

3D TOPOGRAPHIC DATA FOR UTILITIES AND NETWORKS IN THE US

Becci Anderson
Acting Director
National Geospatial Program (NGP)
U.S. Geological Survey

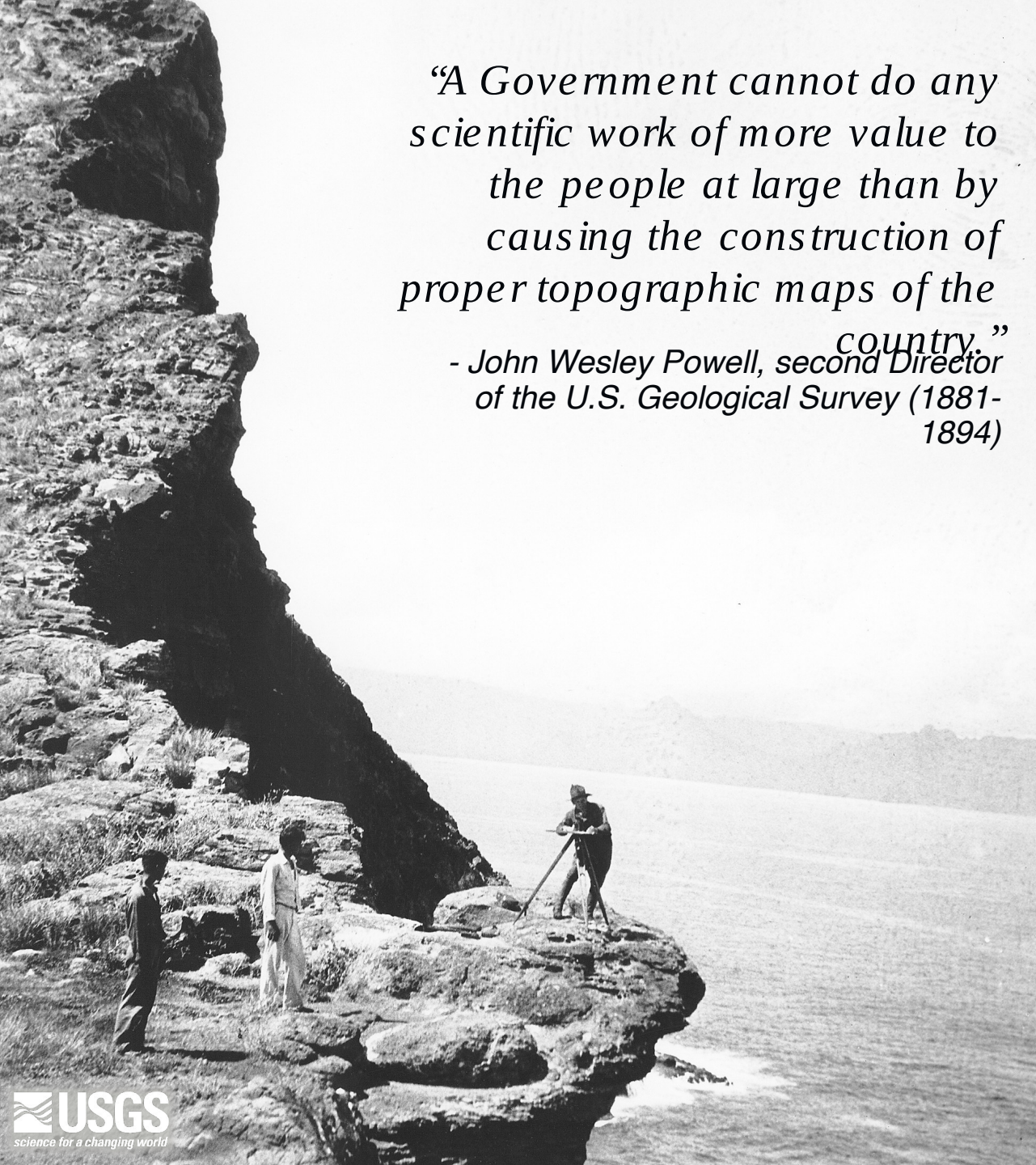
UTILITIES AND NETWORKS IN THE UNITED STATES

- Essential services such as electricity, natural gas, water, wastewater, telecommunications, roads, stream management etc.
- Ownership structures vary
 - Publicly owned - municipal utilities and networks
 - Investor-owned - private companies regulated by states
 - Cooperatives - member-owned, common in rural areas
 - Federal entities - e.g., TVA, Bureau of Reclamation (hydropower assets)
- Electric, gas, and water utilities typically rely on grid operations centers or control rooms that use real-time monitoring and systems to manage distribution networks
- Mapping and geospatial data play a central role, including parcel data, land ownership, environmental constraints, imagery, elevation models, hydrology layers, and utility-specific asset inventories
- Specialized geospatial datasets, such as network topology, easements, rights-of-way, risk models, and outage history, are used to maintain infrastructure, support emergency response, guide capital improvements, and plan system



“A Government cannot do any scientific work of more value to the people at large than by causing the construction of proper topographic maps of the country.”

- John Wesley Powell, second Director of the U.S. Geological Survey (1881-1894)



1882: Historical Topographic Map Collection

The U.S Geological Survey (USGS) has provided the United States with topographic maps for over 140 years

Today, USGS topographic maps and geospatial data provide the baseline mapping for the country

USGS NATIONAL GEOSPATIAL PROGRAM

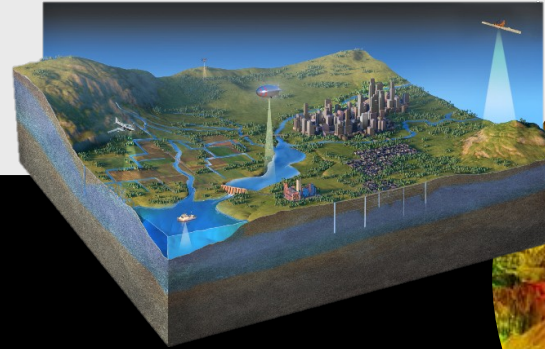


The National Map

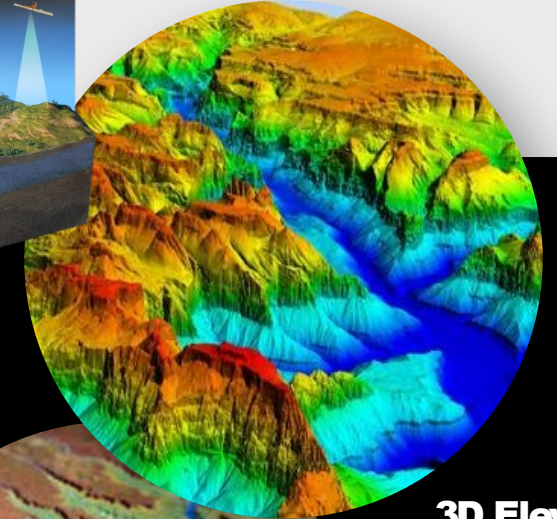
Your Source for Topographic Information

- The Nation's authoritative, comprehensive topographic mapping of natural landscapes and built environments - serving professionals and the public alike
- Technology-driven nationwide baseline and repeat coverage mapping
- Collaboration with public and private industry partners to ensure quality and useability
- Products are freely available through easy-to-use platforms
- Products support applications like minerals and energy exploration, natural hazards response, infrastructure development, and recreational opportunities

3D National Topo Model



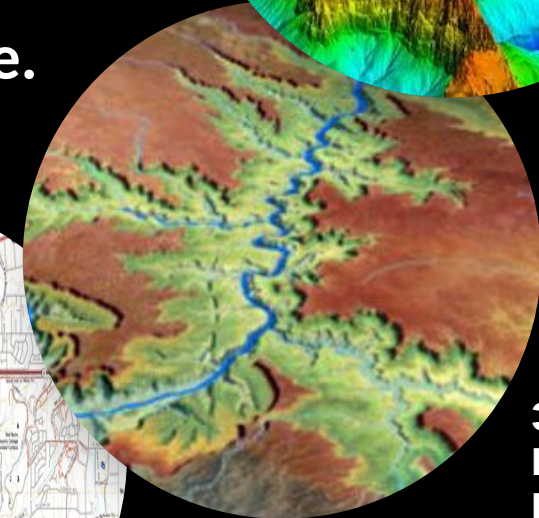
- ✓ **Accurate.**
- ✓ **Authoritative.**
- ✓ **Accessible.**



3D Elevation Program (3DEP)



