

United States Geological Survey Programs in Nevada



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.

The U.S. Geological Survey (USGS) has been collecting and interpreting natural-resources data in Nevada for more than 100 years. This long-term commitment enables planners to manage better the resources of a State noted for paradoxes. Although Nevada is one of the most sparsely populated States in the Nation, it has the fastest growing population (fig. 1). Although 90 percent of the land is rural, it is the fourth most urban State. Nevada is the most arid State and relies heavily on water resources.

Historically, mining and agriculture have formed the basis of the economy; now tourism and urban development also have become important. The USGS works with more than 40 local, State, and other Federal agencies in Nevada to provide natural-resources information for immediate and long-term decisions.

Investigations of Low-Level Radioactive-Waste Disposal

Low-level radioactive waste has been buried at a site near Beatty since 1962. Long-term data on the movement of water and radioactive solutes in arid lands were not available at that time, and the risk of contamination was assumed to be low.

The USGS is conducting long-term research at the site to improve the understanding of the mechanisms that control the migration of radioactive contaminants in soil moisture (liquid and vapor). The results are being used nationally to evaluate the geohydrologic suitability of arid sites for waste containment and to develop guidelines and criteria for selection and establishment of future burial sites for low-level radioactive waste at arid sites. The project also has developed new approaches and methods

Index of Subjects

- Low-Level Radioactive-Waste Disposal
- Mining and Water in the Humboldt Basin
- Aquifer Systems in the Great Basin
- Water Allocation in Truckee and Carson Basins
- National Water-Quality Assessment Program
- Minerals Assessment for Land Management
- Irrigation Drainage
- Ground-Water Movement at Nevada Test Site
- Oil and Gas Resources
- National Mapping Program
- Digital Mapping and Aerial Photography
- Collection of Hydrologic Data
- Geologic Mapping
- Earthquake Hazards
- Assessing Mineral Resources of the Subsurface
- Earth Observation Data
- Cooperative Programs

for measuring properties of and water movement in dry alluvial soils. These methods are being applied elsewhere in the West, including Yucca Mountain, Nevada, and Ward Valley, California.

Designers of waste-disposal sites are concerned because preliminary evidence indicates that water vapor could flow upward from a deep water table into shallow soil zones used for waste disposal. Specific studies are underway at the Beatty site to evaluate the magnitude of this potential flow.

Mining and Water in the Humboldt River Basin

In the past two decades, the Humboldt River Basin has been a major center for gold and other mining activities. Increased mining, together with steady agricultural and municipal growth, have altered the soil and surface and ground water. Little is known about the individual or cumulative effects of intensive mine dewatering on the regional aquifer system or the flow regime of the Humboldt River. Drainage of water containing selenium, a naturally occurring element, into the Humboldt Sink and altered habitat conditions for endangered Lahontan cutthroat

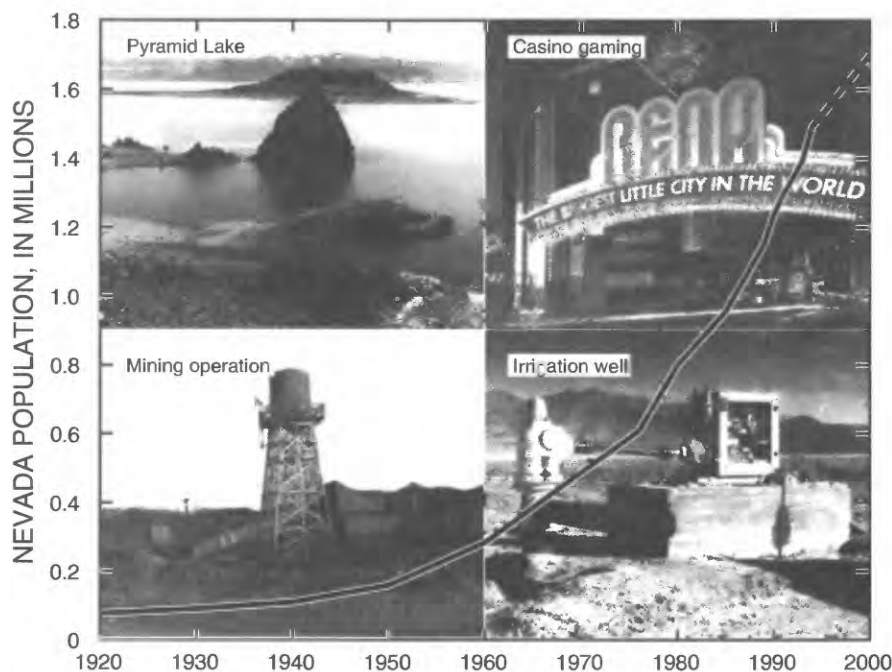


Figure 1. Nevada is the Nation's fastest growing and most arid State, and depends on tourism, mining, and agriculture. Collection and unbiased analysis of earth-science information by the USGS are essential to responsible planning.

trout are recognized ecosystem problems; the causes of the problems are complex and are the focus of ongoing study.

