



PRECISION LIDAR & TERRAIN MAPPING WITH UAVS

Chris McMurtry, president





**ESTABLISHED IN
2013**

**AERIAL INSPECTION
RESOURCES**



TEC-1521
GE48.7XL SET-499



**ESTABLISHED IN
2013**

**A FULL SERVICE
UAV SOLUTION
PROVIDER**



**ESTABLISHED IN
2013**

**A FULL SERVICE
DATA SOLUTION
PROVIDER**

**COLLECT DATA
& PROVIDE
DATA ANALYTICS**

**AERIAL INSPECTION
RESOURCES**



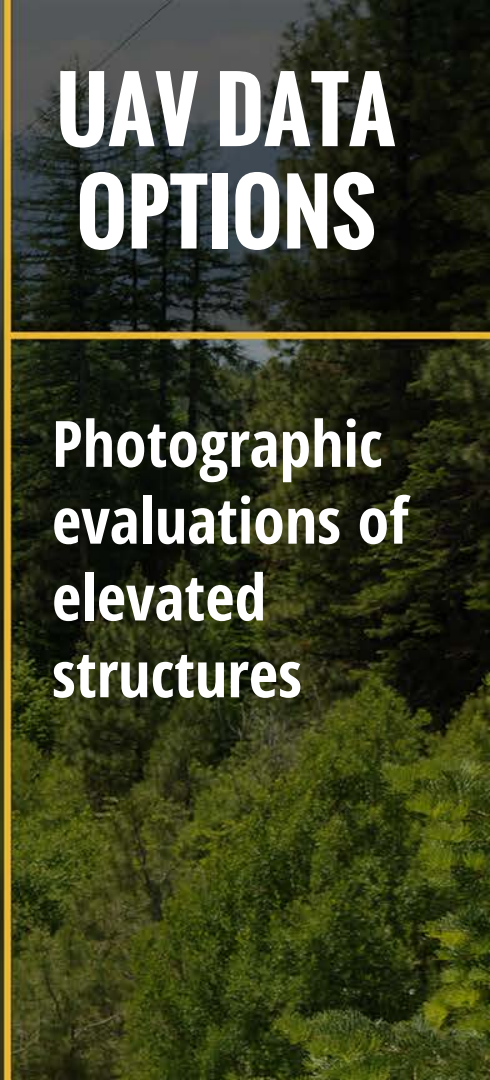
UAV DATA OPTIONS

Photographic
evaluations of
elevated
structures



UAV DATA OPTIONS

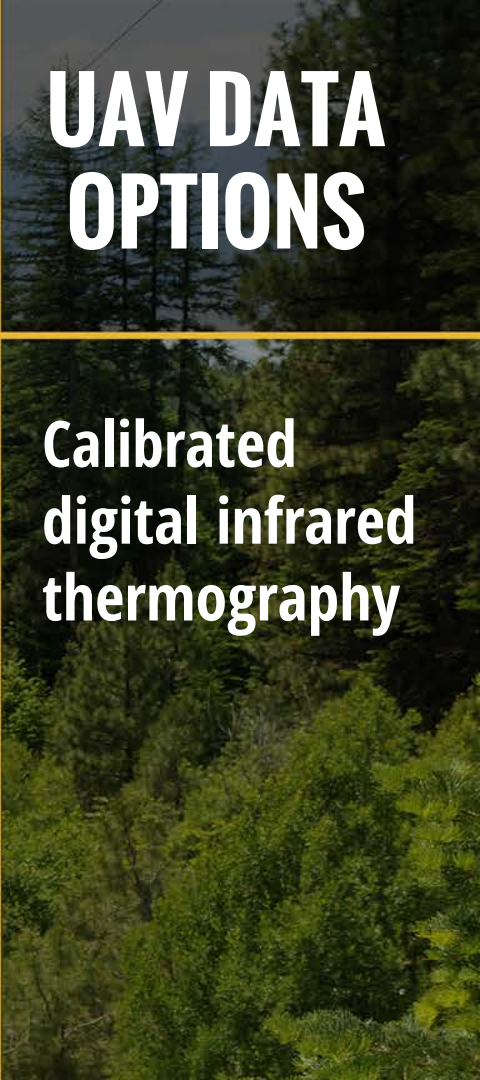
Photographic
evaluations of
elevated
structures





UAV DATA OPTIONS

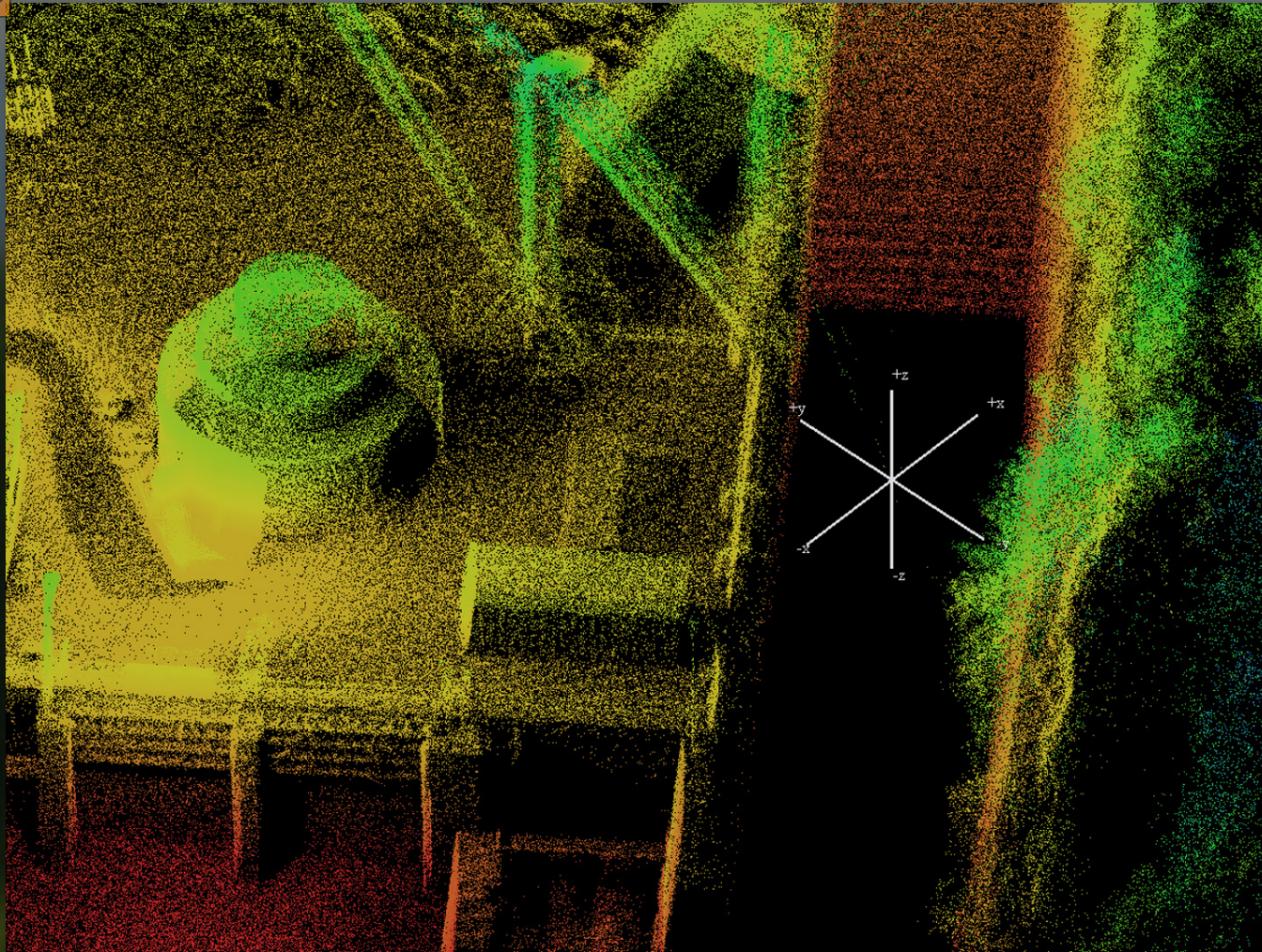
Calibrated
digital infrared
thermography