OnDemand Topo from topoBuilder

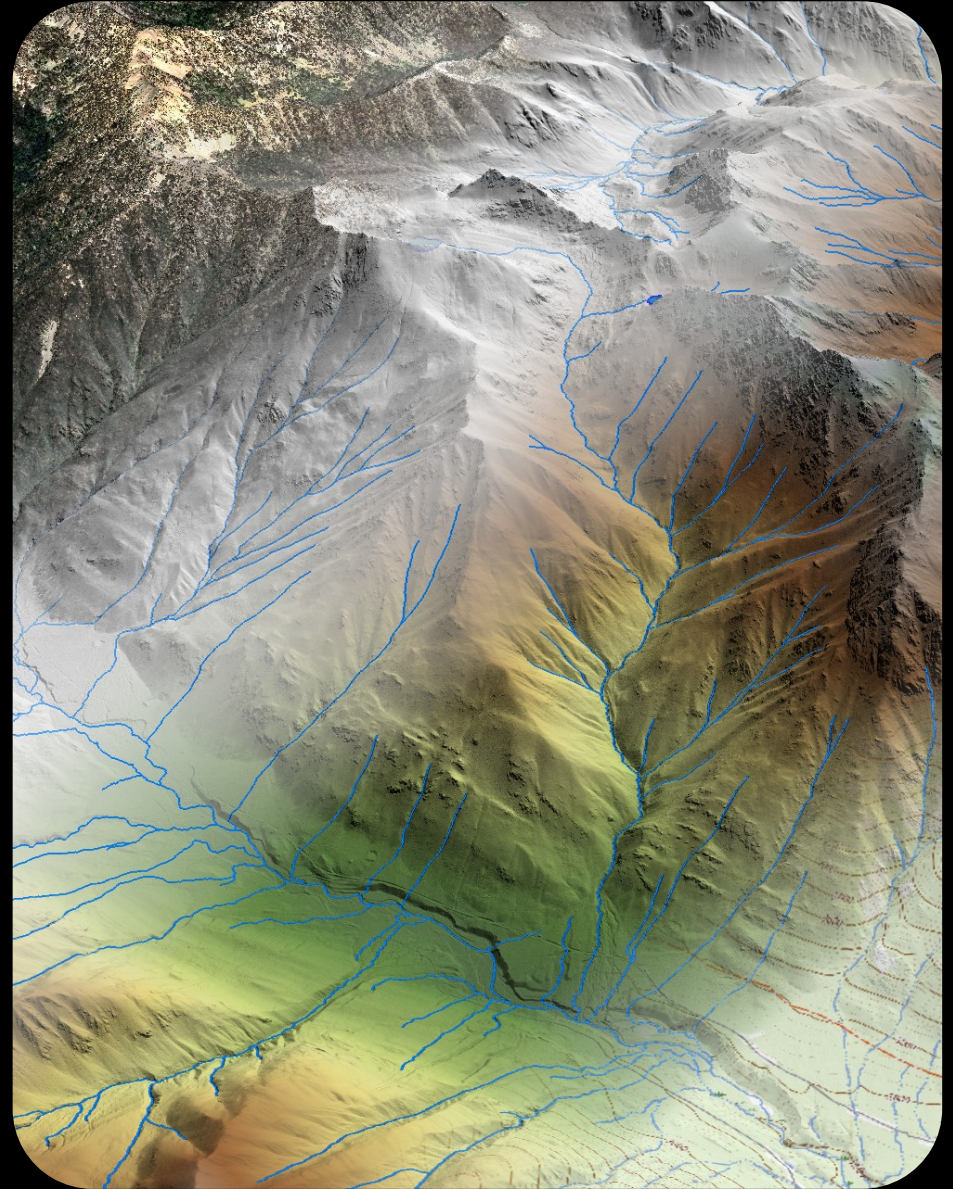


3D Hydrography Program (3DHP)

3D ELEVATION PROGRAM

3DEP is a partnership program that provides high-quality, high-resolution 3D data for the entire Nation in free and open formats.

- Designed to acquire and disseminate standardized, consistent, vetted 3D data for a wide range of uses
- Used for a vast array of applications, including within USGS as the foundational input for the 3D Hydrography Program (3DHP) and US Topo



BUILDING 3DEP ONE YEAR AT A TIME



\$13B

Potential annual benefit with ROI of 5:1



> 300

Partner Organizations



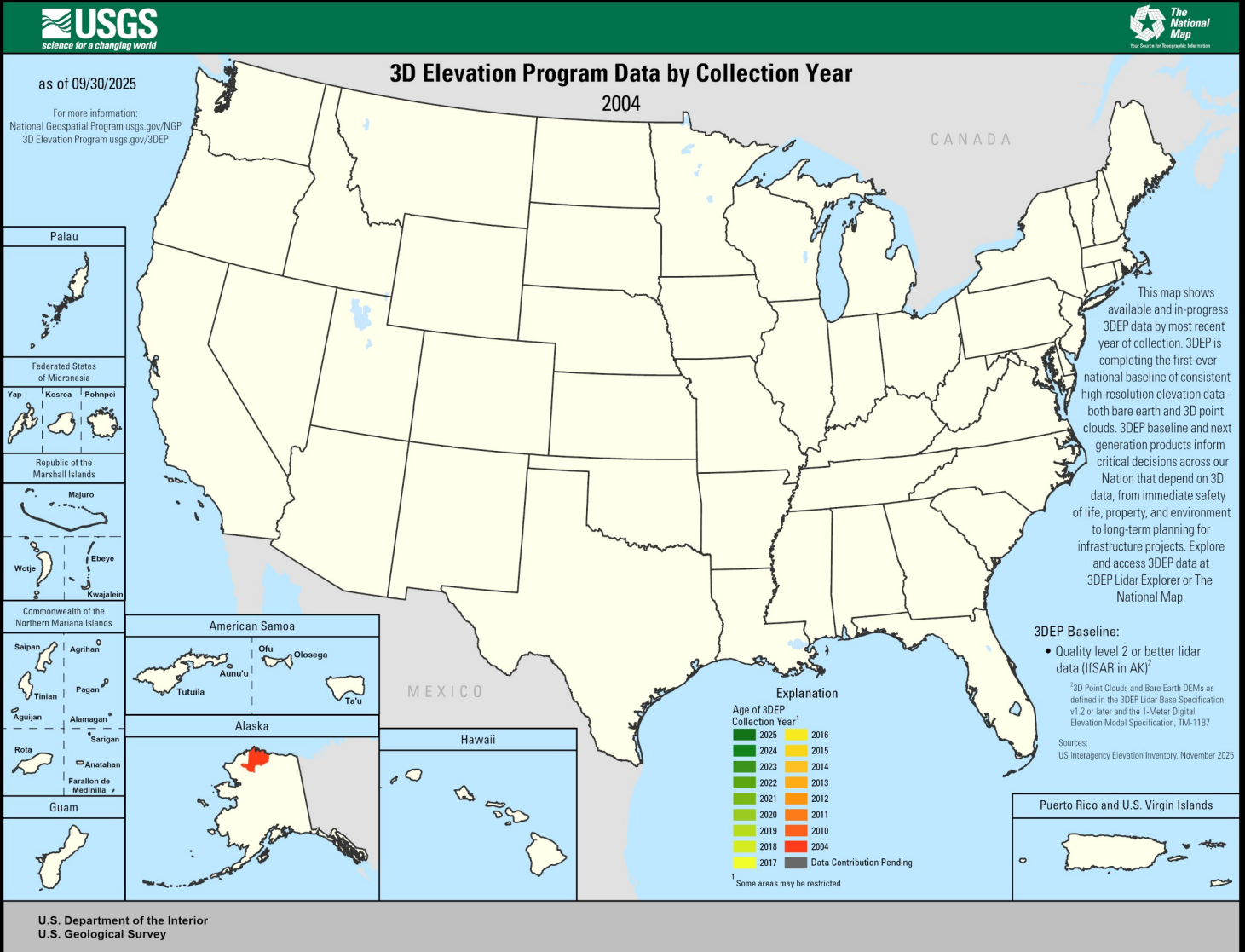
65

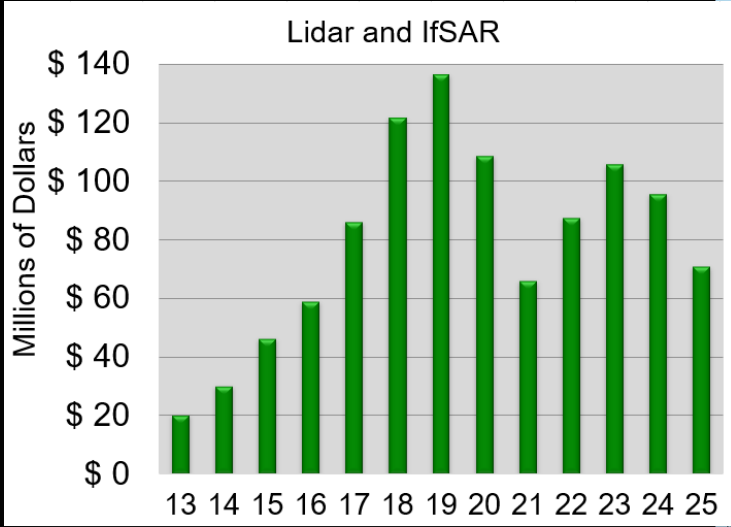
Percent of total 3DEP cost contributed by partners



