

# The U.S. Geological Survey Recent Highlights—Natural Resources



U.S. Department of the Interior

U.S. Geological Survey

*“Meeting the needs of every person, every day”*

## Introduction

The Nation’s natural resources include its minerals, energy, land, water, and biota. In 1996, U.S. Geological Survey (USGS) efforts to provide relevant, objective, and timely information on the location, quantity, and quality of our natural resources were enhanced by two significant changes. With the addition of minerals information specialists from the former U.S. Bureau of Mines, and with the merger of scientists from the former National Biological Service, the USGS stands uniquely positioned to help Federal, State, and local government organizations, private industry, specific-interest groups, and the general public better address the Nation’s natural resources needs.

## The Nation’s Economic Decisions Depend on USGS Mineral Information

The recent debate on mining near Yellowstone National Park highlights the importance of minerals information in national land use and economic decisions. The USGS provided estimates on the economic mineral value of the New World mine site near Yellowstone; these estimates were used to negotiate a compromise among competing interests represented by the Federal Government, mining companies, and other property owners. Objective evaluations by the USGS of economic mineral values and potential are often used by others in making sound marketing, finance, and land-use decisions.

The Federal Government also relies on minerals information to set royalty rates on commodities such as gold, silver, copper, and soda ash that are mined from public lands (fig. 1). The USGS provided information and analysis on the domestic and world soda ash industry that Congress, the Bureau of Land Management, the State of Wyoming, and indus-

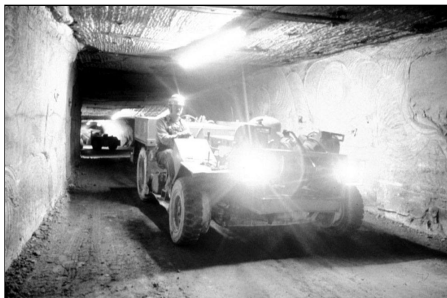


Figure 1. Trona soda ash mine, Wyoming.

try used to negotiate the new royalties for soda ash mined in Wyoming. Revenues generated by the proposed increase from a rate of 5 percent to 8 percent on new leases and 6 percent on lease renewals will be split between the Federal Government and the State of Wyoming.

Following the breakup of the former Soviet Union, huge quantities of aluminum ingots were brought to the world market from Russia. This action, at a time of worldwide economic recession, drove prices below the cost of production for many of the world’s aluminum producers, including those in the United States. The USGS participated in international negotiations to resolve this economic problem, contributing on-the-spot analyses of proposed solutions. The signed agreement helped stabilize the world aluminum market and laid the groundwork for more orderly integration of the Russian aluminum industry into the world market.

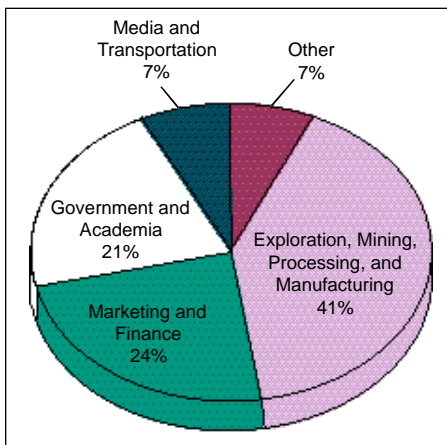


Figure 2. Principal users of minerals publications.

*How was the USGS able to respond to these critical issues?* The USGS Minerals Information Team (MIT) was formed in 1996 following the transfer of specific minerals functions from the former U.S. Bureau of Mines. The MIT, with its broad knowledge of how minerals are extracted, used, and recycled, complements our traditional expertise in the scientific study of in-place resources. These combined capabilities now allow the USGS to provide the information and analysis required to ensure a dependable supply of minerals and mineral-derived materials for the Nation’s defense and industrial needs. Customers who rely on this information to assess and make decisions related to our Nation’s economic trends include agencies of the Federal and State governments; the U.S. Congress; regional, national, and multinational companies and trade associations; marketing and finance groups; educational institutions; environmental interest groups; and the general public (fig. 2).

