Below is an Electronic Version of an Out-of-Print Publication

You can scroll to view or print this publication here, or you can borrow a paper copy from the Texas State Library, 512/463-5455. You can also view a copy at the TCEQ Library, 512/239-0020, or borrow one through your branch library using interlibrary loan.

The TCEQ's current print publications are listed in our catalog at www.tnrcc.state.tx.us/admin/topdoc/index.html.

Groundwater Assessment

Groundwater well in City of Friona

Groundwater Assessment

Overview - Groundwater Resources and the Texas Groundwater Protection Committee

Groundwater is a major source of the water used by Texans for domestic, municipal, industrial, and agricultural purposes. Water use in the state of Texas varies with the annual climate conditions. In 1996, a “drought” year, total use was approximately 16.8 million acre-feet. In 1997, a relatively “wet weather” year, Texans used about 15.4 million acre-feet of water, of which 9.4 million acre-feet, or 61 percent, was derived from groundwater sources. About 79 percent of the groundwater used in 1997 was for irrigation, with the remainder being used for municipal supplies, rural and municipal domestic consumption, rural livestock, electric utility, and industry. Approximately 39 percent of municipal water is obtained from groundwater sources.

Texas’ major and minor aquifers underlie approximately 76 percent of the state's surface area of 267,338 square miles (TWDB, 1995). Major aquifers are defined as producing large quantities of water in a comparatively large area of the state, whereas minor aquifers produce significant quantities of water within smaller geographic areas or small quantities in large geographic areas. Minor aquifers are very important as they may constitute the only significant source of water supply in some regions of the state. The major and minor aquifers are composed of many rock types, including limestones, dolomites, sandstones, gypsum, alluvial gravels, and in some parts of the state, igneous rocks. Nine major aquifers and twenty minor aquifers have been delineated within the state. Two appendices at the back of this portion of the report illustrate the geographic distribution of the state's major (Appendix B) and minor aquifers (Appendix C) (TWDB, 1991). Other undifferentiated, local aquifers may represent the only source of groundwater where major or minor aquifers are absent. These local aquifers, which provide groundwater that is utilized for all purposes, vary in extent from very small to several hundred square miles (TWC, 1989).

In March 1985 the Texas Department of Water Resources, predecessor to the TNRCC and the TWDB, received a grant from the EPA to improve coordination of groundwater protection activities undertaken by State agencies. In response to this federal mandate, the interagency Groundwater Protection Committee was established.

In 1989, the 71st Texas Legislature created the Texas Groundwater Protection Committee (Committee or TGPC) as a means to bridge the gap between existing state groundwater programs and to optimize water

quality protection by improving coordination among agencies involved in groundwater activities. State law (Texas Water Code, §§ 26.401 through 26.407) establishes the Committee and outlines the powers, duties, membership, and responsibilities of the Committee. The Committee effectively replaced, and continued with the efforts of the predecessor Groundwater Protection Committee.

Section 26. 401 of the Texas Water Code establishes the state's groundwater protection policy. The policy sets out nondegradation of the state's groundwater resources as the goal for all state programs. The policy recognizes the variability of the state's aquifers, the importance of maintaining water quality for existing and potential uses, the protection of the environment, and the maintenance and enhancement of the long-term economic health of the state. The policy states that discharges of pollutants, disposal of wastes, and other regulated activities be conducted in a manner that will maintain present uses and not impair potential uses of groundwater or pose a public health hazard. The use of the best professional judgement by the responsible state agencies in attaining the goal and policy is also recognized.

The TGPC actively seeks to implement this policy by identifying opportunities to improve existing groundwater quality programs and promoting coordination between agencies. The Committee also strives to improve or identify areas where new or existing programs could be enhanced to provide additional protection (TGPC, 1996a).

TWC §26.403 and subsequent legislative amendments identify the following entities with groundwater protection programs for membership to the TGPC:

- Texas Natural Resource Conservation Commission
- Texas Water Development Board
- Railroad Commission of Texas
- Texas Department of Health
- Texas Department of Agriculture
- Texas State Soil and Water Conservation Board
- Texas Alliance of Groundwater Districts
- Texas Agricultural Experiment Station
- Bureau of Economic Geology
- Texas Department of Licensing and Regulation

The TNRCC is designated as the lead agency of the TGPC. The regulatory protection of groundwater is primarily the responsibility of the TNRCC. Certain activities requiring the regulatory protection of groundwater are under the jurisdiction of the Railroad Commission of Texas, the Texas Department of Agriculture, the TSSWCB, and the Texas Depart-

ment of Licensing and Regulation. The TWDB has certain monitoring authorities in regard to groundwater but does not possess the statutory authority to regulate activities which may contaminate groundwater. The Texas Alliance of Groundwater Districts, as an organization, has no regulatory or enforcement authority, but individual groundwater districts may have limited authorities for action with regard to groundwater contamination. The Texas Agriculture Experiment Station and the Bureau of Economic Geology conduct research activities related to groundwater.

Table 1 has been complied to summarize the state's groundwater protection programs. The table provides a list of the programs or activities, and indicates the implementation status of the program and the state agency with the major responsibilities related to the program. A brief summary of the groundwater protection responsibilities and activities under the jurisdiction of the TGPC's member agencies/organizations follows Table 75.

Table 75. Summary of State Groundwater Protection Programs

Programs or Activities	**Check (X)**	**Implementation Status**	**Responsible State Agency**
Active SARA Title III Program	X	fully established	TNRCC*
Ambient Groundwater Monitoring System	X	fully established	TWDB
Aquifer Vulnerability Assessment	X	continuing efforts	TNRCC*
Aquifer Mapping	X	fully established	TWDB
Aquifer Characterization	X	fully established	TWDB
Comprehensive Data Management System	X	under development	TGPC*
Core Comprehensive State Groundwater Protection Program (CSGWPP)	X	under development	TGPC*
Groundwater Best Management Practices	X	under development	TGPC*
Groundwater Legislation	X	fully established	TNRCC*
Groundwater Classification	X	fully established	TGPC*
Groundwater Quality Standards	X	fully established	TNRCC
Interagency Coordination for Groundwater Protection Initiatives	X	fully established	TGPC*
Municipal Solid Waste Program (Subtitle D Primacy)	X	fully established	TNRCC
Nonpoint Source Controls/Agricultural & Silvicultural	X	continuing efforts	TSSWCB
Nonpoint Source Controls/All Others	X	continuing efforts	TNRCC
Pesticide State Management Plan (Generic)	X	received EPA concurrence	TGPC*
Pesticide Specific Regulation Programs	X	fully established	TDA

Table 75. Summary of State Groundwater Protection Programs (Continued)

Programs or Activities	Check (X)	Implementation Status	Responsible State Agency
Pollution Prevention Program	X	fully established	All Agencies
Radioactive Waste Disposal Program	X	fully established	TNRCC
Resource Conservation and Recovery Act (RCRA) Primacy	X	fully established	TNRCC
State Hydrocarbon Exploration/Production Regulations	X	fully established	RCT
State Superfund	X	fully established	TNRCC
State Oilfield Cleanup Fund	X	fully established	RCT
State Petroleum Storage Tank Remediation Fund	X	fully established	TNRCC
State RCRA Program incorporating more stringent requirements than RCRA Primacy		not applicable	
State Septic System Regulations	X	fully established	TNRCC*
Surface Mining and Reclamation Regulations	X	fully established	RCT
Underground Storage Tank Installation Requirements	X	fully established	TNRCC
Underground Storage Tank Registration Program	X	fully established	TNRCC
Underground Injection Control Program/Industrial	X	fully established	TNRCC
Underground Injection Control Program/Oil & Gas	X	fully established	RCT
Vulnerability Assessment for Drinking Water/ Source Water Protection	X	fully established	TNRCC
Wellhead Protection Program (EPA-approved)	X	fully established	TNRCC
Wastewater Permits	X	fully established	TNRCC
Water Well Abandonment Regulations	X	fully established	TDLR
Water Well Installation Regulations	X	fully established	TDLR

NOTES:
TNRCC - Texas Natural Resource Conservation Commission
TGPC - Texas Groundwater Protection Committee
TDA - Texas Department of Agriculture
TDLR - Texas Department of Licensing and Regulation
TWDB - Texas Water Development Board
TSSWCB - Texas State Soil and Water Conservation Board
RCT - Railroad Commission of Texas

* Indicates responsibility for the program falls to more than one state agency.

Texas Natural Resource Conservation Commission

The TNRCC conducts various groundwater protection programs that focus on both prevention of contamination and remediation of existing problems through education, permitting, and enforcement. As the state lead agency for water resources, the TNRCC administers both state and federally mandated programs including: the Resource Conservation and Recovery

Act; the Comprehensive Environmental Response, Compensation and Liability Act; the Clean Water Act; the Safe Drinking Water Act; and the development of state management plans for groundwater under the Federal Insecticide, Fungicide and Rodenticide Act.

TNRCC reorganized the primary agency operations into three main functional offices, designed to streamline regulatory processes: the Office of Permitting Remediation and Registration, the Office of Environmental Planning, Assessment and Analysis, and the Office of Compliance and Enforcement. Under the Commission and Executive Director, these three offices, with support help from the Office of Legal Services, Office of Administrative Services:

- regulate underground and above ground product storage tanks and require groundwater monitoring and remediation at contaminated sites
- prevent groundwater contamination and insuring remediation at industrial sites through the waste disposal facility permitting program, the Class I, Class III and Class V underground injection control programs, and uranium and radioactive waste disposal programs
- monitor activities associated with the collection, handling, storage, processing, and disposal of municipal solid waste to ensure protection of groundwater and require remediation where these activities have failed
- are responsible for both Federal and State Superfund activities, including conducting remedial investigations, and seeking funding for remedial activities based upon a health risk ranking program
- are responsible for the surface and groundwater quality management and planning programs , the implementation of the surface and groundwater nonpoint source pollution programs, the pesticides in groundwater program, and supporting the TGPC
- are responsible for the development and implementation of water quality standards
- ensure that groundwater resources are protected through permitting activities related to confined animal feeding operations, municipal and industrial wastewater treatment
- monitor public water systems for compliance with state drinking water standards, implements the Safe Drinking Water Act Source Water Protection Program, and conducts the Wellhead Protection Program
- investigate contamination complaints and the inspect permitted and non-permitted facilities
- administer the Edwards aquifer pollution abatement plan review program and administer the on-site wastewater program
- ensure that groundwater resources are protected during enforcement activities related to the municipal solid waste, industrial and hazardous waste, petroleum storage tank, agricultural/watershed management, water utilities, and public water supply programs.

In November 1999, the State of Texas received EPA approval of its Source Water Assessment and Protection (SWAP) Program. This approval represents a major milestone in an ongoing cooperative effort between the TNRCC and the USGS to develop and implement a scientifically-defensible methodology for assessing susceptibility of Texas' public water supplies (PWS) to contamination. Significant progress toward this goal is being achieved as well as all tasks and time lines being met.

As per EPA's agreement and approval of the program in November 1999, no assessments will be released until May 2003. At that point in time, over 17,000 assessments will be complete and released to both EPA and the public.

Railroad Commission of Texas

The Surface Mining and Reclamation Division of the Railroad Commission of Texas (RCT) is authorized to enforce laws and regulations consistent with the Texas Surface Coal Mining and Reclamation Act and the Texas Uranium Surface Mining and Reclamation Act. Groundwater information is required in the regulations, as are monitoring plans for pre-mining and post-mining conditions. Groundwater investigations and monitoring by the Surface Mining and Reclamation Division is conducted in response to citizen complaints of adverse impact from surface mining activities.

The RCT's Oil and Gas Division is responsible for protecting groundwater from activities related to the drilling, exploration, and production of oil, gas, and geothermal resources, the underground storage of hydrocarbons, and the solution mining of brine. The regulations of the Oil and Gas Division for the well drilling, completion, and plugging focus on the protection of groundwater resources. The RCT administers the EPA-delegated Underground Injection Control Program under the Safe Drinking Water Act for Class II injection wells associated with oil and gas activities. The RCT regulates the handling, storage, treatment, and disposal of oil and gas wastes. The RCT responds to spills from pipelines under its jurisdiction and to other emergencies related to the production and transportation of oil and gas. The RCT responds to citizen complaints regarding alleged groundwater contamination from oil and gas activities and to alleged unauthorized activities, which may endanger groundwater.

Texas Department of Agriculture

The Texas Department of Agriculture (TDA) has lead authority for pesticide regulation in the state of Texas. Recognizing pesticides as potential groundwater contaminants, and having primary responsibility to

prevent unreasonable risk to humans or the environment from the use of pesticides, TDA performs studies and analyses aimed at assessing health, ecological, and environmental effects of various pesticides. This analysis is performed by the agency's Pesticide Impact Evaluation activity in order to ensure compliance with federal laws and regulations relating to the use of pesticides and eventual protection of groundwater resources. TDA accomplishes this by independently substantiating and validating claims of pesticide contamination relating to human health and the environment.

Texas Department of Health

The Texas Department of Health's (TDH) Bureau of Radiation Control (BRC) regulates radioactive materials in Texas under the authority of the Atomic Energy Act of 1954 as amended. The BRC monitors groundwater for radionuclides on a routine basis at two facilities in Texas - Pantex and the University of Texas System Interim Storage site. Intermittently the BRC will sample groundwater as a result of an incident, complaint, or situation which leads the BRC to believe there may be groundwater contamination.

Texas State Soil and Water Conservation Board

The TSSWCB, under Title 7, Chapter 201 and 203 of the Agriculture Code of Texas, is charged with the overall responsibility for administering and coordinating the state's soil and water conservation program with the state's soil and water conservation districts. Section 201.016 gives the agency responsibility for planning, implementing, and managing programs and practices for abating agricultural and silvicultural nonpoint source pollution. Currently, the agricultural/silvicultural nonpoint source management program includes: problem assessment, management program development and implementation, monitoring, education, and coordination.

Texas Water Development Board

The Texas Water Development Board (TWDB) collects data on the state's aquifers which includes the occurrence, availability, quality, and quantity of groundwater and the current and projected demands on groundwater resources. This is done through the statewide groundwater level measurement program, groundwater quality sampling program, and groundwater studies.

The purpose of the groundwater quality sampling program is to: 1) monitor changes, if any, in the quality of groundwater over time; and 2) establish, as accurately as possible, the baseline quality of groundwater occurring naturally in the state's aquifers. The groundwater quality monitoring program is accomplished in accordance with procedures

established in the TWDB's *Field Manual for Groundwater Sampling*, in supplemental samples analyzed on Hach instruments, and by obtaining data collected by other entities such as groundwater conservation districts and other state/federal agencies (Nordstrom and Beynon, 1991).

Texas Department of Licensing and Regulation

The Texas Department of Licensing and Regulation (TDLR) is responsible for the water well drilling program in which all monitor wells, water wells, and Class V injection wells are subject to the TDLR's rules regarding driller licensing, reporting, and well construction criteria.

Texas Alliance of Groundwater Districts

The Alliance is the umbrella organization composed of groundwater conservation districts within the state. Its membership is restricted to groundwater conservation districts which have the powers and duties to manage groundwater as defined in Chapter 36 of the TWC. The districts were created by the Legislature or by the TNRCC with the purpose and responsibility of preserving and protecting groundwater. The districts are local or regional in their jurisdiction and have, for the most part, elected boards of directors. Among their legislatively granted authorities is the power to monitor groundwater quality. A number of districts also have the authority to bring civil court proceedings for injunctive relief against an entity causing groundwater contamination.

Texas Agricultural Experiment Station

The Texas Agricultural Experiment Station (TAES) is the official agricultural research agency in Texas. Headquartered at Texas A&M University, TAES promotes food and fiber production that emphasizes water conservation and the protection of natural resources. Broad goals of the TAES groundwater research program are to protect, preserve, and efficiently use water resources, and to develop sustainable agricultural production systems. Groundwater programs of TAES stress the development of management strategies, technologies, and educational programs to support sustainable agriculture. TAES groundwater quality research focuses on reductions in chemical use; the control, fate, and transport of agricultural chemicals; and the remediation of contaminated groundwater.

Bureau of Economic Geology

The Bureau of Economic Geology is a research entity of The University of Texas at Austin and functions as the State Geological Survey. Extensive advisory, technical, and informational services relating to the geology and groundwater resources of Texas are provided by the Bureau. In addition,

the Bureau conducts basic and applied research projects in energy and mineral resources and in hydrogeology, groundwater resources, and geochemistry. Some projects are conducted jointly with other units of the University as well as with state, federal, and local agencies, industry associates, and foreign companies.

State law mandates the major responsibilities of the Committee are, on a continuing basis:

- to improve interagency coordination in the area of groundwater protection;
- to develop and update a comprehensive groundwater protection strategy for the state;
- to study and recommend to the Legislature groundwater protection programs for areas in which groundwater is not protected by current regulation;
- to publish an interagency groundwater monitoring and contamination report; and
- to file with the governor, lieutenant governor, and speaker of the house of representatives a report of the Committee's activities during the biennium preceding each regular legislative session, including any recommendations for legislation for groundwater protection.

During Fiscal Year 1991, EPA required states to reassess their groundwater protection strategies in a process called profiling the state's groundwater protection program. The Committee completed this profile and submitted it to EPA in June of 1991. During Fiscal Years 1992 and 1993, EPA developed and published draft guidance for the development of a comprehensive state groundwater protection program (CSGWPP). Final guidance was published by EPA in December of 1992. EPA developed its concept of such a program and encouraged states to further their efforts in developing existing programs into a more comprehensive approach. The guidance first calls for the development of a core protection program, a basic program from which states would work with EPA over the next few years to build a fully integrated protection program.

In meeting its mandated responsibilities to improve interagency coordination and updating a comprehensive strategy for groundwater protection, the TGPC prepared and submitted a Core Program Assessment to EPA in October of 1993. This represented the first step EPA had identified in developing a CSGWPP. The core assessment compared the Texas groundwater protection program, as strengthened and coordinated by the Committee, to federal CSGWPP guidance. The Committee believes that the core assessment demonstrated core program compliance, and thus provides the base from which to develop the fully integrating CSGWPP. EPA provided comments on the Texas Core Program

Assessment in February of 1995, and the Committee is currently working on revisions for the submission of a fully integrated CSGWPP.

The Committee took on the task of improving data sharing between various levels of government, the academic community, and the private sector in 1992. The main goals were to develop ways of linking and sharing groundwater data and to develop standards or templates to facilitate the sharing of information. After more than two years in development, the Texas Groundwater Data Dictionary was published in1996 (TGPC, 1996b).

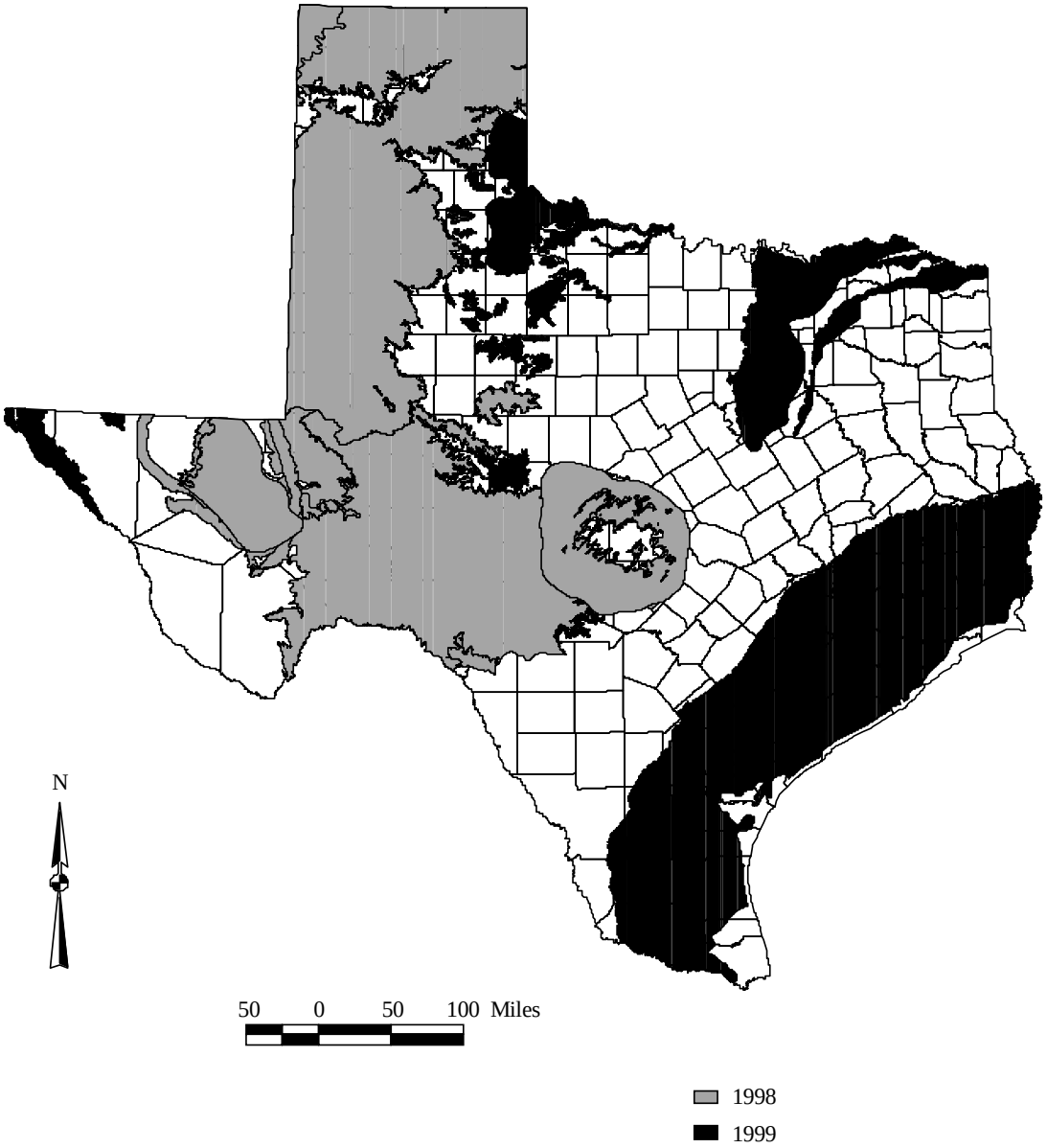
Upon completion of its efforts concerning the data dictionary, the Committee elected to begin the design and facilitation of a formal committee process for the coordination/integration of groundwater data collection and the assessment of the groundwater quality of the state's aquifers as an integral part of the state's comprehensive groundwater protection program. Additionally, the TGPC sought recommendations for the continuing improvement of groundwater data collection and assessment for the state's groundwater protection programs.

