Texas Water Development Board Statement of Interest to participate as a pilot project in the National Ground-Water Monitoring Network

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1.0 Introduction and overview

Texas has numerous aquifers that are capable of producing groundwater for household, municipal, agricultural, and industrial uses. Texas Water Development Board (TWDB) recognizes nine major aquifers—aquifers that produce large amounts of water over large areas (Figure 1-1)—and 21 minor aquifers—aquifers that produce minor amounts of water over large areas or large amounts of water over small areas (Figure 1-2). These aquifers are a critical source of water for Texas, supplying 59 percent of the 15.6 million acre-feet of water used in the state in 2003. In addition, nearly 220,000 ac-ft. of groundwater is produced from local aquifers that are not designated as major or minor. About 79 percent of groundwater produced from major and minor aquifers is used for agriculture (mostly for irrigation), with irrigators withdrawing most of this water from the Ogallala Aquifer (82 percent of all groundwater used for irrigation or 6.0 million acre-feet per year). About 36 percent of water used to meet municipal demands is from groundwater. More than 99 percent of rural households rely on groundwater for their drinking water supply.

TWDB has operated groundwater data collection programs throughout the state of Texas since the agency's inception in 1957. Sections of the Texas Water Code (TWC) mandate and allow studies and data collection of the state's groundwater resources, analysis and dissemination/publication of the data, and assistance to the state's groundwater conservation districts (TWC §16.012(a), (b), (d); §16.013; §16.015). For thirty years, during different incarnations of the agency, team leaders determined the goals of any water level and water quality monitoring programs for a variety of projects, but none were conducted from a statewide perspective. After 1988, TWDB management centralized decisions about groundwater data collection and initiated three monitoring programs that complement other local, state, and federal monitoring programs within the state. Two of these programs monitor groundwater levels and one monitors water quality. TWDB recognized that attention to systematic collection of data was essential for more accurate reporting of current conditions and to collect data allowing for determination of any changes in water levels and water quality over time.

As important as the development of systematic data collection was the creation of a centralized, relational database with the flexibility to query for all types of information in all aquifers, also supported by TWDB management in the late eighties. The TWDB groundwater database, housed on a Microsoft SQL server with a Microsoft Access interface, contains information on more than 130,000 wells and springs within the state, representing many years of collection efforts from different agencies for a variety of projects (Figure 1-3). These 130,000+ sites are considered, at most, as only one tenth of all water wells that have been drilled in Texas during the last century and nearly the first decade of the 21st. TWDB is constantly adding data to and editing data in this database, from its own data collection programs and those of other entities throughout the state. Control of the database structure, however, is not completely in the agency's own hands; TWDB must coordinate with the state's Department of Information Resources and its information technology contract with an outside vendor (IBM) before implementing any changes.

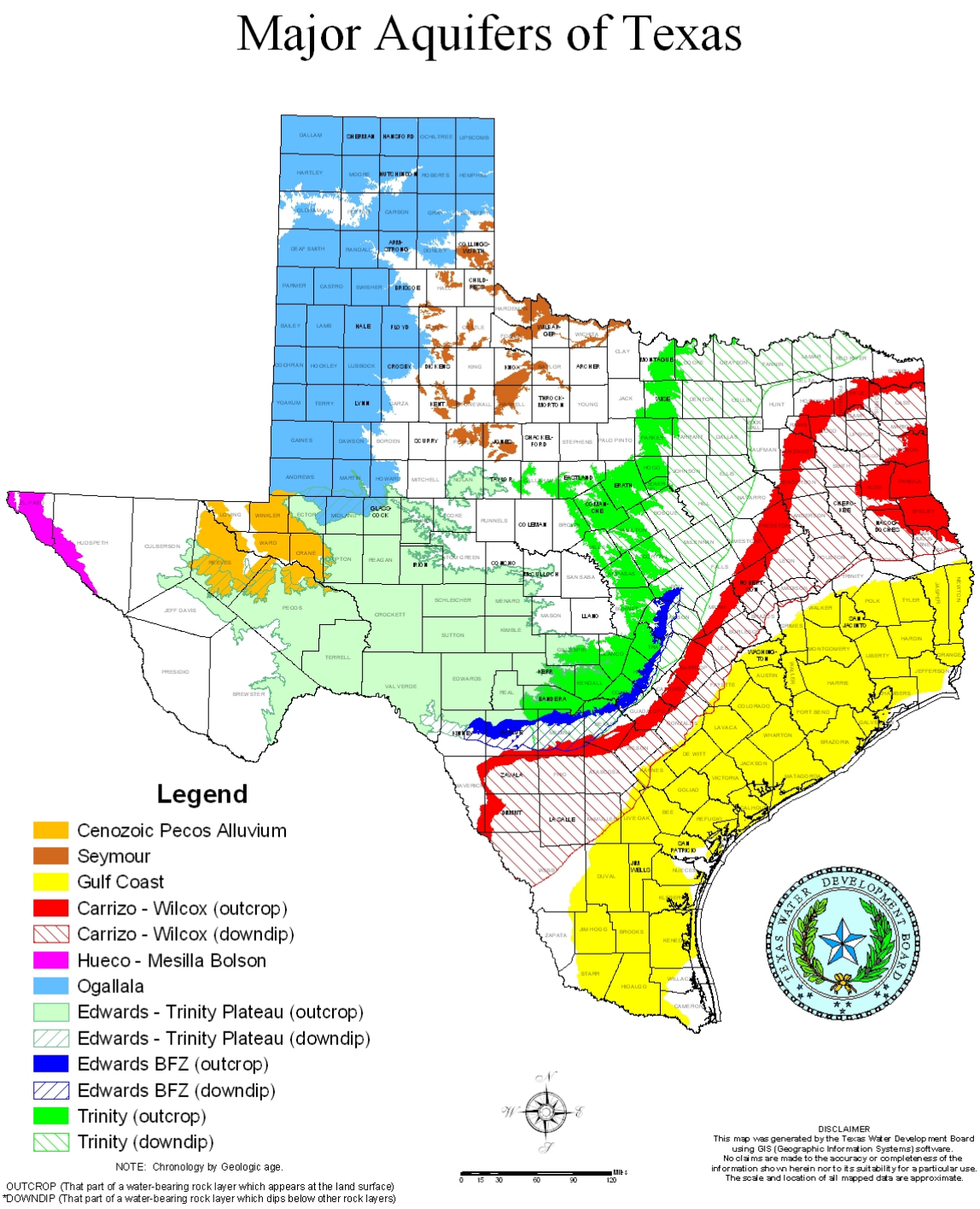

Figure 1-1. Major Aquifers of Texas.

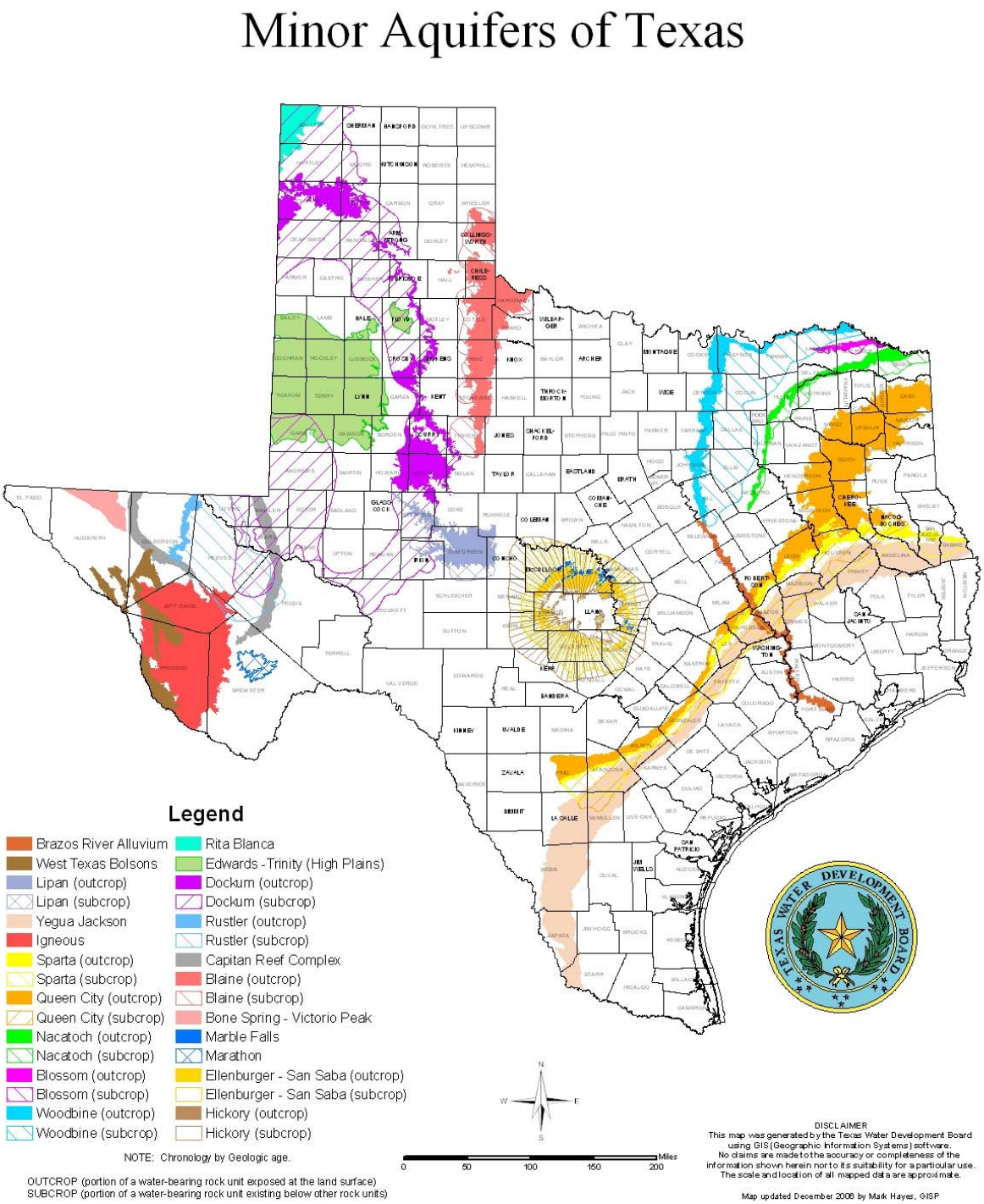

Figure 1-2. Minor Aquifers of Texas.

