LiDAR

VERMONT SOCIETY of LAND SURVEYORS

J. Thaddeus “Thadd” Eldredge

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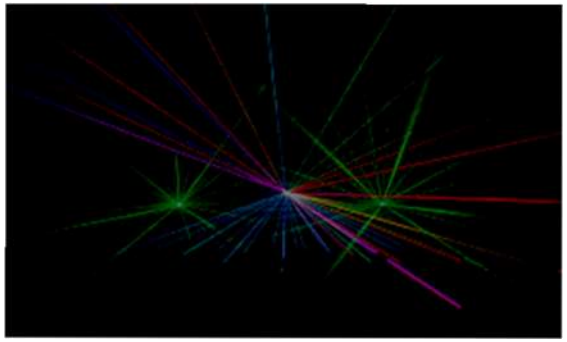
www.ese-llc.com

J. Thaddeus "Thadd" Eldredge

- BA in Theoretical Mathematics, Colby College
- PLS Certificate from Wentworth Institute of Technology
- PLS 46471, MA
- Soil Evaluator, MA
- Certified Floodplain Manager, USA
- Has a fancy pants name; goes by Thadd.
- I will try to not put you to sleep.

What is LiDAR?

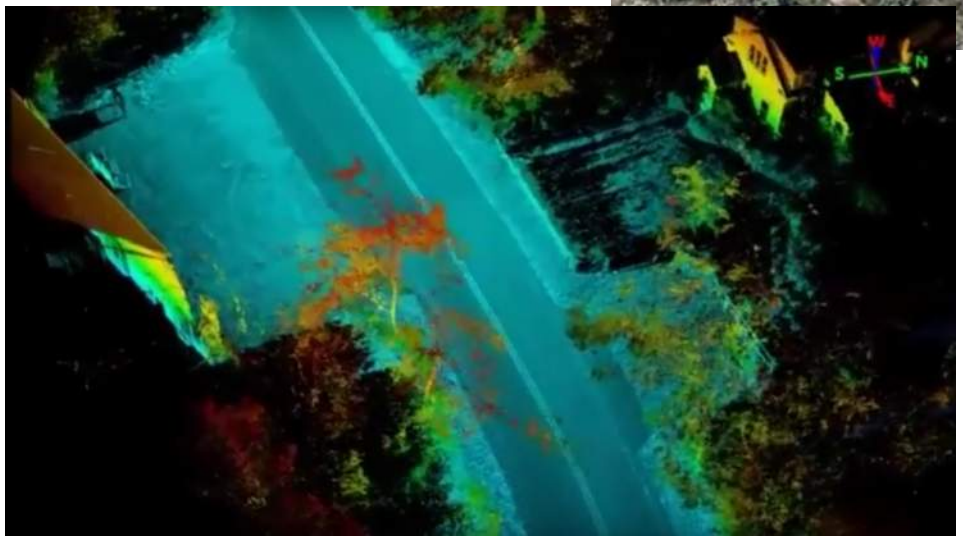
- Laser Radar
- Light Detection and Ranging
- Scanning



Lidar (also written LIDAR, **LiDAR** or LADAR) is a remote sensing technology that measures distance by **illuminating a target with a laser and analyzing the reflected light.** Although thought by some to be an acronym of Light Detection And Ranging,[1] the term lidar was actually created as a portmanteau of "light" and "radar".
[2][3] Lidar is popularly used as a technology to make high-resolution maps, with applications in geomatics, archaeology, geography, geology, geomorphology, seismology, forestry, remote sensing, atmospheric physics, airborne laser swath mapping (ALSM), laser altimetry, and contour mapping. (wikipedia) **SURVEYING!!!**

Who Is Using LiDAR?

- Aerial
- Static
- Mobile



Oyster Bay Lane

Sullivan

Stream Analysis

Video Sources:

2014 NOAA Aerial LiDAR "Post-Sandy"

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Point Cloud Formats

Rapidlasso - ***.las** and ***.laz**
ASTM – ***.e57**
Text - ***.xyz** and ***.pts**

There are more.

E57 is being developed by a committee within the American Society for Testing and Materials. It may one day be the universal standard for imagery and scan data.

Text formats are valid and you can make your own point clouds!
X,Y,Z
X,Y,Z
X,Y,Z

I like the LAS and LAZ formats the best. LAZ is the most compact format. **The Vermont LiDAR all seems to be in LAS format.**
https://rapidlasso.com/

- Downloadable tools with a rough GUI. Some are open license and others require licensing.
- Downloadable toolboxes for:
  - ARC
  - QGIS

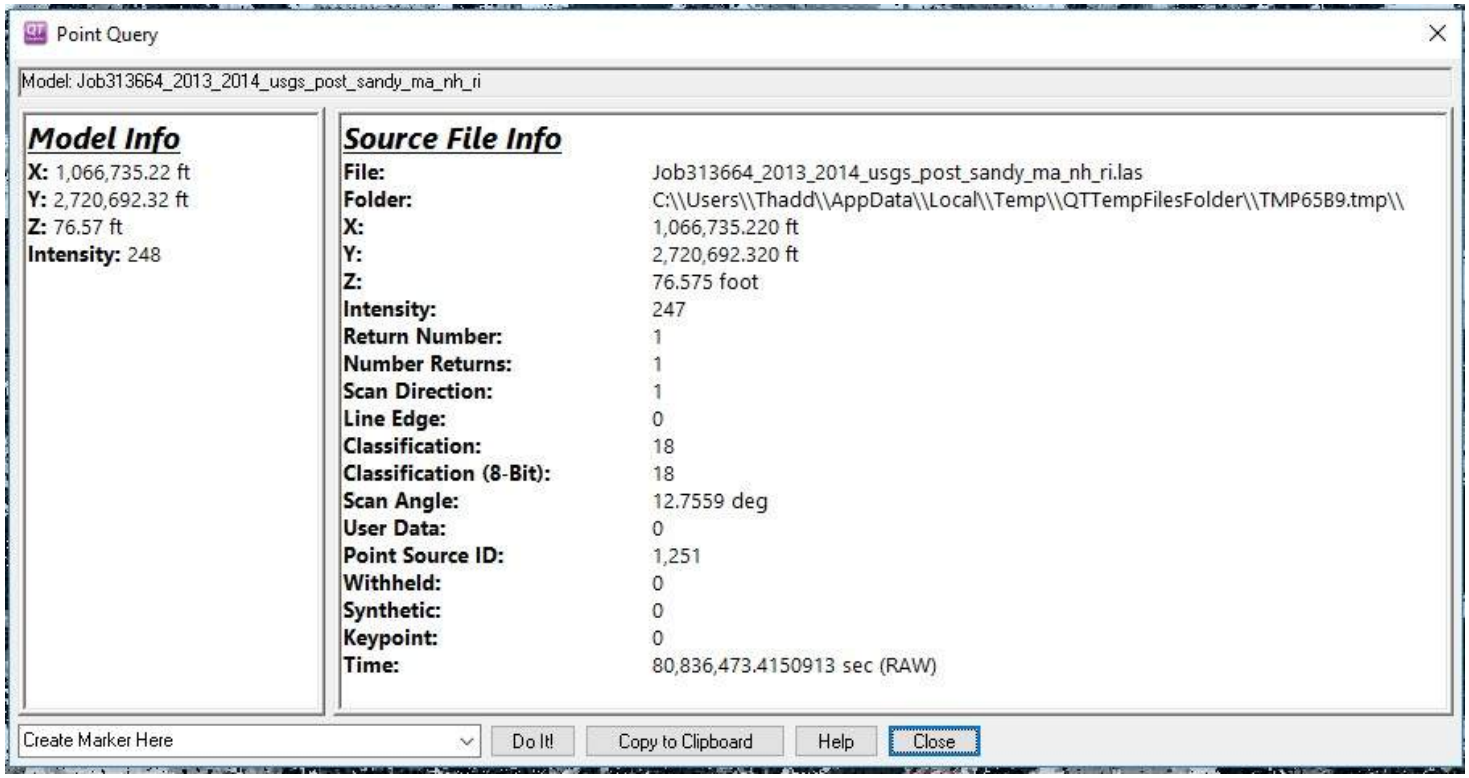
Survey Points v. Point Cloud

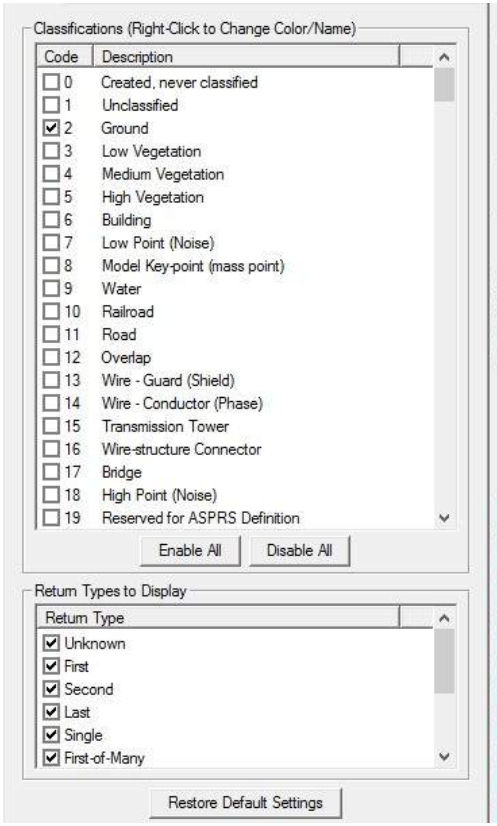
- Surveyed Points (smart)
- Few
- Specific targets – That point is along that edge of pavement and that one is at the building corner.
- Described – Even when the descriptor is cryptic, there is still something there.

- Scanned Points (dumb)
- Many
- Unspecific targets – That point is on an object and I don't know if it is at the edge of the pavement or right at the building corner.
- Undescribed - That point is on an object and when I look at the 2000 points around it plus the imagery, I see a bush.

Attributes

These are More than Just Points





Software

http://www.ese-llc.com/lidar - This is a dumping ground webpage for links to LiDAR software.

Software you may have:

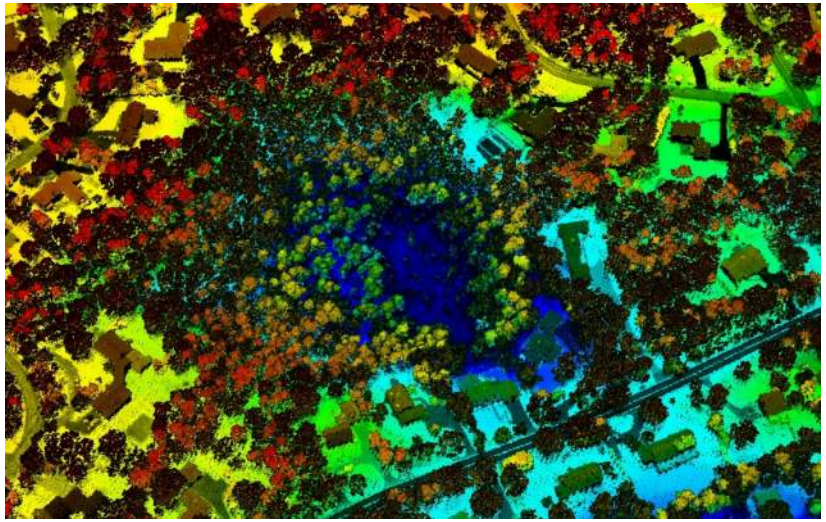
ESRI ARC 10.1 or greater
AutoDesk **Civil3d**
AutoDesk **ReCap**
QGIS

Free Software:

Fugro Viewer – Great for surface visualization. Will export points and lines to SHP files.
Quick Terrain Viewer – Great for viewing. Measurement and listing of points available.
LasTools – A tool for manipulating, converting or otherwise using clouds.
Fusion – US Forest Service tool for Trees
MeshLab – Will create 3d models from clouds
Cloud Compare – It will compare two clouds and more.
PointCloudViz – Viewer
SceneLT – View clouds

Marketed Software:

Global Mapper – Great for all LiDAR types, best value
Carlson Point Cloud – Great for a surveyor using Carlson to get into clouds
TopoDOT – If you have MicroStation, it is an excellent product
Quick Terrain Modeler – Excellent tools for the toolbox.
Faro Scene – Stitches scans and extracts some data.
And More… (These are the ones that we have in the office)



Tilipi Run

Guillard

Coastal Bank

Video Sources:

2014 NOAA Aerial LiDAR "Post-Sandy"

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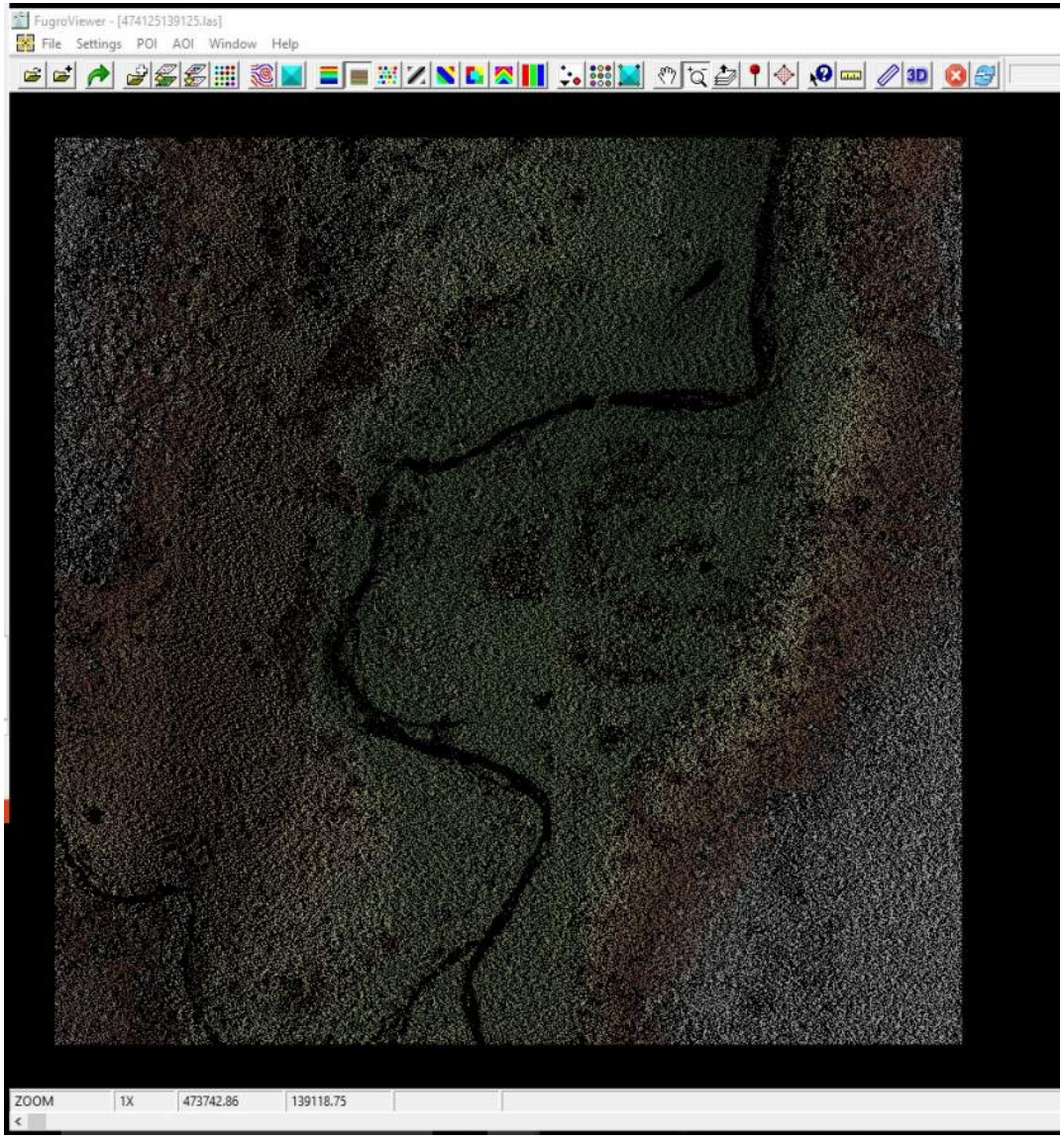
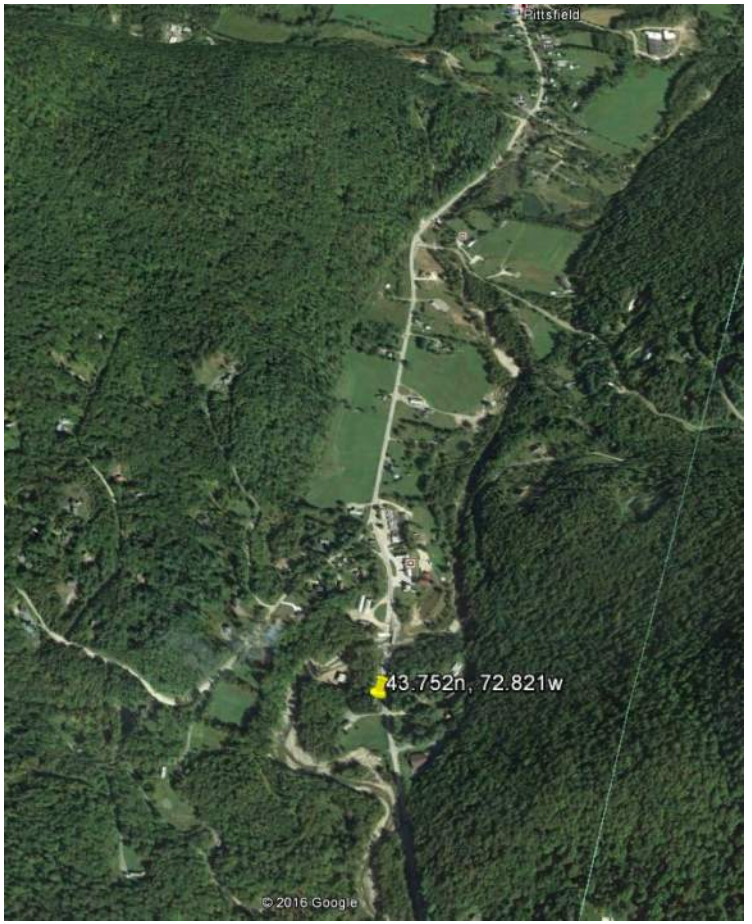
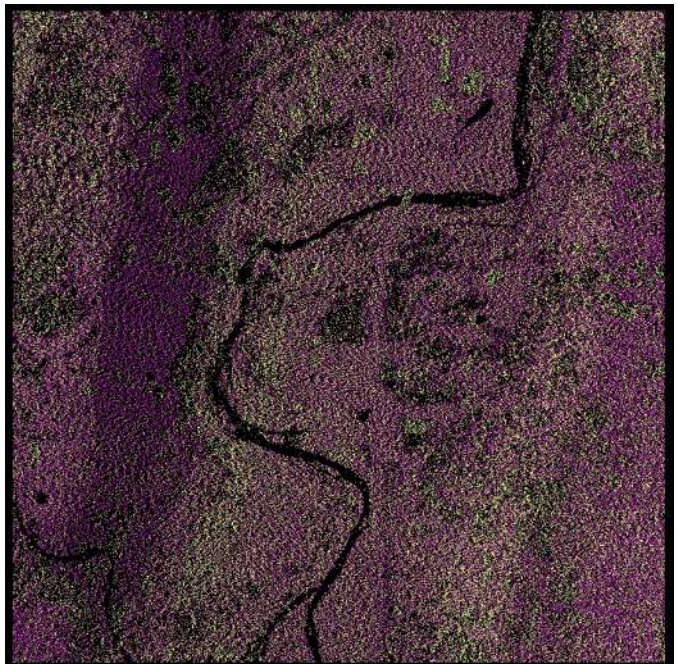
FUGRO VIEWER



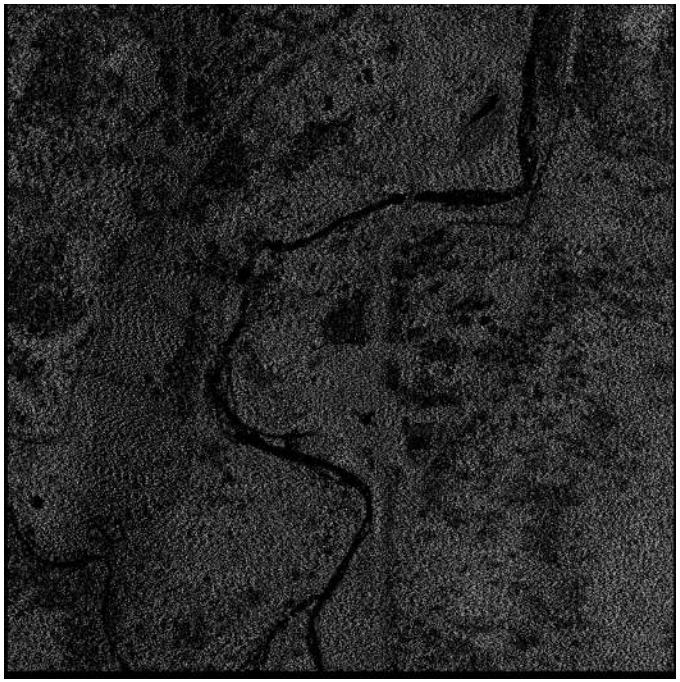
Just an example from Pittsfield, VT.
Heights are visualized by color.

