Geospatial Capabilities

Sam Moffat - Program Director
Annie Ding, PhD - Director of Research

WOOLPERT

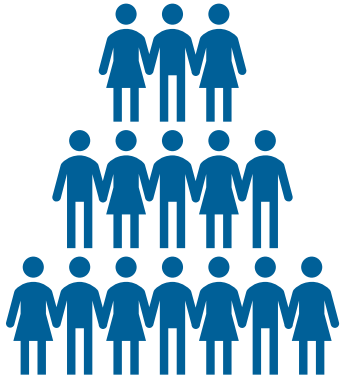
Woolpert at a Glance

1911

Founded in
Dayton, Ohio

30+

Offices Worldwide



2000+

Employees

Woolpert Global Offices

Updated 12.12.2022

North America

Athens, AL
Atlanta, GA
Austin, TX
Bay St. Louis, MS
Charlotte, NC
Chesapeake, VA
Chicago, IL
Cincinnati, OH
Cleveland, OH
Columbia, SC
Columbus, OH
Cypress, TX
Dayton, OH
Denver, CO
Egg Harbor Township, NJ
Fairfax, VA
Fairview Heights, IL
Fort Worth, TX
Greenville, SC
Houston, TX
Indianapolis, IN
Jackson Hole, WY
Jacksonville, FL
Jefferson City, MO
Kansas City, MO
LaPorte, TX
Lexington, KY
Miami, FL
N. Charleston, SC
Oklahoma City, OK
Orlando, FL
Pensacola, FL
Pittsburgh, PA
Port Orchard, WA
Provo, UT
Richmond, VA
Salt Lake City, UT
San Antonio, TX
San Jose, CA
San Rafael, CA
Springfield, OH
St. George, UT
St. Louis, MO
St. Petersburg, FL
Toledo, OH
Ventura, CA
Virginia Beach, VA
Wasilla, AK
Calgary, Canada

Europe

London, UK

Africa and Middle East

Abu Dhabi, UAE
Cape Town, RSA
Johannesburg, RSA

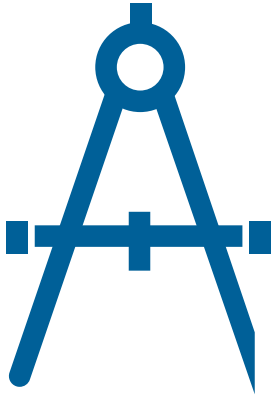
Asia

Kuala Lumpur, Malaysia
Singapore

Australia and New Zealand

Fortitude Valley, QLD
Macquarie Park, NSW
Napier, NZ
Perth, WA
Richmond, VIC
Sydney, NSW
Wollongong, NSW

Our Areas of Expertise



ARCHITECTURE

ENGINEERING

GEOSPATIAL

Geospatial Sector Markets/Services

State & Local Government

Aerial and mobile mapping
Enterprise GIS
Topographic lidar and imagery
3D modeling
Impervious surface delineation
Thermal imaging
Uncrewed aircraft systems
Geodetic survey

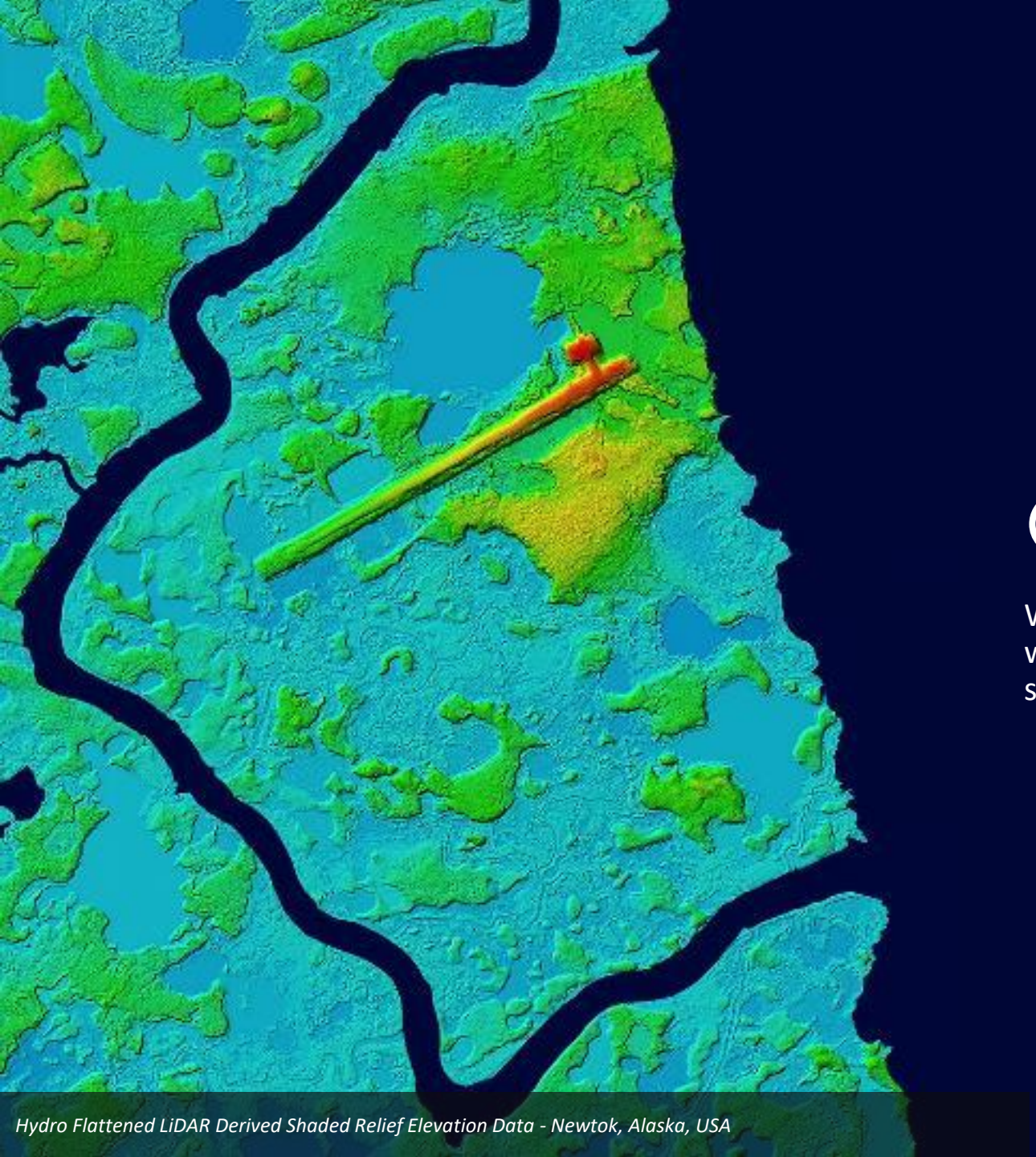
Maritime

Hydrographic survey
Coastal, riverine engineering/resilience
Bathymetric lidar, reflectance imagery
Side-scan sonar, vessel-based lidar
Critical infrastructure assessment, design
Habitat modeling
Nautical charting
Sediment management

