# Ad Hoc DOE-GIS Users Group Newsletter

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## GIS User Group News

I hope that all of you have had a happy and joyous holiday season. This past year has been an exciting one for the ad hoc DOE GIS Users Group with meetings at the ESRI conference this past July in San Diego and the recent meeting held in conjunction with the TIE Workshop in Oakland, CA. Two GIS sessions were held at TIE, which featured 10 very interesting and informative papers. A list of the papers presented is available on the TIE website:http://www.em.doe.gov/tie/14tie.html. These papers represent the wide ranging talents and abilities of GIS professionals throughout the complex.

Finally, an important survey is currently being conducted to assess the use of GIS technology and related resources throughout DOE. The survey is being sponsored by the DOE headquarters office of the Chief Information Officer and by the Energy Information Agency. The survey can be taken over the web at http://peak.lanl.gov:1900/sm2/surveys/4793213.html. I urge you to take the survey so that an accurate and complete assessment can be made. The survey can be taken through January 24.

Wishing you the very best of 2003.

Jim Bollinger
Savannah River Technology Center

## Upcoming Events

- User Group meeting at the ESRI Conference—Date to be determined.
- User Group meeting at the TIE Workshop—Date to be determined.

## Feedback

Your feedback regarding the DOE-GIS user group newsletter and planned user group activities is welcomed and would be greatly appreciated. Please send comments to:

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*Ad hoc GIS User Group Meeting at the ESRI International User Conference, July 2002.*

## Los Alamos National Laboratory Honored for GIS Accomplishments

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On July 11, 2002 Los Alamos National Laboratory received a Special Achievement in GIS award, in recognition of GIS efforts in support of the Cerro Grande Rehabilitation Project. This award was given to select sites around the world in recognition of their outstanding work in the field of GIS. Los Alamos was chosen to receive this prize from over 100,000 organizations worldwide.

In May 2000, the Cerro Grande Fire swept through Los Alamos, NM, burning more than 48,000 acres, and causing evacuation of the Laboratory and townsite. GIS was an integral part of response during the fire, and continues to be used for restoration and environmental monitoring under the Cerro Grande Rehabilitation Project. During the fire, Los Alamos staff and volunteers worked day and night in an emergency GIS laboratory set up in Santa Fe, producing literally hundreds of maps to monitor the fire progression, plan for protection of key facilities, and assist the fire fighters.

The Special Achievement in GIS award was awarded to GISLab and colleagues at Los Alamos National Laboratory (CGRP, ER, ESH, FWO, PM, EOC..)

and elsewhere who contributed to GIS efforts. Many groups outside of Los Alamos National Laboratory contributed, including Sandia National Laboratory, Loft4, the Earth Data Analysis Center (EDAC), and the multi-agency Burned Area Emergency Rehabilitation (BAER) team.

Recently, a public display of the Cerro Grande Rehabilitation Project GIS was featured at the Bradbury Museum in downtown Los Alamos. Information about the CGRP-GIS is available on the web at http://cgrp-gis.lanl.gov. More information about the GISLab is available on the web at http://gislab.lanl.gov.

GISLab Team Leader Paul Rich commented "The events of May 2000 were extraordinary. The response of the GIS community was equally extraordinary. At one level, everybody was caught unprepared. At another level, the most important preparation was in place: a dedicated community of GIS professionals, skilled at solving problems. These professionals worked together to reconstruct the GIS database, to set up an emergency GIS center in Santa Fe, and to produce maps day and night. GIS efforts have continued in the Cerro Grande Rehabilitation Project. Activities range from floodplain mapping and sediment transport modeling, to planning for forest management, to planning for emergency preparedness, to building a spatial data warehouse for institutional and fire-related spatial data."

"I am honored, pleased, and humbled to accept this award on behalf of my colleagues: honored because of the recognition, pleased because the recognition is deserved, and humbled because this not an award for one individual, or even one organization, but rather an entire community of dedicated GIS professionals. The cloud of smoke that was the Cerro Grande Fire has a silver lining. That silver lining is the way the GIS community came together during and after the fire."