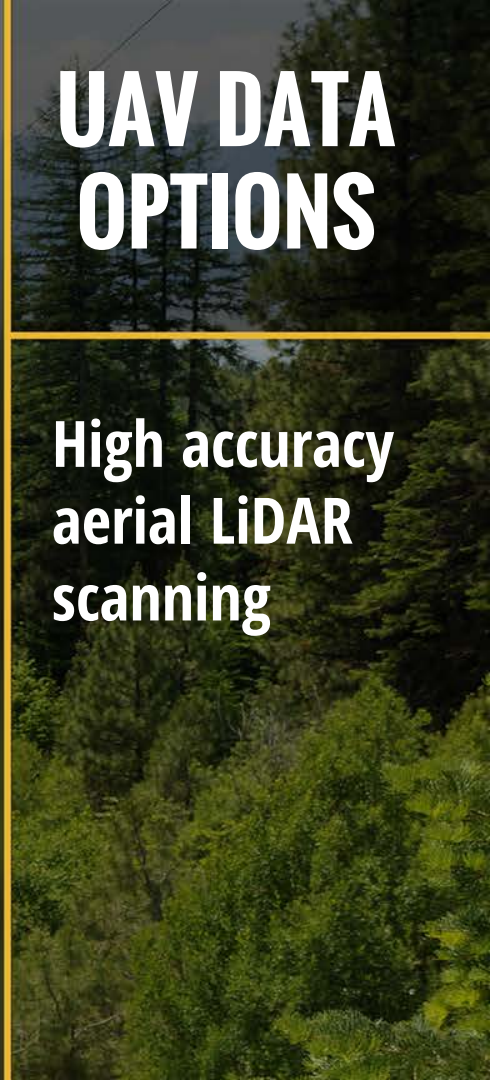
UAV DATA OPTIONS

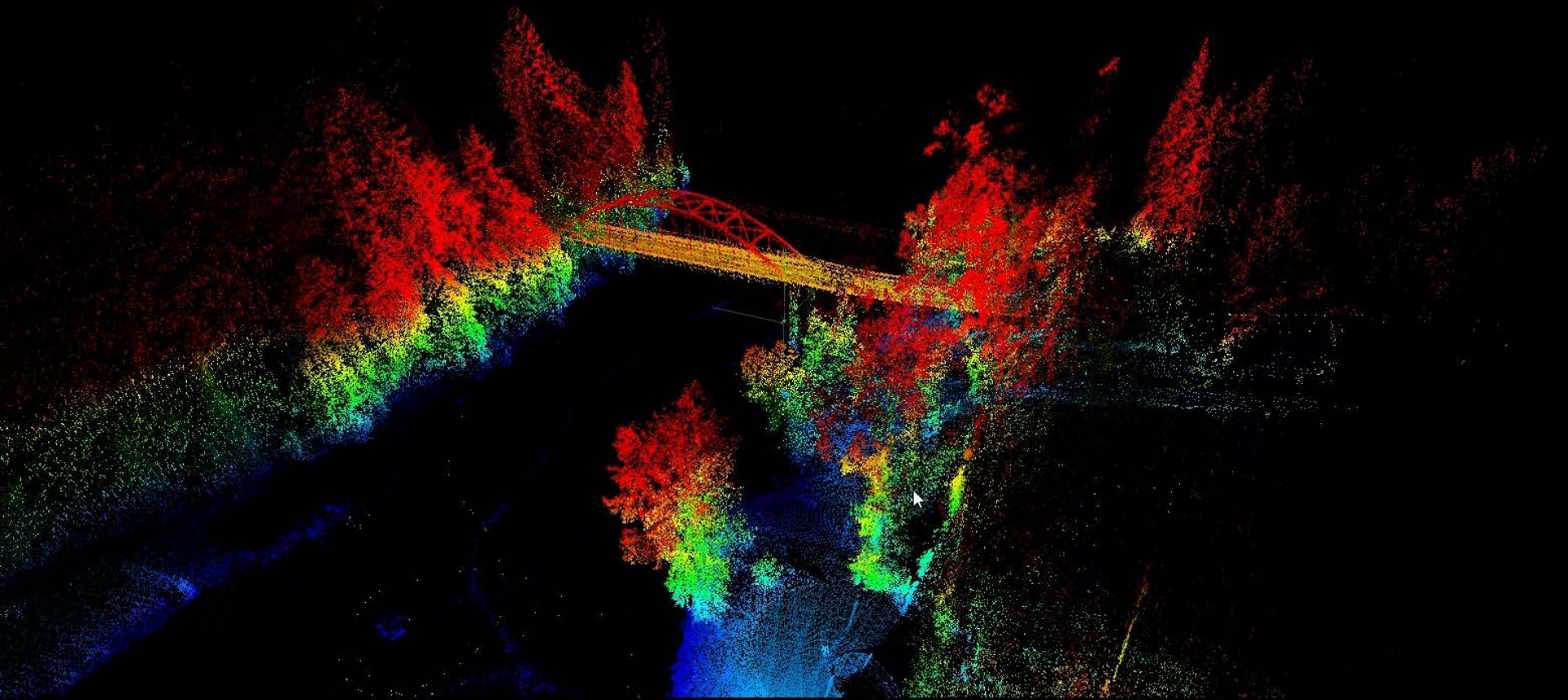
Daylight
UltraViolet
"Corona"
photography



UAV DATA OPTIONS

High accuracy
aerial LiDAR
scanning











AIR “READY COPTER”



