



North Region Construction UAS



*Aaron Chamberlin
Resident Engineer*



Current NRC UAS program

- 1 Licensed UAS Pilot- Aaron Chamberlin Remote Pilot # 4157568
- 1 DJI Phantom 4 Pro Registration # FA3KFRRKAP
- 165 Flights completed to date all recorded with Division of Aeronautics
- Working Closely with Chris Thornton from NR Surveys
- All flights fully compliant with DD-118 and Caltrans UAS Handbook





Current NRC UAS program

- DD-118 “USE OF UNMANNED AIRCRAFT SYSTEM” and Caltrans UAS handbook are fully implemented.
- 22 Flights have been utilizing new Smartsheet flight logging per Division of Aeronautics guidelines
- Visual Observer used for every flight per DD-118 and Caltrans UAS Handbook



UAS OPERATIONS

- **UAS OPERATIONS HANDBOOK REQUIREMENTS**
 - 3.1.4 Remote Pilot**

- The Remote Pilot shall hold a Federal Aviation Administration (FAA) Remote Pilot Certificate and is the only member of the UAS Flight Crew who may operate the flight controls of the unmanned aircraft during a UAS operation. The Remote Pilot has final authority and responsibility over the UAS flight.

- **3.1.3 UAS Flight Crew**

- A UAS Flight Crew is the team responsible to perform a UAS operation. The UAS Flight Crew must include at a minimum, a Remote Pilot and a Visual Observer. Support Personnel may be assigned, as needed, to ensure the safe and effective operation of the UAS.

- **3.1.4 Remote Pilot**

- The Remote Pilot shall hold a Federal Aviation Administration (FAA) Remote Pilot Certificate and is the only member of the UAS Flight Crew who may operate the flight controls of the unmanned aircraft during a UAS operation. The Remote Pilot has final authority and responsibility over the UAS flight. \

- **3.2.2 Visual Observer**

- The Visual Observer is responsible for aiding the Remote Pilot in maintaining situational awareness. The primary communication during flight is between the Remote Pilot and the Visual Observer. Responsibilities of the Visual Observer are to:
 - Be familiar with the UAS Operation
 - Assist the Remote Pilot in identifying any potential hazards or changing conditions
 - Scan the airspace for aircraft or collision hazards and maintain awareness of the position of the aircraft and the surrounding airspace
 - Listen and observe any abnormal sounds or flight characteristics exhibited by the UAS
 - Maintain two-way communication with the Remote Pilot at all times during the UAS operation
 - Assist in carrying out emergency plans and procedures in the event of an emergency

UAS Construction Applications

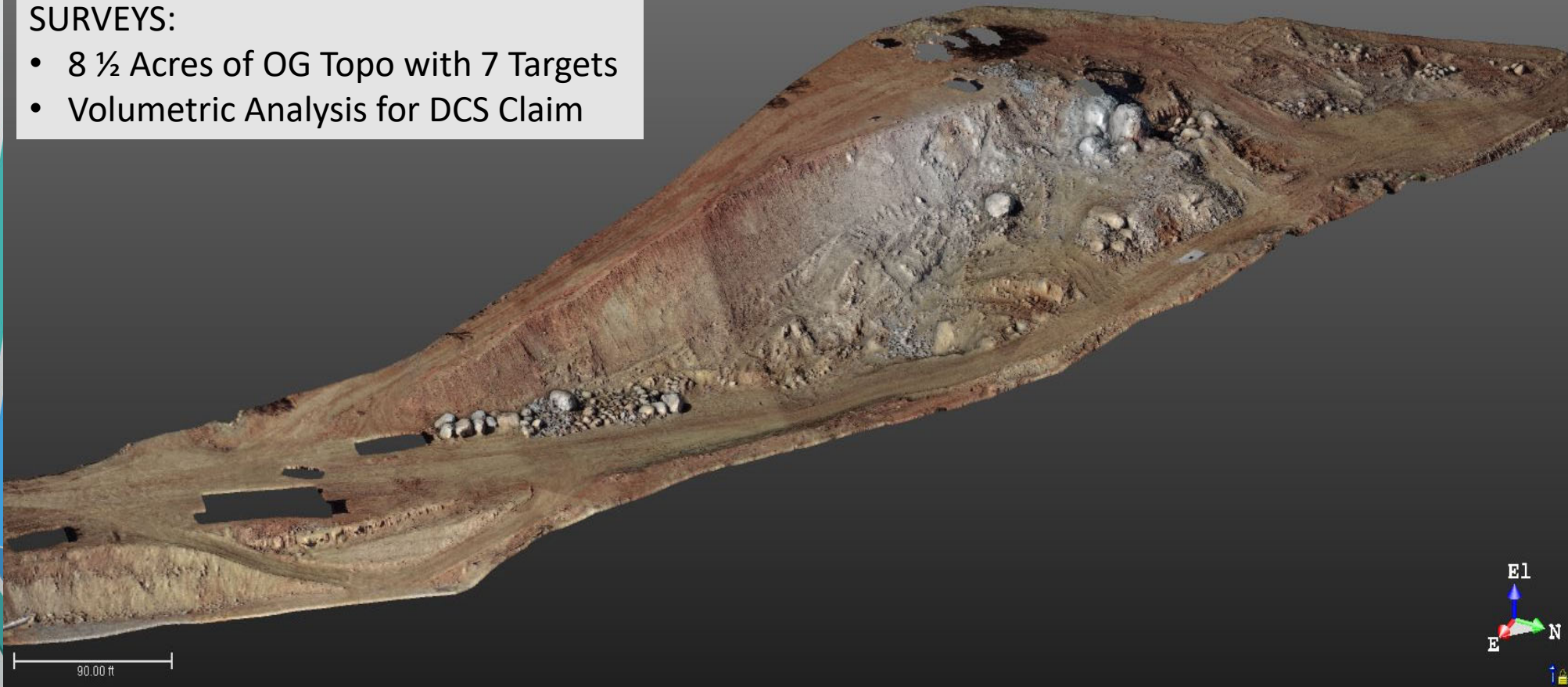
- Major Damage Assessment
- Public Information
- Bridge Inspections
- Geotechnical/Slope Investigations
- Earthwork Calculations
- Traffic Monitoring
- Construction Documentation
- Asset Management Data Collection (GIS)



