

The 3D Elevation Program—Summary for Delaware

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 Delaware, elevation data are critical for agriculture and precision farming, river and stream resource management, natural resources conservation, flood risk management, coastal zone management, geologic resource assessment and hazard mitigation, and other business uses. 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 publicly available 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 Delaware by the Numbers

Expected annual benefits	\$680 thousand
Estimated total cost	\$671 thousand
Payback	1.0 year
Quality level 1 buy-up estimate	\$427 thousand

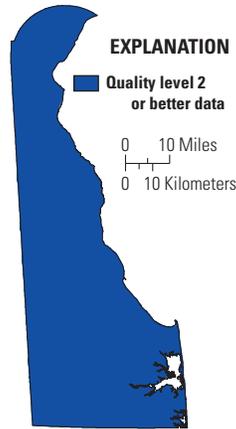


Figure 1. Map of Delaware showing publicly available lidar data. Information source is the United States Interagency Elevation Inventory, June 2014 (<http://coast.noaa.gov/inventory/?redirect=301ocm#>), which is updated annually. Quality level 2 or better lidar data meet 3DEP requirements. See table 1 for quality level information.

3D Elevation Program Benefits for Delaware

The top 10 Delaware 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 Delaware estimated that the national 3DEP initiative would result in at least \$680 thousand in new benefits annually to the State. The cost for such a program in Delaware is approximately \$671 thousand, resulting in a payback period of 1.0 year and a benefit/cost ratio of 8.1 to 1 over an 8-year period. Because monetary estimates were not provided for all reported benefits, the total benefits of the 3DEP to Delaware are likely much higher. On the basis of the NEEA survey results, all levels of government and many organizations in Delaware could benefit from access to statewide high-resolution elevation data.

For Delaware, approximately 80 percent of the identified business use requirements will be met in agriculture and precision farming, river and stream resource management, natural resources conservation, and flood risk management uses, as shown in table 2. The status of publicly available lidar data in Delaware is shown in figure 1. The most recent lidar data for Delaware were collected for all three counties in early 2014, paid

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.

for by Hurricane Sandy Relief funds. By enhancing coordination between 3DEP and various government and private organizations in Delaware, 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 Delaware: (1) The availability of more accurate statewide elevation data would reduce onsite data-collection costs and the amount of time required to complete some phases of flood risk projects, thereby improving the quality of the analyses and study results. Comprehensive lidar coverage enables detailed modeling of the overflow from streams and other water bodies as a result of large storm events and overland coastal storm surges (fig. 2). The Delaware Coastal Flood Monitoring System (<http://coastal-flood.udel.edu/>) relies on the land surface digital elevation model to depict the extent and severity of real-time flood inundation due to storm surge within local communities. With an enhanced ability to predict surface-water movement along high-risk coastal areas, communities and agencies have the ability to design improved evacuation routes to better prepare and protect the public should a

disaster strike. (2) Approximately 41 percent of the land area of Delaware is devoted to agricultural uses. Enhanced elevation data can provide a more accurate depiction of terrain and dramatically improve cropland precision farming activities, which helps improve crop yields, prevent soil degradation, and reduce agricultural chemical runoff—factors that help farmers realize a larger return on their investments.

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/>.

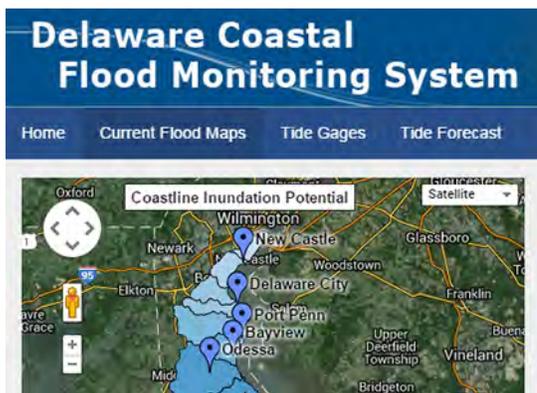


Figure 2. Cropped screenshot of the Delaware Coastal Flood Monitoring System (<http://coastal-flood.udel.edu/>), which is a Web-based tool and alert system designed to provide emergency managers, planners, and others the information needed regarding impending coastal events. Image courtesy of Delaware Geological Survey.

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

Rank	Business use	Annual benefits (thousands)
1	Agriculture and precision farming	\$209.3
2	River and stream resource management	148.7
3	Natural resources conservation	93.7
4	Flood risk management	92.7
5	Coastal zone management	42.8
6	Sea level rise and subsidence	42.3
7	Infrastructure and construction management	18.0
8	Water supply and quality	9.5
9	Aviation navigation and safety	7.2
10	Forest resources management	6.6
	Other	8.9
	Total	679.7

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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ISSN 2327-6932 (online)
<http://dx.doi.org/10.3133/fs20153031>