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Water-Level Altitudes and Continuous and Discrete Groundwater Quality at and near an Aquifer Storage and Recovery Site, Bexar, Atascosa, and Wilson Counties, Texas, June 2004–September 2011

Scientific Investigations Report 2012–5260

U.S. Department of the Interior
U.S. Geological Survey

Front cover: The aquifer storage and recovery plant (in background) is located in a rural area of southern Bexar County, Texas, on land that is still used mainly for cattle ranching (2011; photograph by Michael B. Nyman, U.S. Geological Survey).

Back cover:

Left, U.S. Geological Survey hydrologic technician preparing to sample an injection/recovery well at the aquifer storage and recovery site, Bexar County, Texas (2008; photograph by Cassi L. Crow).

Right, Cascading aerator at the aquifer storage and recovery site, Bexar County, Texas (2010; photograph by Christopher Langston, San Antonio Water System).

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Suggested citation:
Crow, C.L., 2012, Water-level altitudes and continuous and discrete water quality at and near an aquifer storage and recovery site, Bexar, Atascosa, and Wilson Counties, Texas, June 2004–September 2011: U.S. Geological Survey Scientific Investigations Report 2012–5260, 85 p., 7 apps.

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Conversion Factors

Inch/Pound to SI

Multiply	By	To obtain
	Length	
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Area	
acre	4,047	square meter (m^2)
acre	0.4047	hectare (ha)
acre	0.4047	square hectometer (hm^2)
acre	0.004047	square kilometer (km^2)
	Volume	
gallon (gal)	3.785	liter (L)
million gallons (Mgal)	3,785	cubic meter (m^3)
acre-foot (acre-ft)	1,233	cubic meter (m^3)
acre-foot (acre-ft)	0.001233	cubic hectometer (hm^3)
	Flow rate	
gallon per minute (gal/min)	0.06309	liter per second (L/s)
million gallons per day (Mgal/d)	0.04381	cubic meter per second (m^3/s)

SI to Inch/Pound

Multiply	By	To obtain
	Volume	
liter (L)	33.82	ounce, fluid (fl. oz)
liter (L)	2.113	pint (pt)
liter (L)	1.057	quart (qt)
liter (L)	0.2642	gallon (gal)
liter (L)	61.02	cubic inch (in^3)
	Mass	
gram (g)	0.03527	ounce, avoirdupois (oz)
kilogram (kg)	2.205	pound avoirdupois (lb)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$°F=(1.8×°C)+32$$

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Vertical coordinate information is referenced to the North American Vertical Datum of 1988 (NAVD 88).

Water-Quality Units

Concentrations are reported in metric units. Chemical concentrations are reported in milligrams per liter (mg/L), micrograms per liter (μg/L), and milliequivalents per liter (meq/L). Milligrams per liter and micrograms per liter are units expressing the concentration of chemical constituents in solution as weight of solute (milligrams or micrograms) per unit volume (liter) of water. For concentrations less than 7,000 mg/L, the numerical value of milligrams per liter is equivalent to the concentration in parts per million. The numerical value of micrograms per liter is equivalent to the concentration in parts per billion. Milliequivalents per liter is a unit expressing the concentration of chemical constituents in solution as 1/1,000 the molecular weight, in milligrams, divided by the valence of one molecule of the constituent per unit volume (liter) of water.

Specific conductance is reported in microsiemens per centimeter at 25 degrees Celsius (μS/cm at 25 °C).

Turbidity is reported in nephelometric turbidity ratio units (NTRU).

Isotope Unit Explanations

Per mil: A unit expressing the ratio of stable-isotope abundances of an element in a sample to those of a standard material. Per mil units are equivalent to parts per thousand. Stable-isotope ratios are computed as follows (Kendall and McDonnell, 1998):

$$\delta X = \{(R_{sample} - R_{standard})/R_{standard}\} \times 1{,}000,$$

where

- δ is the "delta" notation,
- X is the heavier stable isotope, and
- R is the ratio of the heavier, less abundant isotope to the lighter, stable isotope in a sample or standard.

The δ values for stable-isotope ratios discussed in this report are referenced to the following standard materials:

Element	R	Standard identity and reference
Hydrogen	Hydrogen-2/hydrogen-1	Vienna Standard Mean Ocean Water (Fritz and Fontes, 1980)
Oxygen	Oxygen-18/oxygen-16	Vienna Standard Mean Ocean Water (Fritz and Fontes, 1980)

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Abstract

The U.S. Geological Survey (USGS), in cooperation with the San Antonio Water System (SAWS), collected data during 2004–11 to characterize the quality of native groundwater from the San Antonio segment of the Edwards aquifer (hereinafter, Edwards aquifer) and preinjection and postinjection water from the Carrizo aquifer (informal name commonly applied to the upper part of the Carrizo-Wilcox aquifer in the area) at and near an aquifer storage and recovery (ASR) site in Bexar, Atascosa, and Wilson Counties, Texas. Daily mean water-level altitude, water temperature, and specific conductance were measured continuously in a monitoring well on the ASR site to determine how injection and withdrawal at the ASR site might affect local groundwater. Groundwater samples were collected and analyzed for selected physical properties and constituents to characterize the quality of native groundwater from the Edwards aquifer and preinjection and postinjection water from the Carrizo aquifer near the ASR site to provide a better understanding of possible changes in the quality of groundwater near an active ASR site that might result from the mixing of water from different aquifers. During injection periods, the water-level altitude in the monitoring well generally increased as the amount of water being injected into all wells at the ASR site increased and decreased as the amount of water being injected into all wells at the ASR site decreased. During withdrawal periods, the water-level altitude in the monitoring well generally increased as the total volume of water being withdrawn from all wells at the ASR site decreased and generally decreased as the total volume of water being withdrawn from all wells increased. Daily mean water temperature fluctuated by less than 1 degree Celsius and was determined to be independent of injection or withdrawal conditions at the ASR site. Changes in daily mean specific-conductance values measured at four depths in the monitoring well at the ASR site occurred without regard to total ASR site injection or withdrawal volumes. No substantial differences were measured over time in major-ion, trace-element, or isotope chemistry of water samples collected from the wells that supplied water from the Edwards aquifer. Little variation in water chemistry was detected in the samples collected from four wells designed to inject and withdraw water at the ASR site, regardless of whether the ASR site was injecting or withdrawing water. The similarity of major-ion and isotope chemistry between the Edwards aquifer source wells and the four ASR wells indicates that little, if any, migration of injected water away from the ASR wells has occurred. In a well located closest to the ASR site in the direction of regional flow for the Carrizo aquifer, a greater alkalinity value and a smaller concentration of chloride were measured in the most recent sample than in all other samples collected at this well. Substantial increases in dissolved iron and manganese concentrations also were observed in this well. The increased alkalinity value and dissolved iron and manganese concentrations and the decreased chloride concentration in the well could indicate that the injected water from the Edwards aquifer had begun to move into at least a part of the strata supplying these wells and might be causing iron and manganese mobilization in the Carrizo aquifer.

Introduction

The San Antonio segment of the Edwards aquifer (hereinafter, Edwards aquifer) is the main source of public-water supply for the City of San Antonio in Bexar County, Texas, and adjacent counties and provides nearly all of the water for municipal, commercial, and agricultural purposes in the region. The San Antonio Water System (SAWS) is the primary water provider for the city. Withdrawals from the aquifer are regulated by the Edwards Aquifer Authority (EAA) to protect federally listed endangered species that rely on the discharge at large springs emerging from the aquifer (Edwards Aquifer Authority, 2009). In August 2002, SAWS began construction of an aquifer storage and recovery (ASR) plant in southern Bexar County on an approximately 3,200-acre site that extends into northern Atascosa and western Wilson Counties (fig. 1). Wells at the site are designed to

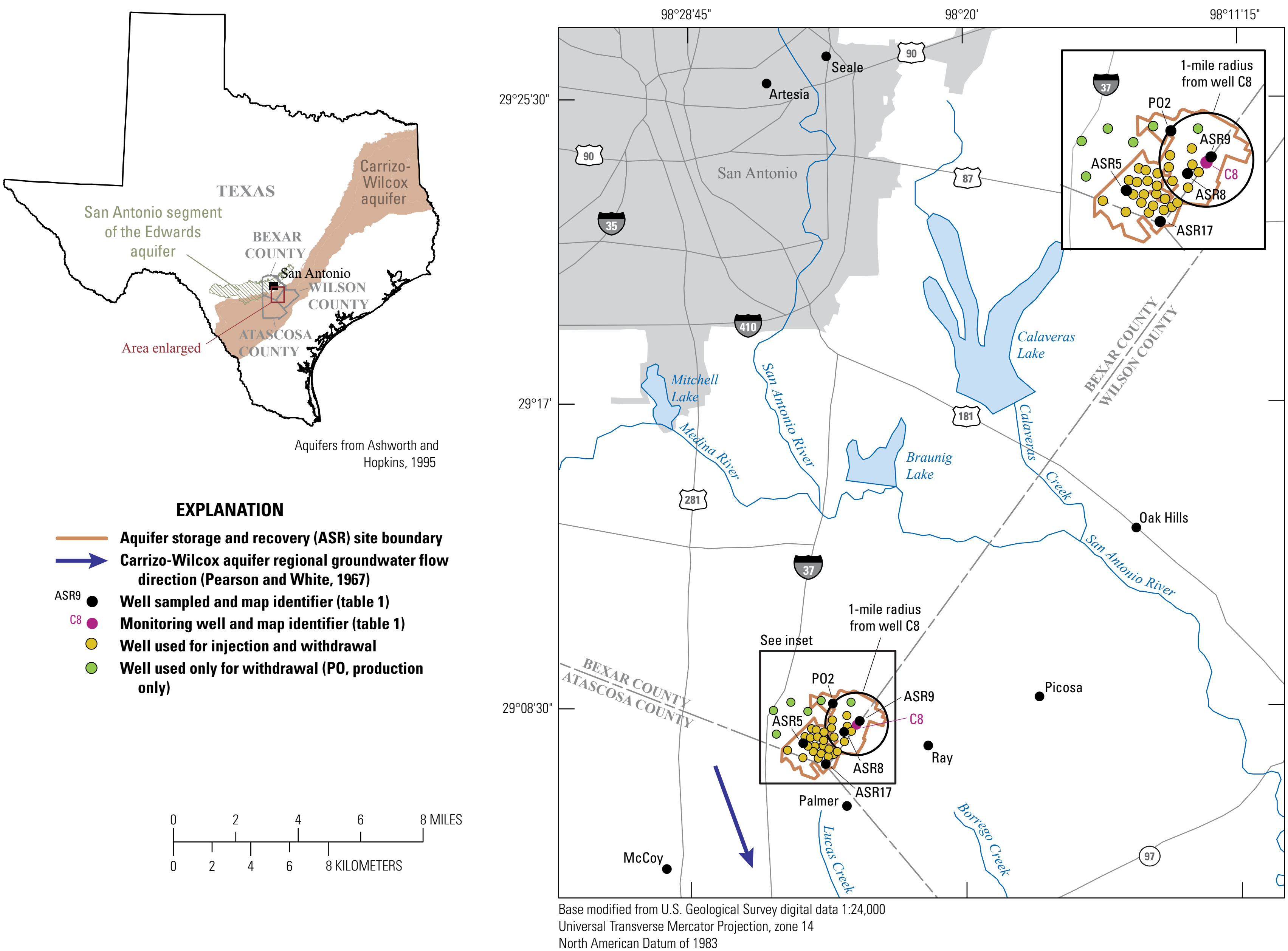

Figure 1. Locations of an aquifer storage and recovery site and data-collection sites, Bexar, Atascosa, and Wilson Counties, Texas.

inject water into and withdraw water from the Carrizo aquifer (the informal name commonly applied to the upper unit of the Carrizo-Wilcox aquifer in the area). In June 2004 phase one of the ASR plant became operational, enabling SAWS to pump water from the Edwards aquifer when water levels are sufficiently high and withdrawals from the Edwards aquifer are less than the EAA-enforced limit, transfer the water through a 38-mile pipeline (actual length) (Adam E. Conner, San Antonio Water System Planner II, Water Resources, written commun., 2010) to the ASR plant, and inject the water into the Carrizo aquifer through 16 wells. Injected water could then be recovered from the Carrizo aquifer, treated, and distributed during times of drought to alleviate stress on the Edwards aquifer. Subsequent phases have increased the total number of injection/withdrawal wells to 29.

In addition to withdrawing injected Edwards aquifer water, SAWS can withdraw as much as 6,400 acre-feet (or 2 acre-feet per acre of owned land) of water from the Carrizo aquifer as defined by the rules of the Evergreen Underground Water Conservation District (2009). To take advantage of the ability to withdraw water from the Carrizo aquifer and to not disturb the injected Edwards aquifer water, SAWS installed 7 wells upgradient from the injection field at the ASR plant. These wells are called production-only (or PO) wells.

The U.S. Geological Survey (USGS), in cooperation with SAWS, collected data during 2004–11 to characterize the quality of and ascertain changes in groundwater at and near the ASR site. Findings of the study are intended to provide a better understanding of possible changes in the quality of groundwater near an active ASR site that might result from the mixing of water from different aquifers. Mobilization of trace elements in groundwater as a result of changes in oxidation and pH conditions has been observed at other ASR sites (Heilweil and others, 2009). Reduction-oxidation reaction (redox) conditions in an aquifer can change when nonnative water is introduced to the aquifer, and redox conditions exercise important controls on water chemistry, including several redox-influenced trace elements (Smedley and Edmunds, 2002; Basu and others, 2007). In particular, iron and manganese mobilization was a concern at the SAWS ASR site. The results of this study also are applicable to other ASR investigations in similar hydrogeologic environments and to investigations of the Carrizo-Wilcox aquifer. This study advances the knowledge of how ASR plant operations affect native groundwater in sandstone aquifers and the hydrologic processes that occur in carbonate/sand aquifer systems. Results of this investigation can be used by local and State water managers to address issues of increased demand for water resources in areas of increasing population such as San Antonio.

Purpose and Scope

This report describes results of the analysis of hydrologic and geochemical groundwater data collected during 2004–11 from the Carrizo aquifer in parts of Bexar, Atascosa, and Wilson Counties at and near an ASR site. Hydrologic data include water-level altitude, water temperature, and specific conductance collected hourly at a monitoring well at the ASR site. Water-quality and isotope data collected in June 2004 are used to characterize the water of the Carrizo aquifer before the ASR site became operational; water-quality and isotope data collected from September 2005 through July 2011 are used to characterize groundwater near the ASR site after the site became operational. Native water from the Edwards aquifer is analyzed, and a preliminary assessment of the effects on groundwater quality from injecting water from the Edwards aquifer into the Carrizo aquifer is made by using the water-quality data collected during the study. Data also are analyzed to determine if water injected into or withdrawn from the ASR site had any effect on water quality at or near the site. The wording and presentation of material in this report are based on a previous USGS report (Otero and Petri, 2010); the contents of each section herein are modified from this previous report.

Geology and Hydrology

The Wilcox Group and the overlying Carrizo Sand of the Claiborne Group are important water-yielding formations near the ASR site (fig. 2). The Wilcox Group and Carrizo Sand consist mostly of sand, locally interbedded with gravel, silt, clay, and lignite, that dips into the subsurface toward the coast of the Gulf of Mexico (Gulf Coast). Most of the sand beds that compose the Wilcox Group are less permeable than those that compose the Carrizo Sand (Klemt and others, 1976).

The Wilcox Group and the hydraulically connected Carrizo Sand together form the Carrizo-Wilcox aquifer, a major aquifer in Texas (Ashworth and Hopkins, 1995) (fig. 2). The upper unit of the Carrizo-Wilcox aquifer, the Carrizo Sand, ranges in thickness from 150 to 1,200 feet in south Texas (Klemt and others, 1976, p. 4) and commonly is referred to as the Carrizo aquifer. The specific target formation for water storage at the ASR site is the Carrizo Sand, a fine to coarse grained, poorly sorted, noncalcareous sandstone (University of Texas, Bureau of Economic Geology, 1974) that dips into the subsurface toward the Gulf Coast.

The recharge zone (aquifer outcrop) of the Carrizo aquifer forms a relatively narrow band roughly parallel to the Gulf Coast. Recharge to the Carrizo aquifer occurs through direct infiltration of rainfall on the land surface in the recharge zone, through the beds of streams that flow across the recharge zone, and as leakage from overlying formations that compose the Carrizo-Wilcox aquifer in subcrop areas. Water in the aquifer typically is fresh (dissolved solids concentration less than 1,000 milligrams per liter) in and near the recharge zone and becomes progressively more mineralized with distance downdip. Some wells screened in the Carrizo aquifer yield more than 1,000 gallons per minute of water (Ashworth and Hopkins, 1995, p. 17), and the Carrizo aquifer is an important source of water for agriculture and public supply.

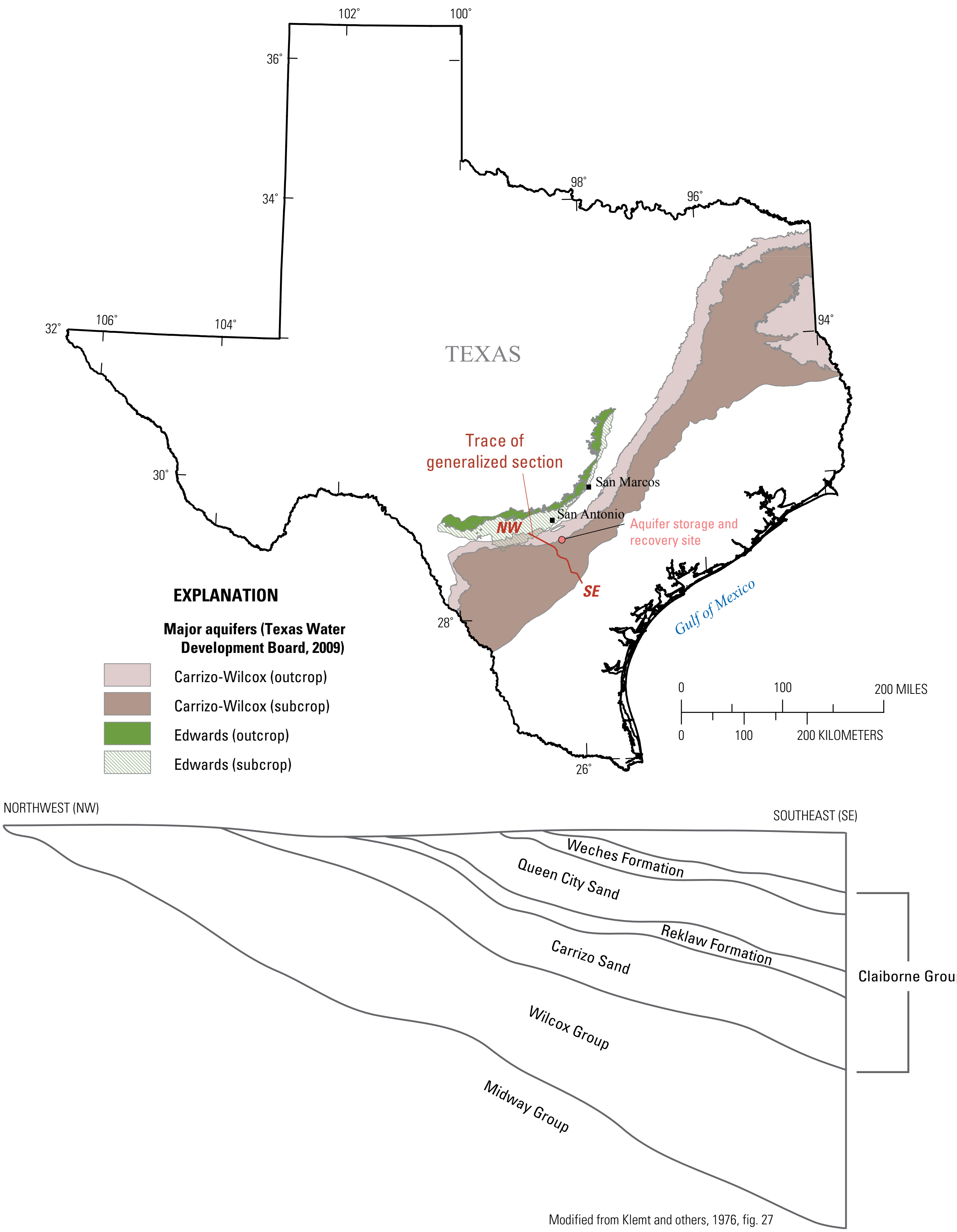

Figure 2. Outcrops and subcrops of the Carrizo-Wilcox aquifer and Edwards aquifer in Texas, and a generalized hydrogeologic section of the water-yielding Carrizo Sand and Wilcox Group and other near-surface formations at and near an aquifer storage and recovery site, Bexar, Atascosa, and Wilson Counties.

The ASR site is located at the southern margin of the recharge zone where the outcrop and subcrop areas of the Carrizo-Wilcox aquifer meet (fig. 2). The Carrizo aquifer is about 800 feet thick at the ASR site, with a net sand thickness of about 700 feet (Klemt and others, 1976, fig. 9). Haque and Johannesson (2006, p. 59) noted other investigators' findings:

> Precipitation recharges the Carrizo Sand aquifer in the outcrop area in northwest Atascosa County, and the resulting groundwaters subsequently flow down-gradient towards the southeast (Pearson and White, 1967; Castro et al. [and others], 2000). High fluid pressure causes groundwater to discharge from the aquifer by crossformational upward leakage (Castro and Goblet, 2003).

The prevailing regional flow pattern from northwest to southeast might affect the movement of water injected into the Carrizo aquifer at the ASR site. The hydrogeologic units above and below the Carrizo aquifer are less permeable relative to those of the aquifer and tend to keep injected water from migrating vertically, allowing more of the injected water to be withdrawn later.

The water injected at the ASR site is sourced from the Edwards aquifer (fig. 2). The Edwards aquifer comprises Lower Cretaceous-age rocks of the Edwards Group (Rose, 1972) and the Georgetown Formation. The Edwards Group in the study area comprises two stratigraphic units, the basal Kainer Formation and the upper Person Formation. Each of those units comprises several informal members (Rose, 1972). The Edwards aquifer occurs at depths of approximately 2,000 feet below the Carrizo aquifer at the ASR site (Klemt and others, 1976, fig. 10; Lindgren and others, 2004, fig. 5).

Most recharge to the Edwards aquifer occurs in the recharge zone west of San Antonio, Tex. (fig. 2), where streams originating north of the aquifer flow across and lose most or all of their flows into highly faulted and fractured limestone. After water enters the aquifer, it moves generally in an easterly direction to discharge points in and near San Antonio, mainly municipal water-supply wells. Water not discharged to wells then continues generally toward the northeast along and parallel to northeast-trending faults in the study area to discharge at major spring complexes (Maclay, 1995; Otero, 2007; Musgrove and Crow, 2012).

The Edwards aquifer is about 450 feet thick in the study area (Small and Hanson, 1994, p. 5; Stein and Ozuna, 1994, p. 5). The hydrogeology of the Edwards aquifer is substantially controlled by faulting. For example, flow in the aquifer is affected by faults and their subsequent erosion and dissolution (Maclay and Small, 1984; Maclay, 1995; Mahler and others, 2011). Maclay and Small, (1984, p. 50) estimated transmissivities for the Edwards aquifer to range from 200,000 to 2,000,000 feet squared per day.

Previous Study

Otero and Petri (2010) analyzed groundwater samples to characterize the quality of native groundwater from the Edwards aquifer and preinjection and postinjection water from the Carrizo aquifer at and near the ASR site. Geochemical and isotope data indicated that no substantial changes in major-ion, trace-element, and isotope chemistry occurred as the water from the Edwards aquifer was transferred through a 38-mile pipeline to the ASR site. The samples collected from four ASR recovery wells were similar in major-ion and isotope chemistry compared to the samples collected from the Edwards aquifer source wells and the ASR injection well, possibly indicating that as Edwards aquifer water was injected it displaced native Carrizo aquifer water, or alternatively, if mixing of Edwards and Carrizo aquifer waters was occurring, the major-ion and isotope signatures for the Carrizo aquifer water might have been obscured by the signatures of the injected Edwards aquifer water. Differences over time in the dissolved iron and dissolved manganese concentrations (in this report, dissolved concentrations refer to concentrations measured in samples filtered through a 0.45-micrometer filter) measured in water samples collected from individual wells indicate either that minor amounts of mixing occurred between the waters from the two aquifers or that as Edwards aquifer water displaced Carrizo aquifer water it mobilized the iron and manganese directly from the Carrizo Sand. Concentrations of radium-226 in the samples collected at the ASR recovery wells were less than the concentrations in samples collected from the Edwards aquifer source wells and from the ASR injection well. The smaller radium-226 concentrations in the samples collected from the ASR recovery wells likely indicate that some degree of mixing of the two waters occurred rather than indicating continued decay of radium-226 in the injected water. Geochemical and isotope data measured in samples collected in May 2005 from two Carrizo aquifer monitoring wells and in July 2008 from the three ASR production-only wells in the northern section of the ASR site indicated that injected Edwards aquifer water had not migrated to these five sites. With the exception of a few samples, major-ion concentrations measured in samples collected in Carrizo aquifer wells in 2004, 2005, and 2008 were similar. Although in some cases the computed percent differences (compared to concentrations from June 2004) in dissolved iron and dissolved manganese concentrations in 11 wells sampled in the Carrizo aquifer in 2005 and 2008 were quite large, no patterns in the concentrations that might have been caused by migration of injected Edwards aquifer water were observed. Because of the natural variation in geochemical data in the Carrizo aquifer and the small dataset collected for this study, differences in major-ion and trace-element data among the samples collected in 2004, 2005, and 2008 could not be directly attributed to the ASR site operations. When the data were analyzed graphically, no appreciable differences in isotope concentrations were observed between samples collected in 2004 and 2008 from Carrizo aquifer wells, indicating that the Edwards aquifer source water might not have affected the isotope chemistry of the native Carrizo aquifer water near the sampled Carrizo wells by July 2008.

Methods of Investigation

Water-level altitude, water temperature, and specific conductance were measured in a monitoring well at the ASR site from August 2009 to September 2011. Discrete water-quality samples were collected from 12 wells in the study area during June 2004–July 2011 (table 1). In June 2004, 4 of the 12 wells described in this report were sampled by Otero and Petri (2010) as part of a larger set of wells near the ASR site. The samples collected in 2004 were used to determine the water chemistry of the Carrizo aquifer near the ASR site prior to injection of water from the Edwards aquifer into the ASR site. Samples collected in subsequent years served to determine to what extent, if any, the injected water might be affecting the water chemistry of the Carrizo aquifer near the ASR site.

Table 1. Wells from which data were collected at or near an aquifer storage and recovery (ASR) site, Bexar, Atascosa, and Wilson Counties, Texas, 2004–11, and the sampling years.

[X, open hole; --, not sampled; e, well sampled for native Edwards aquifer characterization; S, screened; w, well sampled while ASR site was in withdrawal mode; i, well sampled while ASR site was injecting; G, gravel packed; c, well sampled for native Carrizo aquifer characterization; s, well sampled while ASR site was in standby mode following injection; P, perforated or slotted; uk, unknown; N/A, not applicable; r, real-time water-level altitude, water temperature, and specific conductance]

Well name (fig. 1)	U.S. Geological Survey station number	U.S. Geological Survey station name	Well identifier[1]	Total depth (feet)	Open interval(s) (feet)	Completion type	Depth to pump intake (feet)	Sampling year					
								2004	2005	2008	2009	2010	2011
Edwards aquifer source wells													
Artesia	292557098261401	AY–68–37–508	ED1	1,318	982–1,318	X	569	--	e	--	e	e	--
Seale	292643098242101	AY–68–37–610	ED2	1,145	995–1,145	X	542	--	e	--	e	e	--
ASR injection/withdrawal wells													
ASR5	290732098251101	AY–68–53–811	RW1	665	605–660	S	400	--	--	w	w	i	w
ASR8	290750098235301	AY–68–53–912	IW1	685	445–685	S	400	--	i	--	w	--	w
ASR9	290809098232301	AY–68–53–913	RW3	685	450–685	S	400	--	--	w	w	i	w
ASR17	290657098242801	AY–68–61–319	RW4	775	610–775	G	400	--	--	w	w	i	--
ASR production-only well													
PO2	290838098241401	AY–68–53–916	ASR–PO2	565	380–390	G	355	--	--	w	w	i	w
					480–550								
Carrizo aquifer wells													
McCoy	290403098293201	AL–68–61–413	WC1	1,200	1,124–1,200	S	320	c	i	i	s	i	w
Oak Hills	291330098143301	ZL–68–55–111	NC4	422	uk	G	275	c	i	w	s	i	w
Palmer	290546098234801	AL–68–61–320	N/A	950	760–860	S	231	--	--	--	s	i	w
					880–950	X							
Picosa	290849098174001	ZL–68–54–807	NC3	838	738–828	S	231	c	i	w	s	i	w
Ray	290727098211301	ZL–68–62–108	NC2	938	838–938	P	uk	c	--	w	s	i	w
Monitoring well													
C8	290802098232901	AY–68–53–928	N/A	530	370–390	S	N/A	--	--	--	r	r	r
					450–470	S							
					510–530	S							

[1]Well identifier corresponds to well name used in Otero and Petri (2010).

Two additional wells completed in the Edwards aquifer that supplied water to the ASR site for injection were sampled beginning in 2005. These wells originally were sampled by Otero and Petri (2010) to determine the chemistry of the water being injected into the Carrizo aquifer at the ASR site, but sampling of these wells continued as part of the sampling of the 12 wells described in this report so that any changes in the water chemistry of the water being injected at the ASR site could be ascertained.

Collection of Continuous Data

Water-Level Altitudes

Continuous water-level-altitude data were collected in monitoring well AY–68–53–928 (hereinafter, C8; fig. 1; table 1) by using methods described by Freeman and others (2004). The well was equipped with a submersible pressure transducer and a data-collection platform (DCP) for real-time data transmission. The data stored in the DCP were transmitted every 4 hours by satellite telemetry to a geostationary operations environmental satellite that transmitted the data through a USGS ground station to the USGS National Water Information System (NWIS) database (U.S. Geological Survey, 2012).

Water Temperature and Specific Conductance

Water temperature and specific conductance were measured in well C8 during August 20, 2009–September 30, 2011. Table 2 shows the depths at which water temperature and specific conductance were measured by using a real-time water-quality monitor. During August 20, 2009–October 13, 2010, the real-time water-quality monitor measured water temperature and specific conductance at the depth of 530 feet below land surface corresponding to the bottom of the deepest of three screened intervals in the monitoring well. During November 9, 2010–September 30, 2011, the real-time water-quality monitor was used to measure water temperature and specific conductance at the depth of 460 feet below land surface corresponding to the center of the middle of the three screened intervals in the monitoring well. Two additional monitors were installed and used to collect data during July 30, 2010–September 30, 2011, at depths corresponding to the centers of the shallowest and deepest screened intervals (380 and 520 feet below land surface) in the monitoring well to determine simultaneously how water injections, withdrawals, or both might be affecting the water quality within all three screened intervals of well C8.

The sensors on the monitors were operated and maintained and the data were managed as described in Wagner and others (2006). The three water-quality monitors measured water temperature and specific conductance hourly. Data from the real-time water-quality monitor were recorded by a DCP at the site and transmitted to NWIS every 4 hours. The remaining two monitors recorded the data internally, and their data were downloaded during maintenance visits to the site.

Table 2. Depths at which water temperature and specific conductance data were collected at U.S. Geological Survey station 290802098232901 AY–68–53–928 (C8) and period of record for each depth, Bexar County, Texas, August 2009–September 2011.

Screened interval number	Top of interval (feet)	Bottom of interval (feet)	Monitor depth (feet)	Period of record
1	370	390	380	July 30, 2010–September 30, 2011
2	450	470	460	November 9, 2010–September 30, 2011
3	510	530	520	July 30, 2010–September 30, 2011
			530	August 20, 2009–October 13, 2010

Collection and Analysis of Discrete Data

Sample Collection

A total of 50 environmental water-quality samples (app. 1) and 6 quality-assurance samples (apps. 1 and 2) were collected from the 12 wells described in this report from June 2004–July 2011 (table 1). Water-quality samples were collected and processed by following standard USGS methods documented in the “National Field Manual for the Collection of Water-Quality Data” (U.S. Geological Survey, variously dated). All 12 wells sampled for this study had permanently installed pumps from which samples were collected from raw-water spigots at or near the well head, prior to any pressure tanks or water treatment. All wells were pumped to remove three casing volumes of water or until the physicochemical properties of water temperature, specific conductance, pH, turbidity, and dissolved oxygen concentration stabilized before samples were collected and processed to ensure that the samples collected were representative of water from the aquifer (U.S. Geological Survey, variously dated). Physicochemical properties were considered stable when the variation between five or more sequential field-measurement readings were within plus or minus 0.2 degree Celsius for water temperature, 5 percent for specific conductance, 0.10 unit for pH, 10 percent for turbidity, and 0.3 milligram per liter for dissolved oxygen (Wilde, 2008).