National Security

Coastal management and restoration
Intelligence analysis
Secure software development
Data analytics, hosting, management
Cadastral research, survey
Topographic lidar and imagery
3D modeling
Emergency response support

Woolpert Geospatial Capabilities

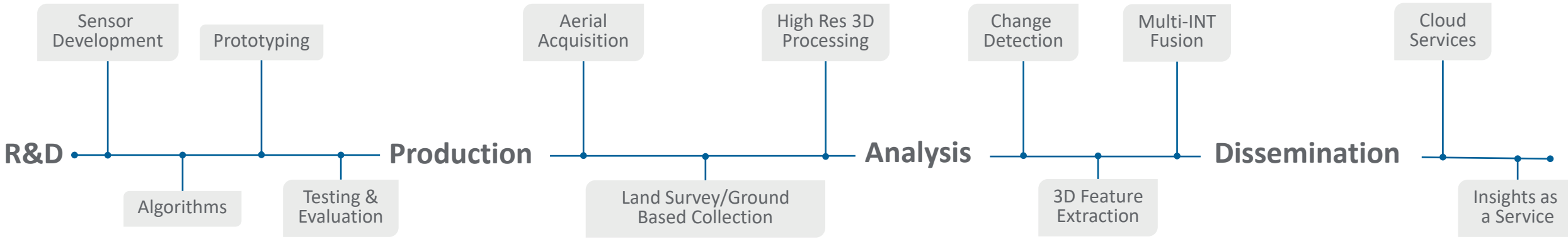


Hydro Flattened LiDAR Derived Shaded Relief Elevation Data - Newtok, Alaska, USA

GEOSPATIAL

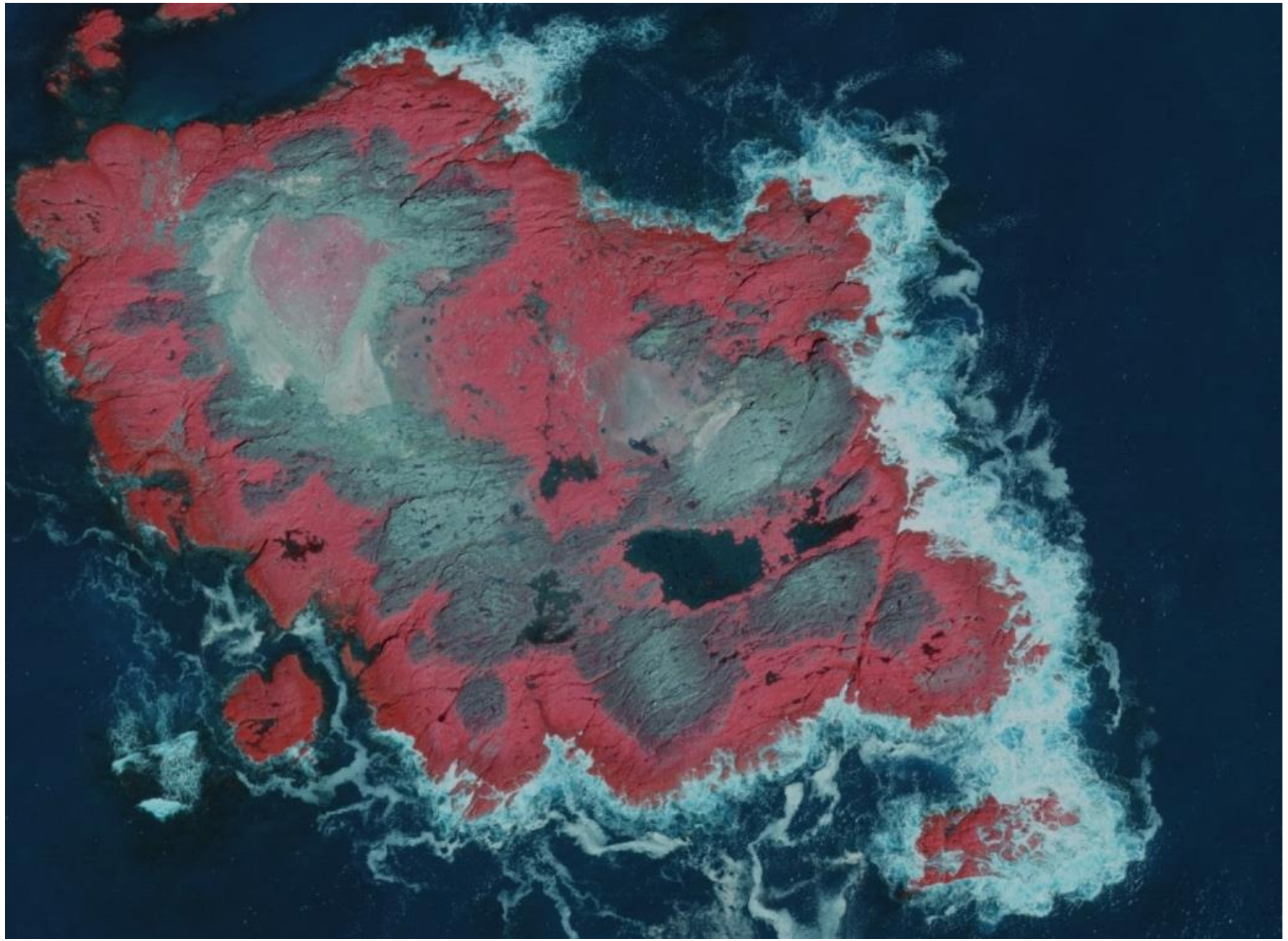
With the ability to explore above, on and below Earth's surface, we excel in providing cutting-edge mapping services to lead and support complex, multidisciplinary projects.

