Version

7.0

April 2016

CONNECTICUT DEPARTMENT OF TRANSPORTATION

AEC Applications – Division of Facilities & Transit

CTDOT

InRoads SS2 V8i

Survey Guide

CTDOT InRoads Survey V8i Guide

CTDOT – AEC Applications

2800 Berlin Turnpike • Room 3213

Newington, CT 06131

Phone 860.594.3320 • Fax 860.594.3372

Thanks!

Thanks go out to all that contributed to the creation of this document, especially to Sarah Rose who served as editor; Jeff Beckwith for his survey expertise and the late Harry Smith for his encouragement to continue moving forward. The support that they have provided has been invaluable and is appreciated beyond measure.

Elaine Richard

Preface

Overview

The goals of the CTDOT InRoads V8i Guide are:

- To provide detailed instructions and technical support on the methods and standards used by CTDOT with Bentley InRoads V8i and beyond.
- To provide assistance for locating InRoads resource files within CTDOT's Digital Design Environment (DDE).
- To aid in the creation of high-value electronic data.

The CTDOT InRoads Survey V8i Guide will identify standard resource files, configurations, and CAD functions used in the creation high value data.

The material covered in this guide does not replace the need for other references and training regarding InRoads software. Additional publications and training may be needed for further clarification of CAD procedures and functions. The intent of this guide is not to prevent or limit individual initiatives and engineering judgment. Rather, it is meant to document standard digital design procedures currently in practice at CTDOT.

The information provided in this guide is subject to change as technology and experience warrant. Therefore, this guide will be updated as major revisions in design software and CTDOT DDE policies occur.

Distribution

This manual, in its entirety, may be freely copied and distributed for the purpose of providing a consistent guide to InRoads Design requirements of the Connecticut Department of Transportation. The CTDOT InRoads Survey V8i Guide is available on the web.

Trademarks

"MicroStation" and "InRoads", are registered trademarks of Bentley Systems, Incorporated. Other trade names, computer protocols, and file formats mentioned in this manual are the trademarks of their respective owners. In no event will the appearance of any graphic, description of a graphic, picture, screen display, or any other method of conveying meaning, be considered to impair the rights of the respective owners.

Prerequisites

The required prerequisites for installing and using InRoads V8i are listed below.

- MicroStation V8i SS 2 Version 08.11.07.492 or higher,
- MicroStation V8i SS 3 Version 08.11.09.397 or higher,
- InRoads V8i SS2 Version 08.11.07.428 or higher,
- This is not configured to work with OpenRoads (InRoads V8i SS 3)

Online Application Help

As mentioned earlier, this manual is not intended to be a sole source of information for the InRoads user. InRoads software has extensive online help available through Help on the InRoads Menu Bar. Additionally, when using the different InRoads dialog boxes, each box has a Help button. These buttons link directly to information specific to the InRoads process being performed. It is generally expected that new or even seasoned InRoads users will need to reference the online help regularly. The best solution to a problem usually requires testing and selecting from multiple options. Practice and experience using InRoads is the key to becoming a proficient InRoads user. Also, InRoads Help contains a media library with video presentations and examples of standard workflows.

In addition, there are other outside InRoads learning resources for CTDOT users. **CTDOT employees** can access the internet for help and training on the Bentley Learning Web site: http://www.bentley.com/en-US/Training/, or call Bentley directly at *1-800-778-4277* only for SELECTservices or **all others** call 1-800-BENTLEY. To access these learning resources from Bentley Systems, Inc., CTDOT employees should contact AEC Applications to have a Bentley SELECT-ID issued to them. However, Consultant Engineering firms need to purchase their own training subscriptions directly through Bentley.

CTDOT ACE Applications has setup InRoads preferences and standardized CTDOT InRoads practices in an effort make using InRoads as productive as possible. If you have questions regarding this manual or the CTDOT InRoads preference files, please contact:

Elaine Richard	**Gabriele Hallock**	**Samantha Scharpf**
Phone: 860-594-3278	Phone: 860-594-3244	Phone: 860-594-2902
Elaine.Richard@ct.gov	Gabriele.Hallock@ct.gov	Samantha.F.Scharpf@ct.gov

Table of Contents

SECTION 1 ORIENTATION TO INROADS 11
1.1 InRoads File Types 11
1.2 Resource File Storage Location 12
1.3 Project Defaults 12
1.4 **Lab 1** Start up 13
SECTION 2 SURVEY ELECTRONIC DATA REDUCTION WORKFLOW 18
2.1 **Lab 2** Importing the Traverse 18
2.2 Traverse Adjustments 22
2.3 **Lab 3** Adjusting the Traverse using Least Squares 23
2.4 **Lab 4** Processing the Survey Data 28
2.5 Point Codes 31
2.6 Style Manager and Alpha/Numeric codes 34
2.7 Fieldbook Data 35
2.8 **Lab 5** Chainage 37
SECTION 3 FIELDBOOK EDITING 39
3.1 **Lab 6** Fixing Code Errors 39
3.2 **Lab 7** Fixing Point Codes 42
3.3 **Lab 8** Fixing a Closed Shape 46
3.4 **Lab 9** Adjusting PC' and PT's, ... 48
SECTION 4 SURFACE AND GROUND FILE CREATION 50
4.1 **Lab 10** Write Survey Data to Graphics 50
4.2 **Lab 11** Survey Data to Surface 51
4.3 **Lab 12** Surface Editing 54
4.4 **Lab 13** Deleting Triangles 60
4.5 **Lab 14** Checking the Contours 61
SECTION 5 HORIZONTAL ALIGNMENTS 62
5.1 **Lab 15** Start Up 62
5.1.1 Opening Files 62
5.1.2 Surface Properties 62
5.2 **Lab 16** Creating Horizontal Alignments 65
5.2.1 Naming the Geometry 65
5.2.2 Using Horizontal Alignment Tools 68

5.2.3 Importing a Linestring 69
5.2.4 PI Method 71
5.2.5 Defining Curve Sets 72
5.2.6 Define Stationing 74
5.3 **LAB 17** STATIONING AND ANNOTATION 74
5.3.1 Display Stationing 74
5.3.2 Display Bearings 75
5.3.3 Display Curve Data 76
5.3.4 Display Intersection Coordinates 77
SECTION 6 PROFILES AND VERTICAL ALIGNMENTS 78
6.1 **LAB 18** WORKING WITH PROFILES 78
6.1.1 Placing a Profile Window 78
6.1.2 Updating a Profile Display 79
6.2 **LAB 19** WORKING WITH VERTICAL ALIGNMENTS 80
6.2.1 Creating a Vertical Alignment 80
6.2.2 Defining Vertical Curves 80
6.2.3 Annotating a Vertical Alignment 81
SECTION 7 CROSS SECTIONS CREATION 82
7.1 **LAB 20** PLACING CROSS SECTIONS 82
7.1.1 Creating Working Cross Sections 82
7.1.2 Generating End-Area Volumes 83
7.1.3 Generating Cross Section Sheets 85
7.2 **LAB 21** USING COGO POINTS TO CREATE A SURFACE 88
SECTION 8 MISC TOOLS 94
8.1 **LAB 22** PLACING A GRID 94
8.2 **LAB 23** WORKING WITH SCALES 95
APPENDIX A INROADS CUSTOM OPERATIONS 97
APPENDIX B USING THE SURVEY MENU BAR 99

List of Figures

Figure 1-1 Accounting icon 13
Figure 1-2 CTDOT Accounting Menu 13
Figure 1-3 MicroStation Open File Dialog Box 14
Figure 1-4 MicroStation Create User Interface Dialog Box 14
Figure 1-5 MicroStation Open File Dialog Box, Create New File 15
Figure 1-6 MicroStation Select Seed File Dialog Box 15
Figure 1-7 Activate InRoads Suite & Open Project Defaults… 16
Figure 1-8 Configuration Names 17
Figure 1-9 InRoads Set Project Defaults Dialog Box 17
Figure 2-1 InRoads Customize Dialog Box 18
Figure 2-2 InRoads Import Dialog Box 19
Figure 2-3 MicroStation View of Traverse Points 20
Figure 2-4 InRoads Network Symbology Dialog Box 20
Figure 2-5 MicroStation View of Traverse Lines 21
Figure 2-6 InRoads Fieldbook Dialog Box 23
Figure 2-7 InRoads Build Single Route Dialog Box 24
Figure 2-8 InRoads Network - Single Route Dialog Box 24
Figure 2-9 InRoads Least Squares Adjustment Dialog Box 25
Figure 2-10 Bentley InRoads Report Browser 25
Figure 2-11 InRoads Adjusted Data on the Network - Single Route Dialog Box 26
Figure 2-12 Adjusted Data in the InRoads Fieldbook 27
Figure 2-13 InRoads Survey Options Dialog Box 28
Figure 2-14 InRoads Import Dialog Box 29
Figure 2-15 InRoads Resolve Code Errors Dialog Box 30
Figure 2-16 MicroStation View of InRoads Fieldbook Data 30
Figure 2-17 Edit Style Dialog Box 32
Figure 2-18 Planimetric Figure Using Numeric Codes 33
Figure 2-19 Chainage 37
Figure 3-1 InRoadsView Survey Data Toolbar 39
Figure 3-2 MicroStation View of Point 2941 39
Figure 3-3 InRoads Survey Toolbox 40

Figure 3-4 InRoads Fieldbook Data Dialog Box - Fixing Code Errors 40
Figure 3-5 InRoads Edit Observation Dialog Box 41
Figure 3-6 MicroStation View of Updated Point 2941 41
Figure 3-7 MicroStation View of needed window area 42
Figure 3-8 InRoads Fieldbook Dialog Box - code edit 43
Figure 3-9 InRoads Edit Observation Dialog Box 43
Figure 3-10 MicroStation View of corrected data 44
Figure 3-11 InRoads Save As Dialog Box 45
Figure 3-12 MicroStation View of Point 1051 46
Figure 3-13 MicroStation View 47
Figure 3-14 MicroStation View 48
Figure 3-15 MicroStation View 49
Figure 4-1 InRoads Write Survey to Graphics Dialog Box 50
Figure 4-2 InRoads Survey Data To Surface Dialog Box 51
Figure 4-3 InRoads Triangulate Surface Dialog Box 51
Figure 4-4 InRoads Surface Properties Dialog Box Main Tab 52
Figure 4-5 InRoads Surface Properties Dialog Box Advanced tab 53
Figure 4-6 Select by Attributes Dialog Box 54
Figure 4-7 Select By Warning 55
Figure 4-8 Update 3-D/Plan Surface Display 55
Figure 4-9 Crossing Segments Tool 56
Figure 4-10 View Crossing Segments 57
Figure 4-11 MicroStation View indicating a Crossing Segment 57
Figure 4-12 Edit Feature Point Tool 58
Figure 4-13 Edit Feature Point Dialog Box 58
Figure 4-14 MicroStation View 59
Figure 4-15 MicroStation View 59
Figure 4-16 Edit Feature Point Dialog Box 59
Figure 4-17 Delete Triangle Dialog Box 60
Figure 4-18 Import Surface Dialog Box 60
Figure 4-19 InRoads View Contours Dialog Box 61
Figure 4-20 MicroStation View of Existing Contours 61
Figure 5-1 Importing Levels 62

Figure 5-2 Browsing for Highway Levels 63
Figure 5-3 InRoads Surface Properties Dialog Box 64
Figure 5-4 InRoads New Dialog Box & Geometry Tab 65
Figure 5-5 InRoads Project Options Dialog Box 66
Figure 5-6 InRoads Save As Projects Dialog Box 67
Figure 5-7 InRoads Horizontal Curve Set Toolbar 68
Figure 5-8 Import Geometry Tool 69
Figure 5-9 InRoads Import Geometry Dialog Box 70
Figure 5-10 Location of Linestring to Import 71
Figure 5-11 InRoads Define Horizontal Curve Set 73
Figure 5-12 InRoads View Horizontal Annotation Dialog Box 75
Figure 5-13 Curve Set Annotation 76
Figure 5-14 Annotated Alignment Intersection 77
Figure 6-1 Create Profile Dialog Box 78
Figure 6-2 Update Profile 79
Figure 6-3 InRoads Dynamics Settings Dialog Box 80
Figure 6-4 InRoads Define Vertical Curve Set Dialog Box 81
Figure 7-1 InRoads Create Cross Section Dialog Box 82
Figure 7-2 InRoads End-Area Volumes Dialog Box 83
Figure 7-3 InRoads Report Browser Basic End Area Report 84
Figure 7-4 InRoads Create Cross Section Dialog Box - General Folder 85
Figure 7-5 InRoads Create Cross Section - Sheet Border Folder 86
Figure 7-6 InRoads Update Cross Section Dialog Box 87
Figure 7-7 New Cogo Point 88
Figure 7-8 Import Surface from Graphics 89
Figure 7-9 View Contours 90
Figure 7-10 Create Cross Section 90
Figure 7-11 Surface Properties 91
Figure 7-12 Update Cross Section 92
Figure 7-13 Cross Section to Surface 93
Figure 8-1 InRoads Place Grid Command 94
Figure 8-2 InRoads Place Grid Dialog Box 94
Figure 8-3 InRoads Preferences Dialog Box 95

Figure 8-4 MicroStation Menu Pull Down Tool 95
Figure 8-5 InRoads Preference Dialog Box 96
Figure 8-6 Survey Options setting scale factor 96

Section 1 Orientation to InRoads

InRoads Survey provides a vehicle for data transfer and reduction from total stations, GPS, and other raw data sources. It includes a complete set of tools for adjustments, data analysis and editing of raw input data. Also included are tools for coordinate geometry and DTM display. InRoads Survey allows you to save data in geometry and DTM file types for further usage by other applications within the InRoads product group. InRoads Survey has resource files that have been configured with CTDOT standards.

MicroStation is the platform application which allows InRoads data to be displayed. MicroStation and InRoads applications both work together to provide users with CAD functions. For example, InRoads uses MicroStation files to display CAD graphics for a DTM. This guide will outline the InRoads commands that are available to view, display and present InRoads design data in CAD files.

1.1 InRoads File Types

The InRoads road design process uses several different file types. All InRoads data is stored in external files. The CAD file is used to view a graphical representation of the design data, but the graphics files do not store the InRoads Data. For example, if the graphics that represent the horizontal alignment are deleted, the InRoads geometry file is not modified.

The following InRoads resource files have been configured for the V8i Environment:

Preference File (*.xin) - This file contains the control settings of all the dialog boxes within InRoads. The settings for surface, geometry and survey tools have all been confined to one .xin file, replacing the previous two .ini files, .fxp and .fwf files. This is the main source of standardization where all InRoads design and graphical output are configured to meet CTDOT standards.

Template Library (*.itl) – This file contains a storage area for typical sections. A template is comprised of a series of points and components that represent breakline features. These are processed later using the Roadway Designer command. Roadway features that have been processed are then saved to the design surface. CTDOT has two standard .itl files; one for roadway use and the other for airport taxiway and runway uses.

Style Sheet (*.xsl) - All style sheets have been provided by Bentley and are located on the local hard drive, in the Inroads directory under Civil/XML Data. The View XML Reports command allows users to select an .xsl style sheet, which specifies the exact information to pull from the .xml file and how to format it. To further clarify, the .xml file contains raw or computed data; the .xsl file specifies how to format the data into a report.

Drafting Notes (*.dft) - This file is used to enhance the production of final drawings. Use the commands across the design session to place intelligent annotation notes on features and geometry, in the plan, profile, and cross section views, as well as at the intersection of two alignments.

Pay Items (*.mdb) - This file is used with Quantity Manager. Quantity formulas and CTDOT pay items are stored in this Microsoft Access database.

Drainage Structures (*.dat) - This file is used with InRoads Storm and Sanitary. This file has been configured with CTDOT standard drainage structure information, including sizes, shapes, materials, and many other parameters.

Rainfall Table (*.idf) - This file is used with InRoads Storm and Sanitary. This file contains a table of Rainfall/Time of Concentration data that conforms to CTDOT drainage standards.

The following InRoads files need to be created for the project design:

Projects (*.rwk) - This file contains directory and file information for loading and saving InRoads data files. Once the project file is open, all of the specific project files are also opened.

Roadway Design (*.ird) - This file contains roadway model definitions. This file stores station and typical section information used by the Roadway Modeler command to create surface models along alignments. The Roadway Design (*.ird) is also the storage location for the superelevation design data.

Surfaces (*.dtm) - A Digital Terrain Model (DTM) file is a surface where existing ground and design terrain surface models are stored.

Geometry Projects (*.alg) – This file contains coordinate geometry and alignment information for a specific geometric project.

Survey Data (*.fwd) – This InRoads Survey Fieldbook data file is created by importing survey data from a field data collector.

XML Data (*.xml) - The XML Reports command, available as an application add-in under Tools on the pull down menu, generates XML data files. The XML files are not reports, but contain data that can be formatted into reports by using the View XML Reports command. XML data files are ASCII files that are not formatted as a report for direct viewing. A report is the output generated when users display data from an XML file using the View XML Reports command.

Quantity Manager (*.mdb) – This file contains a database of quantity information for a project.

Drainage (*.sdb) – This InRoads Storm and Sanitary file is where the project storm drainage design information is stored. This includes type and locations for catch basins, manholes and pipes.

1.2 Resource File Storage Location

The latest versions of all V8i resource files will be kept in the workspace under InRoads_V8i _RSC. Before starting an InRoads project copy the InRoads_V8i _RSC folder from the workspace to the C drive. Resource files for Surveys are copied to the local hard drive to improve the processing performance of the data. The INI's, FWF and FXP files for older level structures have all been converted to XIN files in both English and metric units. These files can be found in the J_Environment and SE_Environment folders. The newest V8 level structure resource files will be found in the folder V8_Environment.

1.3 Project Defaults

An organized work environment along with a standardized file management system provides a consistent way to maintain digital design data. These measures decrease the chance that users will create and/or work with incorrect InRoads files. File management also eliminates the creation of multiple copies of the same file. Therefore, a standardized file management system greatly increases productivity by ensuring the availability of correct InRoads files and eliminating duplicate files.

By setting up the project defaults and creating a project file, users can quickly load all files needed for project design. Additionally, the project file helps coworkers load and analyze current design data. The Project Defaults command is used to open resource files including the preferences file (.xin) and drafting file. This command is also used to set up default directories for all file types that can be accessed through the File/Open and File/Save As dialog boxes. These include Project (.rwk), Surface (.dtm), Geometry (.alg) and Survey Data (.fwd). All other files, which are opened or saved throughout the InRoads program, use the Project Default Directory setting. The project default file directories are stored in the computer's registry on the local hard drive.

1.4 **Lab 1** Start up

A. **Open** Windows Explorer and **Browse** to the *CTDOT V8i workspace*, **copy** the Folder **InRoads_V8i_RSC** (W:\Workspace\InRoads_V8i_RSC) to your computer **C:\Bentley_V8i\Civil\InRoads Group V8.11.**

B. Click on the **Accounting** icon located on your desktop, see Figure 1-1.

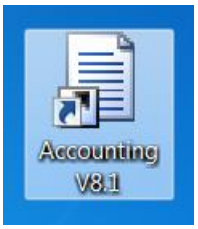


Figure 1-1 Accounting icon

C. Follow the steps in Figure 1-2. Within the Accounting Menu select **Run Program (1)**, choose the **MicroStation V8i D1/2/3 or 4** whichever is your District number. Select a project number from **Available Accounts (2)** and then highlight it within the **Frequently Used Accounts**. Select the correct **Resource Type (3)** and click on the **Start (4)** button.

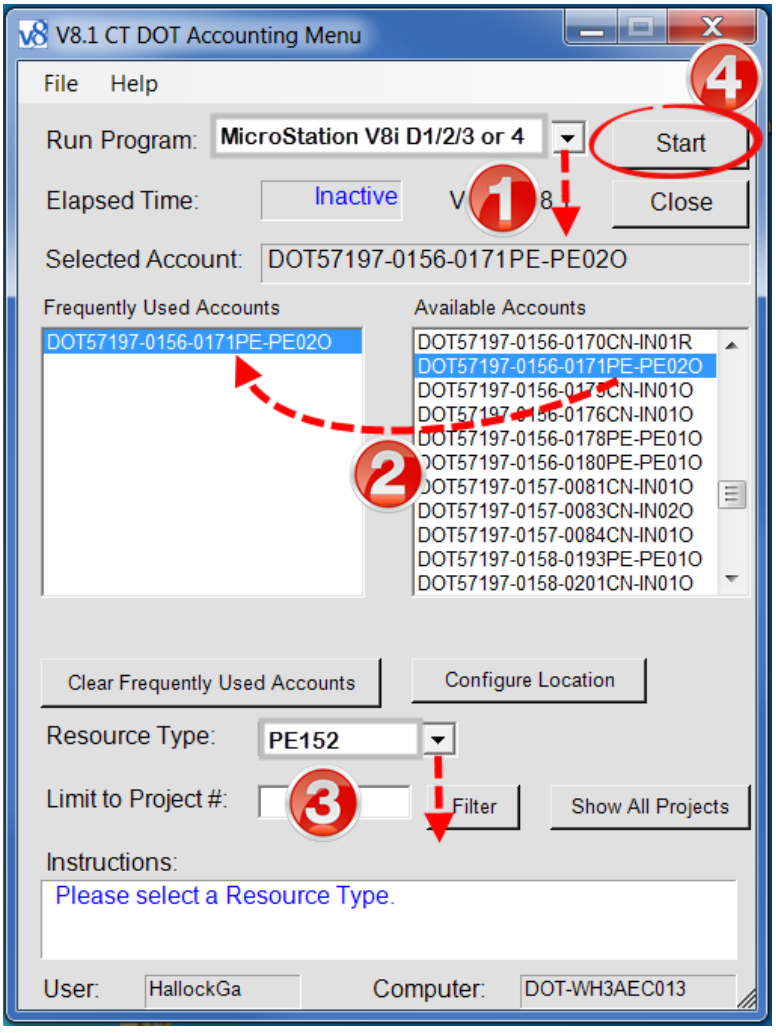


Figure 1-2 CTDOT Accounting Menu

D. The first time into MicroStation V8i the "out of the box" MicroStation Manager Interface will appear. Select the **Interface** pull down first, pick **New** (Figure 1-3) and type in your user name (Figure 1-4). **It must match your computer login exactly and it is case sensitive.** Click the **OK** button.

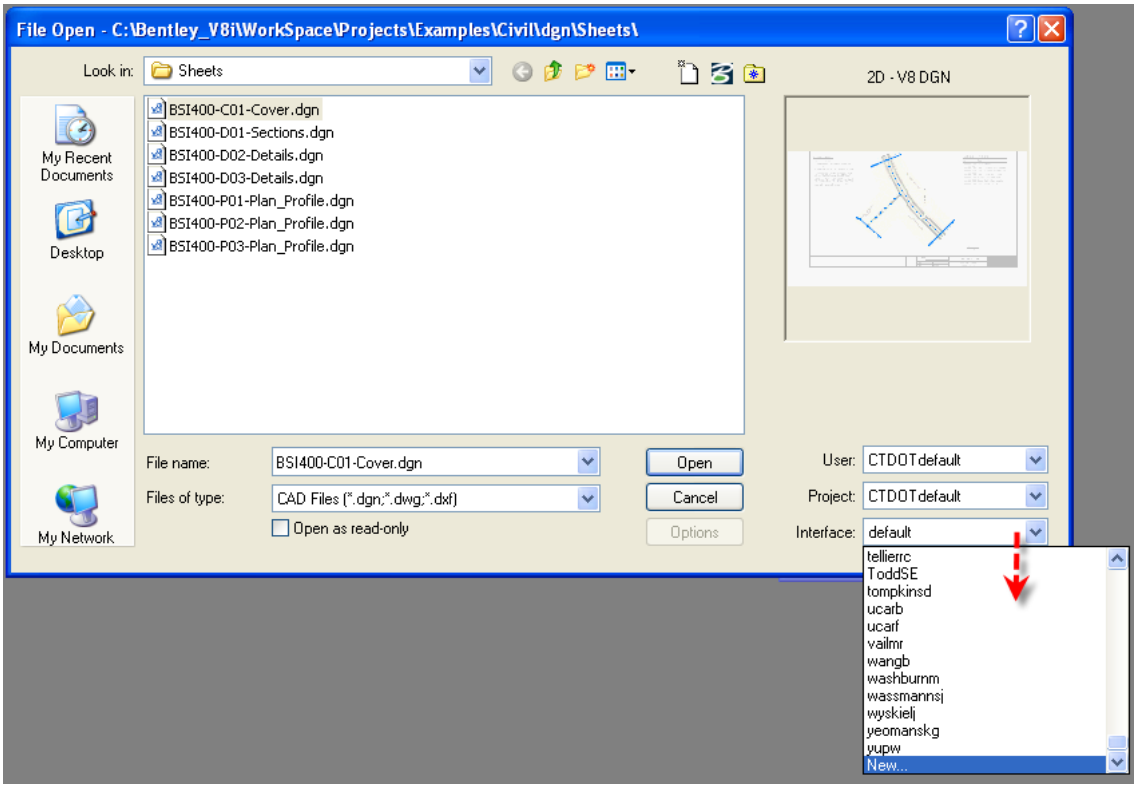


Figure 1-3 MicroStation Open File Dialog Box

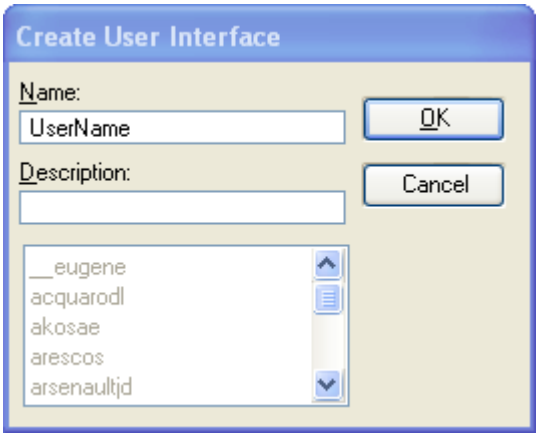


Figure 1-4 MicroStation Create User Interface Dialog Box

E. Select the **User** pull down second, pick **New** and type in your user name, again **it must match your Windows computer login exactly and it is case sensitive**. This will create your user configuration file (.ucf). Click the OK button.

F. In the Project drop down select one of your projects. Browse to **any** .dgn file, open the file and **then immediately exit out of MicroStation**. The next time you go into MicroStation you should see the CTDOT MicroStation Interface.

G. On the Accounting dialog box start up MicroStation again using the settings in Figure 1-2. In the bottom right corner of the MicroStation Manager, select the project number. Browse to the **Survey** folder and select the **"New File"** icon to create a new MicroStation file see Figure 1-5.

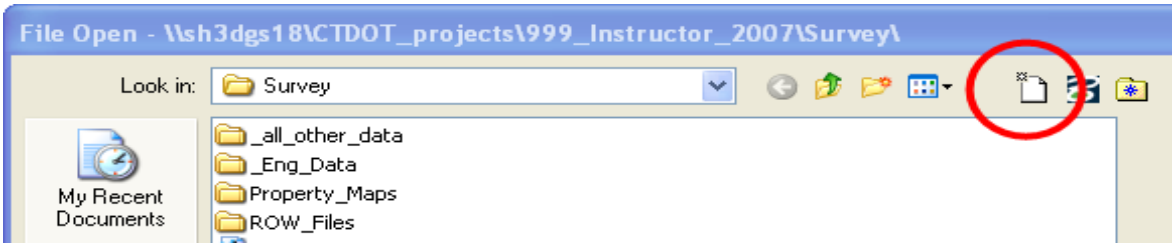


Figure 1-5 MicroStation Open File Dialog Box, Create New File

H. In the New dialog box select 'Browse' to select a seed file, go to (your Districts CTDOT_V8_Workspace drive), as example: **W:\CTDOT_Standards\Workspace\Standards\seed\SV_Design_Civil_3D_V8i.dgn** and select **Open** as in Figure 1-6. Back in the 'New' dialog box type in a file name (see Appendix 'C': File Naming Conventions; DDE Guide) and select the **Save** button.

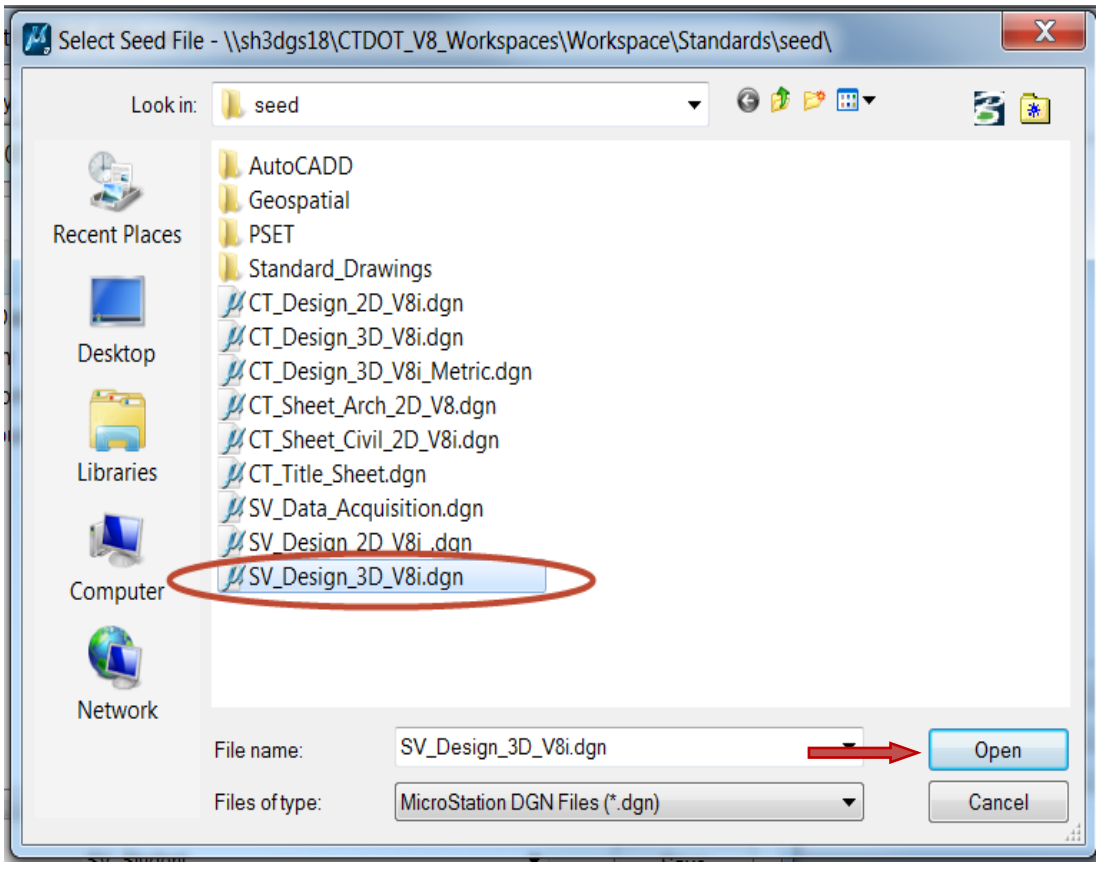


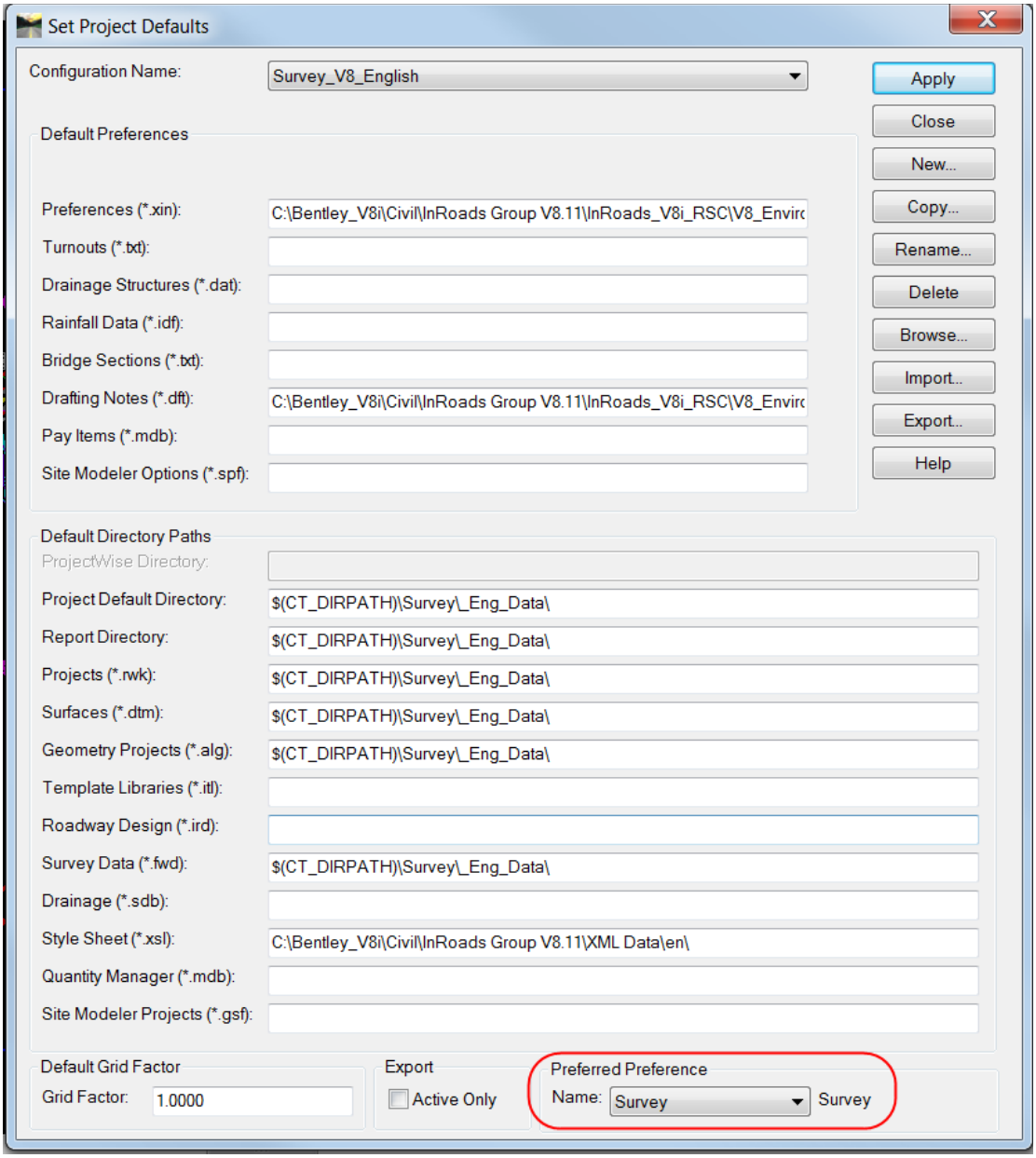
Figure 1-6 MicroStation Select Seed File Dialog Box

I. In the 'File Open' dialog box select the file that was just created and select the **Open** button. MicroStation will open.

J. On the MicroStation top pull down menu select **Applications > InRoads Group > Activate InRoads Suite** and InRoads will open.

Figure 1-7 Activate InRoads Suite & Open Project Defaults…

K. From the InRoads main menu bar select **File > Project Defaults**. The Set Project Defaults dialog box will appear. Click **Import…**



L. The Open dialog box will appear, browse to **C:\Bentley_V8i\Civil\InRoads Group V8.11\InRoads_V8i_RSC. Double click Survey_V8i.reg**.

M. For the Configuration Name select the required corresponding level structure, for class Survey_SE_English. Click **Apply** and **Close** on the Set Project Defaults dialog box.

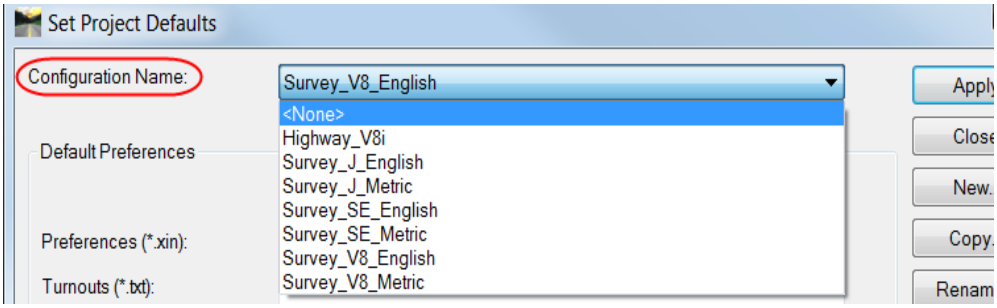


Figure 1-8 Configuration Names

N. Complete this step only if you are using the V8 level structure. From the InRoads Menu Bar "reselect" **File > Project Defaults**. At the bottom of the dialog box select **Survey** for the Preferred Preference (Figure 1-9). Click **Apply** and **Close**.

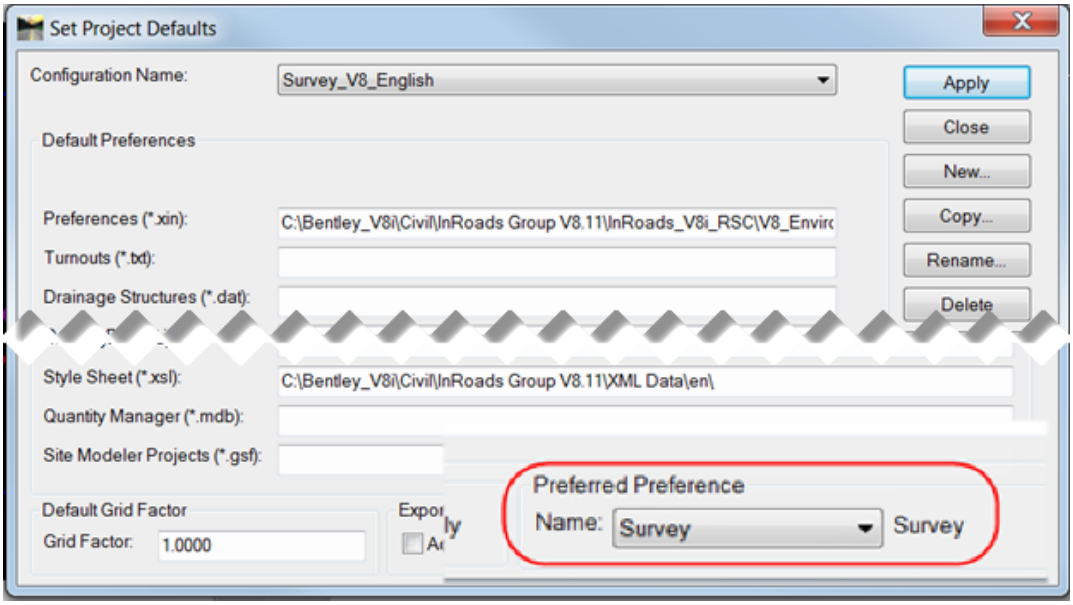


Figure 1-9 InRoads Set Project Defaults Dialog Box

O. On the MicroStation main menu select **Element > Cells.** On the Cell Library Dialog box select **File > Attach File… > Attach Cell Library.** Browse to **C:\Bentley_V8i\Civil\InRoads Group V8.11\InRoads_V8i_RSC\V8_Environment\cell** and select **SV_V8_LEVELS_40e.cel**, double-click or click Open. If you are working with SE or J levels pick the corresponding Environment and select the cell library in that folder. Close the cell library box.

