Fact Sheet

United States Geological Survey
Programs in Texas

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.

Index of Subjects

Flood-Related Activities

Meteorologic and physiographic factors in parts of Texas combine to produce some of the most intense rainstorms in the Nation; these rainstorms cause severe, destructive floods somewhere in the State almost every year. A recent example is the catastrophic flooding in the Houston area in October 1994 that resulted in at least 22 deaths, hundreds of millions of dollars in property damage, and substantial environmental damage. When flooding is imminent, the U.S. Geological Survey (USGS) mobilizes field crews that work around the clock making direct measurements of streamflow and water-surface elevations. The data collected by USGS personnel are provided continuously to the National Weather Service and the Federal Emergency Management Agency among others. The data collected during a series of floods provide a chronology of historical peak streamflows and water-surface elevations that aid in flood forecasting and the design of structures to convey or withstand flood waters.

The USGS also is involved in related statewide studies, including a flood-frequency analysis and a study of channel scour at bridges. The flood-frequency analysis, which is done in cooperation with (that is, on a cost-sharing basis with) the Texas Department of Transportation, uses streamflow data collected at previous and current (1995) streamflow-gaging sites to predict streamflow characteristics, such as flood magnitude and probability. The information from this study, together with knowledge of low-flow streamflow characteristics at gaging sites, is useful in bridge and highway design, reservoir design and operation, and waste-discharge and pollution-abatement activities.

Strong currents, such as those caused by floodwaters, can erode the streambed at the foundation of a bridge. If the streambed is eroded (scoured) sufficiently, then the foundation can shift, causing sudden failure of the bridge. Studies of streambed scour in Texas by the USGS, done in cooperation with the Texas Department of Transportation, are identifying the bridges in the State most susceptible to scour-related failure. The work also includes development and testing of instrumentation for monitoring streambed scour at bridges during floods.

Figure 1. The effects of land subsidence—tidal inundation of yard at Baytown, Texas.

Monitoring of Land Subsidence

Compaction of underground clay layers caused by the withdrawal of large amounts of ground water, as well as oil and gas, in the Houston area has resulted in land subsidence from 1 to nearly 10 feet in an area of more than 5,000 square miles. Tidal inundation and (or) increased frequency of flooding in subsidence-affected areas (fig. 1) have required the expenditure of millions of dollars to reclaim submerged lands, construct levees, and elevate structures and roadways.

The USGS, in cooperation with the Harris–Galveston Coastal Subsidence District, continually monitors land subsidence in the Houston area. Global Positioning System technology uses satellites to measure land-surface elevations with an accuracy of less than 1 centimeter. The elevation data are electronically transmitted each day to a computer at the Subsidence District office.

Figure 2. NAWQA study units in Texas.

Aquifers are an important source of water supply in the Houston area, although measures have been taken to reduce the area's dependence on ground water and thus reduce land subsidence. Because of the relation between groundwater withdrawals and land subsidence, the USGS, in cooperation with the Harris–Galveston Coastal Subsidence District, the Fort Bend Subsidence District, and the city of Houston, measures and prepares reports of changes in groundwater levels in the Houston area.

National Water-Quality Assessment Program

The long-term goals of the National Water-Quality Assessment (NAWQA) Program are to describe the status and trends in the quality of a large representative part of the Nation's surface- and ground-water resources and to identify the natural and human factors that affect their quality. The NAWQA Program will produce a wealth of water-quality information that will be useful to policymakers and water managers at local, State, and national levels.

Two NAWQA Program studies are underway in Texas: the Trinity River Basin, which was started in 1991, and the South-Central Texas, which was started in 1994 and focuses on the Edwards aquifer in the San Antonio region (fig. 2). Communication and coordination with water-management, environmental-protection, and other water-resources agencies and institutions are key components of the Program studies. Results of the studies are presented in a variety of technical and lay reports to local, State, and Federal agencies and to the public.

A principal goal of the Trinity River Basin study is the detection of trends in streamwater quality over time. This is being done by examining cores of bottom sediments in reservoirs and by correlating the ages of sediment layers in the cores to concentrations of various trace elements and organic constituents in those layers. For example, examination of cores of sediment from White Rock Lake in Dallas has shown that concentrations of lead in the bottom sediments were constant from 1910 to the late 1950's. Lead concentrations increased about fivefold between about 1960 and the early 1970's, when rapid urbanization of the watershed began. Concentrations decreased markedly from the early 1970's to the present, coincident with the change to unleaded gasoline.

Effects of Urbanization and Agriculture on Water Quality

The USGS is cooperating with local water-resources management agencies to monitor stormwater runoff in many of the major urban areas in Texas. These data have been collected for several years in the Austin, the Dallas–Fort Worth, the Houston, and the San Antonio metropolitan areas. Information obtained from stormwater monitoring and characterization studies has been used by the cooperating agencies to assess the effectiveness of stormwater-detention structures, to establish basinwide water-quality ordinances, to assess the quality of recharge water entering the Edwards aquifer in the Austin and the San Antonio areas, and to serve as the basis for permitting stormwater discharges into streams in the Dallas–Fort Worth and the San Antonio metropolitan areas.