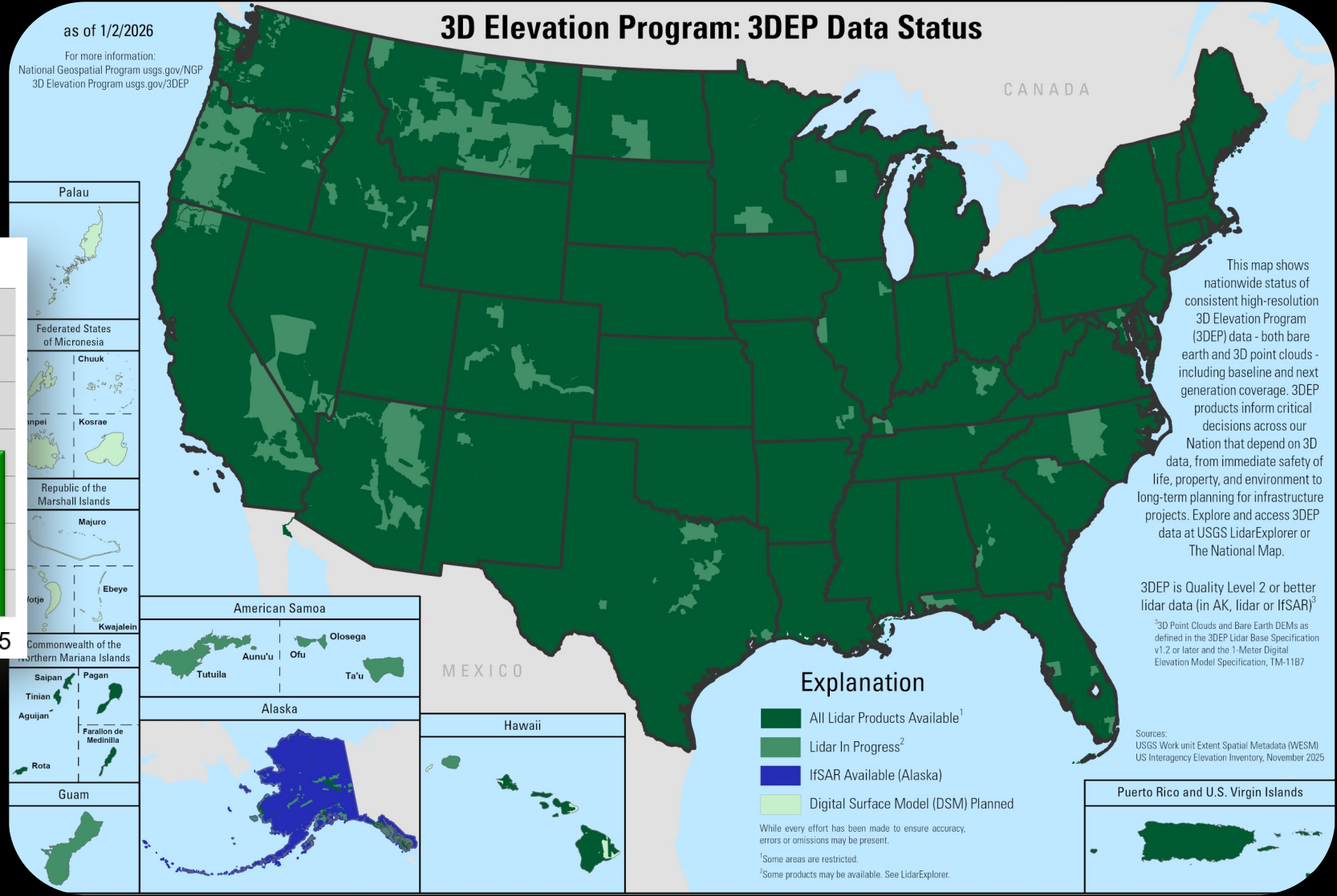
77 Trillion

Lidar data points being distributed





Data acquisition investments by all partners, by fiscal year



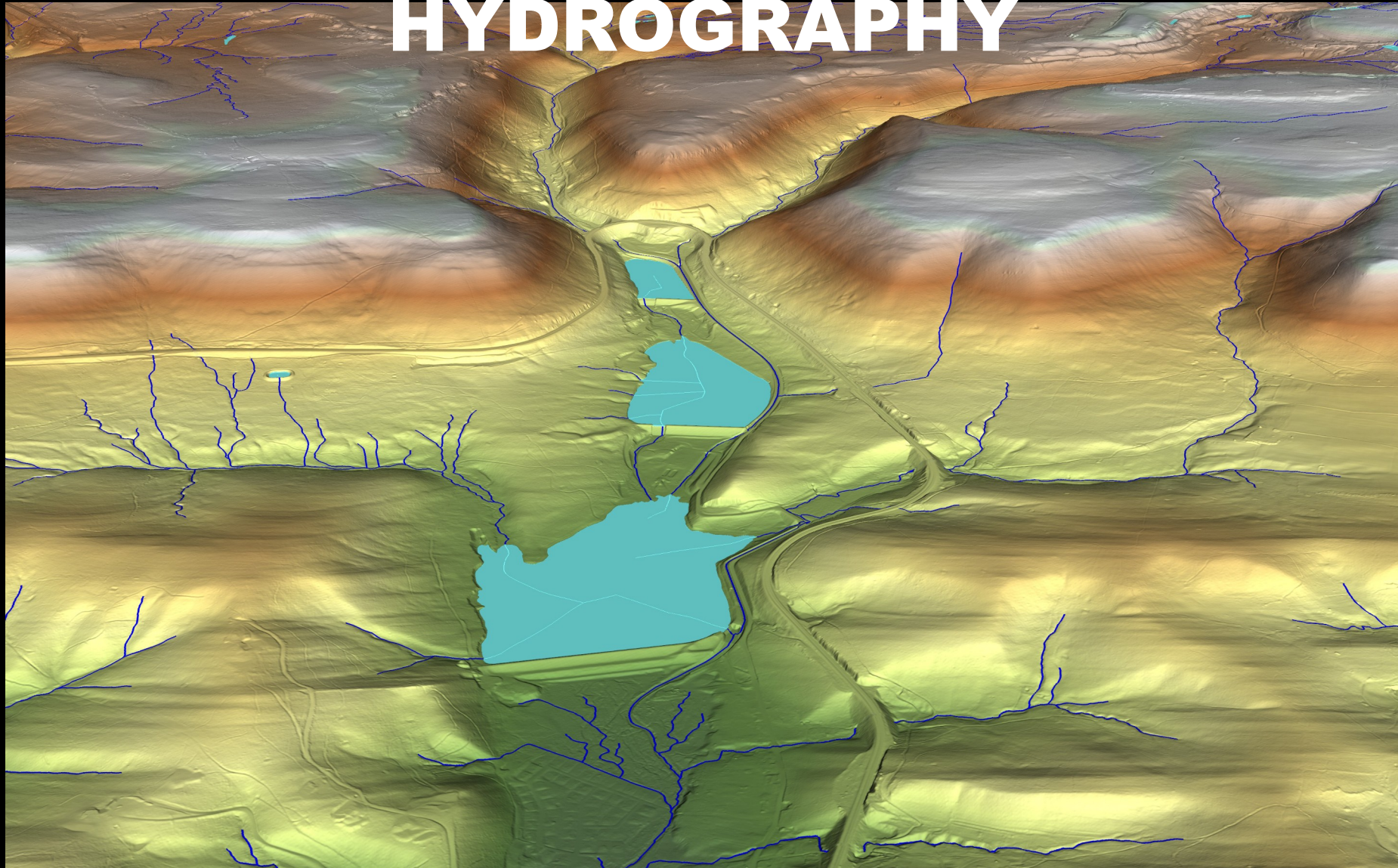


100

of the Nation will have
3DEP
baseline data available or
in progress by the end of
FY26



STREAMLINING 3DEP INTO 3D HYDROGRAPHY



Horseshoe curve near Altoona,
PA

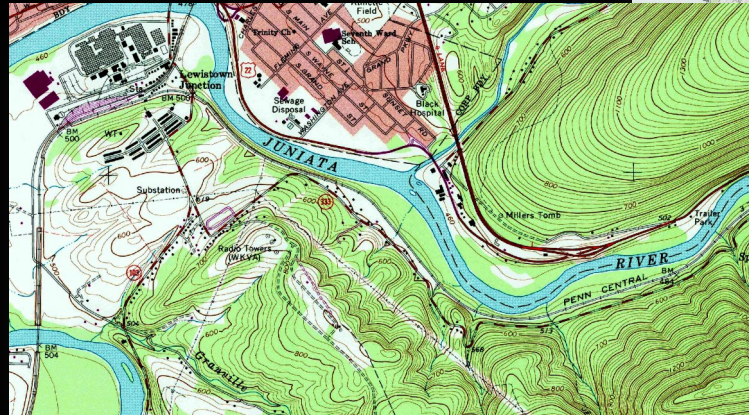
3D HYDROGRAPHY PROGRAM

A new era for surface water mapping

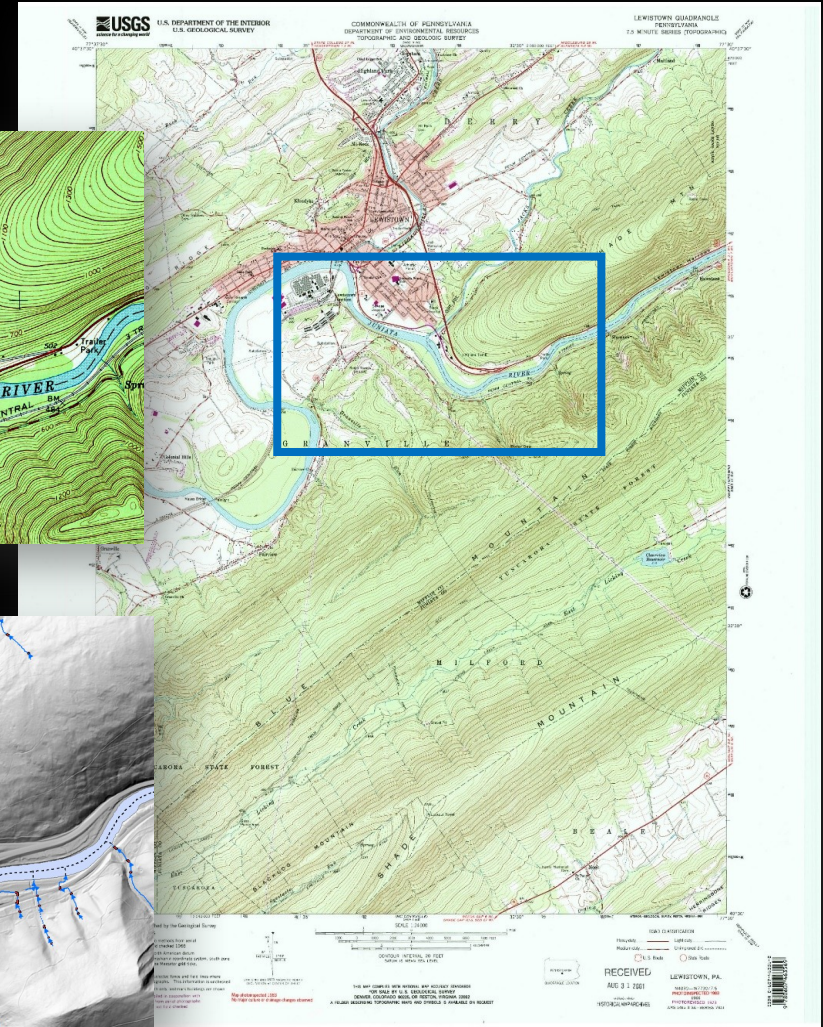
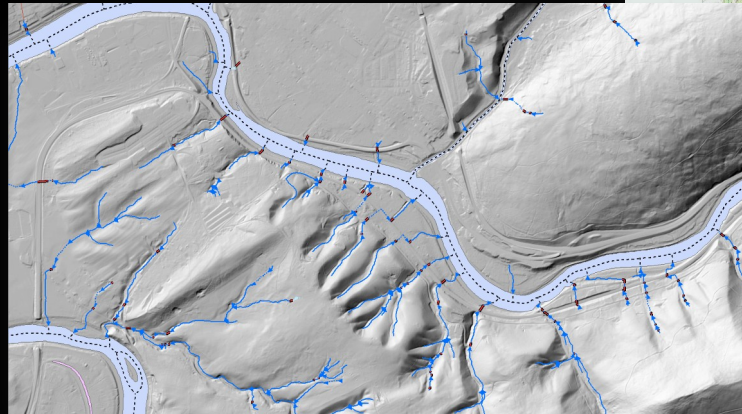
3DHP is the first systematic remapping of the Nation's hydrography since the original USGS 24K topographic mapping program