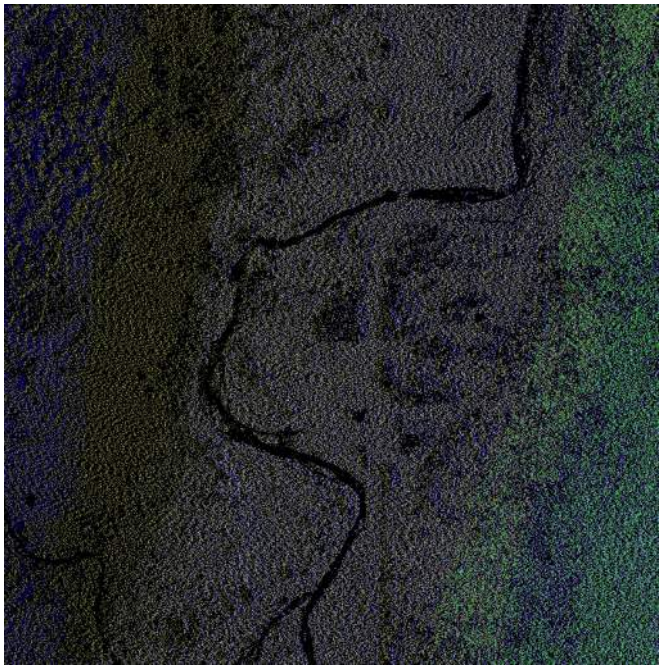




Colored by Classification

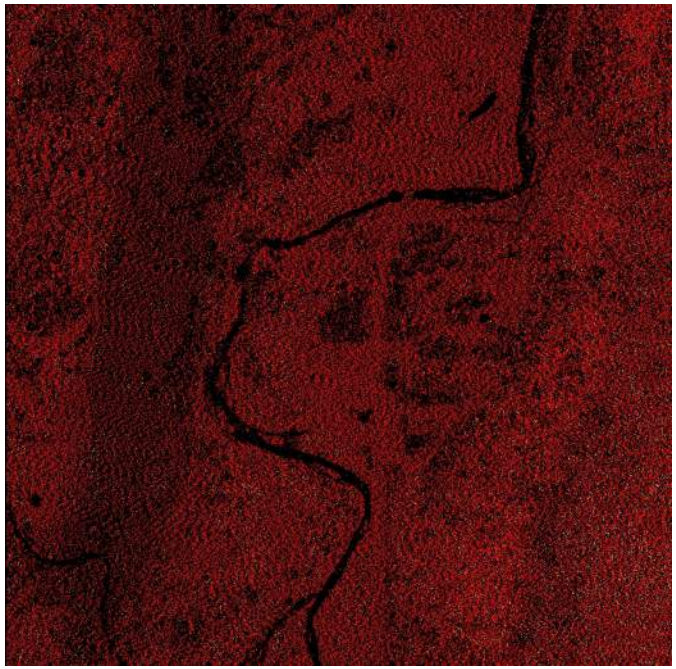
Colored by Intensity





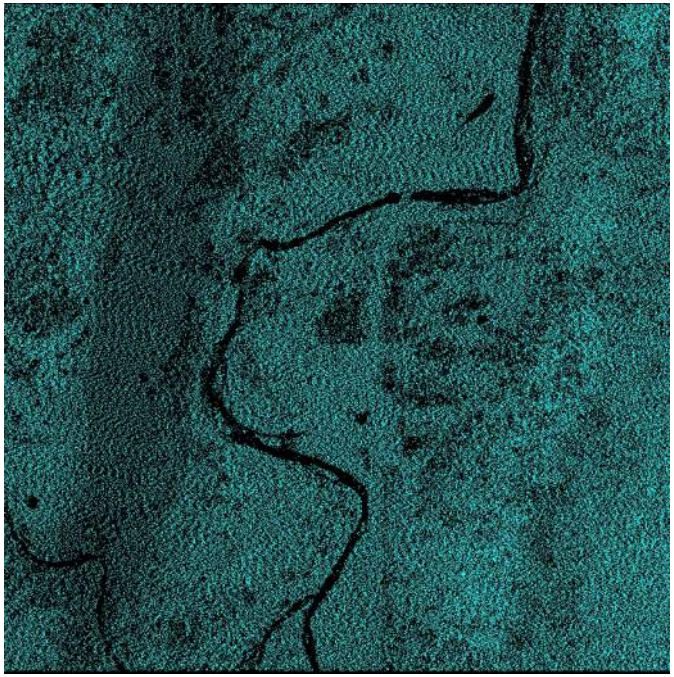
Colored by Source ID
(Flightline)

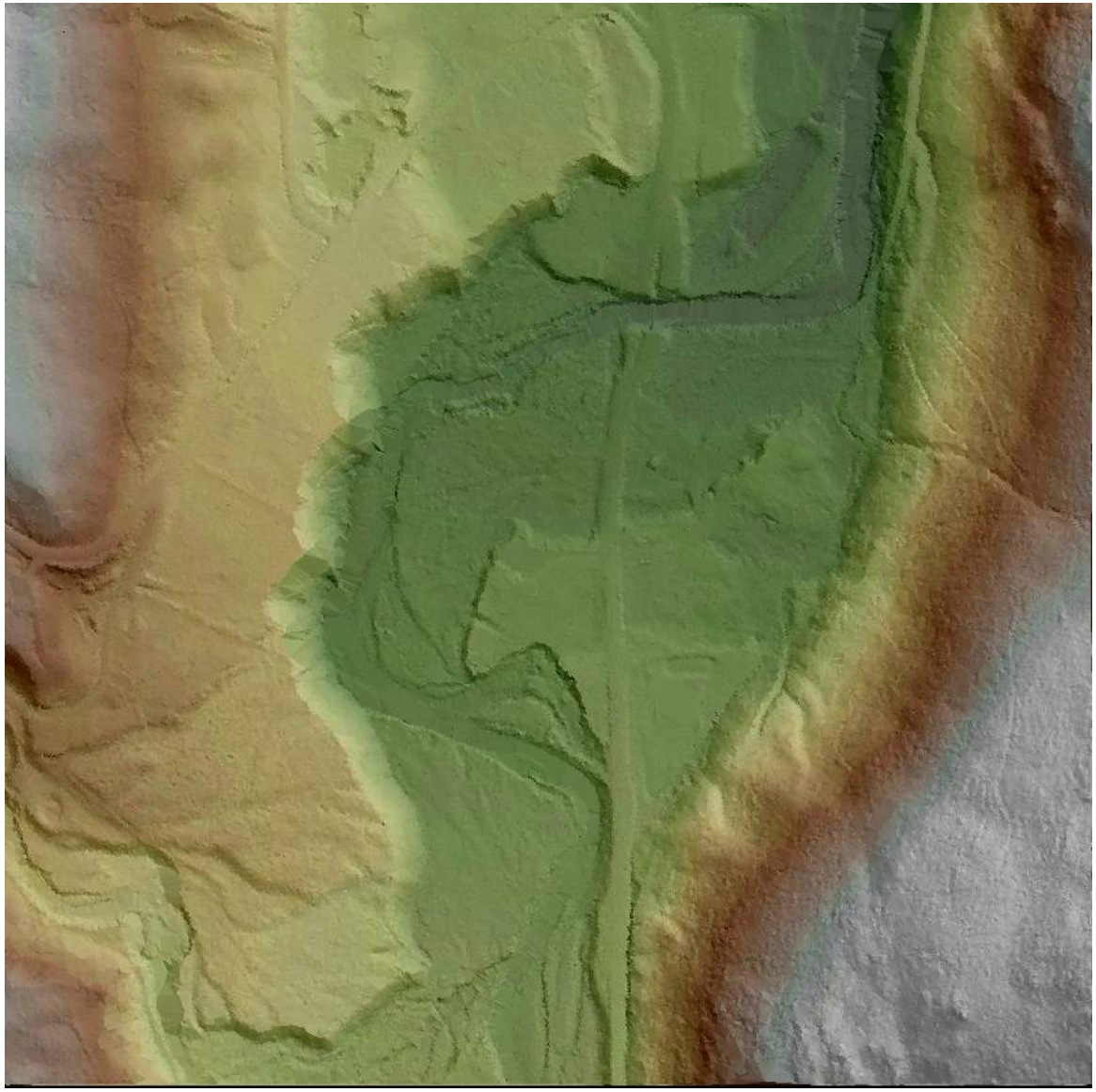
Colored by Return



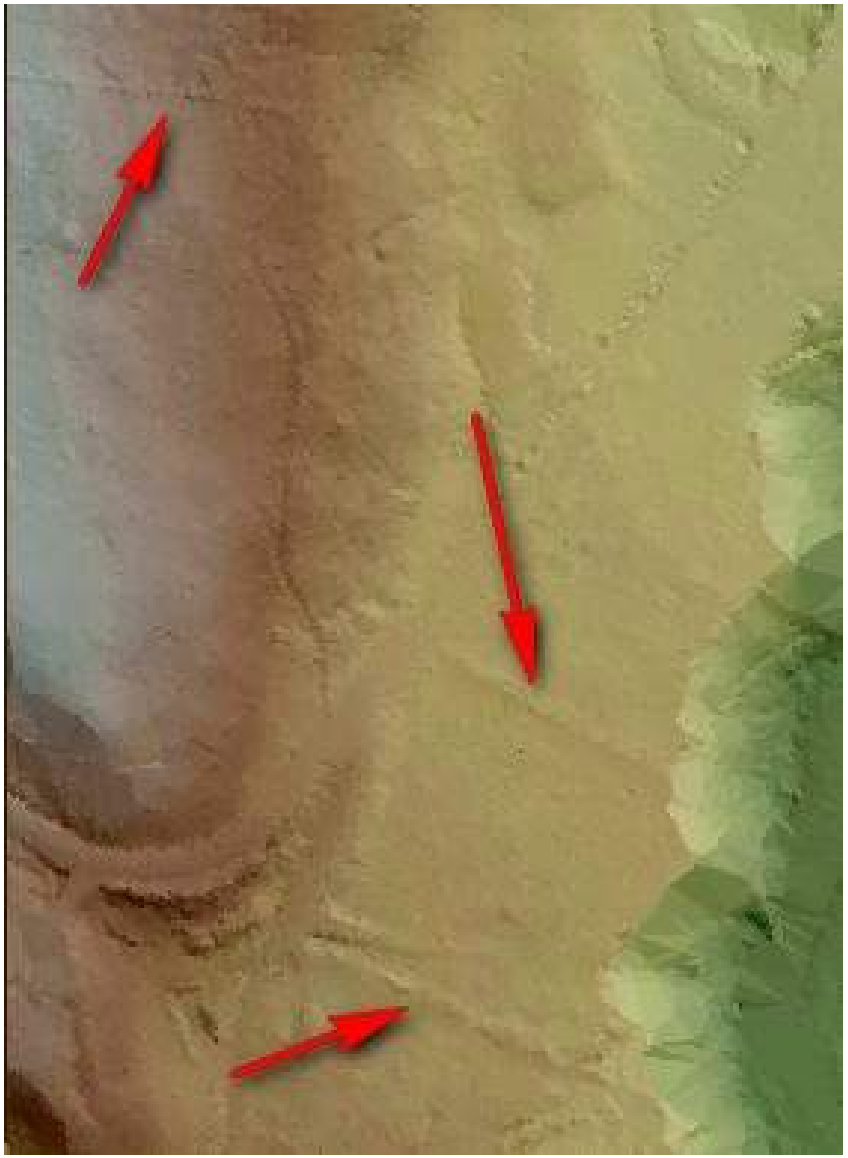
Colored by Imagery

Colored by File (You need 2 files to see it.)



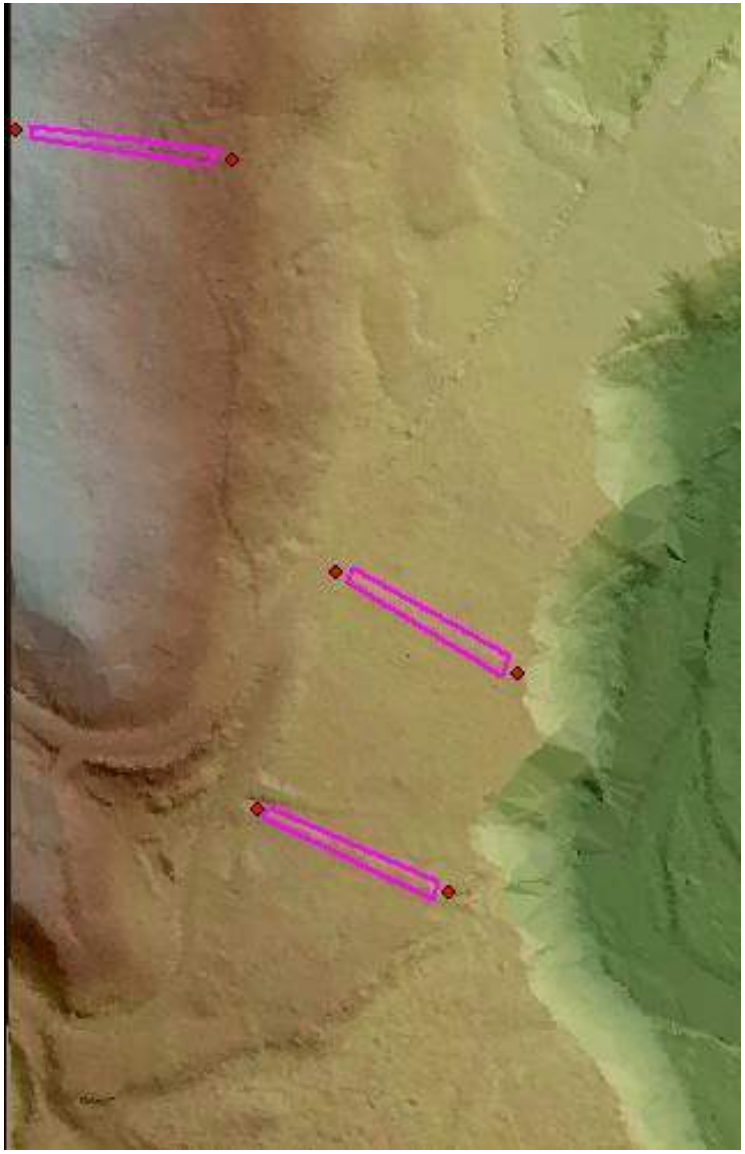


With a few clicks, you can create a solid surface model from the previously classified ground points. Take a moment and pick out some features:
River & Escarped Embankment
Roads & Driveways
Trails & Paths
Potential Stone Walls



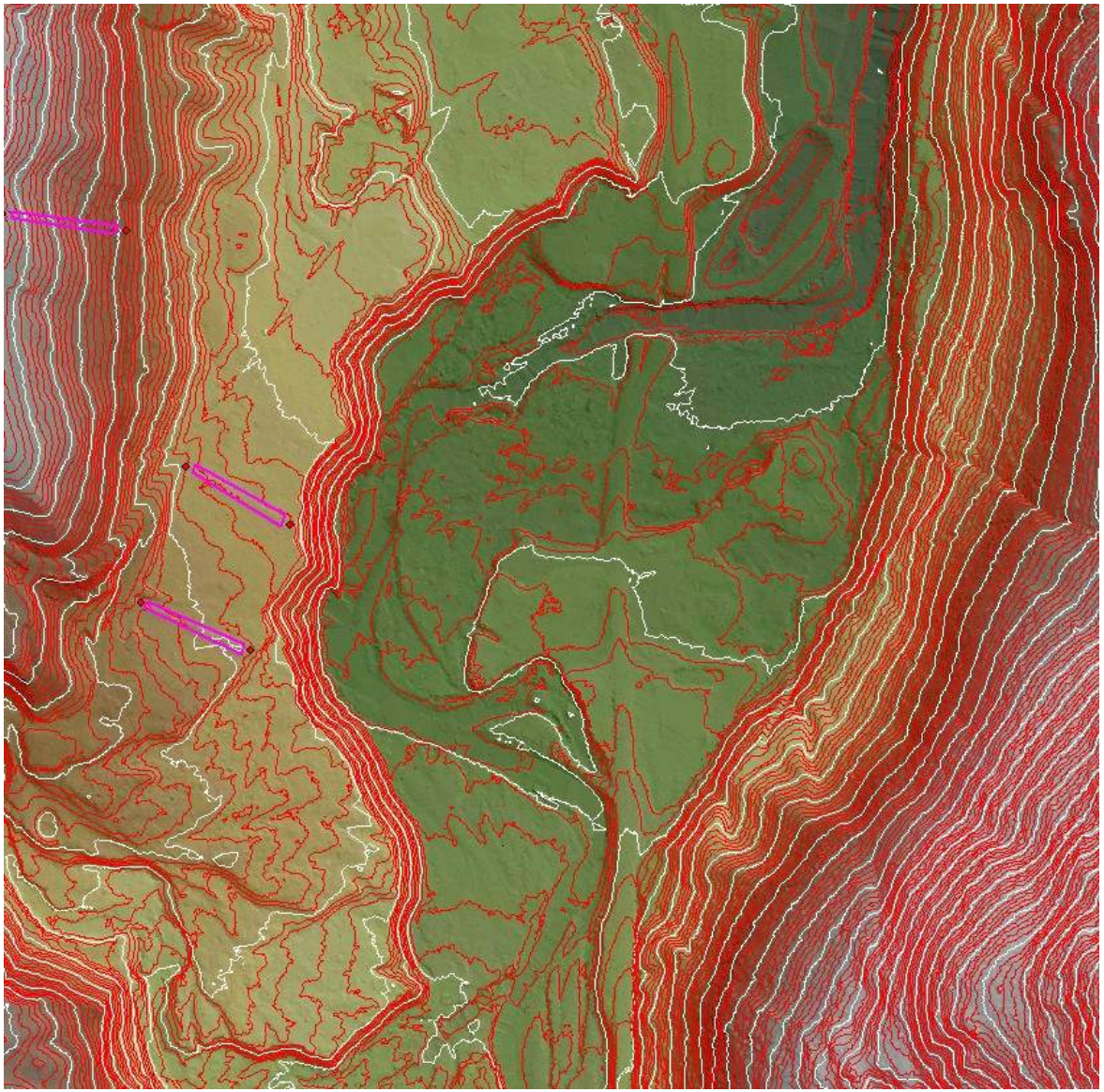
The two potential walls adjacent to the field could very well be there. These could be picked out from aerial photography. If the one to the north is a stone wall, one would be hard pressed to find it in the aerials.

We have recovered dozens of ancient boundaries with the aerial lidar surface models. We have used these models to rough in deeds and prepare for the ground surveys to locate features on the ground.

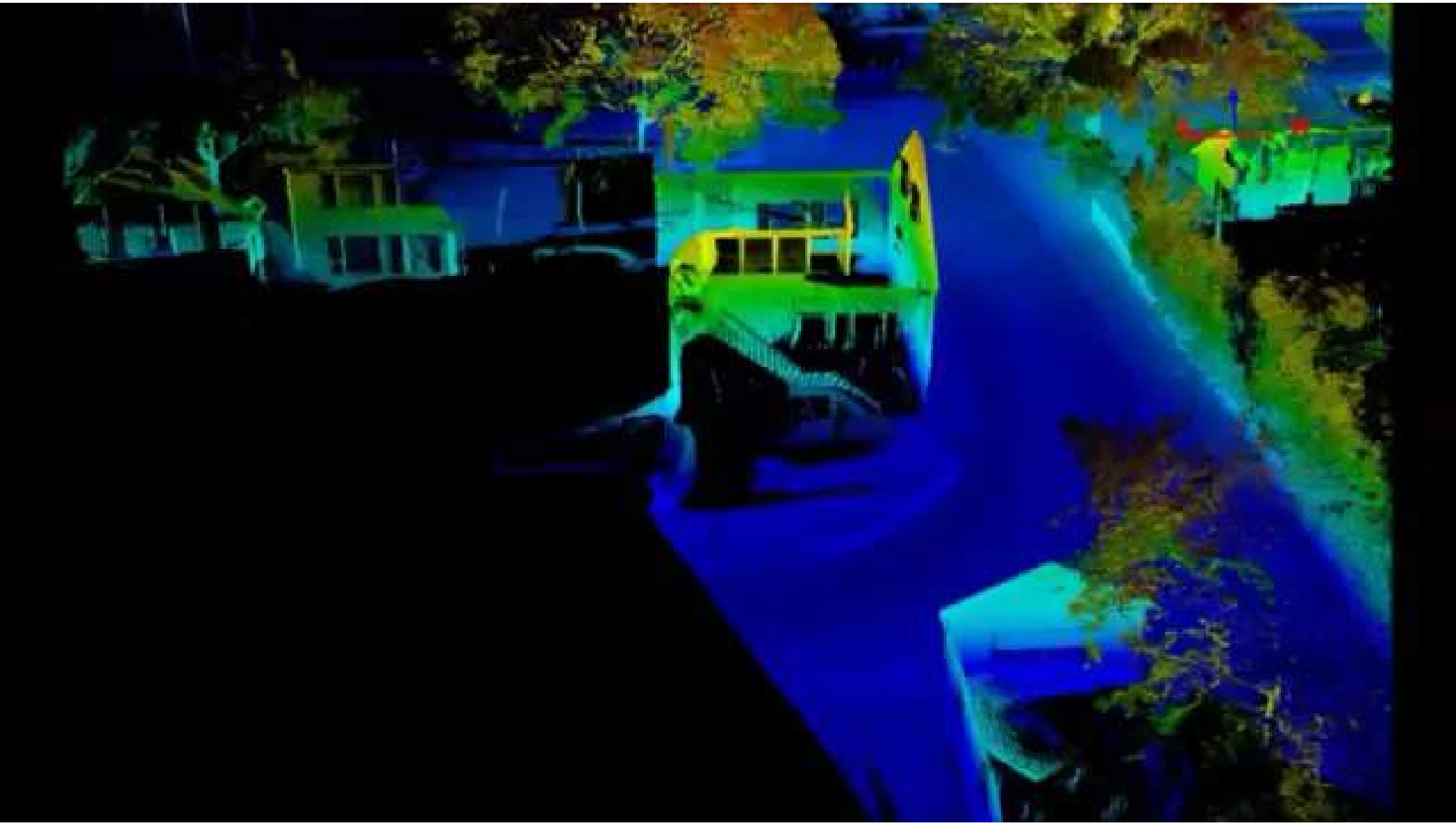


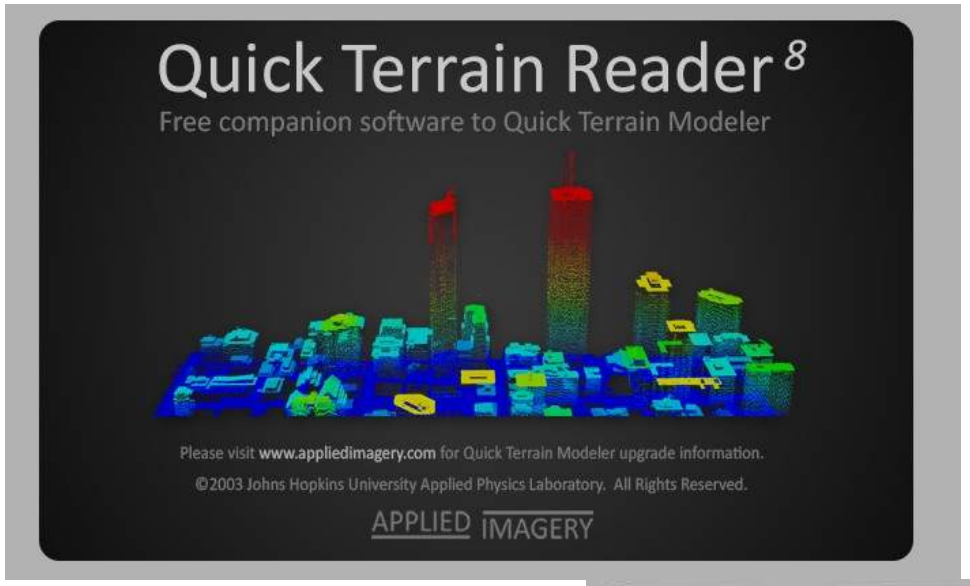
Fugro allows you to create POI and AOI: Points of Interest and Areas of Interest. These can be exported to Shape Files, then used accordingly.

Please note that there are other items in the surface that can look like walls, paths, streams and other features. This can be a great starting point. It can help point those boots on the ground but cannot replace them.

