

# USGS: 3D Elevation Program (3DEP) Meeting the needs of the Nation

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***The National Map***  
Your Source for Topographic Information

# 3D Elevation Program (3DEP)

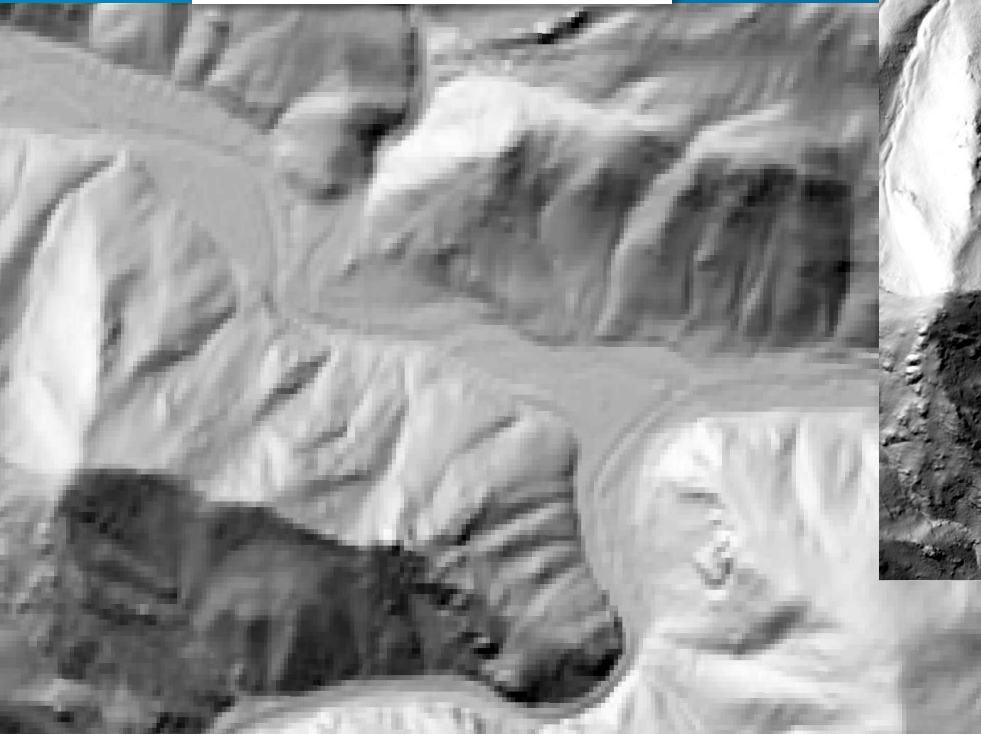


- Applies ground-breaking lidar technology to acquire and distribute three-dimensional data of bare earth, vegetation and structures at centimeter-level accuracy
- Increases the quality level of lidar being acquired to enable more accurate understanding, modeling, and prediction
- Goal to acquire national coverage in 8 years to serve a broad range of critical applications

# 3DEP Data Quality

Improves and Enables Applications

10 meter resolution



1 meter resolution



# Enable: Flood Risk Management

## Centimeters Matter!

- Red River, MN lidar shows changing river morphology
- QL2 provides 10 cm of additional accuracy over QL3 – critical to flood risk management, particularly in areas of low relief

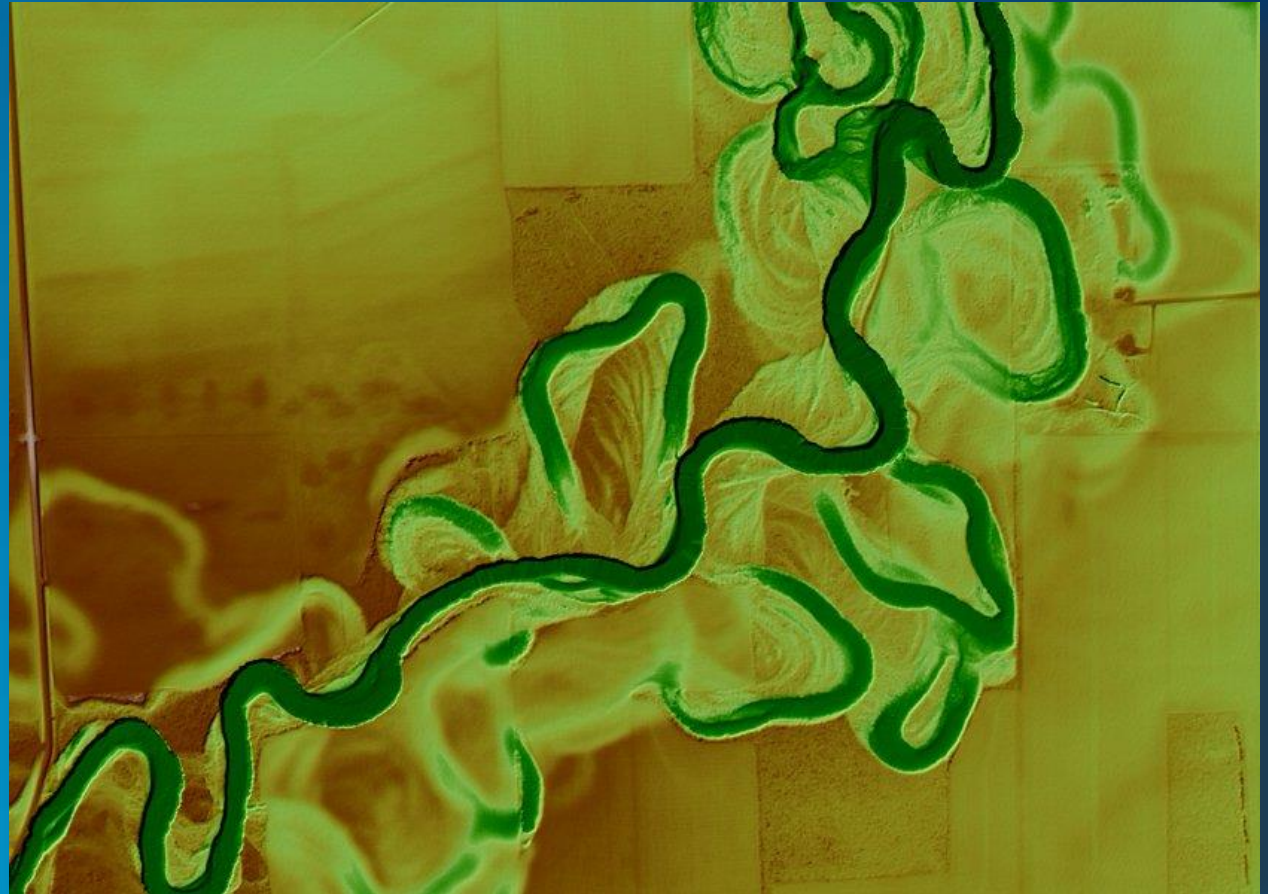
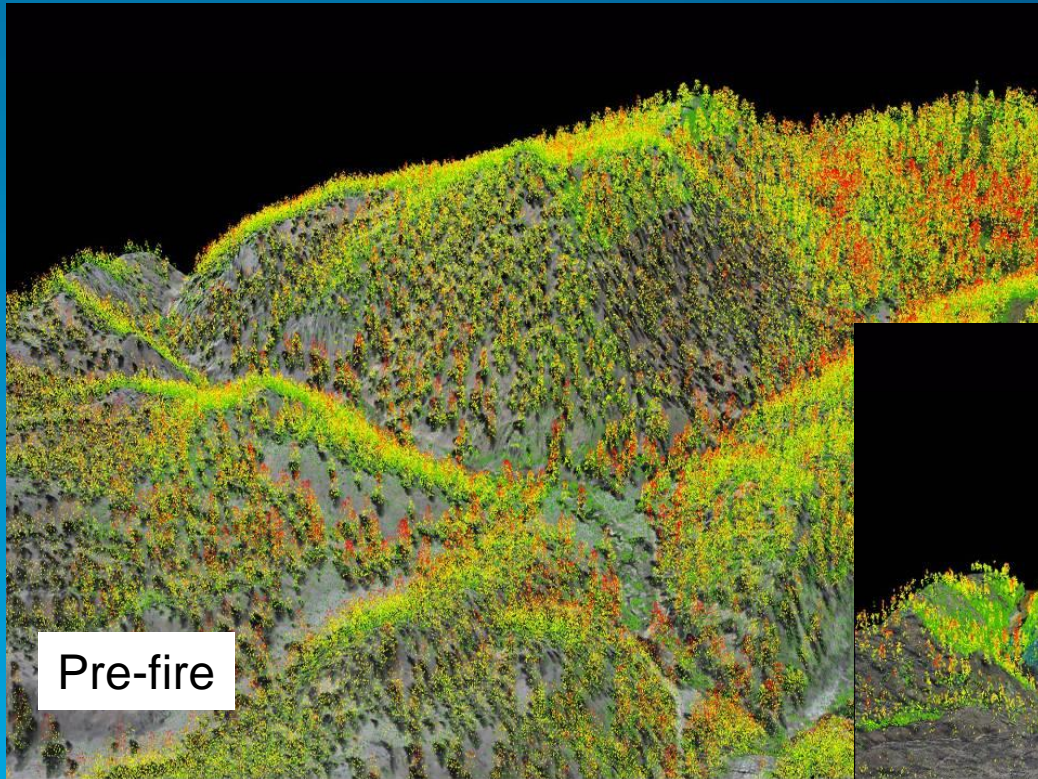


