Lidar-Derived Products and Applications

Houston-Galveston Area Council

Jason Nyberg
Account Manager Mountain Region
Manitou Springs, Colorado

Michael Shillenn
Senior Account Manager
Sewell, New Jersey

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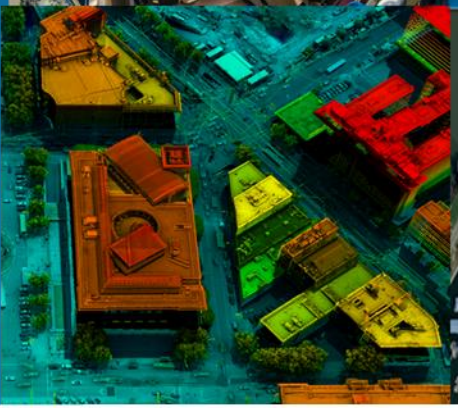
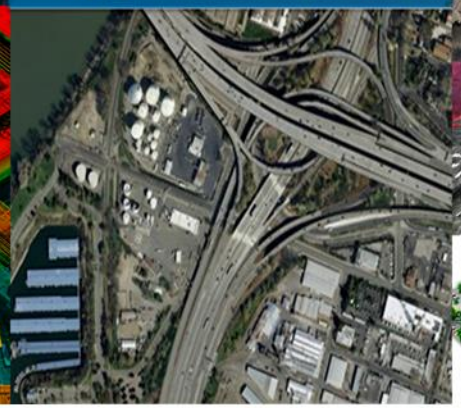
WHO WE ARE

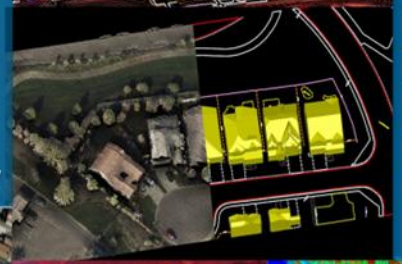
NV5 GEOSPATIAL

ACQUIRE

- Fixed and rotary wing lidar
- Unmanned Aerial Solutions
- Mobile lidar
- Topobathymetric lidar
- Bathymetry
- Multispectral imagery
- Hyperspectral and thermal imagery

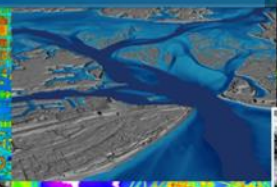


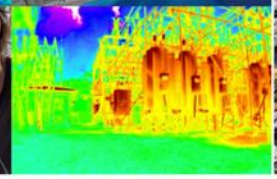


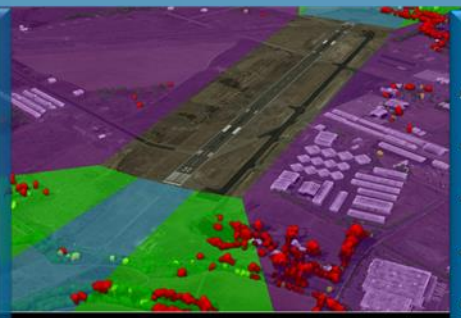


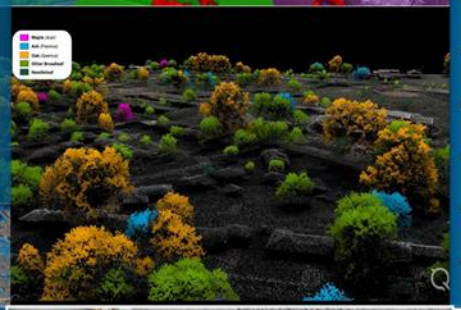
ANALYZE

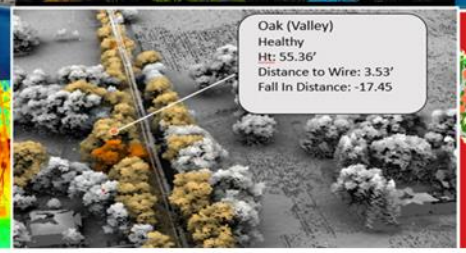
- Orthoimagery
- Full Feature LIDAR Classification
- Topographic /Planimetric Mapping
- 3D Modeling
- Machine Learning
- Process Automation
- Spatial Data Analysis
- Geospatial Cloud Solutions
- Enterprise GIS





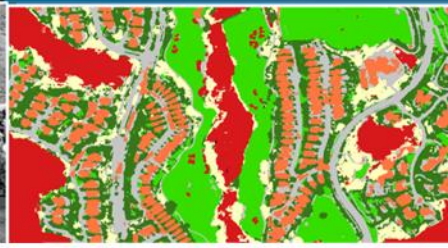






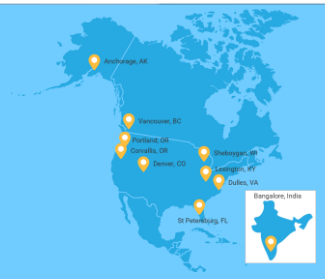
ANSWER

- Emergency Response
- Disaster Preparedness
- Resources Management
- Hazard Detection
- Damage Assessment
- Regulatory Compliance
- Vegetation Analysis
- Environmental Monitoring
- Infrastructure Management



LARGEST LIDAR PROVIDER

with a true North American footprint – annual project execution in all 50 US States & Canada



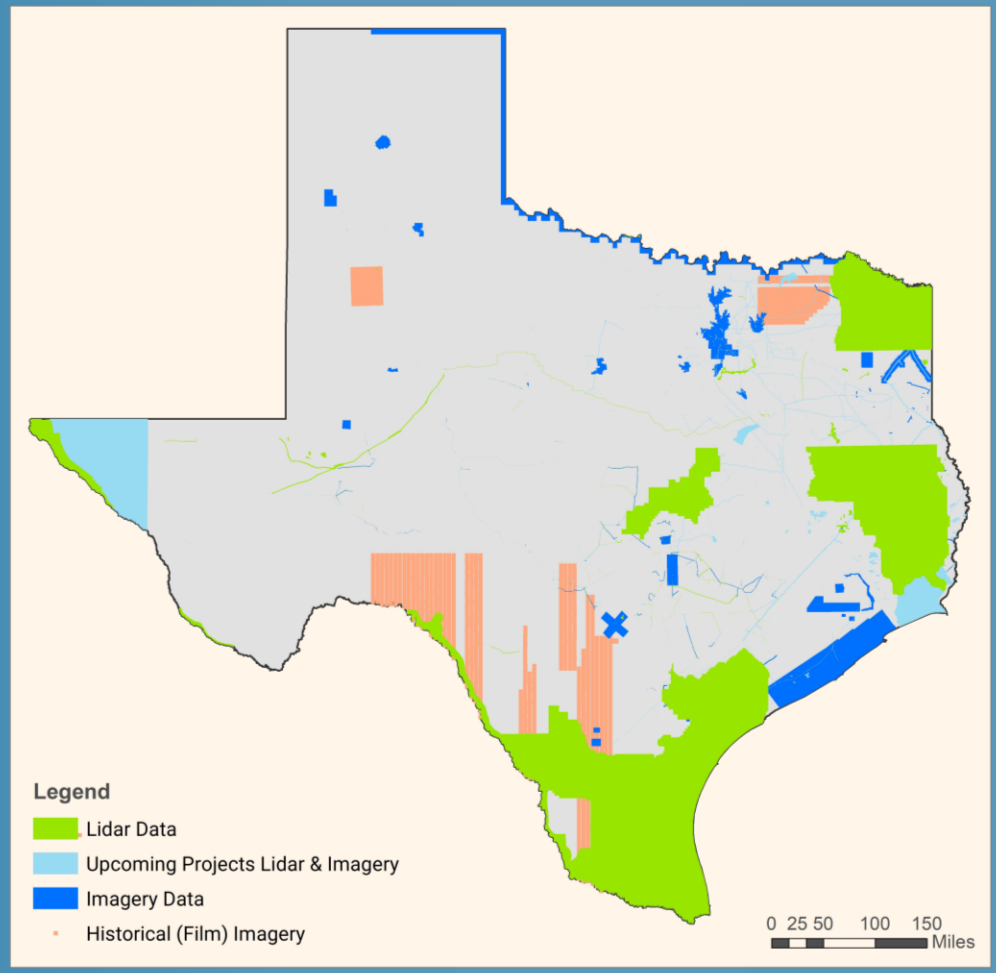
WHO WE SERVE

State & Regional

Federal

Commercial

Texas Mapping Experience

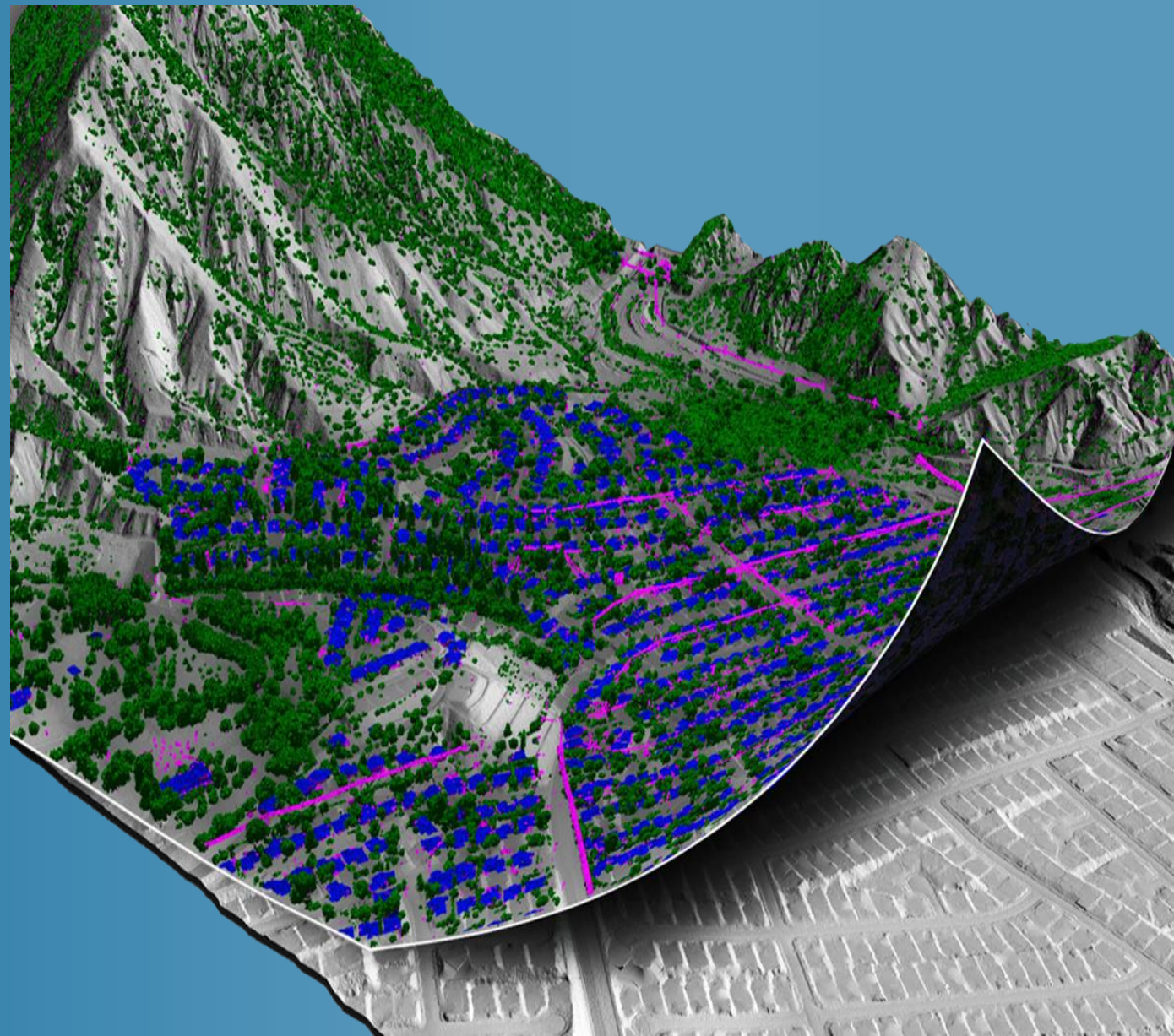


- 20+ Years in Texas
- TWDB, TXDOT, FEMA, the USGS, LCRA, ONCOR, NCTCOG and numerous engineering consultants,
- 40,000+ square miles of lidar data.
- Current project for TWDB, USGS, and NCTCOG

Presentation Goals

- To get you thinking about:

- Possible use cases you may not have considered
- What problems lidar can help you solve
- How it might inform discission making in your community or organization
- How it could make your life easier
- How you can collectively maximize the value of the project