The TGPC, as the coordinating entity for groundwater protection issues in Texas, has begun the process of consolidating ambient, facility, and public water supply groundwater monitoring data as the groundwater component of a continuing water quality inventory that will be readily available to the public, local government, state agencies, the Texas Legislature, the EPA, and Congress, to evaluate Texas water quality. This report, submitted to the EPA under the CWA, Section 305(b), shows some TGPC groundwater inventory efforts performed in 1998 and 1999. In that span, six major and twelve minor aquifers were addressed (Figure 27).

The remaining Texas aquifers will be reported on during 2000 and 2001, so that all of Texas' significant groundwater resources will be inventoried during a five-year period. Figure 28 shows the aquifers that have been inventoried in 1996, 1998, and 1999. Funding for these inventories has been made available to the TNRCC through the EPA 106 grant program.

The TGPC's goal is to inventory the water quality of all major and minor aquifers at least every five years, using ambient, facility, and public water supply data. Statewide groundwater quality data will be compiled and made readily available to the public for current and historical analyses of state groundwater quality.

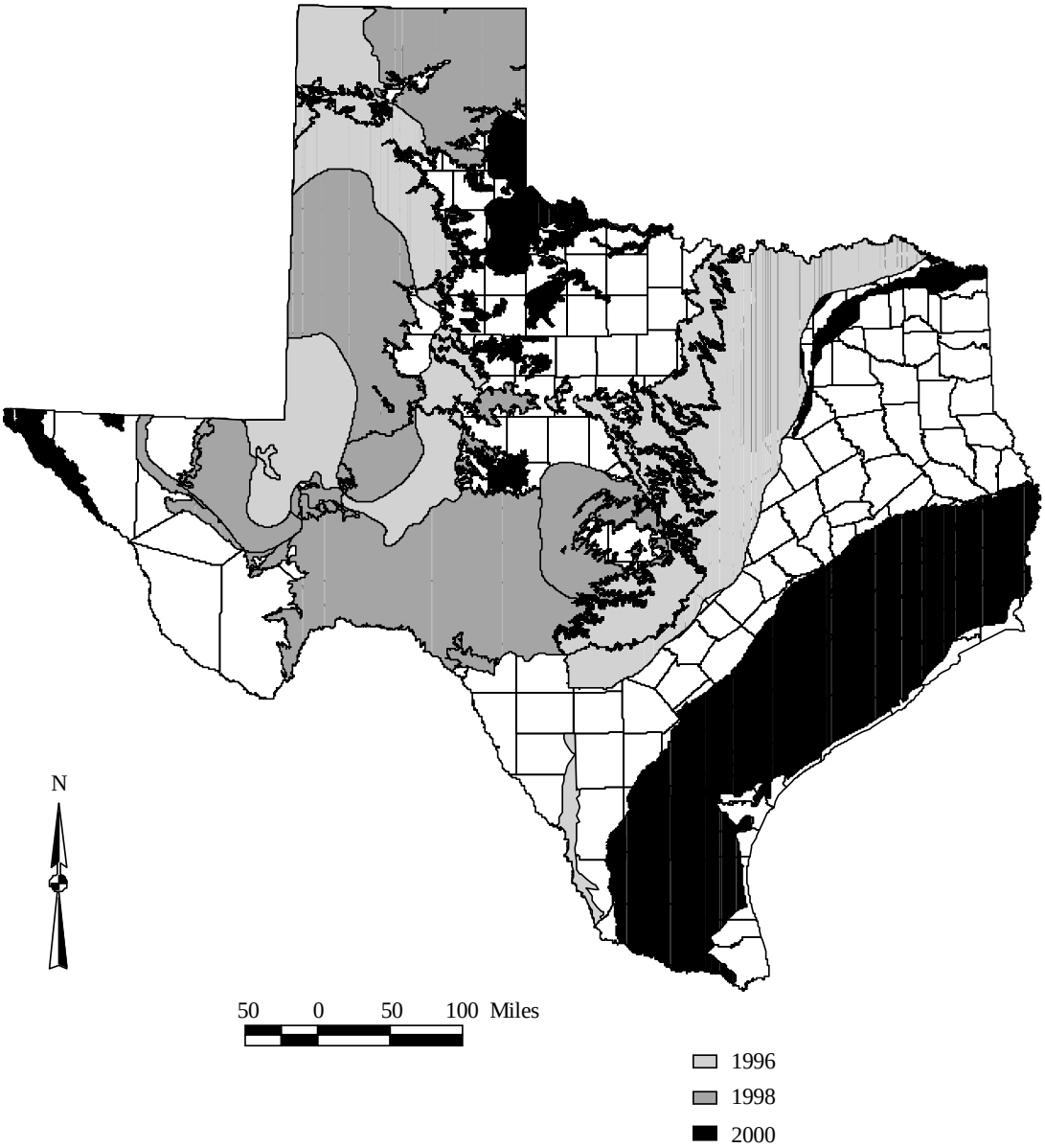
Figure 27. Selected Texas Aquifers - 1998 and 1999



State of Texas Water Quality Inventory - Aquifers Inventoried in 1998 and 1999

TNRCC

Figure 28. Selected Texas Aquifers - 1996, 1998, and 2000 Reports



State of Texas Water Quality
Inventory - Aquifers in
1996, 1998 and 2000 Reports

TNRCC

Process

TGPC member agencies provide data for the TGPC's groundwater quality inventorying efforts. In 1996, the TGPC, through the partnership of two of its member agencies, the TNRCC and the TWDB, began this process by performing an inventory of the groundwater quality of one major, one minor, and two of Texas' local aquifer systems. This information was published in the TNRCC's *State of Texas Water Quality Inventory 1996*, addressing both surface water and groundwater quality (TNRCC, 1996).

EPA representatives requested that the 1998 report update emphasize the spatial and graphical representation of the most recent available groundwater quality data, with maps showing examples of groundwater quality in wells located in the selected aquifers. This 2000 report continues to honor that request by illustrating, as an example, ambient nitrate concentrations for the selected aquifers, and demonstrates the efforts toward TGPC's goal of providing timely and concurrent analyses of state groundwater quality using the most current spatially related data from available sources. Each selected aquifer is represented with a map showing the locations of water wells sampled by the TWDB from 1994 to 1996, or from 1996 to 1997, showing nitrate analyses exceeding EPA drinking water standards (10 mg/l). Tables follow each map showing analyzed values of a number of EPA drinking water standard parameters (Ambient Monitoring Groundwater Quality Data) and summaries of the sources and types of groundwater contamination at regulated facilities (Groundwater Contamination Summary).

Currently, spatial groundwater quality data is only reliably available for ambient water well monitoring efforts performed by the TWDB. Data from other state agencies is increasingly but not consistently available with geographic coordinates, but rather as location addresses (street, city, county, etc.). Correlating this address information with the spatial representation that is the TGPC's goal is problematic, and is not attempted in this report. Efforts to provide spatial data representation for these facilities is a primary focus for the TGPC, and will be supplied in future groundwater inventory reporting.

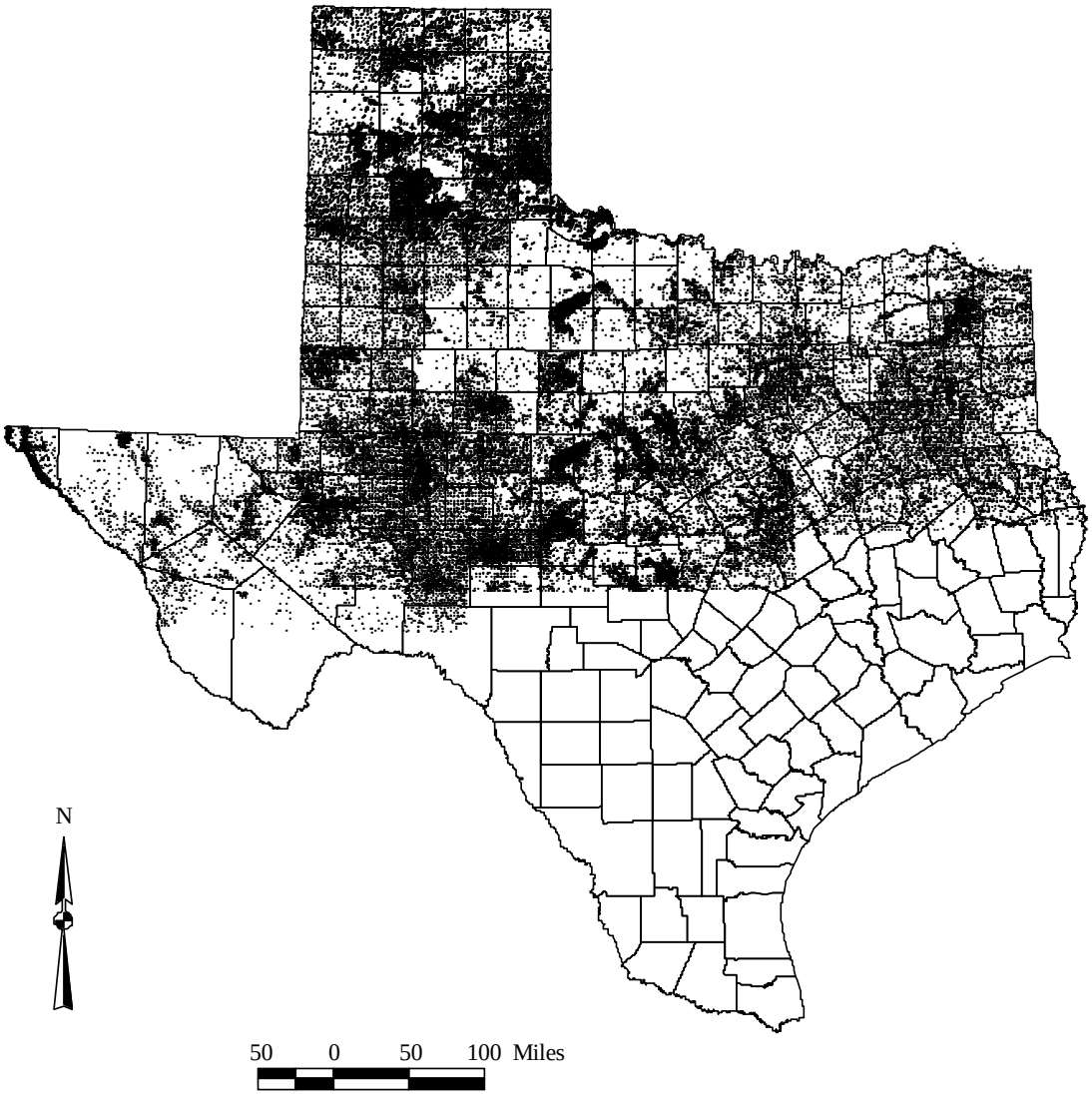
The TGPC relies upon ambient monitoring data available from the TWDB for state groundwater quality information. The TWDB maintains a database of ambient groundwater monitoring data for the state from over 51,000 water wells (Figure 29), and performs ambient groundwater monitoring on water wells in a particular number of Texas aquifers each year, so that all major and minor aquifers of the state are monitored approximately every five years. The TGPC's groundwater quality inventory efforts correspond to the TWDB's monitoring schedule. Sample data from TWDB sampling programs for the eighteen selected aquifers,

Table 76. Ambient Monitoring Groundwater Quality Data / Selected Major and Minor Aquifers (1994 - 1997)

Parameter Groups	Maximum Contamination Limit (MCL)	Number of Wells			
		Total Wells Sampled	< MDL[1]	< MCL[2] (other than <MDL)	$MCL
Primary Constituents					
Arsenic	50 µg/l	1020	350	659	12
Barium	2 mg/l	1021	8	1013	0
Cadmium	5 µg/l	236	232	2	2
Chromium	100 µg/l	226	170	56	0
Fluoride	4 mg/l	1022	13	864	145
Mercury	2 µg/l	210	196	14	0
Nitrate (N)	10 mg/l	1022	35	509	479
Selenium	50 µg/l	1019	489	451	77
Secondary Constituents					
Chloride	300 mg/l	1022	0	857	165
Copper	1 mg/l	1012	321	691	0
Fluoride	2 mg/l	1022	13	584	524
Iron	0.3 mg/l	1037	437	523	77
Manganese	50 µg/l	1021	617	368	36
Silver	100 µg/l	223	209	11	1
Sulfate	300 mg/l	1022	3	823	196
Dissolved Solids	1000 mg/l	1022	0	788	235
Zinc	5 mg/l	1013	92	921	0
Radioactivity					
Gross Alpha	15 pCi/l	287	65	153	73
Beta	50 pCi/l	287	70	198	21

Notes:
1. MDL = Method Detection Limit. The MDL is the lowest analysis value available for a particular constituent analysis at a particular sampling event. The MDL is determined by the analyzing laboratory.
2. MCL = Maximum Contamination Level. The MCL of a particular constituent is the maximum analysis level for safe drinking water. MDL's for certain constituents at certain sampling events were greater than the MCL's, and analyses from those events were not utilized when counting samples less than or greater than particular MCL's.

Figure 29. Ambient Monitoring Network Wells



State of Texas Water Quality Inventory - Texas Ambient Groundwater Monitoring Wells

Data provided by the Texas Water Development Board - 1998

TNRCC

nine completed in 1995 and 1996, and nine others completed in 1997 and 1998, and taken from nearly 2,000 domestic and agricultural water wells, were used as part of the 2000 current report. Table 76 is a summary of analyses results of samples taken from the eighteen aquifers. The TWDB has published detailed reports of some of its collected groundwater quality data in *Hydrologic Atlases* of certain individual aquifers (Ashworth, 1991; Payne, 1991; Hopkins, 1995; Hopkins, 1996a; Biri, 1996; Brown; 1996; Hopkins 1996b; Brown; 1997; and Brown; 1998).

Joint Groundwater Monitoring and Contamination Report

State law (TWC, §§26.405 & 26.406) requires the TGPC to compile and publish an annual report to describe the current status of groundwater monitoring activities conducted by or required by each state agency at regulated facilities or associated with regulated activities. The report is required to contain a description of each case of groundwater contamination documented during the previous calendar year, and a description of each case of contamination documented during previous periods for which enforcement action was incomplete at the time of issuance of the preceding report. The report is also required to indicate the status of enforcement action for each case of groundwater contamination.

The purpose of the annual *Joint Groundwater Monitoring and Contamination Report* (henceforth referred to as the joint report) is to compile and make available to the public the status of groundwater monitoring associated with activities regulated by the contributing state agencies, and the status of groundwater contamination reasonably suspected of having been caused by activities regulated by state agencies. The report provides background information on monitoring and regulatory rules and policies. The information is provided to assist the public and state policy makers in interpreting the current picture of groundwater contamination in the state and the status of state agency response.

The groundwater protection programs of the state agencies generally fall within one of three categories: regulatory agencies requiring or conducting groundwater monitoring to assure compliance with guidelines and regulations for the protection of groundwater from discharges of contaminants; agencies or entities conducting groundwater monitoring to assess ambient or existing groundwater quality conditions and to track changes in water quality over time; and agencies or entities conducting research activities related to groundwater resources and groundwater conservation.

Each regulatory agency which requires or conducts groundwater monitoring to assure compliance with guidelines and regulations to protect groundwater from discharges of contaminants has its own monitoring

program requirements and procedures. The criteria used to assess the need for groundwater monitoring varies among the regulatory entities. There are thirteen programs in three agencies monitoring changes in groundwater quality for permit and operational requirements at more than 8,650 facilities statewide. An estimated 24,650 monitor and water wells are being used for groundwater monitoring purposes at these facilities. The majority (greater than 98%) of the facilities being monitored are under the jurisdiction of the TNRCC, with the remainder under the jurisdiction of the RCT, and the TDH.

Some agencies or entities do not have specific regulatory functions which would be served by groundwater monitoring programs. Agencies or entities such as the TWDB and the member districts of the Texas Alliance of Groundwater Districts conduct groundwater monitoring to assess ambient or existing groundwater quality conditions and to track changes in water quality over time. Some monitoring programs are developed for water quality assessment studies which target specific geographic areas, specific contaminants or constituents, or specific activities. Contamination cases discovered by these agencies or entities through groundwater studies or groundwater sampling programs are referred to the regulatory agency with appropriate jurisdiction.

Regulatory groundwater monitoring data is extensive in many program areas. However, the application of monitoring requirements within and across regulatory programs can be diverse, dependent upon the level of program development and the potential of the regulated activity to impact public health. Many non-permitted facilities were in existence prior to the implementation of the current regulatory program, and are therefore exempt or grandfathered from monitoring requirements. In the wastewater programs, there are also areas where monitoring is not required, however permits for older facilities are now are limited to a five year duration, and any change in the permit for municipal, agricultural, and industrial wastewater treatment facilities will subject the facility to a review of it's potential for groundwater impact. Monitoring for pesticides in groundwater targets only areas with the highest risk for impact, as determined by a vulnerability assessment, and is not routinely conducted statewide.

As defined by Committee rules (Title 30, Texas Administrative Code, § 601.3) for inclusion in the annual joint report, groundwater contamination is the detrimental alteration of the naturally occurring physical, thermal, chemical, or biological quality of groundwater reasonably suspected of having been caused by the activities of entities under the jurisdiction of the agencies with groundwater protection responsibilities. The Committee recognizes that groundwater contamination may result from many sources, including current and past oil and gas production and related practices,

agricultural activities, industrial and manufacturing processes, commercial and business endeavors, domestic activities, and natural sources that may be influenced by, or may result from, human activities. The contamination cases identified in the annual joint report are primarily those where contaminants have been discharged to the surface, to the shallow subsurface, or directly to groundwater from activities such as the storage, processing, transport, or disposal of products or waste materials.

There were 7,627 documented groundwater contamination cases addressed in the 1998 (most recently published) joint report. Approximately 99 percent of the reported cases were under the jurisdiction of the TNRCC. The remainder of the cases were under the jurisdiction of the RCT and the groundwater conservation districts which make up the Texas Alliance of Groundwater Districts. The vast majority of the cases documented under the jurisdiction of the TNRCC were identified through regulatory compliance monitoring, while the cases under the jurisdiction of the RCT and the groundwater conservation districts were identified from special studies, investigations in response to complaints, or ambient groundwater quality monitoring activities (TGWPC, 1998).

The most common contaminants reported in 1998 included gasoline, diesel, and other petroleum products, due to the large number of petroleum storage tank related cases in this report. Less common contaminants included volatile organic compounds (such as benzene, toluene, xylene, phenol, trichloroethylene, carbon tetrachloride, dichloroethylene, and naphthalene), pesticides (such as alachlor, atrazine, bromacil, dicamba, and prometon), creosote constituents, solvents, heavy metals, and sodium chloride (TGWPC, 1998).

In general, once groundwater contamination has been confirmed through regulatory compliance monitoring, the case will follow a generic sequence of actions until the investigation concludes no further action is necessary. The sequence of actions generally consists of confirmation of the contamination; an investigation to study the extent, composition, and circumstances of the contamination; the planning of corrective action measures based upon the investigation; the implementation of the corrective action plan; monitoring of the effectiveness of the corrective action measures; and ultimately, the completion of the corrective action measures. Table 77 is a list of ten major contaminant sources, some of which are quantifiable through information obtained from documented cases of groundwater contamination, and some selected using best professional judgement and from reliable but anecdotal information.

Figure 30 shows the number of regulated facilities with known groundwater contamination by county, and Table 78 lists statewide documented groundwater contamination case data collected by the

TNRCC for 1998, by agency and division. Table 79 is a "Groundwater Contamination Summary" listing sites with groundwater contamination by source type for all counties which contain outcrop of the nine selected aquifers inventoried in this report. Since spatial data does not exist for most of these facilities, it is difficult to correlate this groundwater contamination data with aquifer locations. These facilities are currently listed by county, but the TNRCC has begun to collect spatial location (latitude and longitude) data so that the distribution of facilities with known groundwater contamination can be analyzed precisely.

Public water supply (PWS) system water quality data is maintained by the TNRCC for all drinking water systems in Texas. Many PWS systems obtain some or all of their water from groundwater sources (Figure 31), and all systems must have periodic outflow water quality testing. It is difficult to use this data for ambient monitoring purposes since testing is performed after treatment, yielding results which are not representative of in situ groundwater quality. A few sites with known groundwater contamination are listed in the *Joint Groundwater Monitoring and Contamination Report*. In the 1996 report, 2 aquifers were analyzed for ambient purposes. This analysis was not performed for this inventory cycle because it is difficult to associate analytical data with specific wells and accurate well completion data was not available. The TNRCC is currently reviewing submitted monitoring data to recognize data useful for ambient monitoring and as indicators of groundwater quality. When this is accomplished, and since PWS systems are precisely geographically located, the data will be used to provide additional aquifer-level analyses of ambient groundwater quality.

