

The U.S. Geological Survey (USGS) has been assessing, mapping, and reporting on Idaho's earth resources for more than 100 years. Ongoing USGS programs in Idaho include topographic and geologic mapping, surface- and ground-water data collection, geochemical and biological investigations of lakes and rivers, mineral exploration, and assessments of water-quality, hydrologic, and geologic conditions, including earthquakes and floods. The USGS contributes to the health, safety, and economic well being of Idaho's citizens through each of these programs and in cooperative efforts with State, local, and Federal agencies, universities, and other public organizations.

Earthquake-Hazards Research

The USGS, in cooperation with the Idaho Geological Survey and the Montana Bureau of Mines, is studying the Lewis and Clark seismic activity zone in northern Idaho and western Montana. The safety of workers and equipment in mines that are thousands of feet deep depends upon knowledge about spatial, temporal, and intensity distributions of earthquakes along active faults in this zone.

National Water-Quality Assessment

The long-term goals of the National Water-Quality Assessment (NAWQA) Program are to describe the status and trends in the water quality of a large, representative part of the Nation's rivers and aquifers and to identify the primary natural and human factors that affect water-quality conditions. The NAWQA Program is designed to produce water-quality, geographic, and ecological information that will be useful to policymakers and water managers at the local, State, and national levels.

One NAWQA Program study—the upper Snake River Basin (fig. 1)—has been underway in Idaho since 1991. Analysis of historical water-quality data indicates that from 1980 to 1989, nutrient concentrations in the Snake River generally increased in a downstream direction. Nutrient concentrations were significantly greater at measurement

sites affected by agricultural activities and sites on the main stem of the Snake River than at those unaffected or minimally affected by agriculture. Nitrate concentrations in ground water sampled from 1980 to 1991 were significantly greater in agricultural areas than in rangeland areas. Nitrate concentrations exceeded the U.S. Environmental Protection Agency (USEPA) drinking-water standard of 10 milligrams per liter at the Idaho National Engineering Laboratory (INEL), which is north of Pocatello, and in the Burley area. Sources of nutrients, including nitrate, are synthetic and natural fertilizers, atmospheric deposition that results from combustion of fossil fuels, and effluent from industrial and wastewater-treatment facilities.

Concentrations of DDT and PCB's were found in most tissue samples from fish collected in the Basin between 1970 and 1990. Some concentrations exceeded criteria for the protection of predatory fish and wildlife. However, other long-term data for DDT and PCB's indicated declining concentrations in fish tissue during the collection period. Mercury concentrations in bed-sediment and tissue samples were below levels of concern for

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the protection of bottom-dwelling organisms and fish-eating birds and wildlife.

In 1996, upper Snake River Basin NAWQA began monitoring trends in surface-water and ground-water quality and aquatic conditions and to update the compilation of environmental setting information.

Another NAWQA Program study—the Northern Rocky Mountains Intermontane Basins (fig. 1)—is scheduled to begin in 1997.

Topographic Mapping

The widespread use of maps and digital cartographic data is expanding dramatically. The National Mapping Program of the USGS strives to ensure that map data in graphic and digital form are available to the public through timely and effective data-collection and revision procedures.

Among the most popular and versatile products of the USGS are the 1:24,000-scale topographic maps (1 inch on the map represents 2,000 feet on the ground). Idaho is represented by 1,715 maps at this scale. These maps depict basic natural and cultural features of the landscape, such as lakes and streams, highways and railroads, boundaries, and geographic names and include contour lines that depict the elevation and shape of the terrain. The maps are useful for civil engineering, land-use planning, natural-resource

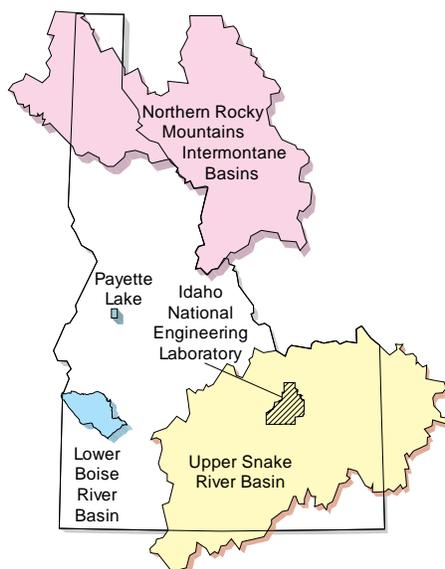


Figure 1. Some areas studied by the USGS in Idaho.

monitoring, and other technical applications and have long been favorites with the general public for a wide variety of outdoor uses.