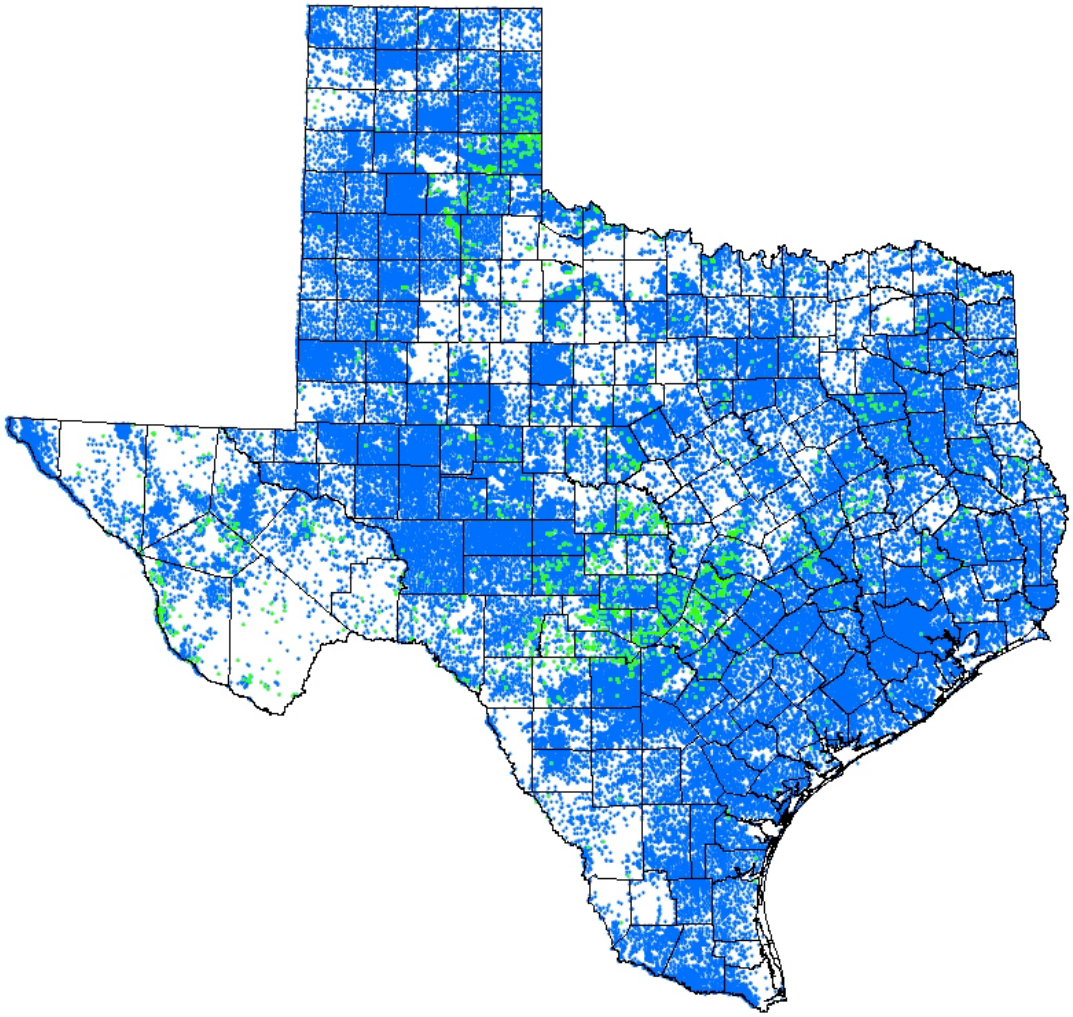

Figure 1-3. Water wells (blue) and springs (green) in the TWDB groundwater database.

2.0 Project area description

As of October 2009, nearly 8,700 wells are considered part of the current water level observation network; more than 65,000 wells have at least one or more miscellaneous measurements; and nearly 10,000 wells that used to be part of the observation well network but have since been dropped are classified as historical. Sites that would be most appropriate for inclusion in this pilot project will be chosen from the approximate 7,000 measured (from all major and minor aquifers), at least once annually, during the last two fiscal years (Figure 2-1). Similarly, although more than 55,000 sites in the TWDB groundwater database contain water quality information, only sites from among the 2,500+ most recently sampled sites during the last complete statewide cycle (Figure 2-2) would be tagged for the pilot. Wells in the recorder program operated solely by the TWDB are potential candidates (Figure 2-3).

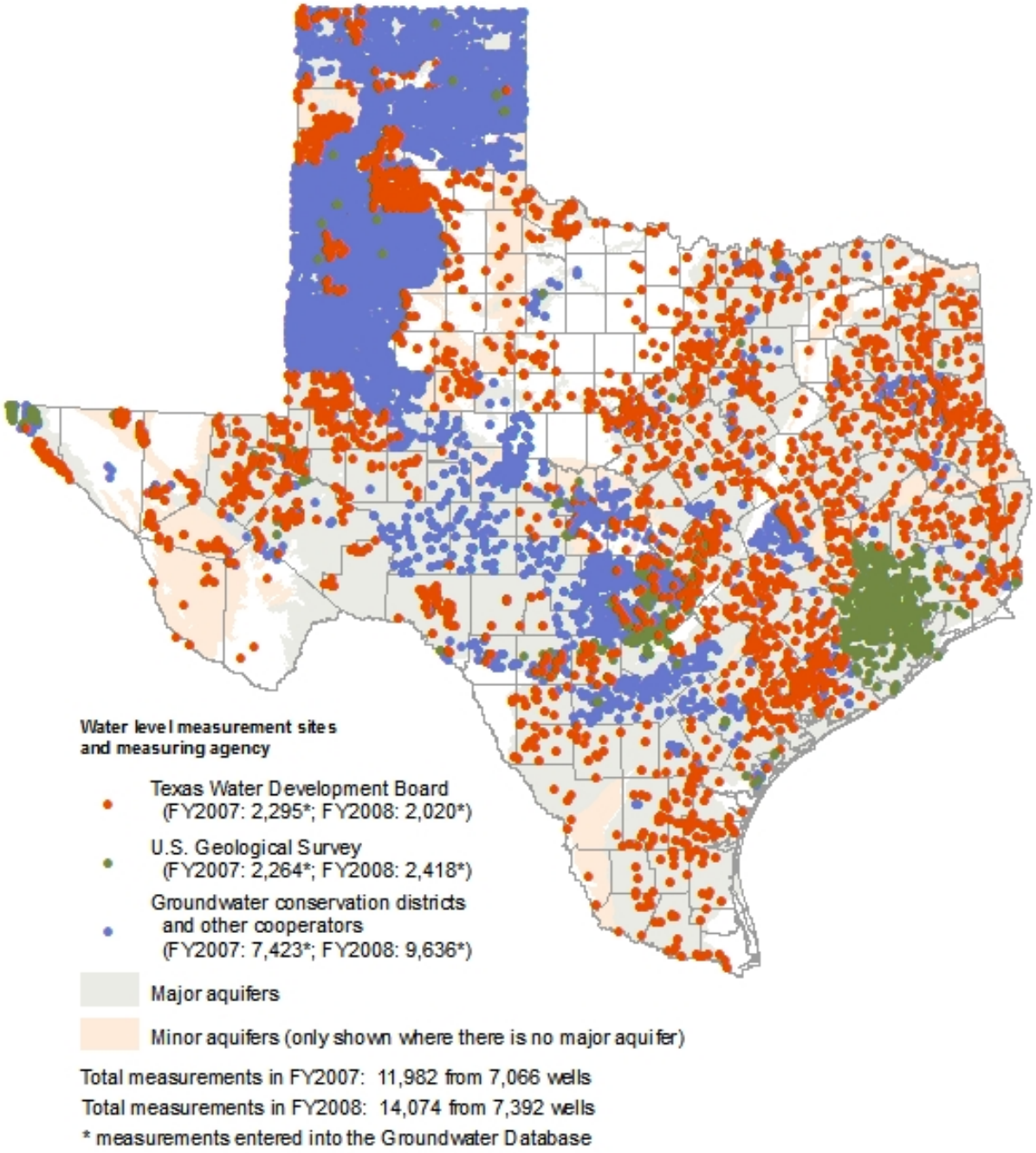

Figure 2-1. Wells measured by TWDB and cooperators in fiscal years 2007 and 2008.