AIR READY COPTER

Wingspan: 5 Feet

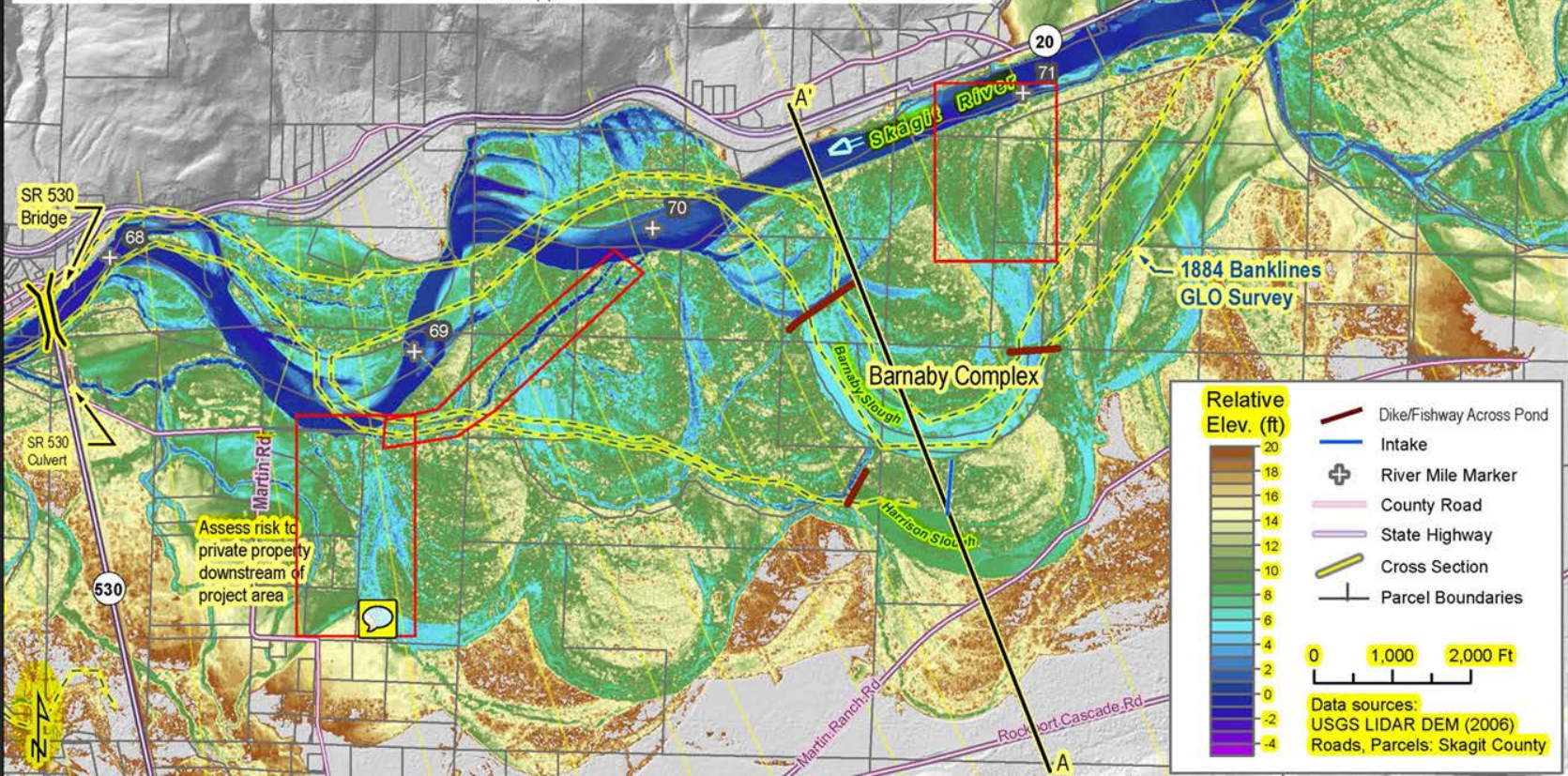
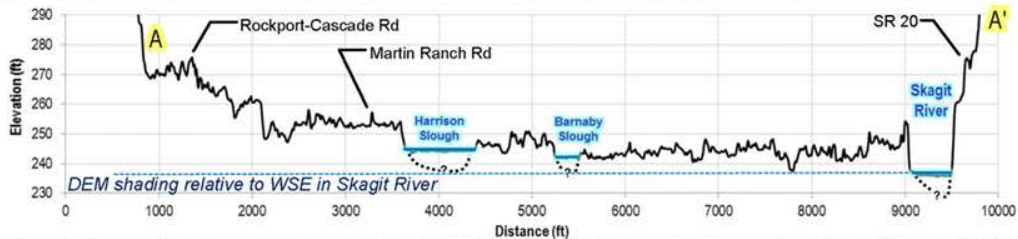
Weight: 14 lbs.

Payload: 20 lbs.

