Terrace Design Tool (TDT)

Version 3.0

User Documentation

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EFT - Engineering Field Tools

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1. Starting EFT & TDT

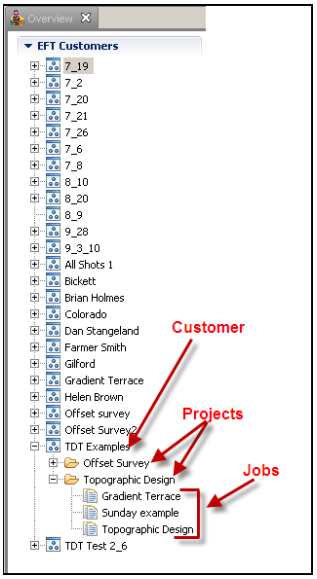
For all instructions in this document "click" means clicking the left mouse button. "Right click" means clicking the right mouse button. Text that is in ***italics*** refers to functional actions in TDT.

After installing TDT according to the instructions, navigate to the folder that contains EFT. Double click the file ***EFT.exe*** to start EFT.

Close the ***Welcome*** screen by clicking on the ***X***.

Jobs are stored in EFT in the following hierarchy:

- Customer
  - Project
    - Job (SET Waterway, TDT).



This hierarchy allows the user to identify a Customer. The Customer can have multiple Projects and each Project can have multiple Jobs. The user can access all of the Projects and Jobs for a Customer from one folder, and once the Customer information is filled out, it stays with all the Customer's Projects and Jobs.

1.1 Creating a New Customer, Project & Job

To create a new Customer, Project and Job, move the cursor to ***EFT Customers***.

- Right click, then click ***New Customer***.
- Fill in the ***New Customer*** information.
- Click ***OK***

This information is now available for all jobs associated with this customer. The new customer name appears in the folder tree. To start a new Job for this customer:

- Right click on the new customer's name.
- Click ***New Project***.
- Give the new project a name and click ***OK***.
- Click the + sign beside the new customer name to expand the folder and show the project name(s).
- Right click the project name.
- Click on ***New Terrace***.
- Enter a name for the terrace and click ***OK***.

This opens the design window to allow the design of a new terrace.

2. TDT Quick Start Guide

The following is a short outline explaining the steps to follow in TDT to design a terrace. Each step is covered in detail in the User's Guide and the relevant sections are referenced in the Quick Start outline.

2.1 Storage Terrace and WASCOB Design

1. Generate a surface (topographic map) – **Section 6**
2. Define the terrace alignment – **Section 7**
   a. Layout an alignment – **Section 7.2**
   b. Select the alignment to be used for a terrace – **Section 8.2**
3. Design the terrace – **Section 8**
   a. Complete the data entry for the ***Hydrology, Soil, Vegetal*** and ***Template*** tabs – **Section 8.3**
   b. Examine the profile and enter the terrace channel – **Section 8.5**
   c. Set the outlet location – **Section 8.7.3**
   d. Complete initial terrace design – **Section 8.9**
   e. Make adjustments in design inputs if necessary
   f. Balance cuts and fills – **Section 8.10**
4. Design the underground outlet – **Section 8.12**
   a. Layout an alignment for the underground outlet – **Section 8.12.1**
   b. Layout the profile of the underground outlet – **Section 8.12.2**
   c. Design the inlet for the underground outlet – **Section 8.12.3**
   d. Design the outlet for the underground outlet – **Section 8.12.3**
   e. Select appurtenances such as grade breaks and junctions – **Section 8.12.3**
   f. Size the underground outlet – **Section 8.12.7**
5. Generate construction plans and documentation – **Section 11**

2.2 Level Terrace Design

1. Generate a surface (topographic map) – **Section 6**
2. Terrace alignment – **Section 7**
   a. Layout an alignment – **Section 7.2**
   b. Select the alignment to be used for a terrace – **Section 8.2**
3. Design the terrace – **Section 9**
   a. Complete the data entry for the ***Hydrology*** and ***Template*** tabs – **Section 9.2**
   b. Examine the profile and enter the terrace channel – **Section 9.4**
   c. Complete initial terrace design – **Section 9.9**
   d. Make adjustments in design inputs if necessary
   e. Balance cuts and fills – **Section 9.10**
4. Generate construction plans and documentation – **Section 11**

2.3 Gradient (Waterway Outlet) Terrace Design – Section 10

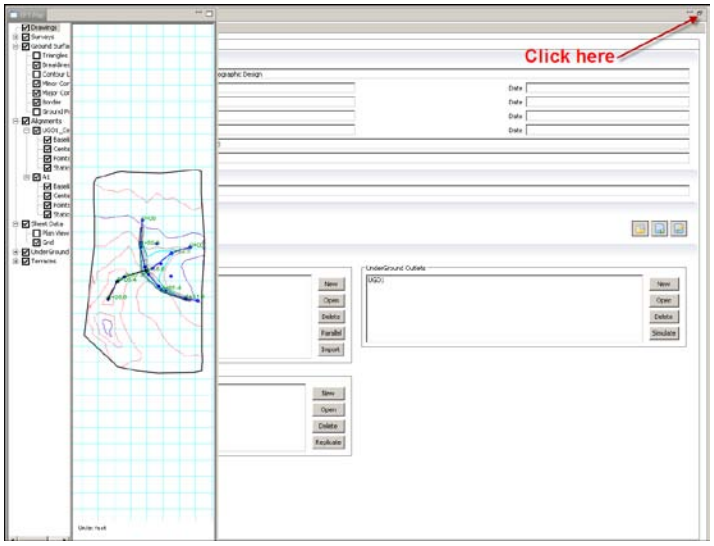
1. Generate a surface (topographic map) – **Section 6**
2. Terrace alignment- **Section 7**

   a. Layout an alignment – **Section 7.2**
   b. Select the alignment to be used for a terrace – **Section 8.2**
3. Design the terrace – **Section 10.3**
   a. Complete the data entry for the ***Hydrology*** and ***Template*** tabs – **Section 10.3, Section 10.6**
   b. Examine the profile and enter the terrace channel – **Section 10.7**
   c. Complete initial terrace design – **Section 10.9**
   d. Make adjustments in design inputs if necessary
   e. Balance cuts and fills – **Section 10.10**
4. Generate construction plans and documentation – **Section 11**

2.4 Common Problems Encountered in TDT

Listed below are some of the common problems that are encountered in TDT and how to correct them. These issues may be more understandable after the user has run TDT a few times. Refer back to this section if these problems are encountered.

- If a job is closed without saving or is otherwise closed improperly, when TDT is restarted, the Map Function buttons may not be displayed across the top of the map area. To correct this problem, save the current file by clicking File, Save. Close then re-open TDT. The Map Function buttons should now be displayed above the mapping area of the screen.
- If a file is closed with one of the views expanded to full screen, when TDT is reopened, the views will overlap each other as shown in the screen shot below. To correct this problem click in the upper right corner as shown.

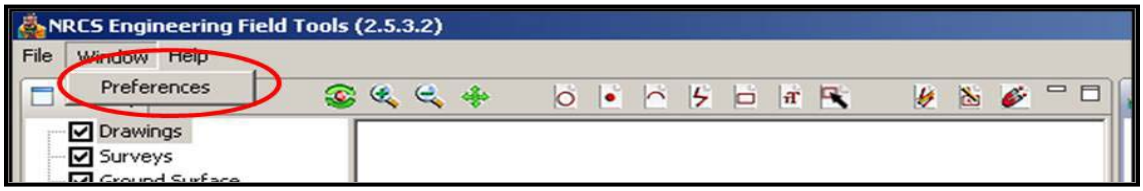


- Sharp curves or angles can cause problems during surface generation. This will show up as an error when the terrace is designed. Correct this problem by enabling curves on the terrace alignment.
- Particularly on flat terrain, the terrace design may generate an error message about overflow at the terrace ends. Correct this problem by revising the terrace channel profile and/or enable end blocks.

- For terraces on steep topography, the cut slope needs to be steep enough to intercept original ground in a reasonable distance. If not, an error may be generated because the design may extend beyond available topo information. Correct this problem by steepening the cut slope or adding more topo information.
- Similar problems can occur simply because the survey data does not encompass the entire terrace footprint. This can be a problem on steep terrain where a flat back slope runs past available survey data or there is no survey data past the ends of terrace channel. Correct this problem by changing terrace slopes, alignment length or by gathering additional survey information.
- A common error is to forget or incorrectly identify the uphill direction when filling in terrace template information. This will generate an error during design. Always check to ensure the uphill direction has been correctly identified. Uphill from an alignment is identified by standing at station 0+00 and looking towards increasing stations.

3. Preferences

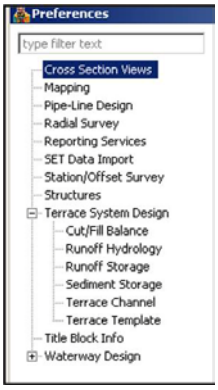
Preferences allow the user to pre-set many values that are used over and over in EFT. If similar terraces with similar inputs are being designed, time can be saved during the design process by populating input values in ***Preferences***. ***Preferences*** can be set by clicking on ***Window, Preferences*** located in the top left of the menu bar.



It may be helpful to go through a few designs before setting the ***Preferences***. Default values are used unless changes are made in ***Preferences***. Any of these values can be changed in the program during the design process.

To get started in Terrace the user should consider setting values for the following items:

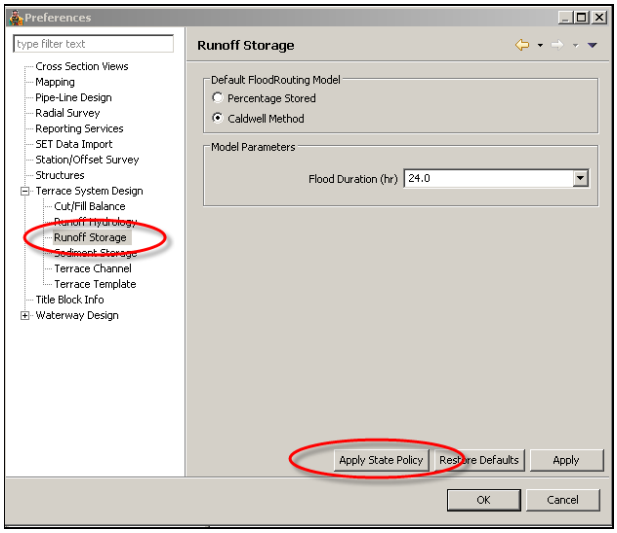
- SET Data Import
- Station Offset
- Terrace System Design
    - Cut/Fill Balance
    - Runoff Hydrology
    - Runoff Storage
    - Sediment Storage
    - Terrace Channel
    - Terrace Template



3.1 Apply State Policy

In addition to user defined preferences, TDT also allows the application of "State Policy" for a few items. This function allows certain criteria in ***Preferences*** that will make underlying changes in the information TDT uses for design processes, to be pre-set at an Area Office or State Office level, as opposed to making a simple ***Preferences*** change, which only affects data values that will be pre-populated on a user interface.

The items where "State Policy" can be applied are ***PipeMaterials, Runoff Storage*** and ***Terrace Template***. To make "State Policy" changes, State Conservation Engineers should contact the EFT development team for assistance.

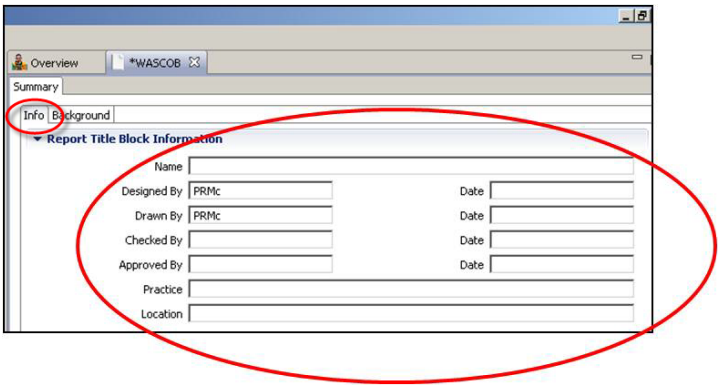


Each of the ***Apply State Policy*** items is explained below.

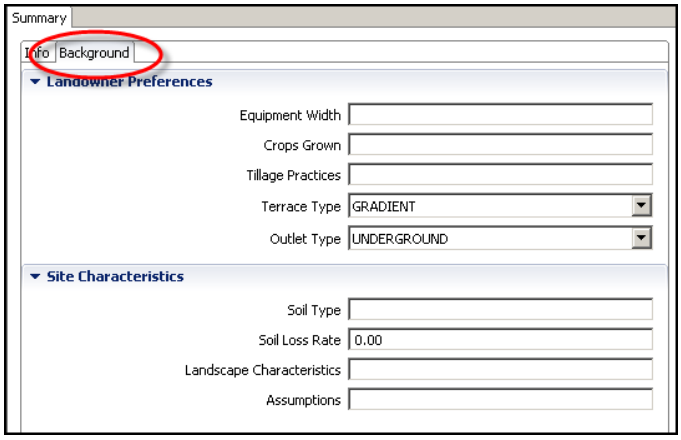
- ***PipeMaterials*** – This is a list of available pipe materials, the corresponding Manning's n value, whether it is perforated and whether the pipe can be pressurized.
- ***Runoff Storage*** – This is a table of the values used in the Caldwell routing procedure.
- ***Terrace Template*** – These are tables of values used to define the characteristics of terrace templates such as side slopes.

4. Using TDT

After setting up a new ***Customer, Project*** and ***New Terrace*** the ***Info Tab*** for designing a terrace will now come up and a user interface will open. On the right are 2 tabs, ***Info*** and ***Background***. The first step is to fill in the ***Title Block Information*** on the ***Info*** tab. The user must enter at least a ***Name*** or TDT will generate an error. The other information in the ***Title Block*** is not required for functionality but it is useful because it will be carried through to the output and printed in the output reports.

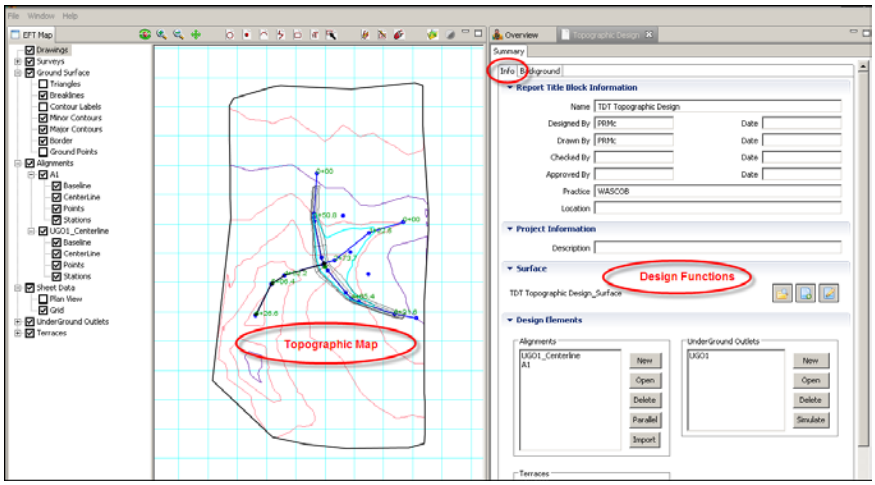


The ***Background*** tab lets the user fill in information for documentation purposes. The information filled in here is not used in the design but is carried through the design and can be included in the report output.

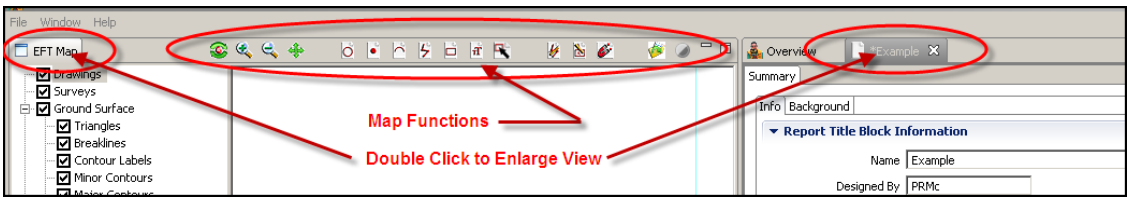


4.1 Info Tab

The ***Info*** tab is the user interface where the terrace will be designed. Click the ***Info*** tab to open it. The topographic map is displayed at the left once it is created. To the right are the tabs for the design functions that will be used to design the terrace.

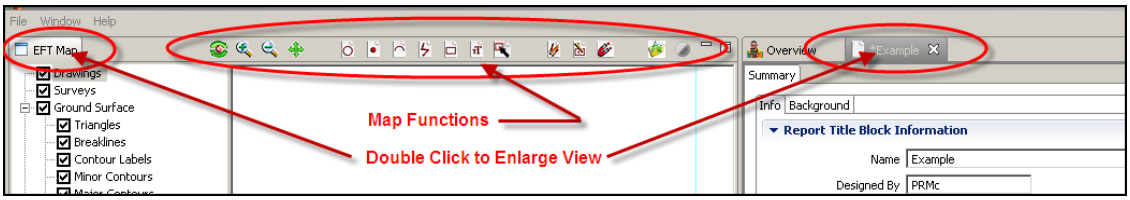


Both halves of the page have a tab at the top that controls how they are viewed. The left tab title is ***EFT Map***, the right tab shows the ***Terrace Name***. Double clicking either of these tabs or clicking the ***Maximize*** icon, fills the screen with that view. Return to the normal view by double clicking the tab again.



4.1.1 Map Functions

EFT Map also has a series of map function buttons across the top of the view. These allow zooming, panning, measuring and drawing on the map. Mousing across each button will display its function. The buttons and their functions are:



a. View ***Full Extent, Zoom In, Zoom Out*** and ***Pan*** - allow the user to move around the map.

b. ***Circle, Point, Arc, Polyline, Rectangle, and Text*** – allow the user to add simple lines, shapes and text to the map.

c. ***Select*** – allows the user to select an object that has been drawn on the map and move it.

d. ***Measure Line*** – allows the user to measure the length of a straight line. The coordinates of the cursor are displayed at the bottom of the map along with the slope of the line that has been drawn. This can be used to estimate watershed length and to estimate watershed slope.

e. ***Measure Area*** – allows the user to draw a polygon around an area and determine the area of the polygon. This can be useful in estimating the drainage area for a terrace.

f. ***Snap to Point*** – allows the user to snap to a surveyed point on the map. This is useful when laying out an alignment that follows points that have been surveyed in.

5. TDT Design Logic

The design process in TDT attempts to mimic the process a designer might use if the design were being done manually. Key steps are automated and the output from the program includes construction plans and documentation information. TDT can be used to design storage terraces, water and sediment control basins, gradient terraces and level terraces. The design processes for each type of terrace are outline below.

5.1 Storage Terrace or WASCOB

1. Generate a surface (topographic map)
2. Define the terrace alignment
    a. Layout an alignment
    b. Select the alignment to be used for a terrace
3. Design the terrace
    a. Complete the data entry for the ***Hydrology, Soil, Vegetal*** and ***Template*** tabs
    b. Examine the profile and enter the terrace channel
    c. Set the outlet location
    d. Complete initial terrace design
    e. Make adjustments in design inputs if necessary
    f. Balance cuts and fills
4. Design the underground outlet
    a. Layout an alignment for the underground outlet
    b. Layout the profile of the underground outlet
    c. Choose the inlet for the underground outlet
    d. Choose the outlet for the underground outlet
    e. Select appurtenances such as grade breaks and junctions
    f. Size the underground outlet
5. Generate construction plans and documentation

5.2 Level terrace

1. Generate a surface (topographic map)
2. Terrace alignment
    a. Layout an alignment
    b. Select the alignment to be used for a terrace
3. Design the terrace
    a. Complete the data entry for the ***Hydrology*** and ***Template*** tabs
    b. Examine the profile and enter the terrace channel
    c. Complete initial terrace design
    d. Make adjustments in design inputs if necessary
    e. Balance cuts and fills
4. Generate construction plans and documentation

5.3 Gradient Terrace

1. Generate a surface (topographic map)
2. Terrace alignment
    a. Layout an alignment

   b. Select the alignment to be used for a terrace
3. Design the terrace
   a. Complete the data entry for the ***Hydrology*** and ***Template*** tabs
   b. Examine the profile and enter the terrace channel
   c. Complete initial terrace design
   d. Make adjustments in design inputs if necessary
   e. Balance cuts and fills
4. Generate construction plans and documentation

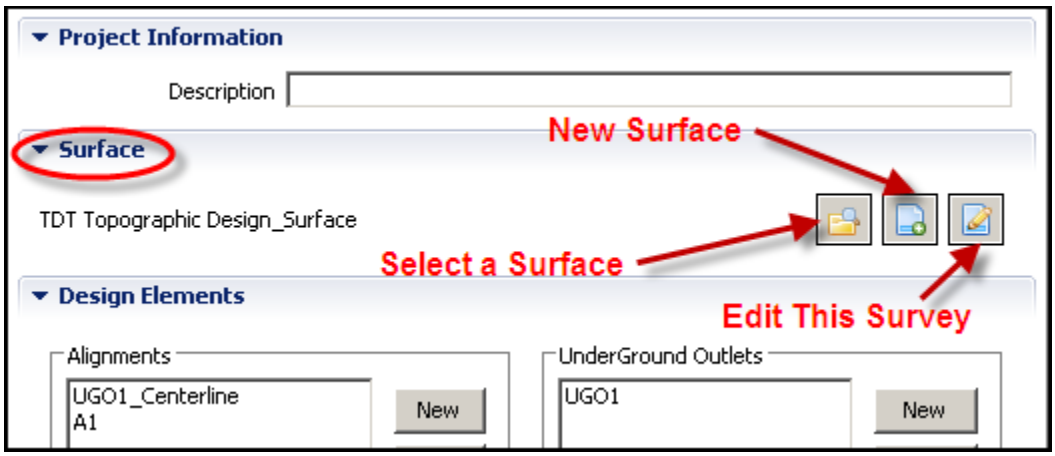
The generation of a surface or topographic map, the laying out of an alignment and the development of construction plans and documentation are the same for all types of terraces. These processes will be explained generically and apply to all types of terraces. The design processes for each type of terrace will be explained individually.

6. Surface Generation

TDT performs all volume calculations (both storage volumes and earthwork quantities) by comparing the original ground surface to the ground surface defined by the terrace that is being designed. The original ground surface is defined by survey data supplied by the user. The survey information can be a simple station offset survey or complete topographic survey. The more detailed the survey information the more accurate the volume calculations. As a minimum the survey data must cover slightly more than the footprint of the terrace including the embankment, channel and cut slope. The process for entering survey data depends upon the type of survey method used but is the same for all types of terraces.

Survey information can be entered in TDT or through Survey Engineering Tool (SET). Entering survey data through SET offers some advantages in the flexibility of manipulating data such as combining surveys. Refer to SET instructions for entering and manipulating survey data through SET.

In TDT all survey data is entered from the ***Surface*** tab on the front page of the terrace design user interface.



Three options are available (mouse over the buttons to see their function):

- Select a Surface – Used if a surface has already been generated
- New Surface – Used to enter new survey data
- Edit This Survey – Used if a surface has already been selected for a terrace

Click on the appropriate choice to enter or edit survey data.

