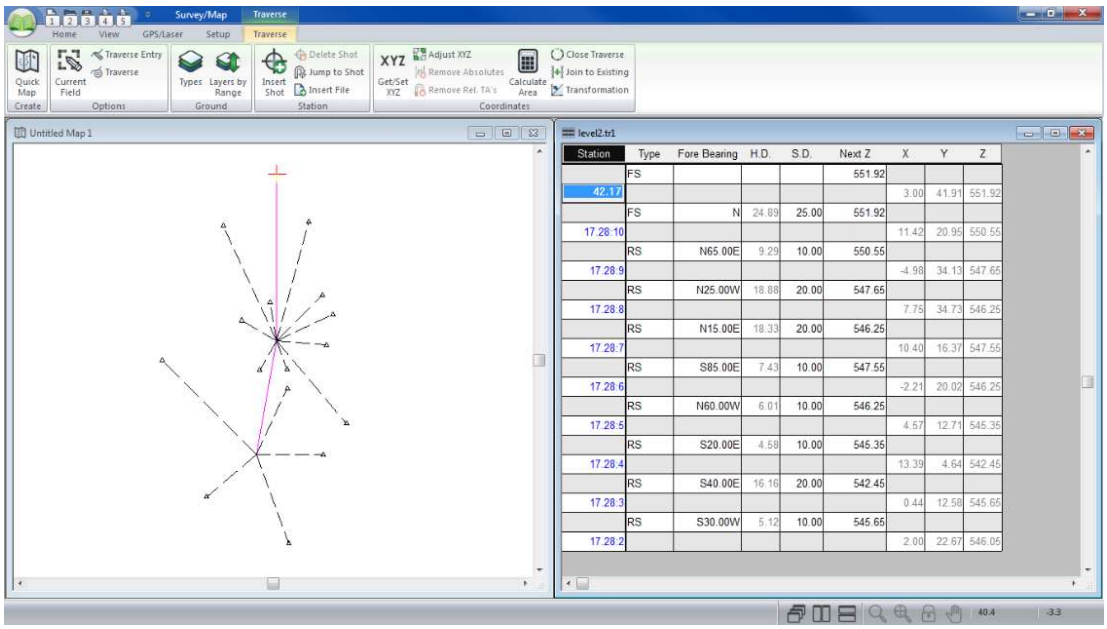


Figure 6-8: Map of Level Survey

Note: If you select a shot in the Traverse window, the Map window will indicate the selected shot with a red cross.

17. *Close* both windows. Do not save changes

User Defined Columns and Pick Lists

In this section, we will describe additional features for creating *User Defined Columns* and *Picklists.*

User defined columns can be used to save information along the traverse. To demonstrate user defined attributes, we will create a new column for *Tree Species.*

1. *File | New*, select Traverse Document. Press *OK*. Press *OK* again to accept the default start coordinates.
2. *Traverse | Traverse Entry Options*. Press the *Columns* button then press *New Column…* button. The *Create New Column* dialogue box will appear as shown below.

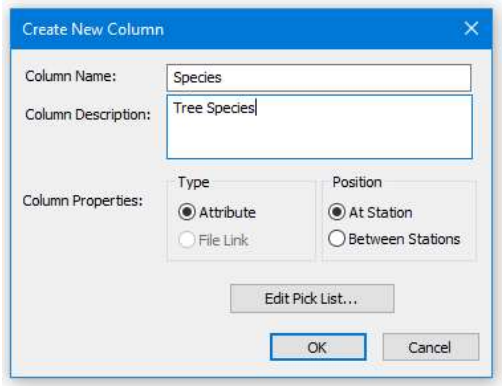


Figure 6-9: New Column Dialogue Box

3. Type in **Species** for *Column Name* and type in the description: **Tree Species** as shown above.

Pick lists allow you to predefine common field entries. With pick lists users can quickly pick a column entry from a list.

4. Press *Edit Pick List…* Press the *Add Item* and type **Spruce**. Press the <Enter> key and create a **Hemlock** entry. Continue this process and create entries for **Fir** and **Cedar**, as shown below. Then press *OK*.

