

North Region Office of Surveyors UAS Program

September 2020



Why UAS?!

Difficulty
Hiring
Surveyors

Accelerated
Project
Delivery

Surveys
Backlog

Enhance
Safety

Implement
Innovation

Increase
Efficiency

Background

- NROS began the UAS Pilot Program sponsored by North Region Management in August 2018 with 2 DJI Phantom 4 Pro.
 1. Gain Management Buy In
 2. Affordable entry cost of UAS and software
 3. Provide sample data from projects
 4. Demonstrated cost savings
 - Estimated crew hours verses estimated hours for flight and processing
- NROS has 11 part 107 UAS pilots
 - District 1 – 3, District 2 – 3, District 3 - 5

North Region Surveys' UAS Fleet

DJI Phantom 4 Pro

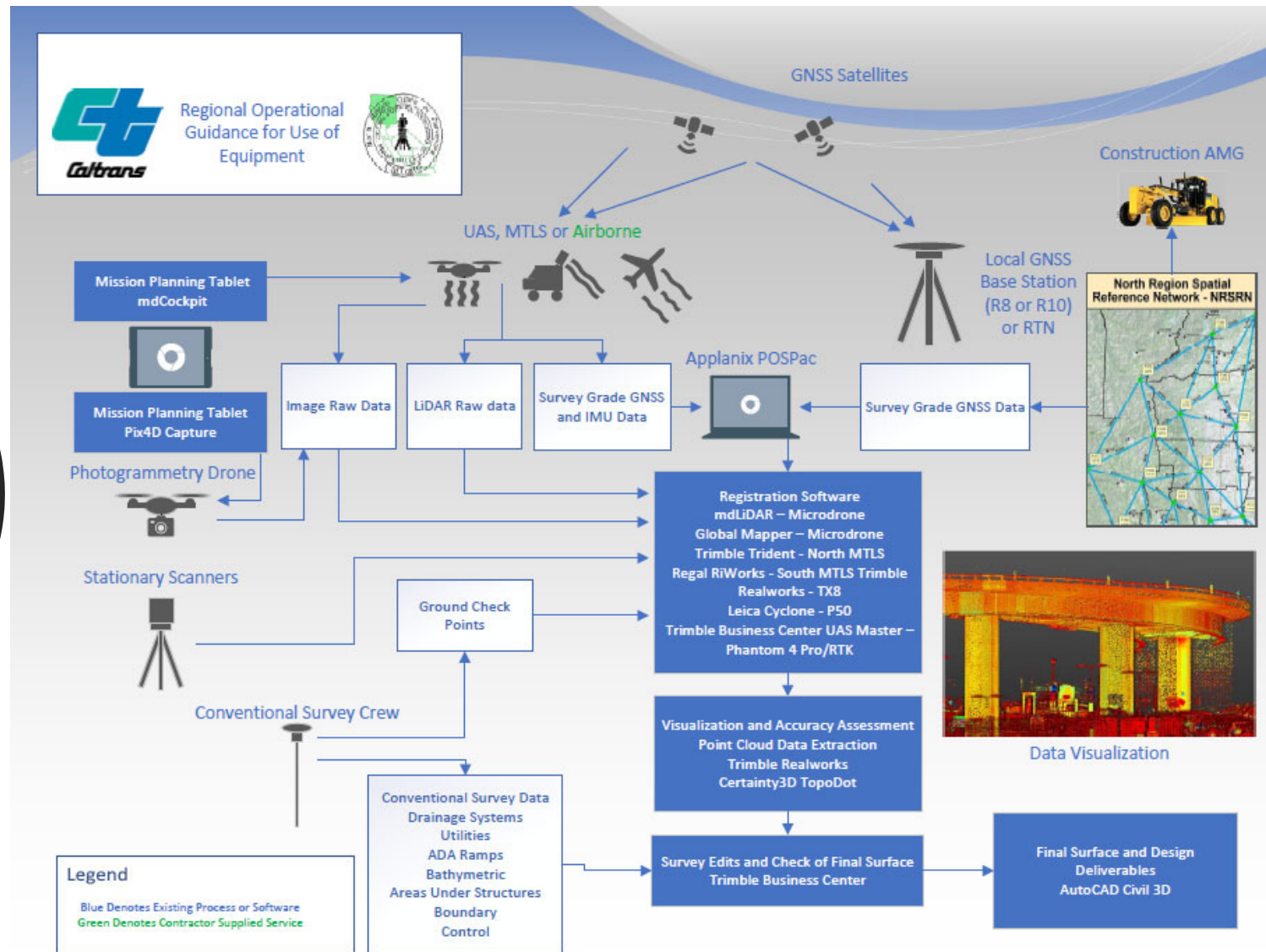
DJI Phantom 4 RTK

Microdrone mdLiDAR 3000

- May 2018: 2 - DJI - Phantom Pro UASs
- Mar 2019: DJI – Phantom 4 RTK + D- RTK 2 Mobile Station
- August 2019 – Microdrone mdLiDAR3000 with Riegl sensor
- (2) DJI Phantom 4 RTK



NROS Workflow Chart



UAS Partnerships Across Divisions

Construction

- Georeferenced orthorectified imagery
- Point cloud data & maps
- Document potential CCO's
- Quantities

Planning

- K-Phase Projects
- Public meeting displays
- Georeferenced orthorectified imagery
- Video

Environmental

- Environmental sensitive areas
- Georeferenced orthorectified imagery
- Point cloud data & maps

Design

- Emergency slides
- Georeferenced orthorectified imagery
- Point cloud data & maps

