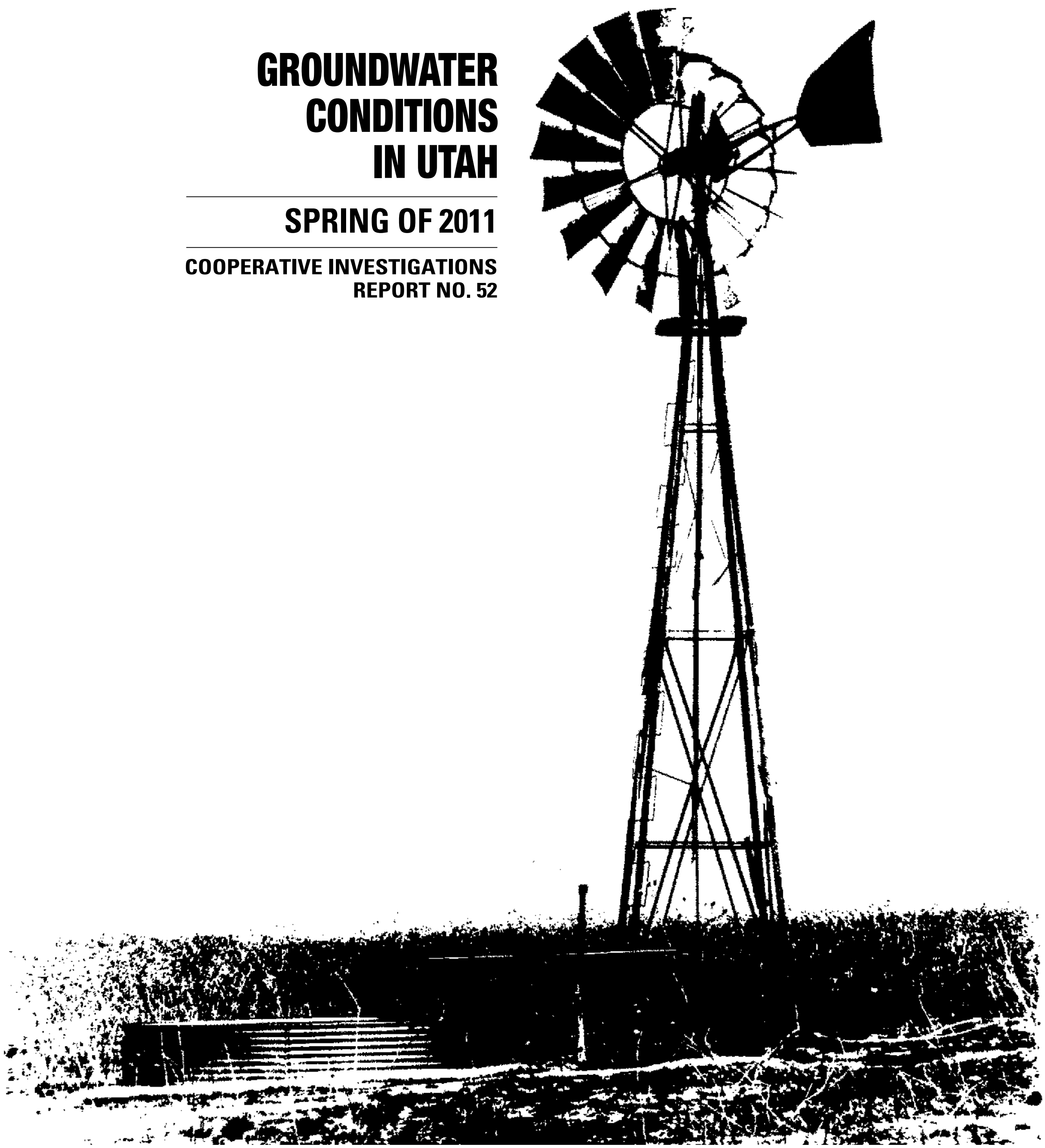
GROUNDWATER CONDITIONS IN UTAH

SPRING OF 2011

COOPERATIVE INVESTIGATIONS REPORT NO. 52



UTAH DEPARTMENT OF NATURAL RESOURCES and
UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

