National States Geographic
Information Council
(NSGIC)

State Guide to the Development of an Enhanced Elevation (Lidar) Acquisition Plan

version
June 15, 2020

Developed in cooperation with the
U.S. Geological Survey (USGS) National Geospatial Program (NGP)
3D Elevation Program (3DEP)

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Introduction

NSGIC 3DEP for the Nation is a collaboration between the National States Geographic Information Council (NSGIC) and the United States Geological Survey (USGS) National Geospatial Program (NGP) 3D Elevation Program (3DEP). 3DEP supports the systematic collection of Quality Level 2 or better light detection and ranging (lidar) data over the conterminous United States, Hawaii and U.S. territories, and QL5 Interferometric synthetic aperture radar (IFSAR) data for Alaska. The goal is to accrue complete, quality, national elevation data coverage by 2023.

3DEP is a partnership program. Federal, State, Local and Tribal governments, academia, non-profit and the private sector all contribute to the development, execution and maintenance of the program. USGS provides guidance on policies, specifications, procedures and opportunities that support national 3DEP efforts and facilitates dialog among federal agencies. Using the existing NSGIC network, 3DEP for the Nation guides states and territories to document collaborative roles, responsibilities, and timeframes for completing 3DEP coverage within a given state or territory that build upon existing federal and state 3DEP planning efforts and resources. Together, these stakeholders identified the core components of effective statewide lidar acquisition planning.

This guide outlines a step-by-step approach to lidar acquisition planning. It provides general guidance, lessons learned, a plan template, and links to relevant resources. The guide was piloted by a team of NSGIC members active in lidar acquisition planning. The team included individuals with a wide range of expertise and experience in state-wide acquisition programs. The diversity in experience enabled the development of a document capable of meeting the needs of those new to lidar acquisition while at the same time providing insights into long-term lidar planning, archive, delivery and maintenance.

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Get Organized

It Takes a Team

Statewide 3DEP acquisition planning requires a team of individuals and organizations with a range of elevation data knowledge including:

- technical aspects of the data
- community needs and issues to which the data can be applied
- statewide policies, procedures, and funding mechanisms.

When this knowledge is concentrated in a few individuals, the team may be small. However, in most cases the team will require coordination across organizations and include administrators, GIS technical staff, and subject matter experts in various application areas. The following guidance outlines key roles that should be considered when developing a 3DEP acquisition planning team.

Find the Leader, Be the Leader!

As with most initiatives, everything starts with a leader. An individual willing to put the gears in action and enlist the right people to keep the effort in motion. The leader can wear any hat - administrator, scientist, planner, it doesn't matter. What does matter is the desire and ability to:

- clearly express and demonstrate the need for enhanced elevation data
- inform and engage stakeholders at all levels
- identify and enlist effective subject matter experts and team members
- organize and motivate the collaboration
- outline and delegate activities
- build upon existing enhanced elevation programs, policies, and initiatives.

Lessons Learned:

- Successful leaders tend to be those that utilize elevation data in their work and are aware of existing resources, stakeholders, challenges, and opportunities
- Given the range of capabilities required of the leader, Co-Chairs can be highly effective. This is especially true when one Chair is able to address technical issues related to the data and its application and the other Chair serves as an organizational leader, taking the lead in stakeholder communications and coordination.

Build and Expand the Team

Once the leader, or leaders, have stepped up to the plate, it's time to build a team. The leader(s) will initially direct the team but member roles and responsibilities may evolve as stakeholders are enlisted and connections made with subject matter experts. The team should be comprised of individuals that possess a range of knowledge and skills including:

- application of elevation data
- elevation data needs within the state
- lidar data that exists within the state
- elevation data stakeholder community members

- lidar acquisition methods and protocols
- lidar acquisition funding strategies and opportunities.

Lessons Learned:

- A range of expertise and knowledge enables an effective distribution of effort.

Define Coordination Goals and Objectives

The team is responsible for defining the 3DEP coordination goals and objectives. The goals and objectives will be used to enlist stakeholders and sponsors and will serve as the basis for moving forward with coordination. The goals and objectives should address the following questions.

Why develop a 3DEP acquisition plan?
Who will participate in the development of the plan?
What outcomes and solutions are intended?

Lessons Learned:

- The more concise and informative the goals and objectives, the more effective.
- A one-page project description based on the goals and objectives provides a consistent message that can be used to enlist and engage participants and support.

