

United States Geological Survey

Programs in Arizona



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.

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 1,968 maps at this scale, which are 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.

Water and Mineral Data

Streamflow data are needed for water rights issues (compacts, court decrees, and adjudications), flood-plain management, bridge design, water supply, reservoir operations, and flood warning. The USGS operates 192 streamflow-gaging stations in Arizona and provides data to local, State, and Federal agencies; utilities; and irrigation districts that actively manage the storage and release of water. At 117 of these stations, streamflow data are relayed by satellite (fig. 1) to a USGS computer in Tucson and can be accessed by agencies in near real time for immediate water-management decisions. The importance of the streamflow network was demonstrated during the floods of January and February 1993 when streamflow data from satellite telemetry was used by the Bureau of Reclamation and the Salt River Project to manage storage and releases from the reservoir systems along the Verde, Salt, and Gila Rivers.

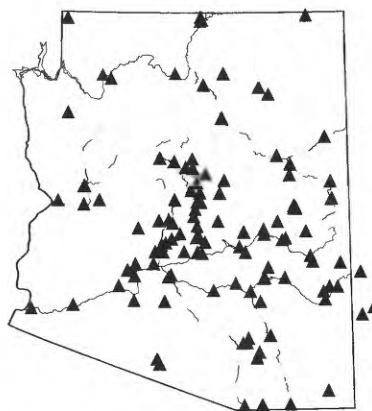


Figure 1. Streamflow-data-collection network.

In 1993, the USGS initiated a regional assessment of water quality in central Arizona and northern Mexico. The purpose of the study is to describe the status and trends in the quality of Arizona's major ground-water and surface-water resources (fig. 2), and to provide a better understanding of the factors that affect water quality. The study area encompasses 34,700 square miles and includes a population of more than 3.1 million people. The program focuses on pesticides, nutrients (such as nitrates and phosphates),

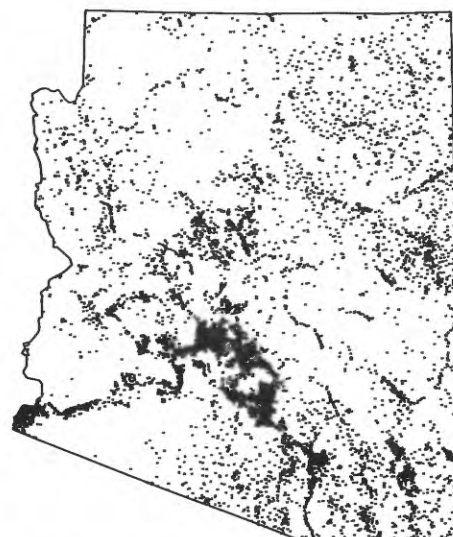


Figure 2. Water-quality data-collection sites in Arizona.

volatile organic compounds, and aquatic ecology. A retrospective review of existing data is in progress and will be used to determine where additional data need to be collected during the sampling phase from 1996 to 1998.

The USGS also collects data on minerals in Arizona. As a result of the North American Free Trade Agreement, the USGS also is developing cooperative projects with Mexican counterparts to inventory and assess the quantity and quality of mineral resources in the border area between Arizona and Sonora, Mexico (fig. 3). This information is vital to land-management agencies, regional planners, industries, and local governments that are responsible for ensuring adequate mineral supplies.

Beach Erosion in Grand Canyon National Park

In Grand Canyon National Park, erosion along the Colorado River (fig. 4) is affecting recreational use of beaches, possibly damaging riverine habitat for plants and animals, and threatening a loss of archeological sites. Glen Canyon Dam has reduced the sediment supply to the Grand Canyon and decreased the magnitude and frequency of floods that deposit sand and rebuild the beaches. Understanding the effects of regulated flows on the physical and biological systems along the Colorado River downstream from the dam is the objective of a series of studies, which began in 1982. USGS studies show that the low, moderately fluctuating flows that are now in effect are causing sand to be transported through the canyon along the channel bed. Flows more than power-plant capacity may be required to rebuild sand bars eroded by extended lower flows. The studies are being conducted by, or in cooperation with, public and private organizations that include contractors, universities, the Bureau of Reclamation,

