

Discussion of Topo

Topo is software created to assist “terraformers” in the exploration of field topography and the design of land leveling or other topographic adjustments to farm fields. Topo is directly integrated with AGIS and Pocket DLog.

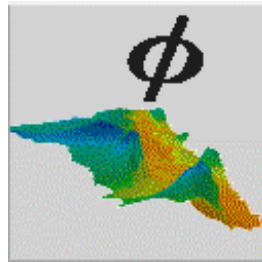
You need to start with an understanding of the system inputs and outputs.

Primary Inputs

X,Y,Z data collected by any survey method (RTK GPS, Laser, Total Station) in any of the following formats: Pocket DLog, .xls, .mdb, .txt/.csv, .dbf.

Secondary Inputs

“GIS Data” as ancillary information in any of the following formats: (raster) GeoTif, AGIS, Geojpeg, DEM, (vector) AGIS, DXF, .shp, .mif, .xls, .dbf, .mdb, .txt/.csv.



Primary Outputs

Elevation surfaces, “Planes of Fit”, Cut/Fill maps and Cut/Fill reports.

Secondary Outputs

Slope and Aspect images, vector extractions of surfaces, grade break points, slope and side slope values.

Create New Job

Job :

Client :

Farm :

Field :

1

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Create New Job

Units System : Metric English

Horizontal Units : Slope Units :

Vertical Units : Area Units :

Vertical Precision : Direction Units :

Volume Units :

Map Coordinates:

Degrees, Minutes, Seconds

Decimal Degrees

Easting/Northing (m.)

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Create New Job

Job location information :

County :

State :

Range :

Township :

Section :

2

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Create New Job

Job contractor information :

Contractor Name :

Contractor Address :

Contractor Phone :

Contractor EMail :

Designer :

Water Mgt Permit :

5

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Create New Job

Billing Information :

Name :

Address 1 :

Address 2 :

Town/City :

State : Zip Code :

3

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Create New Job

Cut / Fill Ratio :

X Resolution (meters) :

Y Resolution (meters) :

6

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You have to create a Job in order to work in Topo. Job creation is simply establishment of Job description and job parameters.

Setup is performed once with most entries at user's option. Required are Job Name and Projection. Options for English or Metric units, output resolution and Cut/Fill ratio.

Once Job is created, all parameters are fixed until and unless Modified or until and unless Job is Deleted.

Create New Job

If you need a unique map projection for this job, you should choose it here.

Current Projection Parameters :

Projection :	Universal Transverse Mercator
Datum :	WGS Datum (1984)
Zone Number :	15
Hemisphere :	North

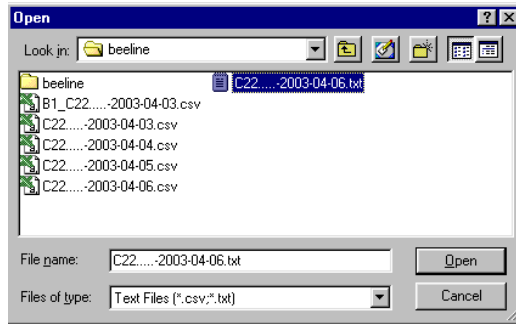
Change Projection...

7

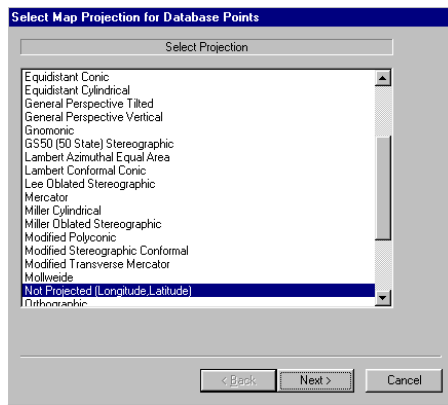
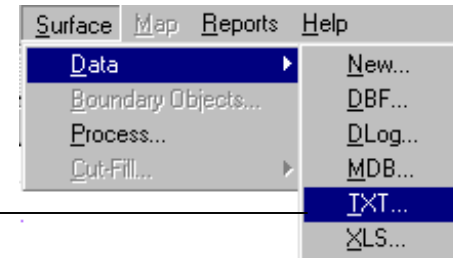
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Surface Construction: XYZ data import (.txt example)