6.1 Entering Survey Data

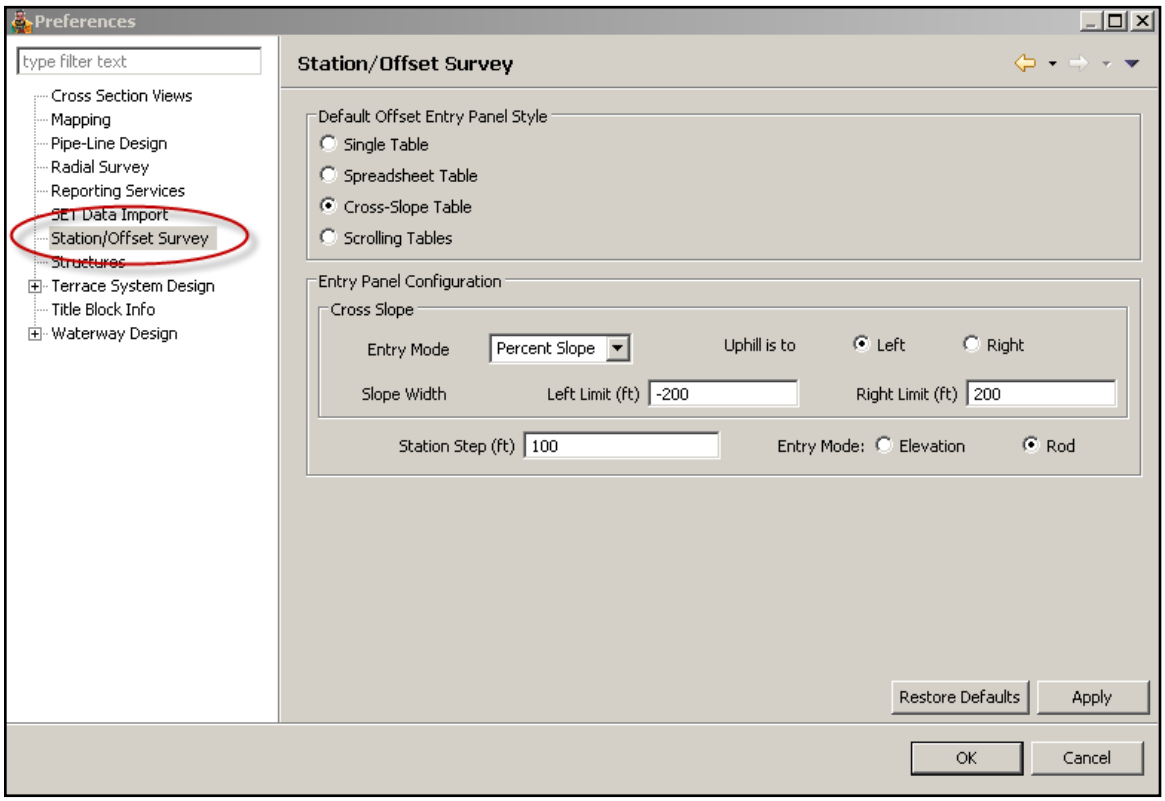
Described below are instructions for station offset surveys and X,Y,Z topographic surveys, the most commonly used survey methods for terraces. To enter a radial survey, refer to SET instructions.

6.1.1 Station Offset Survey Preferences

A level is generally used for a station offset. Side shots are taken from the terrace alignment which establishes a baseline for the survey. TDT offers 4 different methods to enter data from a station offset survey.

- Scrolling Table
- Single Table
- Spreadsheet Table
- Cross Slope Table

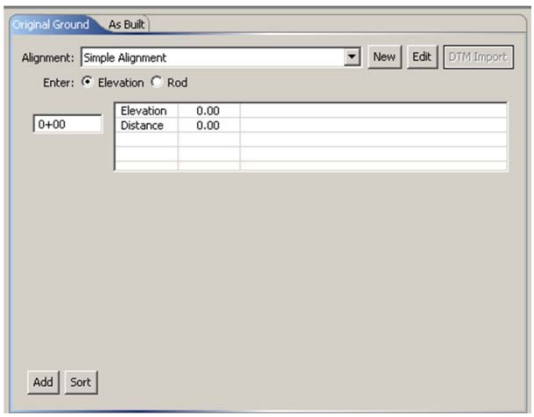
These different methods refer to how the data is handled as it is input by the user. The choice of which method to use is made from ***Preferences***. Click on ***Window, Preferences, Station/Offset Survey***. This will display the 4 choices with a button beside each one. Click the appropriate button to set this choice in ***Preferences***. The chosen method for station offset data entry will now come up automatically until this ***Preference*** is changed.



6.1.2 Scrolling Table

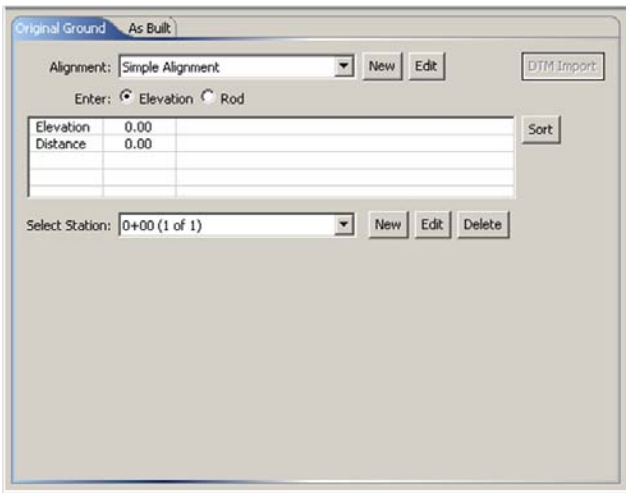
This data entry method provides a simple table for data entry. Survey data can be entered as HI, rod readings and distance or as distance and elevation. Pressing ***Enter*** after entering a rod reading or distance, moves the cursor to the next column ready for the next entry. After 2 points are entered, the cross-section is displayed. The alignment of the survey is assumed to be a simple baseline without defined curves or angles. Negative and positive distances can be entered to designate left or right of the baseline. The ***Sort***

button will reorder shots in the table according to distance if they were not entered sequentially. Click ***Add*** when a cross-section is finished to enter the next station number. Another table is displayed and the data for the next cross-section can be entered. Continue this process until all cross-sections have been entered. Press ***Accept Edits*** and TDT will generate a topographic map from the data.



6.1.3 Single Table

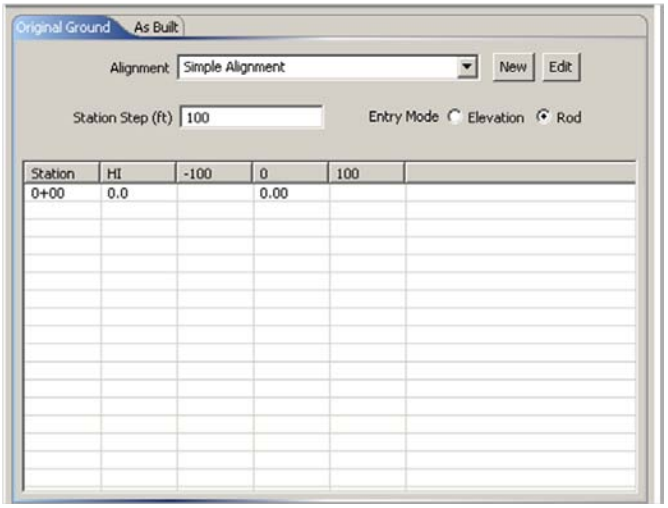
Data entry is similar to the scrolling table with HI, rod readings and distance or as distance and elevation. Click on ***New*** after completing data entry for a cross-section to add the next station. Enter the next station and click ***OK***. The table for the next station is displayed ready for entry. The ***Sort*** button will reorder shots in the table according to distance if they were not entered sequentially. The ***Edit*** button allows the user to edit the data for the currently displayed station. The ***Delete*** button allows the user to delete the currently displayed station. Click ***Accept Edits*** when all data has been entered. TDT will generate a topographic map from the data.



6.1.4 Spreadsheet Table

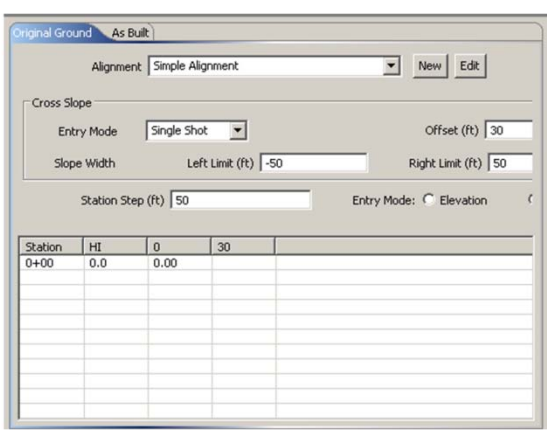
This data entry method presents the user with a table that is pre-populated with offset distances for each cross-section. The offset distances are entered on the ***Preferences*** tab along with the stationing interval and the choice of elevation or rod reading entry. The

example shown below only shows a single shot to the left and right of the baseline but the user can define as many side shots as they need. However, once these values have been entered in ***Preferences*** they cannot be changed on the spreadsheet. Rod readings or elevations are entered for each distance. The ***Tab*** or ***Enter*** key is used to move through the table. At the end of the distance entries for a cross-section, ***Tab*** or ***Enter*** moves the cursor to the next cross-section. Click ***Accept Edits*** when all data has been entered. TDT will generate a topographic map from the data.



6.1.5 Cross slope table

This is the simplest data entry method for a station offset survey. In this method the user enters only a single elevation shot along the alignment and either a percent slope that defines the land slope of the cross-section or a single side shot that will be used along with the alignment shot to define the land slope for the cross-section. This method should only be used for terrain that is very uniform in slope. For the survey input, the user needs to choose a single shot or percent slope. For a single shot, input the offset that will be used. For a percent slope indicate which direction is uphill. Next define the limits of the survey left and right. Next input the station interval. Finally, choose elevation or rod reading. The user can now input data into the table for each station along the alignment. Click ***Accept Edits*** when all data has been entered. TDT will generate a topographic map from the data.



6.1.6 Using Offset Surveys

Because TDT does volume calculations by generating a surface model and for underground outlets, needs enough data to define the profile of the underground outlet, the amount and type of data that must be gathered may be different from what has been traditionally gathered for a simple station offset survey for a terrace layout and design. Some of the things that a user needs to keep in mind when conducting a station offset survey that will be used in TDT are:

- The station offset survey needs to extend beyond the planned ends of the terrace alignment. TDT cannot accommodate negative stationing, so add a station or two to the planned beginning and end of the survey for the terrace alignment.
- Likewise the offset shot(s) need to fully encompass the footprint of the terrace embankment, channel, cut slope and back cut slope if applicable.
- If the user wants to plan multiple terraces in a field that share an underground outlet system, then each terrace needs to have an alignment along with an alignment for the underground outlet that spatially ties the terrace alignments together as well as locates the underground outlet. The process for doing this is explained below.
- These considerations may change slightly the way that station offset surveys have traditionally be done for terraces but improvements in design accuracy and the ease of producing professional quality plans and documentation should compensate for any small increases in survey data collection.

6.1.6.1 Offset Survey Procedures for Multiple Terraces with or without Underground Outlets

To use the station offset survey procedure for multiple parallel terraces in a field and to have TDT show these terraces in relationship to each other, the survey data must be entered in a specific way. An underground outlet can also be included in this process if handled correctly. The procedures discussed below will include an underground outlet. If a station offset survey is used for a terrace system that does not include an underground outlet (level terrace or gradient terrace) the process is the same. Just ignore the information about the underground outlet.

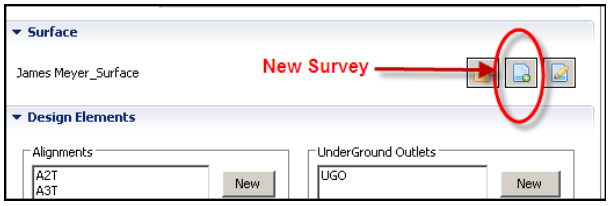
The following procedure can be used to link together station offset surveys for any of the data entry methods. However, the directions are written specifically for the Cross-Slope method to include an underground outlet. For Spreadsheet, Scrolling Table and Single Table follow this procedure except steps 17 & 18.

A quick outline of this process is:

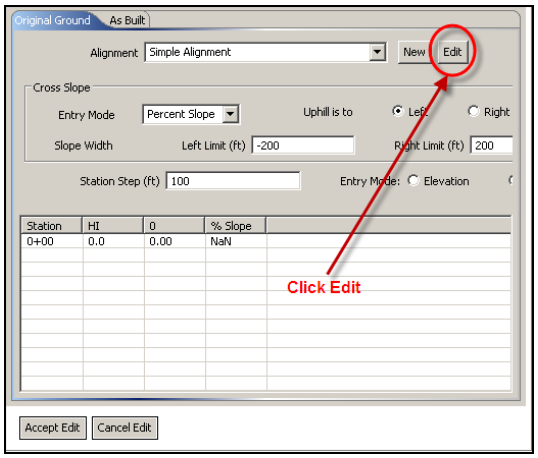
- Define an alignment for each terrace in the system.
- Include an extra alignment that will only have one centerline and side shot for the outlet of the underground outlet.
- Enter the side shots for each alignment.
- After all side shots are entered click ***Accept Edits*** to generate the topographic map.

A detailed description of each step follows.

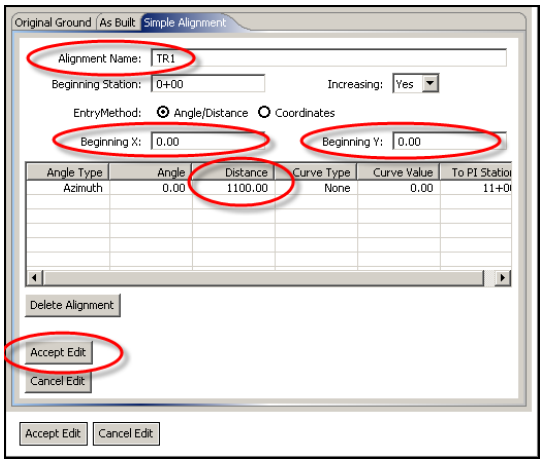
1. From the ***Info*** tab click ***New Survey***.



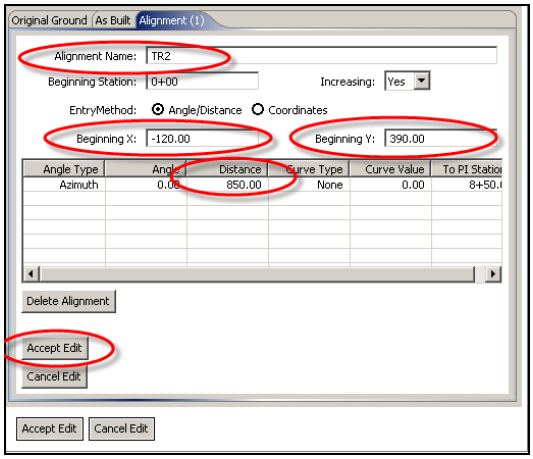
2. Give the survey a name and select ***Station Offset*** from the drop down menu.
3. From the station offset entry screen select ***Edit***.



4. This will open a new interface where the alignment can be re-named. Enter a new alignment name. For this example TR1 is shown. This will be the alignment name for the first terrace. **Note:** By editing this Simple Alignment and renaming it, it removes this alignment and avoids potential conflicts.
5. Enter a beginning X, Y. For this example 0, 0 is shown.
6. Enter a distance. This distance is the length of the first terrace alignment. Remember to make this length longer than the planned terrace length. For this example 1100 ft is shown. This will result in a straight north-south alignment, 1100 feet long. **Note:** If ***Enter*** is pressed while the cursor is in the distance field, an extra alignment segment will be created. If this occurs, right click on the extra row and delete it.
7. Click ***Accept Edits*** for this tab. ***Accept Edits*** appears twice on this screen. Note which one is circled on the screen shot below and should be clicked to accept the alignment edits.



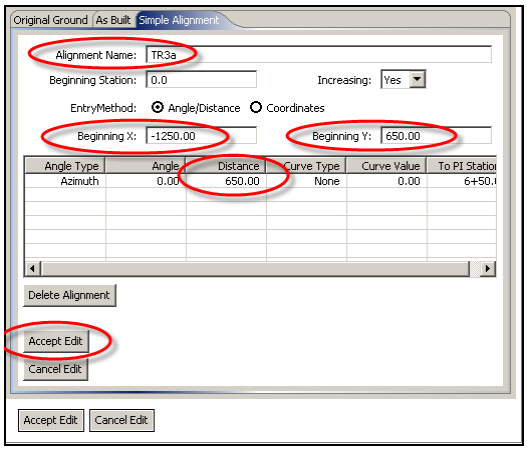
8. A new station offset screen will open. Click ***New*** to add an alignment for the second terrace. Edit the alignment name to something more appropriate. For this example TR2 is shown.
9. Enter a beginning X, Y. Enter an X value to separate terrace 1 from terrace 2. Typically this will be equal to the terrace spacing, in this case 120 feet to the left (west). So X = -120.00. Y is the north/south beginning point relative to the first terrace. Entering a Y coordinate allows the user to adjust the position of the riser intake relative to the one in the first terrace. The result will be an underground outlet that is the same length as measured in the field. In this case 390 feet north of the original point so Y = 390.00
10. Enter a distance. As before the distance is the length of the alignment. In this case 850 feet.



11. Click ***Accept Edits*** as before. For additional terraces, repeat steps 8 through 10 to enter their alignments. Create additional parallel alignments for each terrace in this same manner using the correct X, Y values that are in relationship to the 0, 0 points entered for the first alignment.
12. When the last terrace alignment is entered click ***Accept Edits*** as before but the next alignment to be entered will be an extra alignment for the underground outlet

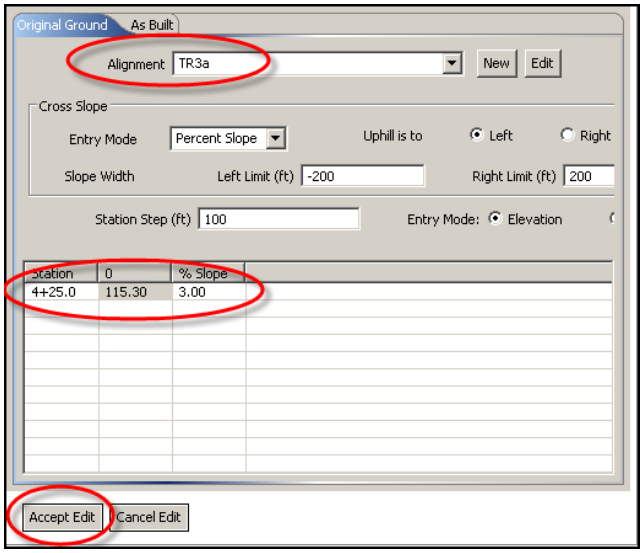
surveyed point. For simplicity, create this alignment parallel to the lowest terrace alignment.

13. Click ***New*** and give the alignment for the underground outlet a name, in this case TR3a.
14. Enter a beginning X, Y. X will represent the total distance to the left (west) of the first terrace where the outlet shot was taken. In this case 1250 feet. For simplicity's sake make Y the same as the last terrace.
15. Enter a distance. This number is not critical. Use the same distance as the last terrace. By using the same Y and distance, an alignment the same length will be created parallel to the last terrace offset a distance that corresponds to the distance to the outlet shot.
16. Click ***Accept Edits*** as before.

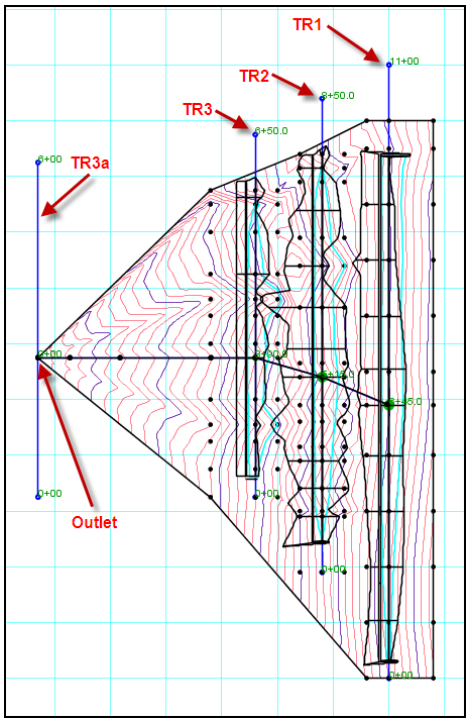


17. For the Spreadsheet, Scrolling Table and Single Table data entry methods the underground outlet can be defined by simply extending the offset shots on the station that corresponds to the location of the underground outlet downhill to the actual outlet. For the Spreadsheet, right click on a side shot to add an extra column at the distance for the underground outlet shot. In the field, when gathering survey data for the outlet, the only requirement is to take the shot at the outlet a known distance from the downhill terrace alignment.
18. Now that the alignments for all of the terraces and the underground outlet shot have been defined, the centerline shots and side shots or slope percentage values need to be entered for each alignment.
19. Enter the centerline and side shots as you normally would, according to the directions in **Section 6.1.2, 6.1.3, 6.1.4 or 6.1.5** depending on the input method used.
20. For the extra alignment that represents the underground outlet, only one centerline shot will be entered. This shot will be the outlet shot. Locate it at a station along the alignment that will represent its Y location in relationship to the last terrace. The side shot or percent slope at this station should represent the slope of the ground leading to the outlet. However, since this method automatically calculates points (shots) at the left and right limits, choose appropriate distances for these limits. These could be as little as 1 foot, but 10 or 20 feet will place these points

further away from the outlet point, making it easier to select the outlet point when sketching the underground outlet alignment.

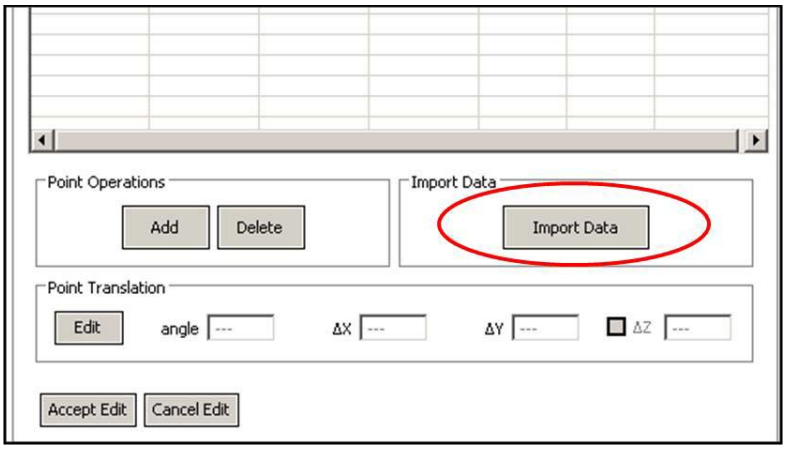


21. Click the ***Accept Edits*** button at the bottom of the page and TDT should generate a topo map that includes all of the alignments entered and the outlet shot. The topo lines leading down to the outlet may appear distorted but this does not matter since this information will only be used to generate a profile for the underground outlet. The actual alignment for the underground outlet still needs to be defined. This will be covered in **Section 7**.

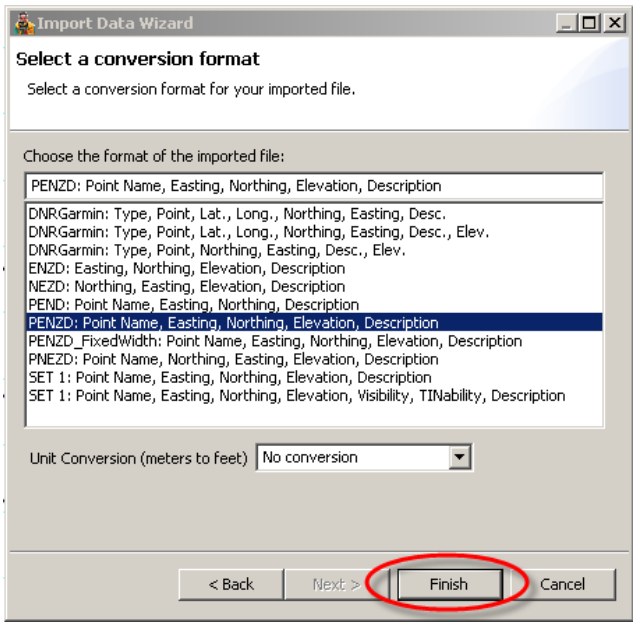


6.2 X, Y, Z Point Data From a Topographic Survey

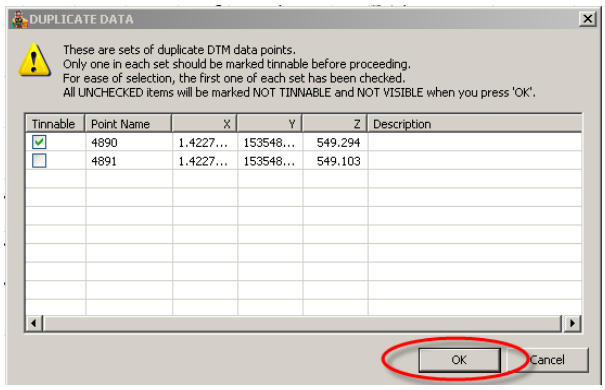
Use this method if a topographic survey has been done that generates X, Y, Z points. Start the process by clicking on ***Generate a Surface***. Give the survey a name and click OK. Click on ***Import Data***. Browse to where survey data is stored.



