Texas Water Development Board

Technical Note 13-01

Summary of Groundwater Conditions in Texas: Recent (2010-2011) and Historical Water Level Changes in the TWDB Online Recorder Network

by

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As program specialist for the recorder program, Blake Neffendorf installed, operated, and maintained the recorder network; created the maps, hydrographs, and tables; and provided the photographs.

Geocientist Seal

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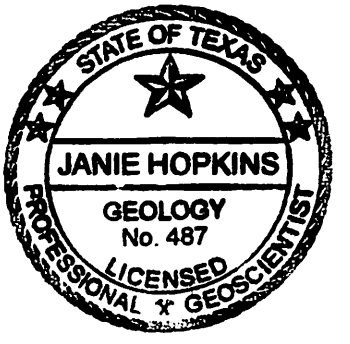

Janie Hopkins

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Summary of Groundwater Conditions in Texas: Recent (2010-2011) and Historical Water Level Changes in the TWDB Online Recorder Network

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1.0 Executive Summary

The Texas Water Development Board (TWDB), in partnership with its cooperators, continues to install and monitor automatic water level recorders in observation wells throughout the state. This report discusses the water level changes observed in 2011 in the 110 recorder wells in the state's nine major aquifers and in the 16 recorder wells in eight minor and three undesignated aquifers. The TWDB posts hydrographs and daily water level measurements for these wells at http://www.twdb.texas.gov/groundwater/data/waterlevel.asp. The report does not include data from recorders added to the network during 2011 or from wells equipped only with dataloggers. A relatively greater number of recorders exist in areas that have experienced water level declines, such as in the High Plains, and more recently in areas where groundwater use is increasing, such as in Central Texas. More than half of the 110 recorders discussed in this report are in wells in major aquifers: 26 are in wells in the Ogallala Aquifer and 33 are in wells in the Central Texas Trinity Aquifer.

A greater median water level decline occurred in more recorder wells from 2010 to 2011 in comparison to 2009 to 2010. Water level declines with a median total of 4.8 feet occurred in 101 of 110 wells completed in major aquifers from 2010 to 2011. This median water level decline was nearly three times greater than the water level decline of 1.9 feet that occurred in 55 of these 99 (with available measurements) wells in major aquifers from 2009 to 2010. The water level rise of 2.5 feet that occurred in 44 (of the 99 wells with available measurements) from 2010 to 2011 was only 40 percent greater than the median 1.5 feet of rise that occurred in nine of the 110 wells from 2010 to 2011.

Considering water level change by region, the 33 Central Texas Trinity Aquifer wells experienced the greatest decline, or a total median change of -16.7 feet from 2010 to 2011. The 16 west Texas Edwards-Trinity (Plateau) wells experienced the least decline, a median change of -0.7 feet. The one recorder well in the Hueco-Mesilla Bolson Aquifer in El Paso that experienced a rise of 1.5 feet from 2010 to 2011, was not included in this comparison. From 2009 to 2010, the Central Texas Trinity Aquifer wells experienced the greatest total median water level change, a rise of 2.8 feet. The La Salle County recorder well experienced the greatest decline (and change) of any of the recorders, or 76.5 feet, from 2010 to 2011.

2.0 Introduction

An automatic groundwater level recorder well, or recorder well, refers to an unused water well equipped with a water-level recording instrument (a recorder) and a datalogger. The recorder is a sensor that obtains the actual water level measurement. An optical sensor (or encoder—a measurement device that converts mechanical motion into electronic signals) uses a float and pulley system to obtain measurements, whereas a pressure sensor uses water pressure changes to obtain the data. Typically older recorders use encoders, and newer ones are outfitted with pressure sensors or transducers; the TWDB operates both. The main electronic unit that receives the data from the sensor and stores the measurements is the logger or datalogger.

Additionally, the majority of TWDB (and cooperator) wells with recorders are also equipped with telemetry. This report summarizes water level changes from these wells but does not include a discussion of water level changes in a number of wells (mainly in Pecos County) that are only equipped with dataloggers. A transmitter receives data from the logger at scheduled intervals and transmits the information to a receiving site. TWDB (and cooperator) recorders use the Geostationary Operational Environmental Satellite (GOES satellite) system to relay data, although some groundwater conservation district (GCD) programs use a cell phone network.

As of January 2011, the TWDB was operating 110 recorders in the state's nine major aquifers, 13 recorders in eight minor aquifers, and three recorders in three undesignated aquifers. All recorder wells are equipped with satellite telemetry that allows publication of near real-time (provisional) data on the TWDB web site. This annual summary report includes location maps, tables listing water level changes, and hydrographs for the period of record (up through the end of 2011) in all online recorders in these geographic areas (figure 2-1):

- Northwest Texas (Ogallala and Seymour major aquifers; Edwards-Trinity (High Plains) minor aquifer; and one undesignated aquifer),
- West Texas (Hueco-Mesilla Bolson and Pecos Valley major aquifers; Bone Spring-Victorio Peak, Igneous, West Texas Bolsons, and Lipan minor aquifers; and two undesignated aquifers),
- North-Central Texas (Trinity and Edwards (BFZ) major aquifers and Woodbine minor aquifer),
- East and South Texas (Carrizo-Wilcox and Gulf Coast major aquifers), and
- Central Texas (Trinity and Edwards-Trinity (Plateau) major aquifers and Hickory and Ellenburger-San Saba minor aquifers).

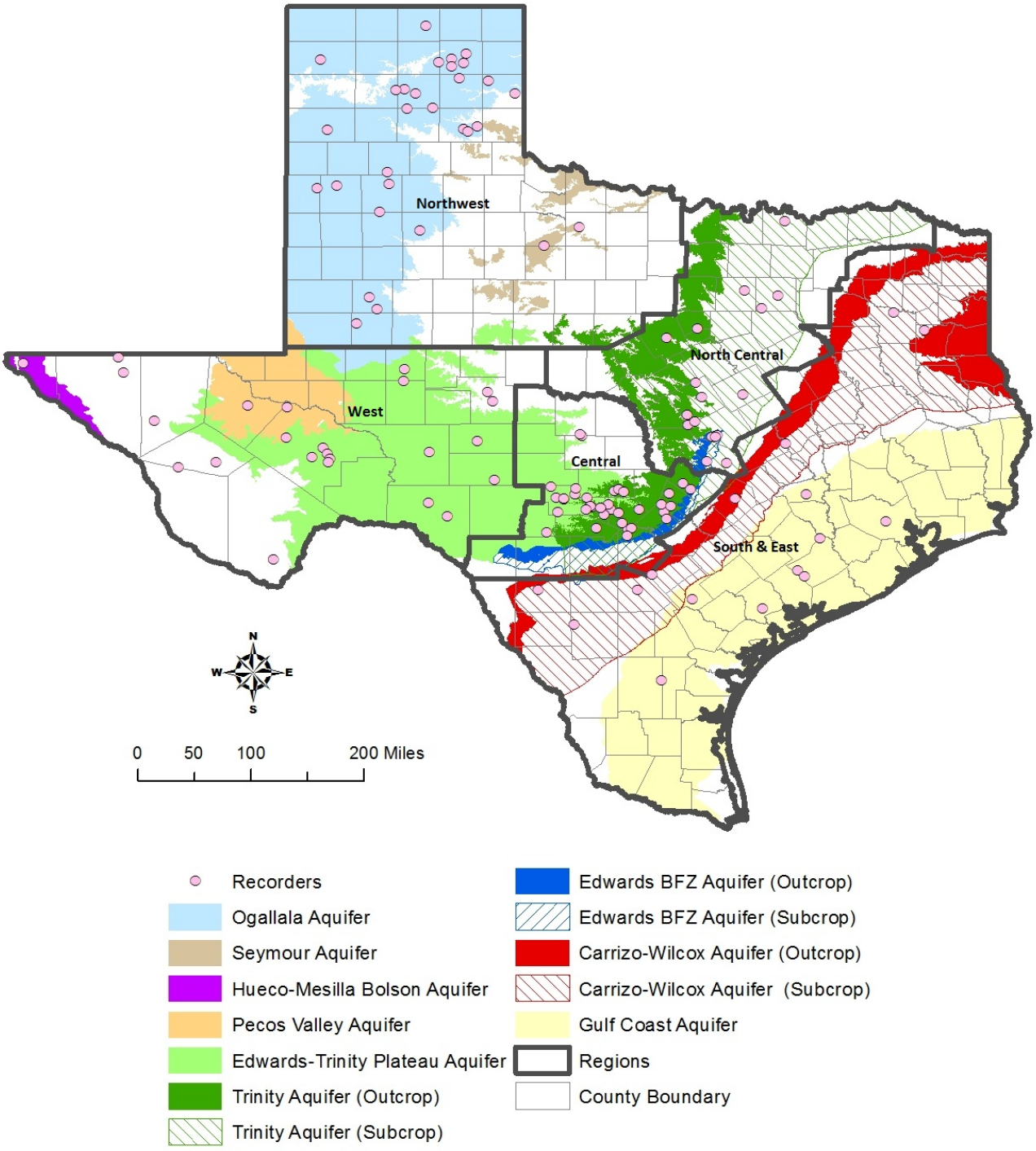


Figure 2-1. Location of 110 recorder wells operated by the TWDB and cooperators and areas discussed in this report.

3.0 Northwest Texas (including the High Plains and Rolling Plains)

The TWDB monitors 30 recorder wells in the northwest part of the state, in the High Plains (Panhandle) and the Rolling Plains areas (figure 3-1). There are 28 wells in the High Plains, including 26 wells completed in the Ogallala Aquifer, one in the Edwards-Trinity High Plains Aquifer (in Hale County), and one in the Whitehorse Aquifer (in Wheeler County). Two wells are in the Rolling Plains and are completed in the Seymour Aquifer.

3.1 Major aquifers

Water levels declined in all but one of the 26 Ogallala Aquifer wells from 2010 to 2011 (table 3-1 and figure 3-2). Changes in levels ranged from +1.2 feet to -36.9 feet, with a median of -1.8 feet and an average of -3.5 feet. By contrast, water level changes in these Ogallala Aquifer wells from 2009 to 2010 ranged from -18.4 feet to +6.48 feet, with a median change of -0.4 feet and an average change of -1 foot.

The Ogallala Aquifer is used primarily for crop irrigation and has experienced water level decline throughout its extent as corroborated in the historical and yearly average changes. The Panhandle Groundwater Conservation District has also increased monitoring efforts in the past decade through the installation of 11 recorder wells where groundwater is also being pumped for municipal purposes, e.g. in Roberts, Carson, Potter, and Armstrong counties. The largest 2010 to 2011 decline (nearly 37 feet) in the Ogallala Aquifer occurred in one of the district's monitoring wells—0510923—in Roberts County.

Water level rises in the Ogallala Aquifer have occurred, but less frequently and in fewer locations than water level declines. Typically, these water level rises occur within an overall trend of decline. Smaller rises, such as the one experienced in the southern High Plains (e.g., a 1.2 foot rise in Dawson 2825604 recorder well after a 1.1 foot rise in the previous year) for the most recent year occur in a few other areas throughout the Panhandle where irrigation pumping has decreased. There may be other factors that account for the small declines in several Dawson County wells.

The Seymour Aquifer wells experienced declines of 2.3 feet in Haskell County and 4.0 feet in Baylor County from 2010 to 2011, after a rise in each of 0.2 and 2.2 feet, respectively, between 2009 and 2010. Well depths in Baylor County in general and specifically in this recorder well (35 feet vs. Haskell County's 59-foot depth) are shallower, which may account for the slightly more pronounced declines and rises in the Seymour Aquifer in Baylor County.

3.2 Minor and undesignated aquifers

As with the majority of the recorder wells in this region, the water levels in the Hale County Edwards-Trinity High Plains and Wheeler County Whitehorse Aquifer recorder wells declined 2.6 feet and 4.5 feet respectively from 2010 to 2011. The preceding year's change was a rise of 2.8 feet in the Hale County well, but a decline of 1.7 feet in the Wheeler County well.

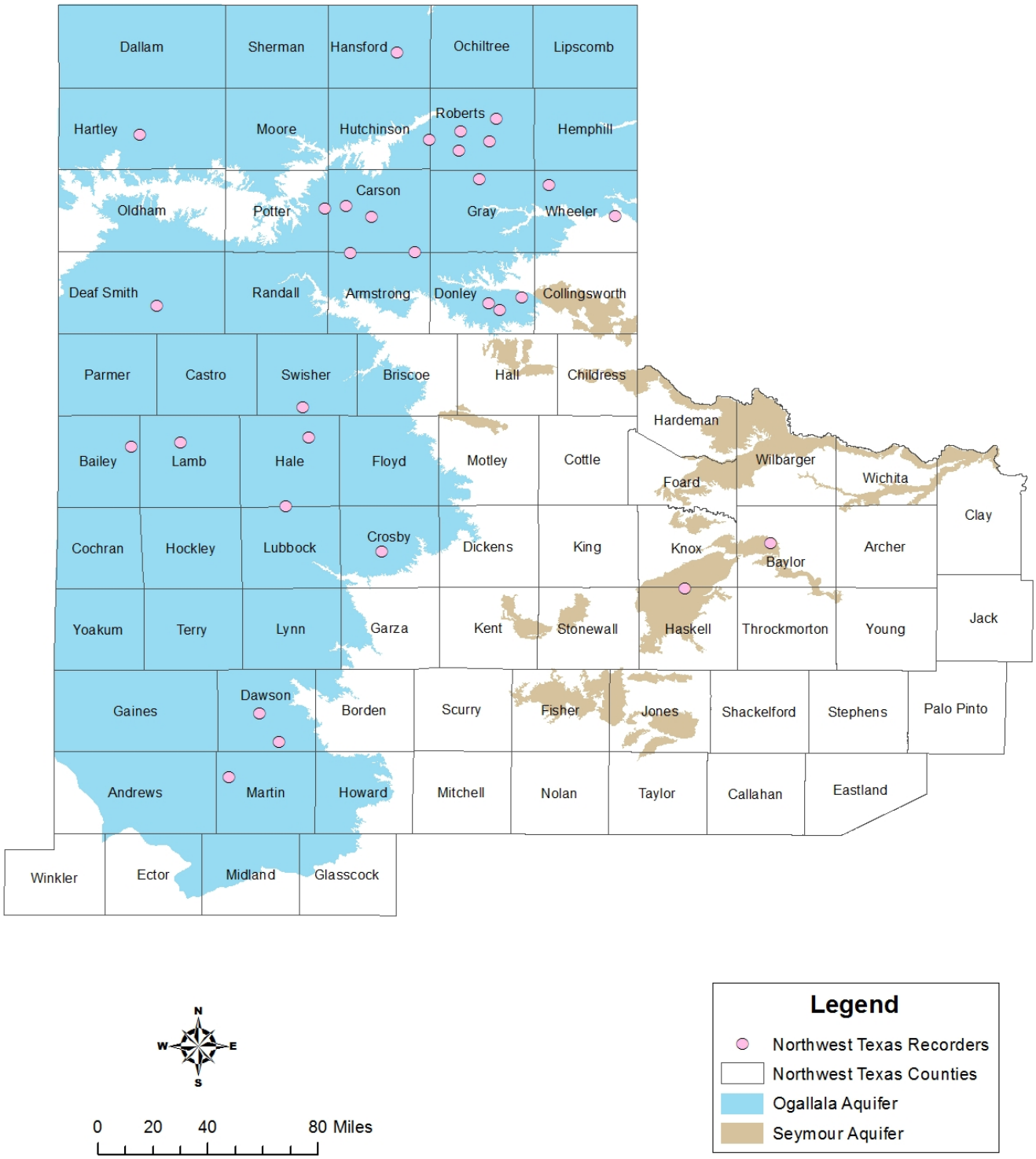


Figure 3-1. Location of wells with TWDB operated automatic water level recorders in northwest Texas.

Table 3-1. Water level changes, in feet, in TWDB recorder wells in northwest Texas counties for various time periods.

