



transforming the way the world works



# Technology Update

“What’s the point(s)?!”

# What's the point(s)?!

- Total Stations becoming scanners
- Surveyors taking to the air
- Surveyors taking to the road
- What next....?





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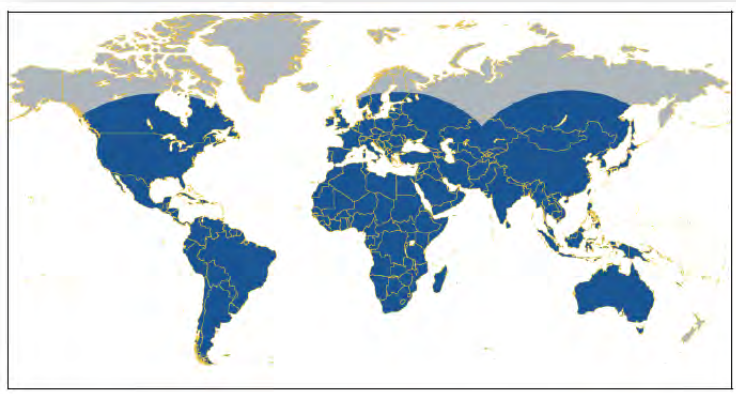


“Centimeters everywhere”

# Latest in GNSS Corrections

Launched 19 November 2012

- Trimble CentrePoint RTX
  - Near 'Global' correction service





# Development in GNSS Receivers

## Trimble R10

### Features

- Smallest and lightest receiver in its class
- Cutting edge Trimble HD-GNSS processing engine
- Automatic point measurement and traceable tilt values
- Electronic bubble so you can focus in one place
- Trimble xFill™ technology provides RTK coverage during connection outages
- Powerful 440 channel solution with Trimble 360 technology advanced satellite tracking
- Pair with Trimble Access and the TSC3 controller for the most powerful solution on the market
- Now subscribe to Trimble CentrePoint RTX for cm positioning without the need for a network or base station





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# Trimble V10 Imaging Rover

“A picture says a thousand words”  
(or a thousand points...)



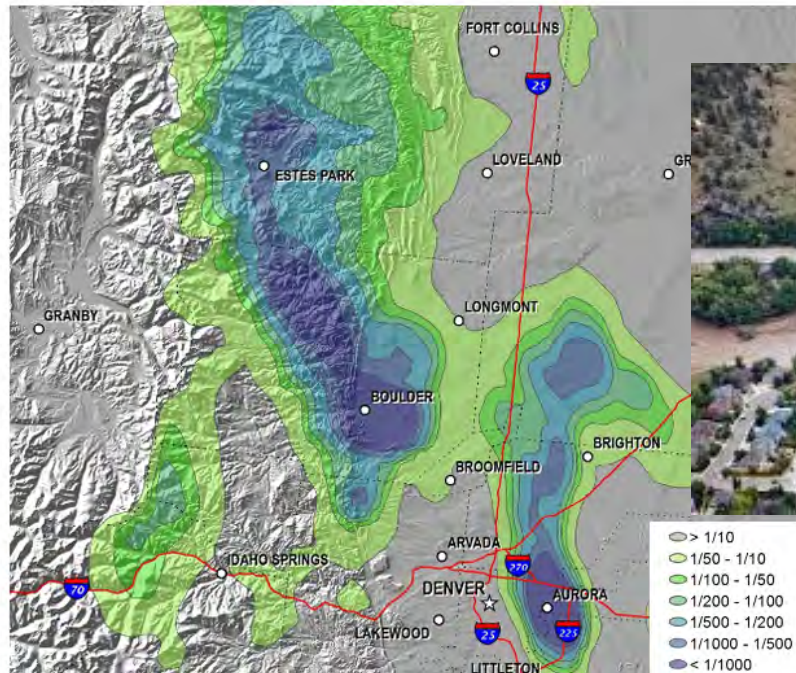
# Colorado Floods

## Colorado's exceedingly rare flood in 3 maps

By Jason Samenow, Published: September 19 at 1:56 pm [E-mail the writer](#)

New visuals from the National Oceanic and Atmospheric Administration reveal the exceptional nature of rainfall that flooded parts of 17 counties in Colorado last week.

The map below – as an example – shows the likelihood of the maximum 24-hour rainfall totals (in any given year) that occurred along the Colorado Front Range between September 9 and 16.



Annual exceedance probabilities for the worst case 24-hour rainfall. (NOAA)

## Rain slows rescue efforts amid deadly Colorado floods

Join the conversation  
CNN iReport

By David Simpson, Nick Valencia and Emma Lacey-Bordeaux, CNN  
updated 12:33 AM EDT, Mon September 16, 2013



Railroad tracks washed from their path by floodwaters are seen in Longmont on Thursday, September 12. Massive flooding has left people dead and thousands of homes in state.

HIDE CAPTION

17 18 19 20 > >>

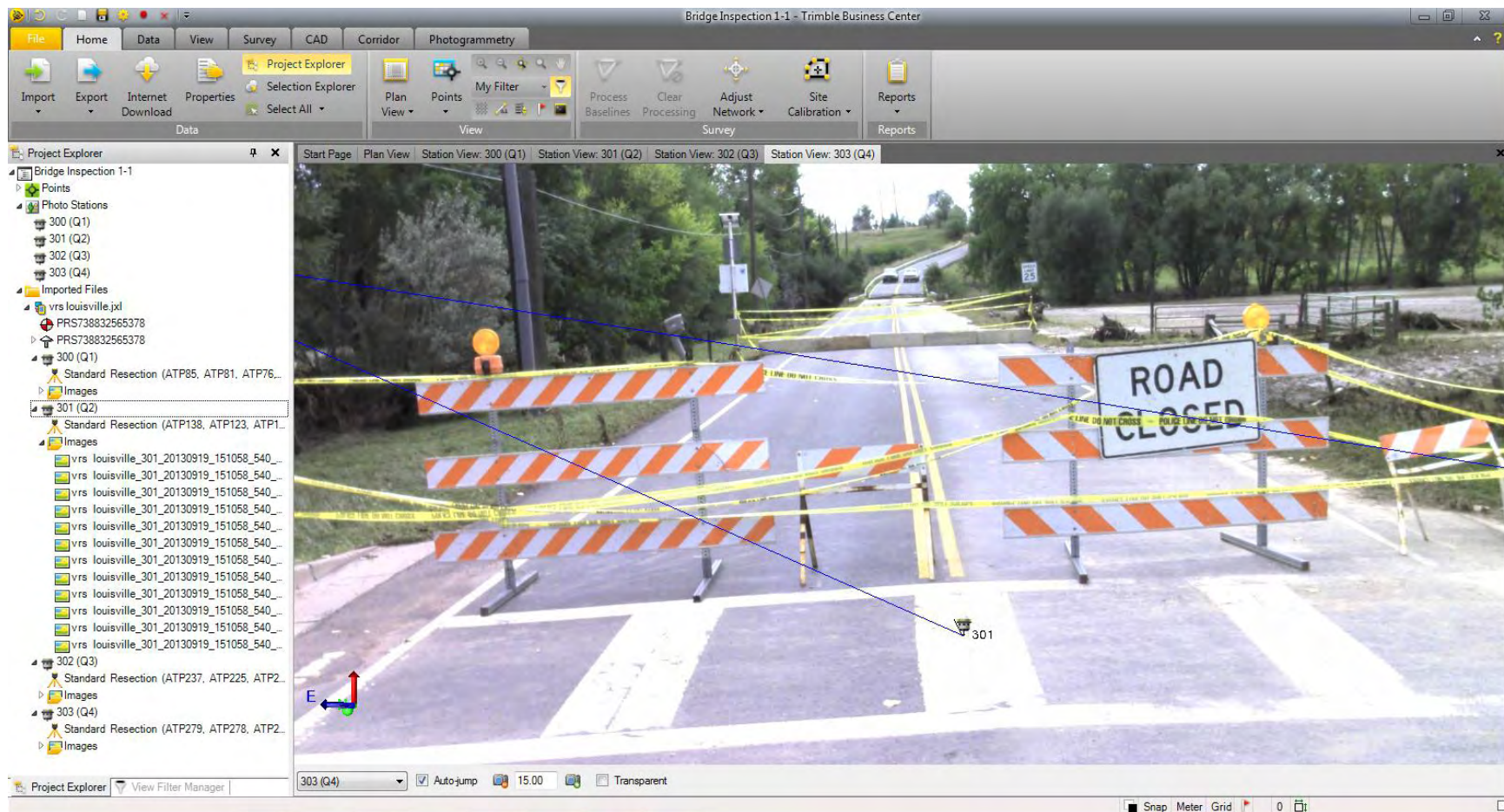




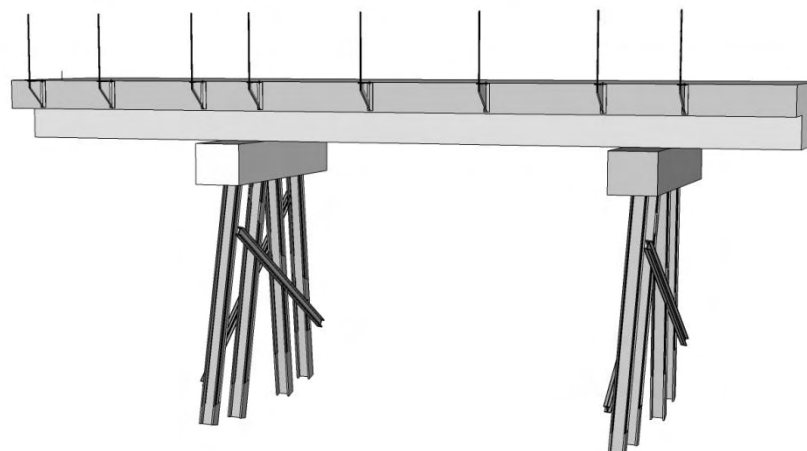
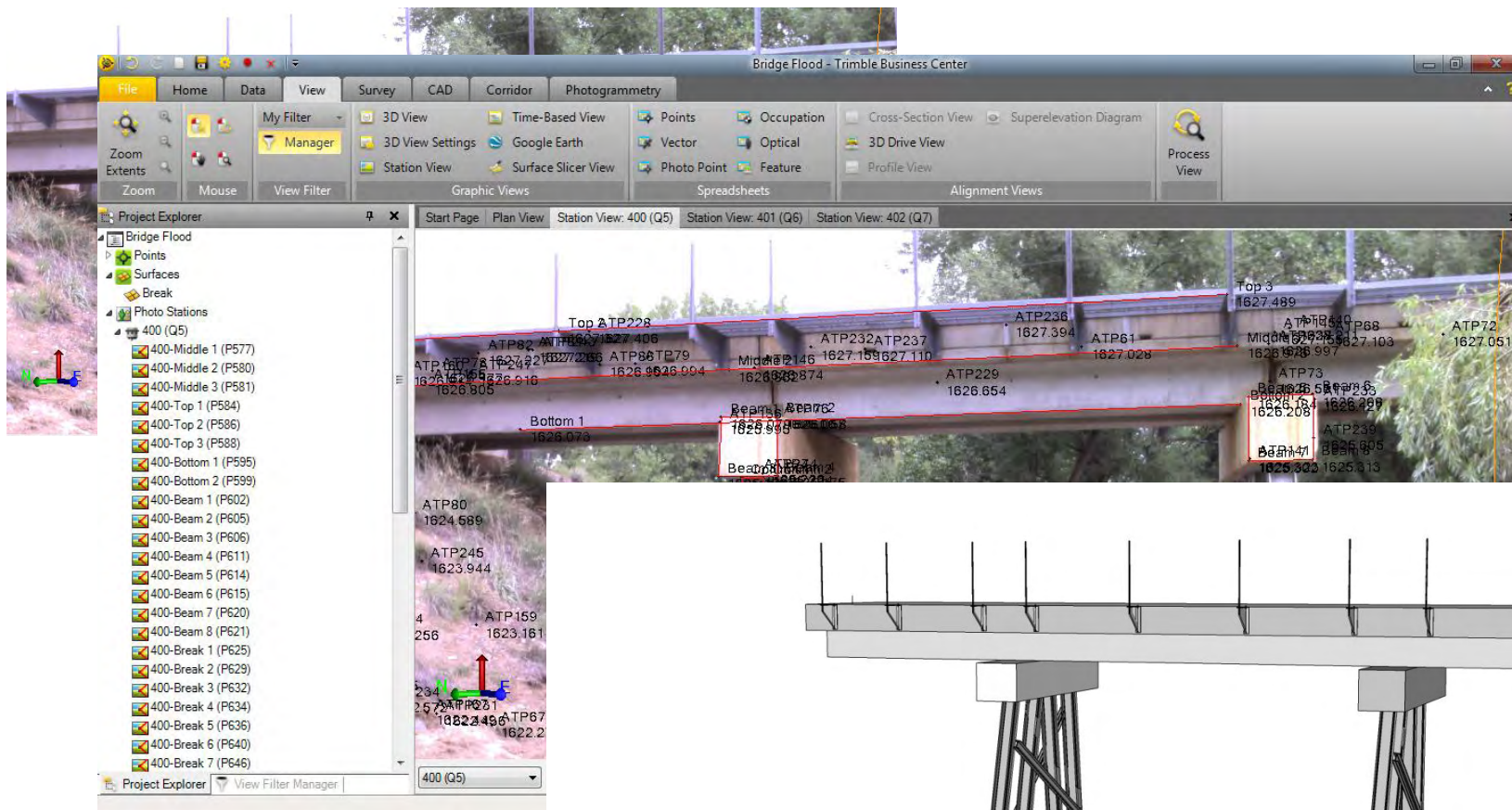
# Emergency Management







