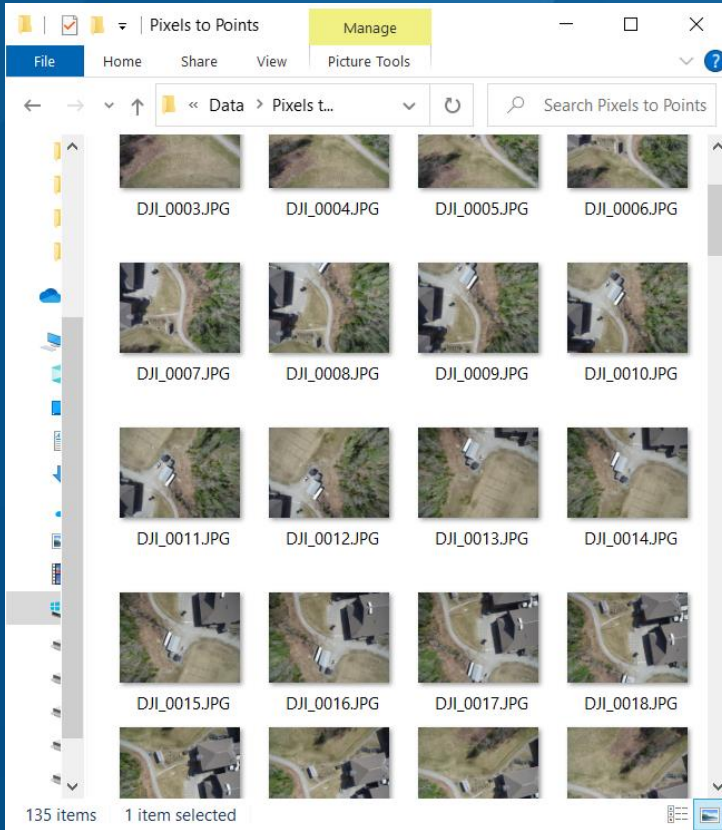


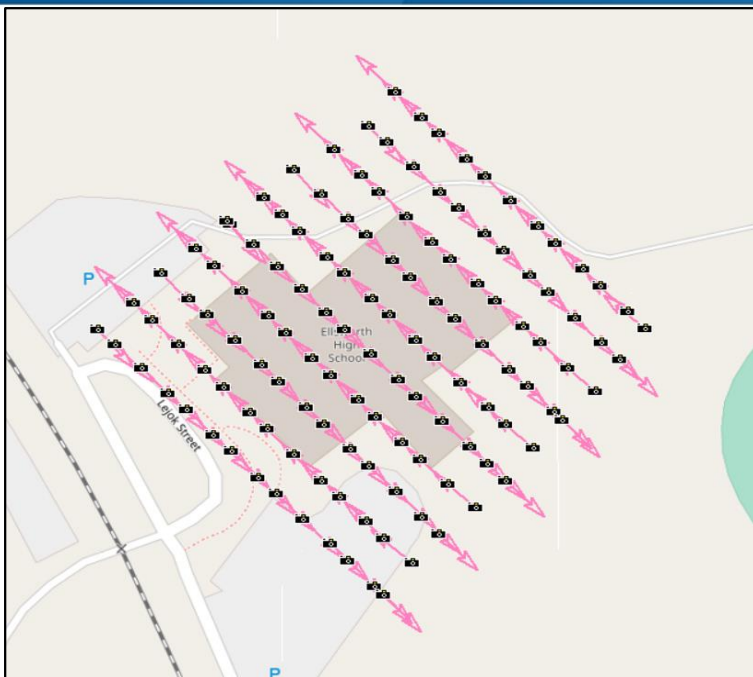
Creating a Digital Twin with UAV-collected Data





Agenda

- Data Requirements
- Data Preparation
- Create high-density 3D point cloud using SfM
- Data thinning
- Identify points for ground classification
- Vertical rectification
- Identify buildings with segmentation classification method
- Extract building features
- Create digital terrain model

