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Photograph: Railroad Canyon Reservoir, California

Santa Ana Basin

NATIONAL WATER-QUALITY ASSESSMENT PROGRAM

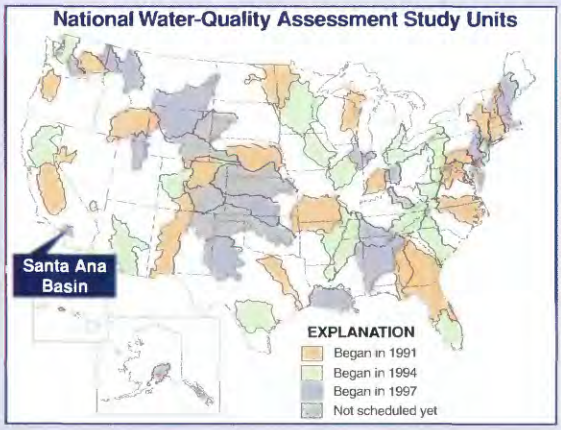
What is the National Water-Quality Assessment Program?

During the past 25 years, industry and government made large financial investments in pollution control that have resulted in better water quality across the Nation; however, many water-quality problems remain. To address the need for consistent and scientifically sound information for managing the Nation's water resources, the U.S. Geological Survey began a full-scale National Water-Quality Assessment (NAWQA) Program in 1991. This program is unique in that it integrates the monitoring of the quality of surface and ground water with the evaluation of aquatic ecosystems.

The goals of the NAWQA Program are to:

(1) *describe current water-quality conditions for a large part of the Nation's freshwater streams and aquifers,*
(2) *describe how water quality is changing over time, and*
(3) *improve our understanding of the primary natural and human factors affecting water quality.*

Assessing the quality of water in every location of the Nation is not practical; therefore, NAWQA studies are conducted within areas called study units. These study units are composed of 59 major river and aquifer systems that represent the environmental diversity of the Nation. The Santa Ana Basin is one of several NAWQA studies that began in 1997.



Major Water-Quality Issues

The Santa Ana Basin NAWQA study will increase the scientific understanding of aquatic ecology, surface- and ground-water quality, and the factors that influence water quality.

The study also will provide information needed by water-resources managers to implement effective water-quality management actions and evaluate long-term changes in water quality.

The Santa Ana Basin in southern California is home to more than 4 million people. Because of the relative aridity of the climate, ground water and imported water are the main sources of water supply. Surface water in the Santa Ana River, and in its tributaries, is primarily important as a source of recharge to ground water.

Among the significant water-quality issues in the study unit are dissolved-solids concentrations (salinity), nutrient loading, volatile organic compounds (VOCs), trihalomethane precursors, and pathogens. In general, the quality of surface water and ground water becomes progressively poorer as water moves along hydraulic flow paths. The highest quality water typically is associated with tributaries flowing from surrounding mountains and ground water recharged by these streams. Water quality is altered by several factors, including consumptive use, importation of relatively high-salinity water, runoff from urban and agricultural areas, and the recycling of water within the basin.

Water recycling in the Santa Ana Basin, California

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

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Study Unit Description

The Santa Ana Basin NAWQA study unit covers an area of about 2,700 square miles consisting of parts of Orange, San Bernardino, Riverside, and Los Angeles Counties. The Santa Ana Basin is substantially urbanized: about 34 percent of the land use is residential, commercial, or industrial. Agricultural land use accounts for about 10 percent of the watershed.