Full Spectrum of Geospatial Services



Full Spectrum of Geospatial Applications

3D modeling
Asset management
Automated feature extraction
Change detection
Coastal management and restoration
Consulting
Contingency planning for disasters
Corridor mapping
Data analytics
Digital terrain models
Elevation data updates
Emergency response support
Environmental monitoring
Flood mapping and analysis
Forestry
GIS
Hydrology
Impervious surface delineation
Land use/land cover
Lidar
Solar potential
Strategic planning
Surface models
Urban modeling



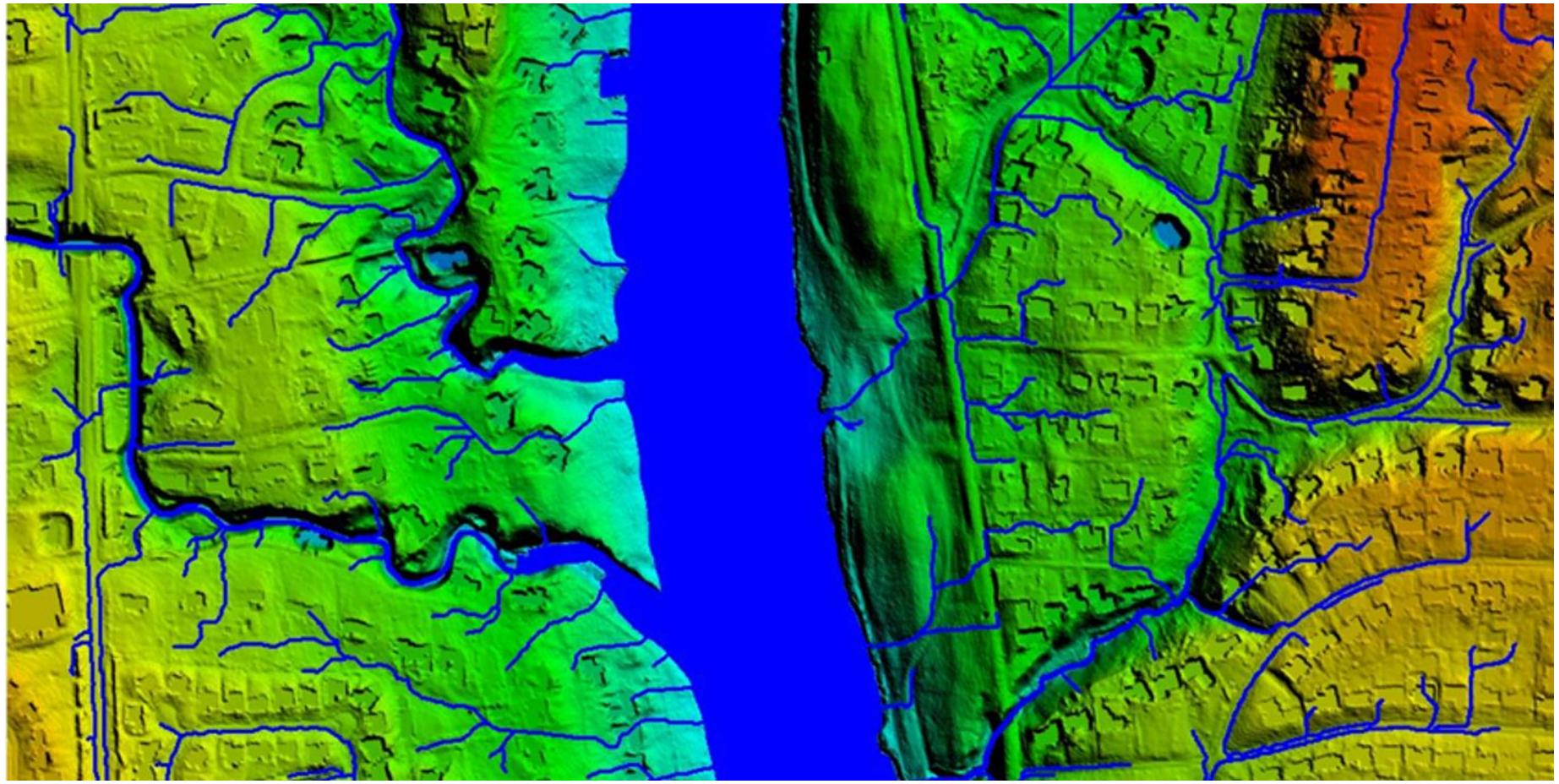
Advanced Sensors

Woolpert owns and operates state-of-the-art airborne lidar and multi-spectral imaging systems. Woolpert also has undertaken the research and development of several advanced special-purpose airborne lidar mapping systems. As the leader in airborne lidar, Woolpert's expertise is sought by customers for much more than acquisition and data processing. Woolpert is solving some of the toughest challenges in the industry and pushing the advancement of airborne lidar to new levels.

Geospatial Information Systems (GIS) Solutions

Leveraging our strategic business partnerships with Google and Esri, a global leader in GIS software, we're able to provide several advanced geospatial products and tools for GIS applications:

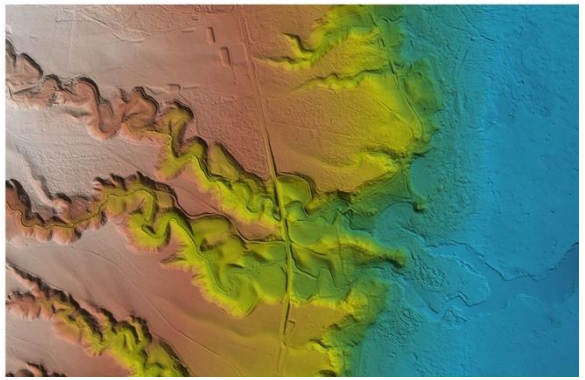
- Consulting and strategic planning
- Data maintenance
- GIS databases and big-data solutions
- GIS training, staff augmentation and support
- Graphical outputs and media
- Implementation services
- Interactive web maps
- Mobile and hand-held solutions
- Software and application development
- Solution and architecture design
- Spatial analytics
- Workflow analysis

