

Partners in Research

Posted: November 1, 2007

Multiple agencies band together to complete a LiDAR survey of a Central Minnesota region.



After collecting the data, Merrick & Company personnel began performing the rectification and quality control of imagery for the St. Cloud-area LiDAR project.

Central Minnesota, acknowledged for its abundance of lakes, friendly small towns, wildlife conservation, and recreational activities surrounding its forests and lakes, includes several areas undergoing strong urban growth. The city of St. Cloud, for example, located just 60 miles northwest of the Twin Cities region, is the nucleus for the three biomes of Minnesota where coniferous forest, prairie grassland and deciduous forest converge, creating diverse environmental conditions that appeal to recreation seekers, animal inhabitants and scientists alike. In recent years, the city has experienced steady development and expansion, including an estimated population increase from 59,000 in 2000 to approximately 65,000 today.

To keep up with this growth, several regional agencies required geospatial data to assist in their efforts for economic development, environmental stewardship and scientific research. This past May, a cooperative venture among the Minnesota Department of Transportation (DOT), Camp Ripley (a 53,000-acre National Guard training facility in nearby Little Lakes) and Crow Wing County commissioned a complete LiDAR survey of the region. The project encompasses the camp, county and Mille Lacs Lake (one of the most productive and popular walleye fishing spots in the world), including the northern part of the Rum River, the channel connecting it with the Mississippi River. The endeavor brought together federal, state and county governments and was administered by St. Cloud State University. Each area surveyed would benefit from the LiDAR data in its own individual way while supporting the region's vision for growth.

A Collaborative Effort



Crow Wing County's preliminary LiDAR and digital imagery flight plan covered 1,155.95 square miles.

Merrick & Company of Aurora, Colo., was selected to perform the \$616,000 LiDAR and digital orthophotography data collection and processing contract. Because this LiDAR survey represents a huge financial and time investment for all the partners, it was important to choose a company that would deliver the data in a format that is usable by each entity. "One of the most appealing parts of Merrick's approach is the development of prototype data and results from select portions of the project area," says Camp Ripley's project leader, Craig Erickson, a GIS manager for the Minnesota Army National Guard. "We all are public agencies and need to be accountable for the use of our funds. We saw that Merrick's clear communication and its presentations would help us achieve our goals." The goals Erickson speaks of are individual and diverse.

Camp Ripley



The preliminary LiDAR and digital imagery flight plan for Camp Ripley covered 218.48 square miles.

Camp Ripley serves as an exceptional resource for all branches of the military, as well as state and international agencies. Ripley's mission includes utilizing its resources to serve the community and to support its commitment to environmental stewardship. Because of its efforts, the camp was presented with the 2005 National Guard Bureau Natural Resources Conservation Team Award. Major sections of the camp act as necessary buffers to outside properties and are rarely used for training; training, in fact, only takes place on a small portion of the campgrounds. While perhaps counterintuitive, the camp is a wonderful natural refuge, containing clean waters, healthy plants and a thriving wildlife population.

Camp Ripley's Erickson had considered a LiDAR survey of the camp for some time to obtain topographic data with sufficient vertical accuracy to assist in preliminary site planning. "Camp Ripley is always concerned with maximizing the conservation of the facility's wide expanse of land," he says. "The LiDAR data will be used to enhance existing maps and records as well as to help mission planning to ensure that the conservation function of the camp is not only maintained but increased."

Data obtained from the LiDAR survey will also be used in support of statistical model development that measures forest structure characteristics and identifies potential bird nesting habitat for select species. Marco Restani, St. Cloud State University's associate professor of biological sciences, and Wes Newton, supervisory statistician for the USGS Northern Prairie Wildlife Research Center, plan to use the data from the survey (including filtered bare earth data, a bare earth digital elevation model [DEM] with breaklines supporting 1-foot contour interpolation, and digital orthoimagery at a 6-inch resolution) to create maps and models of understudy habitat for birds and other animals on Camp Ripley.

Crow Wing County

Crow Wing County's government is noted for its diligence in preserving its abundant lakes and vast forests while cultivating the growth of business and tourism. The county is experiencing exceptional growth and development that requires county officials to address a variety of land management issues, especially on lakeshores. Detailed topographic data is needed for mapping, planning and zoning issues, as well as for countywide conservation concerns; the LiDAR survey data will assist in these efforts.

Don Sigety, LLS, Crow Wing County surveyor, wanted to work closely with the neighboring Camp Ripley to obtain a large LiDAR data set that would serve the needs of a variety of land management, highway, forestry and site development uses. "There are many rules concerning development near shorelines based both on proximity to water and the terrain," Sigety explains. "The LiDAR data will allow the county to learn, for example, if there is a small bluff near a lake on someone's property without having to send a crew out to check. Although the initial cost of the LiDAR data is high, it will quickly be recouped by the amount of personnel time saved, and by the accuracy and

efficiency of the data.”

Mille Lacs Lake

Directly northeast of the project area sits the sole source of the Rum River, Mille Lacs Lake, the third largest lake in Minnesota, which covers 206 square miles. Mille Lacs is bordered by the Indian reservation of the Mille Lacs Band of Ojibwe and the Mille Lacs Kathio State Park. The data collected from the Rum River wetlands boundaries will be used in conjunction with hydrology data for a study conducted by St. Cloud State University and the Mille Lacs Band of Ojibwe aimed at assessing the feasibility to restore the wild rice habitat of the area, which has suffered greatly in recent years.



Merrick & Company mobilized its Cessna 402C aircraft for the LiDAR acquisition of the St. Cloud region.