Flight Time: 15 to 25 Minutes







Assess risk to private property downstream of project area



Barnaby Slough

Located at 48.484, 122.544

48.485, -122.54, 35

© Mapbox © OpenStreetMap Improve this map

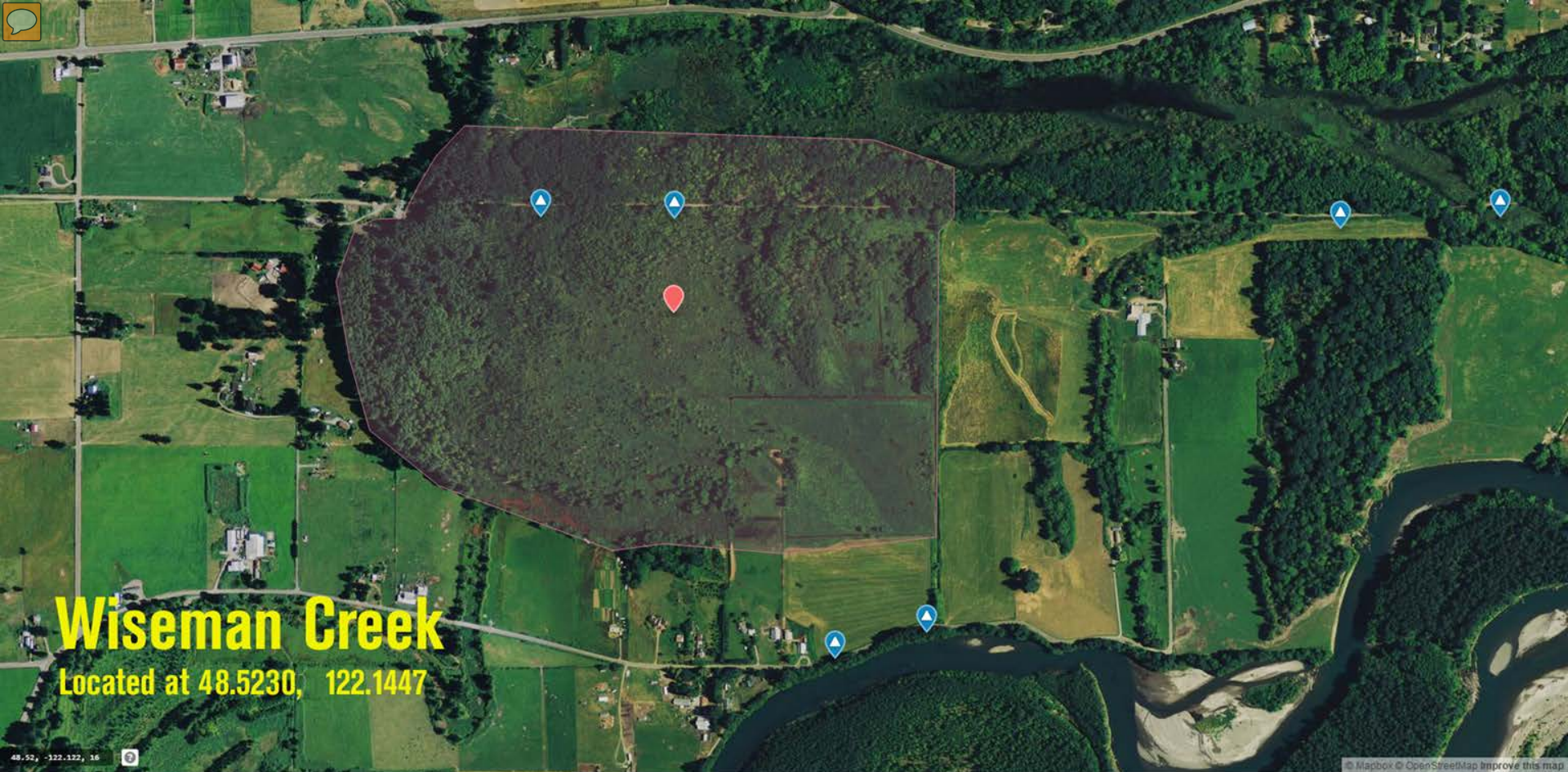
LIDAR ACQUISITION PRIMARY ROI (PINK): 134.1 ACRES - SECONDARY ROI (YELLOW): 63.2 ACRES



Barnaby Slough

Located at 48.484, 122.544

LIDAR ACQUISITION PRIMARY ROI (PINK): 134.1 ACRES - SECONDARY ROI (YELLOW): 63.2 ACRES



Wiseman Creek

Located at 48.5230, 122.1447

LIDAR ACQUISITION PRIMARY REGION OF INTEREST: 202.4 ACRES

48.52, -122.122, 16



© Mapbox © OpenStreetMap improve this map

SKAGIT RIVER SYSTEM COOPERATIVE LIDAR SURVEY

AREA: 459 total acres in 3 separate parcels

DELIVERABLES:

1) Surface Elevation Model of the first return surface.

SEM.* as ASCII and Raster

SEM_GRID.* as ASCII and Raster

2) A Digital Elevation Model (1m cell size) of the bare earth surface.