Heavy Elements in the Coeur d'Alene River Valley

A large part of the Coeur d'Alene River Valley in northern Idaho (fig. 2) is blanketed by sediment with high concentrations of heavy elements (lead, zinc, and cadmium) that resulted from more than a century of mining, milling, and smelting to process lead, zinc, and silver. In 1986, the USEPA established the Bunker Hill Superfund site along a 7-mile stretch of Valley around the smelter complex. In the Valley outside the Superfund site, a study by the Idaho Department of Health and Welfare is underway to assess lead and cadmium levels in people, and a Natural Resource Damage Assessment is being conducted by U.S. Departments of the Interior and Agriculture and the Coeur d'Alene Tribe to evaluate toxic effects of heavy elements on fish and wildlife. In coordination with these ongoing studies, USGS research in the Coeur d'Alene Valley provides information about the distribution, mobility, and bioavailability of heavy elements. This information can be used in the development of remediation strategies to reduce effects of dissolved and particulate heavy elements on surface water in the Valley by these agencies.

Sediments, with high concentrations of heavy elements blanket the 100-year flood plain throughout the Valley, are intermixed with cobbles in active and abandoned channels in the upper Valley, and form thick (10 to 20 foot) submerged point-bar deposits in the lower Valley. Heavy-element content is highest in the sediment section deposited after mining first began and progressively decreases upward. Flood-plain sediments at land surface in the mining district in the upper Valley contain from 1 to 3 percent lead and about 1 percent zinc (more than 100 times the percentages found outside the min-

ing district); sediments in the 30-mile-long lower Valley contain 0.4 percent lead and slightly less zinc.

Successful remediation strategies will depend on understanding and disrupting the pathways through which potentially toxic heavy elements move from sediments to specific organisms. Presently, these pathways are only partially understood. To summarize, metallic sulfides in the original mine tailings are stable until they start to break down upon contact with air or water. As the sulfides break down, heavy elements are released into solution and can form a variety of heavy-element-bearing secondary minerals during summer drying or when chemical conditions change. Sulfides that break down in the flood plain produce high concentrations of dissolved zinc and cadmium. These potentially toxic elements enter surface water by groundwater transport and are present at levels that are lethal to fish throughout most of the mining district. Lead released from the breakdown of lead sulfide quickly forms lead-bearing secondary minerals that readily enter the food chain. As these pathways and their interrelations are better understood through continuing research, strategies can be developed to disrupt them before toxic elements adversely affect the health of people, fish, and wildlife.

Water-Quality and Biological Assessment of the Lower Boise River

Land development, road construction, urban runoff, animal-feeding operations, and agricultural land and water uses contribute to increased nutrient and sediment loads, high bacteria levels, and elevated water temperatures that exceed water-quality criteria established for the lower Boise River (fig. 1). Consequently, in October 1994, the State of Idaho was required by the USEPA to develop an implementation plan to restore water-quality

conditions to the established criteria by 1997. To assist the State with this requirement, an 8-year study was designed to define water-quality and biological integrity in the river for current conditions and for identification of long-term trends. The study began in 1994 and is conducted by the USGS, in cooperation with the Idaho Department of Health and Welfare, Division of Environmental Quality, and a consortium of local governments, water districts, and water-user organizations.

Nutrients, suspended sediment, bacteria, dissolved oxygen, pH, and water temperature measured before and after the irrigation season at 4 river and 12 irrigation drain sites since 1994 provide baseline water-quality conditions that are useful for assessing changes in conditions from year to year as the implementation plan is executed. Also, bimonthly measurements at four river and eight drain sites are useful for assessing seasonal changes. Measurements of algae, invertebrates, and fish at five river sites in the spring and fall are useful for assessing changes in biological integrity. Other data collected during this study, including point-source locations, land use, land-management practices, and agricultural chemical use are being compiled in a geographic information system and used to examine relations among potential contamination sources, water-quality conditions, and biological integrity.