P. From the InRoads Menu Bar select **File > Project Options….** At the bottom select **Preferences…** Make sure **Survey** is loaded.

Section 2 Survey Electronic Data Reduction Workflow

2.1 **Lab 2** Importing the Traverse

A. On the InRoads Interface right click next to Help and select **Locks**.

B. On the InRoads Interface right click next to Help and select **Customize**...

C. On the Customize dialog box (Figure 2-1) toggle on **Survey** and **View Survey Data** and click **Close**.

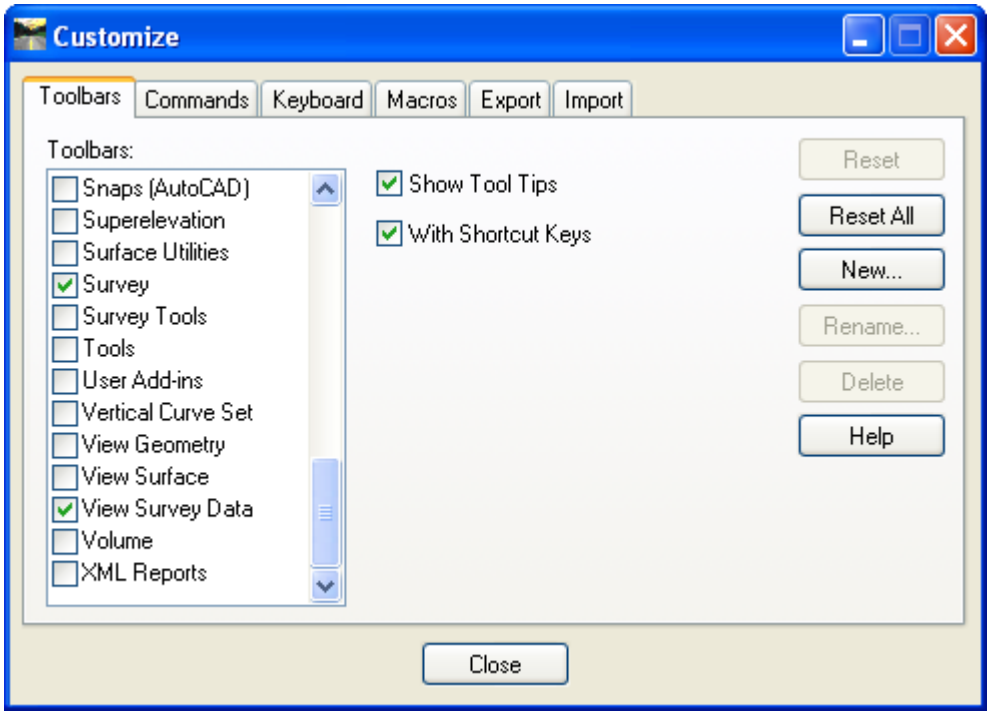


Figure 2-1 InRoads Customize Dialog Box

D. From the InRoads main menu bar select **File > Import > Survey Data**. The Import dialog box shown in Figure 2-2 will appear.

E. Browse to the project being used. (e.g.999_Student##_2007\Survey_Eng_Data\InRoads_Traverse\). Change Files of type to TDS (*>rw5), data point on Trav.rw5 and select **Import**. This will make the screen flash and data will be read. After the flash select **Close**.

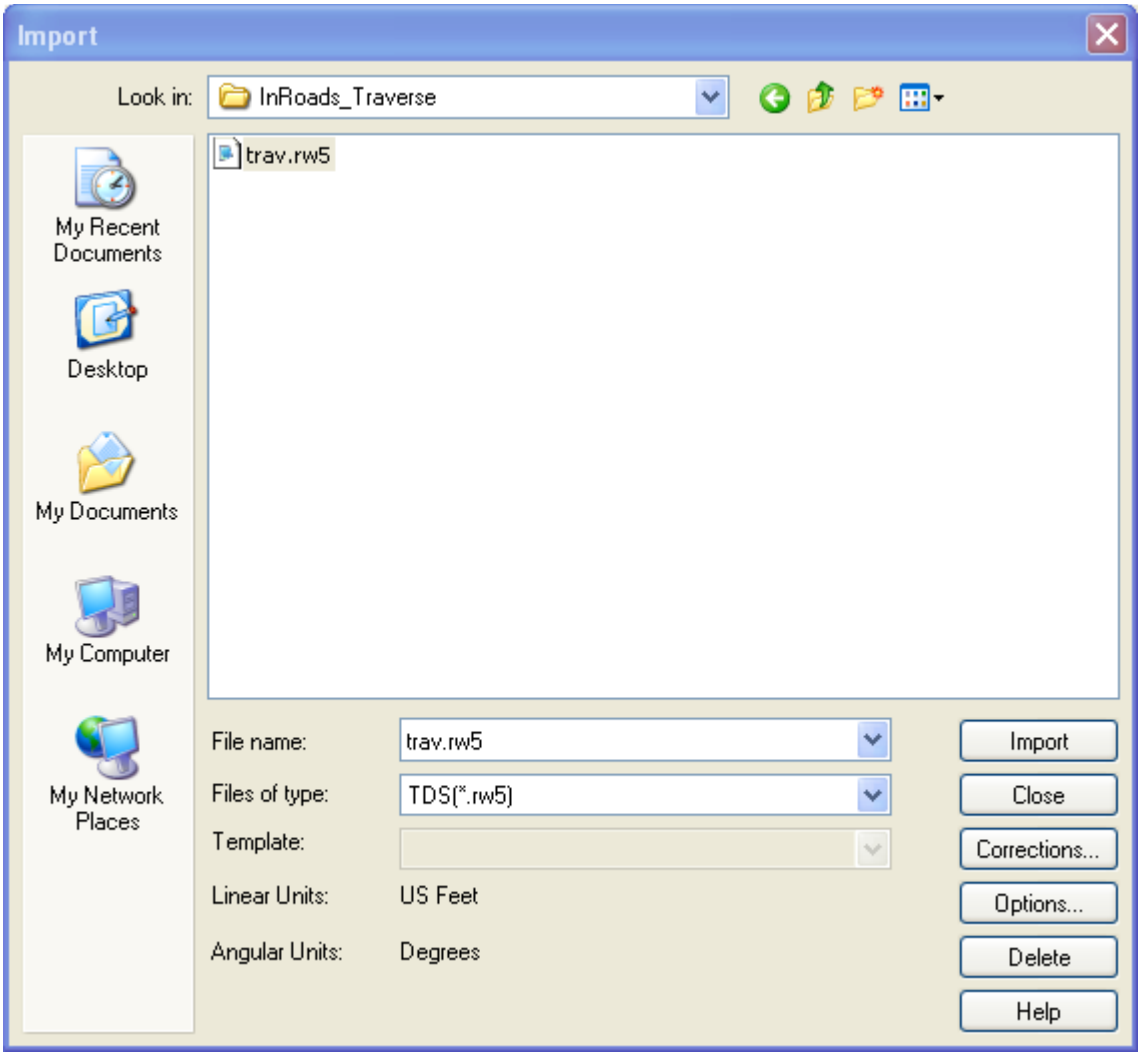


Figure 2-2 InRoads Import Dialog Box

F. Use the MicroStation **Fit View** command as shown in Figure 2-3. Notice the Traverse Points are displayed.

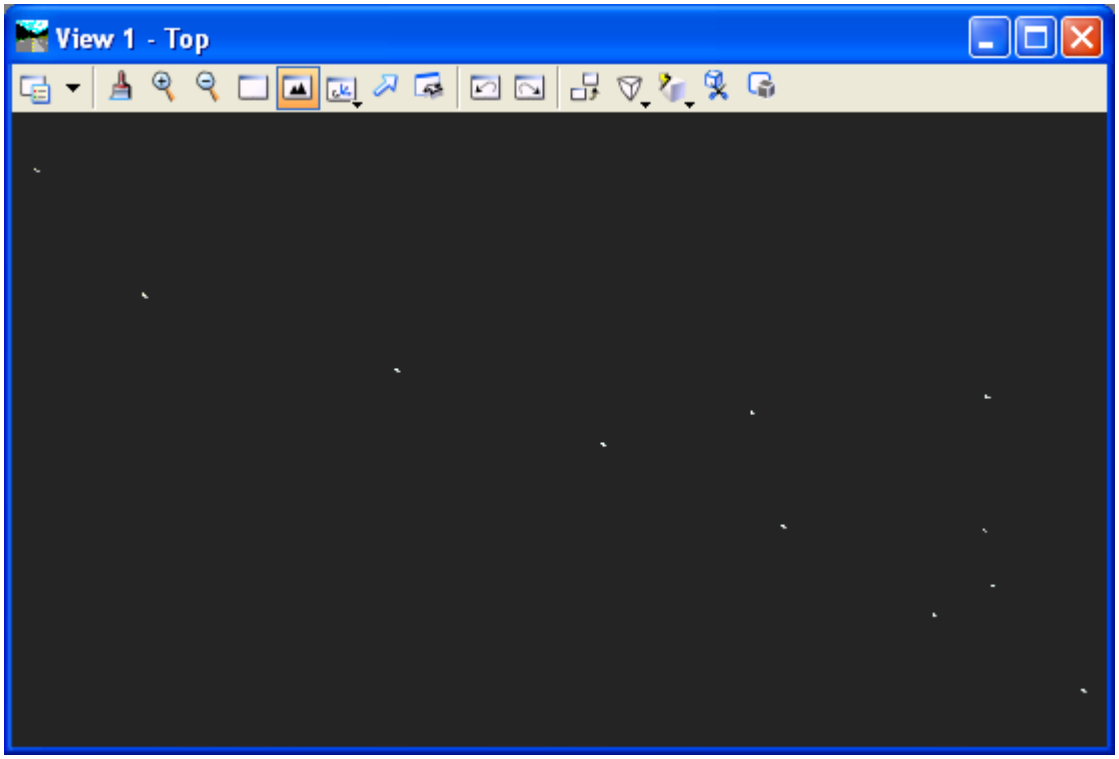


Figure 2-3 MicroStation View of Traverse Points

G. From the InRoads main menu bar select **Survey > Network Symbology**, check the boxes for Line Traverse and Line Single Route, and then click **Apply** and **Close**.

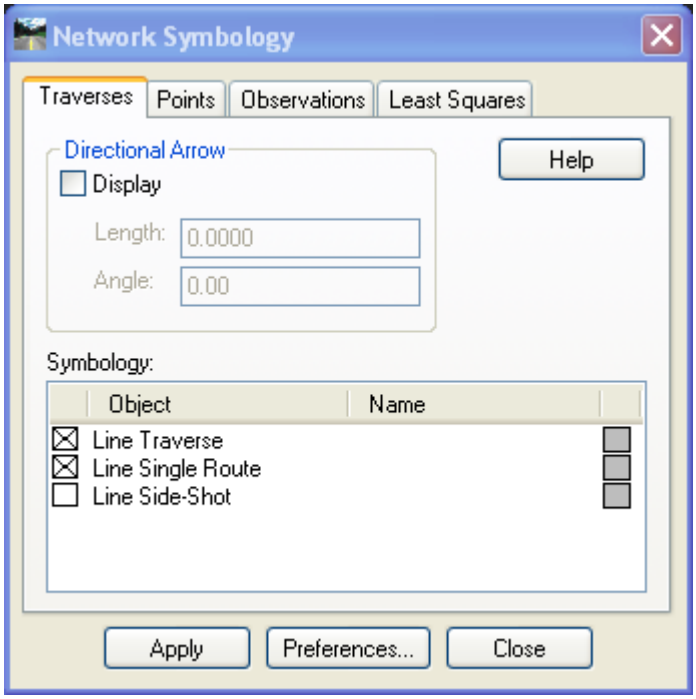


Figure 2-4 InRoads Network Symbology Dialog Box

H. From the InRoads main menu bar select **Survey > View Survey Data > Network**. This will display the Traverse lines between the points as shown in Figure 2-5

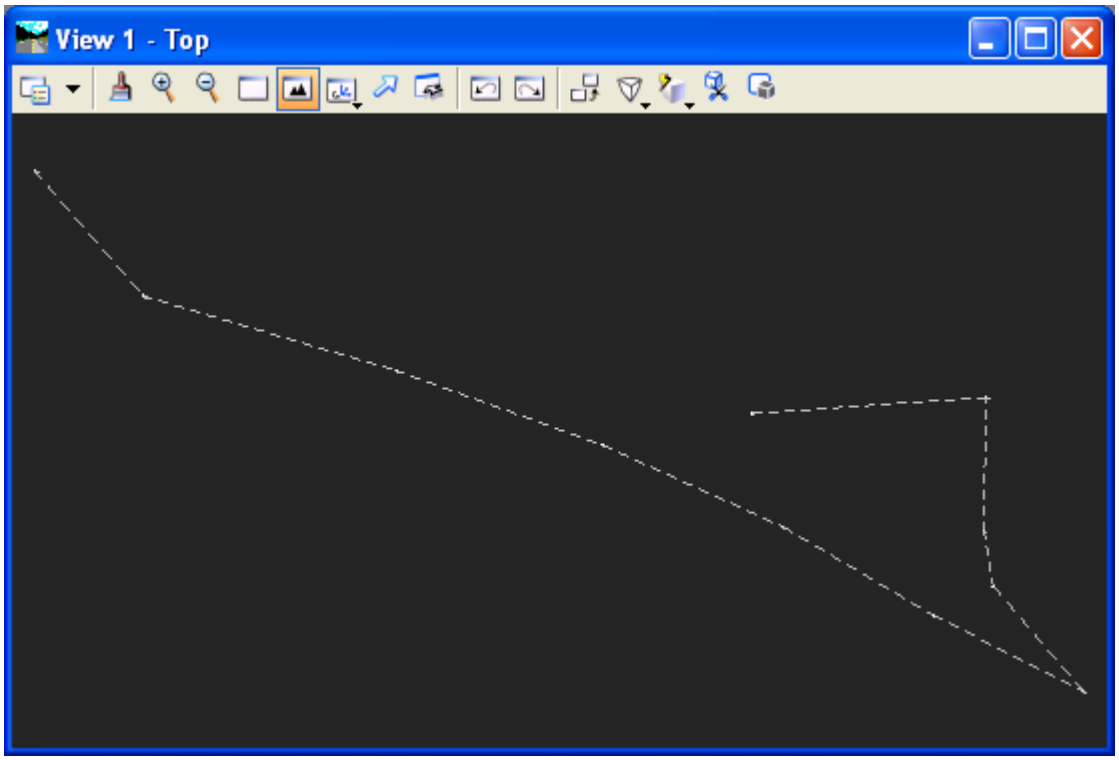


Figure 2-5 MicroStation View of Traverse Lines

2.2 Traverse Adjustments

The Route command initiates a route for adjustments (route begins at the selected station) activates the Build Single Route command, which allows you to choose a single route through your survey data. After you choose the route, the Survey > Network command is automatically activated, and the selected route is loaded into the Network dialog box, allowing you to perform adjustments on the selected route.

Choosing the Route command not only activates the Build Single Route dialog box but also turns on the View Survey Data > Network command, which displays network graphics as defined on the Network Symbology dialog box (under Survey > Network Symbology).

If the Report lock is on when you activate the Route command, InRoads Survey generates a report containing the following information:

- The number of control points (fixed points) in the route.
- Whether the route has horizontal position control, horizontal angle control, or vertical position control.
- Whether the route is closed or open.
- The unadjusted area and length of the route.

Highlight Stations (command on popup menu) provides an indication in graphics of the station that is selected in the Stations list. The selected station is indicated by a magenta square containing an X.

A Highlight Observations command is available on the popup menu from the Observations list. However, you can run only one of these commands at once so that there is no confusion about whether a highlighted point is a station or an observation.

Edit Style (command on popup menu) displays the Edit style dialog box, which lets you edit the survey style associated with the station that is selected in the Stations list. Edit Style is available only when a single station is selected in the Stations list.

If a point is dual coded, the popup menu allows you to choose the particular style you want to edit.

2.3 **Lab 3** Adjusting the Traverse using Least Squares

A. From the InRoads main menu bar select **Survey > Fieldbook Data**

B. In the Stations portion of the Fieldbook Data dialog box (Figure 2-6) right click on the first station 49. A menu will appear then slide down and select **Route....**

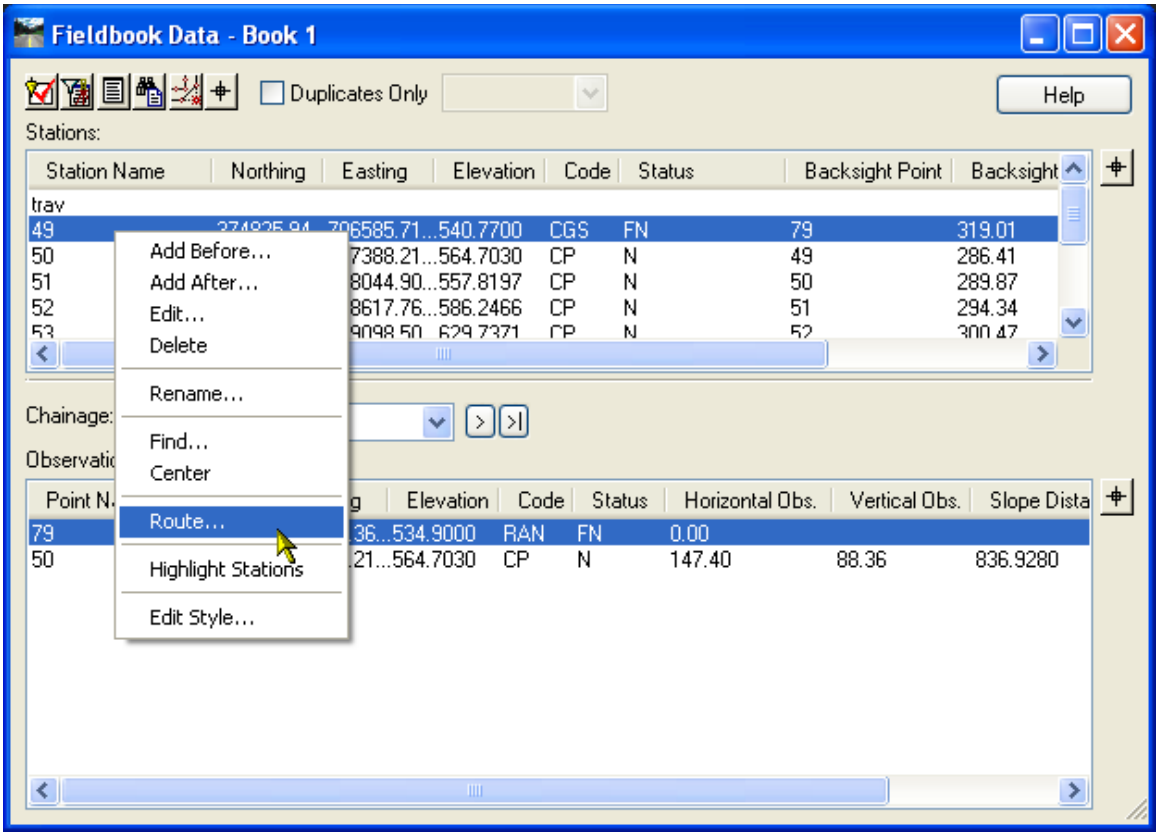


Figure 2-6 InRoads Fieldbook Dialog Box

C. The **Build Single Route** box, Figure 2-7, will appear and show you the data for the traverse. Notice that the fixed points are symbolized with a triangle and the computed points are circles. Click **OK**.

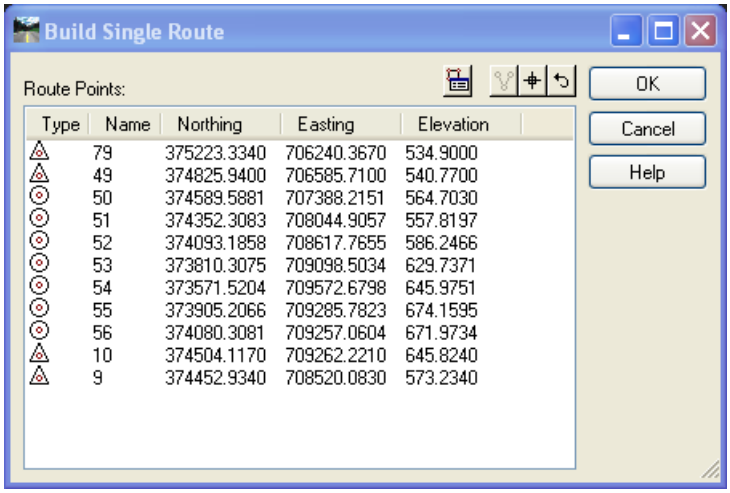


Figure 2-7 InRoads Build Single Route Dialog Box

D. This brings the Network data into the **Network - Single Route** dialog box (Figure 2-8). Data point on the Least Squares button.

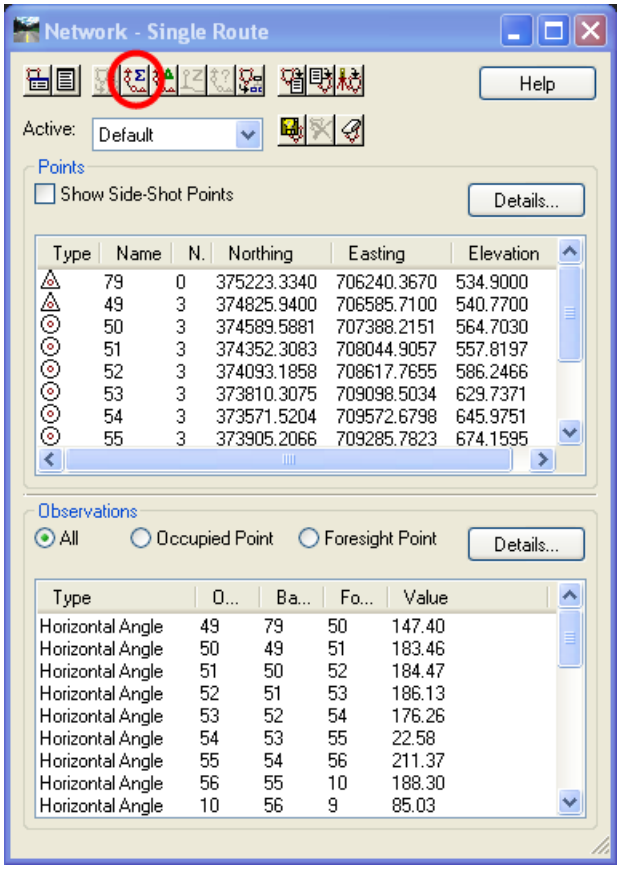


Figure 2-8 InRoads Network - Single Route Dialog Box

E. Match the dialog with the one shown in Figure 2-9 and select **Adjust**.

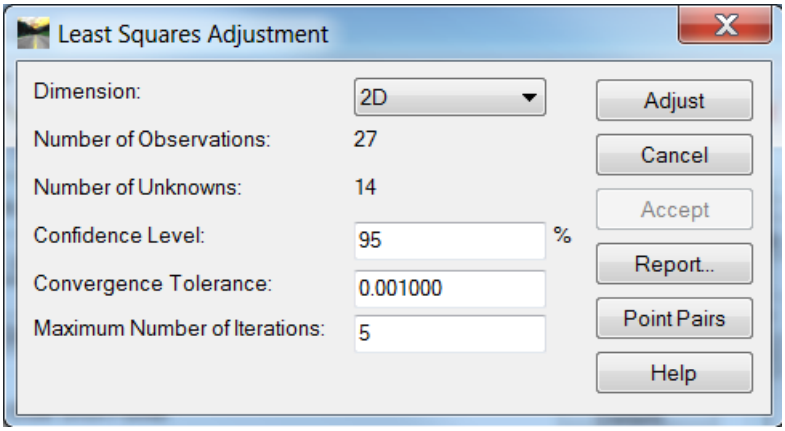


Figure 2-9 InRoads Least Squares Adjustment Dialog Box

F. To view a report click on **Report….** In the report browser select the LeastSquares.xsl report. Check the adjustments and see if everything is adjusted correctly.

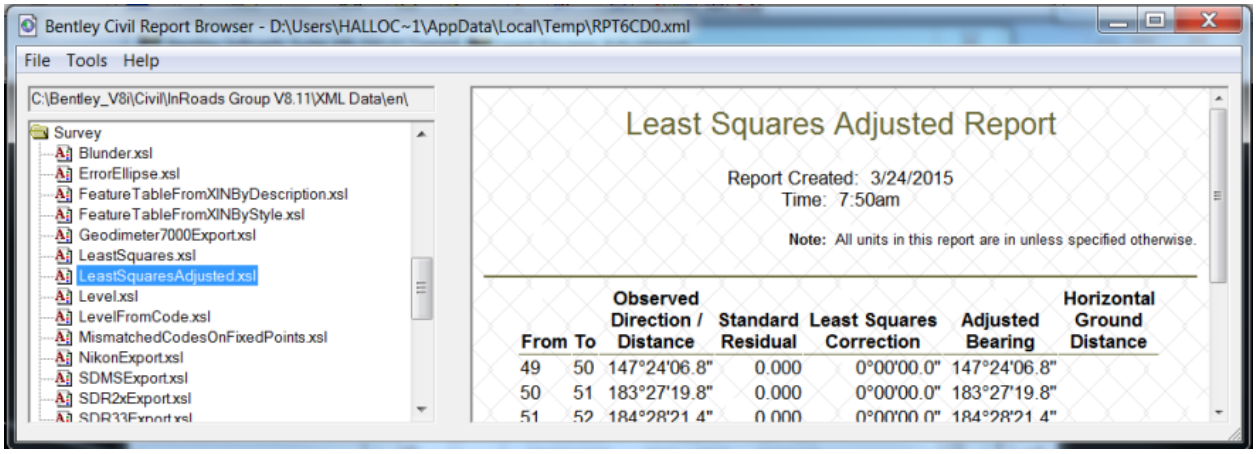


Figure 2-10 Bentley InRoads Report Browser

G. After review close the report browser and the Least Squares Adjustment Dialog will still be available.

H. Select the **Accept** on the Least Squares Adjustment Dialog Box; this will bring the adjusted data forward. Notice the xyz values change based on the adjustment.

Note: Even after we accept the Network we could still return to the adjustment commands and start again. InRoads will retain the original data information so that the Network can be recomputed anytime.

I. Now we still need to bring the adjusted data forward one more time. Even though we have accepted the data for the adjustment we still need to bring it forward to the fieldbook. Select the Network to Fieldbook Icon on the Network – Single Route Dialog box. This brings the adjusted data into the fieldbook. The traverse points are now fixed.

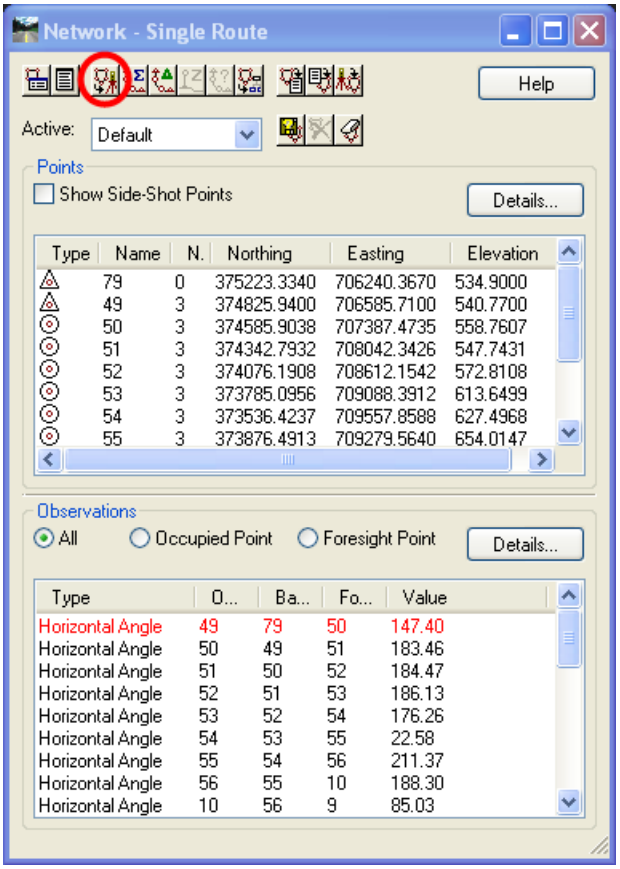


Figure 2-11 InRoads Adjusted Data on the Network - Single Route Dialog Box

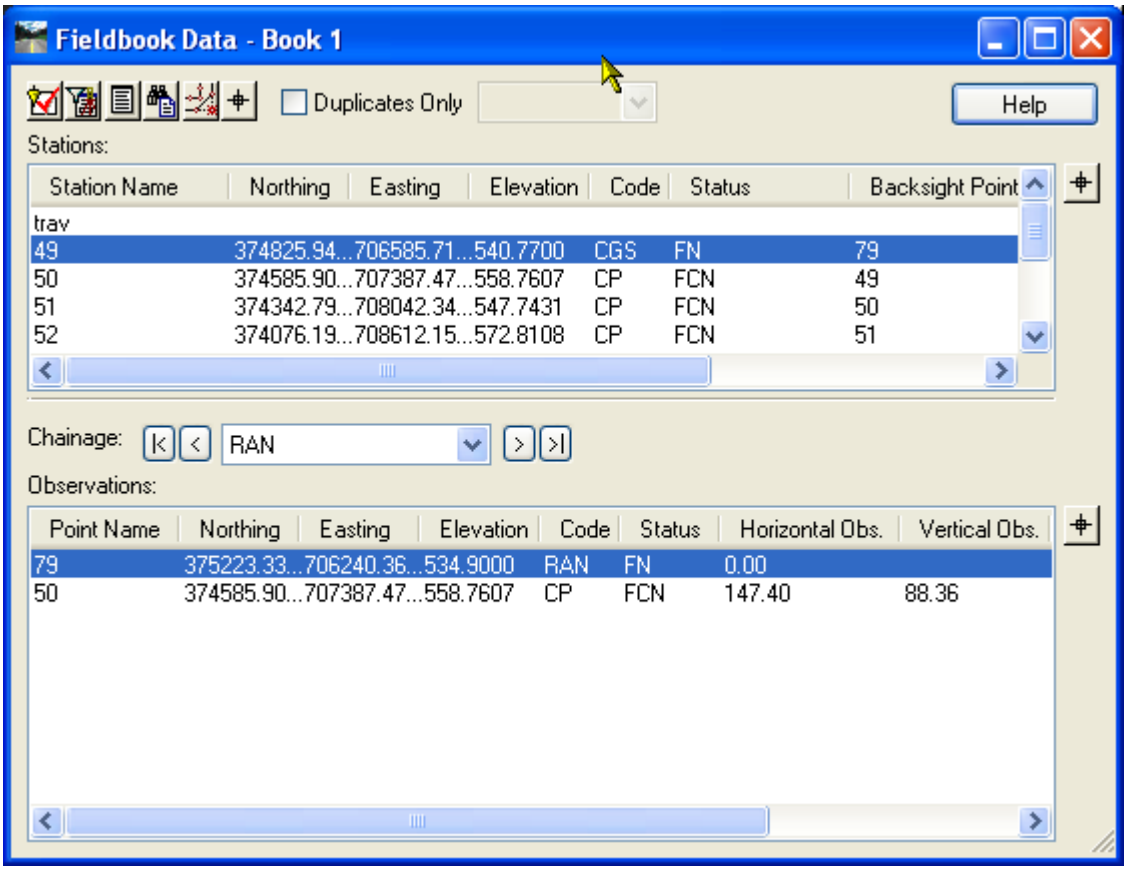


Figure 2-12 Adjusted Data in the InRoads Fieldbook

Status indicates the relevant status code(s) for each station.

The status codes are:

N - The point has notes.

E - The point has been edited.

F - The point is a keyed-in (fixed) coordinate.

A - The point has attributes.

V - At least one of the attributes has a value.

I - An inserted point

C - An adjusted point.

2.4 **Lab 4** Processing the Survey Data

A. In MicroStation first make sure you have the correct cell library loaded from your C: drive and have the True Scale on by selecting **Location Survey > True Scale Cells** from the bar menu at the top. Having the correct cell library open will dramatically reduce the amount of time it takes for the field data to load and appear on the screen.

B. On the InRoads Menu bar click on **Tools > Survey Options…** on the Import dialog box (Figure 2-14). The Survey Options dialog box will appear (Figure 2-13), in the File Options portion toggle on **Resolve Code Errors** and **Log Code Errors. Click OK.**

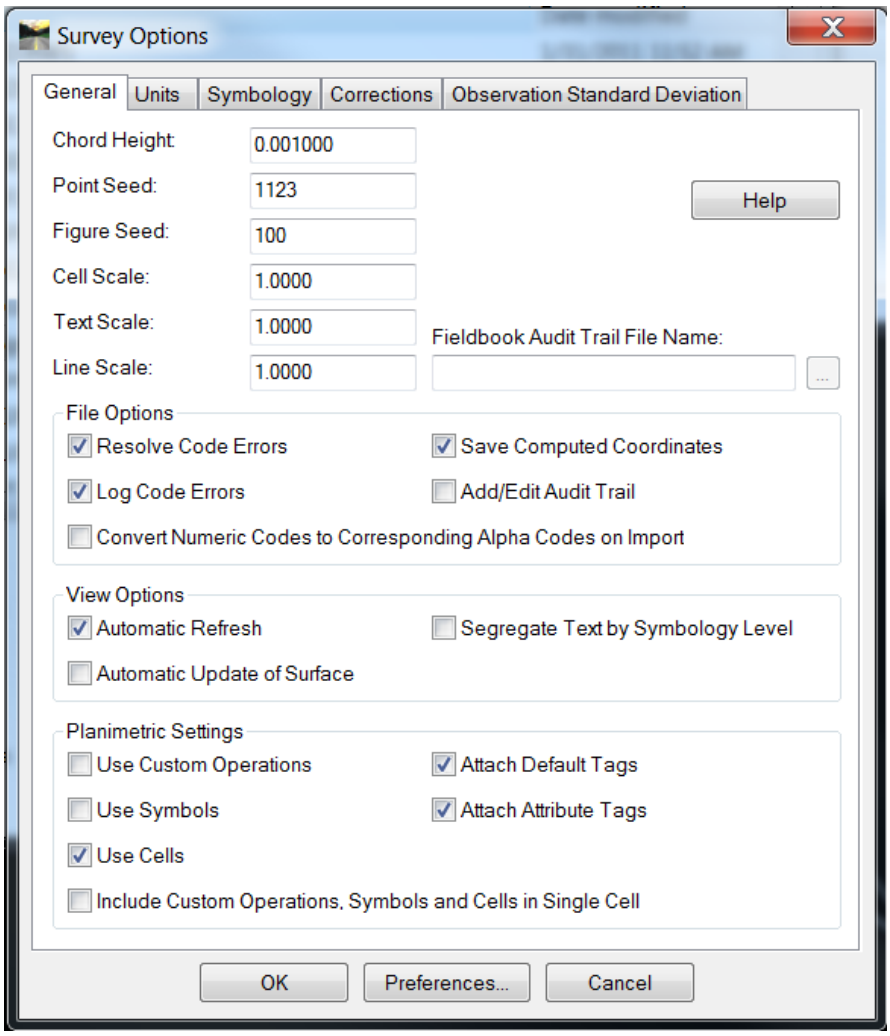


Figure 2-13 InRoads Survey Options Dialog Box

C. From the InRoads main menu bar select **File > Import > Survey Data**. The Import dialog box shown in Figure 2-14 will appear.

D. Browse to the project being used. **(e.g.999_Student##_2007\Survey_Eng_Data\InRoads_Field\).** Change Files of Type to **Group of files (*.*).** You can select a text file with all of the RWS files listed and click **Import**. If you want to load files one at a time then change Files of Type to **TDS(*.rw5)** and double click each file or data point on each file and select **Import**.

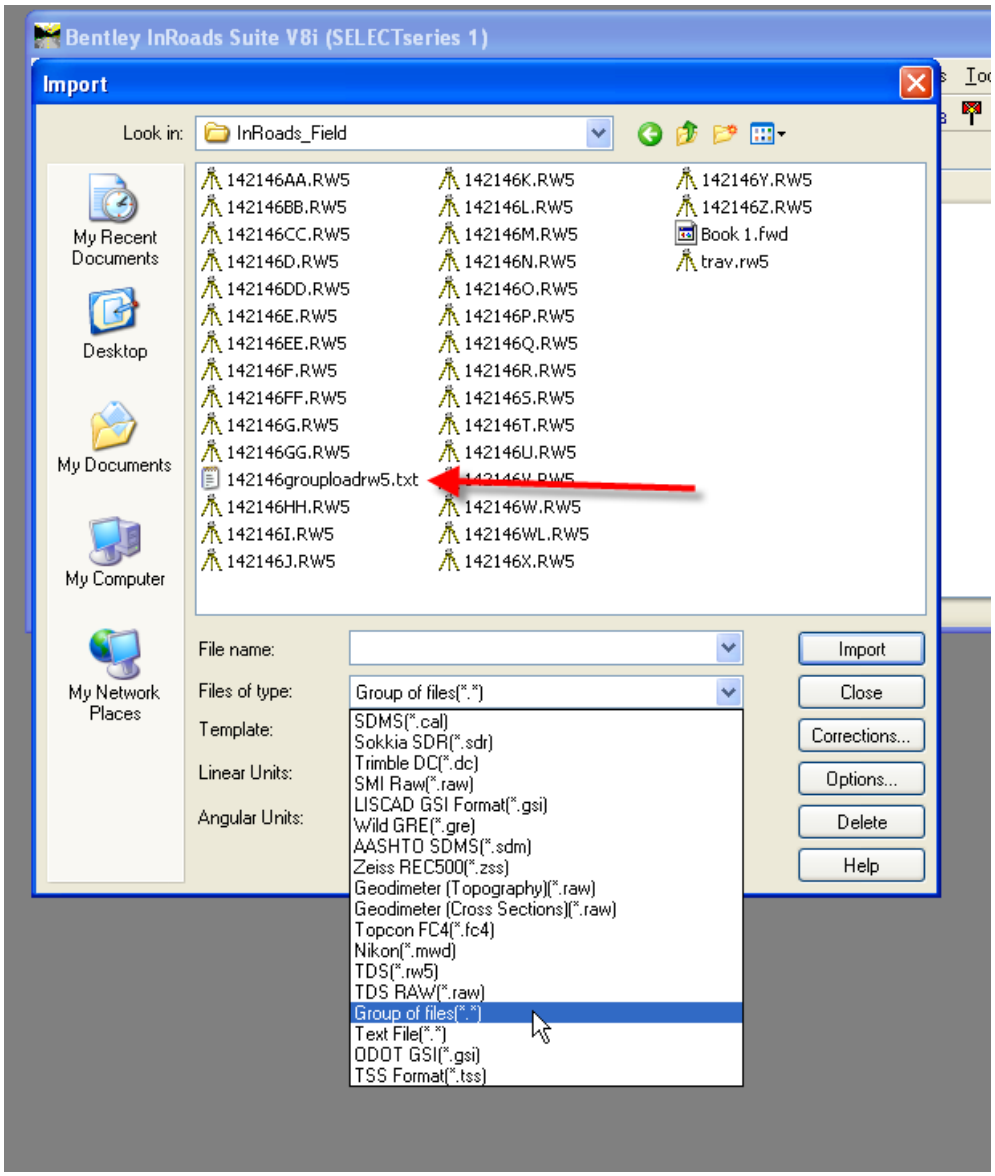


Figure 2-14 InRoads Import Dialog Box

E. Click on **Close** on the Import dialog box (Figure 2-14). The Resolve Code Error dialog box will appear (Figure 2-15). Select **Ignore All**. This will process the data and allow the user to fix the code errors later. After a few seconds the view will appear as shown in Figure 2-16.