Groundwater Quality Data

The 2000 groundwater inventory efforts show that ambient groundwater quality in Texas varies among the eighteen study aquifers, with maximum contaminant level (MCL) exceedances occurring for some parameters (nitrate, sulfate, total dissolved solids, or others) in groundwater taken from water wells sampled in the Ogalalla aquifer in the Texas Panhandle; in some wells in the Edwards-Trinity, Cenozoic Pecos Alluvium, Capitan Reef Complex, and Rustler aquifers in West Texas; in some wells in the Gulf Coast aquifer; in the majority of the wells in the Blaine and Lipan aquifers in the north-central and west-central parts of Texas. Fluoride (naturally occurring) appears as a secondary contaminant of concern sporadically throughout the wells sampled. Wells sampled in the Seymour aquifer indicate that nitrate is also a major concern in north-central Texas. Ambient groundwater quality is generally good in the other aquifers inventoried in 1998 and 1999.

In the following section, each inventoried aquifer is illustrated on a map delineating aquifer outcrop, downdip extent if present, sample well locations, and wells with groundwater samples which exceeded the maximum contamination level (MCL) for nitrate according to EPA drinking water standards. Each map is followed by an "Ambient Monitoring Groundwater Quality Data " table listing drinking water standard parameter analyses and a "Groundwater Contamination Summary" table listing the program-specific number of contaminated sites in counties where subject aquifers outcrop. Since spatial data for these facilities is not available, they may not occur at an aquifer location in particular counties. Note that sites may be counted more than once in the latter table if they occur in a county where more than one aquifer is present. This redundancy is not reflected in Table 79.

Groundwater contamination at regulated facilities occurs principally in heavily populated areas of the state, such as Houston, Dallas, Fort Worth, San Antonio and El Paso, primarily at petroleum storage tank facilities. An evaluation of the spatial occurrence of regulated facility and PWS system groundwater impacts will be completed and reported in a subsequent inventory.

Comparing ambient water quality data to the occurrence of contamination sites suggests that a high concentration of regulated surface activity sites with groundwater contamination does not correlate with area-wide ambient groundwater degradation. This is understandable, given that contamination from most regulated surface activities tends to impact shallow, local water bearing zones that are separated from the major and minor aquifers.

Table 77. Ten Major Sources of Documented/Potential Groundwater Contamination

Contaminant Source	Factors Considered in Selecting a Contaminant Source [1]	Contaminants [2]
Storage, Treatment, and Disposal Activities		
Storage tanks (underground)	A, B, C, D	D, C
Storage tanks (above ground)	A, B, C, D	D, C
Surface impoundments	A, F, D, C, G	D, G, H, A, B
Landfills	A, F, D, E, G	C, G, A, B, H
Septic systems	F, B, C, D, E, G	E, B, A
Agricultural Activities		
Unknown/not quantified	A, F, C, D, E, G	E, A, B
Other		
Abandoned wells	A, F, C, D, E, G	NA
Oil & Gas activities	F, C, D, E, G	D, G
Grandfathered sites/past practices	A, F, D, E, G	D, E, G, H, A, B
Natural sources	F, E, G, I	G, F, E, H

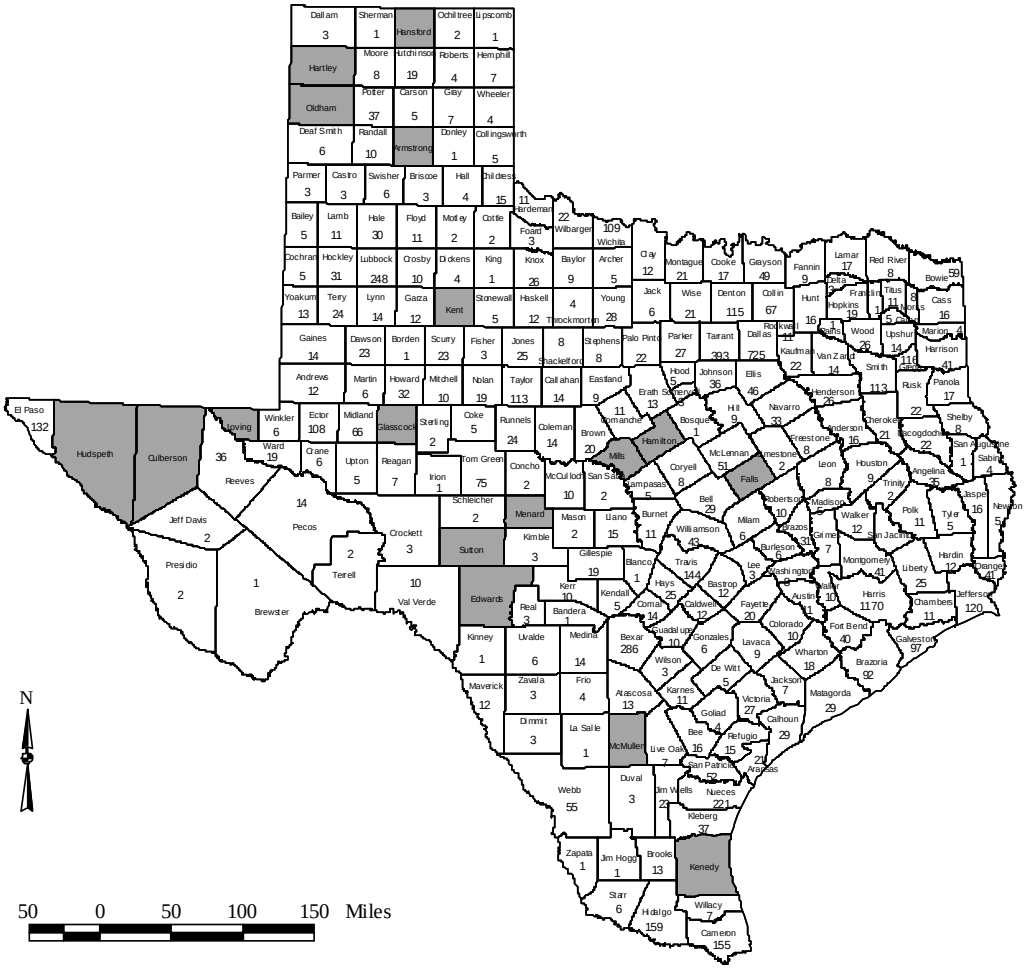
1. Factors Considered for Selection

A. Documented from mandatory reporting
B. Size of population at risk
C. Location of the sources relative to drinking water sources
D. Number and/or size of contaminant sources
E. Hydrogeologic sensitivity
F. Potential from state and other findings
G. Geographic distribution/occurrence
H. Human health and/or environmental risk (toxicity)
I. Other criteria (described in narrative)

2. Contaminants

A. Inorganic compounds
B. Organic compounds
C. Halogenated solvents
D. Petroleum compounds
E. Nitrate
F. Fluoride
G. Salinity/brine
H. Metals

Figure 30. Texas Regulated Facilities With Known Groundwater Contamination



State of Texas Water Quality Inventory - Number of texas Regulated Facilities With Known Groundwater Contamination By County

Data Provided by the Texas Natural Resource Conservation Commission - 1998

TNRCC

Table 78. Statewide Documented Groundwater Contamination Cases by Agency/Activity Status, 1998

Agency/Division	Total Cases (1998)[1]	New Cases (1998)[2]	Activity Status Code[3]							
			0	1	2	3	4	5	6	None
Texas Natural Resource Conservation Commission										
/Remediation Division - Corrective Action Section	501	63	18	31	182	113	114	84	15	6
/Remediation Division - Voluntary Cleanup Section	333	99	19	3	157	41	32	25	56	0
/Remediation Division - Petroleum Storage Tanks Section	6341	1116	0	1405	3530	132	301	168	805	0
/Remediation Division - Superfund Cleanup Section	58	3	0	3	20	14	11	8	3	5
/Remediation Division - Superfund Site Discovery & Assessment	35	1	2	23	1	0	9	6	0	0
/Remediation Division -Voluntary Cleanup/Innocent Landowner	33	33	0	0	31	0	0	1	1	0
/Enforcement Division	99	11	2	8	4	230	10	12	0	1
/Field Operations Division	11	0	0	0	3	0	1	0	5	2
/Permitting Division - Municipal Solid Waste Section	25	2	0	0	13	5	1	5	4	0
/Water Quality Division	47	1	0	26	15	0	4	6	0	0
/Water Utilities Division	30	6	0	1	0	2	0	7	20	0
Subtotal	7513	1335	41	1500	3956	537	483	322	909	14
Railroad Commission of Texas/Oil and Gas Division	94	25	0	9	15	19	25	14	12	0
Texas Alliance of Groundwater Districts	20	2	6	4	8	1	1	0	0	0
Total	7627	1362	47	1513	3979	557	509	336	921	14

Notes:
1. Total number of groundwater contamination cases documented or under enforcement during calender year 1998.
2. Number of new cases documented or under enforcement during calender year 1998.
3. Activity Status Codes: 0—No Activity; 1—Contamination Confirmed; 2—Ongoing Investigation; 3—Corrective Action Planning; 4—Corrective Action Implementation; 5—Monitoring Action; 6—Action Completed Facilities may have more than one Activity Status Code.

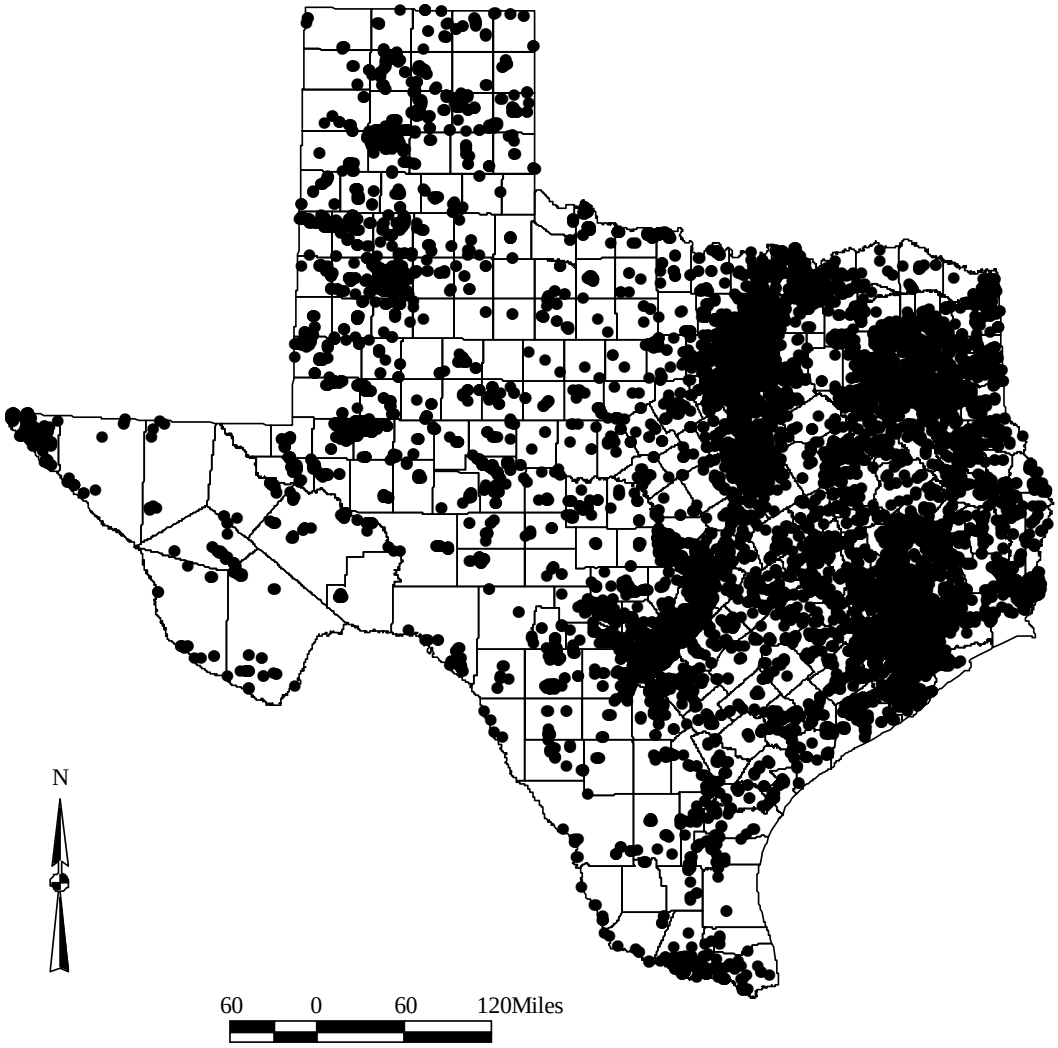
Table 79. Groundwater Contamination Summary / Selected Major and Minor Aquifers Outcrops (1998)

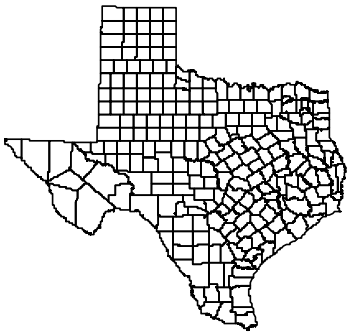
Source Type	Documented Groundwater Contamination Present in Reporting Area	Number of Sites With Confirmed Groundwater Contamination	Site Activity Status						Contaminants
			Contamination Confirmation	Ongoing Investigation	Corrective Action Planning	Corrective Action Implemented	Monitoring of Corrective Action	Action Completed	
NPL	Yes	39	7	9	7	10	6	3	VOCs, chromium benzene, TCE, high explosives,
CERCLIS (non-NPL)	Yes	8		2		6			
DOD/DOE	Yes	4		2				1	benzene, TCE, high explosives, chromium
LUST*	Yes	3651	711	2084	91	192	128	471	gasoline, diesel, waste oil, jet fuel, BTEX, TPH
RCRA Corrective Action	Yes	335	14	118	30	67	84	22	VOCs, BTEX, TPH, chromium, lead
Underground Injection	No								
State Sites	Yes	45	15	7	7	9	8	10	
Nonpoint Sources	Yes	36	30	1		4	1		pesticides, nitrate, arsenic
Oil/Gas Activities	Yes	59	8	12	14	13	9	9	VOCs, NaCl, crude oil, natural gas, HCL, sulfates, chromium
Totals		4168	800	2229	142	296	230	666	

NPL - National Priority List
DOE - Department of Energy
LUST - Leaking Underground Storage Tanks
*These sites may be combined with NPL sites

CERCLIS (non-NPL) - Comprehensive Environmental Response, Compensation, and Liability Information System
DOD - Department of Defense
RCRA - Resource Conservation and Recovery Act

Figure 31. Public Water Supply Wells



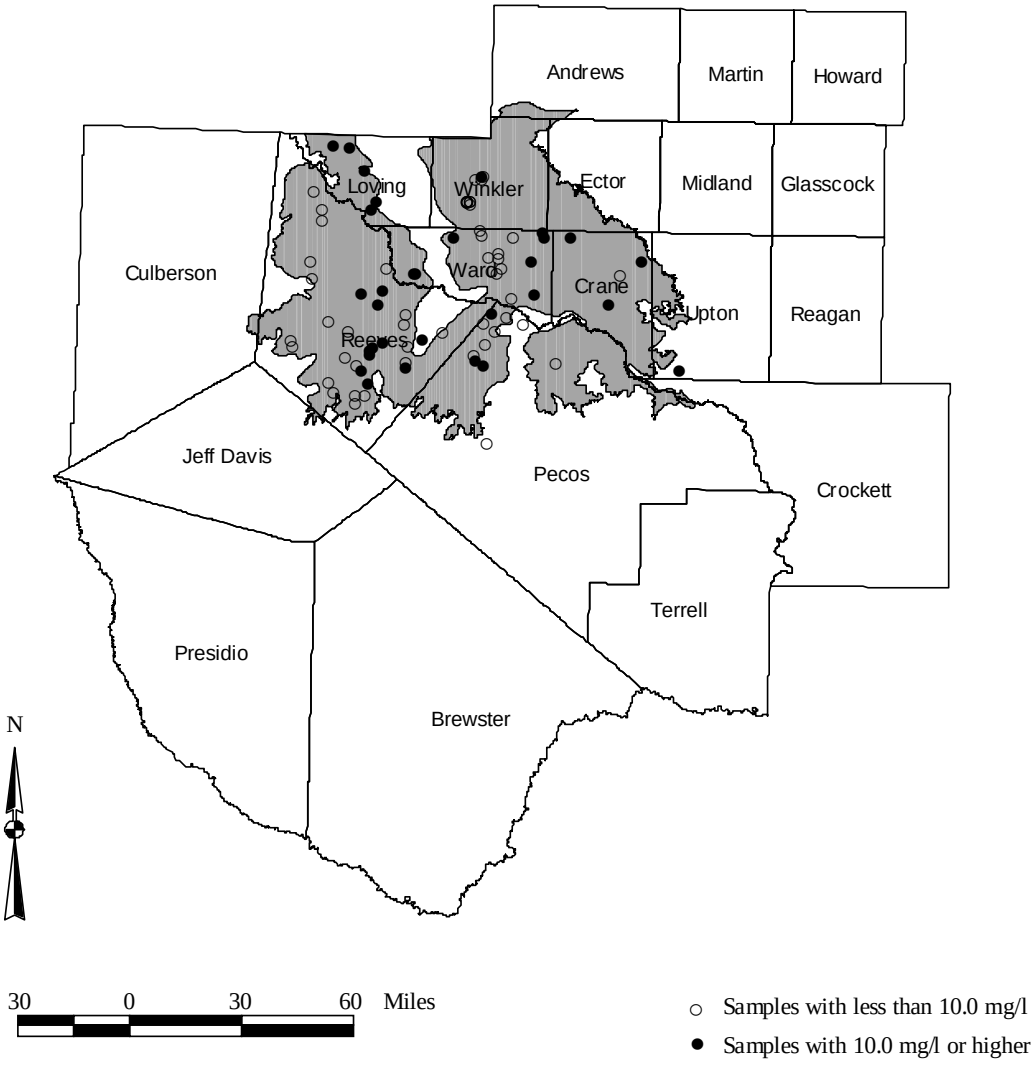


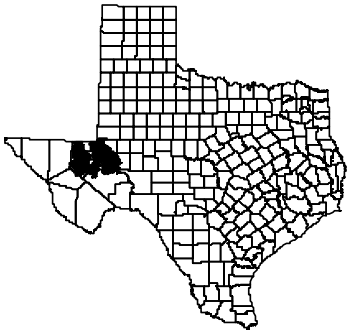
State of Texas Water Quality Inventory - Texas Public Water Supply Wells

Data provided by the Texas Natural Resource Conservation Commission - 1998

TNRCC

Figure 32. Cenezoic Pecos Alluvium Aquifer





State of Texas Water Quality Inventory - Nitrate Concentrations in Water Wells

Water monitoring data provided by the Texas Water Development Board - 1995

TNRCC

Table 80. Ambient Monitoring Groundwater Quality Data
Cenozoic Pecos Alluvium Aquifer (1995)

Parameter Groups	Maximum Contamination Limit (MCL)	Number of Wells			
		Total Wells Sampled	< MDL[1]	< MCL[2] (other than <MDL)	$MCL
Primary Constituents					
Arsenic	50 µg/l	95	68	27	0
Barium	2 mg/l	95	3	92	0
Cadmium	5 µg/l	95	91	2	2
Chromium	100 µg/l	93	78	15	0
Fluoride	4 mg/l	95	3	91	1
Mercury	2 µg/l	93	91	2	0
Nitrate (N)	10 mg/l	95	3	49	43
Selenium	50 µg/l	94	84	8	2
Secondary Constituents					
Chloride	300 mg/l	95	0	46	49
Copper	1 mg/l	93	79	14	0
Fluoride	2 mg/l	95	3	73	19
Iron	0.3 mg/l	94	12	73	9
Manganese	50 µg/l	95	50	37	8
Silver	100 µg/l	94	84	8	0
Sulfate	300 mg/l	95	0	35	60
Dissolved Solids	1000 mg/l	95	0	30	65
Zinc	5 mg/l	93	17	76	0
Radioactivity					
Gross Alpha	15 pCi/l	95	28	51	16
Beta	50 pCi/l	95	16	76	3

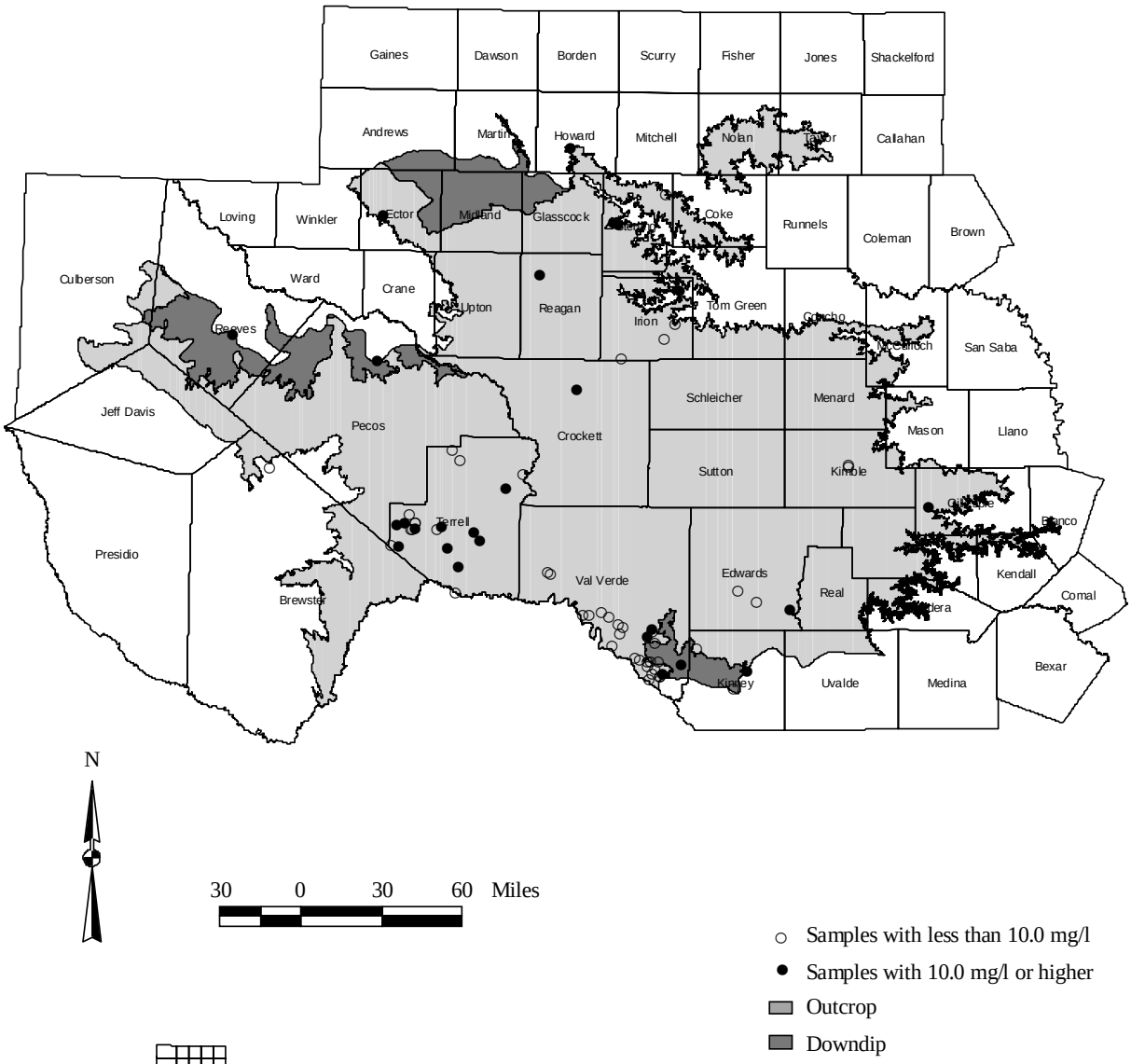
Notes:
1. MDL = Method Detection Limit. The MDL is the lowest analysis value available for a particular constituent analysis at a particular sampling event. The MDL is determined by the analyzing laboratory.
2. MCL = Maximum Contamination Level. The MCL of a particular constituent is the maximum analysis level for safe drinking water. MDL's for certain constituents at certain sampling events were greater than the MCL's, and analyses from those events were not utilized when counting samples less than or greater than particular MCL's.