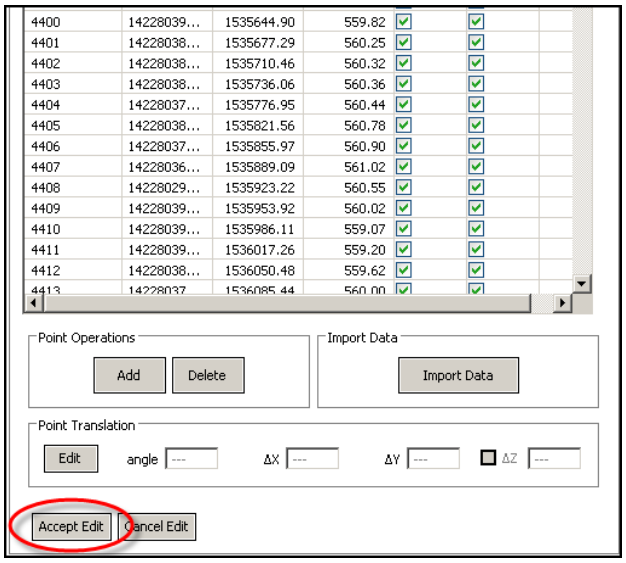
Select the file and click ***OK***. Choose the correct format of the file from the list and click ***Finish***.



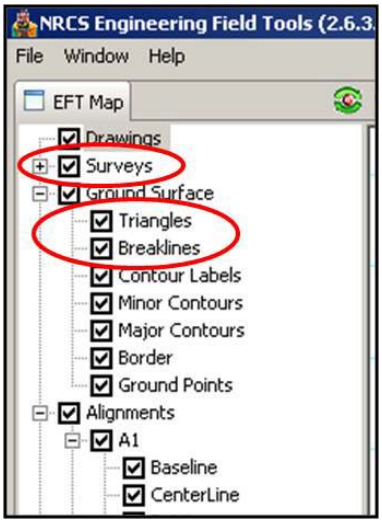
TDT checks the data for duplicate points, Click ***OK***.



The points are now displayed. Further editing can be done for the points that will used to generate the topo such as removal of benchmarks and TBMs from tinnable points. Tinnable points are those that will be used to generate the topo map. When complete click the ***Accept Edit*** button. A topo map will appear on the left side of the page.



On the left side of the topo map un-check the boxes for *Surveys* and *Triangle*s to get a better view of the topo map. Zoom in on the area of interest by clicking on the magnifying glass with the + sign on the left side of the toolbar. Place the cursor in the upper left corner of the area you want to zoom in on. Left click and hold down on the button as you drag the box over the area to be zoomed in on. Release the button and the display will zoom in.


NRCS Engineering Field Tools (2.6.3
File
Window
Help
EFT Map
Drawings
Surveys
Ground Surface
Triangles
Breaklines
Contour Labels
Minor Contours
Major Contours
Border
Ground Points
Alignments
A1
Baseline
CenterLine

7. Alignment

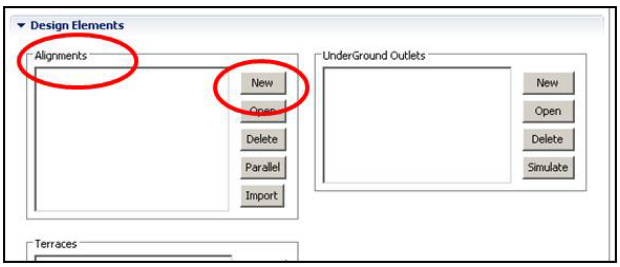
After a surface has been generated the next step is to layout the alignment for the terrace. The process is the same for all types of terraces although it can be slightly different for different types of surveys.

7.1 Simple Alignments and Station Offset Surveys

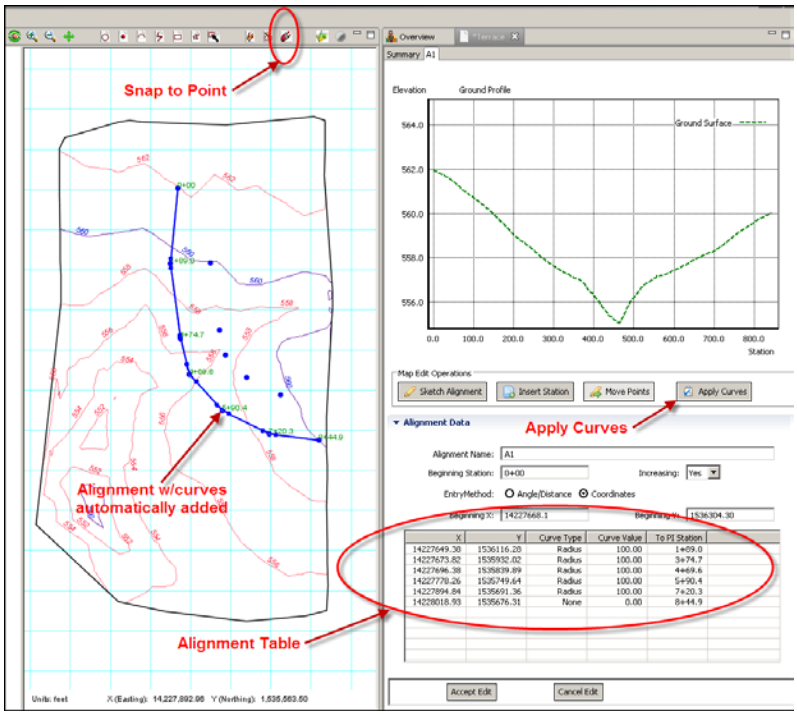
Station offset surveys automatically generate a default alignment called a "Simple Alignment" that follows the zero offset shots entered for the survey. For a station offset survey, if this is the alignment that will be used for a single terrace, no other alignment layout is needed. However, TDT will prompt the user to enter a new name for the alignment.

7.2 Alignment Layout

The alignment can be laid out from points that have been surveyed or it can be laid out freehand to fit the topography. The process is started from the ***Design Elements*** tab. Under ***Alignments*** click ***New***. Enter a name for the alignment and click ***OK***. An alignment editor screen now opens. The alignment can be entered on this screen either by entering the coordinates of each point or by drawing on the screen. The preferred method is to draw on the screen.



To use surveyed points to layout the alignment click on the ***Snap to Point*** icon on the toolbar above the map. This icon can be identified by mousing over the icons and reading the names. Surveyed points do not have to be used, the alignment can be drawn in free hand. Do not use ***Snap to Point*** if the alignment is to be drawn free hand.



Click on the points for the alignment and watch the location of the alignment as it is laid out on the screen. At the same time a table is populated with coordinates and other information about each alignment segment. Double click on the last point to end the alignment. Ending the alignment can be tricky. If an extra station or 2 is inadvertently added or you just want to remove a station, right click on the station in the table to remove it.

7.3 Refining the Alignment

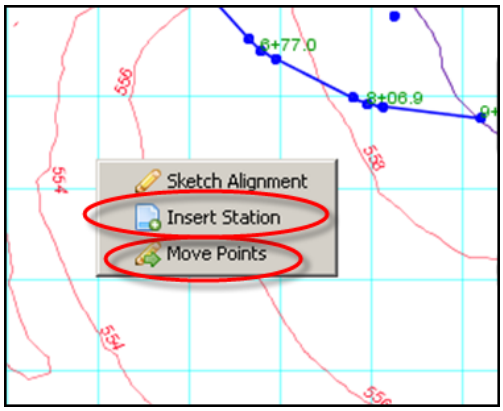
After the alignment is entered it should be refined. This is done by clicking on ***Apply Curves, Move Point*** or ***Insert Station.*** In order to calculate volumes, the alignment must have relatively smooth curves. If the alignment has sharp angles an error may occur during the design process as TDT generates the surface model. This can be avoided by adding curves to the alignment to smooth out any angles or sharp curves in the alignment. ***Apply Curves*** globally adds curves to the entire alignment. ***Move Points*** allows the user to re-position existing stations. ***Insert Stations*** allows additional stations to be inserted.

7.3.1 Apply Curves

After the alignment has been successfully laid out, quickly add curves to the entire alignment by clicking the ***Apply Curves*** button. TDT will apply curves to each station along the alignment. See the screen shot above that shows the radius points added to the alignment.

7.3.2 Move Points

To move individual station points along the alignment, right click and a drop down menu appears or click the ***Moves Points*** button.



Move the cursor to a station on the map view that needs to be moved. A green circle should be displayed around the point. To move the point, click on the point and drag it to a new location.

7.3.3 Insert Station

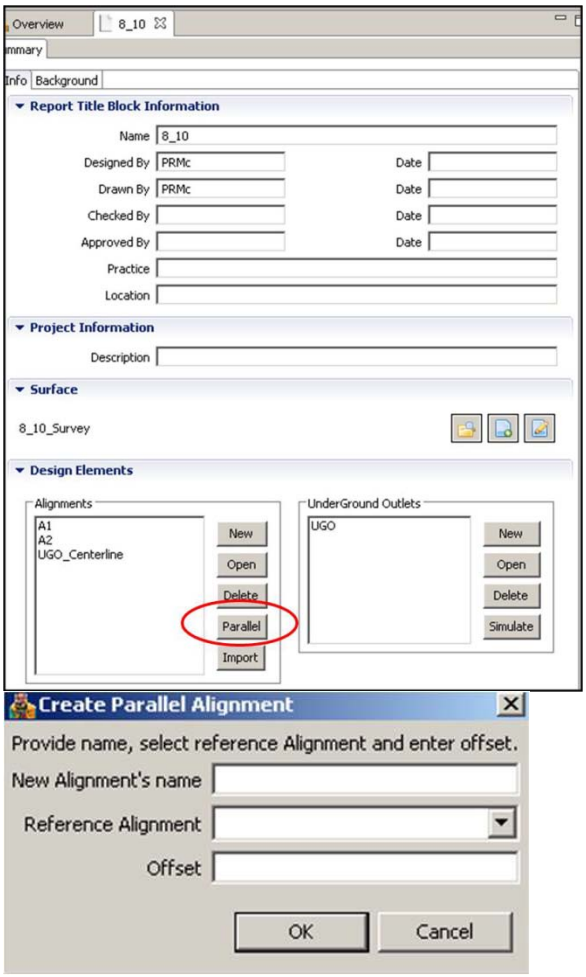
Stations can also be inserted. Click on ***Insert Station*** or right click on the topo map and move the cursor to the alignment to add stations by clicking where a new station needs to be inserted.

Use these tools to make all necessary adjustments in the alignment. When an acceptable alignment has been developed click ***Accept Edits***. Alignments for additional terraces or underground outlets may be entered at this time if desired. Just give each one a unique name. To discard the entire alignment and start over, click on ***Cancel Edits***. This deletes the entire alignment.

7.4 Parallel alignments

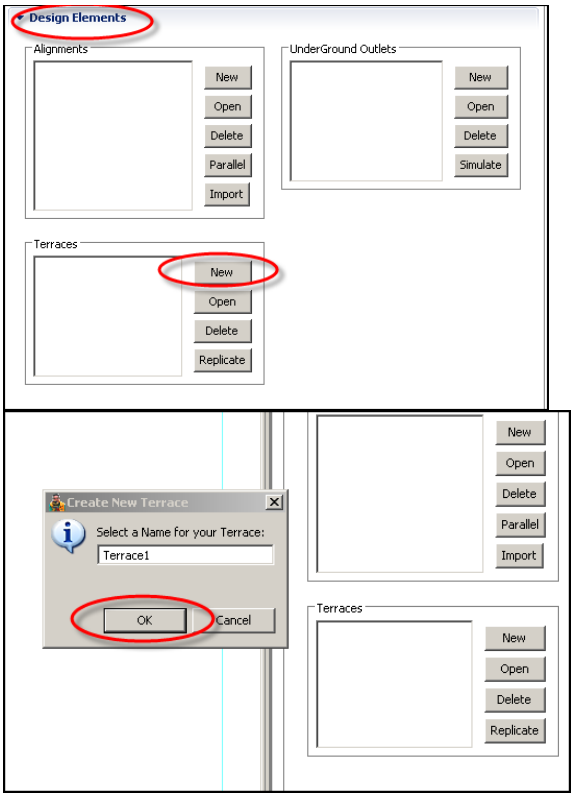
Once an alignment has been entered, it can be used to generate parallel alignments either up or downhill at a user defined distance. To create a parallel alignment, go to the main user interface for terrace design. Under the ***Design Elements, Alignments*** tab, click ***Parallel.***

This opens a dialogue box that asks for an alignment name, reference alignment and offset. The offset is the distance the new parallel alignment will be created from the reference alignment. Negative distances are uphill and positive distances are downhill.


Overview
8_10
Info
Background
Report Title Block Information
Name
8_10
Designed By
PRMc
Date
Drawn By
PRMc
Date
Checked By
Date
Approved By
Date
Practice
Location
Project Information
Description
Surface
8_10_Survey
Design Elements
Alignments
A1
A2
UGO_Centerline
New
Open
Delete
Parallel
Import
UnderGround Outlets
UGO
New
Open
Delete
Simulate
Create Parallel Alignment
Provide name, select reference Alignment and enter offset.
New Alignment's name
Reference Alignment
Offset
OK
Cancel

8. Designing a Storage Terrace or WASCOB

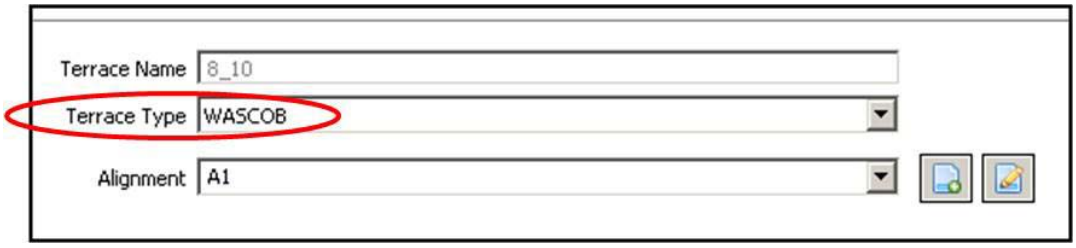
The design process for storage terraces and WASCOBs is the same. Under the ***Design Elements*** tab, ***Terraces*** click ***New***. Give the terrace a name and click ***OK***. This will open the user interface to design a terrace.



8.1 Choosing a Terrace Type and Alignment

The first step is to select the type of terrace that will be designed from the ***Type of Terrace*** drop down menu. The choices are:

- ***Gradient***
- ***Level***
- ***Storage***
- ***WASCOB***

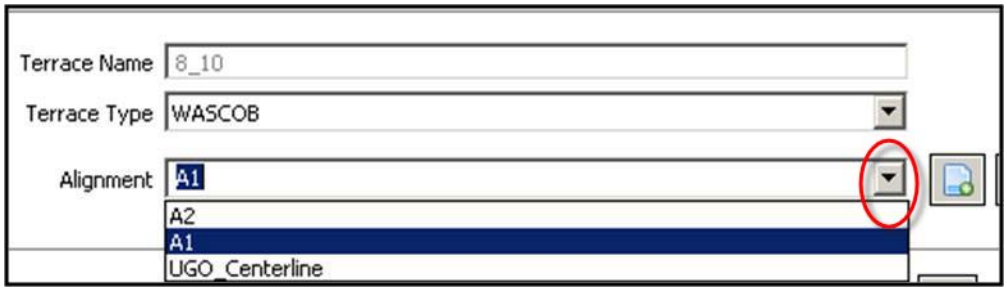


There are separate choices for storage terrace and WASCOB because the top width of a WASCOB varies with height while a storage terrace does not. Otherwise the design

process is the same. It is important to correctly choose the type of terrace you will be designing since this will affect functionality that will be available during the design process.

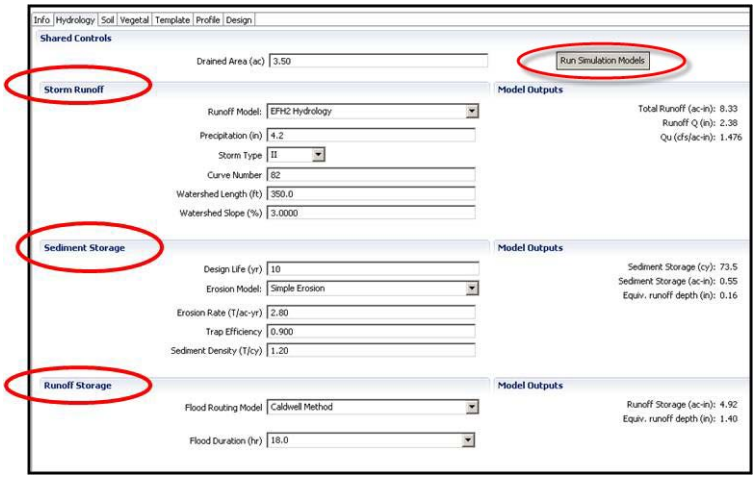
8.2 Selecting Alignment

After selecting the type of terrace choose the alignment that will be used for the terrace. Click the button beside the ***Alignment*** box. A drop down menu will display all of the alignments that have been entered for this terrace. Choose the appropriate alignment.



8.3 Entering Hydrology and Storage Data

Click on the ***HydrologyTab*** at the top of the page. Enter the ***drainage area, precipitation amount, storm type, curve number, watershed length and watershed slope***. Next go to the ***Sediment Storage*** tab. Enter the ***Design Life, Erosion Rate and Sediment Density***. At this time TDT does not support any ***Erosion Models***.



8.3.1 Runoff Storage

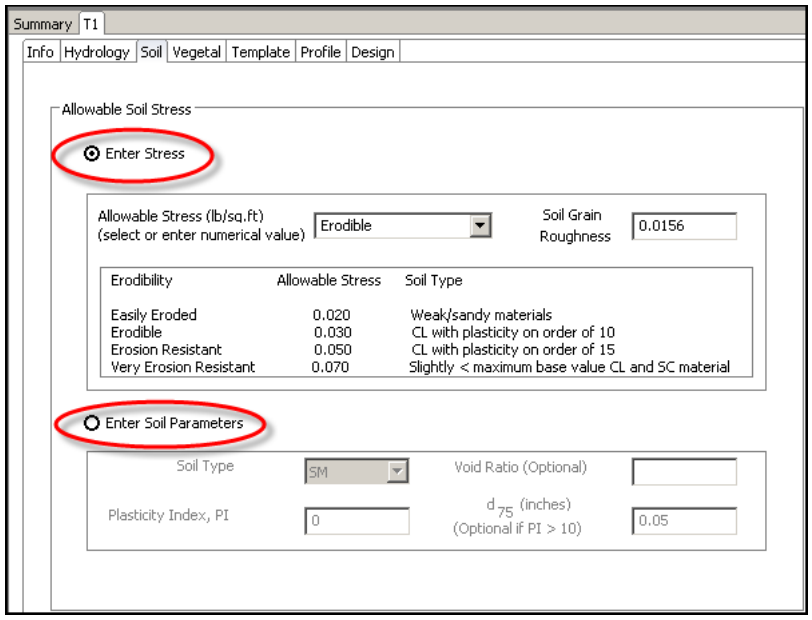
Next go to the ***Runoff Storage*** tab. TDT has 2 flood routing methods available. A defined percentage of the storm runoff can be stored or the Caldwell method can be used. The Caldwell method is a simplified routing procedure that is widely used by NRCS throughout the Midwest. TDT uses a table of flood durations versus release rates based on the Caldwell method. This table can be edited to customize storm durations and release rates for local conditions. See **Section 3.1** for this information.

Choose the flood routing method from the drop down menu. For the ***Caldwell Method*** choose the ***Flood Duration***. For the ***Percentage Method*** choose the ***Percentage of Runoff*** to store.

After all storage data has been entered click the *Run Simulations Models* button at the top of the page to calculate the runoff, sediment storage and required runoff storage volume.

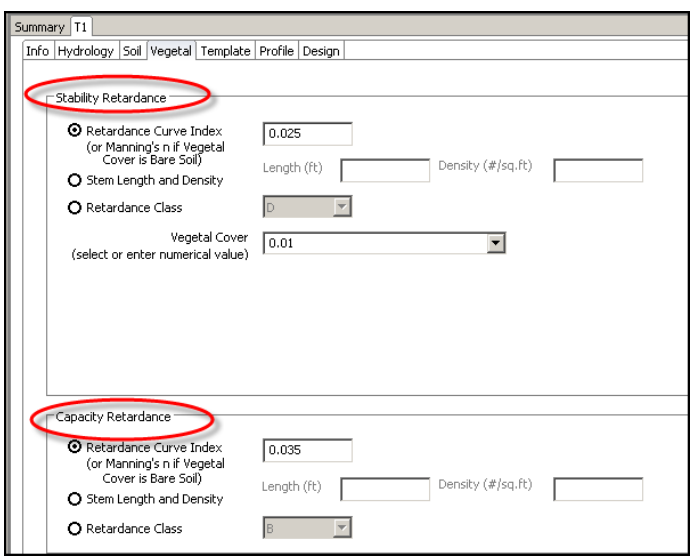
8.3.2 Entering Soil Data

Soil data is used by TDT to check the stability of the terrace channel. Click on the Soil tab to open the user interface. TDT uses the WDT tractive stress method to check the stability of the terrace channel. Enter either tractive stress values or actual soil properties.



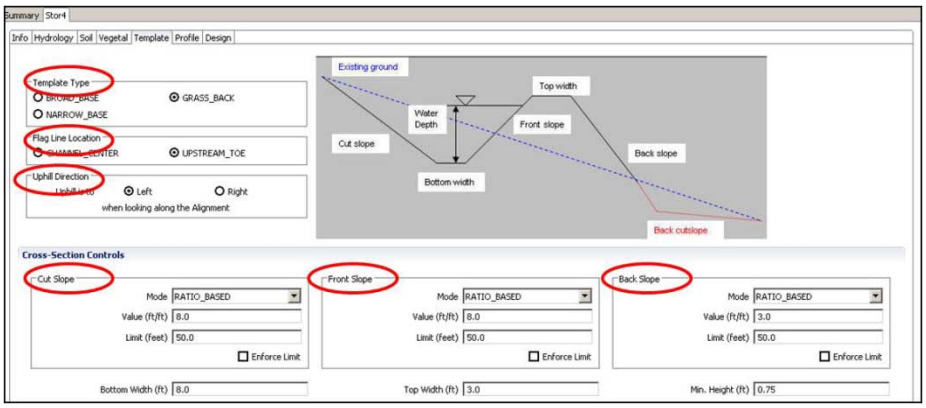
8.3.3 Entering Vegetal Parameters

The vegetal retardance factors are used by TDT in the channel stability check. Click on the ***Vegetal*** tab to open the user interface. Choose the appropriate retardance values for stability and capacity.



8.4 Terrace Template Data

This tab is used to define the template for the terrace that will be designed. Much of this information can be pre-populated in ***Preferences*** or it can be input from this tab.

