The 3D Elevation Program—Summary for Virginia

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 Commonwealth of Virginia, elevation data are critical for urban and regional planning, natural resources conservation, flood risk management, agriculture and precision farming, resource mining, infrastructure and construction management, 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 Virginia

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

3DEP in Virginia by the Numbers

Expected annual benefits	$10.32 million
Estimated total cost	$13.50 million
Payback	1.3 years
Quality level 1 buy-up estimate	$8.59 million

EXPLANATION

- 3DEP data (quality level 2 or better)
- Quality level 3 data
- Quality level 4 or lower data
- No publicly available lidar data

0   60 Miles
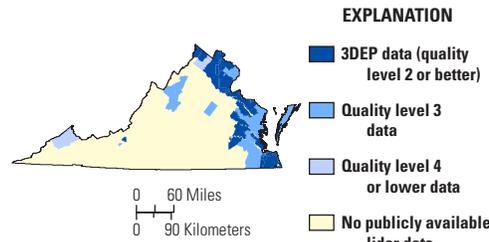0   90 Kilometers

Figure 1. Map of Virginia showing the areal extent and quality level of planned and existing publicly available light detection and ranging (lidar) data in November 2012. See table 2 for quality levels.

3DEP initiative would result in at least $10 million in new benefits annually to the Commonwealth. The cost for such a program in Virginia is approximately $13 million, resulting in a payback period of 1.3 years and a benefit-to-cost ratio of 6.1 to 1 over an 8-year period. Because monetary estimates were not provided for all reported benefits, the total benefits of the 3DEP to Virginia are likely much higher. On the basis of the NEEA survey results, all levels of government and many organizations in Virginia could benefit from access to statewide high-resolution elevation data.

The NEEA evaluated multiple data collection programs to determine the optimal data quality and data replacement cycle relative to cost to meet the stated needs. For Virginia, approximately 72 percent of the total benefits are realized in urban and regional planning, natural resources conservation, flood risk management, and agriculture and precision farming uses alone, as shown in table 1. The status of publicly available lidar data in Virginia is shown in figure 1. By enhancing coordination between the 3DEP and the various government and private organizations in Virginia, it may be possible to meet a higher percentage of the needs.

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—Reduces State and local partner contributions.

- Acquisition assistance—Provided through readily available contracts and published acquisition specifications.

The following examples highlight how 3DEP data can support business needs in Virginia: (1) The Virginia Institute of Marine Science conducts scientific research and supports integrated and adaptive management of coastal zone resources. Comprehensive lidar coverage enables detailed modeling efforts for a variety of critical topics, including understanding risks from sea level rise and storm surges (fig. 2) and vulnerability of shallow tidal water habitats to climate change. (2) The Hampton Roads Sanitation District can use the lidar-based digital elevation models to support flood and hydraulic analysis around critical infrastructure, as well as to support early planning designs for new wastewater pipelines. The elevation data will help to more accurately assess flood risks to the infrastructure and to assist in developing more realistic conceptual designs and cost estimates for planned infrastructure.

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. The Coleman Bridge at Gloucester Point and Yorktown, Virginia. Floodwater covers a park and parking lot in the foreground and in the distance waves can be seen breaking over the riverbank. Lidar data are critical for elevation modeling and for predicting potential flooding zones and risk assessment analysis. Photo courtesy of Virginia Institute of Marine Science.

Table 1. Conservative benefits for the top 10 business uses of the proposed 3DEP data identified in the National Enhanced Elevation Assessment for Virginia (Dewberry, 2011).

Rank	Business use	Annual benefits (millions)
1	Urban and regional planning	$3.03
2	Natural resources conservation	1.75
3	Flood risk management	1.53
4	Agriculture and precision farming	1.11
5	Resource mining	0.76
6	Infrastructure and construction management	0.74
7	Geologic resource assessment and hazard mitigation	0.32
8	Water supply and quality	0.30
9	Forest resources management	0.29
10	Coastal zone management	0.17
	Other	0.33
	Total	10.33

3D Elevation Program—Continued

The USGS and its partners will acquire quality level 2 or better (table 2) three-dimensional 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 2) in Alaska. The data will be acquired over an 8-year period and will be made available to the public. A number of high-quality elevation-data products will be created to serve a wide range of business needs in government and the private sector.

Table 2. Data quality levels used in the National Enhanced Elevation Assessment (Dewberry, 2011).

[≤, less than or equal to]

Quality level	Nominal pulse spacing (meters)	Vertical accuracy (centimeters)
1	0.35	9.25
2	0.7	9.25
3	1–2	≤18.5
4	5	46–139
5	5	93–185

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, 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 from government and other stakeholders and users.