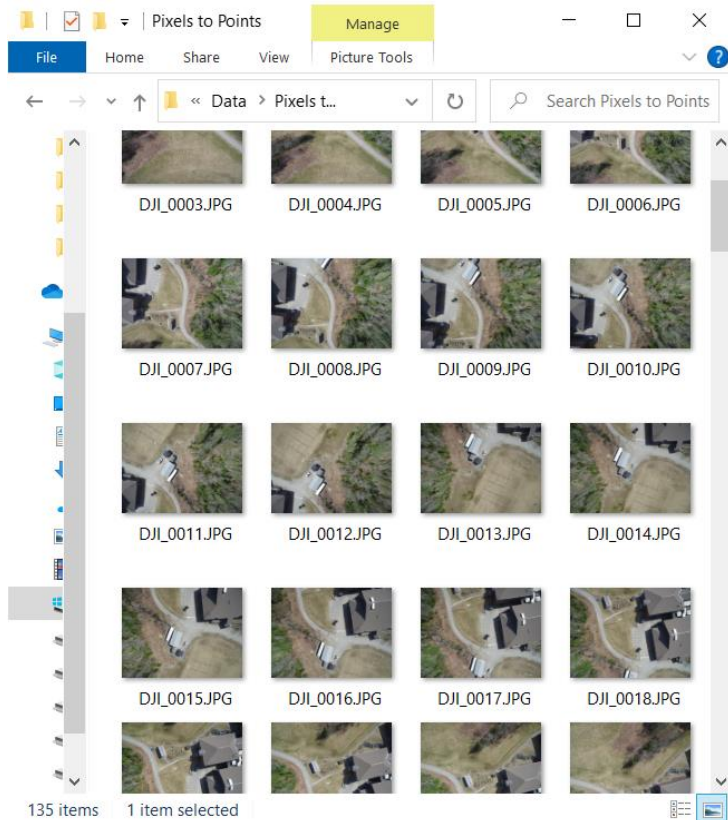


Images collected
by Kelly Bellis

Available Data

- Publicly Available Data
 - USGS 3DEP
 - Open Street Maps
- UAV-collected image set
 - Geotagged
 - Overlapping





Data Requirements

- Static
- Identifiable Features
- Image Overlap

Optimal conditions for data collection:

- High visibility
- Low wind



Data Preparation

- Evaluate Image overlap
- Image clarity
- Remove erroneous images
(apply masks if needed)

Input Image Files 130 of 130 Images Checked

Filename	Latitude	Longitude	Elevation	Relative Altit.
<input checked="" type="checkbox"/> DJI_0001.JPG	44° 33' 21.9403" N	68° 25' 35.5297" W	163.841 m	50 m
<input checked="" type="checkbox"/> DJI_0002.JPG	44° 33' 22.1687" N	68° 25' 35.8428" W	163.641 m	49.8 m
<input checked="" type="checkbox"/> DJI_0003.JPG	44° 33' 22.5294" N	68° 25' 36.3198" W	163.341 m	49.5 m
<input checked="" type="checkbox"/> DJI_0004.JPG	44° 33' 22.7597" N	68° 25' 36.6382" W	163.741 m	49.9 m
<input checked="" type="checkbox"/> DJI_0005.JPG	44° 33' 23.1116" N	68° 25' 37.1161" W	163.441 m	49.6 m
<input checked="" type="checkbox"/> DJI_0006.JPG	44° 33' 23.3502" N	68° 25' 37.4263" W	163.841 m	50 m
<input checked="" type="checkbox"/> DJI_0007.JPG	44° 33' 23.7030" N	68° 25' 37.9056" W	163.641 m	49.8 m
<input checked="" type="checkbox"/> DJI_0008.JPG	44° 33' 24.0523" N	68° 25' 38.3702" W	163.141 m	49.3 m

Ground Control Points

Name	Symbol	# Points	Snap	Latitude	Longitude	Elevation	X	Y

Image Preview (DJI_0006.JPG)

Buttons: New Point..., Remove Selected, Add Control Point to Image..., New Mask..., Home

Outputs

- Point Cloud: Generated Point Cloud, C:\Data\My project.gmp, Select...
- Create Point Cloud by Resampling Mesh (3D Model) [Takes Longer but Less Noisy Result]
- Orthoimage: Generated Orthoimage, C:\Data\My project.gmp, Select...
- Resolution: 1, Point Spacings, Resampling: No Resampling (Nearest Neighbor)
- Create Higher Quality Orthoimage from Mesh (3D Model) [Takes Longer]
- Ortho-rectify Each Image Individually
- Mesh / 3D Model: Generated Mesh, C:\Data\My project.gmp, Select...
- Log/Stats Folder: C:\Data\, Select...

