TENNESSEE DEPARTMENT OF TRANSPORTATION

Geopak Survey Training Manual

ISSUED BY THE DESIGN DIVISION

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CHAPTER 1 - INTRODUCTION TO GEOPAK® SURVEY FOR TDOT

This training course is intended to assist the surveyor with the setup, creation, and processing of survey data using GEOPAK® Survey to conform with the TDOT Survey & Design Computer-aided Drafting and Design CADD Standards. Please refer to the GEOPAK® help files for more specific information regarding GEOPAK® functions.

1.1 COURSE OUTLINE

As part of this course, we will process the survey data for a small TDOT project in Smith County. The dataset includes survey data from multiple days of data collection which contain RTK, Total Station, and Aerial Survey data. The following topics are covered in the course:

- Field Codes and COGO Element Names
- Standard Project Directory Structure
- Standard Design File Names
- Survey Project Preferences
- Creating a new survey project
- Creating and Processing a new Survey Dataset
- Survey Mapping and MicroStation® v8 Levels
- DTM Creation
- Processing Additional Datasets

1.2 CADD STANDARDS AND SUPPORT

TDOT CADD Standards for MicroStation® and GEOPAK® is maintained and distributed by the CADD Support section of the Design Division. This information is available on the TDOT website at the following URL:

http://www.tdot.state.tn.us/Chief_Engineer/assistant_engineer_design/design/v8/V8design.htm#Documentation

This manual is available online in Adobe Acrobat PDF format at the following URL:

http://www.tdot.state.tn.us/Chief_Engineer/assistant_engineer_design/design/survey.htm

Support for GEOPAK® survey is provided through the TDOT Design Division. Questions or comments regarding the use of the GEOPAK® Survey Training Manual should be directed to the TDOT Regional Survey offices.

The following software versions were used in the development of this manual:

- MicroStation® 08.05.02.35
- GEOPAK® 08.08.02.73

1.3 COURSE DATA FILES

The data files provided for this course include:

- SM080-01.doc (Limits of project with GPS Control Information)
- SM080-01.ctl (GPS Control Point File output from TN DOT Geodetic Control Database)
- SmithSR80-topo.dgn (3D topographic DGN File from Aerial Survey)
- SmithSR80-dtm.dgn (3D graphic surface features from Aerial Survey)
- SM080-01TP1.txt (Day 1 Field Collected Data in ASCII format)
- SM080-01TP2.txt (Day 2 Field Collected Data in ASCII format)
- SM080-01CTL.txt (Control Point Data in ASCII format)
- Alg3o4.isu (SR 80 proposed alignment input file)
- Par3o4.isu (Parcel input file)

The files are available online at the following URL:

http://www.tdot.state.tn.us/Chief_Engineer/assistant_engineer_design/design/survey.htm

The latest Standard TDOT Survey files for MicroStation® and GEOPAK® should be downloaded to the user's computer prior to the training course. These files and support documents are available at the following URL:

http://www.tdot.state.tn.us/Chief_Engineer/assistant_engineer_design/design/survey.htm

It is recommended the user to allow the self-extracting executables to install in the default directories. This will allow the TDOT visual basic applications and interface to locate the designated files required to operate.

1.4 TDOT WORKFLOW

The workflow processes followed in this manual are recommended as a best practice. The following are examples of recommended workflow processes:

For **New Projects**:

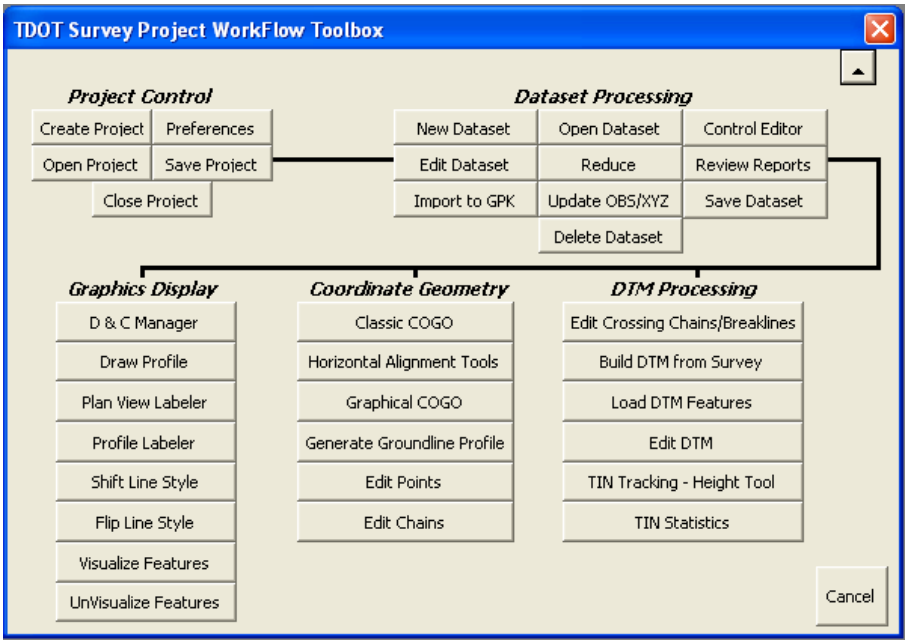
- Create Project Directory
- Create Survey MicroStation® File
- Open new Survey MicroStation® File
- Activate GEOPAK®
- Access GEOPAK® Survey
- Set Survey Preferences
- Create New Survey Project
- Recheck Survey Preferences
- Create New Dataset
- Check and edit Dataset
- Import, Reduce and Map Dataset
- Visual checks of Points and Survey Chains

- Edit Points and Survey Chains as needed
- Run Crossing Chain
- Build DTM
- Visual checks of DTM and Contours

For **Existing Projects**:

- Open existing Survey MicroStation® File (if the user receives a "GEOPAK® Units Synchronization Alert" dialog about GEOPAK® Preferences Unit System being set to English while MicroStation® is set to meters, then simply select "Cancel". This is an issue with DGN files from the office of Aerial Survey's seed files due to their necessary software setup).
- Activate GEOPAK®
- Access GEOPAK® Survey
- Open Existing survey project
- Check Survey Preferences
- Create Additional Datasets
- Check and edit Dataset
- Import, Reduce and Map Additional Datasets
- Visual checks of Points and Survey Chains
- Edit Points and Survey Chains as needed
- Run Crossing Chain
- Build DTM
- Visual checks of DTM and Contours

The following screen capture shows the **Survey Project WorkFlow Toolbox** developed by TDOT that can be activated from the custom TDOT menu in MicroStation®. This toolbox allows for quick access to commonly used tools once the user obtains a basic understanding of GEOPAK® Survey.



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CHAPTER 2 - FIELD SURVEY AND RELATION TO COGO

2.1 CONTROL POINTS

TDOT maintains a database containing all Geodetic Survey Control Point data for the entire state. This information is typically supplied by TDOT when the project is assigned and will serve as the primary project control for field survey work. The database is available, if needed, online at the following URL:

http://www.tdot.state.tn.us/Chief_Engineer/assistant_engineer_design/design/survey.htm

2.2 SURVEY POINTS

All survey data processed through GEOPAK® Survey is stored in a GEOPAK® Coordinate Geometry (COGO) database. The database is given a .gpk file extension. Each point must have a unique name. Point names can be alpha-numeric, but not numeric-alpha. For example, S2 is supported, however S2S is not. All points shall have an "S" as the prefix. Example: S2000, S2001, etc. No special characters or other naming conventions are allowed.

Field Codes (descriptors)

In order for data to be processed by GEOPAK® and displayed correctly in MicroStation®, the correct codes must be used when collecting data in the field. It is extremely important that field personnel be very careful about the proper use of point descriptors. Proper understanding will make the office processing much more efficient and prevent errors in the finished survey. The following rules should be observed:

- Use only those descriptors that are supported by our system. These are outlined in the TDOT Survey Manager Database (SMD) V8 Feature Codes document, found at the following website: (http://www.tdot.state.tn.us/Chief_Engineer/assistant_engineer_design/design/survey.htm). Appendix A (Pages A1-A3) contains the current version of this document. If in doubt or if the identity of the point is unknown, use XMISC and make a note. NEVER INVENT OR MAKE UP A DESCRIPTOR.
- Additional information can be stored for any survey point by adding a comment to the point descriptor. For items below indicating a note, the note is necessary on one survey point in a given feature. The length of a note is limited only by the data collector. The specific codes documented below make use of field comments.
- The equal sign is the delimiter used by TDOT to indicate field notes. This is user definable. Also, TDOT uses "+" as the begin line code, "-" as the end line code, "*" as the curve code and "~" as a separator between double-coded points. These are also user definable.

Example Field Coding of Points

1. Drainage Structures

   Pipes
   PIPE=note
   Where note contains description including size and type, for example a 15" concrete pipe would be coded **+PIPE=15" RCP** on one end and **-PIPE** on the other.
   Pipes connected to manholes or catchbasins are located with the storm sewer code (STS) to properly generate the DTM. In the case where one end of pipe is in a manhole and one end is open, locate the pipe with storm sewer code and shoot an extra ground shot at the pipe outlet to properly generate DTM.

   Box Culverts
   CV=note
   Where note contains description of culvert.

2. Utilities

   To field code the size of utilities, precede the TDOT SMD code with the size of the utility in inches. This is applicable for all codes that are preceded by a question mark in the TDOT SMD Feature Code document. For example, code a 12" gas line as 12GL, an 18" water line as 18WL, and a 15" storm sewer as 15STS. Individual custom line styles exist for each size utility.

   Water & gas valves, Water & gas meters
   XWV=note
   XGV=note
   XWM=note
   XGM=note
   Where note contains optional number for use when many valves or meters are very close and would be overlapping on the map.

   Overhead wires
   XLW=note
   Shoot low wire at point directly over proposed centerline at true elevation. Note contains description of the various wires.

   Utility Poles
   XUP=note (utility poles without lights)
   XLP1=note (utility poles with one light)
   XLP2=note (utility poles with two lights)
   XLP3=note (utility poles with three lights)
   XLP4=note (utility poles with four lights)

   Note contains abbreviations for types of wires hanging on pole, for example P, P/T etc.

3. Driveways (DR), field entrances (FE), business entrances (BE), and parking lots (PK)

   DR=note
   Where note contains description (width and surface material) placed on one point in line only.

4. Edge of Pavement

   EP=note
   Where note contains description of surface type (ie: GRAVEL).
   This should be used for the edge of traveled roadway only.

5. Property line information
   XIP=note (existing iron pin property corner)
   Where note contains description of condition of iron pin, ie: 3/4" Rebar, Bent, etc.

   XPL=note (other types of monumentation)
   Where note contains description of monument (ie: Planted Stone, AXLE, Wood Post, etc).

   XROWA (ROW monument in a straight line or near straight line break (Type A)

   XROWB (ROW monument in 90 degree break (TYPE B or C)

6. Buildings

   BC=note
   Where note contains a description according to TDOT standards including type and number of stories. If building contains a business, include the business name.

7. Bridges

   BRI=note
   Where note contains description of structure.

8. Fences

   FN=note
   Where note contains description of the type of fence.

9. Edge of Pavements

   EP=note

   Shoulders (paved only)
   SH=note
   Where note contains description including width and surface material.

10. Underground Tanks

    T=note
    Where note contains description of tank including size and type of fluid stored.

11. Trees

    XTREE=x type
    Where x contains the diameter of the tree trunk in inches. Assumes 6" if blank
    Type contains the tree species (ie: Sweet Gum). This is optional.

2.3 SURVEY CHAINS

A series of Survey Points representing a linear feature can be connected together as a Survey Chain. Linking codes are used to designate how individual field shots are reconnected to form Survey Chains. Linking codes are special characters pre-pended to the feature in the field as the data is collected. TDOT utilizes the following linking codes:

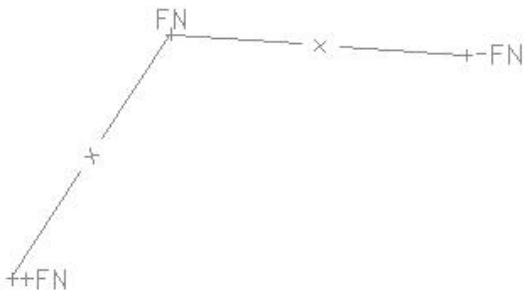
`+` Begin Line
`-` End Line
`*` Close Figure

The following additional linking codes are available but not utilized by TDOT:

`PC*` Begin Curve (tangent to previous line)
`OC*` Point on Curve (begin/end non-tangent curve)
`PT*` End Curve (tangent to next line)
`CC*` Point of Compound or Reverse curve
`CF*` Curve Fit (spline fit to irregular curves)

To collect a series of 3 points representing a fence line; each point would be coded as follows in the field (Note, the field code `FN` is used for a Fence Line):

```
+FN
FN
-FN
```



When the survey data is processed, GEOPAK® will automatically generate the names for the Survey Chains. Therefore, there is not a standard definition for Survey Chain names in the TDOT CADD Standards manual.

Survey Chains are named according to the feature code name used to collect the shots defining the chain. In the above example, a Survey Chain named “FN" will be created in the .gpk file. If a second fence line is collected, GEOPAK® will increment the name by 1. For example, a second fence line would be named “FN-1" in the .gpk file. Subsequent fence lines would be incremented by 1.

IMPORTANT: Survey Chains are connected by the order of point numbers. The point numbers do not have to be sequential, but they must be in increasing order. Since the actual mapping is produced by the reduced coordinate file and not the raw data file, the point numbers determine the sequence, not the order of field location (order of shots in raw data file).

2.4 CROSSING BREAKLINES

When collecting field data, personnel should attempt to avoid crossing breaklines that have a DTM surface attribute of breaklines. This will facilitate proper creation of the TIN file by the office personnel. If this guidance is not followed, additional vertices will be inserted at the point of crossing in the TIN file.

2.5 DATASETS

A project can be comprised of multiple datasets. These can include different source formats, different areas of a project, or individual field crews. Typical TDOT practice is to create a dataset for each day's work.

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CHAPTER 3 - SETTING UP A GEOPAK® SURVEY PROJECT

3.1 DIRECTORY STRUCTURE

For the purpose of this training manual the directory structure will show a local directory from the user's personal computer (i.e. C:\Projects\SM080-01).

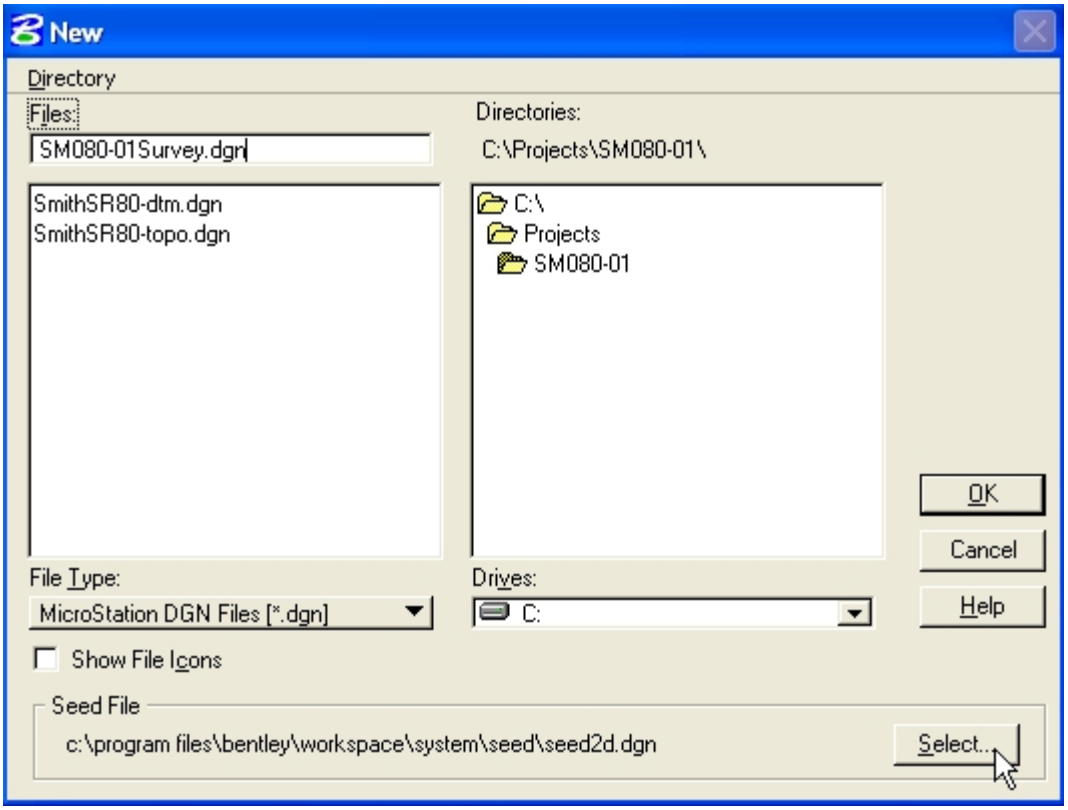
3.2 CREATING A DGN

The TDOT Survey Manual, Section 3.4.2.1 Filename, defines the standard MicroStation® design file names to be used on TDOT survey projects. The following paragraph was taken from that section.

This file shall have the form 11222-33filetype.DGN where:

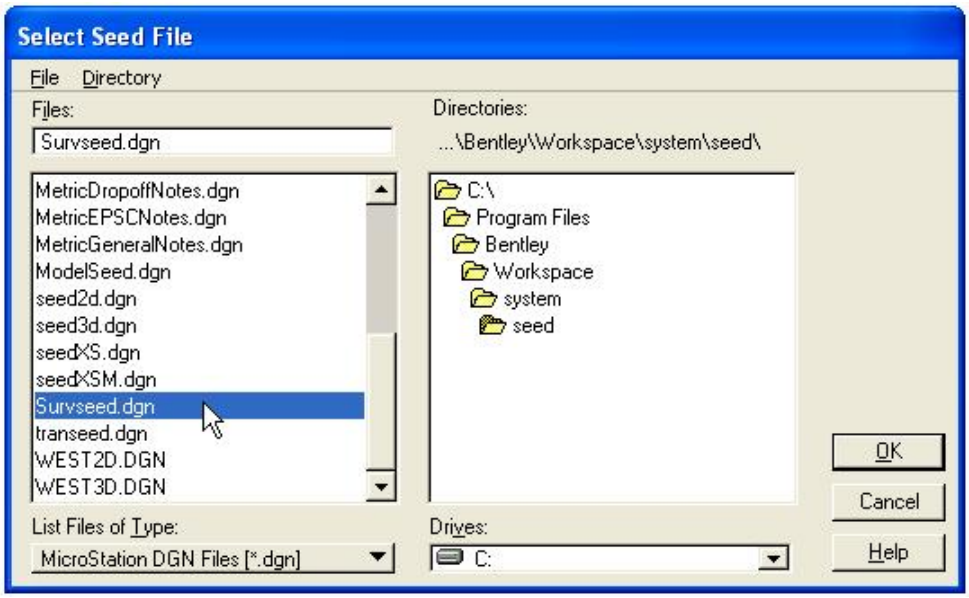
- 11 = the county code (See Table A-7), and as shown in the CADD Guidelines
- 222 = the route number (if not a state route the surveyor's discretion is allowed.)
- –33 = GNSS project number (Contact the Regional Survey Supervisor for this number)
- Filetype = Survey (Survey Topography and Profile data)
  - Example: DV155-01Survey.DGN
- Filetype = SurveySUE (Survey Subsurface Utility Engineering data)
  - Example: DV155-01SurveySUE.DGN

Open MicroStation® and create a new .dgn as shown in the dialog below.

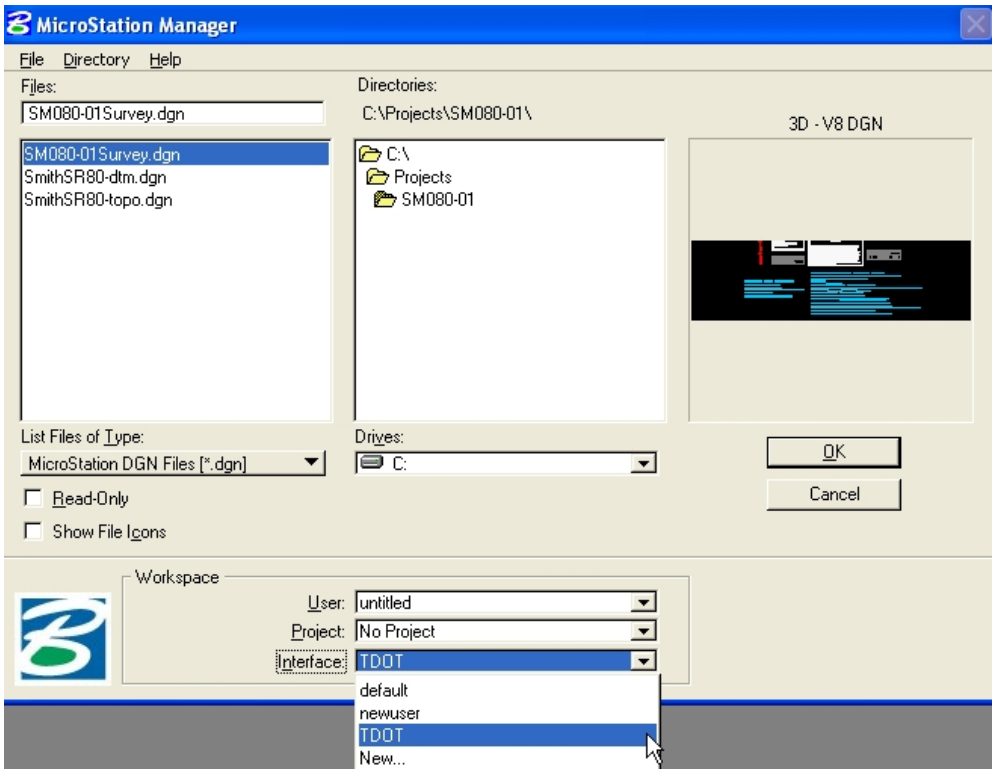


Use the **Select** Seed File button shown in the dialog above to select the seed file (or template file) to be used to create the new file. For the purpose of this training manual Survseed.dgn is to be used. The seed files can be downloaded through the following TDOT website:

http://www.tdot.state.tn.us/Chief_Engineer/assistant_engineer_design/design/v8/V8design.htm#MicroStation®

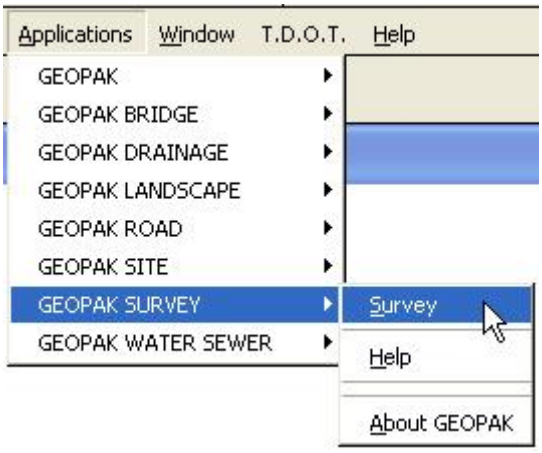


The **TDOT** Interface in the MicroStation® Manager Workspace should be selected in order for many custom applications to appear.

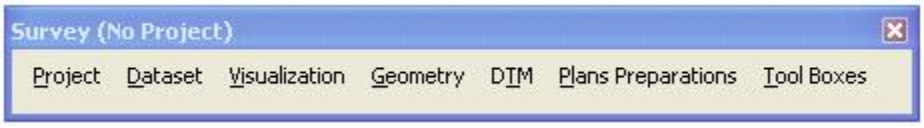


3.3 ACCESSING GEOPAK® SURVEY

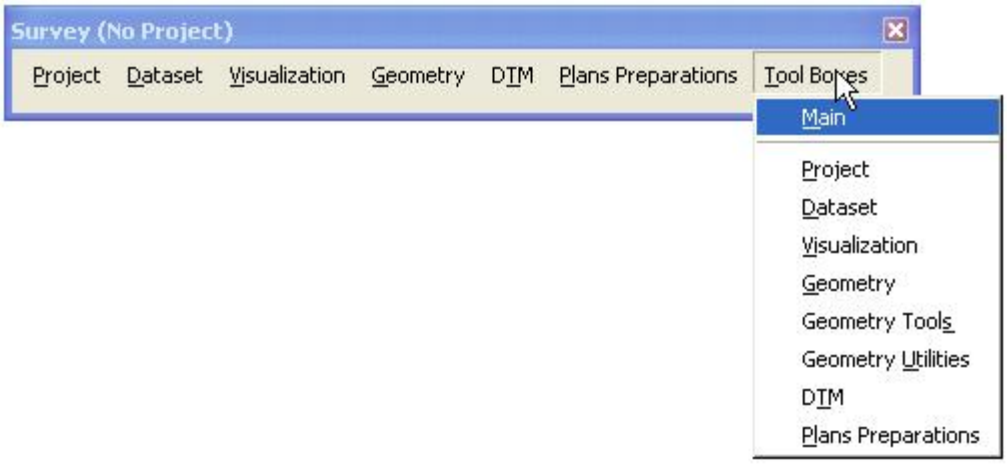
To access GEOPAK® Survey, open the survey MicroStation® File (the file created in Section 3.2) and select **Applications** → **GEOPAK® Survey** → **Survey** from the MicroStation® pull down menu as shown below.



The **Survey** toolbar, shown below, is opened.

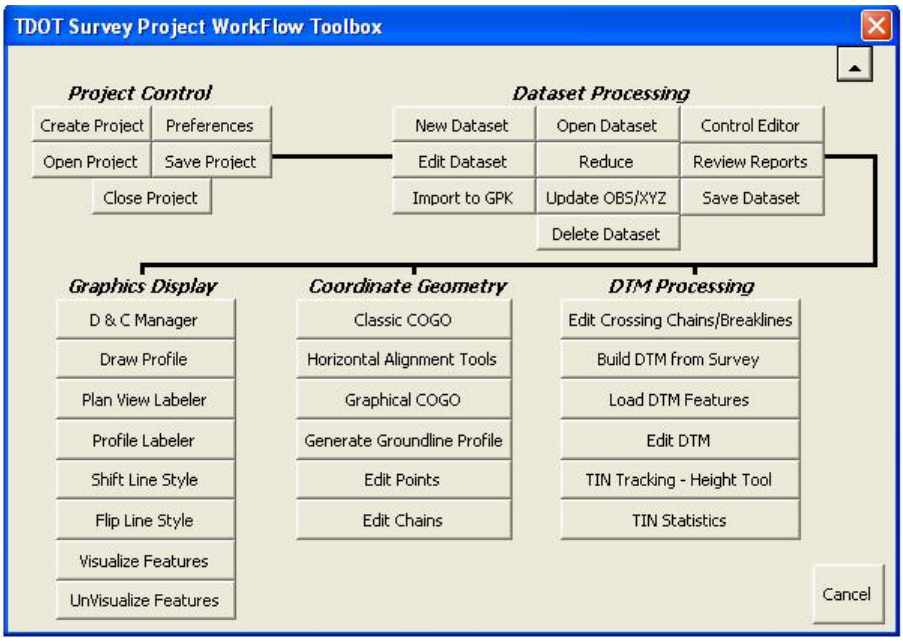


To open the individual **Tool Boxes** for the items listed on the **Survey** toolbar, click on **Tool Boxes** and toggle on / off as shown below.



The **Main** tool box contains all the tool boxes listed in the **Tool Boxes** pull down menu. This training guide will document using the **Survey** toolbar to access the various GEOPAK® Survey functions. GEOPAK® Survey can also be opened through **TDOT Survey Project Workflow Toolbox** as shown below (Note: The TDOT Interface in the MicroStation® Manager Workspace must be selected in order for this option to appear).

The following screen capture shows the **TDOT Survey Project WorkFlow Toolbox** developed by TDOT that can be activated from the custom TDOT menu in MicroStation®. This toolbox allows for quick access to commonly used tools once the user obtains a basic understanding of GEOPAK® Survey.

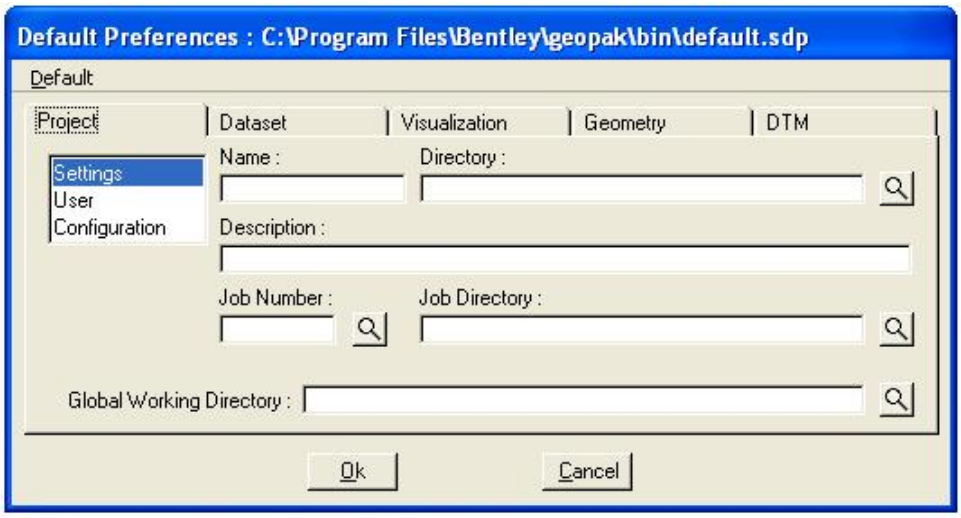


CHAPTER 4 - SURVEY PROJECT PREFERENCES

Before the user creates a new survey project, the user must first set the default Survey Preferences. This preference file will be used as a basis for individual project preference files. From the **Survey** toolbar, select **Project** → **Preferences** to access the dialog shown below.

The dialog could differ from the one shown below depending on the past history of the user's machine. Select **Default** → **Save As…** to save the `default.sdp` file in the C:\Program Files\Bentley\geopak\bin directory.

Important! Always close the active survey project to edit the default preference file.



4.1 PROJECT TAB

In the **Project** tab three options are listed on the left portion of the dialog box: **Settings**, **User**, and **Configuration**.

Settings
When the **Settings** option is selected, the dialog appears as shown above. ***All fields in the setting group should be left blank*** for the default survey preferences, but may be entered for the project specific survey preference file later.

Name:
This field is used to key-in the **Name** that will be used for the creation of a new survey project file. The survey project file (.prj file) associates projects with their respective job number, user, working directory, survey and Coordinate Geometry database, and other associated project files. The **Name** is assigned by the respective TDOT Regional Survey office.

Directory:
This key-in field is used to identify the Directory where the .prj file will be stored. By pressing the magnifier button the desired directory may be identified.

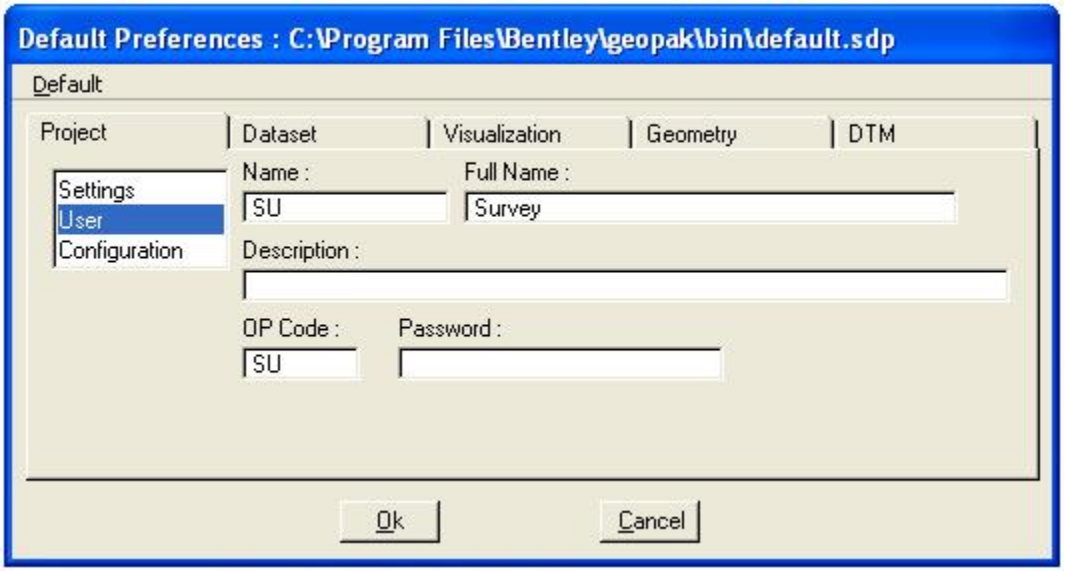
Description:
This field is used to specify an optional Description to be associated with the project.

Job Number:
This field is used to specify the Coordinate Geometry database (.gpk file) that will be used with this project. The GPK file is used to store all data that is processed through GEOPAK® Survey or GEOPAK® COGO commands. The **Job Number** is assigned by the respective TDOT Regional Survey office.

Job Directory:
This key-in field is used to identify the Directory where the .gpk file will be stored. By pressing the magnifier button the desired directory may be identified.

Global Working Directory:
The Global Working Directory should be left blank.

User
When the **User** option is selected, the **Project** tab should be completed as described below.



Name:
Key-in field to identify the **Name** of the survey project user. The name should consist of alphanumeric characters with no spaces or special characters.

Full Name:
The **Full Name** field further identifies project users and will be displayed when users are being selected as a project is opened.

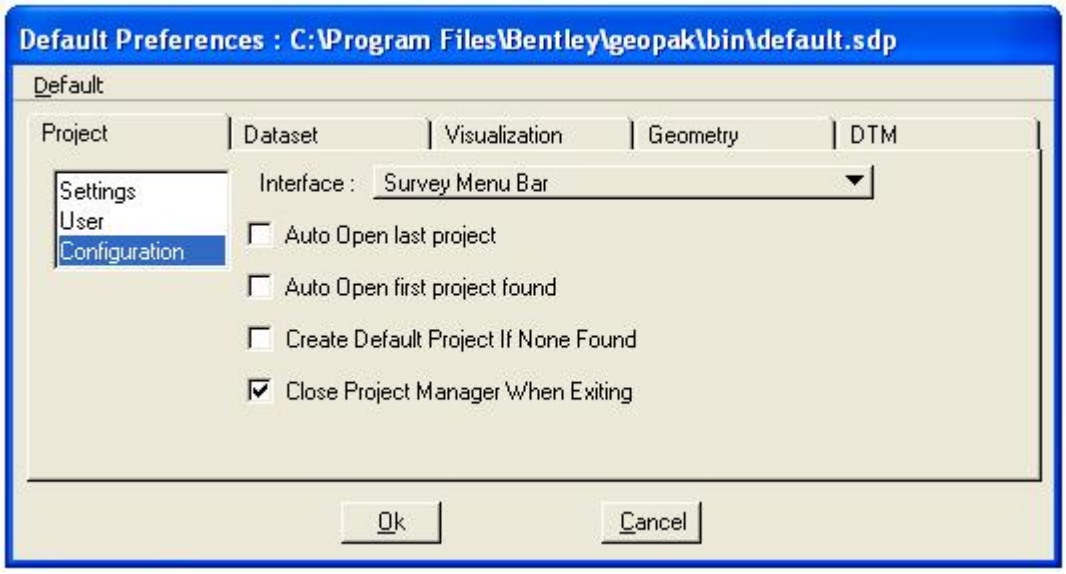
Description:
The **Description** field further identifies the user by associating an optional description with a particular user.

OP Code:
The **OP Code** field sets the GEOPAK® Operator Code used for all coordinate geometry operations during this session. The Operator Code, along with the Job Number, will also be used whenever an input file is created by the software. The Operator Code can be a maximum of two characters.

Password:
Passwords are **NOT** to be used or set for any TDOT projects.

Configuration

When the **Configuration** option is selected, the **Project** tab should be completed as shown below.



Interface:
The pull down menu allows the user to select how the **Survey Menu** is displayed.

Auto Open Last Project
The **Auto Open Last Project** toggle allows GEOPAK® to automatically open the last active project when GEOPAK® Survey was invoked. This command is useful if you are working on only one project at a time.

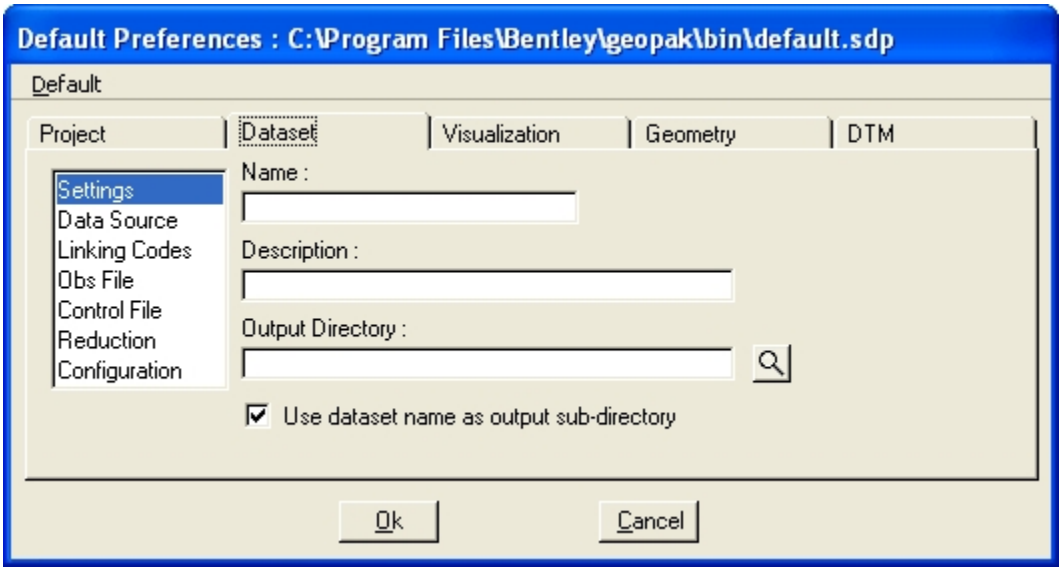
Auto Open First Project Found
The **Auto Open First Project Found** toggle allows GEOPAK® to automatically open the first project found in the working directory when GEOPAK® Survey is invoked.

Create Default Project If None Found
The **Create Default Project If None Found** toggle allows GEOPAK® to automatically create a project if no project is found in the working directory when GEOPAK® Survey is invoked.

Close Project Manager When Exiting
The **Close Project Manager When Exiting** toggle allows GEOPAK® to close the active project when GEOPAK® Survey is exited.

4.2 DATASET TAB

When the **Dataset** tab is selected, the dialog should be completed as described below.



Settings
When the **Settings** option is selected, the **Dataset** tab appears as shown above. Leave the fields blank for this class.

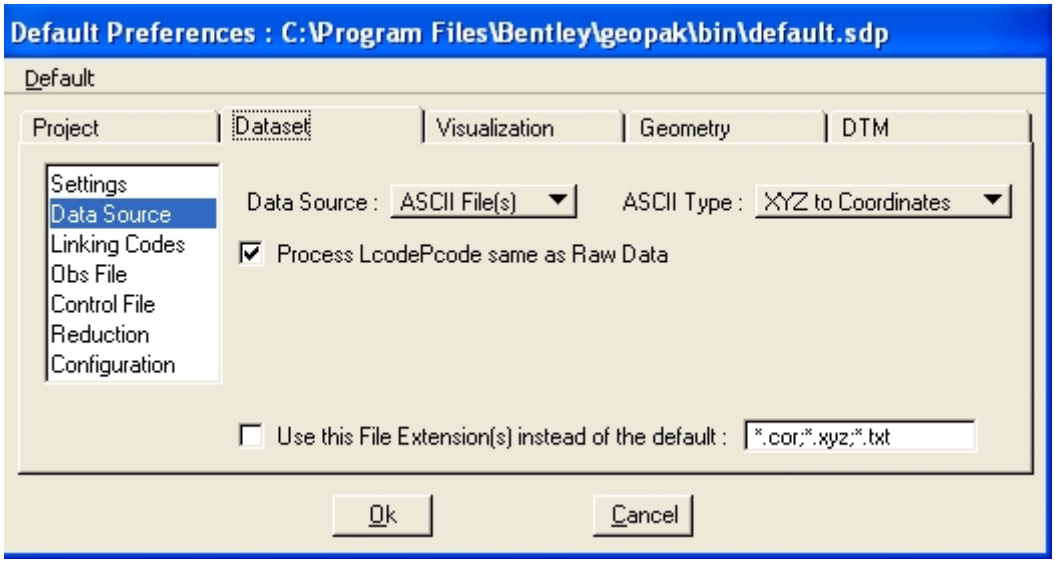
Name:
The **Name** field will set the default name when a new dataset is created. In this class, the name of the first dataset will be “TP1” (represents topography) and will be set when the dataset is created. The **Name** can be changed when each new dataset is created. The **Name** field should be limited to alphanumeric characters with no special characters or spaces used other than a hyphen “-“ or an underscore “_” character.

Description:
The **Description** field provided. A description can be entered when a new dataset is created within a survey project

Output Directory:
The **Output Directory** is used to identify the directory where output information (i.e., reports, OBS and control files, etc.) related to the dataset is placed.

Use dataset name as output sub-directory
When toggled on, a directory of the same name as the dataset is created in the directory specified by the **Output Directory**, and used for all output files created by the reduction process. For this class, the option should be on.

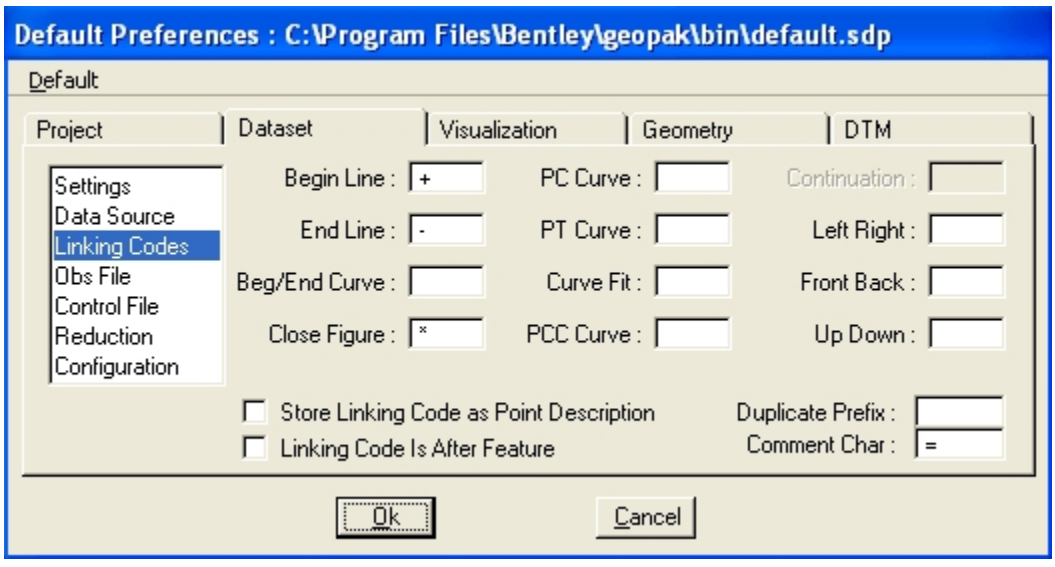
Data Source
When **Data Source** is selected, the **Dataset** tab should be completed as shown below.



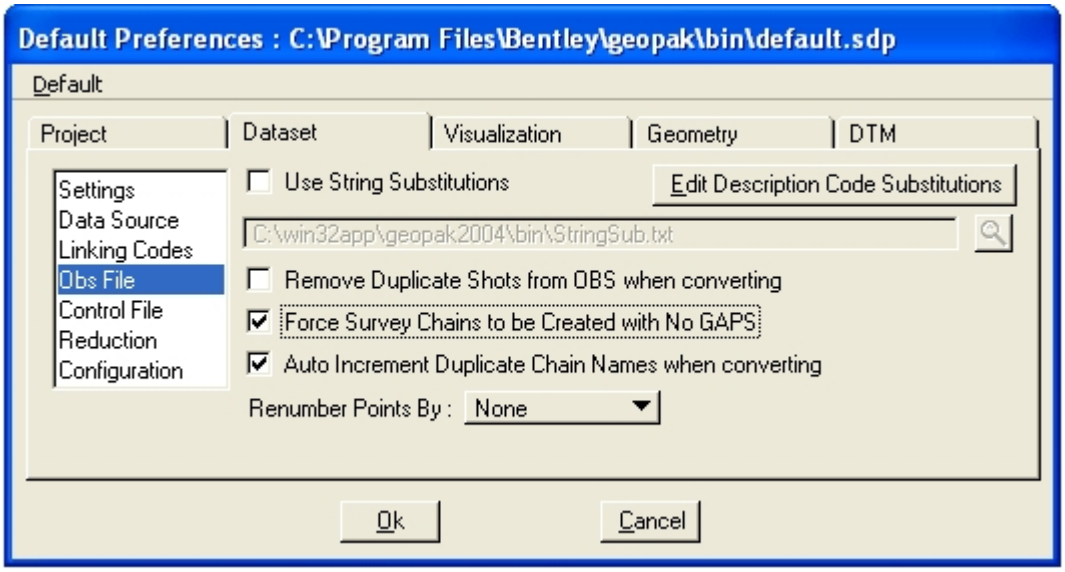
Data Source:
The drop down list contains options for importing / downloading files into GEOPAK®.

ASCII Type:
The drop down list contains options for different formats of ASCII types.

Linking Codes
When **Linking Codes** is selected, the **Dataset** tab should be completed as shown below. Linking Codes are explained in further detail in Section 2.3.

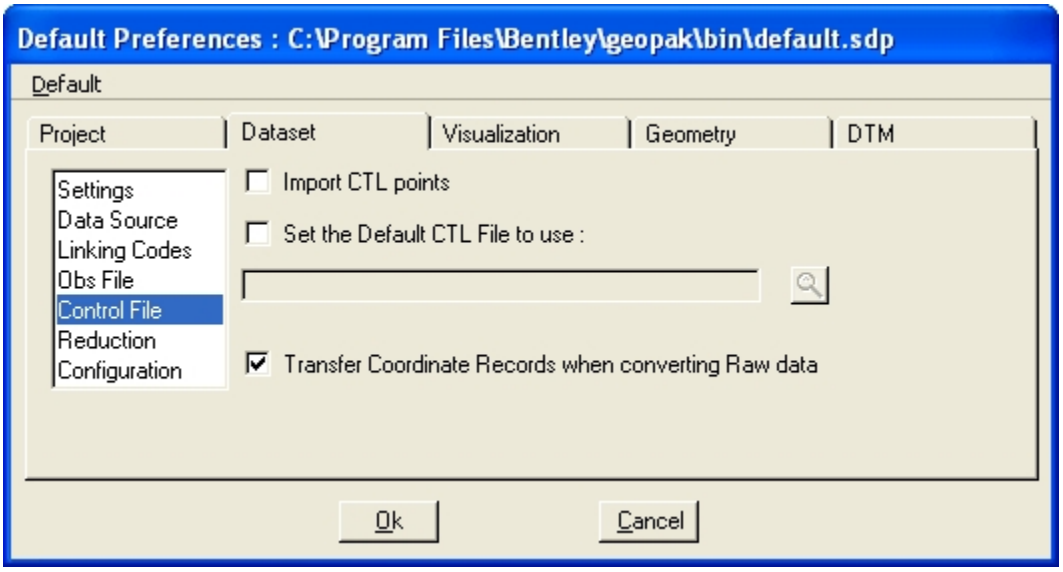


Obs File
When **Obs File** is selected, the **Dataset** tab should be completed as shown below.

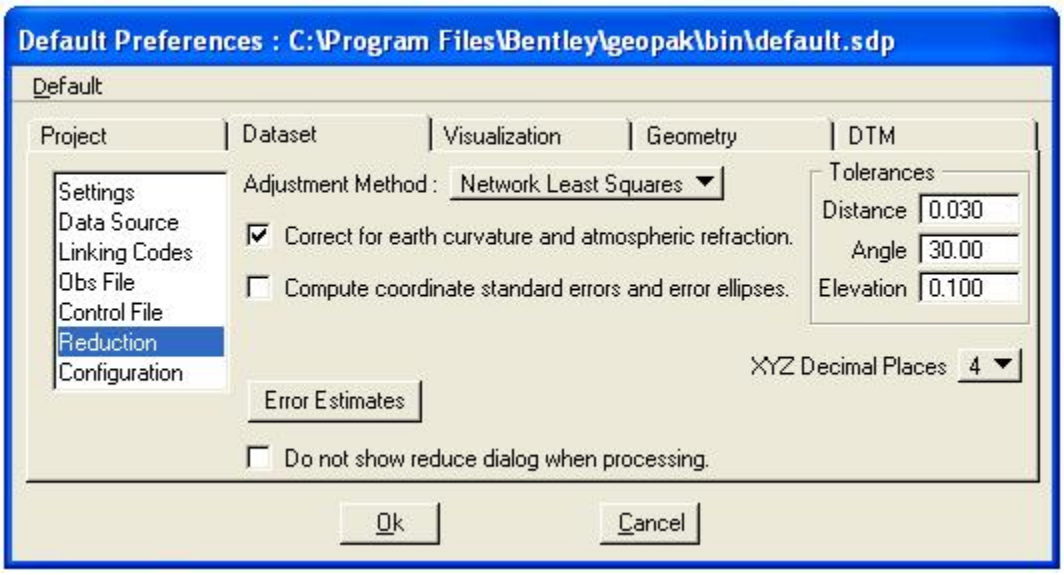


Auto increment Duplicate Chain Names when converting
Select this option to add a number to the end of the duplicate Survey Chain Names.

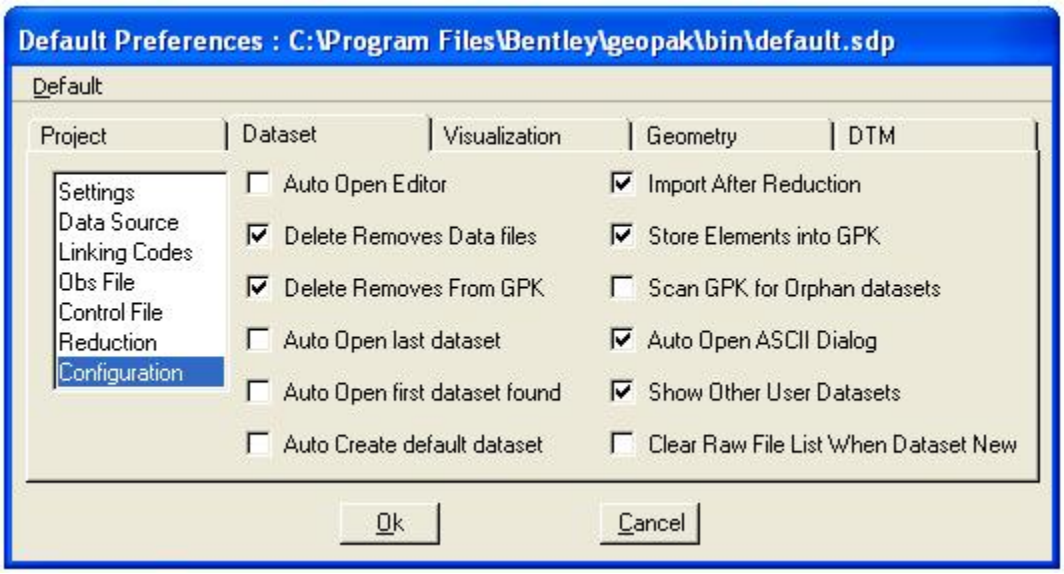
Control File
When **Control File** is selected, the **Dataset** tab should be completed as shown below.



Reduction
When **Reduction** is selected, the **Dataset** tab should be completed as shown below.

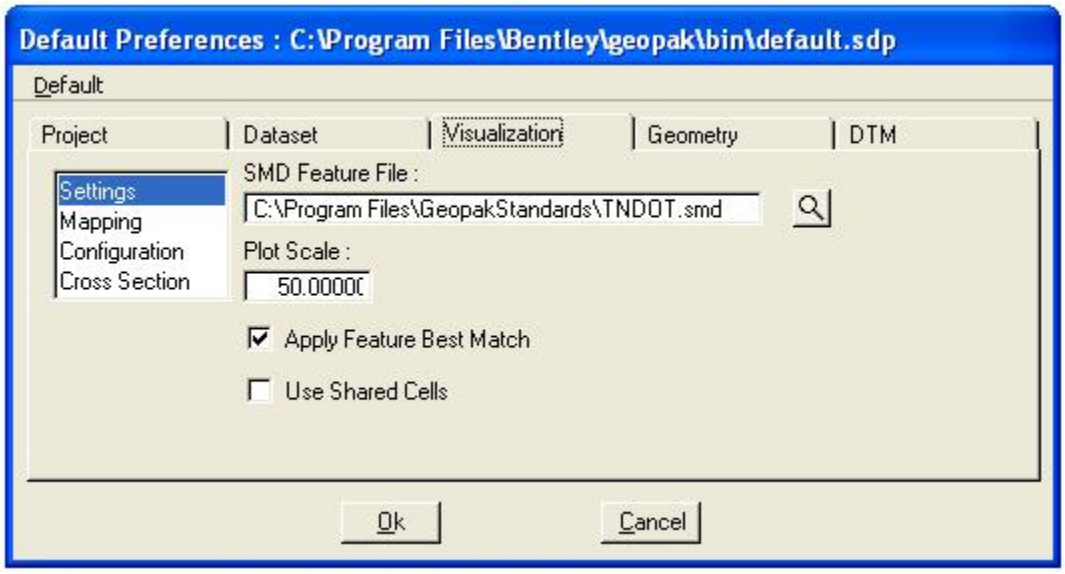


Configuration
When **Configuration** is selected, the **Dataset** tab should be completed as shown below.



4.3 VISUALIZATION TAB

When the **Visualization** tab is selected, and the **Settings** option is selected, the dialog should be completed as shown below.



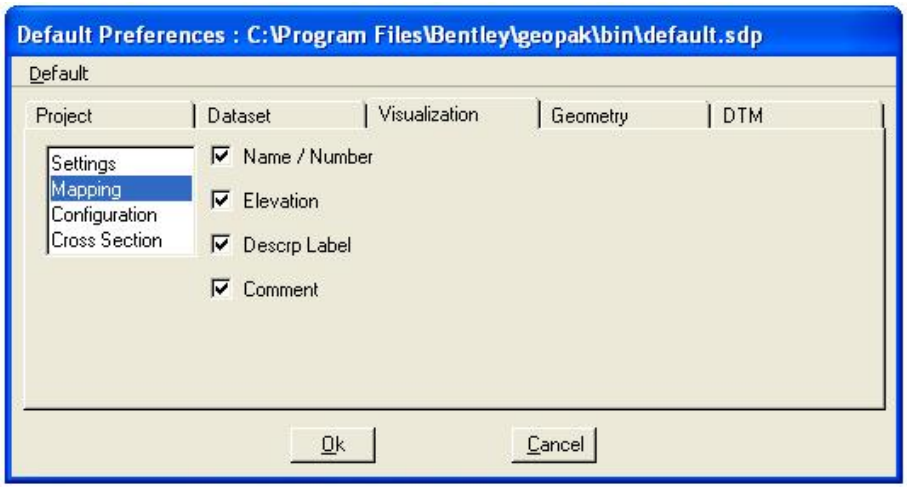
Settings
SMD Feature File:
Specifies the SMD file to be used for mapping the survey field codes to MicroStation®. The latest TDOT .smd file can be downloaded through the following link:

http://www.tdot.state.tn.us/Chief_Engineer/assistant_engineer_design/design/v8/V8design.htm

Plot Scale:
Indicates the scale at which Points, Symbols, Survey Chains, etc., will be mapped into the drawing. For TDOT surveys, the scale is always 50.00.

Apply Feature Best Match
When toggled on, GEOPAK® will match the field codes found in the raw data to the feature codes defined in the SMD file in the event there is not an exact match. For example, the SMD file contains the code “EP” for an edge of pavement. The field data may include multiple field codes named “EP1”,”EP2”, etc. With **Apply Feature Best Match** toggled on, each of these surveyed lines will be matched to the feature code “EP” in order to define how the lines will be visualized in MicroStation®.

Mapping
When **Mapping** is selected, the **Visualization** tab should be completed as shown below.



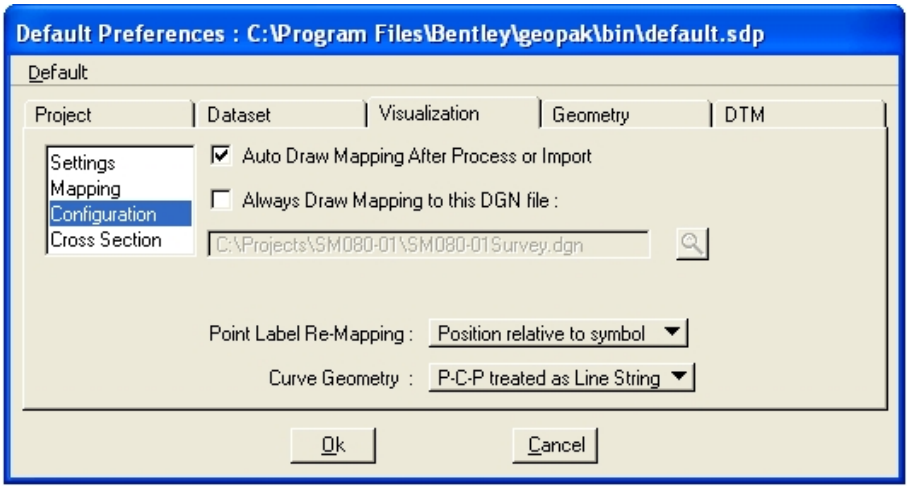
Name / Number
When toggled on, the point name / number information is placed on the drawing on the appropriate level.

Elevation
When toggled on, the point elevation information is placed in the drawing on the appropriate level.

Description Label
When toggled on, the point description information is placed in the drawing on the appropriate level.

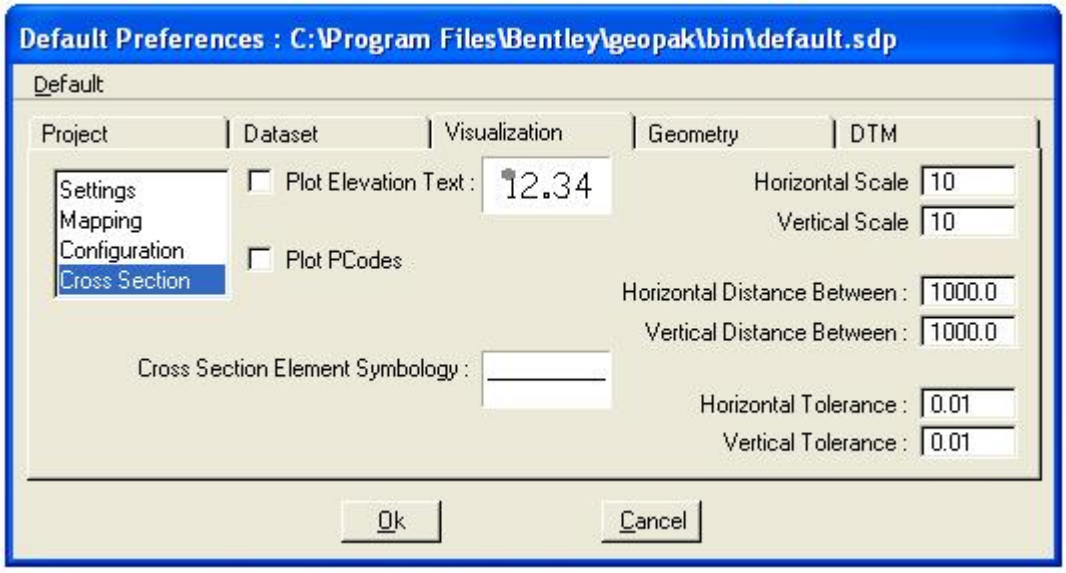
Comment
When toggled on, the point attribute information is placed in the drawing on the appropriate level.

Configuration
When **Configuration** is selected, the **Visualization** tab should be completed as shown below.



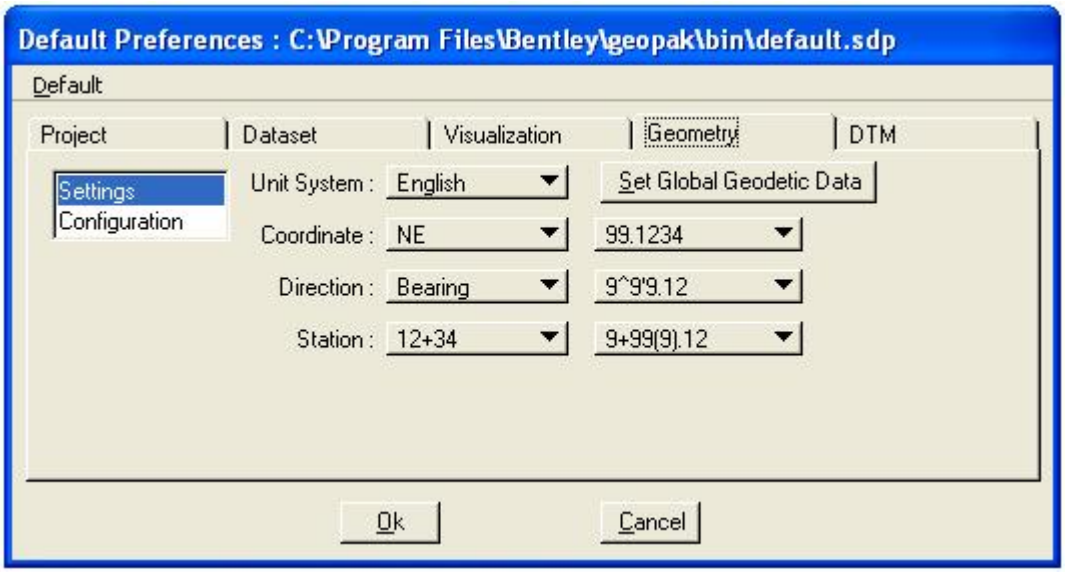
Auto Draw Mapping After Process or Import
When toggled on, survey points and chains will be automatically placed into the drawing on the appropriate levels.

Cross Section
When **Cross Section** is selected, the **Visualization** tab should be completed as shown below.



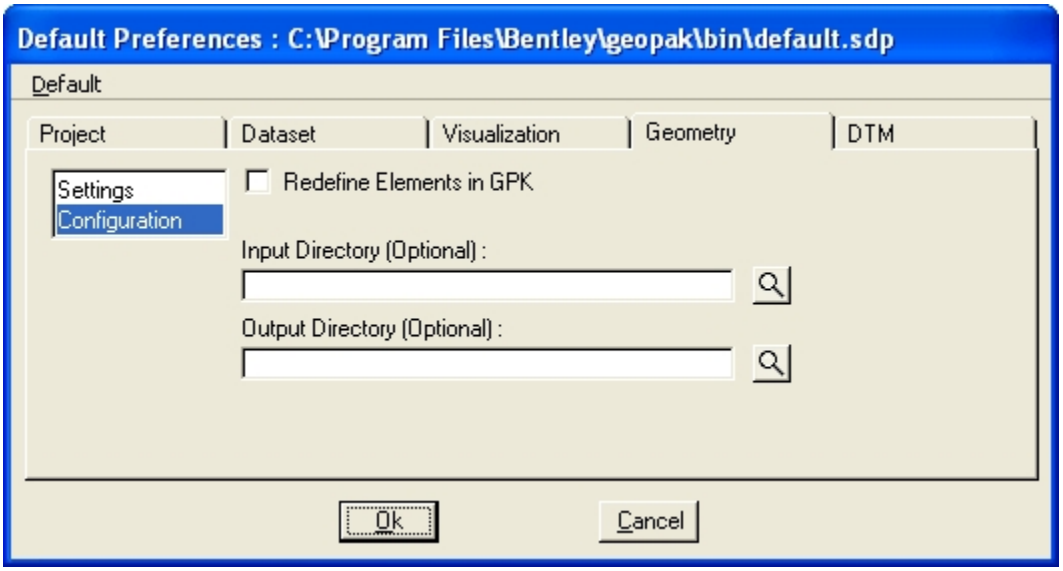
4.4 GEOMETRY TAB

When the **Geometry** tab is selected, and the **Settings** option is selected, the dialog should be completed as shown below.



Settings
Set Global Geodetic Data
TDOT does not use this option.

Configuration
When the **Geometry** tab is selected and the **Configuration** option is selected, the dialog should be completed as shown below.



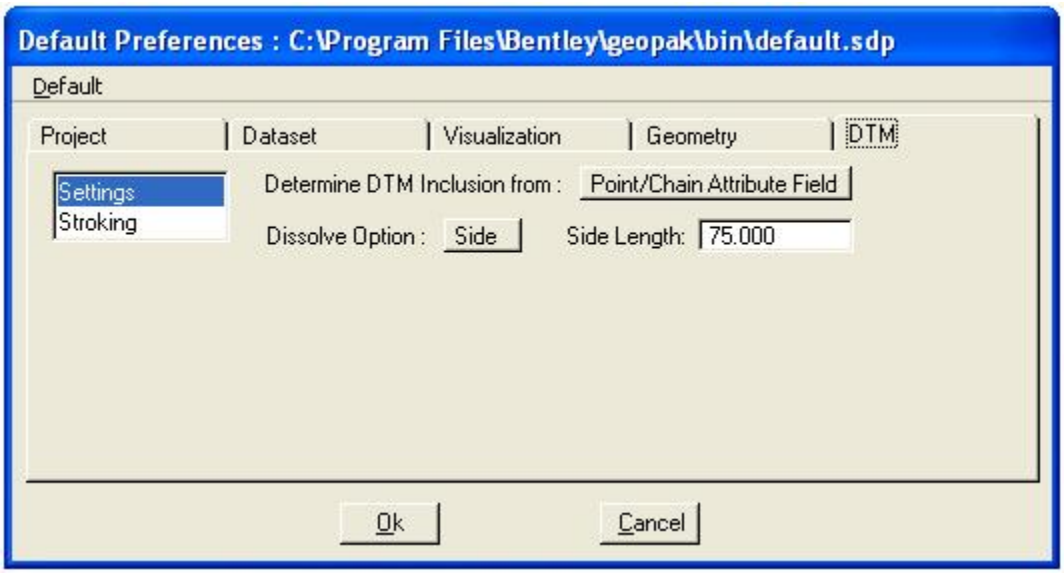
Redefine Elements in GPK
When toggled on, sets the redefine parameter in the Classic COGO dialog in GEOPAK®. As a TDOT best practice recommendation, leave this option toggled off.

Input Directory (Optional)
This option is used to specify the directory where properly formatted COGO input files are located.

Output Directory (Optional)
This option is used to specify the directory to save COGO output files to.

4.5 DTM TAB

When the **DTM** tab is selected and the **Settings** option is selected, the dialog should be completed as shown below.



Settings

Determine DTM Inclusion from:

Specifies how the **Build GEOPAK® DTM** (from Survey Data) dialog controls the inclusion or exclusion of survey points and survey chains collected in the field.

All Points/ Chains included - All surveyed points and chains will be included in the DTM. survey chains will be included as breaklines.