Image from Fugro Geospatial

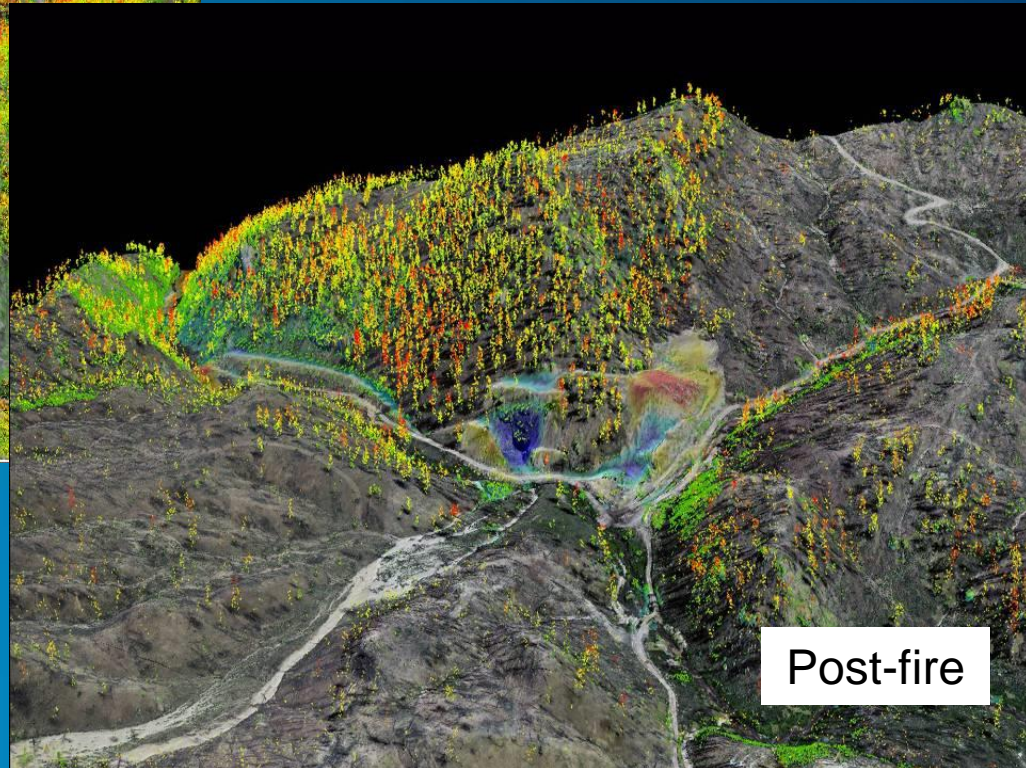


# Enable: Fire Disturbance Assessment



Pre-fire

Hayman Fire, CO



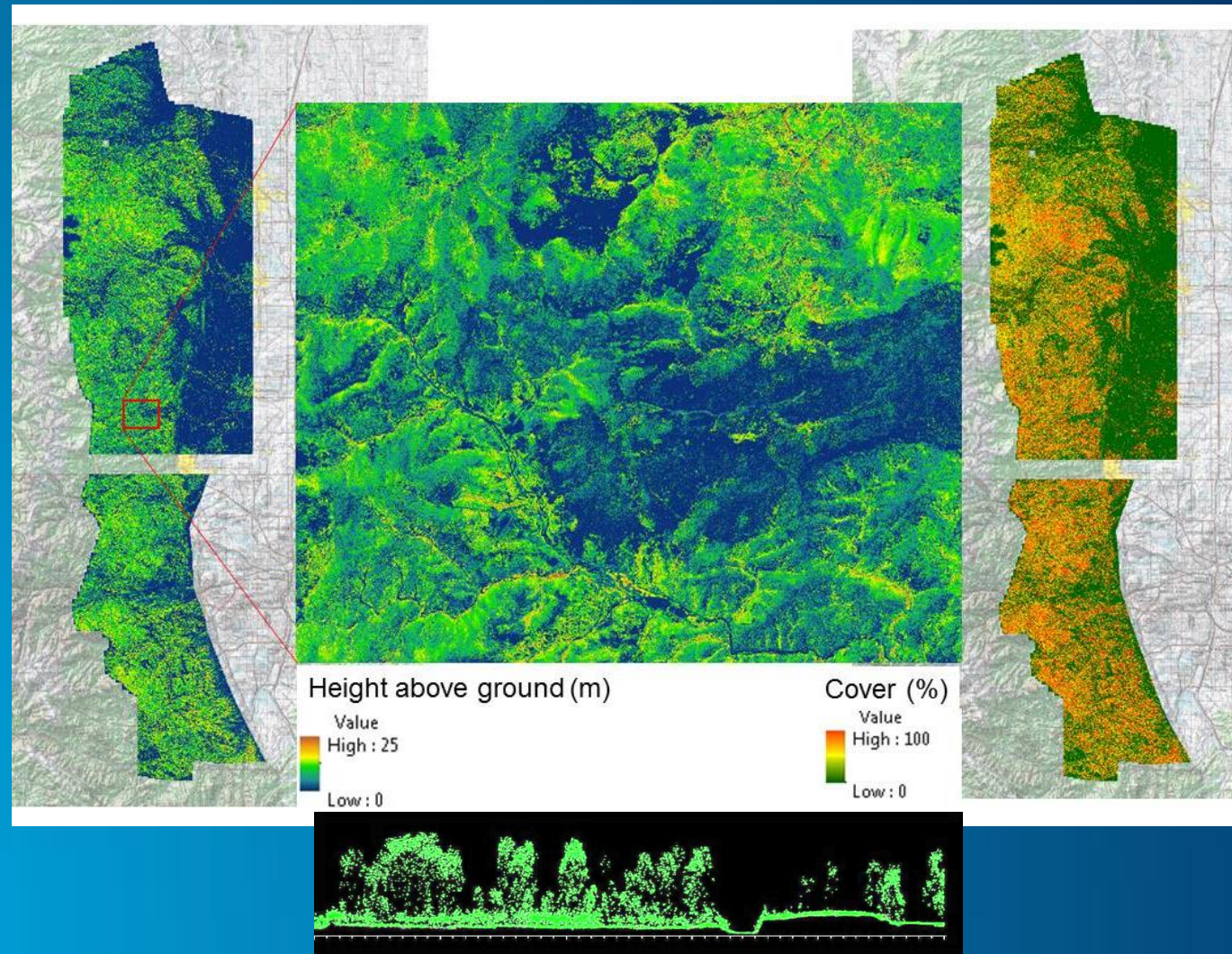
Post-fire



# Enable: Land Management

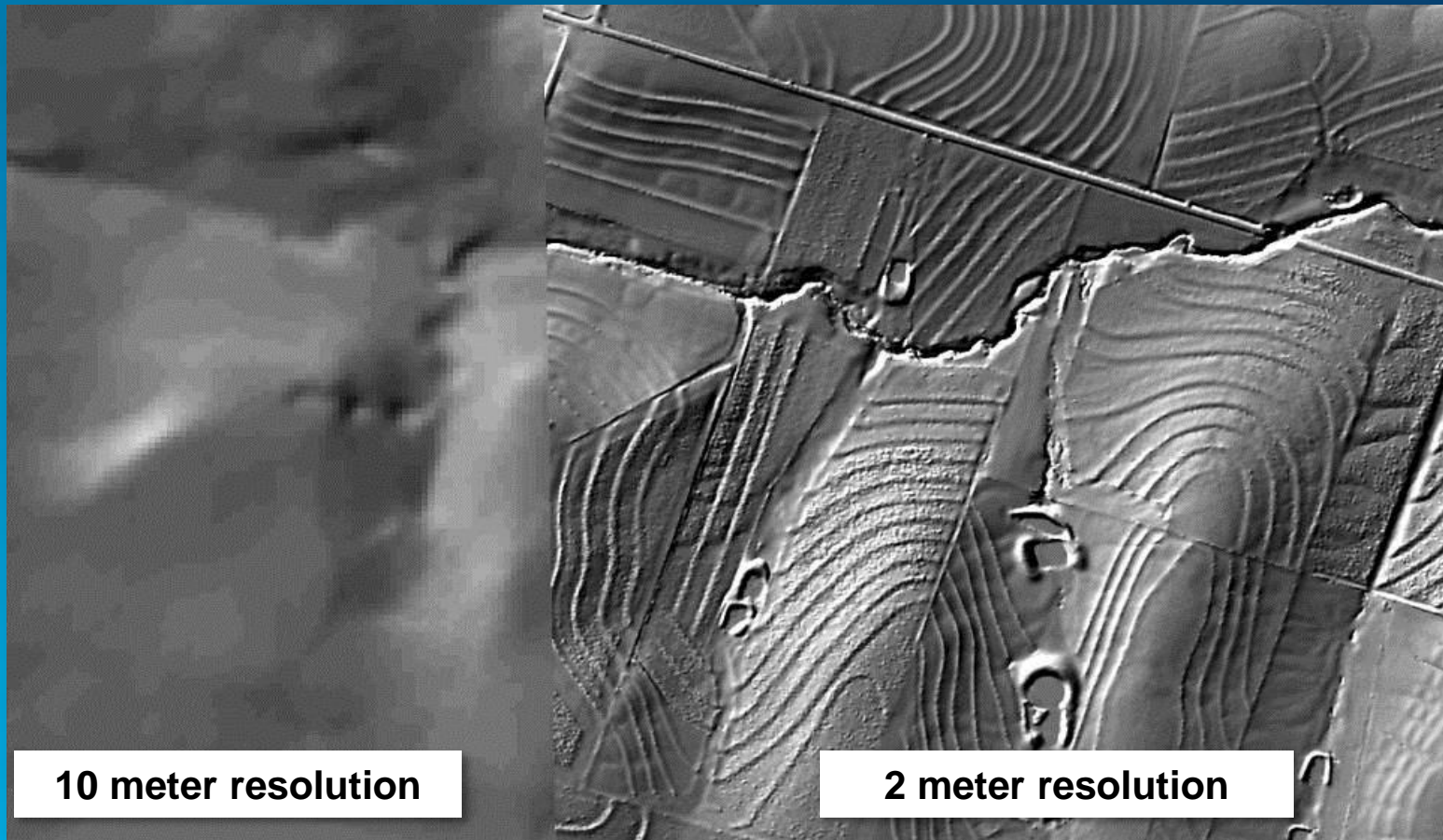
## Vegetation Height and Cover: Inputs to Multiple Applications

- Biomass/ carbon estimations
- Habitat suitability models
- Fire behavior models
- Identify structures that may be at risk for fire



# Enable: Precision Agriculture

Improved Data Quality



**10 meter resolution**

**2 meter resolution**

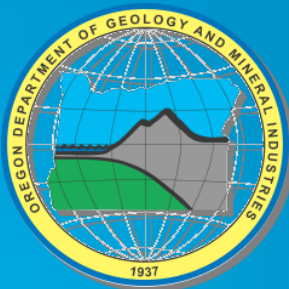
Courtesy of NRCS



# Enable: Landscape-Level Understanding

## Landslide hazards John Day, OR area




- Aerial photo image (top)
- Lidar image (bottom) of same area provides visible evidence of landslide activity

