

# Unmanned Aerial Systems in Natural Disasters (et al.)

October 20, 2015

Jarlath O'Neil-Dunne



Funding for this work was provided under a grant from the US Department of Transportation  
DISCLAIMER: The views, opinions, findings and conclusions reflected in this presentation are the responsibility of the authors only and do not represent the official policy or position of the USDOT/OST-R, or any State or other entity.











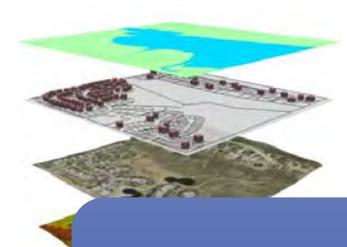
Flight  
Planning



Data  
Acquisition



Post  
Processing



GIS  
Integration

1



2





## UAS Flight Operations

Funding for this project, "Unmanned Aerial Systems for Transportation Decision Support" was provided by the U.S. Department of Transportation Office of the Assistant Secretary for Research and Technology



fulcrum

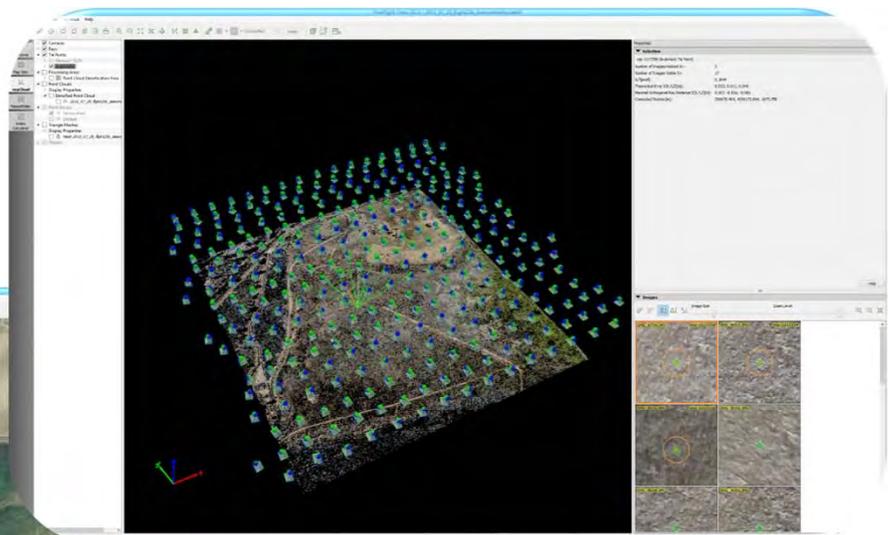
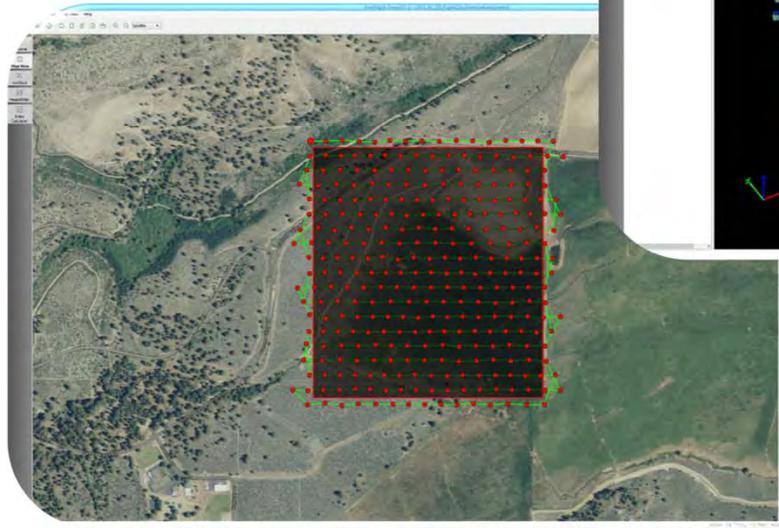


APPLIED RESEARCH

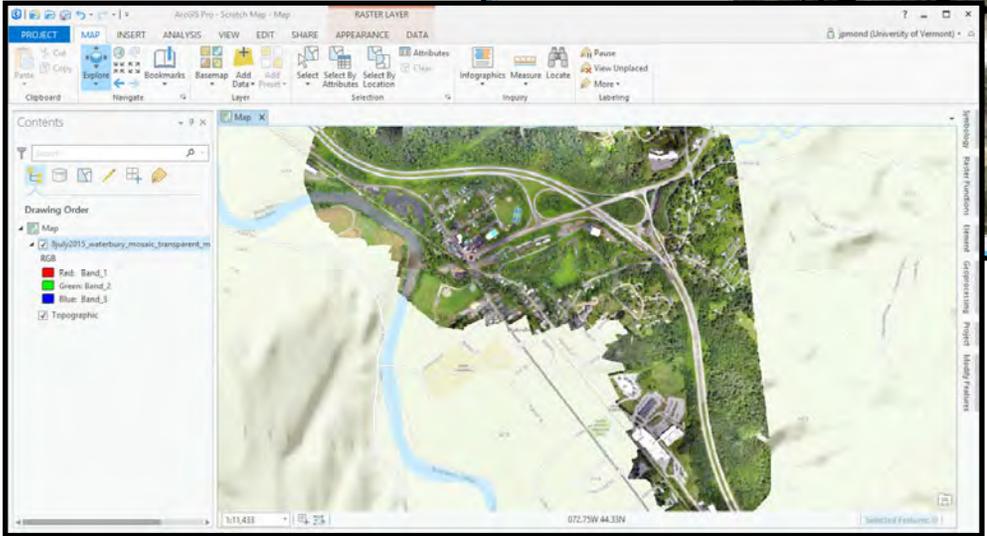
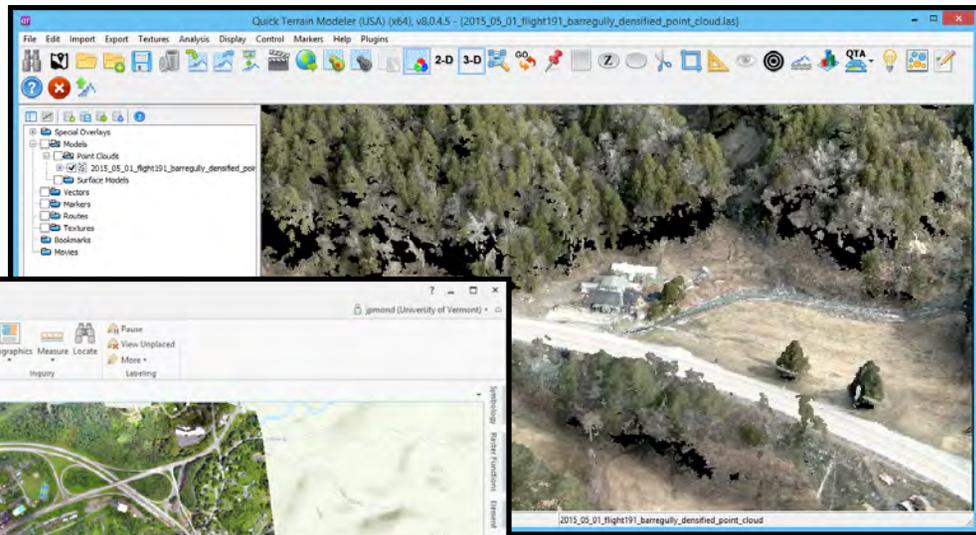


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3



4



### Flight time

- 30-40 min



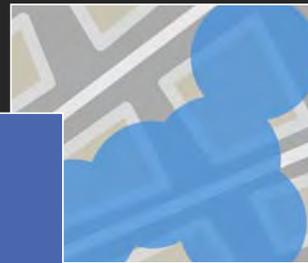
### Coverage

- Up to 250 acres



### Range

- 3km



### Weather

- No rain, heavy wind, or extreme heat



### Personnel

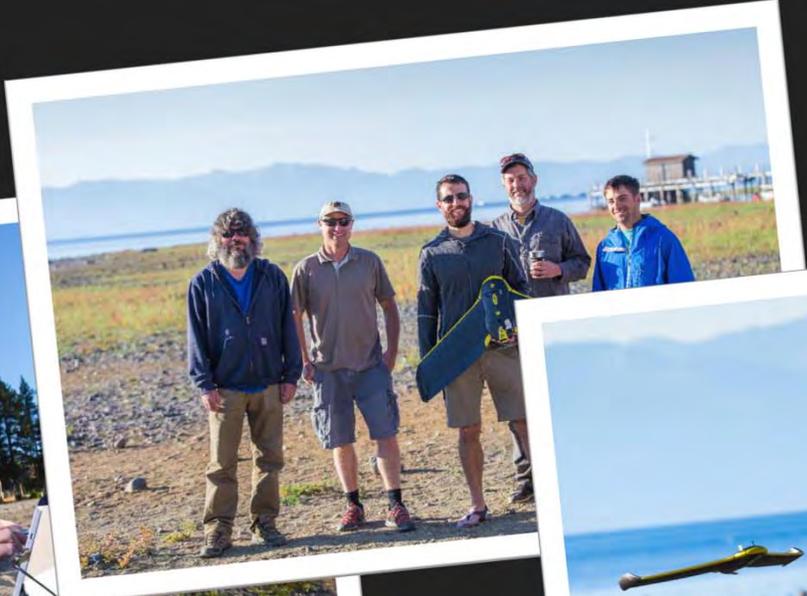
- Crew of 3-5



### Sensors

- True Color
- CIR
- [Thermal]





- eBee (\$25k)
- eBee RTK (\$50k)

## UAS



- 320+ flights
- Statewide
- All weather conditions
- Varied terrain

## Flights



- (4) Mission commanders
- Response time < 24 hours
- 3 years experience
- ICS trained
- Military, counter-terrorism, emergency experience

## Team



- Upon landing: KML overlay
- Within 24 hours:
  - Orthophoto
  - DSM
  - Point cloud
- Special
  - DEM
  - Contours
  - Feature mapping