Archaeological and historical evidence indicates that in the past 50 years, the rice in Lake Ogechie, a portion of the Rum River and the only outlet of Mille Lacs Lake, has disappeared because of a dam built at the lake’s outlet that has exceeded the water level in which the rice can cultivate (a mere 3 feet). The engineers and hydrologists planning the removal or modification of this dam will use the survey data--including raw LiDAR data, filtered bare earth data, a bare earth DEM with breaklines and 2-foot contours--to carefully model the wetlands that surround the lake. This will provide the detailed information needed to restore the wild rice habitat.

The Data Acquisition

On May 9, Merrick’s LiDAR acquisition Technical Lead Matt Bethel, along with a pilot, began the survey of the St. Cloud region. Merrick mobilized one of its Cessna 402C aircrafts with a Leica Geosystems (Norcross, Ga.) ALS50 Airborne Laser System for the LiDAR acquisition, and Merrick’s Digital Airborne Camera System (DACS) for the digital imagery collection. The ALS50 and DACS were co-mounted on the aircraft for simultaneous acquisition, which eliminated the need for separate flights.



Surveyors from Crow Wing County and Houston Engineering Inc. provided the ground surveying support for the project.

Houston Engineering Inc. of Fargo, N.D, provided the ground surveying support for Merrick. The two companies have partnered on similar LiDAR projects in this region in the past, and have a working relationship dating back to the mid-1990s. Houston Engineering was able to provide the project surveying requirements at a lower cost than Merrick’s Colorado crew based on its proximity to the site, as well as its offering of Minnesota-licensed surveyors. Prior co-projects have also enabled Houston Engineering to glean extensive knowledge of what is required for the LiDAR survey quality control points. To expedite the project, Crow Wing County provided Houston Engineering with additional support for the aerial target placement, existing control information and local knowledge needed for efficient ground support. “Merrick picked the coordinates and then we worked in conjunction with Houston Engineering to set the photo control points,”

Sigety says. "We set a total of ninety points, each made of white vinyl and measuring about one foot wide by five or six feet wide."

The entire data acquisition process took more than a month, ending on June 24, and was no easy task. Merrick's crew faced several obstacles, including inclement weather and security issues with Camp Ripley. While the camp is committed to natural resources conservation, its first and foremost duty is military training. Throughout the data collection process, there were many days when Merrick's crew was forbidden to fly. On several flight days, the crew had to carefully avoid live fire exercises.

Once the crew was given clearance to fly and obtained large amounts of LiDAR information, Merrick turned to its proprietary software, Merrick Advanced Remote Sensing (MARS), to help the three partners process, analyze and manage the data. The MARS software application, comprised of a Windows-based modular suite of tools used to manage field collection, production and client deliverable workflows, ensured that there were no omissions of data collection prior to demobilizing the flight crew from the site. As the project progresses, MARS will be used for all LiDAR post-processing, boresighting, classification, breakline collection and contour interpolation. MARS will also be provided to St. Cloud State University under the project contract for viewing, exporting and analyzing the LiDAR data in preparation for the spatial analyses that will be conducted by each of the agencies.

An Advantageous Endeavor



The preliminary LiDAR and digital imagery flight plan for the Mille Lacs Lake project area covered 38.2 square miles.

With the initial data procured, Merrick will now classify (filter) the LiDAR data for final distribution in the winter of 2008. Although final data has not yet been delivered, each partner involved with the survey recognizes that sharing costs, personnel and data in this LiDAR partnership project will enable its group to perform valuable work that would not have been possible with independent budgets. While the partnership among the university and the three levels of governments is unique, the ability to share the expertise, work and data on the survey has made the process easier and more efficient for all parties. "Also important to the project is the experience and opinions of the Merrick staff," Crow Wing County's Sigety adds. "[During the data acquisition], Merrick kept us informed every step of the way, took the time to show us their equipment and addressed our concerns."

Prof. Restani adds: "A key to the success of this project is the willingness of the agencies to share their staff. The Minnesota DOT, for example, has lended staff with expertise in topographic data to examine the deliverables before final acceptance as part of the quality assurance/quality control process." This collaborative approach is fiscally responsible and ensures that the LiDAR data will be widely used for the upcoming research projects at Camp Ripley, Crow Wing County, Mille Lacs Lake and St. Cloud State University.

Sidebar: Utilizing LiDAR Data at Camp Ripley

St. Cloud State University's Marco Restani and the USGS' Wes Newton will assist the Department of Military Affairs at Camp Ripley in addressing a need for a suite of decision support tools to better understand, predict and assess various land management activities of the camp.

LiDAR data for Camp Ripley, as well as the three-mile Army Compatible Use Buffer (ACUB) around the Camp, will be used to derive a highly accurate DEM as well as provide non-ground information for modeling forest structural and breeding bird occurrences in a spatially explicit framework. These models can then be used in a decision support system for assessments, projections and simulations to execute scenarios of various management activities occurring on and around the camp. In addition, forest inventory is an ongoing effort at Camp Ripley that provides planners with a quality representation of the resource. In an effort to reduce data collection labor of forest inventory survey crews, the potential to apply these models to future LiDAR data captured at the installation is being considered.

The largest benefit of the LiDAR data for the camp is quality information for the entire military installation and beyond for planning and land management purposes. Reliable data on hand eliminates the need for separate site specific surveys when addressing facility and range development. This translates into faster more efficient planning processes. The data set will also allow land managers to consider proactive management practices throughout Camp Ripley rather than reacting only to known problem areas.