



INEEL/CON-04-02093  
PREPRINT

## Integrating GIS, Archeology, And The Internet

Sera White  
Brenda Ringe Pace  
Randy Lee

August 9-13, 2004

## ESRI International Users Conference

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# **Integrating GIS, Archeology, and the Internet**

Sera White

Brenda Ringe Pace

Randy Lee

Idaho National Engineering and Environmental Laboratory

Idaho Falls, ID

83415

## **Abstract**

At the Idaho National Engineering and Environmental Laboratory's (INEEL) Cultural Resource Management Office, a newly developed Data Management Tool (DMT) is improving management and long-term stewardship of cultural resources. The fully integrated system links an archaeological database, a historical database, and a research database to spatial data through a customized user interface using ArcIMS and Active Server Pages. Components of the new DMT are tailored specifically to the INEEL and include automated data entry forms for historic and prehistoric archaeological sites, specialized queries and reports that address both yearly and project-specific documentation requirements, and unique field recording forms. The predictive modeling component increases the DMT's value for land use planning and long-term stewardship. The DMT enhances the efficiency of archive searches, improving customer service, oversight, and management of the large INEEL cultural resource inventory. In the future, the DMT will facilitate data sharing with regulatory agencies, tribal organizations, and the general public.

## **Background**

The U.S. Department of Energy (DOE) is committed to the preservation and protection of cultural resources in a spirit of stewardship for future generations. DOE facilities across the country contain large numbers of cultural resources, many of which are in a remarkable state of preservation as a result of access restrictions imposed by security requirements. At the Idaho National Engineering and Environmental Laboratory (INEEL), cultural resource management activities have been ongoing for more than 40 years (Braun et al. 2000). In that time, approximately 7.5 % of the undeveloped portion of the 890 square mile facility has been systematically surveyed, local tribal people whose aboriginal homelands included the INEEL have been consulted, and the main buildings under DOE-ID jurisdiction have been evaluated. A variety of cultural resources have been identified as a result of these ongoing efforts. Archaeological sites, contemporary Native American cultural resources, historic architectural properties, and paleontological localities are all present in the inventories that have been completed.

Federal law requires DOE to preserve and protect these fragile remnants of America's cultural heritage. The INEEL Cultural Resource Management (CRM) Office takes a lead role in this task by serving as an information repository for up-to-date, accurate information on the distribution, nature, and condition of all known INEEL cultural resources. Most of these records consist of hard-copy paper maps, documents and illustrations, tabular data stored in outdated software systems, and some microfiche information that has become increasingly difficult to access. The INEEL CRM Office has long recognized the value of converting this information to digital formats. Since the beginning of the program in the mid 1980s, field-recording forms have been stored and maintained using various word processing programs. Beginning in 1993, cultural resource locations were digitized from hard-copy maps and stored in ARC/INFO<sup>1</sup>. At the same time, a preliminary interface between these Geographic Information System (GIS) files and complementary descriptive archaeological data in Oracle was also developed (Lee et al. 1993). In 1999, hard copy digitizing of cultural resource locations was discontinued in favor of the greater accuracy achieved through use of a GPS (Global Positioning System) unit.

The main objective of this project was to develop a fully integrated automatic system for accessing and archiving information on INEEL Cultural Resources, using Microsoft Access and Environmental Systems Research Institute (ESRI)<sup>1</sup> ArcView. The developed system is called the Data Management Tool (DMT).

## **DMT Description**

The DMT consists of four components: the GIS, the Archeological database, the Historical database, and the Research database. The GIS is the visual interface that seamlessly connects the three databases. The three databases were developed in Microsoft Access 2000. The GIS component was developed with Active Server Pages (ASP) and ArcIMS 4.0.1. The DMT runs on Windows Server 2000.

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<sup>1</sup> References herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the U.S. Government, any agency thereof, or any company affiliated with the Idaho National Engineering and Environmental Laboratory

The Archeological database was modeled after a legacy database called the Intermountain Antiquities Computer System (IMACS). The IMACS stored all field data collected by the CRM. The IMACS has long been obsolete and the CRM had resorted to using paper forms once again (Figure 1). Although the IMACS was obsolete, the CRM staff believed its data model was solid and wanted a new version of the old system.

Figure 1. Shows an example IMACS Paper Site Form.

coverage for specific management areas can be reported. It is possible to email the reports, publish them in Microsoft Word, preview or print them.

The screenshot displays the 'Main Switchboard' application window. It features a menu bar (File, Edit, View, Insert, Format, Records, Tools, Window, Help) and a toolbar with various icons. Three overlapping data entry forms are visible:

- Part C - Historic Sites** (top): Includes a 'Field number' input field and a 'Site Type' dropdown menu.
- Part B - Prehistoric Sites** (middle): Includes a 'Field Number' input field and a 'Site Type' dropdown menu.
- Part A - Administrative Data** (bottom): Includes a 'Find Record' button, and input fields for Site Number, Field Number, State (set to Idaho), County, Project Number, Report Number, and Project Name. It also has checkboxes for Site Class (Prehistoric, Historic, Paleontologic, Ethnographic, Traditional), a Meridian dropdown (set to Boise), a Map dropdown, and an Elevation input field (set to 0 ft.). A button labeled 'Open Map Information' is present. Below these fields is a text prompt: 'How were easting and northing obtained? (GPS or other)'. At the bottom, a status bar shows 'Record: 14 of 657' and 'a state assigned smithsonian number'.

Figure 2. The automated data entry forms of the archeological database.

