

# State of Kansas LiDAR Implementation Plan

May 13, 2011



This plan is a State deliverable for the Cost Sharing Agreement for Planning Assistance between the U.S. Army Corps of Engineers (USACE) and the State of Kansas for Kansas River Water Resources Study Light Detection and Ranged (LiDAR) Surface Elevation Data Agreement #3-102609.

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## 1. Introduction

In May 2008, the GIS Policy Board adopted a business plan for Improved Elevation Data for Statewide Applications. High-resolution digital elevation data were identified as the highest programmatic goal in the Kansas GIS Strategic Plan. This State LiDAR Implementation Plan for Kansas serves as framework of the components required to implement a LiDAR project and provides long-term objectives for a statewide implementation plan.

This plan is an in-kind State deliverable for the Cost Sharing Agreement for Planning Assistance between the U.S. Corps of Engineers (USACE) and the State of Kansas for Kansas River Water Resources Study Light Detection and Ranged (LiDAR) Surface Elevation Data Agreement #3-102609, which provided funds for the 2010 LiDAR project. The scope of work for the report described in Appendix A of the agreement states:

The State of Kansas GIS Policy Board will develop a plan that prioritizes statewide development of LiDAR data. To date, acquisition of LiDAR data have been project, or program, specific. Agencies with funding identify areas of special interest and then collaborate to acquire LiDAR for the largest area possible with the greatest benefit to the participating agencies. This has worked well considering the limited funding available and the high cost of LiDAR data. Although data development may continue in the same vein for the near future due to budget constraints, it is important for the State to have a plan in place that can more effectively guide the development of LiDAR. For example, it is much more efficient to fly a single large block than many small, irregular areas. In addition, some areas of the state may have a greater need for LiDAR data due to complex topography, or a more immediate use of LiDAR in planning projects that require high accuracy elevation data; or to help address pressing policy issues.

The Policy Board will direct its Technical Advisory Committee (TAC) to develop a plan for statewide development of LiDAR in Kansas. The State GIS Director staffs the GIS Policy Board, and will coordinate the activities of the TAC which will include meetings, working groups and the development of the plan for presentation to, and approval by, the Policy Board. The State of Kansas will also have project coordination and review responsibilities for the specified product of this agreement.

## 2. Implementation Approach

With a history of LiDAR projects in Kansas, the intent of this implementation plan is to document our process while incorporating our lessons learned and thus eventually leading to implementing LiDAR statewide.

