

SCIENCE

The U.S. Geological Survey (USGS) is a natural science organization that is recognized worldwide as scientifically credible, objective, and demonstrably relevant to society's needs. The USGS provides the Nation with reliable information to describe and understand the Earth. This information is used to minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; enhance and protect the quality of life; and contribute to wise economic and physical development. USGS conducts research in four major science disciplines -- biology, geology, hydrology and cartography -- through which it develops and applies innovative means to solving problems in resource management.

The USGS has an important and essential role in building and rebuilding the Nation in the 21st century as we did in the 19th and 20th centuries, but the role will be different and it will change with time. We have become the Nation's chief natural science agency for a reason and a purpose -- to provide the kind of science that will serve the citizen and help the Nation adapt to a rapidly changing world; to be the agency that can help this Nation find, protect, develop, and enjoy the natural resources that are essential for building and living in the next century; and to be an agency that can help significantly reduce the risks from natural hazards. The new USGS motto, "science for a changing world," appropriately reflects the importance of looking forward and being sensitive to the changing needs of society.



USGS scientist uses a theodolite to measure the volcano dome at Redoubt Volcano, Alaska (photo by USGS).

USGS Mission

"The U.S. Geological Survey provides the Nation with reliable, impartial information to describe and understand the Earth."

The USGS is well positioned to make major scientific contributions. Land and water resources are increasingly constrained and the use and conservation of these national assets will become increasingly important in the future. Several decades of major research accomplishments related to earthquakes, volcanic eruptions, floods, and other natural hazards place the USGS in an excellent position to make further contributions in reducing the loss of human life and property resulting from these events. The capability to provide information about hazards on a real-time basis is transforming the way Government officials and the public prepare for and respond to natural disasters. The Bureau's extensive mapping, geographic information, and data storage and transfer expertise will allow USGS to play a leadership role in ensuring a solid scientific foundation for future natural resource decision making. The USGS will certainly continue to be called on to use its multidisciplinary expertise to address the many environmental challenges facing the Nation and the world. All of these activities benefit from appropriately balanced fundamental and applied research and other activities.

The following sections summarize 1997 accomplishments as they relate to the USGS's Government and Performance Results Act business activities and performance measures.

Water-Quality Monitoring

USGS data and new scientific methods resulting from the National Water-Quality Assessment Program (NAWQA) are being used by a number of State agencies to design new and more cost-effective water pro-

tection strategies, or to improve water-quality monitoring and assessment techniques. For example:

- USGS biological and habitat protocols have recently been integrated into Idaho's statewide surface water-quality monitoring network. The prior network design had focused primarily on water chemistry constituents.
- The Texas Natural Resource Conservation Commission is initiating a new Source Water Assessment Program, mandated by the Environmental Protection Agency (EPA), with significant technical support from the USGS. The approach, designed with input from USGS, borrows heavily from the NAWQA program's retrospective approach and relies on USGS pesticide data sets for the State of Texas.
- The Pennsylvania Department of Agriculture has decided to begin using the concepts of the NAWQA program to prioritize groundwater areas for assessments of pesticides. This constitutes a major component of the State's strategy for groundwater protection. As part of this effort, the USGS will provide pesticide analysis and quality assurance support for the Pesticides and Ground Water Strategy. Also, based on USGS findings of bacterial contamination in rural household wells, the State is analyzing additional samples from rural areas to determine the extent of bacterial contamination.

Avian Botulism in Wetland Ecosystems

Avian botulism, caused by a highly potent toxin produced by bacteria commonly found in wetland soils, kills large numbers of birds annually throughout North America and the world. Tens of thousands of birds can die in a single outbreak, and annual losses in the hundreds of thousands are common. USGS scientists have developed models for the occurrence of this disease based on specific environmental conditions in wetland ecosystems that cause the bacteria which pro-

1997 Science and Research Highlights

- *Provided oversight and policy guidance on numerous water resource management issues throughout the Western states such as implementing the Central Valley Project Improvement Act and the State-Federal comprehensive strategy to conserve San Francisco Bay-Sacramento River Delta resources.*
- *Developed eight geospatial data integration applications including the Mississippi River, Yazoo River and Rio Puerco River Basin data sets.*
- *Increased State usage of the National Water Quality Assessment Program to design new and more cost-effective water protection strategies.*
- *Established a flood monitoring network for the Amite River Basin to provide real-time stage and discharge data to emergency response agencies and the public.*
- *Expanded monitoring activities for high-altitude volcanic ash at the Alaska Volcanic Observatory to improve flight safety for commercial and military aircraft in the Alaska and Pacific regions.*

duce the toxin. These models will allow wildlife managers to predict outbreaks and develop wetland management techniques to reduce the risk of avian botulism.