County & well #	Aquifer	2011 Change (ft)	2010 Change (ft)	2007-2011 Change (ft)	2002-2011 Change (ft)	Historical Change (ft)	Historical Yearly Avg. (ft)
Hansford 0354301	Ogallala	-0.83	-0.50	-4.29	-10.24	-83.18 (1951)	-1.36
Roberts 0503709	Ogallala	-0.59	0.63	0.09	N/A	-1.00 (2005)	-0.15
Roberts 0509553	Ogallala	-2.56	-0.33	-9.09	N/A	-16.30 (2002)	-1.81
Roberts 0510953	Ogallala	-36.93	-18.35	-56.58	-57.18	-57.18 (2002)	-5.72
Roberts 0517203	Ogallala	-0.62	-0.37	-3.07	-6.27	-6.73 (2000)	-0.56
Gray 0526501	Ogallala	-1.65	-1.90	-3.13	-5.89	-25.05 (1958)	-0.46
Wheeler 0529711	Ogallala	-1.75	-0.39	-3.19	N/A	-10.24 (1967)	-0.23
Wheeler 0539904	Whitehorse	-4.51	-1.71	0.05	N/A	-15.44 (1966)	-0.34
Hutchinson 0616702	Ogallala	-0.76	-0.80	-0.41	N/A	-4.17 (2003)	-0.52
Potter 0635912	Ogallala	-1.69	-0.63	-4.79	N/A	-5.33 (2006)	-0.97
Carson 0636602	Ogallala	-4.79	-1.82	-16.94	-24.65	-95.46 (1955)	-1.74
Carson 0645305	Ogallala	-4.15	-1.45	-7.18	N/A	-9.18 (2003)	-1.02
Armstrong 0652603	Ogallala	-0.46	-0.17	-1.58	-2.17	-2.17 (2001)	-0.22
Armstrong 0655504	Ogallala	-2.52	-0.18	N/A	N/A	-31.75 (1975)	-0.88
Hartley 0712401	Ogallala	-2.52	-1.03	-9.01	-20.33	-29.56 (1963)	-0.60
Deaf Smith 1004901	Ogallala	-2.23	-1.59	-5.68	-4.58	-27.67 (1975)	-0.75
Bailey 1051909	Ogallala	-1.10	1.04	-5.25	-11.51	-17.37 (1981)	-0.58
Lamb 1053602	Ogallala	-1.30	-1.91	-8.88	-22.80	-112.33 (1951)	-1.84
Swisher 1142315	Ogallala	-0.49	-0.42	-2.07	-4.71	-15.67 (1988)	-0.67
Hale 1151403	Ogallala	-1.88	-2.70	-10.52	-19.90	-45.13 (1988)	-1.91
Donley 1202959	Ogallala	-4.86	N/A	N/A	N/A	-4.08 (2010)	-4.08
Donley 1204452	Ogallala	-5.52	1.85	N/A	N/A	-4.22 (2009)	-1.69
Donley 1211118	Ogallala	-0.41	-0.43	N/A	N/A	-2.41 (2008)	-0.64
Baylor 2122850	Seymour	-3.96	2.23	N/A	N/A	-2.94 (2009)	-0.98
Haskell 2135748	Seymour	-2.34	0.24	-3.84	N/A	-4.75 (2002)	-0.51
Hale 2310401	Edwards-Trinity (High Plains)	-2.62	2.75	-0.18	0.14	0.58 (2001)	0.06
Crosby 2330103	Ogallala	-3.40	1.83	-4.02	-7.73	-8.13 (1965)	-0.18
Martin 2739903	Ogallala	-2.95	-3.10	-5.99	-6.94	-35.37 (1964)	-0.75
Dawson 2817119	Ogallala	-5.34	6.48	-1.88	-13.86	-16.28 (2001)	-1.48
Dawson 2825604	Ogallala	1.20	1.09	4.65	3.28	4.56 (2000)	0.38

Potter County Recorder 0635912

Carson County Recorder 0636602

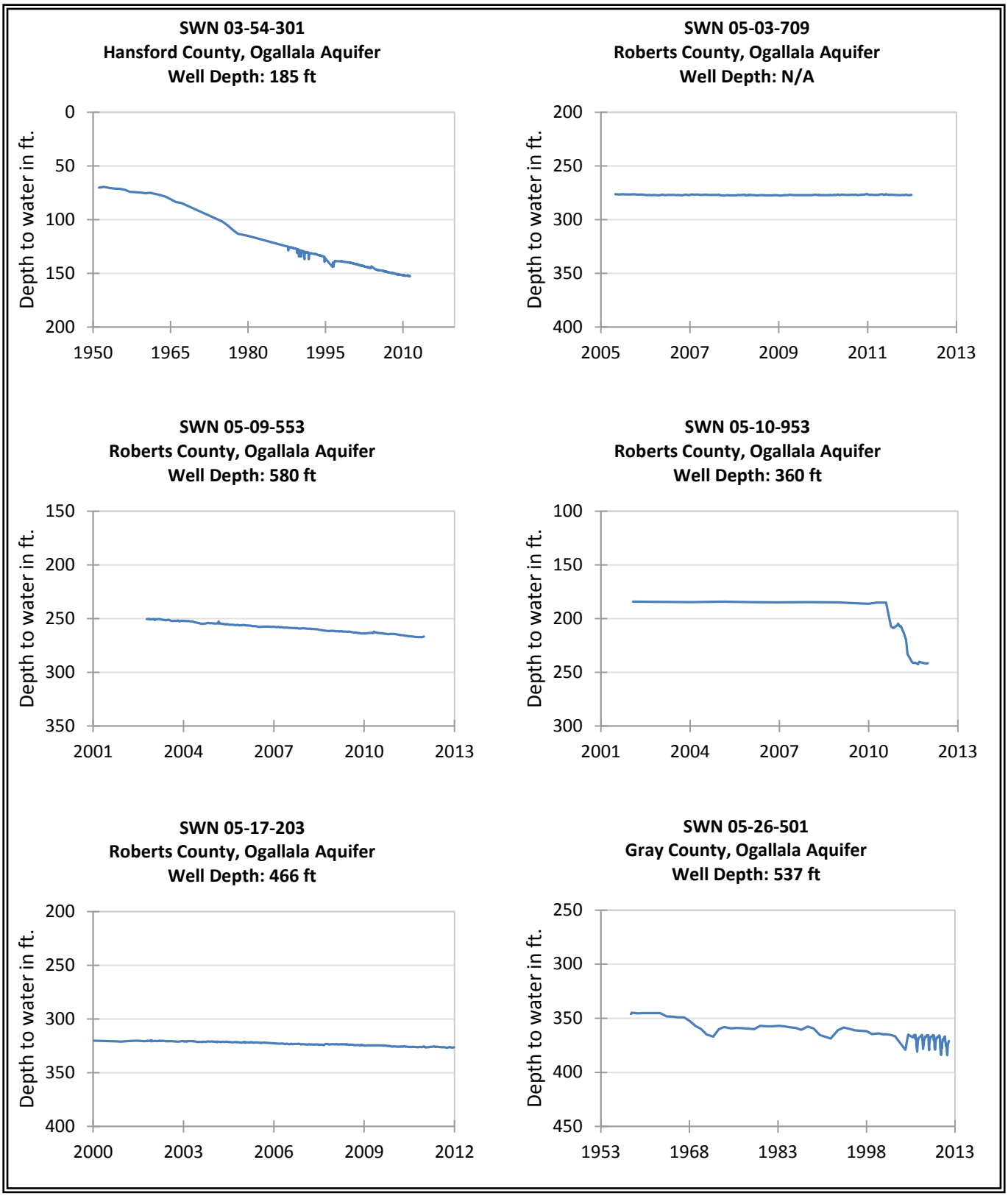


Figure 3-2. Selected hydrographs of TWDB recorder wells in northwest Texas counties.

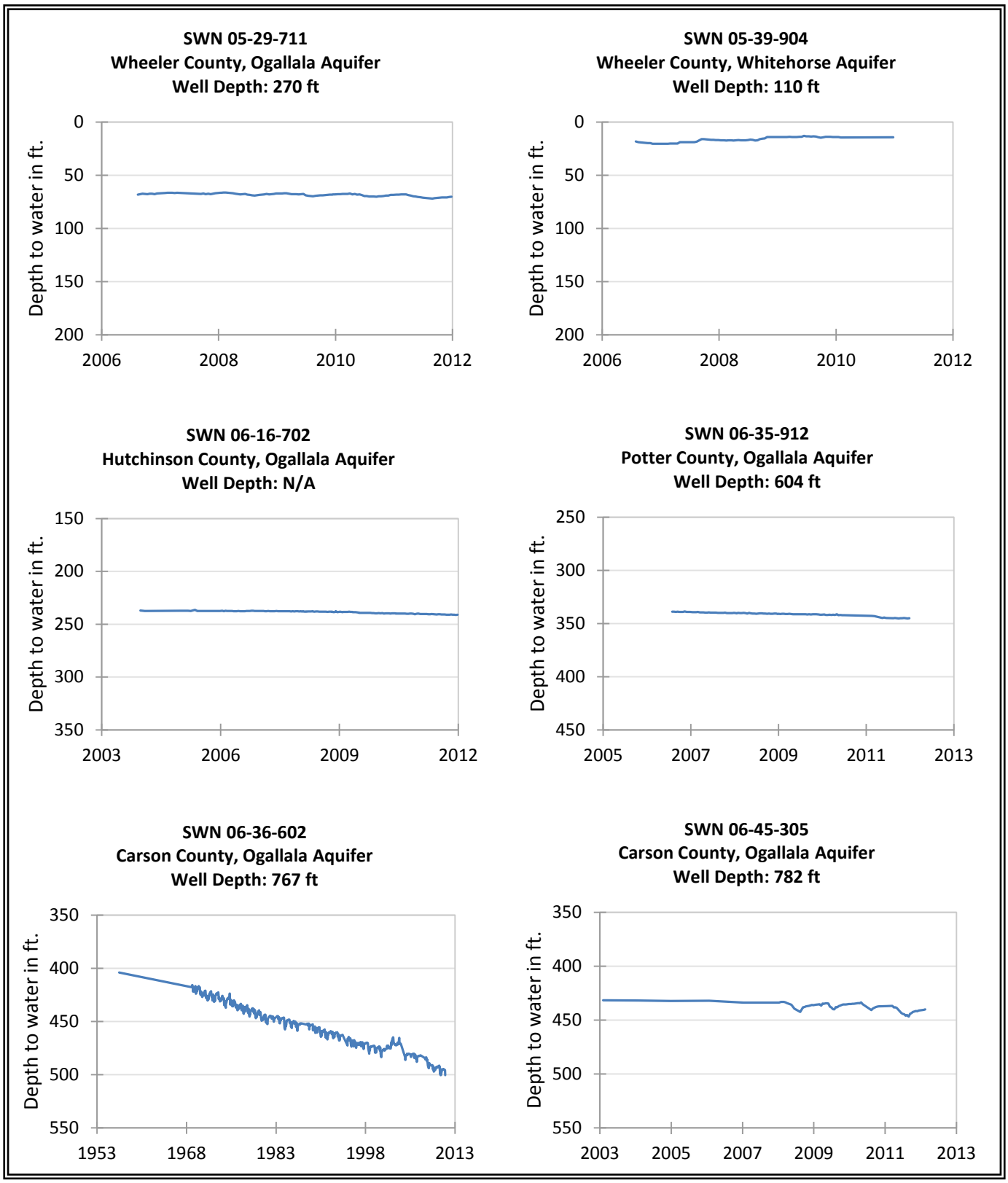


Figure 3-2 (cont'd). Selected hydrographs of TWDB recorder wells in northwest Texas counties.

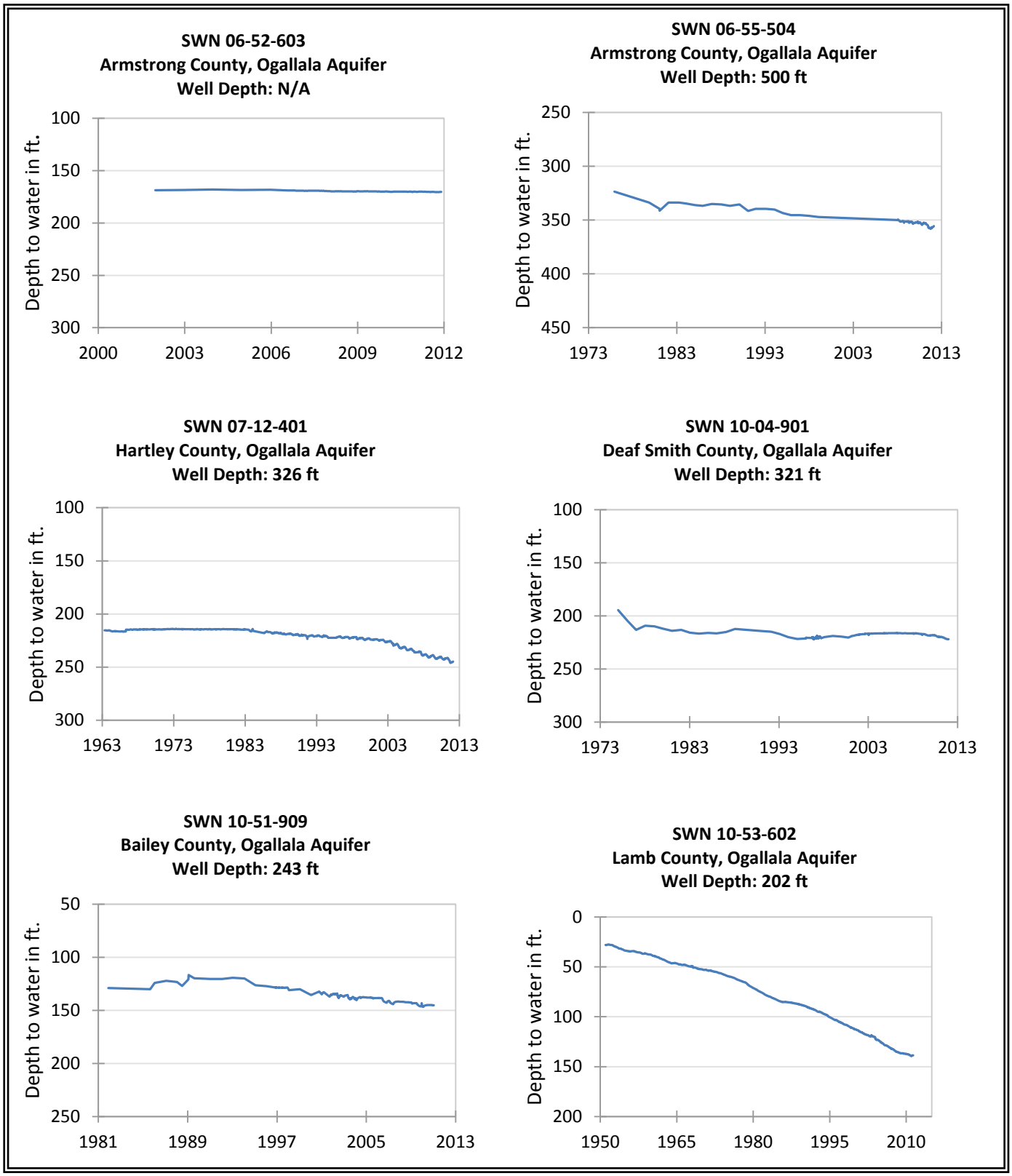


Figure 3-2 (cont'd). Selected hydrographs of TWDB recorder wells in northwest Texas counties.

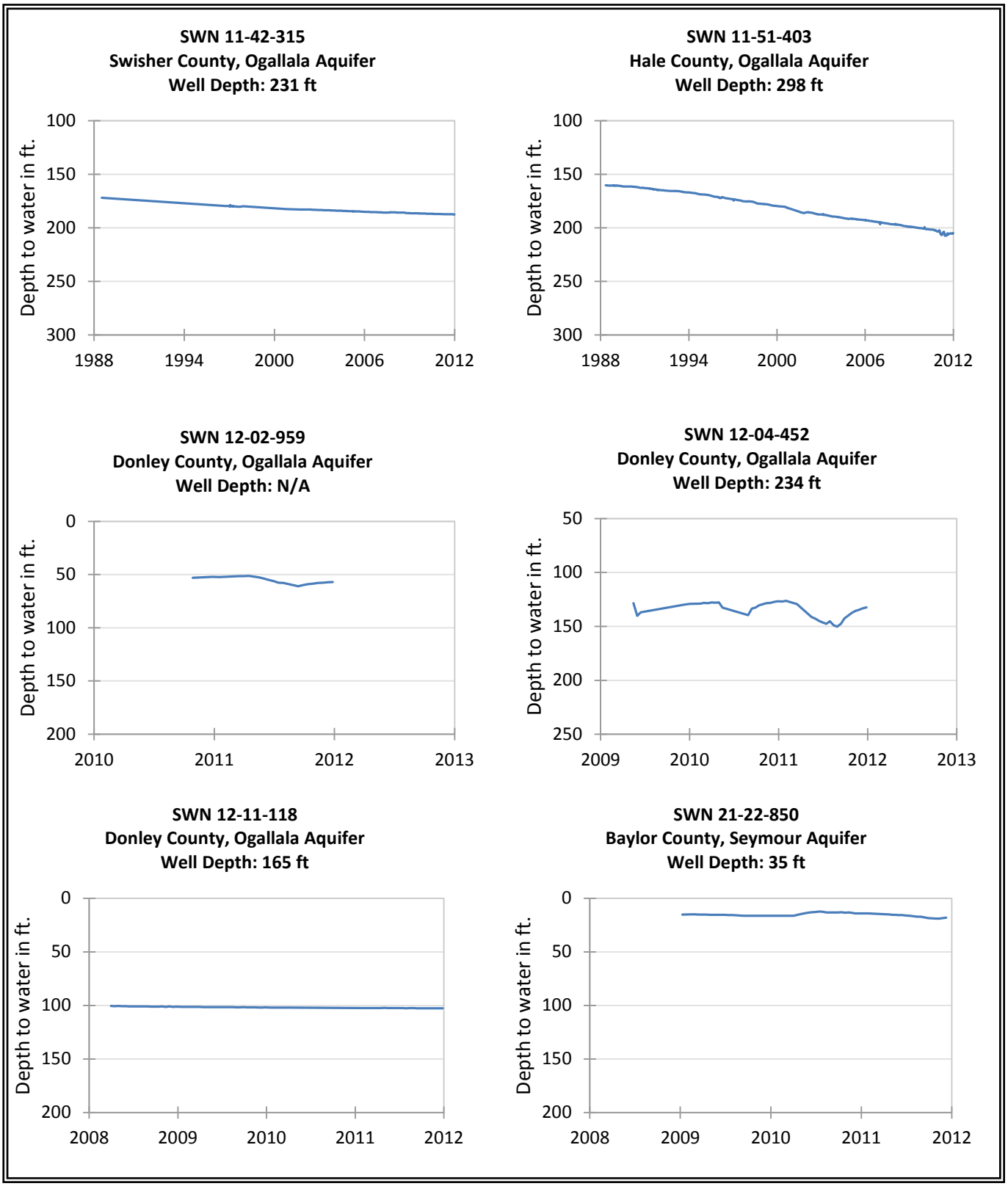


Figure 3-2 (cont'd). Selected hydrographs of TWDB recorder wells in northwest Texas counties.

