Groundwater Assessment

2022 State of Texas Water Quality Inventory

Prepared by
TCEQ Water Availability Division

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TEXAS COMMISSION ON ENVIRONMENTAL QUALITY • PO BOX 13087 • AUSTIN, TX 78711-3087

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Summary

Groundwater in Texas is produced from numerous aquifers, which provide water for many purposes, including domestic and livestock uses, municipal use, industrial activities, irrigation, and agriculture. Texas Water Development Board (TWDB) recognizes nine major aquifers and 22 minor aquifers which underlie about two-thirds of the state's 268,596 square miles of total surface area. Major aquifers produce substantial amounts of water over large areas and minor aquifers produce either minor amounts of water over large areas or substantial amounts of water over small areas.

In 2020, Texas' existing water supply of approximately 16.8 million acre-feet consists roughly of half surface water and half groundwater, with reuse contributing four percent. Groundwater is the source for almost 20 percent of public water supplies and over 99 percent of drinking water for the rural population of over 1.32 million Texans. Irrigation and livestock users rely on groundwater for 80 percent of their total existing water supply (7.9 million acre-feet per year).[1]

The 71st Texas Legislature created the Texas Groundwater Protection Committee (TGPC) in 1989 to bridge gaps between existing state groundwater programs and to optimize water-quality protection by improving coordination among agencies involved in groundwater activities. By statute,[2] TGPC's membership is composed of the following individuals or their designated representative:

- Executive Director of TCEQ
- Executive Administrator of TWDB
- Executive Director of the Railroad Commission of Texas (RRC)
- Commissioner of Health of the Texas Department of Health (TDH)
- Deputy Commissioner of the Department of Agriculture (TDA)
- Executive Director of the State Soil and Water Conservation Board (TSSWCB)
- Director of Texas A&M AgriLife Research (AgriLife Research)
- Director of the Bureau of Economic Geology of The University of Texas at Austin (UTBEG)
- A representative selected by the Texas Alliance of Groundwater Districts (TAGD)
- A representative of the Water Well Drillers and Water Well Pump Installers Program of the Texas Department of Licensing and Regulation (TDLR) selected by the executive director of the department.

TCEQ, the lead agency for the TGPC, administers its activities. TCEQ's executive director serves as TGPC's chairperson and TWDB's executive administrator serves as TGPC's vice-chairperson.

TGPC's member agencies provide data for its groundwater quality inventory efforts. In 1996, TGPC began conducting an inventory of groundwater quality of the state's aquifers through the partnership of two member agencies: TCEQ and TWDB. This information was published in the State of *Texas Water Quality Inventory 1996*, which precedes this report. Additional aquifers were included in subsequent reports until inventories of all 30 of the state's aquifers were completed for the 2002 report.

In subsequent *Water Quality Inventory* reports TCEQ has utilized information from the TWDB groundwater database to inventory ambient water quality in each of the state's major and

[1] https://www.twdb.texas.gov/waterplanning/swp/2022/index.asp
[2] http://www.statutes.legis.state.tx.us/Docs/WA/htm/WA.26.htm#26.403

minor aquifers for the most recent ten-year period. In 2017, TWDB named a new minor aquifer, the Cross Timbers aquifer, which is now included in this assessment.

Each year TGPC publishes the *Joint Groundwater Monitoring and Contamination Report (Joint Report)*,[3] describing the documented cases of groundwater contamination in the state resulting from activities regulated by Texas state agencies. Groundwater contamination is defined in TGPC rules[4] as the detrimental alteration of the naturally occurring physical, thermal, chemical, or biological quality of groundwater, based on the definition of "pollution" in the Texas Water Code (TWC), Section 26.001.[5] Further, TGPC describes groundwater contamination in the *Joint Report* as contamination suspected of having been caused by activities of entities under the jurisdiction of the TGPC member agencies, as identified in TWC, Section 26.406, TGPC rules, and subsequent legislative amendments. Reported contamination cases are typically limited to those affecting usable quality groundwater, defined as less than 10,000 milligrams per liter of dissolved solids.

The most recently published *Joint Report* for 2020 (TGPC, 2021) includes 3,056 groundwater contamination cases documented or under enforcement during the 2020 calendar year. Approximately 81 percent (2,468) of the documented cases fall under TCEQ's jurisdiction, with the remainder (588 cases) under the jurisdiction of RRC.

The groundwater contamination cases in the *2020 Joint Report* were documented primarily through regulatory requirements for compliance monitoring, with most identified by release-detection monitoring in the TCEQ Petroleum Storage Tank (PST) Program. The report also identifies cases documented through permit monitoring requirements, investigations of groundwater contamination complaints, or self-reporting. Groundwater contamination is most often detected during site-specific groundwater monitoring at waste disposal or product storage sites (TGPC, 2021).

The most common contaminants in the *2020 Joint Report* are gasoline, diesel, and other petroleum products such as benzene, toluene, ethylbenzene, and xylenes. These constituents reflect the fact that 42 percent of TCEQ's documented contamination cases were reported by the PST Program. Some of the other contaminants at sites in this report include heavy metals, organic compounds such as phenols, trichloroethylene, carbon tetrachloride, dichloroethylene, naphthalene, creosote constituents, various solvents, and pesticides.

This 2022 groundwater inventory effort shows that ambient groundwater quality in Texas is good, but it varies among the state's aquifers. The ambient concentration in a small percentage of wells exceeds the drinking water maximum contaminant level for some parameters such as nitrate and arsenic, and secondary standards for parameters such as sulfate, and total dissolved solids. Dissolved fluoride, naturally occurring in Texas, appears as a secondary contaminant of concern sporadically throughout the wells sampled during this period.

Groundwater contamination at regulated facilities still occurs principally in heavily populated areas, such as Houston, Dallas, Fort Worth, San Antonio, and El Paso, and primarily at PST facilities. Geographic data for the *Joint Report* suggests that a high concentration of regulated surface activity sites with groundwater contamination does not necessarily correlate with area-wide ambient groundwater degradation. In general, contamination from regulated surface activities tends to impact shallow, local water-bearing zones separated from the major and minor aquifers. While some wells in aquifer outcrop areas show elevated levels of certain constituents of concern; those wells typically draw water from deeper aquifers rather than the aquifer outcrop area.

[3] https://www.tceq.texas.gov/groundwater/groundwater-planning-assessment/sfr-056-joint-groundwater-monitoring-contamination-report
[4] https://texreg.sos.state.tx.us/public/readtac$ext.ViewTAC?tac_view=4&ti=31&pt=18&ch=601
[5] https://statutes.capitol.texas.gov/Docs/WA/htm/WA.26.htm#26.001

Overview – Groundwater Resources

Each year TWDB estimates the water used in Texas by reviewing water use surveys of public water systems and industrial facilities. In 2019 Texans used approximately 14.17 million acre-feet of water, most of which was from groundwater sources (approximately 55 percent, or 7.74 million acre-feet). Approximately 42 percent came from surface water sources (about six million acre-feet) and three percent was from reuse (nearly 0.5 million acre-feet).[6]

Aquifers produce most of the groundwater used by Texans. An aquifer is made of underground layers of rock that store and can transmit water through the pore spaces, cracks, or voids in the rock. Texas aquifers are composed of a variety of rock types, such as limestone, dolomite, sandstone, gypsum, alluvial gravels, and igneous rocks. Major aquifers produce large quantities of water over large areas of the state. Minor aquifers may produce large quantities of water over small areas or small quantities of water over large areas, and in some regions of the state may constitute the only significant source of water supply in some regions of the state. In addition, groundwater provides a significant amount of the base flow for many Texas rivers and streams, which adds to the reasons that groundwater is important to maintaining the state's environment and economy.

The major aquifers include (see Figure 1):

1. Carrizo–Wilcox
2. Edwards (Balcones Fault Zone / BFZ)
3. Edwards–Trinity (Plateau)
4. Gulf Coast
5. Hueco–Mesilla Bolsons
6. Ogallala
7. Pecos Valley
8. Seymour
9. Trinity

The minor aquifers include (see Figure 2):

1. Blaine
2. Blossom
3. Bone Spring–Victorio Peak
4. Brazos River Alluvium
5. Capitan Reef Complex
6. Cross Timbers
7. Dockum
8. Edwards–Trinity (High Plains)
9. Ellenburger–San Saba

[6]https://www.twdb.texas.gov/waterplanning/waterusesurvey/estimates/data/2019TexasWaterUseEstimatesSummary.pdf?d=5769.100000000559

10. Hickory
11. Igneous
12. Lipan
13. Marathon
14. Marble Falls
15. Nacatoch
16. Queen City
17. Rita Blanca
18. Rustler
19. Sparta
20. West Texas Bolsons
21. Woodbine
22. Yegua–Jackson

In addition to these major and minor aquifers, smaller local aquifers may provide groundwater for an area.[7] Groundwater quality of these smaller groundwater sources is not directly addressed in this assessment, as they are too small and numerous to be characterized within its scope.

[7] TWDB Report #380, *Aquifers of Texas*, 2011, http://www.twdb.texas.gov/publications/reports/numbered_reports/doc/R380_AquifersofTexas.pdf

Figure 1. Major Aquifers of Texas

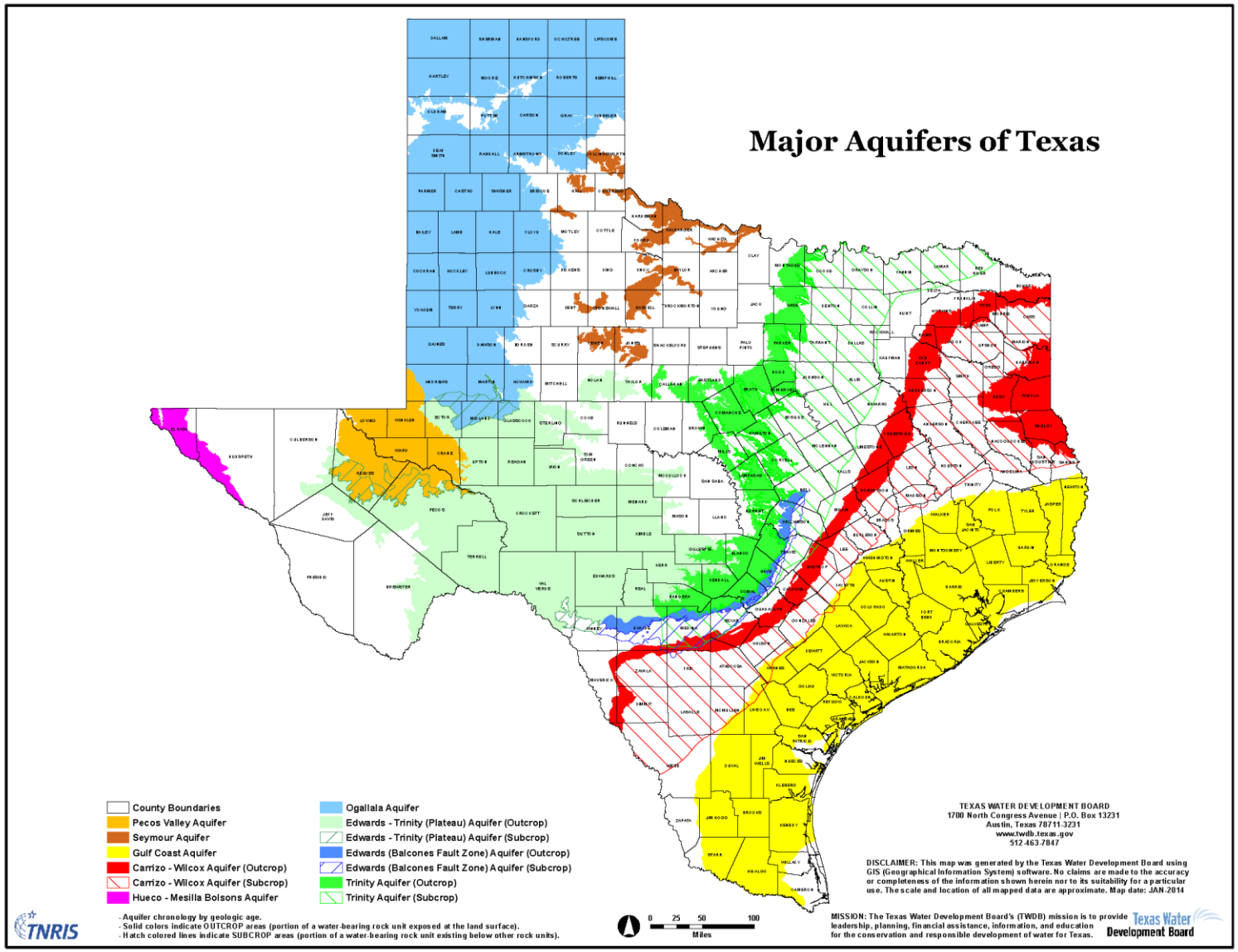
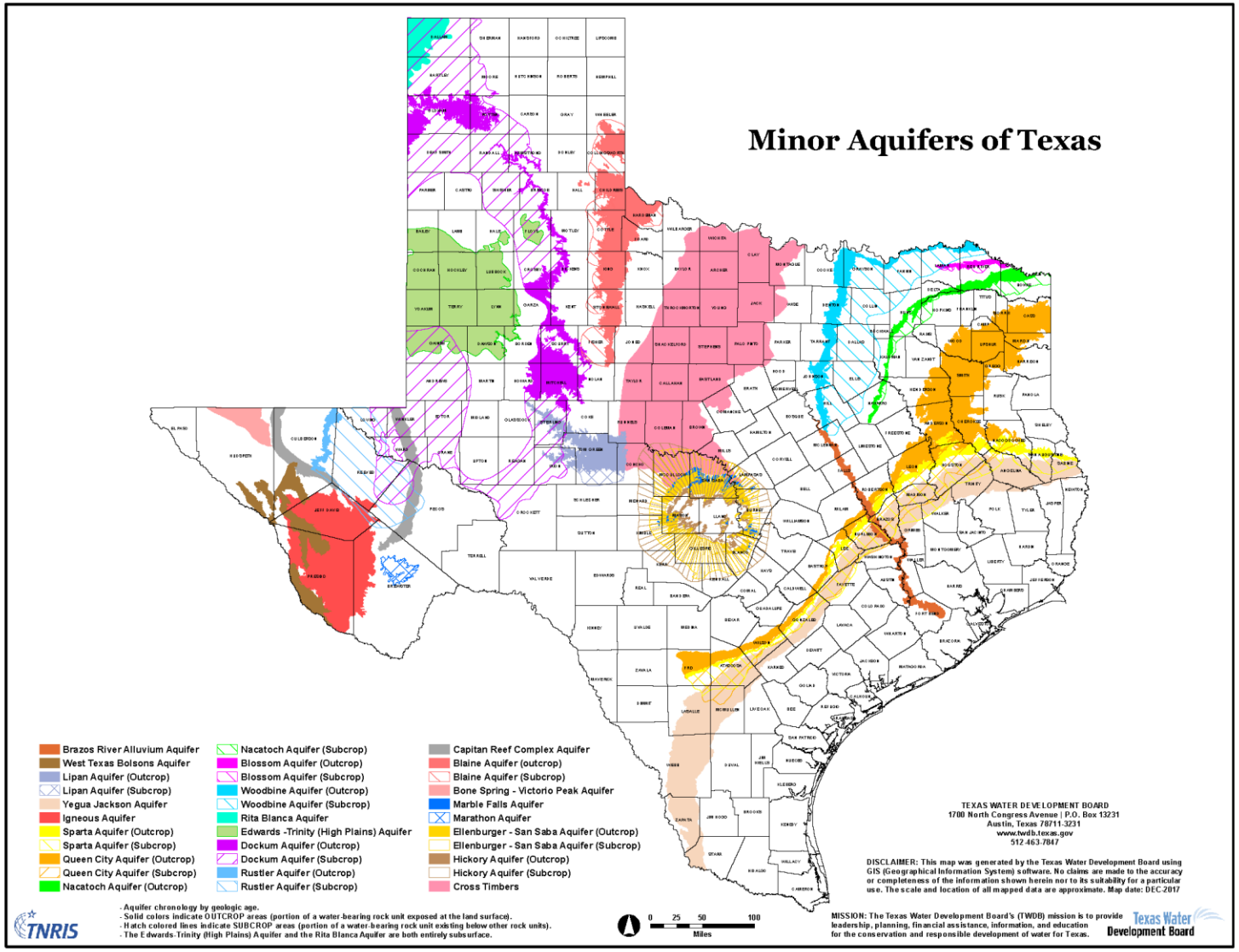


Figure 2. Minor Aquifers of Texas



Groundwater Protection

Texas Groundwater Protection Committee

TGPC was created by the 71st Texas Legislature in 1989 to bridge gaps between existing state groundwater programs and to optimize water quality protection by improving coordination among agencies involved in groundwater activities. The resulting statute, TWC Sections 26.401–26.408, sets out the state's groundwater protection policy and provides legislative recognition for TGPC. The statute requires TGPC to accomplish the following:

- Coordinate the groundwater protection activities of its members.
- Develop and update a comprehensive state groundwater protection strategy.
- Study and recommend to the legislature groundwater protection programs for each area in which groundwater is not protected by current regulation.
- Before the beginning of each biennial legislative session, file a report of the TGPC's activities and recommendations for groundwater protection legislation to the Governor, Lieutenant Governor, and Speaker of the House of Representatives.
- Each year publish the *Joint Report*.

TGPC includes representatives from ten agencies. TCEQ administers the activities of TGPC and is designated as the lead agency for the committee. TCEQ's executive director serves as the committee's chairperson and TWDB's executive administrator serves as the vice-chairperson.

Coordination with Federal Agencies

TGPC actively coordinates with federal agencies on groundwater protection issues that affect the state. Past coordination efforts included working with federal agencies on a core assessment for a comprehensive state groundwater protection program and on the development of pesticide management plans to prevent groundwater contamination

In March 1985, U.S. Environmental Protection Agency (EPA) provided a grant to the Texas Department of Water Resources, predecessor to TCEQ and TWDB, to improve the coordination of groundwater protection activities undertaken by state agencies. In response to this federal initiative, the state formed the interagency Groundwater Protection Committee, predecessor of TGPC. Since then, through grants administered under the Clean Water Act (CWA) Section 106, EPA has funded the coordination of groundwater protection activities of the various state programs and agencies and the development of a groundwater protection strategy.

TGPC and the member agencies regularly provide national level input to federal agencies on groundwater protection and program issues through the Ground Water Protection Council (GWPC), an association of state and groundwater and Underground Injection Control (UIC) program directors; the State Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) Issues Research and Evaluation Group, which includes state agricultural regulatory officials; and other state and federal stakeholder and regulatory guidance groups.

TGPC and its members also work closely with the U.S. Geological Survey (USGS), a federal agency with responsibilities that include geologic mapping and hydrologic studies. USGS staff participate in TGPC-sponsored projects and TGPC subcommittees, provide groundwater expertise to TGPC, and allow opportunities for agencies to provide input on federal research.

Groundwater Protection Programs

The table below summarizes existing groundwater monitoring programs and activities and describes the groundwater protection programs performed by TGPC member agencies.

Table 1. Summary and Status of State Groundwater Protection Programs

Groundwater Protection Program	Implementation Status	Responsible Agency
Active SARA Title III Program	fully established	TCEQ[8]
Ambient Groundwater Monitoring System	fully established	TWDB
Aquifer Vulnerability Assessment	continuing efforts	TCEQ[8]
Aquifer Mapping	fully established	TWDB
Aquifer Characterization	fully established	TWDB
Comprehensive Data Management System	continuing efforts	TGPC[8]
State Groundwater Protection Strategy	continuing efforts	TGPC[8]
Dry Cleaner Remediation Program	fully established	TCEQ
Groundwater Best Management Practices	continuing efforts	TGPC[8]
Groundwater Legislative Goal	fully established	TGPC[8]
Groundwater Classification	fully established	TGPC[8]
Groundwater Quality Standards	fully established	TCEQ
Interagency Coordination for Groundwater Protection Initiatives	fully established	TGPC[8]
Municipal Setting Designations	fully established	TCEQ
Municipal Solid Waste (Subtitle D) State Authorized Program	fully established	TCEQ
Nonpoint Source Controls/Agricultural & Silvicultural	continuing efforts	TSSWCB
Nonpoint Source Controls/All Others	continuing efforts	TCEQ
Pesticide State Management Plan (Generic)	received EPA concurrence	TGPC[8]
Pesticide Specific Regulation Programs	fully established	TDA
Pollution Prevention Program	fully established	All Agencies
Radiation Control Program	fully established	DSHS
Radioactive Waste Disposal Program	fully established	TCEQ
Resource Conservation and Recovery Act (RCRA) – State Authorized Program	fully established	TCEQ
State Hydrocarbon Exploration/Production Regulations	fully established	RRC
State Superfund	fully established	TCEQ
State Oilfield Cleanup Fund	fully established	RRC
State Petroleum Storage Tank Remediation Fund	fully established	TCEQ
State Septic System Regulations	fully established	TCEQ[8]
Surface Mining and Reclamation Regulations	fully established	RRC
Underground Storage Tank (UST) Installation Requirements	fully established	TCEQ
UST Registration Program	fully established	TCEQ
Underground Injection Control (UIC) Program/Industrial	fully established	TCEQ
UIC Program/Oil & Gas	fully established	RRC
Vulnerability Assessment for Drinking Water/Source Water Protection	fully established	TCEQ
Wellhead Protection Program (EPA-approved)	fully established	TCEQ
Wastewater Discharge and Disposal Permits	fully established	TCEQ
Water Well Abandonment Regulations	fully established	TDLR
Water Well Installation Regulations	fully established	TDLR

[8] The responsibility for this program lies with more than one agency.

Agencies and entities who are members of TGPC participate in groundwater monitoring. Detailed information on individual programs is provided and updated each year in TGPC's *Joint Report*.[9]

Texas Commission on Environmental Quality

TCEQ is responsible for regulatory groundwater protection programs that aim to prevent contamination and to identify, assess, and remediate existing problems. TCEQ implements these programs through education, voluntary action assistance, permitting, and enforcement. As the state's lead agency for water quality protection, TCEQ administers both state and federally mandated programs. Federal programs that TCEQ administers include the Resource Conservation and Recovery Act (RCRA); the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA); the Clean Water Act (CWA); and the Safe Drinking Water Act (SDWA). TCEQ also develops state management plans under the FIFRA aimed to prevent the contamination of groundwater by pesticides.

Multiple programs within TCEQ have responsibilities related to the protection of groundwater resources, including the Office of Compliance and Enforcement, the Office of Waste, and the Office of Water.

Texas Water Development Board

TWDB conducts an active groundwater resource assessment program. TWDB personnel have identified boundaries and various characteristics for all the state's major and minor aquifers including geologic information, water availability, and recharge. In addition, TWDB has identified the major entities using groundwater within each river basin, the aquifer(s) from which they pump, the quality of water being developed, and the quantity of water needed for a 50-year planning period. To accomplish this, TWDB has been collecting data on the occurrence, availability, quality, and quantity of groundwater present and the current and projected demands on groundwater resources. The statewide groundwater level measurement programs, groundwater quality sampling program, and groundwater studies are vital to the state's regional water planning efforts.

Data collection under the ambient groundwater quality sampling program allows TWDB to monitor any changes in the quality of groundwater over time and to establish as accurately as possible the baseline quality of groundwater occurring naturally in the state's aquifers. TWDB personnel and cooperators typically collect about 400 samples each year from a subset of the major and minor aquifers, covering all the aquifers in a four-year period. TWDB conducts the groundwater quality monitoring program in accordance with procedures established in its Field Manual for Groundwater Sampling. It also obtains data collected by other entities that follow these and similar procedures, such as groundwater conservation districts, the USGS, and other state and federal agencies.

TWDB personnel process and store collected data by state well number in the TWDB groundwater database, which also contains indicators of sample reliability, collecting entity, and analytical laboratory along with sample results. Using the geographical coordinates stored in TWDB's groundwater database, statewide water quality data are analyzed using geographical information systems software. Through TWDB's Water Data Interactive portal, these data are available on TWDB's Groundwater Data Viewer,[10] an internet-based mapping application. The data are also available from specific reports on the portal.[11]

[9] https://www.tceq.texas.gov/groundwater/groundwater-planning-assessment/sfr-056-joint-groundwater-monitoring-contamination-report
[10] https://www3.twdb.texas.gov/apps/WaterDataInteractive/GroundwaterDataViewer/
[11] http://www.twdb.texas.gov/groundwater/data/gwdbrpt.asp

Railroad Commission of Texas

RRC regulates the disposal by injection of oil and gas wastes generated in connection with activities associated with the exploration, development, and production of oil or gas or geothermal resources (Statewide Rule 9), the injection of fluid for enhanced oil recovery (Statewide Rule 46), and the underground storage of hydrocarbons (Statewide Rules 95, 96, and 97). As of December 31, 2020, the inventory of active wells in these categories was 29,380 out of 54,462 currently permitted wells. RRC's UIC Program for these categories of wells (Class II) is administered under authority issued by EPA under the SDWA. The focus of the program is the protection of underground sources of drinking water. Class II wells must meet permitting standards and be tested and monitored to demonstrate mechanical integrity.

Brine mining injection wells (Class III) are typical of solution mining wells. The RRC Class III Brine Mining Injection Well Program was approved on March 29, 2004. Since then, all active brine-mining facilities were re-permitted per the provisions of Statewide Rule 81. Most brine mining facilities are required to monitor groundwater quality and submit groundwater-monitoring reports. Groundwater monitoring is not conducted at facilities where usable quality groundwater is not present, typically located on salt domes along the Gulf Coast.

RRC regulates the acceptance, handling, treatment, storage, reclamation, recycling, and disposal at or near ground surface of oil and gas wastes[12]. These waste streams are generated from activities associated with the exploration, development, and production of oil, gas, or geothermal resources. Statewide Rule 8 prohibits the waste of hydrocarbon resources and the pollution of surface and subsurface waters of the state, and requires permits for various pits, waste haulers, and other waste management practices, such as landfarming and land treatment, that are not specifically authorized by rule. Statewide Rule 57 specifies the permitting and reporting requirements for the reclamation of hydrocarbons from tank bottoms and other hydrocarbon wastes. Chapter 4, Subchapter B specifies permit requirements and provides guidance for the recycling of generated fluids and solids into a recycled product(s) that has a legitimate commercial reuse

RRC regulates oil-field cleanup activities, which are subject to Statewide Rule (SWR) 8, SWR 20, SWR 91, and RRC Special Orders. Other rules that protect groundwater and influence cleanup activities include: SWR 13 (well completion requirements), SWR 14 (plugging requirements), SWR 9 (injection [disposal] into a non-productive zone), SWR 46 (injection into a productive zone), SWR 57 (reclamation plants), SWR 93 (water quality certification), SWR 98 (standards for management of hazardous oil and gas waste), and 16 Texas Administrative Code (TAC) 4.601 - 4.632 (disposal of oil and gas NORM (Naturally Occurring Radioactive Materials) waste). Through SWR 30 (Memorandum of Understanding), RRC maintains jurisdiction over natural gas plants and compressor stations

The Surface Mining and Reclamation Division (SMRD) of RRC is authorized to enforce state laws and regulations consistent with the Texas Surface Coal Mining and Reclamation Act, Texas Natural Resources Code (TNRC), Chapter 134 (TSCMRA) and the Texas Uranium Surface Mining and Reclamation Act, TNRC 131 (TUSMRA). As part of the groundwater information required in the regulations, determination of the quality of subsurface water includes the analysis of common inorganic groundwater constituents plus certain trace metals. Monitoring plans for pre-mining, mining, and post-mining conditions are required, normally on a three-month basis, to track variations in water-quality parameters.

RRC typically conducts monitoring only during investigations made for a specific reason, such as water-quality complaints. RRC no longer maintains a laboratory, and samples collected by enforcement personnel are sent to a commercial laboratory under contract with the Division for chemical and physical analyses. Typically, between one and five water-quality and quantity

[12] 16 TAC Part 1, Chapter 3.8 (Statewide Rule 8 Water Protection), Chapter 3.57 (Statewide Rule 57 Reclamation Activities) and Chapter 4, Subchapter B (Recycling Programs)

complaints are investigated annually by RRC field personnel. To date, investigations have not borne out any confirmed contamination cases.

Texas Department of State Health Services

DSHS is responsible for promoting and protecting the health and well-being of Texans. Regarding groundwater issues, DSHS has several programs related to groundwater safety and public health concerns.

The DSHS Health Assessment and Toxicology Program is responsible for preventing or reducing the harmful effects of exposure to hazardous substances on human health in Texas. The program offers support when issues arise regarding potential contamination of drinking water, including drinking water that is produced from a groundwater source. DSHS performs Public Health Assessments (PHAs) and Health Consultations to determine if adverse health effects might result from exposures to hazardous substances. Through a cooperative agreement with the Agency for Toxic Substances and Disease Registry, DSHS performs PHAs for all sites on or proposed for listing on the National Priorities List (NPL) of Superfund sites. DSHS provides toxicological and epidemiological support with the goal of protecting public health.

The DSHS Texas Fluoridation Program (TFP) assists public water systems (PWS) in adjusting the fluoride level in the drinking water, which helps Texans improve their oral health by reducing and preventing tooth decay. TFP promotes community water fluoridation by assisting PWS operators with all the design, installation, maintenance, and inspection of fluoride systems; and by providing training on water fluoridation for the PWS personnel engaged in fluoridation. The program also collects and records fluoride levels in the drinking water for quality control.

The DSHS Radiation Control Program (RCP) regulates radioactive materials in Texas. Intermittently, the RCP samples groundwater resulting from an incident, complaint, or situation that leads the RCP to believe there may be groundwater contamination.

The DSHS Laboratory Services Section is the principal drinking water laboratory in the state. The laboratory performs water quality testing, including chemical and radiological analyses required by the U.S. EPA SDWA, and other analyses in support of any DSHS program requiring testing of drinking water samples. The Laboratory Services Section also accepts water samples for routine microbiological analysis from the public for a fee.

Texas Department of Agriculture

TDA has lead authority for pesticide regulation in Texas. TDA recognizes certain pesticides as potential groundwater contaminants and is responsible for preventing unreasonable risk to human health and the environment from the use of pesticides.

The agency conducts a variety of activities designed in part or entirely to reduce the potential of groundwater contamination by pesticides, including:

- Product registration
- Pesticide label compliance and enforcement
- Pesticide applicator training
- Pesticide laboratory services

Texas State Soil and Water Conservation Board

TSSWCB is the state agency that administers Texas' soil and water conservation law and delivers coordinated natural resource conservation programs through the state’s 216 Soil and Water Conservation Districts.

TSSWCB administers several programs as the lead state agency for planning, managing, and abating agricultural and silvicultural (forestry) nonpoint source pollution. TSSWCB has a

Nonpoint Source Grant Program that provides funding for assessment, demonstration, implementation, education, and research related to nonpoint source pollution.

The Water Quality Management Plan Program offers landowners and operators of agricultural and silvicultural lands a voluntary mechanism for being protective of state water quality with respect to nonpoint source pollution. This program offers cost-share funding for the installation of soil and water land improvement measures to serve as an incentive for participating.

TSSWCB also provides grants to local government sponsors to operate, maintain, and repair flood control dams to ensure that the state's network of 2,000 flood control dams protect lives and property.

Texas Alliance of Groundwater Districts

TAGD was formed on May 12, 1988. Its core District Membership is restricted to groundwater conservation districts (GCDs, or districts) in Texas who have legal authority to manage groundwater; and other organizations and individuals with an interest in groundwater management may become Associate Members. TAGD is organized exclusively for charitable, educational, or scientific purposes within the meaning of Section 501(c)(3) of the Internal Revenue Code. As such it can accept tax-deductible donations and use these donations to educate the public to the growing need for water conservation and groundwater protection.

TAGD's bylaws provide that its purpose and missions are:

- To provide its members with information, ideas, practices, and programs which will conserve and protect the groundwater resources of the state
- To exchange information between member districts and Associate Members concerning rules, procedures, programs, practices, and other duties involved in the operation of a district
- To review and analyze methods and techniques employed by members and their associates in conducting studies and research on management of groundwater, and in designing and obtaining solutions to problems associated therewith
- To provide resource information to state and federal legislators and agencies concerning legislation and policies which involve groundwater
- To evaluate activities, policies and plans of governmental bodies and other organizations and associations as they relate to groundwater and to provide the information to all member districts

TAGD maintains contact with members of the private sector and various local, state, and federal officials and their agencies to obtain, and provide, timely information on activities and issues relevant to groundwater conservation districts. To date there are 90 district members of TAGD.

Texas law authorizes the creation of GCDs to provide for the conservation, preservation, protection, recharging, and prevention of waste of groundwater. GCDs can be created by one of three procedures: (1) special law districts can be established by the legislature; (2) districts can be created through a property-owner petition filed with TCEQ; and (3) districts can be created in priority groundwater management areas through procedures initiated by TCEQ. Districts are local or regional in their jurisdiction and typically have elected boards of directors. Among other things, GCDs have been granted authority to monitor groundwater quality. Districts also have the authority to bring civil court proceedings for injunctive relief against an entity causing groundwater contamination.

Texas A&M AgriLife Research

AgriLife Research is the state's premier research and technology development agency in agriculture, natural resources, and the life sciences. Headquartered in College Station, AgriLife Research has a statewide presence, with scientists and research staff on other Texas A&M University System campuses and at the 13 regional AgriLife Research and Extension Centers. The agency conducts basic and applied research to improve the productivity, efficiency, and profitability of agriculture, with a parallel focus on conserving natural resources and protecting the environment. AgriLife Research has more than 550 doctoral-level scientists, many of whom are recognized internationally for their work. The Texas Water Resources Institute is an administrative unit of AgriLife Research and coordinates much of the internal water-related research.

Broad goals of the AgriLife Research program include those specifically targeted to protect, preserve, and efficiently use groundwater resources. Groundwater programs of AgriLife Research stress the development of management strategies, technologies, and educational programs to support sustainable quality water supplies.

AgriLife Research scientists are working to address a variety of groundwater planning, supply, quality and use issues:

- Planning:
  - Aquifer characterization
  - Policy analysis
  - Modeling
  - Irrigation water conservation
- Supply:
  - Water conservation methods
  - Enhancing aquifer recharge
  - Rainwater harvesting for aquifer recharge
- Water quality:
  - Waste and wastewater management
  - Proper use of agriculture chemicals (nutrients and pesticides)
  - Pathogens
  - Remediation of contaminated groundwater
- Use:
  - Irrigation systems research and development
  - Economics of water use
  - Efficiency of irrigation and water management
  - Crop selection keyed to water availability
  - Development of drought-resistant crop varieties
  - Conservation in urban and agriculture sectors

Some of the recent AgriLife Research groundwater-related research activities include:

- Developing technologies, procedures and strategies for deficit irrigation applications and effective water management policies to efficiently use and protect the Ogallala Aquifer as well as decrease pumping from the aquifer.
- Optimizing limited early season irrigation, overcoming poor germination associated with subsurface drip irrigation and evaluating crop rotations among drought-tolerant crops with the goal of sustaining agriculture through adaptive management to preserve the Ogallala Aquifer under a changing climate.
- Using electron beam technology to destroy short-chain and perfluoroalkyl substances in groundwater, wastewater, sewage sludges, and soil.
- Using remote-sensing technologies to measure, model and track soil moisture in agriculture to optimize irrigation to save groundwater.
- Developing a web-based irrigation scheduling tool to efficiently irrigate cotton with limited water, thus saving groundwater.
- Identifying and assessing the condition of transboundary aquifers between the United States and Mexico.
- Characterizing the gradient of water, climate, and biodiversity in the watershed of a tropical montane forest in central Costa Rica.
- Developing specially designed biochar tailored for dairy and other waste material to help enhance the water quality of potential agricultural runoff.
- Improving yield, water use, water use efficiency and stress tolerance/resistance in major crops in the Texas High Plains where groundwater is utilized for irrigation.
- Determining links between pathogens in surface or near-surface sources, runoff and streams and their impacts on groundwater.
- Improving drought tolerance of crops (corn, cotton, and others), including plant breeding, conservation tillage systems and water management strategies to conserve groundwater.
- Managing hydrologic processes, water resources, aquifer recharge and aquifer mechanics in the El Paso and other arid regions.
- Training future groundwater professionals through undergraduate and graduate education and research programs at Texas A&M University and other System institutions; many of AgriLife Research scientists at Texas A&M University in College Station also hold joint teaching appointments, thus providing the latest research results to students.