Table 81. Groundwater Contamination Summary
Cenozoic Pecos Alluvium Aquifer Outcrop (1997)

Source Type	Documented Groundwater Contamination Present in Reporting Area	Number of Sites With Confirmed Groundwater Contamination	Site Activity Status						Contaminants
			Contamination Confirmation	Ongoing Investigation	Corrective Action Planning	Corrective Action Implemented	Monitoring of Corrective Action	Action Completed	
NPL	Yes	7	1	2		3			chromium
CERCLIS (non-NPL)	No								
DOD/DOE	No								
LUST	Yes	139	20	87	6	10	4	12	gasoline, diesel, waste oil, jet fuel, BTEX, TPH
RCRA Corrective Action	Yes	29		8	6	4	9	2	VOCs, BTEX, TPH, chromium, lead
Underground Injection	No								
State Sites*	No								
Nonpoint Sources	No								
Oil/Gas Activities	Yes	9	2	1	2	1	3		VOCs, NaCl, crude oil, HCL, sulfates, chromium
Totals		189	23	98	15	18	16	14	

NPL - National Priority List
DOE - Department of Energy
LUST - Leaking Underground Storage Tanks
*These sites may be combined with NPL sites
CERCLIS (non-NPL) - Comprehensive Environmental Response, Compensation, and Liability Information System
DOD - Department of Defense
RCRA - Resource Conservation and Recovery Act

Figure 33. Edwards - Trinity (Plateau) Aquifer



State of Texas Water Quality Inventory - Nitrate Concentrations in Water Wells

Water monitoring data provided by the Texas Water Development Board - 1996

TNRCC

Table 82. Ambient Monitoring Groundwater Quality Data
Edwards-Trinity (Plateau) Aquifer (1996)

Parameter Groups	Maximum Contamination Limit (MCL)	Number of Wells			
		Total Wells Sampled	< MDL	< MCL (other than <MDL)	$MCL
Primary Constituents					
Arsenic	50 µg/l	71	56	15	0
Barium	2 mg/l	71	0	71	0
Cadmium	5 µg/l	58	58	0	0
Chromium	100 µg/l	58	44	14	0
Fluoride	4 mg/l	72	8	64	0
Mercury	2 µg/l	51	48	3	0
Nitrate (N)	10 mg/l	72	2	44	26
Selenium	50 µg/l	71	61	9	1
Secondary Constituents					
Chloride	300 mg/l	72	0	65	7
Copper	1 mg/l	71	36	35	0
Fluoride	2 mg/l	72	8	57	7
Iron	0.3 mg/l	76	39	20	17
Manganese	50 µg/l	72	33	36	3
Silver	100 µg/l	53	52	1	0
Sulfate	300 mg/l	72	0	65	7
Dissolved Solids	1000 mg/l	72	0	64	8
Zinc	5 mg/l	71	4	67	0
Radioactivity					
Gross Alpha	15 pCi/l	54	13	33	8
Beta	50 pCi/l	54	22	31	1

Notes:
1. MDL = Method Detection Limit. The MDL is the lowest analysis value available for a particular constituent analysis at a particular sampling event. The MDL is determined by the analyzing laboratory.
2. MCL = Maximum Contamination Level. The MCL of a particular constituent is the maximum analysis level for safe drinking water. MDL's for certain constituents at certain sampling events were greater than the MCL's, and analyses from those events were not utilized when counting samples less than or greater than particular MCL's.

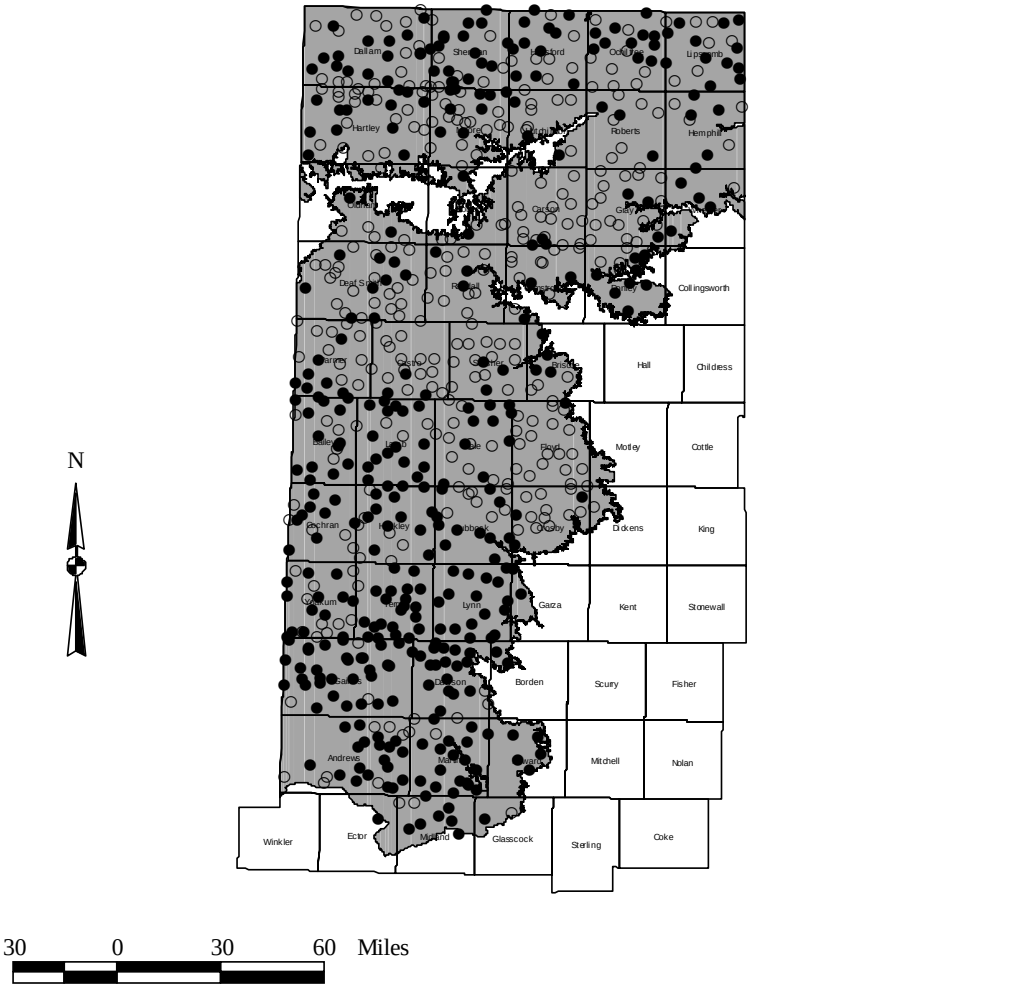
Table 83. Groundwater Contamination Summary
Edwards - Trinity (Plateau) Aquifer Outcrop (1997)

Source Type	Documented Groundwater Contamination Present in Reporting Area	Number of Sites With Confirmed Groundwater Contamination	Site Activity Status						Contaminants
			Contamination Confirmation	Ongoing Investigation	Corrective Action Planning	Corrective Action Implemented	Monitoring of Corrective Action	Action Completed	
NPL	Yes	7	1	2	1	3			chromium
CERCLIS (non-NPL)	No								
DOD/DOE	No								
LUST	Yes	449	79	260	20	25	8	57	gasoline, diesel, waste oil, jet fuel, BTEX, TPH
RCRA Corrective Action	Yes	65		22	15	7	16	3	VOCs, BTEX, TPH, chromium, lead
Underground Injection	No								
State Sites*	No								
Nonpoint Sources	Yes	5	5						pesticides, nitrate, arsenic
Oil/Gas Activities	Yes	18	3	2	2	6	4	1	NaCl, crude oil, natural gas, HCL, sulfates, chromium
Totals		544	88	286	38	41	28	61	

NPL - National Priority List
DOE - Department of Energy
LUST - Leaking Underground Storage Tanks
*These sites may be combined with NPL sites

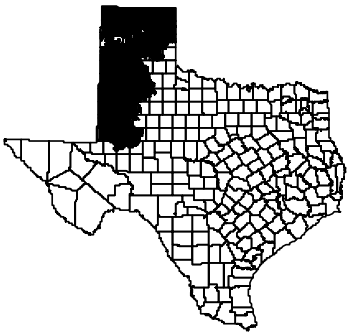
CERCLIS (non-NPL) - Comprehensive Environmental Response, Compensation, and Liability Information System
DOD - Department of Defense
RCRA - Resource Conservation and Recovery Act

Figure 34. Ogallala Aquifer



○ Samples with less than 10.0 mg/l

● Samples with 10.0 mg/l or higher



State of Texas Water Quality Inventory - Nitrate Concentrations in Water Wells

Water monitoring data provided by the Texas Water Development Board - 1996

TNRCC

Table 84. Ambient Monitoring Groundwater Quality Data
Ogallala Aquifer (1996)

Parameter Groups	Maximum Contamination Limit (MCL)	Number of Wells			
		Total Wells Sampled	< MDL	< MCL (other than <MDL)	$MCL
Primary Constituents					
Arsenic	50 µg/l	723	117	594	12
Barium	2 mg/l	724	2	722	0
Cadmium	5 µg/l	26	26	0	0
Chromium	100 µg/l	26	2	24	0
Fluoride	4 mg/l	724	1	586	137
Mercury	2 µg/l	26	21	5	0
Nitrate (N)	10 mg/l	724	3	336	385
Selenium	50 µg/l	723	237	415	71
Secondary Constituents					
Chloride	300 mg/l	724	0	640	84
Copper	1 mg/l	723	149	574	0
Fluoride	2 mg/l	724	1	353	370
Iron	0.3 mg/l	737	317	394	26
Manganese	50 µg/l	723	469	238	16
Silver	100 µg/l	26	26	0	0
Sulfate	300 mg/l	724	0	621	103
Dissolved Solids	1000 mg/l	724	0	599	125
Zinc	5 mg/l	723	25	698	0
Radioactivity					
Gross Alpha	15 pCi/l	25	1	20	4
Beta	50 pCi/l	25	1	24	0

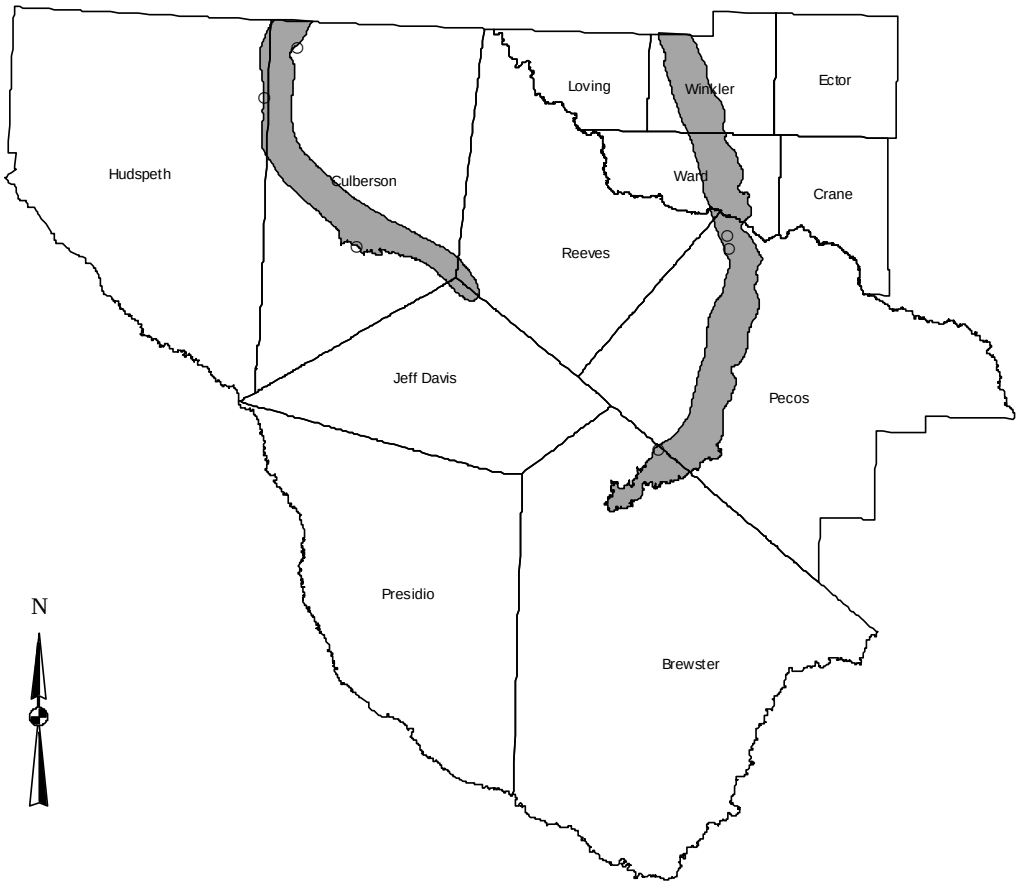
Notes:
1. MDL = Method Detection Limit. The MDL is the lowest analysis value available for a particular constituent analysis at a particular sampling event. The MDL is determined by the analyzing laboratory.
2. MCL = Maximum Contamination Level. The MCL of a particular constituent is the maximum analysis level for safe drinking water. MDL's for certain constituents at certain sampling events were greater than the MCL's, and analyses from those events were not utilized when counting samples less than or greater than particular MCL's.

Table 85. Groundwater Contamination Summary
Ogallala Aquifer Outcrop (1997)

Source Type	Documented Groundwater Contamination Present in Reporting Area	Number of Sites With Confirmed Groundwater Contamination	Site Activity Status						Contaminants
			Contamination Confirmation	Ongoing Investigation	Corrective Action Planning	Corrective Action Implemented	Monitoring of Corrective Action	Action Completed	
NPL	Yes	11	5	2	1	3			benzene, TCE, high explosives, chromium
CERCLIS (non-NPL)	No								
DOD/DOE	Yes	1		1					benzene, TCE, high explosives, chromium
LUST	Yes	649	101	417	25	29	9	68	gasoline, diesel, waste oil, jet fuel, BTEX, TPH
RCRA Corrective Action	Yes	87	1	18	13	15	32	6	VOCs, BTEX, TPH, chromium, lead
Underground Injection	No								
State Sites*	No								
Nonpoint Sources	Yes	11	11						pesticides, arsenic
Oil/Gas Activities	Yes	25	5	6	5	3	5	1	VOCs, NaCl, crude oil, natural gas, HCL, sulfates, chromium
Totals		784	123	444	44	50	46	75	

NPL - National Priority List
DOE - Department of Energy
LUST - Leaking Underground Storage Tanks
*These sites may be combined with NPL sites
CERCLIS (non-NPL) - Comprehensive Environmental Response, Compensation, and Liability Information System
DOD - Department of Defense
RCRA - Resource Conservation and Recovery Act

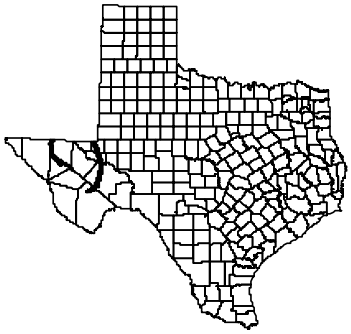
Figure 35. Capitan Reef Complex Aquifer



20 0 20 40 Miles

○ Samples with less than 10.0 mg/l

● Samples with 10.0 mg/l or higher



State of Texas Water Quality Inventory - Nitrate Concentrations in Water Wells

Water monitoring data provided by the Texas Water Development Board - 1995

TNRCC

Table 86. Ambient Monitoring Groundwater Quality Data
Capitan Reef Complex Aquifer (1995)

Parameter Groups	Maximum Contamination Limit (MCL)	Number of Wells			
		Total Wells Sampled	< MDL	< MCL (other than <MDL)	$MCL
Primary Constituents					
Arsenic	50 µg/l	12	10	2	0
Barium	2 mg/l	12	1	11	0
Cadmium	5 µg/l	12	12	0	0
Chromium	100 µg/l	9	7	2	0
Fluoride	4 mg/l	12	0	12	0
Mercury	2 µg/l	5	2	3	0
Nitrate (N)	10 mg/l	12	0	12	0
Selenium	50 µg/l	12	10	0	0
Secondary Constituents					
Chloride	300 mg/l	12	0	3	9
Copper	1 mg/l	11	8	3	0
Fluoride	2 mg/l	12	0	6	6
Iron	0.3 mg/l	11	5	3	3
Manganese	50 µg/l	12	5	3	4
Silver	100 µg/l	10	9	0	1
Sulfate	300 mg/l	12	0	4	8
Dissolved Solids	1000 mg/l	12	0	2	10
Zinc	5 mg/l	11	7	4	0
Radioactivity					
Gross Alpha	15 pCi/l	11	2	3	6
Beta	50 pCi/l	11	1	8	2

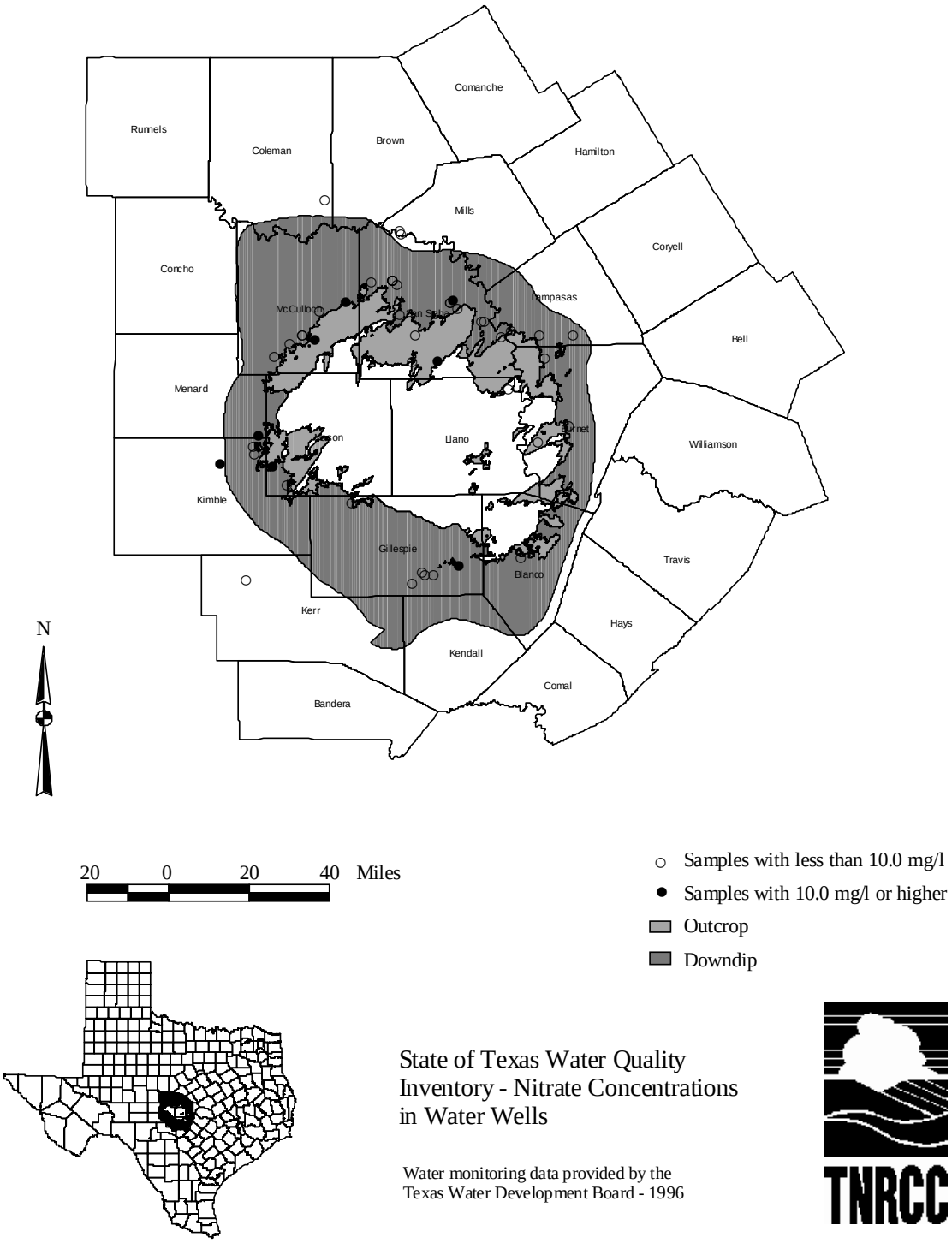
Notes:
1. MDL = Method Detection Limit. The MDL is the lowest analysis value available for a particular constituent analysis at a particular sampling event. The MDL is determined by the analyzing laboratory.
2. MCL = Maximum Contamination Level. The MCL of a particular constituent is the maximum analysis level for safe drinking water. MDL's for certain constituents at certain sampling events were greater than the MCL's, and analyses from those events were not utilized when counting samples less than or greater than particular MCL's.