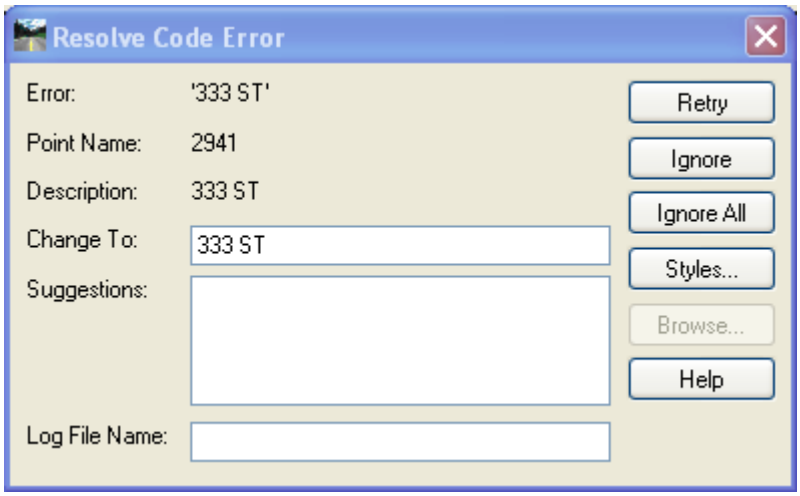


Figure 2-15 InRoads Resolve Code Errors Dialog Box

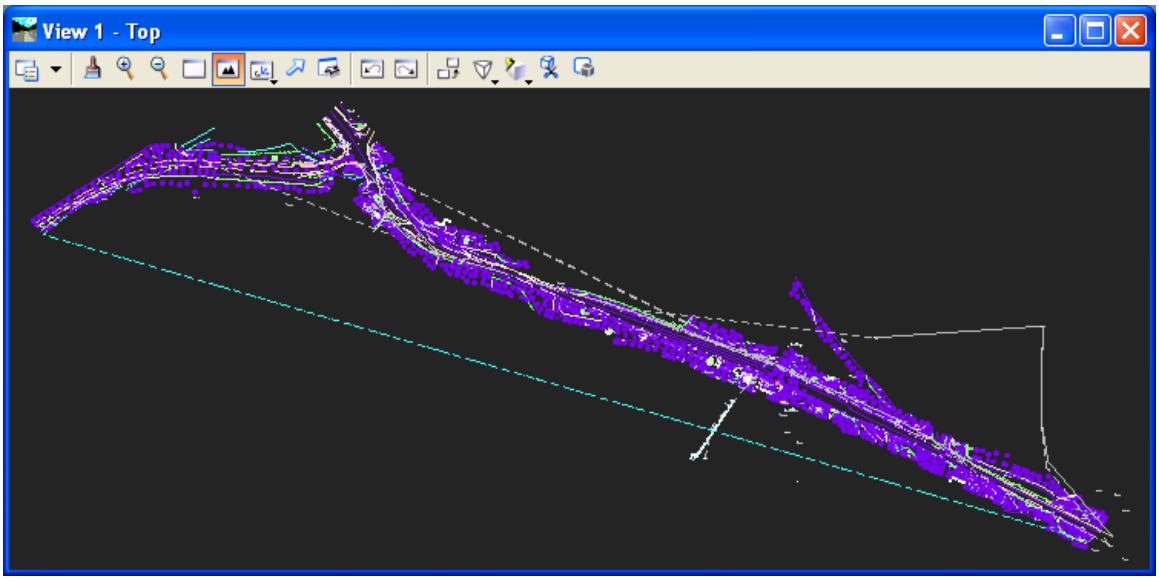


Figure 2-16 MicroStation View of InRoads Fieldbook Data

2.5 Point Codes

Each station or observation in the field book is assigned a point code. The point code consists of two parts, an alpha/numeric code and a control code. By assigning an alpha/numeric code to a particular station or observation, that point will be associated to one or more styles listed in the Style Manager. By assigning a control code to a station or observation the construction of the planimetric graphics (arcs and line segments) related to that point are determined. The process of combining alpha/numeric codes with control codes is called point coding. Surveyors typically record point codes in the field. In InRoads Survey, the point codes are activated from the Field book Data dialog box by right-clicking in the Stations list or the Observations list. The alpha/numeric codes and control codes embedded in the field book data, act in concert to define the construction and symbology of planimetric figures.

Control codes describe geometric relationships among stations/observations in the field book. There are 15 control codes in InRoads Survey. Control Codes entered incorrectly in the field can to be edited and fixed in the Field book.

Feature	Description	Control Code
Start	Start a line	ST
Close	Close an object	CL
Point of Curvature	Start a curve	PC
Point of Tangency	End a curve	PT
Exclude from Triangulation	No DTM information	DNC
Random	Random point type in surfaces generated by Survey Data to Survey	RND
Rectangle	Form a rectangle based on two shot points and a taped distance	RECT
Close Rectangle	Close a rectangle based on three shot points	CLSR
Nontangent Curve	Use in conjunction with the PC and PT to specify a nontangent curve	NT
Join Point	Join to a specified point number	JPT
Join Nearest Code	Join to the nearest previously shot specified code	JNC
Distance	Form a closed or open shape based on two shot points and taped distances	DIST
Template	Set up a template to run multiple linear features	TMPL
Cross Section Code	Cross section code	XS

Add to Adjustment Set	Defines a foresight unknown point to be included with adjustments data	ADJ
Extend Arc	Closes an arc with another arc based on three field points, creating a circle	EXTARC

Planimetric figures in InRoads Survey are graphical representations of objects with linear characteristics (for example, the edge of pavement, the centerline of a roadway, a guardrail). The style used for existing bituminous concrete lip curbing named CRBBCL as shown in Figure 2-17 has been created with an Alpha Code BC and a Numeric Code 104. To begin a planimetric figure on a particular station or observation a code plus the designated start control code: <Feature Code> + <Start Control Code> must be specified. To start Bituminous Concrete Lip Curbing the Alpha Code BC ST or Numeric Code 104 ST is used. Any subsequent station or observation containing the code BC or 104 is included in the planimetric figure until another ST code is encountered. The following point codes might model a small portion off a simple roadway. Notice in Figure 2-18 that two BCLC planimetric figures are being constructed concurrently. Manholes are not typically part of a planimetric figure because they are usually single shot points that have cells or attribution representation, so the Storm Manhole point has no start code.

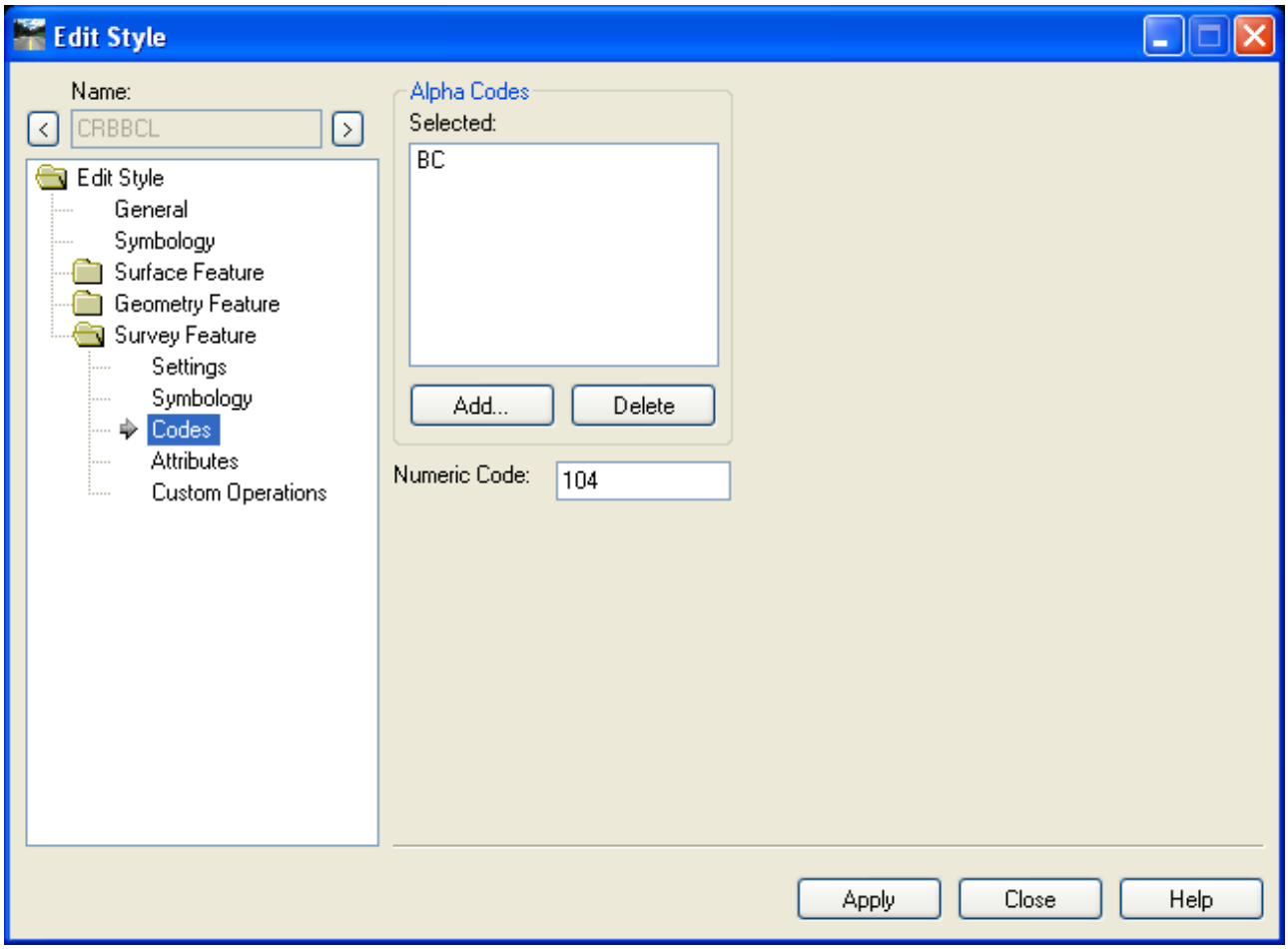


Figure 2-17 Edit Style Dialog Box

Notice in Figure 2-18 that two BCLC planimetric figures are being constructed. Catch basins are not typically part of a planimetric figure because they are usually single shot points that have cells or attribution representation, so this point has no start code.

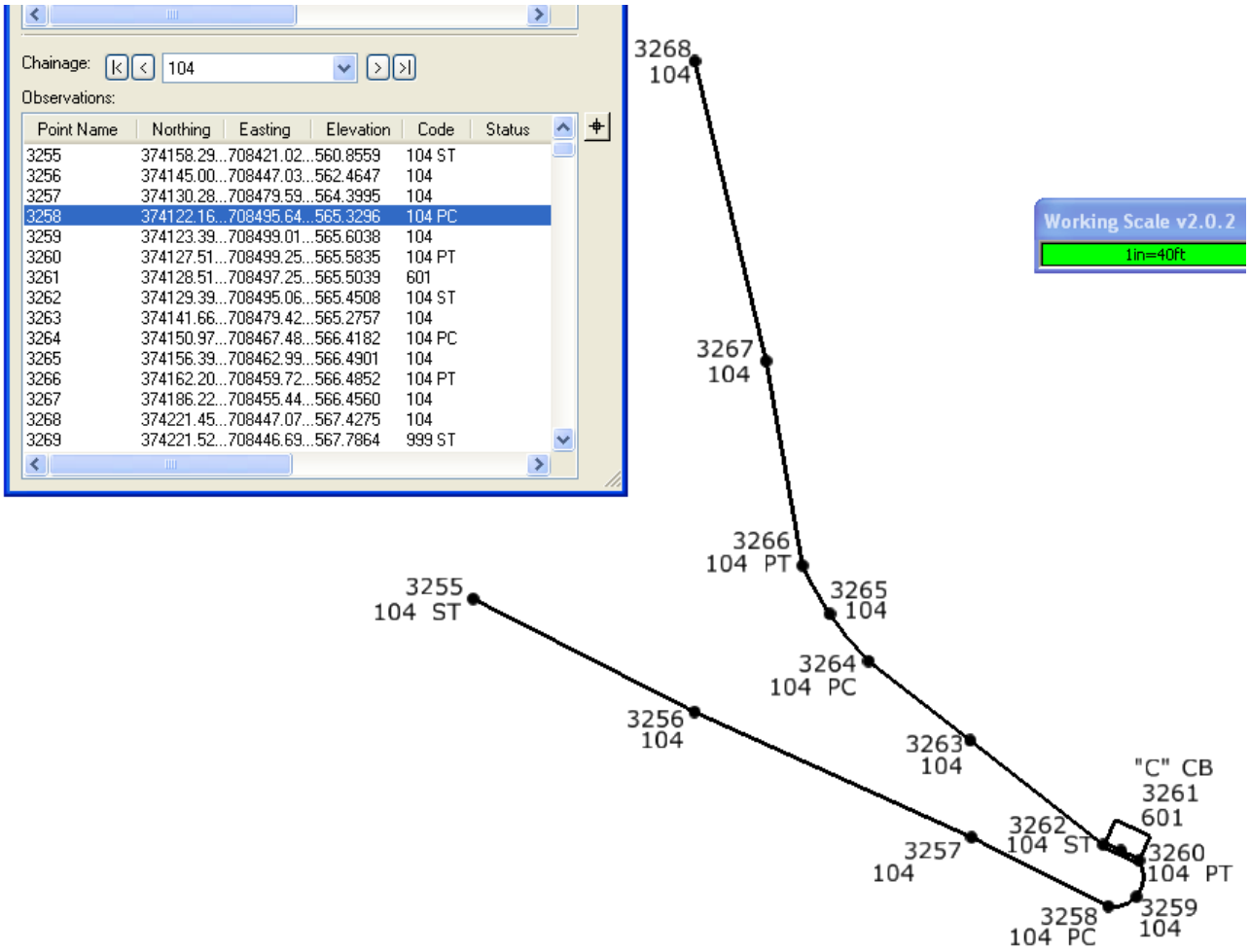


Figure 2-18 Planimetric Figure Using Numeric Codes

2.6 Style Manager and Alpha/Numeric codes

The XIN file allows the user to create a feature usable by all areas of the product. The XIN is a combination of the InRoads 8.5 Feature Style Manager, Geometry Style Manager and Feature Table into a single Style Manager.

Survey point data is typically composed of two key aspects:

- Point location (Northing, Easting and Elevation)
- Physical characteristics of the object being recorded (Style Manager).

Each Survey Style has been predefined with CTDOT standard properties including:

- Named Symbology (color, line weight, line style, cell, text size and font)
- Codes - Alpha Codes and a Numeric Code.
- Custom Operations

A style is associated with a particular station or observation in the fieldbook only when the appropriate alpha/numeric code is used and the CTDOT XIN is loaded. A point entered in the field with the incorrect code will not have the correct style or have no style associated to it when it is imported into the InRoads Fieldbook.

The object's physical characteristics are modeled in the style. In other words, styles define symbology (and more) for representing various real-world objects.

Example – Suppose a utility pole was shot at a certain point. The surveyor wishes to place a cell to represent the utility pole in the CAD file at the point location. A style has been created that controls which cell is placed at the point, the cell scale, rotation of the cell, level of the cell, and so on.

Example – Suppose a series of points representing an edge of pavement has been collected. A style has been created that controls the color and line style of the graphics representing the edge of pavement.

The previous examples contain what are considered generic properties (cell, line style, level, color, and so on). The surveyor often records more specific physical characteristics, and the style can model these specific characteristics using attributes and custom operations, as in the following example.

Example – Suppose a manhole was shot at a certain point. In addition to a cell at the point, the surveyor records an ID number of the manhole, as well as incoming and outgoing invert elevation. A style has been made that controls the cell, and also recognizes three specific attributes (manhole ID number, invert in, and invert out). Then using custom operations in InRoads Survey (discussed in a later section), data related to the three attributes can be displayed for each manhole shot.

Associating stations/observations with styles is part of the process called point coding which is discussed in Section 2

2.7 Fieldbook Data

This command lets you manage your field data. You can add, edit, delete, and find stations and observations with the resizable Fieldbook Data dialog box. The Stations list contains occupied stations. Selecting a station in the Stations list affects the Observations list. The Observations list contains observations that were shot from the station points.

Stations List

Station Name indicates the name of the occupied station. Stations are listed in the order in which they were gathered in the field.

Northing indicates the northing coordinate for each station.

Easting indicates the easting coordinate for each station.

Elevation indicates the elevation for each station.

Code indicates the control code associated with each station.

Status indicates the relevant status code(s) for each station. The status codes are:

N The point has notes.

E The point has been edited.

F The point is a keyed-in (fixed) coordinate.

A The point has attributes.

V At least one of the attributes has a value.

I An inserted point.

C An adjusted point.

Backsight Point indicates the name of the backsight point for the selected station.

Backsight Direction indicates the backsight direction from either a north or south azimuth

Instrument Height indicates the instrument height for each station.

Notes indicates notes for the selected station.

Attributes indicates attributes for the selected station.

Observations List

Point Name indicates the name of the observation. When you open or import a survey data file, if a fixed point is encountered that has the same name but different coordinates from a previously encountered fixed point, the name of the second occurrence of the point is assigned a suffix of _1. The suffix for each subsequent occurrence is incremented (_2, _3, and so on).

Northing indicates the northing coordinate for each point.

Easting indicates the easting coordinate for each point.

Elevation indicates the elevation for each point.

Code indicates the feature code(s) associated with each observation.

Status indicates the relevant status code(s) for each observation. The status codes are:

N The point has notes.

E The point has been edited.

F The point is a keyed-in (fixed) coordinate.

A The point has attributes.

V At least one of the attributes has a value.

I An inserted point.

C An adjusted point.

Horizontal Observation indicates the horizontal angle for each observed point.

Vertical Observation indicates the vertical angle for each observed point.

Slope Distance indicates the slope distance to each observed point.

Target Height indicates the height of the prism above the observed point.

Notes indicates notes for the selected observation.

Attributes indicates attributes for the selected observation.

2.8 **Lab 5** Chainage

The Observations area of the fieldbook dialog box provides a convenient way of locating the observations that constitute a particular planimetric figure. The Chainage parameter lists the feature codes associated with the observation that is selected in the Observations list. If an observation is dual-coded, the Chainage parameter lists each of the feature codes for the observation. (If multiple observations are selected, the Chainage parameter lists the feature codes from only the first of the selected observations.).

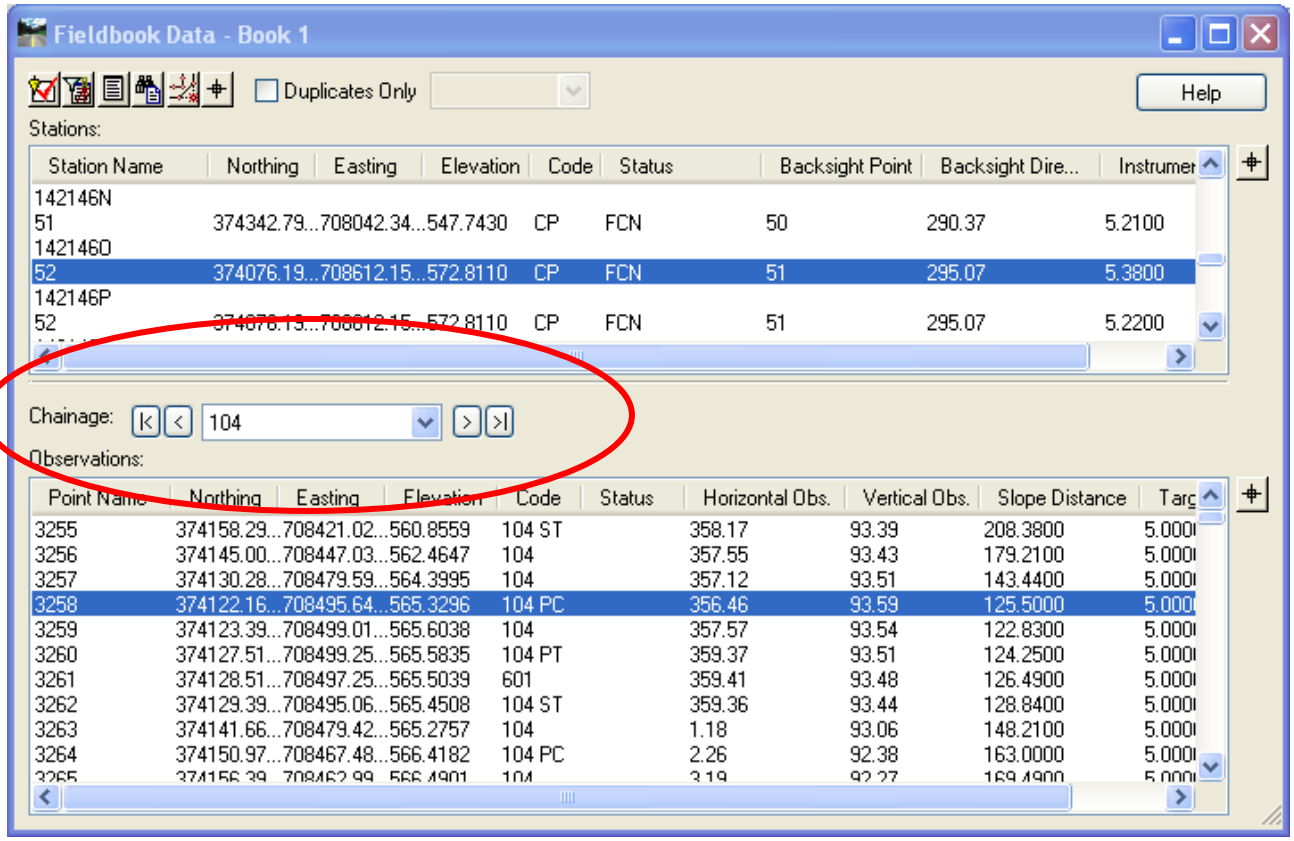


Figure 2-19 Chainage

To step through the observations related to a particular planimetric figure:

- Select an observation that is part of the planimetric figure. You can use the Select Figure button at the top of the dialog box or the Select Observation button to the right of the Observations list.
- Make sure that the feature code that you are interested in is set in the Chainage parameter.
- Use the arrow buttons to move to the first (|<), previous (<), next(>), and last (>|) observations in the figure.
- You may want to select the Highlight Observations option, available by right-clicking on an observation in the Observations list. When the Highlight Observations option is selected, as you step through each point in a figure the current point is indicated in graphics by a magenta square containing an X.
- As you move from point to point using Chainage, if a point does not fall within the graphics view, the command automatically centers the point.
- You can use Chainage along with the Edit Observation dialog box to easily edit each of the points involved in a planimetric figure, even if the points are scattered throughout the Observations list.

For example, after using the Edit Observation dialog box to edit the first point in your planimetric, you could use the arrow buttons to move to the next observation in the figure. The Edit Observation dialog box is instantly updated with the information for the next point in the figure. Repeating these steps (edit the point, move to the next one), you can quickly edit each of the points in the figure.

Section 3 Fieldbook Editing

3.1 **Lab 6** Fixing Code Errors

A. The first Code error we will fix is the code error that was reported as we processed the data. From the InRoads main menu bar select **Survey > Find Point in View** command

B. When the Find Point in View dialog appears enter the point number: **2941** (Pt # observed when the code errors were reported.) radius: **2.000** (feet) and click **Apply**. This will center the point to the screen and everything that is within a 2 foot radius.

C. Turn on the point numbers, from the InRoads main menu bar select **Survey > View Survey Data > Names** or select the View Names tool as shown on Figure 3-1.

Figure 3-1 InRoadsView Survey Data Toolbar

Notice there is no symbology for point 2941 (Figure 3-2) this is because the code was entered incorrectly in the field.

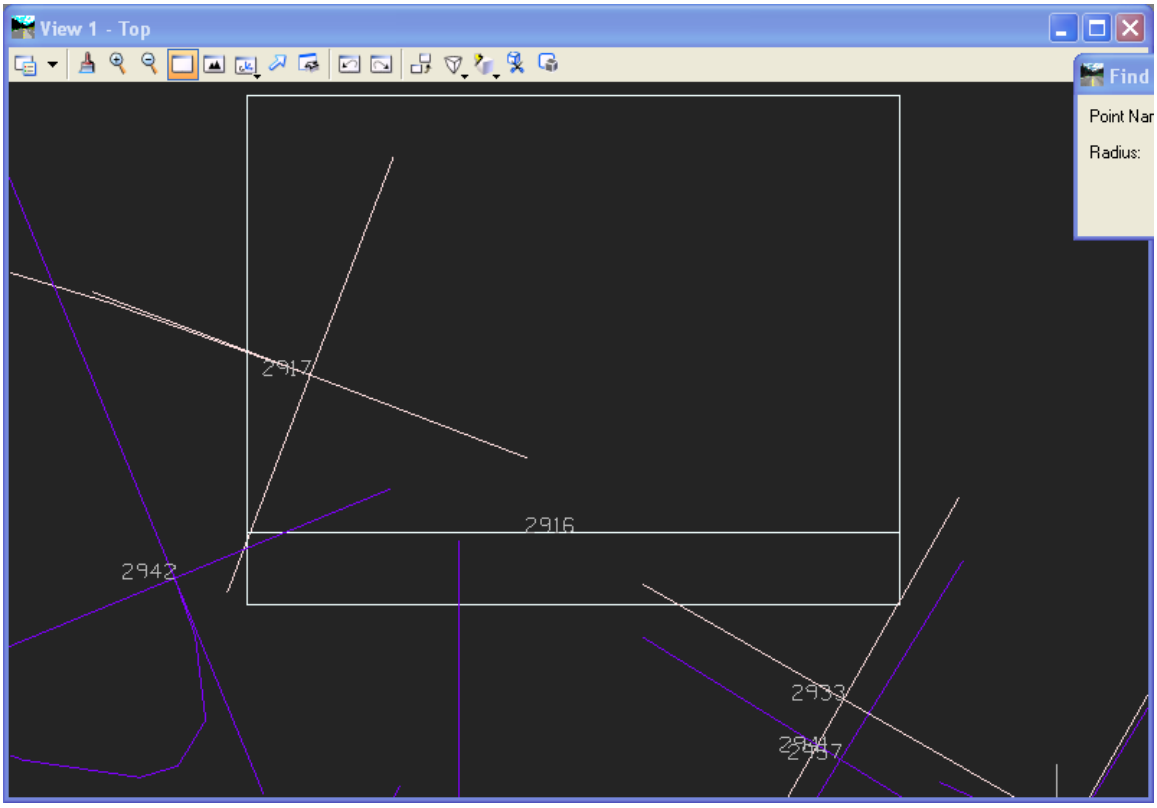


Figure 3-2 MicroStation View of Point 2941

D. From the InRoads main menu bar select **Survey > Fieldbook Data** or select the Fieldbook Data tool as shown on Figure 3-3.

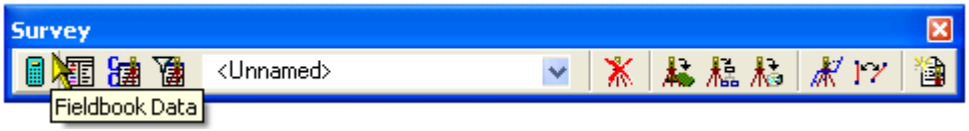


Figure 3-3 InRoads Survey Toolbox

E. After the Fieldbook Data dialog box appears select the selector button from the Observations area this will cause the dialog to minimize and InRoads will prompt you to identify a point 2941 in the MicroStation view. The minimized dialog might be covering the prompt just move it out of the way.

F. The Fieldbook Data dialog will display again with the point 2941 selected. Notice that the code is red. This indicates that there is a code error and the system does not recognize the code that was used in the field. Right Click on the hi-lighted line in the Observations area (as shown in Figure 3-4) and select **Edit**.

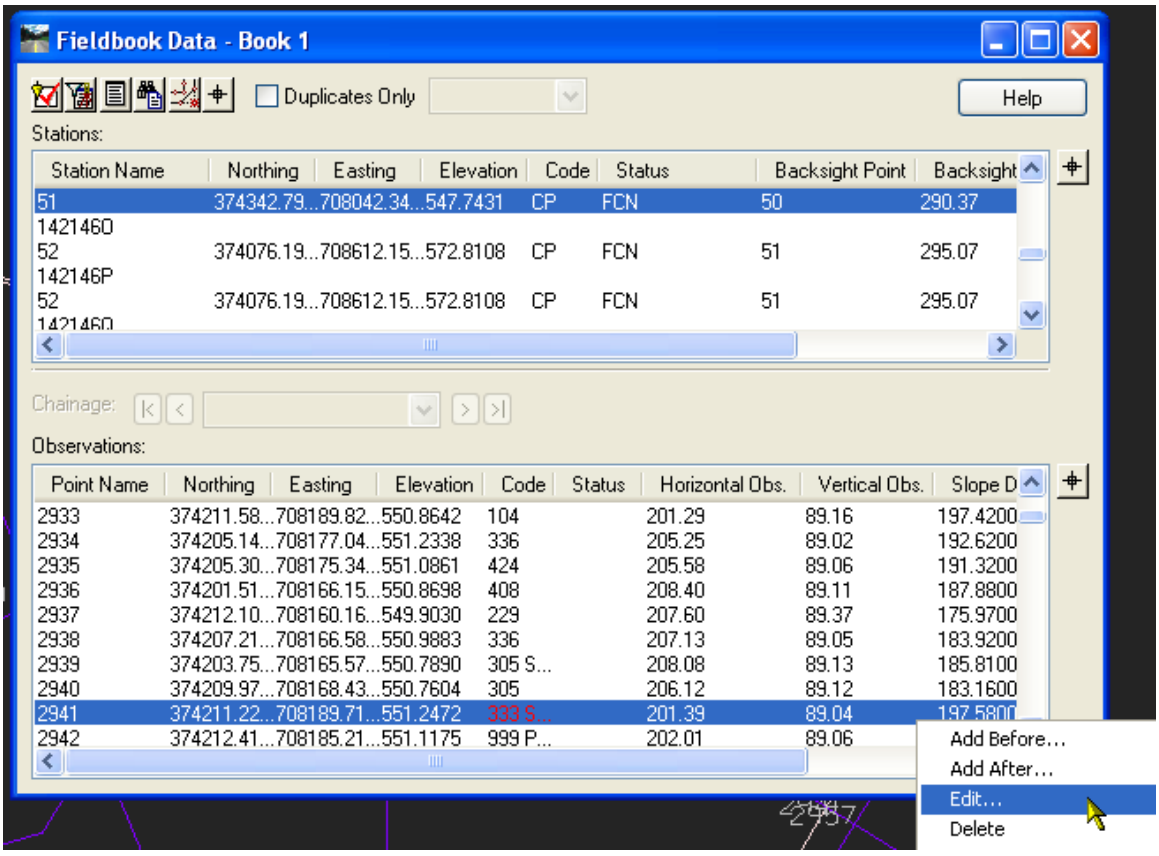


Figure 3-4 InRoads Fieldbook Data Dialog Box - Fixing Code Errors

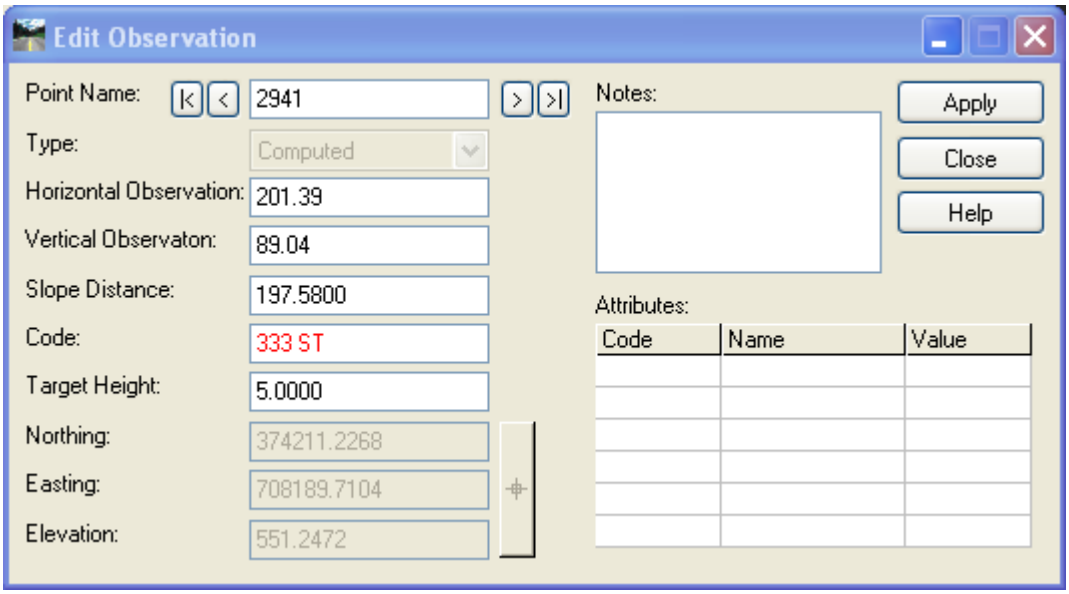


Figure 3-5 InRoads Edit Observation Dialog Box

G. Enter **999** not **333** as the code click **Apply** on the Edit Observation Dialog Box (Figure 3-5), this will execute the command. Notice (Figure 3-6) the point now has the correct symbol for the point.

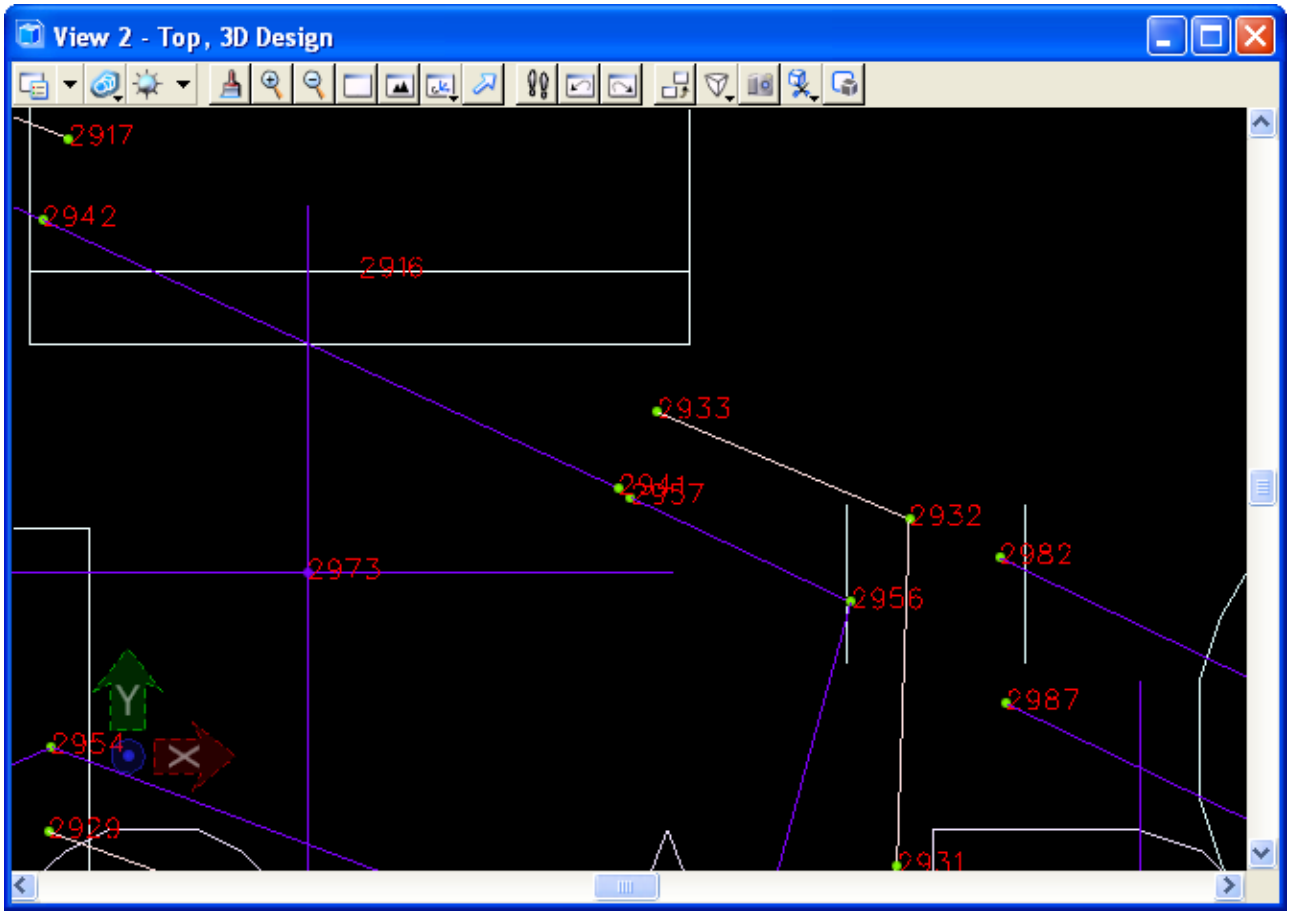


Figure 3-6 MicroStation View of Updated Point 2941

3.2 **Lab 7** Fixing Point Codes

A. Turn off the point numbers, from the InRoads main menu bar select **Survey > View Survey Data > Names** or select the View Names tool as shown on Figure 3-1.

B. From the InRoads main menu bar select **Survey > Fit View**. This will fit the dynamic survey data display to your screen.