USGS scientists, in cooperation with the Bureau of Land Management, are studying the geology and hydrology of the Humboldt River ecosystem. Plans are to determine the effects of large-scale mining pits and dumps; to study dewatering, geologic processes, and transport of materials; and to evaluate the hydrologic system by computer modeling. The knowledge gained will be important in land-management decisions and in mitigating the environmental effects of mining in northern Nevada.

Regional Analysis of Aquifer Systems in the Great Basin

The Great Basin contains about 200 valley-fill aquifers that, in some places, are underlain and interconnected by permeable consolidated rock to form extensive regional ground-water-flow systems. These systems were included in a national program of Regional Aquifer-System Analysis (RASA). In the Great Basin area of Nevada, population and demands for water are increasing; as a result, careful management is now needed in many areas to meet anticipated future demands.

The Great Basin RASA study described the predevelopment and present ground-water systems, provided a regional synthesis of prior studies, and developed models for simulating the potential effects of further ground-water use. The RASA study was the impetus for further cooperative investigations of regional aquifers in eastern and southern Nevada. The results of these studies have been widely used by public and private agencies and their consultants to assess the potential of the regional aquifers for water supply, as well as the likely hydrologic effects of such future development on the ecosystems of the Great Basin.

Water Allocation in Truckee and the Carson River Basins

The Truckee–Carson–Pyramid Lake Water Rights Settlement Act (Title II of Public Law 101–618) contains many explicit and implicit requirements for U.S. Department of the Interior agencies. The USGS is providing detailed water-resources data and analysis for the Carson and the Truckee River Basins of California and Nevada (fig. 2). A Federal river-monitoring network was designed and

implemented to provide consistent, long-term data. River-basin simulation models are being developed, tested, and applied. These efforts provide a framework for assessing alternatives for river operations, water-right allocations, and irrigation.

The USGS occupies a unique niche among the Federal agencies involved in settlement of the long-standing legal, operational, and ecological issues in the Basins. Because the USGS does not have specific resource-management or regulatory responsibilities, it is recognized as an objective source of information to be used in further negotiations and in carrying out provisions of the Act.

National Water-Quality Assessment Program

In response to the lack of long-term, consistent information on the Nation's quality of water, the USGS developed the National Water-Quality Assessment (NAWQA) Program. The goals are to describe the status and trends in the quality of a representative part of the Nation's surface- and ground-water resources and to provide scientific understanding of the natural and human factors that affect water quality.

In 1986, the Carson River Basin was selected as one of three NAWQA Program pilot studies of ground-water quality. The Nevada Basin and Range region was selected in 1991 as 1 of the first 20 study areas for a full-scale NAWQA Program. This study unit consists of the Carson and the Truckee River Basins and Las Vegas Valley (fig. 2). These three Basins include 80 percent of the total population in Nevada and 74 percent of the total water use for urban communities in the State. Project scientists are comparing and contrasting the effects of land and water uses on water quality in urban and agricultural areas, an issue of paramount importance in fast-growing, arid Nevada.

Minerals Assessment for Land-Management Planning

A large area of the Black Rock–High Rock Desert in northwestern Nevada has been listed as a candidate for designation as a National Conservation Area. Minerals, geothermal energy, and oil and gas continue to be developed there. The Bureau of Land Management needs information to predict likely locations and effects of continued exploration and development. The USGS and U.S. Bureau

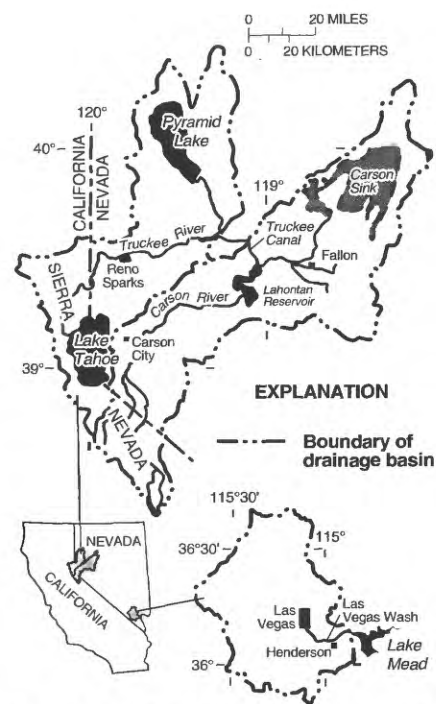


Figure 2. Urban and hydrologic features in the Carson and Truckee River Basins and Las Vegas Valley.

of Mines are assessing potential undiscovered resources and providing economic analyses that will allow land managers to estimate potential socioeconomic and environmental effects of future development of resources. Development in the area could affect threatened and endangered species, lead to the withdrawal of public lands from further mineral development, and increase the effects of mine dewatering on ground-water resources.