Feature Table (SMD) - The DTM inclusion is determined by feature definition in the SMD file.

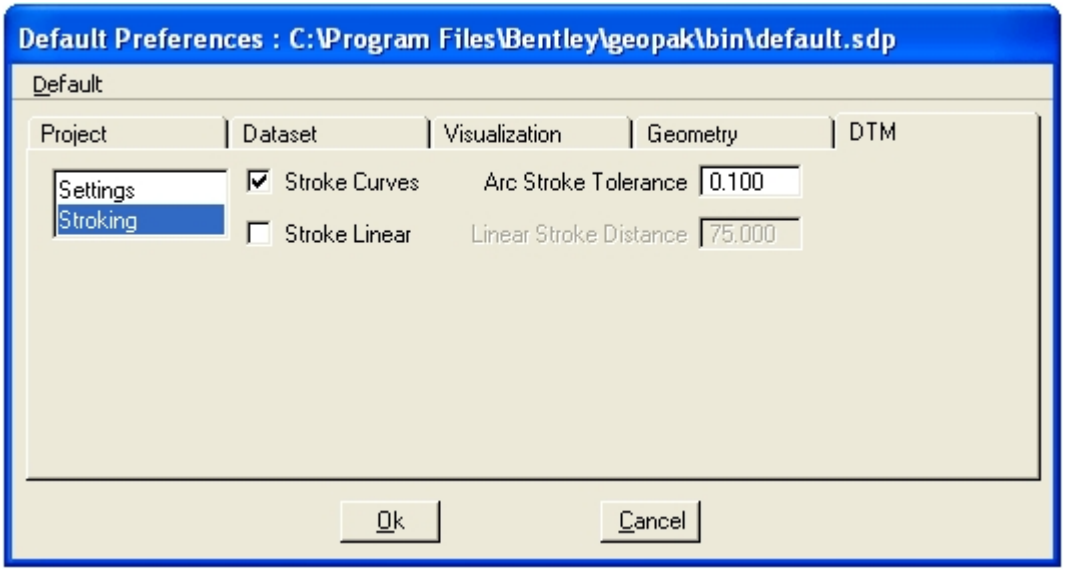
Point/ Chain Attribute Field - The DTM inclusion is determined by the Attribute field of the individual survey points and survey chains.

Dissolve Option:

Specifies how the **Build GEOPAK® DTM** (from Survey Data) dialog controls the creation of individual triangles in the TIN model. Options are **None, Sliver** and **Side** (preferred). If the **Side** option is used the maximum triangle side length can be input.

Stroking

When **Stroking** is selected, the **DTM** tab should be completed as shown below.



Once all of the preferences have been chosen, select the **OK** button to accept.

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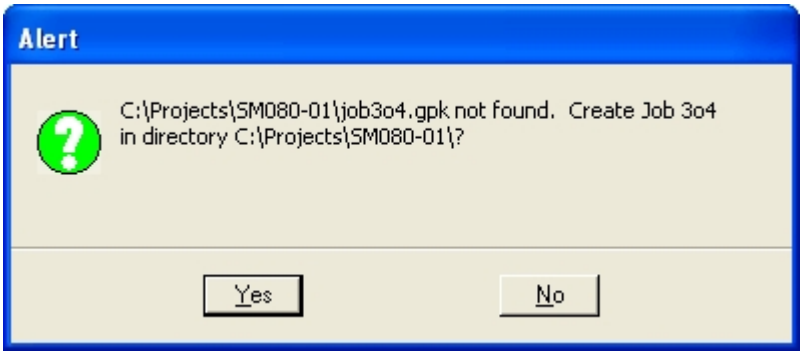
CHAPTER 5 - CREATING A NEW SURVEY PROJECT

5.1 CREATING A NEW SURVEY PROJECT

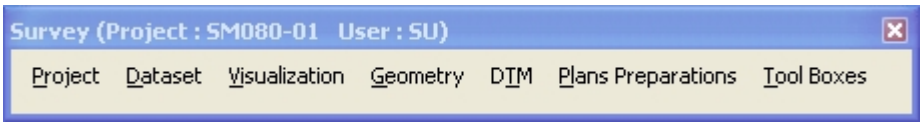
After the Project Preferences have been set, you are ready to create a new GEOPAK® Survey project. This process will copy the default preference file (default.sdp) to your project working directory and it then becomes a project specific preference file (*.spp). From the **Survey** toolbar, select New and the following dialog is opened.

Populate the dialog with the appropriate values. Once the dialog is populated, select **OK** to create the new project.

After the survey project has been created, the user can change the Project Preferences to suit the user's needs. Select **Yes** in the dialog below to create the .gpk file.



The **Survey** toolbar should reflect the active project and user as shown below.



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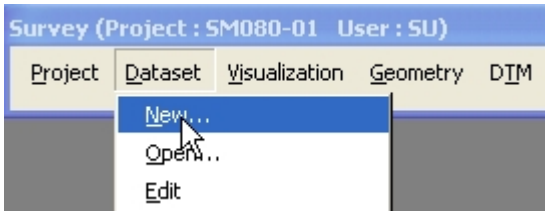
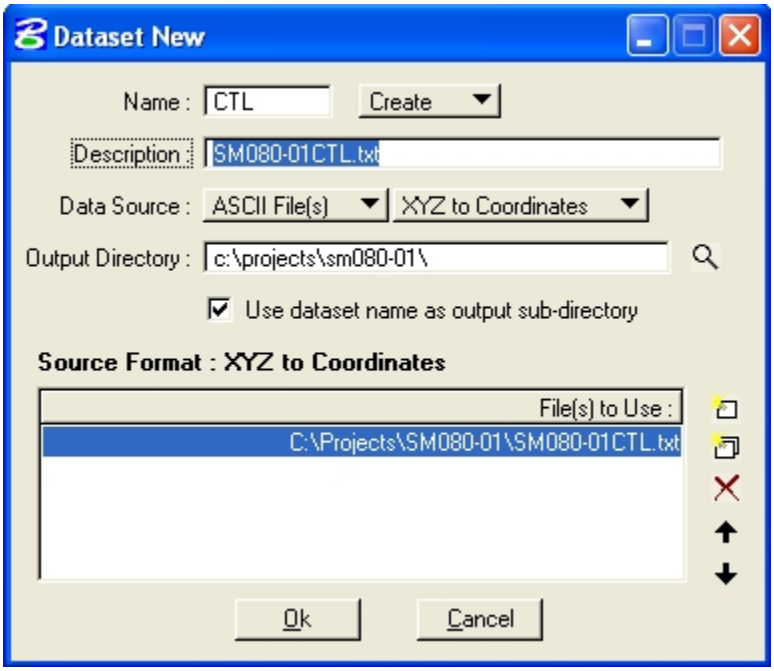
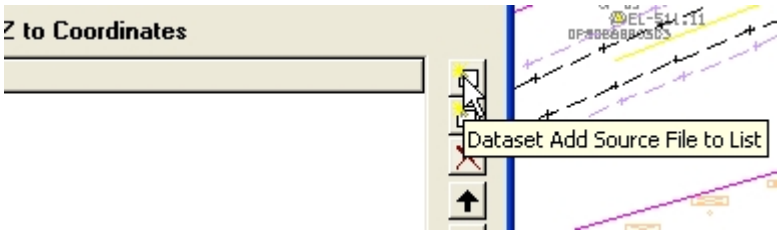
CHAPTER 6 - PROCESSING SURVEY DATA

6.1 CREATING NEW DATASETS

To create a new dataset and process the raw data, select **Dataset** → **New**… from the **Survey** toolbar and the following dialog is opened. Select the **Dataset Add Source File** to List button to add the SM080-01CTL dataset.







Name:

The **Name** of the dataset is user definable. The **Name** will also be used as the name of the sub-directory if the **Use dataset name as output sub-directory** option is checked. Each set of raw data that is processed for the project should have a unique name assigned. The **Name** field should be limited to alphanumeric characters with no special characters or spaces used other than a hyphen "-" or an underscore "_" character.

Description:

This key-in field is used to enter an optional description for the dataset.

Data Source:

A variety of data source options are supported in GEOPAK® Survey. For this example the ASCII file was exported from the data collector to a coordinate file.

Output Directory:

Select the directory where output information for this dataset (i.e., reports, OBS and control files) is placed.

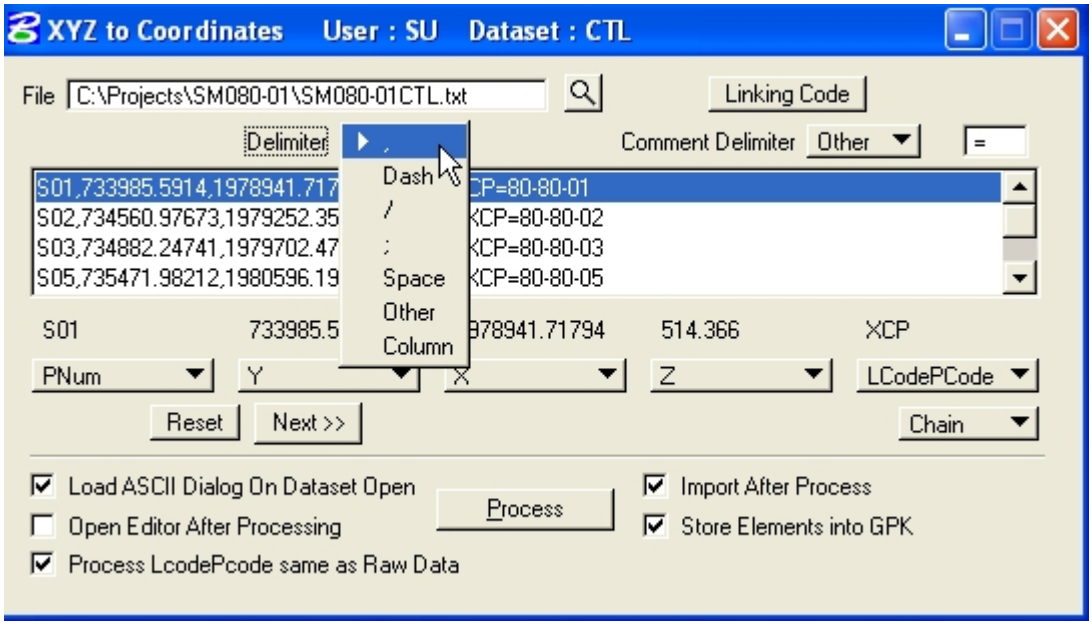
Use dataset name as output sub-directory

When toggled on, a directory of the same name as the dataset is created, and used for all output files. When not toggled on, the specified **Output Directory** is used. If the **Output Directory** field is left blank, the **Working Directory** is used.

Select the **OK** button to create the new dataset or **Cancel** to abort the operation.

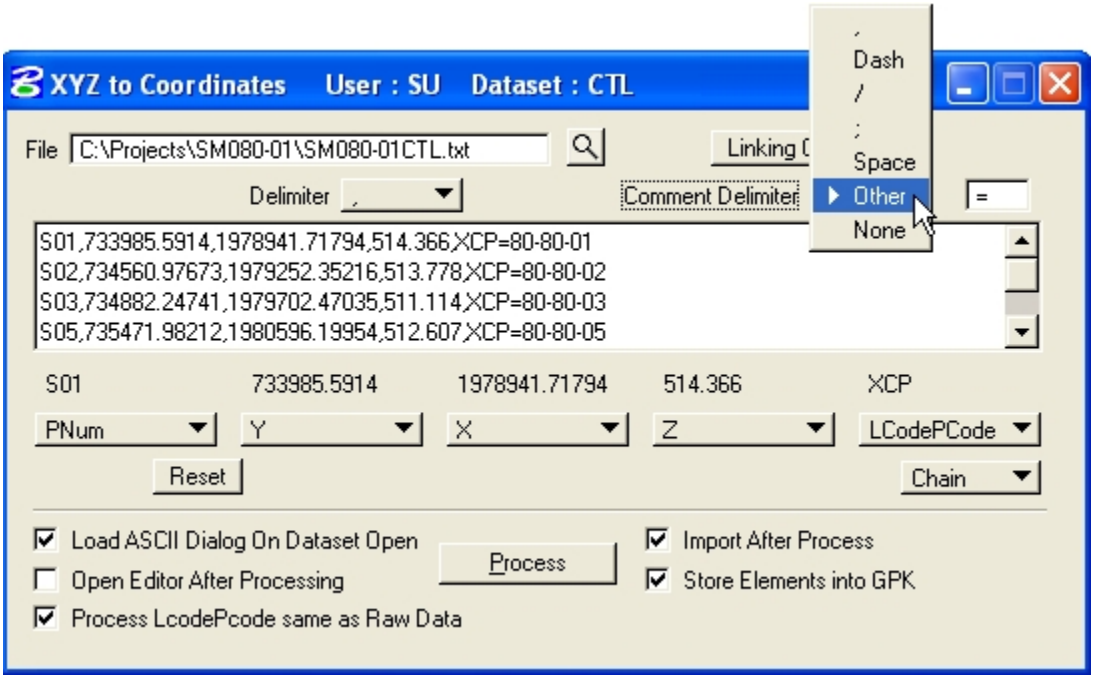
Delimiter

The user must set the delimiter for the dataset when using ASCII format. The dialog shown below illustrates the use of a "," to separate columns in the ASCII file. Note: To begin select a line as shown below.

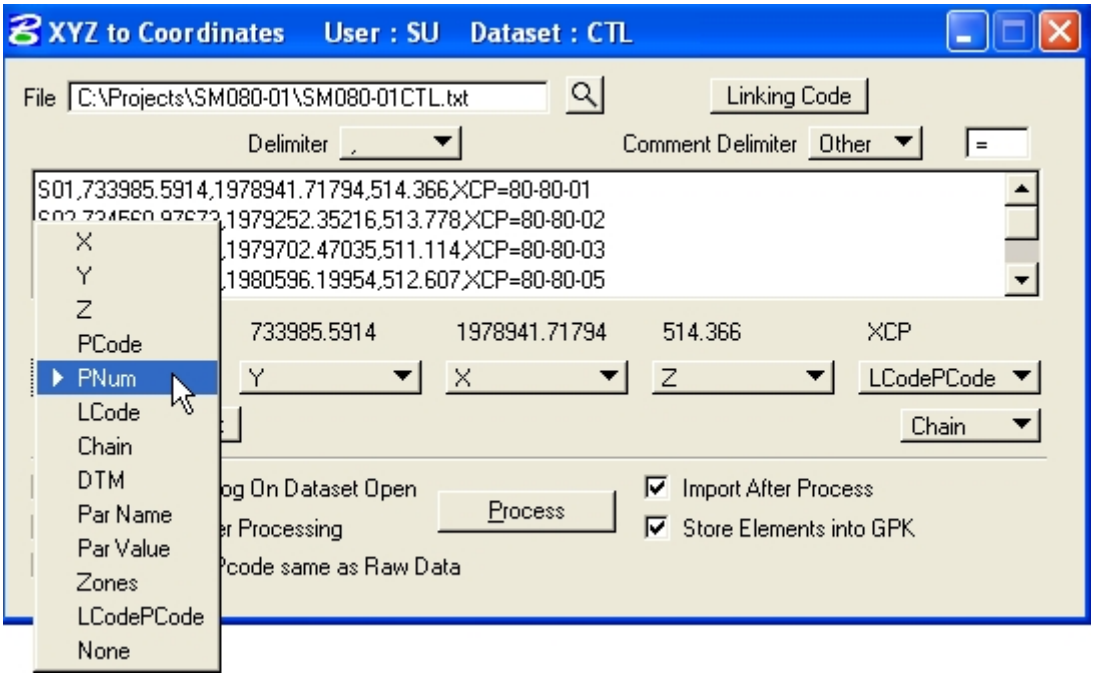


Comment Delimiter

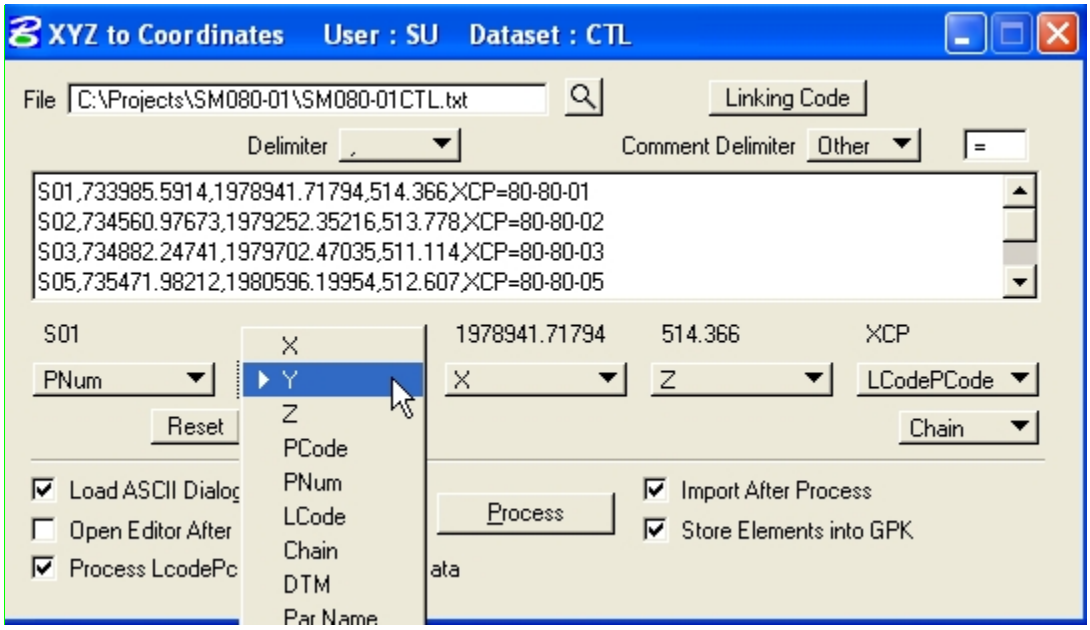
The dialog below shows the Comment Delimiter used for adding a comment to a field point.



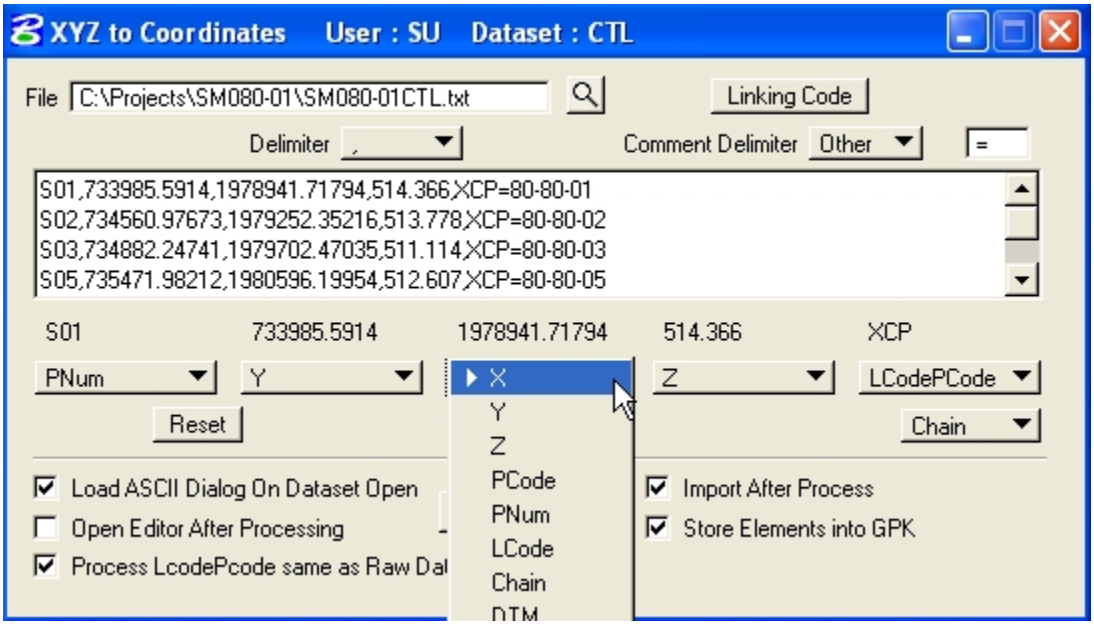
PNum identifies the first column in the ASCII file to be the point number.



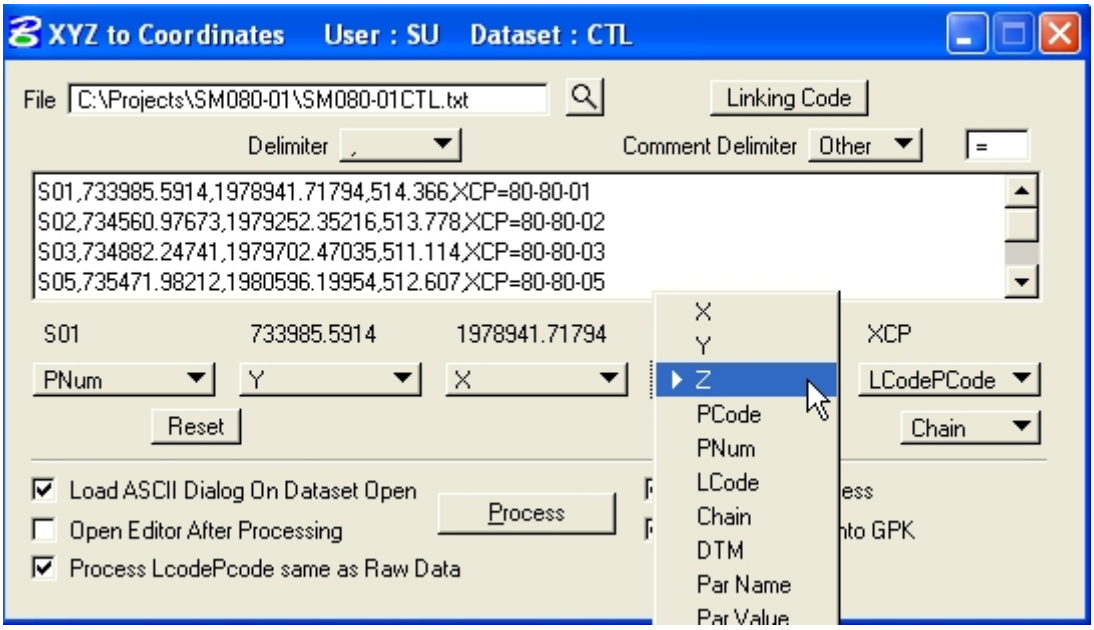
Y identifies the second column in the ASCII file to be the northing.



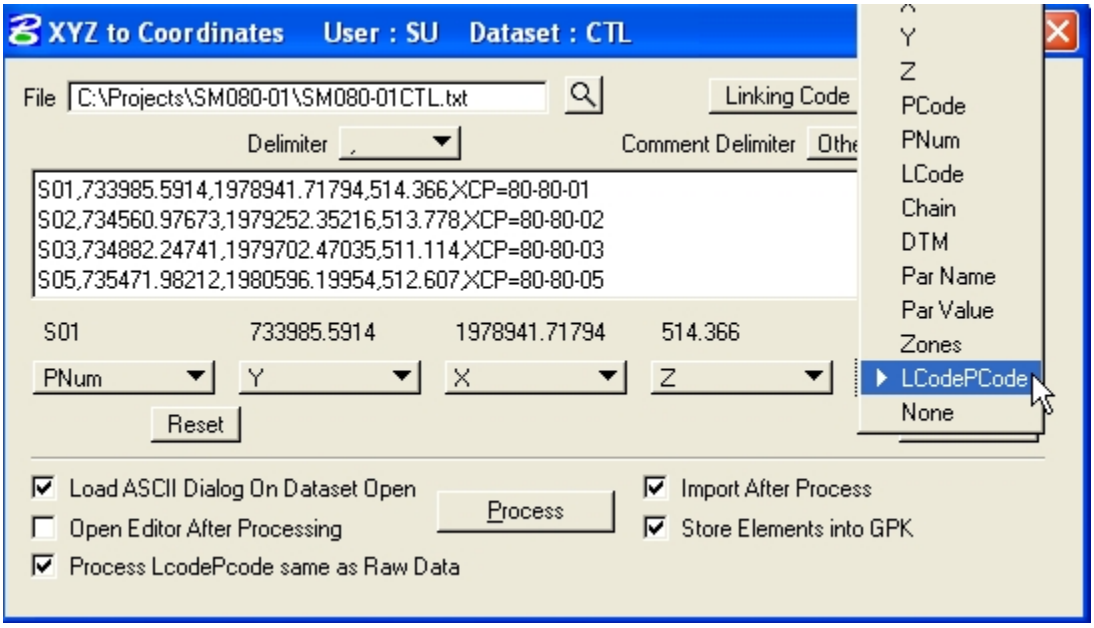
X identifies the third column in the ASCII file to be the easting.



Z identifies the fourth column in the ASCII file to be the elevation.

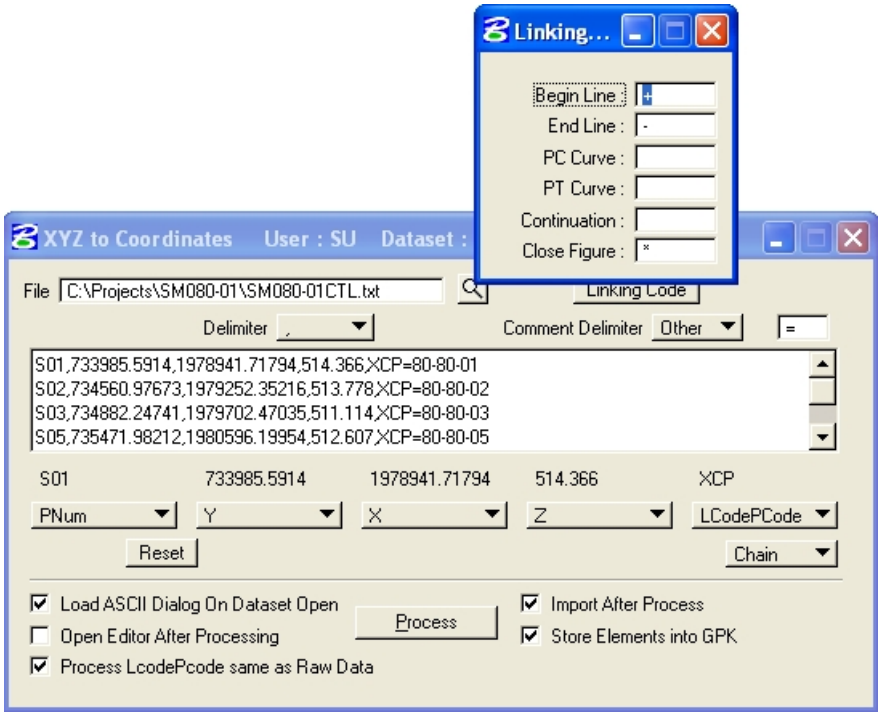


LCodePCode identifies the fifth column in the ASCII file to be the linking and feature code.

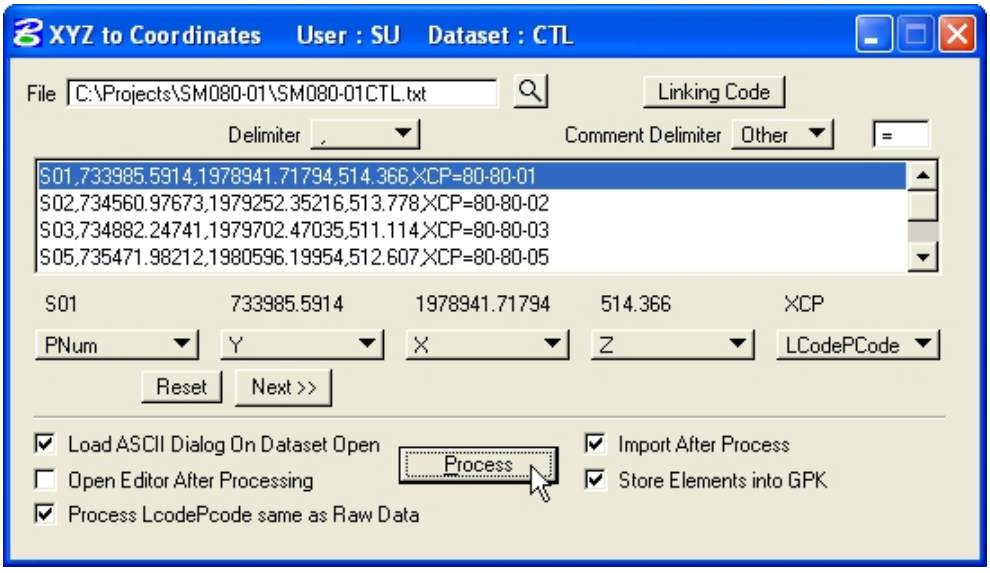


Linking Code

The dialog below shows the Linking codes used for **Begin Line**, **End Line** and **Close Figure**. Note: The **Linking Code** button is available after the **LCodePCode** field is selected.



Once the dataset format has been defined, the user can proceed with processing. Note: A point must be highlighted as shown in the dialog to be able to process the dataset.

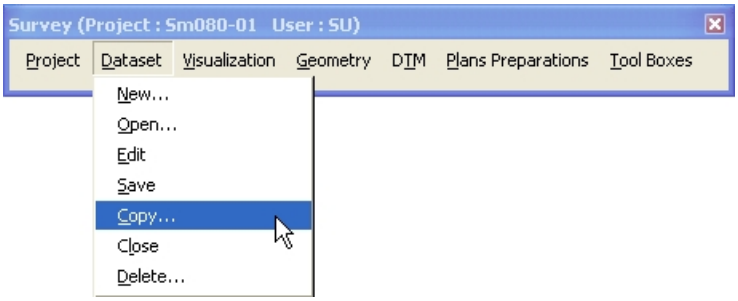


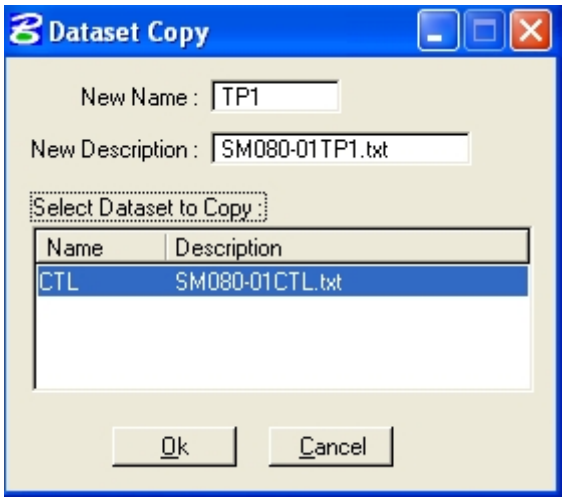
The dataset is mapped based on the SMD file selected in Section 4.3 **Visualization** tab.

The user should repeat the same process for the TP1 and TP2 datasets. Once the **Dataset New** dialog is invoked again, the user will have to remove the existing CTL (or TP1) information, replace with the new dataset information, then process.

6.2 COPYING DATASETS

Additional datasets can be created as described above or if the source format is the same, datasets may be copied under a different file name as shown below. Only the new source file would need to be defined. Select **Dataset** → **Copy…** from the **Survey** toolbar. Sub directories will not be created using this method.

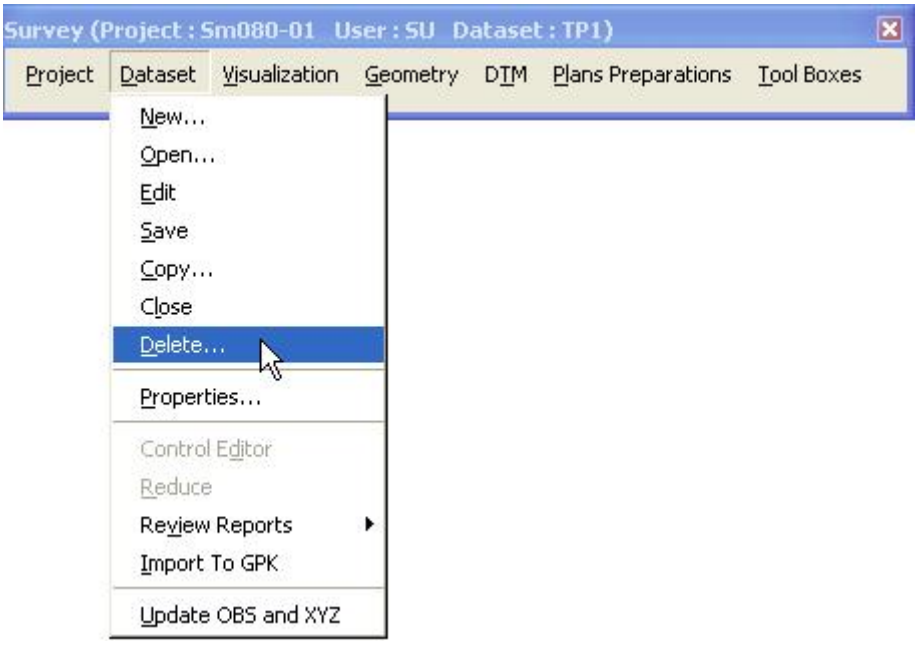




For the purposes of this class, the user should not copy a dataset.

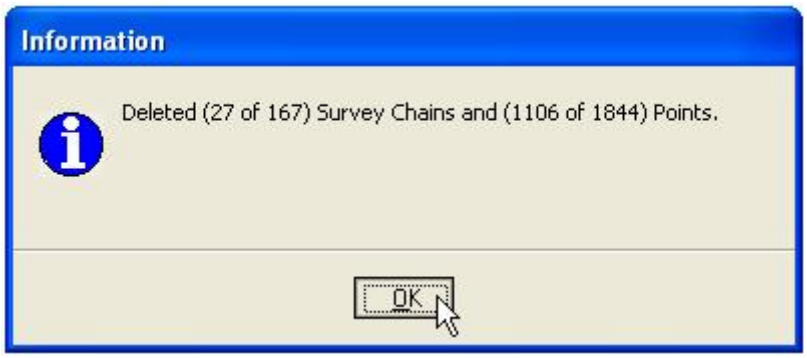
6.3 DELETING A DATASET

Note: The dataset being deleted has to be the active or open dataset. Only the information in this particular dataset is deleted. This is a useful tool since GEOPAK® creates various files that are associated with the dataset. This tool would be used if an incorrect source file was processed or if there was a major error in the source file making the dataset invalid. For the purposes of this class the user **should not** delete any datasets.



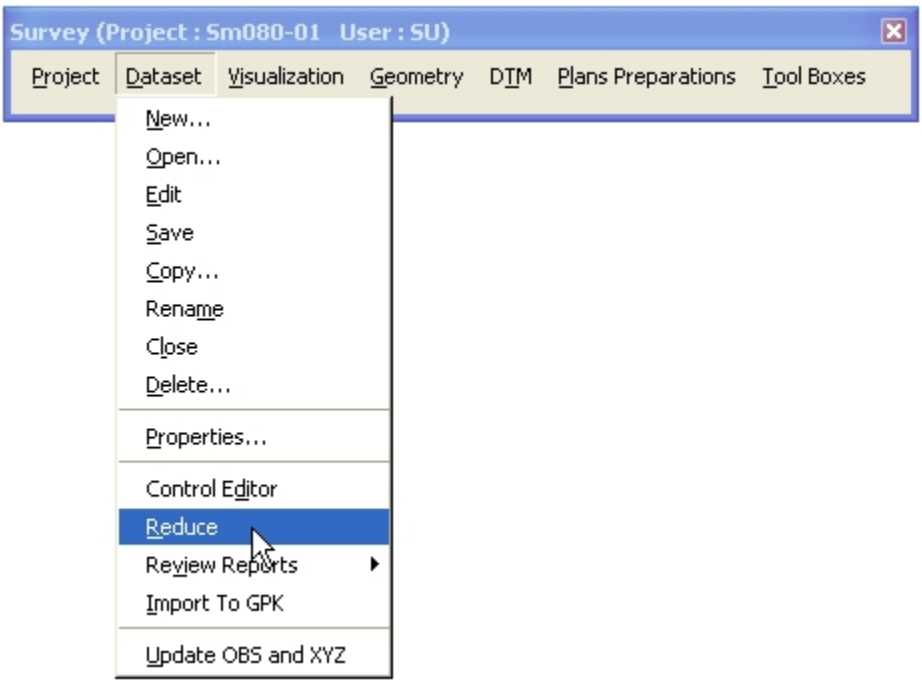
By selecting the following toggles, the .obs and .xyz files are deleted as well as the elements removed from the .gpk file.

The dialog shown below will appear confirming the deletion of the survey chains and points. The **Information** dialog summarizes the points and chains from the active dataset that will be deleted and the total number of points and chains contained in the GPK file. The original dataset source file remains intact.

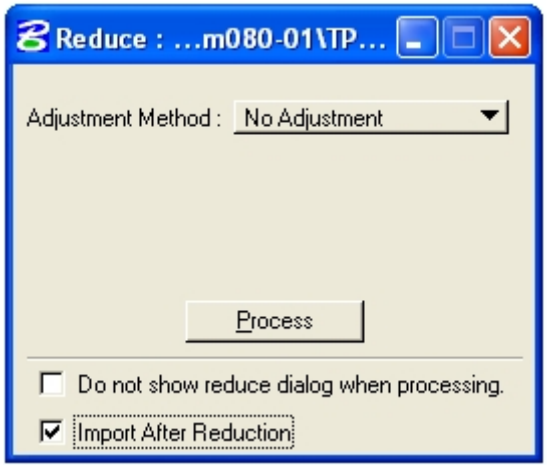


6.4 REDUCE DATASET

To reduce the dataset, populate the GPK file and map elements into MicroStation®, access **Dataset Reduce** as shown below. For the purposes of this class the user **should not** reduce any datasets.

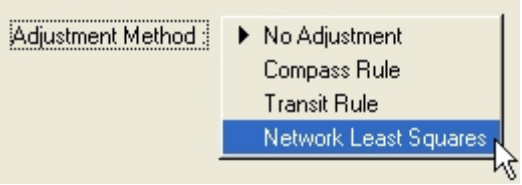


The **Dataset Reduce** window will open, as shown below.



Adjustment Method:

The **Adjustment Method** is selected by the **Project Preferences** dialog at the creation of the project; however, it can be modified at this point. The options shown below are supported by GEOPAK® Survey.



Import After Reduction

Select this option to automatically import the survey data into the .gpk file after the data is reduced. The value for this option is set in the **Project Preferences** at the creation of the project, but can be modified at this point.

Process

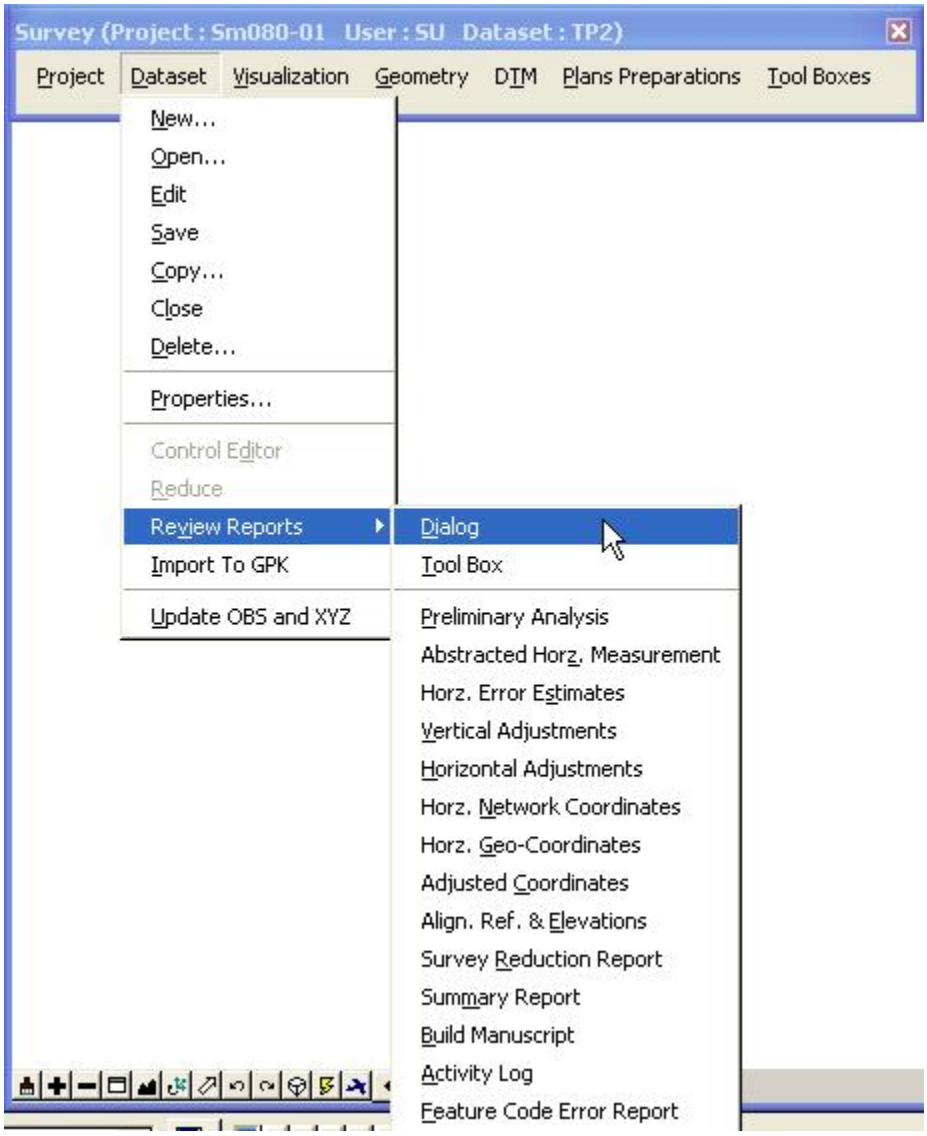
This starts the dataset reduction process.

When the **Process** button is selected, the following actions occur:

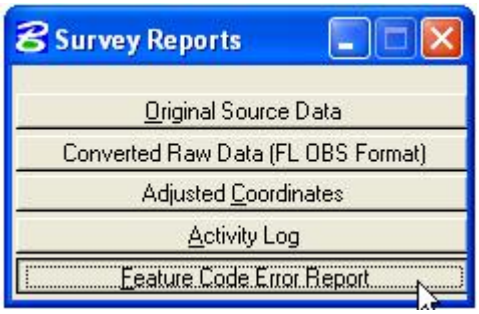
- The survey data is reduced according to the selected **Adjustment Method.**
- Several reports are generated in the sub-directory for the dataset. The Data Reduction Report (.rpt) is automatically opened in a MicroStation® text editor.
- If **Import After Reduction** is toggled on, the survey data is imported into the .gpk file.
- If **Import After Reduction** is toggled off, the user must select **Dataset → Import to GPK** from the **Survey** toolbar to initiate the import process.

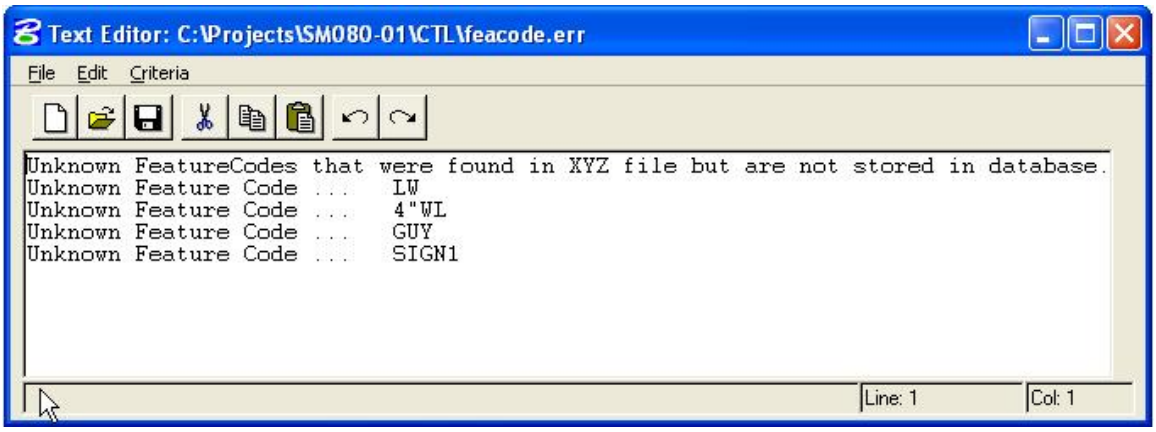
6.5 REVIEW REPORTS

The user can now review the available reports. The reports can be reviewed by opening the **Survey Reports** dialog by selecting **Dataset → Review Reports → Dialog** from the **Survey** toolbar.

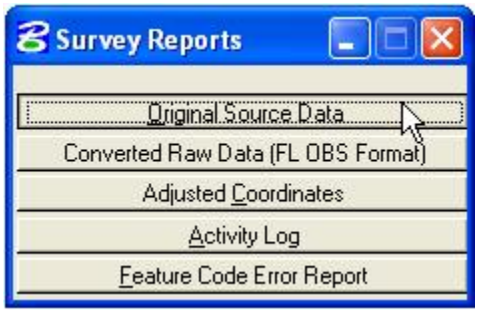


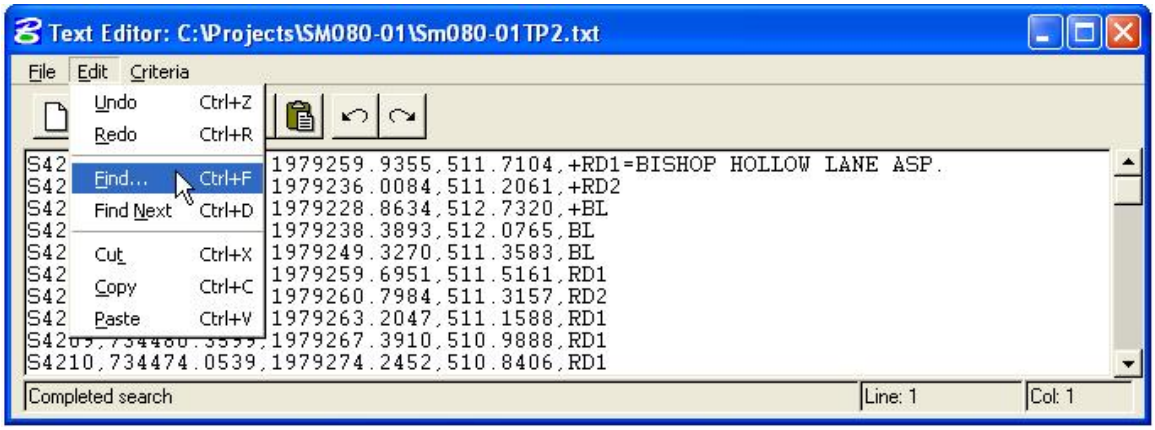
The Feature Code Error Report button can be selected to view the feature code errors (or unrecognized descriptors) as shown in the text editor window below.

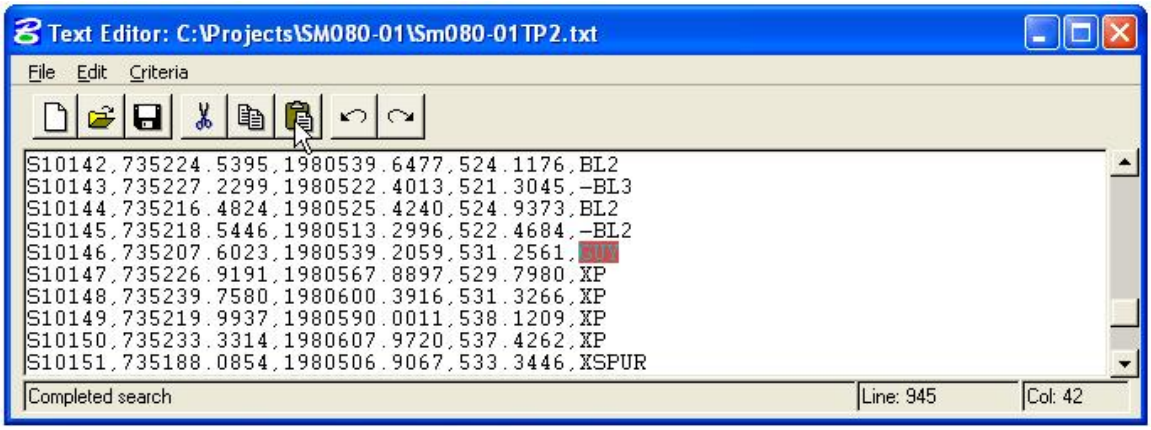




Once the incorrect Feature Code is known, open the Original Source Data file to determine which points were incorrectly coded.

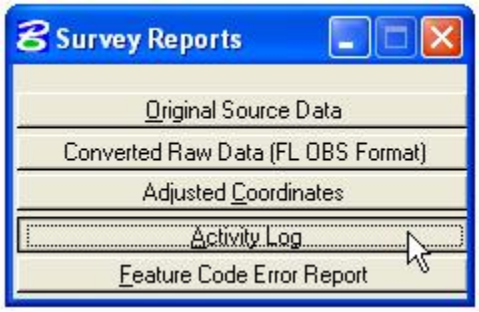




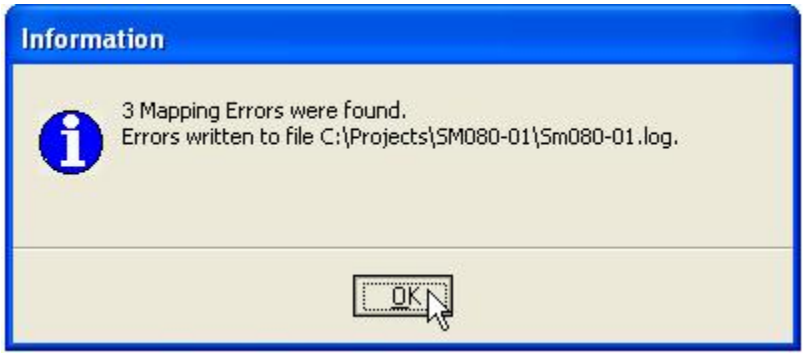


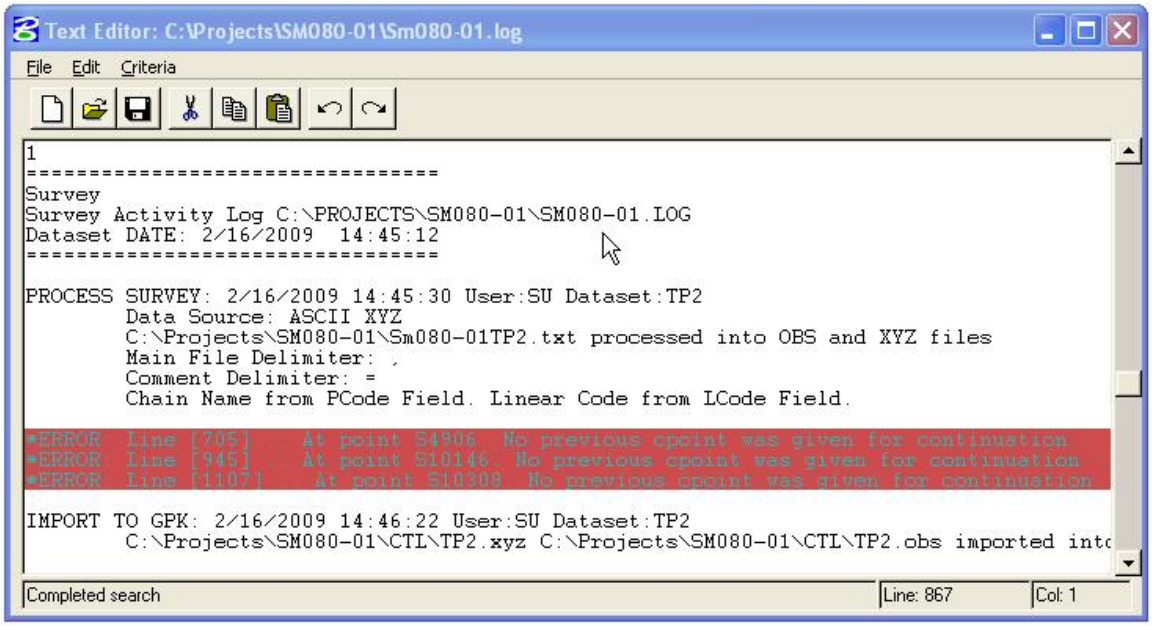
The feature codes will be corrected in Chapter 8. The point will be remapped to the correct settings as defined by the SMD file (Note: Redefine must be active in the COGO dialog). Once updated, the new information pertaining to the edited point is stored in the GPK file. The Original Source Data file remains intact.

The **Activity Log** tracks (all activity) the detailed history of the .gpk file including all the modifications, additions, or changes to the .gpk file.



If the following **Information** dialog appears after processing or importing the dataset into the GPK file, errors were encountered in chains being miscoded. These chains are displayed but the SMD file does not know how to interpret them. The user must review the Activity Log to determine which points need to be corrected.





Open and review the Activity Log for any errors in processing the dataset.

6.6 RAW DATA EDITOR

The user can review the obs file by selecting **Dataset** → **Edit** from the **Survey** toolbar to open the GEOPAK® Survey Editor. The raw data editor is used to review and correct raw data prior to processing. For the purposes of this class, the Raw Data Editor will not be used to edit the raw data.

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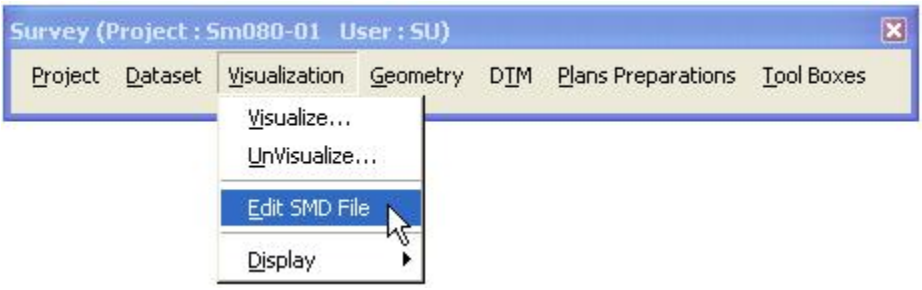
CHAPTER 7 - VISUALIZING SURVEY DATA

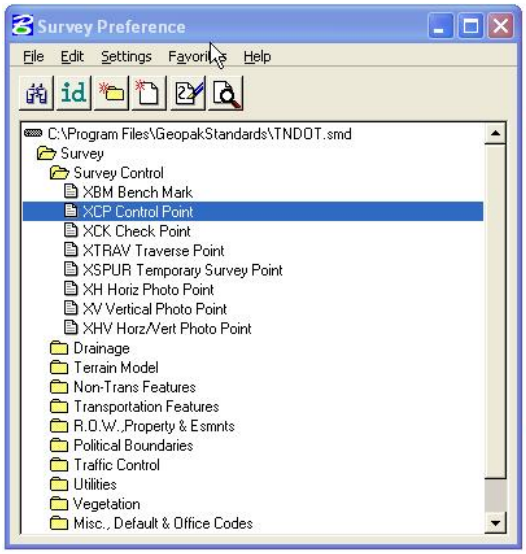
7.1 TDOT SMD (SURVEY MANAGER DATABASE)

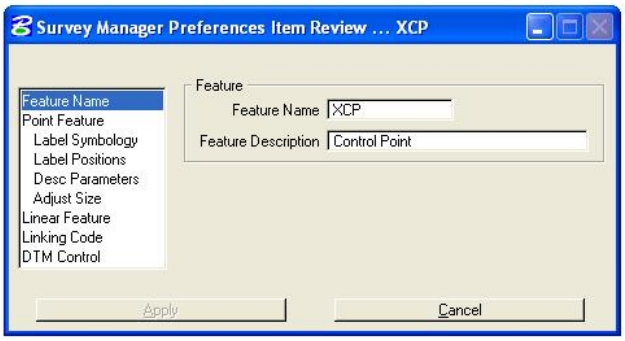
The SMD Database dictates various graphic and surface functions. To review the SMD settings choose **Visualization → Edit SMD File**.

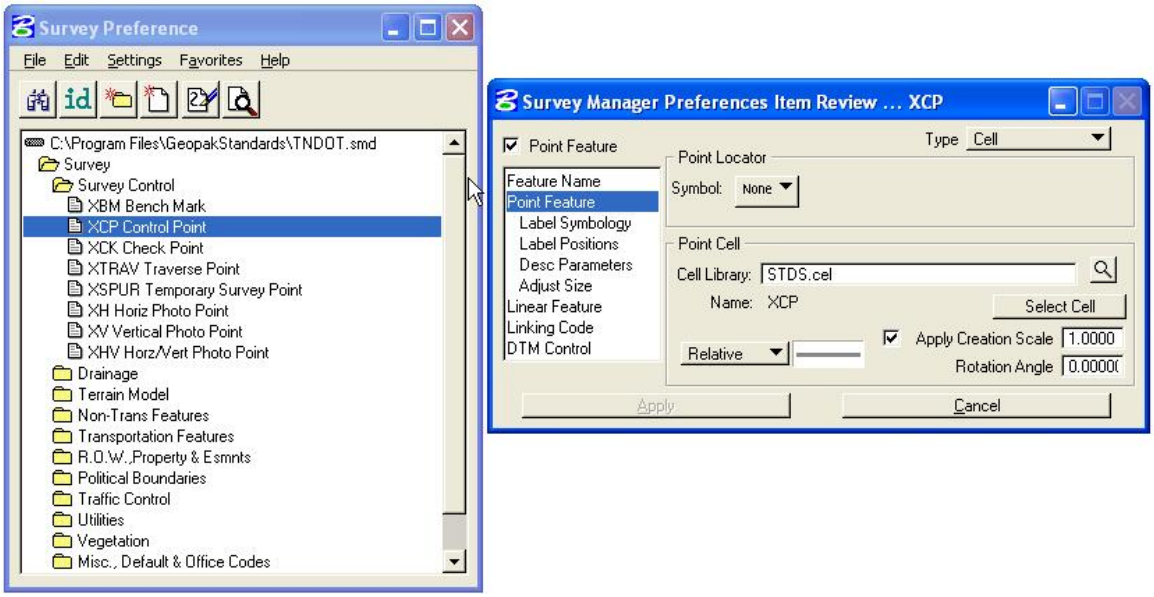


The `TNDOT.smd` file is password protected and cannot be modified, but can be viewed by selecting Cancel in lieu of entering a Password.

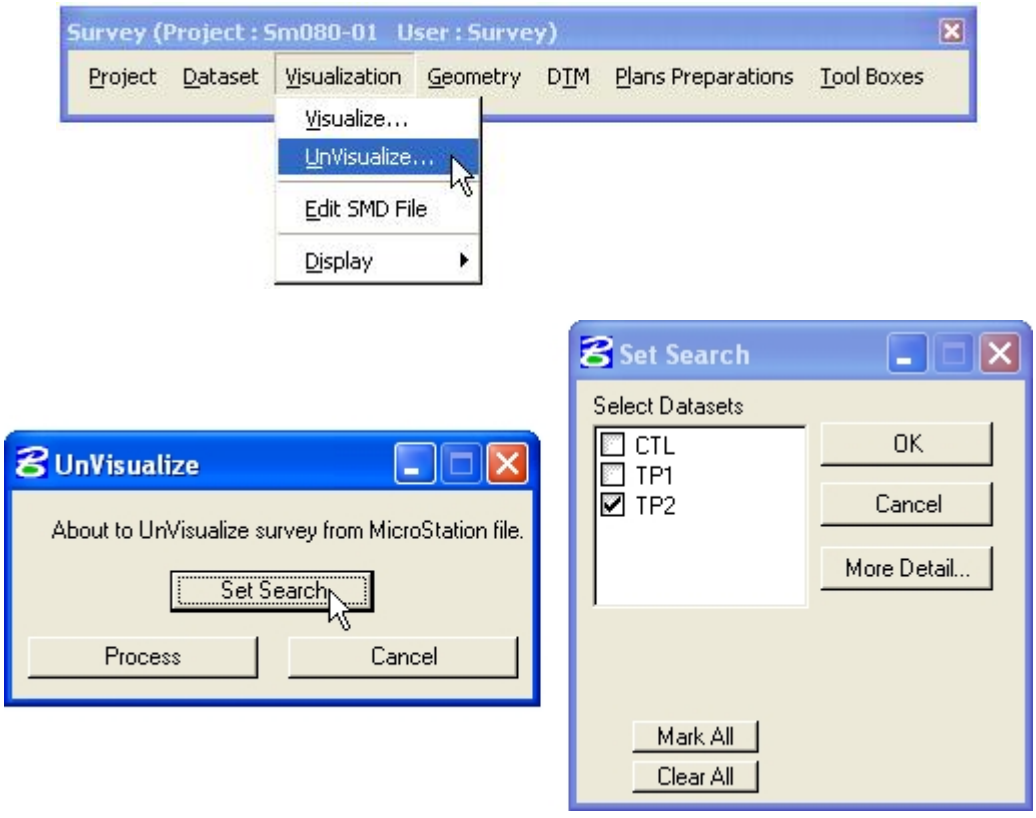
Select the Feature or Item to Review and a full definition of the Feature can be viewed.



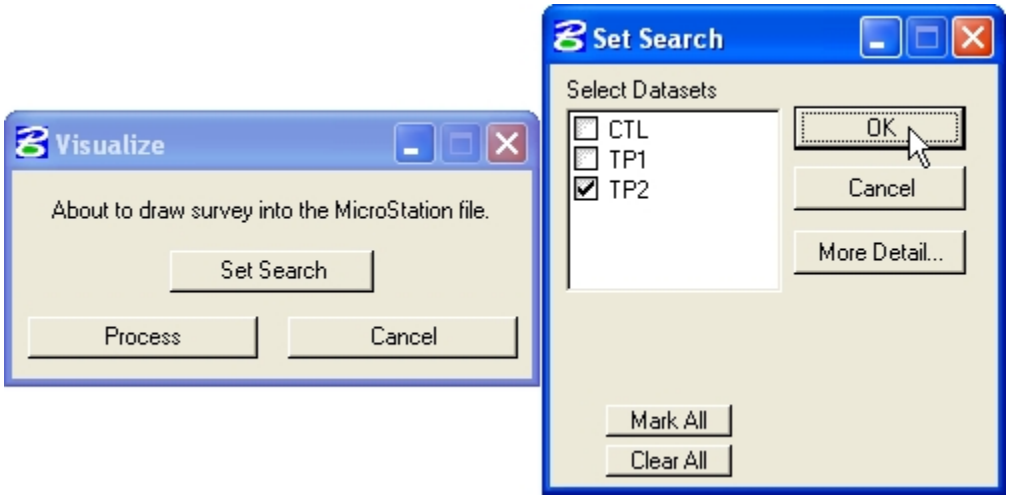




Individual datasets can be visualized or unvisualized by using the **Visualization** menu. This command is writing or deleting the graphic information to the MicroStation® file. The command is not mapping new information. In order to visualize a dataset, the dataset must first be imported into the GPK file. For the purposes of this class, the user **should not** visualize or unvisualize any datasets.



The Set Search feature, which can be utilized in other applications, allows the user to identify which elements are to be used. Toggle TP2 in the **Set Search** dialog to unvisualize the elements in the TP2 dataset. Select **Process** from the **UnVisualize** dialog. The graphics will be removed from the drawing file. After unvisualizing the graphics, the graphics can now be visualized. Select **Process** as shown in the dialog below.



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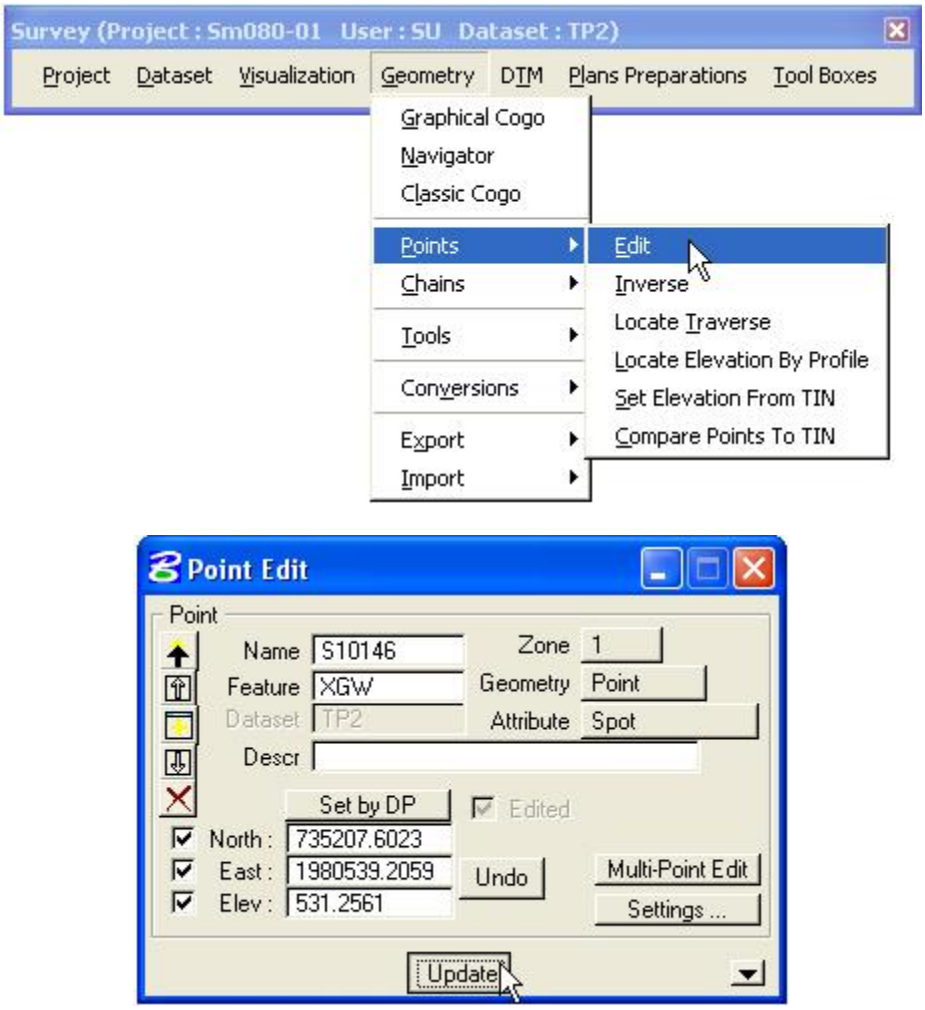
CHAPTER 8 - MANIPULATING SURVEY DATA

8.1 POINT EDITING

Select **Geometry** → **Points** → **Edit** from the **Survey** toolbar to access the **Point Edit** dialog shown below.



