# T3RRA Design™

# User Manual

This manual is a work in progress and subject to changes.
Feedback welcome, use
Help > Send Feedback…

T3RRA Design v2 Manual Edition 0.2

© 2019 T3RRA Pty Ltd

# Manual Update Log

| November 2020 | Beta 0.2 | • Rearranged chapters<br>• Updated tool information<br>• Added new contour features |
|---|---|---|
| June 2021 | 1.0 (v2.22) | Many updates |
| July 2021 | 1.1 (v2.27) | • Added Layer menu options<br>• Added importing files<br>• Added exporting control files<br>• Added keyboard shortcuts<br>• Updated Troubleshooting<br>• Updated Expand/Contract Surface |

# Table of Contents

# Introduction

Hi! Welcome to our manual. We're kind of excited to have a manual, because for the longest time we haven't. There have been ~~excuses~~ reasons for this:

- We'd rather put effort into writing software than books.
- We update functionality so quickly that a manual is almost always out of date
- Our service and support network has always been really good at educating users
- Our software is kind of simple and intuitive anyway

Maybe there is some merit in the above. Maybe there isn't. In any case, our latest iteration of software has significantly raised the bar vis-a-vis functionality and capability. That's brilliant, but it also means that the complexity has also increased significantly. Regretfully, we've realized that there is no way around just sucking it up and getting a bit serious about documentation.

So there you go.

And here it is.

Enjoy!

*Stu Pocknee*
Special Counsel to The Royal Commission Into Making Our Software More Awesome[1]

---

[1] This commission is possibly not officially sanctioned by any particular Royalness and may, or may not bear resemblance to any commision living or deceased.

# Disclaimer

Important: Please read this before using any of our software products.

We at T3RRA are software developers. We are not irrigation engineers or designers.

We build tools. We do **NOT** create designs for customers, or provide advice on any aspect of agronomy, irrigation, drainage, landforming or earthworks design. **We cannot (and do not) warrant or guarantee the appropriateness of any design created with our software** *for any purpose.*

It is your responsibility to evaluate the fitness and correctness of the designs created in our software for your purposes. This includes meeting all local rules, regulations, requirements and laws.

**Do NOT** blindly follow the output of this software. Monitor work progress and evaluate the correctness of implementation continuously. Independently verify that the evolving job is meeting your exact requirements. Any perceived deviation, real or imagined, must be taken seriously and work must cease until you are satisfied that the results are within your tolerable margins of error. Seek professional advice from qualified and certified engineering personnel if you have *any* doubts about the correctness of suitability of your design.

Use of our software constitutes an implicit agreement that we and our partners (dealers, distributors, representatives, business associates, etc) will not be held responsible for any damages resulting from the use of our software.

# What is T3RRA Design?

T3RRA Design is a suite of software tools for designing agriculturally focused earthworks. It contains a number of tools that enable sophisticated earthwork design and automated control. These functions offer full design options combined with many CAD drawing capabilities.
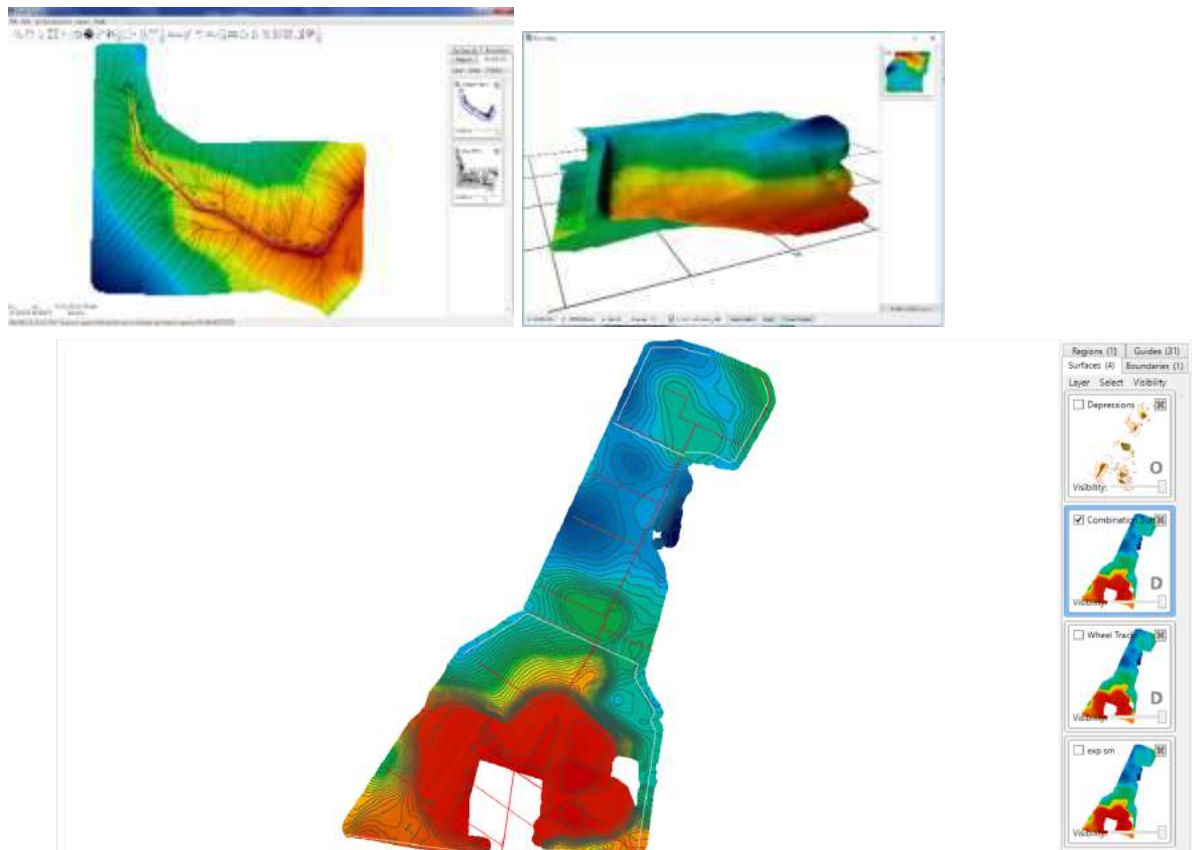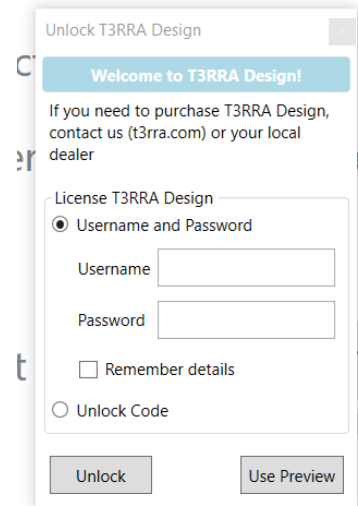
# Installation

To install T3RRA Design onto your desktop or laptop you will need your username and password, which will be supplied to you by your dealer

To download the Installer, go to users.t3rra.com and enter your credentials. This will launch the Installer.

Once T3RRA Design is installed, you will see this pop up window. Enter your credentials, which would have been provided by your dealer (these are the same used to login to users.t3rra.com)

NOTE: T3RRA Design can be installed on two (2) devices, using the same credentials.

Antivirus software sometimes prevents T3RRA Design from running or updating. If you have any trouble running T3RRA Design and have custom antivirus software installed, you can add an exclusion for the T3RRA Design folder. For more information, see Software fails to start in Troubleshooting.

# Updating your Software

There are three options for updating your software which will ensure T3RRA Design stays updated.

NOTE: You will need to restart your T3RRA Design program for updates to take effect.
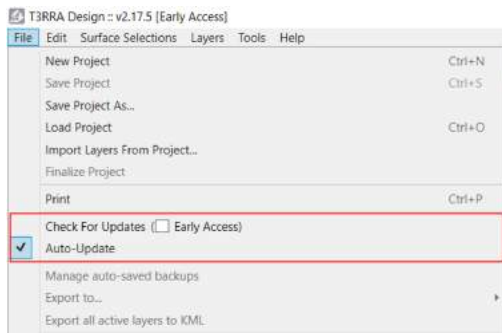


To update your T3RRA Design software, go to the File Menu in the top left of the screen:

## Option One (recommended)

Select 'Auto-Update' - this will automatically update your software when updates become available.

## Option Two

Select 'Early Access' - this will automatically update your software to the latest code which is available.

Note: Be aware that this will be test code and is subject to bugs.

## Option Three

Click on the 'Check For Updates' - this will run a check at that point in time and will not automatically update without your knowledge.

# Reverting back to a previous version

There is a provision to revert updates if needed. This is not a process that should normally be necessary, or that is recommended to be performed by customers. Please contact T3RRA or your dealer for information about this.

# What's on the Screen

The screen for T3RRA Design can be broken into 3 main sections:
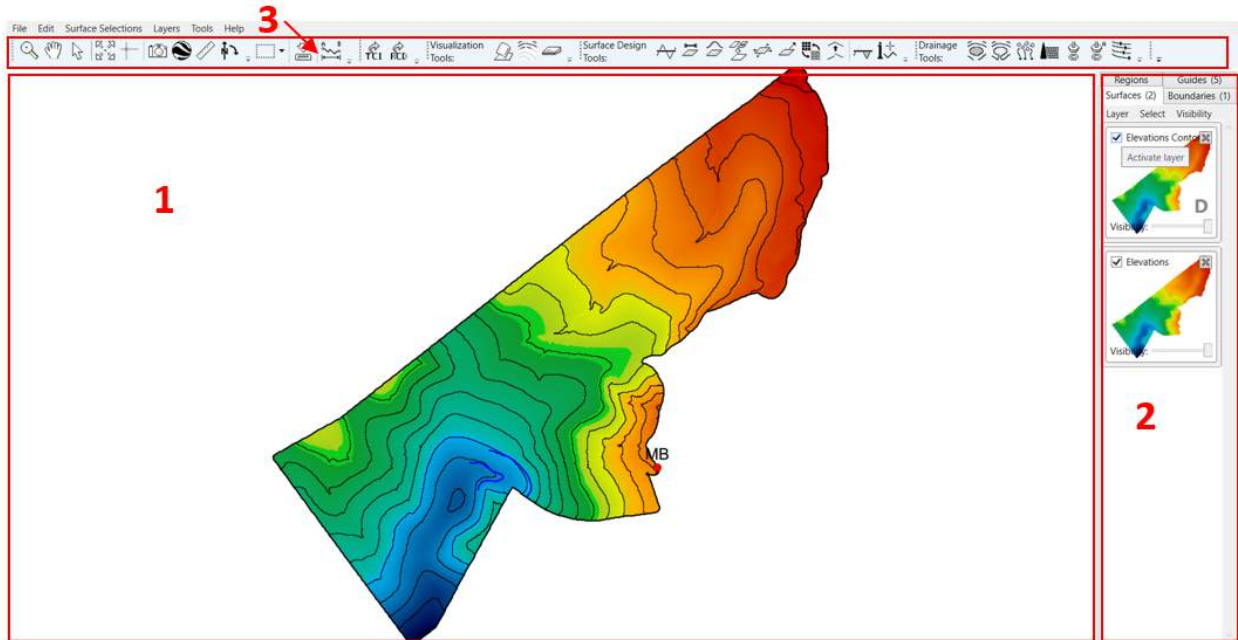


1. The 'Working Area'. Elevation surfaces, designs and surface overlays are displayed in this area.
2. Layer selection panel. This panel displays the layers of a project and will tailor the available tools in the toolbar (section 3) for each layer type (surfaces, boundaries, regions, guides).
3. Menus and Toolbar. The menus provide advanced tools and options to adjust how T3RRA Design operates. The tools that are currently available change depending on the layer type chosen in the layer selection panel (section 2).

Note: Tools that can be used on all layer types need to be reselected when the layer selection changes.

# The Working Area

**'The Working Area'** of T3RRA Design displays the topmost selected layer from each of the different layer types in the layer selection panel.

To keep your design from getting cluttered, turn some layers off. You can do this on the right by clearing the checkboxes on unwanted layers or dragging the visibility adjuster for each individual layer.

When T3RRA Design is first opened, the working area will display a notice that there are no active layers and that you should activate some. It will also show where you can find more information about T3RRA Design, including current news and tips.
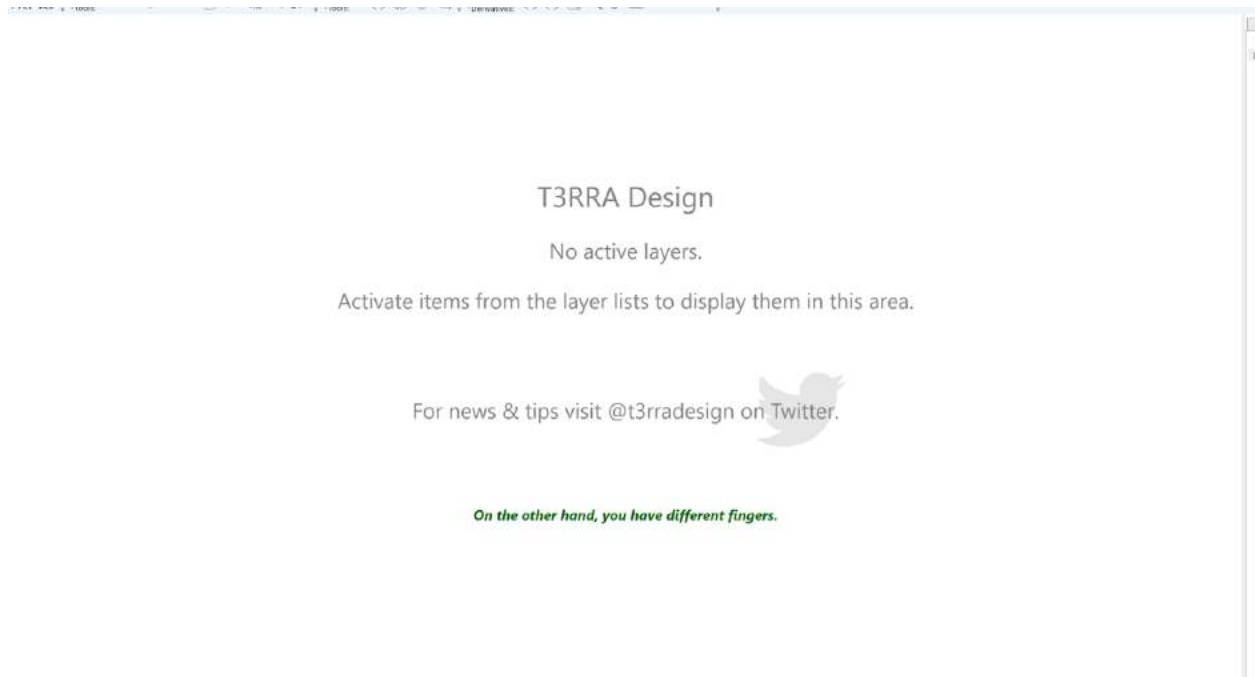
When you do create or import an active layer, there are some additional areas of information to make note of which may be helpful
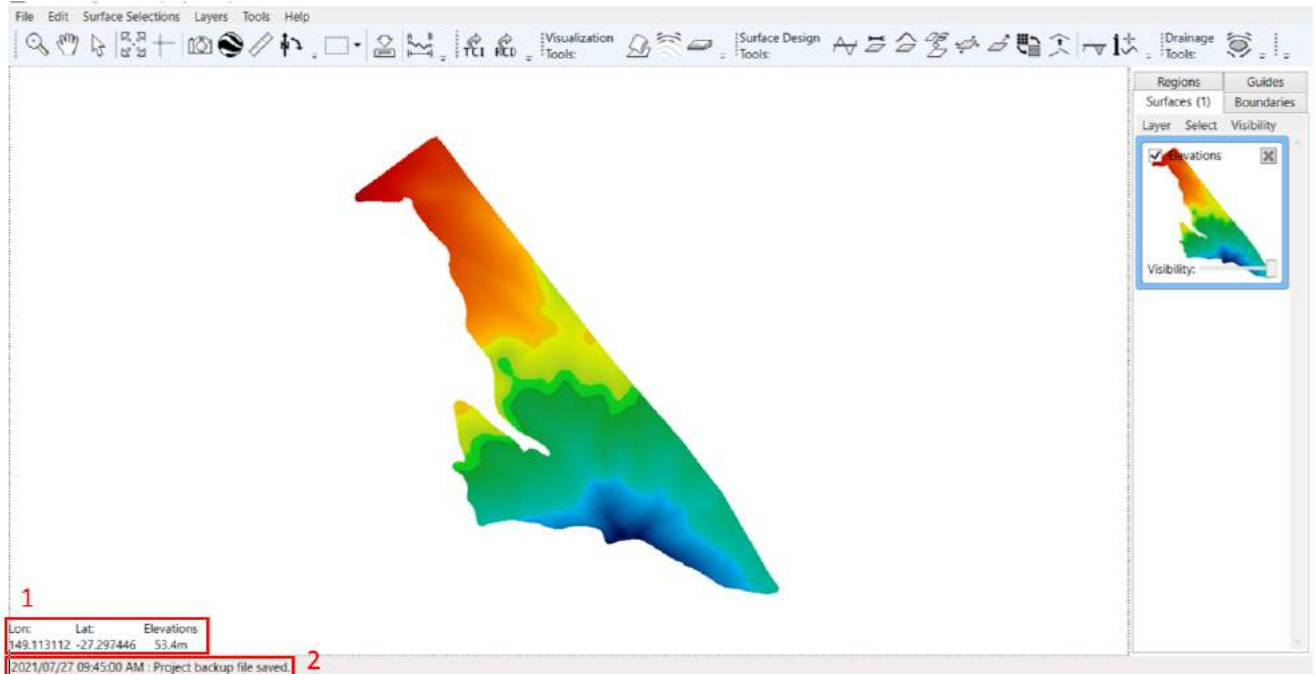


1. Shows the latitude and longitude of the position of your mouse. If your mouse is over a surface, the elevation height will also be displayed.
2. Displays a time stamp of the last action taken on T3RRA Design.

# Layer type Selection

On the right side of the screen is the layer type selection panel. This panel allows you to select any layer to view it in the working area, as well as change which layers are currently visible. Four different types of layers are available:

- Surfaces
- Boundaries
- Regions
- Guides

Each layer type has specific tools relating to them, which can be found in two separate places. Firstly, the tools displayed in the toolbar will update and change to match the selected layer type.

Secondly, located under the tab there are three other menu options: Layer, Select and Visibility.
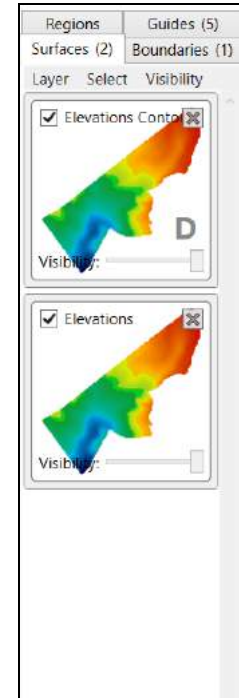


The Layer menu offers various tools and changes depending on the layer type selected. See more here.

The Select and Visibility menus have similar options for each layer type, these are:
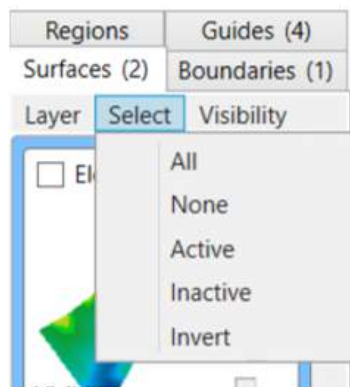


Select Menu:
- All - selects all listed layers.
- None - deselects all listed layers.
- Active - selects all layers which are active (checkbox selected).
- Inactive - selects all layers which are inactive (checkbox not selected).
- Invert - selects just the layers that are not selected.

Visibility Menu:
- All Visible - will make all listed layers visible
- All Invisible - will make all listed layers invisible

  Note: The toggle bar on each individual listed layer square can be used to make layers visible/invisible also
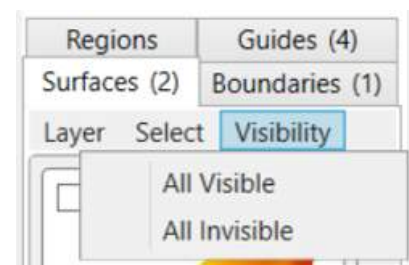
# Surfaces
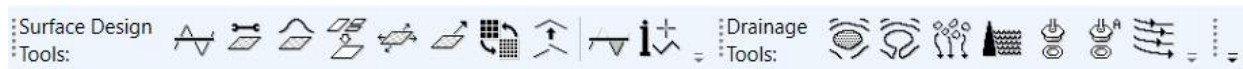
The tools specific to surfaces fall into three main groups:

- Surface design
- Drainage
- Surface Derivatives

Surfaces are the primary layer type for work in T3RRA Design, however many of the surface tools are dependent on other layer types being present. For example, the surface design tools require a boundary to be present.

These are explained in more detail in Surface Tools

# Boundaries

The toolbars specifically for Boundaries are:

- Boundaries

T3RRA Design boundaries are used to limit the extent of a design. They are different to regions in that they typically outline the entire project area.

After a surface is imported into T3RRA Design, a boundary will need to be either imported or created to tell T3RRA Design where the desired edges of the surface are.

These are explained in more detail in Boundary Tools

# Regions

The toolbar specifically for Regions are:

- Regions

Regions in T3RRA Design are flexible and easy to place. Non-linear shaped regions can be easily made by using the point-to-point creation tool or the line split tool. Regions can be used to split a design surface into many sub-surfaces, allowing the user to easily modify multiple parts of the surface independently.

These are explained in more detail in Region Tools

# Guides
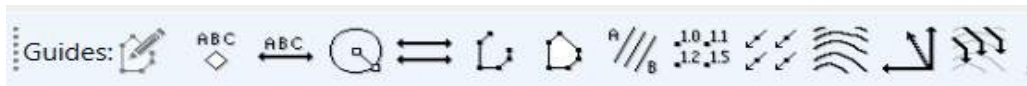


The toolbars specifically for Guides are:

- Guides

Guides are typically used as visual markers and aids when designing. The guides are powerful
when visualising and planning the project and can be leveraged to design from and modify
the surfaces with many of the tools available. It is possible to add:

- Labels at specific points, useful as benchmarks and references
- Straight and segmented lines, and AB lines
- Polygons to indicate specific areas (however, use regions to design in specific
areas)
- Strips
- Circles

These are explained in more detail in Guide Tools

# Menus

The menus, which are located on the top left hand side for the T3RRA Design screen, include many options which you would expect to find in a File or Edit menu. It also includes some T3RRA exclusive options. These are all listed below.

In addition, there are some very helpful Keyboard Shortcuts to compliment the menu options and also to add to the ease and efficiency of T3RRA Design.

## Keyboard Shortcuts

| Keypad Keys | Function |
|---|---|
| ESC | Exits or closes any tool/pop up window and returns you to 'the pointer tool' |
| Ctrl + C | Copy |
| Ctrl + V | Paste |
| Ctrl + N | Open new project |
| Ctrl + S | Save project |
| Ctrl + O | Open/load existing project |
| Ctrl + P | Print project |

| | |
|---|---|
| Ctrl + Z | Undo |
| Ctrl + Y | Redo |
| Alt + F | Open File menu<br>Replace 'F' with the following to open other menus: 'E' (Edit), 'S' (Surface Selections), 'L' (Layers), 'T' (Tools), H (Help) |

## File Menu

Under the File tab you will find the following options:

- New Project - Create a new blank project.
- Save Project - Save your project. If it is the first time saving, you will be prompted to select a location and file name.
- Save Project As - Either rename an existing project or save a replica project in a different location.
- Load Project - Load a previously saved project .pctgdp or .project.

File | Edit | Surface Selections | Layers | Tools | Help

| | |
|---|---|
| New Project | Ctrl+N |
| Save Project | Ctrl+S |
| Save Project As... | |
| Load Project | Ctrl+O |
| Import Layers From Project... | |
| Finalize Project | |
| Print | Ctrl+P |
| Check For Updates (☐ Early Access) | |
| Auto-Update | |
| Manage auto-saved backups | |
| Export to... | ▶ |
| Export all active layers to KML | |
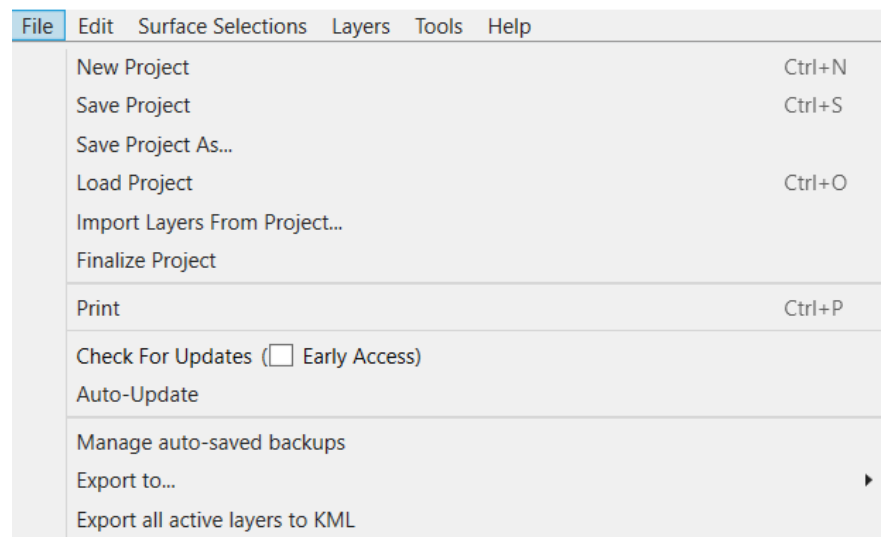
- Import Layers from project - Allows you to import numerous or single layers from previous projects:
    - Select the project that you would like to import layers from.
    - This window will pop up on screen (see below), allowing you to manually select which layers you want to import. You can also 'Select All' or 'Select None'
    - Once your selection is correct, press 'Import'.
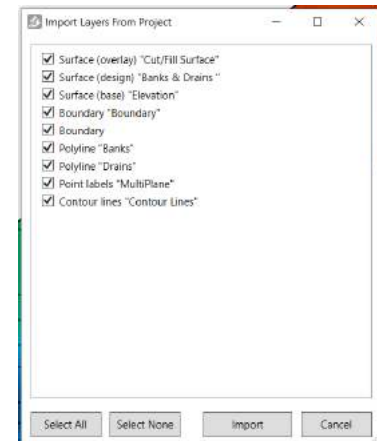
- Finalize Project - Lock project so no edits can be made. You won't be able to save this project again without giving it a new name.
- Print - Opens a print preview window from which you can print the project.
  Note: When printing to PDF, we recommend using the built in Microsoft Print to PDF. Some other print-to-PDF tools produce unexpected output (e.g. Foxit PDF Printer).
- Check For Updates Online - Downloads new updates to T3RRA Design. Check the box to get early access versions (see section: Updating your Software).
- Auto-Update - When selected, T3RRA Design will automatically check for new updates.
- Manage auto-saved backups - Reopens the list of auto-saves so you can open or delete them.
- Export all active layers to KML - Export visible data to a format that can be loaded by Google Earth.
- Exit - Closes T3RRA Design.

## Edit Menu

Under the Edit menu you will find the following options:
- Undo (Ctrl + Z) - undoes the last change made.
- Redo (Ctrl + Y) - redoes the last undo.
- Edit units - this allows you to change various units of measurement.
  Note: you should restart T3RRA Design after making any changes to the units.
- Edit credentials - user credentials are the same details used to access your users.t3rra.com account. These details can be obtained by contacting your T3RRA Representative.
- Show Action Log - catalogues all steps taken to create the current design/project

## Surface Selections Menu

'Surface Selections' provides tools that can be used to select specific areas of the active surface:

- **'Select all'** - selects the entire field in the current layer.
- **'Select all (including background)'** - creates a selection box from the widest points of the current layer.
- **'Select field edge'** - selects the outer edge of the field.
- **'Select none'** - removes current selections.
- **'Invert'** - inverts the current selection (e.g. if the edge is selected it will be inverted to select the inside of the field.)
- **'Expand'** - expands the selection by the set distance.
- **'Contract'** - contracts the selection by the set distance.
- **'Collapse selection to field'** - moves the selection to only apply to the active field.
- **'Load/Save selection'** - save the current selection for later use/reference, or load a previous selection to reuse.

## Layers Menu

Under the Layers menu you will find the following options:

- Surfaces
- Boundaries
- Regions
- Guides

These options are also available at the top of the '[Layer Selection Panel]' on the right of the display.

## Tools Menu

Under the Tools menu you will find 2 options:

- **'3D Viewer'** (see [3D Viewer]) - to look at a surface in 3D.
- **'Simulate surface water flow'** (see [Simulated Surface Flow]) - which simulates a rainfall event on the surface (this rainfall event is simulated as though the ground were a solid surface such as concrete.)

## Help Menu

Under the Help menu you will find multiple options:

- '**News and Social**' - Links provided to find us online
- '**Change Log**' - Opens a .TXT file with a record of software changes for each version
- '**Relink file associations**' - Sets windows defaults to open T3RRA Design when a compatible file is opened directly from your PC.
- '**Show .NET Status of this computer**' - Shows information about the computer currently running T3RRA Design. This can be very helpful when troubleshooting.
- '**About**' - Version Information

# Toolbar

## Navigation Tools

**The magnifying glass** allows you to zoom in or out on a selected point of a surface. Left clicking will zoom in, right clicking will zoom out. Clicking and dragging the left mouse button will zoom in on an area of interest.

**The grab tool** allows you to move the surface on the screen by clicking and holding, then dragging. This is most useful with large surfaces or when zoomed into a single section of the surface.

**The pointer tool** switches the cursor back to selection mode.

**Zoom to full extent** will change the zoom level to fit the entire surface on the screen.

**The crosshairs** will toggle on and off the display of a crosshair at the mouse's position on the working area.

**The camera** captures the surface as a geo-image with latitude and longitude or UTM (easting and northing), in multiple standard image types.

**Google Earth** will capture the current display area and overlay it on a satellite image of the field location.
Note: You must have Google Earth Pro installed on your computer for this to work.

**The ruler** is used to measure the distance along a selected origin point and the current cursor position. Left-click to add points, and right-click to start measuring a new line. The tool measures the total length of the line and the area enclosed by the line will also be displayed.

**Rotate** will cause the surface to rotate $90°$ to the right with each click. There is no option to change rotation direction or degrees it will rotate by.

## Selection Tools

There are several selection tool options available.
To access more selection tools, left click on the arrow next to the currently selected tool in the toolbar at the top of the screen.

| | Box Selection |
| --- | --- |
| | Circle Selection |
| | Point-to-Point Selection |
| | Freehand Selection |
| | Magic Wand Selection |

**Box Selection** allows you to select everything within a rectangular space. To make a selection hold down the left mouse button and drag until desired size then release the button to select and activate the selection.

**Circle Selection** selects everything within the circumference of the circle. To make a selection with this tool hold down the left mouse button starting at your desired center point, drag the mouse away to increase the size of the circle releasing the button once the desired size has been reached.

| | |
|---|---|
| Point-to-Point Selection | **Point-to-Point Selection** allows you to make rigid non-linear shapes. Click at each desired point and double-click to finalize your selection. |
| Freehand Selection | **Freehand Selection** allows you to make free form shape selection. Press and hold the left mouse button to trace around an area. |
| Magic Wand Selection | **'Magic Wand Selection'** allows you to left click on any space to select all adjacent space that falls within the selected height range. |

## Surface profile tool
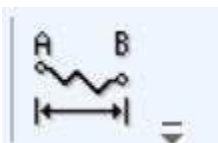
The **Surface profile tool** presents a cross-section of the field along the line or path you specify. It samples and plots the elevation of one or two surfaces at  evenly spaced points along the line. The distance between samples is specified in meters. It can also calculate slope.
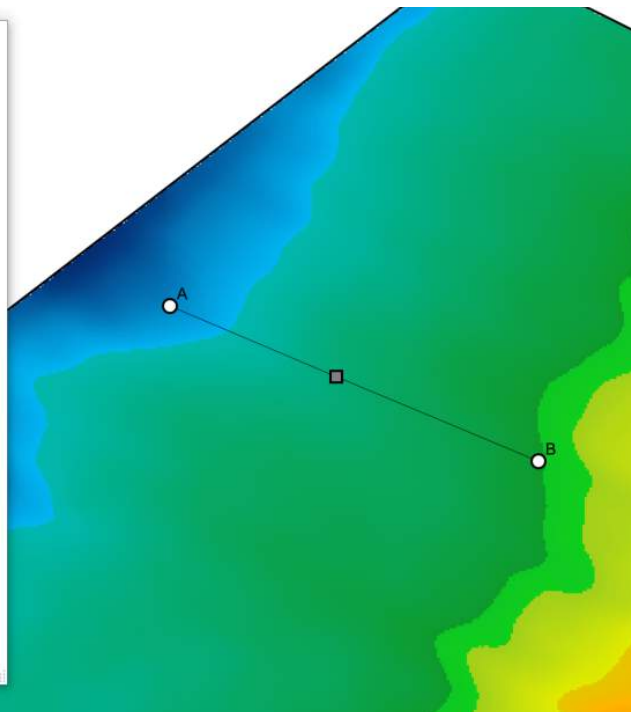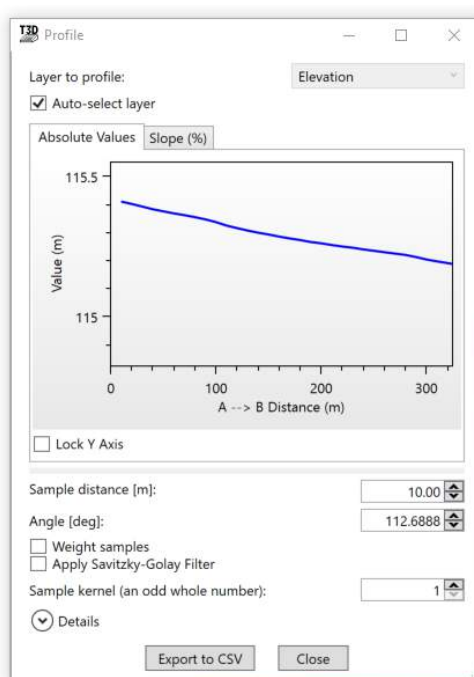


When using the **'Surface profile tool'**, a window will open, displaying a plot of elevation along the sample line. The sample line has three handles that can be dragged to manipulate the line as desired.