Sample Analysis

Two laboratories analyzed samples for this study. The USGS National Water Quality Laboratory (NWQL) in Lakewood, Colo., was the primary laboratory and analyzed samples for total dissolved solids, major ions (calcium, magnesium, potassium, sodium, chloride, fluoride, silica, and sulfate), and trace elements (aluminum, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, lithium, manganese, molybdenum, nickel, silver, strontium, vanadium, zinc, antimony, arsenic, boron, and selenium). The NWQL also analyzed samples for total iron and manganese. The USGS Reston Stable Isotope Laboratory (RSIL) in Reston, Va., analyzed samples for oxygen-18 (^{18}O) to oxygen-16 (^{16}O) and deuterium (^{2}H) to protium (^{1}H) isotopic ratios.

Total dissolved solids were measured by using techniques described in Fishman and Friedman (1989). Major ions were measured by using ion-exchange chromatography (for anion concentrations) and inductively coupled plasma-atomic emissions spectrometry (ICP-AES) (for cation concentrations) as described by Fishman (1993). Trace-element concentrations were measured by using collision-reaction cell inductively coupled plasma-mass spectrometry (cICP-MS) (Garbarino and others, 2006). Total iron and manganese were measured by using inductively coupled plasma-optical emission spectrometry (ICP-OES) and inductively coupled plasma-mass spectrometry (ICP-MS) as described in Garbarino and Struzeski (1998). ^{18}O, ^{16}O, ^{2}H, and ^{1}H isotope compositions were measured by using techniques in which the sample is equilibrated with either gaseous hydrogen or carbon dioxide as described in Révész and Coplen (2008a, b).

Results Reporting

The analytical quantification procedure used by the NWQL for reporting results is based on long-term method detection levels (LT–MDL) and laboratory reporting levels (LRL). The LT–MDL concentrations are defined for most analytical methods at the NWQL to limit the false positive rate to less than or equal to 1 percent. At the LT–MDL, the occurrence of false positive detections is limited to less than or equal to 1 percent (Childress and others, 1999). Childress and others (1999, p. 1) stated:

> …at the long-term method detection level, the risk of a false negative occurrence (analyte reported not present when present at the long-term method detection level concentration) is up to 50 percent. Because this false negative rate is too high for use as a default "less than" reporting level, a more reliable laboratory reporting level is set at twice the determined long-term method detection level.

The LRL is therefore defined as twice the LT–MDL. A constituent concentration greater than the LT–MDL and less than the LRL indicates that the detection of a constituent is considered likely, but quantification is considered questionable. These results are considered estimated, and the remark code of "E" is assigned by the laboratory for these results (Childress and others, 1999). A constituent concentration less than the LT–MDL is considered a nondetection and is reported as less than the LRL. The LT–MDLs and LRLs changed for some constituents during the study because the NWQL reassesses the values on a regular basis. Table 3 shows all the LT–MDLs and LRLs that were in effect during the study for the constituents sampled.

Stable environmental oxygen and hydrogen are measured as the ratio of the two most abundant isotopes of a given element. The most abundant isotopes of oxygen are ^{18}O and ^{16}O, and the most abundant isotopes of hydrogen are ^{2}H and ^{1}H (Clark and Fritz, 1997). Water molecules with a greater amount of the lightest oxygen and hydrogen isotopes (^{16}O and ^{1}H, respectively) evaporate preferentially compared to water molecules with a greater amount of the heaviest oxygen and hydrogen isotopes (^{18}O and ^{2}H, respectively) (Bruckner, 2009).

Stable isotopic compositions of oxygen and hydrogen are reported as relative isotope ratios in parts per thousand (per mil) by using the standard delta (δ) notation (Coplen and others, 2002; Coplen, 2011):

$$\delta^{i}X = R_{sample}/R_{reference} - 1, \quad (1)$$

where

$\delta^{i}X$ is the heavier isotope (^{18}O or ^{2}H),

R_{sample} is the ratio of the abundance of the heavier isotope to the lighter isotope (^{16}O or ^{1}H) in the sample, and

$R_{reference}$ is the ratio of the abundance of the heavier isotope to the lighter isotopein the reference material.

The reference material for oxygen and hydrogen is Vienna Standard Mean Ocean Water (VSMOW), which is assigned $\delta^{18}O$ and δD values of zero per mil (Clark and Fritz, 1997). Positive values indicate enrichment of the heavier isotope, and negative values indicate depletion of the heavier isotope, compared to the ratios observed in the VSMOW standard.

Quality Control

Quality-assurance samples were collected and processed by using the same procedures as those for the environmental water-quality samples as outlined in the "National Field Manual for the Collection of Water-Quality Data" (U.S. Geological Survey, variously dated). Quality-assurance samples collected for this study included blank and replicate samples. Blank samples (app. 1) were processed during the study to evaluate the extent of contamination introduced during sampling, sample processing, shipping, or laboratory analysis. Replicate samples (apps. 1 and 2) were collected during the study to evaluate variability introduced during processing or laboratory analysis.

Table 3. Summary of long-term method detection levels and laboratory reporting levels for constituents sampled for study of an aquifer storage and recovery site, Atascosa, Bexar, and Wilson Counties, Texas, June 2004–July 2011.

[LT–MDL, long-term method detection level; LRL, laboratory reporting level; mg/L, milligrams per liter; N/A, not applicable; µg/L, micrograms per liter]

Constituent	Begin date	End date	LT–MDL	LRL
Total dissolved solids (mg/L)	10/1/2010	9/30/2011	N/A	12
	5/15/2001	9/30/2010	N/A	10
Calcium (mg/L)	10/1/2009	9/30/2011	0.022	0.044
	10/1/2008	9/30/2009	0.01	0.02
	10/1/2007	9/30/2008	0.02	0.04
	10/1/2004	9/30/2007	0.01	0.02
	10/1/2003	9/30/2004	0.005	0.01
Magnesium (mg/L)	10/1/2009	9/30/2011	0.008	0.016
	10/1/2008	9/30/2009	0.006	0.012
	10/1/2007	9/30/2008	0.01	0.02
	10/1/2006	9/30/2007	0.007	0.014
	10/1/2003	9/30/2006	0.004	0.008
Potassium (mg/L)	10/1/2010	9/30/2011	0.022	0.044
	10/1/2009	9/30/2010	0.032	0.064
	10/1/2008	9/30/2009	0.03	0.06
	10/1/2007	9/30/2008	0.01	0.02
	10/1/2006	9/30/2007	0.02	0.04
	10/1/2002	9/30/2006	0.08	0.16
Sodium (mg/L)	10/1/2010	9/30/2011	0.06	0.12
	10/1/2009	9/30/2010	0.05	0.1
	10/1/2007	9/30/2009	0.06	0.12
	10/1/2004	9/30/2007	0.1	0.2
	10/1/2003	9/30/2004	0.05	0.1
Chloride (mg/L)	10/1/2006	9/30/2011	0.06	0.12
	10/1/2002	9/30/2006	0.1	0.2
Fluoride (mg/L)	10/1/2008	9/30/2011	0.04	0.08
	10/1/2007	9/30/2008	0.06	0.12
	10/1/2004	9/30/2007	0.05	0.1
	10/1/2003	9/30/2004	N/A	0.17
Silica (mg/L)	10/1/2009	9/30/2011	0.029	0.058
	10/1/2008	9/30/2009	0.01	0.02
	10/1/2006	9/30/2008	0.009	0.018
	10/1/2003	9/30/2006	0.02	0.04
Sulfate (mg/L)	10/1/2002	9/30/2011	0.09	0.18
Aluminum (µg/L)	10/1/2009	9/30/2011	1.7	3.4
	10/1/2008	9/30/2009	2	4
	10/1/2002	9/30/2008	0.8	1.6
Barium (µg/L)	10/1/2009	9/30/2011	0.07	0.14
	10/1/2007	9/30/2009	0.2	0.4
	10/1/2006	9/30/2007	0.04	0.08
	10/1/2003	9/30/2006	0.1	0.2
Beryllium (µg/L)	10/1/2009	9/30/2011	0.006	0.012
	10/1/2008	9/30/2009	0.01	0.02
	10/1/2007	9/30/2008	0.004	0.008
	10/1/2002	9/30/2007	0.03	0.06
Cadmium (µg/L)	10/1/2010	9/30/2011	0.016	0.032
	10/1/2008	9/30/2010	0.01	0.02
	10/1/2003	9/30/2008	0.02	0.04
Chromium (µg/L)	10/1/2006	9/30/2011	0.06	0.12
	1/1/2004	9/30/2006	0.02	0.04
Cobalt (µg/L)	10/1/2010	9/30/2011	0.02	0.04
	10/1/2009	9/30/2010	0.005	0.01
	10/1/2007	9/30/2009	0.01	0.02
	1/1/2004	9/30/2007	0.02	0.04
Copper (µg/L)	10/1/2007	9/30/2011	0.5	1
	1/1/2004	9/30/2007	0.2	0.4
Iron (µg/L)	10/1/2010	9/30/2011	3.2	6.4
	10/1/2009	9/30/2010	3	6
	10/1/2008	9/30/2009	2	4
	10/1/2007	9/30/2008	4	8
	10/1/2004	9/30/2007	3	6
	10/1/2003	9/30/2004	3.2	6.4
Total iron (µg/L)	10/1/2009	9/30/2011	4.6	9.2
	10/1/2008	9/30/2009	7	14
	10/1/2004	9/30/2008	3	6
	10/1/2003	9/30/2004	4.5	9
Lead (µg/L)	10/1/2009	9/30/2011	0.015	0.03
	10/1/2008	9/30/2009	0.03	0.06
	10/1/2007	9/30/2008	0.04	0.08
	10/1/2006	9/30/2007	0.06	0.12
	10/1/2002	9/30/2006	0.04	0.08
Lithium (µg/L)	10/1/2009	9/30/2011	0.22	0.44
	10/1/2007	9/30/2009	0.5	1
	10/1/2003	9/30/2007	0.3	0.6
Manganese (µg/L)	10/1/2009	9/30/2011	0.13	0.26
	10/1/2003	9/30/2009	0.1	0.2
Total manganese (µg/L)	10/1/2009	9/30/2011	0.4	0.8
	10/1/2008	9/30/2009	0.2	0.4
	10/1/2007	9/30/2008	0.4	0.8
	4/1/2006	9/30/2007	0.3	0.6
	10/1/2003	3/31/2006	0.1	0.2

Table 3. Summary of long-term method detection levels and laboratory reporting levels for constituents sampled for study of an aquifer storage and recovery site, Atascosa, Bexar, and Wilson Counties, Texas, June 2004–July 2011.—Continued

[LT–MDL, long-term method detection level; LRL, laboratory reporting level; mg/L, milligrams per liter; N/A, not applicable; µg/L, micrograms per liter]

Constituent	Begin date	End date	LT–MDL	LRL
Molybdenum (µg/L)	10/1/2009	9/30/2011	0.014	0.028
	10/1/2008	9/30/2009	0.01	0.02
	10/1/2007	9/30/2008	0.1	0.2
	10/1/2006	9/30/2007	0.06	0.12
	10/1/2003	9/30/2006	0.2	0.4
Nickel (µg/L)	10/1/2010	9/30/2011	0.09	0.18
	10/1/2008	9/30/2010	0.06	0.12
	10/1/2007	9/30/2008	0.1	0.2
	1/1/2004	9/30/2007	0.03	0.06
Silver (µg/L)	10/1/2009	9/30/2011	0.005	0.01
	10/1/2008	9/30/2009	0.004	0.008
	10/1/2006	9/30/2008	0.05	0.1
	10/1/2002	9/30/2006	0.1	0.2
Strontium (µg/L)	10/1/2009	9/30/2011	0.2	0.4
	10/1/2007	9/30/2009	0.4	0.8
	10/1/2003	9/30/2007	0.2	0.4
Vanadium (µg/L)	10/1/2008	9/30/2011	0.08	0.16
	10/1/2006	9/30/2008	0.02	0.04
	1/1/2004	9/30/2006	0.05	0.1
Zinc (µg/L)	10/1/2009	9/30/2011	1.4	2.8
	10/1/2008	9/30/2009	1	2
Zinc (µg/L)—Continued	10/1/2007	9/30/2008	0.9	1.8
	1/1/2004	9/30/2007	0.3	0.6
Antimony (µg/L)	10/1/2009	9/30/2011	0.027	0.054
	10/1/2008	9/30/2009	0.02	0.04
	10/1/2007	9/30/2008	0.07	0.14
	10/1/2006	9/30/2007	0.03	0.06
	10/1/2003	9/30/2006	0.1	0.2
Arsenic (µg/L)	10/1/2009	9/30/2011	0.022	0.044
	10/1/2007	9/30/2009	0.03	0.06
	10/1/2004	9/30/2007	0.06	0.12
Boron (µg/L)	10/1/2010	9/30/2011	3	6
	10/1/2009	9/30/2010	1.4	2.8
	10/1/2008	9/30/2009	2	4
	10/1/2007	9/30/2008	3	6
	10/1/2003	9/30/2007	4	8
Selenium (µg/L)	10/1/2010	9/30/2011	0.03	0.06
	10/1/2009	9/30/2010	0.02	0.04
	10/1/2008	9/30/2009	0.03	0.06
	10/1/2007	9/30/2008	0.02	0.04
	1/1/2004	9/30/2007	0.04	0.08

Blank samples were processed by using deionized water obtained from the NWQL and certified to contain undetectable concentrations of constituents to be analyzed. A total of 102 concentrations for 34 constituents were analyzed in three blank samples. Detectable concentrations were measured in 7 of the 102 values measured in the blank samples. Of the 7 detected concentrations, 4 concentrations in environmental samples were rejected and not reported because the associated blank sample had a concentration greater than that of the environmental sample.

Three replicate samples were compared to the associated environmental samples by calculating the relative percent difference (RPD) for each pair of detected constituents (app. 2). The RPD was not computed for a constituent pair if one or both of the concentrations were nondetections or were reported as estimated. Of the total 105 constituent pairs, RPD was computed for 75 pairs. RPD was computed by using the equation

$$RPD = |C_1 - C_2|/((C_1 + C_2)/2) \times 100, \qquad (2)$$

where

C_1 is the concentration from an environmental sample, and

C_2 is the concentration from a replicate sample.

RPDs of 15 percent or less were determined for this study to indicate good agreement between analytical results if the concentrations were sufficiently large compared to the LRL. For 75 sample pairs for which the RPD was computed, the RPD was within 15 percent for 68 sample pairs. RPDs of zero were computed for 10 of the 75 sample pairs. The nonzero RPDs between environmental and replicate samples collected for this study ranged from 0.20 percent for sulfate in the McCoy well to 164 percent for cobalt in the same well, with a median value of 3.68 percent. Three of the seven sample pairs with RPDs exceeding 15 percent had concentrations that were not sufficiently large compared to the LRL, resulting in a large RPD from a small difference between concentrations.

Water-Chemistry and Isotope Analysis

Water-chemistry and isotope data were analyzed to evaluate the quality of water in the Carrizo aquifer before and after water from the Edwards aquifer was injected at the ASR site. Major-ion, trace-element, and isotope data were graphically evaluated for differences between samples of the Edwards aquifer source water before it was injected at the ASR site and samples of native (preinjection of Edwards aquifer water) Carrizo aquifer water collected from wells near the ASR site and to assess changes in preinjection and postinjection quality of water in the Carrizo aquifer in the study area. A trilinear diagram (Hem, 1992) and Stiff diagrams (Stiff, 1951) were constructed by using major-ion-chemistry data to depict changes in water composition. Iron and manganese concentrations, which were observed to be generally much larger in water from the Carrizo aquifer than in water from the Edwards aquifer, were used as indicators of whether the injected Edwards aquifer water might be causing any changes in water chemistry at wells screened in the Carrizo aquifer at or near the ASR site. Edwards aquifer groundwater was chlorinated before it was injected at the ASR site (Kirk Nixon, San Antonio Water System, Manager, Protection and Compliance Department, oral commun., 2011). There was concern that the injected, chlorinated Edwards aquifer water, in which dissolved oxygen concentrations are generally greater than those in water from the Carrizo aquifer, might cause an increase in iron or manganese precipitation in parts of the Carrizo aquifer where reducing conditions might be present. Scatter plots of stable isotope data measured in samples collected from the Carrizo aquifer were constructed to help discern whether any changes in isotope chemistry occurred after the injection of water from the Edwards aquifer into the Carrizo aquifer.

Water-Level Altitudes and Continuous Groundwater Quality

Daily mean water-level altitude from monitoring well C8 and daily volume of water injected and withdrawn from the ASR site were analyzed to determine how injection and withdrawal from the wells at the ASR site might affect local groundwater altitude. Daily mean water-level altitude in well C8 fluctuated between 331.66 and 465.02 feet above North American Vertical Datum of 1988 (NAVD 88) between August 20, 2009, and September 30, 2011 (app. 3).

Injection occurred for a total of about 1,846 days (about 70 percent of the total days) from June 29, 2004, when water was first injected into the ASR plant, through September 30, 2011 (app. 4; fig. 3). The total volume of water injected at the site during the time period was approximately 35.5 billion gallons (Anastasia R. Valdes, San Antonio Water System Geographic Information Systems Professional, Production Department, written commun., 2012). This volume of water would be enough to sustain the City of San Antonio's current water needs for approximately 6 months based on SAWS statistics for the period of June 29, 2004, through September 30, 2011, during which average daily withdrawal from the Edwards aquifer by the water purveyor was 183.2 million gallons (San Antonio Water System, 2012).

Withdrawals from the ASR site usually occurred when conditions in the San Antonio area required SAWS to augment water supplies either by recovering previously injected Edwards aquifer water or by pumping water from the PO wells to supply the City of San Antonio's water needs and alleviate pumping stress on the Edwards aquifer. Groundwater withdrawals from the ASR and PO wells occurred during 681 days (about 26 percent of total days) from June 29, 2004, through September 30, 2011 (app. 5; fig. 3). The total volume of water withdrawn from the site during that time period was approximately 11.9 billion gallons, with about 8.2 billion gallons coming from recovering ASR wells (Anastasia R. Valdes, San Antonio Water System, Geographic Information Systems Professional, Production Department, written commun., 2012). The ASR site was in standby mode during the remaining 123 days (about 4 percent of total days) between June 29, 2004, and September 30, 2011; on these days, no water was withdrawn or injected (fig. 3).

Water-Level Altitude

Daily mean water-level altitude in well C8 and daily injection and withdrawal volume from wells at the ASR site during August 20, 2009–September 30, 2011, are shown in figure 4. Total daily injection and withdrawal volumes from all 36 wells (29 injection/withdrawal and 7 PO wells) at the ASR site and total daily injection and withdrawal volumes from 11 of the 36 wells (9 injection/withdrawal and 2 PO wells) located within a 1-mile radius of well C8 are shown. During injection periods, the water-level altitude in well C8 generally increased as the amount of water being injected into all wells at the ASR site increased and decreased as the amount of water being injected into all wells at the ASR site decreased. While the amount of water injected into all wells at the ASR site decreased during October and November 2010, the daily mean water-level altitude in well C8 continued to increase. Although the amount of water injected at the ASR site decreased, the total amount of water injected into the nine injection/withdrawal wells within a 1-mile radius of well C8 increased during October and November 2010 and likely was the cause of the continued increase in water-level altitude in well C8.

During withdrawal periods, the water-level altitude in well C8 generally increased as the total volume of water being withdrawn from all 36 wells at the ASR site decreased and generally decreased as the total volume of water being withdrawn from all wells increased (fig. 4). During a sustained period of withdrawal from April 2011 through September 2011, total daily withdrawal from the 11 wells within a 1-mile

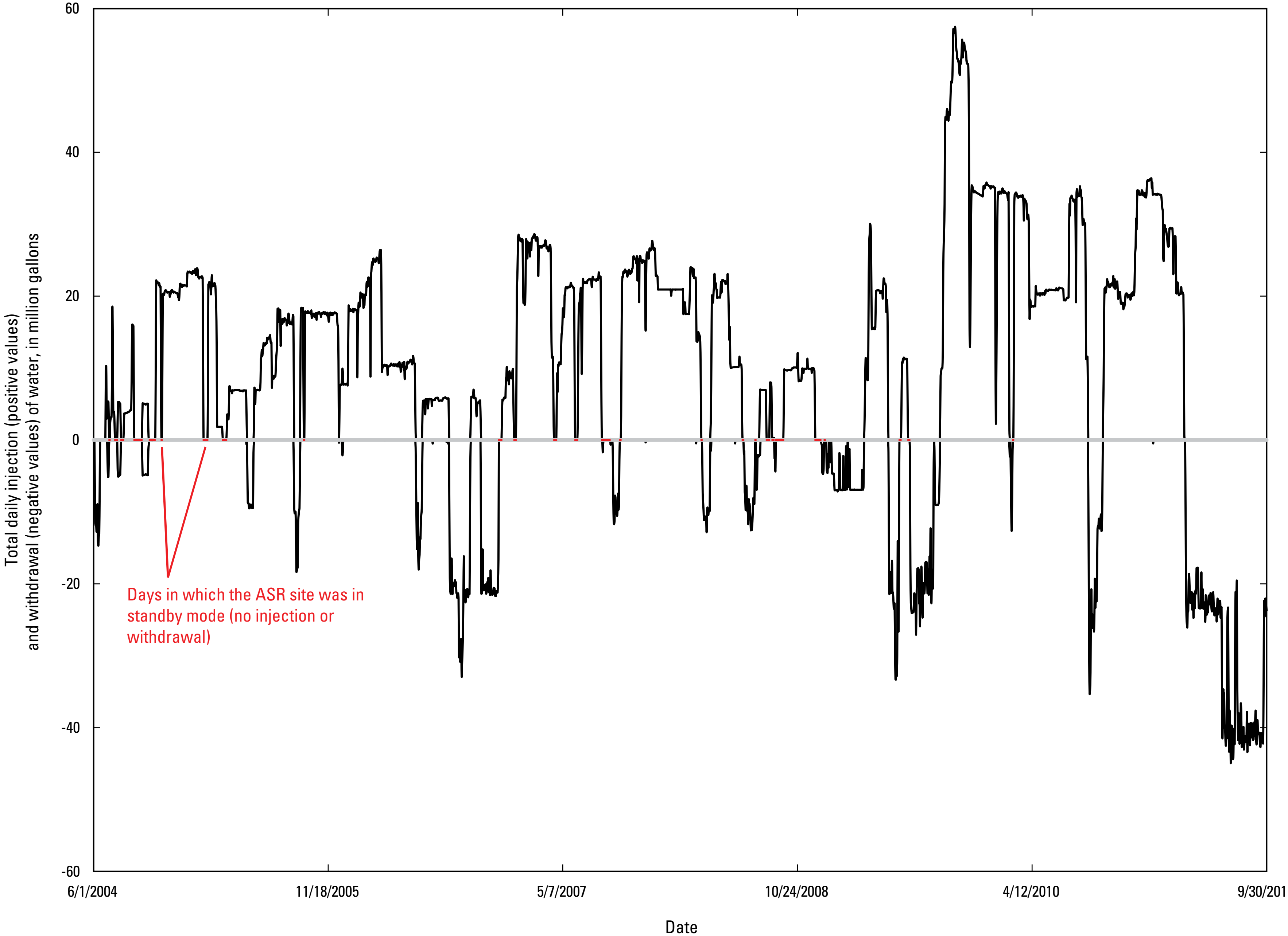

Figure 3. Total daily volume of water injected or withdrawn at an aquifer storage and recovery (ASR) site, Bexar County, Texas, 2004–11.

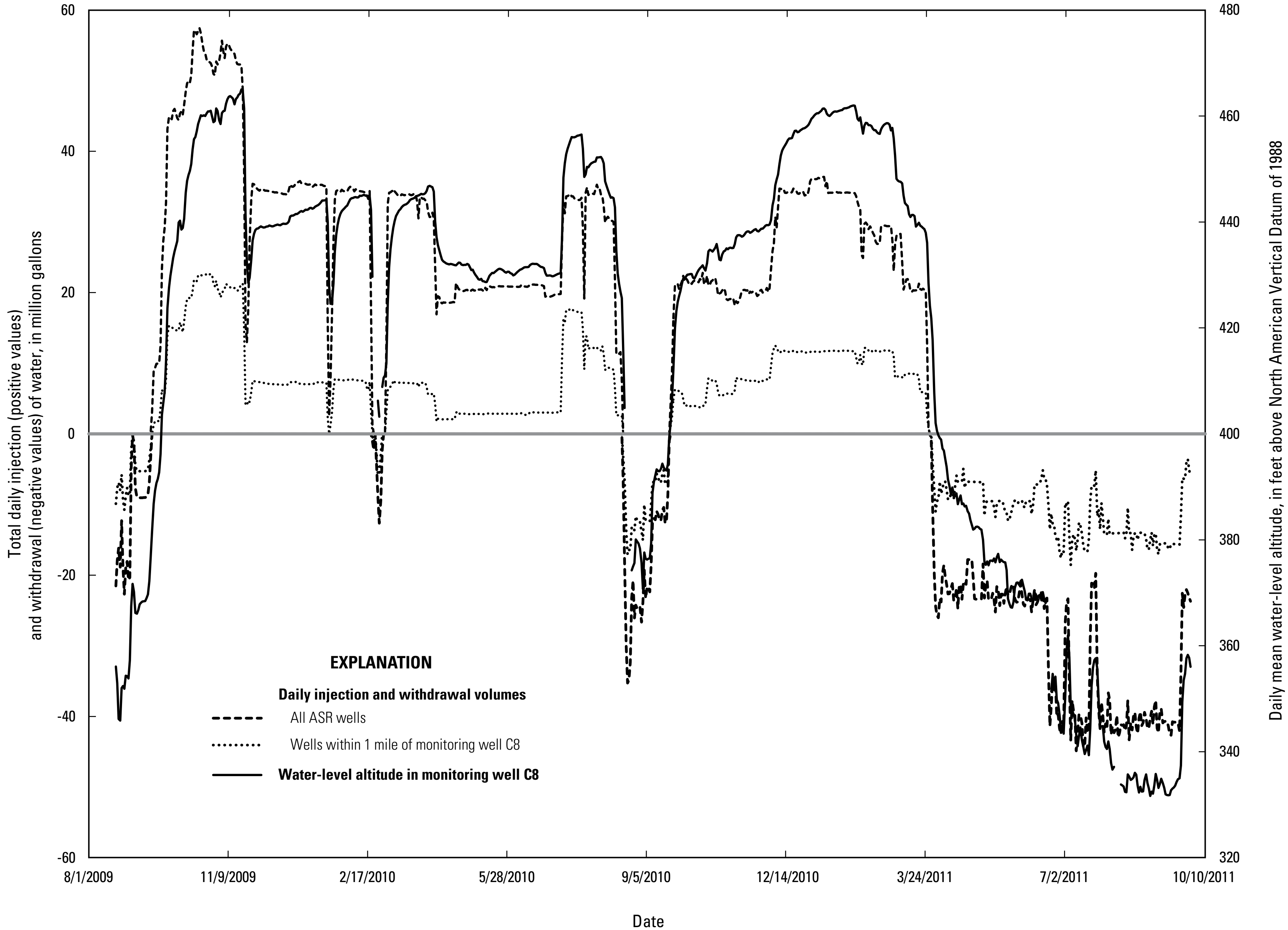

Figure 4. Daily mean water-level altitude at U.S. Geological Survey station 290802098232901 AY–68–53–928 (C8), Bexar County, Texas, 2009–11, with total daily volume of water injected or withdrawn at an aquifer storage and recovery (ASR) site.

radius of well C8 remained at a fairly constant volume while total daily withdrawal from all the wells at the ASR site increased by approximately 10 million gallons in June 2011 and then remained relatively constant through September 2011. The increase in total daily withdrawal from all wells at the ASR site caused a decrease in water-level-altitude values in well C8, indicating that withdrawals of large volumes of water at the ASR site might cause a change in water-level altitudes at distances more than 1 mile away.

Water Temperature and Specific Conductance

Daily mean water temperature data were collected at four depths within the three screened intervals of well C8 (apps. 6.1–6.4). Daily mean water temperature values fluctuated by less than 1 degree Celsius from August 20, 2009, to September 30, 2011 (fig. 5; table 4) at all four depths and were determined to be independent of the injection or withdrawal of water.

Daily mean specific-conductance values were measured in microsiemens per centimeter at 25 degrees Celsius (µS/cm) at four depths in well C8 (apps. 7.1–7.4). The ranges of daily mean specific-conductance values were measured at the four depths in well C8 (table 5). During some periods the daily mean specific-conductance values measured at 530 feet below land surface appeared to vary independently of changes in the total volume injected into all wells at the ASR site, but during other periods appeared to vary in accordance with changes in the total volume injected (fig. 6). During September and October 2009, daily mean specific-conductance values increased approximately 30 µS/cm following a large increase in daily injection volume. In late August 2009, the ASR site transitioned from a negative injection volume (withdrawals were occurring) to a period of positive injection volume (fig. 4). Large amounts of injected water during November 2009–July 2010 did not result in large increases in daily mean specific-conductance values and, in July 2010, daily mean specific-conductance values decreased by approximately 20 µS/cm when the volume injected into the entire ASR site was increased by approximately 10 million gallons (fig. 6). Examination of the volume of water injected into wells within 1 mile of well C8 provided no additional evidence into the cause of differences in daily mean specific-conductance values at the depth of 530 feet in well C8.

Daily mean specific-conductance values measured at depths 380, 460, and 520 feet below land surface were similar and responded in the same way to changes in total volume of water injected at the ASR site (fig. 6). Like the daily mean specific-conductance values measured at the depth of 530 feet below land surface in well C8, the daily mean specific-conductance values measured for the three shallower depths also varied independently from injection rates. Within about a week after the ASR site switched from withdrawing to injecting water in September 2010, daily mean specific-conductance values at depths of 380, 460, and 520 feet below land surface began to decrease until they stabilized at about 185 µS/cm from approximately November 2010 to March 2011. This period of stable daily mean specific-conductance values occurred despite concurrent changes in injection volumes at the entire ASR site and at sites within 1 mile of well C8. In March 2011, an increase of approximately 30 µS/cm was measured in daily mean specific-conductance values corresponding to a reduction in injection volume from approximately 10 million gallons to approximately 7 million gallons (Anastasia R. Valdes, San Antonio Water System Geographic Information Systems Professional, Production Department, written commun., 2012).

Discrete Groundwater Quality

Groundwater quality was assessed according to the aquifer from which the samples were collected. Samples collected from wells providing Edwards aquifer water for injection into the ASR site were analyzed and compared with data previously collected by Otero and Petri (2010) from wells completed in the Carrizo aquifer near the ASR site. The previously collected data were from samples collected before any Edwards aquifer water was injected and were used to determine native groundwater quality of the Carrizo aquifer. Samples collected from 12 wells completed in the Carrizo aquifer at and near the ASR site were analyzed after injection of Edwards aquifer water to determine how much, if any, mixing of the injected Edwards aquifer water with the native Carrizo aquifer water was evident.

Edwards Aquifer Water Quality

The two wells from which water from the Edwards aquifer is supplied to the ASR (Artesia and Seale, fig. 1) were sampled periodically to monitor for temporal changes that might have occurred in water quality. Changes in the source water for the ASR site were determined so that any similar changes observed in the samples collected from the wells at the ASR site would not automatically be associated with changes occurring in the subsurface while the water was stored at the ASR site.

