LOUISIANA GROUND-WATER QUALITY

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FOREWORD

This report contains summary information on ground-water quality in one of the 50 States, Puerto Rico, the Virgin Islands, or the Trust Territories of the Pacific Islands, Saipan, Guam, and American Samoa. The material is extracted from the manuscript of the *1986 National Water Summary*, and with the exception of the illustrations, which will be reproduced in multi-color in the *1986 National Water Summary*, the format and content of this report is identical to the State ground-water-quality descriptions to be published in the *1986 National Water Summary*. Release of this information before formal publication in the *1986 National Water Summary* permits the earliest access by the public.

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LOUISIANA
Ground-Water Quality

Ground water is the principal source of water for domestic use for almost 69 percent of the population of Louisiana. About two-thirds of the total ground water withdrawn for domestic use is delivered by public-supply systems in populous areas; the remaining one-third is delivered by self-supply systems in rural areas (fig. 1). As of 1985, about 1,450 Mgal/d (million gallons per day) of ground water was withdrawn in Louisiana for irrigation, industry, public-supply, rural and domestic livestock, and power generation. The Chicot aquifer system is the major source of ground water in Louisiana (D.L. Lurry, U.S. Geological Survey, written commun., 1986).

The quality of ground water in Louisiana is generally suitable for public supply, except where dissolved-solids concentrations are larger than 1,000 mg/L (milligrams per liter). Additionally, in some areas of the Pleistocene and Pliocene-Miocene aquifers, saltwater contamination of freshwater aquifers degrades ground-water quality. Water color and hardness or iron concentration can also render ground water locally unsuitable for public supply without treatment. Some areas, primarily coastal, have no fresh ground water at any depth.

Saltwater encroachment into freshwater aquifers (fig. 2) is not an immediate threat to public supply. However, saltwater encroachment is a potential threat to public supply in the Chicot aquifer, the "400- and 600-foot" sands of the southeastern Pleistocene aquifers, and the "1,200-foot" and deeper sands near Baton Rouge. At current pumping rates, saltwater encroachment probably will not degrade any major water supply in the State for about 30 years. Upconing of saltwater locally affects ground-water quality.

Louisiana contains 5 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites; 50 Resource Conservation and Recovery Act (RCRA) sites; 29 active industrial landfill sites; 71 Class I hazardous-waste injection sites; 138 parish and municipal solid-waste landfill sites; and an unknown number of oil-field waste-disposal pits (fig. 3). In addition, 14 sites at 2 U.S. Department of Defense (DOD) facilities had required response action in accordance with CERCLA as of September 1985. Shallow ground-water contamination has been documented at 23 RCRA, 3 industrial landfill, and the 5 CERCLA (Superfund) sites. Saltwater contamination in the terrace aquifers has been partly attributed to oil and gas production activities, which includes oil-field waste disposal. Industrial waste has contaminated shallow sands in the area of some disposal sites and is a potential threat to the quality of potable ground water in Louisiana. Efforts are currently underway to define the distribution and concentration of organic chemicals in the ground water.

WATER QUALITY IN PRINCIPAL AQUIFERS

The principal aquifer groups of Louisiana, from youngest to oldest, are the alluvial, Pleistocene, Pliocene-Miocene, Cockfield and Sparta, and Carrizo-Wilcox aquifers (figs. 2*A*,*B*). Major concerns about the quality of ground water in Louisiana are (1) excessive concentrations of dissolved solids, iron, and hardness in the alluvial aquifers, (2) large concentrations of iron in the Chicot aquifer of the Pleistocene aquifers group and the Cockfield and Sparta aquifers, and (3) saltwater contamination of aquifers in coastal areas. Also, concern is increasing about contamination of ground water by surface waste disposal and use of agricultural chemicals.

Ground-water-quality information is collected through a cooperative program with the State of Louisiana. These cooperative efforts include areal ground-water and water-quality studies as well as a statewide water-quality monitoring system.