More points may be added to the sample line to create a non-linear path by left-clicking on a red node. Red nodes appear when the mouse is in close proximity to a line. The red node will turn white when clicked to show it can be moved to the desired location.
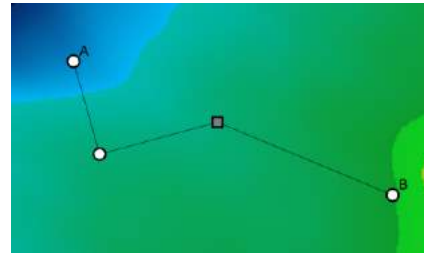


## Visualization tools

The '**Visualization tools**' are used to view surfaces in different ways. The options available are 3D Viewer, Simulated waterflow, and Wetting front.

### 3D Viewer

When using the '**3D viewer**', a window will appear that displays the field as a 3D model (shown below), this view can be controlled with the mouse. All selected surfaces will be displayed

- By left clicking and dragging on the surface the model can be rotated, allowing for viewing from multiple angles.



- The 3D focal point is indicated by the point where all 4 of the red lines meet. These lines can be seen by holding the left mouse button down anywhere on the viewer surface. Holding left-click and moving the mouse will also allow you to change the viewing angle.
- Holding the <Shift> key while left clicking and dragging allows you to shift the focal point of the terrain model. This allows you to rotate around different parts of the model and zooming in on the exact point of interest. Holding down the <Alt> key while left clicking will cause the focal point to shift up or down only.
- Scrolling the mouse wheel will zoom in and out (based on the model's current focal point).
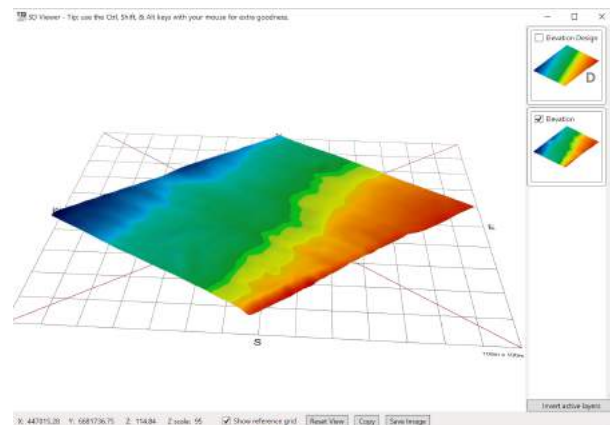
- Holding the <CTRL> key while scrolling will alter the vertical scale of the terrain model. This controls exaggeration of the surface features and can be helpful to understand small local height differences.
- Overlays can be added to the 3D Viewer by dragging the layer from the surface display on the right of the screen onto the 3D Viewer surface.

How does this tool help?

There are multiple ways in which the 3D viewing tool can be implemented to make design work easier:

- Swapping between surfaces - Multiple surface layers can be added into the 3D viewer. In the main window, activate (tick) just the base and final design surfaces in your project, to show just two surfaces in 3D. Then by turning one off in the 3D viewer and pressing the 'Invert active layers' button you are able to switch between them to identify where the biggest changes were made.
- Edge matching regions - Sometimes the design surface is divided into multiple regions to allow custom designs on each part. For example, you may apply Multi-Fit to two sides of a drain. This will often lead to vertical jumps or 'cliffs' between regions. The 3D Viewer tool allows for a more detailed view that is updated at the same time as adjustments to the surface are made. This can help you line up the edges of the design.

## Adding Overlays to the 3D Viewer

You can drag any number of overlays and guides right onto the 3D Viewer window. This can really help you understand the design. For example, you can add a cut/fill overlay, or a drain line. If you drag in the wrong overlays, click the Clear Overlays button and start again. If you just want to see the overlays, and not the surface elevation-based colouring, check the "Only overlays" box.

## Simulated Surface Flow

The **'Simulated Surface Flow'** tool opens a window to display a simulation of water flow across the selected layer. The water simulator helps understand how water will flow, both on an existing field surface, and on a surface with a design applied to it.



- The layer selector allows you to choose which layer the simulation will be applied to.
    - The layers available in this pulldown are the ones that have been activated in the main window surface tab.
- The graph shows the percentage of water remaining on the field over time.
- 'Depth to apply' is a setting for the amount of water to be applied to the field.
    - A larger initial depth of application will cause the field to take longer to drain
    - Differences in initial depth may cause different issues to become apparent - for instance a large application may cause banks to overtop and different water flow paths to become apparent.
- 'Water on field' displays how much water is currently on the field.
- 'Water drained' shows how much water has been drained from..
- 'Time (iteration count)' is an indicator of how much time has elapsed since the model started running.
- Points to consider:
    1. Time in the simulation is not any set measurement of seconds or minutes. The passage of time is tracked with a counter called 'iterations'.
    2. The simulation should only be used as an estimate because the simulation does not take soil qualities into account and treats the surface like a concrete slab.
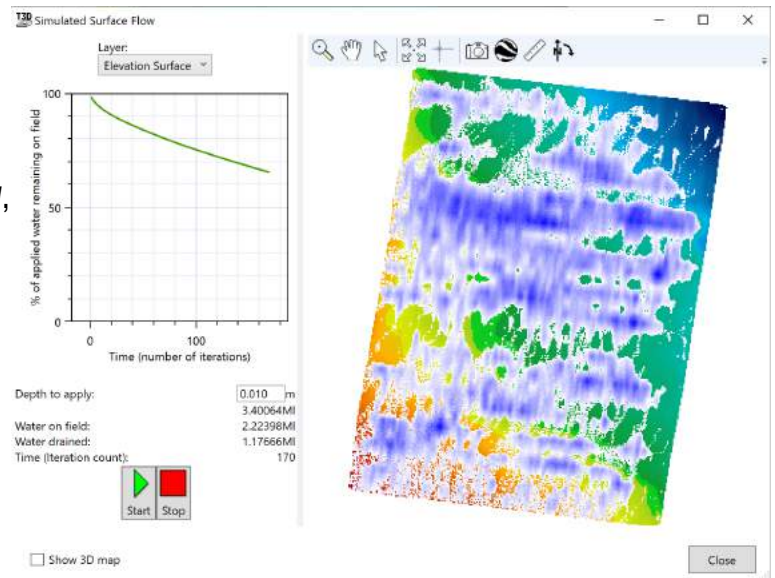
## Wetting Front

'**Wetting Front'** is a tool that allows you to visualize how a field will react with certain depths of static water on the field.

The pop-up window for this tool has 2 sliders that control the water appearance on the field.

- The vertical slider controls depth of water displayed on the field, the sliders minimum and maximum values are based on the elevations of the field.
- Right of the vertical slider is the current 'Elevation' , as well as 'Submerged area'
- The horizontal slider controls 'Transparency', the further to the left that this slider is the fainter the submerged area will appear. If the slider is at its left most position the overlay will not be visible.
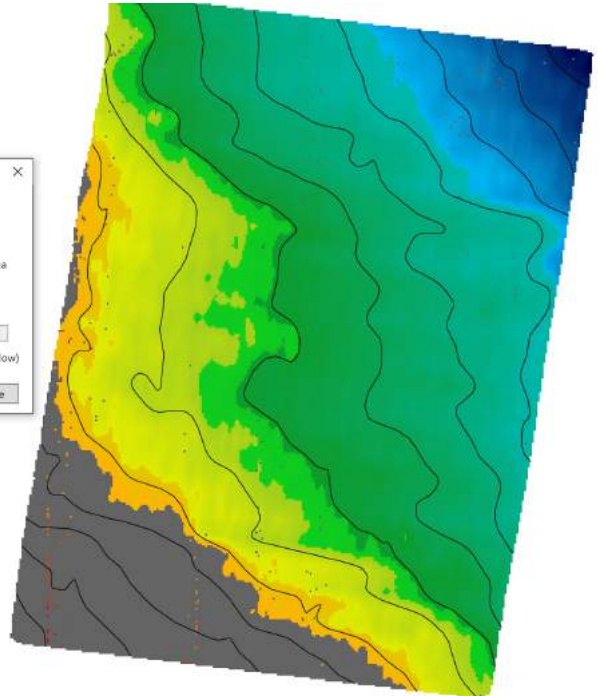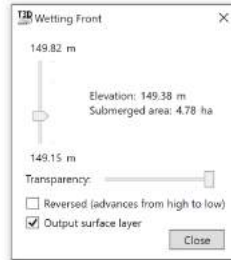
There are 2 checkboxes:

1. 'Reversed' will reverse how the overlay is generated on the field moving from the highest point to the lowest.
2. 'Output surface layer' will create a surface overlay layer of the submersion data that is being displayed when the tool is closed.

# Importing and Exporting Files in T3RRA Design

## Importing and Creating Surfaces in T3RRA Design

There are many different file types which can be used to import or create surfaces in T3RRA Design. This will generally need to be done to start a new project.

The file type that you will be working with will depend on how you acquired your data. That is, if you are a T3RRA Cutta user or a John Deere operator, you will have different types of data available for import.

Note: Import elevation data into an existing nearby project to ensure the same UTM Zone.

## Importing Elevations from T3RRA Cutta (.tci) to Create a Surface

If you are a T3RRA Cutta user, you can easily import a surface from T3RRA Cutta into T3RRA Design

1. Select the TCI button on the left hand side of the menu bar



2. This will open up a pop up window, select relevant .tci file here and press OK
3. Once a file has been selected, press the open button and after a conversion process the elevation surface and identified design surfaces will appear in the working area and the layer selection area.

To import surveyed points from a .tci file and surface within T3RRA Design, from the top Layers menu, choose Surfaces > Layer > Import > From raw data points (Deere RCD, CSV, etc) > T3RRA Software Survey Points (*.tci) and follow the prompts.

# Importing Elevations if you are a John Deere operator

T3RRA Design can import elevation data from three separate John Deere sources. These are:

- John Deere RCD logs

    These are from Gen3 and earlier John Deere displays (such as the 2630). You would normally download the data from your display using a thumb drive and then copy it to the computer running T3RRA Design. Be sure to copy the entire folder structure, not simply individual files.

- John Deere RCD SWM Survey logs

    Deere customers who have 'Surface Water Pro' may have data in this format. These logs are collected specifically in the tractor as elevation surveys.

- John Deere Gen4 (ADAPT) logs

    These are from Gen4 John Deere displays (such as the 4640). You would normally download the data from your display using a thumb drive and then copy it to the computer running T3RRA Design. Be sure to copy the entire folder structure, not simply individual files.

## Importing Elevations from John Deere RCD logs

Note: You must have a folder named RCD on your computer for this to work

1. Select the RCD button on the left hand side of the menu bar



2. This will pop up a window, select relevant RCD file and press OK
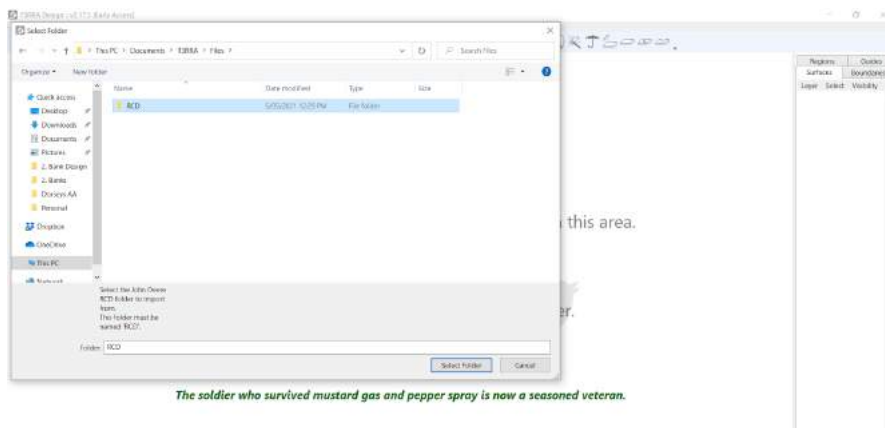


The soldier who survived mustard gas and pepper spray is now a seasoned veteran.

3. Once a file has been selected, press the open button and after a conversion process the elevation surface and identified design surfaces will appear in the working area and the layer selection area.

# Importing a Surface from an Existing Elevation Surface

By working in the Surface Tab in the Layers Panel, select: Layer > Import > From existing elevation surface:

- PCT Image elevations (*.pcti)
- USGS DEM elevations (*.dem)
- Space Shuttle Radar Topography
- Generic XYZ elevations (*.xyz)
- DXF (*.dxf)
- LandXML surface (*.xml)
- JSONGrid elevations (*jsongrid)
- Surfer grid elevations (*.grd)
- Esri ASCII elevations (*.asc)
- UK LIDAR (OSGB 1936 / British National Grid (*.asc)
- Trimble Field Level II (*.gps)
- Ezigrade surfaces (*.ezigrade)
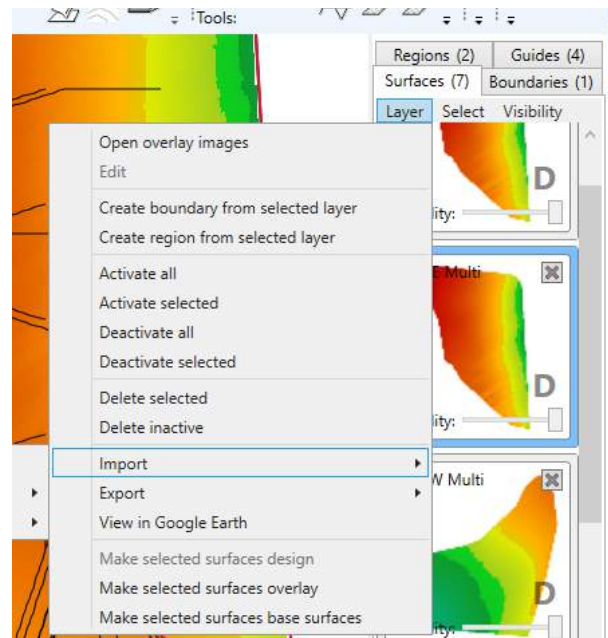


Examples of Importing a Surface from an Existing Elevation Surface

File Type: DXF Surface

DXF files are a standard format used by civil designers, with file names that end in ".dxf". They can contain all manner of drawings and text in 2D and 3D. Because of this, they are not georeferenced and require you to know the georeference information. They can be exported from all civil CAD programs. We support importing surfaces from DXF, but also linework and markers.

Note: DWG is a file format related to DXF. If you encounter a DWG, we recommend you request your designer to re-export it as a DXF. It is possible to convert most DWG to DXF with free tools like "DWG DXF Converter" by AnyDWG Software (available in the Windows Store). However, the quality of the conversion is not guaranteed.

To Import a DXF Surface:

> From the Surface Tab in the Layers Panel, select: Layer > Import > From existing elevation surface > DXF (*.dxf)

Select the relevant option from the below list:

- DXF 3D Faces (*.dxf)
  - NOTE: If you are not sure, choose this, as it is the most common option.
  - It is when you have triangulated points to create an elevation surface.
- Gridded DXF elevation points (*.dxf)
  - Is a grid of regularly spaced points with no triangles between them.
- DXF PolyFaceMesh (*.dxf)
  - This is an uncommon alternative mesh format, usually with a mesh composed of squares.

This coordinate system selection window will then appear. Since projection information is not included in DXF files, you will need to select it now. This tells the importer how to correctly interpret the X, Y and Z coordinates as locations on the Earth.

Common selections include:

- WGS84 (longitudes and latitudes) is under:
  - ◉ Named System
    - > Type: Geographic
    - > Category: World
    - > Projection: WGS 1984.
- UTM Zone projections are (see screen capture for an example):
  - ◉ Named System
    - > Type: Projected
    - > Category: UTM Wgs 1984.
- Map Grid of Australia projections are under:
  - ◉ Named System
    - > Type: Projected
    - > Category: National Grids Australia.
- State Planes are under:
  - ◉ Named System
    - > Type: Projected
    - > Categories like State Plane Nad 1983 Feet.
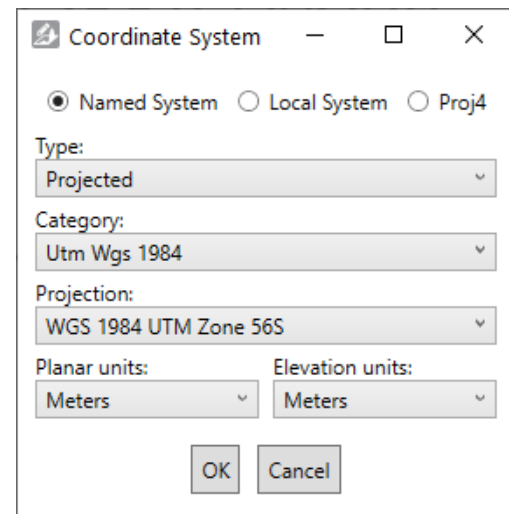
A local system is a custom coordinate system, and you will need the reference longitude and latitude, the location of the reference point locally, and the local system type (e.g. Orthographic).

After selecting 'OK', the 'Import elevation surface' screen will pop up. Ensure you select the appropriate pixel size (in the lower right of the window) for the type of work you are doing, but remember that smaller pixel sizes produce larger files that take longer to process. If there are multiple layers in the file, you can select them with the drop-down in the lower left of the window.



At this point, it is recommended that you verify the projection was correct by opening it in Google Earth.

To export it to Google Earth:

    > Select the Google Earth icon    in the toolbar

        > Enter a name and click OK

> Compare the elevation map's location to the satellite imagery. If the projection is correct, it should line up pretty well with field boundaries and landmarks.

In the 'Import elevation surface' window there are several options:

- Import boundary - This allows you to import only a part of the field. You can draw a boundary polygon in Google Earth, export it as KML, then import it here. Note that a path (like a polyline) is not a valid boundary - it has to be a polygon.
- Import layer - Select which layers to import. Some files contain more than one surface layer.
- UTM zone and Hemisphere - For new projects, when your field crosses a UTM boundary or hemisphere, you can choose which UTM Zone it is imported into.
- Surface resolution - Read the descriptions for each pixel size to help you choose appropriately.

NOTE: The lower the surface resolution, the longer the import will take to complete.

## File Type: Trimble Field Level II (*.gps)

.gps files are used in Trimble FMX and TMX displays

To Import a .GPS Surface:

> From the Surface Tab in the Layers Panel, select: Layer > Import > From existing elevation surface > Trimble Field Level II (*.gps) > Select the relevant file

A box will appear stating which surface resolution has been selected based on the file you are importing.
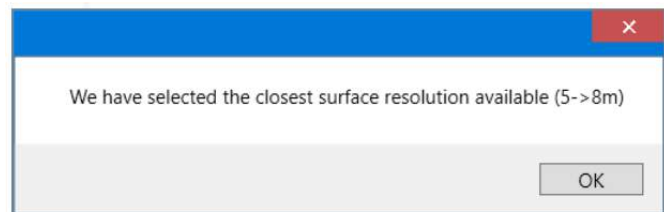


We have selected the closest surface resolution available (5->8m)

OK

At this point, it is recommended that you verify the projection was correct by opening it in Google Earth.

NOTE: You must have Google Earth Pro installed on your computer to do this.

To export it to Google Earth:

> Select the Google Earth icon  in the toolbar

> Enter a name and click OK

> Compare the elevation map's location to the satellite imagery. If the projection is correct, it should line up pretty well with field boundaries and landmarks.

In the 'Import elevation surface' window there are several options:

- Import boundary - This allows you to import only a part of the field. You can draw a boundary polygon in Google Earth, export it as KML, then import it here.
- Import layer - Select which layers to import. Some files contain more than one surface layer.
- UTM zone and Hemisphere - For new projects, when your field crosses a UTM boundary or hemisphere, you can choose which UTM Zone it is imported into.
- Surface resolution - This will be preselected (see above) during the import process.

NOTE: The lower the surface resolution, the longer the import will take to complete. .

Once you are happy with the above surface and selections, press 'Import current elevation surface'. A pop up window will appear:



The elevation surface was successfully imported. You can go ahead and import more fields if you have more data...

OK
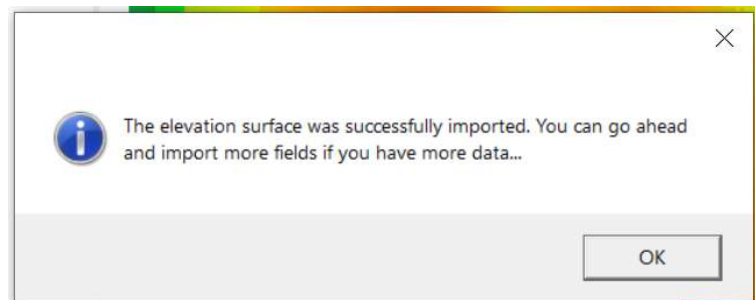
This then imports that surface into the working area of T3RRA Design, while still keeping the 'importer' running. You can either close out of the Importer or import more surfaces if required. It will also import the linework and master benchmark (MB) into Guides. These can be included in a .gps export to ensure it has the same reference point.

## Importing a Surface from Raw Data Points

By working in the Surface Tab in the Layers Panel, select: Layer > Import > From raw data points (Deere RCD, CSV, etc.):

- John Deere Gen4 ADAPT (logs)
- John Deere RCD logs
- John Deere RCD SWM survey logs
- Raw CSV Data Points (*.csv) - can thin points to be more manageable
- Raw shapefile data points (*.shp)
- Multiplane data points (*.txt)
- FieldLevel XML survey points (*.xml)
- APRS LASer file format (*.las/z) - can thin points to be more manageable

Examples of Importing a Surface from Raw Data Points

File Type: Multiplane data points (*.txt)

To Import:

> From the Surface Tab in the Layers Panel, select: Layer > Import > From raw data points (John Deere RCD, CSV, etc) > Select relevant Multiplane (*.txt) file.

Once you have selected the relevant file to import, the following pop ups will appear:
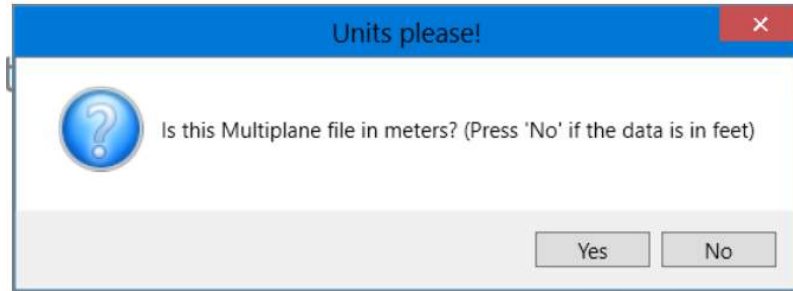


Select 'YES' if the Multiplane file is in meters or 'NO' if it is in feet.

The next pop-up will be:

Sometimes the master benchmark has a separate offset, but it is actually the elevation there.
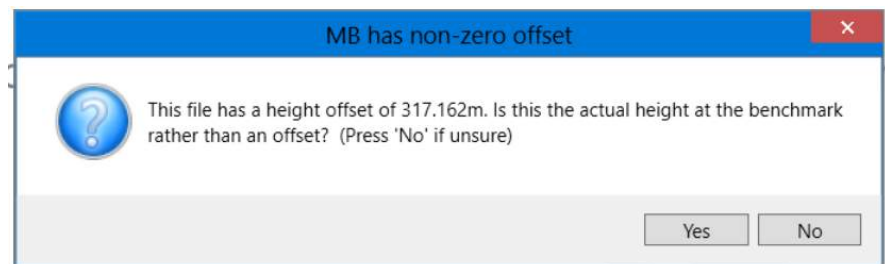


This is a somewhat unusual variation, so you're advised to press 'No' if you're not sure. If you will be exporting your design to a Multiplane file, a .gps file or a FieldLevel.xml file, the height mentioned here can be used for your Master Benchmark (MB) in those exports. In that case, import the MB from the same Multiplane file by going to the Guides Tab in the Layers Panel and selecting: Layer > Import > Import benchmarks from Multiplane file. The same pop ups will appear.

Continuing on, a new import screen will appear. Here there will be many of the same tools which can be found on the standard T3RRA Design screen. These tools include:

- Navigation Tools
    - The Pointer Tool
    - The grab tool
    - The magnifying glass
    - The ruler
    - Zoom to full extent
    - Rotate
    - The crosshairs
    - The camera
    - Google Earth

To find out more about the above tools go to Navigation Tools

- Selection Tools are always available in a drop-down list. To find out more about these tools, go to Selection Tools
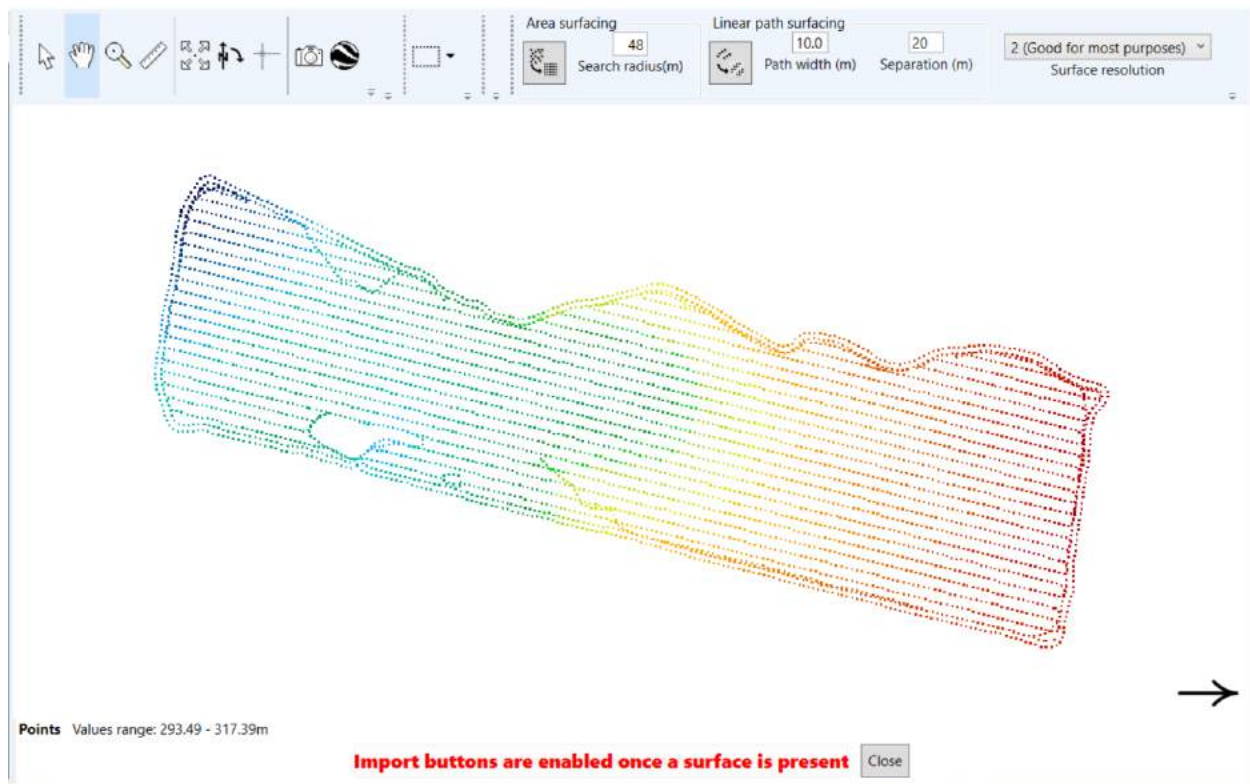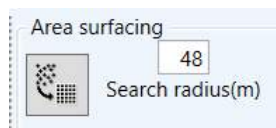
## Area surfacing

The search radius (m) is pre populated based on the data set that has been imported. This figure can be changed to to achieve a different surface outcome.

➢ To surface all points, click this icon

NOTE: Depending on the size of the surface, this can sometimes take some time to process.
NOTE: If your surface is not complete (i.e. there are areas of white), you will need to 'remove surface' by clicking the icon on the right and increasing the search radius.

## Linear Surfacing
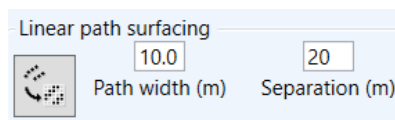
Linear path surfacing is for when you have a single string of survey points. Since it is a single line, this method does not triangulate between nearby points - it sets the elevation of each pixel to the closest survey point. Linear path surfacing is the same as surfacing drains in T3RRA Cutta.

## Surface Resolution

This setting allows you to select the pixel size for the surface that you are creating. Smaller pixels are good for precision drainage work, larger pixels are good for wide scale leveling.
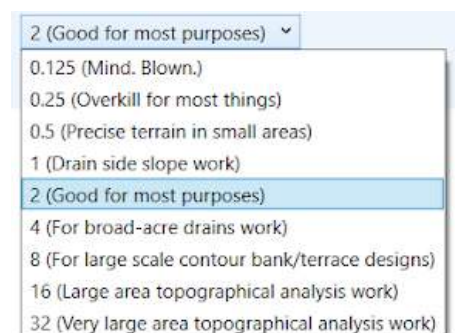
Once you've surfaced and are happy with the results, click the "Import current elevation surface" (1) button at the bottom of the window (see below). Click OK on the prompt that comes up (2), and then click "Close" (3) to get back to T3RRA Design and work with your new surface.
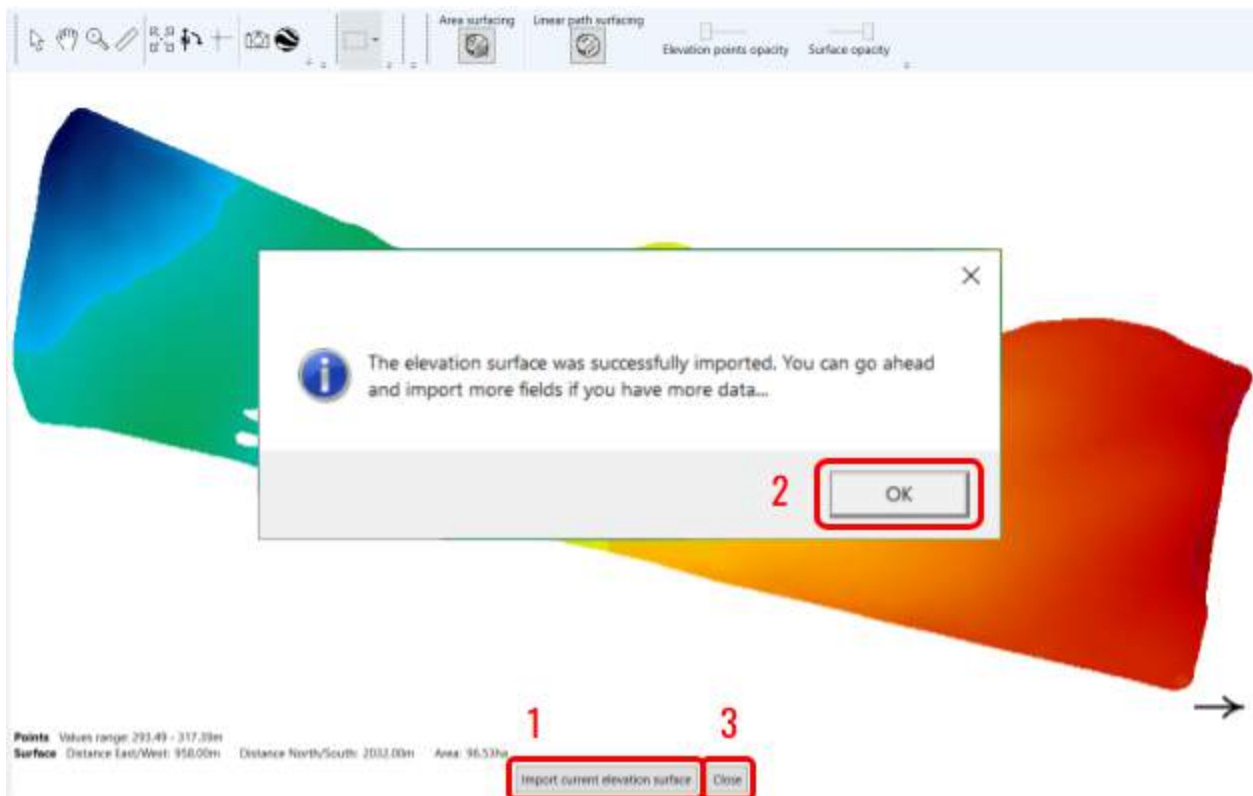
# Exporting Files from T3RRA Design

You can either export individual layers from T3RRA Design (and depending on the type of layer that you are trying to export, there will be a variety of formats available) or you can export a control file with either individual layers or a combination of layers.