Table 87. Groundwater Contamination Summary
Capitan Reef Complex Aquifer Outcrop (1997)

Source Type	Documented Groundwater Contamination Present in Reporting Area	Number of Sites With Confirmed Groundwater Contamination	Site Activity Status						Contaminants
			Contamination Confirmation	Ongoing Investigation	Corrective Action Planning	Corrective Action Implemented	Monitoring of Corrective Action	Action Completed	
NPL	No								
CERCLIS (non-NPL)	No								
DOD/DOE	No								
LUST	Yes	65	11	39	1	4	2	8	gasoline, diesel, waste oil, jet fuel, BTEX, TPH
RCRA Corrective Action	Yes	3		2			1		VOCs, DDT, dieldrin, methyl parathion
Underground Injection	No								
State Sites*	No								
Nonpoint Sources	No								
Oil/Gas Activities	Yes	8	2		1	1	1		VOCs, crude oil, sulfates
Totals		73	13	41	2	5	4	8	

NPL - National Priority List
DOE - Department of Energy
LUST - Leaking Underground Storage Tanks
*These sites may be combined with NPL sites
CERCLIS (non-NPL) - Comprehensive Environmental Response, Compensation, and Liability Information System
DOD - Department of Defense
RCRA - Resource Conservation and Recovery Act

Figure 36. Ellenberger - San Saba Aquifer



State of Texas Water Quality Inventory - Nitrate Concentrations in Water Wells

Water monitoring data provided by the Texas Water Development Board - 1996

TNRCC

Table 88. Ambient Monitoring Groundwater Quality Data
Ellenberger - San Saba Aquifer (1996)

Parameter Groups	Maximum Contamination Limit (MCL)	Number of Wells			
		Total Wells Sampled	< MDL	< MCL (other than <MDL)	$MCL
Primary Constituents					
Arsenic	50 µg/l	44	35	9	0
Barium	2 mg/l	44	0	44	0
Cadmium	5 µg/l	16	16	0	0
Chromium	100 µg/l	16	16	0	0
Fluoride	4 mg/l	44	0	40	4
Mercury	2 µg/l	16	16	0	0
Nitrate (N)	10 mg/l	44	11	26	8
Selenium	50 µg/l	44	34	7	3
Secondary Constituents					
Chloride	300 mg/l	44	0	37	7
Copper	1 mg/l	44	18	26	0
Fluoride	2 mg/l	44	0	37	7
Iron	0.3 mg/l	44	30	6	8
Manganese	50 µg/l	44	26	17	1
Silver	100 µg/l	16	16	0	0
Sulfate	300 mg/l	44	3	40	1
Dissolved Solids	1000 mg/l	44	0	36	8
Zinc	5 mg/l	44	11	33	0
Radioactivity					
Gross Alpha	15 pCi/l	38	13	18	9
Beta	50 pCi/l	38	18	18	3

Notes:
1. MDL = Method Detection Limit. The MDL is the lowest analysis value available for a particular constituent analysis at a particular sampling event. The MDL is determined by the analyzing laboratory.
2. MCL = Maximum Contamination Level. The MCL of a particular constituent is the maximum analysis level for safe drinking water. MDL's for certain constituents at certain sampling events were greater than the MCL's, and analyses from those events were not utilized when counting samples less than or greater than particular MCL's.

Table 89. Groundwater Contamination Summary
Ellenberger - San Saba Aquifer Outcrop (1997)

Source Type	Documented Groundwater Contamination Present in Reporting Area	Number of Sites With Confirmed Groundwater Contamination	Site Activity Status						Contaminants
			Contamination Confirmation	Ongoing Investigation	Corrective Action Planning	Corrective Action Implemented	Monitoring of Corrective Action	Action Completed	
NPL	Yes	1	1						VOCs
CERCLIS (non-NPL)	No								
DOD/DOE	No								
LUST	Yes	55	15	30	2	4		4	gasoline, diesel, waste oil, jet fuel, BTEX, TPH
RCRA Corrective Action	Yes	8		2			2		VOCs, nitrate, pesticides, arsenic
Underground Injection	No								
State Sites*	No								
Nonpoint Sources	No								
Oil/Gas Activities	No								
Totals		64	16	32	2	4	2	4	

NPL - National Priority List
DOE - Department of Energy
LUST - Leaking Underground Storage Tanks
*These sites may be combined with NPL sites

CERCLIS (non-NPL) - Comprehensive Environmental Response, Compensation, and Liability Information System
DOD - Department of Defense
RCRA - Resource Conservation and Recovery Act

Figure 37. Hickory Aquifer

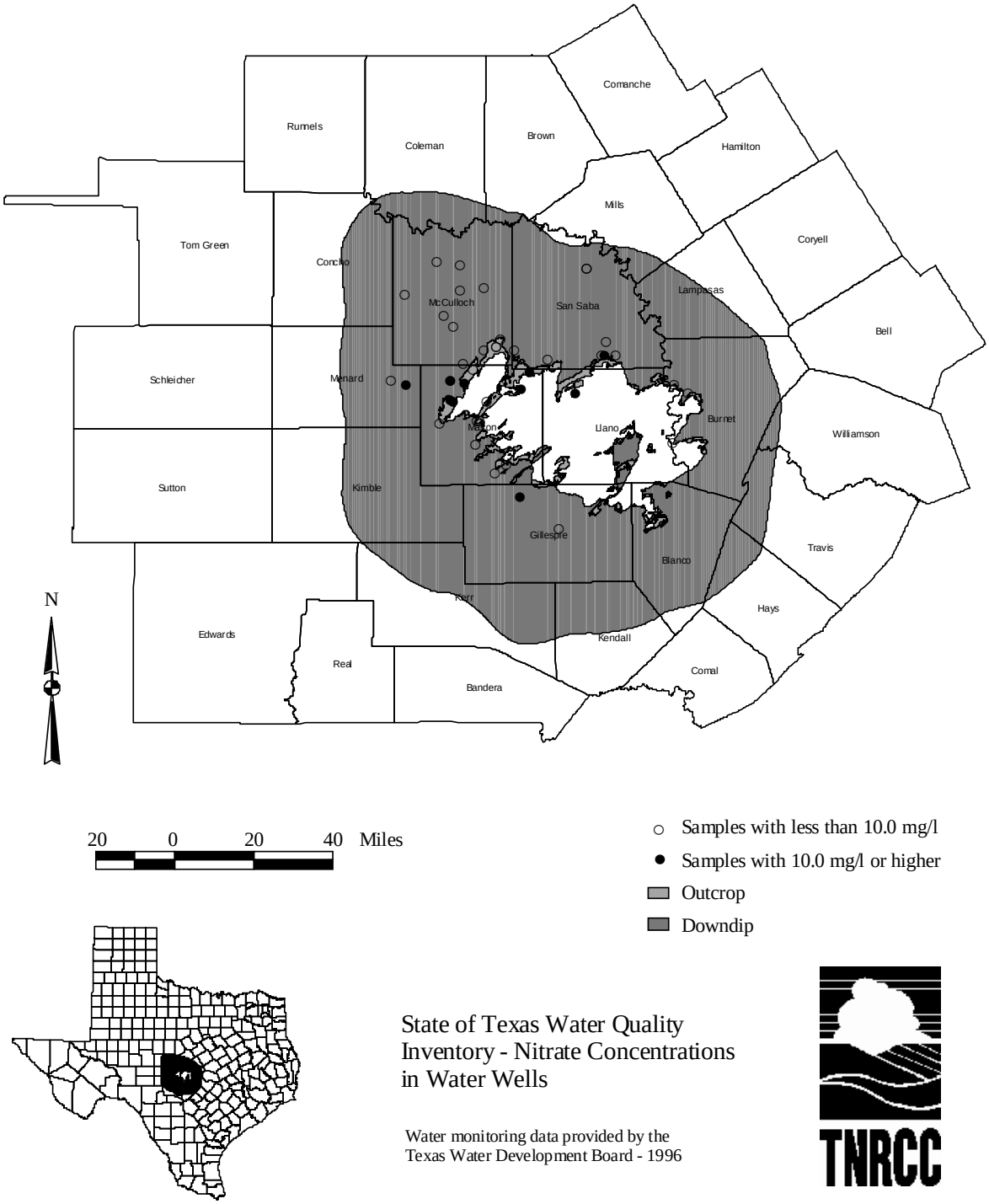


Table 90. Ambient Monitoring Groundwater Quality Data
Hickory Aquifer (1996)

Parameter Groups	Maximum Contamination Limit (MCL)	Number of Wells			
		Total Wells Sampled	< MDL	< MCL (other than <MDL)	$MCL
Primary Constituents					
Arsenic	50 µg/l	40	37	4	0
Barium	2 mg/l	40	1	39	0
Cadmium	5 µg/l	11	11	0	0
Chromium	100 µg/l	11	11	0	0
Fluoride	4 mg/l	40	0	39	1
Mercury	2 µg/l	11	11	0	0
Nitrate (N)	10 mg/l	40	11	19	10
Selenium	50 µg/l	40	36	4	0
Secondary Constituents					
Chloride	300 mg/l	40	0	39	1
Copper	1 mg/l	40	16	24	0
Fluoride	2 mg/l	40	0	36	4
Iron	0.3 mg/l	41	26	8	7
Manganese	50 µg/l	40	20	17	3
Silver	100 µg/l	11	11	0	0
Sulfate	300 mg/l	40	0	40	0
Dissolved Solids	1000 mg/l	40	0	40	1
Zinc	5 mg/l	40	17	23	0
Radioactivity					
Gross Alpha	15 pCi/l	40	4	21	17
Beta	50 pCi/l	40	7	30	4

Notes:
1. MDL = Method Detection Limit. The MDL is the lowest analysis value available for a particular constituent analysis at a particular sampling event. The MDL is determined by the analyzing laboratory.
2. MCL = Maximum Contamination Level. The MCL of a particular constituent is the maximum analysis level for safe drinking water. MDL's for certain constituents at certain sampling events were greater than the MCL's, and analyses from those events were not utilized when counting samples less than or greater than particular MCL's.

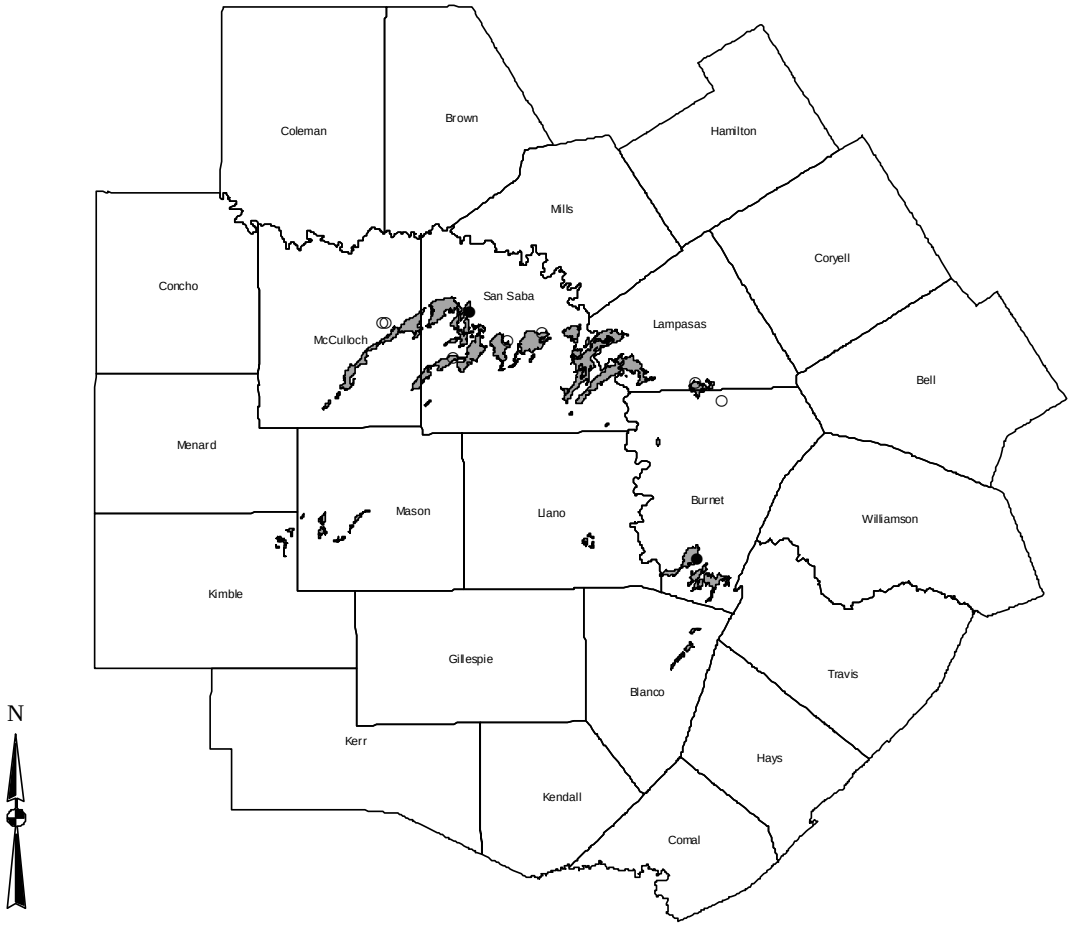
Table 91. Groundwater Contamination Summary
Hickory Aquifer Outcrop (1997)

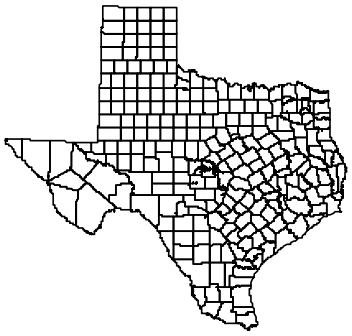
Source Type	Documented Groundwater Contamination Present in Reporting Area	Number of Sites With Confirmed Groundwater Contamination	Site Activity Status						Contaminants
			Contamination Confirmation	Ongoing Investigation	Corrective Action Planning	Corrective Action Implemented	Monitoring of Corrective Action	Action Completed	
NPL	Yes	1	1						VOCs
CERCLIS (non-NPL)	No								
DOD/DOE	No								
LUST	Yes	49	15	25	1	4		4	gasoline, diesel, waste oil, jet fuel, BTEX, TPH
RCRA Corrective Action	Yes	5	1	2			1		VOCs, pesticides, arsenic
Underground Injection	No								
State Sites*	No								
Nonpoint Sources	No								
Oil/Gas Activities	No								
Totals		55	17	27	1	4	1	4	

NPL - National Priority List
DOE - Department of Energy
LUST - Leaking Underground Storage Tanks
*These sites may be combined with NPL sites

CERCLIS (non-NPL) - Comprehensive Environmental Response, Compensation, and Liability Information System
DOD - Department of Defense
RCRA - Resource Conservation and Recovery Act

Figure 38. Marble Falls Aquifer





State of Texas Water Quality Inventory - Nitrate Concentrations in Water Wells

Water monitoring data provided by the Texas Water Development Board - 1996

TNRCC

Table 92. Ambient Monitoring Groundwater Quality Data
Marble Falls Aquifer (1996)

Parameter Groups	Maximum Contamination Limit (MCL)	Number of Wells			
		Total Wells Sampled	< MDL	< MCL (other than <MDL)	$MCL
Primary Constituents					
Arsenic	50 µg/l	9	7	2	0
Barium	2 mg/l	9	0	9	0
Cadmium	5 µg/l	1	1	0	0
Chromium	100 µg/l	1	1	0	0
Fluoride	4 mg/l	9	0	9	0
Mercury	2 µg/l	1	1	0	0
Nitrate (N)	10 mg/l	9	3	4	2
Selenium	50 µg/l	9	8	1	0
Secondary Constituents					
Chloride	300 mg/l	9	0	8	1
Copper	1 mg/l	9	4	5	0
Fluoride	2 mg/l	9	0	8	1
Iron	0.3 mg/l	9	6	3	0
Manganese	50 µg/l	9	3	6	0
Silver	100 µg/l	1	1	0	0
Sulfate	300 mg/l	9	0	8	1
Dissolved Solids	1000 mg/l	9	0	8	1
Zinc	5 mg/l	9	3	6	0
Radioactivity					
Gross Alpha	15 pCi/l	9	3	5	1
Beta	50 pCi/l	9	5	4	0

Notes:
1. MDL = Method Detection Limit. The MDL is the lowest analysis value available for a particular constituent analysis at a particular sampling event. The MDL is determined by the analyzing laboratory.
2. MCL = Maximum Contamination Level. The MCL of a particular constituent is the maximum analysis level for safe drinking water. MDL's for certain constituents at certain sampling events were greater than the MCL's, and analyses from those events were not utilized when counting samples less than or greater than particular MCL's.

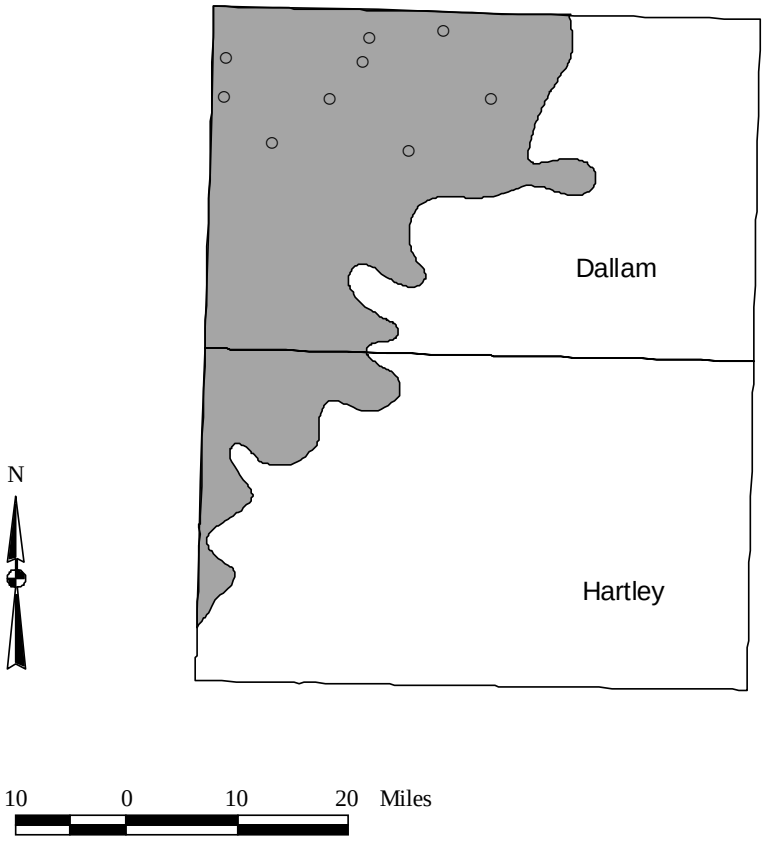
Table 93. Groundwater Contamination Summary
Marble Falls Aquifer Outcrop (1997)

Source Type	Documented Groundwater Contamination Present in Reporting Area	Number of Sites With Confirmed Groundwater Contamination	Site Activity Status						Contaminants
			Contamination Confirmation	Ongoing Investigation	Corrective Action Planning	Corrective Action Implemented	Monitoring of Corrective Action	Action Completed	
NPL	Yes	1	1						VOCs
CERCLIS (non-NPL)	No								
DOD/DOE	No								
LUST	Yes	37	10	20	2	2		3	gasoline, diesel, waste oil, jet fuel, BTEX, TPH
RCRA Corrective Action	Yes	4		1			2		VOCs, pesticides, arsenic
Underground Injection	No								
State Sites*	No								
Nonpoint Sources	No								
Oil/Gas Activities	No								
Totals		42	11	21	2	2	2	3	

NPL - National Priority List
DOE - Department of Energy
LUST - Leaking Underground Storage Tanks
*These sites may be combined with NPL sites

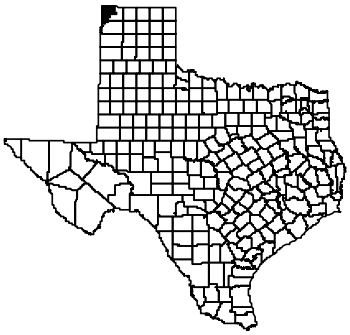
CERCLIS (non-NPL) - Comprehensive Environmental Response, Compensation, and Liability Information System
DOD - Department of Defense
RCRA - Resource Conservation and Recovery Act

Figure 39. Rita Blanca Aquifer



○ Samples with less than 10.0 mg/l

● Samples with 10.0 mg/l or higher



State of Texas Water Quality Inventory - Nitrate Concentrations in Water Wells

Water monitoring data provided by the Texas Water Development Board - 1996

TNRCC

Table 94. Ambient Monitoring Groundwater Quality Data
Rita Blanca Aquifer (1996)

Parameter Groups	Maximum Contamination Limit (MCL)	Number of Wells			
		Total Wells Sampled	< MDL	< MCL (other than <MDL)	$MCL
Primary Constituents					
Arsenic	50 µg/l	9	3	6	0
Barium	2 mg/l	9	0	9	0
Cadmium	5 µg/l	0	-	-	-
Chromium	100 µg/l	0	-	-	-
Fluoride	4 mg/l	9	0	8	1
Mercury	2 µg/l	0	-	-	-
Nitrate (N)	10 mg/l	9	0	9	0
Selenium	50 µg/l	9	7	2	0
Secondary Constituents					
Chloride	300 mg/l	9	0	9	0
Copper	1 mg/l	9	2	7	0
Fluoride	2 mg/l	9	0	8	1
Iron	0.3 mg/l	9	1	8	0
Manganese	50 µg/l	9	4	5	0
Silver	100 µg/l	0	-	-	-
Sulfate	300 mg/l	9	0	9	0
Dissolved Solids	1000 mg/l	9	0	9	0
Zinc	5 mg/l	9	1	8	0
Radioactivity					
Gross Alpha	15 pCi/l	0	-	-	-
Beta	50 pCi/l	0	-	-	-

Notes:
1. MDL = Method Detection Limit. The MDL is the lowest analysis value available for a particular constituent analysis at a particular sampling event. The MDL is determined by the analyzing laboratory.
2. MCL = Maximum Contamination Level. The MCL of a particular constituent is the maximum analysis level for safe drinking water. MDL's for certain constituents at certain sampling events were greater than the MCL's, and analyses from those events were not utilized when counting samples less than or greater than particular MCL's.

