



sanborn

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# Using Lidar and Multispectral Aerial Imagery for Wildfire Support and Recovery

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**For the Attention of:**  
Santa Clara County GIS Day  
November 2<sup>nd</sup>, 2022



**Presented by:**  
Jason Caldwell, VP of Business Development and Sales

# AGENDA



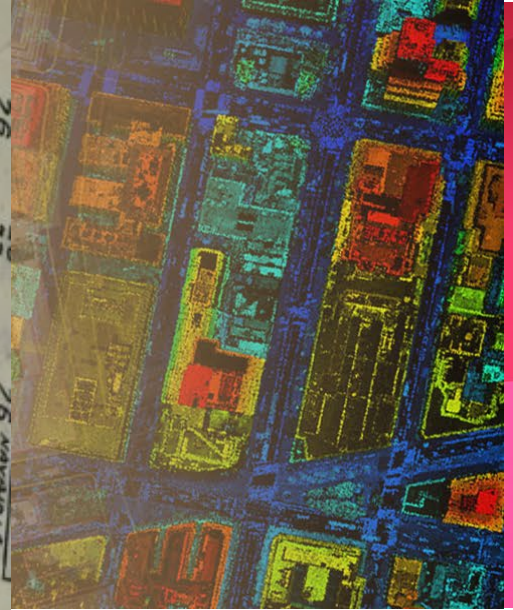
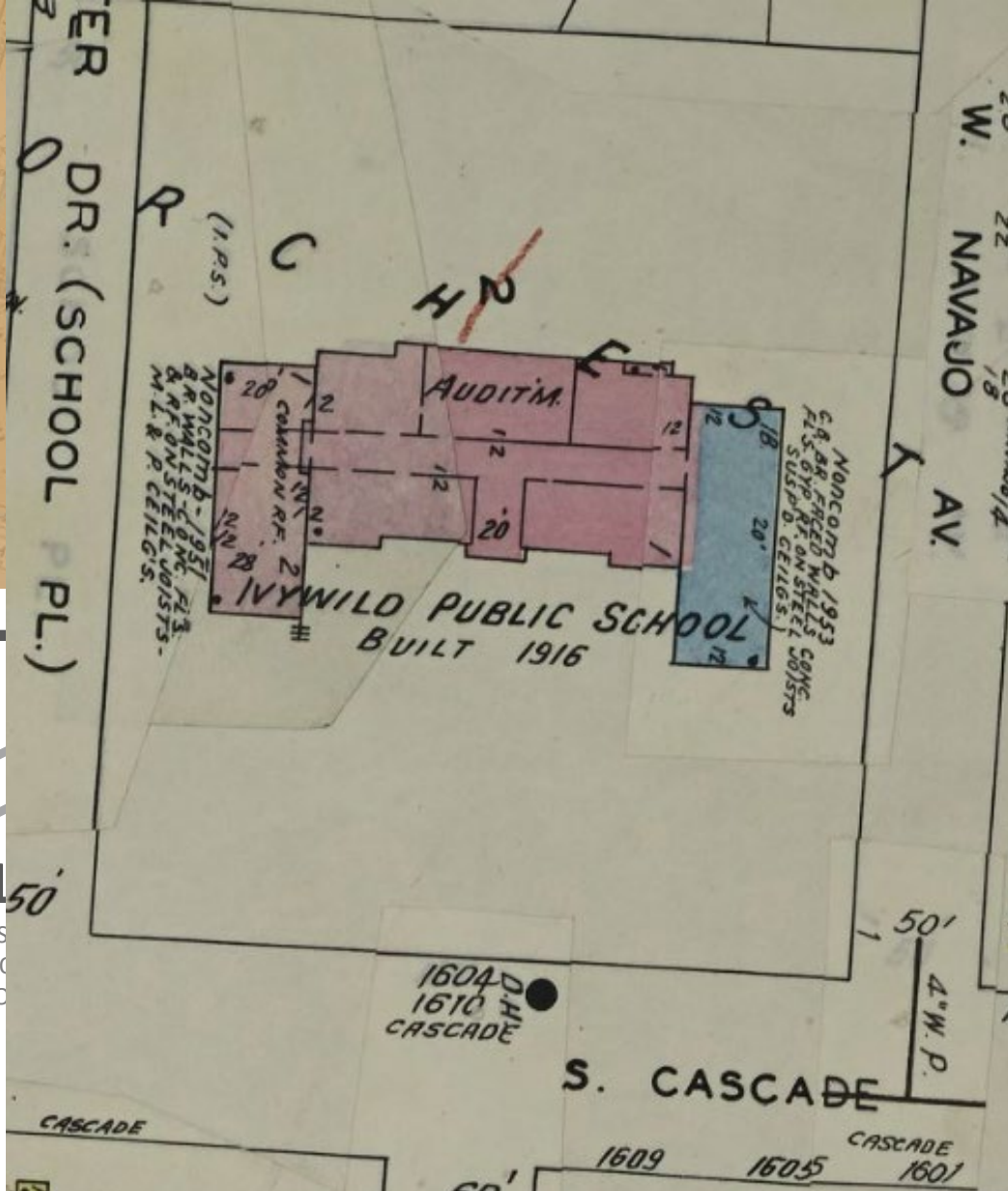
- Company Overview
- Technology Overview
- Wildfire Problem
- Multi-spectral imagery for planning
- Lidar and imagery for response and recovery
- Questions



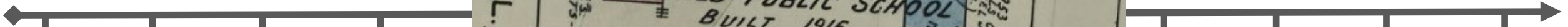
# SANBORN HISTORY



1866



2022



**1866**  
 FOUNDED & BEGAN GROUND SURVEYS

**1966**  
 BEGAN AERIAL SURVEYS

**1979**  
 BEGAN DIGITAL PHOTOGRAMMATIC MAPPING

**1984**  
 PIONEERED DIGITAL TERRAIN MODELING

**2014**  
 BUILDING FORMATION MAPPING (BIM)

**2016**  
 HD MAPS

**2018**  
 CLOUD SERVICES

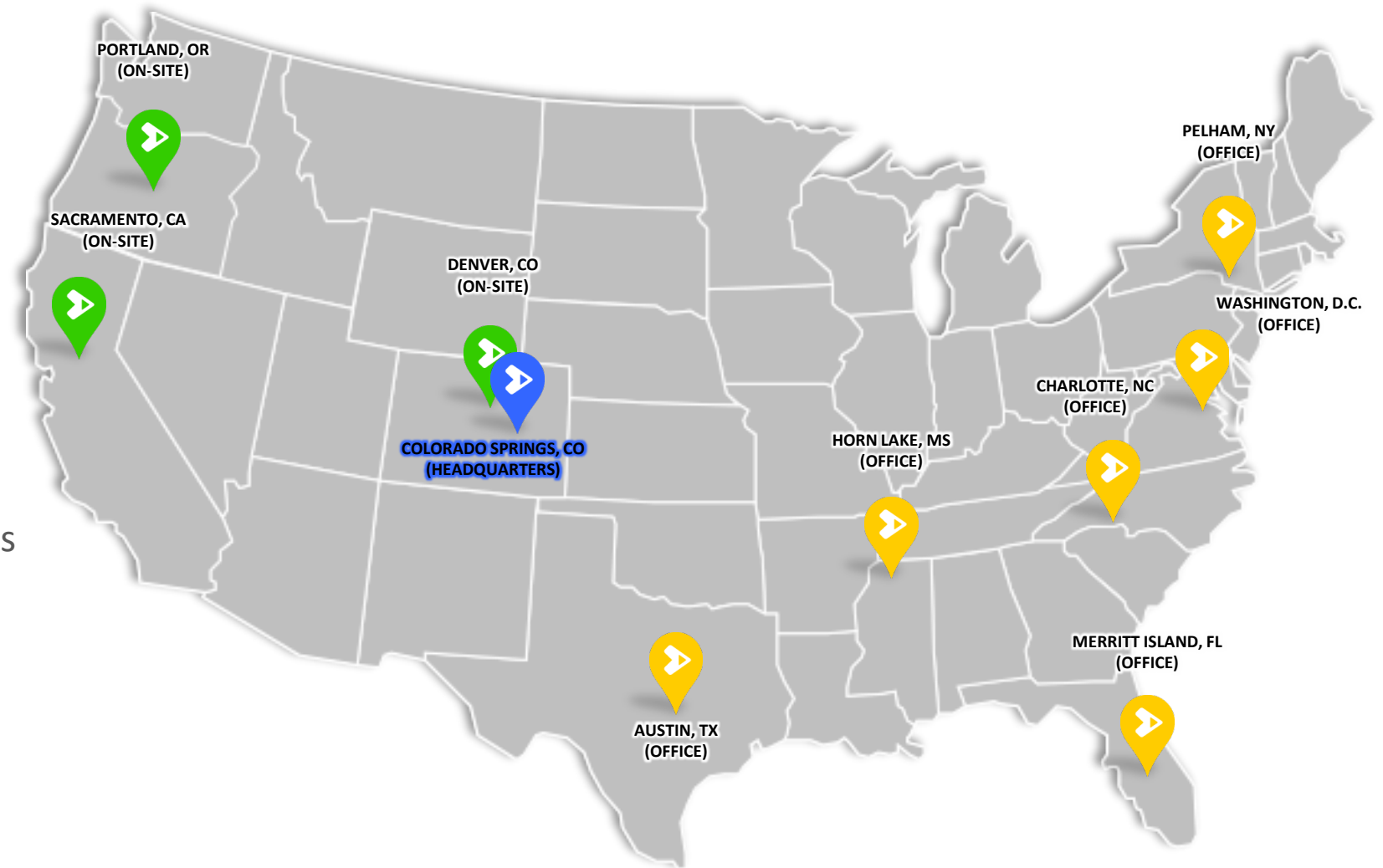
**2020**  
 LIDAR HARDWARE



# 50+

## LICENSED PROFESSIONALS

- Certified Mapping Scientist – Lidar
- Program Management Professionals
- Certified Photogrammetrists
- Professional Land Surveyors
- Various ESRI Certifications
- Microsoft Certifications
- CISCO Certifications





