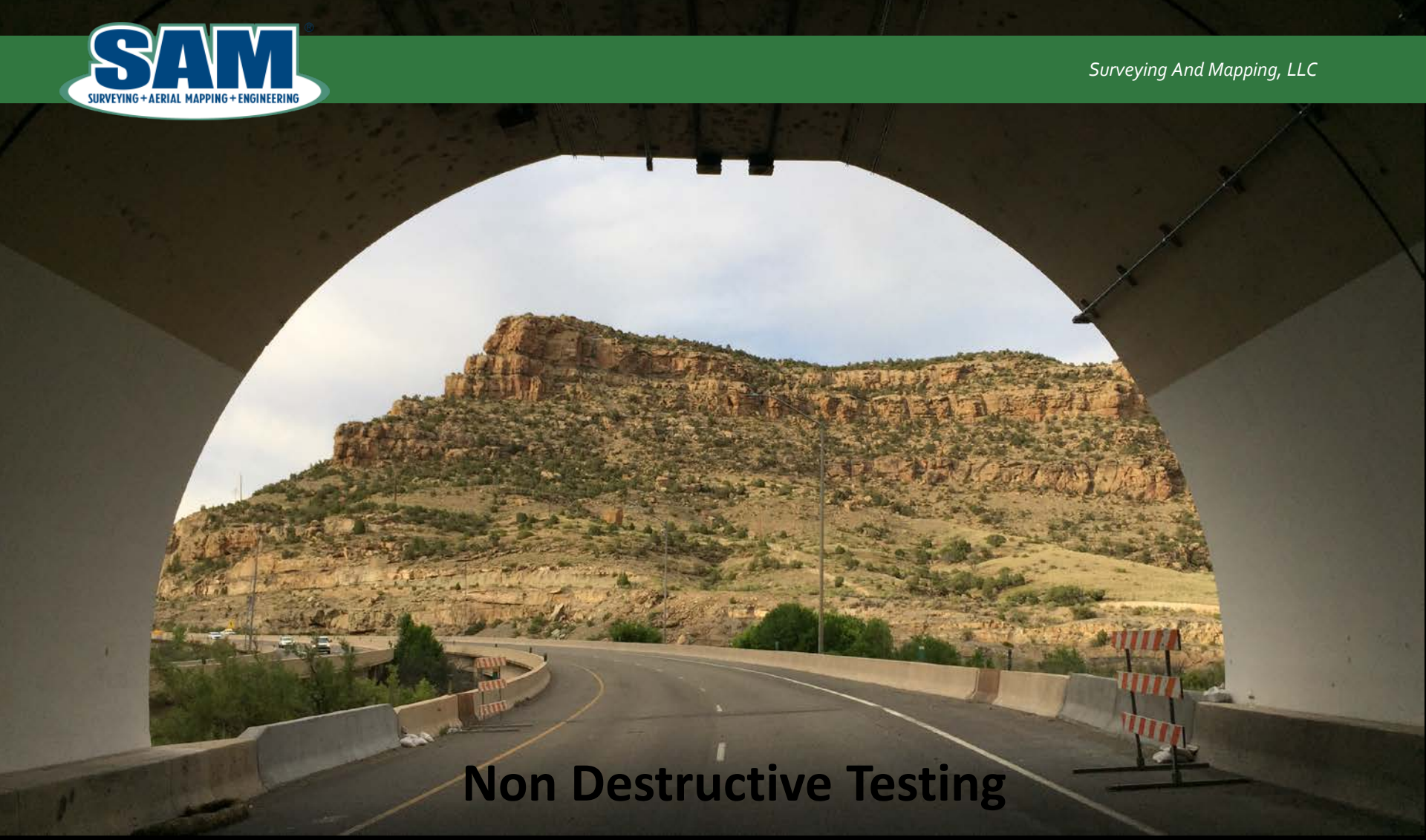


Non Destructive Testing

SHRP2 SOLUTIONS
TOOLS FOR THE ROAD AHEAD

July 2017

The Project