Engage the Stakeholder Community

Outreach to federal, state, local, tribal, private sector, and not-for-profit stakeholders within the state assures a comprehensive plan that addresses the needs of the statewide community. Stakeholders may also have insights and access to key decision-makers. Stakeholders support the plan by:

- prioritizing areas of interest
- identifying enhancements, products and services beyond the requirements of the USGS base lidar specification
- identifying potential funding sources.

Stakeholder outreach can begin with team affiliates but should expand to ensure that a range of interest and expertise are included, e.g. public safety, natural environment, infrastructure and built environment, and experts in elevation data standards and technologies. States that participated in the USGS National Enhanced Elevation Assessment (NEEA) and the USGS/NOAA 3D Nation Elevation Requirements and Benefits Study (3DNation) will have a headstart on developing their stakeholder community. The '3DEP Stakeholder Checklist' on the next page outlines key organizations for consideration.

Lessons Learned:

- Think beyond the usual suspects when reaching out to potential stakeholders. non-profits, utility companies, professional organizations, and other groups may bring new perspectives and new resources.
- Stakeholder engagement requires a lot of work- regular outreach, meeting logistics, facilitating and collecting input, etc.. If Co-Chairs are not appointed to fill the roles of Organizational and Technical Points of Contact, team members can be enlisted into these roles.

Consider the following stakeholders when developing your 3DEP program team
Stakeholders aware of local, regional, and tribal elevation data needs and applications: ❏ Municipalities ❏ Counties ❏ Council of Government ❏ Native American Tribes ❏ Conservation Districts ❏ Watershed Districts
Stakeholders aware of state elevation data needs and applications: ❏ 3D Nation Requirements and Benefits study respondents ❏ State Geological Survey / State Geologist ❏ Emergency Management ❏ Floodplain Mapping ❏ Natural Resources ❏ Environmental Protection and Permitting ❏ Transportation ❏ Agriculture and Forestry ❏ Cultural and Historic Preservation ❏ Facility Management ❏ Revenue and Budget
Stakeholders aware of interstate/regional/federal/national elevation data needs and applications: ❏ Federal Geospatial 3D Elevation Program (3DEP) Working Group Members ❏ USGS National Geospatial Program 3D Elevation Program ❏ Conservation Organizations (Nature Conservancy, Land Trust, etc.) ❏ Agricultural Interest Groups
Stakeholders aware of commercial enterprise elevation data needs and applications: ❏ Utility, Telecommunications and Energy Companies ❏ Railroad ❏ Forestry and Timber ❏ Mining ❏ Developers, Engineers, and Surveyors ❏ Agriculture Operations, e.g. precision agriculture ❏ Recreational Resorts (ski, zipline, viewshed, etc.)
Lidar collection subject matter experts: ❏ USGS National Map Liaisons ❏ Academics ❏ Lidar Data and Acquisition Private Industry Consultants

Table 1. 3DEP Stakeholder Checklist

Establish a Stakeholder Working Group and Charter

Several states have established Stakeholder Working Groups to organize stakeholder participation. The format of the working group will depend on the structure of the lead organization and the level of authority of the working group within the organization. Some are established as formal committees while others may be an affiliation of interest groups. Sub-groups may also be established to address specific activities, e.g. project coordination, funding, technical specification, etc. Regardless of the format, a roster of working group members, their affiliation, and contact information should be actively maintained.

A charter defines the Stakeholder Working Group purpose and function. It builds upon the project description by adding operational information. The development of the charter is an opportunity to explore and discuss the purpose of the working group and the roles of its members. Charters can vary in formality from simple agreements to detailed operational guidelines. Depending on your need for formality, consider the following components when developing a Stakeholder Working Group charter.

Intended lifespan of the community
- standing
- time limited
- objective limited, e.g. when 'x' is achieved

Roles
- Chairperson(s)
- Sub-committee Chairs
- Members

Activities, Duties, and Responsibilities
- charge of the committee
- role of the committee within the planning effort
- charge of individual committee roles

Operating Procedures
- meeting schedule
- reporting requirements and schedule
- voting procedures
- authority to perform specific actions

The Stakeholder Working Group provides critical input in the form of research, plan review, outreach to other Stakeholders, documentation of needs, the identification of funding, and more. Together, the Plan Team and the Stakeholder Working Group collect and compile information into a formal acquisition plan.

Lessons Learned:
- Regularly scheduled meetings, e.g. first Tuesday of the month, enable participants to plan ahead and are therefore more likely to attend meetings.
- While it is useful to look at working group charters developed by other organizations for guidance, it is important that your charter be specific to your mission and not simply an adaptation of a charter developed for a different purpose or organization.