Flooding in Louisiana

Flooding in Louisiana is a serious and recurring problem. Seven major floods have occurred in the Amite River basin since 1977, primarily the result of backwater flooding along the Amite and Comite Rivers and their tributaries. In cooperation with the Amite River Basin Drainage and Water Conservation District, the USGS has established a flood monitoring network in the Amite River Basin to provide real-time stage and discharge data to emergency response agencies and the general public.

During a flood event, real-time data is available through a USGS World Wide Web page on the Internet and also via a telephone information line provided by a local newspaper and updated frequently by USGS staff. In addition to these resources, the USGS published a "Flood Tracking Chart" for the Amite River Basin, Louisiana (USGS Open-File Report 96-649). Modeled after a hurricane tracking chart common along the Gulf and Atlantic Coast States, the chart includes a map showing the location of gages from which real-time data are available during floods and bar charts showing the relative peaks of historical floods at each station. By providing this geographical and historical



Ash/steam plume rises from one of the many active Cook Inlet, Alaska volcanos. Photo shows the aviation hazard to an airplane (upper right) in its normal flight path (photo by USGS).

context, the chart aids users in understanding and responding to a flood.

A local Congressman from Baton Rouge combined the tracking chart with public safety information from a local USGS cooperator and published it in a mail-out to 290,000 Baton Rouge area residents, with appropriate credit to the USGS. He further pointed out that communities in his district could claim public education credit from Federal Emergency Management Agency for his mail-out and help lower their flood insurance rates.

Improved Aviation Safety

With funding from the Federal Aviation Administration (FAA), the USGS expanded its monitoring activities at the Alaska Volcanic Observatory (AVO) in 1997. Volcanic ash erupted high into the atmosphere is very hazardous to modern high-performance aircraft because it erodes compressor blades, melts onto critical engine parts, and causes loss of engine power. Hazardous concentrations of volcanic ash can drift at air-

traffic altitudes for hundreds to thousands of miles downwind following a volcanic eruption. Worldwide, about 80 jet aircraft in the past five years have accidentally entered volcanic-ash clouds and put thousands of passengers at risk. Within U.S.-controlled airspace, the ash-aviation issue is especially important in the North Pacific region where many active and potentially active volcanoes are overflowed daily by commercial and military aircraft in heavily traveled international and domestic air routes. By using data from its monitoring networks, USGS provides eruption reports and prognoses of future activity to the National Weather Service (NWS), the FAA, and the aviation industry. The NWS uses USGS information to help track eruption clouds, while the FAA uses the USGS and NWS information to route air traffic away from dangerous ash clouds. In 1997, USGS monitored seismic unrest at three Alaskan volcanoes and tracked eruptions at an additional three, as well as one in the Kamchatka Peninsula of Russia.

Water Resources Data on the Internet

Historical streamflow data is available on the Internet for all 50 States. Having this information available is a valuable tool for Federal and State agencies when they are designing water resource projects or making water resource decisions.

Real-time streamflow information is available for all States except Hawaii. The real-time streamflow sites are the most popular and useful sites on the USGS water resources Internet pages with an estimated 1.2 million real-time hydrographs being downloaded from January to September 1997. Not only is this information critical to resource managers and emergency management coordinators during times of flooding, but citizens also use the information for making decisions about when and where to repair the dikes and levees on their farms, when to move their property to higher ground, and when to evacuate.

USGS water resources web sites are building a loyal clientele. For example, 18,000 users of USGS water resources web sites, 16 percent of the total, come back more than once per month. Almost 96 percent of users are from outside the USGS; the majority -- 78 percent -- are from commercial sites; about 12 percent are from educational domains; 6 percent are foreign; and 4 percent are from government sites other than the USGS.

“Webmaster Magazine” named the USGS as one of its “50/50” awardees, signifying the agency as one of the 50 Internet sites contributing most to its organization’s business purpose. The USGS was chosen by a panel of judges from over 700 entrants, including many major corporations and government sites.

Abandoned Mine Lands

In 1997, the USGS successfully implemented the Abandoned Mine Lands (AML) Initiative. The goal of this five-year initiative is to develop a watershed approach to gathering the scientific information needed by Federal land management agencies to effectively and cost-efficiently remediate contamination associated with abandoned mine lands. A significant early accomplishment of the AML Initiative is the completion of four tracer injection studies in mountain streams affected by acid mine drainage. A tracer injection study identifies and prioritizes the many individual sources of metals and acid in a mountain watershed, thus enabling targeting of resources on contaminant sources that will have the greatest improvement in watershed quality. The tests were conducted in the Initiative’s pilot watersheds -- the Upper Animas River, Colorado, and the Bolder River, Montana. As a result of their success, two additional tests were requested by the U.S. Environmental Protection Agency to support their decisions related to remediation at Fisher Creek, Montana (New World Mine), and Wightman Fork, Colorado (Summitville Mine).