Radioactive and Chemical Wastes in the Eastern Snake River Plain Aquifer System

The INEL, which is operated by the U.S. Department of Energy, is located on the eastern Snake River Plain in southeastern Idaho (fig. 1). Facilities at the INEL are used in the development of peacetime atomic-energy applications, nuclear safety research, defense programs, and advanced energy concepts. Wastewater that contains radiochemical and chemical wastes generated at these facilities has been discharged to infiltration ponds and disposal wells since 1952. Wastewater disposal has resulted in detectable concentrations of waste constituents in water from the Snake River Plain aquifer system that underlies the INEL. Water from the aquifer system hydraulically downgradient from the INEL is used extensively for drinking, irrigation, and aquaculture.

The USGS has monitored hydrologic conditions in the Snake River Plain aquifer at the INEL since the early 1950's. A multiphase project began in 1987 to characterize the fate and transport of radioactive and chemical constituents in the aquifer. In the first phase

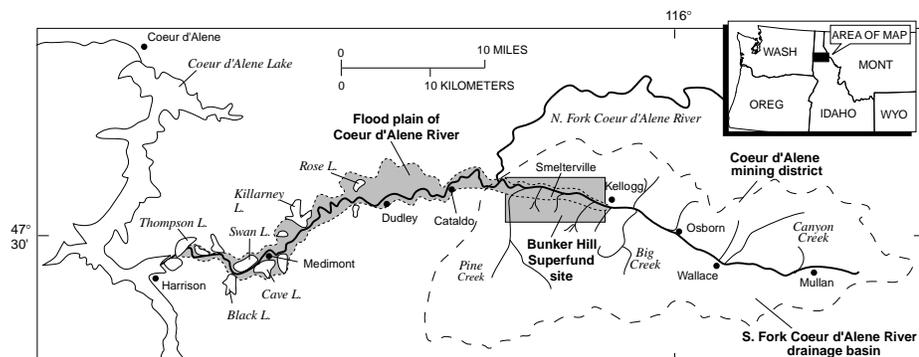


Figure 2. The Coeur d'Alene area showing the Coeur d'Alene mining district, the Coeur d'Alene River, the Bunker Hill Superfund site, and other significant features.

of this project, stratigraphic, geochemical, and hydraulic studies are being incorporated to define the ground-water flow system at the INEL. Complementary studies include the use of environmental tracers to provide information about the rate of ground-water flow and geochemical-reaction experiments to evaluate the chemical processes that affect the transport of waste constituents in the subsurface. In the second phase, numerical flow models are developed to simulate the occurrence and movement of water in the aquifer system. These models integrate data obtained from the first-phase studies and are used to evaluate the conceptual model of the flow system. In the third phase, a solute-transport model is developed to test hypotheses about the movement of radiochemical constituents in the aquifer. In addition to the large-scale characterization study, the USGS began a flood-plain study in 1994 to delineate the possible extent, volume, and velocity of floods in relation to INEL processing and storage facilities. Other USGS activities at the INEL include regional and local surface geologic mapping and subsurface stratigraphic, isotopic, and paleomagnetic studies to help develop hazard assessments for potential threats from earthquakes and volcanic eruptions for the INEL and for specific reactor and radioactive-waste storage facilities.

Payette Lake

Payette Lake is a 8.3-square-mile natural lake situated in a mountain valley in west-central Idaho (fig. 1). The city of McCall (1990 population, 2,000) is located at the Lake's outlet. McCall is a popular recreation area, and the population increases seasonally in summer and winter. The area's substantial growth in resident population over the past decade, coupled with increased developmental pressure and heavy recreational use of the Lake, prompted local residents to request a comprehensive water-quality study of the Lake. The objective of this study, which is being conducted in cooperation with the Idaho Department of Health and Welfare, Division of Environmental Quality, is to develop a nutrient load/lake response model of Payette Lake. The study will evaluate the physical, chemical, and biological characteristics of the lake; quantify discharge and nutrient loadings associated with major inflow from the North Fork Payette River and minor tributaries and outflow from the lake; and calibrate, verify, and use the model to simulate the Lake's response to hypothetical alterations in nutrient loading. The study began in July 1994 and includes 2 years for data collection and an additional year to complete data interpretation and modeling.