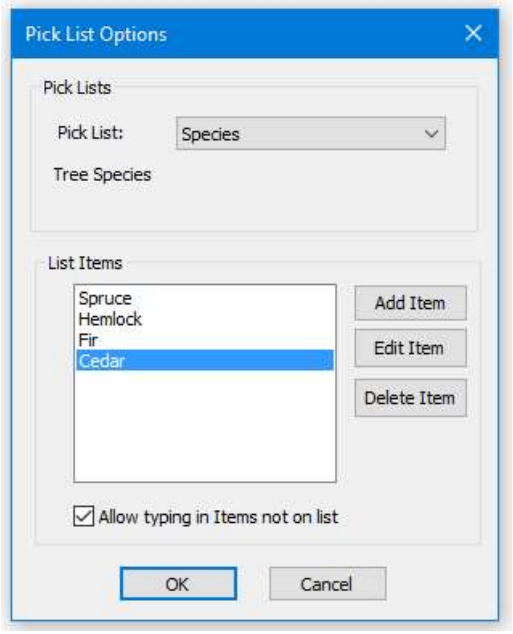


Figure 6-10: Pick List Options Dialogue Box

After returning to the main traverse screen, notice how the new species column allows picklist entries.

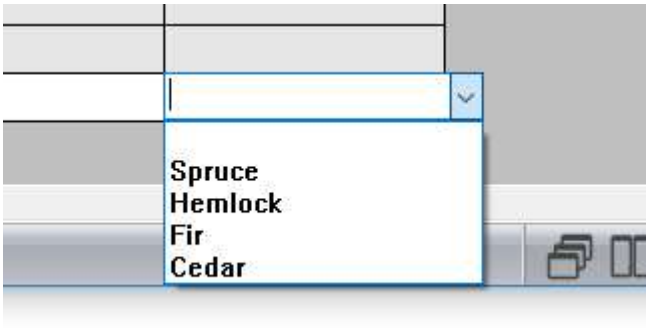


Figure 6-11: Picklist Entry

5. *Close* the traverse window. Do not save changes

7. Working with a GPS Device

GPS coordinates can be incorporated into Survey/Map, either by directly attaching a GPS or by entering coordinates. Traditional survey methods (bearing, distance and slope) can be combined with GPS in several ways to improve accuracy and productivity. The following examples illustrate ways to combine GPS data with conventional surveys:

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

Tying to known GPS benchmark(s). This is done either in the field or in the office using the *Traverse | Get/Set XYZ*

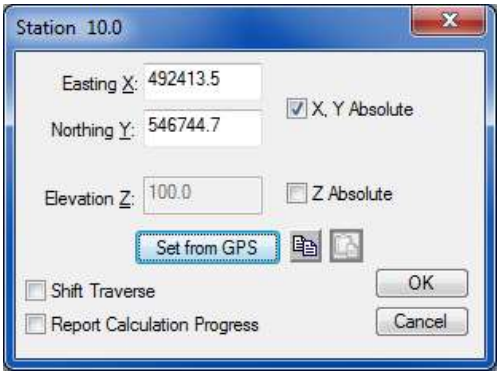


Figure 7-1: Get/Set Coordinates Dialogue

XY from GPS, Z from slope. This is done using the *Traverse | Insert Shot dialogue*, *X-Y-Slope*. XY coordinates are taken from the GPS and the slope % (or similar measure of vertical angle) is entered.

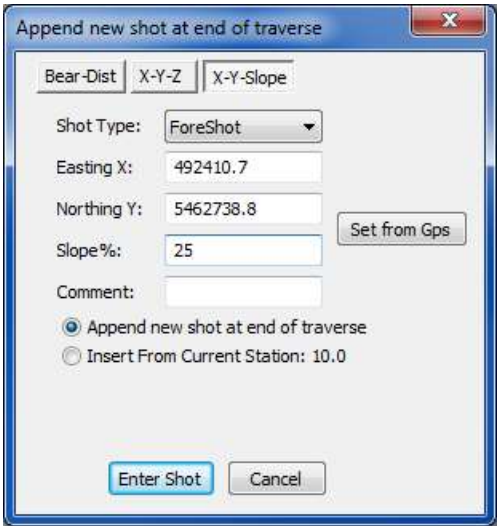


Figure 7-2: XY From GPS Combined with Slope Angle

XYZ from GPS. This is done using the *Station | Insert Shot dialogue, X-Y-Z*. XYZ coordinates are taken from the GPS.