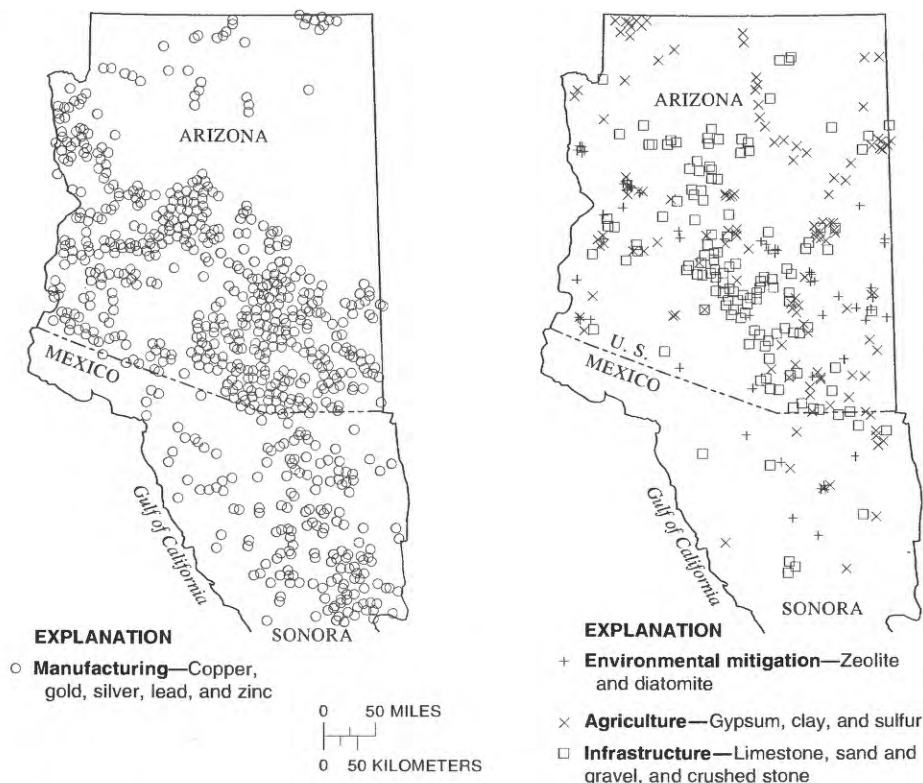


Figure 3. Mines and mineral occurrences in the border region of Arizona and Sonora, Mexico.

National Park Service, National Biological Survey, Bureau of Indian Affairs, U.S. Fish and Wildlife Service, Western Area Power Administration, Arizona Game and Fish Department, Hopi Tribe, Navajo Nation, Hualapai Tribe, Pueblo of Zuni, and two Southern Paiute entities.

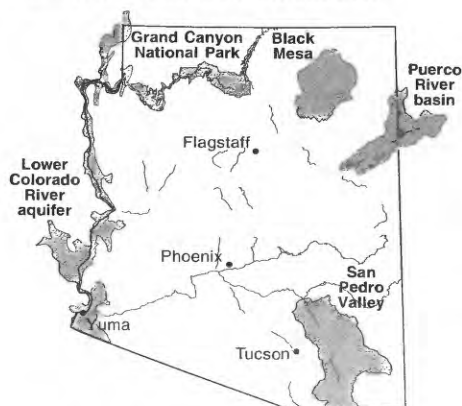


Figure 4. Selected project areas.

After the studies are complete, managers will have a scientific basis for optimizing dam operations. The USGS is developing a series of precise, well-tested computer models that describe the sedimentation and erosion processes and may predict the effects of various alternatives for operating the dam. Such information is needed to minimize effects on the can-

yon, while maximizing production of electricity. The USGS also will produce records of terrain altitudes near the Grand Canyon that can be used for forest-fire control and determining landslide probabilities.

Water Resources of the Upper San Pedro River Basin

The San Pedro River in southeastern Arizona is the site of the first National Riparian Conservation Area established by the Bureau of Land Management (BLM). The area is habitat for diverse plants and animals, some of which are threatened or endangered, and is the basis of the substantial ecotourism industry in the area. Ground-water pumping in the upper San Pedro River basin may decrease streamflow in the San Pedro River, which would adversely affect the riparian area and complicate the adjudication of water rights involving Native American Tribes. Increasing use of ground water is a result of continued population growth in the unincorporated areas of Cochise County and the City of Sierra Vista. The possible transfer of the Defense Language Institute to Ft. Huachuca from California could significantly increase water use in

the basin. The future of Fort Huachuca may depend on ground-water availability. Federal entities, including the Department of Defense, Forest Service, Fish and Wildlife Service, and BLM, have vested interests on both sides of the issue.