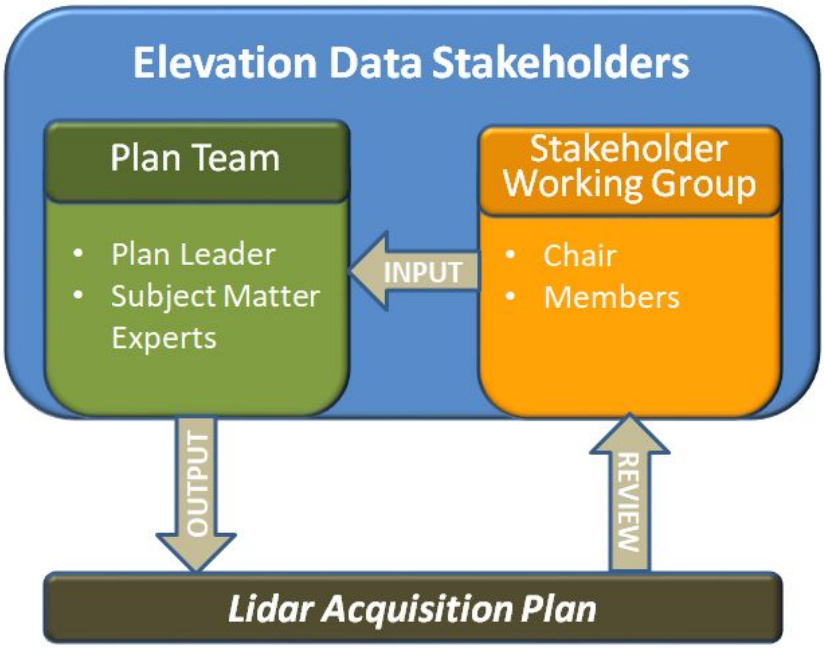

Figure 1. Relationship Between the Plan Team and Stakeholder Working Group

Identify Plan Champions

The Plan Team, the Stakeholder Working Group, and the broader Stakeholder community provide the technical and applied knowledge necessary to develop a statewide lidar acquisition plan. However, additional skills are needed to effectively promote the plan and solicit for funding. This is the role of the plan champion.

The plan champion has the insights necessary to steward the plan through the decision-making and funding process. This requires an understanding as to why the data is needed, strong communications skills, and access to decision-makers. The primary role of the plan champion is to effectively explain and advocate for the plan.

Plan champions can come in different forms. State agency administrators often serve as champions. They are well-positioned to interact with stakeholders, technical staff, and those responsible for developing and approving budgets. At the same time, local and regional government and tribal representatives can be effective champions, closely representing the needs of the constituency. Private sector champions can be critical to the success of the plan as they, unlike government staff, are able to directly lobby legislators. If a private sector champion is available, state representatives should be aware of, and abide by, regulations regarding conducting state business with the private sector. Seek out and cultivate these champions throughout the lidar acquisition planning process.

Lessons Learned:

- If you are able to enlist multiple champions, make sure that they are aware of one another's efforts and, if possible, facilitate communications among the champions. Poorly coordinated advocacy makes the plan look unorganized and can generate more questions and concerns than support.

Putting the Project Team Together

Once the key players are drafted, it's time to assign positions. The Plan Team serves as the collective captain, responsible for managing the plan and directing tasks and activities. The Champion is the team sponsor, responsible for promoting the plan and soliciting support for approval and funding. Stakeholder Working Group members are the fielders, performing tasks as the ball comes their way. Stakeholders help to distribute the effort and can be organized into three key groups, Plan Developers, Content Providers, and Resource Providers. Figure 2 illustrates how the Project Team comes together.

Plan Developers

Plan developers are the stakeholders that are familiar with organizing and documenting data acquisition and other technical plans. These team members are knowledgeable about the steps and processes necessary to acquire lidar data and best methods for packaging the information in a logical and effective plan. Enlist these members to organize and compile plan content.

Content Providers

Content providers are the subject matter experts. They are knowledgeable about lidar technology and/or the application of lidar data to specific issues. Enlist these members to identify the areas of interest, describe the need for and application of lidar data, and outline data specifications such as quality level, acquisition conditions, and the type and content of derived products.

Resource Providers

Resource providers enable the plan by contributing funding, skills, and equipment. They have the knowledge, software, tools, and funding needed to process the data so that it is usable by the broader community. They provide and manage the servers that store and distribute the data. They develop the websites that educate and inform the community about the use and availability of the data.

Lessons Learned:

- Clearly defined roles and responsibilities enable team members to work independently and effectively.

