

# United States Geological Survey

## Programs in South Dakota



*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 1,552 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-Resource Data Collection

The U.S. Geological Survey (USGS) data-collection program in South Dakota has evolved as needs for water data have increased. The systematic collection of streamflow data in South Dakota began in 1903 with the establishment of 13 gaging

stations in the Black Hills area. The USGS now operates an extensive data-collection network in South Dakota in cooperation with 32 Federal, State, and local agencies. During 1994, the network included 143 continuous-record gaging stations on streams and lakes, 30 crest-stage and early warning stations, 46 precipitation stations, 34 water-quality and sediment stations, and 7 observation wells. Basic data are published annually in "Water Resources Data-South Dakota." Locations where water-quality data were collected by the USGS during 1994 and in previous years are shown in figure 1.

### Geologic Mapping and Mineral-Resource Appraisals

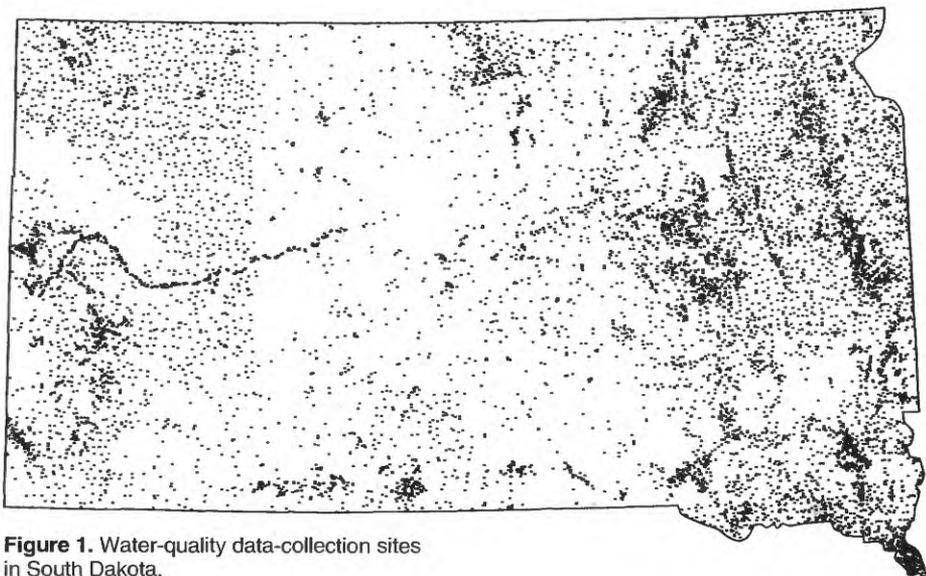
During the early 1900's, the USGS began a program of geologic mapping and mineral-resource appraisals in western South Dakota. Regional geologic maps, produced during 1908–26, delineated the geologic framework of the Black Hills, produced conceptual models for numerous mineral deposits, and synthesized the geologic history of western South Dakota. Efforts during 1935–60 resulted in publi-

cation of numerous geologic quadrangle maps in the central and southern Black Hills, especially in areas of uranium mines and abundant pegmatite deposits that yielded strategic minerals during both World Wars and the Korean conflict. Since 1970, ore-deposit research and further mapping of the northern Black Hills, where large reserves of gold and silver are mined, have been performed. These maps, and associated research efforts, have been used in completing a regional geologic map and publications on mineral resources of the Black Hills.

### Map Production

The USGS produces, in cooperation with numerous Federal and State agencies, maps that are vitally important to the State in managing its resources. Perhaps the most important uses, however, are as bases for hundreds of other special-purpose maps produced by other agencies. Most maps in use today originated from USGS base maps. Examples include State, county, and local highway maps; land-use and ownership maps; geologic maps; and recreational maps. Widely used, full-coverage maps of South Dakota and numerous special maps also are available from the USGS.

Recent technological advances, especially in the field of Geographic Information Systems (GIS), have increased demand for digital map products, especially in the Black Hills area because of increasing population, diversity of land use and ownership, pronounced topographic relief, and complex hydrology and geology. To meet this need, 10 Federal, State, and local agencies are cooperating to produce 1:24,000-scale digital products for the area of the Black Hills Hydrology Study.