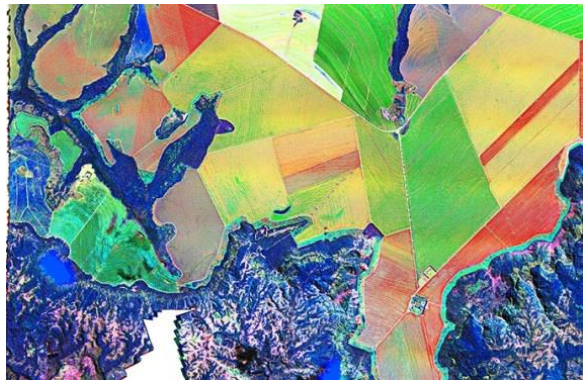


Photogrammetry and Remote Sensing

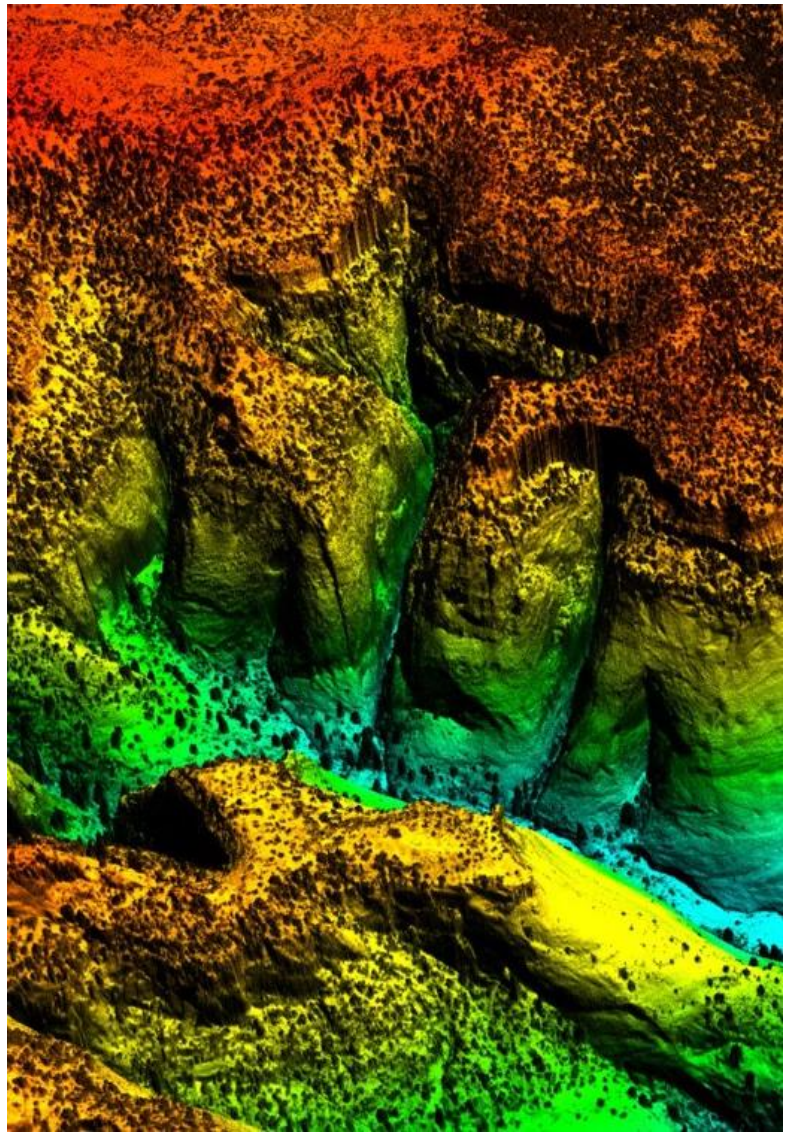
As an industry-leading provider of geospatial data acquisition, Woolpert provides the following services (including simultaneous collection of multiple datasets):

- Aerial lidar
- Bathymetric lidar
- Color infrared
- Digital imagery
- Hyperspectral
- Mobile mapping
- Multi-spectral
- Oblique aerial imagery
- Orthoimagery
- Sonar
- Terrestrial scanning
- Thermal imaging





Leading Provider of Lidar Data and Solutions



Aerial Lidar

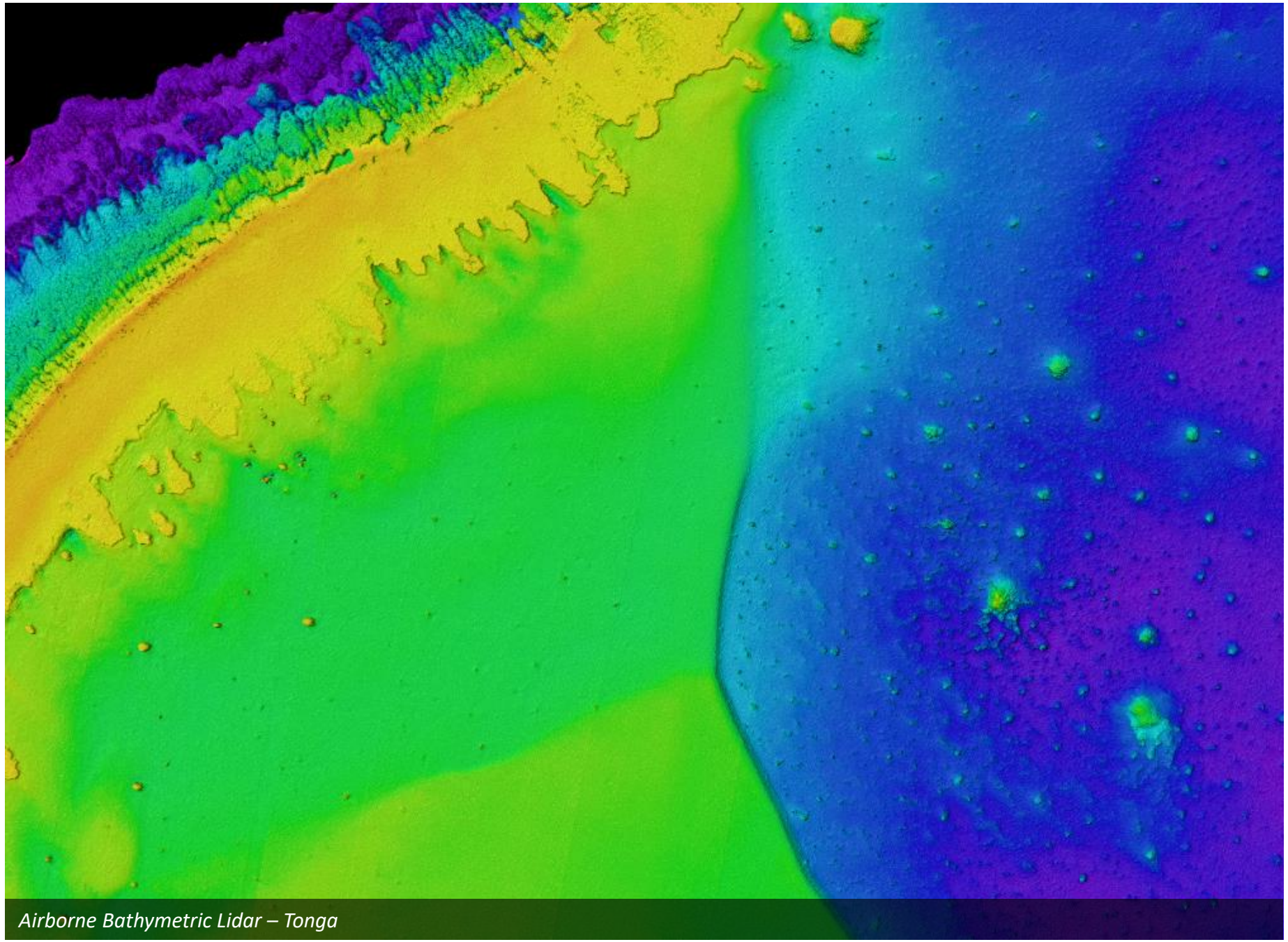
Mobile Mapping

Terrestrial Lidar

Bathymetric Lidar

As a leader among lidar providers, we do more than just create traditional map products, such as contours and digital terrain models; we also create the following value-added products:

- Biomass and carbon/greenhouse gas calculations
- Building and structure outlines
- Emergency response plans
- Land cover characterizations
- Land use and land cover analyses
- Pre- and post-event/disaster planning
- Solar maps for photovoltaic array placement
- Transmission and utility maps
- Vegetation classifications
- Littoral zone mapping
- Seafloor mapping
- Coastal management



Airborne Bathymetric Lidar – Tonga

Maritime Solutions

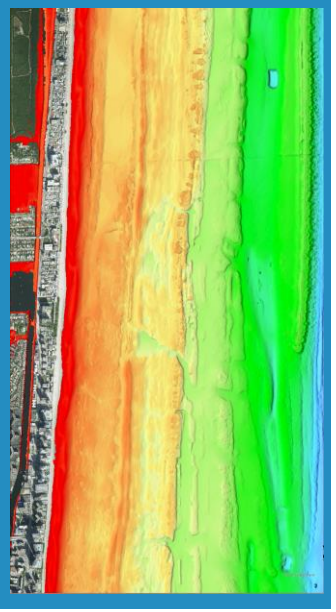
Our agile team of hydrographers, surveyors and GIS professionals use state-of-the-art technologies to create seamless topographic products in the coastal zone and inland riverine environments. From chart data inputs and classified point clouds to digital elevation models and identified feature classes, these geospatial products support applications such as:

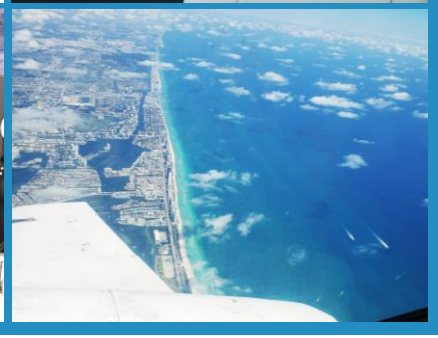
- Coastal and riverine engineering
- Coastal and riverine resilience
- Critical infrastructure design and assessing
- Habitat modeling and assessing
- Nautical charting
- Regional sediment management

Bathymetric Unmanned Littoral LiDar for Operational GEOINT (BULLDOG)

Woolpert Proprietary
Woolpert, Inc.
02/06/2022

High Altitude 3D Topo-Bathy lidar system for accurate scanning of coastal littorals



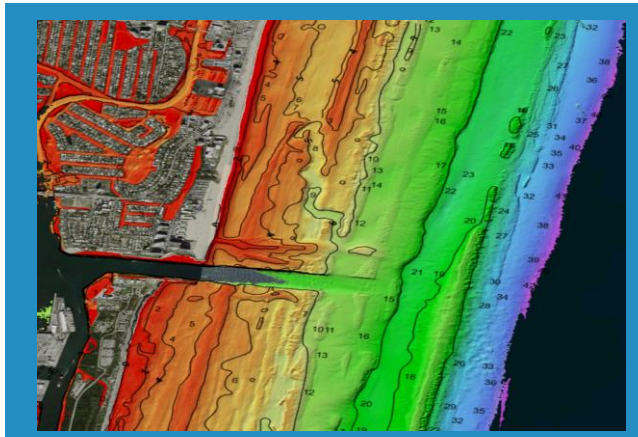
2018: Research, Design, Lab Test
2019: Flight Test, Refine, Document
2020: Field Test, Refine, Production
2021: Flight Test, Refine, Assessment Flights
2022: Flights, Analysis, Reporting

Technical Performance:

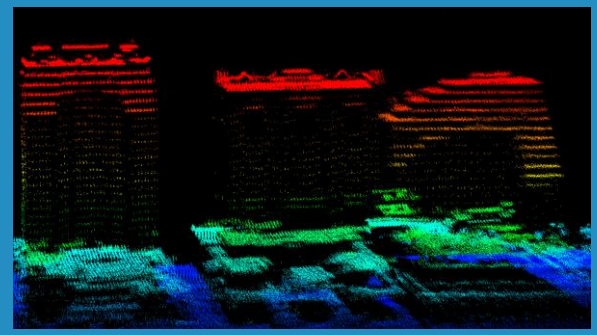
- Woolpert's **next-generation**, topo-bathy lidar sensor. Designed to simultaneously collect both topographic and bathymetric measurements, BULLDOG merges the most-desirable features of traditional topographic and bathymetric lidar sensors to capture accurate data over a variety of coastal environments.
- BULLDOG is the **first-ever high altitude** (10,000ft) bathymetric lidar, operating an order of magnitude higher than existing sensors, which allows for a 400 percent increase in area coverage rate.
- This **rapid-collection sensor** supports both tactical and civil mapping missions/applications with real-time, first-look 3D lidar and precise elevation data from a wide area of interest. This data can be processed quickly into highly accurate cartographic products. This sensor reduces the number of labor and platform hours needed for data collection.

Technical Specifications:

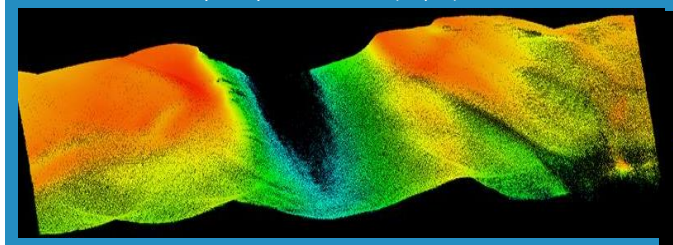
- High altitude/large swath **(3048m/856m)**
  - Single pass coastline characterization
  - 10,000ft + collection capabilities
- Multispectral multichannel system: (**532**, **647** and **1064** nm)
  - Co-located Green and IR footprints
  - Depth range: 0 to 50+ meters
- Hybrid detector system
  - Geiger + Linear mode detectors capture **sea** and **land** information
- **Real-time** data processing: Products on Demand (PoD)
- Modular construction could support off nadir capabilities



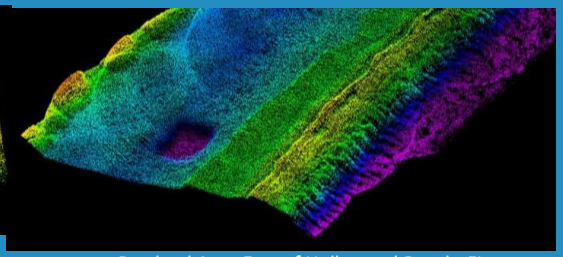
Ft. Lauderdale, FL
Bathymetry from 10,000ft (Depth)



Hotels and Shops, Ft. Lauderdale, FL
Topographic Point Cloud from 10,000ft (Elevation)



Little Dog Keys Pass Mississippi Sound
Bathymetry Point Cloud from 10,000ft (Depth)



Dredged Area East of Hollywood Beach, FL
Bathymetry Point Cloud from 10,000ft (Depth)

Unmanned Aircraft Systems

We merge traditional data collection techniques with untraditional unmanned aircraft to provide robust UAS services. Capitalizing on internal capabilities and strategic partnerships, we optimize the entire UAS workflow—from sensor selection, calibration and collection to processing and dissemination.