## Exporting Files - Individual Layers

To export a file from T3RRA Design, there are two ways to do this:

1. Click 'Layers' in the top menu bar
   > Select which 'layer type' you are wanting to export e.g. Surfaces
   > Layer
   > Export

2. In the Layer Type Selection window on the right hand side
   > Select the relevant tab and ensure the individual layer is highlighted
   > Select 'Layer'
   > Export

As stated above, depending on the type of layer you are exporting, there will be a different selection of file types available. These include:

- Surfaces
  - .kml
  - .csv
  - .csv (CSV UTM)
  - .csv (CSV Grid)
  - .tsv
  - .pcti
  - .dxf (This is a great format for most CAD packages like AutoCAD, QGIS, Magnet and BricsCAD)
  - .jsongrid
  - .shp
  - .rcd (Deere Background image)
- Boundaries
  - .shp

- ○ .kml
- ○ .csv
- Regions
  - ○ .shp
  - ○ .kml
  - ○ .csv
- Guides
  - ○ .shp
  - ○ .kml
  - ○ .csv
  - ○ .dxf (this is limited to poly measurement lines)
  - ○ Guidance lines (this is limited to poly measurement lines)

# Exporting Files - Control File

It is also possible to export a Control File from T3RRA Design. This is how you get your design into a tractor or bulldozer with T3RRA Cutta (.tci), or produce a Trimble FMX/TMX compatible file (.gps). You can either create a control file with an individual layer or by combining many layers, such as surfaces, guides, regions and boundaries, etc.

To export a control file, simply select the below icon on the menu bar at the top:

Once selected, a box will pop up. You will then be able to select from a drop down menu, which file type you are wanting to export. The options are:

- T3RRA Cutta (*.tci)
- Field Level II for FMX/TMX (*.gps)
- SBG SmartProfiler Shapes (*.shp)
- Comma Separated Values (*.csv)
- Ezigrade (*.ezigrade)
- DXF 3D Faces (*.dxf)
- Field Level XML (*.xml)
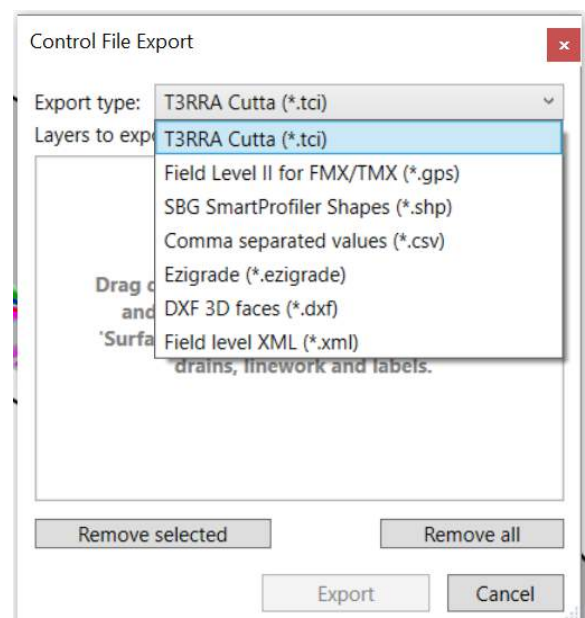
After the export file type has been selected, you need to drag layers from the 'Layer Type Selection Panel'.

From the Surface Tab, these will (could) include:

- Design surface
- Base surface (optional)
- Difference surface (optional)

You can also drag in several other layers, like from the Guides Tab, including Drains, Linework, and Labels (e.g. a Master Bench). To remove layers, select them and click 'Remove Selected'. You can also remove all layers as well.

NOTE: The 'Export' button will remain inactive until you have included the minimum layers needed for that export file type

## Exporting a DXF Control File

The DXF file type is a common interchange format used by civil designers. We support exporting a DXF file of a surface. It may be exported as 3D faces or a grid of points. A 3D faces file contains a collection of triangles that define the surface. To export this type of file:

➢ Open the Control File Export window as described above.
➢ Select DXF 3D faces (*.dxf) from the Export type drop down list.
➢ Drag and drop required design surface layer.
➢ Select Export.
➢ Then a few more options will appear. Choose your export type, file size, and coordinate system. A lower file size is achieved by intelligently simplifying the triangles that are output.
➢ Ensure you record which coordinate system and give this information to whoever will be using the DXF file.
➢ When you have specified each option, click OK.
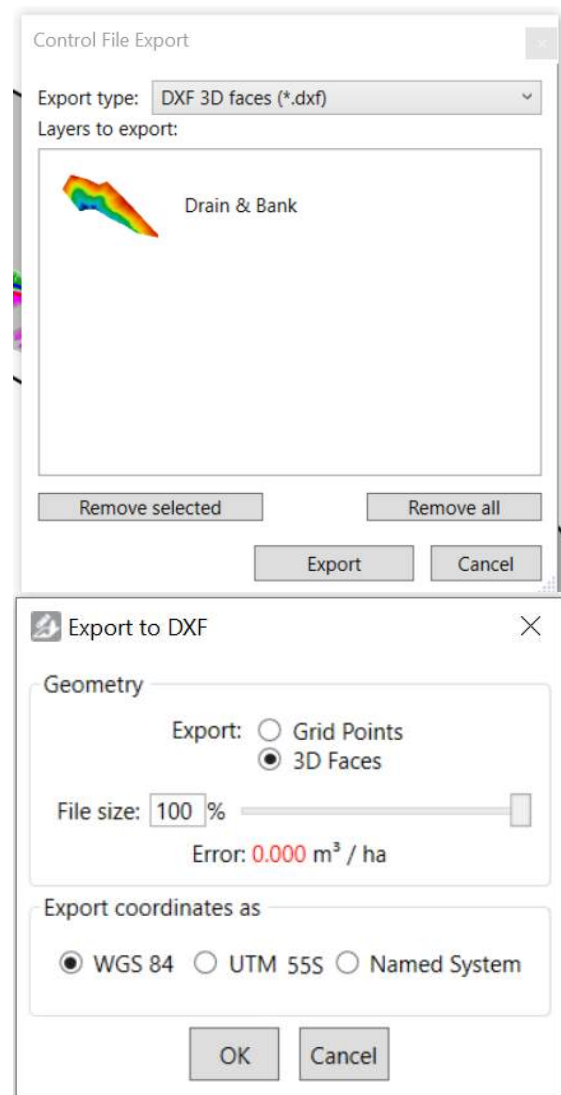
## Exporting a Field Level II for FMX/TMX (*gps) display

The .gps file is used in Trimble displays. We support exporting files for these systems with a design surface, a base surface, linework, and markers. To export this type of file:

➢ Open the Control File Export window as described above.
➢ Select Field Level II for FMX/TMX (*.gps) from the Export type drop down list
➢ Drop and drag the required layers, ensuring you include those that are required (MB Marker, design surface)
➢ When you have finished selecting layers, click OK.

**Control File Export**

Export type:  Field Level II for FMX/TMX (*.gps) ⌄
Layers to export:

Drag MB marker, design surface, base surface (optional) and difference surface (optional) from 'Surfaces' tab into this area. We also accept drains, linework and markers.

**Warning: Design surface is mandatory!**

| Remove selected | Remove all |

Export    Cancel
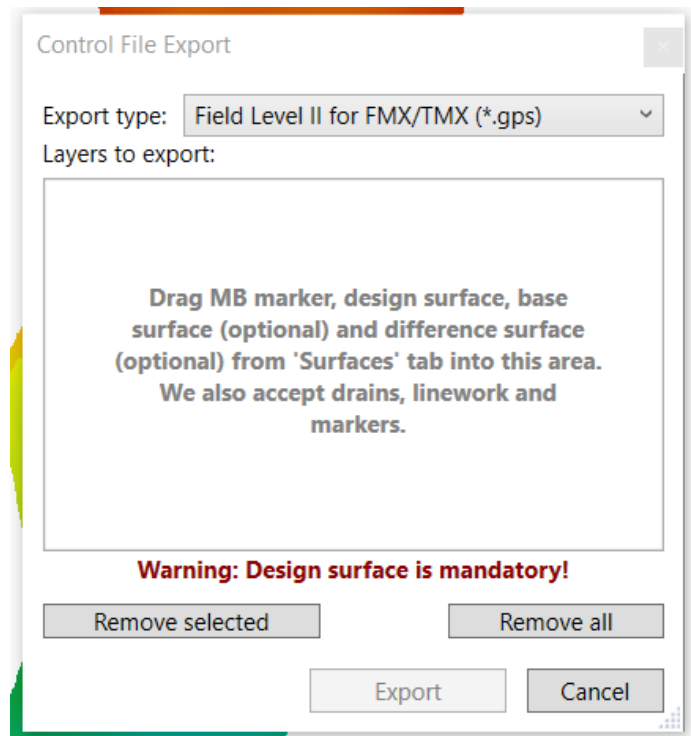
# Surface Tools

When the Surface tab is selected on the right hand side, the relevant tools can be accessed in two different areas. Firstly, on the menu bar (this changes depending on which layer type is selected) and is explained below in Surface design tools and secondly, in the Layer menu on the selected tab and is explained in Surface tools - Layer Menu.
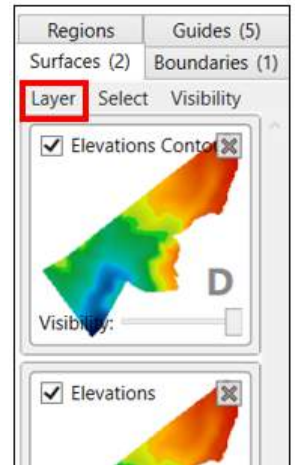
## Surface design tools

The '**Surface Design Tools**' are used to create designs for the whole surface. Before any designs are able to be made, the surface you want to work on must have a boundary and any desired regions.
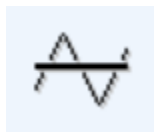
### Create a surface design for the selected area

This tool is the primary method for creating field designs. This tool opens a window with several design options to choose from: 'Plane of Best Fit', 'Directional Best Fit Design', 'Multifit Design', 'Omni-fit Design', 'Surface Smoothing Design', and Duplicating the current surface.

All the options available in the create a surface design tool can be limited to the boundary, all region parts, or an individual region.

The additional options that are available in most surface design options are 'Shift design vertically', 'Cut/fill ratio', and 'Import/Export'.

- 'Shift design vertically' will move the design layer vertically according to the value that is input. A negative value should be used to move the design down.
- 'Compaction ratio' will adjust the design to accomodate a specific cut /fill ratio.
- 'Import/Export' will set the design to ensure a certain amount of soil is present to import and available for exporting. (importing and exporting volumes cannot be set at the same time)

## Plane of Best Fit

A 'Plane of Best Fit' will attempt to create a flat plane on the elevation surface that flows with the field's natural slope direction.
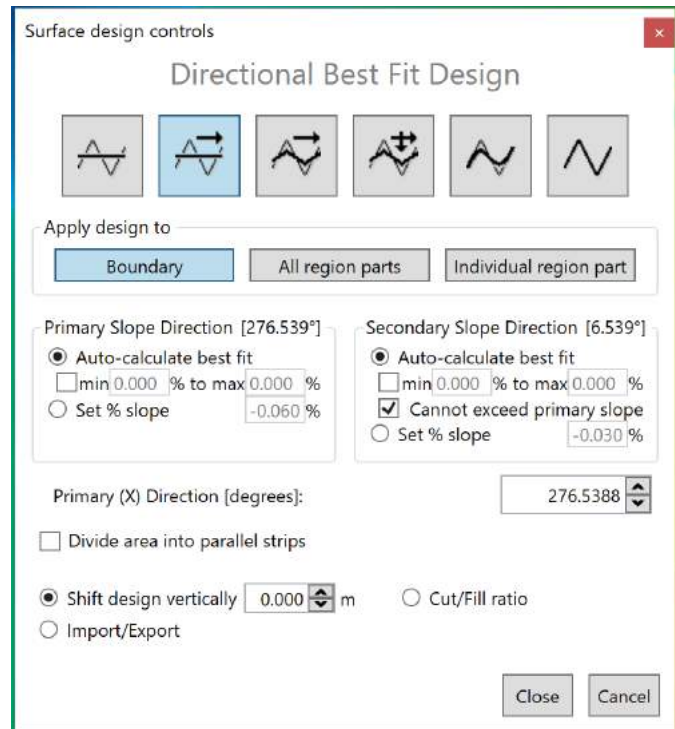
- The 'Plane of Best Fit' will apply both a primary slope and a secondary slope. The secondary slope will always be at 90° to the primary. The direction of the slope is shown next to the slope and the severity of the slope is displayed on the right side of the window.

- There are 3 design options for creating a 'Plane of Best Fit'.
  - 'Shift design vertically' changes how far above or below the design is made from the surface.
  - 'Cut/Fill Ratio' allows you to set the ratio of the Cut and Fill to what is appropriate for your soil properties.
  - 'Import/Export' allows you to set how much soil needs to be brought in from another location or how much needs to be taken from this location to be used elsewhere.

- The Design details drop down will display information about the design such as the total area, total area cut, total area filled and volumes.

- Show cut/fill surface, this button is a toggle which will only show the Cut/Fill while it is selected.
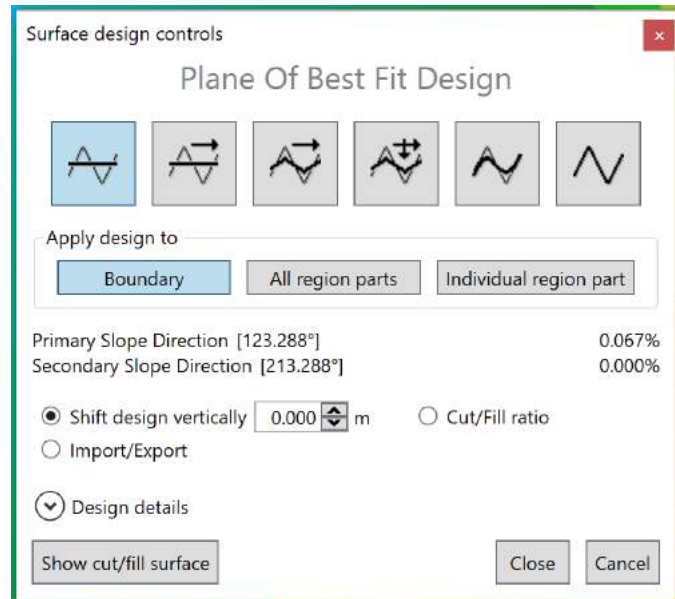
## Directional Best Fit Design

'Directional Best Fit' creates a straight plane and allows you to completely control the direction of the field slope.

- When using 'Directional Best Fit' a blue line will appear on the field. This line is used to control the direction of the plane.
- 'Auto-calculate best fit' will have the tool automatically generate the most effective plane of best fit in the set directions.
- 'min(x)% to max(X)%' will tell the tool to generate the most effective plane of best fit following the set direction and within the set parameters.
- 'Set % slope' will create a plane of best fit at the set slope value in the set direction.
- 'Primary (X) Direction' displays the current direction of the line and allows you to manually set the slope direction without using the blue line.

The field design is also able to be split into parallel strips. These strips will flow in the direction set by the primary slope.

- There are also options such as shifting the design vertically by a set distance, set a Cut/Fill ratio and setting the Import/Export for soil that may be brought in from another location.
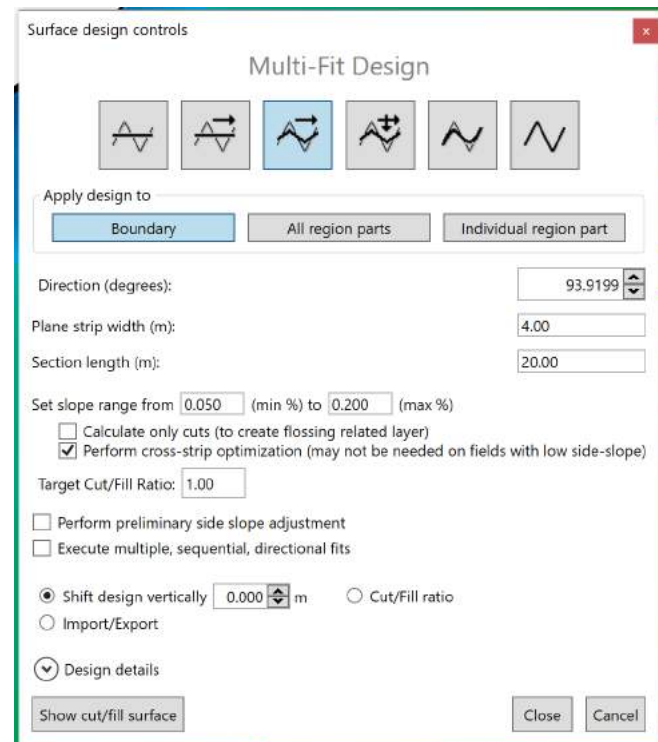
## Multi-Fit Design

Using Multi-Fit design will create a design for the field in the work area that follows the movements of the surface more closely in an attempt to reduce the amount of earth moved.



The desired direction can be set using the 'Direction (degrees)' option which will shift the direction of the line.

- A Multi-Fit design is made by breaking the surface into strips and cutting those strips into smaller sections.
  - 'Plane strip width' controls how wide the strips are that the field is broken into.
  - 'Section length' controls how long each segment is along each strip
  - The smaller the value set in these options to the smoother the design will be, but the longer it will take to calculate.
- 'Set the slope range' creates a minimum and maximum grade that you want to be present in the design. Multi-Fit will attempt to follow the natural flow of the field within the set range.
- 'Calculate only cuts' this option will tell the tool to ignore any section that requires a fill. The resulting surface will be at or below the original surface at all points. This parameter is normally activated in situations where you always want water to flow in the primary direction and do not care what the maximum slope is. It will create a design where obstructions to flow are shaved away and naturally draining sections remain undisturbed. The most usual use case for this option is when 'flossing' existing beds in furrow irrigation scenarios (the cut dirt is swept up onto the beds, so fill zones are not required).
- 'Perform cross-strip optimization' this option will tell the tool to optimize the design by checking it against a secondary slope. This may not be needed with fields that have a low side slope. This will attempt to tilt the strip sections to match the actual side slope present. Use this parameter in fields that have high side slopes. It is unlikely to provide any benefit in relatively flat fields.
- 'Target Cut/Fill' allows you to set the desired cut and fill ratio for the field.

- 'Perform preliminary side slope adjustment' this option will cause an initial side slope adjustment to occur. It will attempt to ensure that the side slope is no greater than the minimum row slope. Use this parameter if water might have a tendency to run across rows rather than down the rows. It always uses the 'minimum parameter' as it's 'maximum parameter'.
- 'Execute multiple, sequential, directional fits' is an option to "customize" the land forming design by breaking it down into multiple slope directions. This is for an advanced user with engineering knowledge.

Multi-Fit tends to keep closer to the starting elevation of each strip than the end elevation. If you want the Multi-Fit to keep the end elevation close to the existing level, reverse the direction (add or subtract 180°), and swap your minimum and maximum grades. Additional options include being able to Shift design vertically by a set distance, Cut/Fill allows you to set the cut and fill ratio, and Import/Export which allows you to set the amount of soil that may be brought into or out of the field.
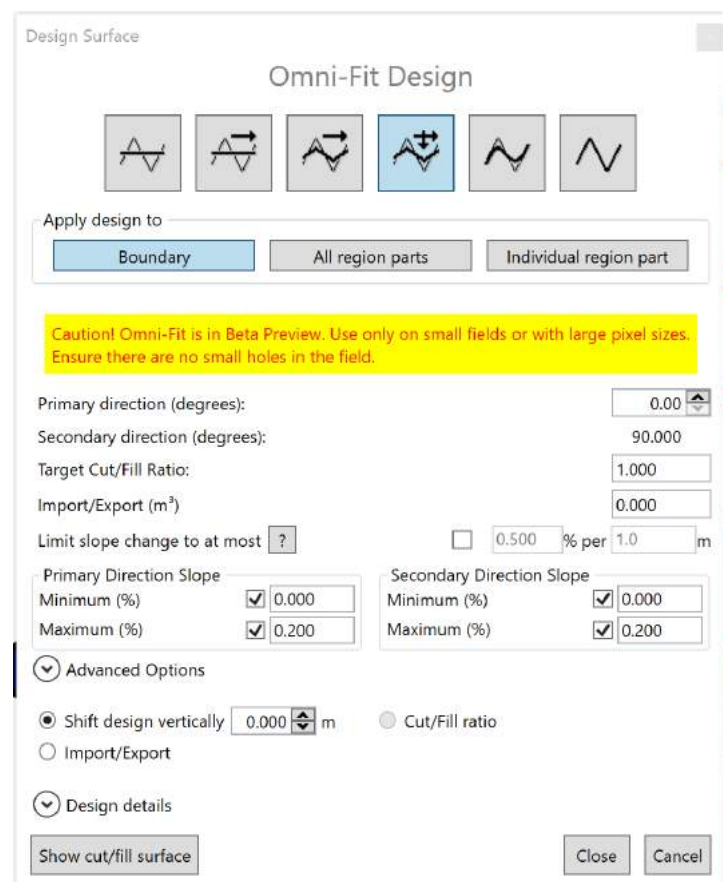
Note: Vertical offset relates to the ground, not the orientation of the computer monitor.

## Omni-Fit Design

'Omni-Fit' is best suited for smaller fields.

'Omni-Fit' is the implementation of a Multi-Fit surface with an added secondary slope allowing for further controlled water flow direction.

- 'Primary direction' is used to adjust the main direction you wish the slope to move in.
- 'Secondary direction' will always be at a 90° angle to the 'Primary direction'.
- 'Target Cut/Fill Ratio' will adjust the design in order to match the cut and fill ratio that you put in this section.
- 'Import/Export' sets the amount of soil that would be brought into

and out of the field, this is measured in cubic metres.

- 'Limit slope change to at most (%/m)' is an optional setting, by putting a value in this setting you are able to limit how sharply the field's slope may change.
  - Pressing the Question mark button next to this tool will open a graphic calculator making it easier to find the % per unit of measurement.
- Primary and Secondary direction slope allows you to set the minimum and maximum grade of slope that can be present in the design. Setting the slope for the secondary direction is an optional setting.

The Following settings are available by clicking on Advanced Options

- The 'Engine' setting. These are external optimization software engines. COIN-OR Clp will complete the work faster, whereas LP Solve is more robust. If you are having issues with COIN-OR Clp try switching to LP Solve.
- The 'Quality' option controls the field resolution used by the optimizer. "Draft" is recommended for normal use as it takes far less time to process. "Final" takes significantly longer to process the field data but creates a finer surface, best used to optimize finer details. When you have settings you are happy with in Draft mode, save your work (as a separate file), then you can try running it overnight with Quality set to Final. Be sure to stop your computer from going to sleep while running the optimization. Be warned, it can take a lot longer to complete a final run.
- The Advanced Options allow for specific limitations to the elevation as well as maximum cut and maximum fill. The maximum cut and fill can be set to a maximum distance to cut or fill by, as well as a maximum total amount of soil cut or filled from the area. Be careful with these, as if restricted too much there will be no valid solution.
- The Cut/fill option at the bottom of the window is disabled in the Omni-Fit tool to ensure it does not interfere with the 'Target Cut/Fill' setting.

## Surface Smoothing Design

The surface smoothing will smooth out any dips or bumps in the surface by taking samples from the surrounding points and generating an average of what the surface should be.

The smoothing tool changes depending on whether you have 'Directional smooth' checked or not.

Without Directional smooth

- The 'smoothing strength' slider controls the size of the radius T3RRA Design will look at for each point in
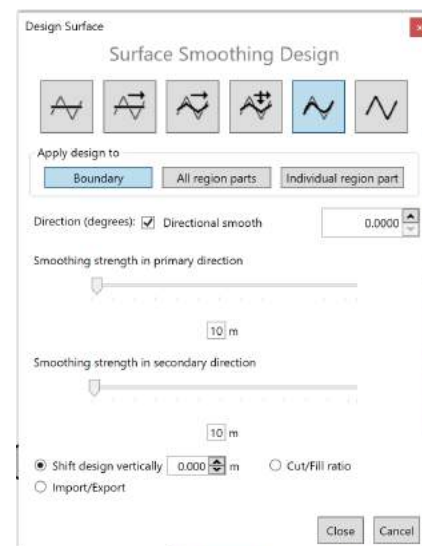
order to smooth the surface. The larger the radius, the smoother the surface.

With Directional smooth
- This will smooth more in one direction than the other. It is useful to quickly increase trafficability in the row direction, and will move less dirt than the equivalent 'non-directional' smooth. The second slider that appears controls the smoothing strength in the secondary direction (right-angles to the primary direction). It should normally be less than the first smoothing strength.

## Duplicate Current Surface

Duplicating a surface will create an exact copy of the currently selected surface.

The area that is copied can be limited to the boundary of the surface in the working area, all the regions, or a single specific region.
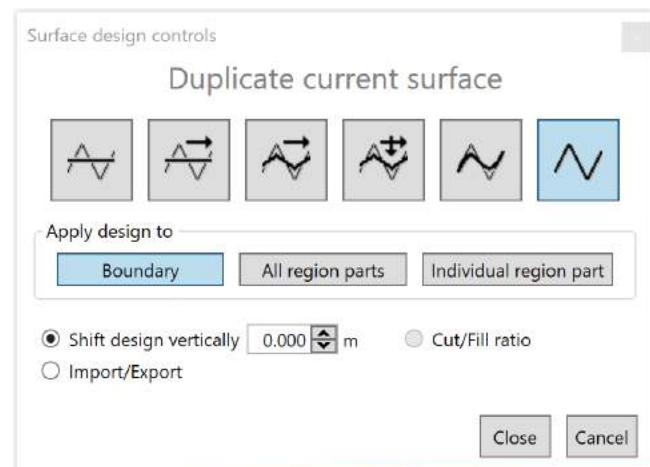


## Adjust surface (used to adjust a design surface)

'Surface Adjustment' allows you to make additional changes to the designs that were made in the layer creation.
- 'Vertical offset' which can be adjusted with up and down buttons at 0.01 increments or by typing in a set value to shift the design vertically up or down.
- 'Rotation axis' This can be adjusted by typing in a value, using the up and down buttons or by using the yellow dot that appears in the working area.
- 'Offset at tip point' works in conjunction with the 'Rotation axis' setting to make the changes along the set point.
- The bottom portion of the window displays information about the whole design surface and the
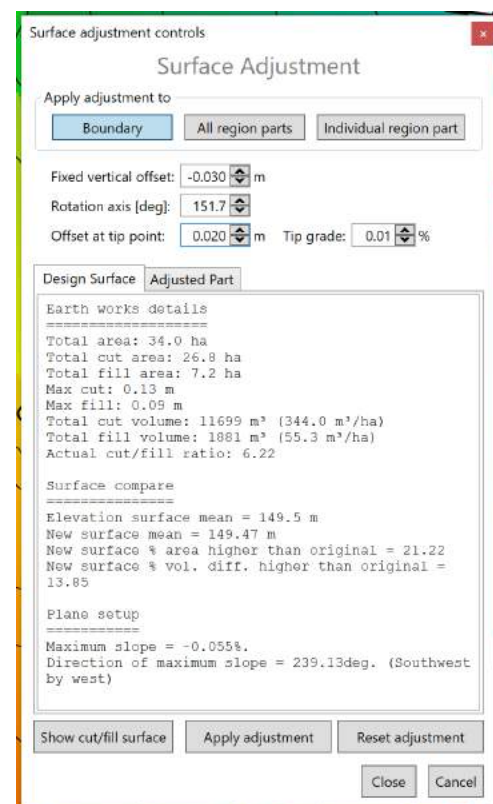
adjusted part, including a comparison to the original elevation surface.
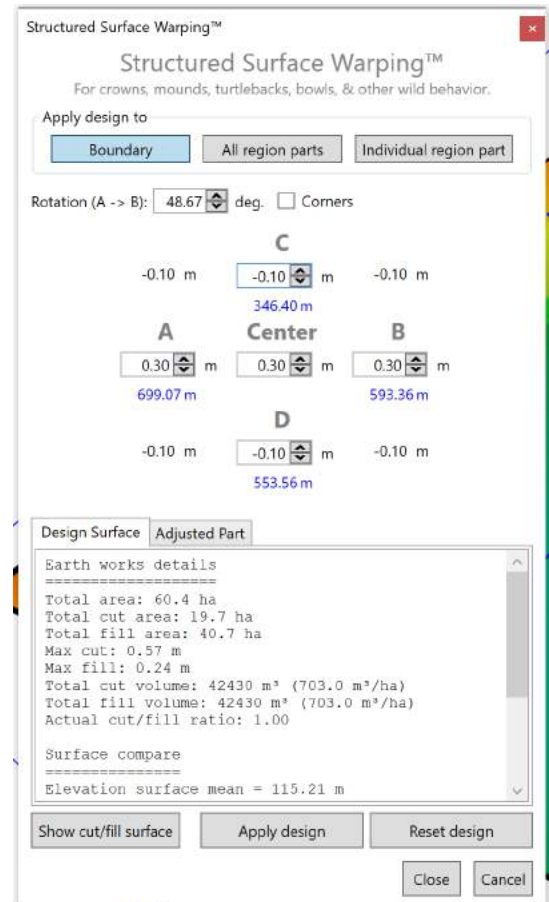
As you make changes, the cut/fill map will automatically adjust accordingly. Once you are done changing it, you need to accept or reject it by pressing either the 'Apply adjustment' or the 'Reset adjustment' button at the bottom.

## Structured Surface Warping

'Structured Surface Warping^tm' allows controlled manipulation of the field. This tool can be used to create non-standard designs.

- The warping area is designated by the blue square and can be manipulated by using the yellow anchor points.
- The blue numbers under each point in the pop-up window are the distance of each anchor from the central point.
- 'Rotation (A->B)' Displays the current heading of the line between the A point and the B point. The rotation can also be manually set in this option.
- The values corresponding to each anchor point will adjust the vertical shift of the surface around the area of said point.
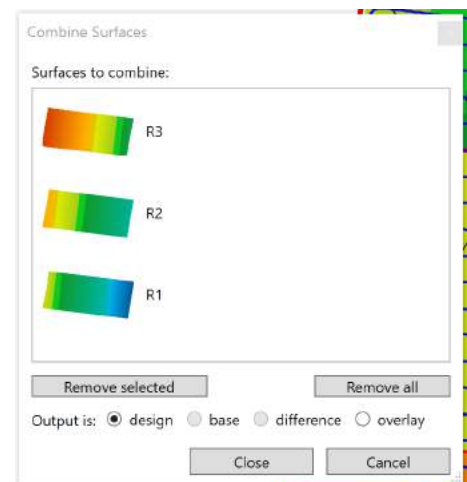
## Combine Surfaces

Combine surfaces allows you to combine multiple elevation and design surfaces into a single layer. This tool can be used to combine multiple surveyed fields into a singular layer for a full farm view.

Drag the layers you wish to combine into the pop-up window. Select what type you want the output layer to be before closing the tool.

Note: If there are any overlapping areas in the selected layers, it will pick the topmost in the list for the result.

# Expand/contract surface

The 'Expand/contract surface' tool allows you to make a surface larger or smaller.

To expand the surface:

Enter a positive value into the "Expand or contract" field. When making a surface larger, it takes the available information and makes an estimate to try to create the area outside the existing elevations. You can choose between these expansion methods:

- Flat: Simply uses the closest elevation point and extends based on that data
- Trend 1: Each new pixel is calculated from just the original elevation surface pixels. Pixels close to the edge use near elevations. Pixels further from the edge use existing elevations in a wider range.
- Trend 2: Expands the field iteratively, in pixel layers out from the existing edge. An additional parameter is available for this method. It allows you to modify how far the pixel by pixel expansion of Trend 2 will look for elevations. A larger number will lead to a smoother expanded surface.

NOTE: Expanding a surface is by nature an estimate or guess. It will not be accurate.

To shrink the surface, enter a negative value into the "Expand or contract" field. When shrinking, elevation points will be deleted.
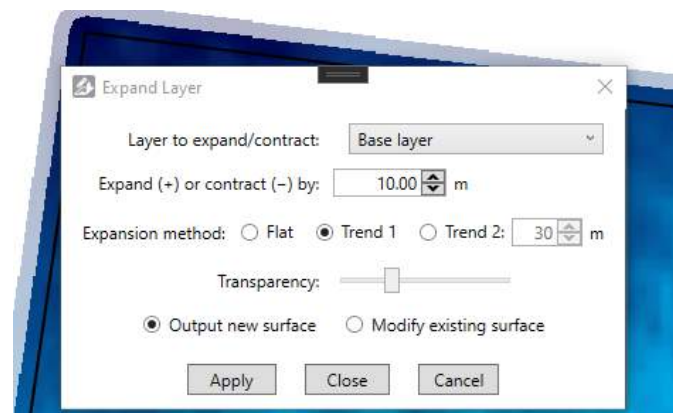
The option is also available to either create a new surface or to modify the existing surface. Select the appropriate button for this.

To calculate and apply the expanded or contracted surface, click the Apply button. Once it has been calculated, you may modify its transparency with the slider. To keep your new/changed surface, click the Close button.
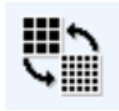
# Change pixel size for all surfaces

The function of this tool is to change the size of the pixels across all surfaces. The pixel sizes are read in meters, for example if the pixel size is set to 2 then each square dot on the screen is equal to 2 square meters in the real world. The sizes available in T3RRA Design go from 0.5 meters all the way up to 1024 meters.

