

United States Geological Survey

Programs in Colorado



The USGS provides maps, reports, and information to help others meet their needs to manage, develop, and protect America's water, energy, mineral, and land resources. We help find natural resources needed to build tomorrow, and supply scientific understanding needed to help minimize or mitigate the effects of natural hazards and environmental damage caused by human activities. The results of our efforts touch the daily lives of almost every American.

Oil Resource Assessments on National Forest Lands

Working with the U.S. Forest Service and the State of Colorado, the U.S. Geological Survey (USGS) has provided petroleum-resource-potential data for National Forest lands in Colorado, in particular for development of resources in the White River National Forest. This assessment has provided the U.S. Forest Service and the State of Colorado with the information needed to formulate development plans that take into consideration the preservation of the natural ecosystem. The USGS, in cooperation with the U.S. Department of Energy, recently completed an assessment of the petroleum potential on two Naval Oil Shale Reserves in Colorado.

Coal-Bed-Methane Resources

Recognition of coal-bed-methane resources in the San Juan Basin of southern Colorado (fig. 1) and the application of production technology to other parts of the Nation has slowed the decline in domestic hydrocarbon exploration and production. The early and rapid dissemination of coal-bed-methane technology and resource estimates was key to the development of this energy source that

now supplies a significant part of the Nation's domestically produced natural gas. In 1988, the USGS, the Southern Ute Tribe, and the Bureau of Indian Affairs hosted the first coal-bed-methane symposium that was based on recent USGS research. From this beginning, the southern Colorado area has seen the development of an additional 800 wells that produce more than 130 billion cubic feet of gas per year, which has resulted in a significant increase in tribal revenues from methane production. In cooperation with the U.S. Forest Service and the Bureau of Land Management, the USGS recently completed an assessment of coal-bed-methane resources on Federal lands in southern Colorado.

The USGS is investigating methane in ground water and the long-term effects of coal-bed-methane development. Recent development of methane from coal beds in the Animas River Valley of the San Juan Basin has caused public concern about the possibility of increasing concentrations of natural gas in domestic water supplies. The occurrence of natural gas in domestic wells and water supplies in places presents a safety hazard. The USGS, in cooperation with the Colorado Oil and Gas Conservation Commission, La Plata County, and the Southern Ute Tribe, has studied the

occurrence of natural gas in near-surface ground water in the area. A report published by the USGS documented the presence of methane in 70 of the 205 wells sampled and identified potential sources of gases in water, soil, and gas-well surface casings.

National Water-Quality Assessment Program

The long-term goals of the National Water-Quality Assessment (NAWQA) Program are to describe the status and trends in the quality of a large representative part of the Nation's surface- and ground-water resources and to identify the natural and human factors that affect their quality. The NAWQA Program will produce a wealth of water-quality information that will be useful to policy makers and water managers at the local, State, and national levels.

Three NAWQA Program studies are underway in Colorado—the South Platte, the upper Colorado, and the Rio Grande—and another, the Upper Arkansas, is planned for 1997 (fig. 2). Communication and coordination among the USGS and water-management and other water-resource agencies are key components of the Program projects in the State. The projects will distribute findings in a variety of technical and lay reports to local, State, and Federal agencies as results become available.

A critical requirement of the NAWQA Program is up-to-date information on land use/land cover to determine their influence on water quality. The USGS, in cooperation with several other Federal agencies, is acquiring satellite image data for the entire United States. These data are processed according to a consistent standard, then forwarded to NAWQA Program projects, as well as to

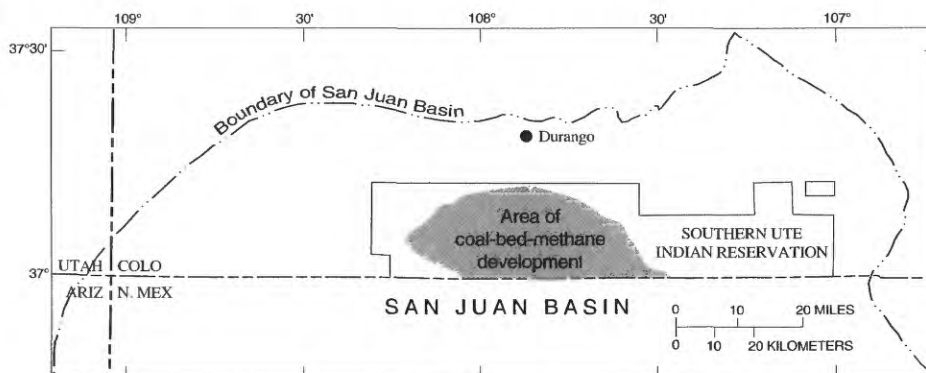


Figure 1. Map of southern Colorado showing the Southern Ute Indian Reservation and areas of coal-bed-methane development within the northern part of the San Juan basin.