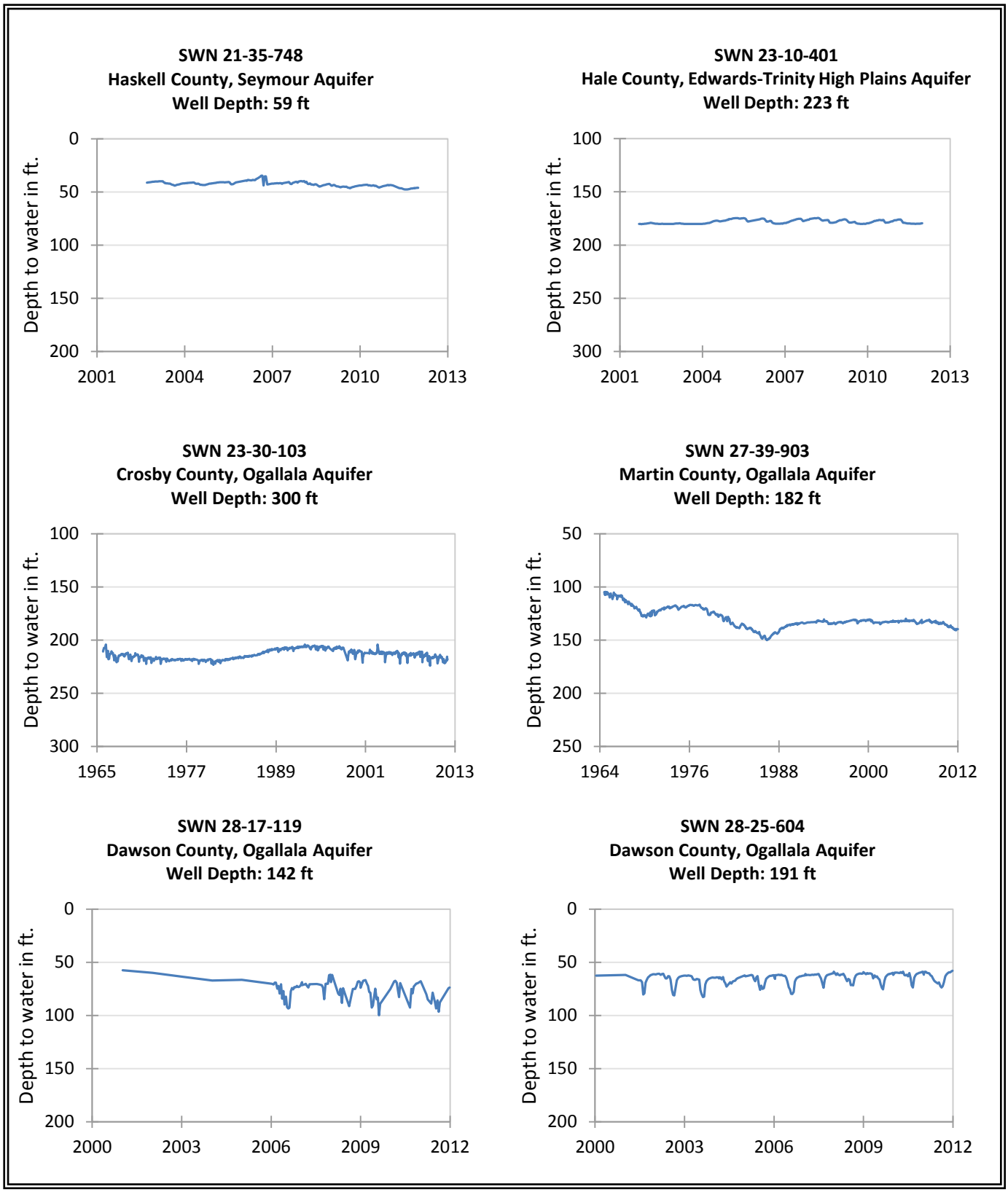


Figure 3-2 (cont'd). Selected hydrographs of TWDB recorder wells in northwest Texas counties.

4.0 West Texas

TWDB monitors 24 wells in West Texas (figure 4-1) of which 16 are wells completed in major aquifers and 8 are wells completed in the minor aquifers. The wells completed in the major aquifers include 13 wells in the Edwards Trinity (Plateau) Aquifer, two wells in the Pecos Valley Aquifer, and one well in the Hueco-Mesilla Bolson Aquifer. The eight recorder wells in minor aquifers include two in the Lipan Aquifer, two wells in the Bone Spring-Victorio Peak Aquifer, one well in the West Texas Bolsons, and one well in the Igneous Aquifer. One recorder well is completed in Quaternary volcanic rocks of an undesignated aquifer in Brewster County, and one recorder well is completed in the Cretaceous Aquifer in Culberson County.

4.1 Major Aquifers

Water level changes in the wells completed in major aquifers were mainly declines (table 4-1 and figure 4-2). Water level changes in the Edwards-Trinity (Plateau) Aquifer wells between 2010 and 2011 ranged from +1.87 foot in Sutton County to -11.9 in central Pecos County, with a median of -0.7 feet and an average of -2.25 feet. The median water level change in the wells with available measurements from the preceding year (2009 to 2010) was -1.3 feet with an average of -1.8 feet and a range of +0.8 to -8.1 feet.

Water levels in two Pecos Valley Aquifer recorder wells declined 2.6 and 12. 5 feet from 2010 to 2011, in comparison to the previous year declines of 2.5 feet and 0.5 feet, respectively.

Water levels in the Hueco-Mesilla Bolson Aquifer well rose 1.5 feet from 2010 to 2011 after the preceding year's rise of nearly one foot. The levels in this well have declined 58 feet over a nearly 60-year period. However, in the past several years the water levels, while continuing to fluctuate a negligible amount, have remained relatively flat.

4.2 Minor and Undesignated Aquifers

Water level changes in wells completed in minor aquifers were the greatest in the two Lipan Aquifer wells in Tom Green County. Water levels from 2010 to 2011 declined in both wells: 13.1 and 14.0 feet, compared to the 2009 to 2010 change of +0.1 and +4.0 feet, respectively.

The hydrograph of the Bone Spring-Victorio Peak Aquifer well in Hudspeth County with the longest (56 year) history in these West Texas wells reveals an overall water level decline. However, water levels in this aquifer have experienced seasonal rebounds and remained relatively flat from the mid-1980s to mid-1990s. The hydrograph of the recently-installed second Bone Spring-Victorio Peak Aquifer well recorder also reveals an average rate of decline at 1.1 feet/year, a decline rate greater than that in the recorder on the well with the long history, currently at 0.7 feet/year of decline.

From 2010 to 2011 water level changes in the recorder wells were -0.5 feet in the Igneous Aquifer of Jeff Davis County (Fort Davis State Park) and +0.3 feet in the West Texas Bolsons Aquifer of Presidio County From 2009 to 2010 these changes were +0.1 and +0.4 feet, respectively. For the 12 and 32 years of monitoring, water levels in these wells have experienced changes of -3.7 and +16.7, respectively.

The water level change from 2010 to 2011 in the Cretaceous Aquifer recorder well in Culberson County was -0.3 feet following a 2009 to 2010 change of- 0.1 feet. For the 16-year period of record, the water level declined by 0.7 feet. The water level change from 2010 to 2011 in the Volcanics Aquifer recorder well in Brewster County was -10.6 feet following a 2009 to 2010 change of -12.8 feet. For the four-year period of record, the water level declined by 21.7 feet. This unused well in Big Bend National Park is within 100 to 200 feet of several active municipal supply park wells.

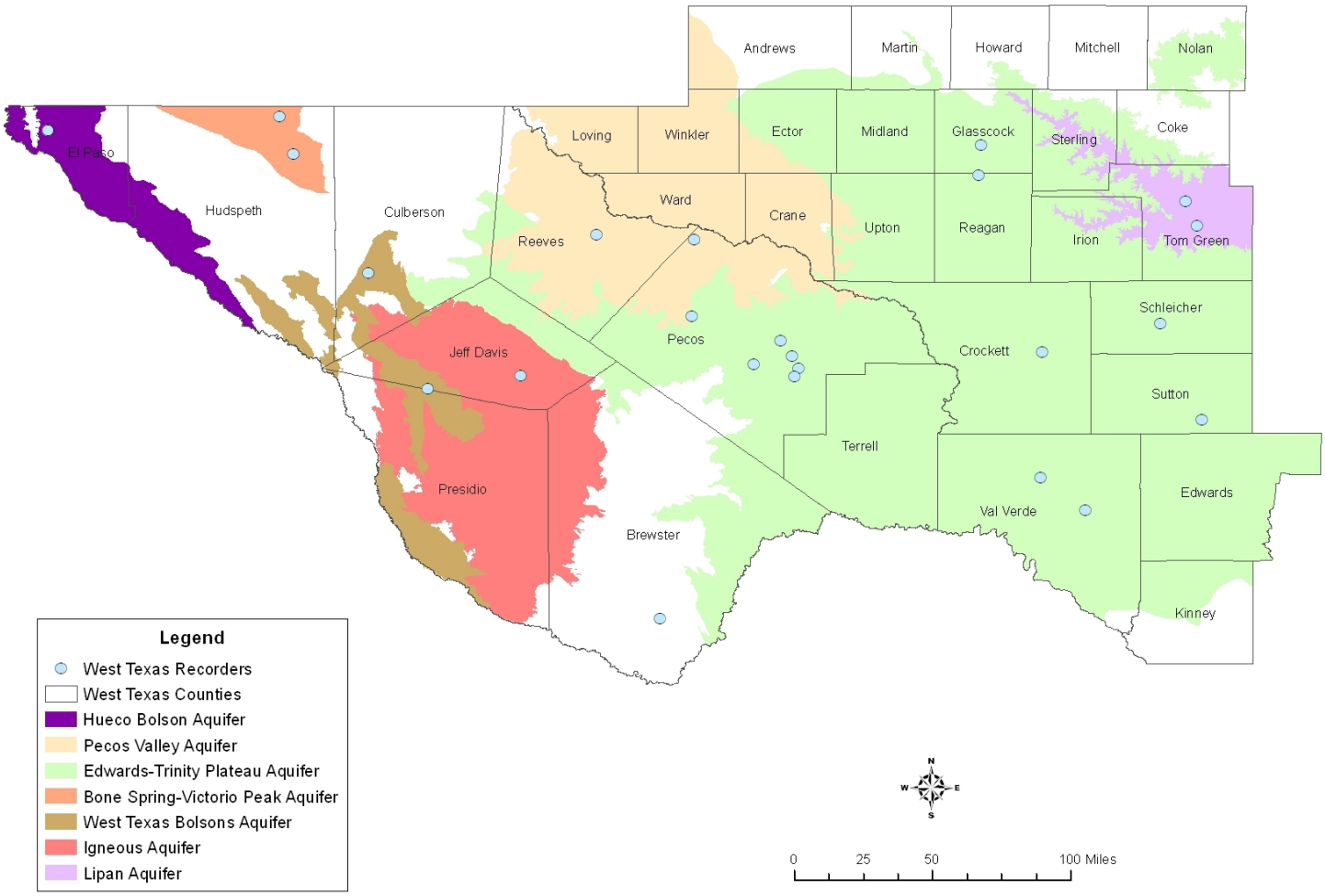


Figure 4-1. Location of wells with TWDB operated automatic water level recorders in Wwest Texas.

Table 4-1. Water level changes, in feet, in TWDB recorder wells in West Texas counties for various time periods.

County & well #	Aquifer[1]	2011 Change (ft)	2010 Change (ft)	2007-2011 Change (ft)	2002-2011 Change (ft)	Historical Change (ft)	Historical Yearly Avg. (ft)
4337101 Tom Green	Lipan	-13.11	0.11	-10.71	N/A	-13.44 (2005)	-2.07
4345306 Tom Green	Lipan	-13.95	3.95	-2.68	-6.32	-24.14 (1991)	-1.21
4412611 Glasscock	ET (P)	-3.02	-0.17	-6.58	-15.93	-15.03 (2001)	-1.40
4420854 Reagan	ET (P)	-0.12	-1.33	-2.46	-5.15	-15.8 (1990)	-0.72
4644501 Reeves	Pecos Valley	-2.58	-2.49	-6.87	-12.15	-54.39 (1952)	-0.91
4648604 Pecos	Pecos Valley	-12.45	-0.49	-19.68	-15.76	-163.38 (1958)	-3.03
4759123 Culberson	Cretaceous	-0.30	-0.16	-2.51	-4.32	-11.88 (1995)	-0.74
4807516 Hudspeth	Bone Spring-Victorio Peak	-2.19	-0.12	-4.88	-9.47	-31.61 (1966)	-0.69
4815903 Hudspeth	Bone Spring-Victorio Peak	-2.90	0.80	-5.50	N/A	-6.40 (2006)	-1.11
4913301 El Paso	Hueco Mesilla Bolson	1.51	0.98	-0.75	-3.42	-57.70 (1964)	-1.23
5129805 Presidio	West Texas Bolson	0.29	0.40	1.20	2.63	16.72 (1979)	0.51
5216802 Pecos	ET (P)	-5.55	-8.14	-22.22	0.36	45.78 (1976)	1.27
5225209 Jeff Davis	Igneous	-0.54	0.08	-1.83	-2.81	-3.68 (1999)	-0.29
5319701 Pecos	ET (P)	-11.93	-4.94	N/A	N/A	-16.13 (2009)	-8.07
5320603 Pecos	ET (P)	-0.96	-1.64	N/A	N/A	-2.80 (2009)	-1.12
5320903 Pecos	ET (P)	-0.74	N/A	N/A	N/A	-1.33 (2010)	-0.89
5321704 Pecos	ET (P)	0.07	N/A	N/A	N/A	-0.22 (2010)	-0.18
5328303 Pecos	ET (P)	0.19	0.05	N/A	N/A	0.69 (2008)	0.20
5423106 Crockett	ET (P)	-0.67	-0.84	0.15	N/A	1.80 (1963)	0.04
5463401 Val Verde	ET (P)	-0.67	0.77	N/A	N/A	-0.43 (2005)	-0.07
5512134 Schleicher	ET (P)	-7.74	-1.88	-15.72	N/A	-9.08 (2003)	-1.07
5545308 Sutton	ET (P)	1.87	-2.08	N/A	N/A	-1.49 (2009)	-0.50
7001707 Val Verde	ET (P)	0.02	0.03	N/A	N/A	-3.55 (2006)	-0.62
7347404 Brewster	Volcanics	-10.59	-12.79	N/A	N/A	-21.71 (2007)	-4.82

1. ET(P) – Edwards Trinity (Plateau) Aquifer

Brewster County Recorder 7347404

Pecos County Recorder 5216802

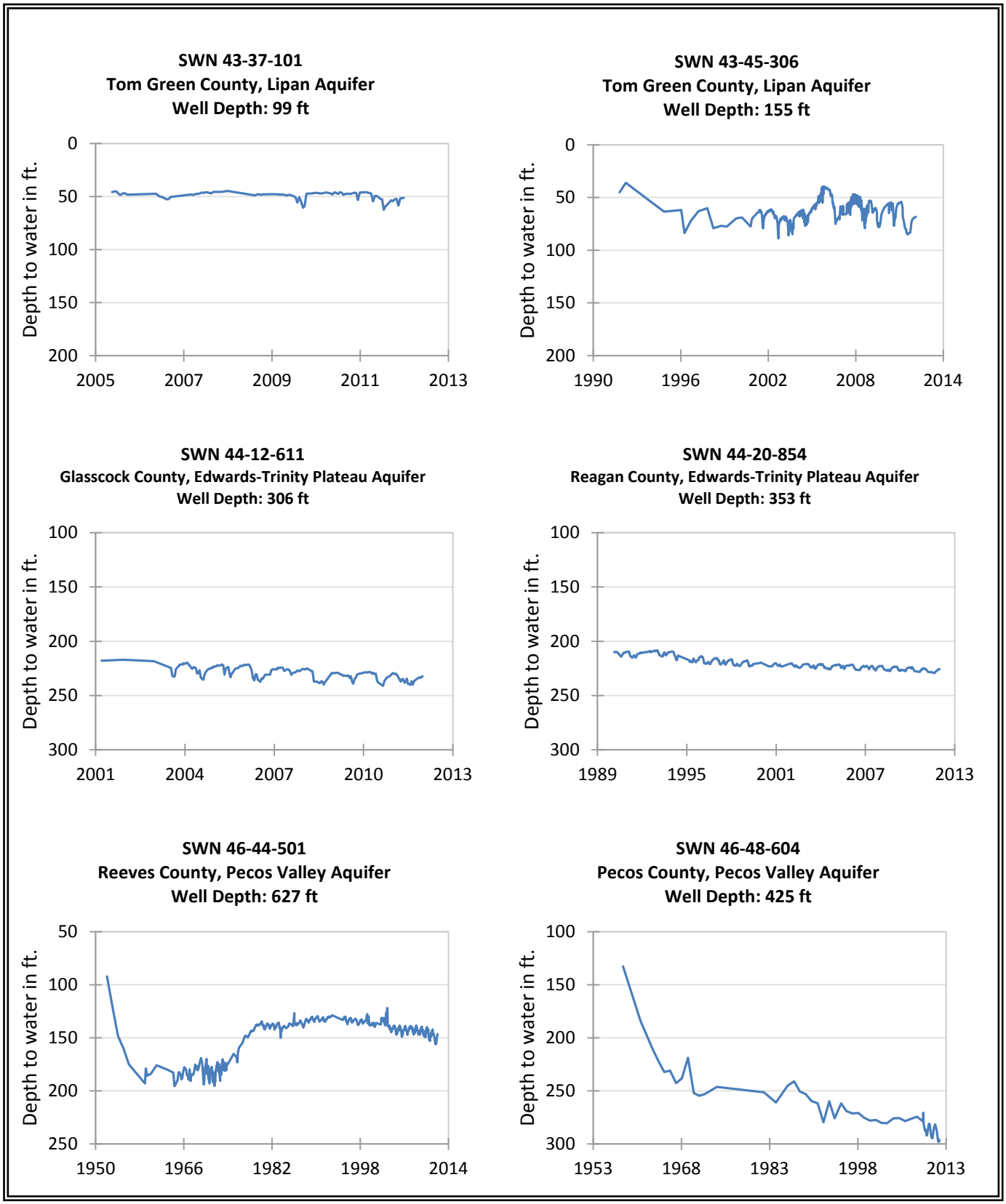


Figure 4-2. Selected hydrographs of TWDB recorder wells in West Texas.