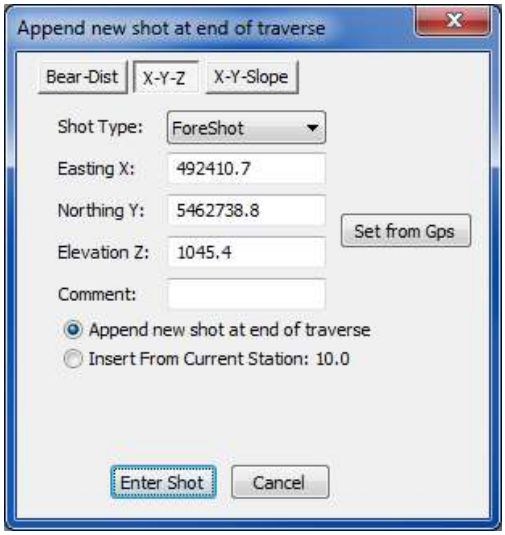


Figure 7-3: XYZ from GPS

Configuring a GPS Device

Before going out in the field with Survey/Map it is important to make sure your GPS device is properly configured.

Identify the Connection Type (either Serial or USB):

Survey/Map supports Garmin devices in either a serial (RS232) connection or a direct USB connection. The connection type can be determined by how the cable plugs into the Garmin device. If the cable plugs into a round Garmin-type connector on the back of the GPS unit, then it is a serial connection. If the cable plugs into a standard USB connector on the back of the GPS unit (same plug type as on digital cameras), then it is a USB connection.

Set the Device Mode (either NMEA or Garmin):

USB Garmin devices only communicate in Garmin proprietary mode. For some reason, the newer Garmin USB devices do not support the industry standard NMEA mode. Set USB Garmin devices to Garmin Data Format on the Interface - Settings page of the GPS unit.

Serial Garmin devices communicate using serial (RS232) protocol, however most laptops only support USB ports. This means you may require a *serial to USB adapter cable* to connect your GPS to Survey/Map. Specifications for the serial interface are included in Appendix B – GPS Hardware Configuration. Set Serial Garmin devices to NMEA Data Format on the Interface - Settings page of the GPS unit.

Test your GPS device

6. Connect the GPS to the laptop using either a Serial or USB cable and turn on your GPS device.
7. Start Survey/Map and choose *GPS/Laser | Connect*.

Survey/Map should automatically detect the GPS device. The *GPS Confirmation Dialogue* will appear showing the connection information.

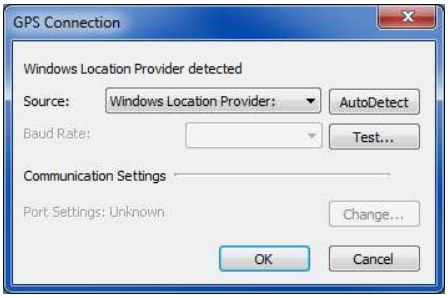


Figure 7-4: GPS Auto-Detect Confirmation

Survey/Map should now be connected and ready to track GPS coordinates.

8. Try moving the GPS device near a window or taking it outside. When the GPS has enough satellites the red *Status* indicator on the tool bar should turn to green.

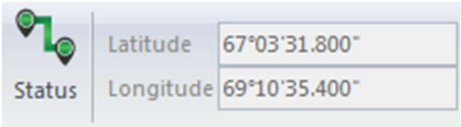


Figure 7-5: GPS Tracking Indicator

If the GPS device is not found, check to make sure you have the GPS in the correct mode (NMEA mode for serial connections or Garmin mode for USB connections) and that the cables are connected correctly.

8. Working with a Laser Rangefinder

Laser rangefinders utilize a laser beam to determine the distance to an object. The most common of these rangefinders utilize the time of flight principle by sending a laser pulse in a narrow beam towards the object and measuring the time taken by the pulse to be reflected off the target and returned to the sender. These handheld devices are generally used in a field setting in applications where high precision sub-millimeter measurements are not required.

Configuring the Laser Rangefinder (TRUPULSE)

Turn on Devices Bluetooth (Models 200B, 360B/R):

1. Press and hold *down arrow* on side of unit, until *(Units)* is visible on the view finder screen looking through eye piece, then press *down arrow* again until *(bt)* is visible.