Lidar

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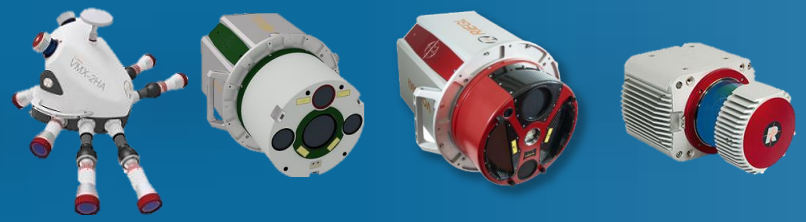
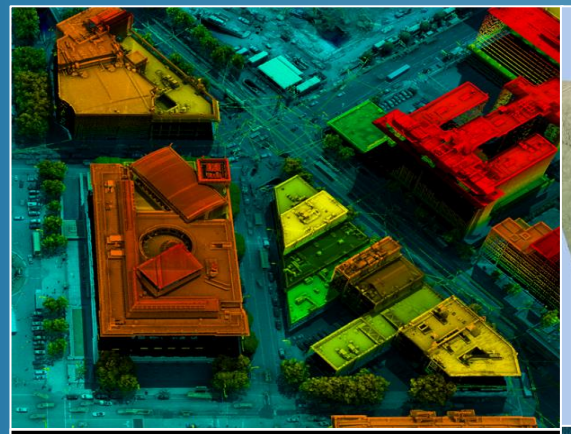
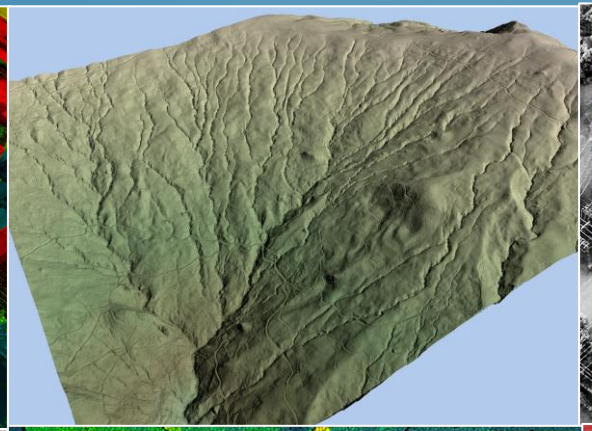
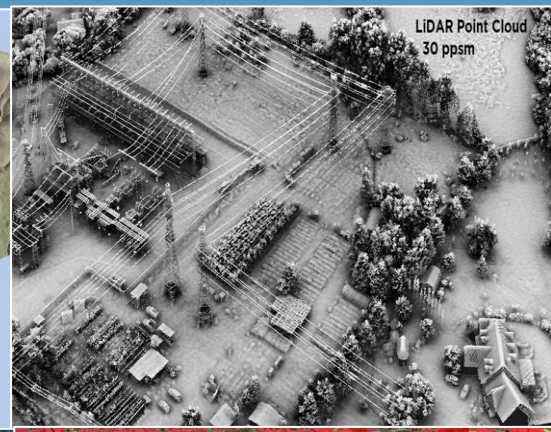
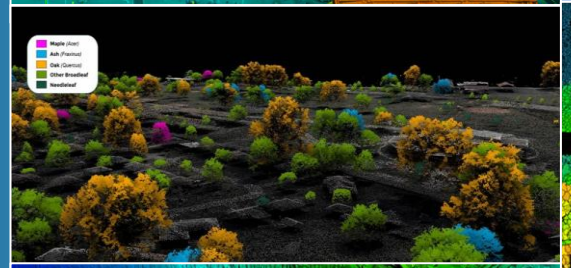
- Lidar, which stands for Light Detection and Ranging, is a remote sensing method that uses light in the form of a pulsed laser to measure ranges (variable distances) to the Earth. These light pulses—combined with other data recorded by the airborne system — generate precise, three-dimensional information about the shape of the Earth and its surface characteristics

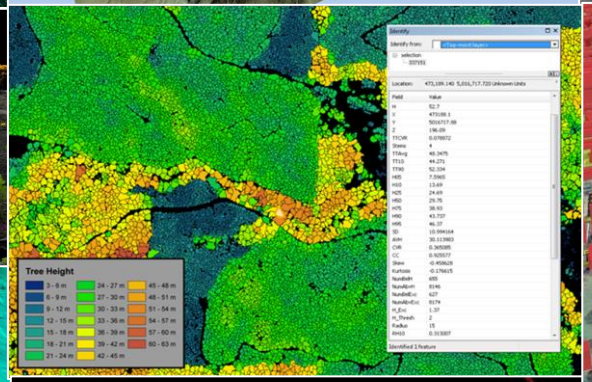


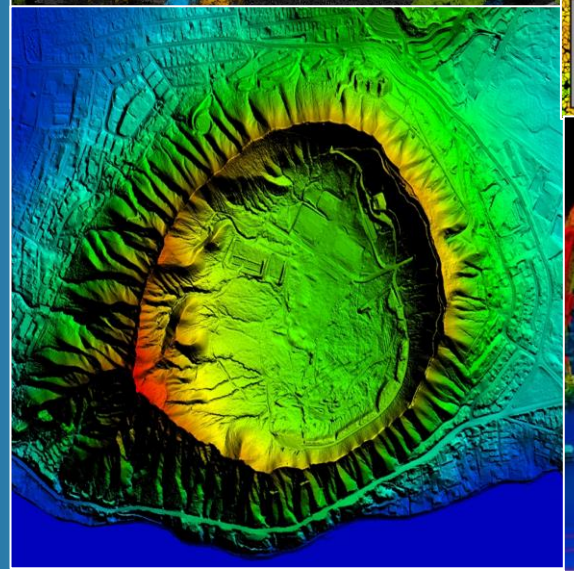


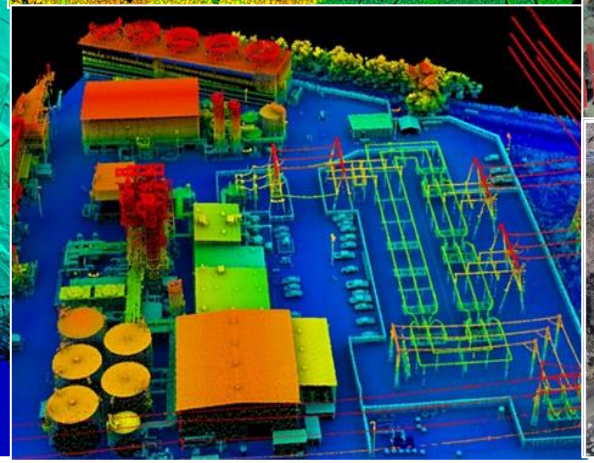












Point Density

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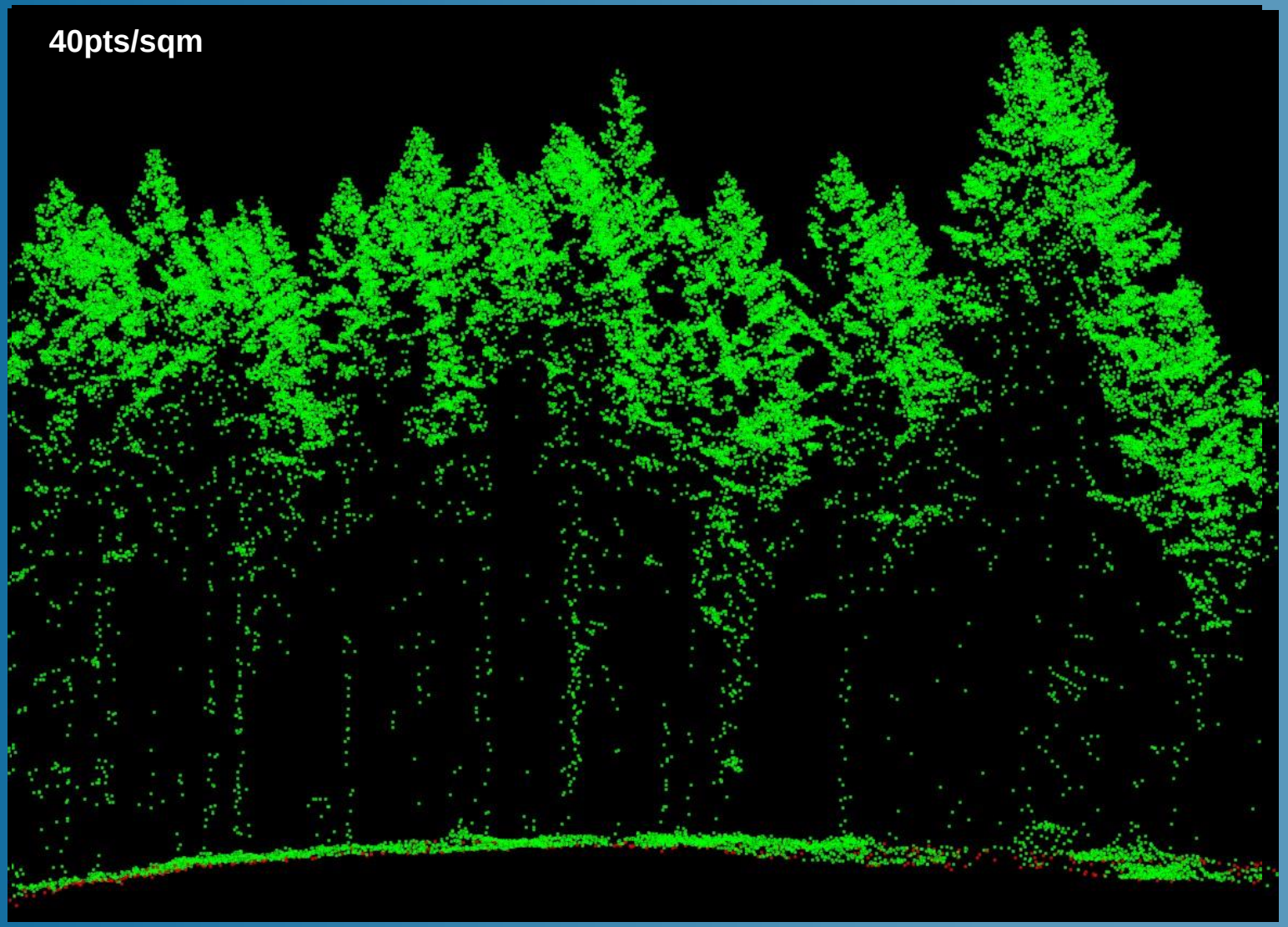


Standards

- USGS
- ASPRS
- Client

USGS Compliant

Point Cloud is classified to:

- Class 1 - Processed, but unclassified
- Class 2 - Bare-earth ground
- Class 7 - Low Noise
- Class 9 - Water
- Class 17 - Bridge Decks
- Class 18 - High Noise
- Class 20 - Ignored Ground
- Class 21 - Snow
- Class 22 - Temporal exclusion

Common Expanded Classifications

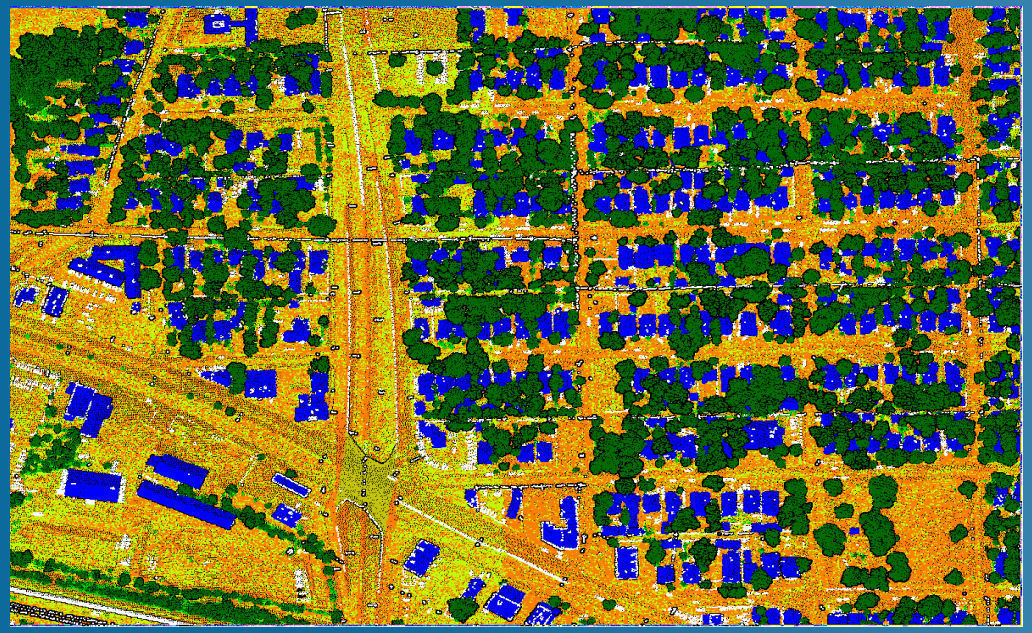
Further classification, in addition to Base:

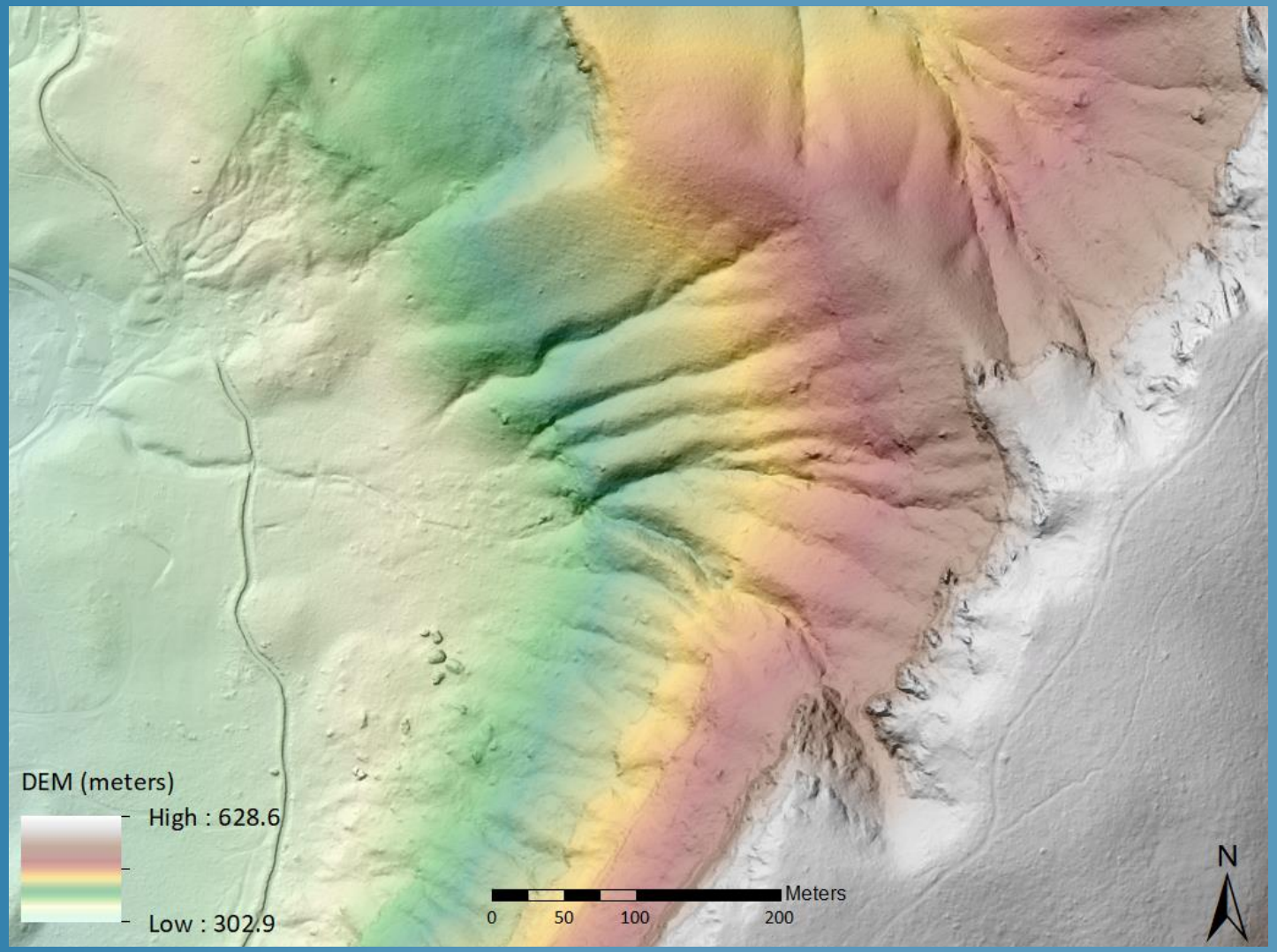
- Class 3 - Low vegetation
- Class 4 - Mid vegetation
- Class 5 - High vegetation
- Class 6 - Buildings
- Class 14 -Culverts

Deliverables	Format
Classified Point Cloud (Tiled)	Fully compliant LAS v1.4 using the following Classification Scheme: Class-1: Processed but unclassified Class-2: Ground Class-7: Low Noise Class-9: Water Class-17: Bridge Decks Class-18: High Noise Class-20: Ignored Ground (break line proximity) Class 21: Snow (where reliably identified) Class 22: Temporal Exclusion (typically non-favored data in intertidal zones)
Bare Earth Surface (Raster DEM)	Hydro-flattened and delivered in GeoTIFF format, Cell Size no greater than 0.5 for QL1, and no less than the design Aggregate Nominal Pulse Spacing (ANPS).
Hydro Breaklines	Developed to support hydro-flattening and bridge conditioning delivered in ESRI file geodatabase formats, as PolylineZ and PolygonZ feature classes, as appropriate to the type of feature represented and the methodology used by NV5 Geosptial
Height Separation Rasters	GeoTIFF format representing the interswath alignment between flight lines and provides a qualitative evaluation of the positional quality of the point cloud.
Project Vectors (project area, LAS tiling scheme, GRID tiling scheme, etc.)	Esri Feature Class in File Geodatabase
Intensity Image (Tiled)	Cell size will be 1 meters in GeoTIFF format tiled to match the Classified LAS and DEMs.
Metadata	Ancillary products used in processing (ie Tile Index) Lidar Mapping Reports Flight Index (geodatabase format) Ground Survey Reports with control points and checkpoints Product Metadata (USGS/FGDC compliant)
Control points	Control Survey Reports, excel and shape files of all control (both supplemental and QA (NVA/VVA) points
Project Reports	PDF

Point Clouds and Digital Elevation Model – DEMs

- DEM -Elevation model derived from ground returns – CAD and GIS
- Point Cloud – LAS/LAZ files – CAD and GIS





Use Cases

Engineering and Infrastructure

- Preliminary engineering and estimate development,
- Infrastructure site analysis and selection
- Hydraulic and hydrologic modeling
- Permit application and construction plan development
- Dam, levee, and coastal-structure failure modeling and mitigation
- Cut-and-fill estimates
- Transportation route and utility surveys and corridor mapping
- Terrain and other obstruction identification for aviation

Flood Risk Management

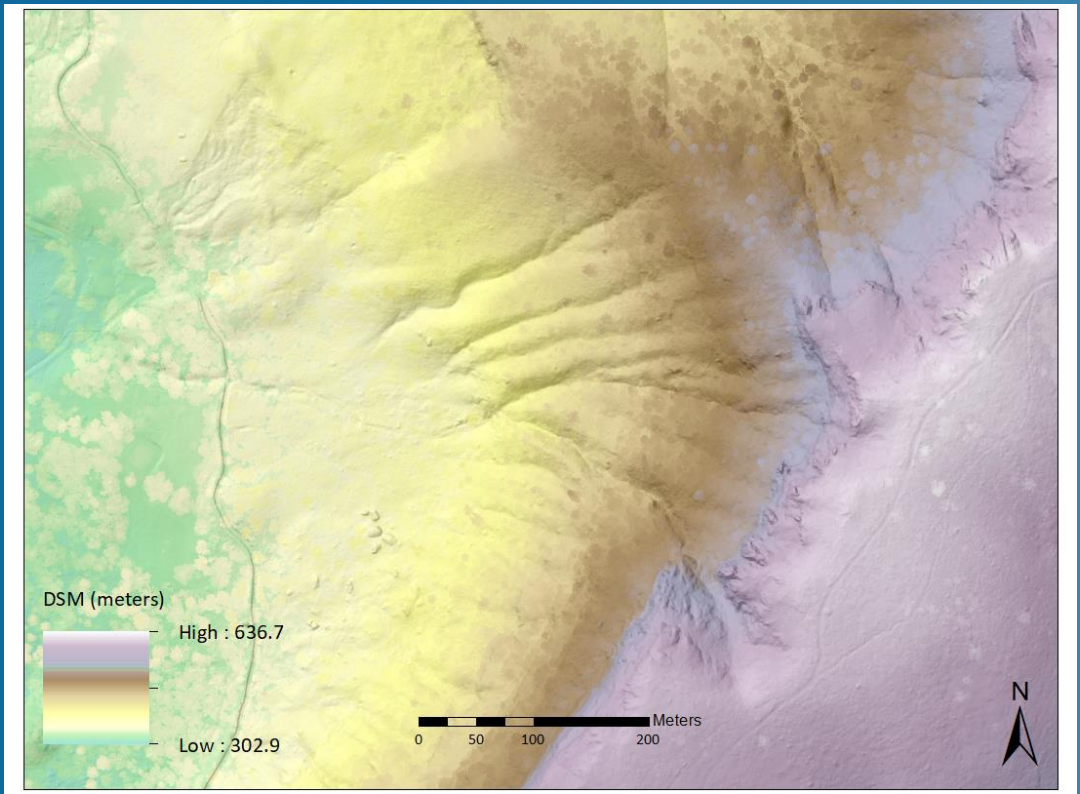
- Higher quality flood maps, including Flood Insurance Rate Maps
- Dam and levee safety programs to reduce flood risks
- Improve State and local flood risk management and response
- Improve storm water facilities and structure design

Other Uses

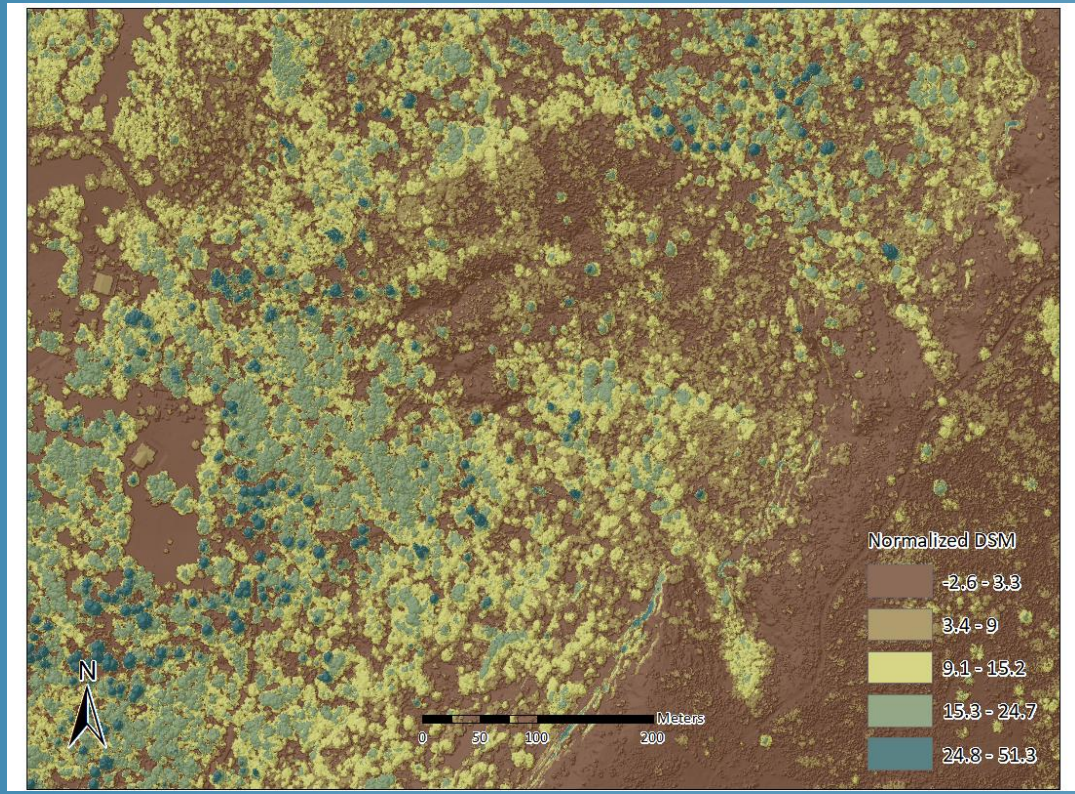
- Forestry/Vegetation Management
- Geologic Resource Assessment
- Feature Extraction
- Habitat Assessment and Restoration
- Land Use Land Class Mapping
- Evaluations of geologic, coastal, and other natural hazards, and geotechnical evaluations
- Fire Mitigation
- Emergency Management and Response

Additional Surface Models

Elevation model of ‘upper surface’ derived from first returns, all above-ground features retained (trees, buildings, etc.)