Smartsville Realignment Project

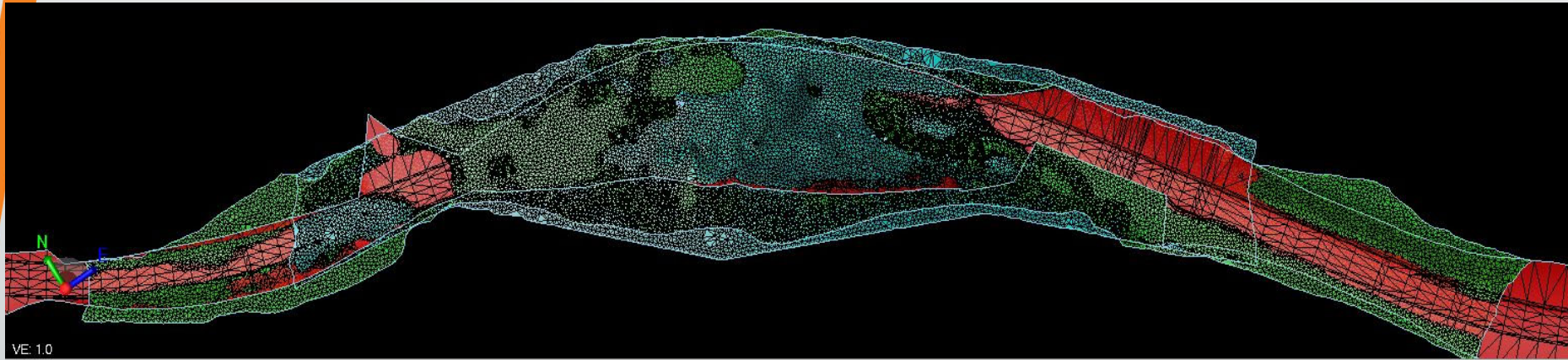
SURVEYS:

- 8 ½ Acres of OG Topo with 7 Targets
- Volumetric Analysis for DCS Claim

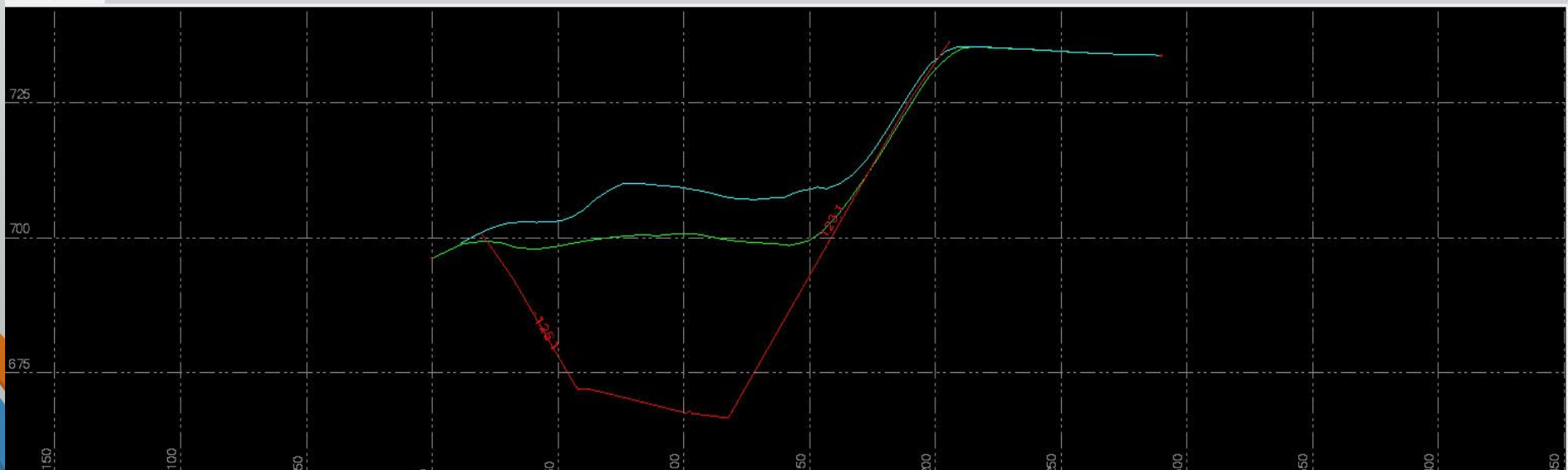


Smartsville Realignment Project

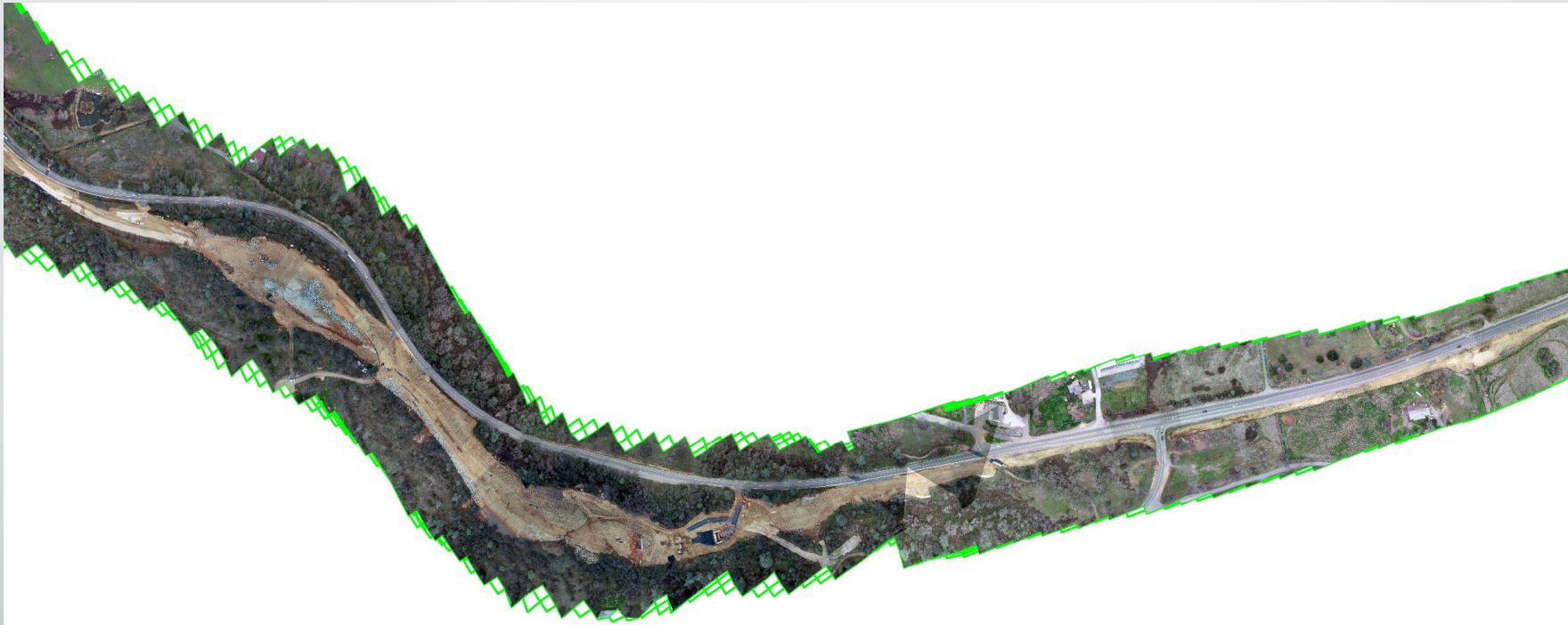
Volumetric Analysis for DSC Claim



Surface Slicer x



*03-2F5904 Smartsville Realignment
2D Orthographic image of 2.1 mile project*




UAS documentation of Precast Girder Placement



*03-2F5904 Smartsville Realignment
Deck Pour Documentation*



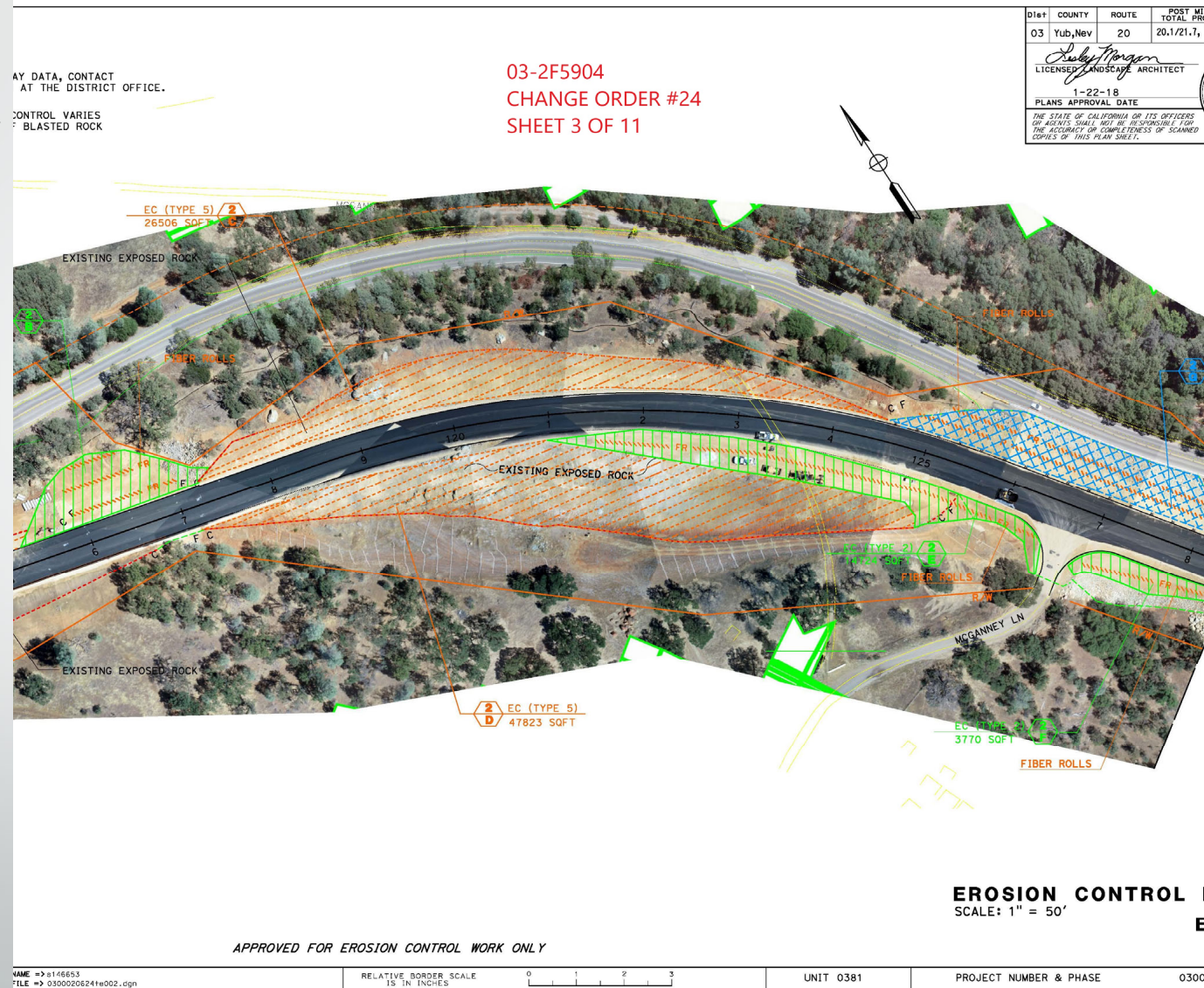
An aerial photograph of a highway construction site. In the foreground, a multi-lane highway runs horizontally. To the right of the highway, a large area of land is covered with green erosion control blankets, sloping upwards. Several yellow tower cranes are positioned on the construction site, some near the highway and others further back. Various construction vehicles, including trucks and cars, are scattered throughout the site. The background shows a line of trees and a clear sky. On the left side of the image, there is a decorative graphic consisting of several parallel diagonal lines in teal, blue, and orange colors, and a large, semi-transparent white circle that serves as a background for the text.