U.S. GEOLOGICAL SURVEY

GROUNDWATER CONDITIONS IN UTAH, SPRING OF 2011

By
Carole B. Burden and others
U.S. Geological Survey

Prepared by the U.S. Geological Survey
in cooperation with the Utah Department of Natural Resources,
Division of Water Rights; and
Utah Department of Environmental Quality, Division of Water Quality

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Conversion Factors, Datums, and Water-Quality Units

Multiply	By	To obtain
acre-foot	1,233	cubic meter
foot	0.3048	meter
gallon per minute	0.06308	liter per second
inch	25.4	millimeter
mile	1.609	kilometer
square mile	2.59	square kilometer

Vertical coordinate information is referenced to the National Geodetic Vertical Datum of 1929 (NGVD 1929). Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Chemical concentration is reported only in metric units. Chemical concentration in water is reported in milligrams per liter (mg/L) or micrograms per liter (µg/L), which express the solute mass per unit volume (liter) of water. One thousand micrograms per liter is equivalent to one milligram per liter. For concentrations less than 7,000 milligrams per liter, the numerical value is about the same as for concentrations in parts per million.

Specific conductance is a measure of the ability of water to conduct an electrical current. It is expressed in microsiemens per centimeter at 25 degrees Celsius. Specific conductance is related to the type and concentration of ions in solution and can be used for approximating the dissolved-solids concentration in the water. Commonly, the concentration of dissolved solids (in milligrams per liter) is about 65 percent of the specific conductance (in microsiemens). This relation is not constant in water from one well or stream to another, and it may vary for the same source with changes in the composition of the water.

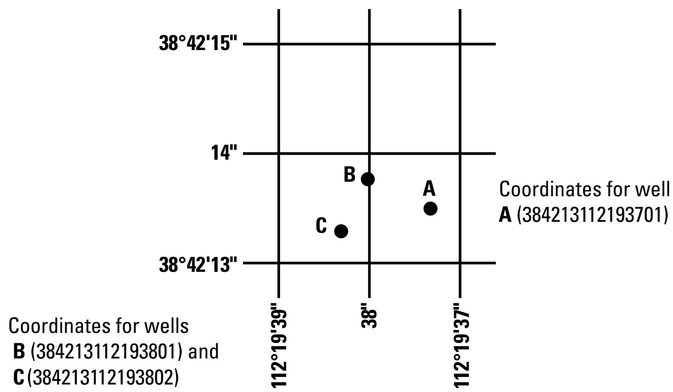
Definition of Terms

Acre-foot—The quantity of water required to cover 1 acre to a depth of 1 foot; equal to 43,560 cubic feet or about 326,000 gallons or 1,233 cubic meters.
Aquifer—A geologic formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield substantial amounts of water to wells and springs.
Artesian—Describes a well in which the water level stands above the top of the aquifer tapped by the well (confined). A flowing artesian well is one in which the water level is above the land surface.
Average annual withdrawal—Calculated average from estimated withdrawals, rounded to the nearest thousand acre-feet.
Cumulative departure from average annual precipitation—A graph of the departure or difference between the average annual precipitation and the value of precipitation for each year, plotted cumulatively. A cumulative plot is generated by adding the departure from average precipitation for the current year to the sum of departure values for all previous years in the period of record. A positive departure, or greater-than-average precipitation, for a year results in a graph segment trending upward; a negative departure results in a graph segment trending downward. A generally downward-trending graph for a period of years represents a period of generally less-than-average precipitation, which commonly causes and corresponds with declining water levels in wells. Likewise, a generally upward-trending graph for a period of years represents a period of greater-than-average precipitation, which commonly causes and corresponds with rising water levels in wells. However, increases or decreases in withdrawals of groundwater from wells also affect water levels and can change or eliminate the correlation between water levels in wells and the graph of cumulative departure from average precipitation.
Dissolved—Material in a representative water sample that passes through a 0.45–micrometer membrane filter. This is a convenient operational definition used by Federal agencies that collect water data. Determinations of "dissolved" constituents are made on subsamples of the filtrate.
Land-surface datum (lsd)—A datum plane that is approximately at land surface at each groundwater observation well.
Maximum Contaminant Level (MCL)—The maximum concentration of a substance that is allowed in public drinking-water systems, as established by the U.S. Environmental Protection Agency (EPA).
Precipitation—The total annual precipitation in inches, rounded to tenths of an inch. For selected locations, is computed from monthly total precipitation (rain, sleet, hail, snow, etc.). Data supplied by the National Oceanic and Atmospheric Administration (NOAA) and the Utah Climate Center. Data may be provisional and/or estimated when used to compute annual total and long-term average precipitation values.