New data
New data model
New products

1966

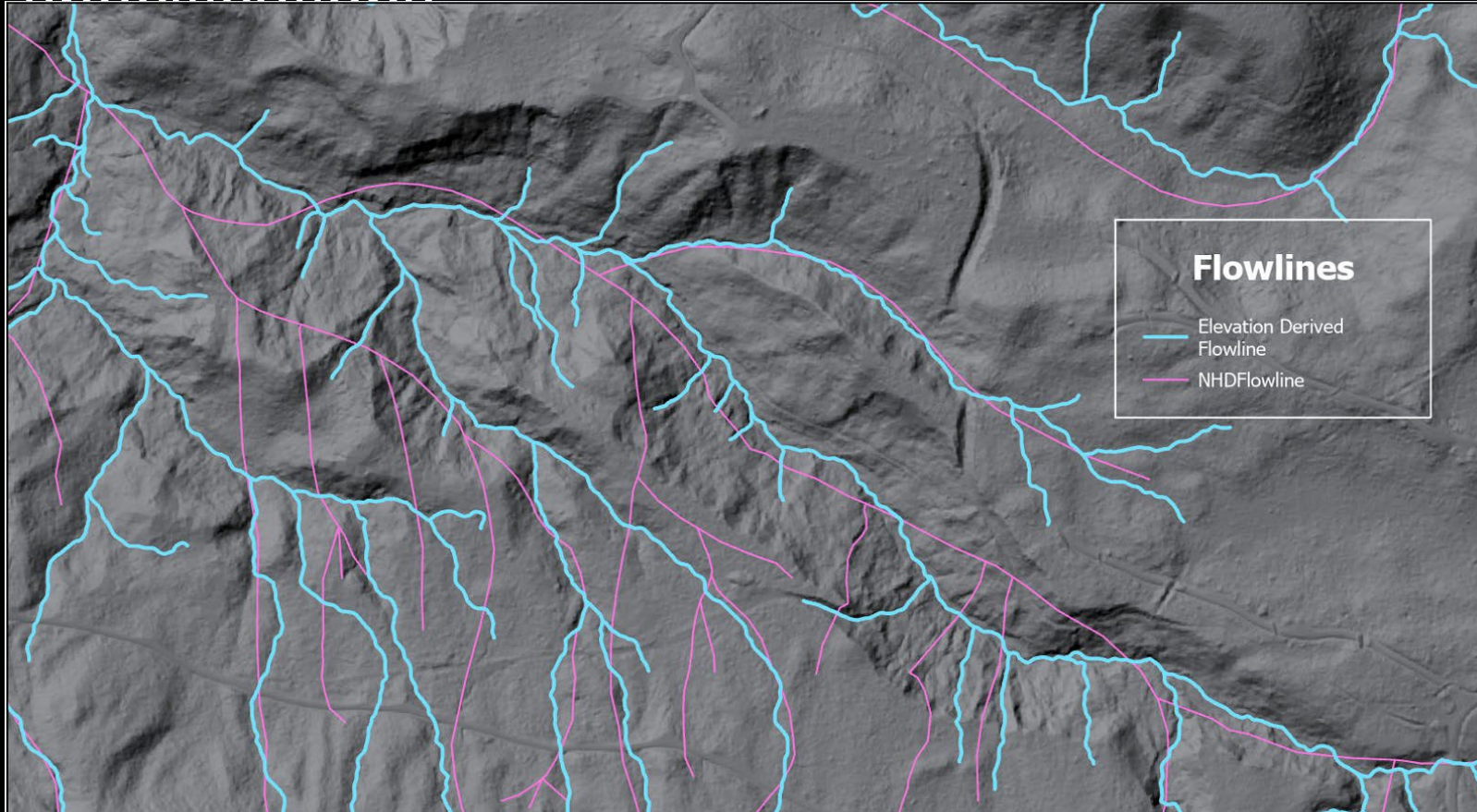


2022



3DHP | MORE ACCURATE, MORE PRECISE

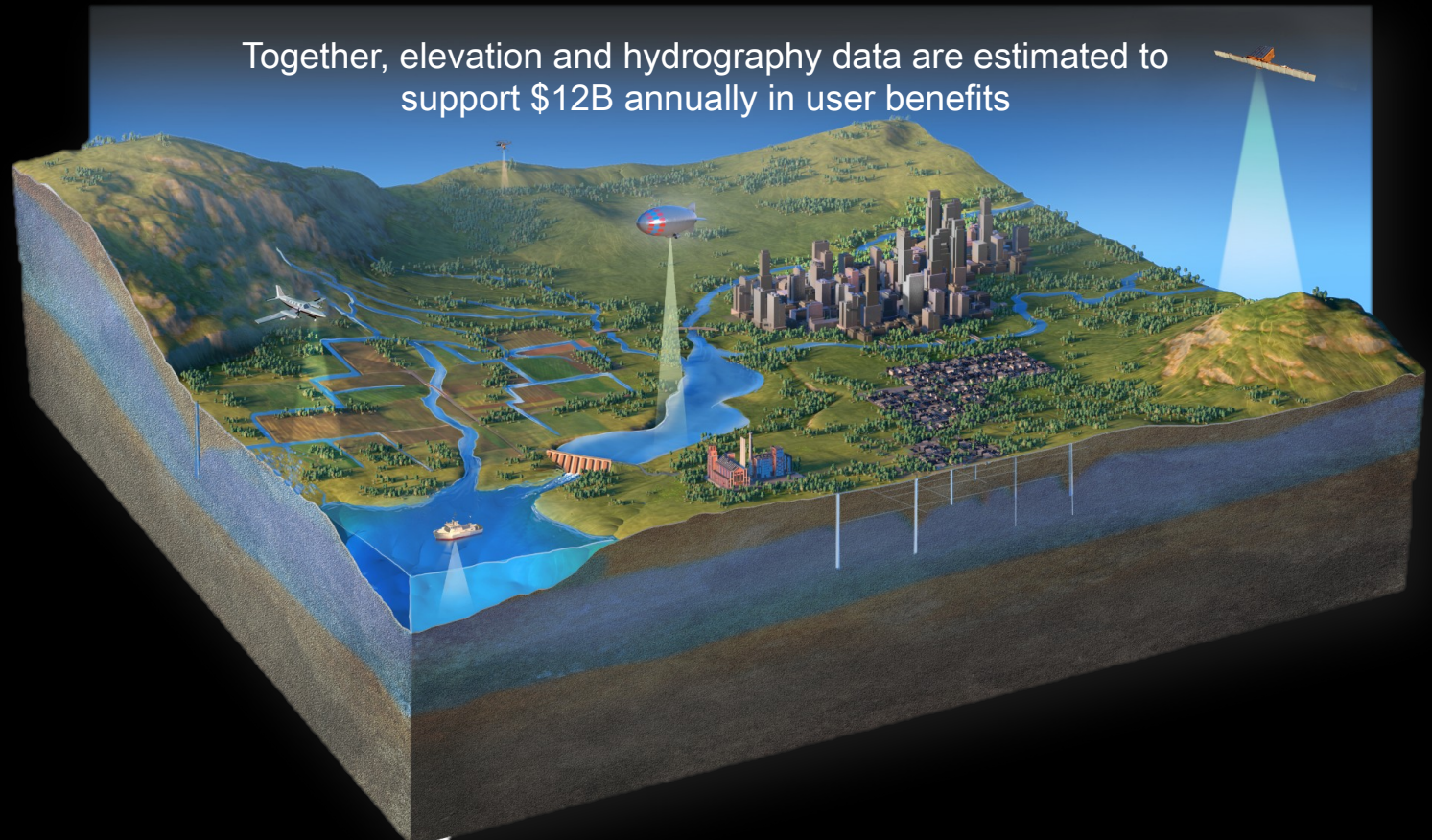
Data collected and validated to meet
specifications



