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The 3D Elevation Program—Summary for New Hampshire

Introduction

Elevation data are essential to a broad range of applications important to New Hampshire, including flood mitigation, land development, agriculture, transportation planning and design, infrastructure asset inventory and management, and many others. For the State of New Hampshire, elevation data are critical for many business uses such as flood risk management, natural resources conservation, forest resources management, agriculture and precision farming, infrastructure and construction management, and geologic resource assessment and hazard mitigation. Today, high-density light detection and ranging (lidar) data are the primary sources for deriving elevation models and other datasets. Federal, State, Tribal, and local agencies work in partnership to (1) replace data that are older 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 National Enhanced Elevation Assessment (NEEA; Dewberry, 2011) evaluated multiple elevation data acquisition options to determine the optimal data quality and data replacement cycle relative to cost to meet the identified requirements of the user community. The evaluation demonstrated that lidar acquisition at quality level 2 (table 1) for the conterminous United States and quality level 5 interferometric synthetic aperture radar (ifsar) data (table 1) for Alaska with a 6- to 10-year acquisition cycle provided the highest benefit/cost ratios. The 3D Elevation Program (3DEP) initiative (Snyder, 2012a,b) selected an 8-year acquisition cycle for the respective quality levels. 3DEP, managed by the U.S. Geological Survey (USGS), the Office of Management and Budget Circular A–16 lead agency for terrestrial elevation data, responds to the growing need for high-quality topographic data and a wide range of other 3D representations of the Nation's natural and constructed features.

3DEP in New Hampshire by the Numbers

Expected annual benefits	$1.68 million
Estimated total cost	$3.09 million*
Payback	1.8 years
Quality level 1 buy-up estimate	$1.97 million
*State-estimated acquisition cost (2014)	$2.0 million

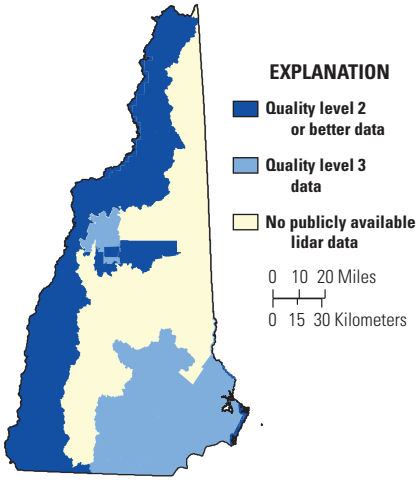

Figure 1. Map of New Hampshire showing publicly available lidar data. Information source is the United States Interagency Elevation Inventory, March 2015 (http://coast.noaa.gov/inventory/?redirect=301ocm#), which is updated annually. Quality level 2 or better data meet 3DEP requirements. See table 1 for quality level information.

3D Elevation Program Benefits for New Hampshire

The top 10 New Hampshire business uses for 3D elevation data, which are based on the estimated annual conservative benefits of the 3DEP initiative, are shown in table 2. The NEEA survey respondents in the State of New Hampshire estimated that the national 3DEP initiative would result in at least $1.68 million in new benefits annually to the State. The cost for such a statewide program in New Hampshire is approximately $3.1 million, resulting in a payback period of 1.8 years and a benefit/cost ratio of 4.3 to 1 over an 8-year period. In 2014, the State estimated a lidar acquisition cost of $2.0 million (Rick Chormann, written commun., April 16, 2014) to complete the statewide coverage (see figure 1 to identify areas currently without lidar data). Because monetary estimates were not provided for all reported benefits, the total benefits of the 3DEP to New Hampshire are likely much higher. On the basis of the NEEA survey results, all levels of government and many organizations in New Hampshire

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 have complete coverage of the United States by the end of 2022, depending on funding and partnerships. 3DEP can conservatively provide new benefits of $1.2 billion/year and 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). A shared, common elevation dataset would foster cooperation and improve decision-making among all levels of government and other stakeholders.

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—Reduces State and local partner contributions.
- Acquisition assistance—Provided through readily available contracts and published acquisition specifications.

could benefit from access to statewide high-resolution elevation data.

For New Hampshire, approximately 78 percent of the identified business use requirements will be met in flood risk management and natural resources conservation uses, as shown in table 2. The status of publicly available lidar data in New Hampshire is shown in figure 1. By enhancing coordination between 3DEP and various government and private organizations in New Hampshire, it may be possible to realize more than the cited conservative benefits and attain the higher potential benefits for many business uses.