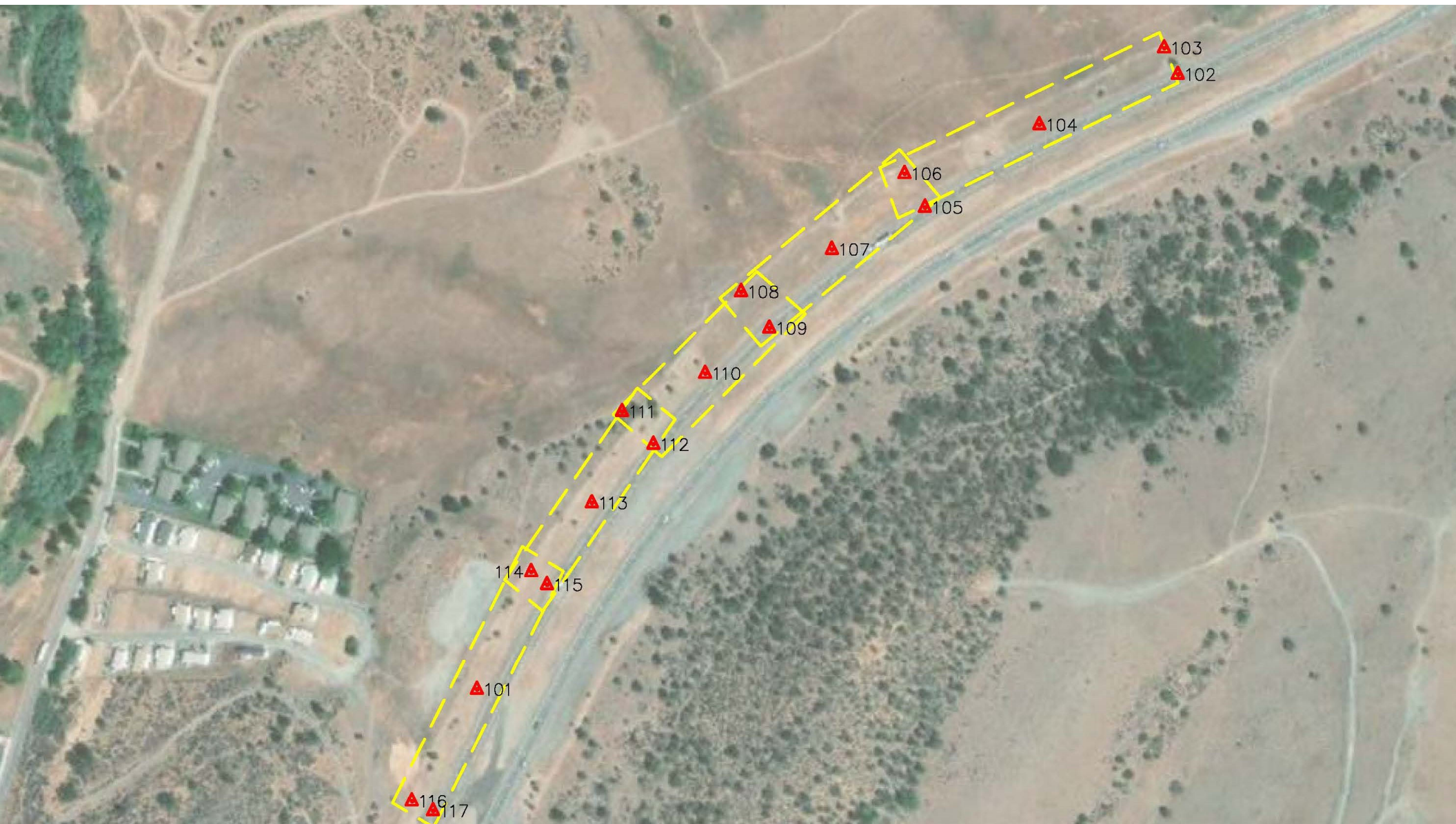
Mission Planning and Field Work

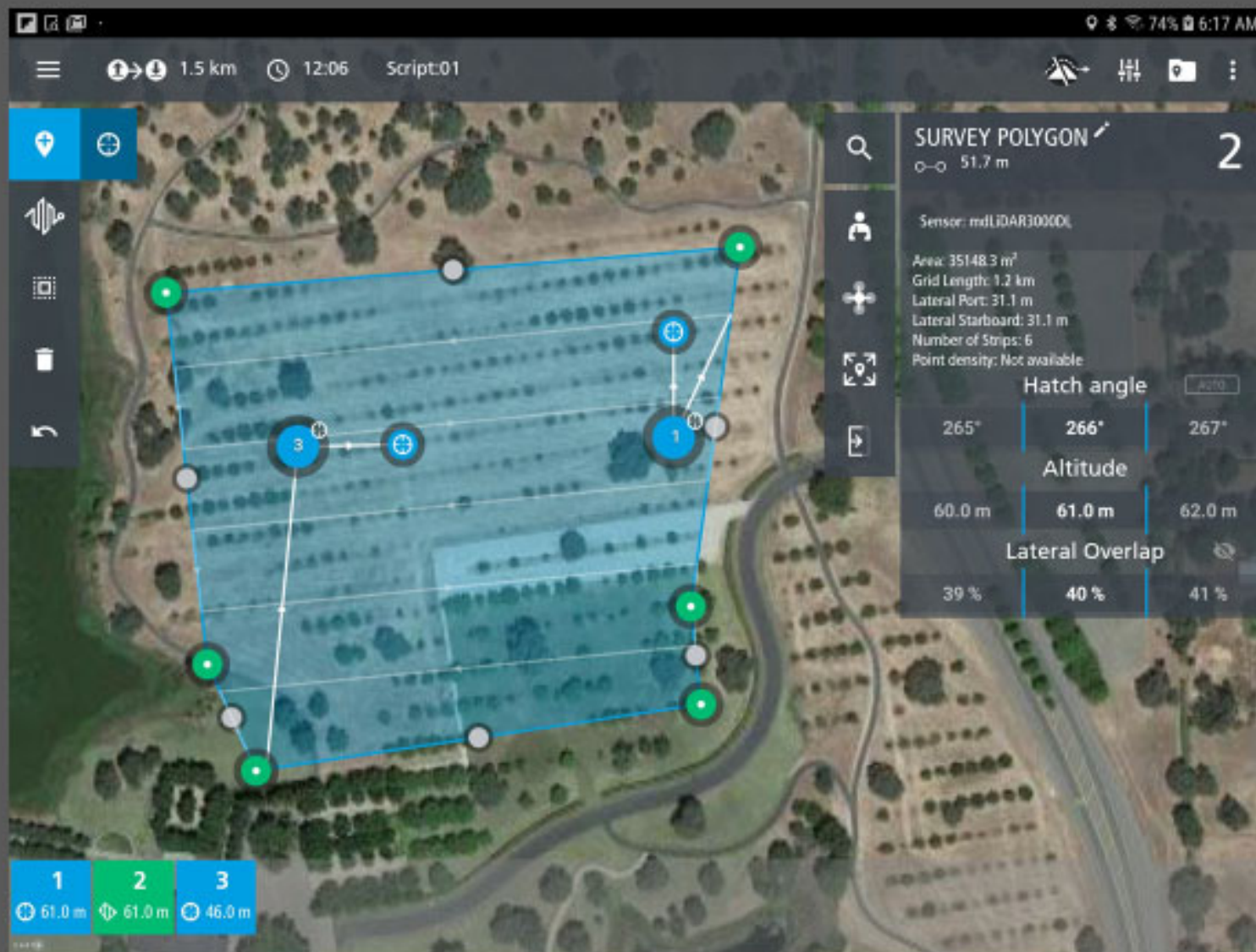
Pre Flight Considerations

- Roadway and Pedestrian Traffic
- Trees and obstructions
- Restricted Airspace
- Launch/Landing sites
- Weather Conditions
- Permission to fly outside of R/W