C. Turn on the point numbers, from the InRoads main menu bar select **Survey > View Survey Data > Names** or select the View Names tool as shown on Figure 3-1.

D. The view shows a blue line from one end of the data to the other; this is not right. With the MicroStation Window tool, select the area in on the lower end of the line as shown in Figure 3-7.

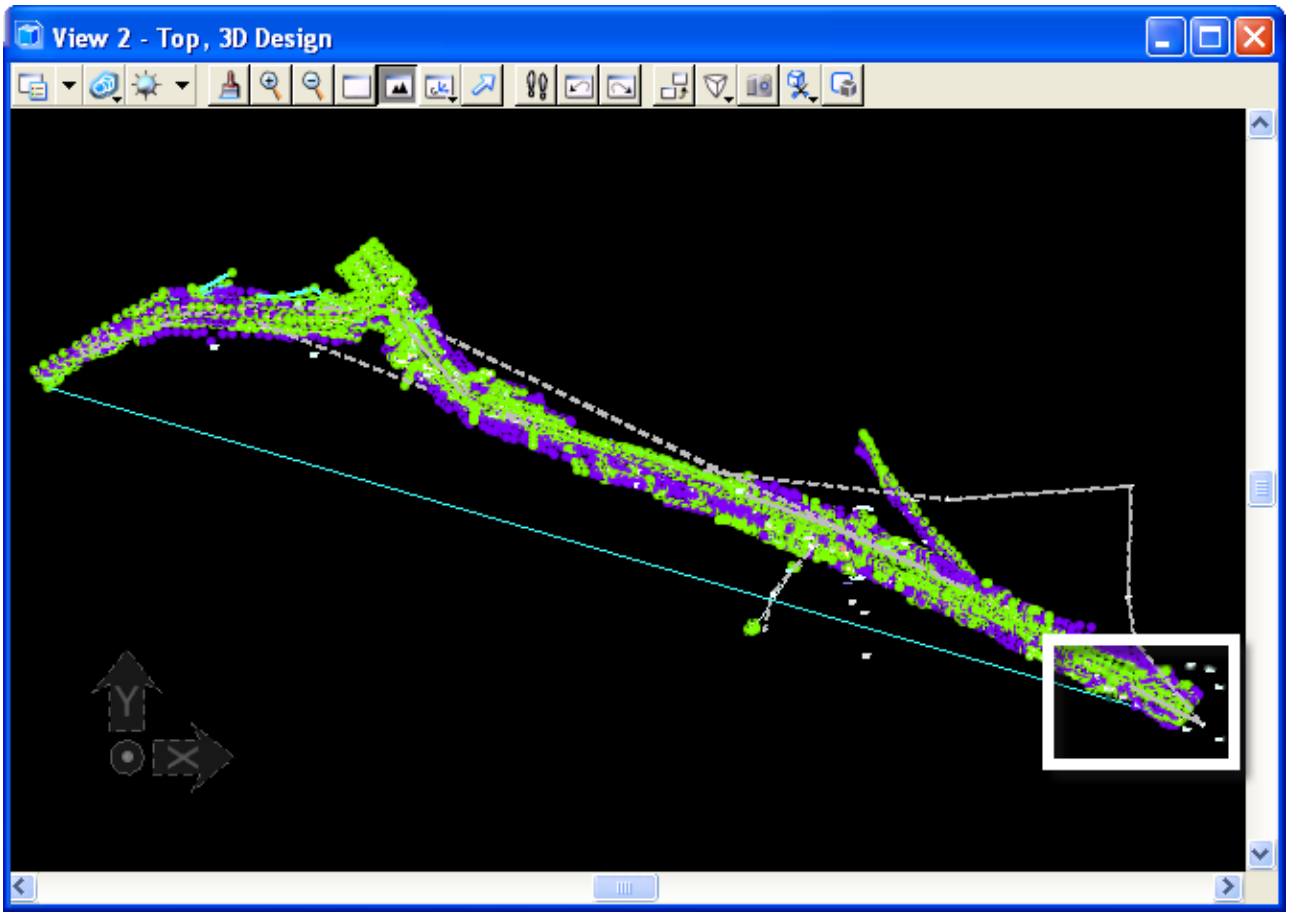


Figure 3-7 MicroStation View of needed window area

E. From the InRoads main menu bar select **Survey > Fieldbook Data.**

F. After the Fieldbook Data dialog appears select the selector button from the Observation section. This will cause the dialog to minimize and InRoads will prompt you to Identify Point in the lower left hand corner of the screen.

G. Select point **4287** in the view.

H. The Fieldbook Data dialog will display again with the point 4287 selected. Notice that the code is 118 and that the second point of this chain has ST after it. After some trial and error we find that the ST should have been applied to the first point on this chain.

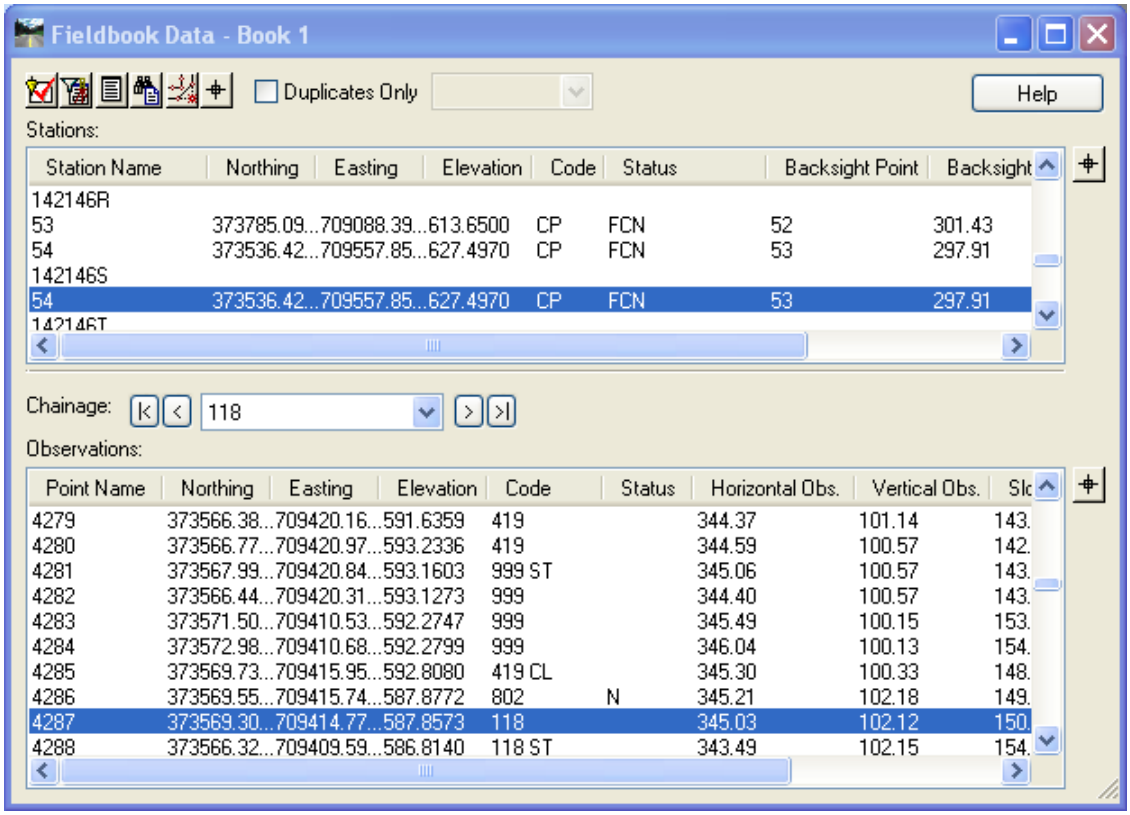


Figure 3-8 InRoads Fieldbook Dialog Box - code edit

I. Right Click on the blue bar for point 4287and select **Edit**.

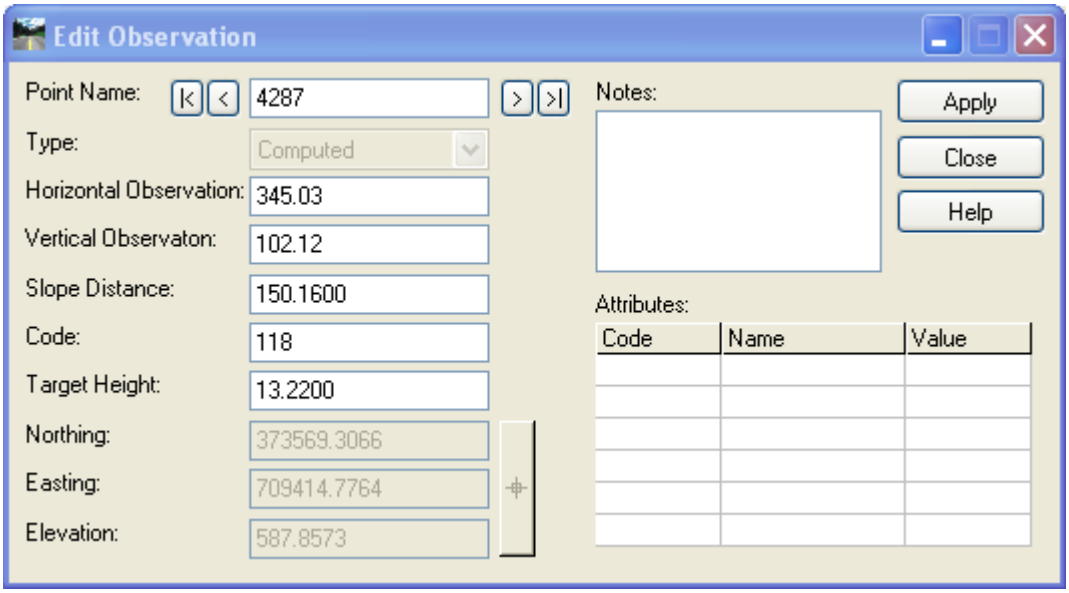


Figure 3-9 InRoads Edit Observation Dialog Box

J. Add ST to the code line and click **Apply** then select the next button this will take you to the next point where you will remove the ST and **Apply**. Notice Figure 3-10 the long line is gone and the channel is now displayed correctly.

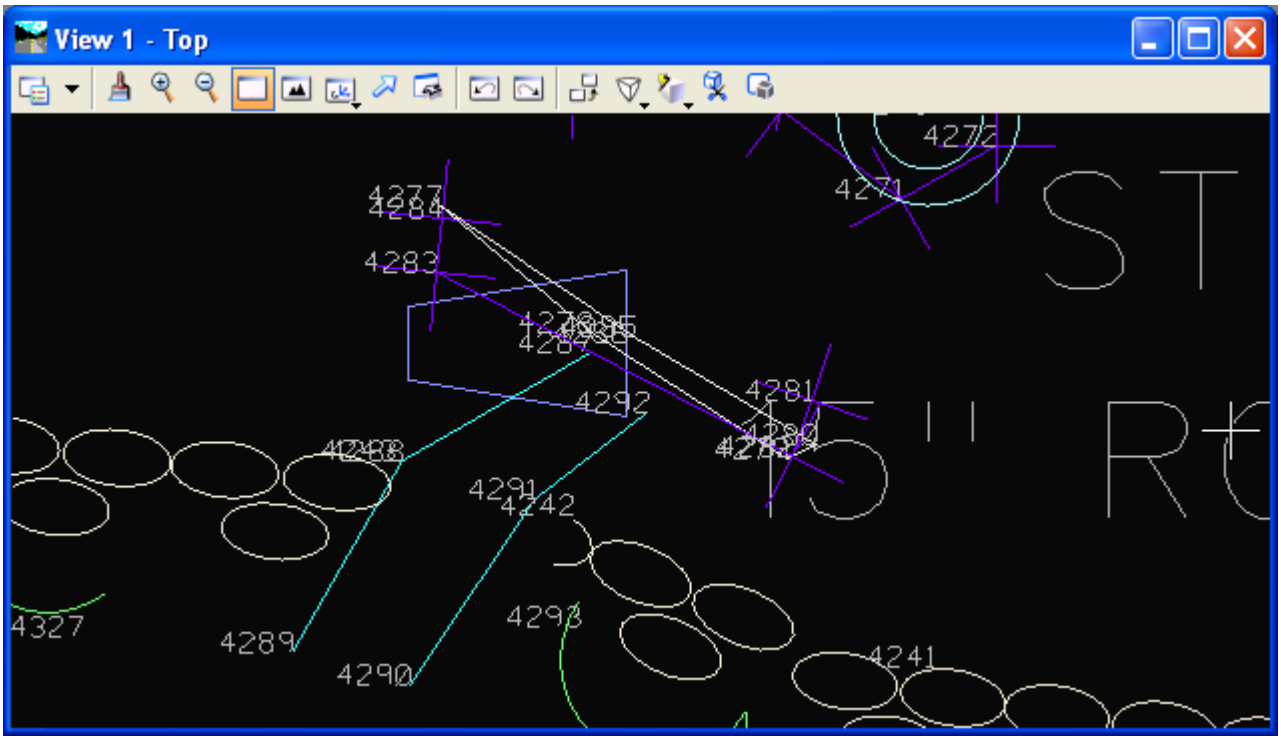


Figure 3-10 MicroStation View of corrected data

Complete Steps I. and J. for the following survey point numbers:

Point Number	From	To
299	999	999 ST
2297	delete	
2021	999	999 ST
495	102	102 CL
2486	205	205 ST
3089	104	104 PC
1092	102	102 CL
1032	104	104 ST
5425	999	999 ST
2642	delete	
7210	117	117 ST
5317	delete	
3120	999	999 ST
3123	999	999 CL
2298	102	102 ST

K. After all the data has been adjusted or at the end of each day you will want to save the Survey Data. From the InRoads main menu bar select **File > Save As**.

L. The Save As dialog appears Figure 3-11, select the Save as type: **(*.fwd)** and enter a file name then click **Save**. This saves the data to a file and the next day you will load the .fwd and either continue with the edit process or import more field data or both. Remember to save the .fwd when ever exiting InRoads Survey.

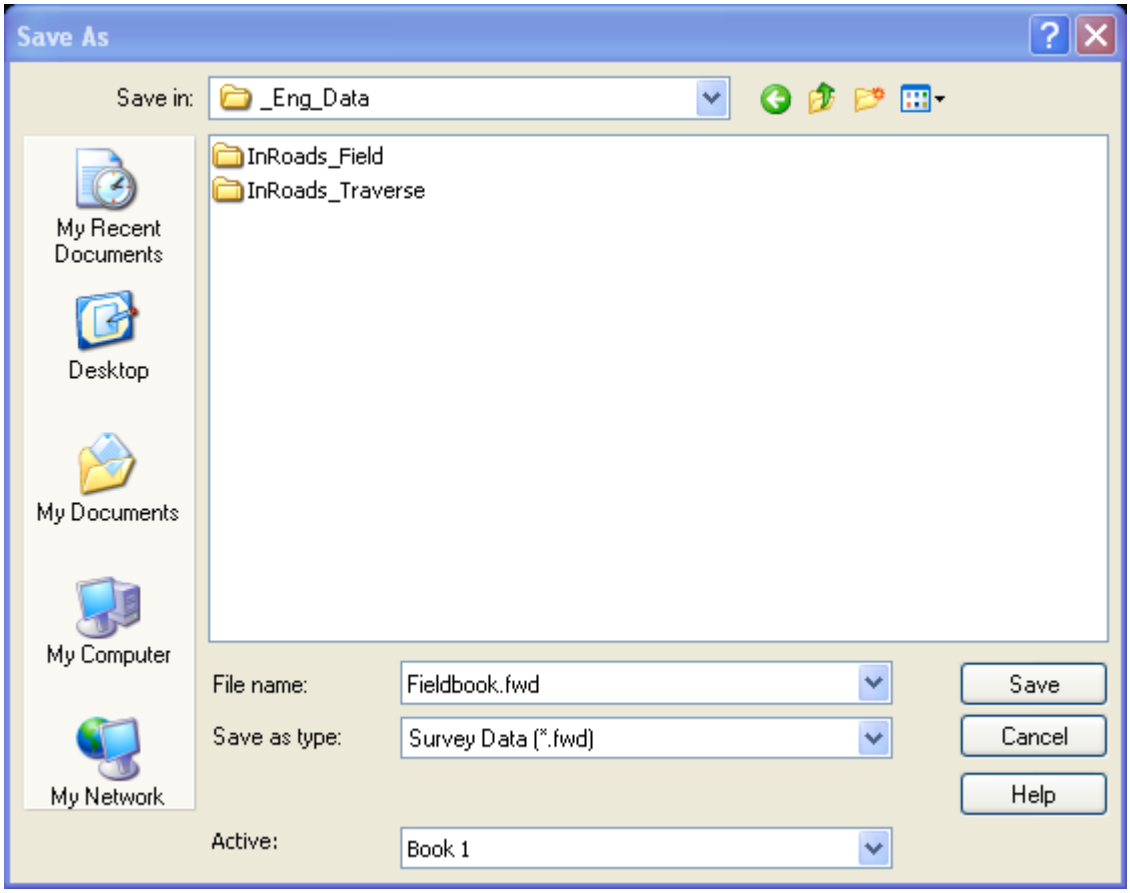


Figure 3-11 InRoads Save As Dialog Box

3.3 **Lab 8** Fixing a Closed Shape

A. From the InRoads main menu bar select **Survey > Find Point in View...**

B. We will be working around point 1051; it's a building corner. Enter the Point Name: **1051** and Radius: **10** (feet) and click **Apply**.

C. Turn on the Point Name display. From the InRoads main menu bar select **Survey > View Survey Data > Names.**

D. Zoom in a little using **Find Point in View...** again. This time use a 2 foot radius.

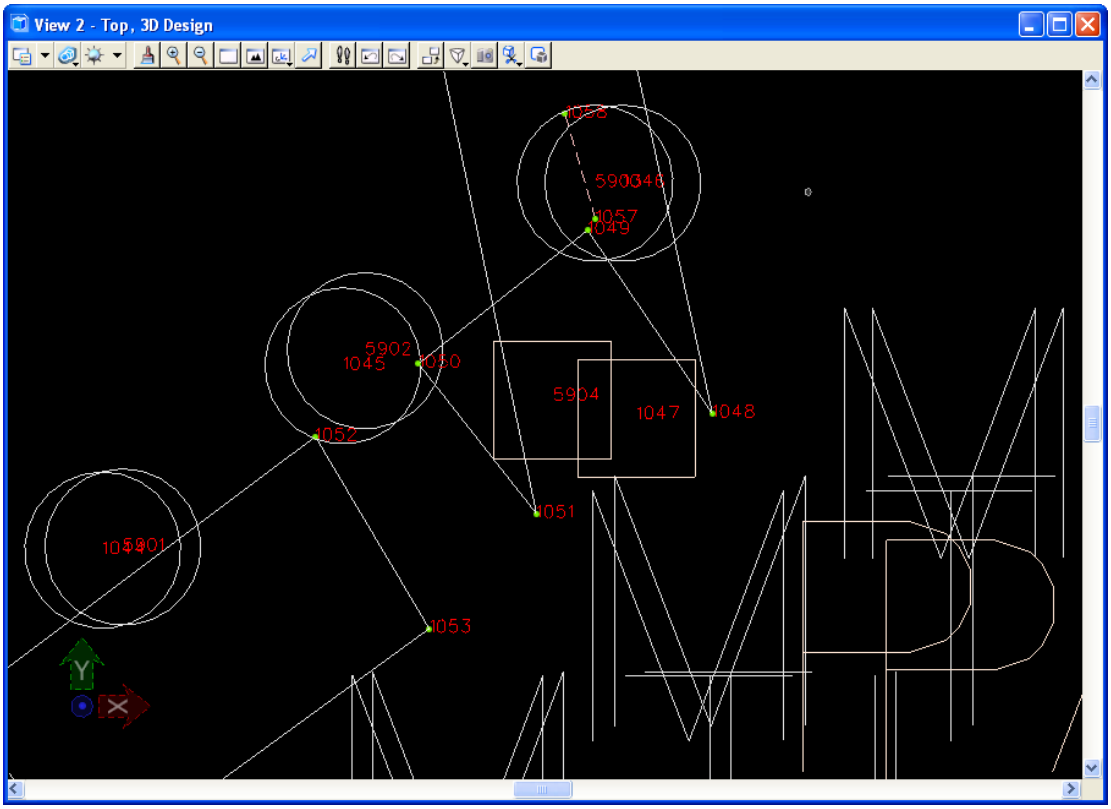


Figure 3-12 MicroStation View of Point 1051

Notice in this view (Figure 3-12) the lines taking off from points 1048 and 1051. Use MicroStation tools to zoom out so see how the lines are not connecting correctly. The fieldbook data will need to be adjusted so 1051 will close on 1048.

E. From the InRoads main menu bar select **Survey > Fieldbook Data...**

M. From the Observation section of the dialog select and data point 1051 in the view. The dialog will reappear and point 1051 should be highlighted. Notice that 1051 has CL Code but point 1048 has no ST to start this shape. Right click on point 1048 and select edit. Add the Code ST and this will fix the problem.

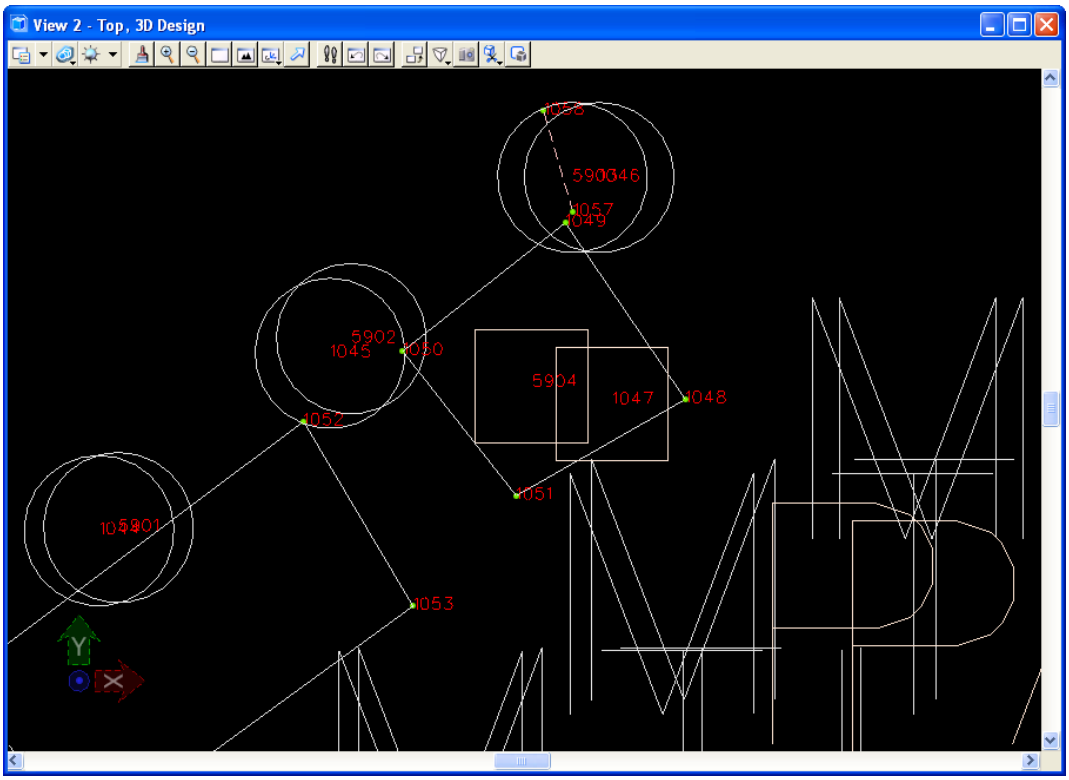


Figure 3-13 MicroStation View

3.4 **Lab 9** Adjusting PC' and PT's,

A. From the InRoads main menu bar select **Survey > Find Point in View**. Enter Point Name: **211** and Radius: **12**, Click **Apply**. The MicroStation view shown in Figure 3-14 will appear.

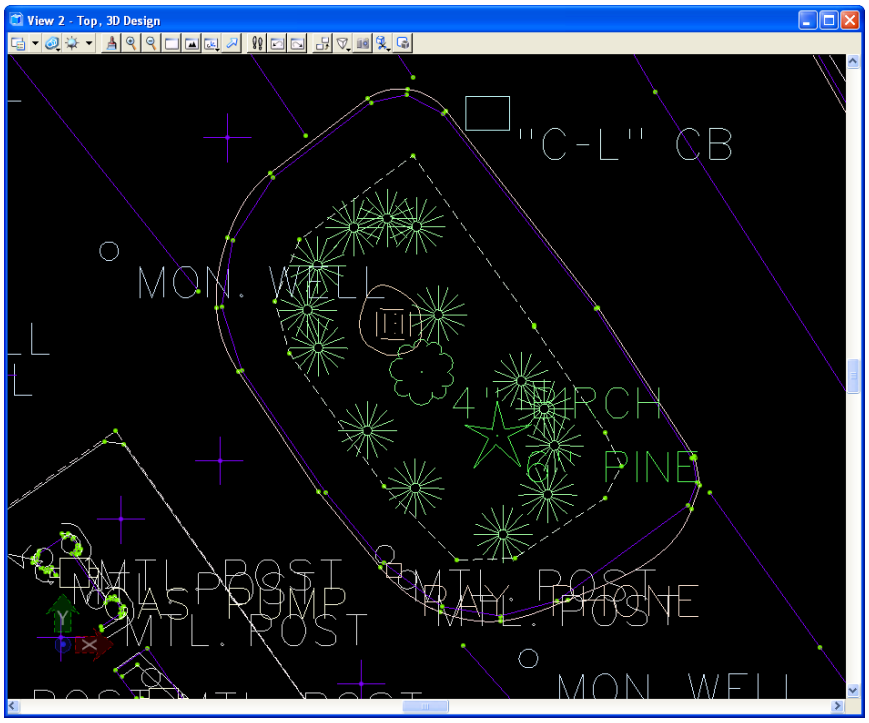


Figure 3-14 MicroStation View

B. Turn on the display of Point Names. Enter the following edits to the island. The graphics should reflect the line work shown in Figure 3-15.

Point 113 add PT

Point 114 add PC

Point 116 add PT

Point 119 add PC

Point 121 add PT

Point 122 add PC

Point 125 add PT

Point 127 add PC

Point 130 add PT

Point 131 add PC

Point 133 add PT

Point 2730 add PC

Point 2733 add PT

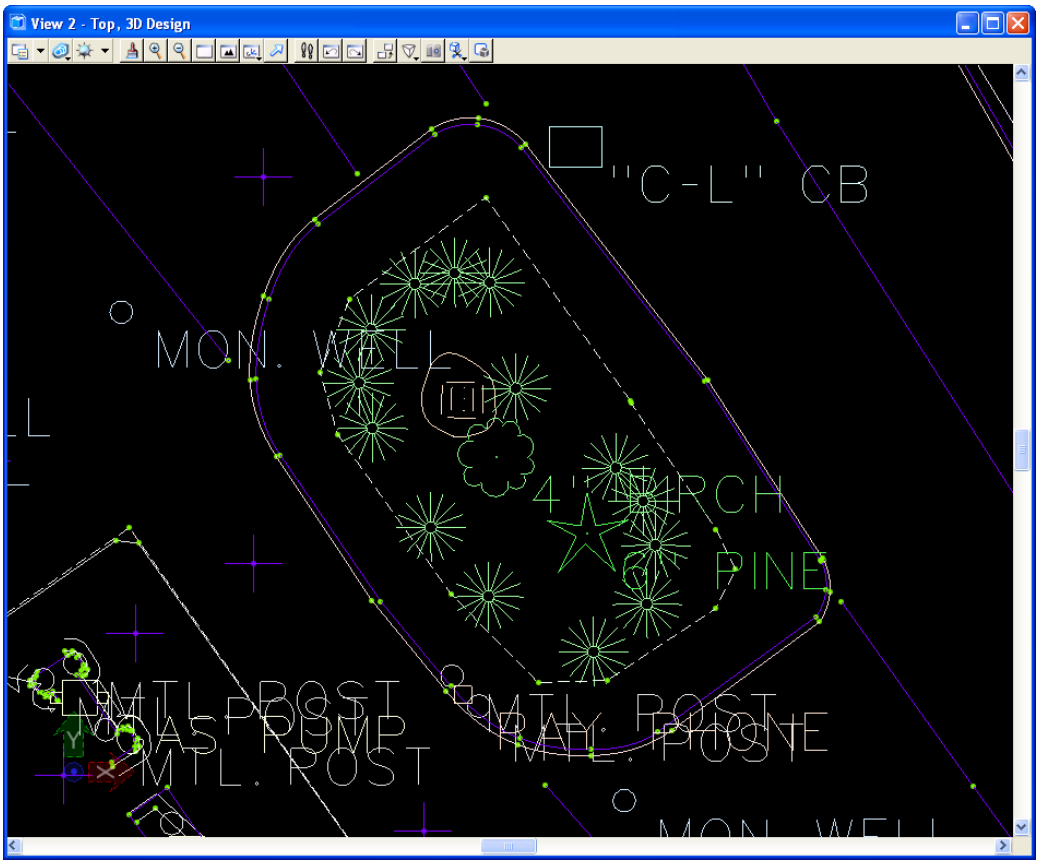


Figure 3-15 MicroStation View

Section 4 Surface and Ground File Creation

4.1 **Lab 10** Write Survey Data to Graphics

A. Now we will want to save the graphics to a design file. From the InRoads main menu bar select **Survey > View Survey Data > Write Survey Data to Graphics.**

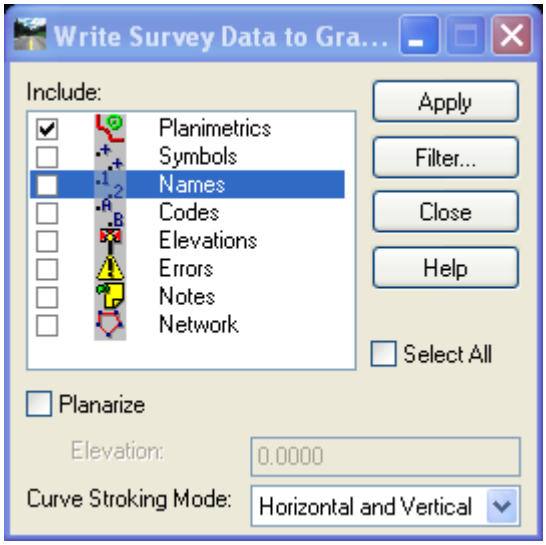


Figure 4-1 InRoads Write Survey to Graphics Dialog Box

B. In the dialog box select the fields for Planimetrics, Names, Codes, Elevations and Notes. Click **Apply** and then **Close**. This will write the graphics to the design file.

C. From the InRoads main menu bar select **Survey > View Survey Data**, turn off Planimetrics and Names.

4.2 **Lab 11** Survey Data to Surface

A. From the InRoads main menu bar select **Survey > Survey Data to Surface.** For Surface Name input **existing**. Adjust the setting to match Figure 4-2 and click **OK**.

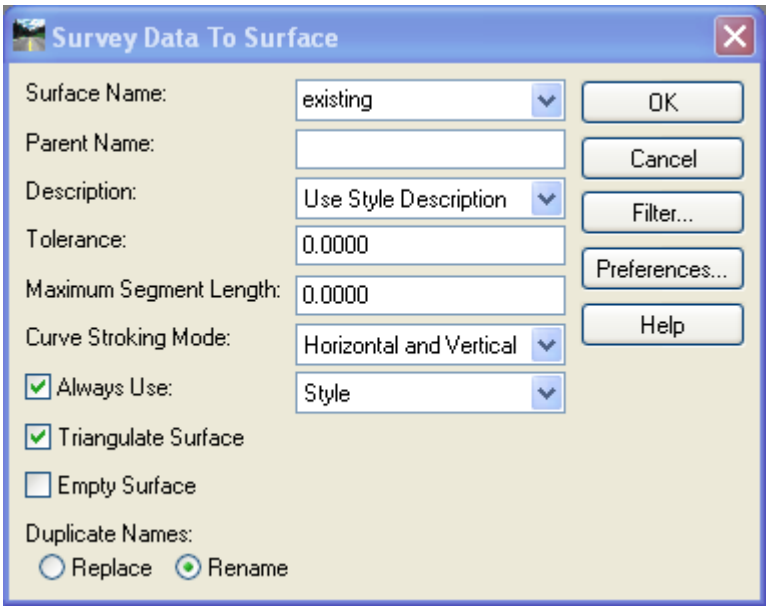


Figure 4-2 InRoads Survey Data To Surface Dialog Box

B. Turn on Extended Data Checks. In the Results area click the **More…**

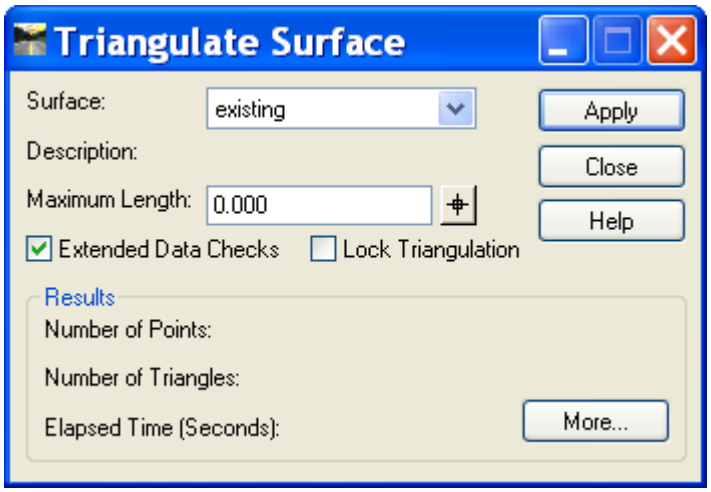


Figure 4-3 InRoads Triangulate Surface Dialog Box

C. On the Main Tab change Preference to **Survey.**

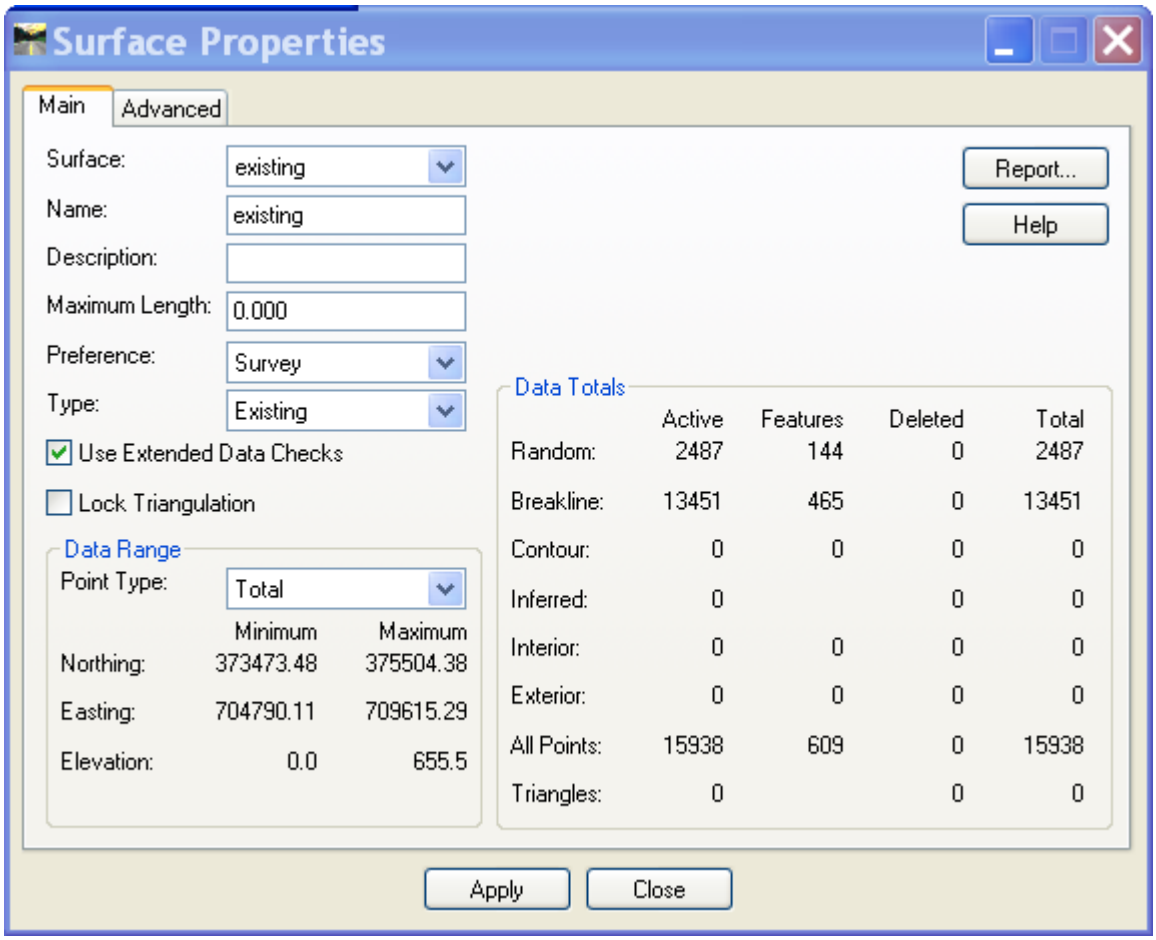


Figure 4-4 InRoads Surface Properties Dialog Box Main Tab

D. On the Advanced tab change Cross Section and Profile Symbology to **EXISTING**.

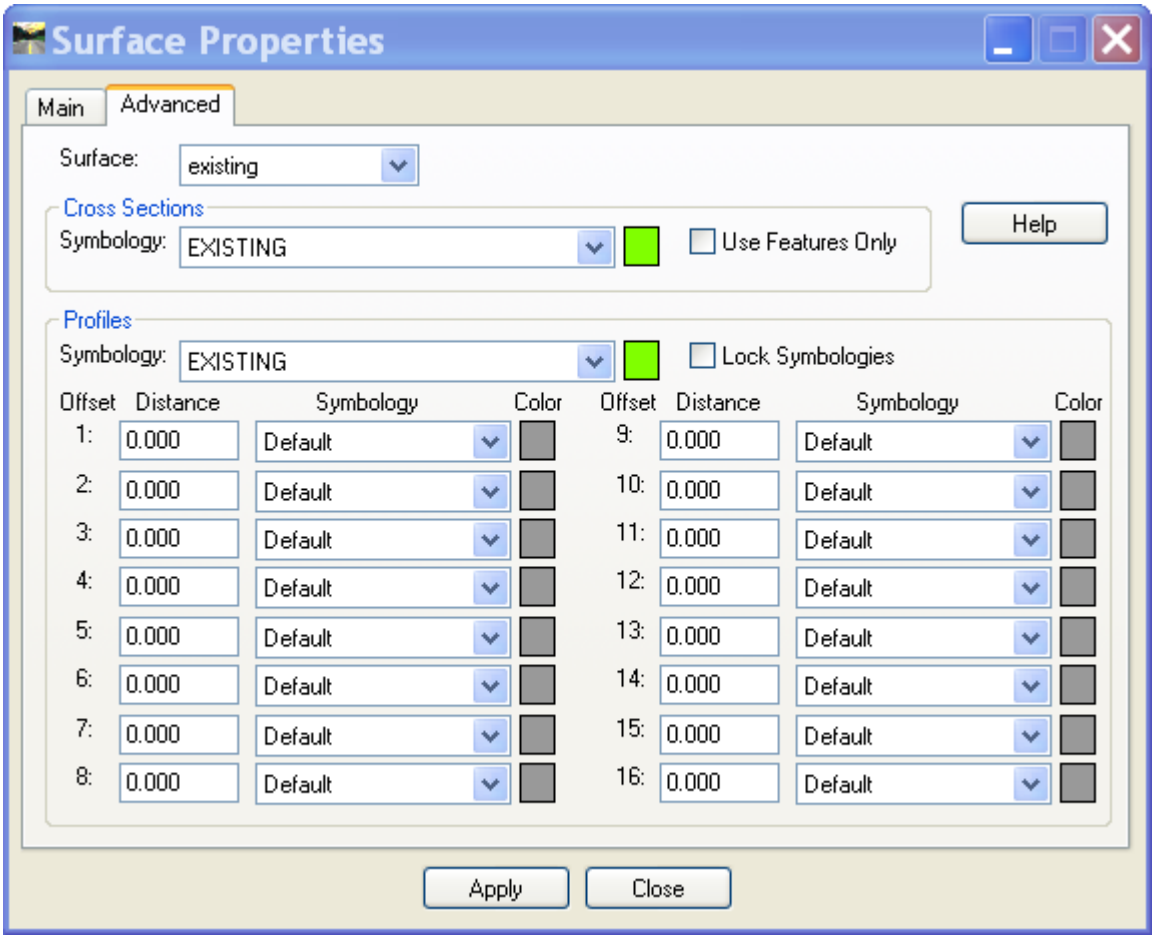


Figure 4-5 InRoads Surface Properties Dialog Box Advanced tab

E. Click **Apply** then **Close** on the Surface Properties dialog box and **Close.**

F. On the Triangulate Surface Dialog box click **Apply and Close**.

G. Save your field book. **File > Save > Survey Data.**

4.3 **Lab 12** Surface Editing

A. Start by closing your field book, any changes made to the features in the existing surface will be saved in the DTM (Digital Terrain Model) and not the field book. In the survey tab **right-click** on the **Fieldbook > Close.**