The USGS is studying the geology and hydrology of the upper San Pedro River basin to obtain objective data on the amount of ground water stored in basin aquifers, the character of the aquifers, and the connection between aquifers and the river. These data are essential to all the parties involved in the debate on water usage in the San Pedro Valley, including the cooperating agencies: BLM, Bureau of Reclamation, the U.S. Army, the Arizona Department of Water Resources, University of Arizona, Arizona Geological Survey, the San Pedro Technical Advisory Panel, the Nature Conservancy, and Cochise County.

Phoenix Replacement Mapping Project

The USGS has scheduled a 1:24,000-scale series mapping revision/replacement project for 41 maps covering Phoenix and the surrounding area. Existing maps will be updated to reflect recent urban growth and ground subsidence. The project is part of the Survey's program for replacement mapping in areas of critical need, such as those with rapid urban growth.

To date, aerial photographs have been acquired for the area and high-accuracy altitude surveys have been completed in partnership with the Department of Commerce, National Geodetic Survey. The USGS is evaluating additional cartographic-control requirements that are necessary for compiling new maps. Once analyzed, these data will provide critical information concerning the location and magnitude of subsidence in the Phoenix area.

Mineral-Resource and Environmental Assessment of Prescott National Forest

Prescott National Forest (1.2 million acres), centered around the rapidly growing city of Prescott, and bordering the developing Verde and Chino Valleys in central Arizona, was one of the first min-

eralized tracts discovered in the State. The forest and bordering areas continue to attract commerce, recreation, and mineral exploration. Recent economic development and growth around the forest have placed demands on water resources and industrial materials within the forest and have created conflicting views on future mining. In 1994, the USGS began a project to assess the mineral resources of the forest and to evaluate the historical and current environmental hazards associated with mining. The USGS also has recently completed mineral-resource assessments of the Coronado and Kaibab National Forests. These studies were undertaken at the request of the U.S. Forest Service.

Accounting for Consumptive Use of Lower Colorado River Water

The Colorado River Compact of 1922 requires the participation of the U.S. Geological Survey and Bureau of Reclamation to monitor flow and estimate consumptive use of water from the Colorado River. The U.S. Supreme Court Decree of 1964, *Arizona v. California* is specific about the responsibility of the Secretary of the Interior to account for the consumptive use and distribution of water from the lower Colorado River in Arizona, California, and Nevada. The Lower Colorado River Accounting System (LCRAS) and the accounting surface are tools that enable the Secretary to comply with the Compact and Decree. The LCRAS was designed to estimate the annual consumptive use of river water by vegetation from the lower Colorado River and allow equitable distribution of that use among water users between Hoover Dam and Mexico. Domestic, municipal, and industrial consumptive use of water pumped from wells is a component of the LCRAS water budget; therefore, accounting for consumptive use from all these wells provides a more equitable estimate and distribution of consumptive use by vegetation to agricultural users. The identification of wells outside the flood plain that yield water that will be replaced by water from the river is based on the concept of a river aquifer and an accounting surface within the river aquifer. The accounting surface provides a uniform criterion of identification based on hydrologic

principles for all users pumping water from wells. Accounting for the consumptive use of Colorado River water requires the identification of all points of withdrawal of water; however, this accounting is incomplete because the location of all wells is unknown. Cooperative work continues with the Bureau of Reclamation to inventory all wells completed in the river aquifer so they can be included in the water-accounting process.

Geological and Ecological Occurrence Models for Valley Fever

Coccidioidomycosis (Valley Fever), which results from infection of individuals by the fungus *Coccidioides immitis*, is a public-health issue of increasing importance because of rapid population growth in the southwestern United States and the large number of individuals with suppressed immune systems. In endemic areas, the disease results in an average of 33 to 35 lost work days per infected individual, with an annual cost of an estimated 1 million person-days of labor. Thus, the Centers for Disease Control and Prevention has listed Valley Fever as an important emerging health threat and called for greatly expanded studies of the disease. The USGS project initially focuses on Arizona and California. Geological and ecological habitat models of *C. immitis* are used to delineate infested areas; satellite data are used to identify land characteristics associated with *C. immitis* growth and infestation sites. Collaborators include physicians, veterinarians, microbiologists, and soil scientists from universities, private laboratories, and Federal and State agencies.