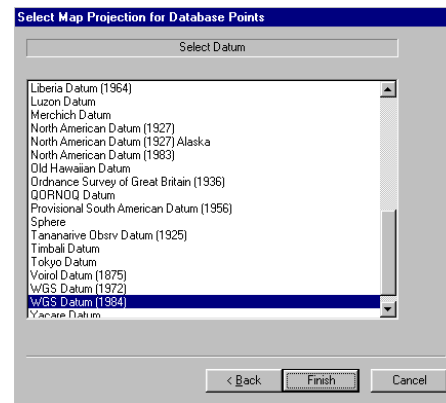
All Topo operations are based on a model of the physical surface of the field. Surface construction is an estimation of a physical surface from a population of survey points. First step is import and mapping of the points.



1. Open the XYZ input file. .txt in this case.



2. Define the projection of the XYZ data. Lat/Lon in this case.

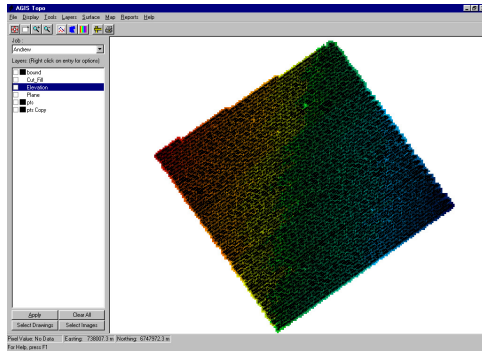


3. Define the horizontal datum of the XYZ data. WGS84 in this case.

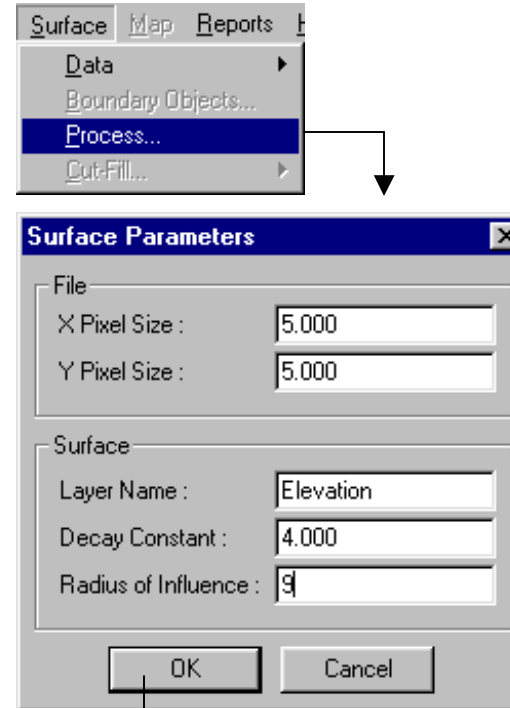
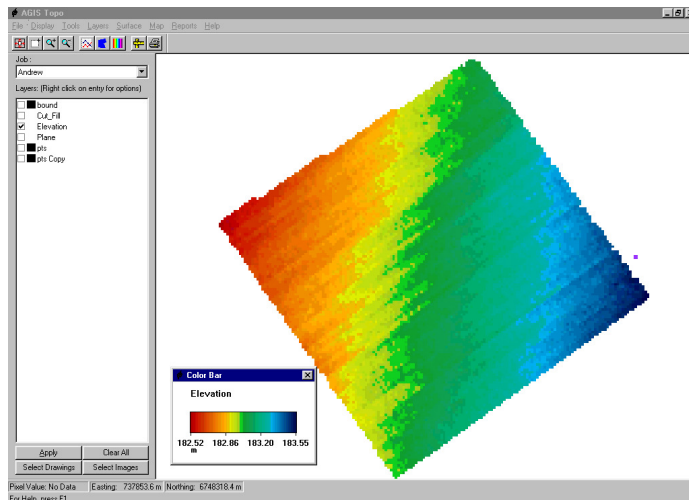


4. Define the file positions and vertical units of the XYZ data.

Surface Construction: Building the Surface



The XYZ data are read in and mapped as XYZ points to the display.



