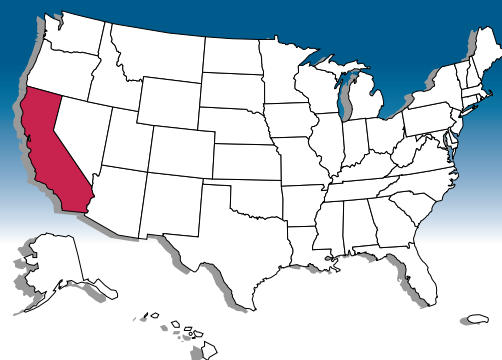




U.S. Geological Survey Programs in California

U.S. Department of the Interior ■ U.S. Geological Survey



The U.S. Geological Survey (USGS) has been mapping and studying California's natural resources and hazards for more than 100 years. In this time, the State population has grown from less than 1 million to more than 30 million, which has increased demands on resources and exposed more people to natural hazards. Many population centers are in areas of natural hazards. Population growth, combined with development in arid and semiarid regions of the State, has stressed California's water resources. USGS information is available to help people understand and deal with natural hazards and water-supply stresses.

Earthquakes

Although most major population centers in California are in seismically active areas, no earthquake in the past few decades has approached the maximum anticipated magnitudes. The principal earthquake hazard is the damage or collapse of buildings or of the infrastructure. The USGS, in cooperation with the California Department of Conservation's Division of Mines and Geology (CDMG), the California Institute of Technology, and the Southern California Earthquake Center is collecting ground-motion data to produce regional risk-assessment maps that provide estimates of the probability of significant ground movement (fig. 1). These maps are used by Federal, State, and local agencies as a basis for building codes and land-use zoning that can reduce loss of life and property.

In the San Francisco Bay region, USGS scientists are collaborating with the California Department of Transportation to improve the seismic safety of six bridges that cross San Francisco and San Pablo Bays. Deep core sediment samples collected beside the bridge foundations are being analyzed to determine the capability of the sediment to support the foundations during earthquake shaking. The USGS study uses geographic information system computer modeling to evaluate the spatial variation of sediment properties beneath these bridges.

Floods

Floods are a perennial concern for much of California, and flood forecasting is an essential part of flood management. The ability to

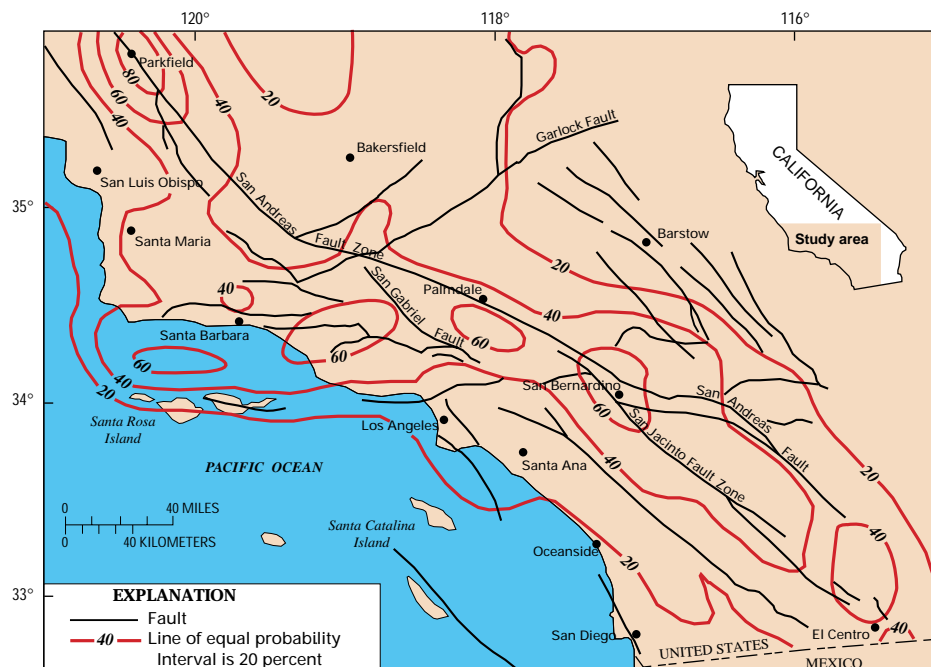
predict flood frequency and magnitude depends on long-term, continuous records at many widespread sites. The USGS, in cooperation with Federal, State, and local water agencies, operates or reviews data for about 1,000 surface-water stations throughout California. Data collected are used by those water agencies to design measurable, effective, and economically sound programs and practices for flood protection. Strategically located streamflow-gaging stations equipped with automatic recording instruments are connected to computerized flood-warning systems. Water levels, precipitation, and other data can be accessed by computer from anywhere.