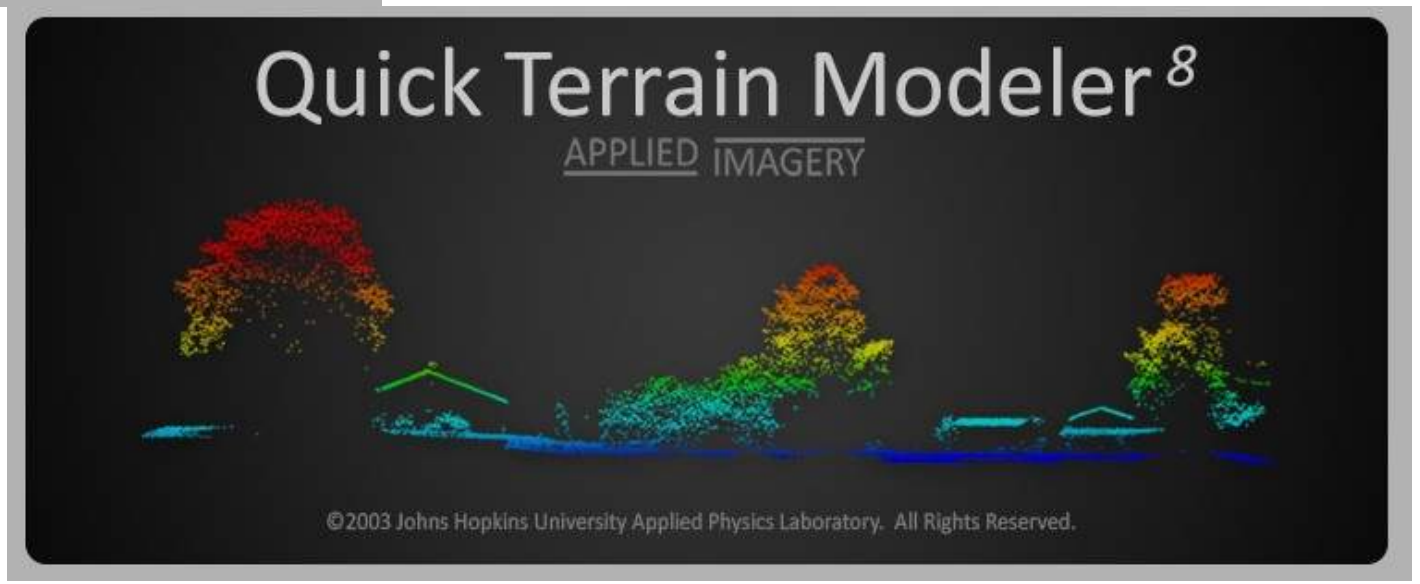


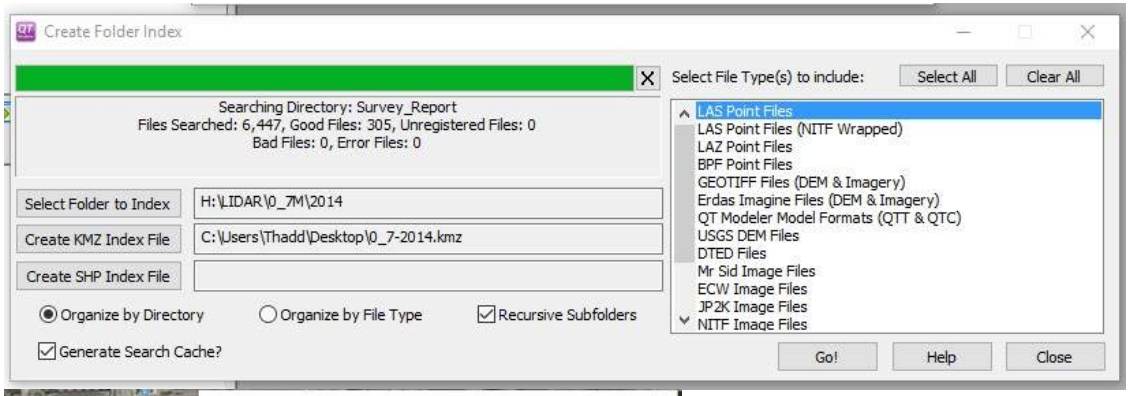
Fugro will allow you to show the contours from the surface, but you cannot export them.
There are image overlay options as well, go have some fun.

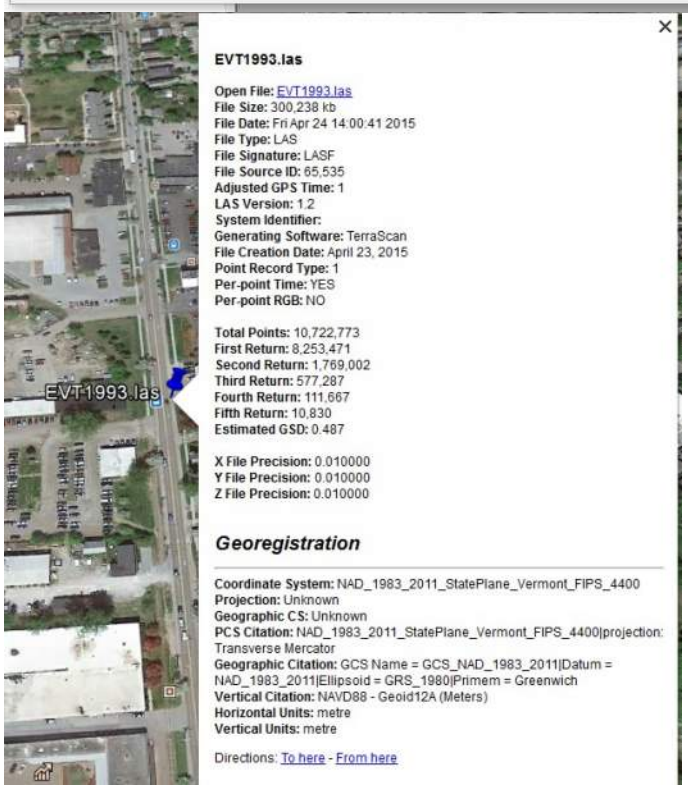




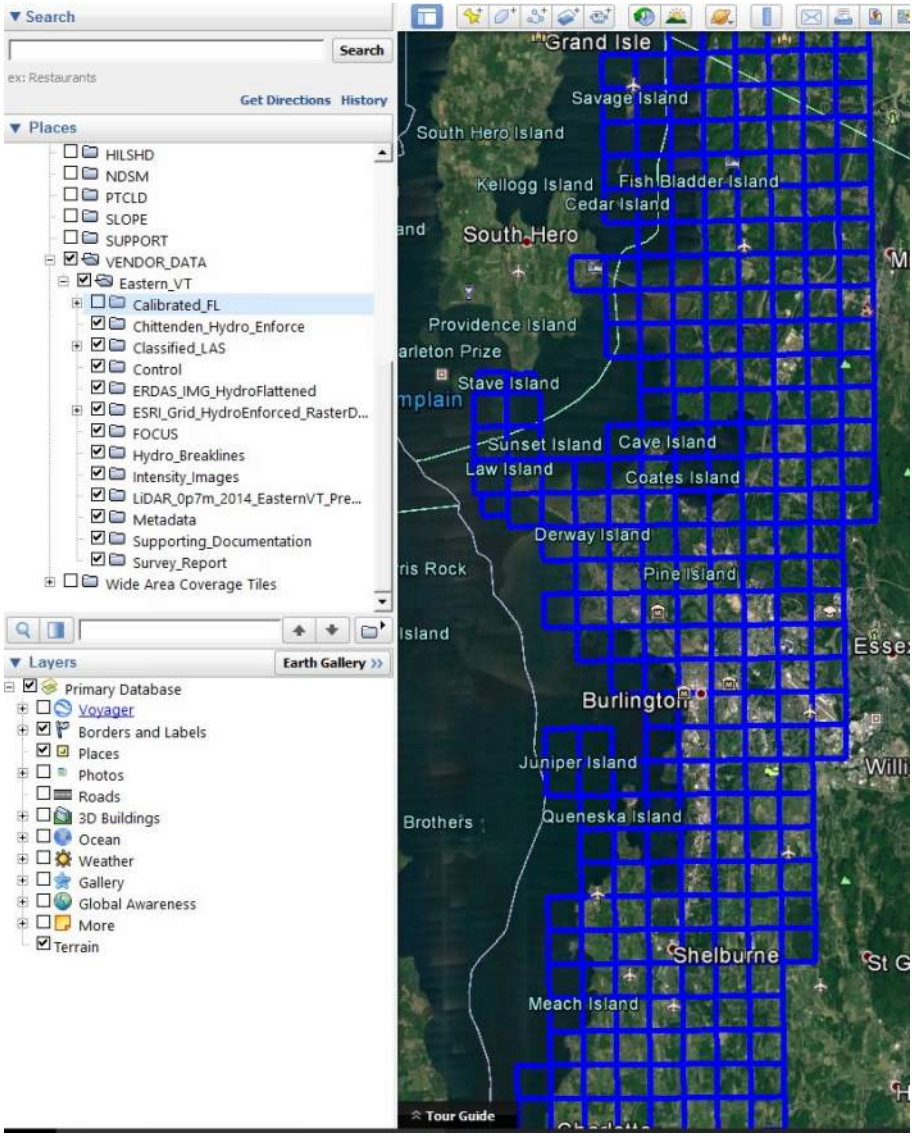
The Reader has some great qualities, but the Modeler has so many more.

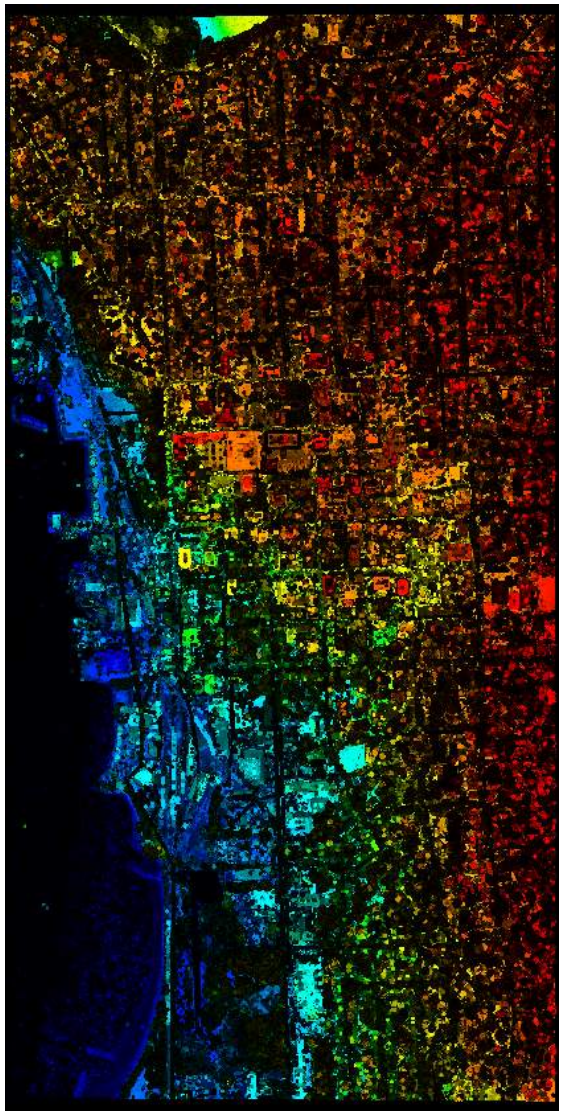


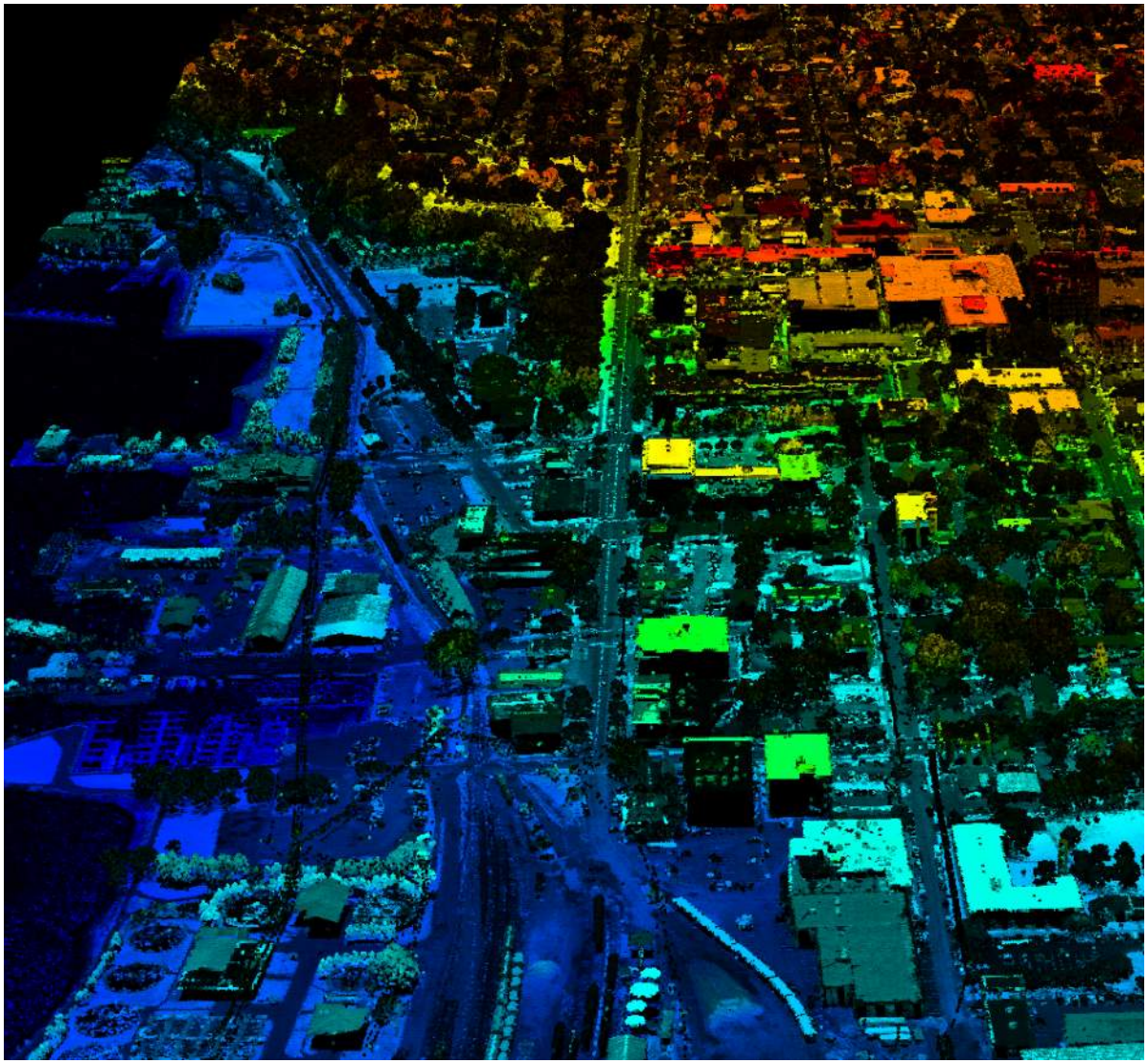


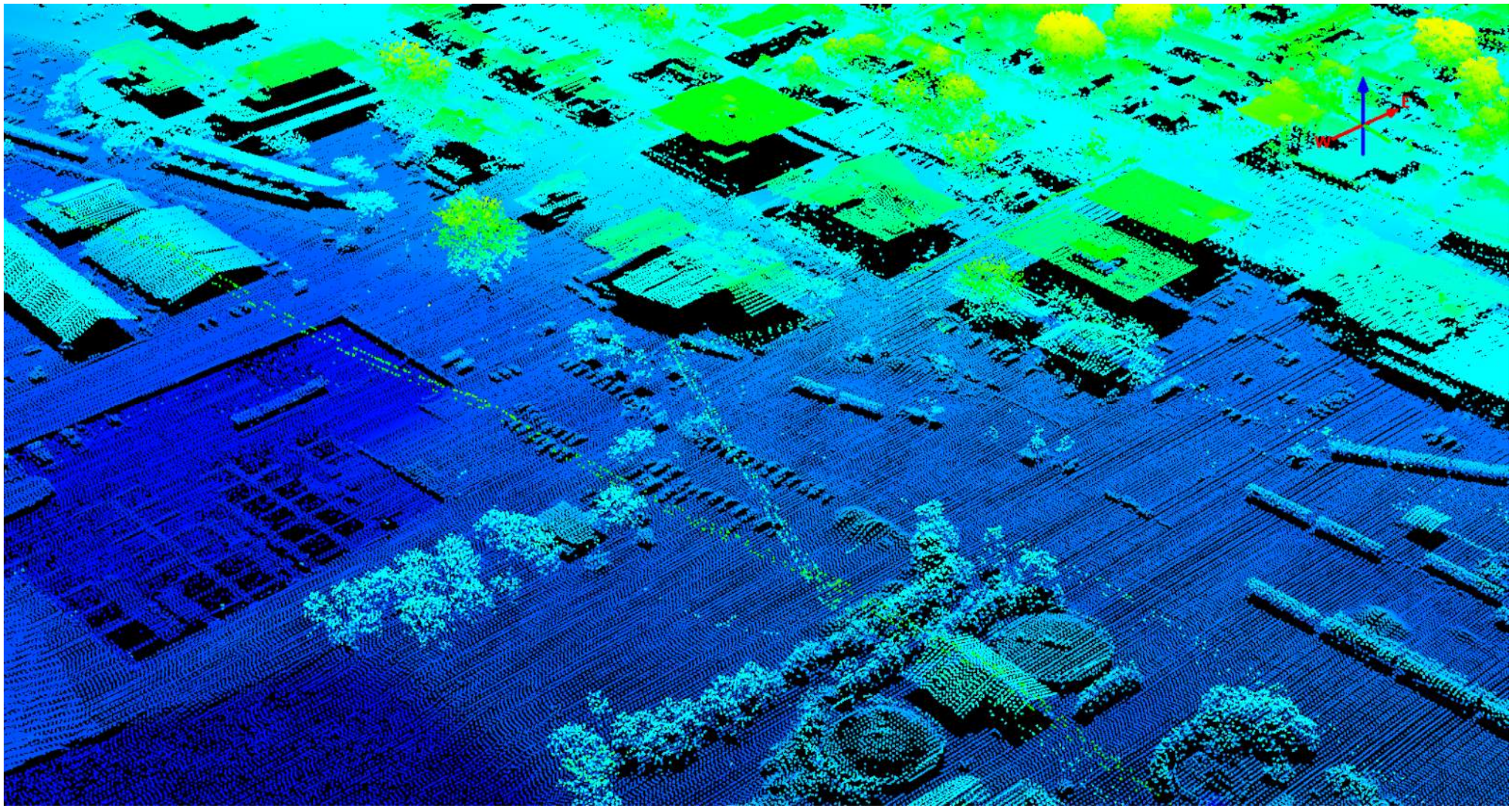


Took a directory, made an index to KMZ. Found an interesting area in Google Earth. Listed the tiles and all kinds of information comes out.