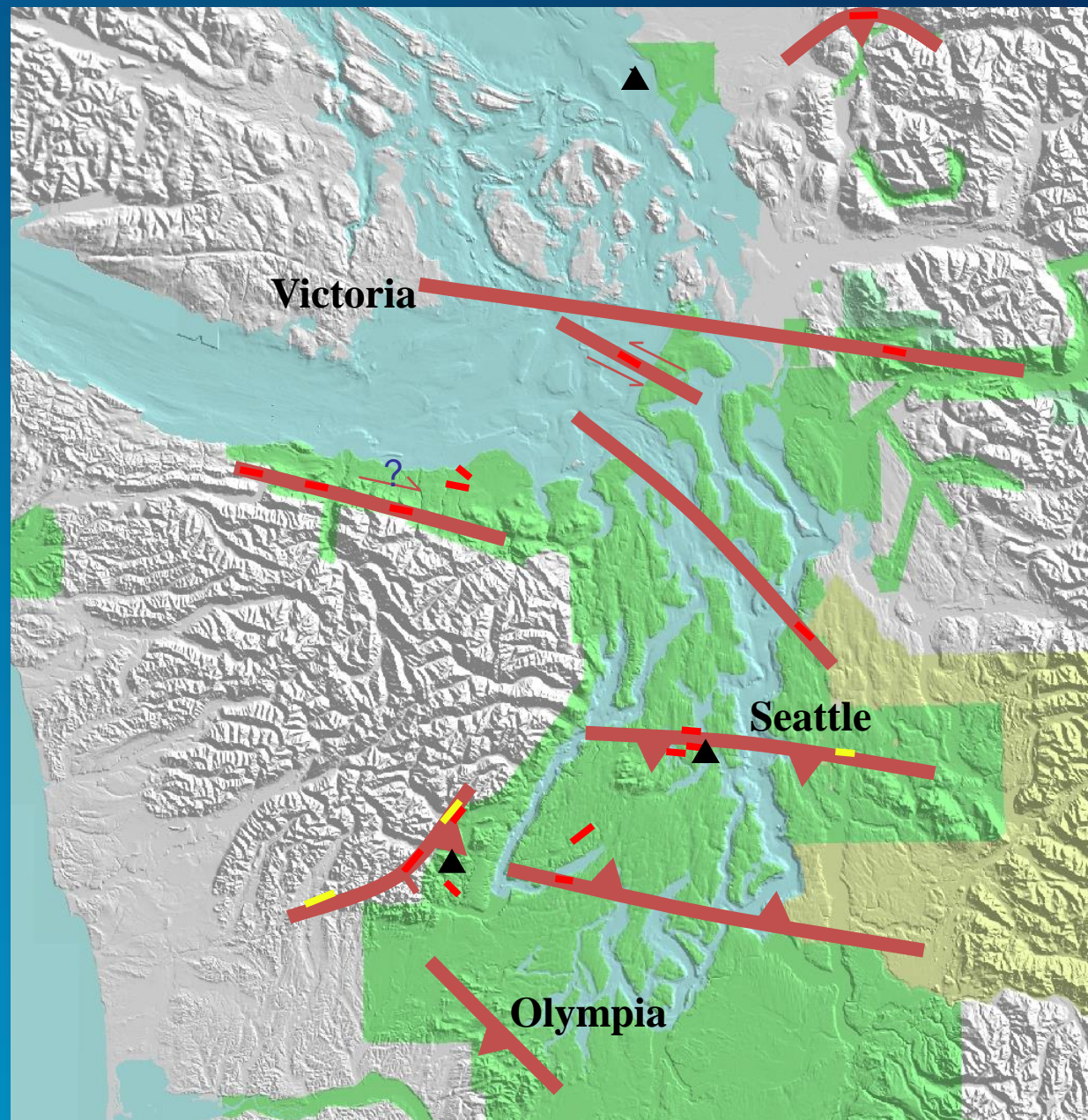




# Enable: Hazards Mitigation

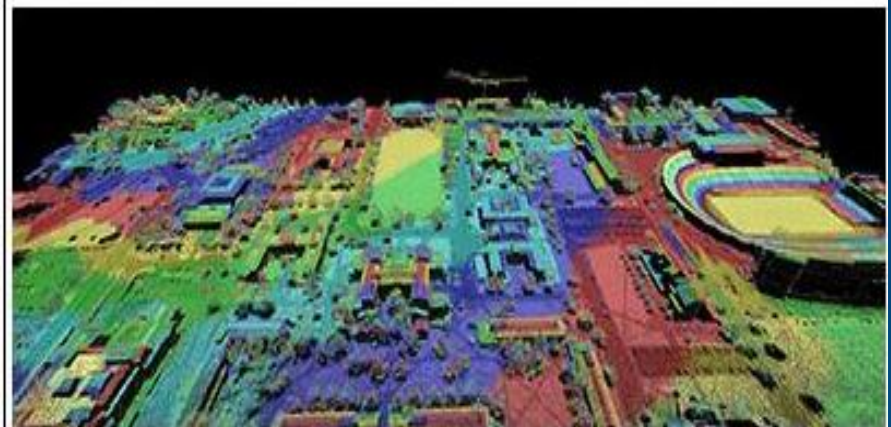
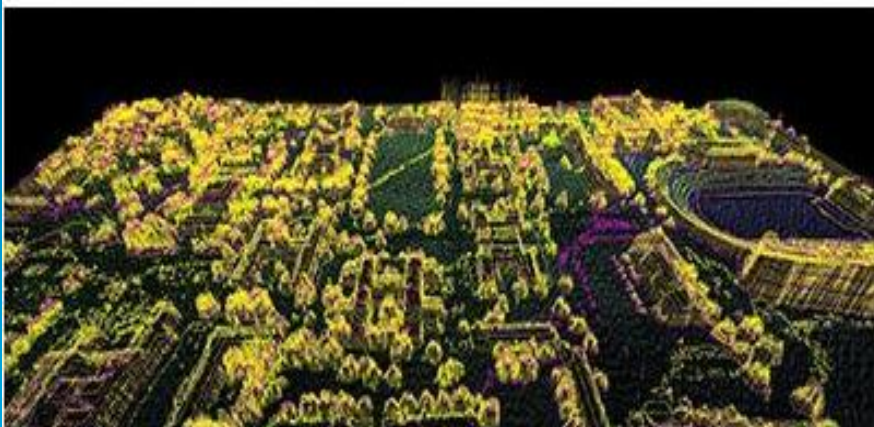
## Detecting Faults

-  Scarp found with LiDAR
-  Scarp found other means
-  Geomorphic evidence of shoreline uplift