Figure 2. Project Team Member Roles

Develop the Plan

Establish Plan Goals and Objectives

The goals and objectives established earlier focused on the who, what, and why of the 3DEP Stakeholder coordination effort. The development of the plan requires a new set of goals and objectives that establish the purpose and intended accomplishments of the lidar (IFSAR in Alaska) acquisition project .

The project goal defines the ultimate destination the project intends to reach. In some cases the project may be driven b multiple goals. Goals are the primary outcomes at the broadest level. Examples of lidar acquisition planning goals include:

- *Integrate stakeholder, state, and federal interests in achieving statewide lidar coverage at QL2 or better.*
- *Collect and compile lidar data that can be used to better understand and address the natural and infrastructure hazards affecting the state.*
- *Improve the quality, currency, and standardization of the elevation data within the state.*

Project objectives are the progress steps that must be achieved to attain the goal. These should be specific, measurable, and reasonable. For example, objectives relative to the last goal presented above:

Improve the quality, currency, and standardization of the elevation data within the state.

might include:

- Document the need for elevation data within the state.
- Develop a specification for the state based upon the USGS base specification.
- Secure funding for the acquisition of lidar data.
- Coordinate and document lidar collection with local, regional, tribal, federal, and other lidar acquisition stakeholders.

Goals and objectives should be derived from stakeholder input. This input can be gathered and vetted via in-person meetings, online forums and surveys, or via the state contribution to the NEEA and the 3D Nation studies. If possible, representatives from the Plan Team should travel to regional sites where they can meet stakeholders and visit sites that have been impacted by a lack of quality elevation data. The goals and objectives developed from stakeholder input should be made available to the Stakeholder Working Group for review and endorsement.

Lessons Learned:

- Test your objectives by asking the question, “Is the objective clear, results-oriented, measurable, and realistic?”

Develop a Strategy for Achieving Your Goal

The objectives will drive the plan strategy. How, exactly, will you address your objectives? What methods will be used? In what order will the objectives be addressed? Based on the set of objectives presented in the example above:

- How will the need for elevation be assessed? Using what criteria? How will these areas be documented? Is an application needed to collect and map this information?
- How will the state lidar specification be developed? What information is needed? What are the specific needs of the state with regard to lidar format and quality? How does the state specification differ from the USGS specification? Are different specifications needed for different areas of the state?
- How much will lidar acquisition cost? Can acquisition be phased over multiple years? What are the potential sources of funding?
- How will the state coordinate with others on the lidar collection? What organizations and individuals should be contacted? Can Seasketch be used effectively to monitor and engage with related lidar acquisition activities? Is a state-driven application needed to compile information from participants at all levels?
- What steps are needed to address each of the above?
- What is the most effective order for implementing the steps? Which steps can occur concurrently?
- Who will participate in each step and for what actions and products will they be responsible?
- What is the timeframe needed to complete the steps?

By carefully considering your objectives and the processes necessary to achieve them, you can derive a work plan that specifies:

- tasks to be accomplished in each stage of the plan
- milestones (products and expected outcomes) for each task
- timeline for completing each task and the acquisition project.

Lessons Learned:

- If the Plan Team establishes a strong framework for the strategy, stakeholders can be enlisted, based on their expertise, to refine components. By distributing the effort, you gain efficiency and expand the knowledge base.
- Alignment of fiscal schedules across organizations can be challenging. When developing your strategy, establish a timeline that documents the availability of funds from all committed, anticipated, and potential Plan contributors. Also inquire about options to commit funds in advance of acquisition, e.g. the USGS 3DEP Annual Broad Agency Announcement (BAA) program allows partners using Geospatial Products and Services Contracts (GPSC) program to commit funds in the year prior to acquisition.

Develop A Plan Summary

Once you have a clear vision for your plan, develop a Plan Summary that can be used to inform and enlist participants. Much like the Project Description that was developed to engage stakeholders, the Plan Summary provides the additional details necessary to coordinate with others on the collection of lidar, especially federal partners that need a quick snapshot of state elevation data needs and planned acquisition activities.

Based on the recommendations of the Federal 3DEP Working Group, the Plan Summary should include:

- A brief justification for the data collection including the needs to be addressed.
- A map indicating the areas that are in need of lidar data and the priority of that need
- A description of data specifications that vary from the USGS Lidar Base Specification and an explanation as to why the variation is needed, e.g. QL1 data quality is needed to estimate tree heights, forest structure, and other forest inventory parameters
- A proposed timeline for acquiring the data
- An estimate of the funding available.

Lessons Learned:

- A well-written Plan Summary enables data acquisition partnerships while the formal plan is under development.