The historical database component is modeled after a custom built DB4 system. The DB4 system was rebuilt in Microsoft Access. The database contains all historical data collected on the INEEL. The historical database produces SHPO's required report as well as blank field forms that match the data entry order of the input forms.

The research database component is simpler than that of the historical database or the archeological database. The primary purpose of the research database was to house the data needed for a predictive model that was created in collaboration with Idaho State University. The database contains only data entry forms. The ArcIMS component displays the results of the predictive model. The predictive model is used to anticipate the time and funding requirements associated with any given development project on the

INEEL. The model is a valuable tool for INEEL land managers and could also prove of value to other land managing agencies on the Upper Snake River Plain.

Originally, the archeological database was linked to ESRI ArcView, enabling the user to visually query the database. The standard ArcView user interface was customized for simplicity. Some additional customized functionality was built into the system via Avenue. However, the ArcView application had its limitations. It was restricted to single use and available from only one workstation. Simple queries returned results in cumbersome tables. ArcView's interface required extensive training. Unfortunately, creating layouts using ArcView was fairly complicated. The GIS component needed updating every time the database structure changed.

The GIS component was ported to ArcIMS 4.0.1. ArcIMS is easily customizable. ASP can be used to create nice functional reports that maintain a dynamic connection to a database. Most importantly, the ArcIMS application can be accessed from any workstation that has access to the secure server hosting the website.

The main objective to building the ArcIMS component was to create a simple user interface that allows the scientists to operate the system with minimal training. It contains simpler reporting features than the archeological and historical databases. It allows the familiar "point and click" functionality. The user simply clicks on a site and relevant information about the site is returned. All of the customized tools built into the ArcIMS component were designed to perform within a minimum number of mouse clicks. The ArcIMS component contains a customized query tool from which the user can select a predefined query from the dropdown menu. It contains a classification tool as well as a labeling tool. A screenshot of the ArcIMS component can be viewed in Figure 3.

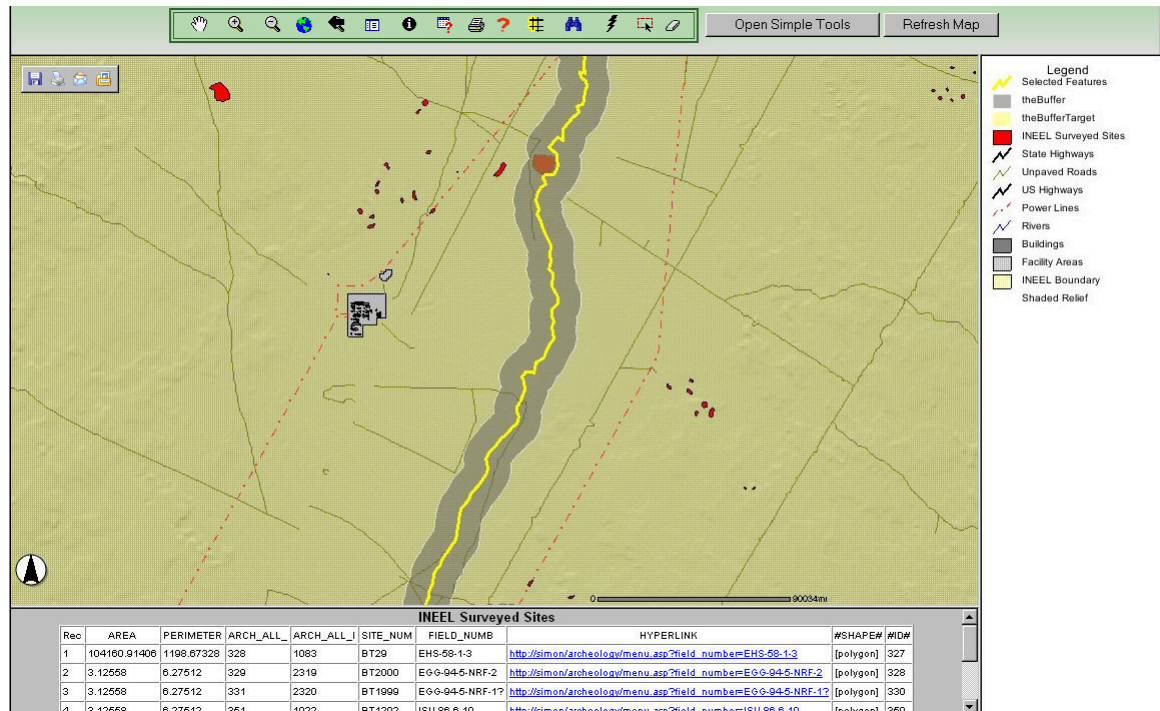


Figure 3. Shown above is a screenshot of the GIS component. A buffer was created around the river to show all archeological sites within .25 miles. The bottom screen shows the attributes returned for all of the sites that were found.

This project has taken approximately four years a team of skilled professionals to complete. The DMT has been very useful to the CRM. Last summer, the CRM was asked to determine archeologically significant sites for the Emergency Response (ER) group at the INEEL. The DMT saved the CRM from “digging” through over seven hundred paper records. The DMT is capable of handling many similar situations that the CRM may encounter in day-to-day business. It is also capable of producing presentation quality maps to show potential customers where significant sites are and which areas are not yet surveyed. The DMT can handle changes in SHPO and other reporting requirements. It also has potential for becoming a publicly oriented interface that facilitates communication with stakeholders. This application and future enhancements will lower the costs for the customer, improve the services rendered, and improve the overall management of the resources.



**Work supported by the Office of Nuclear Energy, under DOE Idaho Operations  
Contract DE-AC07-99ID13727**

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