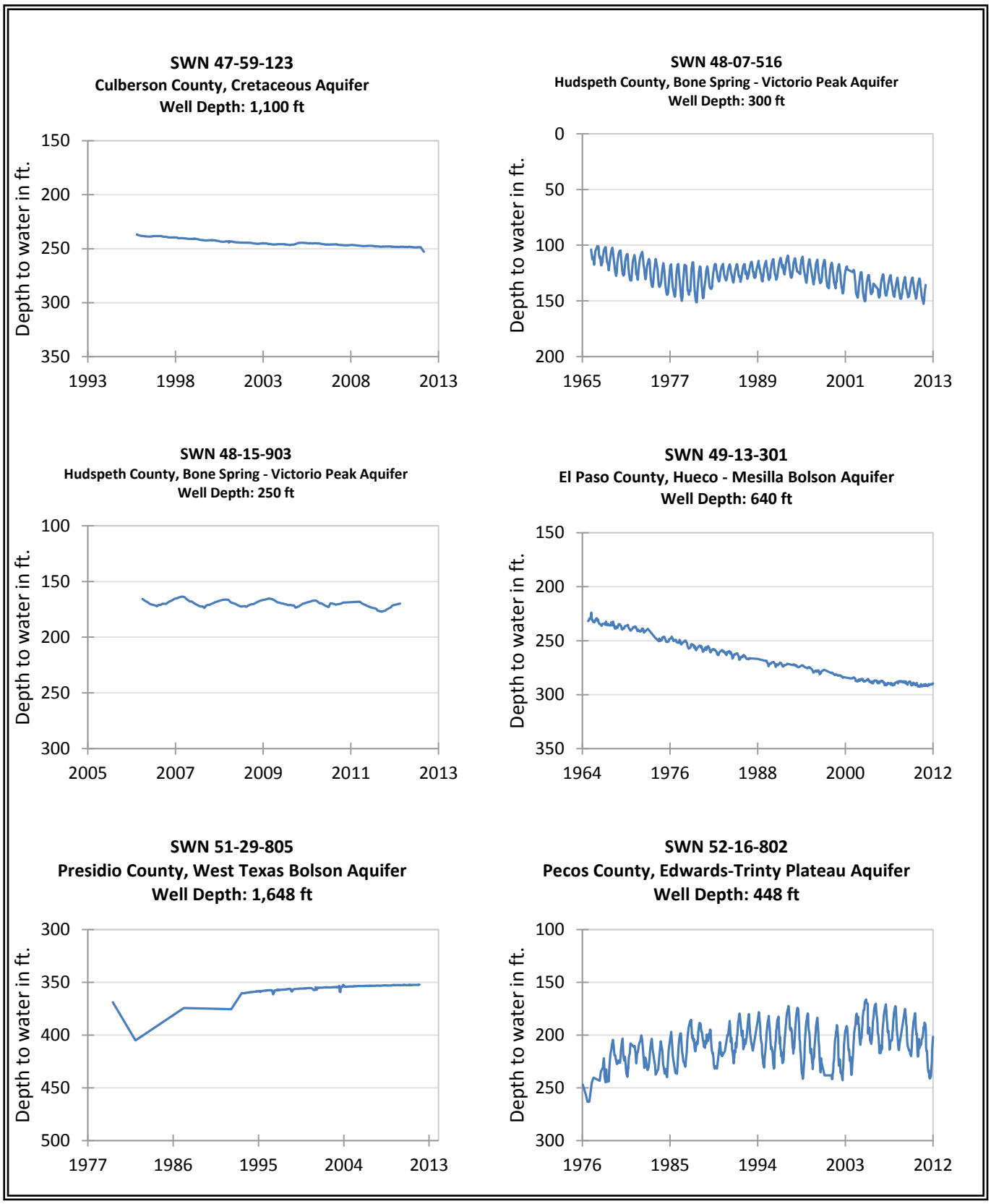


Figure 4-2 (cont'd). Selected hydrographs of TWDB recorder wells in West Texas.

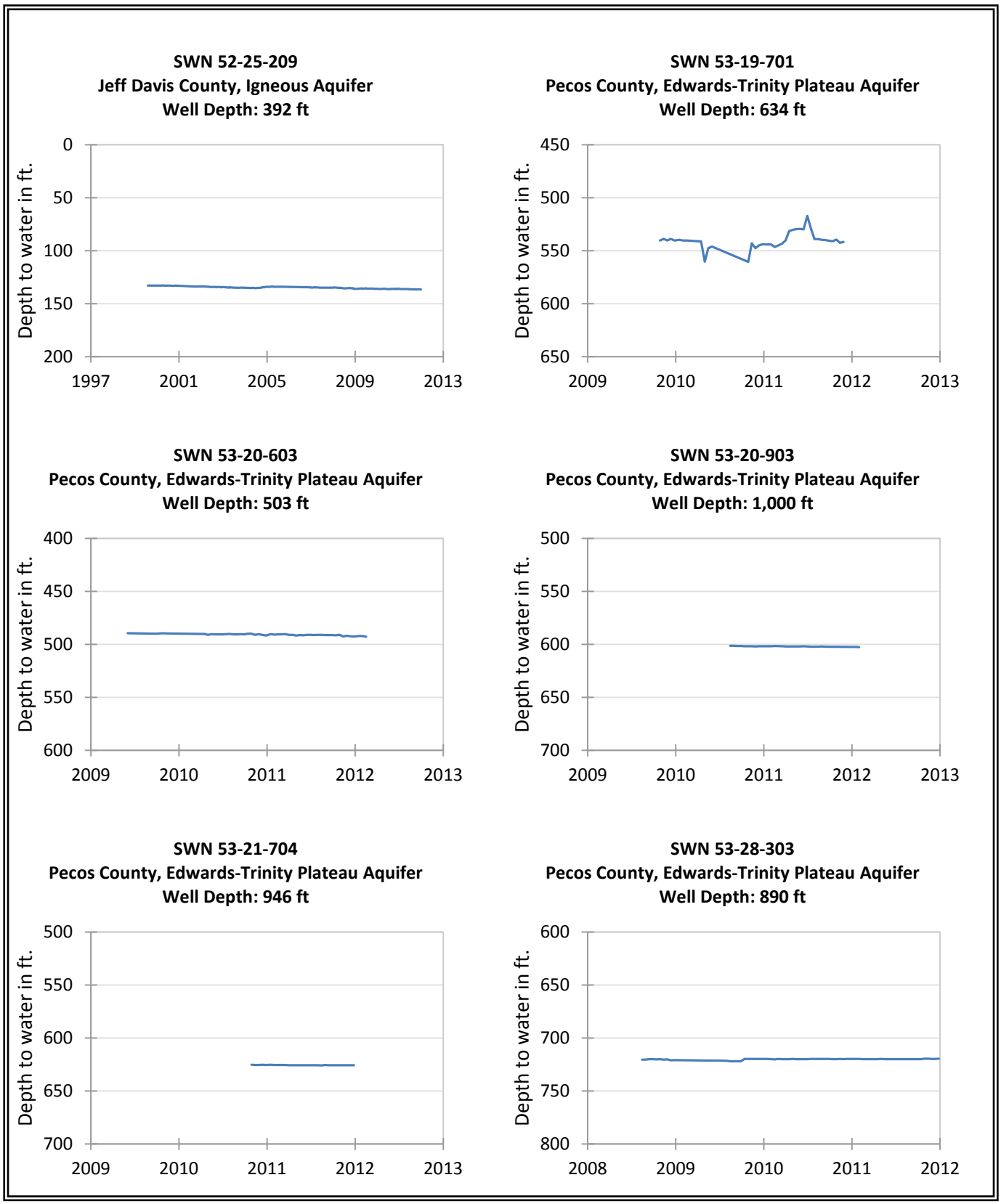


Figure 4-2 (cont'd). Selected hydrographs of TWDB recorder wells in West Texas.

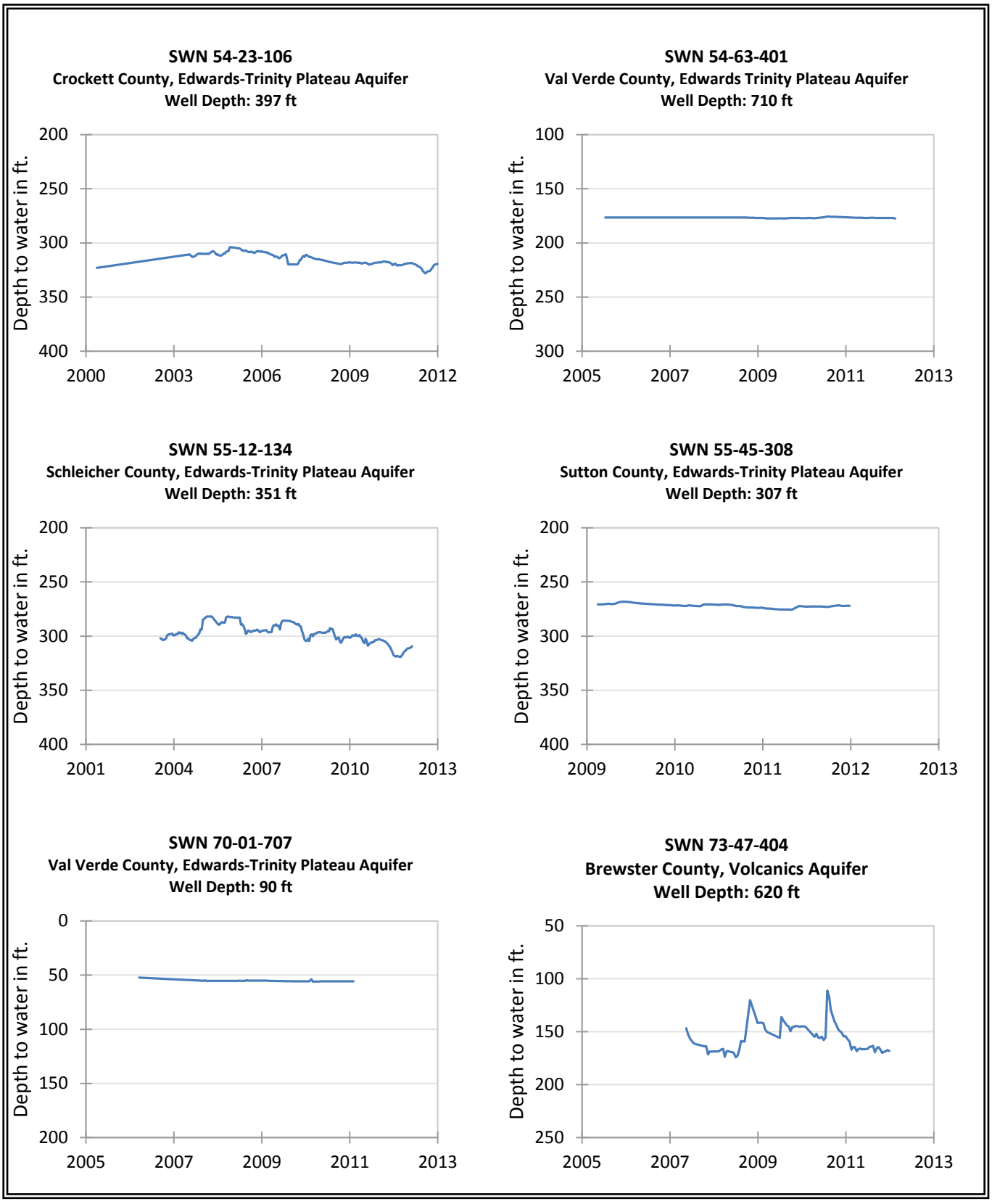


Figure 4-2 (cont'd). Selected hydrographs of TWDB recorder wells in West Texas.

5.0 North Central Texas

TWDB monitors 18 recorders in North Central Texas, all but one of which are in wells completed in major aquifers (figure 5-1). Thirteen wells are completed in the Trinity Aquifer, four wells are in the northern segment of the Edwards Trinity (Balcones Fault Zone (BFZ)) Aquifer in (south central) Bell and Williamson counties, and one well is in the minor Woodbine Aquifer in Grayson County.

5.1 Major Aquifers

The Trinity Aquifer covers a large area with diverse hydrologic conditions. Monitoring wells with recorders operated by the TWDB extend from Tarrant and Dallas counties in the north to Williamson County in the south and are also completed in both the outcrop and downdip (artesian) portions of the aquifer. Water levels in recorder wells in the Trinity Aquifer experienced relatively large declines compared to water level declines in recorder wells in other major aquifers (table 5-1 and figure 5-2). Between 2010 and 2011, changes ranged from -0.6 feet in the Tarrant County well to -43.1 foot in the McLennan County recorder south of Waco, with a median change of -8.5 feet and an average of -12.0 feet. By contrast, between 2009 and 2010, water level changes ranged from +2.4 to -8.8 feet with a median water level change in the 11 wells with available measurements of -0.2 feet and an average of -2.5 feet.

The McLennan County recorder well has been measured since 1964 and water levels have declined nearly 720 feet. The Williamson County 5859603 well was initially monitored as a flowing artesian well, with a water level at an estimated height of 50 feet above land surface from the 1958 original pressure gauge reading. However, recent water level measurements show a water level at nearly 200 feet below land surface.

In the four Edwards (BFZ) Aquifer recorder wells, changes between 2010 and 2011 ranged from +10.5 to -21.4 feet, with a median change of -3.5 feet and an average change of -4.5 feet. Between 2009 and 2010, changes ranged from +2.7 to -22.8 feet with a median change of -2.6 feet and and average change of -6.3 feet.

Two of these Edwards (BFZ) Aquifer wells have been measured since 1980 (table 5-1), with water level declines ranging from . -7.2 and -4.8 feet, or an average of -0.2 feet per year. These overall changes are similar to the changes experienced in other Edwards (BFZ) Aquifer wells farther to the south. Recorders in the Barton Springs and San Antonio segments of the Edwards (BFZ) Aquifer, operated by other entities, are not discussed in this report.

5.2 Minor Aquifer

The TWDB monitors one unused public (City of Dennison) supply well in the Woodbine Aquifer. The water level declined by 18.9 feet from 2010 to 2011, a sharper decline than the previous year's decline of 13.6 feet. Overall, levels have dropped nearly 50 feet since the well was first measured in 1969.

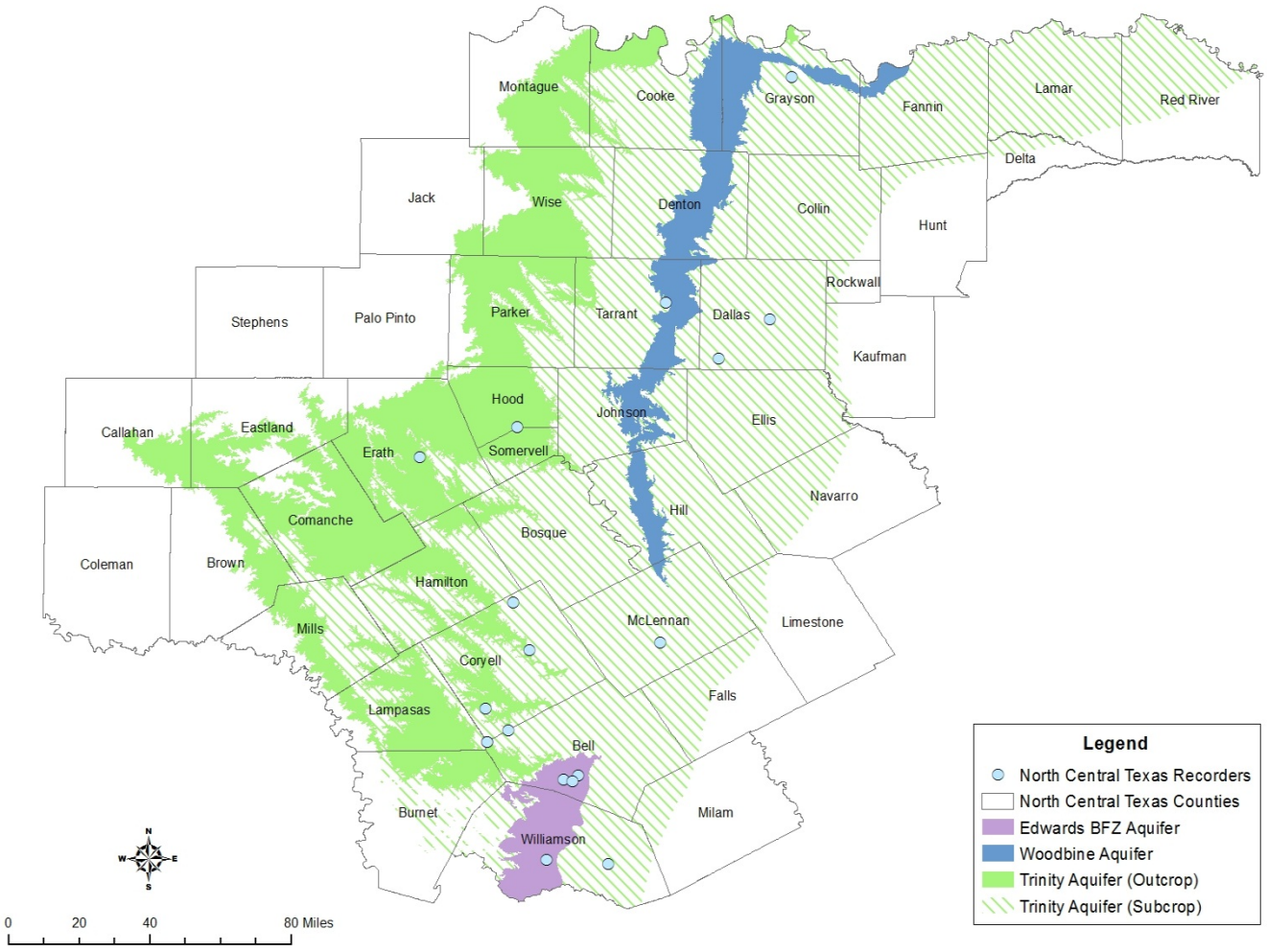


Figure 5-1. Location of wells with TWDB operated automatic water level recorders in North Central Texas.

Table 5-1. Water level changes, in feet, in TWDB recorder wells in North Central Texas counties for various time periods.

