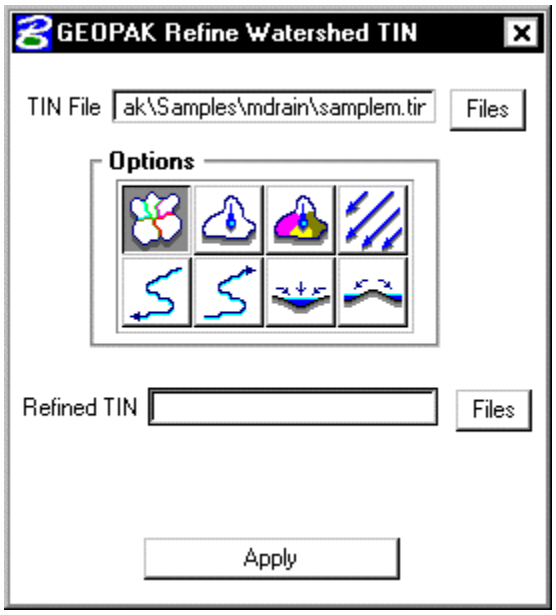
Drainage Tools

15.1 Overview

GEOPAK supports a myriad of tools to analyze and evaluate drainage patterns of a GEOPAK Digital Terrain Model. Tools for delineating watersheds, flow paths, flow directions, and hydrographic features exist as depicted in the dialog below.

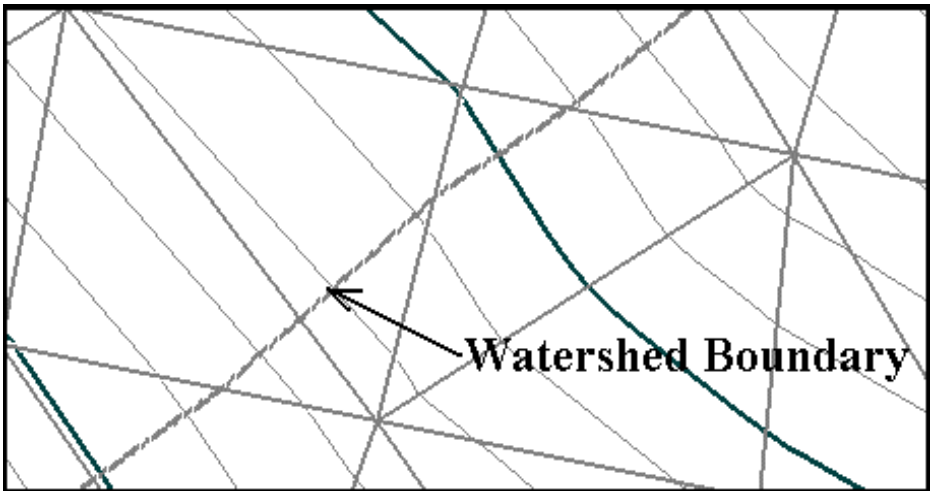


The nature of TIN files and their subsequent use in drainage evaluation may require initial processing of the TIN file to insure suitable results from these tools. As a precursor to the use of the tools, it is recommended that a TIN specifically for drainage evaluation be created using these tools representing a more refined surface. The CREATE WATERSHED TIN tool is provided for creation of this refined TIN file and subsequent evaluation and analysis may be performed using this new TIN file.