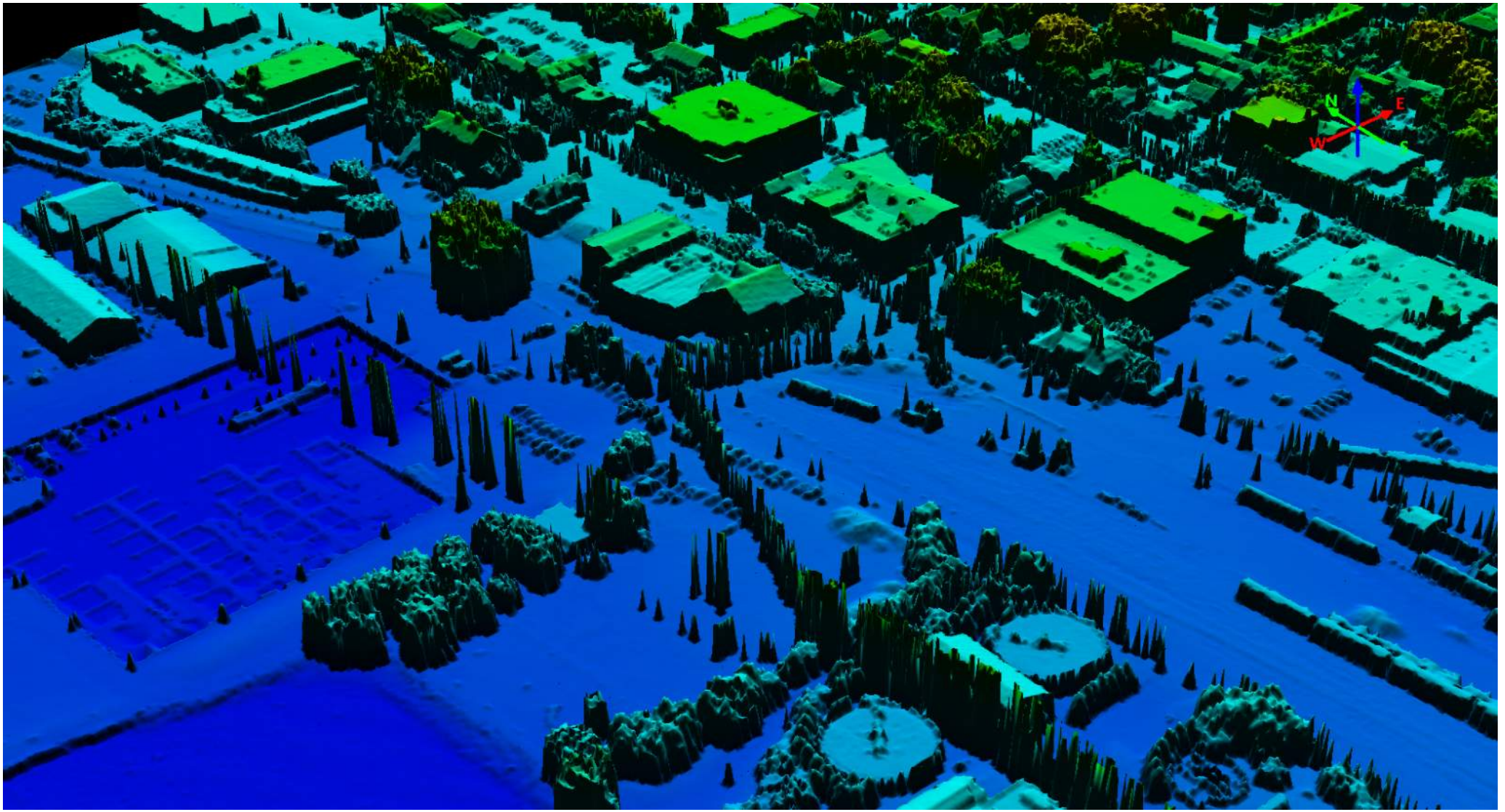




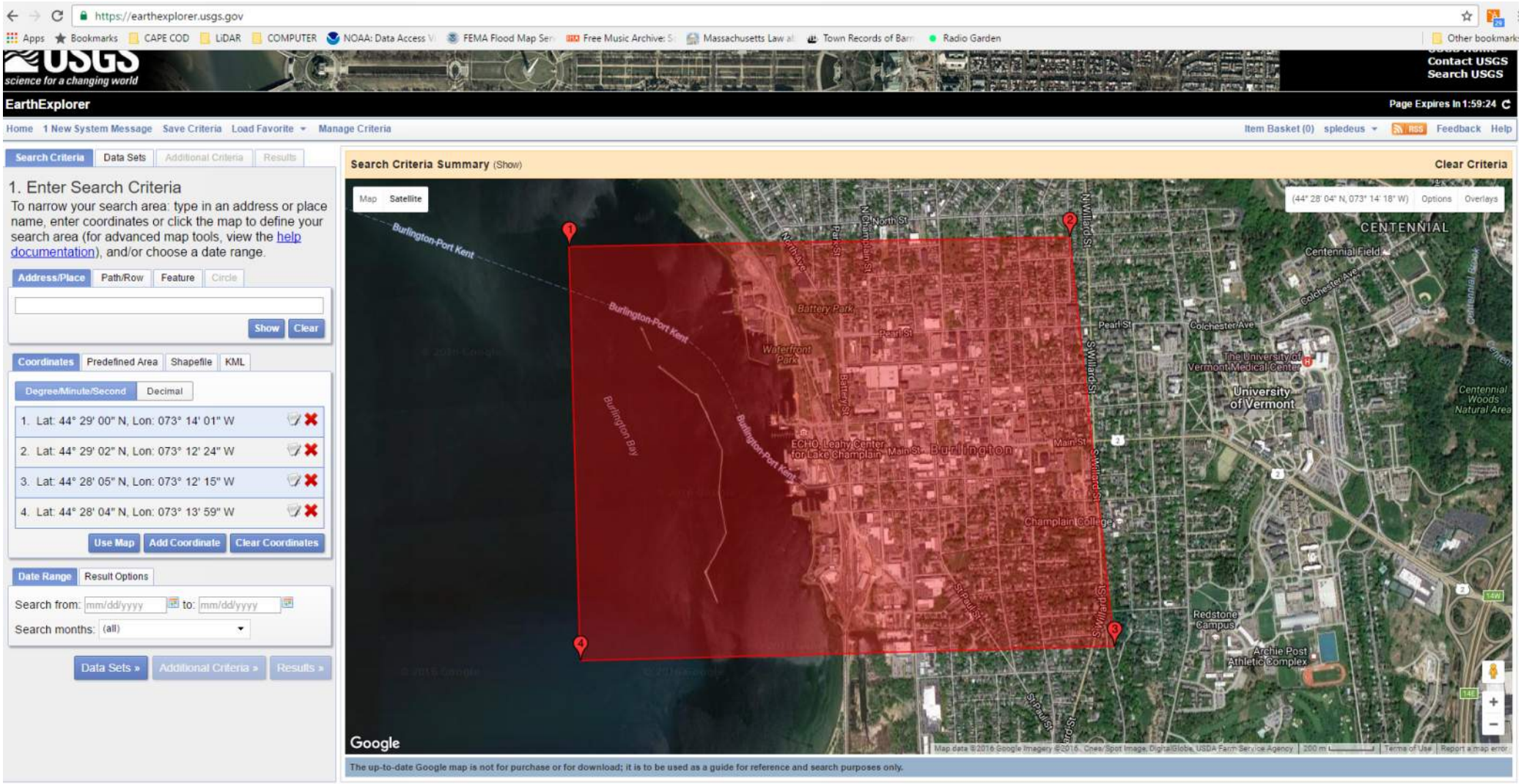




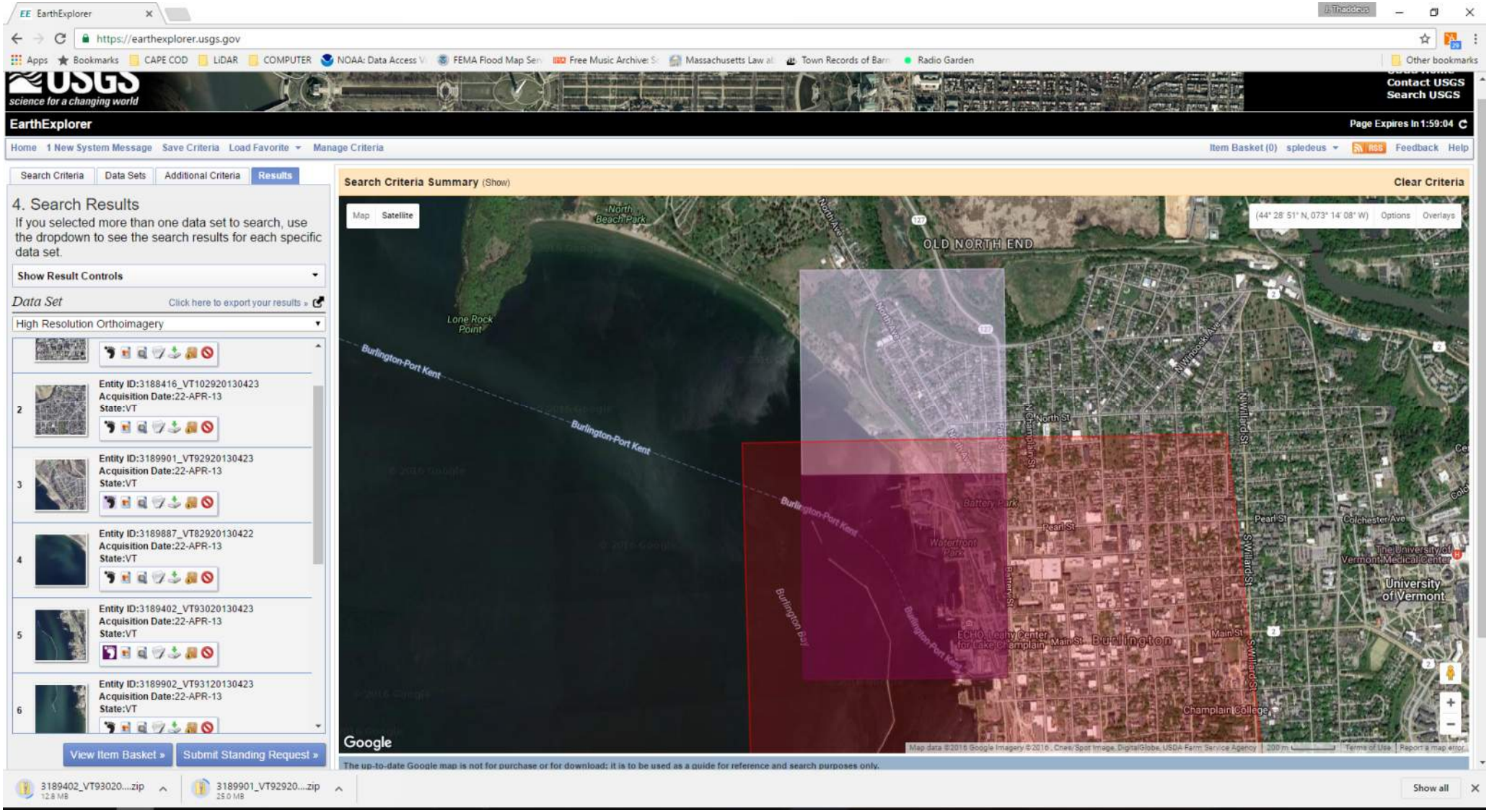
An oblique view.



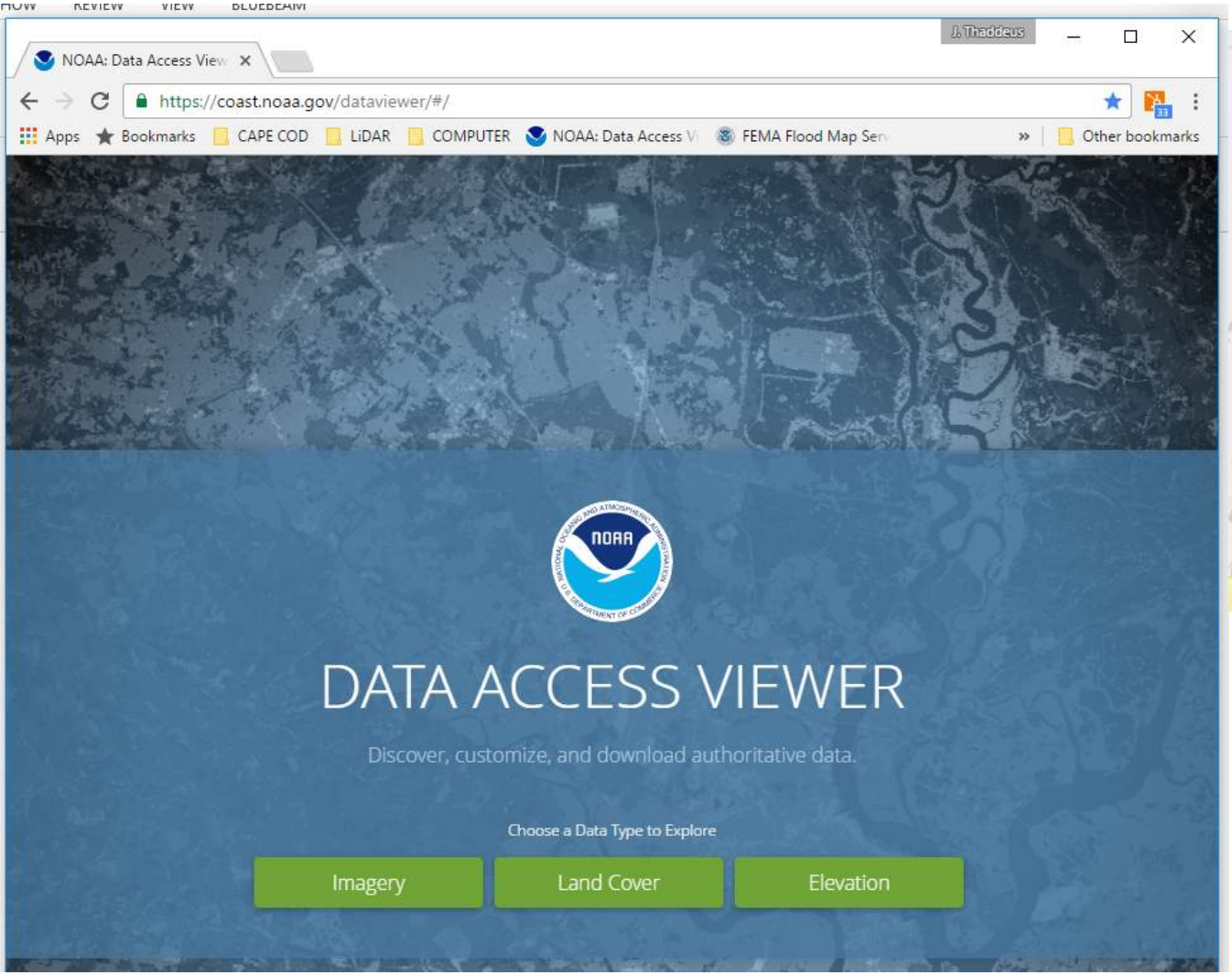
Created a surface with all the points.



USGS Earth Explorer (write that one down and google it or https://earthexplorer.usgs.gov)



Downloaded some 2013 High Resolution Orthoimagery.

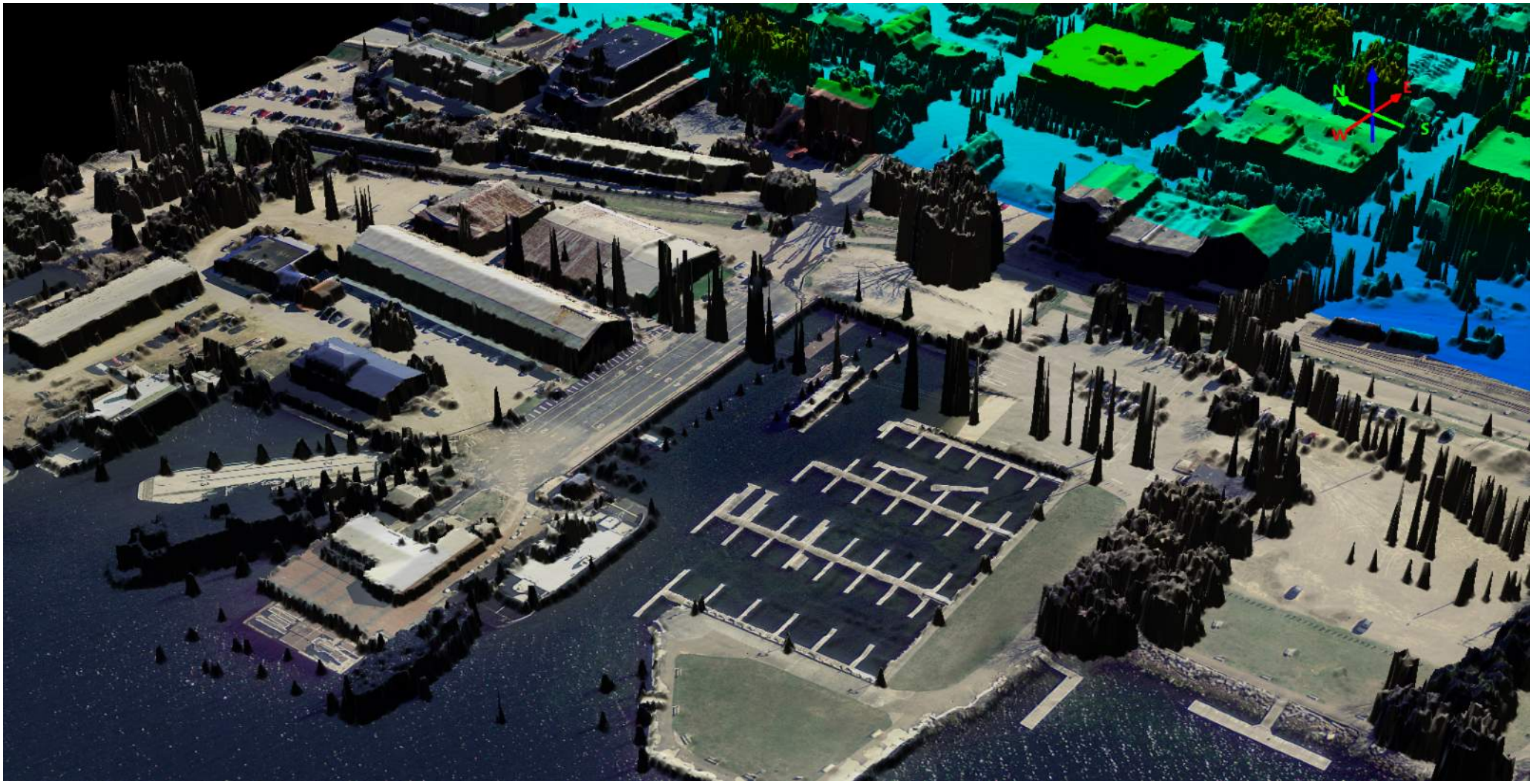


Elevation (On some borders)

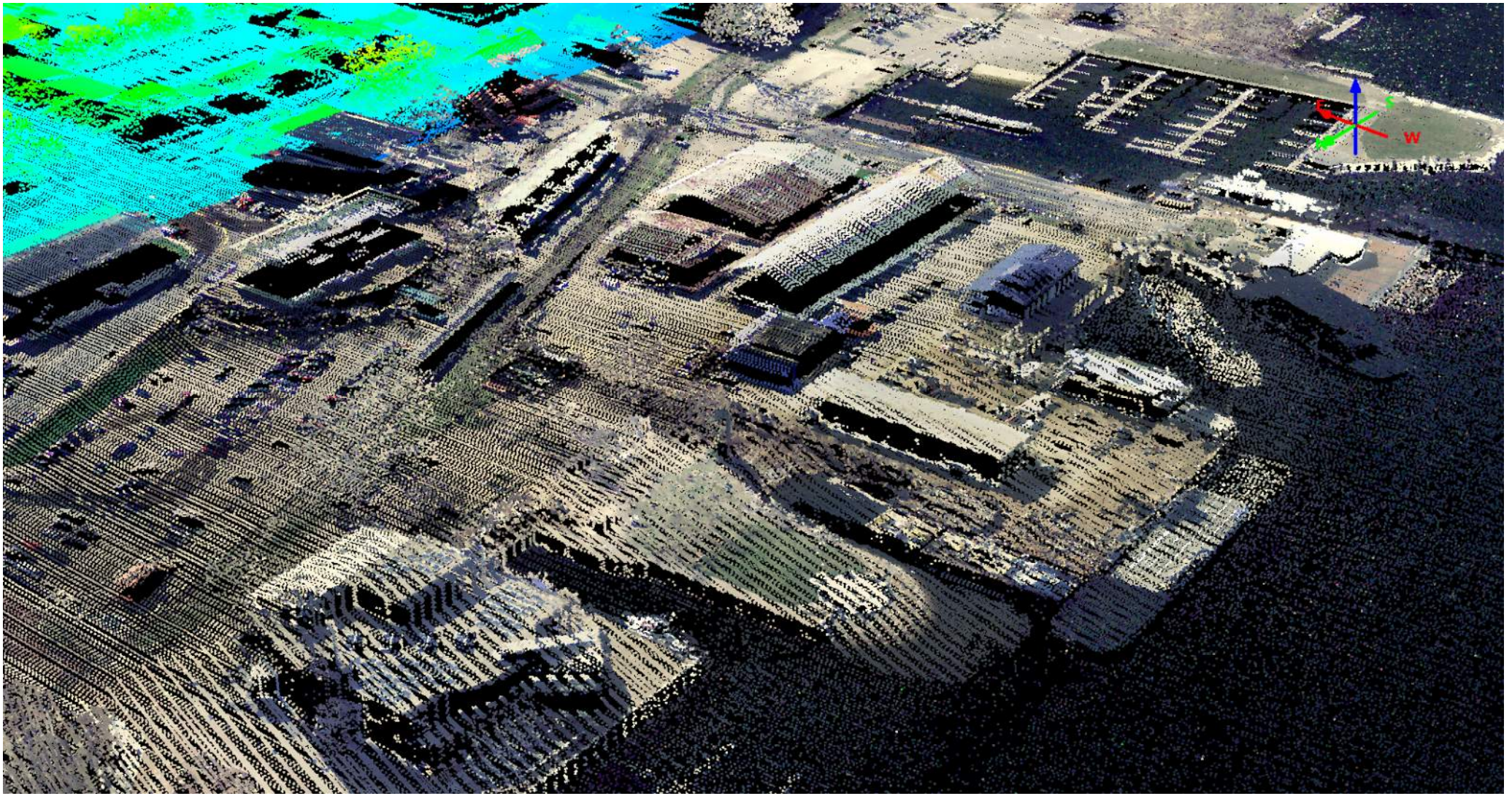
Imagery (A little)

https://Coast.noaa.gov/dataviewer/#/

The USGS Earth Explorer delivers tiles on mostly in UTM Meters.
The NOAA viewer allows you to take random areas and converts them to any system you'd like.



This makes for a great 3d visualization of the scene.
Some spikes are from noise, others are along the power lines.



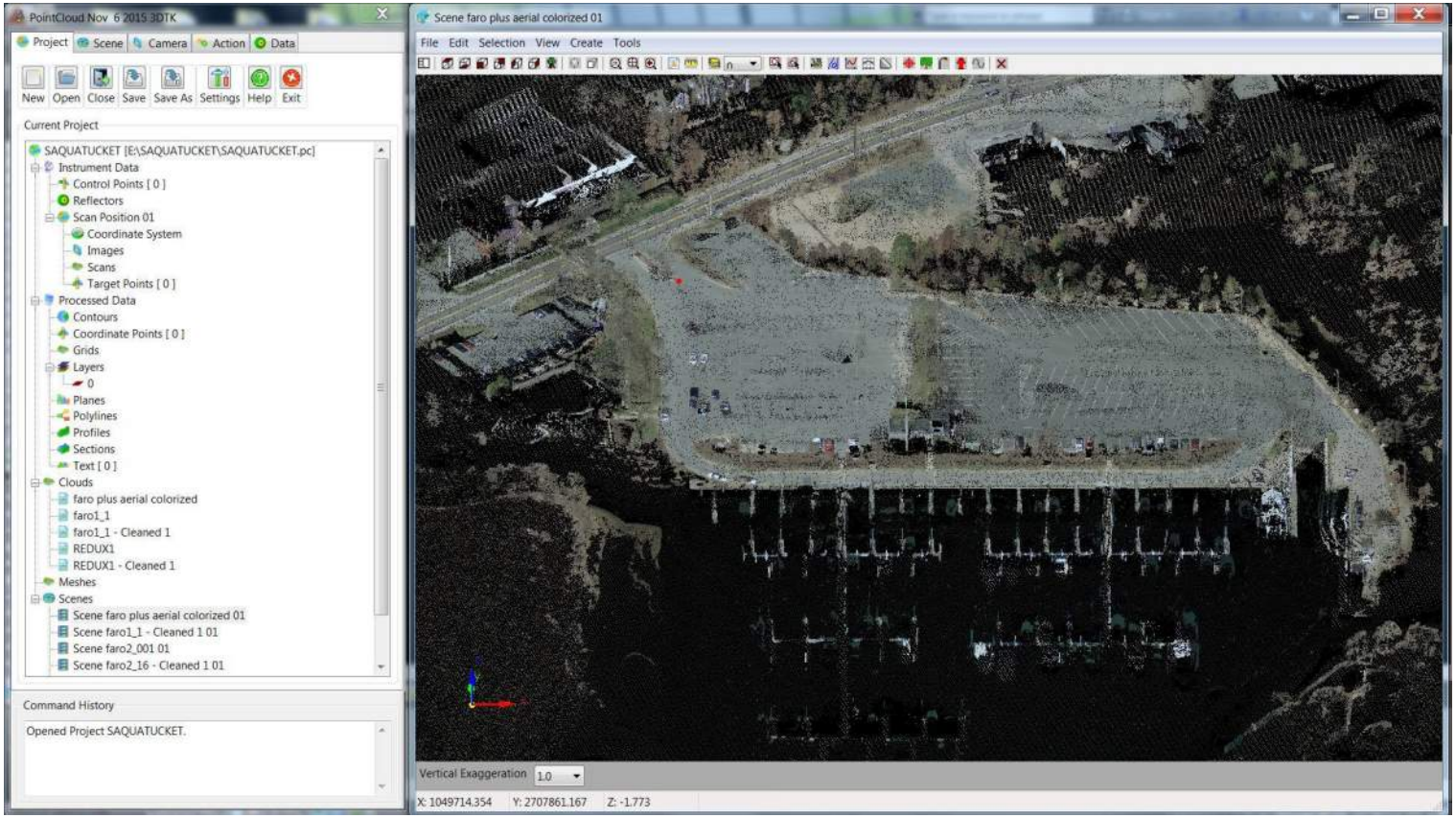
The points remain colorized.