Surface estimation employs an inverse distance model.

User may define output grid resolution (here 5m), decay constant ($1/d^4$), and radius of influence (to limit extrapolation).

Optionally, field boundary(ies) may be used to limit the operation.

Process executes with OK.

Note that you can operate Surface | Process on any set, super-set or subset of survey points.

Result is a geo-referenced model of the physical surface as Layer | Elevation. All input data are projected to the system selected in Job Creation (In this case UTM 55 S on WGS84). The Elevation Layer is the base on which various 'terraforming' models are run.

Design Issues

What is a “Good Design”?

Generally, one that contributes to effective water management and does so requiring movement of the least amount of dirt with a balanced outcome. Problem is that an effective design may not be an economically viable design- one that moves the least amount of dirt in balance. The good news is that Topo lets you quickly explore a number of design options. The bad news is there is no magic. You may often have to explore a number of design options. You explore plan possibilities by operating one of several Cut Fill (terraforming) models on the physical surface model.

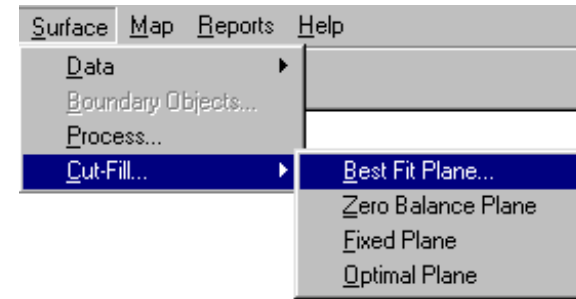
What do you know when you start?

1. Not much? Use **Best Fit Plane** to build a cut fill plan based on general surface trends of plane orientation and slope. The result may or may not yield balanced quantities of cut and fill.
2. That you have constraints of orientation and slope. Use **Zero Balance Plane** to build a balanced cut fill plan that is the only possible outcome under your constraints.
3. You have constraints of a fixed position, elevation and orientation through which your plane must pass. Use **Fixed Plane** to build a cut fill plan that is the only possible outcome under your constraints. The plan very well may deliver imbalances in cut or fill quantities.
4. You only know the desired slope. Use **Optimal Plane Orientation** to calculate a model plane orientation that will result in moving the least amount of dirt in balance.
5. You only know the desired plane orientation. Use **Optimal Slope** to calculate a model plane slope that will result in moving the least amount of dirt in balance.
6. You work in slope and side slope (decomposition of a single plane). You know the primary slope and orientation. Use **Optimal Side Slope** to calculate a model plane side slope that will result in moving the least amount of dirt in balance.

Terraforming Model Example: Best Fit Plane

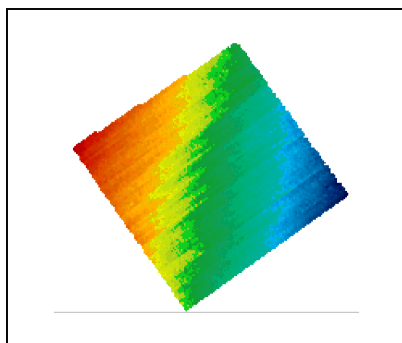
An understanding of field topography may begin with visualization of the general field trends of plane slope and plane orientation. **Best Fit Plane** builds a first order trend surface of the XYZ points and processes the trend and the physical surface to yield a Cut/Fill surface. The report of this operation (at right) tells us that the trend of the field is oriented 279.034 degrees with a slope of 0.114%.

Although the Best Fit Plane has provided information on general field trend, the information only serves to suggest that conforming to trend may or may not be a workable solution.