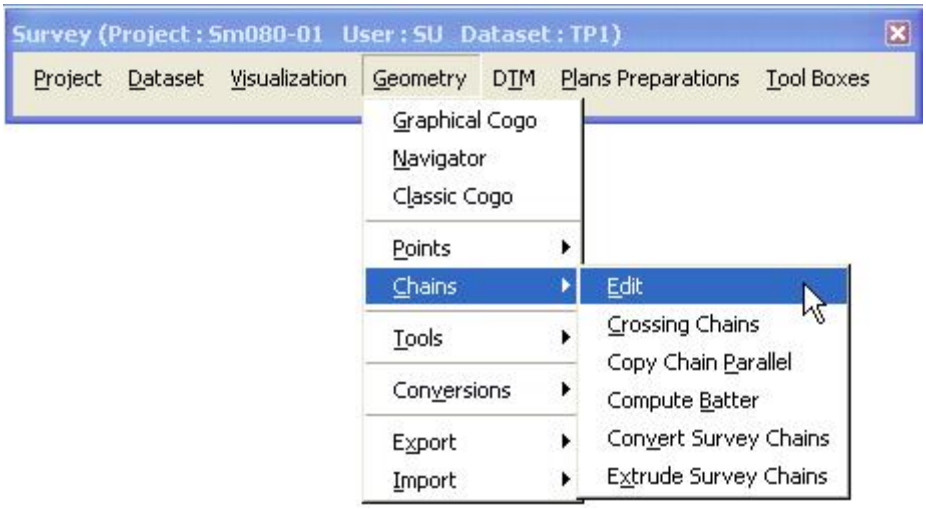
The **Point Edit** dialog can be used to edit, create, and delete Survey Points.

Point S10146 was miscoded in the data collector so the user will have to edit the point. As described in Section 6.6 the incorrect feature code was “GUY”. The user should enter S10146 in the **Name** field and press the TAB key. This will load the data for this point. Update the **Feature** field with the appropriate code XGW and change the **Attribute** field to **Spot** as shown above and select **Update**.

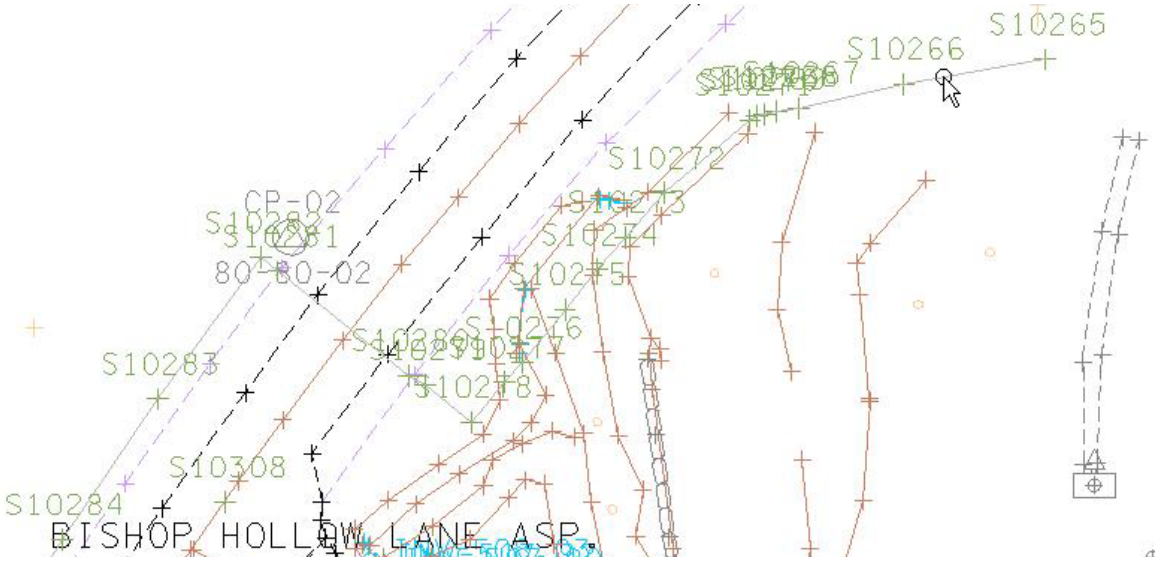
The user can use the same procedure described above for the additional miscoded points. All edits are made to the Survey Points stored in the .gpk file. See the GEOPAK® online help for complete information.

8.2 CHAIN EDITING

Select **Geometry** → **Chains** → **Edit** from the **Survey** toolbar to access the **Chain Edit** dialog shown below.

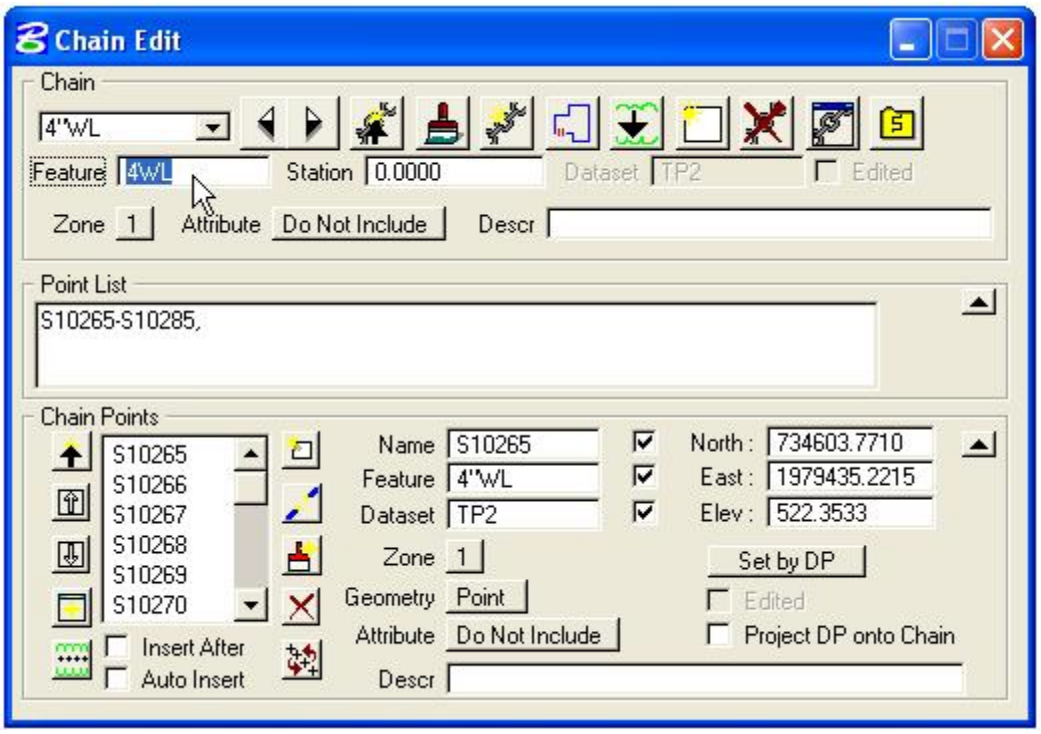


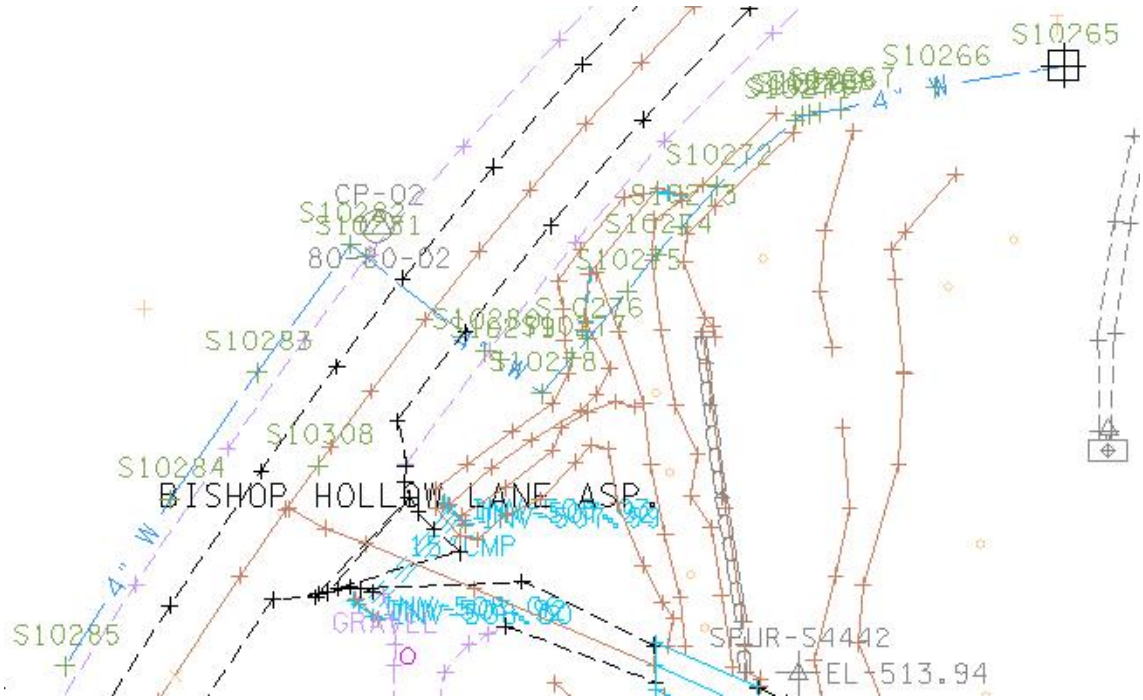
When the **Chain Edit** dialog appears, the 4" water line chain will not be selected. The user can graphically select the chain or choose from the chain pull down. Select the 4"WL chain beginning with point S10265 either graphically or from the Chain list in the dialog. The 4"WL chain is shown in the screen capture below. Once the chain is selected, the respective boxes to that chain will be populated and can be edited.



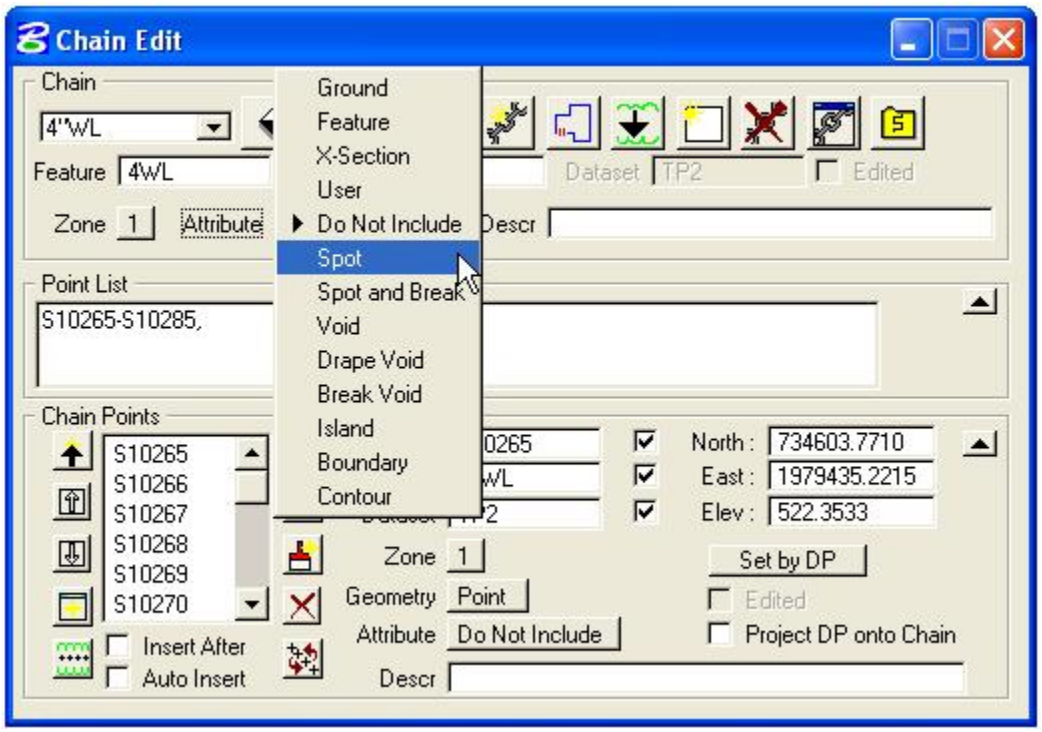
In this case, each of the points associated with the 4” Water Line were miscoded as 4”WL. The correct feature code should have been 4WL. Using the **Chain Edit** dialog, the user can edit the feature code for each individual point as well as the chain. Each point feature code should be corrected in order for the point locators, numbers, elevation, etc. to be mapped to the correct symbology. The **Attribute** setting will need to be manually corrected for each point. The dialog will not look to the SMD file to update this setting.

Edit or correct the feature code for the chain and select the **Update** button (paintbrush icon).

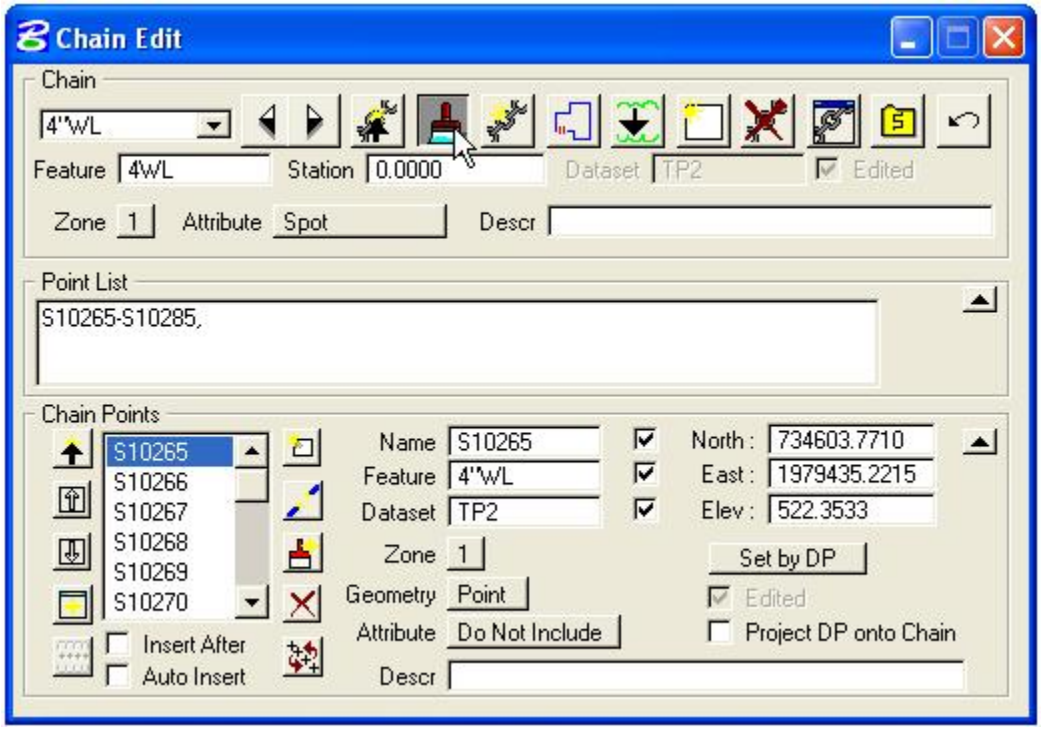




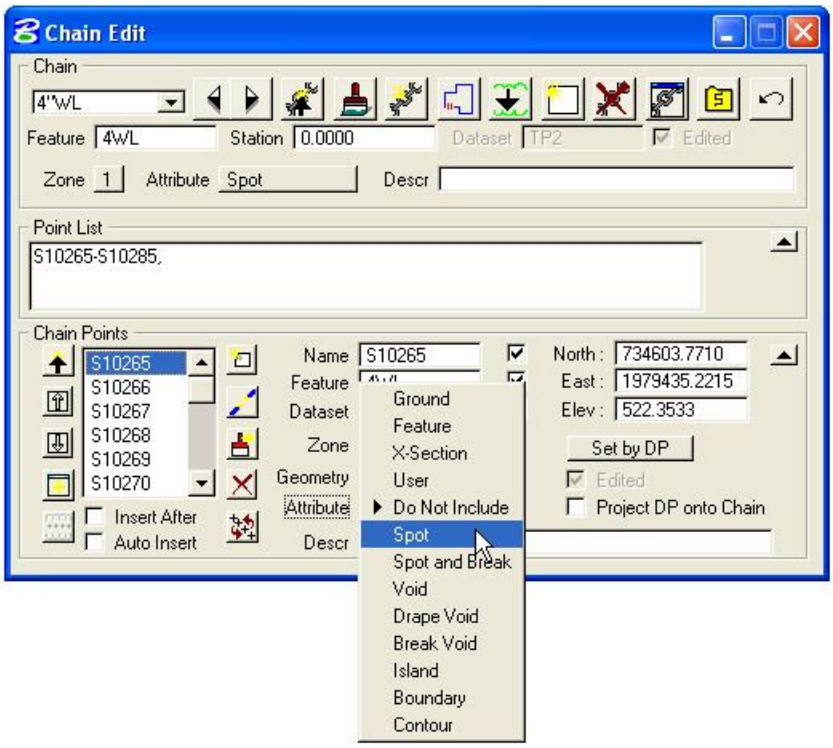
Change the **Attribute** to Spot for the chain.



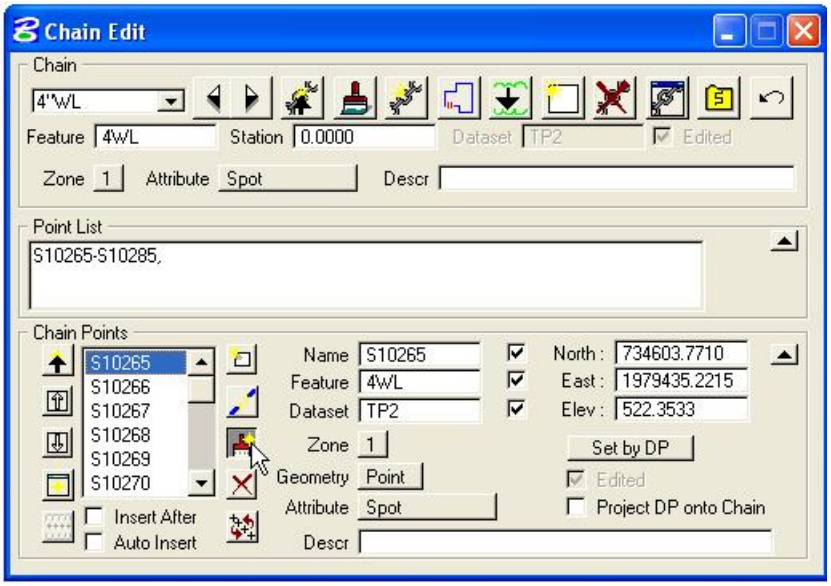
Anytime features or other information are edited, updating the chain is recommended. This procedure automatically remaps the chain and graphically updates the chain feature.



Now, edit each individual point to reflect the correct feature code and attribute settings as shown below. In this case, begin by selecting the first point in the chain. Correct the feature code and then change the **Attribute** setting.



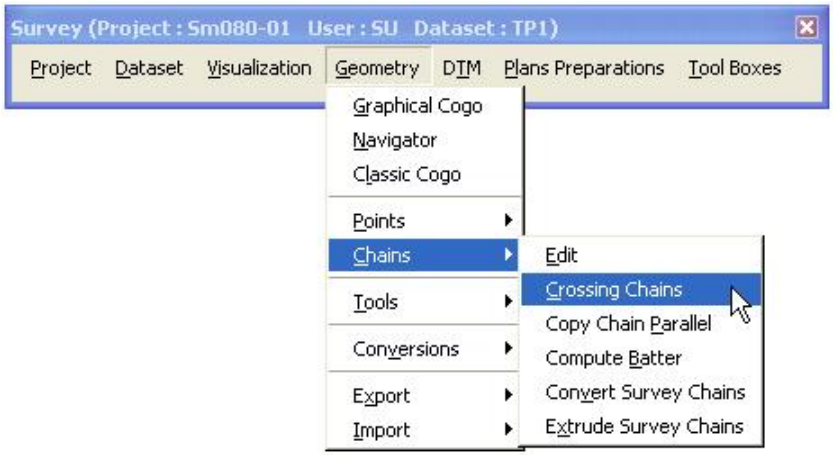
The paintbrush icon next to the list of chain points must be selected to update the point data.

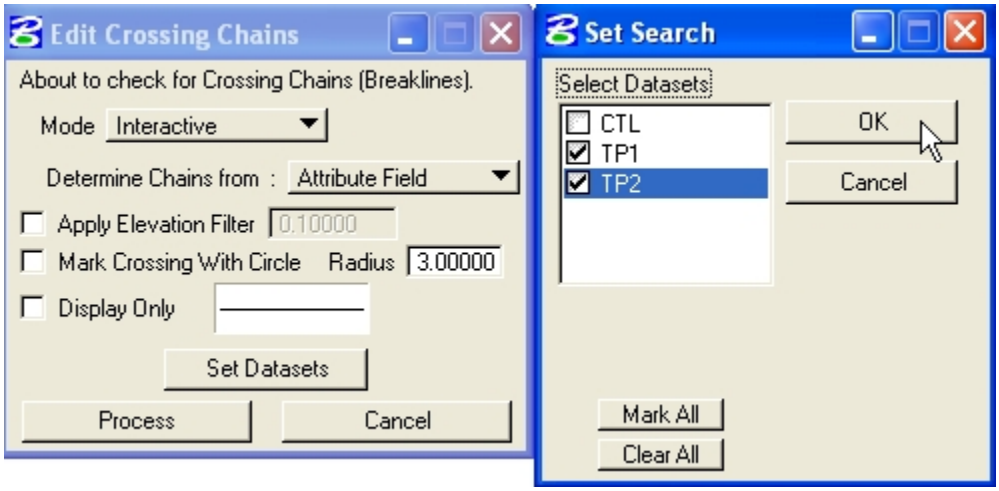


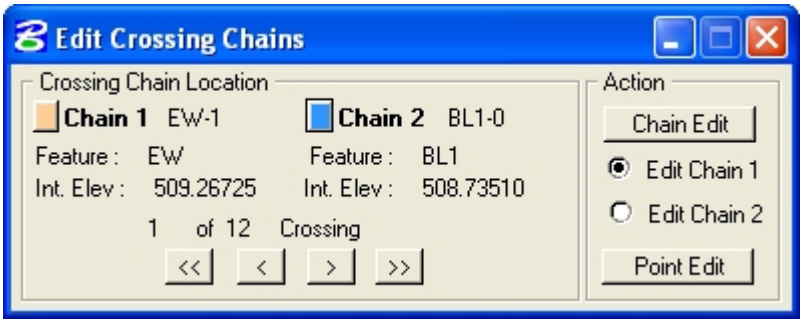
Repeat this process for each individual point in the chain.

8.3 CROSSING BREAKLINE DETECTION

Before creating the DTM File for a project, it is good practice to check for crossing break lines in the survey data. Crossing break lines can lead to unpredictable results in the completed DTM surface. To check for crossing break lines, select **Geometry → Chains → Crossing Chains** from the **Survey** toolbar to access the **Edit Crossing Chains** dialog shown below. Complete the dialogs as shown below. Once the datasets are selected, select the **Process** button from the **Edit Crossing Chains** dialog.





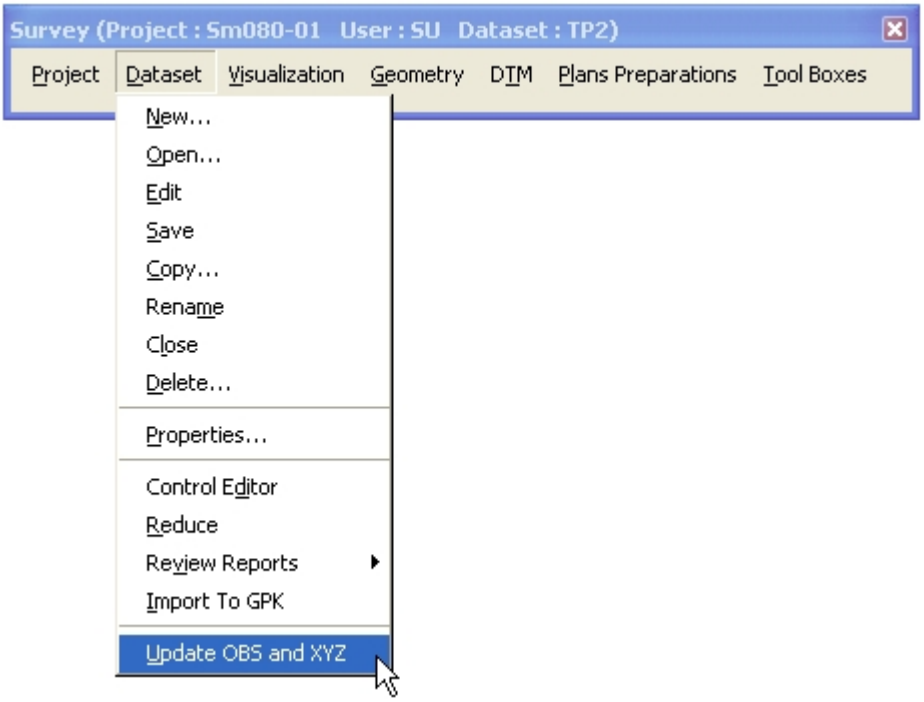


All edits are made to the Survey Chains stored in the .gpk file.

See the GEOPAK® online help for details running the **Edit Crossing Chains** dialog.

8.4 UPDATE OBS / XYZ

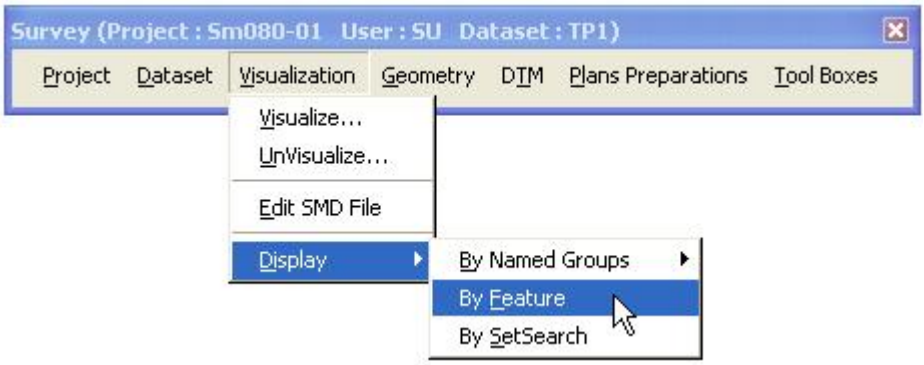
Edits preformed on Survey Points and Survey Chains are stored in the .gpk file and are not reflected in the raw data files for the dataset. The **Update OBS and XYZ** command should always be used to update the raw data after performing edits to the Survey Point and Survey Chain definitions. Select **Dataset** → **Update OBS and XYZ** from the **Survey** toolbar to access the **Updating** dialog shown below.



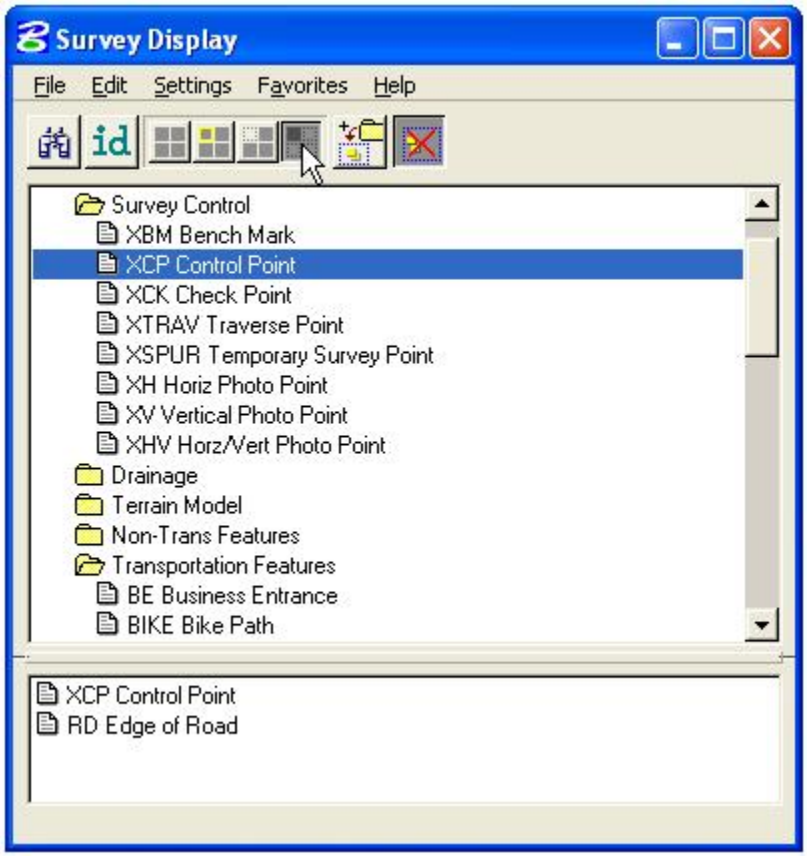
Use the **Set Datasets** dialog to select the TP2 dataset. Select **Process Update** to update the **.obs** and **.xyz** files for the selected dataset.

8.5 DISPLAY BY FEATURE

The **Display By Feature** option gives the user control to analyze the processed data according to features from the SMD file. When invoked, this opens the SMD file allowing for the selection and / or grouping of desired features.



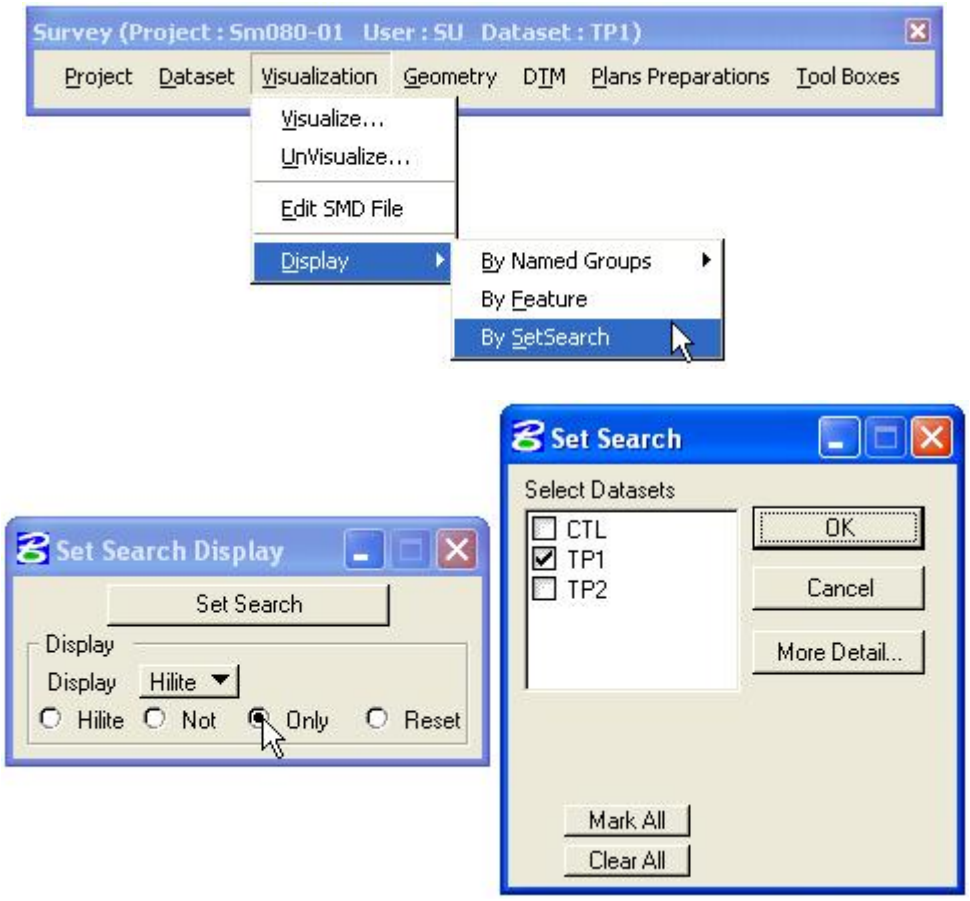
Once selected, the feature editor opens as shown below.



It is important to remember that no editing of the feature table can occur from the application, only selection for viewing. By selecting a category or an individual item and adding into the collection window on the bottom of the dialog, the user has the ability to control how the elements are viewed. The button selected above will only display the elements added to the collection. By selecting the **Settings** pulldown from the top of the dialog, a masking color to be applied to the entire file can be set. This simply shades all the elements to the selected color for viewing purposes.

8.6 DISPLAY BY SET SEARCH

The **Display By Set Search** is also a viewing tool that provides the capability to view project elements with the control over selecting Runs and then filtering based on Points, Chains, Feature, Zones, and Attributes just as the Multi Point Edit and various other survey tools do.



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CHAPTER 9 - DIGITAL TERRAIN MODELS

A **Digital Terrain Model (DTM)** represents the topography of a project in the form of a triangulated network. The DTM can be drawn in a 2D or 3D file, and then rotated to see the existing surface of the project area.

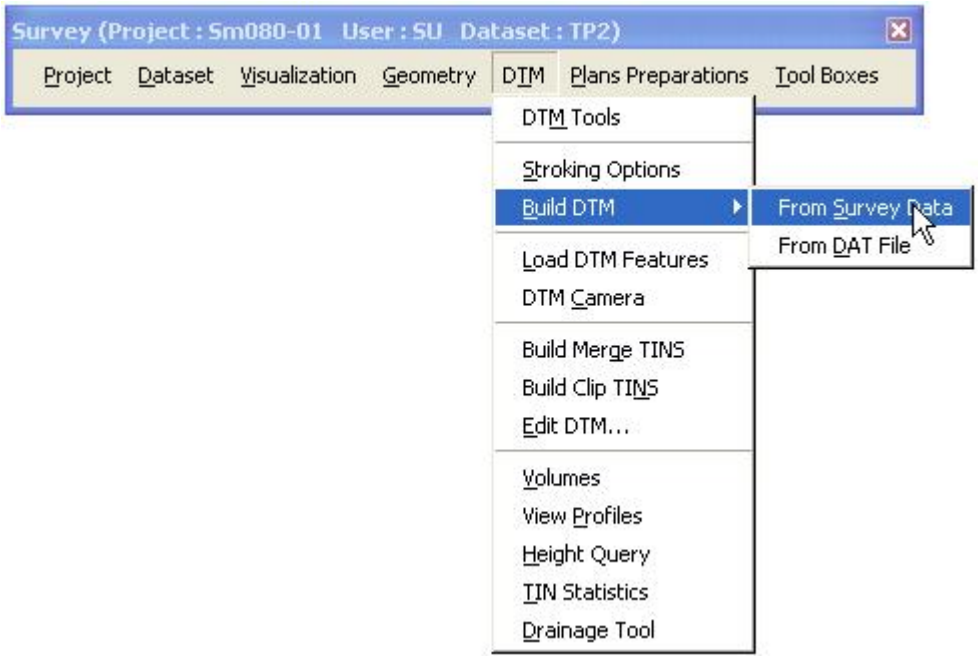
Digital Terrain Models can be generated from various sources including MicroStation® Elements, survey data, photogrammetric data, GEOPAK® cross sections, and geometry data.

Triangulation is a mathematical process applied to stored elevation points and stored elevations along DTM break lines to create surfaces. The result of triangulation is the creation of a TIN file from which existing ground profiles and existing ground cross sections can be generated.

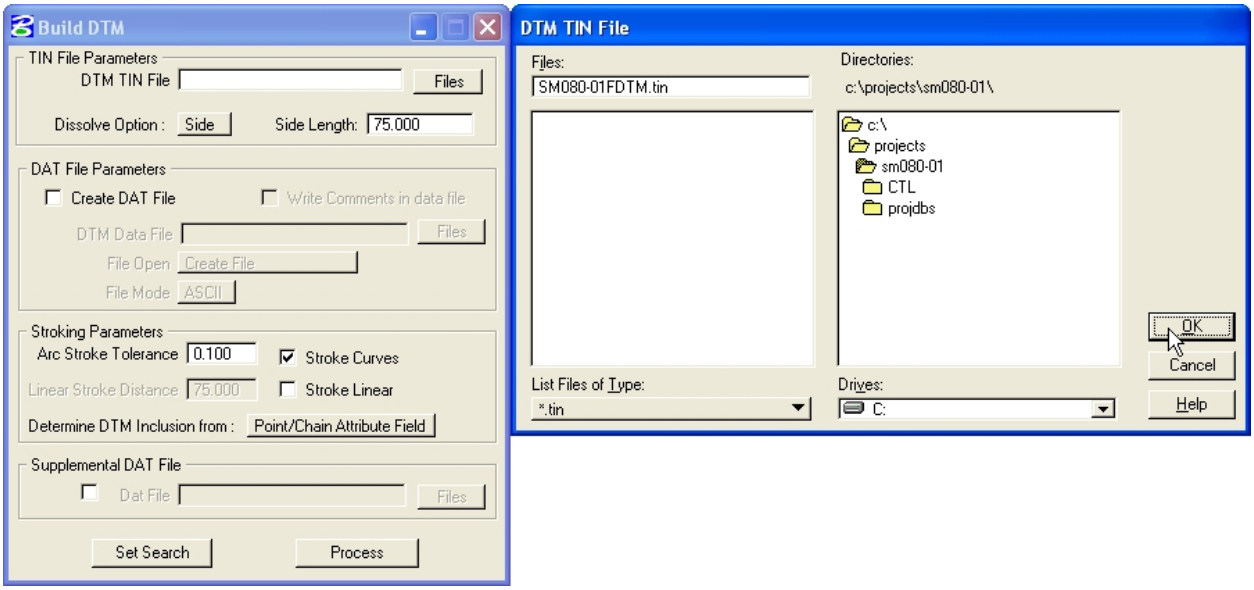
9.1 CREATING A DTM FROM SURVEY DATA

To create the DTM model for the existing field survey data, select **DTM → Build DTM → From Survey Data** as shown below.

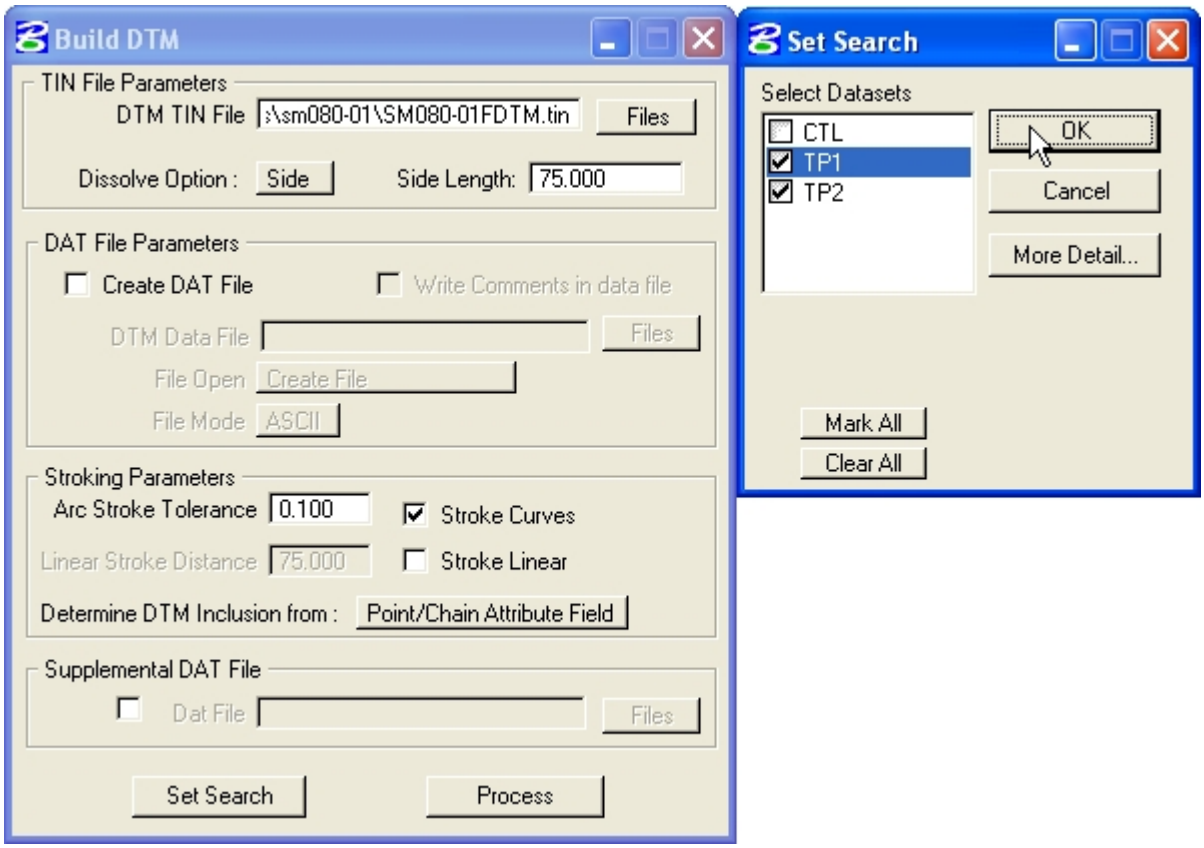
Note: This section is for field survey only and does not include aerial data. A similar process is used in Section 9.6 for combining field and aerial survey data.



The **Build DTM** dialog opens as shown below. The user will name the `.tin` file by selecting the **Files** button and typing in the name of the TIN. The "F" in the name of the tin represents field survey.



Select the **Set Search** button to open the following dialog. Select the TP1 and TP2 datasets and select **OK**.



Setting DTM Inclusions
Revisions made to points or chain surface attributes will only be recognized if Point Chain Attribute Field is toggled on. If not toggled, the DTM Inclusions will be determined from the SMD file and any revisions made to the point or chain DTM Attribute will be ignored. This should typically be set to **Point/Chain Attribute Field** for TDOT projects.

See the GEOPAK® online help for a complete description of all the dialog options. The options most commonly used are detailed below.

DTM TIN Files
Key-in the name and path for the new TIN file to be created. The TDOT CADD Standards manual details the standard file naming requirements for GEOPAK® Digital Terrain Model (.tin file).

Set Search
The **Set Search** dialog will allow you to select which datasets to process.

Select **Process** to start the build DTM operation.

Building Triangles from combined .dat file: **Build Triangles** processes the information stored in a DTM input file (**`.dat`**) to create a triangulated model (**`.tin`**). The file extension **`.tin`** represents a *triangulated irregular network*.

Data File is the DTM input file where the extracted topological features are stored.

TIN File stores the triangulated model in binary format.

The user does not have to enter the file extension with the file names. The user can always navigate to an existing file using the **Files** button. If the full path is not given, the files will be created in the working directory.

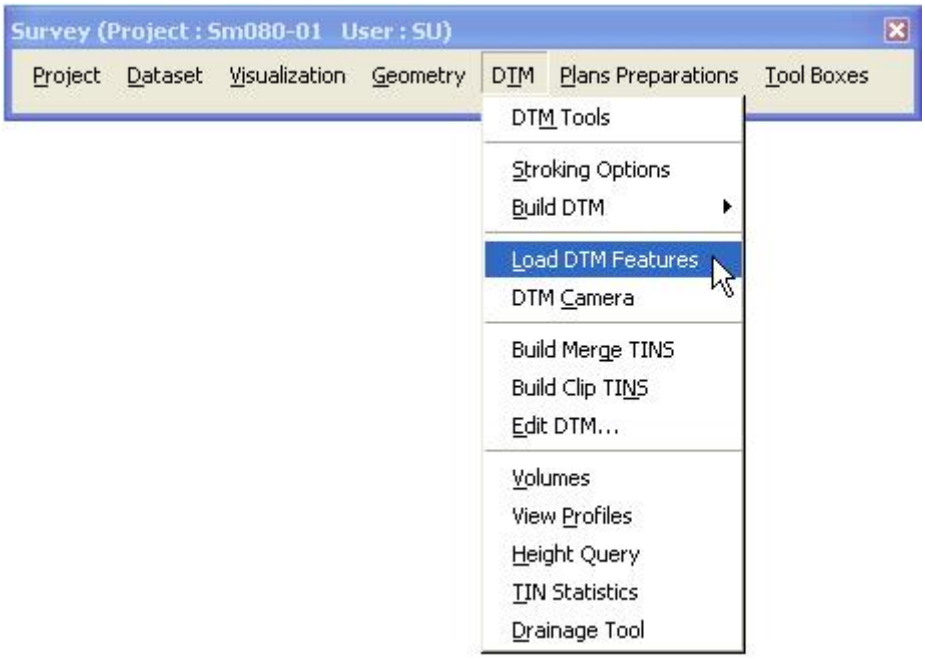
The **Dissolve Option** eliminates triangles that are not representative of the surface. These dialogs are populated by the settings initially set in the **Project Preferences** dialog. They can however be changed at this time.

The three options are:

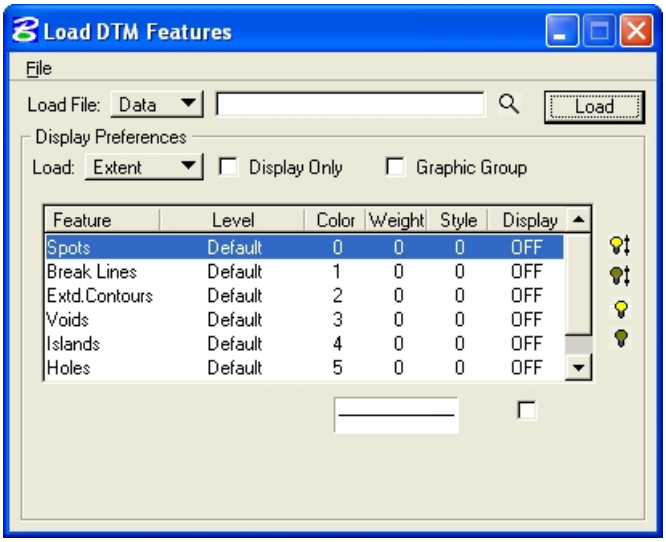
- **None** - no external triangles are dissolved
- **Sliver** - long, thin triangles dissolved
- **Side** - external triangles whose external side is longer than a user specified length are dissolved (recommended)

9.2 LOADING DTM FEATURES

To visualize the DTM information in MicroStation®, select **DTM → Load DTM Features** from the **Survey** toolbar.



The **Load DTM Features** dialog opens as shown below.



Load File:

Select the file type that you wish to use to load information from. Supported file types are **Data, TIN, and Lattice**.

Load Button

Select this button to start the drawing or displaying of DTM Features in the active MicroStation® design file.

Display Preferences

Load:

Features for an entire model can be drawn utilizing the **Extent** option, while partial model features can be accomplished by the **For Fence** option. Regardless of the MicroStation® Fence option selected, the overlap method will be utilized. When utilizing the **For Fence** option, the MicroStation® fence must be placed prior to pressing the Load button. The **For View** option draws only features with in the current view.

Display Only

When this toggle is activated, elements are not drawn into the MicroStation® file and disappear when an update or view control command is issued. When not activated, elements are drawn into the file at the specified element symbology.

Graphic Group

When activated, all elements placed with in a single processing (each pressing of the Load button) are placed into a graphic group for easy manipulation and /or deletion.

Level Preference File

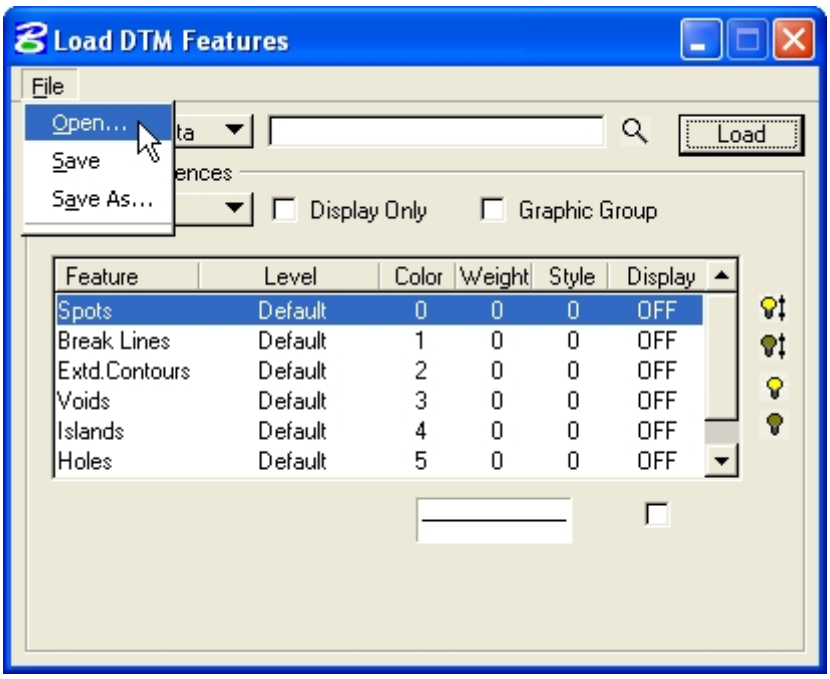
To set the **Level, Color, Weight, and Style,** two display preference files have been configured according to TDOT standards:

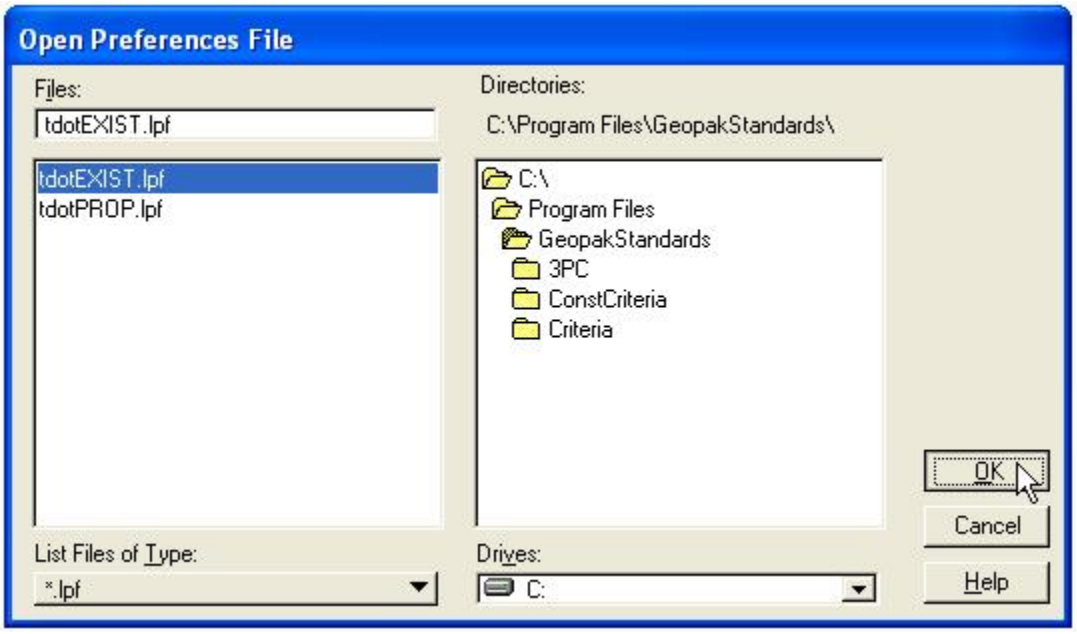
- **`tdotEXIST.lpf`** - Display preferences for plotting existing DTM features.
- **`tdotPROP.lpf`** - Display preferences for plotting proposed DTM features.

To access these files, select **File** → **Open…** from the **Load DTM Features** dialog. These files are maintained on the “c" drive at the following location:

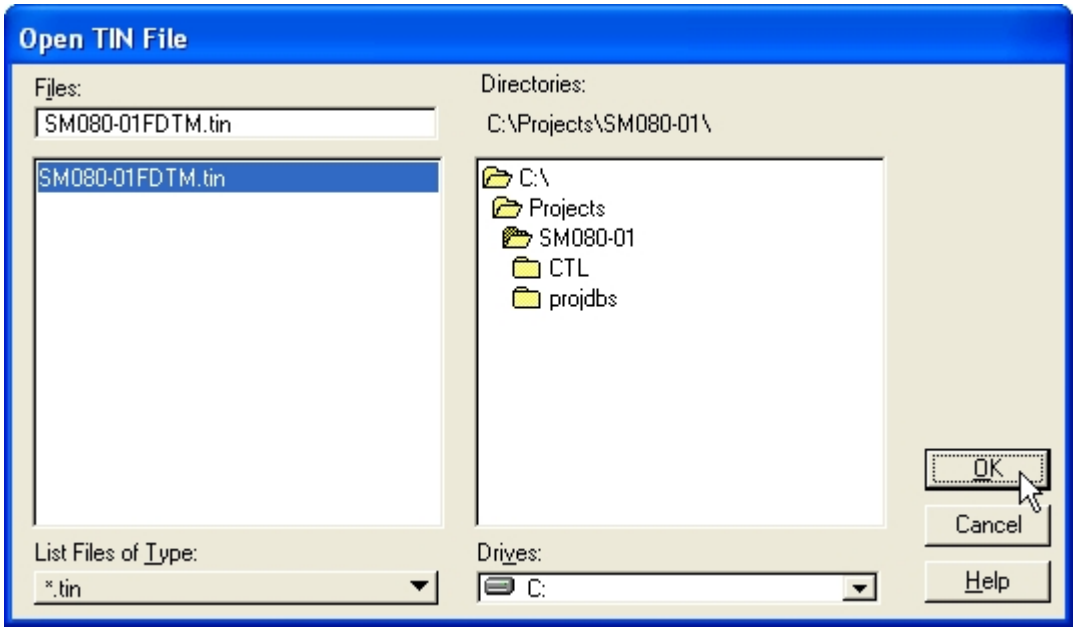
- C:\Program Files\GEOPAKStandards\

Load the tdotExist.lpf file to display the DTM features on the correct levels and symbology. After the preference file is loaded you will notice that the **Level, Color, Weight, and Style** parameters are now set according to TDOT standards as shown below.





Load the appropriate tin by selecting the magnifying glass button from the **Load DTM Features** dialog.



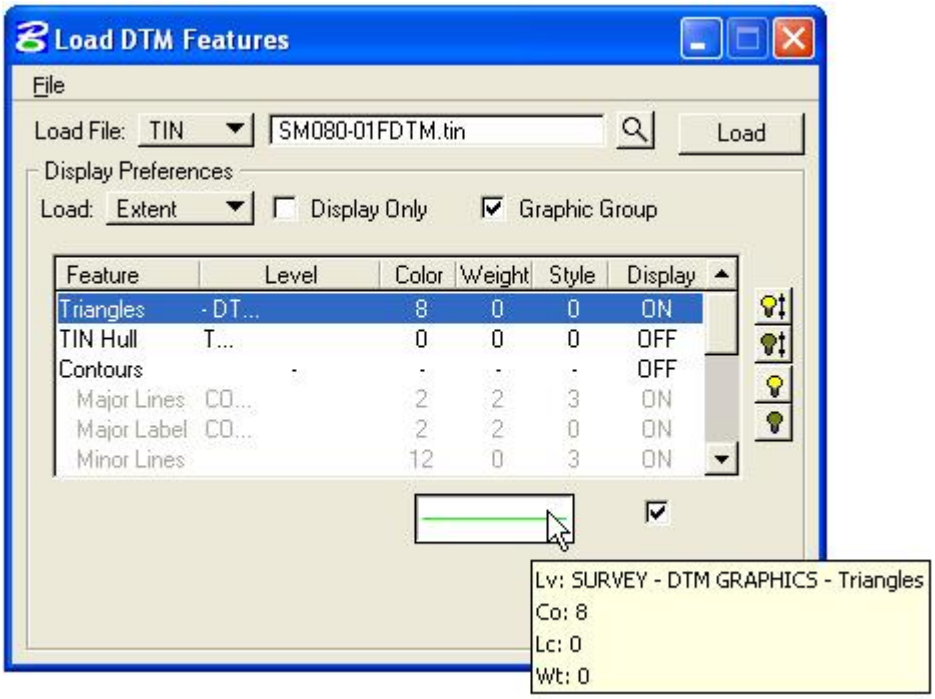
The features of the **Load DTM Features** dialog are discussed on the following pages. See the GEOPAK® online help for more details not covered in this training course.

Different **DTM Features** can be loaded, depending on the type of source file selected.

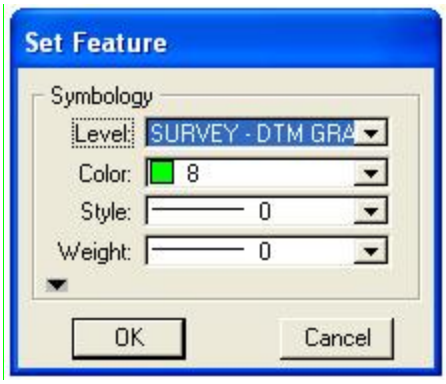
The light bulb icons to the right of the dialog can be used to toggle on/off the display for all features, or selected features. The bright light bulb (top) activates the display for all features, regardless of their current status. The darkened bulb (second one down) deactivates the display for all features, regardless of their current status. The bottom two light bulbs activate and deactivate the current highlighted feature.

DTM Feature Symbology List Box

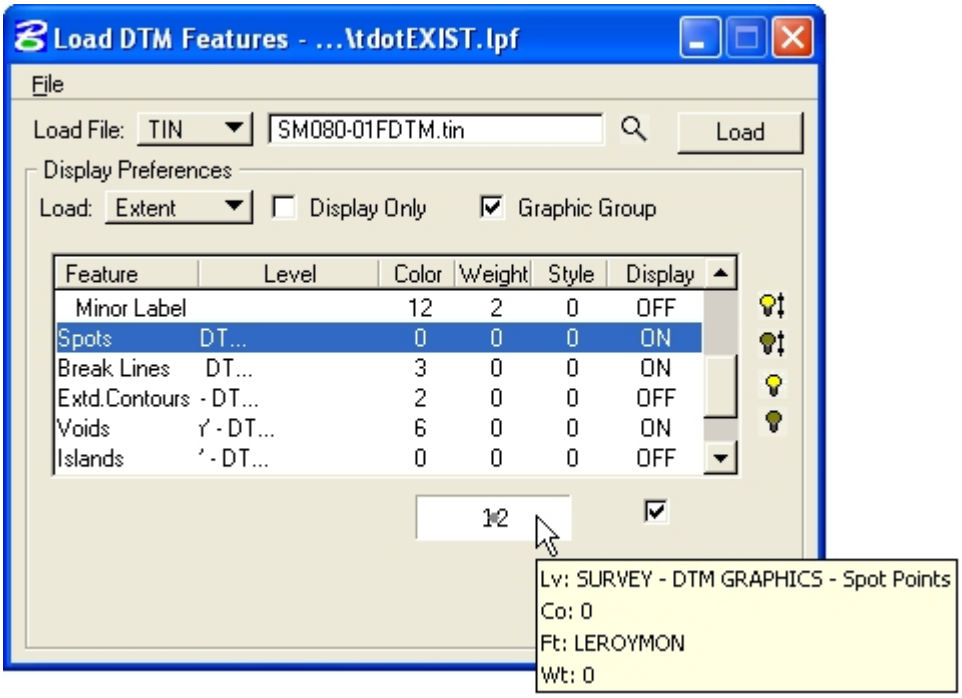
For each Feature, there are element symbology options (**Level, Color, Weight**, and **Style**) and **Display** mode (on/off). As each **Feature** is highlighted, its element symbology is displayed directly below the list box in the symbology box. Note the toggle to the right of the element symbology indicates whether the display is on (toggle is on) or off (not toggled). For example, when **Triangles** is selected, the dialog is displayed as depicted below.



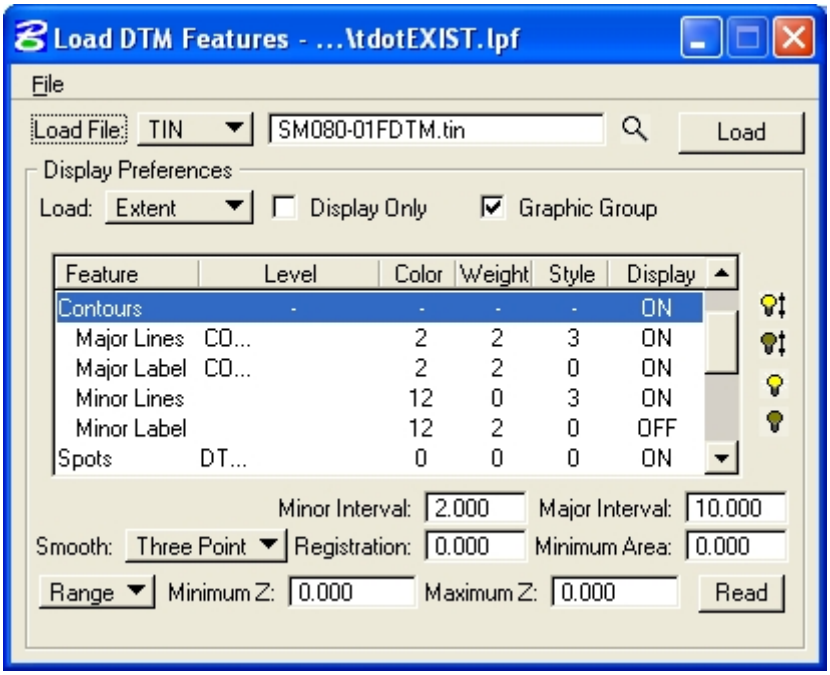
The symbology for the selected item can be changed by double-clicking the symbology box to access the **Set Feature** dialog shown below. Floating your cursor over the symbology box will reveal the current settings for the selected **Feature** as shown above.



If the selected feature requires text (i.e., Spots) the dialog dynamically changes as shown below when the feature is highlighted. Text parameters (Font, Text Height, Text Width, Number of Decimal Places and Justification) may be defined or modified by double-clicking on the symbology box.

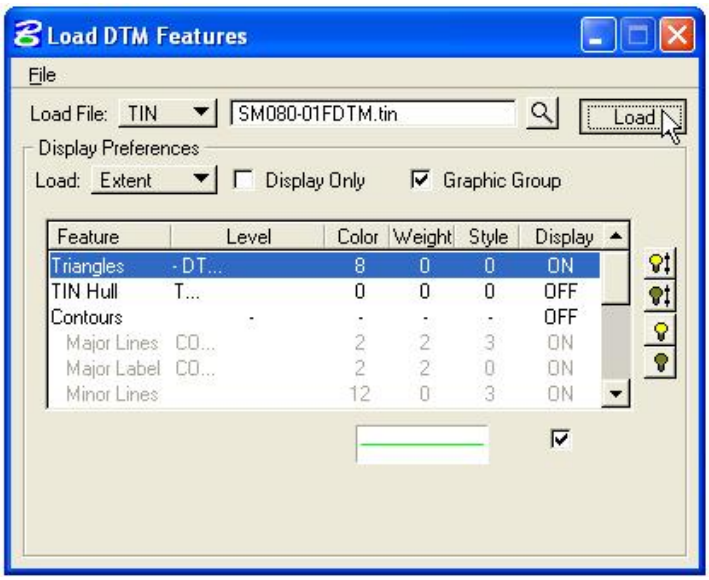


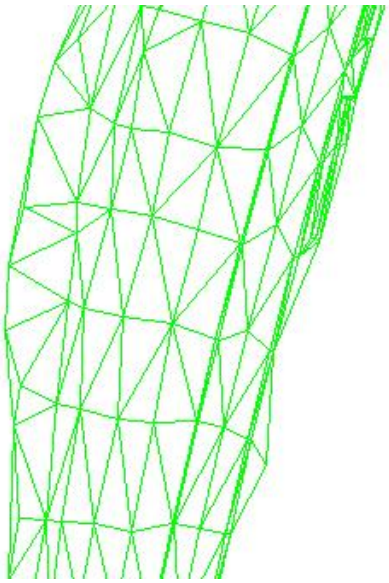
Contours require additional parameters as shown below.



Plotting Triangles

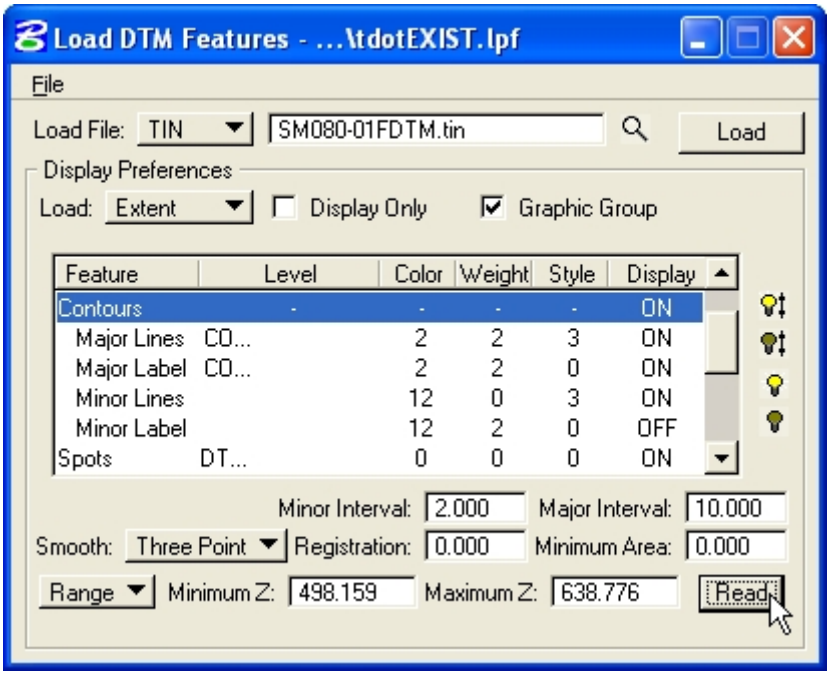
Triangles can be plotted as shown in the example below right. Using the TDOT preference file **`tdotEXIST.lpf`**, the triangles are plotted on the level **`Survey-DTM Graphics-Triangles`**.



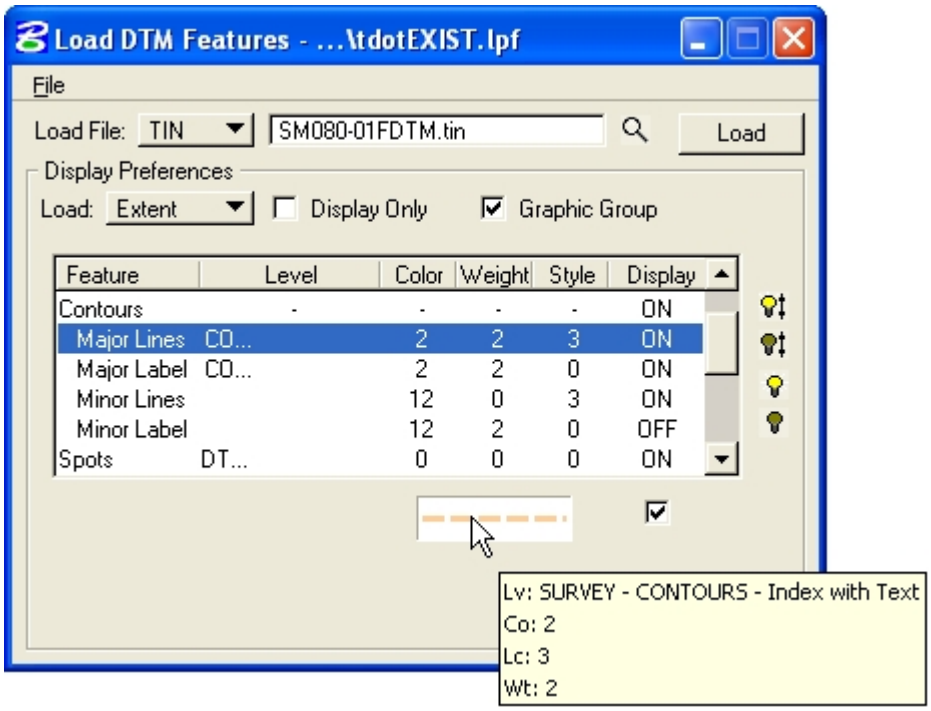


Plotting Contours

Contours can be plotted at a user defined **Minor Interval** and **Major Interval** as shown in the example below. The intervals used will vary from project to project depending on the vertical extents of the project data. The **Read** button can be used to read the **Minimum Z** and **Maximum Z** values from the select TIN file.