Louisiana Wetlands Restoration

Results from the USGS barrier island and wetland studies in Louisiana are being widely used by the Federal-State Coastal Wetlands Restoration Task Force as part of a \$200 million effort to conserve and restore coastal wetlands in Louisiana. This is a long-term activity and much of the baseline scientific information and guidance is provided by the USGS. A follow-on study in Louisiana addresses loss of biologically important wetlands and pollution in Lake Pontchartrain; these issues concern Federal agencies, State and city governments, and the public. Results of these USGS studies are providing information in the form of workshops, computer data bases, and detailed maps of the sea floor and shoreline used to restore the estuary and manage the urban coastal region.



Great Plains Desertification - sand dunes in the Great Plains (photo by USGS).

Great Plains Desertification

Windblown sand deposits with sparse vegetation surround primary croplands in the central United States. These deposits are vulnerable to extensive movement during periods of prolonged drought. USGS research is designed to find out when these sands were active in the past and to anticipate the conditions under which they could reactivate in the future, encroaching on lands that are now in productive agriculture. USGS research on desertification in the Great Plains has attracted the attention of the “New York Times,” ABC News, the Public Broadcasting System, and the Smithsonian Institution for news articles and stories, thereby informing a larger audience of the potential impacts of climate change.

Evaluation of Water Management in South Florida

USGS scientists in South Florida developed the Across Tropic Level System Simulation (ATLSS). This simulation is linked to a series of ecological models that integrate landscape and hydrological factors and predict the effects of changes in important groups of organisms, such as wading birds and endangered species. ATLSS was used for the first time to aid in evaluation of water-management alternatives for the South Florida Ecosystem Restoration.

Mineral Deposits in Alaska, Canada, and Russian Far East

In an unprecedented cooperative effort with Alaskan, Canadian, and Russian organizations, the USGS has



USGS, Russian, and Alaskan State field party at Democrat lode gold mine, East-Central Alaska. From left to right Warren Nokleberg (USGS, Menlo Park), Ilya Rozenblum (Roskomnedra, Magadan), Stanislav Byalobzhesky and Roman Eremin (Russian Academy of Sciences, Magadan) and Thomas Bundtzen (Alaska Division of Geological and Geological Surveys, Fairbanks) (photo by USGS).

just completed a series of maps providing locations and narrative summaries of geologic features and settings for mineral deposits in mainland Alaska, Canada and the Russian Far East. These maps correlate the occurrence of known deposits and mineralized belts across the northern Pacific and provide information critical to the exploration for new deposits. The first of these maps has been published by the USGS (Open-File Report 96-727) in collaboration with the Geological Survey of Canada; joint publication of other maps is expected. This unique data set promotes trade, joint exploration ventures, and international scientific cooperation.

Postings and Closures

The National Park Service (NPS) used data collected by a USGS study in Nevada to support their rationale for posting notices that the Las Vegas Wash inlet to Lake Mead was affected by urban runoff and treated sewage effluent. USGS scientists cooperated with several agencies, including NPS and the EPA, to investigate the occurrence of human-made organic chemicals in Las Vegas Wash and Lake Mead and to evaluate glandular irregularities in common carp. Results of the study indicated that these constituents were present, resulting in the posting of the Las Vegas Wash inlet. Study results also led the NPS and Nevada Division of Wildlife to sample edible tissues of striped bass and catfish for exceeding pesticide consumption guidelines. Finally, all these results led to the formation of the Lake Mead Water Quality Forum by the Nevada Division of Environmental Protection. This forum of local, State,

and Federal agencies was formed to enhance communication and cooperation on Lake Mead water-quality issues.

Mercury and Fishing in Alaska

USGS studies of mercury in southwestern Alaska showed that mercury levels in the environment do not pose a significant risk to fish, which supply both food and income to residents. USGS investigations, in this historical mercury mining district that covers thousands of square kilometers, demonstrated that mercury concentrations in stream sediment, stream water, plant, soil, and fish samples collected near the old mines are elevated over local backgrounds. However, mercury concentrations in stream water, freshwater fish, and salmon are below regulatory guidelines, and mercury concentrations in fish are still below the Food and Drug Administration (FDA) standards. These conclusions are the result of cooperative studies with the U.S. Fish and Wildlife Service and the Calista Corporation (an Alaska Native Corporation).