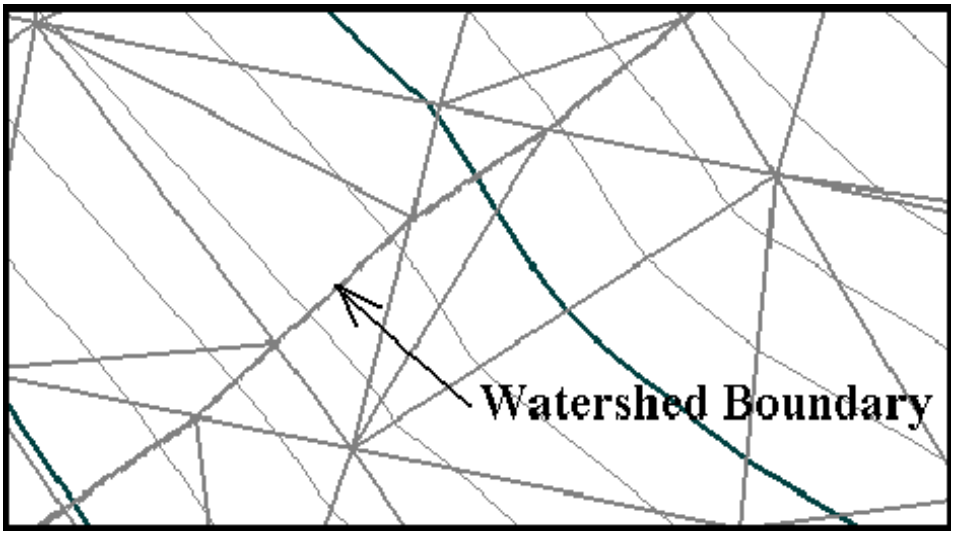
15.2 Create Refined Watershed TIN

The Create Refined Watershed Tool, depicted above, is utilized to refine a TIN file for use with further Drainage - DTM tools. Creation of the TIN accommodates much faster processing of further tools since the TIN is refined and prepared specifically for drainage evaluation tools. This tool processes the entire TIN evaluating ridges, sumps, and low points and determines more precise flow boundaries within the

triangles. It does not retriangulate, more specifically it insert lines within the TIN that actually represent flow divides. Triangles that currently represent ridges or are not bounding the watershed ridges are not altered. Note in the figure below, the triangle boundaries that exist in an original TIN file versus the location of the true watershed boundary.

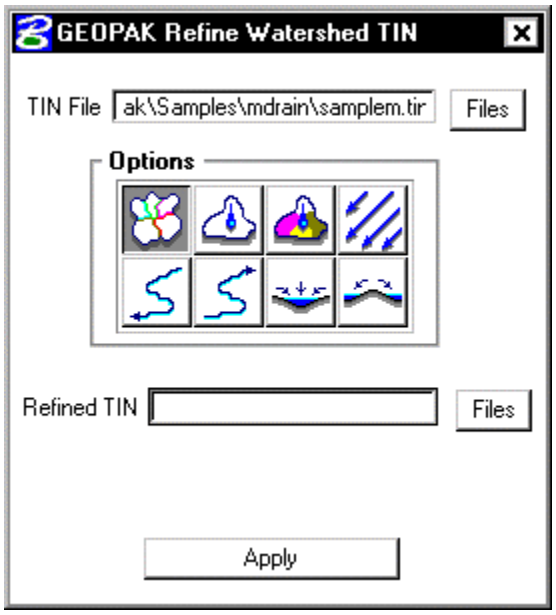


Upon the creation of the refined watershed TIN, this region appears as follows:



Notice the triangle boundaries follow the true watershed boundary and further Drainage DTM evaluation tools may utilize this for faster and more accurate results.

Selection of the **Create Refined Watershed TIN** icon invokes the dialog depicted below.



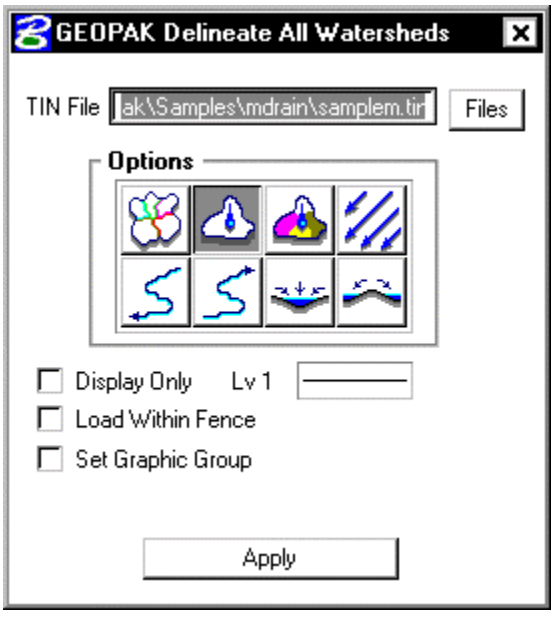
Fields in this dialog are described in the table below.

TIN File	GEOPAK binary TIN file. Selecting the **Files** button invokes a File Manager wherein the desired TIN may be selected
Refined TIN	Refined GEOPAK binary TIN file to create. Selecting the **Files** button invokes a File Manager wherein the desired TIN may be specified
Apply	Commences the processing.