Numbering System for Wells and Surface-Water Sites

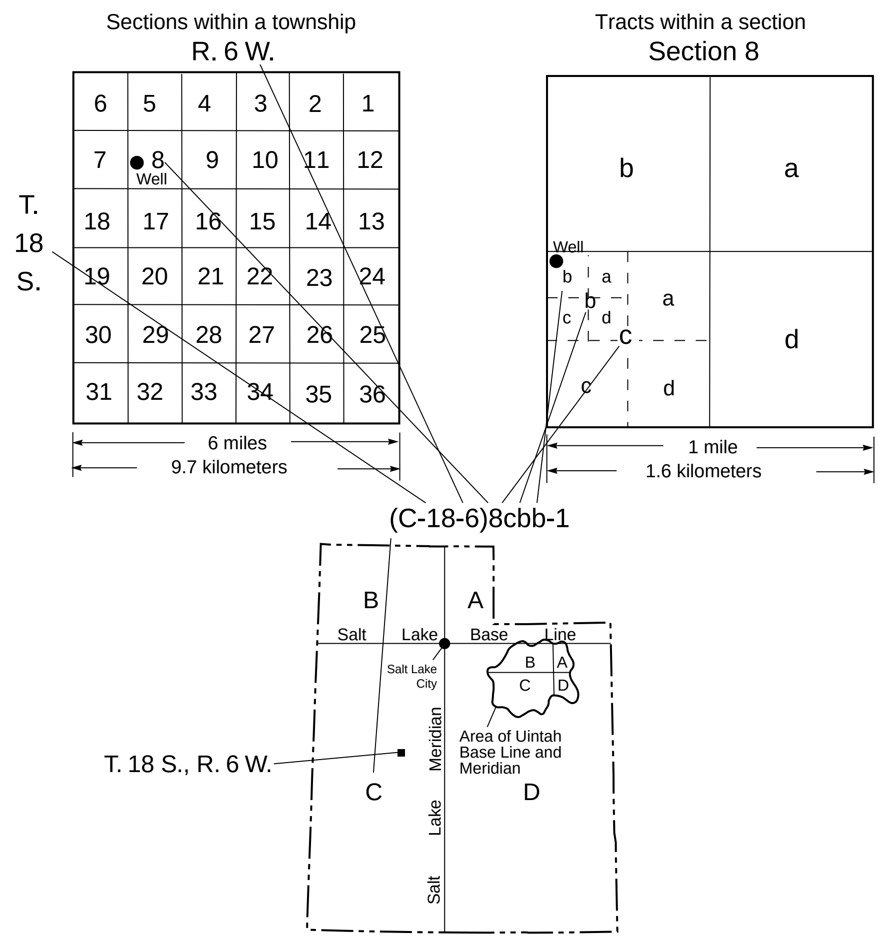
Wells by Latitude and Longitude

The U.S. Geological Survey well-numbering system is based on the grid system of latitude and longitude. The system provides the geographic location of the well and a unique number for each site. The number consists of 15 digits. The first six digits denote the degrees, minutes, and seconds of latitude, and the next seven digits denote degrees, minutes, and seconds of longitude; the last two digits are a sequential number for wells within a 1-second grid. In the event that the latitude-longitude coordinates for a well are the same, a sequential number such as "01," "02," and so forth, would be assigned. Even though the site number is based on latitude and longitude, it may not reflect the accurate location of the site. When error corrections or new technology locate a site more accurately, latitude-longitude coordinates will change but the site number will not. In addition to the well number that is based on latitude and longitude for each well, another well number is assigned based on the U.S. Bureau of Land Management system of land subdivision.



Wells by the Cadastral System of Land Subdivision

The well-numbering system used in Utah is based on the Cadastral system of land subdivision. The well-numbering system is familiar to most water users in Utah, and the well number shows the location of the well by quadrant, township, range, section, and position within the section. Well numbers for most of the State are derived from the Salt Lake Base Line and the Salt Lake Meridian. Well numbers for wells located inside the area of the Uintah Base Line and Meridian are designated in the same manner as those based on the Salt Lake Base Line and Meridian, with the addition of the "U" preceding the parentheses.