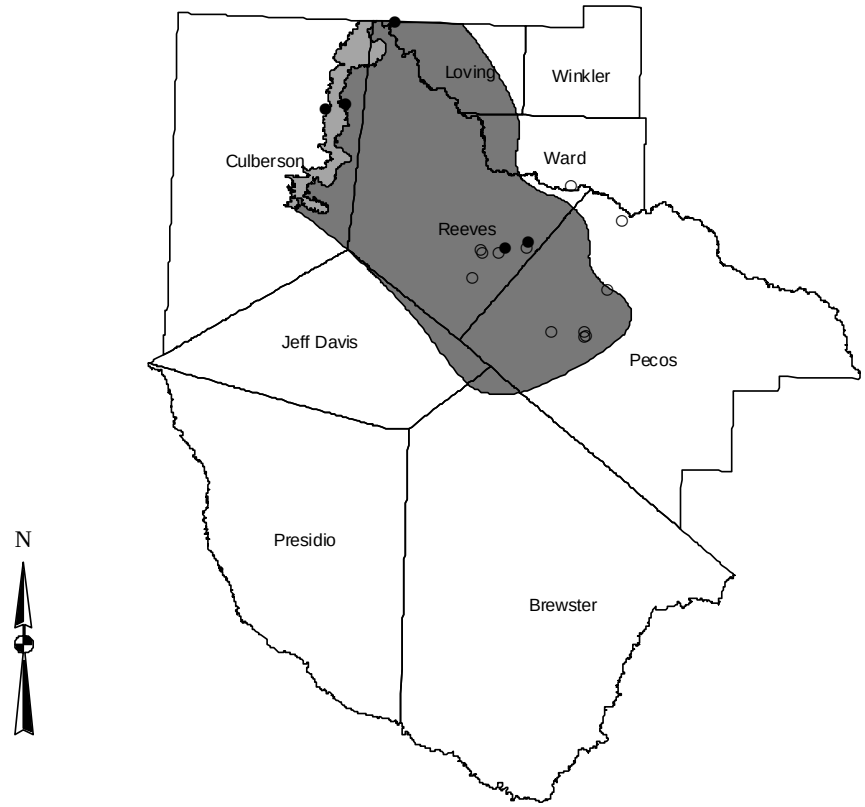
Table 95. Groundwater Contamination Summary
Rita Blanca Aquifer Outcrop (1997)

Source Type	Documented Groundwater Contamination Present in Reporting Area	Number of Sites With Confirmed Groundwater Contamination	Site Activity Status						Contaminants
			Contamination Confirmation	Ongoing Investigation	Corrective Action Planning	Corrective Action Implemented	Monitoring of Corrective Action	Action Completed	
NPL	No								
CERCLIS (non-NPL)	No								
DOD/DOE	No								
LUST	Yes	3	2	1					gasoline, diesel, waste oil, jet fuel, BTEX, TPH
RCRA Corrective Action	No								
Underground Injection	No								
State Sites*	No								
Nonpoint Sources	No								
Oil/Gas Activities	No								
Totals		3	2	1					

NPL - National Priority List
DOE - Department of Energy
LUST - Leaking Underground Storage Tanks
*These sites may be combined with NPL sites

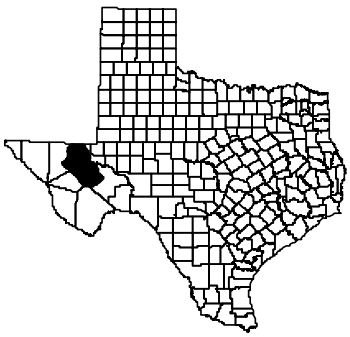
CERCLIS (non-NPL) - Comprehensive Environmental Response, Compensation, and Liability Information System
DOD - Department of Defense
RCRA - Resource Conservation and Recovery Act

Figure 40. Rustler Aquifer



30 0 30 60 Miles

○ Samples with less than 10.0 mg/l
● Samples with 10.0 mg/l or higher
Outcrop
Downdip



State of Texas Water Quality Inventory - Nitrate Concentrations in Water Wells

Water monitoring data provided by the Texas Water Development Board - 1995

TNRCC

Table 96. Ambient Monitoring Groundwater Quality Data
Rustler Aquifer (1995)

Parameter Groups	Maximum Contamination Limit (MCL)	Number of Wells			
		Total Wells Sampled	< MDL	< MCL (other than <MDL)	$MCL
Primary Constituents					
Arsenic	50 µg/l	17	17	0	0
Barium	2 mg/l	17	1	16	0
Cadmium	5 µg/l	17	17	0	0
Chromium	100 µg/l	12	11	1	0
Fluoride	4 mg/l	17	1	15	1
Mercury	2 µg/l	7	6	1	0
Nitrate (N)	10 mg/l	17	2	10	5
Selenium	50 µg/l	17	12	5	0
Secondary Constituents					
Chloride	300 mg/l	17	0	10	7
Copper	1 mg/l	12	9	3	0
Fluoride	2 mg/l	17	1	6	10
Iron	0.3 mg/l	16	1	8	7
Manganese	50 µg/l	17	7	9	1
Silver	100 µg/l	12	10	2	0
Sulfate	300 mg/l	17	0	1	16
Dissolved Solids	1000 mg/l	17	0	0	17
Zinc	5 mg/l	13	7	6	0
Radioactivity					
Gross Alpha	15 pCi/l	15	1	2	12
Beta	50 pCi/l	15	0	7	8

Notes:
1. MDL = Method Detection Limit. The MDL is the lowest analysis value available for a particular constituent analysis at a particular sampling event. The MDL is determined by the analyzing laboratory.
2. MCL = Maximum Contamination Level. The MCL of a particular constituent is the maximum analysis level for safe drinking water. MDL's for certain constituents at certain sampling events were greater than the MCL's, and analyses from those events were not utilized when counting samples less than or greater than particular MCL's.

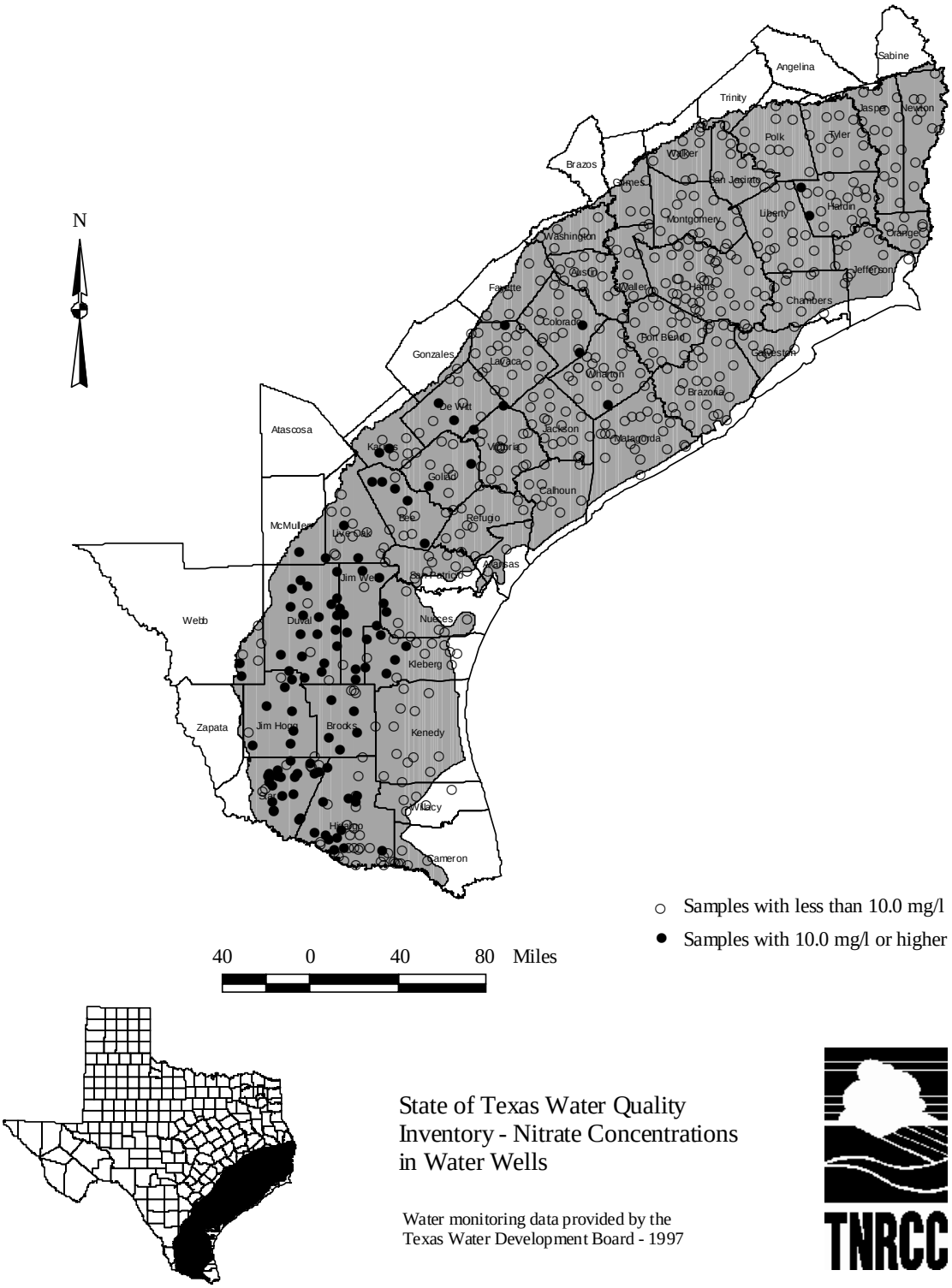
Table 97. Groundwater Contamination Summary
Rustler Aquifer Outcrop (1997)

Source Type	Documented Groundwater Contamination Present in Reporting Area	Number of Sites With Confirmed Groundwater Contamination	Site Activity Status						Contaminants
			Contamination Confirmation	Ongoing Investigation	Corrective Action Planning	Corrective Action Implemented	Monitoring of Corrective Action	Action Completed	
NPL	No								
CERCLIS (non-NPL)	No								
DOD/DOE	No								
LUST	Yes	33	8	20	1	3		1	gasoline, diesel, waste oil, jet fuel, BTEX, TPH
RCRA Corrective Action	Yes	1		1					DDT, Dieldrin, methyl parathion
Underground Injection	No								
State Sites*	No								
Nonpoint Sources	No								
Oil/Gas Activities	No								
Totals		34	8	21	1	3		1	

NPL - National Priority List
DOE - Department of Energy
LUST - Leaking Underground Storage Tanks
*These sites may be combined with NPL sites

CERCLIS (non-NPL) - Comprehensive Environmental Response, Compensation, and Liability Information System
DOD - Department of Defense
RCRA - Resource Conservation and Recovery Act

Figure 41. Gulf Coast Aquifer



State of Texas Water Quality Inventory - Nitrate Concentrations in Water Wells

Water monitoring data provided by the Texas Water Development Board - 1997

TNRCC

Table 98. Ambient Monitoring Groundwater Quality Data
Gulf Coast Aquifer (1997)

Parameter Groups	Maximum Contamination Limit (MCL)	Number of Wells			
		Total Wells Sampled	< MDL	< MCL (other than <MDL)	$MCL
Primary Constituents					
Arsenic	50 µg/l	964	631	323	10
Barium	2 mg/l	966	18	940	8
Cadmium	5 µg/l	362	361	1	0
Chromium	100 µg/l	360	310	50	0
Fluoride	4 mg/l	650	348	302	15
Mercury	2 µg/l	303	289	14	0
Nitrate (N)	10 mg/l	650	413	130	107
Selenium	50 µg/l	966	842	119	5
Secondary Constituents					
Chloride	300 mg/l	650	0	466	184
Copper	1 mg/l	964	534	429	1
Fluoride	2 mg/l	650	348	220	97
Iron	0.3 mg/l	993	318	513	162
Manganese	50 µg/l	962	363	599	0
Silver	100 µg/l	312	312	0	0
Sulfate	300 mg/l	650	23	565	62
Dissolved Solids	1000 mg/l	650	0	481	169
Zinc	5 mg/l	964	303	657	0
Radioactivity					
Gross Alpha	15 pCi/l	278	136	127	15
Beta	50 pCi/l	280	107	173	0

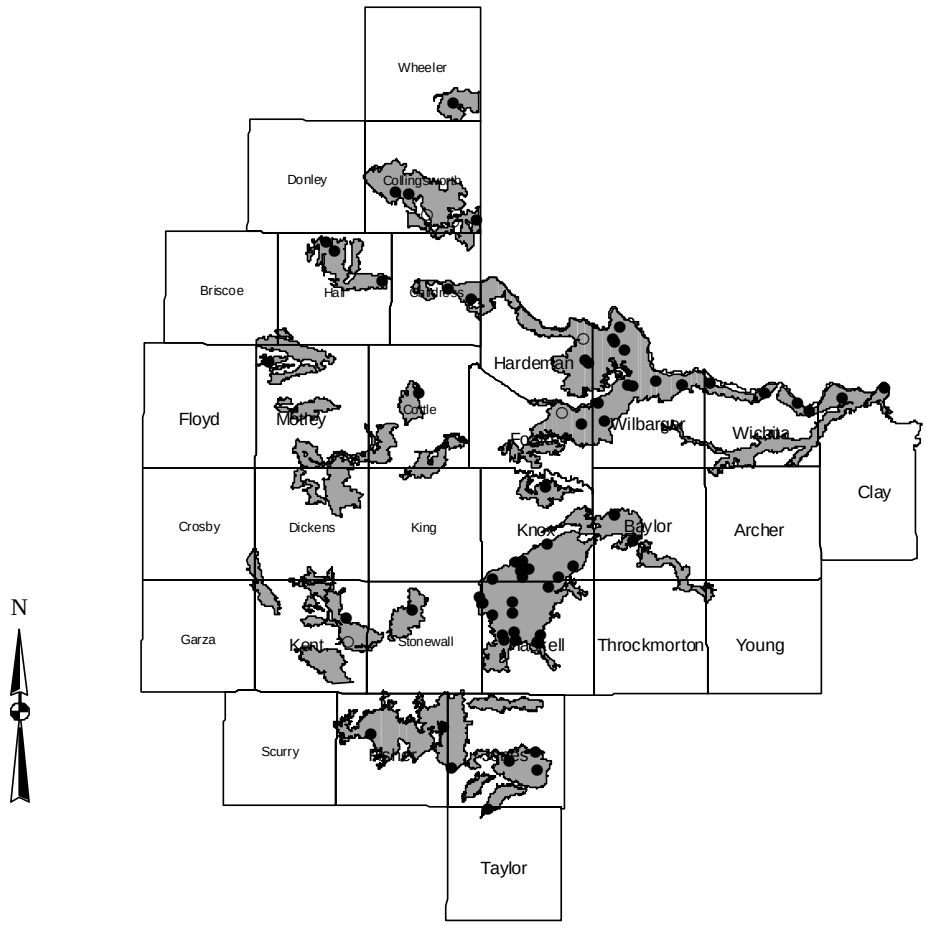
Notes:
1. MDL = Method Detection Limit. The MDL is the lowest analysis value available for a particular constituent analysis at a particular sampling event. The MDL is determined by the analyzing laboratory.
2. MCL = Maximum Contamination Level. The MCL of a particular constituent is the maximum analysis level for safe drinking water. MDL's for certain constituents at certain sampling events were greater than the MCL's, and analyses from those events were not utilized when counting samples less than or greater than particular MCL's.

Table 99. Groundwater Contamination Summary
Gulf Coast Aquifer Outcrop (1998)

Source Type	Documented Groundwater Contamination Present in Reporting Area	Number of Sites With Confirmed Groundwater Contamination	Site Activity Status						Contaminants
			Contamination Confirmation	Ongoing Investigation	Corrective Action Planning	Corrective Action Implemented	Monitoring of Corrective Action	Action Completed	
NPL	Yes	25	1	6	6	6	6	1	Metals, VOC,, arsenic, organic chemicals, creosote
CERCLIS (non-NPL)	Yes	7		2		5			Metals, VOC,, arsenic, organic chemicals
DOD/DOE	No								
LUST	Yes	1816	333	1003	41	111	74	254	gasoline, diesel, waste oil, jet fuel, BTEX, TPH
RCRA Corrective Action	Yes	184	10	65	44	47	43	4	DDT, Dieldrin, methyl parathion
Underground Injection	No								
State Sites*	Yes	38	11	5	6	9	8	1	Organic chemicals, creosote, pH, Epichlorohydrin, DCE, metals
Nonpoint Sources	No								
Oil/Gas Activities	Yes	18	1	4	5	6	1	1	Chloride, TDS
Totals		2088	356	1085	102	184	132	275	

NPL - National Priority List
DOE - Department of Energy
LUST - Leaking Underground Storage Tanks
*These sites may be combined with NPL sites
CERCLIS (non-NPL) - Comprehensive Environmental Response, Compensation, and Liability Information System
DOD - Department of Defense
RCRA - Resource Conservation and Recovery Act

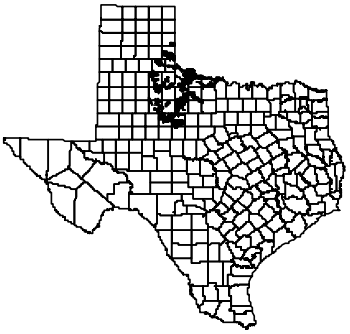
Figure 42. Seymour Aquifer



30 0 30 60 Miles

○ Samples with less than 10.0 mg/l

● Samples with 10.0 mg/l or higher



State of Texas Water Quality Inventory - Nitrate Concentrations in Water Wells

Water monitoring data provided by the Texas Water Development Board - 1997

TNRCC

Table 100. Ambient Monitoring Groundwater Quality Data
Seymour Aquifer (1997)

Parameter Groups	Maximum Contamination Limit (MCL)	Number of Wells			
		Total Wells Sampled	< MDL	< MCL (other than <MDL)	$MCL
Primary Constituents					
Arsenic	50 µg/l	95	63	32	0
Barium	2 mg/l	103	0	103	0
Cadmium	5 µg/l	57	57	0	0
Chromium	100 µg/l	36	12	24	0
Fluoride	4 mg/l	70	14	56	0
Mercury	2 µg/l	12	11	1	0
Nitrate (N)	10 mg/l	70	0	5	65
Selenium	50 µg/l	98	49	49	0
Secondary Constituents					
Chloride	300 mg/l	70	0	60	10
Copper	1 mg/l	95	27	68	0
Fluoride	2 mg/l	70	14	46	10
Iron	0.3 mg/l	103	63	38	2
Manganese	50 µg/l	95	70	25	0
Silver	100 µg/l	0	0	0	0
Sulfate	300 mg/l	70	0	56	14
Dissolved Solids	1000 mg/l	70	0	48	22
Zinc	5 mg/l	95	21	74	0
Radioactivity					
Gross Alpha	15 pCi/l	25	5	20	0
Beta	50 pCi/l	24	16	8	0

Notes:
1. MDL = Method Detection Limit. The MDL is the lowest analysis value available for a particular constituent analysis at a particular sampling event. The MDL is determined by the analyzing laboratory.
2. MCL = Maximum Contamination Level. The MCL of a particular constituent is the maximum analysis level for safe drinking water. MDL's for certain constituents at certain sampling events were greater than the MCL's, and analyses from those events were not utilized when counting samples less than or greater than particular MCL's.