DEM.* as ASCII and Raster

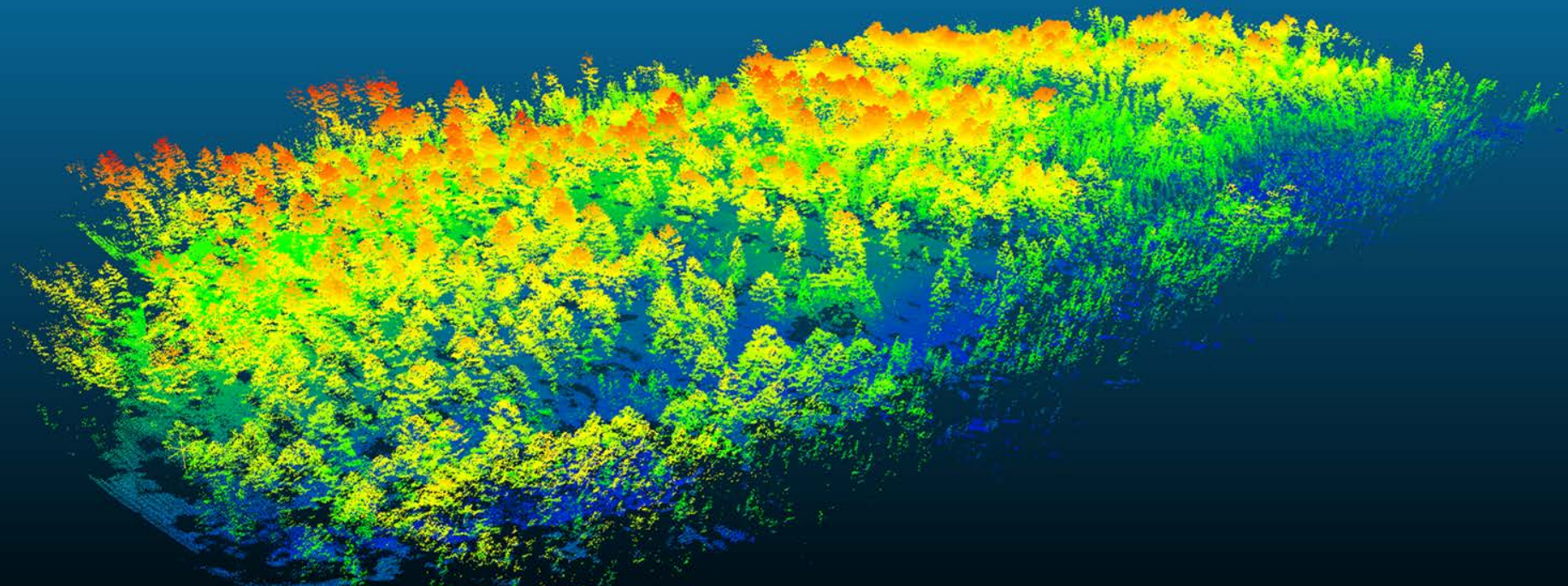
DEM_GRID.* as ASCII and Raster



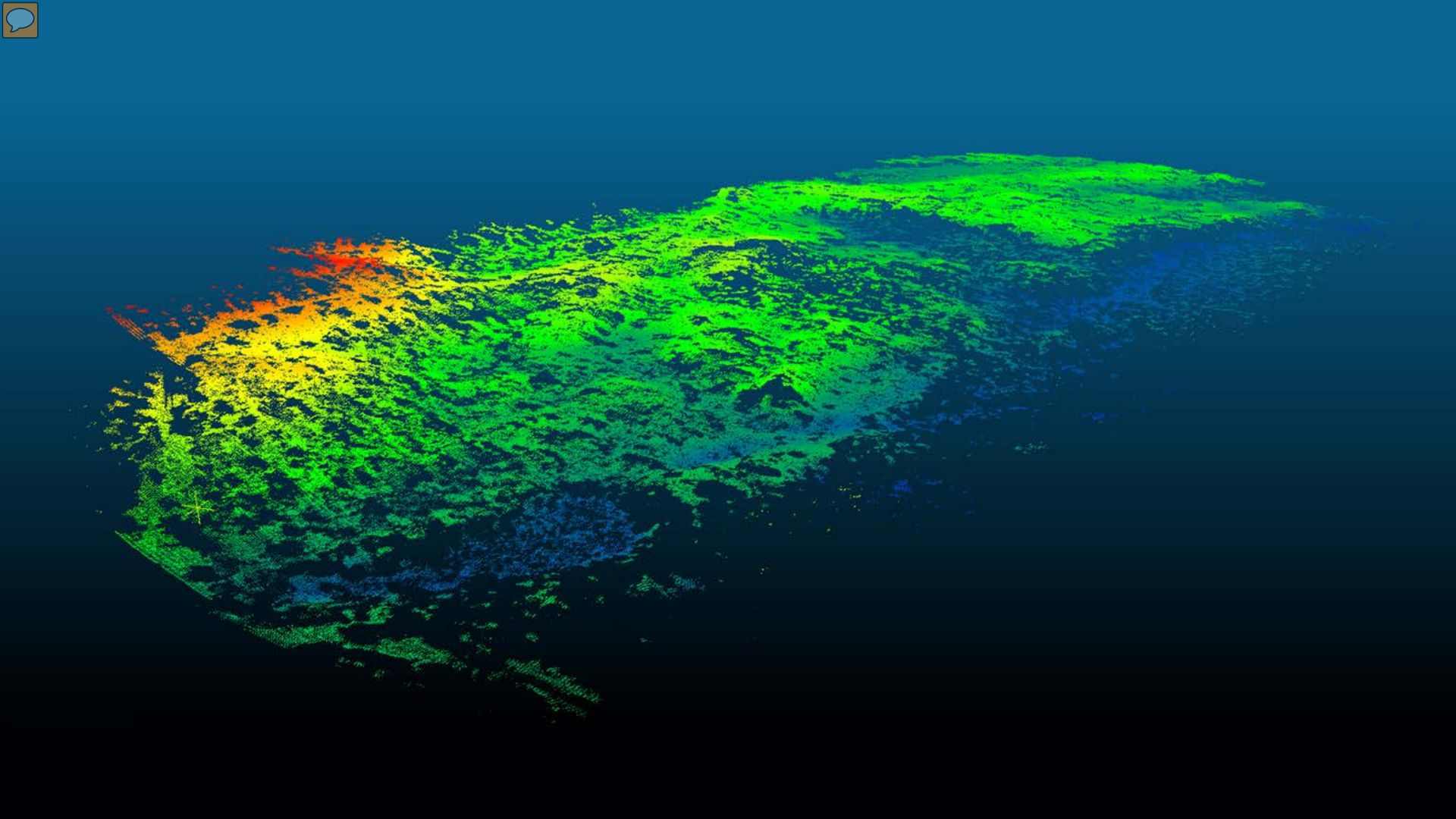
SKAGIT RIVER SYSTEM COOPERATIVE



- **LIGHTEST LIDAR SYSTEM AVAILABLE: 2.2 KG**
- **8 LASER SYSTEM WITH MULTI-RETURN CAPABILITY**
- **BETTER THAN 35 CM ACCURACY**



**MULTI RETURN LIDAR SYSTEM – CAN PROCESS
“ECHOES” FROM A LASER PULSE PENETRATING FOLIAGE**



SRSC LIDAR SURVEY: MINIMUM SPECS

- UAV Maximum AGL 50m (25m optimal)
- 100 degree field of view
- YellowScan at 80,000 pulses per second
- Nominal pulse spacing 0.4m
- 50% sidelap between LIDAR strips
- +/- 35 cm vertical accuracy
- +/- 60 cm horizontal accuracy



SKAGIT RIVER SYSTEM COOPERATIVE

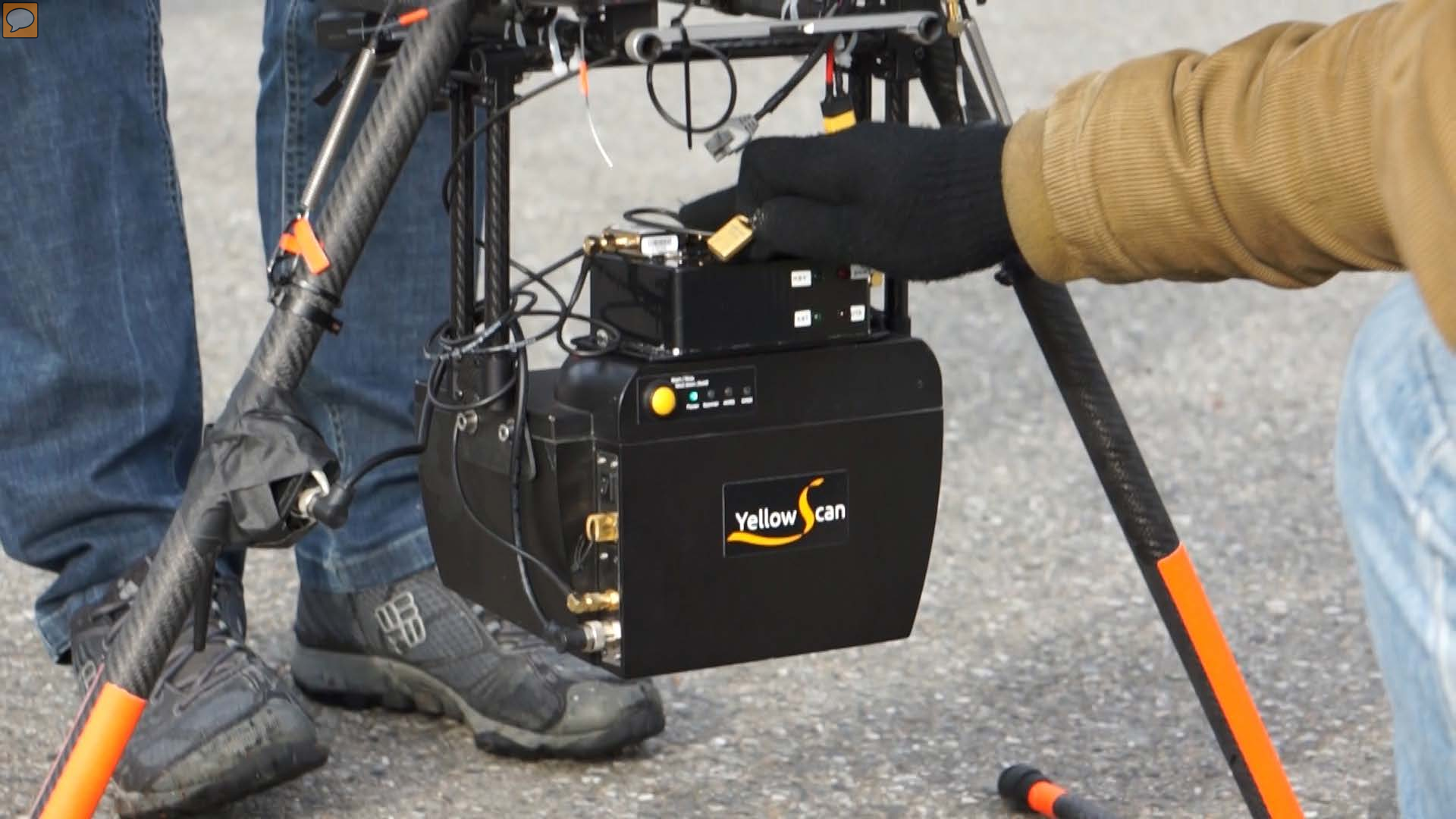
Add Area

Delete Area

Rotate Area:
 on: 00:00:00
 on: 01:03:??
 / av: 12.061k

Template	Alti	Para
Point	200	1
Line	200	2
Triangle	200	3
Rectangle	200	4
Circle	200	20
Scan	40	15