Selecting the **Major Lines** option allows the user to define the level symbology for the major contour lines. Using the TDOT preference file **`tdotEXIST.lpf`**, the major contour lines are plotted on the level **`Survey-Contours-Index with Text`** as shown below.



Selecting the **Major Label** option allows the user to define the level symbology for elevation labels placed on the major contour lines. Using the TDOT preference file **`tdotEXIST.lpf`**, the major contour lines are plotted on the level **`Survey-Contours-Index with Text`**.

Double-click on the text symbology box to access the **Set Feature** dialog. This dialog is used to set the text values for the major contour elevation labels.

The TDOT DTM preference files have been configured with a default text size of 0.10 for any feature that places text. The user will need to modify the text size for **Spots** and **Contour** text placement depending on the plotting scale. For example, the user loads **`tdotEXIST.lpf`** preference file but needs to plot the text for a scale of 50:1. The user must change the key-in field from 0.10 to 5.0 (0.10 x 50=5.0) for both text values **Th** (text height) and **Tw** (text width).

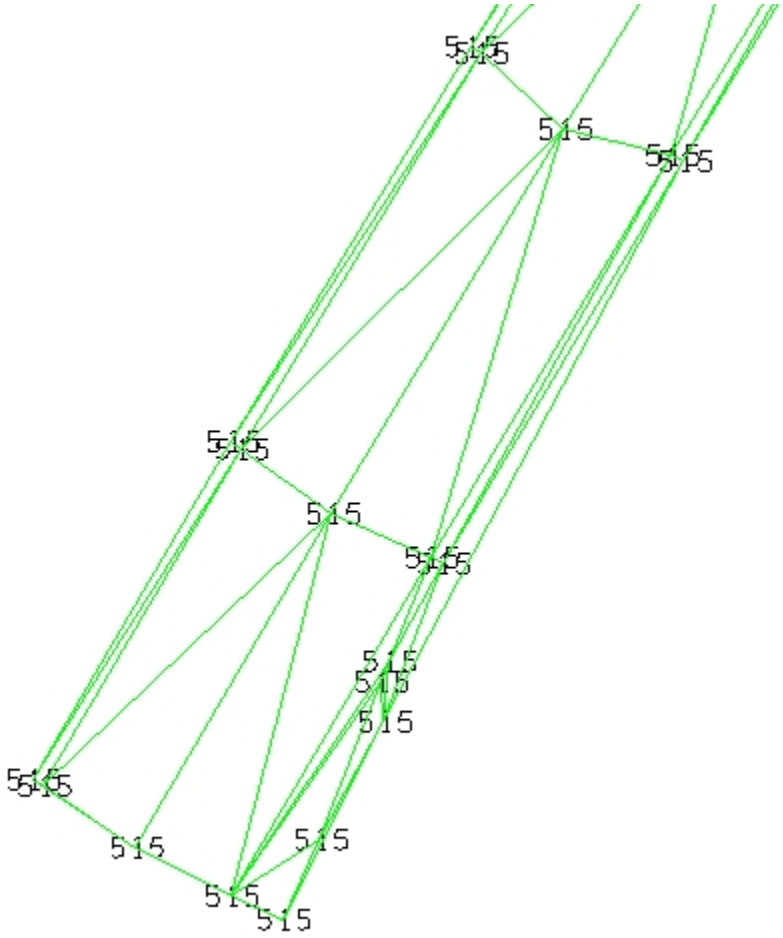
Selecting the **Minor Lines** option as shown above allows you to define the level symbology for the minor contour lines. Using the TDOT preference file **`tdotEXIST.lpf`**, the minor contour lines are plotted on the level **`Survey-Contours-Intermediate with Optional Text`**.

Contour elevation labels are not normally placed for minor contour lines, therefore the **Minor Label** option is toggled off in **`tdotEXIST.lpf`**.

Select the **Load** button from the **Load DTM Features** dialog once the following features are turned on:

- Triangles
- TIN Hull
- Contours (Major lines, Major labels and Minor lines)
- Spots
- Break Lines
- Voids

Use the DTM Graphics level filter in the MicroStation® **Level Display** dialog to view the graphics as shown below. By using the level filter option, the graphics are “filtered” to only show those graphics included in DTM graphics.

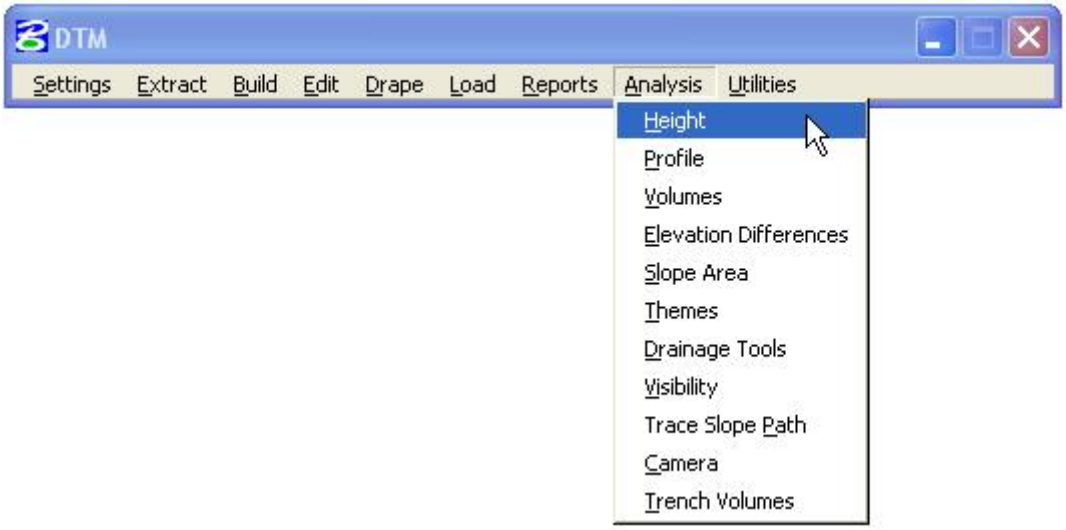


9.3 TIN TRACKING (HEIGHT TOOL)

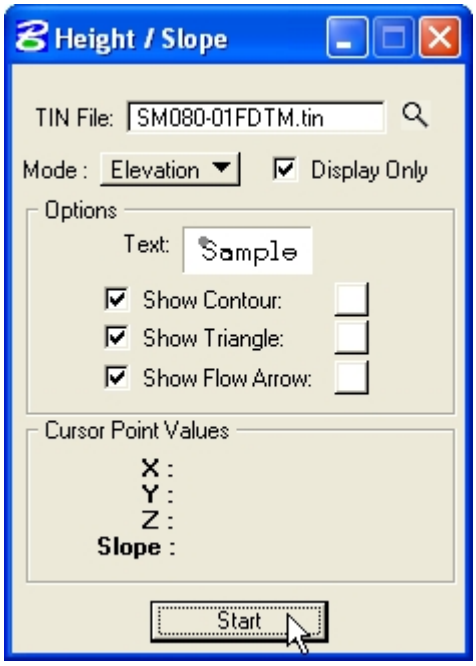
Select **DTM → DTM Tools** from the **Survey** toolbar. A **Select Run** dialog will appear. For the purpose of this class use an untitled run. The following tool palette will appear. Select **DTM Menu** from the following dialog.

The **Analysis** tools allow the user to utilize the digital terrain model in many different analyses such as a profile, height, and drainage.

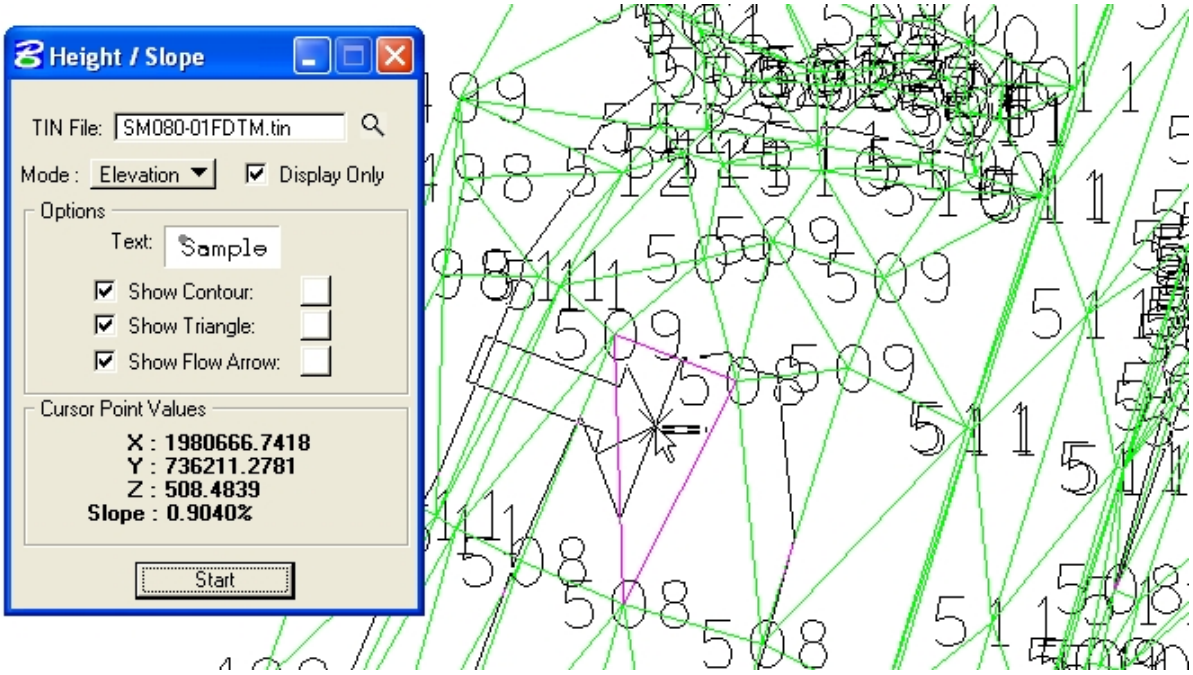
The **Height** command shows the user the x, y, and z coordinates and the slope of a given data point. The contour at that elevation, the triangle the point lies within, and the direction of flow can be displayed.



Set the GEOPAK® **Height / Slope** dialog as shown below.

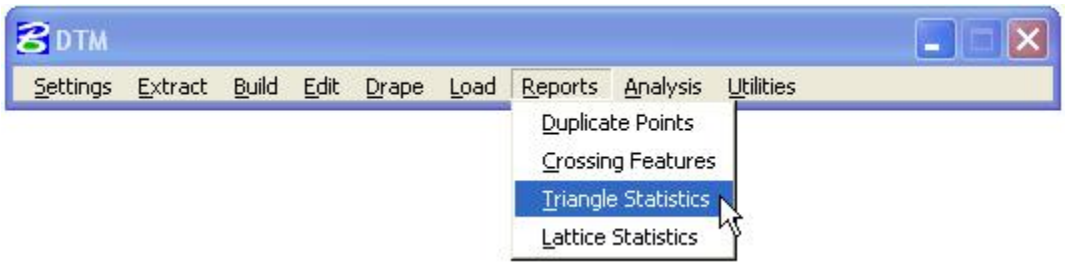


Use the **Start** button to show the Flow Arrow, Contour and Elevation of different areas of the DTM as shown in the dialog below. The text size can be changed by selecting **Sample** and choosing the appropriate text size.

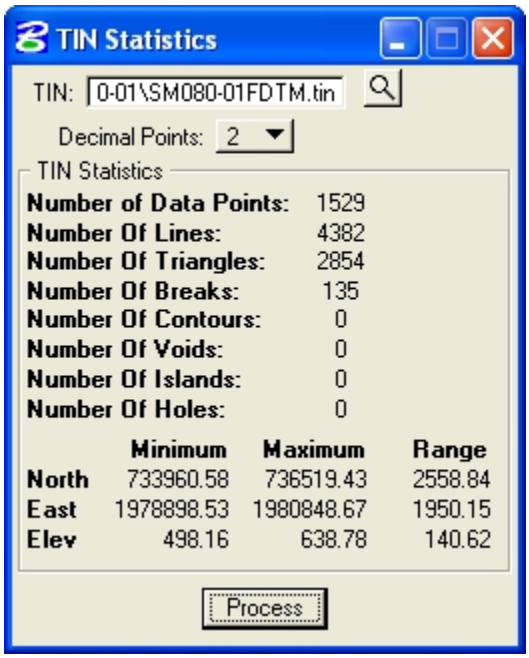


9.4 TIN STATISTICS

The TIN statistical data can give the user some information as to the size of tin with regards to number of triangles, points, breaks and other features that may have been written to the file. Select **Reports** → **Triangle Statistics** from the **DTM** toolbar.

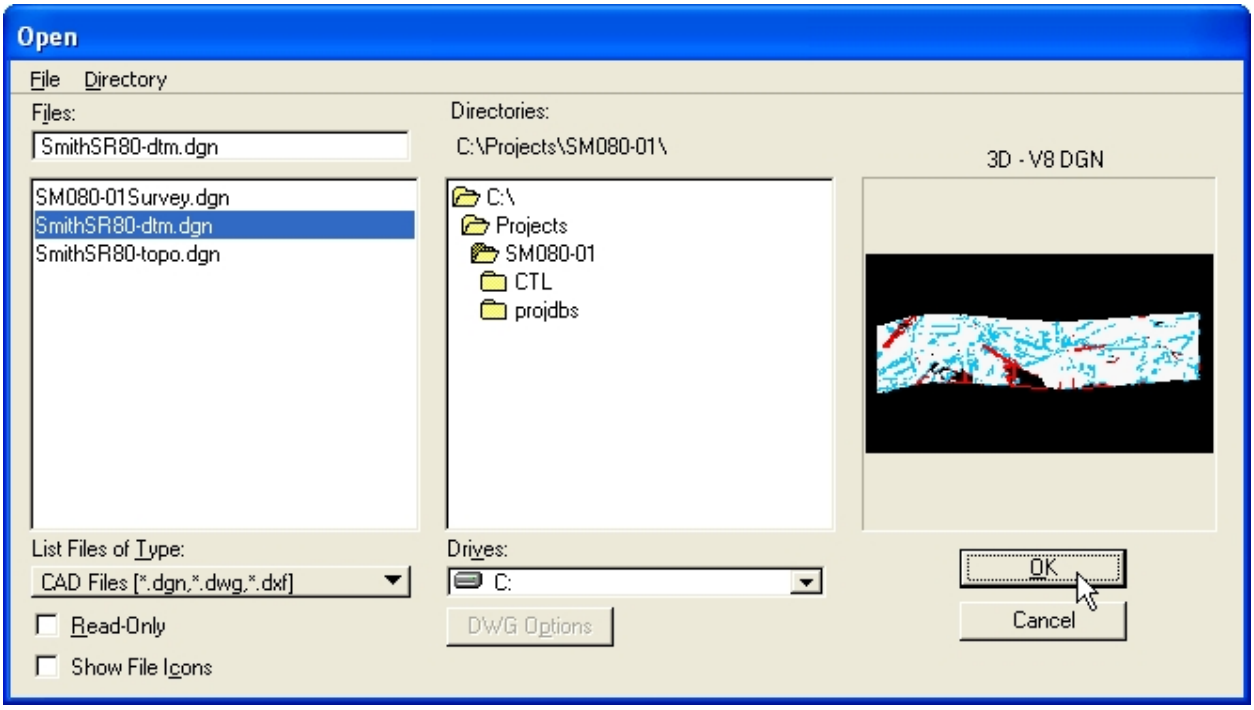


Display the GEOPAK® **TIN Statistics** dialog as shown below. Change the **Decimal Points** to 2. Select the **Process** button to review the **TIN statistics**.

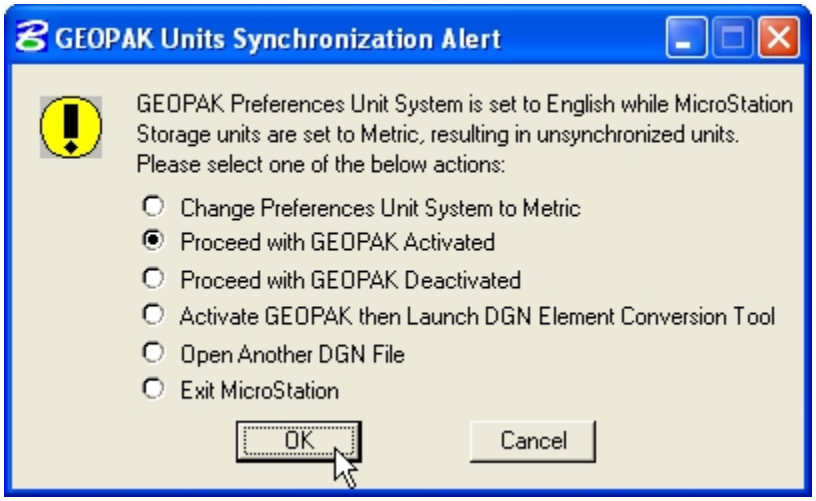


9.5 EDITING DTM GRAPHICS

The digital terrain model used in this class consists of two parts, the aerial data and the field data. Open the aerial survey file (SmithSR80-dtm.dgn) containing DTM graphics.

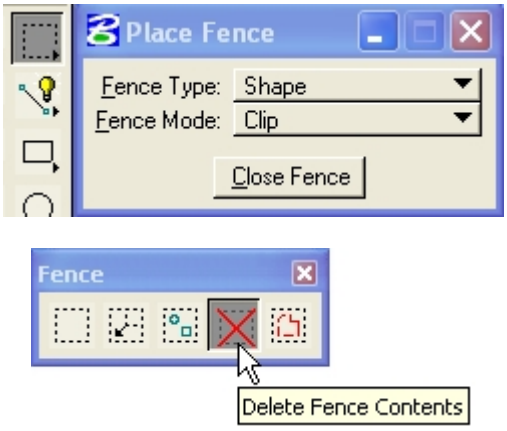


If the dialog below appears, select the option as shown and select **OK**.



In order to preserve the original aerial DTM data, save the file as **SmithSR80-MDTM.dgn**. Reference the field survey file (SM080-01Survey.dgn) into this file. Turn off levels in the survey file not included in the DTM. The DTM Graphics level filter, described in Section 9.2, can be used for this purpose. The user must delete aerial DTM graphics that overlap field DTM graphics. In this class, the user will edit the aerial graphics, build a `.dat` from those graphics, create the field DTM, and supplement with the aerial `.dat` file.

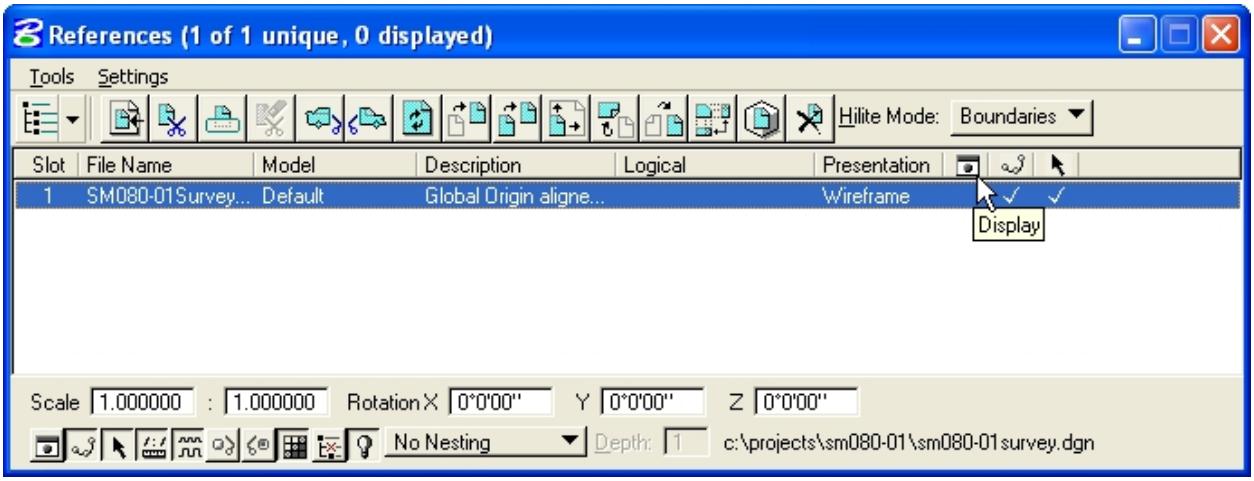
To begin editing, carefully draw a fence shape with clip mode selected around the aerial survey graphics and delete the fence contents. The fence drawn should not be a duplicate of the hull, but should leave an area of overlap between the aerial and field DTM to be edited manually.



Use partial delete to delete part of a breakline or obscure line crossing a survey file graphic.

Use the delete command to erase the unwanted lines and points.

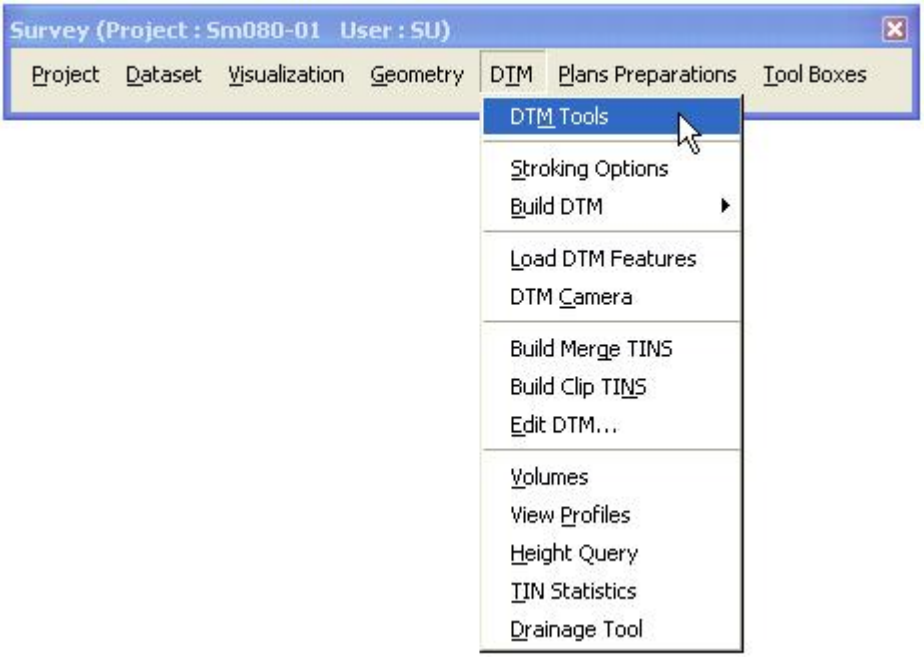
When editing of the aerial DTM graphics is complete, unvisualize the field survey reference file.



9.6 COMBINING AERIAL AND FIELD DTM'S

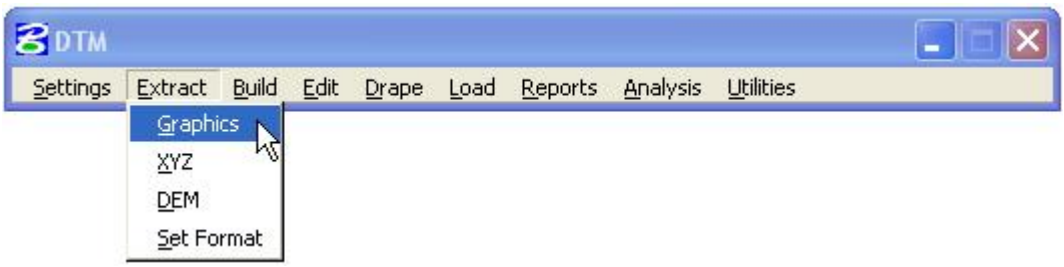
From the **Survey** toolbar select **DTM → DTM Tools** if the **DTM Menu** bar is not already loaded. Select **OK** on the **Run** dialog.

Note: The user should still be in the modified aerial survey file.

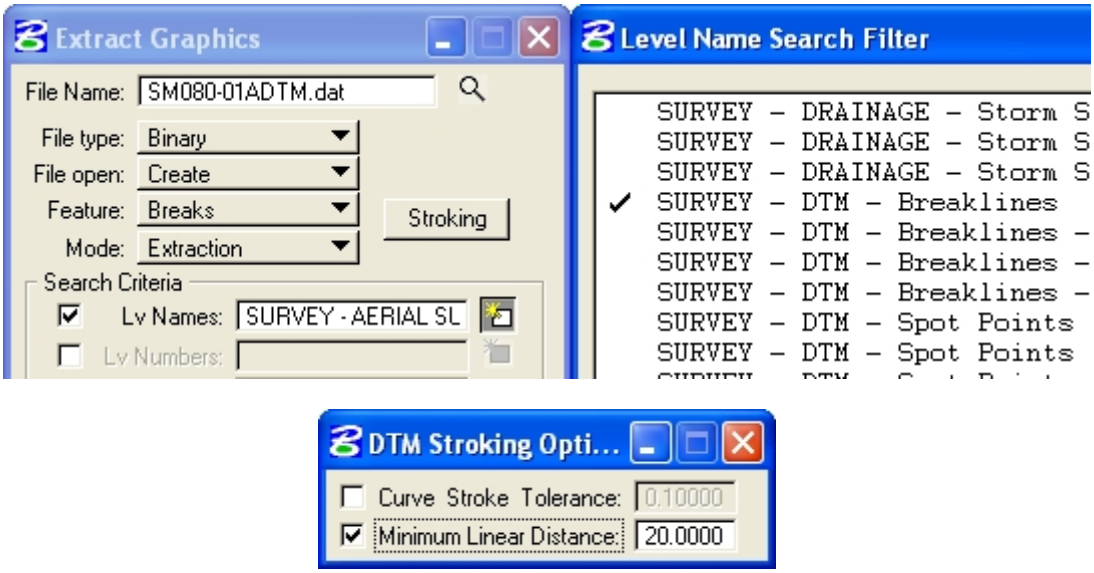


The following dialog will appear. Select **DTM Menu** as shown below.

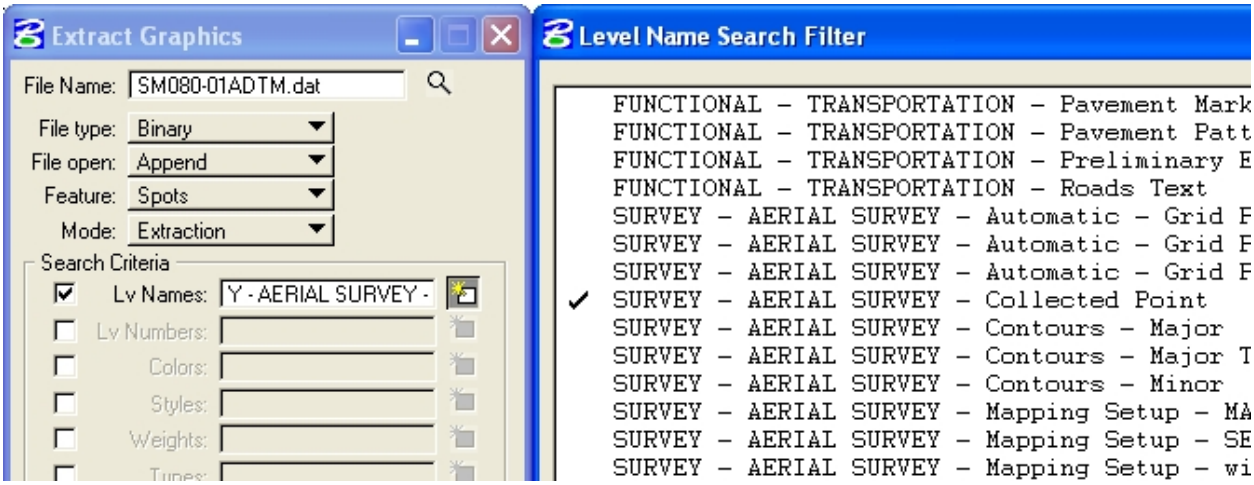
From the **DTM Menu** select **Extract → Graphics.**



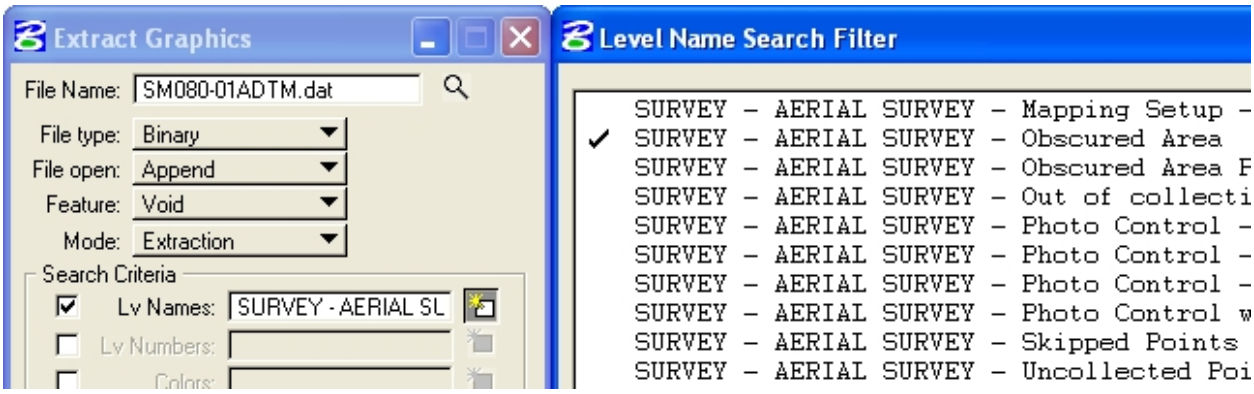
The following dialog will appear. Select the magnifying glass button to create a new **.dat** file. The new file will represent the extracted aerial DTM graphics. Name the file **SM080-01ADTM.dat**. Complete the dialog as shown below. Select the appropriate **Search Criteria** as shown below. Select the **SURVEY – DTM – Breaklines** level. Zoom extents so the entire project is shown in View 1. Select the **Stroking** button and set as shown below. Then select **Apply**.



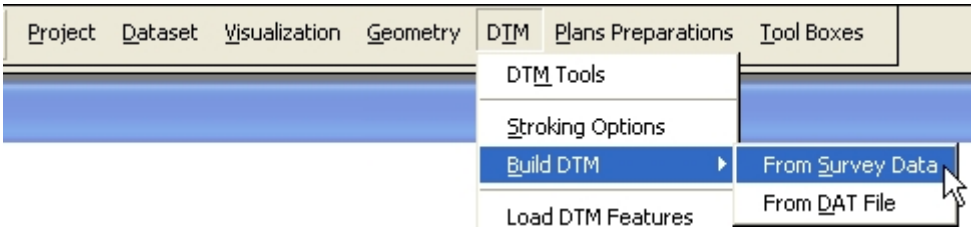
The **.dat** file has now been created with breaklines. The user will append the **.dat** file with spots and obscured areas in the next two passes. Complete the dialog as shown below. Select the appropriate **Search Criteria** as shown below. In the second pass, the user will extract the spot points into the **.dat** file. Select the **SURVEY – AERIAL SURVEY – Collected Point** level. Assure the previously selected level for breaklines is unselected. Zoom extents so the entire project is shown in View 1. Then select **Apply** to append the **.dat** file.



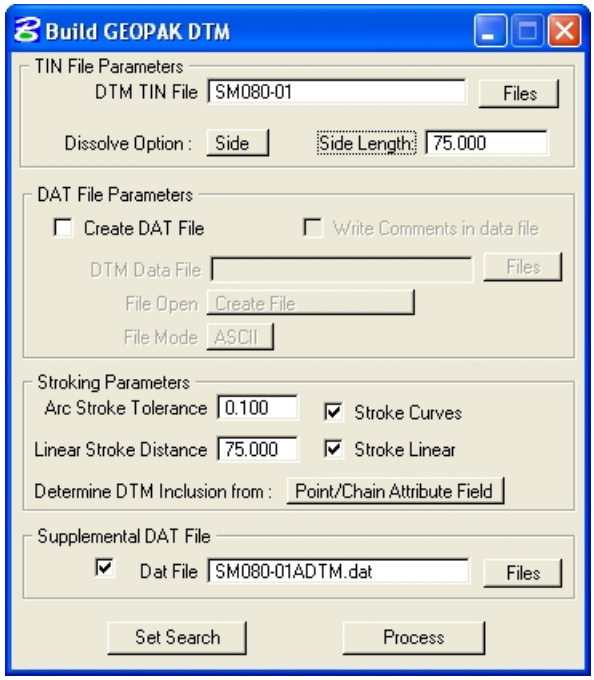
In the third pass, the user will extract the void / obscure areas into the **.dat** file. Complete the dialog as shown below. Select the **SURVEY – AERIAL SURVEY – Obscured Area** level. Assure the previously selected level for collected points is unselected. Zoom extents so the entire project is shown in View 1. Then select **Apply** to append the **.dat** file. The aerial DTM graphics have been extracted. Exit the aerial DTM dgn file and return to the survey file.



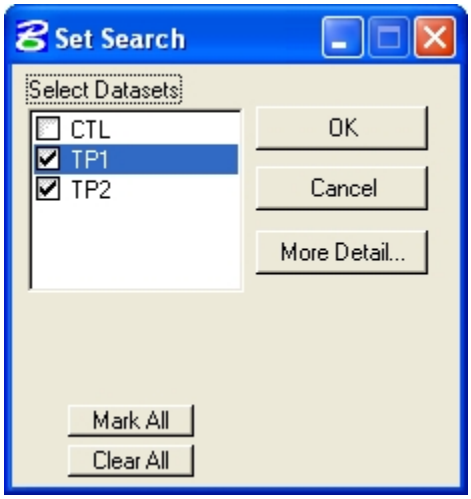
On the **Survey** toolbar, select **DTM → Build DTM → From Survey Data.**



Set the dialog below as shown. The aerial data will be included as a Supplemental DAT File by checking the **Dat File** option. In the **DTM TIN File** field, type in the appropriate file name without the tin extension.



Select the **Set Search** button and complete as shown below. Select **OK**.



In the **Build GEOPAK DTM** dialog, select **Process** to create the TIN.

The user can now refer to Section 9.2 for loading the DTM features from the new TIN. The previously loaded features for a field only survey will need to be deleted or the user can create a new dgn for DTM graphics.

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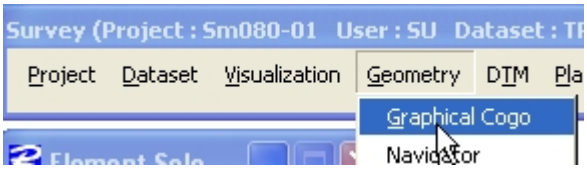
CHAPTER 10 - COORDINATE GEOMETRY

10.1 ESTABLISHING ALIGNMENTS (GEOPAK® CHAINS)

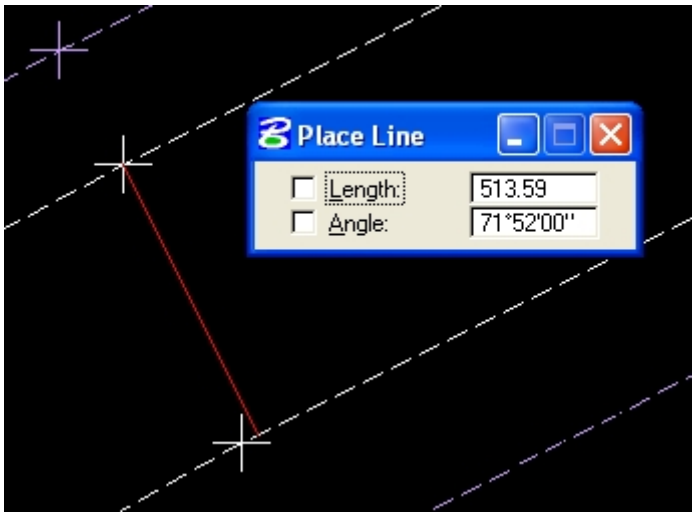
GEOPAK® chains can be created multiple ways. The **Classic COGO** method fits tangents to field located points, fits curves between the tangents, and creates a chain from the tangent and curve segments. By using the **Best Fit** command, GEOPAK® points are selected as event points (i.e. PC, PT, BP, etc.). The **Store Chain** from graphics allows the user to manually establish the alignment and then create as a chain. From **Input File Utility,** the user can regenerate an alignment previously created. For the purposes of this class, the input file method will be used and is explained further in this section.

Classic COGO Method

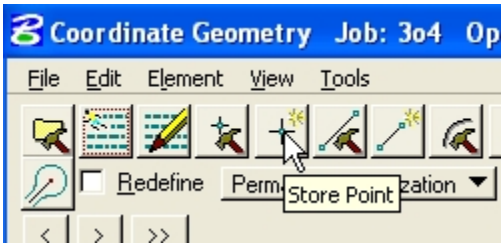
Select **Geometry** → **Graphical COGO** from the **Survey** toolbar to access coordinate geometry.



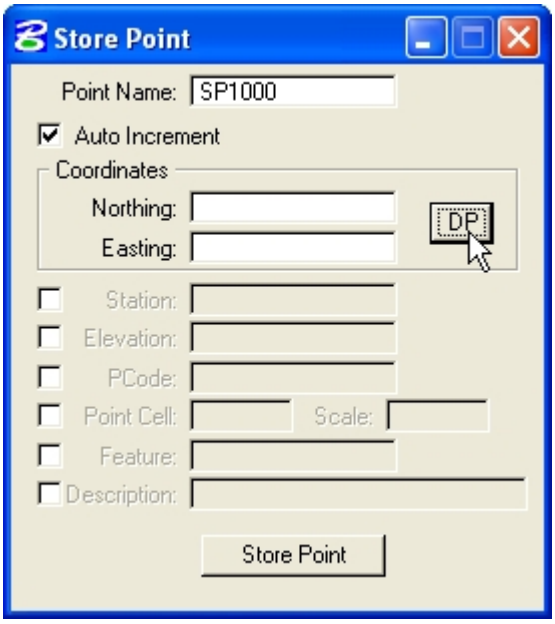
To fit tangents the user may need to create points bisecting existing pavement or median. The user can use MicroStation® commands and snaps to accomplish this. Using the draw line command, set the snap to keypoint and snap to a point on an edge of road survey chain. Change the snap mode to perpendicular and snap to the opposite edge of roadway.



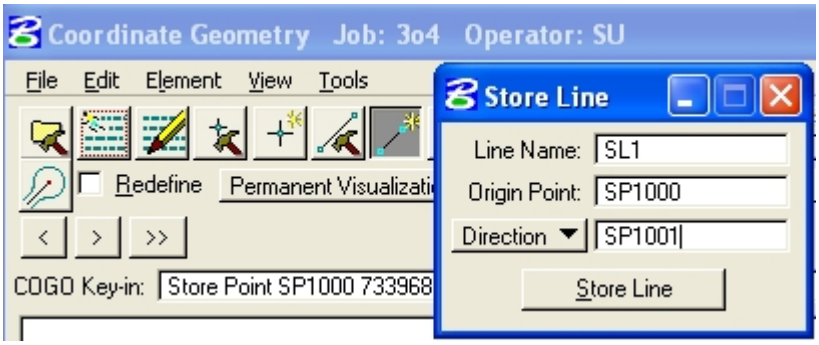
Select **Store Point** as shown in the dialog below.



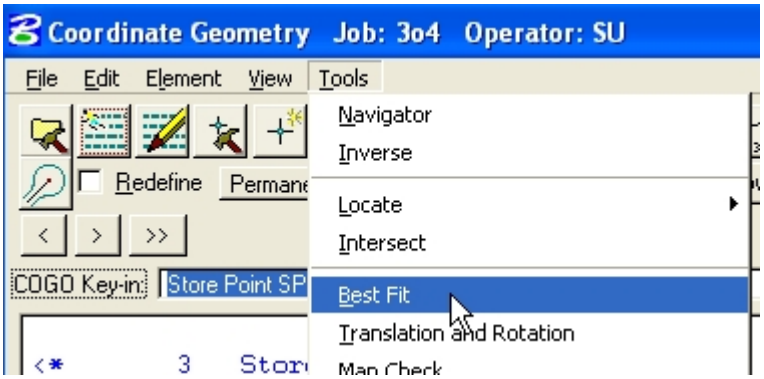
Enter the starting point number as shown in the dialog below. Select **DP** and set snap mode to midpoint and snap to the MicroStation® line created above to draw a COGO point at the line's midpoint and accept. Once the data point is accepted, select Store to store the point in GEOPAK®. Repeat this procedure at other locations on tangent sections of roadway. These points will be used to create the tangent lines.



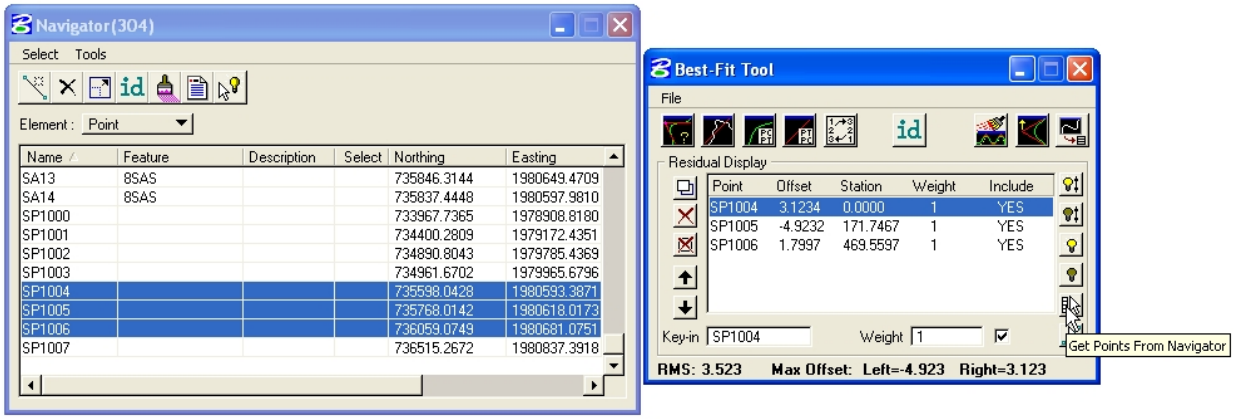
If only two good points exist which will control the tangent, draw a line between the points with the line command. The line should have prefix of SL. The first and second point can either be selected or typed in the space provided. Select **Store Line** after the proper points are selected.



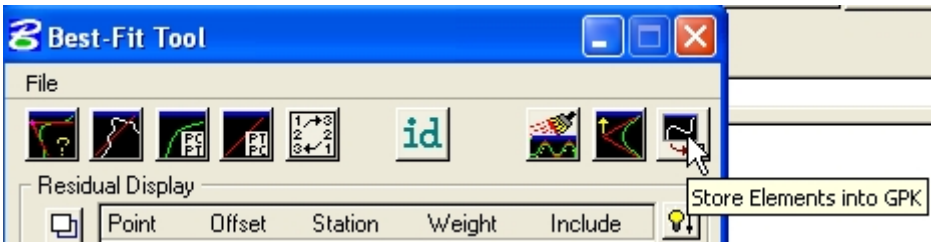
If there are several points and would like a best fit line, use the power selector in MicroStation® to pick the points. Select **Tools** → **Best Fit** from the **Coordinate Geometry** toolbar.



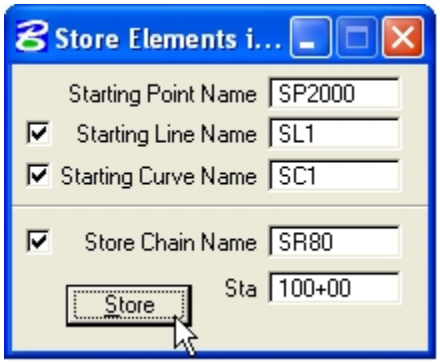
Select the button shown in the dialog below to add the points to the **Best Fit Tool**. A temporary line will be drawn on the screen for inspection. Points can be added or removed from the tool.



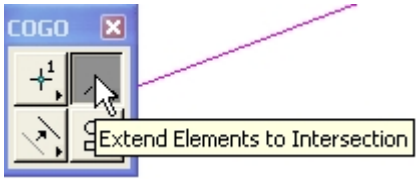
When satisfied, select the **Store Elements into GPK** button.



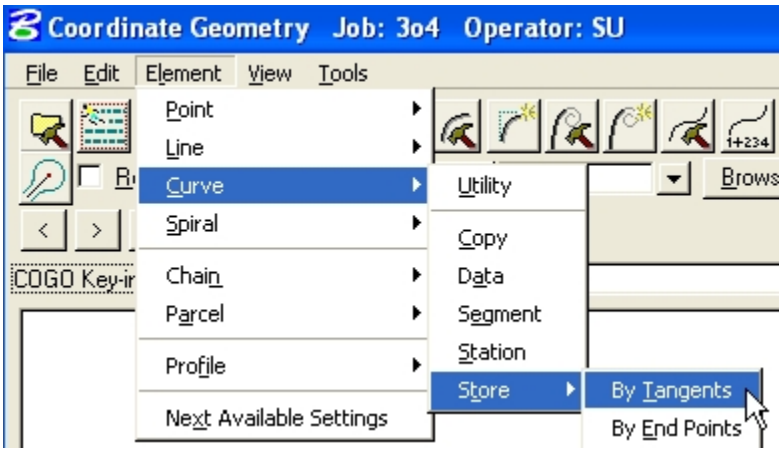
Fill in point and line numbers and the information will be stored for later use.



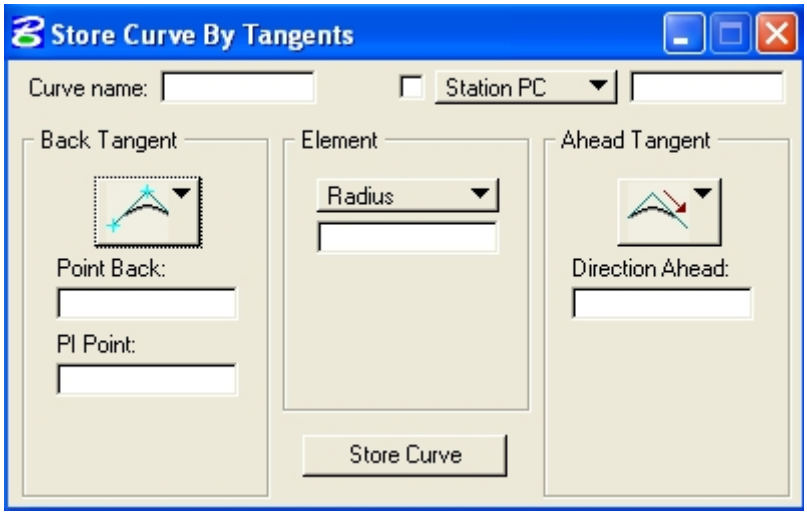
To create curves select **Extend Elements to Intersection** on the **COGO** toolbar.



Select the tangent lines to connect with a curve or spiral. Select **Element** → **Curve** → **Store** → **By Tangents** from the **COGO** toolbar.

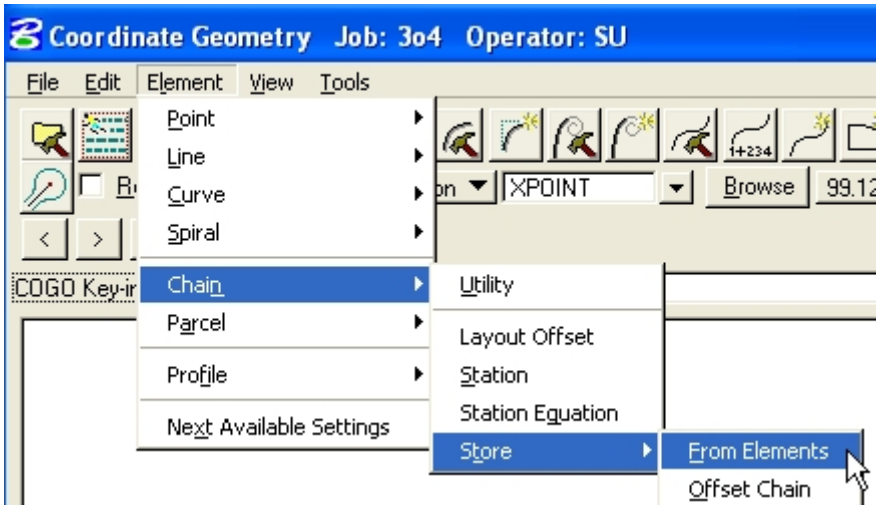


In the dialog below use the PB and PI option for the back tangent and the PA option for the ahead tangent option. Generally use radius or degree arc for the element. Type in or select on the screen the Point Back, PI Point, and Direction Ahead points. Type in a curve name that has not been used and then store the curve. The radius can be changed and the curve restored until the optimal curve is achieved.

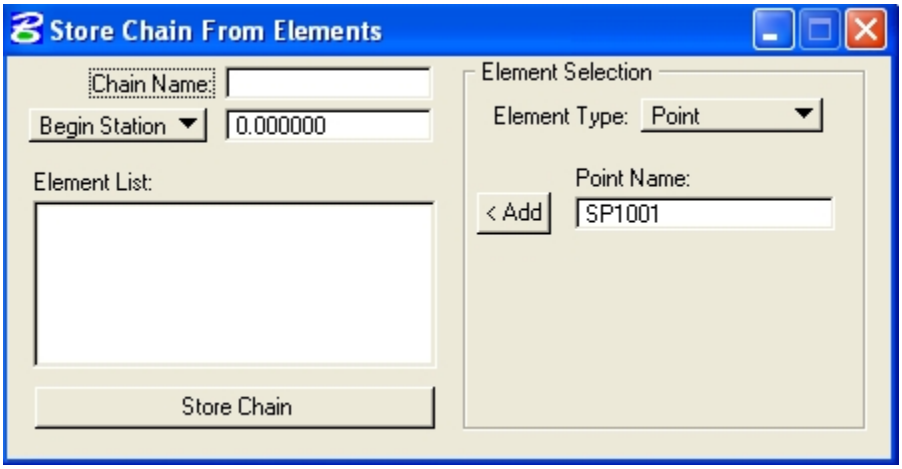


To create the chains, delete the lines used to create the curves from the gpk file. This can be accomplished through the COGO Navigator.

Select **Element** → **Chain** → **Store** → **From Elements** from the **COGO** toolbar.

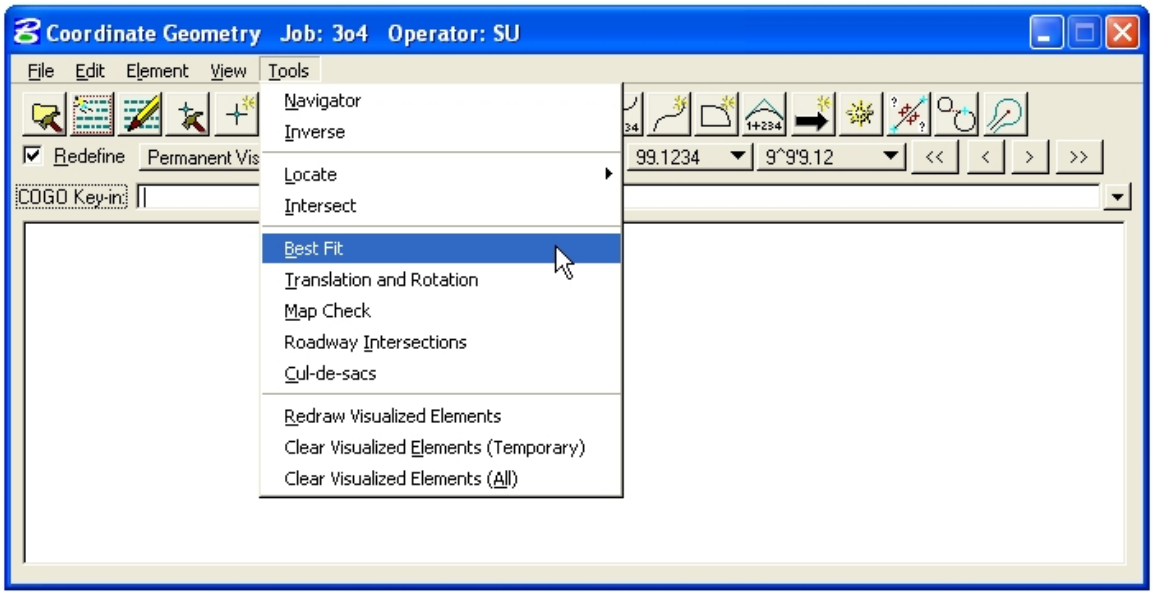


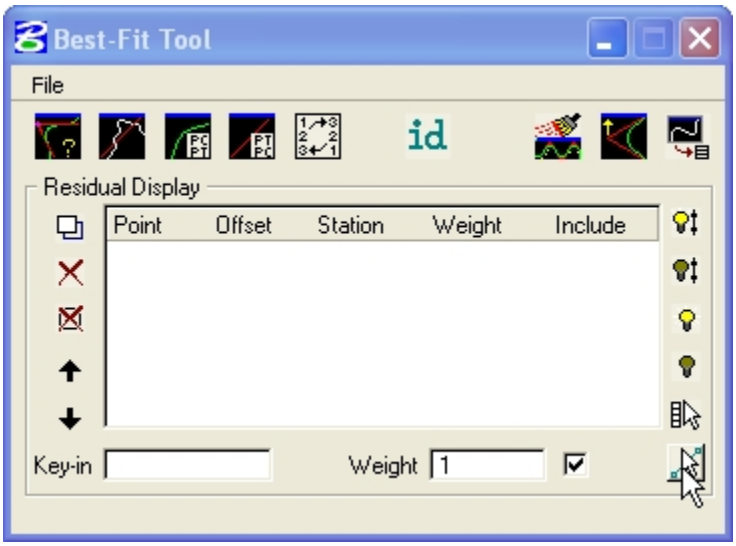
In the element list field, type in or graphically pick the elements to compose the chain. Type in a descriptive name for the chain and type in a beginning station. Select the store chain button to store the chain in the GEOPAK® file.



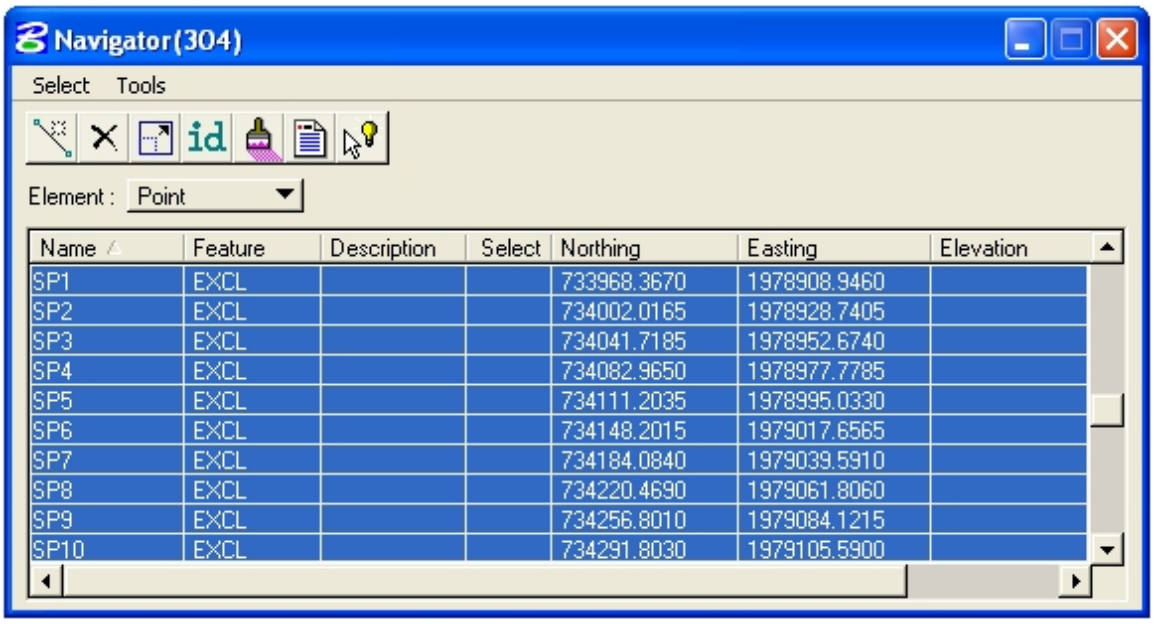
Best Fit Method

From the **Coordinate Geometry** dialog, choose **Tools** → **Best Fit.**



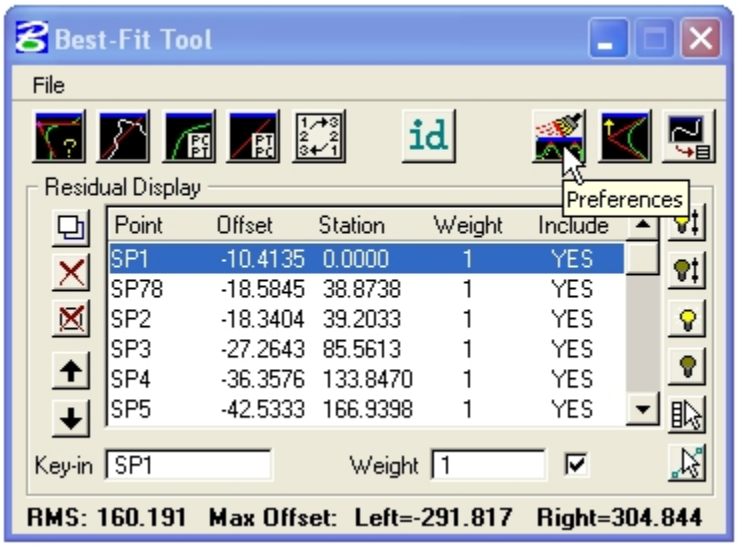


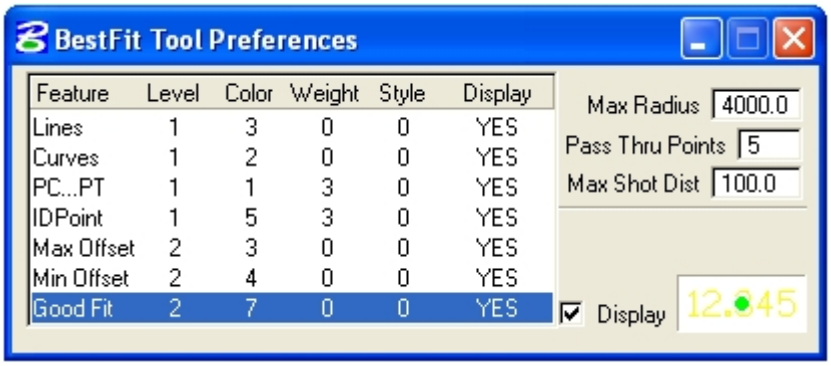
The following screen capture will appear once the user selects the button shown in the dialog above. The points selected must exist in the gpk file. The user can use the points created in the Classic COGO Method section for constructing the chain. The points to be used to construct the chain can be selected as shown in the dialog below. The user can key-in, ID, obtain from COGO navigator, or use a MicroStation® selection set to select the points. For this example, COGO navigator was used to select the points.



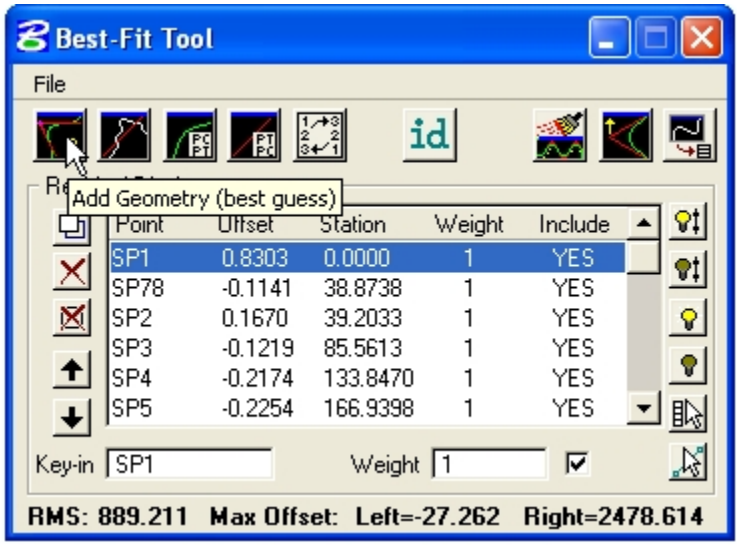
Note: The points in the dialog may be out of order and need rearranging to display the alignment ahead station.

The preferences can be set by selecting the button in the dialog shown below.

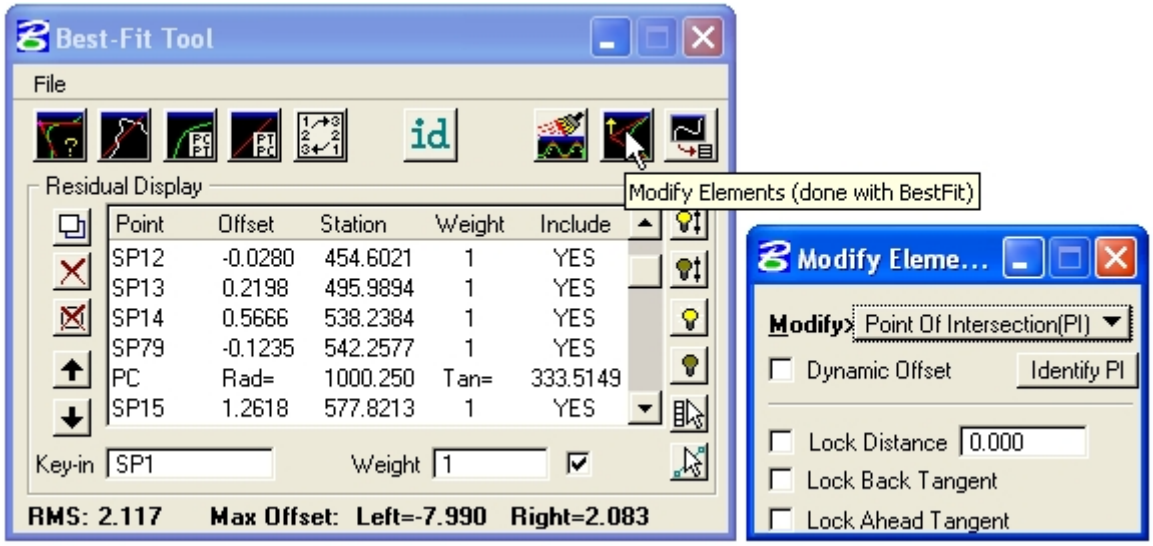




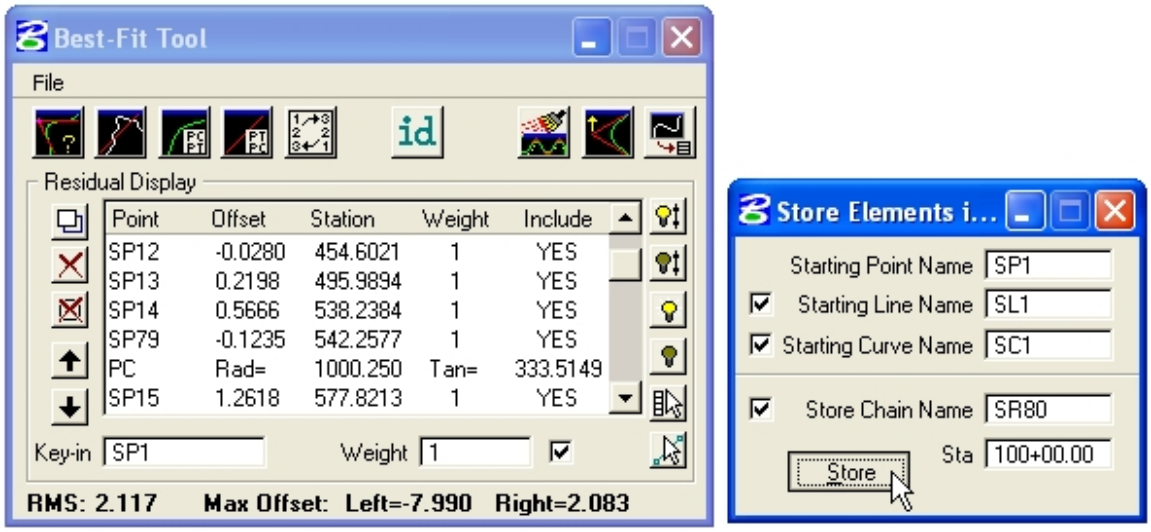
To temporarily display the alignment in the dgn select **Add Geometry (best guess)** as shown in the dialog below. The graphics are not written to the MicroStation® file and not stored in the gpk file.



The elements displayed can be modified as shown in the dialog below.



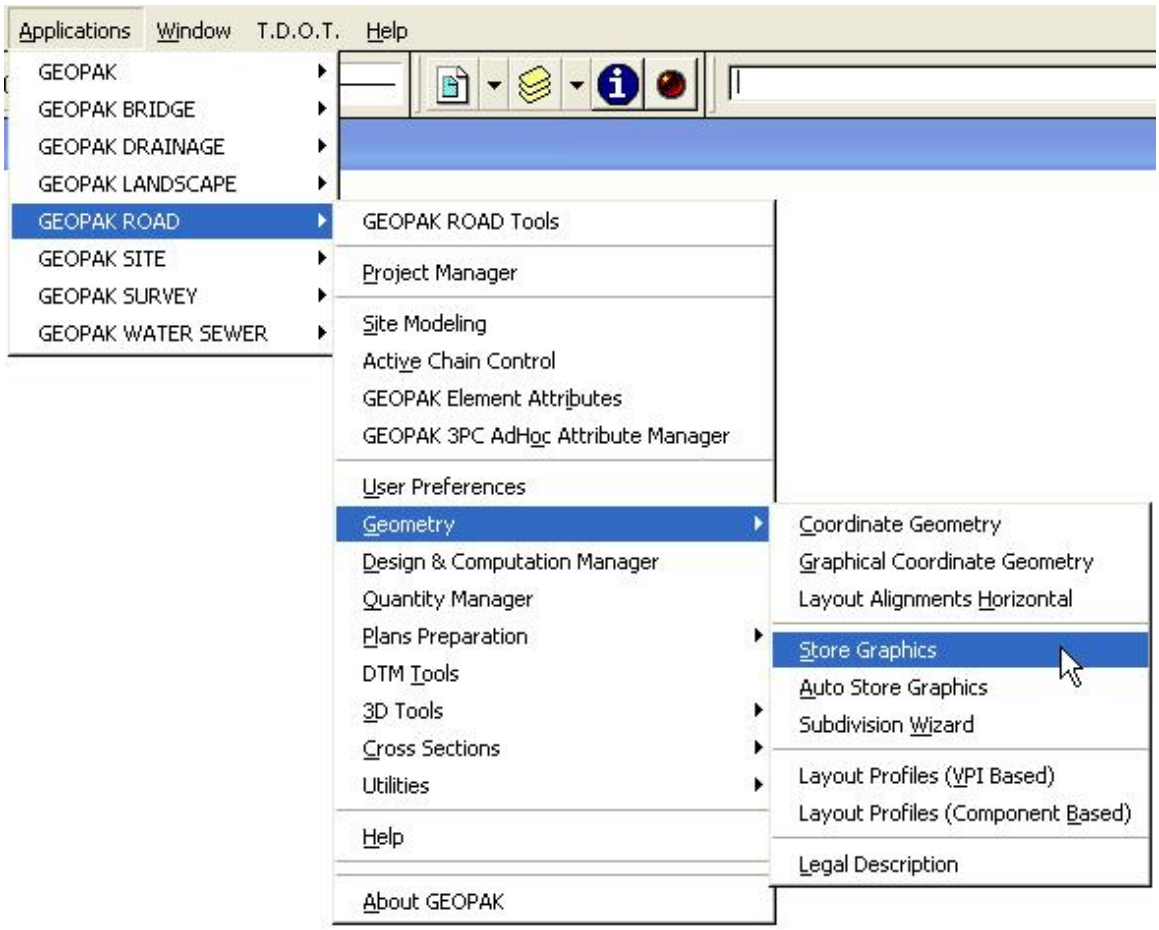
Once the alignment is modified select the Store button to store the alignment in the gpk file and permanently display in the MicroStation® file. The user will need to define the information shown below prior to storing the alignment.