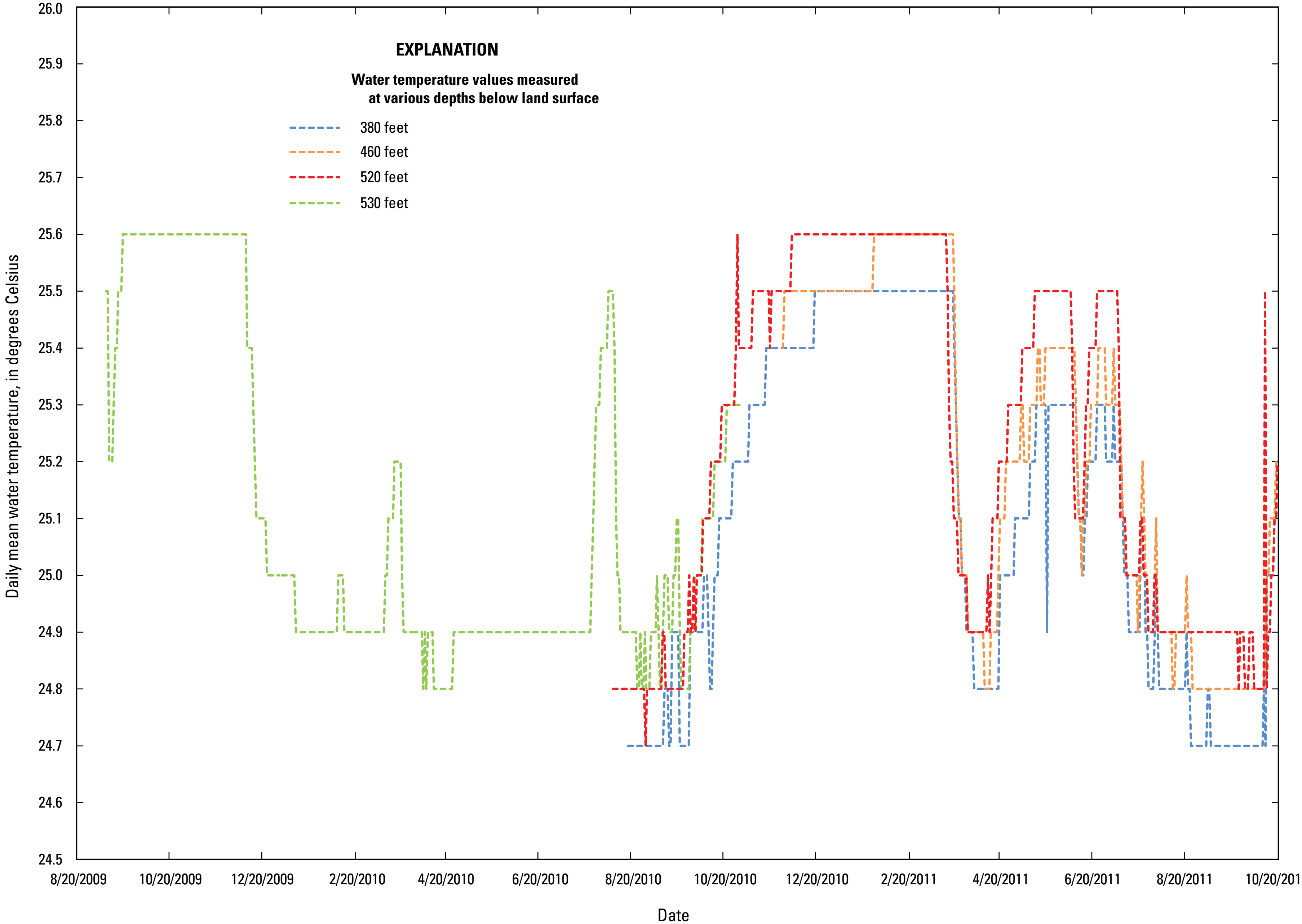

Figure 5. Daily mean water temperature at four depths at U.S. Geological Survey station 290802098232901 AY–68–53–928 (C8), Bexar County, Texas, 2010–11.

Table 4. Ranges of daily mean water temperature at four depths at U.S. Geological Survey station 290802098232901 AY–68–53–928 (C8), Bexar County, Texas, 2010–11.

[Temperature in degrees Celsius]

Depth (feet below land-surface datum)	Minimum daily mean water temperature	Maximum daily mean water temperature
380	24.7	25.5
460	24.8	25.6
520	24.7	25.6
530	24.8	25.6

Table 5. Ranges of daily mean specific conductance at four depths at U.S. Geological Survey station 290802098232901 AY–68–53–928 (C8), Bexar County, Texas, 2010–11.

[Specific conductance in microsiemens per centimeter at 25 degrees Celsius]

Depth (feet below land-surface datum)	Minimum daily mean specific conductance	Maximum daily mean specific conductance
380	181	221
460	186	215
520	180	215
530	191	243

Major-Ion Chemistry

The major-ion chemistry for samples collected in the 12 wells from June 2004 through July 2011 (table 1) is represented in a trilinear diagram (fig. 7) and Stiff diagrams (fig. 8). On the trilinear diagram, individual samples are plotted with a triangle if the samples were collected when water from the Edwards aquifer was being injected into the ASR site or with an inverted triangle if collected when water was being withdrawn from the ASR site. The major-ion chemistry of groundwater samples collected from the Edward aquifer source wells is indicative of calcium-bicarbonate type water, the dominant groundwater type in the freshwater section of the Edwards aquifer (Lambert and others, 2000; Fahlquist and Ardis, 2004; Otero, 2007) (fig. 7). No substantial differences were measured in major-ion chemistry of water samples collected in 2005, 2009, and 2010 from the Artesia and Seale wells (app. 1). The Stiff diagrams created from the major-ion chemistry (fig. 8) indicate very similar water in the two wells. No substantial temporal changes in major-ion chemistry occurred in samples collected from the Edwards aquifer source wells. Therefore, any substantial differences in major-ion chemistry between the Edwards aquifer source wells and the ASR wells most likely will have been caused by mixing or subsurface processes that occurred during the time when the water was stored in the Carrizo aquifer at the ASR site.

Trace-Element Chemistry

In the water samples collected from the two Edwards aquifer source wells (Artesia and Seale), the dissolved iron concentrations were less than 6 μg/L (LRL), and dissolved manganese concentrations ranged from less than 0.2 μg/L (LRL) to 0.3 μg/L (app. 1). The negligible concentrations of dissolved iron and manganese in water native to the Edwards aquifer did not change temporally. Any increases in dissolved iron or manganese concentrations observed after injection of the water into the ASR site most likely could be attributed to the mixing of water from the Edwards and Carrizo aquifers or interaction of water with the iron- and manganese-rich Carrizo Sand formation.

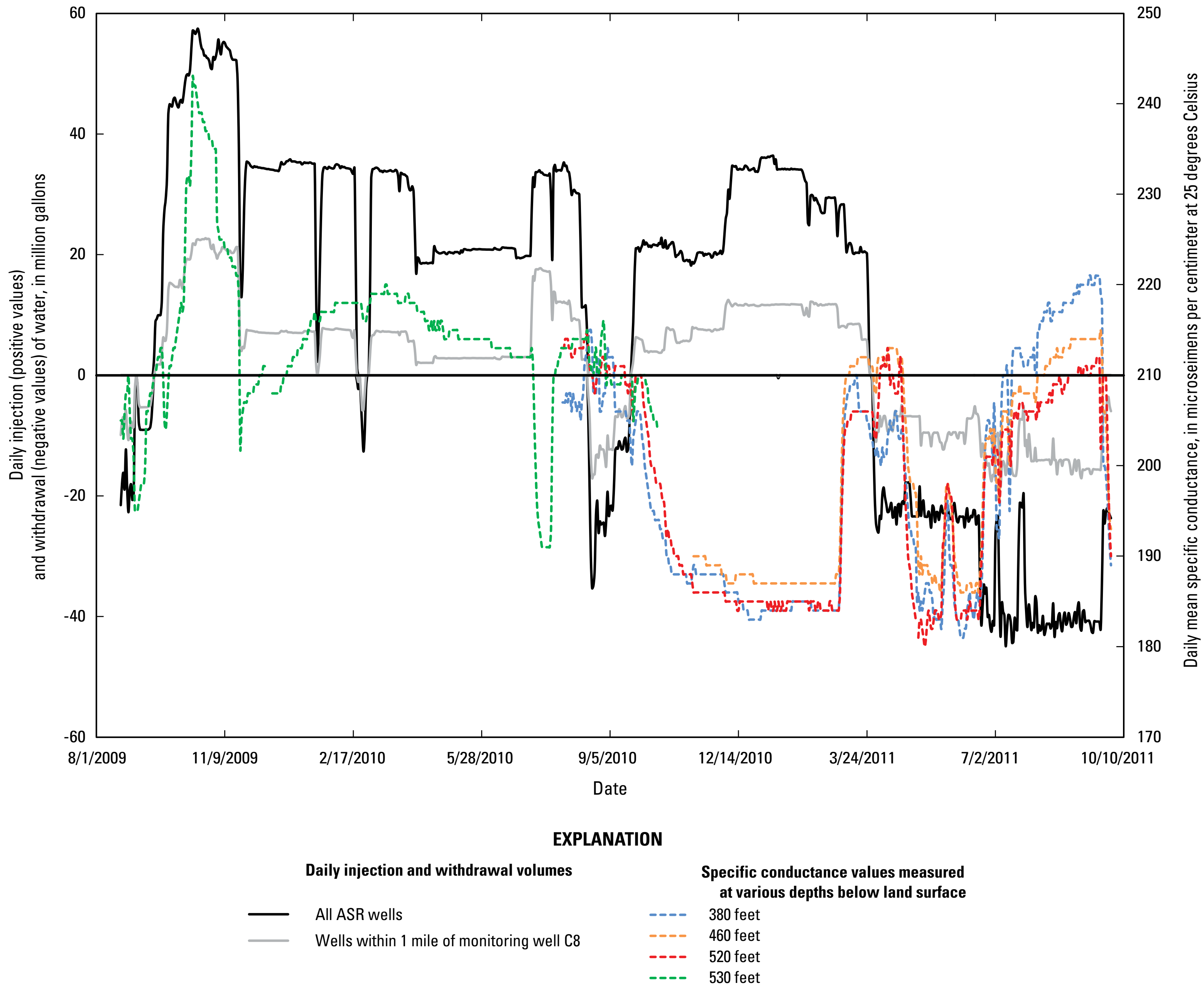

Figure 6. Daily mean specific conductance at four depths at U.S. Geological Survey station 290802098232901 AY–68–53–928 (C8), Bexar County, Texas, 2009–11, with daily volume of water injected or withdrawn at an aquifer storage and recovery (ASR) site.

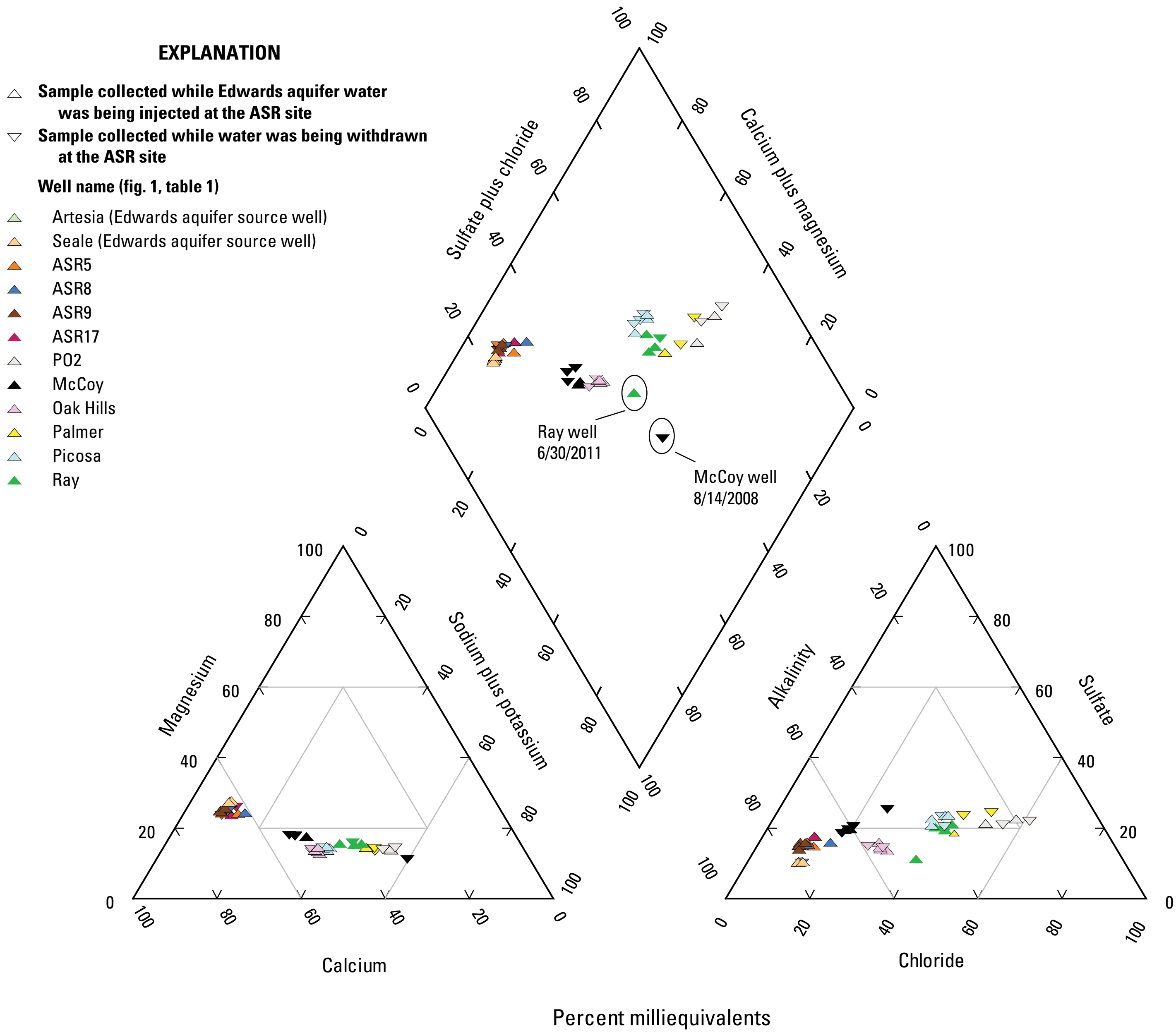

Figure 7. Trilinear diagram showing composition of water samples collected from 12 wells at and near an aquifer storage and recovery (ASR) site, Bexar, Atascosa, and Wilson Counties, Texas, 2004–11.

Isotopes

The relation between δD and $\delta^{18}O$ in water samples collected from the 12 wells is plotted with two meteoric water lines (fig. 9). Craig (1961) constructed the global meteoric water line by using isotopic signatures (the unique concentrations of δD and $\delta^{18}O$ measured in different samples) from precipitation all over the world, whereas Pape and others (2010) constructed the local meteoric water line (LMWL) by using isotopic signatures for δD and $\delta^{18}O$ from precipitation in central Texas. Samples collected from the Edwards aquifer source wells, Artesia and Seale, plotted below the LMWL of δD = 7.1 * δ18O + 6.7 calculated by Pape and others (2010), indicating that the lighter water molecules were preferentially removed by evaporation before precipitation entered the Edwards aquifer as recharge.

Preinjection Carrizo Aquifer Water Quality

Otero and Petri (2010) assessed the quality of groundwater in the Carrizo aquifer before any water from the Edwards aquifer was injected at the ASR site. Samples were collected from selected wells completed in the Carrizo aquifer within a 20-mile radius of the ASR site. Historical data from their study were evaluated to represent water chemistry of the Carrizo aquifer prior to injection of water from the Edwards aquifer into the ASR site.

Major-Ion Chemistry

Otero and Petri (2010) showed that calcium, sodium, bicarbonate, and chloride concentrations in the samples collected from the Carrizo aquifer wells varied greatly in the study area, resulting in a wide range of water types. Wells in the recharge zone and shallow sections of the confined Carrizo aquifer produced water with small concentrations of major ions. Confined wells located generally in the western section of the study area produced water with relatively large calcium concentrations compared to water sampled from the other wells in the study area. Confined wells located generally in the eastern section of the study area produced water with relatively large sodium and bicarbonate concentrations compared to the other wells in the study area.

Trace-Element Chemistry

The largest dissolved iron concentrations in the study area were measured by Otero and Petri (2010) in samples collected from the wells in the recharge zone and shallow sections of the confined Carrizo aquifer. The smallest dissolved iron concentrations in the study area were measured in samples collected from confined wells located generally in the western section of the study area. Dissolved manganese concentrations varied greatly and generally were smaller in confined wells located in the eastern section of the study area compared to all other wells in the study area.

Isotopes

Similar to the highly variable major-ion and trace-element concentrations in the samples collected by Otero and Petri (2010) from the Carrizo aquifer prior to injection of water from the Edwards aquifer at the ASR site, isotope concentrations and ratios in the samples also were highly variable: δD ranged from -27.50 to -20.90 per mil, and δ18O ranged from -4.94 to -3.66 per mil.

Postinjection Carrizo Aquifer Water Quality

After water from the Edwards aquifer was injected at the ASR site beginning in June 2004, the quality of groundwater in the Carrizo aquifer was assessed in 2005, 2008, 2009, 2010, and 2011. Four Carrizo aquifer wells (McCoy, Ray, Picosa, and Oak Hills) that had been sampled in 2004 by Otero and Petri (2010) were selected for long-term sampling. (Samples collected from the McCoy, Picosa, and Oak Hills wells were collected again in 2005; the Ray well was not sampled in 2005 because of mechanical difficulties with the well pump.) Beginning in 2008, five wells at the ASR site (ASR5, ASR8, ASR9, ASR17, and PO2) and the McCoy, Palmer, Ray, Picosa, and Oak Hills wells were selected to be sampled annually to characterize postinjection water from the Carrizo aquifer. Wells ASR5, ASR8, ASR9, and ASR17 at the ASR site are used for injection and subsequent recovery of water from the Edwards aquifer; well PO2 is designed to pump water from, but not inject water into, the Carrizo aquifer. Because of mechanical difficulties with the well pumps, the Palmer well was not sampled in 2008, and the ASR8 well was not sampled in 2008 and 2010.

Major-Ion Chemistry

Water samples collected from the ASR5, ASR8, ASR9, and ASR17 wells plot as calcium-bicarbonate type water (fig. 7). Little variation is evident in the samples collected over time from the individual wells, regardless of whether the ASR site was injecting or withdrawing water (figs. 7 and 8; table 1). Similarity of major-ion chemistry between the Artesia and Seale wells and the four ASR wells (ASR5, ASR8, ASR9, and ASR17) indicates that the water withdrawn from the ASR wells is most likely the same water that was injected into the ASR wells; little, if any, migration of injected water away from the ASR wells occurred.

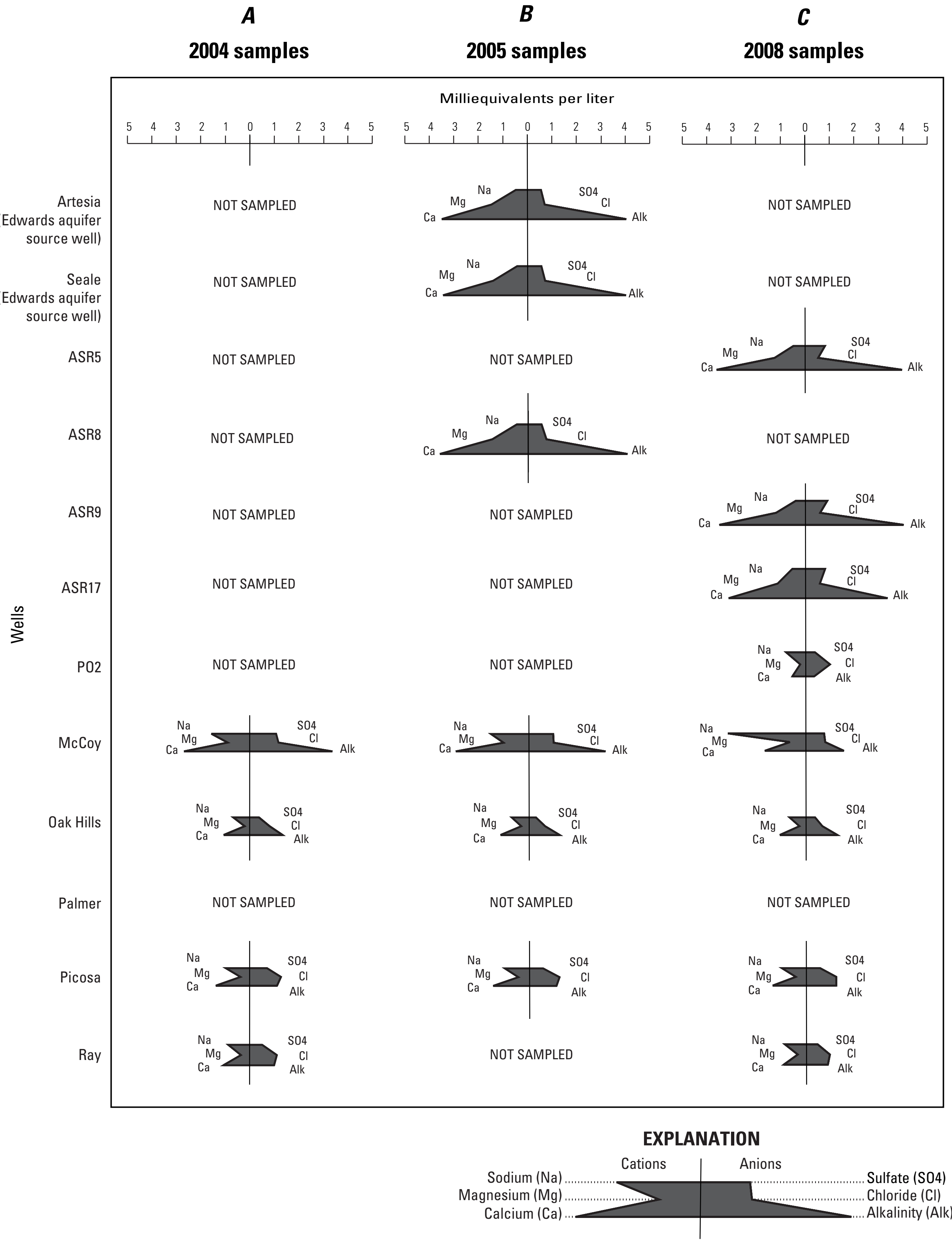

Figure 8. Stiff diagrams showing composition of water samples collected from 12 wells at and near an aquifer storage and recovery site, Bexar, Atascosa, and Wilson Counties, Texas, 2004–11. *A*, 2004. *B*, 2005. *C*, 2008. *D*, 2009. E, 2010. *F*, 2011.

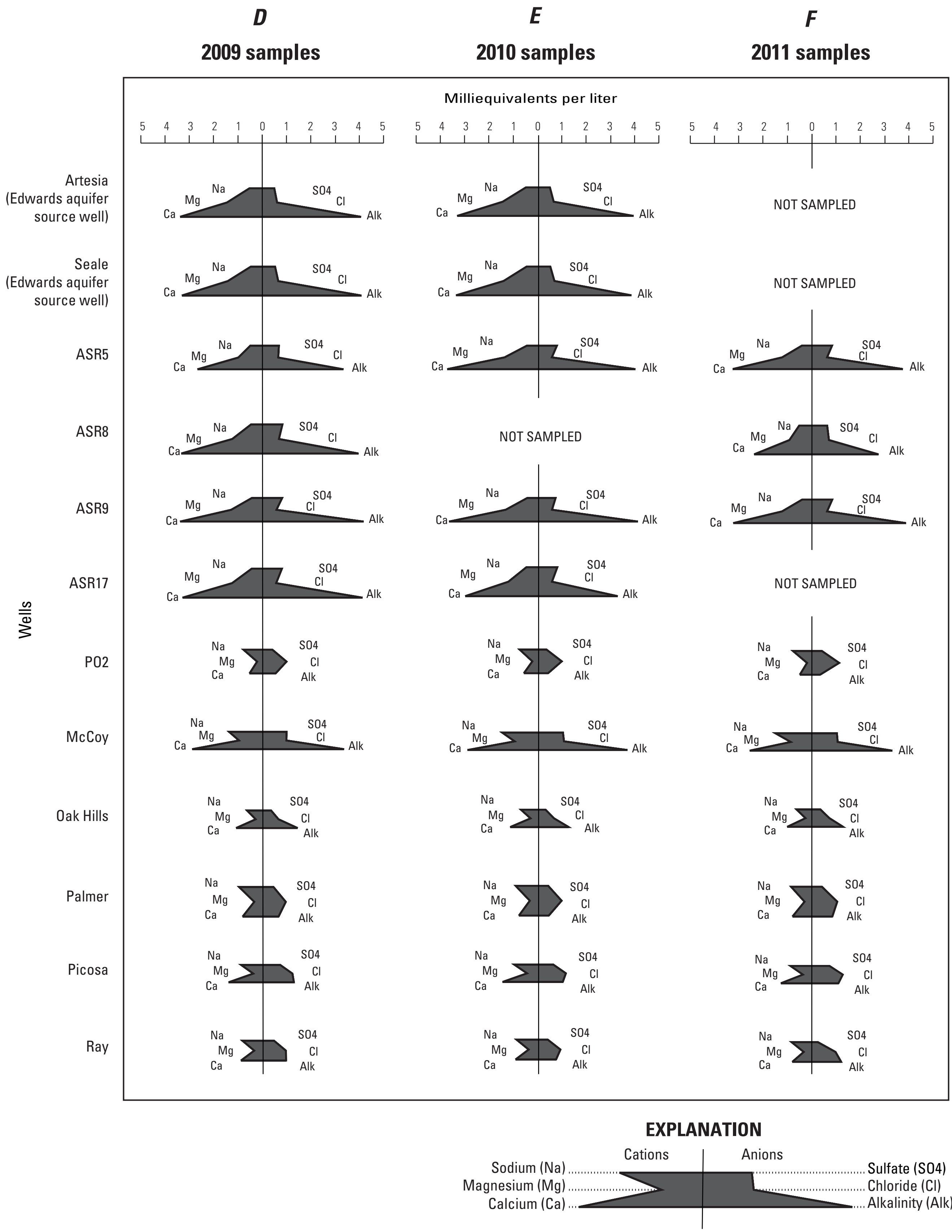

Figure 8. Stiff diagrams showing composition of water samples collected from 12 wells at and near an aquifer storage and recovery site, Bexar, Atascosa, and Wilson Counties, Texas, 2004–11. *A*, 2004. *B*, 2005. *C*, 2008. *D*, 2009. E, 2010. *F*, 2011.—Continued

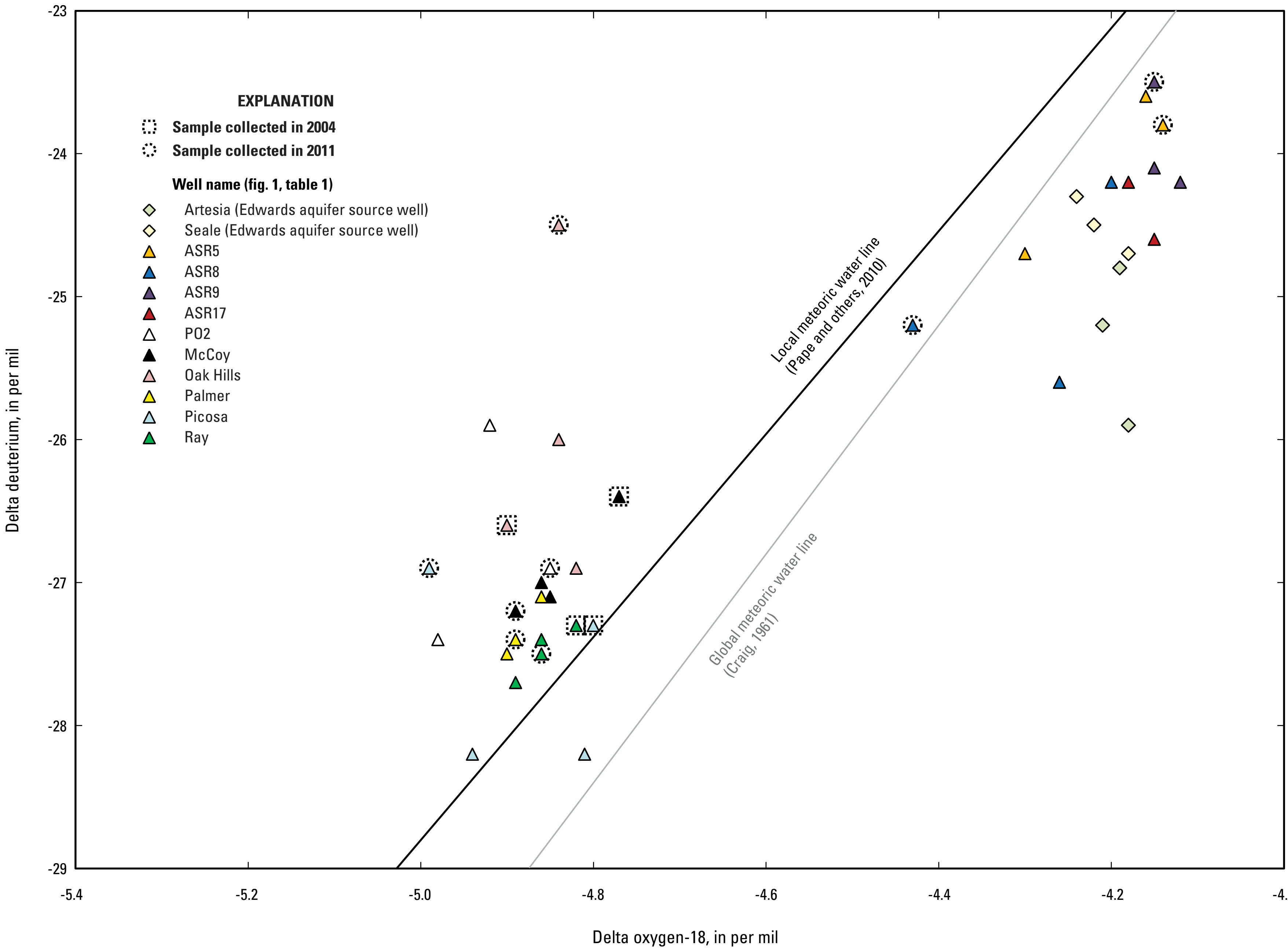

Figure 9. Relation between delta deuterium and delta oxygen-18 for 12 wells sampled at and near an aquifer storage and recovery site, Bexar, Atascosa, and Wilson Counties, Texas, 2004–11.

Water sampled from the PO2, Palmer, Ray, and Picosa wells vary in water type (fig. 7). The major-ion chemistry in most of the water sampled from June 2004 through July 2011 in these four wells did not change substantially, regardless of whether the ASR wells were injecting or withdrawing water, with the exception of the sample collected from the Ray well in 2011 (fig. 7; fig. 8). A greater alkalinity value and a smaller concentration of sulfate were measured in the sample collected from the Ray well in 2011 than in all other samples collected at this well. An increase in alkalinity could be an indicator that water from the Edwards aquifer injected into the ASR site for more than 6 years is beginning to move into at least a part of the water-bearing strata that supply the Ray well.

The major-ion chemistry in most of the water sampled from the McCoy and Oak Hills wells from June 2004 through July 2011 did not change appreciably, regardless of whether the ASR site was injecting or withdrawing water, with the exception of the sample collected from the McCoy well in 2008 (fig. 7; fig. 8). Calcium compositions were smaller and sodium compositions were larger in the sample collected from the McCoy well in 2008 compared to all other samples collected from this well. The reason for this change in major-ion chemistry is not known, and the major-ion compositions returned to previously measured levels in 2009 and remained constant throughout the rest of the study period.

Trace-Element Chemistry

The percent differences (PD) in dissolved iron and manganese concentrations between samples first collected at a well and those collected in subsequent sampling years are shown in table 6. PD was computed by using the equation

$$PD = ((C_1 - C_3)/C_3) \times 100, \qquad (3)$$

where

C_1 is the concentration from subsequent years' environmental sample, and

C_3 is the concentration from first year environmental sample.

The PDs for dissolved iron ranged from a 100-percent decrease between the samples collected in 2004 and 2008 in the McCoy well to a 5,870-percent increase between the samples collected in 2004 and 2005 in the same well, whereas the PDs for dissolved manganese ranged from an 83.6-percent decrease between the samples collected in 2005 and 2009 in the ASR5 well to a 359-percent increase between the samples collected in 2004 and 2011 in the Ray well.

Substantial increases in dissolved iron and manganese concentrations were observed in the Palmer and Ray wells in 2011. These wells are located southeast and downgradient from the ASR site along the regional flow direction of the Carrizo aquifer (fig. 1). The increase in dissolved iron and manganese in these wells could indicate that the injected Edwards aquifer water had begun to migrate into at least a part of the strata supplying these wells and might have caused iron and manganese mobilization in the Carrizo aquifer. Increased dissolved iron concentrations in the ASR5 and ASR8 wells and increased dissolved manganese concentration in the ASR5 well in 2011 indicate that water from the Edwards aquifer injected into those wells might have been removed after more than 90 days of withdrawal at the ASR site (table 7) and had begun to be replaced by either native Carrizo aquifer water or a mix of water from the Edwards aquifer and native Carrizo aquifer water.

Isotopes

The $\delta^{18}O$ and δD values in water from the ASR site wells (ASR5, ASR8, ASR9, and ASR17) were similar to those in water from the Edwards aquifer source wells (Artesia and Seale), indicating that the water injected into these four ASR wells did not migrate away from the wells before it was recovered. The $\delta^{18}O$ values measured in samples collected from these four wells ranged from -4.43 to -4.12 per mil, and δD values ranged from -25.6 to -23.5 per mil (app. 1). Similar to the isotopes values measured in samples collected from the Artesia and Seale wells, the isotope values measured in samples collected from wells ASR5, ASR8, ASR9, and ASR17 plot below the LMWL (Pape and others, 2010) (fig. 9).