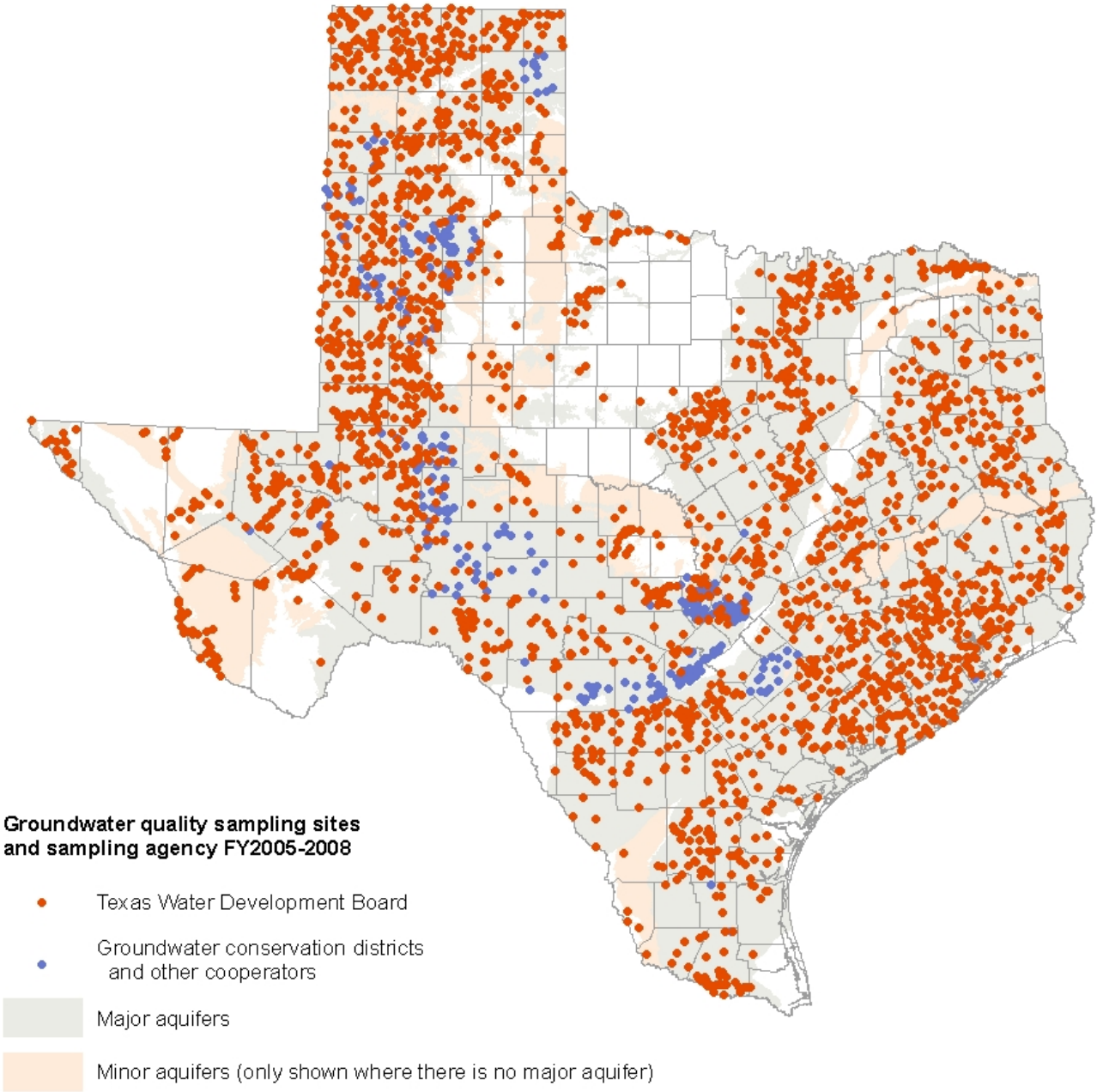

Figure 2-2. Wells and springs sites sampled by the TWDB and cooperators during fiscal years 2005 through 2008.

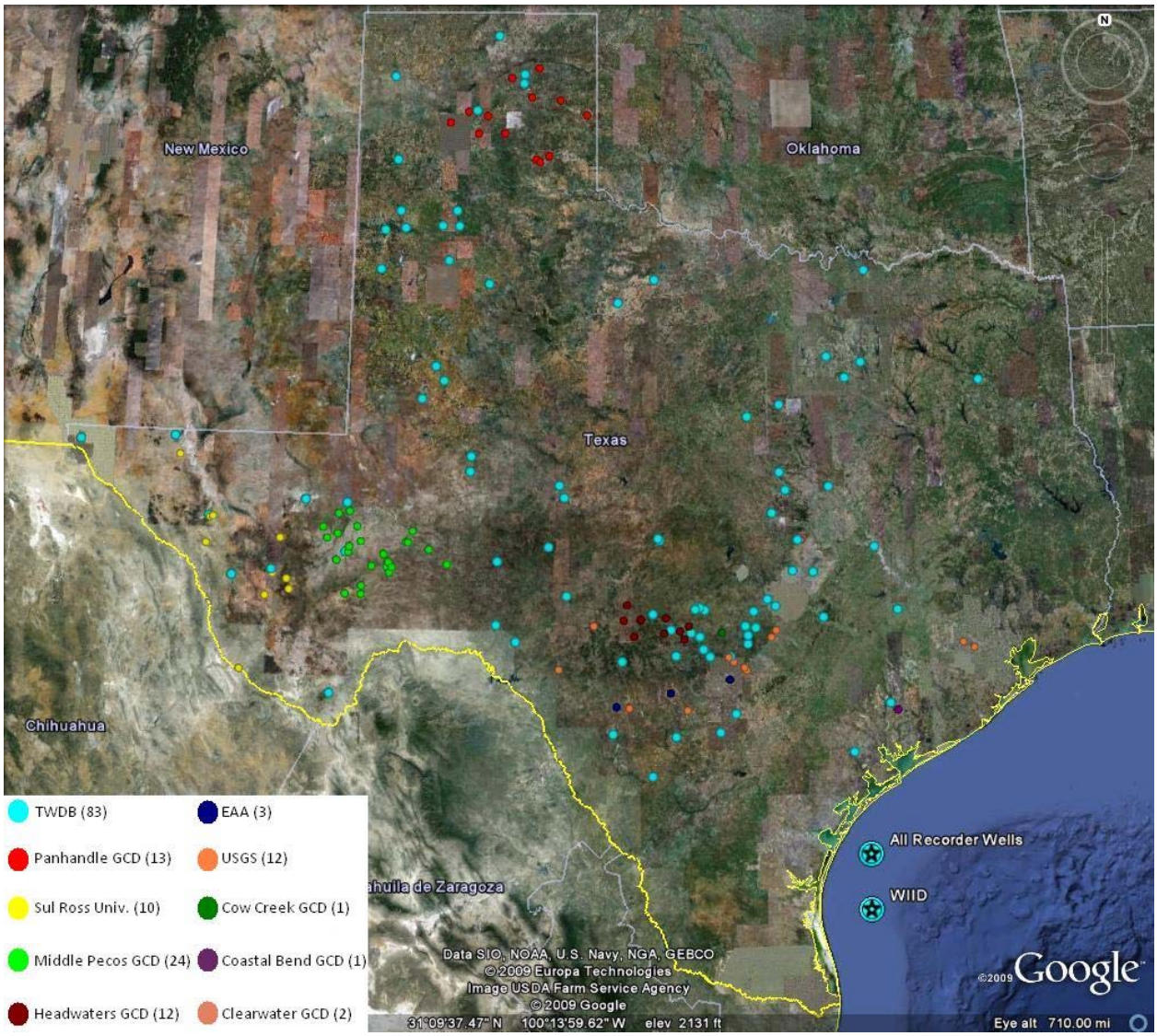

Figure 2-3. Recorder wells operated by the TWDB and cooperators as of October 15, 2009.

3.0 Existing networks, goals, and objectives

Overall, the goal of all three groundwater data collection programs at the TWDB is to monitor the state of the state's groundwater resources. Primary objectives include monitoring of water levels to track changes in levels over time; and baseline, spatial, and temporal characterization of ambient, or background water quality to track any changes that may be occurring over time; and contamination assessments of naturally occurring constituents. Secondary objectives include scientific investigations; these data are used by outside consultants and university staff as well as by TWDB employees in a variety of publications. TWDB monitoring personnel collect information essential to regional and state water planning and groundwater management; maintain the state's water well database; and provide and communicate the results of their work through a number of portals available online and a variety of publications.