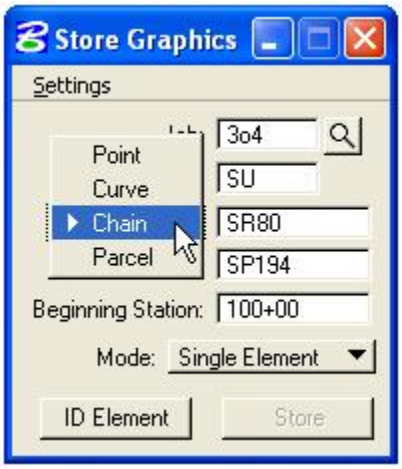
Store Chain by Graphics Method

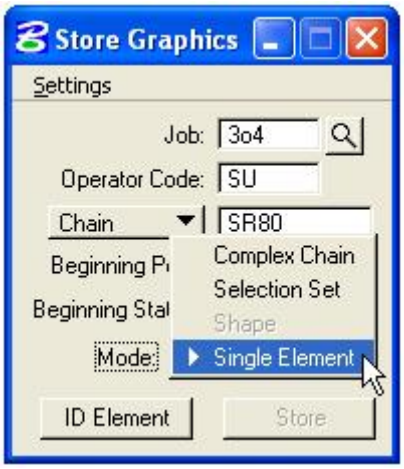
From Applications select **GEOPAK® Road → Geometry → Store Graphics** to display the dialog shown below.

Note: The user must create the alignment in MicroStation® and then create a complex chain of the elements in the alignment (i.e. lines, curves, etc.). The complex chain must be linked ahead station.

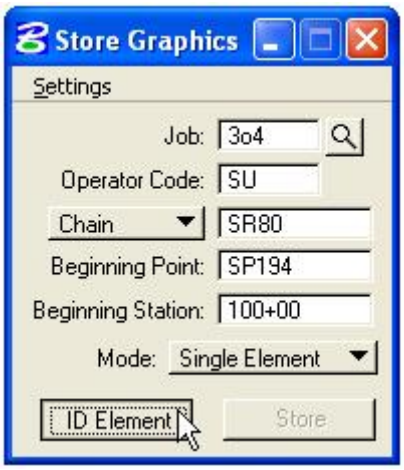


The following dialog will appear. Enter the information as shown below.





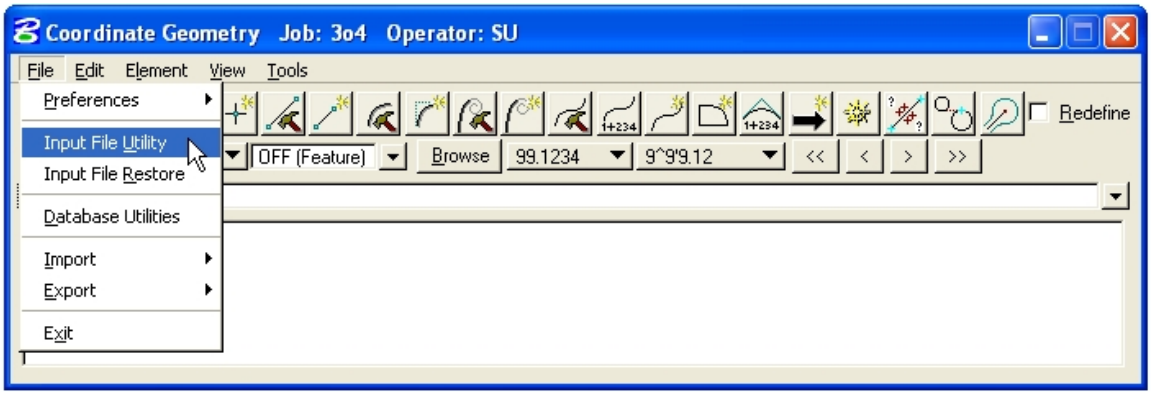
The Store Graphics function will create points along the alignment therefore the user must start with a point number that does not exist. If the redefine function is on in COGO and a point number already exists then the point will be overwritten in the **.gpk** file.



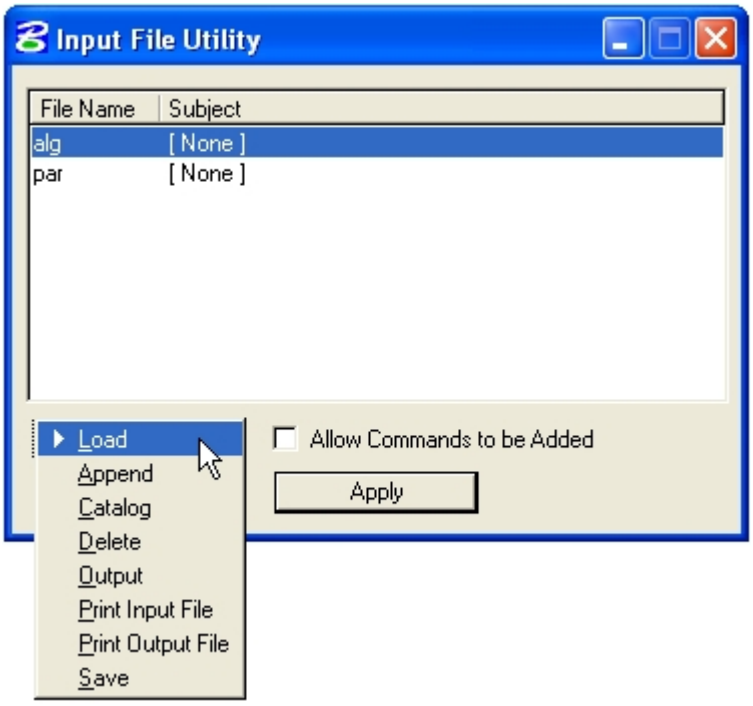
The user will be prompted to identify the element. Accept the element and store the chain. The chain can now be viewed in the COGO navigator.

Input File Utility Method

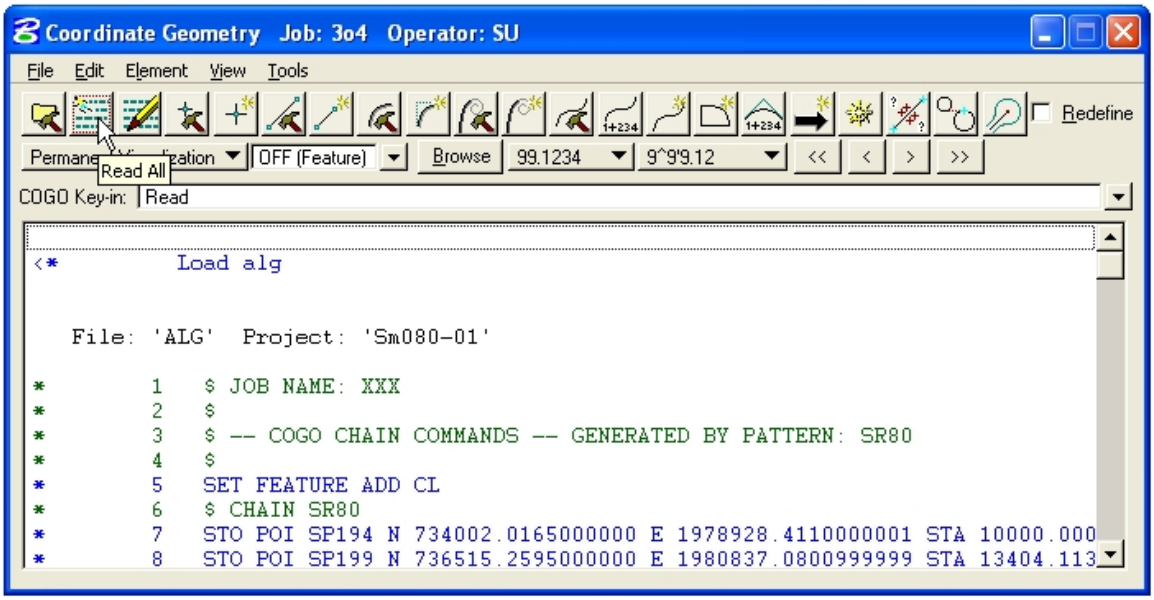
From the COGO menu, select **File** → **Input File Utility**.



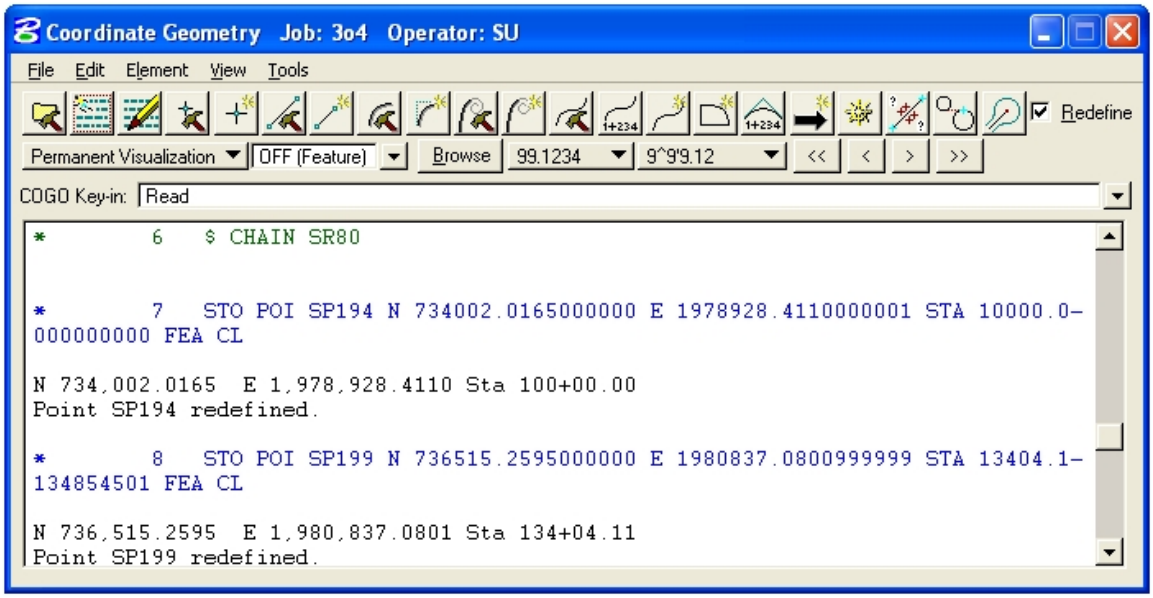
The input files should be placed in the project working directory for them to be displayed in the following list. Load the **`.alg`** input file. Then select **Apply**.



Select **Read All** from the COGO menu to display the chain elements.

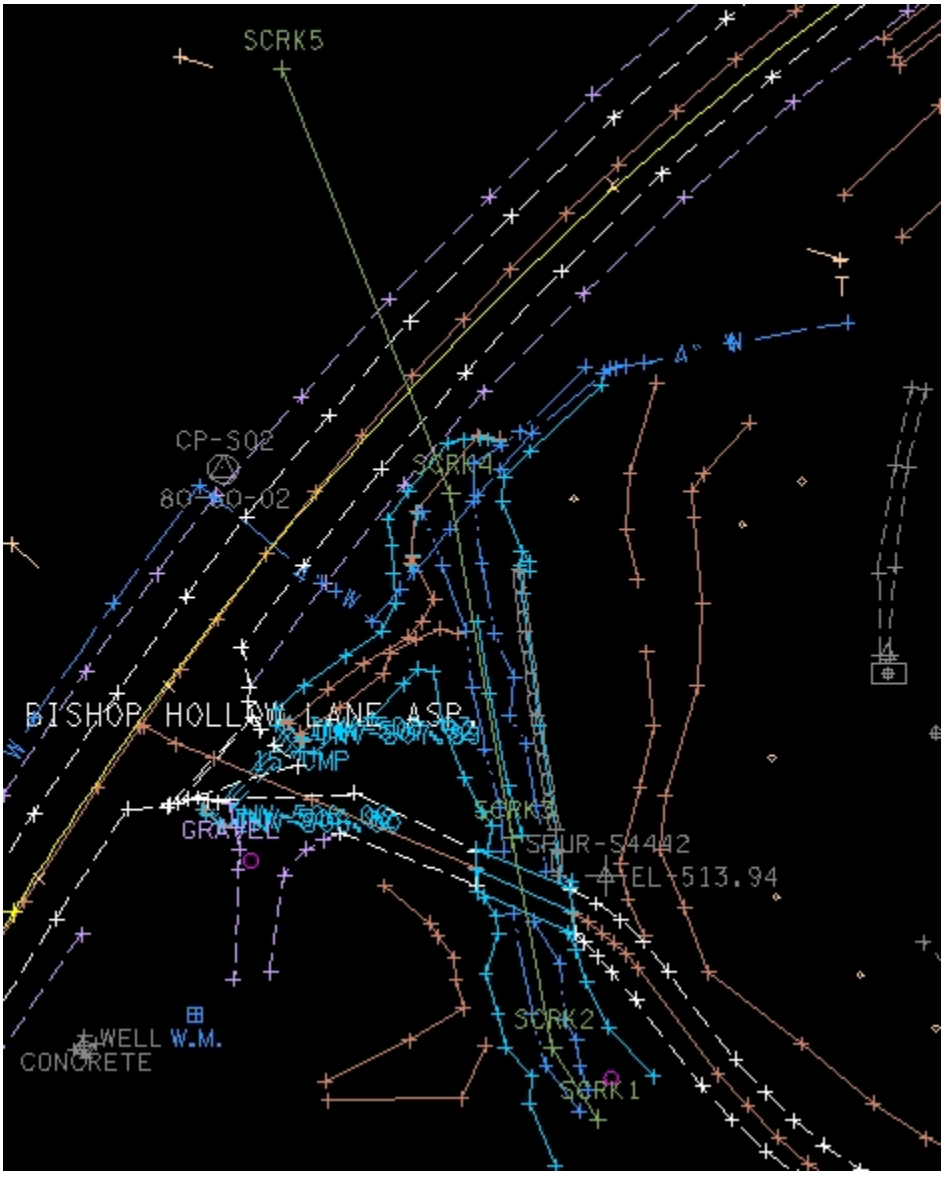


If an alignment, points, curve, etc. already exists, the redefine option must be toggled on for points with the same name to be overwritten as shown in the dialog below.

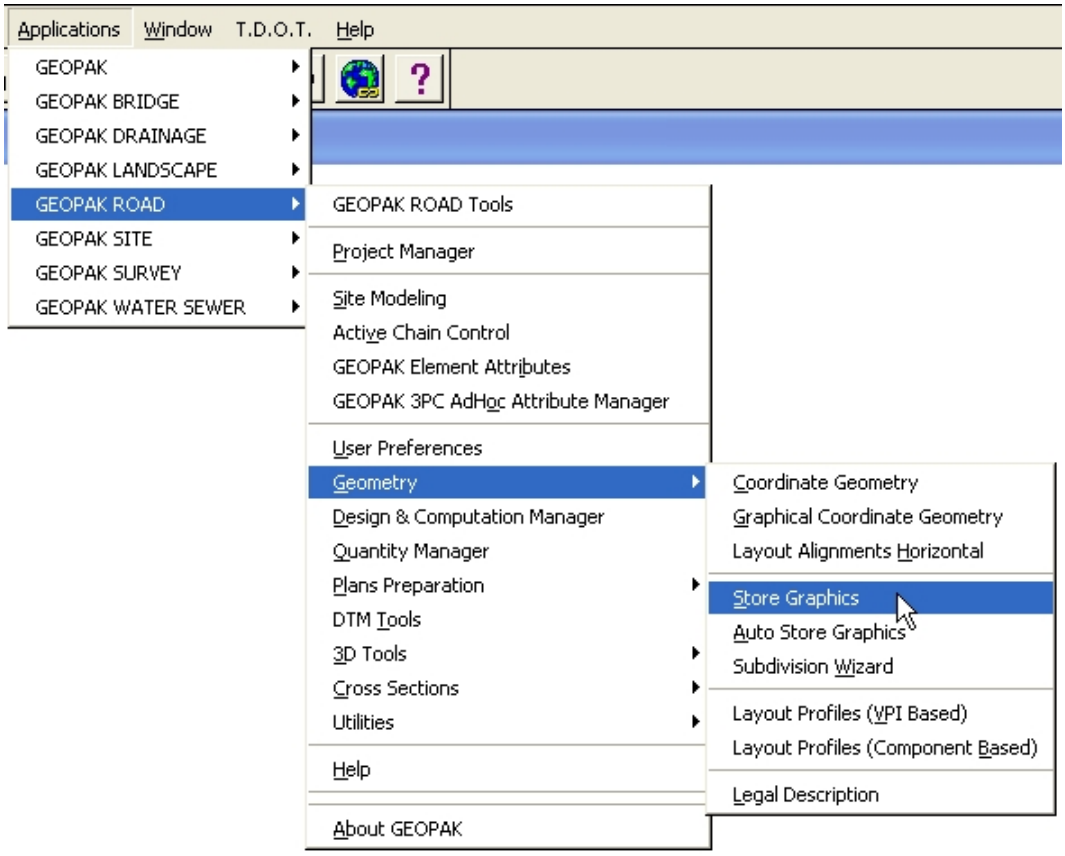


10.2 STREAM ALIGNMENTS

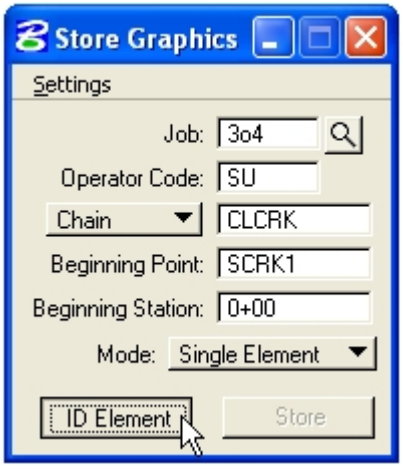
The user must graphically create a line string following the centerline of the creek that passes under Bishop Hollow Lane, keeping the number of vertices to a minimum. Create the line starting in an upstream direction. Once the line is drawn, store the chain by using the store graphics command. The screen capture below shows the GEOPAK® points stored along the creek centerline. The aerial topo file was referenced into the survey file to determine the direction of the creek on the northwest side of the road.



From Applications select **GEOPAK® ROAD → Geometry → Store Graphics** to create the alignment for the existing stream.



The **Store Graphics** dialog opens as shown below. Enter the information as shown below. The Store Graphics function will create points along the alignment therefore the user must start with a point number that does not exist. If the redefine function is on in COGO and a point number already exists then the point will be overwritten in the **.gpk** file. Select **ID Element**.



The user will be prompted to identify the element. Accept the element and then select **Store**. A notification will appear that the data is about to written to the GPK file. The chain can now be viewed in the survey file and COGO navigator.

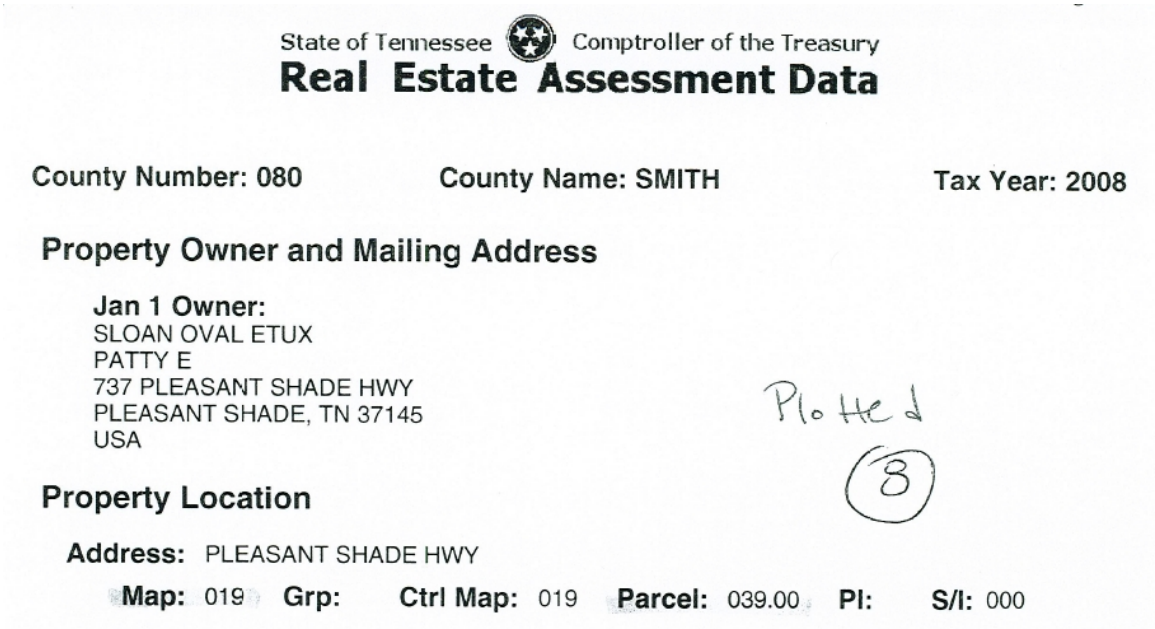
10.3 ESTABLISHING TRACTS BASED ON PROPERTY RECORDS AND FIELD LOCATED EVIDENCE

Prior to creating individual parcels in GEOPAK®, property information must be obtained from the local courthouse and located in the field. By using a county tax map of the project area, the user can determine which properties adjoin or will be impacted by the project. Assign sequential tract numbers, in ascending order, to each individual parcel regardless of common ownership. Try to establish an organized method, since these Tract Numbers will be used throughout the project. The user should utilize the deed as a guide in creating parcels and should rely on field located evidence for storing the parcels in Coordinate Geometry. If the user encounters discrepancies between the deed and the measured parcel area, the measured area will be used in the right-of-way acquisition table.

A useful tool to research property deed information can be found on the State of Tennessee – Comptroller of the Treasury Real Estate Assessment Data web site found at the following link:

http://www.assessment.state.tn.us/

The website allows the user to search by various means but by Tax Map and Parcel Number would be the easiest since that information is at hand. The Tax Card information contains Owner, Owner Address, Deed Reference (Book and Page Number) and Approximate Acreage. This information will be used later to complete the Right-of-Way Acquisition Table. Print the Tax Card and note on it which assigned Tract Number it corresponds to. In this class we will be utilizing the property shown below.



State of Tennessee Comptroller of the Treasury

Real Estate Assessment Data

County Number: 080 **County Name: SMITH** **Tax Year: 2008**

Property Owner and Mailing Address

Jan 1 Owner:
SLOAN OVAL ETUX
PATTY E
737 PLEASANT SHADE HWY
PLEASANT SHADE, TN 37145
USA

Plotted
(8)

Property Location

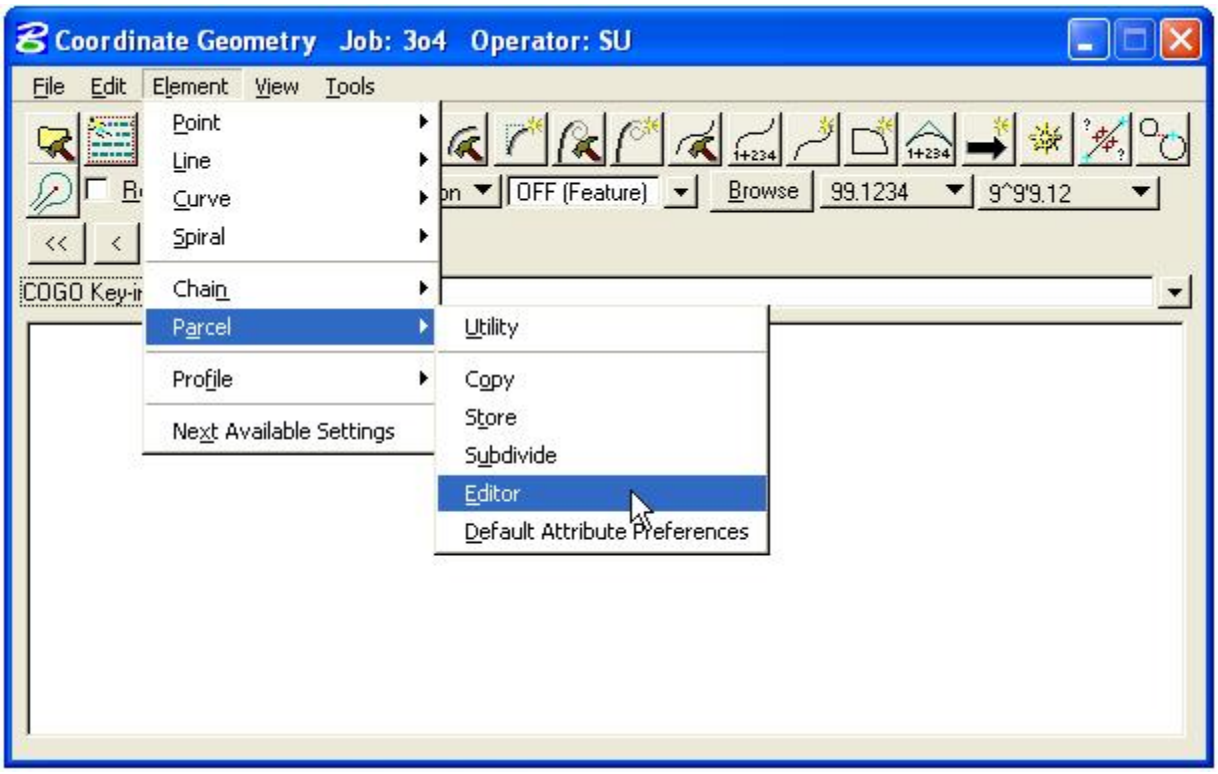
Address: PLEASANT SHADE HWY

Map: 019 **Grp:** **Ctrl Map:** 019 **Parcel:** 039.00 **PI:** **S/I:** 000

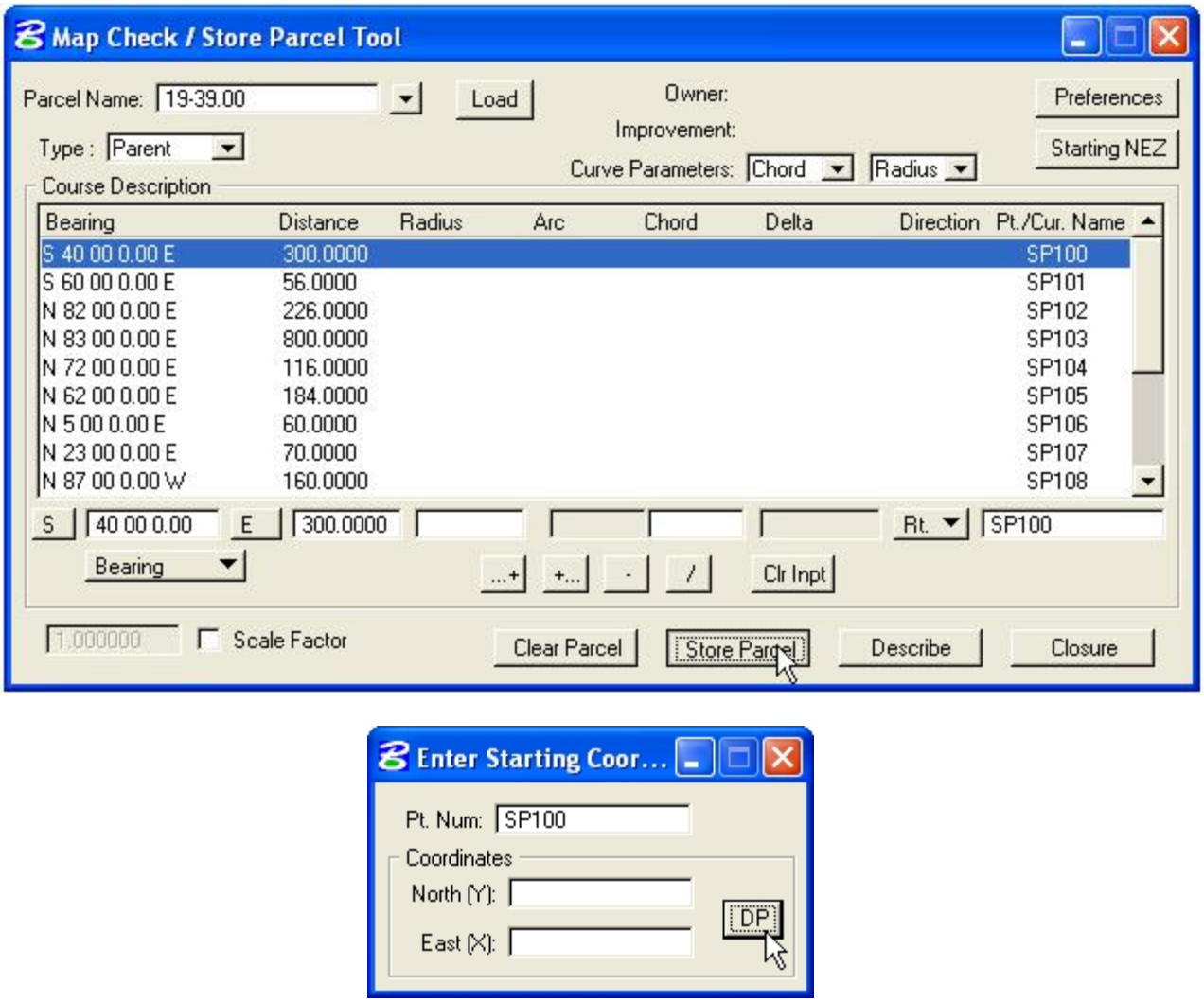
The latest Deed Reference for each Parcel will need to be obtained from the Register of Deeds Office for the county in which the project is in. Note: Some Parcels that are within a subdivision may have information on the Subdivision Plat that may not be reflected in the Deed (i.e. Revision to the Subdivision, Easements, or Right-of Way Dedication). A subdivision Plat may also encompass multiple Parcels within the project area which will facilitate inputting the information.

Inputting the parcel based on the Deed Description

In GEOPAK®, open the **Coordinate Geometry** dialog and select **Element → Parcel → Editor.** The user should open the survey design file.



Beginning on a stake at Highway 80 and a corner to Jolly Taylor and running with Taylor line up the hill S 40 E 300', S 60 E 56', N 82 E 226' to a Cedar Tree a corner to Billy Sloan; thence with Sloan's line N 83 E 800', N 72 E 116', N 62 E 184' stake a corner to the new line to Oval Sloan; thence with O. Sloan N 5 E 60', N 23 E 70' Hickory; thence down the drain and with O. Sloan N 87 W 160' Elm, N 65 W 200' Cedar, N 58 W 280' Elm, N 85 W 620' to a stake at Highway on the north side of a culvert; thence with a line of the Highway S 18 W 200', S 42 W 100', S 60 W 294' to the beginning stake. Containing 12.513 acres, more or less.



The Parcel Name should be the respective Tax Map-Parcel (Map 019 Parcel 39.00) being input and the Starting NEZ, an arbitrary point in the MicroStation® file. This step can also be accomplished using MicroStation® commands but by using the GEOPAK® Coordinate Geometry input a record of the input is stored and can be edited if an incorrect call (bearing and distance) is entered. A portion of the deed is shown in the dialog.

SP100 will be the first point for the parcel. Once the first bearing and distance has been stored, the Starting Point will automatically increment with the next available point. Select the "**...+**" button to add the boundary segment. The deed descriptions will vary in detail and accuracy, so discretion should be used as to which the user should use to resolve discrepancies between adjoining parcels.

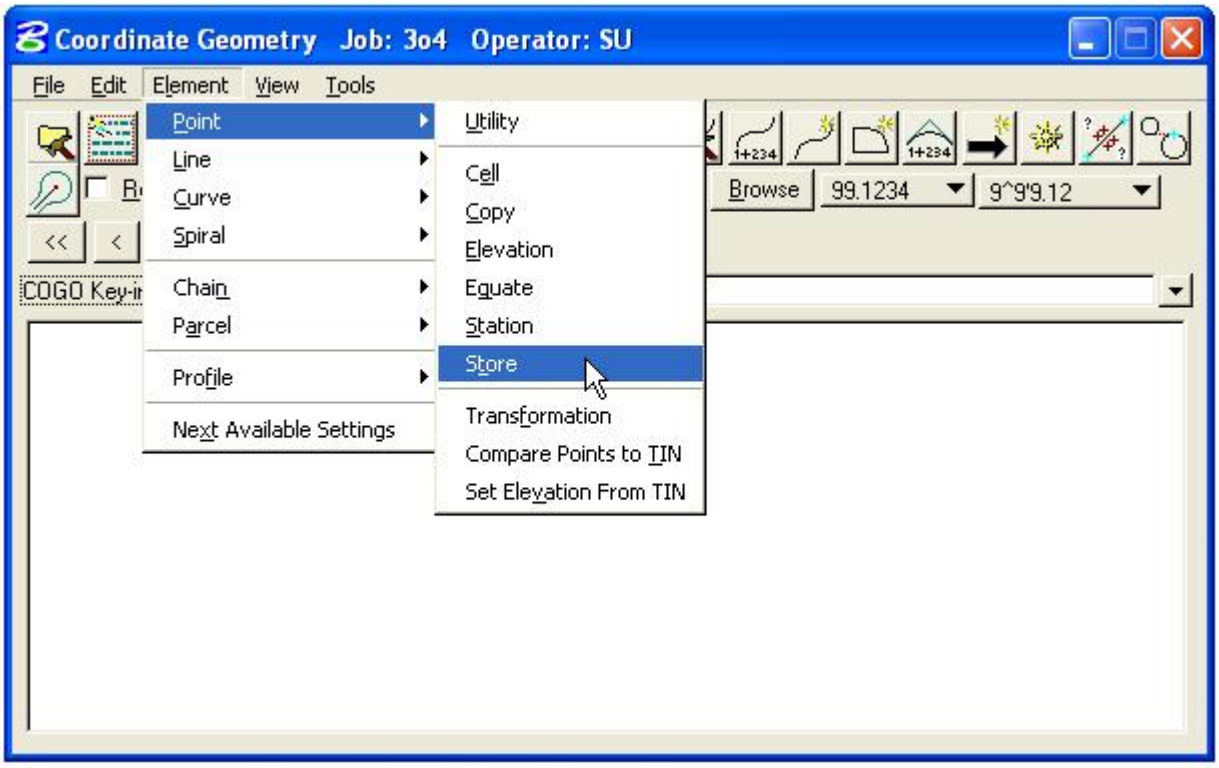
Once the Parcel has been created, it should be visualized and the graphic shape moved and/ or rotated to best fit any property monumentation (i.e. iron pin, row marker, existing fence) corresponding to the parcel that was field located. For this particular piece of property the parcel should be aligned with the existing fence near Station 121+00 Rt. The user should move the parcel with MicroStation® commands and not GEOPAK® commands. Also, if a parcel is created and does not close, the user should not close the parcel unless there is an obvious mistake (i.e., a bearing is reversed). (Note: The GEOPAK® Parcel still resides in the original location.)

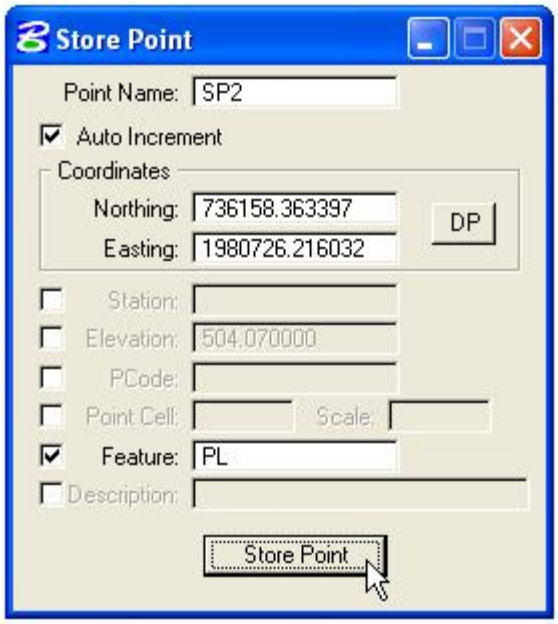
If existing Right-of-Way plans exist, they should be input and taken into account since the property deed may have preceded the ROW plans and is not reflected in the deed description.

The individual properties are then assembled as a whole, resolving any discrepancies which may be encountered by taking fences, buildings and other features into account.

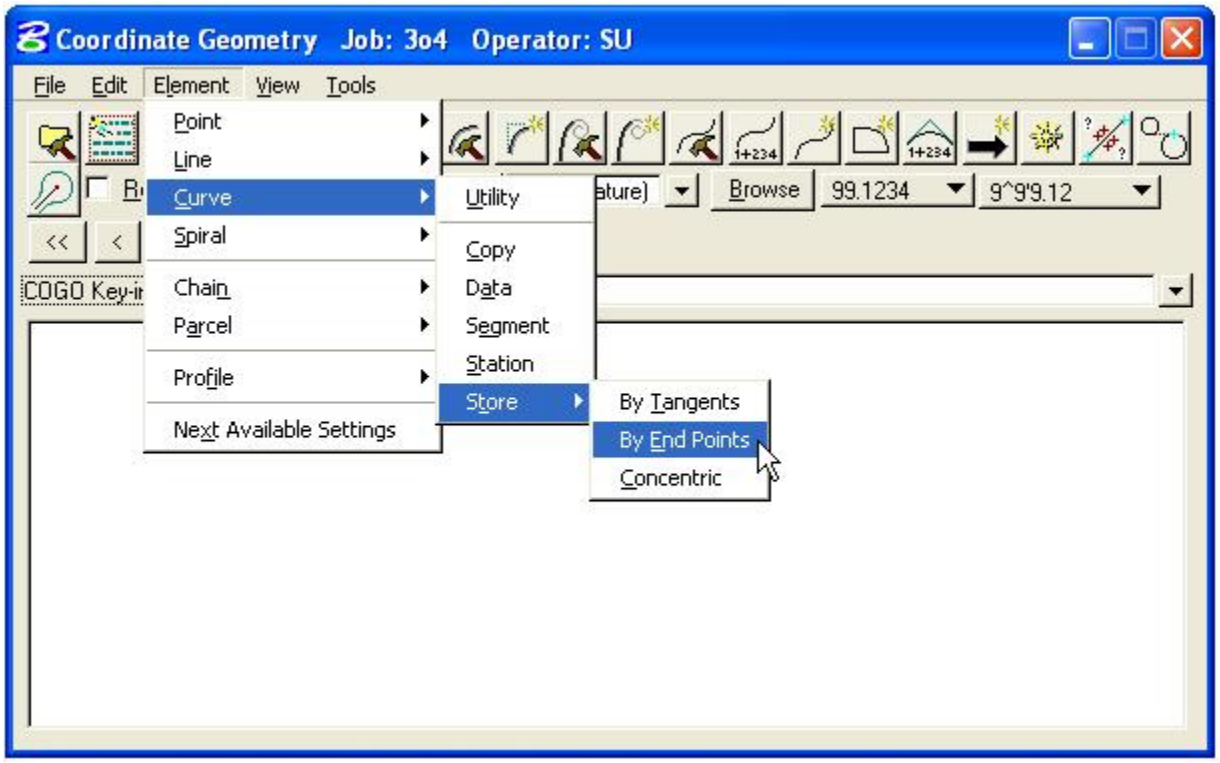
Once all of the ROW parcels have been relocated to the proper location and all discrepancies resolved, it is preferable to store new points at all of the ROW vertices to recreate the parcels in the correct location. In the GEOPAK® Coordinate Geometry, store points using the **Store Point** command. Store the points using SP1 as the first point and select Auto Increment. Select DP (data point) and set the feature to PL. Once the point has been selected, by snapping to the desired point in MicroStation®, select Store Point. Repeat this step for all vertices of the property lines. (Note: Vertices common to multiple Parcels should contain only one point, not duplicate points.) The dialog below describes how to store one of the points in a parcel.

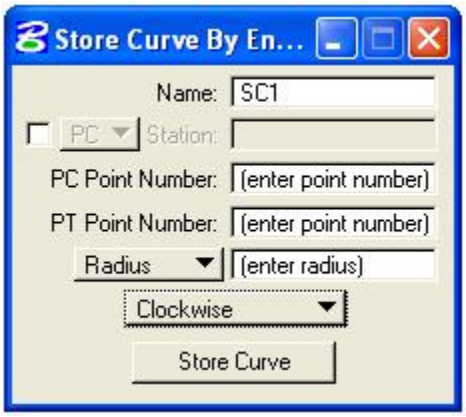
For the purpose of this class the user should go through the following exercises to gain familiarity with the process. To allow all users to proceed with the same property information after the exercises, an input file will be loaded at the end of Section 10.2.



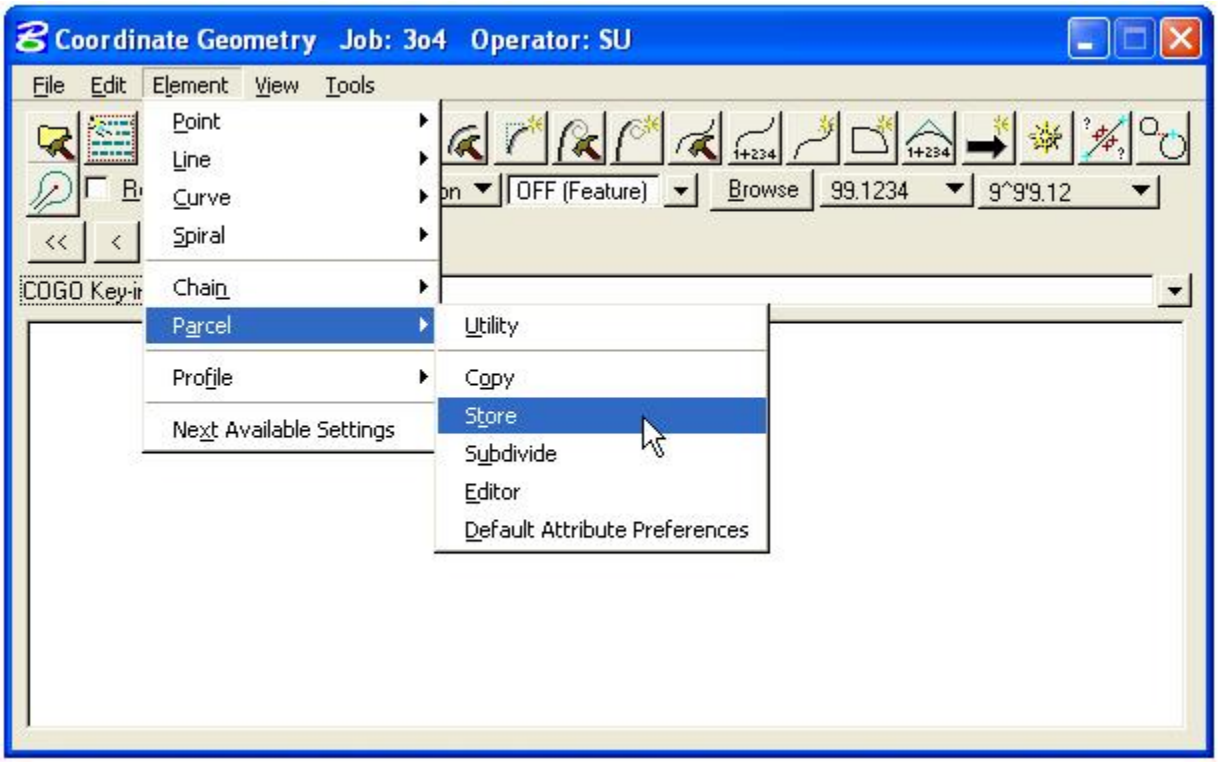


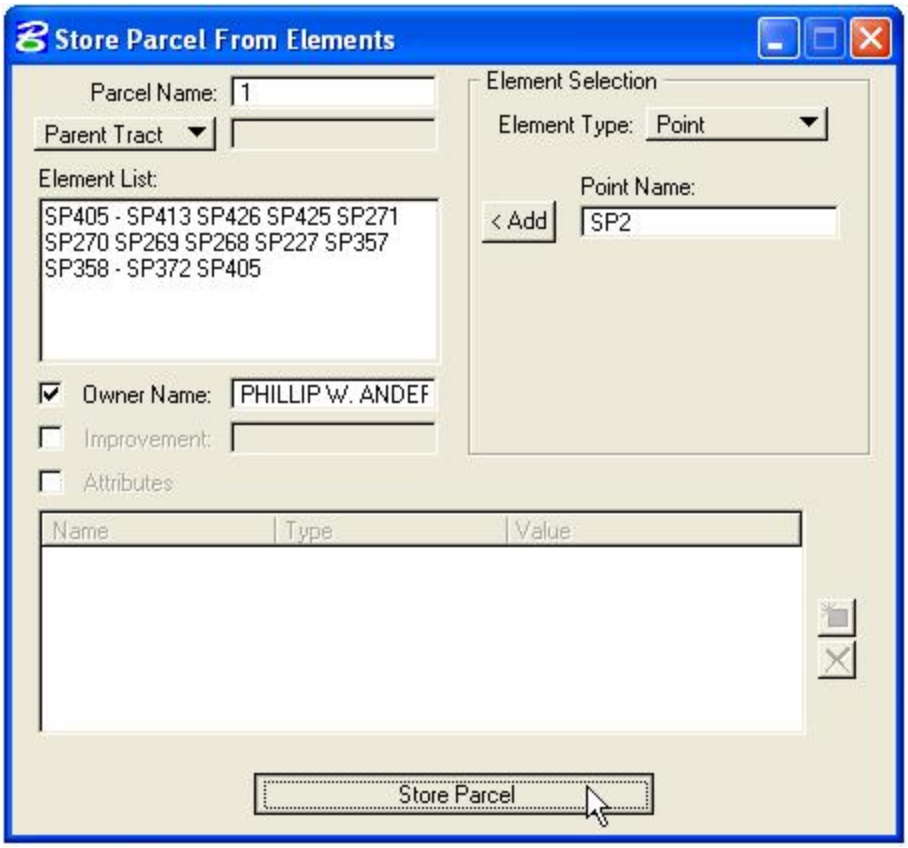
In **GEOPAK® Coordinate Geometry**, store curves using the **Store Curve by Endpoints** command. Store the curves by using SC1 as the first curve name. (Note: Be sure to give each curve a different name before storing or it may be overwritten if the redefine toggle is turned on in the **Coordinate Geometry** dialog.) Choose whether the curve is **Clockwise** or **Counterclockwise** and select **Store Curve**.





In the **GEOPAK® Coordinate Geometry** store parcel using the **Store Parcel From Elements**. The **Parcel Name** at this point would be the **Tract Number** assigned earlier. The parcel can be made up of various **Element Types** (i.e. Points, Curves and Spirals). In the **Element List**, list the elements that make up the parcel starting at the first point encountered going up station to the project alignment and always in a clockwise direction. This may require entering a curve common to two properties twice, due to the clockwise direction. The parcel **Owner Name** may also be entered at this point or can be added later by either using a **GEOPAK® Coordinate Geometry** command or by creating and using an input file. (Note: Be sure that **Feature** in the **GEOPAK® Coordinate Geometry** dialog is set to PARCEL for the shape to be given to correct symbology.) Select **Store Parcel**, if redefine is toggled on, any parcel by the same name will be overwritten with no warning.

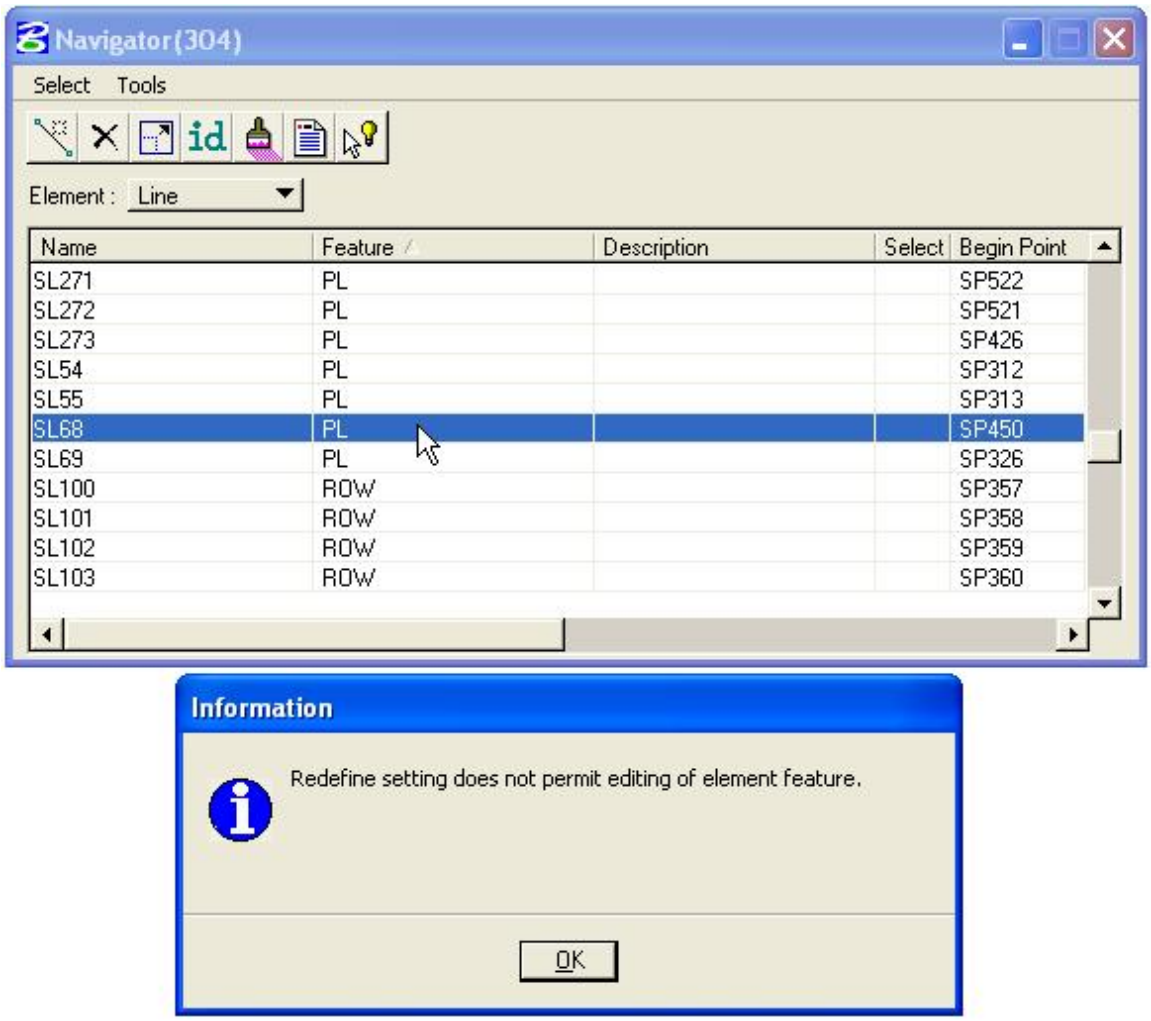




For the purpose of this class the user will load the input file provided to create all of the parcels along this project. Load the parcel input file (`Par3o4.isu`) provided using the process detailed at the end of Section 10.1.

10.4 ROW AND PROPERTY LINES

In order to display the Right-of-Way and Property Lines correctly, they need to be stored in GEOPAK® as lines or curves. The Store Line or Store Curve From Elements commands can be used and the correct Feature must be defined (i.e. Property, ROW, Easement, etc.). If the incorrect Feature is selected, it can be edited without recreating the elements. The Navigator Tool will allow the user to display all of the various elements contained in the GPK file. One of the attributes listed is the element feature. By double-clicking on the desired element's active feature it can then be redefined. In this case, the redefine toggle will need to be toggled off and the user will be notified.



Once all of the ROW and Property Lines have been created and properly displayed, they can be labeled with Bearing / Distances and Station / Offsets. In order to label Station / Offsets, alignments need to be available to reference to. **Plan View Labeling** techniques will be discussed in Section 11.3.

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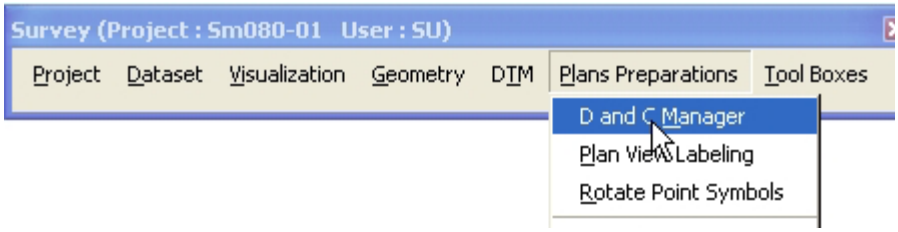
CHAPTER 11 - PLAN DEVELOPMENT

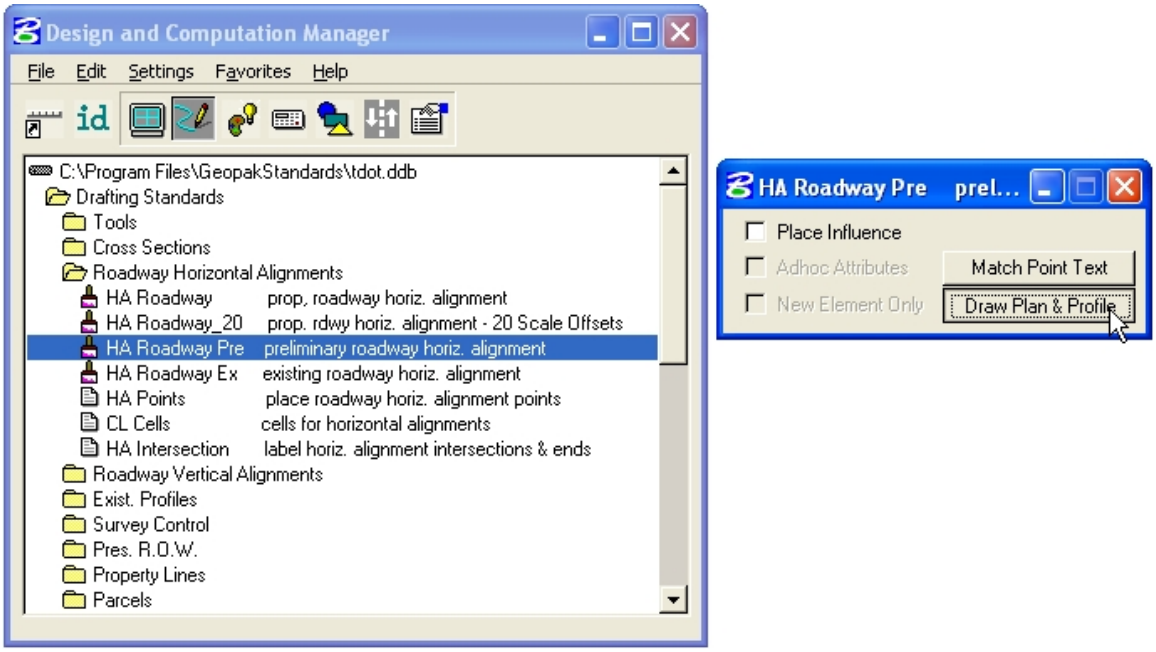
The **Design and Computation Manager** (D&C Manager) is a tool that allows the user to standardize graphic elements for drafting and pay item quantities.

A hierarchical database is used with the **Design and Computation Manage**r. This database stores information concerning functional classification and display preferences for each feature and item used in a MicroStation® file. This file is commonly referred to as the **.ddb** file.

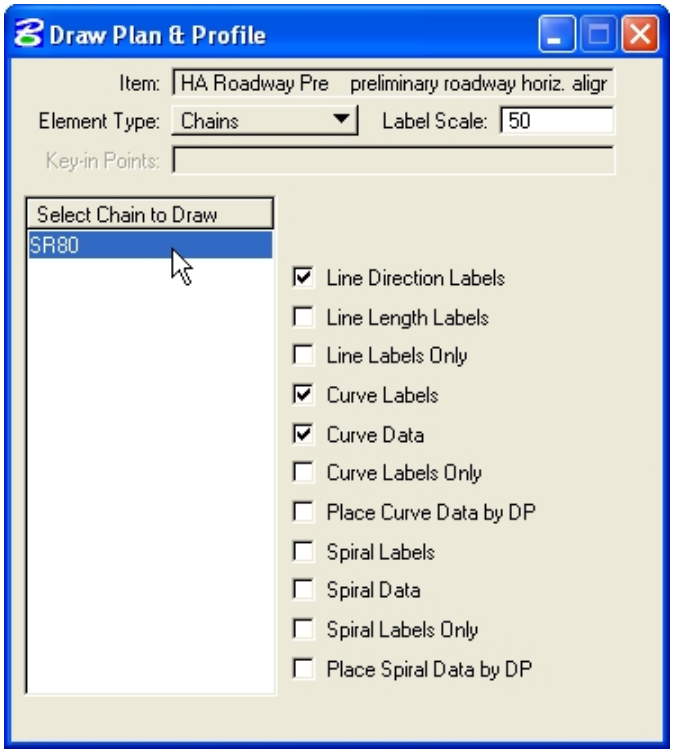


11.1 DISPLAYING AND LABELING CENTERLINES AND ALIGNMENT POINTS

From the **Design and Computation Manager**, select **Drafting Standards → Roadway Horizontal Alignments → HA Roadway Pre** (preliminary roadway horiz. alignment). Next, select **Draw Plan & Profile** button in the supplemental dialog (displayed on the screen but not attached to the main **D&C Manager**).

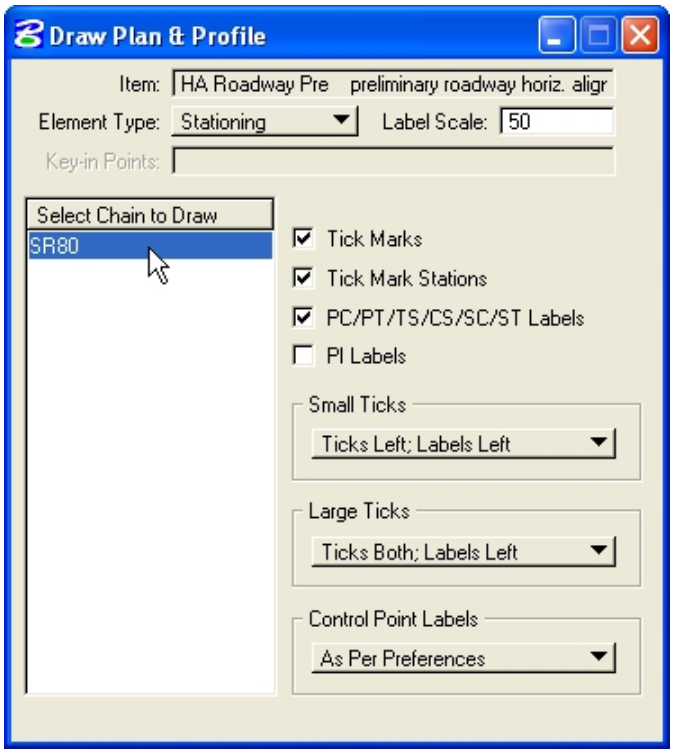


Select the **Chain** operation and set the options as shown. Set the **Label Scale** to 50.

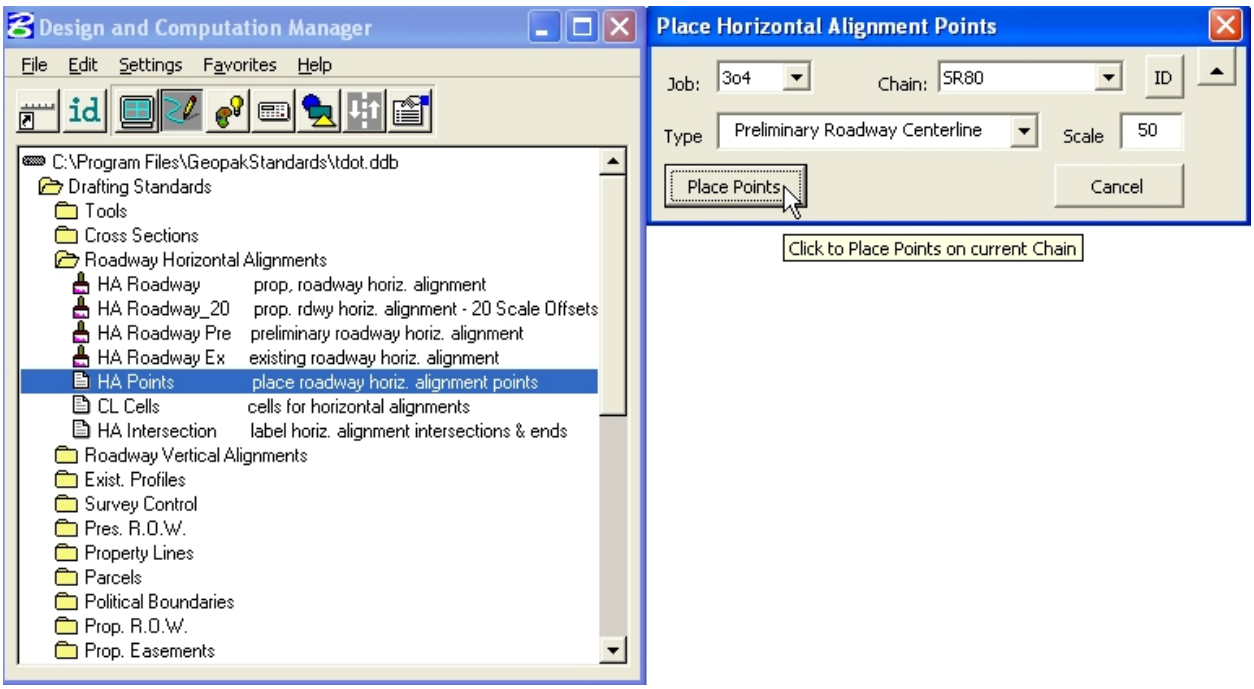


Draw the chain **SR80** by selecting it in the dialog.

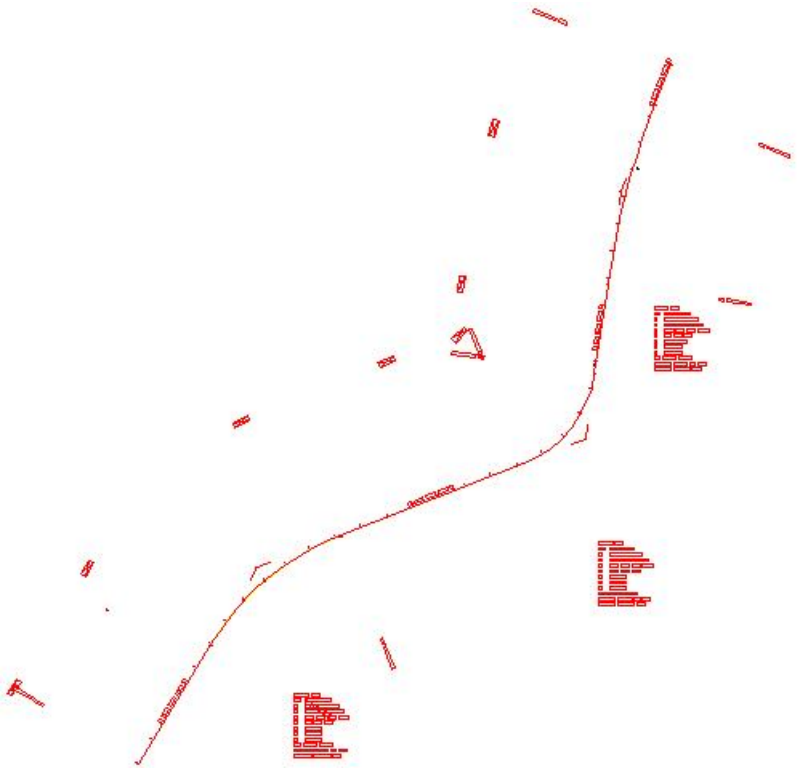
To Label Horizontal Alignment Stationing, change the **Element Type** to **Stationing,** set the options as shown below, and select the SR80 chain to draw it.



To display the points, select **Drafting Standards → Roadway Horizontal Alignments → HA Points** (prop. roadway horiz. alignment). Populate the **Place Horizontal Alignment Points** dialog, set options and select **Place Points**.

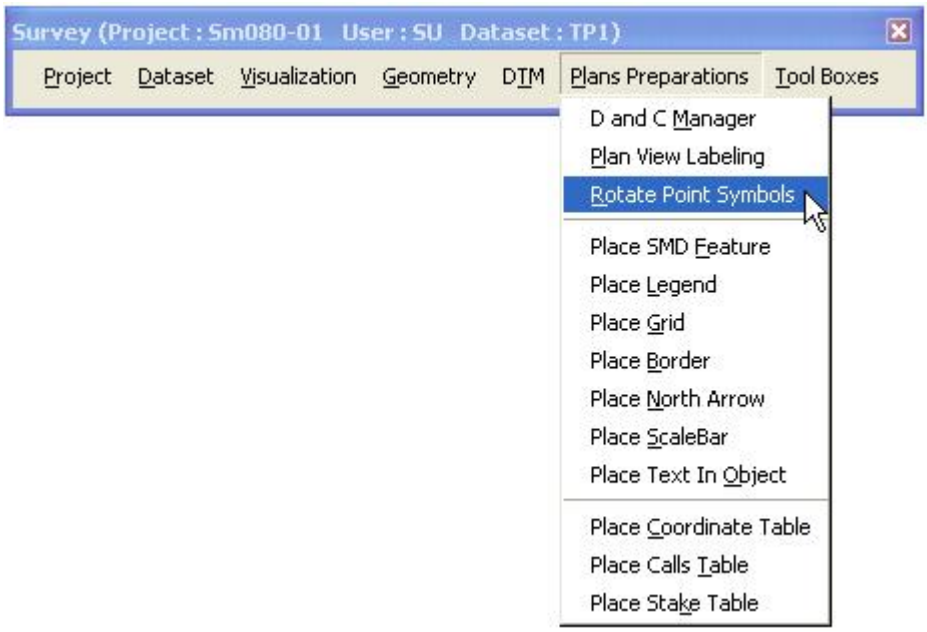


The screen capture below shows the finished results as defined by the **D&C Manager**.