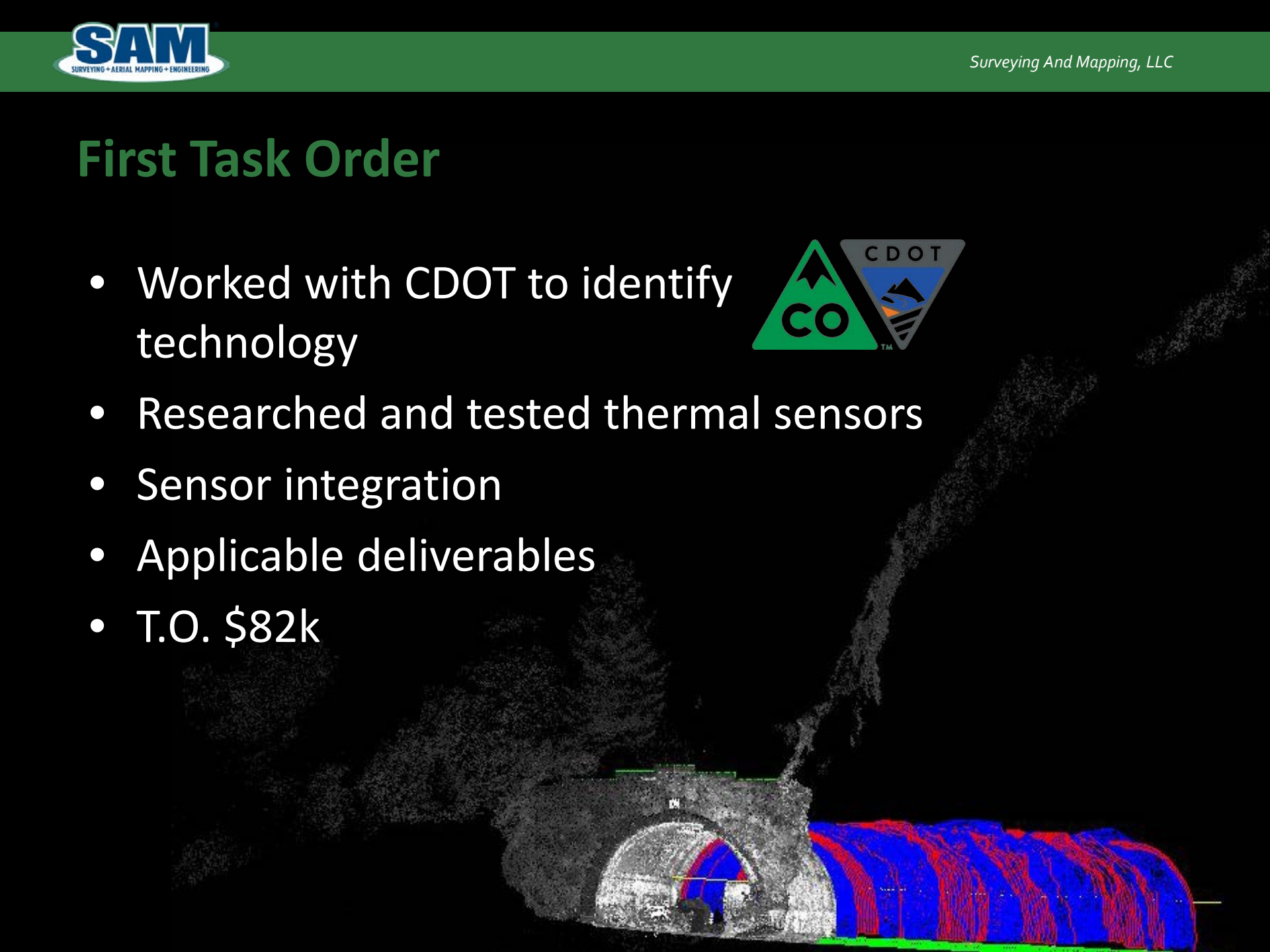
NDT of Tunnel Liners

Understanding the advantages and limitations of using thermography and LiDAR as a NDT tool.