AgriLife Research efforts are complimented by the outreach educational programs of the Texas A&M AgriLife Extension Service (AgriLife Extension). AgriLife Extension specialists provide educational and training programs and meetings and provide easy-to-read fact sheets and other publications for specific targeted clientele, such as landowners interested in pumping and desalinating brackish groundwater, proposed guidelines for injection wells and groundwater management among others. Other AgriLife Extension activities include field demonstrations and educational programs for youth and adults.

Specifically, through the Texas Well Owners Network (TWON) AgriLife Extension specialists provide leadership for programs educating private water well owners about potential pollutant sources and what steps can be taken to lessen potential impacts from these sources and plugging abandoned wells to protect groundwater quality and groundwater conservation districts as well as characterizing potable water hazards and resources needs in private well communities impacted by extreme flooding events. Extension specialists also provide technical leadership for development of pesticide-specific management plans adapted to Texas.

Other examples where AgriLife Extension's work compliments the groundwater efforts of AgriLife Research include the Healthy Lawns and Healthy Waters (HLHW) project and several programs related to on-site sewage facilities (OSSFs). HLHW provides Texas homeowners with practical information on lawncare that directly benefits local watersheds. Similarly, OSSF-related programs work with OSSF owners and service providers to inspect and repair or replace failing septic systems in impaired watersheds to help improve area water quality. Projects like these and others are the result of AgriLife Research partnerships with groundwater conservation districts, river authorities, county Extension agents, cities, counties and more.

The Bureau of Economic Geology of The University of Texas at Austin

Established in 1909, UTBEG is a research entity of the University of Texas (UT) and functions as the State Geological Survey. UTBEG is also a research unit within UT Austin's Jackson School of Geosciences. UTBEG conducts basic and applied research, including projects related to groundwater resources and quality, water and energy issues, and brackish groundwater assessments in support of other state agency missions and for federal agencies and industry. Research activities involve original field research, data collection, including groundwater quality samples, and chemical analyses, and evaluation of water-quality data from existing databases.

Recent UTBEG groundwater-related research topics include the following:

- Regional groundwater-quality issues related to nitrate, arsenic, fluoride, and other related contaminants
- Assessment of noncompliance issues for public water systems relative to EPA's SDW
- Analysis of water quality issues related to aquifer storage and recovery (ASR), particularly arsenic mobilization and guidelines for ASR related to potential water quality issue
- Development and update of the Surface Casing Estimator[13] to protect groundwater, which includes mapping critical hydrogeologic intervals across Texas counties using RRC-provided data, Q-logs, as well as water-quality data from TWDB and RRC
- Brackish groundwater resource assessment for the Carrizo/Wilcox and Queen City/Sparta aquifers in southwest Texas
- Water-quality impacts of energy production, focusing on methane sources using isotopes
- Water quality characterization based on samples from major unconventional oil and gas reservoirs in the state
- Groundwater/surface-water interactions and impacts on endangered species

As part of sponsored-research projects, UTBEG staff measure groundwater quality and water levels in selected public and private wells across many parts of Texas. Most water-quality data collected in these studies consist of pH, temperature, conductivity, major and minor inorganic ions, total organic carbon, isotopes, and other constituents of interest. Data are used to interpret rates and modes of hydrologic processes and the source and movement of groundwater. Project-specific data are collected in data reports or topical reports. Periodically, digitized data are compiled for inclusion in the Texas Natural Resources Information System (TNRIS).

Texas Department of Licensing and Regulation

The Texas legislature recognized the need to identify and protect the state's groundwater resources and in 1965 created the Water Well Drillers Board (Board). In 1991, the 72nd

[13] https://www.beg.utexas.edu/sce

Legislature expanded the Board's functions to include licensing and regulation of water well pump installers. In 1997, Senate Bill 1955 (75th Legislature, 1997) transferred the Water Well Driller Advisory Council (Council) and the Drillers/Pump Installers (WWD/PI) Program from TCEQ (then the Texas Natural Resource Conservation Commission, TNRCC) to the Texas Department of Licensing and Regulation (TDLR).

The WWD/PI/Abandoned Well Referral and Notification Program maintains communications with the Council, industry, various state agencies, and GCDs; and investigates all alleged violations of Title 12, Texas Occupations Code (TOC), Chapters 1901 and 1902, and 16 TAC 76. The program also investigates consumer complaints filed against well drillers, pump installers, and performs compliance investigations of water, monitor, closed loop geothermal injection, and dewatering wells to ensure compliance with well construction standards.

Investigations include, but are not limited to, surface completions, depth of annular cement, regulated distances from contamination sources and property lines, abandoned and deteriorated water wells, and licensing requirements. In addition, rules requiring isolation of zones containing undesirable or poor-quality water are enforced to prevent commingling with and degradation of fresh-water zones.

TDLR's WWD/PI Program staff also administers the Abandoned Well Notification Program, which is authorized by 12 TOC (Texas Occupations Code) 1901 and 1902. Investigations are conducted, and landowners are notified that within 180 days of notification, the abandoned or deteriorated water well must be plugged, completed, or capped in accordance with 16 TAC 76 specifications.

Violations of 12 TOC 1901 and 1902 and agency rules are enforced by TDLR's Enforcement Division through TDLR orders requiring administrative penalties and corrective actions, cease and desist orders, or referral to the Office of the Attorney General. Investigations that involve groundwater contamination are referred to the appropriate state agency with jurisdiction for the activity believed to be the cause of the contamination.

State Groundwater Protection Policy

TWC, Section 26.401[14] establishes the state's groundwater protection policy, which includes a goal of nondegradation of groundwater resources for all state programs. This 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 public health and welfare, and the maintenance and enhancement of the long-term economic health of the state. Further, the policy 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 use of the best professional judgment by the responsible state agencies in attaining the goal and policy is also recognized.

The policy states that discharges of pollutants, disposal of wastes, and other regulated activities should be conducted in a manner that will maintain present uses and not impair potential uses of groundwater or pose a public health hazard. The programs of the various state agencies are generally coordinated to attain this goal.

Groundwater Classification System

TGPC and its member agencies recognize that groundwater classification is a valuable tool for implementing the state's groundwater protection policy. Through classification, the groundwater in the state can be categorized and protection or restoration measures can then be specified by member agencies according to the quality and present or potential use of the groundwater.

TGPC developed a Groundwater Classification System for use by state agencies, which defines four classes of groundwater based on the concentration of total dissolved solids (TDS). The names and concentration ranges are based on traditional nomenclature associated with each class. Fresh groundwater is classified as having a TDS concentration range from zero to 1,000 milligrams per liter (mg/l); slightly saline groundwater has a TDS concentration range from greater than 1,000 to 3,000 mg/l; moderately saline groundwater, a TDS concentration range from greater than 3,000 to 10,000 mg/l; and very saline groundwater to brine, a TDS concentration greater than 10,000 mg/l. Quality also determines usability; however, it is implicit in the classification that a water-bearing zone must be able to produce sufficient quantities of water to meet its intended use. The annual *Joint Report*[15] describes in detail the Groundwater Classification System developed by TGPC.

The Groundwater Classification System applies to all groundwater in the state. In assigning a classification, the member agencies attempt to use the natural quality of the groundwater that is unaffected by discharges of pollutants from human activities. All usable and potentially usable groundwater is subject to the same protection provided by the state's groundwater protection policy. Starting with the nondegradation goal, protection or restoration measures can be varied according to the response level set by the classification so long as all the following conditions are met:

- Current groundwater uses are not impaired.
- Potential groundwater uses are not impaired.

[14] https://statutes.capitol.texas.gov/Docs/WA/htm/WA.26.htm#26.401
[15] https://www.tceq.texas.gov/groundwater/groundwater-planning-assessment/sfr-056-joint-groundwater-monitoring-contamination-report

- A public health hazard is not created.
- The quality of groundwater is restored, if feasible.

An agency considers all present or potential beneficial uses of groundwater of a given quality in determining protection or restoration measures. Generally, drinking water for human consumption would require the highest degree of protection or restoration, so protection for drinking water standards should be protective of other uses. These considerations resulted in two response levels for purposes of assigning protection or restoration measures, commensurate with the potential to impact human health and the environment:

- Level I response for fresh, slightly saline, and moderately saline classes should be based on the current or potential use as a human drinking water supply
- Level II response for very saline to brine class should be based on indirect exposure (i.e., by means other than drinking) or no human consumption.

In specifying a protection or restoration measure, member agencies should apply the best professional judgment on a case-by-case basis. Evaluations should include such factors as productivity, the availability of alternate sources of water, background concentrations of naturally occurring constituents, the effect of constituents on usability, traditional and potential beneficial uses of the water, economic and technical feasibility of treatment, projected needs for and types of impacts on the groundwater.

The classification system is intended to be implemented by member agencies as an integral part of their groundwater protection programs. In addition to its response-setting function, the classification system fosters consistency among the various programs.

State Groundwater Protection Strategy

TGPC is required by statute to develop a comprehensive strategy that coordinates the activities of all the participating agencies and documents what needs to be done to protect groundwater in the state of Texas. The TGPC addressed this duty directly in 1988 through the formal publication of the *Texas Ground Water Protection Strategy (Strategy)*. Since that time, there have been several documents published that describe changes to the groundwater protection programs and authorities of state agencies with respect to groundwater. This includes the Texas Ground Water Protection Profiles, 1991, and later the annual Joint Report. There have been many changes in agencies and the programs that they administer since 1988. The more recent publications have focused on the water quality aspects of various programs rather than the state strategy for groundwater protection.

Recognizing the changes that had occurred since the state's first groundwater protection strategy was developed, TGPC decided in January 2001 to begin an update. That process resulted in the development of *Texas Groundwater Protection Strategy* (TCEQ Publication AS-188, February 2003) which provided a road map for the activities of the TGPC. It was divided into thematic sections designed to highlight the state's protection activities, and importantly, to identify any gaps that may have needed to be filled among those programs. This 2003 *Strategy* included:

- the state's groundwater protection goal as established by the legislature
- the statewide groundwater classification system and how the state identified contamination and quantity issues
- the roles and responsibilities of the various state agencies involved in groundwater protection and discussed the TGPC as a coordinating mechanism
- examples of how the various state agencies implemented groundwater protection programs through regulatory and non-regulatory models

- how the local, state, and federal agencies coordinated management of groundwater data for the enhancement of groundwater
- the role research played in understanding the importance of groundwater and of coordinating research
- public education related to groundwater that was being performed in the state
- public participation in establishing and implementing groundwater policy
- a plan to update the groundwater strategy
- proposals for the next document to identify and rank significant threats to the state's groundwater resources, consideration of the vulnerability of groundwater resources, and a prioritization of actions to address those threats
- recommendations and actions that could be taken to protect groundwater

TGPC began updating the *Strategy* again in 2017, and at its quarterly public meeting in October 2018, adopted the updated *Strategy* (TCEQ Publication AS-188, November 2018).[16] The comprehensive strategy for protecting groundwater in Texas includes both the TGPC members' internal programs and the TGPC's internal processes outlined in this adopted *Strategy* update.

The 2018 updates streamlined the *Strategy* for better integration into TGPC's vision for the committee's mandated reports. By streamlining the documents, TGPC has sought to reduce redundancy and increase the inter-dependency between the mandated products of the legislation that created the committee. The 2018 updates also represent an initial move toward a dynamic document that can be updated rapidly to respond not only to advances in groundwater technology and contaminant detection and forecasting, but also to issues not anticipated at this time. TGPC believes that a dynamic strategy, which facilitates addressing not only the "known" groundwater issues, but emerging issues, is critical to maintaining the protection of the resource.

The principles and mechanisms that characterize groundwater for protection and conservation identified in the previous *Strategy,* (AS-188, February 2003), were not in any way invalidated, amended, modified, or "repealed," and remain in effect. Similarly, no existing groundwater protection measure acquired, adopted, or incurred; nor any rule or order adopted; nor any proceeding instituted by the program areas of any member agency that were pursuant to AS-188 (February 2003), were affected by the adoption of the updated *Strategy*.

The updated *Strategy* addresses a new approach to the contents of the remaining chapters in AS-188 (February 2003), and, as mentioned previously, is the initial framework for a dynamic *Strategy* moving forward.

[16] https://www.tceq.texas.gov/groundwater/groundwater-planning-assessment/prot_prog.html

Groundwater Assessment

Methodology Used to Prepare this Assessment

The member agencies of TGPC provide data for groundwater quality inventory efforts. In 1996, the TGPC began conducting an inventory of groundwater quality of the state's aquifers through the partnership of two of the TGPC member agencies: the TCEQ and the TWDB. This information was published in the *State of Texas Water Quality Inventory 1996*, which is a predecessor to this report.

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. Subsequent reports continued this spatial and graphical representation as additional aquifers were inventoried.

In subsequent *Water Quality Inventory* reports, TCEQ has utilized information from TWDB's groundwater database[17] to inventory ambient water quality in each of the state's major and minor aquifers for the most recent ten-year period. This report is the first to include water quality information for the Cross Timbers minor aquifer, which was first named by the TWDB at the end of 2017.

For this report, TCEQ evaluated ambient groundwater data for Fiscal Year (FY) 2012 through FY2021 (September 1, 2011, through August 31, 2021) from the TWDB groundwater database. The following constituents were chosen from all the analyses conducted because they are listed in state rules related to drinking water standards: arsenic, barium, cadmium, chromium, copper, iron, manganese, selenium, zinc, sulfate, chloride, nitrate-nitrogen, total dissolved solids, and alpha radiation.

In evaluating these constituents of interest, staff sorted the data and filtered the results to eliminate duplicate samples for any given well, giving a "snapshot" of the highest concentration value for each well that is available. The purpose for choosing the highest concentration at each sampled well during the ten-year period was to be conservative in estimating concentrations of constituents in each aquifer. Concentrations illustrated in previous reports may have changed at specific sampling sites since each report looks at the most recent ten-year period.

For each constituent, results were evaluated to determine how many wells in each sampled aquifer were above an accepted regulatory value, typically the maximum contaminant level (MCL) for drinking water established by US EPA. For those aquifers in which a considerable number of samples demonstrated concentrations above the MCL, the values were imported into a GIS (Geographic Information Systems) application and presented spatially on a map of the aquifer (Figures 3 through 40). There is no specific number or percentage of samples that demonstrated what a "significant" quantity of samples above the MCL would be. Instead, staff examined the data and weighed the numbers of samples, the extent of the aquifer, the demand in or use of the aquifer, and the distribution of the concentrations to determine the relative importance of the concentration data. After these constituents are identified for each aquifer, staff generated GIS-based maps for those select aquifers and constituents (see Figures 3 through 40, Constituents of Concern in Selected Aquifers). In general, maps were developed when staff identified a concern with a parameter that exceeded a primary drinking water MCL; though maps were also included for some aquifers where analyses exceeded a secondary MCL.

[17] http://www.twdb.texas.gov/groundwater/data/gwdbrpt.asp

For those analyses that are not represented spatially, Section 4 of this report, Ambient Groundwater Monitoring, includes a set of tables for each aquifer showing the total number of wells sampled for each constituent and the number of wells that exceeded the MCL. For detailed water quality data of a particular well, aquifer, or county, TWDB groundwater data[18] may be useful to address specific concerns or questions.

Limitations

The TWDB ambient groundwater quality database contains a large amount of data collected over a span of several decades. Quantitative laboratory methods used to analyze water samples have changed over time, and even in recent years, analysis may be performed by a lab, or by Hach "kits." Consequently, the data is not directly comparable without qualification.

Additionally, wells are sampled on a cycle, and there may be several intervening years between sample events. The sampling program does not consider differences in aquifer conditions due to drought, seasonal variation, or local flow directions. Therefore, the analytical results, even if performed using the same laboratory methods, may still not be directly comparable over time due to cyclical variation in aquifer conditions. This data presented in this report is intended as an overview of areas where there could be potential water quality issues and presents a "snapshot" of groundwater quality conditions for each of the major and minor aquifers.

While MCLs for drinking water are based on "total" values for a constituent, the greatest amount of data available is for "dissolved" concentrations. Because of the amount of data available, this report described the dissolved concentrations of each constituent. In general, dissolved concentrations are slightly lower than the total values. The tables and figures in this report might portray a slightly lower concentration of constituents in groundwater than exists in the field, nonetheless they serve to illustrate a general trend or areas of potential concern.

The groundwater assessment has historically utilized analyses for "Gross Alpha (total)" as an indicator for naturally occurring radioactive elements. A concentration of 15 pCi/l at a public drinking water system is typically used as a screening value that may warrant additional analysis to determine the source. In this ten-year period evaluation, very few data points for gross alpha were available, so staff utilized data for "dissolved alpha," which should provide a general estimate of the concentration of radionuclides. Additional information on naturally occurring radioactive materials in Texas is available in the following publications:

- *Drinking Water Problems: Radionuclides* (Texas A&M Agrilife Extension)[19]
- Searchable *TWDB Groundwater Database*[20]
- *Naturally Occurring Groundwater Contamination in Texas* (2011 TWDB Report)[21]

Another limitation is the relative simplicity of the methodology for this assessment. The data is evaluated using a qualitative approach to the character of water quality. However, given the size of the state and the volume of data available, this approach is adequate to present general information on ambient groundwater quality and identify areas of potential concern.

The groundwater assessment is a general water quality inventory, and the limitations discussed should restrict the conclusions that can be drawn from this data. This document may provide guidance for future investigations to better characterize aquifer quality. Similarly, water resource planners, water suppliers, and regulators could use this report to add a water quality component to future planning efforts.

[18] http://www.twdb.texas.gov/groundwater/data/index.asp
[19] https://agrilifeextension.tamu.edu/library/water/drinking-water-problems-radionuclides/
[20] http://www.twdb.texas.gov/groundwater/data/index.asp
[21] http://www.twdb.texas.gov/publications/reports/contracted_reports/doc/1004831125.pdf

Ambient Groundwater Monitoring

Summary of Ambient Groundwater Monitoring

TWDB administers an ambient groundwater monitoring program which collects data on the occurrence, availability, quality, and quantity of groundwater present. The purposes of the ambient groundwater quality sampling program are to collect data to 1) monitor any changes 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. This information helps assess the current and projected demands on groundwater resources; and accordingly, is vital to the state's regional water planning efforts.

TWDB conducts the groundwater quality monitoring program according to procedures established in the TWDB *Field Manual for Groundwater Sampling*.[22] TWDB performs ambient groundwater monitoring on water wells throughout the extent of an aquifer, such that each of the major and minor aquifers of the state are monitored approximately every four years. This data is available in several reports on TWDB's web site.[23] Ambient groundwater quality data is also collected by other entities that follow these or similar procedures, including GCDs, USGD, and other state and federal agencies. TWDB's "Water Data Interactive" is a web-based map viewer that contains information on selected water wells, springs, oil/gas tests, water levels, and water quality data.[24]

TWDB staff entered those water-quality data reports into the Groundwater Database (GWDB). TGPC relies upon ambient monitoring data available from this database, which is maintained by TWDB and includes years of sampling and analysis. According to TWDB the GWDB contains information for approximately 140,000 sites, including water wells, springs, oil/gas tests that were originally intended to be or were converted to water wells, water levels, and water quality. In 2020 TWDB sampled 101 sites (wells and springs) and cooperators sampled 125 sites, for a total of 226 sampling sites. This report includes data from approximately 2,300 water wells across Texas that were sampled between September 1, 2011, and August 31, 2021.

Ambient monitoring groundwater quality data for the major and minor aquifers used in this report are summarized in Tables 2, 3, and 4 below, with detailed data for each aquifer in Tables 5 through 35. In addition to the ambient water quality data tables in this assessment, TWDB has created detailed reports of some of its collected groundwater quality data in hydrologic atlases of certain individual aquifers.[25]

Table 2. Ambient Monitoring Groundwater Quality Data (Primary Drinking Water Constituents), FY2012 through FY2021

[22] https://www.twdb.texas.gov/groundwater/docs/UMs/UM-51.pdf
[23] https://www.twdb.texas.gov/groundwater/data/gwdbrpt.asp
[24] https://www2.twdb.texas.gov/apps/waterdatainteractive/groundwaterdataviewer
[25] https://www.twdb.texas.gov/publications/reports/numbered_reports/index.asp

Parameters with a Primary MCL	Primary MCL[26]	Number of Wells	<MDL[27]	<MCL (except <MDL)	≥MCL
Arsenic, dissolved	10 µg/l	2,292	1,356	786	151
Barium, dissolved	2 mg/l	2,296	4	2,291	1
Cadmium, dissolved	5 µg/l	2,266	2,190	82	-
Chromium, dissolved	100 µg/l	2,291	550	1,754	-
Fluoride, dissolved	4 mg/l	2,373	28	2,238	107
Mercury, dissolved	2 µg/l	2,238	2,196	42	-
Nitrate-Nitrogen, dissolved	10 mg/l	2,305	778	994	533
Selenium, dissolved	50 µg/l	2,292	1,666	544	82

Table 3. Ambient Monitoring Groundwater Quality Data (Secondary Drinking Water Constituents), FY2012 through FY2021

Parameter	Secondary Standard[28]	Number of Wells	<MDL	<Secondary Standard (other than <MDL)	≥Secondary Standard
Chloride	300 mg/l	2,363	-	2,102	275
Copper	1 mg/l	2,292	782	1,510	-
Fluoride	2 mg/l	2,373	28	1,853	492
Iron	0.3 mg/l	2,371	1,644	455	272
Manganese	50 µg/l	2,311	878	1,253	189
Sulfate	300 mg/l	2,316	114	1,857	361
Dissolved Solids	1,000 mg/l	2,376	-	1,923	453
Zinc	5 mg/l	2,291	902	1,389	3

Table 4. Radioactivity

Parameter	Screening Level[29]	Number of Wells	<MDL	<Screening Level (other than <MDL)	>Screening Level
Alpha, dissolved	15 pCi/L	1,061	542	426	103

[26] "MCL" or Maximum Contaminant Level, is the maximum concentration of a regulated contaminant that is allowed in drinking water before the public water system is considered in violation of Public Drinking Water rules. Units of concentration are in micrograms per liter (µg/l) or milligrams per liter (mg/l).
[27] "MDL" or Method Detection Limit is the lowest analysis value available for a parameter at a particular sampling event, as determined by the analyzing laboratory.
[28] "Secondary Standard" is a concentration above which water in a public system may only be used with written approval from the TCEQ. Note that fluoride has both an MCL and a secondary standard. Units of concentration are in micrograms per liter (µg/l) or milligrams per liter (mg/l).
[29] "Screening Level" means, for the purpose of this assessment, a concentration that is generally comparable to drinking water standards. Units are in picocuries per liter (pCi/L)

Tables 5 through 35 – Ambient Groundwater Monitoring Data in Texas Aquifers

Tables 5 through 35 – Ambient Groundwater Monitoring Data, Tabulated by Aquifer, FY2012 through FY2021

Note: For each of the tables the following footnotes and definitions apply:

- "Constituent" is the parameter which is analyzed. For this report, each constituent is reported as "dissolved" unless otherwise noted.
- "Criterion" is the level by which the concentration in groundwater is compared.
- MCL, or Maximum Contaminant Level, is the maximum concentration of a regulated contaminant that is allowed in drinking water before the public water system is considered in violation of Public Drinking Water rules.
- "Secondary Standard," or secondary constituent level, is a concentration above which water in a public system may only be used with written approval from the TCEQ. Note that Fluoride has both an MCL and a secondary standard.
- "Number of Wells" means the number of unique wells sampled for the constituent between September 1, 2011, and August 31, 2021.
- MDL, or Method Detection Limit, is the lowest analysis value available for a parameter at a sampling event, as determined by the analyzing laboratory. For this report, if an MDL was greater than a constituent's criterion, that analysis was not utilized when counting samples less than or greater than the MCL.
- mg/l means milligrams per liter
- µg/l means micrograms per liter
- pCi/l means picocuries per liter

Table 5. Blaine Aquifer – Groundwater Monitoring Data

Constituent (dissolved)	Criterion	Source of Criterion	Number of Wells	<MDL	<Criterion (except <MDL)	≥Criterion
Arsenic	10 µg/l	MCL	16	13	3	0
Barium	2 mg/l	MCL	16	0	16	0
Cadmium	5 µg/l	MCL	16	16	0	0
Chromium	100 µg/l	MCL	16	1	15	0
Fluoride	4 mg/l	MCL	16	3	13	0
Mercury	2 µg/l	MCL	16	16	0	0
Nitrate-Nitrogen	10 mg/l	MCL	16	1	4	11
Selenium	50 µg/l	MCL	16	2	13	1
Chloride	300 mg/l	Secondary Standard	16	0	9	7
Copper	1 mg/l	Secondary Standard	16	1	15	0
Fluoride	2 mg/l	Secondary Standard	16	3	13	0
Iron	0.3 mg/l	Secondary Standard	16	13	1	2
Manganese	50 µg/l	Secondary Standard	16	8	7	1
Sulfate	300 mg/l	Secondary Standard	16	0	0	16
Total Dissolved Solids	1,000 mg/l	Secondary Standard	16	0	0	16
Zinc	5 mg/l	Secondary Standard	16	2	14	0
Dissolved Alpha	15 pCi/L	Screening Level	0	0	0	0

Table 6. Blossom Aquifer – Groundwater Monitoring Data

Constituent (dissolved)	Criterion	Source of Criterion	Number of Wells	<MDL	<Criterion (except <MDL)	≥Criterion
Arsenic	10 µg/l	MCL	1	1	0	0
Barium	2 mg/l	MCL	1	0	1	0
Cadmium	5 µg/l	MCL	1	1	0	0
Chromium	100 µg/l	MCL	1	0	1	0
Fluoride	4 mg/l	MCL	1	0	1	0
Mercury	2 µg/l	MCL	1	1	0	0
Nitrate-Nitrogen	10 mg/l	MCL	1	1	0	0
Selenium	50 µg/l	MCL	1	1	0	0
Chloride	300 mg/l	Secondary Standard	1	0	1	0
Copper	1 mg/l	Secondary Standard	1	1	0	0
Fluoride	2 mg/l	Secondary Standard	1	0	1	0
Iron	0.3 mg/l	Secondary Standard	1	1	0	0
Manganese	50 µg/l	Secondary Standard	1	0	1	0
Sulfate	300 mg/l	Secondary Standard	1	0	1	0
Total Dissolved Solids	1,000 mg/l	Secondary Standard	1	0	0	1
Zinc	5 mg/l	Secondary Standard	1	1	0	0
Dissolved Alpha	15 pCi/L	Screening Level	0	0	0	0

Table 7. Bone Spring–Victorio Peak Aquifer - Groundwater Monitoring Data

Constituent (dissolved)	Criterion	Source of Criterion	Number of Wells	<MDL	<Criterion (except <MDL)	≥Criterion
Arsenic	10 µg/l	MCL	2	0	2	0
Barium	2 mg/l	MCL	2	0	2	0
Cadmium	5 µg/l	MCL	2	2	0	0
Chromium	100 µg/l	MCL	2	1	1	0
Fluoride	4 mg/l	MCL	2	0	2	0
Mercury	2 µg/l	MCL	2	2	0	0
Nitrate-Nitrogen	10 mg/l	MCL	2	0	1	1
Selenium	50 µg/l	MCL	2	0	2	0
Chloride	300 mg/l	Secondary Standard	2	0	0	2
Copper	1 mg/l	Secondary Standard	2	0	2	0
Fluoride	2 mg/l	Secondary Standard	2	0	1	1
Iron	0.3 mg/l	Secondary Standard	2	2	0	0
Manganese	50 µg/l	Secondary Standard	2	1	1	0
Sulfate	300 mg/l	Secondary Standard	2	0	0	2
Total Dissolved Solids	1,000 mg/l	Secondary Standard	2	0	0	2
Zinc	5 mg/l	Secondary Standard	2	0	2	0
Dissolved Alpha	15 pCi/L	Screening Level	1	1	0	0

Table 8. Brazos River Alluvium Aquifer - Groundwater Monitoring Data

Constituent (dissolved)	Criterion	Source of Criterion	Number of Wells	<MDL	<Criterion (except <MDL)	≥Criterion
Arsenic	10 µg/l	MCL	6	4	2	0
Barium	2 mg/l	MCL	10	0	10	0
Cadmium	5 µg/l	MCL	6	0	6	0
Chromium	100 µg/l	MCL	6	0	6	0
Fluoride	4 mg/l	MCL	6	0	6	0
Mercury	2 µg/l	MCL	6	6	0	0
Nitrate-Nitrogen	10 mg/l	MCL	6	1	1	4
Selenium	50 µg/l	MCL	6	6	0	0
Chloride	300 mg/l	Secondary Standard	10	0	10	0
Copper	1 mg/l	Secondary Standard	6	1	5	0
Fluoride	2 mg/l	Secondary Standard	6	0	6	0

Constituent (dissolved)	Criterion	Source of Criterion	Number of Wells	<MDL	<Criterion (except <MDL)	≥Criterion
Iron	0.3 mg/l	Secondary Standard	6	4	2	0
Manganese	50 µg/l	Secondary Standard	6	0	6	0
Sulfate	300 mg/l	Secondary Standard	6	0	6	0
Total Dissolved Solids	1,000 mg/l	Secondary Standard	6	0	4	2
Zinc	5 mg/l	Secondary Standard	6	1	5	0
Dissolved Alpha	15 pCi/L	Screening Level	4	4	0	0

Table 9. Capitan Reef Complex Aquifer - Groundwater Monitoring Data

Constituent (dissolved)	Criterion	Source of Criterion	Number of Wells	<MDL	<Criterion (except <MDL)	≥Criterion
Arsenic	10 µg/l	MCL	3	2	1	0
Barium	2 mg/l	MCL	3	0	3	0
Cadmium	5 µg/l	MCL	3	3	0	0
Chromium	100 µg/l	MCL	3	1	2	0
Fluoride	4 mg/l	MCL	3	0	2	1
Mercury	2 µg/l	MCL	3	3	0	0
Nitrate-Nitrogen	10 mg/l	MCL	3	2	0	1
Selenium	50 µg/l	MCL	3	1	1	1
Chloride	300 mg/l	Secondary Standard	3	0	1	2
Copper	1 mg/l	Secondary Standard	3	1	2	0
Fluoride	2 mg/l	Secondary Standard	3	0	0	3
Iron	0.3 mg/l	Secondary Standard	3	1	2	0
Manganese	50 µg/l	Secondary Standard	3	1	2	0
Sulfate	300 mg/l	Secondary Standard	3	0	1	2
Total Dissolved Solids	1,000 mg/l	Secondary Standard	3	0	1	2
Zinc	5 mg/l	Secondary Standard	3	2	1	0
Dissolved Alpha	15 pCi/L	Screening Level	1	1	0	0

Table 10. Carrizo–Wilcox Aquifer - Groundwater Monitoring Data

Constituent (dissolved)	Criterion	Source of Criterion	Number of Wells	<MDL	<Criterion (except <MDL)	≥Criterion
Arsenic	10 µg/l	MCL	326	288	37	1
Barium	2 mg/l	MCL	326	0	326	0
Cadmium	5 µg/l	MCL	326	326	0	0
Chromium	100 µg/l	MCL	326	145	181	0
Fluoride	4 mg/l	MCL	345	11	333	1
Mercury	2 µg/l	MCL	324	324	0	0
Nitrate-Nitrogen	10 mg/l	MCL	326	262	58	6
Selenium	50 µg/l	MCL	326	280	37	9
Chloride	300 mg/l	Secondary Standard	328	0	328	13
Copper	1 mg/l	Secondary Standard	326	175	151	0
Fluoride	2 mg/l	Secondary Standard	345	11	327	7
Iron	0.3 mg/l	Secondary Standard	345	208	55	82
Manganese	50 µg/l	Secondary Standard	321	23	236	62
Sulfate	300 mg/l	Secondary Standard	309	44	261	4
Total Dissolved Solids	1,000 mg/l	Secondary Standard	345	0	330	15
Zinc	5 mg/l	Secondary Standard	326	198	128	0
Dissolved Alpha	15 pCi/L	Screening Level	217	184	31	12

Table 11. Cross Timbers Aquifer - Groundwater Monitoring Data

Constituent (dissolved)	Criterion	Source of Criterion	Number of Wells	<MDL	<Criterion (except <MDL)	≥Criterion
Arsenic	10 µg/l	MCL	3	1	2	0
Barium	2 mg/l	MCL	3	0	3	0
Cadmium	5 µg/l	MCL	3	0	0	0
Chromium	100 µg/l	MCL	3	0	0	0
Fluoride	4 mg/l	MCL	3	0	3	0
Mercury	2 µg/l	MCL	3	3	0	0
Nitrate-Nitrogen	10 mg/l	MCL	3	0	1	2
Selenium	50 µg/l	MCL	3	3	0	0
Chloride	300 mg/l	Secondary Standard	3	0	3	0
Copper	1 mg/l	Secondary Standard	3	2	1	0
Fluoride	2 mg/l	Secondary Standard	3	0	3	0
Iron	0.3 mg/l	Secondary Standard	3	3	0	0
Manganese	50 µg/l	Secondary Standard	3	0	3	0
Sulfate	300 mg/l	Secondary Standard	3	0	2	1
Total Dissolved Solids	1,000 mg/l	Secondary Standard	3	0	2	1
Zinc	5 mg/l	Secondary Standard	3	1	2	0
Dissolved Alpha	15 pCi/L	Screening Level	1	0	1	0

Table 12. Dockum Aquifer – Groundwater Monitoring Data

Constituent (dissolved)	Criterion	Source of Criterion	Number of Wells	<MDL	<Criterion (except <MDL)	≥Criterion
Arsenic	10 µg/l	MCL	24	12	12	0
Barium	2 mg/l	MCL	24	0	24	0
Cadmium	5 µg/l	MCL	23	19	4	0
Chromium	100 µg/l	MCL	24	0	24	0
Fluoride	4 mg/l	MCL	24	0	22	2
Mercury	2 µg/l	MCL	24	24	0	0
Nitrate-Nitrogen	10 mg/l	MCL	24	5	12	7
Selenium	50 µg/l	MCL	24	13	11	0
Chloride	300 mg/l	Secondary Standard	24	0	22	2
Copper	1 mg/l	Secondary Standard	23	4	19	0
Fluoride	2 mg/l	Secondary Standard	24	0	4	20
Iron	0.3 mg/l	Secondary Standard	24	16	7	1
Manganese	50 µg/l	Secondary Standard	24	6	18	0
Sulfate	300 mg/l	Secondary Standard	24	0	21	3
Total Dissolved Solids	1,000 mg/l	Secondary Standard	24	0	19	5
Zinc	5 mg/l	Secondary Standard	24	7	17	0
Dissolved Alpha	15 pCi/L	Screening Level	16	2	12	2