The smaller the pixel size the more detail there will be on the surface in the working area and vice versa, however the smaller the pixel size the more strain T3RRA Design will put on your computer, so use at your own discretion.
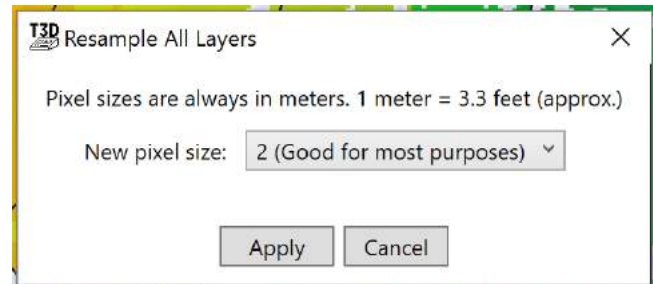
# Smooth Region Boundary

'Smooth Region Boundaries' is used to smooth the transition between different regions in a design.

- The top slider is the 'Max Allowable slope'. It sets the steepest allowable slope in the transition around the region lines.
- The bottom slider is 'Distance From Region line'. This sets how far away from the region line blending can occur.
- Both values can be set manually by typing a value into the spaces available underneath the sliders.
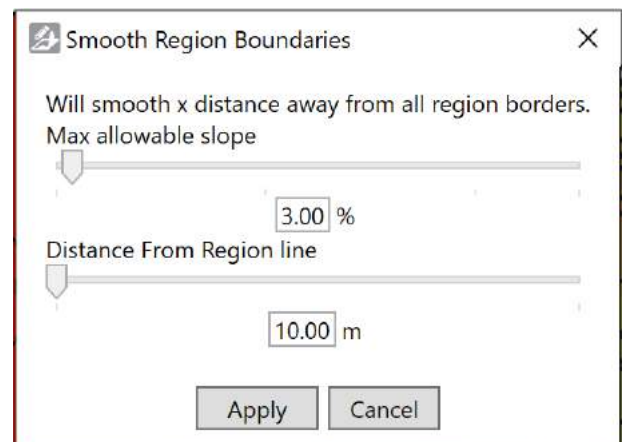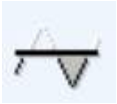
## Create a cut/fill overlay
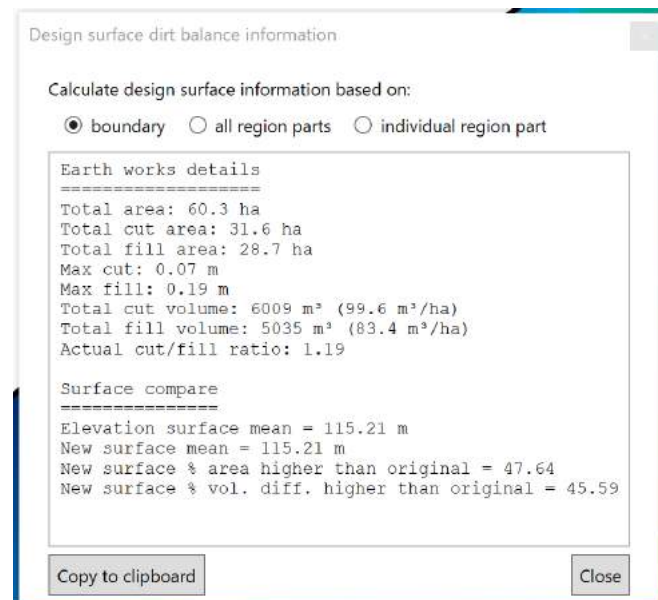
'Create a cut/fill surfaces' creates a surface layer that shows how much soil must be moved to and from areas to reach the design surface.

- To create a cut/fill map start by selecting a design surface and dragging it into the left side box, and drag an original elevation surface into the right box.
- 'Surface statistics' displays the earth moving details between the 2 layers.
- The slider allows you to adjust the point of the largest fill and deepest cut and set whether the Cut/Fill surface should display heights equal to and within this range, equal to the slider points and outside the range or just everything equal to the range found.

**Cut/Fill Surface**

Designed surface(s):

Elevation Design Surface

Source/base surface(s):

Elevation

☑ Restrict to designed surfaces
Remove selected   Remove all

☑ Restrict to source/base surfaces
Remove selected   Remove all

**Surface statistics**

```
Earth works details
===================
Total area: 60.4 ha
Total cut area: 31.6 ha
Total fill area: 28.8 ha
Max cut: 0.07 m
Max fill: 0.19 m
Total cut volume: 6010 m³ (99.6 m³/ha)
Total fill volume: 5037 m² (83.5 m³/ha)
Actual cut/fill ratio: 1.19

Surface compare
```

Cut
-0.068m

Fill
0.187m

=>  <=  <=>  ===

☐ Alter design surface height

Close   Cancel

## Show design surface balance figures

This tool provides a separate output of the information that is available in other tools, this tool is limited to only design surfaces. This information displayed can be limited to the boundary, a single region or a group of regions.

**Design surface dirt balance information**

Calculate design surface information based on:

◉ boundary   ○ all region parts   ○ individual region part

```
Earth works details
===================
Total area: 60.3 ha
Total cut area: 31.6 ha
Total fill area: 28.7 ha
Max cut: 0.07 m
Max fill: 0.19 m
Total cut volume: 6009 m³ (99.6 m³/ha)
Total fill volume: 5035 m³ (83.4 m³/ha)
Actual cut/fill ratio: 1.19

Surface compare
===============
Elevation surface mean = 115.21 m
New surface mean = 115.21 m
New surface % area higher than original = 47.64
New surface % vol. diff. higher than original = 45.59
```

Copy to clipboard   Close

# Drainage Tools

## Fill Depressions

'Fill Depressions' creates a design surface with the largest indentations in the field filled in.

A pop-up window will appear allowing you to change how transparent the fills are on the field as well as a checkbox that will allow you to select whether you would like a surface layer to be created from this tool or not.
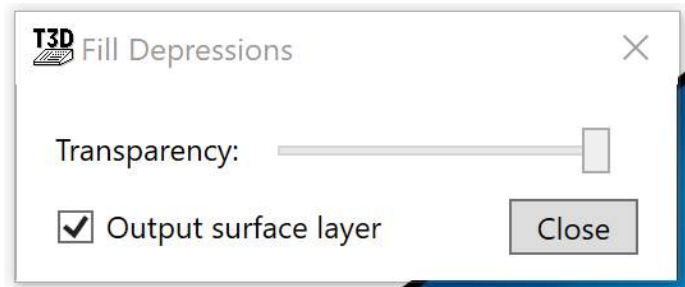
## Breach Depressions

'Breach Depressions' allows you to break through a depression and allow water to flow out.

- 'Layer to breach' selects which surface layer the breaching should be applied to.
- 'Transparency' of the design can be altered using the slider.
- 'Output new surface' will create a new design layer.
- 'Modify existing surface' will make breaching changes to the selected surface.
- 'Create breach paths as polylines on close' by selecting this option polylines will be generated according to the 'Min path length'.
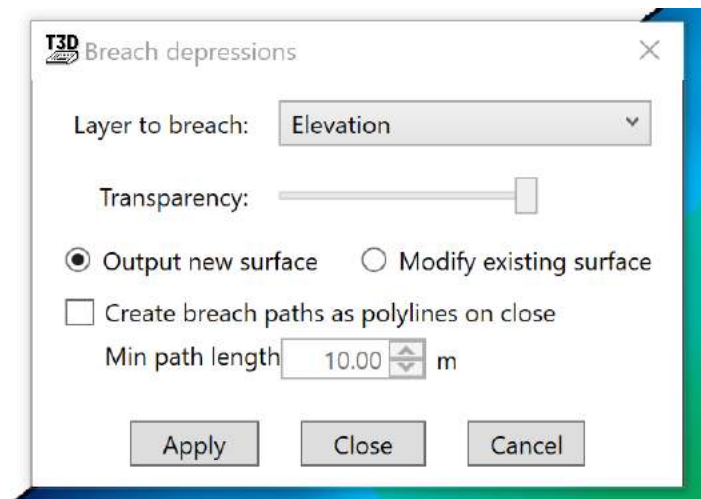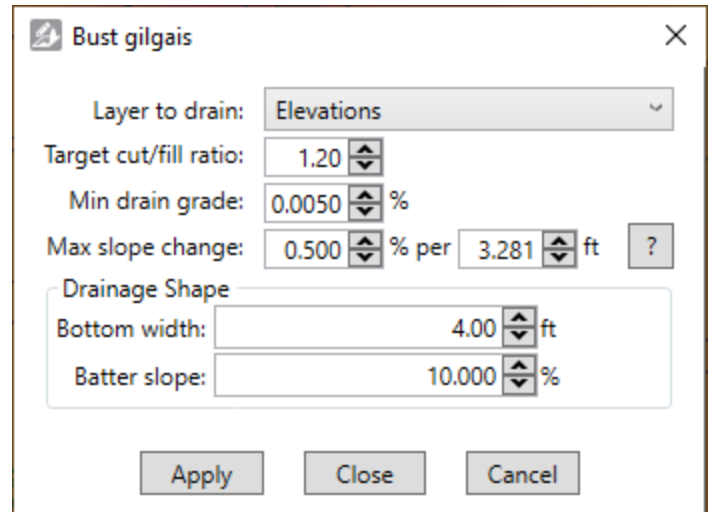
# Bust Gilgais

'Bust Gilgais' breaches and evens out depressions (also known as melon holes or gilgais) in the field while moving as little dirt as possible. It is a blend between breach depressions and fill depressions.

- 'Layer to drain' lets you choose the elevations to use. It lists the layers in the Surface tab.

- 'Target cut/fill ratio' lets you adjust how the design balances dirt with compression/compaction of cuts.
- 'Min drain slope' sets the target slope that can be used in drain lines to drain gilgais. The resulting slope may be less to fit the target cut/fill ratio.
- 'Max slope change' controls the smoothness of the surface. Decreasing this can increase trafficability, but will increase the time it takes for the tool to complete.
- 'Drainage Shape' will set an ideal cross section for how the gilgais should be drained. The system will try to ensure that each breach matches these settings as closely as possible. Widening the drainage shape will also help make the design more trafficable.

Helpful tip: If you know where a lot of melon holes are, try placing a drain nearby in the design before using this tool. This will straighten the busting lines that converge on the drain.

# ⛰ Dam Creator

The 'Dam creator' tool provides a simple process of creating a dam on any selected space on the field surface. This tool is able to make two types of dam, 'Full Cut' dams and 'Borrow Pit' Dams. So what are the differences and benefits for these dam types?

**'Full Cut' dams** take the earth needed to build the walls/banks from the center of the dam. The advantage of this type of dam is that it maximizes the amount of water that can be stored. The disadvantage is that the earth needs to be moved a greater distance. This makes it better suited to smaller diameter designs.

**'Borrow Pit' dams** take the earth they need from the inner edge of the dam to build the bank. The benefit of this style of dam is that it is faster to make and the earth needed is not moved as far, the disadvantage is that it has less water storage capacity compared to the full cut design.

1. Select the tool.
2. The cursor will change into a crosshair used to place the dam centerline. Click on the map to add points to the dam outline. Double-click the last point to finalize the outline. More points can be inserted later.
3. After creating the outline, a pop up window will appear, showing 2 design options. 'Create Full Cut Dams' or 'Create Borrow Pit Dams'
   - The 'Full Cut Dam' creates a default wall with outer and inner slopes, height, and width.
   - The 'Borrow Pit Dam' creates a default cross section with both bank (i.e. wall) and channel (i.e. borrow pit) slopes, heights, and widths.
4. Once you have chosen a dam type, you will be able to further customize your dam.
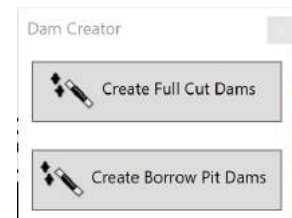
Note: If you wish to edit a dam that has already been made, first switch to Guides layers in the right panel. Next find the guidelines for the dam, select them and left-click on the 'Edit guides' tool.

## Design

Design contains all the settings required for making dams in T3RRA Design.
- 'Profile' is the cross section of the dam. Multiple profiles can be added by pressing the '+' button.
  - When using multiple profiles, all settings are made from the "origin" point which is a red node on one of the corners.
  - A profile can be moved around the dam wall by setting its 'Distance from start'.

- When you have more than one profile, the dam wall blends the profiles between them. To create a length of the dam wall with a constant cross section, put the same profile on each side of the length. Hint: Right-click in a blank part of the cross section plot to save and/or load a specific cross section shape.
- Template is the settings for the dam profile. By clicking the 'Edit cross section directly' button, the cross section can be changed manually. Simply click and drag the blue and green markers.
- 'Dam Bottom Height' is the grouping of settings for the inside bottom of the dam.
- 'Dam Bottom Shape/Drainage' is a group of settings that also control the bottom of the dam, however they differ from height by controlling slope and heading to allow for specific outlet points to be made.
- 'Surface layer' selects which layer the dam design changes will be made to.
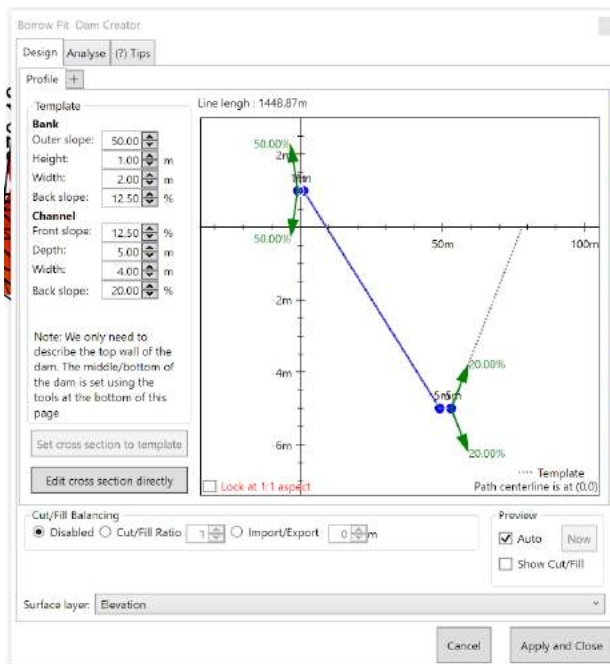


Borrow Pit Dam design
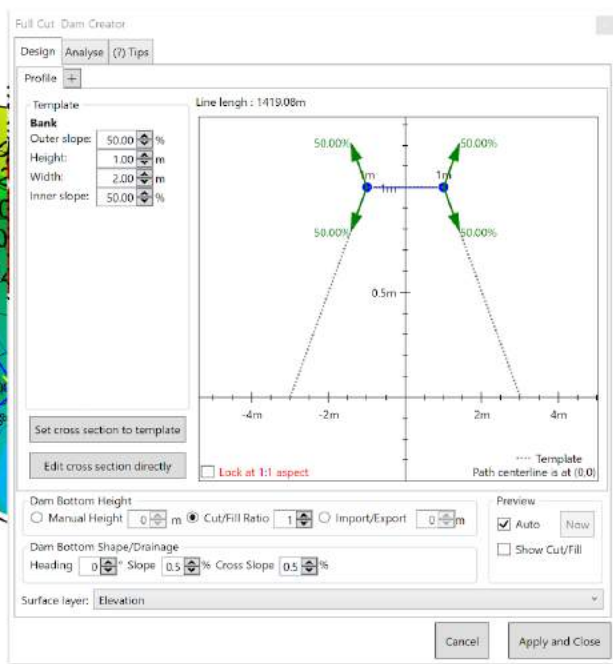


Full Cut Dam design

## Analyse

The analysis page displays a summary of earth moving and water capacity. This includes a graph of water volumes by depth. The freeboard distance can be set at the bottom of the window to adjust the water capacity details.

## Tips

The 'Tips' page provides some quick notes on the use of the dam creation tool.
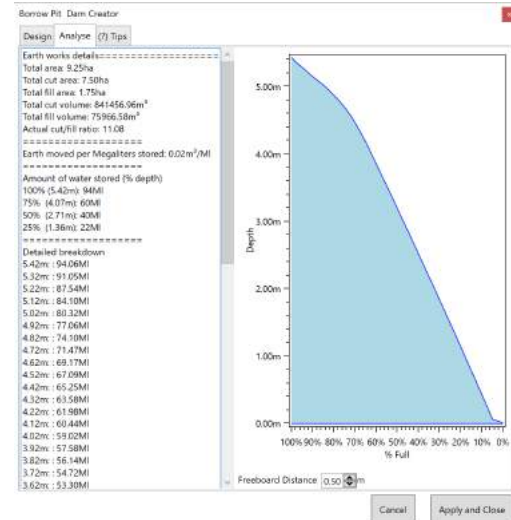
## Drains and Banks Tool

The drains and banks tool is great for planning drains, ditches, channels, and troughs. Also roads, banks, ridges, levees and embankments. With it's 2021 update, it now lets you plan more complex structures, like roads with drains on each side, custom contours - even whole shed pads and feeding lots. The key attribute is that you can create these structures by extruding a cross section design along a line (or lines). If you can describe your cross section and the path it should follow, then you can design drains, roads, pads, borrow-pits and contours.

The tool requires three inputs - path creation, longitudinal design, and cross sections. They can be edited independently while using this tool, although the line must exist to edit the longitudinal design.

### Create the path

When you first open the tool, define the path by clicking on the surface at its starting point, any midpoints and finally the endpoint. The points can be dragged around to move them, and right-clicked to delete them.

Tip: Shift+click to add points to the beginning, rather than the end.
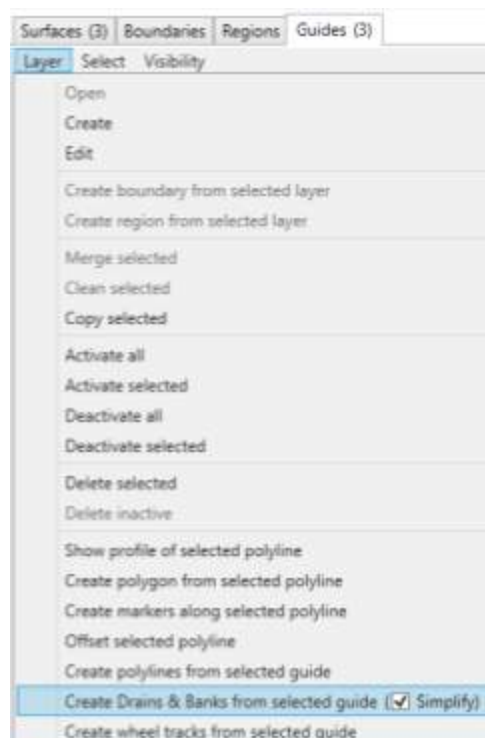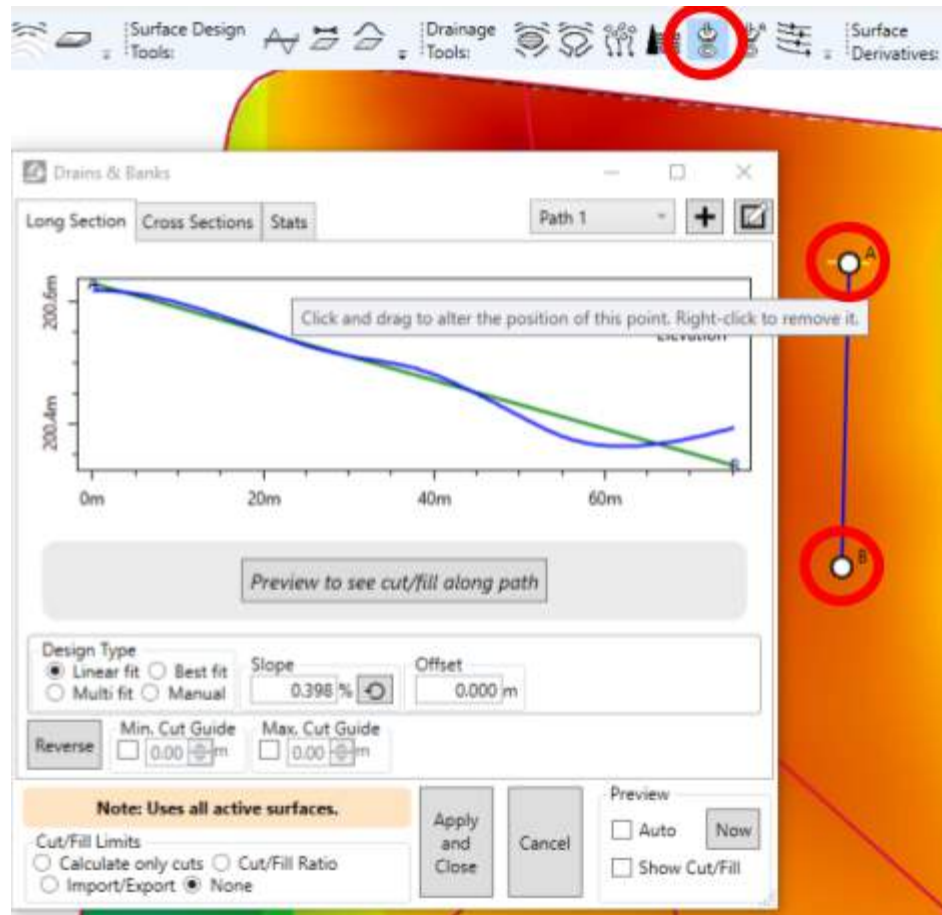
If you've already got your path in an existing guide, then you can create a drain from it. To do so, select the layer in guides and then in the Layers menu, click "Create Drains and Banks from selected guide". The simplify option is recommended, as it removes any points that don't contribute to the shape of the path. This makes designing easier and quicker to run.

## Design your path's elevations (long section)

With a path chosen and shown on the map, there are two more things to design - the longitudinal (aka long section) and the cross section. The longitudinal design defines how the elevations/depths vary as you travel from the path's start to end.
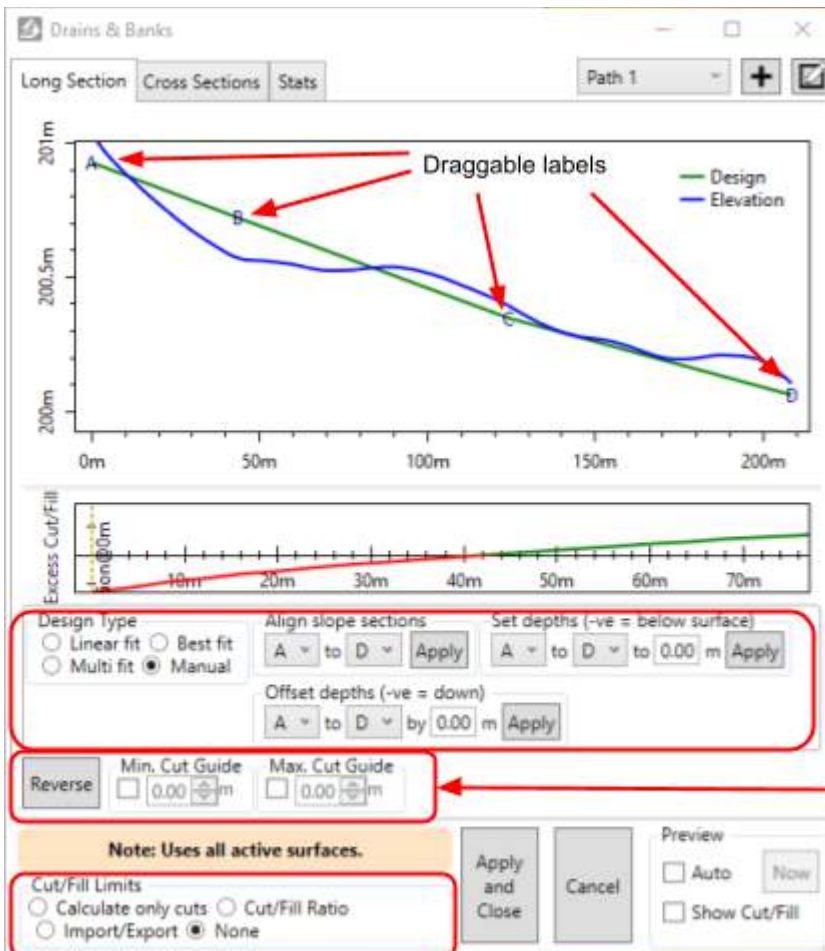


This shows the longitudinal profile. Click & drag the labels (A,B,C,etc) up and down to the point's height.

Click anywhere along the line to add an extra drag handle.

This shows the excess cut/fill along the path.

This section allows you to define the path's heights using algorithms.

Allows you reverse the direction of the path, and add some guides (that don't affect the design algorithm)

These let you adjust the way that we will import/export dirt.
Note: They achieve this by moving the design line (green in the above plot) up or down until balanced.

## Edit Cross Sections

The cross sections define the shape to extrude along the chosen path, following the elevations/depths from the long section design.



This shows the long section design along with cross section placements.

This section is to manage your cross section placements (chainage).

These allow you to quickly edit normal drain/road designs.

Click this to create advanced designs
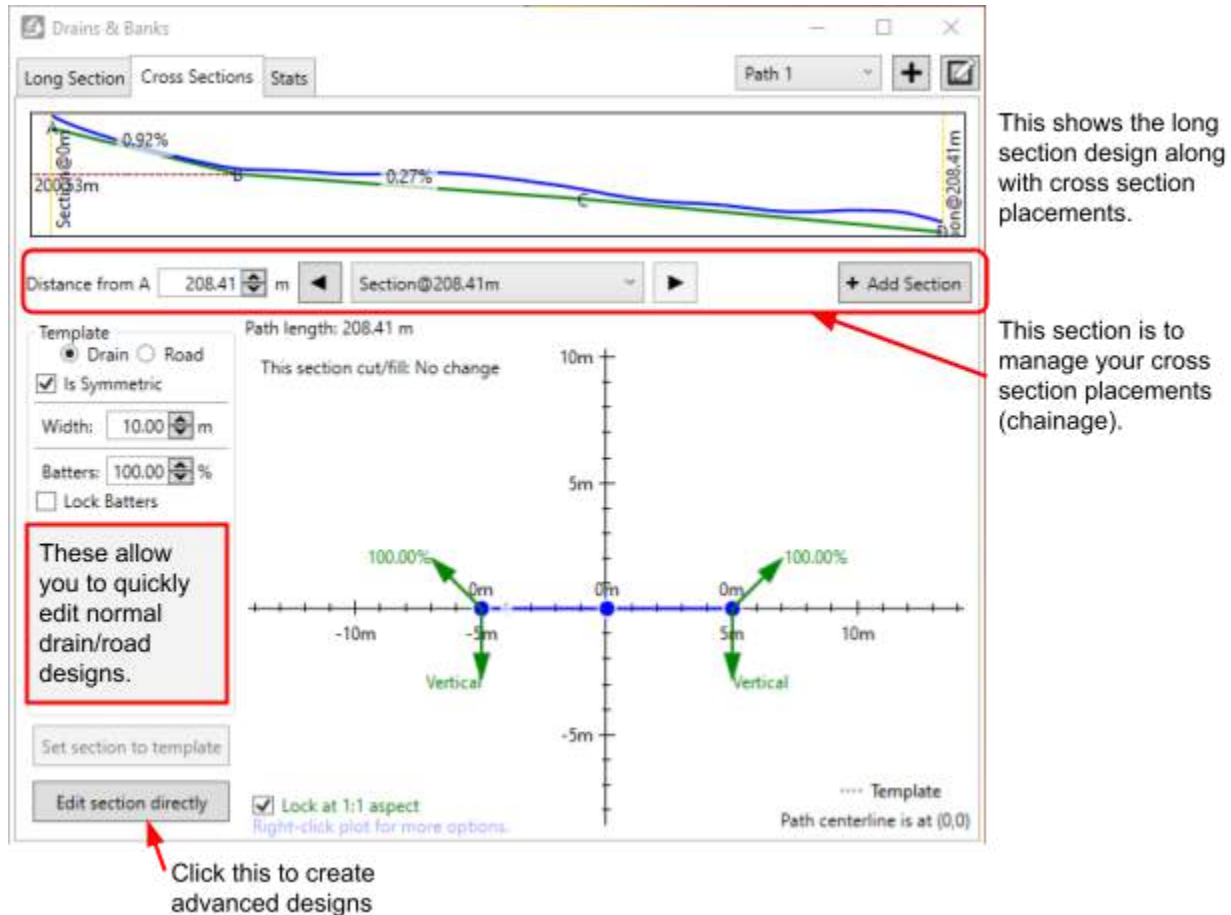
A game-changing feature of this tool is the ability to set multiple profiles along the path. This allows you to create a drain that has a small width at the head and then progressively gets wider all the way to the end. This can dramatically reduce the earthworks to implement. You can add as many sections as you want, and it will smoothly transition between each of them.

NOTE: The green batter arrows on the end indicate that the algorithm will follow that angle until it reaches the surface - going at a constant slope until it does.

## Working with advanced cross section designs

Path length: 208.41 m

This section cut/fill: ~0.04
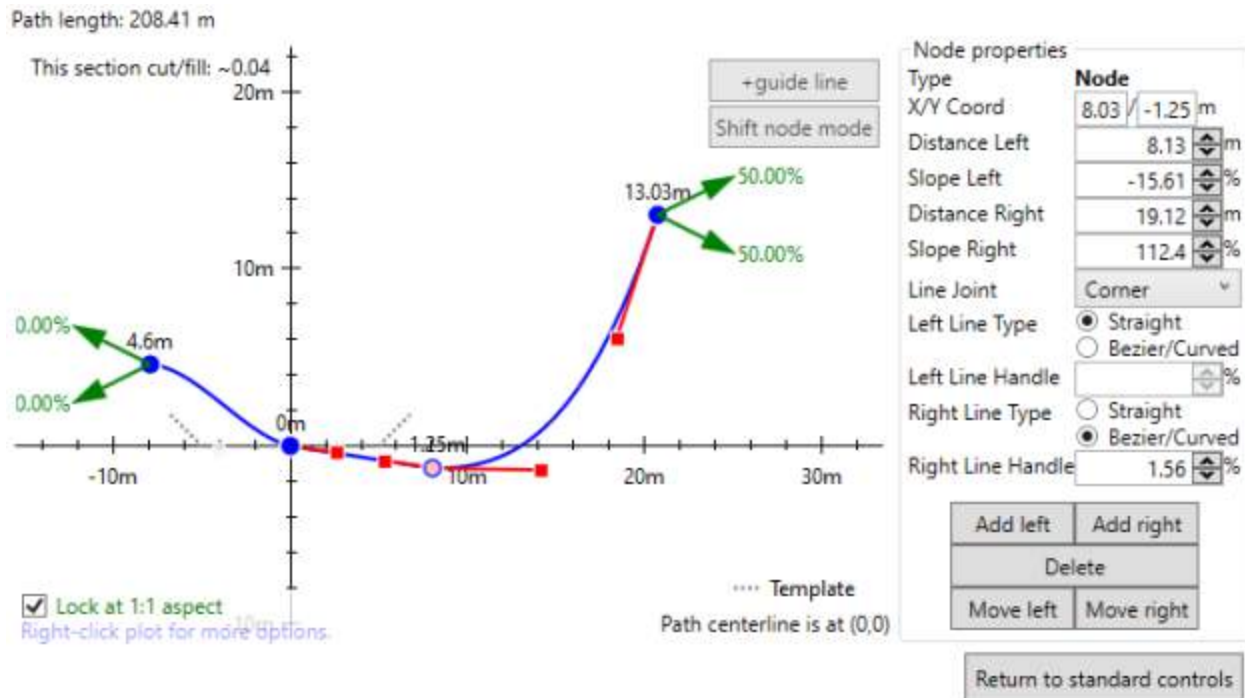


Advanced cross section designs allow you to create custom profiles, but take a bit more work. The plot shows where the profile is relative to the longitudinal line. The longitudinal line's position is at 0,0 (where the two black axes meet).

A VERY important concept is that 0,0 (where the two plot axes meet) is the same elevation as the longitudinal design (green line). If you don't go through 0,0 then you will be effectively modifying the long section design. This is very useful in some circumstances, however, it can bite you (if you raise one cross section too high, it may make the drain go uphill for a bit and pool water).

### How to edit advanced cross sections

You can either create your profile by just clicking and dragging the cross section line around, or you can use the properties tab on the right. The selected node appears pink so you can easily identify it. The clicking UI is the same as other places you edit lines. Click on the line to add drag handles, right-click to remove handles, click and drag to move handles.

Cross sections can be linear or curved. Curved segments are created with curves called beziers. To use them, click on a point and two red drag handles will appear. The red lines with handles show the tangent of their attached node, allowing you to set up
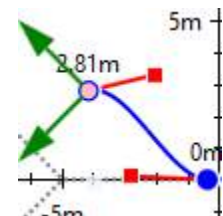
a smooth (or not!) transition. This feature can really help when implementing with a T3RRA-enabled bulldozer (where you mainly push across cross sections rather than longitudinally).

## Adding guide lines

Guide lines were added so you can export guidance lines (e.g. as John Deere Adaptive Curves). To create guide lines, you must be in in the advanced design tools, and then you can click the "+guide lines" button. It will add a vertical line that you can drag left and right to position. To remove a guide line, right-click on it.