# Positions from Pictures





# Trimble V10 Imaging Rover



# Trimble V10 Imaging Rover

*The Trimble V10 Imaging Rover is an integrated camera system that precisely captures 360° digital panoramas used to visually document and measure the surrounding environment.*

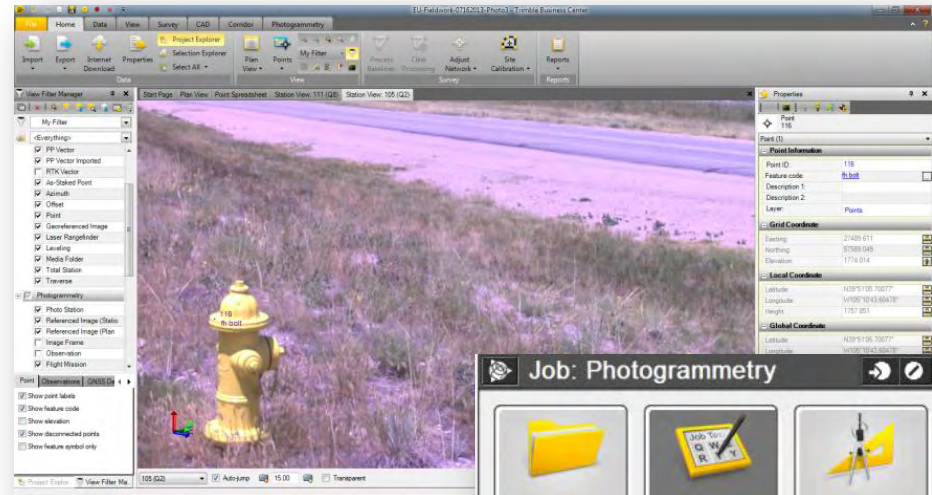


Trimble V10 – *Positions from Pictures*



# System Overview

- Position sensor
- Camera system
- Power rod
- Tablet
- Field software
- Office software



# Positioning Sensor

- Integrates seamlessly with R10 GNSS receiver and S-Series total station positioning sensors.
- Panoramas may also be captured standalone pre- or post- survey of occupied points





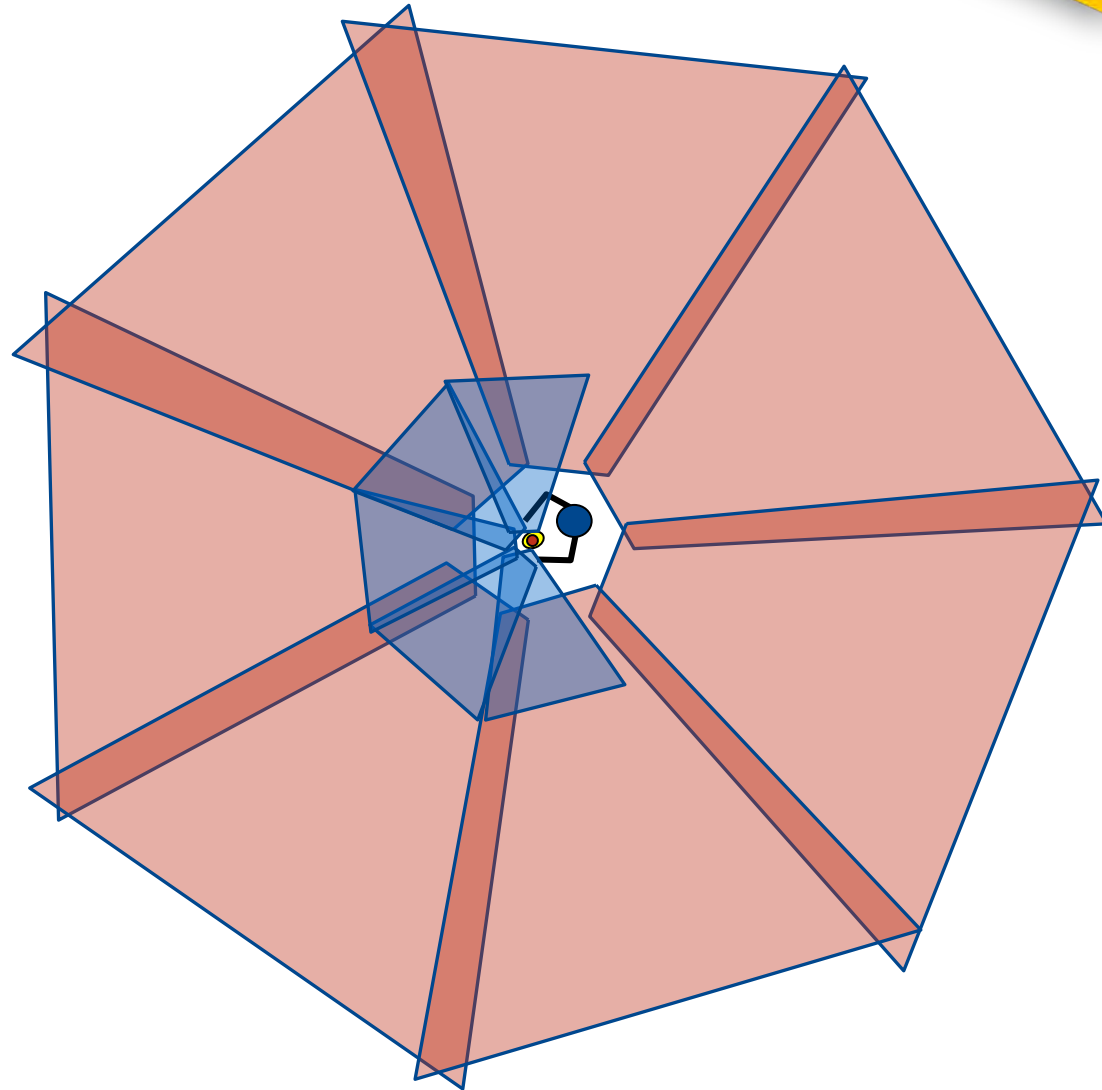
# Camera System

- 12 calibrated cameras
- 60 Megapixel 360° panorama
- Sequential image capture
- Tilt sensors
- Magnetic compass
- Gyrometers and accelerometers
- On-board data storage
- USB communications
- 2m pole drop tested
- IP 54 environmentally protected



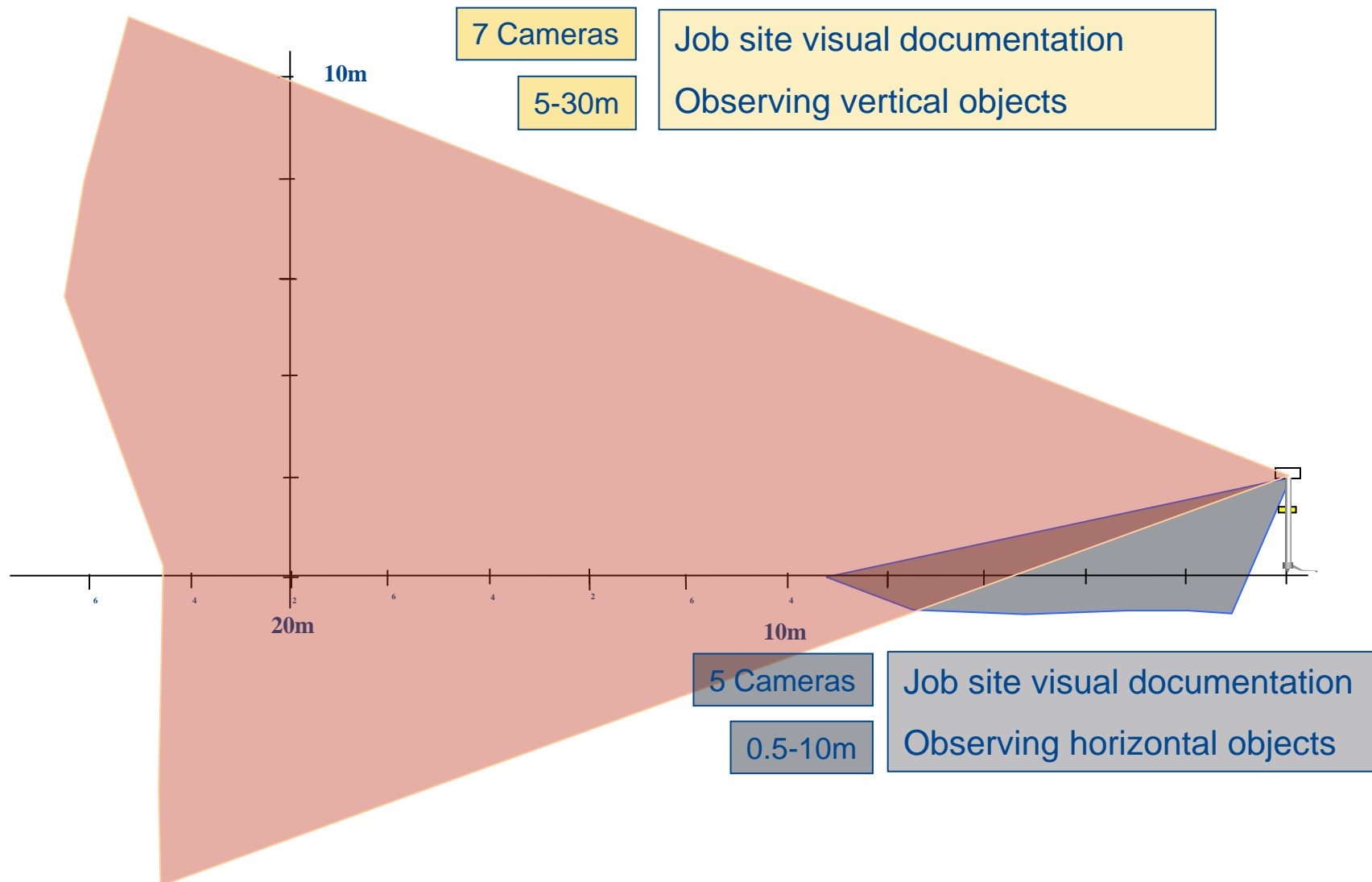
# Camera System

- 7 panoramic cameras
- 5 downward-looking cameras





# Camera System

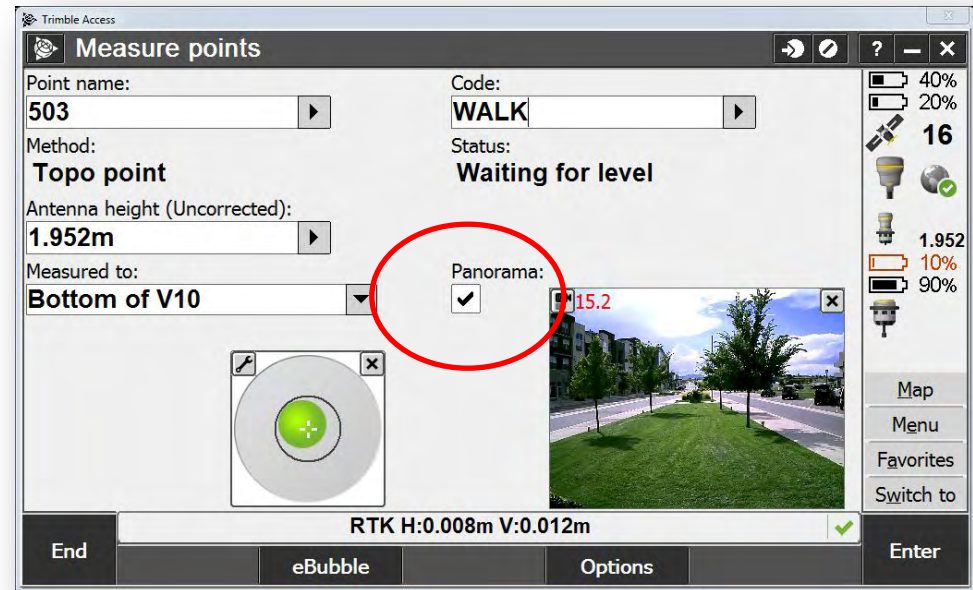


# Field Software



## Trimble Access

1. Streaming video
2. Capture and store panoramas simultaneously with points or standalone
3. Review thumb-nail images
4. Review Panoramas