N
W
E
S

Carlson Point Cloud

Carlson PC is built on the Carlson methodology. It runs through CAD or IntelliCAD in its own window and menu.

I chose this program because of their excellent support for their other products. They have not failed that support with this module.



Beautiful Saquatucket Harbor, Harwichport, MA. There is noise from the water.
This was colorized from 2014 Aerial Imagery (3” pixel) and it was scanned (Mobile, FARO) in the early Fall, 2015. The outlying areas are based on 2014 Aerial LiDAR.
The point cloud module runs outside or alongside AutoCAD or IntelliCAD.

Action

Selection – 8 tools to select point with 2 pairs of radios.

Edit – Hide, show, list and colorize the clouds. Smooth evens out meshes (think TINs) and Clean reduces points from a cloud (some get a little dense)

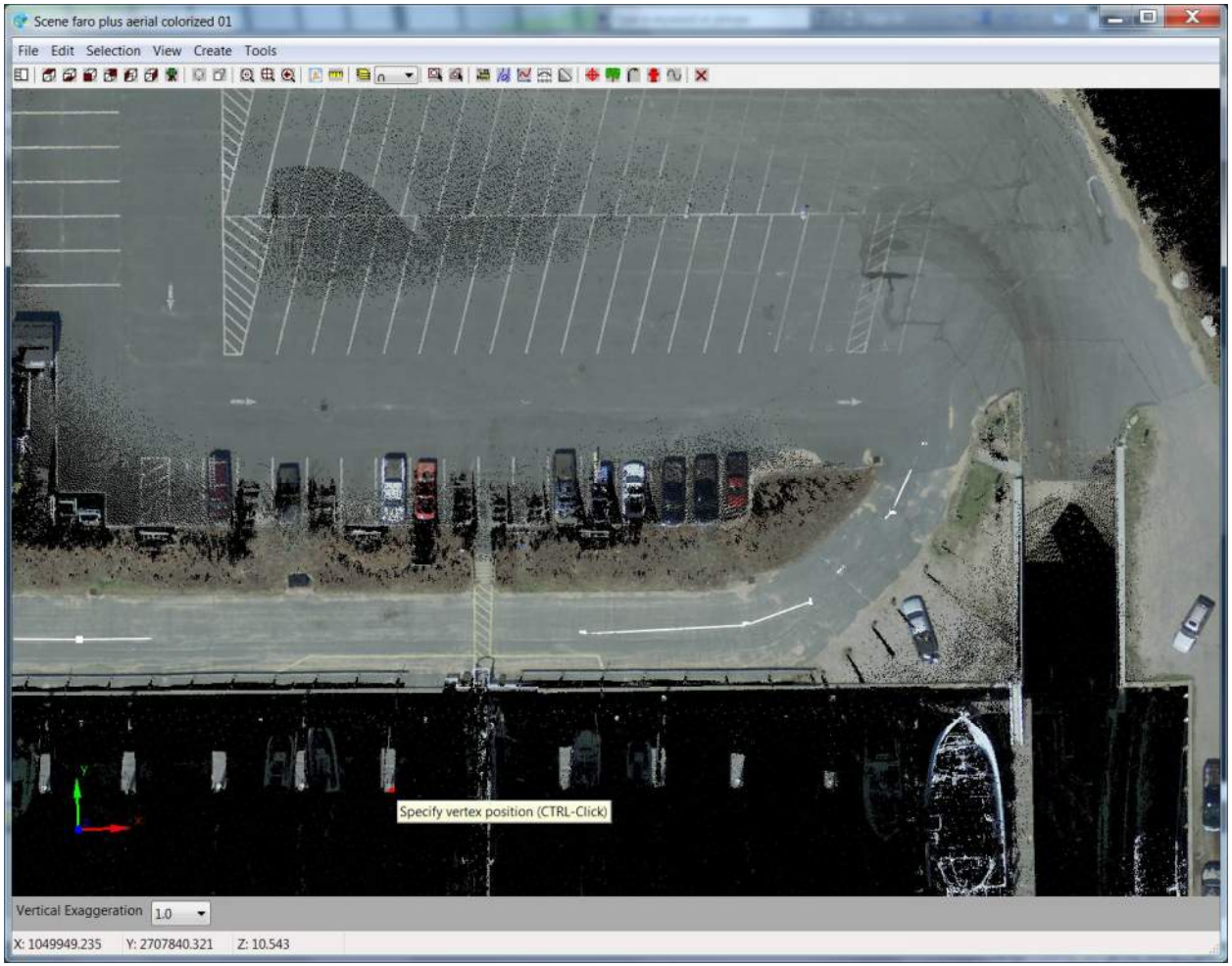
Transform – The transform functions will move the clouds.

Create -

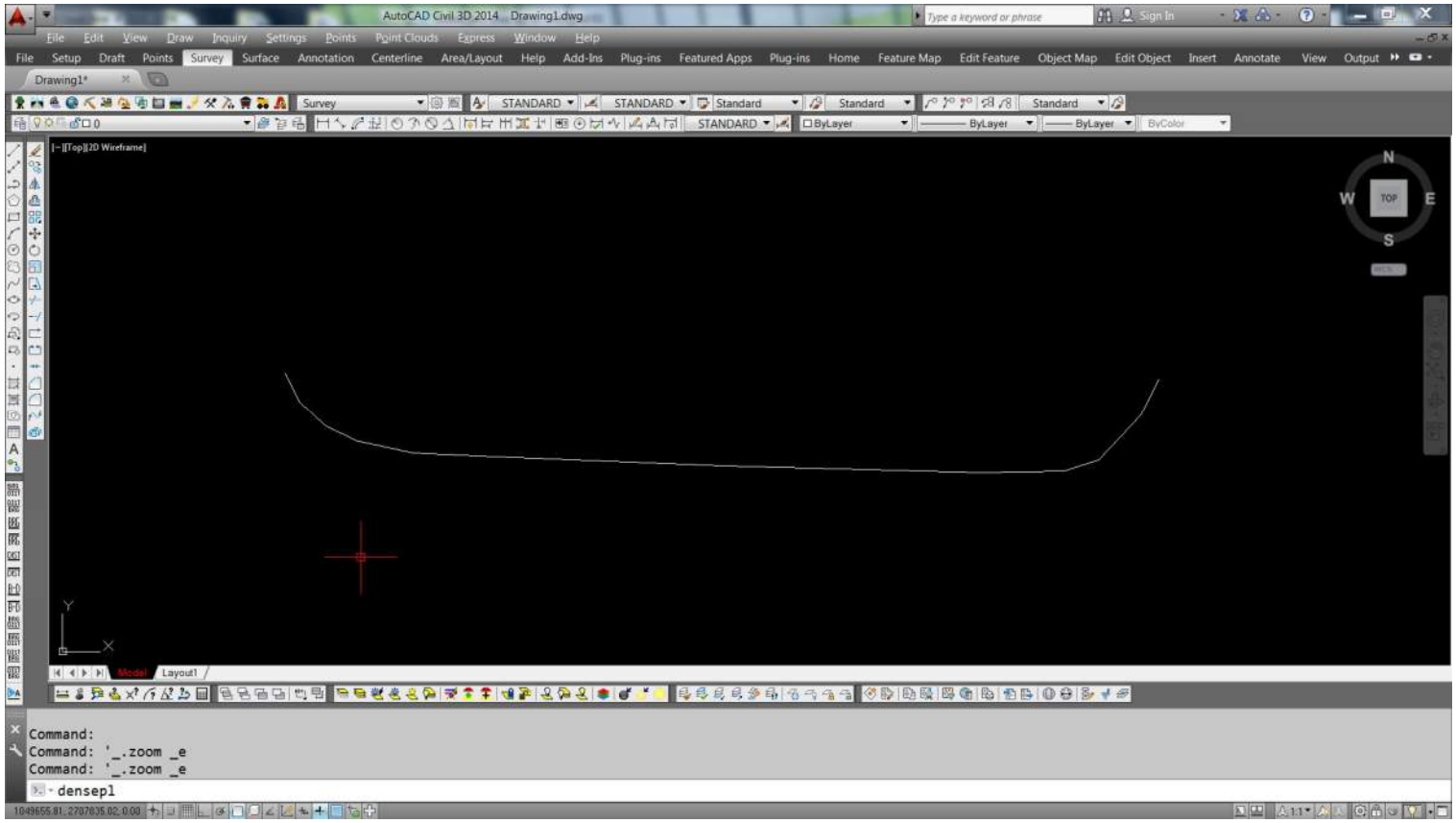
- Point – points with your F2F codes
- Polylines – simple 3-d polylines
- Cloud – Select an area and create a neww (smaller) cloud
- Mesh – A surface
- Text – Text
- Grid – Grid

Extract -

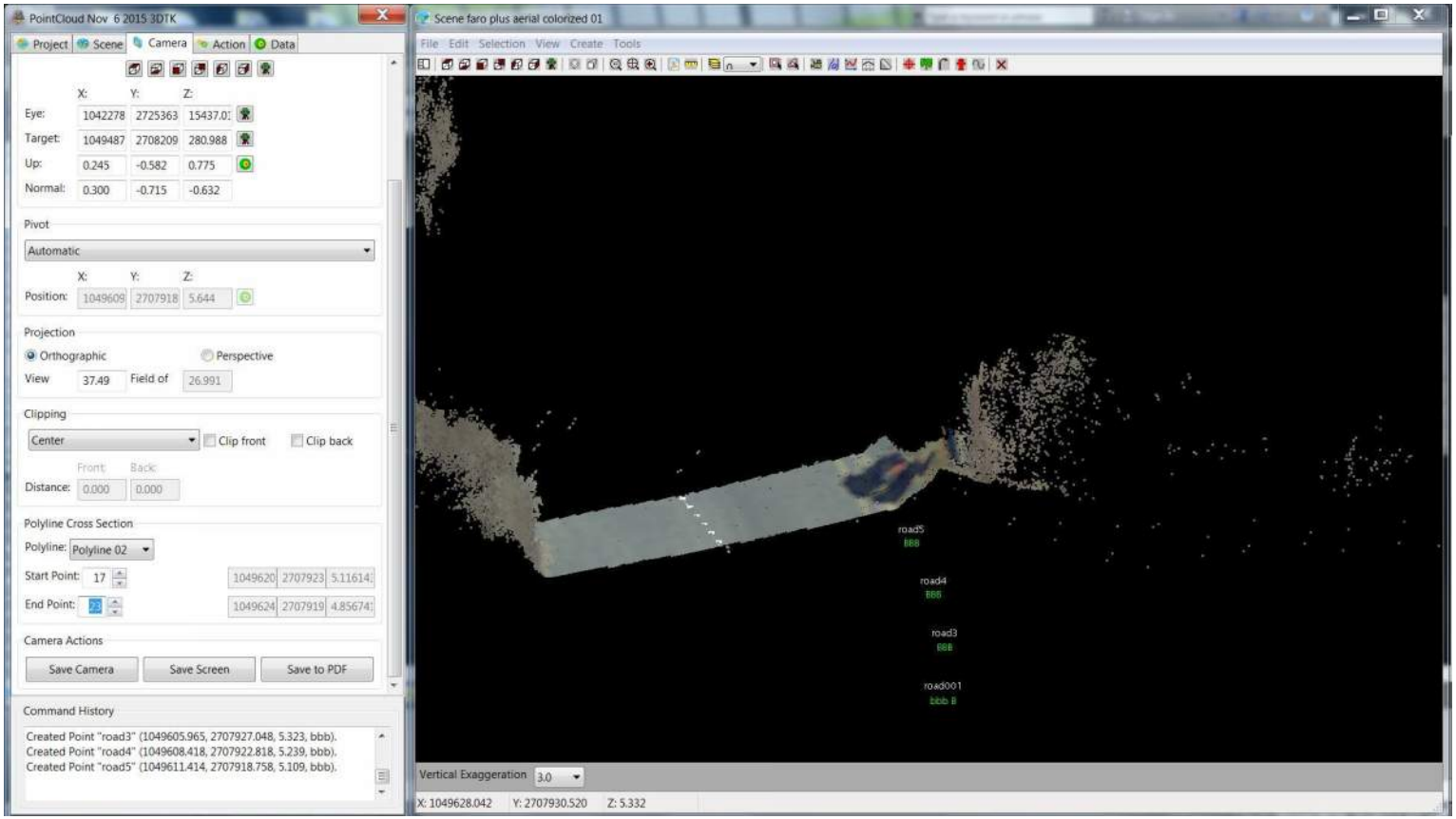
- Breaklines – from a mesh
- Contours – from a mesh
- Profile & Section – need a CL file in Carlson
- Bare Earth – Creates a new cloud with the ground only
- Plane – flat plane
- Intersections – Intersects two planes
- Polyline – Automatic extraction based on Intensity



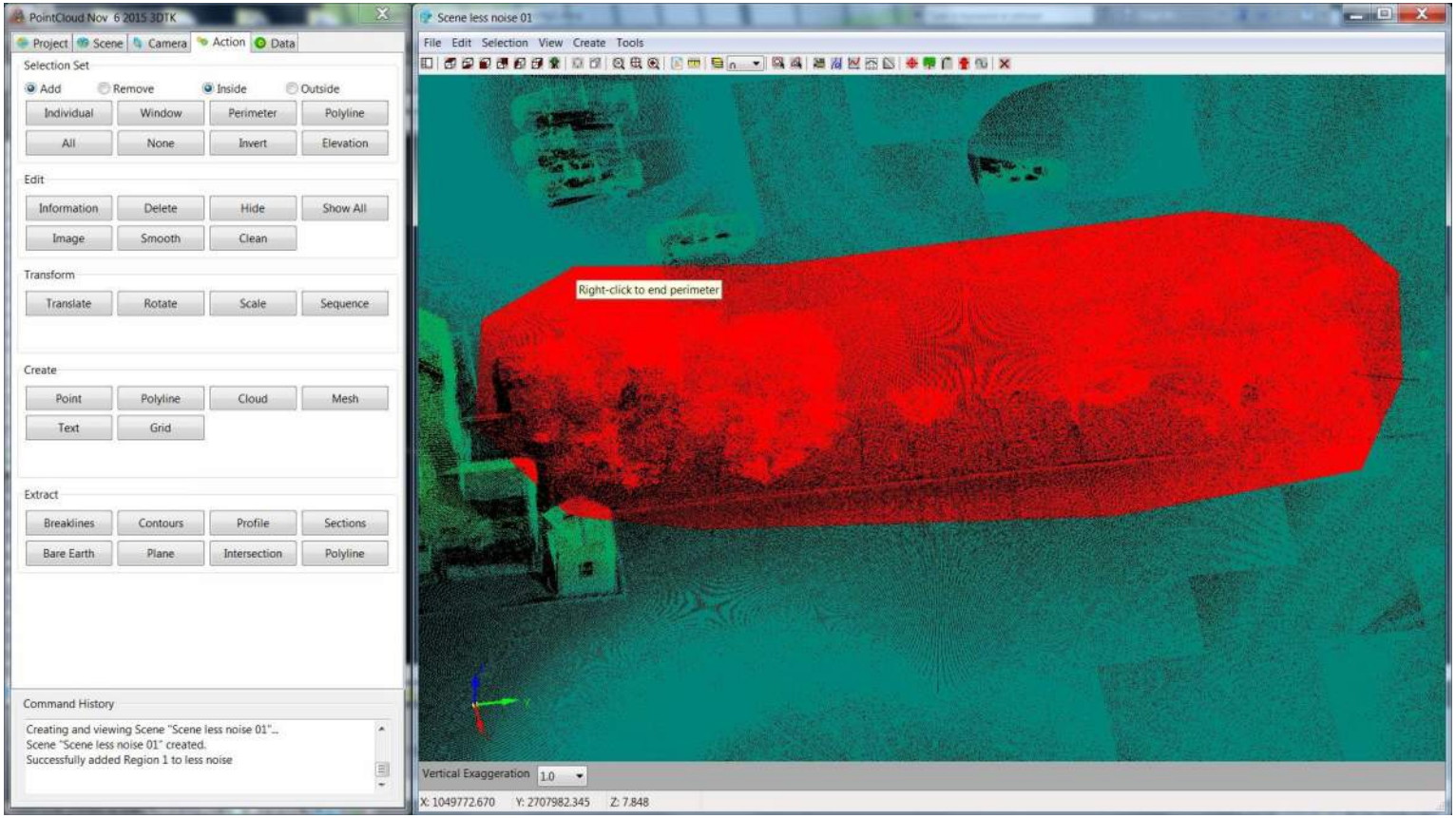
A polyline was created along the centerline of the drive. At this vantage, it appears to be above and below the cloud.



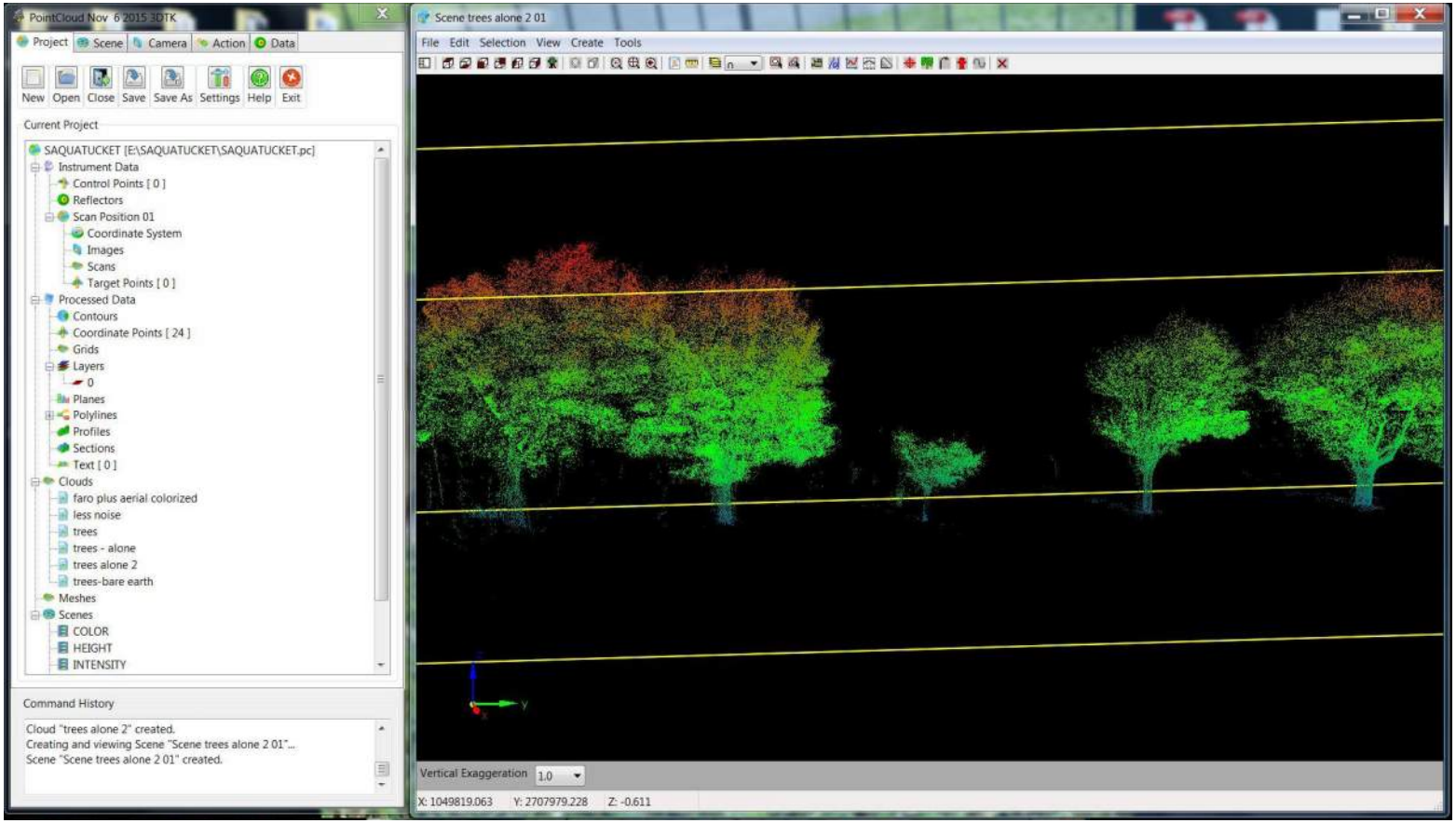
The polyline can be quickly drawn into the open CAD session. The same goes for points and Field 2 Finish can be executed directly from the Point Cloud module.
The objects in a CAD drawing can be imported into the Point Cloud session.



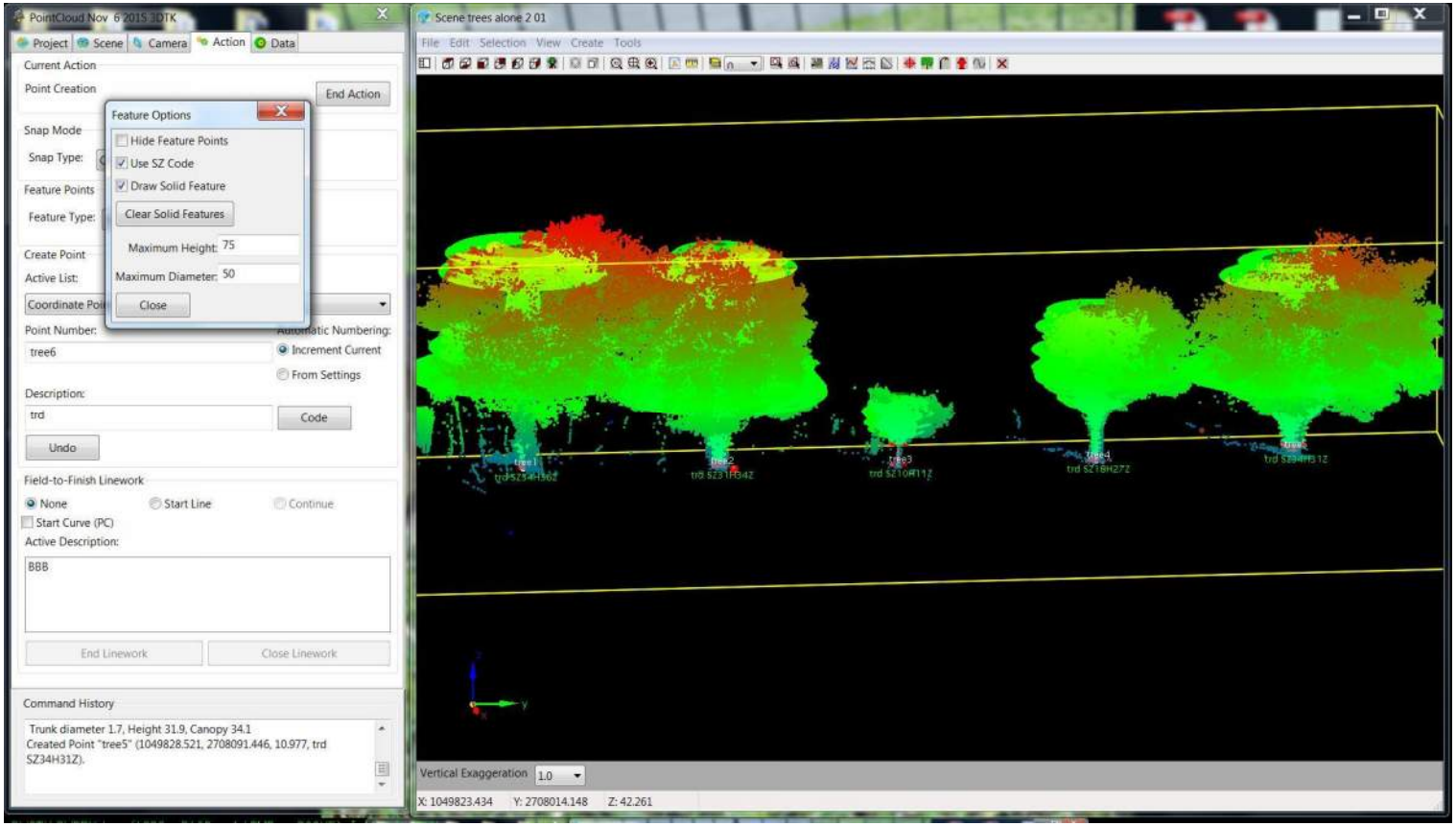
The polyline can be used to show a slice of the cloud. The points shown here are along the flow line at the base of a Cape Cod Berm. The cloud has been vertically exaggerated by 3.