- Services and Tools
- Mobile Mapping Data Collection
- LiDAR
- Thermocouple Data Loggers
- Thermal Imagery and Video

First Task Order

- Worked with CDOT to identify technology
- Researched and tested thermal sensors
- Sensor integration
- Applicable deliverables
- T.O. $82k

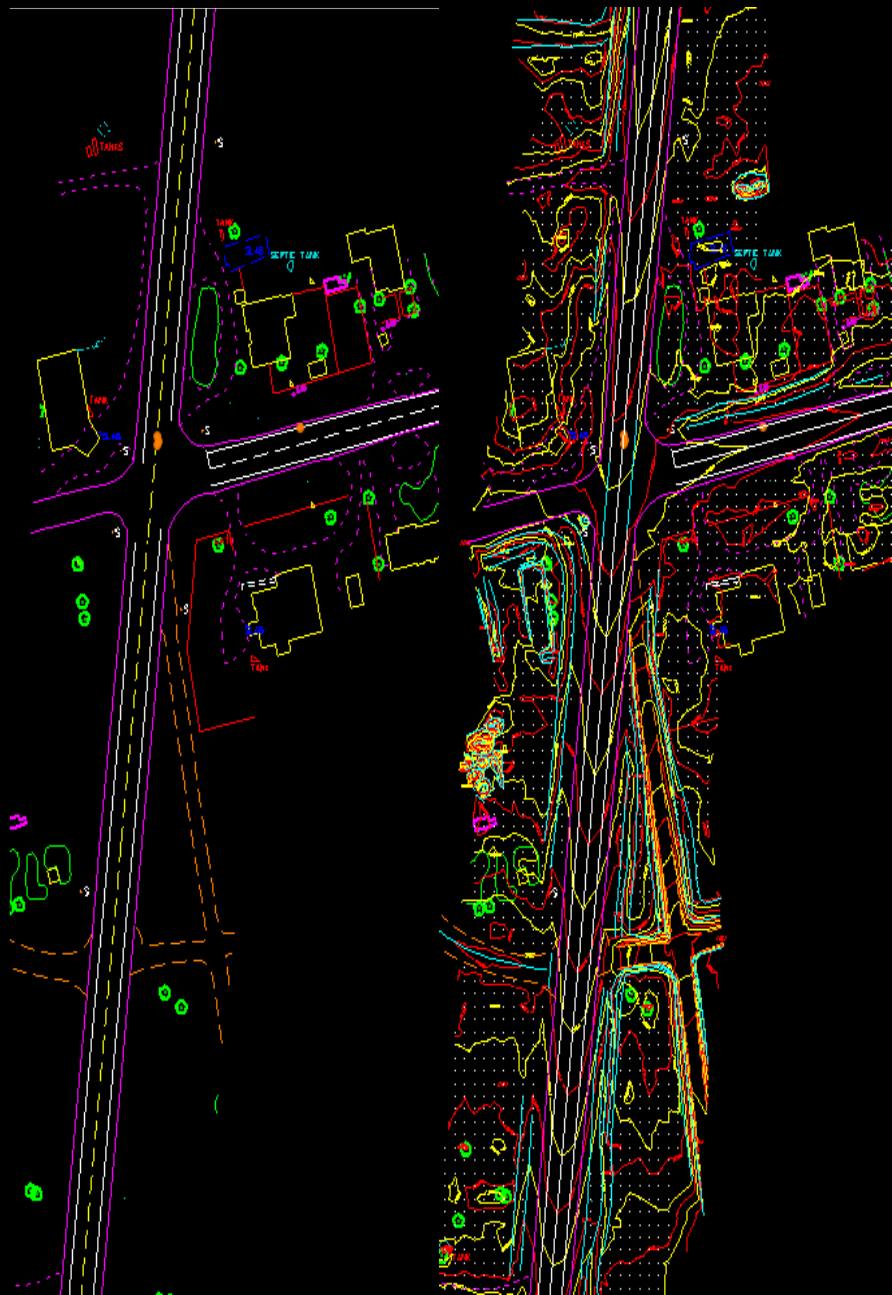


Initial Thermal Sensors

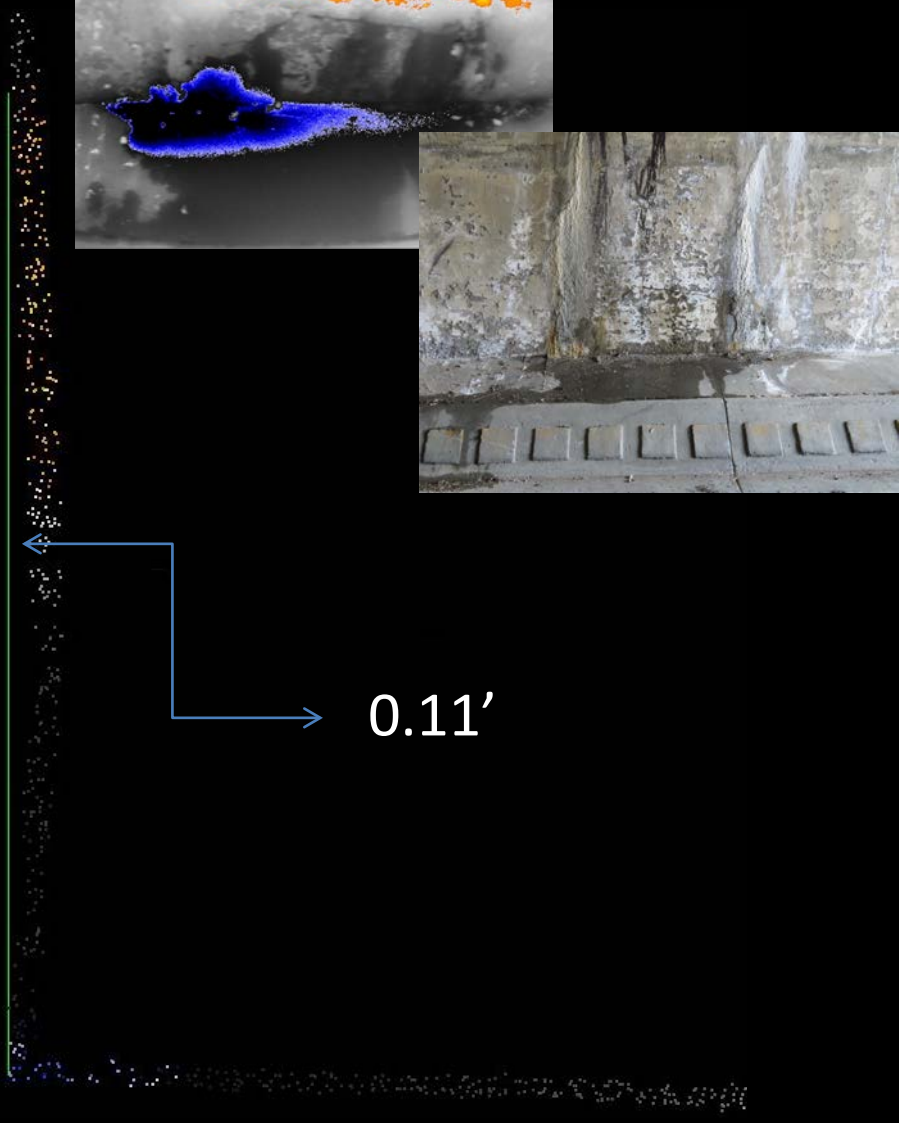
- Cooled Sensor
  - Sensitivity <20mK
- Resolution
  - 640 x 512
- FOV
  - 13mm Lens
  - 40.53° x 32.91 °