County & well #	Aquifer	2011 Change (ft)	2010 Change (ft)	2007-2011 Change (ft)	2002-2011 Change (ft)	Historical Change (ft)	Historical Yearly Avg. (ft)
Grayson 1819301	Woodbine	-18.86	-13.63	12.94	N/A	-48.27 (1969)	-1.15
Erath 3155504	Trinity	-9.20	1.57	-5.45	-3.52	-5.94 (2000)	-0.30
Tarrant 3215504	Trinity	-0.58	-5.20	-6.78	-6.09	-73.20 (1955)	-1.30
Hood 3242604	Trinity	-4.14	0.71	0.73	-14.27	-26.08 (1997)	-1.80
Dallas 3319101	Trinity	-15.79	N/A	-14.77	-8.41	-268.79 (1954)	-4.67
Dallas 3325202	Trinity	-30.39	1.22	N/A	-59.67	-36.05 (2000)	-3.20
Coryell 4026201	Trinity	-5.38	-2.10	-15.48	-30.52	-56.49 (1990)	-2.66
Coryell 4035404	Trinity	-10.71	-3.84	-26.28	-47.69	-200.23 (1955)	-3.54
McLennan 4039204	Trinity	-43.15	-8.75	-64.48	-96.59	-718.78 (1964)	-15.29
Coryell 4049601	Trinity	-4.93	-0.16	-1.34	-14.98	-17.81 (1993)	-0.94
Bell 4057601	Trinity	-8.48	2.43	N/A	N/A	8.22 (2009)	3.65
Bell 4057602	Trinity	-2.85	1.14	N/A	N/A	-3.96 (2009)	-1.76
Bell 4058201	Trinity	-1.06	N/A	N/A	N/A	-1.93 (2010)	-1.10
Bell 5804628	Edwards (BFZ)	10.35	-22.81	N/A	N/A	4.00 (2008)	1.33
Bell 5804702	Edwards (BFZ)	-3.77	-1.59	-2.65	-3.40	-4.80 (1980)	-0.15
Bell 5804816	Edwards (BFZ)	-3.25	-3.64	N/A	N/A	-2.01 (2008)	-0.57
Williamson 5827305	Edwards (BFZ)	-21.43	2.66	5.30	-26.29	-7.24 (1980)	-0.23
Williamson 5829603	Trinity	-19.52	-7.59	-20.64	-22.35	-244.48 (1946)	-3.73

Hood County Recorder 3242604

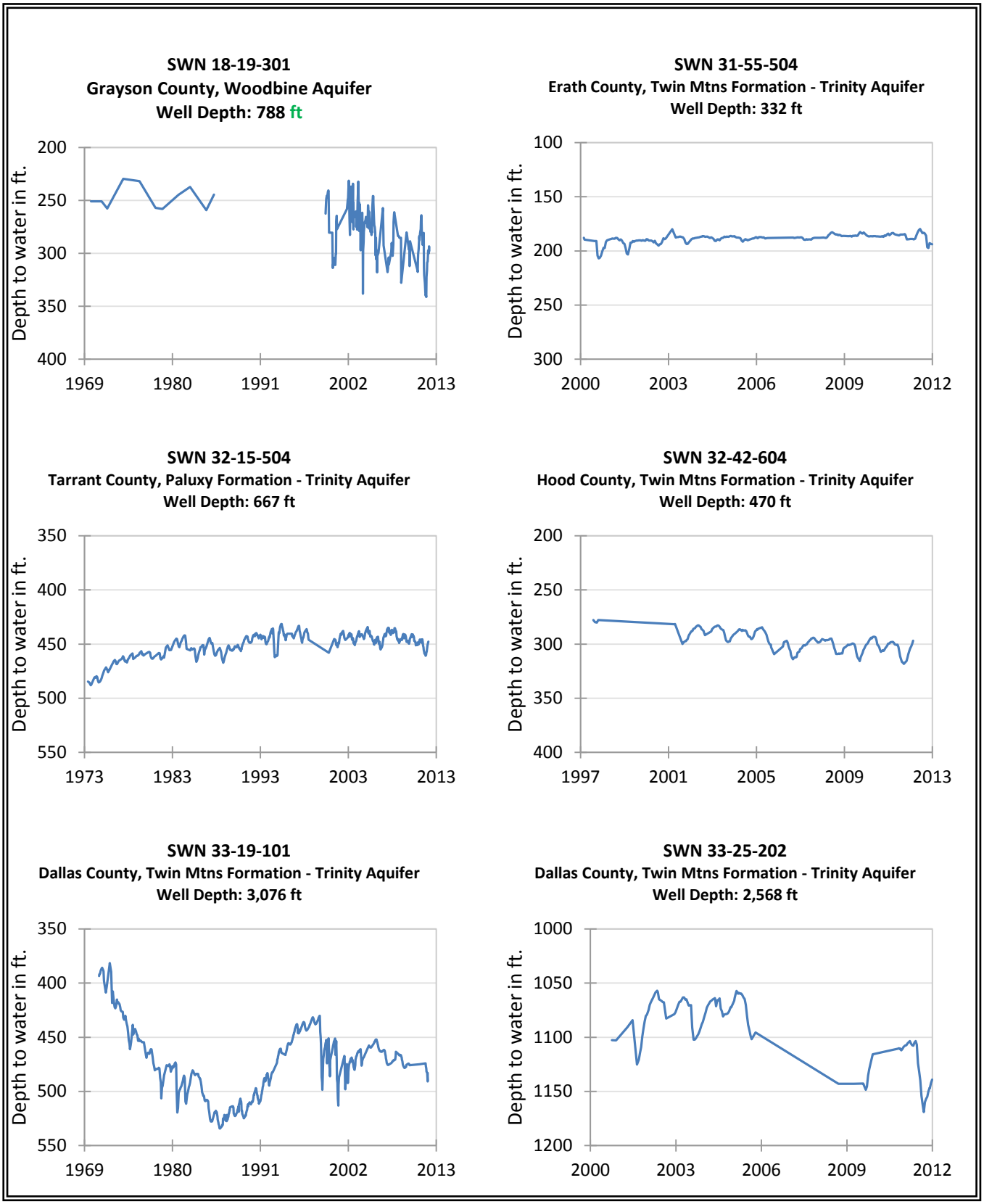


Figure 5-2. Selected hydrographs of TWDB recorder wells in North Central Texas.

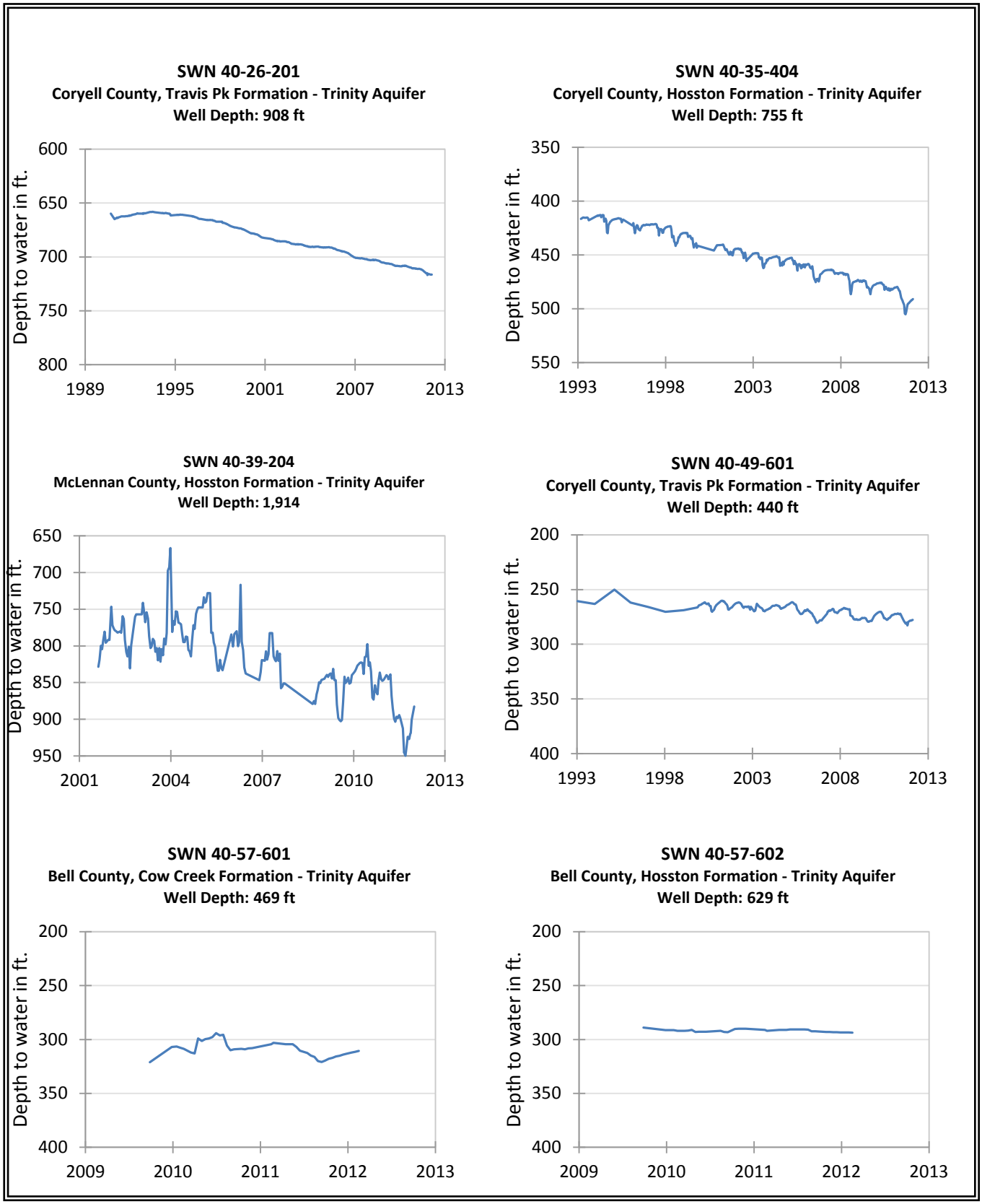


Figure 5-2 (cont'd). Selected hydrographs of TWDB recorder wells in North Central Texas.

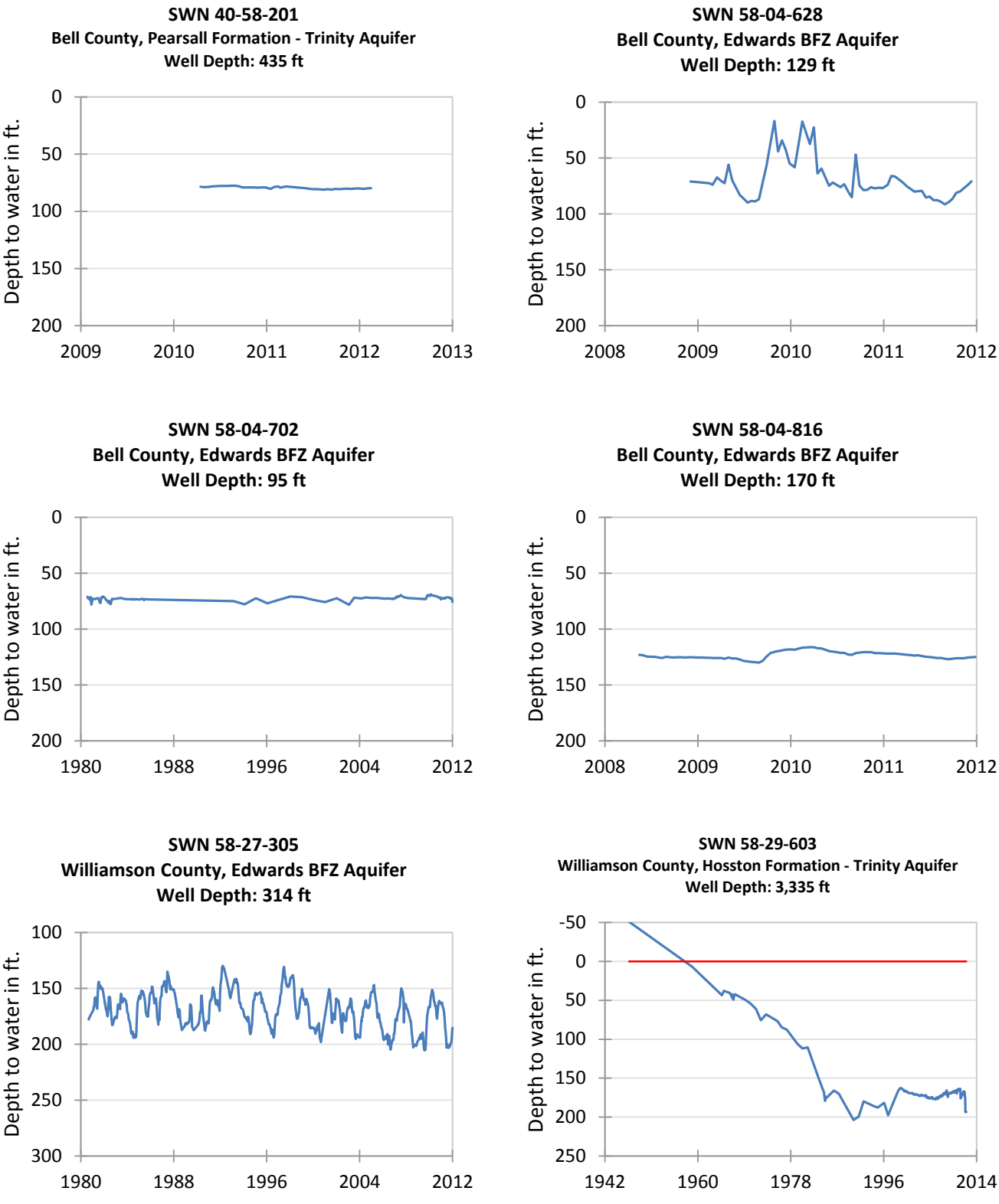


Figure 5-2 (cont'd). Selected hydrographs of TWDB recorder wells in North Central Texas.

6.0 South and East Texas

The TWDB monitors 16 recorder wells in South and East Texas(figure 6-1) that are completed in either the Carrizo-Wilcox or Gulf Coast major aquifers. Most of the wells have short historical periods of record, with the exception of three recorders in Gulf Coast Aquifer wells in Harris, Victoria, and Duval counties, in which records begin in the late 1940s, late 1950s, and early 1960s, and in two Carrizo-Wilcox wells in Milam and Smith counties, in which records began in the 1980s. Some entities in Harris County have measured water levels for the past 60 years. Currently, the TWDB is operating eight recorders in wells completed in the Gulf Coast Aquifer and eight recorders in wells completed in the Carrizo-Wilcox Aquifer throughout the region.

6.1 Major Aquifers

Water level declines in the eight Carrizo-Wilcox Aquifer recorder wells ranged from 0.6 feet in the Bastrop County well to 76.5 feet in the La Salle County well during the 2010-2011 period (table 6-1 and figure 6-2). The median water-level decline was 4.4 feet and the average decline was 17.1 feet. From 2009 to 2010, the change in water levels ranged from +7.6 feet to -14.6 feet and the median change was -1.5 feet, with an average change of -2.2 feet.

Irrigation pumpage during the drought has increased substantially in the Wintergarden area of southwest Texas, particularly Zavala, Wilson, and Atascosa counties. Pumping of groundwater has also increased to support oil and gas exploration and production activities related to the Eagle Ford Shale. The greatest decline of water level has been in the La Salle County well, which, in comparison to water levels in all of the recorder wells in the Carrizo-Wilcox Aquifer, has shown the greatest historical change—nearly 136 feet of decline—since measurements began in 2003.

Between 2010 and 2011, water level changes in the eight Gulf Coast Aquifer wells ranged from +8.7 feet in northernmost Wharton County well to -13.8 feet in the Karnes County well with a median change of -6.3 feet and an average of -5.7 feet. Between 2009 and 2010, the change in the five wells with available measurements ranged from +7.4 feet to -0.9 feet with a median change of +0.9 feet and an average change of +2.2 feet.

The Wharton County (6661302) and the Duval County wells are located in areas that experience groundwater pumping for seasonal irrigation and municipal needs, respectively. Municipal groundwater pumping also occurs in the vicinity of the Karnes County well. This well, first measured in 1956, has experienced nearly 144 feet of water-level decline, the greatest decline historically of these recorder wells. Currently, the rate of water level decline is lower than that in the La Salle Carrizo(-Wilcox) Aquifer well, but a comparison is not quite appropriate due to the much longer period of record in the Karnes County well.

The Harris County well hydrograph illustrates a decline and rebound pattern typical in several monitored wells in southern Harris County and northern Fort Bend, Brazoria, and Gavleston counties. Municpal groundwater pumpage from the 1950s to the late 1970s/early 1980s was great enough to cause subsidence in much of these counties. With a switch from groundwater to surface water for municipal supply, groundwater levels began to rise, and in some areas to levels higher than originally recorded.

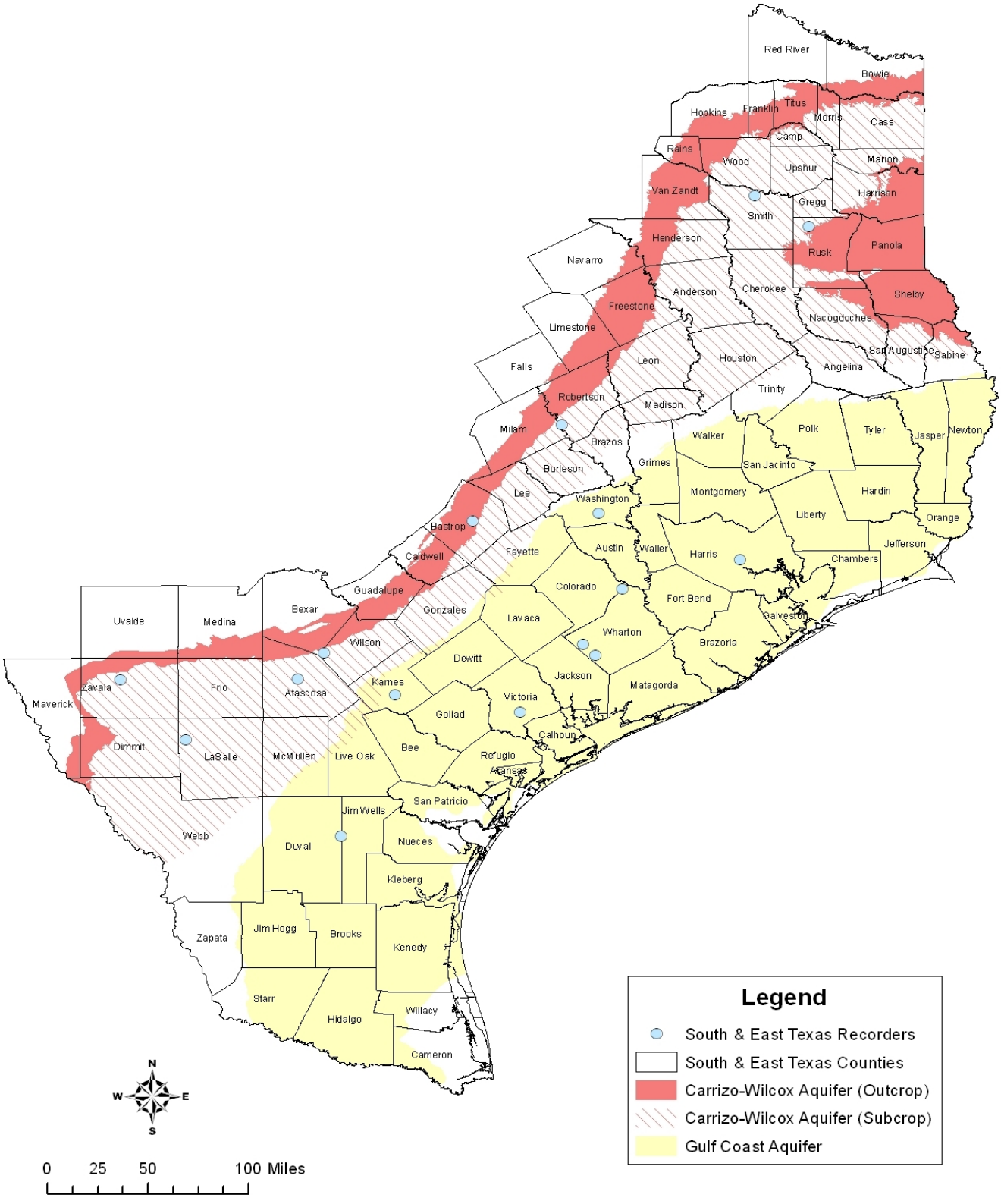


Figure 6-1. Location of wells with TWDB operated automatic water level recorders South and East Texas.