Prior to Flight

- Locating/establishing control
- Setting targets within flight zone





McConnell Flight Plan



Project Samples and Deliverables

- NROS has been utilized to support all divisions across the Region.
- OLS is working to establish accuracies and standards for UAS and LiDAR applications.

**Butte City Bridge Hwy 162 Pre-Project*



**Butte City Bridge Hwy 162 Conceptual Design*



K-Phase Planning Public Display



Imagery for Alternative Planning



Imagery for environmental impact monitoring



Imagery of completed project for public presentation

Emergency Projects

- These projects were all flown with the DJI photogrammetry drone

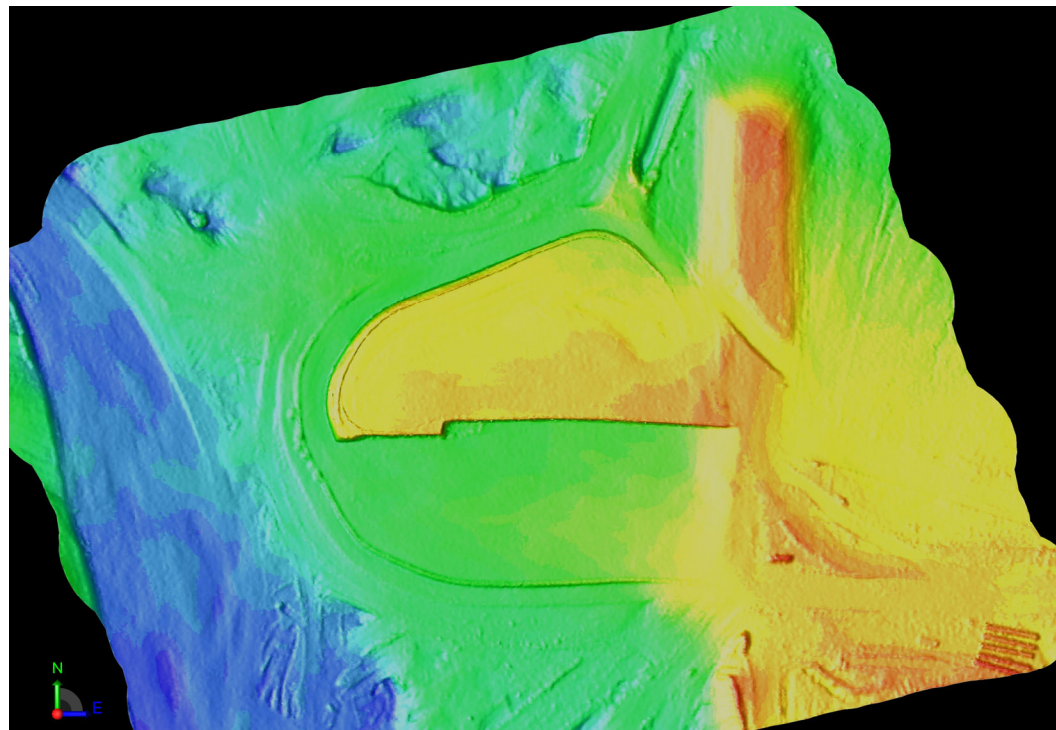
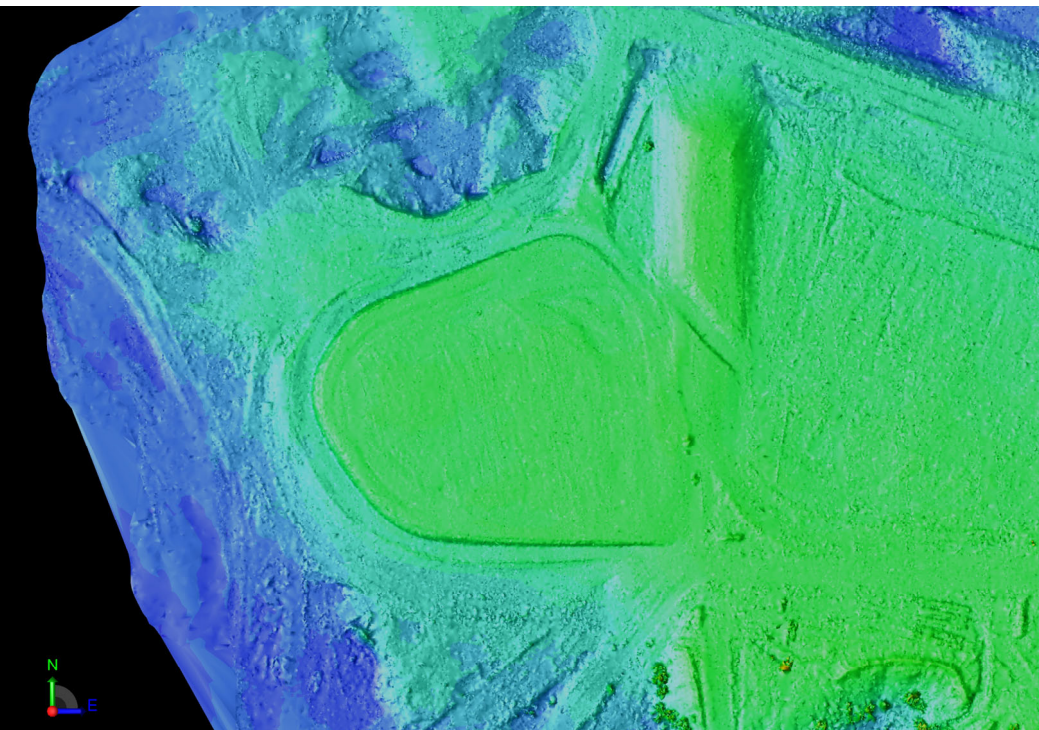
<http://svgcesridvweb.ct.dot.ca.gov/arcgis/apps/View/index.html?appid=e7efbfab8ca14f7b83c45b3346f5fca9>