## Products



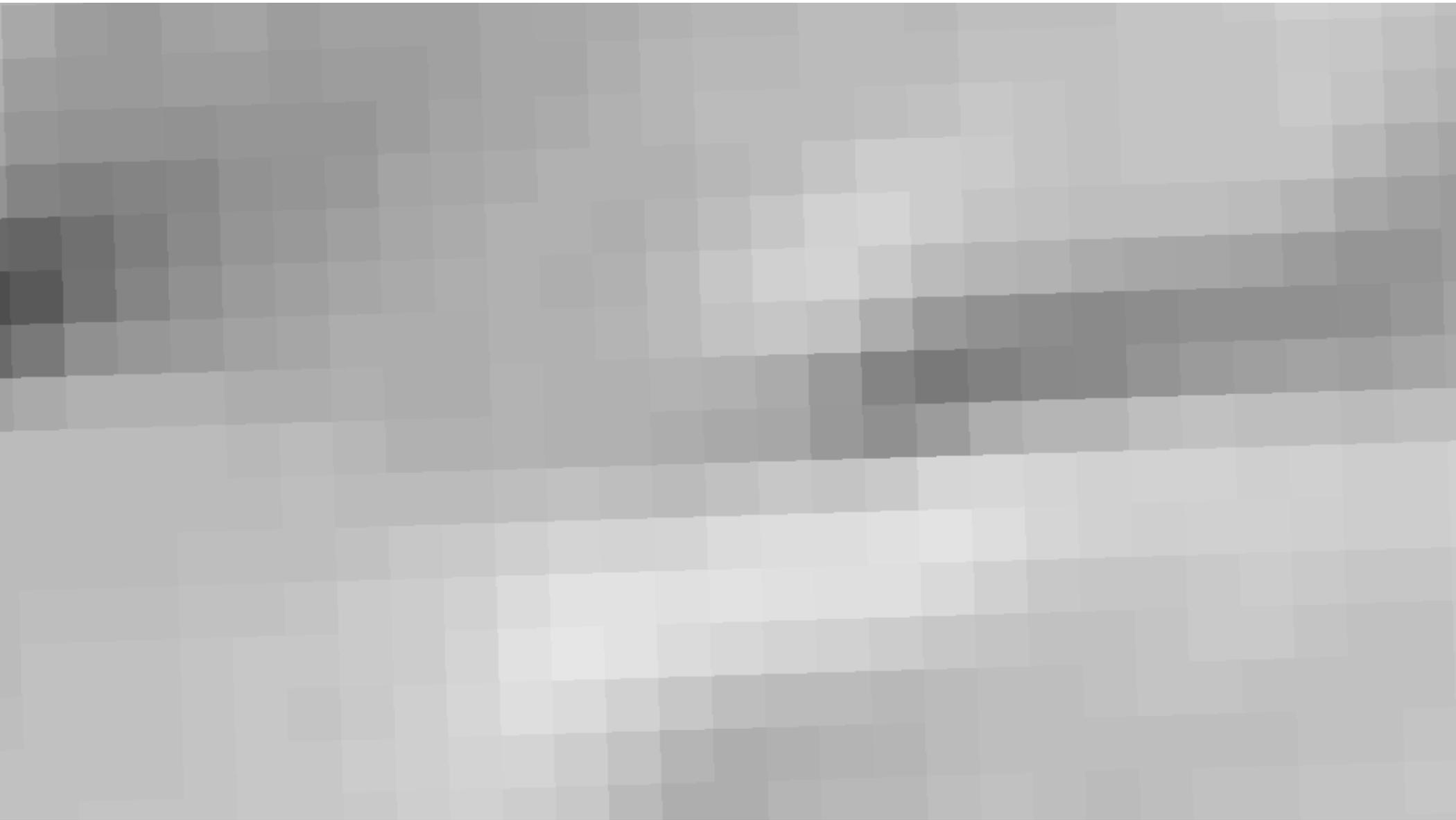
- (2) \$25k photogrammetric workstations
- 30TB online storage
- \$100k geospatial software
- (2) Field laptops
- \$10k+ supporting equipment