2. Press *FIRE* button on the top of unit, the press *down arrow* on side of unit to scroll through Bluetooth on/ Bluetooth off *(bt. on) (bt off)*.

3. Press *FIRE* button to select *(bt. on)* - Bluetooth on. Bluetooth should now be on the device.

Pairing the Device with your Computer:

Microsoft Windows 7:

- Open Control Panel
- Find path Control Panel > All Control Panel Items > Devices and Printers or in the Control Panel search box, type **Bluetooth**, and then click Change Bluetooth settings.
- Click *Add a device* button, select TP360B-102260 | click *Next*
- Enter the pairing code for the device, default code is *1111*.
- Device should now be paired with the computer.

Microsoft Windows 10:

- Ensure the Laser gun in powered up.
- Click on the Notification Box in the bottom right corner (Refer to Figure 8-1). You may be able to click directly on the Bluetooth icon usually in the lower right corner of the screen.

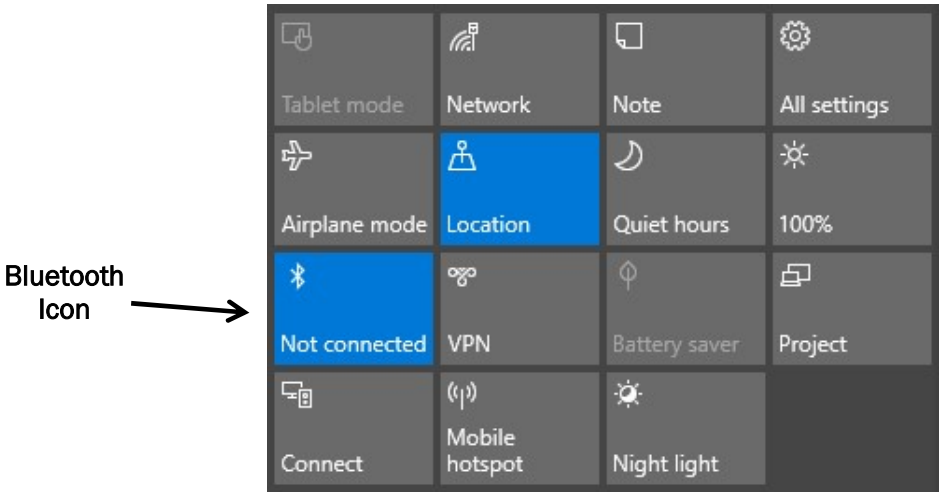


Figure 8-1: Expanded Windows 10 Notification Sidebar

- *Right click* on Bluetooth icon | Select *Go to Settings*
- Click on *plus* sign for Add Bluetooth or other device
- Click on Bluetooth (Mice, keyboards, pens, or other kinds of Bluetooth devices) Refer to Figure 8-2.

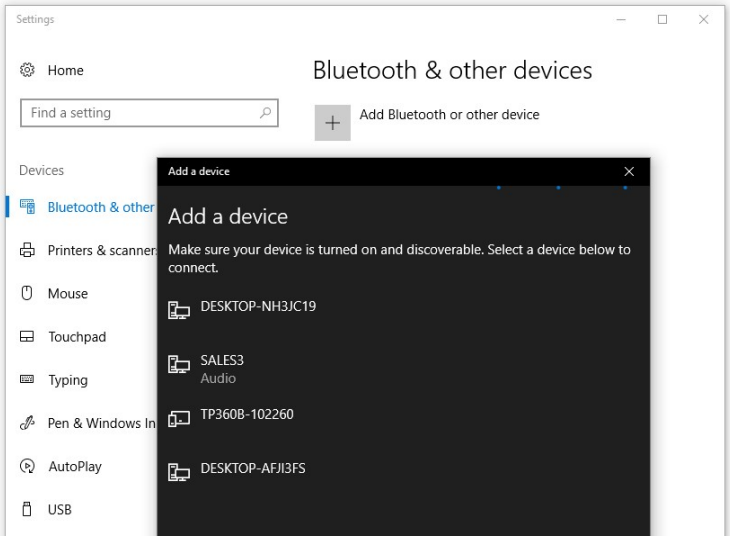


Figure 8-2: Add Device Dialogue Box

- Select *TP360B-102260*, the default PIN number for TruPulse is **1111.**
- Device should be paired with the computer.
- Next you must check the COM the device is connected on:
- Left click on the Bluetooth icon
- Select Open Settings
- Within the *Bluetooth & other devices* dialogue box select *More Bluetooth options* under '*Related settings*'. Refer to Figure 8-3.
- Click on *COM Ports* tab note the port set for *Outgoing*.