**Sanborn is an industry leader in terms of acquisition resources and data processing throughput, assets included:**

- Multiple single and twin-engine Aircraft
- Airborne Lidar Systems
- UltraCam Eagle Digital Camera Systems
- UltraCam Osprey 5-way oblique system
- Sonar Based Hydrographic Acquisition
- Mobile Lidar Systems
- Airborne GPS systems
- Inertial Navigation Systems
- Trimble GPS survey equipment
- IT Infrastructure: Over 11 Petabytes of active onsite storage, multi-core distributed processing clusters for both CPU and GPU software packages, networking capabilities up to 100Gbps and multi-host virtual environment



# SANBORN QUALIFICATIONS



- Over 200,000 square miles of mapping completed in the State of California
- Have completed a wide range of photogrammetric and LiDAR based projects for Consortiums, Municipalities, Counties, FedCiv, and Utility Organizations including:

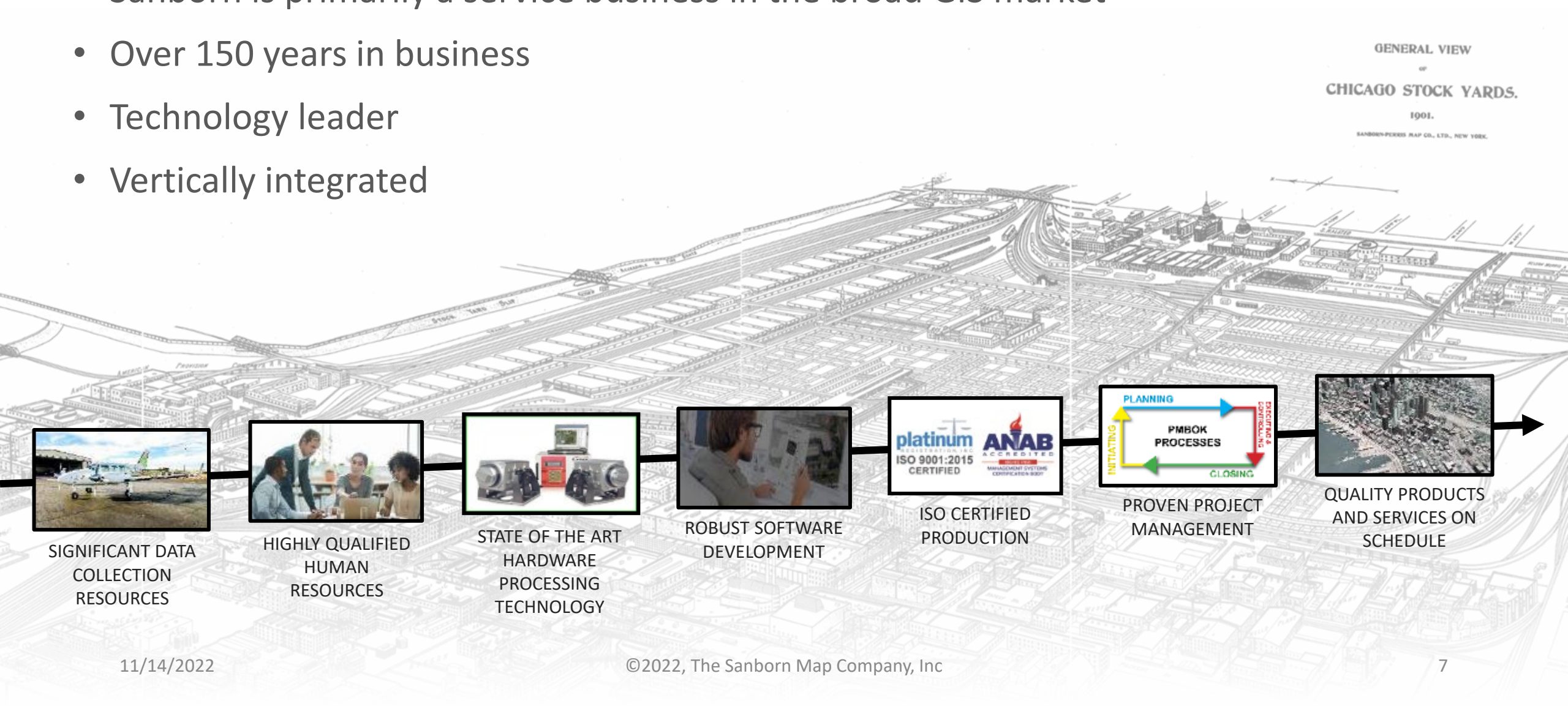
- Santa Clara County
- Solano County
- CIRGIS
- Ventura County
- SACOG
- Los Angeles Region Imagery Acquisition Consortium (LAR-IAC)
- CalWater
- Cities of Pasadena, City of Roseville, City of Los Angeles
- Colusa County, Sonoma County,
- USGS, USDA, Forest Service, Marine CORPS



# SANBORN OVERVIEW



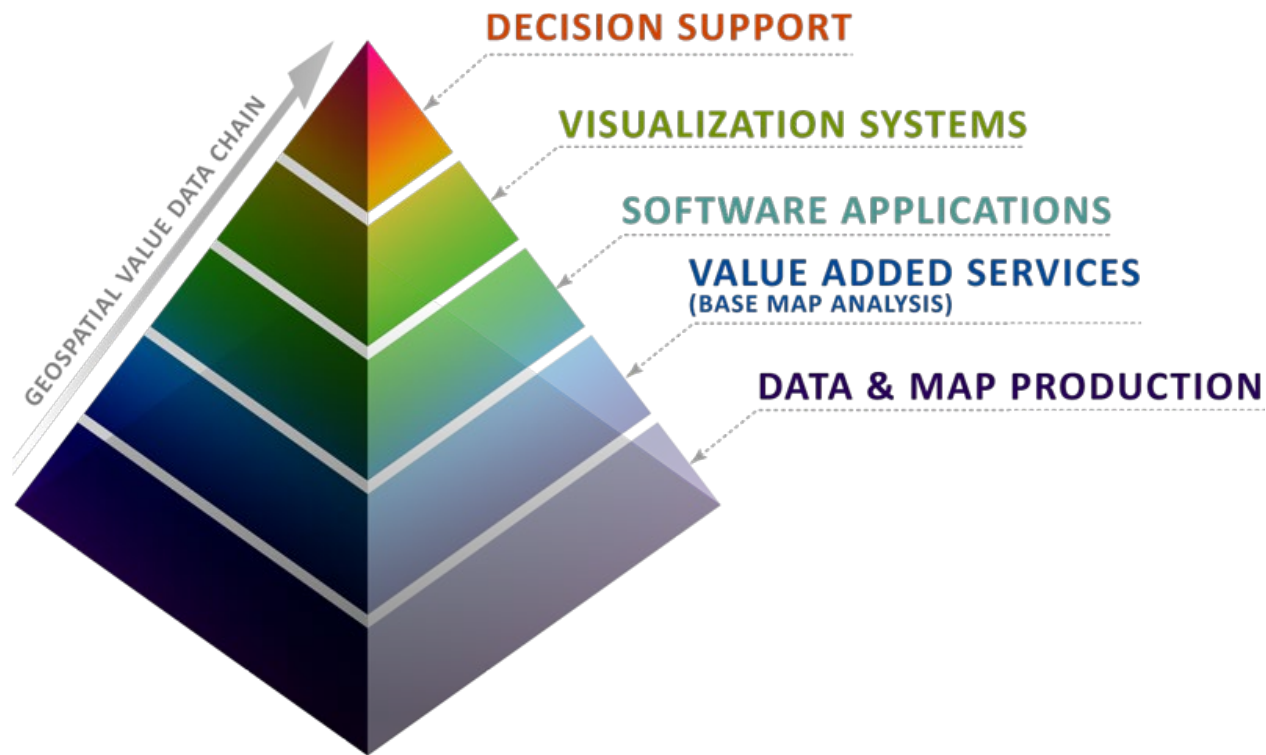
- Sanborn is primarily a service business in the broad GIS market
- Over 150 years in business
- Technology leader
- Vertically integrated



# FULL RANGE OF SERVICES



- Sanborn enables superior information and decisions with a broad range of products and services.