Options

- Reduce Image Size (Faster / Less Memory) by Factor of 1
- Use Relative Altitude Based on Ground Height of 0 m
- Harmonize Color
- Enable Clustering: Upper Bound 100, Lower Bound 50
- Save Work Files to Allow Resuming Cancelled Operations Setup...
- Use GPU if Supported (CUDA / nVidia)
- Analysis Method:
 - Incremental / Sequential (Default) - Typically Best Option
 - Global - Works Well for Large Overlap, May be Much Faster and Provide Better Results in Some Situations
- Quality: Normal (Default), Camera Type: Pinhole Radial 3 (Default)

Buttons: Help..., RUN

Import Images

Ground Control Points

Pixels to Points in Global Mapper Pro

Analysis Methods

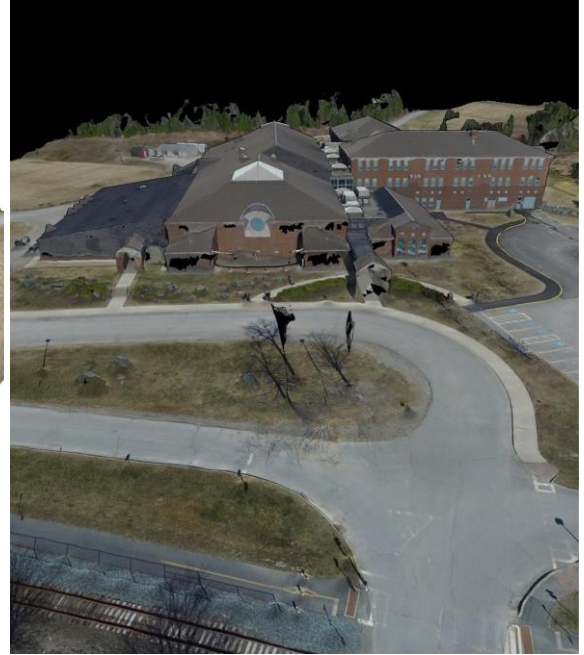
Point Cloud



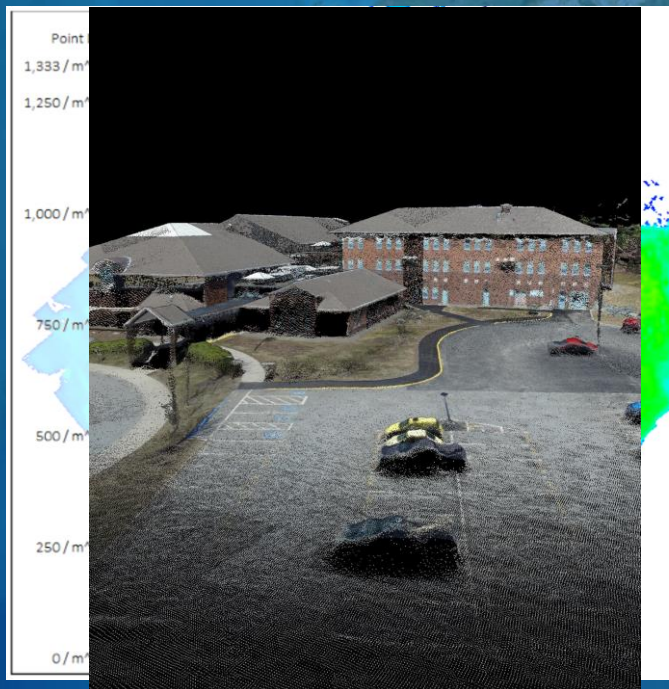
Orthoimage



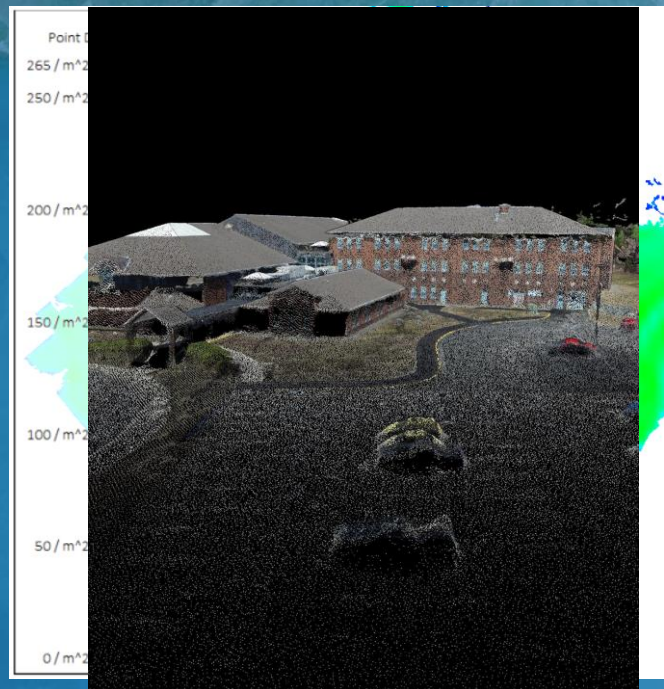
3D Model

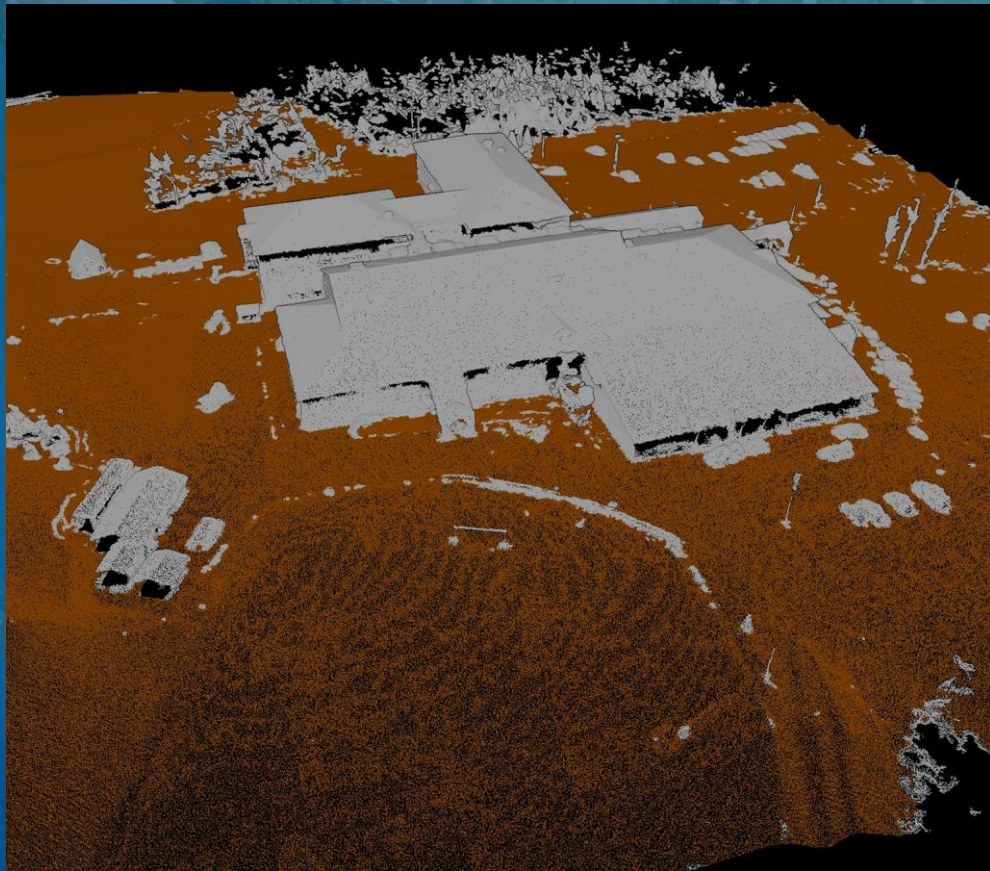


458.82 samples/m²



69.565 samples/m²





Ground Classification

- Segmentation classification

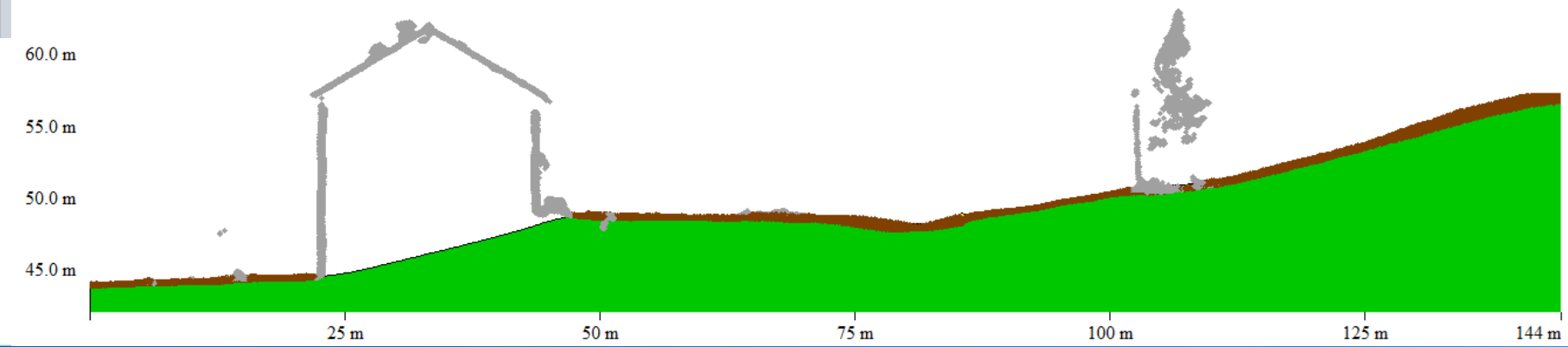
Vertical Rectification

Feature Measurement Information

Selected Feature Information

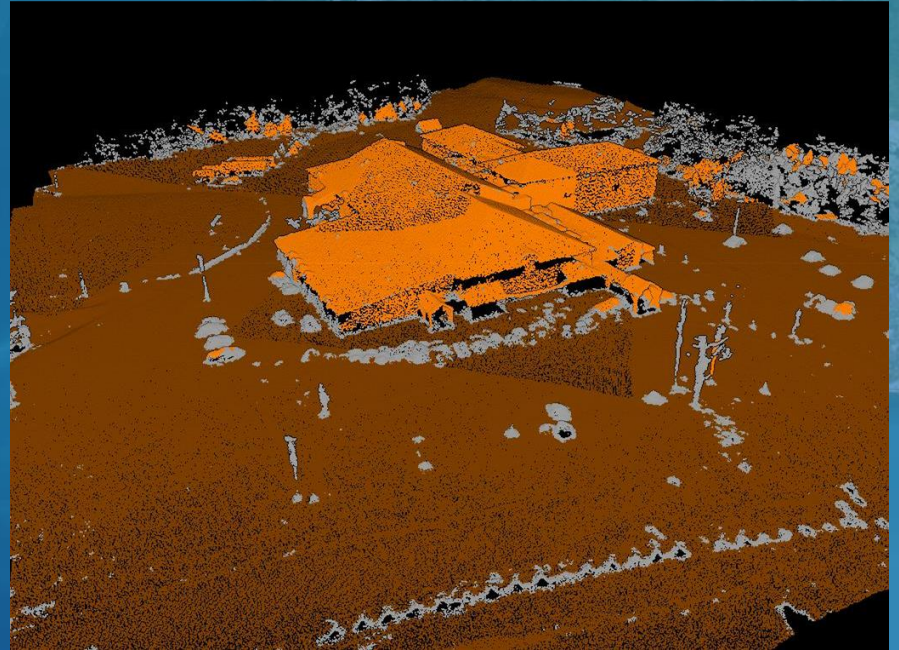
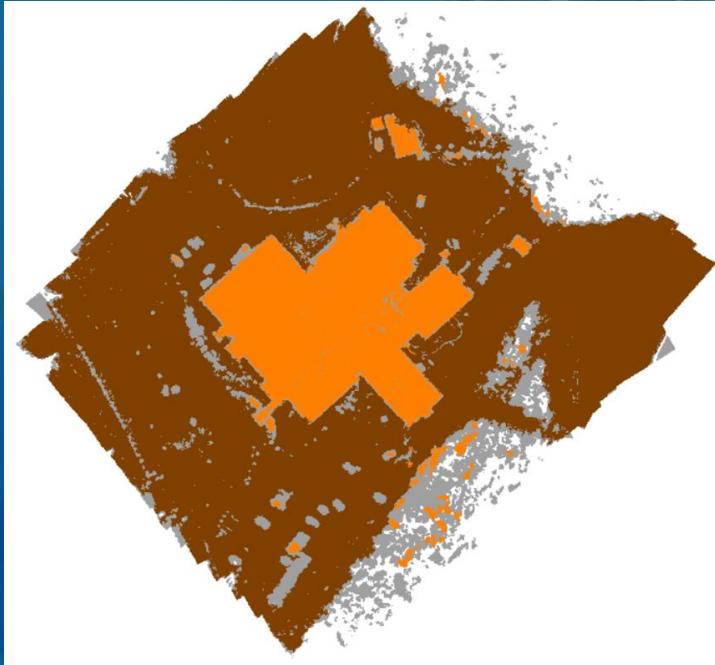
<Feature Type>	RMSE	LIDAR_ELEV	ELEV_DIFF	ELEV_DIFF_ABS	ELEVATION	LIDAR_POINT_COUNT