What else can these tools be used for?

- Progress pay estimates
- Linear measurements
- Area Measurements
- Volume Measurements
- Work Progress
- Claims documentation
- Extra work bill review
- Change Order Development

Change Order Development

- Orthographic Imaging
- Cost Savings
- Accurate
- Efficient



Linear Measurements

The screenshot displays the rayCloud software interface. The main window shows a 3D point cloud of a construction site with a green mesh overlay. A red line segment is drawn on the mesh, representing a linear measurement. The left sidebar contains a 'Layers' panel with a list of point clouds and groups. The right sidebar shows the 'Properties' panel for the selected 'Polyline 1 (Polyline)', displaying its length and error.

rayCloud Project Process View rayCloud Help

Create

Layers

- ☒ mtp79 (0)
- ☒ mtp80 (0)
- ☒ mtp81 (0)
- ☒ mtp82 (0)
- ☒ mtp83 (0)
- ☒ mtp84 (0)
- ☒ mtp85 (0)
- ☒ mtp86 (0)
- ☒ Automatic
- ☒ Point Clouds
 - ☒ Densified Point Cloud
 - ☒ Display Properties
 - ☒ 03-1E0604 12-5-11
- ☒ Point Groups
 - ☒ Display Properties
 - ☒ Unclassified
 - ☒ Disabled
 - ☒ Ground
 - ☒ Road Surface
 - ☒ High Vegetation
 - ☒ Building
 - ☒ Human Made Object
- ☐ Triangle Meshes
- ☒ Objects
 - ☒ Polylines
 - ☒ Display Properties
 - ☒ Polyline 1
 - ☒ Polyline 2
 - ☒ Polyline 3
 - ☒ Polyline 4
 - ☒ Polyline 5
 - ☐ Surfaces
 - ☐ Animation Trajectories
 - ☐ Orthoplanes
 - ☐ Scale Constraints
 - ☐ Orientation Constraints

Properties

Selection

Polyline 1 (Polyline)

Number of Vertices: 3

Measurements

Terrain 3D Length [ft]:	180.86	error n/a
Projected 2D Length [ft]:	180.80	error n/a

Copy to Clipboard Apply Cancel Help

Images

Image Size Zoom Level

DJI_0426.JPG Polyline 1 DJI_0404.JPG Polyline 1

DJI_0365.JPG Polyline 1 DJI_0366.JPG Polyline 1

DJI_0367.JPG Polyline 1 DJI_0364.JPG Polyline 1

DJI_0363.JPG Polyline 1 DJI_0428.JPG Polyline 1

NAD_1983_StatePlane_California_II_FIPS_0402_Feet (EGM 96 Geoid) - (6677646.44, 2187048.47, 54.01) [ft]

Area Measurements

The screenshot displays the Pix4Dmapper software interface. The main window shows a 3D point cloud model of a construction site. A green highlighted area on the ground surface is selected for measurement. The left sidebar contains a 'Layers' panel with a list of point cloud files (mtp79 to mtp115) and a 'Map View' panel with icons for Home, Map View, rayCloud, Volumes, Mosaic Editor, and Index Calculator. The top menu bar includes Project, Process, View, rayCloud, and Help. The top toolbar contains icons for Project, Process, View, Navigation, Clipping, and Point Cloud Editing. The right sidebar shows the 'Properties' panel with 'Selection' and 'Measurements' sections. The 'Measurements' section displays the following data:

Measurements		
Terrain 3D Length [ft]:	552.81	error n/a
Projected 2D Length [ft]:	546.45	error n/a
Enclosed 3D Area [ft²]:	4116.79	error n/a
Projected 2D area [ft²]:	3859.55	error n/a

Below the measurements, there are checkboxes for 'Use for DSM and Triangle Mesh' (unchecked) and 'Automatic Orientation' (checked). The bottom right corner shows a grid of six thumbnail images labeled 'DJI_0339.JPG Surface 1', 'DJI_0132.JPG Surface 1', 'DJI_0025.JPG Surface 1', 'DJI_0131.JPG Surface 1', 'DJI_0026.JPG Surface 1', and 'DJI_0340.JPG Surface 1'.