## GIS Technologies for Archival, Cataloging, and Retrieval of Digital Imagery for Waste Site Characterization and Remediation

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GIS technologies provide the key to unlocking historical photographic records of waste site operations and activities within the DOE complex. For example, the Savannah River Site (SRS) has over 40,000 frames of vertical and oblique photography covering the time period from pre-SRS in 1938 to 2001. However, much of this imagery was collected in a variety of formats and for different projects, and thus was not easily accessible to users. With a variety of file locations, image formats, data types and spatial extents, a means to archive, catalog, and easily retrieve this valuable resource with a user-friendly interface was needed.

The first task was to standardize the archival and storage of the imagery. A selected subset of almost 5,000 frames of photography representing 210 gigabytes of data was compressed to less

## DOE ad hoc GIS User Group and Core Team Mission Statement

The Department of Energy (DOE) GIS User Group and the DOE GIS Core Team promote effective utilization of GIS science and technology in the DOE complex. Our major goals are to foster technical excellence and communication, to identify and advocate best business practices, and to provide sound recommendations on policy and standards.

## DOE GIS User Group and Core Team Objectives

- Encourage communication and broad technical exchange among DOE GIS users to reduce costs and foster technical excellence
- Assist DOE with developing and implementing best business practices regarding the sharing of geographic data and GIS capabilities and long term stewardship of this data
- Work closely with DOE to implement the President's e-government management agenda; in particular the geospatial one-stop initiative (see http://www.whitehouse.gov/omb/budintegration/pma_index.html)
- Assist DOE with implementation of OMB's geospatial policies and development of best geospatial data management practices (see http://www.fgdc.gov/)

than 11 gigabytes of data using the MrSid image compression software. MrSid provided a means to convert the various image file formats to one standard format in a much more manageable storage size. In addition, a standardized directory structure according to imagery type, geo-referencing information, spatial extent, and year was adopted.

The next step was to catalog the existing imagery. Two GIS layers were developed to accomplish this task. Approximate image center points for both geo-referenced and non-geo-referenced vertical, and oblique photography were created. An automated process was then developed to capture image wire frames for the geo-referenced vertical, raster, and satellite imagery. Associated image attributes were then created in the Spatial Data Standard (SDSFIE) format and linked to the wire frame layer to consolidate the imagery information. Once this consolidation was completed, two approaches were developed to serve the data to the user community.

The first approach used ESRI's ArcIMS software to create an interactive map of SRS with major features or landmarks such as the site boundary, major roads, streams, operating areas, and waste sites for easy referencing. The map "view" was web-enabled so that users could zoom to a particular location, select a set of image center points, and return a list of imagery for an area or waste site of interest. The returned table contains information on the date, type, scale, and storage location of the file as an http path. The path to the image file is hyper-linked and will automatically launch Netscape or Internet Explorer and allow the user to quickly view the image via the MrSid browser plug-in application.

The second approach involved the development of a Visual Basic extension to ArcGIS enabling users to search for imagery by year, type, scale, area of interest, or other attributes. The user can then preview the selected images and the information from the returned list of photography for addition into an ArcGIS.

The SRS imagery database is Spatial Data Standard (SDSFIE) compliant and is designed in such a manner that additional photography can be added to the GIS server and automatically updated in the imagery wire frame GIS layer and its related attribute tables. Thus, GIS projects or the web-based viewing interface will update dynamically and not require changes due to new data in the future.

Using these innovative approaches, this rich and valuable historical resource provides information about the location and activities for over 500 waste sites on SRS and places it at the finger tips of the SRS Environmental Restoration community, thus accelerating characterization, evaluation, remediation, and closure activities.