BACKGROUND WATER QUALITY

A graphic summary of selected water-quality variables compiled from the U.S. Geological Survey's National Water Data Storage and Retrieval System (WATSTORE) is presented in figure 2*C*. The summary is based on dissolved-solids, hardness, iron, chloride, and pH analyses of water samples collected from 1970 to 1986 from the principal aquifers in Louisiana. Percentiles of these variables are compared to national standards that specify the maximum concentration or level of a contaminant in drinking-water supply as established by the U.S. Environmental Protection Agency (1986b). Primary maximum contaminant level standards are health related and are legally enforceable. Secondary maximum contaminant level standards apply to esthetic qualities and are recommended guidelines. The secondary drinking-water standards include maximum concentrations of 500 mg/L dissolved solids, 300 μg/L (micrograms per liter) iron, and 250 mg/L chloride, and a range of 6.5–8.5 for pH.

Alluvial Aquifers

The alluvial aquifers (fig. 2*A*) grade from silt and clay at the surface to poorly to moderately well-sorted sand and gravel at the base (Whitfield, 1975a, 1980). Fresh ground water is typically a calcium or magnesium bicarbonate type. Excessive concentrations of dissolved solids, hardness, iron, or localized salinity limit ground water to primarily industrial and agricultural use (U.S. Geological Survey, 1985, p. 229–235). Dissolved solids and hardness are less near the surface, owing to mixing of fresh recharge water from precipitation with older ground water, but generally increase and have less temporal fluctuation with depth. The pH is as low as 5.2 standard units and iron concentration is as large as 49,000 μg/L where recharge is through thick organic-rich sediments. Large concentrations of chloride accompanying large concentrations of dissolved solids (as much as 8,000 and 14,000 mg/L, respectively) indicate saltwater contamination (Whitfield, 1975a, 1980).

Pleistocene Aquifers

The major Pleistocene aquifers of Louisiana include the terrace aquifers, the Chicot aquifer, and the southeastern Pleistocene aquifers (including the "400- and 600-foot" sands at Baton Rouge, the upper Ponchatoula aquifer, and the Gonzales-New Orleans aquifer) (fig. 2*A*) (U.S. Geological Survey, 1985).

The terrace aquifers generally are unconsolidated, poorly to well sorted, and grade from very fine sand near the surface to coarse sand and gravel in the lower three-fourths of the aquifer. The small saturated thickness of the aquifer limits its use in some areas (Snider and Sanford, 1981). Fresh ground water is generally a soft calcium or sodium bicarbonate type, but locally is very hard (as much as 450 mg/L as calcium carbonate). Low values of pH are attributed to large concentrations of dissolved carbon dioxide (Snider and Sanford, 1981). Anomalously large chloride concentrations have been partly attributed to oil and gas activities (Snider and Sanford, 1981).

The Chicot aquifer is a stratigraphically complex series of fluvial deposits characterized by thick sequences of sand and gravel separated by clay layers (Jones and others, 1956). Fresh ground water is dominantly a calcium bicarbonate type (D.J. Nyman, U.S. Geological Survey, written commun., 1986). Ground water is generally suitable for irrigation but, because of locally large iron concentrations, may require treatment for public supply (U.S. Geological Survey, 1985). Large concentrations of iron are spatially related to Pleistocene channel sands of the Red River (D.J. Nyman, U.S. Geological Survey, written commun., 1986). Large concentrations of chloride and dissolved solids (as much as 3,000 and 4,900 mg/L, respectively) indicate saltwater contamination (Nyman, 1984).

The southeastern Pleistocene aquifers are generally confined and range from the well-sorted, fine-grained "400- and 600-foot" sands at Baton Rouge to the moderately well-sorted, medium to coarse sands and gravel of the upper Ponchatoula aquifer (Meyer and Turcan, 1955; Nyman and Fayard, 1978). Fresh ground water is generally a moderately hard, sodium bicarbonate type. Locally, saltwater contamination (dissolved solids and chloride as much as 6,600 and 3,800 mg/L, respectively) and color problems make ground water unsuitable for public supply (Rollo, 1966; Whiteman, 1979). Ground-water use is primarily industrial (U.S. Geological Survey, 1985).