YellowScan





GROUND CONTROL POINTS

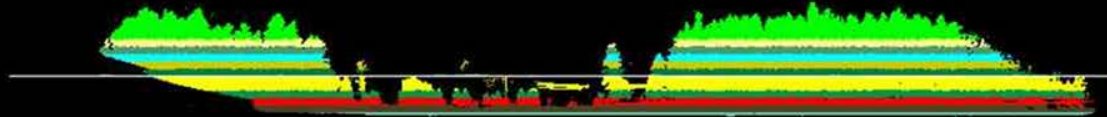
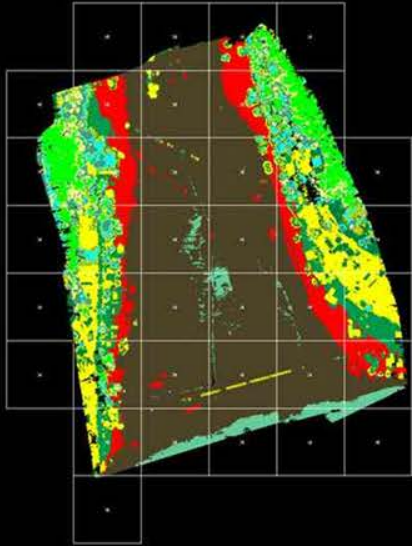