## LandTrek Moving Forward with GIS at BNL, Long Island, NY and Bernalillo County, NM

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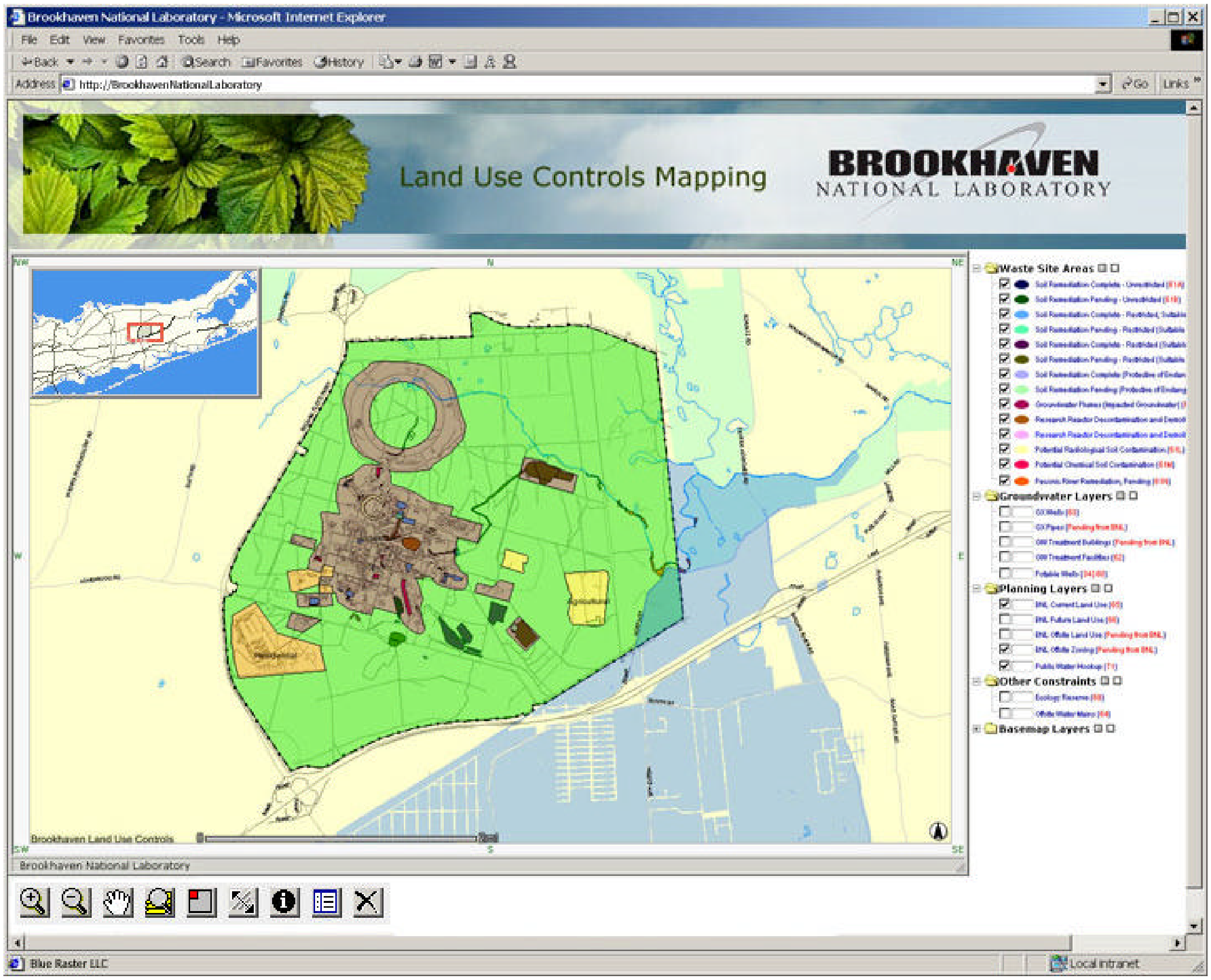
Brookhaven National Laboratory (BNL) and Bernalillo County are both developing new environmental web GIS applications and expect to demonstrate them at the 2002 TIE conference in November. The applications, developed in conjunction with the LandTrek program, use GIS to display environmental data in a spatial format. The LandTrek program facilitates federal facility site cleanup, closure and transfer or reuse through a web application located at www.landtrek.org. When completed, both BNL and Bernalillo County's LandTrek pilots will be linked to www.landtrek.org.