# Enable: Infrastructure Management



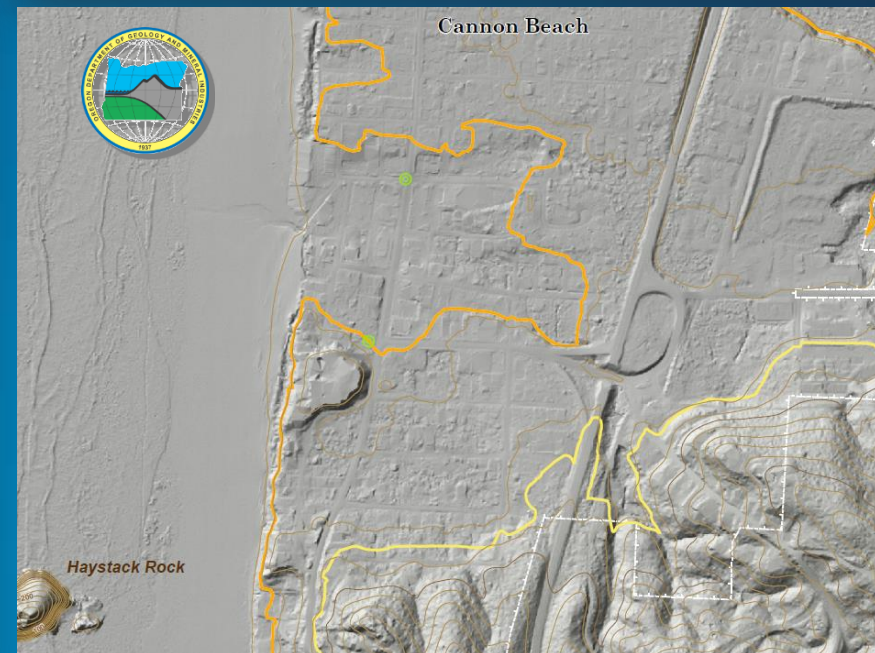
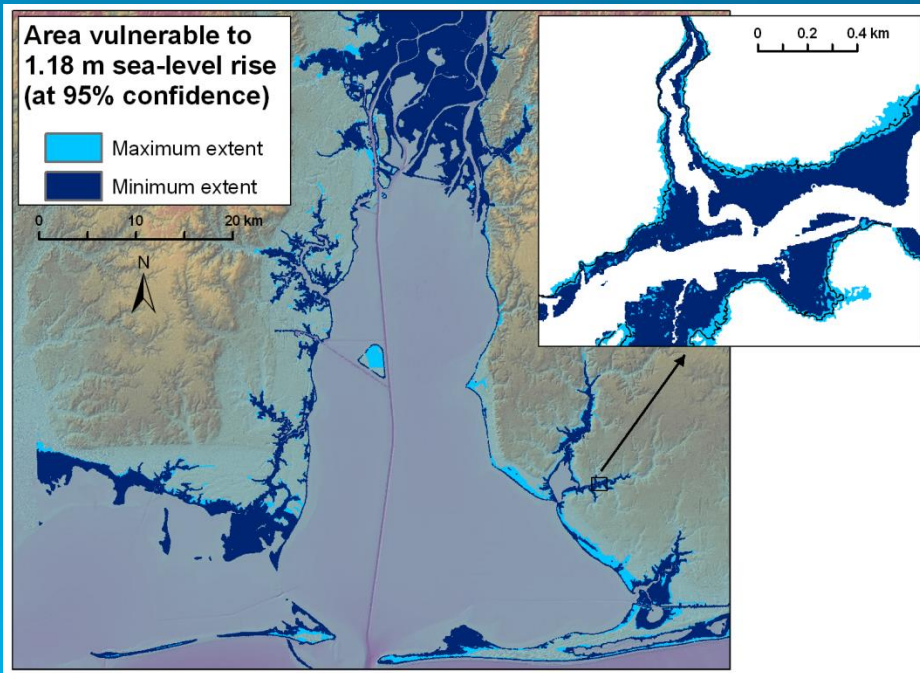
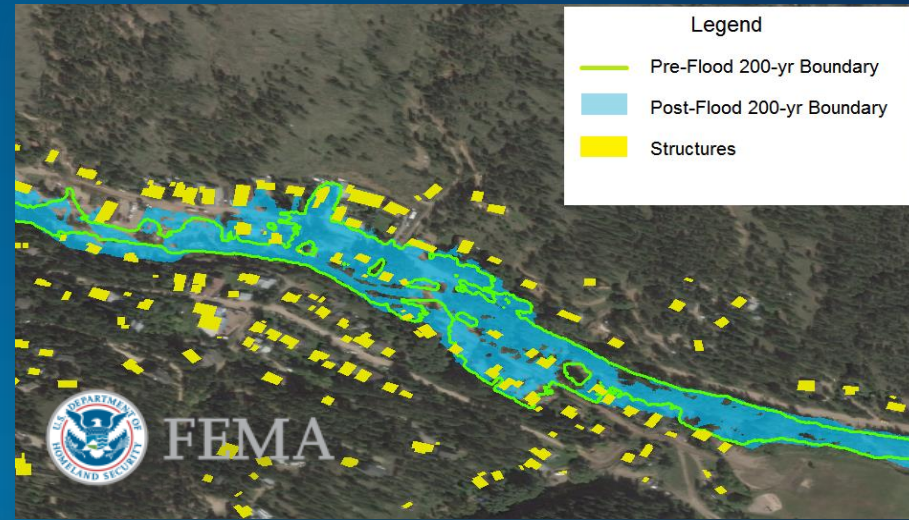
- Route, grade, line-of-sight, and utility surveys and corridor mapping
- Terrain and other obstruction identification
- Dam, levee, and coastal structure failure modeling and mitigation
- Hydraulic and hydrologic modeling

- Geotechnical evaluations
- Permit application and construction plan development and evaluation
- As-built model development
- Preliminary engineering, estimate development, and quantity estimation activities