## Decision Support

- Wildfire Management
- Forestry and Ecosystem Management
- Emergency Response

## Visualization Systems

- 2D and 3D
- Prism 4D
- Common Operating Picture

## Software Applications

- GIS Software Development (Enterprise/Desktop/Web)
- Cloud Services
- Portals and Distribution Tools

## Value-Added Services

- Land use and land cover analyses
- Change detection
- Other imagery analysis services

## Data & Map Production

- Lidar, Digital Orthoimagery, Photogrammetric, Topographical Maps



# AERIAL LIDAR



Aerial Lidar (Light Detection and Ranging) is aerial mapping technology that uses calibrated laser returns from the earth's surface are reflected to an overflying GPS-monitored aircraft equipped with on-board positional and IMU sensors. After post-flight production processes, the acquired Lidar Map data determines the precise elevation and geospatial location of features on the earth's surface. With innovations such as multiple intensity returns and increased pulse repetition rates, Lidar data is an accurate and effective method for creating three-dimensional topographical aerial maps and highly accurate aerial surveys of both surface terrain elements and man-made structures.

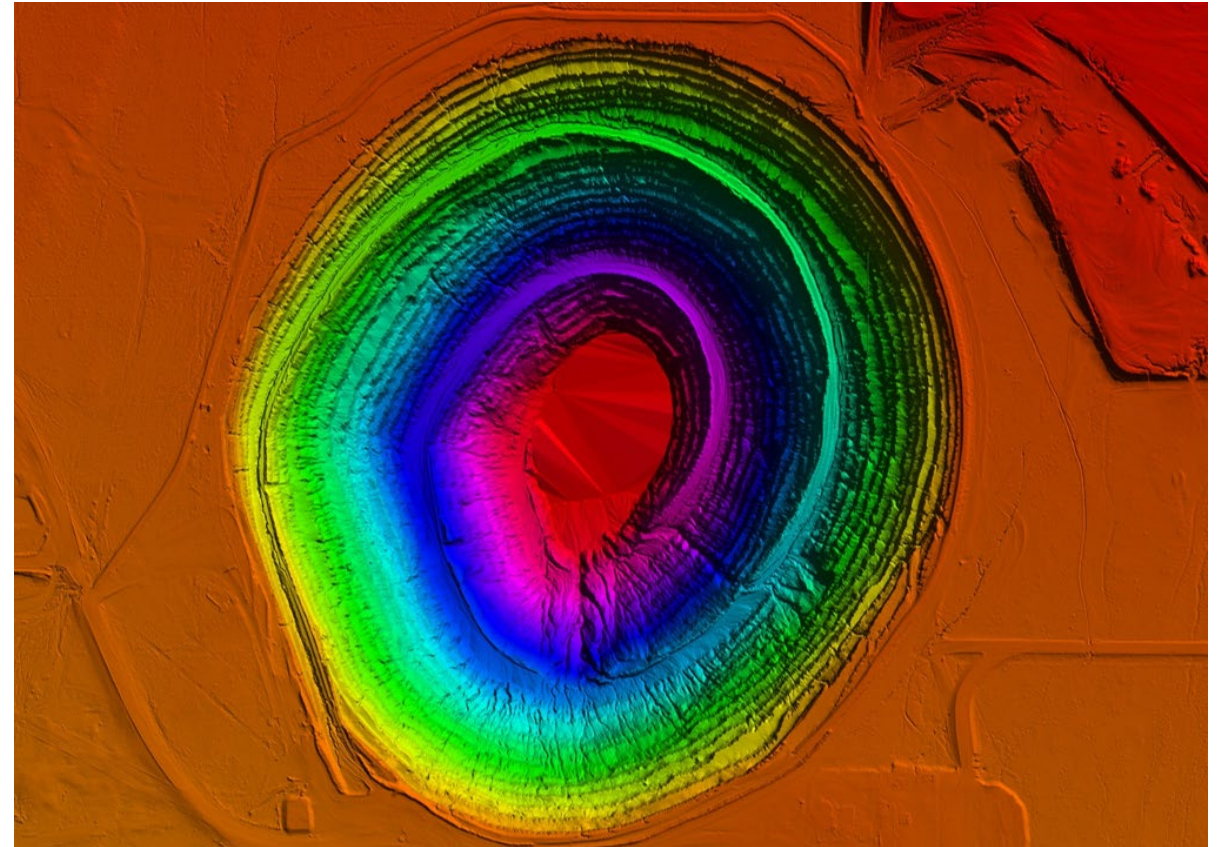


IMAGE DESCRIPTION

# ORTHOIMAGERY



Constantly changing conditions in the world around us have created an awareness of the importance of an accurate, up-to-date understanding of our environment and resources. Sanborn orthophotography products and services deliver a suite of digital aerial photography products that provide geospatially accurate visual representations of the earth and are useful for many mapping applications.



IMAGE DESCRIPTION

# THE WILDFIRE PROBLEM



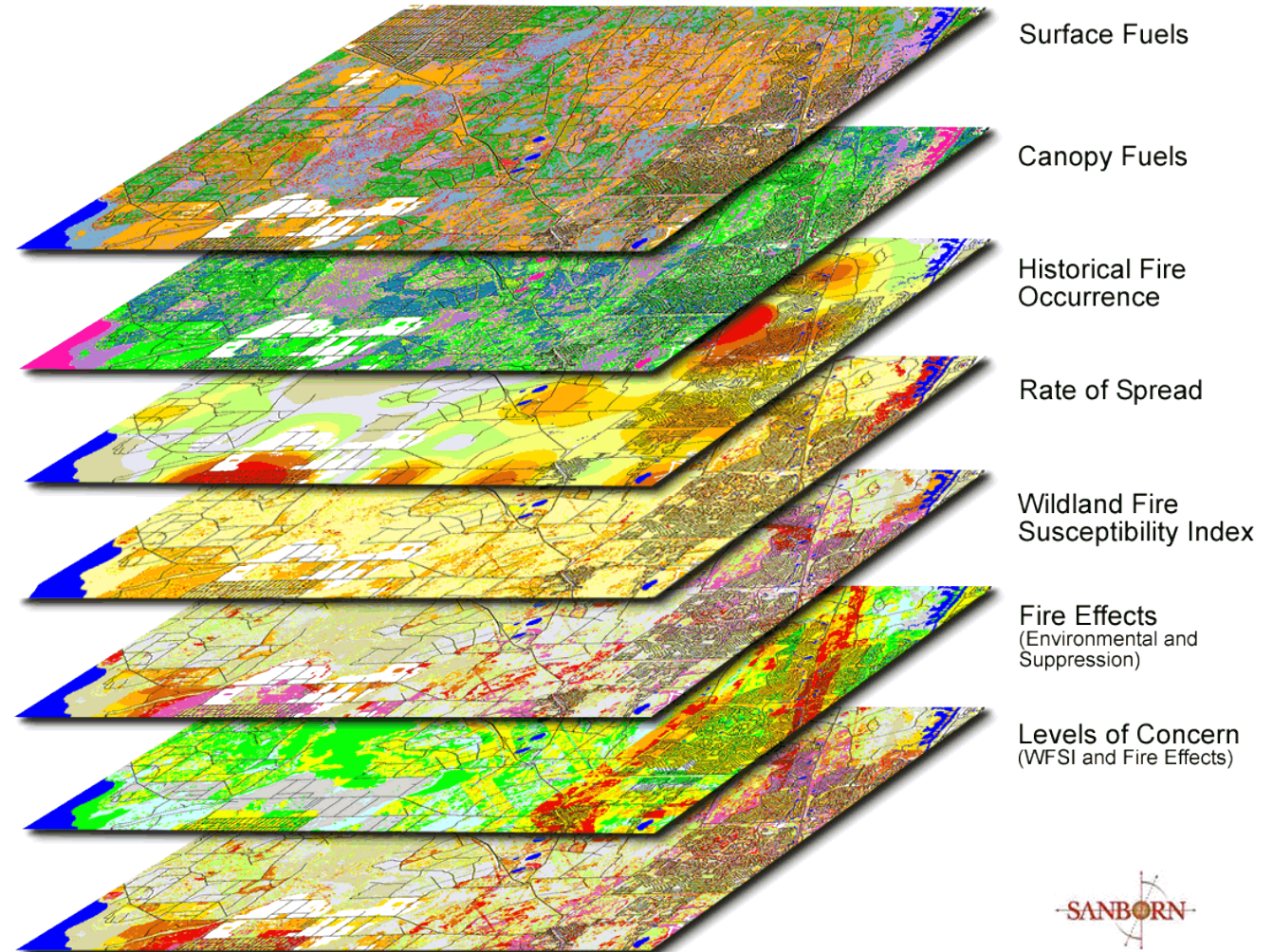
- Over the past 3 decades the number of acres burned by wildland fire has steadily risen
  - Past management practices, including a concerted federal policy of suppression, has unintentionally led to a steady accumulation of dense fuels across the U.S.
  - This fuels buildup has resulted in several years of catastrophic wildfires that has cost lives and significant damage to property and the ecosystems in the Wildland Urban Interface
- 1990 to present
  - Massive shift in available monetary resources in response to catastrophic wildland fire seasons