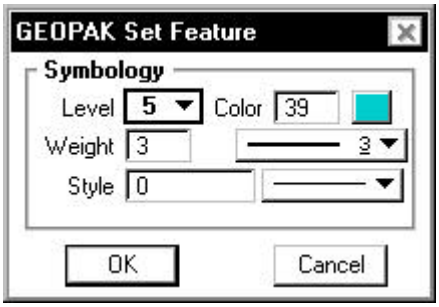
15.3 Delineate TIN Watersheds

The Delineate TIN Watershed tool displays the watershed boundaries that exist within a DTM. A Watershed is defined by either a low point within the TIN or a low edge point along the TIN hull. MicroStation shapes may be created for each watershed contained in the TIN. The figure below is a typical result of delineating the watersheds with shapes being crested for the contributing watershed to each low point within the TIN.

Selection of the **Delineate Watershed TIN** icon invokes the dialog depicted below.



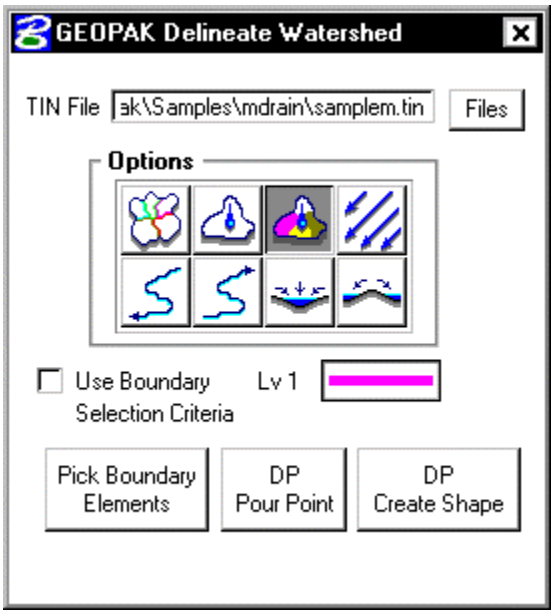
Fields in this dialog are described in the table below.

TIN File	GEOPAK binary TIN file. Selecting the **File** button invokes a File Manager wherein the desired TIN may be selected.
Display Only	When activated, elements are displayed and not drawn. Therefore, the display is erased when any screen refreshing is done.
Load Within Fence	When a MicroStation fence is placed and the toggle is activated, only elements within the fence will be drawn or displayed.
Set Graphic Group	When activated, all drawn elements are placed in a single graphic group each time the Apply button is pressed.
Level 1 Element Symbology	Clicking on the element symbology box, the dialog depicted below is displayed.  Within this dialogs, all element symbology options are supported. Simply set the level, weight, color, style, and text parameters (if present) and press the **OK** button to automatically close the dialog and return to the main dialog. Pressing the **Cancel** button closes the dialog with no changes occurring. The dialog can also be invoked by pressing the right mouse button while the cursor is located on the element symbology, and selecting the Feature Dialog.  In addition, the element symbology can be set **By Current**. When selected, the active element parameters are utilized to set the feature. By the **By Element** option is selected, the user is prompted to select any MicroStation element, which is then highlighted and its symbology is populated within the dialog. Copy and Paste options are also supported. For example, if we want to use the same symbology for two items, simply place the cursor over the first element symbology, then right mouse click and select **Copy**. Note the **Paste** option is ghosted. Next, select the element symbology of the second item, right mouse click and select **Paste**. The symbology copied from the first item is now pasted into the second item symbology.
Apply	Commences the Delineate TIN Watershed procedure.

15.4 Delineate Watershed

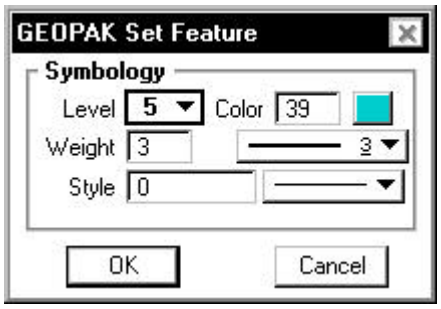
The Delineate Watershed Tool further delineates watersheds at any location within the TIN. A data point representing the pour point of the watershed is indicated and the contributing watershed area is computed and delineated. Pour points must be located near sumps in the terrain because a point lying on the side of a hill does not actually have a contributing area. This tool also relies on the overall watershed boundary containing the pour point be selected. This facilitates subdividing watersheds as is often necessary in drainage facility design. The resulting watersheds can then remove previously defined upstream watersheds to depict conditions as would occur if structures upstream are intercepting portions of the contributing watershed. The Delineate TIN Watershed tool is provided for such a purpose.