Table 13. Edwards (Balcones Fault Zone) Aquifer – Groundwater Monitoring Data

Constituent (dissolved)	Criterion	Source of Criterion	Number of Wells	<MDL	<Criterion (except <MDL)	≥Criterion
Arsenic	10 µg/l	MCL	137	132	5	0
Barium	2 mg/l	MCL	137	0	137	0
Cadmium	5 µg/l	MCL	137	137	0	0
Chromium	100 µg/l	MCL	137	34	103	0
Fluoride	4 mg/l	MCL	158	2	154	2
Mercury	2 µg/l	MCL	135	135	0	0
Nitrate-Nitrogen	10 mg/l	MCL	149	15	113	21
Selenium	50 µg/l	MCL	137	134	2	1
Chloride	300 mg/l	Secondary Standard	157	0	156	1
Copper	1 mg/l	Secondary Standard	137	46	91	0
Fluoride	2 mg/l	Secondary Standard	158	2	144	12

Constituent (dissolved)	Criterion	Source of Criterion	Number of Wells	<MDL	<Criterion (except <MDL)	≥Criterion
Iron	0.3 mg/l	Secondary Standard	157	144	6	7
Manganese	50 µg/l	Secondary Standard	143	123	19	1
Sulfate	300 mg/l	Secondary Standard	158	0	153	5
Total Dissolved Solids	1,000 mg/l	Secondary Standard	150	0	146	4
Zinc	5 mg/l	Secondary Standard	137	62	75	0
Dissolved Alpha	15 pCi/L	Screening Level	6	3	2	1

Table 14. Edwards–Trinity (Plateau) Aquifer - Groundwater Monitoring Data

Constituent (dissolved)	Criterion	Source of Criterion	Number of Wells	<MDL	<Criterion (except <MDL)	≥Criterion
Arsenic	10 µg/l	MCL	240	145	94	1
Barium	2 mg/l	MCL	240	0	240	0
Cadmium	5 µg/l	MCL	240	240	0	0
Chromium	100 µg/l	MCL	240	41	199	0
Fluoride	4 mg/l	MCL	240	0	239	1
Mercury	2 µg/l	MCL	240	240	0	0
Nitrate-Nitrogen	10 mg/l	MCL	239	13	121	105
Selenium	50 µg/l	MCL	240	190	50	0
Chloride	300 mg/l	Secondary Standard	242	0	216	27
Copper	1 mg/l	Secondary Standard	240	55	185	0
Fluoride	2 mg/l	Secondary Standard	240	0	192	48
Iron	0.3 mg/l	Secondary Standard	240	213	11	16
Manganese	50 µg/l	Secondary Standard	240	150	87	3
Sulfate	300 mg/l	Secondary Standard	242	0	183	59
Total Dissolved Solids	1,000 mg/l	Secondary Standard	244	0	184	60
Zinc	5 mg/l	Secondary Standard	239	49	190	0
Dissolved Alpha	15 pCi/L	Screening Level	20	11	7	2

Table 15. Edwards–Trinity (High Plains) Aquifer - Groundwater Monitoring Data

Constituent (dissolved)	Criterion	Source of Criterion	Number of Wells	<MDL	<Criterion (except <MDL)	≥Criterion
Arsenic	10 µg/l	MCL	4	0	1	3
Barium	2 mg/l	MCL	4	0	4	0
Cadmium	5 µg/l	MCL	4	4	0	0
Chromium	100 µg/l	MCL	4	0	4	0
Fluoride	4 mg/l	MCL	4	0	1	3
Mercury	2 µg/l	MCL	4	4	0	0
Nitrate-Nitrogen	10 mg/l	MCL	4	0	2	2
Selenium	50 µg/l	MCL	4	0	4	0
Chloride	300 mg/l	Secondary Standard	4	0	4	0
Copper	1 mg/l	Secondary Standard	4	0	4	0
Fluoride	2 mg/l	Secondary Standard	4	0	0	4
Iron	0.3 mg/l	Secondary Standard	4	2	2	0
Manganese	50 µg/l	Secondary Standard	4	1	3	0
Sulfate	300 mg/l	Secondary Standard	4	0	4	0
Total Dissolved Solids	1,000 mg/l	Secondary Standard	4	0	4	0
Zinc	5 mg/l	Secondary Standard	4	0	4	0
Dissolved Alpha	15 pCi/L	Screening Level	4	2	2	0

Table 16. Ellenburger–San Saba Aquifer - Groundwater Monitoring Data

Constituent (dissolved)	Criterion	Source of Criterion	Number of Wells	<MDL	<Criterion (except <MDL)	≥Criterion
Arsenic	10 µg/l	MCL	55	48	7	0
Barium	2 mg/l	MCL	55	0	55	0
Cadmium	5 µg/l	MCL	55	55	0	0
Chromium	100 µg/l	MCL	55	6	49	0
Fluoride	4 mg/l	MCL	55	0	55	0
Mercury	2 µg/l	MCL	55	54	1	0
Nitrate-Nitrogen	10 mg/l	MCL	55	7	37	11
Selenium	50 µg/l	MCL	55	50	5	0
Chloride	300 mg/l	Secondary Standard	55	0	52	3
Copper	1 mg/l	Secondary Standard	55	14	41	0
Fluoride	2 mg/l	Secondary Standard	55	0	52	3
Iron	0.3 mg/l	Secondary Standard	55	45	6	4
Manganese	50 µg/l	Secondary Standard	55	35	19	1
Sulfate	300 mg/l	Secondary Standard	55	0	43	12
Total Dissolved Solids	1,000 mg/l	Secondary Standard	56	0	47	9
Zinc	5 mg/l	Secondary Standard	55	32	23	0
Dissolved Alpha	15 pCi/L	Screening Level	17	11	5	1

Table 17. Gulf Coast Aquifer – Groundwater Monitoring Data

Constituent (dissolved)	Criterion	Source of Criterion	Number of Wells	<MDL	<Criterion (except <MDL)	≥Criterion
Arsenic	10 µg/l	MCL	399	152	192	55
Barium	2 mg/l	MCL	399	0	398	1
Cadmium	5 µg/l	MCL	399	399	0	0
Chromium	100 µg/l	MCL	399	87	312	0
Fluoride	4 mg/l	MCL	399	7	392	0
Mercury	2 µg/l	MCL	350	350	0	0
Nitrate-Nitrogen	10 mg/l	MCL	399	223	123	53
Selenium	50 µg/l	MCL	399	306	89	4
Chloride	300 mg/l	Secondary Standard	398	0	290	108
Copper	1 mg/l	Secondary Standard	399	174	225	0
Fluoride	2 mg/l	Secondary Standard	399	7	370	22
Iron	0.3 mg/l	Secondary Standard	399	206	122	71
Manganese	50 µg/l	Secondary Standard	399	75	239	92
Sulfate	300 mg/l	Secondary Standard	398	61	290	47
Total Dissolved Solids	1,000 mg/l	Secondary Standard	398	0	300	98
Zinc	5 mg/l	Secondary Standard	399	171	227	1
Dissolved Alpha	15 pCi/L	Screening Level	366	195	139	32

Table 18. Hickory Aquifer – Groundwater Monitoring Data

Constituent (dissolved)	Criterion	Source of Criterion	Number of Wells	<MDL	<Criterion (except <MDL)	≥Criterion
Arsenic	10 µg/l	MCL	23	18	5	0
Barium	2 mg/l	MCL	23	0	23	0
Cadmium	5 µg/l	MCL	23	23	0	0
Chromium	100 µg/l	MCL	23	3	20	0
Fluoride	4 mg/l	MCL	23	0	23	0
Mercury	2 µg/l	MCL	23	23	0	0
Nitrate-Nitrogen	10 mg/l	MCL	23	5	13	5
Selenium	50 µg/l	MCL	23	22	1	0
Chloride	300 mg/l	Secondary Standard	23	0	23	0
Copper	1 mg/l	Secondary Standard	23	4	19	0
Fluoride	2 mg/l	Secondary Standard	23	0	23	0

Constituent (dissolved)	Criterion	Source of Criterion	Number of Wells	<MDL	<Criterion (except <MDL)	≥Criterion
Iron	0.3 mg/l	Secondary Standard	23	16	4	3
Manganese	50 µg/l	Secondary Standard	23	10	13	0
Sulfate	300 mg/l	Secondary Standard	23	1	22	0
Total Dissolved Solids	1,000 mg/l	Secondary Standard	23	0	22	1
Zinc	5 mg/l	Secondary Standard	23	6	16	1
Dissolved Alpha	15 pCi/L	Screening Level	15	1	10	4

Table 19. Hueco–Mesilla Bolsons Aquifer - Groundwater Monitoring Data

Constituent (dissolved)	Criterion	Source of Criterion	Number of Wells	<MDL	<Criterion (except <MDL)	≥Criterion
Arsenic	10 µg/l	MCL	7	0	4	3
Barium	2 mg/l	MCL	7	0	7	0
Cadmium	5 µg/l	MCL	7	7	0	0
Chromium	100 µg/l	MCL	7	4	3	0
Fluoride	4 mg/l	MCL	7	0	7	0
Mercury	2 µg/l	MCL	7	7	0	0
Nitrate-Nitrogen	10 mg/l	MCL	10	2	5	3
Selenium	50 µg/l	MCL	7	5	2	0
Chloride	300 mg/l	Secondary Standard	10	0	6	4
Copper	1 mg/l	Secondary Standard	7	4	3	0
Fluoride	2 mg/l	Secondary Standard	7	0	7	0
Iron	0.3 mg/l	Secondary Standard	7	5	1	1
Manganese	50 µg/l	Secondary Standard	7	2	5	0
Sulfate	300 mg/l	Secondary Standard	7	0	4	3
Total Dissolved Solids	1,000 mg/l	Secondary Standard	7	0	4	3
Zinc	5 mg/l	Secondary Standard	7	5	2	0
Dissolved Alpha	15 pCi/L	Screening Level	0	0	0	0

Table 20. Igneous Aquifer - Groundwater Monitoring Data

Constituent (dissolved)	Criterion	Source of Criterion	Number of Wells	<MDL	<Criterion (except <MDL)	≥Criterion
Arsenic	10 µg/l	MCL	20	5	14	1
Barium	2 mg/l	MCL	20	2	18	0
Cadmium	5 µg/l	MCL	20	20	0	0
Chromium	100 µg/l	MCL	21	8	13	0
Fluoride	4 mg/l	MCL	21	0	21	0
Mercury	2 µg/l	MCL	21	21	0	0
Nitrate-Nitrogen	10 mg/l	MCL	21	2	13	6
Selenium	50 µg/l	MCL	21	20	1	0
Chloride	300 mg/l	Secondary Standard	21	0	21	0
Copper	1 mg/l	Secondary Standard	21	9	12	0
Fluoride	2 mg/l	Secondary Standard	21	0	11	10
Iron	0.3 mg/l	Secondary Standard	21	20	1	0
Manganese	50 µg/l	Secondary Standard	21	11	10	2
Sulfate	300 mg/l	Secondary Standard	21	0	21	0
Total Dissolved Solids	1,000 mg/l	Secondary Standard	20	0	20	0
Zinc	5 mg/l	Secondary Standard	21	6	13	0
Dissolved Alpha	15 pCi/L	Screening Level	2	0	1	1

Table 21. Lipan Aquifer - Groundwater Monitoring Data

Constituent (dissolved)	Criterion	Source of Criterion	Number of Wells	<MDL	<Criterion (except <MDL)	≥Criterion
Arsenic	10 µg/l	MCL	10	0	10	0
Barium	2 mg/l	MCL	10	0	10	0
Cadmium	5 µg/l	MCL	10	10	0	0
Chromium	100 µg/l	MCL	10	10	16	0
Fluoride	4 mg/l	MCL	10	0	10	0
Mercury	2 µg/l	MCL	10	10	0	0
Nitrate-Nitrogen	10 mg/l	MCL	10	0	0	10
Selenium	50 µg/l	MCL	10	7	3	0
Chloride	300 mg/l	Secondary Standard	10	0	4	6
Copper	1 mg/l	Secondary Standard	10	0	10	0
Fluoride	2 mg/l	Secondary Standard	10	0	10	0
Iron	0.3 mg/l	Secondary Standard	10	10	0	0
Manganese	50 µg/l	Secondary Standard	10	9	1	0
Sulfate	300 mg/l	Secondary Standard	10	0	17	9
Total Dissolved Solids	1,000 mg/l	Secondary Standard	10	0	3	7
Zinc	5 mg/l	Secondary Standard	10	2	8	0
Dissolved Alpha	15 pCi/L	Screening Level	0	0	0	0

Table 22. Marathon Aquifer – Groundwater Monitoring Data

Constituent (dissolved)	Criterion	Source of Criterion	Number of Wells	<MDL	<Criterion (except <MDL)	≥Criterion
Arsenic	10 µg/l	MCL	11	11	0	0
Barium	2 mg/l	MCL	11	0	11	0
Cadmium	5 µg/l	MCL	11	11	0	0
Chromium	100 µg/l	MCL	11	0	11	0
Fluoride	4 mg/l	MCL	11	0	11	0
Mercury	2 µg/l	MCL	11	11	0	0
Nitrate-Nitrogen	10 mg/l	MCL	11	1	6	4
Selenium	50 µg/l	MCL	11	9	2	0
Chloride	300 mg/l	Secondary Standard	11	0	11	0
Copper	1 mg/l	Secondary Standard	11	3	8	0
Fluoride	2 mg/l	Secondary Standard	11	0	11	0
Iron	0.3 mg/l	Secondary Standard	11	10	1	0
Manganese	50 µg/l	Secondary Standard	11	5	6	0
Sulfate	300 mg/l	Secondary Standard	11	0	6	5
Total Dissolved Solids	1,000 mg/l	Secondary Standard	11	0	8	3
Zinc	5 mg/l	Secondary Standard	11	4	7	0
Dissolved Alpha	15 pCi/L	Screening Level	1	0	1	0

Table 23. Marble Falls Aquifer – Groundwater Monitoring Data

Constituent (dissolved)	Criterion	Source of Criterion	Number of Wells	<MDL	<Criterion (except <MDL)	≥Criterion
Arsenic	10 µg/l	MCL	7	5	2	0
Barium	2 mg/l	MCL	7	0	7	0
Cadmium	5 µg/l	MCL	7	7	0	0
Chromium	100 µg/l	MCL	7	1	6	0
Fluoride	4 mg/l	MCL	7	0	7	0
Mercury	2 µg/l	MCL	7	7	0	0
Nitrate-Nitrogen	10 mg/l	MCL	7	2	5	0
Selenium	50 µg/l	MCL	7	6	0	1
Chloride	300 mg/l	Secondary Standard	7	0	6	1
Copper	1 mg/l	Secondary Standard	7	5	2	0
Fluoride	2 mg/l	Secondary Standard	7	0	6	1

Constituent (dissolved)	Criterion	Source of Criterion	Number of Wells	<MDL	<Criterion (except <MDL)	≥Criterion
Iron	0.3 mg/l	Secondary Standard	7	7	0	0
Manganese	50 µg/l	Secondary Standard	7	2	5	0
Sulfate	300 mg/l	Secondary Standard	7	0	7	0
Total Dissolved Solids	1,000 mg/l	Secondary Standard	7	0	6	1
Zinc	5 mg/l	Secondary Standard	7	5	2	0
Dissolved Alpha	15 pCi/L	Screening Level	1	0	0	1

Table 24. Nacatoch Aquifer – Groundwater Monitoring Data

Constituent (dissolved)	Criterion	Source of Criterion	Number of Wells	<MDL	<Criterion (except <MDL)	≥Criterion
Arsenic	10 µg/l	MCL	0	0	0	0
Barium	2 mg/l	MCL	0	0	0	0
Cadmium	5 µg/l	MCL	0	0	0	0
Chromium	100 µg/l	MCL	0	0	0	0
Fluoride	4 mg/l	MCL	0	0	0	0
Mercury	2 µg/l	MCL	0	0	0	0
Nitrate-Nitrogen	10 mg/l	MCL	0	0	0	0
Selenium	50 µg/l	MCL	0	0	0	0
Chloride	300 mg/l	Secondary Standard	0	0	0	0
Copper	1 mg/l	Secondary Standard	0	0	0	0
Fluoride	2 mg/l	Secondary Standard	0	0	0	0
Iron	0.3 mg/l	Secondary Standard	0	0	0	0
Manganese	50 µg/l	Secondary Standard	0	0	0	0
Sulfate	300 mg/l	Secondary Standard	0	0	0	0
Total Dissolved Solids	1,000 mg/l	Secondary Standard	0	0	0	0
Zinc	5 mg/l	Secondary Standard	0	0	0	0
Dissolved Alpha	15 pCi/L	Screening Level	0	0	0	0

Table 25. Ogallala Aquifer – Groundwater Monitoring Data

Constituent (dissolved)	Criterion	Source of Criterion	Number of Wells	<MDL	<Criterion (except <MDL)	≥Criterion
Arsenic	10 µg/l	MCL	426	48	302	76
Barium	2 mg/l	MCL	426	0	426	0
Cadmium	5 µg/l	MCL	403	332	71	0
Chromium	100 µg/l	MCL	426	17	409	0
Fluoride	4 mg/l	MCL	426	0	355	71
Mercury	2 µg/l	MCL	426	389	37	0
Nitrate-Nitrogen	10 mg/l	MCL	425	3	223	199
Selenium	50 µg/l	MCL	426	106	258	62
Chloride	300 mg/l	Secondary Standard	424	0	380	44
Copper	1 mg/l	Secondary Standard	426	45	381	0
Fluoride	2 mg/l	Secondary Standard	426	0	194	232
Iron	0.3 mg/l	Secondary Standard	426	294	128	4
Manganese	50 µg/l	Secondary Standard	426	212	206	8
Sulfate	300 mg/l	Secondary Standard	424	1	371	52
Total Dissolved Solids	1,000 mg/l	Secondary Standard	430	0	368	62
Zinc	5 mg/l	Secondary Standard	426	71	354	1
Dissolved Alpha	15 pCi/L	Screening Level	316	75	200	41

Table 26. Pecos Valley Aquifer – Groundwater Monitoring Data

Constituent (dissolved)	Criterion	Source of Criterion	Number of Wells	<MDL	<Criterion (except <MDL)	≥Criterion
Arsenic	10 µg/l	MCL	41	19	17	5
Barium	2 mg/l	MCL	41	0	41	0
Cadmium	5 µg/l	MCL	41	41	0	0
Chromium	100 µg/l	MCL	41	8	33	0
Fluoride	4 mg/l	MCL	41	0	40	1
Mercury	2 µg/l	MCL	41	41	0	0
Nitrate-Nitrogen	10 mg/l	MCL	41	3	23	15
Selenium	50 µg/l	MCL	41	19	22	0
Chloride	300 mg/l	Secondary Standard	41	0	27	14
Copper	1 mg/l	Secondary Standard	41	9	32	0
Fluoride	2 mg/l	Secondary Standard	41	0	25	16
Iron	0.3 mg/l	Secondary Standard	41	23	11	7
Manganese	50 µg/l	Secondary Standard	41	13	22	6
Sulfate	300 mg/l	Secondary Standard	41	0	21	20
Total Dissolved Solids	1,000 mg/l	Secondary Standard	41	0	22	19
Zinc	5 mg/l	Secondary Standard	41	14	27	0
Dissolved Alpha	15 pCi/L	Screening Level	0	0	0	0

Table 27. Queen City Aquifer - Groundwater Monitoring Data

Constituent (dissolved)	Criterion	Source of Criterion	Number of Wells	<MDL	<Criterion (except <MDL)	≥Criterion
Arsenic	10 µg/l	MCL	22	22	0	0
Barium	2 mg/l	MCL	23	0	23	0
Cadmium	5 µg/l	MCL	22	22	0	0
Chromium	100 µg/l	MCL	22	10	12	0
Fluoride	4 mg/l	MCL	28	1	26	1
Mercury	2 µg/l	MCL	22	22	0	0
Nitrate-Nitrogen	10 mg/l	MCL	22	10	9	3
Selenium	50 µg/l	MCL	22	19	3	0
Chloride	300 mg/l	Secondary Standard	31	0	29	2
Copper	1 mg/l	Secondary Standard	22	7	15	0
Fluoride	2 mg/l	Secondary Standard	28	1	26	1
Iron	0.3 mg/l	Secondary Standard	28	15	5	8
Manganese	50 µg/l	Secondary Standard	22	1	21	0
Sulfate	300 mg/l	Secondary Standard	22	4	17	1
Total Dissolved Solids	1,000 mg/l	Secondary Standard	28	0	25	3
Zinc	5 mg/l	Secondary Standard	22	7	15	0
Dissolved Alpha	15 pCi/L	Screening Level	21	18	2	1

Table 28. Rita Blanca Aquifer - Groundwater Monitoring Data

Constituent (dissolved)	Criterion	Source of Criterion	Number of Wells	<MDL	<Criterion (except <MDL)	≥Criterion
Arsenic	10 µg/l	MCL	3	1	1	1
Barium	2 mg/l	MCL	3	0	3	0
Cadmium	5 µg/l	MCL	3	3	0	0
Chromium	100 µg/l	MCL	3	0	3	0
Fluoride	4 mg/l	MCL	3	0	1	2
Mercury	2 µg/l	MCL	3	3	0	0
Nitrate-Nitrogen	10 mg/l	MCL	0	0	0	0
Selenium	50 µg/l	MCL	3	2	1	0
Chloride	300 mg/l	Secondary Standard	3	0	3	0
Copper	1 mg/l	Secondary Standard	3	1	2	0
Fluoride	2 mg/l	Secondary Standard	3	0	1	2

Constituent (dissolved)	Criterion	Source of Criterion	Number of Wells	<MDL	<Criterion (except <MDL)	≥Criterion
Iron	0.3 mg/l	Secondary Standard	3	1	0	2
Manganese	50 µg/l	Secondary Standard	3	0	3	0
Sulfate	300 mg/l	Secondary Standard	3	0	2	1
Total Dissolved Solids	1,000 mg/l	Secondary Standard	3	0	2	1
Zinc	5 mg/l	Secondary Standard	3	1	2	0
Dissolved Alpha	15 pCi/L	Screening Level	3	0	0	3

Table 29. Rustler Aquifer – Groundwater Monitoring Data

Constituent (dissolved)	Criterion	Source of Criterion	Number of Wells	<MDL	<Criterion (except <MDL)	≥Criterion
Arsenic	10 µg/l	MCL	6	6	0	0
Barium	2 mg/l	MCL	6	0	6	0
Cadmium	5 µg/l	MCL	6	6	0	0
Chromium	100 µg/l	MCL	6	5	1	0
Fluoride	4 mg/l	MCL	6	0	6	0
Mercury	2 µg/l	MCL	6	6	0	0
Nitrate-Nitrogen	10 mg/l	MCL	6	3	2	1
Selenium	50 µg/l	MCL	6	1	4	1
Chloride	300 mg/l	Secondary Standard	6	0	2	4
Copper	1 mg/l	Secondary Standard	6	5	1	0
Fluoride	2 mg/l	Secondary Standard	6	0	2	4
Iron	0.3 mg/l	Secondary Standard	6	5	1	0
Manganese	50 µg/l	Secondary Standard	6	1	5	0
Sulfate	300 mg/l	Secondary Standard	6	0	0	6
Total Dissolved Solids	1,000 mg/l	Secondary Standard	6	0	0	6
Zinc	5 mg/l	Secondary Standard	6	5	1	0
Dissolved Alpha	15 pCi/L	Screening Level	1	0	0	1

Table 30. Seymour Aquifer – Groundwater Monitoring Data

Constituent (dissolved)	Criterion	Source of Criterion	Number of Wells	<MDL	<Criterion (except <MDL)	≥Criterion
Arsenic	10 µg/l	MCL	30	12	17	1
Barium	2 mg/l	MCL	30	0	30	0
Cadmium	5 µg/l	MCL	30	30	0	0
Chromium	100 µg/l	MCL	30	0	30	0
Fluoride	4 mg/l	MCL	30	1	28	1
Mercury	2 µg/l	MCL	30	30	0	0
Nitrate-Nitrogen	10 mg/l	MCL	30	1	3	26
Selenium	50 µg/l	MCL	30	12	17	1
Chloride	300 mg/l	Secondary Standard	30	0	27	3
Copper	1 mg/l	Secondary Standard	30	0	30	0
Fluoride	2 mg/l	Secondary Standard	30	1	28	1
Iron	0.3 mg/l	Secondary Standard	30	29	1	0
Manganese	50 µg/l	Secondary Standard	30	24	6	0
Sulfate	300 mg/l	Secondary Standard	30	0	23	7
Total Dissolved Solids	1,000 mg/l	Secondary Standard	30	0	27	3
Zinc	5 mg/l	Secondary Standard	30	11	19	0
Dissolved Alpha	15 pCi/L	Screening Level	0	0	0	0

Table 31. Sparta Aquifer – Groundwater Monitoring Data

Constituent (dissolved)	Criterion	Source of Criterion	Number of Wells	<MDL	<Criterion (except <MDL)	≥Criterion
Arsenic	10 µg/l	MCL	14	14	0	0
Barium	2 mg/l	MCL	14	0	14	0
Cadmium	5 µg/l	MCL	14	14	0	0
Chromium	100 µg/l	MCL	14	6	8	0
Fluoride	4 mg/l	MCL	21	0	21	0
Mercury	2 µg/l	MCL	14	14	0	0
Nitrate-Nitrogen	10 mg/l	MCL	14	8	6	0
Selenium	50 µg/l	MCL	14	12	2	0
Chloride	300 mg/l	Secondary Standard	21	0	18	3
Copper	1 mg/l	Secondary Standard	14	5	9	0
Fluoride	2 mg/l	Secondary Standard	21	0	20	1
Iron	0.3 mg/l	Secondary Standard	21	12	8	1
Manganese	50 µg/l	Secondary Standard	14	0	14	0
Sulfate	300 mg/l	Secondary Standard	14	2	10	2
Total Dissolved Solids	1,000 mg/l	Secondary Standard	21	0	18	3
Zinc	5 mg/l	Secondary Standard	14	10	4	0
Dissolved Alpha	15 pCi/L	Screening Level	11	8	3	0

Table 32. Trinity Aquifer – Groundwater Monitoring Data

Constituent (dissolved)	Criterion	Source of Criterion	Number of Wells	<MDL	<Criterion (except <MDL)	≥Criterion
Arsenic	10 µg/l	MCL	404	354	48	2
Barium	2 mg/l	MCL	403	2	401	0
Cadmium	5 µg/l	MCL	402	402	0	0
Chromium	100 µg/l	MCL	402	131	271	0
Fluoride	4 mg/l	MCL	429	3	408	18
Mercury	2 µg/l	MCL	403	399	4	0
Nitrate-Nitrogen	10 mg/l	MCL	406	178	195	33
Selenium	50 µg/l	MCL	403	391	12	0
Chloride	300 mg/l	Secondary Standard	428	0	418	10
Copper	1 mg/l	Secondary Standard	404	189	215	0
Fluoride	2 mg/l	Secondary Standard	429	3	328	98
Iron	0.3 mg/l	Secondary Standard	428	311	63	54
Manganese	50 µg/l	Secondary Standard	421	159	249	13
Sulfate	300 mg/l	Secondary Standard	424	0	328	96
Total Dissolved Solids	1,000 mg/l	Secondary Standard	423	0	329	94
Zinc	5 mg/l	Secondary Standard	404	197	207	0
Dissolved Alpha	15 pCi/L	Screening Level	11	9	2	0

Table 33. West Texas Bolsons Aquifer – Groundwater Monitoring Data

Constituent (dissolved)	Criterion	Source of Criterion	Number of Wells	<MDL	<Criterion (except <MDL)	≥Criterion
Arsenic	10 µg/l	MCL	7	0	7	1
Barium	2 mg/l	MCL	7	0	7	0
Cadmium	5 µg/l	MCL	7	7	0	0
Chromium	100 µg/l	MCL	7	0	7	0
Fluoride	4 mg/l	MCL	7	0	6	1
Mercury	2 µg/l	MCL	7	7	0	0
Nitrate-Nitrogen	10 mg/l	MCL	7	0	4	3
Selenium	50 µg/l	MCL	7	5	2	0
Chloride	300 mg/l	Secondary Standard	7	0	7	0
Copper	1 mg/l	Secondary Standard	7	4	3	0
Fluoride	2 mg/l	Secondary Standard	7	0	5	2

Constituent (dissolved)	Criterion	Source of Criterion	Number of Wells	<MDL	<Criterion (except <MDL)	≥Criterion
Iron	0.3 mg/l	Secondary Standard	7	7	0	0
Manganese	50 µg/l	Secondary Standard	7	5	2	0
Sulfate	300 mg/l	Secondary Standard	7	0	7	0
Total Dissolved Solids	1,000 mg/l	Secondary Standard	7	0	7	0
Zinc	5 mg/l	Secondary Standard	7	3	4	0
Dissolved Alpha	15 pCi/L	Screening Level	6	0	5	1

Table 34. Woodbine Aquifer - Groundwater Monitoring Data

Constituent (dissolved)	Criterion	Source of Criterion	Number of Wells	<MDL	<Criterion (except <MDL)	≥Criterion
Arsenic	10 µg/l	MCL	23	23	0	0
Barium	2 mg/l	MCL	23	0	23	0
Cadmium	5 µg/l	MCL	23	23	0	0
Chromium	100 µg/l	MCL	23	23	0	0
Fluoride	4 mg/l	MCL	23	0	21	2
Mercury	2 µg/l	MCL	23	23	0	0
Nitrate-Nitrogen	10 mg/l	MCL	23	18	4	1
Selenium	50 µg/l	MCL	23	23	0	0
Chloride	300 mg/l	Secondary Standard	23	0	22	1
Copper	1 mg/l	Secondary Standard	23	10	13	0
Fluoride	2 mg/l	Secondary Standard	23	0	20	3
Iron	0.3 mg/l	Secondary Standard	23	13	9	1
Manganese	50 µg/l	Secondary Standard	23	1	22	0
Sulfate	300 mg/l	Secondary Standard	23	1	20	2
Total Dissolved Solids	1,000 mg/l	Secondary Standard	23	0	17	6
Zinc	5 mg/l	Secondary Standard	23	17	6	0
Dissolved Alpha	15 pCi/L	Screening Level	0	0	0	0

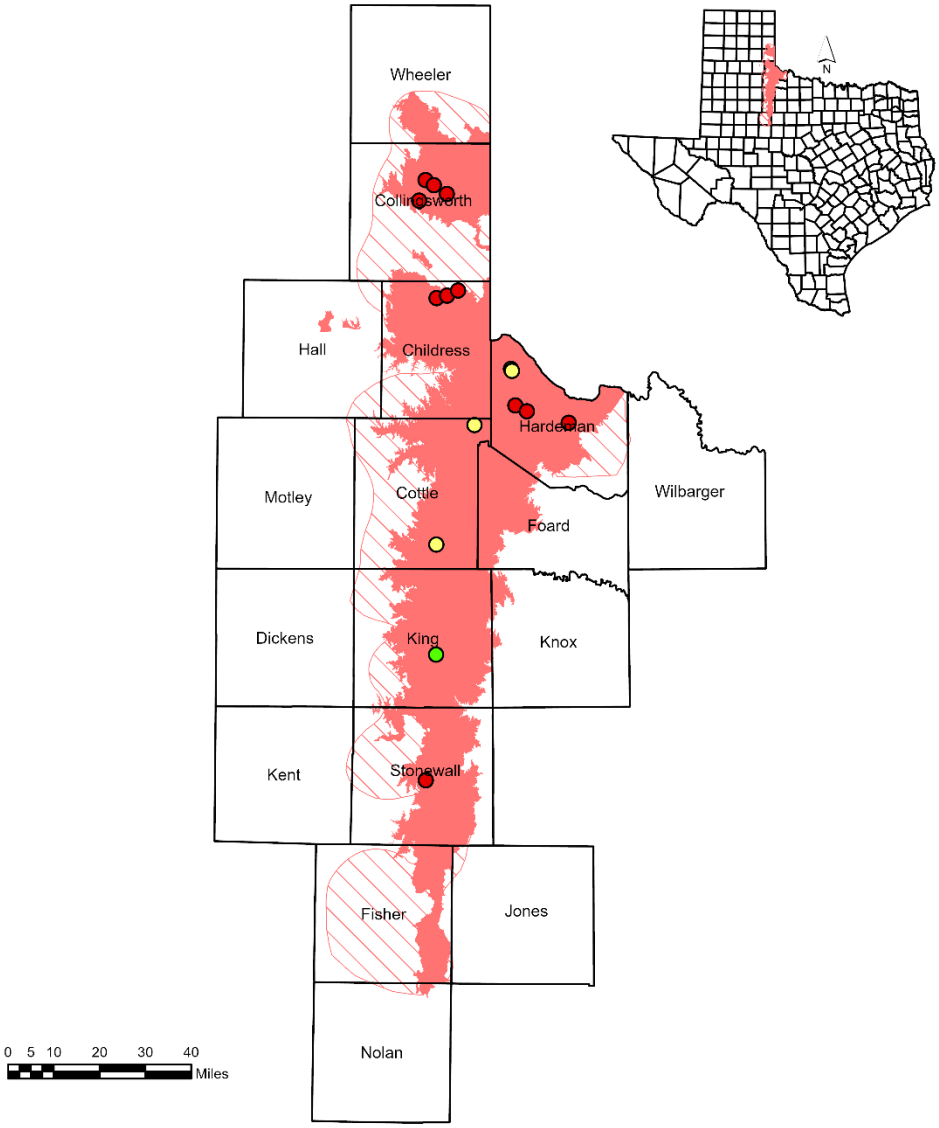
Table 35. Yegua–Jackson Aquifer - Groundwater Monitoring Data

Constituent (dissolved)	Criterion	Source of Criterion	Number of Wells	<MDL	<Criterion (except <MDL)	≥Criterion
Arsenic	10 µg/l	MCL	22	20	1	1
Barium	2 mg/l	MCL	22	0	22	0
Cadmium	5 µg/l	MCL	22	21	1	0
Chromium	100 µg/l	MCL	22	8	14	0
Fluoride	4 mg/l	MCL	24	0	24	0
Mercury	2 µg/l	MCL	21	21	0	0
Nitrate-Nitrogen	10 mg/l	MCL	22	12	10	0
Selenium	50 µg/l	MCL	22	21	0	1
Chloride	300 mg/l	Secondary Standard	24	0	6	18
Copper	1 mg/l	Secondary Standard	22	8	14	0
Fluoride	2 mg/l	Secondary Standard	24	0	23	1
Iron	0.3 mg/l	Secondary Standard	24	8	8	8
Manganese	50 µg/l	Secondary Standard	22	0	22	0
Sulfate	300 mg/l	Secondary Standard	22	0	16	6
Total Dissolved Solids	1,000 mg/l	Secondary Standard	34	0	8	26
Zinc	5 mg/l	Secondary Standard	21	12	14	0
Dissolved Alpha	15 pCi/L	Screening Level	20	17	3	0

Figures 3 through 40 – Constituents of Concern in Selected Aquifers

Figures 3 through 40 illustrate the distribution of selected constituents for certain aquifers for the ten-year period beginning FY 2012 and lasting through FY 2021. Constituents with concentrations above the MCL are shown in red, while concentrations above the secondary standard or screening level are shown in red or yellow. Concentrations below these levels are shown in green.