**Figure 1.** Water-quality data-collection sites in South Dakota.

The USGS recently signed an agreement with the U.S. Fish and Wildlife Service to produce digital Public Land Survey System data for the eastern third of South Dakota. The data will be used by Fish and Wildlife's regional Wetland Habitat Office for spatial analysis of wetland areas by township and section.

The Earth Resources Observation Systems (EROS) Data Center in Sioux Falls distributes aircraft-image and satellite-image data products. EROS also captures images of land areas from sensors on meteorological satellites. The images are converted into maps that depict vegetation throughout the growing season. Such maps of South Dakota have been produced continuously since 1988 and are used to monitor growing conditions for crops, rangeland, and timber.

## **Water-Resource Appraisals**

The USGS, in cooperation with the South Dakota Geological Survey and various local agencies (counties and Water Development Districts), has been performing water-resources appraisals in South Dakota since 1959. Typically, the studies are done on a county-by-county basis and last 3 to 4 years. Many studies have involved multiple counties or Indian reservations. Most county studies in the eastern part of the State have been completed. Areal studies have recently begun in the western part of the State. The studies typically use extensive test-hole drilling and observation-well installation and monitoring to determine the availability, movement, recharge, discharge, and quality of water in glacial and bedrock aquifers.

## **Geologic Information for Land-Use Planning**

USGS geologists, in cooperation with the State Geological Survey, are involved in studies to identify potential consequences of land-use and land-management activities. The distribution, thickness, and engineering characteristics of surficial deposits are being mapped and compiled for the Quaternary Atlas of the United States. Detailed maps showing bedrock geology, erosion and deposition, areas of geologic hazards, and potential effects of land use and development in South Dakota are being prepared as part

of a regional study of environmental change in the Missouri River Basin.

## **Studies in Environmental Health**

Selenium is an essential element for proper plant and animal health; however, it can be toxic when present in large concentrations in water or food. Reconnaissance investigations of the Angostura and Belle Fourche Irrigation Projects, in cooperation with the Bureau of Reclamation and the Fish and Wildlife Service, were completed in 1990 in response to nationwide concern about the effects of irrigation drainage on human health, fish, and wildlife. The Angostura and Belle Fourche Projects were selected for study because the project areas overlie Cretaceous marine shales in western South Dakota that contain large concentrations of trace elements, including selenium.

The USGS has worked with the Bureau of Reclamation to identify areas where soils have high potential for producing selenium in irrigation-drainage waters. One such area is the site of the proposed Lake Andes-Marty II Demonstration Program in southeastern South Dakota, where marine shales contain high concentrations of selenium. The USGS has collected baseline trace-element data, including selenium concentrations, in water samples at 13 sites within the proposed area of the Demonstration Project since 1984. The USGS also has collected baseline water-quality data on nutrient and pesticide concentrations in the Lake Andes area.

Molybdenosis, a disease of grazing cattle and sheep, is caused by the depressing effect of molybdenum on the uptake of essential copper. In areas where bedrock units contain high concentrations of molybdenum, the element can be absorbed by pasture vegetation. The USGS, in cooperation with veterinarians and State universities, has studied this disease as it relates to regional geology in northwestern South Dakota.

Various problems have occurred from development of mineral resources in the Black Hills area. The most notable example resulted from discharge of mill tailings to Whitewood Creek over the course of about 100 years of gold-mining activ-

ity. Whitewood Creek was listed as an Interim Priority Site under the Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA). The site was intensively studied throughout the 1980's by the USGS under the Toxics Hydrology Program. Contamination of the creek by arsenic, mercury, and cyanide were determined to be the largest problems.

Recent development of several open-pit, heap-leach gold mines has caused concern regarding the quantity and quality of streamflow. In response to this concern, the USGS operates streamflow-gaging and water-quality-sampling stations at various locations in the Black Hills area in cooperation with State and local agencies. A separate study of the origin and geochemistry of ore bodies at two major mines will provide information relative to future water-quality concerns at other potential mine locations.

## **Water-Resources Information for South Dakota Indian Tribes**

Water-resources information is critical for water-management planning, quantification of water rights, and environmental compliance on South Dakota's nine Indian reservations (fig. 2). Hydrogeologic studies of six reservations were completed during the 1970's and 1980's as a part of the U.S. Department of the Interior's Program for Development of the Missouri River Basin. Water-resource studies are now in progress on five of the reservations to meet today's changing needs.