GROUND CONTROL POINTS

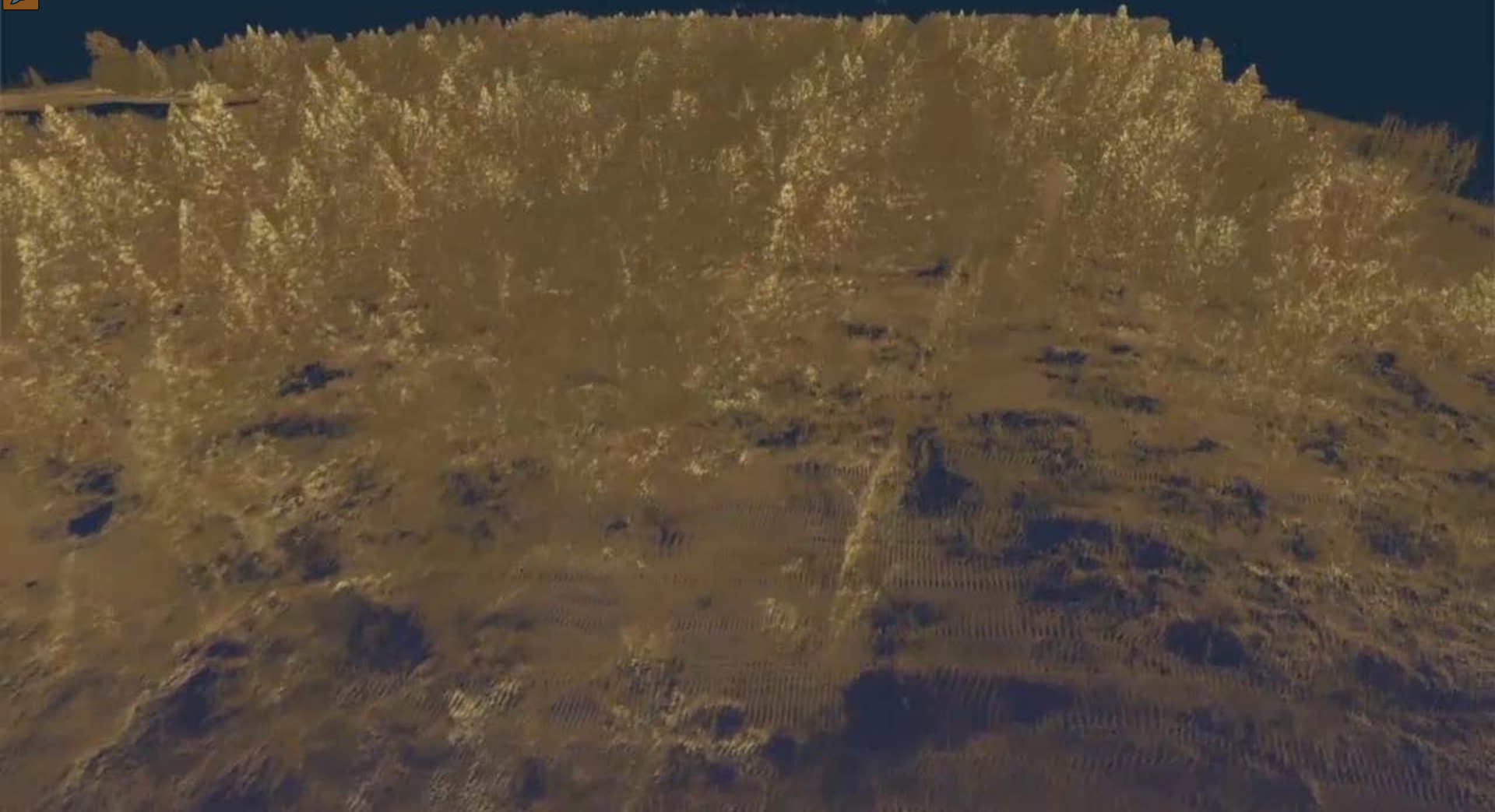


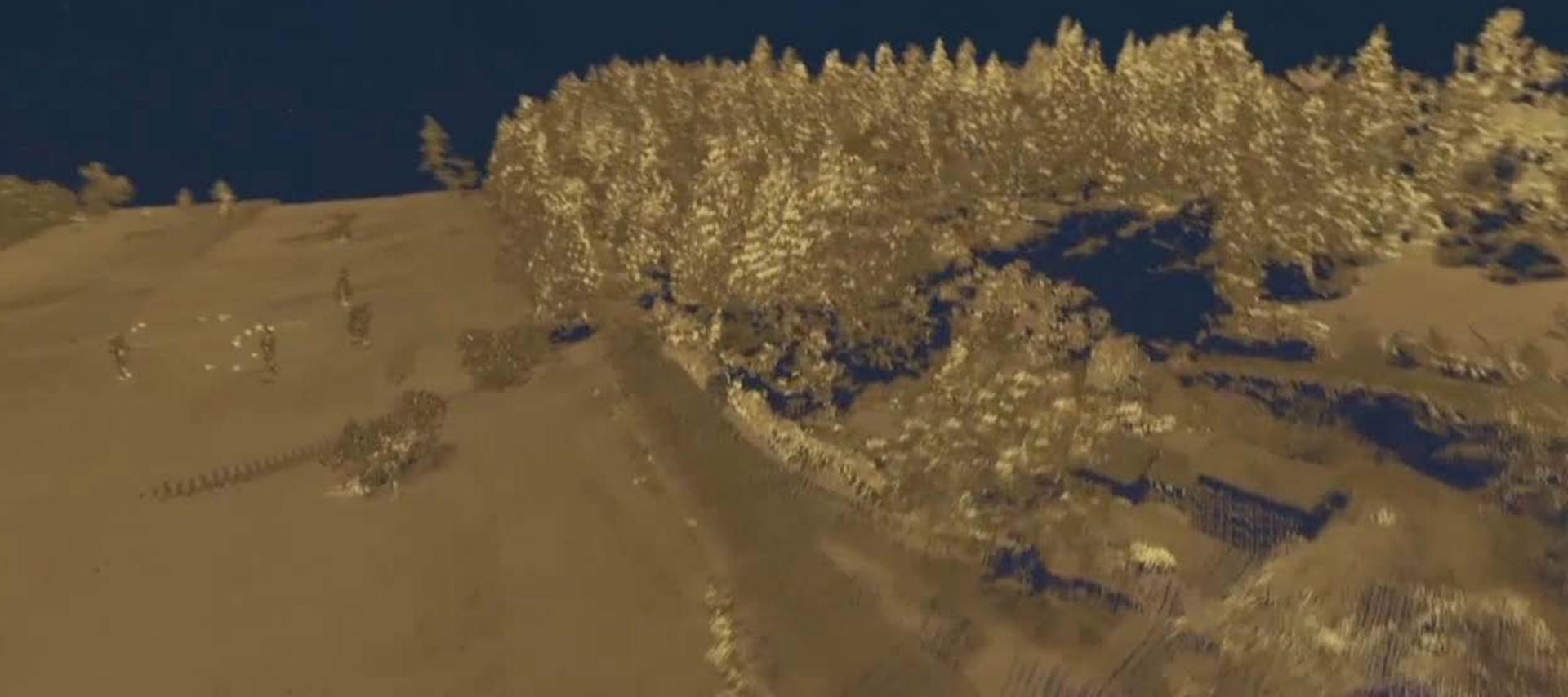
CHC 900 + Dual Frequency GPS

**LIDAR POSTPROCESSING HANDLED BY A PARTNER
COMPANY – PORTLAND BASED XGEOS**











SRSC LIDAR PROJECT – FINAL STATISTICS

Relative point accuracy:

Barnaby 1 = 6.7 cm

Barnaby 2 = 9.7 cm

Barnaby 3 = 8.5 cm

Barnaby 4 = 8.5 cm

Wiseman Creek = 5.2 cm

Point density across all sites came in at approximately 70 points per meter on average

COST COMPARISON – FIXED WING VS. UAV LIDAR

	FIXED WING 1		FIXED WING 2		UAV LIDAR	
Acres Surveyed	50,537 acres	Cost per acre	20,631 acres	Cost per acre	1,286 acres	Cost per acre
Acquisition	\$37,606	\$0.74	\$24,772	\$1.20	\$10,455	\$8.13
Processing	\$16,590	\$0.33	\$18,150	\$0.88	\$4,500	\$3.50
Roads & Streams	\$5,970	\$0.12	\$5,390	\$0.26	\$0	\$0.00
Total	\$60,166	\$1.19	\$48,312	\$2.34	\$14,955	\$11.63
Forestry Metrics	\$8,080	\$0.16	\$5,960	\$0.00	\$3,000	\$2.33
Ditches	\$0	\$0.00	\$1,680	\$0.08	\$0	\$0.00
Contours	\$0	\$0.00	\$1,240	\$0.06	\$0	\$0.00
Grand Total	\$68,246	\$1.35	\$57,192	\$2.77	\$17,955	\$13.96

When beyond visual line of site is available to UAS, these ratios will most likely invert.



THE FAA & THE REGULATORY ENVIRONMENT

Rules for
commercial use of
UAS:
JUNE, 2016?



THE “333” EXEMPTION

- ▶ Grants flight exemptions to UAS that are deemed low risk
- ▶ First exemptions issued September, 2014

SEC. 333. SPECIAL RULES FOR CERTAIN UNMANNED AIRCRAFT SYSTEMS

“...the Secretary of Transportation shall determine if certain unmanned aircraft systems may operate safely in the national airspace system ...”

FAA Modernization and Reform Act of 2012, Feb. 14 2012



THE “333” EXEMPTION

Even with a 333 Exemption, you must also hold a COA. A “Blanket COA” allows for flights without filing more paperwork

- ▶ Less than 55 lbs
- ▶ Under 400 feet (200 feet for “Blanket COA”)
- ▶ Line of sight only
- ▶ Daytime flights only
- ▶ Clear weather only – 3 miles visibility
- ▶ Away from urban areas
- ▶ 2 miles from uncontrolled airports
- ▶ 3 miles from airports with Instrument rules
- ▶ 5 miles from airports with control towers
- ▶ 500 feet from nonparticipating people, structures and vessels

SkyPan International

innovation

quality

experience

27 years of high-end aerial photography

Section 333 UAS Exemption Holder



FLIGHT APPROVED

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Federal Aviation
Administration

Press Release – FAA Proposes \$1.9 Million Civil Penalty Against SkyPan International for Allegedly Unauthorized Unmanned Aircraft Operations

For Immediate Release

October 6, 2015

Contact: Les Dorr or Alison Duquette

Phone: (202) 267-3883; email: les.dorr@faa.gov

NEW YORK – The U.S. Department of Transportation's Federal Aviation Administration (FAA) today announces the largest civil penalty the FAA has proposed against a UAS operator for endangering the safety of our airspace.

The FAA proposes a \$1.9 million civil penalty against SkyPan International, Inc. of Chicago. Between March 21, 2012, and Dec. 15, 2014, SkyPan conducted 65 unauthorized operations in some of our most congested airspace and heavily populated cities, violating airspace regulations and various operating rules, the FAA alleges. These operations were illegal and not without risk.

The FAA alleges that the company conducted 65 unauthorized commercial UAS flights over various locations in New York City and Chicago between March 21, 2012 and Dec. 15, 2014. The flights involved aerial photography. Of those, 43 flew in the highly restricted New York Class B airspace. "Flying unmanned aircraft in violation of the Federal Aviation Regulations is illegal and can be dangerous," said FAA Administrator Michael Huerta. "We have the safest airspace in the world, and everyone who uses it must understand and observe our comprehensive set of rules and regulations."