If you have created multiple cross sections, add guide lines to each cross section. If you have the same number of guide lines in each cross section, they will join up. That way you can vary the sideways position of your guide lines along the drain (e.g. for finishing). Below is an example of going from 20m between the guide lines at the South end to 100m at the North end.
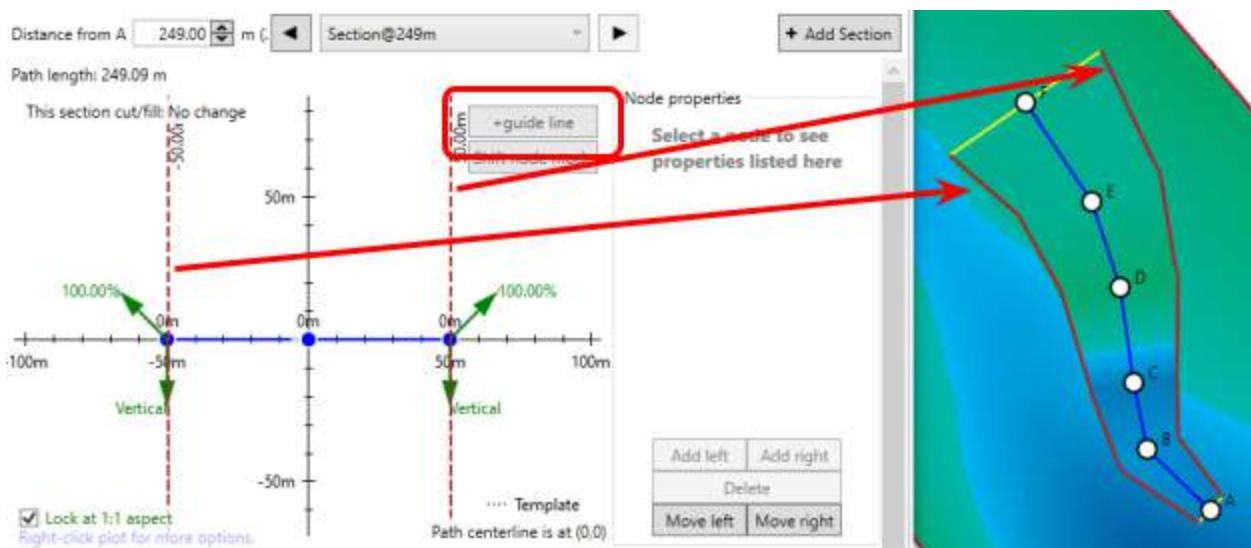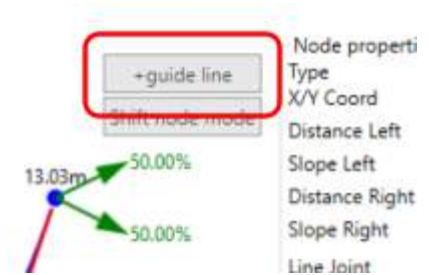


## Cross section batters

A concept that is a bit confusing is the batters on the sides of the cross section (the green arrows). They tell the algorithm how to join up with the existing surface. If the profile would end beneath the surface, it will follow the angle shown in the upwards facing arrow, and the opposite is true if it ends above the surface. This means that you can easily design a profile that is both cutting and filling, with the batters allowing it to smoothly transition in either case.

## Working with multiple paths

The section at the top right of the window allows you to change the working path. Click the "+" button to add a new line. Clicking the edit button on the far right will let you rename and reorder the paths so you can more easily understand which is which.



All the tabs apply to just the selected path, so when you're working on multiple paths you will need to make sure you design all paths one by one.

NOTE: If you want to copy your current design (both long section and profiles) you can click "Copy To All Paths". This copies design parameters (except for manual elevation edits), and cross sections to the other paths.
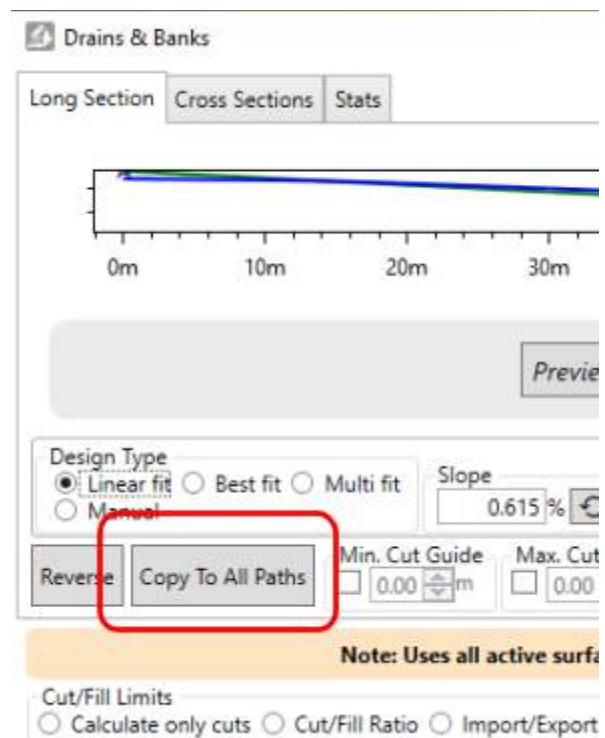
# Add contour banks / terraces

This tool is used to add contour banks/terraces. To begin creating a new set of contour banks/terraces click on the 'Add new contour bank / terrace set' button in the pop-up window. When creating contour banks/terraces a blue line in the working area is used to control the placement, point A on the line will act as the starting point when generating the design lines.

The Contour design window can be broken into a top and bottom sections:

The Top section

- 'Contour bank grade (%)' allows you to control the slope of the contour banks
- 'Sample Distance (m)' will control how often T3RRA Design will look at the lines to make sure they are at the desired slope.
- Contour banks/terraces can be set to run to the left, right or both sides of the start line, by selecting the option you would like. The 'Both' option is linked to a checkbox allowing you to reverse the grade of the contour banks/terraces.
- 'Add contour: Vertical/Horizontal distance from A = X m' this button will display a distance from the starting point. If the checkbox for 'Starting point distances measured horizontally' is selected this distance will rise by 50 meters horizontally each time the button is pressed and a new line added. If the checkbox is left unselected, the distance will rise by 2 meters vertically each time the button is pressed and a new line added. These distances from the start point can be altered manually by clicking on the distance value where each line appears in the box on the top left hand side and typing in the new value.
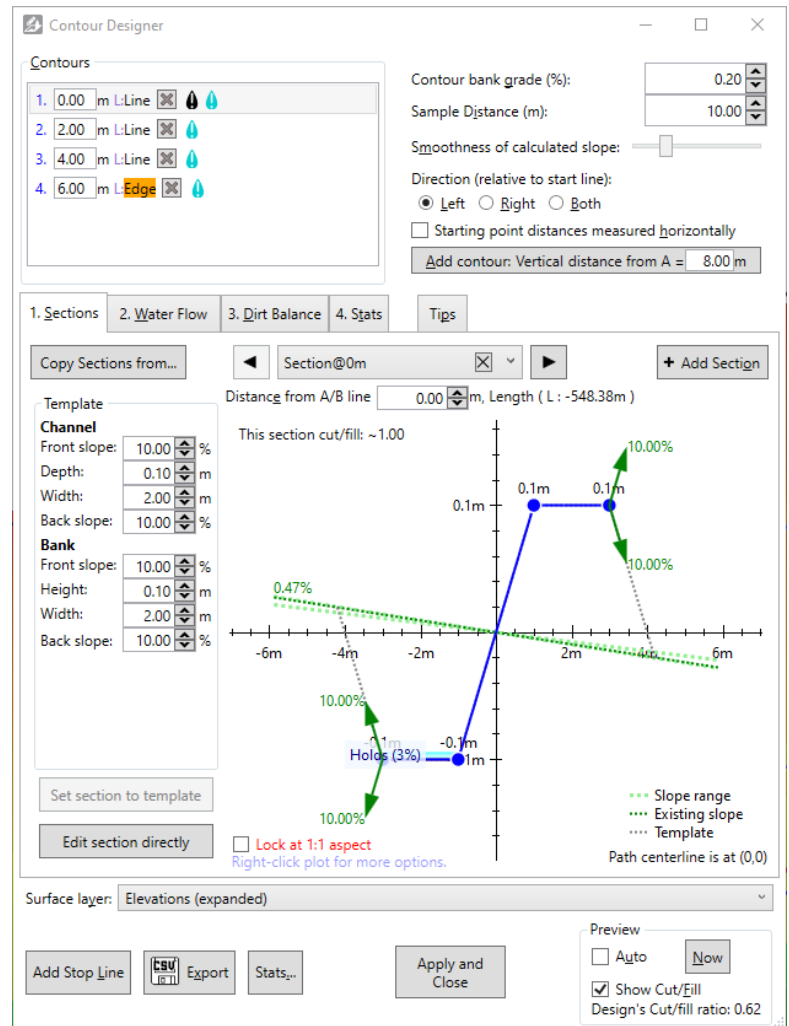
## Tab 1: Sections

There are many values to tweak on the left in the 'Template' section. They are broadly grouped into two sections depending on whether they affect the channel or the bank. Try changing a few values to see how they affect the cross section shown on the right. They include:

- Height and depth. Use these to balance cut and fill while setting your desired total contour height. The capacity of the contour is affected by the sum of these two. A high bank increases capacity, but can lead to water backing up onto the nearby field.
- Width. A wider contour can carry more water without it getting too fast, but this can lead to increased earthworks in steeper areas. Increase width for sections where more water is expected. You can adjust the width of the bank to balance cut and fill.
- Slopes. These control how quickly your contour transitions between the natural surface, the bank, and the channel. Flatter slopes are better for trafficability, but can lead to more earthmoving. Steeper slopes reduce earthmoving, but can cause extra erosion.

Contour cross sections can be highly customized. Just click on the [Edit section directly] button to get started. You can even save your custom cross sections for later reuse. Simply right-click on a clear part of the plot (when editing directly) and click Save. Load, and some other handy tools, are also in the same menu. If you have made a mess (why not try click around and edit things for a while) and want to go back to the simpler template based section, just click on [Return to standard controls] in the bottom right, then click on [Set section to template] in the bottom left.

## Tab 2: Water Flow

Here you can enable water flow estimates for your contours. This helps you choose an appropriate size for your contours at various points. To start working with water flow in contours, you should start by deciding on a rainfall event, a surface roughness, and maximum desired water flow speed.

Note that the water flow estimates are just estimates, and can only be as good as your inputs. There are various tips in this section to help you choose conservative values, but we take no responsibility for breached contours - this is just a guide to help with on-site planning and adjustments.

Once water flow is enabled, the designer starts to calculate the accumulated water flow. Once that is complete, a series of water flow plots appear in this tab, and each cross section profile displays the estimated water level. The map and designer will also highlight
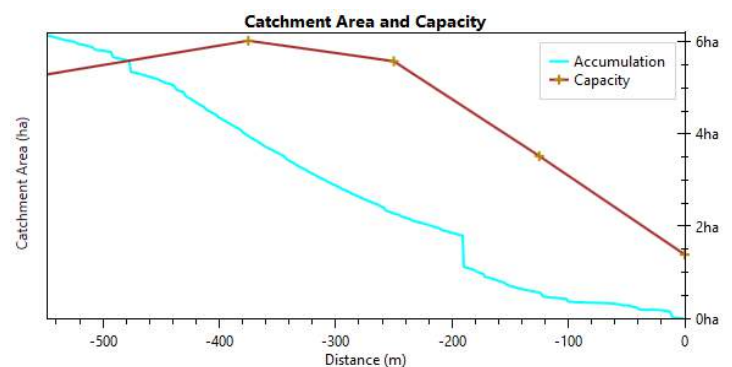
sections of each contour that may breach or erode (see right).

NOTE: Contour capacity will vary depending on the shape of the contour and the prevailing slope. A contour through very flat country will carry extra water across the uphill slope.

## Tab 3: Dirt Balance

This tab displays the dirt balance along the length of the selected contour. This is very helpful for avoiding long-distance movement of dirt. If the dirt balance has been minimized, implementing the design with a bulldozer (or bucket scraper) can be a lot more efficient.

## Tab 4: Stats

Various statistics for the current contour are displayed here. For more information, including earthmoving, water flow details (and more), click on the 'Stats...' button at the bottom of the window.

## Using the Contour tool

With all the functions that we've managed to put into the contours tool it can be confusing on where to start. Here is a helpful guide on creating a contour/levee design.

## Step 1: Initial setup of paths

Move the pop-up window so you can see the surface. Adjust the start line so that it is at one end of the area you would like the contour bank and press the 'Add contour' button. The first bank will be added at the start line's Point A. Then select the contour's direction, the contour grade, and apply any required path smoothing to remove kinks. Contour direction is relative to the start line, looking from A to B.
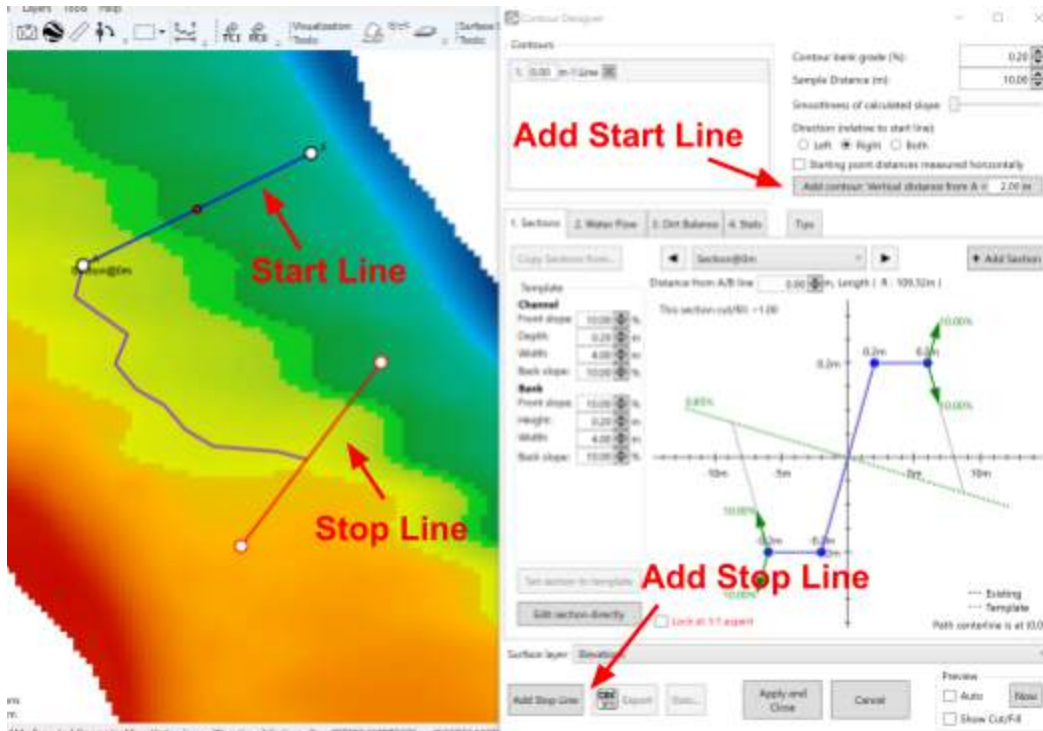
To avoid flooding the next field over, put a stop line in the contour's path so it drains at a planned location:

## Step 2: Refine your contour with water flow

Once you are satisfied with the contour's location, refine your contour's shape with the template settings in the Sections tab. Pressing the 'Edit section directly' button gives you full control over the cross section:
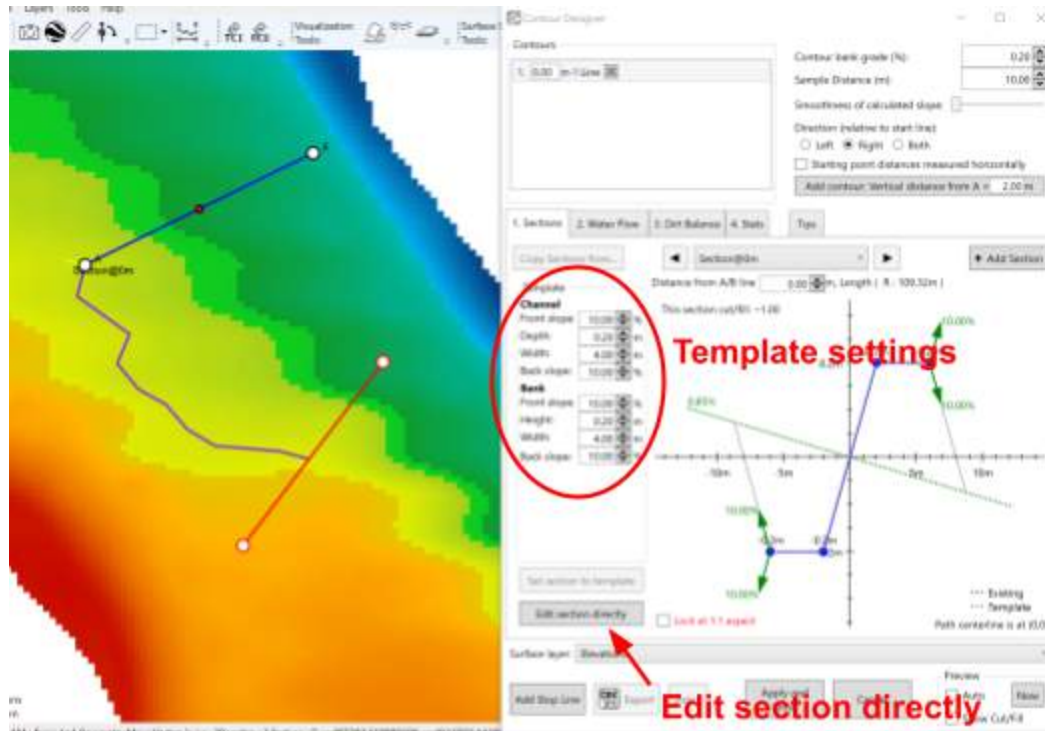
Making a contour the same size along the whole length works, but involves moving a lot of dirt. A 2/3rds reduction in dirt volume can be achieved by matching the bank capacity to the actual water volume predicted at each point along the bank. To taper the contour, add multiple sections with the 'Add Section' button and position them by editing the 'Distance from A/B line' field. You can now smoothly vary the size and shape of the contour:
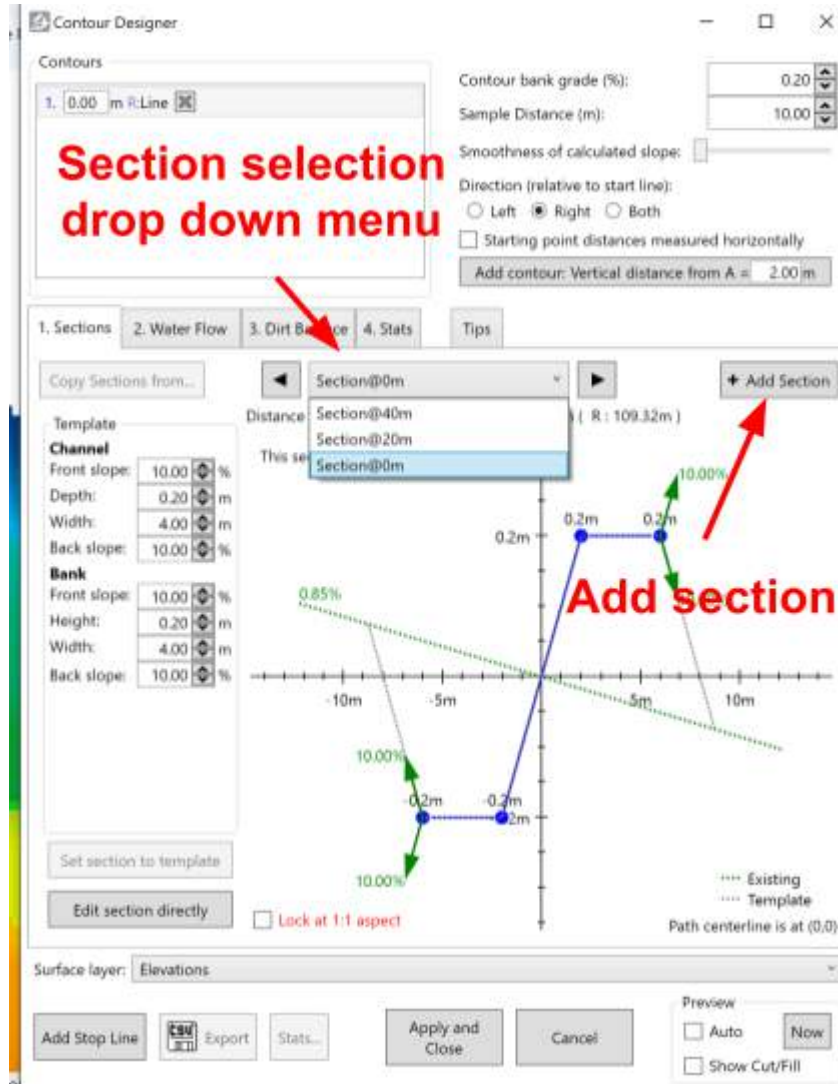
To help guide your adjustments, turn on water estimates with the 'Enable water' button. Enter details for a heavy rainfall event and some soil settings in the window that appears:
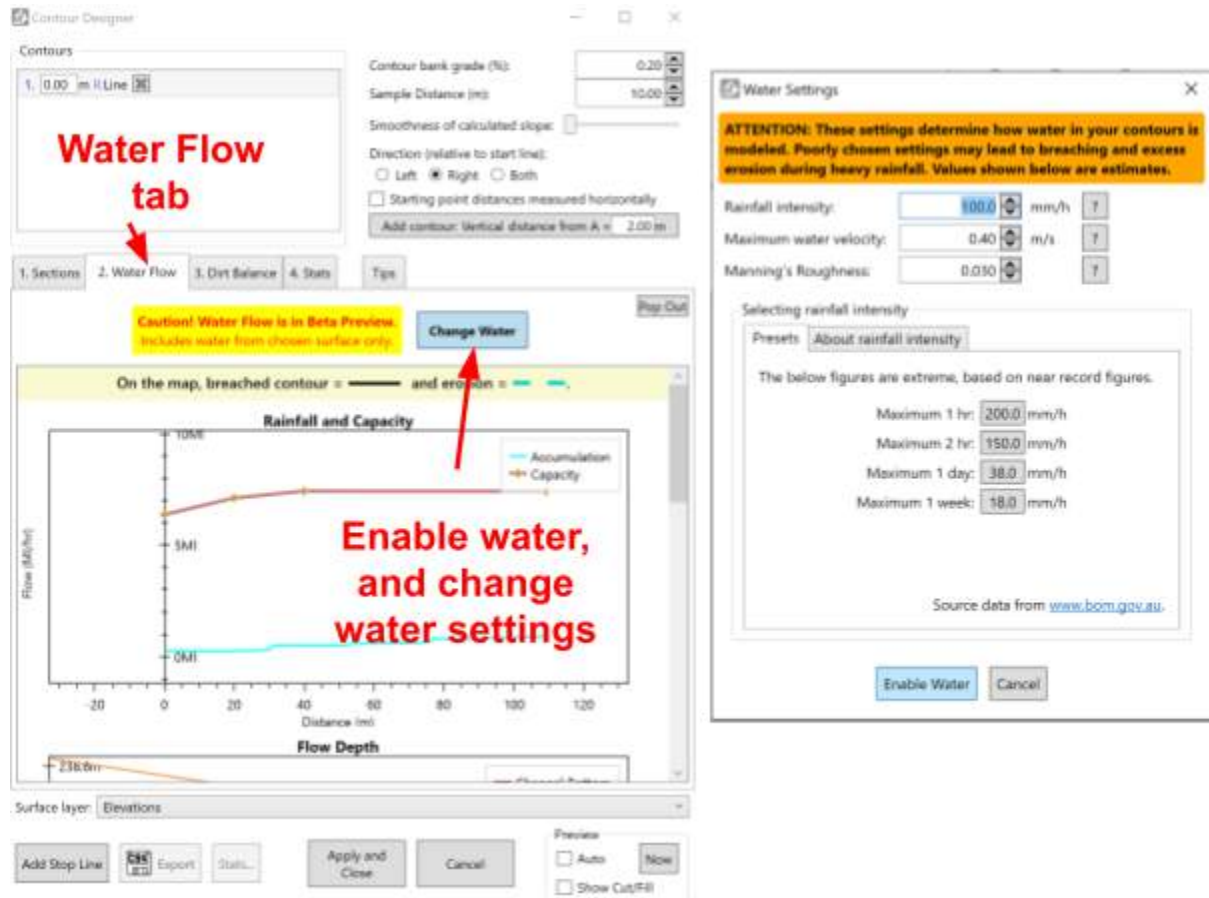
Once calculations are complete, the 'Water Flow' tab will display all the water estimates. That includes estimated water depth, water flow speed, and contour capacity (in terms of flow rate and catchment area). The estimated water depth is also shown in each cross section:
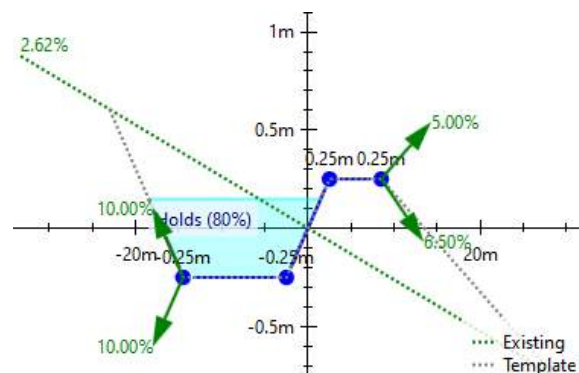


When editing your contour, it can be helpful to view the water plots at the same time as you edit cross sections. To do so, click the "Pop out" button in the top right under the water flow tab. The water plots will update as you make changes to each section.

While you are working on the water flow, remember that you can stop a contour from breaching by increasing channel capacity or by increasing the grade (moving the water

faster). If you do this, ensure you don't risk eroding the contour channel. You can increase the grade for the whole contour or for one section at a time. To change the grade for one part of a contour, move sections vertically. Do this by 'editing the section directly' and entering "Shift node mode" (see right). You may have to move the rest of the sections up or down to match so that they continue to drain appropriately. When doing this, it is helpful to pop out the water depth plot and view the longitudinal profile at the same time.
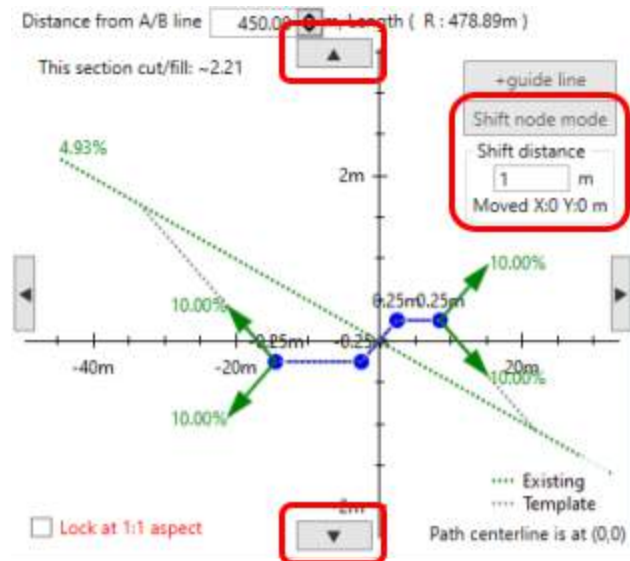


Conversely, to reduce channel erosion, you can widen your contour channel or decrease contour grade. Bank design must balance the competing need to slow water down (reducing channel erosion) and to move adequate volumes of water (to avoid over-topping).

If you will be farming over (and in) your contours, check the water flows you expect with and without standing crops. Vegetation can slow down water flow quite a bit, leading to contour breaches.

## Step 3: Save on earthmoving

When you are implementing your design, you don't want to move dirt over long distances. This is especially true for bulldozers, where it would take a lot of effort to move dirt from one end of the contour to the other. Dirt imbalance at a location along the bank occurs because grade and path smoothness considerations result in the channel being too shallow to provide enough dirt for the bank, or so deep that there is no close location to put the dirt. It can also occur in curved sections of the bank where the length of the channel does not match the length of the bank. To manage this, go to the 'Dirt Balance' tab and press the 'Preview pre-balance cut/fill' button. This shows where there is unbalanced cut (red) and fill (green). While mousing over the graph, a marker appears on the map to show its location.
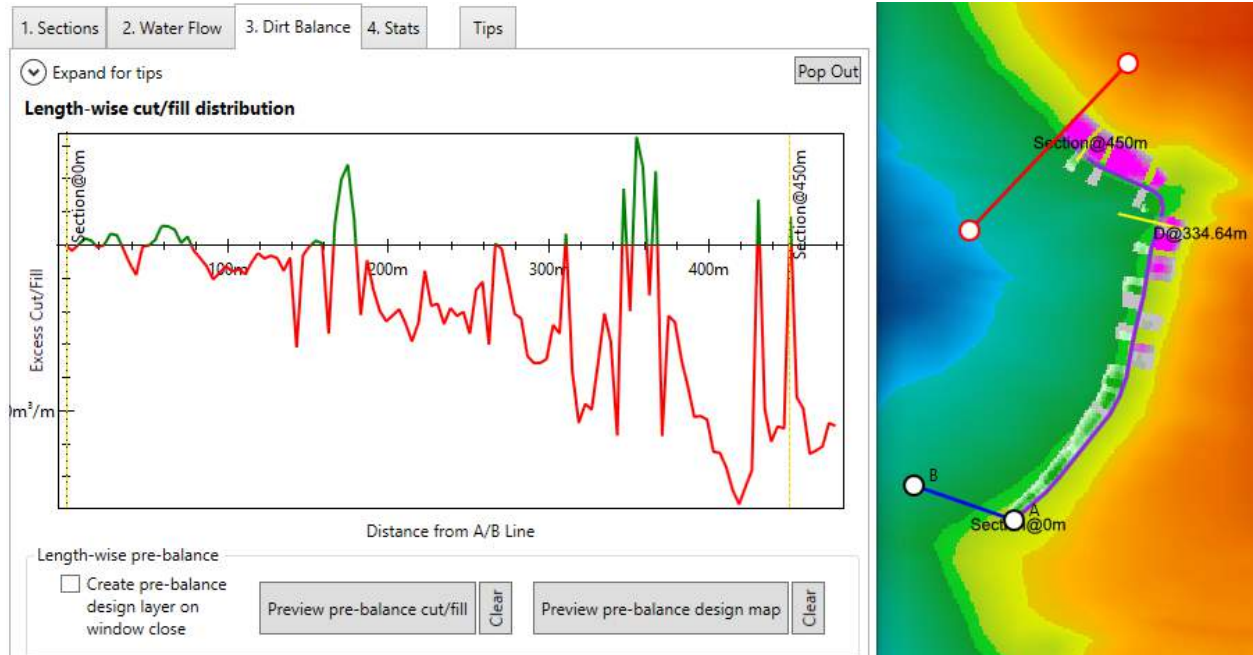
It can be very helpful to pop out the dirt balance graph while you adjust the sections individually. If you do, ensure you have Auto-preview checked. To fix this without ruining water flow, only edit the cross sections by moving them left or right. The example above shows excessive cuts at the north end (at the right end of the graph), so the section at that end should be moved out of the hill (to the right in the section plot below). You can easily move a section left/right by 'editing the section directly' and entering "Shift node mode":
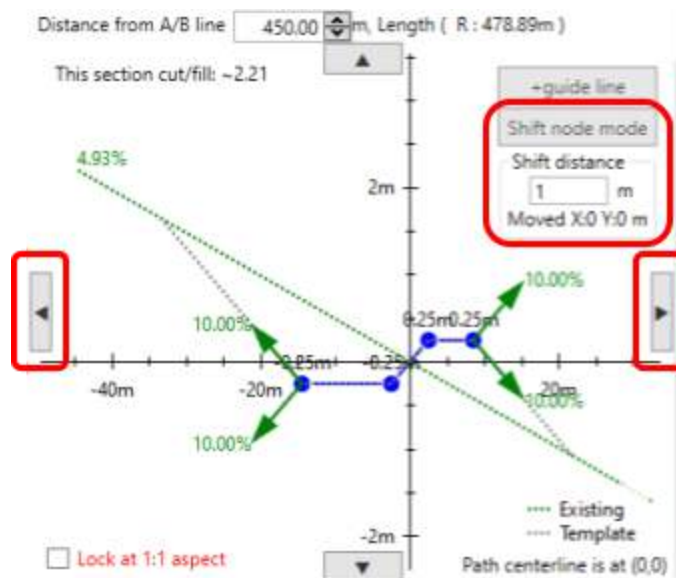
## Step 4: Guide with guidelines

To help make implementing easier, guidelines are your friend. These can be exported as tractor auto-steer paths. Well placed guidelines can make the finishing pass with a bucket scraper very clean. To output guidelines, add guideline markers to each section by editing the section directly. The 'add guideline' button is just above the "Shift node mode" button. If the number of guidelines on two neighbouring sections matches, the guidelines will join up with a smooth transition (see right). If you're using a bulldozer and want cross contour guidelines, let us know and we'll get onto it!
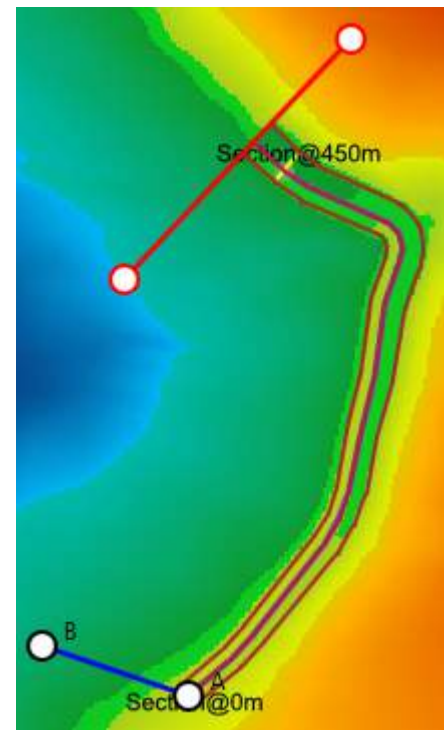
## Step 5: Implement!