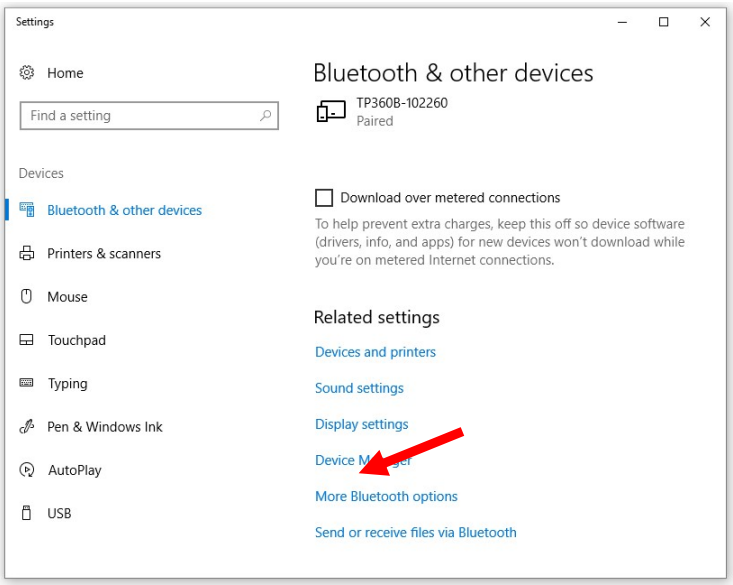


Figure 8-3: Select More Bluetooth options from *Bluetooth & other devices* Dialogue Box

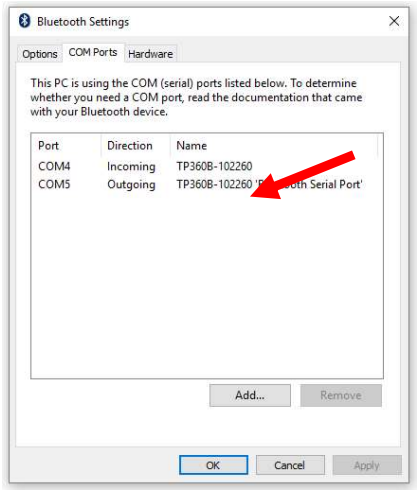


Figure 8-4: Bluetooth Settings Note the Outgoing COM Port Setting

Using Rangefinder in Survey/Map

Connect Laser Rangefinder within Survey/Map Software

Unlike other tutorial sections, this is not a specified example; instead, it outlines the basic steps . You will require a TruPulse 360B or 360R device in order to proceed.

1. Open a new traverse: *Home* | *New Traverse* | Select *Traverse Document*, press *OK*.
2. Enter *Starting Coordinate*, press *OK, OK*.
3. Connect to device (TRUPULSE 360B): *GPS/Laser* | *Connect* button.

4. Serial Setting Dialogue - COM Port: 5 (or select outgoing port device is configured for) | *Baud Rate*: **4800** | *OK*.

For Laser Technologies TruPulse 200 Series the recommended settings are:

- 4800 baud
- 8 data bits
- no parity
- 1 stop bit
- Xon/Xoff

For other models and brands, check the manufacturer's recommendations.