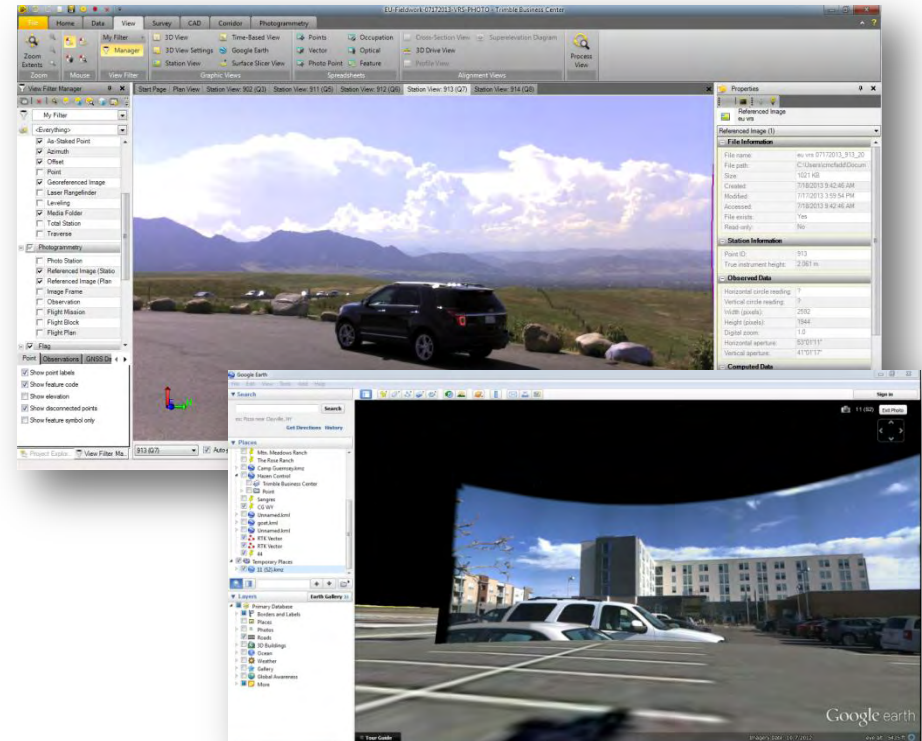


# Office Software



## Trimble Business Center

1. Network adjustment of panoramas
2. Measure photo points
3. Panoramic review with data overlay
4. Export panoramas (jpeg, html, kmz)
5. Export deliverables (CAD, GIS)



# Old Survey Workflow

Capture points in the field

Download CSV file

Import to CAD

Connect the dots

Publish 2D+ Paper

A	B	C	D	E
1	Jobord topo	Version:12.40	Units:Metres	
2	JEFFCO AZ MK	267995.216	948994.155	1690.26 disk
3	RESET	269123.462	948831.23	1694.016 disk
4	rd	269151.288	948910.316	1692.218 nail
5	700	269173.234	948993.425	1688.387 nail
6	701	269156.363	949005.57	1686.323 nail
7	702	269106.877	948895.396	1688.728 epmt
8	703	269106.917	948896.102	1688.732 epmt
9	704	269119.592	948895.05	1688.588 epmt
10	705	269119.699	948896.101	1689.932 cmh
11	706	269141.697	948893.316	1690.259 epmt
12	707	269149.048	948893.194	1690.268 epmt
13	708	269149.063	948895.975	1690.203 lp
14	709	269146.909	948894.306	1690.209 sp
15	710	269155.376	948893.92	1690.274 epmt
16	711	269162.194	948896.931	1690.165 epmt
17	712	269164.646	948900.184	1690.102 epmt
18	713	269166.73	948900.841	1690.06 epmt
19	714	269155.277	948894.238	1690.178 rb
20	715	269160.339	948896.202	1690.1 rb
21	716	269163.319	948898.879	1690.093 rb
22	717	269166.873	948905.379	1689.89 rb
23	718	269167.475	948905.338	1689.999 epmt
24	719	269166.587	948906.738	1690.005 sp
25	720	269167.955	948911.792	1689.791 epmt
26	721	269168.318	948923.306	1689.645 rb
27	722	269169.165	948923.289	1689.645 epmt
28	723	269171.634	948949.88	1689.204 epmt
29	724	269170.482	948946.445	1689.238 rb
30	725	269169.771	948949.92	1689.273 rb



8/6/12 6011 DIA DAT WEST SOUTH  
 BASE @ 788 HZ = 605  
 CHECK # 5413 STORED @ 6010

STORE	DESC
6011 → 6080	GND
100971 → 100974	BOC2
100975 → 100976	SIGN
100977 → 100978	E ELECTRIC CAM
100979 → 100980	SIGN
100981 → 100984	EOC
100985 → 100989 (N)	RIM LIGHT
101000	(W) RIM LIGHT CUMULATIVE TO SELECT A RIM
101001-101010	E LIGHT (RUNWAY/FWY)
101011-101019	RIM(N) LIGHTS
101020-101175	E LIGHTS (RUNWAY/FWY)
101176-101190	RIM (N) LIGHTS
101191	RIM (W) LIGHTS
101192-101284	RIM(N) LIGHTS (END OF RUNWAY)
101285-101289	GND
101290-101299	GB
101300-101303	COR INLET
101304	E INLET (924 BOTTOM OF BOX)
101308-101323	GB 2
101323-101344	GB 3
101356-101367	WAL (TOP EDGE HEADWALL)
101368	PIPE 30" RCP (IN)
101369	CHK 5360



# Trimble V10 Survey Workflow

Mission planning

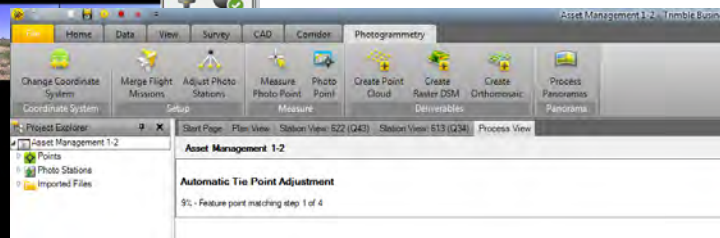
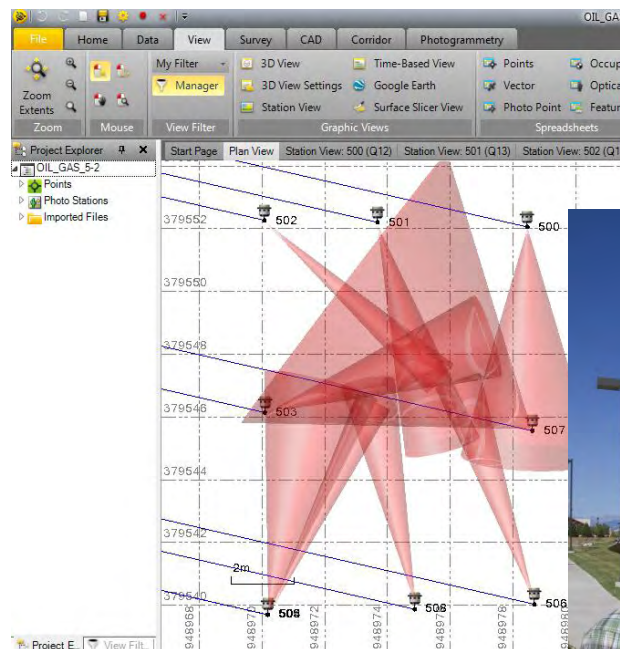
Capture panoramas

Process photo stations

Measure objects in the photos

Prepare new deliverables

Reduce field time by ~30%





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# Trimble UX5 Aerial Imaging Solution

“Point Clouds from below the clouds”



# What is UAS?

- An unmanned aerial vehicle (UAV), commonly known as a drone, is an aircraft without a human pilot on board. Its flight is controlled either autonomously by computers in the vehicle, or under the remote control of a pilot on the ground or in another vehicle.
- The term **unmanned aircraft system (UAS)** emphasizes the importance of other elements beyond an aircraft itself. A typical UAS consists of the:
  - unmanned aircraft (UA)
  - control system, such as Ground Control Station (GCS)
  - control link, a specialized datalink
  - other related support equipment.

# Benefits of Aerial Imaging Solutions

- Economic solution – enables aerial mapping technology, once reserved for the largest surveying & engineering firms, to be used by the masses
- Safety – enables surveying of rugged, hazardous, hard-to-reach or unhealthy areas without risking injury (or worse) to them or individuals in the area
- Efficient process – ability to collect and process data faster than often achievable with terrestrial-based survey technology
- Rapid workflow – system is designed to quickly plan a flight and collect data, allowing rapid response to your customer's needs (traditional photogrammetry processes)
- Versatile – a technology that can be used to serve numerous professional markets and applications



# Typical Applications

	Boundary Surveys	Topographic Surveys	Site Planning	Route Planning	Progress Monitoring	As-Builts	Resource Mapping	Volume Calculation	Disaster Analysis	Vegetation Health
Engineering & Surveying	✓	✓			✓			✓		
Mining	✓	✓	✓	✓	✓	✓		✓		
Civil & Heavy Earthworks Construction	✓	✓	✓		✓					
Oil & Gas	✓	✓	✓	✓	✓	✓	✓	✓		
Environmental & Landfill	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Public Agencies	✓	✓	✓	✓	✓		✓		✓	✓
Agriculture & Forestry	✓		✓		✓		✓		✓	✓

# Topographic Survey



Switzerland  
510 Images  
400 m Flight Height  
11 cm GSD  
3.12 km<sup>2</sup>



# Route Planning

Belgium  
462 Images  
150 m Flight Height  
5 cm GSD  
0.8 km<sup>2</sup>





# Progress Monitoring Example



United Kingdom  
150 m Flight Height  
5.7 cm GSD  
2.4 km<sup>2</sup>

# Volume Calculation Example

Open Pit Mine  
641 Images  
150 m Flight Height  
5.6 cm GSD  
0.12 km<sup>2</sup>