# GEOSPATIAL DATA FOR WILDFIRE RISK MITIGATION



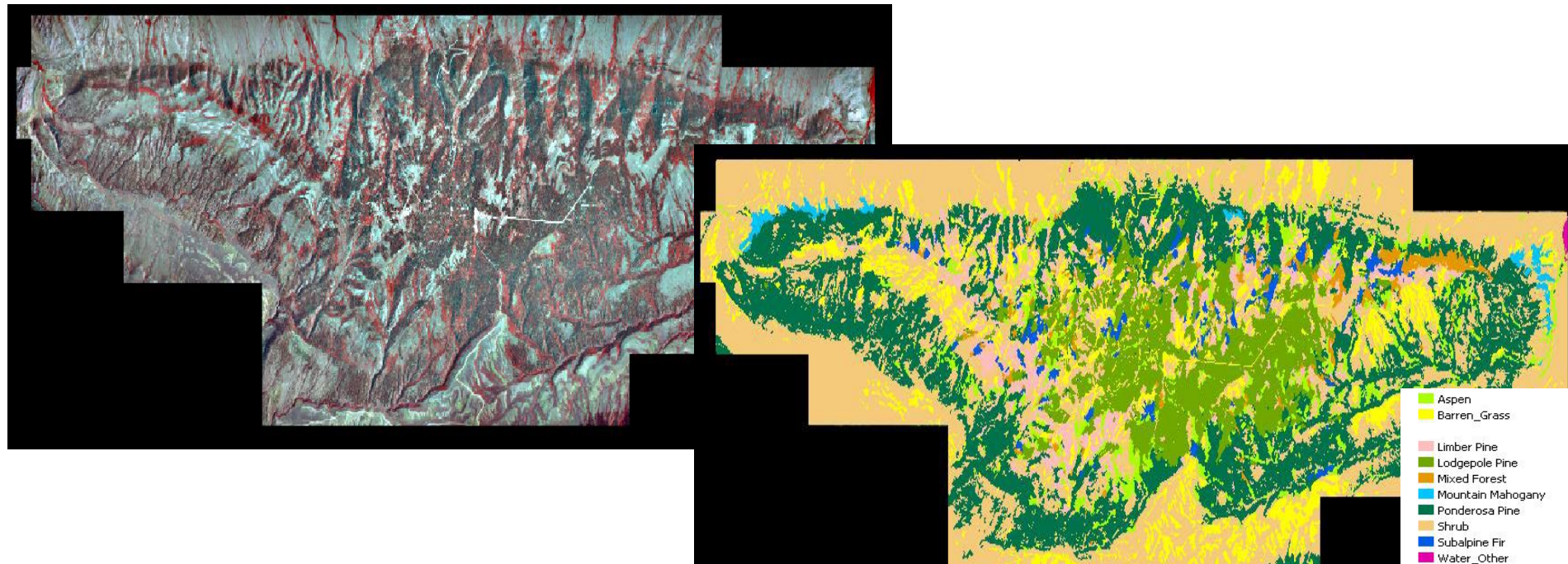
- Advanced wildfire risk models integrates fuels (vegetation), historical weather and fire ignition data with current hazard data, fire behavior analysis, and fire effects to derive measures of Wildland Fire Susceptibility
- High resolution imagery provides greater detail for mapping



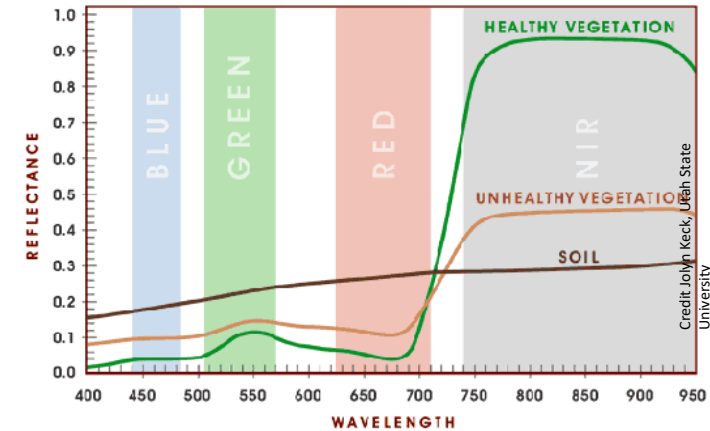
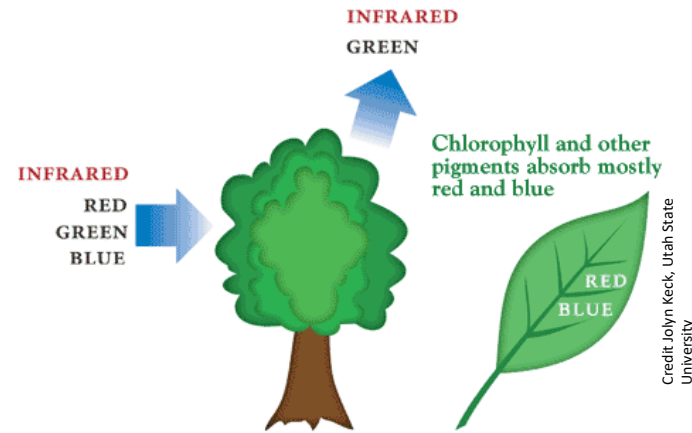
# WILDFIRE FUELS MAPPING



- Advanced image classification techniques are used in combination with field surveys to develop a fuel model classification scheme
- Supports the 13 FBPS fuel models, or Scott/Burgen 40 fuel models