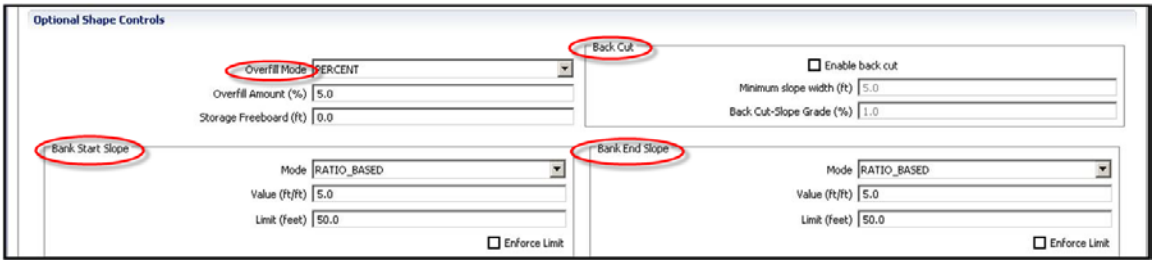


The information input on this tab is:

- Template Type
  - ***Broad base***
  - ***Narrow base***
  - ***Grass back***
- Flagline – this is the reference line that will be held constant as the terrace is being designed.
  - ***Channel center***
  - ***Upstream toe*** (of the embankment)
- Uphill direction – TDT needs to know what direction is uphill in relation to the alignment. This is determined by looking towards increasing stations along the alignment.
  - ***Left***
  - ***Right***
- Cross-section controls – These inputs define the cross-section of the terrace. There is a separate input for cut slope, front slope and back slope as well as bottom width, top width and minimum height.
  - ***Mode*** – how the side slopes are defined, either ratio based or width based.
  - ***Value*** – either the side slope ratio or the width depending upon the ***Mode*** chosen.
  - ***Limit*** – the maximum horizontal width for the slope
  - ***Enforce limit*** – the user can force the program to stay within the bounds defined in this section.
  - ***Bottom width*** – The user defined bottom width. This will be the same for the entire terrace channel. It can be changed station by station (Section 8.8). A zero bottom width (triangular channel) is acceptable.
  - ***Top width*** – User defined terrace embankment top width. For WASCOBs this value is defined from the table in the Terrace Conservation Practice Standard.
  - ***Minimum height*** – User defined minimum terrace embankment height.

8.4.1 Optional Shape Controls

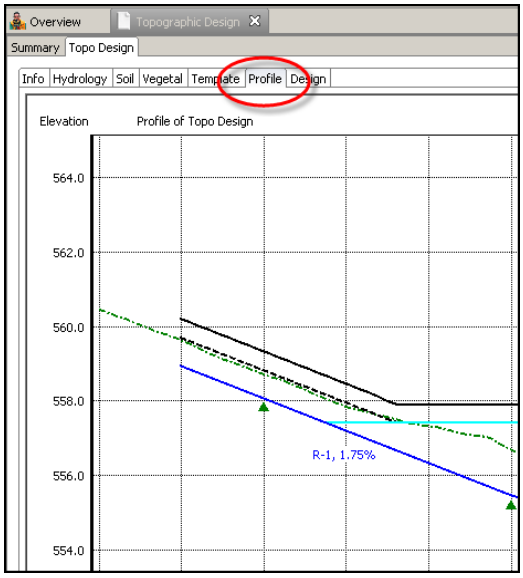
Optional shape controls are additional inputs that are not required but can be used to further define the terrace template.



- ***Overfill mode*** (choose either percent or height)
  - ***Height***
  - ***Percent***
- ***Storage freeboard***
  - Extra height added to the embankment as a factor of safety.
- ***Bank start slope*** and ***bank end slope*** – these inputs tell TDT the slope to use from the embankment to original ground at the start and end of the terrace if the embankment is above ground. To force the top to run level back to original ground choose ratio based with a side slope of zero. Be careful in doing this on relatively flat ground. On nearly flat ground the level line can be forced to run a very long distance to an intercept. Entering at least a small slope, will ensure that the top intercepts the ground in a reasonable distance.
  - ***Mode*** – how the side slopes are defined, either ratio based or width based.
  - ***Value*** – either the side slope ratio or the width depending upon the Mode chosen.
  - ***Limit*** – the maximum horizontal width for the slope
- ***Back cut slope*** – this input defines the parameters to be used if the user wants TDT to excavate material downhill from the terrace to obtain fill material. This option will not be available unless enabled here by the user.
  - ***Minimum slope width***, this is the user defined slope width. TDT will use the slope ratio to force the back slope into the ground until the defined slope width is achieved.
  - ***Back cut slope grade***, this is the user defined grade from the back slope toe to daylight.

8.5 Terrace Channel Profile

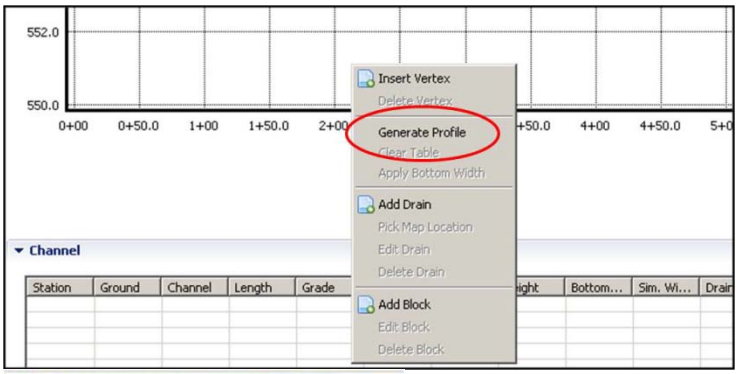
The ***Profile Tab*** allows the user to define the terrace channel profile. The ground profile along the previously chosen alignment should be displayed when this tab is clicked. (If it is not, make sure that an ***Alignment*** on the ***Info*** tab was selected for the terrace design user interface.) The planned profile of the terrace channel is drawn on this screen.

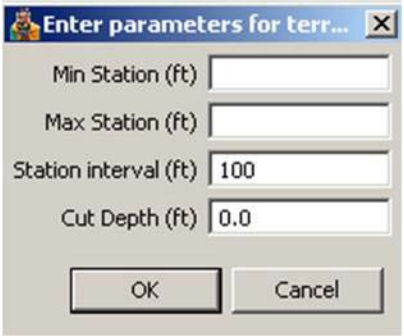


There are 2 ways to define the terrace channel profile. A profile can be defined to follow the existing ground or the user can draw in the profile.

8.6 Generate a Profile

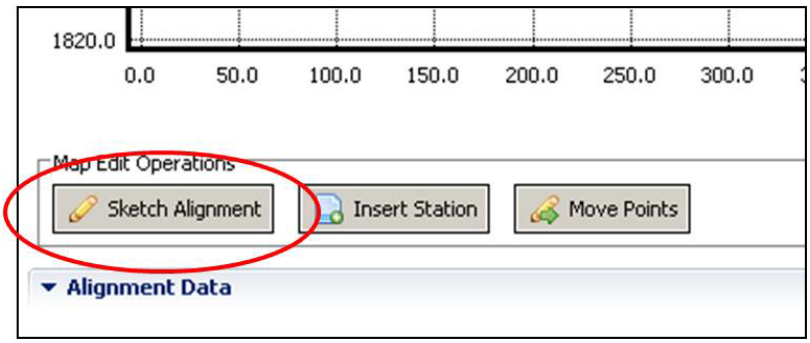
To define a profile that follows the existing ground, place the cursor in the table below the graph. Right click and a popup menu will be displayed. One of the choices will be ***Generate Profile***. Click on this and an additional popup will be displayed. Enter the beginning and ending stations for the alignment, a station interval for the profile and, if needed, a depth of cut. Click ***OK***. TDT will generate a channel alignment that follows the existing ground as closely as it can within the bounds of the stationing that is used. The user can make further refinements to the alignment by choosing ***Move Points*** or ***Insert Station***.





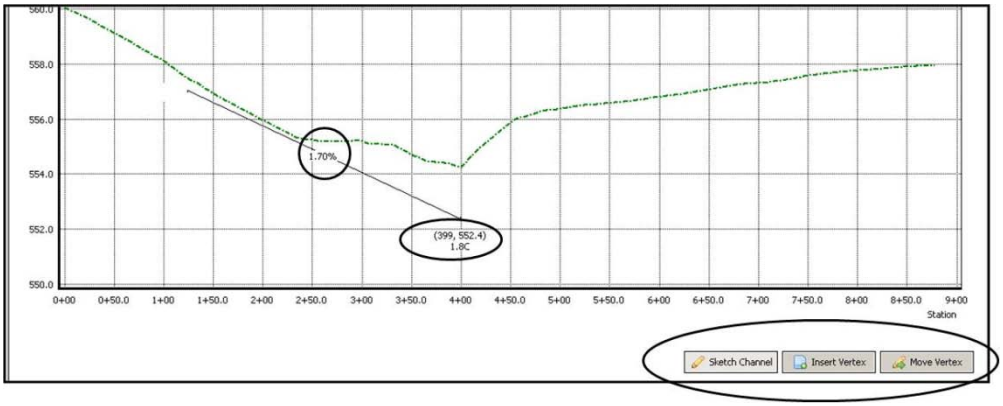
8.7 Draw a Profile

The other option for generating the terrace channel alignment is to draw the alignment on the screen. Click the ***Sketch Channel*** button or alternatively right click for a drop down menu and click ***Sketch Channel***. Channel reaches can now be drawn.



- Position the cursor where the channel will start. Note that the X, Y position and cut depth of the cursor position are displayed.
- Click and release the mouse button. This sets the first point.
- Now drag out the profile of the channel. Note that the slope of the line, X, Y position and cut depth at the cursor are displayed.
- Click additional points along the channel profile. Notice that the grade of the line as well as the cut or fill at the end of the line is displayed.
- To end the profile, double click or release the button and move the cursor off of the graph.

The user does not need to draw the channel back to the original ground surface. TDT will do this automatically during the design process using either the front slope or the cut slope, whichever is flatter.

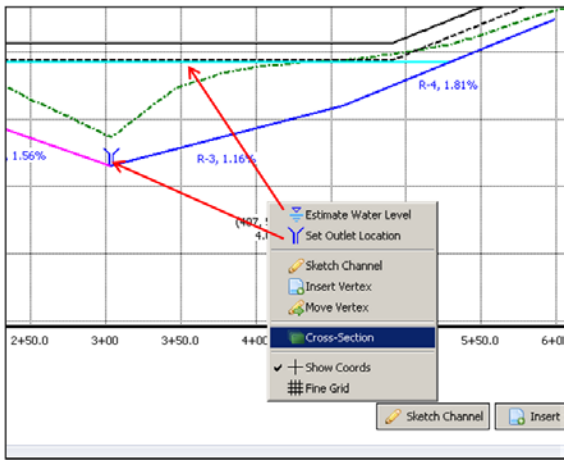


8.7.1 Edit the Profile

The resulting profile can be edited by using the ***Insert Vertex*** and ***Move Vertex*** buttons. These buttons are also accessible by right clicking. After choosing these functions, simply use the cursor to insert new vertices in the profile or move existing ones by clicking on the profile.

8.7.2 Estimate Water Level

The next step is to estimate the water elevation in the storage area. This input is optional, however if the user has a definite water level that needs to be checked, it can be entered here. This function can be used in combination with the ***Compute Storage*** button under the ***Design*** tab to compute storage at a given elevation. Right click and choose ***Set Water Elevation*** from the menu. Position the cursor at a water level and click. TDT will draw a light blue line representing the chosen water level.



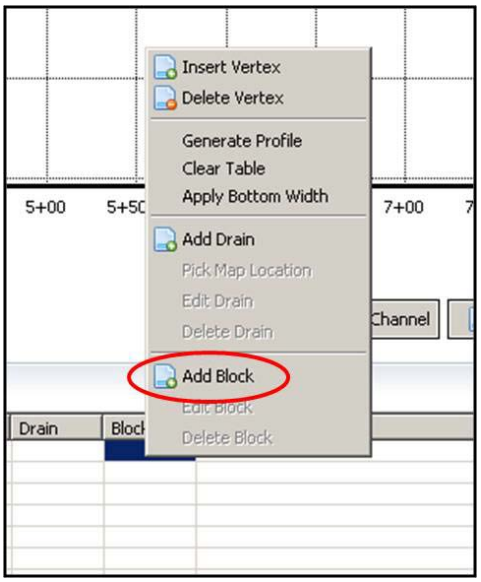
8.7.3 Set Outlet Location

The next step on this screen is to locate the outlet. Right click for the ***Set Outlet*** function. Place the cursor near the vertex where the outlet will be located and click. An outlet will

be placed at the nearest vertex. A dialogue box will also pop up. Fill in a ***Drain Name*** and ***Drain Fraction.*** This is the fraction of runoff from the terrace that will use this outlet. For a single outlet enter 100%. For terraces with multiple outlets enter the correct percentage for each outlet. Click ***OK***.

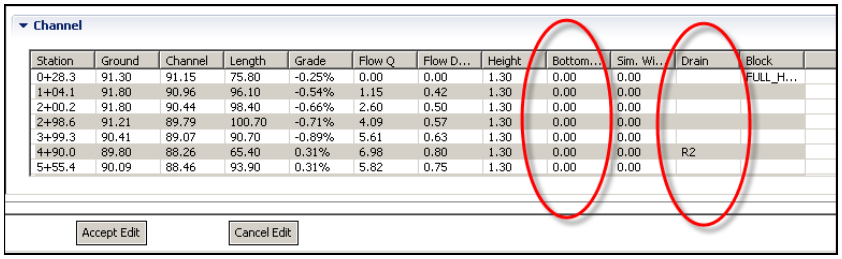
8.8 Channel Blocks, Drains and Bottom Width

Also on this screen, blocks can be placed in the terrace channel. These can be end blocks or blocks anywhere along the channel. Blocks are placed by using the table at the bottom of the screen. In the far right is a column titled "***Blocks***". Simply right click in this column on the station where a block needs to be installed. A dialogue box will pop up. Fill in the ***Top Width*** and ***Block Height***. Choose how the side slopes will be defined, either by ***Ratio*** or ***Width***. Then input the ***Limit*** to be used for the side slopes.



From this table, drains can be inserted or deleted. Right click on the appropriate station and fill in the dialogue box to add a drain. To delete a drain, right click on an existing drain shown in the table and click ***Delete***.

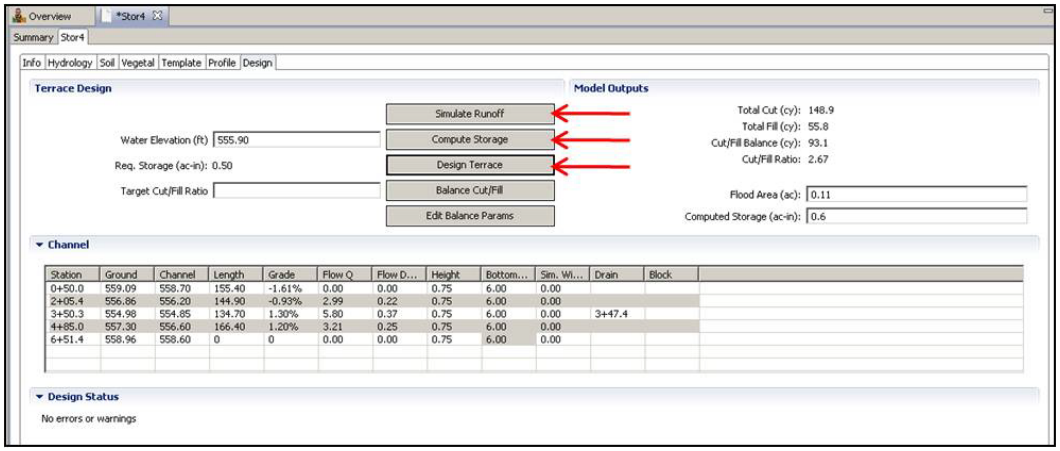
The channel bottom width can also be modified from this table. Click in the ***Bottom Width*** column enter new bottom widths by station.



Station	Ground	Channel	Length	Grade	Flow Q	Flow D...	Height	Bottom...	Sim. Wi...	Drain	Block
0+28.3	91.30	91.15	75.80	-0.25%	0.00	0.00	1.30	0.00	0.00		FULL_H...
1+04.1	91.80	90.96	96.10	-0.54%	1.15	0.42	1.30	0.00	0.00		
2+00.2	91.80	90.44	98.40	-0.66%	2.60	0.50	1.30	0.00	0.00		
2+98.6	91.21	89.79	100.70	-0.71%	4.09	0.57	1.30	0.00	0.00		
3+99.3	90.41	89.07	90.70	-0.89%	5.61	0.63	1.30	0.00	0.00		
4+90.0	89.80	88.26	65.40	0.31%	6.98	0.80	1.30	0.00	0.00	R2	
5+55.4	90.09	88.46	93.90	0.31%	5.82	0.75	1.30	0.00	0.00		

8.9 Designing the Terrace.

The terrace is now ready to design. Click on the ***Design Tab*** to open the user interface for the terrace design. The water elevation previously chosen should be populated on this page. Click on ***Simulate Runoff***. The flow depths in the channel should appear in the table. These should be checked to ensure that the minimum terrace height chosen on the ***Template*** page is sufficient.



The ***Compute Storage*** button allows a quick calculation of the amount of storage available at the water level defined on the ***Profile*** tab. This is useful to compute a water storage volume at a known elevation but is not a necessary step.

To design the terrace, click on the ***Design Terrace*** button. TDT should generate an initial terrace design. Cut and fill values will be displayed to the right. TDT will give warnings about channel stability but will not reject a design on this basis. Channel stability is checked using peak rates of runoff. The calculated peak flow is proportioned by station along the length of the channel with the largest amount at the downstream end and the least at the upstream end.

If the design is not successful an error message will be shown. The most common problems are:

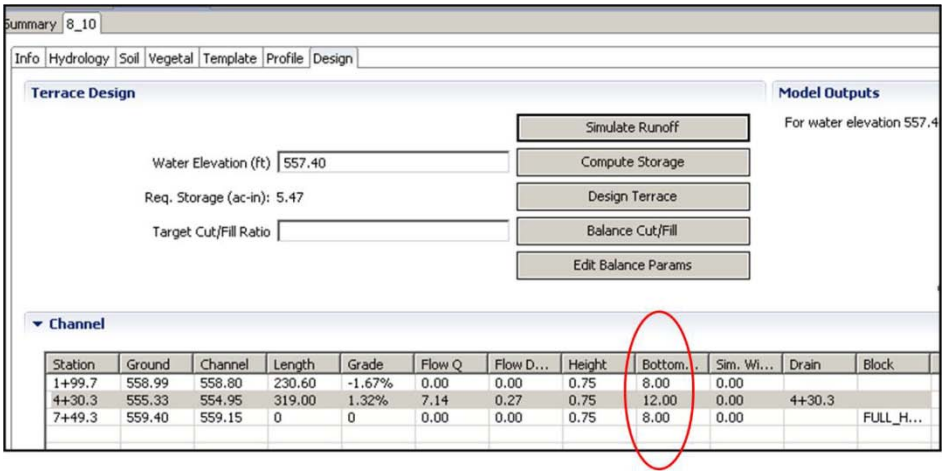
- Sharp alignment changes causing cross-sections to intersect. If this occurs TDT should indicate the stations where the problem has occurred. Go to the Alignment page and smooth out any sharp angles by adding curves.
- Overflow at the terrace ends. Correct this problem by revising the terrace channel profile and/or enable end blocks.
- For terraces on steep topography, the cut slope needs to be steep enough to intercept original ground in a reasonable distance. If not, an error will be generated.
- Be sure that the uphill direction is correctly selected on the terrace template interface.
- Enough survey data needs to be gathered so that the surface generated will encompass the entire terrace footprint. This can be a problem on steep terrain

where a flat back slope runs past available survey data or there is no survey data past the ends of terrace channel.

8.9.1 Bottom Width Adjustment

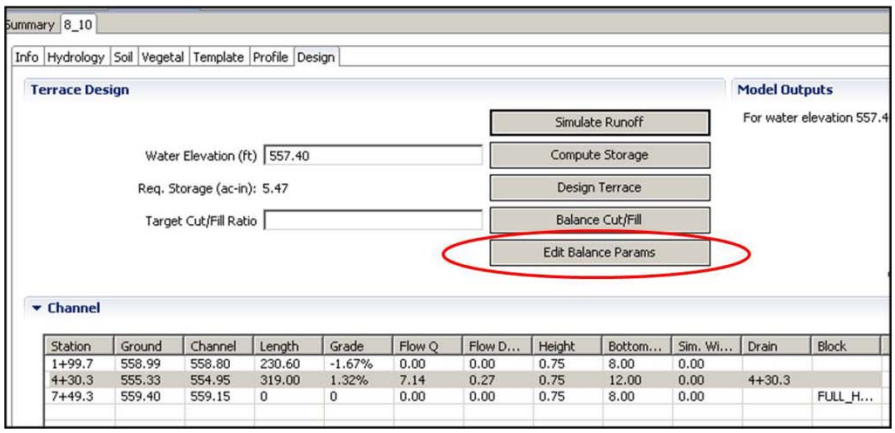
At this point the design can be accepted or adjustments can be made. One adjustment that is often needed is the bottom width of the terrace channel. The initial design is based on the uniform bottom width specified on the ***Template*** page. After the initial design, the user can change the bottom width station by station. (This can also be done prior to design as described in **Section 8.8**.)

This is done in the table that is displayed on the ***Terrace Design*** page. In the column labeled ***Bottom***, click in the cell for the station that will be changed. Enter a new value. TDT will now use the newly defined bottom width for this station. The new bottom width will be tapered into the bottom widths for the adjoining stations. Click the ***Design Terrace*** button again to incorporate the new bottom widths into the design. **Note,** at this point in the design process changing the bottom width on the ***Template*** page does not affect the current design of the terrace.



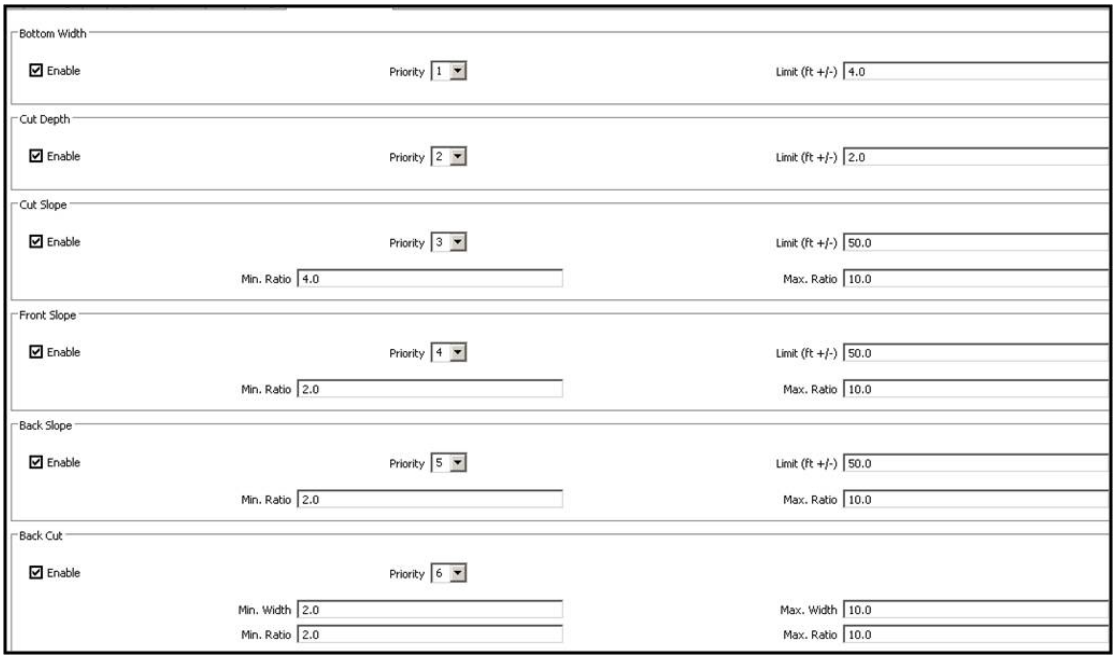
8.10 Balancing Cuts and Fills

Balance cuts and fills by clicking the ***Balance Cut and Fill*** button. TDT will balance the cuts and fills by changing the values associated with the template for the terrace. The priority of how these values are changed and incremented is a user defined function. Click the button ***Edit Balance Parameters***.