Wetlands Restoration

USGS scientists are coordinating a multiagency evaluation of restored wetlands in the U.S. portion of the prairie pothole region. This region includes portions of Montana, North Dakota, South Dakota, Minnesota, and Iowa. In 1997, the USGS completed an extensive survey of 204 restored and reference wetlands to assess the ecological outcome of wetlands restoration. Data will be made available to agencies conducting studies on a subset of these wetlands and will allow them to extrapolate their results to the prairie pothole region. Studies at the Delta National Wildlife Refuge, located at the mouth of the Mississippi River, have demonstrated that vegetated wetlands that have degraded to shallow open-water habitats can be restored to vegetated marsh by use of artificial, uncontrolled, sediment diversions. Sediment deposition through artificial crevasses constructed along tributaries of the Bird's Foot delta have been successful at restoring elevations to the height needed to sustain vegetated marsh.

Cooperative Fish and Wildlife Research Units

In 1997, USGS continued its partnership with States and universities to operate 40 Cooperative Fish and

Wildlife Research Units in 38 States. These units performed research on over 1,200 topics, addressing a diversity of issues in response to management information needs expressed by State and university cooperators and collaboratively conducted with funding from Department of Interior agencies as well as the U.S. Department of Agriculture, EPA, Department of Defense, NOAA, and other Federal and State agencies. Research products delivered to management agencies included detailed scientific reports that are being used to establish management policy and actions for resource management on issues related to biodiversity, environmental toxicology, animal population assessment and management, habitat management and restoration ecology, fishery resource management, and numerous others as identified by Unit cooperators. Results from these studies were made available to the scientific and management community at large via more than 600 published papers, books, and presentations made before scientific conferences. As university faculty members at host universities, USGS scientists participated in the training of graduate students in several fields of natural resource science and management.

Implementing the Government Performance and Results Act

During 1997, the USGS completed its first five-year strategic plan in support of the Government Performance and Results Act (GPRA). The plan describes the present and future scientific and technical efforts of the USGS as business activities. The business activities convey the breadth, integration, and flexibility in the description of programs in which the USGS must excel over the next decade. The eight USGS business activities and goals are:

Water Availability and Quality

Goal: Manage the Nation's water resources wisely for present and future generations.

The USGS provides reliable, impartial, timely data on and an understanding of the quantity and quality of the Nation's water resources. This enables decision makers to plan, operate, and regulate the water resources infrastructure of the Nation and to undertake cost-effective programs to preserve and enhance water quality.

Natural Hazards

Goal: Reduce the loss of life and property from natural hazards.

The USGS roles are to advance our understanding of the fundamental processes that control or trigger hazardous events or situations; lead in developing real-time monitoring and warning systems; and enhance the use of hazards assessments by decisionmakers, in order to improve disaster response and mitigation planning.

Geographic and Cartographic Information

Goal: Provide maps and map data for the Nation.

The USGS role is to acquire, produce, manage, and disseminate geospatial data; cultivate partnerships with other governmental organizations, academia, and the private sector for geospatial-data activities; provide leadership in establishing national geospatial data policies and standards; and conduct a geographic research and development program focused on interpretation and application of geospatial data.

Contaminated Environments

Goal: Reduce both environmental contamination and the cost of cleaning up existing contamination.

The USGS role is to identify and define the occurrence and effects of contamination, broaden our basic understanding of contaminant hazards, and provide pertinent information to those concerned with mitigation and prevention.

Land and Water Use

Goal: Improve the land and water use decisions made by the public and private sector.

The USGS role is to provide integrated earth science information about land and water use in support of management and other policy decisions, develop analytical tools for improved decision-making, and enhance the understanding of how natural processes at the Earth's surface are affected by changes in climate or land and water use.

Nonrenewable Resources

Goal: Enhance economic development and growth.

The USGS role is to determine the location, quantity, and quality of nonrenewable resources both domestically and internationally; determine the environmental effects of resource extraction and use; and improve assessments of resource potential, making possible the formulation of the best strategies for development of future resource supplies.

Biological Resources

Goal: Conserve and manage the Nation's biological resources for present and future generations.

The USGS role is to provide reliable, impartial and timely data on the status and trends of the Nation's biological resources, to provide an understanding of biological systems, and to assess natural and human induced changes to those systems.

Environmental Effects on Human Health

Goal: Reduce risks to human health from hazardous chemicals and disease-causing organisms.

The USGS role is to provide information on the occurrence of environmental toxins and pathogens and the factors affecting fate and transport of these agents from their sources to humans.