Mobile LiDAR

- 1 million points per second
- Survey grade accuracy
- Highway speeds
- New and Standard deliverables

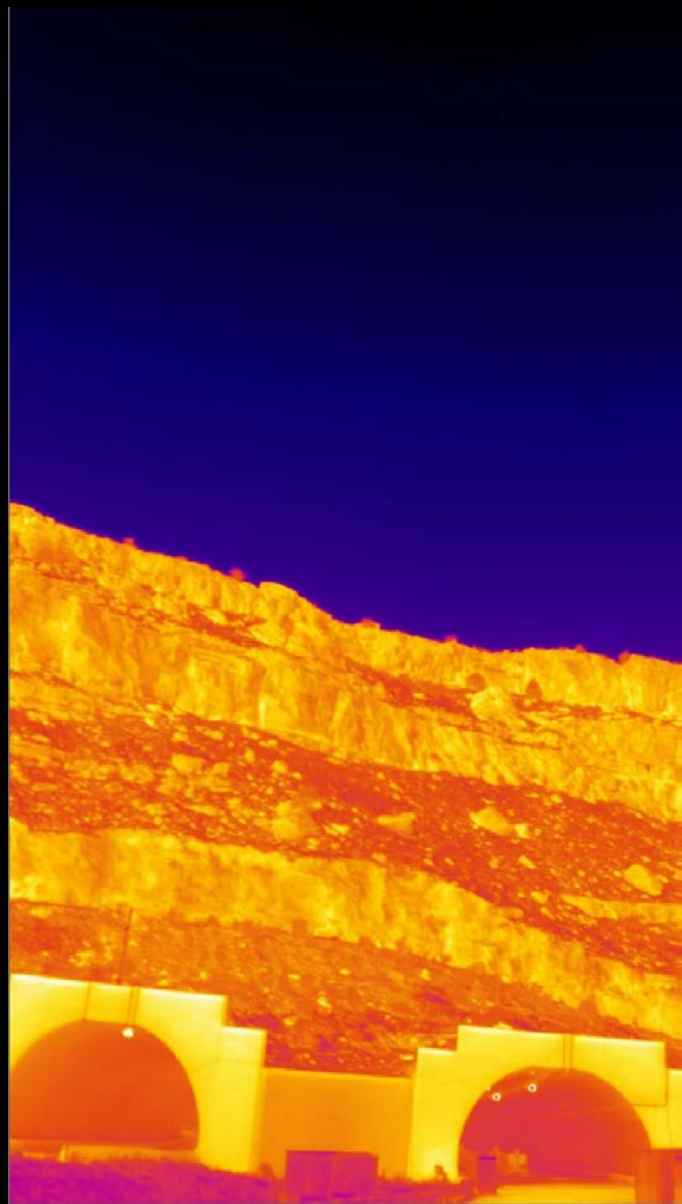


Mobile LiDAR



Current Task Order

- Furthering the concept
  - Adding RGB
  - Multiple thermal sensors
  - Identified where others were unsuccessful with thermography & how to address those challenges
  - Understanding the tunnel environment
  - Sharing data with the School of Mines
  - T.O. $157k