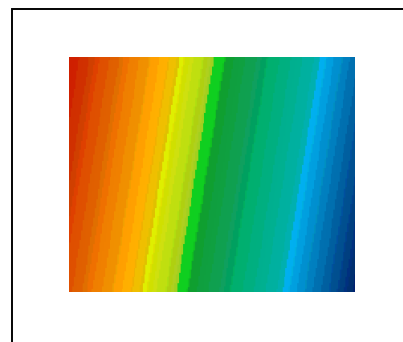
Cut-Fill Report

Layer : Cut_Fill
Direction = 279.034 deg
Slope = 0.114 %
Cut Volume = 3723.78 cu m
Fill Volume = 3397.93 cu m
Net Volume = 325.85 cu m



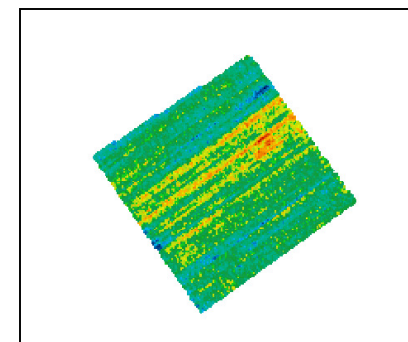
Elevation Surface

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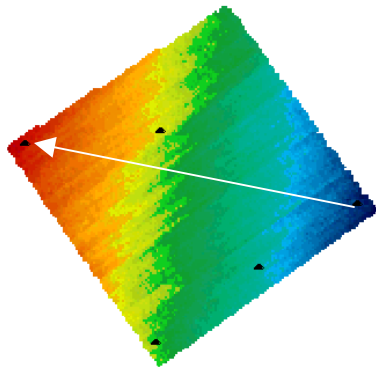
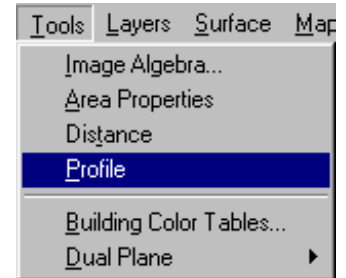
Trend Surface

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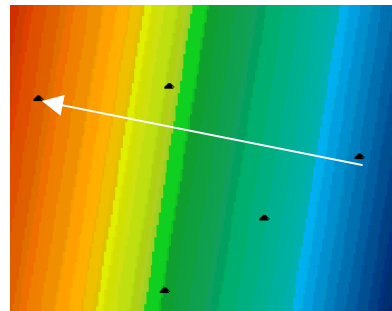


Cut Fill Surface

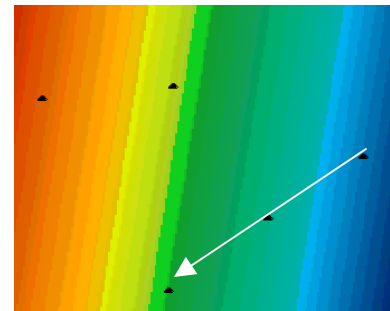
Looking at Profiles of the Elevation and Best Fit Plane