NHD-3DHP Comparison, Northern WA

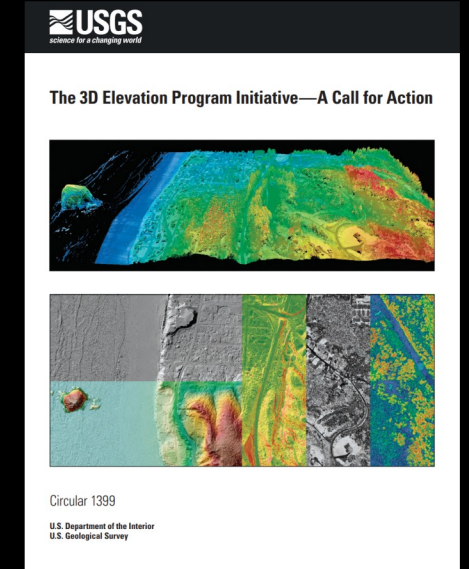
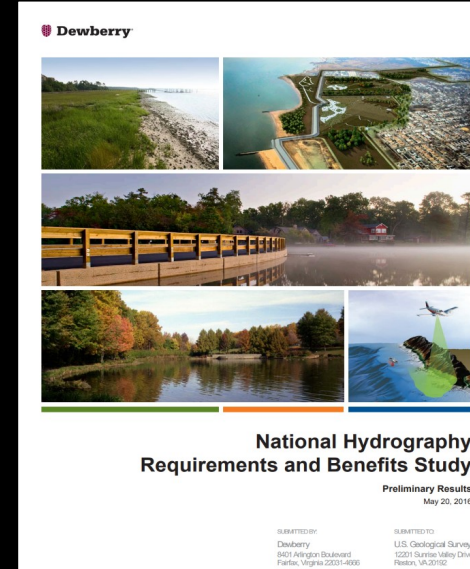
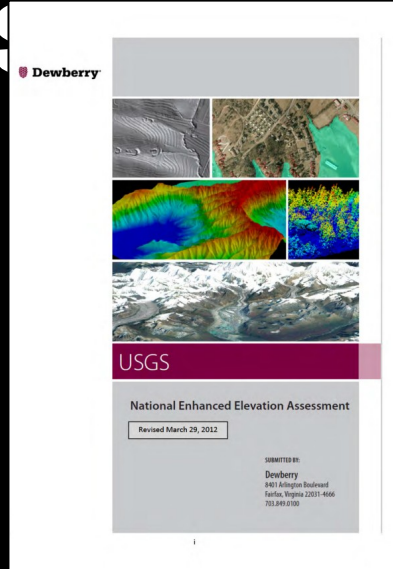
3D NATIONAL TOPOGRAPHY MODEL (3DNTM)

- A living model of the Nation's topography in 3D that incorporates the latest geospatial data
- A landscape-level digital twin
- Spatial and temporal alignment of USGS elevation and hydrography
- Provides foundational data to Earth MRI, National Landslides Preparedness Act, and more
- Together, elevation and hydrography data are estimated to support \$12B annually in user benefits



3DNTM BENEFITS

3D Elevation Program (3DEP) \$690 million annually in benefits for baseline elevation coverage of the country, 3DEP next generation data is estimated at \$7.6 billion in annual benefits



3D Hydrography Program (3DHP) When fully implemented, \$1.047 billion in annual benefits

Together, elevation and hydrography data are estimated to support **\$12B annually in user benefits**

Business Use Type	Potential Annual Benefits		
	Elevation	Hydrography	Combined
Flood Risk & Coastal Zone Management	\$ 4.1 B	\$ 149.1 M	\$ 4.3 B
Security, Safety & Disaster Response	\$ 2.6 B	\$ 5.6 M	\$ 2.6 B
Infrastructure	\$ 1.9 B	\$ 16.0 M	\$ 1.9 B
Water Resource Management	\$ 279.9 M	\$ 825.8 M	\$ 1.1 B
Critical Minerals & Unleashing Energy for America	\$ 886.3 M	\$ 5.8 M	\$ 892.1 M
Natural Resource Development	\$ 739.3 M	\$ 119.3 M	\$ 858.6 M
Agriculture & Land Management	\$ 83.7 M	\$ 11.4 M	\$ 95.1 M
Other	\$ 156.3 M	\$ 8.6 M	\$ 164.9 M
Total	\$ 10.9 B	\$ 1.1 B	\$ 12.0 B

Annual benefits calculated through the National Enhanced Elevation Assessment, 3D Nation Elevation Requirements and Benefits Study, and National Hydrography Requirements and Benefits Study)

DATA ARE CRITICAL TO PROVIDING INSIGHTS



How LiDAR is Being Used to Help With Natural Disaster Mapping and Management

10 May 2019 | THE ENGINEERING COMMUNITY



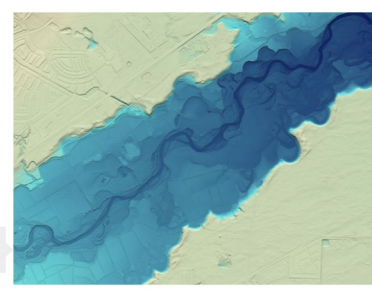
Figure 1. U.S. Geological Survey (USGS) flood-inundation maps for a 3.95-mile reach of the Saluda River near Greenville, South Carolina, originating approximately 150 feet downstream from Saluda Lake Dam. A lidar-derived digital elevation model was used to aid in hydraulic modeling to create these maps. The extent of inundation depicted corresponds to river stages of 20.0 feet (A) and 6.0 feet (B) at USGS streamgage 02162500 (yellow triangle) on the Saluda River. The red line corresponds to the model extent.

Revealing our dynamic landscape through new high-resolution topographic data

Nevada Bureau of Mines and Geology's regional-scale lidar mapping provides novel insights into earthquake, flood and glacial history

Science & Technology | December 16, 2018
Jane Torn

Lidar mapping of the Carson River near Dayton, Nevada, indicates flood history and helps inform planning by accurately defining what land could be inundated when flood waters rise.

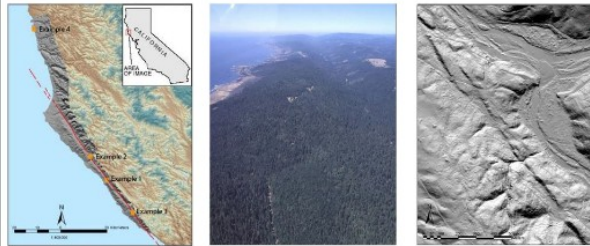


July 19, 5 p.m.



NY Times article "See How the Dixie Fire Created Its Own Weather"

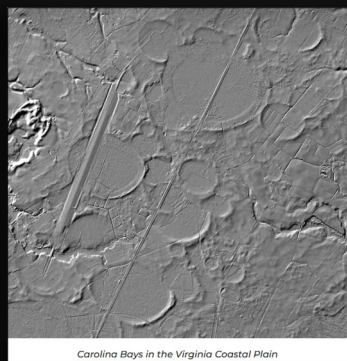
Lidar for earthquakes



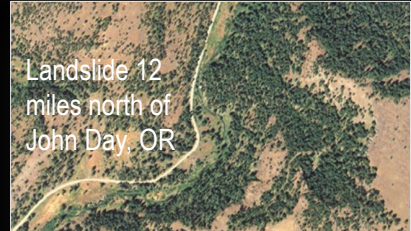
- Lidar allows us to see hazards through heavy forest
- Hillshade from bare-earth DEM
- San Andreas fault, CA



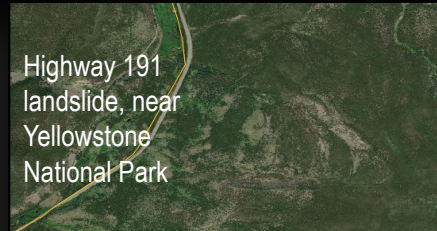
Lidar Reveals Chacoan Roads and Ritual Sites at Gasco Site



Carolina Bays in the Virginia Coastal Plain



Landslide 12 miles north of John Day, OR



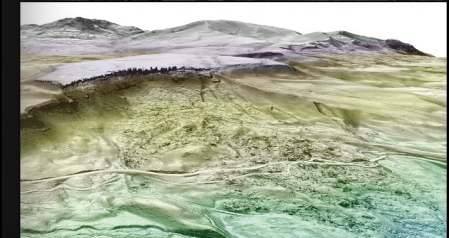
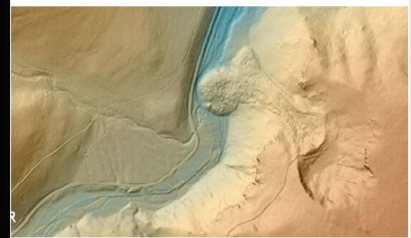
Highway 191 landslide, near Yellowstone National Park