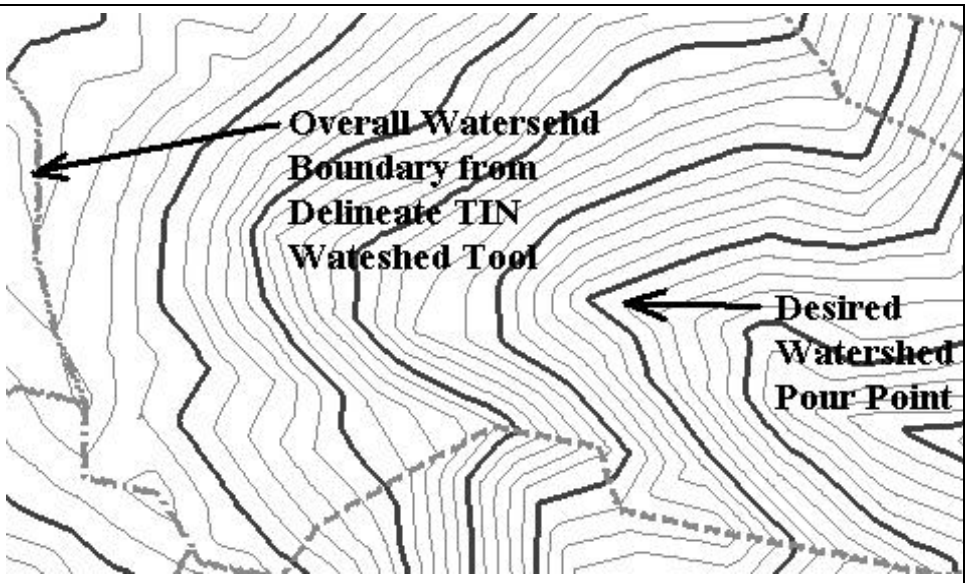
The Delineate Watershed dialog is depicted below.

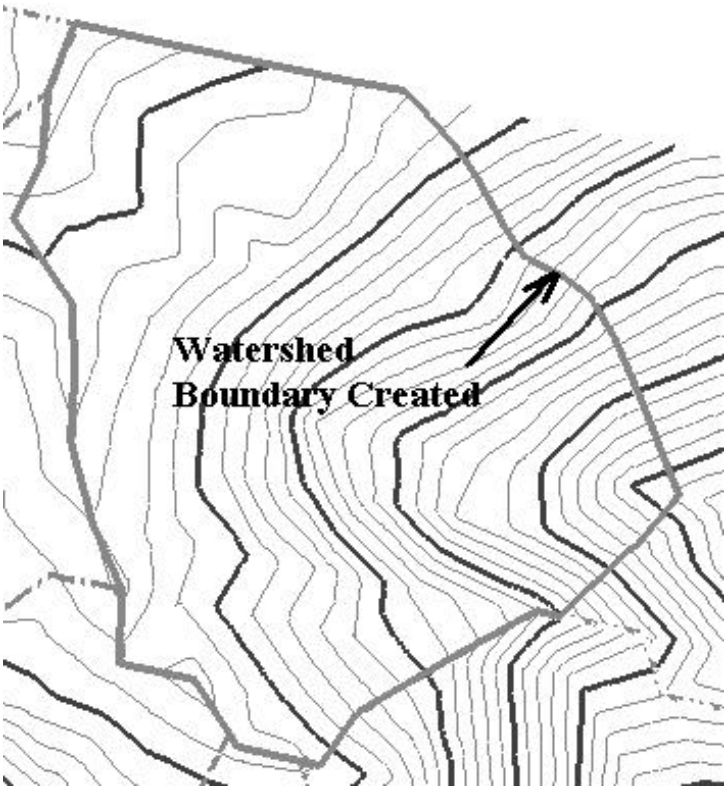


Fields in this dialog are described in the table below.

TIN File	The GEOPAK TIN file containing the DTM for watershed delineation. Selecting the File button invokes a File Manager wherein the desired TIN may be selected
Use Boundary Selection Criteria	Toggle to indicate the overall watershed boundary is selected using the symbolic criteria specified below.
Boundary Area Selection Criteria	Element symbology for placed basin and used if the Use Boundary Selection Criteria toggle is activated as the boundary selection criteria.
Level 1 Element Symbology	Clicking on the element symbology box, the dialog depicted below is displayed.