**Hwy 191 Camp Fire Area*



**Hwy 101 Howling Wolf Land Slide*

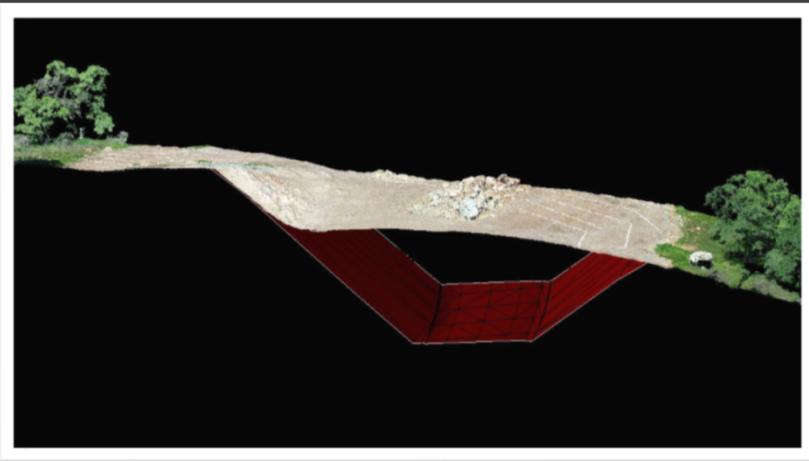


Vineyard Borrow Site

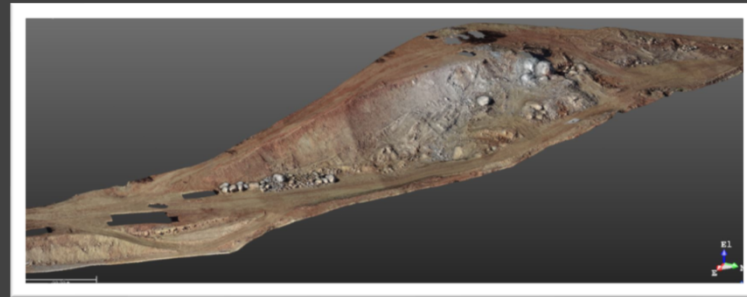
Earthwork Volume Report	
Unclassified surface compared to Unclassified surface	
Surfaces	
Vineyard Borrow Site 9-12-19	Classification: Unclassified
10-1-19 Surface	Classification: Unclassified
Bank Volumes Based on Surface Geometry Alone	
Cut material	38,189.5 yd ³
Fill material	1,241.4 yd ³
Excess	36,948.2 yd ³