The $\delta^{18}O$ values in samples collected from the PO2, McCoy, Palmer, Ray, Picosa, and Oak Hills wells ranged from -4.99 to -4.77 per mil, and δD values ranged from -28.2 to -24.5 per mil (app. 1); the δ18O and δD values plotted above the LMWL (Pape and others, 2010) (fig. 9), indicating that the water collected from these wells had not been subjected to much evaporation prior to recharge into the Carrizo aquifer. The $\delta^{18}O$ and δD values were generally less than those in the samples collected from the Edwards aquifer source wells and ASR site wells (ASR5, ASR8, ASR9, and ASR17), indicating that, during the study period, injected water from the Edwards aquifer either had not migrated into the water-bearing strata that supply these wells or that, if it had, the volumes were small enough that the isotopic signature of the native water from the Carrizo aquifer dominated the isotopic signature of the injected Edwards aquifer water.

Table 6. Dissolved iron and dissolved manganese concentrations in samples from 10 wells at and near an aquifer storage and recovery site, Bexar, Atascosa, and Wilson Counties, Texas, 2004–11, with percent difference between concentration in first sample collected at well and subsequent samples.

[µg/L, micrograms per liter; --, not computed]

Well name (fig. 1)	U.S. Geological Survey station number	U.S. Geological Survey station name	Sample date	Iron[1] (µg/L)	Percent difference between dissolved iron concentration in first sample collected at well and subsequent samples	Manganese[1] (µg/L)	Percent difference between dissolved manganese concentration in first sample collected at well and subsequent samples
ASR5	290732098251101	AY–68–53–811	7/18/2008	5	--	11.6	--
			6/11/2009	19	280	9.2	-20.7
			8/5/2010	10	100	1.9	-83.6
			7/1/2011	99	1,880	11.3	-2.6
ASR8	290750098235301	AY–68–53–912	5/9/2005	0	--	0	--
			6/11/2009	0	--	10.1	--
			7/1/2011	58	--	11.4	--
ASR9	290809098232301	AY–68–53–913	7/18/2008	87	--	8.6	--
			6/11/2009	3	-96.6	5.9	-31.4
			8/5/2010	13	-85.1	7.9	-8.1
			7/1/2011	20	-77.0	9.2	7.0
ASR17	290657098242801	AY–68–61–319	7/18/2008	279	--	15.8	--
			6/11/2009	3	-98.9	8.2	-48.1
			8/5/2010	186	-33.3	24.1	52.5
PO2	290838098241401	AY–68–53–916	7/28/2008	373	--	10.8	--
			6/11/2009	316	-15.3	10	-7.4
			8/5/2010	2,300	517	42.5	294
			7/1/2011	699	87.4	16.2	50.0
McCoy	290403098293201	AL–68–61–413	6/14/2004	10	--	26.7	--
			9/19/2005	597	5,870	24	-10.1
			8/14/2008	0	-100	34.3	28.5
			7/8/2009	342	3,320	40	49.8
			8/6/2010	497	4,870	25.1	-6.0
			6/30/2011	394	3,840	29.7	11.2

Table 6. Dissolved iron and dissolved manganese concentrations in samples from 10 wells at and near an aquifer storage and recovery site, Bexar, Atascosa, and Wilson Counties, Texas, 2004–11, with percent difference between concentration in first sample collected at well and subsequent samples.—Continued

[µg/L, micrograms per liter; --, not computed]

Well name (fig. 1)	U.S. Geological Survey station number	U.S. Geological Survey station name	Sample date	Iron[1] (µg/L)	Percent difference between dissolved iron concentration in first sample collected at well and subsequent samples	Manganese[1] (µg/L)	Percent difference between dissolved manganese concentration in first sample collected at well and subsequent samples
Oak Hills	291330098143301	ZL–68–55–111	6/15/2004	2,310	--	125	--
			9/20/2005	2,150	-6.9	136	8.8
			7/14/2008	1,920	-16.9	118	-5.6
			7/7/2009	1,650	-28.6	120	-4.0
			8/6/2010	1,970	-14.7	125	0
			6/29/2011	2,090	-9.5	123	-1.6
Palmer	290546098234801	AL–68–61–320	7/7/2009	1,220	--	24.1	--
			8/6/2010	1,300	6.6	25.6	6.2
			7/1/2011	4,130	239	107	344
Picosa	290849098174001	ZL–68–54–807	6/14/2004	1,400	--	51.7	--
			9/19/2005	2,530	80.7	136	163
			7/21/2008	3,270	134	162	213
			7/8/2009	1,570	12.1	56.1	8.5
			8/6/2010	1,160	-17.1	50.6	-2.1
			6/29/2011	1,400	0	51.9	0.4
Ray	290727098211301	ZL–68–62–108	6/17/2004	2,550	--	46.6	--
			7/15/2008	4,690	83.9	76.1	63.3
			7/7/2009	3,280	28.6	48.3	3.6
			8/5/2010	2,970	16.5	37.5	-19.5
			6/30/2011	13,300	422	214	359

[1]Nondetections considered zero for percent difference computation.

Table 7. Summary of conditions at an aquifer storage and recovery (ASR) site, Bexar, Atascosa, and Wilson Counties, Texas, for dates on which samples were collected, 2004–11.

[N/A, not applicable]

Sample dates	Total volume injected at ASR site since June 29, 2004 (million gallons)	Total volume withdrawn at ASR site since June 29, 2004 (million gallons)	Days of withdrawal immediately prior to sampling date	Average daily withdrawal rate during days prior to sampling (million gallons per day)
6/14/2004	N/A	N/A	N/A	N/A
6/15/2004	N/A	N/A	N/A	N/A
6/17/2004	N/A	N/A	N/A	N/A
5/9/2005	3,329.88	118.39	0	N/A
9/19/2005	4,632.68	419.53	0	N/A
9/20/2005	4,650.84	419.53	0	N/A
7/14/2008	18,416.91	3,016.46	20	8.94
7/15/2008	18,416.91	3,025.13	21	9.02
7/18/2008	18,416.91	3,050.77	24	8.95
7/21/2008	18,416.91	3,054.37	27	8.42
7/28/2008	18,416.91	3,080.95	34	7.40
8/14/2008	18,522.09	3,087.31	0	N/A
6/11/2009	20,244.74	4,088.79	22	22.39
6/24/2009	20,307.87	4,127.36	0	N/A
7/7/2009	20,399.30	4,127.36	0	N/A
7/8/2009	20,399.30	4,127.36	0	N/A
7/20/2010	29,893.66	5,363.81	0	N/A
8/5/2010	30,419.80	5,363.81	0	N/A
8/6/2010	30,449.74	5,363.81	0	N/A
6/29/2011	35,566.62	8,247.24	93	23.64
6/30/2011	35,566.62	8,287.96	94	23.84
7/1/2011	35,566.62	8,329.39	95	24.02

Summary

The U.S. Geological Survey (USGS), in cooperation with the San Antonio Water System (SAWS), collected data during 2004–11 to characterize the quality of native groundwater from the Edwards aquifer and preinjection and postinjection water from the Carrizo aquifer (informal name commonly applied to the upper part of the Carrizo-Wilcox aquifer in the area) at and near an aquifer storage and recovery (ASR) site in Bexar, Atascosa, and Wilson Counties, Texas. Findings of the study are intended to provide a better understanding of possible changes in the quality of groundwater near an active ASR site that might result from the mixing of water from different aquifers. Possible iron and manganese mobilization, caused by changes in reduction-oxidation reaction (redox) conditions in an aquifer that might occur when nonnative water is introduced to the aquifer, was a concern at the ASR site.

Daily mean water-level altitude, water temperature, and specific conductance were measured continuously (hourly) in a monitoring well (USGS station AY–68–53–928; hereinafter, C8) on the ASR site from August 2009–September 2011 to determine how injection and withdrawal from the wells at the ASR site might affect local groundwater altitude, water temperature, and specific conductance. Daily mean water temperature and specific conductance were collected at four depths corresponding to the bottom of the deepest of three screened intervals and the centers of the three intervals in the monitoring well.

Groundwater samples were collected and analyzed for selected physical properties and constituents to characterize the quality of native groundwater from the Edwards aquifer and preinjection and postinjection water from the Carrizo aquifer near the ASR site. Water-chemistry and isotope data were analyzed to evaluate the quality of water in the Carrizo aquifer prior to and after water from the Edwards aquifer was injected at the ASR site. Water-chemistry and isotope data also were used to evaluate whether any change in water-chemistry or isotope composition occurred on the basis of the status of the ASR site (whether water was being injected into or withdrawn from the site).

During injection periods, the water-level altitude in well C8 generally increased as the amount of water being injected into all wells at the ASR site increased and decreased as the amount of water being injected into all wells at the ASR site decreased. During withdrawal periods, the water-level altitude in well C8 generally increased as the total volume of water being withdrawn from all wells at the ASR site decreased and generally decreased as the total volume of water being withdrawn from all wells increased.

Daily mean water temperature values fluctuated by less than 1 degree Celsius from August 20, 2009, to September 30, 2011, at all four depths in well C8 and were determined to be independent of injection or withdrawal conditions. Daily mean specific-conductance values measured at the bottom of the deepest screened interval appeared to react both independently and dependently of changes to total volumes injected into or withdrawn from all wells at the ASR site. Examination of the volume of water injected into or withdrawn from wells within 1 mile of the monitoring well provided no additional evidence into the cause of the differences in daily mean specific-conductance values at that depth in the monitoring well. Daily mean specific-conductance values measured from depths corresponding to the centers of the three screened intervals in the monitoring well were similar and reacted in the same way to changes in total volume of water injected into or withdrawn from the ASR site. Like the daily mean specific-conductance values measured at the bottom of the deepest screened interval in the monitoring well, the daily mean specific-conductance values for the four shallower depths also seemed to react both independently and dependently of changes to total volumes injected into or withdrawn from all wells at the ASR site.

The two wells from which water from the Edwards aquifer is supplied to the ASR were sampled to monitor for temporal changes so that any changes in the water chemistry of the water being injected at the ASR site could be ascertained No substantial differences were measured in major-ion, trace-element, or isotope chemistry of water samples collected from the Edwards aquifer wells, indicating that any substantial differences in major-ion chemistry between the Edwards aquifer source wells and the ASR wells most likely will have been caused by subsurface processes that occurred during the time when the water was stored in the Carrizo aquifer at the ASR site.

Quality of groundwater in the Carrizo aquifer had been assessed in a previous study before any water from the Edwards aquifer was injected at the ASR site. Samples had been collected from selected wells in the Carrizo aquifer within a 20-mile radius of the ASR site in June 2004. These historical data were evaluated to represent water chemistry of the Carrizo aquifer prior to injection of water from the Edwards aquifer into the ASR site.

After water from the Edwards aquifer was injected at the ASR site beginning in June 2004, the quality of groundwater in the Carrizo aquifer was assessed five times during the next 7 years (2005–11). Five wells at the ASR site (including four wells designed to inject and withdraw water and one well designed to pump water from, but not inject water into, the Carrizo aquifer) and five wells completed in the Carrizo aquifer near the ASR site were sampled for major-ion, trace-element, and isotope chemistry.

Little variation in water chemistry was evident in the samples collected over time from the four wells designed to inject and withdraw water at the ASR site, regardless of whether the ASR site was injecting or withdrawing water. Similarity of major-ion and isotope chemistry between the Edwards aquifer source wells and the four ASR wells indicated that the water withdrawn from the ASR wells is most likely the same water that was injected into the ASR wells, indicating that little, if any, migration of injected water away from the ASR wells occurred. Increases in dissolved iron concentrations in samples collected from two of the injection/withdrawal wells (along with an increased dissolved manganese concentration in another sample collected in 2011) indicated that the water from the Edwards aquifer injected into those wells might have been removed after more than 90 days of withdrawal at the ASR site and had begun to be replaced by either native Carrizo aquifer water or a mix of water from the Edwards aquifer and native Carrizo aquifer water.

The major-ion, trace-element, and isotope chemistry in most of the water sampled from June 2004 through July 2011 in the five wells completed in the Carrizo aquifer near the ASR site and the well at the ASR site designed to pump water from, but not inject water into, the Carrizo aquifer did not change substantially, regardless of whether the ASR site was injecting or withdrawing water. In a well located closest to the ASR site in the direction of regional flow for the Carrizo aquifer, however, a greater alkalinity value and a smaller concentration of sulfate were measured in the sample collected in 2011 than in all other samples collected at this well. Substantial increases in dissolved iron and manganese concentrations also were observed in this well and another well downgradient from the ASR site along the regional groundwater flow direction. The increased alkalinity value and dissolved iron and manganese concentrations and the decreased sulfate concentration in water from the well could indicate that the injected water from the Edwards aquifer had begun to move into at least a part of the strata supplying these wells and might be causing iron and manganese mobilization in the Carrizo aquifer.

Isotope chemistry in the samples collected from the four wells designed to inject and withdraw water from the Carrizo aquifer at the ASR site was similar to that in the samples collected from the two wells that supply the water from the Edwards aquifer for injection at the ASR site. Isotope chemistry in these samples indicated that the water supplying these wells was subjected to some degree of evaporation prior to recharging an aquifer. Isotope chemistry in the samples collected from the well designed to only withdraw water from the Carrizo aquifer at the ASR site was similar to that in the samples collected from the five wells completed in the Carrizo aquifer near the ASR site. Isotope chemistry in these samples indicated that, unlike the water sampled from the Edwards aquifer supply wells, the water supplying these wells had not been subjected to much evaporation prior to recharging an aquifer. The lack of variation in isotope chemistry in the two groups of wells indicates that, during the study period, injected water from the Edwards aquifer either had not migrated into the strata that supply these wells or that, if it had, the volumes were small enough that the isotopic signature of the native water from the Carrizo aquifer dominated the isotopic signature of the injected water.

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Appendix 1—Water-Quality and Isotope Data from Wells Sampled at and near an Aquifer Storage and Recovery Site, Bexar, Atascosa, and Wilson Counties, Texas, 2004–11

Appendix 1. Water-quality and isotope data from wells sampled at and near an aquifer storage and recovery (ASR) site, Bexar, Atascosa, and Wilson Counties, Texas, 2004–11.

[mg/L, milligrams per liter; µS/cm, microsiemens per centimeter; °C, degrees Celsius; NTRU, nephelometric turbidity ratio units; $CaCO_3$, calcium carbonate; µg/L, micrograms per liter; δD, delta deuterium; per mil, parts per thousand; $\delta^{18}O$, delta oxygen-18; --, not analyzed for; <, less than; E, estimated; R, replicate; B, blank]

Well name (fig. 1)	U.S. Geological Survey station number	U.S. Geological Survey station name	Sample date	Sample start time	Dissolved oxygen (mg/L)	pH (standard units)	Specific conductance (µS/cm at 25 °C)	Water temperature (°C)	Turbidity (NTRU)	Sampling depth (feet)
Edwards aquifer source wells										
Artesia	292557098261401	AY–68–37–508	5/9/2005	1345	4.9	7.3	510	27	<2.0	569
			6/24/2009	1100	7.7	7.5	516	26.5	<2.0	--
			6/24/2009 R	1105	7.7	7.5	516	26.5	E4.2	--
			7/16/2010 B	1100	--	--	--	--	<2.0	--
			7/20/2010	1015	6.8	7.6	517	26.7	<2.0	--
Seale	292643098242101	AY–68–37–610	5/9/2005	1425	4.7	7.3	505	27.1	<2.0	542
			6/24/2009	1000	7.3	7.5	512	--	E2.2	--
			7/20/2010	1100	5.3	7.3	511	26.7	<2.0	--
ASR injection/withdrawal wells										
ASR5	290732098251101	AY–68–53–811	7/18/2008	800	3.1	7.1	520	25	<2.0	--
			6/11/2009	1130	4.6	7	435	25	<2.0	--
			8/5/2010	1230	0.6	7	530	25.7	E4.1	--
			7/1/2011	1145	0.6	6.9	509	24.9	<2.0	--
ASR8	290750098235301	AY–68–53–912	5/9/2005	1600	5.9	7.5	510	26.3	<2.0	--
			6/11/2009	1430	4.1	7.2	507	25.5	<2.0	--
			7/1/2011	1000	0.7	6.9	417	25.5	<2.0	--
ASR9	290809098232301	AY–68–53–913	7/18/2008	1100	3	7.1	515	24.5	<2.0	--
			6/11/2009	1530	4.4	7.2	512	25	<2.0	--
			8/5/2010	1300	0.6	7.1	534	25.7	<2.0	--
			7/1/2011	900	0.6	7	514	24.8	<2.0	--
ASR17	290657098242801	AY–68–61–319	7/18/2008	1000	3.1	7	E474	25	2.4	--
			6/11/2009	1330	4.5	7.1	503	25	<2.0	--
			8/5/2010	1530	0.5	6.7	464	26.4	E3.1	--
ASR production-only well										
PO2	290838098241401	AY–68–53–916	7/28/2008	1430	3.7	5.8	E208	25	<2.0	355
			6/11/2009	1030	5.4	6	214	25	<2.0	--
			8/5/2010	1630	0.5	5.8	212	25.2	<2.0	--
			7/1/2011	1045	1	5.6	216	25.2	<2.0	--
Carrizo aquifer wells										
McCoy	290403098293201	AL–68–61–413	6/14/2004	1330	5.9	7.2	561	29	2.5	320
			9/19/2005	1010	4.5	7.2	531	29.5	5.7	320
			8/14/2008	1200	4.1	7.8	549	29.5	E1.9	320
			7/8/2009	1100	0.8	7.7	514	28.4	E3.4	--
			8/6/2010	1500	1	7.2	551	29.6	E3.1	--
			6/30/2011	1300	5.1	7.5	545	29.5	E2.9	--
			6/30/2011 R	1305	5.1	7.5	545	29.5	E3.1	--

Appendix 1. Water-quality and isotope data from wells sampled at and near an aquifer storage and recovery (ASR) site, Bexar, Atascosa, and Wilson Counties, Texas, 2004–11—Continued.

[mg/L, milligrams per liter; µS/cm, microsiemens per centimeter; °C, degrees Celsius; NTRU, nephelometric turbidity ratio units; $CaCO_3$, calcium carbonate; µg/L, micrograms per liter; δD, delta deuterium; per mil, parts per thousand; $\delta^{18}O$, delta oxygen-18; --, not analyzed for; <, less than; E, estimated; R, replicate; B, blank]

Well name (fig. 1)	U.S. Geological Survey station number	U.S. Geological Survey station name	Sample date	Sample start time	Dissolved oxygen (mg/L)	pH (standard units)	Specific conductance (µS/cm at 25 °C)	Water temper-ature (°C)	Turbidity (NTRU)	Sampling depth (feet)
Oak Hills	291330098143301	ZL–68–55–111	6/15/2004	930	<1.0	6.4	255	24	21	275
			9/20/2005	1030	2.9	6.5	253	24.5	16	273
			7/14/2008	1100	4.1	6.7	E247	24.5	13	273
			7/7/2009	930	3.8	6.7	246	24.2	E12	--
			8/6/2010	1000	0.5	6.4	246	24.3	E12	--
			6/29/2011	1130	0.7	6.7	246	24.3	E8.1	--
Palmer	290546098234801	AL–68–61–320	7/7/2009	1100	3	6.1	247	27.6	<2.0	--
			8/6/2010	1330	0.4	5.8	249	27.7	<2.0	--
			8/6/2010 R	1335	0.4	5.8	249	27.7	<2.0	--
			7/1/2011	1400	0.6	6.2	252	27.9	<2.0	--
Picosa	290849098174001	ZL–68–54–807	6/14/2004	1130	<1.0	6.1	346	29	5.3	231
			9/19/2005	1310	3.9	6.6	349	29	13	231
			7/21/2008 B	800	--	--	--	--	<2.0	--
			7/21/2008	900	E4.2	E7.7	E312	E27.0	9.6	231
			7/8/2009	930	2.3	6.7	348	29	E6.8	--
			8/6/2010	1200	0.4	6.4	341	29.2	E3.3	--
			6/29/2011	1000	0.6	6.7	342	29.3	E2.7	--
Ray	290727098211301	ZL–68–62–108	6/17/2004	1100	E5.5	E6.8	E304	E27.5	22	--
			7/15/2008	1800	1.7	6.3	E270	28	12	310
			7/7/2009	1900	1.9	6.1	266	27.9	E7.0	--
			8/5/2010	1800	1.3	6.1	261	28	E12	--
			6/30/2011	1800	3.9	6.5	286	27.4	93	--
			6/30/2011 B	1830	--	--	--	--	<2.0	--

Appendix 1. Water-quality and isotope data from wells sampled at and near an aquifer storage and recovery (ASR) site, Bexar, Atascosa, and Wilson Counties, Texas, 2004–11.—Continued

[mg/L, milligrams per liter; µS/cm, microsiemens per centimeter; °C, degrees Celsius; NTRU, nephelometric turbidity ratio units; $CaCO_3$, calcium carbonate; µg/L, micrograms per liter; δD, delta deuterium; per mil, parts per thousand; $\delta^{18}O$, delta oxygen-18; --, not analyzed for; <, less than; E, estimated; R, replicate; B, blank]

Well name (fig. 1)	Total dissolved solids (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Alkalinity (mg/L as $CaCO_3$)	Chloride (mg/L)	Fluoride (mg/L)	Silica (mg/L)	Sulfate (mg/L)	Aluminum (µg/L)	Barium (µg/L)	Beryllium (µg/L)
Edwards aquifer source wells													
Artesia	289	70.9	18.3	1.25	11.6	200	23.6	0.28	13.2	24.8	4.3	115	<0.06
	296	68.2	17.5	1.24	11.3	209	23.5	0.27	12.8	26.1	4.6	107	<0.02
	292	67.5	17.4	1.23	11.3	208	23.2	0.26	12.7	26.1	18.9	107	<0.02
	<10	<0.04	<0.016	<0.06	<0.10	<8	<0.12	<0.08	<0.06	<0.18	<3.4	<0.14	<0.01
	302	67.2	17.5	1.17	10.8	202	24.4	0.27	12.1	25.6	<3.4	117	<0.01
Seale	295	71	18	1.23	11.4	199	23.1	0.29	13.2	23.9	2.8	114	<0.06
	282	67.1	17.6	1.2	11.3	205	22.9	0.26	12.6	24.7	11.6	106	<0.02
	288	68.2	17.4	1.16	10.9	194	24	0.26	12	24.1	<3.4	118	<0.01
ASR injection/withdrawal wells													
ASR5	264	73.1	15.2	1.39	11.1	200	19.2	0.35	11.8	39.3	1.8	70	<0.01
	256	54.4	12.3	1.88	11.9	168	22.8	0.3	14.7	32.3	<4.0	69	<0.02
	314	75.4	16.7	1.38	10.3	203	20.8	0.24	13.1	38.2	5.1	83	<0.01
	290	66.6	15.5	1.3	10.3	187	21.1	0.42	12.6	38.5	<1.7	77	<0.01
ASR8	290	72.5	18.2	1.27	11.7	199	24.4	0.54	13.5	23.8	16.3	107	E0.05
	289	67.5	15.4	1.66	11.4	197	23.2	0.31	12.5	38.4	<4.0	85	<0.02
	245	48.1	11.3	1.82	12.1	138	25.1	0.3	16.3	30.6	<1.7	81	0.01
ASR9	313	71.8	15.4	1.42	10.6	197	18.8	0.47	11.5	39.3	E1.2	62	E0.01
	298	68.8	15.9	1.31	10.4	210	20.1	0.4	12.3	38.8	38.7	62	<0.02
	313	73.8	16.2	1.26	10.1	208	21	0.25	12.4	35.5	6.8	84	<0.01
	293	66.2	15.5	1.16	10.1	194	21.1	0.44	12	38.9	1.8	69	<0.01
ASR17	255	62.4	13.5	2.07	11.8	169	21.5	0.4	13.4	39.4	E1.1	78	0.01
	292	66.2	15.3	1.46	10.3	206	19.6	0.31	12.5	37.9	<4.0	69	<0.02
	270	59.9	14.7	3.74	10.7	165	20.8	0.41	14.9	38.8	<3.4	128	E0.01
ASR production-only well													
PO2	147	11	2.77	5.8	18.3	17	35	<0.12	24.4	18	<1.6	90	0.1
	138	11	2.82	5.42	18.3	26	34.7	E0.06	24.5	19.1	<4.0	94	0.11
	144	11.5	2.71	5.57	17.2	21	35.1	E0.07	23.7	17.3	E2.8	100	0.1
	145	10.7	2.9	5.55	18.8	15	38.6	0.04	27.1	18.1	<1.7	108	0.13
Carrizo aquifer wells													
McCoy	312	54.1	11.2	6.92	36.4	167	40.5	<0.17	13.3	50.2	<1.6	75	<0.06
	325	58.8	11.7	7.16	34	162	39.2	0.18	13.4	52.2	<1.6	73	<0.06
	322	32.4	7.07	6.14	72.1	E82	31	0.26	12.7	39.8	<1.6	66	M
	299	57.6	11.3	6.76	30.8	172	37	0.13	12.6	50.6	186	78	<0.02
	317	57.7	11.4	7.28	33.2	186	38.8	0.19	12.6	50.5	15.9	84	<0.01
	303	51.4	10.6	6.51	34.5	166	38	0.15	13.4	49.7	<1.7	95	<0.01
	324	52.8	11.1	6.78	36.7	162	37.8	0.17	13.8	49.6	<1.7	99	<0.01

Appendix 1. Water-quality and isotope data from wells sampled at and near an aquifer storage and recovery (ASR) site, Bexar, Atascosa, and Wilson Counties, Texas, 2004–11.—Continued

[mg/L, milligrams per liter; µS/cm, microsiemens per centimeter; °C, degrees Celsius; NTRU, nephelometric turbidity ratio units; $CaCO_3$, calcium carbonate; µg/L, micrograms per liter; δD, delta deuterium; per mil, parts per thousand; $\delta^{18}O$, delta oxygen-18; --, not analyzed for; <, less than; E, estimated; R, replicate; B, blank]

Well name (fig. 1)	Total dissolved solids (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Alkalinity (mg/L as $CaCO_3$)	Chloride (mg/L)	Fluoride (mg/L)	Silica (mg/L)	Sulfate (mg/L)	Aluminum (µg/L)	Barium (µg/L)	Beryllium (µg/L)
Oak Hills	156	22.8	3.45	5.18	17.2	63	26	0.17	24.4	14.3	<1.6	104	<0.06
	153	22.7	3.46	5.1	15.5	64	24.2	0.19	23.6	14.8	<1.6	99	<0.06
	151	21.7	3.43	5.41	15.8	63	23	0.21	23.8	16.7	<1.6	99	0.01
	--	22.1	3.55	5.05	14.8	72	23	0.15	23.1	16.7	<4.0	102	E0.02
	163	22.8	3.62	5.38	15.9	64	23.8	0.19	23.1	15.4	E1.9	113	0.02
	141	21.1	3.64	4.94	15.4	63	24.2	0.16	25.4	15	<1.7	111	0.02
Palmer	150	15.1	3.26	6.61	20.7	37	37	E0.05	18.1	25.4	80.1	84	0.13
	160	14.7	3.4	6.59	19.9	25	36.8	0.09	18	23.1	<3.4	93	0.11
	145	15.3	3.32	6.76	20	29	38	0.1	18.3	23.1	49.9	253	0.12
	149	15.9	3.58	6.7	19.6	43	37.5	0.07	18.1	20.3	<1.7	94	0.08
Picosa	207	28.3	4.77	7.37	22.9	55	44.7	<0.17	16.6	33.1	<1.6	91	<0.06
	197	28.9	4.97	7.35	22	58	45.2	0.14	15.1	28.9	<1.6	98	<0.06
	<10	<0.04	<0.020	<0.02	<0.12	<5	<0.12	<0.12	0.04	<0.18	<1.6	<0.4	<0.01
	204	27.2	4.95	7.62	22.5	63	44.2	0.13	15.2	28	<1.6	89	0.02
	206	28.8	5.07	7.39	21.1	63	42.8	E0.09	16.1	33.6	91.7	89	0.03
	189	28.5	4.99	7.62	21.5	54	42.5	0.16	15.8	32.8	3.7	98	0.03
	199	26.4	4.93	7.01	21.1	53	43.9	0.09	16.6	33.2	<1.7	92	0.03
Ray	165	22.1	4.72	6.37	20.7	48	37.8	<0.17	18.5	22.7	<1.6	100	0.07
	165	18.1	4.04	6.54	19.6	45	34.6	0.12	18.2	22.7	<1.6	89	0.06
	148	17.8	4.14	6.22	19.1	50	34.9	E0.09	18.3	23.4	65.3	95	0.1
	152	17.4	3.88	6.25	19	41	35.7	0.11	17.9	22.8	<3.4	101	0.09
	156	15.9	3.83	5.86	19	62	35.8	0.08	19.1	13	<1.7	103	0.07
	<12	<0.02	<0.008	<0.02	<0.06	<4	<0.06	<0.04	<0.03	<0.09	<1.7	<0.07	<0.01

Appendix 1. Water-quality and isotope data from wells sampled at and near an aquifer storage and recovery (ASR) site, Bexar, Atascosa, and Wilson Counties, Texas, 2004–11.—Continued

[mg/L, milligrams per liter; µS/cm, microsiemens per centimeter; °C, degrees Celsius; NTRU, nephelometric turbidity ratio units; $CaCO_3$, calcium carbonate; µg/L, micrograms per liter; δD, delta deuterium; per mil, parts per thousand; $\delta^{18}O$, delta oxygen-18; --, not analyzed for; <, less than; E, estimated; R, replicate; B, blank]

Well name (fig. 1)	Cadmium (µg/L)	Chromium (µg/L)	Cobalt (µg/L)	Copper (µg/L)	Iron (µg/L)	Total iron (µg/L)	Lead (µg/L)	Lithium (µg/L)	Manganese (µg/L)	Total manganese (µg/L)	Molybdenum (µg/L)
Edwards aquifer source wells											
Artesia	<0.04	<0.8	0.125	1.6	<6	<6	0.09	10.2	<0.2	<0.2	3.11
	<0.02	E0.11	0.06	E0.59	<4	E8	0.8	8.5	<0.2	<0.4	3.72
	E0.01	0.13	0.06	E0.62	<4	15	0.89	8.4	<0.2	E0.2	3.78
	<0.02	<0.12	0.24	<1.0	<6	<9	<0.03	<0.4	0.4	<0.8	<0.03
	<0.02	E0.12	--	<1.0	<6	<9	0.57	6.8	--	<0.8	3.89
Seale	<0.04	<0.8	0.123	1	<6	E3	0.18	9.7	0.3	0.2	2.44
	E0.01	0.12	0.06	<1.0	<4	E10	0.07	8	<0.2	E0.3	2.99
	<0.02	E0.11	0.09	<1.0	<6	<9	0.08	6.1	--	<0.8	3.01
ASR injection/withdrawal wells											
ASR5	<0.04	<0.12	0.55	3.5	E5	6	2.63	3.9	11.6	13.4	1.8
	0.02	E0.11	2.4	1.6	19	21	1.01	5.7	9.2	9.6	2.78
	<0.02	<0.12	0.25	1.4	10	88	0.79	5.5	1.9	3.8	1.56
	0.04	<0.06	2	1.4	99	115	0.86	4.6	11.3	11.6	8.14
ASR8	<0.04	<0.8	0.123	0.9	<6	<6	0.11	10	<0.2	<0.2	3.06
	0.02	<0.12	1.9	1.2	<4	<14	0.8	5	10.1	11.1	4.35
	0.03	<0.06	5.4	1.2	58	66	0.77	5.3	11.4	11.2	3.33
ASR9	E0.03	<0.12	2.4	1.3	87	105	1.45	4.3	8.6	9.4	4.11
	E0.02	E0.08	1.5	E0.98	E3	<14	0.98	4.8	5.9	6.5	2.28
	<0.02	<0.12	0.57	1.9	13	35	0.76	5.3	7.9	9	1.48
	0.02	<0.06	1.3	1.7	20	14	0.66	4.7	9.2	9	3.04
ASR17	E0.03	<0.12	4.2	1.2	279	311	1.72	4.9	15.8	18.3	7.73
	0.03	<0.12	2.8	1.3	E3	<14	1.37	4.5	8.2	8.7	4.69
	0.06	<0.12	5.8	1.8	186	452	0.11	4.9	24.1	26	6.02
ASR production-only well											
PO2	<0.04	<0.12	0.92	<1.0	373	368	0.16	7.7	10.8	11.8	<0.20
	<0.02	<0.12	1.1	<1.0	316	338	1.76	7.1	10	11.2	0.05
	<0.02	<0.12	0.39	<1.0	2,300	2,210	1.1	7.6	42.5	43.7	0.11
	<0.02	<0.06	1.3	1.4	699	801	1.07	7.8	16.2	17.5	0.05
Carrizo aquifer wells											
McCoy	<0.04	<0.8	0.134	0.4	10	622	<0.08	34.1	26.7	25.8	<0.40
	<0.04	<0.04	<0.04	<0.40	597	575	<0.08	37.6	24	26.7	E0.20
	<0.04	<0.12	E0.02	<1.0	<8	397	<0.08	34	34.3	38.2	0.35
	<0.02	0.25	0.07	<1.0	342	700	0.08	33.5	40	43.5	0.19
	<0.02	<0.12	0.12	<1.0	497	488	<0.03	37.8	25.1	26.5	0.19
	<0.02	<0.06	1.2	<0.50	394	735	0.04	36	29.7	29.3	0.19
	<0.02	<0.06	0.12	<0.50	354	746	0.02	37.7	29.1	29	0.21