Surface-Water Sites— Downstream Order and Station Number

Since October 1, 1950, hydrologic-station records in U.S. Geological Survey reports have been listed in order of downstream direction along the main stream. All stations on a tributary entering upstream from a main-stream station are listed before that station. A station on a tributary entering between two main-stream stations is listed between those stations.

As an added means of identification, each hydrologic station and partial-record station has been assigned a station number. These station numbers are in the same downstream order used in this report. In assigning a station number, no distinction is made between partial-record stations and other stations; therefore, the station number for a partial-record station indicates downstream-order position in a list composed of both types of stations. Gaps are consecutive. The complete 8-digit (or 10-digit) number for each station such as 09004100, which appears just to the left of the station name, includes a 2-digit part number "09" plus the 6-digit (or 8-digit) downstream order number "004100." In areas of high station density, an additional two digits may be added to the station identification number to yield a 10-digit number. The stations are numbered in downstream order as described above between stations of consecutive 8-digit numbers.

Groundwater Conditions in Utah, Spring of 2011

By Carole B. Burden and others
U.S. Geological Survey

Introduction

This is the forty-eighth in a series of annual reports that describe groundwater conditions in Utah. Reports in this series, published cooperatively by the U.S. Geological Survey and the Utah Department of Natural Resources, Division of Water Rights, and the Utah Department of Environmental Quality, Division of Water Quality, provide data to enable interested parties to maintain awareness of changing groundwater conditions.

This report, like the others in the series, contains information on well construction, groundwater withdrawal from wells, water-level changes, precipitation, streamflow, and chemical quality of water. Information on well construction included in this report refers only to wells constructed for new appropriations of groundwater. Supplementary data are included in reports of this series only for those years or areas that are important to a discussion of changing groundwater conditions and for which applicable data are available.

This report includes individual discussions of selected significant areas of groundwater development in the State for calendar year 2010. Most of the reported data were collected by the U.S. Geological Survey in cooperation with the Utah Department of Natural Resources, Division of Water Rights, and the Utah Department of Environmental Quality, Division of Water Quality. This report is also available online at http://www.waterrights.utah.gov/techinfo/ and http://ut.water.usgs.gov/publications/GW2011.pdf. Groundwater conditions in Utah for calendar year 2009 are reported in Burden and others (2010) and available online at http://ut.water.usgs.gov/publications/GW2010.pdf.

Analytical results associated with water samples collected from each area of groundwater development were compared to State of Utah Maximum Contaminant Levels (MCLs) and secondary drinking-water standards of routinely measureable substances present in water supplies. The MCLs and secondary drinking-water standards can be accessed online at http://www.rules.utah.gov/publicat/code/r309/r309-200.htm#T5. The U.S. Environmental Protection Agency (EPA) drinking-water standards can be accessed at http://www.epa.gov/safewater/mcl.html#mcls. Maximum Contaminant Levels and secondary drinking-water standards were developed for public water systems and do not apply to the majority of wells sampled during this study.

Utah's Groundwater Reservoir

Small amounts of groundwater can be obtained from wells throughout most of Utah, but large amounts that are of suitable chemical quality for irrigation, public supply, or industrial use generally can be obtained only in specific areas. The areas of groundwater development discussed in this report are shown in figure 1 and listed in table 1. Relatively few wells outside of these areas yield large amounts of groundwater of suitable chemical quality for the uses listed above, although some basins in western Utah and many areas in eastern Utah have not been explored sufficiently to determine their potential for groundwater development.

Most wells in Utah yield water from unconsolidated basin-fill deposits. These deposits may consist of boulders, gravel, sand, silt, or clay, or a mixture of some or all of these materials. The largest yields are obtained from coarse-grained materials that are sorted into deposits of uniform grain size. Most wells that yield water from unconsolidated deposits are in large intermountain basins that have been partly filled with rock materials eroded from adjacent mountains.

A small percentage of wells in Utah yield water from consolidated-rock (bedrock) aquifers. Consolidated rocks that have the highest yield are basalt, which contains interconnected vesicular openings, fractures, or permeable weathered zones at the tops of lava flows; limestone, which contains fractures or other openings enlarged by solution; and sandstone, which contains open fractures. Most wells that penetrate consolidated rock are in the eastern and southern parts of the State in areas where water cannot be obtained readily from unconsolidated deposits.