DSM with heights from ground as zero (DSM minus bare earth DEM) “Canopy Height Model” if Expanded Point Classification



Additional Surface Models

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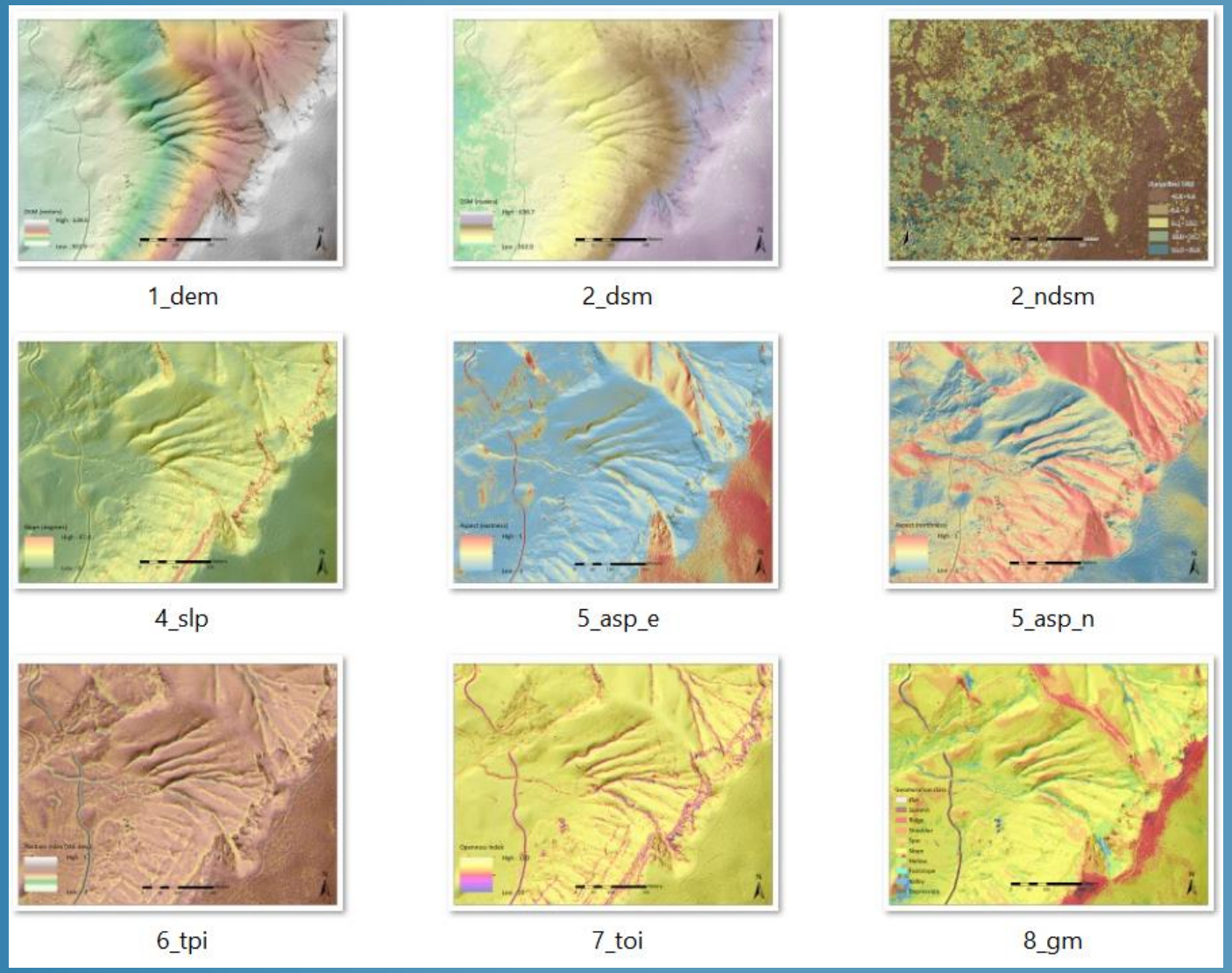
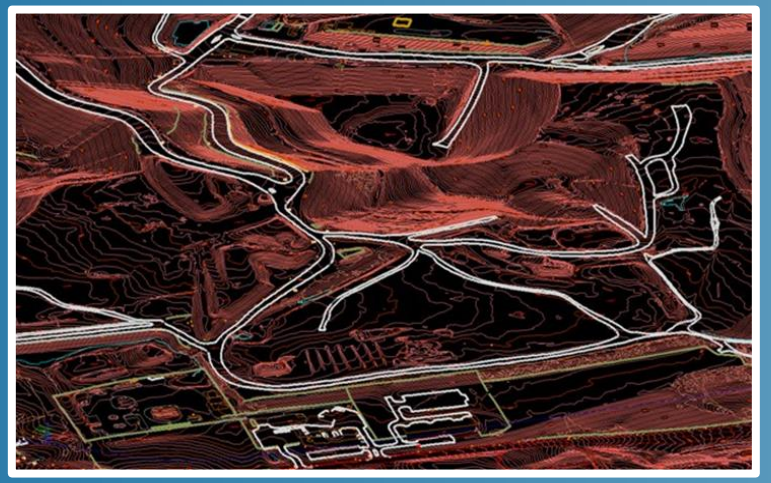
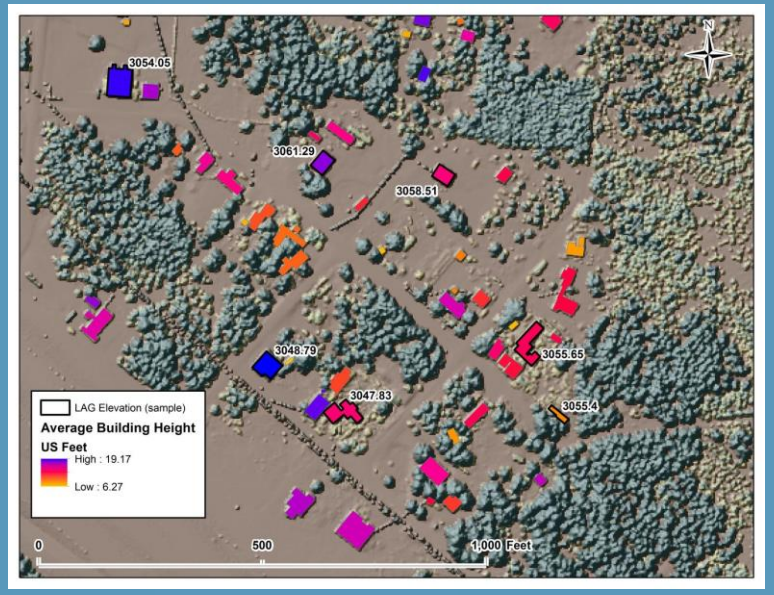
- Additional layers Can be generated
  - Provide high resolution information on ground surface - Slope, Aspect, Topographic Position, Topographic Openness, Geomorphon Class (peaks, pits, slopes, ridges, valleys)
  - Informs drainage, vegetation community, solar exposure, fire behavior
  - Aid in detection of roads, bridges, ditches/canals, drainage areas
  - Provide context describing relationship to surrounding terrain

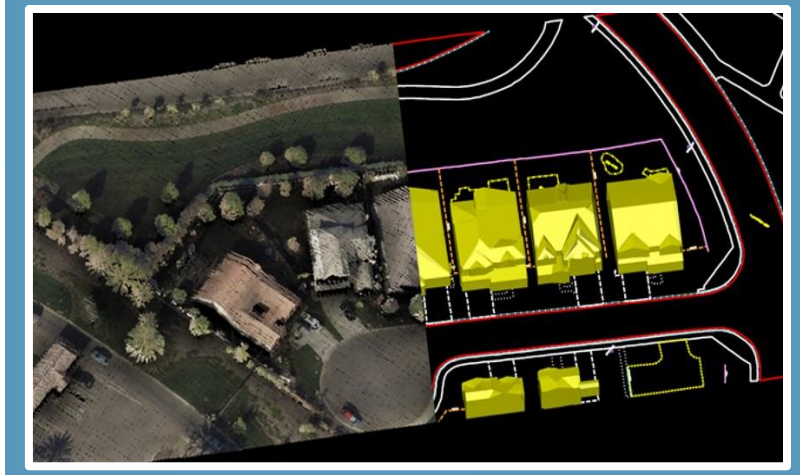


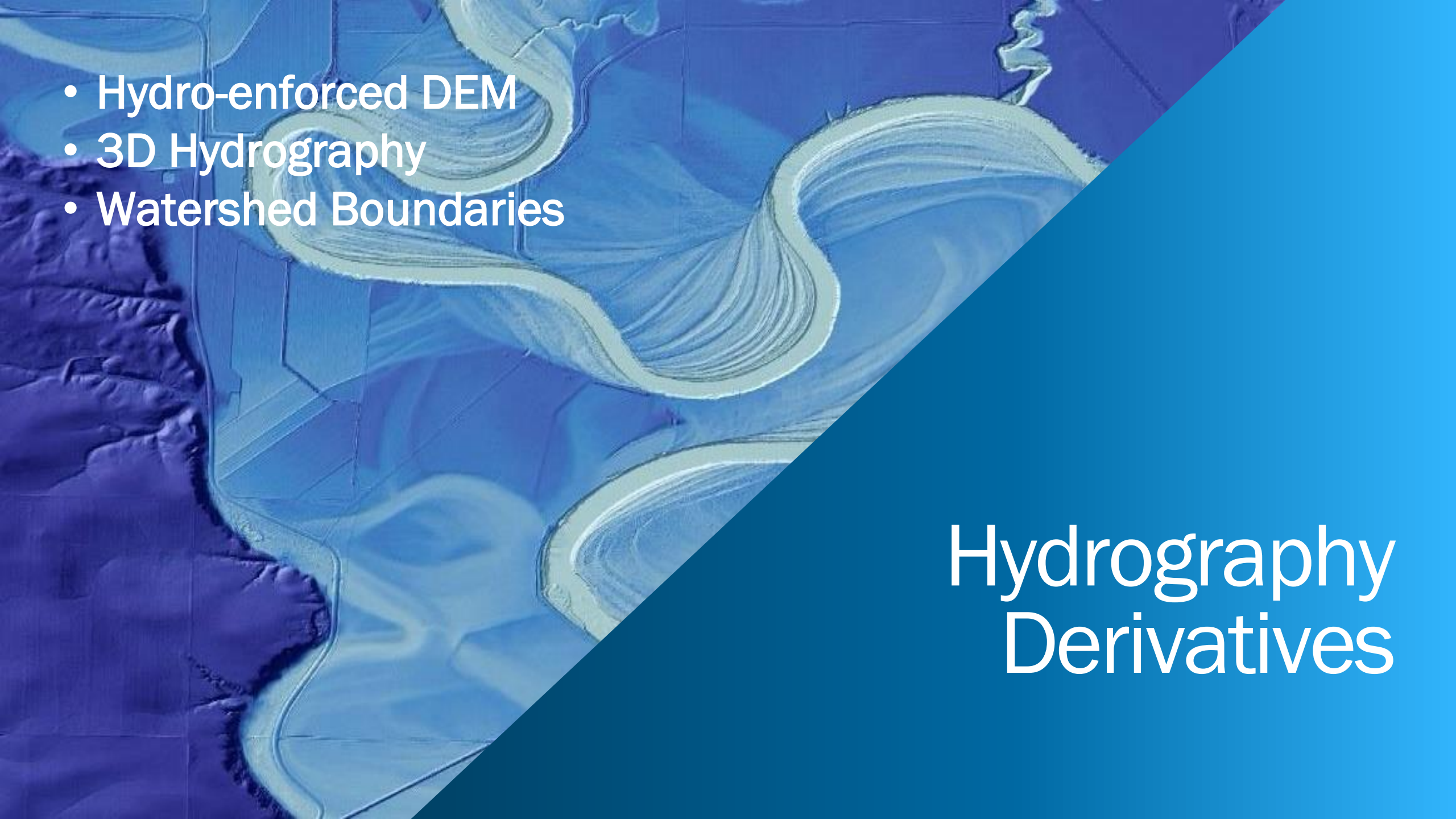
Contours, Building Footprints, Planimetric mapping

- Contours
- Automated building delineation w/manual clean up
- 3D Planimetric Mapping – dependent on point density can be done in conjunction with imagery