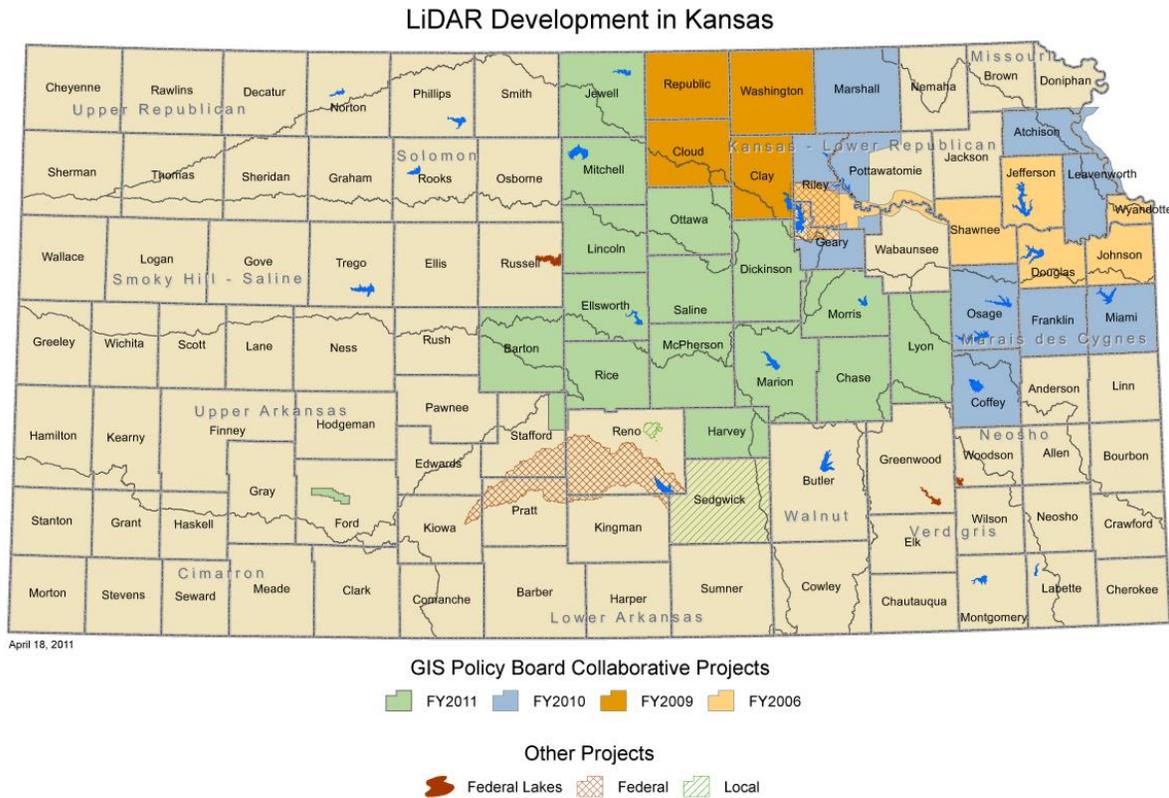
### 2.1 Initial Activities

LiDAR data acquisition is underway or completed for 34 full counties and 7 partial counties, for a total of 24,957 square miles, or 30 % of the state. The first LiDAR project in Kansas was flown in 2006 and is known as the Kansas River Corridor Project. This project involved 15 partners and covered 4,084 square miles (2,763 square miles in Kansas). The U. S. Geological Survey (USGS) Cartographic Services Contract was utilized.

In 2009, LiDAR data were collected as part of the Rainwater Basin Nebraska project. In this project, three Kansas partners—the Natural Resources Conservation Service (NRCS), USGS, and the Kansas GIS Policy Board—joined with federal and State agencies in Nebraska to partner on a 13,000 square mile project. The four north central Kansas counties included in the project covered almost 3,000 square miles. This project was contracted through the federal USACE contracting services.

The third LiDAR project was a multi-agency partnership flown in 2010. Partners are the USACE, USGS, NRCS, the Kansas Department of Agriculture, Division of Water Resources (KDA-DWR), and the Kansas GIS Policy Board. This nine county area (plus one partial county) in northeast Kansas was also contracted through the USACE.

The latest contract for LiDAR collection in 2011 covers 15 counties in central Kansas, a small levee area in Ford County, and the Quivira Wildlife Refuge. Partners in the project are the KDA-DWR, (using Federal Emergency Management Agency (FEMA) funds), the Kansas Water Office (using U.S. Environmental Protection Agency (EPA) funds), the Kansas GIS Policy Board, the Kansas Information Technology Office (KITO), the Harvey County Commission, NRCS, USGS, and the U.S. Fish & Wildlife Service. The project area comprises 11,853 square miles. FY 2011 has proven to be the most cost effective year for LiDAR acquisition by utilizing a State contracting process, rather than federal contracting mechanisms through the federal partners. By the end of 2011 approximately 30% of the state will be mapped with LiDAR.



## 2.2 Identification of Roles & Responsibilities

To ensure a successful LiDAR implementation plan, a number of roles have been identified that support the various aspects of the project. These roles are summarized as:

- Contract Administrator/Project Manager – State GIS Director
- Partnership Coordination – USGS Geospatial Liaison
- Technical Support – Kansas GIS Policy Board Elevation Team
- Data Manager – Kansas Data Access & Support Center

**Project Manager:** The State GIS Director within the Kansas Information Technology Office (KITO) serves as the project manager for the State contracting process. The project manager interfaces with the Kansas Department of Administration Division of Purchases during the Request for Proposal (RFP), proposal review, and contract award. In addition to managing the State’s contract with a vendor, the State GIS Director also administers all of the agreements with the contributing partners.

**Partnership Coordination:** The USGS Geospatial Liaison for Kansas works with the Kansas GIS Policy Board Elevation Team to facilitate partnership coordination. Several participating agencies have ongoing requirements

for LiDAR data. The liaison and other team members also share information about a potential LiDAR project to potential partners outside the Elevation Team.

**Technical Support:** The Kansas GIS Policy Board Elevation Team provides technical support to all aspects of the LiDAR activities. The team meets regularly to provide direction to LiDAR activities in the State. The team has developed marketing materials that highlight uses of LiDAR data in the State. The most recent RFP specification will be reviewed and updated by the team for each new LiDAR project. Team members also share technical skills in using the LiDAR data at meetings and State and regional conferences.