Summary of Conditions

The total estimated withdrawal of water from wells in Utah during 2010 was about 975,000 acre-feet (table 2), which is about 6,000 acre-feet more than the total for 2009 and 61,000 acre-feet more than the 2000–2009 average annual withdrawal (table 3). The increase in withdrawal resulted mostly from increased industrial use. The total estimated withdrawal for industry was about 105,000 acre-feet, which is about 10,000 acre-feet more than the value for 2009. Withdrawal for irrigation was about 544,000 acre-feet, which is 6,000 acre-feet less than the value for 2009. Withdrawal for public-supply use was about 262,000 acre-feet, which is the same as in 2009. Withdrawal for domestic and stock use was about 63,000 acre-feet, which is the same as in 2009.

From 2009 to 2010, groundwater withdrawal increased in 7 of the 16 areas of groundwater development discussed in this report, decreased in 7, and remained the same in 2 (table 2). Withdrawal in the Milford area of Escalante Valley increased about 6,000 acre-feet, the largest increase of any of the groundwater development areas shown in figure 1. Withdrawal in the central Virgin River area decreased about 4,000 acre-feet, the largest decrease of any of the areas. The 2010 withdrawal was more than the average annual withdrawal for 2000–2009 in 11 of the 16 areas (tables 2 and 3).

The amount of water withdrawn from wells is related to demand and availability of water from other sources, which, in turn, are partly related to local climatic conditions. Precipitation during calendar year 2010 at 27 of 28 weather stations included in this report (National Oceanic and Atmospheric Administration, 2010), was greater than the long-term average. The greatest increase in precipitation from average was 12.6 inches at Silver Lake Brighton. The only decrease in precipitation from average was 2.4 inches at Ogden Pioneer Power House.

During February, March, and April 2011, about 650 water-level measurements were made in wells for areas included in this report. Most water-level data included in the hydrographs in this report are from measurements made during February and March, but may include some water-level measurements made in April and May. Many of the wells in this report have additional water-level measurements made throughout the year which are not included in this report. All water-level data are available online at http://nwis.waterdata.usgs.gov/ut/nwis/gwlevels.

In 2010, 327 wells were constructed for new appropriations of groundwater, as determined by the Utah Division of Water Rights (table 2), which is 32 more wells than the total reported for 2009. In 2010, 24 large-diameter wells (12 inches or more) were constructed for new appropriations of groundwater (table 2), which is 13 more than the total reported for 2009. These are principally for withdrawal of water for public supply, irrigation, and industrial use.

