USGS 3D Elevation Program and Application for the National Hydrography Datasets – Status, Future Plans, and Opportunities to Collaborate

North Carolina Geographic Information Coordinating Council
3D Elevation Program (3DEP) Goal

Complete acquisition of nationwide lidar (IfSAR in AK) by 2023 to provide the first-ever national baseline of consistent high-resolution elevation data collected in a timeframe of less than a decade.
3D Elevation Program (3DEP) Goal

- Complete acquisition of nationwide lidar (IfSAR in AK) by 2023 to provide the first-ever national baseline of consistent high-resolution elevation data – both bare earth and 3D point clouds – collected in a timeframe of less than a decade
- Address Federal, state and other mission-critical requirements
- Realize ROI 5:1 and potential to generate $13 billion/year
- Leverage the expertise and capacity of private mapping firms
- Achieve a 25% cost efficiency gain
- Completely refresh national data holdings

<table>
<thead>
<tr>
<th>Rank</th>
<th>Business Use</th>
<th>Conservative</th>
<th>Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Flood Risk Management</td>
<td>$295M</td>
<td>$502M</td>
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<tr>
<td>2</td>
<td>Infrastructure and Construction Management</td>
<td>$206M</td>
<td>$942M</td>
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<tr>
<td>3</td>
<td>Natural Resources Conservation</td>
<td>$159M</td>
<td>$335M</td>
</tr>
<tr>
<td>4</td>
<td>Agriculture and Precision Farming</td>
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<td>$2,011M</td>
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<td>5</td>
<td>Water Supply and Quality</td>
<td>$85M</td>
<td>$156M</td>
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<td>6</td>
<td>Wildfire Management, Planning and Response</td>
<td>$76M</td>
<td>$159M</td>
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<td>7</td>
<td>Geologic Resource Assessment and Hazard Mitigation</td>
<td>$52M</td>
<td>$1,067M</td>
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<td>8</td>
<td>Forest Resources Management</td>
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<td>River and Stream Resource Management</td>
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<tr>
<td>10</td>
<td>Aviation Navigation and Safety</td>
<td>$35M</td>
<td>$56M</td>
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<td>17</td>
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<td>20</td>
<td>Land Navigation and Safety</td>
<td>$0.2M</td>
<td>$7,125M</td>
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</table>

Total for all Business Uses (1 – 27) $1.2B $13B

- Realize ROI 5:1 and potential to generate $13 billion/year
- Leverage the expertise and capacity of private mapping firms
- Achieve a 25% cost efficiency gain
- Completely refresh national data holdings
3DEP Status Including FY19 Partnerships

Data are available or in progress for 67% of the Nation

*includes lidar and AK IfSAR

![3DEP Status Including FY19 Partnerships](http://usgs.gov/3DEP/numbers)

http://usgs.gov/3DEP/numbers
## NC Partnerships

### Project Name | FY | Partners | Area (Sq. Mi.) | QL | USGS Mechanism | Acquisition Window
--- | --- | --- | --- | --- | --- | ---
SANDY Lidar (Phase 1) | 14 | NCDPS, NRCS | 9,396 | 2 | GPSC | Spring 2014
Phase 2 Lidar | 15 | NCEM, NC Geodetic Survey, NCDOT | 12,348 | 2 | Contributed | Spring 2014
Phase 3 Lidar | 15 | NC | 10,007 | 2 | Contributed | Spring 2015
Phase 4 Central West NC GEIGER | 16 | FEMA, NCDOT, NCEM, USGS | 3,700 | 1 | Coop | Spring 2016
Phase 4 Lidar | 17 | NCDPS, USGS | 4,143 | 1 | Coop | Spring 2016-Spring 2017
Phase 5 lidar | 18 | NCDOT, NCFMP, USGS | 8,729 | 1 | Coop | Spring 2016-Spring 2017
Hurricane Florence Supplemental | 20 | USGS | ~20,000 | 1 | GPSC | TBD
Hurricane Florence NOAA Topobathy | 20 | NOAA | | 1 | Partner (Non GPSC/Coop) | TBD

Explanation:
- Planned FY26 3DEP Lidar Partnerships (subject to change)
- Available or In-Progress Data that Meet 3DEP Specification

as of October 2019
3D Elevation Program (3DEP)

Governance

- USGS and NOAA co-lead the OMB A-16 Elevation Theme
- 3DEP Executive Forum
  - Facilitates executive collaboration on strategies to fund and implement 3DEP for the benefit of all its stakeholders
  - Executive Outreach to Industry Partners and Stakeholder Groups
  - Provides direction to 3DEP Working Group
- 3DEP Working Group - Coordinates implementation of 3DEP