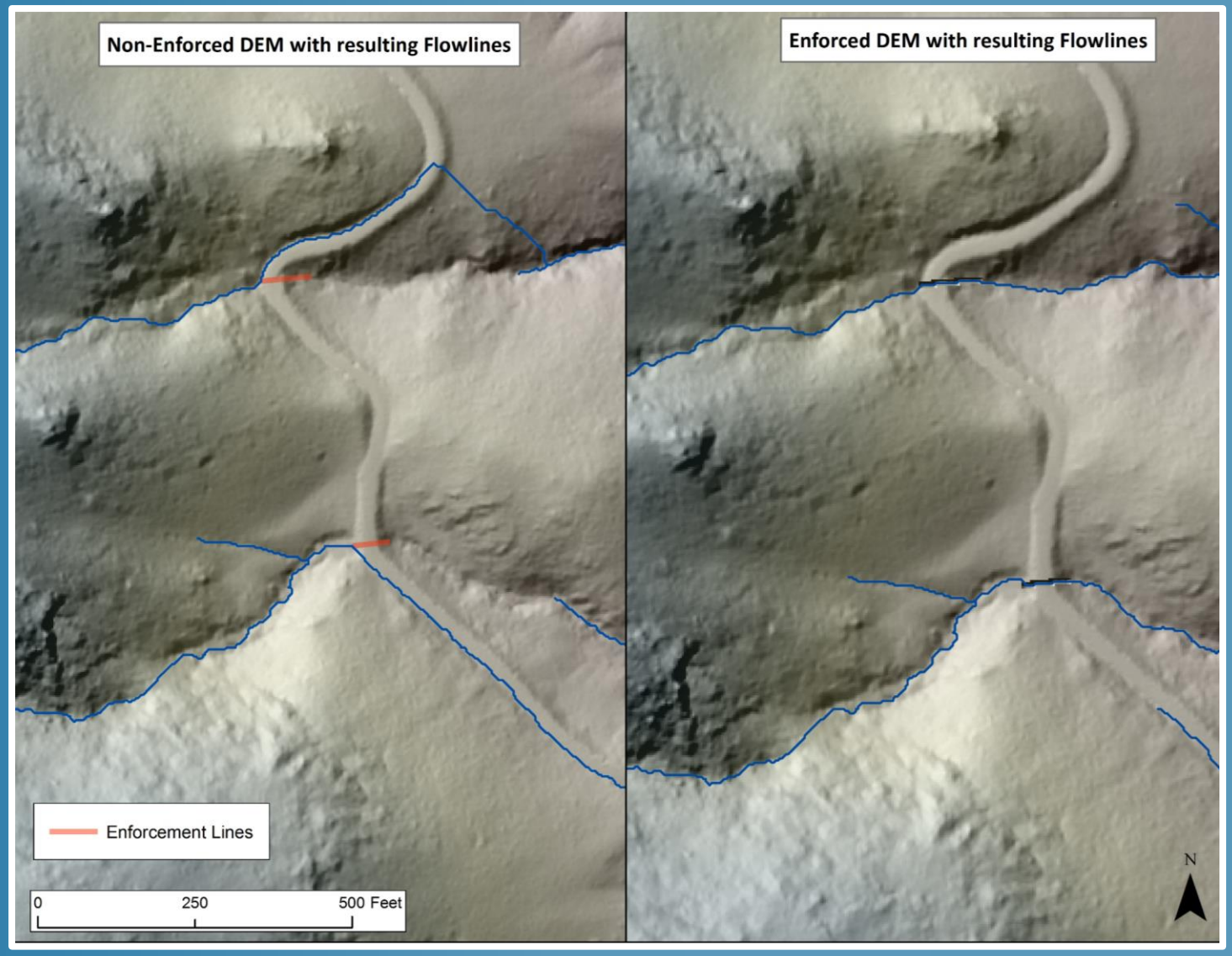


- Hydro-enforced DEM
- 3D Hydrography
- Watershed Boundaries

Hydrography Derivatives

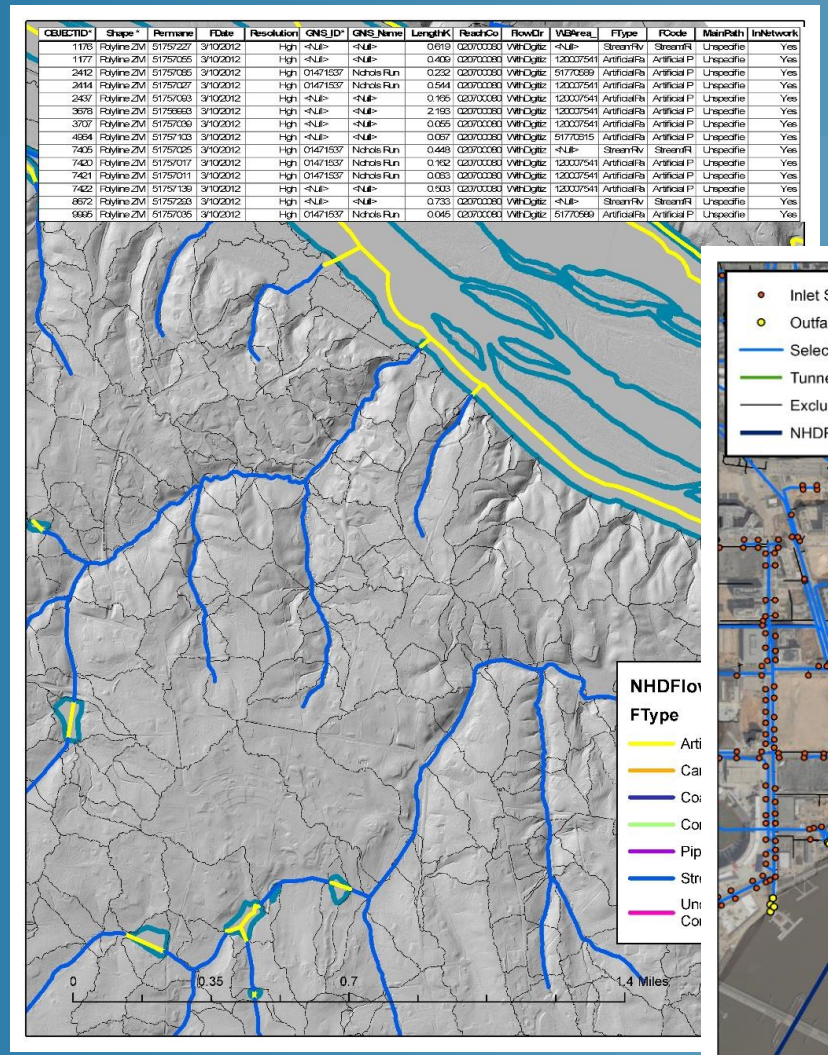
Hydro-enforced DEM

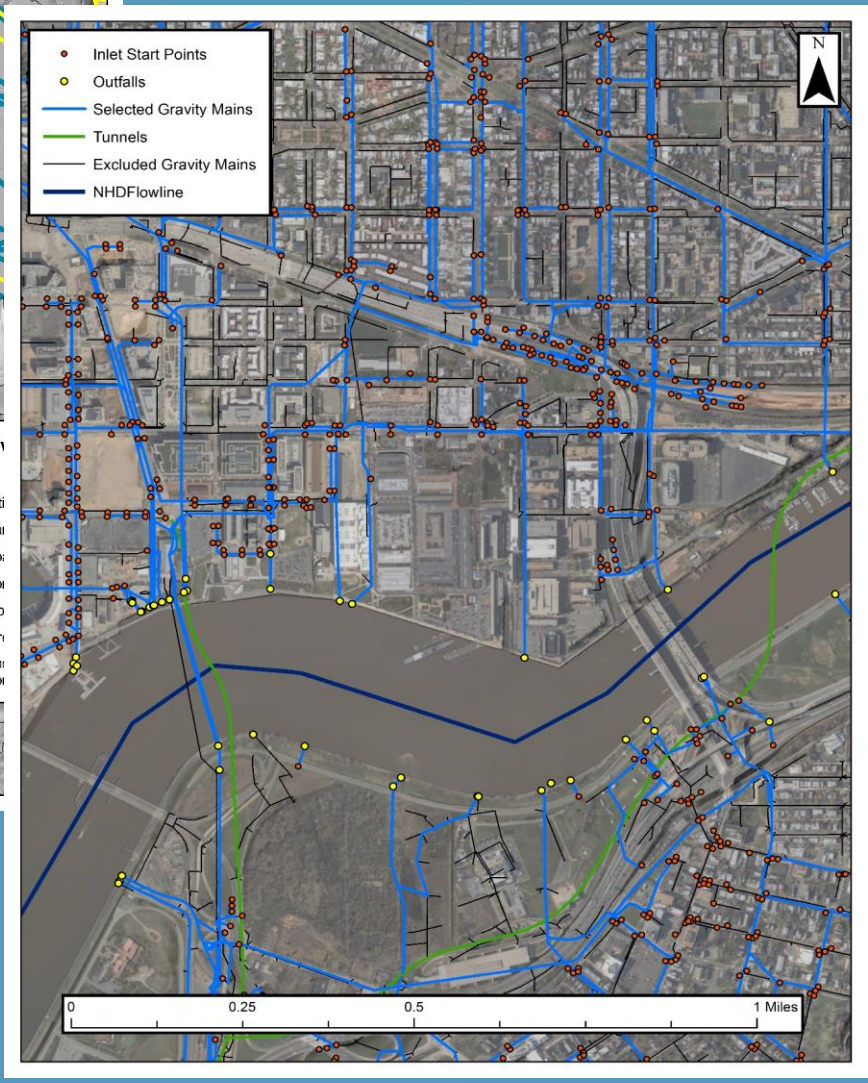
- DEM on which the hydrography is delineated, removing false blockages and filling sinks
- Iterative process to remove false obstruction to flow.
- Enforce known culverts
- Identify unmapped road crossings
- Each enforcement classified as culvert (including “false” culverts)



3D Hydrography

- Elevation Derived Hydrography Network
- Delineation of ponds, lakes, rivers, and streams
- Stream and river flowlines refined to the USGS 3D hydrology program specifications including conflated attribution
- Standardized Authoritative Hydrography Dataset
- Can be integrated with stormwater network.