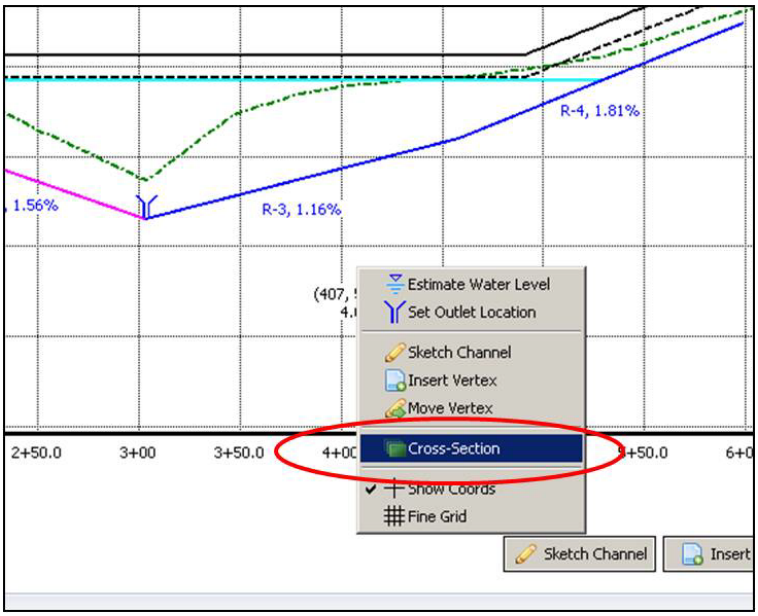
A screen will open showing the variables that are incremented to balance cuts and fills and the order in which they are used. Each variable is incremented separately. The user can change the order of use, disable the use of a variable completely and set limits on how much a variable is incremented. The use and ordering of these balancing parameters can also be set from ***Window, Preferences***.

After running through a cut and fill balance the user should check to ensure that all aspects of the resulting cross-section are still acceptable. For example, if the cut and fill are balanced by increasing the depth of the channel, the minimum embankment height may be increased outside the storage area. The result may be unacceptable to the user. In this case the user should accept the cut and fill balance, go to the ***Template*** tab and reset the minimum height to an acceptable value. Clicking ***Compute Storage*** on the ***Design*** tab will re-compute the storage along with recalculating the cut and fill based on the reset minimum height. The new values should be fairly close to those computed after balancing the cut and fill. However, if they are not within acceptable limits, re-balance the cut and fill and check the results as described above.

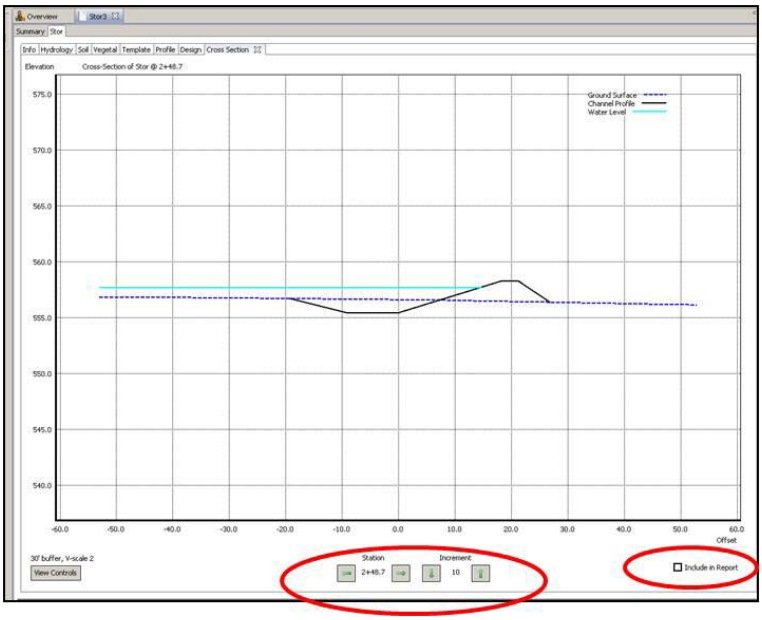

Bottom Width
Enable
Priority 1
Limit (ft +/-) 4.0
Cut Depth
Enable
Priority 2
Limit (ft +/-) 2.0
Cut Slope
Enable
Priority 3
Limit (ft +/-) 50.0
Min. Ratio 4.0
Max. Ratio 10.0
Front Slope
Enable
Priority 4
Limit (ft +/-) 50.0
Min. Ratio 2.0
Max. Ratio 10.0
Back Slope
Enable
Priority 5
Limit (ft +/-) 50.0
Min. Ratio 2.0
Max. Ratio 10.0
Back Cut
Enable
Priority 6
Min. Width 2.0
Max. Width 10.0
Min. Ratio 2.0
Max. Ratio 10.0

8.11 Cross-Sections

Now that the terrace is designed, the user should look at the cross-sections for the terrace. These are accessed from the ***Terrace, Profile*** page. Position the cursor on the graph and right click for a drop down menu. Choose ***Cross-Sections*** from the menu.

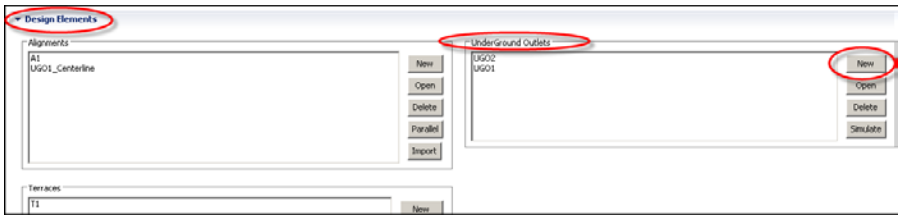


Now click on a station on the graph to display the cross-section. Use the buttons on the page to scroll through the entire list of cross-sections. Click the check box at the right side of the page to indicate those that should be included in the design.

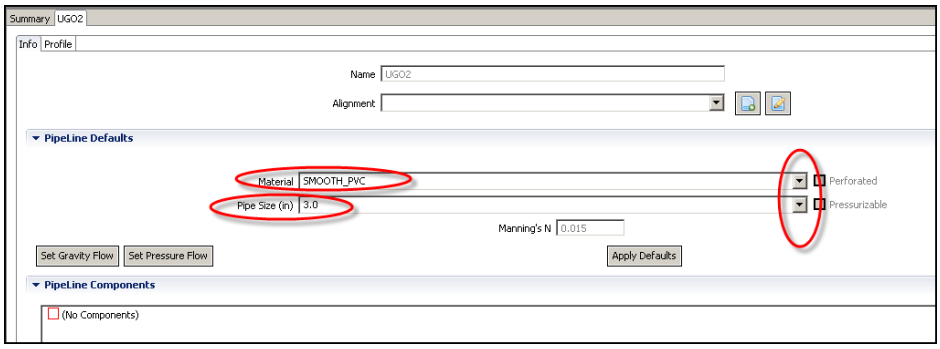


8.12 Underground Outlet

To start the UGO design, from the TDT design interface, ***Design Elements, Underground Outlet***, click ***New***.

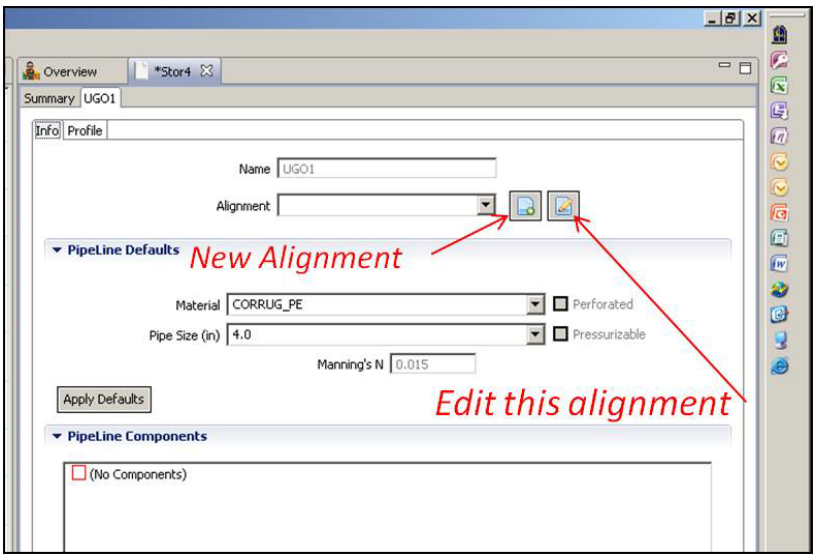


This will open the UGO interface. Under ***Pipeline Defaults***, the default material and pipe size will be displayed. These are the defaults selected in ***Preferences***. To change these inputs for the current job, click on the drop downs to the right of pipe material and size. The TDT pipeline design process is set up to increment to larger pipe sizes from the default pipe size. It does not increment down. Therefore the user should either have the default pipe size set to the smallest that is acceptable or it can be changed here to the smallest that is acceptable for the current job.



8.12.1 UGO Alignment

The first task in the design of the underground outlet (UGO) is to draw in the UGO alignment. This can be done either from the ***Alignment*** page or the ***Underground Outlet*** tab. The process is the same for either method. Start drawing the UGO from the ***Underground Outlet*** tab by mousing over the 2 buttons at the top right of the screen. Click on ***New Alignment***.



The process is the same as drawing the terrace alignment. All edit capabilities are available for the points on the alignment. When the alignment is complete, click ***Accept Edits*** to close the page.

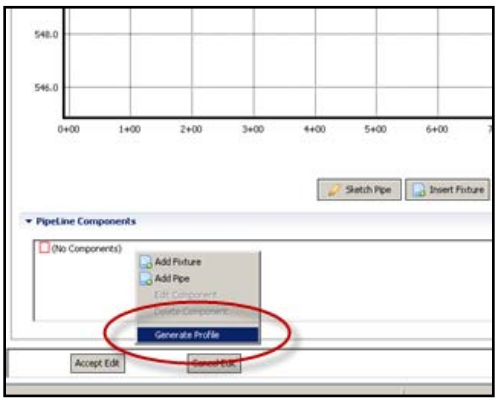
8.12.2 UGO Profile

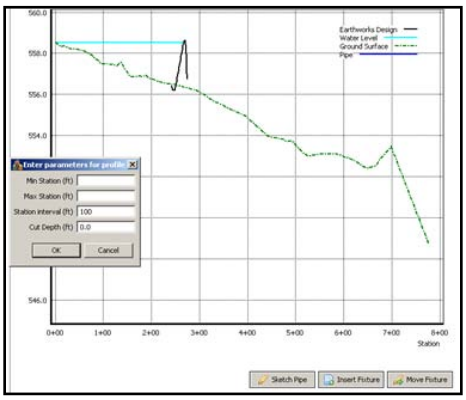
The next step is to draw the profile of the UGO. On the UGO page click the ***Profile*** tab. The profile of the ground along the alignment should be displayed with the terrace cross-section shown. There are 2 methods to draw the UGO profile similar to the methods for drawing the terrace profile. TDT can generate a profile that follows the existing ground or the user can draw in the profile.

To generate a profile, place the cursor in the ***Pipeline Components*** table at the bottom of the page and right click, then click ***Generate Profile***. A dialogue box will open to allow the user to identify the beginning and ending stations along with the depth of cut. Since the user can input the exact beginning and ending station it is useful to identify these stations before opening the dialogue boxes. This can be done by placing the cursor where the beginning and ending points will be and recording X coordinate which will correspond to the station. It is also useful to remember that the cut depth is from the

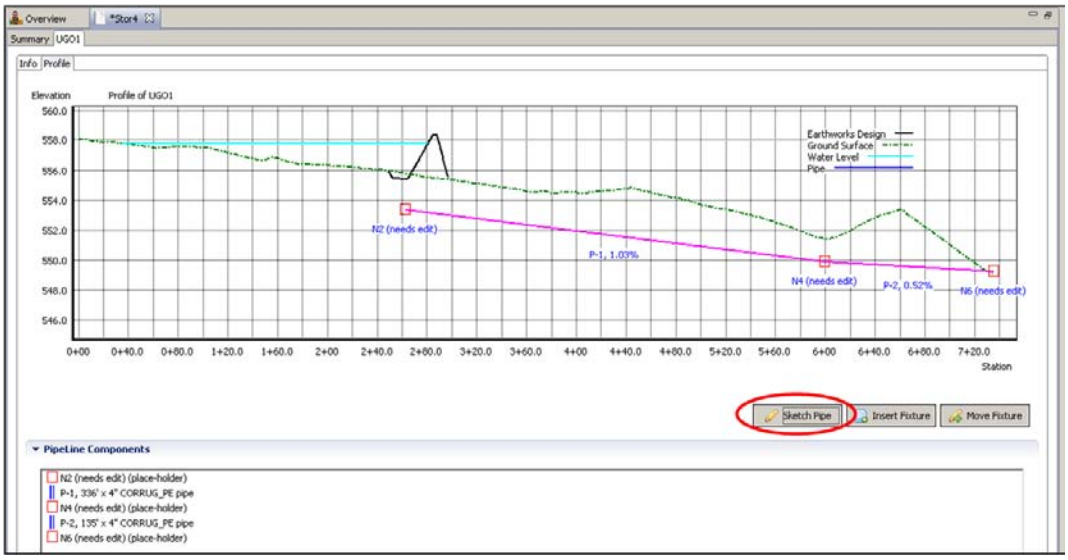
existing ground elevation. So, if a specific cut is needed from the bottom of the channel this may be different than the cut from existing ground.

After clicking ***OK*** on the second dialogue box the profile will be automagically generated. The user can then adjust the location of points along the profile by clicking ***Move Points*** or insert additional points by clicking ***Insert Points.***



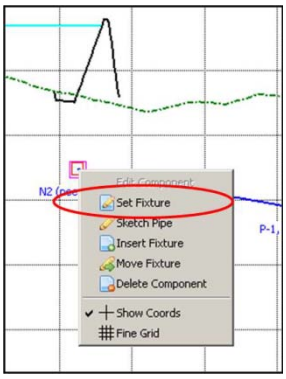


The UGO profile is drawn the same way as the terrace channel profile. Move the cursor to the starting point of the UGO, click and release the mouse button. Simply drag the profile line as needed to draw in the profile. Clicking the mouse button anchors a point to define grade changes or other points that need to be defined such as junctions with other UGOs. Note that the cursor displays the X, Y location, grade and the depth of cut from original ground. The last point on the profile must be within UGO alignment. Move the cursor off of the profile graph to end the profile. The profile can be edited by using the ***Insert Fixture*** or ***Move Fixture*** buttons. Clicking these buttons allows the user to insert new points or move existing points.



8.12.3 Setting Fixtures

Once the profile is complete, fixtures need to be set along the pipeline at each vertex for the inlet, any junctions, grade breaks, the outlet and any other fixtures that are needed.



This can be done by right clicking at one of the vertices along the profile or by right clicking in the table that displays the vertices. Once a fixture is set it can be edited by right clicking on a vertex. This includes editing the pipe reaches. For each pipe reach the material and size can be changed.

From this popup interface the user can also insert a fixture where no vertex exists. Clicking ***Insert Fixture*** places a small pink box on the profile at the cursor for the location of the fixture and then an interface pops up to enter information about the fixture. The required information is the same whether ***Setting*** or ***Inserting*** a fixture and is explained below.

The following fixtures can be set in a pipeline:

Fixture Type	**Additional Information Req'd.**
1. Grade Break	Nothing
2. Elbow	ID, Station, Elevation & Pipe Materials
3. Tee	ID, Station, Elevation & Pipe Materials
4. Junction	ID, Station, Elevation, Pipe Materials & Additional Flow
5. Canopy Inlet	See information below
6. Riser	See information below
7. Standard Outlet	ID, Guard Type, Station, Elevation, Pipe Materials, Pipe Size (pipe size is not critical as it will default to the UGO size once it is designed), Head
8. Bubble-up Outlet	ID, Guard Type, Station, Elevation, Pipe Materials, Pipe Size, Head, Height, Perforation Size & Shape, Holes/ft
9. No Fixture	Nothing

For the two inlet fixtures, Riser and Canopy the requirements are shown below.

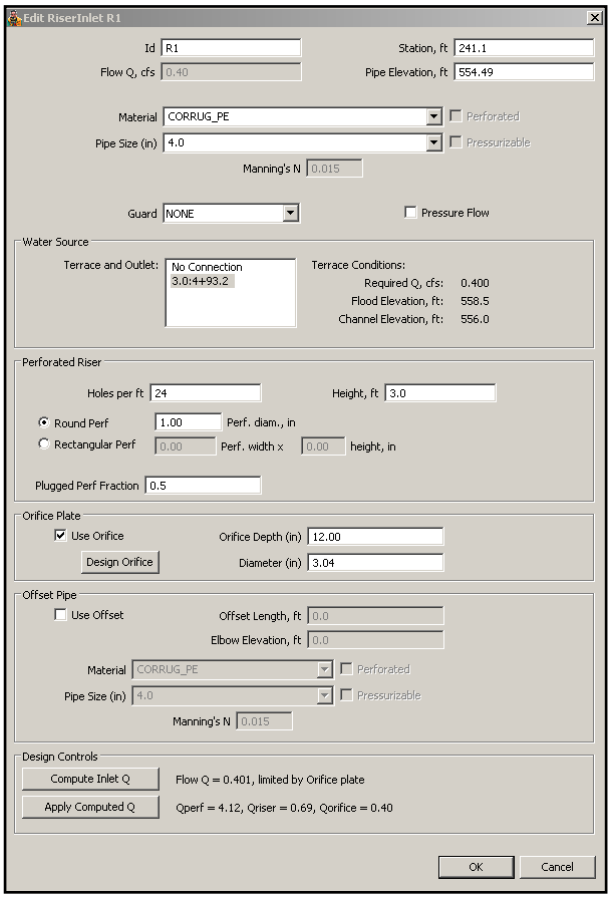
8.12.4 Setting an Inlet - Riser

Right click at one of the vertices along the profile or right click in the table that displays the vertices. Select ***Set Fixture***. A dialogue box will pop up with a list of possible

fixtures. Choose ***Riser*** or ***Canopy*** depending on the type of fixture desired. A dialogue box will pop up for information required for the inlet.

For a riser the following information is needed:

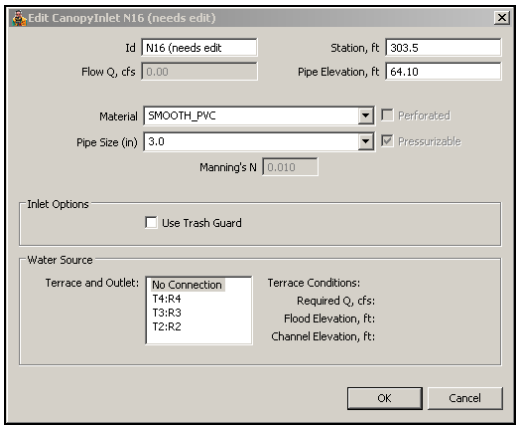
a) Enter an ID for the inlet.
b) Choose the riser pipe material and size.
c) Choose pipe size
d) Choose whether the riser has a trash guard, is capped or is open.
e) Water source
    i. Select the water source for the inlet. The choices displayed will be in the order of which one is closest to the underground outlet. Clicking on the choice will display the flow amounts.
f) Perforated riser
    i. Enter the number of holes per foot in the riser.
    ii. Enter the height of the riser (from the channel bottom).
    iii. Choose either round or rectangular perforations. Enter the dimensions for the choice.
g) Orifice plate
    i. If an orifice plate is used click the box.
    ii. Enter either Orifice Depth (the distance in inches the orifice plate is below the channel grade) or enter a diameter for the orifice. TDT will calculate the value not entered.
    iii. Click Design Orifice
h) Offset Pipe
    i. If an offset pipe is used click the box
    ii. Enter offset pipe length
    iii. Enter planned elbow elevation
    iv. Enter Pipe material
    v. Enter pipe size
i) Click ***Compute Inlet Q.*** TDT will calculate flow values. If satisfied with values click ***Apply Computed*** Q. Otherwise make necessary changes.
j) Click ***OK*** to close the dialogue box.



8.12.5 Setting an Inlet – Canopy Inlet

For a canopy inlet or hooded inlet the following information is needed:

a) Enter an ID for the inlet.
b) Choose pipe material and size.
c) Choose whether the pipe has a trash guard.
d) Select the water source for the inlet. The choices displayed will be in the order of which one is closest to the underground outlet. Clicking on the choice will display the flow amounts.
e) Click ***OK***.



8.12.6 Pressure Flow

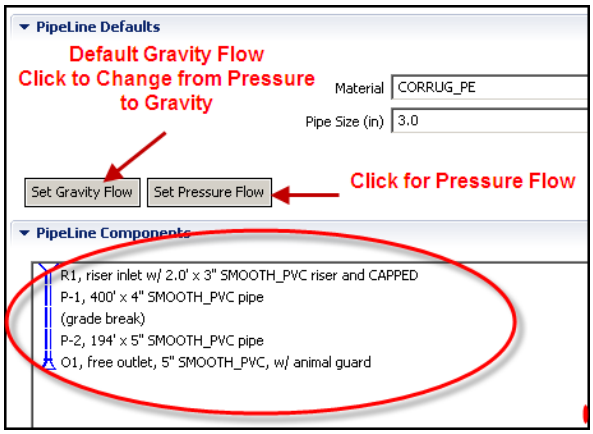
The default design for a UGO in TDT is for non-pressure flow. Unless a canopy inlet is used. A canopy inlet and underground outlet will always be designed in pressure flow. TDT will generate an error if the canopy inlet is designed with a lower head than will generate full flow in the conduit. All of the conduit materials used for the UGO with a canopy inlet must be capable of withstanding pressure.

TDT can only design a pressure flow system where everything that is downstream from the point of pressurization is also in pressure. In other words, the user can not designate a UGO to be under pressure flow and then have junction that is not in pressure flow that joins the UGO downstream. The exception to this is that an offset pipe will automatically be designed for pressure flow if no orifice plate is used.

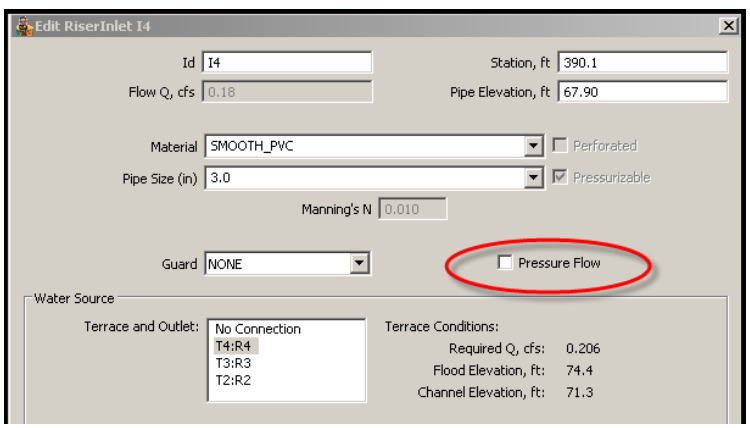
To design a system in pressure flow the user must enable pressure flow design for the inlet as well as all pipe components. The first step to do this is to ensure that the pipe materials specified are capable of withstanding pressure flow. If pressure flow is enabled and materials are specified that are not capable of withstanding pressure, TDT will generate an error. Materials capable of withstanding pressure flow are identified in a customizable table for pipe materials. See **Section 3.1** for instructions on modifying this table.

Note: Manufactured risers are often made of heavy “corrugate polyethylene plastic”. However, this is not the same as corrugate polyethylene plastic that is used for drain conduit. Corrugate PE drain conduit is generally not considered suitable for pressure flow while a manufactured riser, with an appropriate connection at the elbow, would be. Since TDT cannot distinguish between corrugate PE used for a riser versus drain conduit it will assume that a corrugated PE riser cannot be pressurized. To solve this problem in design just designate in TDT a riser with a material that can be pressurized such as solid PVC.

Once the correct pipe material is specified, pressure flow calculations are enabled by clicking the ***Set Pressure Flow*** button on the ***Info*** tab of the UGO design interface. This will enable pressure flow calculations for all pipeline components currently displayed on the ***Pipeline Components*** tab.