Pliocene-Miocene Aquifers

The Pliocene-Miocene aquifers include the Evangeline, Jasper, and Catahoula aquifers and the "1,200-foot" and deeper sands near Baton Rouge (fig. 2*A*). The Evangeline, Jasper, and Catahoula aquifers are composed of unconsolidated, moderately well to well-sorted, fine to medium sands. All are confined by extensive clays. Freshwater in the aquifer is a soft, sodium bicarbonate type. Large concentrations of fluoride (more than 1.6 mg/L) and high color make ground water locally unsuitable for public supply (Whitfield, 1975b). The lower part of each of these aquifers contains saltwater.

The "1,200-foot" and deeper sands near Baton Rouge consist of the Pliocene "1,200-, 1,500-, and 1,700-foot" sands and the Miocene "2,000-, 2,400-, and 2,800-foot" sands. The Pliocene sediments are fine- to medium-grained and moderately to well-sorted sands. The Miocene sediments are fine sand to gravel. Grain size increases and degree of sorting decreases with depth in the Miocene sediments. Both Pliocene and Miocene aquifers are confined and typically contain a soft, sodium bicarbonate type water with moderately alkaline pH in areas of fresh ground water (Buono, 1983; Meyer and Turcan, 1955). The "1,500-, 2,000-, and 2,800-foot" sands contain some saltwater north of the Baton Rouge fault (fig. 3*B*) (Whiteman, 1979).

Cockfield and Sparta Aquifers

The Cockfield aquifer is composed of fine, commonly massive or cross-bedded sand, silty clay, and lignite. The Sparta aquifer consists of very fine to medium sand, silty clay, and lignite. The lithology of the Sparta ranges widely, both vertically and laterally. The Cockfield and Sparta aquifers (fig. 2*A*) are generally confined and are separated by the Cook Mountain Formation. Freshwater in the Cockfield and Sparta aquifers is typically a soft, sodium bicarbonate type. Large iron concentrations (as much as 44,000 μg/L) and color problems occur locally. Dissolved-solids and chloride concentrations generally increase with depth in the Sparta aquifer (Payne, 1968, 1970; Rogers and others, 1972).

Carrizo-Wilcox Aquifer

The Carrizo-Wilcox aquifer includes the Eocene Carrizo sand and the sands of the Eocene-Paleocene Wilcox Group (fig. 2*A*). The Carrizo sand is well-sorted fine to medium sand. The Wilcox Group is composed of interbedded fine sand, silt, clay, and variable amounts of lignite. The Carrizo sand and the Wilcox aquifer are hydrologically connected and form a generally confined hydrologic system which typically contains a soft, sodium bicarbonate type water. Iron concentrations are locally as much as 40,000 μg/L (U.S. Geological Survey, 1985; Ryals, 1983; Payne, 1975).

Effects of Land Use on Water Quality

The quality of ground water in Louisiana has changed in some areas because of surface waste disposal and the encroachment of saltwater into freshwater aquifers. Waste disposal has contaminated ground water primarily by organic compounds. saltwater degradation has resulted primarily from withdrawal of ground water near the coast and from oil and gas activities.

Waste-Disposal Sites

Petrochemical wastes including benzene, toluene, xylene, and many chlorinated organics are disposed, treated, or stored at 5 CERCLA sites and 50 RCRA sites in Louisiana (fig. 3*A*). The five CERCLA sites are included by the U.S. Environmental Protection Agency (1986c) in the National Priorities List (NPL). Other types of industrial wastes are only a small part of the total waste processed. Materials from 23 of the RCRA sites have contaminated shallow ground water (fig. 3*A*). An unknown number of oil-field waste-disposal pits exist in Louisiana. These pits contain organic chemicals, drilling fluids, and brines. Also, aqueous industrial waste is injected below the base of the deepest underground source of drinking water in 71 class I wells in Louisiana (fig. 3*A*). In addition, Louisiana has 29 active industrial landfill sites (other sites) (fig. 3*A*), 3 of which have contaminated shallow ground water, and 138 parish and municipal solid-waste landfill sites (fig. 3*C*).