Watershed Boundaries

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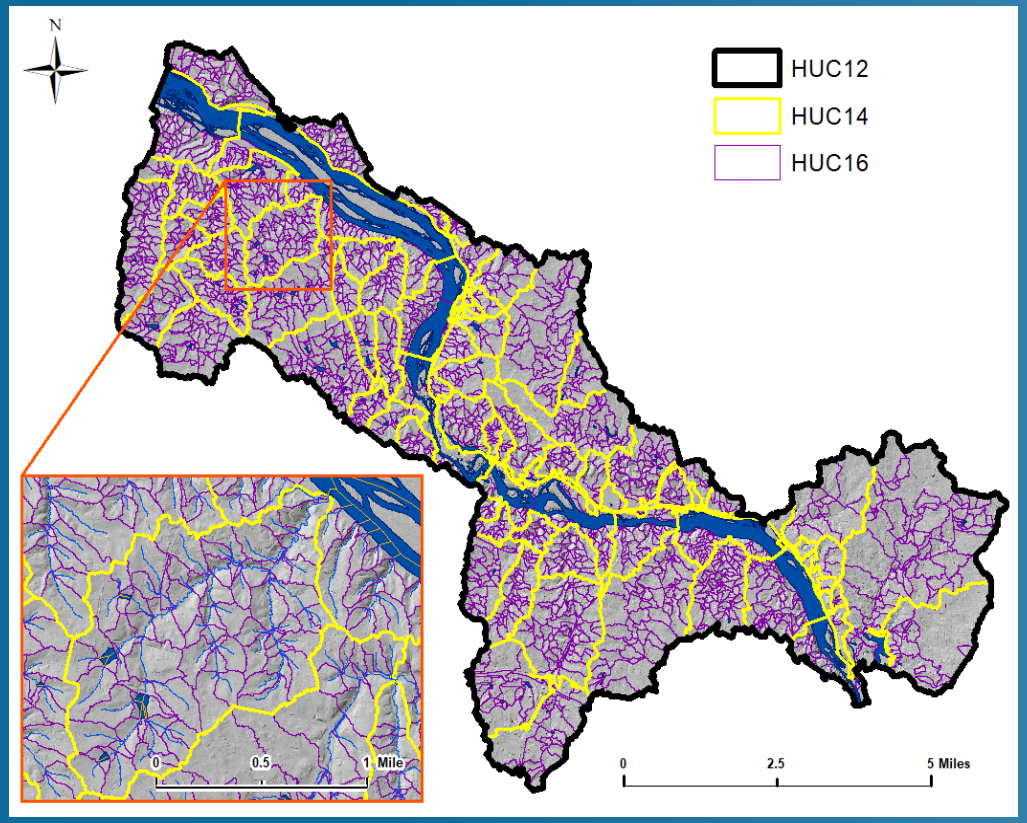
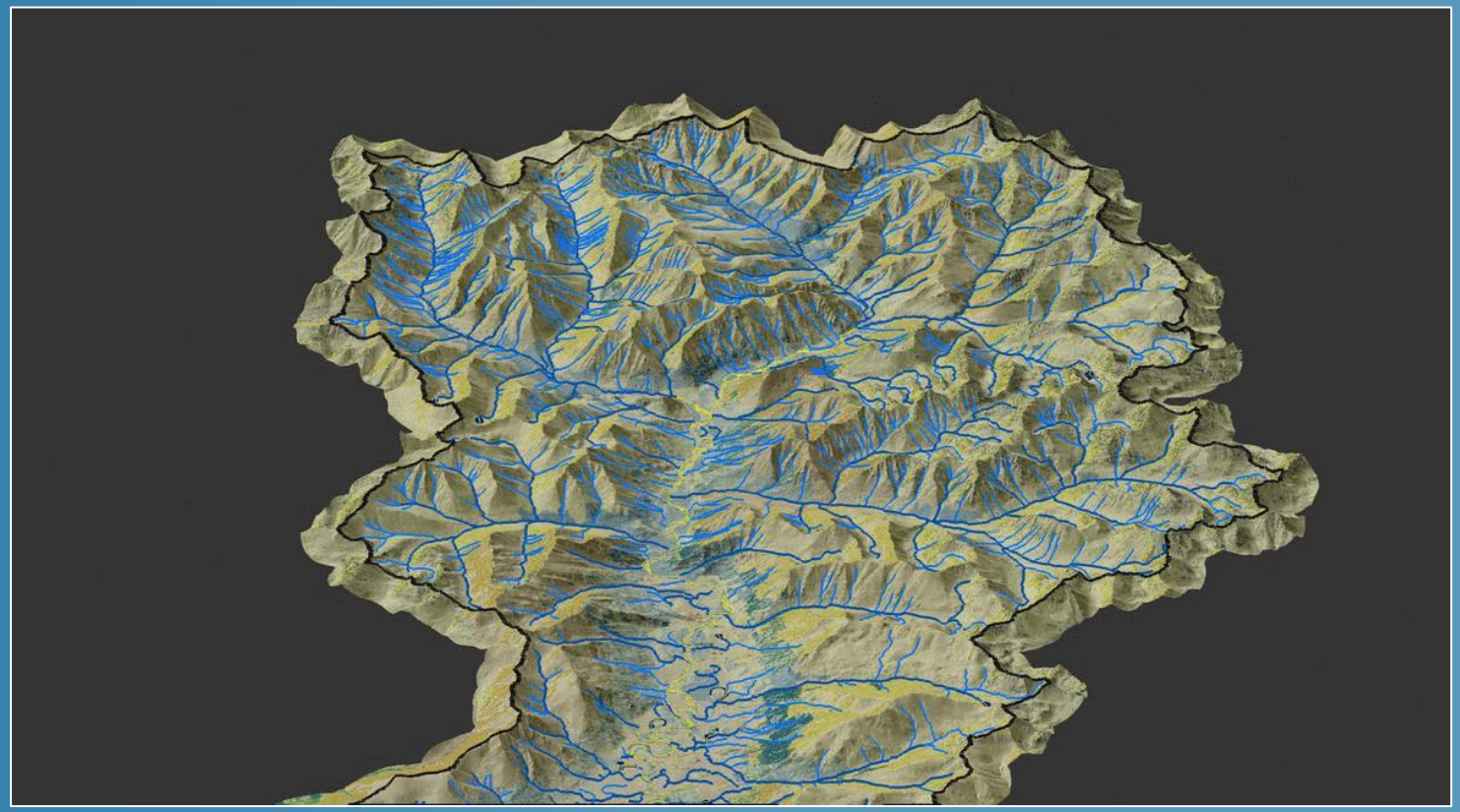
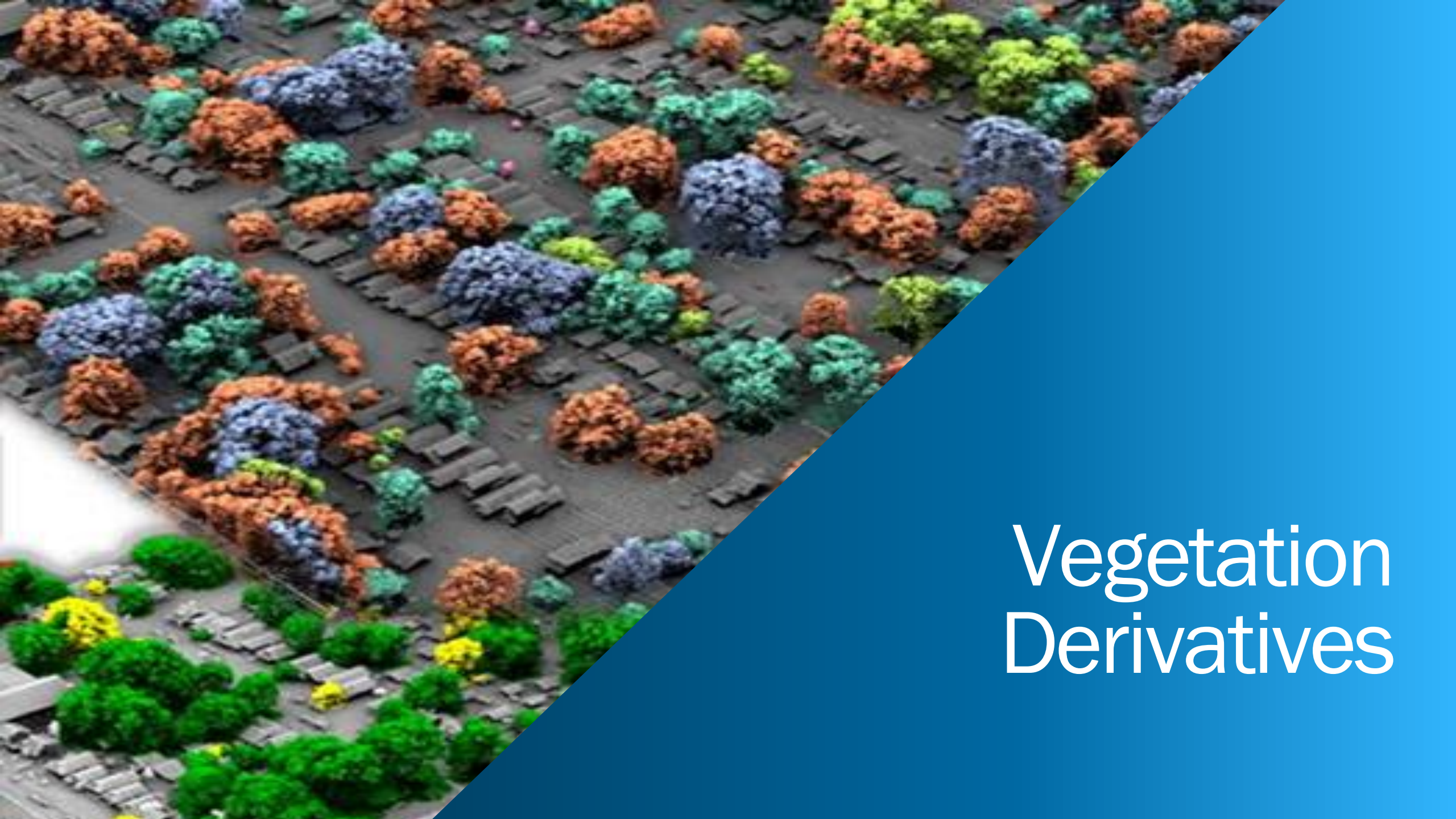
- Hydrologic Units (or basins) delineated from lidar elevation models.
- Defines catchments for consolidation of precipitation into flow paths.
- Can be generated at any scale relevant to application.