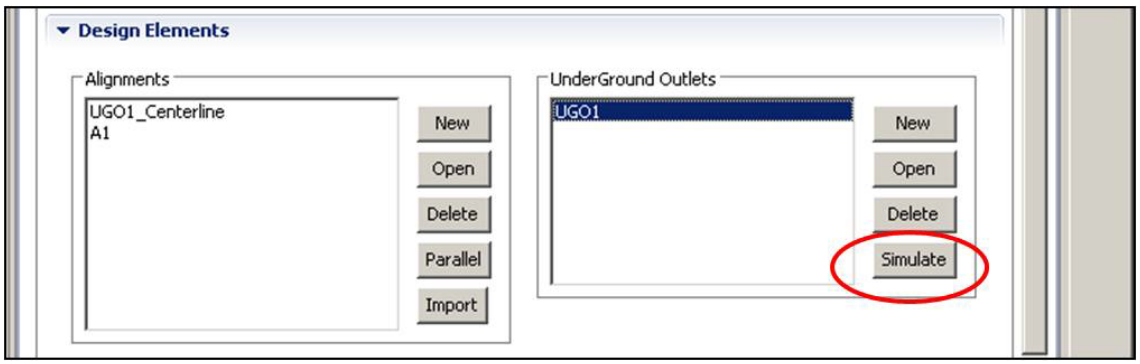
The situation where the UGO has upstream sections that should be designed in gravity flow and a downstream section starting at another terrace that should be designed in pressure flow, cannot be handled by the procedure described above. In this situation, use the check box for pressure flow in the riser interface for the downstream terrace. This will enable pressure flow for the inlet and all components downstream. All of the components as well as the riser materials must be capable of pressure flow. See the note above about pressure flow materials for risers. If a canopy inlet is chosen, by default everything below it will be pressure.



The last task on this page is to click ***Accept Edits***. This closes the user interface for inputting the UGO profile information.

8.12.7 Sizing the Underground Outlet.

Now that the UGO has been set up it is ready for design. To design the underground outlet, on the main user interface under ***Design Elements, Underground Outlets***, highlight the UGO name by clicking it. Then click the ***Simulate*** button.



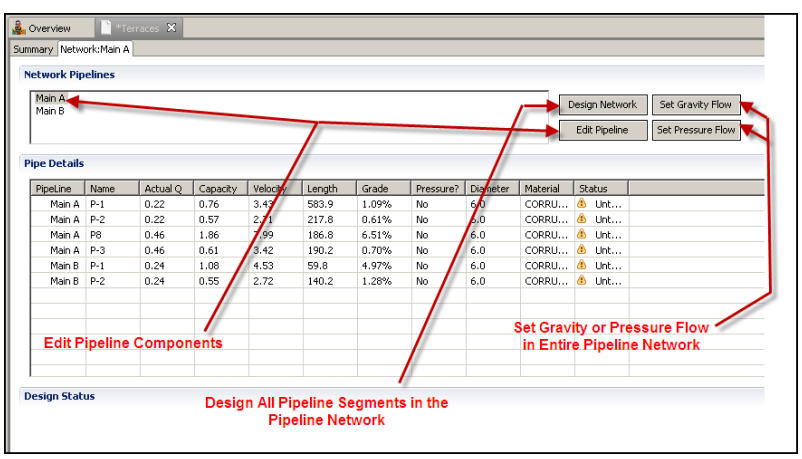
TDT will open a new user interface. From this interface the user can:

- ***Set gravity flow***
- ***Set pressure flow***
- ***Edit pipeline***
- ***Design network***

Clicking either the ***Set Gravity Flow*** or ***Set Pressure Flow*** will change the flow regime for all of the pipelines that are joined together. This is different from the process explained in the previous section which affects only the pipeline section open in the interface.

The ***Edit Pipeline*** button will open an interface that will allow the user to edit the pipeline components for the pipeline that is highlighted to the left. This function basically takes the user back to the interface described in the previous section.

The ***Design Network*** button will design the entire pipeline and report the pipe size for each reach in a table on the page. The table shows Q, velocity, whether there is pressure flow (the default is non-pressure flow, the user must designate pressure flow), pipe size and material and any problems or issues with the design. If there are any errors or concerns with the design, the ***Edit Pipeline*** button previously described will open the interface to allow changes in the pipeline. Once the design is satisfactorily completed, click ***Accept Edits*** to accept the design.



9. Level Terrace Design

Level terraces are used primarily for water conservation. They are laid out on the contour with a level bottom and a level embankment top. Level terraces have no outlet. One hundred percent of the runoff entering the terrace is stored and allowed to soak into the soil. Sediment trapping efficiency is considered to be 100%.

The design of a level terrace is similar to a storage terrace except that no outlet is designed. The surface generation and alignment layout should follow the procedures described previously. To start the design process, on the ***Design Elements*** tab, ***Terraces*** click ***New***. Give the terrace a name and click ***OK***. This will open the user interface to design a terrace.

9.1 Choosing a terrace type and alignment

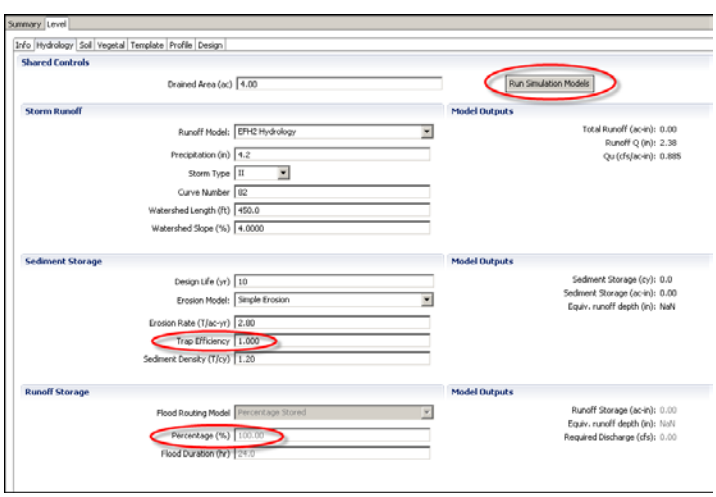
The first step is to select the type of terrace that will be designed from the ***Type of Terrace*** drop down menu. Choose ***Level***. This will limit the functionality of the design process to level terraces.

9.1.1 Selecting Alignment

After selecting the type of terrace, choose the alignment that will be used for the terrace. Click the button beside the ***Alignment*** box. A drop down menu will display all of the alignments that have been entered for this terrace. Choose the appropriate alignment.

9.2 Entering Hydrology and Storage Data

Click on the ***HydrologyTab*** at the top of the page. Enter the ***drainage area, precipitation amount, storm type, curve number, watershed length and watershed slope***. Next go to the ***Sediment Storage*** tab. Enter the ***Design Life, Erosion Rate*** and ***Sediment Density***. At this time there are no ***Erosion Models*** to enter.



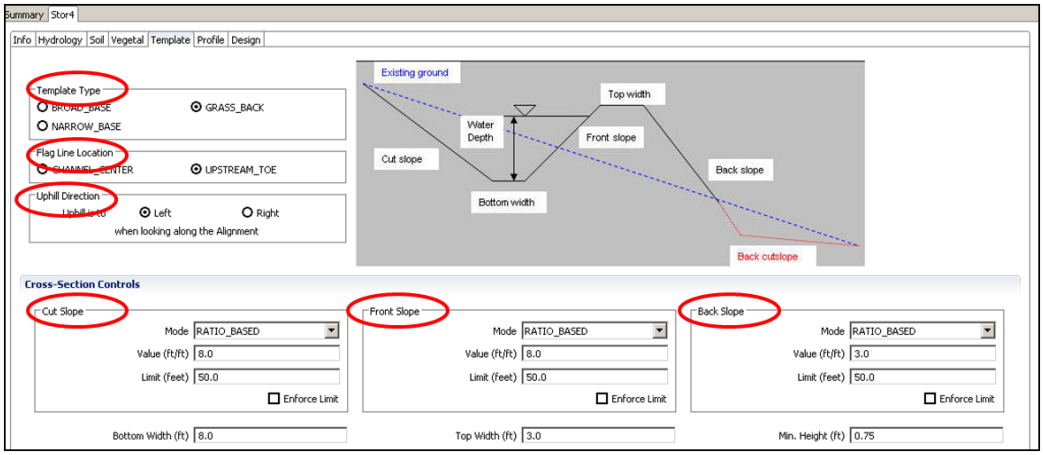
Click the ***Run Simulation*** button to calculate the runoff totals and the sediment storage.

9.2.1 Soil and Vegetal

While TDT will allow the user to enter or change the soil and vegetal parameters for a level terrace, these values are not used. Since the channel of a level terrace is flat there is no need to check the stability of the channel.

9.3 Terrace Template Data

This tab is used to define the template for the terrace that will be designed. Much of this information can be pre-populated in ***Preferences*** or it can be input from this tab.



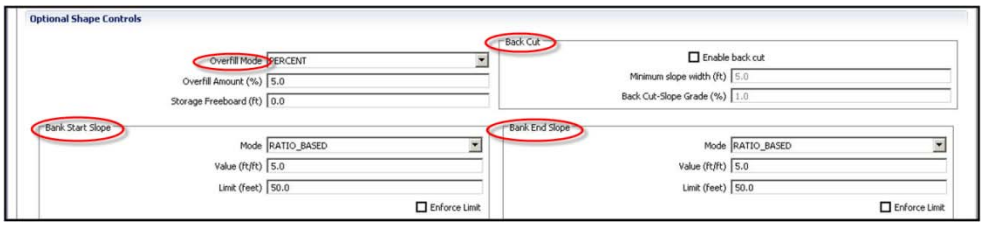
The information that is input on this tab is:

- Template Type
  - ***Broad base***
  - ***Narrow base***
  - ***Grass back***
- Flagline – this is the reference line that will be held constant as the terrace is being designed.
  - ***Channel center***
  - ***Upstream toe*** (of the embankment)
- Uphill direction – TDT needs to know what direction is uphill in relation to the alignment. This is determined by looking towards increasing stations along the alignment.
  - ***Left***
  - ***Right***
- Cross-section controls – These inputs define the cross-section of the terrace. There is a separate input for cut slope, front slope and back slope as well as bottom width, top width and minimum height.
  - ***Mode*** – how the side slopes are defined, either ratio based or width based.
  - ***Value*** – either the side slope ration or the width depending upon the Mode chosen.
  - ***Limit*** – the maximum horizontal width for the slope

- ***Enforce limit*** – the user can force the program to stay within the bounds defined in this section.
- ***Bottom width*** – The user defined bottom width. This will be the same for the entire terrace channel. It can be changed station by station later on.
- ***Top width*** – User defined terrace embankment topwidth. For WASCOBs this value is defined from the table in the Terrace Conservation Practice Standard.
- ***Minimum height*** – User defined minimum terrace embankment height.

9.3.1 Optional Shape Controls

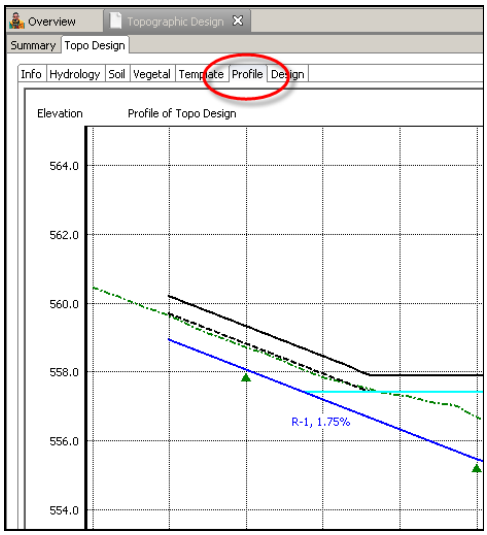
Optional shape controls are additional inputs that are not required but can be used to further define the terrace template.



- ***Overfill*** (choose either percent or height)
  - ***Height***
  - ***Percent***
- ***Storage freeboard***
  - Extra height added to the embankment as a factor of safety.
- ***Bank start and end slope*** – these inputs tell TDT the slope to use from the embankment to original ground at the start and end of the terrace.
  - ***Mode*** – how the side slopes are defined, either ratio based or width based.
  - ***Value*** – either the side slope ratio or the width depending upon the Mode chosen.
  - ***Limit*** – the maximum horizontal width for the slope
- **Back cut slope** – this input defines the parameters to be used if the user wants TDT to excavate material from below the terrace to obtain fill material. This option will not be available unless enabled here by the user.
  - ***Minimum slope width***, this is the user defined slope width. TDT will use the slope ratio to force the back slope into the ground until the defined slope width is achieved.
  - ***Back cut slope grade***, this is the user defined grade from the back slope toe to daylight.

9.4 Terrace Channel Profile

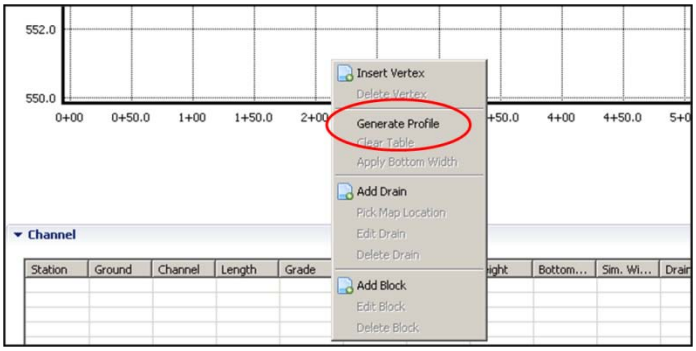
The ***Profile Tab*** allows the user to define the terrace channel profile. The ground profile along the previously chosen alignment should be displayed when this tab is clicked. (If it is not, make sure that ***Alignment*** on the ***Info*** tab of the terrace design user interface was selected.) The planned profile of the terrace channel is drawn on this screen.

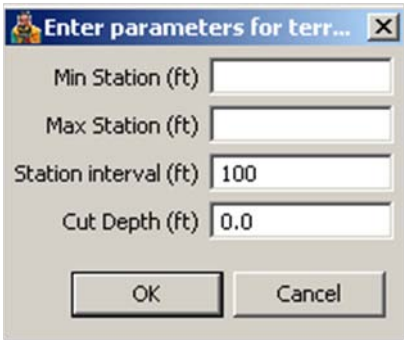


There are 2 ways to define the terrace channel profile. A profile can be defined to follow the existing ground or the user can draw in the profile.

9.5 Generate a Profile

To define a profile that follows the existing ground, place the cursor in the table below the graph. Right click and a popup menu will be displayed. One of the choices will be ***Generate Profile***. Click on this and an additional popup will be displayed.

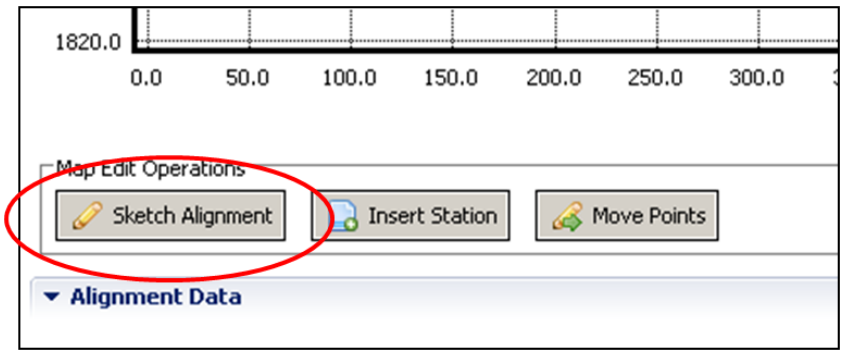




Enter the beginning and ending stations for the alignment, a station interval for the profile and, if needed, a depth of cut. Click ***OK***. TDT will generate a channel alignment that follows the existing ground as closely as it can within the bounds of the stationing that is used. The user can make further refinements to the alignment by choosing ***Move Points*** or ***Insert Station***.

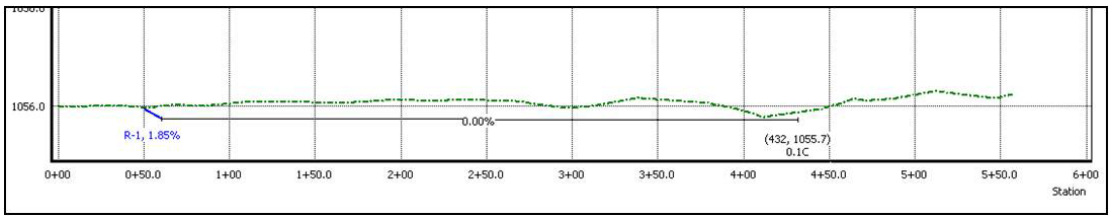
9.6 Draw a Profile

The other option for generating the terrace channel alignment is to draw the alignment on the screen. Click the ***Sketch Channel*** button or alternatively right click for a drop down menu and click ***Sketch Channel***.



Channel reaches can now be drawn. Position the cursor on one end of the channel where the channel will start. Note that the X, Y position and cut depth of the cursor position are displayed.

Click and release the mouse button. This sets the first point. Now drag out the profile of the channel. Note that the slope of the line, X, Y position and cut depth at the cursor are displayed. Click additional points along the channel profile. Notice that the grade of the line as well as the cut or fill at the end of the line is displayed. To end the profile, double click or release the button and move the cursor off of the graph.



9.6.1 Edit the Profile

The resulting profile can be edited by using the ***Insert Vertex*** and ***Move Vertex*** buttons. These buttons are also accessible by right clicking. After choosing these functions, simply use the cursor to insert new vertices in the profile or move existing ones by clicking on the profile.

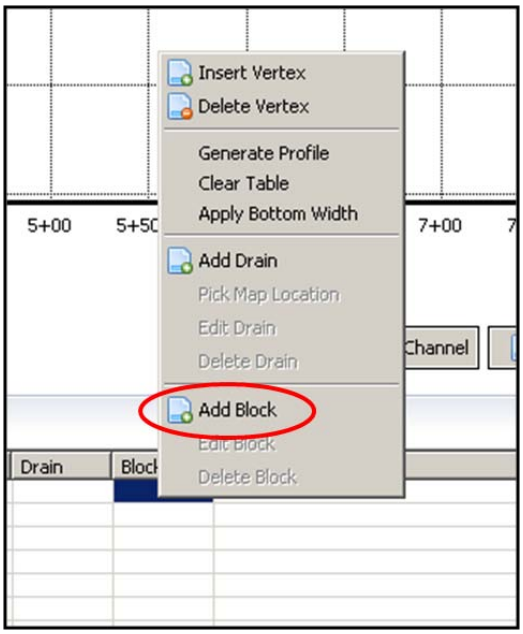
9.7 Estimate Water Level

It is not necessary to estimate the water level in a level terrace. However, if there is a need to check the volume of storage at a particular elevation, it can be entered here and checked using the ***Compute Storage*** button explained in ***Section 9.9***. Right click and choose ***Set Water Elevation*** from the menu. Position the cursor at an approximate water level and click. TDT will draw a light blue line representing the chosen water level.

9.8 Channel Blocks

Also on this screen, blocks can be placed in the terrace channel. These can be end blocks or blocks anywhere along the channel. Blocks are placed by using the table at the bottom of the screen. In the far right is a column titled ***"Blocks"***. Simply right click in this column on the station where a block needs to be installed. A dialogue box will pop up.

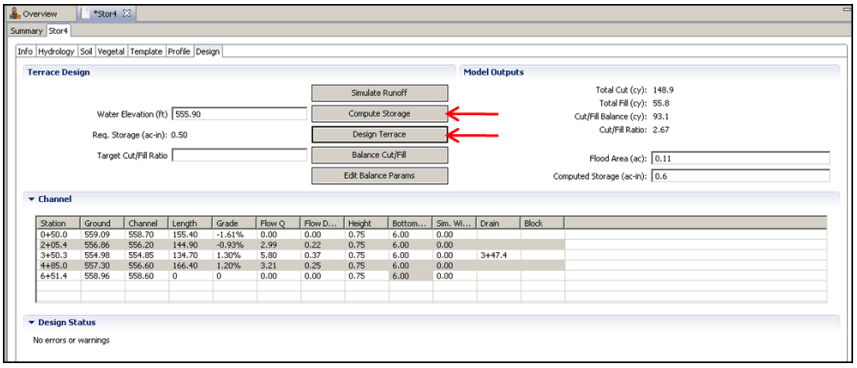
Fill in the ***Top Width*** and ***Block Height***. Choose how the side slopes will be defined, either by ***Ratio*** or ***Width***. Then input the ***Limit*** to be used for the side slopes.



9.9 Designing the Terrace

The terrace is now ready to design. Click on the ***Design Tab*** to open the user interface for the terrace design. The water elevation previously chosen should be populated on this page. The ***Compute Storage*** button allows a quick calculation of the amount of storage available at the water level defined on the ***Profile*** tab. This is useful to compute a water storage volume at a known elevation.

To design the terrace, click on the ***Design Terrace*** button. TDT should generate an initial terrace design. Cut and fill values will be displayed to the right. If the design is not successful an error message will be shown.

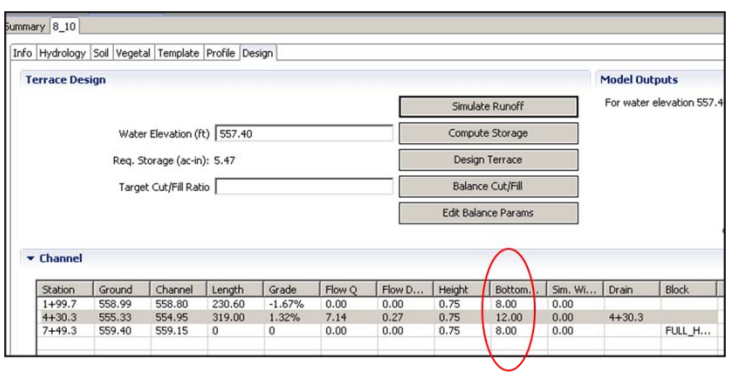


The most common problems are:

- Sharp alignment changes causing cross-sections to intersect. If this occurs TDT should indicate the stations where the problem has occurred. Go to the Alignment page and smooth out any sharp angles by adding curves.
- Overflow at the terrace ends. Correct this problem by revising the terrace channel profile and/or enable end blocks.
- For terraces on steep topography, the cut slope needs to be steep enough to intercept original ground in a reasonable distance. If not, an error will be generated.
- Be sure that the uphill direction is correctly selected on the terrace template interface.
- Enough survey data needs to be gathered so that the surface generated will encompass the entire terrace footprint. This can be a problem on steep terrain where a flat back slope runs past available survey data or there is no survey data past the ends of terrace channel.

9.9.1 Bottom Width Adjustment

At this point the design can be accepted as is or adjustments can be made. One adjustment that is often needed is the bottom width of the terrace channel. The initial design is based on the uniform bottom width specified on the ***Template*** page. After the initial design the user can change the bottom width station by station. This is done in the table that is displayed on the ***Terrace Design*** page.

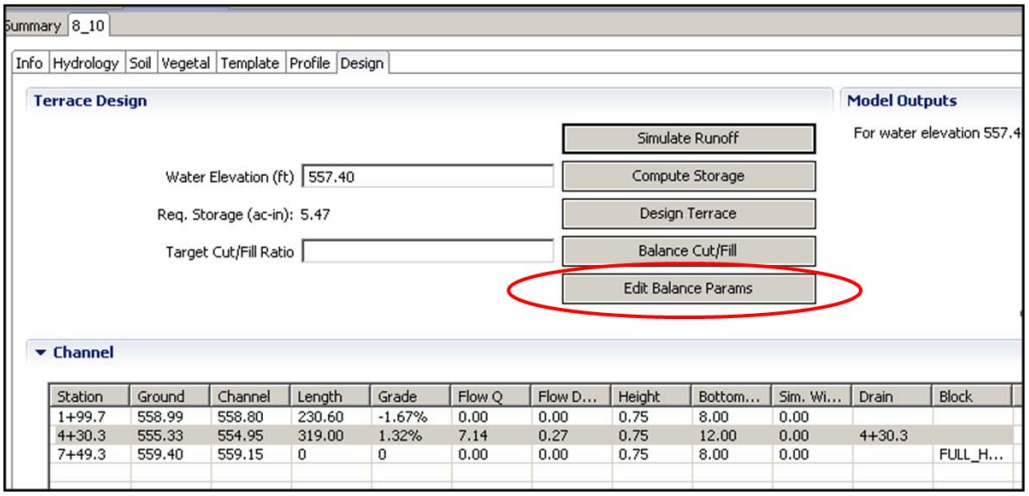


In the column labeled ***Bottom***, click in the cell for the station to be changed. Enter a new value. TDT will now use the newly defined bottom width for this station. The new bottom width will be tapered into the bottom widths for the adjoining stations. Click the ***Design Terrace*** button again to incorporate the new bottom widths into the design. **Note,** at this point in the design process changing the bottom width on the ***Template*** page does not affect the design of the terrace.