Current studies of the Lake Traverse and Rosebud Reservations are underway by the USGS in cooperation with the Bureau of Indian Affairs, Tribes, State Geological Survey, counties, and local water districts. Water-resources appraisals of the Lower Brule, Cheyenne, and Pine Ridge Reservations will be used to support development of comprehensive water plans. Subsequent studies have begun on several reservations to integrate hydrologic and geologic data by GIS analysis. The USGS has performed aquifer tests on the Pine Ridge Reservation to evaluate ground water as a source for irrigation. Sampling is underway to evaluate water quality of the proposed source for the Mni Wiconi rural water system.

## Effects of Floods and Droughts

A comprehensive understanding of flood characteristics is necessary for design of highway and flood-control structures, land-use planning, establishment of flood-insurance rates, and development of evacuation plans. The USGS completed statewide flood-frequency studies in 1974 and again in 1980. A current study to update the relation of peak-flow magnitudes to basin characteristics for the entire State is underway in cooperation with the South Dakota Department of Transportation (DOT). In addition, maps of flood-prone areas and flood reports documenting 1993 floods in eastern South Dakota and the 1972 flood in Rapid City have been published.

A 1991 survey of bridge failures in the United States since 1950 showed that 60 percent of the failures were associated with channel instability and scour around bridge piers and abutments. The USGS, in cooperation with the DOT and the Federal Highway Administration, is accomplishing a 5-year investigation of scour at 31 bridges in South Dakota.

Droughts in South Dakota are devastating to the State's agriculture industry. During periods of drought, the USGS works with numerous agencies to disseminate streamflow and water-level data needed to regulate water rights and maintain instream-flow requirements.

## Lake and Reservoir Sedimentation

In response to public concern relating to water quality and sedimentation of South Dakota lakes, the Department of Environment and Natural Resources (DENR) is accomplishing diagnostic/feasibility studies in conjunction with the Clean Lakes Program in the State. DENR and local lake associations have requested the USGS to conduct sediment surveys of lakes.

The Corps of Engineers is concerned about sedimentation of Missouri River reservoirs, especially Lake Francis Case near the confluence of the White River, and Lake Sharpe near the confluence of the Bad River. The USGS recently completed a sediment survey near the White River confluence. The USGS also collects hydrologic data in cooperation with the local Conservation District and the Soil Conservation Service in support of sediment studies within the Bad River Basin. The Bad River Basin has been identified as one of the demonstration projects for "Ecosystem Management."

## Potential for Artificial Recharge

The USGS is cooperating with the Bureau of Reclamation, U.S. Environmental Protection Agency (EPA), South Dakota State University, and the City of Huron to demonstrate the potential of artificial recharge in eastern South Dakota.

The Huron site is one of about 20 projects in the High Plains States Groundwater Recharge Demonstration Program. Water is withdrawn from the James River, treated, and used to recharge aquifers at the City's well field.

## Use of Bedrock Aquifers for Water Supply

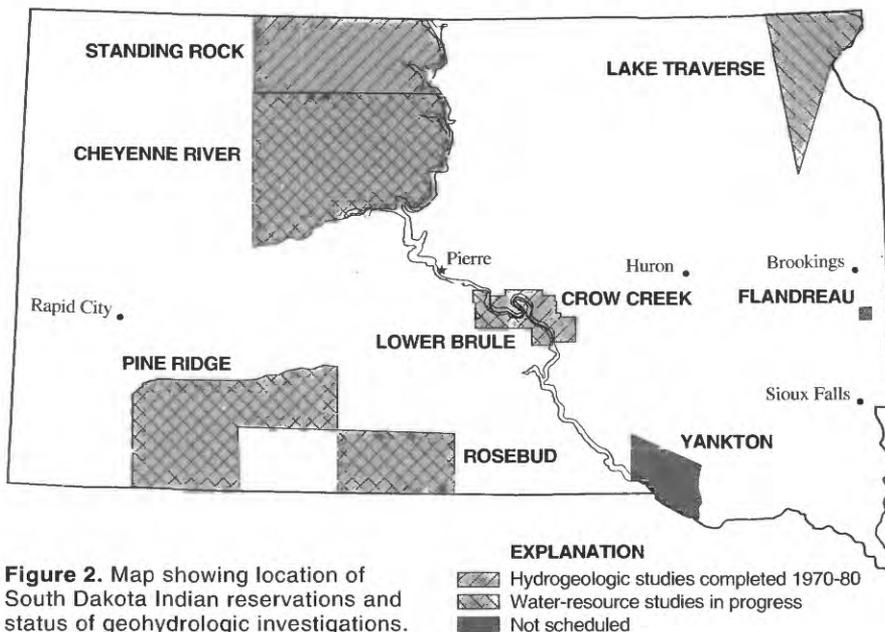
A series of bedrock aquifers is recharged in outcrop areas of the Black Hills of western South Dakota. Population growth and associated development in the Black Hills area is increasing water demand from, as well as potential for, contamination of these aquifers. Several studies are underway to address these issues.