Table 6-1. Water level changes, in feet, in TWDB recorder wells in South and East Texas counties for various time periods.

County & well #	Aquifer	2011 Change (ft)	2010 Change (ft)	2007-2011 Change (ft)	2002-2011 Change (ft)	Historical Change (ft)	Historical Yearly Avg. (ft)
3430907 Smith	Wilcox	-2.94	-1.34	-4.84	-21.29	-70.18 (1977)	-2.81
3541604 Rusk	Wilcox	-4.66	N/A	N/A	N/A	-1.96 (2010)	-1.57
5862208 Bastrop	Wilcox	-0.56	-2.64	2.34	N/A	-6.90 (2003)	-0.84
5911621 Milam	Wilcox	-3.70	-1.48	-3.82	N/A	-5.14 (1981)	-0.17
5953915 Washington	Gulf Coast	-4.28	-0.88	-3.96	N/A	-5.73 (2002)	-0.59
6514409 Harris	Gulf Coast	-10.07	7.39	1.19	39.47	-71.93 (1947)	-1.16
6631107 Wharton	Gulf Coast	8.74	N/A	N/A	N/A	10.92 (2010)	8.74
6653406 Wharton	Gulf Coast	-4.50	0.94	N/A	N/A	-30.27 (1947)	-0.47
6661302 Wharton	Gulf Coast	-9.41	3.04	-9.72	N/A	11.78 (2005)	1.81
6862104 Wilson	Carrizo	-18.60	7.59	15.70	16.73	-2.12 (1994)	-0.12
7702509 Zavala	Carrizo	-4.15	-14.62	-14.74	N/A	-22.97 (2002)	-2.46
7738103 La Salle	Carrizo	-76.51	-5.36	-131.49	N/A	-135.96 (2003)	-17.00
7804508 Atascosa	Carrizo	-25.57	2.41	N/A	N/A	-16.46 (2008)	-4.70
7910406 Karnes	Gulf Coast	-13.76	N/A	N/A	N/A	-143.73 (1956)	-2.57
8017502 Victoria	Gulf Coast	-5.83	0.29	-10.78	10.47	-4.95 (1958)	-0.09
8415702 Duval	Gulf Coast	-6.72	N/A	31.08	23.33	-21.71 (1964)	-0.45

Rusk County Recorder 3541604

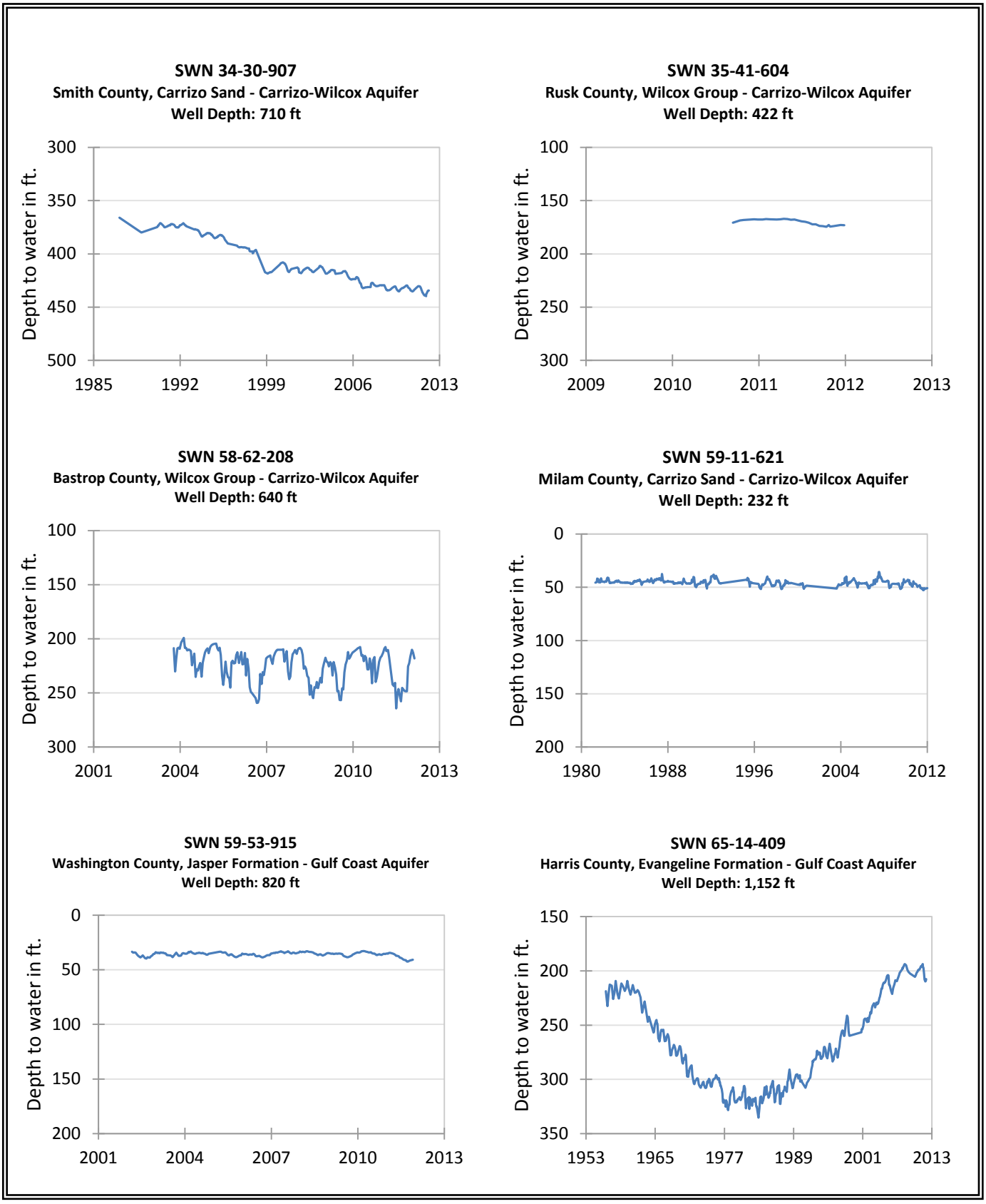


Figure 6-2. Selected hydrographs of TWDB recorder wells in South and East Texas.

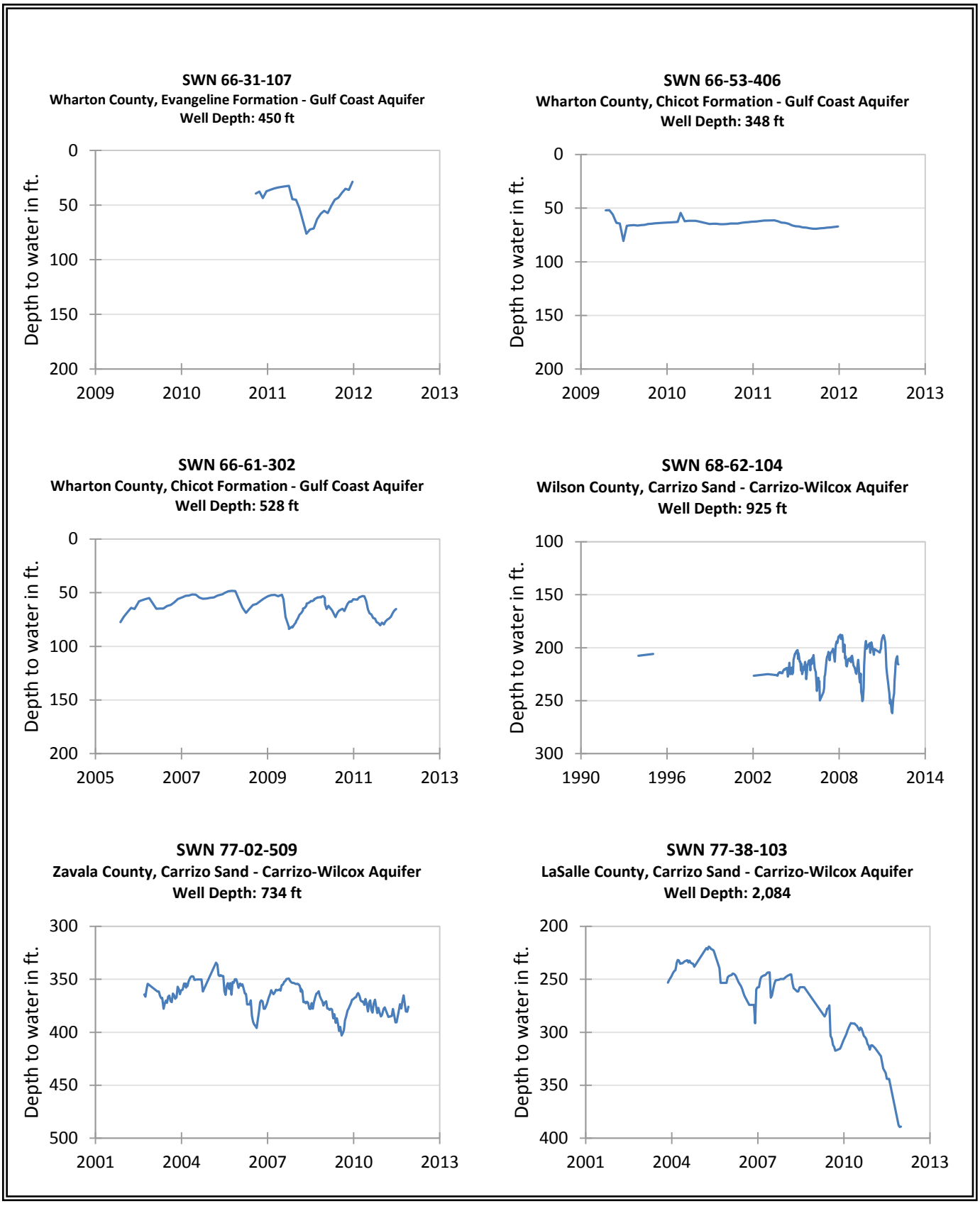


Figure 6-2 (cont'd). Selected hydrographs of TWDB recorder wells in South and East Texas.

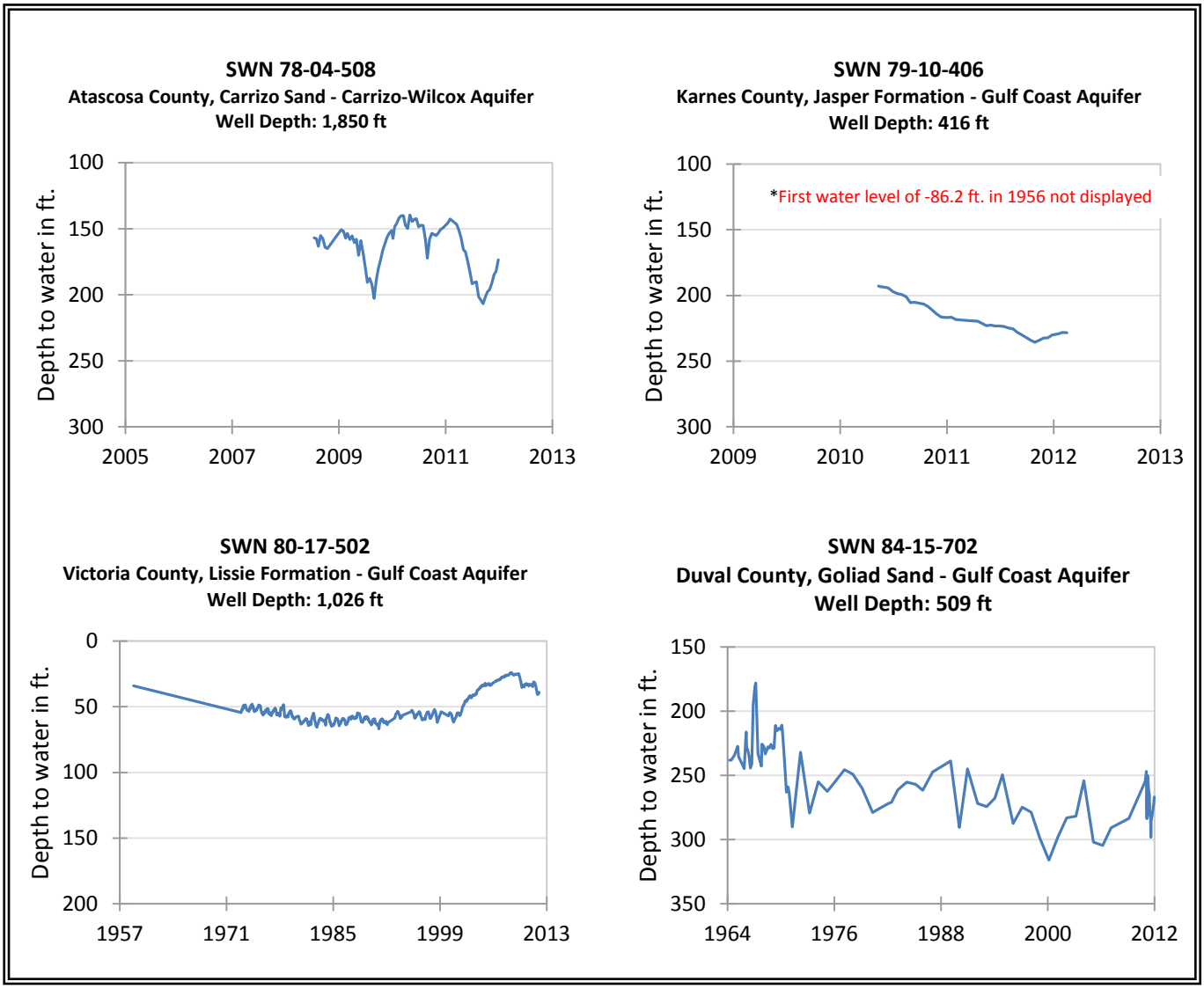


Figure 6-2 (cont'd). Selected hydrographs of TWDB recorder wells in South and East Texas.

Victoria County Recorder 8017502

Wharton County Recorder 6653406

7.0 Central Texas (including the Hill Country)

The majority of the 38 recorder wells in the Central Texas Hill Country are completed in the Trinity Aquifer (figure 7-1). Groundwater conservation districts in five counties co-sponsor 26 of these recorders. These local partnerships with the TWDB monitoring have led to the installation of a relatively larger number of recorders in these counties. Kerr County has facilitated the installation of 12 recorders, mostly since 2005. Districts in Kendall and northern Bexar counties have recently added recorders (not all of which are discussed in this report) with the TWDB, having had recorders for longer time periods on several Trinity wells in these counties. Thirty-two of the recorders are in the Trinity Aquifer, one is in the Edwards-Trinity (Plateau) Aquifer, three are in the Ellenburger-San Saba Aquifer, and two are in the Hickory Aquifer.

7.1 Major Aquifers

Water levels measured in 2010-2011 in the 33 recorder wells in the Trinity Aquifer and the one recorder well in the Edwards-Trinity (Plateau) Aquifer experienced a median change of -16.7 feet and an average of -19.7 feet feet (table 7-1 and figure 7-2). The water level changes ranged from +1.7 feet in the Kerr County 5757805 well to -88.6 feet in the Kerr County (5663924) well. This latter recorder is in the lower Trinity (Hosston) Aquifer portion of a dual completion well, with the upper part completed in the middle Trinity (Glen Rose/Hensel/Cow Creek) Aquifer. The water level decline of 88.6 feet in this Kerr County well was the greatest change in a single recorder in the state from 2010 to 2011.

From 2009 to 2010, the median change in the Central Texas Trinity Aquifer wells with available data (30 wells) was +2.8 feet with an average change of +6.4 feet, with water level changes ranging from +73.1 feet to -26.0 feet.

Although biased in part by the inclusion of the newer recorder wells in Kerr County with short histories, overall historical change in these 34 (mainly) Trinity Aquifer recorder wells ranges from a rise of 1.1 feet (an overall rise has occurred only in two wells) to a decline of 100.4 feet with a median decline of 37.6 feet and an average decline of 35.5 feet.

7.2 Minor Aquifers

The two recorder wells in the Hickory Aquifer from 2010 to 2011 each experienced water level declines of 2.1 (McCulloch County) and 5.4 feet (Mason County), compared to a rise in each, from 2009 to 2010, of 0.5 and 2.8 feet, respectively. Records in both wells extend to 1974, since which time water levels have declined by 19.9 feet (McCulloch) and 5.3 feet (Mason).

Water levels in the three recorder wells in the Ellenburger-San Saba Aquifer from 2010 to 2011 declined between 3.5 to 13.6 feet, with a median decline of 6.0 feet and an average decline of 7.7 feet. From 2009 to 2010, changes ranged from - 9.3 feet to +1.2 feet, with a median change of +0.6 feet and an average change of -2.5 feet.