Figure 2. NAWQA study-units in Colorado.

other water-resource agencies, for water-quality research applications.

National Mapping Program

Among the most popular and versatile products of the USGS are its 1:24,000-scale topographic maps (1 inch on the map represents 2,000 feet on the ground). These maps depict basic natural and cultural features of the landscape, such as lakes and streams, highways and railroads, boundaries, and geographic names. Contour lines are used to depict the elevation and shape of terrain. The entire State is covered by 1,926 maps at this scale, which is useful for civil engineering, land-use planning, natural-resource monitoring, and other technical applications. These maps have long been favorites with the general public for outdoor uses, including hiking, camping, exploring, and back-country fishing expeditions.

Environmental Assessments of Abandoned Mine Lands

The Bureau of Land Management and the U.S. Forest Service have been charged with identifying and prioritizing for remediation tens of thousands of abandoned mine sites in Colorado. The USGS, in cooperation with the Bureau of Land Management and the Colorado Geological Survey, has developed a geology-based regional screening process that was used to identify and rank Colorado mining districts according to their likely mine-drainage hazards. This screening process allows land-management agencies to focus rapidly their remedial efforts on mining districts with the greatest potential for environmental problems, thereby avoiding costly field assessments of all mining districts. The Bureau of Land Management, the U.S. Forest Service, and other Federal agencies are proposing that the U.S. Environmental Protection Agency use geology-

based regional screening to help assign and assess storm-water permits for abandoned mine sites on public lands. The mining industry also can use this process to predict, plan for, and mitigate the environmental consequences of mineral-resource development.

Landslide Hazards

Huge ancient landslides cover mountainsides throughout western Colorado, and many of these slides are near towns, recreational facilities, railroads, and major highways. Should any of these landslides become reactivated through climate change, earthquakes, or human activities, nearby towns or facilities could be destroyed. USGS scientists in Lake City and Grand Mesa are studying large ancient and modern landslides. Through these studies, the USGS is documenting many of the conditions that caused the landslides and is formulating models that can be used for predicting where and when landslides can occur or be reactivated in the event of changing climate or earthquakes.

Studies of Stream Contamination from Mine Waste

Historic and recent mining can adversely affect the water quality of

streams in Colorado. Significant water-quality problems have resulted from wastes related to metal mining in the Rocky Mountains. The USGS is conducting investigations near Summitville in the Alamosa River Basin (fig. 3), near Leadville in the upper Arkansas River Basin, in the upper Animas River Basin near Durango, and along Clear Creek west of Denver. The purposes of the studies are to assess the extent of the problem, to define background conditions, to aid local, State, and Federal agencies in making decisions on appropriate remediation strategies, to determine the processes involved in the transport of contaminants from the waste sites, and to predict the movement of the contaminants. Some of these studies are being done in cooperation with other Federal and State agencies.

Stream contamination resulting from open-pit gold mining near Summitville has gained national attention. Acid drainage and leaks of cyanide-bearing processing solutions into the Wightman Fork of the Alamosa River are of concern because of the extensive downstream use of the Alamosa River water for livestock, agricultural irrigation, and wildlife habitat. USGS studies have provided unbiased information on the Summitville Mine and its downstream environmental effects (fig. 3). This information is being