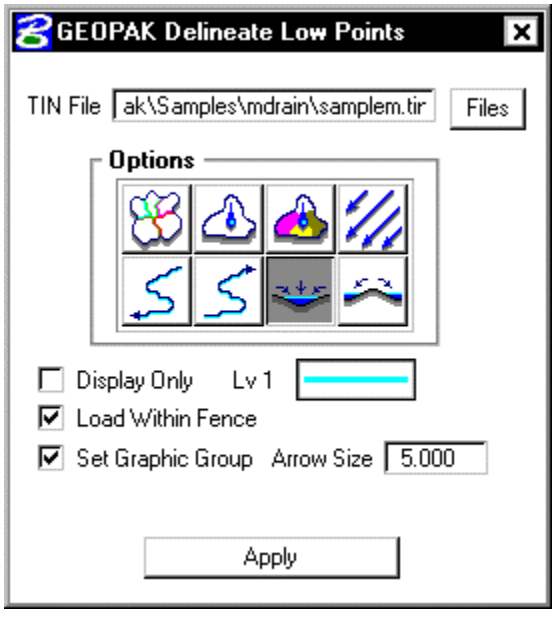
	 Within this dialogs, all element symbology options are supported. Simply set the level, weight, color, style, and text parameters (if present) and press the **OK** button to automatically close the dialog and return to the main dialog. Pressing the **Cancel** button closes the dialog with no changes occurring. The dialog can also be invoked by pressing the right mouse button while the cursor is located on the element symbology, and selecting the Feature Dialog.  In addition, the element symbology can be set **By Current**. When selected, the active element parameters are utilized to set the feature. By the **By Element** option is selected, the user is prompted to select any MicroStation element, which is then highlighted and its symbology is populated within the dialog. Copy and Paste options are also supported. For example, if we want to use the same symbology for two items, simply place the cursor over the first element symbology, then right mouse click and select **Copy**. Note the **Paste** option is ghosted. Next, select the element symbology of the second item, right mouse click and select **Paste**. The symbology copied from the first item is now pasted into the second item symbology.
Set Boundary	Commences the definition of the overall watershed boundary. Either graphical selection of the overall boundary or automatic selection based on symbology if the Use Boundary Selection Criteria is toggled. Any MicroStation Element or group of elements may be selected; either those watersheds created previously with the Drainage tools or just user defined boundaries.

	
DP Pour Point	The data point indicating the pour point, most downstream point, of the desired watershed. Points must be adjacent to sumps so that a contributing area physically exists. If the point is not adjacent to a sump line, no action is taken. The Set Boundary must be executed prior to this in order to establish the most remote limits of the watershed.
Bound Area	Upon execution of the Set Boundary and DP Pour Point functions, this commences final construction of the watershed shape. A data point within the basin is required for completion. If the execution of Set Boundary and DP Pour Point does not result in an entirely closed region, a watershed cannot be constructed. Otherwise, the basin shape will be constructed

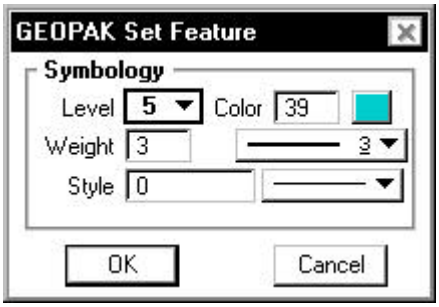


15.8 Delineate Low Points

The Delineate Low Points Tool locates all the low points within a region of a TIN. The dialog is depicted below.

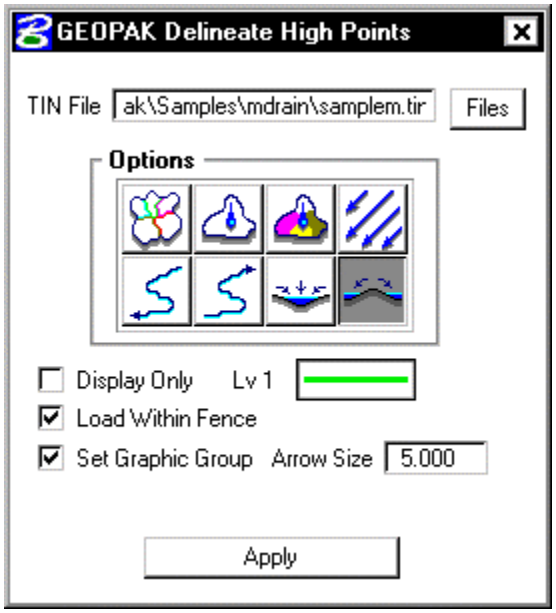


Fields in this dialog are described in the table below.