3.1 TWDB groundwater level observation and ambient water quality networks

The annual water level observation and ambient water quality network designs are based on aquifer distribution and groundwater production or level of development. Statewide monitoring spatially reflects Texas geology and agriculturally developed areas such as the High Plains. In a few such areas, both quantity and quality are of concern; for example, water levels are declining due to the historical mining of the Ogallala Aquifer to meet irrigation needs, and in some areas of the aquifer with poorer quality water due to naturally occurring contamination, water levels are also declining. Other local interests are also instrumental in network design—several counties in the Texas Hill Country that are undergoing rapid development are dedicated to data collection that will trigger drought restrictions as well as help determine overall availability.

In part, these monitoring program TWDB network designs have been influenced by mandates from the Texas State Legislature. In 1991, the legislature required all state agencies to produce performance measures to reflect the results of their work as accurately as possible. Agencies began to compile and report their measures at least annually and typically every quarter. TWDB groundwater and surface water staff created two basic measures. One of these they designed to reflect all of the data the agency collected, an “output” reporting on the number of data units collected and/or processed by TWDB staff in support of monitoring, investigating, and defining the state's surface water and groundwater resources. This number includes the total number of water levels and samples collected and/or analyzed by TWDB and its cooperators. The second, an “outcome” measure, or the “percent of information available to adequately monitor the state's water supplies,” was the impetus behind the determination of an adequate network, an attempt to gage the relevancy of the total amount of data collected.

The challenge of formulating an adequate network of water level and water quality wells capable of producing level and quality data for any purpose imaginable at any location is obvious: the future is difficult to predict, and almost all data become more valuable with time. As a response to this legislation, geologists at the TWDB realized the need for designating areas from which to choose water level and water quality network wells based on criteria that would ensure a representative number of levels and samples per aquifer per county. No significant funding has ever been available for drilling wells for a dedicated network; therefore considering this limitation, the water level network was always intended to consist of existing wells, preferably unused. Annual measurements have always been conducted during cooler months when there is less pumping and levels are more likely to reflect static conditions. Furthermore, wells chosen for the water-level observation network included, to the extent possible, wells with long-term histories of measurement, no matter their location and aquifer completion.

Production primarily determines the number of wells considered adequate for each county-aquifer combination (Table 3-1); however, spacing requirements are more flexible. Staff attempt to include wells that are relatively well spaced, but this ideal situation is challenging when much of the production in a county is from a very limited area geographically. Well owner cooperation is essential, and fortunately many owners are interested in contributing information from their wells to a non-regulatory agency. In water level network wells that are still equipped, TWDB personnel take care to be aware of recent pumping histories. In the water level network, 28 percent are irrigation wells; 24 percent are unused; 15 percent are municipal; 12 percent are other, including industrial; 11 percent are domestic; and 10 percent are stock.

Table 3-1. Criteria determining number of adequate current water level observation wells per county-aquifer combination.

.

- **1 well/25 sq. mi.** (> 100,000 ac-ft of groundwater pumped annually)
- **1 well/50 sq. mi**. (> 10,000 & < 100,000 ac-ft of groundwater pumped annually; this can be modified to 1 well/75 sq. mi. in areas with little water level fluctuation--< 50 feet of decrease per decade in artesian aquifers or < 20 feet per decade in water-table aquifers as determined from the latest water-level change maps--or where few wells available as in extreme downdip limits)
- **1 well/100 sq. mi.** (> 2,500 ac-ft & < 10,000 ac-ft of groundwater pumped annually; this can be modified to 1 well/125 sq. mi in areas of little water level fluctuation or few wells available)
- **1 well/150 sq. mi.** (> 1,000 & < 2,500 ac-ft groundwater pumped annually)
- **1 well** for entire aquifer-county combination (<1,000 acre-feet groundwater pumped annually)

Annual production, from year 2000 reported amounts, resulted in the following number of aquifer-county combinations (617 aquifer-county combinations for 254 counties):

- 26 – greater than 100,000 acre-feet/year
- 70 – greater than 10,000 and less than 100,000 acre-feet/year
- 92 – greater than 2,500 and less than 10,000 acre-feet/year
- 57 – greater than 1,000 and less than 2,500 acre-feet/year
- 188 – less than 1,000 acre-feet/year
- 184 – with no reported production

TWDB updates the water level and quality network wells when the most recent production amounts are tabulated/estimated and when aquifer boundaries change. Any significant amount of pumpage or aquifer boundary changes will result in an increased or decreased number of network wells. TWDB must then find more wells to add to the network or decide whether to drop wells. Because of the value of wells with long measuring histories—especially those with highly fluctuating levels, however, rarely does TWDB drop wells from the network.

County-aquifer combinations with large production are commonly found in areas where groundwater conservation districts (districts) have long engaged in monitoring activities, for example in the High Plains. These districts measure and share their data with the TWDB. District and other cooperation has allowed TWDB to focus its monitoring efforts on other geographical areas; train newer districts in water level measuring procedures; and help them obtain data, maps, and reports to facilitate their new data collection programs.

The length of record for wells measured annually by the TWDB and its three major cooperating entities (districts, the USGS, and public supply well operators) ranges from 1 to 95 years, with a median of 32 years (1977 to 2008); an irrigation well in Hale County completed in the Ogallala Aquifer, was initially measured in1914. The total number of measurements in the water level observation program ranges from 1 to 825, with a median of 24 water level readings (not all annual visits result in a water level measurement). In general, large numbers of wells limited to one county during any given time period reflect concentrated monitoring start-up activities by individual districts. Wells have been routinely added in aquifers where production is highest, such as in the High Plains (Ogallala) and the Gulf Coast, or in areas where relatively extreme water level fluctuations (such as in the Hill Country) are common and of concern to the public (Figure 3-1).

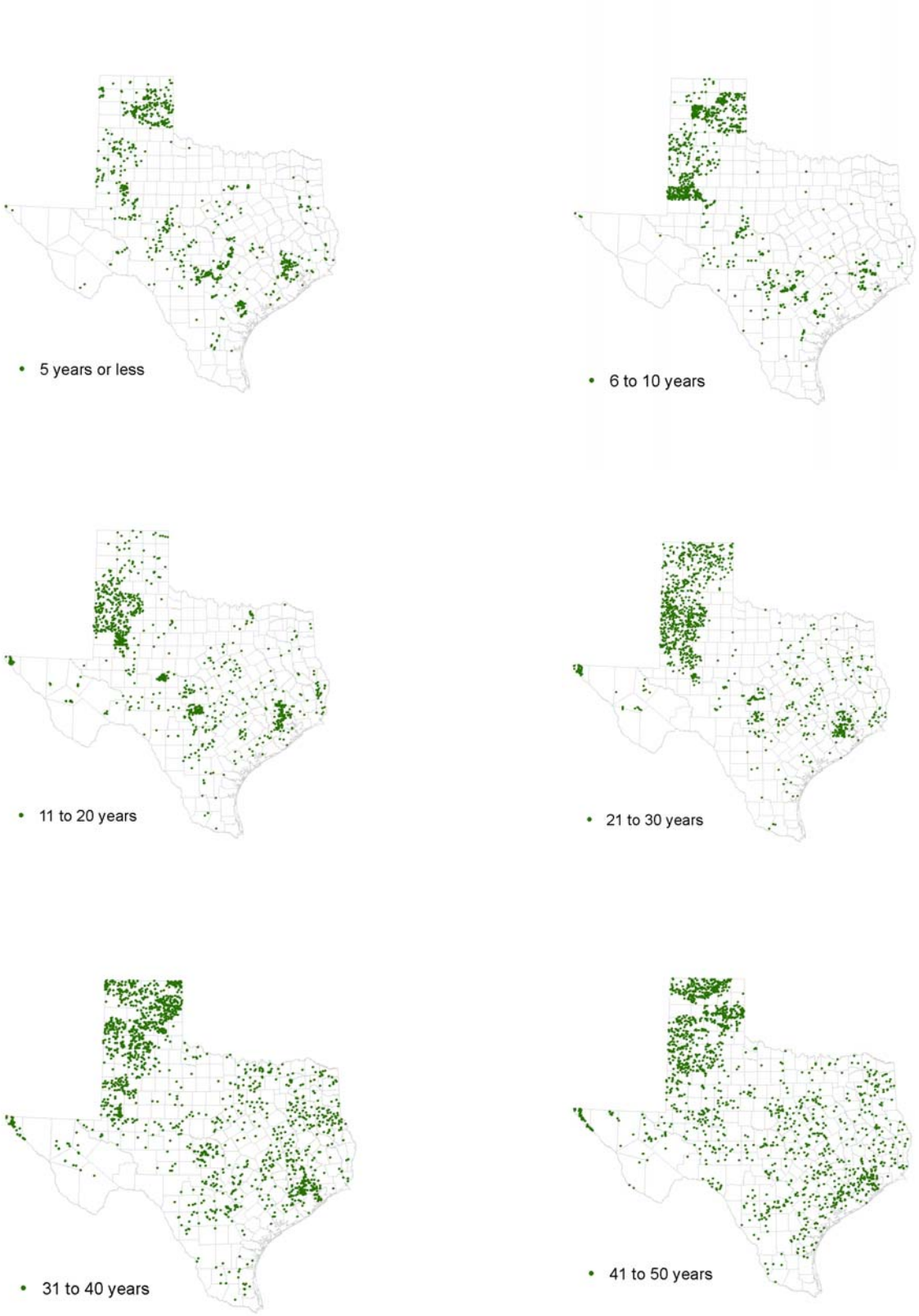

Figure 3-1. Geographic distribution of wells added to the TWDB water level observation network during the past fifty years.