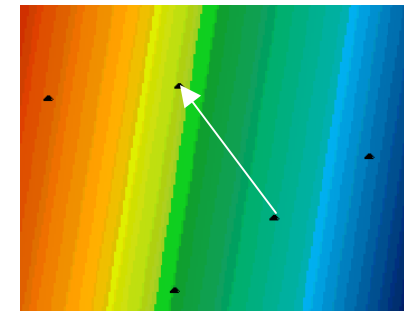
Elevation 279° .116%



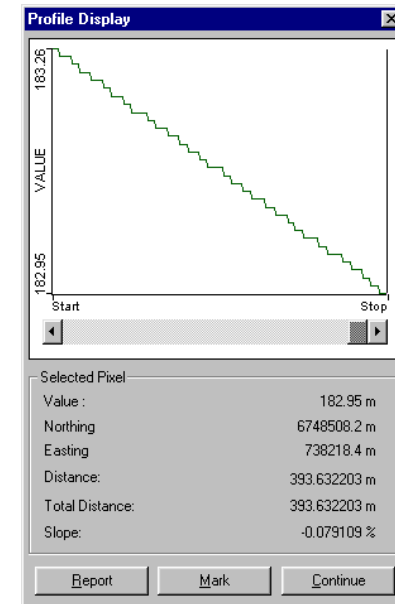
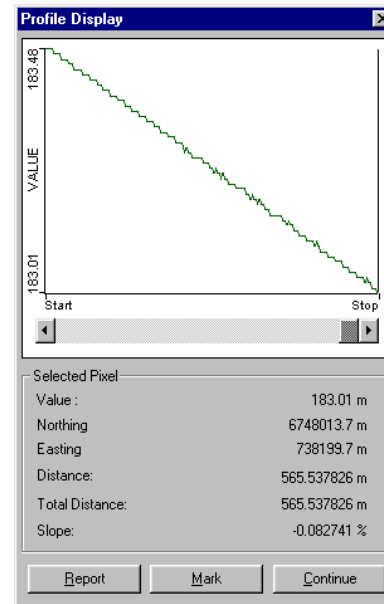
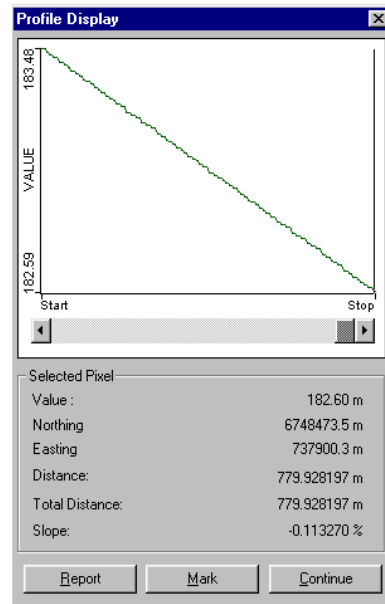
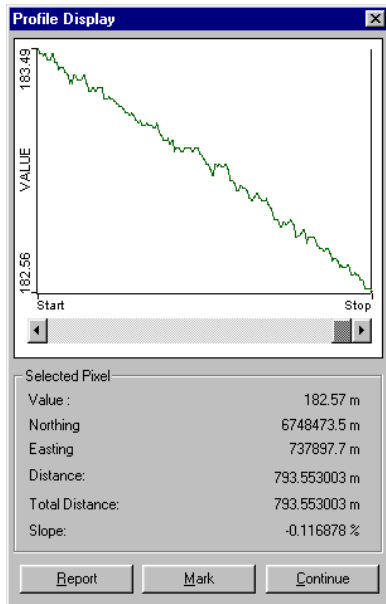
B.F.P. 279° .113%



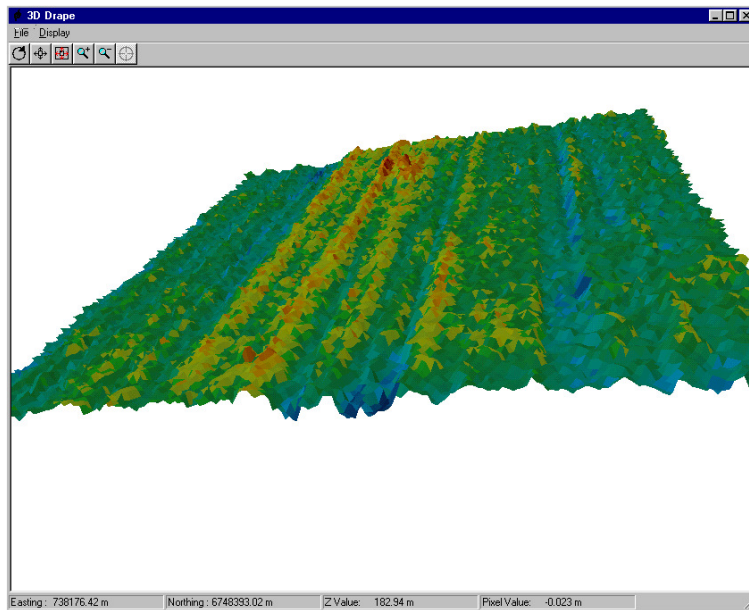
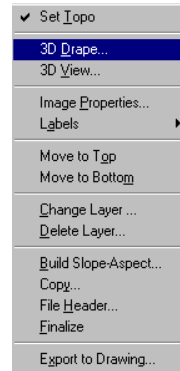
Row Direction 233° .082%