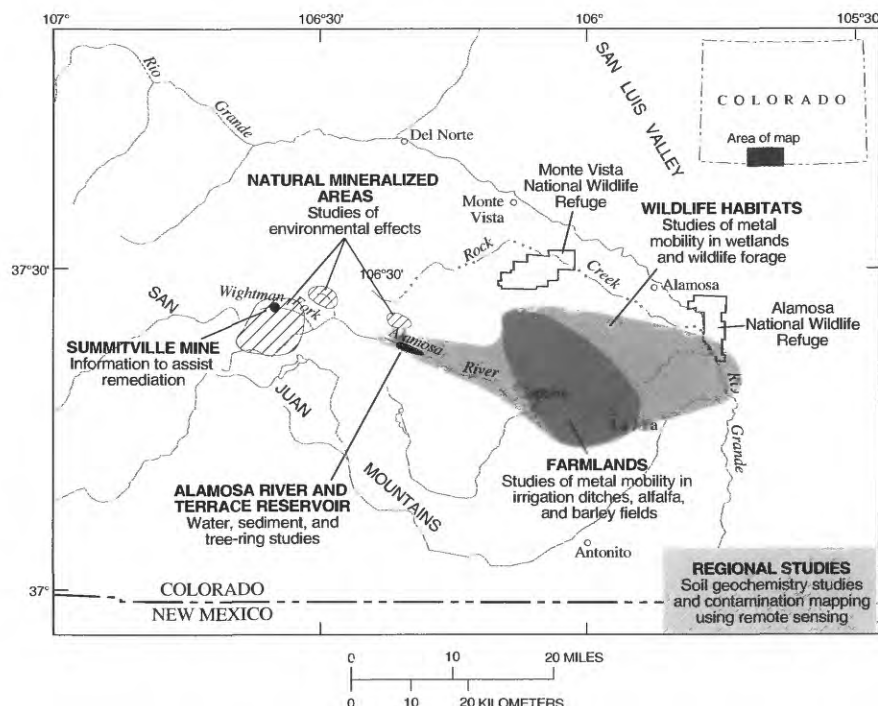


Figure 3. Environmental studies in the Summitville Mine area, southern Colorado.

used by (1) the U.S. Environmental Protection Agency to help improve site remediation, (2) the State of Colorado, Federal land-management agencies (Bureau of Land Management, U.S. Forest Service), and the mining industry to help understand and prevent similar environmental problems at other mines, and (3) downstream water users, such as farmers, water conservancy districts, and the Alamosa National Wildlife Refuge (managed by the U.S. Fish and Wildlife Service) to evaluate potential effects of the Summitville Mine on agriculture and wildlife habitat.

Studies of Contamination at U.S. Department of Defense and U.S. Department of Energy Sites

Several U.S. Department of Defense and U.S. Department of Energy sites in Colorado have some level of contamination caused by past production, storage, or destruction of chemical agents, munitions, or radioactive materials. Near some of the sites, radioactive and chemical contaminants have migrated into drinking-water supplies or have contaminated soils. The USGS is collecting hydrologic data and is conducting investigative studies at the Rocky Mountain Arsenal and the Rocky Flats Environmental Technology Site near Denver, the U.S. Air Force Academy near Colorado Springs, and the Pueblo Depot Activity near Pueblo. The purposes of the studies include characterization of the hydrology of the sites, definition of the extent of contamination, evaluation of monitoring networks, determination of contaminant transport mechanisms, and prediction of the fate of contaminants.

National Irrigation Water-Quality Program

Since 1985, the U.S. Department of the Interior has been studying the effects of irrigation drainage from Federal projects in the Western United States. These studies were done to determine whether irrigation drainage was causing problems related to human health, water quality, and fish and wildlife resources. Beginning in 1987, the USGS, in cooperation with the U.S. Fish and Wildlife Service, the Bureau of Indian Affairs, and the Bureau of Reclamation, has con-

ducted studies of irrigation drainage in the lower Gunnison, the Uncompahgre, the Dolores, and the Los Pinos Rivers and the Grand Valley in western Colorado and the Arkansas River Basin in the eastern part of the State. The USGS found high selenium concentrations in water and sediment in the irrigated areas. Because selenium can have adverse effects on fish and wildlife, investigations are continuing to determine if certain measures can be implemented to mitigate selenium contamination.

Although the emphasis has been on determining the effects of selenium on fish and wildlife, mitigation measures could involve methods of improving irrigation practices, conserving water, and improving the water quality of the Colorado and the Arkansas Rivers.

Collection of Hydrologic Data

Colorado has four major rivers: the Colorado, the South Platte, the Arkansas, and the Rio Grande. These rivers supply water not only to users within Colorado, but to many downstream States. The USGS, in cooperation with more than 50 local, State, and Federal agencies, collects streamflow and (or) water-quality data at sites throughout the State (fig. 4). These data are critical for day-to-day administration and management of water resources, for determining the extent and

severity of droughts, for characterizing and predicting conditions during floods, and for monitoring the effects of human activities on streamflow and water quality. The data also are essential to interpretive studies that provide information for making decisions about water issues that affect millions of people.