Silver Gate landslide, Yellowstone National Park

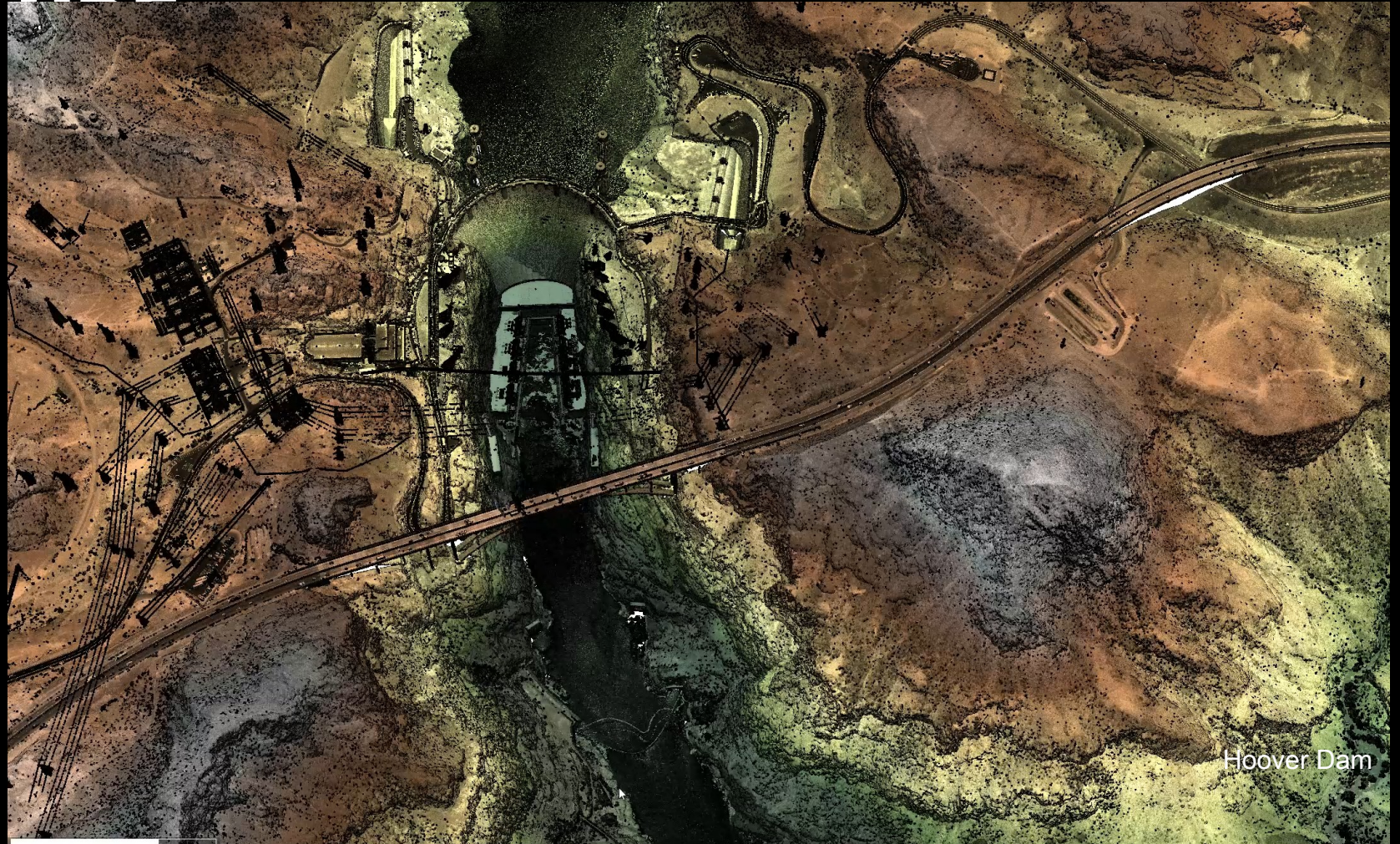


Sinkholes in Knox Group near Highway 460 Giles County



3DEP | INFRASTRUCTURE

3DEP lidar point clouds provide high-resolution, survey-grade data to map once, use many times
Terrain, vegetation, constructed features and water all captured simultaneously
Derivatives integrate due to source lidar
Enables landscape-level digital twins for simulation and modeling



Hoover Dam

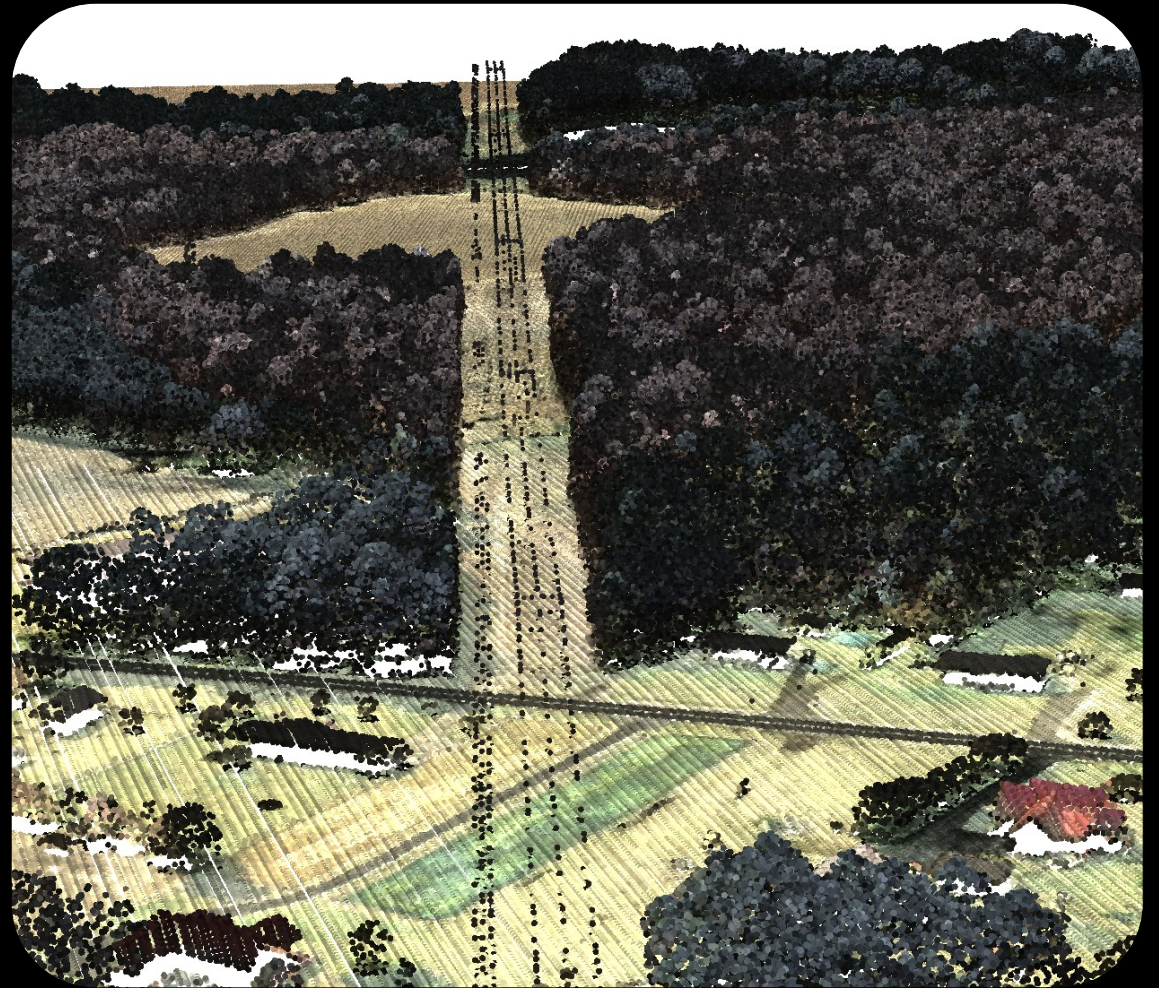
3DEP | UTILITY VEGETATION ENCROACHMENT

Lidar is excellent at mapping the relationship between vegetation and power lines
Enables 3D modeling of potential trees 'falling over' on to power lines based on tree heights and distance to lines

The North American Electric Reliability Corporation (NERC) is a not-for-profit, international regulatory authority dedicated to effectively and efficiently reducing risks to the reliability and security of the bulk power system.

NERC compliance for vegetation control, governed by standard FAC-003-5, requires transmission owners to prevent vegetation-related outages on lines

Utilities must maintain a minimum vegetation clearance distance (MVCD), perform annual inspections (max 18 months apart), and document maintenance strategies to avoid penalties.



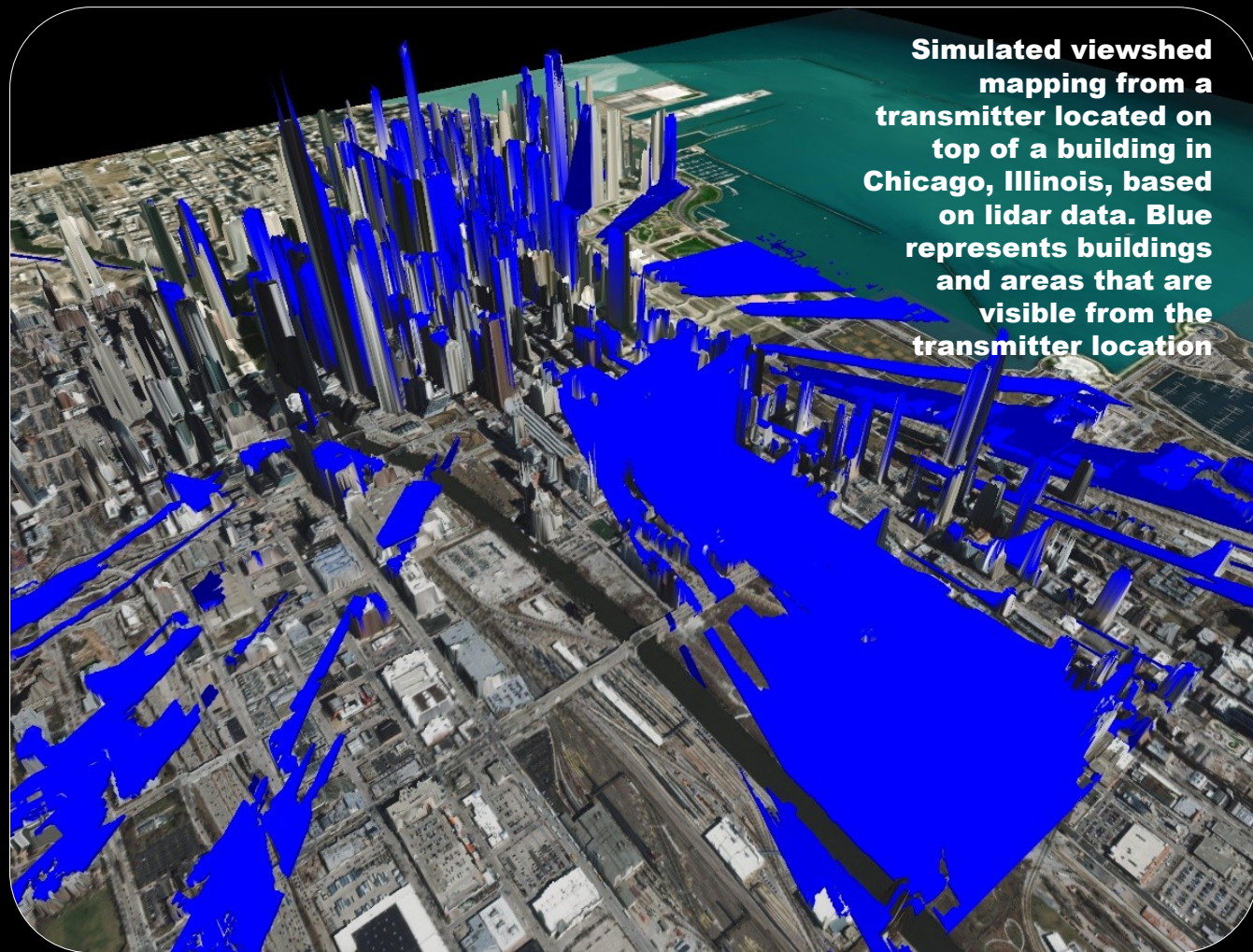
3DEP lidar is essential for broadband permitting, design and siting