The Black Hills Hydrology Study is a 10-year hydrogeologic study in a six-county area that began during 1990 in cooperation with DENR and local cooperators. Preliminary efforts have focused on quantity and quality of surface water and ground water. Water-level records from an extensive network of observation wells are used to monitor water-level trends. Future efforts will involve hydrologic budgeting, determination of aquifer characteristics, and modeling of groundwater flow and solute transport. Solute transport is of particular concern because of the fractured nature of most Black Hills aquifers.

## Quality of Urban Storm-Water Runoff

Information regarding quality of storm runoff from urban areas is critical for determining potential effects of storm runoff on receiving waters, such as degradation of water quality for downstream uses and harm to in-stream biological communities. A 3-year study of storm-water quality in Rapid City was completed in 1987 as part of the Nationwide Urban Runoff Program, in cooperation with the U.S. Environmental Protection Agency (EPA) and three State and local cooperators.

A study of urban storm-water quality, in cooperation with Sioux Falls, will help the City collect technical information necessary for obtaining a National Pollutant Discharge Elimination System (NPDES)



**Figure 2.** Map showing location of South Dakota Indian reservations and status of geohydrologic investigations.

permit. The permit is required by the EPA for municipalities with populations larger than 100,000. The study includes evaluation of storm-water quality in selected storm channels and evaluation of methods for predicting water-quality conditions in urban environments. The results of this study will be applicable to other communities with similar environmental settings.

## **Environmental Concerns at Defense Facilities**

The USGS is cooperating with Ellsworth Air Force Base to study the possible hydrologic effects of the explosive demolition of Minuteman II missile silos in western South Dakota in compliance with the Strategic Arms Reduction Treaty.

The USGS serves on a Restoration Advisory Board that deals with local concerns relating to an abandoned Army ordnance depot near Igloo in southwestern South Dakota. The Corps of Engineers oversees investigation of buried chemical and explosive ordnance at the site, which is frequently proposed as a waste-disposal site.

## **Volatile Organic Chemicals (VOC's) in Ground and Surface Water**

Information on this group of organic contaminants is critical to water-resource managers. A nationwide study of VOC's

is being performed in South Dakota as part of the National Water-Quality Assessment Program (NAWQA). The goals of NAWQA are to (1) describe current water-quality conditions; (2) define trends or lack of trends; and (3) identify, describe, and explain relations among the occurrence and distribution of VOC's in ground and surface water. The VOC study includes compilation of existing data and knowledge about VOC's in the hydrologic cycle.

## **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 NGIC also provides consultation to a variety of Federal, State, and local groups on the effects of magnetic variations. Current programs include

advising Alaska officials on how magnetic variations affect corrosion in pipelines in an attempt to slow corrosion of the Alaska pipeline, working with other Federal agencies to establish a new National Space Weather Program, and providing leadership to the INTERMAGNET Program to develop and deploy ocean bottom geomagnetic observatories to fill gaps in data coverage around the world.

The Center for Environmental Geochemistry and Geophysics (CEGG) focuses on environmental geoscience research and information exchange. CEGG coordinates and supports basic and applied research on the natural and human-induced environmental effects associated with geologic sources—especially those related to mineral and energy resources and their development. Some examples of currently supported investigations include: environmental geochemistry of historic mining and smelting activities, behavior and transport of toxic elements in natural systems, occurrence models for the "Valley Fever" pathogen, use of naturally occurring minerals as scavengers for toxic metals.

## **Cooperative Programs**

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

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### **For more information contact any of the following:**

#### **For water information**

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(605) 394-1780

#### **For map information**

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#### **For geologic information**

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Denver, Colorado 80225  
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National Earthquake Information Center  
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Denver, Colorado 80225  
(303) 273-8500

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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.