Funding Lidar Acquisition

The biggest challenge to lidar data acquisition is commonly funding. Lidar acquisition is expensive. It requires airplanes, sensors, pilots, sensor operators, and experts in post-acquisition data processing.

Estimating Costs

With constantly changing technology and products, it can be difficult to estimate the cost of lidar acquisition. Estimates are commonly derived from past acquisition efforts or acquisitions made in other geographic locations. In some cases, this can result in comparing apples to oranges.

Best estimates are made by those active in the collection of lidar data. This includes federal agencies and private sector lidar service providers. The USGS provides cost estimating services as part of their USGS 3DEP Annual Broad Agency Announcement (BAA) through the Independent Government Cost Estimate (IGCE).

Private sector partners commonly develop cost estimates for potential clients without any commitment to purchase. State agencies are advised to check state regulations regarding private sector interactions before requesting any information.

The USGS also provides 'one-stop shopping' using the Geospatial Products and Services Contracts (GPSC) program. GPSC includes a suite of contracts that have been established and vetted by USGS with selected firms via a Qualifications-Based Selection (QBS) process. GPSC contracts are managed by the USGS, not the State partners, and are not limited to the acquisition of lidar, nor QL2, products and services. The GPSC combination of qualified contractors and experienced Government contracting staff with access to broad-ranging subject matter experts ensures obtaining the desired product or service expeditiously at the best possible price.

Cost estimates should not only include the cost of the data acquisition but also costs associated with:

- inhouse data processing (deriving elevation products, tiling, reformating, etc.)
- data storage equipment and staff
- data distribution application development, equipment, software, staff
- data maintenance and updates
- project management
- quality control and related evaluation of deliverables

Potential Funding Sources

Fortunately, the widespread need for high quality elevation data results in strong opportunities for partnerships and cost-sharing. The following options are commonly combined to accrue the resources necessary.

- USGS 3DEP Annual Broad Agency Announcement (BAA)
  In an effort to establish nationwide elevation data coverage, USGS coordinates partnerships with Federal agencies to acquire high-quality 3D Elevation data.
- Federal Agencies
  In addition to the USGS - FEMA, NRCS, NOAA, USFS, and other federal agencies regularly acquire lidar data to fulfill agency missions. These agencies actively seek partnerships that economize spending and minimize duplication of effort. Collectively these agencies make up the federal 3DEP Working Group and publish their acquisition plans via the Seasketch online participatory mapping application. States are encouraged to review the acquisition plans in Seasketch and contact the regional office of agencies that expressed interest in data collection within the state.
- State Legislatures or State Agency Budgets
  Environmental protection and public safety are common motivations for the collection of lidar data that can be applied to cross-disciplinary and cross-administrative boundaries. As such, they are of great interest to state legislators. Lidar initiatives that demonstrate the value of the data to protect coastal communities, agricultural fields, and urban infrastructure or mitigate fires, flooding, and landslides are quick to get the attention of legislators.
- Local and Regional Governments
  The issues that speak to state legislators occur locally. Municipalities, counties, and regional councils deal directly with citizens that experience the physical, social, and financial impacts of environmental disasters and poor urban planning. As a result, these same citizens are often the ones that approve the use of tax dollars to address such issues.
- Non-Governmental Organizations
  Non-Governmental Organizations (NGO) occasionally use lidar and related data for analysis and decision-making for investments. i.e. conservation organizations.
- Private Sector
  Utilities and other commercial operations may achieve benefits from collaborating on the purchase of lidar data.

Lessons Learned:

- Funding can come from unexpected places. Be prepared with a solid plan and engage stakeholders in identifying potential partnerships and funding sources.

Data Distribution

The USGS provides data distribution for digital elevation models (DEMs), lidar point clouds, and IFSAR products developed as part of 3DEP. All products are available, free of charge via a suite of National Map data download and data visualization services. Many states depend solely on the National Map to archive and distribute their 3DEP data. A National Map API is also available to provide the data directly through a States web portal interface if the State does not want to have to host and manage a copy of the data but wants it discoverable through their site.

When states contract for additional elevation data products or create regional data composites based on administrative, hydrological, economic, or other boundaries, they will need to develop, or procure, a system to distribute these data resources. Data is commonly distributed via direct data download, an interactive online web (REST, WMS, or WCS) service, or cloud-base data storage and distribution.

Lidar Data Download and Compression

Many states distribute lidar using the download method. It is the path of least resistance and requires a small to moderate investment in time and funding. Due to the large size of the files, the data may be compressed into a smaller, more transferable file. Two compression methods, .LAZ and .zlas, are commonly used. The .LAZ method is an open format that can be consumed by a variety of desktop GIS software products. The .zlas format is intended for use with the Esri software environment though it can be consumed by a limited selection of other desktop software. Both methods are able to compress the data to approximately 20% of their original (.las) file size. Products derived from the source lidar data - Digital Elevation Models (DEM), intensity imagery, hydro breaklines, contours, and building footprints - can be compressed using the traditional .zip format.