Wells in the water quality network are determined using similar criteria, but with greater spacing resulting in fewer network wells. TWDB personnel make efforts to resample these wells every cycle. Of the 12,340 wells sampled by TWDB and its cooperators since 1988, 38 percent have been sampled at least twice: 19 percent were sampled twice, 10 percent three times, 4 percent four times, and 3 percent five times or more. Of wells sampled in the water quality network during the last four-year cycle, 41 percent are public supply; 30 percent are domestic; 11 percent each are stock and irrigation; and 7 percent supply water for other purposes, including industrial.

The TWDB's ambient water quality program is designed to collect data to determine baseline conditions and changes over time; the network does not include reference or targeted wells for prediction or determination of contamination. TWDB analyzes samples for major ions (mineral analysis), alkalinity, selected nutrients (typically nitrite plus nitrate), trace elements (primarily metals), radiogenic compounds from selected major and minor aquifers, and isotopes for use in flow-path studies and recharge determination.

However, in the past eight years, TWDB has also collected samples for the state's lead regulatory agency, the Texas Commission on Environmental Quality (TCEQ). TCEQ has used immunoassay techniques to analyze for a number of pesticides to assess where to spend limited funds on lab analysis. In the past couple of years, TCEQ has systematically begun testing for nearly 60 "pesticides of interest" in anticipation of EPA requirements. Of the more than 5,000 sites from which TWDB has collected samples during its ambient monitoring cycles for analysis of nearly 30 pesticides, TCEQ has also conducted sampling in targeted rural and suburban sites. Almost all of the pesticides have been detected below or at only trace levels; fewer than a dozen sites in the Panhandle showed levels in excess of the MCL for atrazine and no more recently than five years ago. TWDB also includes the results of these analyses in its groundwater database.

Reports that TWDB creates from data collected in its monitoring programs consider all water quality from a drinking water perspective, because although the vast majority of groundwater used for drinking in Texas meets state and federal requirements for safety, naturally occurring levels of total dissolved solids, arsenic, and radionuclides, as well as human-caused contamination, prevent the water from meeting those standards in some parts of the state. As the lead regulatory agency dealing with site-specific contamination, the TCEQ, through its Public Water Drinking Section, determines sampling and testing requirements for all water in public water supply wells.

3.2 TWDB recorder network

In the early 1990s, this program consisted of barely 20 chart recorders; today, the TWDB solely operates 83 (several of which it has taken over from the USGS primarily due to funding limitations) and jointly operates another 65. The period of record for the TWDB operated wells ranges from less than one year to 63 years. Not surprisingly, considering the attention long given to declining water levels in the Ogallala, several of these recorders (many of which were originally operated by the US Geological Survey, or USGS) have some of the longest records, such as in Lamb, Hansford, and Carson (with records of 59, 58, and 53 years). From the purchase in the mid 1990s of automatic data loggers, followed by the

adoption of cell-phone telemetry in 2000, the recorder network today consists of almost 150 wells throughout the state that all, with the exception of 16 in Pecos County—scheduled to be equipped with satellite telemetry in the next year—transmit data to the TWDB via satellite telemetry. TWDB posts daily water level measurements from this network on its web site.

Cooperating entities—mainly districts—have begun to purchase recording and telemetry equipment and rely on the TWDB for assistance in installation, operation, and posting of data to the TWDB web site; some entities such as the Edwards Aquifer Authority have installed and now maintain recorders and post data on their own web sites. After measurements from these nearly150 sites are transmitted to the agency, TWDB posts hydrographs and text files of actual measurements (as provisional data arranged by county and well numbers) at http://midgewater.twdb.state.tx.us/twdbwells/), as well as through Google Earth and Virtual Earth map applications at http://www.twdb.state.tx.us/gwrd/waterlevels/waterlevels.html (Figure 2-3).

3.3 Texas Commission on Environmental Quality public drinking water program

More than 20,000 wells are considered part of TCEQ's public drinking water program, of which nearly 14,000 are active. Technically this program oversees the collection of water quality data that is site-specific, regulatory, and requires sampling of treated ("finished") water at points of entry into the distribution system. However, untreated or "raw" samples are collected at approximately 1,000 of these wells in small systems where one well provides the sole source of water. Typically, TCEQ requires analysis of the same inorganic constituents that are analyzed for in the TWDB program in addition to many volatile organic compounds, including chlorination disinfection byproducts. Sampling requirements, including frequency, depend on the number of constituents found in excess of their primary MCLs.

4.0 Potential monitoring points for inclusion in the NGWMN

TWDB will choose potential sites from the 8,642 groundwater level monitoring sites to include only those with the most complete casing information (including screened intervals)—6,498 sites; and of these, only those sites with total well depth information, or 3,986 sites (although screened intervals should suffice, even at sites lacking depth). Because TWDB provides water levels for wells completed in the High Plains Aquifer (Ogallala) to USGS personnel in Nebraska yearly, excluding these observation wells and concentrating on sites from other aquifers to fill in gaps might be reasonable. These exclusions result in 2,285 sites as potential network candidates (Figure 4-1); or, if including the Ogallala, 3,985 sites.

To determine best sites from the 12,340 wells sampled during the last twenty years, TWDB will consider wells sampled during the last complete cycle that have were previously sampled at least once; and of that amount only those with the most complete casing information and depths. Exclusive of wells completed in the Ogallala Aquifer, this pruning results in a potential 1,157 sites (Figure 4.2); if including the Ogallala, this amount is 1,480. However, additional sites from the approximate 1,000 TCEQ public supply wells where raw samples have been collected are also potential candidates.

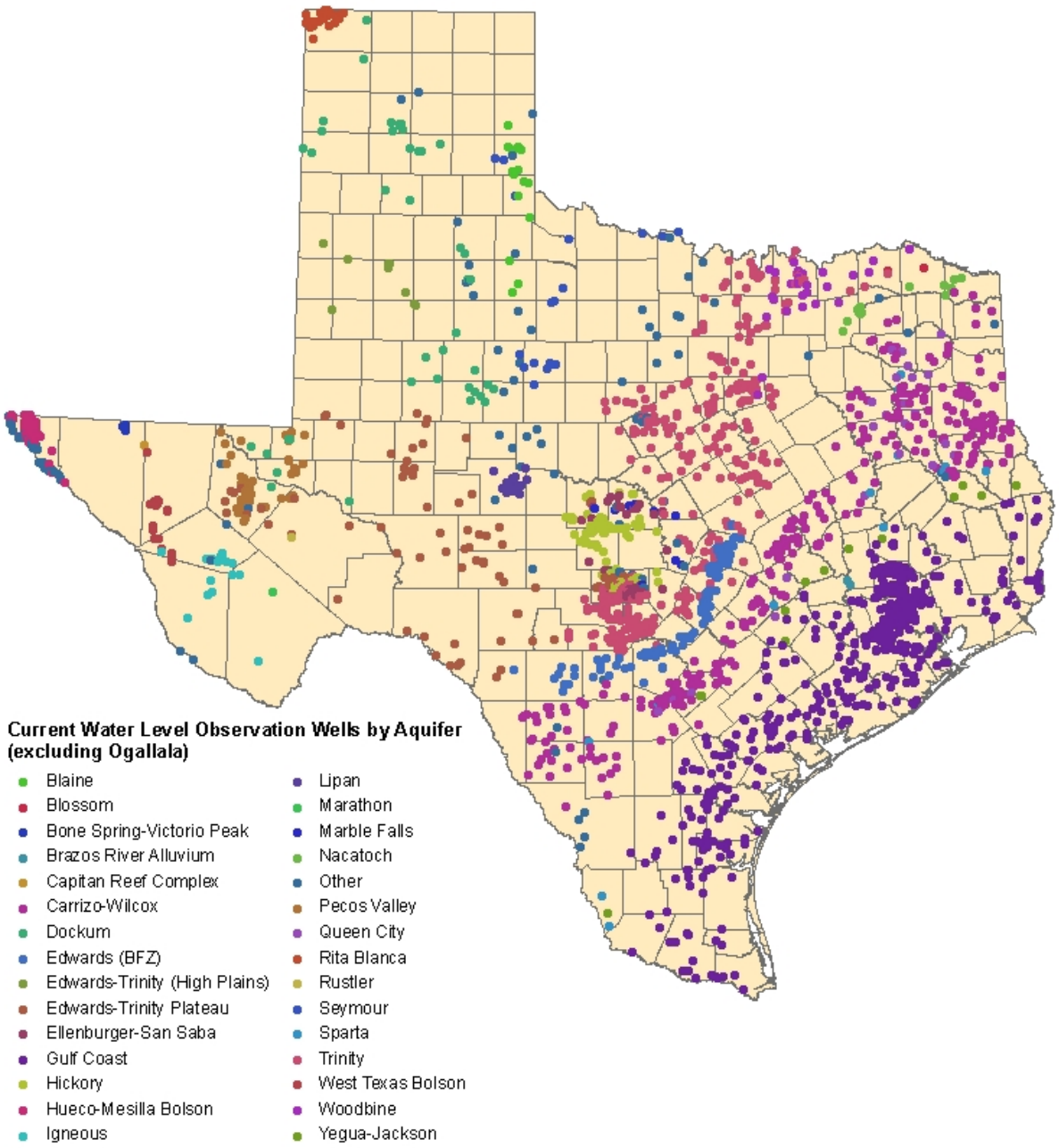

Figure 4-1. Potential water level network sites (2,285), excluding Ogallala wells, for inclusion in pilot project.