# Resource Mapping Example



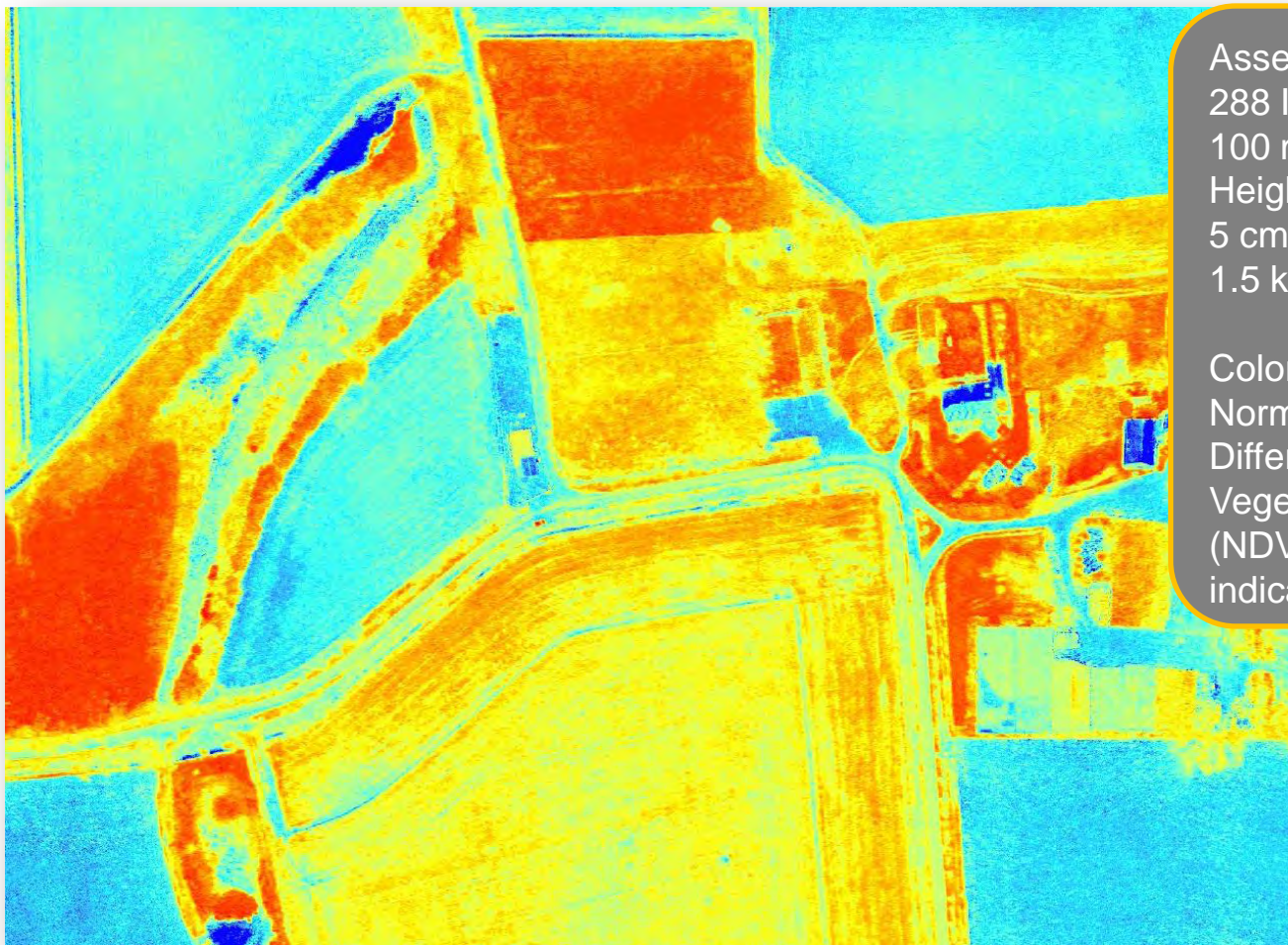
Namibia  
288 Images  
100 m Flight Height  
5 cm GSD  
1.5 km<sup>2</sup>



# Disaster Analysis Example

- Strange how no one will give us permission to use their disaster as an example in our presentation

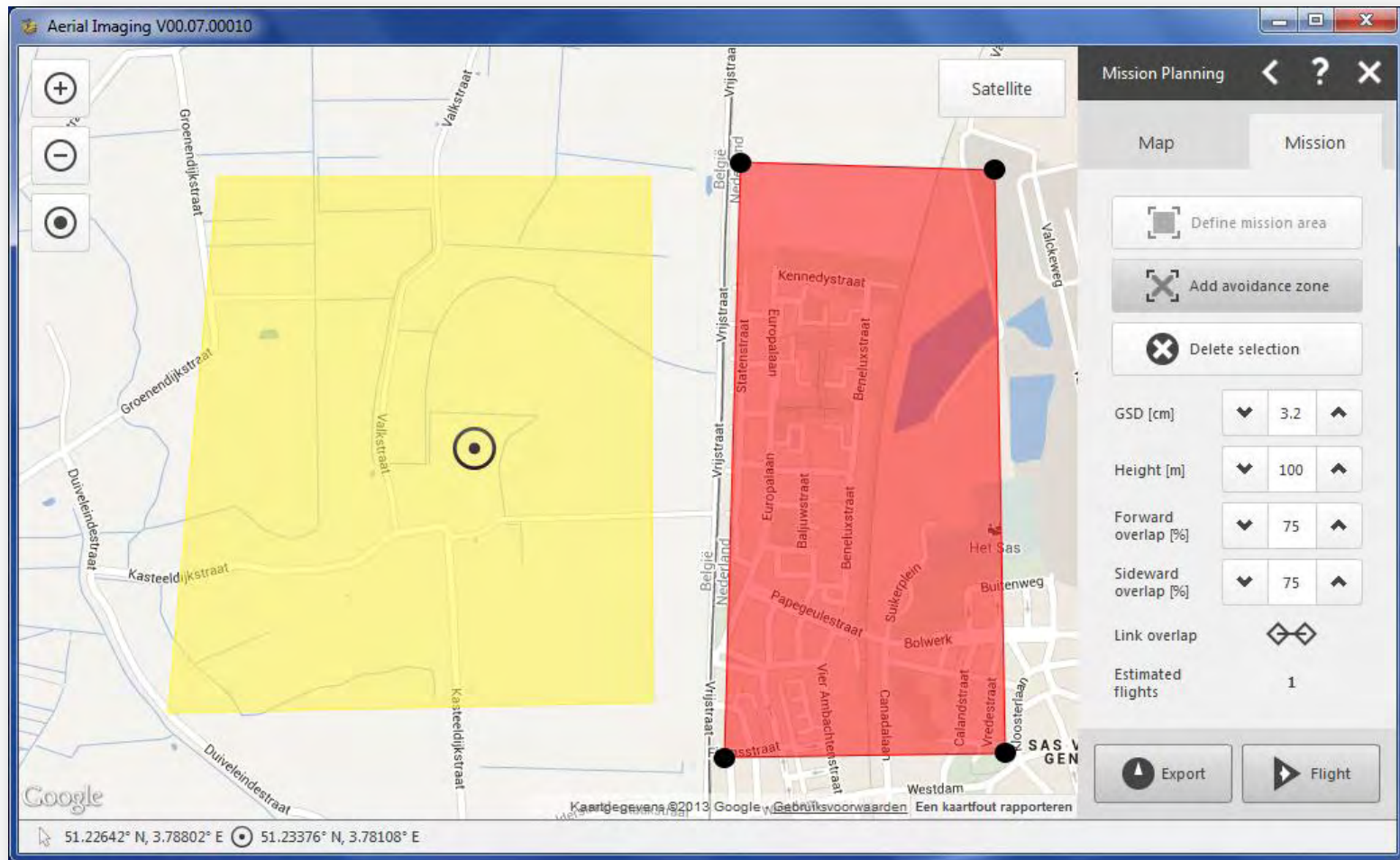
# Vegetation Health Example



Assenede  
288 Images  
100 m Flight  
Height  
5 cm GSD  
1.5 km<sup>2</sup>

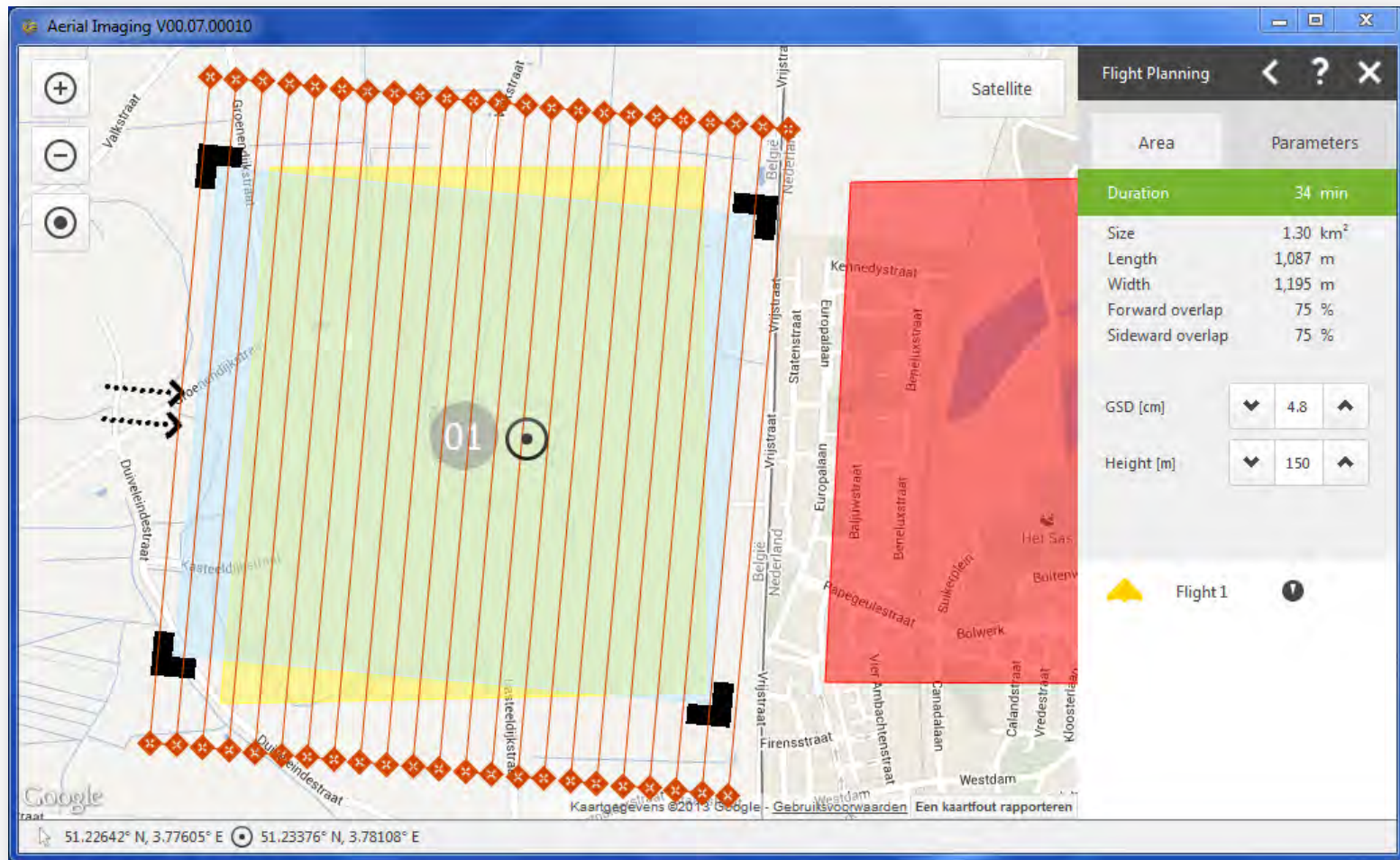
Color relates to  
Normalized  
Difference  
Vegetation Index  
(NDVI) value -  
indication of health