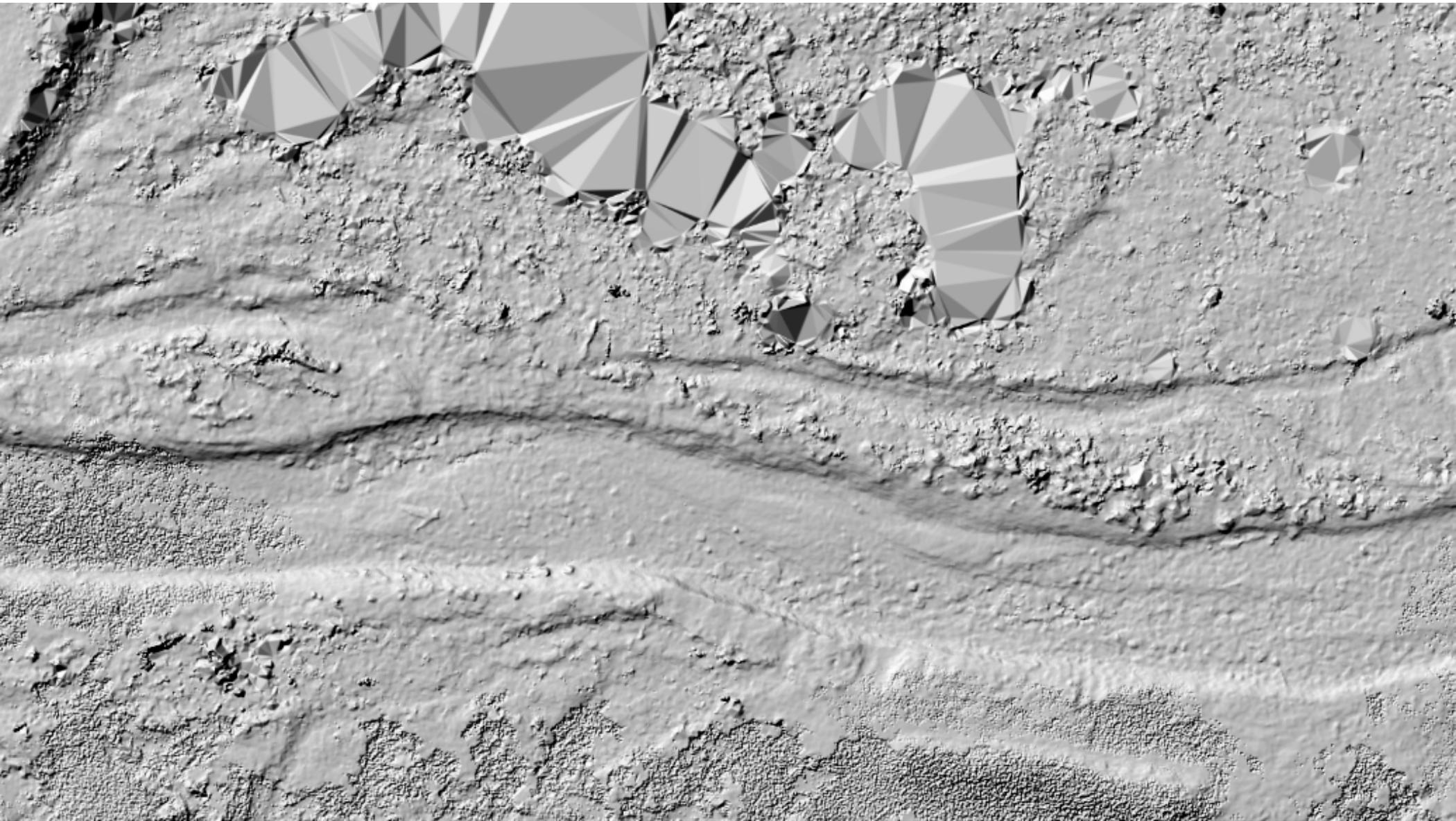
## Other investments













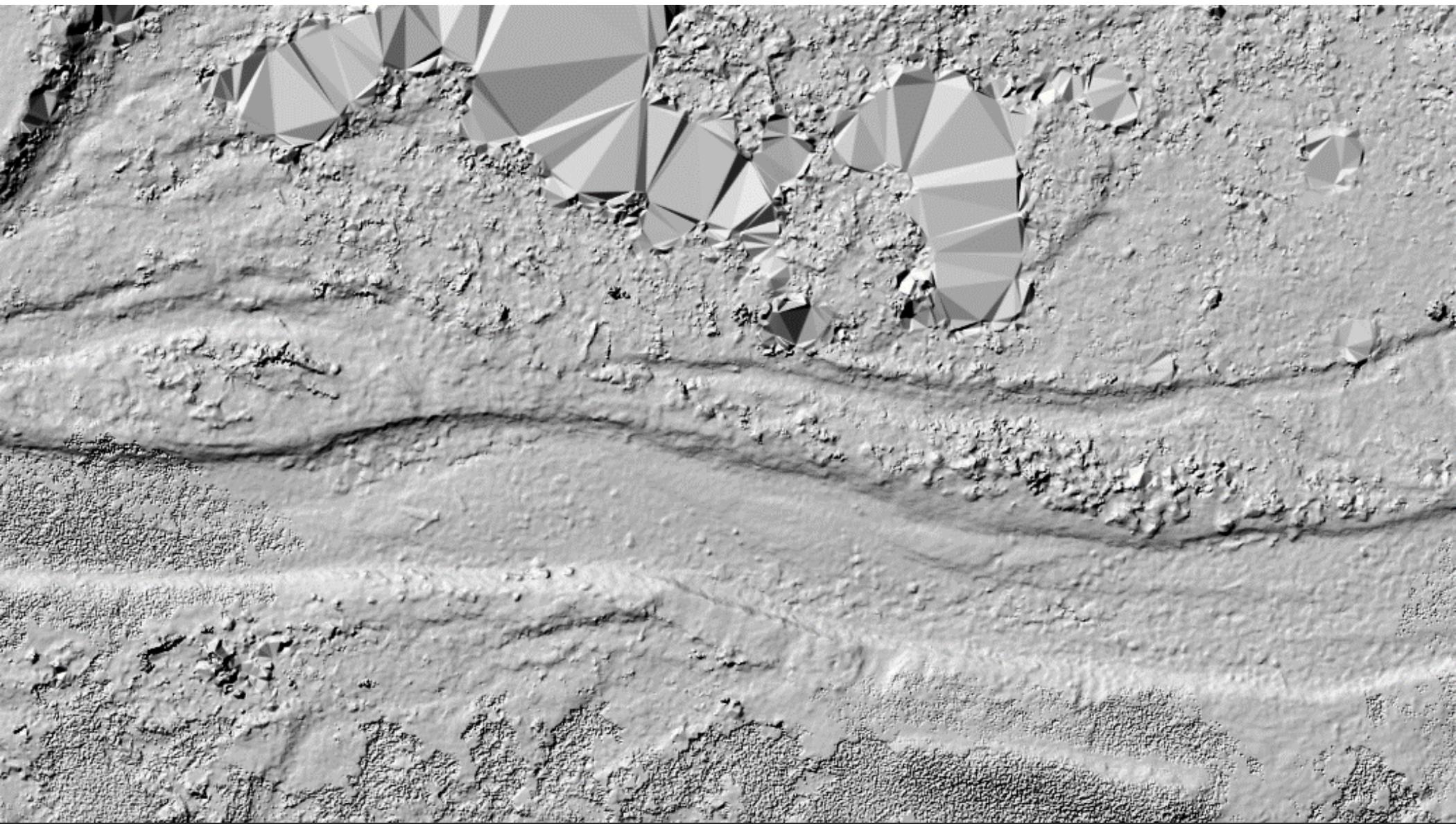
# Case Studies & Decision Support

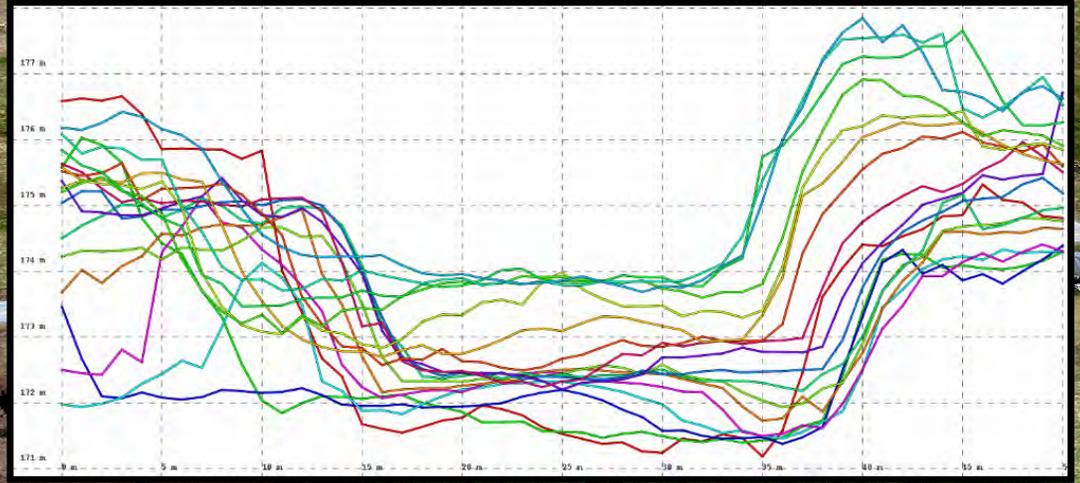
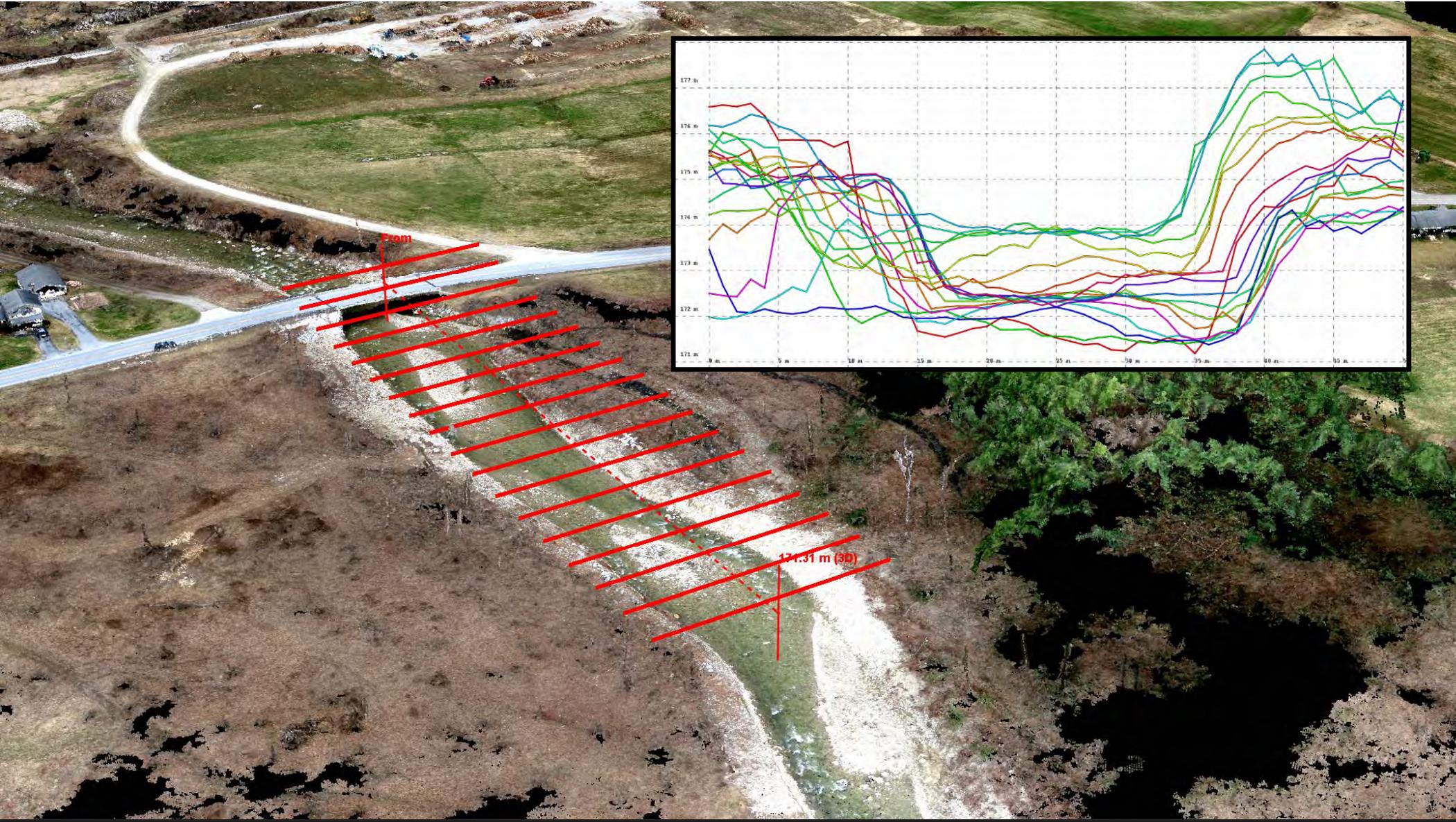
# Post-disaster Analysis