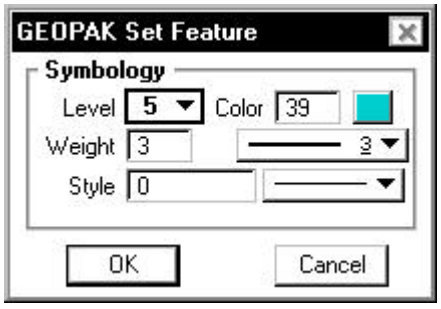
TIN File	GEOPAK binary TIN file. Selecting the **File** button invokes a File Manager wherein the desired TIN may be selected.
Display Only	When activated, elements are displayed and not drawn. Therefore, the display is erased when any screen refreshing is done.
Load Within Fence	When a MicroStation fence is placed and the toggle is activated, only elements within the fence will be drawn or displayed.
Set Graphic Group	When activated, all drawn elements are placed in a single graphic group each time the **Apply** button is pressed.
Level 1 Element Symbology	Clicking on the element symbology box, the dialog depicted below is displayed.  Within this dialog, all element symbology options are supported. Simply set the level, weight, color, style, and text parameters (if present) and press the **OK** button to automatically close the dialog and return to the main dialog. Pressing the **Cancel** button closes the dialog with no changes occurring. The dialog can also be invoked by pressing the right mouse button while the cursor is located on the element symbology, and selecting the Feature Dialog.  In addition, the element symbology can be set **By Current**. When selected, the active element parameters are utilized to set the feature. By the **By Element** option is selected, the user is prompted to select any MicroStation element, which is then highlighted and its symbology is populated within the dialog. Copy and Paste options are also supported. For example, if we want to use the same symbology for two items, simply place the cursor over the first element symbology, then right mouse click and select **Copy**. Note the **Paste** option is ghosted. Next, select the element symbology of the second item, right mouse click and select **Paste**. The symbology copied from the first item is now pasted into the second item symbology.
Arrow Size	Size of Low Point Arrow in master units.
Apply	Commences the Delineate Low Points procedure.

15.9 Delineate High Points

The Delineate High Points Tool locates all the high points within a region of a TIN. The dialog is depicted below.



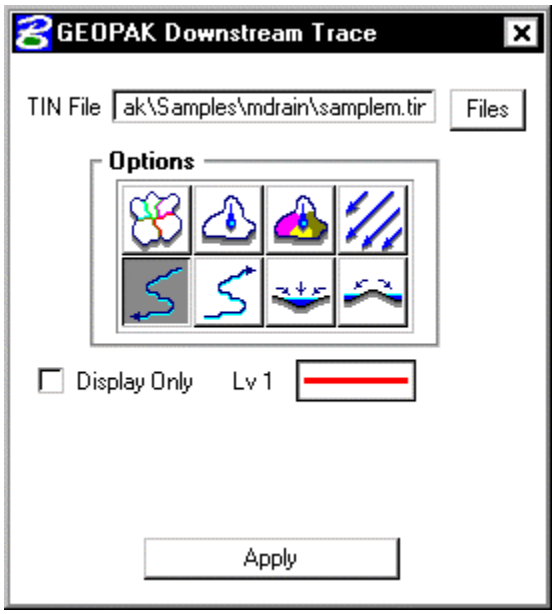
Fields in this dialog are described in the table below.

TIN File	GEOPAK binary TIN file. Selecting the **File** button invokes a File Manager wherein the desired TIN may be selected.
Display Only	When activated, elements are displayed and not drawn. Therefore, the display is erased when any screen refreshing is done.
Load Within Fence	When a MicroStation fence is placed and the toggle is activated, only elements within the fence will be drawn or displayed.
Set Graphic Group	When activated, all drawn elements are placed in a single graphic group each time the **Apply** button is pressed.
Level 1 Element Symbology	Clicking on the element symbology box, the dialog depicted below is displayed. 