The USGS is cooperating with the Texas State Soil and Water Conservation Board in studies designed to help evaluate the effectiveness of agricultural "best management practices." A major study is underway in the Seco Creek Basin west of San Antonio to quantify the effects of farming and ranching best management practices on water quality and quantity, sediment discharge to streams, and rates of recharge to the Edwards aquifer.

Studies of Environmental Contamination at Federal Installations

Several U.S. Department of Defense sites and a U.S. Department of Energy site in Texas have reported the contamination of soil or shallow ground water by hazardous or radioactive substances. These contaminants have the potential to migrate into drinking-water supplies or other water resources. The USGS is cooperating with the U.S. Navy, the U.S. Air Force, the U.S. Army Corps of Engineers, and Department of Energy in a variety of complex contaminant hydrology, hydrogeology, and lake studies at Federal installations. A major study is in progress at the Naval Weapons Industrial Reserve Plant and the adjacent Naval Air Station–Dallas in Grande Prairie to determine whether contaminants from sites on the installations have affected the water quality and aquatic ecology of adjacent Mountain Creek Lake and whether contaminants have migrated into the well casings of deep water-supply wells that pass through contaminated zones in the shallow aquifer.

The USGS is assisting the Air Force Plant 4 in Fort Worth in studies involving issues similar to those at Grand Prairie. Hazardous substances from the Superfund site at the installation have contaminated parts of the shallow aquifer; the installation is adjacent to residential areas and a reservoir. One of the studies is defining the ground-water-flow system and characterizing ground-water quality in the residential areas adjacent to the plant.

At the Superfund site at the Pantex Plant near Amarillo, the USGS, in cooperation with the Department of Energy and the Corps of Engineers, is conducting a study to determine the potential for contaminants in shallow ground water to migrate downward into water-yielding zones of the High Plains aquifer, which is the major source of water supply in the Texas Panhandle.

Studies Involving Availability and Management of Ground Water

Aquifers supply about 60 percent of the freshwater used in Texas. Withdrawals of ground water from some aquifers at

rates exceeding those of natural recharge have reduced supplies and resulted in extensive local water-level declines. For example, the Hueco bolson aquifer, which supplies the municipal and industrial needs in the El Paso, Texas–Ciudad Juárez, Mexico, area could be depleted in the next century if not managed properly. The USGS, in cooperation with the El Paso Water Utilities-Public Service Board, the Texas Water Development Board, and the U.S. Army, has monitored the aquifer since the 1930's and is studying the water resources in this border area.

Competition for ground-water supplies in the San Antonio region is intense, particularly during drought. Withdrawals from the Edwards aquifer to meet increasing water-supply needs in the region are a threat to the continuation of flows at Comal Springs, which is the largest spring in the Southwest, and San Marcos Springs. The highly productive Edwards aquifer is the region's only source of water. Both springs supply base flow to meet downstream water requirements, sustain federally listed endangered species, and are tourist attractions. The USGS has monitored the quality and quantity of the Edwards aquifer for more than 60 years and is involved in studies to provide the information needed by the Edwards Underground Water District, the San Antonio Water System, and other agencies to assess and manage the water resources of the Edwards aquifer.

Collection of Hydrologic Data

The need for hydrologic information is fundamental to the design of water-resources and transportation infrastructure, flood warning and damage mitigation, reservoir operation, maintenance of acceptable water quality, and an understanding of environmental and human health issues. A key part of the USGS work in Texas is the collection of hydrologic data, which is done in cooperation with more than 60 local agencies, 7 State agencies, and 14 Federal agencies.

The current surface-water data-collection network includes about 300 continuous streamflow-gaging sites and more than 200 water-quality-sampling sites. The current ground-water data-collection network comprises about 700 wells, 97 of which are water-quality-sampling sites (fig. 3).

Because of the long-term, continual nature of the data-collection program, the USGS is in a unique position to monitor and assess trends in hydrologic conditions. For example, trends in selected water-quality constituents in the Trinity River downstream of the Dallas–Fort Worth metropolitan area since the mid-1970's indicate that improvements in wastewater treatment facilities have improved the quality of water in the Trinity River.

Assessment of Oil and Gas Resources

Texas is a major producer of oil and gas. The USGS has contracted with the Bureau of Economic Geology at the University of Texas at Austin to help define and assess the potential for future petroleum production in Texas.

Studies of Contamination from Oil and Gas Production

Contamination of soil and surface water by brine, which is a byproduct of oil and gas production, occurs locally in various parts of Texas and other oil- and gas-producing States. Remediation efforts are underway at some of the more contaminated sites, notable on State-owned lands scarred by salt from oil and gas production in West Texas near Big Lake. Studies of geophysical data collected at the Big Lake site and at other sites in Texas show that in addition to salt contamination, the soils may be contaminated by radium-bearing compounds.