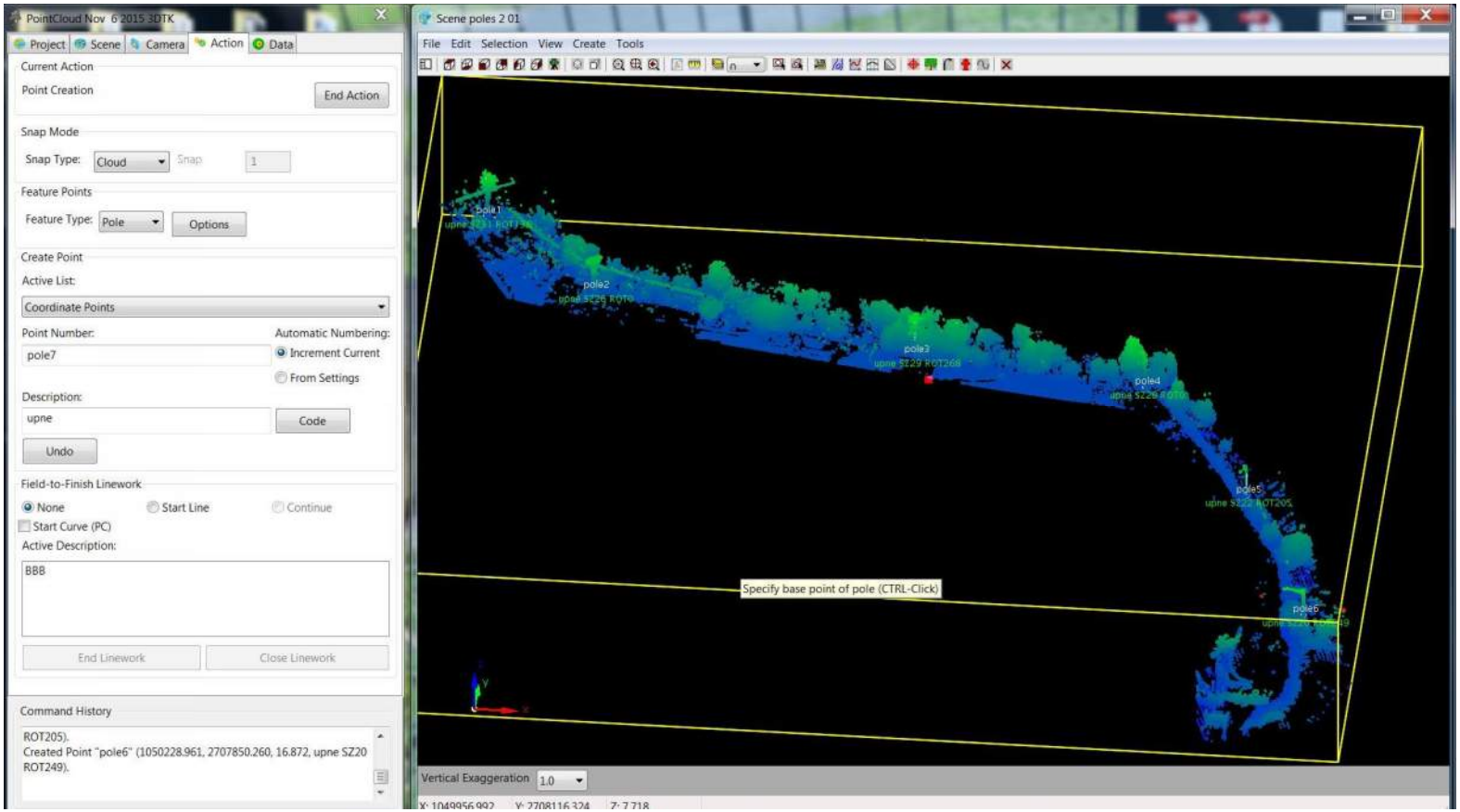
The cloud is being viewed by height. The red is a selection set to be isolated.



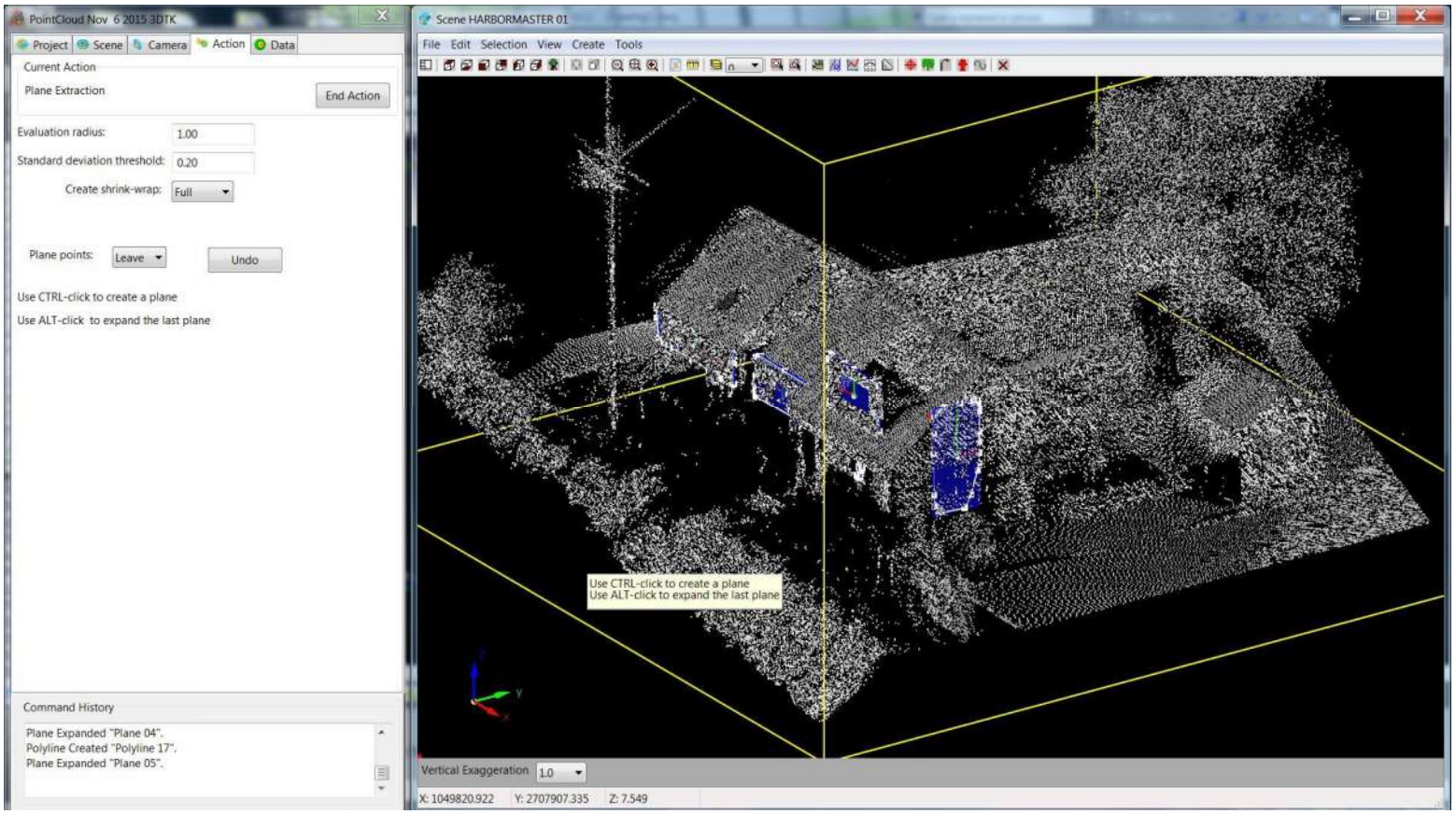
Some additional isolation and resetting the range for height coloration shows the trees.



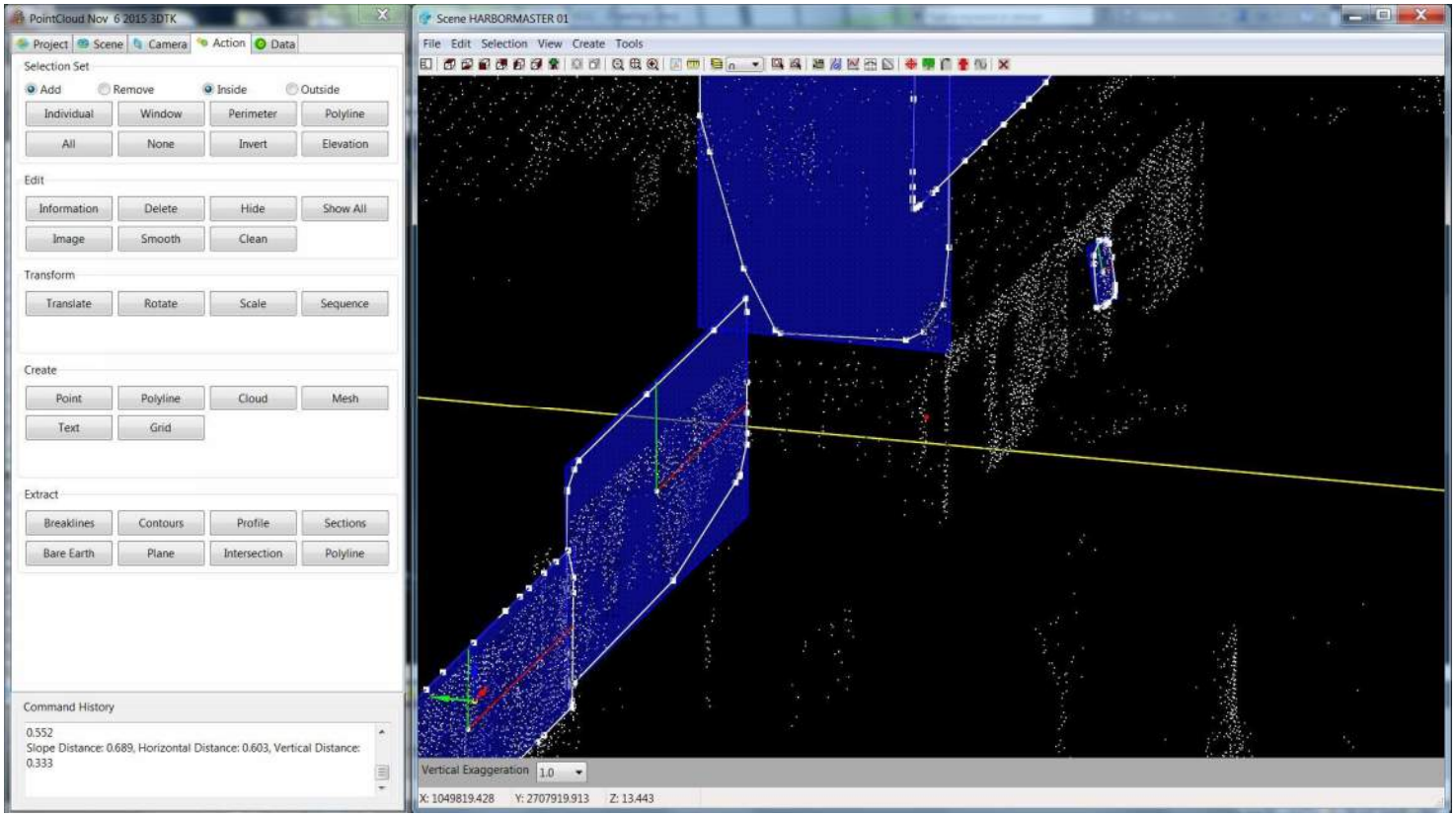
The software has tree extraction functions that work best with isolated trees. It will provide a coded descriptor with caliper, height and spread.



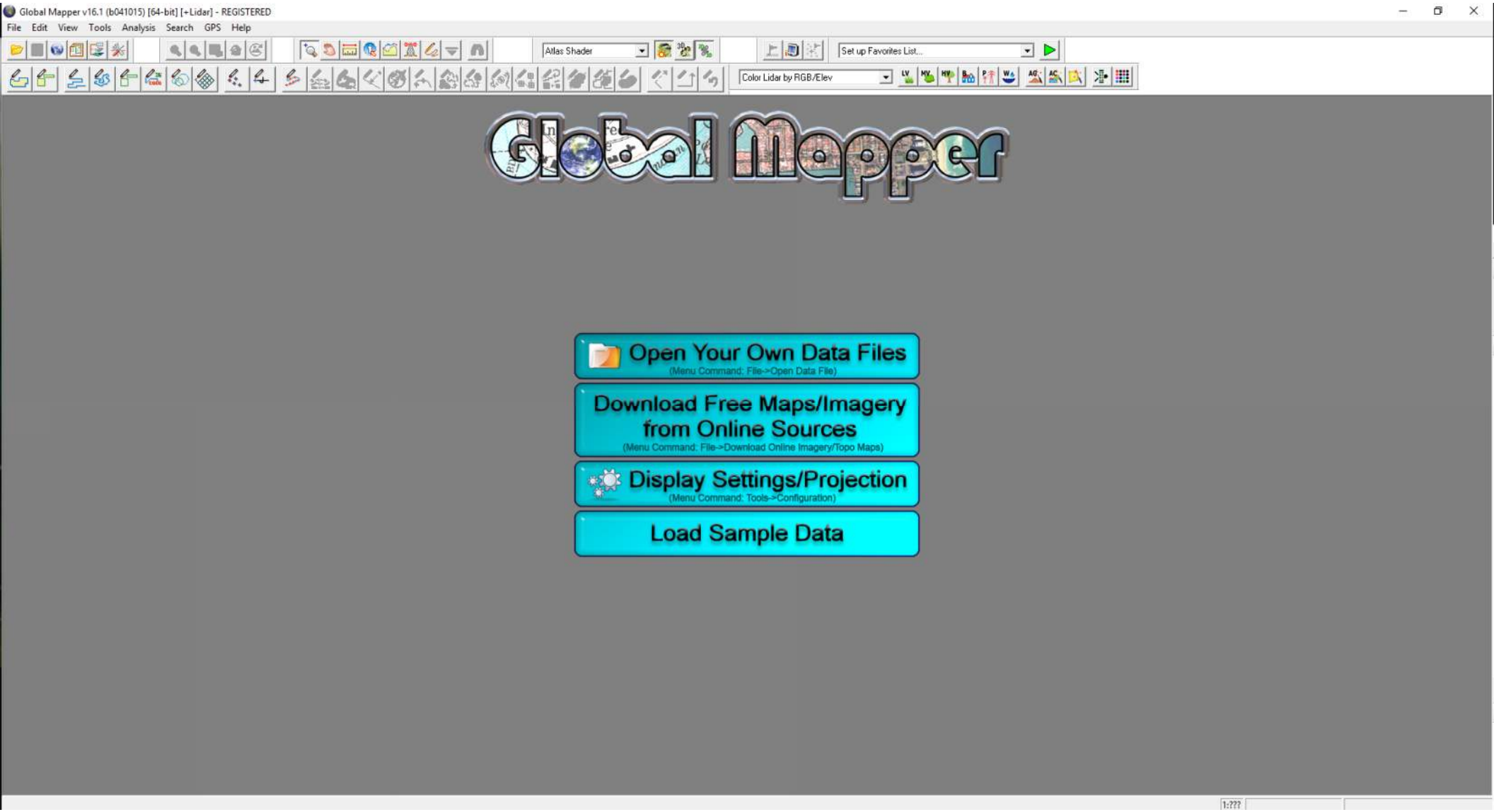
Isolating another part of the cloud allows for the quick extraction of the utility poles. The lines show up and the height above a road can be determined.



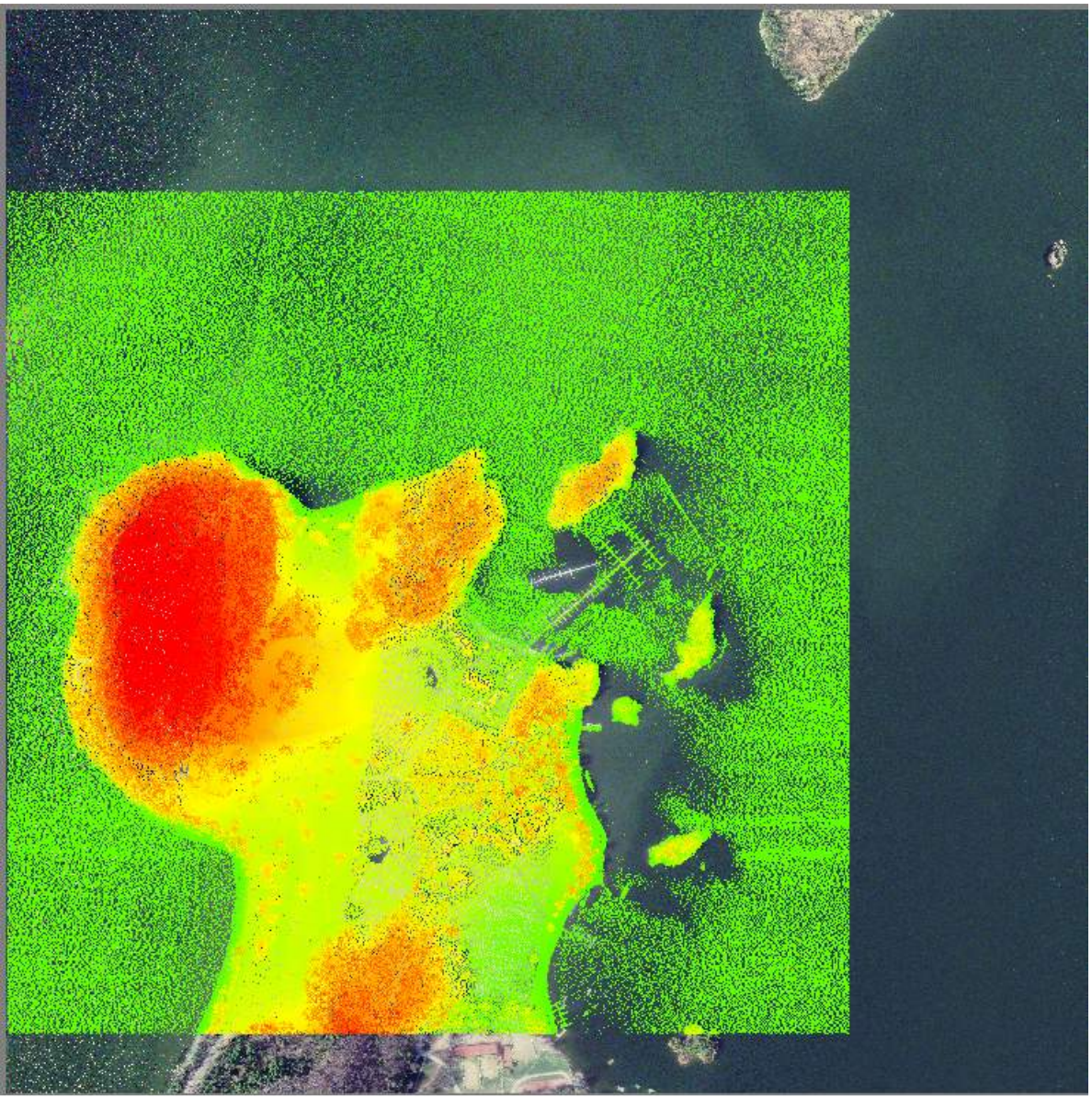
If you can see this building, then good. The blue patches are planes extracted from visible sides. These can be intersected to form corners. The can also be imported into 3d CAD.



The other side of the building.