Stream Cross-Section Profiles









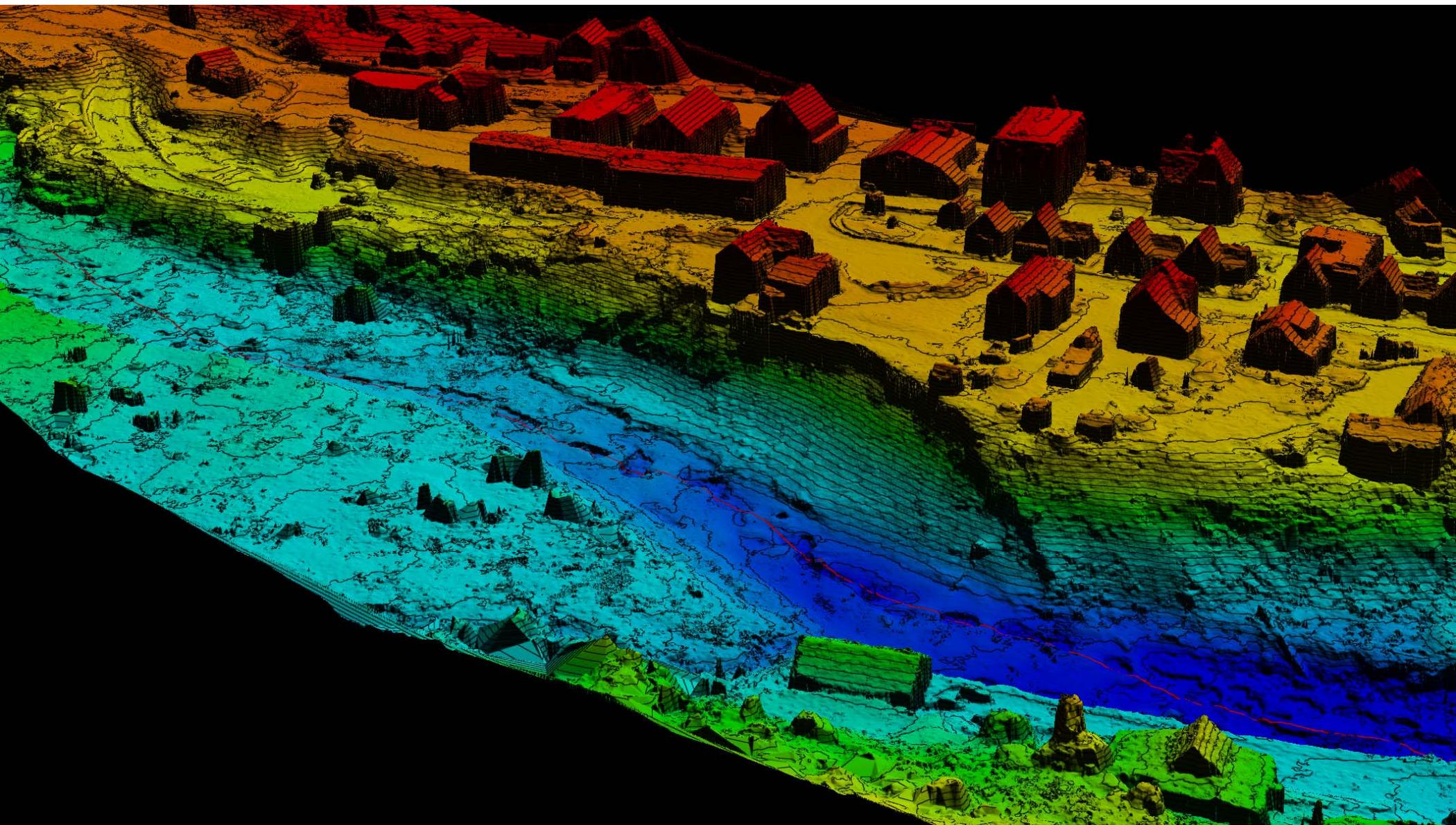
# Post-disaster Analysis

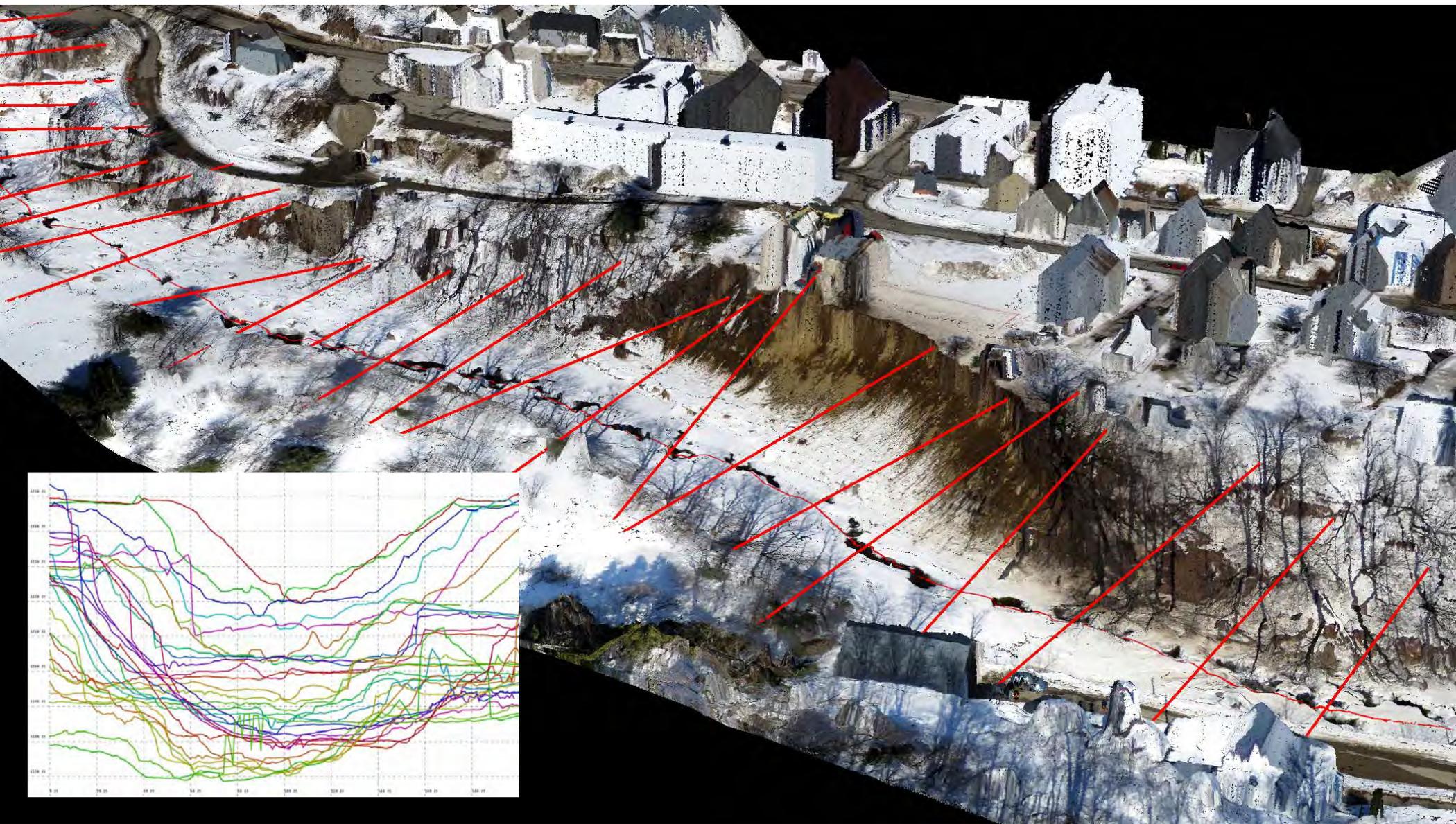
Stream Cross-Section Profiles



Photo credit: Zach Borst







# Construction

GIS Basemap Updating



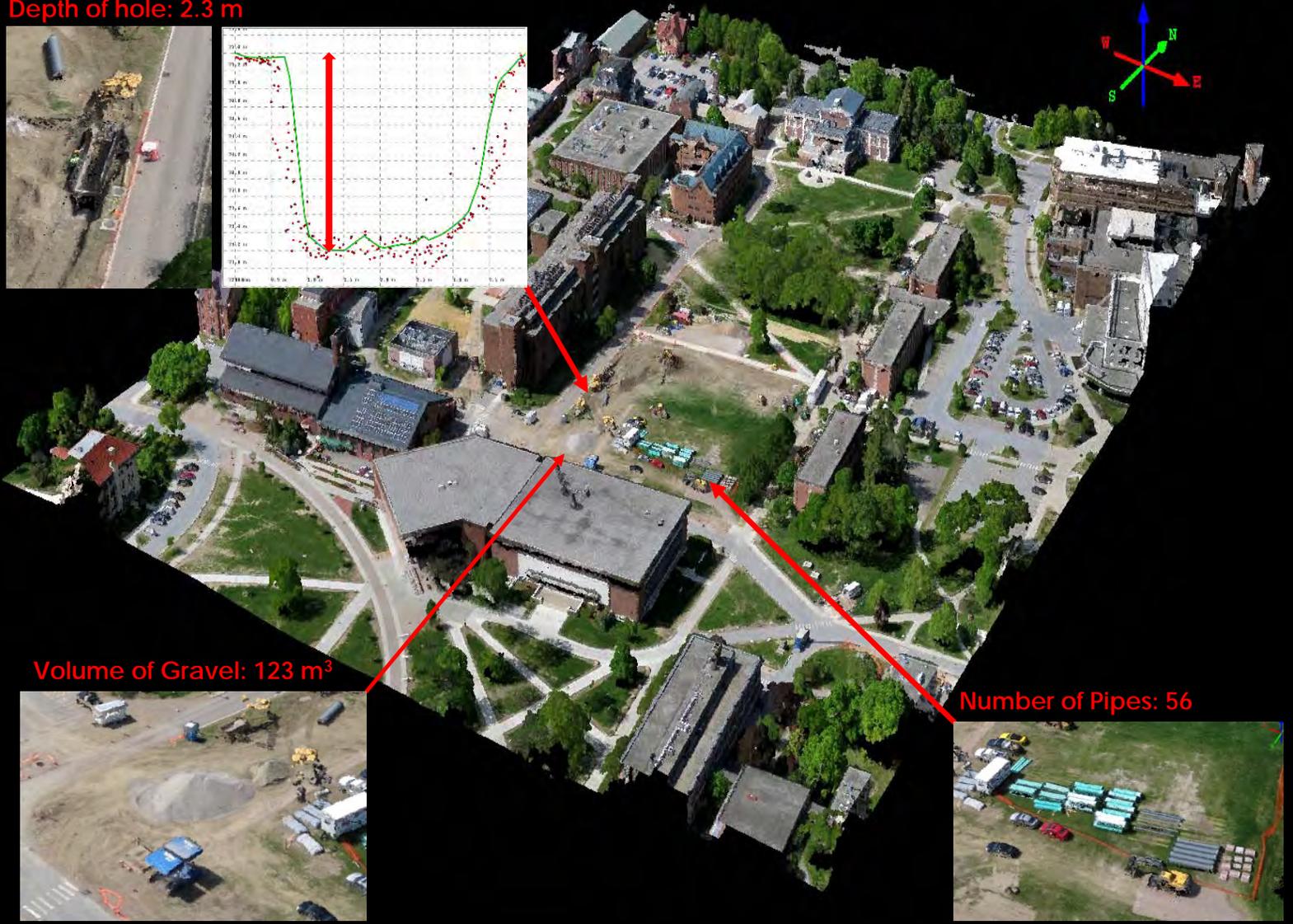


# Construction

Project Monitoring



Depth of hole: 2.3 m



Volume of Gravel: 123 m<sup>3</sup>



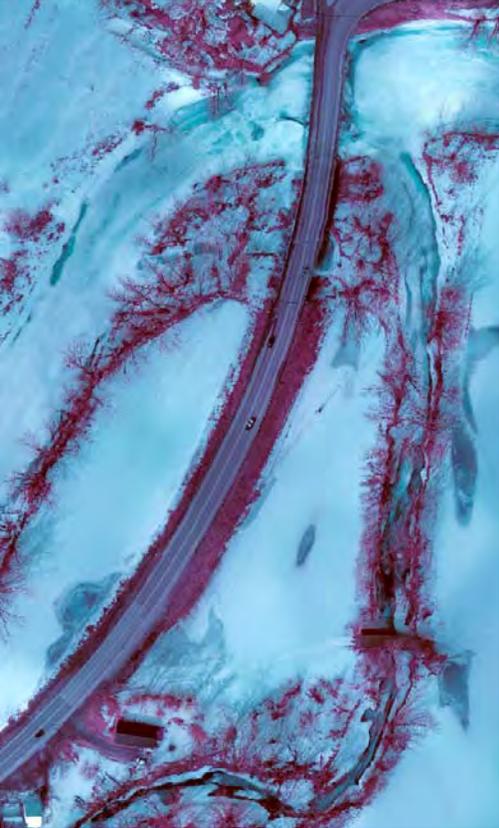
Number of Pipes: 56



# Risk Assessment

Flood Mapping

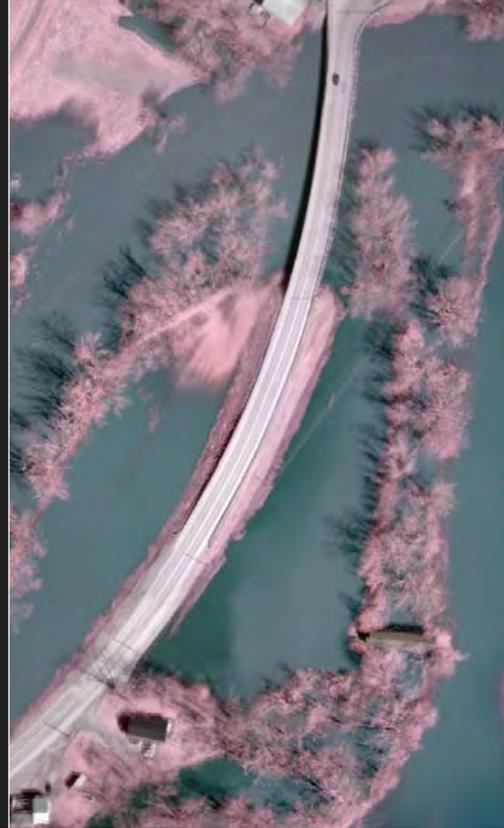
March 20, 2015



April 9, 2015



April 16, 2015

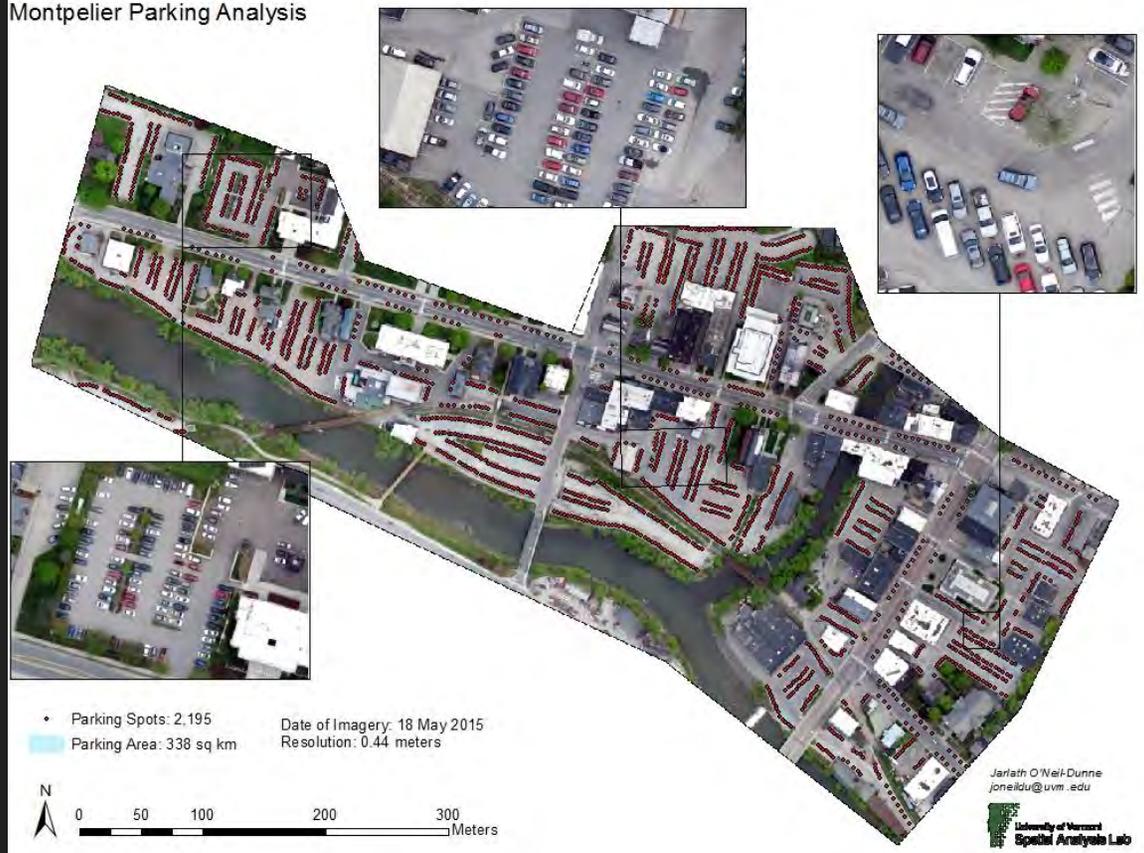


# Urban Planning

Parking Capacity



# Montpelier Parking Analysis



# Disaster Response

FEMA Hard Knox 2015

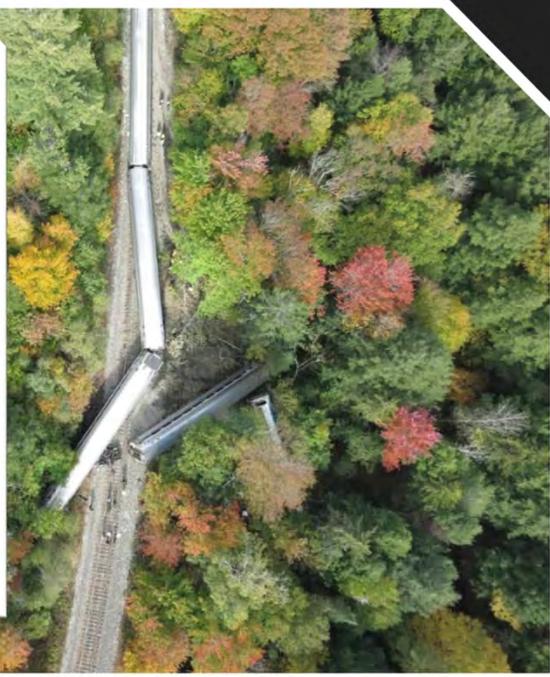
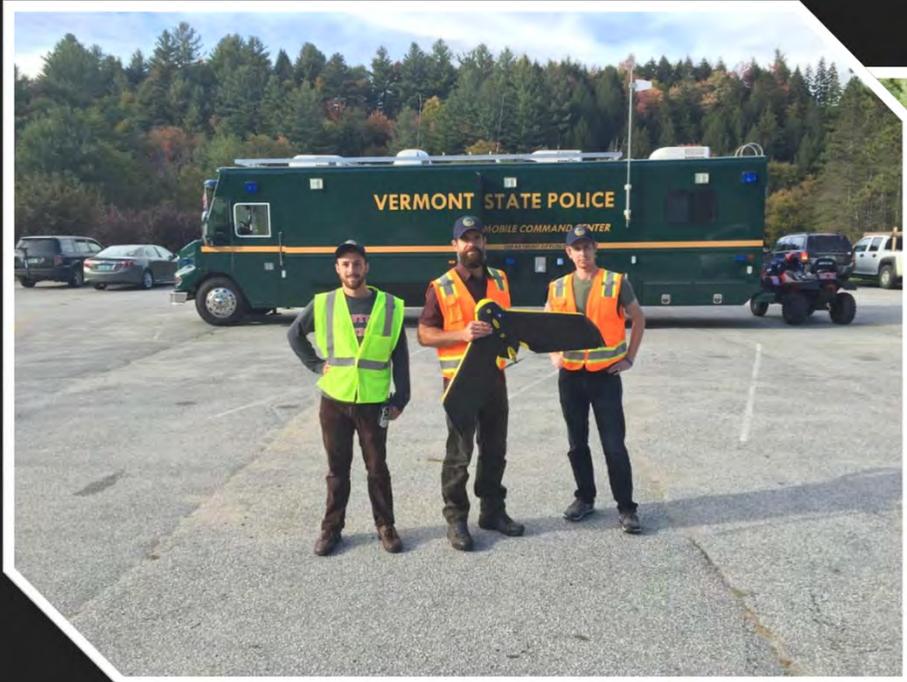