Table 101. Groundwater Contamination Summary
Seymour Aquifer Outcrop (1998)

Source Type	Documented Groundwater Contamination Present in Reporting Area	Number of Sites With Confirmed Groundwater Contamination	Site Activity Status						Contaminants
			Contamination Confirmation	Ongoing Investigation	Corrective Action Planning	Corrective Action Implemented	Monitoring of Corrective Action	Action Completed	
NPL	No								
CERCLIS (non-NPL)	No								
DOD/DOE	Yes	1		1					metals
LUST	Yes	188	58	115		3	2	9	gasoline, diesel, waste oil, BTEX, TPH
RCRA Corrective Action	Yes	5		3	1			9	BTEX. Arsenic, metals,VOC's, SVOC's, MTBE,
Underground Injection	No								
State Sites*	Yes	1		1				2	arsenic, chlorinated hydrocarbons
Nonpoint Sources	Yes	19	19						Pesticides
Oil/Gas Activities	Yes	3		1	2			6	Oil, salt
Totals		197	58	120	3	3	2	26	

NPL - National Priority List
DOE - Department of Energy
LUST - Leaking Underground Storage Tanks
*These sites may be combined with NPL sites

CERCLIS (non-NPL) - Comprehensive Environmental Response, Compensation, and Liability Information System
DOD - Department of Defense
RCRA - Resource Conservation and Recovery Act

Figure 43. Blaine Aquifer

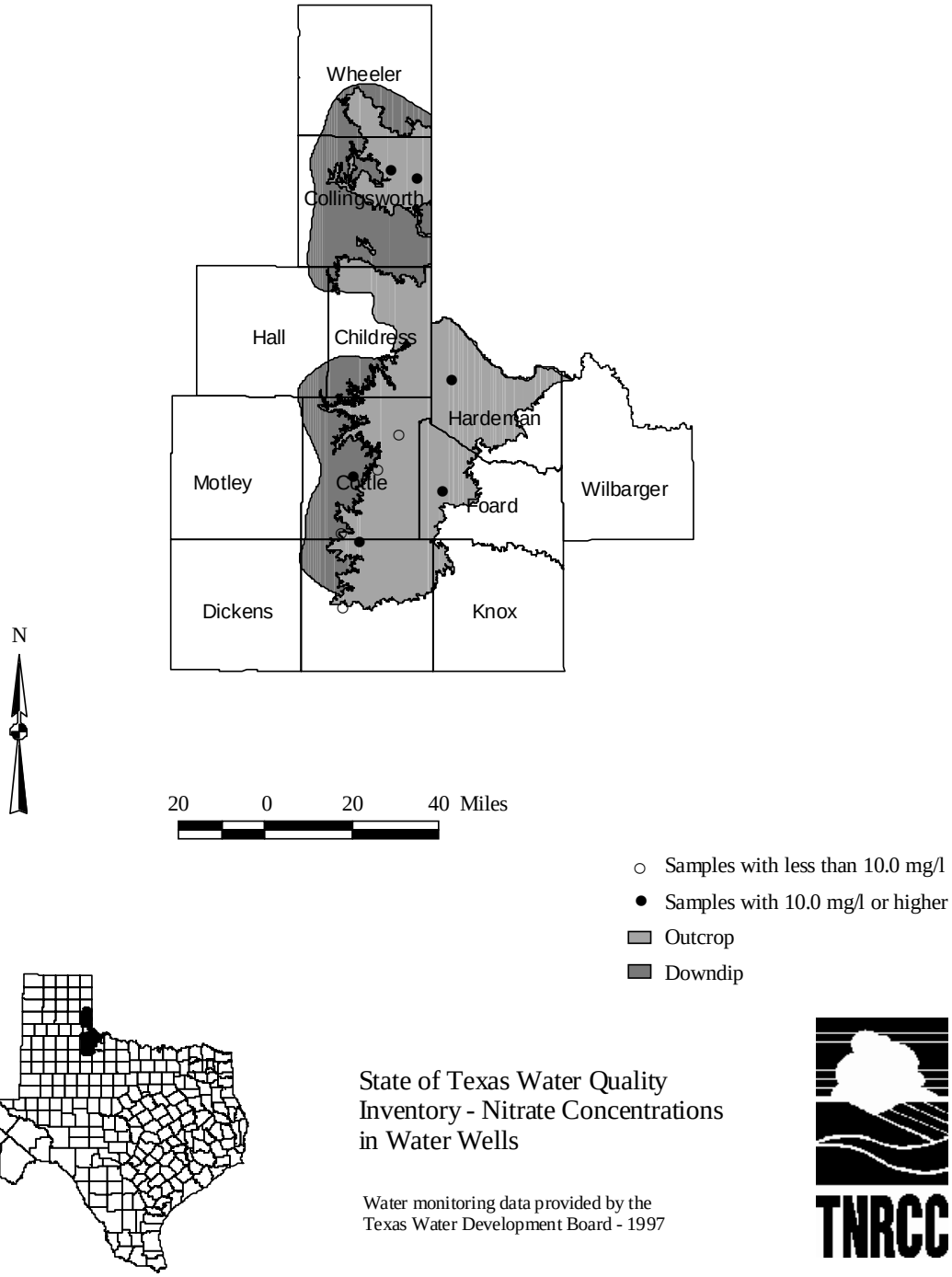


Table 102. Ambient Monitoring Groundwater Quality Data
Blaine Aquifer (1997)

Parameter Groups	Maximum Contamination Limit (MCL)	Number of Wells			
		Total Wells Sampled	< MDL	< MCL (other than <MDL)	$MCL
Primary Constituents					
Arsenic	50 µg/l	12	10	2	0
Barium	2 mg/l	14	0	14	0
Cadmium	5 µg/l	4	4	0	0
Chromium	100 µg/l	1	0	1	0
Fluoride	4 mg/l	10	6	4	0
Mercury	2 µg/l	2	2	0	0
Nitrate (N)	10 mg/l	10	0	4	6
Selenium	50 µg/l	13	5	8	0
Secondary Constituents					
Chloride	300 mg/l	10	0	6	4
Copper	1 mg/l	12	2	10	0
Fluoride	2 mg/l	10	6	4	0
Iron	0.3 mg/l	14	3	6	5
Manganese	50 µg/l	12	3	9	0
Silver	100 µg/l	0	0	0	0
Sulfate	300 mg/l	10	0	1	9
Dissolved Solids	1000 mg/l	10	0	1	9
Zinc	5 mg/l	12	0	12	0
Radioactivity					
Gross Alpha	15 pCi/l	4	0	3	1
Beta	50 pCi/l	4	3	1	0

Notes:
1. MDL = Method Detection Limit. The MDL is the lowest analysis value available for a particular constituent analysis at a particular sampling event. The MDL is determined by the analyzing laboratory.
2. MCL = Maximum Contamination Level. The MCL of a particular constituent is the maximum analysis level for safe drinking water. MDL's for certain constituents at certain sampling events were greater than the MCL's, and analyses from those events were not utilized when counting samples less than or greater than particular MCL's.

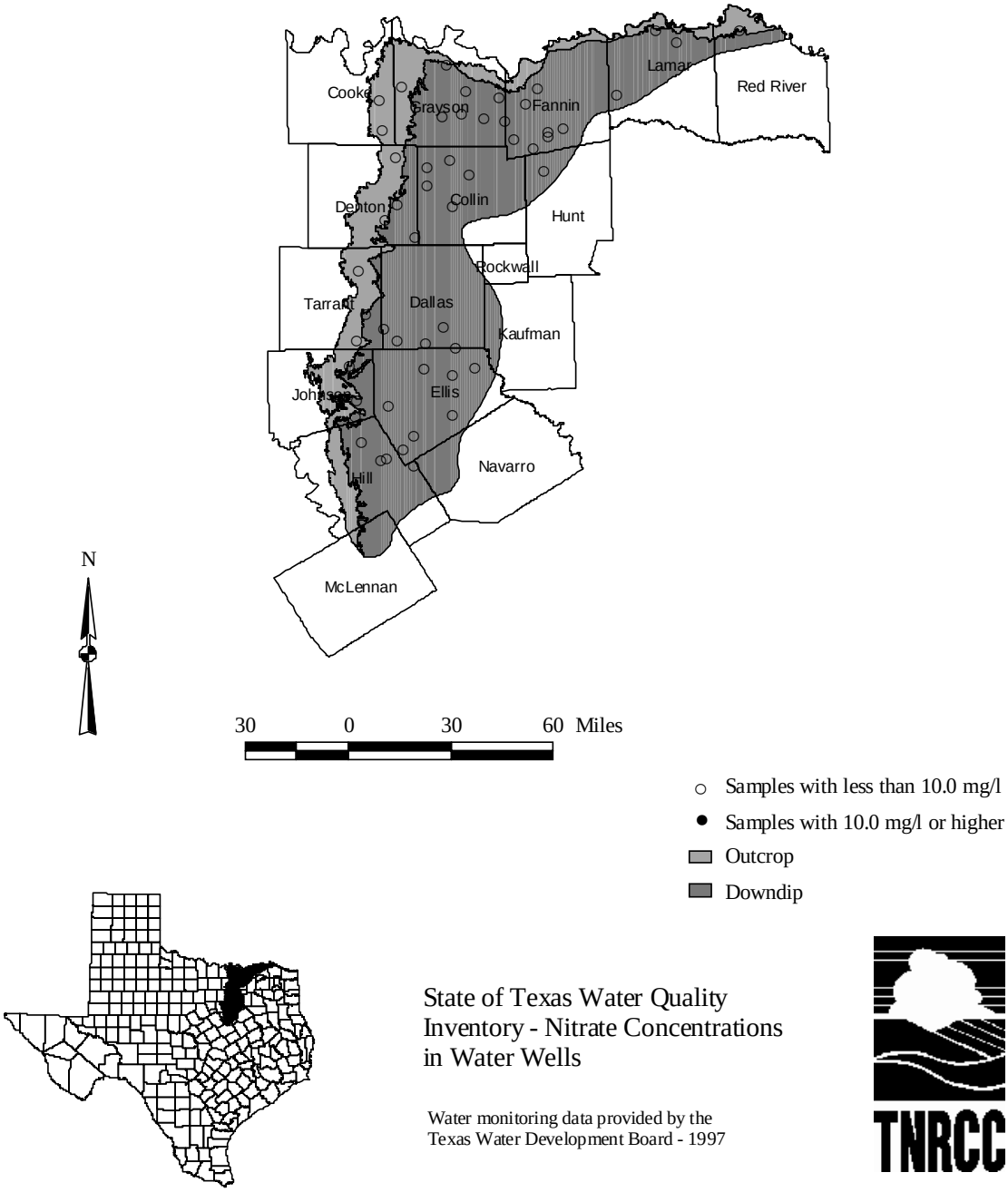
Table 103. Groundwater Contamination Summary
Blaine Aquifer Outcrop (1998)

Source Type	Documented Groundwater Contamination Present in Reporting Area	Number of Sites With Confirmed Groundwater Contamination	Site Activity Status						Contaminants
			Contamination Confirmation	Ongoing Investigation	Corrective Action Planning	Corrective Action Implemented	Monitoring of Corrective Action	Action Completed	
NPL	No								
CERCLIS (non-NPL)	No								
DOD/DOE	No								
LUST	Yes	25	7	15	1		1	1	gasoline, diesel, waste oil, BTEX, TPH
RCRA Corrective Action	Yes	1			1			2	PCE, TCE, 1,2,DCE
Underground Injection	No								
State Sites*	No								
Nonpoint Sources	No								
Oil/Gas Activities	No								
Totals		26	7	15	2		1	3	

NPL - National Priority List
DOE - Department of Energy
LUST - Leaking Underground Storage Tanks
*These sites may be combined with NPL sites

CERCLIS (non-NPL) - Comprehensive Environmental Response, Compensation, and Liability Information System
DOD - Department of Defense
RCRA - Resource Conservation and Recovery Act

Figure 44. Woodbine Aquifer



State of Texas Water Quality Inventory - Nitrate Concentrations in Water Wells

Water monitoring data provided by the Texas Water Development Board - 1997

TNRCC

Table 104. Ambient Monitoring Groundwater Quality Data
Woodbine Aquifer (1997)

Parameter Groups	Maximum Contamination Limit (MCL)	Number of Wells			
		Total Wells Sampled	< MDL	< MCL (other than <MDL)	$MCL
Primary Constituents					
Arsenic	50 µg/l	83	73	10	0
Barium	2 mg/l	83	6	77	0
Cadmium	5 µg/l	79	79	0	0
Chromium	100 µg/l	79	26	53	0
Fluoride	4 mg/l	53	14	35	4
Mercury	2 µg/l	29	29	0	0
Nitrate (N)	10 mg/l	53	46	8	0
Selenium	50 µg/l	29	27	2	0
Secondary Constituents					
Chloride	300 mg/l	53	0	50	3
Copper	1 mg/l	83	21	62	0
Fluoride	2 mg/l	53	14	23	16
Iron	0.3 mg/l	87	12	67	8
Manganese	50 µg/l	82	6	76	0
Silver	100 µg/l	30	30	0	0
Sulfate	300 mg/l	53	0	40	13
Dissolved Solids	1000 mg/l	50	0	40	13
Zinc	5 mg/l	83	43	40	0
Radioactivity					
Gross Alpha	15 pCi/l	27	24	3	0
Beta	50 pCi/l	27	27	0	0

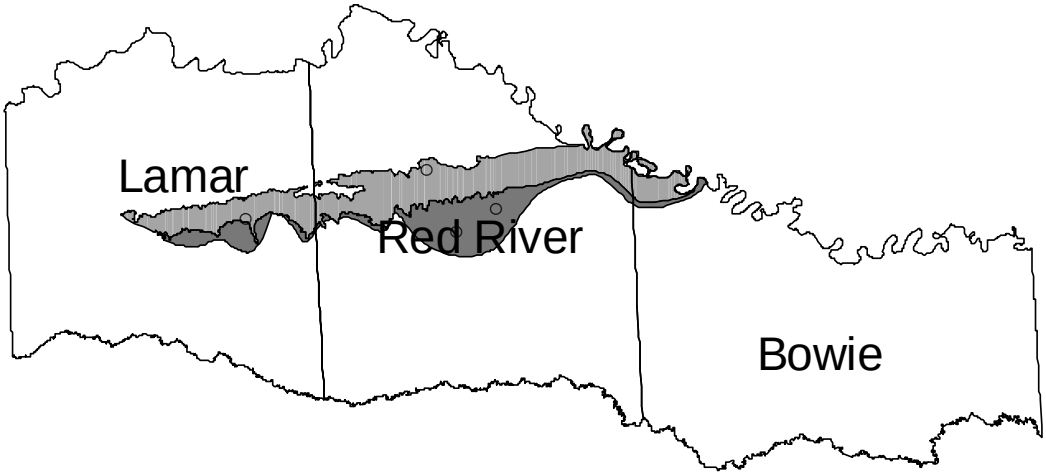
Notes:
1. MDL = Method Detection Limit. The MDL is the lowest analysis value available for a particular constituent analysis at a particular sampling event. The MDL is determined by the analyzing laboratory.
2. MCL = Maximum Contamination Level. The MCL of a particular constituent is the maximum analysis level for safe drinking water. MDL's for certain constituents at certain sampling events were greater than the MCL's, and analyses from those events were not utilized when counting samples less than or greater than particular MCL's.

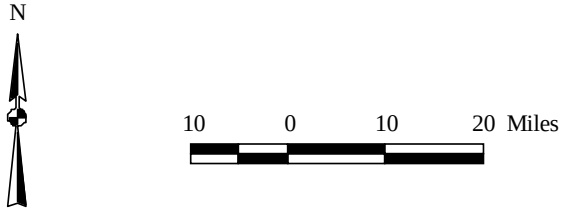
Table 105. Groundwater Contamination Summary
Woodbine Aquifer Outcrop (1998)

Source Type	Documented Groundwater Contamination Present in Reporting Area	Number of Sites With Confirmed Groundwater Contamination	Site Activity Status						Contaminants
			Contamination Confirmation	Ongoing Investigation	Corrective Action Planning	Corrective Action Implemented	Monitoring of Corrective Action	Action Completed	
NPL	Yes	1				1			TCE, vinyl
CERCLIS (non-NPL)	Yes	1				1			metals
DOD/DOE	Yes	1				1			TCE. vinyl
LUST	Yes	472	114	248	11	17	11	71	gasoline, diesel, waste oil, jet fuel, BTEX, TPH
RCRA Corrective Action	Yes	25		16	3	4	1		BTEX, TPH, VOC's, lead, arsenic, MTBE, cadmium, chrome, TCE
Underground Injection	No								
State Sites*	Yes	6	4	1	1				Chromium, Arsenic, Lead, BTEX
Nonpoint Sources	No								
Oil/Gas Activities	No								
Totals		506	118	265	15	24	12	71	

NPL - National Priority List
DOE - Department of Energy
LUST - Leaking Underground Storage Tanks
*These sites may be combined with NPL sites
CERCLIS (non-NPL) - Comprehensive Environmental Response, Compensation, and Liability Information System
DOD - Department of Defense
RCRA - Resource Conservation and Recovery Act

Figure 45. Blossom Aquifer



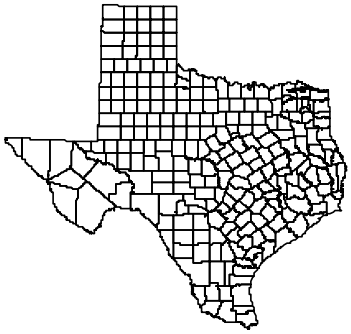


○ Samples with less than 10.0 mg/l

● Samples with 10.0 mg/l or higher

Outcrop

Downdip



State of Texas Water Quality Inventory - Nitrate Concentrations in Water Wells

Water monitoring data provided by the Texas Water Development Board - 1997

TNRCC

Table 106. Ambient Monitoring Groundwater Quality Data
Blossom Aquifer (1997)

Parameter Groups	Maximum Contamination Limit (MCL)	Number of Wells			
		Total Wells Sampled	< MDL	< MCL (other than <MDL)	$MCL
Primary Constituents					
Arsenic	50 µg/l	6	6	0	0
Barium	2 mg/l	6	0	6	0
Cadmium	5 µg/l	2	2	0	0
Chromium	100 µg/l	2	2	0	0
Fluoride	4 mg/l	4	1	3	0
Mercury	2 µg/l	2	2	0	0
Nitrate (N)	10 mg/l	4	4	0	0
Selenium	50 µg/l	6	6	0	0
Secondary Constituents					
Chloride	300 mg/l	4	0	4	0
Copper	1 mg/l	6	2	4	0
Fluoride	2 mg/l	4	1	2	1
Iron	0.3 mg/l	7	0	6	1
Manganese	50 µg/l	6	0	6	0
Silver	100 µg/l	0	0	0	0
Sulfate	300 mg/l	4	0	1	3
Dissolved Solids	1000 mg/l	4	0	1	3
Zinc	5 mg/l	6	3	3	0
Radioactivity					
Gross Alpha	15 pCi/l	2	2	0	0
Beta	50 pCi/l	2	2	0	0

Notes:
1. MDL = Method Detection Limit. The MDL is the lowest analysis value available for a particular constituent analysis at a particular sampling event. The MDL is determined by the analyzing laboratory.
2. MCL = Maximum Contamination Level. The MCL of a particular constituent is the maximum analysis level for safe drinking water. MDL's for certain constituents at certain sampling events were greater than the MCL's, and analyses from those events were not utilized when counting samples less than or greater than particular MCL's.