9.10 Balancing Cuts and Fills

Cuts and fills can be balanced by clicking the ***Balance Cut and Fill*** button. TDT will balance the cuts and fills by changing the values associated with the template for the

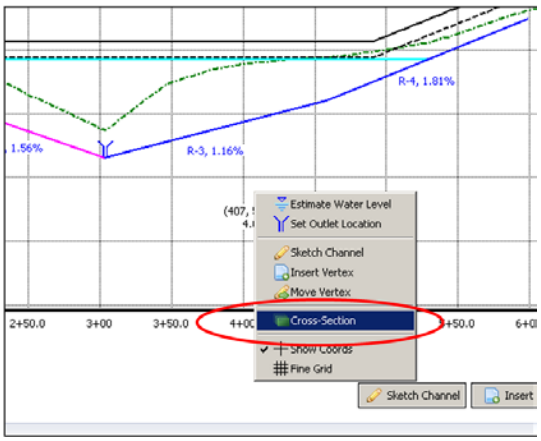
terrace. The priority of how these values are changed and incremented is a user defined function. Click the ***Edit Balance Parameters*** button.

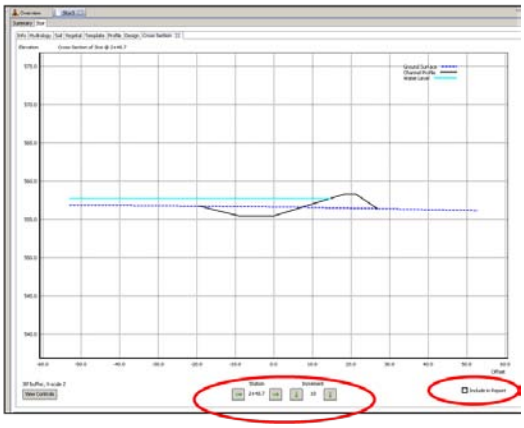


A screen will open showing the variables that are incremented to balance cuts and fills and the order in which they are used. Each variable is incremented separately. The user can change the order of use or disable the use of a variable completely. The use and ordering of these balancing parameters can also be set from ***Window, Preferences***.

9.11 Cross-Sections

Now that the terrace is designed, the user should look at the cross-sections for the terrace. These are accessed from the ***Terrace, Profile*** page. Position the cursor on the graph and right click for a drop down menu. Choose ***Cross-Sections*** from the menu. Now click on a station on the graph to display the cross-section. Use the buttons on the page to scroll through the entire list of cross-sections. Click the check box at the right side of the page to indicate those that should be included in the design.


R-4, 1.81%
R-3, 1.16%
Estimate Water Level
Set Outlet Location
Sketch Channel
Insert Vertex
Move Vertex
Cross-Section
Show Coords
Fine Grid
Sketch Channel
Insert

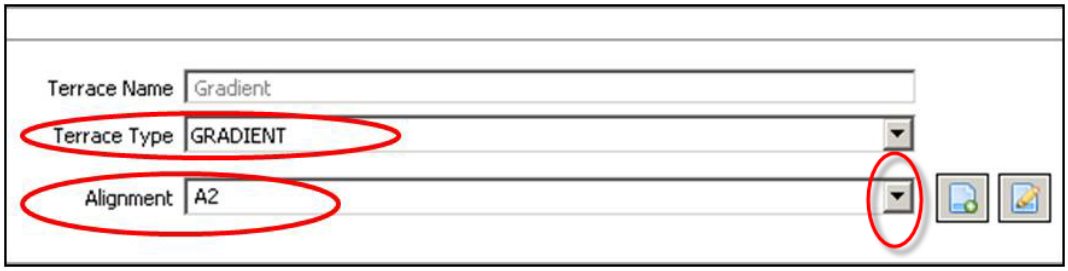


10. Gradient Terrace Design

A gradient terrace is a channel and embankment constructed across a slope to intercept runoff and convey it to a stable outlet such as a grassed waterway. Gradient terraces do not contain any water storage or sediment storage so these processes are not functional in TDT when designing gradient terraces. The design of gradient terraces uses the same design process as Waterway Design Tool (WDT) to size the terrace channel and check for stability. The surface generation and alignment layout should follow the procedures described in **Sections 6** and **7**. To start the design process, on the ***Design Elements*** tab, ***Terraces*** click ***New***. Give the terrace a name and click ***OK***. This will open the user interface to design a terrace.

10.1 Choosing a Terrace Type and Alignment

The first step is to select the type of terrace that will be designed from the *Type of Terrace* drop down menu. Choose *Gradient*. This will limit the functionality of the design process to gradient terraces.



10.2 Selecting Alignment

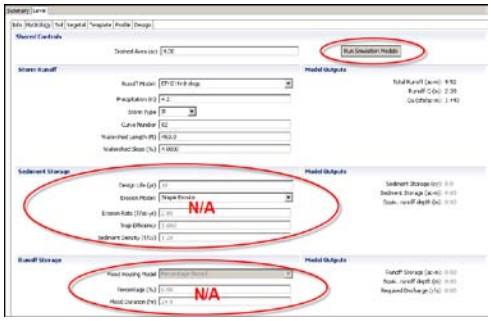
After selecting the type of terrace, choose the alignment that will be used for the terrace. Click the button beside the ***Alignment*** box. A drop down menu will display all of the alignments that have been entered for this terrace. Choose the appropriate alignment.

10.3 Entering Hydrology Data

Click on the ***HydrologyTab*** at the top of the page. Enter the ***drainage area, precipitation amount, storm type, curve number, watershed length and watershed slope***.

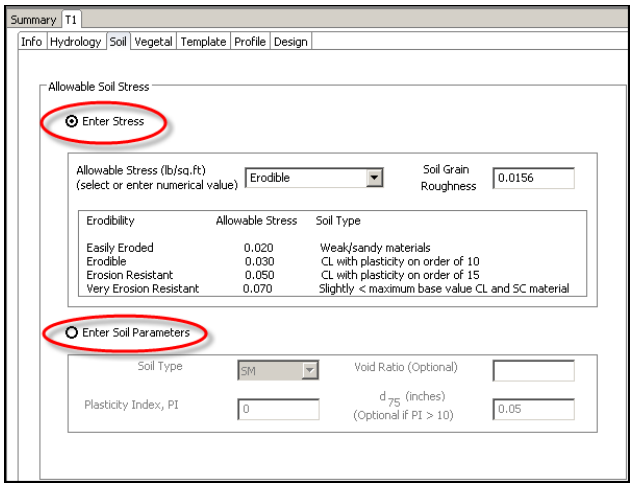
Since a gradient terrace does not store sediment or runoff the sediment calculation and flood routing are not functional.

Click the ***Run Simulation*** button to calculate the runoff totals.



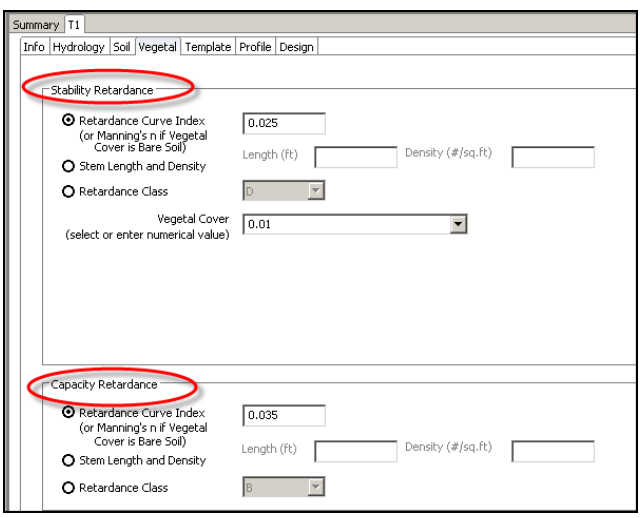
10.4 Entering Soil Data

Soil data is used by TDT to check the stability of the terrace channel. Click on the Soil tab to open the user interface. TDT uses the WDT tractive stress method to check the stability of the terrace channel. Enter either tractive stress values or actual soil properties.



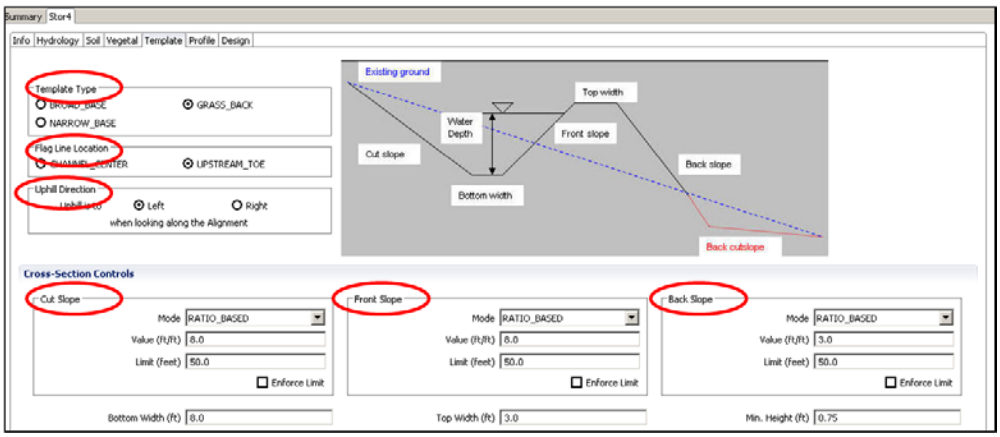
10.5 Entering Vegetal Parameters

The vegetal retardance factors are used by TDT in the channel stability check. Click on the *Vegetal* tab to open the user interface. Choose the appropriate retardance values for stability and capacity.



10.6 Terrace Template Data

This tab is used to define the template for the terrace that will be designed. Much of this information can be pre-populated in ***Preferences*** or it can be input from this tab.

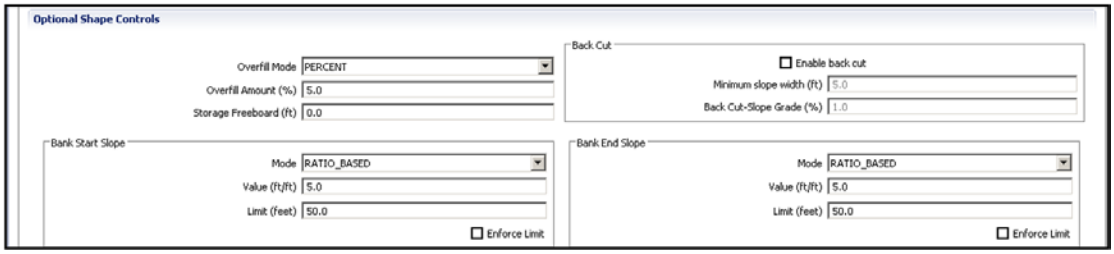


The information that is input on this tab is:

- Template Type
  - ***Broad base***
  - ***Narrow base***
  - ***Grass back***
- Flagline – this is the reference line that will be held constant as the terrace is being designed.
  - ***Channel center***
  - ***Upstream toe*** (of the embankment)
- Uphill direction – TDT needs to know what direction is uphill in relation to the alignment. This is determined by looking towards increasing stations along the alignment.
  - ***Left***
  - ***Right***
- Cross-section controls – These inputs define the cross-section of the terrace. There is a separate input for cut slope, front slope and back slope as well as bottom width, top width and minimum height.
  - ***Mode*** – how the side slopes are defined, either ratio based or width based.
  - ***Value*** – either the side slope ration or the width depending upon the Mode chosen.
  - ***Limit*** – the maximum horizontal width for the slope
  - ***Enforce limit*** – the user can force the program to stay within the bounds defined in this section.
  - ***Bottom width*** – The user defined bottom width. This will be the same for the entire terrace channel. It can be changed station by station later on.
  - ***Top width*** – User defined terrace embankment topwidth. For WASCOBs this value is defined from the table in the Terrace Conservation Practice Standard.
  - ***Minimum height*** – User defined minimum terrace embankment height.

10.6.1 Optional Shape Controls

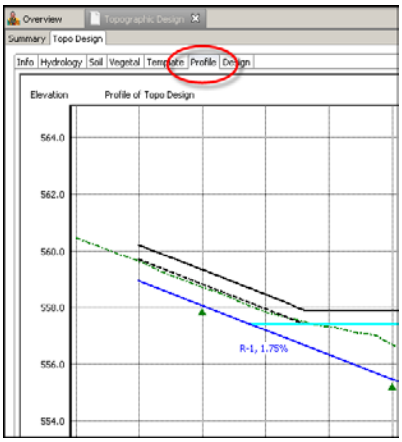
Optional shape controls provide additional inputs that are not required but can be used to further define the terrace template.



- ***Overfill*** (choose either percent or height)
  - ***Height***
  - ***Percent***
- ***Storage freeboard***
  - Extra height added to the embankment as a factor of safety.
- ***Bank start and end slope*** – these inputs tell TDT the slope to use from the embankment to original ground at the start and end of the terrace.
  - ***Mode*** – how the side slopes are defined, either ratio based or width based.
  - ***Value*** – either the side slope ratio or the width depending upon the Mode chosen.
  - ***Limit*** – the maximum horizontal width for the slope
- **Back cut slope** – this input defines the parameters to be used if the user wants TDT to excavate material from below the terrace to obtain fill material. This option will not be available unless enabled here by the user.
  - ***Minimum slope width***, this is the user defined slope width. TDT will use the slope ratio to force the back slope into the ground until the defined slope width is achieved.
  - ***Back cut slope grade***, this is the user defined grade from the back slope toe to daylight.

10.7 Terrace Channel Profile

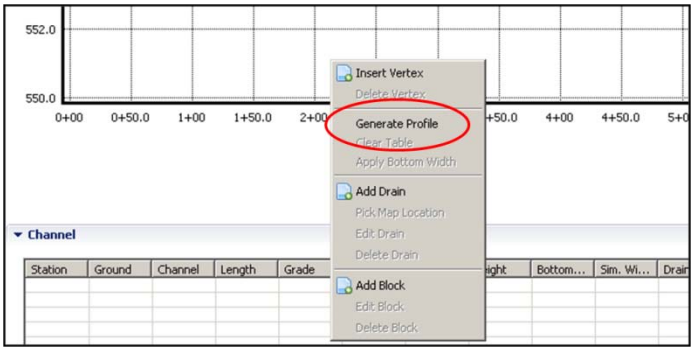
The ***Profile Tab*** allows the user to define the terrace channel profile. The ground profile along the previously chosen alignment should be displayed when this tab is clicked. (If it is not, make sure that you selected an ***Alignment*** on the ***Info*** tab for the terrace design user interface.) The planned profile of the terrace channel is drawn on this screen.

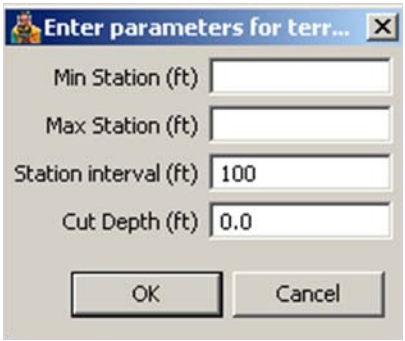


There are 2 ways to define the terrace channel profile. A profile can be defined to follow the existing ground or the user can draw in the profile.

10.8 Generate a Profile

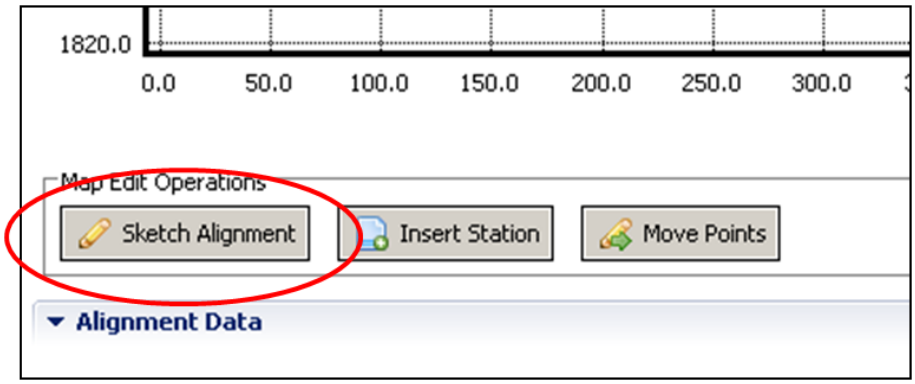
To define a profile that follows the existing ground, place the cursor in the table below the graph. Right click and a popup menu will be displayed. One of the choices will be ***Generate Profile***. Click on this and an additional popup will be displayed. Enter the beginning and ending stations for the alignment, a station interval for the profile and, if needed, a depth of cut. Click ***OK***. TDT will generate a channel alignment that follows the existing ground as closely as it can within the bounds of the stationing that is used. The user can make further refinements to the alignment by choosing ***Move Points*** or ***Insert Station***.



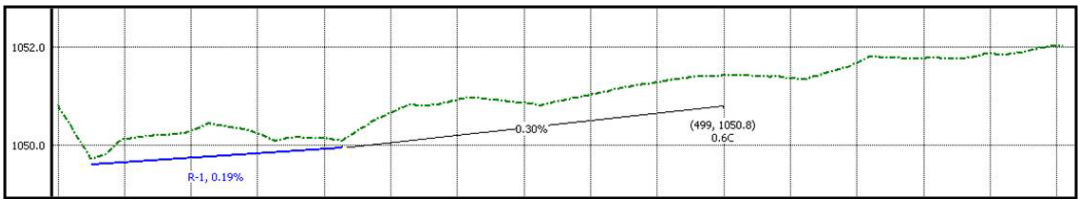


10.8.1 Draw a Profile

The other option for generating the terrace channel alignment is to draw the alignment on the screen. Click the ***Sketch Channel*** button or alternatively right click for a drop down menu and click ***Sketch Channel***.



Channel reaches can now be drawn. Position the cursor on one end of the channel where the channel will start. Note that the X, Y position and cut depth of the cursor position are displayed.

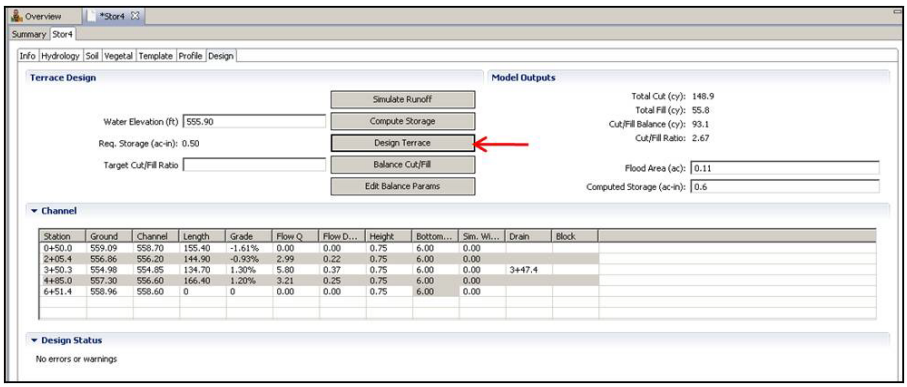


Click and release the mouse button. This sets the first point. Now drag out the profile of the channel. Note that the slope of the line, X, Y position and cut depth at the cursor are displayed. Click additional points along the channel profile. Notice that the grade of the line as well as the cut or fill at the end of the line is displayed. To end the profile, double click or release the button and move the cursor off of the graph.

The resulting profile can be edited by using the ***Insert Vertex*** and ***Move Vertex*** buttons. These buttons are also accessible by right clicking. After choosing these functions, simply use the cursor to insert new vertices in the profile or move existing ones by clicking on the profile.

10.9 Designing the Terrace.

The terrace is now ready to design. Click on the ***Design Tab*** to open the user interface for the terrace design.



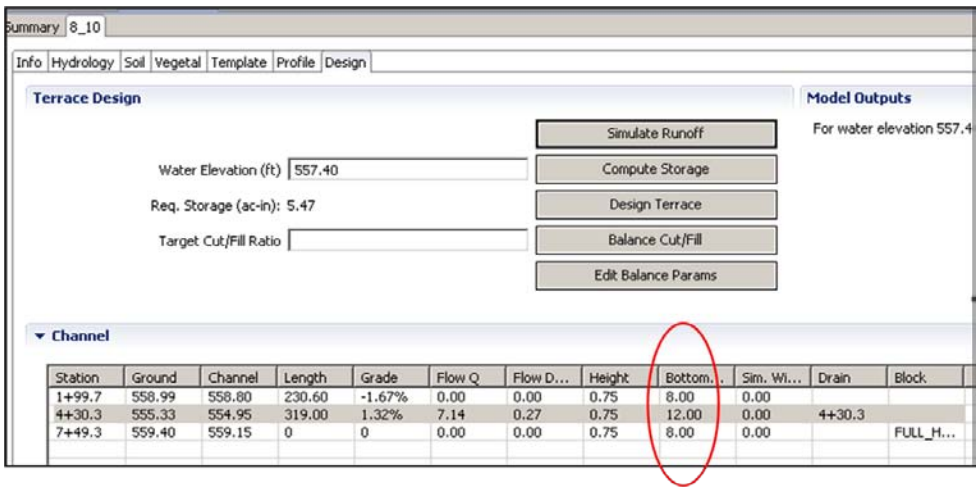
To design the terrace, click on the ***Design Terrace*** button. TDT should generate an initial terrace design. Cut and fill values will be displayed to the right. If the design is not successful an error message will be shown. The most common problems are:

- Sharp alignment changes causing cross-sections to intersect. If this occurs TDT should indicate the stations where the problem has occurred. Go to the Alignment page and smooth out any sharp angles by adding curves.
- Overflow at the terrace ends. Correct this problem by revising the terrace channel profile and/or enable end blocks.
- For terraces on steep topography, the cut slope needs to be steep enough to intercept original ground in a reasonable distance. If not, an error will be generated.
- Be sure that the uphill direction is correctly selected on the terrace template interface.

- Enough survey data needs to be gathered so that the surface generated will encompass the entire terrace footprint. This can be a problem on steep terrain where a flat back slope runs past available survey data or there is no survey data past the ends of terrace channel.

10.9.1 Bottom Width Adjustment

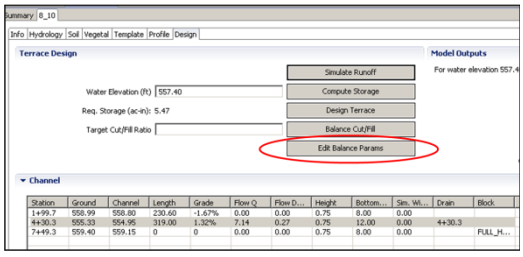
At this point the design can be accepted as is or adjustments can be made. One adjustment that is often needed is the bottom width of the terrace channel. The initial design is based on the uniform bottom width specified on the ***Template*** page. After the initial design the user can change the bottom width station by station.



This is done in the table that is displayed on the ***Terrace Design*** page. In the column labeled ***Bottom***, click in the cell for the station that needs to be changed. Enter a new value. TDT will now use the newly defined bottom width for this station. The new bottom width will be tapered into the bottom widths for the adjoining stations. Click the ***Design Terrace*** button again to incorporate the new bottom widths into the design. **Note,** at this point in the design process changing the bottom width on the ***Template*** page does not affect the design of the terrace.