As of September 1985, 52 hazardous-waste sites at 4 facilities in Louisiana had been identified by the DOD as part of their Installation Restoration Program (IRP) as having potential for contamination (U.S. Department of Defense, 1986). The IRP, established in 1976, parallels the U.S. Environmental Protection Agency (EPA) Superfund program under CERCLA. The EPA presently ranks these sites under a hazard ranking system and may include them in the NPL. Of the 52 sites in the IRP program, 15 sites contained contaminants but did not present a hazard to the environment. Fourteen sites at two facilities (fig. 3*A*) were considered to present a hazard significant enough to warrant response action in accordance with CERCLA. Remedial action at two of these sites has been completed under the program. The remaining sites were scheduled for confirmation studies to determine if remedial action is required.

Saltwater Encroachment

Naturally occurring saltwater occupies the entire water column in some, primarily coastal, areas. In other areas, saltwater sands overlie freshwater sands. Saltwater contamination is caused by pumping from freshwater aquifers and oil and gas activities.

Saltwater encroachment into the Chicot aquifer has occurred along the southwestern coast of Louisiana (not shown in fig. 3*B*). Northward movement of saltwater from about 1968 to 1984 was indicated by increasing chloride concentrations in areas south and east of Lake Charles (fig. 4). However, as of 1984, the net effect on public supply was minimal (Nyman, 1984). Recent data from continuing saltwater-monitoring efforts show no significant increase in chloride since 1984 in the area of concern. Saltwater upconing affects the quality of water in southwestern Louisiana near major pumping centers.

Contamination in the "1,200-foot" and deeper sands near Baton Rouge includes saltwater in the "1,500-, 2,000-, and 2,800-foot" sands north of the Baton Rouge fault (fig. 3*B*). The increase in chloride, from 1971–85, in the "1,500-foot" sand north of the Baton Rouge fault is shown in figure 4. Recent data show no significant increase in chloride since 1985. Given the present rate of withdrawal, the current model of the aquifer indicates that saltwater will not effect the Baton Rouge public supply for about 30 years (Whiteman, 1979).

Saltwater contamination in the alluvial aquifers from oil and gas activities has been documented (Whitfield, 1975a, 1980). Saltwater contamination in the terrace aquifers was caused by oil and gas activities and intrusion of saltwater from underlying Tertiary sediments (Snider and Sanford, 1981).

POTENTIAL FOR WATER-QUALITY CHANGES

Detrimental changes in the quality of ground water in Louisiana could be caused by increased saltwater encroachment, contamination by hazardous chemicals from surface waste-disposal facilities, and agricultural chemicals.

Increased pumping from the "1,200-foot" and deeper sands or the Chicot aquifer could cause more rapid encroachment of saltwater. Pumping from these aquifers has decreased in recent years, but long-term trends are difficult to predict (D.L. Lurry, U.S. Geological Survey, oral commun., 1986).

Both active and abandoned surface industrial waste-disposal facilities (fig. 3*A*), many of which are located along the densely populated industrial Baton Rouge-New Orleans corridor (fig. 1*B*), are a potential threat to ground-water quality. No contamination traceable to surface waste-disposal facilities or to solid-waste landfill sites has been documented in ground water used for public supply.

An analysis of selected organic pesticides in 1981 showed no detectable levels in ground water from the terrace aquifers. However, because of rapid recharge from surface water, the shallow terrace aquifers are particularly susceptible to contamination from surface waste disposal and agricultural chemicals (Snider and Sanford, 1981).