Once compressed, most states host/serve the compressed data products from their existing GIS data clearinghouse or third party hosting (e.g. Google Drive, local university, etc.). The compressed lidar datasets can either be accessed via a map interface or through a traditional non-map, file-based approach.

Another, more advanced approach is what has been dubbed the “clip/ship” method. Instead of compressing the lidar data on the front end, the user defines their area of interest (clip) via a map interface, then the online tool) and delivers (ship) the data to the end user by online download process. The USGS National Map Lidar Explorer site provides data using this method for small areas.

Lidar Distribution via a REST Service

REST services provide a more efficient and less data intense method for accessing lidar data. These services provide 3D and dynamic elevation viewers that enable users to access and interact with lidar data without having thttps://viewer.nationalmap.gov/basic/o

download. Several states have developed their own internal REST services that allow users to manipulate and view the data in a variety of ways (slope, aspect, elevation, etc.).

The USGS National Map Services suite includes both a REST service and an application program interface (API) that can be integrated into a service or application. The 3DEP Dynamic Elevation Service REST service provides access to and visualization of national 3DEP data products. The USGS TNMAccess API enables 3DEP partners to access files from the 3DEP USGS hosting site and make the data available from their own site.

Cloud-based Lidar Public Data Distribution and Storage

Many public data managers have turned to cloud-base data storage and services to address the logistical challenges of managing large lidar data collections. These services commonly support online data access, analysis, and the derivation of custom lidar data products.

All USGS 3DEP data holdings are available via the Amazon Cloud and access is optimized when working directly within the Amazon cloud environment. The original tiled lidar is available from a "requester pays" bucket named usgs-lidar in the us-west-2 region. Most of this lidar has also been converted to the Entwine Point Tile (EPT) format and stored as the Amazon Web Services (AWS) USGS 3DEP LiDAR Point Clouds Dataset. EPT is an optimized format that can be used to visualize lidar data without downloading first using 3D point cloud viewers like Potree and Plas.io. In addition to visualization, all the analysis and manipulation capabilities of the Point Data Abstraction Library (PDAL) can be applied directly to the cloud-based EPT data without downloading first.

The Amazon Web Services (AWS) Public Dataset Program utilized by USGS is available to publishers of "publicly available high-value cloud-optimized datasets." The service provides free access to and analysis of public datasets for a period of two years. Participants are selected based on the public-nature of and customer demand for their data.

OpenTopography is a National Science Foundation (NSF) supported service that specializes in data distribution, visualization, and analysis of topographic and bathymetric data. The site enables users to discover, download, and process lidar data, as well as generate custom derivative products on-the-fly including custom DEMs, hillshades, slope maps, and hydrology products, as well as raster and point cloud visualizations. OpenTopography is a non-commercial enterprise based at the San Diego Supercomputer Center at University of California San Diego, and offers flexible and affordable data hosting services for federal, state, local, or commercial partners.

Lessons Learned:

- States should consider the use of existing 3DEP access and distribution services before investing in the advanced GIS enterprise software and expertise necessary to build and maintain such inhouse distribution services.

Enhanced Elevation (Lidar) Acquisition Plan Template

With the team engaged, goals and objectives established, a strategy outlined, and a plan summary in place, construction of the plan can begin. The following template outlines plan components for consideration.

The template is a *guideline*. It's purpose is to outline components that may be relevant to your plan. Some components will be more applicable than others. The order of the components depends on your strategy. The level of detail necessary per component varies with your objectives. The intent is that you will make the plan your own using the template.

Executive Summary

Insert Plan Summary and modify as needed

Introduction

Provide a brief explanation of the:
- organization(s) that is/are proposing the plan
- reason that the organization(s) is/are proposing the plan
- plan goals
- plan objectives.

Background

Status of State Elevation Data

Provide an overview of elevation data coverage within the state. Consider including both summary text and maps that describe the data:
- geographic extent
- format, e.g. lidar, and quality
- temporal extent
- issues related to limited access or data utility challenges.

Elevation Data Acquisition Past Efforts
Provide a description of how the current lidar data holdings, described above, were acquired. This doesn't need to be a detailed description for each data resource but an overview of how elevation data has been acquired in the past. Include descriptions of: - issues driving the collection of the data - coalition of agencies and partners that cooperated to acquire data - investments to date.