Woolpert provides clients with the following UAS services :

- 3D wireframes and meshes
- Automated and semi-automated feature extraction
- Colorized point clouds
- Digital terrain models and contours
- GIS datasets
- Livestream videos
- Traditional orthophotography
- Virtual reality (VR) fly-throughs

UAS Aerial Imagery

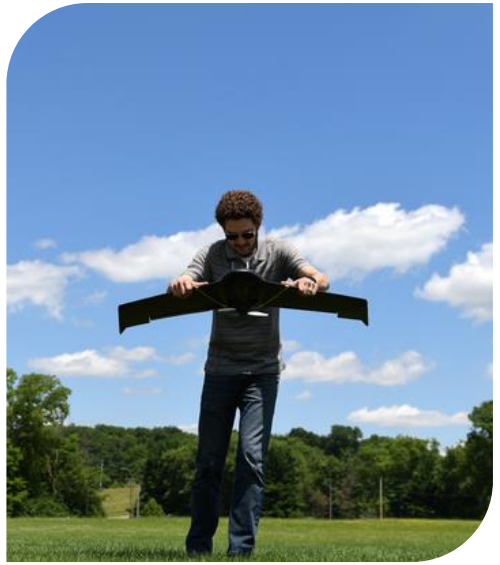
The Woolpert Fleet

SwellPro Splash Drone

Sensfly Albris

DJI Inspire

Sensfly eBee X RTK



UAS altitude is limited to 400ft AGL by the FAA. In restricted airspace, altitude ceiling may be lower.

Use Case Examples

LiDAR Data & Aerial Imagery

Use Case Examples

- Sediment Removal Estimation
- Erosion Hazard Zone Delineation
- Flood Modeling & Flood Risk
- Emergency Resilience Planning
- Pervious/Impervious Surface

LiDAR Data & Aerial Imagery

Use Case Examples

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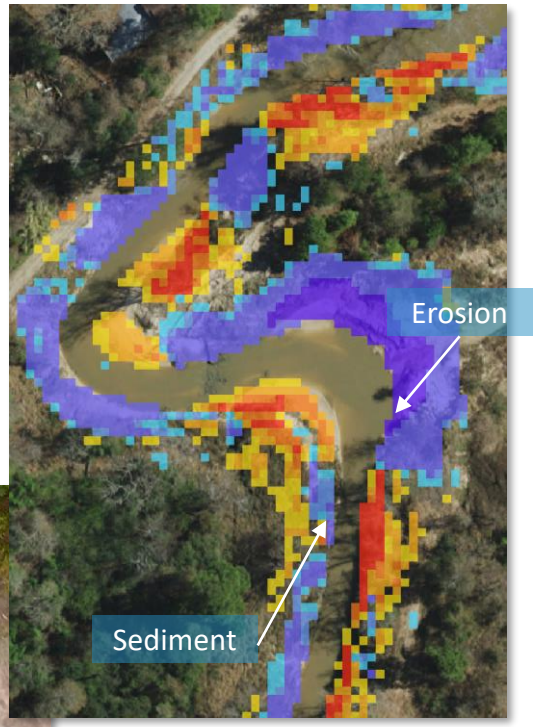

LiDAR Data & Aerial Imagery

Use Case Examples

- Sediment Removal Estimation
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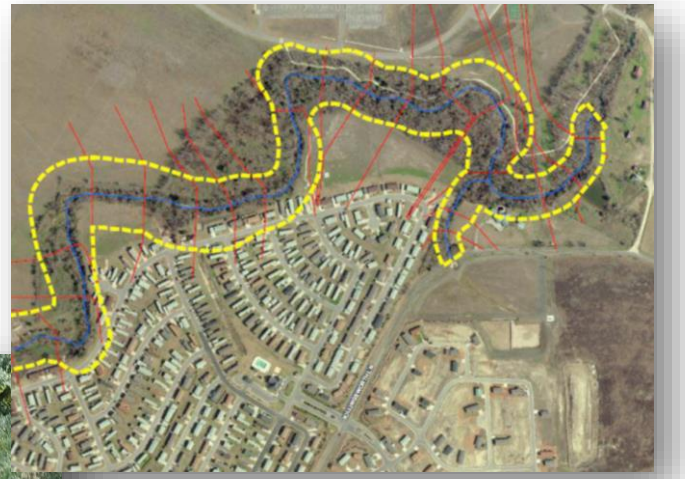
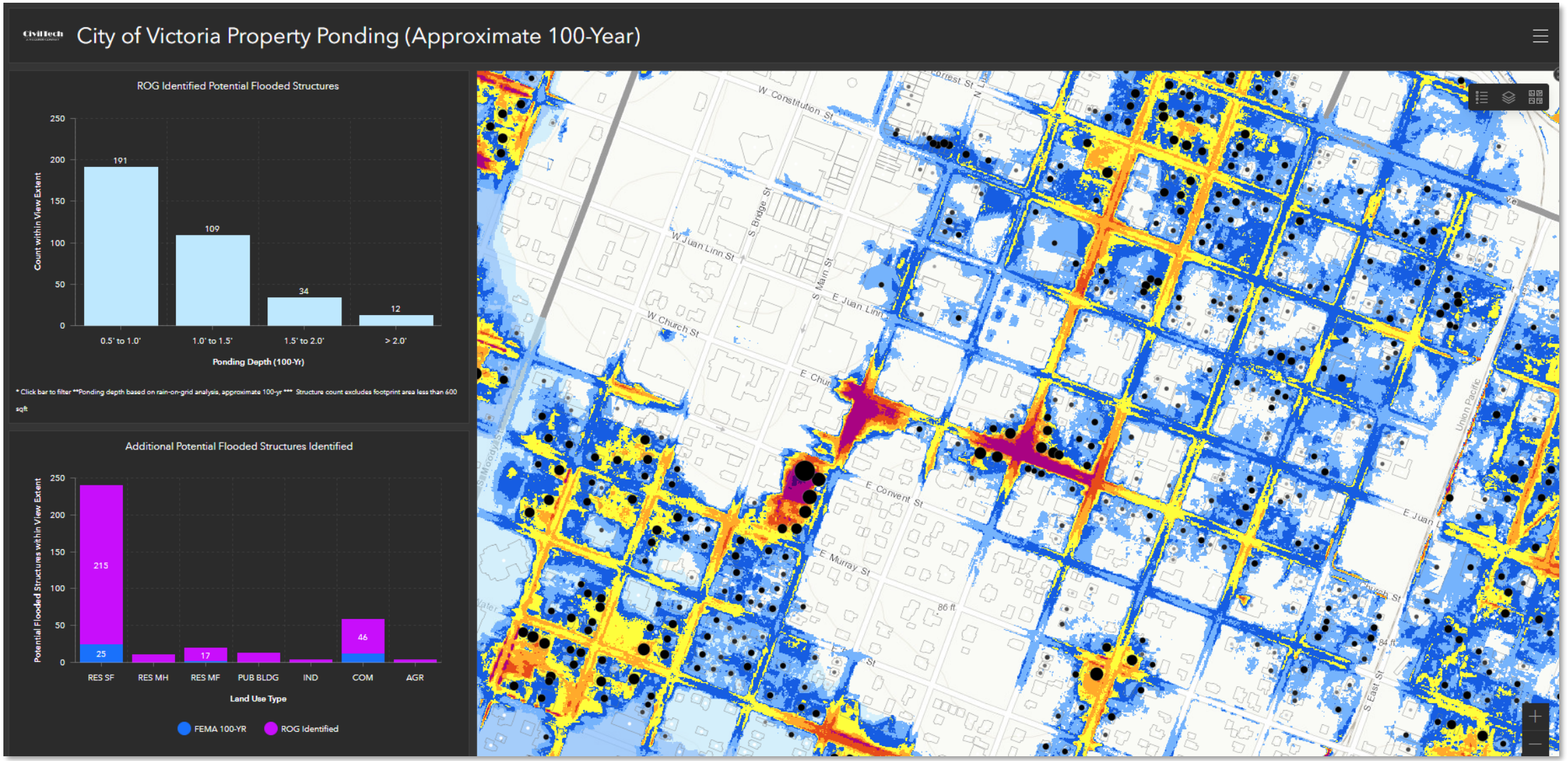
- Emergency Resilience Planning
- Pervious/Impervious Surface