B. In MicroStation select **Edit > Select by Attributes**

C. Select all Types except **Cell**, **Text** and **Text Node** for Levels.

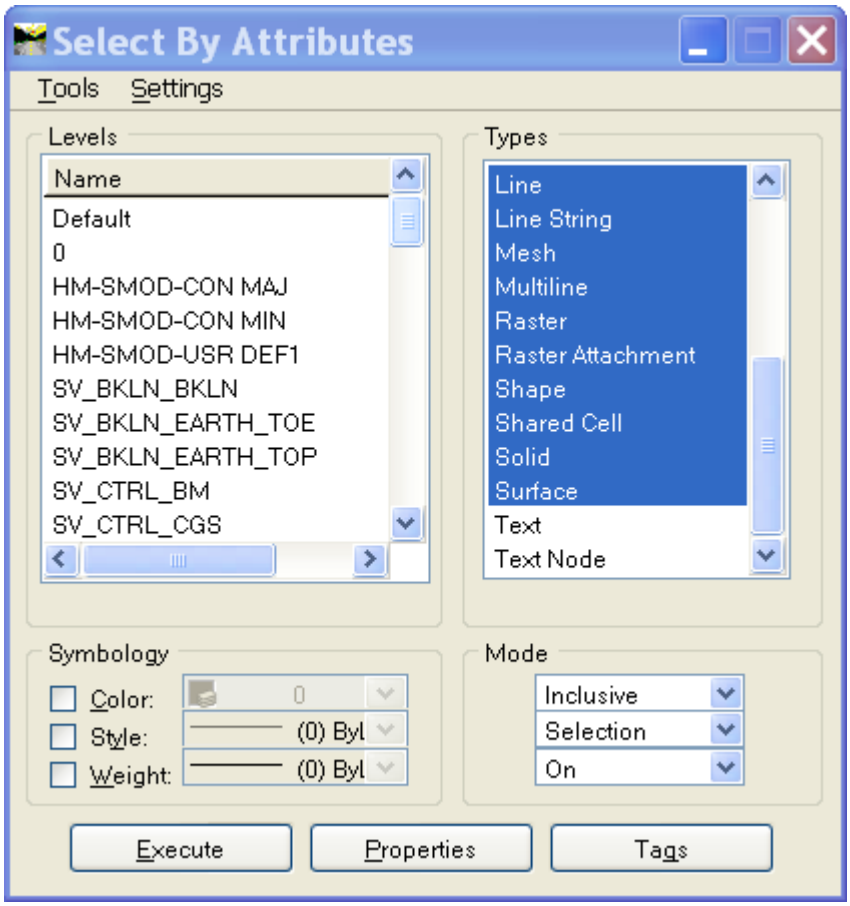


Figure 4-6 Select by Attributes Dialog Box

D. Select **Execute.**

E. Select the MicroStation tool **Delete**.

F. Select **Cell** for Types and select all Levels except **SV_NODES_ACTIVE_POINT**.

G. Select **Execute.**

H. Select the MicroStation tool **Delete** and close the dialog box.

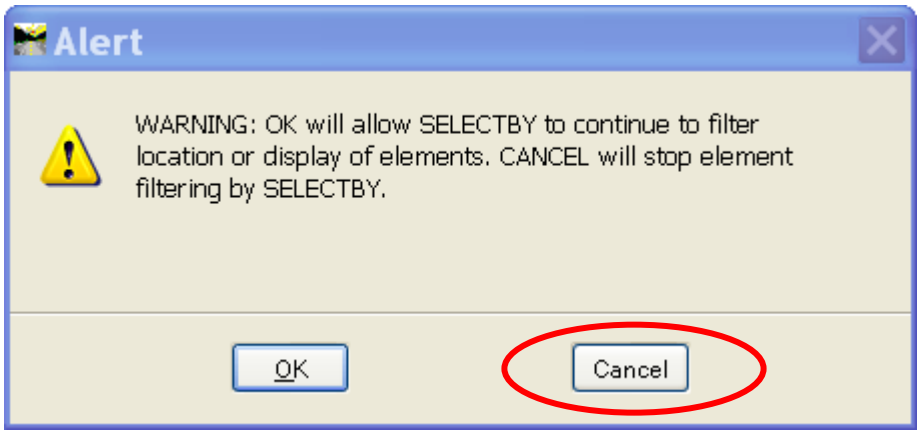


Figure 4-7 Select By Warning

I. A warning will come up; just select the **Cancel** button.

J. On the InRoads Main Menu select **Surface > Update 3-D/Plan Surface Display.**

K. Select the **existing** surface, within the Features: window right-click and **Select All.**

L. Click R**efresh All** and **Close.**

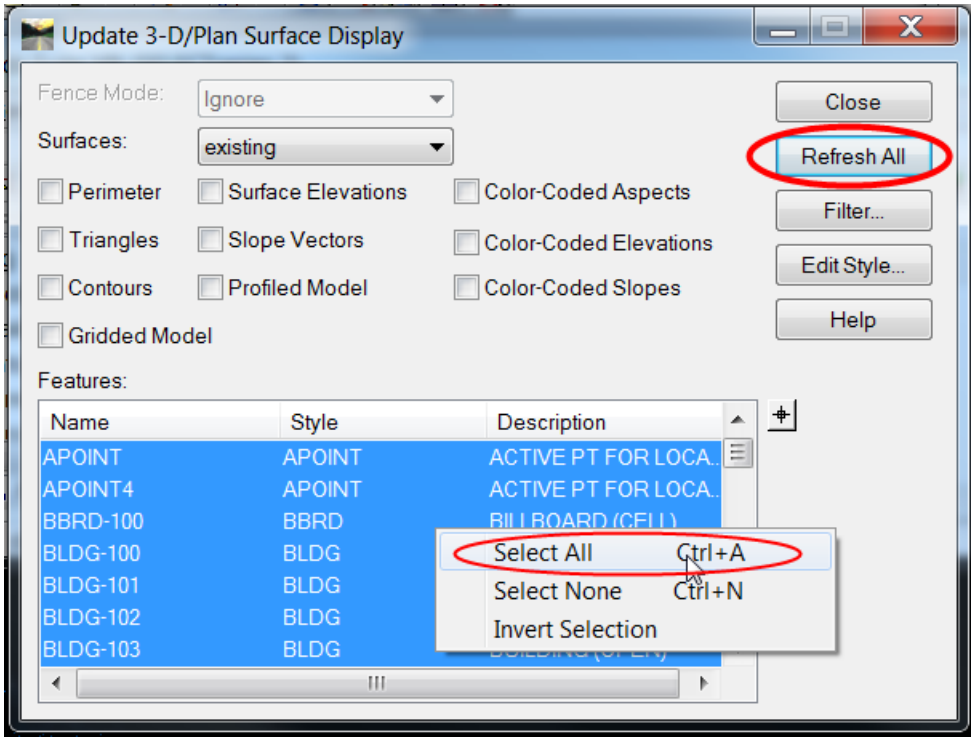


Figure 4-8 Update 3-D/Plan Surface Display

M. Go to **Surface > Utilities > Resolve Crossing Segments**, this tool shows you where there are crossing segments that need to be fixed and can be used to fix them.

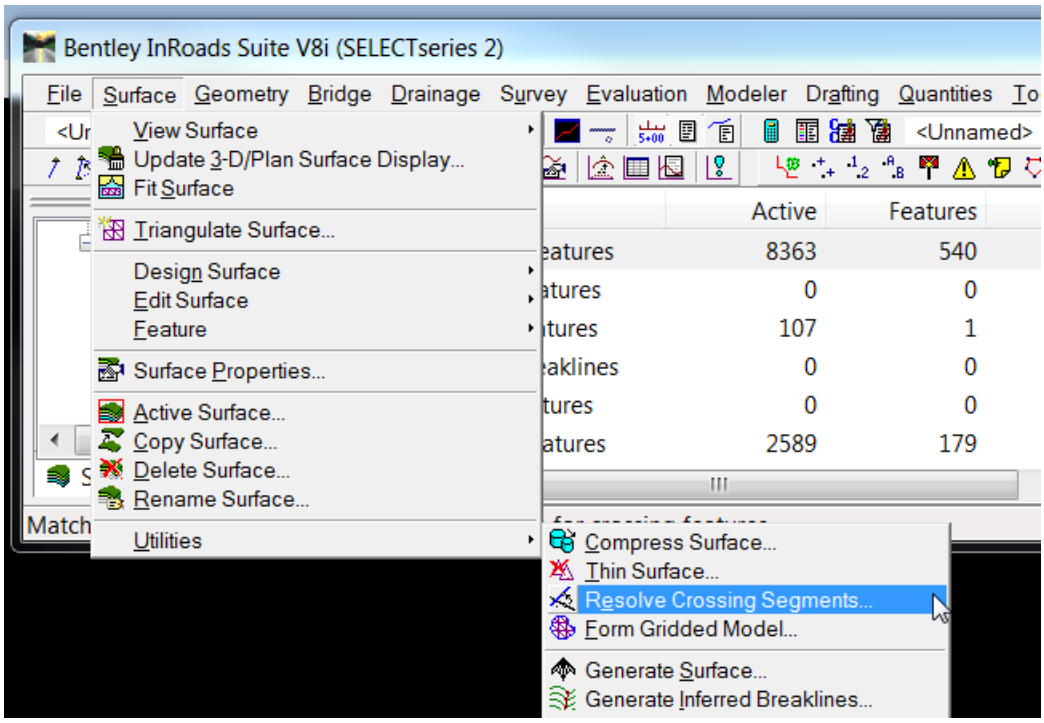


Figure 4-9 Crossing Segments Tool

N. For Mode select **Interactive** and click **Apply**. This will bring up a list of all of the crossing segments. Click on one of the listed segments and the view will center on the crossing segment and highlight it with an X.

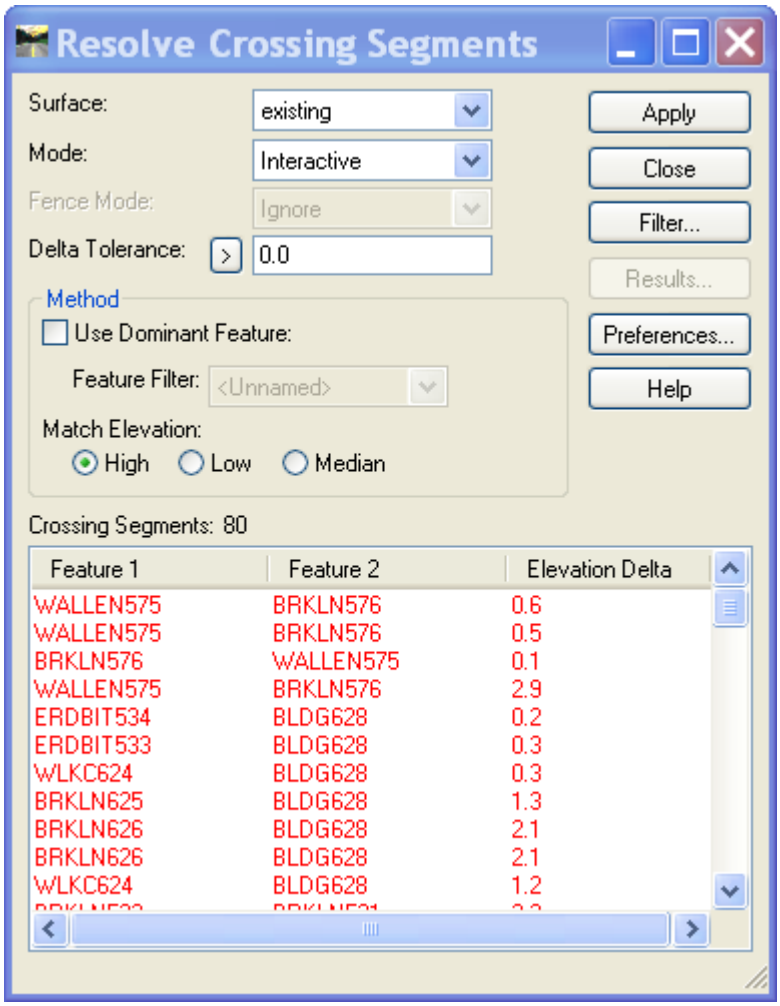


Figure 4-10 View Crossing Segments

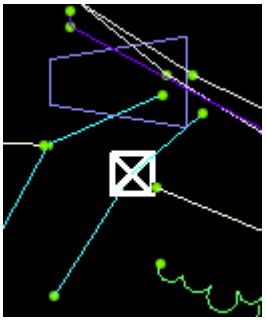


Figure 4-11 MicroStation View indicating a Crossing Segment

O. From the InRoads main menu bar select **Surface > Edit Surface > Edit Feature Point…**

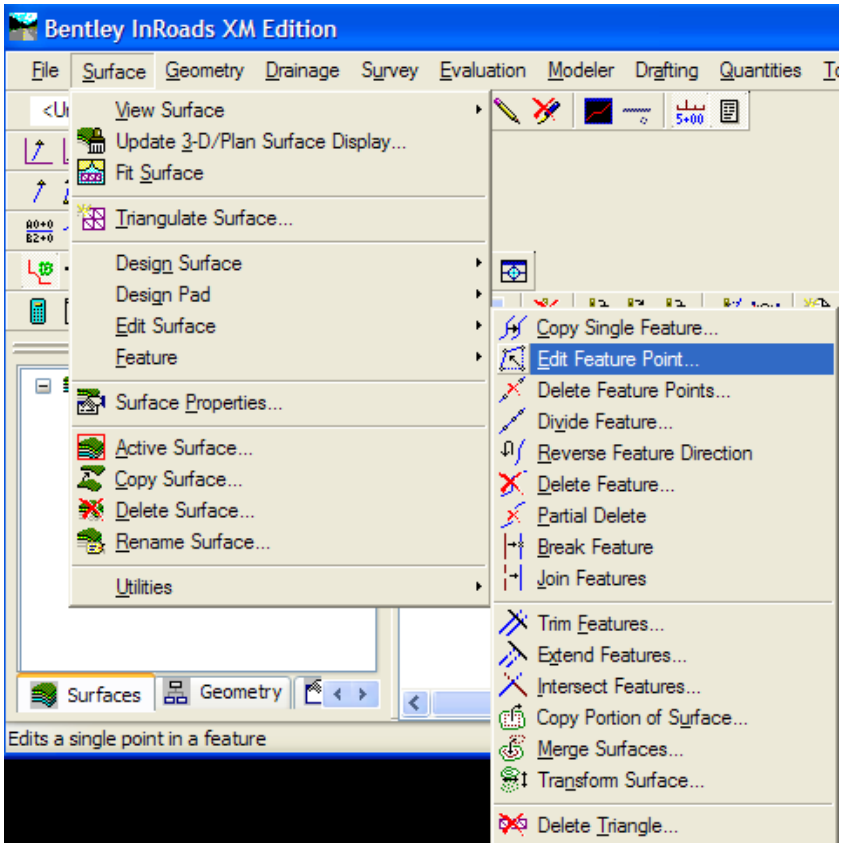


Figure 4-12 Edit Feature Point Tool

P. This tool allows you to edit the features in your surface. Below Figure 4-14 shows two features crossing themselves, first use the target button within the Edit Feature point box to identify the features

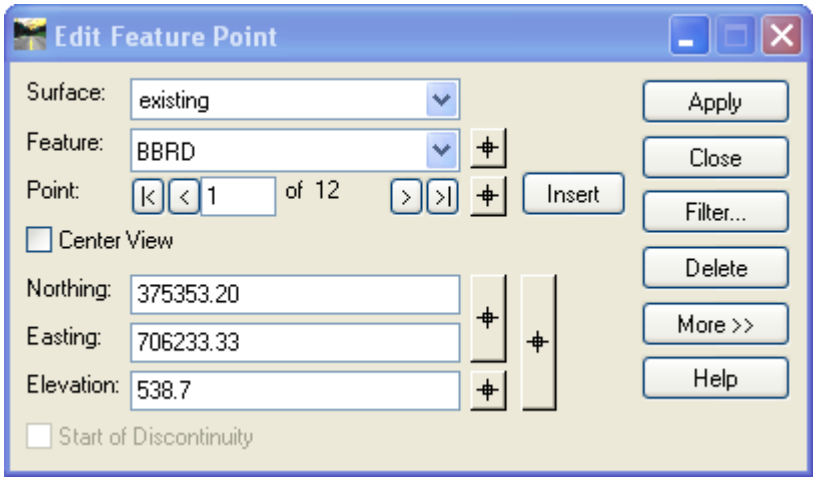


Figure 4-13 Edit Feature Point Dialog Box

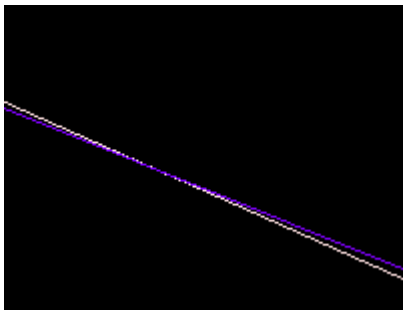


Figure 4-14 MicroStation View

Q. Select the feature you wish to move.

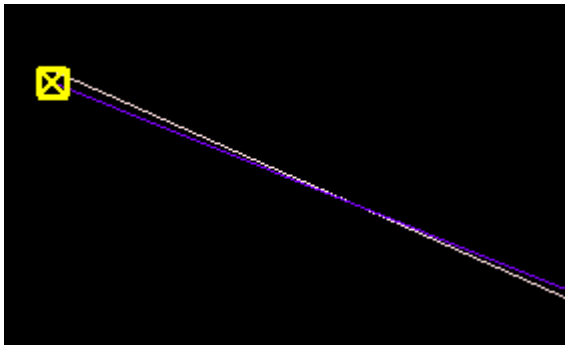


Figure 4-15 MicroStation View

R. When the target shows up on the features you wish to move, then pick the Northing, Easting button to move the feature. The northing, easting and elevation can be adjusted together by picking the biggest target button.

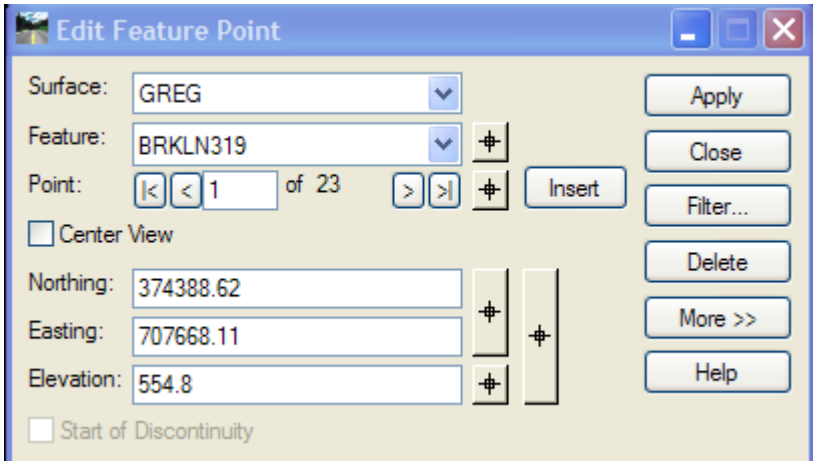


Figure 4-16 Edit Feature Point Dialog Box

S. When this feature is moved, the correction will be saved in the DTM and not the field book.

4.4 **Lab 13** Deleting Triangles

A. Select **Surface > View Surface > Triangles**, click **Apply** and **Close**.

B. Select **Surface > Edit Surface > Delete Triangle.**

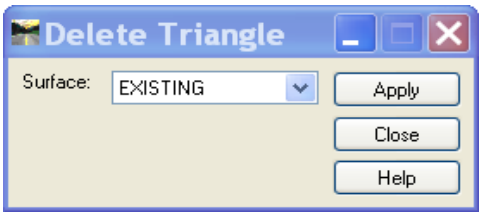


Figure 4-17 Delete Triangle Dialog Box

C. Click **Apply** and data point to create a line over the triangles you would like to delete.

D. Select **Surface > View Surface > Perimeter**, click **Apply** and **Close**.

E. Use MicroStation Tools to manipulate the Perimeter shape. Select the perimeter.

F. In Inroads select **File > Import > Surface**. Modify the dialog box as shown below. Click Apply and select the Perimeter graphics.

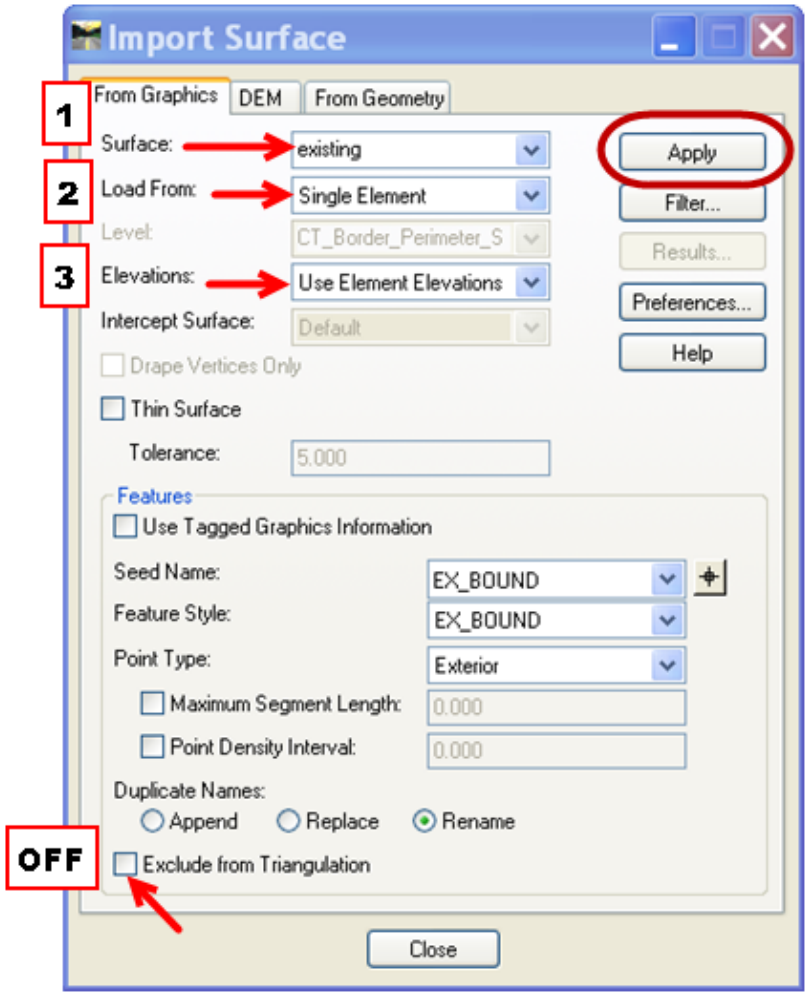


Figure 4-18 Import Surface Dialog Box

G. Select **Surface > View Surface > Triangles**. Click **Apply** and select **Yes** to re-triangulate. **Close** the dialog box.

H. Select **File > Save As**. Save the edited surface.

4.5 **Lab 14** Checking the Contours

A. From the InRoads main menu bar select **Surface > View Surface > Contours…**and click **Apply**.

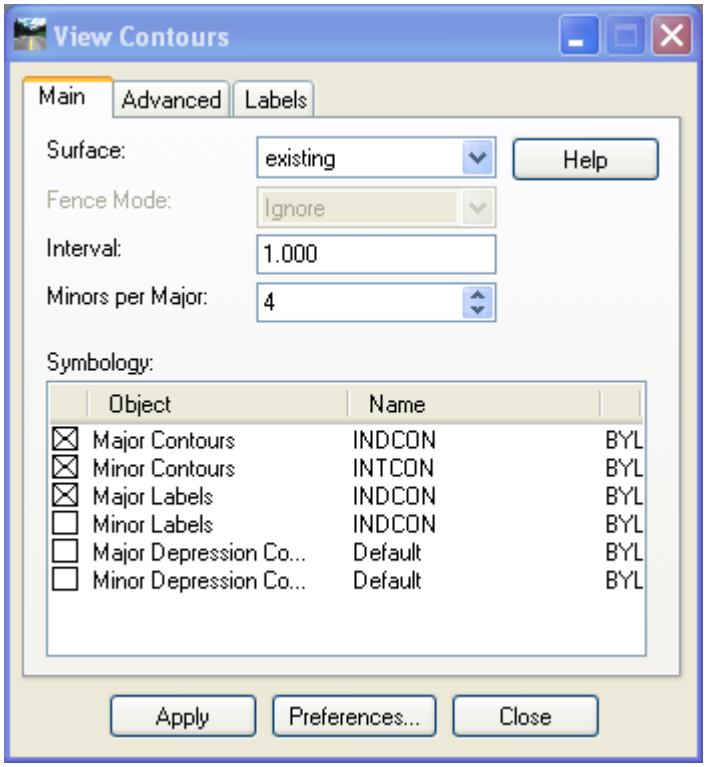


Figure 4-19 InRoads View Contours Dialog Box

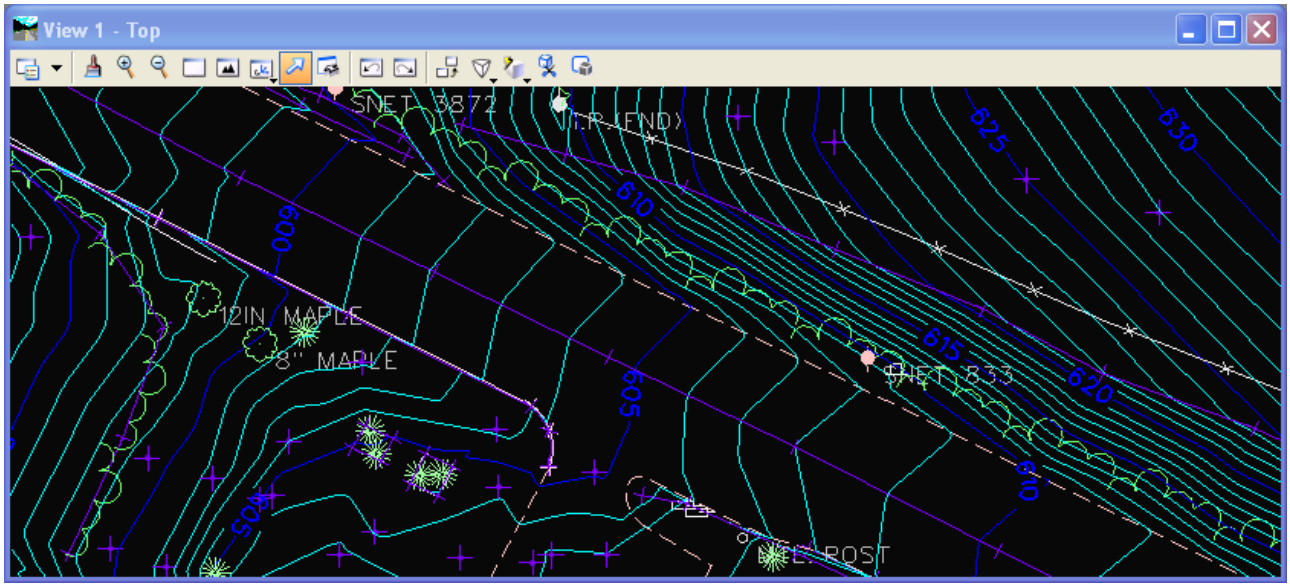


Figure 4-20 MicroStation View of Existing Contours

Section 5 Horizontal Alignments

This chapter will discuss various horizontal alignment commands that are available in InRoads. In this section, users will create horizontal alignments and annotate the alignments to CTDOT standards. Horizontal alignment data and vertical alignment data is stored in the Geometry Project. The process of creating a Geometry Project and naming a Horizontal Geometry is explained below. One horizontal alignment can reference several vertical alignment options. But only one alignment, the active alignment, can be manipulated within a project at a single time.

5.1 **Lab 15** Start Up

5.1.1 Opening Files

A. On the InRoads Main Menu select **File > Close > All**. In MicroStation browse to **X:\999_Student##_2007\Survey** and open the file **SV_Geometry.dgn.**

B. On the InRoads Main Menu click to **File > Open**. Change the Files of type to *.dtm. Browse to the project's survey folder, select **SV_Final.dtm** and **SV_Surface.dtm** click **Open** for each and then **Cancel.**

C. Select **File > Project Options**. Select the **Units and Format Tab** and change Station to ss+ss.ss. Select **Preferences** and save the survey preference. Close.

5.1.2 Surface Properties

Surfaces have default properties and should be modified to display correctly in profile and cross section.

A. In MicroStation open the Level Manager. Select **Levels > Import**.

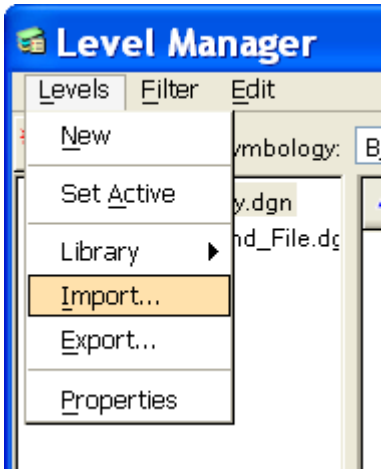


Figure 5-1 Importing Levels

B. Browse to the Workspace path **Highways_Workspace\Standards\dgnlib** and double click on **HW_Levels.dgnlib**.

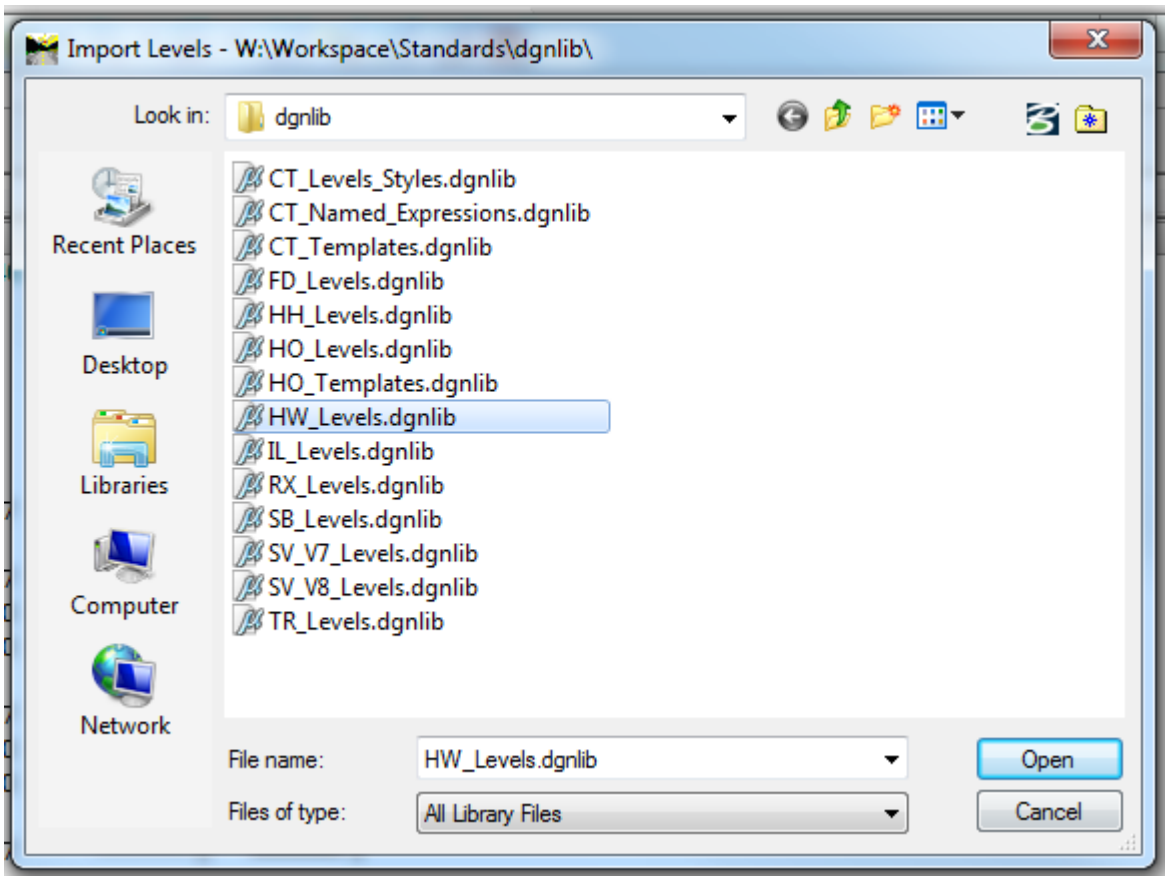


Figure 5-2 Browsing for Highway Levels

C. In the Level/filter Import dialog box click to **select all** and then click the **OK** button. This will import all the Highway Design Levels.

D. From the InRoads workspace bar windows, select the **Surface** tab.

E. **Right click** over the **existing** surface and select Properties.

F. On the **Advanced Tab**, write down the name of the **Cross Section Symbology** and **Profile Symbology.** It should be named existing, be case sensitive.

G. Go to **Tools > Named Symbology Manager**. If 'existing' is not there, copy the Symbology **EXISTING** and name it lower case **existing.**

H. On the **Advanced Tab**, reselect **existing** for **Cross Section Symbology** and **Profile Symbology.** The symbology square will turn green. Click **Apply.**

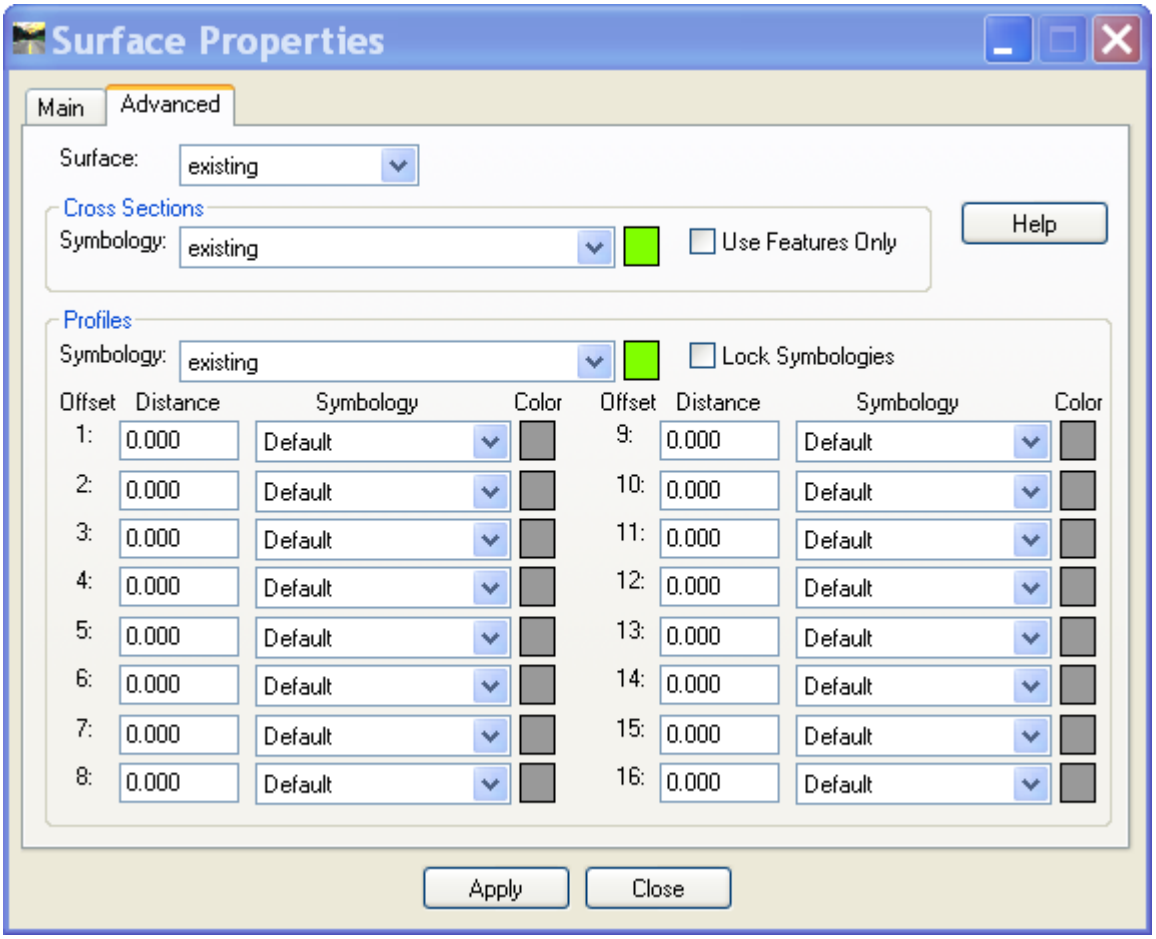


Figure 5-3 InRoads Surface Properties Dialog Box

I. Change the surface to **Final**.

J. For **Cross Section Symbology** select **P_SURF_DESIGN**. Check on the **Use Features Only** box.

K. Change **Profiles Symbology** to **P_SURF_DESIGN**. The symbology square will turn orange.

L. Click **Apply** and **Close**.

5.2 **Lab 16** Creating Horizontal Alignments

5.2.1 Naming the Geometry

A. Click to **File > New** to create a name for the geometry project. This command does not create an actual file it only creates an internal name for the Geometry Project.