Appendix 1. Water-quality and isotope data from wells sampled at and near an aquifer storage and recovery (ASR) site, Bexar, Atascosa, and Wilson Counties, Texas, 2004–11.—Continued

[mg/L, milligrams per liter; µS/cm, microsiemens per centimeter; °C, degrees Celsius; NTRU, nephelometric turbidity ratio units; $CaCO_3$, calcium carbonate; µg/L, micrograms per liter; δD, delta deuterium; per mil, parts per thousand; $\delta^{18}O$, delta oxygen-18; --, not analyzed for; <, less than; E, estimated; R, replicate; B, blank]

Well name (fig. 1)	Cadmium (µg/L)	Chromium (µg/L)	Cobalt (µg/L)	Copper (µg/L)	Iron (µg/L)	Total iron (µg/L)	Lead (µg/L)	Lithium (µg/L)	Manganese (µg/L)	Total manganese (µg/L)	Molybdenum (µg/L)
Oak Hills	<0.04	<0.8	0.051	E0.3	2,310	2,300	<0.08	13.6	125	124	<0.40
	<0.04	<0.04	<0.04	<0.40	2,150	1,980	E0.04	16.3	136	141	<0.40
	<0.04	<0.12	<0.02	<1.0	1,920	1,980	<0.08	12.8	118	132	E0.12
	<0.02	<0.12	0.03	E0.60	1,650	1,800	<0.06	15.1	120	132	0.13
	<0.02	<0.12	0.1	<1.0	1,970	2,080	E0.02	17.5	125	127	0.13
	<0.02	<0.06	0.06	<0.50	2,090	--	<0.01	14.2	123	--	0.15
Palmer	<0.02	E0.10	0.23	<1.0	1,220	1,170	0.16	10.7	24.1	25	0.12
	<0.02	<0.12	0.33	<1.0	1,300	1,280	0.05	12.8	25.6	25.8	0.11
	<0.02	E0.09	0.28	E0.98	1,320	1,310	0.24	13.6	25.4	25.2	0.12
	<0.02	<0.06	0.3	<0.50	4,130	4,170	<0.01	11.5	107	110	0.25
Picosa	<0.04	<0.8	0.068	E0.3	1,400	1,430	<0.08	13.6	51.7	50.3	E0.36
	<0.04	<0.04	0.069	E0.4	2,530	2,550	<0.08	12.4	136	127	0.67
	<0.04	<0.12	<0.02	<1.0	<8	<6	<0.08	<1.0	<0.2	<0.8	<0.20
	<0.04	<0.12	<0.02	<1.0	3,270	2,250	0.17	12.8	162	247	0.81
	<0.02	E0.11	0.04	<1.0	1,570	1,630	E0.04	14.6	56.1	63.1	0.41
	<0.02	<0.12	0.11	<1.0	1,160	1,130	0.03	16.8	50.6	52.2	0.39
	<0.02	<0.06	1.3	<0.50	1,400	--	0.06	13.1	51.9	--	0.37
Ray	<0.04	<0.8	0.717	E0.2	2,550	2,580	<0.08	9.7	46.6	48.5	E0.26
	<0.04	<0.12	0.73	<1.0	4,690	6,080	<0.08	8	76.1	88.8	0.31
	<0.02	E0.12	0.58	<1.0	3,280	4,330	E0.03	9	48.3	55.1	0.33
	<0.02	<0.12	0.88	<1.0	2,970	6,560	<0.03	9.8	37.5	47.5	0.36
	<0.02	<0.06	--	<0.50	13,300	14,500	<0.01	8.8	214	224	0.24
	<0.02	<0.06	0.33	<0.50	<3	<5	<0.01	<0.2	0.6	<0.4	<0.01

Appendix 1. Water-quality and isotope data from wells sampled at and near an aquifer storage and recovery (ASR) site, Bexar, Atascosa, and Wilson Counties, Texas, 2004–11.—Continued

[mg/L, milligrams per liter; µS/cm, microsiemens per centimeter; °C, degrees Celsius; NTRU, nephelometric turbidity ratio units; $CaCO_3$, calcium carbonate; µg/L, micrograms per liter; δD, delta deuterium; per mil, parts per thousand; $\delta^{18}O$, delta oxygen-18; --, not analyzed for; <, less than; E, estimated; R, replicate; B, blank]

Well name (fig. 1)	Nickel (µg/L)	Silver (µg/L)	Strontium (µg/L)	Vanadium (µg/L)	Zinc (µg/L)	Antimony (µg/L)	Arsenic (µg/L)	Boron (µg/L)	Selenium (µg/L)	δD (per mil)	$\delta^{18}O$ (per mil)
					Edwards aquifer source wells						
Artesia	0.9	<0.20	1,660	4.7	1.3	<0.20	0.6	63	0.9	-24.8	-4.19
	0.39	<0.01	1,480	3.3	E1.8	E0.04	0.49	56	0.88	-25.9	-4.18
	0.38	<0.01	1,440	3.3	E1.5	E0.03	0.52	56	0.78	-24.9	-4.21
	<0.12	<0.01	<0.40	<0.16	<2.8	<0.05	<0.04	<3	<0.04	--	--
	0.16	<0.01	1,550	3.4	<2.8	0.06	0.48	53	0.72	-25.2	-4.21
Seale	0.91	<0.20	1,570	4.8	6.5	<0.20	0.5	61	1	-24.7	-4.18
	0.33	0.01	1,430	3.3	4.1	E0.03	0.52	56	0.81	-24.3	-4.24
	0.18	<0.01	1,470	3.5	3.7	E0.05	0.47	52	0.67	-24.5	-4.22
					ASR injection/withdrawal wells						
ASR5	0.63	<0.10	612	2	2.5	<0.14	0.79	49	E0.02	--	--
	1.3	<0.01	484	1.4	15.4	E0.03	0.99	57	<0.06	-24.7	-4.30
	0.46	<0.01	782	2.8	<2.8	0.07	0.39	57	0.06	-23.6	-4.16
	0.95	<0.01	742	1.2	11.2	0.05	0.91	54	<0.03	-23.8	-4.14
ASR8	0.77	<0.20	1,600	4.6	9.5	<0.20	0.7	63	1	-25.6	-4.26
	1.2	<0.01	844	1.6	4.7	E0.03	0.76	53	<0.06	-24.2	-4.20
	3.2	<0.01	567	1	19.5	0.06	0.47	57	<0.03	-25.2	-4.43
ASR9	1.7	<0.10	654	1.1	8.4	<0.14	0.82	46	<0.04	--	--
	1.2	<0.01	651	1.8	4.8	E0.03	0.91	53	<0.06	-24.1	-4.15
	0.55	E0.01	800	2.6	<2.8	0.06	0.37	56	0.21	-24.2	-4.12
	0.75	<0.01	746	1.6	4.6	0.05	0.87	53	<0.03	-23.5	-4.15
ASR17	3	<0.10	572	0.81	29.3	<0.14	1.1	48	<0.04	--	--
	2	<0.01	563	1.5	8.9	E0.03	0.99	51	<0.06	-24.6	-4.15
	6.1	<0.01	722	0.43	27.4	E0.03	0.63	42	<0.04	-24.2	-4.18
					ASR production-only well						
PO2	3.1	<0.10	58.3	0.06	18.9	<0.14	0.14	44	<0.04	--	--
	3.2	<0.01	53.5	<0.16	19.5	<0.04	0.09	47	<0.06	-27.4	-4.98
	1.6	<0.01	56.2	<0.16	15.1	<0.05	0.09	49	<0.04	-25.9	-4.92
	3.3	<0.01	58.7	<0.08	32.9	<0.03	0.06	49	<0.03	-26.9	-4.85
					Carrizo aquifer wells						
McCoy	0.39	<0.20	479	0.2	1.3	<0.20	E0.1	96	E0.3	-26.4	-4.77
	<0.06	<0.20	461	<0.10	1.9	<0.20	<0.12	93	<0.08	--	--
	E0.15	<0.10	378	E0.04	<1.8	<0.14	0.07	148	<0.04	--	--
	0.65	<0.01	456	0.33	10.3	<0.04	0.08	105	<0.06	-27.0	-4.86
	0.15	<0.01	458	<0.16	5.3	E0.03	0.06	90	<0.04	-27.1	-4.85
	0.17	<0.01	454	<0.08	5.4	0.09	0.03	102	<0.03	-27.2	-4.89
	<0.09	<0.01	471	<0.08	5.2	<0.03	0.03	108	<0.03	-25.9	-4.84

Appendix 1. Water-quality and isotope data from wells sampled at and near an aquifer storage and recovery (ASR) site, Bexar, Atascosa, and Wilson Counties, Texas, 2004–11.—Continued

[mg/L, milligrams per liter; µS/cm, microsiemens per centimeter; °C, degrees Celsius; NTRU, nephelometric turbidity ratio units; $CaCO_3$, calcium carbonate; µg/L, micrograms per liter; δD, delta deuterium; per mil, parts per thousand; $\delta^{18}O$, delta oxygen-18; --, not analyzed for; <, less than; E, estimated; R, replicate; B, blank]

Well name (fig. 1)	Nickel (µg/L)	Silver (µg/L)	Strontium (µg/L)	Vanadium (µg/L)	Zinc (µg/L)	Antimony (µg/L)	Arsenic (µg/L)	Boron (µg/L)	Selenium (µg/L)	δD (per mil)	$\delta^{18}O$ (per mil)
Oak Hills	0.11	<0.20	123	<0.1	2	<0.20	<0.2	51	<0.4	-26.6	-4.90
	<0.06	<0.20	130	<0.10	3.3	<0.20	<0.12	53	<0.08	--	--
	<0.20	<0.10	124	<0.04	4.5	<0.14	<0.06	43	<0.04	--	--
	0.45	<0.01	120	E0.09	6.5	<0.04	<0.06	55	<0.06	-26.9	-4.82
	0.13	<0.01	121	<0.16	3.3	<0.05	E0.03	53	<0.04	-26.0	-4.84
	<0.09	<0.01	127	<0.08	2.3	<0.03	<0.02	52	<0.03	-24.5	-4.84
Palmer	0.51	<0.01	77	0.17	3.6	<0.04	0.14	68	<0.06	-27.1	-4.86
	0.49	<0.01	76.3	<0.16	E2.2	<0.05	0.14	58	<0.04	-27.5	-4.90
	0.51	<0.01	76.3	E0.10	84.5	0.28	0.14	121	<0.04	-27.2	-4.98
	0.4	<0.01	86.7	<0.08	10.6	<0.03	0.21	55	<0.03	-27.4	-4.89
Picosa	0.17	<0.20	154	<0.1	2.4	<0.20	E0.1	62	E0.2	-27.3	-4.80
	1.01	<0.20	161	<0.10	1	<0.20	0.18	50	<0.08	--	--
	<0.20	<0.10	<0.80	<0.04	<1.8	<0.14	<0.06	22	<0.04	--	--
	0.25	<0.10	145	0.05	E1.5	<0.14	0.27	59	<0.04	--	--
	0.34	<0.01	140	0.26	73.5	<0.04	0.11	73	<0.06	-28.2	-4.94
	E0.11	<0.01	144	<0.16	13.2	<0.05	0.12	65	<0.04	-28.2	-4.81
	0.16	<0.01	143	<0.08	10.9	0.03	0.12	60	<0.03	-26.9	-4.99
Ray	1.24	<0.20	108	<0.1	3.5	<0.20	E0.2	58	<0.4	-27.3	-4.82
	2	<0.10	92.8	<0.04	<1.8	<0.14	0.11	43	<0.04	--	--
	1.9	<0.01	88.5	E0.12	E2.0	<0.04	0.12	64	<0.06	-27.7	-4.89
	2.8	<0.01	83.9	<0.16	<2.8	E0.04	0.15	54	<0.04	-27.4	-4.86
	0.33	<0.01	84.3	<0.08	1.4	<0.03	0.08	54	<0.03	-27.5	-4.86
	<0.09	<0.01	<0.20	<0.08	<1.4	0.03	<0.02	<3	<0.03	--	--

Appendix 2—Relative Percent Difference for Duplicate Water-Quality and Isotope Data from Wells Sampled at and near an Aquifer Storage and Recovery Site, Bexar, Atascosa, and Wilson Counties, Texas, 2004–11

Appendix 2. Relative percent difference for duplicate water-quality and isotope data from wells sampled at and near an aquifer storage and recovery site, Bexar, Atascosa, and Wilson Counties, Texas, 2004–11.

[rep, replicate; RPD, relative percent difference; mg/L, milligrams per liter; $CaCO_3$, calcium carbonate; µg/L, micrograms per liter; <, less than; nc, not computed; E, estimated; δD, delta deuterium; $\delta^{18}O$, delta oxygen-18; per mil, per thousand]

Well name:	Artesia			Palmer			McCoy		
U.S. Geological Survey station number:	292557098261401			290546098234801			290403098293201		
U.S. Geological Survey station name:	AY–68–37–508			AL–68–61–320			AL–68–61–413		
Date:	6/24/2009	6/24/2009 rep	RPD	8/6/2010	8/6/2010 rep	RPD	6/30/2011	6/30/2011 rep	RPD
Time:	1100	1105		1330	1335		1300	1305	
Total dissolved solids (mg/L)	296	292	1.36	160	145	9.84	303	324	6.70
Calcium (mg/L)	68.2	67.5	1.03	14.7	15.3	4.00	51.4	52.8	2.69
Magnesium (mg/L)	17.5	17.4	0.57	3.4	3.32	2.38	10.6	11.1	4.61
Potassium (mg/L)	1.24	1.23	0.81	6.59	6.76	2.55	6.51	6.78	4.06
Sodium (mg/L)	11.3	11.3	0	19.9	20	0.50	34.5	36.7	6.18
Alkalinity (mg/L as $CaCO_3$)	209	208	0.48	25	29	14.8	166	162	2.44
Chloride (mg/L)	23.5	23.2	1.28	36.8	38	3.21	38	37.8	0.53
Fluoride (mg/L)	0.27	0.26	3.77	0.09	0.1	10.5	0.15	0.17	12.5
Silica (mg/L)	12.8	12.7	0.78	18	18.3	1.65	13.4	13.8	2.94
Sulfate (mg/L)	26.1	26.1	0	23.1	23.1	0	49.7	49.6	0.20
Aluminum (µg/L)	4.6	18.9	122	<3.4	49.9	nc	<1.7	<1.7	nc
Barium (µg/L)	107	107	0	93	253	92.5	95	99	4.12
Beryllium (µg/L)	<0.02	<0.02	nc	0.11	0.12	8.70	<0.01	<0.01	nc
Cadmium (µg/L)	<0.02	E0.01	nc	<0.02	<0.02	nc	<0.02	<0.02	nc
Chromium (µg/L)	E0.11	0.13	nc	<0.12	E0.09	nc	<0.06	<0.06	nc
Cobalt (µg/L)	0.06	0.06	0	0.33	0.28	16.4	1.2	0.12	164
Copper (µg/L)	E0.59	E0.62	nc	<1.0	E0.98	nc	<0.50	<0.50	nc
Iron (µg/L)	<4	<4	nc	1,300	1,320	1.53	394	354	10.7
Total iron (µg/L)	E8	15	nc	1,280	1,310	2.32	735	746	1.49
Lead (µg/L)	0.8	0.89	10.7	0.05	0.24	131	0.04	0.02	66.7
Lithium (µg/L)	8.5	8.4	1.18	12.8	13.6	6.06	36	37.7	4.61
Manganese (µg/L)	<0.2	<0.2	nc	25.6	25.4	0.78	29.7	29.1	2.04
Total manganese (µg/L)	<0.4	E0.2	nc	25.8	25.2	2.35	29.3	29	1.03
Molybdenum (µg/L)	3.72	3.78	1.60	0.11	0.12	8.70	0.19	0.21	10.0
Nickel (µg/L)	0.39	0.38	2.60	0.49	0.51	4.00	0.17	<0.09	nc
Silver (µg/L)	<0.01	<0.01	nc	<0.01	<0.01	nc	<0.01	<0.01	nc
Strontium (µg/L)	1,480	1,440	2.74	76.3	76.3	0	454	471	3.68
Vanadium (µg/L)	3.3	3.3	0	<0.16	E0.10	nc	<0.08	<0.08	nc
Zinc (µg/L)	E1.8	E1.5	nc	E2.2	84.5	nc	5.4	5.2	3.77
Antimony (µg/L)	E0.04	E0.03	nc	<0.05	0.28	nc	0.09	<0.03	nc
Arsenic (µg/L)	0.49	0.52	5.94	0.14	0.14	0	0.03	0.03	0
Boron (µg/L)	56	56	0	58	121	70.4	102	108	5.71
Selenium (µg/L)	0.88	0.78	12.0	<0.04	<0.04	nc	<0.03	<0.03	nc
δD (per mil)	-25.9	-24.9	3.94	-27.5	-27.2	1.10	-27.2	-25.9	4.90
$\delta^{18}O$ (per mil)	-4.18	-4.21	0.72	-4.9	-4.98	1.62	-4.89	-4.84	1.03

Appendix 3—Daily Mean Water-Level Altitude at U.S. Geological Survey Station 290802098232901 AY–68–53–928 (C8), Bexar County, Texas, 2009–11

Appendix 3. Daily mean water-level altitude at U.S. Geological Survey station 290802098232901 AY–68–53–928 (C8), Bexar County, Texas, 2009–11.

[Altitude in feet above North American Vertical Datum of 1988; --, no data]

Water year 2009 (Oct. 2008–Sept. 2009) daily mean values												
Day	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sept.**
1	--	--	--	--	--	--	--	--	--	--	--	371.67
2	--	--	--	--	--	--	--	--	--	--	--	370.16
3	--	--	--	--	--	--	--	--	--	--	--	366.17
4	--	--	--	--	--	--	--	--	--	--	--	366.04
5	--	--	--	--	--	--	--	--	--	--	--	366.76
6	--	--	--	--	--	--	--	--	--	--	--	367.84
7	--	--	--	--	--	--	--	--	--	--	--	368.15
8	--	--	--	--	--	--	--	--	--	--	--	368.35
9	--	--	--	--	--	--	--	--	--	--	--	368.39
10	--	--	--	--	--	--	--	--	--	--	--	368.43
11	--	--	--	--	--	--	--	--	--	--	--	369.02
12	--	--	--	--	--	--	--	--	--	--	--	369.69
13	--	--	--	--	--	--	--	--	--	--	--	372.17
14	--	--	--	--	--	--	--	--	--	--	--	376.77
15	--	--	--	--	--	--	--	--	--	--	--	381.61
16	--	--	--	--	--	--	--	--	--	--	--	386.81
17	--	--	--	--	--	--	--	--	--	--	--	389.29
18	--	--	--	--	--	--	--	--	--	--	--	390.71
19	--	--	--	--	--	--	--	--	--	--	--	391.47
20	--	--	--	--	--	--	--	--	--	--	356.06	392.72
21	--	--	--	--	--	--	--	--	--	--	352.90	396.17
22	--	--	--	--	--	--	--	--	--	--	346.18	403.59
23	--	--	--	--	--	--	--	--	--	--	345.89	405.84
24	--	--	--	--	--	--	--	--	--	--	352.00	407.95
25	--	--	--	--	--	--	--	--	--	--	352.38	413.74
26	--	--	--	--	--	--	--	--	--	--	351.88	423.68
27	--	--	--	--	--	--	--	--	--	--	354.34	427.58
28	--	--	--	--	--	--	--	--	--	--	354.25	429.84
29	--	--	--	--	--	--	--	--	--	--	353.82	431.50
30	--	--	--	--	--	--	--	--	--	--	357.22	433.22
31	--	--	--	--	--	--	--	--	--	--	367.47	--
Mean	--	--	--	--	--	--	--	--	--	--	--	389.18
Maximum	--	--	--	--	--	--	--	--	--	--	--	433.22
Minimum	--	--	--	--	--	--	--	--	--	--	--	366.04

Appendix 3. Daily mean water-level altitude at U.S. Geological Survey station 290802098232901 AY–68–53–928 (C8), Bexar County, Texas, 2009–11.—Continued

[Altitude in feet above North American Vertical Datum of 1988; --, no data]

Water year 2010 (Oct. 2009–Sept. 2010) daily mean values												
Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	434.41	460.95	439.02	441.92	442.91	411.04	446.70	431.44	429.91	429.90	452.19	375.72
2	435.39	459.21	439.18	442.13	443.12	413.30	446.83	430.93	430.06	430.06	452.22	370.75
3	436.41	458.49	439.03	442.31	443.74	424.53	446.69	431.00	430.30	430.16	452.27	377.61
4	439.91	460.56	438.97	442.30	444.26	431.46	446.56	430.42	430.56	430.25	451.86	376.44
5	440.26	460.90	438.99	442.38	444.47	434.87	445.75	430.01	430.80	430.34	451.04	376.25
6	438.58	461.00	439.14	442.62	444.54	437.13	440.08	429.67	431.00	437.07	447.69	376.45
7	438.89	462.36	439.16	442.68	444.66	438.90	437.15	429.20	431.10	448.39	446.87	376.49
8	440.58	463.18	439.36	442.51	444.69	440.18	435.62	429.09	431.24	451.05	446.11	379.36
9	445.53	463.63	439.27	442.63	444.60	441.11	434.67	429.29	431.42	452.77	445.23	388.90
10	447.78	463.78	439.15	442.88	444.67	441.70	433.73	428.84	431.46	453.79	444.58	390.92
11	448.87	463.57	439.21	443.06	444.95	442.14	432.87	428.79	431.49	454.56	444.68	392.13
12	449.62	463.29	439.33	443.19	444.91	442.43	432.56	428.67	431.51	455.35	444.49	393.29
13	450.92	462.21	439.42	443.40	444.99	442.79	432.37	428.66	431.86	456.05	442.78	392.94
14	453.72	463.21	439.50	443.72	445.13	443.08	432.15	429.24	432.05	455.99	434.58	392.94
15	455.63	463.51	439.44	444.04	444.95	443.22	432.09	429.84	432.13	455.99	430.25	393.44
16	456.05	464.04	439.37	444.05	444.99	443.33	432.01	430.13	432.09	456.14	428.32	394.36
17	457.13	464.22	439.55	444.08	444.36	443.51	432.06	430.38	432.08	456.29	426.85	393.64
18	458.50	465.02	439.68	444.15	444.92	443.76	432.04	430.37	432.06	456.35	425.62	393.21
19	459.32	464.81	439.64	439.93	442.26	444.13	431.95	430.60	431.91	456.41	415.95	393.09
20	460.14	461.42	439.63	427.84	429.64	444.30	431.86	430.82	431.71	456.50	404.90	394.24
21	460.01	441.57	439.77	424.57	--	444.40	431.80	431.06	431.50	453.81	--	399.34
22	460.15	432.40	440.09	425.02	--	444.55	432.09	431.19	431.49	448.49	--	401.97
23	460.03	428.51	441.01	428.39	--	444.80	432.32	431.13	431.29	448.99	--	406.45
24	460.48	429.49	441.22	434.43	406.28	444.94	432.29	430.99	430.38	450.42	--	412.06
25	460.86	432.81	441.21	437.59	403.25	445.01	431.94	430.82	429.87	450.33	374.25	419.97
26	460.87	436.48	441.35	439.45	--	445.15	431.88	430.58	429.87	450.76	374.96	423.15
27	461.01	437.76	441.52	440.67	408.87	445.33	431.89	430.42	429.91	451.05	375.62	424.91
28	459.93	438.50	441.51	441.49	410.59	445.23	431.91	430.63	429.88	451.25	380.07	426.01
29	458.84	438.76	441.67	442.03	--	445.26	432.06	430.60	429.75	451.35	379.70	426.98
30	459.06	438.77	441.95	442.34	--	445.42	431.94	430.34	429.78	451.40	379.29	428.26
31	461.44	--	442.06	442.59	--	445.86	--	430.21	--	452.19	378.38	--
Mean	451.95	453.48	439.98	440.01	--	440.09	435.20	430.17	431.02	448.82	--	396.38
Maximum	461.44	465.02	442.06	444.15	--	445.86	446.83	431.44	432.13	456.50	--	428.26
Minimum	434.41	428.51	438.97	424.57	--	411.04	431.80	428.66	429.75	429.90	--	370.75

Appendix 3. Daily mean water-level altitude at U.S. Geological Survey station 290802098232901 AY–68–53–928 (C8), Bexar County, Texas, 2009–11.—Continued

[Altitude in feet above North American Vertical Datum of 1988; --, no data]

Water year 2011 (Oct. 2010–Sept. 2011) daily mean values												
Day	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sept.**
1	429.31	435.00	439.39	459.49	461.95	455.83	400.56	382.36	372.46	343.40	340.51	331.66
2	429.22	434.85	439.51	459.75	460.94	452.56	399.72	382.06	371.32	350.40	341.95	332.48
3	429.69	435.09	440.31	460.08	459.51	448.15	399.21	381.92	370.30	359.35	340.50	332.08
4	430.05	435.13	443.14	460.37	459.15	447.82	398.93	379.98	368.69	361.98	337.88	333.67
5	430.08	435.07	444.36	460.54	459.77	447.66	397.25	375.91	368.56	357.80	336.60	335.81
6	430.17	435.12	446.94	460.53	458.19	447.62	396.84	375.27	369.81	348.32	337.13	334.66
7	430.18	435.81	448.05	460.76	456.68	447.28	395.29	375.92	369.84	347.71	--	333.18
8	429.48	437.10	448.95	461.01	458.19	445.01	393.76	375.17	369.00	347.14	--	333.90
9	429.32	437.48	450.89	461.41	458.72	443.58	391.39	376.06	368.41	346.13	--	334.89
10	429.83	437.54	452.55	461.45	458.68	443.26	390.21	376.08	370.03	343.13	--	334.06
11	430.43	437.46	453.50	461.16	458.26	443.04	388.56	375.98	369.68	341.01	333.79	333.19
12	430.92	437.23	453.99	460.45	458.28	441.47	389.88	376.48	368.80	342.98	333.62	331.95
13	431.27	437.34	454.42	460.16	458.10	440.96	388.61	375.74	369.47	344.58	333.43	331.83
14	431.50	437.67	454.86	460.02	457.60	441.32	388.25	376.69	369.59	342.10	332.42	331.76
15	431.84	438.06	455.48	460.28	457.35	441.33	388.76	377.35	368.56	340.88	332.35	331.81
16	431.24	438.24	455.76	460.57	457.33	441.12	386.71	375.81	370.12	339.56	335.72	332.71
17	430.81	438.21	455.76	460.80	456.95	439.13	387.65	376.28	368.89	340.34	335.32	333.03
18	432.23	437.97	455.88	460.86	456.71	439.43	388.35	375.98	368.07	341.16	334.68	333.24
19	434.47	438.11	456.59	460.85	456.65	439.87	386.73	375.79	368.75	339.36	334.86	333.60
20	434.76	438.29	457.21	460.94	457.50	439.32	386.86	375.76	--	344.30	335.13	334.28
21	434.64	438.54	457.26	461.00	458.00	439.14	386.29	374.27	--	352.39	336.02	334.80
22	434.43	438.66	456.96	461.09	458.34	438.85	386.44	368.88	351.35	355.85	335.67	334.96
23	434.75	438.31	457.01	461.13	458.56	438.64	385.38	367.97	354.71	357.30	333.61	337.38
24	435.15	438.21	457.28	461.38	458.67	437.95	384.97	367.28	351.91	357.62	332.29	349.33
25	435.86	438.46	457.44	461.46	458.61	436.07	383.70	367.18	354.18	355.63	333.36	353.46
26	434.54	438.73	457.63	461.50	458.36	428.40	382.85	368.26	349.80	349.45	332.45	354.67
27	432.91	438.72	457.72	461.56	457.30	424.18	381.91	370.95	349.17	344.66	332.51	357.61
28	432.77	439.02	457.88	461.65	457.78	421.88	382.08	371.90	347.00	344.79	334.65	358.27
29	433.87	439.29	458.11	461.81	--	417.70	382.44	371.95	344.24	344.82	335.72	357.71
30	434.45	439.42	458.42	461.90	--	407.76	382.48	371.45	344.89	341.88	334.05	356.03
31	434.58	--	458.95	462.01	--	402.03	--	372.18	--	340.88	333.07	--
Mean	432.09	437.47	452.97	460.90	458.29	438.01	389.40	374.67	--	347.32	--	338.60
Maximum	435.86	439.42	458.95	462.01	461.95	455.83	400.56	382.36	--	361.98	--	358.27
Minimum	429.22	434.85	439.39	459.49	456.65	402.03	381.91	367.18	--	339.36	--	331.66

Appendix 4—Daily Total Volume of Water Injected at an Aquifer Storage and Recovery Site, Bexar County, Texas, 2004–11

Appendix 4. Daily total volume of water injected at an aquifer storage and recovery site, Bexar County, Texas, 2004–11.