10.10 Balancing Cuts and Fills

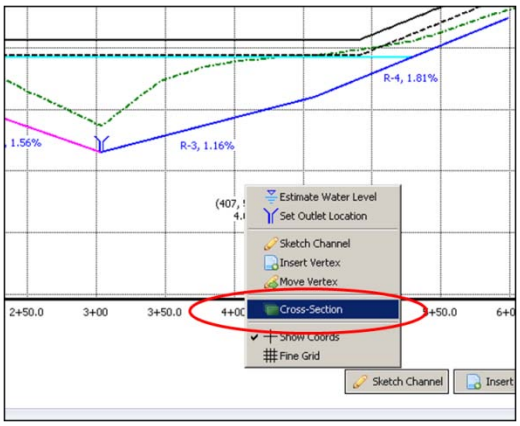
Cuts and fills can be balanced by clicking the ***Balance Cut and Fill*** button. TDT will balance the cuts and fills by changing the values associated with the template for the terrace. The priority of how these values are changed and incremented is a user defined function. Click the ***Edit Balance Parameters*** button.

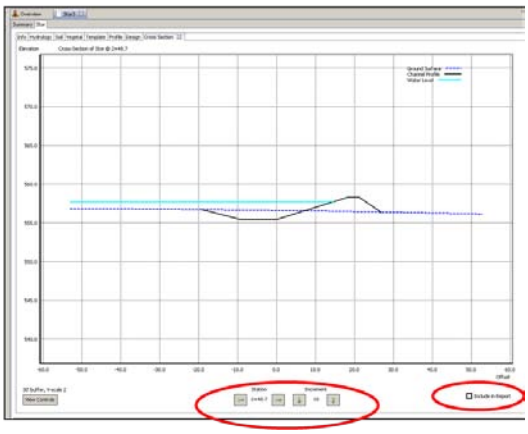


A screen will open showing the variables that are incremented to balance cuts and fills and the order in which they are used. Each variable is incremented separately. The user can change the order of use or disable the use of a variable completely. The use and ordering of these balancing parameters can also be set from ***Window, Preferences***.

10.11 Cross-Sections

Now that the terrace is designed, the user should look at the cross-sections for the terrace. These are accessed from the ***Terrace, Profile*** page. Position the cursor on the graph and right click for a drop down menu. Choose ***Cross-Sections*** from the menu. Now click on a station on the graph to display the cross-section. Use the buttons on the page to scroll through the entire list of cross-sections. Click the check box at the right side of the page to indicate those that should be included in the design.





11.0 Reports and Output

TDT will generate and print out reports and other output that is very useful. These documents can be used for construction plans for a contractor or other client as well as for design documentation for NRCS records. The report generation process for TDT is the same as SET and WDT. However, the instructions that follow are specific to TDT.

11.1 Types of Reports

The type of output that TDT will provide includes:

- Documentation of survey information (this information mirrors the inputs used for the survey)
- Details of terrace and underground outlet alignments
- Terrace channel profile
- Terrace design documentation (this information mirrors the inputs used for design)
- Underground outlet profile
- Underground outlet documentation (this information mirrors the inputs used for design)
- Typical detail of the underground outlet with relevant elevations and other information filled in
- Cross sections for the terrace
- Bill of Materials
- Contractor Cut Sheet
- An Excel file of points that define designed ground surface of the terrace
- A Land XML file defines the designed ground surface of the terrace

In addition to this output that is generated by TDT and is specific to an individual design, additional information can be generated outside of TDT then included in the output printed by TDT. These are called ***Headers*** and ***Footers***.
Examples of this type of output include:

- Cover sheets
- Standard drawings
- Specifications

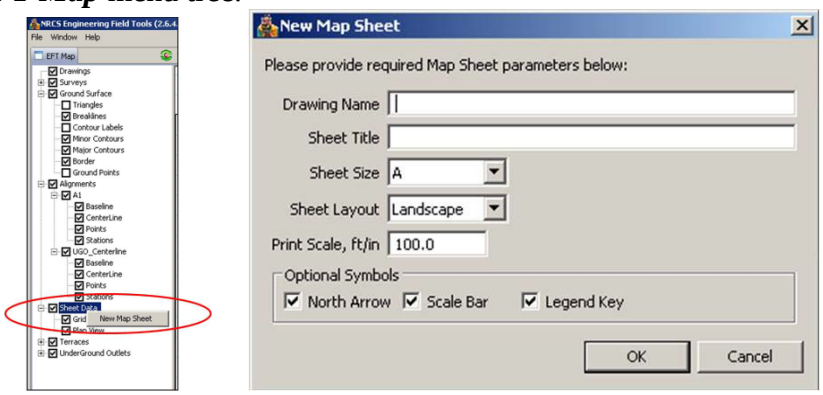
Documents to be used for ***Headers*** and ***Footers*** are developed with other software such as MS Word or AutoCad, and the results saved as pdf documents. TDT then allows the insertion of these pdfs in the output so that the final result from printing reports in TDT is a complete set of construction plans and specifications.

11.2 Generating Reports

Before printing any reports, save the current design to ensure any changes are incorporated in the output. TDT will issue a prompt to save the file. The next task is to set up the ***Map Sheets***.

11.2.1 Map Sheets

In order to print out a plan view of the terrace a "***Map Sheet***" needs to be defined. The map sheet will have a title block that is filled in with information from the ***Report Title Block Information*** in TDT. This is done by right clicking ***Sheet Data*** then ***New Map Sheet*** in the ***EFT Map*** menu tree.



This brings up a dialogue box to fill in information about the map sheet.
The user fills in the following information:

- Drawing name – this is the name that will be displayed in the EFT Map menu tree.
- Sheet title – this is the name that will be printed in the title block on the sheet
- Sheet size – 3 sizes are available, A (8 ½" x 11"), B (11" x 17") and D (22" x 34")
- Sheet layout – landscape or portrait
- Print scale ft/in – This is the scale at which the drawing will be printed. For example, an entry of 100 will be a scale of 1 inch on the paper equals 100 feet in the real world.
- North Arrow – A compass rose indicating north will be printed on the map sheet.
- Scale Bar – A scale bar will be printed on the map sheet
- Legend Key – A legend for the line color and styles will be printed on the map sheet.

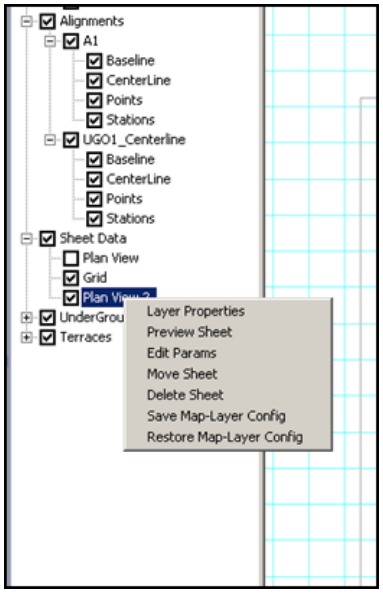
Click ***OK*** after filling in the required information to save the inputs for the map sheet. After ***OK*** is clicked the map sheet border will be displayed on the map view. The border should be moved to correctly position it by clicking within the border and dragging it into position.

One problem that often occurs is that the wrong scale or paper size is initially chosen and the entire topo map will not fit within the sheet size at the scale selected. To correct this problem, right click on the sheet name that appears in the menu tree. A popup menu displays the following choices:

- ***Layer Properties*** - displays the layer properties
- ***Preview Sheet*** - allows a quick preview of the sheet

- ***Edit Params*** - allows previously selected parameters to be changed
- ***Move Sheet*** - allows the current sheet border to be moved
- ***Delete Sheet*** - deletes the current sheet
- ***Save Map-Layer Config*** - saves the current sheet configuration
- ***Restore Map-Layer Config*** - reverts to the previous configuration

Change either the scale or paper size under ***Edit Params***, then reposition the sheet under ***Move Sheet*** to cover the entire topo map.



Additional editing of the map sheet can be done by clicking on any of the items in the popup menu.

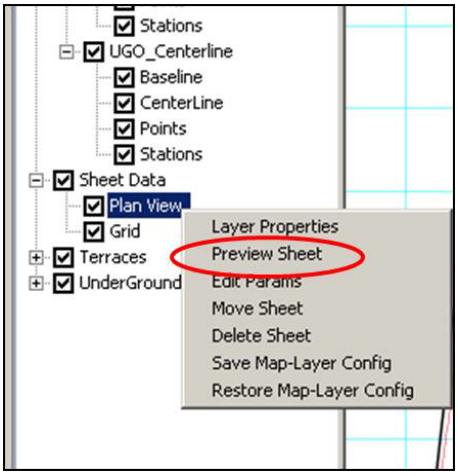
11.2.1.1 Map Sheet Layer Properties

This option allows control of the line size and color of the border around the viewport by right-clicking on the ***Map Sheet*** layer name and choosing ***Layer Properties***.

11.2.1.2 Previewing a Map Sheet

The ***Preview Sheet*** option allows a preview of what will be plotted. This allows the user to see if the map looks correct before plotting. It also allows the quick printing of an individual map sheet without going through the TDT Reports routine. In addition, the preview sheet print will not contain any page numbers.

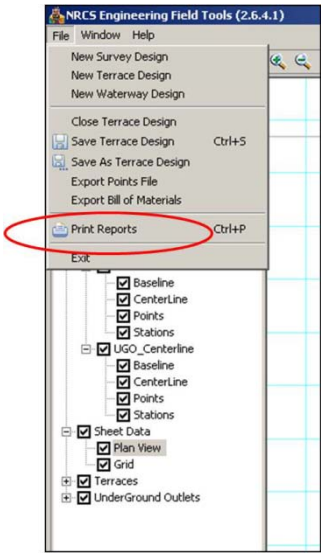
To preview a map sheet, right click the ***Map Sheet*** layer name and choose ***Preview Sheet***. If changes have been made to the terrace files that have not been saved, then a message will be displayed prompting saving of the file. Press ***OK*** and the map will be displayed on the right side of the EFT window.

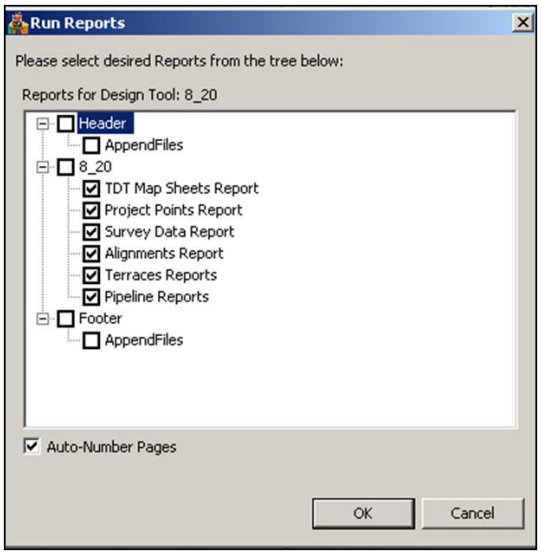


The map sheet will be brought up in a PDF viewer. Maximize the view if needed to get a closer look at the results. The sheet can be saved as a file, printed, or canceled.

11.3 Printing Reports

TDT is now ready to print out reports. Click ***File, Print Reports***. This opens a dialogue box that lists the reports available for printing.



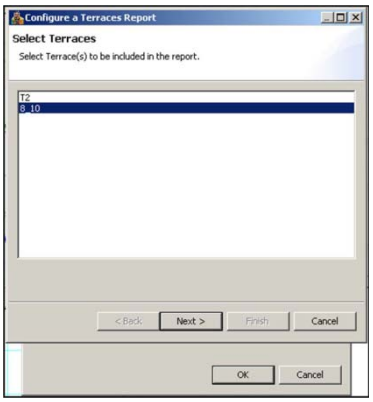


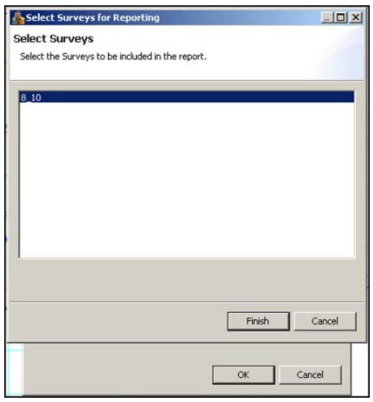
The choices available are:

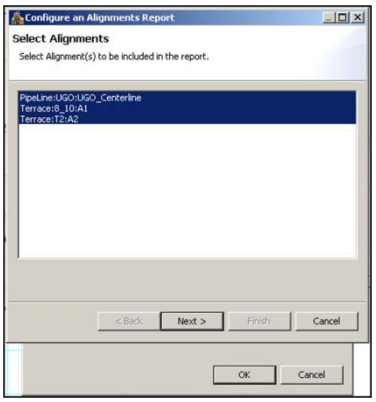
- TDT Map Sheets
- Project Points Report

- Survey Data Report
- Alignment Report
- Terrace Report
- Pipeline Report

Place a check in the box for each report that will be printed. In order to print ***Map Sheets***, they must be set up as previously described in **Section 11.2.1**. In order to include cross-sections in the output the user must have selected the cross-sections during the design process (see **Section 8.11**).Checking the other boxes (except for Project Points) will open a dialogue box that requires the user to identify what will be printed. Examples are shown below.







The ***Select Terraces*** and ***Select Pipelines*** dialogue boxes have secondary dialogue boxes that require the user to enter additional information. Cutsheets for both terraces and pipelines can be selected from these dialogue boxes.

Checking either, ***Header, AppendFiles*** or ***Footer, AppendFiles*** allows the user to add files from outside of TDT (examples include, cover sheets, standard drawings and specifications) to the output report. These files need to be either image files or PDFs. Checking either of these boxes will open a dialogue box that allows the user to browse to where the files are stored on the user's computer. These files will be added to the output and numbered consecutively with the other pages.

Checking Auto-Number Pages will automatically number the pages of output.

11.3.1 Saving the Report

After clicking ***OK*** on the ***Run Reports*** dialogue box, TDT will generate the requested reports. This process may take a minute or so depending on the size of the job. The report is generated in pdf format and the user is asked to ***Open*** or ***Save*** the file. Save the file. If it is opened, the only option then is to view the file and print it. After saving the file, open it and view the results.

11.3.2 Saving Print Report Configuration

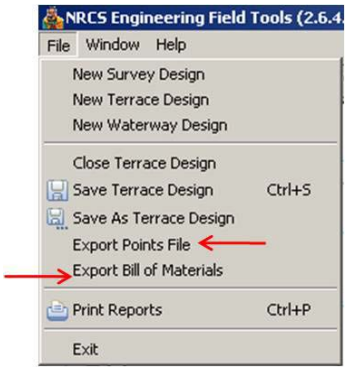
When reports are generated for a design, the full package configuration - which reports were selected, and all the parameters provided through the wizards - is automatically

saved for later reuse. The next time ***Print Reports*** is selected, the previously used configuration will be retrieved and displayed in the ***Run Reports*** window. From this starting point, the user can re-run the same package of reports with the same configuration by clicking ***Finish***. This allows the user to re-print a package later, if needed.

This can save time if one report out of a package was configured incorrectly. To make changes, the user selects the ***Print Reports*** item again, and the ***Run Reports*** window comes up with the same configuration used previously. The user un-checks the report that was configured wrong, and then checks it again. A dialogue box will be opened, allowing the user to enter the correct configuration for the item. Clicking ***Finish*** will print the whole report package, with the error corrected.

11.4 Export Bill of Materials

TDT will generate a ***Bill of Materials*** for the design. TDT populates quantities in an Excel file based on the design. The Excel file will print out a Bill of Materials and a Bid Sheet with quantities filled in. The user can save this file and add or delete items from it as necessary. To produce the file, click on ***File, Export Bill of Materials***.



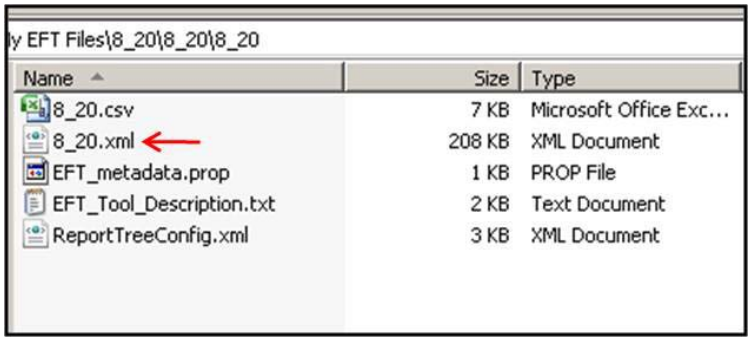
A ***Save As*** dialogue box will pop up asking where to store the file. Choose the location and click ***Save***.

11.5 Export Points

TDT will generate a set of points that define the surface of the newly designed terrace. These points can be used for layout in the field, by a contractor for construction or for checkout of the completed terrace. The points are written to a file in CSV format. To produce the file, click on ***File, Export Points File***. A ***Save As*** dialogue box will pop up asking where to store the file. Choose the location and click ***Save***.

11.6 Land XML File

TDT automatically generates a Land XML file that contains the alignments and surface. The user does not need to take any action to generate this file. To access the file after a design is completed, browse to My EFT Files/Customer Name/Project Name/Job Name/Job Name.xml. This file can be opened in AutoCad, GIS software and uploaded to GPS enabled equipment for construction.



TDT Glossary of Terms

Alignment	Alignments are a linear feature that defines the location of a structure in TDT. Alignments are used to define the locations of terrace and underground outlets. TDT generates horizontal and vertical data for points along an alignment.
Back Cut Slope	The back cut slope is the extension of the back slope into the existing ground to obtain fill material to construct the terrace embankment. The extent the back slope extends below existing ground is defined by the user on the terrace template.
Back Slope	The back slope is the downstream slope of the terrace embankment. The user can define either the steepness or width of the back slope on the terrace template.
Bill of Materials	The bill of materials is a list of materials necessary to build the terrace. This list is generated by TDT and output as an Excel file to allow the user to easily edit the content by adding or deleting items.
Bottom Width	This is the bottom width of the terrace channel. TDT assumes the terrace channel will be a trapezoid. A triangular channel is a special case of the trapezoidal channel with a zero bottom width. The bottom width can be defined on the terrace template and edited in the table on the terrace profile page.
Broad Base	Broad base is a terrace template type where the terrace embankment has front and back slopes that are flat enough to be farmed over, typically 5:1 or flatter.
Bubble-up Outlet	A bubble-up outlet is a type of outlet that consists of a vertical perforate pipe from the underground outlet to a foot or two above the surface of the ground. This type of outlet is used to outlet an underground outlet into a grassed waterway.

Canopy Inlet	A canopy inlet is a type of inlet for an underground outlet system that consists of a pipe that is cut at an angle. This inlet type allows the underground outlet pipe to flow full at a relatively low entrance head. A hooded inlet is considered a special case of the canopy inlet with different entrance loss coefficients. The entrance loss coefficients are editable by the user.
Channel Block	A channel block is small embankment placed perpendicular to the terrace channel to block flow in the channel. This is commonly done at the end of channels to prevent overflow out the ends or within channels to reduce the length of channels. Channel blocks can be input in the table on the profile page.
Cross Slope Table	A cross-slope table is one of the four methods for station offset data entry. This method requires the user to enter a centerline shot and then either one shot or a ground slope to define the ground on either side of the centerline shot. The user must also define how far on either side of the centerline the side shot information will be extrapolated to define the existing ground.
Cross-Sections	A representation of the ground perpendicular to the alignment. Cross-sections can be viewed from the profile page by right clicking and selecting cross-sections. The cross-sections for the entire alignment can then be viewed and selections made for those to be included in output.
Cut slope	The cut slope is the upstream side of the terrace channel. The user can define either the width or steepness of this slope on the terrace template.
Fixtures	A fixture is an appurtenance on an underground outlet conduit. The fixtures that can be set on an underground outlet in TDT are; grade break, elbow, tee, junction, canopy inlet, riser, standard outlet, bubble-up outlet and no fixture.
Flagline	The flagline is the point on a cross-section that coincides with alignment. In TDT this point can be either the toe of the front slope or the centerline of the terrace channel.

Freeboard	Freeboard is additional embankment height that is added above the design elevations. The inclusion of freeboard is a user defined input.
Front Slope	Front slope is the upstream slope of the terrace embankment. The user can define either the steepness or width of the front slope on the terrace template.
Gradient Terrace	A gradient terrace is a terrace that outlets to a surface outlet. A gradient terrace does not contain any temporary storage.
Grassed Back	Grassed back is a terrace template type where the terrace embankment has a steep back slopes that is planted to permanent grass and is not farmed. The grassed back slope is typically 3:1 or steeper.
Hydrology	Hydrology is the determination of the amount of precipitation runoff that the terrace must accommodate. Typically terraces are designed to handle the runoff from a 10 year, 24 hour storm event.
Land XML File	Land XML is a non-proprietary standard for data exchange among the land development, civil engineering and surveying communities. In TDT it is used to output data on the final land surface and alignments for use in other software applications.
Level Terrace	A level terrace is a terrace that has a level embankment top and a level or almost level, wide channel bottom. Generally 100% of the runoff entering the terrace is stored and allowed to infiltrate into the soil. The primary purpose for these terraces is water conservation.
Map Functions	Map functions are buttons on the map view of the terrace in TDT that allow the user to move around the map view, do simple drawing on the map view and take measurements directly on the map view.
Map Sheets	Map sheets is an output function in TDT that provides for the printing of the map view.

Narrow Base	Narrow base is a terrace template type that consists of a terrace embankment with steep side slopes that are generally planted to permanent vegetation.
Non-Pressure Flow	Non-pressure flow refers to the flow condition in an underground outlet conduit. The water is flowing in the conduit only under the force of gravity.
Outlet	Outlet refers to how water intercepted by a terrace, exits the terrace. Three types of outlets are available for terraces; surface or waterway outlet, underground outlet or soil infiltration.
Overfill	Overfill is the additional height that is added to a terrace embankment to compensate for settling that will occur over time as the embankment settles. Overfill amounts generally range from 5% to 15% depending on the soil type and amount of compactive effort used during construction.
Parallel Alignment	TDT has function that allows a new alignment to be defined that is parallel to an existing alignment.
Preferences	TDT has a function that allows the user to pre-set certain values that will be used frequently. This function is accessed by clicking ***Window, Preferences***.
Pressure Flow	Pressure flow refers to the flow condition in an underground outlet. Water in the conduit is flowing under the force of the water head at the upstream end of the pipe.
Profile	A profile is a graph of the elevations along a line. In TDT profiles can be generated for terrace channels and underground outlet alignments.
Reports	TDT can generate a series of reports that provide construction plans and documentation of the design. This function can be accessed from ***File, Print Reports***.
Riser	A riser is the most common type of inlet that is used for an underground outlet. It generally consists of a vertical piece of pipe with holes drilled into it. The riser is connected to the underground outlet below ground.

Scrolling Table	This is one of the data input methods available for a station offset survey. Data is entered as either a rod or elevation reading and distance from the centerline for each station. Data is entered station by station. As many elevation and distance readings as necessary can be entered per station.
Simple Alignment	A simple alignment is the alignment defined by a station offset survey. The alignment coincides with the centerline shots entered in the survey.
Single Table	This is one of the data input methods available for a station offset survey. Data is entered as either a rod or elevation reading and distance from the centerline for each station. Data is entered station by station. As many elevation and distance readings as necessary can be entered per station.
Spreadsheet Table	This is one of the data input methods available for a station offset survey. This entry requires the user to pre-define the offset distance to be used at each station. This one offset shot is used to define the slope at the station. The user must also define the slope width that will be used on either side of the centerline.
Station Offset Survey	This is a survey method that consists of a centerline plus offset shots on either side of the centerline.
Storage Terrace	A storage terrace is a terrace that stores runoff and outlets it through an underground outlet.
Terrace Template	A terrace template is a cross-sectional representation of the terrace shape. The user must define the parameters of the terrace template. TDT uses the terrace template to define the ground surface of the completed terrace
Underground Outlet	An underground outlet is the outlet used for storage terraces. It consists of an inlet and underground conduit.
WASCOB	A water and sediment control basin (WASCOB) is a single terrace constructed across a drainageway to intercept and detain the flow. It is designed similar to a storage terrace.
XYZ Point	Point data that consists of horizontal (X,Y) and vertical

Data	(Z) information. TDT uses the point data to generate a surface model to represent existing ground surface.