Volcano Hazards

USGS scientists are closely monitoring California's active and potentially active volcanos. Mount Shasta and Lassen Peak have been active historically and there are several geologically young volcanic systems, such as Medicine Lake Volcano in northern California and Long Valley Caldera on the eastern Sierra Nevada front. USGS scientists are updating hazards assessments of Lassen Peak, Mount

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Shasta, and Medicine Lake Volcanoes. Magma intrusion and seismic activity at Long Valley Caldera have been closely monitored by the USGS as part of the Volcano Hazards Program since 1978. Since May 1989, USGS scientists have detected and are studying the increased emission of carbon dioxide gas of volcanic origin in the southwestern part of the Caldera.



Modified from the original created by Southern California Earthquake Center

Figure 1. Lines of equal probability, in percent, of earthquake-caused earth movement capable of significant damage in the next 30 years; these lines represent a measure of risk.

The world's largest producing geothermal field, The Geysers near Santa Rosa, produces sufficient power to meet San Francisco's electrical needs despite recent reductions in commercial generating capacity. The geothermal component of the Volcano Hazards Program includes studies at The Geysers.

Landslides and Mudflows

Landslides and mudflows are common in California because of active mountain-building processes, rock characteristics, earthquakes, and periodic intense storms. By using earthquake information and geologic data bases, USGS scientists, in cooperation with the CDMG and the private sector, have created a computer-generated landslide location map of the Los Angeles area. They are now working on landslide-hazard maps that show the slopes most likely to fail in earthquakes. The identification of areas that are likely to produce landslides in conjunction with earthquakes or severe storms enables the public, urban planners, and the private sector to address these conditions as part of any future development.

San Francisco Bay/Delta System

The Sacramento–San Joaquin Delta system (fig. 2) is a vital hydrologic link in California's water supply, and it has been one of the most productive estuarine wetland systems on the West Coast. During the past 150 years, the Bay/Delta system has been greatly modified by human activities. The Delta system is the habitat of two threatened fish species and several additional species of concern, and the perceived environmental consequences to them are constraining hydrologic use of the Delta as part of California's water delivery system.

The USGS provides information for two related interagency programs, the CALFED Bay-Delta Program, which addresses long-term solutions to the Bay/Delta system's problems, and the Interagency Ecological Program (IEP). The IEP is a cooperative study by nine agencies that has generated much knowledge about fish populations in the Bay/Delta system. The USGS provides to this program an improved understanding of the circulation and mixing of fresh and saline waters that affect water quality and fish reproduction and growth.

Additional USGS studies evaluate Delta island subsidence and discharges that affect drinking water quality in southern California, measure suspended sediment and contaminant movements and pesticide transport through the Delta, and investigate wetland functioning and dredge spoil suitability for