Select **Plans Preparation → Rotate Point Symbols** from the **Survey** toolbar.

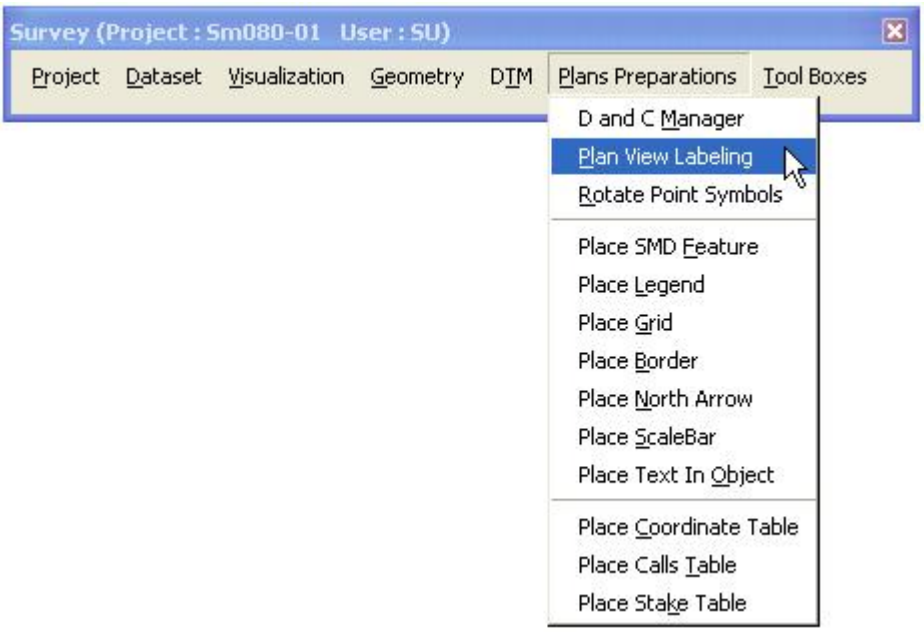
When the dataset is mapped or visualized, the placement of the graphic information is defined in the SMD file. The angle of cells and text placed are at an active angle of 0 degrees by default. The Plan View of the finished design documents is typically rotated to fit parallel to the sheet in which case the cells and text in the survey should be rotated for a more appealing set of plans. This should be done as soon as possible and prior to adding any manual labeling since they would be rotated as well (i.e. bearings, text and manually added graphics would also be rotated).



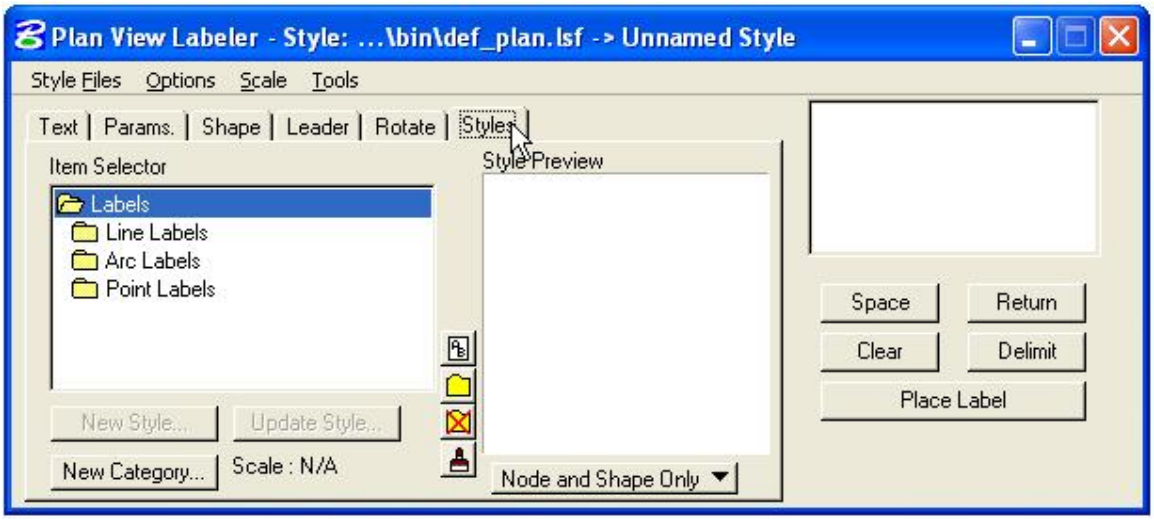
Use the MicroStation® Selection Set tool to chose multiple or all Point Symbols to be rotated or Point Symbols can be rotated by identifying each individually. Select the Baseline to rotate to, enter the Job and the Rotation method. Select **Start** to launch the command. The selected symbols are now rotated tangent with the SR80 chain.

11.2 PLAN VIEW LABELING

GEOPAK®'s labeling tools allow a user to place "intelligent" labels in a MicroStation® drawing. These labels have the ability to calculate XYZ coordinates, station, offset, direction, length, radius, degree of curvature, etc. of the associated element by using the gpk file. To access **Plan View Labeling**, select **Plans Preparation → Plan View Labeling** from the **Survey** toolbar.



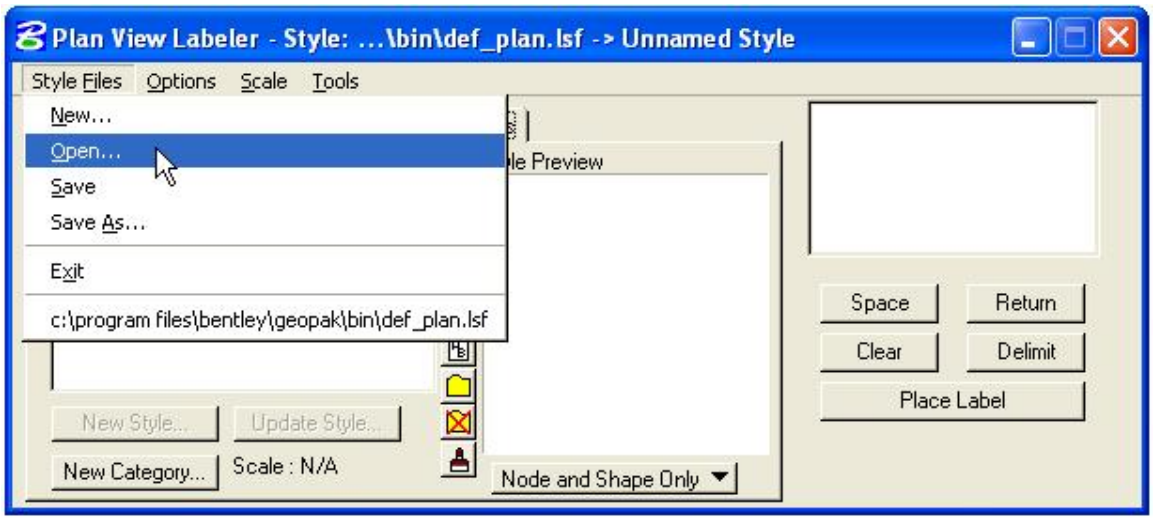
After selecting **Plan View Labeling,** the following dialog will appear.

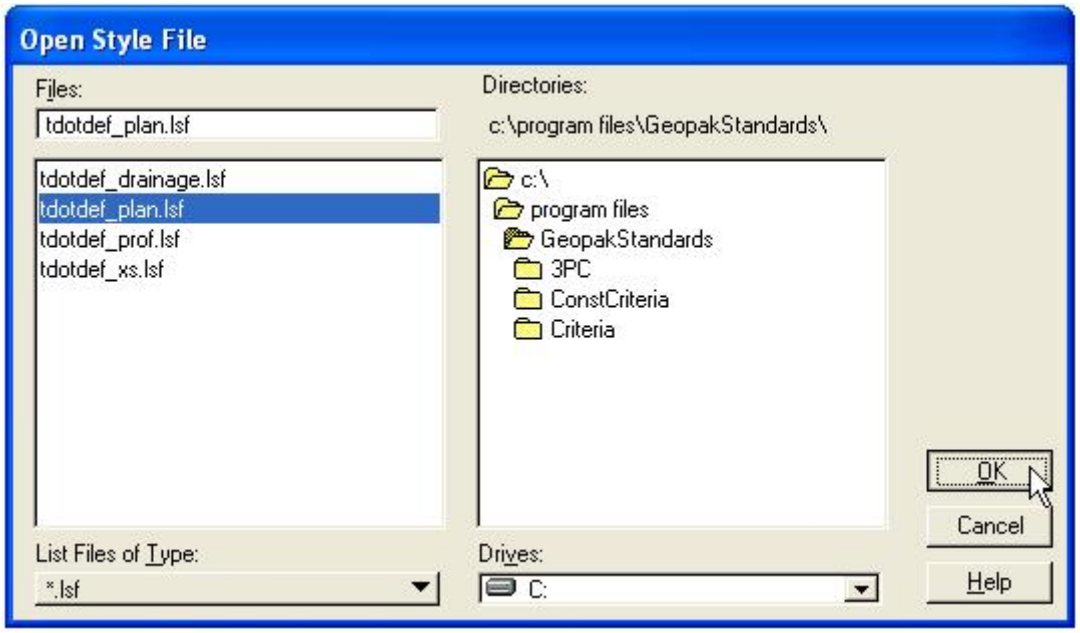


The **Styles** tab allows a user to choose label symbology from a library of pre-defined styles. When the user chooses the style, all symbology, leaders, shapes, etc. is set up for the user. TDOT provides a file (**`tdotdef_plan.lsf`**) for the user with all the necessary styles for plan view labeling. The file can be found through the following TDOT website:

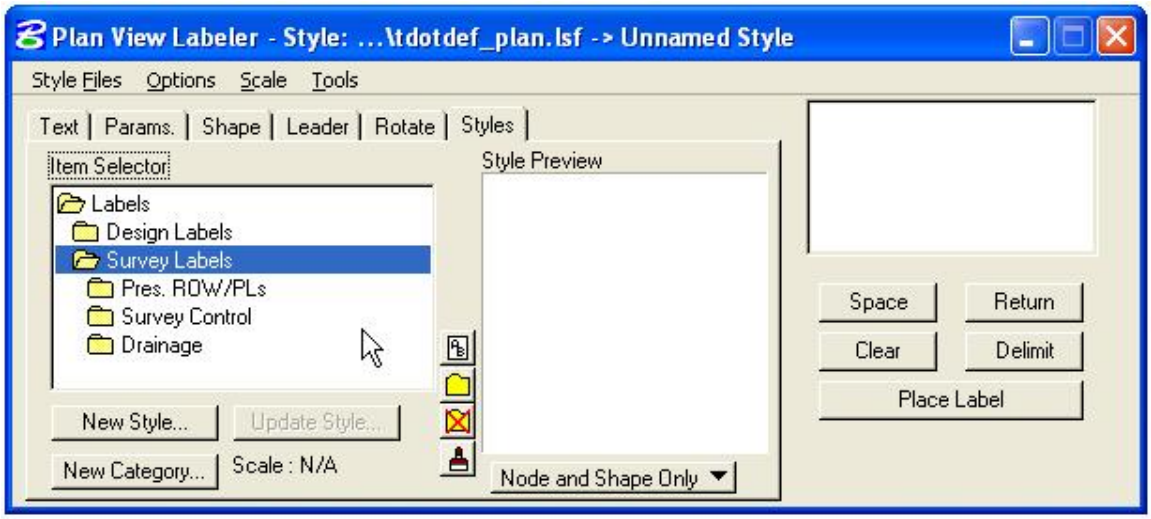
http://www.tdot.state.tn.us/Chief_Engineer/assistant_engineer_design/design/v8/V8design.htm#GEOPAK

If the TDOT line style preference file did not load automatically, the user should open the file located in C:\Program Files\GEOPAKStandards as shown below. The user must be under the **Styles** tab in order to open a style library.

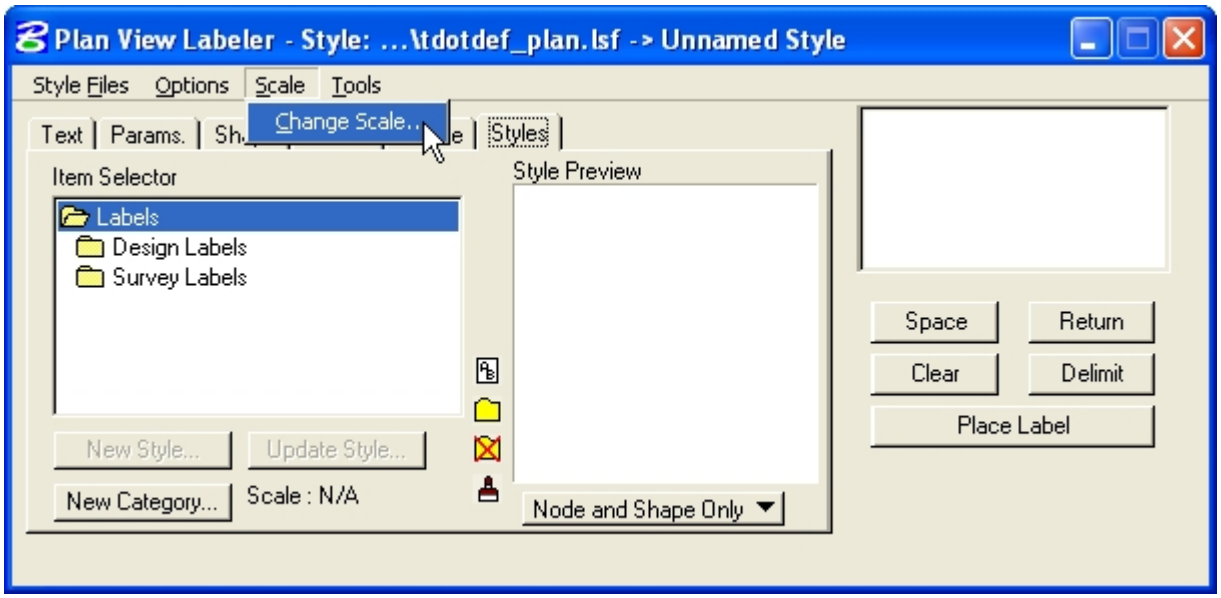


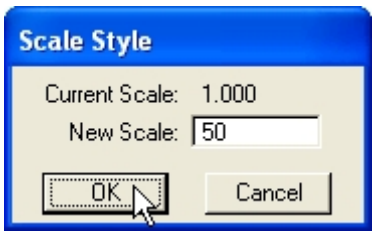


The following screen capture shows the results of opening the TDOT preference file.

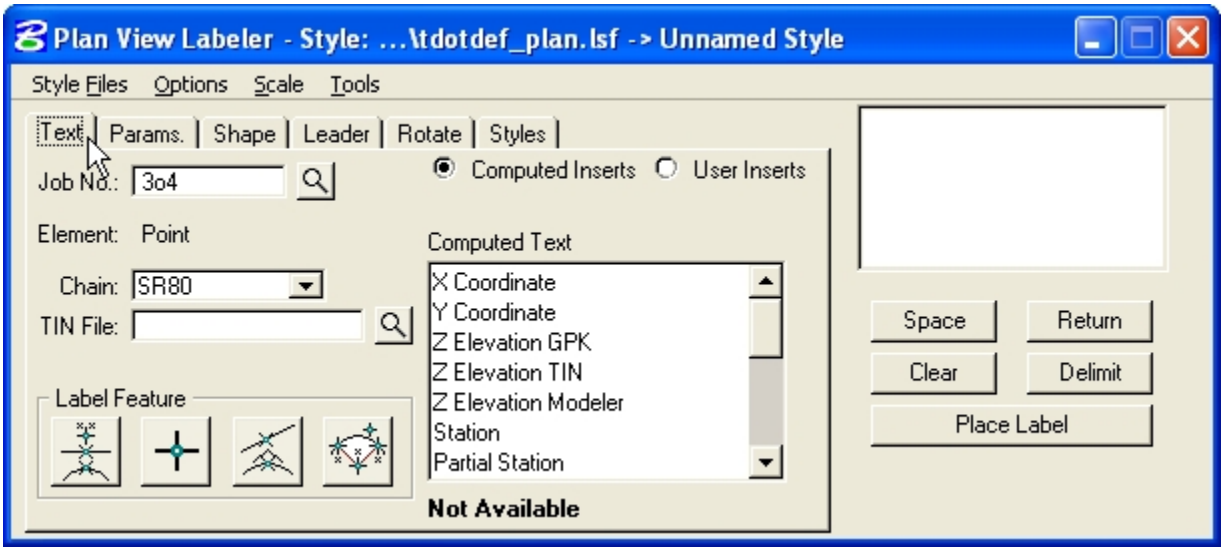


The **Label Scale** menu allows the user to choose a plan scale. All labels will be adjusted according to the plan scale. The user simply keys in a scale, and chooses a **Labeling Style**. The corresponding label will be placed at the correct size for the scale that was chosen.





Navigate to **Text** tab as shown below.



For data to be computed, the **Job Number** and the **Chain** need to be selected. If elevations are to be calculated, a TIN file needs to be chosen.

The **Computed Inserts** are items that GEOPAK® has the ability to calculate for the chosen item. The list of **Computed Inserts** changes with the type of element that is chosen. If a line is chosen, the list of **Computed Inserts** will show inserts of bearing, and length. If a curve is chosen the list of **Computed Inserts** will change to show inserts of radius, curvature, chord length, etc.

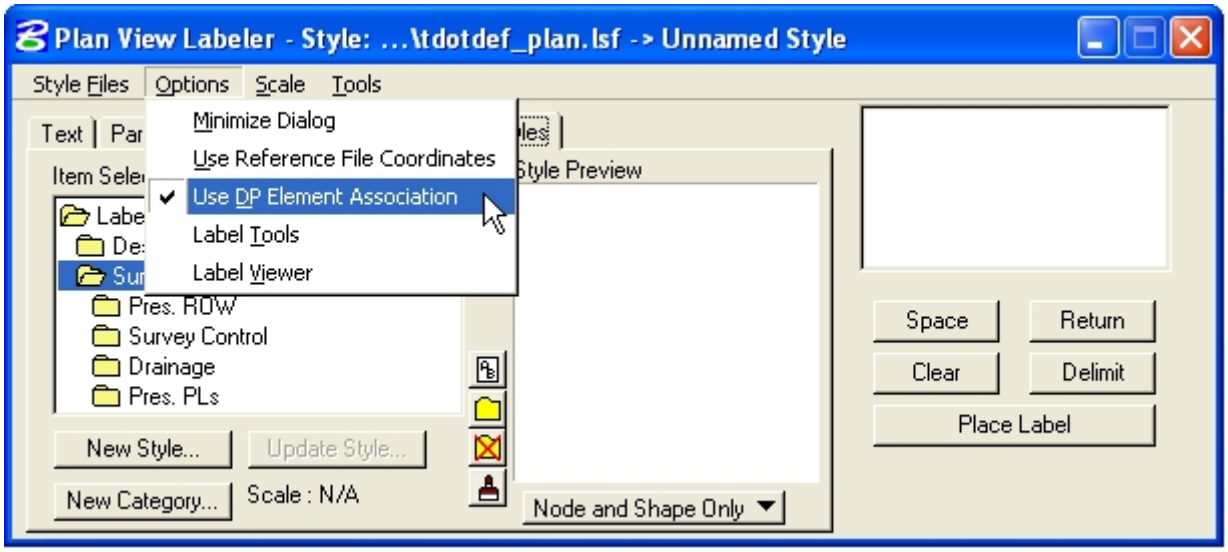
The **User Inserts** are inserts that a user may use on a regular basis. This list can be customized for a specific user's needs.

Label Feature

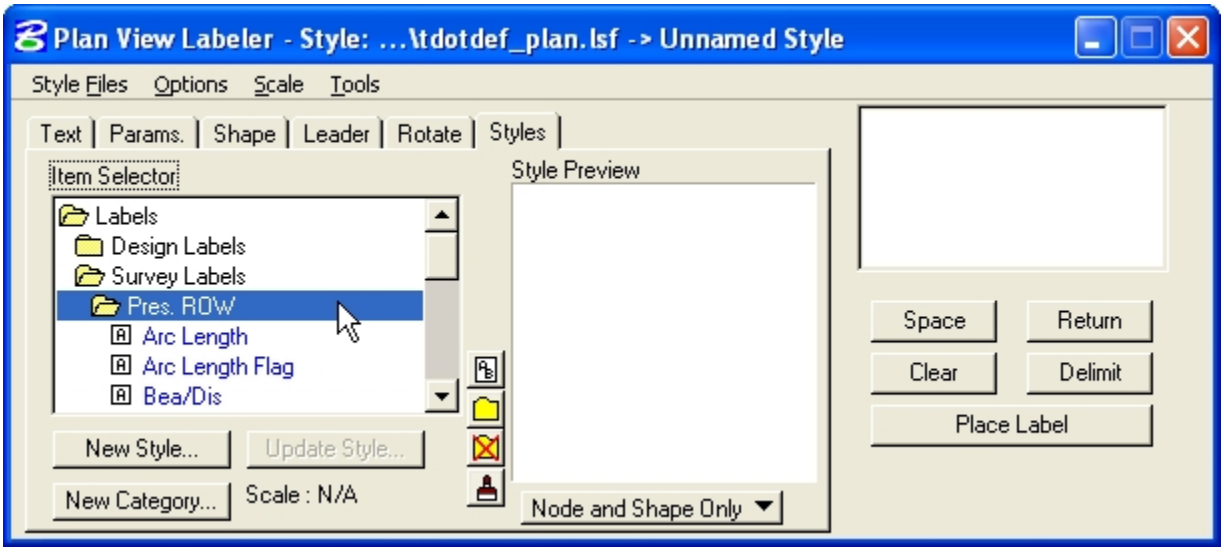
The Label Feature allows a choice of methods to use to select elements to be labeled. The first two options are the most commonly used. They are **Select GEOPAK® or MS Elements** (in the event a line or curve is to be labeled) or **Data Point Location** (in the event the label is for a specific point such as a property corner). Select **Place Label** once the correct information is displayed in the information window. Be sure the proper information is selected if computed inserts are being used. If an incorrect chain or alignment is designated, the Station / Offset label may not have the desired information.

Note: Be sure to review the label placed for accuracy and format. For instance, the bearings are usually computed based on which half of the line is picked when selecting. Some 3-D line segments may not follow this rule and will require manual editing. TDOT wants all bearings to be placed ahead station and away from the proposed alignment.

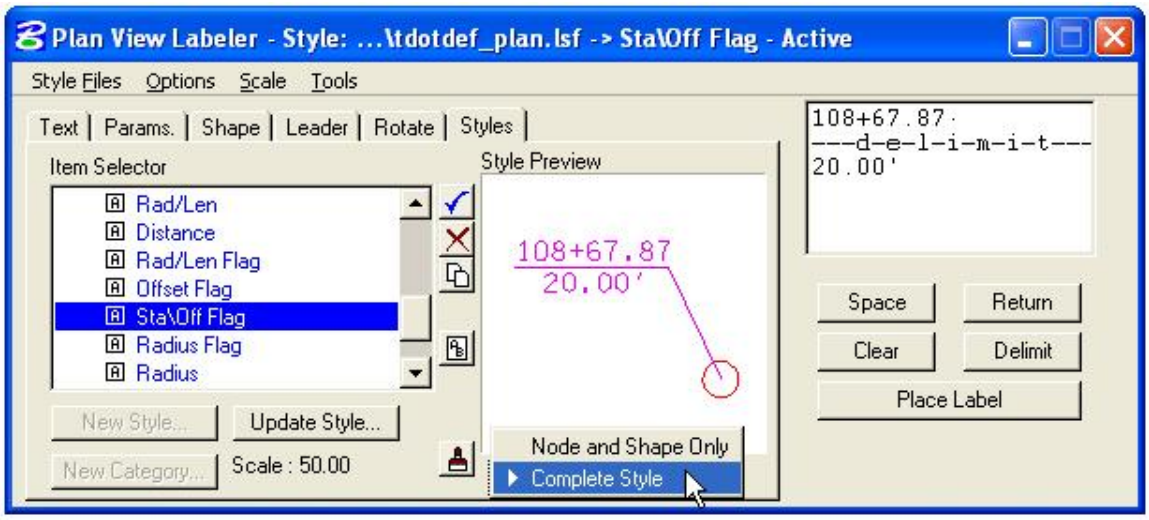
Toggle **Use DP Element Association** in the **Options** Menu.



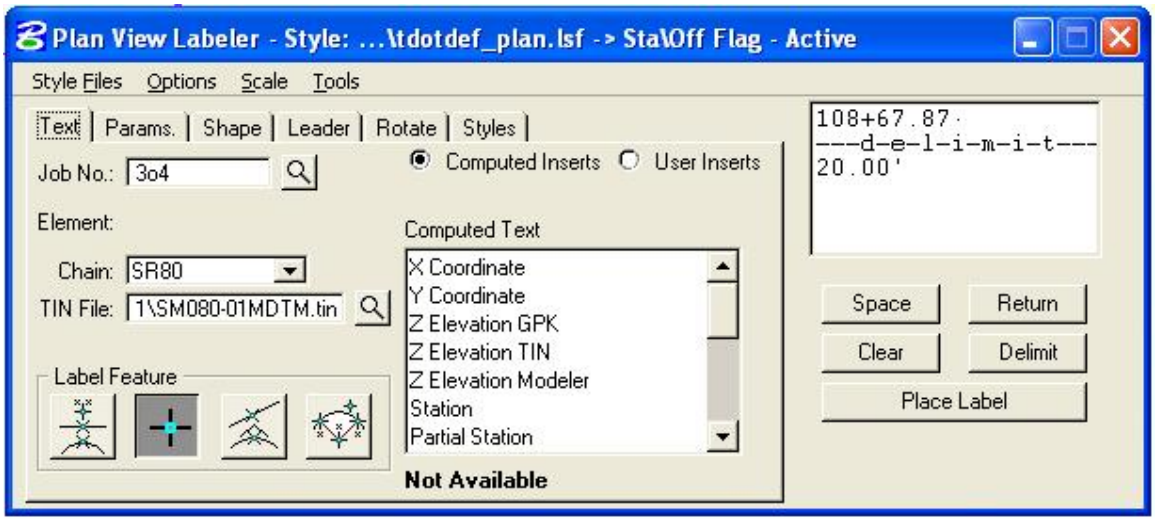
From the Style tab select **Survey Labels → Pres. ROW** as shown in the dialog below.



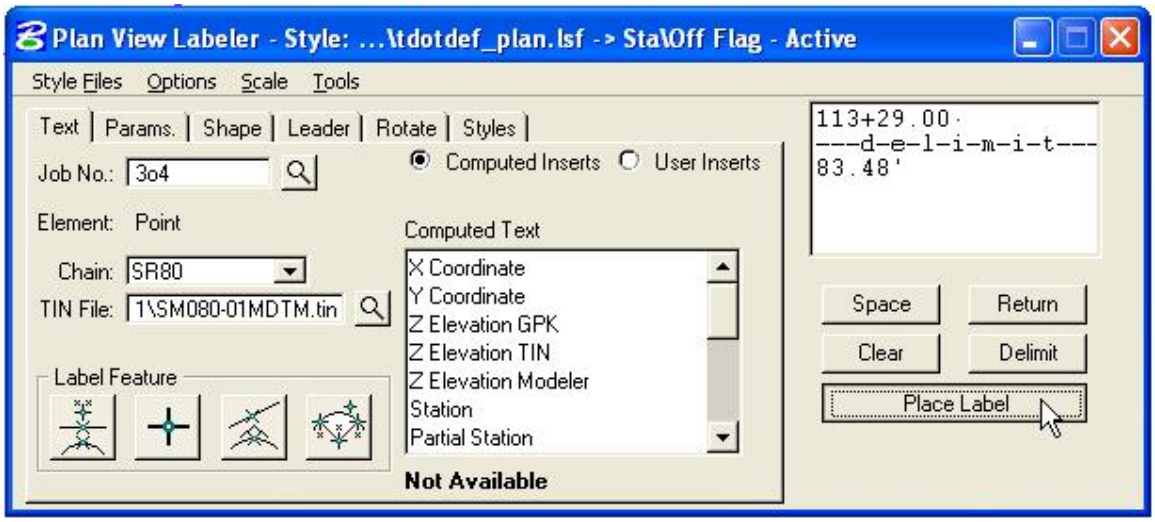
From the Pres. ROW folder select **Sta\Off Flag** and toggle Complete Style as shown in the dialog below.



The user can now label ROW Station and Offsets using the appropriate style. Double-click **Sta\Off Flag** to populate the dialog shown above. Return to the **Text** tab, and choose the **Data Point Label Feature** button.

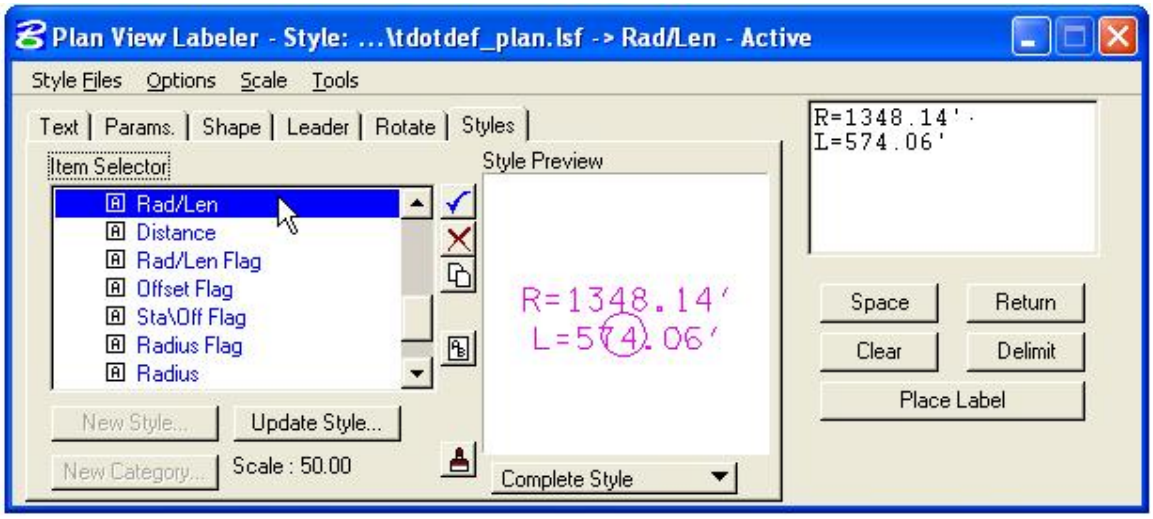


Select the ROW point at Station 113+29 RT in the dgn file and accept the locations. The computed insert should update to reflect the data point selected. Select **Place Label** to insert the label into the plan sheet. Select the desired location for the label and accept then select the side of label the leader should attach to and accept.

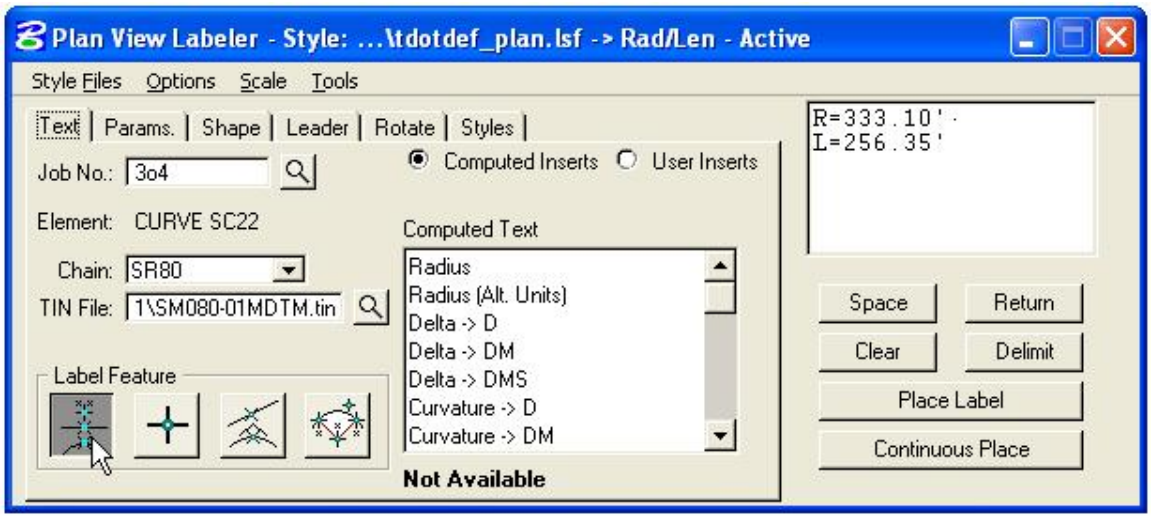


Repeat the labeling process for another ROW point. The display should look similar to the following screen capture.

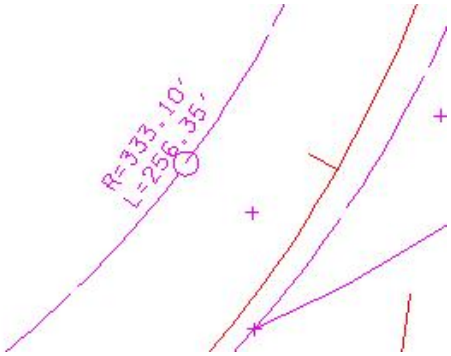
The user can label the radius and length of a curved portion of ROW. From the Item Selector in the **Styles** tab, double-click the **Rad/Len** item.



Return to the **Text** tab and choose the **GEOPAK® or MS Element Label Feature** button.



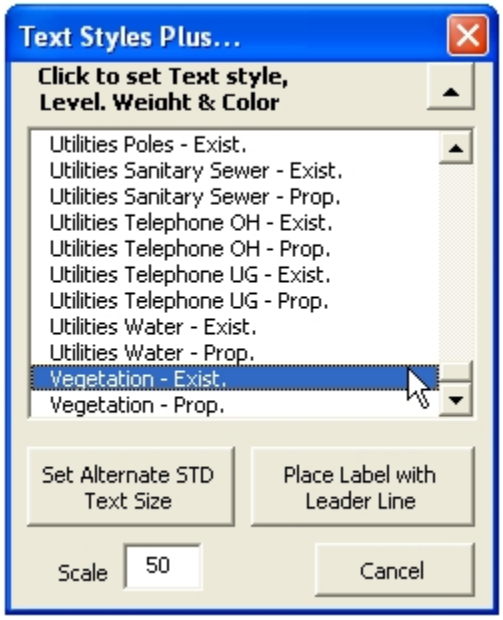
Select the curved portion of ROW near Station 121+00 LT. When the user accepts the element the label should appear. Data point again to accept the location of the label.



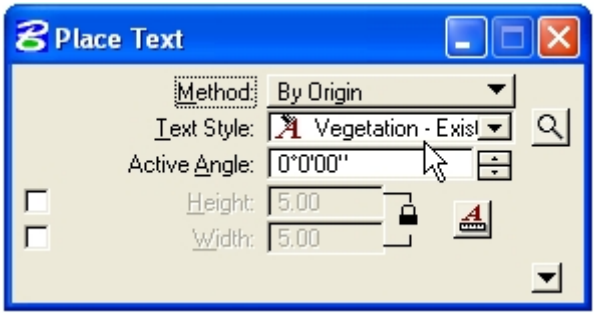
Text Styles Plus… (Placing new text)

From T.D.O.T. select **Text Styles Plus…**

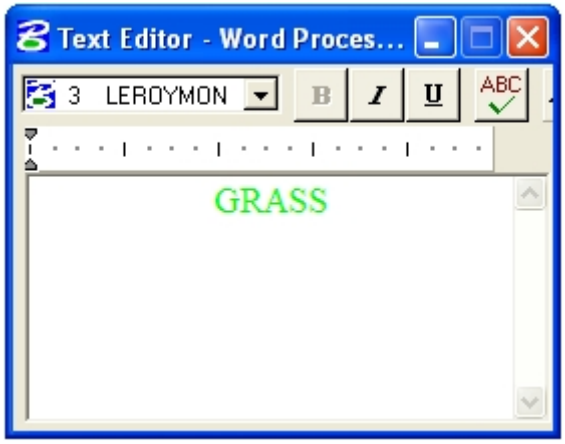
The **Text Styles Plus…** dialog opens as shown below. Highlight the appropriate text style.



In the MicroStation® main toolbox, select the **Place Text** command. The text style will be automatically set as shown in the dialog below.



In the text editor box, type in the appropriate text as shown below. The text should be capitalized and use the enter key to use multiple lines of text.



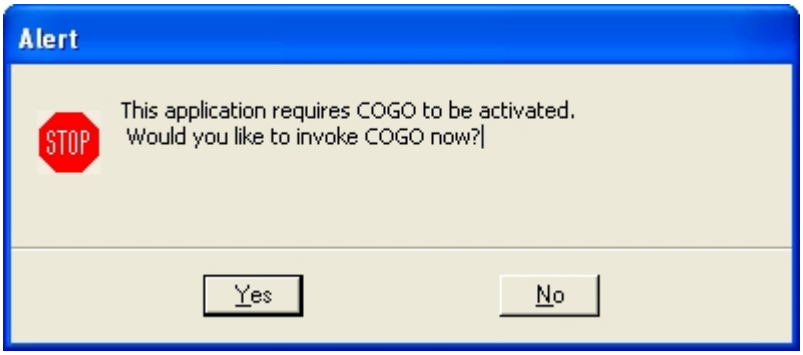
The user can then place the text in the desired locations throughout the project. Click a data point to place the text.

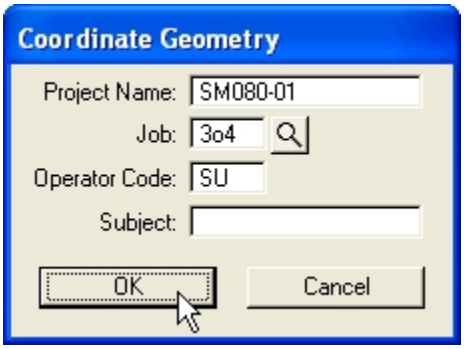
11.3 SURVEY CONTROL: CONTROL POINT TABLE, COORDINATE GRID TICKS

Control Point Table - Survey Toolbar Method

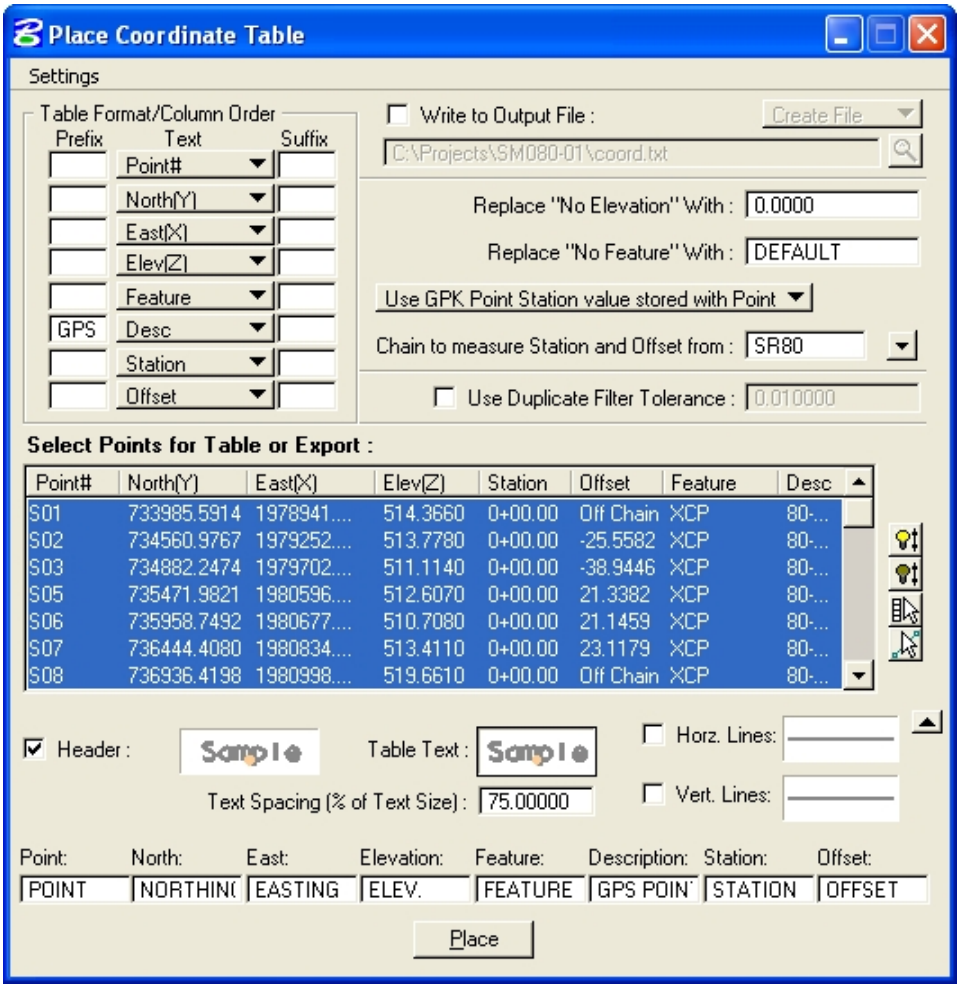
From the **Survey** toolbar select **Plans Preparation → Place Coordinate Table**.

If COGO was not activated, the following **Alert** will appear. Select **Yes**. Verify the information in the Coordinate Geometry dialog and select **OK**.

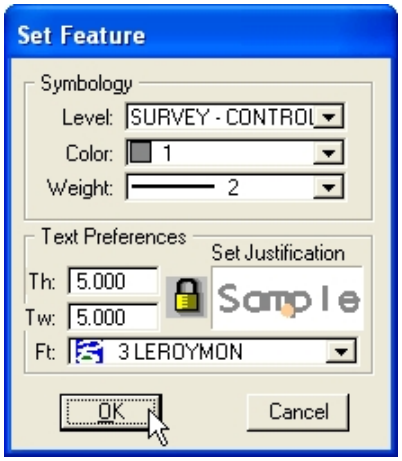




The following dialog will appear. Complete the table as shown below.



To adjust the formatting of the text in the table, double-click **Sample** from the Header menu. The Level should be set to **SURVEY – CONTROL with Text** and the justification is center bottom. Complete the same process for the Table Text formatting. The Header and Table Text formatting should match the dialog as shown below.



Once the formatting is complete, select **Place** from the **Place Coordinate Table** dialog.

Note: Make sure the appropriate levels are on to view the control point table once the table is placed.

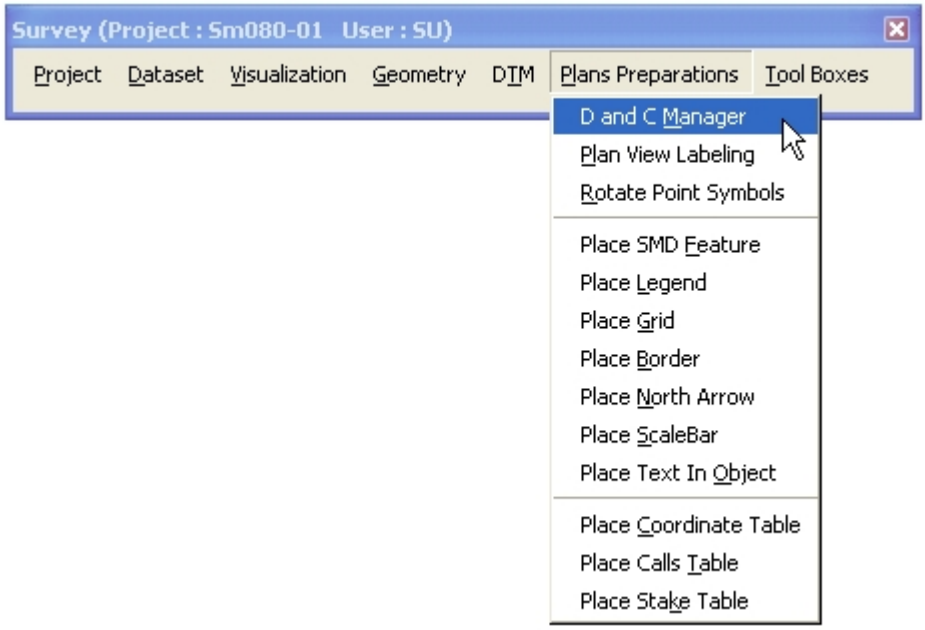
The following table will be created and placed in the MicroStation® file. The user will have to manually place a box around the points, place the “CONTROL POINTS” title, and draw the horizontal lines shown below.

CONTROL POINTS

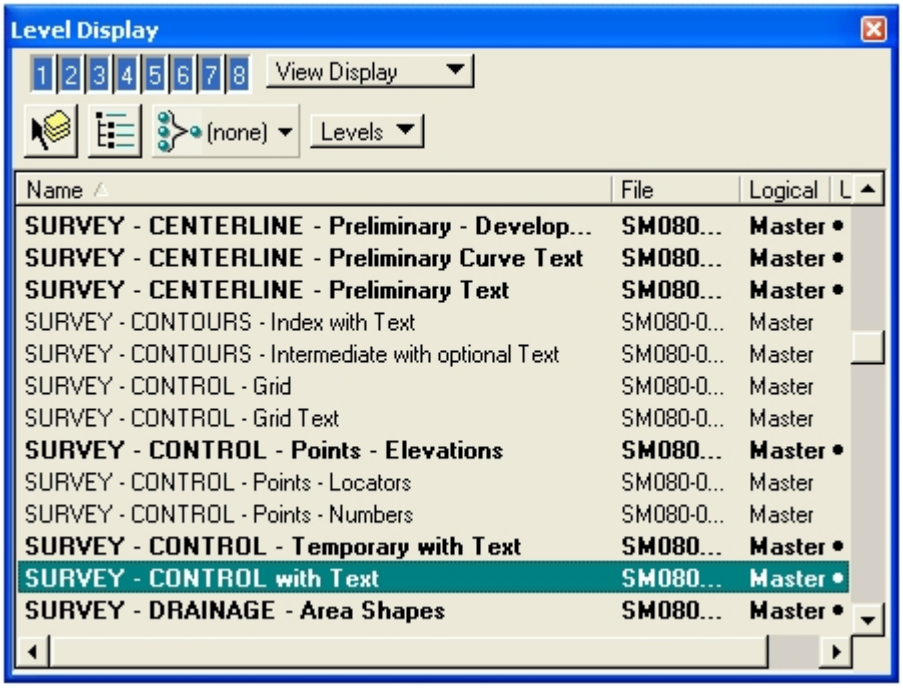
POINT	NORTHING	EASTING	ELEV.	FEATURE	GPS POINT	STATION	OFFSET
S01	733985.5914	1978941.7179	514.3660	XCP	GPS80-8D-01	0+00.00	Off Chain
S02	734560.9767	1979252.3522	513.7780	XCP	GPS80-8D-02	0+00.00	-25.5582
S03	734882.2474	1979702.4704	511.1140	XCP	GPS80-8D-03	0+00.00	-38.9446
S05	735471.9821	1980596.1995	512.6070	XCP	GPS80-8D-05	0+00.00	21.3382
S06	735958.7492	1980677.0324	510.7080	XCP	GPS80-8D-06	0+00.00	21.1459
S07	736444.4080	1980834.5176	513.4110	XCP	GPS80-8D-07	0+00.00	23.1179
S08	736936.4198	1980998.9468	519.6610	XCP	GPS80-8D-08	0+00.00	Off Chain
S09	734340.2961	1979430.4115	517.7650	XCP	GPS80-8D-09	0+00.00	250.3108

Control Point Table - D & C Manager Method

From the **Survey** toolbar select **Plans Preparation → D and C Manager**.

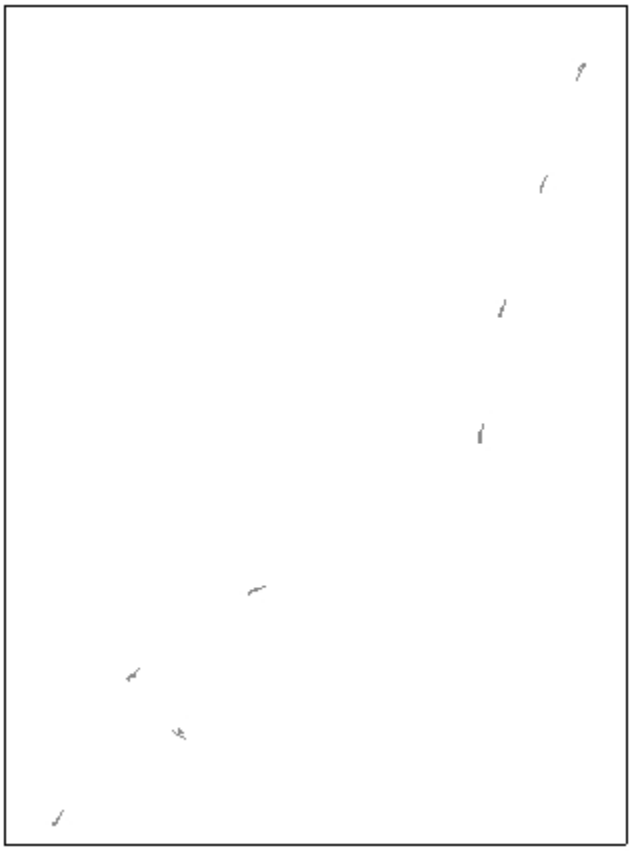


Utilize the **Level Display** to turn off everything except the control point level.

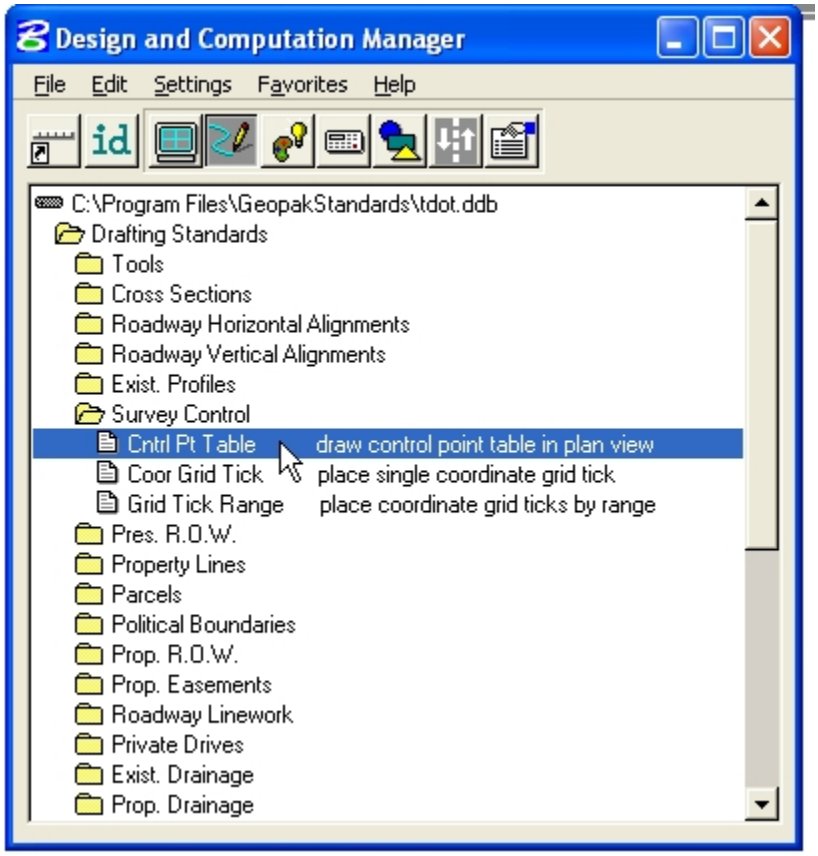


Once all the levels are turned off except for the control points, the result should resemble the following screen capture.

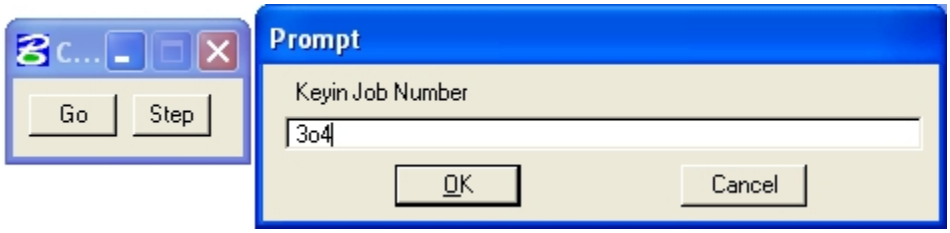
Select all of the control points.



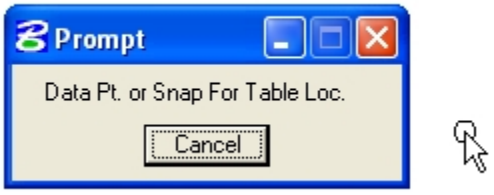
From the **D&C Manager**, Select **Cntrl Pt Table** to draw the control point table in the plan view.



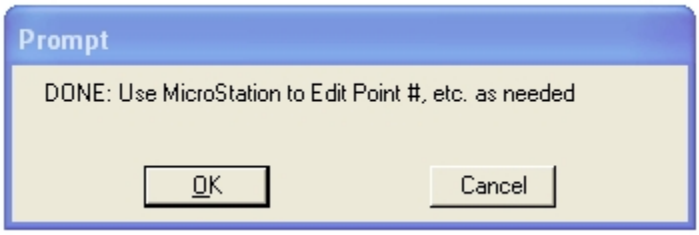
The user will be prompted to keyin job number and chain name. Keyin the job number and chain name shown below.



The following dialog will appear. Click a data point in the DGN to place the control point table.



Select **OK** once the control point table is placed.



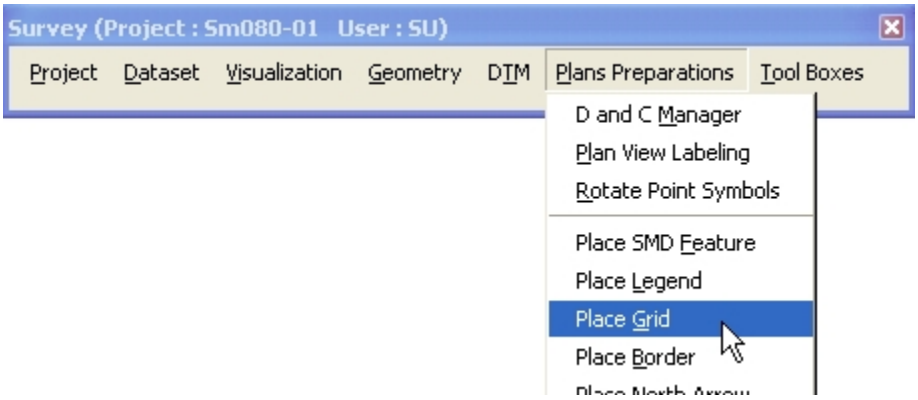
The user will have to manually number the control points using the MicroStation® text editor.

CONTROL POINTS

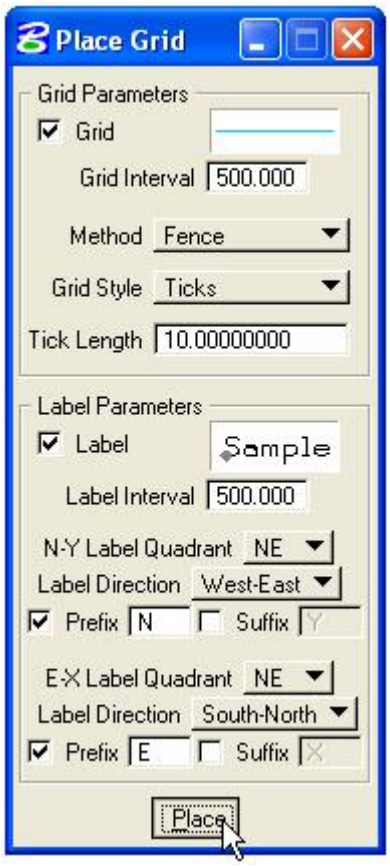
POINT	NORTH	EAST	ELEV.	STATION	OFFSET
S____	734560.9770	1979252.3520	513.78	106+42.64	25.56' (LT)
S____	734882.2572	1979702.4651	511.11	111+86.74	38.96' (LT)
S____	735471.9821	1980596.1995	512.61	123+27.56	21.34' (RT)
S____	735958.7532	1980677.0711	510.71	128+22.89	21.18' (RT)
S____	734340.2961	1979430.4115	517.76	105+67.28	250.31' (RT)
S____	736444.4080	1980834.5176	513.41	133+37.09	23.12' (RT)

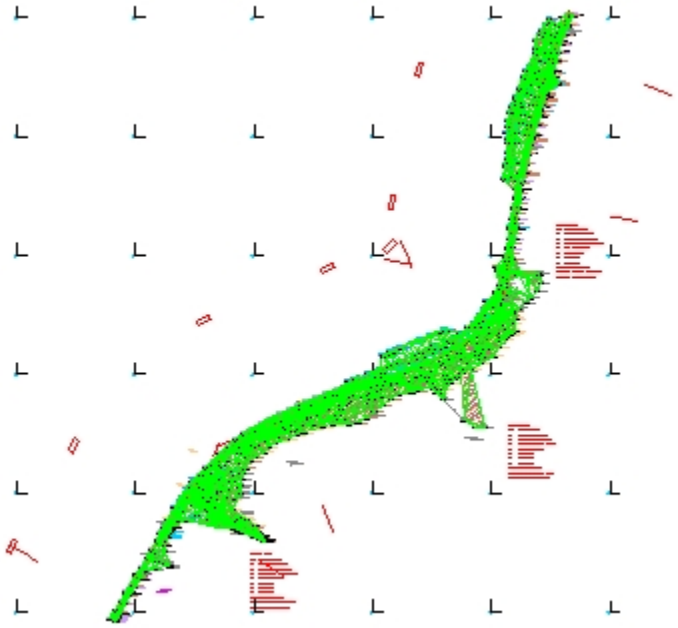
Coordinate Grid Ticks

From the **Survey** toolbar select **Plans Preparation → Place Grid**



The following dialog will appear. Place a fence around the project area. Complete the dialog as shown below and select **Place**.





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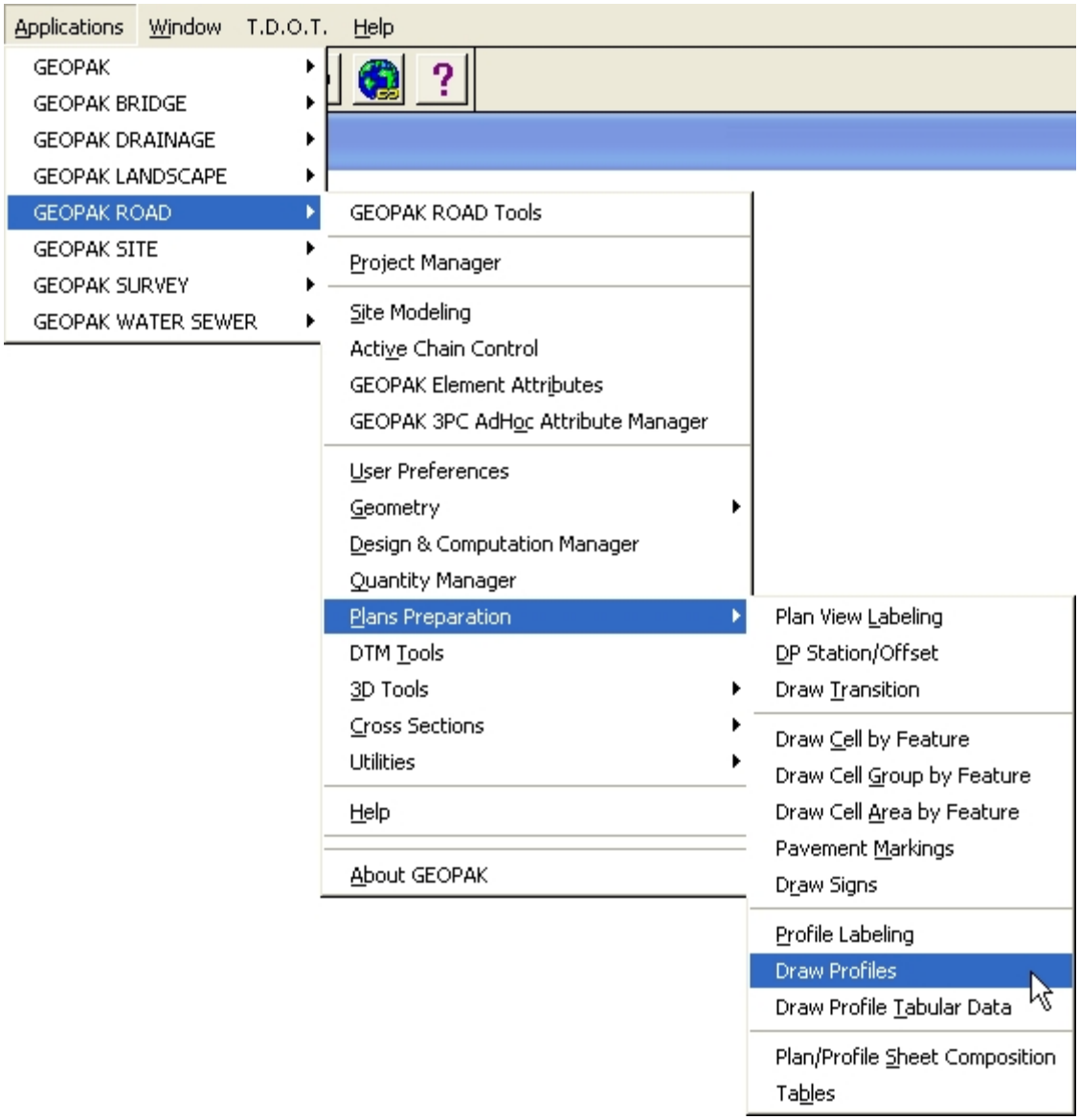
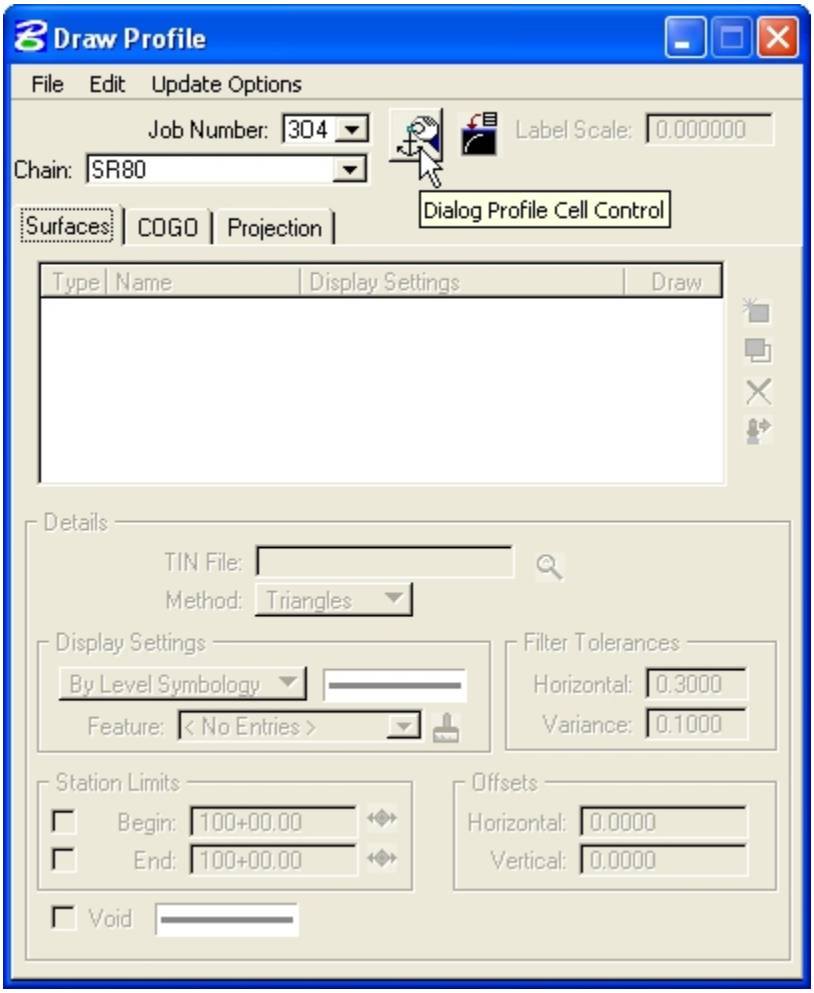
CHAPTER 12 - PROFILE DEVELOPMENT

12.1 DRAWING AND STORING PROFILES

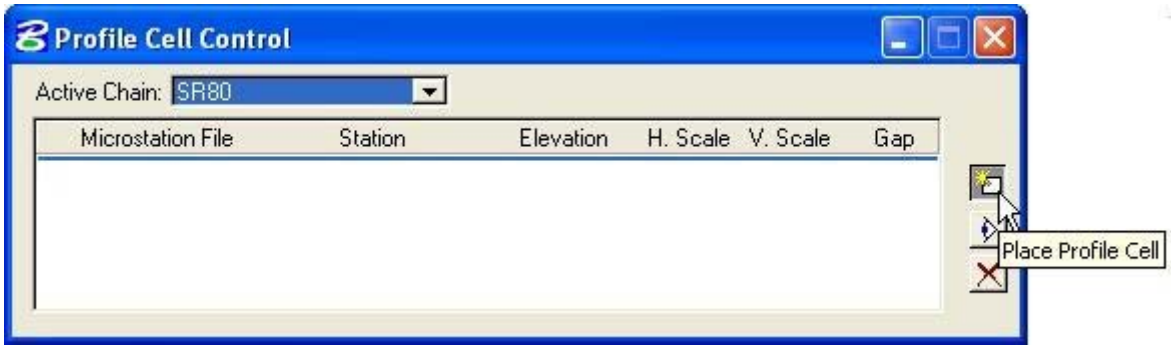
From the **Applications** menu, select **GEOPAK® ROAD → Plans Preparation → Draw Profiles.**



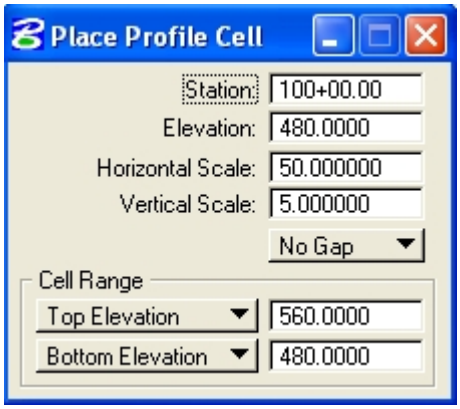
Select the **Job Number** and **Chain**, and then select the **Dialog Profile Cell Control** button from the **Draw Profile** dialog.



