RECLAMATION Managing Water in the West

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The Knowledge Stream
Research Update

Tracking History with LiDAR

Using LiDAR to assess Reclamation's priceless and irreplaceable heritage assets

Bottom Line

LiDAR is a new tool for rapid archaeological site condition assessment.

Better, Faster, Cheaper

When applied at regular time intervals, LiDAR can provide very precise measurements of changes at archaeological sites, furnishing management with information to make informed decisions at reduced expense.

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Collaborators

- **Bureau of Land Management**
- **Idaho State Historical Preservation Office**
- **Idaho State University**

Problem

The American Falls Archaeological District in eastern Idaho is listed on the National Register of Historic Places. The district contains important archaeological sites that represent the entire span of human occupation in southern Idaho. From Paleoindians to modern Indians to pioneers on the Oregon Trail, people have always valued this area just north of the Snake River for its natural resources, spirituality, and beauty. The district contains 158 archaeological sites (131 on Reclamation land and 27 on Bureau of Land Management land) and represents almost continuous human occupation spanning more than 9,000 years.

These assets are non-collectable—they must stay in place. However, these sites are now threatened as shifting ground surfaces can cover and uncover the archaeological resources. When sites are uncovered and exposed, they can be vandalized, washed away, or removed. They are exposed to wind and water erosion, off-road vehicle use, and cattle trampling. Understanding both the natural forces and human activities that impact these sites is critical to managing and preserving these invaluable cultural resources.

Example of the detrimental effect that off-road vehicles have on an area.

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Solution

Tracking changes in the Archaeological District requires a data collection method that can cover a huge area and yet provide enough detail to determine the condition of specific features (which may be as small as a single campfire ring or as large as a 476,000 square-meter prehistoric habitation site).

This Science and Technology Program research project uses a light detection and ranging (LiDAR) system mounted on an aircraft to create finely detailed mapping of this vast area. LiDAR is a remote sensing system that collects topographic data using laser light. LiDAR can provide highly detailed three-dimensional imagery of cultural resources such as rock art and archaeological features. Archaeologists can use these data to document the baseline condition of these resources at a very fine scale. Collecting these data in the same area over a span of years can provide an understanding of erosional patterns and rates that Reclama.tion can then use to assist management with decisions that could alleviate–or possibly eliminate–the existing causes of deterioration.

Research to Date

The project team first assessed conditions at four important archaeological sites. The team then compared these conditions with the last survey from 20 years ago. This comparison provided a baseline to indicate the rate of change for the last 20 years. In 2011, the team flew a LiDAR flight over the entire district, including the four sites that were inventoried on the ground, to provide a comprehensive picture of current ground conditions.

The team quality controlled the data and developed a method for future comparative analysis. This methodology include three parts:

- Experimental uncertainty analysis used to "define an objective representation of the bounding limits distinguishing areas of measured change from differences potentially introduced through data collection and post-processing techniques" (Reclamation 2012)
- Data processing to process LiDAR point cloud data into three-dimensional surfaces and two-dimensional grid surfaces to calculate surface change
- Surface model comparison that will essentially subtract the second-year surface from the first-year surface to determine areas of change.

Future Plans

The team plans on conducting another LiDAR flight in 2013 and then comparing the two datasets. This will help identify specific areas within the Archaeological District that are more subject to erosion—"red flag" areas. The LiDAR comparison will also provide specific data to help determine the causes of this erosion and to help focus management's attention on addressing these causes to preserving the heritage assets. The team also plans on performing a ground survey in the "red flag" areas and setting up a monitoring system after this comparison. The amount of changes shown in the comparisons will help determine how much and how often monitoring, including future LiDAR flights, would be needed.

"This study represents a significant step in cultural resources management using a recently developed digital imaging tool and could be an enormous boon for Reclamation in both its fiscal and legal responsibilities to heritage preservation. Reclamation will likely garner national attention with this project."

Tom Lincoln,
Archaeologist, Reclamation

More Information

Reclamation, 2012
Proposed Methodology for the Application of LiDAR Technology to Improve the Management and Protection of Heritage Assets: American Falls Archaeological District, Idaho, Pacific Northwest Region. Available on request.

Future Applications

The methodology for surface model comparisons with LiDAR could be an enormous help in future applications in areas with similar geology. Comparing the surface models from LiDAR data taken over a period of years can help determine the amount of degradation and if the degradation stems from erosion.