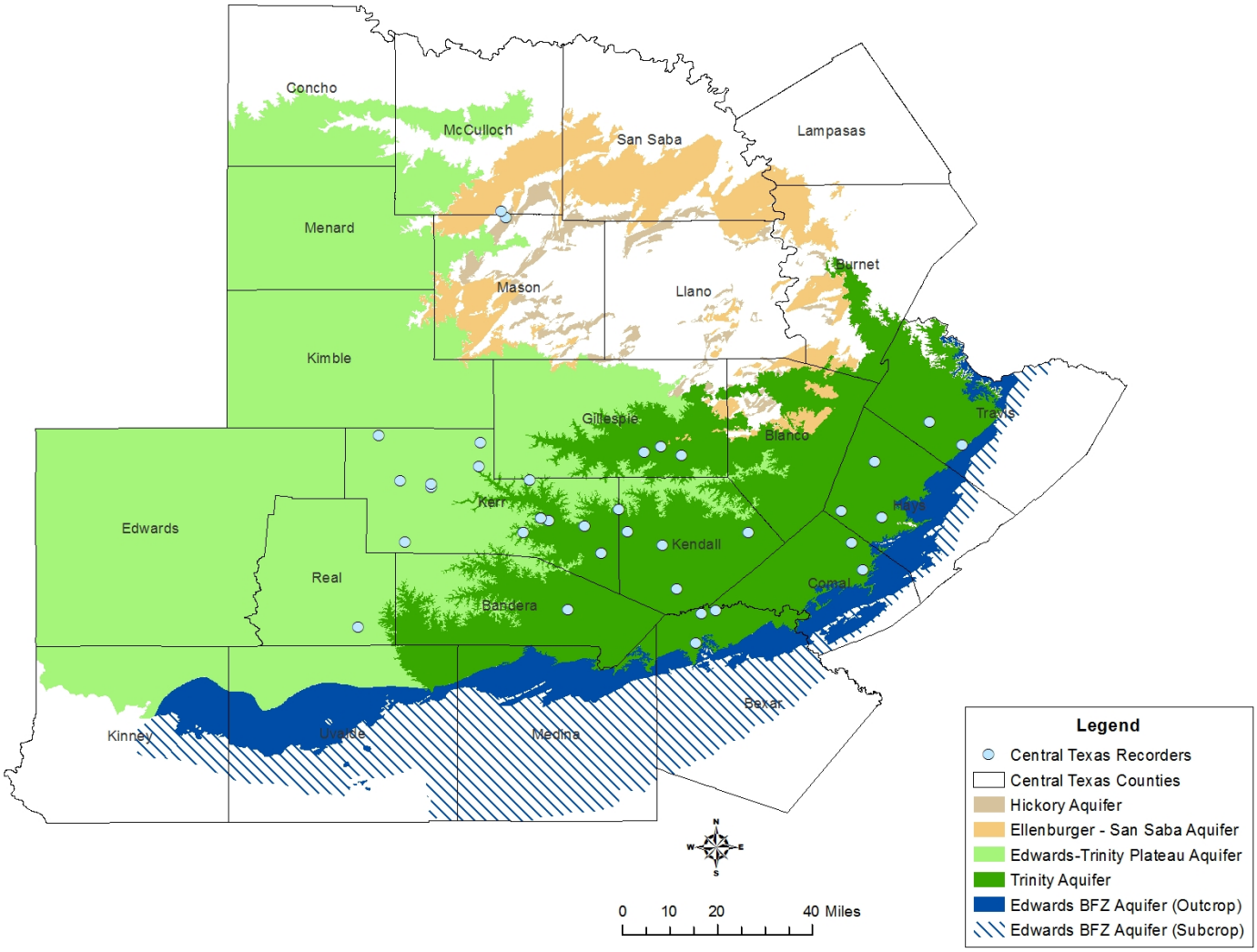


Figure 7.1. Location of wells with TWDB operated automatic water-level recorders in Central Texas**.**

Table 7-1. Water level changes, in feet, in TWDB recorders in Central Texas counties for various time periods.

County & well #	Aquifer	2011 Change (ft)	2010 Change (ft)	2007-2011 Change (ft)	2002-2011 Change (ft)	Historical Change (ft)	Historical Yearly Avg. (ft)
5606613 Mason	Hickory	-5.36	2.77	2.87	6.95	-5.30 (1974)	-0.14
5606614 McCulloch	Hickory	-2.08	0.50	2.99	5.12	-19.90 (1974)	-0.54
5643901 Kerr	Trinity	-3.56	-0.42	N/A	N/A	-8.16 (2007)	-2.04
5652704 Kerr	Trinity	-2.80	-2.22	N/A	N/A	-13.02 (2008)	-4.01
5654106 Kerr	Trinity	-1.88	N/A	N/A	N/A	-1.14 (2010)	-0.62
5654405 Kerr	Trinity	-6.55	2.46	-7.31	N/A	-11.60 (2004)	-1.50
5655805 Kerr	Trinity	-1.12	1.16	0.61	N/A	-0.79 (2005)	-0.13
5661101 Kerr	Trinity	-4.60	-3.91	-14.95	N/A	-16.75 (2005)	-2.75
5661102 Kerr	ET (P)	-0.42	0.40	1.84	N/A	1.14 (2006)	0.20
5663922 Kerr	Trinity	-57.20	30.82	-32.70	-60.78	-88.12 (1998)	-6.41
5663923 Kerr	Trinity	-55.89	-18.60	N/A	N/A	-84.19 (2007)	-21.05
5663924 Kerr	Trinity	-88.57	73.10	N/A	N/A	-100.37 (2007)	-25.09
5750108 Gillespie	Ellenburger – San Saba	-13.59	1.21	-11.58	-19.08	-22.91 (1987)	-0.94
5750324 Gillespie	Ellenburger – San Saba	-3.54	-9.29	-11.84	-13.58	-18.92 (1995)	-1.16
5751407 Gillespie	Ellenburger – San Saba	-5.95	0.64	N/A	N/A	-14.11 (2008)	-3.53
5757805 Kerr	Trinity	1.69	-7.20	-6.01	N/A	31.51 (2003)	-3.71
5755607 Hays	Trinity	-31.42	18.94	-1.45	N/A	-19.65 (2006)	-3.42
5763705 Hays	Trinity	-8.47	-2.35	-17.13	N/A	-8.95 (2002)	-0.92
5764705 Hays	Trinity	-12.51	-0.63	-4.18	N/A	-24.64 (1997)	-1.23
5841406 Travis	Trinity	-33.68	29.06	N/A	N/A	-29.51 (2000)	-2.57
5850120 Travis	Trinity	-28.40	8.51	-11.84	-75.34	-88.19 (1987)	-3.64
6801314 Kendall	Trinity	-14.96	8.78	-12.37	-63.49	-48.16 (1984)	-1.72
6801703 Kerr	Trinity	-24.02	3.61	-27.32	-42.32	-51.62 (2001)	-5.08
6801704 Kerr	Trinity	-19.70	2.59	-28.90	-47.50	-49.80 (2001)	-4.90
6802609 Kendall	Trinity	-18.16	3.08	-22.02	-35.83	-76.01 (1975)	-2.08
6804312 Kendall	Trinity	-16.67	8.52	N/A	N/A	-20.88 (1999)	-1.61
6807407 Comal	Trinity	-17.31	-25.99	-18.68	-20.55	-21.24 (1997)	-1.42
6811417 Kendall	Trinity	-12.93	5.07	-4.25	N/A	-40.35 (1999)	-2.02
6815211 Comal	Trinity	-8.12	N/A	N/A	N/A	-7.95 (2010)	-5.30
6819208 Bexar	Trinity	-3.24	4.03	-3.62	3.59	-61.20 (1977)	-1.80
6819806 Bexar	Trinity	-48.49	28.08	-17.84	-57.83	-52.62 (1990)	-2.48
6820110 Bexar	Trinity	-18.41	2.49	2.84	-111.23	-23.56 (1987)	-0.97
6904503 Kerr	Trinity	-7.50	-2.53	N/A	N/A	-17.90 (2007)	-4.37
6907107 Kerr	Trinity	-31.51	17.01	-31.41	N/A	-56.21 (2003)	-6.25
6908304 Kerr	Trinity	-22.58	11.50	-31.98	N/A	-39.88 (2006)	-7.67
6908305 Kerr	Trinity	-27.67	17.50	-28.57	N/A	-37.57 (2006)	-7.23
6919401 Real	Trinity	-23.12	-6.82	-39.14	-52.48	-71.48 (1974)	-1.91
6924225 Bandera	Trinity	-0.61	-13.41	N/A	N/A	2.60 (2008)	0.13

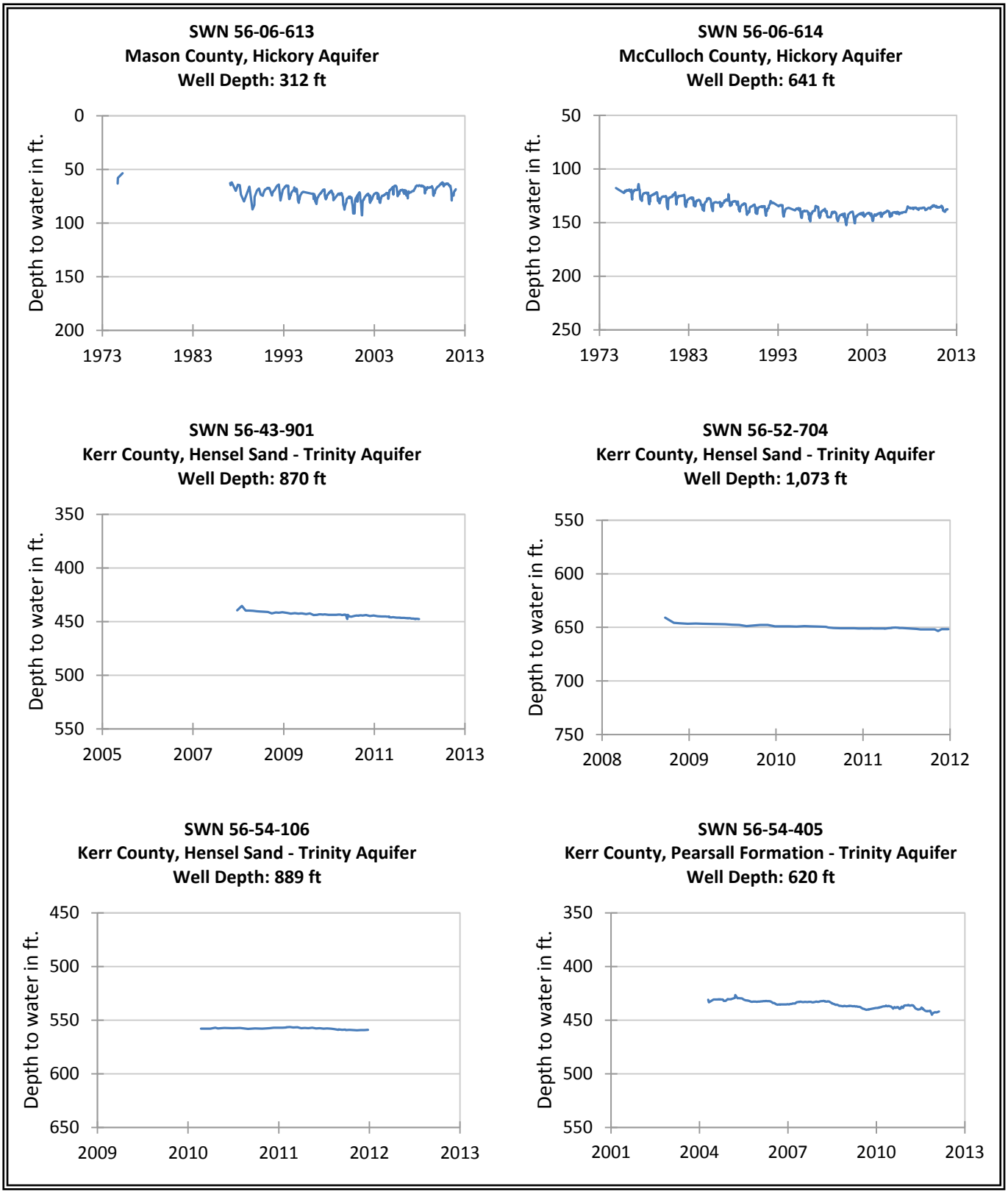


Figure 7-2. Selected hydrographs of TWDB recorder wells in Central Texas.

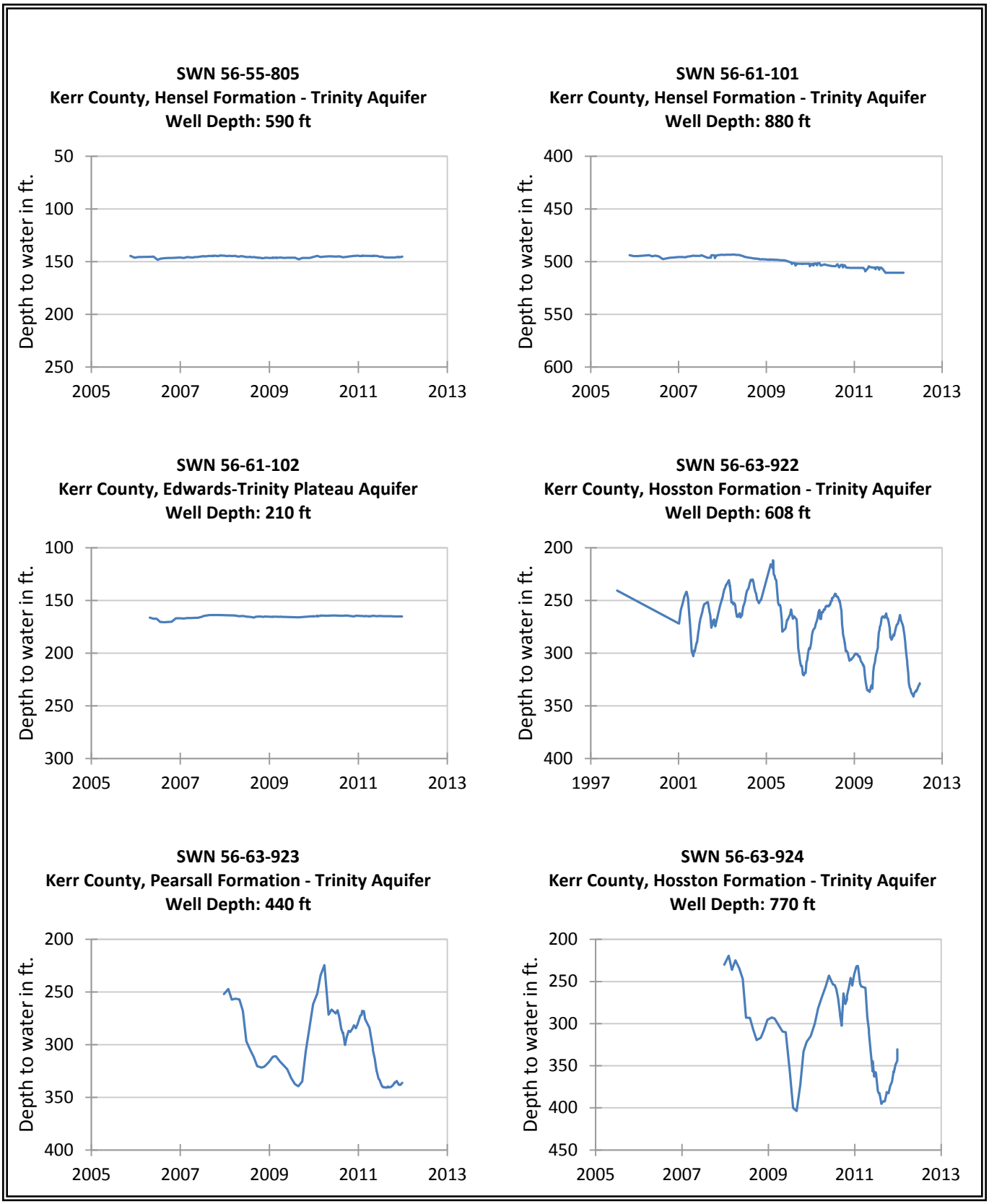


Figure 7-2 (cont'd). Selected hydrographs of TWDB recorder wells in Central Texas.

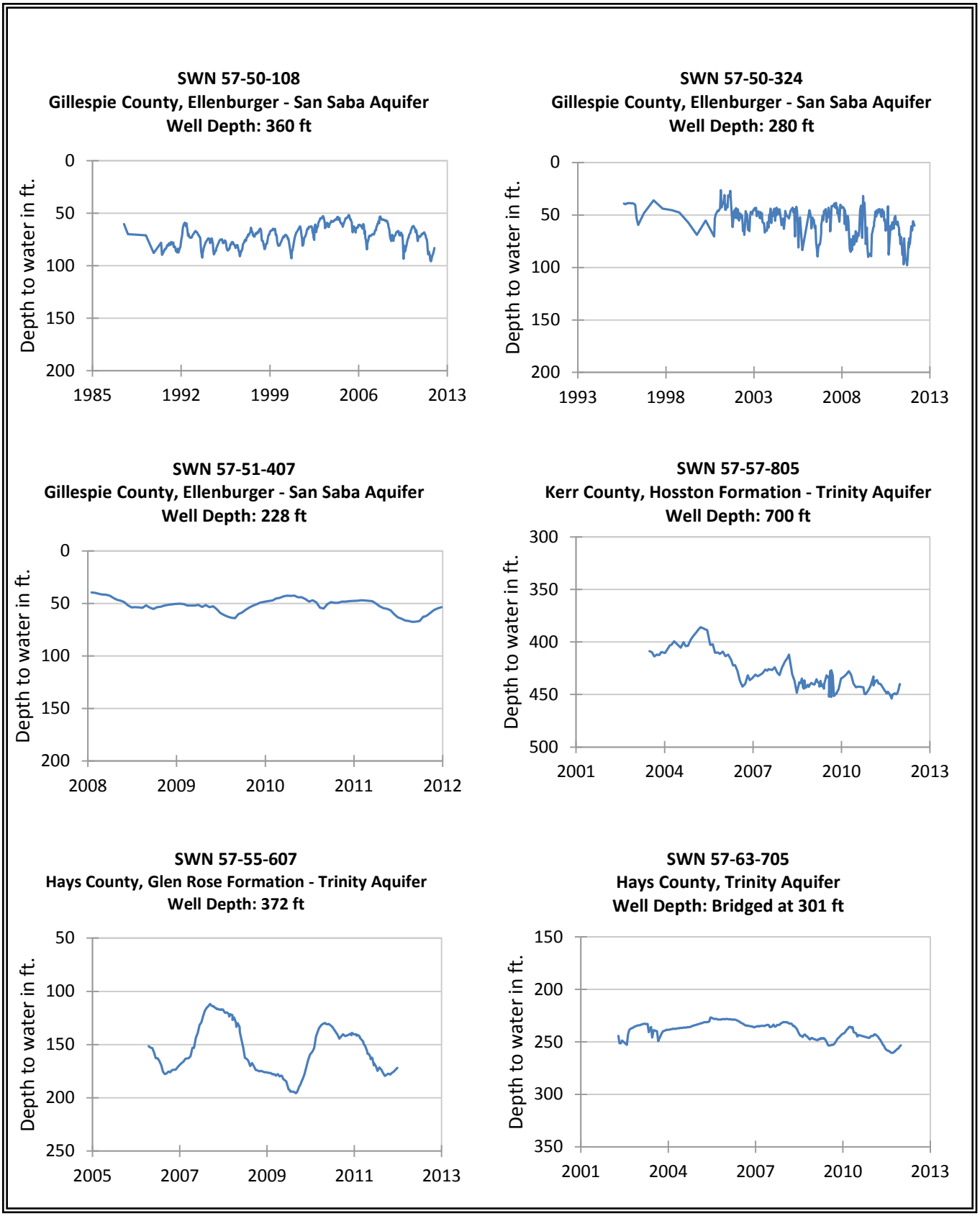
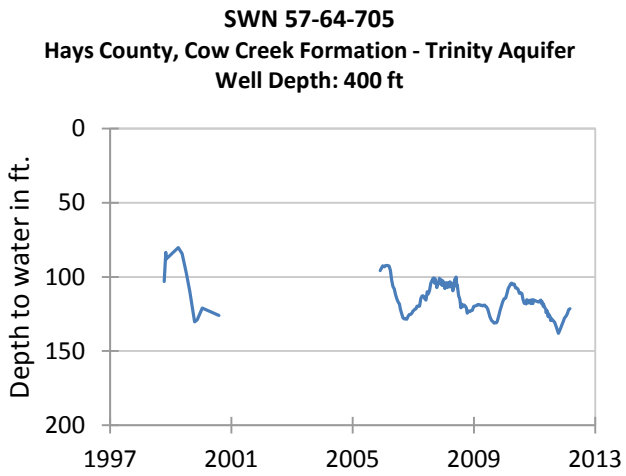
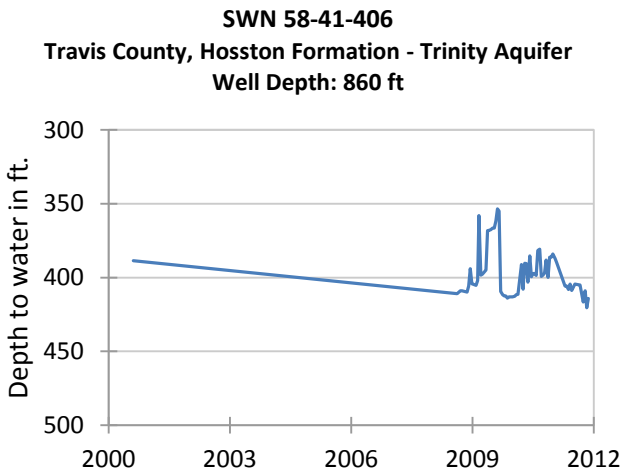
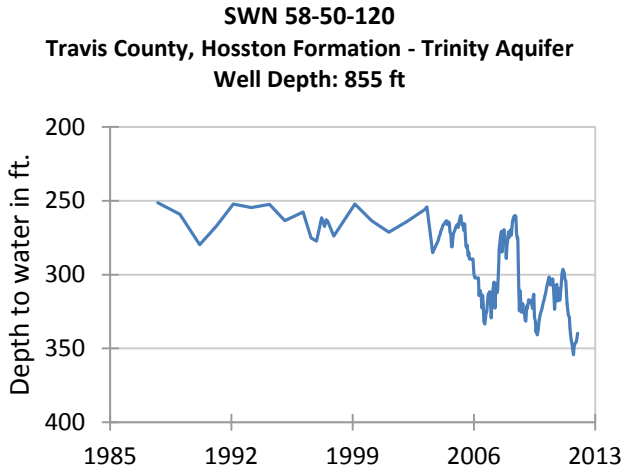
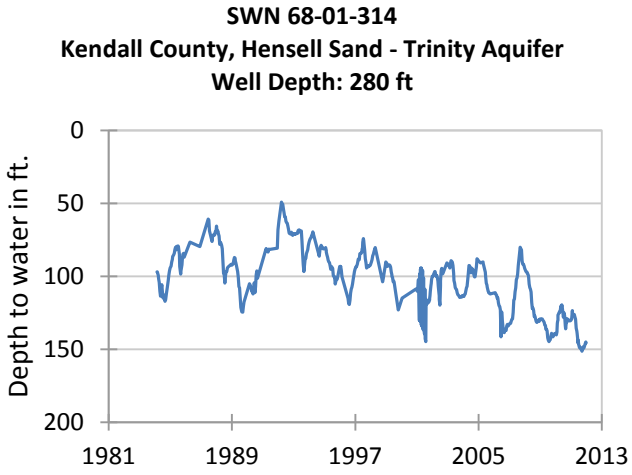