Member Agencies

- Bureau of Land Management
- Department of Homeland Security
- Department of Transportation
- Environmental Protection Agency
- Federal Aviation Administration
- Federal Communications Commission
- Federal Emergency Management Agency
- US Forest Service
- US Fish and Wildlife Service
- National Oceanic and Atmospheric Administration
- National Park Service
- Natural Resources Conservation Service
- Office of Surface Mining Reclamation and Enforcement
- US Department of Agriculture
- US Army Corps of Engineers
- US Geological Survey
- American Association of State Geologists
- National States Geographic Information Council
Funding Challenges and Strategies
Completion of 3DEP nationwide coverage

- Significant amounts of Federal land in western US
- State and local investments in western states are mostly in populated areas, to support infrastructure, natural hazards
- What are strategies for increasing Federal investment in the west?
  - Doing an analysis of costs for Federal land under 3DEP Executive Forum
  - EarthMRI critical minerals initiative
  - Hazards - landslides legislation, supplementals
  - Developing state plans for completing coverage under a project with the National States Geographic Information Council
  - Other western initiatives or groups?
Stakeholder Funding Support - 3DEP Coalition

Alliance of Crop, Soil, and Environmental Science Societies
American Bankers Association
American Council of Engineering Companies
American Geosciences Institute
American Institute of Professional Geologists
American Petroleum Institute
American Property Casualty Insurance Association
American Public Works Association
American Society for Horticultural Science
American Society of Agronomy
American Society of Civil Engineers
American Society of Farm Managers and Rural Appraisers
American Water Resources Association
American Water Works Association
Association of American State Geologists
Association of Environmental & Engineering Geologists
Association of State Floodplain Managers
Crop Science Society of America
Insurance Institute for Business & Home Safety
International Association of Emergency Managers
International Code Council
Interstate Council on Water Policy
Irrigation Association
Land Improvement Contractors of America
National Agricultural Aviation Association
National Apartment Association
National Association of Development Organizations
National Association of Realtors
National Association of Tower Erectors
National EMS Pilots Association
National Flood Association
National Ground Water Association
National Multifamily Housing Council
National Society of Professional Surveyors
National States Geographic Information Council
National Wildlife Federation
Rural & Agriculture Council of America
Society for Range Management
Soil and Water Conservation Society
Soil Science Society of America
Stakeholder Funding Support - MAPPS

- A public/private partnership
  - The inherently governmental responsibility of maintaining a lean core competency, while leveraging the expertise and capacity of the private industry
  - The essential USGS role in acquiring critical public domain data that can be accessed, value-added, and underpin a host of new and evolving uses and technologies
  - The role of the private industry in provisioning the data, maintaining the operational expertise and capacity, developing future technology, and supporting new applications
  - The USGS role as the lead Federal agency for elevation to create a National program that results in quality and consistency while reducing/eliminating duplication

- Together we have crafted and are implementing 3DEP as a model public/private partnership and good government story
3DEP Future Generation Just Around the Corner
3D Nation Elevation Requirements and Benefits Study

- Working with NOAA to understand inland, nearshore and offshore bathymetric data requirements and benefits
- Plan for the next round of 3DEP when the first-ever national baseline of consistent high-resolution data is in place – what is needed for monitoring, change detection and other new applications?
- Gather technology-agnostic user information to be able to assess new technologies against requirements and identify the tradeoffs between different approaches
- Results will lead to a completely new approach regarding QLs, refresh frequency by geography, products offered, and other changes
Study Phases and Timeline

**Study Preparation** (7 months)
- Study Design
- Questionnaire Development
- OMB Approval

**Initial Data Collection** (8 months)
- Identify Fed POCs/State Champions
- Questionnaire Open
- Summary Reports for Validation Phase

**Data Validation** (12 months)
- Conduct Validation Meetings
- Validate Results (Reports & Geodatabase)

**Aggregate/Report** (3 months)
- Aggregate Benefits by Business Use
- Final Report & Geodatabase

**Analysis/Development** (7 months)
- Develop Program Scenarios
- Analyze Benefit/Cost and ROI
- Determine Program Direction

**Information Gathering Phase**

**Follow on Study Tasks**

- 2017
- 2018
- 2019
- 2020

**Timeline**
- 9/2017 – 3/2018
- 1/2018 – 9/2018
- 9/2018 – 10/2019
- 10/2019 – 1/2020
- 1/2020 – 7/2020
3DEP Future Generation Just Around the Corner