### BNL

BNL is developing the LandTrek **BNL Environmental Information Management System (EIMS) Land Use Controls Project** emphasizing land use controls, future land use and other Long Term Stewardship information. The password-protected application will be available to DOE and BNL staff, U.S. EPA and state regulators but not to the public. The project will allow display of land use layers (current and planned) and web access to related land use documents, including facility use agreements. Users can click on a web-based map to access available information, including data stored within the map layer, links to distributed databases, links to scanned documents, and a listing of other (non-digitized) related documents and their locations. Links to metadata will explain the information's source, currency and reliability. Users will be able to download and print retrieved information (e.g., the screen map can be inserted into a preformatted page with legend and scale bar and saved as a




*Prototype for BNL Environmental Information Management System (EIMS) Land Use Controls Project*

graphics file). Data retrieved from a database can also be saved in a format readable in standard spreadsheet or word processing software. The application functions allow users to combine and use data from different data sources. The application architecture is based on the BNL LandTrek Environmental Monitoring pilot presented by Mary Daum at last year's TIE conference. That application uses web GIS to display quarterly groundwater contaminant plume data spatially and in tabular form and is currently password protected due to 9/11 security concerns. BNL plans to demonstrate the Land Use Controls Project at the TIE conference in November.

## Bernalillo County

Bernalillo County is also developing a web GIS application to display county-wide groundwater monitoring data. The Bernalillo County Environmental Health Department is working in coordination with DOE and the LandTrek program to produce the application, which is modeled after the BNL web GIS applications. Bernalillo County stakeholders will be able to access the user-friendly application for timely environmental data. In addition, Bernalillo County and Sandia National Laboratory are discussing future plans and how the LandTrek project could be used as part of a collaborative effort to save environmental resources. Bernalillo County plans to demonstrate its new application at the TIE conference in November.

For program information, contact John Lee of DOE Oakland. For technical information on the LandTrek program, contact Michael Lippmann of Blue Raster LLC at 703-875-0914 or mlippmann@blueraster.com.

## Spatial Data Warehouse Design for Enterprise GIS[1]

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An increasing number of organizations are challenged with implementing a robust enterprise geographic information system (GIS) capable of serving spatial data to a large number of individuals through information sharing and interconnected networks (Von Meyer and Oppman 1999). In the past, numerous technological roadblocks hampered the successful implementation of enterprise GIS.

[1]Presented at GIScience, Second International Conference on Geographic Information Science, Boulder, CO. LA-UR-02-3514.

With the advent of high-speed networks, increasingly fast computers, intelligent spatial data serving technologies, and improved data architecture, the newest challenge involves integration of the various technological components. This integration can be viewed as an inevitable stage in the evolution of GIS. Herein, we present a design and conceptual framework for implementation of enterprise GIS. In particular, we focus on three critical components: 1) recognition of the roles of participants in the process (data providers, data managers, and GIS users), 2) the concept of a complete geospatial data cycle, 3) the design of spatial data warehouses.

Complete enterprise designs consider the diverse and integral roles that participants play in the process (e.g., Dueker and Butler 2000). **Data providers** need consistent standards and effective tools to prepare, organize, and document their data, as well as to ensure that the data will be responsibly managed. **Data managers** need consistent workflow procedures that ensure efficient and standardized means to manage and deliver data. **GIS users** need consistent mechanisms to locate and access well-documented and reliable data. Successful enterprise GIS design depends on facilitating each of these participants in what we refer as a geospatial data cycle.