Value and Benefit of Lidar to the State

Describe the problems facing the state that can be addressed with improved elevation data. Consider: - environmental protection shoreline erosion, soil retention, critical habitat, forest health - hazards and public safety flooding, landslides, fire prevention - built environment highway construction, urban development, landscape development.
Explain how lidar data will address the problem . - better quality data = better understanding of the problem - more effective, efficient analysis and modeling due to lidar content and character - use of standardized elevation data across agencies (state, local, fed) and geographic regions facilitates data consistency and interoperability.
Cite tangible and intangible costs associated with the problems. Make the business case that the cost of the data is less than the cost of the problem. - perform return on investment (ROI) study, if feasible, or cite available relevant ROIs - describe the cost savings associated with existing and developing partnerships.

Statewide Lidar Management and Organization

Describe the lidar acquisition management and organizational roles. Include information about the Plan Team and the key roles team members will have in the plan. Demonstrate continuity and leveraging of work to date. A table can be added for specific individuals or organizations: - identify the manager for the project and outline the management responsibilities - identify task/activity leads and outline the associated responsibilities.

Describe how stakeholders will participate in lidar acquisition and management. Discuss the role that the Stakeholder Working Group played in developing the plan and what role key stakeholders will have in the plan. Again, demonstrate continuity and leveraging of work to date. Consider if stakeholders will:

- provide feedback on and updates to areas of interest
  pilot the use of the acquired data
- promote the use of the acquired data via training, derived products, public meetings, etc.

Lidar Acquisition Areas of Interest

Describe the full extent of the collective areas of interest. Provide a summary of the total acreage and *general* extent of the proposed acquisition areas such as the region(s) of the state, dispersed throughout the state, or geophysical region.

Provide separate descriptions for areas that share a common geography and common issue to which the data will be applied.

- describe the specific boundary condition, e.g. municipal/county boundary, watershed, fire district or other administrative area
- provide a map of the area
- describe the issue to be addressed using the data and why the area was selected. Be sure to note stakeholder input and use of the NEEA and 3D Nation Elevation Requirements and Benefits Study
- describe exclusion areas and reasons for exclusions.

Adherence to Technical Specifications and Standards

Compliance with the most current USGS Lidar Base Specifications
Note: USGS intends to publish an update to the specification in 2020

If the plan intends to comply with the USGS lidar base specification, describe any upgrades or requested exemptions and the reasoning for the upgrade or exemption. For example, some plans may specify the need for:

- QL1 data to support urban planning and the capture of roof tops
- leaf-on conditions to assess forest structure
- additional breaklines to perform hydrologic analyses.

Provide a link to the USGS specification.

Compliance with Other Lidar or Data Collection Standards

If the plan intends to comply with other related standards such as survey control or data processing standards, provide the following for each standard:

- name of the standard
- organization that publishes the standard
- general description of the standard subject matter
- reason for utilizing the standard
- URL, if available, for the standard.

Elevation Products to Be Derived From the Lidar

Describe the products to be derived from the lidar and their intended use. The description and justification of products are important factors to those considering funding or otherwise supporting the plan. See USGS Lidar Base Specifications for a glossary of standard derived products. Include graphics to help visualize products.

Funding

Data Collection Costs

Outline the anticipated costs derived during plan development. Include multi-year estimates if derived. Tables can be used to show estimated costs per square mile, estimates for out-year priority areas, and refresh costs.

Funding Sources

Describe how the data acquisition will be funded. Include confirmed, anticipated, and potential funding sources identified during plan development.

Strategy and Schedule

Based on the plan strategy, describe how the plan will proceed. For each stage, identify the individuals or organizations responsible, products and/or outcomes, and schedule for completion. Consider the following stages:

- plan approval and endorsement
- funding procurement and proposals
- data collection
- data processing

- creation of derived products.

If a work plan was developed during strategic planning, include it as an Appendix.

Data Management and Distribution

Data Storage and Maintenance

Describe how the data will be stored and maintained. Identify the:
- data storage facility and equipment
- security protocols and procedures
- QA/QC procedures and parameters
- data tiling scheme
- data review and maintenance schedules.

Data Distribution

Describe how the data will be distributed to the public.

Lidar Acquisition Plan Maintenance

Describe how the data acquisition plan will be used and maintained. Identify the:
- online location of the plan and whether the site is publicly available
- party responsible for plan review
- schedule for plan review and updates
- method for updating the plan.