GROUND-WATER-QUALITY MANAGEMENT

The Ground Water Protection Division of the Louisiana Department of Environmental Quality is responsible for developing ground-water protection strategy. The responsibility for ground-water-quality management is divided among five agencies within the State government. The agencies and their areas of principal responsibility are:

Department of Environmental Quality	CERCLA, RCRA, and State protection plans
Department of Natural Resources	Underground injection-control program
Department of Transportation and Development	Water-well construction and licensing of drillers
Department of Health and Human Resources	Safe Drinking Water Act and public water supply regulation
Department of Agriculture	Federal Insecticide, Fungicide, and Rodenticide Action and pesticide control

Ground-water-protection strategy is in the developmental stage. Information is still needed on which to base future decisions. Work is underway to delineate the recharge areas and to determine background water quality in the major aquifers of the State. More data are needed to determine the distribution of organic constituents in ground water. All cleanup efforts are directed toward restoration of the ground water to background water-quality conditions.

State law and practice call for an antidegradation standard for all ground water above the lowest level of ground-water sources of drinking water. However, injection of hazardous waste is allowed below sources of drinking water.

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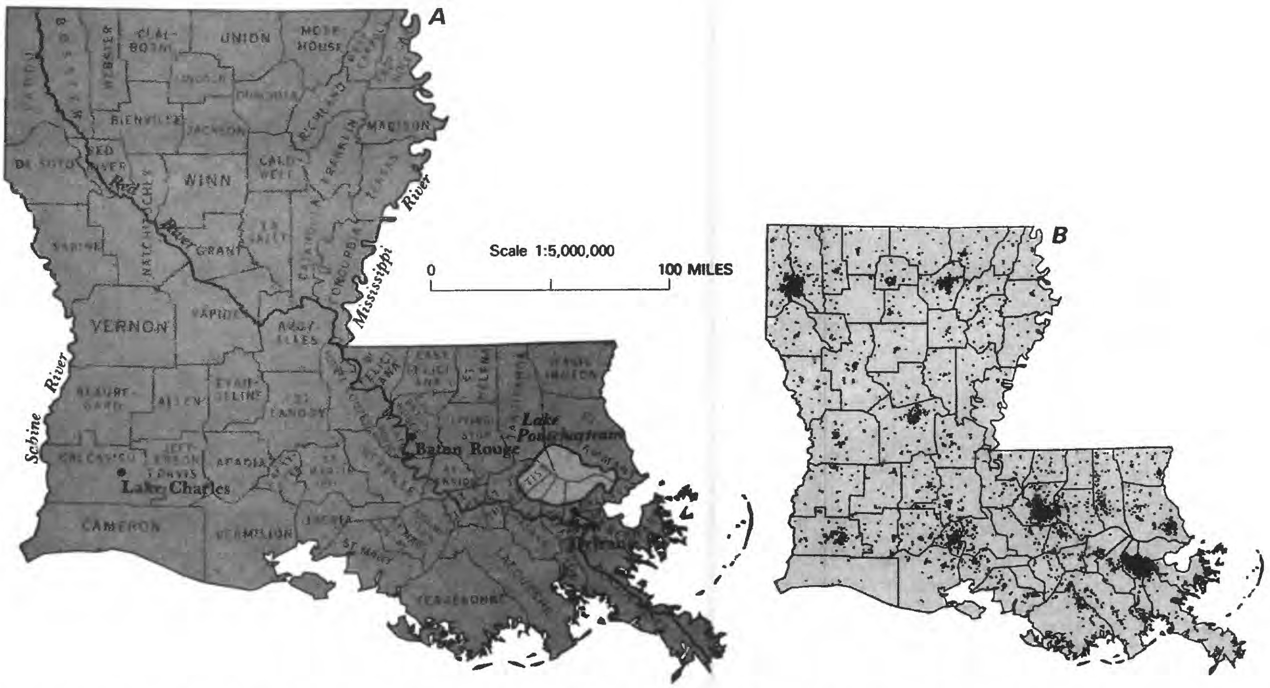

Figure 1. **Selected geographic features and 1985 population distribution in Louisiana.** *A*, Parishes, selected cities, and major drainages. *B*, Population distribution, 1985; each dot on the map represents 1,000 people. (Source: *B*, Data from U.S. Bureau of the Census 1980 decennial census files, adjusted to the 1985 U.S. Bureau of the Census data for county populations.)