Customer Service

The USGS is committed to improving customer service as a key component of "good government," and considers customer satisfaction to be a reflection of our effectiveness as an organization. This concept is so important to the USGS that the need to strengthen customer relationships and partnerships was included as a goal in its strategic plan. In 1997, USGS chartered a Customer Service Team to develop ways to obtain customer satisfaction feedback from its customers, to identify success stories and opportunities for improvement, and to integrate customer feedback into its programs. The Team's efforts during the year have yielded a USGS Customer Service Policy and a refined set of customer service goals that more accu-

Geospatial Data Integration

Eight innovative geospatial data integration applications were developed in fiscal year 1997 to synthesize thematic spatial data from various scientific and cultural fields to promote creative solutions to resource and development issues. Detailed below are three of these applications.

Mississippi River Basin data set. This data set models the role of land use, erosion, sedimentation, and soil development on carbon storage and nutrient cycles. The aim of the application is to better understand and balance the carbon cycles.

Yazoo River Basin data set. The Yazoo River Basin is located in the northwestern portion of the State of Mississippi. Data on soil, land cover, and climate are used as input to models of soil erosion, sedimentation, and carbon storage and flux. The project includes application methods for compiling, integrating, and analyzing spatial data.

Rio Puerco River Basin project. This project is located west of Albuquerque, New Mexico. It is a global change research study to develop information and gain knowledge about the interaction of climate and land use change on the environmental, economic, and social systems of the region.

rately reflect the importance USGS places on serving its customers with excellence.

Goal : To gratify our customers by delivering science and technology that satisfies their requirements and adds value to their work products.

During 1997, USGS collected qualitative and quantitative data to evaluate its progress in meeting this goal. Highlights for the year include:

- The Biological Resources Division (formerly National Biological Service) of the USGS asked 759 of its customers (wildlife managers, State agencies, non-government organizations) how satisfied they were with biological products and services of the USGS. Of the 281 respondents to the survey, more than 90 percent indicated they were satisfied or very satisfied with these products and services. Many indicated that they used USGS information to make important management decisions. The USGS is using these comments to make improvements to its products and customer relations.

- The Information Services Branch in Denver, Colorado, which fills orders for USGS publications and maps, continues to improve. Response cards are mailed with every order shipped (about 300 per day), and about 5 percent of these cards are returned with customer comments. Based on these comments, the Branch identified several areas needing improvement and changed some of its business practices as a result. For example, telephone calls are now answered within 25 seconds; customers can now order maps over the Internet using a credit card; an inventory management project has helped assure that USGS maps do not go out-of-stock so customers do not need to wait for reprints; and, quality control of customer orders has also improved. Before June 1997, the Branch had a fairly high error rate in orders. By implementing a product retrieval contract with 100 percent quality/accuracy requirements, a significant reduction in the number of resent orders has been achieved.
- The USGS Minerals Information Team reaches out to its customers by offering mineral commodity production, consumption, and trends data through a Web page that gets over 12,000 hits per month. It also makes this information available to customers through a FaxBack system that averages 1000 requests per month and a mailing list with over 20,000 subscribers. In addition, the Team receives about 2,000 telephone calls per month, giving team members an ideal opportunity to talk to customers directly to identify problems or customer needs. Customer ideas have led to changes in the way business is conducted. For example, in response to feedback from one customer, the Portland Cement Association, the USGS revised both a monthly and annual minerals statistics survey form. These revisions significantly improved the quality of minerals

Note of Appreciation

The following is some feedback received by the USGS from a customer who uses the Water Resources Web information on a regular basis:

"Just a note of great appreciation for your site. Your site has been the best source of river information we have ever been able to obtain to make rescue and evacuation decisions. We are currently using the...river data to plan the search for two (missing persons)...Your work and site is much appreciated and invaluable to us. Thanks from the citizens of (our) county."

production data collected by USGS, and enabled USGS to provide customers with the type of information they need.

- The Water Resources program of the USGS provides its customers with hydrologic information through its Web pages in a variety of forms, including real-time flood data. These Web pages have links to customer feedback mechanisms so that USGS hydrologists can stay in touch with their customers and ensure customer needs are being met. USGS responds to customer feedback within two business days. Analysis of feedback shows that USGS Water Resources Web information is used for education and to make personal, business, emergency and policy decisions. Feedback is used to make modifications to improve service.
- A 1997 survey of over 1,600 topographic map users and buyers has helped USGS understand how maps are being used and levels of customer satisfaction. Respondent data are being considered as a basis for improving maps and for identifying new types of products, such as digital maps.