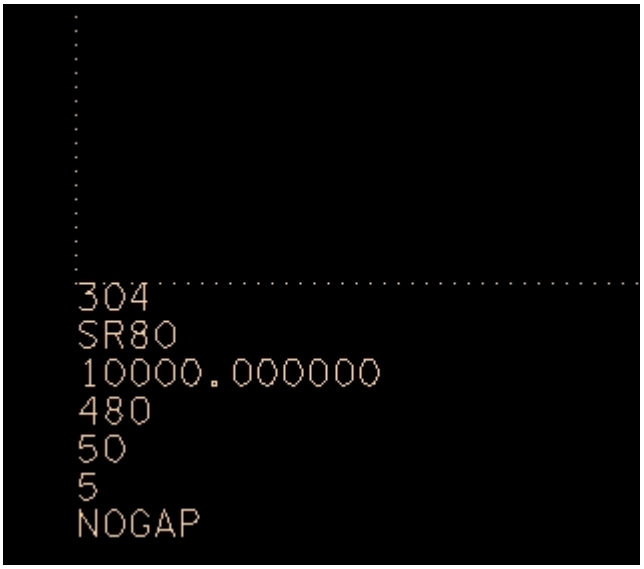
Select the Active Chain, and then select the **Place Profile Cell** button as shown in the dialog below.



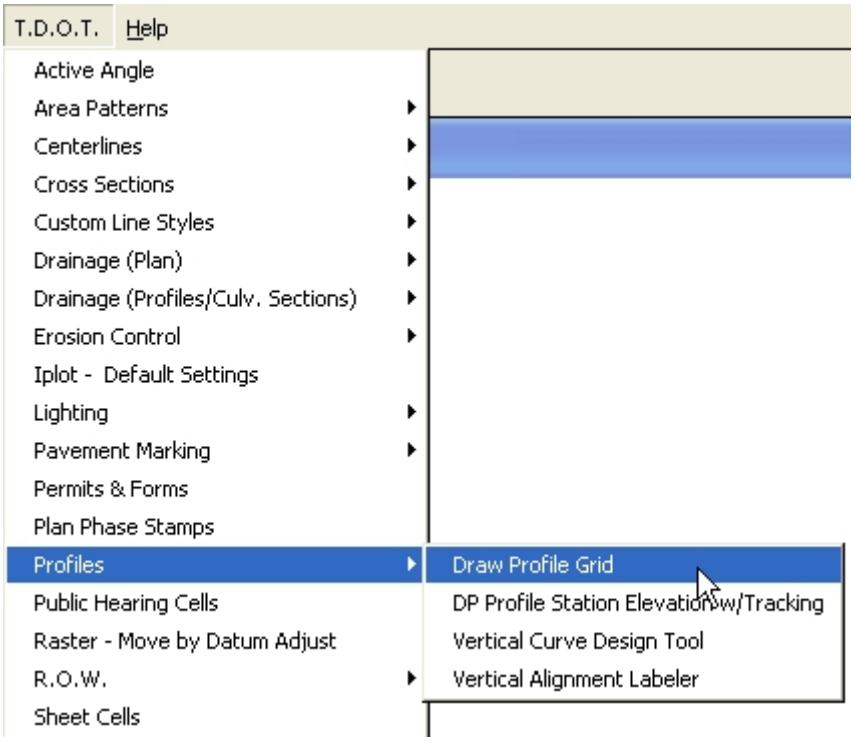
Complete the **Place Profile Cell** dialog as shown below. The Station field populates automatically. Select an Elevation less than the lowest element on the profile. The Top Elevation represents the upper limit in the profile cell. The Bottom Elevation represents the lower limit in the profile cell.



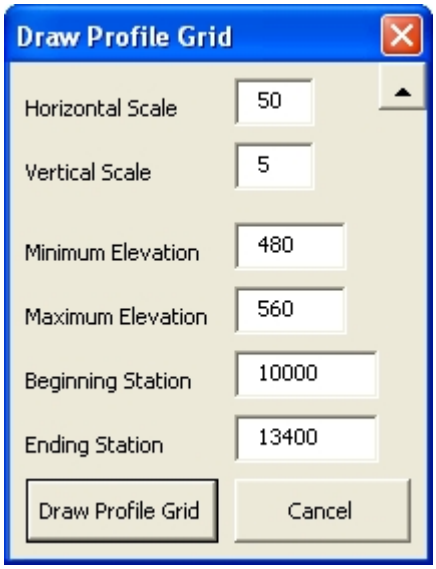
Click a data point outside the area of the survey to place the profile cell in the drawing.



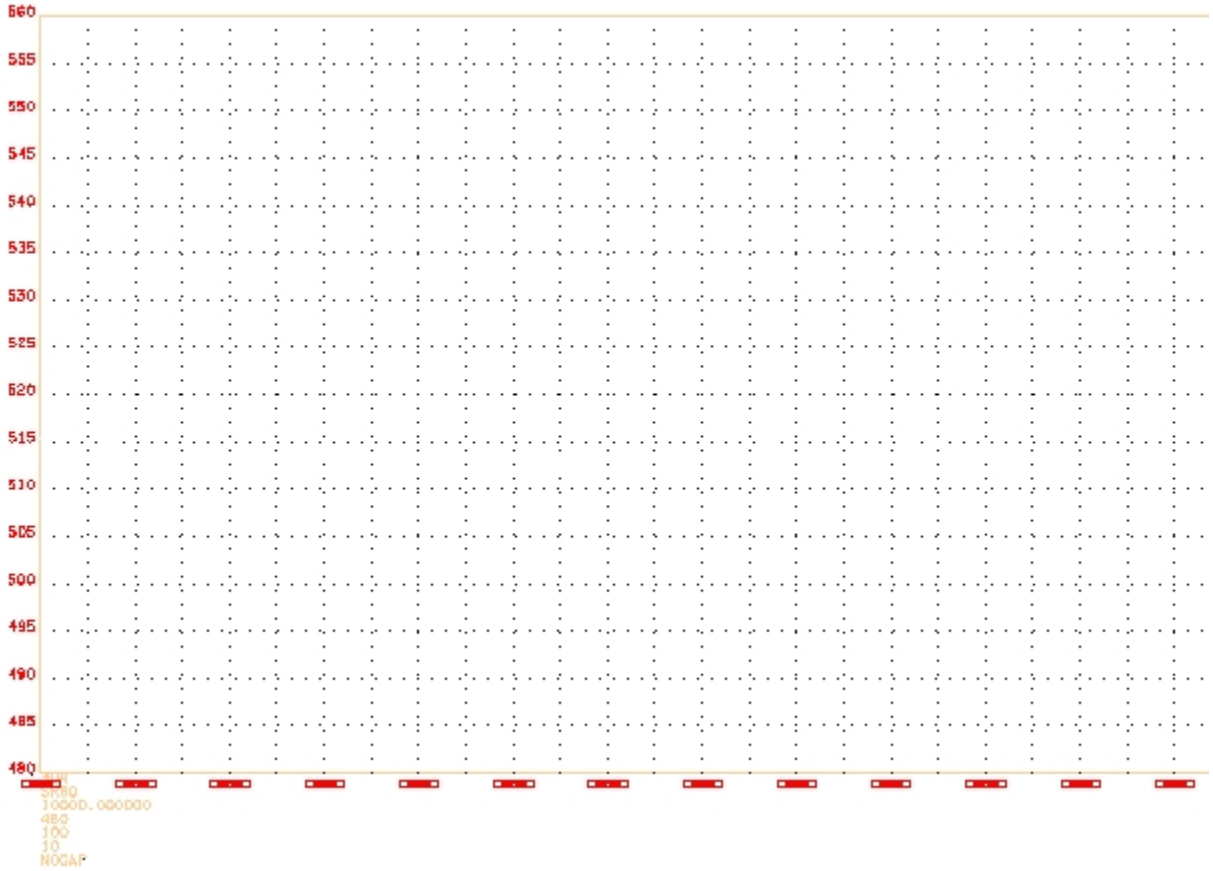
Once the profile cell is placed the profile grid can then be placed. From T.D.O.T select **Profiles → Draw Profile Grid.**



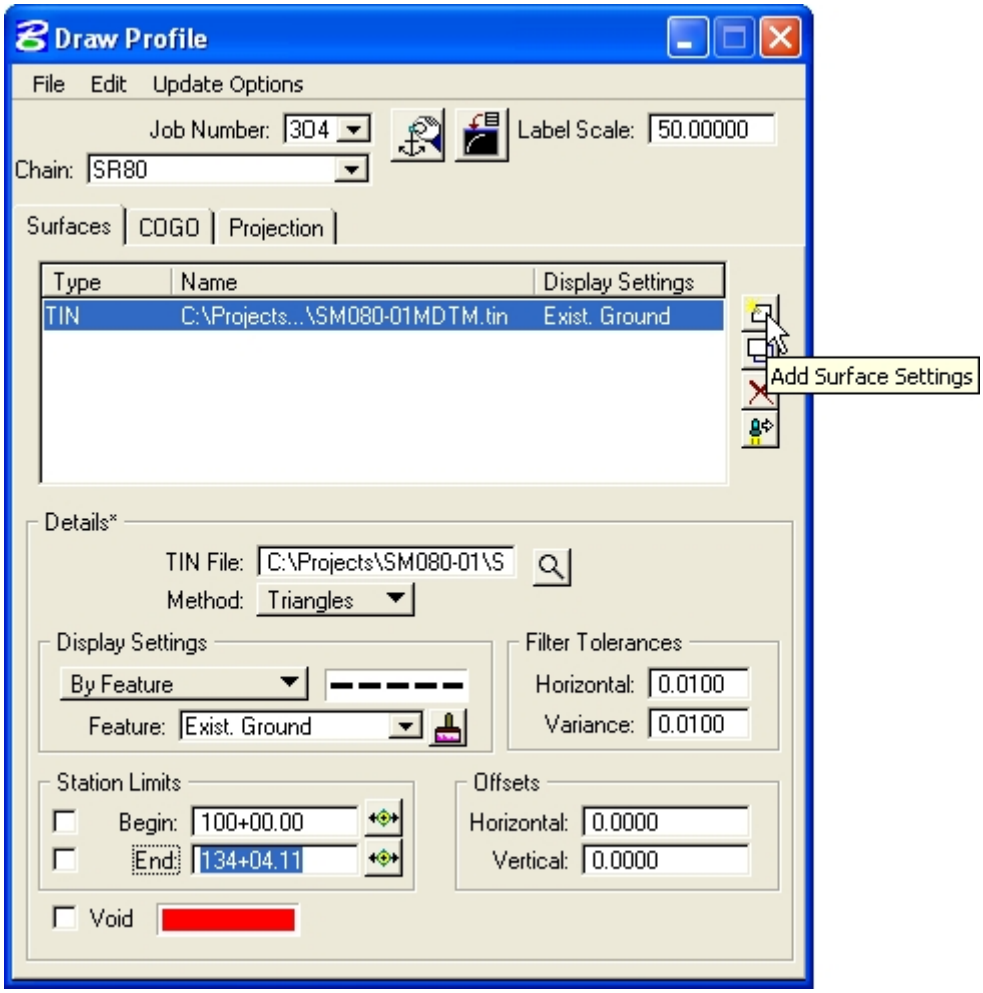
The **Draw Profile Grid** dialog will appear. Complete the dialog as shown. Then select **Draw Profile Grid**.



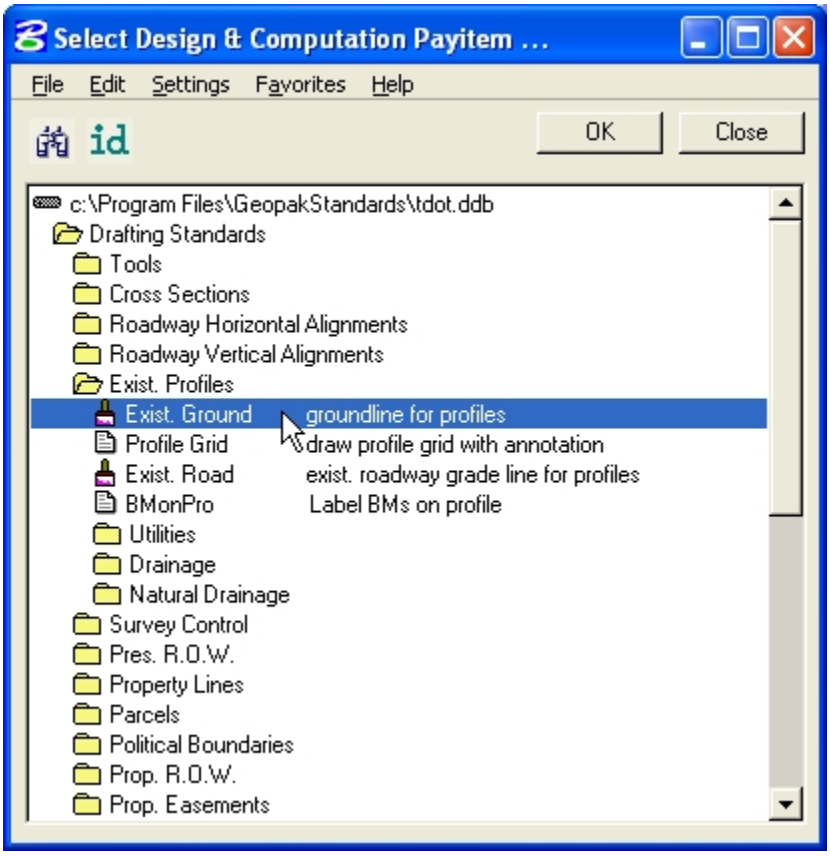
Place the profile grid in the drawing on the appropriate cell. Snap to the origin of the cell.



The **Surfaces** tab defines the surfaces utilized as source data when drawing profiles. Multiple surfaces from a variety of sources can be drawn on a profile in a single dialog. Each surface to be drawn must be added to the list box. This is accomplished via the **Action / Edit buttons** on the right side of the dialog. When a row is added to the list box, the profile is drawn immediately. Use the merged tin file, `SM080-01.tin`, to populate the **TIN File:** dialog. Select the proper feature by pressing the paintbrush icon as shown in the dialog below.

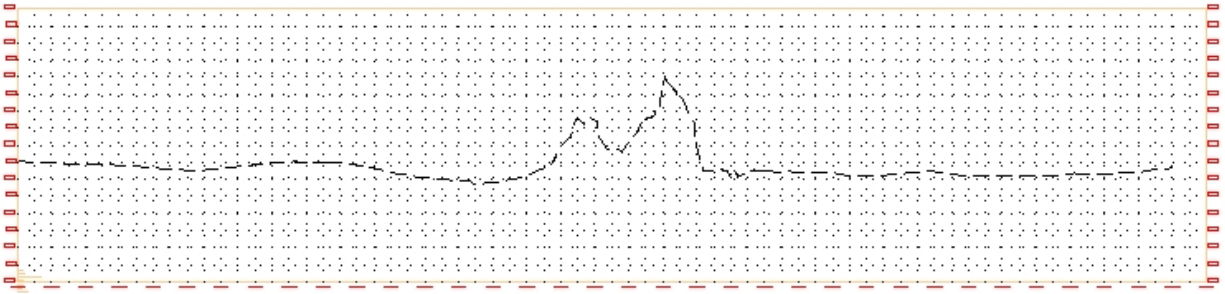


Select the **Exist. Ground** feature as shown below.

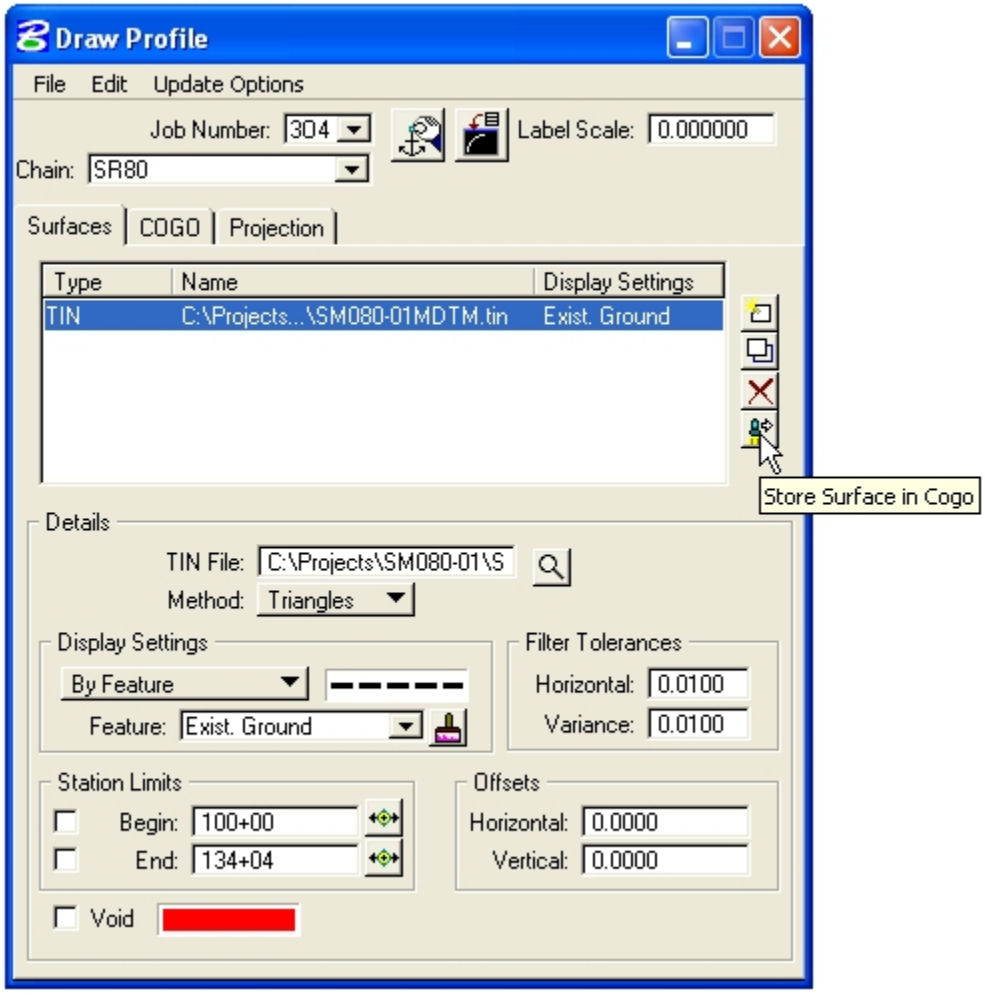


Populate the **Draw Profile** dialog as shown on the previous page. Once the desired settings are selected in the bottom of the dialog, press the **Add Surface Settings** button to draw the profile in the active cell.

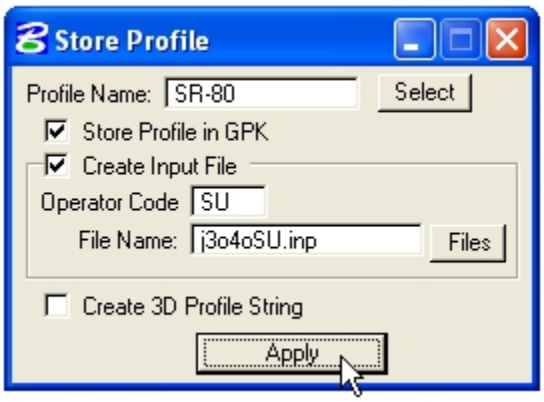
The dialog below shows the existing ground displayed on the profile grid.



The profile can now be stored in COGO. Select the **Store Surface in COGO** button from the **Draw Profile** dialog.

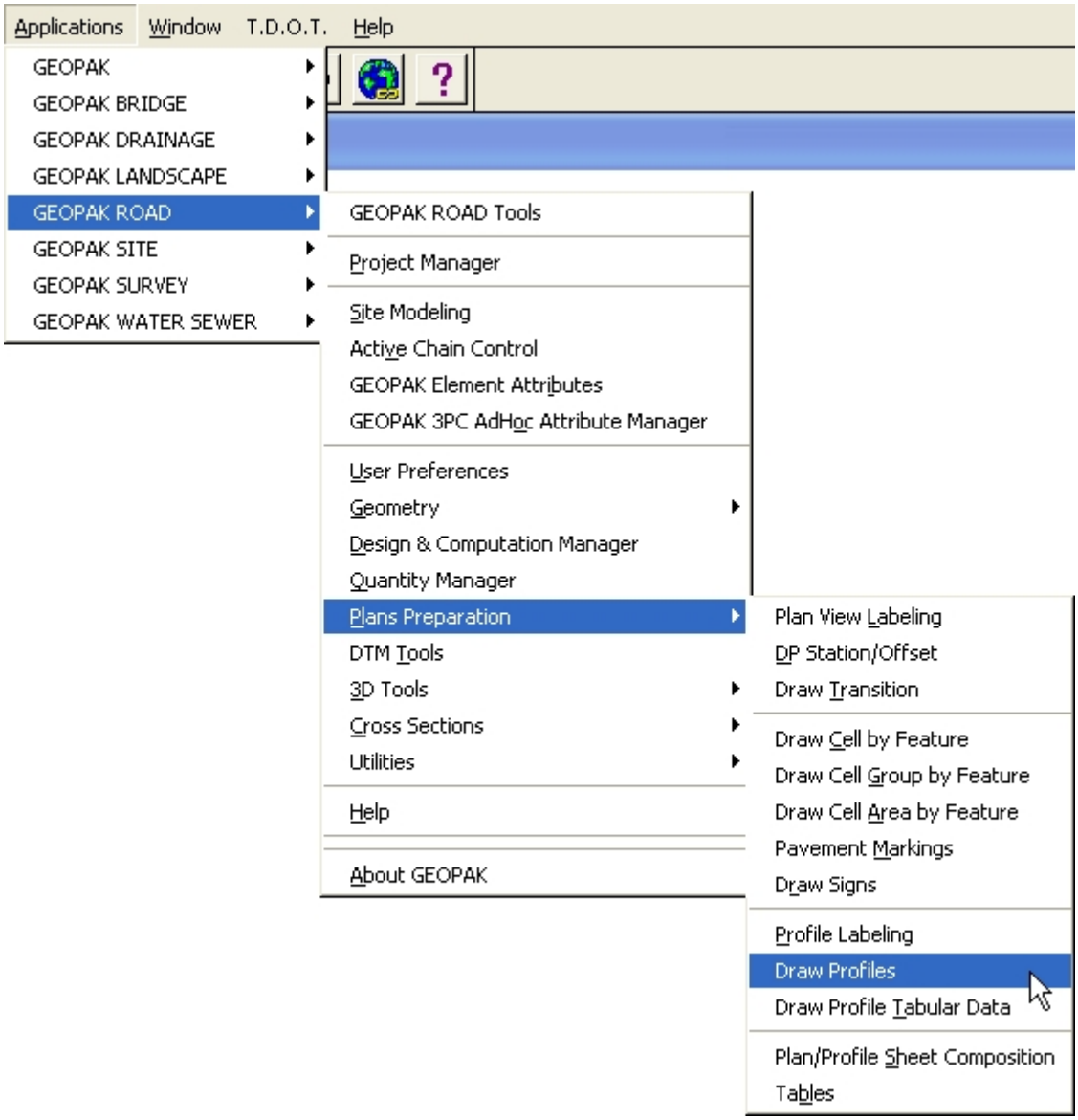


Complete the dialog as shown below to store the profile.

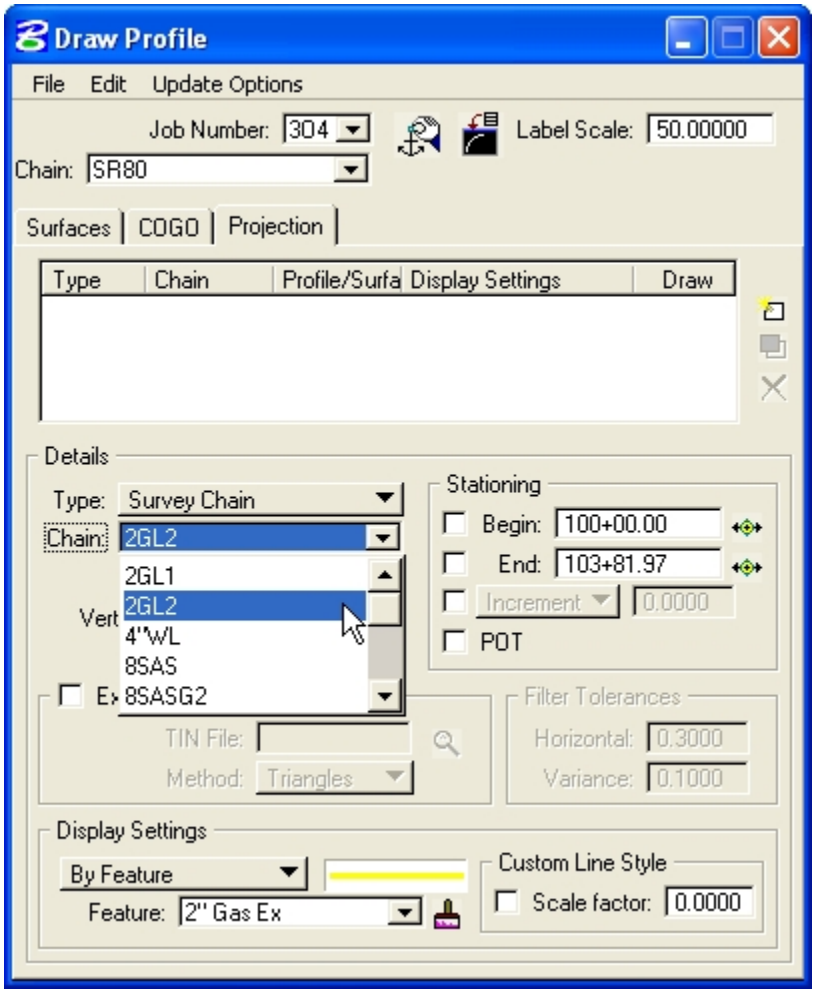


12.2 PROJECT UNDERGROUND UTILITIES USING DRAW PROFILE TOOL

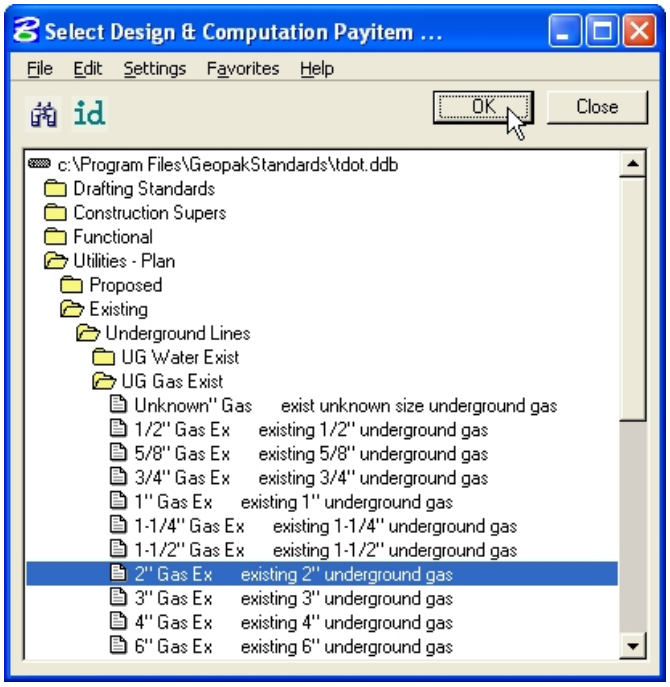
From the **Applications** menu, select **GEOPAK® ROAD → Plans Preparation → Draw Profiles.**



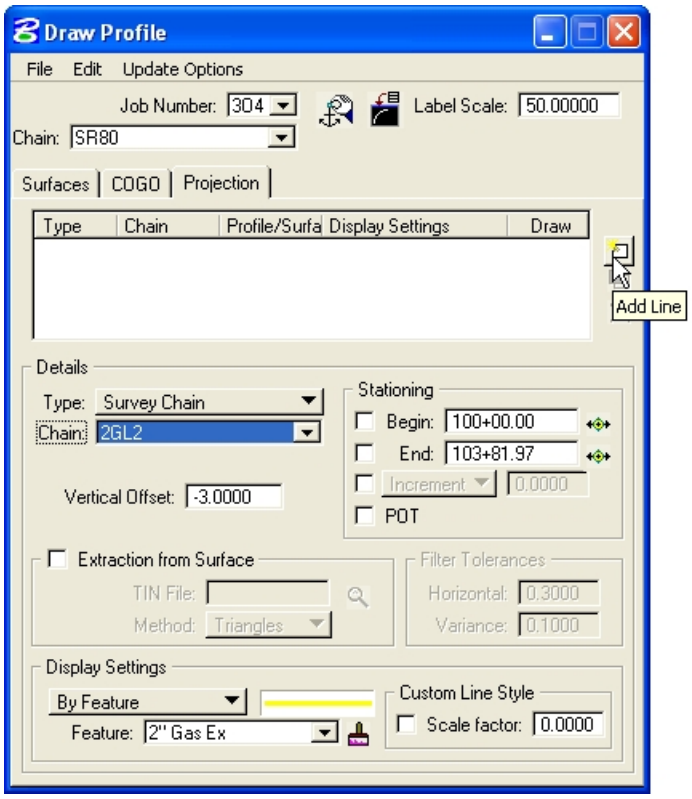
In the **Projections** tab, choose the Job Number, Chain, Label Scale, and specific survey chain as shown below.



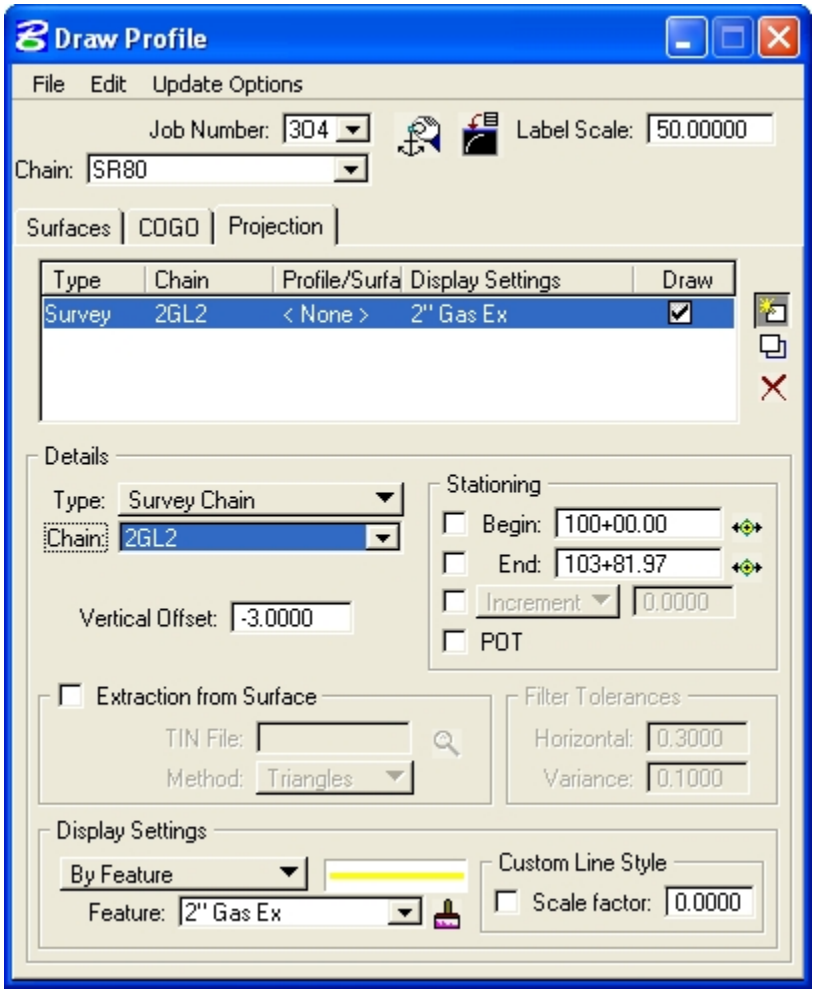
To draw the gas line on the appropriate level, select the paintbrush icon in the **Display Settings** area of the dialog. Select the feature from the **D & C Manager**.



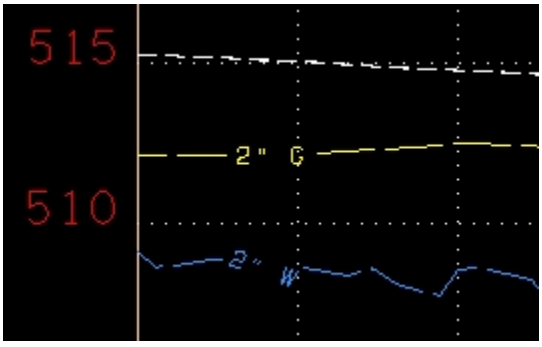
The user can now select **Add Line** to add the survey chain to the profile.



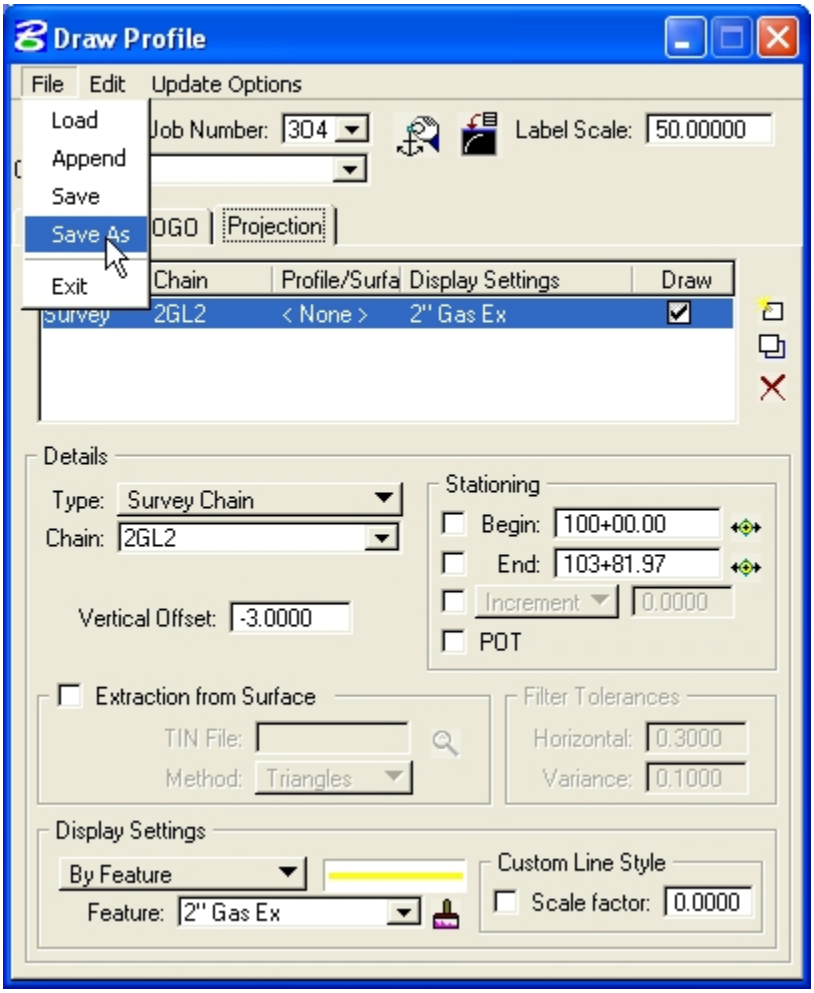
Once the **Add Line** button is selected the survey chain will be added to the **Projection** dialog. Multiple survey chains can be added to the **Projection** dialog. Repeat the process for the other gas line and water line on the project.

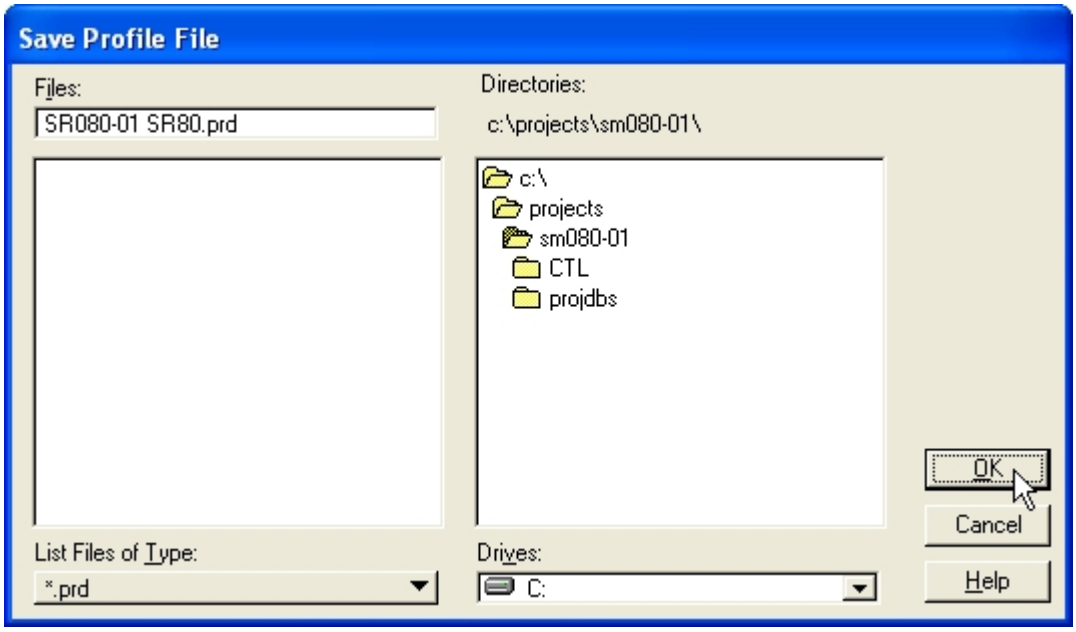


The survey chain will be drawn into the profile cell as shown in the screen capture below.



Save the profile settings to the project file. **File → Save As.**

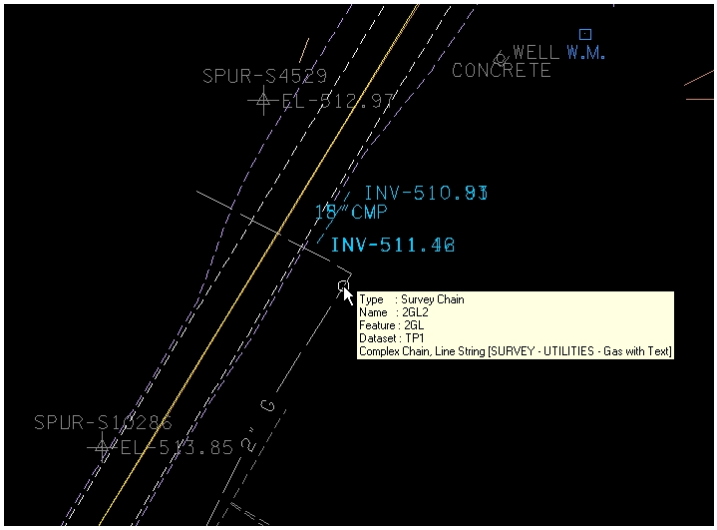


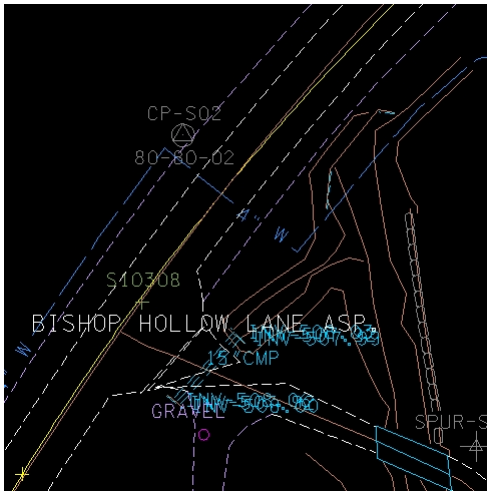


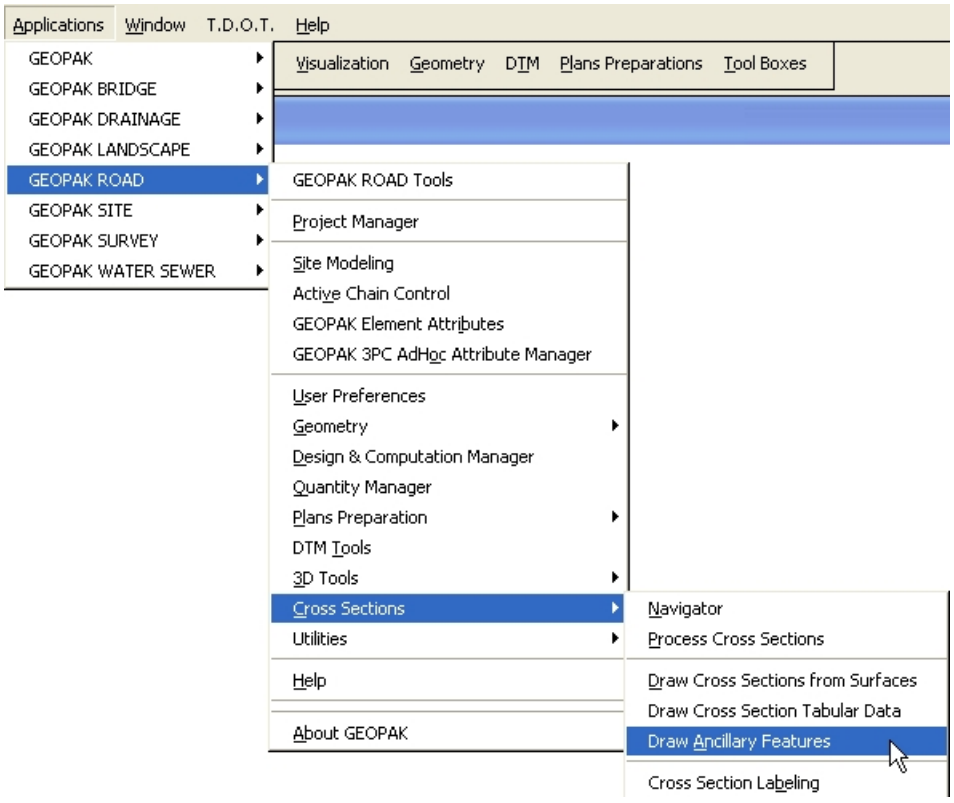
12.3 UTILITY CROSSINGS

To place or draw points at which utilities cross a centerline, select **Applications → GEOPAK® ROAD → Cross Sections → Draw Ancillary Features**.

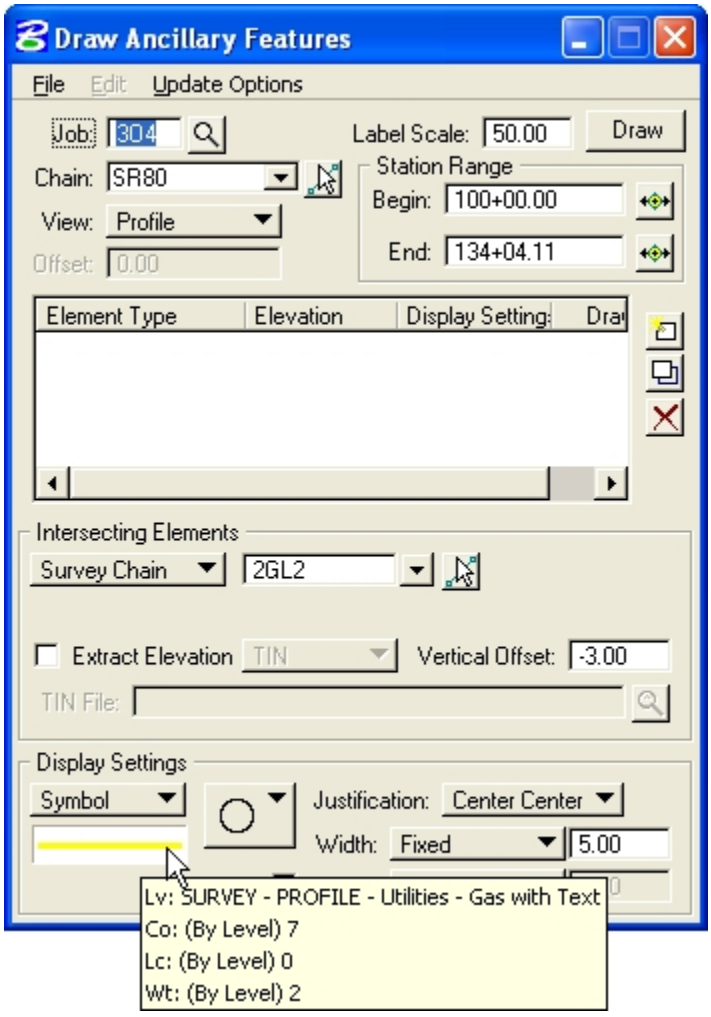
Note: There are two utility crossings on this project: one gas line and one water line. Locate the crossings on the survey and determine the name of the survey chain for each. The gas line is 2GL2, and the water line is 4”WL.



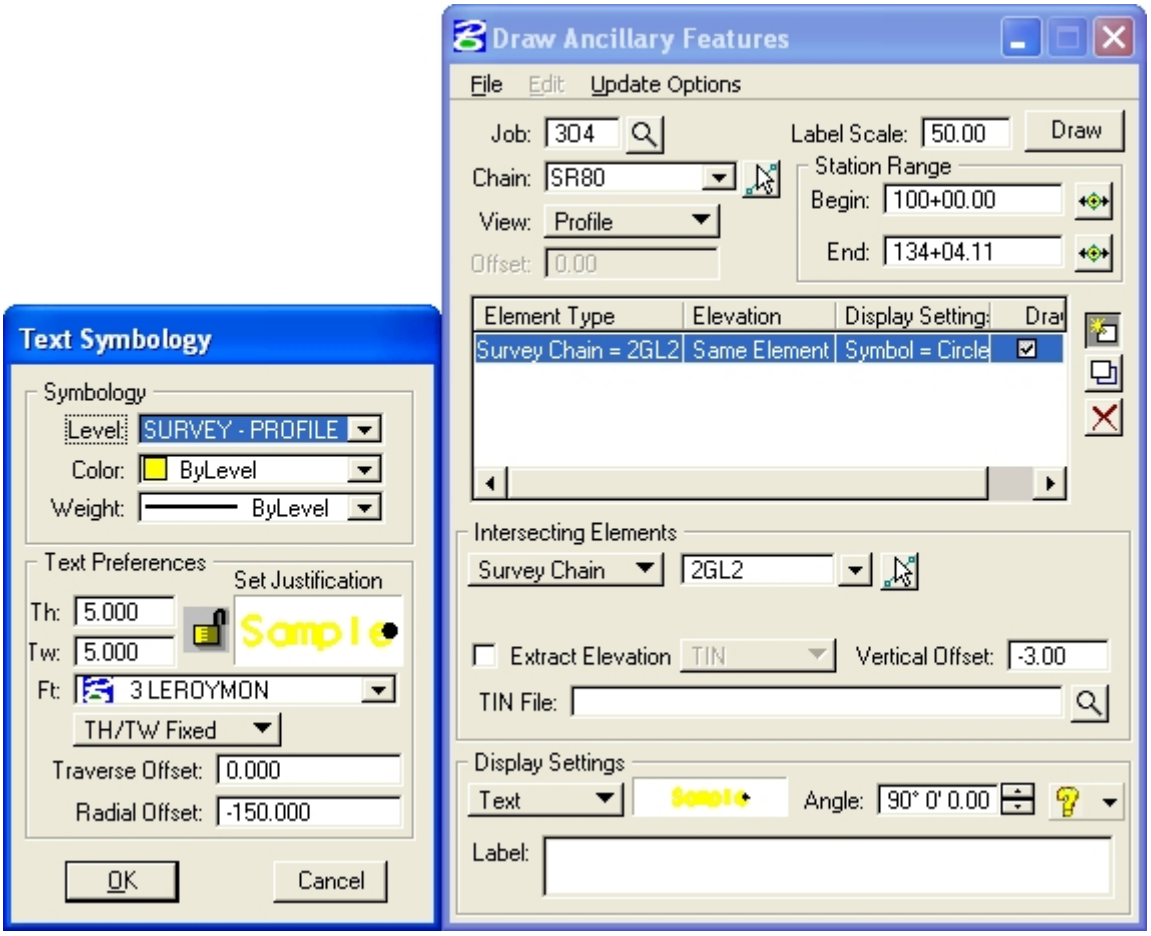




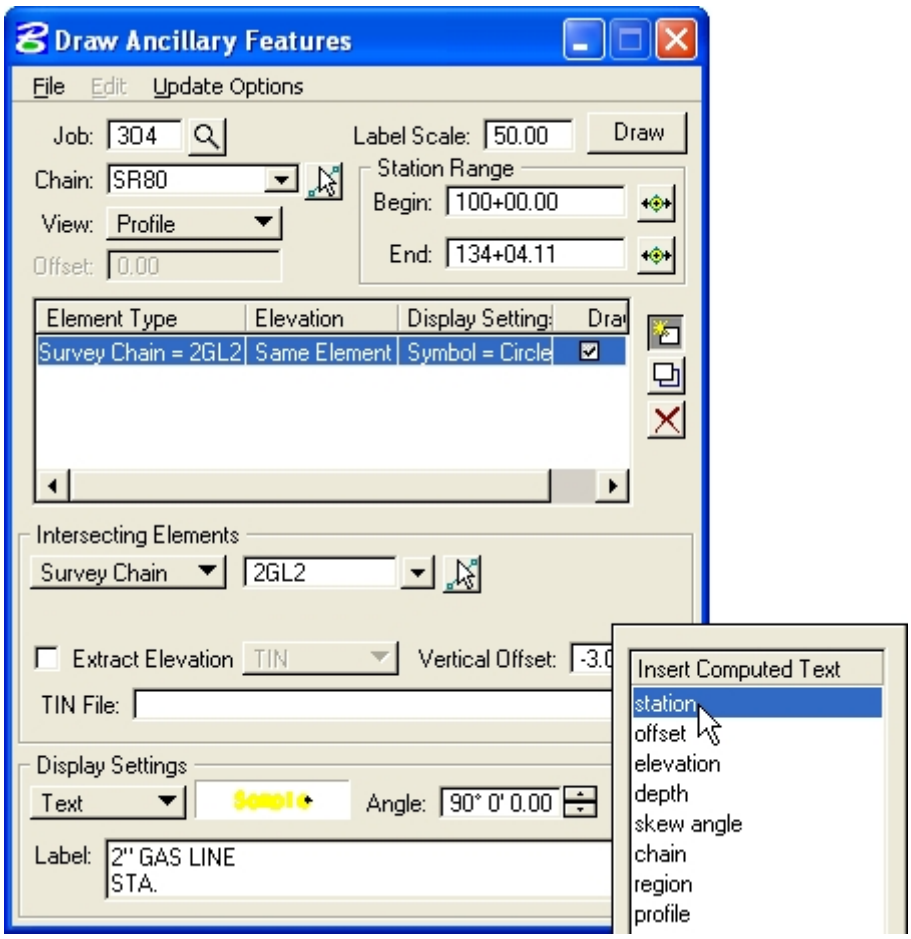
The settings typically used for a gas line are shown in the dialog below. Complete the dialog as shown. Double-click the symbology bar and set the appropriate level, color, linestyle, and weight. Once the dialog is complete, the user can select the **Add Element Set** button to add the settings for the symbol.



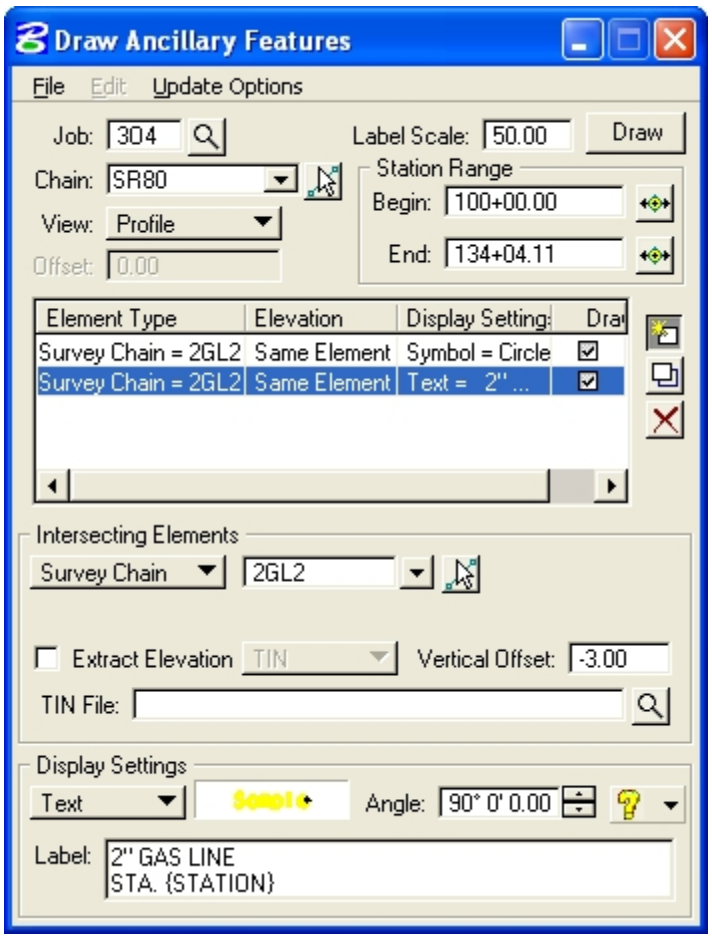
The user can now complete the settings for the text. Double-click the symbology box to change the text symbology to match the settings shown in the dialog below.



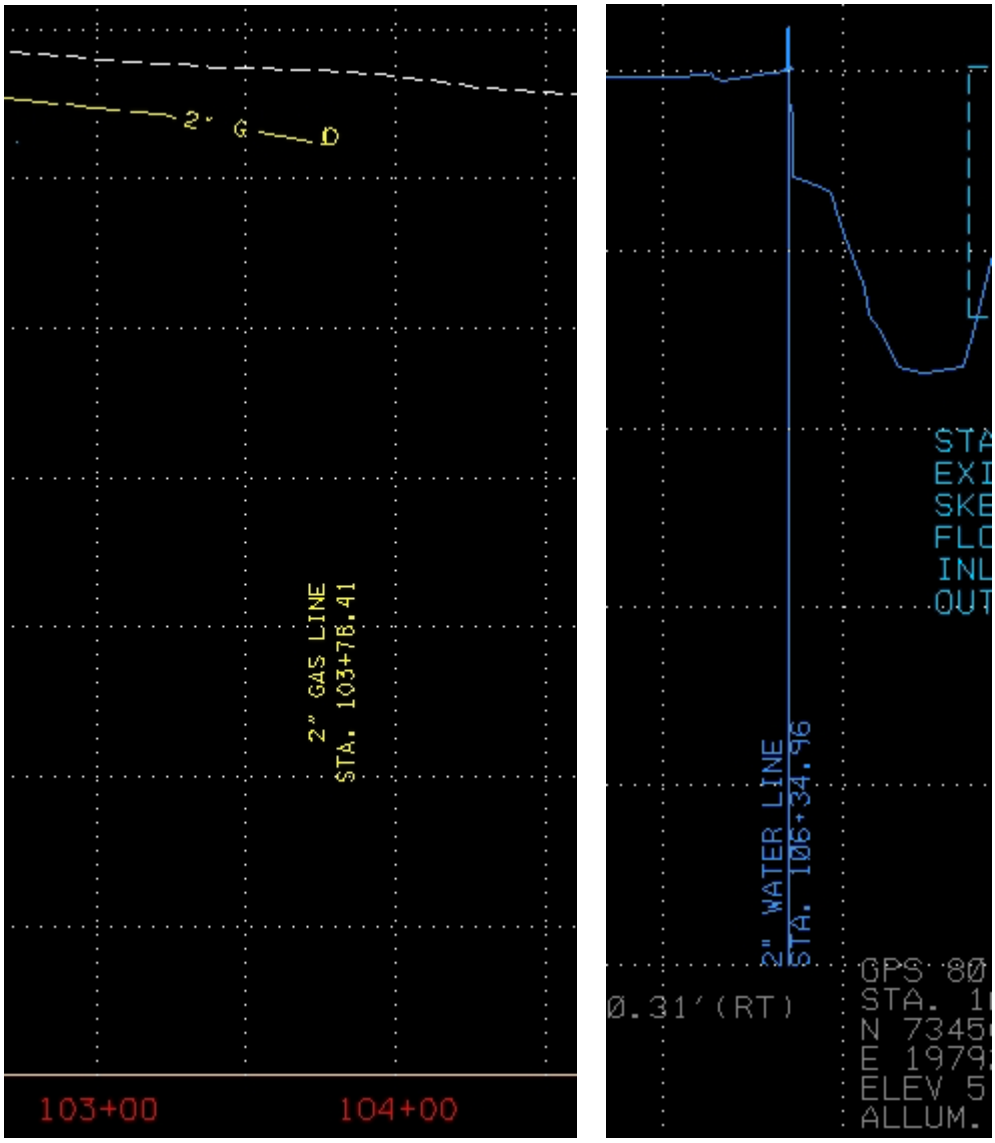
For this class, the user will place the station of the centerline at the point of the utility crossing. Manually type “2” GAS LINE” and “STA.” in the Label: box. Select **station** from the Insert Computed Text box. The Angle is set to 90°.



Once the dialog is complete, the user can select the **Add Element Set** button as shown in the dialog below to add the settings for the text. The completed dialog is shown below. Select the **Draw** button to draw the symbol and text onto the profile.

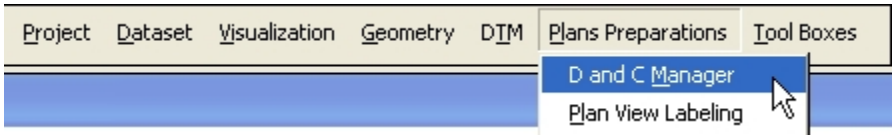


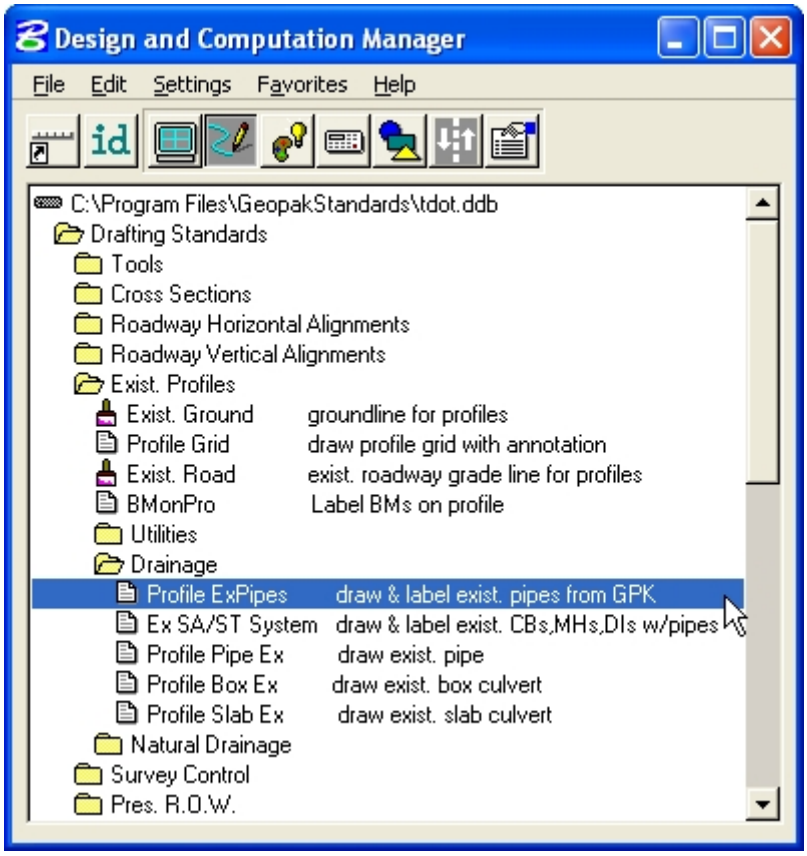
The screen capture below shows the placement of the symbol and the text. A vertical line may be placed from the crossing symbol down through the text if desired. Repeat the entire process for the water line, changing the symbology and labeling accordingly. The completed water line label is shown below.



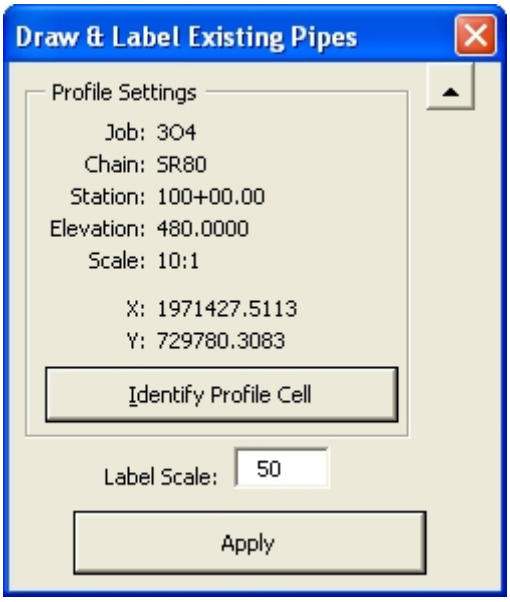
12.4 DRAINAGE CROSSINGS

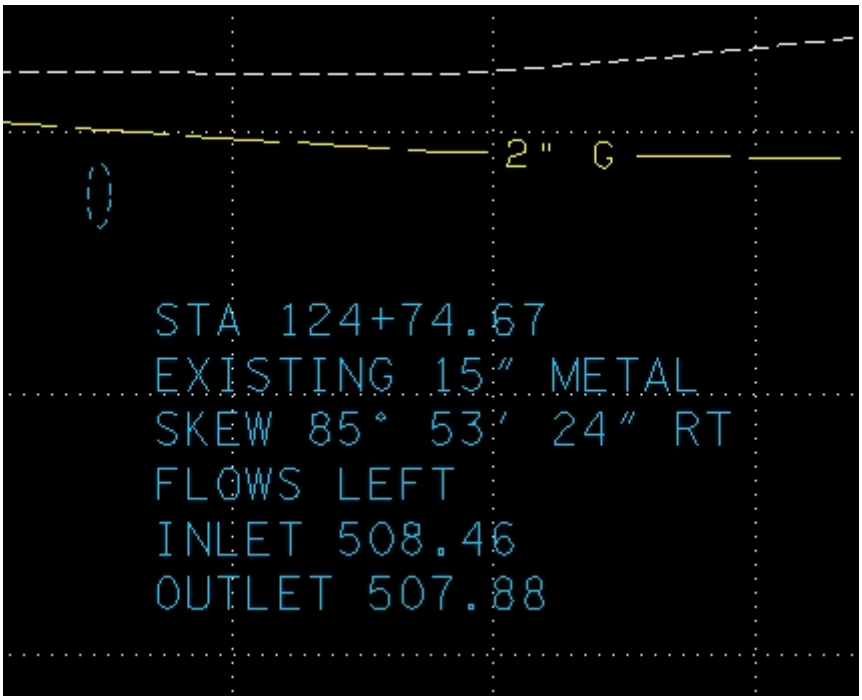
To place pipes on the profile, the **Design and Computation Manager** will be used. TDOT has developed a routine to perform this task. Manual editing of the pipe descriptions might be necessary after the routine is complete to note a unique shape, pipe material, or the condition of the pipe. Select **Plans Preparations → D&C Manager.** Then select the **Profile ExPipes** command.





The following dialog will appear. Select **Identify Profile Cell** and select the profile cell. Edit the pipe information at Station 124+74.67 to reflect the screen capture shown below.

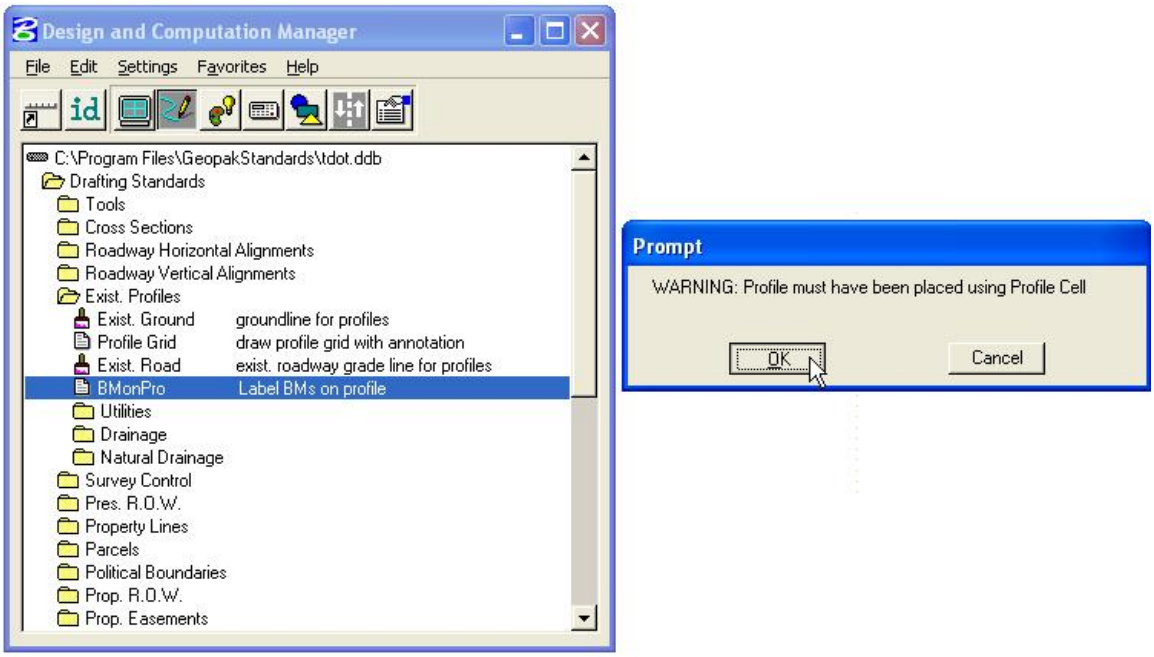




12.5 BENCHMARK & CONTROL POINTS

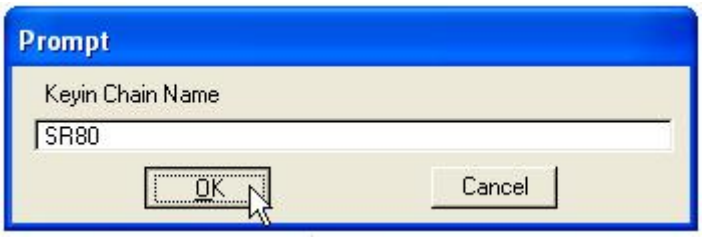
To draw Benchmarks and Control Points in the profile, select the **BMonPro** option from the **D & C Manager** shown below. This routine requires that the Profile must have been placed using Profile Cell as discussed in Section 12.1.

Note: All desired Benchmarks and Control Points that are to be drawn need to be selected in the plan view, using the selection set tool in MicroStation®.