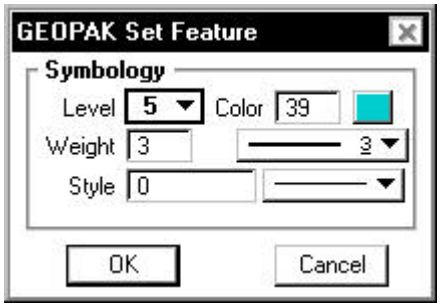
	Within this dialog, all element symbology options are supported. Simply set the level, weight, color, style, and text parameters (if present) and press the **OK** button to automatically close the dialog and return to the main dialog. Pressing the **Cancel** button closes the dialog with no changes occurring. The dialog can also be invoked by pressing the right mouse button while the cursor is located on the element symbology, and selecting the Feature Dialog.  In addition, the element symbology can be set **By Current**. When selected, the active element parameters are utilized to set the feature. By the **By Element** option is selected, the user is prompted to select any MicroStation element, which is then highlighted and its symbology is populated within the dialog. Copy and Paste options are also supported. For example, if we want to use the same symbology for two items, simply place the cursor over the first element symbology, then right mouse click and select **Copy**. Note the **Paste** option is ghosted. Next, select the element symbology of the second item, right mouse click and select **Paste**. The symbology copied from the first item is now pasted into the second item symbology.
Arrow Size	Size of High Point Arrow in master units.
Apply	Commences the Delineate High Points procedure.

15.10 Downstream Trace

The Downstream Trace Tool delineates the flow path downstream from a given point in the TIN. The indicated path follows the steepest descent from the point through the TIN terminating at a low point or the edge of the TIN. The dialog is depicted below.



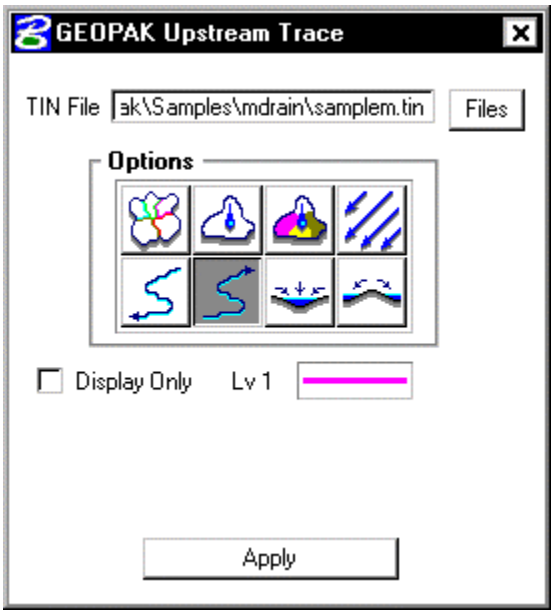
Fields in this dialog are described in the table below.

TIN File	GEOPAK binary TIN file. Selecting the **File** button invokes a File Manager wherein the desired TIN may be selected.
Display Only	When activated, elements are displayed and not drawn. Therefore, the display is erased when any screen refreshing is done.
Level 1 Element Symbology	Clicking on the element symbology box, the dialog depicted below is displayed.  Within this dialog, all element symbology options are supported. Simply set the level, weight, color, style, and text parameters (if present) and press the **OK** button to automatically close the dialog and return to the main dialog. Pressing the **Cancel** button closes the dialog with no changes occurring. The dialog can also be invoked by pressing the right mouse button while the cursor is located on the element symbology, and selecting the Feature Dialog. 

	In addition, the element symbology can be set **By Current**. When selected, the active element parameters are utilized to set the feature. By the **By Element** option is selected, the user is prompted to select any MicroStation element, which is then highlighted and its symbology is populated within the dialog. Copy and Paste options are also supported. For example, if we want to use the same symbology for two items, simply place the cursor over the first element symbology, then right mouse click and select **Copy**. Note the **Paste** option is ghosted. Next, select the element symbology of the second item, right mouse click and select **Paste**. The symbology copied from the first item is now pasted into the second item symbology.
Process	Commences the Downstream Trace processing.

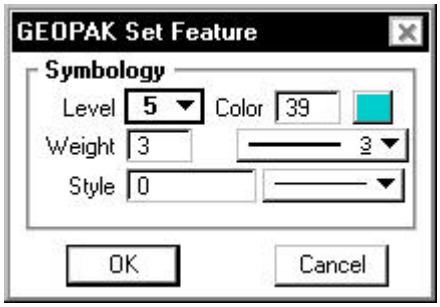
15.11 Upstream Trace

The Upstream Trace Tool delineates the flow path upstream from a given point in the TIN. The indicated path follows the steepest ascent from the point through the TIN terminating at a high point or the edge of the TIN. The dialog is depicted below.