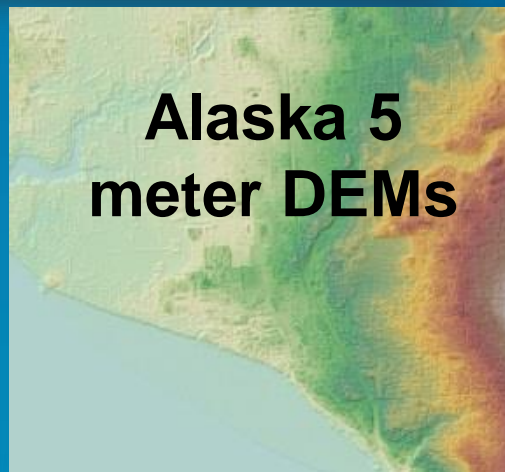
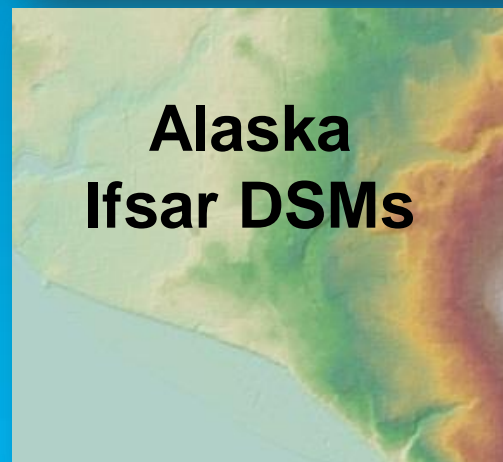
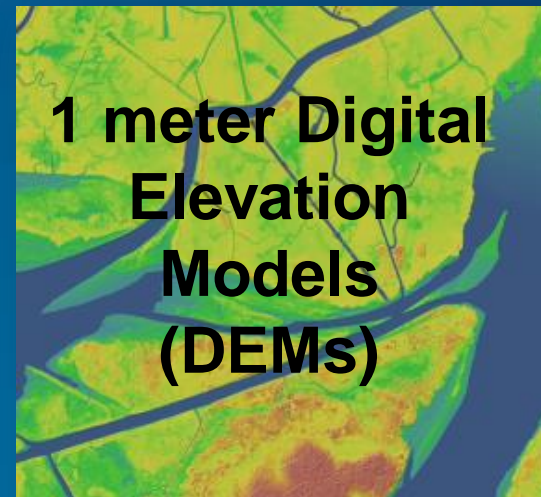
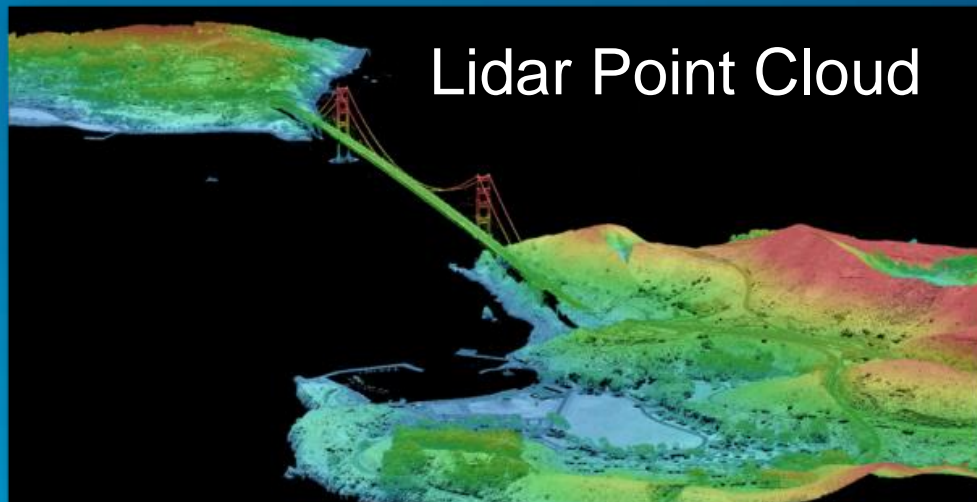
# Enable: Climate Resilience

- Subsidence
- Flood Risk Mapping
- Tsunami Inundation



# 3DEP New Products and Services

In The National Map beginning in 2015





# 3DEP New Products and Services

## In The National Map beginning in 2015

The screenshot displays the USGS TNM Download (V1.0) web application interface. The top navigation bar includes the USGS logo, the title "TNM Download (V1.0)", and links for "How to", "Start Over", "Custom Views", and "Share Link". The right side of the header features "The National Map" logo with the tagline "Your Source for Topographic Information".

The main interface is divided into several sections:

- Left Panel (Filters):**
  - Datasets:** Includes "Advanced Search Options" with a "Find Products" button.
  - Map:** Includes "US Topo" and "Historical Topographic Maps".
  - Data:** Includes "Boundaries - National Boundary Dataset", "Elevation Products (3DEP)", and "Elevation Source Data (3DEP)".
  - Product Search Filter:** Includes "All Subcategories" (DEM Source (OPR), Ifsar Digital Surface Model (DSM), Ifsar Orthorectified Radar Image (ORI), Lidar Point Cloud (LPC)), "File Format" (LAS), and "Data Extent" (Varies).
  - Availability Legend:** A color-coded legend for DEM Source (OPR), Ifsar DSM (Alaska only), Ifsar ORI (Alaska only), LPC - Nominal Pulse Spacing > 0.7m, LPC - Nominal Pulse Spacing 0.36m - 0.7m, LPC - Nominal Pulse Spacing < 0.35m, and LPC - Nominal Pulse Spacing Unknown.
  - Other Filters:** Includes "Hydrography (NHD) and Watersheds (WBD)", "Imagery - 1 foot (HRO)", "Imagery - 1 meter (NAIP)", "Map Indices", and "Names - Geographic Names Information System (GNIS)".
- Right Panel (Map):**
  - Map Tools:** Includes "Use Map", "Map Indices", "Box/Point", "Current Extent", "Coordinates", "Located Point", "Polygon", and "1 Degree", "15 Minute", "7.5 Minute", "All".
  - Search:** Includes "Address/Place" and "Search location" with "Go" and "Clear" buttons.
  - Map View:** A map of the Eastern United States showing various elevation products. A "Description" thumbnail is visible.
  - Scale and Coordinates:** Includes a scale bar (100 km, 100 mi) and "The National Map" logo. Coordinates are shown as "Lat/Lng 34.5247, -89.2529".

# 3DEP New Products and Services

## In The National Map beginning in 2015

The screenshot displays the USGS National Map viewer interface. On the left, the 'Products' tab is active, showing a list of 'Available Products' under the 'Elevation Source Data (3DEP)' category. The list includes five USGS Lidar Point Cloud (LPC) datasets for the Bear River area, each with a preview thumbnail, published date, metadata update date, and format details. A 'Return to Search' and 'View Cart' button are visible above the list. The main map area on the right shows a 3D visualization of the terrain, with the Bear River valley highlighted in a color gradient from purple (low elevation) to green and yellow (higher elevation). The map includes a search bar, navigation controls, and a scale bar. The USGS logo is in the top left, and 'The National Map' logo is in the top right. The footer contains the URL 'viewer.nationalmap.gov/basic/#productSearch' and links for 'Accessibility', 'FOIA', 'Privacy', and 'Policies and Notices'.