Analyses of water samples from the Lake's primary inlet on the North Fork Payette River indicated elevated nitrate concentrations in winter 1995, possibly related to the heavy application of fire retardants and ash produced by major forest fires during fall 1994. Samples from the outlet did not reflect a large nitrate increase, which implies that nutrients were stored in the Lake. Chlorophyll analyses collected at four stations on the Lake indicated abundant phytoplankton growth in response to the plentiful nitrogen content of the Lake. This surge in phytoplankton growth exhausted the supply of dissolved oxygen in the lower water column of the Lake from September to November 1995 for the first time on record. Continuation of these symptoms could presage undesirable changes in the balance among plant, fish, and wildlife communities whereby plant growth could become increasingly predominant. Several years of sampling will be needed to evaluate whether increased phytoplankton growth and oxygen depletion are a transient response to the fires or a chronic problem related to basin and nearshore development.

Interior Columbia Basin Ecosystem

The USGS provides earth science information to the U.S. Forest Service (USFS) and the Bureau of Land Management (BLM) project staff, which is completing a scientific assessment of all land in a seven-State region of the Columbia River Basin east of the Cascade Mountains. Goals of the scientific assessment are to understand the development and current state of land, water, plants, animals, and society within the basin and to model future conditions that could result from different management alternatives and disturbances. In coordination with the scientific assessment, the USFS and BLM staff also is developing regional management strategies for Federal lands in the Basin. Goals of the management strategies are to maintain and improve ecological integrity by promoting the natural processes that operate in healthy aquatic, terrestrial, and landscape ecosystems and to provide sustainable flows of resources from Federal lands.

Mineral-resource potential of the Interior Columbia Basin is a partial indicator of the potential for economic development, land use, and environmental hazards. USGS scientists have provided detailed digital geologic, hydrologic, and mineral-resource information to USFS and BLM staff biologists, botanists, forest ecologists, sociologists, and economists; participated in systems modeling; provided data to be used by the agencies in the

development of management alternatives; and contributed to several reports.

Earth-Science Information

Earth science information is critical in understanding past, present, and future conditions, processes, and potentials in any ecosystem. Geologic and hydrologic interactions provide critical controls on erosion potential and on the occurrence and distribution of aquatic and terrestrial plant and animal populations in various climatic settings. Geologic and hydrologic processes, including volcanic eruptions, earthquakes, and erosion and deposition from floods, have shaped the landscape but also are hazards to people, plants, and animals; disrupt transportation and communication networks; damage structures; and affect economic conditions.

The Earth Science Information Centers (ESIC's) provide the public with information about USGS programs, products, and technological developments. The ESIC in Boise was established under a cooperative agreement between the USGS and the Idaho State Library. The University of Idaho Library in Moscow also is a State ESIC. As part of the national ESIC network, local centers provide information on such earth science topics as cartography, geography, digital data, remote sensing, geology, geophysics, geochemistry, hydrology, geohydrology, aerial photography, and land use. The USGS provides reference materials, technical assistance, training opportunities, outreach activities, and access to USGS data bases in support of the ESIC network.

Environmental Remediation at the Blackbird Mine

Metal-rich acid mine drainage at the inactive Blackbird cobalt-copper mine, which is a proposed Superfund site, has led Idaho to bring suit in Federal court against the mining companies that currently hold the property. The mine drainage has potential adverse effects on wetlands, riparian habitat, and migrating salmon and other anadromous fish in a major tributary to the federally designated "wild and scenic" Salmon River. The USGS has been studying the cobalt resources at Blackbird and in the surrounding region and is now providing critical geologic and geochemical information and expertise directly applicable to cleanup of this site and resolution of the ongoing litigation. This information is being used by State and Federal trustees of public lands that surround the mine to evaluate site standards and remediation; by the U.S. Department of Justice to pursue legal issues; by the USEPA to oversee

remediation at the proposed Superfund site; and by consulting firms that have been hired by the involved mining companies and some government agencies to conduct technical studies relevant to litigation and remediation.