The production of oil and gas in the Colorado River Basin has resulted in widespread contamination of shallow ground-water resources by saline waters. Several thousand acres of farmland and valuable water resources have been affected by these saline waters. The USGS has developed and demonstrated the application of airborne geophysical methods for mapping shallow saline waters. Published reports of studies by the USGS have generated requests by the Texas Railroad Commission, the Lower Colorado River Authority, several municipal water districts, and private citizens for assistance in applying this technology to mapping of subsurface saline waters. The USGS is evaluating test areas for application of airborne geophysical methods.

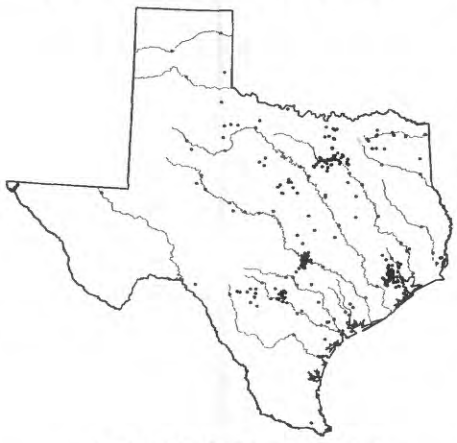

Figure 3. 1995 water-quality data-collection sites in Texas

In addition, the USGS, in cooperation with the Colorado River Municipal Water District, has performed a detailed study of the water-quality characteristics of streams and aquifers and the processes affecting the salinity of water in the upper Colorado River Basin.

Assessment of Environmental Degradation of Estuaries

The environmental degradation of Texas estuaries, which are a major fisheries resource, has prompted a cooperative program between the USGS, the Texas Water Development Board, and the Bureau of Economic Geology. The program began in three Texas estuarine systems in 1993. The goal of the program is to develop a historical record of the water supplied to the estuaries by determining the rate of delta growth. This information will provide the data base needed to develop a water-supply policy. Studies of the Trinity and Lavaca River Systems are near completion; a study of the third system, the Nueces River, is expected to begin in 1995.

National Coal Resources Data System

The USGS, in cooperation with the Bureau of Economic Geology, began a study in 1979 to collect, evaluate, and correlate drill hole, mine, and outcrop data; encode and enter geologic and geochemical data into the National Coal Resources Data System (NCRDS); and access NCRDS data bases and software to

generate new maps, reports, and resource assessments for each State. The continued data collection and support of the NCRDS data bases provide baseline information that can be accessed for annual State resource updates that can be used to meet many foreseen and unforeseen needs as they arise.

In the National Coal Assessment, the USGS is working with the Bureau of Economic Geology to identify the location of coal resources on public and private lands, including coal potentially suitable for the export market. These resources are identified and characterized with regard to quality. Products resulting from the National Coal Assessment are useful to regulatory agencies, information agencies, land-management agencies, and industrial and academic research teams.

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. Topographic contour lines are used to depict the elevation and shape of terrain. The entire State of Texas is covered by 4,416 maps at this scale. The maps are useful for engineering, land-use planning, natural-resource monitoring, and other technical applications, and have long been favorites with the general public for outdoor uses, including hiking, camping, exploring, and back-country fishing expeditions.

Over the past 24 years, the USGS has had cooperative mapping agreements with the State of Texas. Initial agreements were for the completion of 1:24,000-scale USGS maps. A number of local and State agencies use these maps in forest and park management, geologic mapping, oil- and gas-well monitoring and documentation, oil-spill-response operations, support of pipeline safety, environmental studies, damage assessment after coastal storms, land-use studies, portrayal of the State's general land grid, and as a base for the State's transportation system. Agencies involved in the cooperative program with the USGS are: the Texas Parks and Wildlife Department, the Texas Department of Transportation, the Texas Water Development Board, the Railroad Commission of Texas, and the Bureau of Economic Geology.

In recent years, the emphasis on cooperative programs has shifted to support production of 1:24,000-scale computerized (digital) maps. Digital map data are used by the State in its geographic information systems (computer systems capable of assembling, storing, manipulating, and displaying geographically referenced information) to support the applications listed above that were originally accomplished by paper maps.

In 1994, the USGS responded to requirements from State and Federal agencies for digital map products covering areas along the Lower Rio Grande–Rio Bravo Valley in Texas. Agencies requesting the data are: the Bureau of Reclamation, the U.S. Fish and Wildlife Service, the Texas Water Development Board, the Texas Natural Resource Conservation Commission, the General Land Office and Bureau of Economic Geology. These agencies and the USGS are developing a cooperative water-resources project in conjunction with the Mexican government that will serve as a prototype for future water studies along the U.S.-Mexico border.

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 since 1972.

Cooperative Programs

Work is pursued in partnership with numerous State and local agencies in addition to cooperating agencies named above. Others include the Sabine River Authority; the cities of Austin, Dallas, and Corpus Christi; the Brazos River Authority; the Guadalupe–Blanco River Authority; the Tarrant County Water Control and Improvement District No. 1; the North Central Texas Council of Governments; and the Trinity River Authority.

The USGS provides support to the Texas Water Resources Institute at Texas A&M University, which conducts a program of 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.

☆ U.S GOVERNMENT PRINTING OFFICE: 1994--647-231

U.S. Department of the Interior
U.S. Geological Survey
Fact Sheet FS-043-95