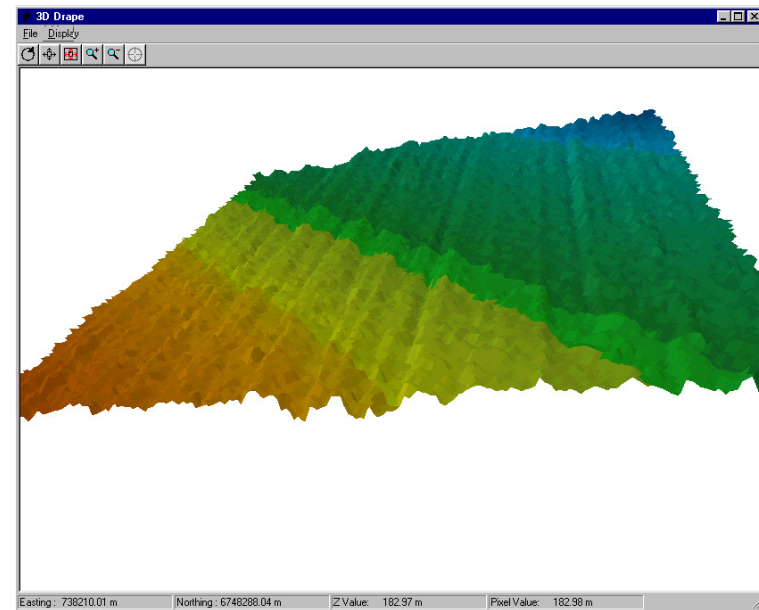
Row Side Fall 323° .079%



3D Visualization as an aid to understanding Field Topography



Cut Fill draped on physical surface. Cursor reports the amount of cut or fill at each xyz location on the surface.



Best Fit Plane draped on physical surface. Cursor reports the elevation differences- XYZ (surface) vs. XYZ (B.F.P.)

Terraforming Model Example: Zero Balance Plane

The issue is often developing a plan that balances cut vs. fill. Assume you know the orientation of the plane and the required slope. Let's say the design orientation is the row direction (of 233 degrees) and the required slope is 0.1% (1 ft of fall in 1000 ft). **Zero Balance Plane** produces a cut fill surface in balance. Note that these quantities are not the same as those developed through **Best Fit Plane** (279.034 degrees at .114%). The result of fixing the parameters of orientation and slope does not move the least amount of dirt- it generates a dirt balance (within 3 m³) given fixed parameters of slope and orientation

Cut-Fill Report

Layer : Cut_Fill2

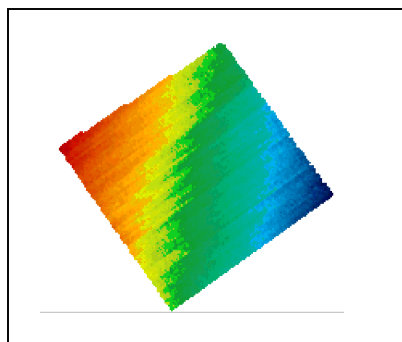
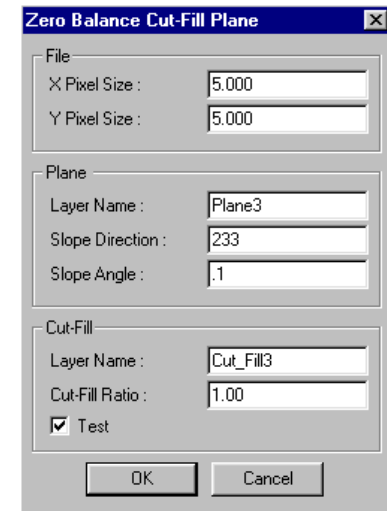
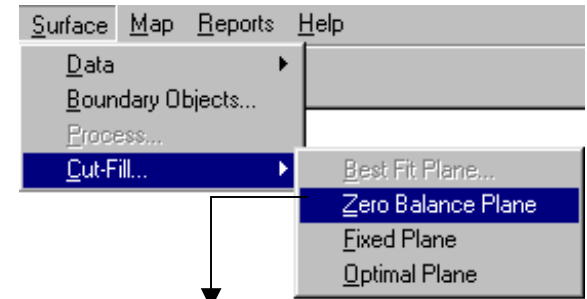
Direction = 233.000 deg