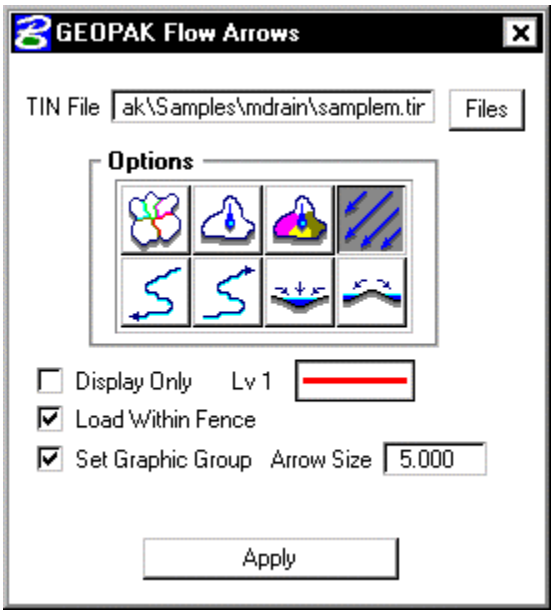
Fields in this dialog are described in the table below.

TIN File	GEOPAK binary TIN file. Selecting the **File** button invokes a File Manager wherein the desired TIN may be selected.
Display Only	When activated, elements are displayed and not drawn. Therefore, the display is erased when any screen refreshing is done.
Level 1 Element	Clicking on the element symbology box, the dialog depicted below is

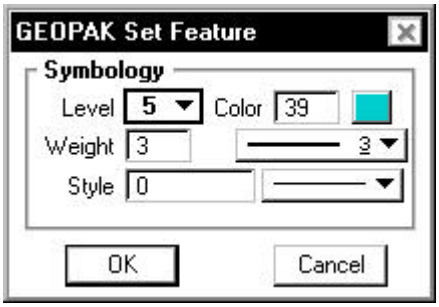
Symbology	displayed.  Within this dialog, all element symbology options are supported. Simply set the level, weight, color, style, and text parameters (if present) and press the **OK** button to automatically close the dialog and return to the main dialog. Pressing the **Cancel** button closes the dialog with no changes occurring. The dialog can also be invoked by pressing the right mouse button while the cursor is located on the element symbology, and selecting the Feature Dialog.  In addition, the element symbology can be set **By Current**. When selected, the active element parameters are utilized to set the feature. By the **By Element** option is selected, the user is prompted to select any MicroStation element, which is then highlighted and its symbology is populated within the dialog. Copy and Paste options are also supported. For example, if we want to use the same symbology for two items, simply place the cursor over the first element symbology, then right mouse click and select **Copy**. Note the **Paste** option is ghosted. Next, select the element symbology of the second item, right mouse click and select **Paste**. The symbology copied from the first item is now pasted into the second item symbology.
Process	Commences the Upstream Trace processing.

15.12 Delineate Flow Directions

The Delineate Flow Directions Tool indicates the direction of flow within the triangles for a given region of the TIN. The dialog is depicted below.



Fields in this dialog are described in the table below.

TIN File	GEOPAK binary TIN file. Selecting the **File** button invokes a File Manager wherein the desired TIN may be selected.
Display Only	When activated, elements are displayed and not drawn. Therefore, the display is erased when any screen refreshing is done.
Load Within Fence	When a MicroStation fence is placed and the toggle is activated, only flow arrows within the fence will be drawn or displayed.
Set Graphic Group	When activated, all flow arrows are placed in a single graphic group each time the Apply button is pressed.
Level 1 Element Symbology	Clicking on the element symbology box, the dialog depicted below is displayed.  Within this dialog, all element symbology options are supported. Simply set the level, weight, color, style, and text parameters (if present) and press the **OK** button to automatically close the dialog and return to the main dialog. Pressing the **Cancel** button closes the dialog with no changes occurring. The dialog can also be invoked by pressing the right mouse button while the cursor is located on the element symbology, and selecting the Feature Dialog.

	 In addition, the element symbology can be set **By Current**. When selected, the active element parameters are utilized to set the feature. By the **By Element** option is selected, the user is prompted to select any MicroStation element, which is then highlighted and its symbology is populated within the dialog. Copy and Paste options are also supported. For example, if we want to use the same symbology for two items, simply place the cursor over the first element symbology, then right mouse click and select **Copy**. Note the **Paste** option is ghosted. Next, select the element symbology of the second item, right mouse click and select **Paste**. The symbology copied from the first item is now pasted into the second item symbology.
Arrow Size	Size of Flow Arrow in master units.
Apply	Commences the Delineate Flow Arrows procedure.