# Disaster Response

Train Derailment

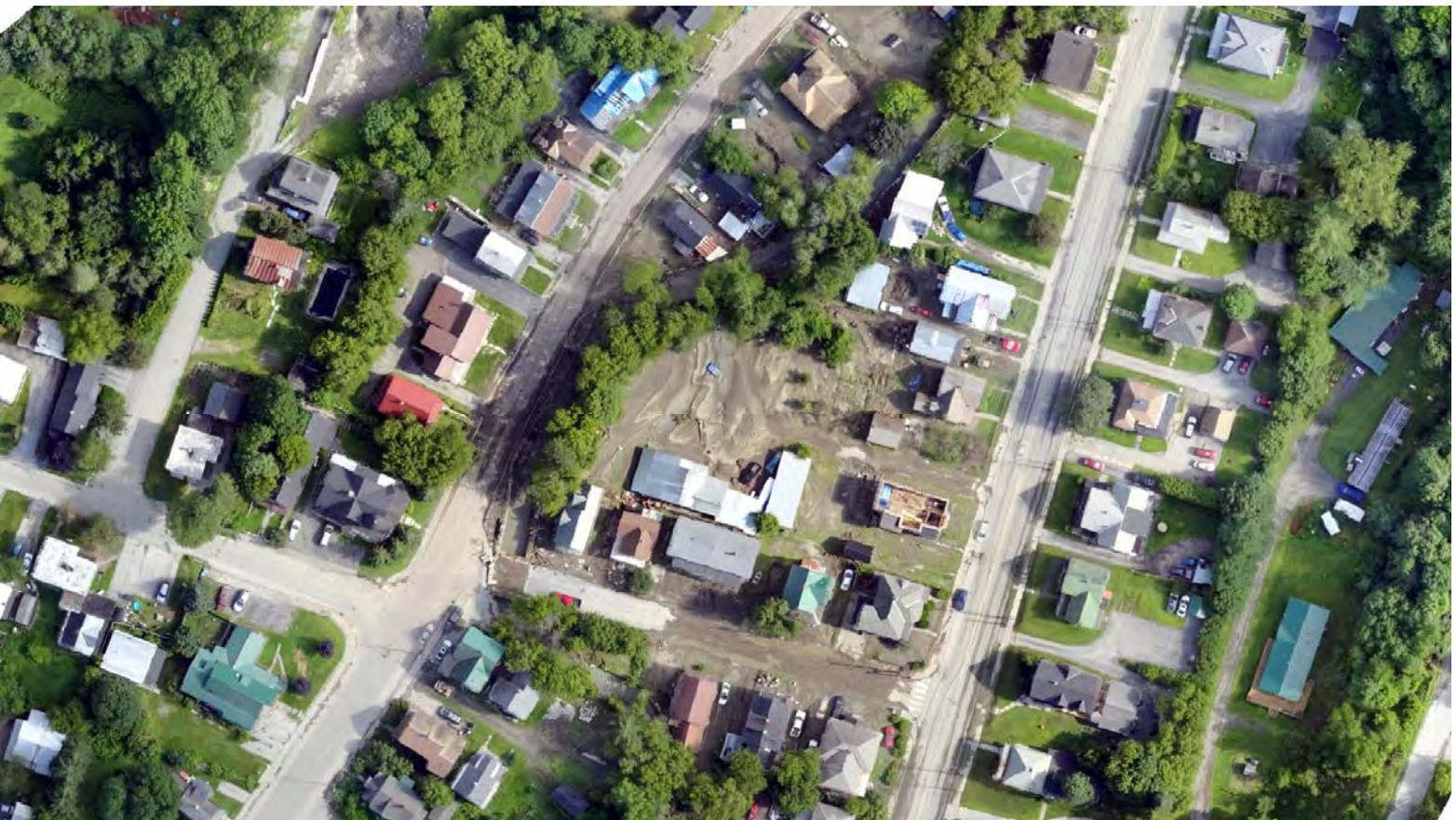


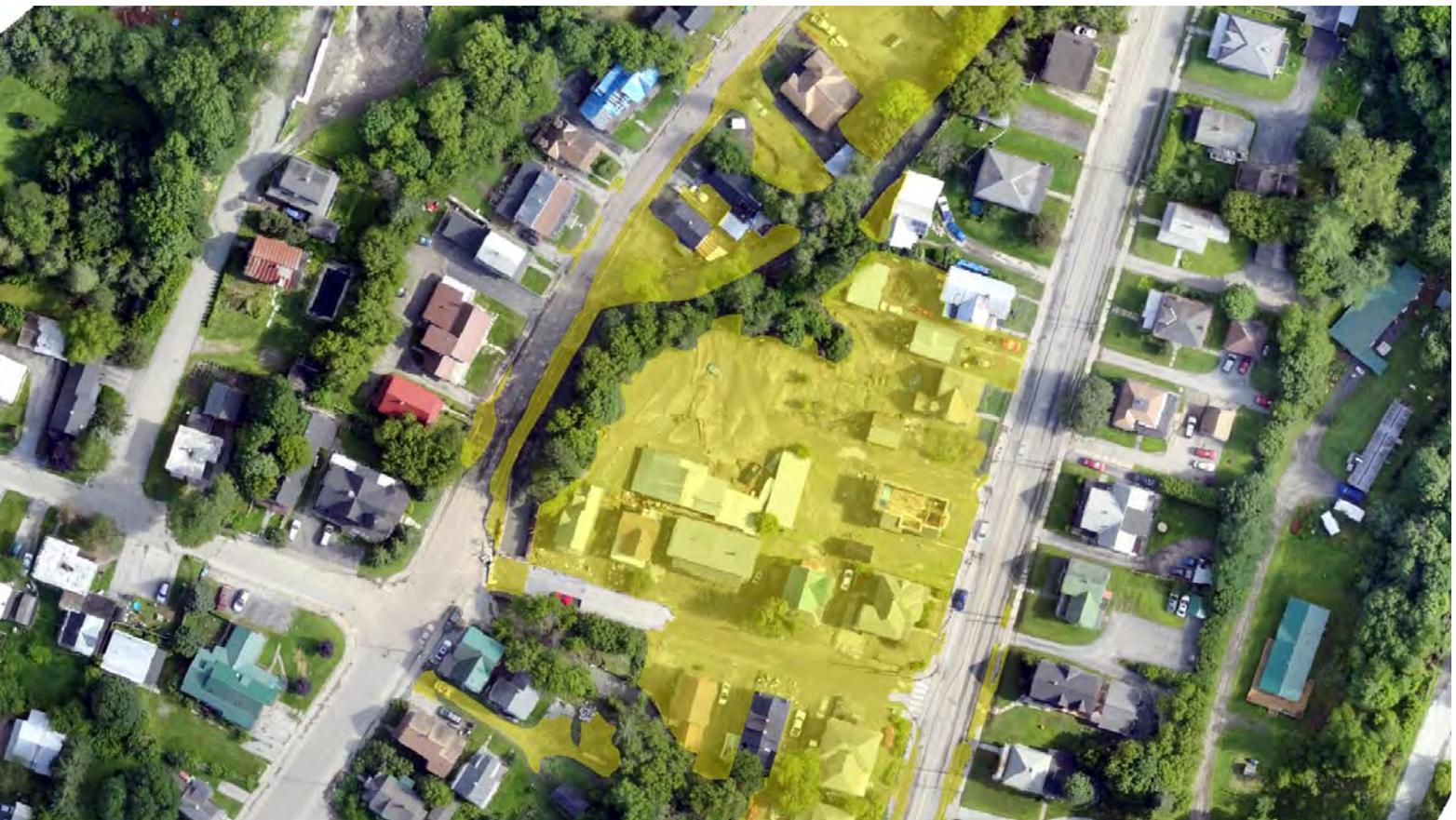
# Timeline

- 11:50 - assistance request received
- 12:15 - airspace coordination completed
- 12:25 - mission preparation completed
- 12:35 - UAS team departs
- 13:30 - UAS team arrives in Northfield
- 13:40 - launch site established
- 13:50 - flight operations commence
- 14:15 - flight operations complete
- 14:20 - KML file produced
- 14:35 - KML file delivered to incident commanders
- 17:00 - UAS team returns to lab
- 19:35 - orthophoto mosaic produced