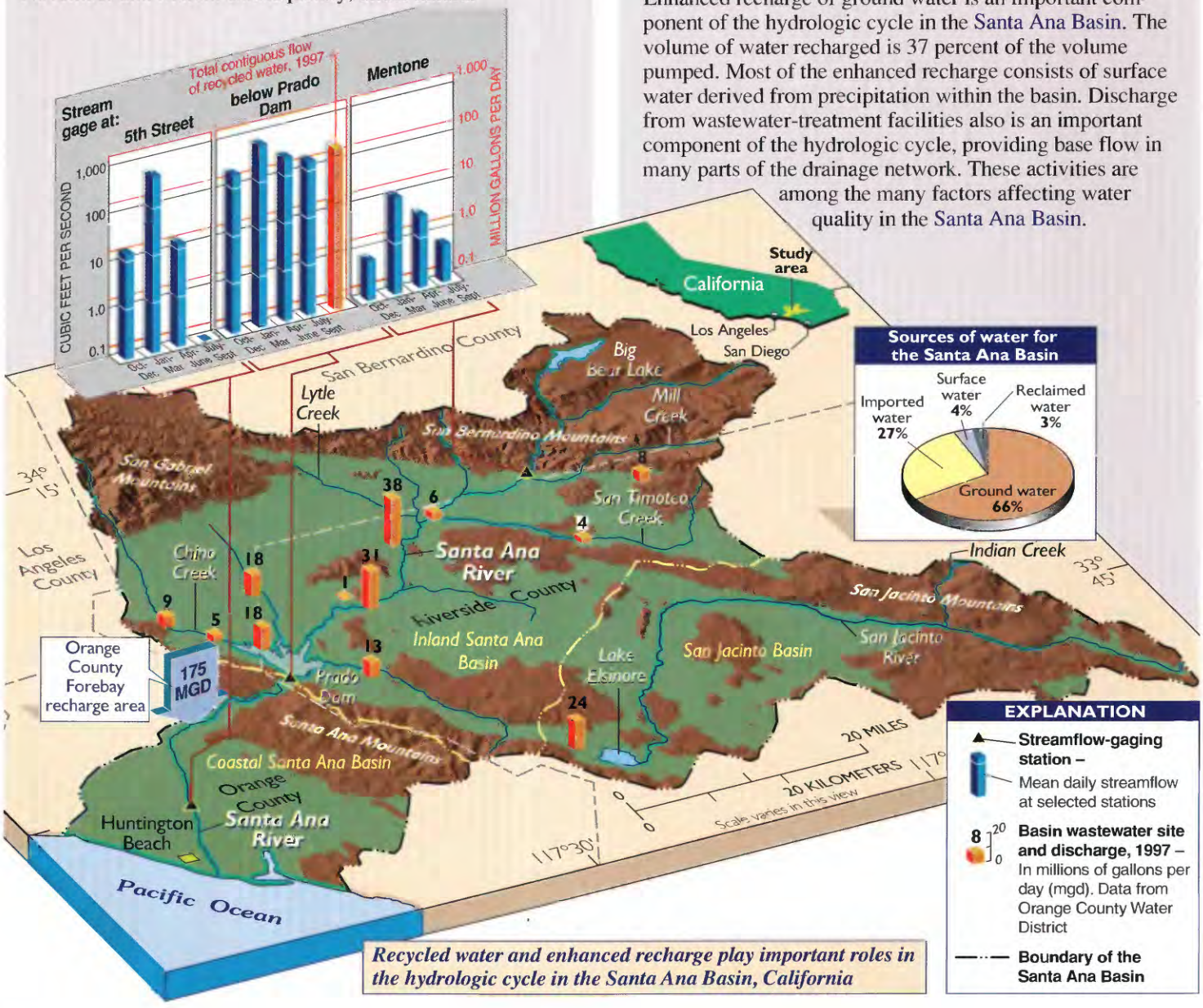
The Santa Ana River is the largest stream system in southern California. It begins in the San Bernardino Mountains, which reach altitudes exceeding 10,000 feet, and flows more than 100 miles to the Pacific Ocean near Huntington Beach. Although the San Jacinto River is a tributary of the Santa Ana River, it normally terminates at Lake Elsinore.

The climate is Mediterranean with hot, dry summers and cool, wet winters. Average annual precipitation ranges from 12 inches in the coastal plain, and 18 inches in the inland alluvial valleys, to 40 inches in the San Bernardino Mountains. Most of the precipitation occurs between November and March. Consequently, under natural conditions, the Santa Ana River would be intermittent with little or no flow in the summer months.

Ground water is the main source of water supply in the watershed, providing about 66 percent of the consumptive water demand. Inland aquifers, upstream from Prado Dam, underlie about 1,200 square miles of the study unit. Coastal aquifers, downstream from Prado Dam, underlie about 400 square miles. Thickness of these aquifers ranges from several hundred to more than 1,000 feet. Depth to ground water ranges from several hundred feet near the flanks of mountains to near land surface along rivers and wetlands, and in the coastal plain.

Imported water from northern California and the Colorado River also is an important source of water supply, accounting for 27 percent of the consumptive demand. Other sources of supply include surface water derived from precipitation within the basin (4 percent) and recycled water (3 percent).

Enhanced recharge of ground water is an important component of the hydrologic cycle in the Santa Ana Basin. The volume of water recharged is 37 percent of the volume pumped. Most of the enhanced recharge consists of surface water derived from precipitation within the basin. Discharge from wastewater-treatment facilities also is an important component of the hydrologic cycle, providing base flow in many parts of the drainage network. These activities are among the many factors affecting water quality in the Santa Ana Basin.



Recycled water and enhanced recharge play important roles in the hydrologic cycle in the Santa Ana Basin, California

Schedule of Study Activities

The Santa Ana Basin study is one of several NAWQA studies that began in 1997. Study planning and analysis of existing data will be done during the first 2 years of the study. After this 2-year period, surface-water, ground-water, and biological data will be collected intensively for 3 years (termed the high-intensity phase). A low-intensity phase will follow for 6 years, during which water quality is monitored at a limited number of sites and areas that were sampled during the high-intensity phase. This combination of high- and low-intensity monitoring phases allows the NAWQA Program to examine long-term trends in water quality and aquatic ecology. A series of technical and non-technical reports will describe and summarize results of high- and low-intensity phases.