Irrigation Drainage in Wildlife Management Areas and Vicinities

Scientists of the USGS, the U.S. Fish and Wildlife Service, and Bureau of Reclamation recently completed a study of the Stillwater Wildlife Management Area and other nearby wetlands near Fallon in west-central Nevada. The project was funded by the National Irrigation Water Quality Program to determine the extent, magnitude, and effects of selected water-quality constituents associated with irrigation drainage on fish, wildlife, and human health. Where adverse effects have been documented, project scientists determined sources and exposure pathways that cause contamination.

The results of this study indicate that the aquatic biota in natural wetlands of the Carson Desert are adversely affected by human-caused hydrologic changes in the natural geochemistry of the Newlands Irrigation Project area. Water that enters the Stillwater Wildlife Management Area from some agricultural drains is acutely toxic to aquatic organisms. Some drains in the agricultural area also are implicated as sites of uptake of selenium and mercury by aquatic organisms. Study results have led to changes in irrigation-management practices. Project data and reports are used to determine potential ecological effects of water-management alternatives being considered for implementation of Public Law 101-618 and for continued negotiations over water rights and environmental concerns in the Carson Desert and tributary basins.

Ground-Water Movement at the Nevada Test Site and Yucca Mountain

At the request of the U.S. Department of Energy, the USGS is studying the hydrologic effect of activities at the Nevada Test Site (NTS). Nuclear weapons have been tested at this remote location north of Las Vegas since the early 1950's. Hydrologists and geologists are determining the regional and local subsurface controls on the rate and path of ground-water flow at the site. The results are crucial to understanding the potential for high-level radionuclides to be transported within regional aquifers and to contaminate future public water supply.

The USGS operates the ground-water-monitoring networks at NTS and Yucca Mountain, a potential location for the Nation's first high-level nuclear-waste repository. The USGS also is studying paleohydrology in the Yucca Mountain area to assess the long-term frequency and magnitude of floods.

Oil and Gas Resources

To evaluate the energy resources of the Nation, the USGS is making a National Petroleum Assessment of potential undiscovered natural gas and oil resources. Recent discoveries of natural gas and oil resources in Nevada may provide significant contributions to the national energy reserves. Because the geology of these potentially productive areas is complex, exploration involves a large element of risk. The USGS is analyzing subsurface structural and strati-

graphic features in detail to determine the depositional history and other factors that affect the location of hydrocarbon resources. Results have provided the exploration industry with new clues about the possible location of untapped petroleum resources.

The many faults bounding the basins and ranges throughout Nevada are critical controls on ground-water flow and resource accumulations. In the oil-bearing Railroad Valley, USGS scientists are combining the extensive network of seismic-reflection and drillhole data released by oil-exploration companies with the Survey's own geologic and geophysical studies. The results are used to develop structural models to study regional ground-water flow and waste disposal and to explore for energy and mineral resources.

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, political boundaries, and geographic names. Contour lines are used to depict the altitude and shape of terrain. Nevada is covered by 1,990 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.

Digital Mapping and Aerial Photography

In cooperation with the Nevada office of the Bureau of Land Management, the USGS recently completed collection of 1:100,000-scale digital map and elevation data for Nevada. These data will be used by local, State, and Federal agencies across Nevada in various computer applications from land-use planning to transportation analysis.

In 1994, the USGS completed statewide coverage of 1:40,000-scale black-and-white aerial photographs. Digital files made from these photographs are planned for automated revisions of outdated maps.

Collection of Hydrologic Data

The systematic collection of hydrologic data and statistics on water use in Nevada are critically needed for the understanding and management of this vital resource. The USGS is the Nation's principal water-data-collection agency, and has measured water quality at more than 3,000 sites in Nevada (fig. 3). Water data are compiled in the National Water Information System (NWIS), a nationally consistent computer data base. NWIS data are accessible to the public and provide a basic resource for engineers, universities, and public agencies.