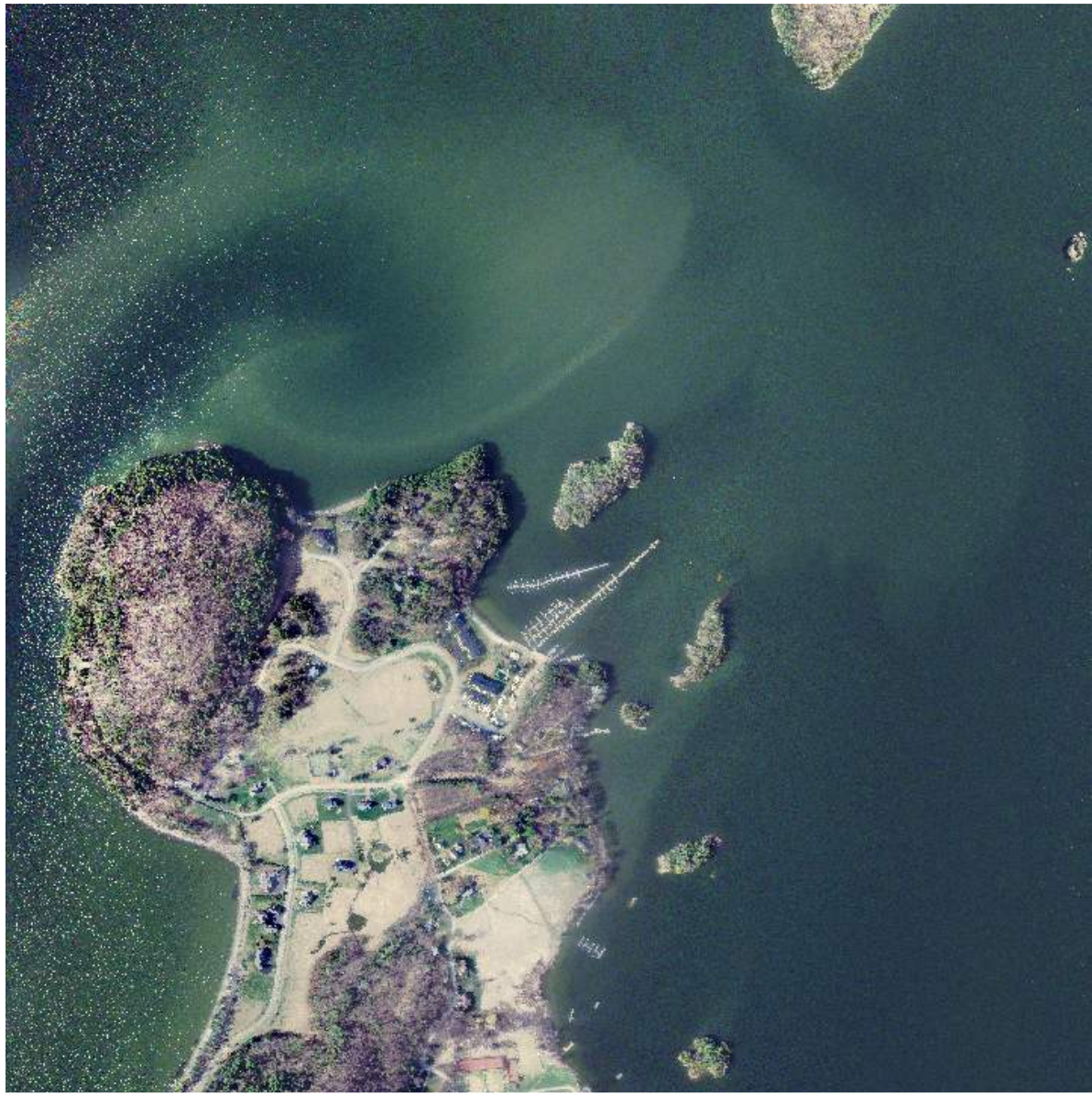

Global Mapper v16.1 (b041015) [64-bit] [+Lidar] - REGISTERED
File Edit View Tools Analysis Search GPS Help
Atlas Shader
Set up Favorites List...
Color Lidar by RGB/Elev
Global Mapper
Open Your Own Data Files
(Menu Command: File->Open Data File)
Download Free Maps/Imagery from Online Sources
(Menu Command: File->Download Online Imagery/Topo Maps)
Display Settings/Projection
(Menu Command: Tools->Configuration)
Load Sample Data
1:???

Colchester, VT



USGS Earth Explorer does have some high resolution orthoimagery.

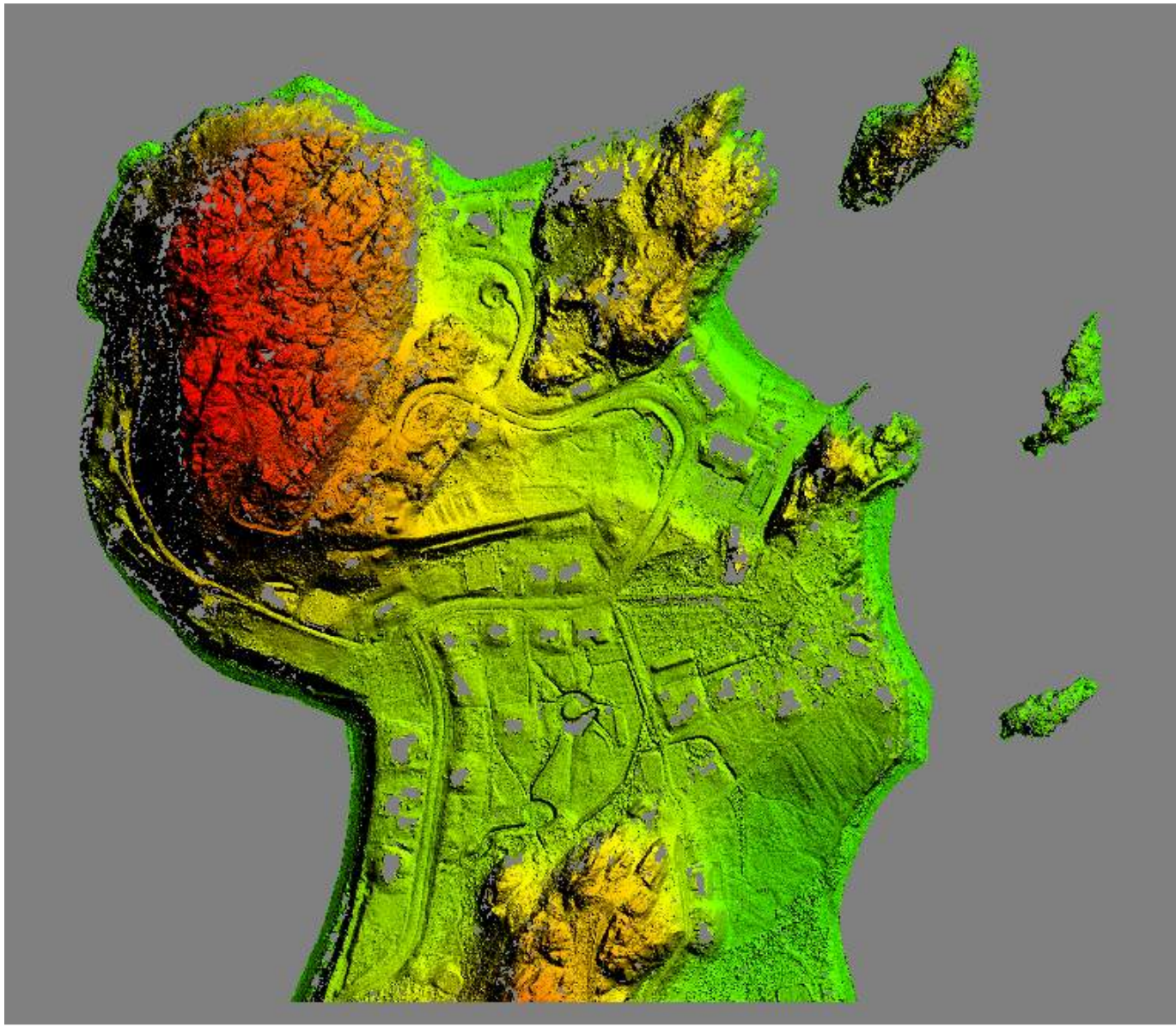
The cloud is still there, it has been colorized based on the imagery.

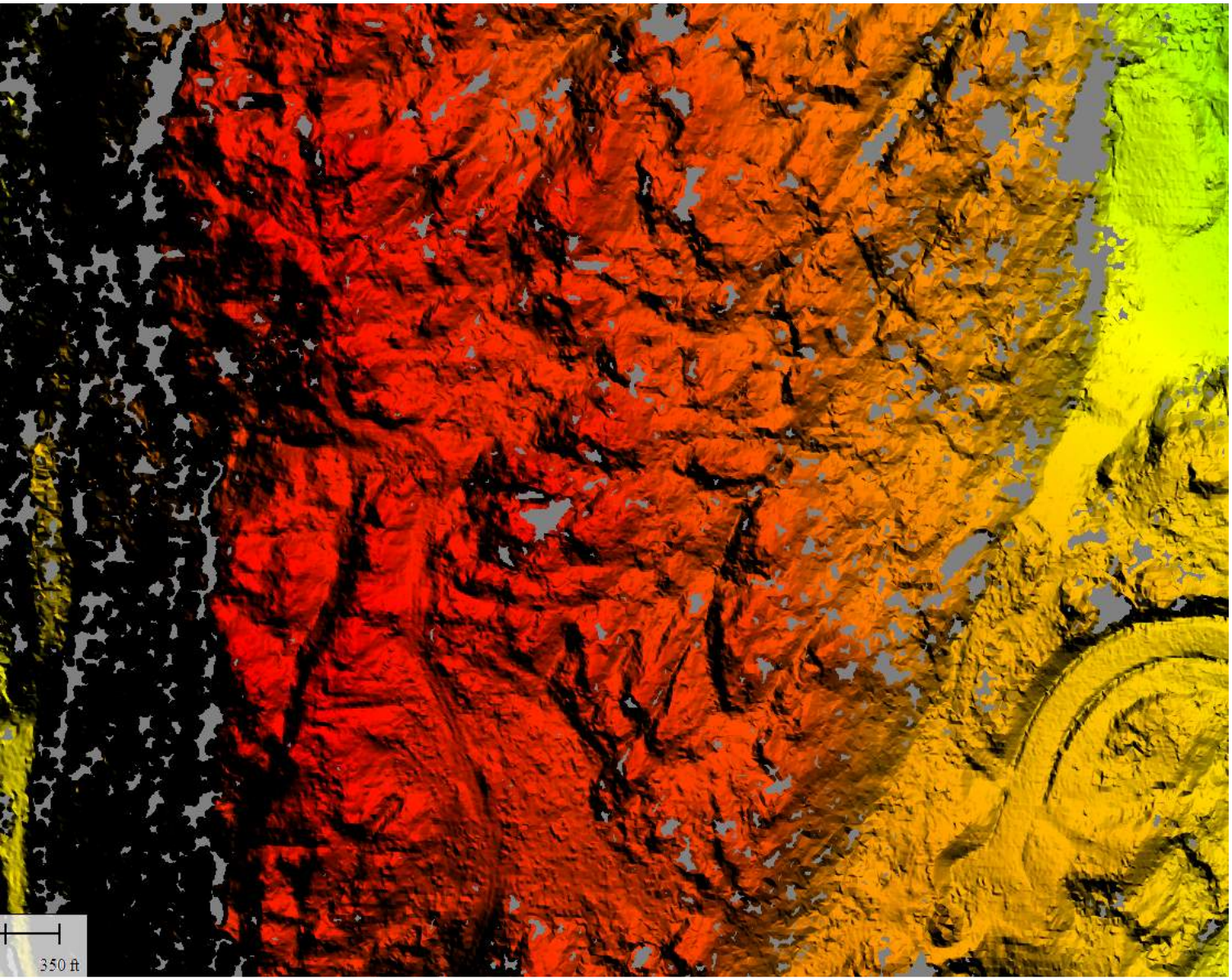


This is just colorized cloud.

Just the ground points.

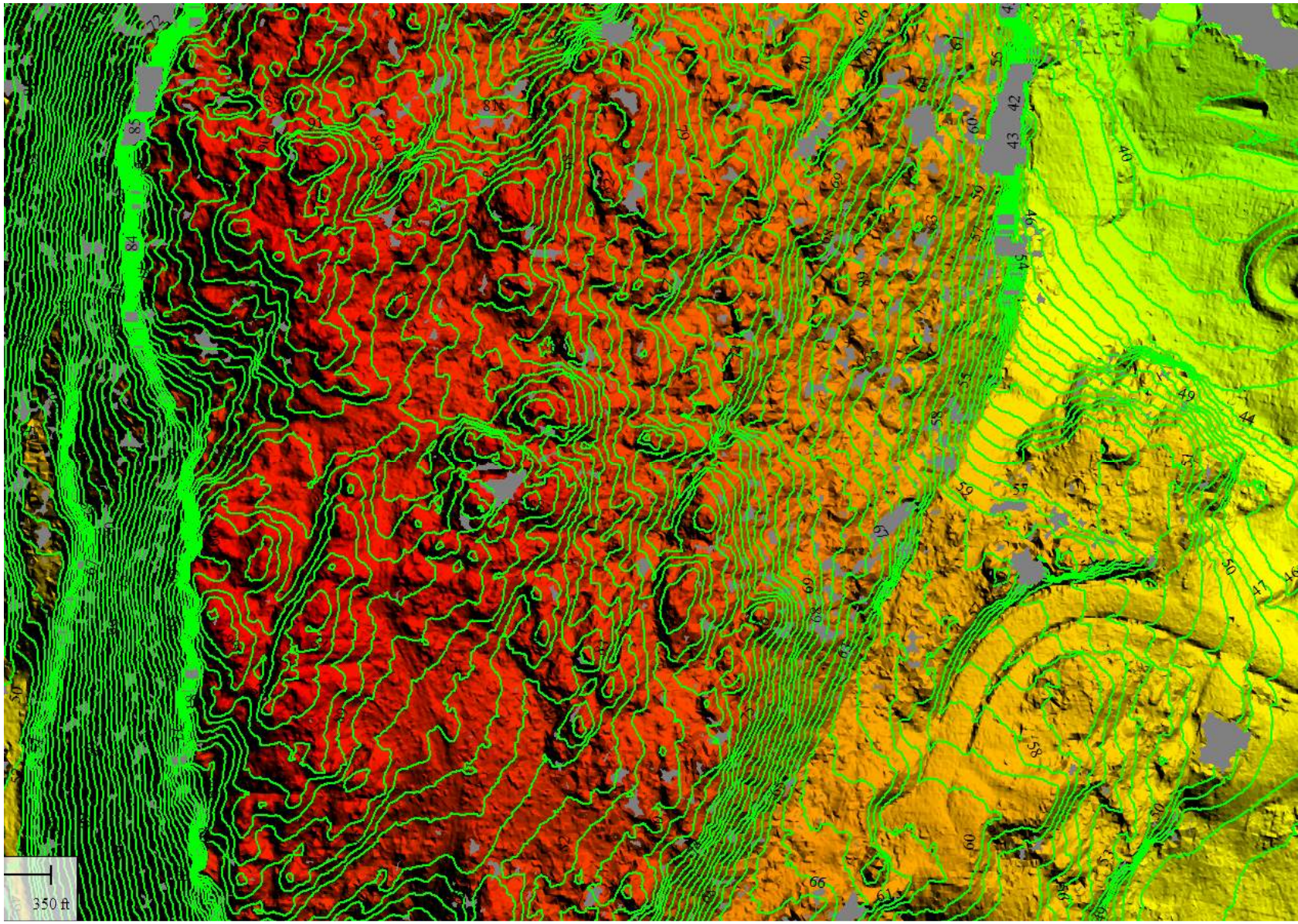
A surface model. This is very similar to the Fugro surface model.



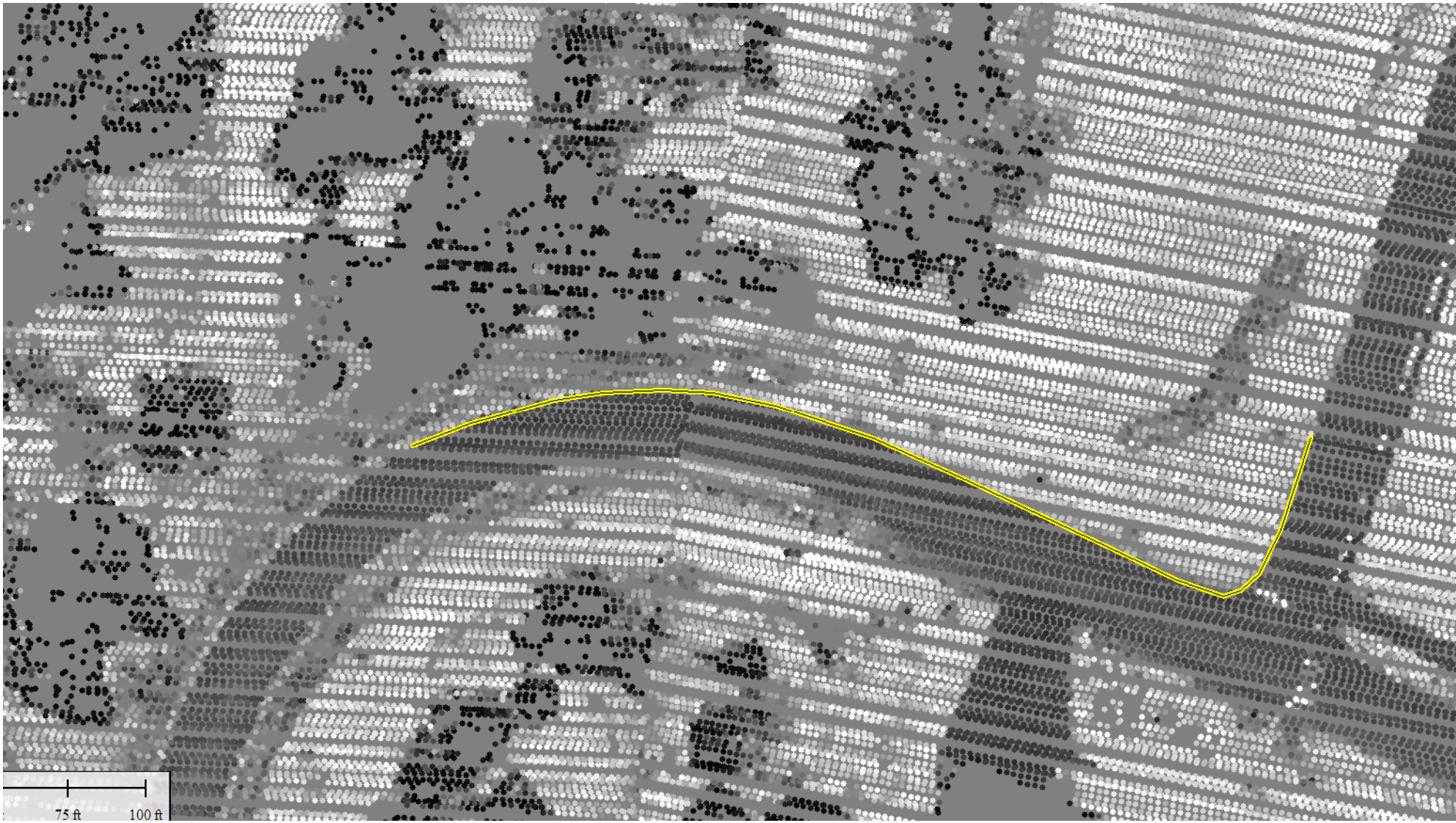


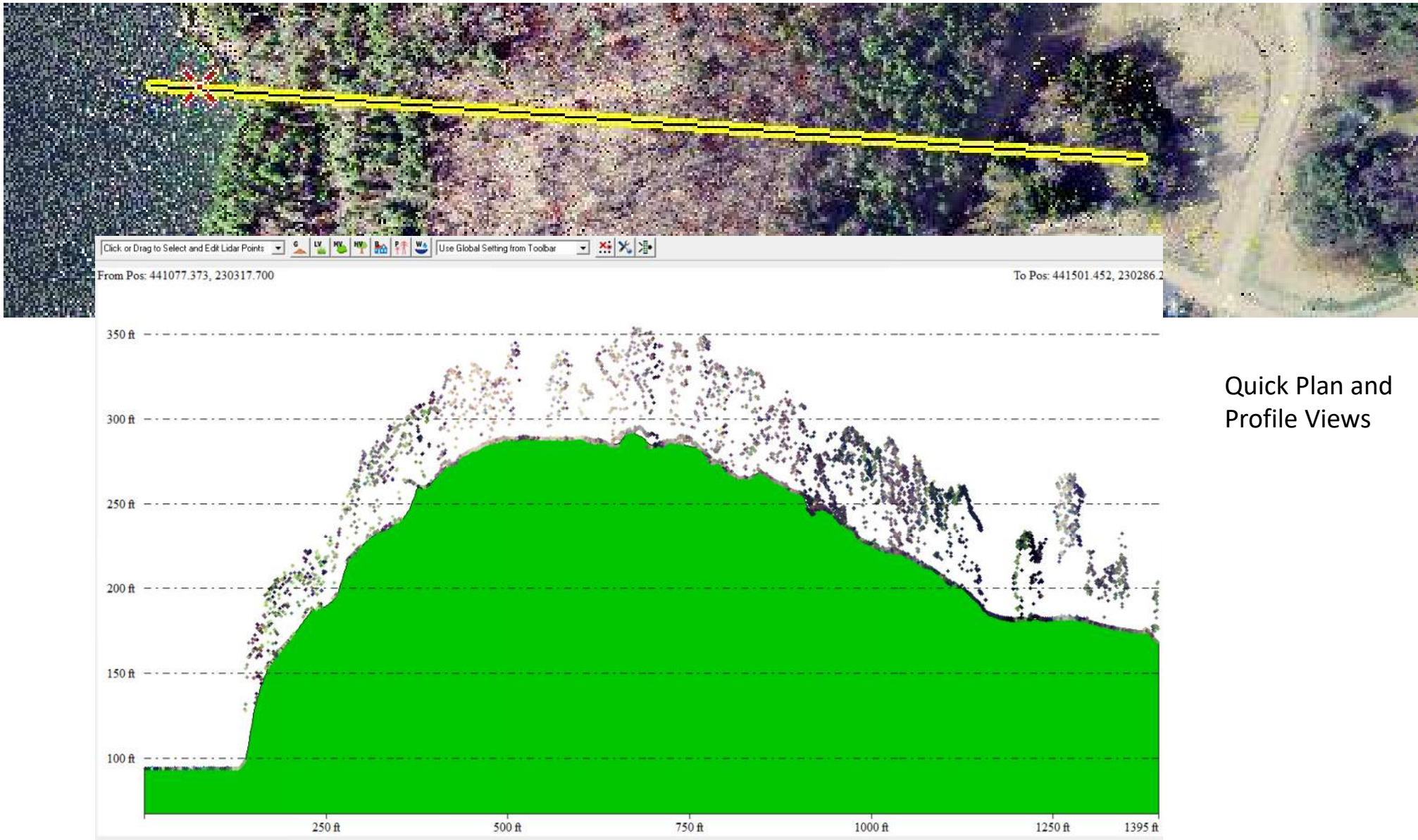
It looks like some trails and some geology atop this rock.

Contours can be created and exported to CAD or SHP. Surface models can be exported.