# Disaster Response

Sediment Mapping



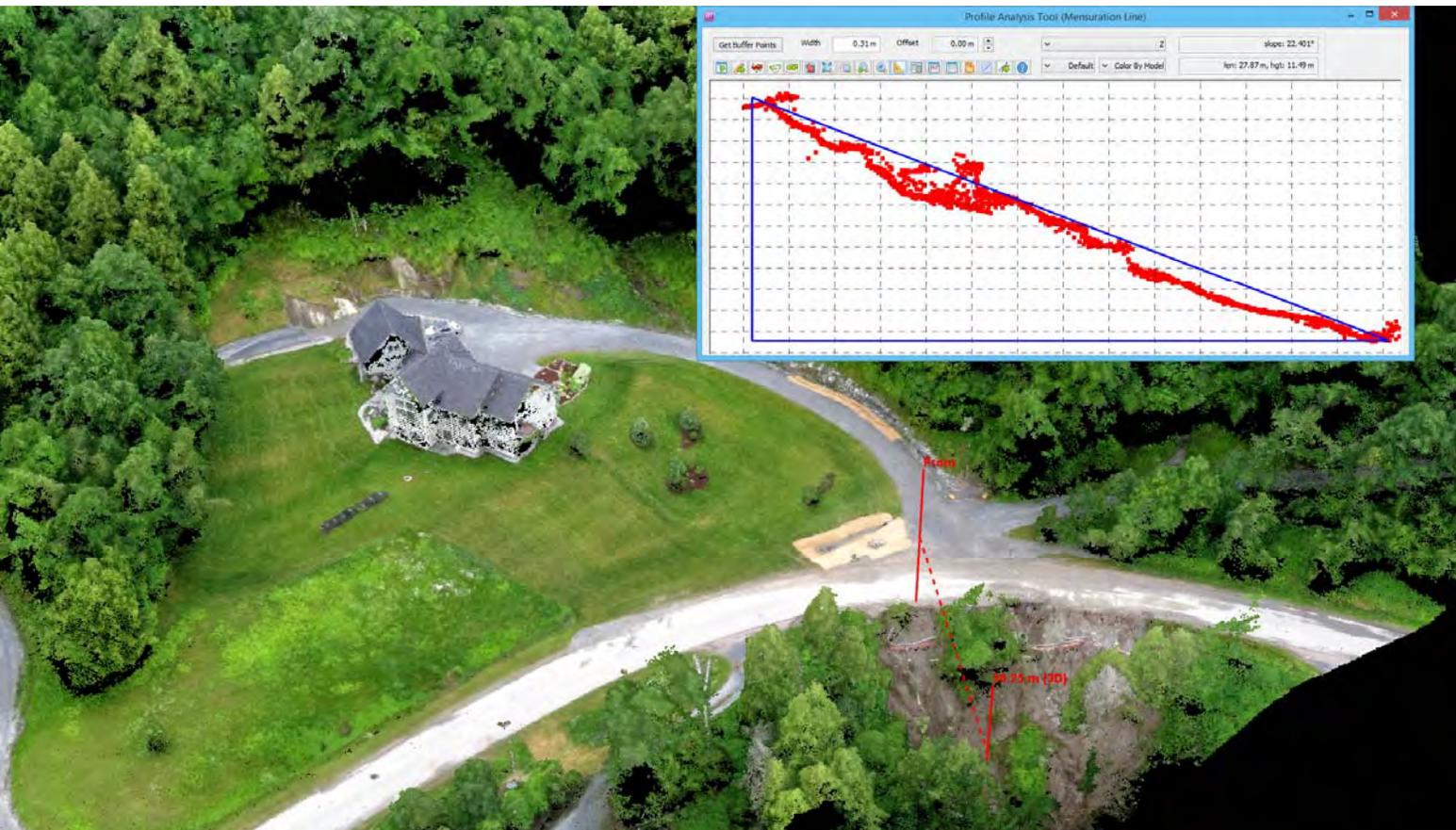






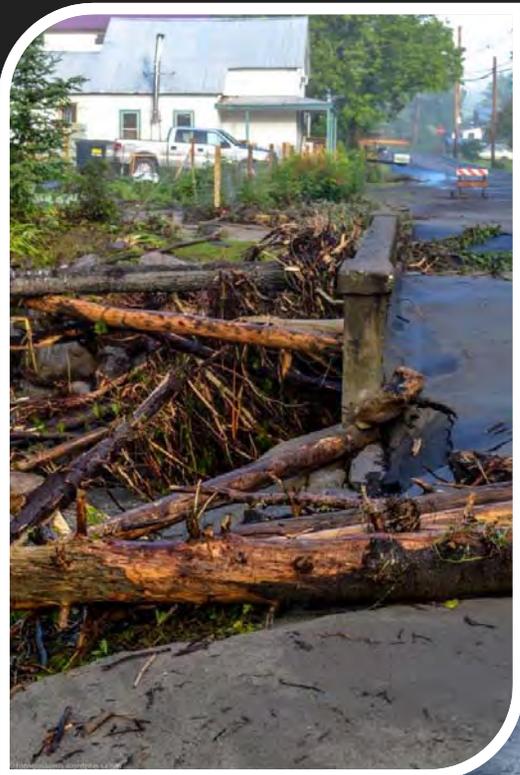
# Disaster Response

Erosion Mapping



# Disaster Response

Woody Debris Budgeting & Bridge Replacement



### Heavy Rain and Possible Flood Threat Developing

As of 7:55 pm EDT - 7/19/15

WVX Radar Image 7:18 PM 7/19/2015

**Heavy Rain Threat Developing**

Shower and Thunderstorms with localized heavy rainfall will continue across North Central and Northeast Vermont through 8 pm.

Some locations within this area have already received 1 to 2 inches of rainfall today and additional heavy rainfall may cause flooding of roads and culverts.

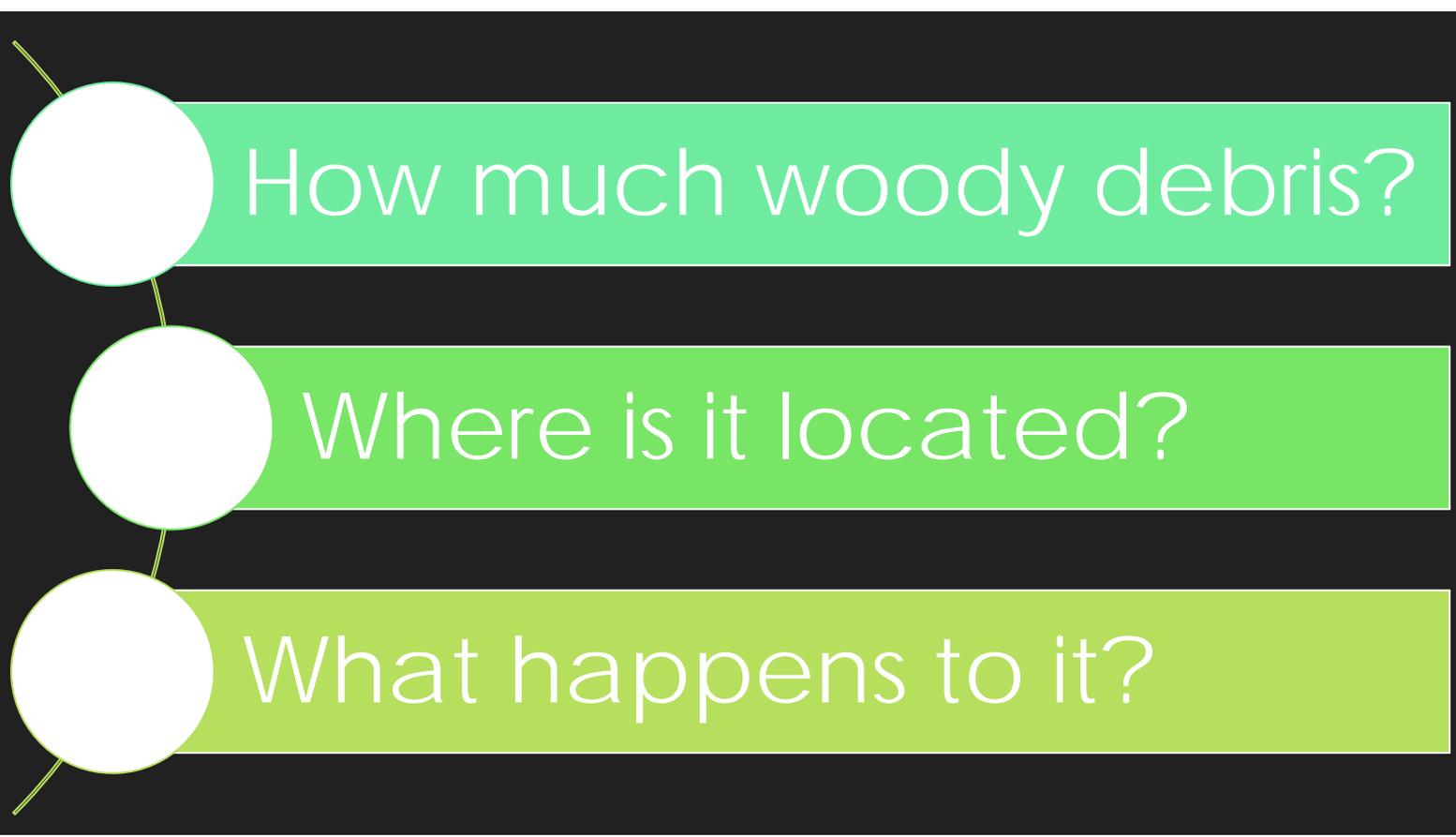
Remember if you cannot see the road driving across a road, **TURN AROUND, DON'T DROWN!!**

**A SEVERE THUNDERSTORM WATCH REMAINS IN EFFECT UNTIL 8:30 PM.**

Localized Severe Thunderstorms with 40-60 mph winds are deemed to be likely, trees and power lines still possible.

Frequent, Intense Lightning is also

National Weather Service Burlington Follow Us [www.weather.gov/bfr](http://www.weather.gov/bfr)



How much woody debris?

Where is it located?

What happens to it?