Figure 3. Distribution of Nitrate in the Blaine Aquifer



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Nitrate Concentration in Blaine Aquifer Water Wells

- Less than 5 µg/L
- 5 µg/L to less than 10 µg/L
- 10 µg/L or greater

Figure 4. Distribution of Selenium in the Blaine Aquifer

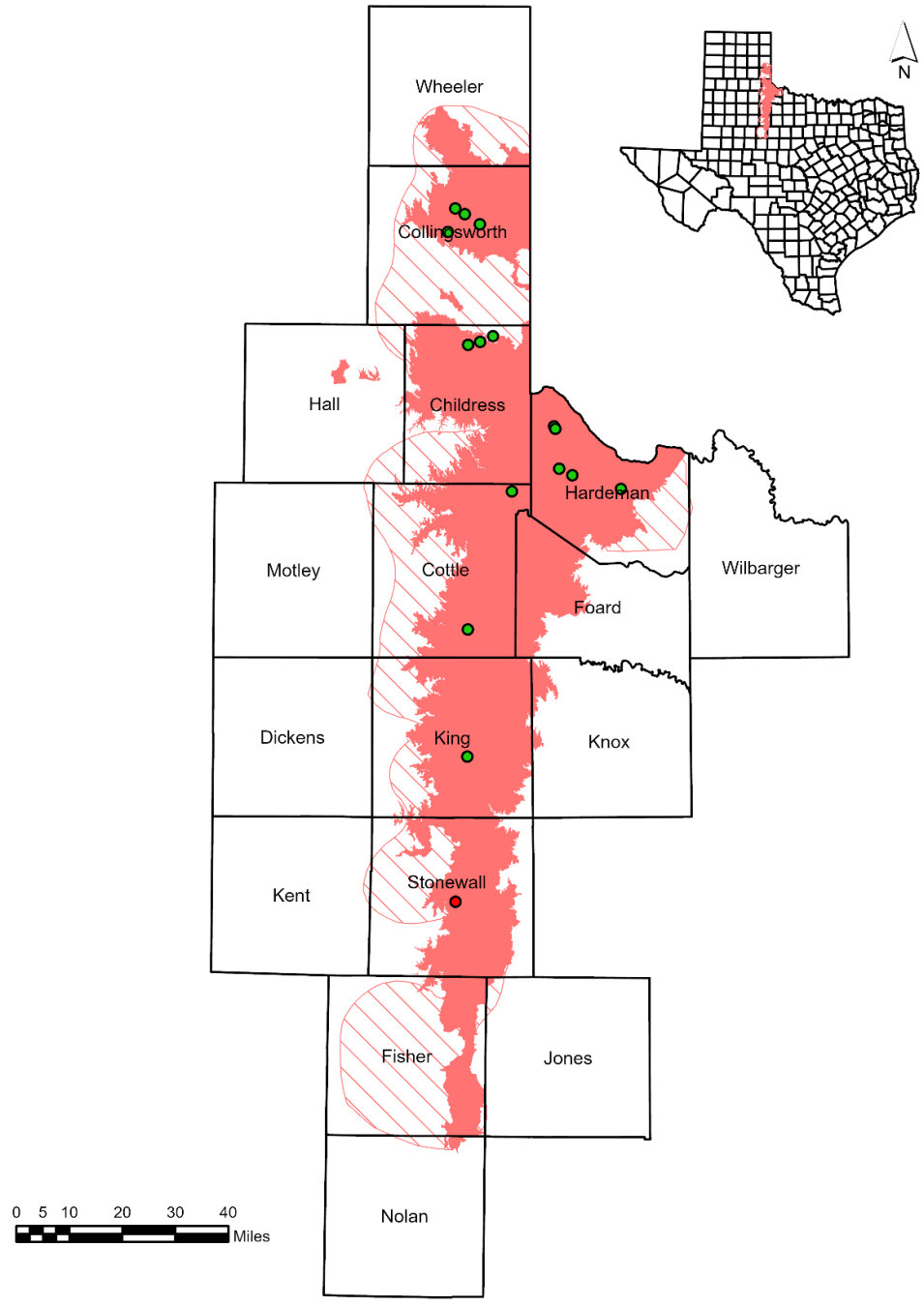
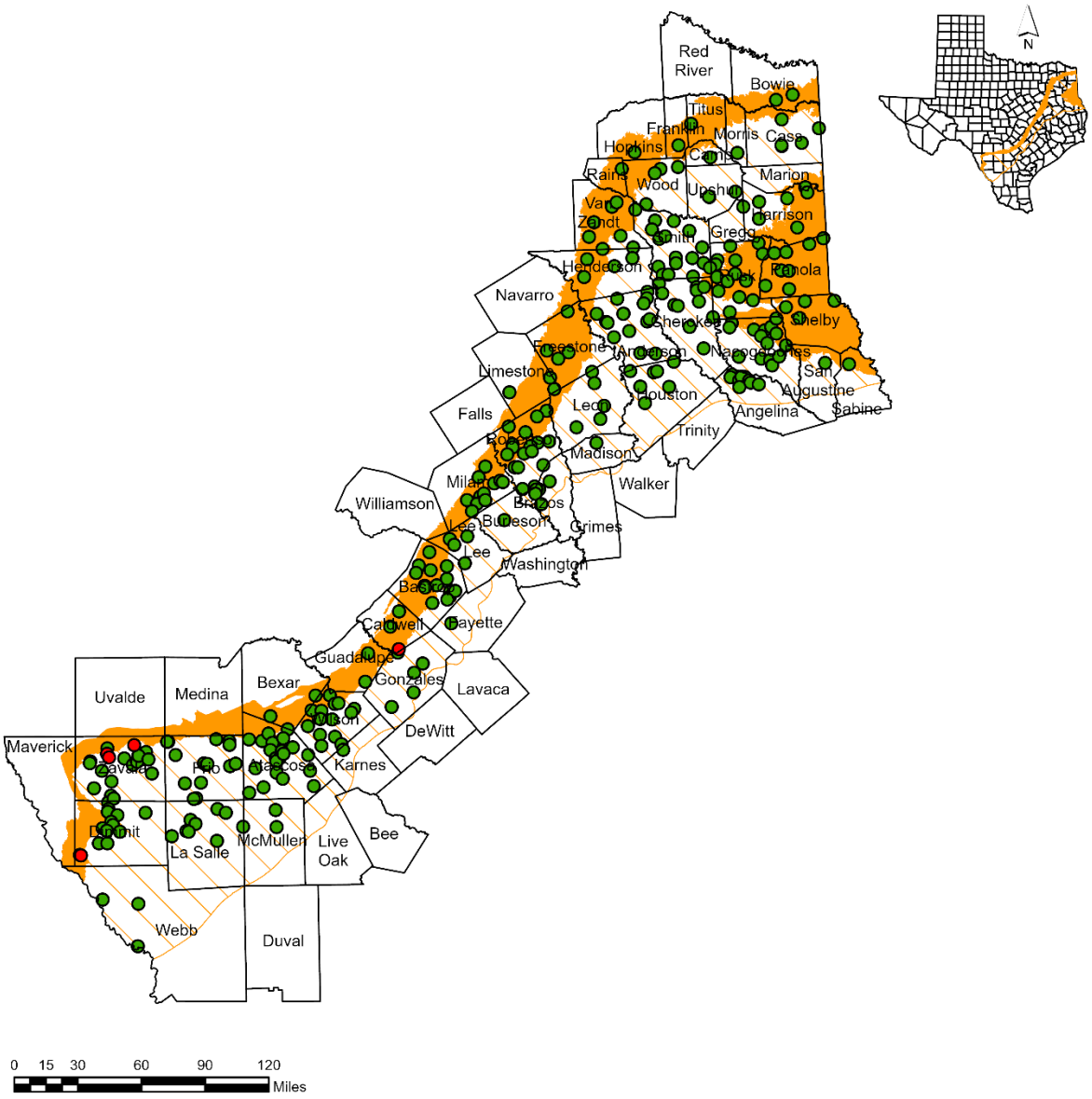


Figure 5. Distribution of Nitrate in the Carrizo–Wilcox Aquifer



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Nitrate Concentration in Carrizo-Wilcox Aquifer Water Wells

- Less than 5 mg/L
- 5 mg/L to 10 mg/L
- 10 mg/L or greater

Figure 6. Distribution of Arsenic in the Dockum Aquifer

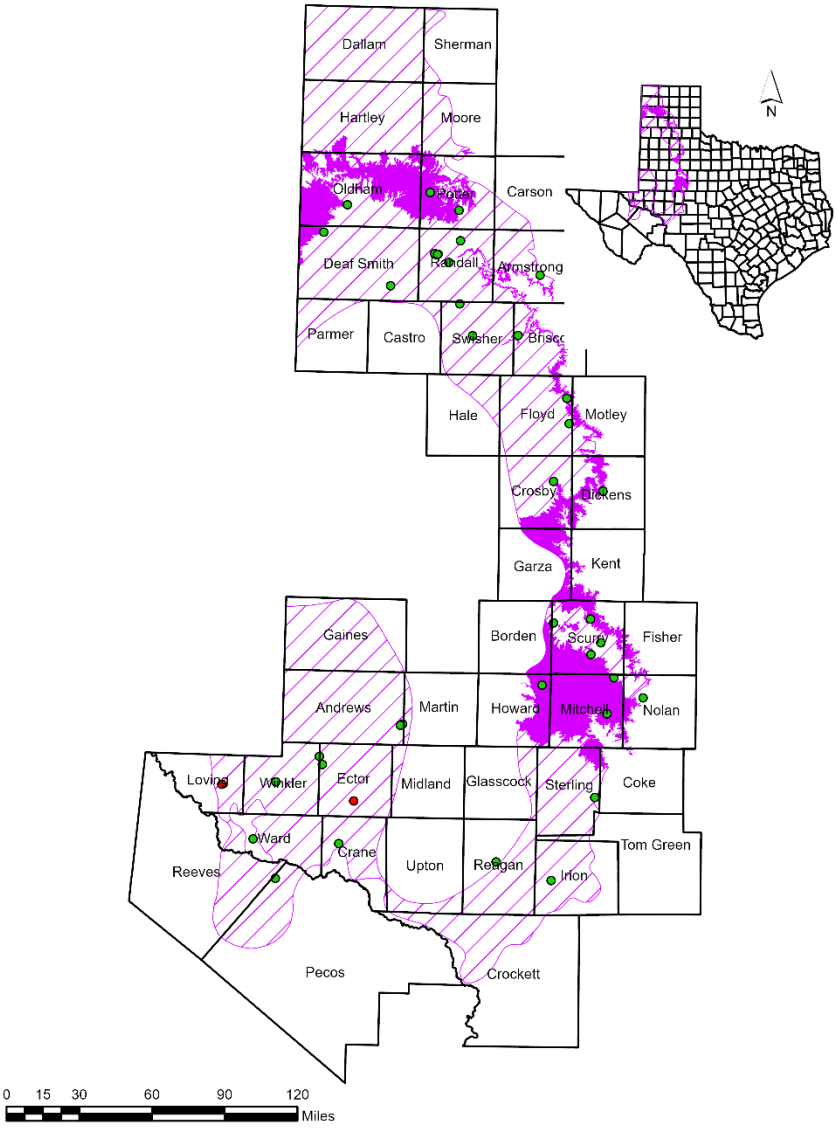


Figure 7. Distribution of Fluoride in the Dockum Aquifer

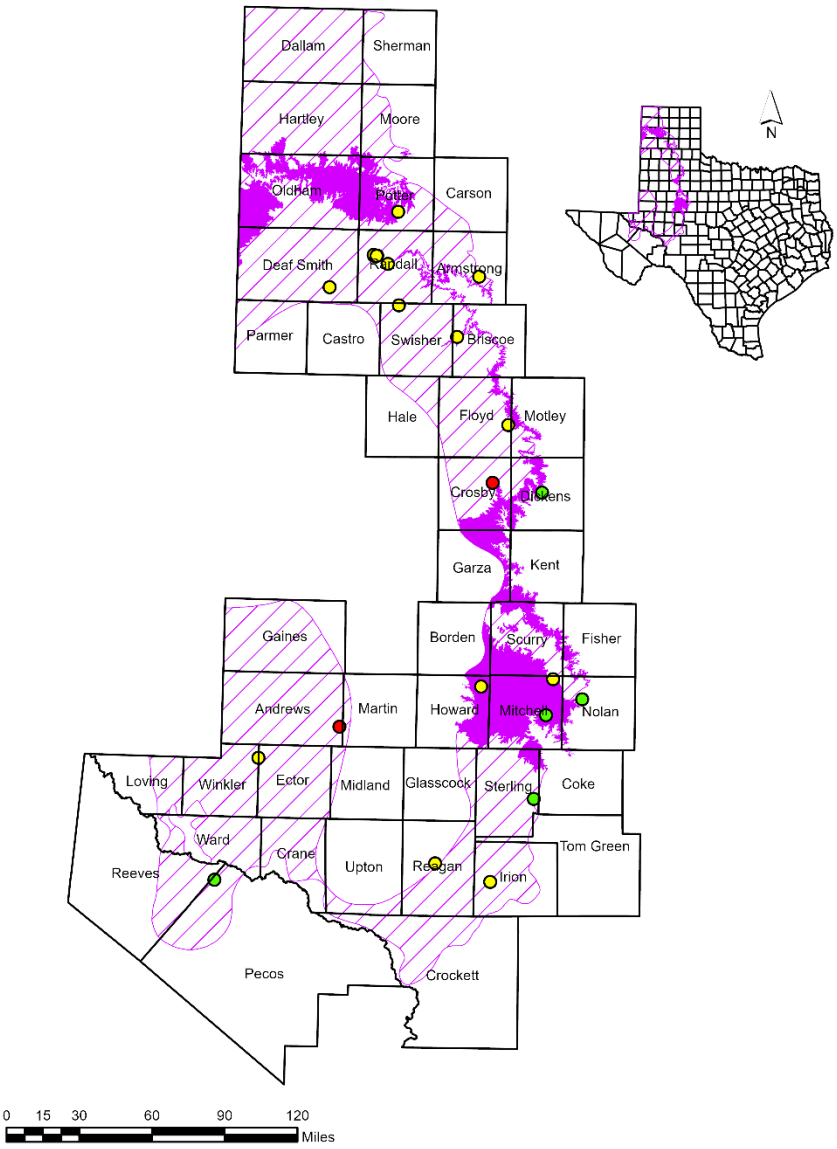


Figure 8. Distribution of Nitrate in the Dockum Aquifer

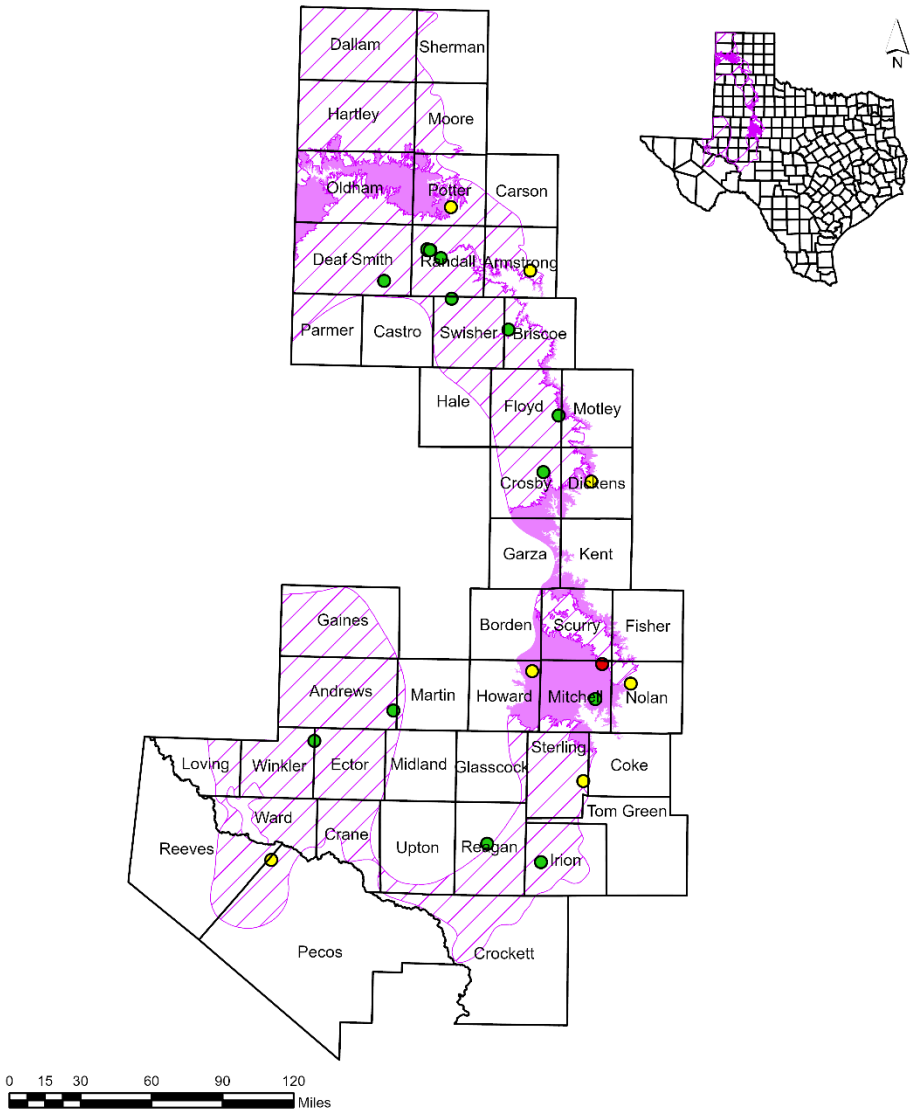


Figure 9. Distribution of Fluoride in the Edwards (Balcones Fault Zone) Aquifer

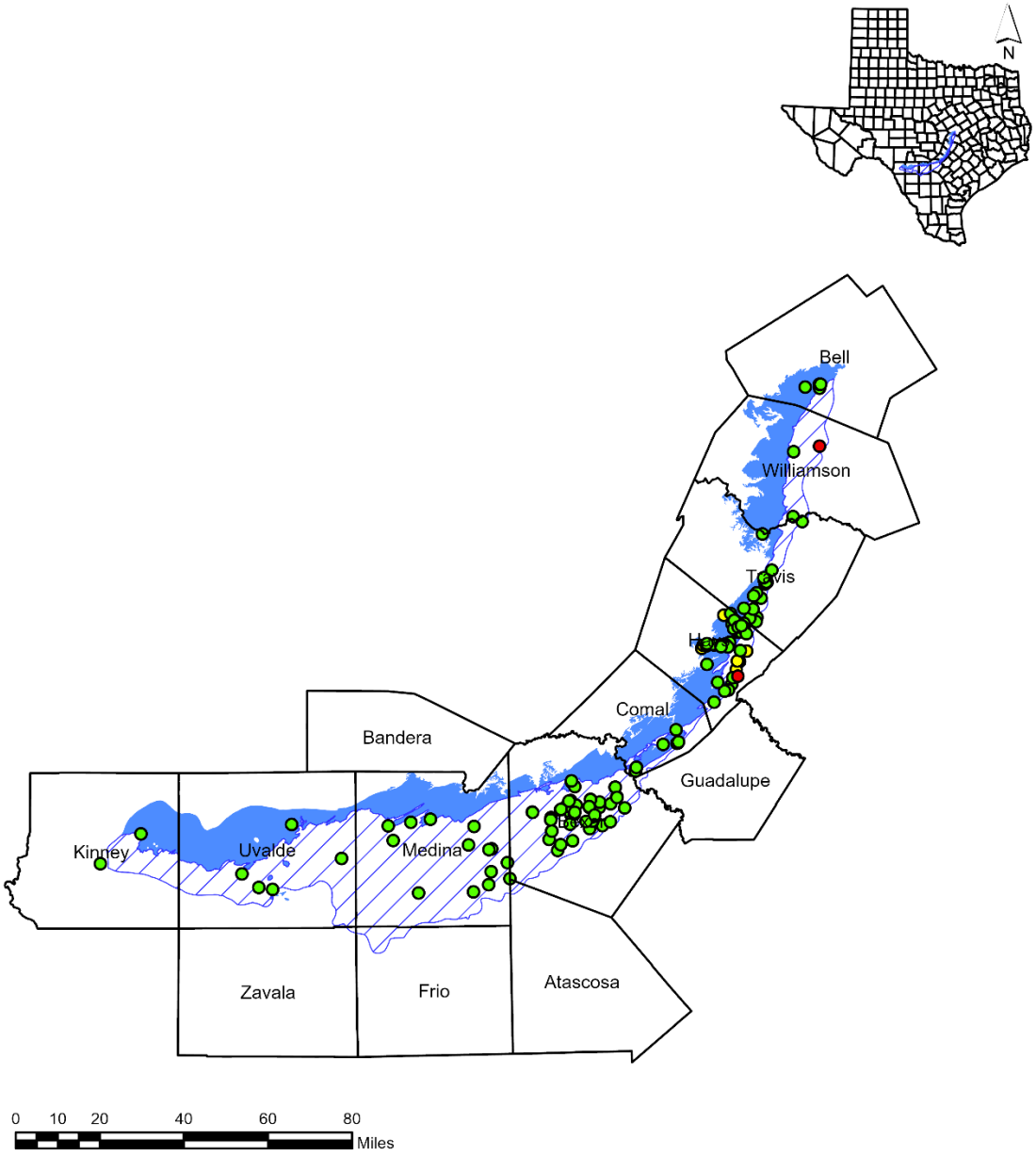


Figure 10. Distribution of Nitrate in the Edwards (Balcones Fault Zone) Aquifer

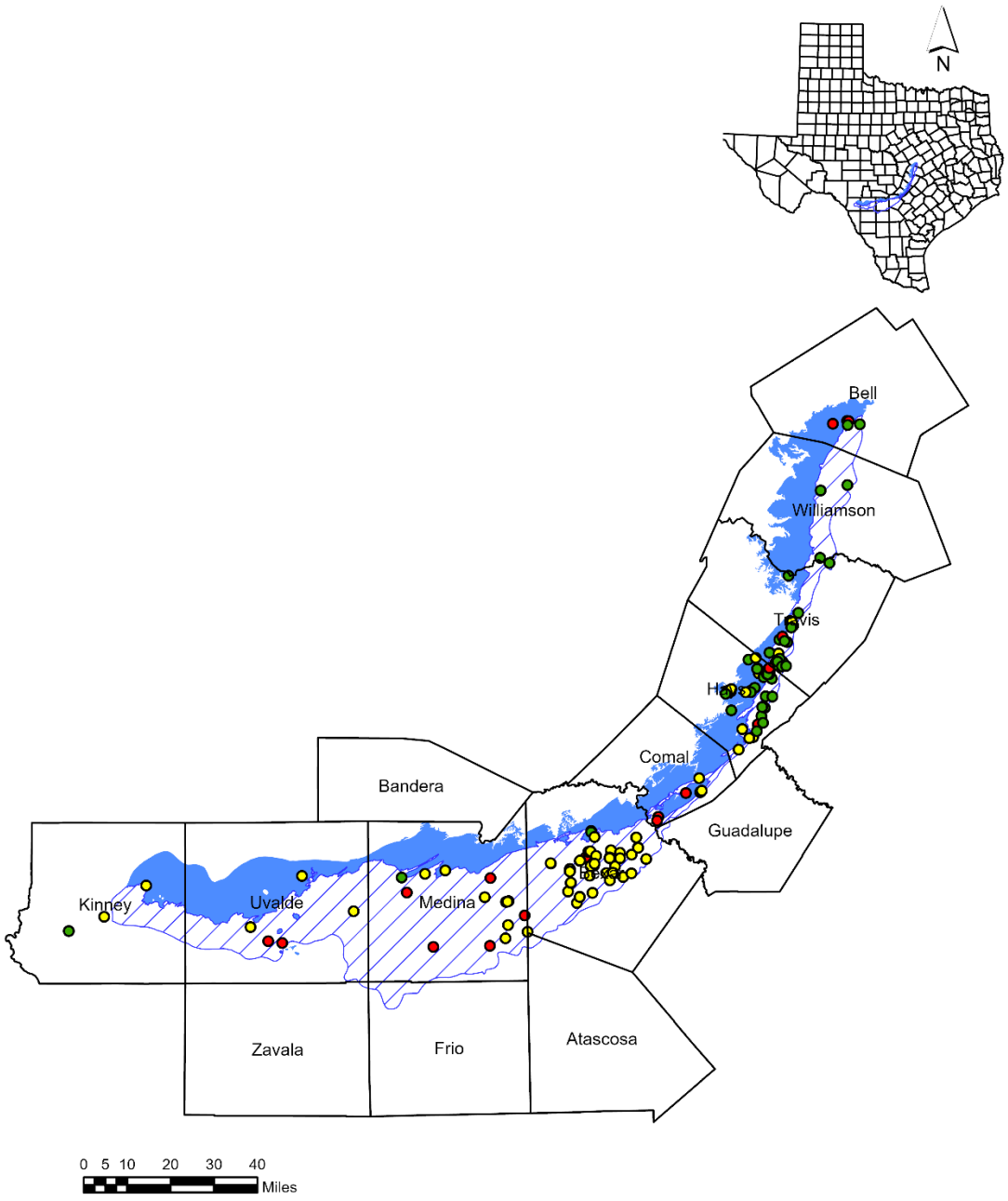


Figure 11. Distribution of Arsenic in the Edwards–Trinity (High Plains) Aquifer

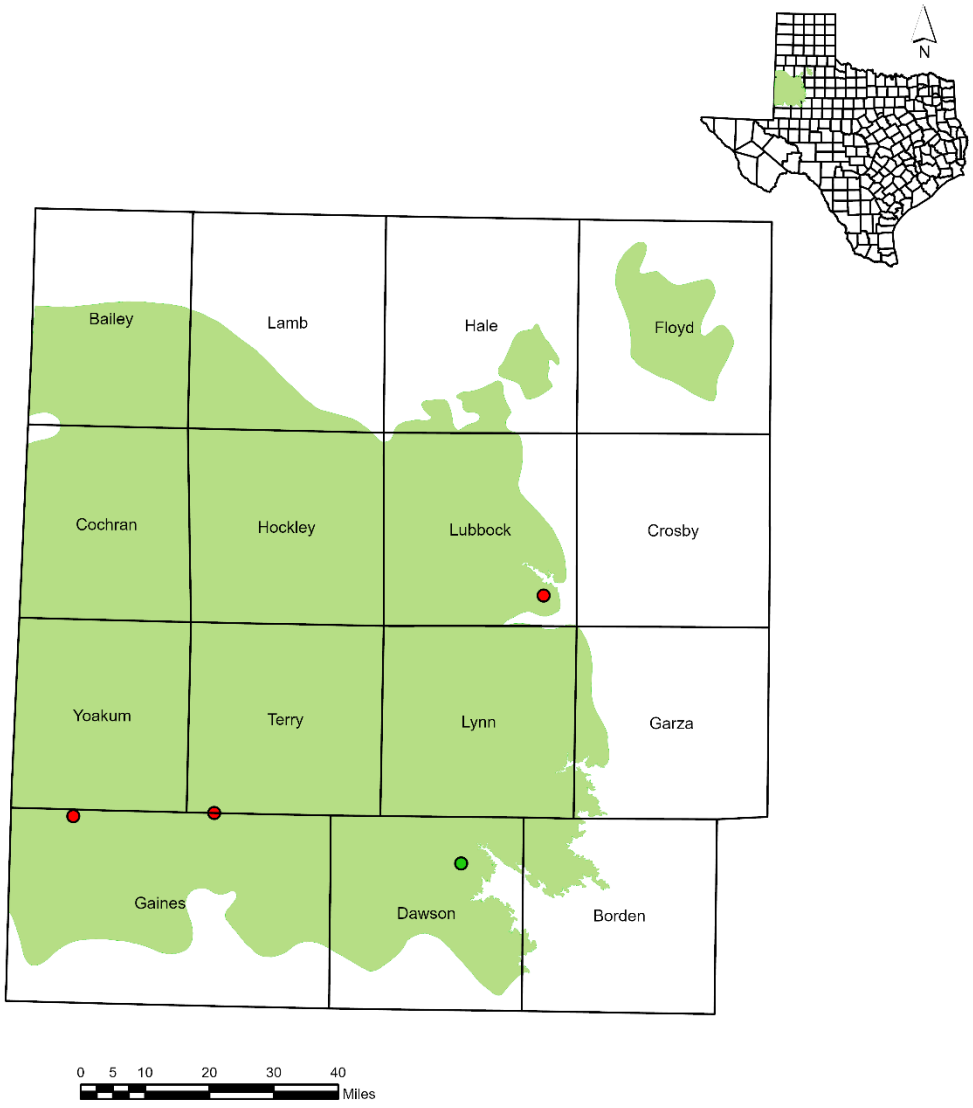


Figure 12. Distribution of Fluoride in the Edwards–Trinity (High Plains) Aquifer

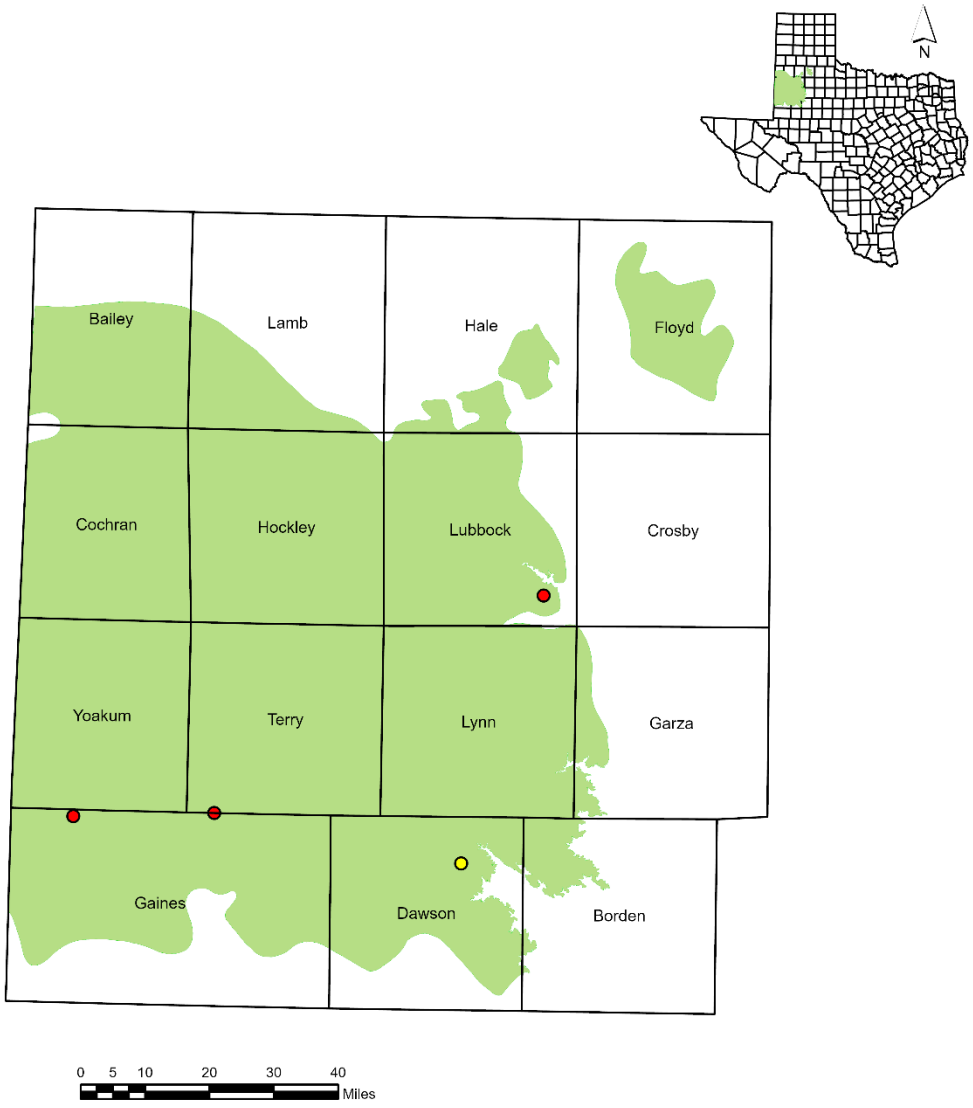


Figure 13. Distribution of Nitrate in the Edwards–Trinity (High Plains) Aquifer

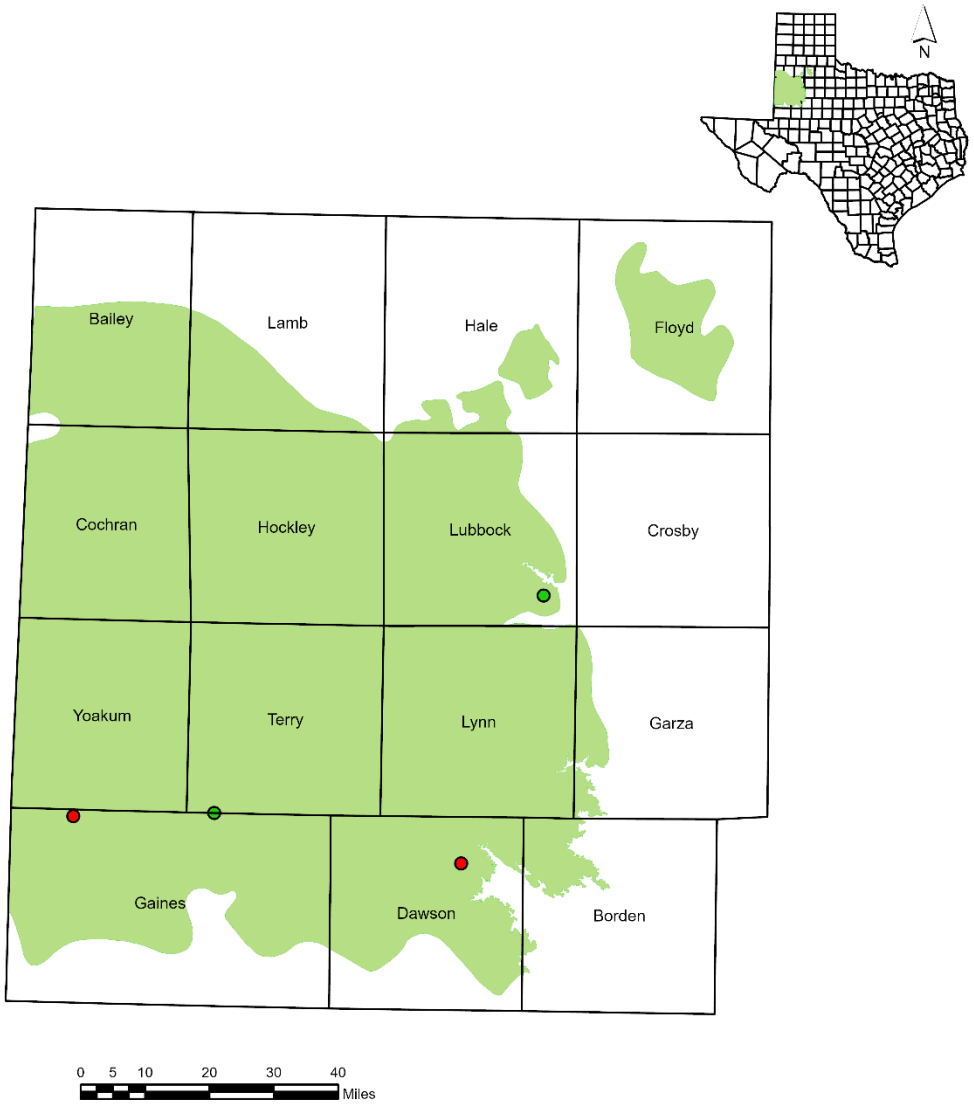
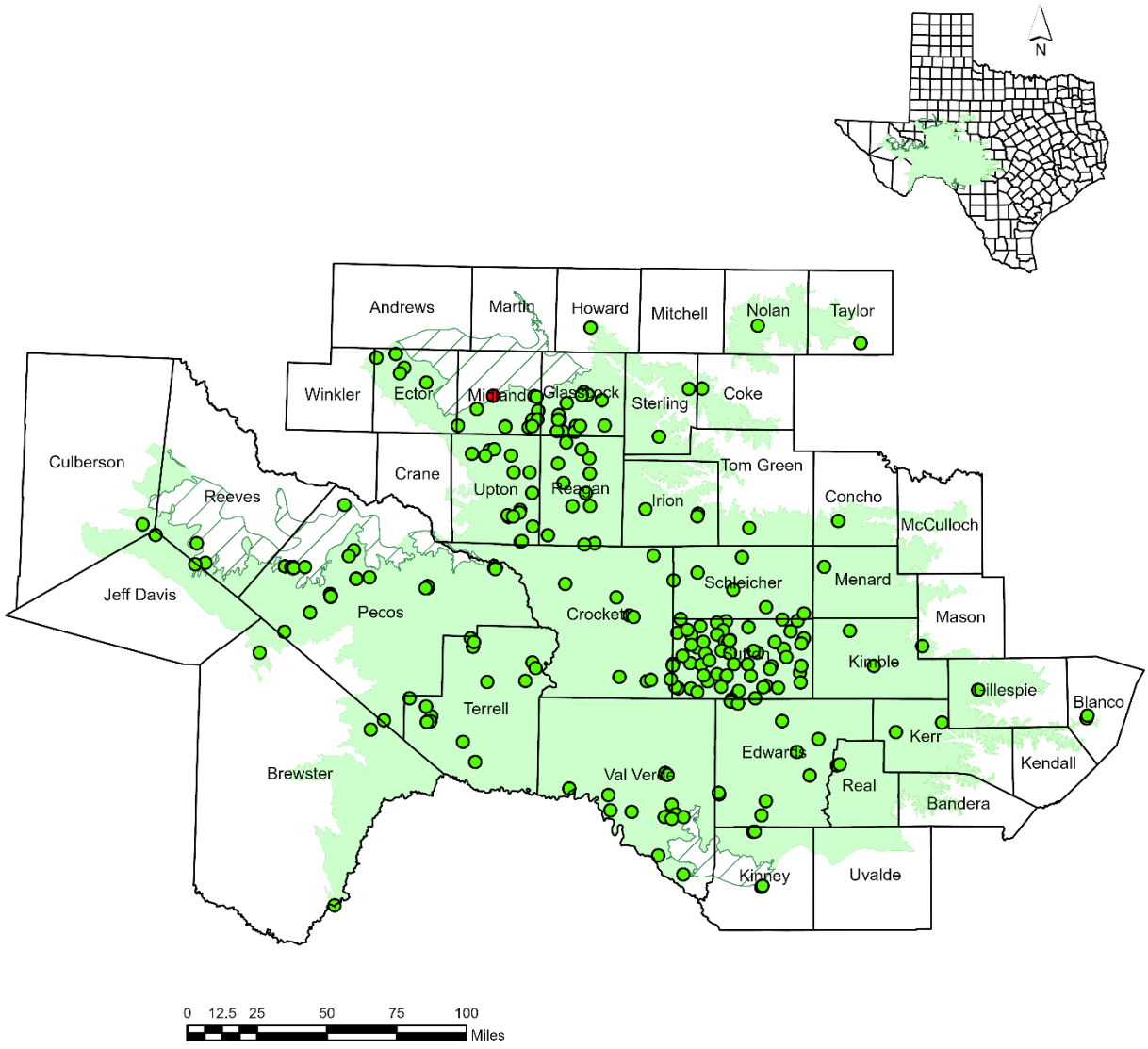