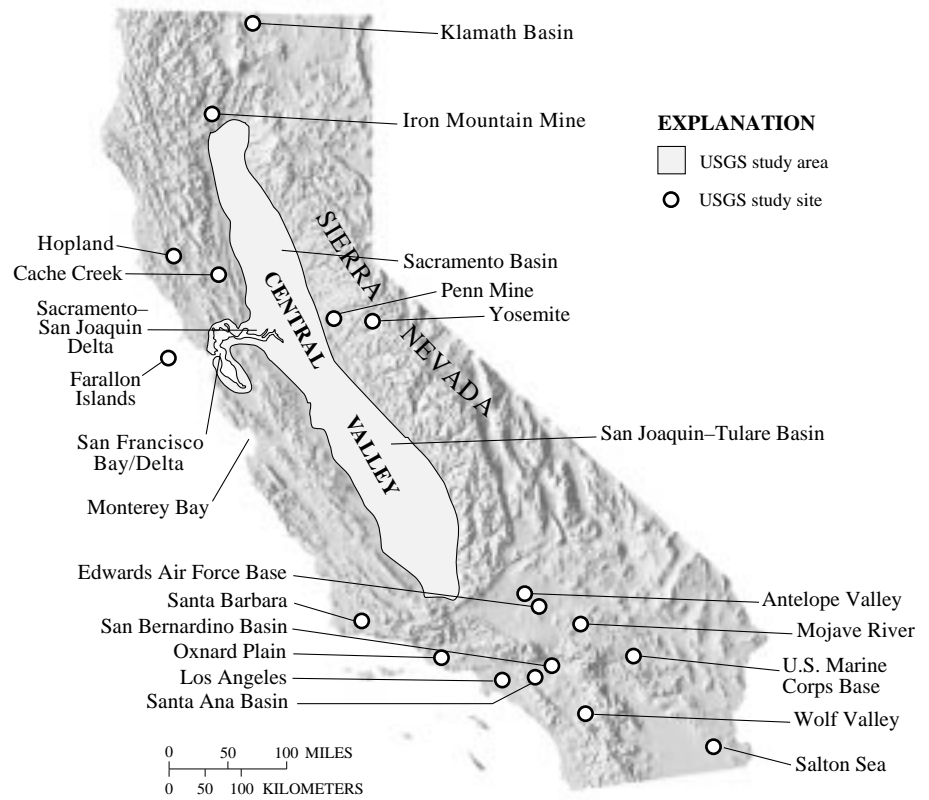


Figure 2. Selected U.S. Geological Survey water-resources study areas, California.

wetland restoration. Results of these studies provide a better understanding of the physical, chemical, and biological factors that cause ecological and water-quality problems, and are used to reestablish functional tidal wetlands in the estuary.

Marine Wastes

Wastes generated by human activities have been relocated to the ocean floor off the California coast. Between 1946 and 1970, as many as 47,800 containers of low-level radioactive waste were dumped on the Continental Shelf, many west of the Gulf of the Farallons National Marine Sanctuary. The USGS, in cooperation with several Federal agencies, has developed computer-enhanced sidescan images useful for locating drums and other objects. Results of this work can be used by environmental, military, and fisheries-management agencies to manage waste disposal and to identify areas critical to fish populations.

The USGS, in cooperation with Federal and State agencies, has identified the distribution and character of effluent-affected marine sediment on the Continental Shelf south of Los Angeles and have modeled its calculated natural recovery during the next century. This information is used by Federal, State, and local agencies to develop and evaluate long-term management options for contaminated sediments.

National Marine Sanctuary

The Monterey Bay National Marine Sanctuary, south of San Francisco, is the largest marine sanctuary in the United States. Its 15,000 square miles are home to a rich diversity of marine life and include Monterey Canyon, a submarine feature that rivals the Grand Canyon in topographic relief and complexity. The USGS, in cooperation with the National Oceanic and Atmospheric Administration and other Federal and State agencies, is studying the sanctuary to understand links among living resources, the physical environment, and human influences. USGS studies include detailed geologic mapping, and modeling sediment movement across the Continental Shelf and down the Canyon. The relations among fault lines, fluid seeps, and carbonate crusts are being discovered and are important to the distribution of clams on the ocean floor. A detailed understanding of these geologic processes will assist in the wise management of the Sanctuary.

Water Quality

Historically, water quantity and distribution have been central issues in California because most water use is in semiarid areas. Because water quality has recently become a major concern, the USGS, in cooperation with State and local water agencies, is assessing the quantity and quality of California's water,

especially in the Central Valley, the San Francisco Bay/Delta system, and the rapidly growing urban areas of southern California.

The USGS studies water quality in the San Joaquin–Tulare, the Sacramento, and the Santa Ana River Basins for the National Water-Quality Assessment Program. These long-term studies of water quality trends are designed to provide a sound scientific understanding of the natural and human factors that affect water quality. They are conducted in cooperation with Federal, State, and local agencies and other interested parties that participate on advisory committees and provide historical and current information and guidance on the priorities for studies and reports.

Water Supply

Throughout southern California, local water supplies are limited, and much of the water is imported from northern California, the Colorado River, and Owens Valley. Aquifers provide storage for the imported and local water supplies. Increasingly, water-management agencies are concerned with making better use of existing and future supplies. The USGS is studying a comprehensive approach to integrated watershed management, which includes surface- and ground-water resources. The USGS, in cooperation with the Water Replenishment District of Southern California, is evaluating the effects of recharge on ground-water quality in the Los Angeles area. The results are being used by the District to develop water-quality criteria for artificial ground-water recharge that uses reclaimed wastewater and to identify specific characteristics of recharge sites that contribute to contaminant reduction.

In parts of San Bernardino and Riverside Counties, water-management agencies anticipate large increases in demand for water early in the next century. The USGS, in cooperation with these agencies, is engaged in studies that are designed to characterize hydrogeologic conditions in areas that appear to have good potential for water banking (recharging ground-water systems for future pumping) or where ground-water quality may be subject to degradation from land-use practices or other causes.