When you are satisfied with the design, press the 'Apply and Close' button at the bottom of the window to output the design and create contour guidance lines. Export the original and design surfaces with any desired guidelines to the format of your choice, and …

# Surface Derivatives

## Show depressions

This tool displays all depressions in the selected surface or any depression that meets the minimum requirements that can be set.

- 'Only include depressions >= (X)m' enables the setting to limit the depressions displayed to only those that exceed a set surface area size.
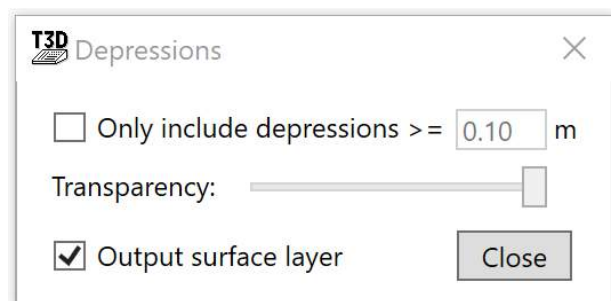
- 'Transparency' is a slider which adjusts how clearly the depressions will be displayed in the working area.
- 'Output surface layer' checkbox will create a design layer when you click on 'Close'

# Show directional depressions

 'Show directional depression' allows you to select a direction and display any depressions that would affect water flow in that specific direction that would otherwise not.

- 'Direction (degrees)' this setting will rotate the simulated water flow direction to help isolate depressions that would affect the water flow.
- 'Plane strip width' this tools performs its calculations in strips following the set direction, small strip sizes allow for more detailed result but take longer to process.
- The Compass is a visual method for controlling the direction that is used to calculate depressions.
- 'Depressions deemed negative' checking this option will tell the tool to display depressions as red on the surface.
- 'Transparency' controls how visible this information will be.
- 'Output result layer' will create an output layer upon closing the tool.
- 'Apply' this button must be pressed each time a change is made in order for it to be correctly displayed.
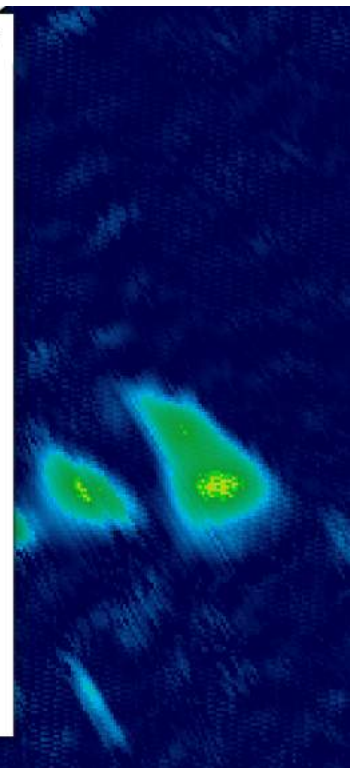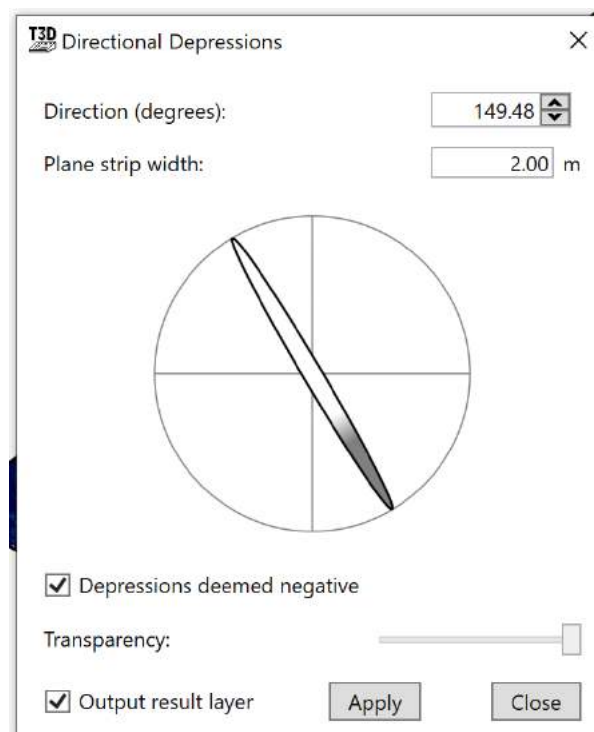
# Show watershed

'Show watersheds' identifies the areas of the surface that will flow together to the same exit point on a field. The working area will display the surface in a patchwork of colours, these indicate your watersheds and what will flow out where, the specific colours do not matter they are only to help identify individual watersheds.

- 'Elevation smoothing' provides control to adjust the level of detail on the surface
- 'Segmentation method' will select a general water event to display watersheds for, the options are Hybrid, Immersion, and Rainfall.
- 'Output watersheds layer' will create a new design layer when the tool is closed.
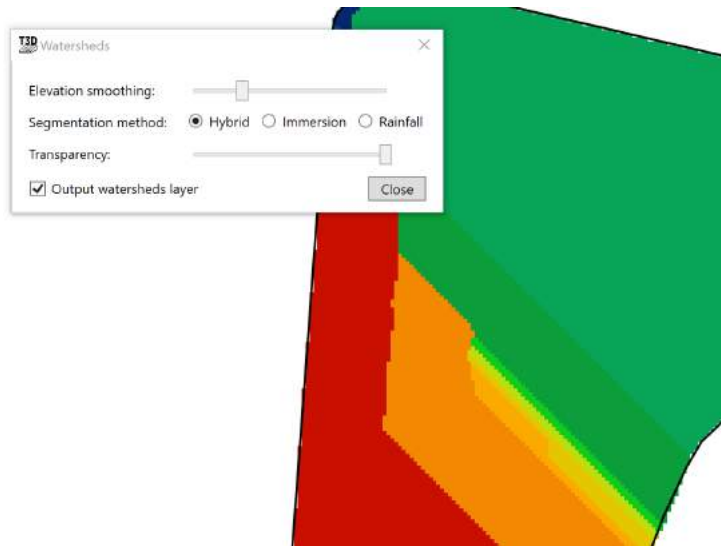
# Show accumulated flow layer

The accumulated flow layer shows paths where the water is most likely to pass through. It is recommended that before using the 'Show accumulated flow' tool that the 'Breach depressions' tool is used for the most accurate water flow results.

- 'Min. drainage area' adjusts what the minimum drainage area needs to be before the paths will appear on the surface. The further to the left that the slider is the lower the amount of water that needs to pass through that area to appear on the field in the working area.



- 'Transparency' controls how the flow is displayed.
- 'Output surface layer' this will tell T3RRA Design to create a design layer upon closing the tool.
- 'Output flow paths' which will create guidelines for the flow paths upon closing the tool.
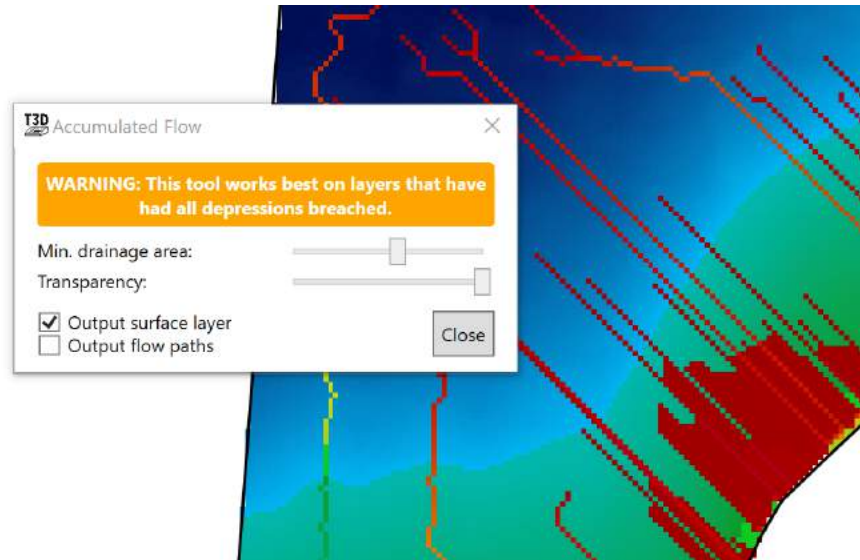

# Show wetness index

'Show Wetness index' also referred to as the Hillslope Wetness Index. This tool creates a grayscale layer of the surface that uses high contrast to show the most affected areas. Darker areas on the field represent where the most water flow is, while lighter areas show where there is little water flow or where the water moves away from.

- 'Elevation smoothing' slider that averages out the information on the field reducing or increasing the number of peaks and valleys.
- 'Transparency' will change how visible the wetness index is.
- 'Output result layer' will create a design layer upon closing the tool.

![Aspect tool icon]
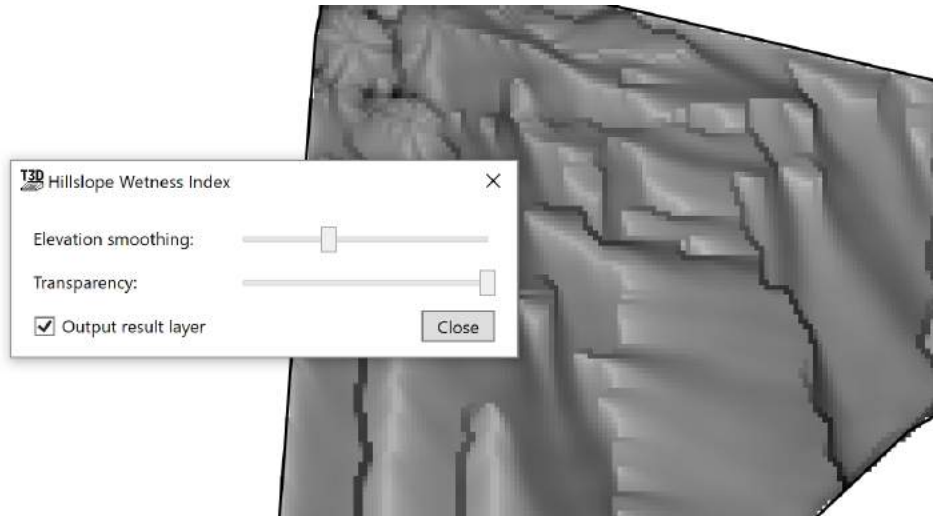
# Show aspect

Showing aspect will change the surface to a grey-scale to highlight where the sun is hitting the surface. North facing areas will be lighter while south facing areas will be a darker grey.

- 'Elevation smoothing' slider that averages out the information on the field reducing or increasing the number of peaks and valleys.
- 'Transparency' controls how visible the layer is.
- 'Output result layer' will create an output layer upon closing the tool.
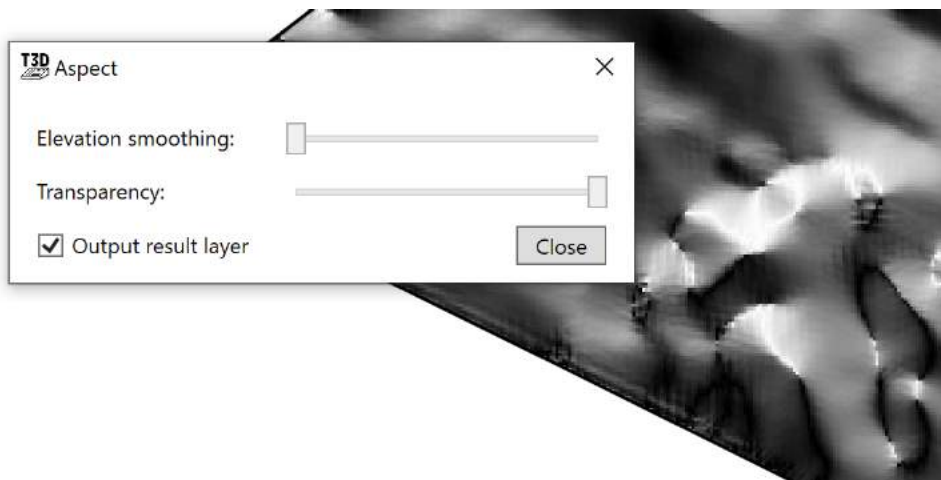
# Show slope

'Show Slope' shows the severity of the slopes in the field in a colour grade. The colour grade used is: Red shows low severity of slope and Dark Blue areas show a high severity of slope.

- 'Elevation smoothing' averages the information to grade how severe the slope is. The right end of the slider is the larger area averaged of the elevation points. The left side of the slider shifts the averaging to its smallest radius, resulting in slope severity to be more precise in which areas it reads.
- 'Transparency' which controls how visible the layer is.
- 'Output result layer' will create a new output surface upon closing the tool.
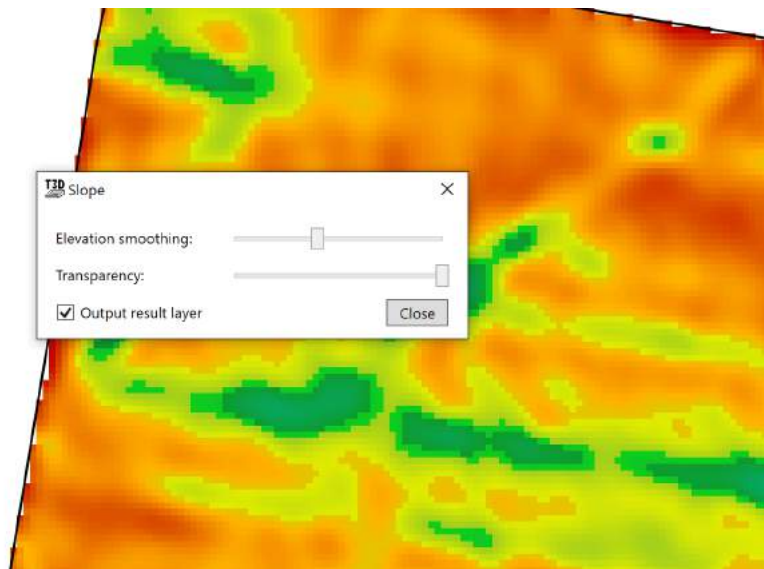


# Show directional slope

'Show Directional slope' allows you to visualize the severity of slopes going a set direction. The severity of the slope is represented by colour with Red showing a low severity of slope and dark Blue showing a high severity of the slope in that direction.

- 'Direction (degrees)', this setting allows you to set the directional slope you would like to see on the field. This is the manual direction setting which can be used if you know exactly which direction you wish to view.
- 'Smooth elevation' This slider manipulates the peaks and valleys in the present data by taking averages of the data around each point. The further to the right the slider is the more data is averaged resulting in fewer peaks and valleys present in the field.

- The compass. The dark end of the compass needle represents the current directional heading you have set. To adjust the compass click and hold on the needle and rotate it to the direction you wish to display the slopes of.
- 'Display back slopes as negative values'. This checkbox will display the slopes going in the opposite direction to the compass as a negative value, causing the field to appear vastly different.
- 'Transparency'. This slider will change how visible the directional slope information is on the surface of the design.
- 'Output result layer' tells the system to create a surface layer when the pop-up window is closed.
- 'Apply'. This button needs to be pressed each time you want to apply a new direction to the field.
- 'Close', this button will close the pop-up window and create a surface layer if the 'Output result layer' checkbox has been selected.
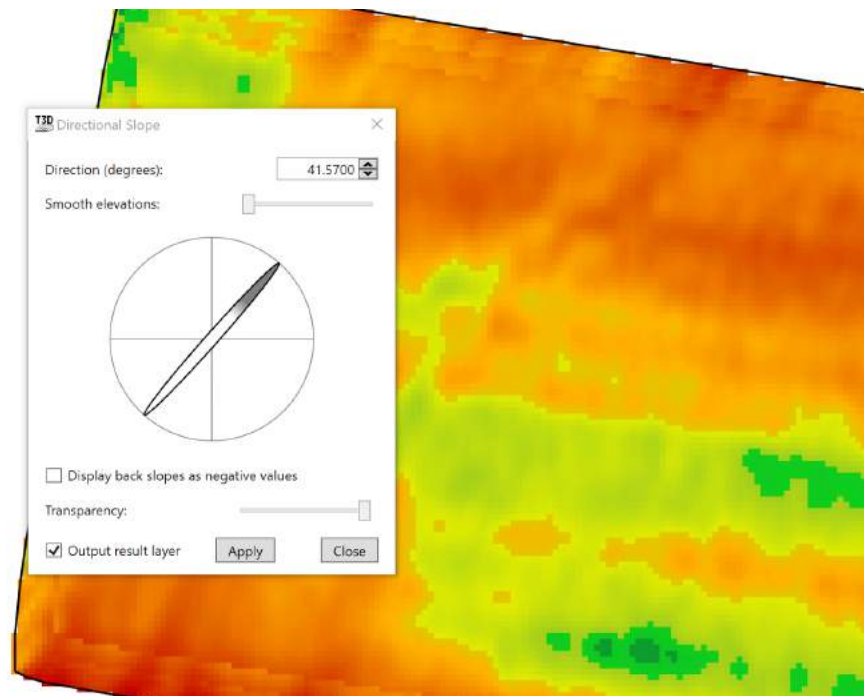


## Show landscape change

Landscape change is a large scale smoothing operation for finding generalized high points.
- 'Radius for gross landscape smooth operation' this slider changes the radius for how far the system will look around each point to find the average height to be displayed.

- 'Consider values higher than the average surface to be positive' this option controls the colour scheme of the display. If left unchecked high point will be coloured red and low points will be dark blue and vice versa if the option is checked.
- 'Perform exhaustive averaging (slow, but accurate)' This slows down the averaging process but more closely analyses the information for more accurate adjustments.
- 'Transparency' controls how visible the changes of the tool are.
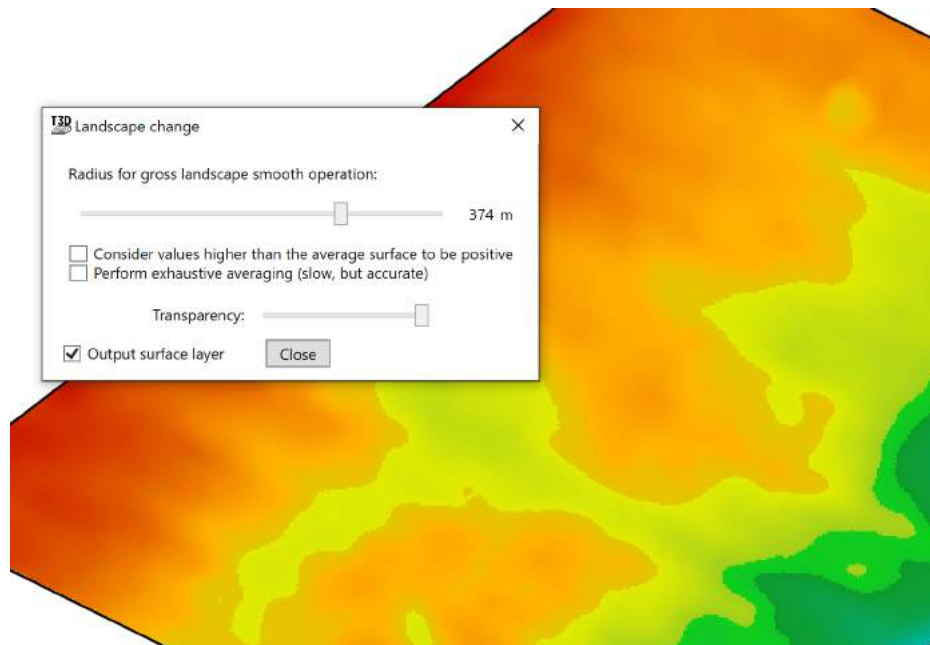


- 'Output surface layer' will create a surface layer upon closing the tool.

# Surface Tools - Layer Menu



- Open overlay images -  this allows layers (such as yields, or imagery etc) to be draped over the elevation layers. These layers are not used in any elevation related calculations and are denoted by the letter 'O' (overlay)
- Edit
- Create boundary from selected layer - this will draw a boundary around the most outer points of the selected surface and will populate a new boundary in the Boundary tab
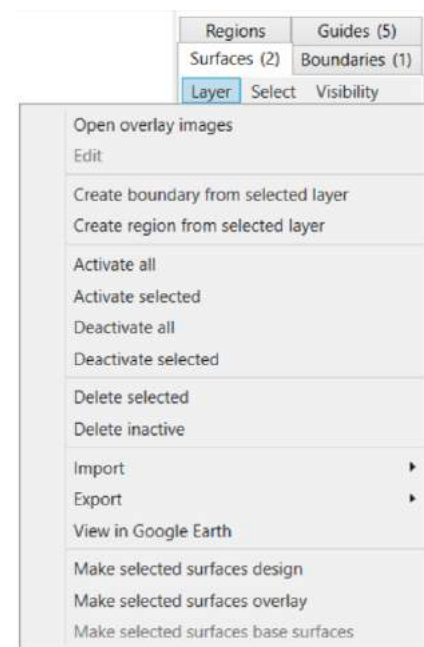
- Create region from selected layer - this will draw a region around the most outer points of the selected surface and will populate a new region in the Region tab
- Activate all - this will activate the surface so it is now visible on the Working Area. This is shown by the checkbox being selected.
- Activate selected - this will activate the surface which you selected (shown by the tile having a blue highlight around it) so it is now visible on the Working Area. This is shown by the checkbox being selected.
- Deactivate all - this will deactivate all surfaces
- Deactivate selected - this will deactivate the surface which you currently have selected (shown by the tile having a blue highlight around it)
- Delete selected - deletes the surface you have currently have selected (shown by the tile having a blue highlight around it)
- Delete inactive - deletes all inactive surfaces (i.e. those without a tick in the checkbox)
- Import >
    - T3RRA Cutta elevations (*.tci) - see Importing elevations from T3RRA Cutta (.tci) in section: Importing and Exporting in T3RRA Design
    - From existing elevation surface - see Importing a Surface from an Existing Elevation Surface in section: Importing and Exporting in T3RRA Design
    - From raw data points (Deere RCD, CSV, etc) - see Importing a Surface from Raw Data Points in section: Importing and Exporting in T3RRA Design
- View in Google Earth - this will open the selected surface in Google Earth
  NOTE: You must have Google Earth installed on your PC for this to work.
- Make selected surfaces design - this will change either a 'base' or 'overlay' surface/s to a 'design' surface and will be denoted by the letter 'D' on the surface/s tile
- Make selected surfaces overlay - this will change either a 'base' or 'design' surface/s to a 'overlay' surface and will be denoted by the letter 'O' on the surface/s tile
- Make selected surfaces base surfaces -  this will change either a 'design' or 'overlay' surface/s to a 'base' surface

# Boundaries Tools

When the Boundary tab is selected on the right hand side, the relevant tools will be accessed in two different areas. Firstly, on the menu bar (this changes depending on which layer type is selected) and is explained below in Boundary Design Tools and secondly, in the Layer menu on the selected tab and is explained in Boundaries Tools - Layer Menu

# Boundaries Design Tools



The Boundary tools available in T3RRA Design create boundaries that are used to limit where field designs will affect. In order to apply any design to elevation data in T3RRA Design they must first have a Boundary.

There are 5 Boundary tools available in T3RRA Design, Point to Point Creation, Boundary Edit, Slice Boundaries, Multiple Cut lines and Open boundaries in Google Earth.

## Point to Point Creation

'Point to Point Creation' changes the mouse icon to a cross. While in this mode, clicking anywhere in the working area will add a point. These points anchor the line that appears on the screen with the last point and the first point connecting automatically to create a closed boundary line at all times. In order to complete and add the boundary to the layer selection, double click on the last desired point.
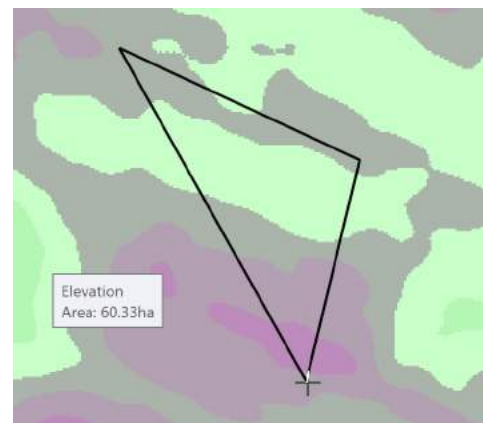
## Boundary Edit

'Boundary Edit' displays a series of nodes along existing boundary lines. By left clicking and holding on these nodes the boundary lines are able to be moved anywhere.

When hovering over a line, a blue node will appear half way between the 2 gray nodes along that line. By clicking on a blue node it will become a new gray node and adding a new point from which the boundary line can be adjusted.
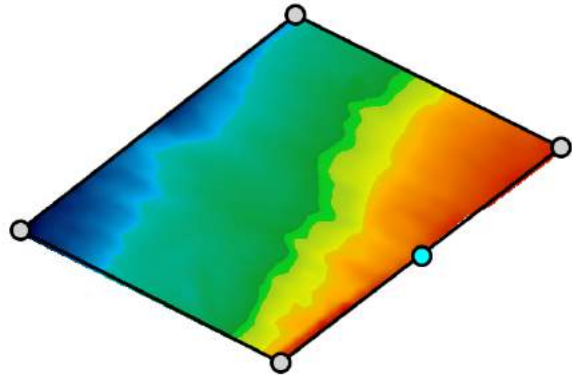
## Slice Boundaries

'Slice Boundaries' is used to split pre-existing boundaries into smaller areas. Once this tool has been selected your mouse cursor will change to a pencil while it is in the working area. To add a line to a boundary click on the outside of the line to create a starting point, from this point wherever you move your mouse a red dotted line will be connected showing where the new boundary line will be created. Clicking on the working area again will place the new boundary line along the red dotted line that intersects with 2 other boundary lines.
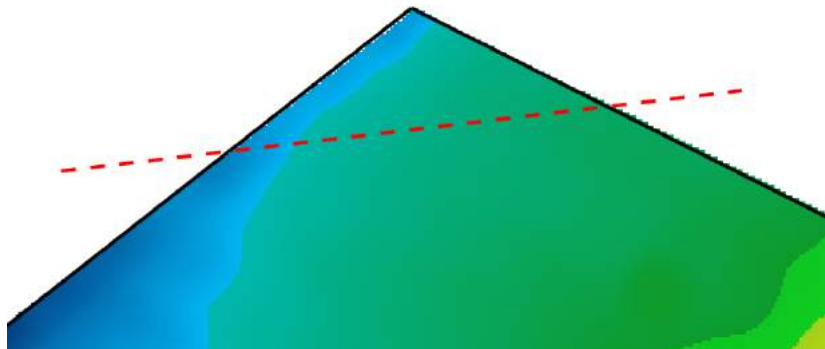
## Multiple Cut Lines

The 'Multiple Cut Lines' tool provides a way of creating equally spaced boundary lines across already existing boundaries.
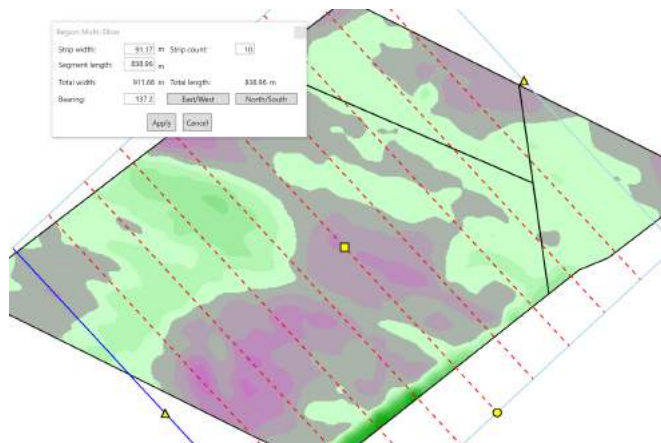
When the tool is selected a pop-up window and a selection tool will appear in the working area.

In order to place the cut lines use the selection tool. The yellow square in the center of the selection tool controls the position of the lines, the yellow triangles on either side of the selection tool control the width of separation between the lines and the yellow circle controls the length of the selection tool as well as the rotation of the selection tool.

## Open Boundaries in Google Earth

'Open Boundaries in Google Earth' allows you to export your boundary lines to Google earth.

When the tool has been selected to export your boundary lines a pop-up window will appear. In this pop-up window the layer that is being exported can be named. Once the layer has been named press 'OK' and the layer will be exported to Google Earth.
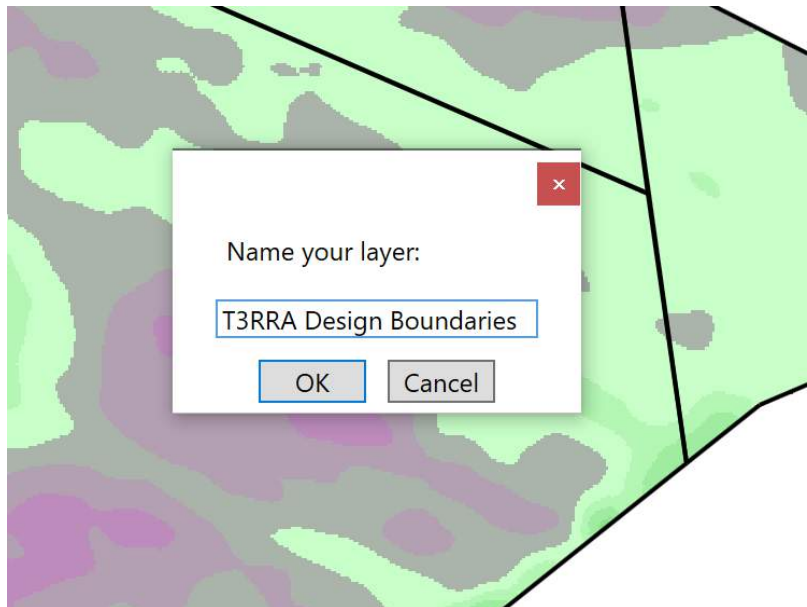


# Boundaries Tools - Layer Menu

- Open
- Create
- Edit
- Create boundary from selected layer
- Create region from selected layer - this will draw a region around the most outer points of the selected surface and will populate a new region in the Region tab
- Merge selected - (ensuring you have 2 or more boundaries selected) this will create a combined boundary, removing the initial boundaries
- Clean Selected

- Copy selected - this will duplicate the selected boundary
- Activate all - this will activate all the boundaries so they are visible on the Working Area. This is shown by the checkbox being selected.
- Activate selected - this will activate the boundary which is selected (shown by the tile having a blue highlight around it) so it is now visible on the Working Area. This is shown by the checkbox being selected.
- Deactivate all - this will deactivate all boundaries
- Deactivate selected - this will deactivate the boundary which you currently have selected (shown by the tile having a blue highlight around it)
- Delete selected - deletes the boundary that is selected (shown by the tile having a blue highlight around it)
- Delete inactive - deletes all inactive surfaces (i.e. those without a tick in the checkbox)
- Import >
  - Import Shapefile
  - Import KML
  - Import Multiplane Boundary
  - Import DXF points/linework
- Export >
  - Export selected to Shapefile
  - Export selected to KML
  - Export selected to Text Columns (CSV, TSV, etc)
- View in Google Earth - this will open the selected surface in Google Earth
  NOTE: You must have Google Earth installed on your PC for this to work.

# Regions Tools

When the Regions tab is selected on the right hand side, the relevant tools will be accessed in two different areas. Firstly, on the menu bar (this changes depending on which layer type is selected) and is explained below in Regions Design Tools and secondly, in the Layer menu on the selected tab and is explained in Regions Tools - Layer Menu

# Regions Design Tools



Regions are a method of dividing a field or alike. Regions allow you to work with multiple fields separately in one project.
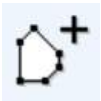
## Point-to-point region creation

This tool lets you create custom regions. When using the creation tool, the cursor will change into a cross. Each left-click will add another corner to the closed region space. To finish adding points to the region, double-click where you would like the final point to be.
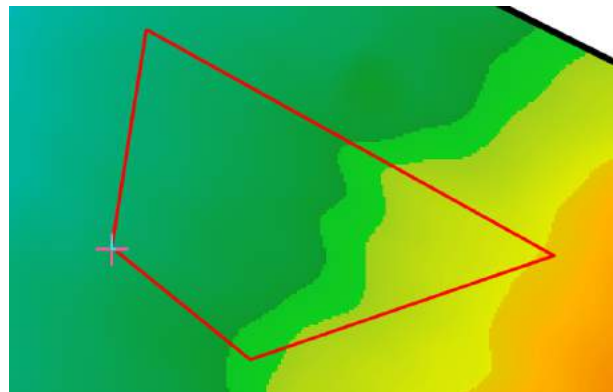


## Edit region nodes and edges

This tool is used to make changes to a region once it has been created.