Beavertail Tunnel

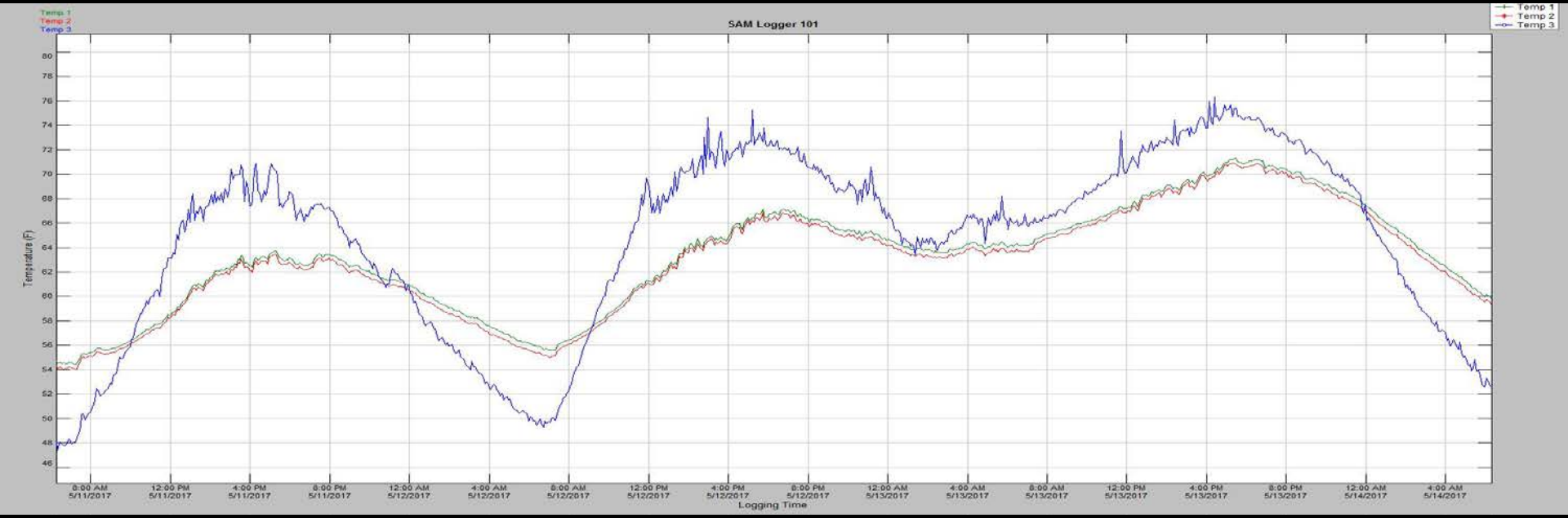
Hanging Lake Tunnel

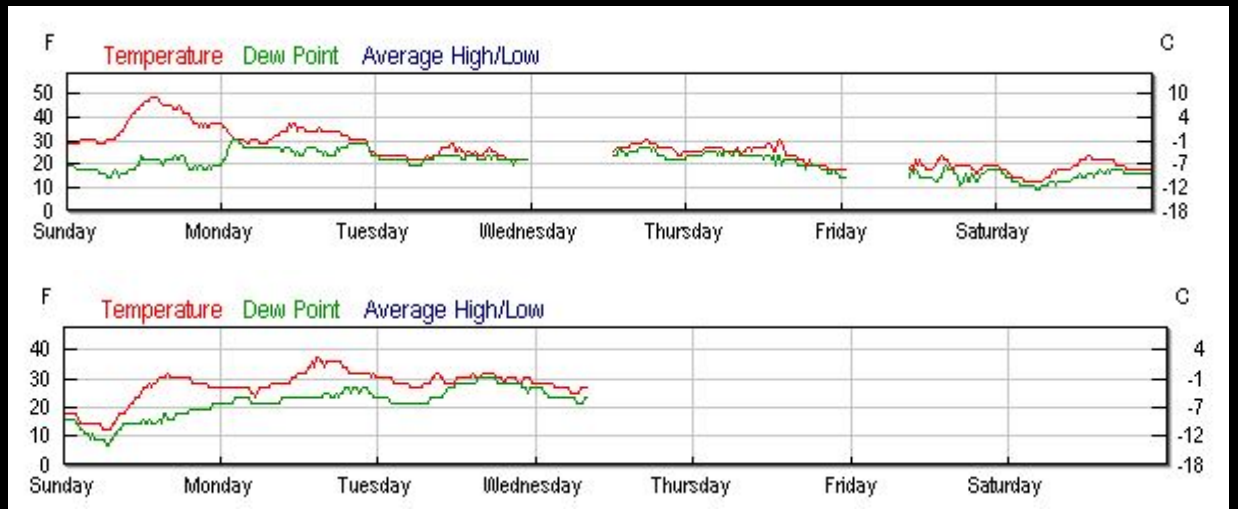
Clear Creek Tunnels

Thermocouple Data Loggers

- Understanding the thermal cycle of the tunnel liner
- Predict optimal collection time
- Ensure acceptable results from mobile collect