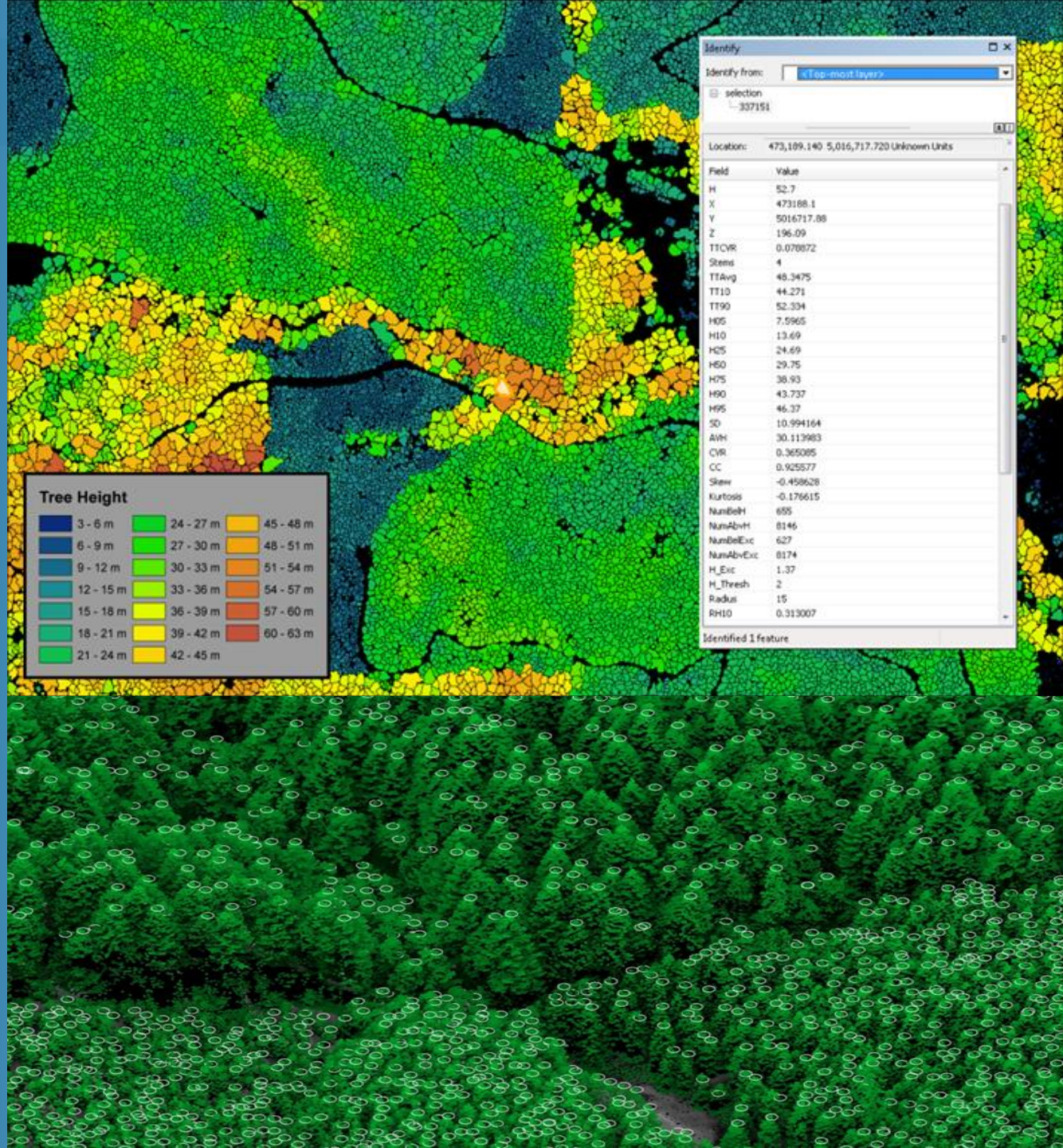




Vegetation Derivatives

Individual Tree Statistics

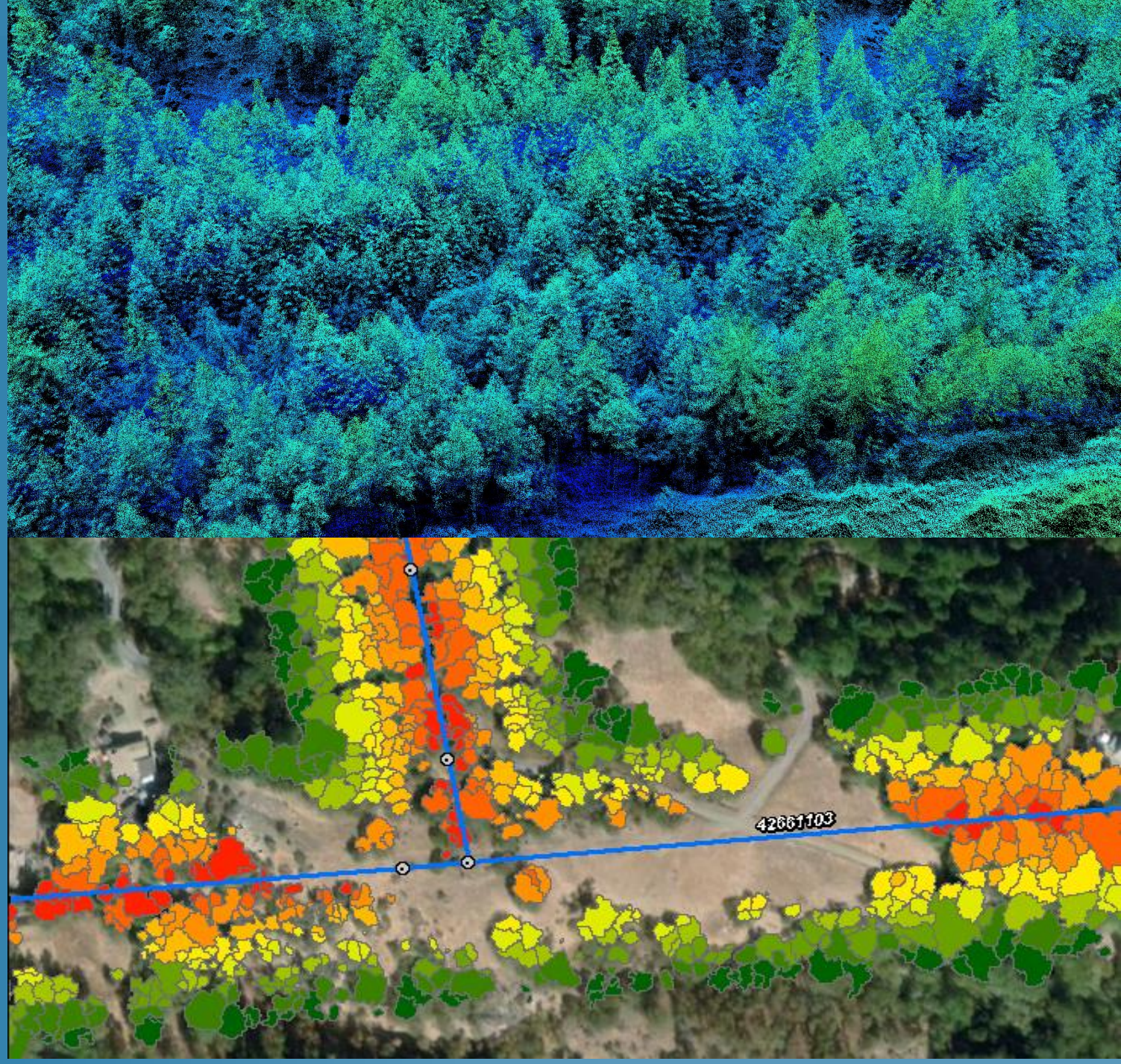
- Canopy Height
- Percent Canopy Cover
- Height Distributions
- Tree Top Locations with associated LiDAR derived and modeled metrics
- Board Feet
- Biomass
- Stems per acre Basal Area
- Mean Height
- Quadratic Mean DBH
- Tree health
- Species



Fire Risk

LiDAR will improve wildfire fuel characterization provides:

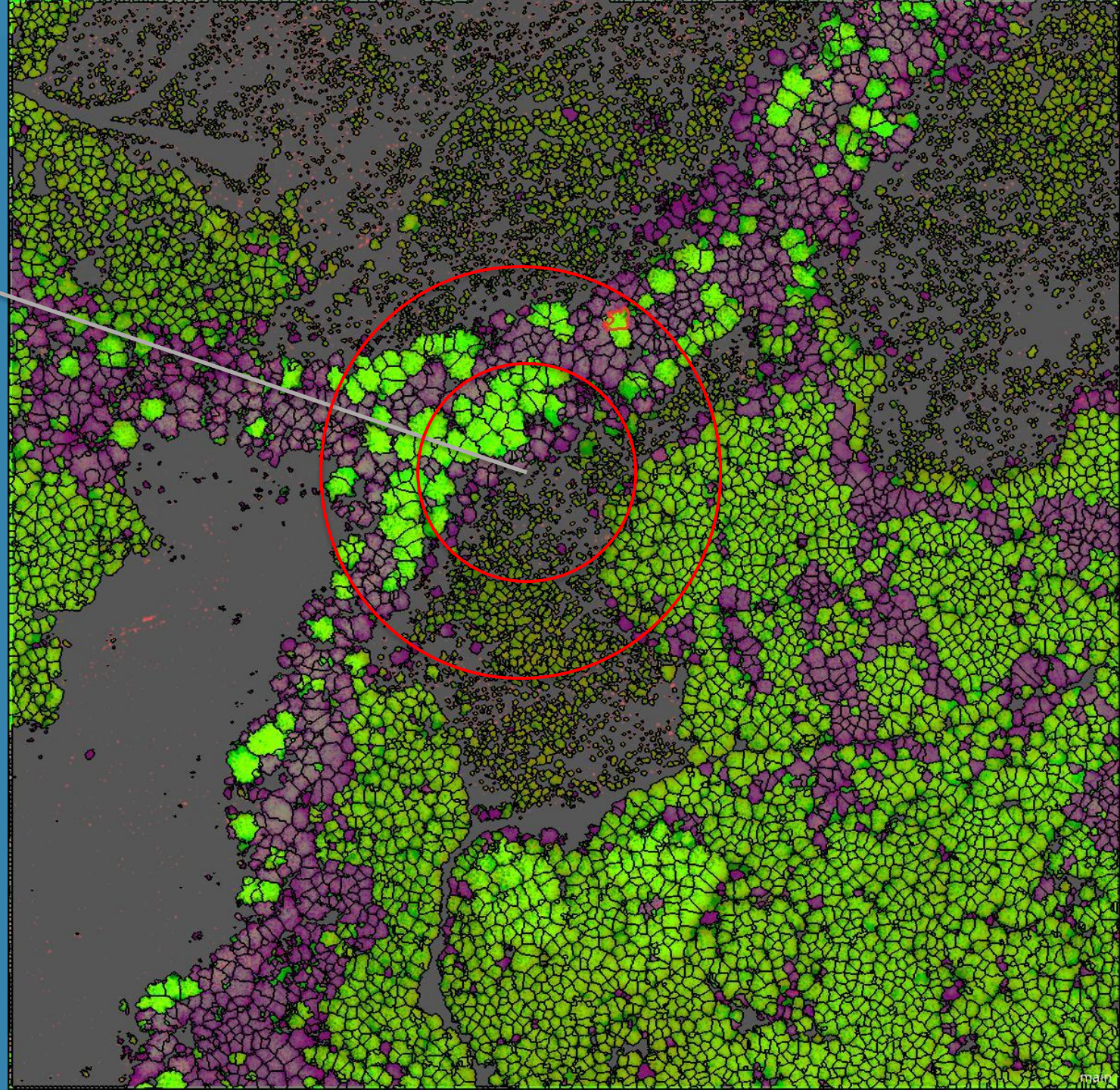
- Canopy height
- Canopy bulk density
- Canopy base height
- Canopy closure
- Ladder fuels
- Ground debris/understory
- Supports local scale fire risk assessment



Wildlife Habitat

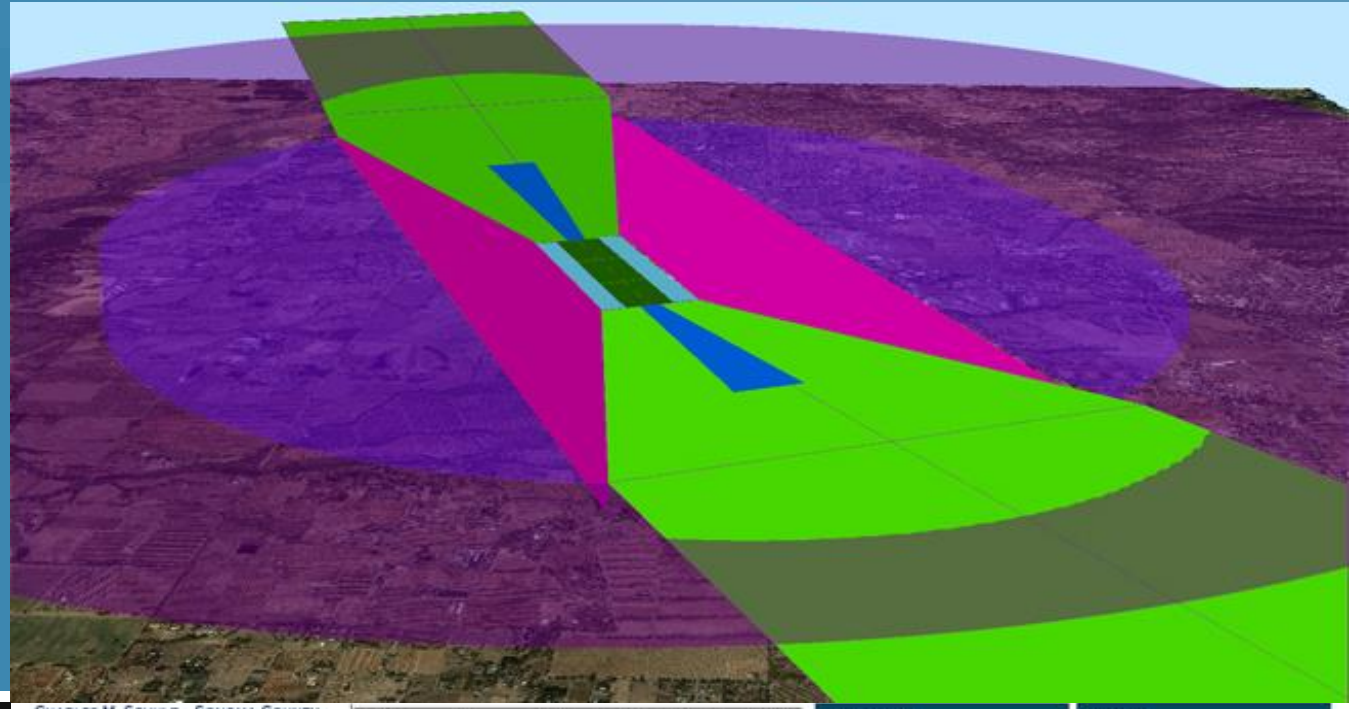
Proximity:
- Water: *5 m*
- *Road:* *147 m*
- Patch edge: *32 m*
- Mature forest: *0 m*

Neighborhoods:
- # of snags: *9*
- *% conifer:* *45*
- *% early seral:* *57*



Airport Obstruction Analysis

- Identify obstruction hazards and facilitate vegetation management by modeling flight paths and vegetation in 3D with LiDAR
- Develop custom reports, visualizations, and



CHARLES M. SCHULZ – SONOMA COUNTY AIRPORT KSTS
SANTA ROSA, CA
PARCEL: 164-150-025

LAND OWNER: JOHN SMITH
ADDRESS: 1480 SANDERS ROAD
ACRES: 10.07
GROUND ELEVATION: 170.7 FT
LATITUDE: 38.520017
LONGITUDE: -122.806891
NUMBER OF OBSTRUCTIONS: 13
TREES: 13
STRUCTURES: 0
GROUND: 0

TREE ID	LAT	LONG	HEIGHT	SURFACE	HEIGHT ABOVE SURFACE
T31041	38.520632	-122.807147	82.92	VGAS 19	9.76
T31042	38.520459	-122.807122	77.41	VGAS 19	6.16
T31046	38.520828	-122.806673	74.88	VGAS 19	3.40
T31052	38.520204	-122.806633	69.93	VGAS 19	2.36
T31053	38.519984	-122.806321	68.78	VGAS 19	1.03
T31055	38.520728	-122.807121	67.63	VGAS 19	1.67
T31071	38.520821	-122.807289	57.37	VGPS 19	0.80
T31102	38.520807	-122.807386	47.79	VGPS 19	4.27
T31208	38.520835	-122.807187	29.42	VGPS 19	7.26
T31224	38.520861	-122.807203	28.47	VGPS 19	-3.23
T31309	38.520806	-122.807189	183.59	VGPS 19	-3.01
T31647	38.518518	-122.806875	183.22	VGAS 19	6.99
T31695	38.519110	-122.806326	172.36	VGAS 19	0.61

*NEGATIVE VALUES ARE BELOW SURFACE

DIRECTIONS

Begin route from Sonoma County Airport
1. Head East on Airport Blvd
2. Turn Right to stay on Airport Blvd
3. Turn Left onto Skylane Blvd
4. Turn Left onto Shiloh Rd
5. Turn Left onto Day Rd
6. Turn Left onto Sanders Rd