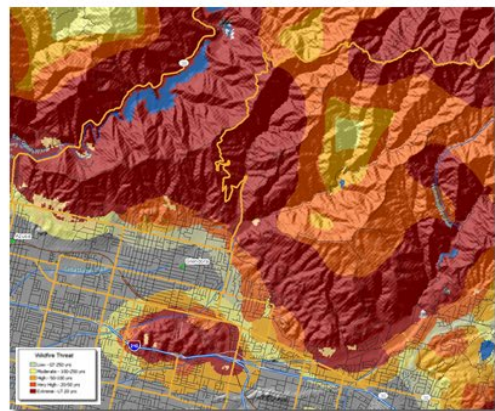
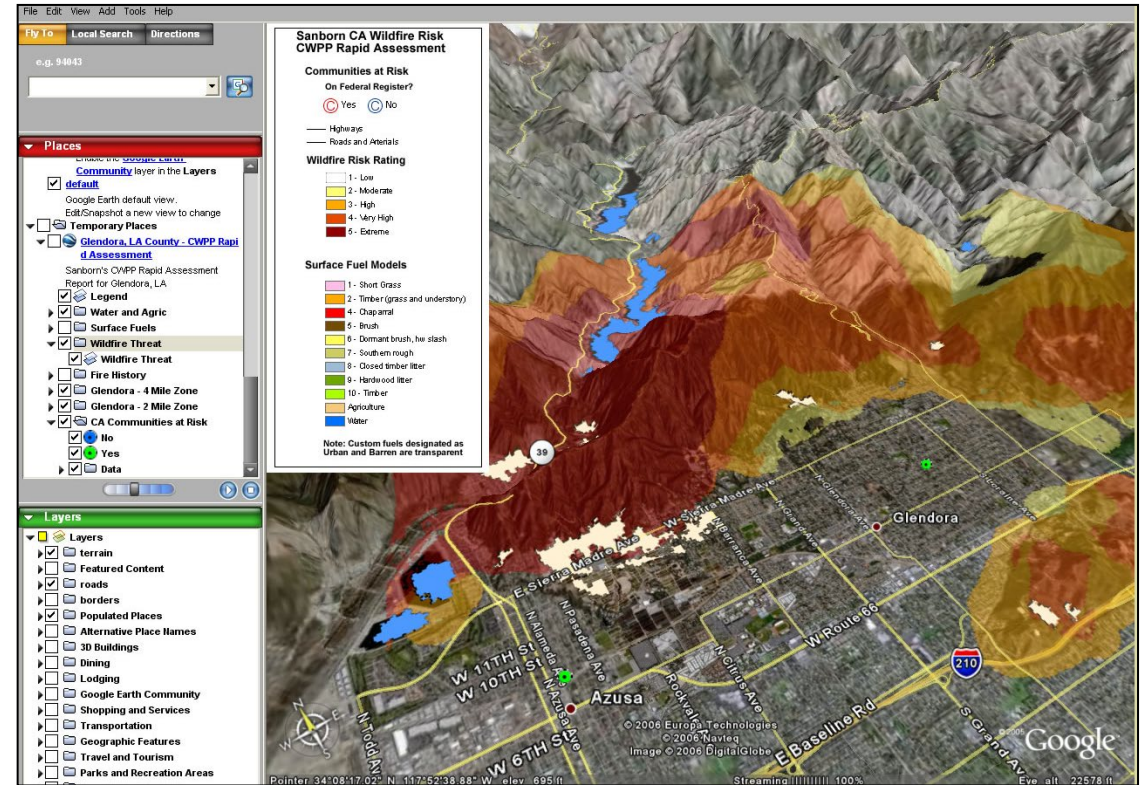
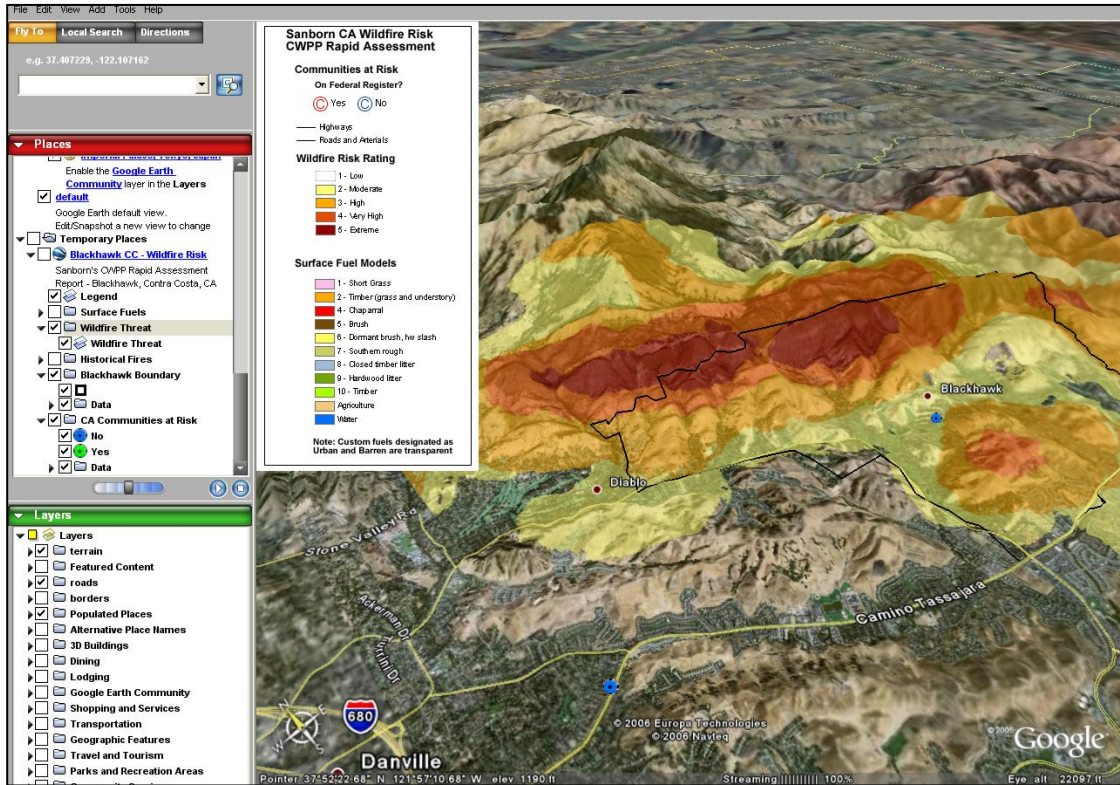


# WHY IS MULTI-SPECTRAL IMAGERY USEFUL?

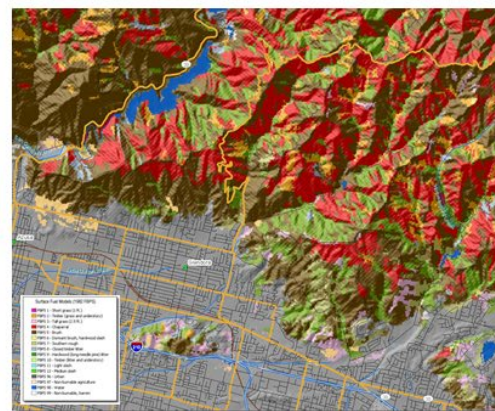


- Many physical objects reflect infrared energy much differently than visible light.
- This makes new forms of analysis possible, and others much more efficient, particularly when it comes to process automation.
- Infrared energy is very sensitive to the chlorophyll in vegetation, so imagery can be used for a variety of unique applications involving vegetation.

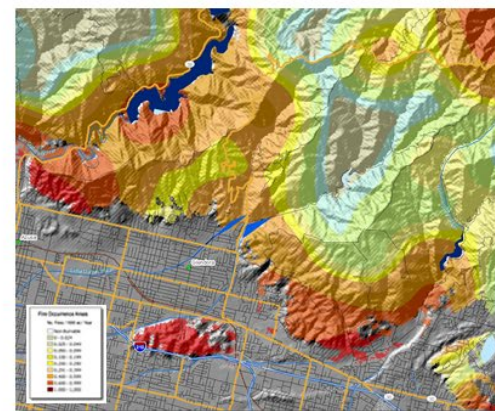
# WILDFIRE RISK INFORMATION - VISUALIZATION



Wildfire Threat



Surface Fuel Models

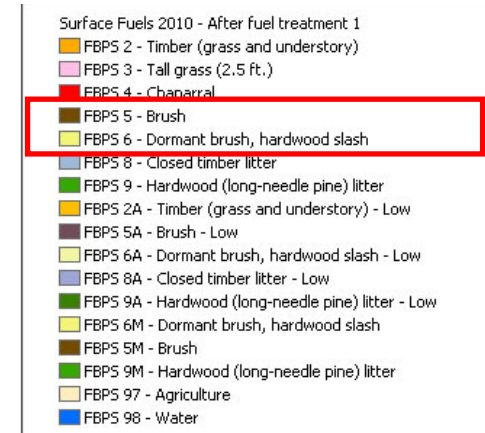
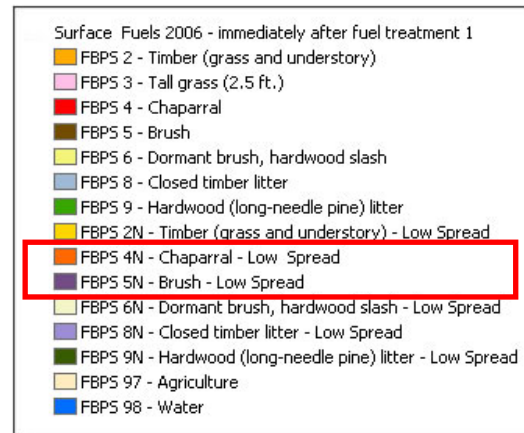
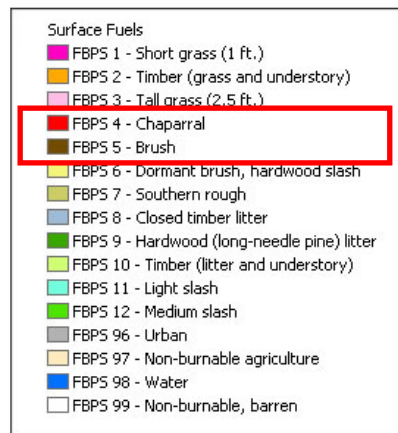
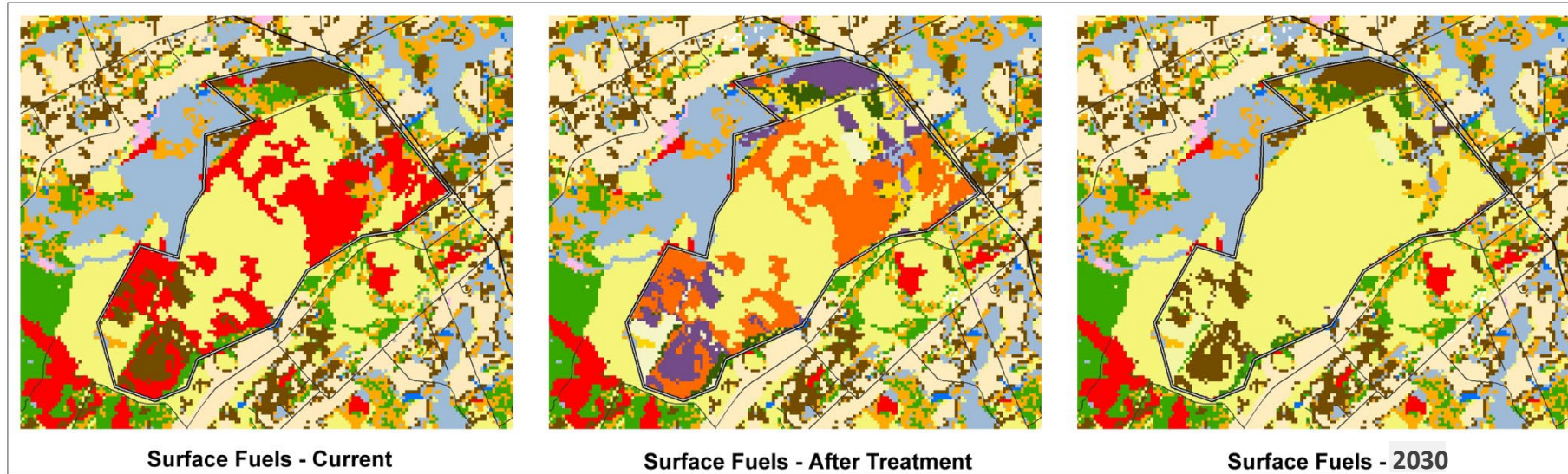