[Volume in million gallons; --, no data or not reported]

Water year 2004 (Oct. 2003–Sept. 2004) daily values												
Day	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sept.**
1	--	--	--	--	--	--	--	--	--	3.1	5.0	5.2
2	--	--	--	--	--	--	--	--	--	4.0	1.9	0.0
3	--	--	--	--	--	--	--	--	--	4.7	0.0	0.0
4	--	--	--	--	--	--	--	--	--	5.4	0.0	0.0
5	--	--	--	--	--	--	--	--	--	5.3	0.0	0.0
6	--	--	--	--	--	--	--	--	--	2.0	0.0	0.0
7	--	--	--	--	--	--	--	--	--	0.0	0.0	0.0
8	--	--	--	--	--	--	--	--	--	0.0	0.0	0.0
9	--	--	--	--	--	--	--	--	--	2.4	1.5	0.0
10	--	--	--	--	--	--	--	--	--	2.9	3.7	0.0
11	--	--	--	--	--	--	--	--	--	3.2	3.7	0.0
12	--	--	--	--	--	--	--	--	--	3.2	3.7	0.0
13	--	--	--	--	--	--	--	--	--	7.5	3.7	0.0
14	--	--	--	--	--	--	--	--	--	18.4	3.8	0.0
15	--	--	--	--	--	--	--	--	--	13.1	3.8	0.0
16	--	--	--	--	--	--	--	--	--	4.0	3.8	0.0
17	--	--	--	--	--	--	--	--	--	3.9	3.8	0.0
18	--	--	--	--	--	--	--	--	--	3.9	3.8	0.0
19	--	--	--	--	--	--	--	--	--	2.1	3.9	0.0
20	--	--	--	--	--	--	--	--	--	0.0	3.9	2.1
21	--	--	--	--	--	--	--	--	--	0.0	4.0	5.1
22	--	--	--	--	--	--	--	--	--	0.0	4.0	5.1
23	--	--	--	--	--	--	--	--	--	0.0	4.1	5.1
24	--	--	--	--	--	--	--	--	--	0.0	4.1	5.1
25	--	--	--	--	--	--	--	--	--	0.0	4.1	5.0
26	--	--	--	--	--	--	--	--	--	2.8	4.2	5.0
27	--	--	--	--	--	--	--	--	--	5.3	8.7	5.0
28	--	--	--	--	--	--	--	--	--	5.3	16.0	4.9
29	--	--	--	--	--	--	--	--	8.9	5.3	16.1	5.0
30	--	--	--	--	--	--	--	--	10.2	5.3	15.9	5.0
31	--	--	--	--	--	--	--	--	--	5.0	15.9	--
Mean	--	--	--	--	--	--	--	--	--	3.8	4.7	1.9
Maximum	--	--	--	--	--	--	--	--	--	18.4	16.1	5.2
Minimum	--	--	--	--	--	--	--	--	--	0.0	0.0	0.0

Appendix 4. Daily total volume of water injected at an aquifer storage and recovery site, Bexar County, Texas, 2004–11.—Continued

[Volume in million gallons; --, no data or not reported]

Water year 2005 (Oct. 2004–Sept. 2005) daily values												
Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	5.0	21.3	20.5	23.0	22.6	21.7	1.4	6.9	0.0	13.4	18.1	7.9
2	5.1	7.7	20.6	23.4	22.6	21.4	3.6	6.8	2.0	14.2	13.1	0.0
3	5.0	0.0	20.6	23.3	22.8	21.7	3.6	6.8	7.3	13.9	16.8	0.0
4	1.7	0.0	20.5	23.3	22.7	21.8	3.1	6.8	7.2	14.1	16.7	0.0
5	0.0	8.5	20.5	23.3	22.5	21.7	2.9	6.9	5.0	14.2	16.6	0.0
6	0.0	20.3	20.5	23.4	12.0	21.4	4.9	6.9	7.0	14.1	16.2	0.0
7	0.0	20.2	20.4	23.4	0.0	20.1	7.5	6.8	7.0	14.2	16.8	0.0
8	0.0	20.2	20.4	23.2	0.0	18.4	7.5	6.8	7.0	14.5	16.7	0.0
9	0.0	20.2	20.4	23.4	0.0	13.1	7.0	6.9	7.0	14.6	16.4	0.0
10	0.0	20.5	20.2	23.3	0.0	1.8	6.9	6.9	7.0	13.7	16.8	0.0
11	0.0	20.7	19.9	23.2	0.0	1.8	6.8	6.9	6.9	13.5	17.0	0.0
12	0.0	20.8	19.9	23.1	0.0	1.8	6.8	6.9	7.0	13.6	16.8	0.0
13	0.0	20.8	19.4	23.2	0.0	1.8	6.5	6.9	7.0	7.4	16.8	0.0
14	0.0	20.7	20.2	23.5	0.0	1.8	6.9	6.9	6.9	8.9	16.7	0.0
15	0.0	20.7	21.7	23.4	0.0	1.8	6.9	6.9	6.9	8.9	16.6	0.0
16	0.0	20.5	21.8	23.4	0.0	1.8	6.9	4.0	7.0	8.9	15.9	9.6
17	0.0	20.5	21.6	23.2	6.3	1.8	6.9	0.7	8.0	8.5	16.6	17.6
18	0.0	20.6	21.5	23.3	21.6	1.8	6.9	0.0	11.2	8.9	16.2	18.4
19	0.0	20.6	21.6	23.8	21.6	1.8	6.9	0.0	11.6	8.7	17.3	18.3
20	0.4	20.6	21.3	23.1	22.0	1.8	7.0	0.0	12.5	8.9	17.6	18.2
21	11.2	20.6	21.6	22.9	21.9	1.8	7.0	0.0	11.7	8.9	17.3	18.2
22	22.2	19.9	21.5	23.5	21.9	1.2	7.0	0.0	12.1	10.0	16.5	18.4
23	21.8	20.2	21.5	23.9	21.1	0.0	7.0	0.0	12.6	11.6	16.1	8.1
24	22.0	20.3	21.4	23.8	20.3	0.0	6.9	0.0	13.5	12.3	16.2	0.0
25	22.0	20.7	21.5	23.5	21.8	0.0	6.9	0.0	13.3	14.2	16.3	0.0
26	21.9	20.8	21.5	22.7	22.9	0.0	7.0	0.0	13.1	18.2	16.3	9.6
27	21.8	20.9	21.5	22.6	21.8	0.0	6.9	0.0	13.2	18.2	16.2	17.9
28	21.5	20.6	21.5	22.4	21.4	0.0	6.9	0.0	13.4	18.3	16.1	17.9
29	21.8	20.7	21.5	22.7	--	0.0	6.9	0.0	13.5	16.6	16.6	17.6
30	21.3	20.6	21.5	22.7	--	0.0	6.9	0.0	13.5	16.4	17.4	17.8
31	21.4	--	21.4	22.7	--	0.0	--	0.0	--	18.1	17.2	--
Mean	7.9	18.4	21.0	23.2	13.2	6.6	6.2	3.5	9.0	12.9	16.6	7.2
Maximum	22.2	21.3	21.8	23.9	22.9	21.8	7.5	6.9	13.5	18.3	18.1	18.4
Minimum	0.0	0.0	19.4	22.4	0.0	0.0	1.4	0.0	0.0	7.4	13.1	0.0

Appendix 4. Daily total volume of water injected at an aquifer storage and recovery site, Bexar County, Texas, 2004–11.—Continued

[Volume in million gallons; --, no data or not reported]

Water year 2006 (Oct. 2005–Sept. 2006) daily values												
Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	17.7	17.5	17.6	7.8	19.9	25.1	10.4	10.5	11.4	5.7	5.5	0.0
2	17.7	17.1	17.7	7.6	19.8	25.2	10.4	10.5	10.8	5.7	5.5	0.0
3	17.9	17.5	17.8	11.3	19.9	25.0	9.0	9.5	10.7	5.6	5.5	0.0
4	17.7	17.5	17.7	18.7	20.1	24.9	10.1	10.1	10.6	4.4	5.5	0.0
5	17.7	17.7	17.7	17.9	20.3	24.8	10.2	10.2	5.9	5.1	5.5	0.0
6	17.7	17.6	17.6	18.0	20.0	24.8	10.2	10.2	1.1	5.7	5.5	0.0
7	17.8	17.6	17.6	18.1	18.4	24.8	10.2	10.7	0.0	5.7	5.7	0.0
8	17.7	17.8	17.5	18.2	20.2	25.1	10.4	10.7	0.0	5.7	5.8	0.0
9	17.7	17.8	16.7	17.9	18.7	25.4	10.3	10.7	0.0	5.7	5.9	0.0
10	17.6	17.7	15.9	18.0	20.0	25.2	10.5	9.7	0.0	5.7	5.9	0.0
11	18.0	17.5	15.8	18.1	20.0	25.2	10.6	10.9	0.0	5.7	5.9	0.0
12	17.0	17.7	10.9	18.0	20.3	25.1	10.5	8.5	0.0	5.7	5.9	0.0
13	17.5	17.7	0.0	18.0	20.2	25.0	10.4	9.5	0.0	4.7	5.9	0.0
14	17.5	17.5	2.8	18.2	21.8	24.6	10.4	10.2	0.0	5.6	5.8	0.0
15	17.5	17.4	7.6	17.8	22.0	25.3	10.4	9.9	0.0	5.6	5.8	0.0
16	17.5	17.3	7.6	18.2	21.3	26.2	10.5	9.9	0.0	5.6	5.8	0.0
17	17.6	17.7	7.6	18.1	21.9	26.4	10.6	10.3	0.0	5.5	5.8	0.0
18	17.1	17.4	7.8	18.2	22.6	26.1	10.3	10.8	0.0	5.6	5.8	0.0
19	17.3	16.8	7.7	18.0	22.4	26.4	10.3	10.9	0.0	5.6	5.8	0.0
20	17.1	16.4	8.5	18.1	22.6	20.5	10.4	10.6	0.0	5.6	5.8	0.0
21	17.6	17.2	9.9	18.1	22.3	9.5	10.4	10.8	1.4	5.8	2.2	0.0
22	17.4	17.6	9.3	18.1	22.3	9.9	10.5	10.9	4.4	5.9	0.0	0.0
23	16.7	17.7	7.7	18.0	8.8	10.2	10.4	10.8	5.5	5.9	0.0	0.0
24	17.5	17.7	7.8	8.7	22.8	10.2	10.3	11.1	5.5	5.9	0.0	0.0
25	17.7	17.4	7.8	15.9	23.4	10.3	10.2	11.1	5.5	5.9	0.0	0.0
26	17.6	17.6	7.7	17.8	24.4	10.4	10.6	11.2	5.5	5.9	0.0	0.0
27	17.6	17.6	7.7	19.1	24.7	10.5	10.4	11.0	4.8	5.9	0.0	0.0
28	17.7	17.4	7.7	18.5	24.3	10.4	10.4	11.0	3.6	5.6	0.0	0.0
29	17.8	17.6	7.7	18.5	--	10.3	10.2	10.5	5.7	5.5	0.0	0.0
30	17.6	17.4	7.8	18.7	--	10.3	10.8	10.7	5.7	5.5	0.0	0.0
31	17.6	--	7.8	20.5	--	10.4	--	11.7	--	5.5	0.0	--
Mean	17.6	17.5	10.9	17.0	20.9	19.8	10.4	10.5	3.3	5.6	3.8	0.0
Maximum	18.0	17.8	17.8	20.5	24.7	26.4	10.8	11.7	11.4	5.9	5.9	0.0
Minimum	16.7	16.4	0.0	7.6	8.8	9.5	9.0	8.5	0.0	4.4	0.0	0.0

Appendix 4. Daily total volume of water injected at an aquifer storage and recovery site, Bexar County, Texas, 2004–11.—Continued

[Volume in million gallons; --, no data or not reported]

Water year 2007 (Oct. 2006–Sept. 2007) daily values												
Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	0.0	4.0	0.0	8.8	27.8	28.3	26.6	10.7	21.2	22.0	22.6	0.0
2	0.0	1.0	0.0	8.7	27.6	28.1	26.9	10.6	21.2	21.8	22.7	0.0
3	0.0	0.0	0.0	8.3	28.0	28.4	26.8	10.6	18.1	22.1	16.2	0.0
4	0.0	0.0	0.0	8.8	28.0	28.7	26.6	12.6	6.5	22.2	5.2	0.0
5	0.0	0.0	0.0	7.7	27.8	28.4	26.2	14.6	0.0	22.2	0.0	0.0
6	0.0	0.0	0.0	9.5	22.2	28.2	26.5	15.0	0.0	22.3	0.0	0.0
7	0.0	0.0	0.0	8.7	19.1	27.8	26.7	16.1	0.0	22.3	0.0	0.0
8	0.0	0.0	0.0	9.3	19.2	27.7	27.1	18.3	0.0	22.4	0.0	0.0
9	0.8	0.0	0.0	9.2	19.0	28.0	27.1	18.3	0.0	22.3	0.0	0.0
10	3.7	0.0	0.0	8.6	18.8	28.2	26.7	17.1	0.0	22.4	0.0	0.0
11	6.0	0.0	0.0	8.7	19.0	28.1	21.8	17.4	2.7	22.3	0.0	0.0
12	6.0	0.0	0.0	8.8	23.0	26.5	13.6	20.2	10.8	21.9	0.0	0.0
13	6.0	0.0	0.0	9.6	27.9	22.8	11.5	20.1	17.3	21.2	0.0	0.0
14	6.0	0.0	0.0	9.9	27.7	26.8	11.5	21.1	19.0	21.9	0.0	0.0
15	5.9	0.0	0.0	5.8	27.5	27.0	11.6	21.3	18.7	22.7	0.0	0.0
16	7.0	0.0	0.0	2.3	25.2	26.8	9.1	21.2	20.3	22.5	0.0	0.0
17	6.9	0.0	0.0	0.0	27.4	27.0	1.9	21.2	20.5	22.4	0.0	0.0
18	5.8	0.0	0.0	0.0	27.5	26.9	0.0	21.1	21.1	22.3	0.0	3.3
19	5.9	0.0	0.0	0.0	27.3	26.7	0.0	21.1	17.0	22.3	0.0	14.5
20	5.8	0.0	3.4	0.0	27.4	26.9	0.0	21.3	9.3	22.3	0.0	21.5
21	5.8	0.0	5.6	0.0	26.5	26.8	0.0	21.3	13.2	22.3	0.0	22.7
22	4.6	0.0	5.5	8.4	25.5	26.9	0.0	21.3	20.8	22.3	0.0	22.7
23	3.3	0.0	5.5	20.7	27.3	27.0	0.0	21.2	22.4	22.1	0.0	23.4
24	4.5	0.0	5.8	22.5	27.5	27.0	5.2	21.3	21.8	22.2	0.2	23.2
25	5.1	0.0	5.9	25.5	26.4	27.1	9.3	21.5	22.0	22.4	0.0	23.5
26	5.1	0.0	5.9	28.3	27.9	27.0	6.7	21.9	22.0	22.4	0.0	23.5
27	5.2	0.0	5.9	28.6	28.0	27.1	10.4	21.7	21.9	22.2	0.1	23.7
28	5.3	0.0	5.9	28.0	28.2	27.5	10.3	21.4	21.9	22.6	0.0	23.5
29	5.2	0.0	8.6	28.2	--	27.8	10.8	21.5	21.8	23.3	0.0	23.3
30	5.3	0.0	8.7	27.7	--	27.7	10.8	21.4	22.0	22.5	0.0	23.4
31	5.5	--	10.2	27.9	--	27.1	--	21.2	--	22.6	0.0	--
Mean	3.9	0.2	2.5	12.2	25.5	27.3	13.7	18.9	14.4	22.3	2.2	9.1
Maximum	7.0	4.0	10.2	28.6	28.2	28.7	27.1	21.9	22.4	23.3	22.7	23.7
Minimum	0.0	0.0	0.0	0.0	18.8	22.8	0.0	10.6	0.0	21.2	0.0	0.0

Appendix 4. Daily total volume of water injected at an aquifer storage and recovery site, Bexar County, Texas, 2004–11.—Continued

[Volume in million gallons; --, no data or not reported]

Water year 2008 (Oct. 2007–Sept. 2008) daily values												
Day	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sept.**
1	23.5	25.5	26.5	20.9	20.9	23.8	0.0	19.8	10.1	0.0	7.0	0.3
2	22.7	24.9	26.4	20.9	20.9	22.5	0.0	21.0	10.1	0.0	7.0	0.0
3	22.9	25.0	26.7	20.9	20.9	22.6	0.0	22.0	10.1	0.0	7.0	0.0
4	23.0	25.0	26.5	20.9	20.9	22.5	0.0	20.5	10.1	0.0	7.0	0.0
5	23.5	24.6	25.0	20.9	20.9	22.5	0.0	22.1	10.1	0.0	7.0	0.0
6	23.7	25.0	22.8	20.9	21.0	22.6	0.0	22.3	10.2	0.0	7.0	0.0
7	23.5	24.8	23.0	20.9	17.5	19.7	0.0	22.2	10.2	0.0	7.0	0.0
8	23.4	24.9	22.9	20.9	19.1	13.7	0.0	22.2	10.2	0.0	7.0	0.0
9	23.1	25.0	22.8	20.9	19.1	13.7	1.6	22.1	10.2	0.0	6.9	0.0
10	23.5	24.9	22.7	20.1	19.1	13.7	3.9	22.1	10.2	0.0	6.9	0.0
11	23.2	24.9	20.9	20.6	19.1	14.2	11.8	22.1	10.2	0.0	6.9	0.0
12	23.4	18.5	20.9	20.9	17.5	15.0	20.1	22.1	10.2	0.0	6.9	0.0
13	23.8	15.3	20.9	20.9	17.5	14.9	20.0	21.7	10.7	0.0	6.9	0.0
14	23.8	22.2	20.9	20.9	17.5	14.7	19.1	21.8	11.6	0.0	3.7	0.0
15	24.8	25.7	20.9	20.9	17.5	14.5	19.5	21.8	10.5	0.0	0.0	0.0
16	25.5	26.1	20.9	20.9	17.5	14.3	20.7	21.8	10.5	0.0	0.0	0.0
17	25.5	25.6	20.9	20.9	17.5	12.2	21.4	21.9	10.5	0.0	0.0	0.0
18	25.4	25.6	20.9	20.9	17.5	5.0	23.1	23.1	10.5	0.0	0.0	0.0
19	25.2	25.6	20.9	20.9	17.5	0.0	21.9	21.8	9.8	0.0	0.0	0.0
20	25.2	25.2	20.9	20.9	17.5	0.0	21.7	19.5	2.6	0.0	0.0	0.0
21	25.0	26.2	20.9	20.9	19.1	0.0	21.8	16.1	0.0	0.0	0.0	0.0
22	25.2	26.6	20.9	20.9	21.2	0.0	21.0	13.9	0.0	0.0	4.8	0.0
23	24.5	26.4	20.9	20.9	24.0	0.0	20.9	15.7	0.0	0.0	8.0	4.3
24	25.5	26.3	20.9	20.9	24.0	0.0	19.8	11.1	0.0	0.0	8.0	9.8
25	22.2	26.4	20.9	20.9	23.8	0.0	19.8	10.0	0.0	0.0	8.0	9.8
26	25.0	26.6	20.9	20.9	23.8	0.0	19.8	10.1	0.0	0.0	7.2	9.7
27	24.4	27.2	20.9	20.9	23.9	0.0	19.8	10.1	0.0	0.0	1.7	9.7
28	24.3	27.7	20.9	20.9	23.1	0.0	19.8	10.1	0.0	0.0	0.0	9.7
29	19.2	27.3	20.9	20.9	22.8	0.0	19.8	10.1	0.0	0.0	0.0	9.7
30	25.3	27.0	20.9	20.9	--	0.0	19.8	10.1	0.0	4.0	0.0	9.7
31	25.6	--	20.9	20.9	--	0.0	--	10.1	--	7.0	0.0	--
Mean	24.0	25.1	22.1	20.9	20.1	9.7	13.6	18.1	6.6	0.4	4.2	2.4
Maximum	25.6	27.7	26.7	20.9	24.0	23.8	23.1	23.1	11.6	7.0	8.0	9.8
Minimum	19.2	15.3	20.9	20.1	17.5	0.0	0.0	10.0	0.0	0.0	0.0	0.0

Appendix 4. Daily total volume of water injected at an aquifer storage and recovery site, Bexar County, Texas, 2004–11.—Continued

[Volume in million gallons; --, no data or not reported]

Water year 2009 (Oct. 2008–Sept. 2009) daily values												
Day	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sept.**
1	9.7	8.2	9.8	0.0	0.0	0.0	8.5	20.4	0.0	11.3	0.0	0.0
2	9.7	8.3	9.6	0.0	0.0	0.0	8.3	20.5	0.0	9.7	0.0	0.0
3	9.7	8.8	5.1	0.0	0.0	0.0	8.3	20.7	0.0	2.8	0.0	0.0
4	9.7	9.9	0.0	0.0	0.0	0.0	12.5	20.8	0.0	0.0	0.0	0.0
5	9.7	9.9	0.0	0.0	0.0	0.0	23.2	20.7	0.0	0.0	0.0	0.0
6	9.7	9.8	0.0	0.0	0.0	0.0	27.6	20.7	0.0	0.0	0.0	0.0
7	9.7	9.3	0.0	0.0	0.0	0.0	28.5	19.6	0.0	0.0	0.0	0.0
8	9.7	9.9	0.0	0.0	0.0	0.0	30.0	21.4	0.0	0.0	0.0	0.0
9	9.7	9.9	0.0	0.0	0.0	0.0	29.8	22.5	0.0	0.0	0.0	0.0
10	9.7	9.9	0.0	0.0	0.0	0.0	28.5	22.4	0.0	0.0	0.0	0.0
11	9.9	9.9	0.0	0.0	0.0	0.0	21.4	21.8	0.0	0.0	0.0	0.0
12	10.0	9.9	0.0	0.0	0.0	0.0	15.4	21.7	0.0	0.0	0.0	0.0
13	10.0	9.9	0.0	0.0	0.0	0.0	15.5	21.7	0.0	0.0	0.0	0.0
14	10.0	10.0	0.0	0.0	0.0	0.0	15.5	21.2	0.0	0.0	0.0	0.3
15	10.1	9.9	0.0	0.0	0.0	0.0	15.6	17.8	0.0	0.0	0.0	3.1
16	10.1	11.3	0.0	0.0	0.0	0.0	15.5	18.9	0.0	0.0	0.0	8.9
17	10.1	10.0	0.0	0.0	0.0	0.0	15.4	19.4	0.0	0.0	0.0	9.3
18	10.1	9.9	0.0	0.0	0.0	0.0	15.7	16.4	1.1	0.0	0.0	9.9
19	10.1	9.9	0.0	0.0	0.0	0.0	15.4	4.8	6.8	0.0	0.0	10.0
20	10.1	9.9	0.0	0.0	0.0	0.0	15.7	0.0	10.8	0.0	0.0	10.0
21	10.1	9.9	0.0	0.0	0.0	0.0	19.4	0.0	10.7	0.0	0.0	12.5
22	10.1	9.9	0.0	0.0	0.0	0.0	20.7	0.0	11.3	0.0	0.0	23.4
23	10.1	9.9	0.0	0.0	0.0	0.0	20.8	0.0	11.0	0.0	0.0	27.3
24	11.2	9.9	0.0	0.0	0.0	0.0	20.8	0.0	11.5	0.0	0.0	29.2
25	12.1	9.9	0.0	0.0	0.0	0.0	20.8	0.0	11.4	0.0	0.0	32.8
26	9.9	9.3	0.0	0.0	0.0	1.4	20.8	0.0	11.3	0.0	0.0	43.2
27	8.2	10.0	0.0	0.0	0.0	4.9	20.8	0.0	11.3	0.0	0.0	44.9
28	8.3	10.0	0.0	0.0	0.0	9.3	20.8	0.0	11.2	0.0	0.0	44.8
29	8.3	10.0	0.0	0.0	--	11.4	20.8	0.0	11.2	0.0	0.0	44.6
30	8.2	10.0	0.0	0.0	--	9.8	20.7	0.0	11.2	0.0	0.0	45.7
31	8.3	--	0.0	0.0	--	9.0	--	0.0	--	0.0	0.0	--
Mean	9.7	9.8	0.8	0.0	0.0	1.5	19.1	12.0	4.4	0.8	0.0	13.3
Maximum	12.1	11.3	9.8	0.0	0.0	11.4	30.0	22.5	11.5	11.3	0.0	45.7
Minimum	8.2	8.2	0.0	0.0	0.0	0.0	8.3	0.0	0.0	0.0	0.0	0.0

Appendix 4. Daily total volume of water injected at an aquifer storage and recovery site, Bexar County, Texas, 2004–11.—Continued

[Volume in million gallons; --, no data or not reported]

Water year 2010 (Oct. 2009–Sept. 2010) daily values												
Day	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sept.**
1	46.0	52.3	34.4	35.5	34.3	0.0	31.4	20.1	20.8	19.8	34.7	0.0
2	45.4	52.8	34.7	35.5	34.3	12.7	30.7	20.3	20.8	19.8	34.7	0.0
3	44.7	54.0	34.5	35.4	34.8	32.6	30.7	20.4	20.8	19.8	33.8	0.0
4	44.4	55.7	34.6	35.3	35.0	34.1	31.3	20.3	20.8	19.8	33.7	0.0
5	45.4	54.2	34.4	35.3	34.9	34.2	30.4	20.3	20.8	19.8	32.2	0.0
6	45.7	53.2	34.4	35.3	34.8	34.4	23.6	20.2	20.8	27.6	29.9	0.0
7	45.2	54.8	34.4	35.3	34.3	34.4	16.9	20.4	21.1	32.8	30.5	0.0
8	46.6	55.3	34.3	35.0	34.6	34.3	19.5	20.4	21.0	31.2	30.8	0.0
9	48.5	55.1	34.3	35.1	34.5	34.1	19.4	20.4	20.9	33.6	30.4	0.0
10	49.6	54.6	34.3	35.3	34.5	33.8	18.6	20.3	20.8	33.7	30.2	0.0
11	49.9	54.3	34.2	35.2	34.4	33.9	18.5	20.2	20.8	33.8	30.2	0.0
12	49.7	54.1	34.2	35.2	34.3	33.7	18.6	20.7	20.9	34.0	30.0	0.0
13	50.8	53.8	34.2	35.2	34.3	33.9	18.6	20.4	21.2	33.6	21.7	0.0
14	54.3	52.9	34.1	35.3	34.2	33.8	18.6	20.9	21.2	33.6	11.3	0.0
15	57.1	52.4	34.1	35.2	34.2	33.8	18.7	20.9	21.1	33.3	11.3	0.0
16	57.1	52.3	34.1	35.1	33.7	33.8	18.5	20.8	21.1	33.2	11.4	0.0
17	56.6	52.3	34.0	35.1	33.4	33.9	18.6	20.8	21.1	33.2	11.6	0.0
18	57.0	52.2	34.0	35.1	34.4	34.0	18.6	20.8	21.1	33.1	7.4	0.0
19	57.5	48.7	33.9	15.6	17.8	33.8	18.7	20.7	21.1	33.1	0.0	0.0
20	56.7	37.1	33.9	2.5	1.4	33.8	18.6	20.8	21.1	33.4	0.0	0.0
21	55.2	15.6	33.9	7.5	0.0	33.9	21.4	20.9	21.1	29.1	0.0	0.0
22	54.2	12.9	34.5	17.6	0.0	34.1	20.8	20.9	21.0	19.2	0.0	4.2
23	53.9	17.7	35.3	27.3	0.0	33.9	20.5	20.9	20.9	34.1	0.0	8.7
24	53.0	27.3	35.0	33.2	0.0	33.0	20.4	20.9	19.4	34.9	0.0	16.4
25	53.0	33.2	35.0	34.4	0.0	30.5	20.2	20.9	19.5	33.8	0.0	21.0
26	52.6	35.4	35.1	34.5	0.0	33.5	20.2	20.9	19.5	34.0	0.0	21.0
27	52.5	35.3	35.5	34.3	0.0	33.5	20.3	20.9	19.4	34.0	0.0	21.2
28	52.0	35.1	35.5	34.2	0.0	33.3	20.4	20.9	19.5	34.0	0.0	20.5
29	51.0	34.8	35.7	34.6	--	33.3	20.4	20.9	19.5	33.9	0.0	21.1
30	50.8	34.6	35.8	34.4	--	33.1	20.2	20.9	19.6	34.6	0.0	21.5
31	52.7	--	35.5	34.3	--	32.9	--	20.9	--	35.3	0.0	--
Mean	51.3	44.5	34.6	31.6	22.8	31.9	21.4	20.6	20.6	30.6	14.7	5.2
Maximum	57.5	55.7	35.8	35.5	35.0	34.4	31.4	20.9	21.2	35.3	34.7	21.5
Minimum	44.4	12.9	33.9	2.5	0.0	0.0	16.9	20.1	19.4	19.2	0.0	0.0

Appendix 4. Daily total volume of water injected at an aquifer storage and recovery site, Bexar County, Texas, 2004–11.—Continued

[Volume in million gallons; --, no data or not reported]

Water year 2011 (Oct. 2010–Sept. 2011) daily values												
Day	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sept.**
1	22.4	19.1	20.1	36.1	34.1	23.1	0.0	0.0	0.0	0.0	0.0	0.0
2	21.7	18.9	20.6	36.1	33.7	26.8	0.0	0.0	0.0	0.0	0.0	0.0
3	22.0	19.1	23.2	36.1	32.9	28.0	0.0	0.0	0.0	0.0	0.0	0.0
4	21.7	19.1	25.9	36.0	32.2	28.3	0.0	0.0	0.0	0.0	0.0	0.0
5	21.3	18.9	27.0	36.1	31.8	28.3	0.0	0.0	0.0	0.0	0.0	0.0
6	21.5	19.1	30.7	36.2	25.3	28.3	0.0	0.0	0.0	0.0	0.0	0.0
7	21.2	18.2	29.3	36.2	24.9	24.4	0.0	0.0	0.0	0.0	0.0	0.0
8	21.6	18.8	32.1	36.3	29.7	20.4	0.0	0.0	0.0	0.0	0.0	0.0
9	21.7	18.5	34.7	36.4	29.9	21.1	0.0	0.0	0.0	0.0	0.0	0.0
10	21.6	18.8	34.7	36.4	29.7	21.8	0.0	0.0	0.0	0.0	0.0	0.0
11	21.6	19.5	34.6	35.0	29.0	21.9	0.0	0.0	0.0	0.0	0.0	0.0
12	21.5	20.3	34.7	35.8	29.4	21.4	0.0	0.0	0.0	0.0	0.0	0.0
13	21.9	20.4	34.1	34.1	29.0	20.3	0.0	0.0	0.0	0.0	0.0	0.0
14	21.8	20.4	34.1	34.2	28.5	20.1	0.0	0.0	0.0	0.0	0.0	0.0
15	22.8	20.3	34.2	34.2	28.1	20.3	0.0	0.0	0.0	0.0	0.0	0.0
16	21.2	20.3	34.1	34.2	27.2	20.3	0.0	0.0	0.0	0.0	0.0	0.0
17	21.2	19.8	34.1	34.2	26.9	20.3	0.0	0.0	0.0	0.0	0.0	0.0
18	22.4	20.1	34.2	34.1	26.9	20.3	0.0	0.0	0.0	0.0	0.0	0.0
19	21.1	20.0	34.7	34.2	27.0	21.3	0.0	0.0	0.0	0.0	0.0	0.0
20	21.1	20.1	34.7	34.1	29.4	20.5	0.0	0.0	0.0	0.0	0.0	0.0
21	21.6	20.2	34.4	34.2	29.4	20.4	0.0	0.0	0.0	0.0	0.0	0.0
22	21.7	20.0	34.0	34.1	29.5	20.5	0.0	0.0	0.0	0.0	0.0	0.0
23	22.0	19.5	34.0	34.1	29.5	20.4	0.0	0.0	0.0	0.0	0.0	0.0
24	22.0	19.7	34.1	34.3	29.4	20.2	0.0	0.0	0.0	0.0	0.0	0.0
25	21.1	20.3	34.2	34.2	29.4	12.5	0.0	0.0	0.0	0.0	0.0	0.0
26	19.7	20.4	34.3	34.2	29.4	0.8	0.0	0.0	0.0	0.0	0.0	0.0
27	19.9	20.0	33.8	34.2	29.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	20.0	20.2	33.8	34.1	27.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	20.3	20.2	33.7	34.1	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	20.6	20.6	34.5	34.1	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	20.2	--	35.7	34.1	--	0.0	--	0.0	--	0.0	0.0	--
Mean	21.4	19.7	32.2	34.9	29.3	17.8	0.0	0.0	0.0	0.0	0.0	0.0
Maximum	22.8	20.6	35.7	36.4	34.1	28.3	0.0	0.0	0.0	0.0	0.0	0.0
Minimum	19.7	18.2	20.1	34.1	24.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix 5—Daily Total Volume of Water Withdrawn at an Aquifer Storage and Recovery Site, Bexar County, Texas, 2004–11

Appendix 5. Daily total volume of water withdrawn at an aquifer storage and recovery site, Bexar County, Texas, 2004–11.