Table 107. Groundwater Contamination Summary
Blossom Aquifer Outcrop (1998)

Source Type	Documented Groundwater Contamination Present in Reporting Area	Number of Sites With Confirmed Groundwater Contamination	Site Activity Status						Contaminants
			Contamination Confirmation	Ongoing Investigation	Corrective Action Planning	Corrective Action Implemented	Monitoring of Corrective Action	Action Completed	
NPL	No								
CERCLIS (non-NPL)	No								
DOD/DOE	No								
LUST	Yes	15	3	8		1	1	1	gasoline, diesel, waste oil, BTEX, TPH
RCRA Corrective Action	Yes	1				1			diesel fuel
Underground Injection	No								
State Sites*	No								
Nonpoint Sources	No								
Oil/Gas Activities	No								
Totals		16	3	8		2	1	3	

NPL - National Priority List
DOE - Department of Energy
LUST - Leaking Underground Storage Tanks
*These sites may be combined with NPL sites

CERCLIS (non-NPL) - Comprehensive Environmental Response, Compensation, and Liability Information System
DOD - Department of Defense
RCRA - Resource Conservation and Recovery Act

Figure 46. Nacatoch Aquifer

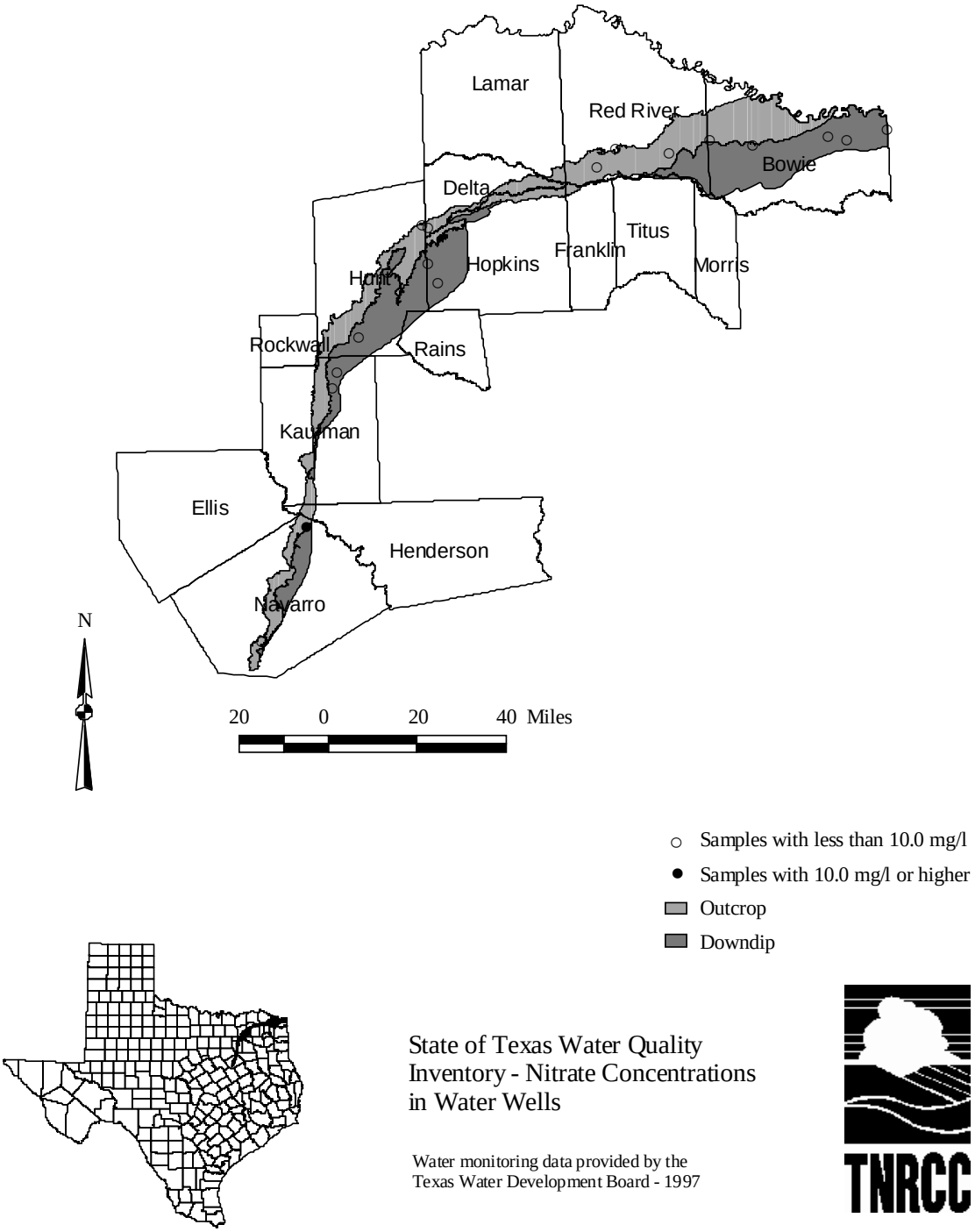


Table 108. Ambient Monitoring Groundwater Quality Data
Nacatoch Aquifer (1997)

Parameter Groups	Maximum Contamination Limit (MCL)	Number of Wells			
		Total Wells Sampled	< MDL	< MCL (other than <MDL)	$MCL
Primary Constituents					
Arsenic	50 µg/l	29	27	2	0
Barium	2 mg/l	29	3	26	0
Cadmium	5 µg/l	19	19	0	0
Chromium	100 µg/l	19	11	8	0
Fluoride	4 mg/l	18	9	9	0
Mercury	2 µg/l	11	11	0	0
Nitrate (N)	10 mg/l	18	15	2	1
Selenium	50 µg/l	0	0	0	0
Secondary Constituents					
Chloride	300 mg/l	18	0	14	4
Copper	1 mg/l	29	11	18	0
Fluoride	2 mg/l	18	9	6	3
Iron	0.3 mg/l	28	9	17	2
Manganese	50 µg/l	28	7	21	0
Silver	100 µg/l	12	12	0	0
Sulfate	300 mg/l	18	0	16	2
Dissolved Solids	1000 mg/l	18	0	12	6
Zinc	5 mg/l	29	12	17	0
Radioactivity					
Gross Alpha	15 pCi/l	10	9	1	0
Beta	50 pCi/l	10	10	0	0

Notes:
1. MDL = Method Detection Limit. The MDL is the lowest analysis value available for a particular constituent analysis at a particular sampling event. The MDL is determined by the analyzing laboratory.
2. MCL = Maximum Contamination Level. The MCL of a particular constituent is the maximum analysis level for safe drinking water. MDL's for certain constituents at certain sampling events were greater than the MCL's, and analyses from those events were not utilized when counting samples less than or greater than particular MCL's.

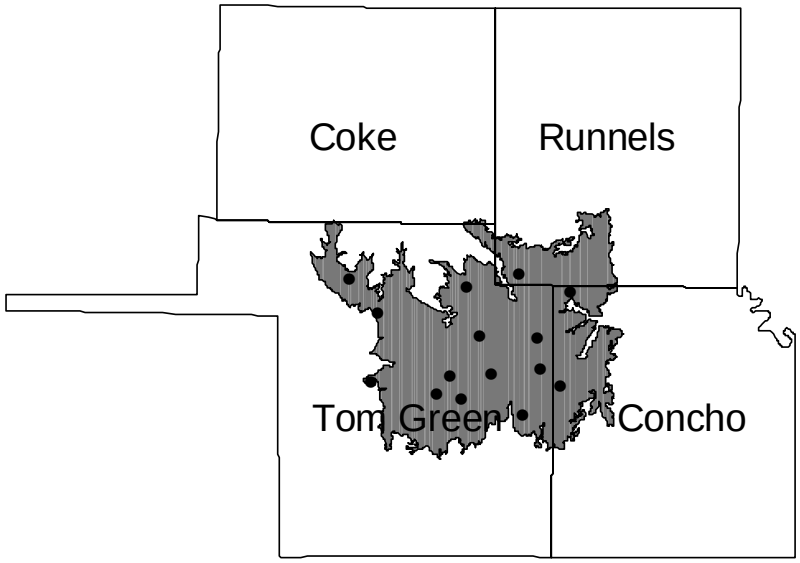
Table 109. Groundwater Contamination Summary
Nacatoch Aquifer Outcrop (1998)

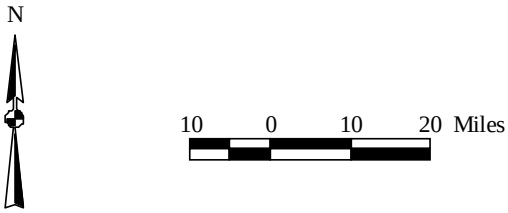
Source Type	Documented Groundwater Contamination Present in Reporting Area	Number of Sites With Confirmed Groundwater Contamination	Site Activity Status						Contaminants
			Contamination Confirmation	Ongoing Investigation	Corrective Action Planning	Corrective Action Implemented	Monitoring of Corrective Action	Action Completed	
NPL	No								
CERCLIS (non-NPL)	No								
DOD/DOE	No								
LUST	Yes	21	9	8		1	1	2	gasoline, diesel, waste oil, BTEX, TPH
RCRA Corrective Action	Yes	1			1	1	1		Solvents
Underground Injection	No								
State Sites*	Yes	1						1	arsenic
Nonpoint Sources	No								
Oil/Gas Activities	No								
Totals		23	9	8	1	2	2	7	

NPL - National Priority List
DOE - Department of Energy
LUST - Leaking Underground Storage Tanks
*These sites may be combined with NPL sites

CERCLIS (non-NPL) - Comprehensive Environmental Response, Compensation, and Liability Information System
DOD - Department of Defense
RCRA - Resource Conservation and Recovery Act

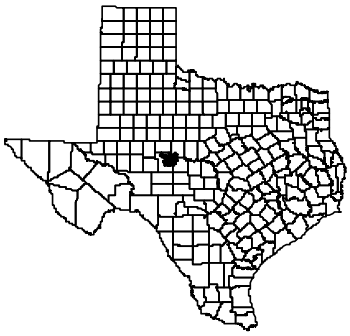
Figure 47. Lipan Aquifer





○ Samples with less than 10.0 mg/l

● Samples with 10.0 mg/l or higher



State of Texas Water Quality Inventory - Nitrate Concentrations in Water Wells

Water monitoring data provided by the Texas Water Development Board - 1997

TNRCC

Table 110. Ambient Monitoring Groundwater Quality Data
Lipan Aquifer (1997)

Parameter Groups	Maximum Contamination Limit (MCL)	Number of Wells			
		Total Wells Sampled	< MDL	< MCL (other than <MDL)	$MCL
Primary Constituents					
Arsenic	50 µg/l	29	11	18	0
Barium	2 mg/l	29	1	28	0
Cadmium	5 µg/l	22	22	0	0
Chromium	100 µg/l	22	6	16	0
Fluoride	4 mg/l	15	0	15	0
Mercury	2 µg/l	7	7	0	0
Nitrate (N)	10 mg/l	15	0	0	15
Selenium	50 µg/l	29	10	19	0
Secondary Constituents					
Chloride	300 mg/l	15	0	3	12
Copper	1 mg/l	29	13	16	0
Fluoride	2 mg/l	15	0	15	0
Iron	0.3 mg/l	29	18	11	0
Manganese	50 µg/l	29	20	9	0
Silver	100 µg/l	7	7	0	0
Sulfate	300 mg/l	15	0	12	3
Dissolved Solids	1000 mg/l	15	0	2	13
Zinc	5 mg/l	29	13	16	0
Radioactivity					
Gross Alpha	15 pCi/l	7	0	7	0
Beta	50 pCi/l	7	3	4	0

Notes:
1. MDL = Method Detection Limit. The MDL is the lowest analysis value available for a particular constituent analysis at a particular sampling event. The MDL is determined by the analyzing laboratory.
2. MCL = Maximum Contamination Level. The MCL of a particular constituent is the maximum analysis level for safe drinking water. MDL's for certain constituents at certain sampling events were greater than the MCL's, and analyses from those events were not utilized when counting samples less than or greater than particular MCL's.

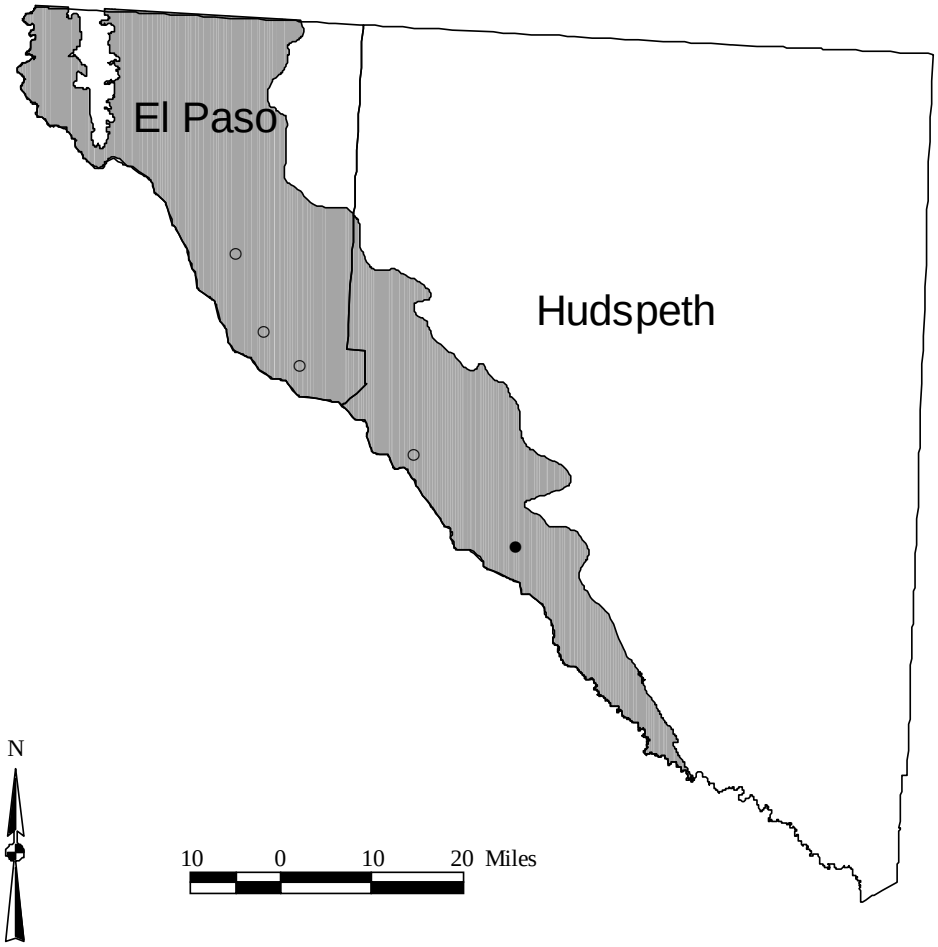
Table 111. Groundwater Contamination Summary
Lipan Aquifer Outcrop (1998)

Source Type	Documented Groundwater Contamination Present in Reporting Area	Number of Sites With Confirmed Groundwater Contamination	Site Activity Status						Contaminants
			Contamination Confirmation	Ongoing Investigation	Corrective Action Planning	Corrective Action Implemented	Monitoring of Corrective Action	Action Completed	
NPL	No								
CERCLIS (non-NPL)									
DOD/DOE	Yes	2		1			5		aviation fuel, gasoline, waste oil
LUST	Yes	62	13	39		5	4	1	gasoline, diesel, waste oil, aviation fuel, BTEX, TPH
RCRA Corrective Action	Yes	7		4	3				Methylene Chloride, metals, PCB's, Chlorinated Hydrocarbons
Underground Injection	No								
State Sites*	No								
Nonpoint Sources	No								
Oil/Gas Activities	No								
Totals		71	13	44	3	5	9	1	

NPL - National Priority List
DOE - Department of Energy
LUST - Leaking Underground Storage Tanks
*These sites may be combined with NPL sites

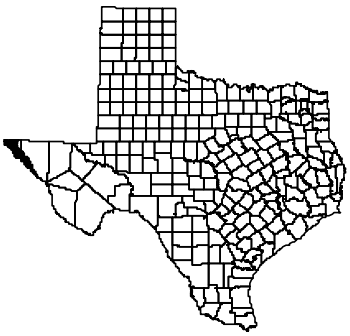
CERCLIS (non-NPL) - Comprehensive Environmental Response, Compensation, and Liability Information System
DOD - Department of Defense
RCRA - Resource Conservation and Recovery Act

Figure 48. Hueco and Mesilla Bolsons



○ Samples with less than 10.0 mg/l

● Samples with 10.0 mg/l or higher



State of Texas Water Quality Inventory - Nitrate Concentrations in Water Wells

Water monitoring data provided by the Texas Water Development Board - 1997

TNRCC

Table 112. Ambient Monitoring Groundwater Quality Data
Hueco - Mesilla Bolsons (1997)

Parameter Groups	Maximum Contamination Limit (MCL)	Number of Wells			
		Total Wells Sampled	< MDL	< MCL (other than <MDL)	$MCL
Primary Constituents					
Arsenic	50 µg/l	6	0	6	0
Barium	2 mg/l	12	0	12	0
Cadmium	5 µg/l	6	6	0	0
Chromium	100 µg/l	5	0	5	0
Fluoride	4 mg/l	5	1	3	1
Mercury	2 µg/l	4	4	0	0
Nitrate (N)	10 mg/l	5	2	2	1
Selenium	50 µg/l	5	3	2	0
Secondary Constituents					
Chloride	300 mg/l	5	0	4	1
Copper	1 mg/l	5	0	5	0
Fluoride	2 mg/l	5	1	2	2
Iron	0.3 mg/l	5	1	4	0
Manganese	50 µg/l	5	1	4	0
Silver	100 µg/l	0	0	0	0
Sulfate	300 mg/l	5	0	2	3
Dissolved Solids	1000 mg/l	5	0	3	2
Zinc	5 mg/l	11	5	6	0
Radioactivity					
Gross Alpha	15 pCi/l	5	0	3	2
Beta	50 pCi/l	11	5	6	0

Notes:
1. MDL = Method Detection Limit. The MDL is the lowest analysis value available for a particular constituent analysis at a particular sampling event. The MDL is determined by the analyzing laboratory.
2. MCL = Maximum Contamination Level. The MCL of a particular constituent is the maximum analysis level for safe drinking water. MDL's for certain constituents at certain sampling events were greater than the MCL's, and analyses from those events were not utilized when counting samples less than or greater than particular MCL's.

Table 113. Groundwater Contamination Summary
Hueco - Mesilla Bolsons Outcrop (1998)

Source Type	Documented Groundwater Contamination Present in Reporting Area	Number of Sites With Confirmed Groundwater Contamination	Site Activity Status						Contaminants
			Contamination Confirmation	Ongoing Investigation	Corrective Action Planning	Corrective Action Implemented	Monitoring of Corrective Action	Action Completed	
NPL	No								
CERCLIS (non-NPL)	No								
DOD/DOE	Yes	1						1	Mercury, chromium
LUST	Yes	120	23	71	1	11	5	9	gasoline, diesel, waste oil, jet fuel, BTEX, TPH
RCRA Corrective Action	Yes	7		3	2		1	1	Plating solution, paint, mercury, chromium
Underground Injection	No								
State Sites*	No								
Nonpoint Sources	No								
Oil/Gas Activities	No								
Totals		128	23	74	3	11	6	11	

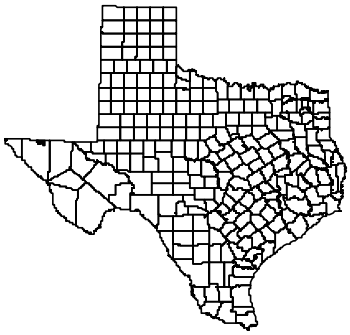
NPL - National Priority List
DOE - Department of Energy
LUST - Leaking Underground Storage Tanks
*These sites may be combined with NPL sites

CERCLIS (non-NPL) - Comprehensive Environmental Response, Compensation, and Liability Information System
DOD - Department of Defense
RCRA - Resource Conservation and Recovery Act

Figure 49. Bone Spring - Victorio Peak Aquifer

○ Samples with less than 10.0 mg/l

● Samples with 10.0 mg/l or higher



State of Texas Water Quality Inventory - Nitrate Concentrations in Water Wells

Water monitoring data provided by the Texas Water Development Board - 1997

TNRCC

Table 114. Ambient Monitoring Groundwater Quality Data
Bone Spring -Victorio Peak Aquifer (1997)

Parameter Groups	Maximum Contamination Limit (MCL)	Number of Wells			
		Total Wells Sampled	< MDL	< MCL (other than <MDL)	$MCL
Primary Constituents					
Arsenic	50 µg/l	18	17	1	0
Barium	2 mg/l	18	5	13	0
Cadmium	5 µg/l	11	11	0	0
Chromium	100 µg/l	12	0	12	0
Fluoride	4 mg/l	12	0	12	0
Mercury	2 µg/l	0	0	0	0
Nitrate (N)	10 mg/l	12	0	3	9
Selenium	50 µg/l	18	15	3	0
Secondary Constituents					
Chloride	300 mg/l	12	0	3	9
Copper	1 mg/l	18	7	11	0
Fluoride	2 mg/l	12	0	3	9
Iron	0.3 mg/l	18	10	7	1
Manganese	50 µg/l	18	15	3	0
Silver	100 µg/l	0	0	0	0
Sulfate	300 mg/l	12	0	0	12
Dissolved Solids	1000 mg/l	12	0	0	12
Zinc	5 mg/l	18	3	15	0
Radioactivity					
Gross Alpha	15 pCi/l	6	1	2	3
Beta	50 pCi/l	6	0	5	1

Notes:
1. MDL = Method Detection Limit. The MDL is the lowest analysis value available for a particular constituent analysis at a particular sampling event. The MDL is determined by the analyzing laboratory.
2. MCL = Maximum Contamination Level. The MCL of a particular constituent is the maximum analysis level for safe drinking water. MDL's for certain constituents at certain sampling events were greater than the MCL's, and analyses from those events were not utilized when counting samples less than or greater than particular MCL's.

Table 115. Groundwater Contamination Summary
Bone Spring - Victorio Peak Aquifer Outcrop (1998)

Source Type	Documented Groundwater Contamination Present in Reporting Area	Number of Sites With Confirmed Groundwater Contamination	Site Activity Status						Contaminants
			Contamination Confirmation	Ongoing Investigation	Corrective Action Planning	Corrective Action Implemented	Monitoring of Corrective Action	Action Completed	
NPL	No								Metals, VOC,, arsenic, organic chemicals
CERCLIS (non-NPL)	No								Metals, VOC,, arsenic, organic chemicals
DOD/DOE	No								
LUST	No								gasoline, diesel, waste oil, jet fuel, BTEX, TPH
RCRA Corrective Action	No								DDT, Dieldrin, methyl parathion
Underground Injection	No								
State Sites*	No								
Nonpoint Sources	No								
Oil/Gas Activities	No								Chloride, TDS
Totals									

NPL - National Priority List
DOE - Department of Energy
LUST - Leaking Underground Storage Tanks
*These sites may be combined with NPL sites
CERCLIS (non-NPL) - Comprehensive Environmental Response, Compensation, and Liability Information System
DOD - Department of Defense
RCRA - Resource Conservation and Recovery Act