*What types of information are available?* USGS scientists regularly monitor more than 600 mineral commodities and publish information on about 100 of them. About 18,000 domestic companies that produce, process, or consume minerals provide statistical data on their production voluntarily. Data on minerals in foreign countries are acquired from several sources, including a questionnaire sent to the appropriate minerals agency in each of 190 countries. The USGS publishes minerals information in more than 600 monthly, quarterly, and annual publications each year. Most minerals information also is accessible immediately through a fax delivery system (MINES FaxBack at 703-648-4999), an electronic bulletin board (Mines Data at 703-648-7799), and the World Wide Web.

*Want to know more?* Contact the USGS Mineral Information Team home page at <URL: <http://minerals.er.usgs.gov/minerals/>>

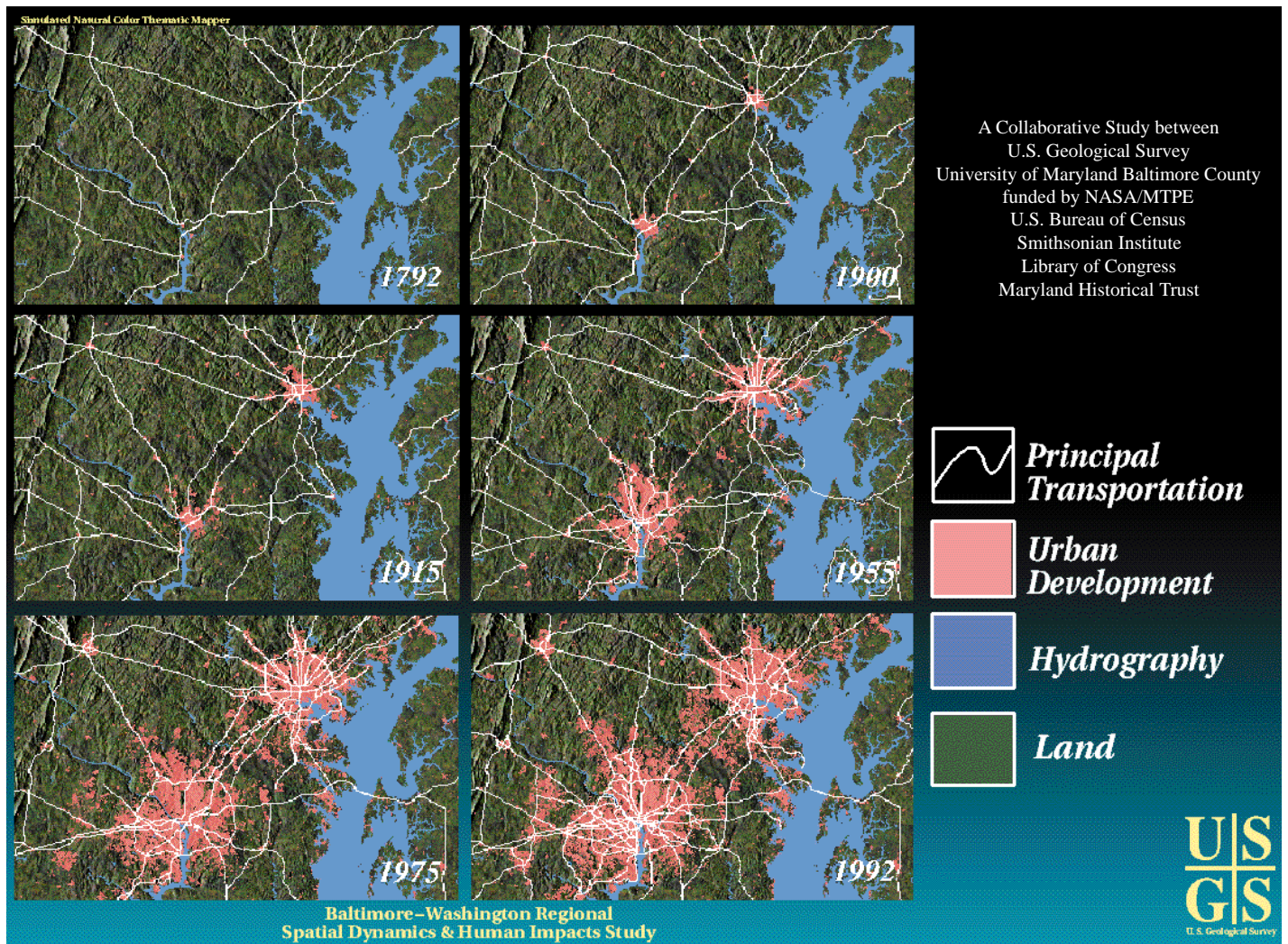


Figure 3. A window into the past—mapping growth trends.