# Defining the Project Area

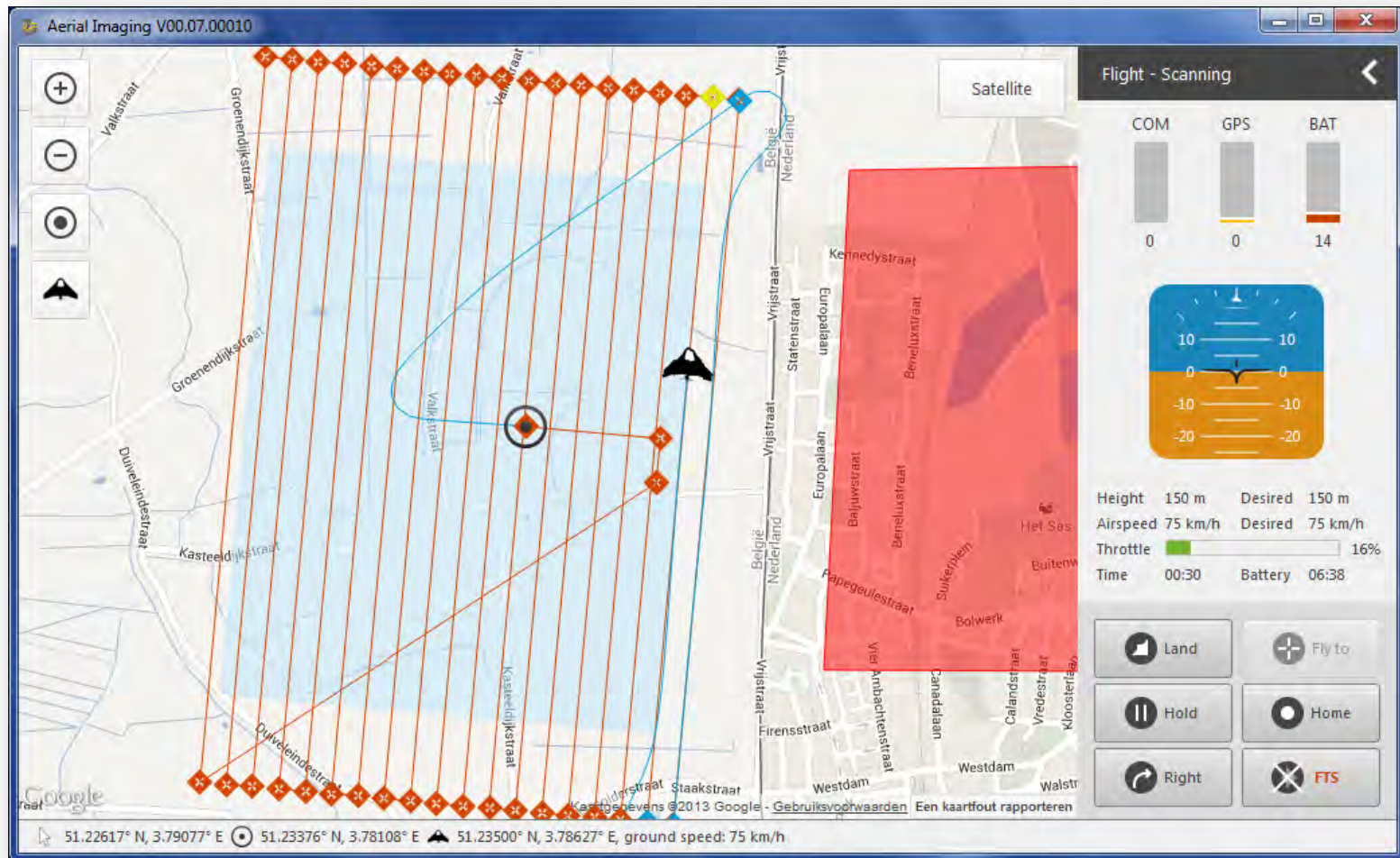




# Defining the Flight



# Flight Operation



# Trimble UX5 Aerial Imaging Rover

- Airframe
  - Internal carbon frame
  - Expanded polypropylene foam body
  - Engine & propeller
  - Servo-controlled elevons
- Payload Bay
  - Battery
  - Camera
  - Tracking beacon
- eBox
  - GPS & orientation sensors
  - 2.4 GHz radio
  - Autopilot





# UX5 Camera



- Sony NEX5R digital camera
- 16.1 MP with APS-C sensor
- Fixed-optics Voigtlander lens
- Image size 4912 x 3261
- Standard color & Near Infra-Red versions
- Fixed lens increases the stability of the camera internal geometry

# Launcher Components

- Ramp
  - Bungee
  - Winching tool
  - Release handle
  - Safety pin
- Launcher Dock
- Support



# Ground Control

- Rugged Tablet
- Flight Planning & Control Software
- Communications Link
- Download Connector





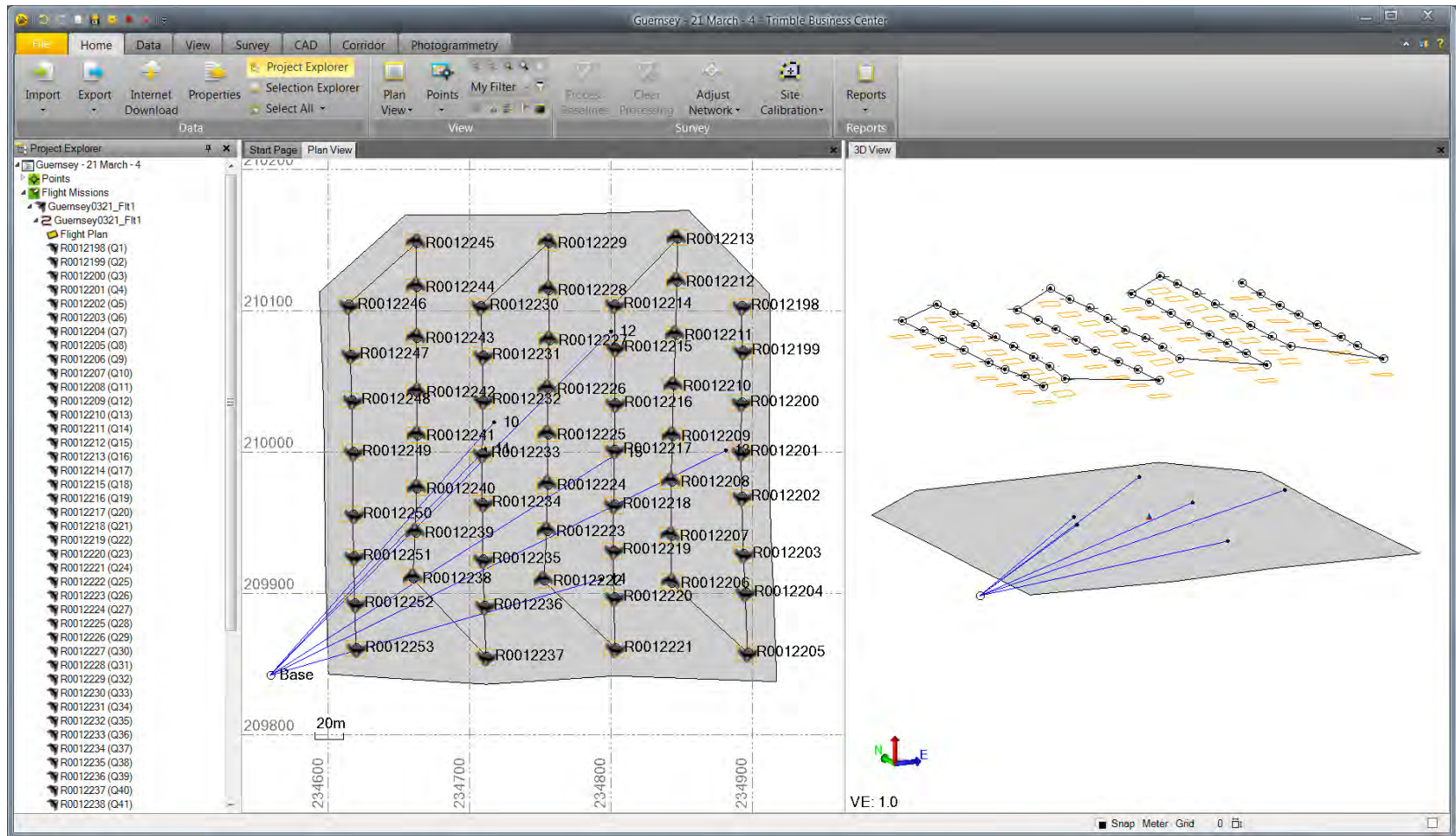
# Trimble Business Center Photogrammetry Module



- Office application for processing traditional and Trimble UAS survey data
- 64-bit processor / operating system requirement
- Photogrammetry processing using technology from Inpho
- Simple workflows for importing flight data, stitching images, identifying ground control points, producing deliverables, and measuring features



# Import Flight Data



# Identify Ground Control Points

The screenshot displays the Trimble Business Center software interface for photogrammetry. The main window shows two side-by-side aerial images. The left image, labeled 'Station View: R0012224 (Q27)', shows a ground control point (GCP) labeled '15' with a yellow crosshair. The right image, labeled 'Station View: R0012218 (Q21)', shows a GCP labeled '5' with a yellow crosshair. Below the images, the 'Process View' tab is active, showing the 'Guernsey - 21 March - 4' project. The 'Adjustment with control points [Guernsey0321\_Flt1]' section indicates 'Step 9 of 33: 0% - The pre-conditions check was successful.' The 'Adjustment with tie points [Guernsey0321\_Flt1]' section indicates 'Step 9 of 9: 100% - Project Output completed.' The 'Select Point' dialog is open, showing a list of photo stations seeing point 15. The 'Adjust Photo Stations' dialog is also open, showing a table of control points and a list of photo stations.

**Control Points Table:**

Point ID	Observations	Qu	Status
10	0	?	Enabled
11	5	?	Enabled
12	5	?	Enabled
13	5	?	Enabled
14	5	?	Enabled
15	5	?	Enabled

**Photo stations seeing point 15:**

Photo Station ID	Status
R0012217 (Q20)	Enab..
R0012216 (Q19)	Enab..
R0012208 (Q11)	Enab..
R0012209 (Q12)	Enab..
R0012224 (Q27)	Enab..
R0012218 (Q21)	Enab..
R0012215 (Q18)	
R0012207 (Q10)	
R0012210 (Q13)	

**Adjust Photo Stations Dialog:**

Flight mission: Guernsey0321\_Flt1

Tie Points Control Points Results

Control Points

Point ID: [ ]

Point selector: [ ]

Photo stations seeing point 15:

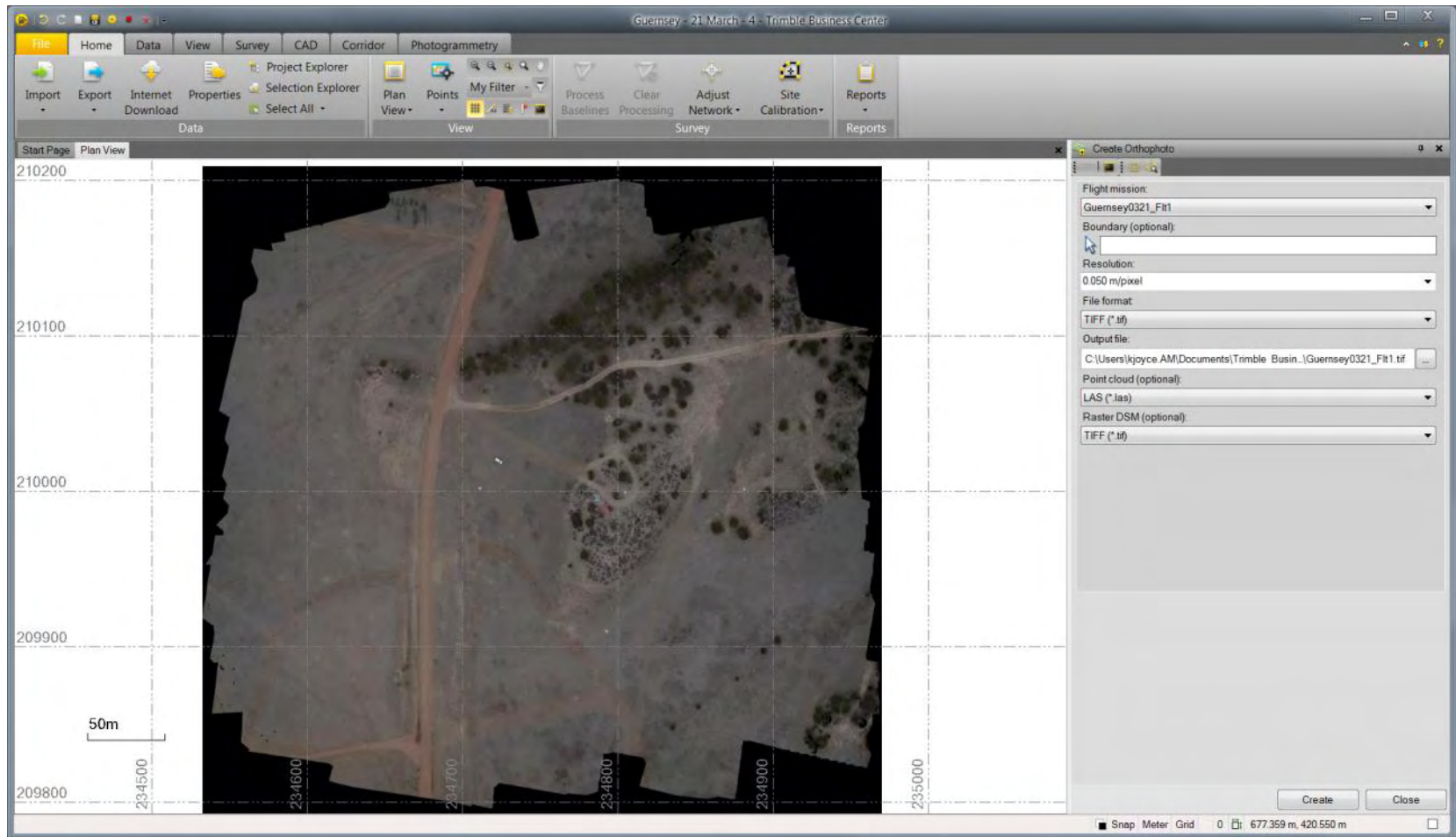
☒ Automatically advance on select

A background process is in progress.

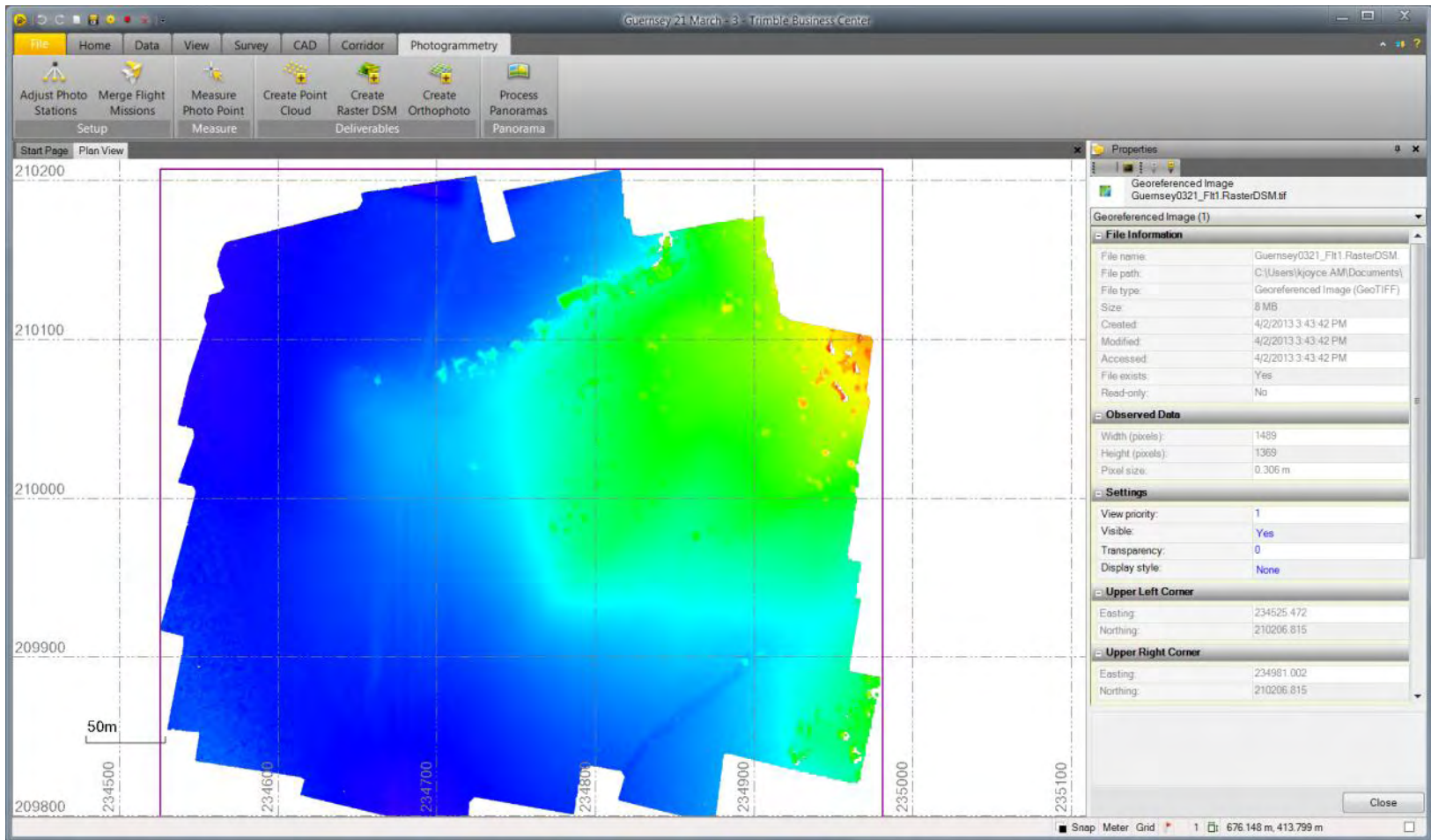
Adjust with Control Points Close



# Create Orthophotos



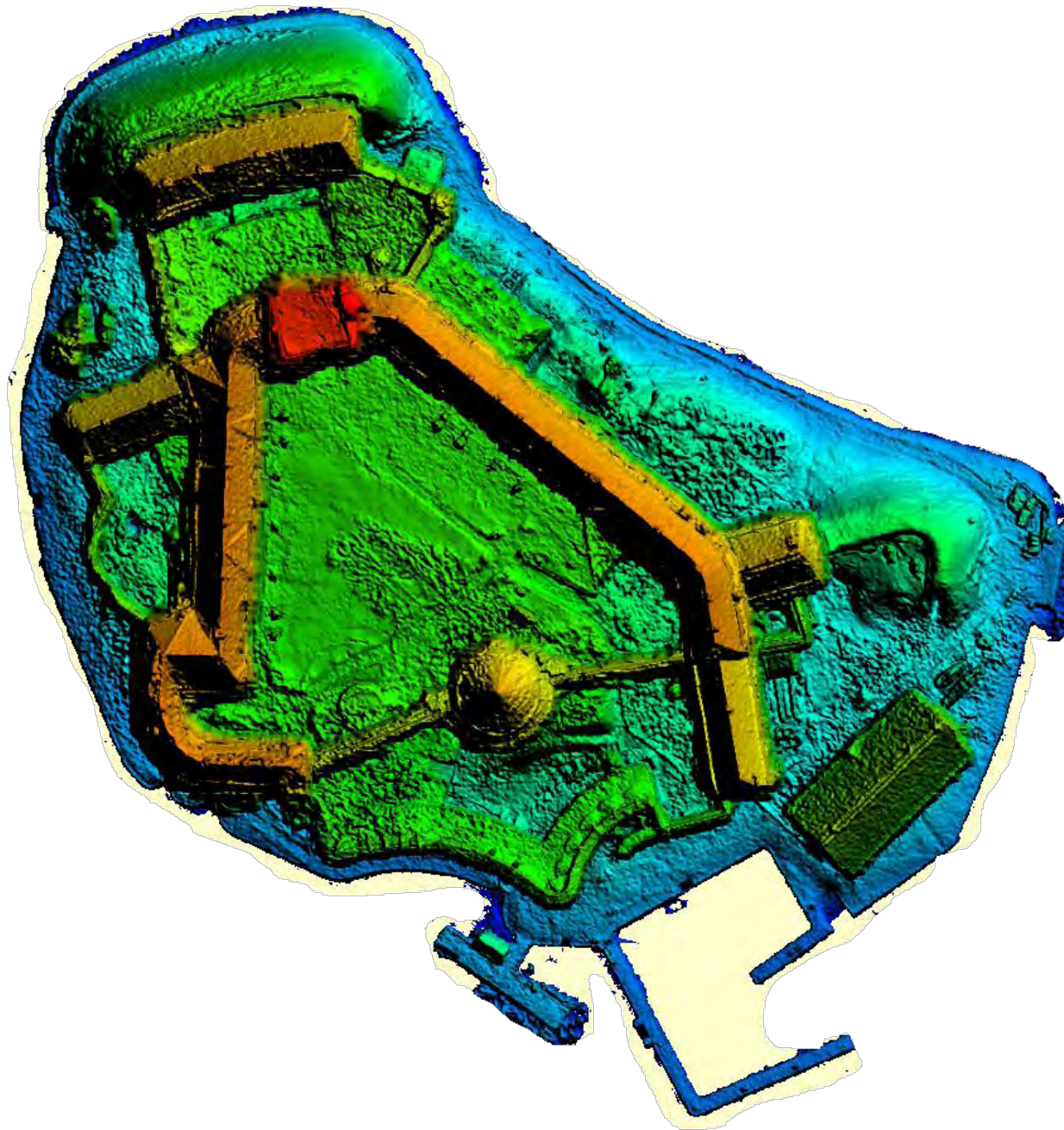
# Create Digital Surface Models





Vaxholm Castle,  
Sweden  
126 Images  
120 m Flight Height  
3.8 cm GSD  
550 x 600 m

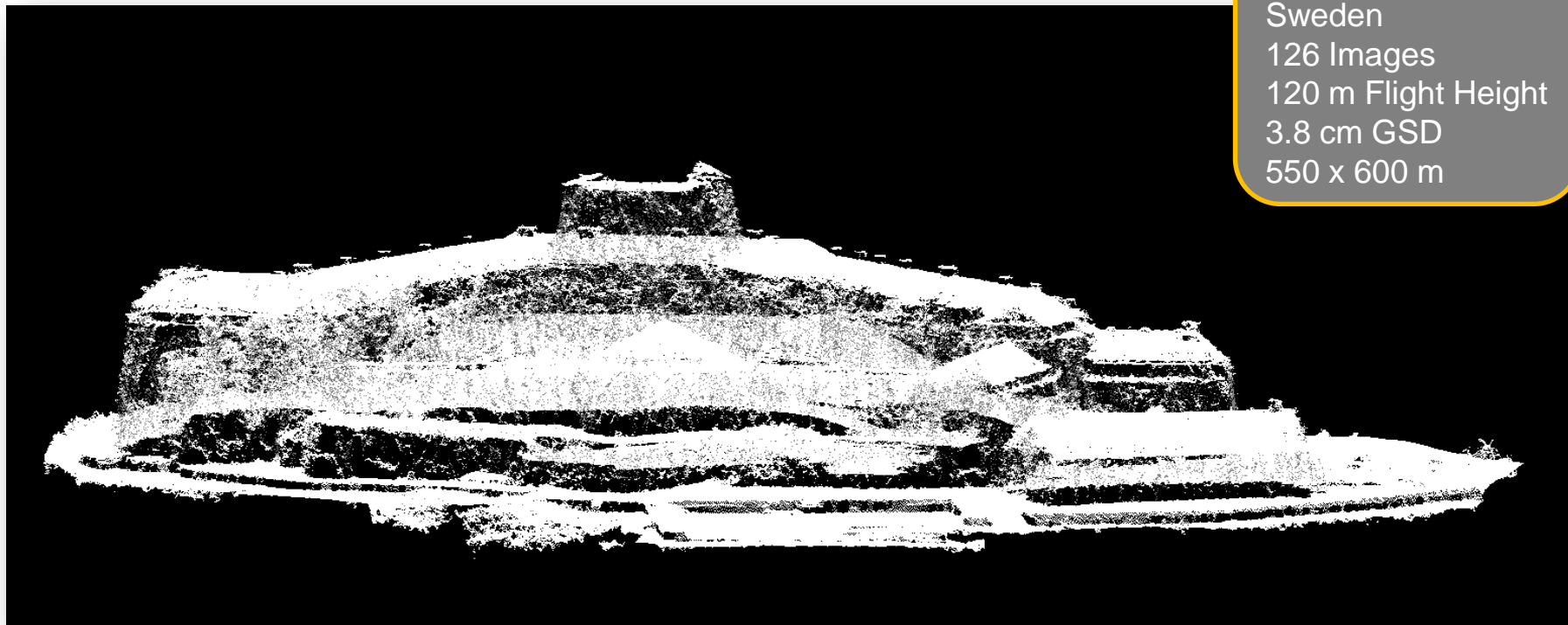




Vaxholm Castle,  
Sweden  
126 Images  
120 m Flight Height  
3.8 cm GSD  
550 x 600 m