Note: When you connect to the Laser Gun via Bluetooth, you should select the Outgoing COM Port

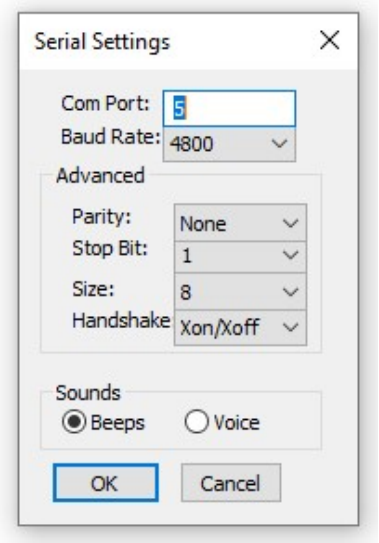


Figure 8-5: Serial Setting Dialogue Box

5. A dialogue box comes up that says, "Port opened successfully". Press *OK*.

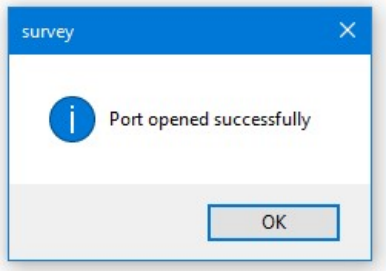


Figure 8-6 – Port Open Successfully

Device should now be connected and allow you to take and record readings.

Start Taking Shots and Uploading Data

6. Within the *Untiled Traverse 1* window click in Fore Azim Column.
7. With the laser rangefinder, sight the next station, press *FIRE* button on rangefinder.
8. Select the *shot type* (e.g. Foreshot) and once you are satisfied data in dialogue box looks correct press *Enter Shot* button within the dialogue box. This automatically sets up the next shot station based on the distance of the shot.

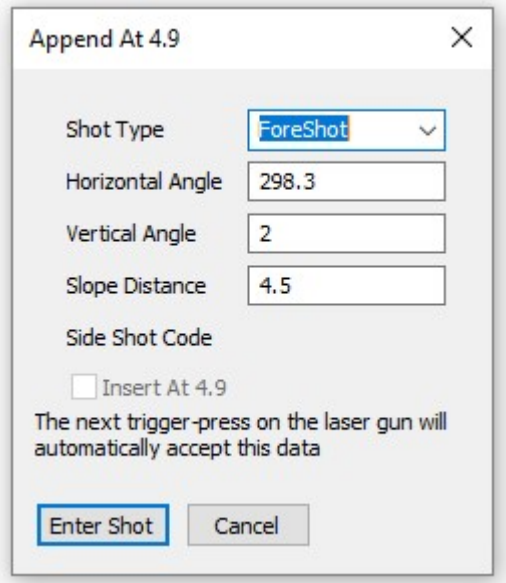


Figure 8-7: Dialogue Box that Opens upon taking Foreshot

9. Take the left-side shot: Select the column SSL Slp. (%)/S.D., take your left side shot and press *Enter Shot* button.
10. Take the right-side shot: Select the column SSR Slp. (%)/S.D., take your right side shot and press *Enter Shot* button.

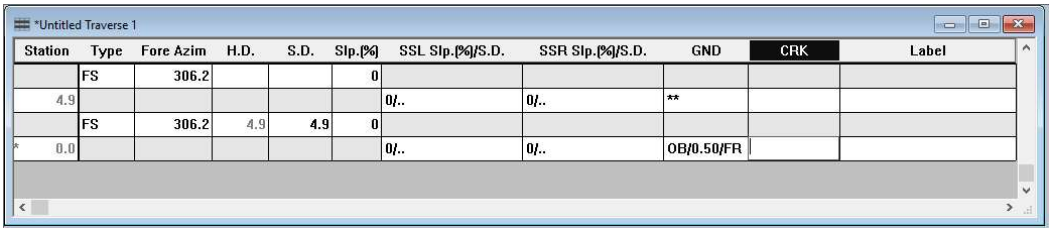


Figure 8-8: First Shot Entered into a Traverse

Note: If your survey requires enter an overburden thickness. Click in the GND column, for example if there is 0.5 of overburden over fractured rock. In Layer 1 select OB Overburden, Layer 2 select FR Fractured Rock. Type *0.5* in C/L Depth.

If a creek is encountered <double-click> in CRK (Creek) column complete details in the Creek Dialogue.

11. Proceed to next station and start again at step 7.
12. To delete a shot, click on Fore Azim row you would like to delete. *Traverse* | *Delete Shot*. Select station(s) you would like to delete. Press *OK*. Confirm deletion of station, press *OK*.
13. To insert a shot press *Traverse* | *Insert Shot*. Data can be inserted from a selected station or appended at the end of the traverse and the fields can be entered manually.
14. *File* | *Save As…* Name file and save it.

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