Photograph: Looking north across the Santa Ana River and the City of Yorba Linda, California

Assessing Water Quality

The NAWQA Program is designed to assess the status of and trends in the quality of the Nation's surface- and ground-water resources and to develop an understanding of the natural and human factors that affect the quality of water. Surface- and ground-water studies are done at local (a few square miles to hundreds of square miles) and regional (thousands of square miles) scales to assess the water-quality conditions and issues within a study unit.

An Occurrence and Distribution Assessment is the largest and most important component of the first intensive-study phase. The goal of the Occurrence and Distribution Assessment is to characterize, in a nationally consistent manner, the broad-scale geographic and seasonal variations of water quality related to major contaminant sources and background conditions.

The following sections describe typical surface- and ground-water monitoring components of the Occurrence and Distribution Assessment.

Surface Water and Aquatic Ecology

The NAWQA study design for surface water focuses on water-quality conditions in streams using three interrelated components:

- Bed-sediment and fish-tissue studies,
- Water-column studies, and
- Ecological studies.

Assessing Water Quality

Surface Water and Aquatic Ecology–*Continued*

The bed-sediment and fish-tissue studies assess the occurrence and distribution of trace elements and hydrophobic organic contaminants at 15 to 30 sites in the study unit.

Water-column studies monitor physical and chemical characteristics, including suspended sediment, major ions, nutrients, organic carbon, and dissolved pesticides, and their relation to hydrologic conditions, sources, and transport. Most surface water is monitored at sites termed either basic-fixed sites or intensive-fixed sites, according to the frequency of the sampling. Most NAWQA study units have 6 to 10 fixed sites of which 2 to 3 are intensive-fixed sites. Basic-fixed sites are sampled monthly and at high flows for 2 years of the 3-year high-intensity phase. The intensive-fixed sites may be monitored more frequently and for an extended suite of constituents, including pesticides, VOCs, and trace elements. Basic-fixed or intensive-fixed sites can be either indicator or integrator sites. Indicator sites represent relatively homogeneous, small basins (less than 100 square miles) associated with specific environmental settings, such as a particular land use. Integrator sites are established in downstream areas that incorporate 10 to 100 percent of the study unit. Water samples also are collected at additional sites for synoptic (short-term) investigations of specific water-quality conditions or issues during a specific hydrologic period (for example, during low streamflow).

Ecological studies evaluate the relations among physical, chemical, and biological characteristics of streams. Aquatic biological communities at the basic- and intensive-fixed sites are surveyed during the high-intensity-sampling period. These surveys are done along delineated stream reaches and include habitat assessments of the sites and surveys of the fish, algal, and benthic invertebrate communities. Ecological sampling results will be integrated with surface-water synoptic studies to evaluate the representativeness of biological communities at basic- and intensive-fixed sites.

Ground Water

The national study design for ground water focuses on water-quality conditions in major aquifers, emphasizing recently recharged ground water associated with present and recent human activities. Ground-water samples will be analyzed for major ions, nutrients, pesticides, VOCs, and trace elements. Study-unit surveys are used to assess the water quality of the major aquifer systems of each study unit. For study-unit surveys, about 20 to 30 existing wells are selected for sampling in each of 2 to 3 aquifer subunits using equal-area randomized selection.

Land-use studies focus on the impacts of specific land uses on aquifer systems. Typically, 20 to 30 observation wells are drilled for land-use studies. Results from land-use studies can be compared with results from the study-unit survey to determine the effects of particular land uses on ground-water quality. Flow-path studies use transects and clustered, multilevel observation wells to examine processes related to specific land-use practices; ground-water flow; interactions between surface water and ground water; and movement of contaminants.

Suggestions for Further Reading

Gilliom, R.J., Alley, W.M., and Gurtz, M.E.,1995, **Design of the National Water-Quality Assessment Program: Occurrence and distribution of water-quality conditions:** U.S. Geological Survey Circular 1112, 33 p.

Leahy, P.P., Rosenshein, J.S., and Knopman, D.S., 1990, **Implementation plan for the National Water-Quality Assessment Program:** U. S. Geological Survey Open-File Report 90-174, 10 p.

Communication and Coordination

The U.S. Geological Survey and other scientific and land- and water-management organizations are critical components of the NAWQA Program. Each study unit maintains a liaison committee consisting of representatives from Federal, State, and local agencies, universities, the private sector, watershed organizations, and those who have water-resource responsibilities and interests. Liaison committee activities include the exchange of information about regional and local water-quality issues, identification of sources of data and information, assistance in the design and scope of studies, and the review of planning documents and reports.

The overall success of the Santa Ana Basin NAWQA study will depend on the advice, cooperation, and information from many Federal, State, regional, and local agencies, and the public concerned about California's water resources. The assistance and suggestions of all are welcomed.

For More Information

Technical reports and hydrologic data collected for the NAWQA Program can be obtained from:

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Dairy farm north of Norco, California