The Mojave Desert region has one of the most rapidly growing populations in California. As a result, water is becoming more scarce, and ground-water resources are frequently pumped at rates that far exceed natural recharge. The USGS, in cooperation with the Mojave Water Agency, is investigating the surface- and ground-water relations along the Mojave River, which is the principal source of ground-water recharge. Study results are

aiding water-management agencies in the efficient management of ground-water resources.

Saltwater Intrusion

Intensive ground-water pumping in coastal areas has contributed to aquifer saltwater intrusion. The USGS is investigating the potential for saltwater intrusion into coastal aquifers in Ventura and Santa Barbara Counties. USGS ground-water models are used with water-supply optimization techniques by State and local agencies to develop management strategies for controlling saltwater intrusion and accommodating water demands. Water managers are using the study results to modify recharge, pumping, and delivery practices.

Geologic Resources

The USGS, in cooperation with the CDMG, conducts geologic mapping activities throughout California for producing and disseminating geologic information to all levels of government, the private sector, and the general public. The USGS and the CDMG produce geologic maps at a scale of 1:100,000, thus improving on the statewide coverage at the 1:250,000 scale. These maps are being produced for areas that are of special interest; for example, various geologic hazards, specific properties, fault zones, and mineral resources. In addition, maps are being produced that provide three-dimensional representations of geologic structures, such as subsurface connections of parallel faults, or geologic changes, such as repeated volcanic eruptions.

Mining Byproducts

A new USGS project is focusing on reducing the environmental impact of mining through better byproduct recovery. The project goal is to provide comprehensive data on the existence and nature of useful substances in ores; the initial study sites are mines in California and Arizona. Better byproduct recovery will reduce the total volume of mine wastes and significantly lower their toxicity. This cleaner and cheaper way to mine can benefit the mineral industry and the environment.

Sources of Mercury

Elevated mercury concentrations in Cache Creek sediments have been a problem for many years. The Cache Creek watershed in the Coast Ranges, which is a tributary to the lower Sacramento River, has numerous mercury-depositing hot springs and abandoned mercury mines. Until recently, however, the primary sources and transport mechanisms

had not been well identified. Studies by the USGS, in cooperation with the Central Valley Regional Water Resources Control Board and the Los Alamos National Laboratories, have identified hot springs in the Sulphur Creek drainage basin as a major mercury source. Abandoned mines are a secondary source in the basin. During most of the year, mercury is deposited primarily in fine-textured creek sediments within 0.5 mile of the sources, mercury concentrations can be as high as 195 parts per million (compared with the average 0.08 to 0.4 part per million for most rock types). During the first seasonal high streamflow, these sediments are transported down the drainage basin. This episodic nature of mercury transport is significant for Cache Creek watershed management and the evaluation of the fate of mercury originating in the area.

Biological Resources

On October 1, 1996, the National Biological Service joined the USGS as the Biological Resources Division. The USGS gathers information on threatened or endangered species throughout California; this information includes the habitat needs of the Central Valley's giant garter snake, populations of the California sea otter and western burrowing owl, and salmon runs. The USGS, in cooperation with the Bureau of Land Management (BLM) and other land managers, also is studying the rare desert tortoise and the Mojave Desert. These studies provide technical information to help the recovery of the desert tortoise and for the better management of the Mojave Desert ecosystems. Additional studies focus on terrestrial and aquatic contaminant problems and on wetland restoration efforts in San Francisco Bay and the Klamath Basin.

Resource Assessment

The BLM is revising the Northern and Eastern Colorado Desert Coordinated Management Plan for 5.5 million acres in southeastern California. The most pressing management issue is implementing a recovery plan for the desert tortoise. Another 30 species of wildlife and plants also are at risk. Other concerns include biodiversity losses, the impact of decades of development along highways, expansion of recreation areas, and coordination among adjacent land-management agencies.

The USGS has undertaken an assessment that includes studies of the environmental impact of mined and unmined mineral deposits, studies in support of mine remediation, and geochemical background and baseline studies. Hydrology and seismic hazards information also are included.

For More Information

Sierra Nevada Ecosystem

The Sierra Nevada Ecosystem Project is a congressionally mandated assessment to aid in developing of various policy choices for the future of the mountain range. The primary goals are a scientific review of mature forests, watersheds, and significant natural areas and an evaluation of the entire set of Sierra Nevada ecosystems that includes social, economic, and environmental components. USGS contributions to the project include information and expertise on mines, mineral resources, and mineral environmental issues, potential volcanic activities, and stream flows. USGS contributions for the final analysis include metal supply (undiscovered resources) and minerals hazards (acidic mine drainage, arsenic and mercury contamination in streams, asbestos, dust from open-pit mines, and cyanide leaks).