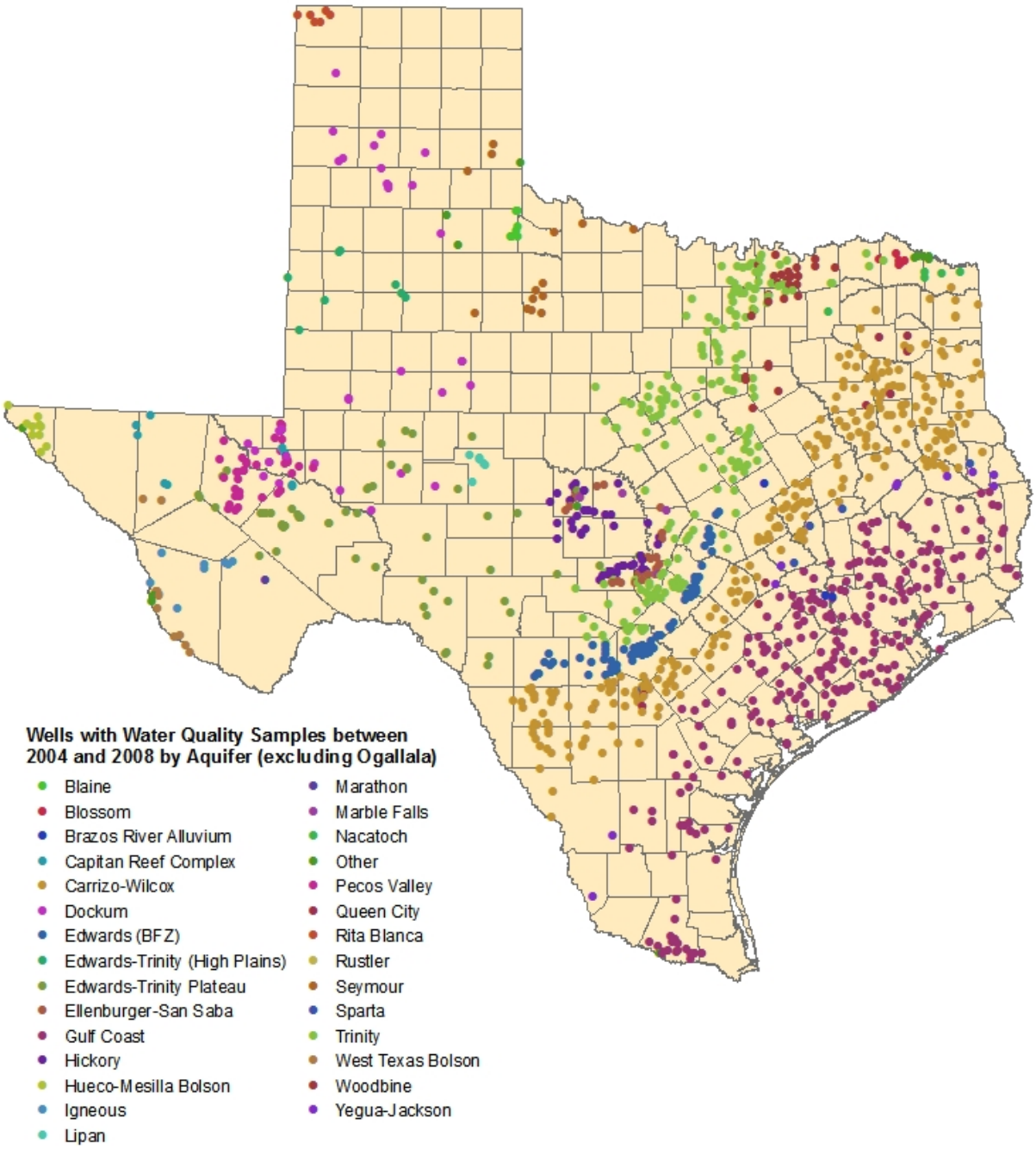

Figure 4-2. Potential water quality network sites (1,157), excluding Ogallala wells, for inclusion in pilot project.

Considering the TWDB's 83 recorder wells, after the same exclusion of wells without the most complete data and elimination of Ogallala wells, results in a potential network of 44 sites for inclusion in the NGWMN (Figure 4-3).

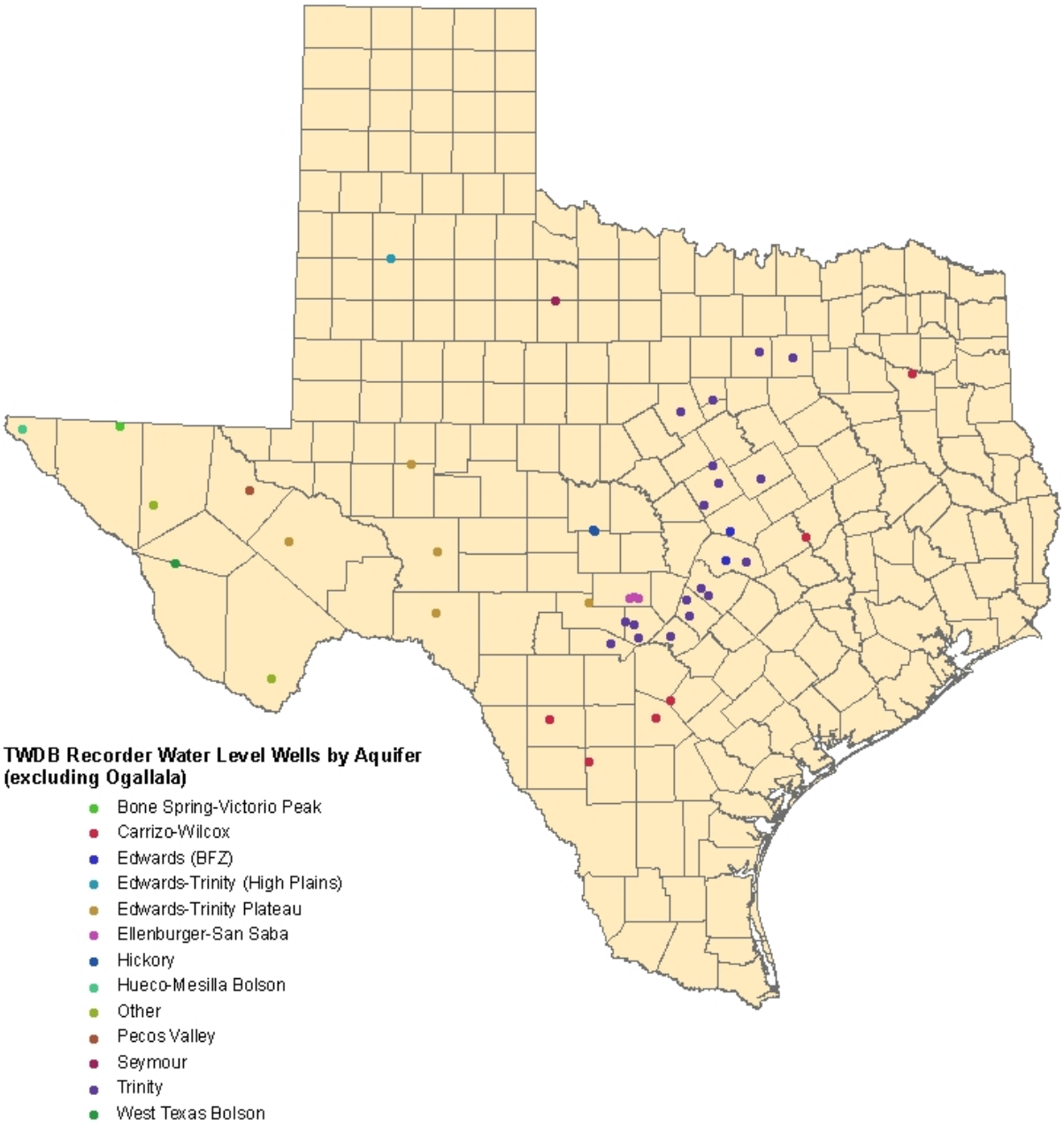

Figure 4-3. Potential recorder network sites (44), excluding Ogallala wells, for inclusion in pilot project.

5.0 Field practices

All TWDB field practices are outlined in three "users manuals": one covers water level measuring procedures; one, updated in 2003, covers water quality sampling protocols; and the third, a recorder manual written in May of 2009, is primarily for internal use and includes photos of and specs for equipment, specific steps for programming, and troubleshooting guides for sensors, loggers, and transmitters. The water level and water quality sampling manuals are available at http://www.twdb.state.tx.us/publications/manuals/UM-52/Um-52.pdf, and http://www.twdb.state.tx.us/publications/manuals/UM-51/FieldManual.pdf. Practices described in these two manuals were originally modeled after and are similar to those used by the USGS. Although TWDB's water quality sampling procedures are relatively rigorous, they are not considered as strict as those used by the USGS, in part due to the non-regulatory nature of the TWDB.