Vaxholm Castle,  
Sweden  
126 Images  
120 m Flight Height  
3.8 cm GSD  
550 x 600 m



Vaxholm Castle,  
Sweden  
126 Images  
120 m Flight Height  
3.8 cm GSD  
550 x 600 m





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# Trimble MX2

**‘For surveyors who want to  
be in the driving seat!’**

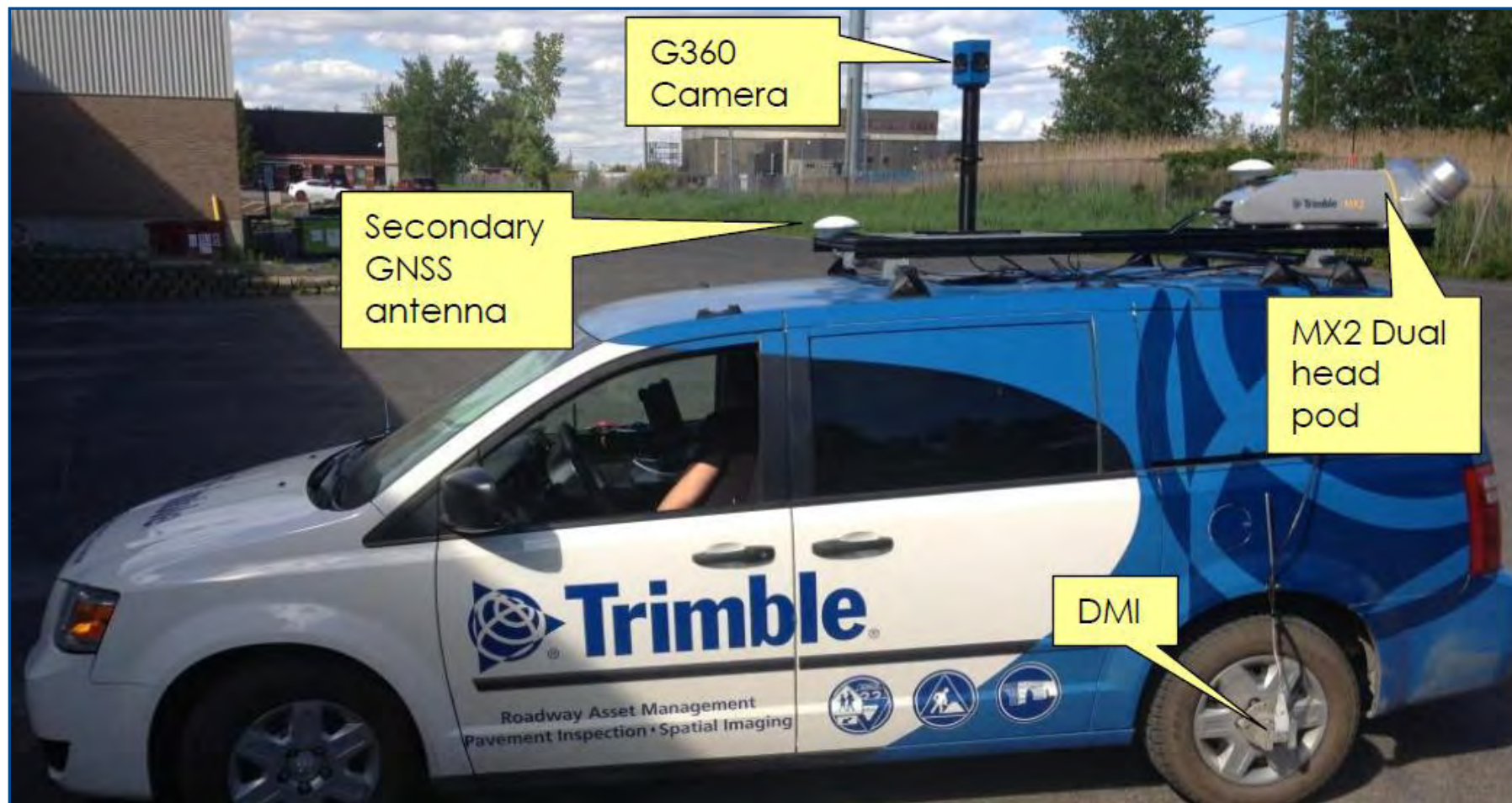


An aerial point cloud visualization of a large stadium or arena. The structure is composed of numerous points, with some areas highlighted in a grid of red, green, and blue lines. The text "...point clouds within your reach" is overlaid in yellow.

...point clouds within your reach

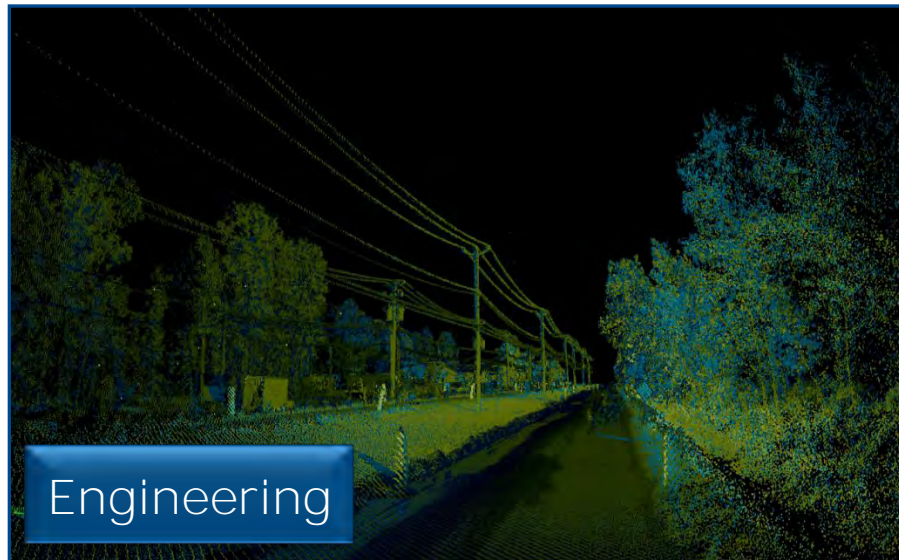
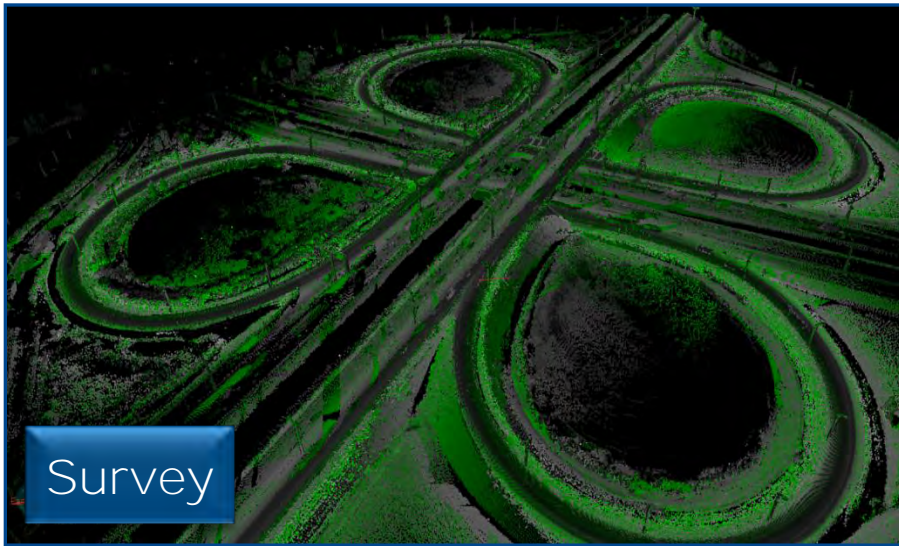