Trace Metal and Radionuclide Contamination Related to Mining

Trace metal and radionuclide contamination of water and sediments from mining is a potential hazard for the people and ecology of Arizona. Copper has been mined near Globe, Arizona, since 1903 and the ground water down gradient from the mines has been contaminated with trace metals. Beginning in 1984, the USGS initiated a study of ground-water contamination in cooperation with the Arizona Department of Health Services and the Salt River Project. The study

focuses on the geochemical processes controlling trace-metal movement in ground-water systems, rather than on sources of ground-water contamination at this particular site. An understanding of the processes controlling trace-metal movement obtained during this ongoing study may be useful in other areas of the United States with contaminated ground water.

More than two decades of uranium-mine dewatering discharges to the upper Puerco River released uranium, radium, and other contaminants into the Puerco and Little Colorado River basins. In addition, failure of a tailings pond in 1979 resulted in the largest release of radioactive material in U.S. history and large amounts of radioactive contaminants spilled into the Puerco River. The USGS, however, determined that ground-water contamination in the New Lands, which borders the Puerco River, is low level and minor in extent and that concentrations of radionuclides in Puerco River streamflow have fallen to near background levels. Contamination of ground water with uranium and other radioactive constituents was of particular concern in the New Lands area, where the population of Navajo Indians has increased significantly as a result of the Navajo-Hopi Settlement Act. The USGS cooperated in this study with the Office of Navajo-Hopi Indian Relocation, Arizona Department of Environmental Quality, and the New Mexico Environmental Improvement Division.

Water, Mineral, and Energy Resources on Indian Reservations

The desert environment, drought, continued growth, and planned development are placing increasing demands on the water and mineral resources and complicating the adjudication of water rights for Native American Tribes throughout Arizona. The economic development and standard of living of many of these tribes is severely limited because of a paucity of water. The diversion of surface flows, pumpage of ground water (such as on Black Mesa), and degradation of water quality from agriculture, urbanization, and mining have decreased the amount of usable water in a region where water is scarce.

The USGS is involved in data collection and interpretive studies on 10 reservations in Arizona that will assess the quantity and quality of the Tribes water resources, provide an understanding of the hydrologic system, and determine how activities in a watershed could divert streamflow and ground water and affect water quality. The results from this work will help the Tribes plan growth and economic development.

The Black Mesa coal field in northeastern Arizona is a major producer of coal for powerplants in the southwestern United States. Production from this field is a major source of revenue for both the Navajo and Hopi Tribes. As part of a national assessment, the USGS study of the Black Mesa, in cooperation with the Tribes, will outline the distribution of coal, determine the geologic controls on coal thickness and distribution, estimate the amount of coal that is economically recoverable, and analyze the coal composition. This information will help predict coal availability, plan long-term usage, and predict environmental effects of coal use. Both Tribes can use results of this study to aid in resource inventories and land-use planning.

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 National Geomagnetic Information Center (NGIC), located in Golden, Colorado, provides magnetic data to the scientific community and the general public over a commercial telephone network. The USGS operates 11 magnetic observatories across the United States, one of which is located in Tucson. Data from these observatories are used for nautical and aeronautical navigation charts, by the Federal Aviation Administration to update magnetic headings on runways and airports, and by other users to improve the accuracy of ground-level base data for satellite and airborne surveys. Information from the NGIC is also used to help power companies understand and plan for power system failures caused by high-frequency magnetic variations.

The Tucson Mineral Information Office provides information about USGS programs in and mineral resources of Arizona, New Mexico, southern California, Colorado, and west Texas. The office is staffed by geologists and technical information specialists who respond to inquiries about mineral resources. The staff has expertise on the geographic region.

The Center for Inter-American Mineral Resource Investigations (CIMRI), located in Tucson, is the main clearing-

house in the United States for Latin American mineral-resource information. The CIMRI coordinates technology transfer and training, cooperative mineral resource investigations, mineral research, and mineral information exchange. The CIMRI is part of a multi-Bureau effort, in cooperation with the Bureau of Land Management, U.S. Fish and Wildlife Service, and National Park Service, to support NAFTA-related activities in the U.S.-Mexico border region. Issues to be addressed include aerial photography and resource mapping, San Pedro River conservation, environmental education, and management of shared water resources.

Cooperative Programs

Work is pursued in partnership with myriad state, local and tribal agencies, as well as Mexican agencies due to the shared border. A few examples not referenced above are: Flood Control District of Maricopa County, Pima County Department of Transportation and Flood Control District, City of Tucson, White Mountain Apache Tribe, Tohono O'Odham Nation, and Consejo Recursos Minerales.

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

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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.