To use this tool ensure that a region layer is selected in the layers display on the right of the screen. Once the layer is selected and the tool is selected, red dots will appear at each corner of
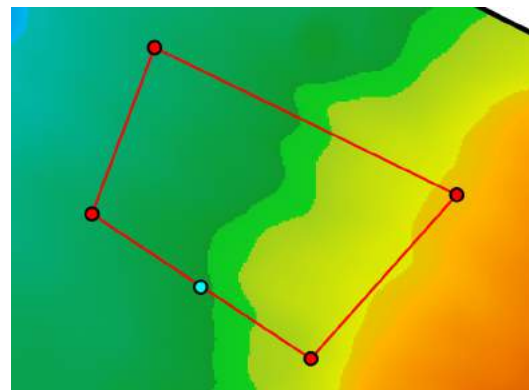
the region. Each of the red dots is a node that can be used to adjust the shape of the region by left-clicking and holding to drag the point to a new location.

When the cursor is over a region line, a blue dot will appear. Left-clicking on a blue dot will insert a new node, at which time it will turn red and become editable.

## Split Region using Cut line

The 'Cut line' tool allows you to place a line to split a single region into two. This is useful when you wish to create different designs on different sections of the surface.

To use this tool ensure that you have an existing region selected in the layer selection.

To make a cut, left-click at one end of where you would like to cut and move the cursor to the other side. A red dotted line will appear along where the line will be cut. Make sure that this line intersects with at least two other lines of the existing region. When you are sure about the placement of the line left-click on the ending point to cut the region. Right-click to cancel the region cut.
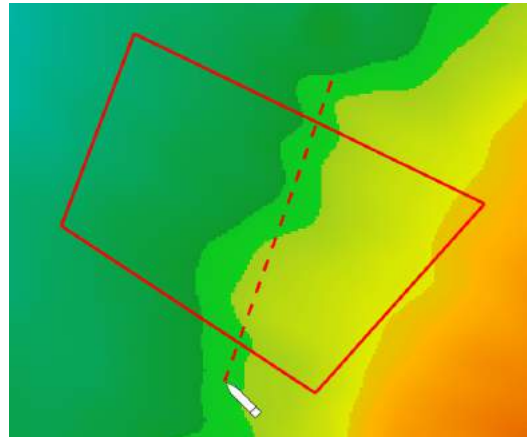
## Region Multi-Slicer

The region multi slicer makes it easy to slice a region into many smaller ones. All cuts made with this tool will follow the same direction and will be parallel to each other.

To use this tool, make sure that you have a region layer selected.
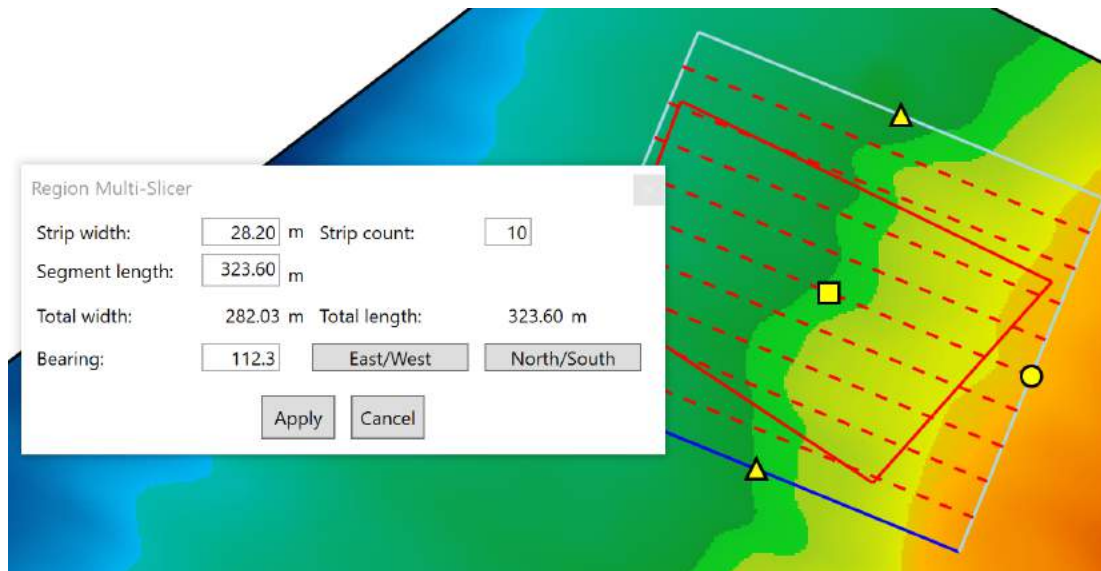
When the tool is selected, it will automatically generate a set of lines. The yellow anchor points can be used to edit the size and positioning of the slices.

- 'Strip width'. This value controls how far apart each line is. This option allows for precise control over the width.
- 'Strip count'. This value controls the number of lines that will be used to cut the field.
- 'Segment length'. This option controls the length of the lines used to cut the region. Adjusting the value here has the same effect as moving the yellow circle anchor.
- 'Total width' and 'Total length' are not adjustable options – they are for display only, and are calculated from 'Strip width' and 'Segment length'.
- 'Bearing'. This option is a more precise method of adjusting the heading of the lines. The 'East/West' and 'North/South' buttons set the heading to follow directly along those directions.

Once all changes have been made, press the 'Apply' button to make the cuts on the selected regions, or the 'Cancel' button to back out of this tool.

# Regions Tool - Layer Menu

- Open
- Create >
    - Create from saved surface
    - Create from selected surface
    - Create from saved boundary
    - Create from selected boun
- Edit
- Create boundary from selected layer
- Create region from selected layer - this will draw a region around the most outer points of the selected surface and will populate a new region in the Region tab
- Merge selected - (ensuring you have 2 or more boundaries selected) this will create a combined boundary, removing the initial boundaries
- Clean Selected
- Copy selected - this will duplicate the selected boundary
- Activate all - this will activate all the boundaries so they are visible on the Working Area. This is shown by the checkbox being selected.
- Activate selected - this will activate the boundary which is selected (shown by the tile having a blue highlight around it) so it is now visible on the Working Area. This is shown by the checkbox being selected.
- Deactivate all - this will deactivate all boundaries
- Deactivate selected - this will deactivate the boundary which you currently have selected (shown by the tile having a blue highlight around it)
- Delete selected - deletes the boundary that is selected (shown by the tile having a blue highlight around it)
- Delete inactive - deletes all inactive surfaces (i.e. those without a tick in the checkbox)
- Import >
    - Import Shapefile
    - Import KML
    - Import Multiplane Boundary
    - Import DXF points/linework
- Export >
    - Export selected to Shapefile
    - Export selected to KML

○ Export selected to Text Columns (CSV, TSV, etc)
● View in Google Earth - this will open the selected surface in Google Earth
NOTE: You must have Google Earth installed on your PC for this to work.

# Guides Tools

## Guides

The 'Guides' layers allow extra information to be displayed on the field in the working area. This information can include elevation grids, flow directions, and contour lines.

There are many tools available in the guides toolbar to help manage and quantify the elevations on the field.

### Edit Guide

The 'Edit guide' tool allows you to make changes to any other guide information set on the field after the initial window has been closed. To use this tool, the appropriate layer needs to be selected in the layers panel on the right side of the screen. After the correct guide layer has been selected, pressing the 'Edit Guide' button will reopen the window that appeared when the layer was first made.

### Point label

This tool lets you place labels on a field as reference points, or simply to remind you of points you may need to watch out for or pay closer attention to. Selecting the tool will change the mouse cursor to a cross, then clicking in the working area will create a point and
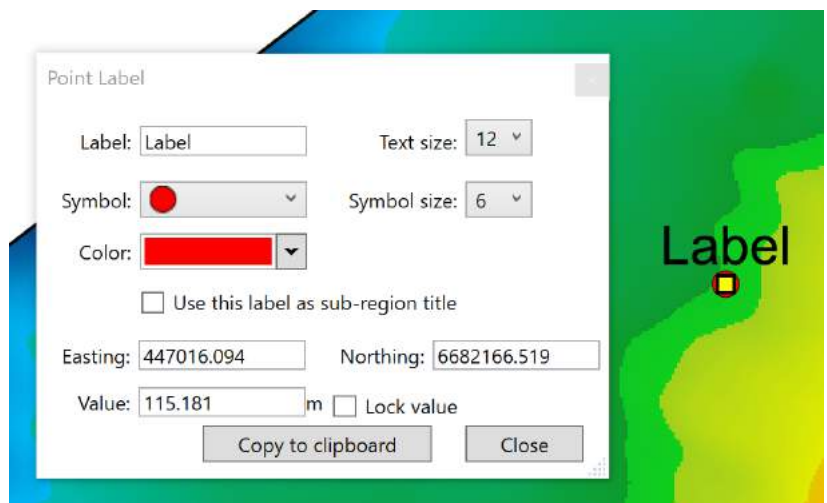
open a pop-up window, allowing you to change its properties:
- 'Label' The text in this box will be displayed on the map. The size of the text can be altered by using the 'Text size' option on its right.
- 'Symbol' allows you to change the symbol or shape that is used for the point.
- 'Symbol size' allows you to make the symbol larger or smaller.
- 'Color' allows you to change the color of the label marker that is placed on the field in the working area.
- 'Use this label as sub-region title' will use the label as the title for the region it is in if multiple regions are present.
- Easting and Northing show the coordinates of where the point label has been placed. It can be changed using the yellow point on the marker or by inputting new values here.
- 'Value' option displays the elevation or height of the label and can be changed by entering a new value here. If you enter a custom value, ensure you lock it with the neighboring option.
- 'Lock value' locks the value that has been set in the 'value' field so that it will not update to the currently active surface. Unlocking a point label is a way to get a surface elevation of cut/fill value at a specific point.
- Clicking on the 'Copy to clipboard' button will copy the name of the label and its coordinates so they can be used elsewhere.

When creating a label, if you have a label layer selected on the right, it will be added to that layer (otherwise it will create a new layer for it).

## ABC Line Label guide

The 'Line Label guide' tool allows you to select two points anywhere on the field and display the distance between them with a label attached. When the tool has been selected the cursor will change into a cross.
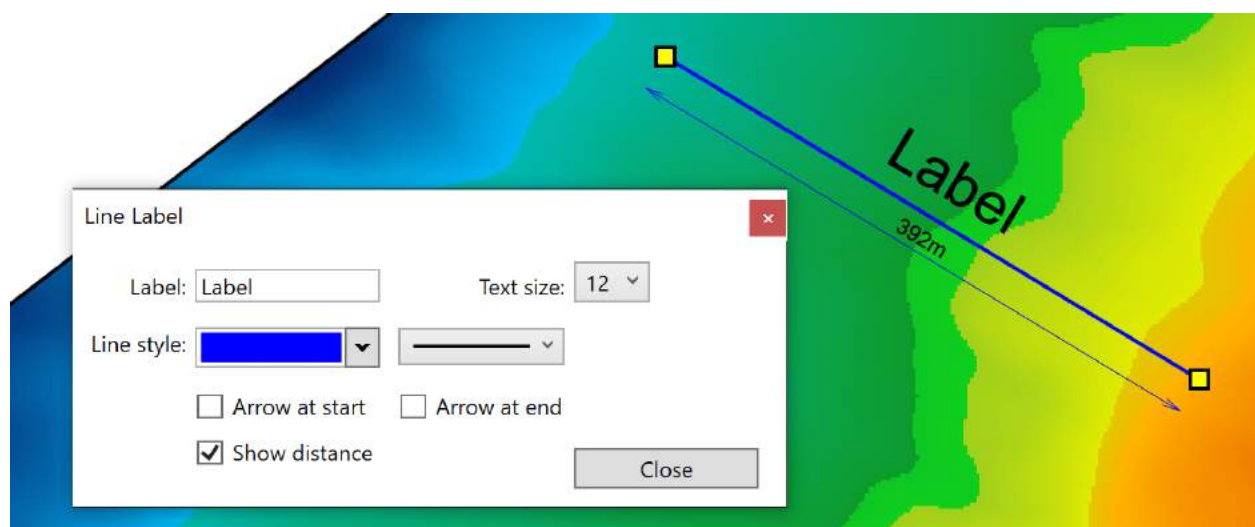
- 'Label' This is the title of the line that has just been created. The label's text size can be changed using the 'Text size' option to its right. This text size option will only affect the title on the guide, it will not increase the size of the text in the measurement.
- 'Line style'. The left drop down menu allows you to change the color of the line, the right drop down menu allows you to select the thickness of the line.
- 'Arrow at start' and 'Arrow at end' allow you to add arrows to the start and end of the line.
- 'Show distance' adds a secondary, thinner, line below the original line that displays the distance covered by the line. This option is turned on by default.

## Circle guide

The 'Circle guide' tool will display the radius and total area covered by the set circle. To use the tool, left click where you want the center of the circle to be and drag the mouse until the circle is at the desired size.
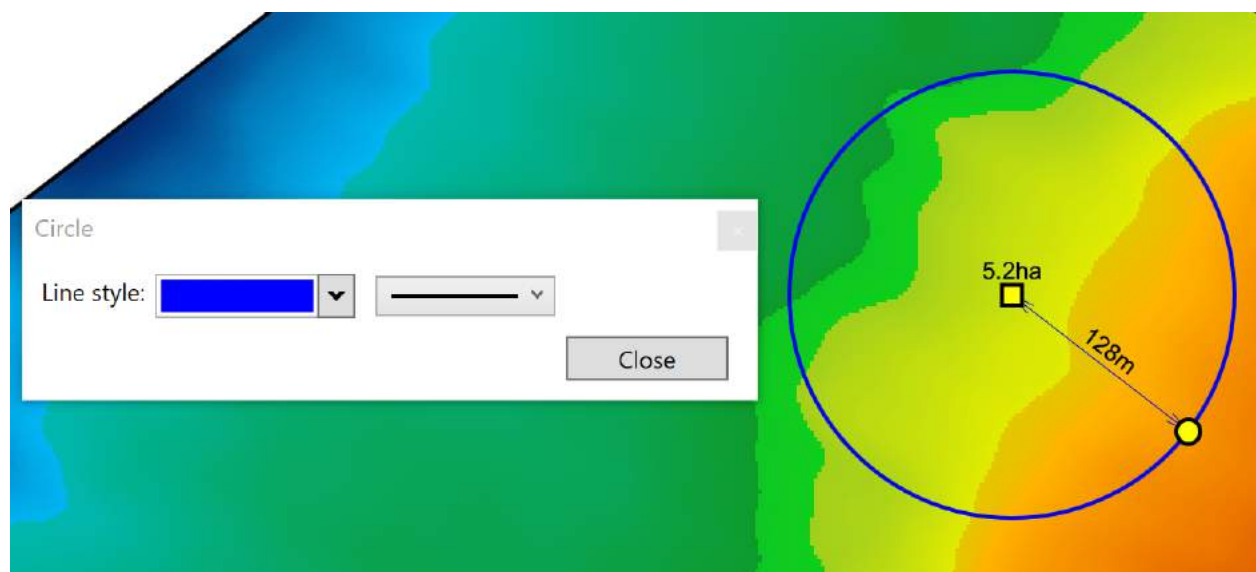


The option on the left in the window allows you to select the color of the circle. The option on the right allows you to select the thickness of the line.

At the center point of the circle, the total surface area of the circle is displayed. Starting from the same central point, a radius line will be placed showing the distance of the center to the edge of the circle.

## ⇄ Strip/Corridor guide

The 'Strip/Corridor guide' tool creates 2 parallel lines. When selecting this tool, click on the field where you would like the center point of 1 line to be, then drag away from this point to create a set of parallel lines.
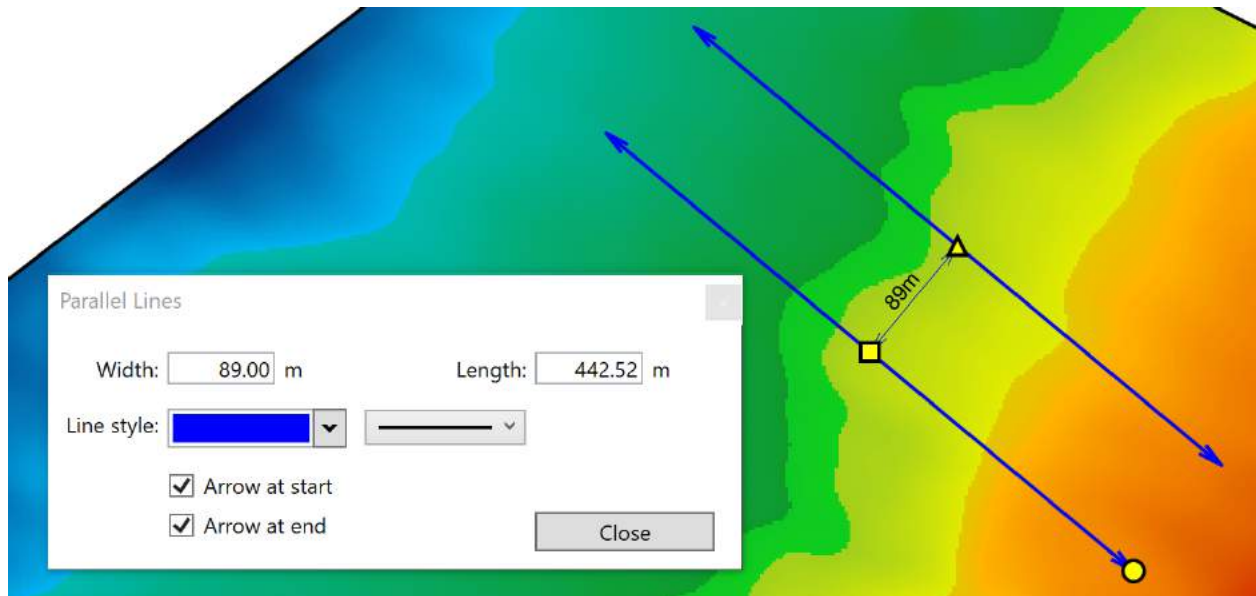


- 'Width' displays the current width set between the lines. The distance between the lines can be adjusted by typing a new value here or by moving the yellow triangle on the surface.
- 'Length'. Changing the length value adjusts the size of both lines. The length may also be adjusted by dragging the yellow circle point that is at the end of one of the lines.
- 'Line style'. The left menu allows you to select the color of the lines, while the right menu lets you select line thickness.
- 'Arrow at start' and 'Arrow at end'. Selecting either of these checkboxes will create arrows at their respective location on the lines.

## ⌐ Polyline measurement

The 'Polyline measurement' tool is used to create a guide line with multiple segments. The length of individual segments and the angles between them may also be displayed. When the tool has been selected, the cursor will change into a cross. Left clicking anywhere in the working area will place the first point, and clicking again will place segments. To finish adding segments, double click on the final point. Double clicking will open a window where settings for the polyline can be changed. The points of the polyline can be adjusted by dragging the yellow squares.
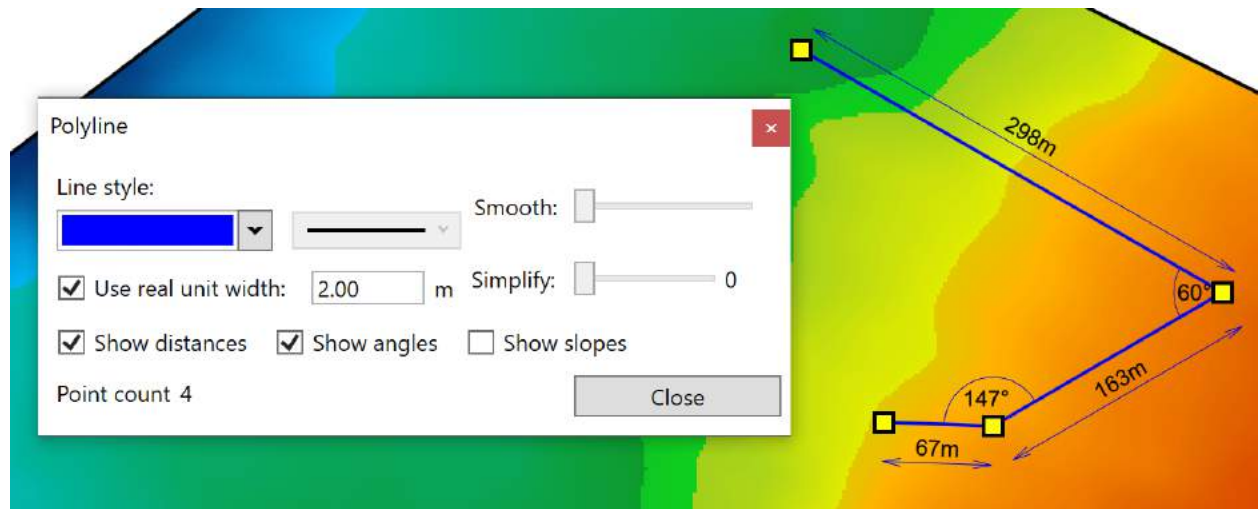
- 'Line style'. The left drop down menu lets you set the line color, while the right drop down menu lets you set line thickness.
- 'Smooth' will take the points that are available and adjust them to a more direct path with fewer corners. When the slider is all the way to the right, the points of the measurement guide will be lined up in a straight line.
- 'Simplify' will remove points along the polyline while attempting to follow the original path as closely as possible. This is most visible when the slider is used on polylines that make small direction adjustments.
- 'Use real unit width' when selected will disable the right drop down menu of 'Line style' and set the width to the value on the right of the checkbox. When using this option, the line thickness is no longer linked to pixels and will increase in size as the zoom level increases.
- 'Show distances' will display the length of each segment of the polyline.
- 'Show angles' will display the inside angles of each joint between segments.
- 'Show slopes' will display the overall grade of each segment as a percentage.

## Polygon measurement

The 'Polygon measurement' tool measures the length of the sides as well as total space covered inside a chosen shape. When selecting the tool, the cursor will change into a cross. Clicking on the working area will place a point – continue clicking where you would like points to be placed, and double click on the final point to finish placement. The yellow squares can then be dragged around to adjust the shape.

- 'Line style'. The left drop down menu lets you select the color of the guidelines. The right drop down menu allows you to change the thickness of the guidelines.
- 'Fill style'. The left drop down menu allows you to set the color of the shape's fill. The right drop down menu provides 3 options as to how the closed shape will be filled: a solid color, a hatched pattern, or a dotted pattern.
- 'Show distances'. Sets whether the distance of each segment is displayed. There are two options to the right to control where they are displayed.
- 'Show angles' will toggle on and off the display of angles between each segment of the polygon guide.
- 'Show area'. This option toggles on and off the value shown at the center of the polygon.
- 'Text size' controls the text size of the total area covered – it does not affect the text size of the distances and angles.

## AB lines

The 'AB lines' tool creates a pattern of guides along the working area. When using the tool, the cursor will change into a cross. Click on two points in the working area to create an AB line.
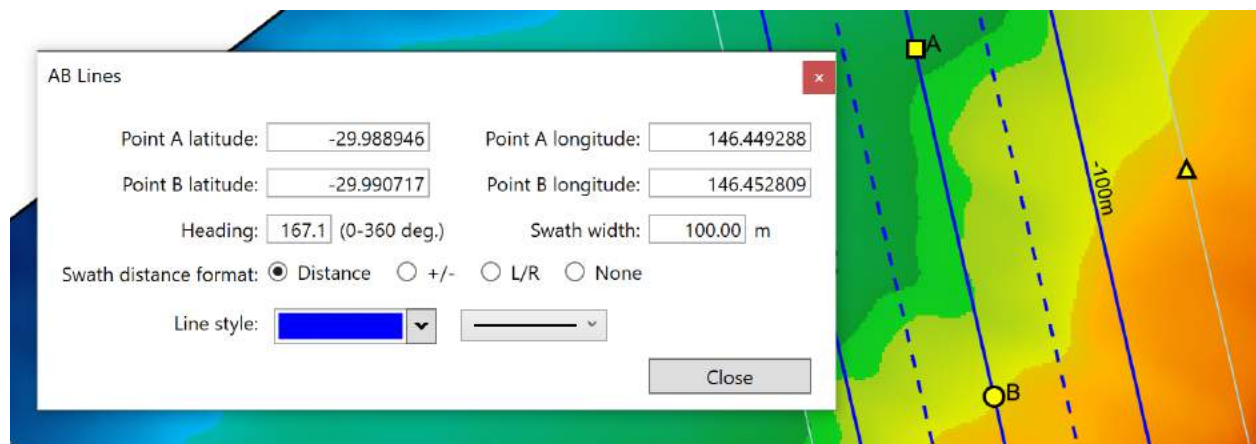
- 'Point A latitude', 'Point A longitude', 'Point B latitude', and 'Point B longitude' are used to precisely control the position of Point A and Point B.
- 'Heading'. The value in the heading setting controls the direction of the guidelines. The value displayed is the heading in degrees of Point B from Point A.
- 'Swath width' controls how far apart the lines are. The two dotted lines (on either side of the central line) show the reach of the implement (its swath width) as it travels down the first/central AB line. Thes can be used to position the first line relative to a boundary, or other feature.
- 'Swath distance format'. This setting changes how the line labels are displayed.
  - 'Distance'- will label each line as how many meters it is from the center line.
  - '+/-' - will label each line as a number and whether it is positive or negative.
  - 'L/R' - will label each line a number and either L or R depending on which side of the center line it is.
  - 'None' will remove all labels from the AB lines.
- 'Line style'. The left drop down menu will let you set the color of the guidelines, while the right drop down menu will let you set the thickness of the guidelines.

## Elevations Guide

The 'Elevations guide' imposes a grid design on a field in the working area and displays the elevation of points at each junction on the grid. When using this tool the cursor will become a crossClicking on the working area in the desired center point will create a grid. The grid size and position can be manipulated by using the yellow anchors.
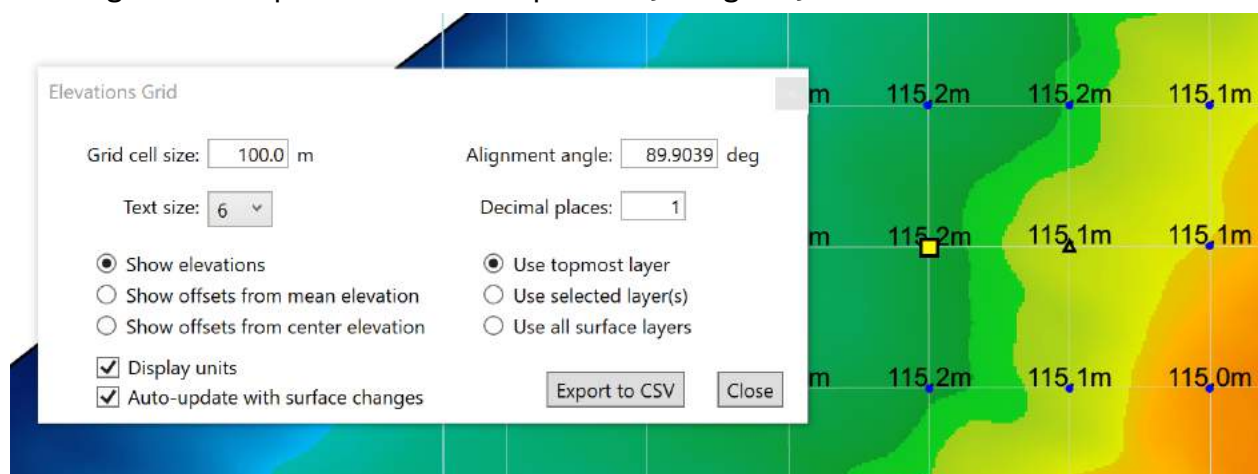


- 'Grid cell size'. This option controls the size of the grid. Setting the size to 100m will result in each junction being 100 meters away from its neighbors.
- 'Alignment angle' is a method of rotating the grid.

- 'Text size'. This option is a drop down menu that allows you to change the text size of the values on the grid.
- 'Decimal places'. Sets how many decimal places will be visible on the grid values.
- 'Show elevation', 'Show offsets from mean elevation', and 'Show offsets from center elevation'. These options will adjust what data is present on the grid.
- 'Use topmost layer', 'Use selected layer(s)', and 'Use all surface layers' control which surface layer is used to calculate the elevation points on the grid.
- 'Display units'. By selecting this checkbox, the measurement units (meters, feet) will be shown on each value on the grid.
- 'Auto-update surface changes'. By selecting this checkbox the grid will automatically update the displayed values when surface layers are changed.
- The grid is able to be exported into a CSV format by pressing the 'Export to CSV' button in the bottom right of the pop-up window.
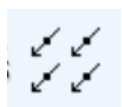
## Flow direction guide

The 'Flow direction' guides creates a grid on the field with arrows at each junction that point in the direction that water is expected to flow. When the tool is selected the cursor will change into a cross, and left-clicking in the working area will create a grid centered where you clicked.
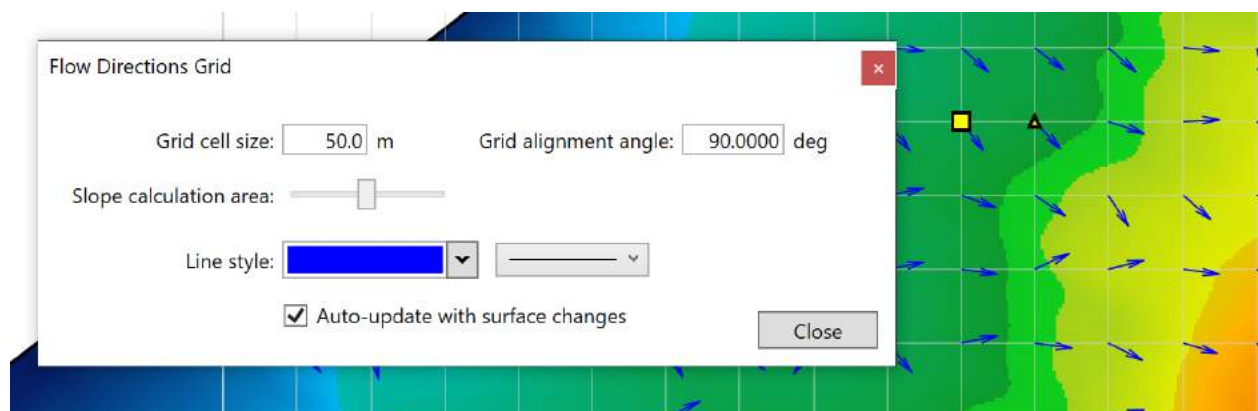


- 'Grid cell size'. Adjusting this value will make the individual squares of the grid larger or smaller.
- 'Grid alignment angle'. This option allows you to change the direction of the grid.The direction is set as the position of the yellow circle in relation to the yellow square.
- 'Slope calculation area'. The further to the right that the slider is, the larger the area that T3RRA Design takes as a sample to find the water flow direction.

- 'Line style'. The left drop down allows you to change the color of the arrows on the field. The drop down menu on the right allows you to adjust the thickness of the arrows.
- 'Auto-update with surface changes'. When this option is selected, the grid will automatically update when the surface layer changes.