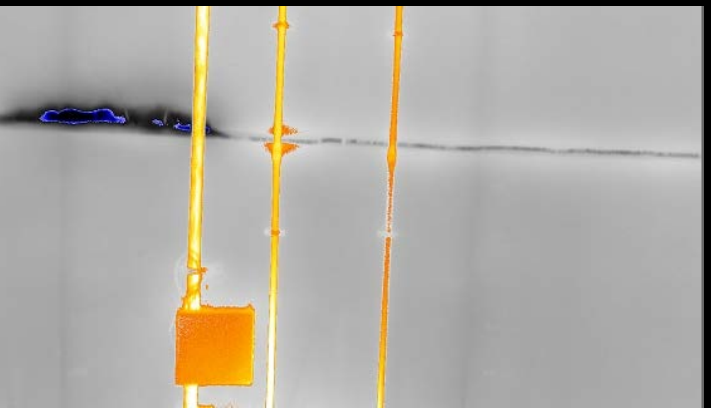
Thermocouple Data





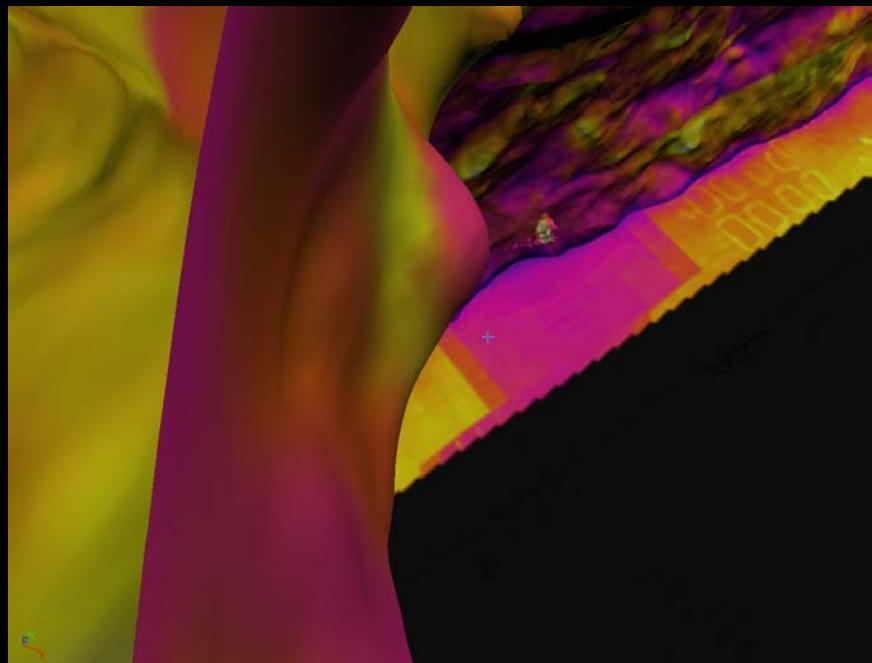
Current Thermal Sensors

- Cooled Sensor
  - Sensitivity <20mK
- Resolution
  - 1024 x 1024
- FOV
  - 17mm Lens
  - 56.93° x 56.93 °