Line-of-sight analyses for signal propagation studies

Identification of the optimum locations and heights for cell tower networks

Modeling the potential impact to wireless signals of future development and vegetation growth

Mapping existing towers and designing and permitting new infrastructure



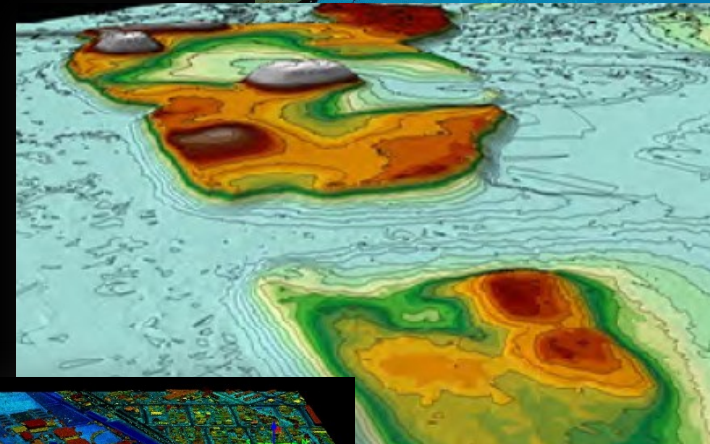
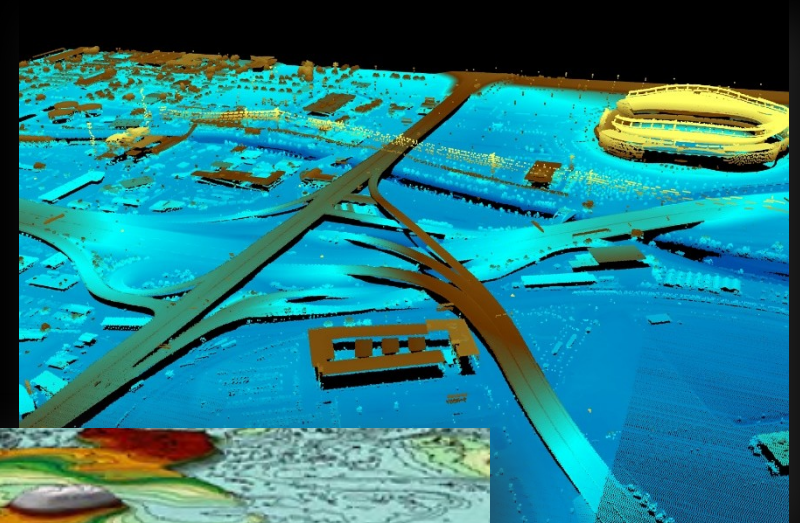
3DEP | TRANSPORTATION Planning and Development

Economically site new or relocate existing infrastructure facilities and make final design plans

- Dramatically reduces the amount of time needed to understand the area in 3D compared to surveying
- Provides greater safety over other traditional surveying methods because it reduces the number of surveyors in traffic
- Reduces intrusion into private properties

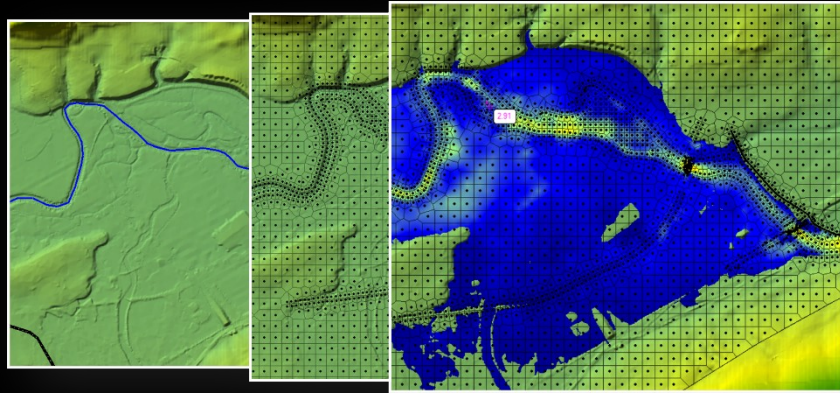
Common uses include:

- Calculate cut and fill, culvert sizing, amount of vegetation removal, grade calculation and more
- Height clearances
- Right of way and surface conditions
- Identification of cultural and sensitive sites

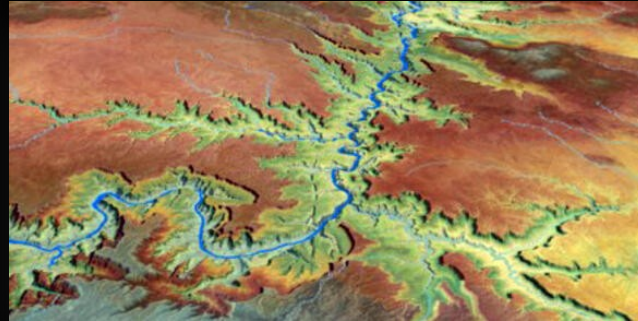


The Kentucky Transportation Cabinet realized tremendous savings from compressed design timeframe and reduced fieldwork, including the identification of previously unknown prehistoric and historic earthworks and mounds and other cultural and sensitive sites

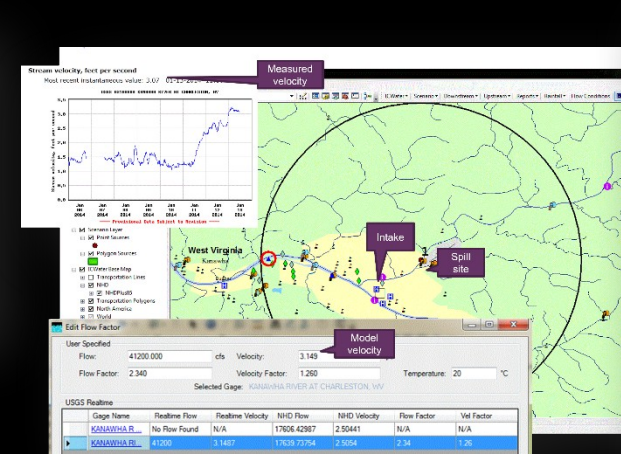
3DEP & 3DHP APPLICATIONS



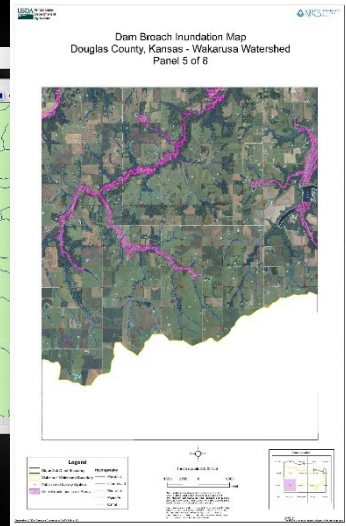
Flood Modeling



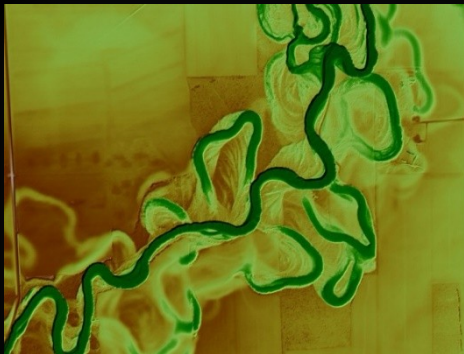
River and Streamflow Management



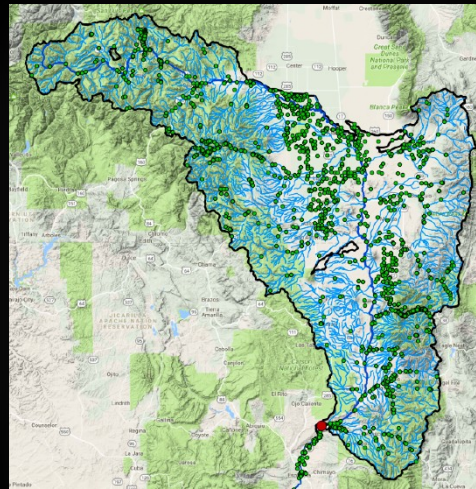
Spill Response



Dam Breach Analysis



Aquatic Habitat Monitoring



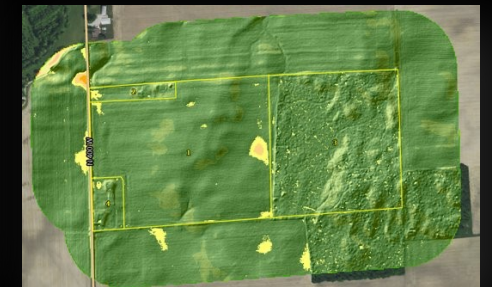
Water Quality Modeling and Monitoring



Active and Post-Fire Response



Flood Risk Management



Agriculture Management

3DEP & 3DHP | FLOOD MODELING

Extent and depth of floodwater

Integrated elevation and hydrography data allow more precise prediction of flood depth

Flood depth is critical to rescue deployment – high clearance vehicle or boat/aircraft