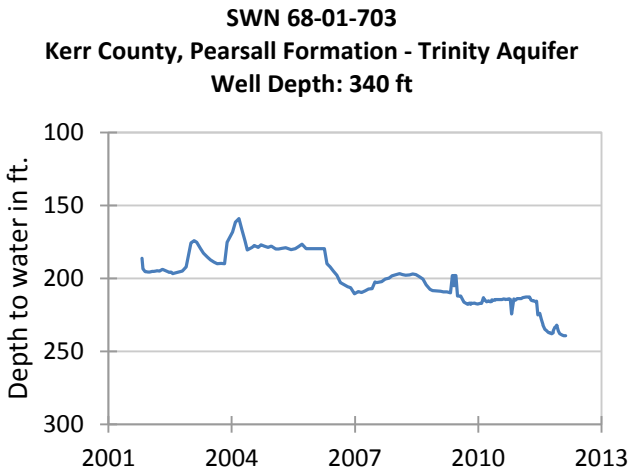
Figure 7-2 (cont'd). Selected hydrographs of TWDB recorder wells in Central Texas.











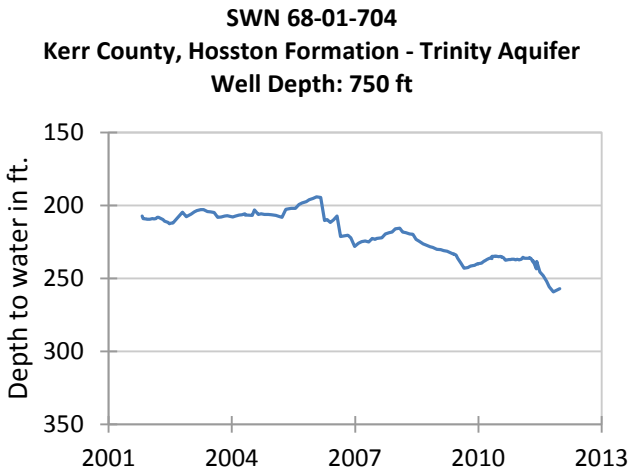


Figure 7-2 (cont'd). Selected hydrographs of TWDB recorder wells in Central Texas.

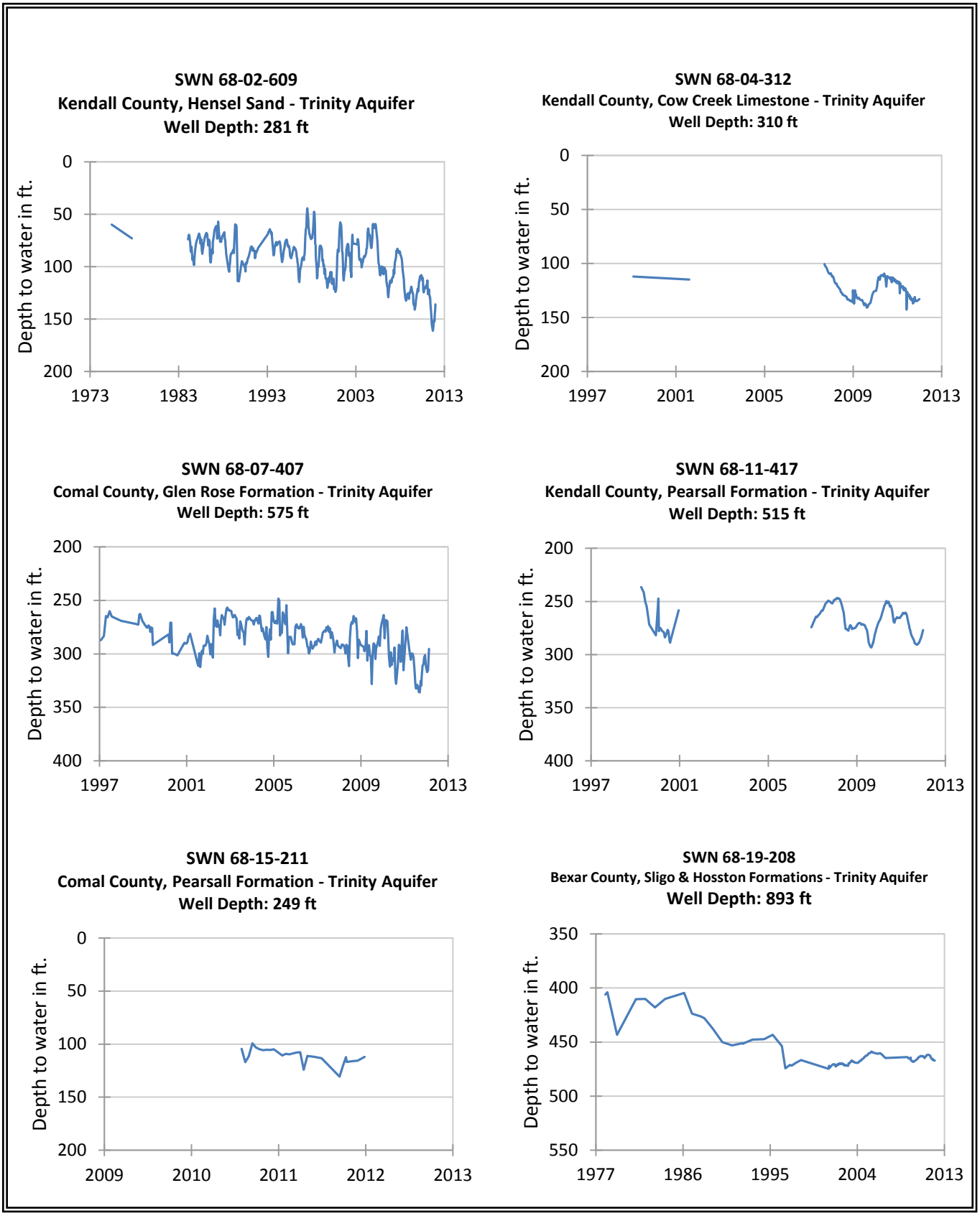


Figure 7-2 (cont'd). Selected hydrographs of TWDB recorder wells in Central Texas.

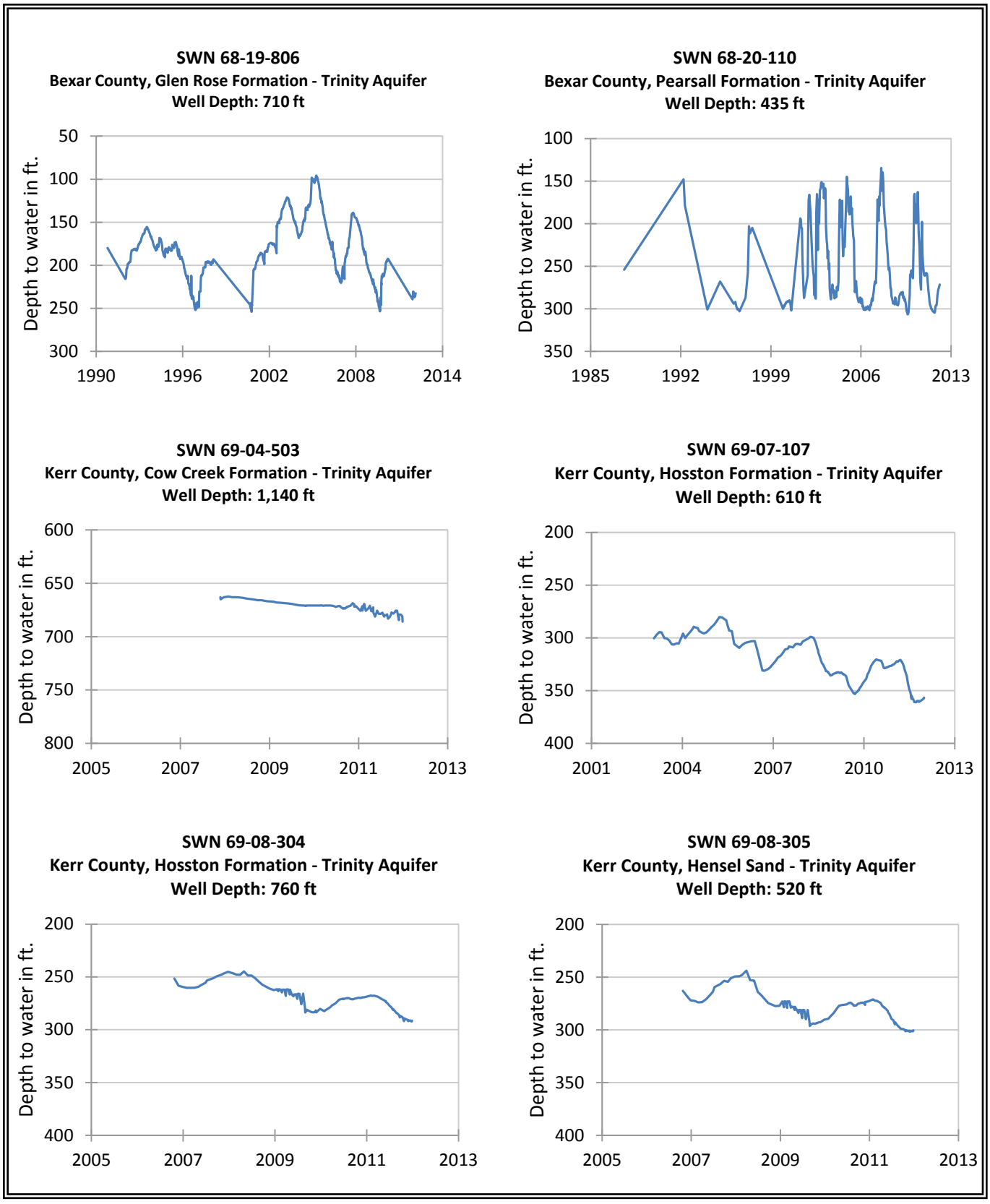


Figure 7-2 (cont'd). Selected hydrographs of TWDB recorder wells in Central Texas.

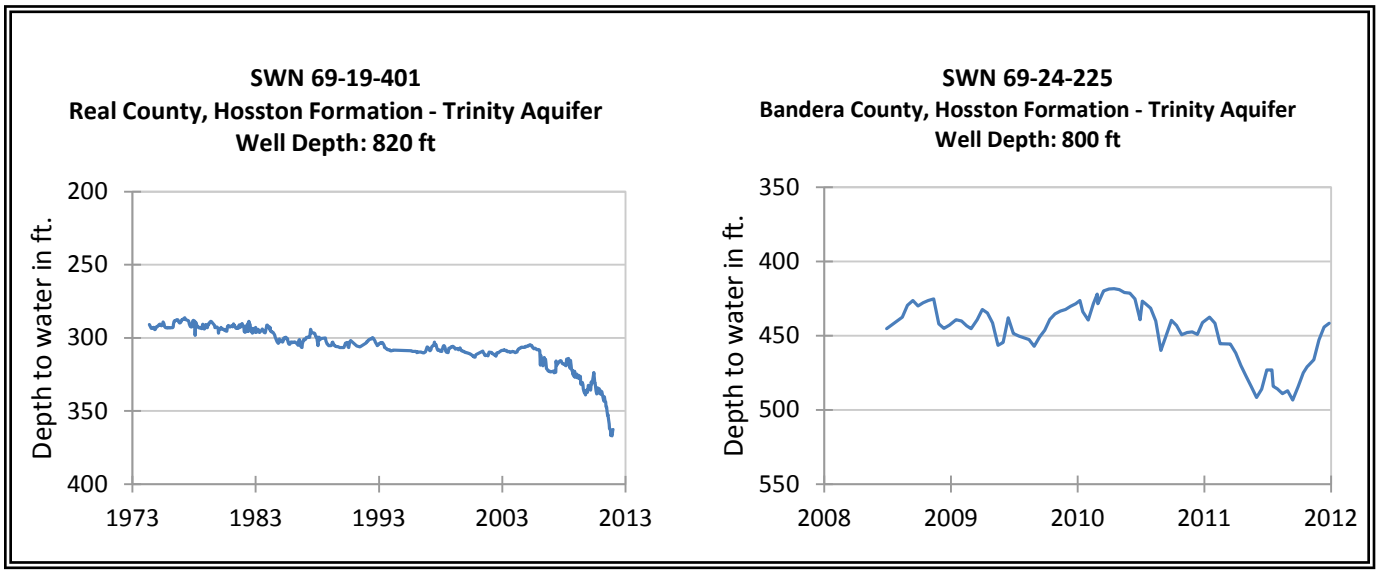


Figure 7-2 (cont'd). Selected hydrographs of TWDB recorder wells in Central Texas

Bexar County Recorder 6820110

8.0 Conclusions

- In 2011, TWDB maintained and monitored a statewide network of 110 wells equipped with automatic groundwater level recording instruments and dataloggers. Central Texas currently has the most recorder wells (33) of any region of Texas.
- Water levels declined in 101 of the 110 recorder wells during the period 2010-2011, compared to water level declines observed in 55 of 99 recorder wells during the 2009-2010 period.
- The statewide median water level decline from 2010 to 2011 in major aquifers was 4.8 feet, compared to the median water level decline from 2009 to 2010 of 1.9 feet.
- Total statewide median water level rise from 2010 to 2011 was 1.5 feet that occurred in 9 recorder wells completed in major aquifers. This compares to the median water level rise of 2.5 feet from 2009 to 2010 in 44 recorder wells .
- Comparing water levels in major aquifer recorders by region (table 8-1), the median water level change from 2010 to 2011 was greatest in the Central Texas Trinity Aquifer wells, a decline of 16.7 feet, and least in the West Texas Edwards Trinity (Plateau) Aquifer wells, with a decline of 0.7 feet. The rise of 1.5 feet in the one Hueco-Mesilla Bolson Aquifer recorder well was not included in this comparison.
- By contrast, the median water level change for 2009 to 2010 for the major aquifer recorders by region was greatest in Central Texas Trinity Aquifer wells, with a rise of 2.8 feet, and least in North Central Trinity Aquifer wells, with a decline of 0.2 feet.

Table 8-1. Summary table of median water level changes by aquifer and region.

Median change (ft) 2010 – 2011	Median change (ft) 2009 - 2010	No. of Wells	Region	Aquifer
-16.7	+2.8	33	Central	Trinity
-8.5	-0.2	13	North Central	Trinity
-7.6	-1.5	2	West	Pecos Valley
-6.3	+0.9	8	South and East	Gulf Coast
-4.4	-1.5	8	South and East	Carrizo-Wilcox
-3.5	-2.6	4	North Central	Northern Segment Edwards (BFZ)
-3.2	+1.2	2	Rolling Plains	Seymour
-1.8	-1.0	26	Northwest	Ogallala
-0.7	-1.3	13	West	Edwards-Trinity (Plateau)
+1.5	+1.0	1	West	Hueco Mesilla Bolson