Knowledge of the Blackbird deposit, which is the only primary source of cobalt in the United States, is essential for long-range national planning for strategic mineral needs. The USGS studies of the Yellowjacket Formation and related rocks and mineral deposits are being used extensively for exploration by domestic mining companies.

Sharing Geospatial Data

The Competitive Cooperative Agreements Program (CCAP) was established by the Federal Geographic Data Committee (FGDC) through the USGS to help form data-sharing partnerships with the non-Federal sector. This program provides funding to State and local government agencies, academia, and the private sector to encourage resource-sharing projects through the use of technology, networking, and interagency coordination. The Idaho Department of Water Resources and the Idaho Geographic Information Advisory Committee were funded by CCAP to establish a metadata (the characteristics and availability of geospatial data) clearinghouse on the Internet as part of the Idaho Geospatial Data Network of the National Spatial Data Infrastructure. This project will build upon activities of the geospatial data community in Idaho to provide an online source of metadata from contributors within Idaho. The project involves developing an implementation strategy for a metadata clearinghouse, defining an Idaho metadata profile compatible with FGDC metadata standards, educating and training clearinghouse contributors and users, implementing access for contributors to the clearinghouse at key data-developer sites, and populating the clearinghouse with metadata.

Hydrologic and Water-Quality Data

Idaho has seven major river basins—the Kootenai, the Pend Oreille, the Spokane, the Clearwater, the Salmon, the Snake, and the Bear. Rivers in these basins supply surface water for agriculture, industry, hydroelectric-power generation, recreation, fish and wildlife habitat, and other uses within Idaho and in adjacent States. Aquifers supply ground water for these same uses in many parts of the State. Water from geothermal aquifers also is used for space heating. Hydrologic and water-quality data are critical for the 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 people activities on streamflow, ground-water supply, and water quality. The data also are essential to plan development activities and to carry out interpretive studies that provide information for making decisions about water issues that affect millions of people.

The USGS, in cooperation with the Idaho Department of Water Resources, the Bureau of Reclamation, and more than 20 other local, State, and Federal agencies, collects surface- and ground-water and water-quality data at numerous sites throughout the State. For example, streamflow discharge was measured at 279 gaging stations; water-quality data were collected at 124 of those stations in 1996 (fig. 3).

Geologic Mapping

With funds provided by the USGS under the STATEMAP component of the National Cooperative Geologic Mapping Program, the Idaho Geological Survey produced geologic maps of the Pocatello South, the Twin Falls, the Filer, and the Clover 1:24,000-scale quadrangles. This work has been of great interest to municipal authorities in Pocatello and Twin Falls and can be combined with other geospatial data to develop plans related to urban expansion, landfills, sewage systems, air and water quality, and seismic risk.

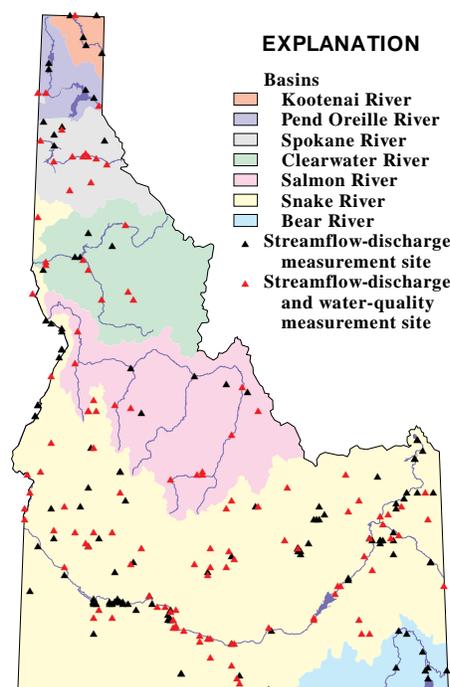


Figure 3. River Basins and sites in Idaho where streamflow and water quality were measured in 1996.

For More Information

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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**

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

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