Future Challenges

Discuss the challenges facing the organization as it strives to develop and maintain a statewide elevation dataset. Consider:
- implications of new datum (2022)
- file format changes (.las to .laz)
- acquiring data for federally owned land within the state
- acquiring data for rural areas
- coordinating with Tribal Nations
- communicating value to executive leadership
- enabling communities to utilize the data
- integrating new technologies
- securing continued funding.

3DEP Planning Resources

3DEP Lidar Acquisition Planning Mapping Application and Guide

The NSGIC 3DEP Lidar Acquisition Planning Mapping Application, an Esri Map Journal Story Map template, is available to states to develop their own online 3DEP application. The template is based on the plan components described above and can be used to document state 3DEP plan implementation, track progress, and inform and engage stakeholders. The 3DEP Lidar Acquisition Planning Mapping Application Implementation Guide provides detailed instructions for applying and populating the template and guidance on integrating the Story Map with other mapping applications including ArcGIS Online, Web AppBuilder, and Survey123.

NSGIC 3DEP Interest Group Resource Library

The NSGIC 3DEP Interest Group is a community of state, federal, local, academic, and private sector NSGIC member 3DEP stakeholders. The group meets regularly to discuss 3DEP issues and activities and to share 3DEP planning, acquisition, and data management resources.

The following 3DEP planning resources are compiled in the 3DEP Interest Group community library:

- Example state lidar acquisition plans
- Example state lidar acquisition planning websites and applications
- Lidar funding approaches
- Cost estimating resources
- Federal coordination models and contacts

If you would like to access, or contribute toward, these resources, create a login at the NSGIC.org website and follow the instructions to join the My.NSGIC 3DEP Interest Group Community.

Appendix: 3DEP Planning Resource URLs

Get Organized

USGS National Enhanced Elevation Assessment (NEEA)
https://pubs.usgs.gov/fs/2012/3088/pdf/fs2012-3088.pdf

USGS/NOAA 3D Nation Elevation Requirements and Benefits Study (3DNation)
https://my.usgs.gov/confluence/display/3DNationStudy/3D+Nation+Requirements+and+Benefits+Study

Develop the Plan

USGS 3DEP Annual Broad Agency Announcement (BAA)
https://www.usgs.gov/core-science-systems/ngp/3dep/broad-agency-announcements

Geospatial Products and Services Contracts (GPSC)
https://www.usgs.gov/core-science-systems/national-geospatial-program/geospatial-products-and-services-contracts

Funding Lidar Acquisition

USGS 3DEP Annual Broad Agency Announcement (BAA)
https://www.usgs.gov/core-science-systems/ngp/3dep/broad-agency-announcements

DOI Independent Government Cost Estimate (IGCE)
https://www.doi.gov/cloud/faq/igce

USGS Geospatial Products and Services Contracts (GPSC)
https://www.usgs.gov/core-science-systems/national-geospatial-program/geospatial-products-and-services-contracts

Federal 3DEP Working Group
https://communities.geoplatform.gov/ngda-elevation/3dep-working-group/

Seasketch online participatory mapping application
https://www.seasketch.org/#projecthomepage/5272840f6ec5f42d210016e4

Data Distribution

National Map (TNM) data download and data visualization suite of services
https://www.usgs.gov/core-science-systems/ngp/tnm-delivery

USGS National Map Download site
https://viewer.nationalmap.gov/basic/

National Map (TNM) 3DEP Dynamic Elevation Service
https://elevation.nationalmap.gov/arcgis/rest/services/3DEPElevation/ImageServer

National Map TNMAccess API
http://viewer.nationalmap.gov/tnmaccess/
Entwine Point Tile (EPT)
https://entwine.io/entwine-point-tile.html

Amazon Web Services (AWS) USGS 3DEP LiDAR Point Clouds Dataset
https://registry.opendata.aws/usgs-lidar/

Potree
http://potree.org/

Plas.io.
https://plas.io/

Point Data Abstraction Library (PDAL)
https://pdal.io/

Amazon Web Services (AWS) Public Dataset Program
https://aws.amazon.com/opendata/public-datasets/

OpenTopography Topographic/Bathymetric Data Distribution Portal
https://opentopography.org/

3DEP Planning Resources

3DEP Lidar Acquisition Planning Mapping Application Implementation Guide
https://nsgic.memberclicks.net/assets/3dep/NSGIC%203DEP%20State%20Planning%20-%20Maps%20and%20Apps%20Implementation%20Guide%20VERSION%202.0.pdf

NSGIC 3DEP Interest Group
https://my.nsgic.org/communities/community-home?CommunityKey=0c79c50a-2f17-4952-9ced-c05507166c47

NSGIC.org
https://www.nsgic.org/