## Urban Dynamics Helps City and County Managers Plan for the Future

Have you ever returned to an area (such as your hometown, college town, or former vacation site) and noticed how much it has grown? Or have you noticed steady construction and more traffic on your way to work? If so, then you've probably had a first-hand experience with urban dynamics and the demand for one of our most valuable resources—land.

*What is urban dynamics and how is it being used?* Urban dynamics is the application of archived and current geographic, topographic, and land use information to document histories of land use change in metropolitan areas.

Urban dynamics helps city and county

planners, regulators, developers, and the general public better visualize the overall

patterns of urban growth, thus providing an important tool for their land use planning decisions. If a picture is indeed worth 1,000 words, a good map may be worth 1,000 pictures. The influences of railroads, interstate highways, and industry on urbanization can be clearly seen and can be used to forecast the effects of future infrastructure changes on growth patterns.

In the Baltimore/Washington area, the USGS, in collaboration with the University of Maryland Baltimore County, NASA Mission to Planet Earth, Bureau of the Census, Library of Congress, Smithsonian Institution, and Maryland Historic Trust, is successfully demonstrating the value of combining historical maps with remotely sensed satellite data and specific geographic information to visually show how the

cities have grown and spread from 1792 through 1992.

*What physical factors have influenced urban development patterns?* Planners can clearly see how roads, railroads, and seaports have shaped urban development in the Baltimore/Washington area. Urban data bases containing information on highways, railroads, houses, buildings, rivers, seaports, reservoirs, and shorelines— at specific points in time—dramatically show how modern urbanization results in profound changes to the landscape. In the Baltimore/Washington area (fig. 3), urban development dramatically increased starting at the turn of the century and continuing to the present day. The hydrography data shows planners the changes in navigable rivers, the development of reservoirs for water supplies, and the changing shoreline resulting from harbor development and salt pond formation.

Animations showing urban growth over time have been created from such data for metropolitan areas in both Baltimore/Washington and San Francisco for use by policymakers, collaborators, and the general public. The timing and pattern of urban growth is being used to study chemical and sediment flows into the Chesapeake Bay and their impact on its living resources, such as aquatic vegetation, crab, and rockfish. By analyzing past trends in urban development, scientists can better understand human impact on water quality.

*Want to know more?* The animation and additional information describing the use of urban dynamics in the Baltimore/Washington area are available over the Internet at

<URL: <http://edcwww.cr.usgs.gov/umap/umap.html>>

## Ground Water Chemistry and Age-Dating Techniques Help City and County Officials Plan for Future Water Supplies

USGS research is helping cities and counties identify the surficial sources of water that eventually is pumped from their deep water wells. By knowing which streams and watersheds are



Figure 4. Doty Spring and the Madison Limestone, South Dakota.