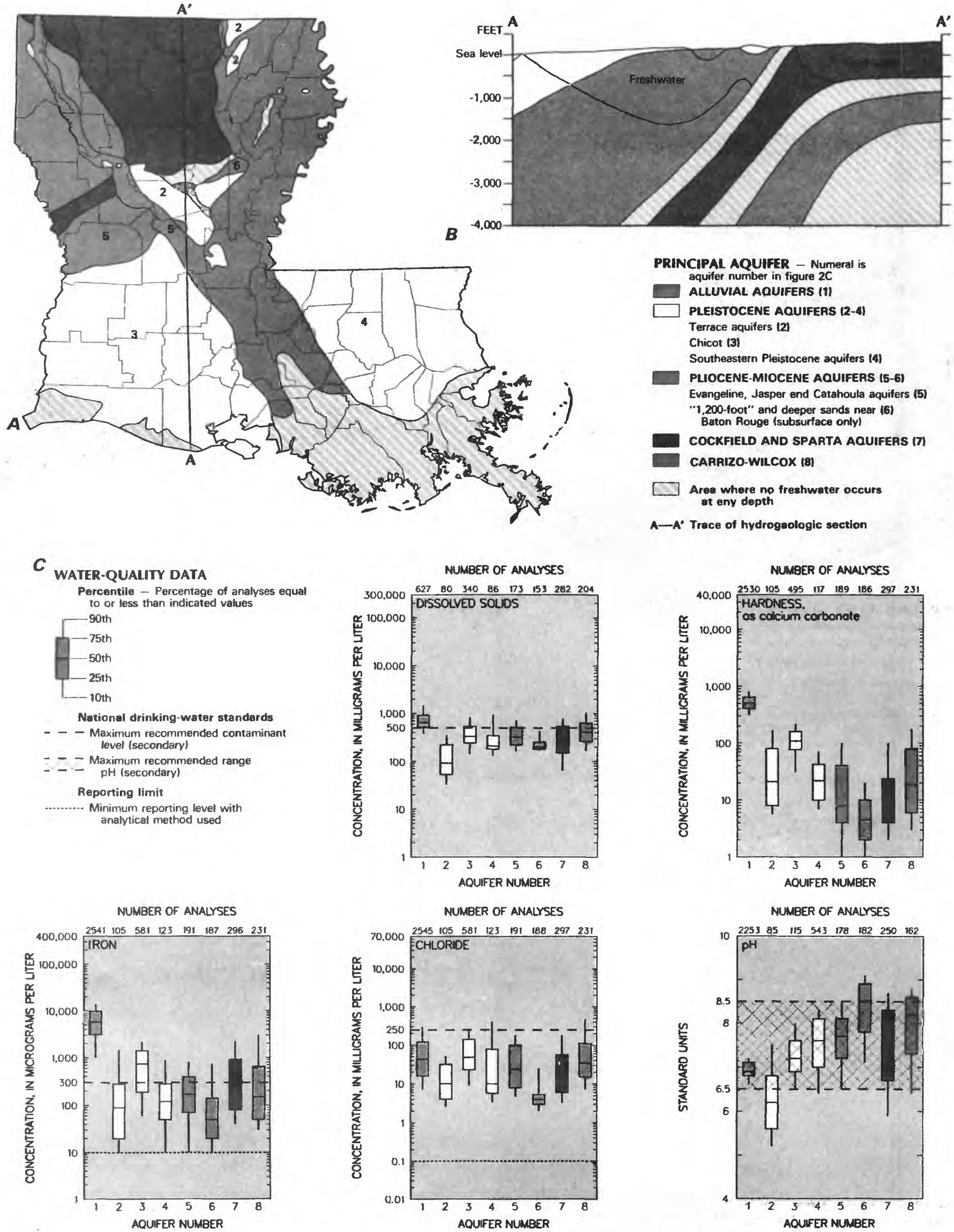

Figure 2. **Principal aquifers and related water-quality data in Louisiana.** *A*, Principal aquifers. *B*, Generalized hydrogeologic section. *C*, Selected water-quality constituents and properties, as of 1970-86. (Sources: *A*, *B*, U.S. Geological Survey, 1985. *C*, Analyses compiled from U.S. Geological Survey files; national drinking-water standards from U.S. Environmental Protection Agency, 1986 a,b.)