Construction Site Monitoring

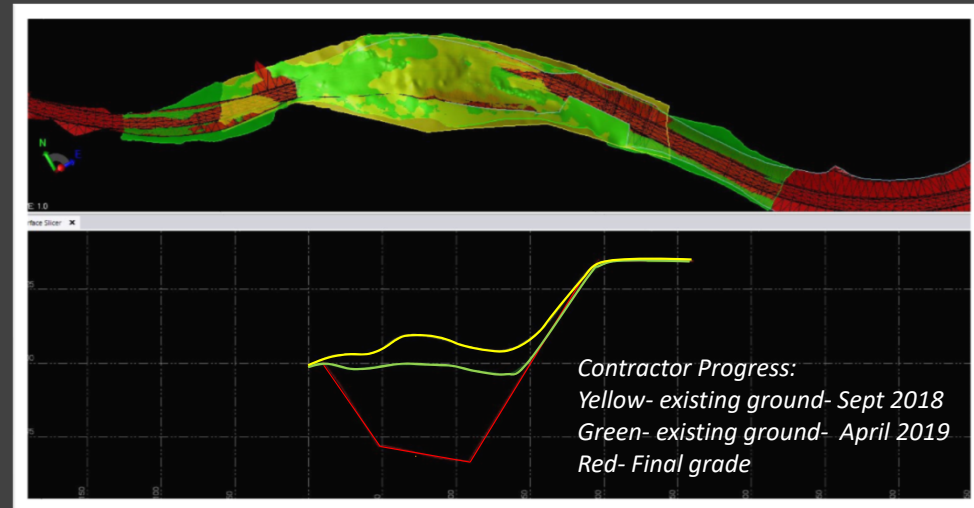
- Document Potential CCO's
- Progress Imagery
- Quantities