Figure 14. Distribution of Arsenic in the Edwards–Trinity (Plateau) Aquifer



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Arsenic Concentration in Edwards Trinity Aquifer Water Wels

- Less than 10 µg/L
- 10 µg/L or greater

Figure 15. Distribution of Fluoride in the Edwards–Trinity (Plateau) Aquifer

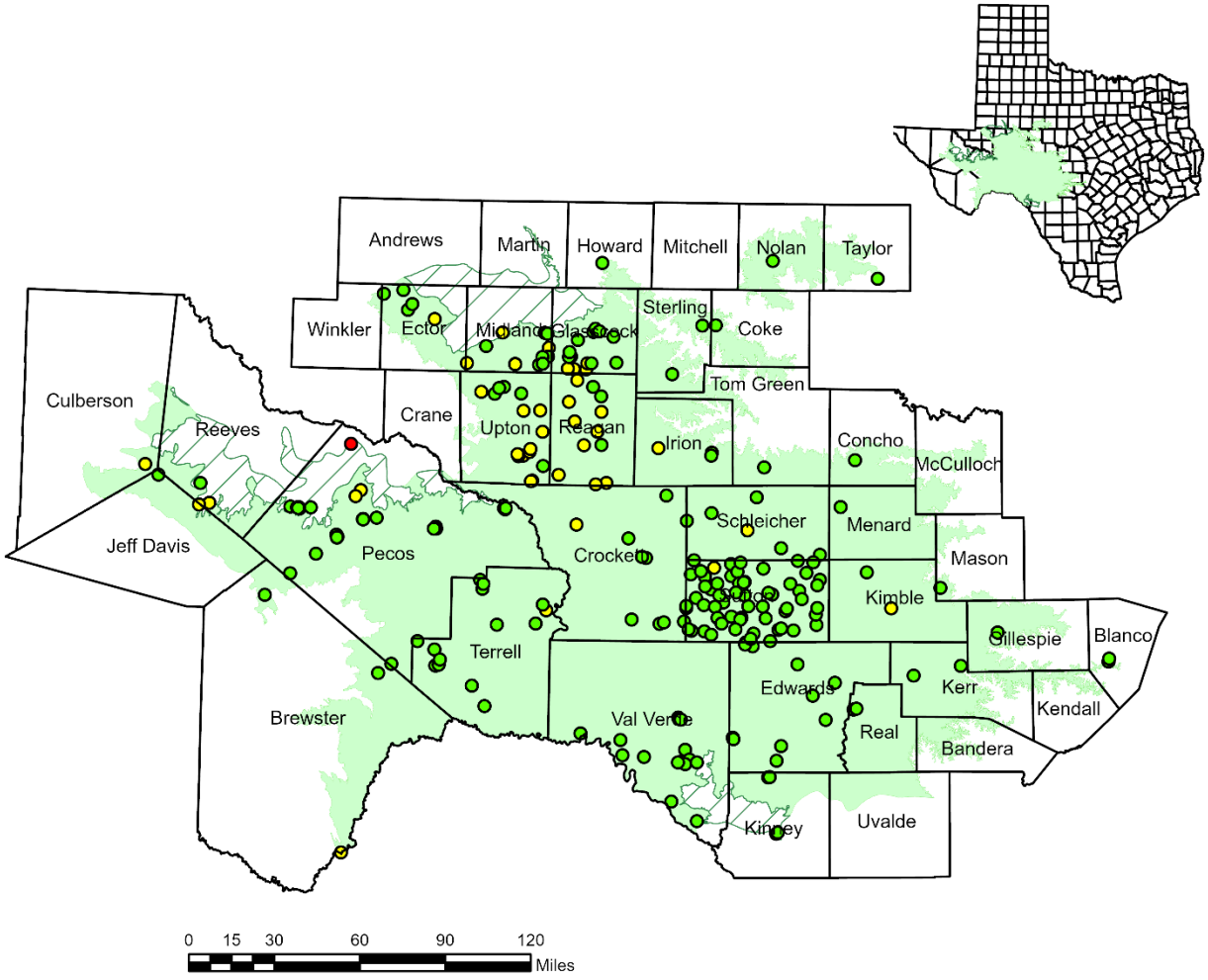


Figure 16. Distribution of Nitrate in the Edwards–Trinity (Plateau) Aquifer

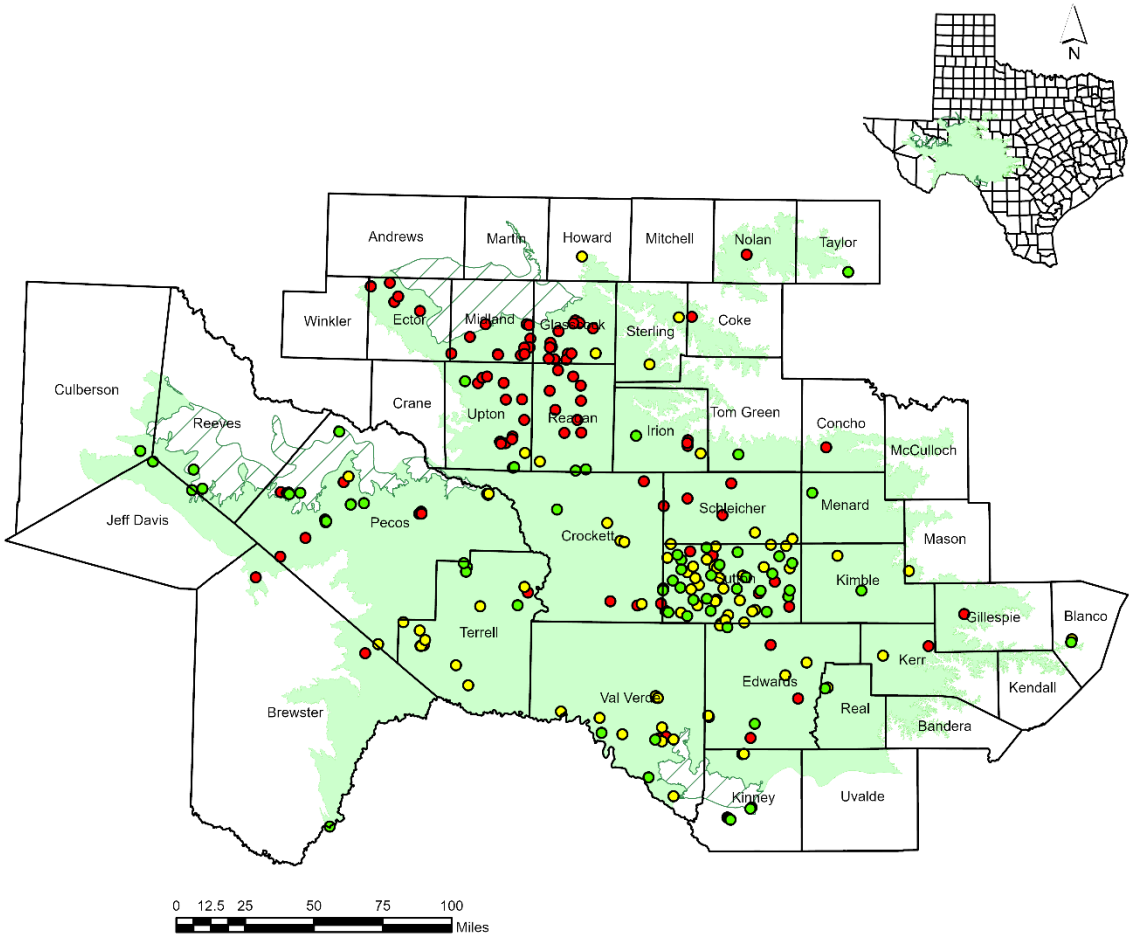
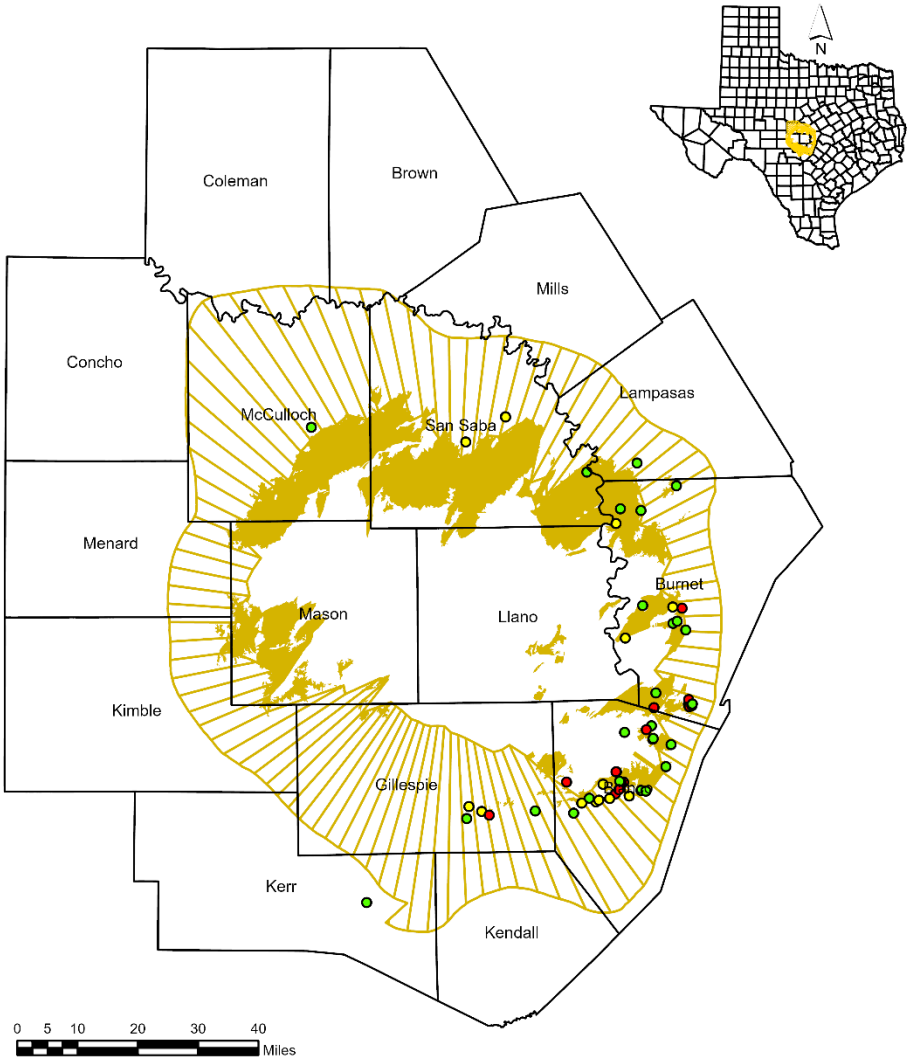


Figure 17. Distribution of Nitrate in the Ellenburger–San Saba Aquifer



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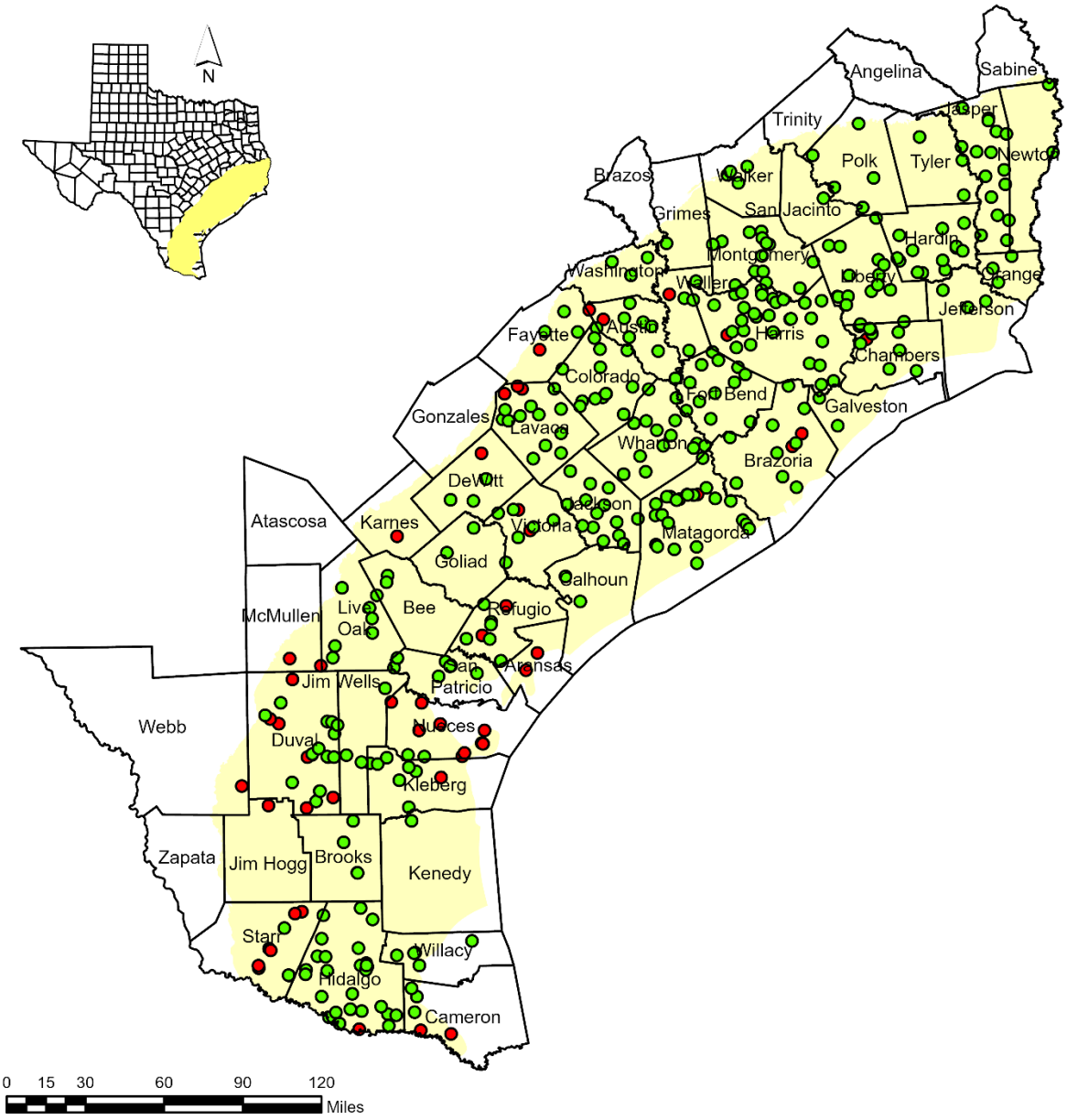
Nitrate Concentration in Ellenburger - San Saba Aquifer Water Wells

- Less than 5 mg/L
- 5 mg/L to less than 10 mg/L
- 10 mg/L or greater

Figure 18. Distribution of Arsenic in the Gulf Coast Aquifer



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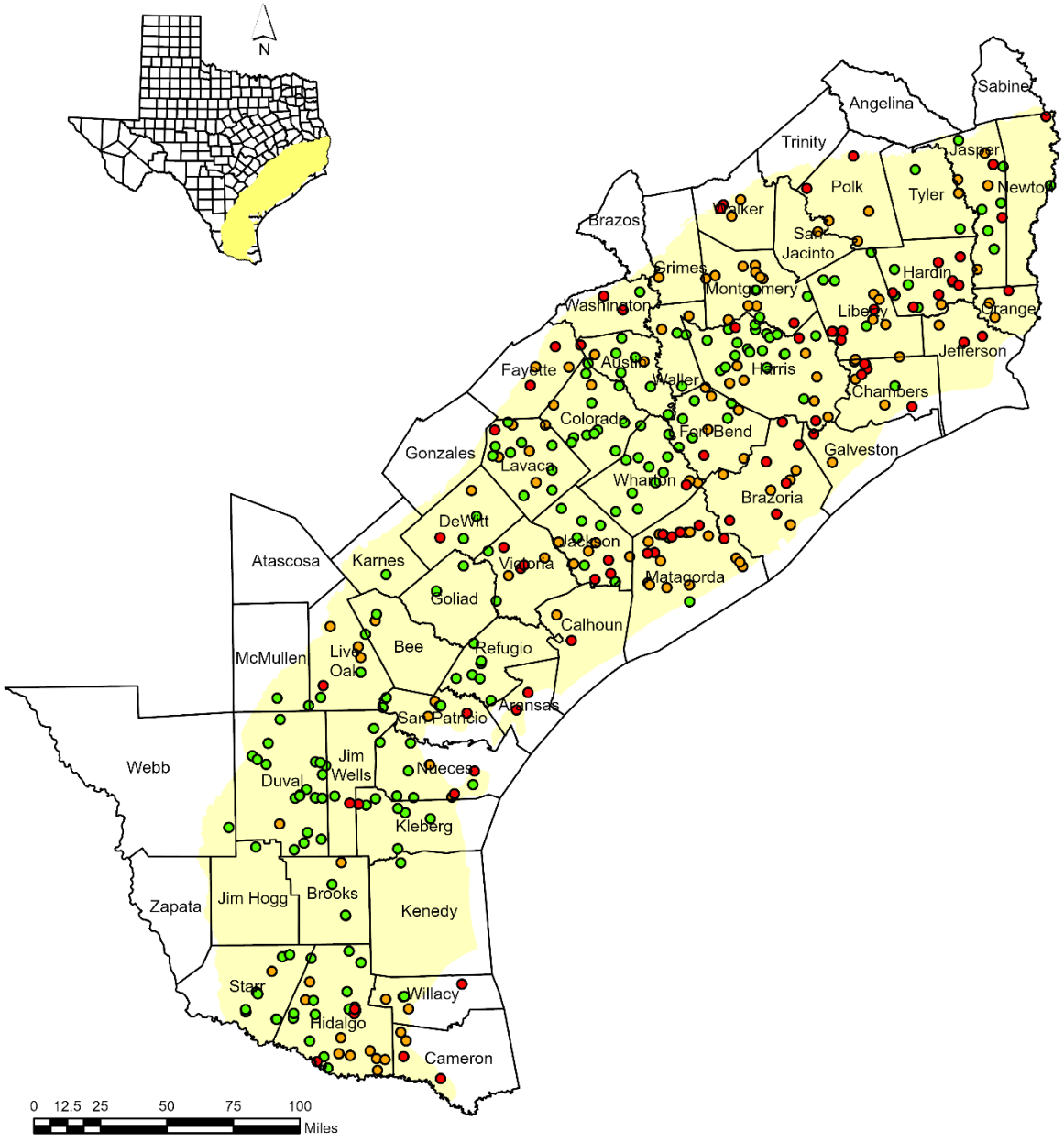
Arsenic Concentration in Gulf Coast Aquifer Aquifer Water Wells

- Less than 10 µg/L
- 10 µg/L or greater

Figure 19. Distribution of Manganese in the Gulf Coast Aquifer



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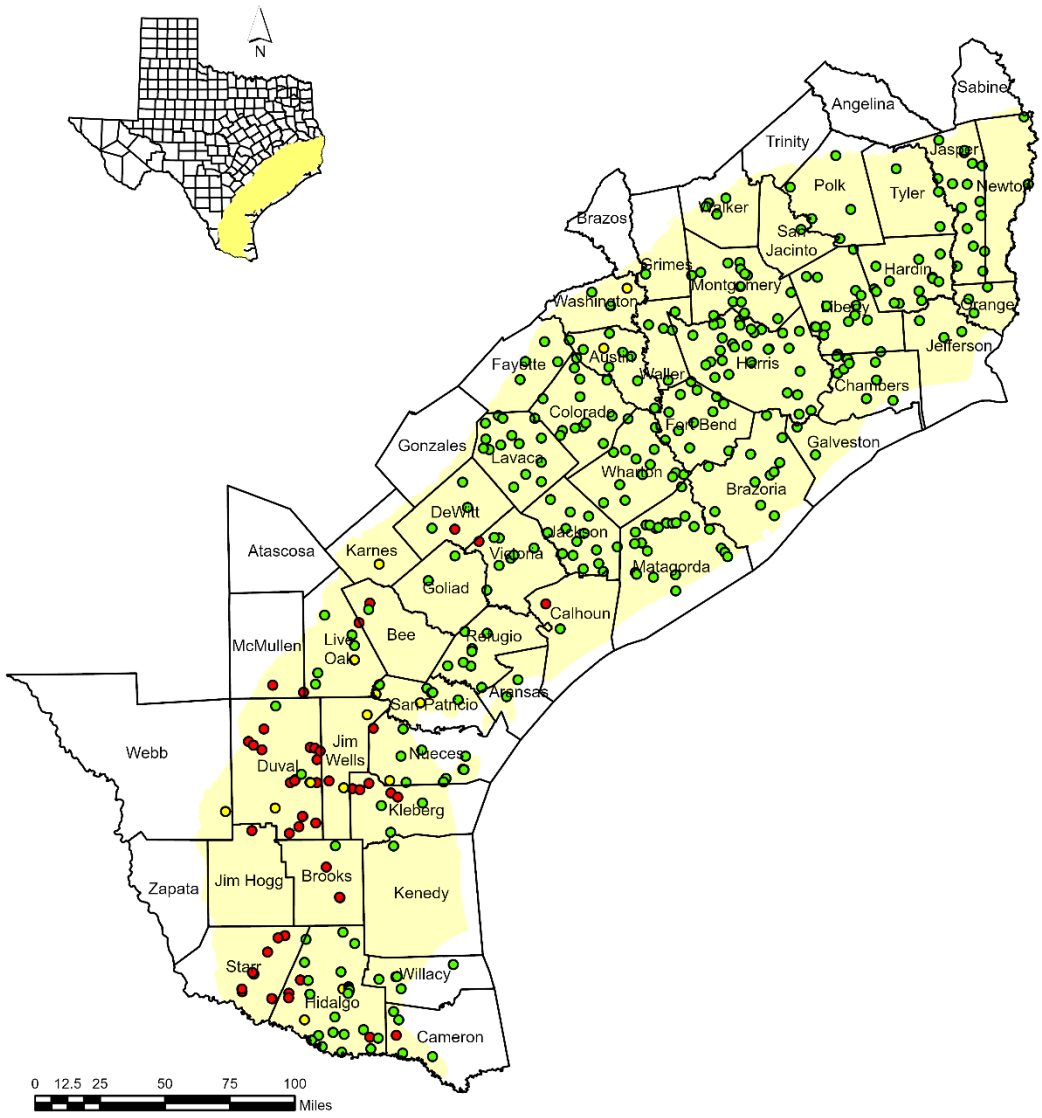
Manganese Concentration in Gulf Coast Aquifer Water Wells

- Less than 10 µg/L
- 10 µg/L to less than 50 µg/L
- 50 µg/L or greater

Figure 20. Distribution of Nitrate in the Gulf Coast Aquifer



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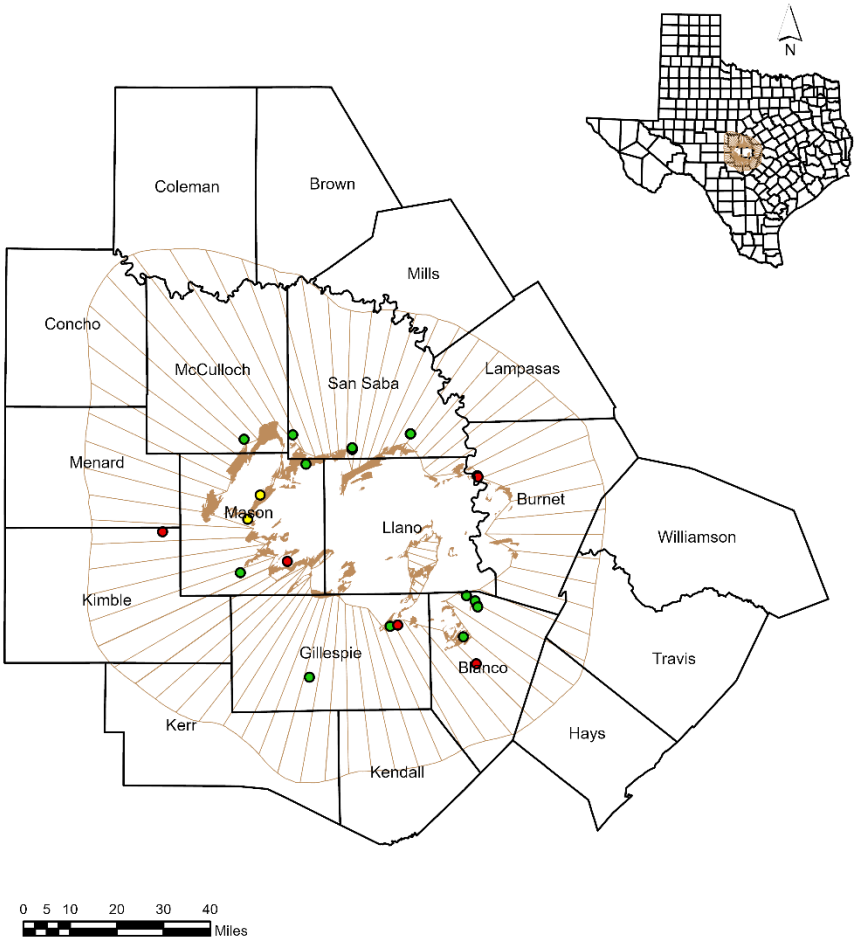
Nitrate Concentration in Gulf Coast Aquifer Water Wells

- Less than 5 mg/L
- 5 mg/L to less than 10 mg/L
- 10 mg/L or greater

Figure 21. Distribution of Nitrate in the Hickory Aquifer



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Nitrate Concentration in Water Wells in the Hickory Aquifer