Preview	Product	Actions	Cart
	USGS Lidar Point Cloud (LPC) UT_BearRiver_2011_000022 2014-09-15 LAS Published Date: 2014-09-16 Metadata Updated: 2014-09-24 Format: LAS (75.30 MB), Extent: Varies	Footprint Thumbnail Zoom To Info/Metadata Download	
	USGS Lidar Point Cloud (LPC) UT_BearRiver_2011_000026 2014-09-15 LAS Published Date: 2014-09-16 Metadata Updated: 2014-09-24 Format: LAS (65.91 MB), Extent: Varies	Footprint Thumbnail Zoom To Info/Metadata Download	
	USGS Lidar Point Cloud (LPC) UT_BearRiver_2011_000037 2014-09-15 LAS Published Date: 2014-09-16 Metadata Updated: 2014-09-24 Format: LAS (86.29 MB), Extent: Varies	Footprint Thumbnail Zoom To Info/Metadata Download	
	USGS Lidar Point Cloud (LPC) UT_BearRiver_2011_000003 2014-09-15 LAS Published Date: 2014-09-16 Metadata Updated: 2014-09-24 Format: LAS (75.40 MB), Extent: Varies	Footprint Thumbnail Zoom To Info/Metadata Download	
	USGS Lidar Point Cloud (LPC) UT_BearRiver_2011_000005 2014-09-15 LAS Published Date: 2014-09-16	Footprint Thumbnail	



As of 1/14/2016

# 3D Elevation Program - FY16 Partnership Opportunities<sup>1</sup> (January, 2016)

For more on the 3D Elevation Program (3DEP) visit:  
<http://www.nationalmap.gov/3DEP>

Visit the US Interagency Elevation Inventory (USIEI) at:  
<http://coast.noaa.gov/inventory/>

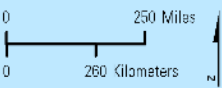
Pacific Ocean

CANADA

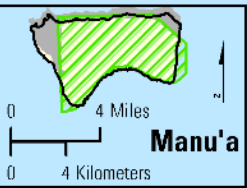
Atlantic Ocean

<sup>1</sup>Map shows extent of projects proposed to the 3D Elevation Program FY16 Broad Agency Announcement (BAA) and through ongoing Federal coordination via the 3DEP Working Group (rechartered NDEP) as of January, 2016. Proposals may be submitted to the BAA through September 30, 2016. Federal coordination is ongoing. The map will be updated as new opportunities and selections are identified.

- 3DEP Specifications:**
- Quality level 2 or better lidar data (ifsar in AK)
  - Publicly available
  - 8 years old or newer as of 2016
- <sup>2</sup>as defined in USGS Lidar Base Specification v1.2



## American Samoa



## Alaska



## Hawaii

MEXICO

### EXPLANATION

- Data Acquisition Partnership Opportunities Selected
- ▨ Data Acquisition Partnership Opportunities Available<sup>1</sup>
- In Progress and Existing Data that Meet 3DEP Specification**
  - lidar
  - ifsar (Alaska)
- Planned Funded Data that Meet 3DEP Specification**
  - ▨ lidar
  - ▨ ifsar (Alaska)
- Data that Do NOT Meet 3DEP Specification**
  - Other lidar data
  - No publicly available lidar data / ifsar in Alaska

Sources:  
3DEP FY15/16 Broad Agency Announcement  
US IEI data from October 2015

## Puerto Rico / US Virgin Islands



Caribbean Sea

## Datasets

[Advanced Search Options](#)

Find Products

Elevation Source Data (OSL)

## Product Search Filter



Description

 All Subcategories DEM Source (OPR)[Show Availability](#) Ifsar Digital Surface Model (DSM)[Show Availability](#) Ifsar Orthorectified Radar Image (ORI)[Show Availability](#) Lidar Point Cloud (LPC)[Hide Availability](#)

## File Format

LAS

## Data Extent

Varies

[Availability Legend](#)

- DEM Source (OPR)
- Ifsar DSM (Alaska only)
- Ifsar ORI (Alaska only)
- LPC - Nominal Pulse Spacing > 0.7m
- LPC - Nominal Pulse Spacing 0.36m - 0.7m
- LPC - Nominal Pulse Spacing < 0.35m
- LPC - Nominal Pulse Spacing Unknown

 Hydrography (NHD) and Watersheds (WBD) Imagery - 1 foot (HRO) Imagery - 1 meter (NAIP) Map Indices Names - Geographic Names Information System (GNIS) National Land Cover Database (NLCD) Small-scale Datasets Structures - National Structures Dataset Topo Map Vector Data Use Map Box/Point Current Extent Coordinates Located Point Polygon: Map Indices 1 Degree 15 Minute 7.5 Minute All

Address/Place ▾

Search location.

Go

Clear



Lat/Lng ▾ 40.1475, -111.0553

100 km  
100 mi  
The National Map

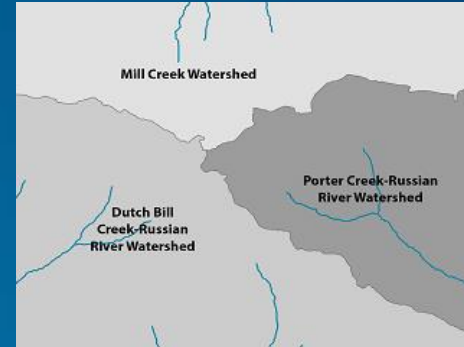


# A best California practice: Sonoma County

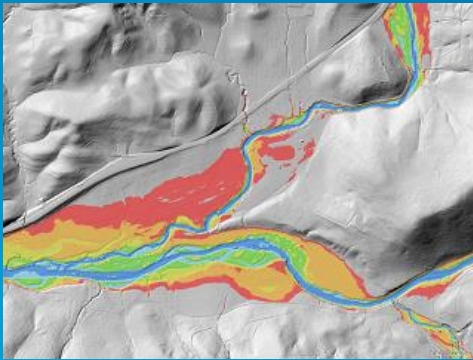
- LiDAR-Derived Streams



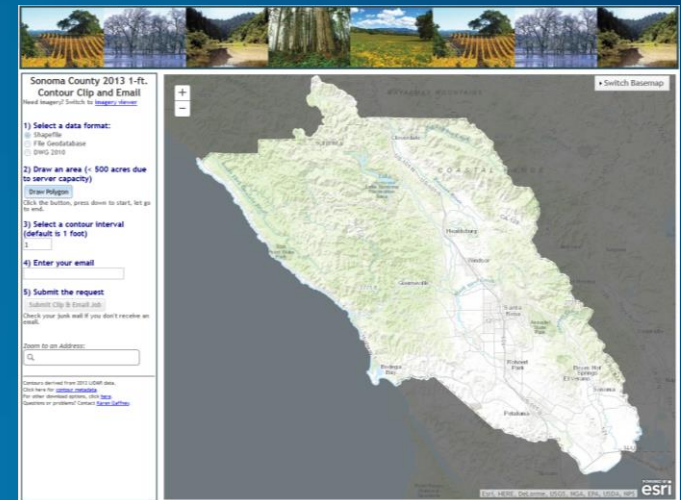
- ◆ LiDAR Derived Watersheds



- LiDAR Derived Hydro-Enforced DEM



- ◆ Clip and ship 1-foot contours



<http://sonomavegmap.org/>

# Quality Level

Quality Level	Source	Vertical Accuracy RMSEz	Nominal Pulse Spacing (NPS)	Nominal Pulse Density (NPD)	DEM Post Spacing
QL1	Lidar	10 cm	0.35 m	8 points/sq meter	0.5 meter
QL2	Lidar	10 cm	0.7 m	2 points/sq meter	1 meter
QL3	Lidar	20 cm	1.4 m	0.5 points/sq meter	2 meter
QL4	Imagery	139 cm	N/A	N/A	5 meters
QL5	Irsar	185 cm	N/A	N/A	5 meters