6.0 Data management and availability

TWDB monitoring staff enter data in laptops while in the field or by hand in field notebooks of well and water level data and water quality field measurements; final data entry occurs in the Access groundwater database on office or remote access computers. TWDB's contracted lab provides the TWDB with electronic delivery of water quality analyses that staff upload in the database; some fields are calculated, including the major ion charge balance error. Staff enter all isotope data by hand. The database coordinator downloads data provided by cooperators in appropriate Excel formats as described at. Recorder program staff update scripts that capture and post telemetry data online as provisional data; later they perform QA/QC on the provisional data before adding five-day recorder measurements and twice monthly recorder measurements to the TWDB database.

The database structure provides certain QA/QC checks: the data base coordinator performs standard weekly database checks and periodically global queries to perform such tasks as flagging inaccurate location data. The TWDB Users Manual-50, "Explanation of the database" the latest revisions of several versions of the Data Dictionary since 1988, includes QA/QC checks that are included in and expanded upon in the thirteen internal procedure documents followed by all Monitoring staff during data collection and data entry.

Beginning in the late 1990s, TWDB staff made text and scanned image files available at http://www.twdb.state.tx.us/publications/reports/GroundWaterReports/GWDatabaseReports/GWdatabaserpt.htm, arranged by county and type of information corresponding to data within main relational tables (e.g. record of wells, water levels, recorder water levels, water quality, casing, etc.), as well as a copy of the groundwater database as an Access .mdb file (Figure 6-1). After 2000, these data also became available online through a mapping application, more suitable for download of data associated with individual well and spring sites, through the Water Information Integration and Dissemination (WIID) system. This portal reflects information in the TWDB groundwater database, updated monthly, and is available at http://wiid.twdb.state.tx.us/ (Figure 6-2). Additionally, beginning in 2004 and in cooperation with the Texas Department of Licensing and Regulation, TWDB began hosting the Submitted Driller's Report Database on the WIID to allow for viewing of these reports as scanned images (Figure 6-3). The system also allows for online filing of required information

that ultimately populates the well drilling reports. The groundwater database and the WIID frequently receive recognition for their comprehensive nature and ease of downloading data and are typically the most viewed of any TWDB web pages. From June 26 through October 7 of 2009, the Groundwater Database Reports page received the most visitors of any TWDB pages: 445 visitors accounted for 1,049 hits to the reports page while downloading more than 350,000 KB of data. The WIID is also always ranked among the top ten most visited sites.

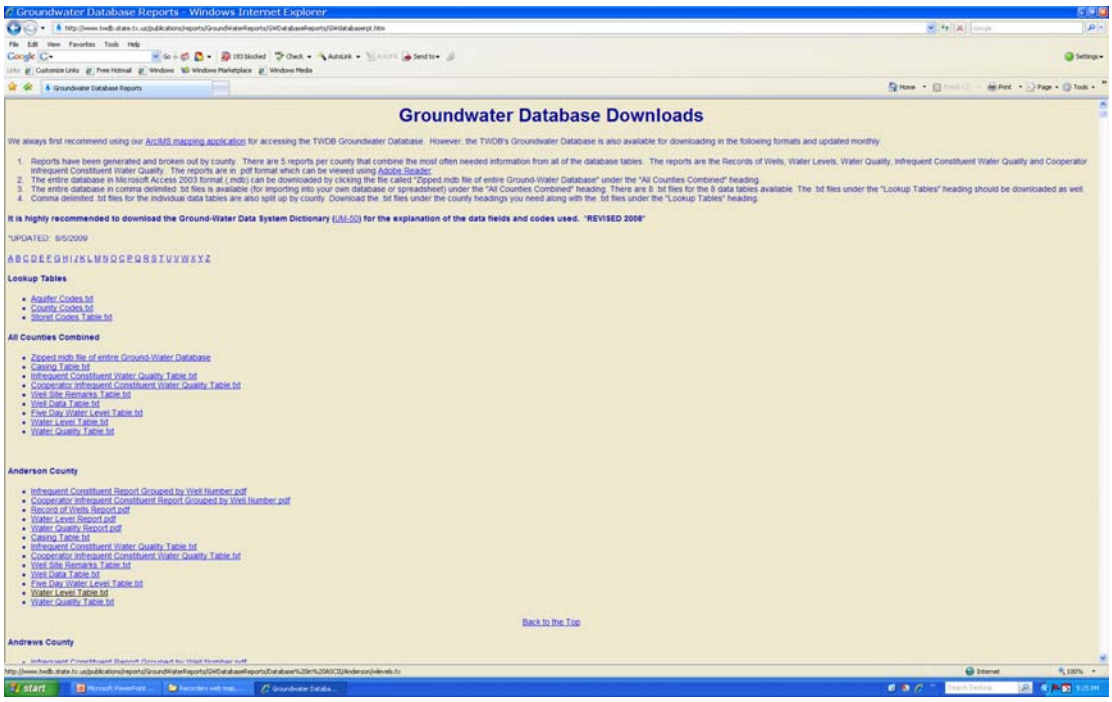

Figure 6-1. Screen shot of TWDB web page with links to scanned image and text files, by county, of main relational tables in the TWDB groundwater database.

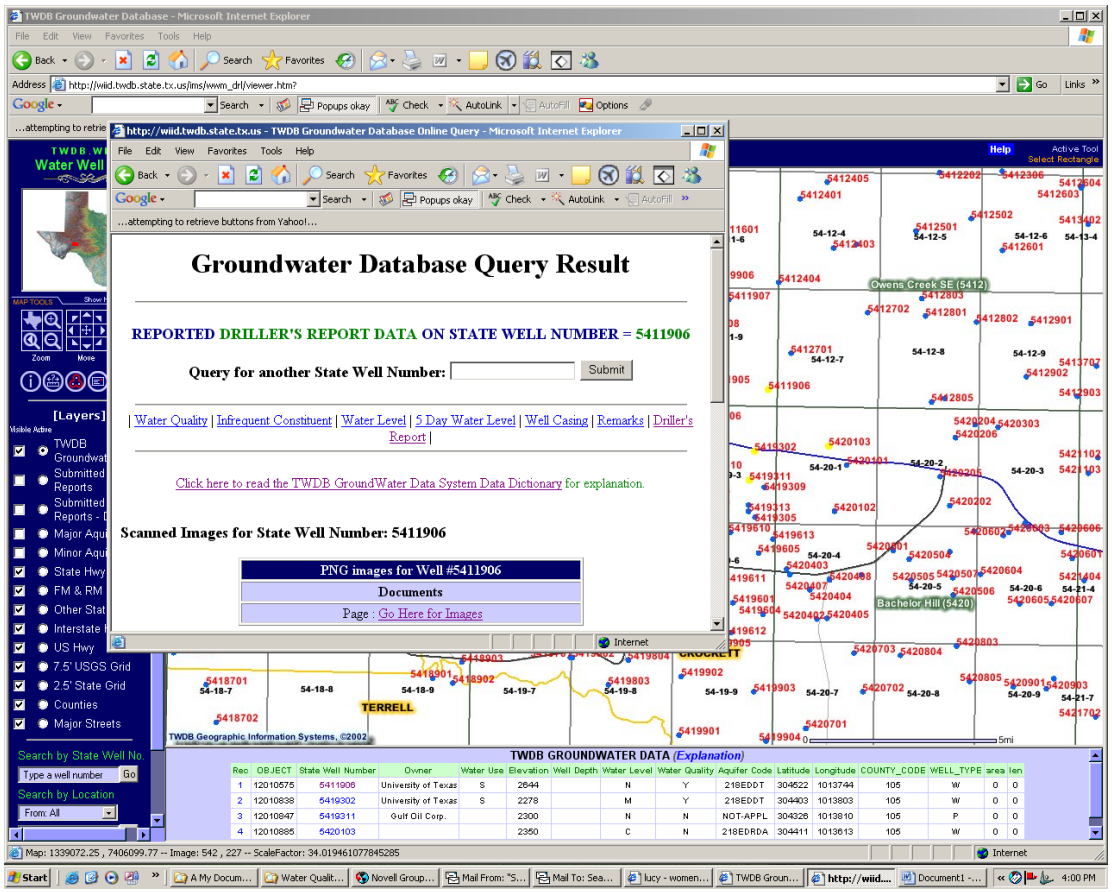

Figure 6-2. Screen shot of TWDB's WIID mapping application showing pop-up menu with links to information in relational database tables.