A complete, or unbroken, geospatial data cycle involves flows of data from data source to database, from database to the GIS user, and, if modifications have been made, from the GIS user back to the database, with necessary steps to

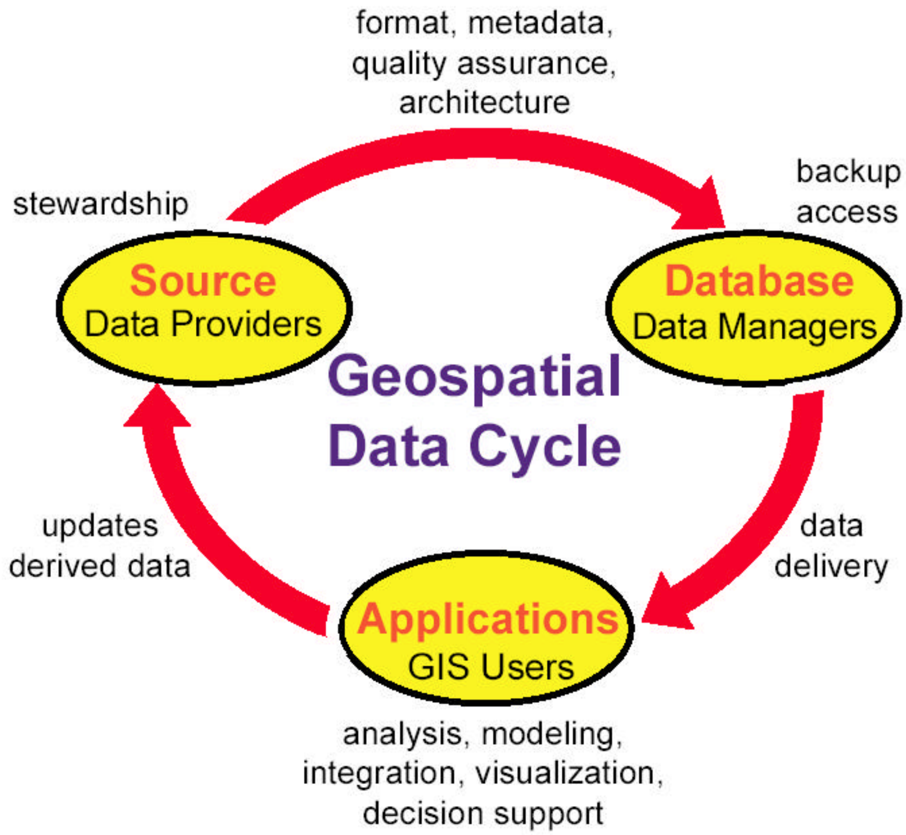


*Figure 1. A complete or unbroken geospatial data cycle ensures that data are complete, secure, documented, and accessible to GIS users.*

ensure that data are complete, secure, documented, and accessible (Figure 1). These steps include a suite of necessary data operations: formatting, quality assurance, documentation (metadata), cataloguing, tracking, backup, delivery, and updating. For example, metadata are often lacking or incomplete, and data are not well organized and made available to others. In addition, important feedback is lost, in particular the data flow from GIS users back to the database. In a complete data cycle, the GIS user is a source for updates and changes to existing data and metadata, and for generation of derived or supplemental data.

At the core of our enterprise design, a spatial data warehouse provides a clean organizational structure that defines three main components of data flow: staging, storage, and delivery. Staging involves receipt of data and preparation for placement in the data warehouse. Storage involves the actual housing of data in the data warehouse. Delivery involves distribution of warehoused data to GIS users. Sound data architecture provides the organizational framework for all steps of data warehousing and delivery (Figure 2). First, in staging, data are placed in workspaces organized by project, spatial domain, and theme. Here, data are processed to ensure standard formatting, quality assurance, and adherence to metadata standards. Second, data are stored in the data warehouse that is organized according to the same architecture. Data security, in terms of access control, is inherent in the architectural design. Third, efficient delivery of the data is enhanced by the multi-tier architecture, via shared directories or relational databases.

Conceptually, the design of our enterprise GIS, like many others (Adelman and Moss 2000), is primarily focused on the flow of information and data to the end user from a centralized or distributed network (Figure 3). One significant difference is our emphasis on integration of workflow, dataflow, and user roles. While advances in commercial GIS software have made many enterprise capabilities available for GIS (e.g., ArcSDE and ArcIMS), the functionality of enterprise GIS as a complete system requires customized tools. For example, tools for tracking work and data flow are typically absent. We employ a web-based tracking system that communicates with our relational database. A unique identifier links work and data flow processes within the logical data architecture (Figure 2). This tracking system integrates all stages of data warehousing and records project information from all participants in the process: geospatial data providers, data managers, and GIS users.