Topographic Mapping

Among the most popular and versatile products of the USGS are its 1:24,000-scale topographic maps that depict natural and cultural features of the landscape. California is covered by 3,289 maps at this scale. The USGS is collaborating with California's Teale Data Center to reproduce these maps for computer use.

Today, scientists and engineers depend on computerized base maps for their research and analyses. Without the geographic context provided by these base maps, it would be impossible to understand the spatial patterns of natural and human activities. The USGS is working to ensure the availability of accurate digital cartographic data to facilitate studies in water, hazards, land, and resource management (fig. 3).

The National Mapping Program in California has focused on those areas where data are not yet complete. The USGS has helped a consortium of Federal, State, and local agencies produce complete coverage of transportation, hydrography, boundaries, public land surveys, and elevation data for most of the Klamath and the Trinity River Basins. The USGS also is working with the U.S. Forest Service to produce digital orthophotoquads of all national forests in California and, through another program, is completing coverage of digital elevation data for the Mojave and the Lower Colorado Desert regions and the rest of southern California.

Earth Science Information Centers

The USGS has an Earth Science Information Center (ESIC) in Menlo Park. In addition to supplying USGS reports, the ESIC searches data bases for aerial photographs, historical maps, and digital cartographic data. Topographic and national park maps for California, as well as other States, are available for sale over the counter, by mail, or FAX. Other State ESIC affiliates for USGS products are the CDMG in Sacramento and the Map and Imagery Laboratory at the University of California–Santa Barbara.

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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.

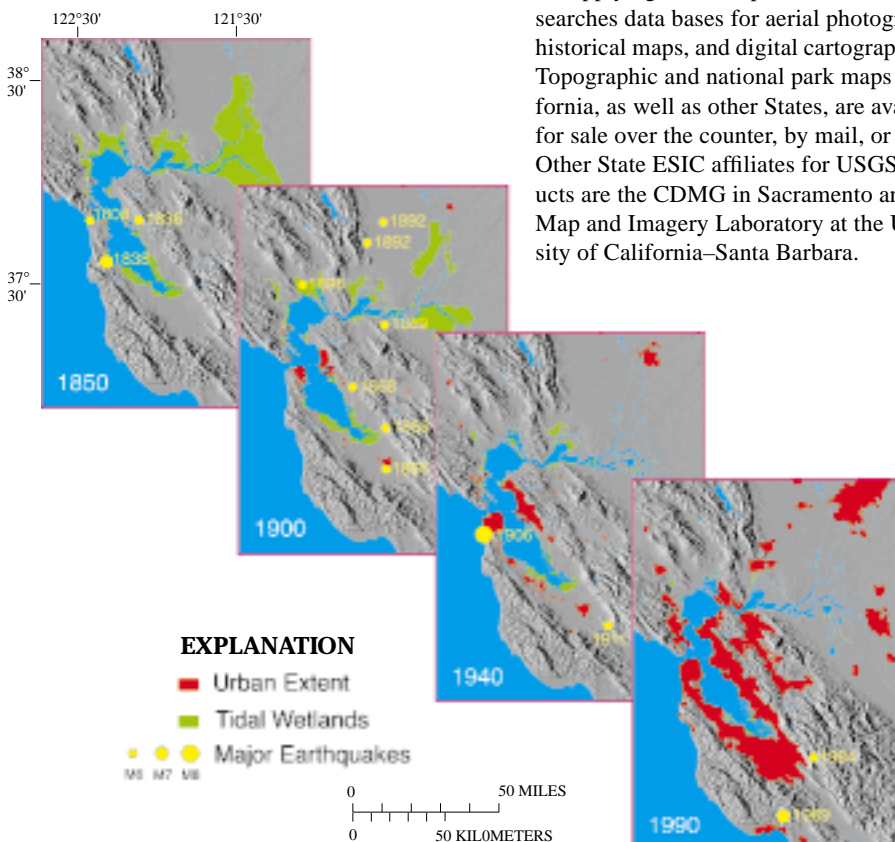


Figure 3. The extent of urban land use, decrease of tidal wetlands, and major earthquakes in the San Francisco Bay region, 1850–1990. Mapping was done by using historical USGS quadrangle maps and satellite images.