Surface-water runoff is highly variable areally and seasonally throughout Nevada. In 1993, the USGS collected and published surface-water data from 172 gaging stations, 121 peak-flow stations, 61 springs, and 23 lakes and reservoirs. The long-term response of ground-water aquifers in Nevada to climatic variations and pumping is largely unknown. The proper planning and management of State water resources requires long-term information on ground-water levels and basin-wide estimates of recharge and discharge in the ground-water system. In 1993, the USGS collected and published water levels for 105 primary and 614 secondary observation wells. The USGS also is cooperating with the Nevada Division of Water Resources to enter well-driller logs, well permits, and other records into a comprehensive computer data base.

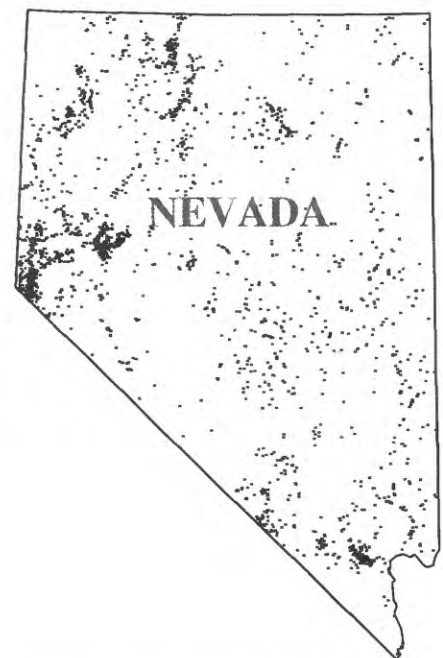


Figure 3. Water-quality data have been collected by the USGS at more than 3,000 sites in Nevada.

The quality of water depends on many natural and human-induced factors and trends. Because USGS monitoring activities generally are focused on the ambient quality of rivers and aquifers rather than on permitted discharges, they provide an essential supplement to the regulatory monitoring conducted by other agencies. In 1993, the USGS collected and published water-quality data for 146 surface-water sites and 54 wells.

Geologic Mapping

Extremely rapid growth of Las Vegas (reportedly 6,000 persons per month) poses an imminent water crisis and contributes to many rapid-growth problems, such as flash flooding, faulting and subsidence, cracking foundations, landsliding, and erosive flood destruction in lower Las Vegas Wash. Although small in area, Mesquite, northeast of Las Vegas, also is growing rapidly and faces similar water and related problems. The USGS, in cooperation with the Las Vegas Valley Water District, is mapping the ground-water geology of a large area, including Mesquite, in eastern Clark and Lincoln Counties. Geologic mapping also has been proposed for the Las Vegas area to provide a basis for evaluating its rapid-growth problems.

Earthquake Hazards

Central Nevada is a natural laboratory for examining the patterns of large-magnitude earthquakes. Between 1915 and

1954, six large earthquakes (magnitude 6.0 or larger) produced surface faulting on six separate fault zones along a roughly linear, nearly continuous 165-mile-long belt. Cooperative paleoseismic investigations by the USGS, the University of Nevada-Reno, and the Nevada Bureau of Mines and Geology are determining whether the pattern of past seismicity is similar to the modern pattern. The results of this research could greatly change the hazard assessments in urban areas adjacent to large normal faults, such as along the eastern front of the Sierra Nevada in western Nevada.

Assessing Mineral Resources of the Subsurface

About 80 percent of Nevada's surface is covered by sedimentary deposits that hamper efforts to explore the underlying bedrock for natural resources. Indirect methods of investigation, such as geophysics, have provided valuable insight into the structure and lithology of the subsurface bedrock. The digital compilation of magnetic data for Nevada, completed by the USGS in 1988, has been used by private citizens, universities, and mining and petroleum companies to explore for metallic deposits. Data from detailed airborne geophysical surveys by the USGS near Gatchell aided industry in selecting drilling sites in the area by revealing faults and favorably altered areas in the subsurface. USGS studies of this type, which are beyond the scope of most efforts by private industry, help

in understanding the genesis of Nevada mineral deposits and in evaluating where other deposits can be discovered.

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 and photography of some sites goes back about 40 years. Satellite images dating from 1972 can be used to study changes in regional landscapes.

Cooperative Programs

The USGS cooperates with more than 40 local, State, and Federal agencies in Nevada. Partnerships with local and State agencies typically are financed on a matching-funds basis. In addition to the agencies already mentioned, the USGS cooperates with the city of Reno, Clark County, the Walker River Irrigation District, the Nevada Division of Environmental Protection, and the Federal Emergency Management Agency.

The USGS provides support to the Desert Research Institute for studies in the arid Great Basin. The Institute has the world's largest faculty for environmental research in arid lands and conducts programs for 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.