April 2019 surface comparison to design surface



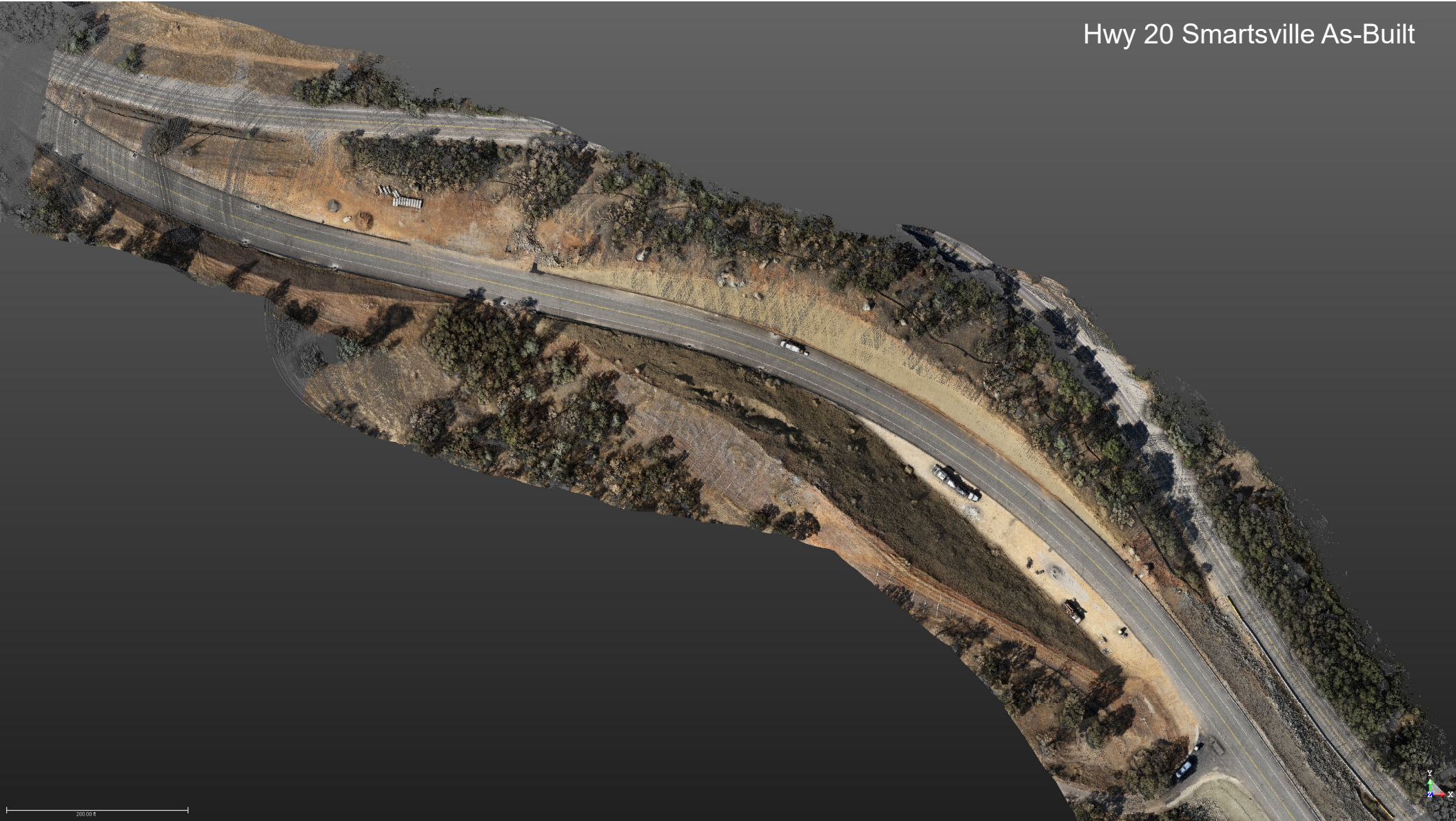
Hwy 20 Smartsville



Smartsville Georeferenced Orthorectified Imagery



Hwy 20 Smartsville As-Built



Benefits of UAS LiDAR

Large data sets can be collected in a fraction of the time when compared to conventional survey methods

LiDAR is capable of penetrating light vegetation

Point cloud data and imagery is collected simultaneously

Data collection is not impacted by cloud cover

LiDAR is not affected by sunlight and shadows

Flights are directly georeferenced (DG) and controlled using a single ground control point with additional checks

Reduced post processing time

Efficiencies

- Cost Savings
 - Higher quality data collected earlier in planning & design phases
 - Average 40+ percentage cost savings compared to conventional field data collection
 - Mine data at a later date for scope change
- Streamline Existing Processes
 - Fits in existing workflow
 - Uses majority existing programs
 - Readily Mobile
- Safety
 - Less exposure to our employees and the traveling public
 - Data collection in inaccessible areas

UAS LiDAR Cost Savings			
Projects	Project Size	LIDAR Drone	Conventional Survey
Vineyard Borrow Pit	60 acres		
Control & data collection		\$7,000	\$19,660
Supplemental data		\$0	\$0
Data processing		\$4,200	\$560
Total cost		\$11,200	\$20,220
Cost Savings Percentage		45%	
Smartsville	1.8 miles		
Control & data collection		\$4,200	\$28,000
Supplemental data		\$11,240	\$0
Data processing		\$5,600	\$1,400
Total cost		\$21,040	\$29,400
Cost Savings Percentage		28%	
Butte 32	3.5 miles		
Control & data collection		\$7,000	\$67,440
Supplemental data		\$16,860	N/A
Data processing		\$5,600	\$2,800
Total cost		\$29,460	\$70,240
Cost Savings Percentage		58%	

Limitations and Things to Remember



- Department UAS Guidelines i.e. flying outside of R/W
- FAA No Fly Zones change daily and have to be checked
- All State & National Parks and Monuments are restricted areas
- Large projects are better suited for Airborne Lidar
- LiDAR can be used to collect data only where natural light can hit the ground
- Must maintain line of sight
- Weather
- Adequate space to take off & land
- Environmental constraints: endangered species, nesting & breeding seasons

Looking Forward

- NROS is working to acquire UAS LiDAR technology in each District in the North Region to further cost savings and reducing traveling associated with having the single unit
- Applied for Federal Grants that would allow for additional sensors, UAV (thermal, rotating and fixed wing UAV), bathymetry and Ground Penetrating Radar (GPR)
- Continue to offer support and training to other districts during procurement, chairside and infield.
- Advance LiDAR standards for UAS and MTLS



Questions