STATE OF TEXAS WELL REPORT for Tracking #40723

Owner:	**Lee Hawkins**	Owner Well #:	**No Data**
Address:	**101 Heritage Place** **Weatherford , TX**	Grid #:	**32-18-6**
Well Location:	**Same** **TX**	Latitude:	**32° 41' 56" N**
Well County:	**Parker**	Longitude:	**097° 46' 23" W**
Elevation:	**No Data**	GPS Brand Used:	**Map**
Type of Work:	**New Well**	Proposed Use:	**Domestic**

Drilling Date:	Started: **6/28/2003** Completed: **6/28/2003**
Diameter of Hole:	Diameter: **7 in From Surface To 260 ft**
Drilling Method:	**Air Rotary**
Borehole Completion:	Gravel Packed From: **150 ft to 260 ft** Gravel Pack Size:
Annular Seal Data:	1st Interval: **From 0 ft to 150 ft with 3 (#sacks and material)** 2nd Interval: **No Data** 3rd Interval: **No Data** Method Used: **Grout** Cemented By: **Larry Peck** Distance to Septic Field or other Concentrated Contamination: **100 ft** Distance to Property Line: **No Data** Method of Verification: **Taped** Approved by Variance: **No Data**
Surface Completion:	**Surface Sleeve Installed**

Water Level:	Static level: **125 ft. below land surface on 6/28/2003** Artesian flow: **No Data**
Packers:	**No Data**
Plugging Info:	Casing or Cement/Bentonite left in well: **No Data**
Type Of Pump:	**Submersible** Depth to pump bowl: **240 ft**
Well Tests:	**Bailer** Yield: **15 GPM with 60 ft drawdown after 2 hours**

Water Quality:	Type of Water: **Good** Depth of Strata: **No Data**

	Chemical Analysis Made: **No** Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**
Certification Data:	The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.
Company Information:	**Peck's Well Service, Inc.** **2650 White Settlement Rd.** **Weatherford , TX 76087**
Driller License Number:	**1598**
Licensed Well Driller Signature:	**Larry Peck**
Registered Driller Apprentice Signature:	**No Data**
Apprentice Registration Number:	**No Data**
Comments:	**Logged by DT$**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking #**40723**) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0-20 Caliche Clay Rock
20-95 Gray Shale and Rock
95-110 Green and Purple Shale
110-150 Yellow Clay Sand
150-160 Green Shale
160-250 Shale with Sand Layers
250-260 Gray Shale and Rock

Figure 6-3. Example of submitted driller's water well report from online database at http://wiid.twdb.state.tx.us/.

7.0 Pilot project tasks and timeline

1) TWDB will identify stressed vs. non-stressed wells, grouping wells by aquifer, using water level sites previously identified in Section 4,. We will begin with major aquifers and intend to include summaries of this task in monthly updates; we intend to complete this by June 1, 2010. These designations, however, will be apart from any database restructuring. As mentioned, the agency does not have complete control over the timing of desired changes. (One note: groundwater users in the Ogallala who are comfortable with planned depletion may not define their wells as stressed.)

2) Obtain data from public supply wells (sampled individually and before treatment) and enter all data equivalent to that collected by the agency in the TWDB database. These sites can then be evaluated for inclusion in the water quality network. TWDB intends to complete this by July 1, 2010.

3) Revise water level measuring manual to include updates to the database; QA/QC or data validation procedures; cooperator updates and data sharing procedures. TWDB will provide an outline by April 1, 2010, and final copy by July 31, 2010.

4) Identify funding needs for filling in other data gaps (determination of casing on all monitored wells, for example) by August 1, 2010.

8.0 Current collaboration

Cooperative agreements between the TWDB and data collectors are informal; TWDB asks for all data and usually most entities agree. Groundwater conservation districts and the USGS have supplied the TWDB with water level data for decades, but other entities participate as well (Table 8-1). The number of districts continues to increase as district management obtains the wherewithal to measure wells. Fourteen districts provided their measurements to the TWDB in 1998; in fiscal year 2008, just over 40 districts provided the TWDB with water level measurements, mainly annual (Table 8-2). Some districts measure twice a year, quarterly or monthly (Figure 2-1).

Table 8-1. Measuring entities providing the TWDB with water level measurements in fiscal years 2007 and 2008.

	Number of measurements	
Measuring entity	**2007**	**2008**
Groundwater conservation districts	6,180	8,599
Texas Water Development Board	2,295	2,020
U.S. Geological Survey	2,264	2,418
Municipal/public water supply corporations	640	800
Groundwater consultants	223	13
Other state agencies	177	2
Registered water well drillers	149	138
Well owner/operator	23	57
Other or source of measurement unknown	19	5
Other federal agencies	6	1

Private firm/industry	5	11
Texas Commission on Environmental Quality	1	10
Total	11,982	14,074

Table 8-2. Groundwater conservation districts providing TWDB with water level measurements in fiscal years 2007 and 2008.

Bandera County River Authority and Groundwater District
Barton Springs/Edwards Aquifer Conservation District
Blanco-Pedernales Groundwater Conservation District
Central Texas Groundwater Conservation District
Clearwater Underground Water Conservation District
Coastal Bend Groundwater Conservation District
Coastal Plains Groundwater Conservation District
Coke County Underground Water Conservation District
Cow Creek Groundwater Conservation District
Emerald Water Conservation District
Evergreen Underground Water Conservation District
Fort Bend Subsidence District
Glasscock County Groundwater Conservation District
Goliad Water Conservation District
Gonzales County Underground Water Conservation District
Hays Trinity Groundwater Conservation District
Harris-Galveston Coastal Subsidence District
Headwaters Groundwater Conservation District
Hemphill County Underground Water Conservation District
Hickory Underground Water Conservation District #1
High Plains Underground Water Conservation District #1
Hill Country Underground Water Conservation District
Irion County Underground Water Conservation District
Kimble County Groundwater Conservation District
Lipan-Kickapoo Water Conservation District
Live Oak Underground Water Conservation District
Llano Estacado Underground Water Conservation District
Mesa Underground Water Conservation District
Mesquite Groundwater Conservation District
North Plains Groundwater Conservation District
Panhandle Groundwater Conservation District
Permian Basin Underground Water Conservation District
Plateau Underground Water Conservation & Supply District
Post Oak Savannah Groundwater Conservation District
Real-Edwards Conservation & Reclamation District
Rolling Plains Groundwater Conservation District
Rusk County Groundwater Conservation District
Sandy Land Underground Water Conservation District
South Plains Underground Water Conservation District
Sterling County Underground Water Conservation District
Sutton County Underground Water Conservation District
Wes-Tex Groundwater Conservation District

Legislation passed in 2005 (House Bill 1763) that regionalizes decisions on groundwater availability, requires the state's regional water planning groups to use groundwater availability numbers from the groundwater conservation districts, and defines a permitting target/cap for groundwater production, is changing the rules and plans of the districts. More districts will begin to collect (or collect more) data to monitor their new and legally defined "desired future conditions."

As noted, some districts have been able to purchase recorder and telemetry equipment (Figure 2.3). The TWDB installs the equipment, helps maintain it, and posts the provisional water levels on its web site. The USGS has operated recorder wells for the agency in the past, but TWDB's availability of funds only allowed the agency to contract for stream gage operation. The Survey does provide the TWDB with recorder measurements, however, at most of the sites it still operates.

After the passage of Senate Bill 1 in 1997, the TWDB's groundwater quality lab services funding increased. This allowed the agency to fund some cooperators, particularly those who had long histories of sharing water level data, such as districts in areas underlain by the Edwards (BFZ) Aquifer in the Hill Country, in their water quality sampling activities. Depending on yearly availability of funds, several districts are still participating (Figure 2.2); they follow protocols as described in the TWDB sampling manual and submit their samples to the TWDB contracted lab. The agency uploads these results to the database.

TWDB also includes other accredited lab analyses from local entities, such as the City of Amarillo and El Paso; from private contractors when appropriate; and from the USGS, after making specific requests to the Austin field office.

TWDB samples for other entities, primarily at the state level, through informal agreements and typically for special projects. For nearly a decade TWDB has collected additional water samples for TCEQ for the analysis of certain pesticides, always after obtaining separate permission from the well owner; these data are ultimately also stored in the TWDB groundwater database. TWDB has worked with the Texas Parks and Wildlife Department in sampling springs; and has conducted additional field measurements and/or collection of samples, such as for arsenic speciation, for staff at the University of Texas Bureau Of Economic Geology.

9.0 Other groundwater monitoring programs

Nearly half of local groundwater districts operating in 88 counties conduct water level measurement programs and share data with the TWDB through informal agreements. More than a few districts also perform analyses of samples with portable spectrophotometric equipment for selected constituents of local interest—such as total dissolved solids, nitrate, and bacteria—in water samples collected by their constituents and brought to district offices. TWDB does not actively seek these data for inclusion in its database, but welcomes these data once districts provide enough additional data about the well site to assign the well a TWDB identification number (state well number). A few districts that have long participated in sharing water level data with the TWDB (primarily in the Hill Country, but also in other areas), and depending on the availability of funds, collect water quality samples using

TWDB protocols. The TWDB's current contracted lab analyzes these samples, and TWDB uploads the results to its database.

At the federal level, the USGS has well established National Assessment of Water Quality (NAWQA) sampling programs that have been conducted and are ongoing in several of the state's major aquifers. This program has collected a wide variety of water quality data but has been restricted to a limited number of sites in a few major and minor aquifers—primarily the Ogallala, Gulf Coast, Edwards (BFZ), and Carrizo-Wilcox aquifers during the past twenty years. As noted, the TWDB has incorporated the results of some of the NAWQA analyses, through informal requests, in addition to more than 2,000 water levels a year from a few regions.

10.0 Lead contact and key pilot partners

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