B. Click on the **Geometry** tab and type **Geometry_Project** in the name box. Click **Apply**

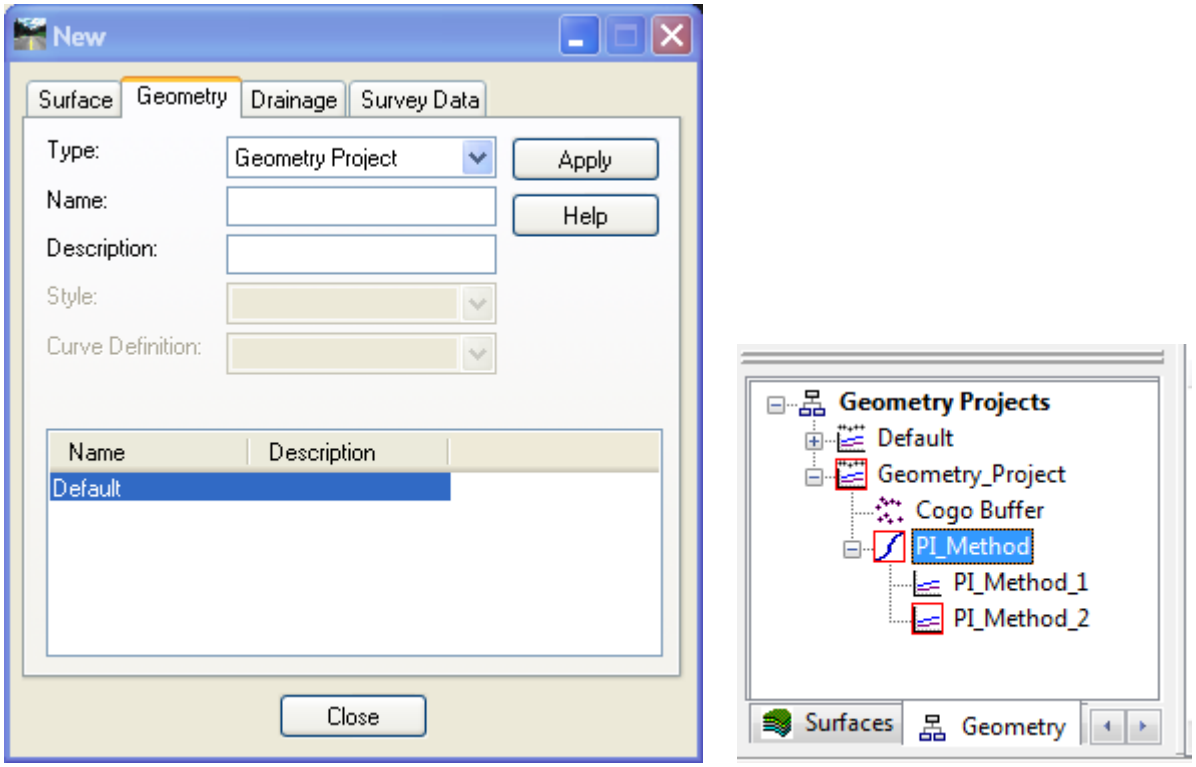


Figure 5-4 InRoads New Dialog Box & Geometry Tab

C. Change Type to **Horizontal Alignment** and type **PI_Method** in the name box. set Style: BL, Curve Definition: Arc, Click **Apply**

D. Change Type to **Vertical Alignment** and type **PI_Method_1**. Style: BL, Curve Definition: Parabolic Click **Apply**

E. Keep Type at **Vertical Alignment** and type **PI_Method_2**. Style: BL Curve Definition: Parabolic, Click **Apply.**

F. Create and Save the .alg (Geometry Project) file. Click to **File > Save > Geometry Project** on the InRoads Menu Bar. Click on the geometry name to save in the Active space and then the File name will appear in the File Name Box. Click **Save**, and then after the file is saved, click **Cancel**.

G. Save files in the RWK (Project). Click to **File > Save As** on the InRoads Main Menu. Change Save as type to **Projects (*.rwk)**. Click the **Options (…)** button on the lower right corner of the Save As dialog box. The Project Options dialog box will appear (fig. 5-5). Check **Add and Update and click on each file under file name** for all the files listed under each tab.

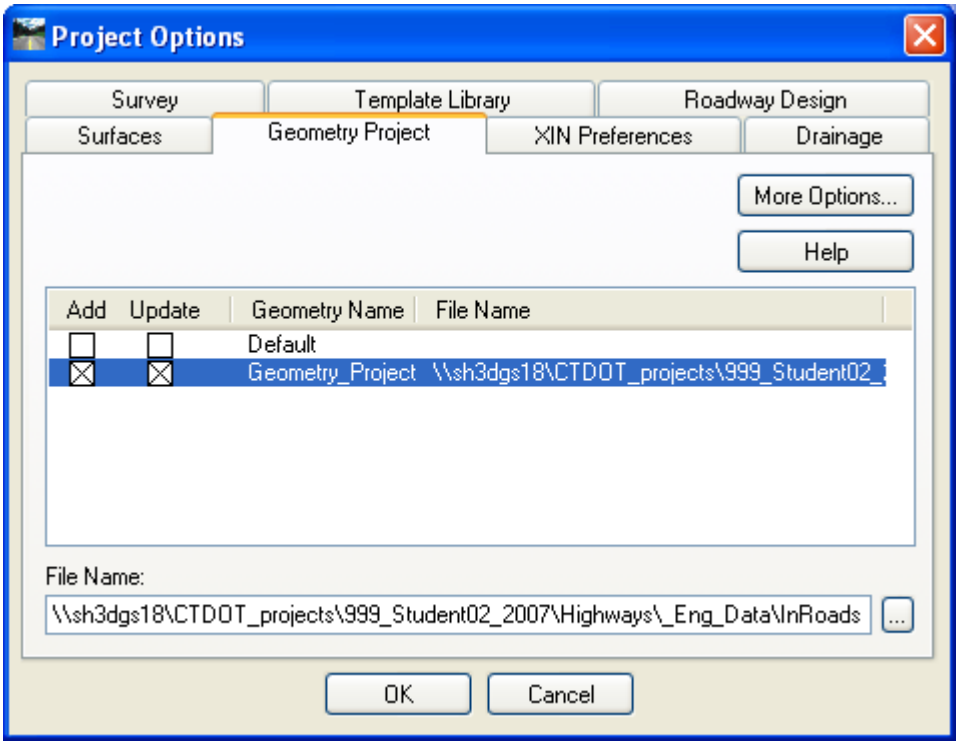


Figure 5-5 InRoads Project Options Dialog Box

H. Click the **OK** button and the Project Options dialog box will close.

I. On the Save As dialog box data point in the File name field and type in the name of the file e.g. **Project_File**. Click the **Save** button and then click **Cancel**.

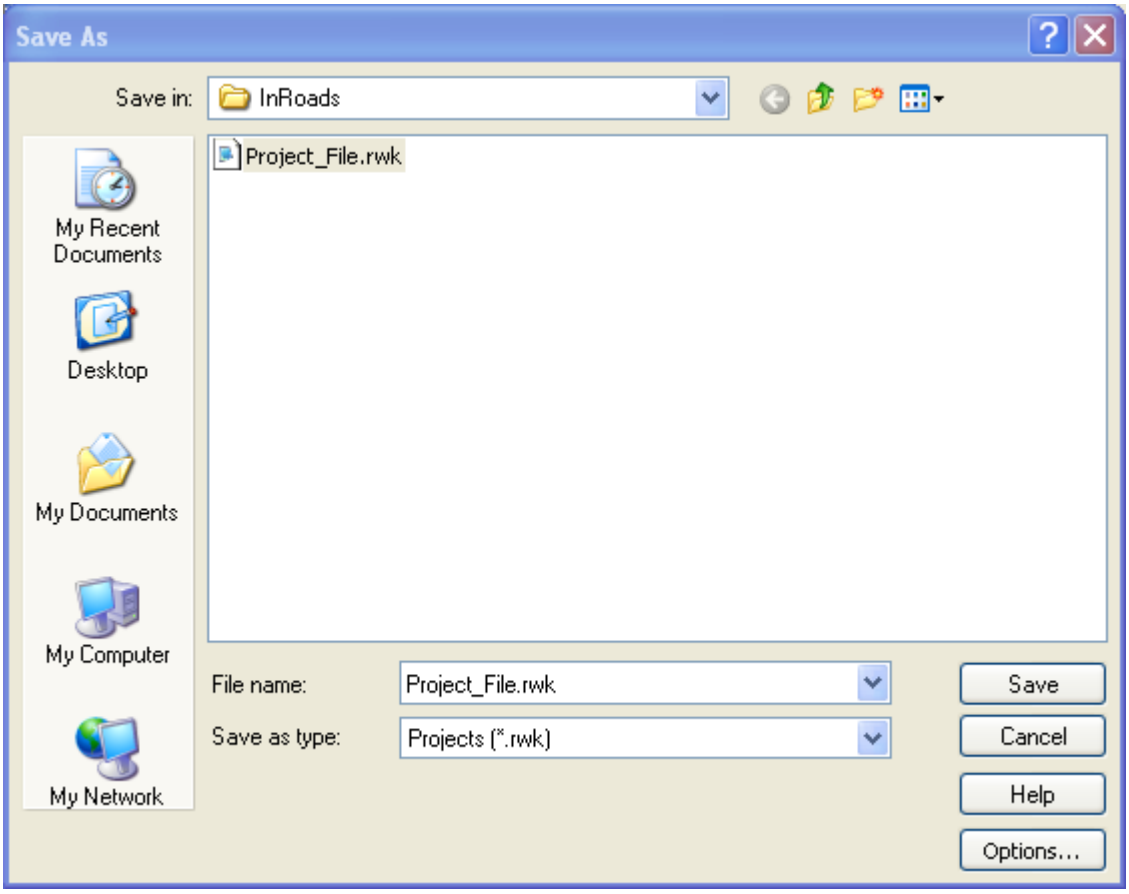


Figure 5-6 InRoads Save As Projects Dialog Box

5.2.2 Using Horizontal Alignment Tools

A. Click on **Tools > Customize**. On the Toolbars Tab, toggle to the **Horizontal Curve Set**, **Vertical Curve Set and Locks**. Click on **Close** and dock them in a logical place on the InRoads Dialog box. Figure 5-7 shows the different horizontal design tools available on the toolbar.

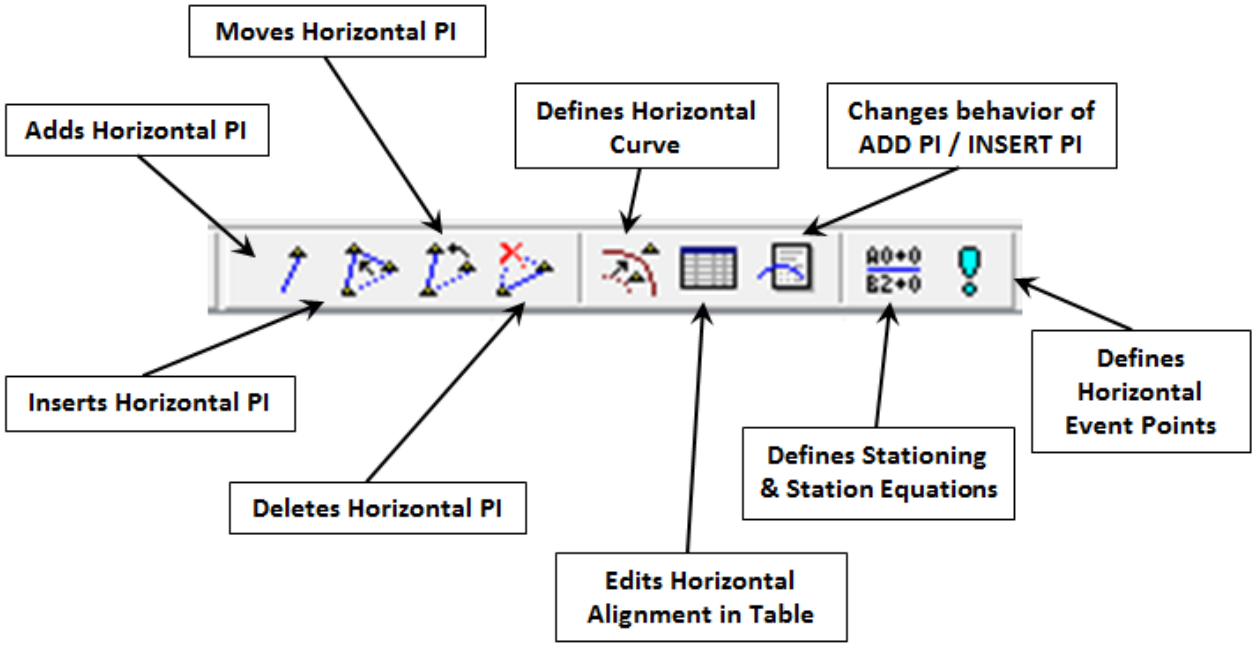


Figure 5-7 InRoads Horizontal Curve Set Toolbar

5.2.3 Importing a Linestring

Before importing a linestring we have to create a linestring using MicroStation tools. Use the alignment data below to create the linestring.

```
Horizontal Alignment Name: Linestring
              Description:
                    Style: BL
                                        STATION      NORTHING       EASTING

Element: Linear
            POB  (        )              100000     223608.10     488448.43
             PC  (        )              100017     223592.46     488440.88
         Tangent Direction:    S 25^44'39.7" W
            Tangent Length:              17.371

Element: Circular
             PC  (        )              100017     223592.46     488440.88
             PI  (        )              100069     223545.59     488418.29
             CC  (        )                         223679.33     488260.74
             PT  (        )              100119     223515.68     488375.71
                    Radius:             200.000
                     Delta:         29^09'48.5" Right
  Degree of Curvature(Arc):         28^38'52.4"
                    Length:             101.800
                   Tangent:              52.028
                     Chord:             100.704
           Middle Ordinate:               6.442
                  External:               6.657
         Tangent Direction:    S 25^44'39.7" W
          Radial Direction:    N 64^15'20.3" W
           Chord Direction:    S 40^19'34.0" W
          Radial Direction:    N 35^05'31.8" W
         Tangent Direction:    S 54^54'28.2" W

Element: Linear
             PT  (        )              100119     223515.68     488375.71
            POE  (        )              100168     223487.81     488336.05
         Tangent Direction:    S 54^54'28.2" W
            Tangent Length:              48.473
```

A. Click on **File > Import > Geometry**.

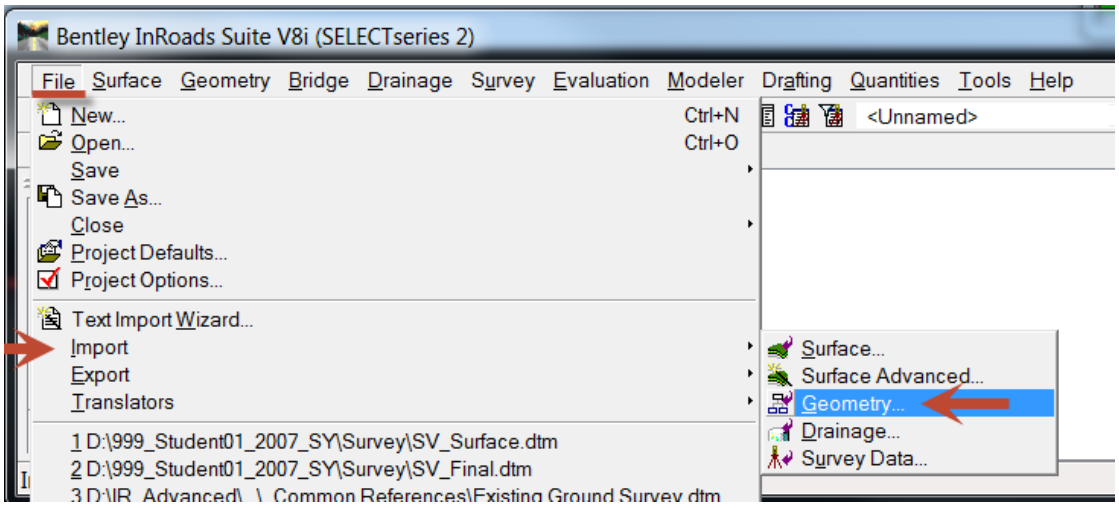


Figure 5-8 Import Geometry Tool

B. Type **Linestring** in the Name box. Style: **BL**, Curve Definition: **Arc,** for the Target Geometry Project select **Geometry_Project**, then click Apply.

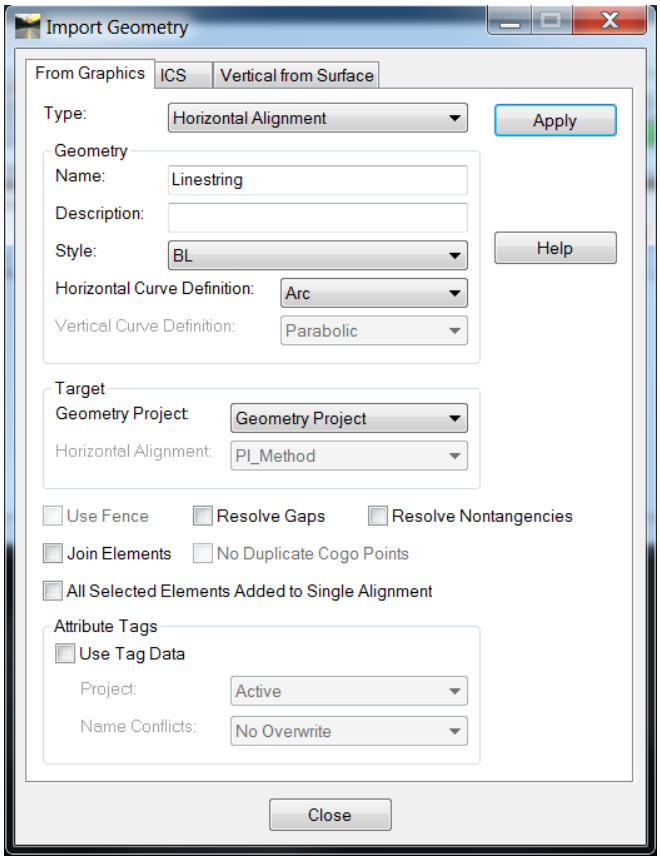


Figure 5-9 InRoads Import Geometry Dialog Box

C. You will now be prompted to pick an element from the graphics. Select the **thick red line** on the side road shown in Figure 5-10. Then click again to accept.

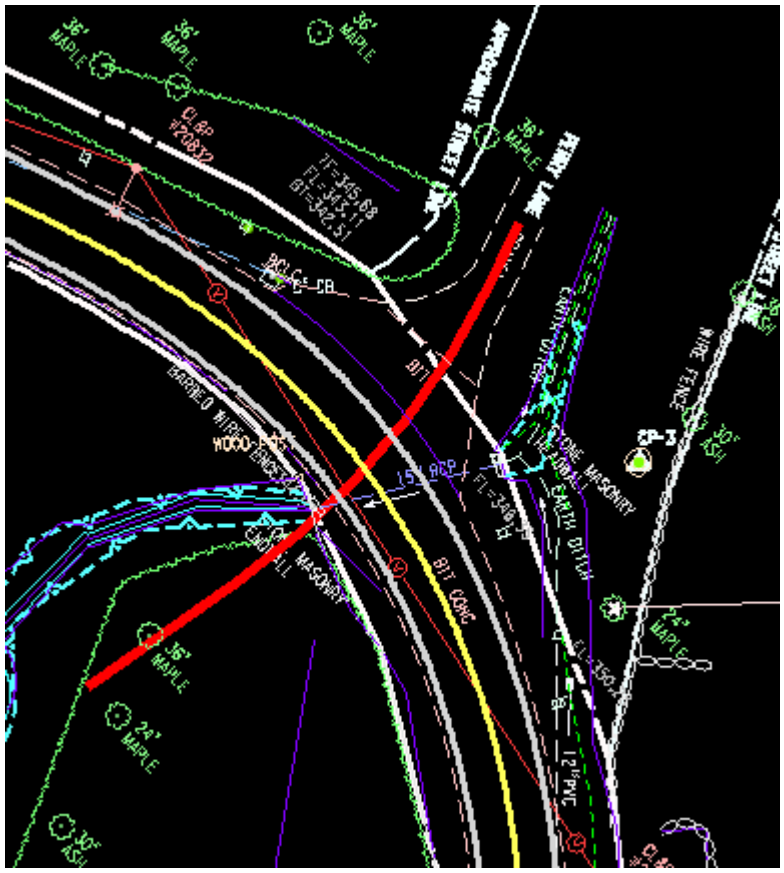


Figure 5-10 Location of Linestring to Import

5.2.4 PI Method

A. On the **Locks** toolbar, toggle **Pen/Pencil** to **Pencil.** Toggle on **Report** and **Station** locks and set the **Point/Element** toggle to **No snap.**

B. In MicroStation Turn **OFF** the survey original ground reference file and window to the beginning of the project.

C. To modify an alignment, it must be made the active alignment. Select the **Geometry > Active Geometry**. Change the **Type** field to Horizontal Alignment. Select the alignment PI_Method from the available list, and then click **Apply**. This will make the alignment PI_Method active for editing. Click **Close**. Another method is to right click in the Alignment to be activated in the workspace bar and choose *Set Active***.**

D. Select **Geometry > Horizontal Curve Set > Add PI**.

E. For setting the first PI location data point on the top most red active point in the MicroStation file. Read the MicroStation prompts at the bottom left corner of the application as you data point. Each point will require two data points one to identify the location and another to accept the location.

F. After accepting PI 1, users will automatically be asked to select the next point. A dynamic display of the geometry tangent should follow the curser to the next point. Select the next red active point near the second stream crossing.

G. Continue to work along the project by selecting the last two red active points.

H. It a good practice to **delete** the graphics generated after creating geometry, and then redisplay the alignment elements. This will ensure that the saved alignment is the same as what is shown on the screen. Do not assume that the graphical elements shown on the screen are the same as what is in memory. If uncertain, redisplay the alignment elements. To redisplay the geometry, **Select > Geometry > View Geometry > Active Horizontal**.

I. The process for creating the horizontal geometry can be iterative. In some cases, the POB of the alignment then the POE (Point of Ending) are placed before any other PI points. The sequence for placing points does not matter. Try the tools below, place points where they seem reasonable, then insert and move points to get the desired alignment.

- Insert PI - Use this command to insert a PI between two existing PI locations. Select **Geometry > Horizontal Curve Set > Insert PI** (read and follow the MicroStation command line readout).
- Move PI - Use this command to move a PI that existing in the active alignment. Select **Geometry > Horizontal Curve Set > Move PI.**
- Delete PI - Use this command to delete a PI that exists in the active alignment. Select **Geometry > Horizontal Curve Set > Delete PI.**

J. When done trying out the commands in Step I, revise the alignment back to the red active points.

K. Redisplay the geometry**,** select **Geometry > View Geometry > Active Horizontal**.

5.2.5 Defining Curve Sets

When a PI is placed, there is no curve associated with it; rather it is just a straight element. When the PIs are in place, the curve can be added. To place a curve set between two straight elements, use the **Define Curve** command.

A. Select **Geometry > Horizontal Curve Set > Define Curve**. The Define Horizontal Curve Set dialog box appears and the first horizontal PI is listed in the dialog box.

B. There are several options on the Define Horizontal Curve Set dialog box. Figure 5-11 shows this box, and at the bottom notice the Next >, Last, and Select curve navigation buttons. If users click the **Next >** button, all of the PI points will be displayed for the alignment. With the MicroStation view, each PI tangent set is highlighted as each curve becomes the active curve.

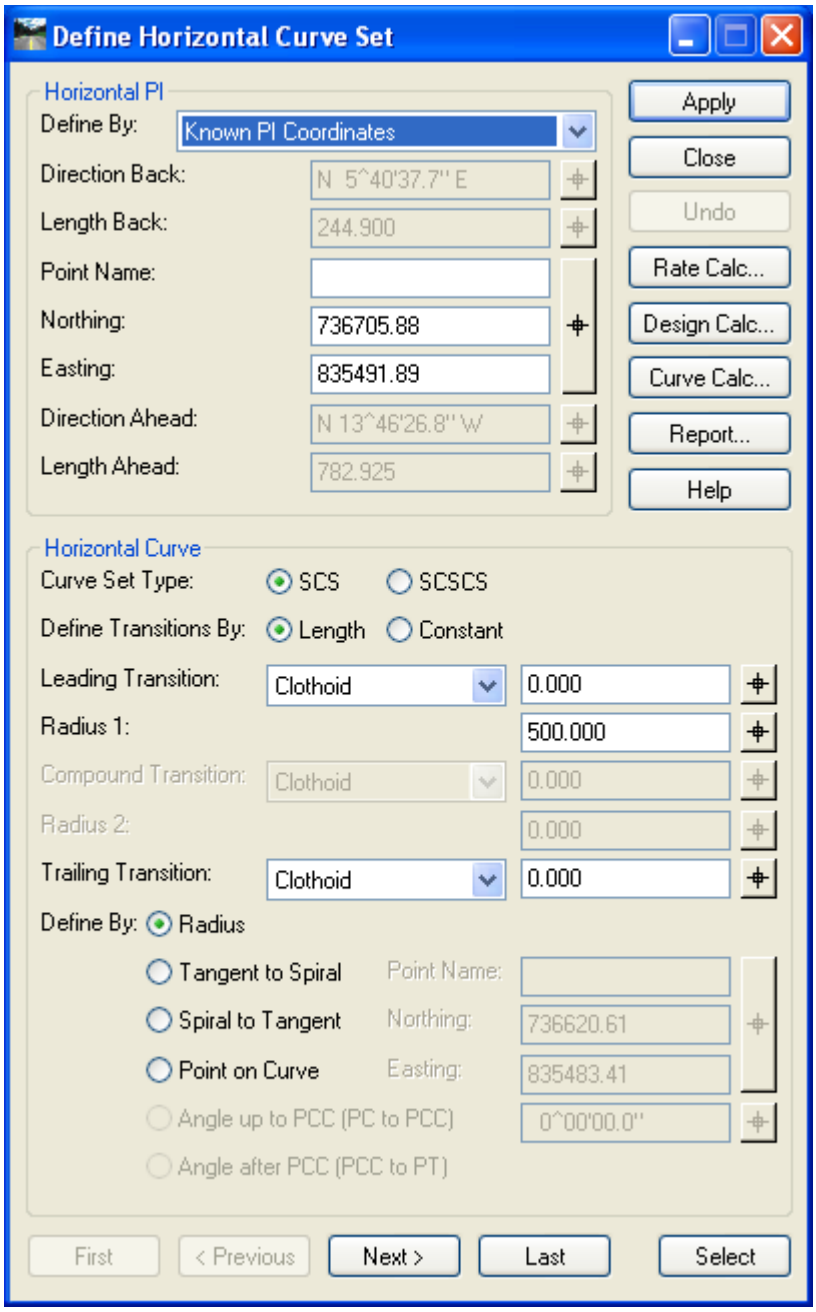


Figure 5-11 InRoads Define Horizontal Curve Set

C. In the bottom portion of the Define Horizontal Curve Set dialog box, above the curve navigation buttons, is the **Define By**: option. Select the ***Radius*** option.

D. Set the **Leading Transition** to *Clothoid*, enter 0 in the key-in field, and **TAB** to the next field.

E. Set the **Curve Set Type** to **SCS**. Go to the First curve set in the horizontal alignment. Notice that the curve radius is set to 0.00 if it has not been changed. Enter in a 500 foot curve radius for the

project. Click the **TAB** key to enter the data. Then click the **Apply** button. The curve should dynamically display the curve radius on the screen. If the radius is too large, the software will not accept it and will notify the user for a solution overlap.

F. Click **Next**. This will set the dialog box to the next PI. Select Radius 1 and key in **500**. Click **Apply** and **Close**.

G. Delete the graphics again and redisplay the alignment once more, select **Geometry > View Geometry > Active Horizontal**.

H. Save the edited geometry by selecting **File > Save > Project**. This will save the all the files added to the RWK file.

5.2.6 Define Stationing

A. Select **Geometry > Horizontal Curve Set > Stationing**.

B. In the Stationing dialog select the Horizontal Alignment "**PI_Method**".

C. In the Starting Station field, enter the stationing value for the alignment (e.g. 10+00). It is not required to type the (+).

D. Vertical Alignments options should be set to **Maintain Station Difference** unless specifically attempting to shift alignment stationing.

E. Click **Apply** and **Close**.

5.3 **Lab 17** Stationing and Annotation

5.3.1 Display Stationing

A. Click **Geometry > View Geometry > Stationing** to display the stations, major ticks, minor ticks, PC & PT cardinal leaders.

B. Expand the View Stationing folder. Click on **General** and for Horizontal alignment select: **PI_Method**. The correct Symbology boxes should already be checked off.

C. Click **Apply** and **Close**.

5.3.2 Display Bearings

A. Click **Geometry > View Geometry > Horizontal Annotation**

B. Click on the pick button and data point on the alignment to annotate. The alignment name should now appear in the Horizontal Alignments field.

C. Click **Apply** to add the bearings and click **CLOSE.**

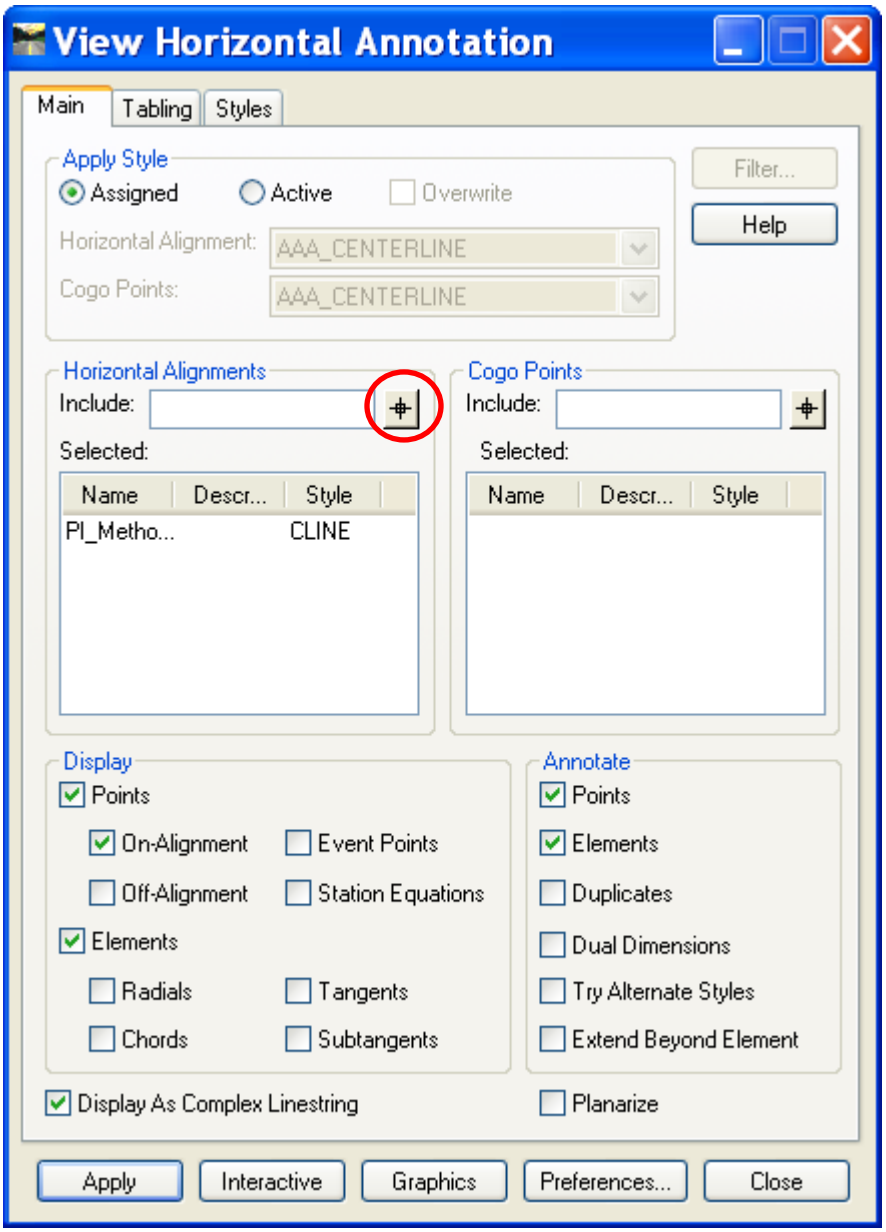


Figure 5-12 InRoads View Horizontal Annotation Dialog Box

5.3.3 Display Curve Data

A. Click **Geometry > View Geometry > Curve Set Annotation.** Click on the pick button and data point on the alignment that you want to annotate. The alignment name should then appear in the Horizontal Alignment field.

B. Click **Apply** and **Close**.

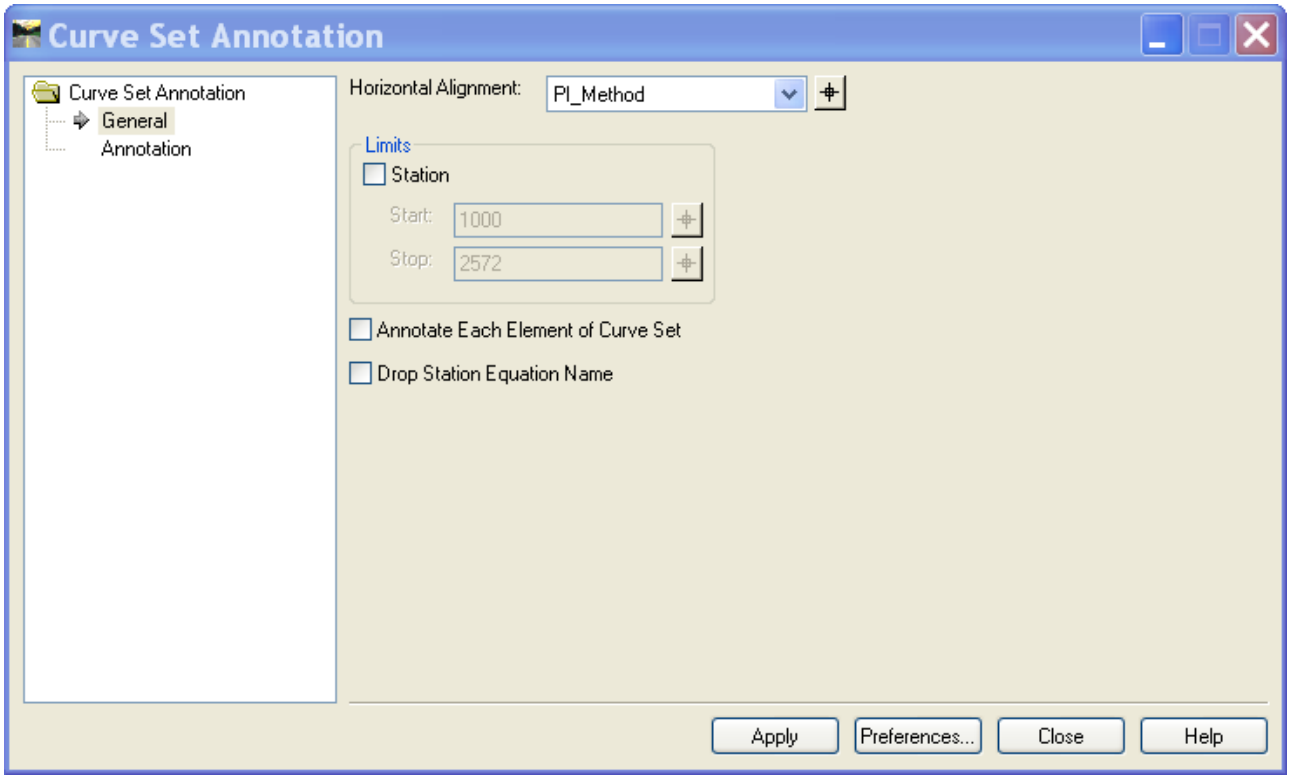


Figure 5-13 Curve Set Annotation

5.3.4 Display Intersection Coordinates

A. Click **Drafting > Place Alignment Intersecting Note**

B. Click on the **Plan** folder to expand the list of plan notes.

C. Select the note **Intersection Alignment Annotation.**

D. Toggle **OFF** the Rotate option.

E. Click **Apply**.

F. Identify the first horizontal alignment by data pointing on it.

G. Click again to accept it.

H. Identify the second horizontal alignment by data pointing on it.

I. Click again to accept it.

J. Data point in the “quadrant” or corner of the intersection to place the leader and text for the intersection alignment information to be placed.

K. The text will now be interactive with the cursor. Click again to place the graphics at the desired location. Figure 5-14 displays a section of an annotated Alignment Intersection.