Slope = 0.100 %

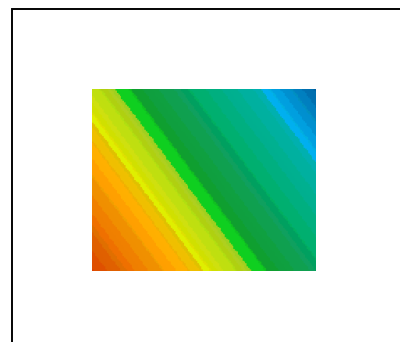
Cut Volume = 23393.35 cu m

Fill Volume = 23392.06 cu m

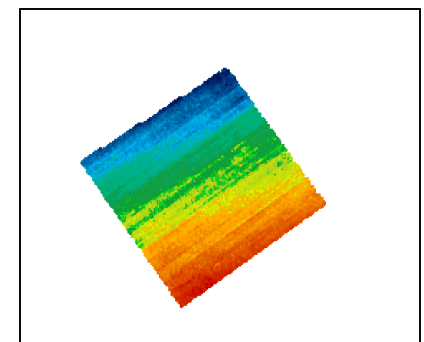
Net Volume = 1.29 cu m



Elevation Surface



Direction, slope, Z-values

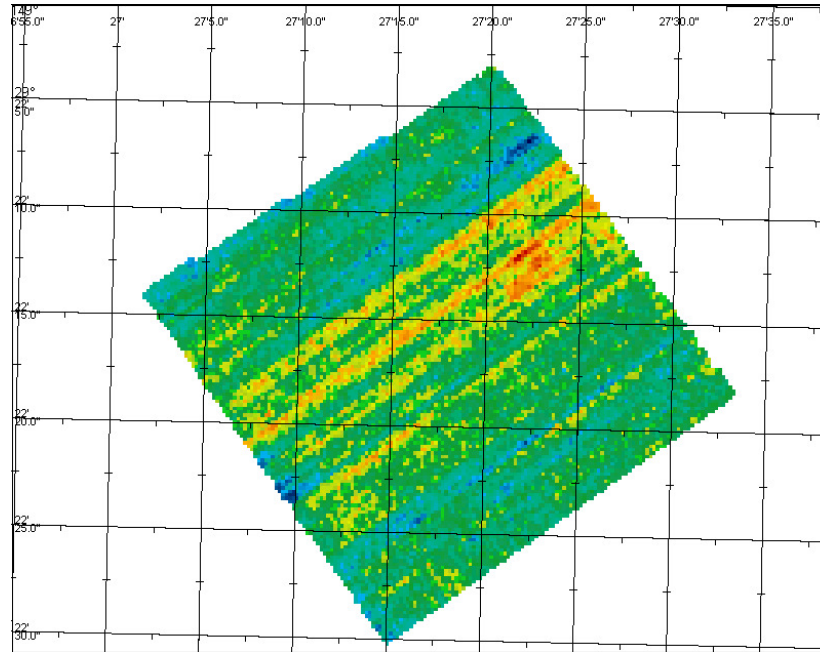


Balanced Cut Fill Surface

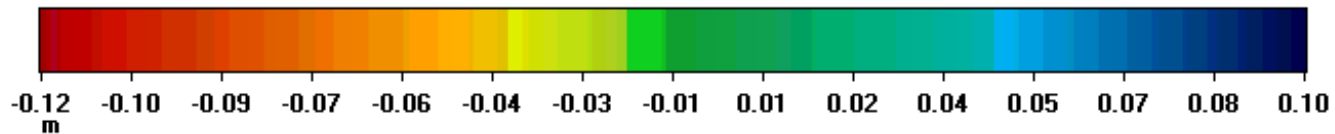
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Final Observation



Cut_Fill



This Cut Fill map is a set of geo-referenced instructions. There is a positive (fill) or negative value (cut) for every x,y position in the grid. This is a Variable Rate Prescription for land leveling. With the increasing use of RTK GPS in both field topographic survey and in machine guidance, the ability to control equipment at a high degree of accuracy is achievable. Topo can build the “player piano rolls” for dirt moving control systems.