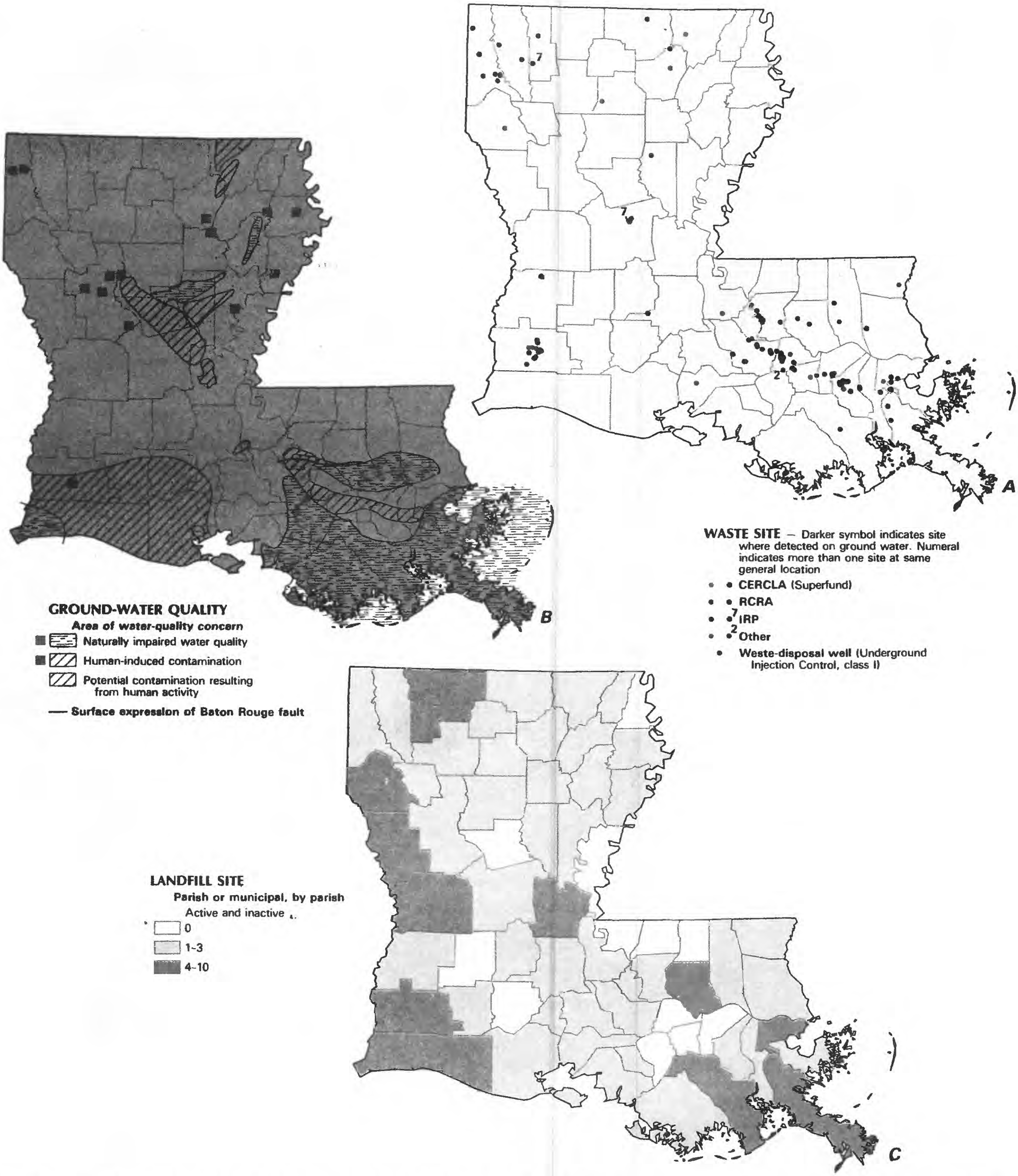

Figure 3. Selected waste sites and ground-water-quality information in Louisiana. *A*, Comprehensive Environmental response, Compensation, and Liability Act (CERCLA) sites, as of 1986; Resource Conservation and Recovery Act (RCRA) sites, as of 1986; Department of Defense Installation Restoration Program (IRP) sites, as of 1985; and other selected waste sites, as of 1986. *B*, Areas of naturally impaired water quality, and areas of human-induced and potential contamination, as of 1986. *C*, Parish and municipal landfills, as of 1986. (Sources: *A*, Louisiana Department