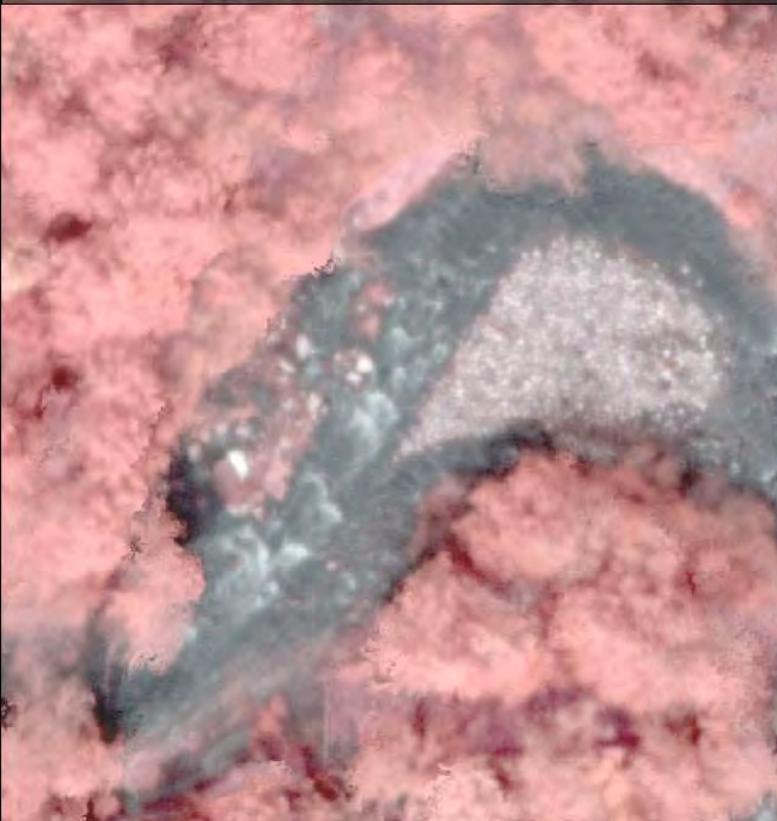
June 25, 2015



July 21, 2015



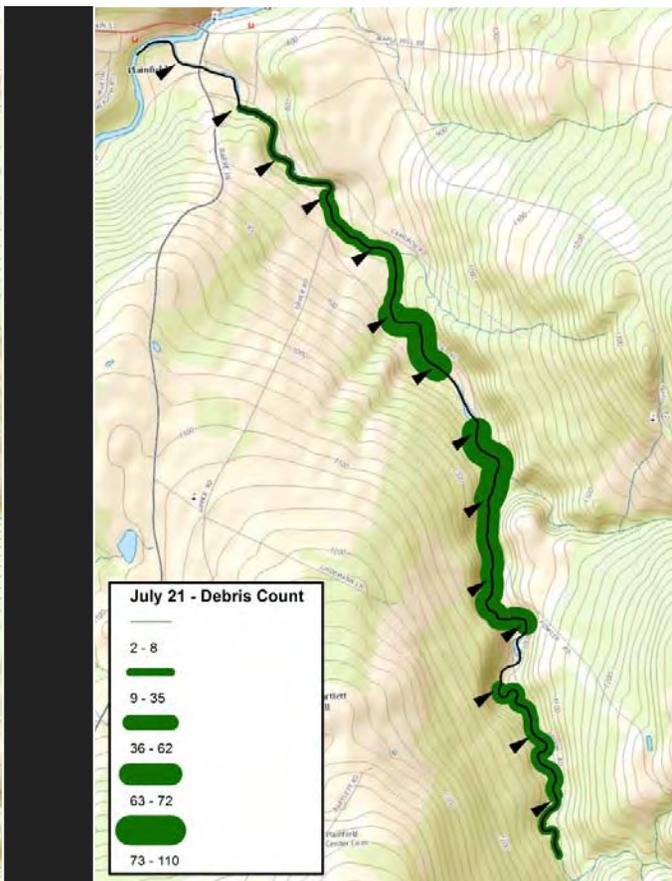
May 12, 2015

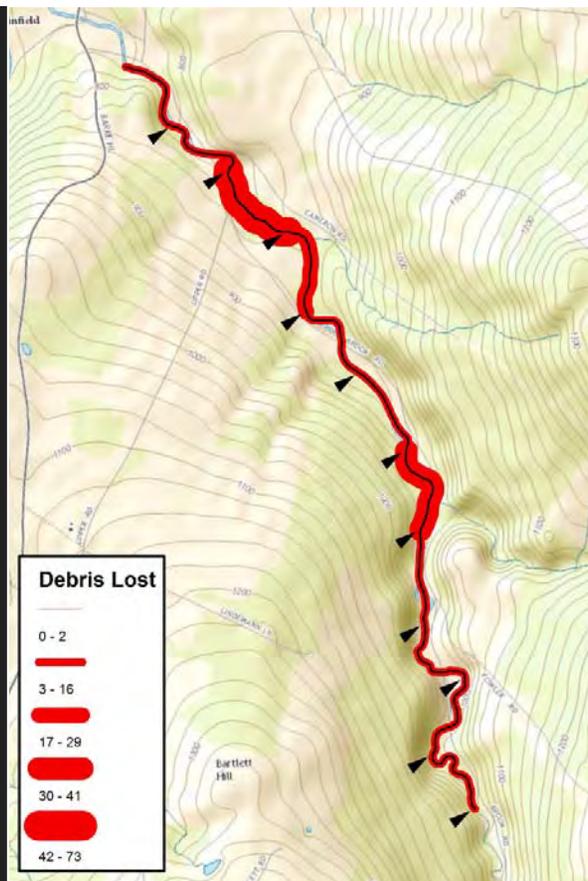


July 21, 2015









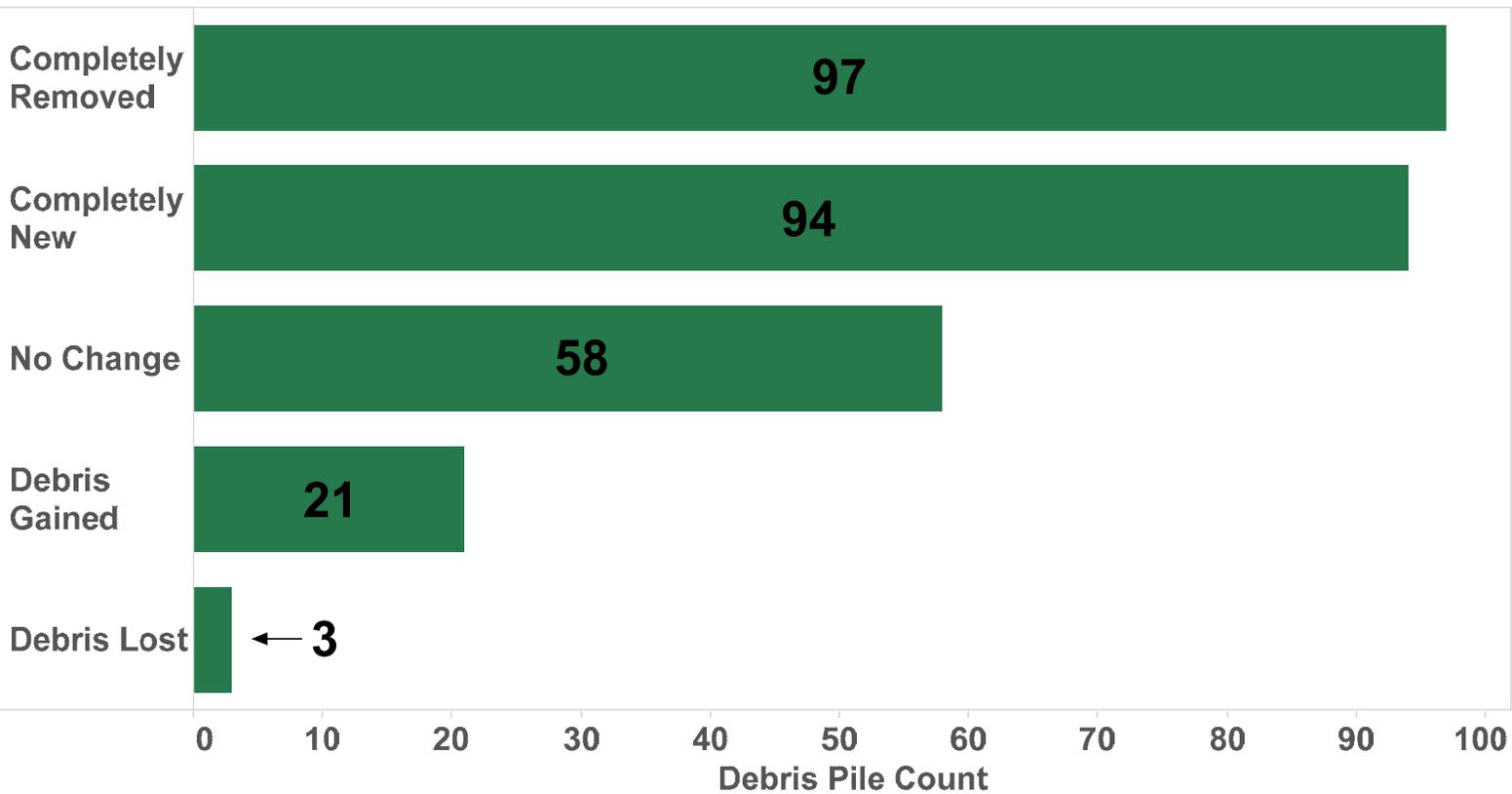
Small Pile: 1 to 5 Trees



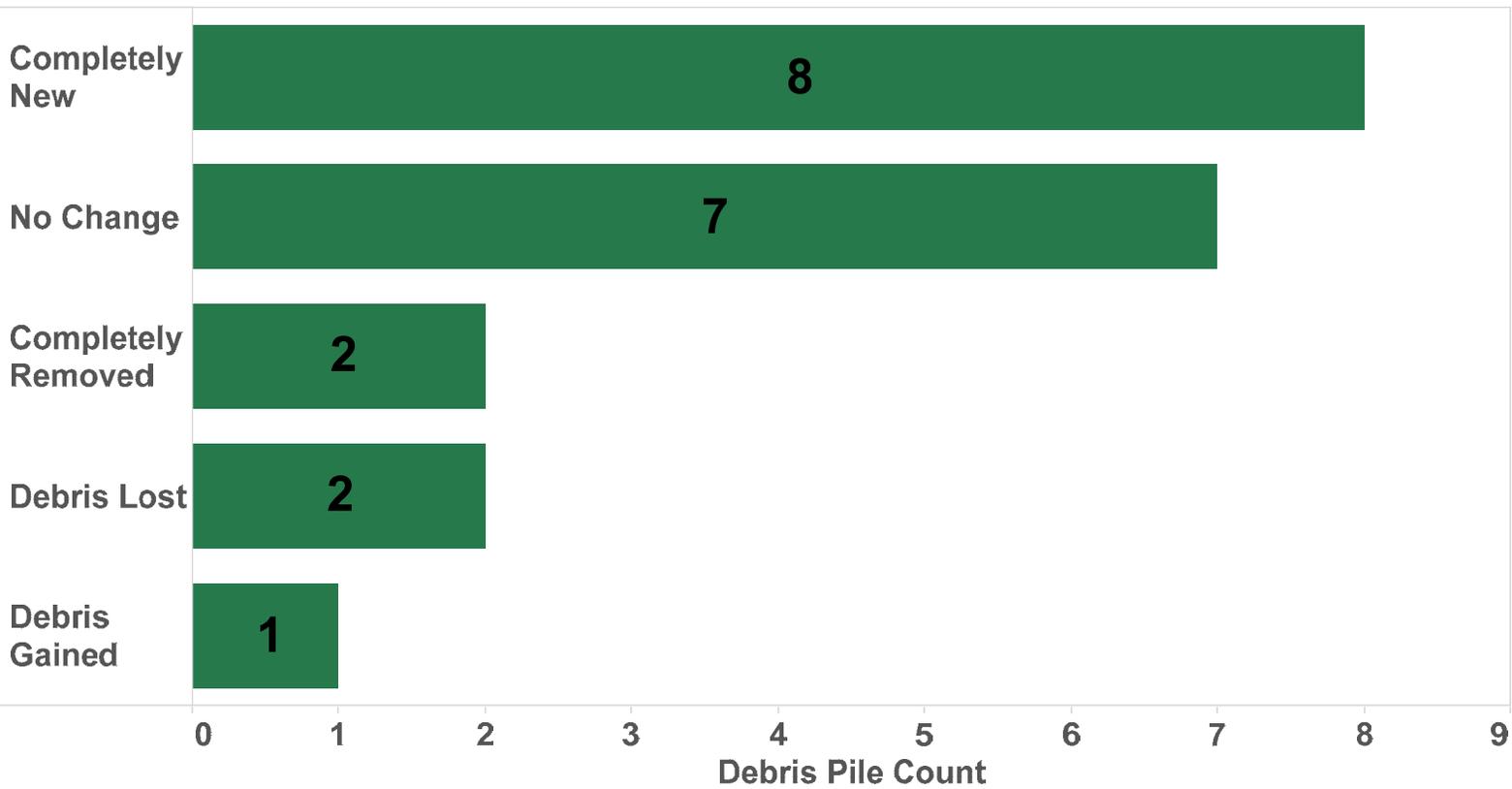
Large Pile: 6 or More Trees



### Small Pile: 1-5 Trees

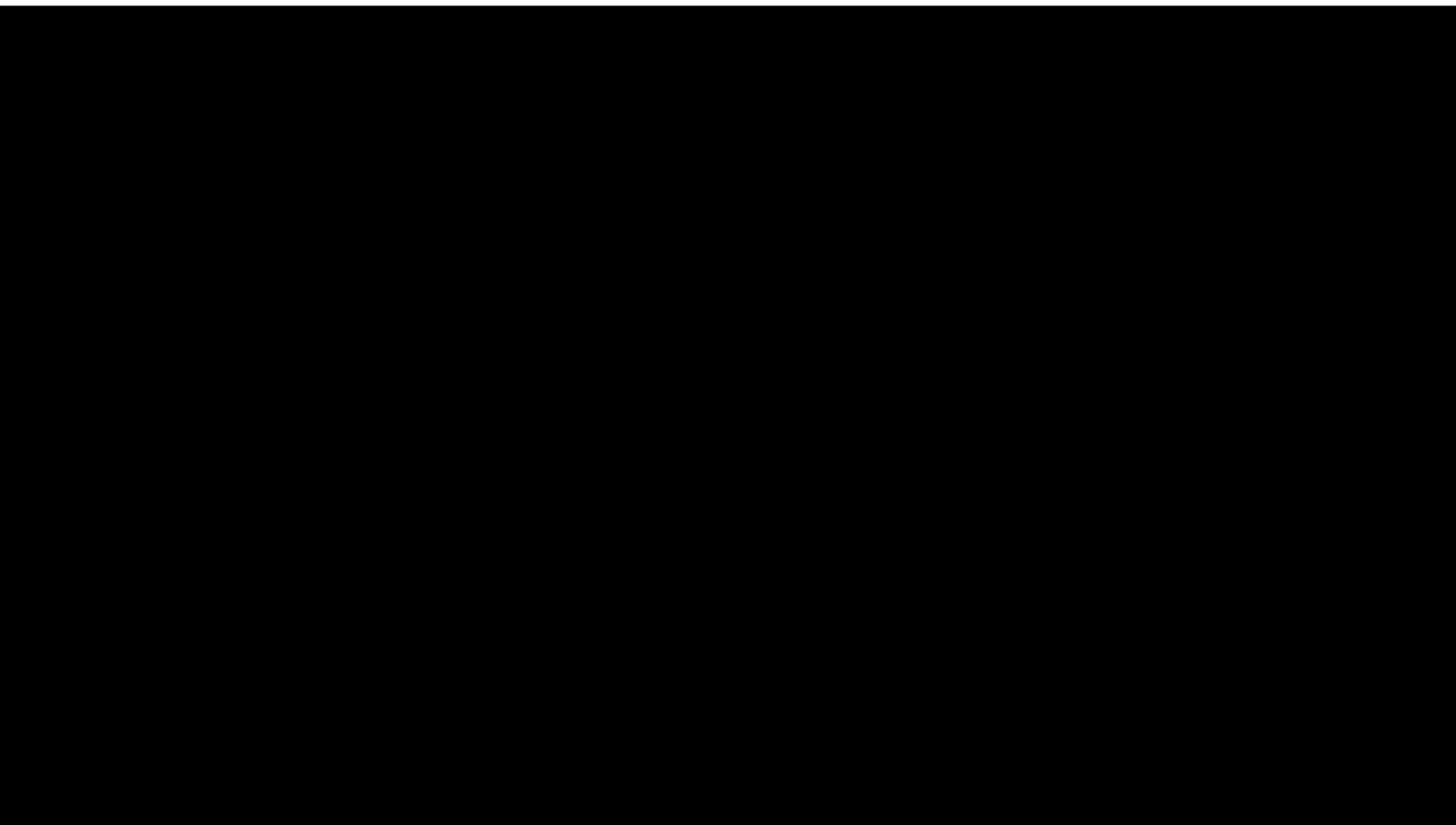


### Large Pile: 6 or More Trees

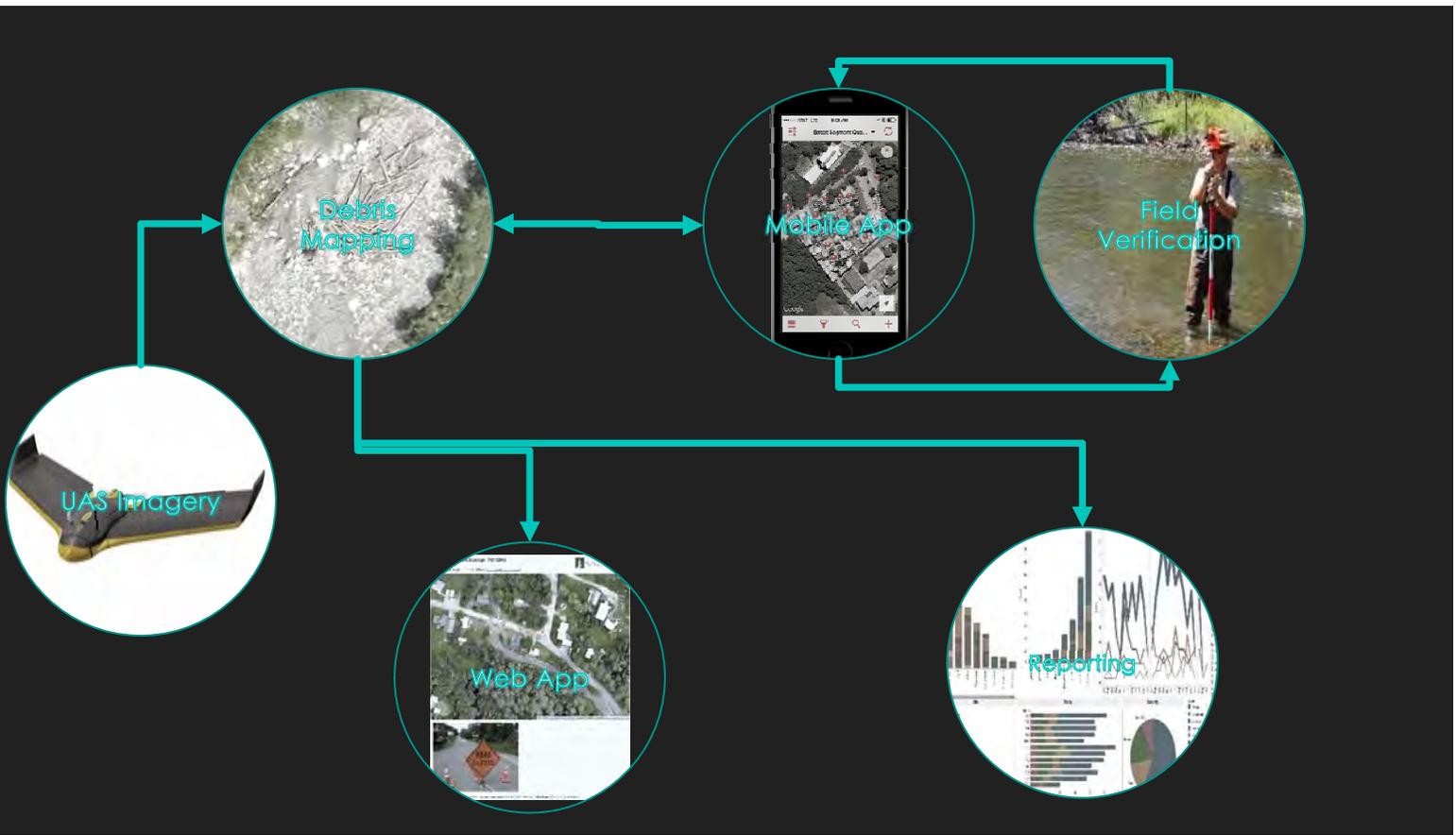


**Pre: 408**

**Post: 604**







The University of Vermont

APPLY SEARCH NEW



### Vermont Unmanned Aircraft Systems

**1: UVM UAS Menu**

- UAS Menu
- Menu Item 2 (template layout 2)
- Menu Item 3 (homepage layout 1)
- Menu Item 4 (news)
- Menu Item 5 (press gallery)
- Menu Item 6 (jobs-and)
- Menu Item 7 (faculty dev)
- Contact Us

**Welcome**

The Vermont Unmanned Aircraft Systems Team was created to assist the public and private sector partners in acquiring high-resolution, highly accurate, and economic aerial imagery. We are currently funded by a US Department of Transportation grant from the Office of Assistant Secretary for Research and Technology. Our mission is to provide decision makers with the best data available more quickly and affordably than other comparable platforms.

**FEATURED VIDEO**

UAS For Agriculture

**NEWS & EVENTS**

**Letters from the SAC**

Pennington Statewide Highways/Infrastructure Program

What's New? In response to the public release of the Pennsylvania State University's "Campus Security Report" on 10/2/2014.

See 2014-07-09

Management Councils: 400 From Campus Explorer

In the spring we completed an aerial mapping of Management Councils, 4000 ft and over. The spring color of the ground was in full bloom.

See 16 2014-07-09

US S Missing of July 2013 Stone Damaged in Stone, VT

GIS collection areas: The

**What's Our Observance with These Jobs As About?**

UVM Program Ranked Fourth in Princeton Review's "Best Schools" List

Campuses Launch Sets Some Good Scenarios for Campus Board Meeting

The University of Vermont

### Unmanned Aerial System Fact Sheet

**EQUIPMENT**

The eBee is a small unmanned aerial system (UAS) for capturing high-resolution imagery at a relatively low cost. The UAS allows us to quickly gather accurate data for assessing conditions of natural and built areas.

**sensify eBee**

The eBee is an Unmanned Aerial System (UAS) made of durable foam. It weighs 1.5 lbs and has a wingspan of 38 in.

**Digital Cameras**

We use two digital cameras to produce true color and color infrared imagery.

**Flight Plans**

We use two digital cameras to produce true color and color infrared imagery. Pre-created flight plans allow the UAS to fly and land itself while being monitored from the ground using a laptop or tablet.

**FLIGHT OPERATIONS**

The flight operations team consists of three to four personnel. Six or more flights can be completed in one day, capturing 1,000+ acres of imagery.

**Flight Time**

40 mins per battery

Depends on weather conditions, & flight area size.

**Flight Area**

74-250 acres per flight

Varies on terrain and design parameters. Up to 1000 acres per flight.

**Flight Range**

Up to 3km

Hills and other obstructions impact range.

**Weather**

Cannot fly in heavy rain, wind conditions greater than 20 mph, or extreme temperatures.