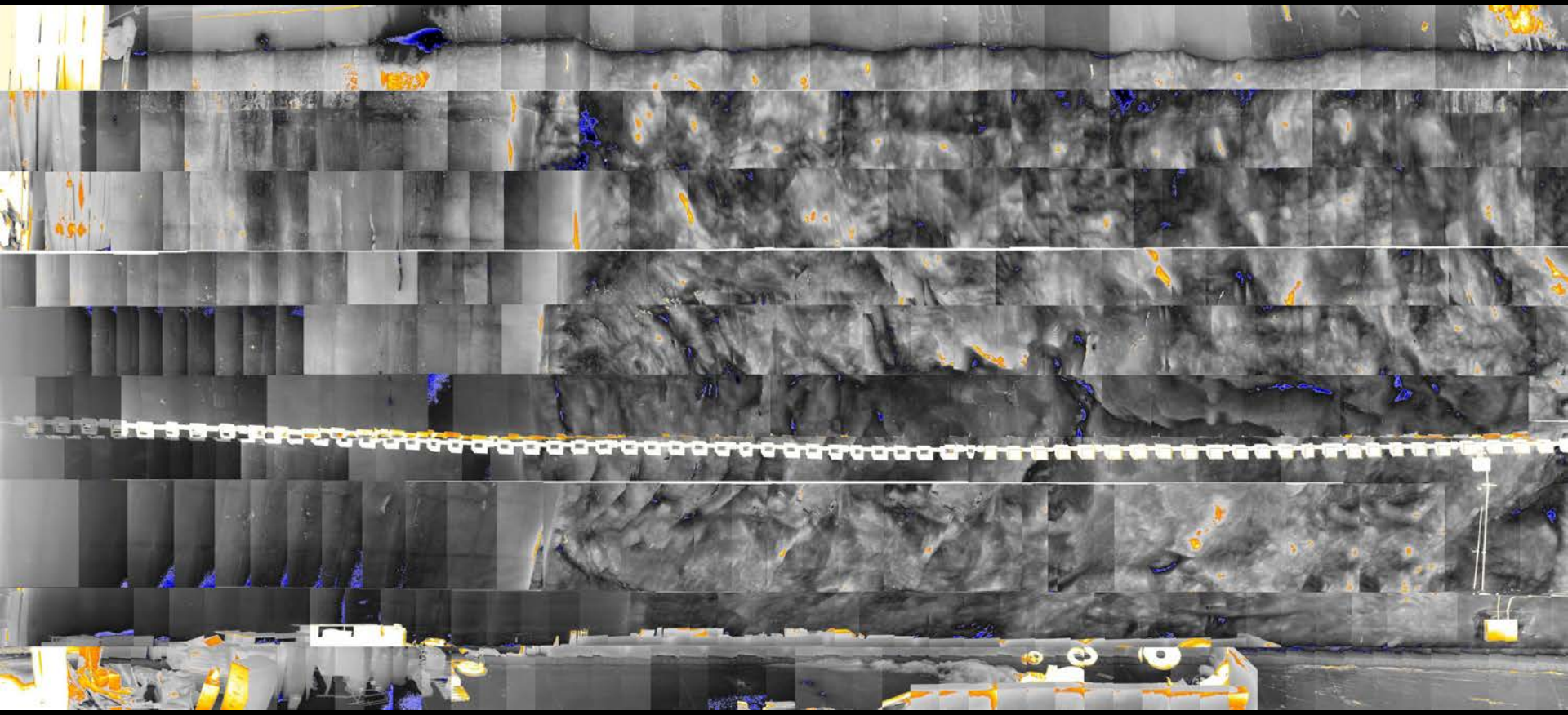


Deliverables

- Tunnel profiles
- 3D tunnel model
- 3D Mesh
- LiDAR point clouds
- Thermography
- Tunnel liner PDF
- RGB image library



Thermal PDF



Key Benefits

- No Lane Closures = Safety
- Supports Asset Management Mindset
- Focuses Boots-on-the-Ground to Critical Areas
- DOT Friendly Deliverables
- Life Cycle of Data


Questions?
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SAM
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