The following examples highlight how 3DEP data can support business uses in New Hampshire: (1) Lidar data provide high-quality terrain information as input for more accurate and less expensive hydrologic and hydraulic modeling for flood studies; for the design of structures, such as bridges and culverts, to accommodate runoff and flooding from large rain events (fig. 2); and for retention dam design, dam breach studies, and stormwater management and engineering. Lidar data also aid the identification of vulnerable properties within a floodplain, facilitating better floodplain-management decisions and education of the public on true flood risks, potentially resulting in avoided costs during flood events. Dynamic 3D models show the potential impact of flooding. (2) Enhanced elevation data could enable State, regional, and local governments to more effectively implement natural resources conservation practices, such as grade stabilization, dam safety, habitat easements, pipelines, terracing, and wetland restoration, while providing additional cost savings to the public. If lidar data were available, public and private organizations would expand their use of lidar for planning and site-level engineering to reduce field work for conservation projects.

References Cited

Dewberry, 2011, Final report of the National Enhanced Elevation Assessment (revised 2012): Fairfax, Va., Dewberry, 84 p. plus appendixes, http://www.dewberry.com/Consultants/GeospatialMapping/FinalReport-NationalEnhancedElevationAssessment.

Snyder, G.I., 2012a, National Enhanced Elevation Assessment at a glance: U.S. Geological Survey Fact Sheet 2012–3088, 2 p., http://pubs.usgs.gov/fs/2012/3088/.

Snyder, G.I., 2012b, The 3D Elevation Program—Summary of program direction: U.S. Geological Survey Fact Sheet 2012–3089, 2 p., http://pubs.usgs.gov/fs/2012/3089/.

Figure 2. Cold River flood damage to State Route 123 (Witcomb Road) bridge and road near Drewsville, New Hampshire, on October 10, 2005. Watershed and hydraulic models and analyses using lidar data-derived digital elevation models can help reduce flood risks from large rain events. Courtesy of New Hampshire State Police.

Table 2. Conservative benefits estimates for the top 10 business uses of the proposed 3DEP data identified in the National Enhanced Elevation Assessment for New Hampshire (Dewberry, 2011).

Rank	Business use	Annual benefits (thousands)
1	Flood risk management	$925.2
2	Natural resources conservation	379.9
3	Forest resources management	93.3
4	Agriculture and precision farming	70.3
5	Infrastructure and construction management	67.7
6	Geologic resource assessment and hazard mitigation	50.1
7	Aviation navigation and safety	32.4
8	Coastal zone management	25.6
9	Sea level rise and subsidence	23.4
10	River and stream resource management	3.8
	Other	5.6
	Total	1,677.3

3D Elevation Program—Continued

The USGS and its partners will acquire quality level 2 or better (table 1) 3D lidar data over the conterminous United States, Hawaii, and the U.S. territories. Interferometric synthetic aperture radar (ifsar) data are being collected at quality level 5 (table 1) in Alaska. The data will be acquired over an 8-year period and will be made available to the public. By using this acquisition scenario a number of high-quality elevation-data products can be created to serve a wide range of business uses in government and the private sector.

Table 1. Data quality levels and related accuracies for the 3D Elevation Program (3DEP) initiative as provided on page 6 in USGS Circular 1399 (http://dx.doi.org/10.3133/cir1399). These data quality parameters for the 3DEP initiative approximate those used in the National Enhanced Elevation Assessment (Dewberry, 2011).

[$RMSE_{(z)}$, root mean square error in the z (elevation) dimension; n/a, not applicable]

Quality level	Nominal pulse spacing (meters)	Vertical error as $RMSE_{(z)}$ (centimeters)
1	0.35	10
2	0.7	10
3	1.4	20
4	n/a	139
5	n/a	185

Next Steps for Implementing 3DEP

Accomplishing the 3DEP initiative's goal of national coverage in 8 years depends on the following factors:

- Increased partnerships among Federal, State, Tribal, and local governments.
- Partnerships that acquire elevation data to the program's specifications across larger project areas.
- Increased communication about and awareness of the program's benefits and goals.
- Support for the program from government and other stakeholders.

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