# Installed System

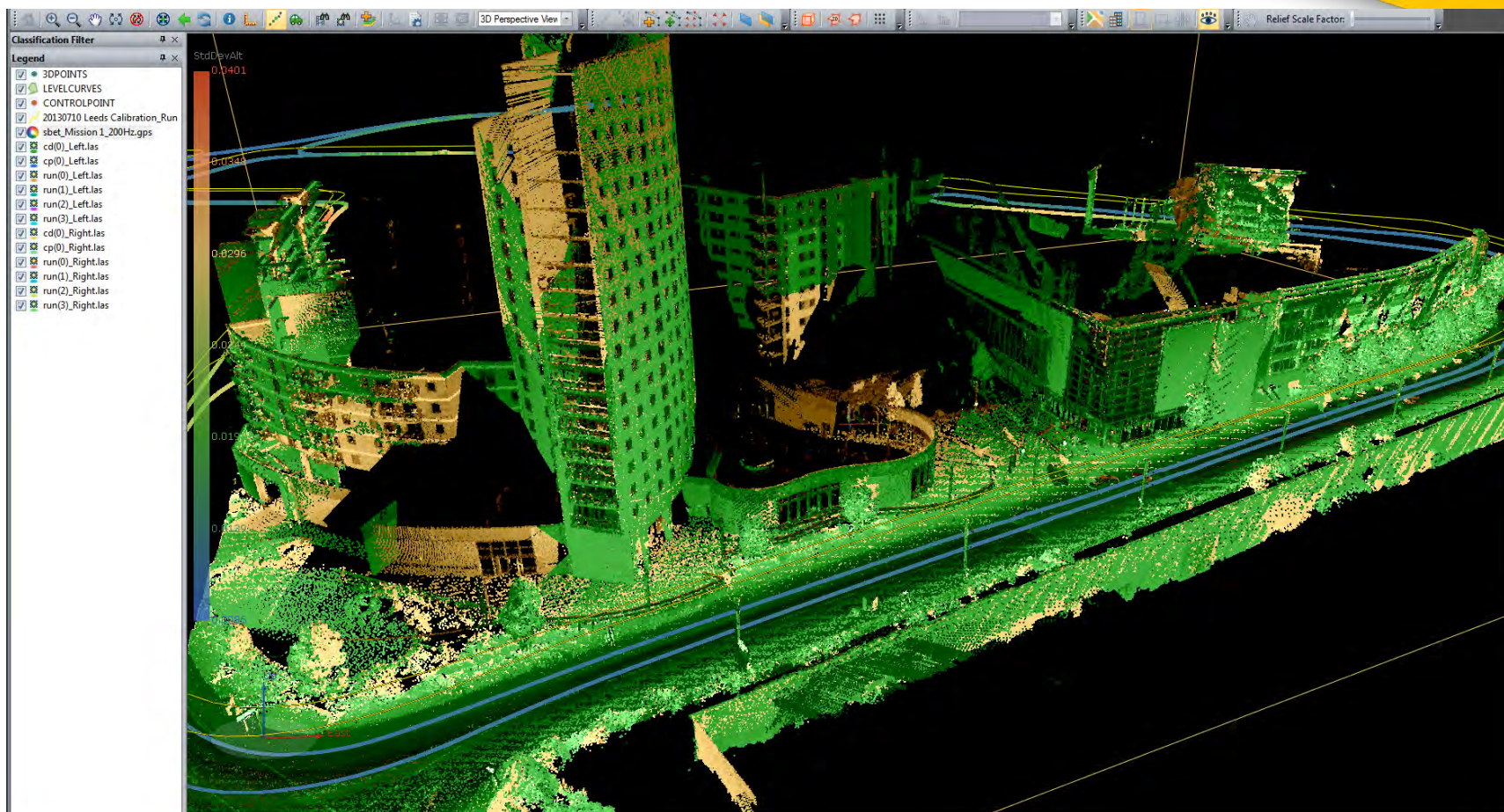




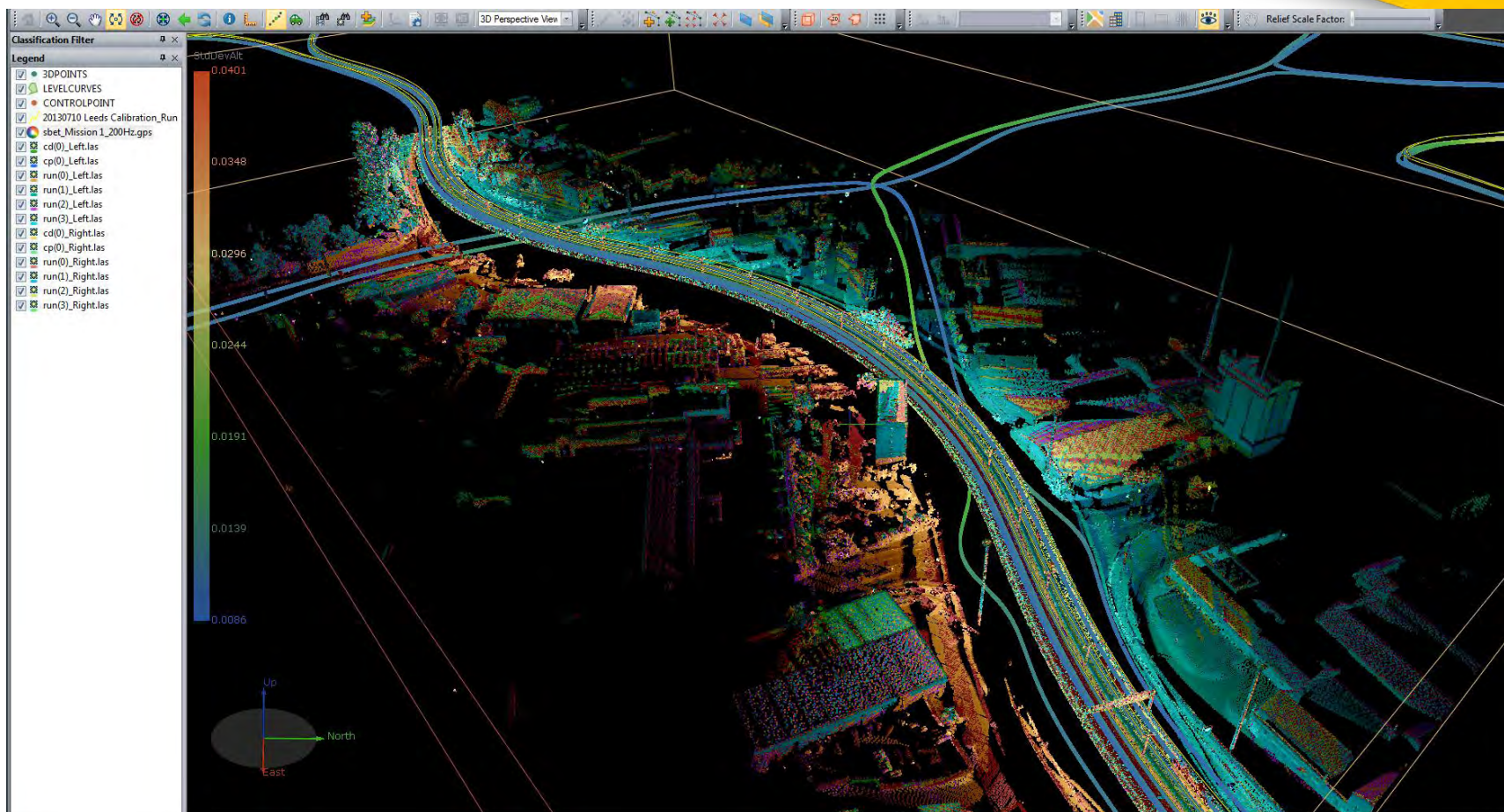
# Trimble MX2 Applications





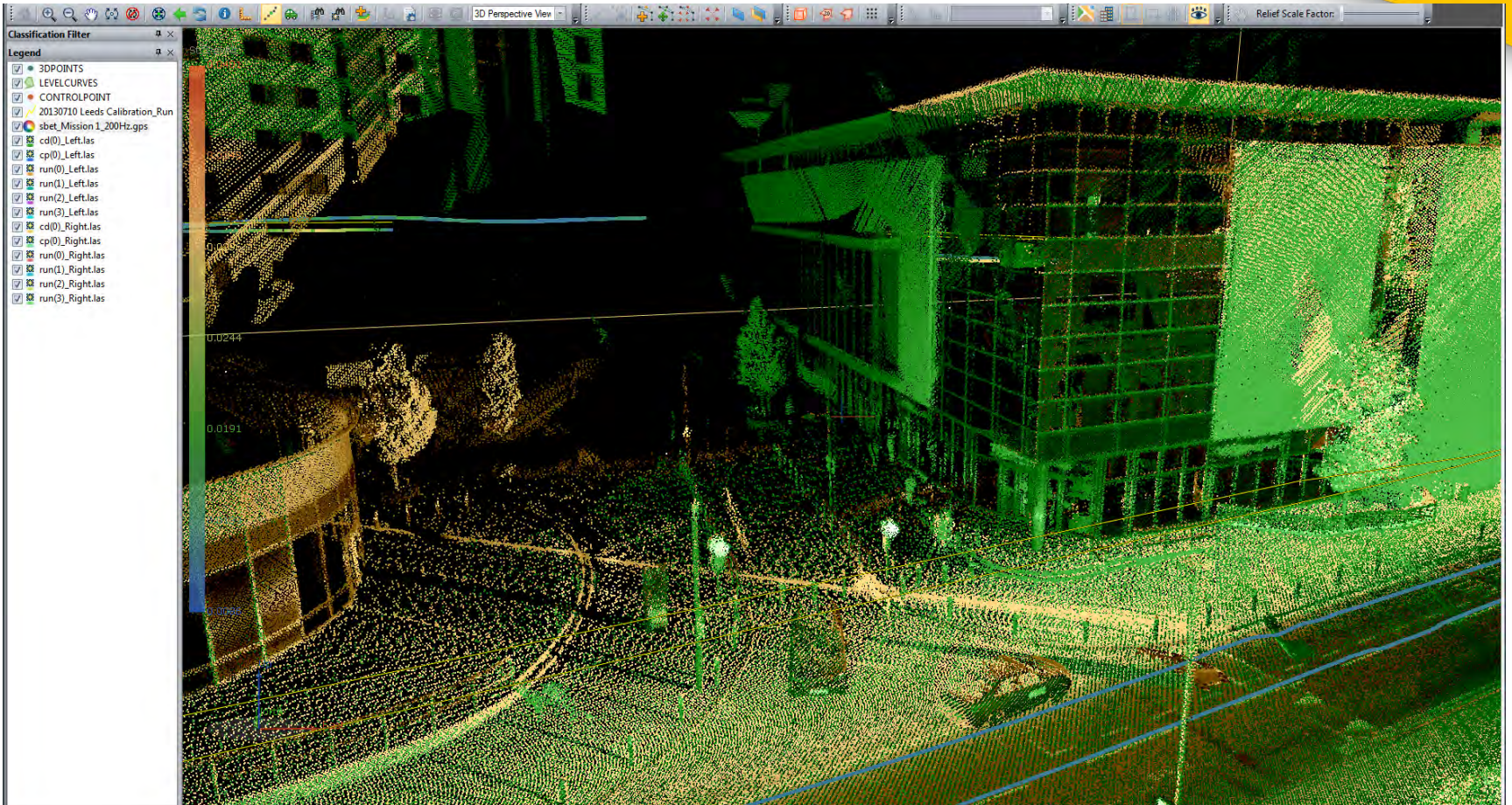


## Clarence Dock



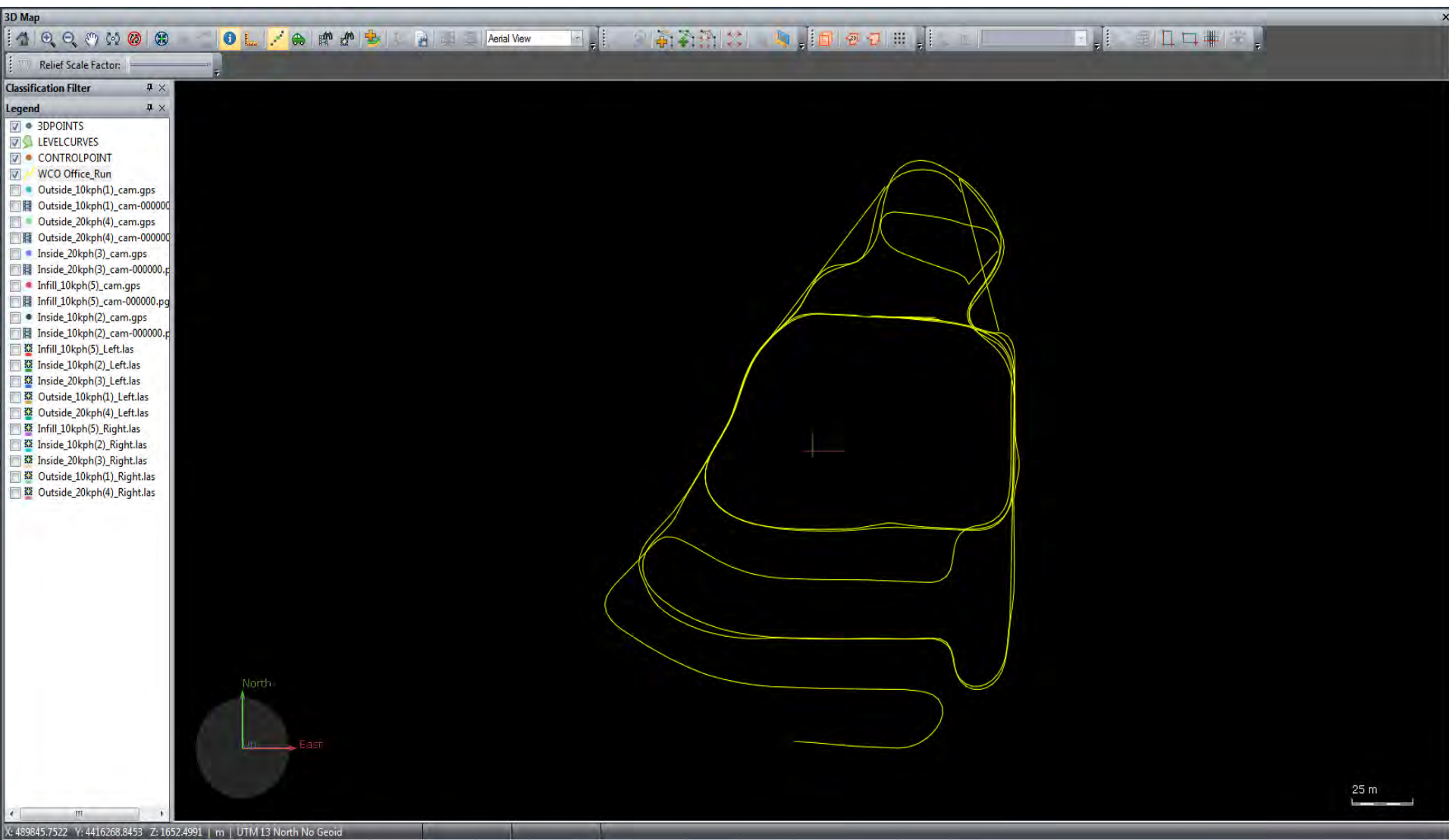
Flyover





Tesco

# MX2 Data Trimble Office WCO





# Our new home...







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Thank you...

‘Any questions?’