# Contour lines

The 'Contour lines' tool allows for the automatic creation of contour lines on the selected field. When the tool is selected, the cursor will change into a cross. Left-clicking on the desired field will generate contour lines and open a pop-up window that allows you to make changes to the contour lines.
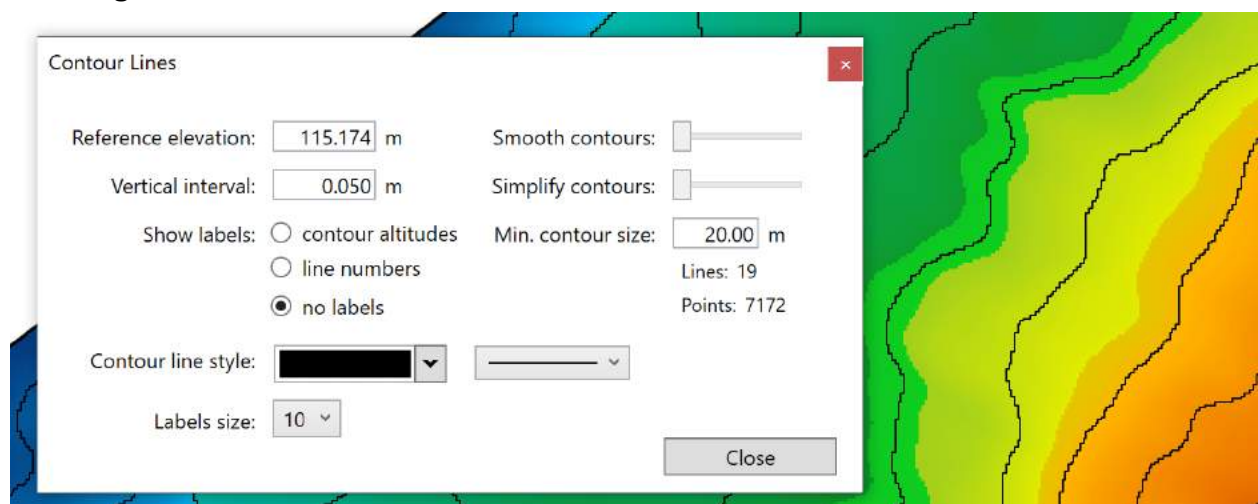


- 'Reference elevation' allows you to change the starting elevation that contours fan out from.
- 'Vertical interval' is used to change the elevation change between contour lines.
- 'Smooth contours'. This slider will smooth out sharp turns in the lines. The further to the right the slider is, the more smoothed the contour lines will be.
- 'Simplify contours'. This slider adjusts how complex the lines are. The further to the right the slider is, the straighter the lines will become.
- 'Show labels'. On the left is a set of 3 choices: 'contour altitudes', 'line numbers', and 'no labels'. These options control the display of information on each contour line. 'Contour altitudes' will display the elevation of each contour line. The second choice, 'line numbers', will display the number of each line, starting from the reference line. The final choice is 'no labels', this choice will leave the lines unlabeled.
- 'Min. contour size' is the minimum length contour lines placed on the field.
- The 'Contour line size' options are a set of drop down menus. The left menu lets you select the colour of the contour line, and the right menu lets you choose line thickness.
- 'Label size' will adjust the size of text along the contour lines.
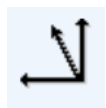
# Slope Indicator

The 'Slope Indicator' tool is used to measure the slope of a particular area. When the tool is selected the cursor will change into a cross. Once a point has been selected, slope indicators will appear on the field and a pop-up window will be opened. The slope indicators can be manipulated on the field by using the yellow anchor points.
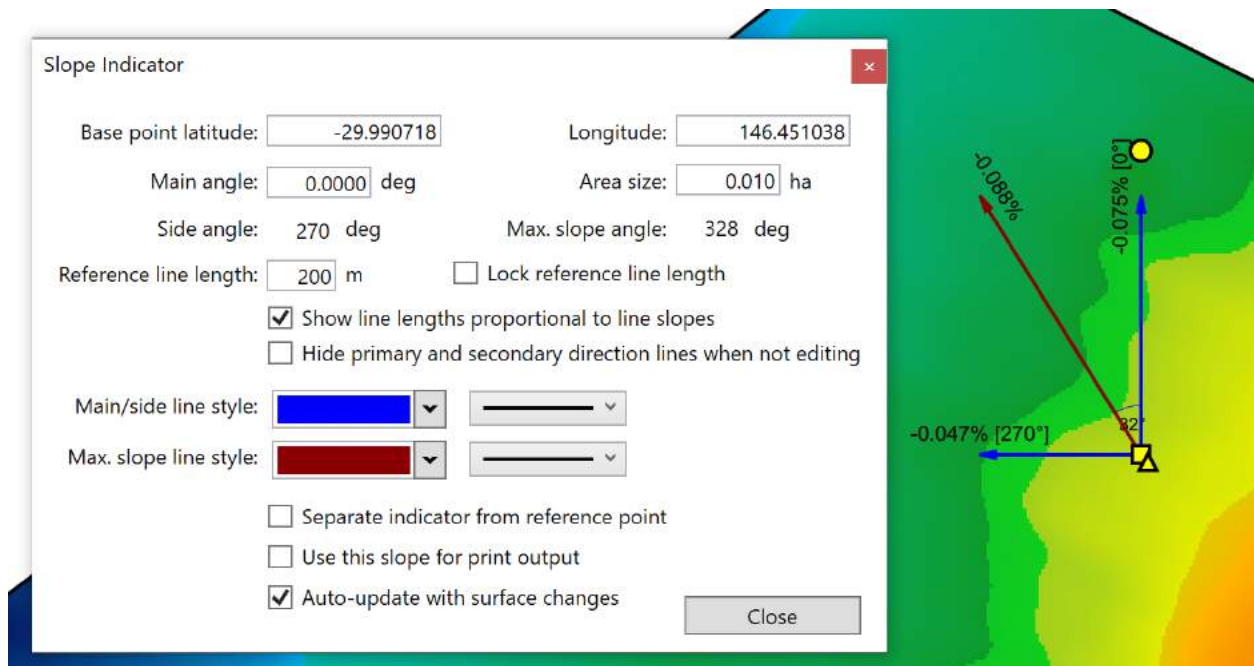


- 'Base point latitude' and 'Longitude'. These options control the position of the indicator on the field. They can be manually changed by typing a new values in the boxes. These changes take immediate effect.
- 'Main angle' This option controls the direction of the main direction line. The line changes size proportionally to the slope of the area. Until the settings have been finalized, the direction of the main line can be modified with the yellow circle anchor.
- 'Area size'. This option controls the sample area of the slope indicator. The elevations within the sample area are read to determine the displayed slope. Increasing the value displayed in the box reads more elevations and provides a more averaged slope measurement. Decreasing the area size gives a more specific and local slope measurement.
- 'Side angle' and 'Max. slope angle' cannot be changed within the window and only display the directions of the lines based on the position and orientation of the guide.
- 'Reference line length' allows you to change the maximum length of the slope indicators.
- 'Lock reference line length'. When selected, this locks the reference line to its current length while dragging the yellow circle.
- 'Show line lengths proportional to line slopes'. When selected, the lines will adjust in length to match the slope of the selected area. They will not exceed the reference line length.

- 'Hide primary and secondary direction lines when not editing', selecting this option will hide the main direction line and the secondary direction line once all settings have been finalized and the window has been closed.
- 'Main/side line style' the left drop down menu lets you select the color of the two slope lines at 90° to each other. The right drop down menu lets you select their thickness.
- 'Max. slope line style' the left drop down menu allows you to change the color of the maximum slope line. The right drop down menu allows you to change the thickness of the slope line.
- 'Separate indicator from reference point'. This option allows you to move the indicator to another location while still using the same reference point. Once settings have been finalized the reference point and area will be invisible.
- 'Use this slope for print output'. This option selects this slope for printing output.
- 'Auto-update with the surface changes'. This check box will cause the slope indicator to adjust the displayed values depending on the top most layer in the surface selection.

# Create flow paths

The 'Create flow paths' tool is used to create a display of the likely water paths present in a field. When the tool is selected, the cursor will change into a cross. Left click on a field to display the flow paths. Once a field has been selected, it will be populated with flow lines and a pop-up window will be opened.
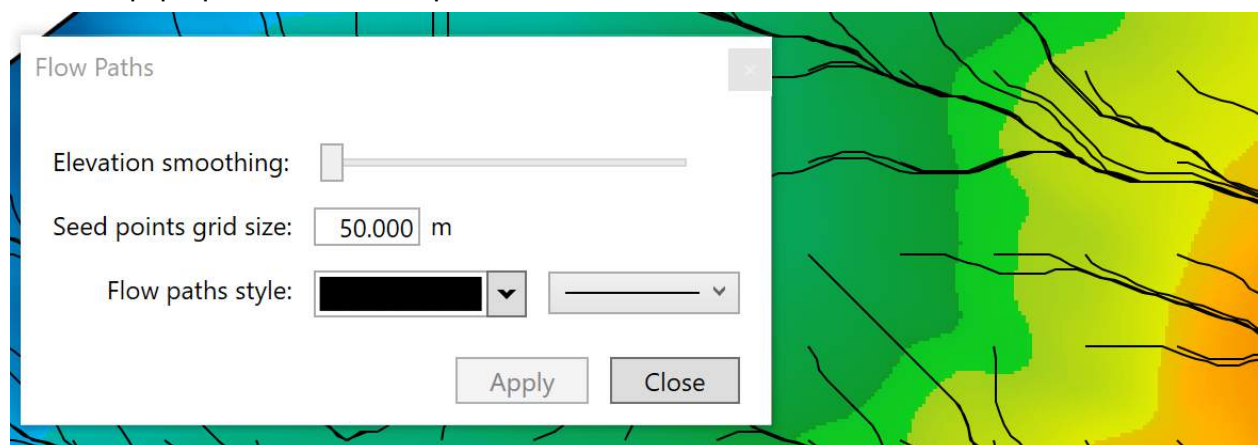


- 'Elevation smoothing'. This option is a slider that controls the smoothing of the elevation before creating the flow lines. The further to the right that the slider is, the more imperfections are taken out of the flow paths, creating straighter paths.

- 'Seed points grid size' controls the size of the grid that is used to take samples for flow paths. Setting a higher value here makes a larger grid and hence takes fewer samples.

- 'Flow path style' is a set of 2 drop down menus. The left drop down menu sets the color of the flow paths, by default this is set to black. The right drop down menu sets the thickness of the flow paths, by default this is set to the thinnest option.

In order for any changes made in the window to be reflected in the field you need to press the 'Apply' button at the bottom of the window. Once all desired changes have been made press the 'Close' button on the window to save all changes.
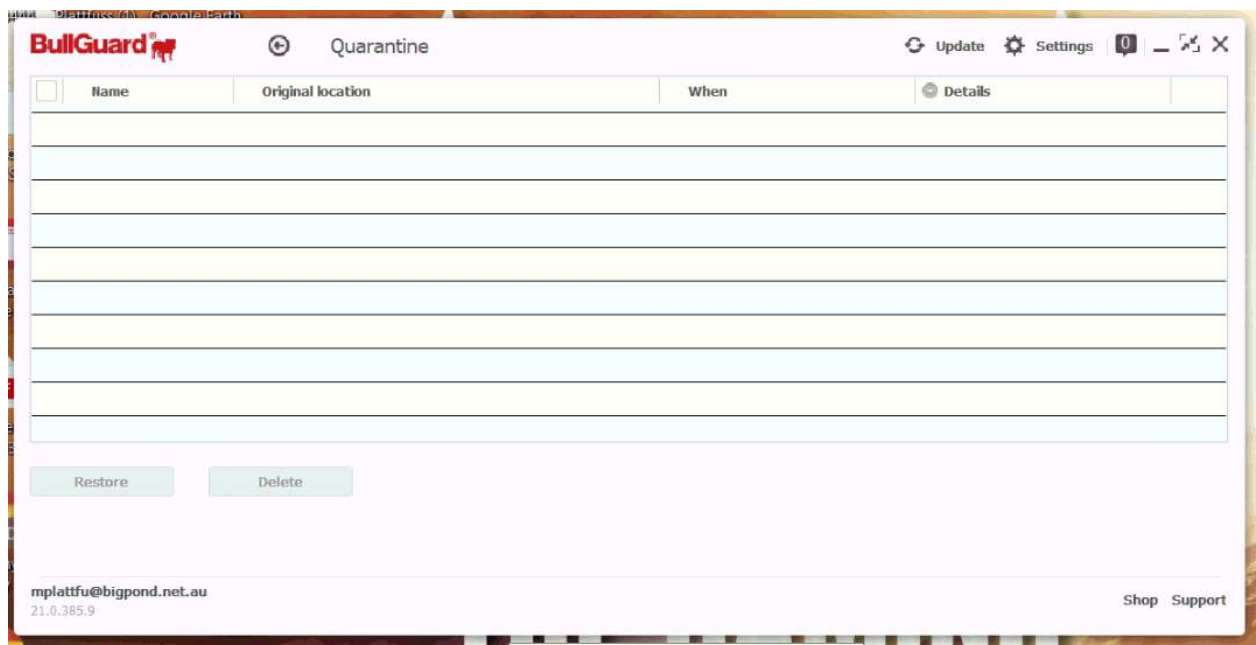
# Troubleshooting Guide

## Antivirus Software

### Software fails to start

Symptoms:
T3RRA Design will not start, or the T3RRA Design update does not work after downloading a
new version.

Cause:



Solutions:
It may be necessary to switch to another version of antivirus software, or to add an exclusion
for the T3RRA Design folder. Most reputable antivirus software providers provide
instructions on how to add an exclusion.

Follow the below links if you use one of these antivirus software:
- [Bullguard](#)
- [AVG AntiVirus](#)
- [Malwarebytes](#)

When adding an exclusion, the path to exclude is:

`C:\Users\`**`YourUserName`**`\AppData\Local\T3RRADesign2`

NOTE: Be sure to replace "**`YourUserName`**" with your actual user name.
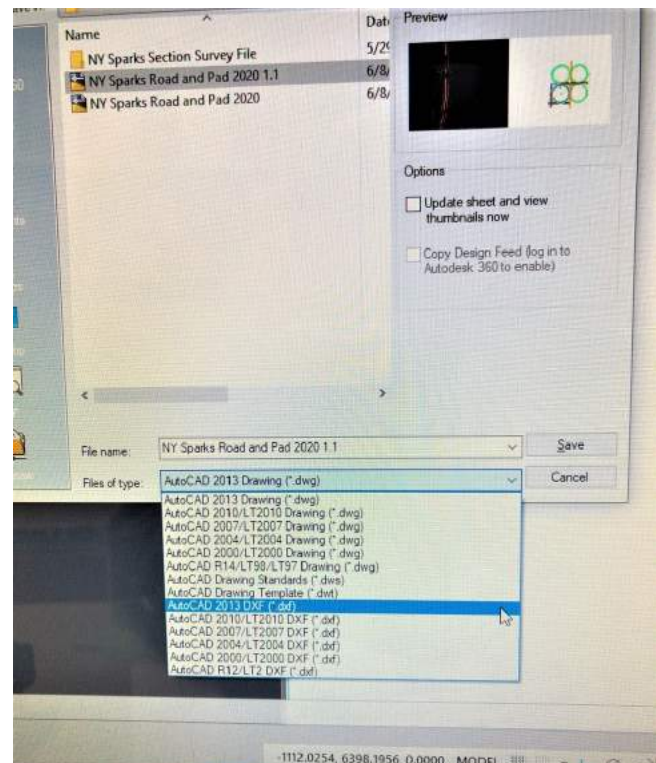
# Importing

## DXF import failure

Symptoms:
DXF file import is unsuccessful. Error message "DXF linework import has failed: Object reference not set to an instance of an object" when importing DXF into T3D.

Cause:
DWG saved as R12/LT2 DXF.

Solutions:
DWG saved as 2013 DXF.

# DXF import into T3RRA Design

### Symptoms

Importing a DXF data into T3RRA Design and when you use the Google earth tool to view the surface it's not in the correct location.

### Cause

There could be many factors that impact importing third party data into T3RRA Design, the most common is the data not being in the correct coordinates format or datum. This data can also be in a localized local format. Always ask for data in latitude and longitude or UTM.

### Solution

Below is a template that can be used for customers wanting to import DXF or third party data into T3RRA Design.

- Original surface survey in DXF 3D Faces,
- Design surface in DXF 3D Faces,
- Any earthworks control points, markers and feature points in DXF (these require lat long and elevations)
- Any design linework you would like displayed over the map, in DXF also, (things like the top of batters bottom of batters, change of grade and roads etc,)
- Any lines you would like made into guidance lines for steering also in DXF,
    - With all of these, we need to know the alignment or any "localised" information please.

NOTE: It is preferential that anyone using JD iGrade have a surveyor provide them with a pegged location to place their base over. Enter the lat and long of the peg manually as an absolute base.

# Removing Bad Data Points

### Symptoms:

- Imported field elevation data is all one colour.
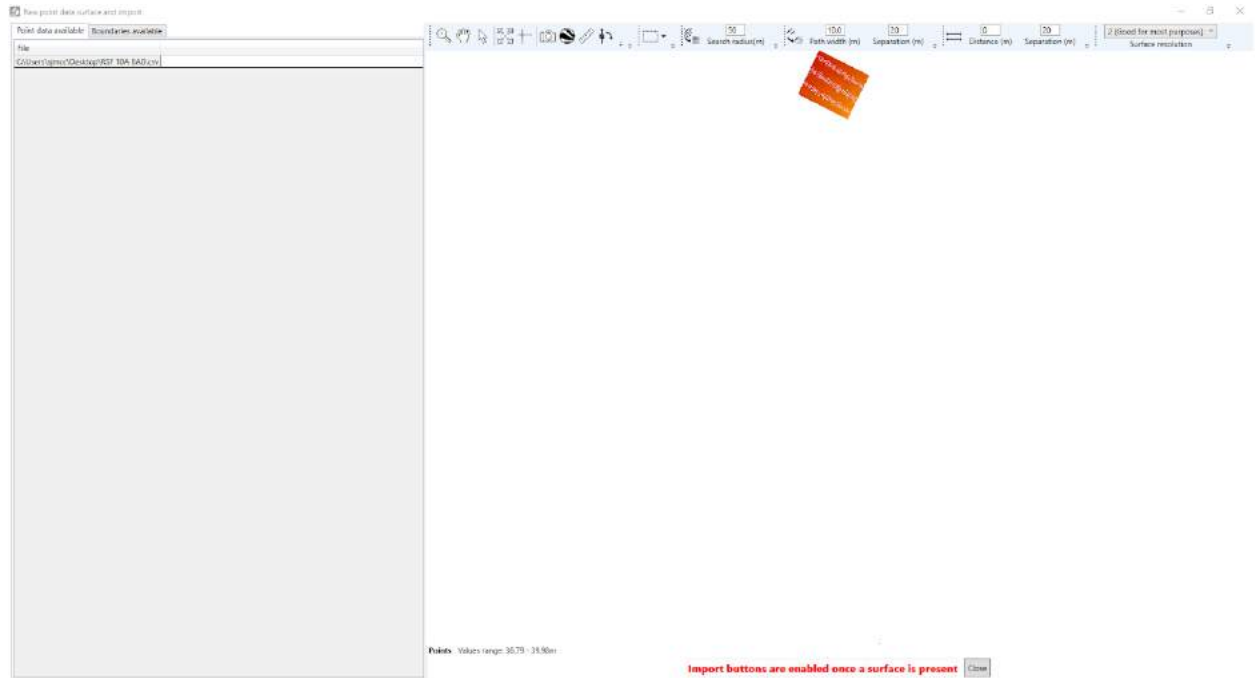- Field is also not centre on the import screen.
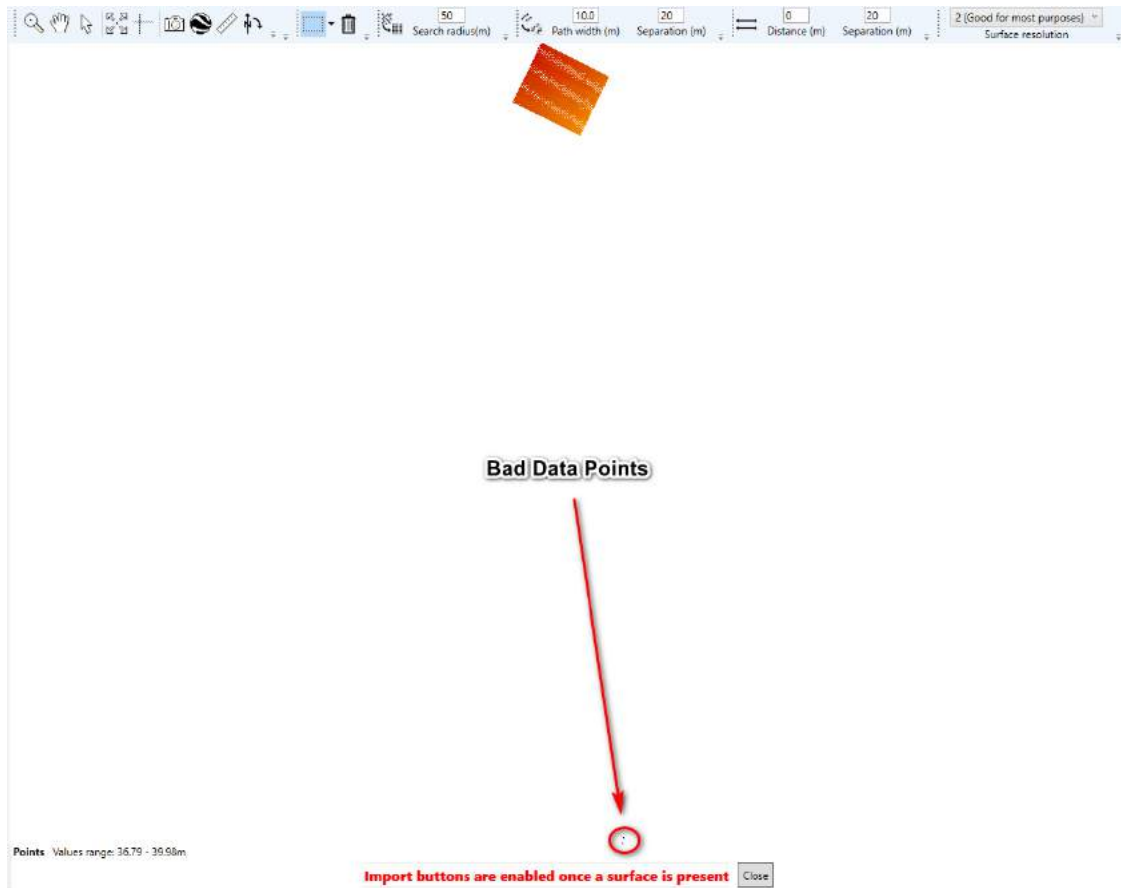
## Cause:

There are many ways in which a system can collect bad data points. This could be due to the tractor being parked at the shed with the linkage down. When the tractor is started and the recording source is set to the linkage. The system will record a couple of points at the location. You will not know that at the time but when you bring that data into T3RRA Design you will see the field to be all one colour.
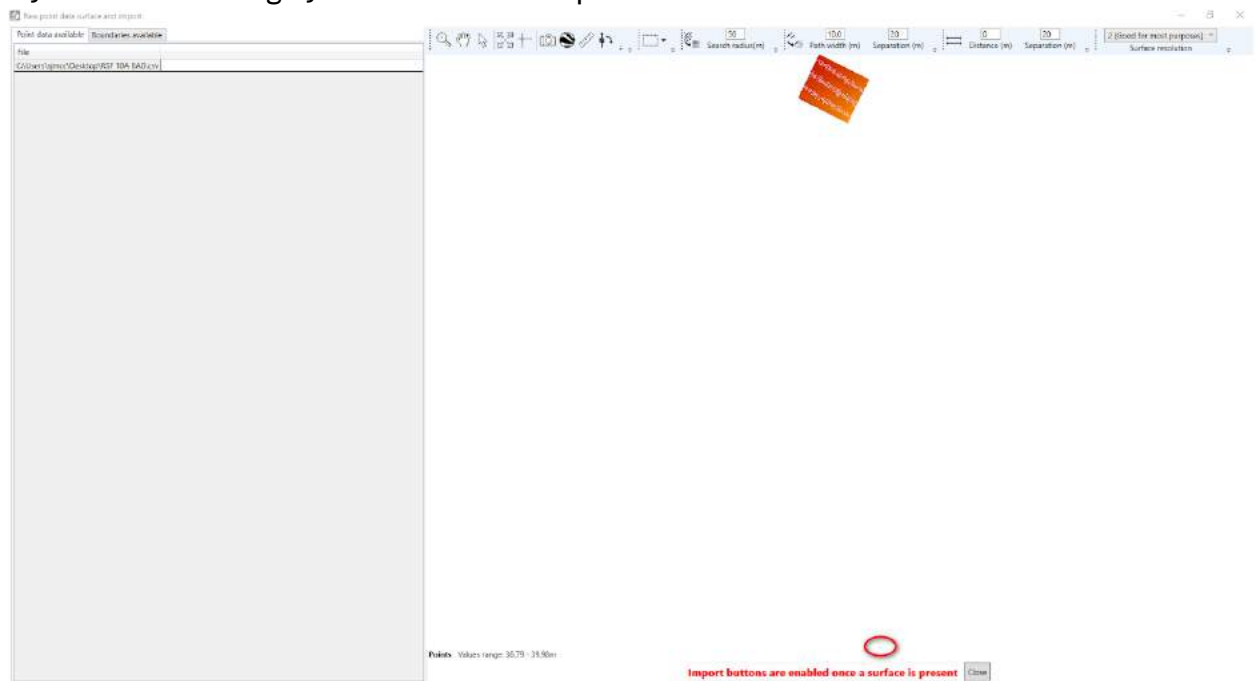
## Solution:

1) Import elevation data for the John Deere display into T3RRA Design and edit the bad points.
2) If you are using the John Deere Operation Center and have documented a task you could also use our on-line tool T3RRA 3D.
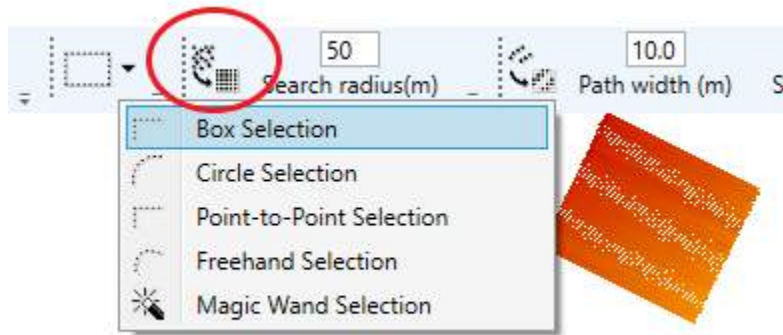
Import your data from your display into T3RRA Design, select OK.



Raw point data surface and import window will open.

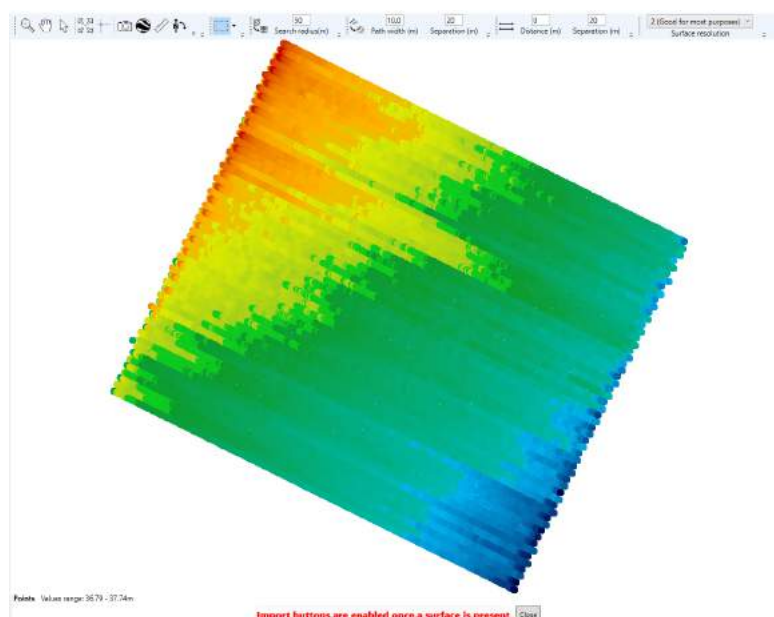If you look hard enough you will see bad data points.

You can use the "Points selection Tools" to select the unwanted points.



Once you have, select the bad points, use the "Trash" icon to remove the points.



Once the bad points have been removed your map should look like the screenshot below.

# Exporting

## Printing to PDF - Logo is upside down

Symptoms:

The logo is upside down when a design is printed to PDF.



Cause:

Using a custom Print to PDF tool. For example, Foxit PDF Printer.

Solutions:

Use the built in "Microsoft Print to PDF" printer. This one is free and provided with Windows.

# Viewing in Google Earth - Google Earth does not open

**Symptoms:**

Clicking the Show in Google Earth button doesn't work.
Opening Google Earth doesn't work either.

**Cause:**

Google Earth has stalled and is not responding.

**Solutions:**

Restart your computer.

To avoid having to restart your computer, open Task Manager by right-clicking a blank part of the taskbar (usually at the bottom of the screen) and selecting Task Manager.

Then, under the Processes tab, right-click on Google Earth and choose End task. Then Google Earth should start up successfully.
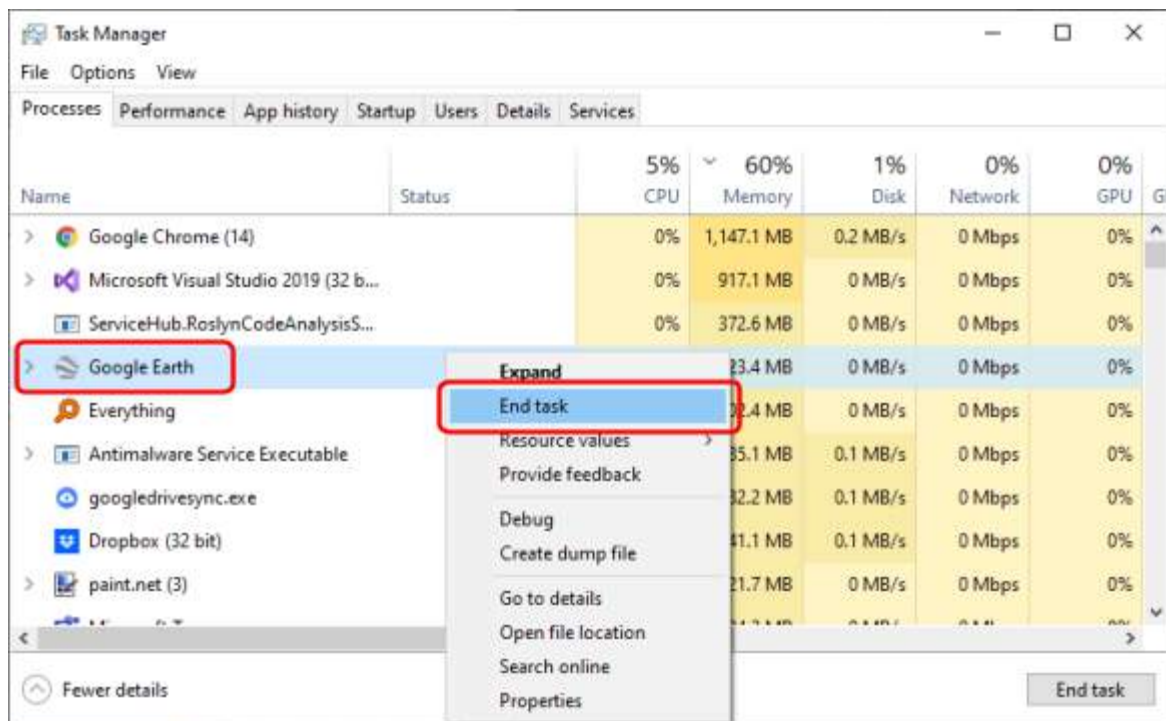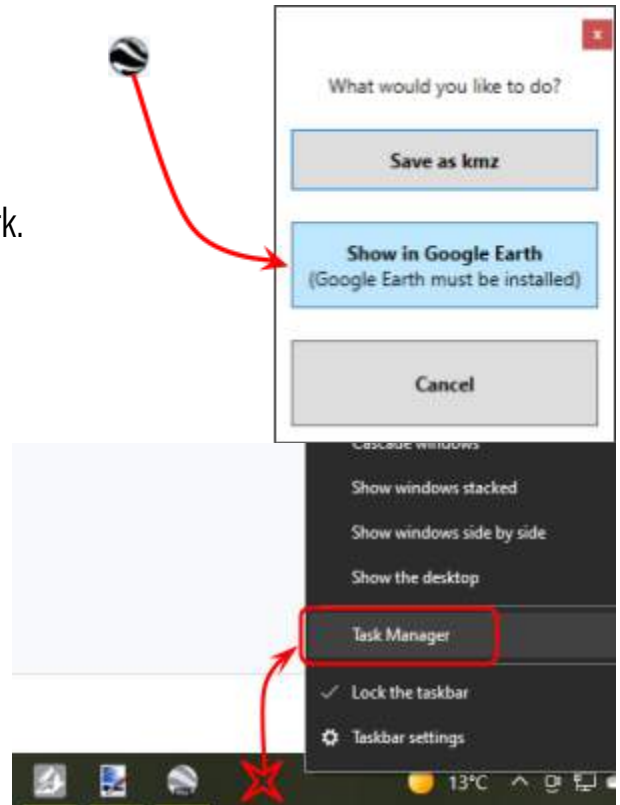
# Updating Software

## Downloading updates seems to have no effect

Symptoms:
T3RRA Design indicates that a new version is available. You successfully download the new version using the normal "File\Check for updates" method. However, upon restarting software T3RRA Design has the same version number as before and is indicating that a new version is available.

Cause:
T3RRA Design is not started directly. To start it you normally must execute a bootstrapping program which in turns selects the version of T3RRA Design to run. If your shortcut is linked to a specific version of the software, this version will always run, even where there are newer versions installed on your machine.
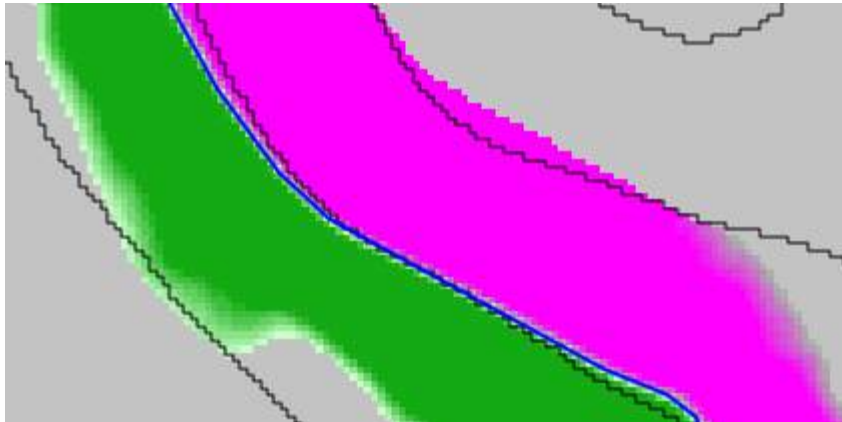
Solution:
Browse to 'C:\Users\<your user>\AppData\Local\T3RRA\T3RRA Design'. There you should find a file named 'T3D Bootstrap.exe'. Depending on your settings, the file extension may or may not show. Note that "C:\Users\<your user>\AppData' is normally a hidden folder so you may have to reveal it using "Show hidden file and folders" on your system. Alternatively, simply type in the path in the Windows Explorer location bar. 'T3D Bootstrap.exe' is the file you want to execute whenever you run T3RRA Design (v0.1). Create a shortcut on your desktop pointing to this file.

# Contour Designer

## Contour has no batter

Symptoms:

A contour is designed, but the cut/fill stops without a batter. In a cut/fill overlay, it will go from (e.g.) bright pink to gray without a transition.



Cause:

The batter is not steep enough. In the case shown above, the hill and the batter both had ~5% slope. That's why it tried to cut forever.

Solution:

Add a section or two around the problem location to avoid changing the whole contour. Then for the affected section, increase the batter a bit above the prevailing slope. Preview cut/fill to verify.