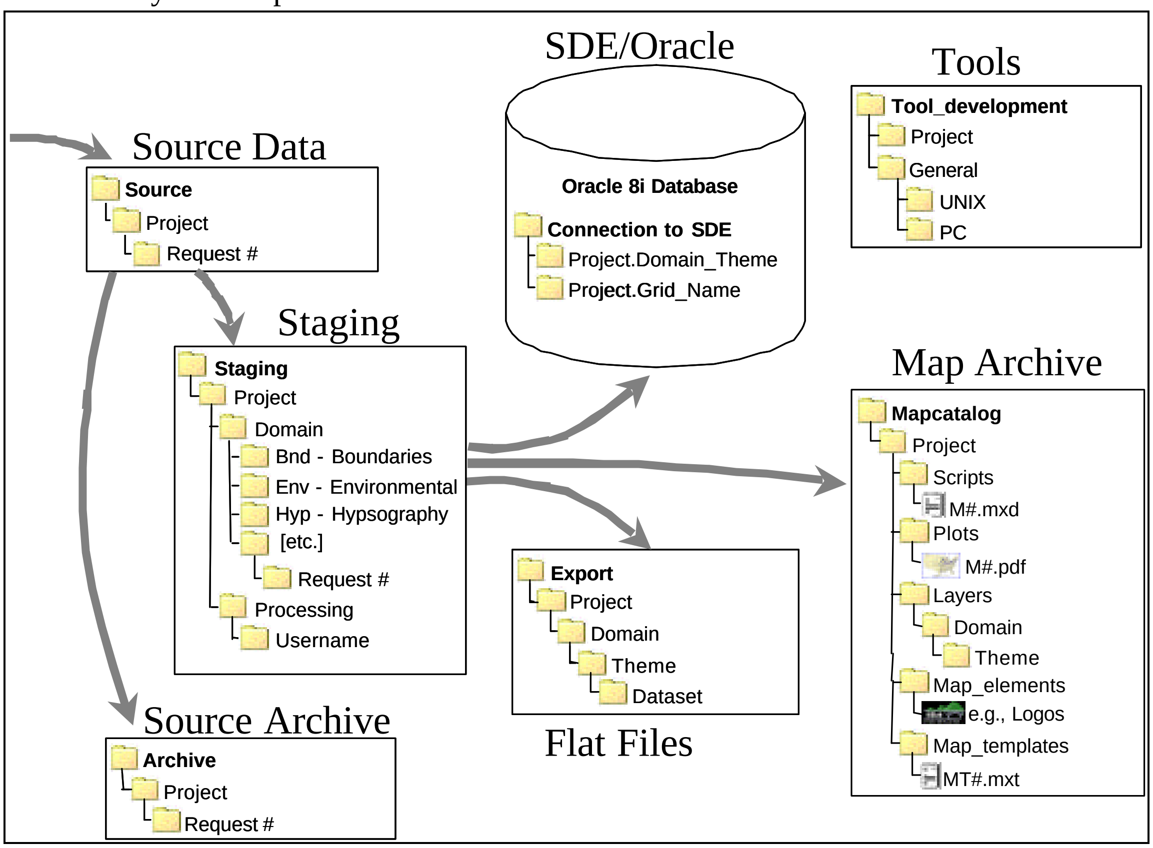


*Figure 2. The logical data architecture enhances data flow from source to staging and finally to data delivery via flat files and relational database access. Archives of source data and products (maps, plots, templates, etc.) are stored for future reference. Tools (scripts, source code, and executables) are also stored in a standardized format.*

Efficient data sharing at an enterprise level requires uniform policies, standards, and procedures for data quality, metadata, and access (Keating et al. 2003). In contrast to ad hoc personal exchanges, it has been shown that formalized processes and procedures for data exchange produce a better flow of information (Pinto and Onsrud 1995), as a result of a better understanding of individual responsibilities and expectations. Policies govern, in general terms, how data will be documented, managed, and made accessible. Standards provide specific formats and processes. Procedures are applied to meet the requirements of policies and standards, for example to assign names for data layers, to ensure complete and consistent metadata, and to provide for access control when required by data providers (Figure 3).