Flood Modeling & Flood Risk

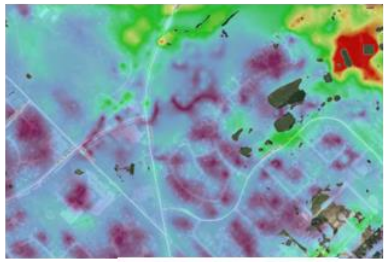


Emergency Resilience Planning

Centerline Split & Buffer

ROG Depth Grid

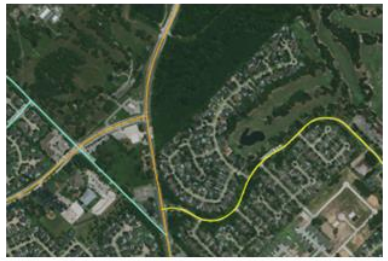
X



ROG Velocity Grid

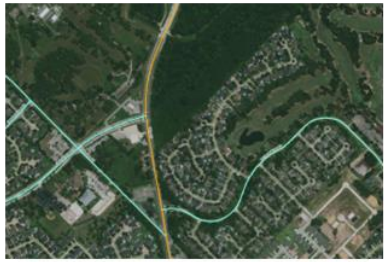
=

DV Index



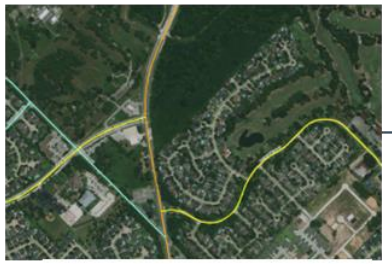
Roadway Classification(C_Rd_Class)

X



Roadway Traffic (C_Traffic)

=



Direct Impact (C_Combined)

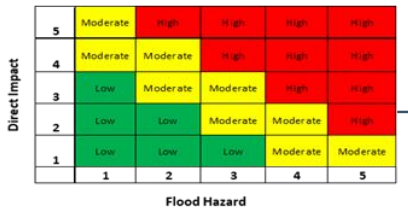
Legend

Depth: High, Low

Velocity: High, Low

Score: 1, 2, 3, 4, 5

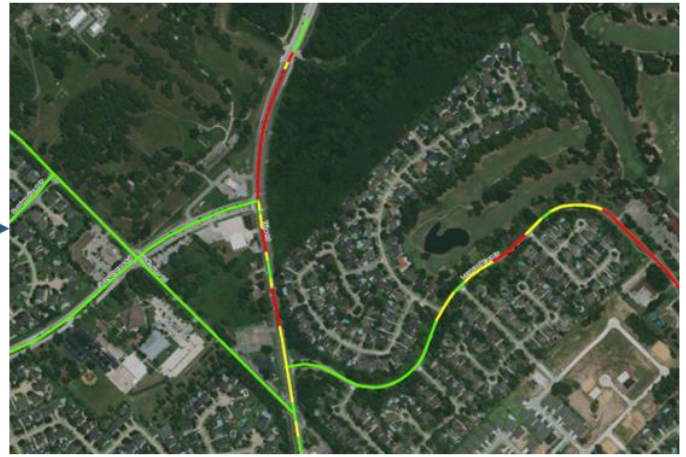
Risk Level: Low, Moderate, High



Flood Hazard/Direct Impact Matrix

WORKFLOW

Roadway Flood Risk Identification and Ranking (Preliminary)



LiDAR Data & Aerial Imagery

Use Case Examples

- Sediment Removal Estimation
- Erosion Hazard Zone Delineation
- Flood Modeling & Flood Risk
- Emergency Resilience Planning
- Pervious/Impervious Surface
  - LiDAR Point Cloud Classification
  - Intensity
  - Aerial Imagery