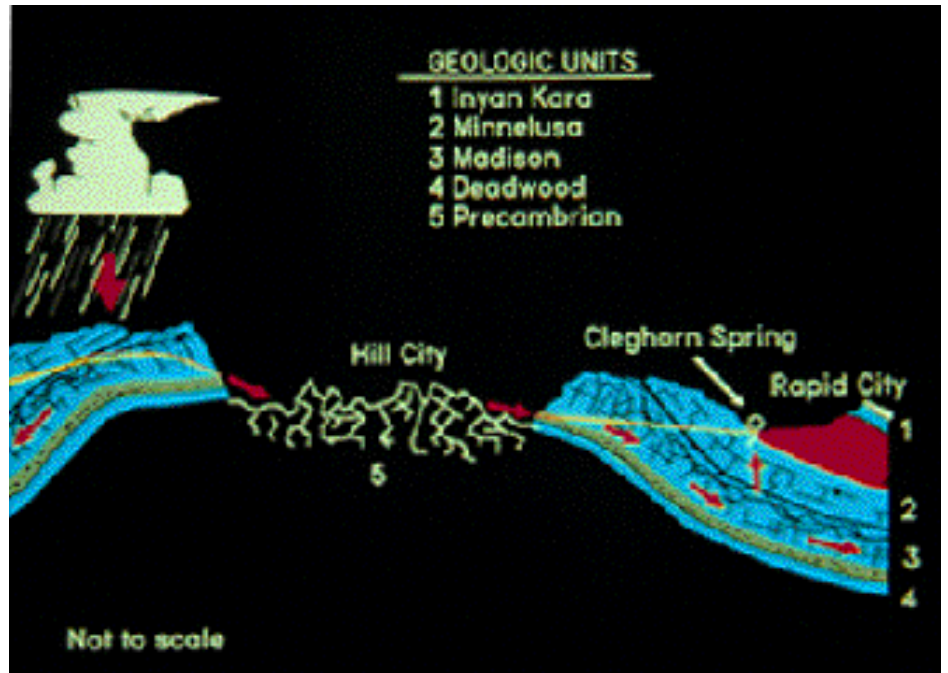


Figure 5. Generalized ground water flow in the Black Hills near Rapid City, South Dakota

contributing water to wells, cities and counties can make better informed decisions regarding land use planning and well-head protection. In the Black Hills area of South Dakota, USGS scientists have used information from the hydrogen and oxygen in local streams and ground water to help Rapid City water managers figure out the source of the water that is pumped from their municipal-supply wells. Why is this important? Because if the city management knows the source of the wells' water, they can more efficiently, economically, and effectively protect the principal source of drinking water for their 50,000-plus residents. Also, they can now forecast and plan more accurately for the effects of reduced stream flow (such as from a drought) on their water supply.

*What clues are hydrogen and oxygen providing?* USGS scientists have found that each of the major streams in the Rapid City area has a distinct identifying feature (called an isotopic signature). As streams flow across porous rocks known as the Madison Limestone (fig. 4), water from the streams sinks into the ground and moves through karst or cave-like features and fractures (fig. 5) until it intersects land surface (a spring) or enters a "capture" area and is pumped to the land surface by a municipal-supply well. Water pumped from the well was analyzed using sophisticated geochemical techniques to determine the hydrogen and oxygen isotopic signatures. By

comparing the signatures in water samples from pumped wells with signatures in samples collected from the streams, the scientists were able to determine how much of the water pumped from the well came from which stream.

*Why age-date water?* Research into ground water age-dating techniques is also helping water managers forecast the effects of pumping from water wells (such as declines in water levels) on ground-water supplies and surface-water flows. USGS scientists are identifying the age of ground water by combining three different methods: (1) detecting the presence or absence of a specific compound; (2) measuring the radioactive decay of tritium (introduced into the atmosphere from above-ground testing of thermonuclear devices); and (3) entering information about the direction and rate of ground water flow and the material through which it flows into a computer model that "tracks" the movement of a particle of water.

USGS scientists have developed a way to determine the concentration of specific compounds called chlorofluorocarbons (CFC) (one of them is Freon) in minute quantities. These CFC's were first manufactured in the 1930's, and if detected in a sample, indicate that the age of the water generally is younger than the 1940's. Combining what is known about the concentrations of Freon

and tritium with a computer representation of the ground water flow system, USGS scientists were able to determine more accurately the location and amount of recharge to an aquifer in southern New Jersey. The recharge numbers can now be used by the State of New Jersey to assess the effects of current and future pumping on water levels in wells, on streamflow, and on water quality.

*Want more information?* Current research into ground water flow in fractured or karst-like areas and using CFC's and tritium to age-date ground water can be found on the Internet at <URL: <http://wwwrvares.er.usgs.gov/nrp/nrp.html>>

## USGS Using Gap Analysis Program to Document Biodiversity Over Large Areas

The Gap Analysis Program (GAP) is a cooperative effort to map natural land cover, vertebrate species, and the lands that are managed in ways that maintain biological diversity. Federal funding is matched at the State level with additional funds and services. The purpose of GAP is to identify the "gaps" in our network of lands used for conservation of species and habitats. GAP is founded on the premise that by building partnerships between government and the private sector for developing and applying this information, future conservation crises can be avoided.

USGS scientists participating in GAP are helping provide a sound scientific basis for tough decisions regarding the planning and use of natural resources facing environmental groups, regulators, developers, State and Federal land management agencies, and the general public. To date, more than 100 GAP data sets have been used for issues ranging from a county open space planning effort to finding the best location for an aspen mill site.