Fire Occurrence

# WILDLAND FIRE RISK ASSESSMENT SYSTEM – DECISION SUPPORT



- Analyzing Fuel Treatment Impacts





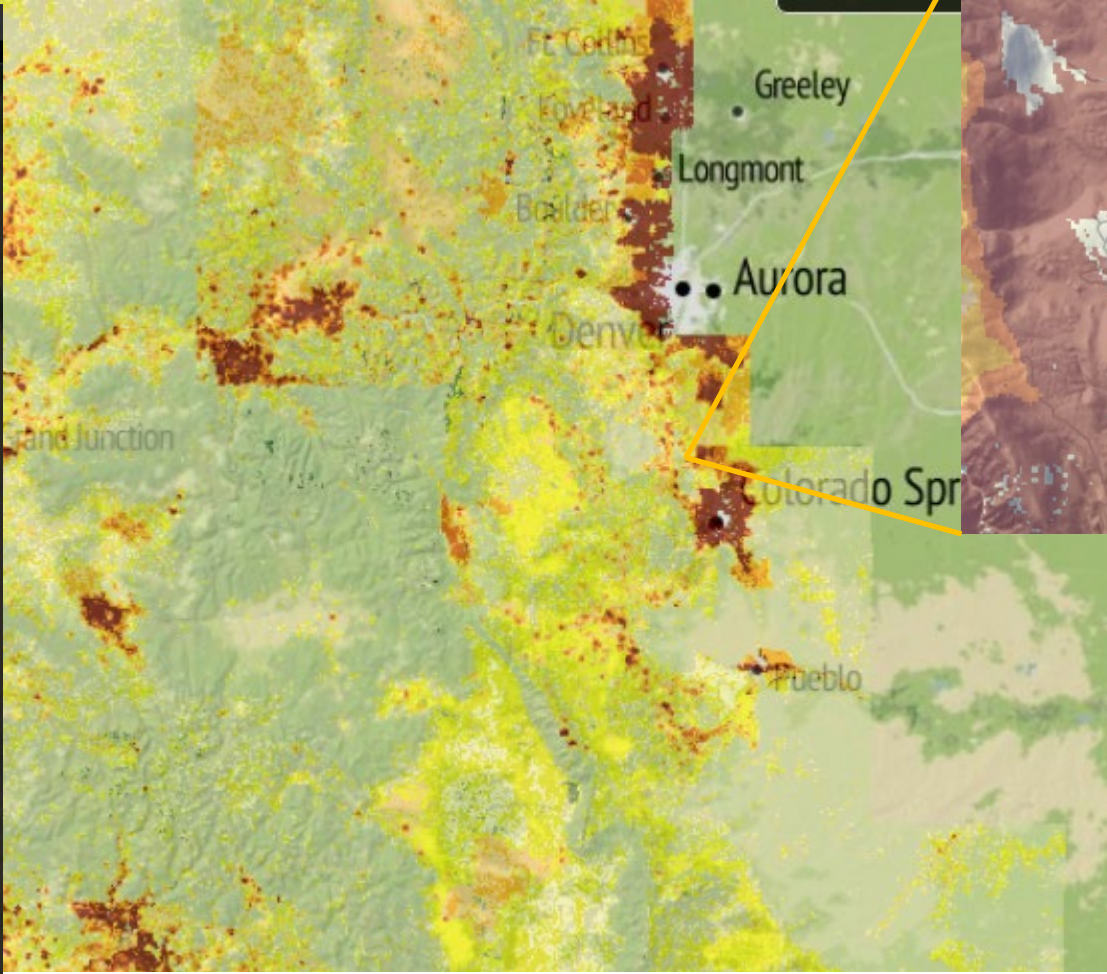
# PREVENTION AND/OR RISK MITIGATION



### Colorado Wildfire Susceptibility Index

- 0
- 0 - 0.0002
- 0.0003 - 0.0008
- 0.0009 - 0.001
- 0.0011 - 0.0016
- 0.0017 - 0.0023
- 0.0024 - 0.0041
- 0.0042 - 0.0089
- 0.0090 - 0.0185
- 0.0186 - 1

Data produced in 2007-2008 by Sanborn Map Company under contract with Colorado State University on behalf of the Colorado State Forest Service.





- Stakeholder seek to accurately identify location, timing, and severity of conditions following an event or disaster.
  - In order to develop a course of action to respond, you need to formulate an accurate assessment of threats, risks, and vulnerabilities to infrastructure and populations within impacted area of interest.
- 

## Critical Factors:

- Ability to perform new data collection in timely fashion
- Speed of delivery
- Accuracy of content analysis
- Ability to generate actionable insights and informative decisions from outputs

# EVENT: MARSHALS FIRE, BOULDER COUNTY, CO



- Started December 30<sup>th</sup>, 2021
- 6,026 acres
- 1084 structures destroyed
- Many overflights completed by multiple vendors



# REMOTE SENSING SOURCE INFORMATION

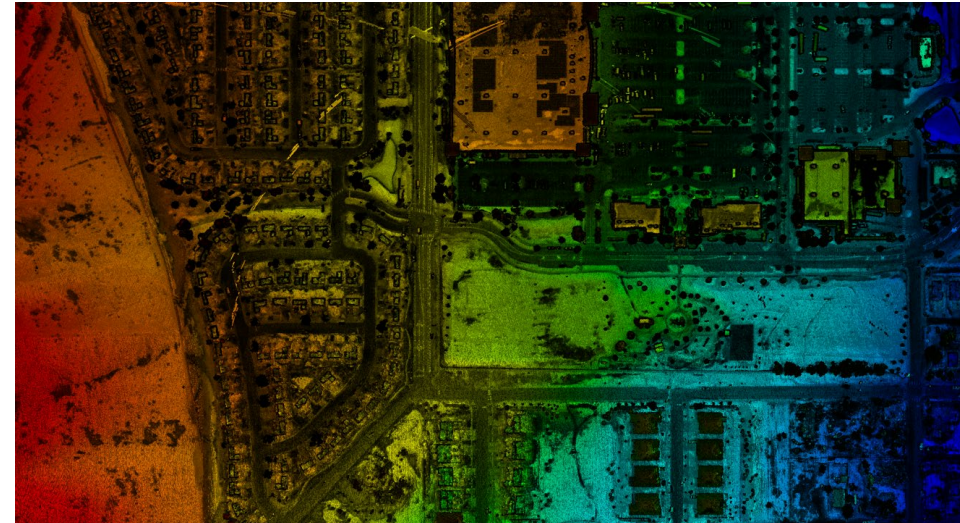


- Remote sensing and GIS modeling can be utilized to acquire information about impacted areas and to speculate about the extent of potential damage.