of Environmental Quality files; Joyce Lehe, U.S. Environmental Protection Agency, written commun., 1986; U.S. Environmental Protection Agency, 1984; U.S. Department of Defense, 1986. *B*, U.S. Geological Survey, 1985; Nyman, 1984; C.W. Smoot, U.S. Geological Survey, written commun., 1986; Snider and Sanford, 1981; Whiteman, 1979; Whitfield, 1975a, 1980. *C*, Louisiana Department of Environmental Quality files.)

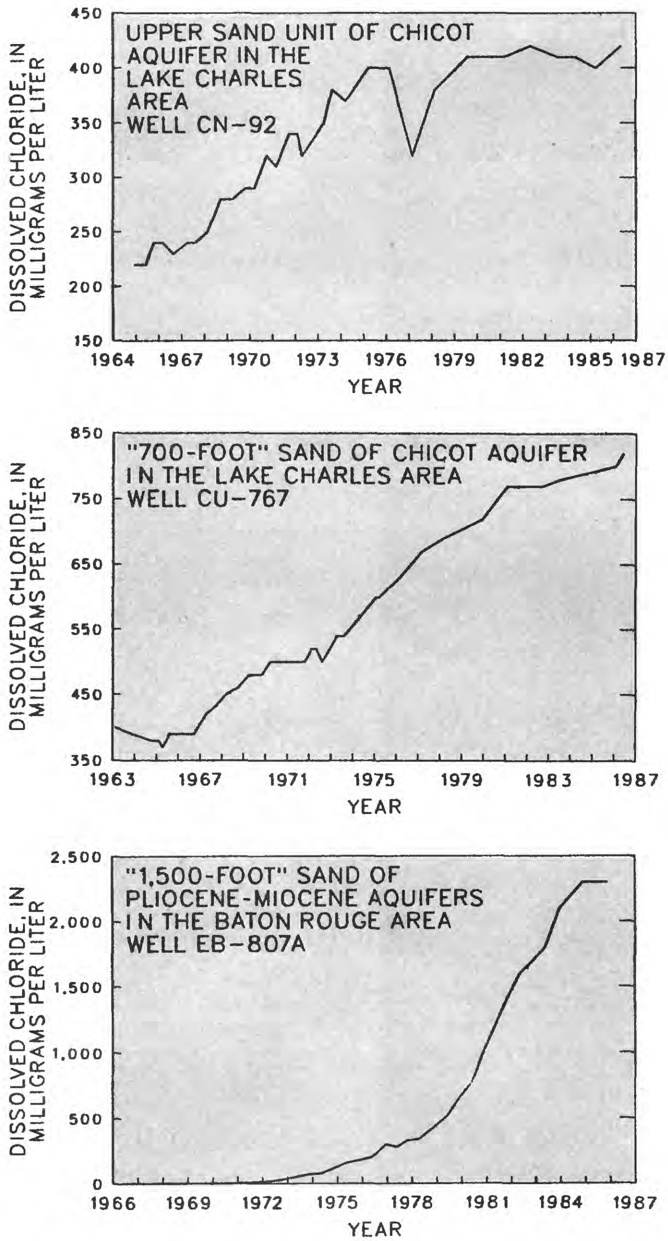

Figure 4. Change in chloride concentration for three wells in the Lake Charles and Baton Rouge areas, Louisiana (Source: U.S. Geological Survey files.)