- Less than 5 mg/L
- 5 mg/L to less than10 mg/L
- 10 mg/L or greater

Figure 22. Distribution of Arsenic in the Hueco–Mesilla Bolsons Aquifer

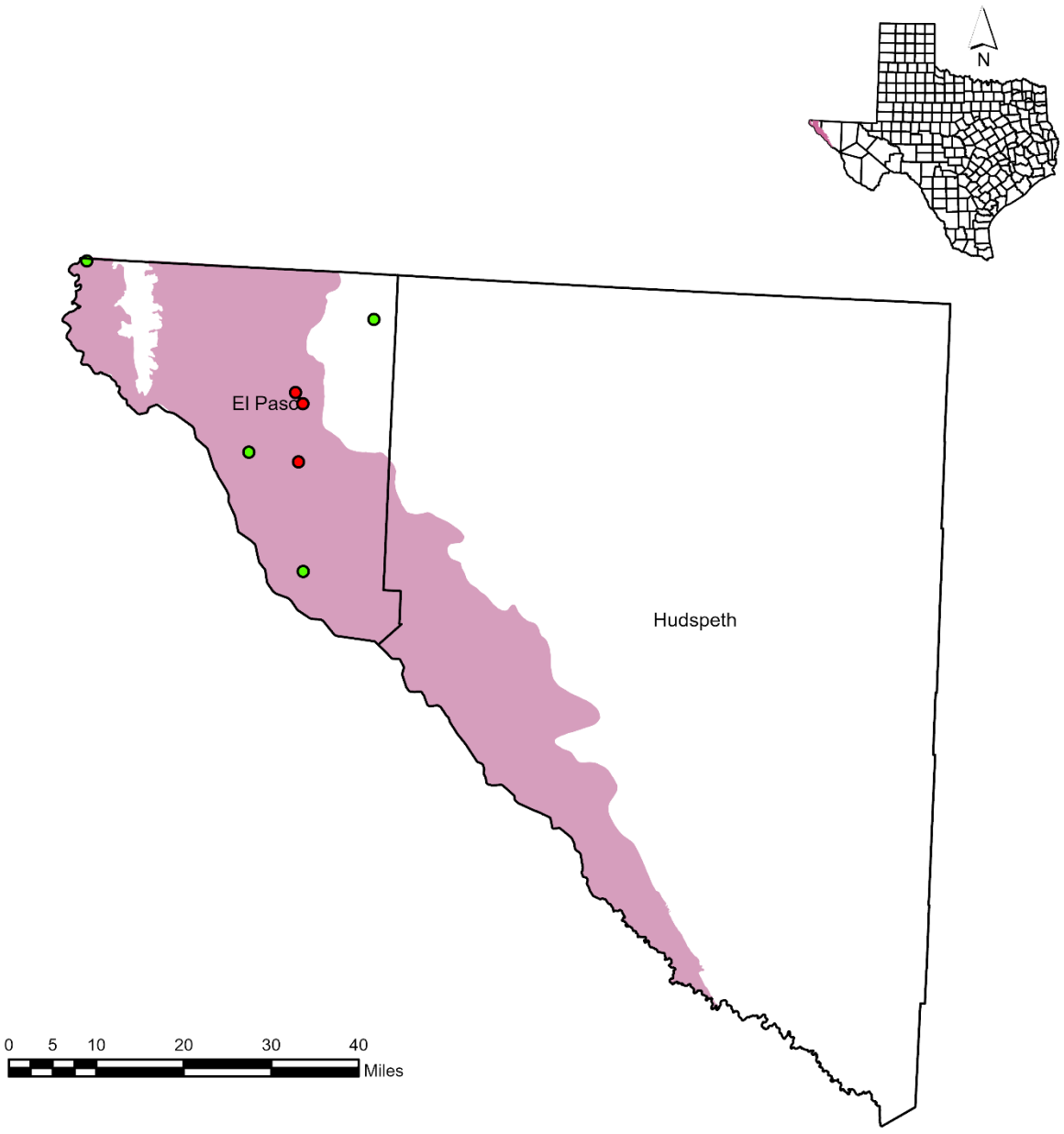


Figure 23. Distribution of Nitrate in the Lipan Aquifer

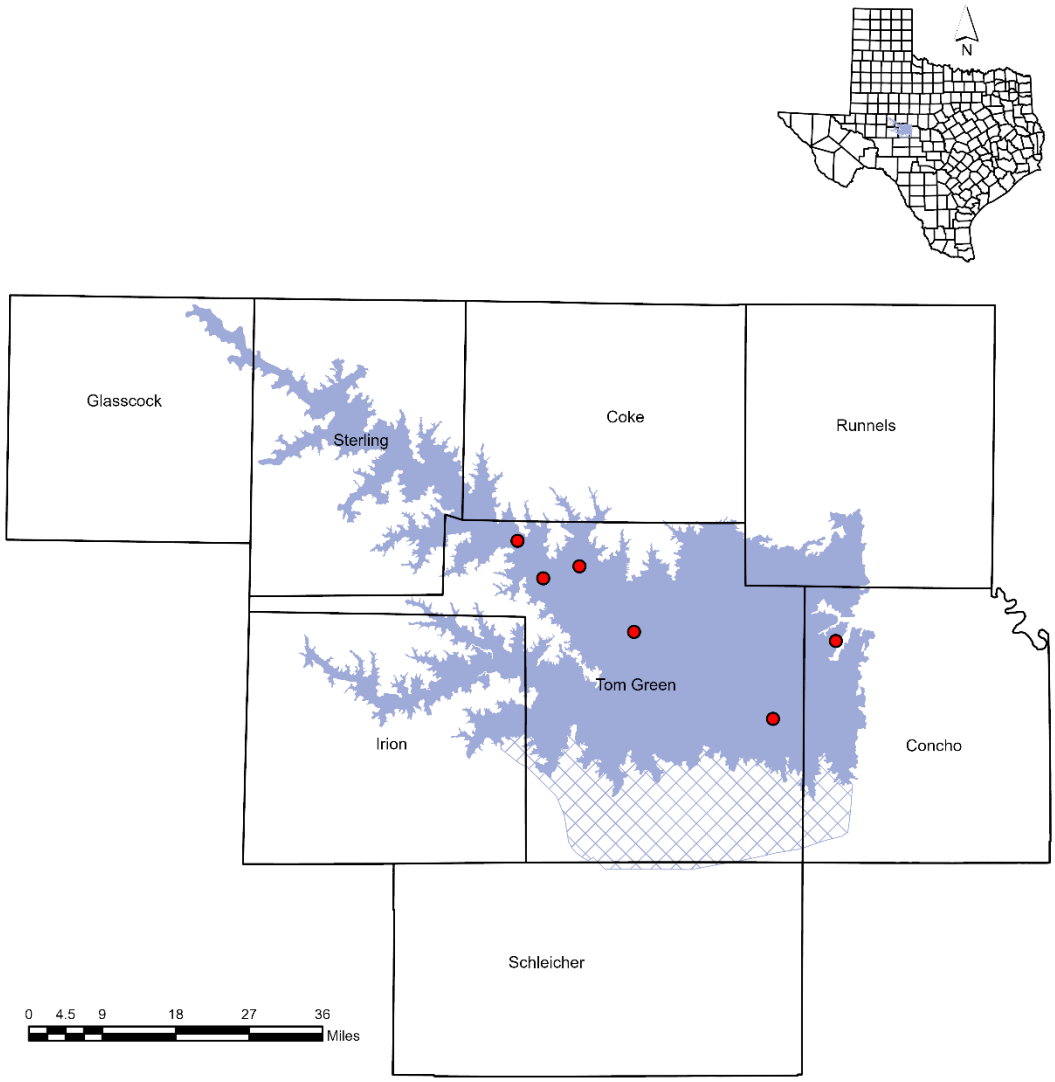


Figure 24. Distribution of Total Dissolved Solids in the Lipan Aquifer

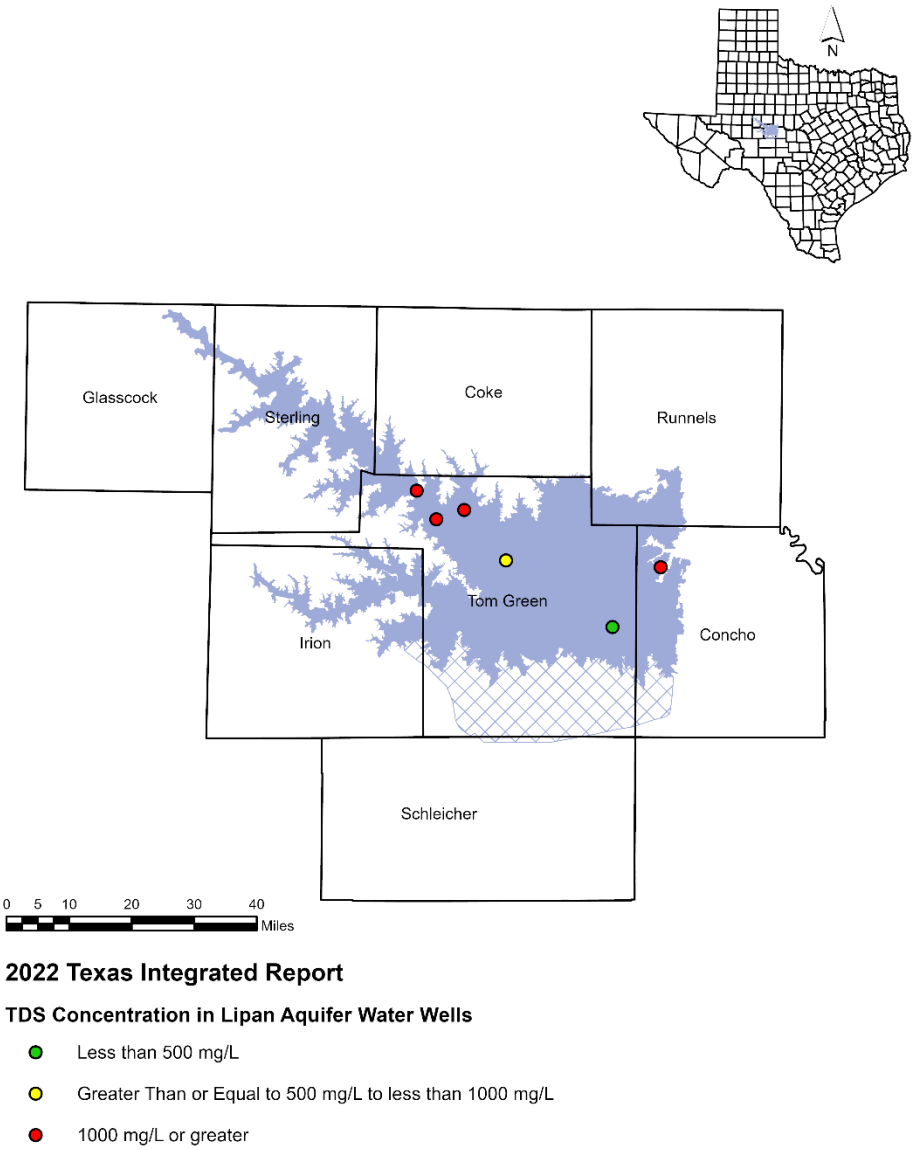


Figure 25. Distribution of Nitrate in the Marathon Aquifer

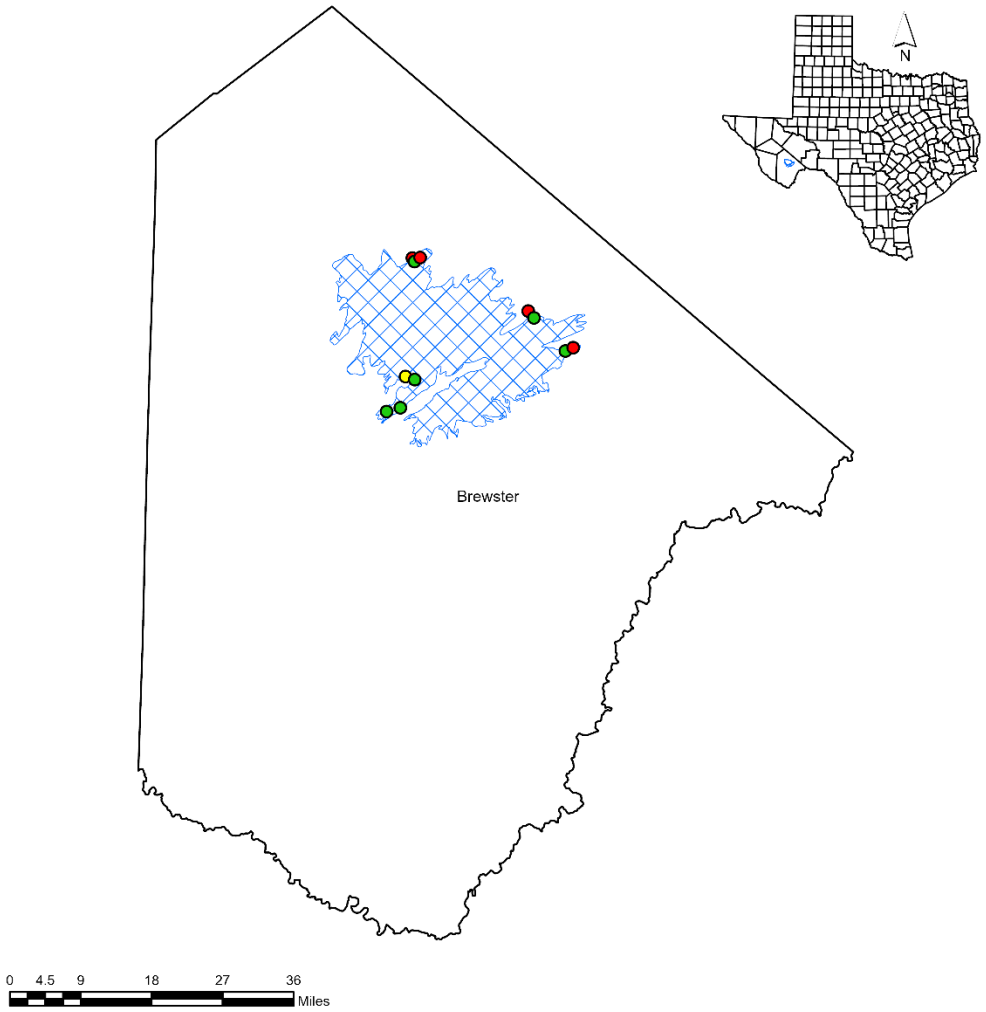
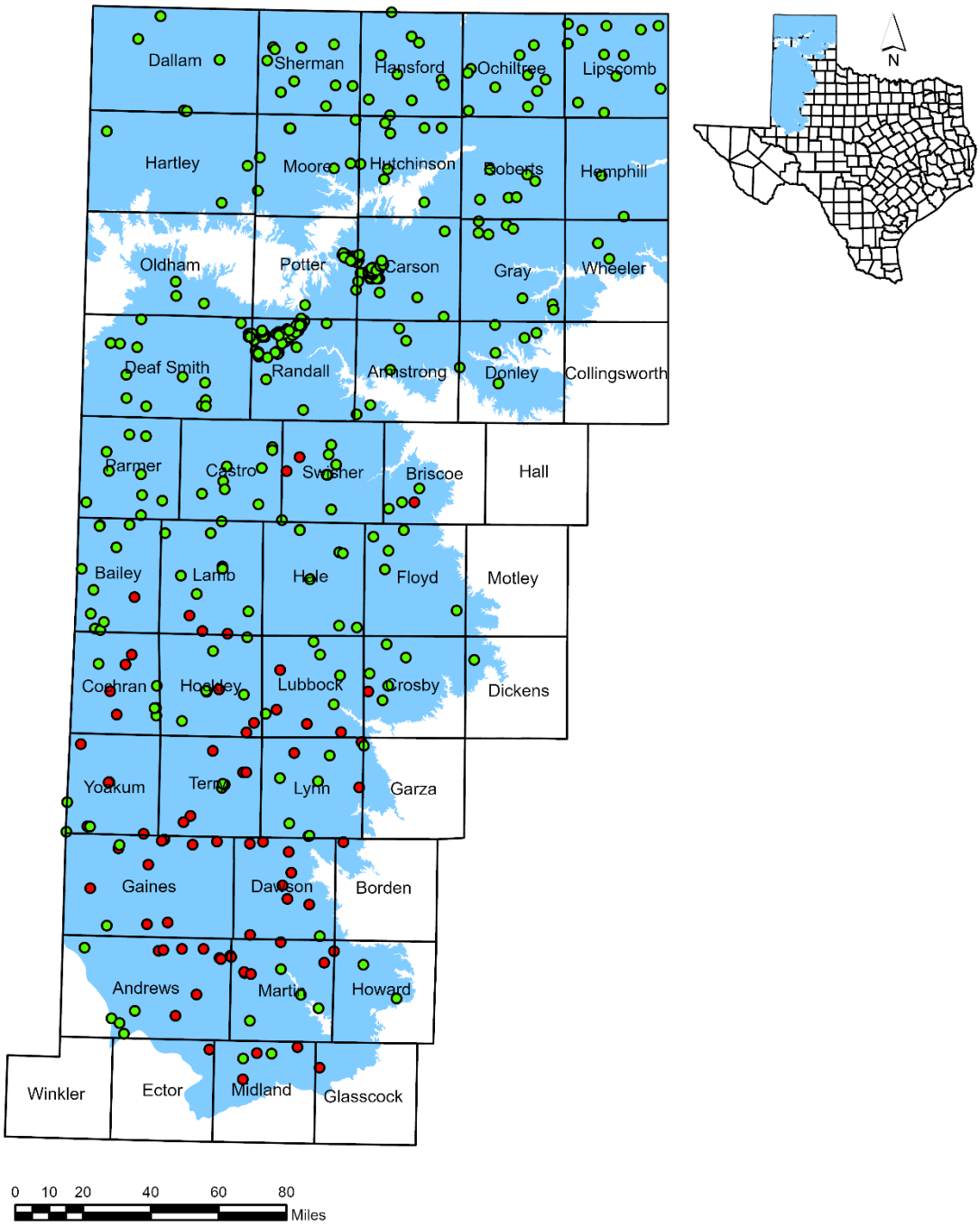


Figure 26. Distribution of Arsenic in the Ogallala Aquifer



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Arsenic Concentration in Ogallala Aquifer Water Wells

- Less than 10 µg/L
- 10 µg/L or greater

Figure 27. Distribution of Fluoride in the Ogallala Aquifer

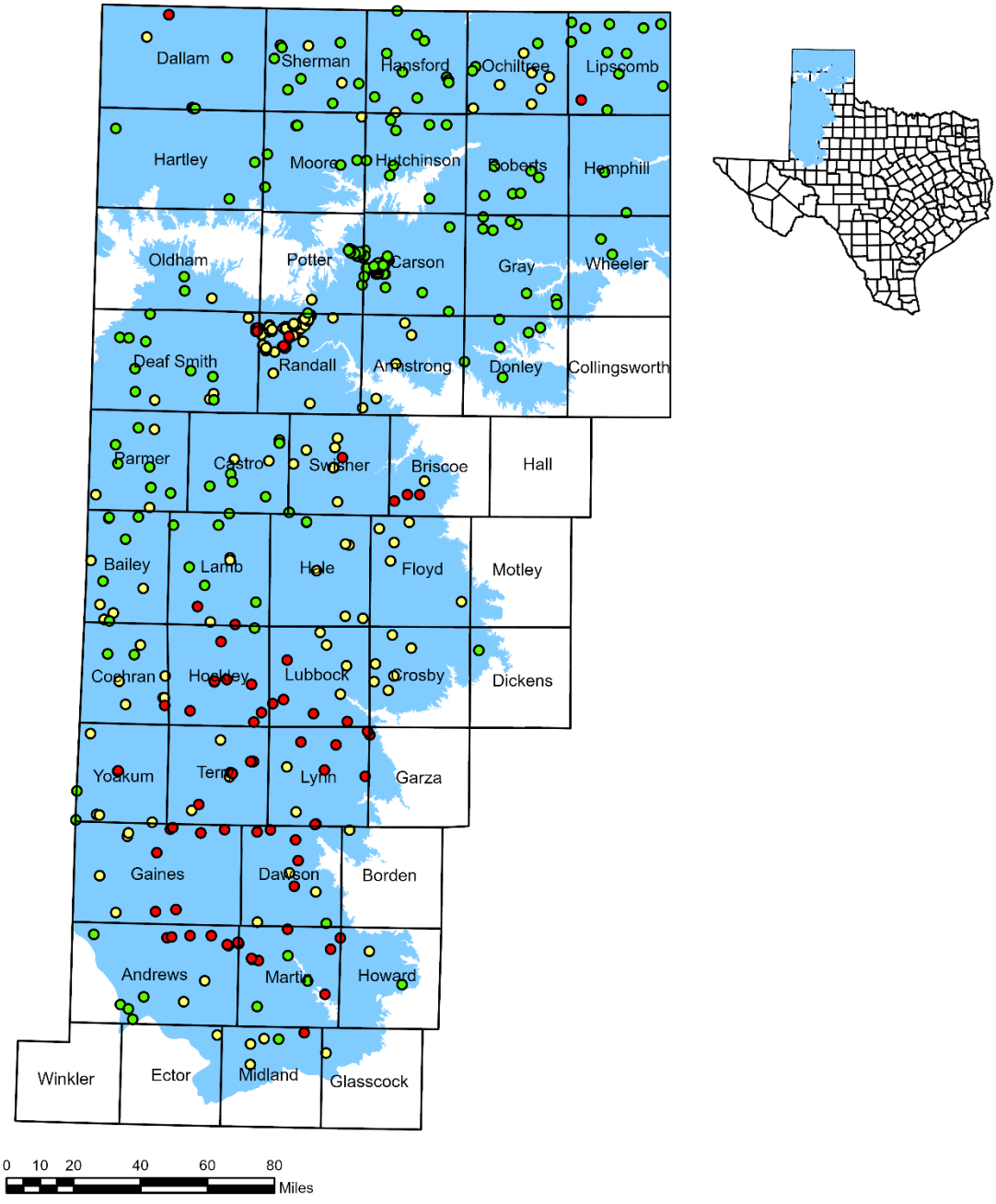


Figure 28. Distribution of Nitrate in the Ogallala Aquifer

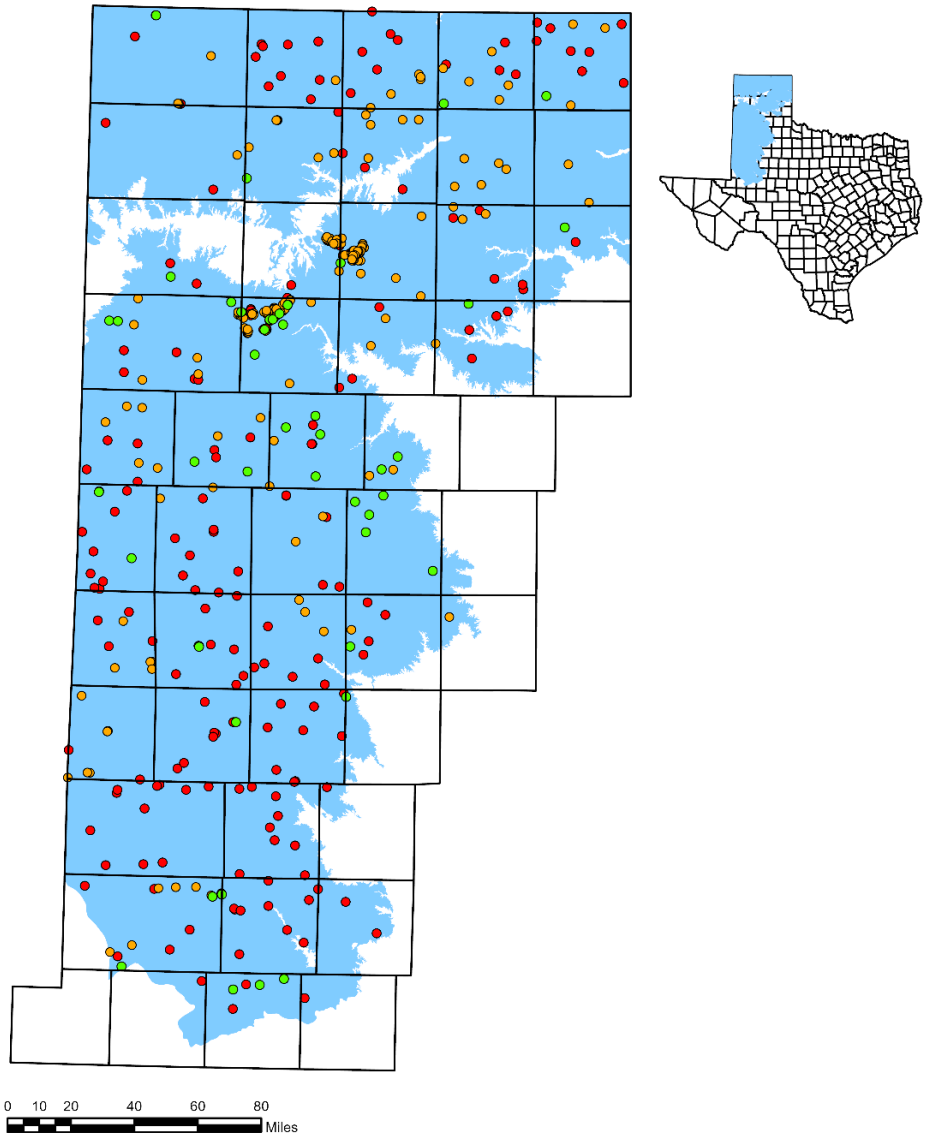


Figure 29. Distribution of Selenium in the Ogallala Aquifer

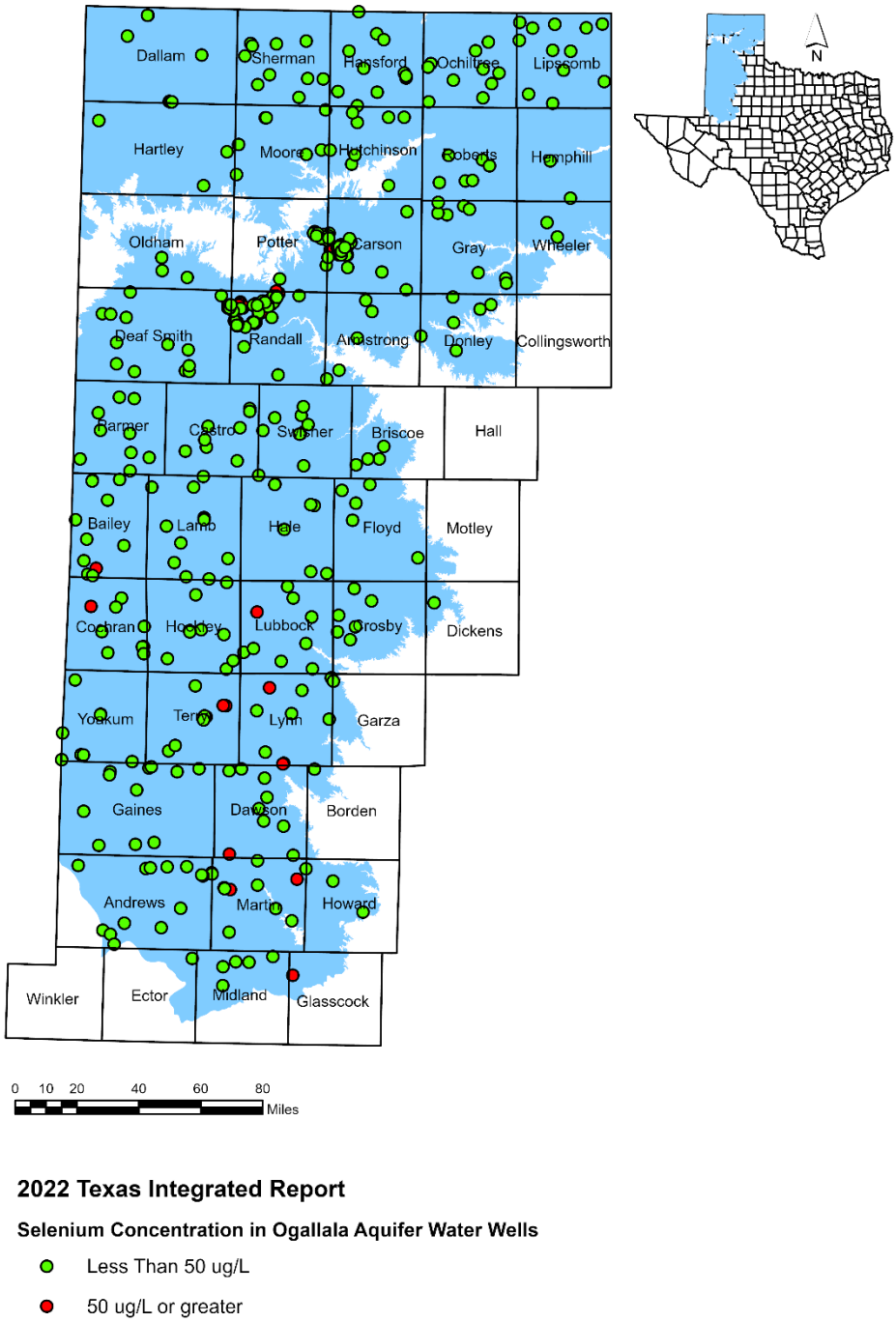


Figure 30. Distribution of Total Dissolved Solids in the Ogallala Aquifer

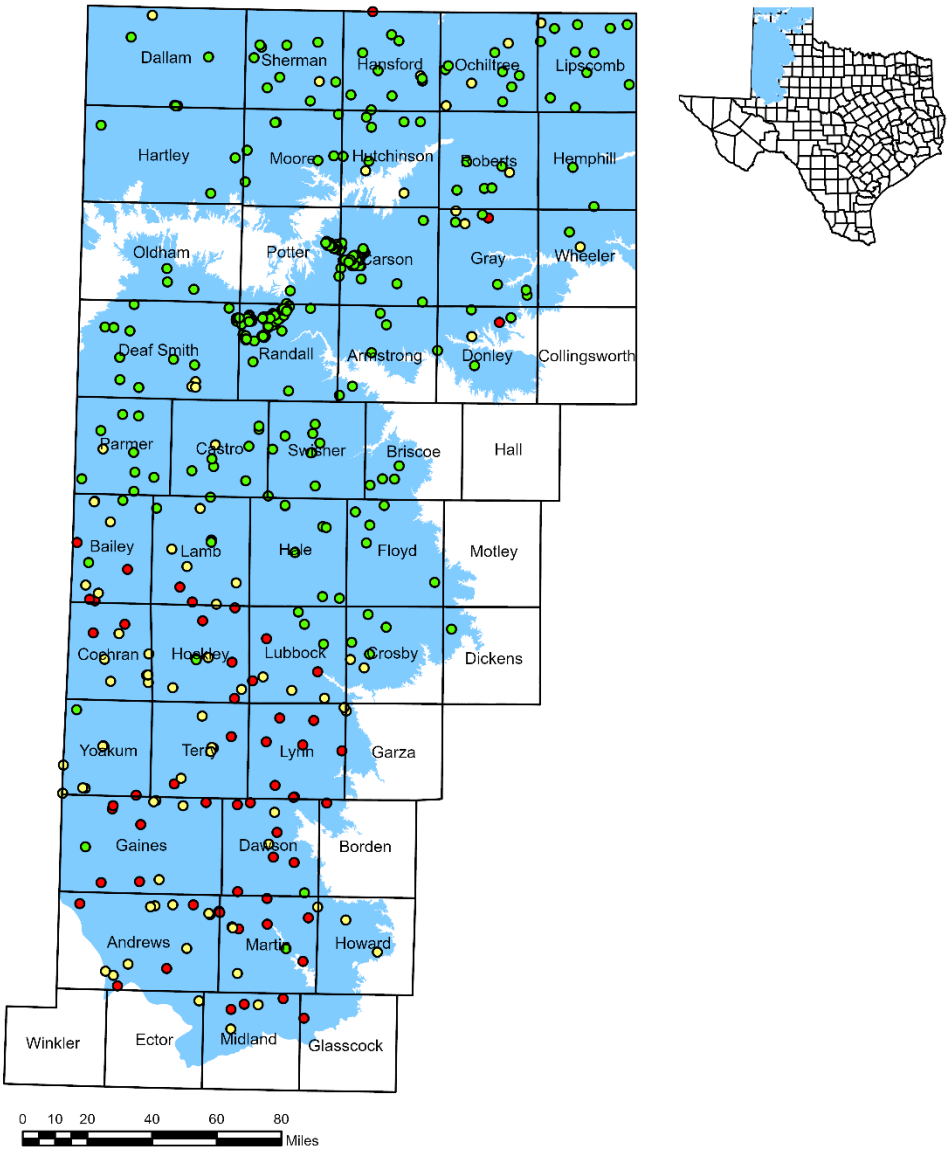


Figure 31. Distribution of Nitrate in the Pecos Valley Aquifer

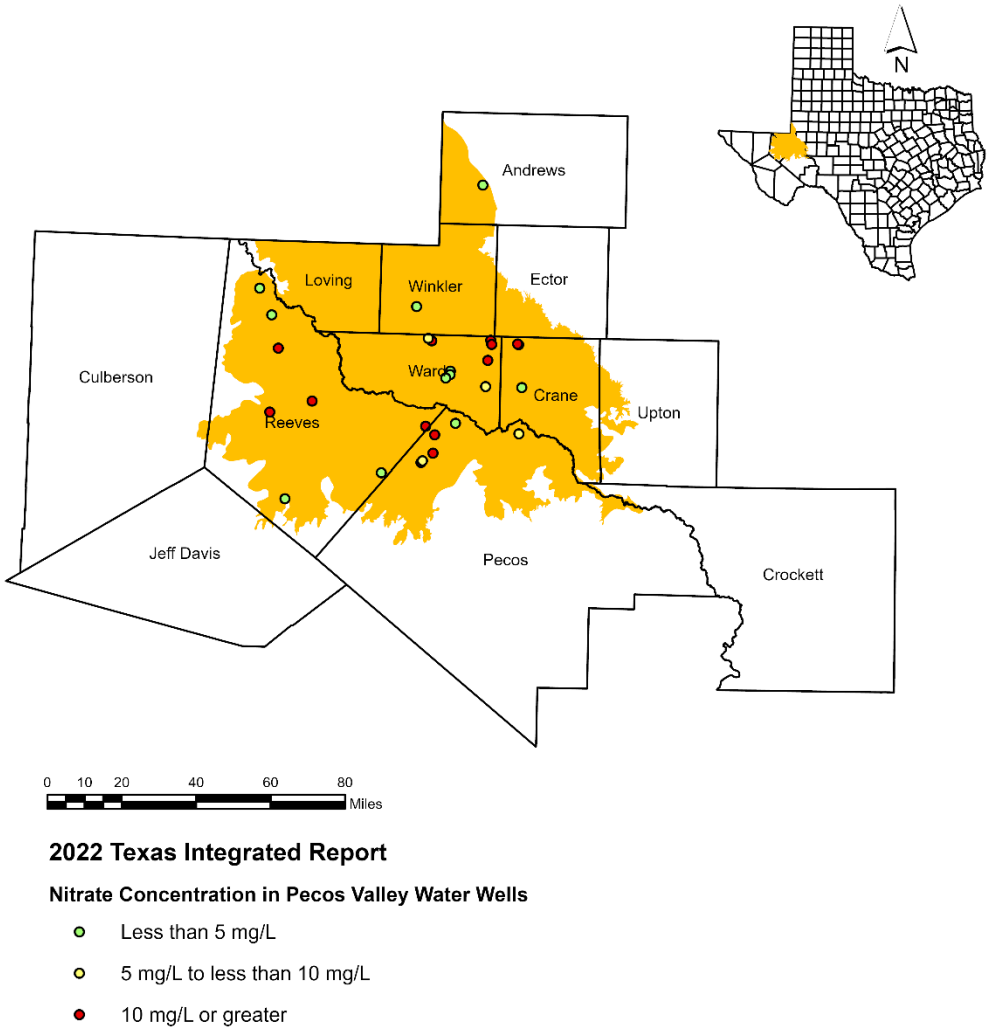


Figure 32. Distribution of Sulfate in the Pecos Valley Aquifer

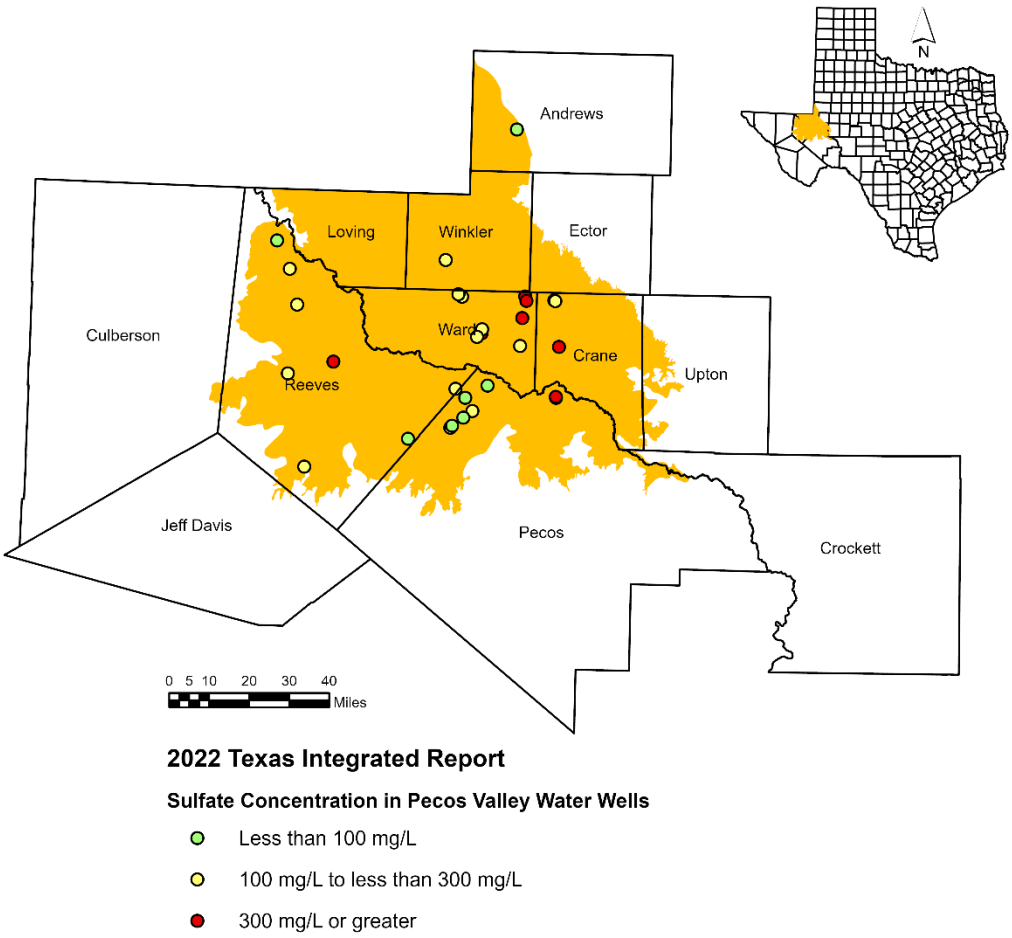


Figure 33. Distribution of Total Dissolved Solids in the Pecos Valley Aquifer

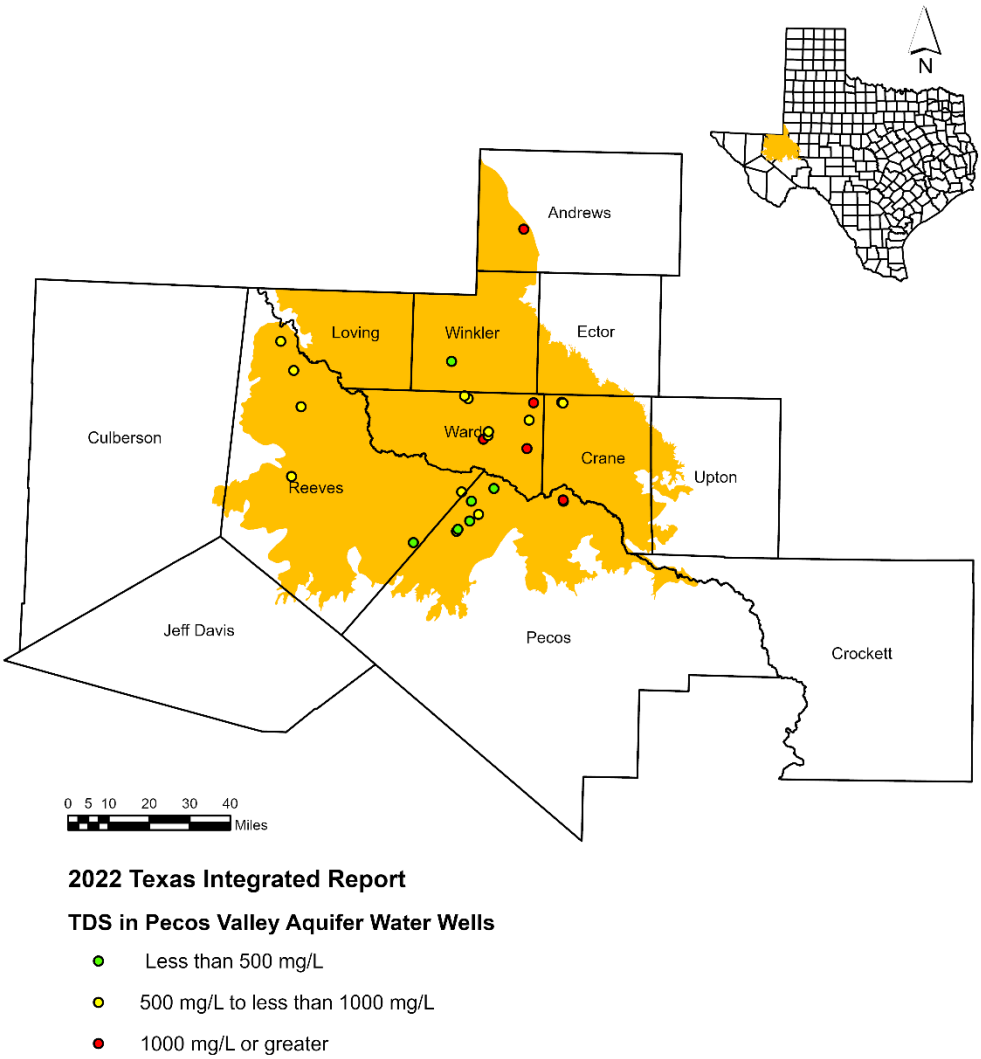
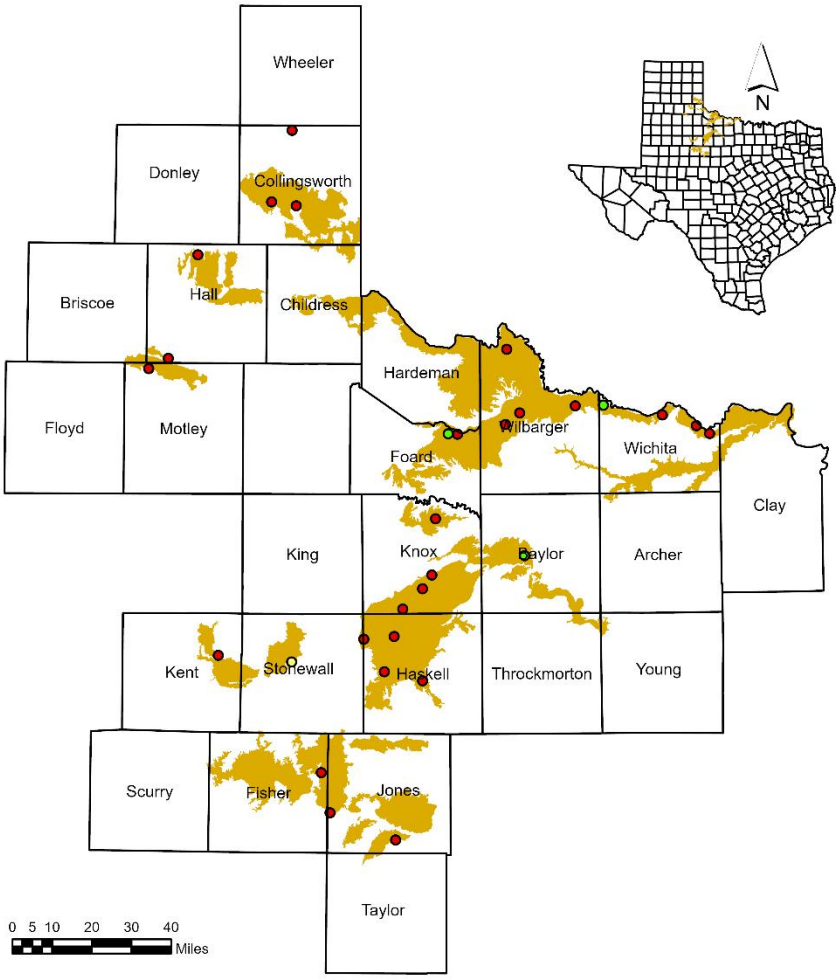