## Optical

- Limited canopy penetration
- Weather (snow) impacts
- Longer time of collection



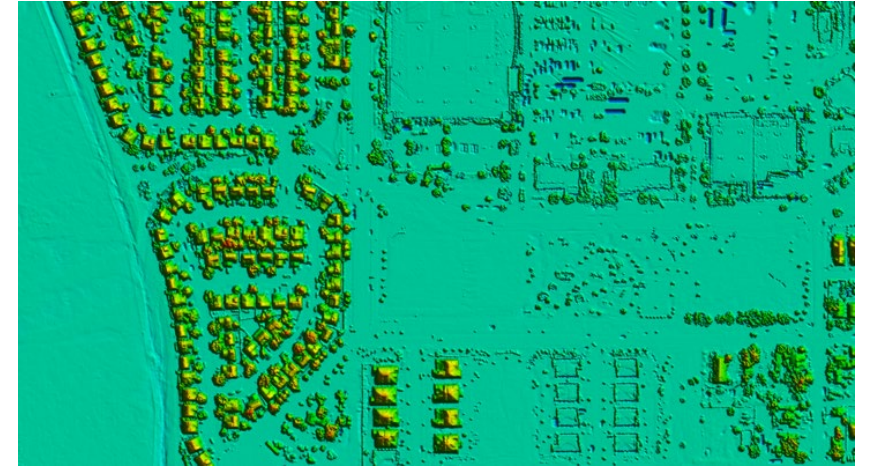
## LIDAR

- Canopy/vegetation penetration
- Weather/light independent
- Higher surface density
- Vertical Accuracy

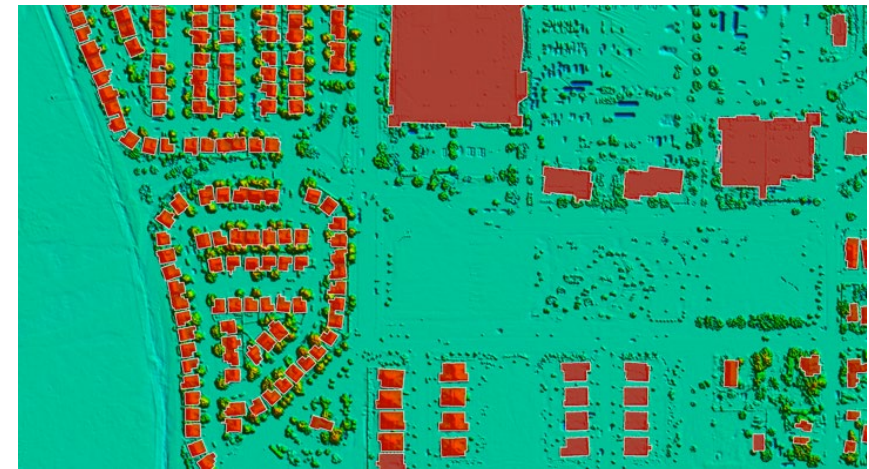
# DATA PROCESSING APPROACH



- Baseline data
  - 3DEP (QL1 and QL2)
  - Additional classification required
  - Feature extraction required
  - Created AI based building footprints
- New data (QL1)
  - Normalized data to baseline
  - Automated change detection
- Volumetric change from 2020 vs 2022 building footprints
- Data Integration - Property Information
- Timelines
  - Collection – 1 day
  - Calibration – 1 day
  - Classification – 1 day
  - Analytics – 1 day
  - Total time: Less than one week