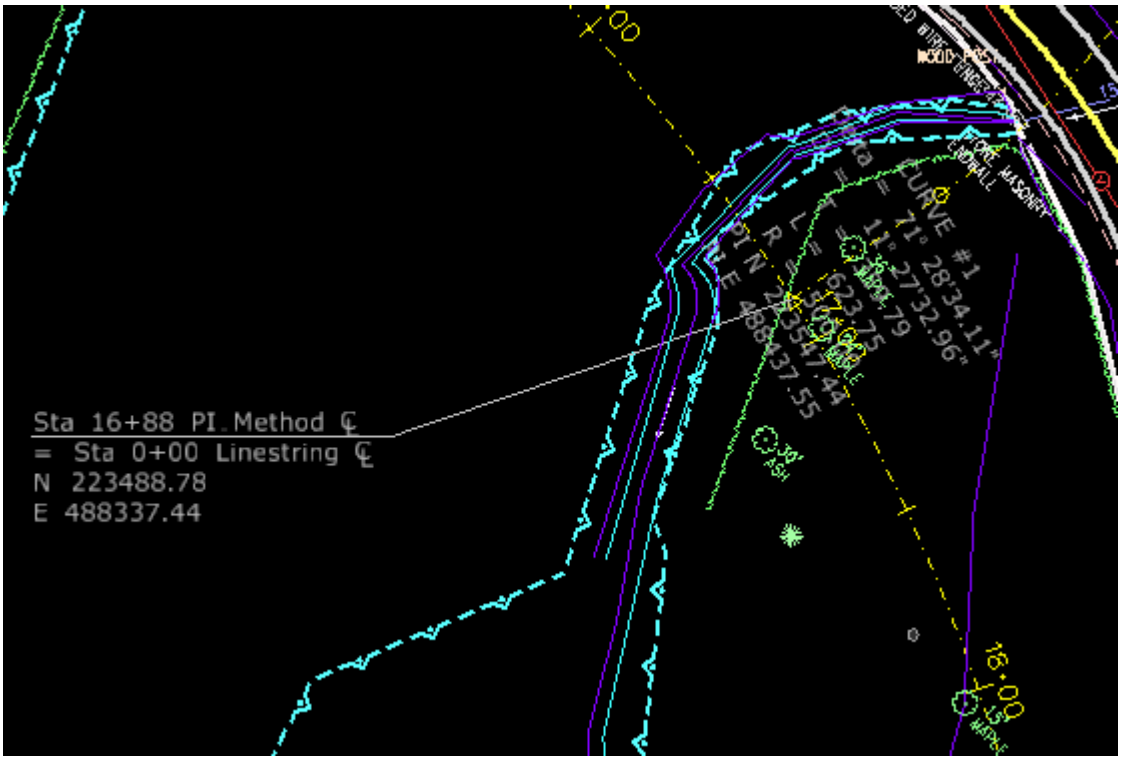


Figure 5-14 Annotated Alignment Intersection

Section 6 Profiles and Vertical Alignments

This section will focus on the basic InRoads tools used to layout vertical control geometry. Vertical geometry is the defined vertical data at or relative to the horizontal control geometry. For example, the vertical geometry defines the grade of the roadway and the vertical curves. In order to layout and design the vertical geometry, a profile generated along a defined horizontal geometry is needed.

6.1 **Lab 18** Working with Profiles

6.1.1 Placing a Profile Window

A. Go to **Evaluation > Profile> Create Profile**.

B. Click on **Source** and select **Alignment**. Make sure that **PI_Method** is the alignment listed. The **Create** data field should be set to **Window and Data**.

C. Click on **General**, the **Set Name** data field should be set to PI_Method. In the Surfaces area, toggle on the existing surface. In the **Exaggeration** area, set the **Vertical** exaggeration to **10.000** and the **Horizontal** exaggeration to **1.000**.

D. Select **Include**. Make sure that Crossing Features and Projected Features are **not** checked.

E. Click on the Details folder and for Title Text: input PI_Method

F. In MicroStation, rotate the view to TOP, and then fit the view. Click the **Apply** button and data point to a blank area in the MicroStation View. This will place a profile window. Click **Close**.

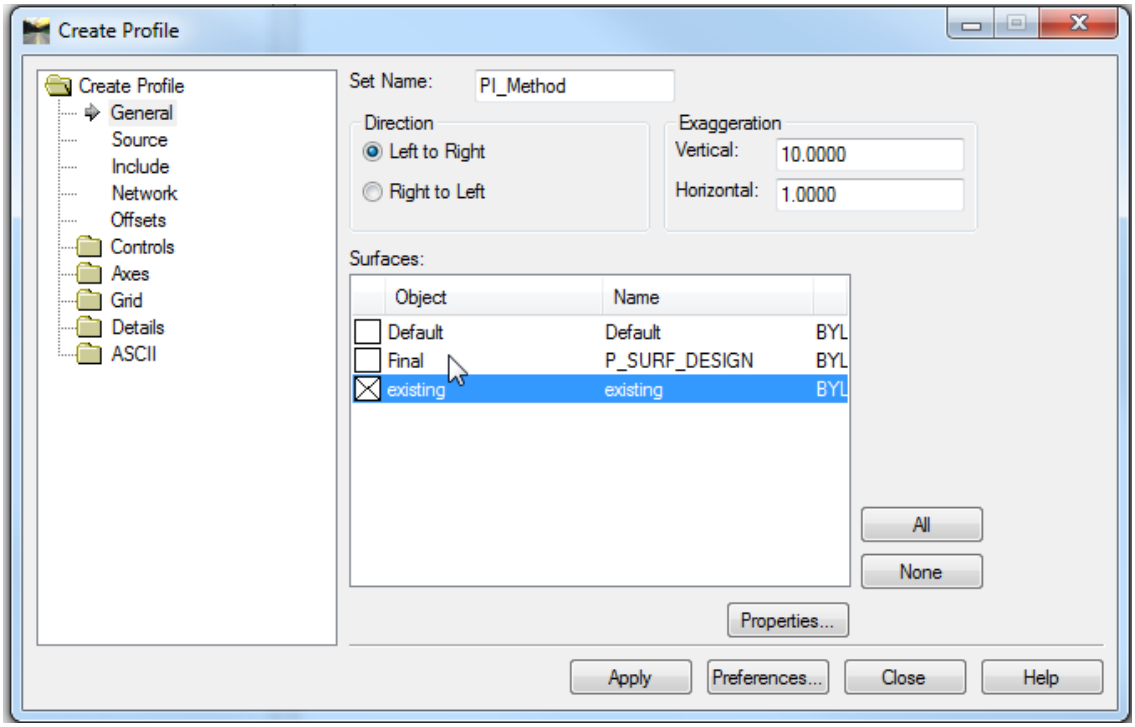


Figure 6-1 Create Profile Dialog Box

6.1.2 Updating a Profile Display

The steps below will result in the projected feature being deleted from the profile.

A. Select **Evaluation > Profile > Update Profile**.

B. In the **Profile Set** data field, select the profile set. It is possible that the profile set name is PI_Method _1, because each time a new profile is created, a new profile set is also created. Select the most recently created set.

C. In the Mode section, toggle on **Display On**. Select **Final**. In the Surfaces section, Click **Apply**.

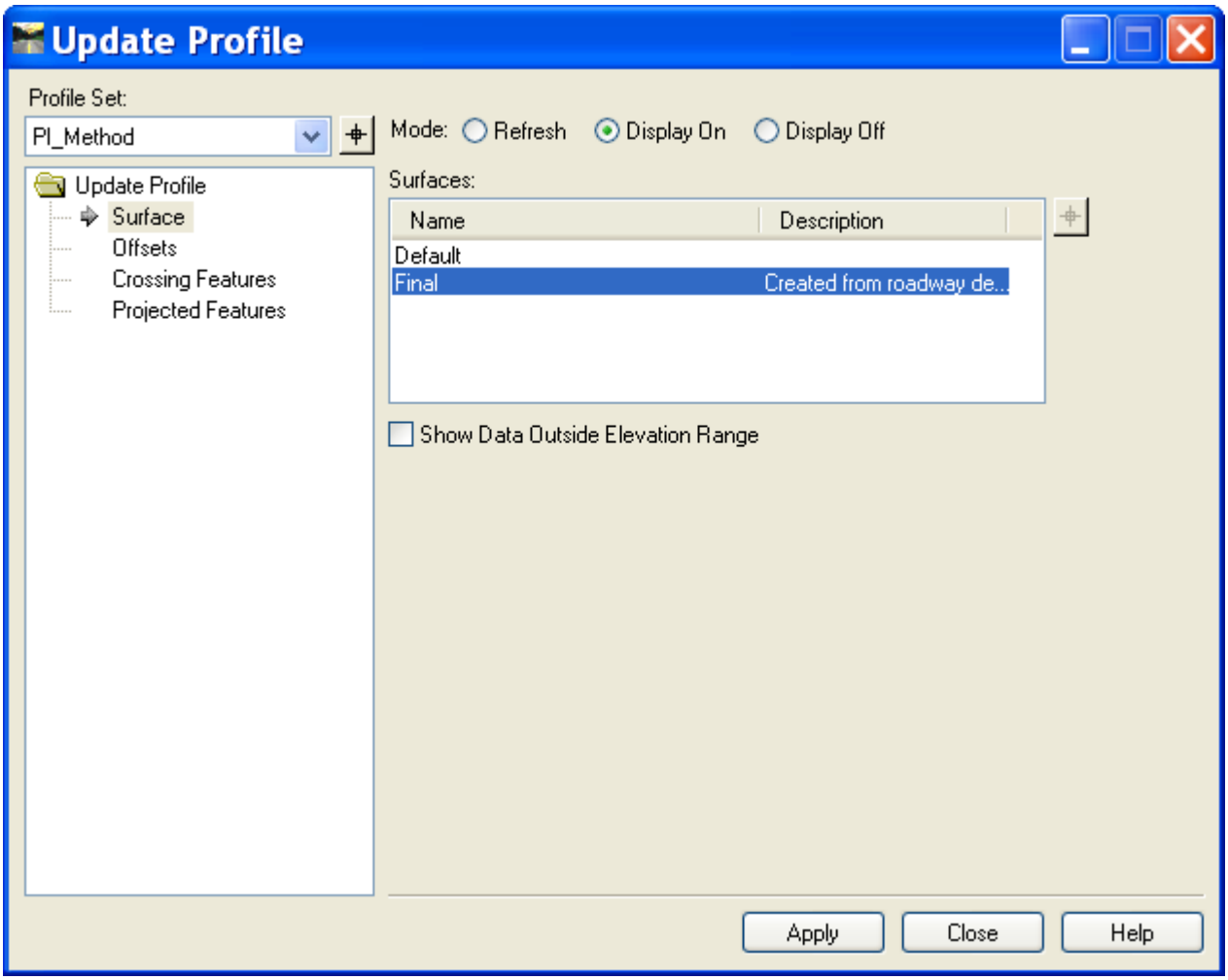


Figure 6-2 Update Profile

D. Try to figure out how to turn the Final surface back off.

6.2 **Lab 19** Working with Vertical Alignments

6.2.1 Creating a Vertical Alignment

Lab 14 of this manual explains the process for creating and naming a Vertical Geometry. At this point, there should be an empty vertical geometry. This had been created and named as a child of the Horizontal geometry which was used to create the profile.

A. Using the **View** [**Zoom**] command, set the MicroStation view so that only the profile is showing.

B. Make sure that the **Pen/Pencil** mode is set to **Pencil** and **PI_Method** is active for the Horizontal and **PI_Method_1** is active for the vertical.

C. Select **Geometry > Vertical Curve Set > Dynamic Settings.**

The **Dynamics Settings** dialog box can be used to set a delta station, elevation, or grade on vertical elements. If a section were toggled on, that parameter would be set. This does not need to be used when creating or modifying a vertical alignment, but it is a helpful tool. Example: If the **Grade** section of the dialog box was toggled on, and a grade of 1.00% was entered in the dialog box, then as the user moves the cursor across the profile, the tangent line following the cursor would snap to the even 1% grades (-5.0%, -4.0%, -3.0%, etc.). Select **Geometry > Vertical Curve Set > Add PI**. Tentative to the intersection of station 11+00 and the existing surface in the profile window and data point to accept.

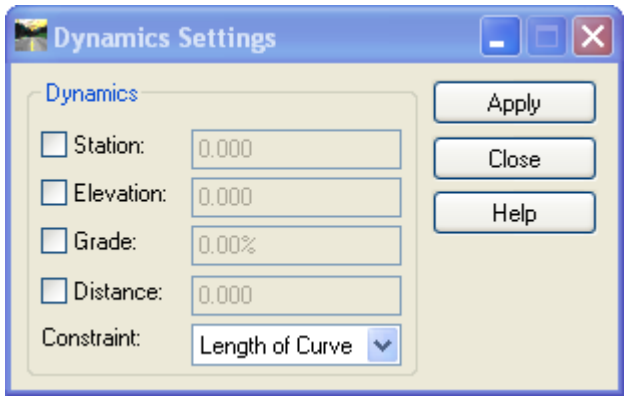


Figure 6-3 InRoads Dynamics Settings Dialog Box

D. Click on the Key Point Snap in MicroStation. Continue down the profile placing PVI's and accept each input. Read and follow the MicroStation command prompt to accept (data point) the PVI location. Try using the Dynamic settings.

E. Try the **Move and Delete Vertical PI tools**.

Notice that as the cursor moves, the tangent line follows it. The message "Out of Range" means that the cursor is located such that the vertical alignment overlaps itself. If the message "Profile not found" appears, this means the cursor is no longer in the profile window.

6.2.2 Defining Vertical Curves

Now the vertical curves can be set. The **Define Vertical Curve** command works just like the **Define Horizontal Curve. The Define Vertical Curve** command finds the first PVI or curve set on an alignment.

A. Select **Geometry > Vertical Curve Set > Define Curve**.

B. In the **Vertical Curve** section of the **Define Vertical Curve** dialog box, set **Calculate By** to Length of Curve and enter a **Length.** Click **Apply**. The vertical alignment display is updated with the vertical curve definition.

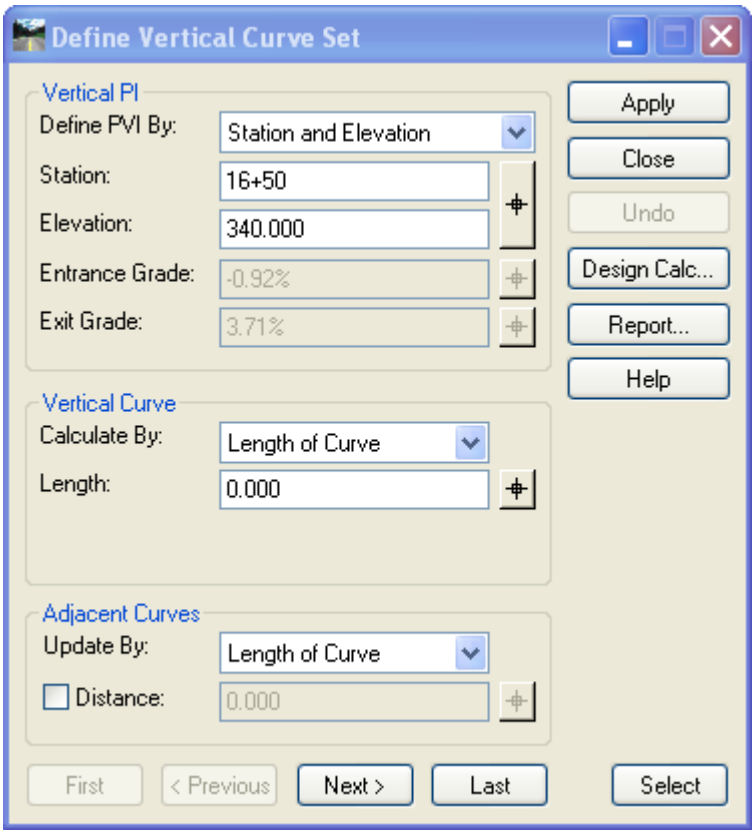


Figure 6-4 InRoads Define Vertical Curve Set Dialog Box

C. Click **Next** and add a length and click **Apply**.

D. Click **Next** and add a length and click **Apply**. Continue for each PVI.

E. **Close** the dialog box and **Save** the Project.

6.2.3 Annotating a Vertical Alignment

Vertical Geometry Annotation is the annotation of vertical elements in a profile.

A. Select **Geometry > View Geometry > Vertical Annotation**. Select the correct Horizontal Alignment and Vertical Alignment.

B. Select the Profile Set. Do not turn on any of the Limits. Click **Apply**. The vertical alignment is annotated. Click **Close.**

Section 7 Cross Sections Creation

7.1 **Lab 20** Placing Cross Sections

7.1.1 Creating Working Cross Sections

A. Select **Evaluation > Cross Section > Cross Sections…**

B. Open the **Create Cross Section folder.**

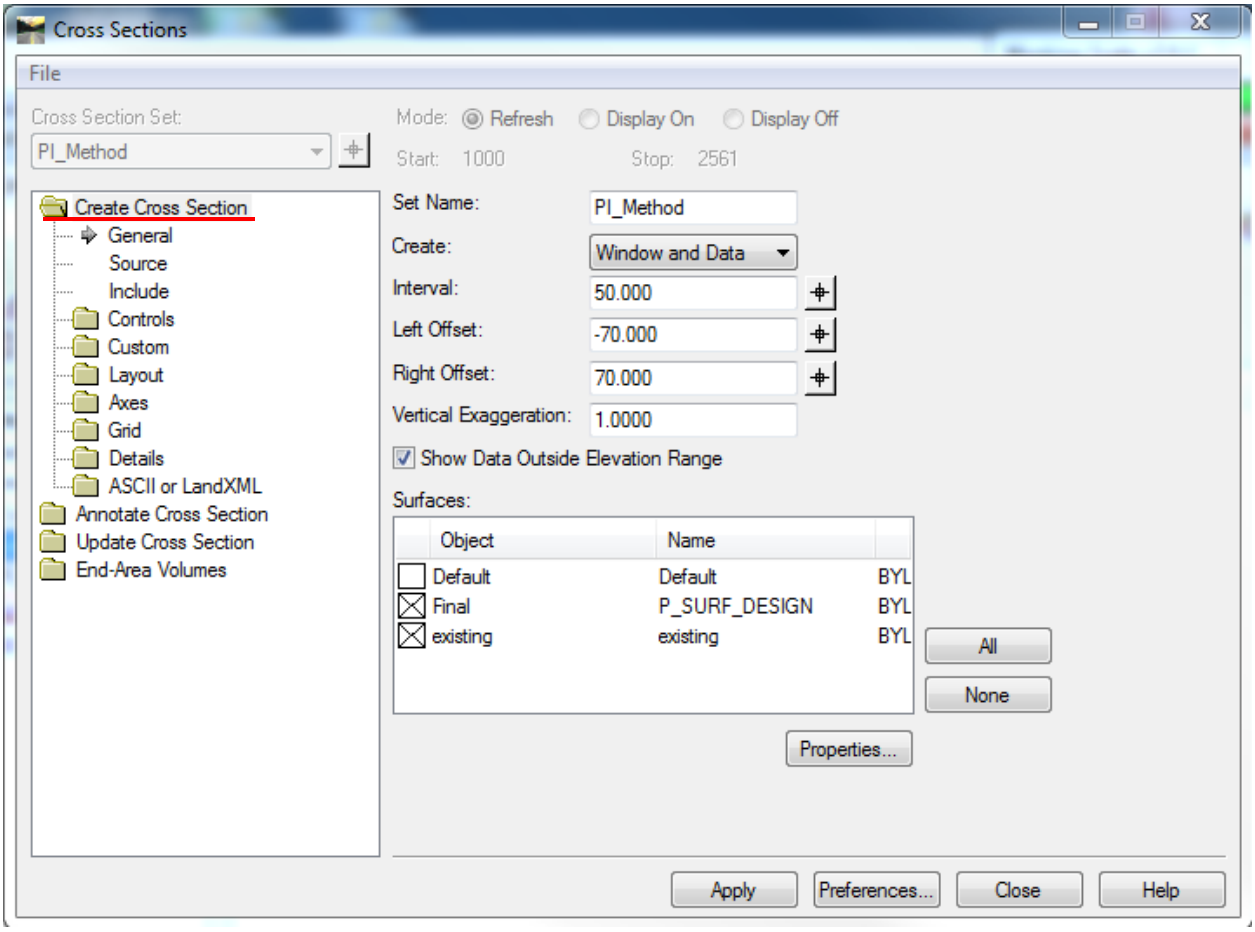


Figure 7-1 InRoads Create Cross Section Dialog Box

C. Click on the existing and Final surfaces.

D. Make sure **Interval** is set to **50**.

E. Click **Apply** and data point in the file where to place the cross sections.

7.1.2 Generating End-Area Volumes

A. In the Cross Sections box. Select the folder **End-Area Volumes**.

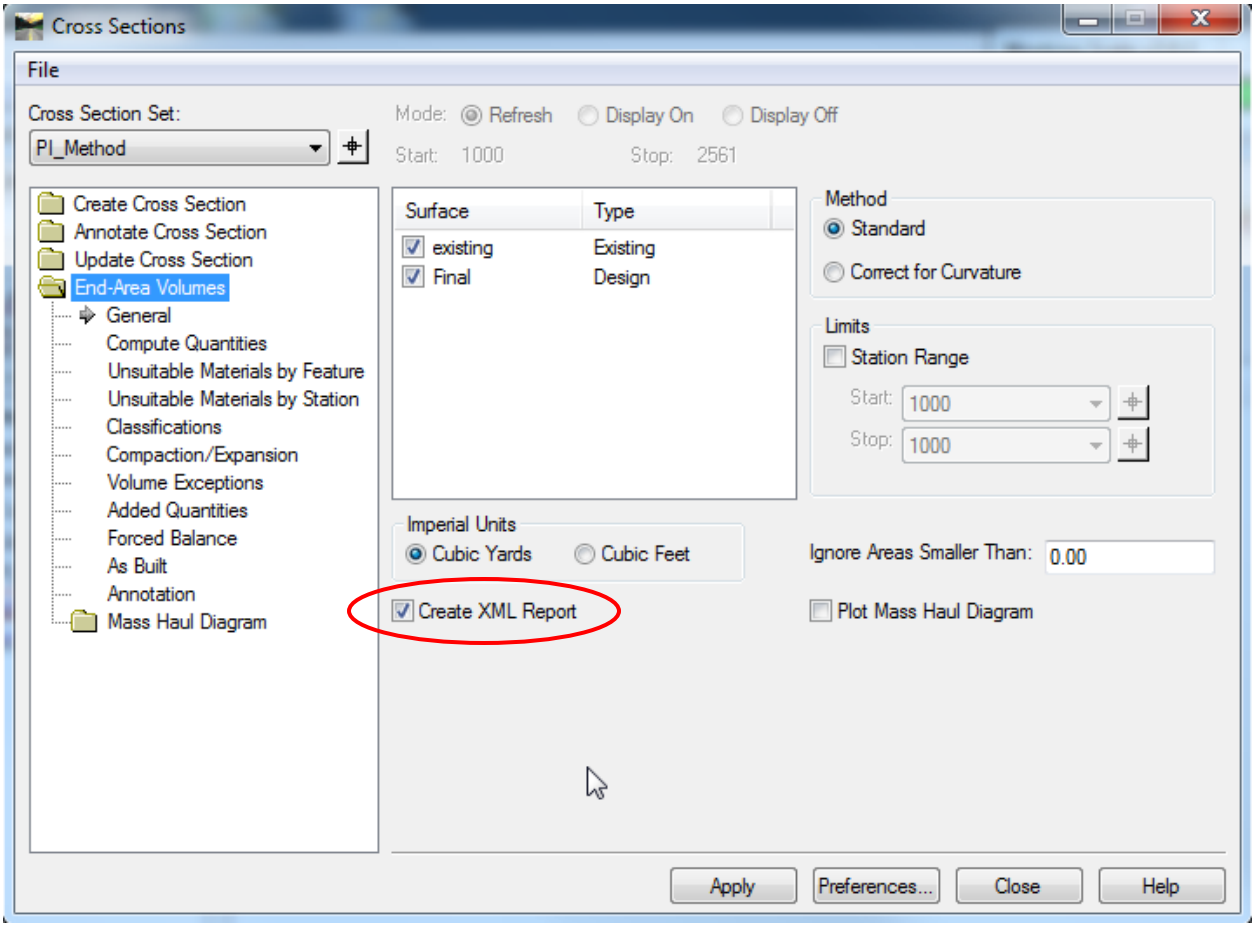


Figure 7-2 InRoads End-Area Volumes Dialog Box

B. Select the name of the cross section set that was just created (PI_Method). A rectangle is displayed around the cross section set in the design file. It may be necessary to zoom out to see it.

C. For the general tab, make sure the **existing** and **Final** surfaces are checked on. Make sure **Create XML Report** is checked on, click **Apply.**

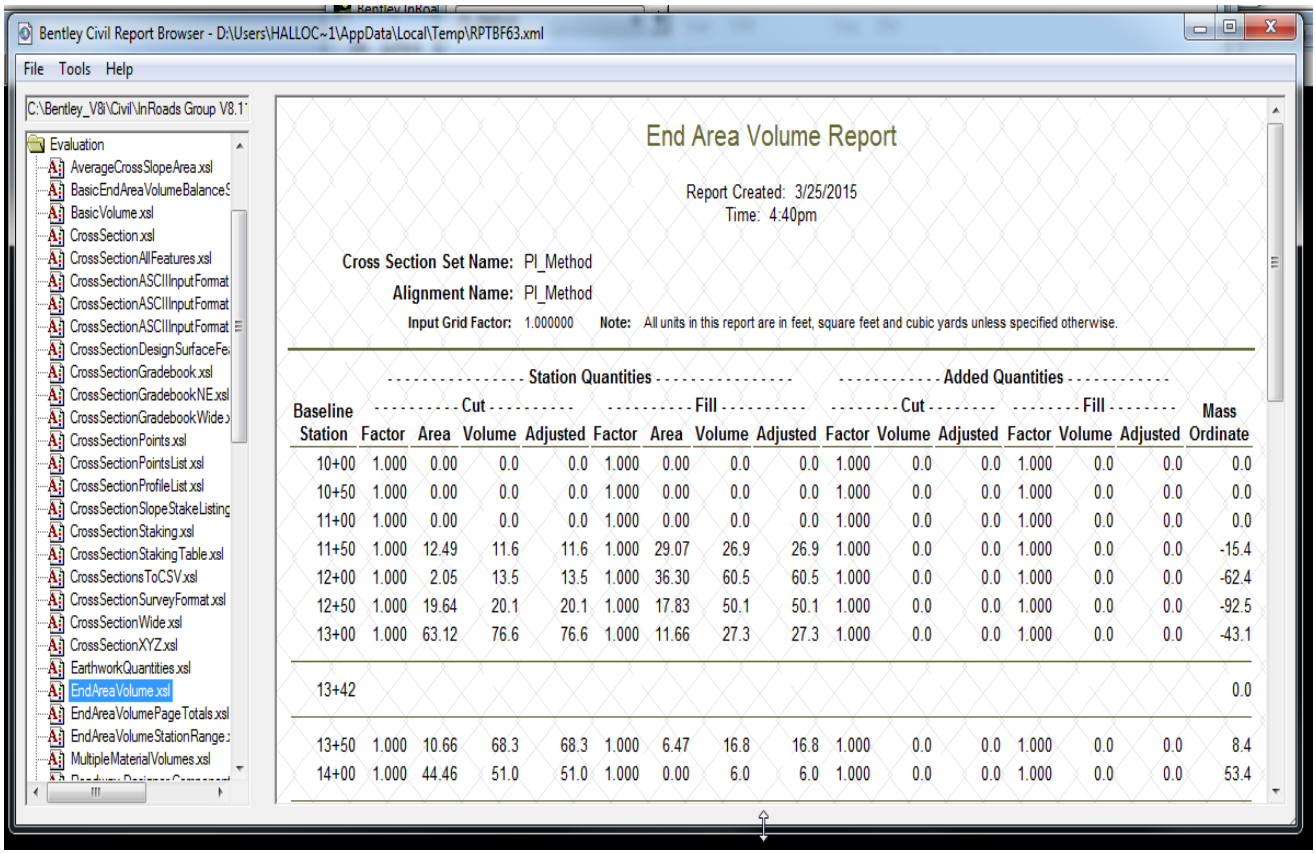


Figure 7-3 InRoads Report Browser Basic End Area Report

D. View the cross sections that have been created. The shaded area represents fill and cut sections.

7.1.3 Generating Cross Section Sheets

The typical final cross section sets are cut perpendicular to the mainline horizontal alignment. Final cut sheets can be created using the command Create Cross Sections. This command is used to extract cross sections along the active horizontal alignment. Multiple cross sections are extracted and displayed with the CTDOT standard cell border.

A. From the InRoads main menu select **Evaluation > Cross Section > Cross Sections…**

B. Open the **Create Cross Section folder.**

C. Load the InRoads Preference **Survey Xsc Bdr Format.**

D. In the **General** settings, toggle on the surfaces **Final** and **existing.**

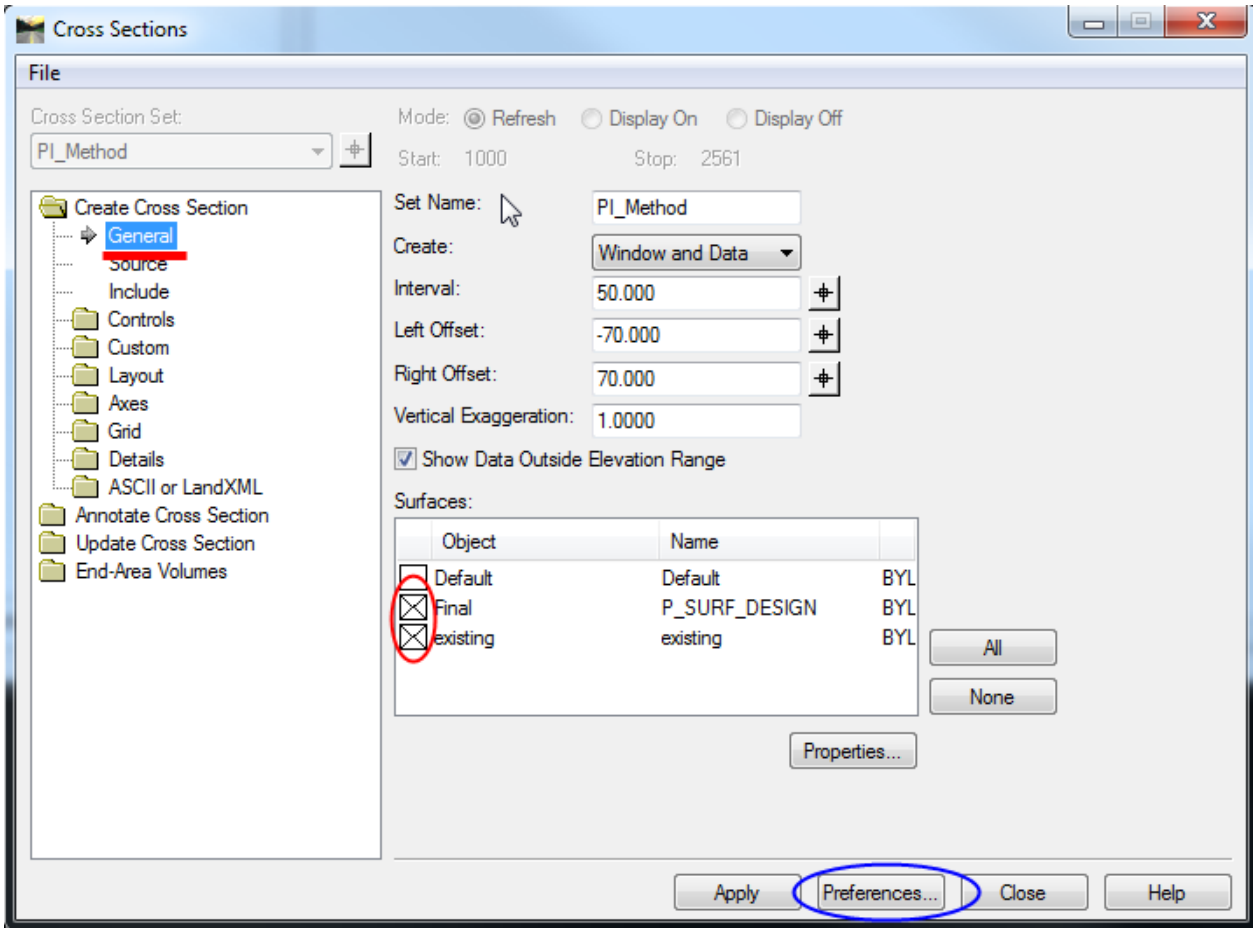


Figure 7-4 InRoads Create Cross Section Dialog Box - General Folder

E. Select the **Layout** folder, mode should be set to **Sheet**.

F. Select Sheet Border and for the cell name should be set to **BDR_XSC_HW.**

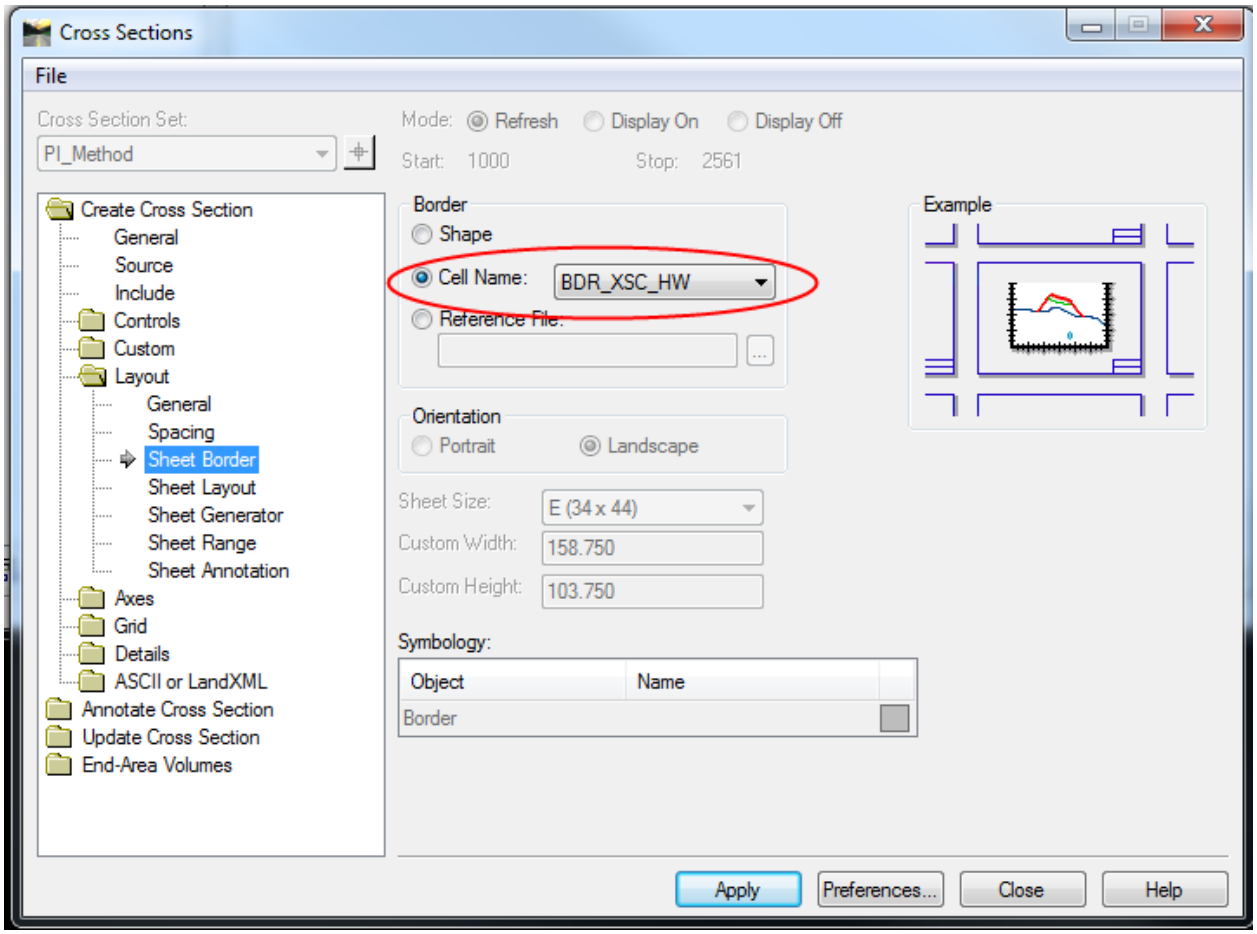


Figure 7-5 InRoads Create Cross Section - Sheet Border Folder

G. Select **Include** and un-check all the options.

H. Select **Apply** and follow the prompts. Click **Close.**

I. On the MicroStation Menu Bar select **Location Survey > True Scale Cells.**

J. On the MicroStation Menu Bar select **Element > Cells.** Select File > Attach File…and browse to **W:\Highways_Workspace\Standards\cell\ HW_Existing_Features.cel.** Select **Open.**

K. Bring the cross section at station 24+00 to view. On InRoads Menu Bar go to **Evaluation > Cross Section > Update Cross Section**. Select Mode: **Display On**, select **Crossing Features**, Surface: **existing**, right click in Feature and choose **Select All**.

L. Select **Apply** and review what displayed on the cross section.

M. Bring the cross section at station 24+00 to view. Go to **Evaluation > Cross Section .** Open the **Update Cross Section** folder. Select **Display On**, **Projected Features**, **existing**, right click in Feature and choose **Select All**.