Unknown Point Feature	53.1277 m	97.061 m	53.1277 m	53.1277 m	43.9333	20
Unknown Point Feature	53.0436 m	101.543 m	53.0436 m	53.0436 m	48.4994	20
Unknown Point Feature	52.7817 m	94.0023 m	52.7817 m	52.7817 m	41.2206	20
Unknown Point Feature	52.7007 m	95.7992 m	52.7007 m	52.7007 m	43.0985	20
Unknown Point Feature	52.565 m	94.9357 m	52.565 m	52.565 m	42.3707	20
Unknown Point Feature	52.5083 m	95.2579 m	52.5083 m	52.5083 m	42.7496	20
Unknown Point Feature	52.3157 m	95.9949 m	52.3157 m	52.3157 m	43.6792	20
Unknown Point Feature	52.0816 m	109.1571 m	52.0816 m	52.0816 m	57.0755	20

X
ELEV_DIFF
53.128 m



Building Classification

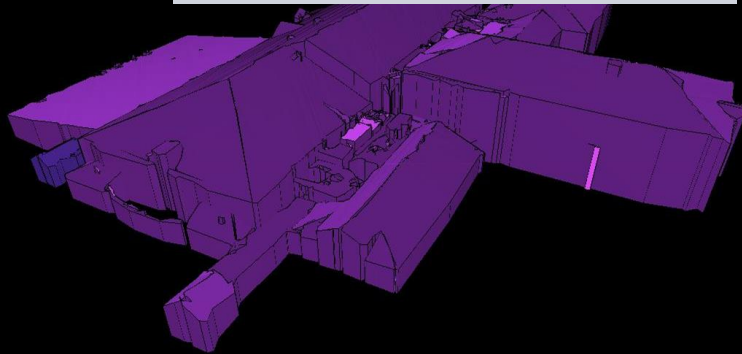
Segmentation non-ground classification



3D Vector Extraction

Building Extraction Settings

Extract Building Features



Lidar Feature Extraction Settings

Select Point Cloud(s) to Extract Features From

- Generated Point Cloud
- Generated Point Cloud (Thinned - 3D - XS)

Only Extract from Lidar Points Selected in Digitizer Tool

Building Extraction Settings

Extract Building Features

Resolution to Extract Buildings at: 4 point spacings

Building Footprints

- Pin Footprints to Height: 0 meters
- Simplify Horizontal Threshold: 2 point spacings
- Regularize