Parcel will be on the Right

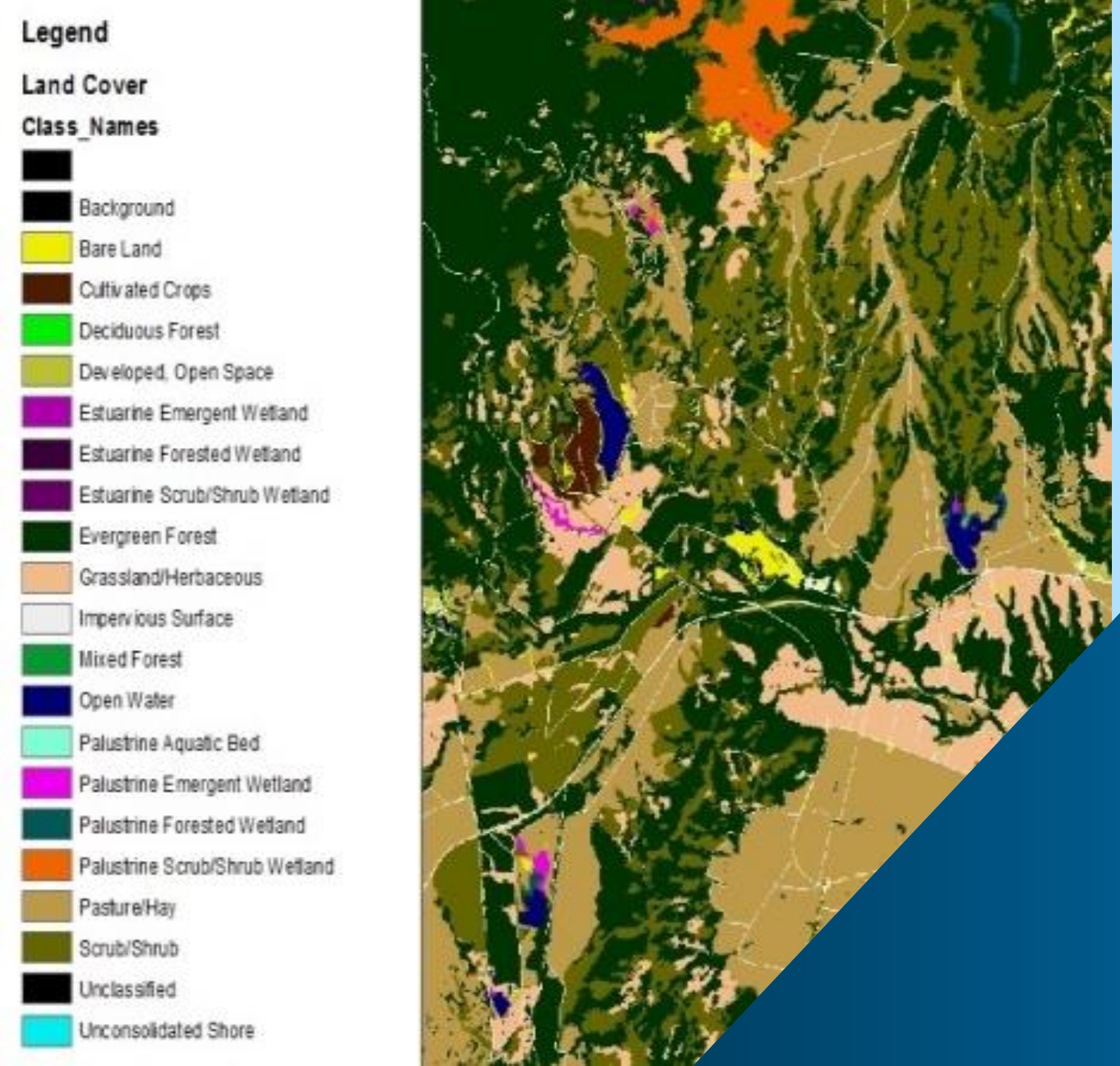
LEGEND

Overview
Parcel 164-150-025
Runway Surfaces: 01-19
Runway Surfaces: 14-32
Planview
Parcels
Parcel 164-150-025
0-6ft Below Surface
Tree Obstructions
Surface Obstructions 01-19
VGPS
VGAS
Surface Obstructions 14-32
VGATS
Oblique View
Above Surface Obstructions
0-6ft Below Surface

OVERVIEW OF PARCEL LOCATION

PLANVIEW OF OBSTRUCTIONS

OBLIQUE VIEW OF OBSTRUCTIONS

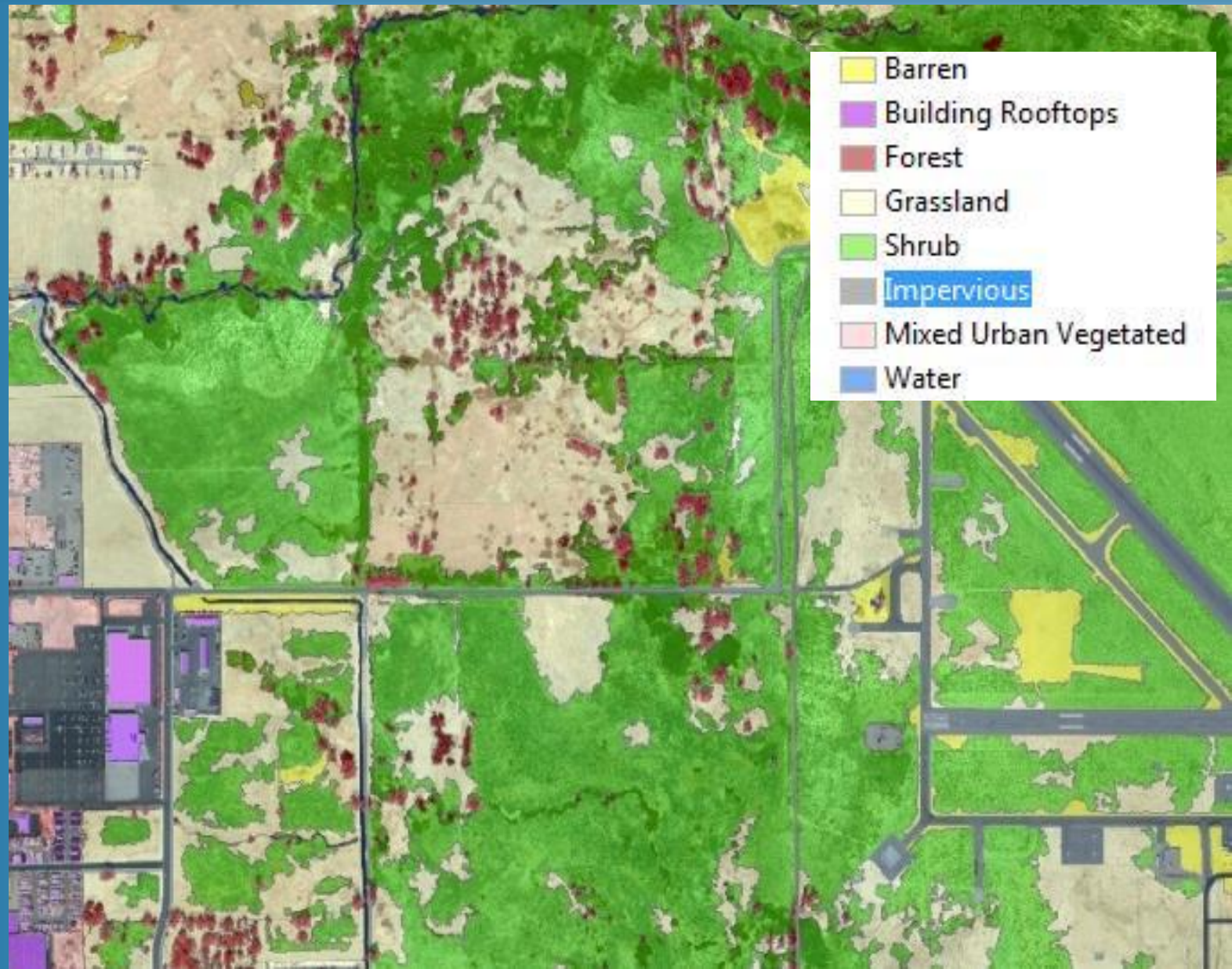


Land Cover Land Use Metrics

- Land Use Land Class
- Impervious Surface
- Irrigated Land Use

Land Cover and Land Use

- Water quality and water quantity in a watershed are determined by the land cover and how that land is used
- Land cover programs covers a large range of datasets
- Requires multispectral imagery



Impervious Surface Mapping

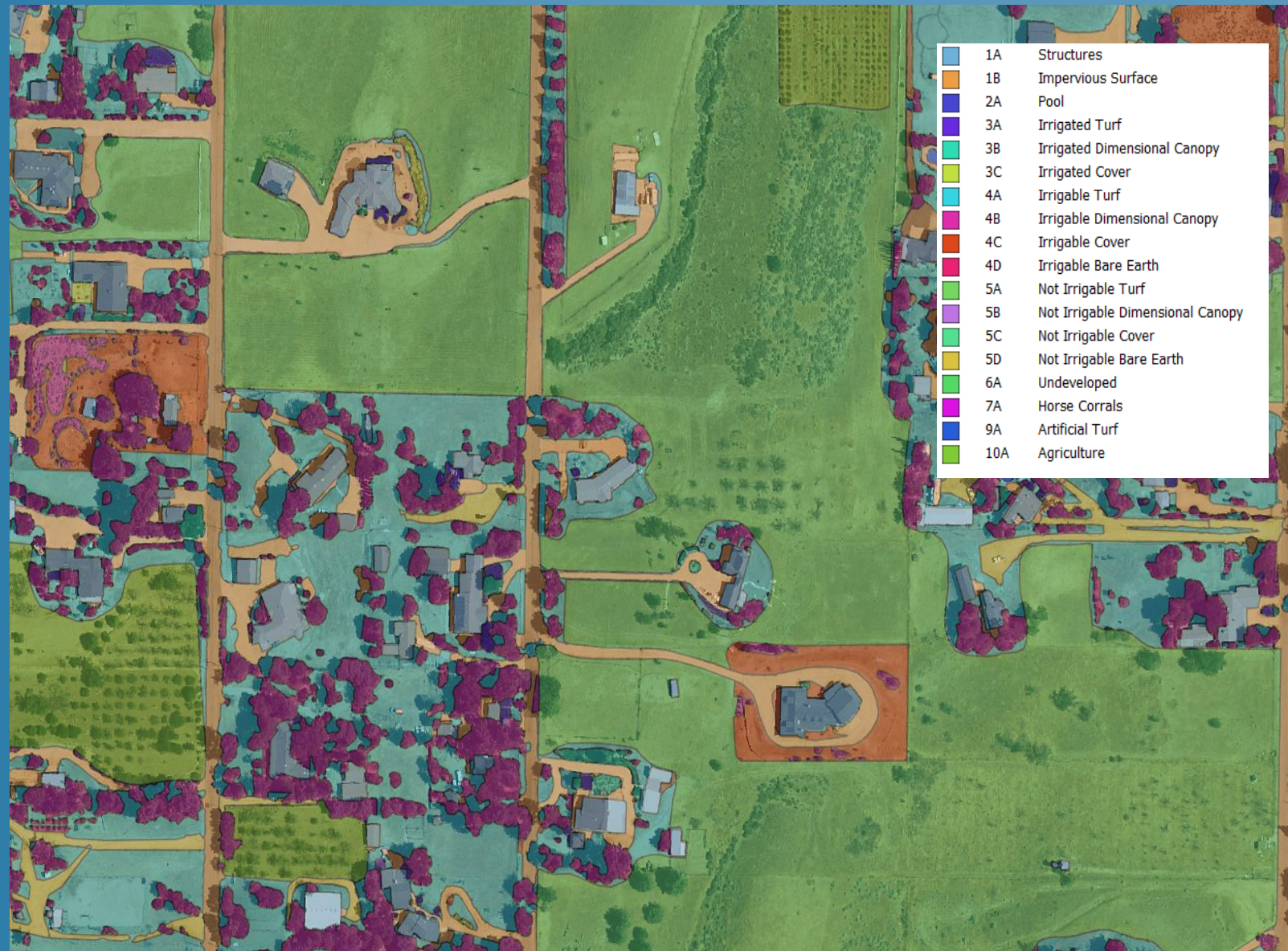
NV5 GEOSPATIAL

- Impervious is generated through semi-automated methods
- Some cities, counties, and states are funding their stormwater costs through a use fee
- Supports planning
- Storm water runoff analysis

Irrigated Landscape

NV5 GEOSPATIAL

- Some states, cities, and water districts have a need to set a baseline for the amount of water allowed for outdoor irrigation
- Using object based classification to classify the land cover and then model the irrigation land use



Use Cases

Engineering and Infrastructure

- Preliminary engineering and estimate development,
- Infrastructure site analysis and selection
- Hydraulic and hydrologic modeling
- Permit application and construction plan development
- Dam, levee, and coastal-structure failure modeling and mitigation
- Cut-and-fill estimates
- Transportation route and utility surveys and corridor mapping
- Terrain and other obstruction identification for aviation

Flood Risk Management

- Higher quality flood maps, including Flood Insurance Rate Maps
- Dam and levee safety programs to reduce flood risks
- Improve State and local flood risk management and response
- Improve storm water facilities and structure design

Other Uses

- Forestry/Vegetation Management
- Geologic Resource Assessment
- Feature Extraction
- Habitat Assessment and Restoration
- Land Use Land Class Mapping
- Evaluations of geologic, coastal, and other natural hazards, and geotechnical evaluations
- Fire Mitigation
- Emergency Management and Response

Thank You!
Jason Nyberg
Account Manager Mountain Region
Jason.Nyberg@NV5.com
512-547-7349
NV5 GEOSPATIAL