A successful enterprise GIS design must accommodate the diverse needs of an organization, including those of data providers, data managers, and GIS users. A primary measure of success is a complete geospatial data cycle with well-integrated work and data flow processes based on sound design.

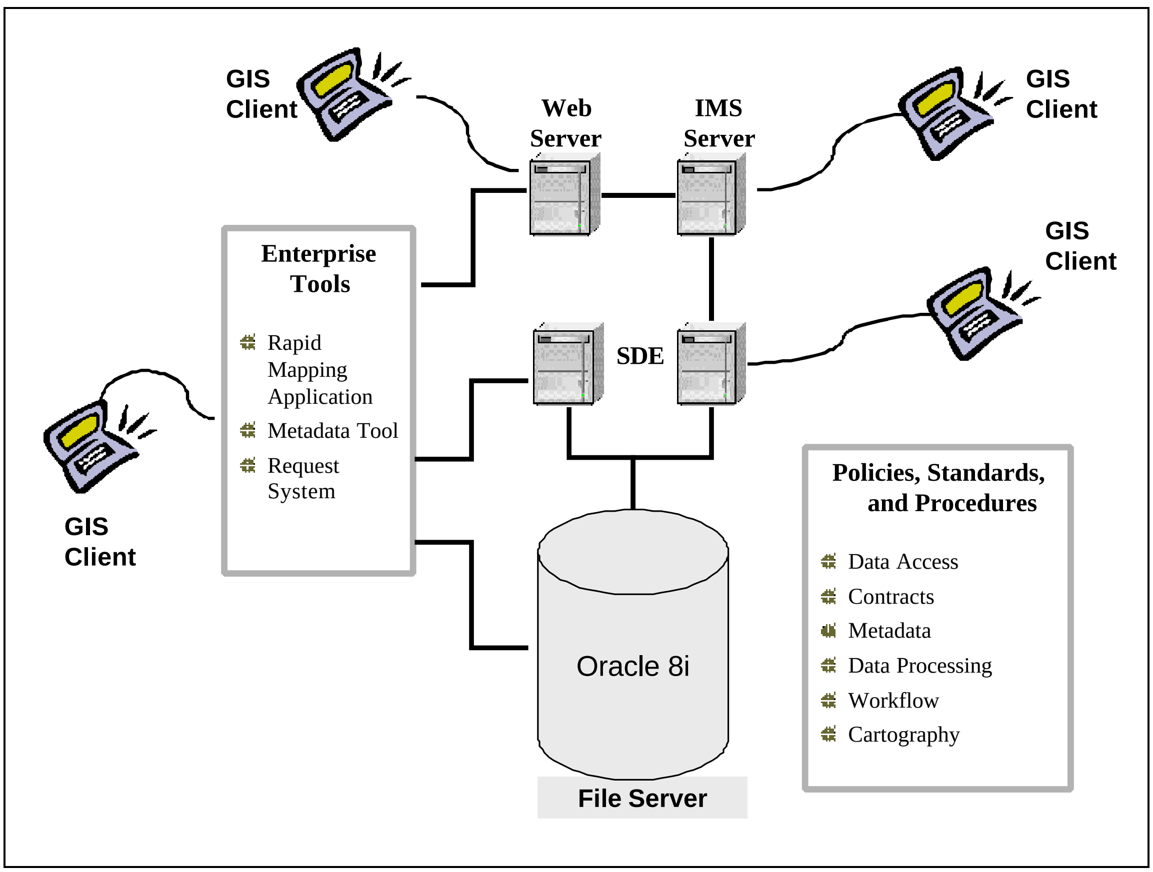


*Figure 3. The spatial data warehouse physical architecture includes servers and software for data storage and delivery; enterprise tools; and policies, standards, and procedures.*

**Acknowledgements**

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