LiDAR Point Cloud Classification

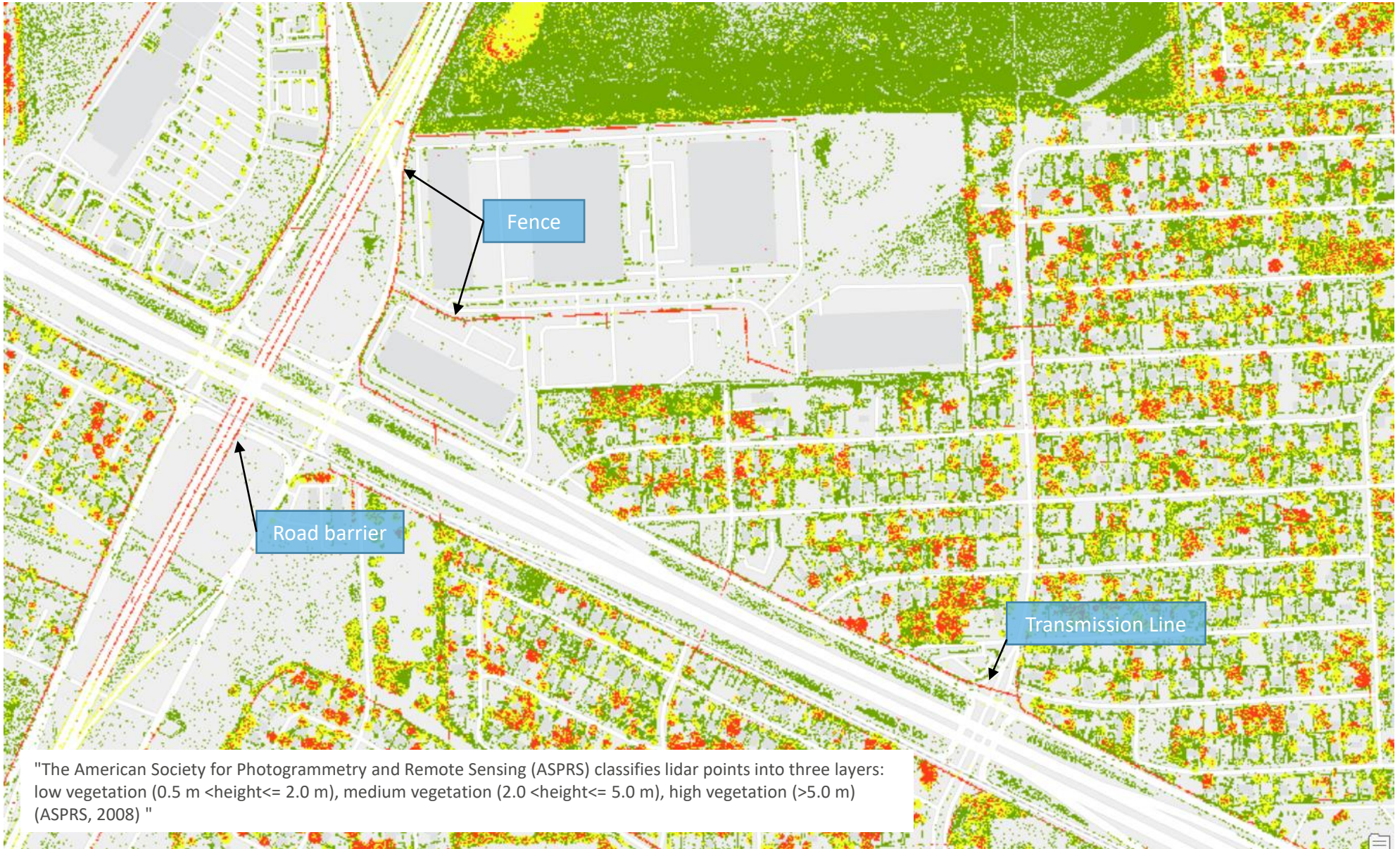
2018 TNRIS Upper Coast LiDAR Metadata Point Classification:

- Class 1: Unclassified
- Class 2: Ground
- Class 3: Low vegetation
- Class 4: Medium vegetation
- Class 5: Tall vegetation
- Class 6: Buildings
- Class 7: Low Point (noise)
- …
- Class 9: Water
- Class 10: Ignored Ground
- …
- …
- …
- Class 14: Culverts
- …
- …
- Class 17: Bridges

Classification from Downloaded Data (TNRIS):

- ☑ 0 Never classified
- ☑ 1 Unassigned
- ☑ 2 Ground
- ☑ 3 Low Vegetation
- ☑ 4 Medium Vegetation
- ☑ 5 High Vegetation
- ☑ 6 Building
- ☑ 7 Low Noise
- ☑ 8 Model Key/Reserved
- ☑ 9 Water
- ☑ 10 Rail
- ☑ 11 Road Surface
- ☑ 12 Overlap/Reserved
- ☑ 13 Wire – Guard
- ☑ 14 Wire – Conductor
- ☑ 15 Transmission Tower
- ☑ 16 Wire – Connector
- ☑ 17 Bridge Deck
- ☑ 18 High Noise

LiDAR Point Cloud - Vegetation



"The American Society for Photogrammetry and Remote Sensing (ASPRS) classifies lidar points into three layers: low vegetation (0.5 m <height<= 2.0 m), medium vegetation (2.0 <height<= 5.0 m), high vegetation (>5.0 m) (ASPRS, 2008) "

LiDAR Point Cloud Intensity

Can be affected by

- Scan angle,
- Range,
- Surface composition,
- Roughness, and
- Moisture content

Advantage

- It is indifferent to shadows

  Unlike passive vision sensors (cameras).

Disadvantage

- Does not always lead to consistent results

  It must be used as a relative measurement.

Can Intensity Help in Pervious/Impervious Identification?

LiDAR Point Cloud – Low Vegetation

Paved or Unpaved

What is intensity good for?

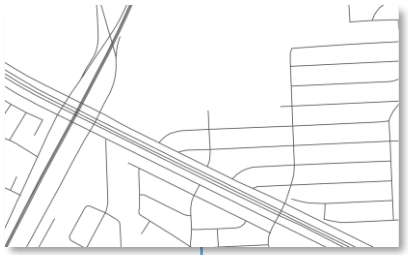
Excellent for Identifying Road Markings

Pervious/Impervious Surface (Aerial Based)

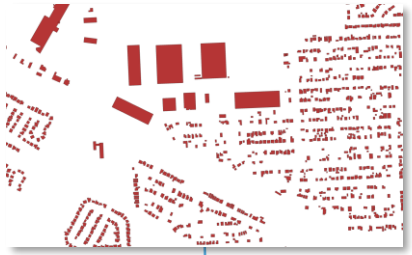
Aerial

CIR Imagery

Street Centerline



Building Footprint



Pervious/Impervious

Segmenting Imagery
- Binary Thresholding

Combine Bands
- Green from Natural Color
- Red from CIR

Denoise
- Smoothing
- Focal Statistic

Data Integration
- Building Footprints
- Roads

QC
- Vectorize
- Manual Edits

6” Aerial Imagery:
2018 Aerial (H-GAC)
2020 CIR Imagery (HGAC)

Step 1: Extract Bands

Binary Thresholding

Step 2: Combine & Reclass

Combine 2022 Red Band

Reclass into Pavement/None Pavement/Shadow

Step 3: Denoise & Step 4: Data Integration

Incorporate → Building Footprints & Roads

Denoise → Smoothing …

Step 5: Vectorize & QC

Polygon

QC

Summary

- We are AEG: Architecture, Engineering and Geospatial all under one roof.
- Full Spectrum of Geospatial Services
- Full Spectrum of Geospatial Applications
- Leading Provider of Photogrammetry and Remote Sensing
  - Advanced Sensor Development
  - Topographic LiDAR
  - Maritime LiDAR
  - Digital Camera
  - Manned Aircraft
  - Unmanned Aircraft System (UAS)
  - Quality LiDAR Data, Aerial and Value-added Products
- Innovative Capabilities
- Cloud Solutions

For Additional Information

Sam Moffat, GISP

Program Director, Government Solutions
Sr. Associate
Sam.moffat@Woolpert.com
865.621.2984

Annie Ding, PhD

Director of Research
Annie.ding@Woolpert.com

346.409.2067