**PRODUCTS**

2-D and 3-D GIS-ready data products are available within 2-8 hours of completion of flight operations.

**Orthomosaic (Color Infrared)**

A single orthorectified image dataset in GeoTIFF format that can be opened in any GIS software. Horizontal accuracy as good as 3cm.

**Point Cloud**

A 3D collection of points with x, y and z coordinates. Stored in the LAS format. Similar to LIDAR. Vertical accuracy as good as 3cm.

**Digital Surface Model**

A 3D raster surface model of the terrain including objects such as trees and buildings. Stored in GeoTIFF format. Can be opened in GIS software.

Contact: [John@uvm.edu](mailto:John@uvm.edu)  
[www.uvm.edu/~johnd](http://www.uvm.edu/~johnd)

### UAS Flight Operations

Funding for this project, "Unmanned Aerial Systems for Transportation Decision Support" was provided by the U.S. Department of Transportation Office of the Assistant Secretary for Research and Technology

0:09 / 1:22

Analytics Video Manager

### UAS Flight Operations

Jarlath O'Neil-Dunne Channel settings

116 views

Published on Jul 16, 2015 An overview Unmanned Aircraft Systems (UAS) flight operations at the University of Vermont.

ALL COMMENTS (1)

Add a public comment...

### UAS

by Jarlath O'Neil-Dunne - 3/5 videos

- 1 UAS Mapping of Spring Floods and Ice Jams in Vermont Jarlath O'Neil-Dunne
- 2 UAS Mapping of Gullies and Landslides in Barre, VT Jarlath O'Neil-Dunne
- 3 UAS Flight Operations Jarlath O'Neil-Dunne
- 4 Great Brook UAS Storm Damage July 21, 2015 Jarlath O'Neil-Dunne
- 5 UAS Mapping of Barre, VT July 2015 Storm Damage Jarlath O'Neil-Dunne



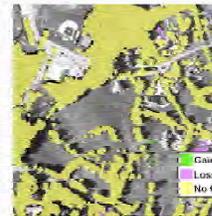
### OCT 5 UAS team deployed to aid in train derailment

This morning the Amtrak Vermonter train derailed in Northfield, VT. Responding to a request from the Vermont Agency of Transportation, we immediately deployed one of our Unmanned Aircraft Systems (UAS) teams to the area. We promptly set up a launch site, coordinated the acquisition area with disaster management officials, and then conducted UAS flight operations.



### Pennsylvania High-Resolution Tree Canopy Explorer

We are thrilled to announce the first public release of the Pennsylvania statewide high-resolution tree canopy data.



### SEP 10 Montgomery County MD Tree Canopy Explorer

In late spring we completed an updated mapping of Montgomery County, Maryland's land cover. The driving factor for this



### JUL 24 UAS Mapping of July 2015 Storm Damage in Barre, VT

The severe storm that dumped close to half a foot of rain on Central Vermont in a matter of hours on July 19, 2015 caused

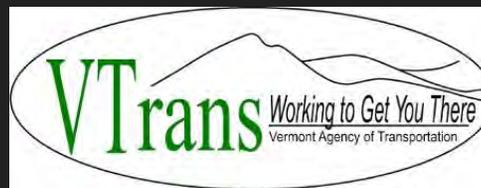


### JUL 22 Great Brook July 2015 Storm Damage - UAS Mapping

On July 19th a series of storms moved through Central Vermont unleashing nearly 6" of rain. The flooding resulted in Great Brook,

### JUL 16 UAS Flight Operations Highlight Reel

Our video production guru Gavin Zeitz put together this highlight reel of our UAS flight operations over the last several months.



# Vermont Emergency Preparedness Conference

October 20, 2015



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letters-sal.blogspot.com

Funding for this work was provided under a grant from the US Department of Transportation  
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