\$89.5M

\$52.8M



# Lidar coordination in California

- ◆ Requirements gathered
- ◆ Main drivers for lidar:
  - ◆ Flood risk management
  - ◆ Fire protection
  - ◆ Ecosystems
  - ◆ Infrastructure
  - ◆ Land cover and monitoring
  - ◆ Seismic and other hazards
- ◆ No designated lead agency



## The 3D Elevation Program—Summary for California

### Introduction

Elevation data are essential to a broad range of applications, including forest resources management, wildlife and habitat management, national security, recreation, and many others. For the State of California, elevation data are critical for infrastructure and construction management; natural resources conservation; flood risk management; wildfire management, planning, and response; agriculture and precision farming; geologic resource assessment and hazard mitigation; and other business uses. Today, high-quality light detection and ranging (lidar) data are the sources for creating elevation models and other elevation datasets. Federal, State, and local agencies work in partnership to (1) replace data, on a national basis, that are (on average) 30 years old and of lower quality and (2) provide coverage where publicly accessible data do not exist. A joint goal of State and Federal partners is to acquire consistent, statewide coverage to support existing and emerging applications enabled by lidar data. The new 3D Elevation Program (3DEP) initiative (Snyder, 2012a,b), managed by the U.S. Geological Survey (USGS), responds to the growing need for high-quality topographic data and a wide range of other three-dimensional representations of the Nation's natural and constructed features.

### 3D Elevation Program Benefits for California

The top 10 California business uses for 3D elevation data, which are based on the estimated annual conservative benefits of the 3DEP initiative, are shown in table 1. The National Enhanced Elevation Assessment (NEEA; Dewberry, 2011) survey respondents in the State of California estimated that the national 3DEP initiative



**Figure 1.** Map of California showing the areal extent and quality levels of planned and existing publicly available light detection and ranging (lidar) data in August 2013. Quality level 2 or better lidar data meet 3DEP requirements. See table 2 for quality level information.

would result in at least \$28 million in new benefits annually to the State. The cost for such a program in California is approximately \$53 million, resulting in a payback period of 1.9 years and a benefit-to-cost ratio of 4.3 to 1 over an 8-year period. Because monetary estimates were not provided for all reported benefits, the total benefits of the 3DEP to California are likely much higher. On the basis of the NEEA survey results, all levels of government and many organizations in California could benefit from access to statewide high-resolution elevation data.

The NEEA evaluated multiple data-collection options to determine the optimal data quality and data replacement cycle relative to cost to meet the stated needs. For California, approximately 74 percent of the total benefits are realized in infrastructure and construction management; natural resources conservation; flood risk management; and wildfire management, planning, and response uses alone, as shown in table 1. The status of publicly available lidar data in California is shown in figure 1. By enhancing coordination between the 3DEP and the various government and private organizations in California, it may be possible to realize more than the cited conservative benefit. The following are examples of how 3DEP data can support business uses in

### 3D Elevation Program

3DEP is a national program managed by the USGS to acquire high-resolution elevation data. The initiative is backed by a comprehensive assessment of requirements (Dewberry, 2011) and is in the early stages of implementation. 3DEP will improve data accuracy and provide more current data than is available in the National Elevation Dataset (NED). The goal of this high-priority cooperative program is to be operational by January 2015 and to have complete coverage of the United States by 2022, depending on funding and partnerships. The new program has the potential to generate \$13 billion/year in new benefits through improved government services, reductions in crop and homeowner losses resulting from floods, more efficient routing of vehicles, and a host of other government, corporate, and citizen activities (Dewberry, 2011).

### Benefits of a Funded National Program

- Economy of scale—Acquisition of data covering larger areas reduces costs by 25 percent.
- A systematic plan—Acquisition of data at a higher quality level reduces the cost of “buying up” to the highest levels needed by State and local governments.
- Higher quality data and national coverage—Ensure consistency for applications that span State and watershed boundaries and meet more needs, which results in increased benefits to citizens.
- Increase in Federal agency contributions—Reduce State and local partner contributions.
- Acquisition assistance—Provided through readily available contracts and published acquisition specifications.

### 3DEP in California by the Numbers

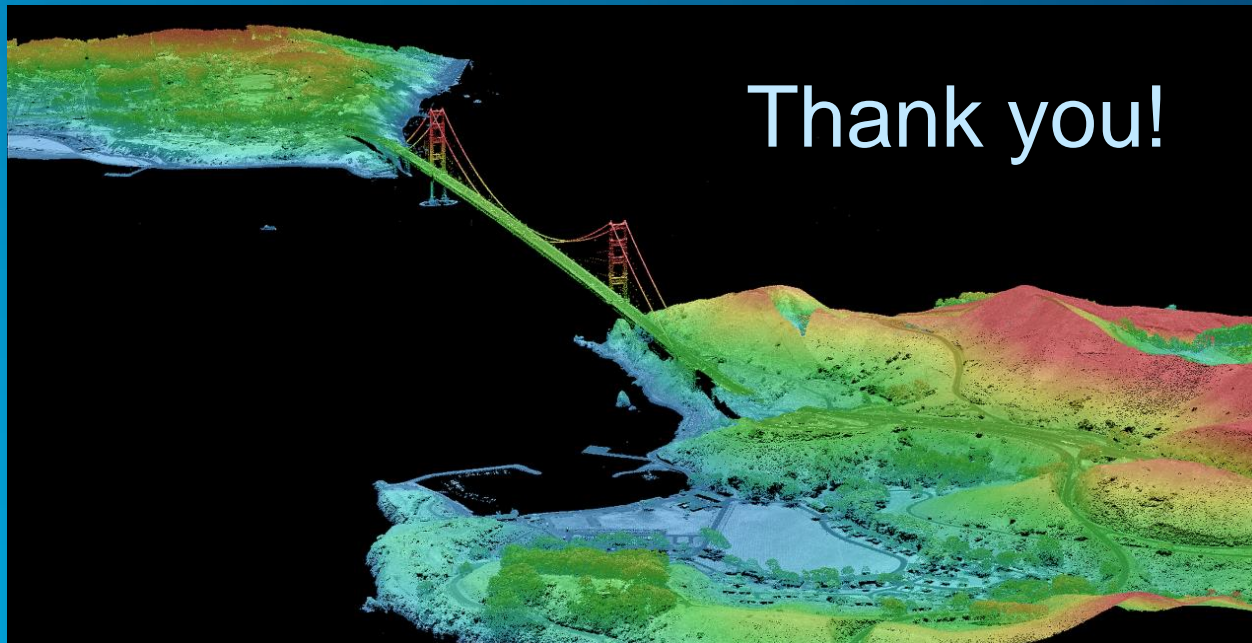
Expected annual benefits	\$28.17 million
Estimated total cost	\$52.87 million
Payback	1.9 years
Quality level 1 buy-up estimate	\$33.63 million

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

Fact Sheet 2013–3056  
November 2013

Learn more at:

<http://nationalmap.gov/3DEP/>





## Your 3DEP and NHD California contacts

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