**Data Manager:** The Kansas Data Access & Support Center (DASC) serves as the State GIS Data Clearinghouse and is the main repository of LiDAR data in Kansas. DASC is responsible for hosting and serving the data to government agencies, private industry, and the public. The massive amounts of LiDAR data associated with each new project require updates to server infrastructure to maintain services.

### **2.3 Partnership Requirements**

Most of the LiDAR data acquired in Kansas has been through partnerships where the costs have been shared among several contributing agencies. Partnerships provide the most cost effective method of acquiring data that would have been cost-prohibitive by individual agencies. Combining multi-agency goals and requirements can be challenging to overcome, but the results easily justify the effort.

Working together to identify a project area is usually the first task. Some partners have their specific area of interest that needs to be incorporated into the new project if possible:

- FEMA's new Risk Mapping program provides funding for LiDAR acquisition, but is very specific on their location requirements based on several factors.
- The KWO has several Kansas Water Plan priorities that can benefit from LiDAR, including the Reservoir Sustainability Initiative that uses LiDAR elevation data for stream stabilization above public water supply reservoirs, and wetland identification. These initiatives, which were developed to support the State water Plan, prioritize the KWO areas of interest.
- NRCS has a variety of applications for LiDAR including dam breach analysis, soil survey updates, watershed planning, and wetlands assessment. Because these applications occur everywhere in the State, NRCS is flexible on project location.
- USGS is producing new topographic maps throughout the state that will benefit from higher accuracy, updated elevation data regardless of location. However, some USGS science activities that depend on LiDAR data may be more location specific.

Another consideration when identifying a project area is to have large contiguous blocks, rather than scattered areas. While this goal is not always achieved, it is the most cost effective. Large blocks result in less airplane mobilization costs (LiDAR data are collected aerially). Larger blocks also minimize project edges (increasing data seamlessness) and make processing easier.

Another challenge with partner funding is that each level of government operates on a different budget cycle. These cycles can affect the ability of an agency to partner. The following shows the level of government with their fiscal years:

- Federal – October 1 to September 30
- State – July 1 to June 30
- Local – January 1 to December 31

The partnership agreements must be in place by the fall, so that LiDAR acquisition can occur during the winter leaf-off season (dense vegetation obscures the ground, and thus limits LiDAR's ability to measure ground elevation). Payments to contractors occur before, during, and after LiDAR acquisition, so funding transfers tend to be a juggling act based on who can pay what amount at what point in time.

## **2.4 LiDAR Acquisition**

### **2.4.1 Specifications**

The Kansas LiDAR specifications, as defined in the two most recent Kansas LiDAR projects, are based on the latest USGS LiDAR specifications with a few enhancements. Kansas requires hydro flattening all water bodies greater than  $\frac{3}{4}$  acre and streams wider than 50 feet. Kansas also requests a first return 1-meter Digital Elevation Model (DEM) as an additional product, which provides information regarding buildings, structures, and vegetation.

### **2.4.2 Contractor Provided Services**

The LiDAR projects described above have all been done by different companies. The contractors are selected based on their technical abilities, capacity to do the work, and competitive price. Some lessons learned from working with different contractors include:

- Contract schedules are subject to change based on weather and equipment malfunctions.
- Contracts need to include consequences for not meeting deadlines that are written into contracts.
- Large projects over 5,000 square miles require a contractor with multiple sensors or multiple contractors to minimize data acquisition delays.

### **2.4.3 Quality Assurance/Quality Control (QA/QC)**

LiDAR data are very detailed and technical and require professional QA/QC. State agencies do not have the capability or expertise to conduct their own QA/QC. Approximately 10-20% of the project cost is required for a separate QA/QC contract.

## **2.5 Outreach**

The Kansas GIS Policy Board Elevation Team is responsible for developing an outreach strategy that includes:

- Identify needs and funding sources
- Application-specific fact sheets
- Presentations for conferences and other events
- Facilitate end-user training on how to use LiDAR data
- Software recommendations
- Feedback from users

## **3. Budget**

LiDAR costs from Kansas projects have ranged from \$80 to \$200 per square mile based on project size. Larger projects typically have a lower the cost per square mile. Project costs have ranged from \$280,000 to just over \$1 million. With approximately 55,000 square miles remaining in Kansas for LiDAR acquisition, a conceivable cost of \$5.5 million (at \$100/sq mile) would be required to acquire the LiDAR, plus up to \$1.1 million for QA/QC, depending on the level of QA/QC.