Effects of Acid Precipitation on Rocky Mountain Lakes and Streams

To determine which Rocky Mountain lakes and streams are most at risk to acid precipitation, the USGS has measured the chemistry of the snowpack and of lakes and streams fed by snowmelt. The chemistry of the snowpack controls how acidic the snowmelt that supplies water to these aquatic systems becomes. The chemistry of the lakes and streams determines how susceptible these systems are to damage by acidic snowmelt. The most acidic snow in the Rocky Mountains falls in northern Colorado in and near the Mt. Zirkel Wilderness Area. Lakes and streams of the Mt. Zirkel Wilderness Area are, because of the geology, among the most sensitive to acidic precipitation in the Rocky Mountains. Thus, in this area, the most acidic snowpack overlaps the most sensitive aquatic systems. The USGS is cooperating with local, State, and Federal agencies, as well as with



Figure 4. Water-quality data-collection sites in Colorado.

industry and environmental groups, in determining what damage might have occurred or is likely to occur in the Mt. Zirkel Wilderness Area. Among the possible effects are damage to trout and amphibian populations.

Geographic Information Systems for Urban Planning

The USGS and the Denver Board of Water Commissioners participated in a joint funding agreement for the production of computerized (digital) maps derived from information on printed maps, including transportation networks, water-related features, the Public Land Survey System, and boundaries. The digital maps provide fundamental geographic information used by water commissioners in maintaining the Denver metropolitan area water system and planning for future water needs. Studies using the digital geographic information have included watershed modeling, historical irrigation, lawn irrigation return flow, and irrigation suitability.

Landscape Change Over Time

As part of the Global Change Program, USGS scientists are cooperating with seven counties in northeastern Colorado to model land changes. Aerial photographs taken in 1937 that cover Adams, Arapahoe, Boulder, Jefferson, Larimer, Morgan, and Weld Counties are being scanned, converted to digital data, interpreted for land-use/land-cover characteristics, and compared with recent digital land-use/land-cover data to deter-

mine change over time. The objective of the project is to develop a method for the prediction of land-use/land-cover change that will facilitate the determination of possible effects on ecoregions and natural resources.

Earth Observation Data

Through its Earth Resources Observation Systems Data Center near Sioux Falls, South Dakota, the USGS distributes a variety of aerial photographs and satellite image data products that cover the entire State. Mapping photographs of some sites go back at least 40 years. Satellite images can be used to study changes in regional landscapes dating from 1972.

Geologic Information Centers

The USGS National Earthquake Information Center (NEIC) in Golden, Colorado, collects, processes, and distributes information from more than 20,000 seismic events each year. This information is distributed in the form of alerts, bulletins, and routine catalogs to emergency management officials at the Federal and state levels, operators of critical facilities, news media, the general public, and the earthquake research community. These catalogs of recent and historical earthquake information are used in earthquake hazards assessments. To better fulfill its mission, the NEIC has developed and is deploying the U.S. National Seismograph Network (USNSN), which, when completed, will consist of approximately 60 seismograph stations nationwide. The USNSN monitors nationwide

seismicity, provides early notification of seismic events to national level emergency services personnel, maintains an archive of high-quality digital data on national seismicity, and provides public information on earthquakes.

Cooperative Programs

The USGS cooperates with more than 90 local, State, and Federal agencies in Colorado. Cooperators include county and municipal public works departments, public health agencies, natural-resource agencies, water and sanitation districts, other Federal agencies, and many more. Cooperative activities include water-resources-data collection, interpretive water-availability and water-quality studies, mineral-resource assessments, and mapping. When local and State agencies are involved, activities typically are funded on a matching-funds basis. In addition to agencies already mentioned, the USGS cooperates with the U.S. Army Corps of Engineers, the Colorado River Water Conservation District, the Southeastern Colorado Water Conservancy District, the Northern Colorado Water Conservancy District, the city of Colorado Springs, and the Denver Metro Wastewater Reclamation District, to name only a few.

The USGS provides support to the Colorado Water Resources Research Institute, which conducts a program of research, education, and information and technology transfer.

For more information contact any of the following:

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For geologic information

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National Earthquake Information Center
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Additional earth science information

can be found by accessing the USGS "Home Page" on the World Wide Web at "<http://www.usgs.gov>".

For more information on all USGS reports and products (including maps, images, and computerized data), call 1-800-USA-MAPS.