Flood depth also directly correlates to damage/loss



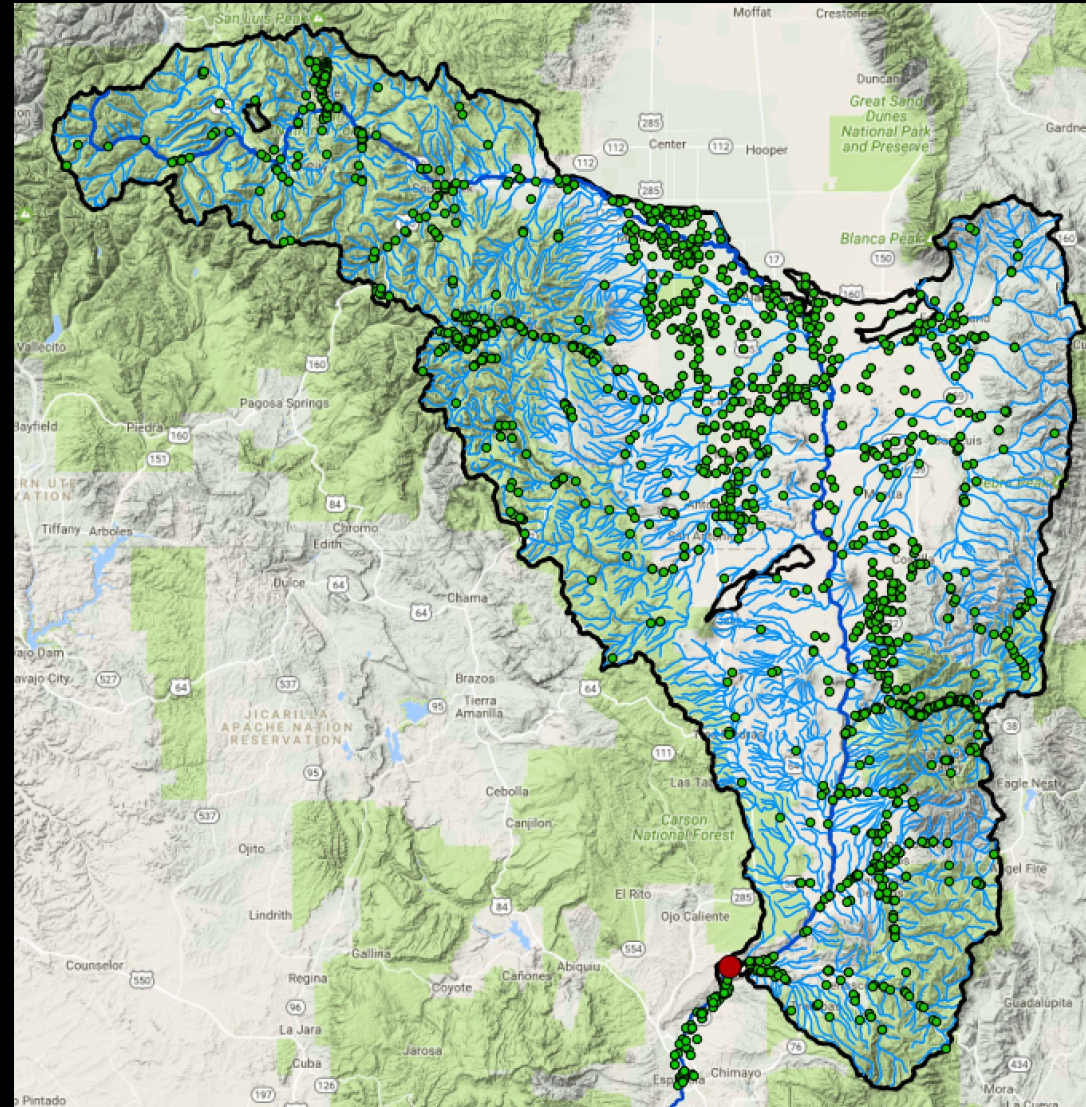
3DHP | RIVER AND STREAMFLOW MANAGEMENT

Many of the Nation's rivers, from the Delaware to the Mississippi, to the Colorado and Columbia are closely managed for competing uses
Making the data collected by many diverse agencies available to everyone is the first step towards shared management

-  **F**indable
-  **A**ccessible
-  **I**nteroperable
-  **R**eusable
-  **+** consistent, high-quality

Making observations
FAIR

HRBS estimated benefit to River and Stream Flow Management - \$155m/year



But this is just the beginning...

THE NEXT GENERATION OF 3DEP

- Notable upgrades to 3DEP will meet user requirements from the 3D Nation Study
 - *Extend* under water with bathymetric data
 - *Integrate* with hydrography and other data layers through a 3D National Topography Model
 - *Interconnect* networked components through an ecosystem approach to provide analysis-ready data
 - *Update* data holdings to improve quality and currency, enabling change detection and analysis

USGS
science for a changing world

National Geospatial Program

The 3D National Topography Model Call for Action—
Part 2: The Next Generation 3D Elevation Program



Circular 1553

U.S. Department of the Interior
U.S. Geological Survey

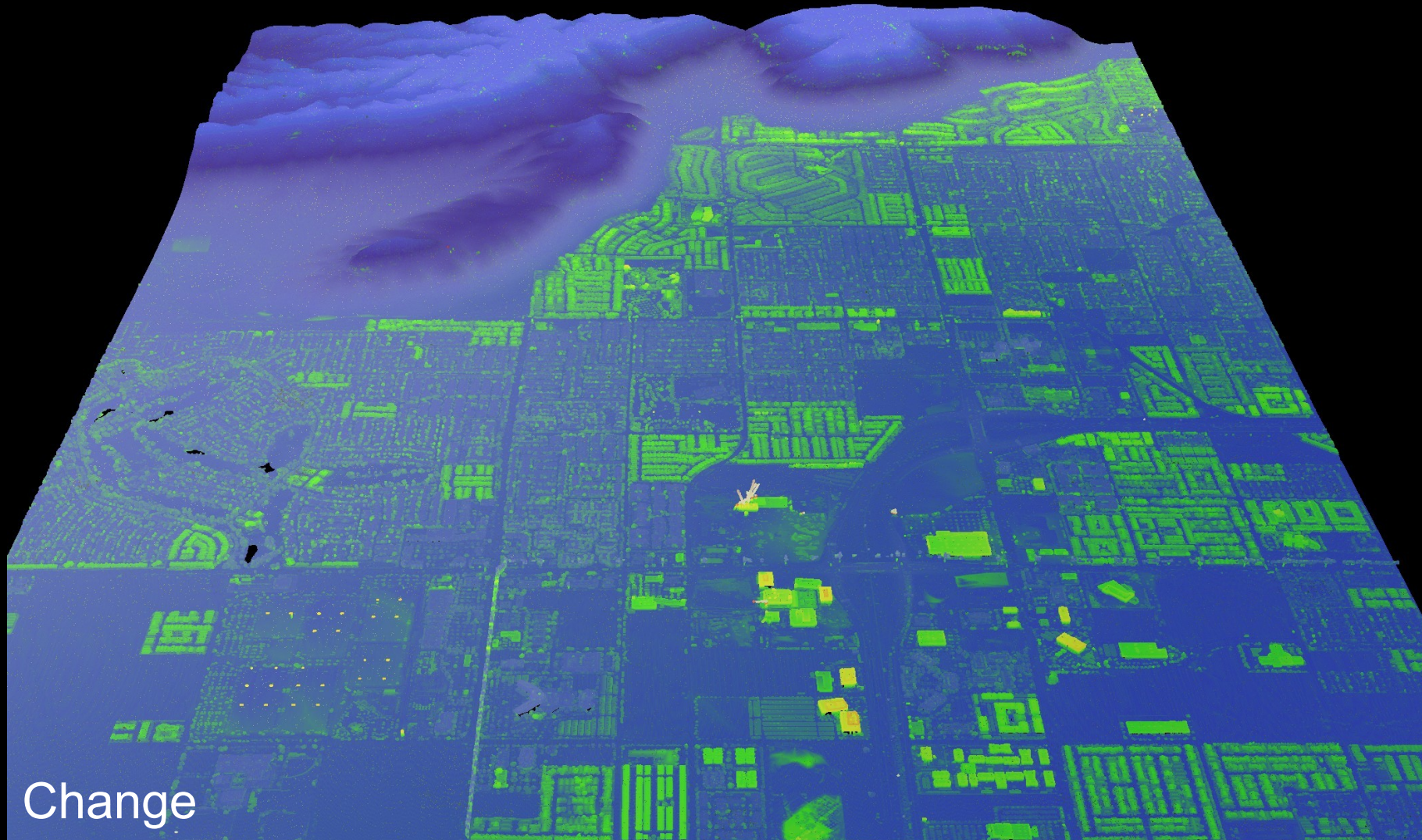
3DEP | DETECTING CHANGE

Before and after the Eaton Fire, Los Angeles County, CA



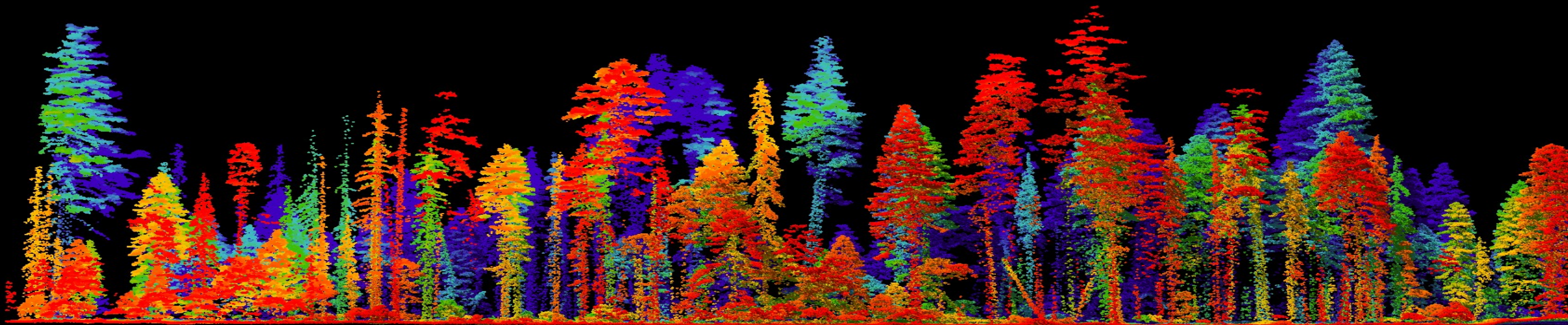
3DEP | DETECTING CHANGE

Land use change- Las Vegas, NV (2010-2022)



Change

THANK YOU!



3DEP Point Cloud
Data
Yosemite National
Park