Digital Change Model



Automated Building Extraction Overlaid Change Model

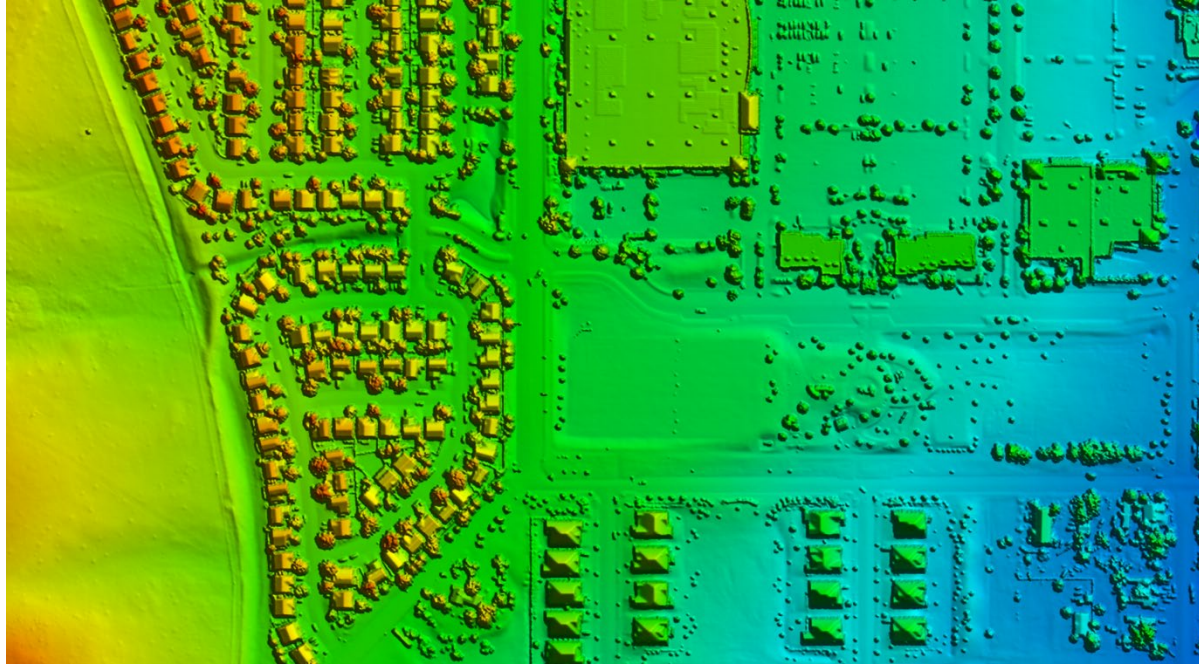
# AI BUILDINGS CAPTURE



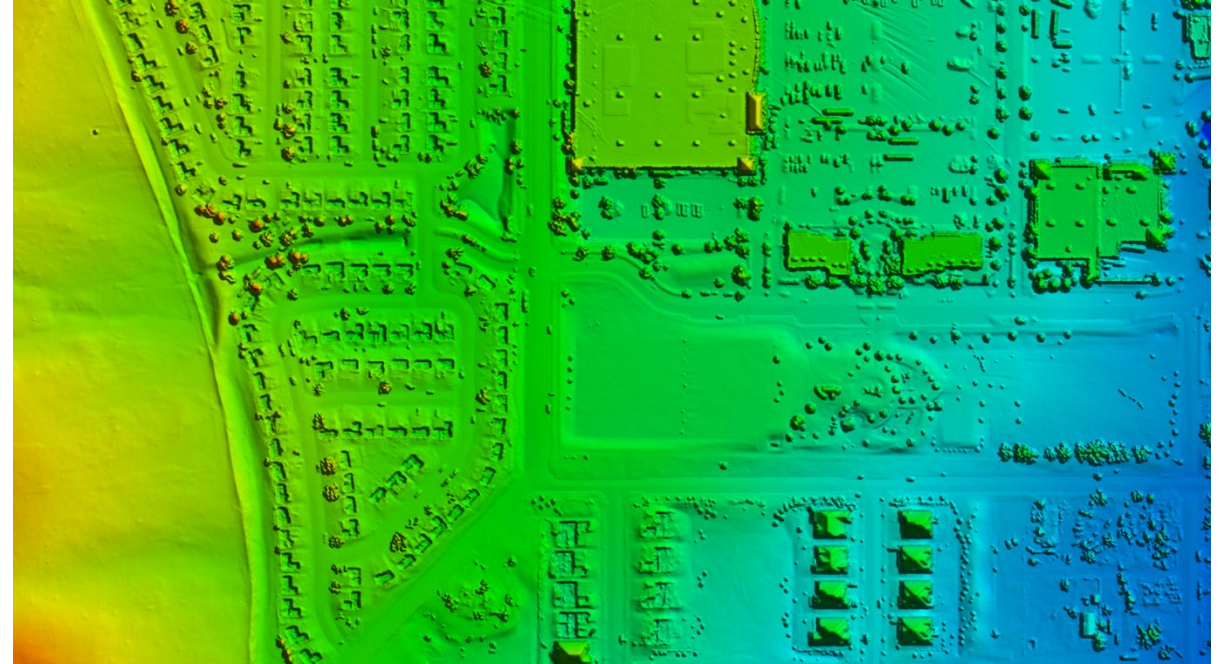
# AI BUILDINGS CAPTURE



# PRE/POST EVENT DSM



2020



2022




# CHANGE DETECTION PROCESS



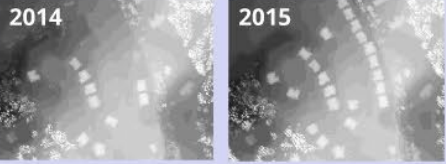
## PRODUCTION

2014 2015



**2D CHANGE DETECTION**  
Imagery input from two vintages

2014 2015



**3D CHANGE DETECTION**  
DSM input from two vintages

**CHANGE MAP GENERATION**



**PARCELS INTEGRATION**



## DELIVERIES

**PARCEL VECTOR CHANGE DETECTION**  
(with change statistics)



**TABULAR PARCEL CHANGE MAP**  
(with change statistics)

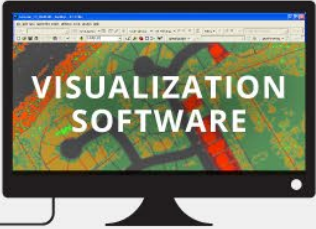


**CHANGE MAP RASTER PRODUCT**



## VALUE-ADDED PRODUCTS

**VISUALIZATION SOFTWARE**



■ Oblique Imagery Integration  
■ Other Desktop / Web Visualization Tools

# SANBORN CHANGE DETECTION VIEWER



Sanborn Change Detection Viewer beta

DEMO Welcome, demo\_user Log In

Enter Search Here Search

PIN	Acres	Perc	Change SQ. FT.	Control
31606062	3.6305	79 %	125665.00	
31607049	92.6618	53 %	2150910.00	
31338083	0.0346	51 %	771.60	
31338033	0.1687	43 %	3129.12	
31609029	6.6246	43 %	125256.00	
31608029	0.1761	37 %	2817.86	
31337047	0.1561	37 %	2517.69	
31338080	0.0316	37 %	511.51	
31608028	0.1786	36 %	2782.25	
31335031	0.2137	36 %	3328.25	
31335030	0.2213	34 %	3268.35	
31335033	0.2157	32 %	3036.11	
31608032	0.1588	32 %	2212.16	
31335040	0.1756	28 %	2103.97	
31606060	0.5795	27 %	6796.51	
31338079	0.0357	27 %	412.56	
31339039	0.1895	25 %	2076.06	
31337056	0.1478	25 %	1641.96	
31334023	0.1587	25 %	1720.64	
31339034	0.1683	24 %	1769.47	
31339059	0.1629	24 %	1719.79	
31609030	5.8730	24 %	60532.40	
31335035	0.1592	23 %	1589.63	
31608025	0.1443	23 %	1428.59	
	0.3288	22 %	3162.89	
31337063	0.1510	22 %	1447.63	
31335023	0.2193	22 %	2088.19	
31338001	0.1740	21 %	1584.05	
31339060	0.1856	21 %	1709.38	

Change

2006

2016

Leaflet | © Sanborn 2016, Google Street

Leaflet | © Sanborn 2016, Google Satellite

Powered by Sanborn

Pop-up window details:

- PIN: 31607049
- Area (acres): 92.6618
- Change Percentage: 53 %
- Open In: SOA
- Options: Zoom Here, Select

Panel showing tabular parcel data and controls.

Panel showing areas of change derived from older versus newer imagery, draped over DTM backdrop (viewer can substitute imagery for DTM backdrop).

Panels showing older imagery and newer imagery (bottom) imagery.

# ESRI DASHBOARD



Parcel Number: 157724013005 Account Number: R0099065 Type: RESIDENTIAL Volumetric Change: 98.02% Classification: Destroyed Est. Value Loss: \$237,200.00
Parcel Number: 157724021005 Account Number: R0029320 Type: RESIDENTIAL Volumetric Change: 97.32% Classification: Destroyed Est. Value Loss: \$28,410.00
Parcel Number: 157724045002 Account Number: R0510469 Type: RESIDENTIAL Volumetric Change: 96.77% Classification: Destroyed Est. Value Loss: \$433,500.00
Parcel Number: 157724011005 Account Number: R0600117 Type: RESIDENTIAL Volumetric Change: 96.16% Classification: Destroyed Est. Value Loss: \$113,000.00
Parcel Number: 157519104007 Account Number: R0109172 Type: RESIDENTIAL Volumetric Change: 96.05% Classification: Destroyed Est. Value Loss: \$373,200.00
Parcel Number: 157724003001 Account Number: R0029345 Type: RESIDENTIAL Volumetric Change: 96.04% Classification: Destroyed Est. Value Loss: \$225,100.00
Parcel Number: 157722000002 Account Number: R0037554 Type: RESIDENTIAL Volumetric Change: 95.98% Classification: Destroyed Est. Value Loss: \$486,380.00
Parcel Number: 157724024008 Account Number: M8800039 Type: MANUFACTURED HOME Volumetric Change: 95.89% Classification: Destroyed Est. Value Loss: \$16,300.00

Zoom to Pan

**Damage Classification: Destroyed**

AccountNo	R0099065
ParcelNo	157724013005
Account_Type	RESIDENTIAL
bldActualVal	237,200.00
Volumetric Change	98.02
Damage Classification	Destroyed
Estimated Value Loss	237,200.00
Full Address	102 WEST WILLIAM STREET

0 60 ft

Maxar, Microsoft | Esri Community Maps Contributors, City of Boulder, City of Westminster, Town of Superior, Boulder County, City and County of Broomfield, © OpenStreetMap, Microsoft, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Cen... Powered by Esri

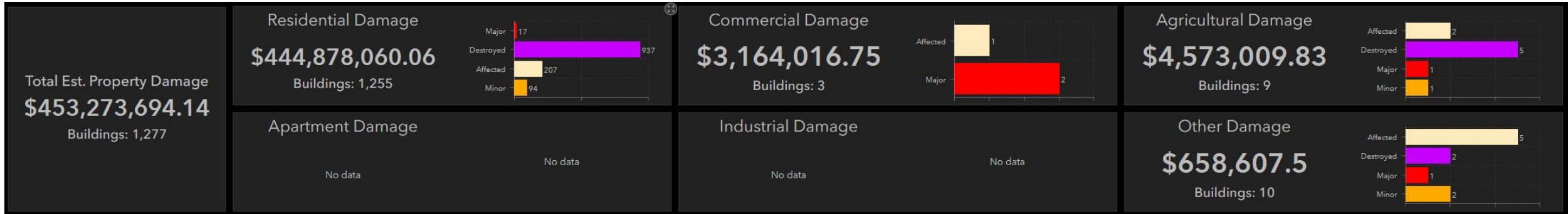
### Map Legend

Property Assessment

Damage Classification

- Destroyed
- Major
- Minor
- Affected
- No Observed Damage
- Unknown
- Unknown

# DAMAGE ASSESSMENT VALUE

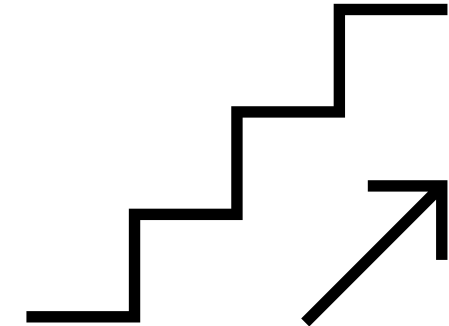
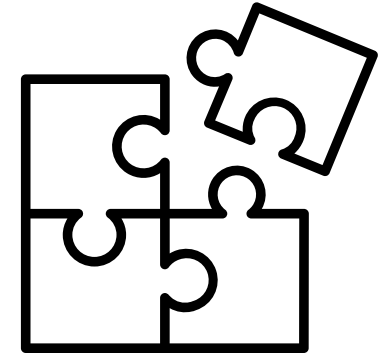


## Property Damage Assessment

# LESSONS LEARNED, FUTURE DEVELOPMENT AND NEXT STEPS



- Lessons Learned
  - Work with baseline data first in order to provide reference points for new data collected post-event
  - Analytics need to be refined for eliminating new structures not in original baseline and significant vegetation differences
- Potential Applications
  - Debris calculations
- Future Development
  - Refine automation to speed up processes
  - Investigate use of open source or off the shelf structures data sets
  - Integrate new data into previous wildfire hazard assessment model
- Next Steps
  - Develop product for a different type of event or area of interest



# QUESTIONS



**Jason Caldwell**  
**Vice President of Business Development and Sales**  
p: 719-264-5547 | c: 719-649-3821 | [jcaldwell@sanborn.com](mailto:jcaldwell@sanborn.com)

Questions	Answers
I suppose that the reason you lost 300 houses is that they are too close together...yes?	I don't know if the authorities would attribute the building density to the structure losses during this event. In the past, HOAs have had some requirements that didn't make sense when considering wildfire concerns. For example, in the past, HOAs have had requirements for wood shake roofs, wood fences and a certain amount of open space areas in the neighborhoods. I believe HOAs have eliminated wood shake roofs but may still allow for wood fences and still consider the natural open spaces as benefits to these types of communities. The open spaces and wood fences contributed to and may have even acted as a conduit to help the fire move from one house to the next. Once the fire contacted the neighborhood the natural landcover in the open space may have been a factor in the overall spread. When you have this type of event, you go through lessons learned from a perspective of HOA and city zoning code to try to prevent a similar event from happening in the future. Metal fence instead of wood fence as well as some type of fire break in the open space may have lowered the impact. With all of this said, this fire was primarily impacted by a weather (wind) event that was the primary reason for such damage.

## Q & A