N. For Bandwidth select **redefine**. Enter **25** for both Ahead and Back.

O. Select **Apply** and review what displayed on the cross section.

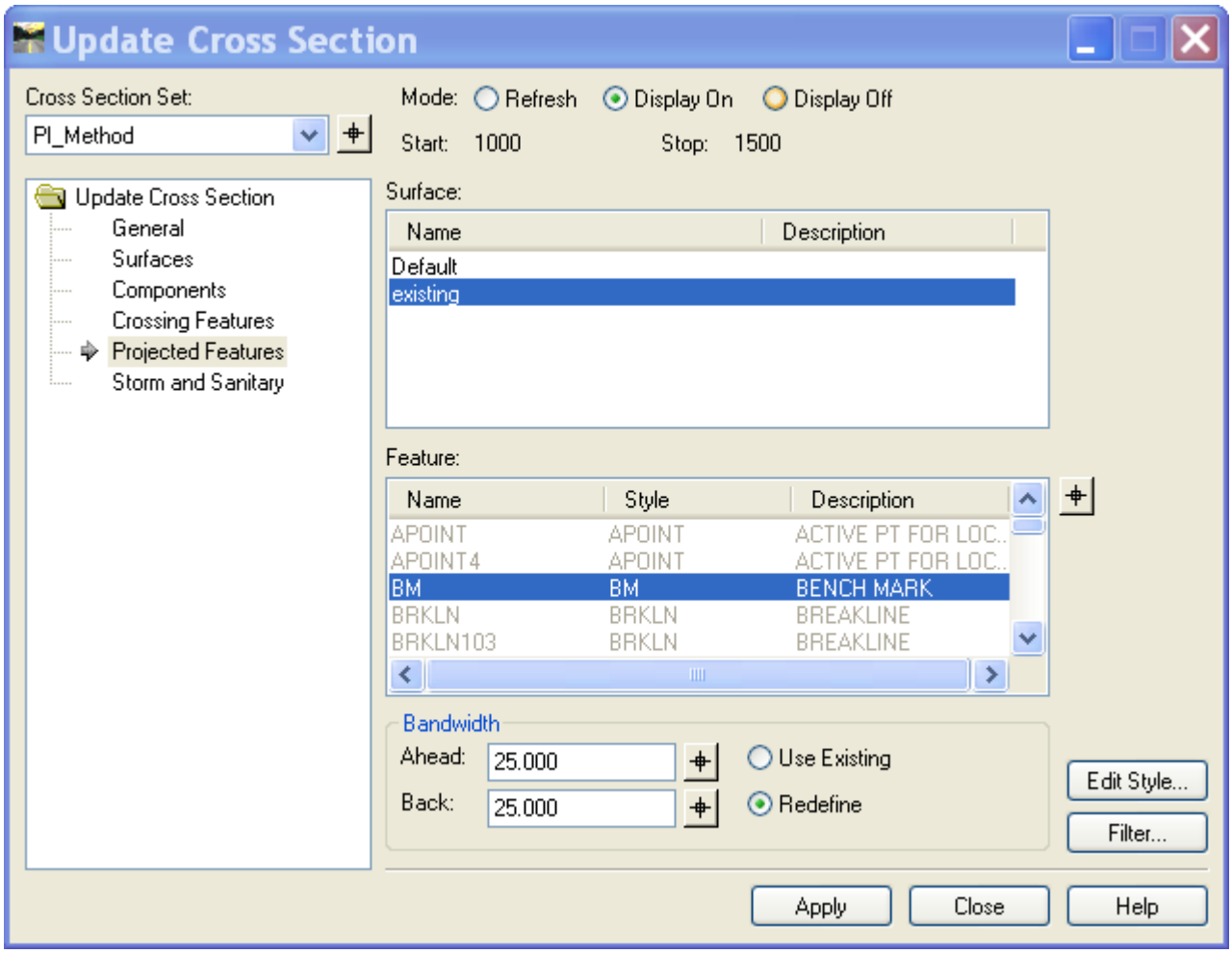


Figure 7-6 InRoads Update Cross Section Dialog Box

7.2 **Lab 21** Using Cogo Points to Create a Surface

A. Select **Geometry > COGO Points > New**. Change Define by to **Station/Offset,** Horizontal Alignment to **PI_Method** and select the Style **APOINT.**

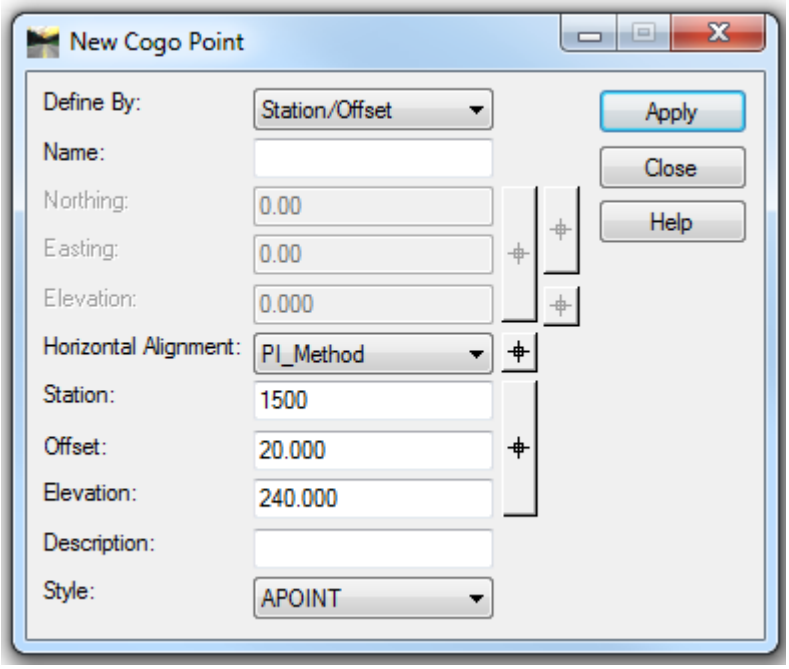


Figure 7-7 New Cogo Point

B. Enter the following for Offset and Elevation

Station	Offset	Elevation
15+00	20	240
	10	241.5
	0	242
	-10	241.5
	-20	239
15+50	20	238
	10	239.5
	0	240
	-10	239.5
	-20	237
16+00	20	236
	10	237.5
	0	238
	-10	237.5
	-20	235

C. In MicroStation turn off the reference file and the alignment levels.
D. Back in InRoads select **File > Import > Surface.**

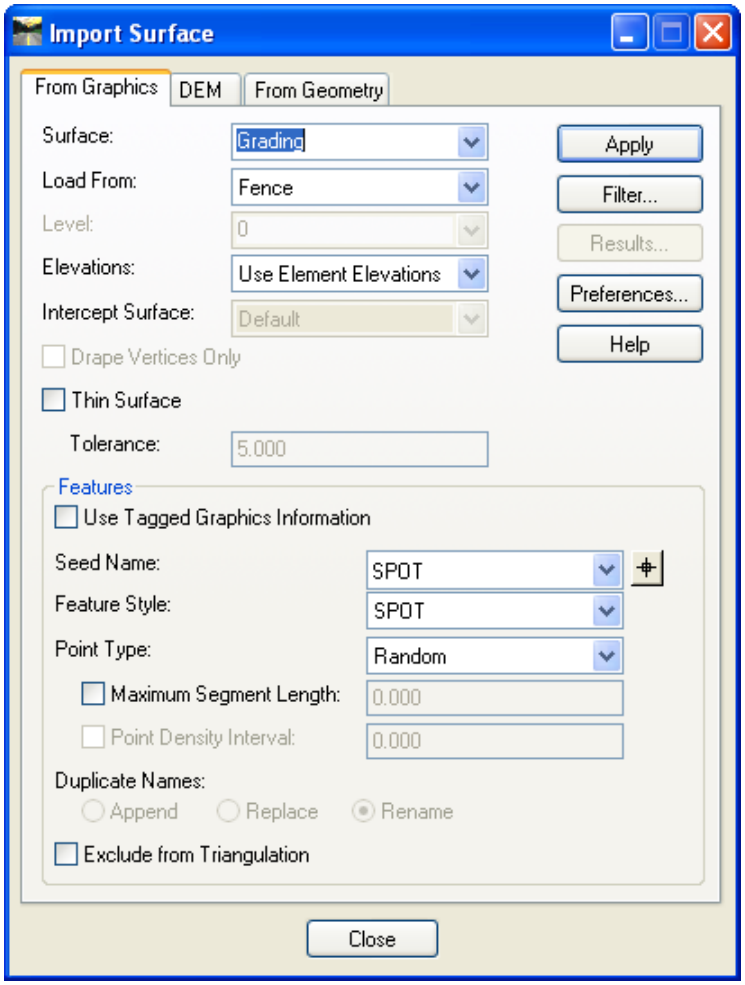


Figure 7-8 Import Surface from Graphics

E. For Surface type **Grading**. Make sure Load From is set to **Fence** and Elevations is set to **Use Element Elevations**. Enter **SPOT** in the Seed Name, select **SPOT** as the Feature Style and set Point Type to **Random**. Place a fence around the 15 spot shots and click the **Apply** button. In the MicroStation window it should say *Import Complete*. Click **Close**.

F. Select **Surface > View Surface > Contours**, select the Grading surface and click **Apply** button.

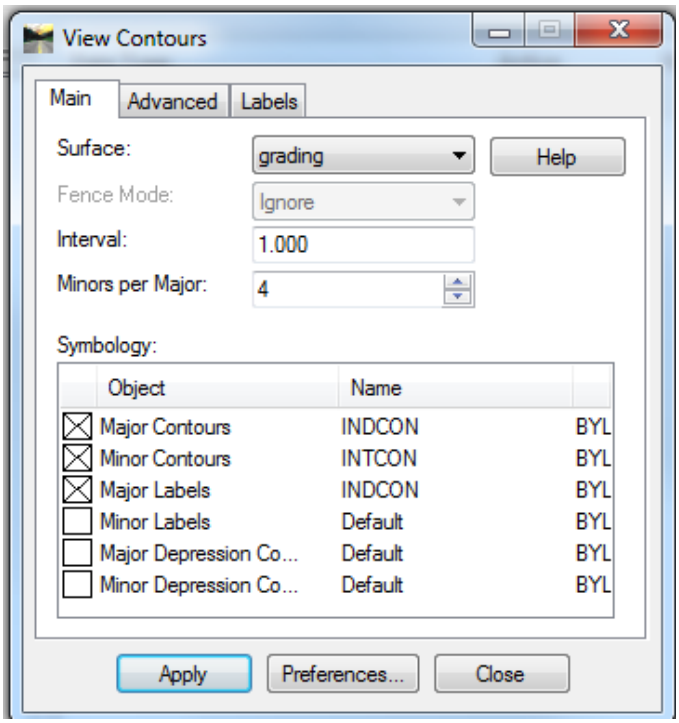


Figure 7-9 View Contours

G. Select **Evaluation > Cross Section > Cross Sections...**. Display the Grading surface on Cross Section at Station 15+00 to 16+00.

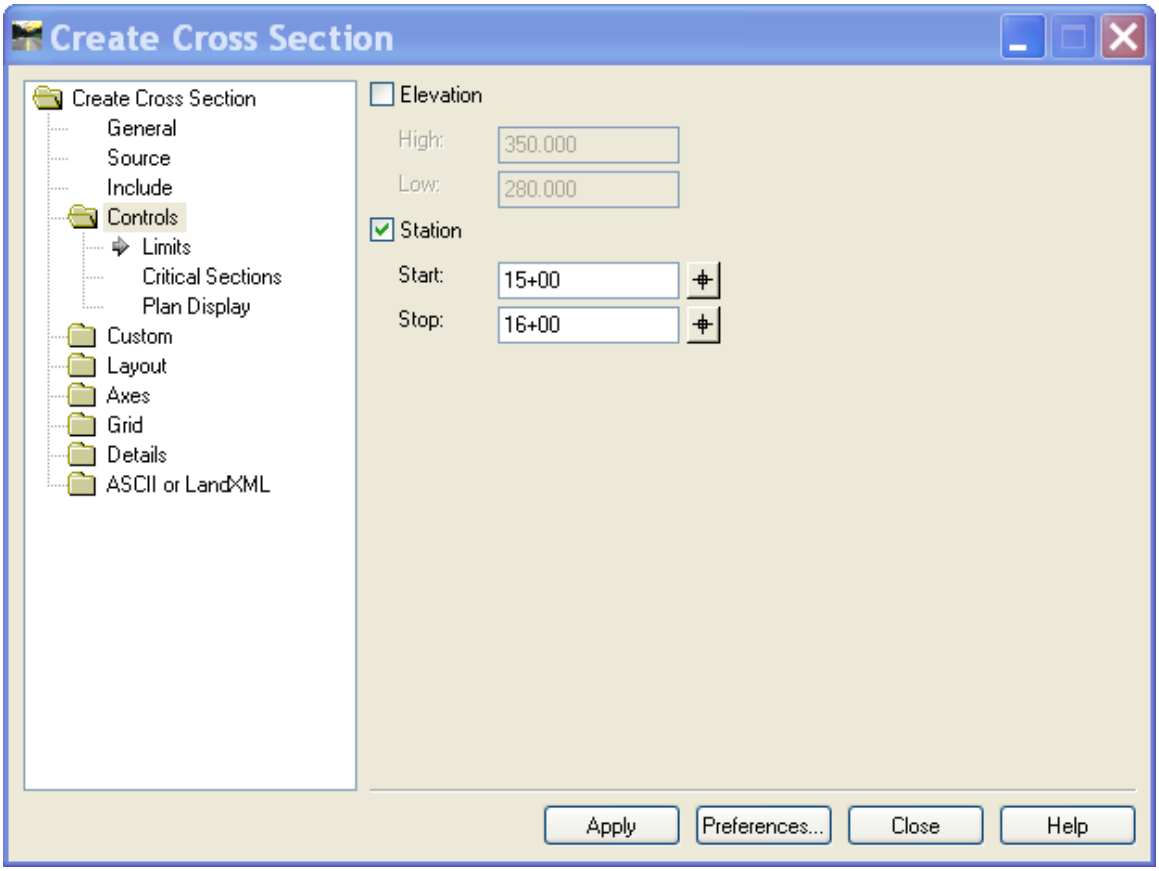


Figure 7-10 Create Cross Section

H. Select **Surface > Surface Properties**. On the Advanced tab change the symbology to **Existing** and click **Apply.**

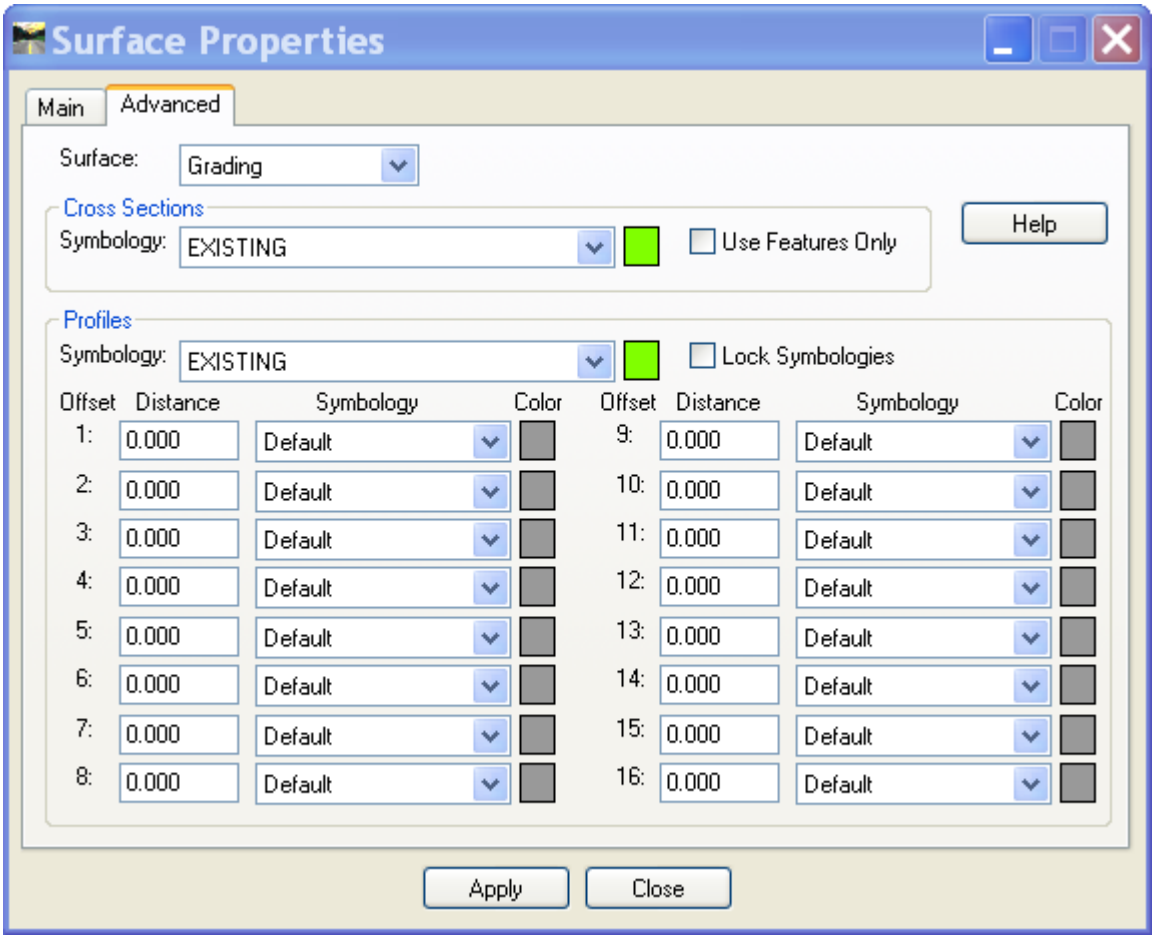


Figure 7-11 Surface Properties

J. Update the surfaces on the Cross Sections to display the new symbology. Select **Evaluation > Cross Section > Update Cross Section**.

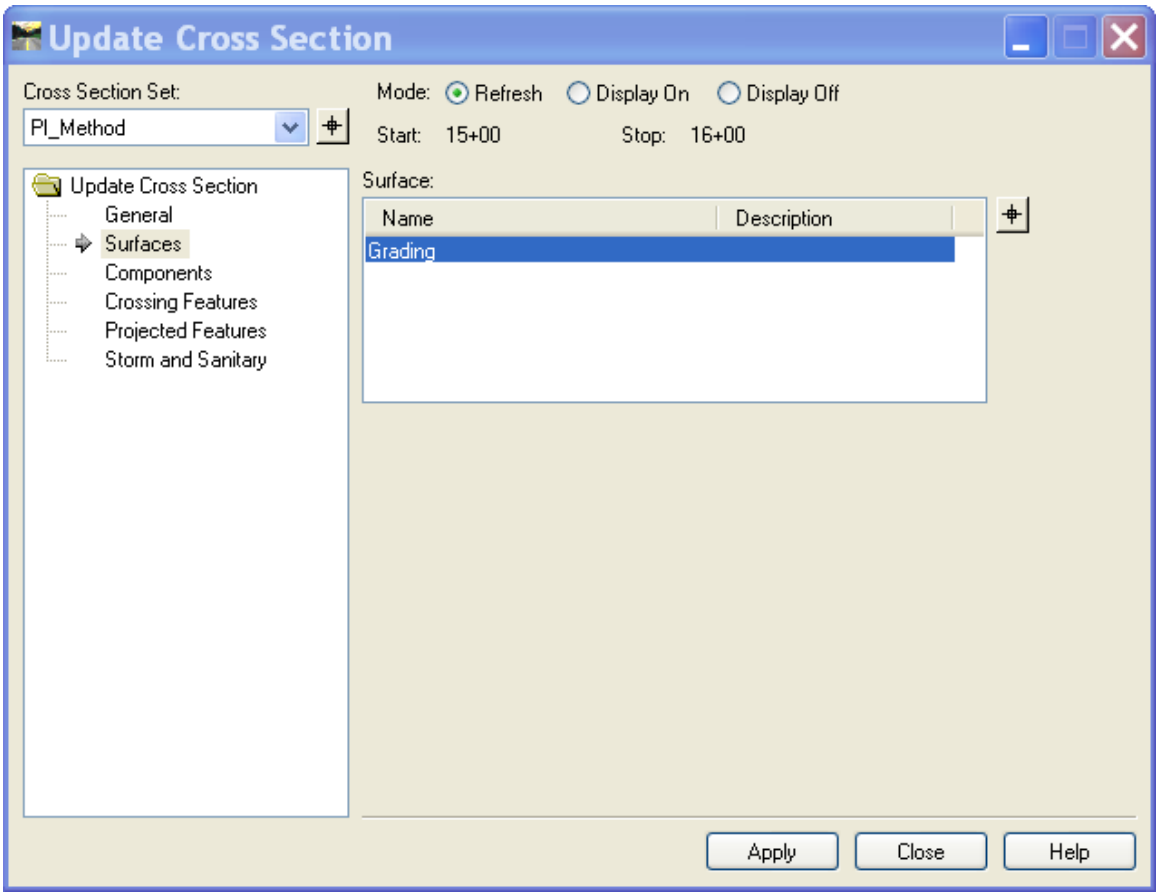


Figure 7-12 Update Cross Section

K. At station 15+00 use MicroStation with AccuDraw to raise the centerline elevation one foot. Select the MicroStation Modify Command and select the point to be modified. Select **Evaluation > Cross Section > Cross Section to Surface**. Now redisplay the contours and they should change.

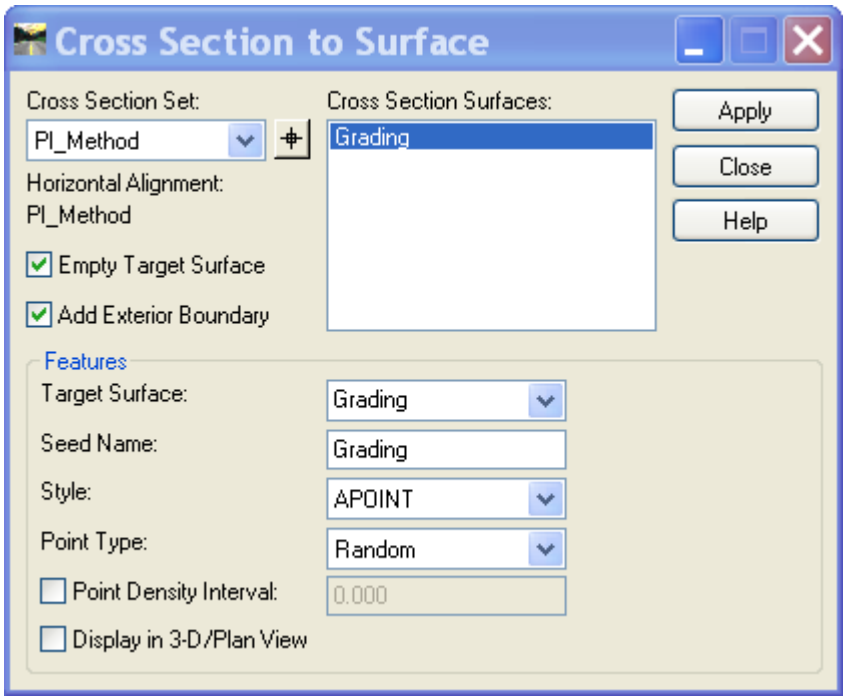


Figure 7-13 Cross Section to Surface

Section 8 Misc Tools

8.1 **Lab 22** Placing a Grid

A. Select **Drafting > Place Coordinate Grid**.

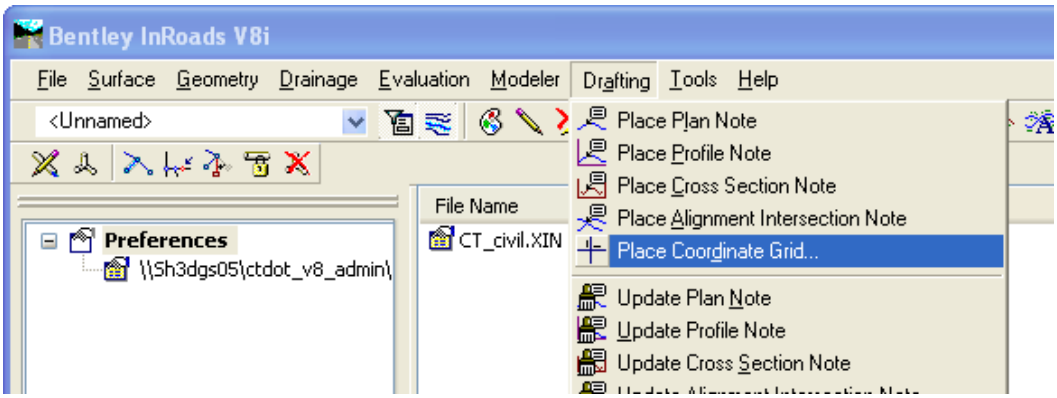


Figure 8-1 InRoads Place Grid Command

B. Using MicroStation place a fence or a shape and toggle on the corresponding Bounded by see Figure 8-2.

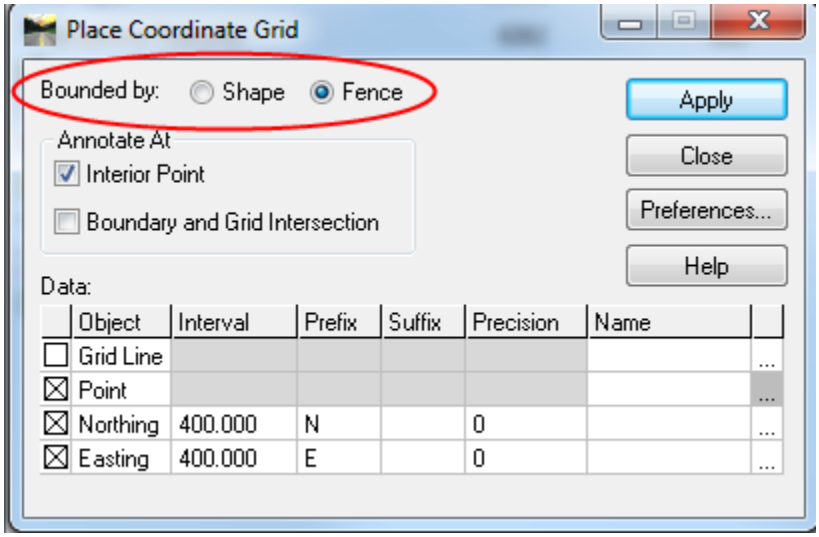


Figure 8-2 InRoads Place Grid Dialog Box

C. Select the **Preferences** Button. To use a **Survey Westerly Grid Mark** data point on it and select **Load** and **Close**.

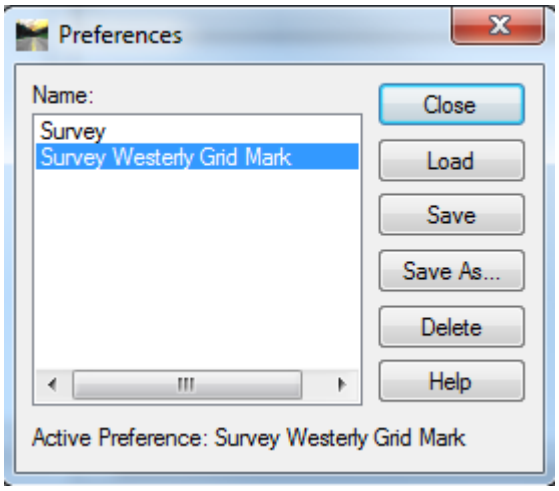


Figure 8-3 InRoads Preferences Dialog Box

D. In the Place Coordinate Grid box click **Apply** and follow the prompts. Click **Close**.

8.2 **Lab 23** Working with Scales

The XIN has been defaulted to use 40 scale units. Preferences for 20, 80, and 100 have been configured. To change the scale, follow this workflow. This procedure must be completed before an InRoads Fieldbook is created.

A. Select the Location Survey Menu Bar located next to the main MicroStation tools. Select **Set Scale factors** and select the desired scale. As shown in Figure 8-4.

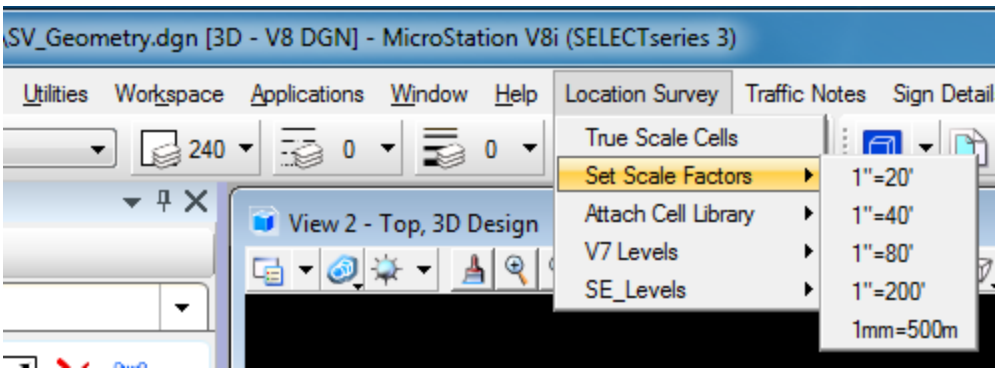


Figure 8-4 MicroStation Menu Pull Down Tool

B. On the InRoads menu select **File > Project Options**. Select the **Preferences** button and load the desired scale see Figure 8-5.

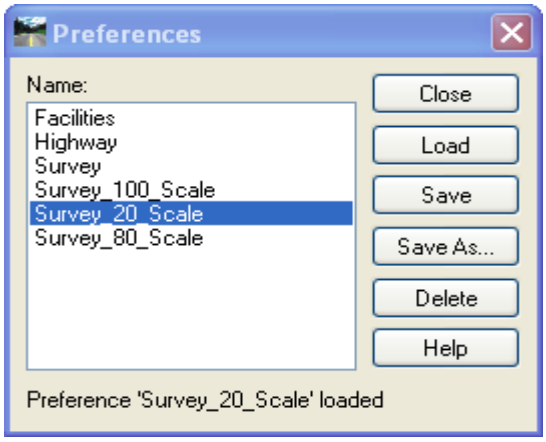


Figure 8-5 InRoads Preference Dialog Box

C. On the InRoads menu select **Tools > Survey Options**. Select the Preferences button and load the desired scale.

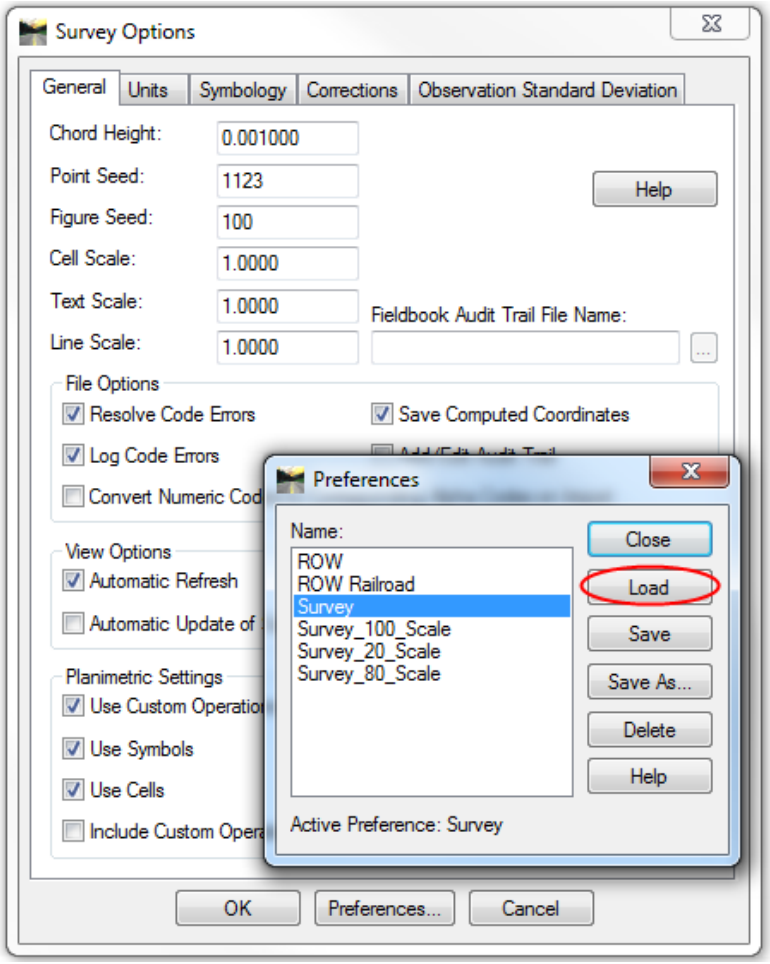
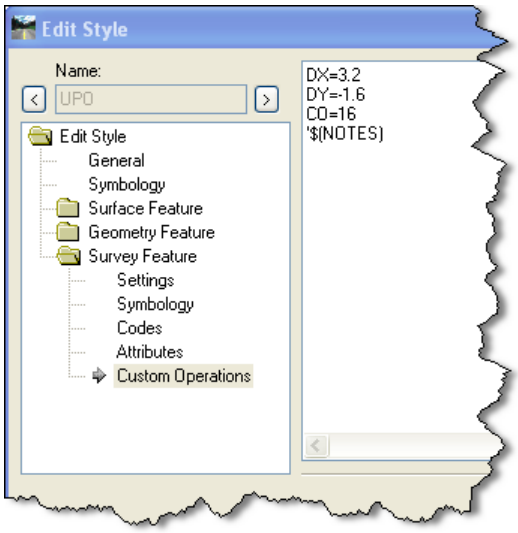
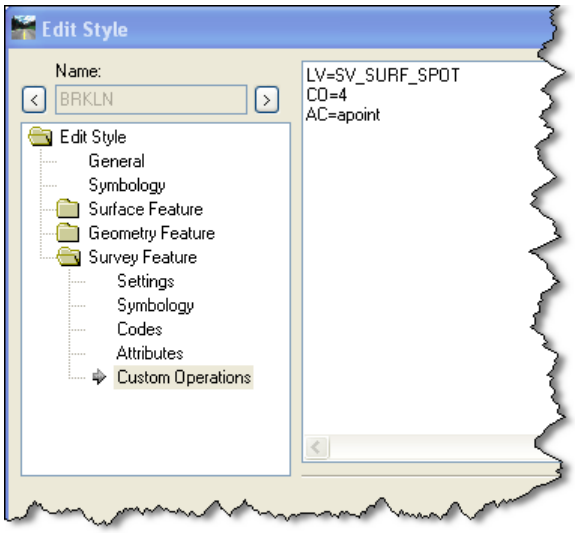
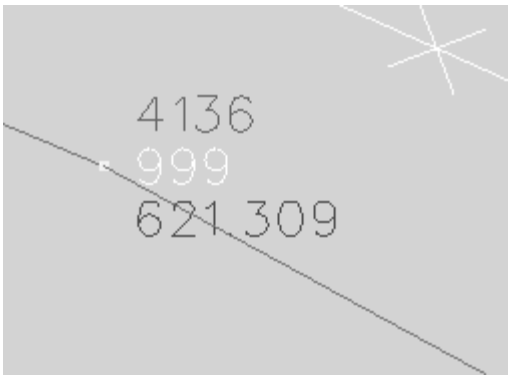


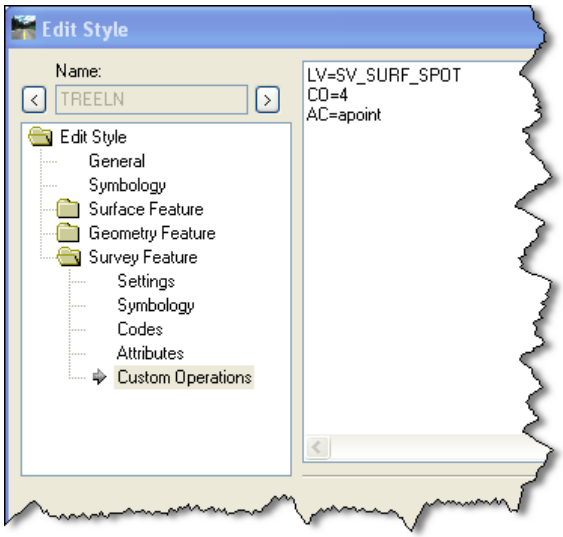
Figure 8-6 Survey Options setting scale factor

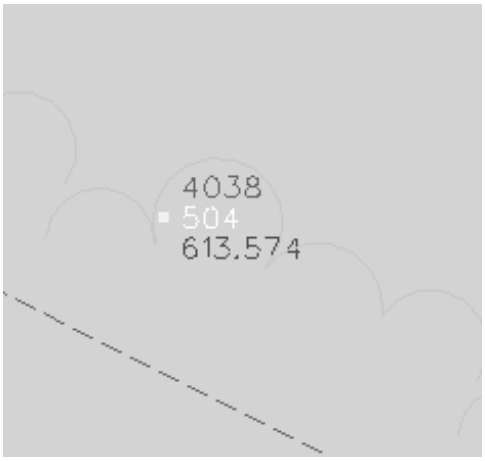
Appendix A InRoads Custom Operations

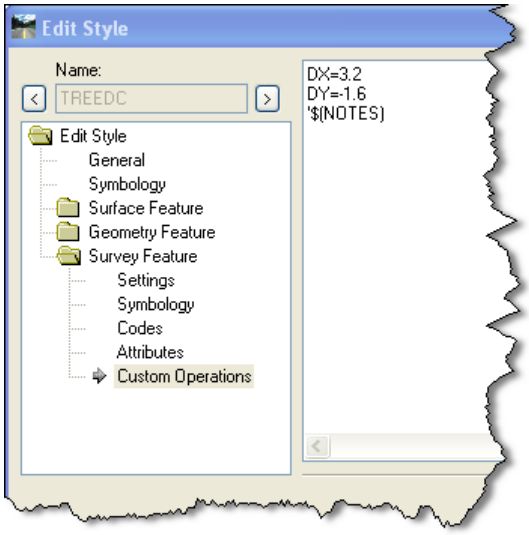







Edit Style
Name:
TREELN
Edit Style
General
Symbology
Surface Feature
Geometry Feature
Survey Feature
Settings
Symbology
Codes
Attributes
Custom Operations
LV=SV_SURF_SPOT
CO=4
AC=apoint

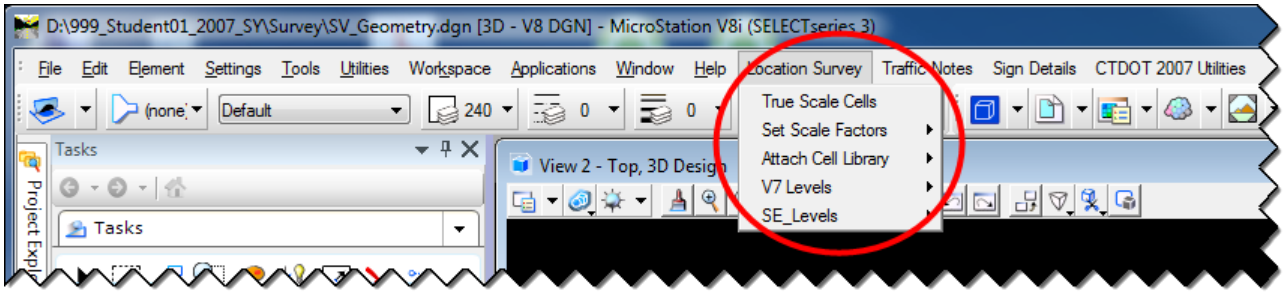

4038
504
613.574


Edit Style
Name:
TREEDC
Edit Style
General
Symbology
Surface Feature
Geometry Feature
Survey Feature
Settings
Symbology
Codes
Attributes
Custom Operations
DX=3.2
DY=-1.6
'$(NOTES)

24 IN OAK
4852
501
605.273

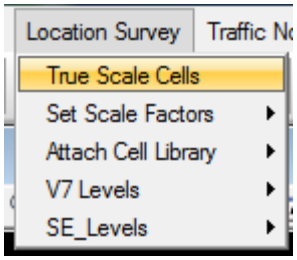
Appendix B Using The Survey Menu Bar

The Menu Bar replaced what used to be called the Bar Menu. It is located along the top on the MicroStation Menu.

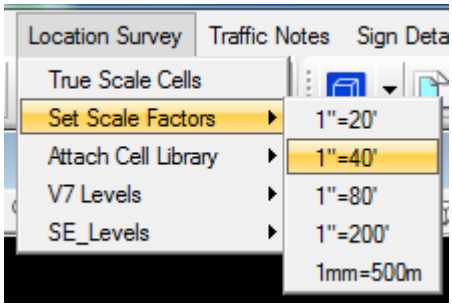


Before starting to work you will need to set True Scale on, select a Scale Factor and attach a Cell Library. This can all be down for the Survey Menu Bar.

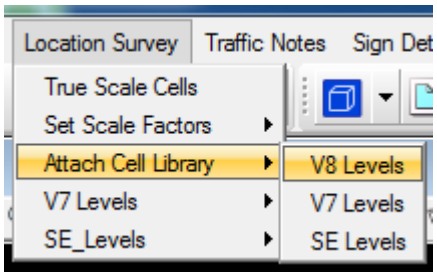
Select True Scale Cells



Select a Scale



Attach the Correct Cell Library



Now you are ready to place cells and text and draw lines.