GAP brings together the problem-solving capabilities of Federal, State, private, and academic scientists to tackle the difficult issues of land cover mapping, vertebrate habitat characterization, assessment, and biodiversity conservation at the State, regional, and national levels. Currently GAP has more than 440 State, private,

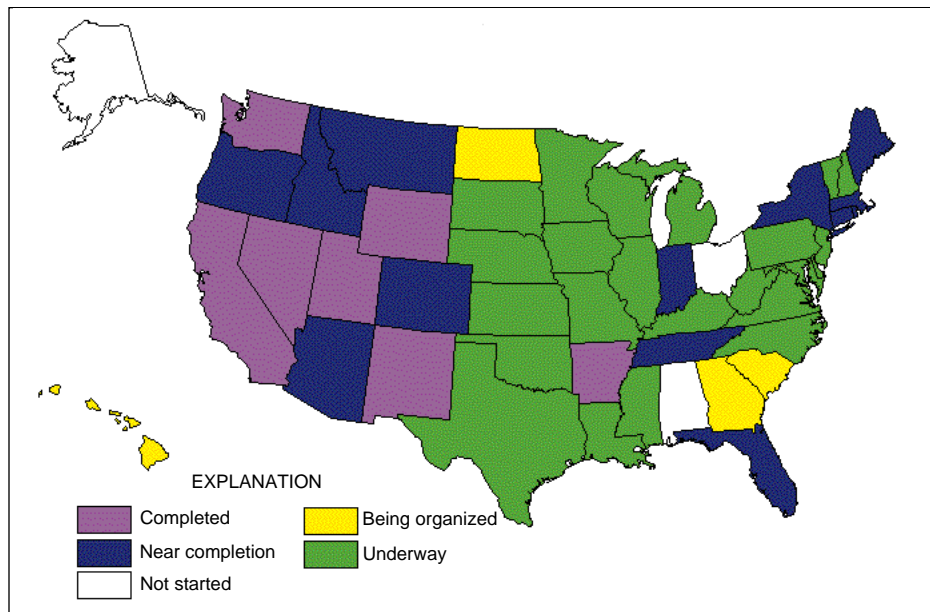


Figure 6. Current status of GAP projects.

and Federal partners, and has active or planned projects in 44 States (fig. 6). For example, in Utah, collaboration between the Environmental Systems Research Institute, USGS EROS Data Center, and GAP produced a prototype compact disk for distribution of GAP data. Now, maps and other data from GAP projects are distributed on compact computer disks and over the Internet.

In Tennessee, the information developed by the Tennessee Gap Analysis Project is used by the Tennessee Wildlife Resources Agency (TWRA) for locating and managing particular habitat types. Information on the locations of these habitat types is provided by the TWRA to the public for a wide variety of public service functions, from education to cooperative resource management. For example, the TWRA provided the foundation material for the Tennessee Biodiversity Educational Initiative.

In California, the Southern California Association of Governments used the GAP information to guide their joint decisions on open space planning, and developers are using California GAP maps to help them make real estate investment decisions. In Arkansas, Weyerhaeuser Corp. is using the Arkansas GAP data to aid in managing its forest lands. IBM Corp. is funding a project at the University of California, Santa Barbara, which uses GAP data in the development of visualization

software. In Montana, Missoula County used the GAP land cover map of the area as a base map for its comprehensive long-range planning, and many other county governments across the United States are doing the same. These are just some of the hundreds of examples of ways in which GAP information is being used by industry and government for the planning and research for managing our natural resources.

Want to learn more about GAP? Contact their home page at <URL: <http://www.gap.uidaho.edu/gap/>>

You can also reach GAP by e-mail at [gap@uidaho.edu](mailto:gap@uidaho.edu), or call 208-885-3555.

## Information

For information on these and other USGS products and services, call 1-800-USA-MAPS, fax 703-648-5548, or e-mail: [esicmail@usgs.gov](mailto:esicmail@usgs.gov).

Receive information from the EARTHFAX fax-on-demand system, which is available 24 hours a day at 703-648-4888.

The address for the USGS home page is <URL: <http://www.usgs.gov/>>

The address for the Natural Resources Theme page is <URL: <http://www.usgs.gov/themes/resource.html>>