Figure 34. Distribution of Nitrate in the Seymour Aquifer



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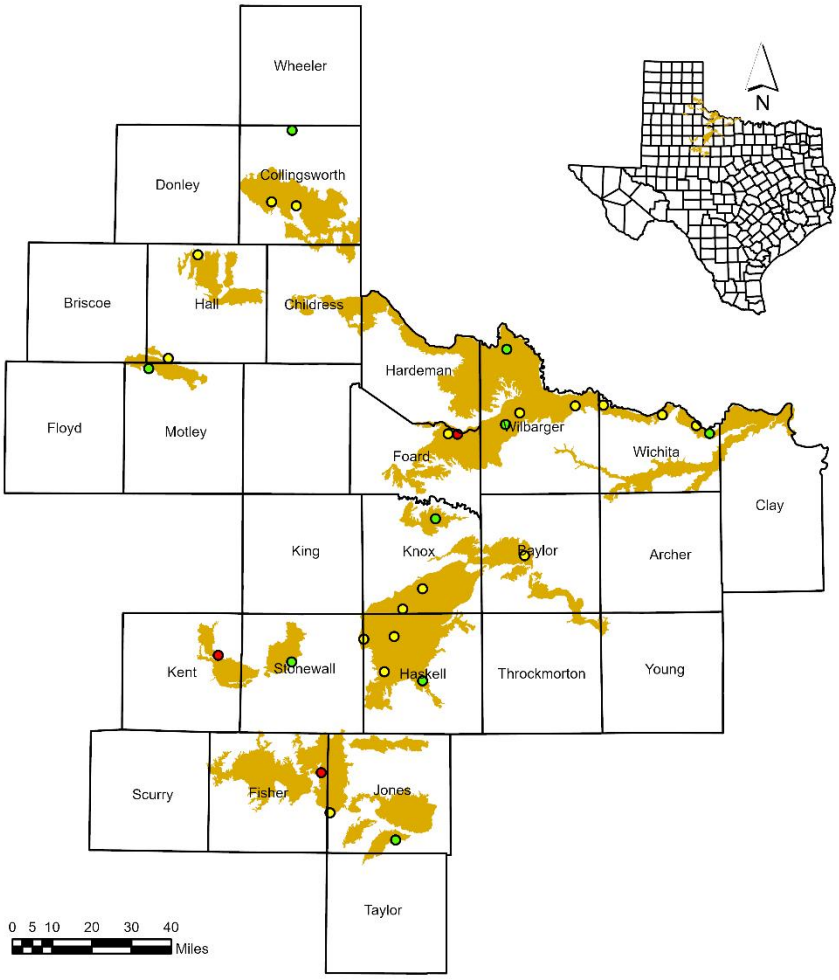
Nitrate Concentration in Seymour Aquifer Water Wells

- Less than 5 mg/L
- 5 mg/L to less than 10 mg/L
- 10 mg/L or greater

Figure 35. Distribution of Total Dissolved Solids in the Seymour Aquifer



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TDS Concentration in Seymour Aquifer Water Wells

- Less than 500 mg/L
- 500 mg/L to less than 1000 mg/L
- 1000 mg/L or greater

Figure 36. Distribution of Fluoride in the Trinity Aquifer

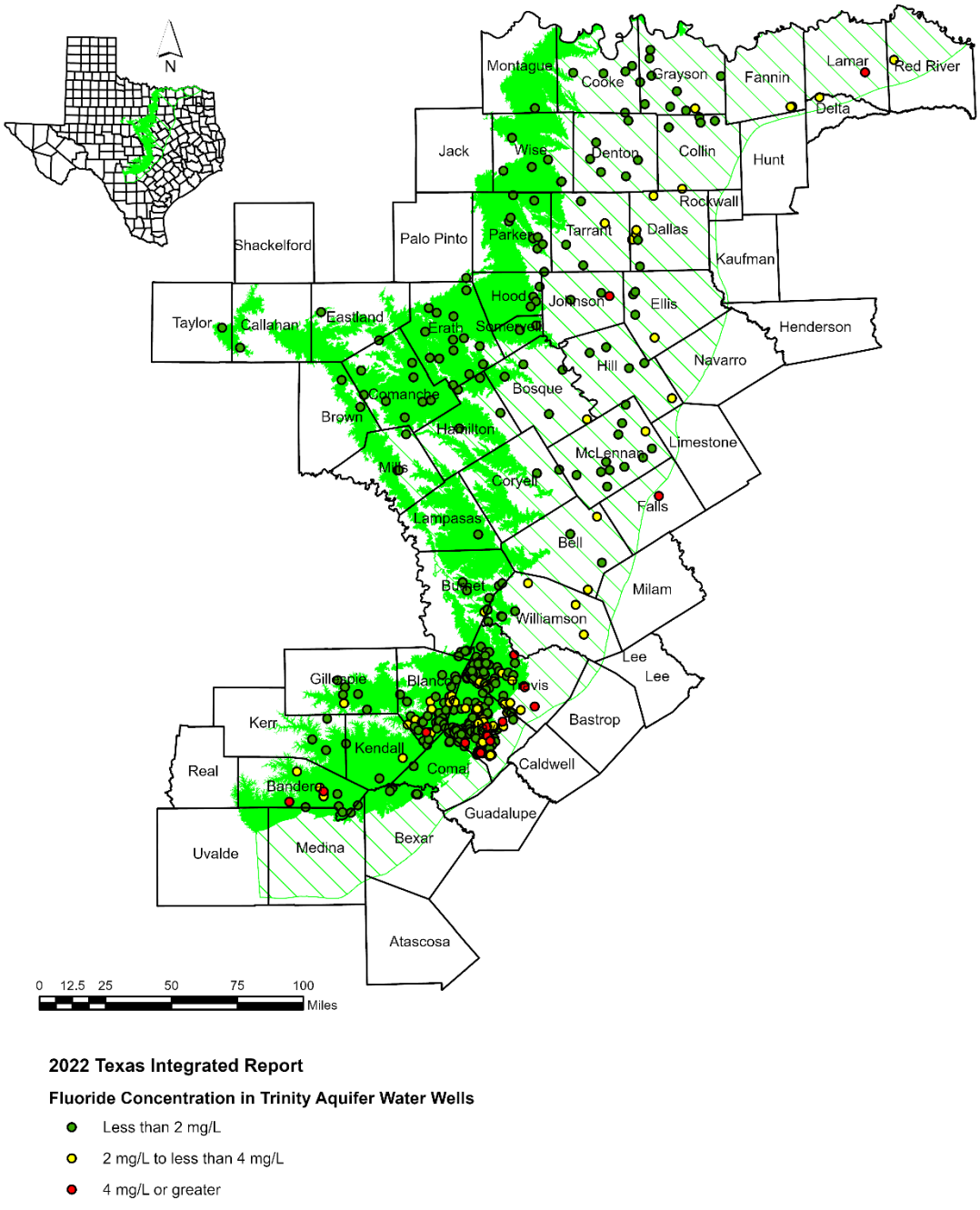
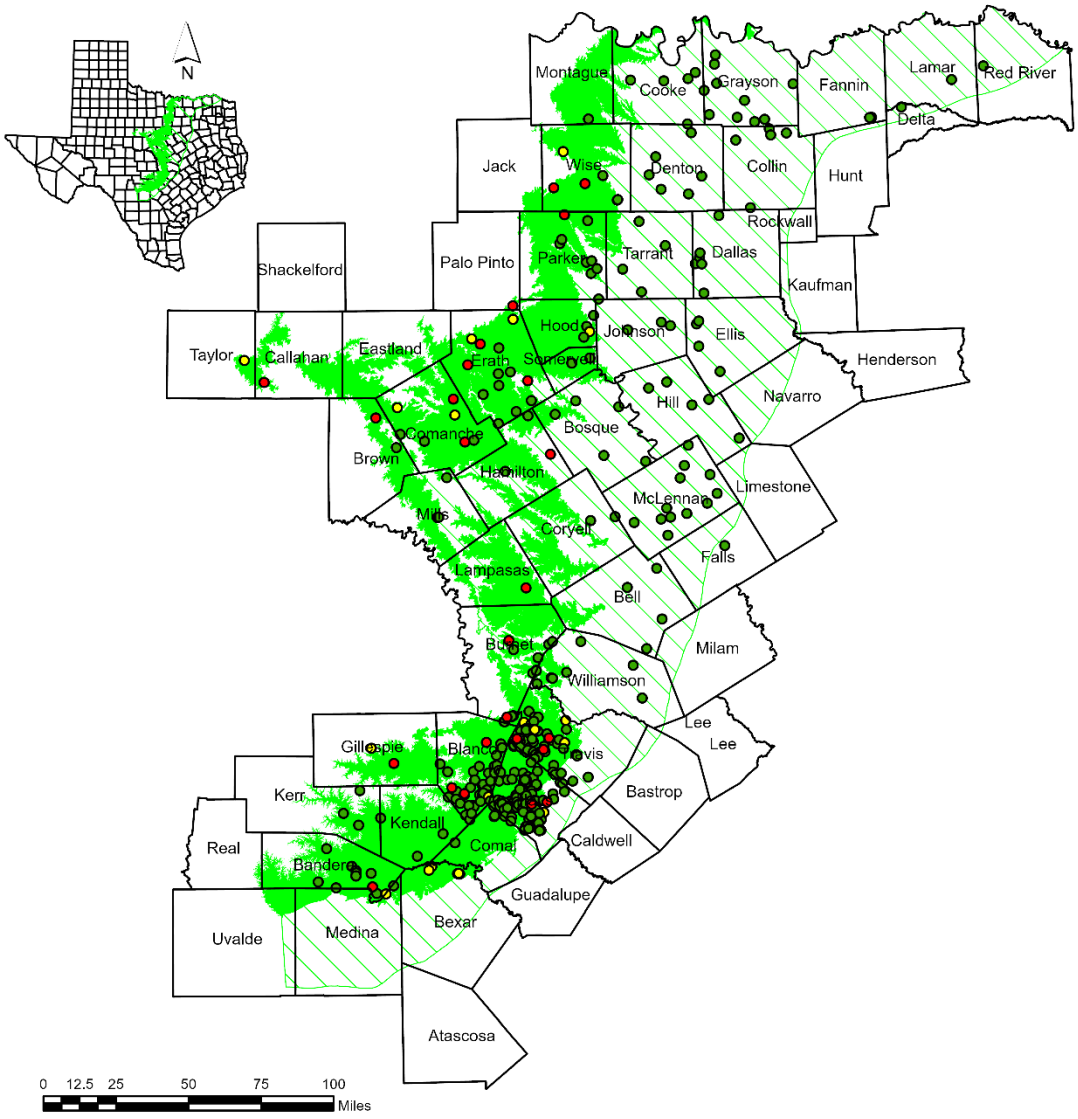


Figure 37. Distribution of Nitrate in the Trinity Aquifer



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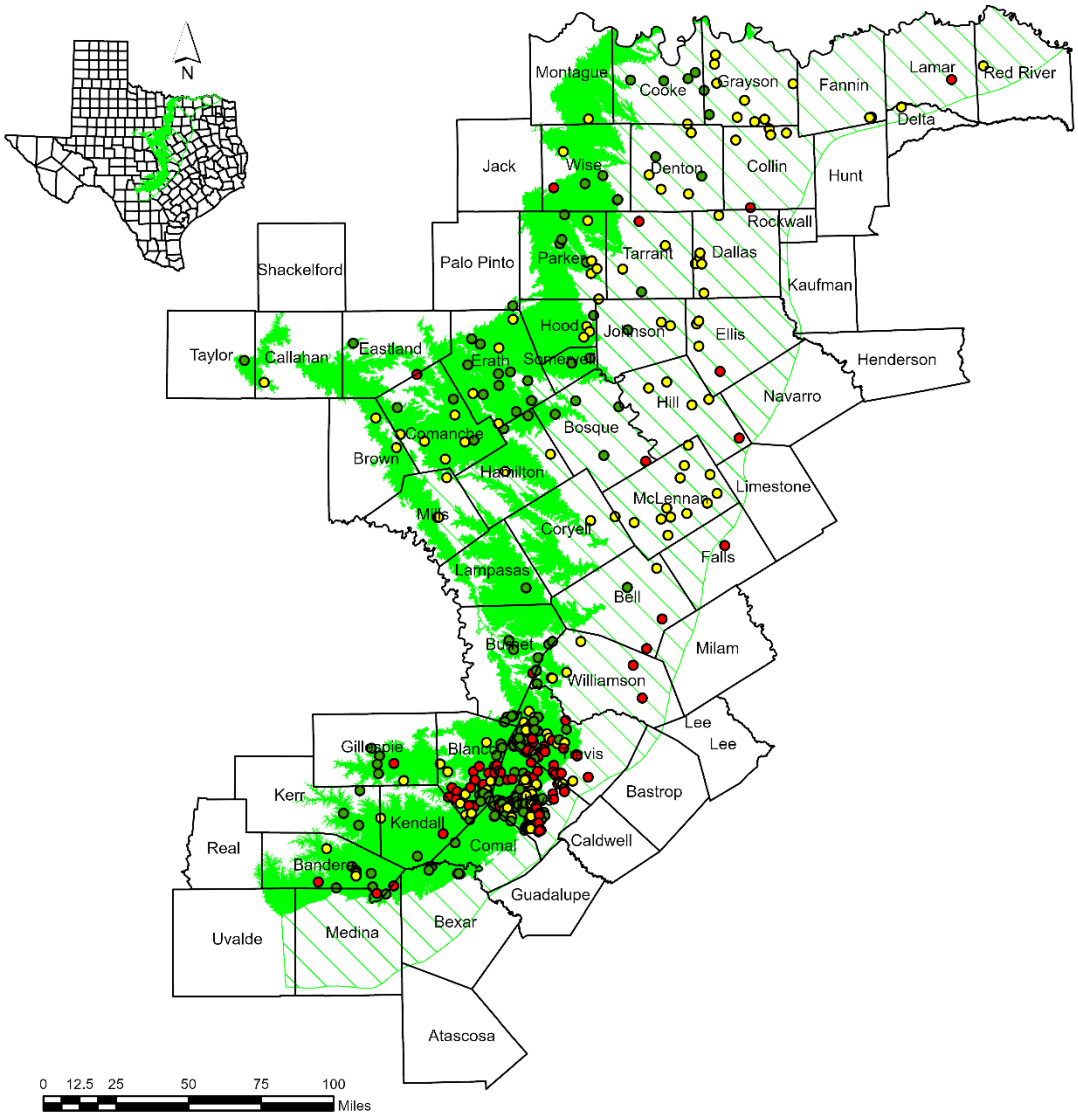
Nitrate Concentration in Trinity Aquifer Water Wells

- Less than 5 mg/L
- 5 mg/L to less than 10 mg/L
- 10 mg/L or greater

Figure 38. Distribution of Total Dissolved Solids in the Trinity Aquifer



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TDS Concentration in Trinity Aquifer Water Wells

- Less than 500 mg/L
- 500 mg/L to less than 1000 mg/L
- 1000 mg/L or greater

Figure 39. Distribution of Arsenic in the West Texas Bolsons Aquifer

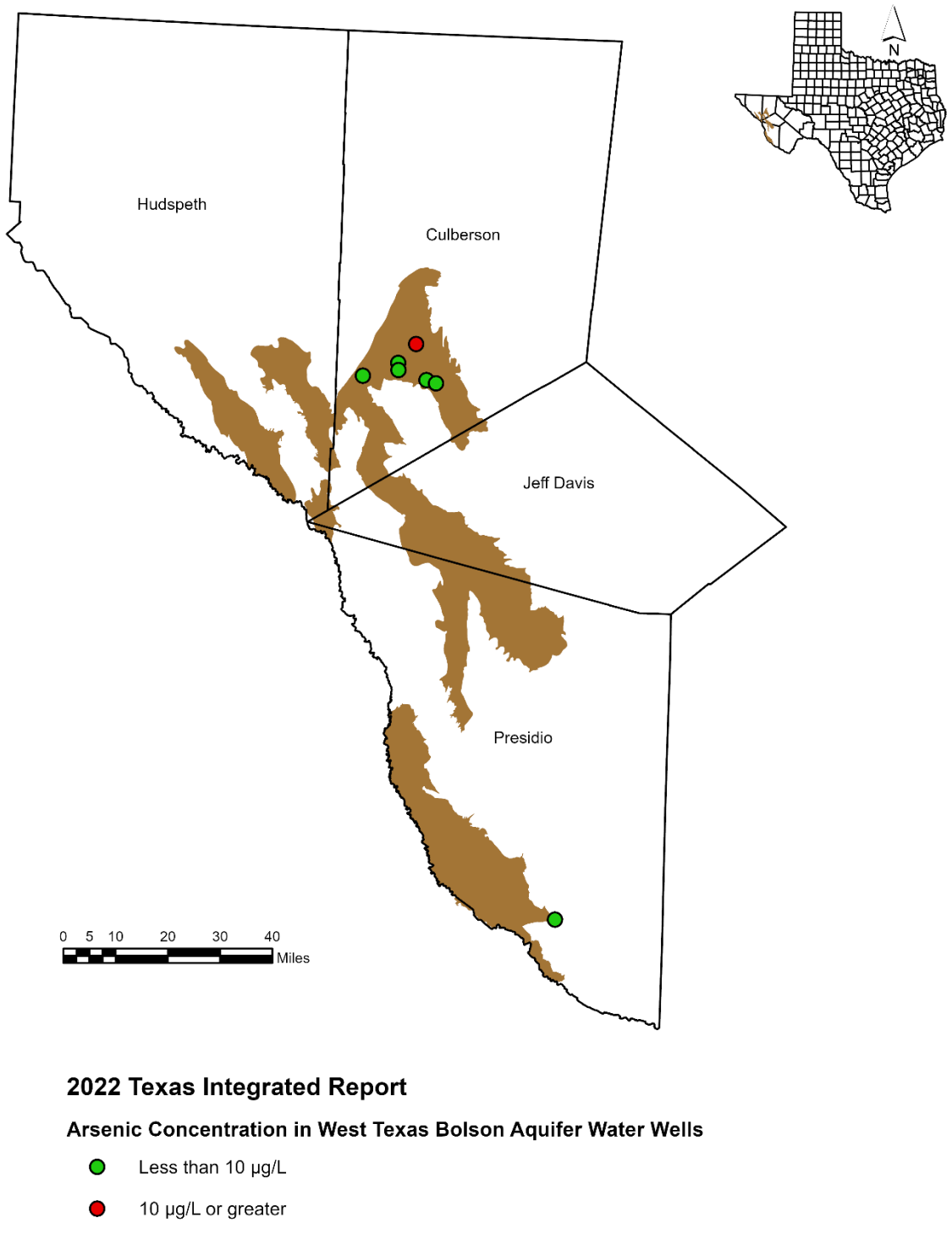


Figure 40. Distribution of Nitrate in the West Texas Bolsons Aquifer

Regulatory Monitoring and Groundwater Contamination

Groundwater monitoring programs of the participating agencies or entities are typically in one of the following three categories:

- Regulatory compliance monitoring required or conducted by an agency to protect groundwater quality from contamination
- Monitoring conducted by agencies or entities to assess ambient or existing groundwater quality conditions and track changes in water quality over time
- Research activities related to groundwater resources and groundwater conservation

Each regulatory agency that requires or conducts groundwater monitoring to ensure compliance with guidelines and regulations to protect groundwater from discharges of contaminants has its own monitoring program requirements and procedures. Criteria used to assess the need for groundwater monitoring vary among the regulatory entities. Major sources of documented or potential groundwater contamination are tabulated in Table 36 below.

In 2020, more than 45,000 wells, including nearly 14,000 public drinking water wells, were utilized for groundwater monitoring purposes in the state.[30] Most of those wells are under TCEQ's jurisdiction, and the remainder are under the jurisdiction of the RRC.

TWDB and the GCD members of TAGD monitor groundwater quality to assess ambient groundwater conditions and to track changes in water quality over time. However, the ambient groundwater monitoring network has historic limitations for the parameters that have been analyzed. For example, very few historical analyses exist for constituents typically attributed to anthropogenic (that is, human-influenced) sources. In addition, data for constituents such as volatile and synthetic organic compounds and certain heavy metals are somewhat limited.

Ambient monitoring has not traditionally targeted pesticides. Drinking water analyses conducted under the SDWA include some pesticides in their suite of chemicals; however, the SDWA targets "finished" water rather than ambient groundwater. Analyses conducted under the USGS National Water Quality Assessment program also include pesticides in a wide range of constituents. TCEQ, TWDB, and GCD members of TAGD have conducted a cooperative sampling program since the year 2000 for atrazine and metolachlor, in which TCEQ analyzes ambient groundwater samples that TWDB and GCDs collect.

Entities may develop monitoring programs as part of water-quality assessment studies that target specific geographic areas, specific contaminants or constituents, or specific activities. If during these studies or sampling an entity discovers groundwater contamination, it refers the case to the regulatory agency with appropriate jurisdiction.

In general, TCEQ and RRC's waste disposal programs monitor existing and permitted facilities. Groundwater monitoring requirements have been established for the following programs: petroleum storage tank (PST), industrial and hazardous waste (IHW), municipal solid waste (MSW), underground injection control (UIC), pollution cleanup, and enforcement programs.

In the municipal and industrial wastewater permitting program, initiatives have required groundwater monitoring at facilities where activities pose a higher risk to groundwater quality. Additionally, permits required for surface storage and disposal of oil and gas waste and brine

[30] https://www.tceq.texas.gov/groundwater/groundwater-planning-assessment/sfr-056-joint-groundwater-monitoring-contamination-report

retention ensure the protection of groundwater by requiring pond liners, leak detection systems, groundwater monitoring, or a combination of these methods.

The Water Supply Division (WSD) of TCEQ regulates public water supply wells. Public water systems receive sufficient monitoring to ensure that violations of drinking water standards are detected and addressed before water is distributed to consumers.

There is currently no state program that requires monitoring of domestic wells, although some GCDs do have programs that routinely monitor private water wells for ambient conditions or suspected contamination. In addition, TWDB's Groundwater Monitoring program includes many types of wells, including domestic wells. TDLR licenses water well drillers, responds to complaints, and routinely checks compliance with TDLR rules; while AgriLife Research provides water quality outreach, continuing education programs, and other educational services.

At facilities regulated by RRC, permits required for surface storage and disposal of oil and gas waste and brine retention ensure the protection of groundwater by requiring pond liners, leak detection systems, groundwater monitoring, or a combination of these methods.

Table 36. Sources of Groundwater Contamination

Contaminant Source	Factors Considered in Selecting a Contaminant Source	Contaminants
Storage tanks (underground or above ground)	Documented from mandatory reporting; Size of population at risk; Location of the sources relative to drinking water sources; Number or size of contaminant sources	halogenated solvents, petroleum compounds
Surface impoundments	Documented from mandatory reporting; Location of the sources relative to drinking water sources; Number or size of contaminant sources, Potential from state and other findings; Geographic distribution/occurrence	inorganic compounds, organic compounds, petroleum compounds, salinity/brine, metals
Landfills	Documented from mandatory reporting; Number or size of contaminant sources.; Hydrogeologic sensitivity; Potential from state and other findings; Geographic distribution/occurrence	inorganic compounds, organic compounds, halogenated solvents, salinity/brine, metals
Septic systems	Size of population at risk; Location of the sources relative to drinking water sources; Number or size of contaminant sources; Hydrogeologic sensitivity; Potential from state and other findings; Geographic distribution/occurrence	inorganic compounds, organic compounds, nitrate
Agricultural activities	Documented from mandatory reporting; Location of the sources relative to drinking water sources; Number or size of contaminant sources. Hydrogeologic sensitivity; Potential from state and other findings; Geographic distribution/occurrence	inorganic compounds, organic compounds, nitrate
Abandoned wells	Documented from mandatory reporting; Location of the sources relative to drinking water sources; Number or size of contaminant sources; Hydrogeologic sensitivity; Potential from state and other findings; Geographic distribution/occurrence	--
Oil & gas activities	Location of the sources relative to drinking water sources; Number or size of contaminant sources; Hydrogeologic sensitivity; Potential from state and other finding; Geographic distribution/occurrence	petroleum compounds, salinity/brine
Grandfathered sites/past practices	Documented from mandatory reporting; Number or size of contaminant sources; Hydrogeologic sensitivity; Potential from state and other findings; Geographic distribution/occurrence	inorganic compounds, organic compounds, petroleum compounds, nitrate, salinity/brine, metals
Natural occurrence	Hydrogeologic sensitivity; Potential from state and other findings; Geographic distribution/occurrence; Other criteria	Nitrate, fluoride, salinity/brine, metals

Groundwater Contamination Cases in the Joint Groundwater Monitoring and Contamination Report

The *2020 Joint Report* includes 3,056 confirmed groundwater contamination cases in Texas. Of these, 2,468 are under the jurisdiction of various TCEQ programs, and 588 are under the jurisdiction of the RRC Oil and Gas Division. Table 37 summarizes the latest activity status for each of these cases and breaks down the numbers among the various programs. Note that the activity status codes are provided by the individual programs. If multiple codes were provided, this table includes the latest status. If no status codes were provided, the totals for each status may not add exactly to the overall total.

Table 37. Status of Groundwater Contamination Cases in 2020

Program	Total Number of Cases	*Number of New Cases*	Status "0"[31]	Status "1"[31]	Status "2"[31]	Status "3"[31]	Status "4"[31]	Status "5"[31]	Status "6"[31]
TCEQ Office of Waste (OOW)/Remediation Division (REM)/Corrective Action	543	*30*	1	43	90	49	75	240	45
TCEQ OOW/REM/Dry Cleaners Remediation	238	*7*	109	0	69	0	0	56	4
TCEQ OOW/REM/Petroleum Storage Tanks	1040	*190*	0	131	680	0	41	0	188
TCEQ/OOW/REM/Superfund Cleanup	83	*1*	0	1	23	8	8	43	0
TCEQ/OOW/REM/Superfund Site Discovery & Assessment program (SSDAP); and Preliminary Assessment & Site Inspection (PASI)	6	*0*	0	0	4	0	0	0	2
TCEQ/OOW/REM/Brownfields Site Assessment	2	*0*	0	0	0	0	0	2	0
TCEQ OOW/REM/Voluntary Cleanup	412	*40*	3	63	88	42	35	94	87
TCEQ OOW/REM/Innocent Landowner	61	*23*	47	0	0	0	0	0	14
TCEQ OOW/Waste Permits Division (WPD)/Industrial & Hazardous Waste	1	*0*	0	0	0	1	0	0	0
TCEQ OOW/WPD/Municipal Solid Waste	52	*3*	0	0	35	1	0	15	1
TCEQ OOW/Radioactive Materials Division	4	*0*	0	0	1	0	0	0	0
TCEQ Office of Compliance & Enforcement (OCE)/Enforcement Division	2	*0*	0	0	0	1	0	0	0
TCEQ OCE/Regional Offices	0	*0*	0	0	0	0	0	0	0
TCEQ Office of Water (OW)/Water Availability Division/Groundwater Planning & Assessment	0	*0*	0	0	0	0	0	0	0
TCEQ OW/Water Supply Division/Public Drinking Water	7	*0*	0	0	0	0	0	0	7
TCEQ OW/Water Quality Division	17	*0*	1	0	6	2	1	7	0
Railroad Commission (RRC) of Texas - Oil & Gas Division	588	*22*	0	10	39	83	254	167	35
TOTAL:	**3056**	***318***	161	248	1037	187	414	622	4

Table 38. Summary of Groundwater Contamination Sites on Aquifer Outcrops in 2020

[31] "0"-No Activity; "1"-Confirmed Contamination; "2"-Ongoing Investigation; "3"-Corrective Action Planning; "4"-Corrective Action Implementation; "5"-Monitoring Action; "6"-Activity Completed.