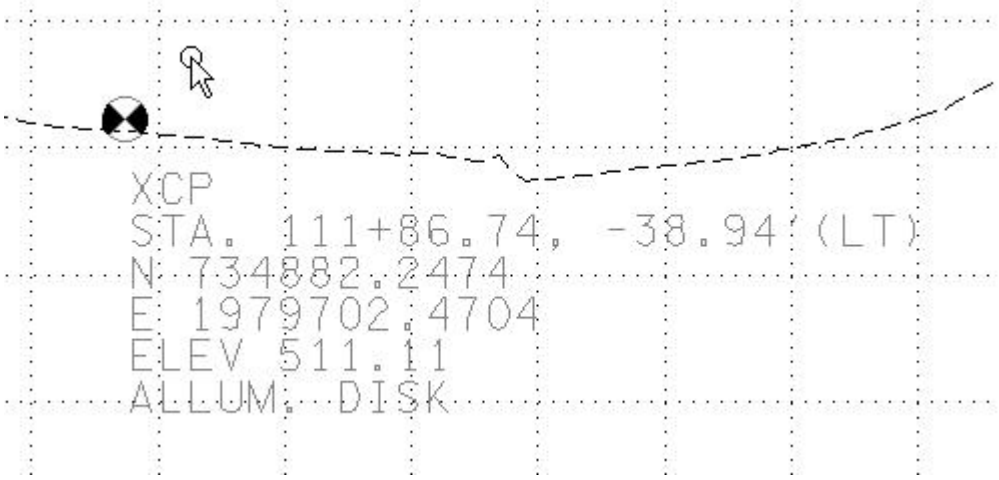
The user will be prompted to **Keyin Job Number**.

The user will be prompted to **Keyin Chain Name**. This is used to compute the Station and Offset relative to the selected Chain or alignment.



A log file (`bmonpro.log`) is created in the project directory which should be reviewed for possible errors.

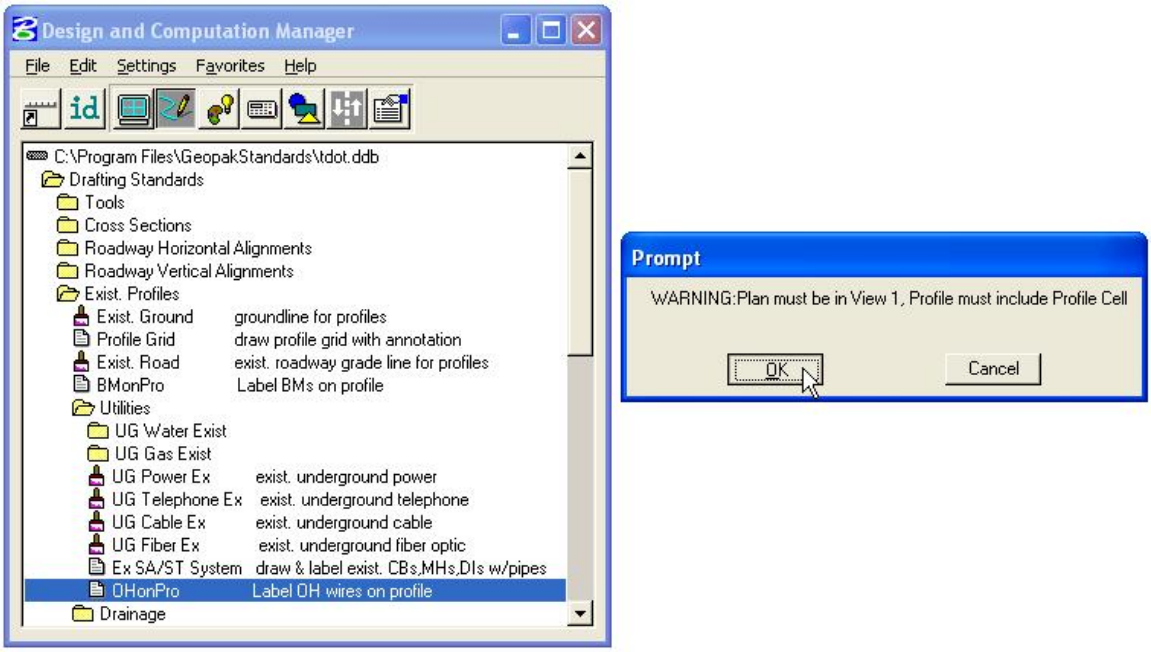
The information shown below is drawn in the selected profile. Some information such as the Control Point Number and Description will need to be manually edited.



12.6 OVERHEAD UTILITY CROSSINGS

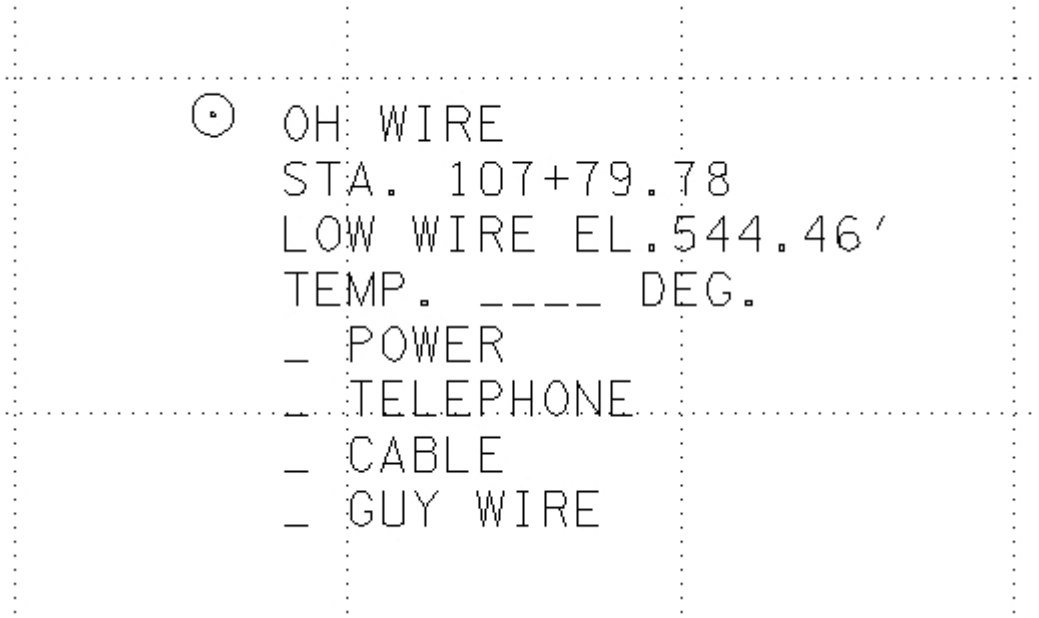
To draw Overhead Utility Crossings in the profile, select the option from the **D & C Manager** shown below. This routine requires that the Profile must have been placed using Profile Cell as discussed in Section 12.1. The routine also has a maximum distance of 5 feet from the selected Chain or alignment for it to be recognized. The user may need to move the position of the XLW point, using the GEOPAK® Point Editor, to position it closer to the selected Chain (Note: If the point is moved be sure not to edit the elevation of the point.)

Note: Ensure all levels are visible prior to selecting. All elements can be selected at one time. All desired Crossings that are to be drawn need to be selected in the plan view, using the selection set tool in MicroStation®. The low wire crossings need to be properly coded (XLW) and be at the proper elevation for the information to be correct.



The user may be prompted for job number and chain name.

The information shown below is drawn in the selected profile. Some information such as the Temperature (on the day the field work was done) and the number and types of wires crossing the Chain will need to be manually edited.



12.7 STREAM PROFILES

In this section, the section of stream alignment created in Chapter 10 will be used to create a profile showing the top of bank, top of water, and streambed. A process similar to Section 12.1 will be used to draw the profile cell and grid. Then, the top of bank, top of water, and streambed lines will be projected onto this profile.

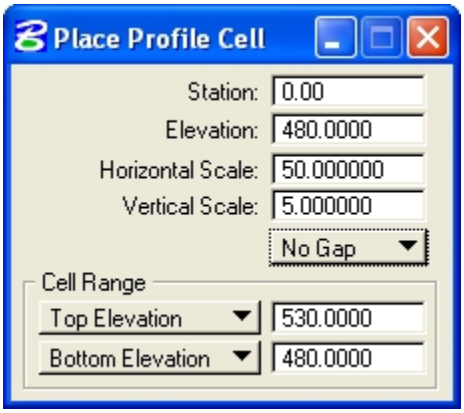
From the Applications menu, select **GEOPAK® ROAD → Plans Preparation → Draw Profiles**.

Select the **Job Number** and **Chain**, and then select the **Dialog Profile Cell Control** button from the **Draw Profile** dialog.

- Job Number: 3o4
- Chain: CLCRK

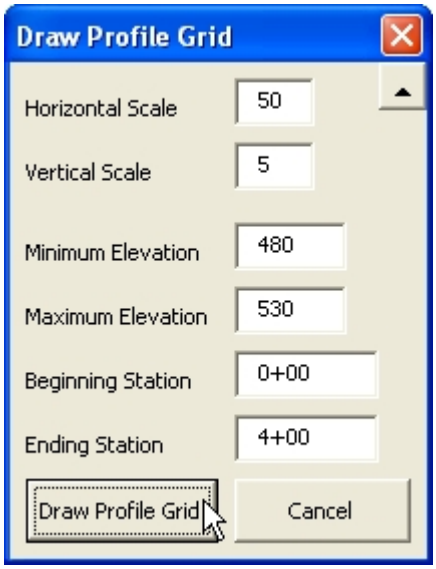
Select the Active Chain, and then select the **Place Profile Cell**.

Complete the **Place Profile Cell** dialog as shown below.



Click a data point outside the area of the survey to place the profile cell in the drawing.

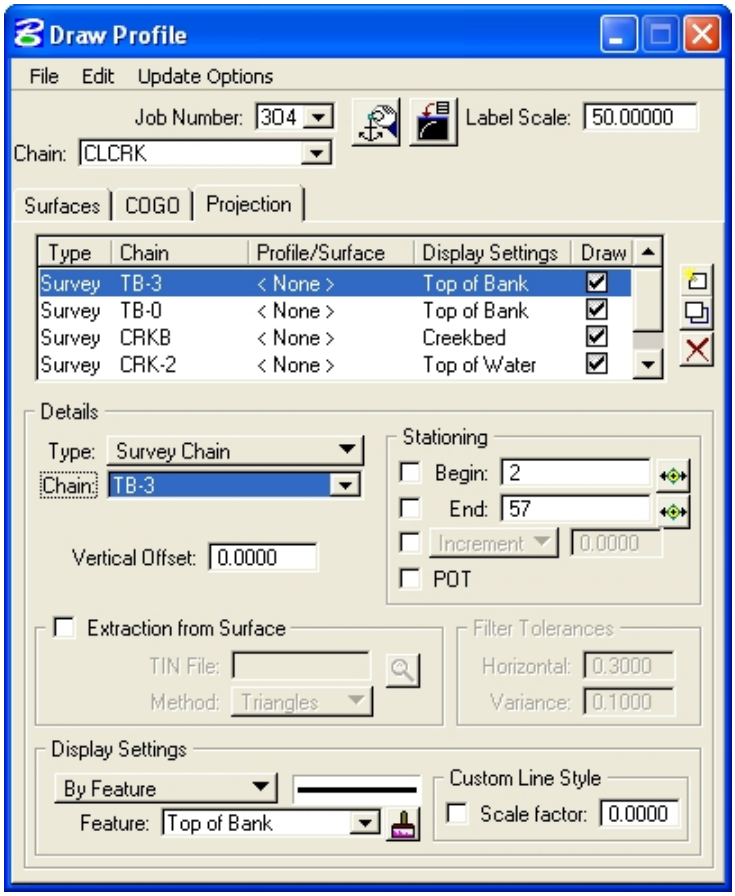
Once the profile cell is placed the profile grid can then be placed. From the **T.D.O.T** menu, select **Profiles → Draw Profile Grid.** The **Draw Profile Grid** dialog will appear. Complete the dialog with the following settings. Then select **Draw Profile Grid**. Snap the profile grid to the origin of the CLCRK profile cell.

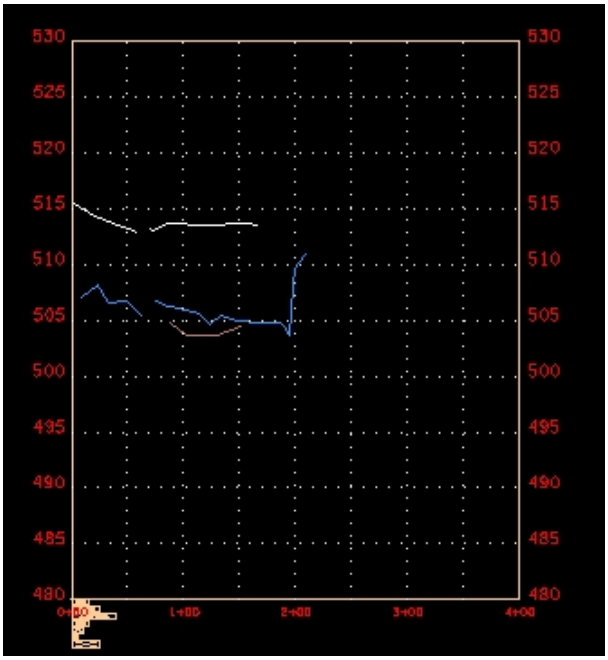


Return to the **Draw Profile** dialog and populate with the following survey chains set to the appropriate feature types in the **Drafting Standards → Exist. Profiles → Natural Drainage** category.

- Top of Bank: TB-0, TB-3
- Top of Water: CRK, CRK-2
- Creekbed: CRKB

The completed dialog box and the results are shown below.





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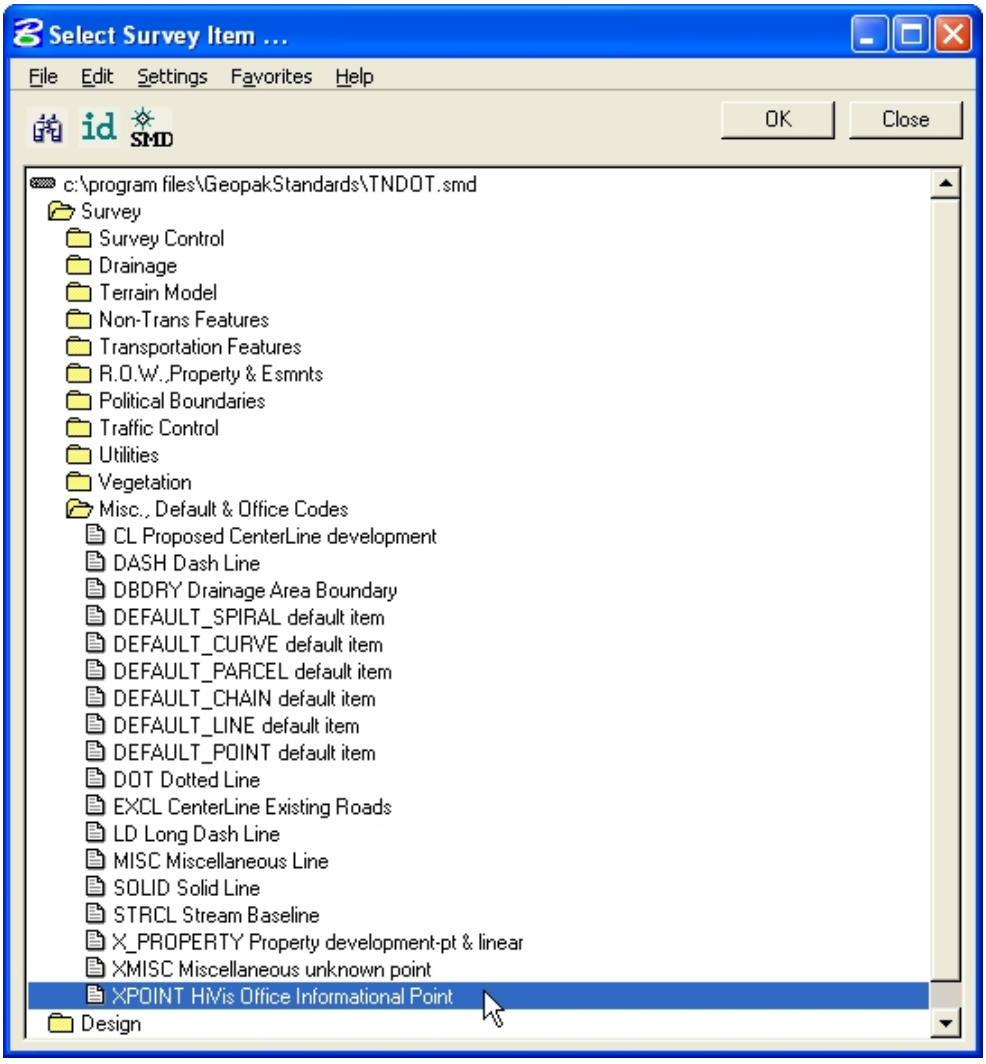
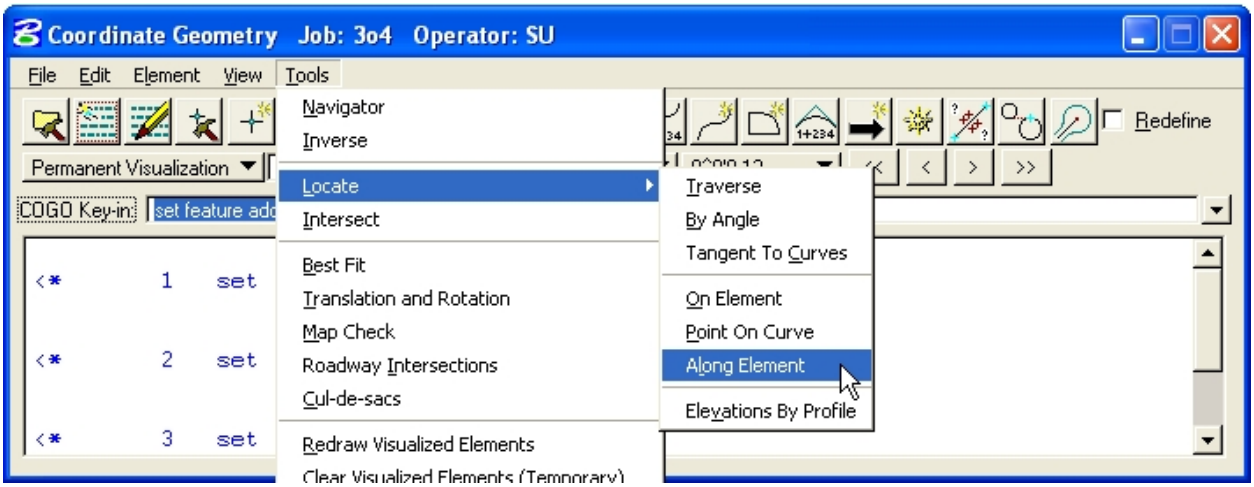
CHAPTER 13 - EXPORTING ALIGNMENTS FOR STAKING

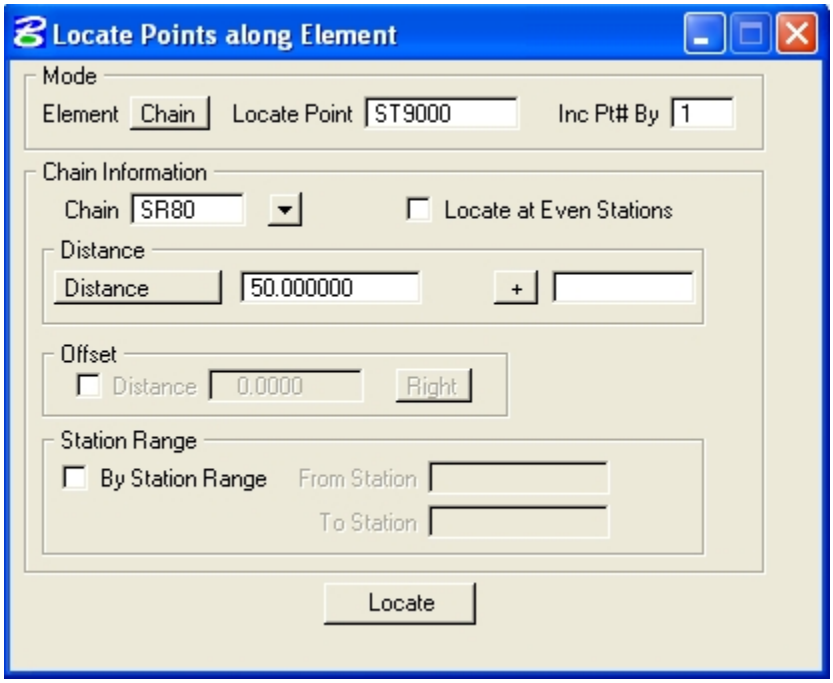
This chapter will describe how to create points at even 50' interval along the SR80 alignment and export them into a text file that can used for staking in the field. Note: This section does not cover how to import the points into the data collector. The procedure in this section can be used to export any points to an ASCII file for staking.

From the main COGO dialog, set feature to XPOINT by using the **Browse** command and navigating to **XPOINT HiVis Office Informational Point**, then select **Tools → Locate → Along Element** as shown below.

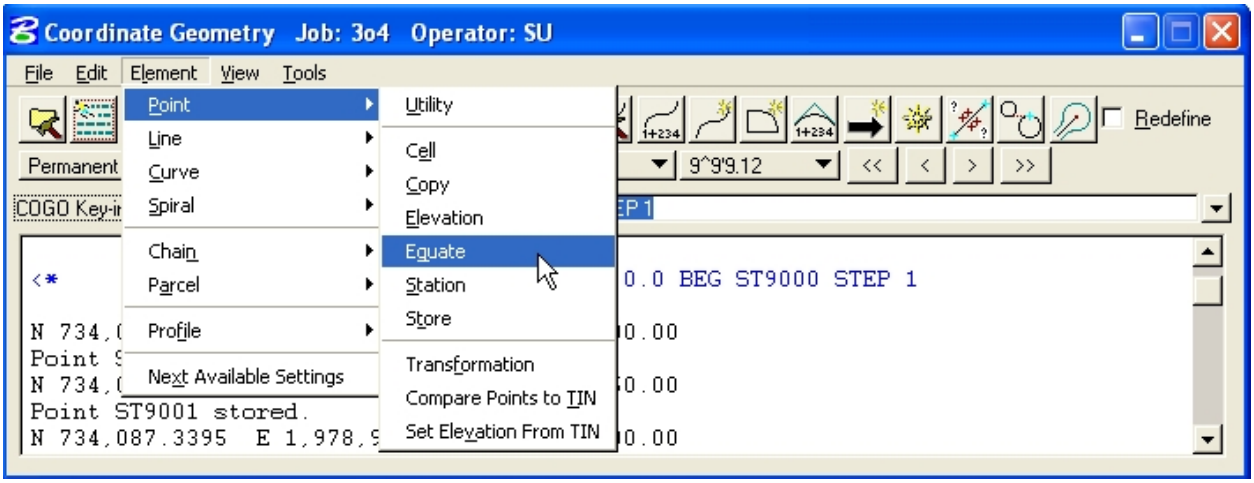




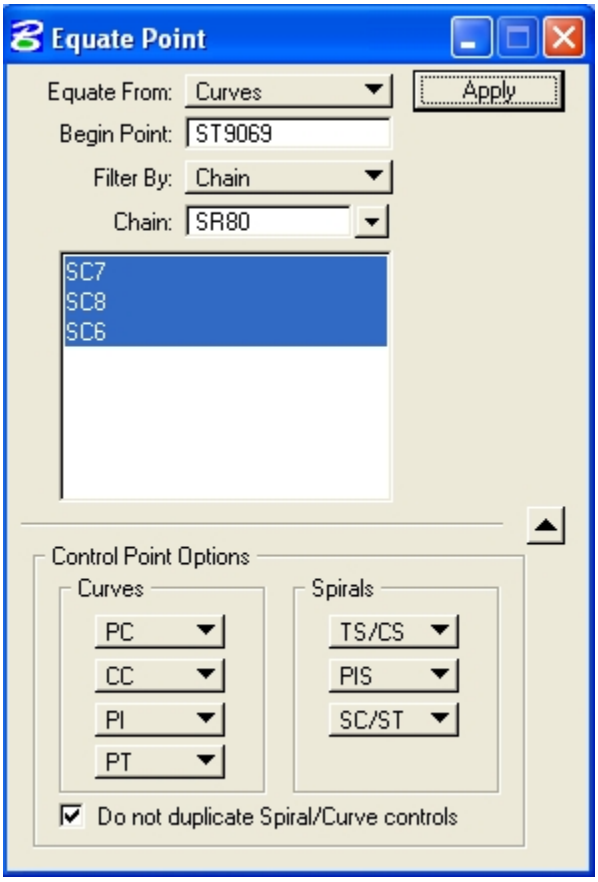
The following dialog will appear. Complete the dialog as shown below. Be sure to use ST9000 as the starting point number. The ST indicates a stakeout point and using 9000 will prevent point number conflicts in the data collector. Set the name of the centerline chain. Set **Distance** to stakeout interval. Press **Locate** to create the points. However, the curve points still need to be created.



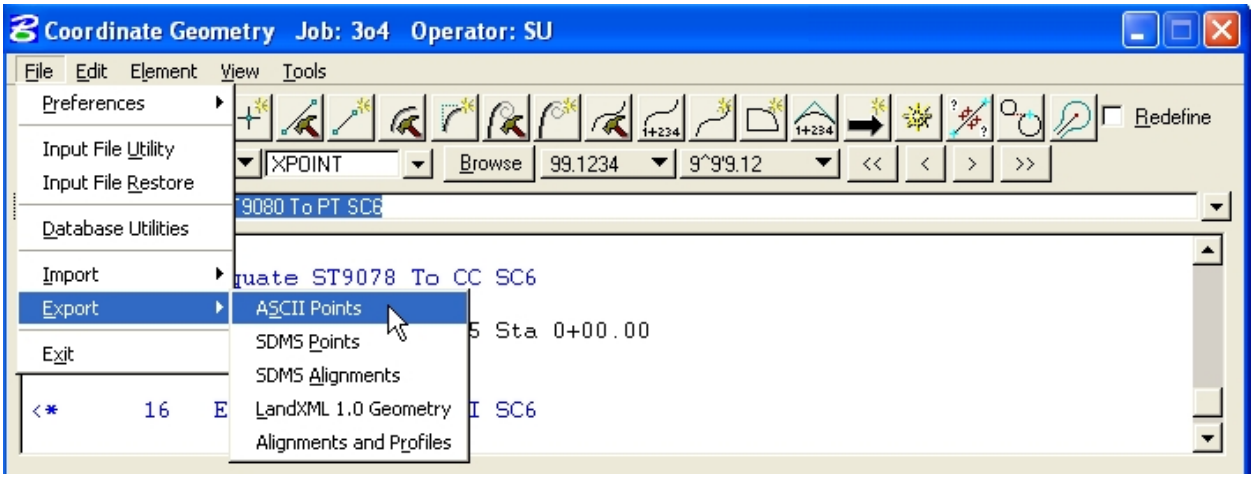
From the main COGO dialog select **Element → Point → Equate** as shown below.



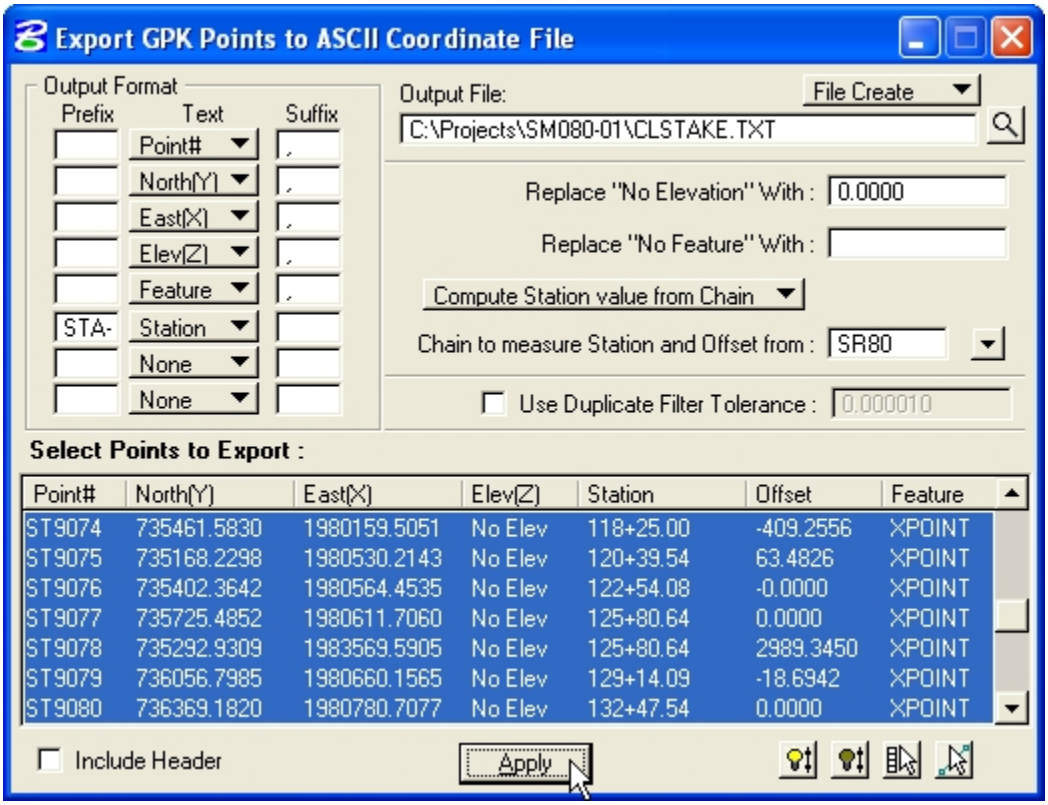
The following dialog will appear. Complete the dialog as shown below. Set **Begin Point** as next available ST point number. Select the chain name and highlight the curves as shown. Press **Apply**. More points will be created.



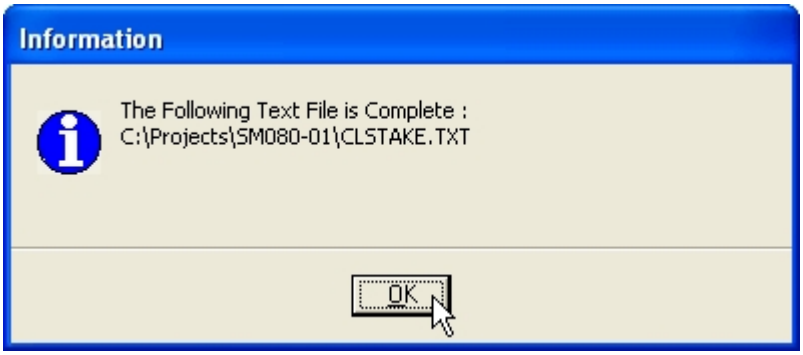
Revert back to the main COGO menu and select **File → Export → ASCII Points.**



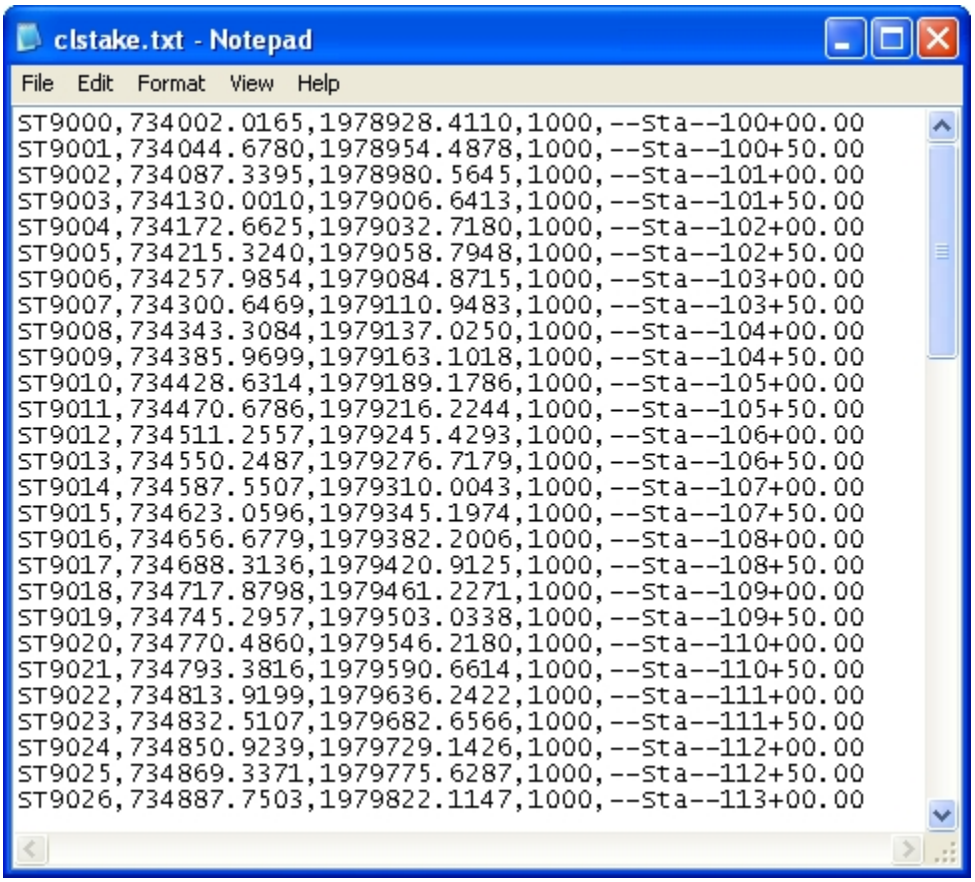
Set the Output File, Output Format, and other inputs as shown below. Highlight the points just created (ST9000 through ST 9080) in the bottom window and press **Apply**.



Once the user selects **Apply** the following dialog will appear.



The `CLSTAKE.txt` file has been created in the project directory. Open the created file in Notepad or any other text editor to view the data.



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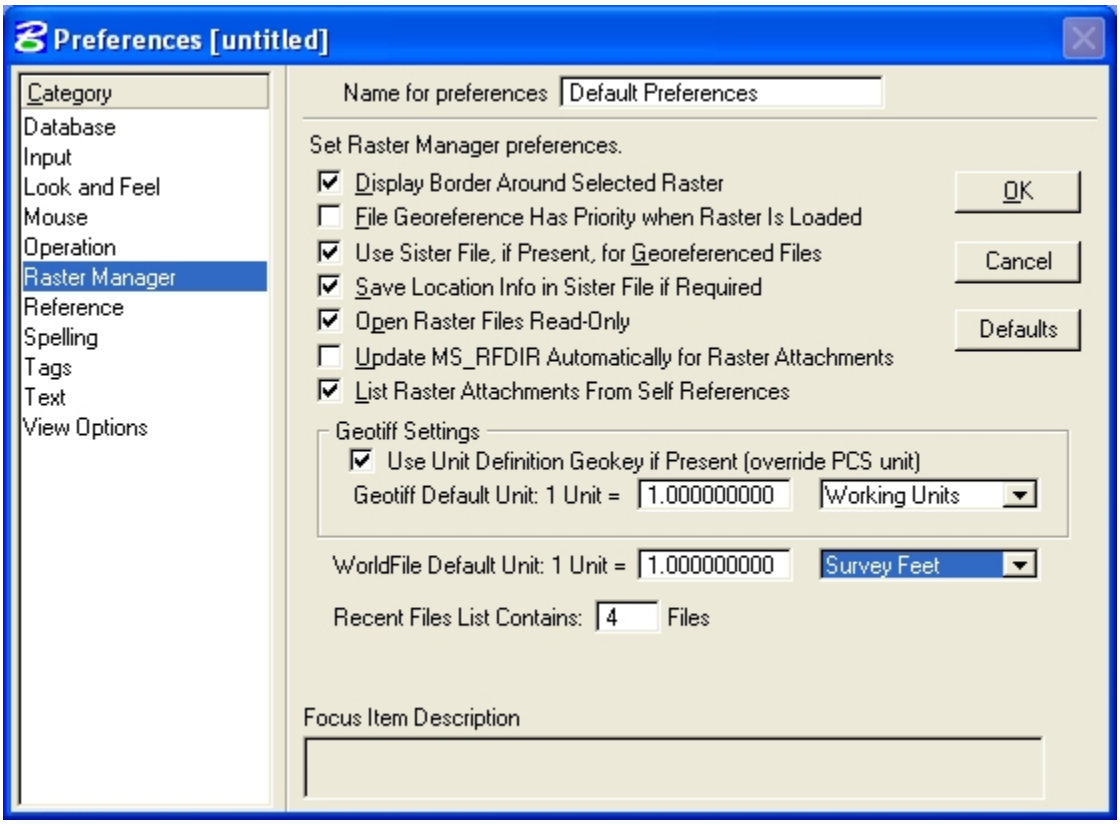
CHAPTER 14 - DRAINAGE MAPS

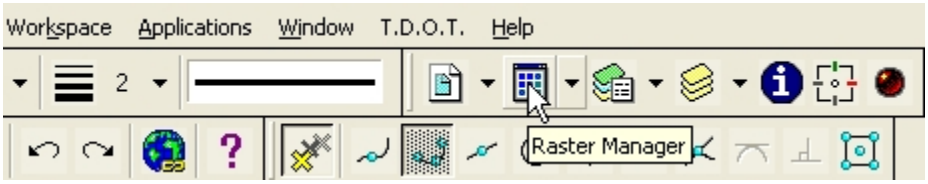
The user must graphically create a shape outlining each drainage area to create a drainage map. The user must attach an image of the appropriate quad map. Quad maps can be obtained from the following website.

http://www.tngis.org/data.html

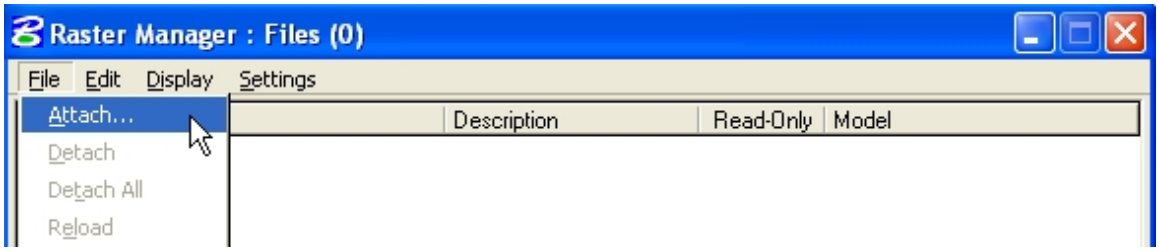
Download the zip file and unzip the files into the project directory. Several georeference files will be included with the quad image in the zip file. Before attaching the raster image the appropriate settings must be checked. From the MicroStation® toolbar select **Workspace → Preferences…** and the following dialog will appear. Complete the **Preferences** dialog as shown below and select **OK**. The **Use Sister File, if Present, for Georeferenced Files** option should be toggled on, and the **WorldFile Default Units** should be set to **Survey Feet**.



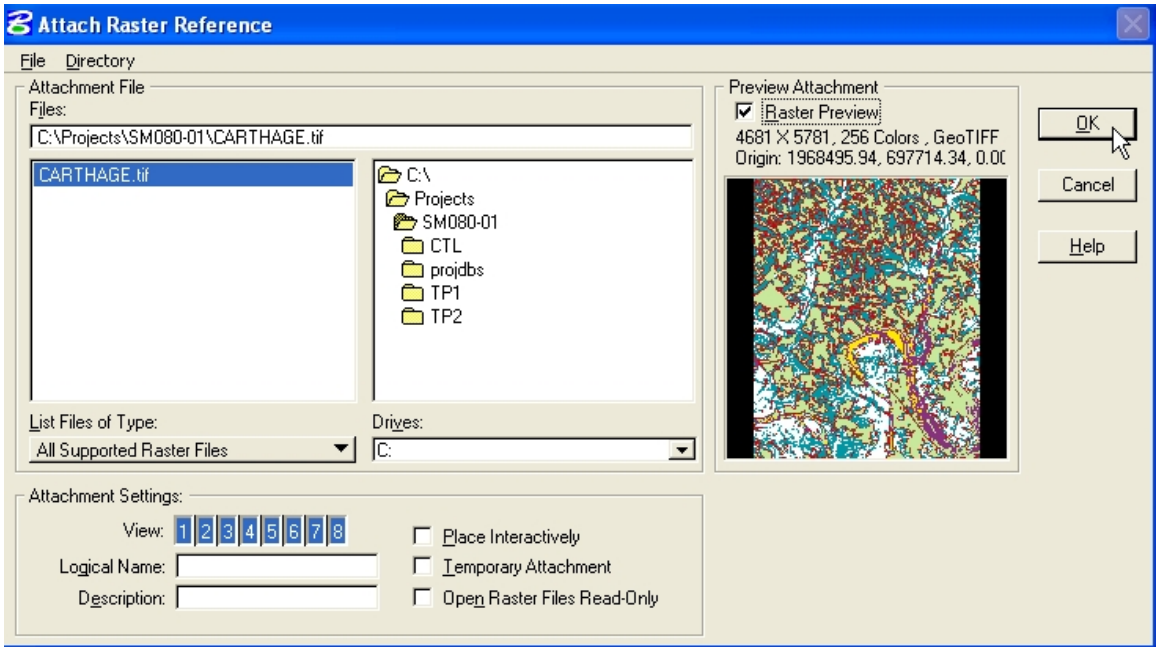
From the Primary toolbar in MicroStation® select the **Raster Manager** button.



The following dialog will appear. Select **File** → **Attach…** from the **Raster Manager** dialog.

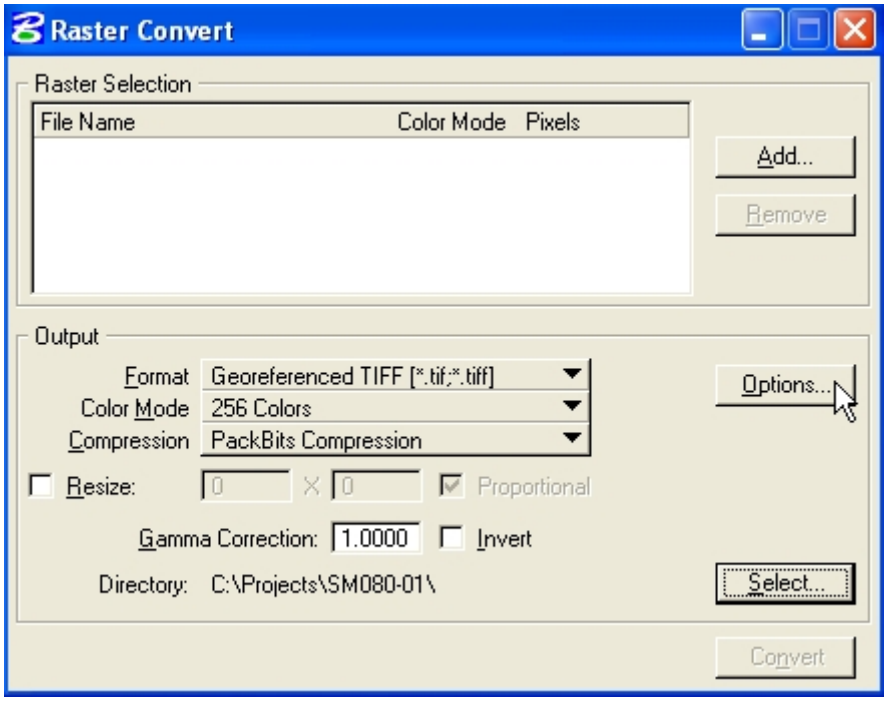


Highlight the CARTHAGE.tif file as shown below. Do not check the **Place Interactively** option and select **OK**. If the image is geo-referenced, then the quad should display in the correct location. The quad used for this class is geo-referenced. If the image is not geo-referenced, then the user will have to move the quad to the correct location. Find a feature on the quad such as a road or intersection and move the quad to the correct point on the graphics.

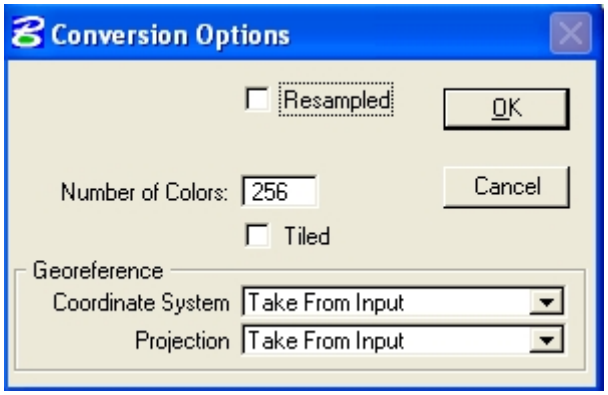


Note: If the image is placed interactively or the scale is incorrect, the user must modify the pixel size. From the **Raster Manager** dialog select **Settings** → **Attachment…** and choose the **Location** tab. The pixel size should be 7.87 for both the X and Y.

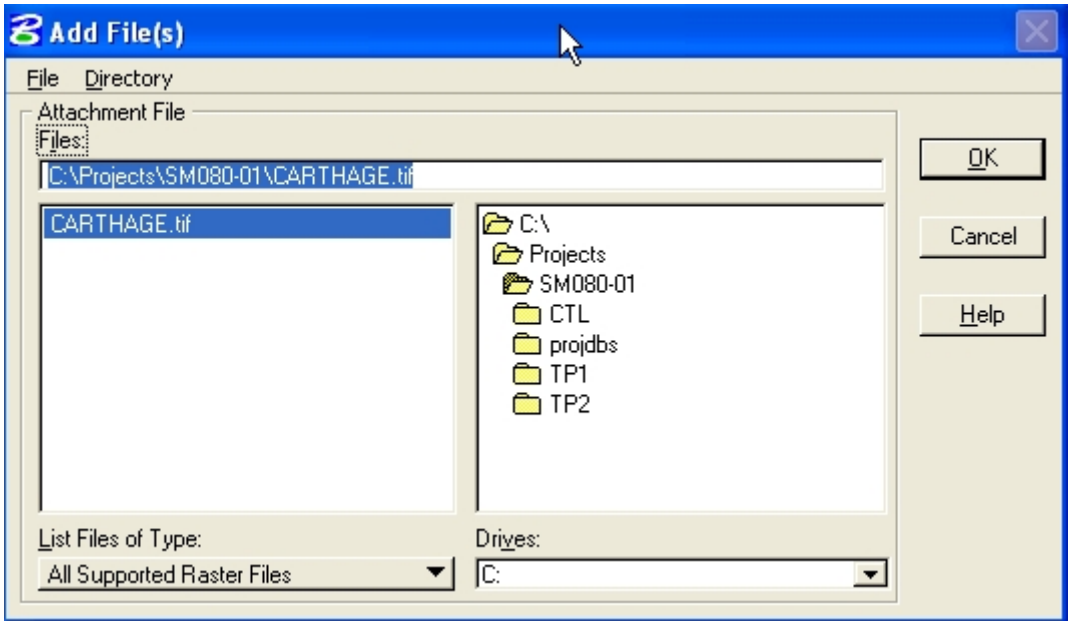
When the image is positioned correctly, save the image and position by selecting **File → Batch Convert** on the **Raster Manager** toolbar. Complete the dialog as shown below and select the **Options** button.



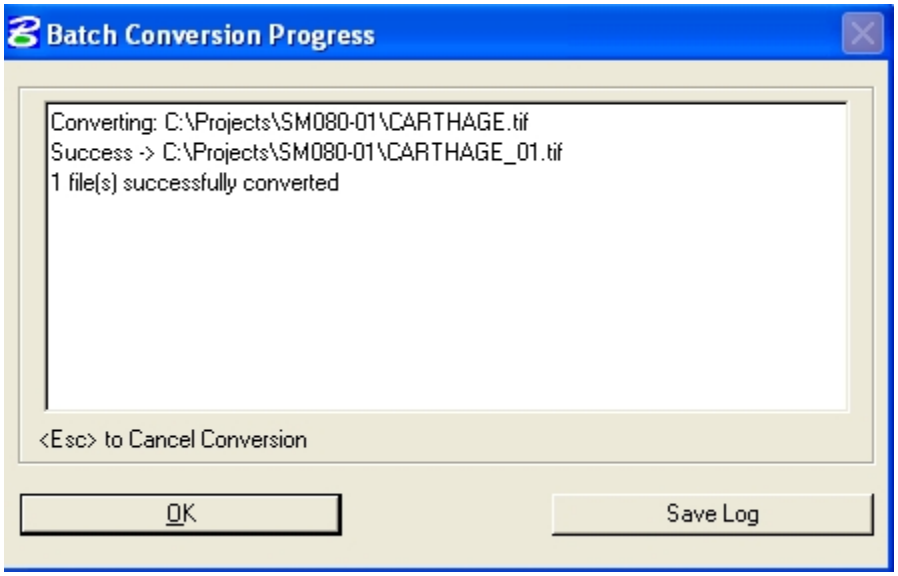
Complete the **Conversion Options** dialog as shown below and select **OK**.



Select **Add** from the **Raster Convert** dialog. Highlight the quad and select **OK**.

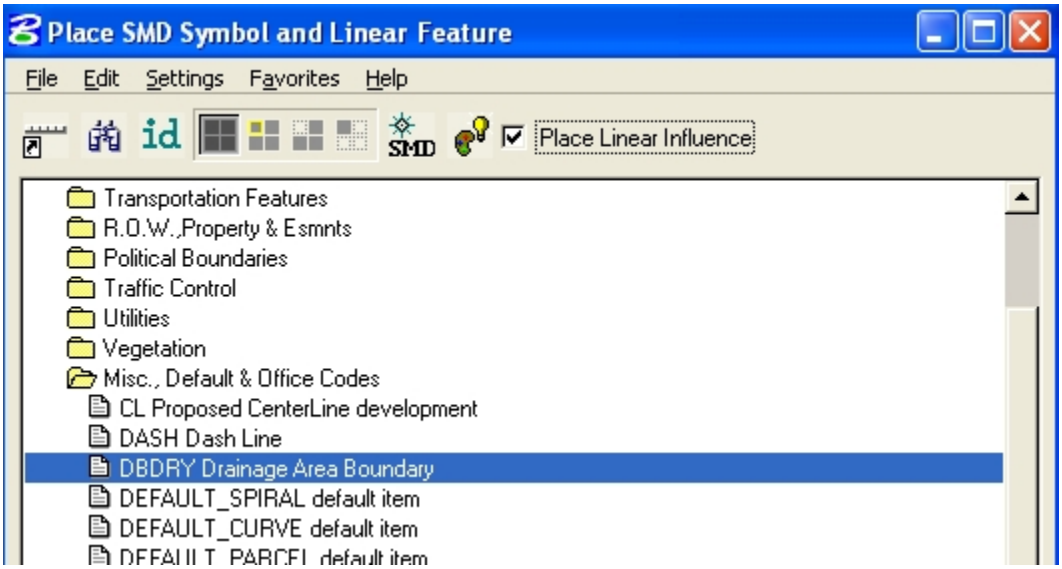


Return to the **Raster Convert** dialog and select the Convert button. The following dialog will show the results of the conversion.

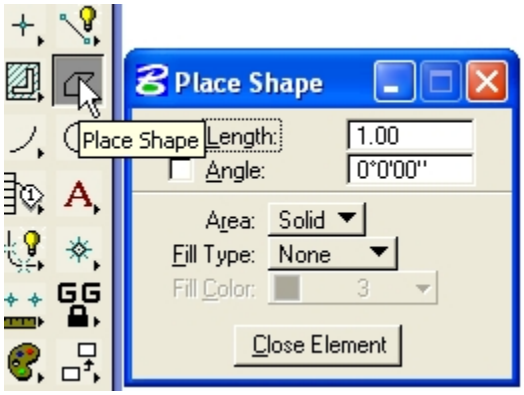


The converted file has the same name, CARTHAGE_01.tif. A backup of the unconverted file is saved with the old name, CARTHAGE.tif. The backup file should be deleted.

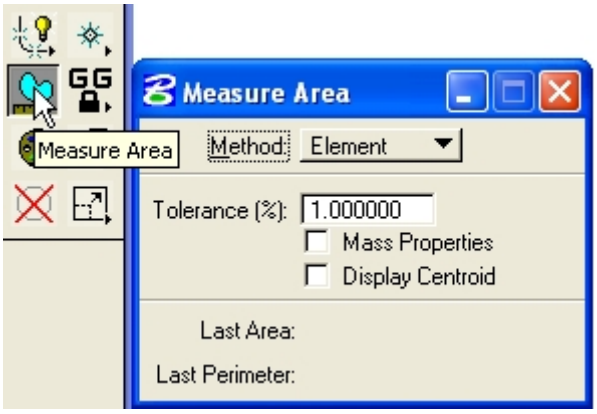
The user will now draw the drainage boundaries manually by interpolating ridges from the quad map contours. From the **Survey** toolbar, select **Plans Preparation → Place SMD Feature.** Choose the **DBDRY Drainage Area Boundary** and toggle the **Place Linear Influence** option on.



Draw a MicroStation® shape using the Place Shape command from the main MicroStation® toolbox. Bound the contours with the new shape. Select **Close Element** once the shape is complete.



Select the shape using the **Measure Area** tool. The area is reported in the status bar in square feet.



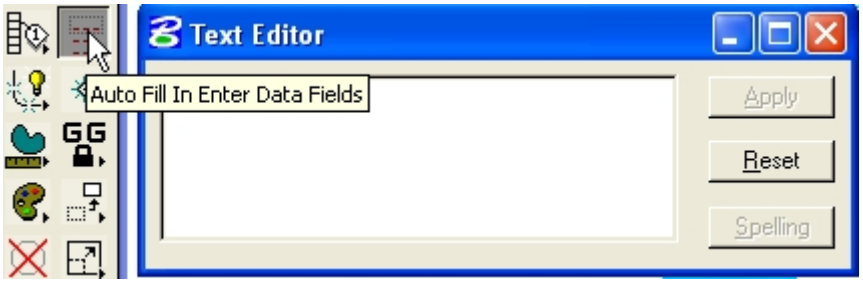
Drainage Info

Bridge and pipe cell are provided in the Survey seed file. The user can copy the cells to the vicinity of the appropriate bridge and drainage areas. The drainage cells for bridges and pipes are shown below.

DRAINAGE/ HYDRAULIC DATA FOR BRIDGE
STATION_____ STREAM NAME_____
STREAM BED LINING:_____
DIRECTION OF FLOW_____
DRAINAGE AREA_____ (_) FLAT (_) ROLLING (_) HILLY (_) MTNS.
PRESENT STRUCTURE: SPAN_____ HEIGHT_____ STRUCTURE_____
BEGIN STATION-OFFSET_____ END STATION-OFFSET_____
LOW BEAM ELEV._____ LOCATION._____
INLET INVERT ELEV._____ OUTLET INVERT._____
NORMAL WATER ELEV._____ EXTREME HIGHWATER ELEV._____ DATE._____
HOW OBTAINED._____
BACKWATER FROM WHAT STREAM (IF APPLICABLE):_____
EXISTING STRUCTURE CONDITION:_____
SEE STREAM CROSS-SECTIONS FOR VEGETATIVE COVER, SEE PRESENT LAYOUT (LEVEL 40) FOR STREAM AI
SEE CENTERLINE PROFILE OR FIELD BOOK FOR EXISTING BRIDGE OPENING SKETCHES.
REMARKS:_____

DRAINAGE DATA FOR PIPE
STATION_____
DIRECTION OF FLOW_____
DRAINAGE AREA_____,(_)FLAT;(_)ROLLING;(_)HILLY;(_)MTNS.
PRESENT STRUCTURE:_____
EXISTING STRUCTURE CONDITION:_____
REMARKS:_____

Use the **Auto Fill In Enter Data Fields** in the MicroStation® text toolbar to fill in the text fields contained in the cell. Click a data point until the first blank in the block above is highlighted and continue to fill in each blank by clicking data points.



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Appendix A
TDOT Survey SMD Feature Codes

For current TDOT feature codes please refer to the following website:

http://www.tdot.state.tn.us/Chief_Engineer/assistant_engineer_design/design/survey.htm

Appendix A - TDOT Survey SMD V8 Feature Codes

TRANSPORTATION FEATURES		IN DTM
BE	Business Entrance	Y-2
BIKE	Bike Path	Y-2
CU	Curb (At Bottom W/BL At Top)	Y-2
DR	Driveway	Y-2
EP	Edge Of Pavement	Y-2
FE	Field Entrance	Y-2
GRM	Guardrail Median	NO
GRL	Guardrail Left	NO
GRR	Guardrail Right	NO
IMP	Impact Attenuator	Y-1
JB	Jersey Barrier	Y-2
MED	Median	Y-2
PK	Parking Lot	Y-2
RD	Edge Of Road	Y-2
RR	Railroad	Y-2
RRSS	Railroad Sw. Stand	Y-2
RWAY	Airport Runway	Y-2
RWT	Ret. Wall (At Bottom W/BL At Top)	Y-2
RWTWF	Ret. Wall W/Fence(At Bottom W/BL At Top)	Y-2
SWT	Sidewalk	Y-2
SH	Edge Of Shoulder	Y-2
TRAIL	Trail	Y-2
TUN	Tunnel	NO
XHRAMP	Handicap Curb Opening	NO
XRRSW	Railroad Switch	Y-1

NON-TRANS FEATURES		IN DTM
AFLD	Athletic Field	Y-2
BC	Building	Y-4
CG	Cattle Guard	Y-1
CEM	Cemetery	Y-1
FN	Fence	Y-1
GATE	Gate	Y-1
GRAVE	Grave	Y-1
PAD	Miscellaneous Pad	Y-2
PIT	Quarry or Pit	Y-2
ROCKW	Rock Wall	Y-2
RWP	Ret. Wall (Private) (AT BOTTOM W/BL AT TOP)	Y-2
RWPWF	Ret. Wall W/Fence (AT BOTTOM W/BL AT TOP)	Y2
SEP	Septic Field Line	Y-1
SIGNP	Sign (Private)	NO
SWP	Sidewalk (Private)	Y-2
TANK	Tank (UG or Above Ground)	NO
TOWER	Tower	Y-1
XBLDR	Boulder	Y-1
XFE	Floor Elevation	NO
XFLAG	Flag Pole	Y-1
XFP	Fence Post	Y-1
XMB	Mail Box	Y-1
XSATLIT	Satellite Dish	Y-1
XSEP	Septic Tank	Y-1
XWELL	Well	NO

DRAINAGE		IN DTM
ABUT	Bridge Abutment	Y-2
APRON	Paved Apron	Y-2
BEAM	Bridge Bottom Beam	NO
BRI	Bridge	NO
CRK	Creek	Y-2
CRKB	Creek Bed	Y-2
CV	Culvert	Y-1
DAM	Dam	Y-2
DECK	Bridge Deck breaklines	NO
DIKE	Dike	Y-2
DIT	Paved Ditch	Y-2
DOWN	Downstream Flood Section	NO
EW	End Wall (At Bottom W/BL At Top)	Y-2
GAGE	Stream Gage	Y-1
LAKE	Lake	Y-2
LEVEE	Levee	Y-2
PIER	Bridge Pier	Y-2
PIPE	Pipe	Y-1
POND	Pond	Y-2
RIVER	River	Y-2
RPDS	Rapids/Waterfall	Y-2
RRAP	Rip-Rap	Y-2
SINK	Sinkhole	Y-2
SPILL	Spillway	Y-2
?STS	Storm Sewer	NO
SKE	Bridge Sketch	NO
TB	Top Of Bank	Y-2
UP	Upstream Flood Section	NO
WET	Wetland Boundary	Y-2
XBOT	Bottom Of MH, CB, Etc.	NO
XCB	Catch Basin	Y-1
XDECK	Bridge Deck	NO
XDI	Drop Inlet	Y-1
XHW	High Water Elevation Point	Y-2
XNW	Normal Water Elevation Point	Y-2
XSPRING	Spring	Y-1
XMHSTS	Storm Sewer Manhole	Y-1

R.O.W./PROPERTY		IN DTM
ESMT	Easement	NO
ESMTD	Drainage Easement	NO
PARCEL	Parcels	NO
PL	Property Line	NO
PLWF	PL W/Fence	NO
ROW	ROW Line	NO
ROWWF	ROW W/Fence	NO
XIP	Iron Pin Existing	NO
XMON	Concrete Marker	NO
XPL	Property Corner	NO
XROW	R.O.W. Monument	NO
XROWA	ROW Monument(inline)	NO
XROWB	ROW Monument(corner)	NO

POLITICAL BOUNDARIES		IN DTM
CITY	City Limits	NO
COUNTY	County Line	NO
STATE	State Line	NO

UTILITIES		IN DTM
?GL	Gas Line	NO
OHW	Overhead Wire	NO
PTOW	Trans. Tower	Y-1
?SAS	Sanitary Sewer	NO
?FMS	Force Main Sanitary Sewer	NO
UGF	Fiber Optic (UG)	NO
UGP	Power (UG)	NO
UGPT	Power/Tel. (UG)	NO
UGT	Telephone (UG)	NO
UGC	Cable (UG)	NO
?WL	Water Line	NO
XFH	Fire Hydrant	NO
XGAA	Guy Device Angle Anchor	Y-1
XGM	Gas Meter	NO
XGV	Gas Valve	NO
XGVA	Guy Device Vertical Anchor	Y-1
XGW	Guy Wire	Y-1
XLP1	Light Pole 1 Light	Y-1
XLP2	Light Pole 2 Lights	Y-1
XLP3	Light Pole 3 Lights	Y-1
XLP4	Light Pole 4 Lights	Y-1

XLW	Low Wire Crossing	NO
XMH	Manhole	Y-1
XMHC	Cable Manhole	Y-1
XMHF	Fiber Optic Manhole	Y-1
XMHG	Manhole Gas	Y-1
XMHP	Manhole Power	Y-1
XMHSAS	Sewer Manhole	Y-1
XSM	Sewer Meter	NO
XSV	Sewer Valve	NO
XUM	Misc. Utility Feature	NO
UM	Misc. Utility Line	NO
XMHT	Telephone Manhole	Y-1
XMHW	Manhole Water	NO
XPB	Utility Boxes (pull box)	NO
XUP	Utility Pole	Y-1
XUPL	Utility Pole with Light	Y-1
XHMPLH	High Mast Light (half)	Y-1
XHMPLF	High Mast Light (full)	Y-1
XLCC	Lighting Control Center	NO
XOFTLP	Offset Type Luminaire & Pole	Y-1
XTBOOTH	Telephone Booth	Y-1
XTBOX	Telephone Box	Y-1
XTGP	Telegraph Pole	Y-1
XTPED	Tele. Pedestal	Y-1
XTOWER	Radio/TV Tower	Y-1
XCPED	Cable Pedestal	Y-1
XWM	Water Meter	NO
XWV	Water Valve	NO

VEGETATION IN DTM

TREE	Tree Drip Line	Y-1
HEDGE	Hedge Line	Y-1
XBUSH	Bush	Y-1
XTREE	Tree	Y-1

(COMMENT : ??" TREE TYPE)

TRAFFIC CONTROL IN DTM

BARR	Barricade	NO
LDECT	Loop Detector	NO
LLD	Lane Line Dashed	Y-1
LLS	Lane Line Solid	Y-1
SIGNT	Transportation Sign	NO
XOHS	Overhead Sign EX: SCHOOL X	NO
XPDMC	Pad Mounted Controller	NO
XPDSHN	Pedestrian Signal	NO
XPLMC	Pole Mounted Controller	NO
XPPH	Pedestrian Pushbutton	NO
XPULLB	Pull Box	NO
XRRFS	RR Flashing Signal Crossing	NO
XRRFSG	RR Flashing Signal Crossing W/Gate	NO
XRRSIG	Railroad Signal	NO
XSHN	Traffic Signal Head	NO
XSHNB	Signal Head W/Backplate	NO
XSIGN1	Small 1-Post Sign	Y-1
XSIGN2	Small 2-Post Sign	Y-1
X2SIGN	Small 2-Faced Sign	Y-1
XSPSS	Strainpole	Y-1
XWPSS	Wood Signal Pole	Y-1

TRAFFIC CONTROL (PAVT. MARKING) IN DTM

NOTE: LOC. ALL PVMT ARROWS AT CENTER OF TRAFFIC LANE RELATIVE TO BOTTOM OF ARROW

CWALK	Crosswalk	NO
STOP	Stop Bar	NO
XLAR	Left Arrow Pave. Mark.	NO
XLRAR	LT & RT Arrow	NO
XONLY	Only Pave. Mark.	NO
XPVTXT	Pave. Marking Words (CENTER)	NO
XRAR	Right Arrow Pave. Mark.	NO
XRRPAV	Railroad Xing Pave. Mark.	NO
XSAR	Straight Arrow	NO
XRARI	Right Arrow Interstate	NO
XSARI	Straight Arrow Interstate	NO
XSRARI	Straight & Right Arrow Interstate	NO
XHOV	HOV Diamond	NO
XSLAR	Str & Lt Arrow	NO
XSLRAR	Str,Lt & Rt Arrow	NO
XSRAR	Str & Rt Arrow	NO

TERRAIN MODEL IN DTM

BL	Breakline	Y-2
OL	Obscure Line	Y-4
XP	GROUND POINT	Y-1

SURVEY CONTROL IN DTM

XBM	Bench Mark	NO
XCP	Control Point	Y-1
XCK	Check Point	NO
XTRAV	Traverse Point	Y-1
XSPUR	Temporary Survey Point	NO
XH	Horz. Photo Point	Y-1
XV	Vert. Photo Point	Y-1
XHV	Horz/Vert Photo Point	Y-1

MISCELLANEOUS & DEFAULT CODES IN DTM

DEFAULT_CHAIN	default item	NO
DEFAULT_CURVE	default item	NO
DEFAULT_LINE	default item	NO
DEFAULT_PARCEL	default item	NO
DEFAULT_POINT	default item	NO
DEFAULT_SPIRAL	default item	NO
DASH	Dash Line	NO
DOT	Dotted Line	NO
LD	Long Dash Line	NO
MISC	Miscellaneous	NO
SOLID	Solid Line	NO
XMISC	Misc. unknown point	NO

OFFICE CODES IN DTM

CL	Proposed Centerline	NO
DBDRY	Drainage Map Boundary	NO
EXCL	Existing Centerline	NO
STRCL	Stream Baseline	NO
X_PROPERTY	Property development	NO
XPOINT	HiVis Generic Office Pt	NO

DTM CODES	
NO-------- Do Not Include in DTM	Y-5-------- Include as a Break Void in DTM
Y-1-------- Include as a Spot in DTM	Y-6-------- Include as a Island in DTM
Y-2-------- Include as a Spot and a Break Line in DTM	Y-7-------- Include as a Boundary in DTM
Y-3-------- Include as a Void in DTM	Y-8-------- Include as a Contour in DTM
Y-4-------- Include as a Drape Void in DTM	

CURRENT REVISION LIST		
DATE	**FEATURE CODE**	**REVISION**
04/27/05		
	ALL	UPDATED FOR V8
02/17/06	NA	CHANGED LAYOUT, CHANGED DESCRIPTION FOR XMHC
	CU, SWT, XHRAMP	CHANGED COLOR TO 64
	XPL	CHANGED LOCATOR
04/19/06	CV, PIPE	CHANGED ELEVATION LEVEL
	20GL	ADDED 20” GAS LINE
09/22/06	EP, RD, XBM, XCP, XTRAV, XSPUR, XH, XV, XHV	CHANGED TEXT SIZE TO MATCH CADD MANUAL
11/03/06	XTREE	CORRECTED SIZE ADJUSTMENT FEATURE
12/05/07	XCK	ADDED XCK FEATURE CODE
03/25/08	XMISC	CHANGED LEVEL
05/19/09	CV & PIPE	CHANGED ELEVATION TO TEXT LEVEL