At this time, there is no consistent annual funding that could be applied to LiDAR acquisition each year. Having consistent annual funding would greatly benefit future project planning.

#### **4. Schedule**

The Kansas GIS Policy Board Elevation Team plans to complete data acquisition for a LiDAR project every winter. The location of a project is driven by the partners with funding. It would be unrealistic to define a collection schedule with unknown funding support. However, every effort is made to identify project areas as soon as possible and notify State, federal, and local governments who may have an interest in, and potential funding for, those areas. Once the priority areas are finalized, the Elevation Team extends the project boundary as much as possible to fill in gaps of coverage.

#### **5. Priority Areas**

Some priority areas have been identified and are documented below. Eventually, these areas will be included in future LIDAR projects as funding becomes available.

Southeast Kansas has a variety of overlapping priorities:

- Southeast Kansas experienced massive flooding in 2007 and continues to be a flood prone area. The six (6) counties of Allen, Bourbon, Neosho, Crawford, Labette, and Cherokee have new flood insurance maps that were developed using existing topographic data at 10-meter resolution and don't have the accuracy that LIDAR could provide. New topographic data is required for FEMA to update these maps again.
- Southeast Kansas also has environmental issues from extensive historical mining activities in the (5) counties of Cherokee, Crawford, Bourbon, Labette and Linn counties. The U.S. Office of Surface Mining provides Abandoned Mine Lands project funding to state agencies for mine waste reclamation and filling in abandoned mine shafts, cave-ins and sink holes that are an on-going problem for citizens in that area. The Environmental Protection Agency (EPA) has a 115 square mile superfund site in Cherokee county to clean-up the lead, zinc, and cadmium mine tailings that leach into groundwater and run-off into streams. The USGS is also studying contaminated sediments in streams and floodplains from toxic surface-water run-off in Cherokee County.

Northeast Kansas priorities include:

- The Kansas Water Office has an interest in acquiring LiDAR data above the Federal reservoirs with Tuttle Creek Reservoir being the highest priority. The Tuttle Creek watershed includes a portion of Nemaha County. The Perry Lake watershed is the next priority area, which includes Nemaha, Brown, and Jackson Counties. LiDAR data in these watersheds will also be useful for the Tuttle Creek Lake and Delaware River Watershed Restoration and Protection Strategy (WRAPS) projects.
- The Kansas Department of Agriculture, Division of Water Resources (KDA-DWR) has identified the six (6) county area of the North East corner of the state which includes Wabaunsee, Pottawatomie, Jackson, Nemaha, Brown and Doniphan counties. Portions of this area have been impacted repeatedly since 1993 by flooding events and contain numerous water structures (dams, stream obstructions, levees and channel changes). The ability to better track and account for changes to flooding characteristics would be greatly improved with new, more detailed topographic data.

South-central Kansas priorities include:

- Butler County. KDA-DWR has an interest in Butler County, which has two specific needs that would be addressed by improved topographic data. In 2009, Butler County received new flood insurance rate maps. Again these were created using topographic information from the 10 meter Digital Elevation Model. Improved topographic data would allow for these maps to be greatly enhanced. Butler County also has more watershed dams than any other county in Kansas. Improved topographic data would allow for the development of more accurate dam inundation maps.

- Reno County. KDA-DWR is also interested in Reno County, which received new flood insurance rate maps in 2010. Again these were created using topographic information from the 10 meter Digital Elevation Model. Improved topographic data would allow for these maps to be greatly enhanced.

## **6. Summary**

The LiDAR implementation plan explains the current LiDAR acquisition process in Kansas incorporating the lessons learned from past projects. Our intent is to provide local entities with advance notice for LiDAR acquisition in their jurisdiction in order to give them the opportunity to plan for and possibly contribute funds to the project. The larger the area collected, the lower the cost per square mile of LiDAR acquisition. Partnerships are the most cost effective method for acquiring data that otherwise would be cost-prohibitive if pursued individually. The result is cost effective contiguous project blocks that benefit all partners, and provides more continuous and extensive coverage for the State.