[Volume in million gallons; --, no data or not reported]

Water year 2004 (Oct. 2003–Sept. 2004) daily values												
Day	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sept.**
1	--	--	--	--	--	--	--	--	--	0.0	4.8	0.0
2	--	--	--	--	--	--	--	--	--	0.0	1.8	0.0
3	--	--	--	--	--	--	--	--	--	3.0	0.0	0.0
4	--	--	--	--	--	--	--	--	--	5.1	0.0	0.0
5	--	--	--	--	--	--	--	--	--	5.1	0.0	0.0
6	--	--	--	--	--	--	--	--	--	1.9	0.0	0.0
7	--	--	--	--	--	--	--	--	--	0.0	0.0	0.0
8	--	--	--	--	--	--	--	--	--	0.0	0.0	0.0
9	--	--	--	--	--	--	--	--	--	0.0	0.0	0.0
10	--	--	--	--	--	--	--	--	--	0.0	0.0	0.0
11	--	--	--	--	--	--	--	--	--	0.0	0.0	0.0
12	--	--	--	--	--	--	--	--	--	0.0	0.0	0.0
13	--	--	--	--	--	--	--	--	--	0.0	0.0	0.0
14	--	--	--	--	--	--	--	--	--	0.0	0.0	0.0
15	--	--	--	--	--	--	--	--	--	0.0	0.0	0.0
16	--	--	--	--	--	--	--	--	--	0.0	0.0	0.0
17	--	--	--	--	--	--	--	--	--	0.0	0.0	0.0
18	--	--	--	--	--	--	--	--	--	0.0	0.0	0.0
19	--	--	--	--	--	--	--	--	--	0.0	0.0	0.0
20	--	--	--	--	--	--	--	--	--	0.0	0.0	2.1
21	--	--	--	--	--	--	--	--	--	0.0	0.0	4.9
22	--	--	--	--	--	--	--	--	--	0.0	0.0	4.9
23	--	--	--	--	--	--	--	--	--	0.0	0.0	4.9
24	--	--	--	--	--	--	--	--	--	0.0	0.0	4.9
25	--	--	--	--	--	--	--	--	--	0.0	0.0	4.9
26	--	--	--	--	--	--	--	--	--	3.9	0.0	4.8
27	--	--	--	--	--	--	--	--	--	5.1	0.0	4.8
28	--	--	--	--	--	--	--	--	--	5.0	0.0	4.8
29	--	--	--	--	--	--	--	--	0.0	5.0	0.0	4.8
30	--	--	--	--	--	--	--	--	0.0	4.9	0.0	4.9
31	--	--	--	--	--	--	--	--	--	4.8	0.0	--
Mean	--	--	--	--	--	--	--	--	--	1.4	0.2	1.7
Maximum	--	--	--	--	--	--	--	--	--	5.1	4.8	4.9
Minimum	--	--	--	--	--	--	--	--	--	0.0	0.0	0.0

Appendix 5. Daily total volume of water withdrawn at an aquifer storage and recovery site, Bexar County, Texas, 2004–11.—Continued

[Volume in million gallons; --, no data or not reported]

Water year 2005 (Oct. 2004–Sept. 2005) daily values												
Day	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sept.**
1	4.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	0.0	0.0	3.8
2	4.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	9.5
3	4.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.2
4	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0
5	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0
6	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.2
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.3
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.1
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.9
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.6
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.5
12	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.4
13	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.8
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.5
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.2
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.2	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.7	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.8	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.8	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.5	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.4	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.4	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.3	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.4	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.4	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	--	0.0	0.0	9.4	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	--	0.0	0.0	9.4	0.0	0.0	0.0	0.0
31	0.0	--	0.0	0.0	--	0.0	--	9.4	--	0.0	0.0	--
Mean	0.6	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.1	0.0	0.0	5.8
Maximum	4.9	0.0	0.0	0.0	0.0	0.0	0.0	9.5	1.8	0.0	0.0	18.3
Minimum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix 5. Daily total volume of water withdrawn at an aquifer storage and recovery site, Bexar County, Texas, 2004–11.—Continued

[Volume in million gallons; --, no data or not reported]

Water year 2006 (Oct. 2005–Sept. 2006) daily values												
Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.4
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.9
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.7
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.5
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.1
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0	19.8
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.1	0.0	0.0	21.3
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.3	0.0	0.0	21.3
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.1	0.0	0.0	22.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.3	0.0	0.0	21.5
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.8	0.0	0.0	21.3
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.1	0.0	0.0	22.2
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.0	0.0	0.0	30.1
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.6	0.0	0.0	28.5
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.0	0.5	0.2	28.5
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.6	0.0	0.0	30.9
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.8	0.0	0.0	29.5
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.4	0.0	0.0	27.8
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.3	0.0	0.5	32.8
20	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	9.5	0.0	0.0	31.1
21	0.0	0.0	2.1	0.0	0.0	0.0	0.0	0.0	4.2	0.0	0.8	29.2
22	0.0	0.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.4	26.6
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.2	22.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.9	16.2
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.4	21.4
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.5	20.8
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.5	21.9
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.5	22.6
29	0.0	0.0	0.0	0.0	--	0.0	0.0	0.0	0.0	0.0	21.4	21.0
30	0.0	0.0	0.0	0.0	--	0.0	0.0	0.0	0.0	0.0	20.4	21.5
31	0.0	--	0.0	0.0	--	0.0	--	0.0	--	0.0	20.3	--
Mean	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	6.2	0.0	6.1	23.7
Maximum	0.0	0.0	2.1	0.0	0.0	0.0	0.0	0.0	18.0	0.5	21.4	32.8
Minimum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.2

Appendix 5. Daily total volume of water withdrawn at an aquifer storage and recovery site, Bexar County, Texas, 2004–11.—Continued

[Volume in million gallons; --, no data or not reported]

Water year 2007 (Oct. 2006–Sept. 2007) daily values												
Day	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sept.**
1	21.2	0.0	20.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.5
2	20.7	10.4	21.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.7
3	21.2	21.4	20.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.1
4	21.9	21.3	21.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.8
5	21.1	21.0	21.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0
6	21.2	15.2	21.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.5
7	21.4	20.1	21.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	8.9
8	11.8	20.8	21.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	10.3
9	2.4	20.9	21.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.5
10	0.0	20.8	21.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.1
11	0.0	20.8	19.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.4
12	0.0	20.1	16.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.7
13	0.0	21.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.0
14	0.0	21.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.8
15	0.0	21.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	19.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	19.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	21.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	20.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	20.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	21.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	18.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	20.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0
26	0.0	20.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	21.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	21.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	21.0	0.0	0.0	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	21.4	0.0	0.0	--	0.0	0.0	0.0	0.0	0.0	2.2	0.0
31	0.0	--	0.0	0.0	--	0.0	--	0.0	--	0.0	7.9	--
Mean	5.3	19.5	8.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	4.2
Maximum	21.9	21.5	21.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.9	11.7
Minimum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix 5. Daily total volume of water withdrawn at an aquifer storage and recovery site, Bexar County, Texas, 2004–11.—Continued

[Volume in million gallons; --, no data or not reported]

Water year 2008 (Oct. 2007–Sept. 2008) daily values												
Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	0.0	0.0	0.0	0.0	0.0	0.0	9.7	0.0	0.0	8.9	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	9.4	0.0	0.0	9.9	0.0	2.6
3	0.0	0.0	0.0	0.0	0.0	0.0	10.4	0.0	0.0	10.1	0.0	1.2
4	0.0	0.0	0.0	0.0	0.0	0.0	10.4	0.0	0.5	11.7	0.0	4.4
5	0.0	0.0	0.0	0.0	0.0	0.0	9.7	0.0	0.0	8.3	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	9.9	0.0	0.0	9.1	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.5	9.9	0.0	0.0	8.9	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.0	0.0	9.8	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.7	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	12.6	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.2	0.0	0.0
12	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.5	0.0	0.0
13	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.9	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.7	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.7	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.7	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.9	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	7.4	0.0	0.0	0.0	3.5	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	8.6	0.0	0.0	0.0	6.9	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	9.8	0.0	0.0	1.9	6.9	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	11.1	0.0	0.0	1.6	2.7	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	10.6	0.0	0.0	7.2	2.1	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	11.1	0.0	0.0	7.7	2.2	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	10.7	0.0	0.0	9.7	2.3	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	10.7	0.1	0.0	8.9	2.2	0.0	0.0
30	0.0	0.0	0.0	0.0	--	10.8	0.0	0.0	6.4	2.1	0.0	0.0
31	0.0	--	0.0	0.0	--	12.8	--	0.0	--	2.1	0.0	--
Mean	0.0	0.0	0.0	0.0	0.0	3.4	2.4	0.0	1.5	7.0	0.0	0.3
Maximum	0.0	0.3	0.0	0.0	0.0	12.8	10.4	0.0	9.7	12.6	0.0	4.4
Minimum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix 5. Daily total volume of water withdrawn at an aquifer storage and recovery site, Bexar County, Texas, 2004–11.—Continued

[Volume in million gallons; --, no data or not reported]

Water year 2009 (Oct. 2008–Sept. 2009) daily values												
Day	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sept.**
1	0.0	0.0	0.0	4.6	7.0	6.9	0.0	0.0	23.4	0.0	21.7	0.2
2	0.0	0.0	0.0	2.0	7.0	6.9	0.0	0.0	23.5	0.0	20.4	1.4
3	0.0	0.0	0.0	3.9	7.0	6.9	0.0	0.0	22.8	0.0	17.6	7.7
4	0.0	0.0	0.0	0.2	7.0	6.9	0.0	0.1	28.9	0.0	19.1	9.0
5	0.0	0.0	0.0	0.2	6.2	6.9	0.0	0.0	33.3	0.0	23.1	9.0
6	0.0	0.0	0.0	0.9	2.2	6.9	0.0	0.0	33.3	0.0	24.6	9.1
7	0.0	0.0	0.0	2.2	6.3	6.9	0.0	0.0	31.6	0.0	19.9	9.0
8	0.0	0.0	0.0	3.0	6.9	6.9	0.0	0.0	32.8	1.6	19.9	9.0
9	0.0	0.0	0.0	0.0	6.9	6.9	0.0	0.0	30.0	17.3	21.3	9.0
10	0.0	0.0	0.0	1.4	6.9	6.9	0.0	0.0	14.2	22.6	21.3	9.0
11	0.0	0.0	0.0	4.6	6.3	6.9	0.0	0.0	15.2	23.4	19.9	8.9
12	0.0	0.0	0.0	4.7	1.0	6.9	0.0	0.0	26.7	24.1	17.1	8.6
13	0.0	0.0	0.0	4.7	2.5	6.9	0.0	0.0	11.9	24.0	17.0	6.9
14	0.0	0.0	0.0	4.7	6.9	6.9	0.0	0.0	0.0	24.0	16.9	3.3
15	0.0	0.0	0.0	4.7	2.1	6.9	0.0	0.0	0.0	24.0	17.0	0.0
16	0.0	0.0	0.0	5.6	0.0	6.9	0.0	0.0	0.0	24.0	18.2	0.0
17	0.0	0.0	0.2	7.0	1.8	6.9	0.0	0.0	0.0	22.7	21.3	0.0
18	0.0	0.0	0.5	7.0	6.4	6.9	0.0	0.0	0.0	21.3	21.3	0.0
19	0.0	0.0	0.8	7.0	4.8	6.9	0.0	0.0	0.0	22.4	18.0	0.0
20	0.0	0.0	4.5	7.0	1.2	6.9	0.0	1.7	0.0	22.4	21.5	0.0
21	0.0	0.0	4.7	7.0	6.2	4.2	0.0	14.1	0.0	23.1	17.9	0.0
22	0.0	0.0	4.7	7.0	6.9	6.2	0.0	21.4	0.0	27.1	16.2	0.0
23	0.0	0.0	3.9	7.0	6.9	6.9	0.0	20.6	0.0	22.2	18.9	0.0
24	0.0	0.0	0.2	7.2	6.9	6.5	0.0	19.3	0.0	19.5	12.3	0.0
25	0.0	0.0	0.0	7.0	6.9	1.9	0.0	18.5	0.0	17.9	18.9	0.0
26	0.0	0.0	0.0	7.0	6.9	0.0	0.0	21.3	0.0	17.9	22.7	0.0
27	0.0	0.0	0.2	6.4	6.9	0.0	0.0	21.2	0.0	17.8	19.0	0.0
28	0.0	0.0	0.0	1.9	6.9	0.0	0.0	16.8	0.0	18.2	18.1	0.0
29	0.0	0.0	0.4	2.4	--	0.0	0.0	21.0	0.0	22.7	20.7	0.0
30	0.0	0.0	4.0	6.9	--	0.0	0.0	21.2	0.0	22.7	20.3	0.0
31	0.0	--	4.5	7.0	--	0.0	--	21.9	--	25.9	4.7	--
Mean	0.0	0.0	0.9	4.6	5.4	5.3	0.0	7.1	10.9	16.4	18.9	3.3
Maximum	0.0	0.0	4.7	7.2	7.0	6.9	0.0	21.9	33.3	27.1	24.6	9.1
Minimum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.7	0.0

Appendix 5. Daily total volume of water withdrawn at an aquifer storage and recovery site, Bexar County, Texas, 2004–11.—Continued

[Volume in million gallons; --, no data or not reported]

Water year 2010 (Oct. 2009–Sept. 2010) daily values												
Day	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sept.**
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.6
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.9
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.3
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.3
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.8
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.6
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.4
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.5
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.5
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.2
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.9
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.4
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.3
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.2
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.8
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.4
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.7
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.9	12.3
20	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	18.2	8.6
21	0.0	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	30.0	1.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.3	0.0
23	0.0	0.0	0.0	0.0	4.3	0.0	0.0	0.0	0.0	0.0	34.9	0.0
24	0.0	0.0	0.0	0.0	8.9	0.0	0.0	0.0	0.0	0.0	32.3	0.0
25	0.0	0.0	0.0	0.0	12.6	0.0	0.0	0.0	0.0	0.0	23.2	0.0
26	0.0	0.0	0.0	0.0	9.3	0.0	0.0	0.0	0.0	0.0	20.8	0.0
27	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	26.1	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.3	0.0
29	0.0	0.0	0.0	0.0	--	0.0	0.0	0.0	0.0	0.0	24.7	0.0
30	0.0	0.0	0.0	0.0	--	0.0	0.0	0.0	0.0	0.0	24.6	0.0
31	0.0	--	0.0	0.0	--	0.0	--	0.0	--	0.0	24.4	--
Mean	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	10.5	10.6
Maximum	0.0	0.0	0.0	0.0	12.6	0.0	0.0	0.0	0.0	0.0	35.3	26.6
Minimum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix 5. Daily total volume of water withdrawn at an aquifer storage and recovery site, Bexar County, Texas, 2004–11.—Continued

[Volume in million gallons; --, no data or not reported]

Water year 2011 (Oct. 2010–Sept. 2011) daily values												
Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	0.0	0.0	0.0	0.0	0.0	0.0	25.7	23.4	22.7	41.4	41.8	40.2
2	0.0	0.0	0.0	0.0	0.0	0.0	26.0	23.4	24.1	26.7	36.7	39.3
3	0.0	0.0	0.0	0.0	0.0	0.0	23.3	23.4	24.4	23.8	37.7	41.1
4	0.0	0.0	0.0	0.0	0.0	0.0	23.8	18.4	23.4	23.3	42.6	38.6
5	0.0	0.0	0.0	0.0	0.0	0.0	19.7	23.2	23.4	35.5	41.4	37.7
6	0.0	0.0	0.0	0.0	0.0	0.0	18.6	21.5	23.5	43.3	42.3	41.7
7	0.0	0.0	0.0	0.0	0.0	0.0	20.2	20.8	23.5	37.8	41.9	42.3
8	0.0	0.0	0.0	0.0	0.0	0.0	21.3	23.4	25.2	39.2	39.9	39.3
9	0.0	0.0	0.0	0.0	0.0	0.0	22.6	23.5	23.4	39.8	43.0	39.0
10	0.0	0.0	0.0	0.0	0.0	0.0	22.6	23.5	22.1	44.9	42.4	40.9
11	0.0	0.0	0.0	0.0	0.0	0.0	21.8	22.6	24.2	42.2	41.2	40.7
12	0.0	0.0	0.0	0.0	0.0	0.0	21.2	23.5	23.9	39.7	41.3	40.7
13	0.0	0.0	0.0	0.0	0.0	0.0	23.6	25.2	23.3	39.8	41.2	40.7
14	0.0	0.0	0.0	0.5	0.0	0.0	23.4	21.6	23.5	41.0	42.0	41.4
15	0.0	0.0	0.0	0.0	0.0	0.0	21.9	22.0	22.4	44.4	41.4	42.5
16	0.0	0.0	0.0	0.0	0.0	0.0	24.7	24.3	22.5	44.2	37.8	42.7
17	0.0	0.0	0.0	0.0	0.0	0.0	21.5	22.7	24.7	40.2	43.3	40.8
18	0.0	0.0	0.0	0.0	0.0	0.0	21.3	22.7	23.5	42.1	40.9	40.8
19	0.0	0.0	0.0	0.0	0.0	0.0	23.4	24.0	23.3	42.3	41.9	40.8
20	0.0	0.0	0.0	0.0	0.0	0.0	21.2	22.6	34.0	29.1	39.9	40.8
21	0.0	0.0	0.0	0.0	0.0	0.0	20.9	21.6	41.4	21.1	39.5	40.9
22	0.0	0.0	0.0	0.0	0.0	0.0	21.3	22.8	38.5	21.2	41.5	42.1
23	0.0	0.0	0.0	0.0	0.0	0.0	17.8	22.8	34.7	21.9	42.4	33.9
24	0.0	0.0	0.0	0.0	0.0	0.0	17.8	21.9	36.2	19.8	40.3	22.6
25	0.0	0.0	0.0	0.0	0.0	0.0	17.8	21.3	35.3	34.5	39.4	24.6
26	0.0	0.0	0.0	0.0	0.0	0.0	17.8	21.7	40.1	39.2	41.3	22.8
27	0.0	0.0	0.0	0.0	0.0	0.0	20.3	23.4	39.7	41.7	40.9	22.0
28	0.0	0.0	0.0	0.0	0.0	1.0	23.4	23.8	41.7	38.0	39.4	22.5
29	0.0	0.0	0.0	0.0	--	10.4	23.4	23.8	42.5	39.8	40.3	23.2
30	0.0	0.0	0.0	0.0	--	19.7	23.4	22.5	40.7	42.2	41.7	23.7
31	0.0	--	0.0	0.0	--	24.4	--	21.2	--	41.1	41.6	--
Mean	0.0	0.0	0.0	0.0	0.0	1.8	21.7	22.7	29.1	36.2	40.9	36.3
Maximum	0.0	0.0	0.0	0.5	0.0	24.4	26.0	25.2	42.5	44.9	43.3	42.7
Minimum	0.0	0.0	0.0	0.0	0.0	0.0	17.8	18.4	22.1	19.8	36.7	22.0

Appendix 6—Daily Mean Water Temperature at U.S. Geological Survey Station 290802098232901 AY–68–53–928 (C8), Bexar County, Texas, 2009–11

Appendix 6.1. Daily mean water temperature at U.S. Geological Survey station 290802098232901 AY–68–53–928 (C8), Bexar County, Texas, 2009–11 (sensor depth 380 feet below land-surface datum).

[Temperature in degrees Celsius; --, no data]

Water year 2010 (Oct. 2009–Sept. 2010) daily mean values												
Day	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sept.**
1	--	--	--	--	--	--	--	--	--	--	24.7	24.9
2	--	--	--	--	--	--	--	--	--	--	24.7	24.7
3	--	--	--	--	--	--	--	--	--	--	24.7	24.7
4	--	--	--	--	--	--	--	--	--	--	24.7	24.7
5	--	--	--	--	--	--	--	--	--	--	24.7	24.7
6	--	--	--	--	--	--	--	--	--	--	24.7	24.7
7	--	--	--	--	--	--	--	--	--	--	24.7	24.7
8	--	--	--	--	--	--	--	--	--	--	24.7	24.7
9	--	--	--	--	--	--	--	--	--	--	24.7	24.9
10	--	--	--	--	--	--	--	--	--	--	24.7	24.9
11	--	--	--	--	--	--	--	--	--	--	24.7	24.9
12	--	--	--	--	--	--	--	--	--	--	24.7	24.9
13	--	--	--	--	--	--	--	--	--	--	24.7	24.9
14	--	--	--	--	--	--	--	--	--	--	24.7	24.9
15	--	--	--	--	--	--	--	--	--	--	24.7	24.9
16	--	--	--	--	--	--	--	--	--	--	24.7	24.9
17	--	--	--	--	--	--	--	--	--	--	24.7	24.9
18	--	--	--	--	--	--	--	--	--	--	24.7	25.0
19	--	--	--	--	--	--	--	--	--	--	24.7	25.0
20	--	--	--	--	--	--	--	--	--	--	24.7	25.0
21	--	--	--	--	--	--	--	--	--	--	24.7	24.9
22	--	--	--	--	--	--	--	--	--	--	24.7	24.8
23	--	--	--	--	--	--	--	--	--	--	24.8	24.8
24	--	--	--	--	--	--	--	--	--	--	24.8	24.9
25	--	--	--	--	--	--	--	--	--	--	24.8	25.0
26	--	--	--	--	--	--	--	--	--	--	24.7	25.0
27	--	--	--	--	--	--	--	--	--	--	24.7	25.0
28	--	--	--	--	--	--	--	--	--	--	24.9	25.1
29	--	--	--	--	--	--	--	--	--	--	24.9	25.1
30	--	--	--	--	--	--	--	--	--	24.7	24.9	25.1
31	--	--	--	--	--	--	--	--	--	24.7	24.9	--
Mean	--	--	--	--	--	--	--	--	--	--	24.7	24.9
Maximum	--	--	--	--	--	--	--	--	--	--	24.9	25.1
Minimum	--	--	--	--	--	--	--	--	--	--	24.7	24.7

Appendix 6.1. Daily mean water temperature at U.S. Geological Survey station 290802098232901 AY–68–53–928 (C8), Bexar County, Texas, 2009–11 (sensor depth 380 feet below land-surface datum).—Continued

[Temperature in degrees Celsius; --, no data]

Water year 2011 (Oct. 2010–Sept. 2011) daily mean values												
Day	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sept.**
1	25.1	25.4	25.5	25.5	25.5	25.5	25.0	25.3	25.2	24.9	24.8	24.7
2	25.1	25.4	25.5	25.5	25.5	25.4	25.0	24.9	25.2	24.9	24.9	24.7
3	25.1	25.4	25.5	25.5	25.5	25.3	25.0	25.3	25.2	25.1	24.8	24.7
4	25.1	25.4	25.5	25.5	25.5	25.2	25.0	25.3	25.3	25.1	24.8	24.7
5	25.1	25.4	25.5	25.5	25.5	25.1	25.0	25.3	25.3	25.1	24.7	24.7
6	25.1	25.4	25.5	25.5	25.5	25.1	25.0	25.3	25.3	24.9	24.7	24.7
7	25.2	25.4	25.5	25.5	25.5	25.0	25.0	25.3	25.3	24.9	24.7	24.7
8	25.2	25.4	25.5	25.5	25.5	25.0	25.0	25.3	25.3	24.8	24.7	24.7
9	25.2	25.4	25.5	25.5	25.5	25.0	25.0	25.3	25.3	24.8	24.7	24.7
10	25.2	25.4	25.5	25.5	25.5	24.9	25.0	25.3	25.2	24.8	24.7	24.7
11	25.2	25.4	25.5	25.5	25.5	24.9	25.1	25.3	25.2	24.8	24.7	24.7
12	25.2	25.4	25.5	25.5	25.5	24.9	25.1	25.3	25.2	24.9	24.7	24.7
13	25.2	25.4	25.5	25.5	25.5	24.9	25.1	25.3	25.2	25.0	24.7	24.7
14	25.2	25.4	25.5	25.5	25.5	24.9	25.1	25.3	25.2	24.9	24.7	24.7
15	25.2	25.4	25.5	25.5	25.5	24.8	25.1	25.3	25.3	24.8	24.7	24.7
16	25.2	25.4	25.5	25.5	25.5	24.8	25.1	25.3	25.2	24.8	24.8	24.7
17	25.2	25.4	25.5	25.5	25.5	24.8	25.1	25.3	25.2	24.8	24.8	24.7
18	25.3	25.4	25.5	25.5	25.5	24.8	25.1	25.3	25.2	24.8	24.7	24.7
19	25.3	25.4	25.5	25.5	25.5	24.8	25.1	25.3	25.2	24.8	24.7	24.7
20	25.3	25.4	25.5	25.5	25.5	24.8	25.1	25.3	25.2	24.8	24.7	24.7
21	25.3	25.4	25.5	25.5	25.5	24.8	25.2	25.3	25.1	24.8	24.7	24.7
22	25.3	25.4	25.5	25.5	25.5	24.8	25.2	25.2	25.0	24.8	24.7	24.8
23	25.3	25.4	25.5	25.5	25.5	24.8	25.2	25.1	25.0	24.8	24.7	24.7
24	25.3	25.4	25.5	25.5	25.5	24.8	25.2	25.1	25.0	24.8	24.7	25.0
25	25.3	25.4	25.5	25.5	25.5	24.8	25.3	25.0	24.9	24.8	24.7	25.0
26	25.3	25.4	25.5	25.5	25.5	24.8	25.3	25.0	24.9	24.8	24.7	25.0
27	25.3	25.4	25.5	25.5	25.5	24.8	25.3	25.1	24.9	24.8	24.7	25.0
28	25.3	25.4	25.5	25.5	25.5	24.8	25.3	25.1	24.9	24.8	24.7	25.0
29	25.4	25.4	25.5	25.5	--	24.8	25.3	25.2	24.9	24.8	24.7	25.1
30	25.4	25.5	25.5	25.5	--	24.8	25.3	25.2	24.9	24.8	24.7	25.1
31	25.4	--	25.5	25.5	--	24.8	--	25.2	--	24.8	24.7	--
Mean	25.2	25.4	25.5	25.5	25.5	24.9	25.1	25.2	25.1	24.9	24.7	24.8
Maximum	25.4	25.5	25.5	25.5	25.5	25.5	25.3	25.3	25.3	25.1	24.9	25.1
Minimum	25.1	25.4	25.5	25.5	25.5	24.8	25.0	24.9	24.9	24.8	24.7	24.7

Appendix 6.2. Daily mean water temperature at U.S. Geological Survey station 290802098232901 AY–68–53–928 (C8), Bexar County, Texas, 2010–11 (sensor depth 460 feet below land-surface datum).

[Temperature in degrees Celsius; --, no data]

Water year 2011 (Oct. 2010–Sept. 2011) daily mean values												
Day	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sept.**
1	--	--	25.5	25.5	25.6	25.6	25.1	25.4	25.3	24.9	24.9	24.8
2	--	--	25.5	25.5	25.6	25.5	25.1	25.4	25.3	25.0	25.0	24.8
3	--	--	25.5	25.5	25.6	25.3	25.1	25.4	25.3	25.1	24.9	24.8
4	--	--	25.5	25.5	25.6	25.2	25.1	25.4	25.3	25.2	24.9	24.8
5	--	--	25.5	25.5	25.6	25.1	25.2	25.4	25.4	25.1	24.9	24.8
6	--	--	25.5	25.5	25.6	25.1	25.2	25.4	25.4	25.0	24.8	24.8
7	--	--	25.5	25.5	25.6	25.0	25.2	25.4	25.4	25.0	24.8	24.8
8	--	--	25.5	25.6	25.6	25.0	25.2	25.4	25.4	24.9	24.8	24.8
9	--	25.4	25.5	25.6	25.6	25.0	25.2	25.4	25.4	24.9	24.8	24.8
10	--	25.5	25.5	25.6	25.6	25.0	25.2	25.4	25.3	24.9	24.8	24.8
11	--	25.5	25.5	25.6	25.6	24.9	25.2	25.4	25.3	24.9	24.8	24.8
12	--	25.5	25.5	25.6	25.6	24.9	25.2	25.4	25.3	25.0	24.8	24.8
13	--	25.5	25.5	25.6	25.6	24.9	25.2	25.4	25.3	25.1	24.8	24.8
14	--	25.5	25.5	25.6	25.6	24.9	25.2	25.4	25.3	24.9	24.8	24.8
15	--	25.5	25.5	25.6	25.6	24.9	25.3	25.4	25.4	24.9	24.8	24.8
16	--	25.5	25.5	25.6	25.6	24.9	25.3	25.4	25.3	24.9	24.8	24.8
17	--	25.5	25.5	25.6	25.6	24.9	25.2	25.4	25.3	24.9	24.8	24.8
18	--	25.5	25.5	25.6	25.6	24.9	25.2	25.4	25.3	24.9	24.8	24.8
19	--	25.5	25.5	25.6	25.6	24.9	25.2	25.4	25.3	24.9	24.8	24.8
20	--	25.5	25.5	25.6	25.6	24.9	25.2	25.4	25.2	24.9	24.8	24.8
21	--	25.5	25.5	25.6	25.6	24.9	25.3	25.3	25.1	24.9	24.8	24.8
22	--	25.5	25.5	25.6	25.6	24.8	25.3	25.2	25.1	24.9	24.8	24.8
23	--	25.5	25.5	25.6	25.6	24.8	25.3	25.1	25.0	24.9	24.8	24.9
24	--	25.5	25.5	25.6	25.6	24.8	25.3	25.1	25.0	24.8	24.8	25.0
25	--	25.5	25.5	25.6	25.6	24.8	25.3	25.0	25.0	24.8	24.8	25.0
26	--	25.5	25.5	25.6	25.6	24.9	25.4	25.1	25.0	24.9	24.8	25.1
27	--	25.5	25.5	25.6	25.6	24.9	25.4	25.1	25.0	24.9	24.8	25.1
28	--	25.5	25.5	25.6	25.6	24.9	25.3	25.2	25.0	24.9	24.8	25.1
29	--	25.5	25.5	25.6	--	24.9	25.3	25.2	25.0	24.9	24.8	25.1
30	--	25.5	25.5	25.6	--	24.9	25.3	25.2	25.0	24.9	24.8	25.2
31	--	--	25.5	25.6	--	25.0	--	25.3	--	24.9	24.8	--
Mean	--	--	25.5	25.6	25.6	25.0	25.2	25.3	25.2	24.9	24.8	24.9
Maximum	--	--	25.5	25.6	25.6	25.6	25.4	25.4	25.4	25.2	25.0	25.2
Minimum	--	--	25.5	25.5	25.6	24.8	25.1	25.0	25.0	24.8	24.8	24.8

Appendix 6.3. Daily mean water temperature at U.S. Geological Survey station 290802098232901 AY–68–53–928 (C8), Bexar County, Texas, 2010–11 (sensor depth 520 feet below land-surface datum).

[Temperature in degrees Celsius; --, no data]

Water year 2010 (Oct. 2009–Sept. 2010) daily mean values												
Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	--	--	--	--	--	--	--	--	--	--	24.8	24.9
2	--	--	--	--	--	--	--	--	--	--	24.8	24.8
3	--	--	--	--	--	--	--	--	--	--	24.8	24.8
4	--	--	--	--	--	--	--	--	--	--	24.8	24.8
5	--	--	--	--	--	--	--	--	--	--	24.8	24.8
6	--	--	--	--	--	--	--	--	--	--	24.8	24.8
7	--	--	--	--	--	--	--	--	--	--	24.8	24.8
8	--	--	--	--	--	--	--	--	--	--	24.8	24.8
9	--	--	--	--	--	--	--	--	--	--	24.8	24.8
10	--	--	--	--	--	--	--	--	--	--	24.8	24.8
11	--	--	--	--	--	--	--	--	--	--	24.8	24.8
12	--	--	--	--	--	--	--	--	--	--	24.8	24.8
13	--	--	--	--	--	--	--	--	--	--	24.8	24.8
14	--	--	--	--	--	--	--	--	--	--	24.8	24.9
15	--	--	--	--	--	--	--	--	--	--	24.8	24.9
16	--	--	--	--	--	--	--	--	--	--	24.8	24.9
17	--	--	--	--	--	--	--	--	--	--	24.8	25.0
18	--	--	--	--	--	--	--	--	--	--	24.8	24.9
19	--	--	--	--	--	--	--	--	--	--	24.8	24.9
20	--	--	--	--	--	--	--	--	--	--	24.7	25.0
21	--	--	--	--	--	--	--	--	--	--	24.8	24.9
22	--	--	--	--	--	--	--	--	--	--	24.8	25.0
23	--	--	--	--	--	--	--	--	--	--	24.8	25.0
24	--	--	--	--	--	--	--	--	--	--	24.8	25.0
25	--	--	--	--	--	--	--	--	--	--	24.8	25.0
26	--	--	--	--	--	--	--	--	--	--	24.8	25.1
27	--	--	--	--	--	--	--	--	--	--	24.8	25.1
28	--	--	--	--	--	--	--	--	--	--	24.8	25.1
29	--	--	--	--	--	--	--	--	--	--	24.8	25.1
30	--	--	--	--	--	--	--	--	--	24.8	24.8	25.1
31	--	--	--	--	--	--	--	--	--	24.8	24.9	--
Mean	--	--	--	--	--	--	--	--	--	--	24.8	24.9
Maximum	--	--	--	--	--	--	--	--	--	--	24.9	25.1
Minimum	--	--	--	--	--	--	--	--	--	--	24.7	24.8

Appendix 6.3. Daily mean water temperature at U.S. Geological Survey station 290802098232901 AY–68–53–928 (C8), Bexar County, Texas, 2010–11 (sensor depth 520 feet below land-surface datum).—Continued

[Temperature in degrees Celsius; --, no data]

Water year 2011 (Oct. 2010–Sept. 2011) daily mean values												
Day	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sept.**
1	25.2	25.5	25.6	25.6	25.6	25.6	25.1	25.5	25.4	25.0	24.9	24.9
2	25.2	25.5	25.6	25.6	25.6	25.5	25.1	--	25.4	25.0	24.9	24.9
3	25.2	25.5	25.6	25.6	25.6	25.3	25.1	25.5	25.4	25.0	24.9	24.9
4	25.2	25.5	25.6	25.6	25.6	25.2	25.2	25.5	25.4	25.1	24.9	24.9
5	25.2	25.5	25.6	25.6	25.6	25.2	25.2	25.5	25.4	25.1	24.9	24.8
6	25.2	25.5	25.6	25.6	25.6	25.1	25.2	25.5	25.5	25.0	24.9	24.9
7	25.2	25.5	25.6	25.6	25.6	25.1	25.2	25.5	25.5	25.0	24.9	24.9
8	25.3	25.4	25.6	25.6	25.6	25.1	25.2	25.5	25.5	25.0	24.9	24.9
9	25.3	25.5	25.6	25.6	25.6	25.0	25.2	25.5	25.5	24.9	24.9	24.8
10	25.3	25.5	25.6	25.6	25.6	25.0	25.3	25.5	25.5	24.9	24.9	24.8
11	25.3	25.5	25.6	25.6	25.6	25.0	25.3	25.5	25.5	24.9	24.9	24.8
12	25.3	25.5	25.6	25.6	25.6	25.0	25.3	25.5	25.5	24.9	24.9	24.9
13	25.3	25.5	25.6	25.6	25.6	25.0	25.3	25.5	25.5	25.0	24.9	24.9
14	25.3	25.5	25.6	25.6	25.6	25.0	25.3	25.5	25.5	25.0	24.9	24.9
15	25.3	25.5	25.6	25.6	25.6	24.9	25.3	25.5	25.5	24.9	24.9	24.8
16	25.3	25.5	25.6	25.6	25.6	24.9	25.3	25.5	25.5	24.9	24.9	24.8
17	25.4	25.5	25.6	25.6	25.6	24.9	25.3	25.5	25.5	24.9	24.9	24.8
18	25.6	25.5	25.6	25.6	25.6	24.9	25.3	25.5	25.5	24.9	24.9	24.8
19	25.4	25.5	25.6	25.6	25.6	24.9	25.4	25.5	25.5	24.9	24.9	24.8
20	25.4	25.5	25.6	25.6	25.6	24.9	25.4	25.5	25.4	24.9	24.9	24.8
21	25.4	25.5	25.6	25.6	25.6	24.9	25.4	25.4	25.1	24.9	24.9	24.8
22	25.4	25.6	25.6	25.6	25.6	24.9	25.4	25.2	25.1	24.9	24.9	25.5
23	25.4	25.6	25.6	25.6	25.6	24.9	25.4	25.1	25.1	24.9	24.9	24.8
24	25.4	25.6	25.6	25.6	25.6	24.9	25.4	25.1	25.1	24.9	24.9	24.9
25	25.4	25.6	25.6	25.6	25.6	24.9	25.4	25.1	25.0	24.9	24.9	24.9
26	25.4	25.6	25.6	25.6	25.6	24.9	25.4	25.1	25.0	24.9	24.9	25.0
27	25.4	25.6	25.6	25.6	25.6	24.9	25.5	25.1	25.0	24.9	24.9	25.0
28	25.5	25.6	25.6	25.6	25.6	25.0	25.5	25.1	25.0	24.9	24.9	25.1
29	25.5	25.6	25.6	25.6	--	24.9	25.5	25.2	25.0	24.9	24.9	25.1
30	25.5	25.6	25.6	25.6	--	25.0	25.5	25.3	25.0	24.9	24.9	25.2
31	25.5	--	25.6	25.6	--	25.1	--	25.3	--	24.9	24.9	--
Mean	25.3	25.5	25.6	25.6	25.6	25.0	25.3	--	25.3	24.9	24.9	24.9
Maximum	25.6	25.6	25.6	25.6	25.6	25.6	25.5	--	25.5	25.1	24.9	25.5
Minimum	25.2	25.4	25.6	25.6	25.6	24.9	25.1	--	25.0	24.9	24.9	24.8

Appendix 6.4. Daily mean water temperature at U.S. Geological Survey station 290802098232901 AY–68–53–928 (C8), Bexar County, Texas, 2009–11 (sensor depth 530 feet below land-surface datum).