Source Type[32]	Number of Sites on Outcrops	ASC 1[33]	ASC 2[33]	ASC 3[33]	ASC 4[33]	ASC 5[33]	ASC 6[33]	Types of Contaminants[34]
NPL: TCEQ Superfund	71	1	20	5	6	38	1	VOCs (including PCE, TCE, DCE, cis 1,2-DCE, 1,2-DCA), TPH, metals, hexavalent chromium, benzene, PCP, chlorobenzene, dioxins, vinyl chloride, methylene chloride
CERCLIS/Non-NPL: TCEQ VCP, VCIO, DCRP, PASI, SSDAP, WQAS, and PWS	556	29	95	38	50	130	78	chlorinated solvents, VOCs (including PCE, TCE, DCE), nitrate, pesticides, chloride, metals, PFAS, BTEX, benzene, TPH, MTBE, PAH, PCB, PFAS, acenaphthene, phenanthrene
US DOD/DOE	-	-	-	-	-	-	-	
LUST: TCEQ PST	907	92	587	-	45	-	183	gasoline, diesel, waste oil, jet fuel
RCRA Corrective Action: TCEQ CA	428	19	62	35	32	176	45	BTEX, VOCs, metals, chlorinated solvents, TPH, PAH, PFAS, pesticides, MTBE, SVOCs, herbicides
UIC: TCEQ RMD sites	4	-	1	-	-	-	-	uranium, radium, gross alpha, tritium, metals
State Sites: TCEQ MSW and IHW permitting; may be combined with NPL and RCRA sites	31	-	17	1	-	12	1	Metals, VOCs (including PCE, TCE, chloroform), vinyl chloride, benzene
Nonpoint Source: TCEQ GPAT	-	-	-	-	-	-	-	
Oil and Gas: RRC	554	6	39	87	251	155	18	BTEX, chloride, TPH, benzene, SVOCs, metals, TDS, natural gas, PSH
Totals	**2,551**	**147**	**821**	**166**	**384**	**511**	**326**	

[32] NPL - "National Priority List;" CERCLIS - "Comprehensive Environmental Response, Compensation, and Liability Information System;" US DOD/DOE - "United States Department of Defense/Department of Energy;" LUST - Leaking Underground Storage Tanks; RCRA - "Resource Conservation and Recovery Act;" MSW - Municipal Solid Waste; IHW - Industrial or Hazardous Waste; GPAT - Groundwater Planning and Assessment team

[33] ASC means "activity status code;" ASC 0-No Activity; 1-Confirmed Contamination; 2-Ongoing Investigation; 3-Corrective Action Planning; 4-Corrective Action Implementation; 5-Monitoring Action; 6-Activity Completed. If multiple status codes were provided, the latest ASC is listed

[34] VOCs - volatile organic compounds; BTEX - benzene, toluene, ethylbenzene, and xylenes; TPH - total petroleum hydrocarbons, PAH - polycyclic aromatic hydrocarbons, PSH - phase separated hydrocarbons, PFAS - polyfluoroalkyl substances, MTBE - methyl tertiary butyl ether, TDS - total dissolved solids, PCP - pentachlorophenol

Figure 41. Map of Major Aquifer Outcrop Areas with Confirmed Groundwater Contamination in 2020

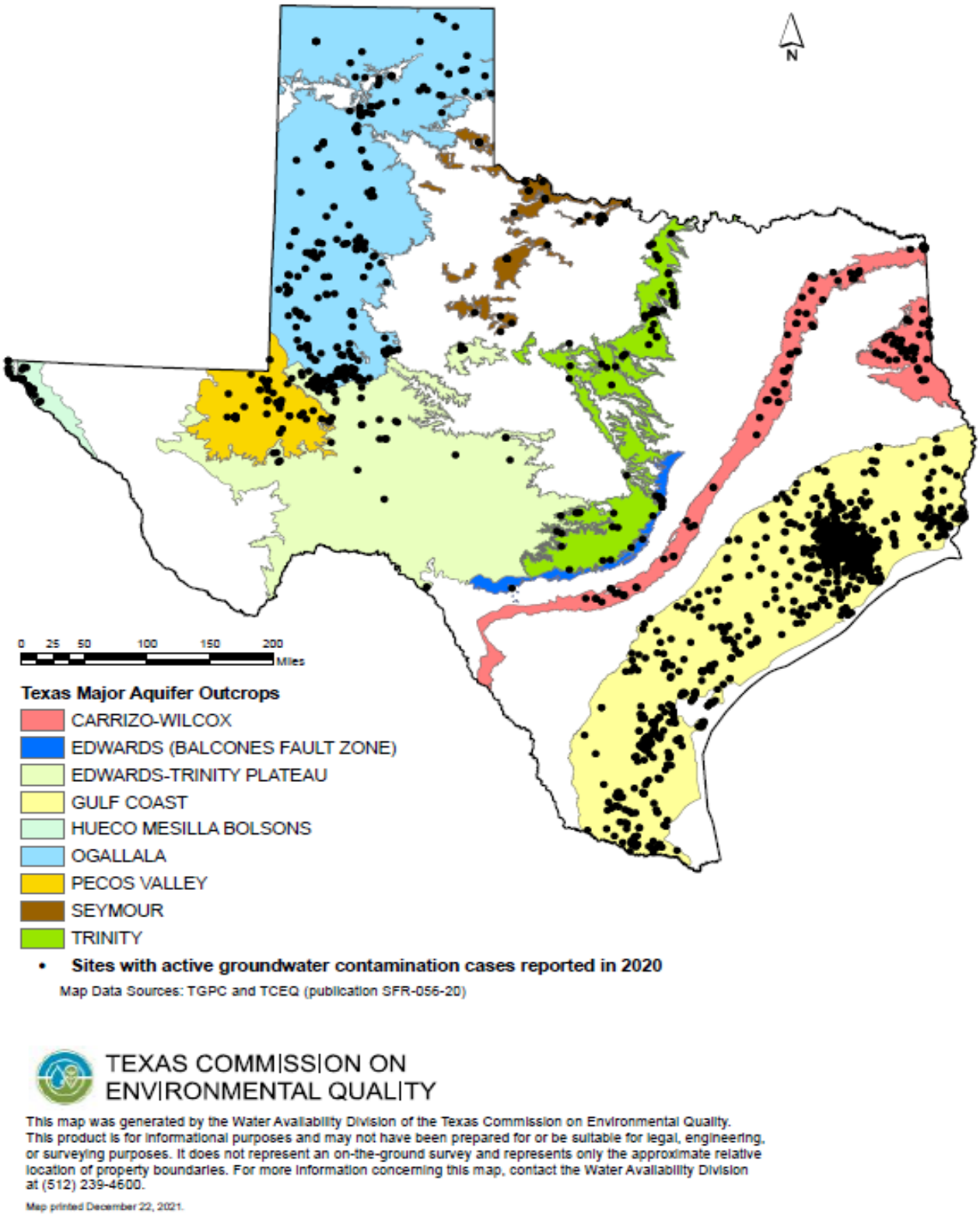
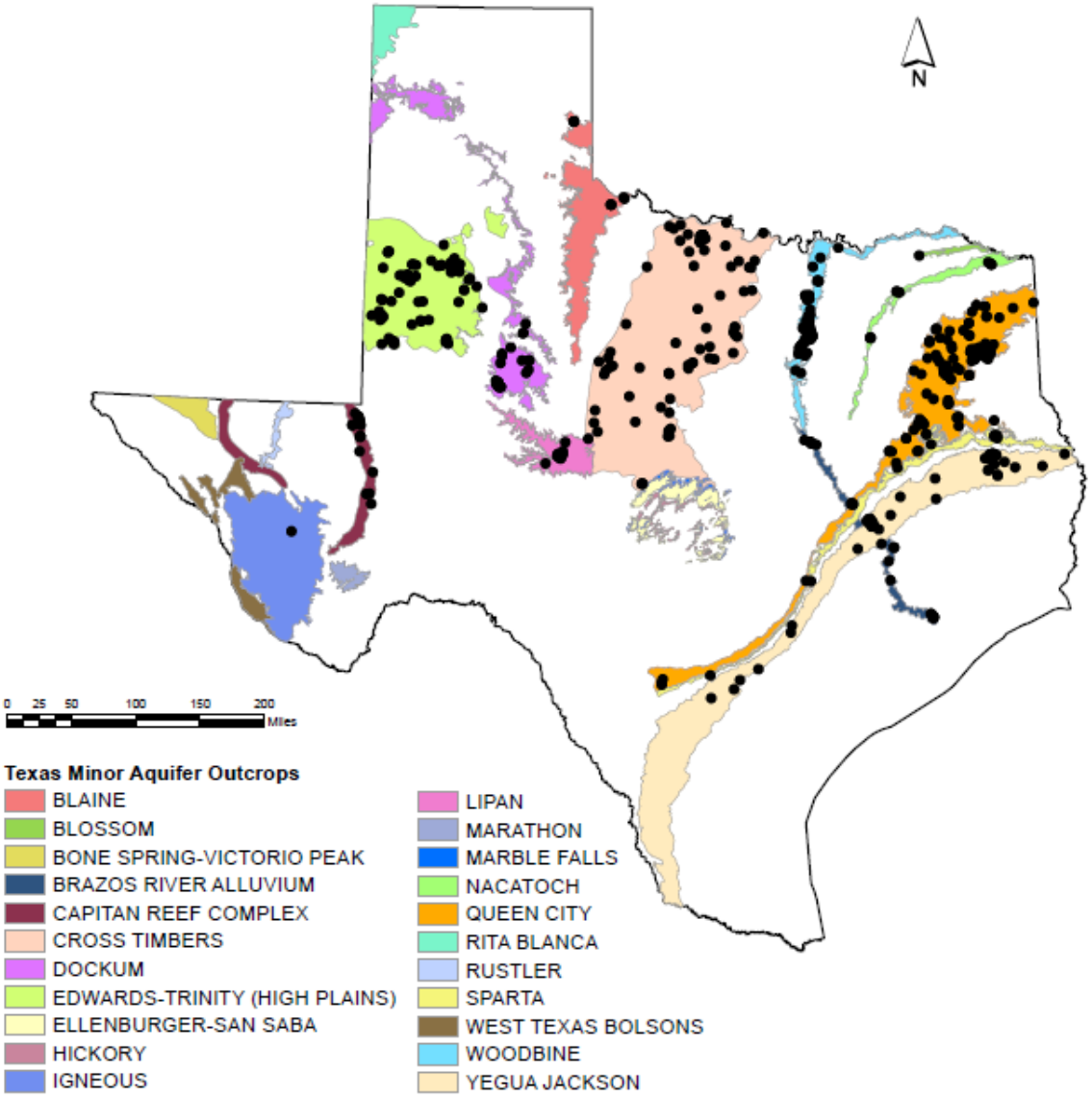


Figure 42. Map of Minor Aquifer Outcrop Areas with Confirmed Groundwater Contamination in 2020



Tables 39 through 62 – Status of Groundwater Contamination Sites at Aquifer Outcrops in 2020

The following tables list the status of groundwater contamination cases that are located over an aquifer outcrop area.

For each of the following tables, the following footnotes and definitions apply:

- NPL means “National Priority List;” CERCLIS is “Comprehensive Environmental Response, Compensation, and Liability Information System;” US DOD/DOE means “United States Department of Defense/Department of Energy;” LUST is Leaking Underground Storage Tanks.
- The following abbreviations related to programs within the TCEQ: LPST means Leaking Petroleum Storage Tank; RCRA means “Resource Conservation and Recovery Act;” MSW is Municipal Solid Waste; IHW means Industrial or Hazardous Waste; PST Program means Petroleum Storage Tank Program, RMD means Radioactive Materials Division, UIC means Underground Injection Control, and GPAT is Groundwater Planning and Assessment program.
- Contaminants may include the following: VOCs - volatile organic compounds; BTEX -- benzene, toluene, ethylbenzene, and xylenes; PSH - phase-separated hydrocarbons; TPH - total petroleum hydrocarbons; PAH - polycyclic aromatic hydrocarbons; PFAS – polyfluoroalkyl substances; PCE - tetrachloroethylene; TCE – trichloroethylene; DCE - dichloroethylene
- These state sites may be combined with NPL and RCRA sites.
- A blank cell means there were zero cases for that category

Table 39. Blaine Aquifer Outcrop – Status of Sites with Confirmed Groundwater Contamination

Source Type	Number of Groundwater Contamination Sites	Status "1"	Status "2"	Status "3"	Status "4"	Status "5"	Status "6"	Examples of Contaminants
NPL: TCEQ Superfund								
CERCLIS/Non-NPL: TCEQ VCP, VCIO, DCRP, PASI, SSDAP, WQAS, and PWS programs								
US DOD/DOE								
LUST: TCEQ PST	6		6					Gasoline, waste oil, diesel
RCRA Corrective Action: TCEQ CA program								
UIC: TCEQ RMD sites								
State Sites: TCEQ MSW and IHW permitting; may be combined with NPL and RCRA sites								
Nonpoint Source: TCEQ GPAT								
Oil and Gas: RRC	2				1	1		TPH, BTEX, PSH
Totals:	**8**		6		1	1		

Table 40. Blossom Aquifer Outcrop - Status of Sites with Confirmed Groundwater Contamination

Source Type	Number of Groundwater Contamination Sites	Status "1"	Status "2"	Status "3"	Status "4"	Status "5"	Status "6"	Examples of Contaminants
NPL: TCEQ Superfund								
CERCLIS/Non-NPL: TCEQ VCP, VCIO, DCRP, PASI, SSDAP, WQAS, and PWS programs								
US DOD/DOE								
LUST: TCEQ PST								
RCRA Corrective Action: TCEQ CA program	1		1					other
UIC: TCEQ RMD sites								
State Sites: TCEQ MSW and IHW permitting; may be combined with NPL and RCRA sites								
Nonpoint Source: TCEQ GPAT								
Oil and Gas: RRC								
Totals:	**1**		1					

Table 41. Brazos River Alluvium Aquifer Outcrop - Status of Sites with Confirmed Groundwater Contamination

Source Type	Number of Groundwater Contamination Sites	Status "1"	Status "2"	Status "3"	Status "4"	Status "5"	Status "6"	Examples of Contaminants
NPL: TCEQ Superfund	1					1		VOCs, TCE, DCE, PCB, arsenic, benzene, BTEX
CERCLIS/Non-NPL: TCEQ VCP, VCIO, DCRP, PASI, SSDAP, WQAS, and PWS programs	2		1					chlorinated solvents
US DOD/DOE								
LUST: TCEQ PST	3	1	2					gasoline, waste oil, diesel
RCRA Corrective Action: TCEQ CA program	9		1	2	1	2	3	metals, VOCs, BTEX, TPH, chlorinated solvents
UIC: TCEQ RMD sites								
State Sites: TCEQ MSW and IHW permitting; may be combined with NPL and RCRA sites								
Nonpoint Source: TCEQ GPAT								
Oil and Gas: RRC	9		1	2	1	2	3	TPH, chloride, BTEX, PSH, SVOCs, barium, arsenic
Totals:	**24**	1	5	4	2	5	6	

Table 42. Capitan Reef Complex Outcrop – Status of Sites with Confirmed Groundwater Contamination

Source Type	Number of Groundwater Contamination Sites	Status "1"	Status "2"	Status "3"	Status "4"	Status "5"	Status "6"	Examples of Contaminants
NPL: TCEQ Superfund	1		1					VOCs
CERCLIS/Non-NPL: TCEQ VCP, VCIO, DCRP, PASI, SSDAP, WQAS, and PWS programs	2						2	benzene
US DOD/DOE								
LUST: TCEQ PST	3	1	1		1			gasoline, diesel
RCRA Corrective Action: TCEQ CA program								
UIC: TCEQ RMD sites								
State Sites: TCEQ MSW and IHW permitting; may be combined with NPL and RCRA sites								

Source Type	Number of Groundwater Contamination Sites	Status "1"	Status "2"	Status "3"	Status "4"	Status "5"	Status "6"	Examples of Contaminants
Nonpoint Source: TCEQ GPAT								
Oil and Gas: RRC	10	1			6	2	1	TPH, BTEX, PSH, natural gas, chloride
Totals:	**16**	2	2		7	2	3	

Table 43. Carrizo–Wilcox Aquifer Outcrop - Status of Sites with Confirmed Groundwater Contamination (2020)

Source Type	Number of Groundwater Contamination Sites	Status "1"	Status "2"	Status "3"	Status "4"	Status "5"	Status "6"	Examples of Contaminants
NPL: TCEQ Superfund	5		1			4		VOCs, metals, perchlorate, arsenic, chromium, PAH, benzene, pentachlorophenol
CERCLIS/Non-NPL: TCEQ VCP, VCIO, DCRP, PASI, SSDAP, WQAS, and PWS programs	8		4			2		metals, chlorinated solvents, PAH, BTEX
US DOD/DOE								
LUST: TCEQ PST	45	5	28		4		8	gasoline, diesel, unknown
RCRA Corrective Action: TCEQ CA program	24	2	1	1	4	15	1	chlorinated solvents, petroleum (BTEX), TPH, SVOCs, PAHs, metals, other
UIC: TCEQ RMD sites								
State Sites: TCEQ MSW and IHW permitting; may be combined with NPL and RCRA sites	1		1					VOCs, metals
Nonpoint Source: TCEQ GPAT								
Oil and Gas: RRC	36	1	3	6	15	8	3	TPH, BTEX, PSH, chloride, NORM, natural gas, metals
Totals:	**119**	8	38	7	23	29	12	

Table 44. Cross Timbers Aquifer Outcrop - Status of Sites with Confirmed Groundwater Contamination

Source Type	Number of Groundwater Contamination Sites	Status "1"	Status "2"	Status "3"	Status "4"	Status "5"	Status "6"	Examples of Contaminants
NPL: TCEQ Superfund	2			1		1		VOCs, antimony, lead
CERCLIS/Non-NPL: TCEQ VCP, VCIO, DCRP, PASI, SSDAP, WQAS, and PWS programs	9	1		2	1	1	2	chlorinated solvents, VOCs, BTEX
US DOD/DOE								
LUST: TCEQ PST	31	2	23		1		5	gasoline, diesel, unknown
RCRA Corrective Action: TCEQ CA program	15		5	2	2	4	2	chlorinated solvents, VOCs, SVOCs, petroleum (BTEX), metals, PFAS
UIC: TCEQ RMD sites								
State Sites: TCEQ MSW and IHW permitting; may be combined with NPL and RCRA sites	1		1					VOCs
Nonpoint Source: TCEQ GPAT								
Oil and Gas: RRC	23	0	6	3	9	3	2	TPH, Chloride, BTEX, PSH, natural gas
Totals:	**81**	3	35	8	13	9	11	

Table 45. Dockum Aquifer Outcrop - Status of Sites with Confirmed Groundwater Contamination

Source Type	Number of Groundwater Contamination Sites	Status "1"	Status "2"	Status "3"	Status "4"	Status "5"	Status "6"	Examples of Contaminants
NPL: TCEQ Superfund	1					1		benzene, BTEX, PAH, BTEX, VOC, naphthalene, phenol, phenanthrene
CERCLIS/Non-NPL: TCEQ VCP, VCIO, DCRP, PASI, SSDAP, WQAS, and PWS programs								
US DOD/DOE								
LUST: TCEQ PST	1				1			unknown
RCRA Corrective Action: TCEQ CA program								
UIC: TCEQ RMD sites								

Source Type	Number of Groundwater Contamination Sites	Status "1"	Status "2"	Status "3"	Status "4"	Status "5"	Status "6"	Examples of Contaminants
State Sites: TCEQ MSW and IHW permitting; may be combined with NPL and RCRA sites								
Nonpoint Source: TCEQ GPAT								
Oil and Gas: RRC	21		2	3	11	5	1	chloride, benzene, BTEX, TPH, PSH, PAH
Totals:	**23**		2	3	12	6	1	

Table 46. Edwards (Balcones Fault Zone) Aquifer Outcrop - Status of Sites with Confirmed Groundwater Contamination

Source Type	Number of Groundwater Contamination Sites	Status "1"	Status "2"	Status "3"	Status "4"	Status "5"	Status "6"	Examples of Contaminants
NPL: TCEQ Superfund								
CERCLIS/Non-NPL: TCEQ VCP, VCIO, DCRP, PASI, SSDAP, WQAS, and PWS programs	7		1			4	1	chlorinated solvents, VOCs, metals, TPH, BTEX
US DOD/DOE								
LUST: TCEQ PST	1						1	gasoline
RCRA Corrective Action: TCEQ CA program	1					1		chlorinated solvents
UIC: TCEQ RMD sites								
State Sites: TCEQ MSW and IHW permitting; may be combined with NPL and RCRA sites								
Nonpoint Source: TCEQ GPAT								
Oil and Gas: RRC								TPH, BTEX, PSH
Totals:	**9**		1			5	2	

Table 47. Edwards–Trinity (High Plains) Aquifer Outcrop - Status of Sites with Confirmed Groundwater Contamination

Source Type	Number of Groundwater Contamination Sites	Status "1"	Status "2"	Status "3"	Status "4"	Status "5"	Status "6"	Examples of Contaminants
NPL: TCEQ Superfund	2		1			1		VOCs, metals

Source Type	Number of Groundwater Contamination Sites	Status "1"	Status "2"	Status "3"	Status "4"	Status "5"	Status "6"	Examples of Contaminants
CERCLIS/Non-NPL: TCEQ VCP, VCIO, DCRP, PASI, SSDAP, WQAS, and PWS programs	9	2	1		1	3		chlorinated solvents, petroleum (BTEX), VOCs, nitrate
US DOD/DOE								
LUST: TCEQ PST	33	1	20		10		2	gasoline, diesel, waste oil, unknown
RCRA Corrective Action: TCEQ CA program	8		3		1	4		VOCs, SVOCs, BTEX, metals, TPH, PAH, PFAS, pesticides
UIC: TCEQ RMD sites								
State Sites: TCEQ MSW and IHW permitting; may be combined with NPL and RCRA sites	1					1		VOCs, metals
Nonpoint Source: TCEQ GPAT								
Oil and Gas: RRC	27	2	5	3	9	6	2	TPH, chlorides, benzene, BTEX, PSH, natural gas, TDS
Totals:	**80**	5	30	3	21	15	4	

Table 48. Edwards–Trinity (Plateau) Aquifer Outcrop - Status of Sites with Confirmed Groundwater Contamination

Source Type	Number of Groundwater Contamination Sites	Status "1"	Status "2"	Status "3"	Status "4"	Status "5"	Status "6"	Examples of Contaminants
NPL: TCEQ Superfund	3		1		1	1	0	PCE, TCE, DCE, chromium, hexavalent chromium, 1,2 DCA, benzene, 1,2,3-TCP, manganese
CERCLIS/Non-NPL: TCEQ VCP, VCIO, DCRP, PASI, SSDAP, WQAS, and PWS programs	1		1					chromium, hexavalent chromium
US DOD/DOE								
LUST: TCEQ PST	11		10		1			gasoline, diesel, unknown
RCRA Corrective Action: TCEQ CA program	7		1	1	2	3		TPH, BTEX, metals, chlorinated solvents, VOCs
UIC: TCEQ RMD sites								

Source Type	Number of Groundwater Contamination Sites	Status "1"	Status "2"	Status "3"	Status "4"	Status "5"	Status "6"	Examples of Contaminants
State Sites: TCEQ MSW and IHW permitting; may be combined with NPL and RCRA sites	1		1					metals, VOCs
Nonpoint Source: TCEQ GPAT								
Oil and Gas: RRC	26		1	1	16	5	2	TPH, BTEX, chloride, PSH, metals, VOCs, SVOCs, amine
Totals:	**49**		15	2	20	9	2	

Table 49. Gulf Coast Aquifer Outcrop – Status of Sites with Confirmed Groundwater Contamination

Source Type	Number of Groundwater Contamination Sites	Status "1"	Status "2"	Status "3"	Status "4"	Status "5"	Status "6"	Examples of Contaminants
NPL: TCEQ Superfund	36		2	4	4	26		benzene, VOCs (including PCE, TCE, DCE), metals, chlorobenzene, methylene chloride, arsenic, benzene, BTEX, MTBE, pesticides, other
CERCLIS/Non-NPL: TCEQ VCP, VCIO, DCRP, PASI, SSDAP, WQAS, and PWS programs	329	25	76	20	12	85	37	chlorinated solvents, metals, VOCs, PCBs, PAH, BTEX, PFAS, pesticides, herbicides, other
US DOD/DOE								
LUST: TCEQ PST	390	48	259		7		76	gasoline, diesel, waste oil, unknown
RCRA Corrective Action: TCEQ CA program	228	15	41	27	32	96	16	metals, VOCs, TPH, BTEX, chlorinated solvents, PFAS, PAH, pesticides, other
UIC: TCEQ RMD sites	3		1					uranium, selenium, molybdenum, radium, tritium (H-3), gross alpha
State Sites: TCEQ MSW and IHW permitting; may be combined with NPL and RCRA sites	12		5	2		5		metals, VOCs (including TCE, DCE, DCA, vinyl chloride)
Nonpoint Source: TCEQ GPAT								

Source Type	Number of Groundwater Contamination Sites	Status "1"	Status "2"	Status "3"	Status "4"	Status "5"	Status "6"	Examples of Contaminants
Oil and Gas: RRC	278	4	14	51	101	94	14	TPH, benzene, BTEX, chloride, PSH, metals, PSH, VOCs
Totals:	**1276**	92	398	104	156	306	143	

Table 50. Hickory Aquifer Outcrop - Status of Sites with Confirmed Groundwater Contamination

Source Type	Number of Groundwater Contamination Sites	Status "1"	Status "2"	Status "3"	Status "4"	Status "5"	Status "6"	Examples of Contaminants
NPL: TCEQ Superfund								
CERCLIS/Non-NPL: TCEQ VCP, VCIO, DCRP, PASI, SSDAP, WQAS, and PWS programs								
US DOD/DOE								
LUST: TCEQ PST								
RCRA Corrective Action: TCEQ CA program								
UIC: TCEQ RMD sites								
State Sites: TCEQ MSW and IHW permitting; may be combined with NPL and RCRA sites								
Nonpoint Source: TCEQ GPAT								
Oil and Gas: RRC								
Totals:	**0**							

Table 51. Hueco–Mesilla Bolsons Aquifer Outcrop - Status of Sites with Confirmed Groundwater Contamination

Source Type	Number of Groundwater Contamination Sites	Status "1"	Status "2"	Status "3"	Status "4"	Status "5"	Status "6"	Examples of Contaminants
NPL: TCEQ Superfund								
CERCLIS/Non-NPL: TCEQ VCP, VCIO, DCRP, PASI, SSDAP, WQAS, and PWS programs	5	1	2		1	1		chlorinated solvents, BTEX, metals, VOCs, TPH
US DOD/DOE								
LUST: TCEQ PST	18	4	11		2		1	gasoline, diesel, unknown

Source Type	Number of Groundwater Contamination Sites	Status "1"	Status "2"	Status "3"	Status "4"	Status "5"	Status "6"	Examples of Contaminants
RCRA Corrective Action: TCEQ CA program	7		1		1	5		VOCs, BTEX, TPH, metals
UIC: TCEQ RMD sites								
State Sites: TCEQ MSW and IHW permitting; may be combined with NPL and RCRA sites								
Nonpoint Source: TCEQ GPAT								
Oil and Gas: RRC								
Totals:	30	5	14		4	6	1	

Table 52. Igneous Aquifer Outcrop – Status of Sites with Confirmed Groundwater Contamination

Source Type	Number of Groundwater Contamination Sites	Status "1"	Status "2"	Status "3"	Status "4"	Status "5"	Status "6"	Examples of Contaminants
NPL: TCEQ Superfund								
CERCLIS/Non-NPL: TCEQ VCP, VCIO, DCRP, PASI, SSDAP, WQAS, and PWS programs	1		1					Nitrate
US DOD/DOE								
LUST: TCEQ PST								
RCRA Corrective Action: TCEQ CA program								
UIC: TCEQ RMD sites								
State Sites: TCEQ MSW and IHW permitting; may be combined with NPL and RCRA sites								
Nonpoint Source: TCEQ GPAT								
Oil and Gas: RRC								
Totals:	1		1					

Table 53. Lipan Aquifer Outcrop – Status of Sites with Confirmed Groundwater Contamination

Source Type	Number of Groundwater Contamination Sites	Status "1"	Status "2"	Status "3"	Status "4"	Status "5"	Status "6"	Examples of Contaminants
NPL: TCEQ Superfund								

Source Type	Number of Groundwater Contamination Sites	Status "1"	Status "2"	Status "3"	Status "4"	Status "5"	Status "6"	Examples of Contaminants
CERCLIS/Non-NPL: TCEQ VCP, VCIO, DCRP, PASI, SSDAP, WQAS, and PWS programs	2					2		VOCs, chlorinated solvents, other
US DOD/DOE								
LUST: TCEQ PST	6		5		1			gasoline, diesel, other
RCRA Corrective Action: TCEQ CA program	3		1			2		chlorinated solvents, metals, VOCs, SVOCs
UIC: TCEQ RMD sites								
State Sites: TCEQ MSW and IHW permitting; may be combined with NPL and RCRA sites	1					1		metals, VOCs
Nonpoint Source: TCEQ GPAT								
Oil and Gas: RRC	1				1			chloride
Totals:	**13**		6		2	5		

Table 54. Nacatoch Aquifer Outcrop – Status of Sites with Confirmed Groundwater Contamination

Source Type	Number of Groundwater Contamination Sites	Status "1"	Status "2"	Status "3"	Status "4"	Status "5"	Status "6"	Examples of Contaminants
NPL: TCEQ Superfund	1	1						chromium, hexavalent chromium, TCE
CERCLIS/Non-NPL: TCEQ VCP, VCIO, DCRP, PASI, SSDAP, WQAS, and PWS programs	1						1	VOCs
US DOD/DOE								
LUST: TCEQ PST	7	3	3				1	gasoline, diesel, unknown
RCRA Corrective Action: TCEQ CA program	1					1		VOCs, chlorinated solvents
UIC: TCEQ RMD sites								
State Sites: TCEQ MSW and IHW permitting; may be combined with NPL and RCRA sites								
Nonpoint Source: TCEQ GPAT								
Oil and Gas: RRC								TPH, BTEX, PSH
Totals:	**10**	4	3			1	2	

Table 55. Ogallala Aquifer Outcrop – Status of Sites with Confirmed Groundwater Contamination

Source Type	Number of Groundwater Contamination Sites	Status "1"	Status "2"	Status "3"	Status "4"	Status "5"	Status "6"	Examples of Contaminants
NPL: TCEQ Superfund	12		7	1	1	3		PCE, hexavalent chromium, VOCs, metals, benzene
CERCLIS/Non-NPL: TCEQ VCP, VCIO, DCRP, PASI, SSDAP, WQAS, and PWS programs	33	2	7	1	1	14	1	chlorinated solvents, PCE, VOCs, SVOCs, pesticides, nitrate, chloride, metals, TPH, BTEX, other
US DOD/DOE								
LUST: TCEQ PST	92	1	70		17		4	gasoline, diesel, jet fuel, unknown
RCRA Corrective Action: TCEQ CA program	43	3	7	3	9	19	2	TPH, BTEX, VOCs, SVOCs, chlorinated solvents, metals, PAH, pesticides, PFAS, other
UIC: TCEQ RMD sites								
State Sites: TCEQ MSW and IHW permitting; may be combined with NPL and RCRA sites	5		2			1		VOCs
Nonpoint Source: TCEQ GPAT								
Oil and Gas: RRC	88	2	6	7	45	24	4	TPH, BTEX, chloride, PSH, benzene, VOCs, metals
Totals:	**273**	8	99	12	73	61	11	

Table 56. Pecos Valley Aquifer Outcrop – Status of Sites with Confirmed Groundwater Contamination

Source Type	Number of Groundwater Contamination Sites	Status "1"	Status "2"	Status "3"	Status "4"	Status "5"	Status "6"	Examples of Contaminants
NPL: TCEQ Superfund	1		1					VOCs (PCE and TCE)
CERCLIS/Non-NPL: TCEQ VCP, VCIO, DCRP, PASI, SSDAP, WQAS, and PWS programs	2						2	benzene
US DOD/DOE	0							
LUST: TCEQ PST	16	1	14		1			gasoline, diesel
RCRA Corrective Action: TCEQ CA program	2				1	1		VOCs, TPH

Source Type	Number of Groundwater Contamination Sites	Status "1"	Status "2"	Status "3"	Status "4"	Status "5"	Status "6"	Examples of Contaminants
UIC: TCEQ RMD sites								
State Sites: TCEQ MSW and IHW permitting; may be combined with NPL and RCRA sites								
Nonpoint Source: TCEQ GPAT								
Oil and Gas: RRC	27	2	2	1	13	5	4	TPH, BTEX, PSH, chloride, PAH, TDS, natural gas, glycol
Totals:	**48**	3	17	1	15	6	6	

Table 57. Queen City Aquifer Outcrop - Status of Sites with Confirmed Groundwater Contamination

Source Type	Number of Groundwater Contamination Sites	Status "1"	Status "2"	Status "3"	Status "4"	Status "5"	Status "6"	Examples of Contaminants
NPL: TCEQ Superfund	4	0	3	0	0	1	0	benzene, arsenic, mercury, cadmium, chromium, vinyl chloride, 1,2-DCE, PCP, dioxins
CERCLIS/Non-NPL: TCEQ VCP, VCIO, DCRP, PASI, SSDAP, WQAS, and PWS programs	14	1	2	3	0	3	1	chlorinated solvents, benzene, metals, BTEX, VOCs, TPH, MTBE, other
US DOD/DOE	0							
LUST: TCEQ PST	59	8	43	0	2	3	6	gasoline, diesel, jet fuel, unknown
RCRA Corrective Action: TCEQ CA program	25	1	3	1	3	13	4	chlorinated solvents, metals, BTEX, VOCs, SVOCs, TPH, PAH, other
UIC: TCEQ RMD sites	0							
State Sites: TCEQ MSW and IHW permitting; may be combined with NPL and RCRA sites	0							
Nonpoint Source: TCEQ GPAT	0							
Oil and Gas: RRC	22	1	2	1	9	9	0	TPH, chloride, BTEX, PSH, metals, benzene, TDS
Totals:	**124**	11	53	5	14	29	11	

Table 58. Seymour Aquifer Outcrop - Status of Sites with Confirmed Groundwater Contamination

Source Type	Number of Groundwater Contamination Sites	Status "1"	Status "2"	Status "3"	Status "4"	Status "5"	Status "6"	Examples of Contaminants
NPL: TCEQ Superfund								
CERCLIS/Non-NPL: TCEQ VCP, VCIO, DCRP, PASI, SSDAP, WQAS, and PWS programs	4	1		2			1	chlorinated solvents, VOCs, BTEX, TPH
US DOD/DOE								
LUST: TCEQ PST	20		13		2		5	gasoline, diesel, unknown
RCRA Corrective Action: TCEQ CA program	8		3	1	1	3		metals, chlorinated solvents, TPH, VOCs, SVOCs, BTEX, other
UIC: TCEQ RMD sites								
State Sites: TCEQ MSW and IHW permitting; may be combined with NPL and RCRA sites	1		1					VOCs (cis-1,2-dichloroethylene)
Nonpoint Source: TCEQ GPAT								
Oil and Gas: RRC	6			2	2	1	1	TPH, BTEX, PSH, chloride
Totals:	**39**	1	17	5	5	4	7	

Table 59. Sparta Aquifer Outcrop - Status of Sites with Confirmed Groundwater Contamination

Source Type	Number of Groundwater Contamination Sites	Status "1"	Status "2"	Status "3"	Status "4"	Status "5"	Status "6"	Examples of Contaminants
NPL: TCEQ Superfund	1		1					TPH, 1-methylnaphthalene, 2-methylnaphthalene, benzene, benzo(a)pyrene, dibenz(a,h)-anthracene
CERCLIS/Non-NPL: TCEQ VCP, VCIO, DCRP, PASI, SSDAP, WQAS, and PWS programs	1					1		other
US DOD/DOE								
LUST: TCEQ PST	6	1	4				1	gasoline, diesel, unknown

Source Type	Number of Groundwater Contamination Sites	Status "1"	Status "2"	Status "3"	Status "4"	Status "5"	Status "6"	Examples of Contaminants
RCRA Corrective Action: TCEQ CA program	3	1	1			1		chlorinated solvents, other
UIC: TCEQ RMD sites								
State Sites: TCEQ MSW and IHW permitting; may be combined with NPL and RCRA sites								
Nonpoint Source: TCEQ GPAT								
Oil and Gas: RRC								
Totals:	**11**	2	6			2	1	

Table 60. Trinity Aquifer Outcrop - Status of Sites with Confirmed Groundwater Contamination

Source Type	Number of Groundwater Contamination Sites	Status "1"	Status "2"	Status "3"	Status "4"	Status "5"	Status "6"	Examples of Contaminants
NPL: TCEQ Superfund	2		1		1			PCE, TCE, cis 1,2-DCE
CERCLIS/Non-NPL: TCEQ VCP, VCIO, DCRP, PASI, SSDAP, WQAS, and PWS programs	9		1	1		1	3	metals, VOCs, TPH, chlorinated solvents, MTBE, toluene, picloram
US DOD/DOE								
LUST: TCEQ PST	38	4	27		1		6	gasoline, diesel, unknown
RCRA Corrective Action: TCEQ CA program	5				1	3	1	chlorinated solvents, metals, VOCs, other
UIC: TCEQ RMD sites								
State Sites: TCEQ MSW and IHW permitting; may be combined with NPL and RCRA sites	3		2			1		VOCs, metals
Nonpoint Source: TCEQ GPAT	0							
Oil and Gas: RRC	9			1	6	2		TPH, BTEX, PSH, chlorides, benzene, metals
Totals:	**66**	4	31	2	9	7	10	

Table 61. Woodbine Aquifer Outcrop - Status of Sites with Confirmed Groundwater Contamination

Source Type	Number of Groundwater Contamination Sites	Status "1"	Status "2"	Status "3"	Status "4"	Status "5"	Status "6"	Examples of Contaminants
NPL: TCEQ Superfund								
CERCLIS/Non-NPL: TCEQ VCP, VCIO, DCRP, PASI, SSDAP, WQAS, and PWS programs	32		5	2	1	5	5	chlorinated solvents, metals, VOCs (PCE, TCE, DCE, others), MTBE, TPH, PFAS, BTEX
US DOD/DOE								
LUST: TCEQ PST	24	4	13				7	gasoline, diesel, unknown
RCRA Corrective Action: TCEQ CA program	7	1	1			5		BTEX, TPH, chlorinated solvents, metals, VOCs
UIC: TCEQ RMD sites								
State Sites: TCEQ MSW and IHW permitting; may be combined with NPL and RCRA sites	3		2			1		VOCs, metals
Nonpoint Source: TCEQ GPAT								
Oil and Gas: RRC								
Totals:	**66**	5	21	2	1	11	12	

Table 62. Yegua–Jackson Aquifer Outcrop - Status of Sites with Confirmed Groundwater Contamination

Source Type	Number of Groundwater Contamination Sites	Status "1"	Status "2"	Status "3"	Status "4"	Status "5"	Status "6"	Examples of Contaminants
NPL: TCEQ Superfund								
CERCLIS/Non-NPL: TCEQ VCP, VCIO, DCRP, PASI, SSDAP, WQAS, and PWS programs	10		1	1	3	2		chlorinated solvents, metals, VOCs, TPH, BTEX
US DOD/DOE								
LUST: TCEQ PST	26	5	16				5	gasoline, unknown
RCRA Corrective Action: TCEQ CA program	15	1	3		5	6		VOCs, BTEX, SVOCs, TPH, metals, herbicides, PAHs, pesticides, chlorinated solvents, other
UIC: TCEQ RMD sites	1							uranium, radium 226-228, gross alpha, cadmium, arsenic
State Sites: TCEQ MSW and IHW permitting; may be combined with NPL and RCRA sites	2		1			1		VOCs (1,1-DCA; cis-1,2-DCE, PCE, TCE, DCB, 1,4-DCB)

Source Type	Number of Groundwater Contamination Sites	Status "1"	Status "2"	Status "3"	Status "4"	Status "5"	Status "6"	Examples of Contaminants
Nonpoint Source: TCEQ GPAT								
Oil and Gas: RRC	3				2	1		BTEX, chloride, benzene, toluene
Totals	57	6	21	1	10	10	5	