Potential multi-modal approach

- Satellite-based
- Airborne-based
- UAS-based
- Ground-based surveys

Areal Coverage

Density and Accuracy

Higher

Lower

Higher

Lower
Inland Bathymetry for 3DEP

3DEP pilot projects help inform

- Development of specifications
- Topo-bathy lidar collection criteria
- Eventual goal to operationalize inland bathy

Completed surveys

Planned surveys

Kootenai River, ID

Klamath River, CA/OR

Potomac River, MD/VA

Niobrara River, NE

Image: Quantum Spatial Inc.

3D Nation Study PRELIMINARY Information
Source of approx. 500 mission critical activities that identified the need for inland bathymetry

<table>
<thead>
<tr>
<th>Source of approx. 500 mission critical activities</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>State or U.S. Territorial government</td>
<td>43%</td>
</tr>
<tr>
<td>Federal Agencies and Commissions</td>
<td>31%</td>
</tr>
<tr>
<td>Regional, County, City, or other local government</td>
<td>11%</td>
</tr>
<tr>
<td>Academic or Not-for-Profit</td>
<td>10%</td>
</tr>
<tr>
<td>Private or Commercial</td>
<td>5%</td>
</tr>
<tr>
<td>Tribal government</td>
<td>1%</td>
</tr>
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</table>
Potential for Future Inland Bathy Lidar Surveys
3DEP Application
Hydrography derived from lidar

**IN USE TODAY:**
- NHDPlus Medium Resolution
- NHD resolution 1:100,000 - 1:24,000 scale or better

**IN PROGRESS:**
- NHDPlus High Resolution
- NHD resolution 1:24,000-scale or better derived from lidar

**FUTURE:**
- Hydrography Derived from Lidar
- NHD resolution 1:5,000-scale or better derived from lidar
- Number of features nationally: 200-300 million

Simulates conditions for 2.7 million stream reaches, representing the biggest improvement in flood forecasting ever.

Forecasting at neighborhood level
Forecasting at street level

<table>
<thead>
<tr>
<th>Elevation source</th>
<th>IN USE TODAY: NHDPlus Medium Resolution</th>
<th>IN PROGRESS: NHDPlus High Resolution</th>
<th>FUTURE: Hydrography Derived from Lidar</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>30 meter</td>
<td>10 meter</td>
<td>1 meter</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hydrography source</th>
<th>IN USE TODAY: NHDPlus Medium Resolution</th>
<th>IN PROGRESS: NHDPlus High Resolution</th>
<th>FUTURE: Hydrography Derived from Lidar</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1:100,000-scale NHD</td>
<td>1:24,000-scale or better NHD</td>
<td>1:5,000-scale or better derived from lidar</td>
</tr>
</tbody>
</table>

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<tr>
<th>Number of features nationally</th>
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<th>FUTURE: Hydrography Derived from Lidar</th>
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<tbody>
<tr>
<td></td>
<td>2.7 million</td>
<td>26 million</td>
<td>200-300 million</td>
</tr>
</tbody>
</table>
National Hydrography Infrastructure

- Combine foundational hydrography datasets with hydrographic addressing, catalog, and search engine functionality.
- Provides the universal infrastructure for sharing and discovering limitless sources and types of water information.
- Underpins interagency hydrologic observing systems and enable models that account for all the water in the water cycle – from the atmosphere to the oceans.
National Hydrography Infrastructure

Working Group

- The NHI WG will advance the NHI to underpin interagency hydrologic observing networks and modeling systems

- Forum for Federal agencies to provide input and collaborate on NHI:
  - Direction
  - Development
  - Priorities
  - Management
  - Technologies
  - Use
  - Resources

- Additionally, USGS and USFWS are OMB A-16 Leads for Inland Water Theme
Next Generation – 3D National Terrain Model

Implement the USGS-NOAA 3D Nation concept of continuous topographic/bathymetric information from the peaks of our mountains to the depths of our oceans

- Integrate surface and subsurface features
  - Elevation and hydrography
  - Inland bathymetry
  - Connection points to groundwater and manmade hydrographic features
  - NOAA bathymetric data
- Improve and enable critical applications
  - Flood forecasting in 3D, at the street level
  - Hydrologic observing systems and models that account for water from the atmosphere to the oceans
  - 3D Geologic models
  - New and unimagined 3D applications
THANK YOU!