SkyPan operated the 43 flights in the New York Class B airspace without receiving an air traffic control clearance to access it, the FAA alleges. Additionally, the agency alleges the aircraft was not equipped with a two-way radio, transponder, and altitude-reporting equipment.

The FAA further alleges that on all 65 flights, the aircraft lacked an airworthiness certificate and effective registration, and SkyPan did not register the aircraft in a careless or reckless manner so as to endanger lives or property. SkyPan operated the aircraft in a careless or reckless manner so as to endanger lives or property. SkyPan has 30 days after receiving the FAA's enforcement letter to appeal the penalty.

CERTIFICATE OF AUTHORIZATION AND WAIVER

- ▶ Only available for public agencies
- ▶ Allows UAS flight for specific purposes
- ▶ Must specify location, time frame, etc.



FAA TO REQUIRE REGISTRATION OF ALL UAS

- ▶ Rules to be drafted by November 20
- ▶ Final rules in place before the holidays
- ▶ Expecting 700,000 UAS sales by during the shopping season






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Enrique Iglesias Accident

CULTURE | By Tim Kenneally on June 1

9 27

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SAN GABRIEL VALLEY NEWS GROUP OPEN HOUSE

Falling drone injures 11-month old near Pasadena City Hall

By Jason Henry, San Gabriel Valley Tribune

POSTED 09/15/15, 4:22 PM PDT UPDATED: ON 09/15/2015

1 COMMENT

A falling drone cut and bruised an 11-month-old girl in a stroller at an event Saturday, according to the Pasadena Police Department.

Police said a 24-year-old man lost control of his DJI Inspire 1, a camera-carrying quadcopter costing nearly \$3,000, causing it to crash to the ground outside of City Hall during a movie screening.

"It lost its signal and ultimately crashed on Marengo Avenue and the debris from hitting the ground went out and hurt the child," said Lt. Mike Ingram, with the department's air operations. "It could have been much worse."

The little girl received a quarter-inch cut on her head and a bump on the forehead, police said. She was treated at Huntington Memorial Hospital and then released.

It's unclear what caused the drone's descent, but police said the operator flew outside his visual range, losing track of the quadcopter. The operator did not face any charges, but police forwarded the accident to the Federal Aviation Administration's Field Standards District Office in Van Nuys for review. The operator had a life of the operator.

RELATED STORIES

Drone crashes into stands at U.S. Open

Schumer: Stop the aircraft

The lawyer defending the city science teacher accused of crashing the aircraft into the Queens stadium hosting a U.S. Open match blamed the incident on the FAA.

DRONES IN THE PRESS

Reports of drones causing mischief multiplying



DRONES IN THE PRESS

Seattle City Light has a Bird on a Wire

GeekWire NEWS ▾ JOBS ▾ EVENTS ▾ RESOURCES ▾ DEALS ▾ ABOUT ▾

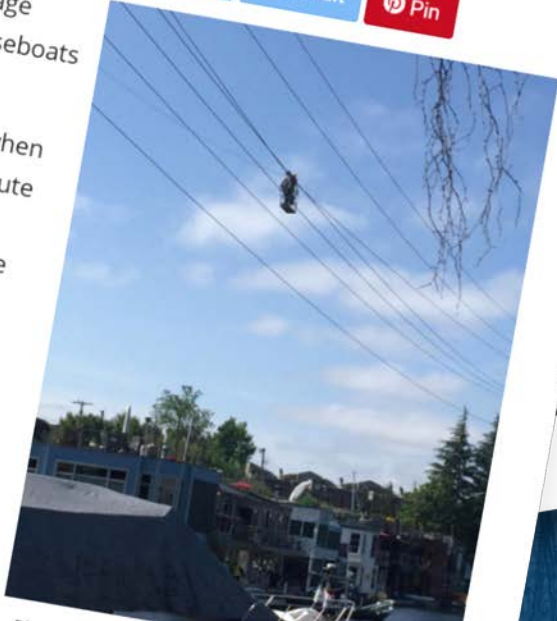
Seattle City Light spends \$35K to remove drone stuck on a power line for one week

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Removing a drone from high-voltage power lines above a group of houseboats is no easy task.

That much was clear on Saturday, when a Seattle City Light crew had to re-route electricity and rent a special carriage before ultimately taking down a drone that was stuck in the air for the past week 120 feet above Lake Union's Mallard Cove.

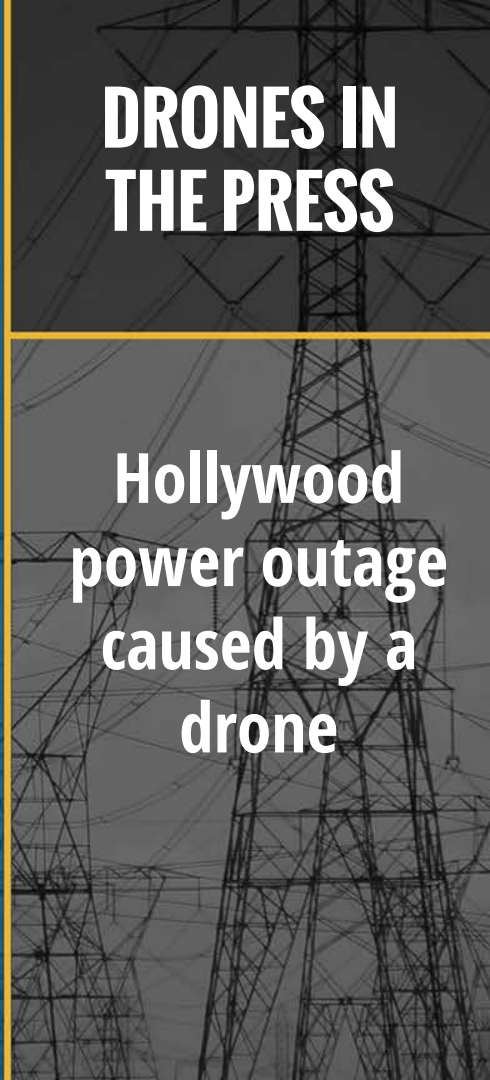
The Seattle Times reported how the drone created a loud buzzing sound for the past several days and that the removal cost Seattle City Light upwards of \$35,000.





DRONES IN THE PRESS

Hollywood power outage caused by a drone





UAS: THINGS TO KEEP IN MIND

IN HOUSE OPERATIONS OR HIRE UAS SERVICES?

The price of the UAS is not the total cost – you need spares, repairs and training

The UAV is simply a platform to carry imaging devices and sensors. The payload is the important piece

The pilot's skill and confidence level need to be higher for larger and more complex systems

Companies need to spend time on compliance with FAA regulations

Liability and insurance are important issues to discuss and verify



For more information:

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