[Temperature in degrees Celsius; --, no data]

Water year 2009 (Oct. 2008–Sept. 2009) daily mean values												
Day	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sept.**
1	--	--	--	--	--	--	--	--	--	--	--	25.6
2	--	--	--	--	--	--	--	--	--	--	--	25.6
3	--	--	--	--	--	--	--	--	--	--	--	25.6
4	--	--	--	--	--	--	--	--	--	--	--	25.6
5	--	--	--	--	--	--	--	--	--	--	--	25.6
6	--	--	--	--	--	--	--	--	--	--	--	25.6
7	--	--	--	--	--	--	--	--	--	--	--	25.6
8	--	--	--	--	--	--	--	--	--	--	--	25.6
9	--	--	--	--	--	--	--	--	--	--	--	25.6
10	--	--	--	--	--	--	--	--	--	--	--	25.6
11	--	--	--	--	--	--	--	--	--	--	--	25.6
12	--	--	--	--	--	--	--	--	--	--	--	25.6
13	--	--	--	--	--	--	--	--	--	--	--	25.6
14	--	--	--	--	--	--	--	--	--	--	--	25.6
15	--	--	--	--	--	--	--	--	--	--	--	25.6
16	--	--	--	--	--	--	--	--	--	--	--	25.6
17	--	--	--	--	--	--	--	--	--	--	--	25.6
18	--	--	--	--	--	--	--	--	--	--	--	25.6
19	--	--	--	--	--	--	--	--	--	--	--	25.6
20	--	--	--	--	--	--	--	--	--	--	25.5	25.6
21	--	--	--	--	--	--	--	--	--	--	25.5	25.6
22	--	--	--	--	--	--	--	--	--	--	25.2	25.6
23	--	--	--	--	--	--	--	--	--	--	25.2	25.6
24	--	--	--	--	--	--	--	--	--	--	25.2	25.6
25	--	--	--	--	--	--	--	--	--	--	25.3	25.6
26	--	--	--	--	--	--	--	--	--	--	25.4	25.6
27	--	--	--	--	--	--	--	--	--	--	25.4	25.6
28	--	--	--	--	--	--	--	--	--	--	25.5	25.6
29	--	--	--	--	--	--	--	--	--	--	25.5	25.6
30	--	--	--	--	--	--	--	--	--	--	25.5	25.6
31	--	--	--	--	--	--	--	--	--	--	25.6	--
Mean	--	--	--	--	--	--	--	--	--	--	--	25.6
Maximum	--	--	--	--	--	--	--	--	--	--	--	25.6
Minimum	--	--	--	--	--	--	--	--	--	--	--	25.6

Appendix 6.4. Daily mean water temperature at U.S. Geological Survey station 290802098232901 AY–68–53–928 (C8), Bexar County, Texas, 2009–11 (sensor depth 530 feet below land-surface datum).—Continued

[Temperature in degrees Celsius; --, no data]

Water year 2010 (Oct. 2009–Sept. 2010) daily mean values												
Day	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sept.**
1	25.6	25.6	25.1	24.9	24.9	25.2	24.8	24.9	24.9	24.9	24.9	25.1
2	25.6	25.6	25.1	24.9	24.9	25.2	24.8	24.9	24.9	24.9	24.9	24.9
3	25.6	25.6	25.1	24.9	24.9	25.0	24.8	24.9	24.9	24.9	24.9	24.8
4	25.6	25.6	25.0	24.9	24.9	24.9	24.8	24.9	24.9	24.9	24.9	24.8
5	25.6	25.6	25.0	24.9	24.9	24.9	24.8	24.9	24.9	24.9	24.8	24.8
6	25.6	25.6	25.0	24.9	24.9	24.9	24.9	24.9	24.9	25.0	24.8	24.8
7	25.6	25.6	25.0	24.9	24.9	24.9	24.9	24.9	24.9	25.1	24.9	24.8
8	25.6	25.6	25.0	24.9	24.9	24.9	24.9	24.9	24.9	25.2	24.8	24.8
9	25.6	25.6	25.0	24.9	24.9	24.9	24.9	24.9	24.9	25.3	24.8	24.9
10	25.6	25.6	25.0	24.9	24.9	24.9	24.9	24.9	24.9	25.3	24.9	24.9
11	25.6	25.6	25.0	24.9	24.9	24.9	24.9	24.9	24.9	25.3	24.8	24.9
12	25.6	25.6	25.0	24.9	24.9	24.9	24.9	24.9	24.9	25.4	24.8	25.0
13	25.6	25.6	--	24.9	24.9	24.9	24.9	24.9	24.9	25.4	24.8	25.0
14	25.6	25.6	25.0	24.9	24.9	24.9	24.9	24.9	24.9	25.4	24.9	25.0
15	25.6	25.6	25.0	24.9	24.9	24.9	24.9	24.9	24.9	25.4	24.9	25.0
16	25.6	25.6	25.0	24.9	24.9	24.9	24.9	24.9	24.9	25.4	24.9	25.0
17	25.6	25.6	25.0	24.9	24.9	24.8	24.9	24.9	24.9	25.5	24.9	25.1
18	25.6	25.6	25.0	24.9	24.9	24.9	24.9	24.9	24.9	25.5	25.0	25.1
19	25.6	25.6	25.0	24.9	24.9	24.8	24.9	24.9	24.9	25.5	24.9	25.1
20	25.6	25.6	25.0	25.0	25.0	24.9	24.9	24.9	24.9	25.5	24.8	25.1
21	25.6	25.4	25.0	25.0	25.0	24.9	24.9	24.9	24.9	25.4	24.8	25.1
22	25.6	25.4	25.0	25.0	25.1	24.9	24.9	24.9	24.9	25.1	24.9	25.1
23	25.6	25.4	24.9	25.0	25.1	24.9	24.9	24.9	24.9	25.0	25.0	25.1
24	25.6	25.4	24.9	24.9	25.1	24.8	24.9	24.9	24.9	25.0	25.0	25.1
25	25.6	25.3	24.9	24.9	25.1	24.8	24.9	24.9	24.9	24.9	25.0	25.2
26	25.6	25.2	24.9	24.9	25.2	24.8	24.9	24.9	24.9	24.9	24.9	25.2
27	25.6	25.1	24.9	24.9	25.2	24.8	24.9	24.9	24.9	24.9	24.9	25.2
28	25.6	25.1	24.9	24.9	25.2	24.8	24.9	24.9	24.9	24.9	24.9	25.2
29	25.6	25.1	24.9	24.9	--	24.8	24.9	24.9	24.9	24.9	25.0	25.2
30	25.6	25.1	24.9	24.9	--	24.8	24.9	24.9	24.9	24.9	25.0	25.2
31	25.6	--	24.9	24.9	--	24.8	--	24.9	--	24.9	25.1	--
Mean	25.6	25.5	--	24.9	25.0	24.9	24.9	24.9	24.9	25.1	24.9	25.0
Maximum	25.6	25.6	--	25.0	25.2	25.2	24.9	24.9	24.9	25.5	25.1	25.2
Minimum	25.6	25.1	--	24.9	24.9	24.8	24.8	24.9	24.9	24.9	24.8	24.8

Appendix 6.4. Daily mean water temperature at U.S. Geological Survey station 290802098232901 AY–68–53–928 (C8), Bexar County, Texas, 2009–11 (sensor depth 530 feet below land-surface datum).—Continued

[Temperature in degrees Celsius; --, no data]

Water year 2011 (Oct. 2010–Sept. 2011) daily mean values												
Day	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sept.**
1	25.2	--	--	--	--	--	--	--	--	--	--	--
2	25.2	--	--	--	--	--	--	--	--	--	--	--
3	25.3	--	--	--	--	--	--	--	--	--	--	--
4	25.3	--	--	--	--	--	--	--	--	--	--	--
5	25.3	--	--	--	--	--	--	--	--	--	--	--
6	25.3	--	--	--	--	--	--	--	--	--	--	--
7	25.3	--	--	--	--	--	--	--	--	--	--	--
8	25.3	--	--	--	--	--	--	--	--	--	--	--
9	25.3	--	--	--	--	--	--	--	--	--	--	--
10	25.3	--	--	--	--	--	--	--	--	--	--	--
11	25.3	--	--	--	--	--	--	--	--	--	--	--
12	25.3	--	--	--	--	--	--	--	--	--	--	--
13	25.3	--	--	--	--	--	--	--	--	--	--	--
14	--	--	--	--	--	--	--	--	--	--	--	--
15	--	--	--	--	--	--	--	--	--	--	--	--
16	--	--	--	--	--	--	--	--	--	--	--	--
17	--	--	--	--	--	--	--	--	--	--	--	--
18	--	--	--	--	--	--	--	--	--	--	--	--
19	--	--	--	--	--	--	--	--	--	--	--	--
20	--	--	--	--	--	--	--	--	--	--	--	--
21	--	--	--	--	--	--	--	--	--	--	--	--
22	--	--	--	--	--	--	--	--	--	--	--	--
23	--	--	--	--	--	--	--	--	--	--	--	--
24	--	--	--	--	--	--	--	--	--	--	--	--
25	--	--	--	--	--	--	--	--	--	--	--	--
26	--	--	--	--	--	--	--	--	--	--	--	--
27	--	--	--	--	--	--	--	--	--	--	--	--
28	--	--	--	--	--	--	--	--	--	--	--	--
29	--	--	--	--	--	--	--	--	--	--	--	--
30	--	--	--	--	--	--	--	--	--	--	--	--
31	--	--	--	--	--	--	--	--	--	--	--	--
Mean	--	--	--	--	--	--	--	--	--	--	--	--
Maximum	--	--	--	--	--	--	--	--	--	--	--	--
Minimum	--	--	--	--	--	--	--	--	--	--	--	--

Appendix 7—Daily Mean Specific Conductance at U.S. Geological Survey Station 290802098232901 AY–68–53–928 (C8), Bexar County, Texas, 2009–11

Appendix 7.1. Daily mean specific conductance at U.S. Geological Survey Station 290802098232901 AY–68–53–928 (C8), Bexar County, Texas, 2010–11 (sensor depth 380 feet below land-surface datum).

[Specific conductance in microsiemens per centimeter at 25 degrees Celsius; --, no data]

Water year 2010 (Oct. 2009–Sept. 2010) daily mean values												
Day	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sept.**
1	--	--	--	--	--	--	--	--	--	--	207	208
2	--	--	--	--	--	--	--	--	--	--	208	211
3	--	--	--	--	--	--	--	--	--	--	207	213
4	--	--	--	--	--	--	--	--	--	--	208	212
5	--	--	--	--	--	--	--	--	--	--	208	212
6	--	--	--	--	--	--	--	--	--	--	206	212
7	--	--	--	--	--	--	--	--	--	--	208	212
8	--	--	--	--	--	--	--	--	--	--	207	210
9	--	--	--	--	--	--	--	--	--	--	207	206
10	--	--	--	--	--	--	--	--	--	--	206	206
11	--	--	--	--	--	--	--	--	--	--	207	206
12	--	--	--	--	--	--	--	--	--	--	207	206
13	--	--	--	--	--	--	--	--	--	--	205	206
14	--	--	--	--	--	--	--	--	--	--	207	206
15	--	--	--	--	--	--	--	--	--	--	208	206
16	--	--	--	--	--	--	--	--	--	--	211	206
17	--	--	--	--	--	--	--	--	--	--	212	206
18	--	--	--	--	--	--	--	--	--	--	213	205
19	--	--	--	--	--	--	--	--	--	--	214	205
20	--	--	--	--	--	--	--	--	--	--	215	205
21	--	--	--	--	--	--	--	--	--	--	215	202
22	--	--	--	--	--	--	--	--	--	--	213	200
23	--	--	--	--	--	--	--	--	--	--	208	203
24	--	--	--	--	--	--	--	--	--	--	208	204
25	--	--	--	--	--	--	--	--	--	--	208	205
26	--	--	--	--	--	--	--	--	--	--	212	206
27	--	--	--	--	--	--	--	--	--	--	212	206
28	--	--	--	--	--	--	--	--	--	--	206	206
29	--	--	--	--	--	--	--	--	--	--	206	205
30	--	--	--	--	--	--	--	--	--	207	207	203
31	--	--	--	--	--	--	--	--	--	207	208	--
Mean	--	--	--	--	--	--	--	--	--	--	209	207
Maximum	--	--	--	--	--	--	--	--	--	--	215	213
Minimum	--	--	--	--	--	--	--	--	--	--	205	200

Appendix 7.1. Daily mean specific conductance at U.S. Geological Survey Station 290802098232901 AY–68–53–928 (C8), Bexar County, Texas, 2010–11 (sensor depth 380 feet below land-surface datum).—Continued

[Specific conductance in microsiemens per centimeter at 25 degrees Celsius; --, no data]

Water year 2011 (Oct. 2010–Sept. 2011) daily mean values												
Day	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sept.**
1	202	188	188	184	185	184	202	191	184	207	213	219
2	200	188	188	184	185	184	201	185	183	201	210	219
3	199	188	187	184	185	188	201	186	183	193	210	219
4	198	187	186	184	185	194	200	184	182	193	215	220
5	197	187	186	184	185	200	202	185	181	192	215	219
6	196	187	186	184	185	204	201	184	181	202	216	220
7	195	187	186	184	185	206	201	185	181	208	216	220
8	195	188	186	184	185	207	201	186	182	210	216	220
9	195	189	186	184	184	208	203	187	182	210	217	220
10	194	189	186	184	184	208	204	187	184	210	217	220
11	194	188	186	184	184	209	205	187	185	211	217	220
12	194	188	186	184	184	209	204	186	186	206	218	220
13	194	188	186	184	184	209	204	186	184	195	218	221
14	193	188	185	184	184	209	205	185	184	204	216	221
15	193	188	185	184	184	210	206	183	183	211	216	220
16	192	188	185	184	184	210	206	184	184	213	217	220
17	192	188	185	184	184	208	204	183	185	213	217	220
18	192	188	184	184	184	206	203	183	186	213	217	221
19	190	188	184	184	184	206	203	183	185	213	217	221
20	190	188	184	184	184	206	204	183	185	213	217	221
21	189	188	184	184	184	206	204	182	186	213	217	221
22	189	188	183	184	184	206	201	185	190	212	217	219
23	188	188	183	184	184	206	199	187	197	212	217	218
24	188	188	183	184	184	205	197	192	202	211	218	200
25	188	188	183	185	184	205	195	195	204	211	218	200
26	188	188	183	185	184	204	193	196	205	211	218	199
27	188	188	183	185	184	203	193	191	205	211	218	197
28	188	188	183	185	184	203	192	189	204	212	218	194
29	188	188	183	185	--	202	192	189	203	212	218	191
30	188	188	183	185	--	202	191	188	201	212	218	189
31	188	--	183	185	--	201	--	185	--	212	218	--
Mean	192	188	185	184	184	203	201	187	189	208	216	214
Maximum	202	189	188	185	185	210	206	196	205	213	218	221
Minimum	188	187	183	184	184	184	191	182	181	192	210	189

Appendix 7.2. Daily mean specific conductance at U.S. Geological Survey Station 290802098232901 AY–68–53–928 (C8), Bexar County, Texas, 2010–11 (sensor depth 460 feet below land-surface datum).

[Specific conductance in microsiemens per centimeter at 25 degrees Celsius; --, no data]

Water year 2011 (Oct. 2010–Sept. 2011) daily mean values												
Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	--	--	188	187	187	188	211	197	189	204	208	214
2	--	--	188	187	187	188	212	194	188	200	207	214
3	--	--	188	187	187	191	212	189	187	198	208	214
4	--	--	188	187	187	198	212	188	187	198	210	214
5	--	--	187	187	187	204	212	190	186	196	210	214
6	--	--	187	187	187	207	212	188	186	202	210	214
7	--	--	187	187	187	209	211	189	186	204	210	214
8	--	--	187	187	187	210	211	189	186	206	210	214
9	--	190	187	187	187	210	212	189	186	206	210	214
10	--	190	187	187	187	210	213	189	187	206	211	214
11	--	190	187	187	187	211	213	188	187	206	211	214
12	--	190	188	187	187	211	213	188	187	203	211	214
13	--	190	188	187	187	211	213	188	187	200	211	214
14	--	190	188	187	187	211	213	187	186	204	212	214
15	--	190	188	187	187	211	213	187	186	207	212	214
16	--	190	188	187	187	211	213	188	186	208	212	214
17	--	190	188	187	187	212	212	187	187	208	212	214
18	--	190	188	187	187	212	211	187	187	208	212	214
19	--	189	188	187	187	212	212	187	186	208	213	214
20	--	189	188	187	187	212	212	186	188	208	212	214
21	--	189	188	187	187	212	210	187	191	209	212	214
22	--	189	188	187	187	212	207	190	195	208	212	215
23	--	189	188	187	187	212	205	192	200	208	212	212
24	--	189	188	187	187	212	203	196	202	208	213	206
25	--	189	188	187	187	212	200	198	203	208	213	206
26	--	189	187	187	187	211	199	198	203	208	213	205
27	--	189	187	187	187	211	198	197	203	208	213	202
28	--	189	187	187	188	211	198	196	204	208	213	197
29	--	189	187	187	--	210	198	195	204	208	213	194
30	--	189	187	187	--	208	197	193	202	208	214	193
31	--	--	187	187	--	208	--	190	--	208	214	--
Mean	--	--	188	187	187	208	209	191	191	205	211	211
Maximum	--	--	188	187	188	212	213	198	204	209	214	215
Minimum	--	--	187	187	187	188	197	186	186	196	207	193

Appendix 7.3. Daily mean specific conductance at U.S. Geological Survey Station 290802098232901 AY–68–53–928 (C8), Bexar County, Texas, 2010–11 (sensor depth 520 feet below land-surface datum).

[Specific conductance in microsiemens per centimeter at 25 degrees Celsius; --, no data]

Water year 2010 (Oct. 2009–Sept. 2010) daily mean values												
Day	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sept.**
1	--	--	--	--	--	--	--	--	--	--	214	211
2	--	--	--	--	--	--	--	--	--	--	214	210
3	--	--	--	--	--	--	--	--	--	--	214	211
4	--	--	--	--	--	--	--	--	--	--	213	211
5	--	--	--	--	--	--	--	--	--	--	213	210
6	--	--	--	--	--	--	--	--	--	--	212	210
7	--	--	--	--	--	--	--	--	--	--	212	210
8	--	--	--	--	--	--	--	--	--	--	212	210
9	--	--	--	--	--	--	--	--	--	--	213	211
10	--	--	--	--	--	--	--	--	--	--	213	211
11	--	--	--	--	--	--	--	--	--	--	213	211
12	--	--	--	--	--	--	--	--	--	--	213	211
13	--	--	--	--	--	--	--	--	--	--	213	211
14	--	--	--	--	--	--	--	--	--	--	213	211
15	--	--	--	--	--	--	--	--	--	--	213	211
16	--	--	--	--	--	--	--	--	--	--	214	211
17	--	--	--	--	--	--	--	--	--	--	214	209
18	--	--	--	--	--	--	--	--	--	--	215	209
19	--	--	--	--	--	--	--	--	--	--	213	208
20	--	--	--	--	--	--	--	--	--	--	211	209
21	--	--	--	--	--	--	--	--	--	--	210	209
22	--	--	--	--	--	--	--	--	--	--	210	207
23	--	--	--	--	--	--	--	--	--	--	209	205
24	--	--	--	--	--	--	--	--	--	--	208	208
25	--	--	--	--	--	--	--	--	--	--	209	210
26	--	--	--	--	--	--	--	--	--	--	210	210
27	--	--	--	--	--	--	--	--	--	--	210	210
28	--	--	--	--	--	--	--	--	--	--	210	210
29	--	--	--	--	--	--	--	--	--	--	211	210
30	--	--	--	--	--	--	--	--	--	213	212	209
31	--	--	--	--	--	--	--	--	--	213	212	--
Mean	--	--	--	--	--	--	--	--	--	--	212	210
Maximum	--	--	--	--	--	--	--	--	--	--	215	211
Minimum	--	--	--	--	--	--	--	--	--	--	208	205

Appendix 7.3. Daily mean specific conductance at U.S. Geological Survey Station 290802098232901 AY–68–53–928 (C8), Bexar County, Texas (sensor depth 520 feet below land-surface datum).—Continued

[Specific conductance in microsiemens per centimeter at 25 degrees Celsius; --, no data]

Water year 2011 (Oct. 2010–Sept. 2011) daily mean values												
Day	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sept.**
1	207	188	186	185	185	184	205	183	184	202	206	210
2	206	188	186	185	185	184	207	--	183	202	206	210
3	205	188	186	185	185	186	210	181	183	202	205	210
4	204	188	185	185	185	193	211	183	183	201	207	210
5	203	188	185	185	185	198	211	183	183	196	206	211
6	201	188	185	184	185	202	212	182	184	198	207	211
7	200	188	185	185	184	204	211	181	184	203	207	210
8	200	187	185	185	185	204	211	180	184	204	207	210
9	200	186	185	184	185	205	213	181	184	204	207	211
10	199	186	185	184	185	205	212	183	183	204	207	211
11	198	186	185	185	185	205	209	184	184	204	207	211
12	198	186	185	184	184	206	210	183	185	204	207	210
13	198	186	184	184	184	206	210	182	184	203	208	210
14	198	186	184	185	185	206	209	182	184	200	208	210
15	197	186	185	184	185	206	208	183	184	205	207	211
16	196	186	185	184	184	206	208	184	184	205	209	211
17	196	186	185	185	184	206	208	184	184	206	209	211
18	194	186	185	184	184	206	210	184	184	206	209	211
19	192	186	185	184	184	206	212	183	183	205	209	212
20	193	186	185	184	184	206	209	183	185	206	209	212
21	192	186	185	185	184	206	204	184	189	207	210	212
22	192	186	185	185	184	206	200	191	192	207	209	202
23	191	186	185	185	185	206	196	192	197	207	208	206
24	191	186	185	185	185	206	193	195	200	206	208	210
25	190	186	185	185	184	206	190	197	201	206	209	210
26	190	186	185	185	184	206	189	198	201	206	209	210
27	190	186	185	185	184	206	188	197	201	205	209	205
28	190	186	185	185	184	206	186	197	201	206	210	198
29	189	186	185	185	--	205	185	196	201	206	210	193
30	189	186	185	185	--	203	184	193	200	206	210	190
31	189	--	185	185	--	203	--	187	--	206	210	--
Mean	196	187	185	185	185	203	204	--	189	204	208	208
Maximum	207	188	186	185	185	206	213	--	201	207	210	212
Minimum	189	186	184	184	184	184	184	--	183	196	205	190

Appendix 7.4. Daily mean specific conductance at U.S. Geological Survey Station 290802098232901 AY–68–53–928 (C8), Bexar County, Texas, 2009–11 (sensor depth 530 feet below land-surface datum).

[Specific conductance in microsiemens per centimeter at 25 degrees Celsius; --, no data]

Water year 2009 (Oct. 2008–Sept. 2009) daily mean values												
Day	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sept.**
1	--	--	--	--	--	--	--	--	--	--	--	195
2	--	--	--	--	--	--	--	--	--	--	--	195
3	--	--	--	--	--	--	--	--	--	--	--	196
4	--	--	--	--	--	--	--	--	--	--	--	197
5	--	--	--	--	--	--	--	--	--	--	--	198
6	--	--	--	--	--	--	--	--	--	--	--	198
7	--	--	--	--	--	--	--	--	--	--	--	198
8	--	--	--	--	--	--	--	--	--	--	--	200
9	--	--	--	--	--	--	--	--	--	--	--	206
10	--	--	--	--	--	--	--	--	--	--	--	206
11	--	--	--	--	--	--	--	--	--	--	--	207
12	--	--	--	--	--	--	--	--	--	--	--	208
13	--	--	--	--	--	--	--	--	--	--	--	208
14	--	--	--	--	--	--	--	--	--	--	--	209
15	--	--	--	--	--	--	--	--	--	--	--	210
16	--	--	--	--	--	--	--	--	--	--	--	210
17	--	--	--	--	--	--	--	--	--	--	--	211
18	--	--	--	--	--	--	--	--	--	--	--	212
19	--	--	--	--	--	--	--	--	--	--	--	212
20	--	--	--	--	--	--	--	--	--	--	205	213
21	--	--	--	--	--	--	--	--	--	--	205	213
22	--	--	--	--	--	--	--	--	--	--	203	210
23	--	--	--	--	--	--	--	--	--	--	206	205
24	--	--	--	--	--	--	--	--	--	--	208	204
25	--	--	--	--	--	--	--	--	--	--	208	206
26	--	--	--	--	--	--	--	--	--	--	210	209
27	--	--	--	--	--	--	--	--	--	--	206	211
28	--	--	--	--	--	--	--	--	--	--	203	211
29	--	--	--	--	--	--	--	--	--	--	203	212
30	--	--	--	--	--	--	--	--	--	--	201	213
31	--	--	--	--	--	--	--	--	--	--	195	--
Mean	--	--	--	--	--	--	--	--	--	--	--	206
Maximum	--	--	--	--	--	--	--	--	--	--	--	213
Minimum	--	--	--	--	--	--	--	--	--	--	--	195

Appendix 7.4. Daily mean specific conductance at U.S. Geological Survey Station 290802098232901 AY–68–53–928 (C8), Bexar County, Texas, 2009–11 (sensor depth 530 feet below land-surface datum).—Continued

[Specific conductance in microsiemens per centimeter at 25 degrees Celsius; --, no data]

Water year 2010 (Oct. 2009–Sept. 2010) daily mean values												
Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	213	235	208	212	217	218	219	214	214	212	213	213
2	214	235	209	212	217	218	218	214	214	212	213	209
3	215	227	209	212	218	219	218	215	214	212	213	210
4	216	226	209	212	218	219	218	215	214	212	213	210
5	217	225	209	213	218	219	218	215	213	212	213	210
6	218	225	210	213	218	219	218	215	213	213	213	209
7	217	225	210	213	218	219	218	215	213	211	214	209
8	218	225	210	213	218	219	217	215	213	205	214	209
9	224	224	211	214	218	219	217	215	213	200	214	209
10	231	224	211	214	218	219	217	214	213	196	214	209
11	232	224	211	214	218	219	217	214	213	194	214	209
12	232	223	211	214	218	219	217	214	213	193	214	209
13	231	223	--	215	218	219	217	214	213	192	214	209
14	235	223	--	215	218	220	216	214	213	191	214	210
15	243	222	--	216	218	220	216	214	213	191	214	210
16	242	222	208	216	218	219	216	214	213	191	214	210
17	242	222	208	216	218	219	215	214	213	191	214	210
18	241	221	208	217	218	219	215	214	213	191	215	210
19	240	221	208	216	218	219	216	214	213	191	214	210
20	239	218	208	216	218	219	215	214	212	191	211	210
21	239	202	208	216	218	219	216	214	212	193	211	210
22	239	205	208	216	218	219	215	214	212	204	210	210
23	238	206	209	217	218	219	215	214	212	210	210	205
24	238	207	209	217	217	218	216	214	212	210	212	207
25	237	207	210	217	216	218	215	214	212	211	213	209
26	237	207	210	217	216	218	216	214	212	211	210	209
27	237	208	210	217	216	218	216	214	212	212	210	210
28	236	208	211	217	217	218	215	214	212	212	211	210
29	236	208	211	217	--	218	214	214	212	213	214	210
30	236	208	211	217	--	219	214	214	212	213	215	210
31	235	--	211	217	--	219	--	214	--	213	216	--
Mean	231	219	--	215	218	219	216	214	213	203	213	209
Maximum	243	235	--	217	218	220	219	215	214	213	216	213
Minimum	213	202	--	212	216	218	214	214	212	191	210	205

Appendix 7.4. Daily mean specific conductance at U.S. Geological Survey Station 290802098232901 AY–68–53–928 (C8), Bexar County, Texas, 2009–11 (sensor depth 530 feet below land-surface datum).—Continued

[Specific conductance in microsiemens per centimeter at 25 degrees Celsius; --, no data]

Water year 2011 (Oct. 2010–Sept. 2011) daily mean values												
Day	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sept.**
1	210	--	--	--	--	--	--	--	--	--	--	--
2	210	--	--	--	--	--	--	--	--	--	--	--
3	209	--	--	--	--	--	--	--	--	--	--	--
4	209	--	--	--	--	--	--	--	--	--	--	--
5	207	--	--	--	--	--	--	--	--	--	--	--
6	207	--	--	--	--	--	--	--	--	--	--	--
7	206	--	--	--	--	--	--	--	--	--	--	--
8	206	--	--	--	--	--	--	--	--	--	--	--
9	205	--	--	--	--	--	--	--	--	--	--	--
10	205	--	--	--	--	--	--	--	--	--	--	--
11	205	--	--	--	--	--	--	--	--	--	--	--
12	204	--	--	--	--	--	--	--	--	--	--	--
13	204	--	--	--	--	--	--	--	--	--	--	--
14	--	--	--	--	--	--	--	--	--	--	--	--
15	--	--	--	--	--	--	--	--	--	--	--	--
16	--	--	--	--	--	--	--	--	--	--	--	--
17	--	--	--	--	--	--	--	--	--	--	--	--
18	--	--	--	--	--	--	--	--	--	--	--	--
19	--	--	--	--	--	--	--	--	--	--	--	--
20	--	--	--	--	--	--	--	--	--	--	--	--
21	--	--	--	--	--	--	--	--	--	--	--	--
22	--	--	--	--	--	--	--	--	--	--	--	--
23	--	--	--	--	--	--	--	--	--	--	--	--
24	--	--	--	--	--	--	--	--	--	--	--	--
25	--	--	--	--	--	--	--	--	--	--	--	--
26	--	--	--	--	--	--	--	--	--	--	--	--
27	--	--	--	--	--	--	--	--	--	--	--	--
28	--	--	--	--	--	--	--	--	--	--	--	--
29	--	--	--	--	--	--	--	--	--	--	--	--
30	--	--	--	--	--	--	--	--	--	--	--	--
31	--	--	--	--	--	--	--	--	--	--	--	--
Mean	--	--	--	--	--	--	--	--	--	--	--	--
Maximum	--	--	--	--	--	--	--	--	--	--	--	--
Minimum	--	--	--	--	--	--	--	--	--	--	--	--

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Crow—**Water-Level Altitudes and Continuous and Discrete Groundwater Quality at and near an ASR Site**—SIR 2012–5260

ISBN 978-1-4113-3523-3

Printed on recycled paper