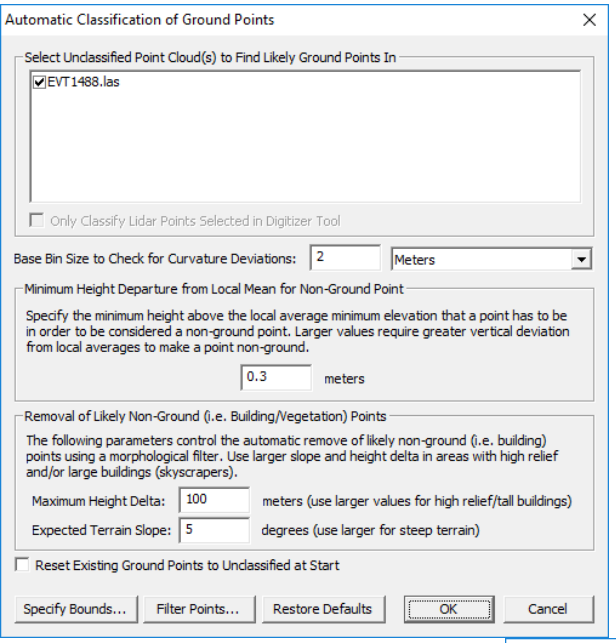


Linework can be determined and extracted (Digitized)

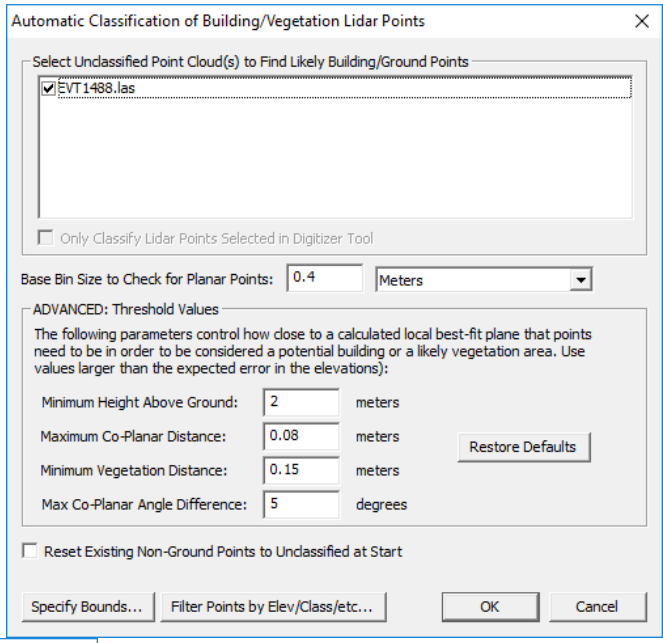


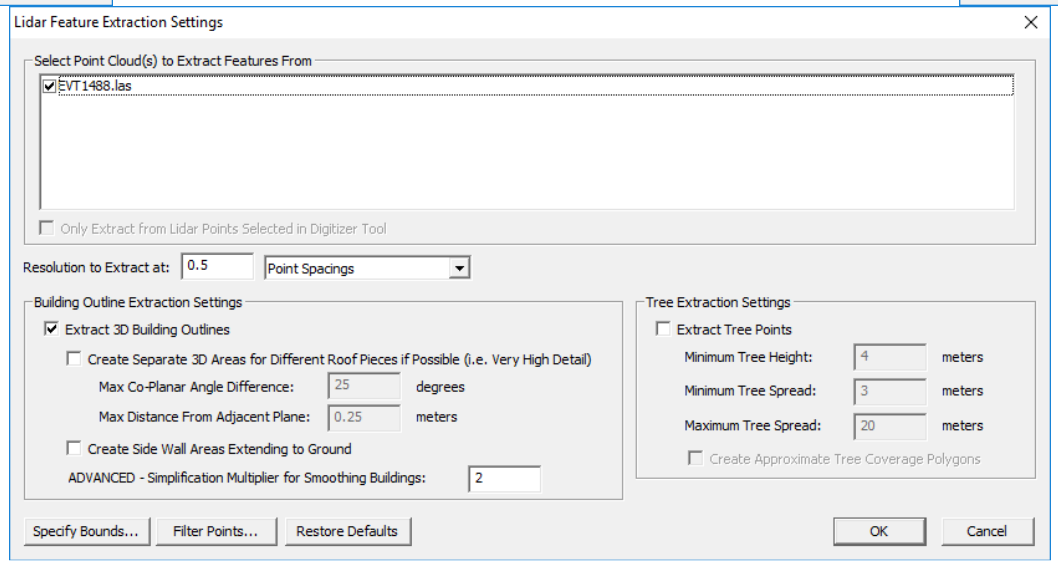


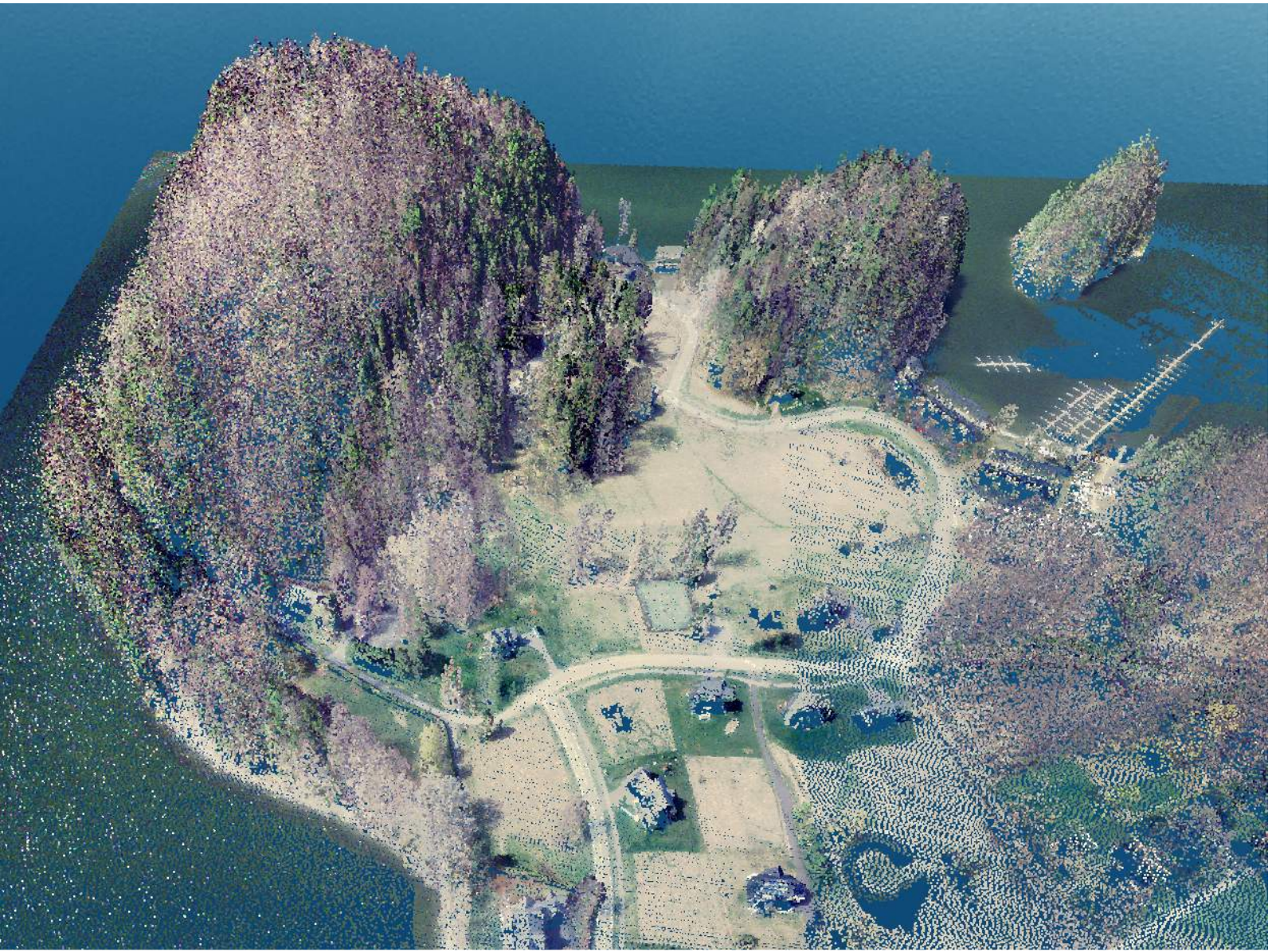
Quick Plan and Profile Views



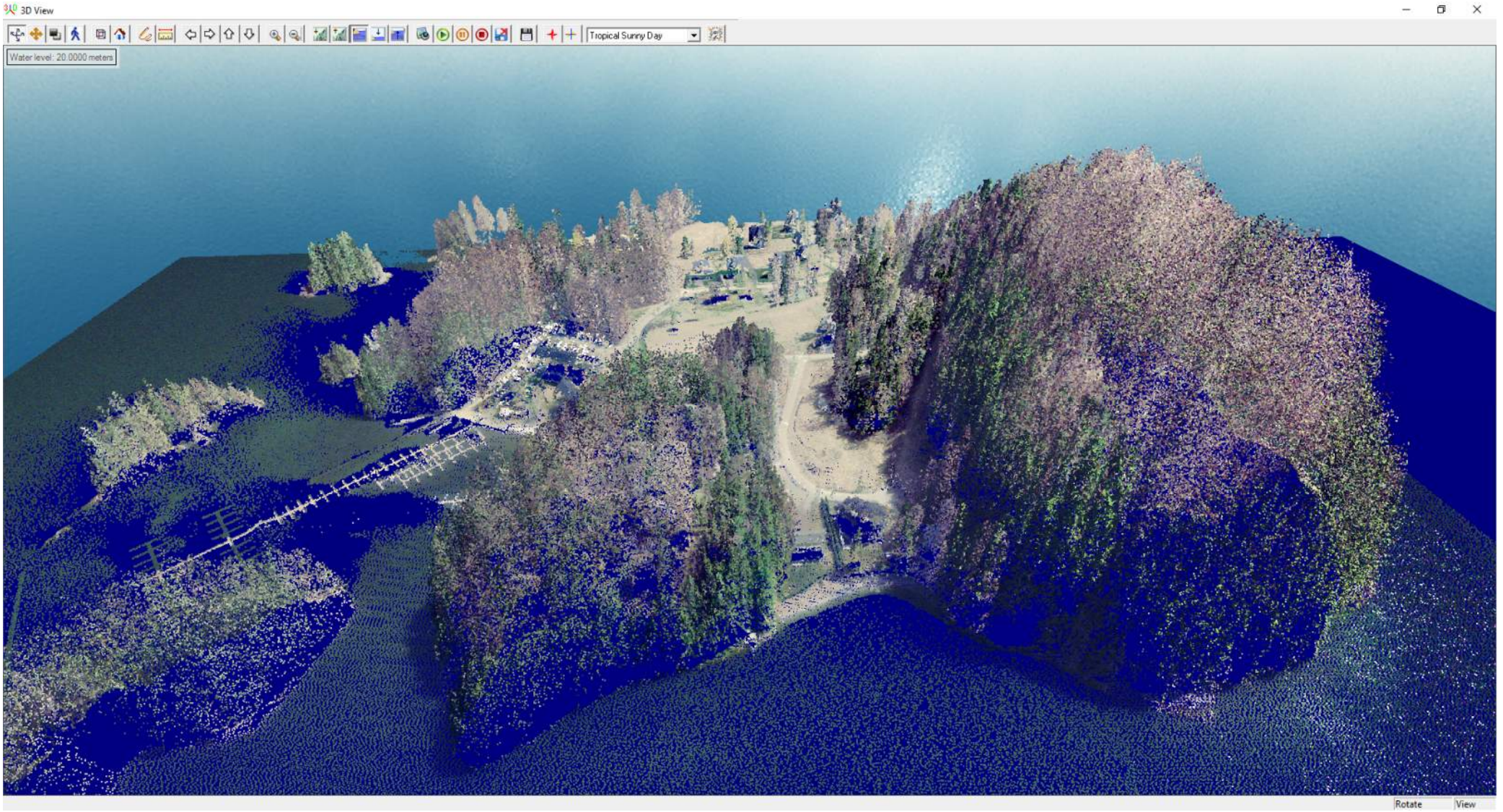
Now we can get into the real fun: Classification Tools based on mathematical models of the world in point format. Pull out the ground, vegetation and buildings. Results can be verified and adjusted as needed.
Once classified, there are some features that can be extracted.



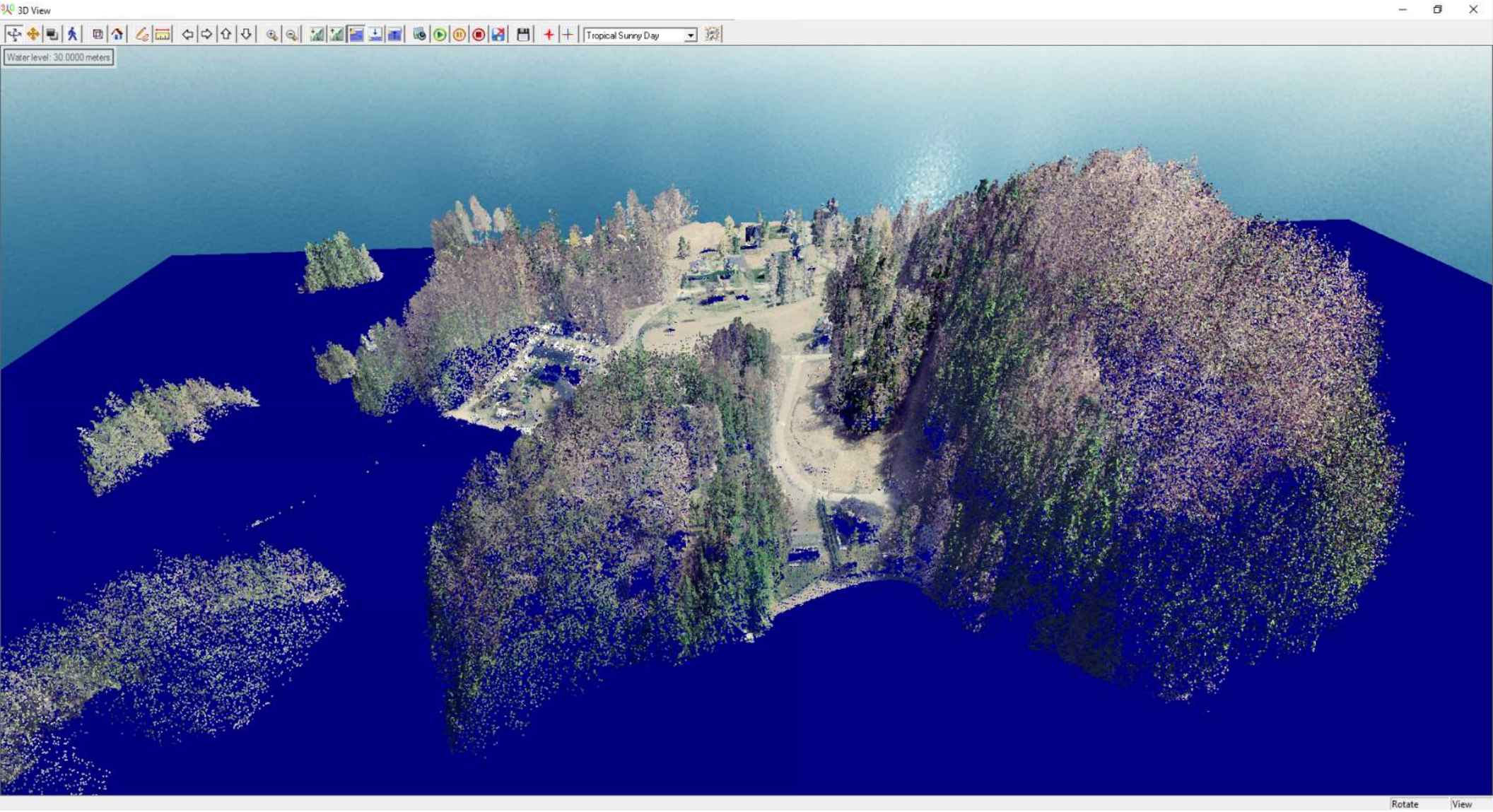


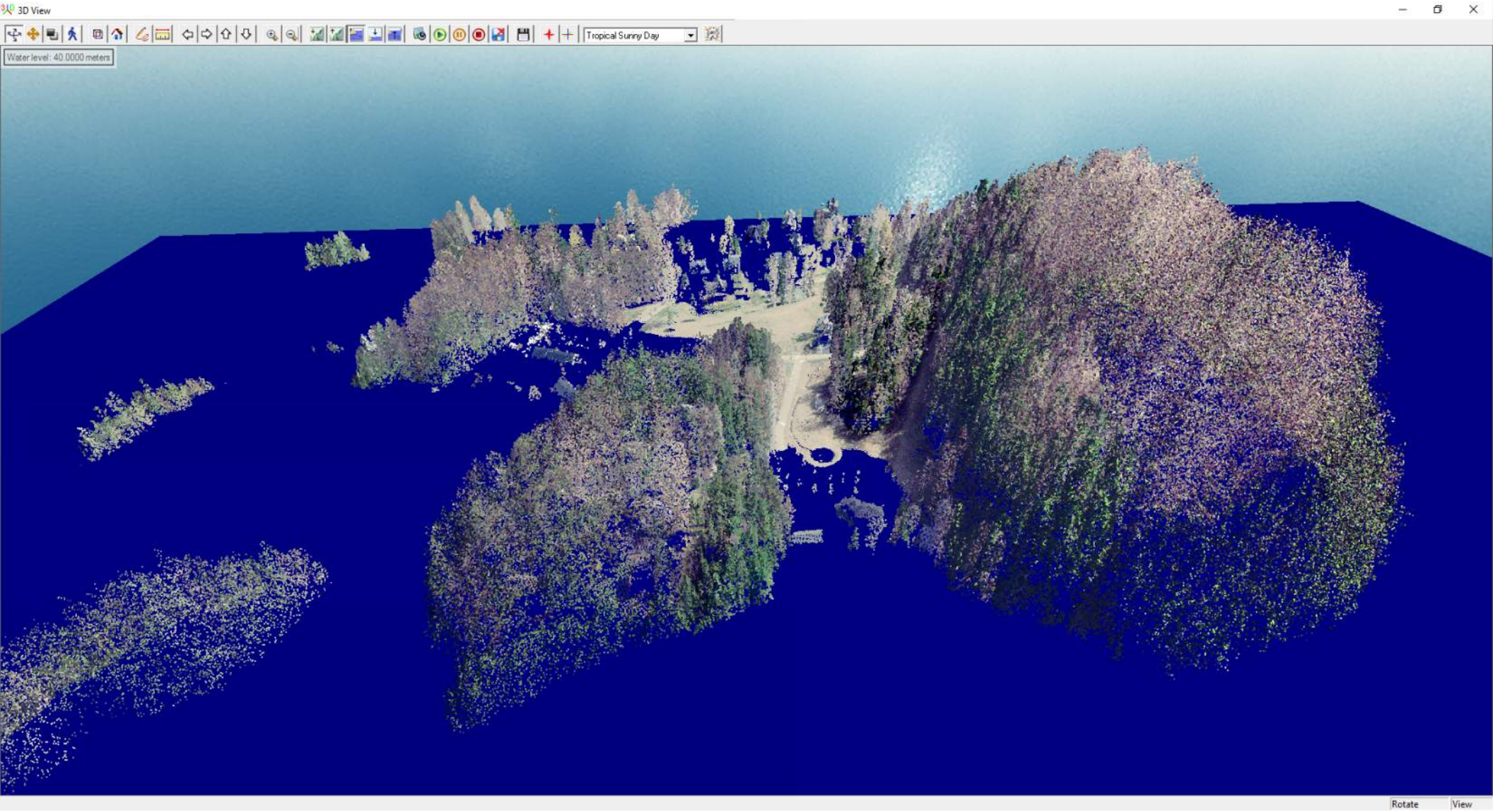


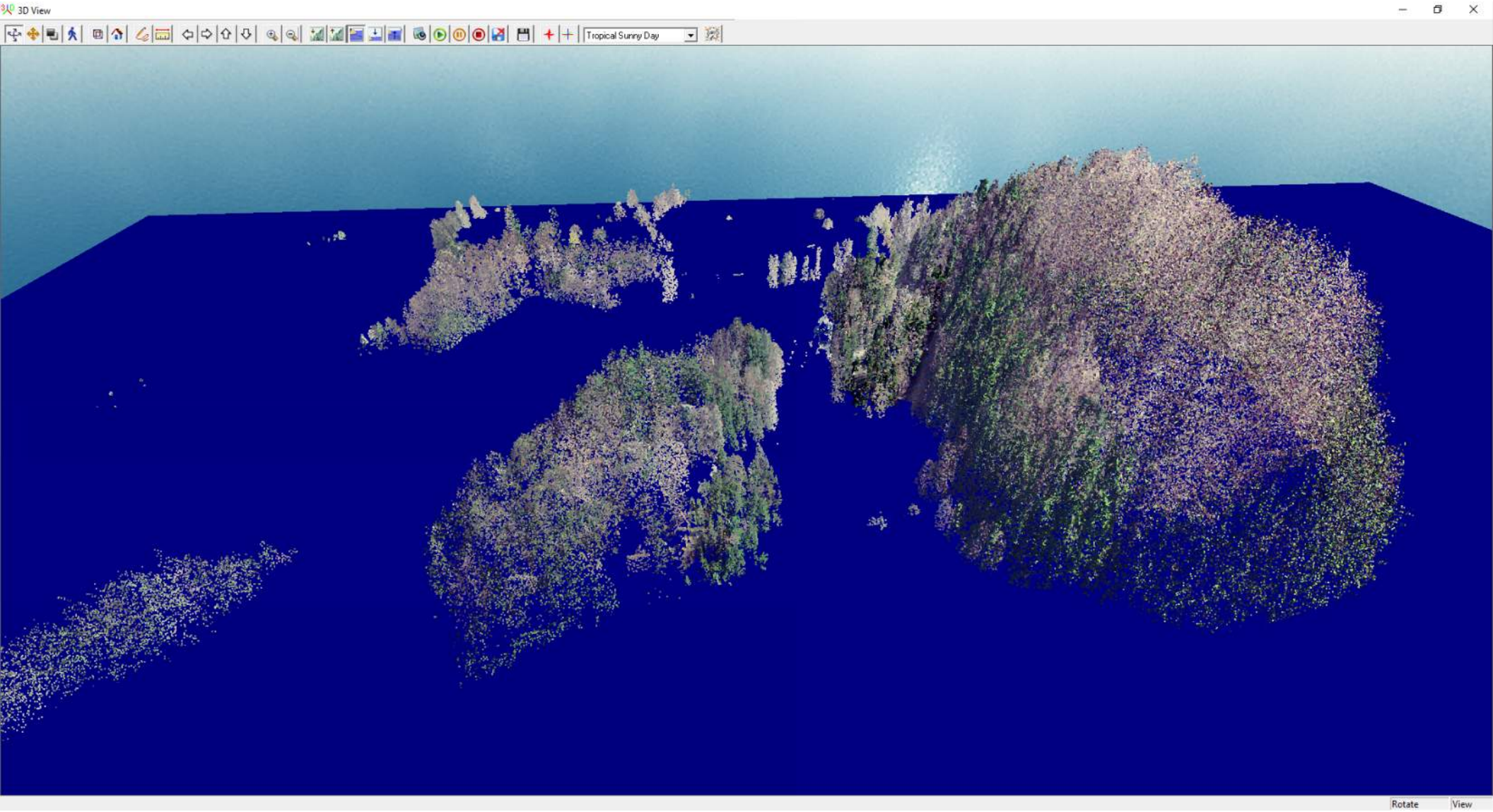
All the previous work was completed in 2d from above. There is also a 3d viewer.



Flood visualization. (Not well advanced for large area flood analysis)


3D View
Tropical Sunny Day
Water level: 30.0000 meters
Rotate
View


3D View
Tropical Sunny Day
Water level: 40.0000 meters
Rotate
View


3D View
Tropical Sunny Day
Rotate
View

LiDAR

VERMONT SOCIETY *of* LAND SURVEYORS

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