Minimum Footprint Area: 0 meters sq

Roof Planes

Side Walls

Sharpen Edges and Stitch Planes by Adding Points at Planar Intersections

Buildings As Mesh (3D Model)

- Color Vertices By Lidar Intensity
- Reconstruct Surface: 100 percent of extracted points

RANSAC Plane Extraction Settings

Maximum Distance to Plane: 0.2 meters

Minimum Number of Points in Plane: 10

Max Iterations: 1000

Normal Weight: 0

Tree Extraction Settings

Extract Tree Feature

Resolution to Extract Trees at: 5 point spacings

Minimum Tree Height: 4 meters

Minimum Tree Spread: 3 meters

Maximum Tree Spread: 20 meters

Point Type to use: Tree

Create Approximate Tree Coverage Polygons

Powerline Extraction Settings

Extract Powerline Features

Maximum Dist from Best Fit Line: 0.2 meters

Maximum Angle Delta Allowed: 6 degrees

Minimum Powerline Length to Keep: 4 meters

Pole Extraction Settings

Extract Pole Features

Minimum Pole Height: 4 meters

Minimum Pole Point Count: 4

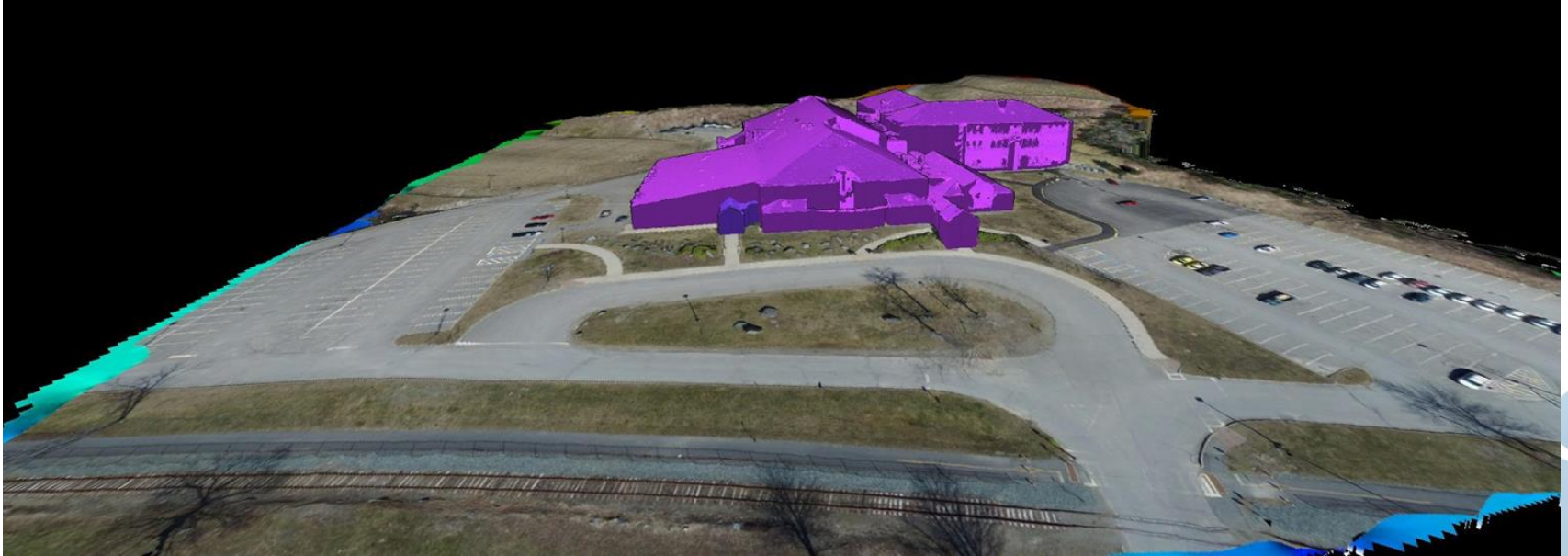
Maximum Pole Spread: 200 meters

Mark Top of Pole

Specify Bounds... Filter Points... Restore Defaults

OK Cancel Help

Terrain



Thank you!
Questions? Comments?



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geohelp@blumarblegeo.com