NAD_1983_StatePlane_California_II_FIPS_0402_Feet (EGM 96 Geoid) - (6677717.76, 2187790.03, 77.17) [ft]

Volume Measurements

The screenshot displays the Pix4Dmapper software interface. The central 3D view shows a point cloud model of a construction site, featuring a large pile of material (likely sand or gravel) and several vehicles. The left sidebar contains the 'Create' tab with 'Layers' and 'Volumes' sections. The 'Layers' section lists various point cloud data (mtp155 to mtp159) and includes checkboxes for 'Automatic', 'Point Clouds', 'Densified Point Cloud', 'Display Properties', 'Point Groups', 'Triangle Meshes', 'Objects', 'Polylines', and 'Surfaces'. The 'Surfaces' section is expanded, showing 'Surface 1' and 'Surface 2'. The right sidebar contains the 'Properties' panel for 'Surface 2 (Surface)', displaying measurements such as 'Terrain 3D Length [ft]: 82.00', 'Projected 2D Length [ft]: 81.83', 'Enclosed 3D Area [ft²]: 493.43', and 'Projected 2D area [ft²]: 492.05'. Below the properties is an 'Images' panel showing a grid of image thumbnails with green crosshair overlays.

Properties

Selection

Surface 2 (Surface)

Number of Vertices: 21

Measurements

Terrain 3D Length [ft]:	82.00	error n/a
Projected 2D Length [ft]:	81.83	error n/a
Enclosed 3D Area [ft²]:	493.43	error n/a
Projected 2D area [ft²]:	492.05	error n/a

Use for DSM and Triangle Mesh ☐

Automatic Orientation ☒

Copy to Clipboard Apply Cancel Help

Images

DJI_0120.JPG Surface 2 DJI_0121.JPG Surface 2

DJI_0122.JPG Surface 2 DJI_0123.JPG Surface 2

DJI_0124.JPG Surface 2 DJI_0125.JPG Surface 2

NAD_1983_StatePlane_California_II_FIPS_0402_Feet (EGM 96 Geoid) - (6677609.53, 2188105.29, 65.75) [ft]

- Logs can be exported to Excel
- More accurate, repeatable results
- Raw Data Stored for backup

A	B	C	D	E	F	G	H	I	J
Name	Projected	Projected	Terrain 3D	Terrain 3D	Projected 2D	Projected	Enclosed 3	Enclosed 3	Terrain 3
Polyline 1	180.804		180.861		127.568				
Name	Projected	Projected	Terrain 3D	Terrain 3D	Projected 2D	Projected	Enclosed 3	Enclosed 3	Terrain 3
Polyline 2	604.64		606.422						
Name	Projected	Projected	Terrain 3D	Terrain 3D	Projected 2D	Projected	Enclosed 3	Enclosed 3	Terrain 3
Polyline 3	539.647		540.882						
Name	Projected	Projected	Terrain 3D	Terrain 3D	Projected 2D	Projected	Enclosed 3	Enclosed 3	Terrain 3
Polyline 4	493.407		493.999						
Name	Projected	Projected	Terrain 3D	Terrain 3D	Projected 2D	Projected	Enclosed 3	Enclosed 3	Terrain 3
Polyline 5	414.974		415.261						
		TOTAL	2237.425 LF						
Name	Projected	Projected	Terrain 3D	Terrain 3D	Projected 2D	Projected	Enclosed 3	Enclosed 3	Terrain 3
Surface 1	546.446		552.805		3859.55 SQFT		4116.79		
Name	Projected	Projected	Terrain 3D	Terrain 3D	Projected 2D	Projected	Enclosed 3	Enclosed 3	Terrain 3
Surface 2	81.827		82.0017		492.048		493.433 C.F.		



UAS Direct Savings and Benefits

- \$60K in Extra work bills rejected
- Measurements on average take 1/3 less time
- Change Order Development led to **74K** in item savings.



UAS Costs

- DJI Phantom 4 Pro ~\$2000.00.
- Ipad Used as Controller
- Expected lifespan 2-3 years
- Analysis Software- Cost vary
- FAA pilot License fee - \$150.00