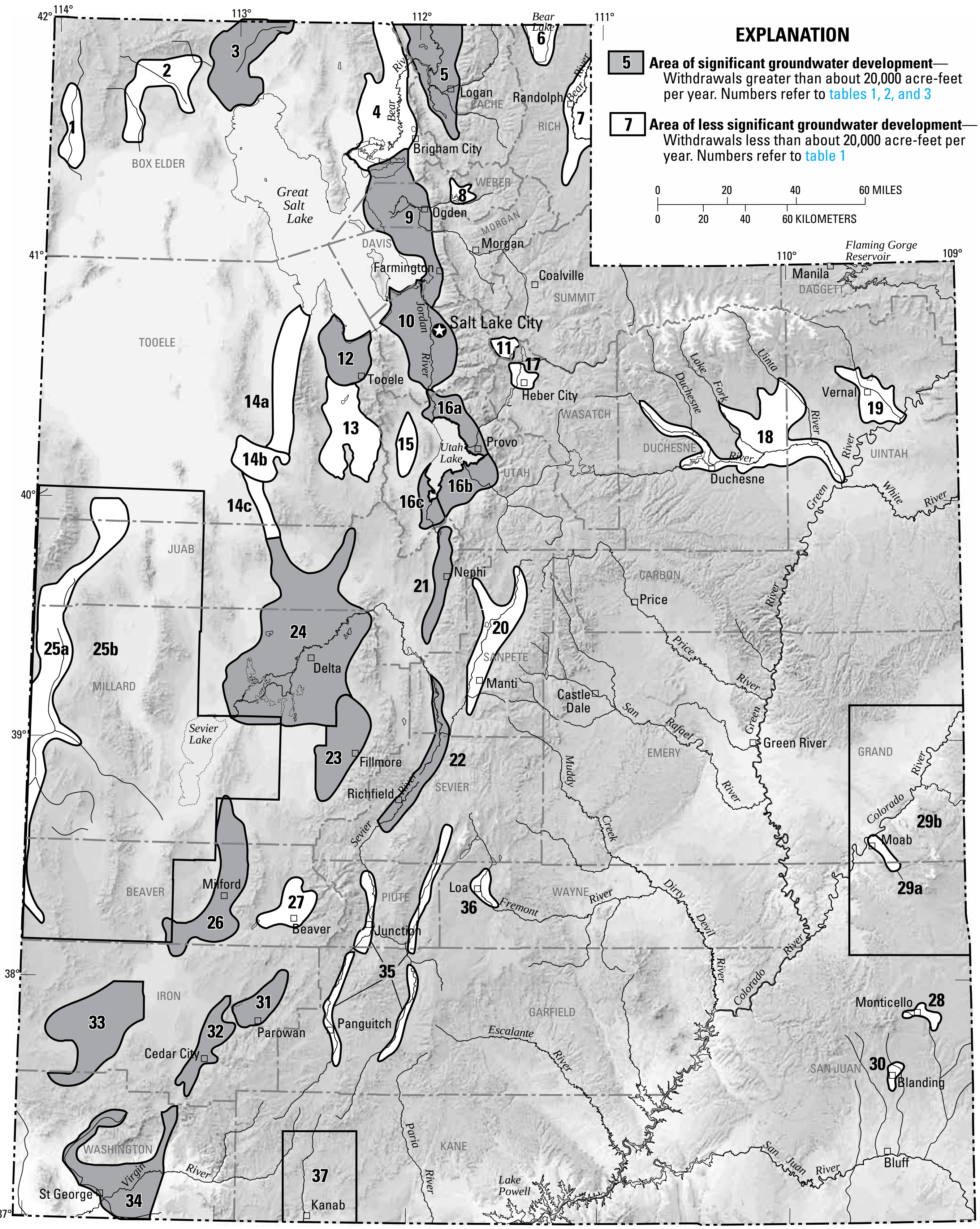


Figure 1. Areas of groundwater development in Utah specifically referred to in this report.

Table 1. Areas of groundwater development in Utah specifically referred to in this report.

[Do., ditto]

Number in figure 1	Area	Principal types of water-bearing lithologies
1	Grouse Creek Valley	Unconsolidated deposits
2	Park Valley area	Do.
3	Curlew Valley	Unconsolidated and consolidated-rock deposits
4	Lower Bear River area	Unconsolidated deposits
5	Cache Valley	Do.
6	Bear Lake Valley	Do.
7	Upper Bear River area	Do.
8	Ogden Valley	Do.
9	East Shore area	Do.
10	Salt Lake Valley	Do.
11	Park City area	Unconsolidated and consolidated-rock deposits
12	Tooele Valley	Do.
13	Rush Valley	Do.
14a	Skull Valley	Unconsolidated deposits
14b	Dugway area	Do.
14c	Old River Bed	Do.
15	Cedar Valley, Utah County	Do.
16a	Northern Utah Valley	Do.
16b	Southern Utah Valley	Do.
16c	Goshen Valley	Do.
17	Heber Valley	Do.
18	Duchesne River area	Unconsolidated and consolidated-rock deposits
19	Vernal area	Do.
20	Sanpete Valley	Do.
21	Juab Valley	Unconsolidated deposits
22	Central Sevier Valley	Do.
23	Pahvant Valley	Unconsolidated and consolidated-rock deposits
24	Sevier Desert	Unconsolidated deposits
25a	Snake Valley	Do.
25b	West Desert	Do.
26	Milford area (Escalante Valley)	Do.
27	Beaver Valley	Do.
28	Monticello area	Consolidated-rock deposits
29a	Spanish Valley	Unconsolidated and consolidated-rock deposits
29b	Upper Colorado River area	Do.
30	Blanding area	Consolidated-rock deposits
31	Parowan Valley	Unconsolidated and consolidated-rock deposits
32	Cedar Valley, Iron County	Unconsolidated deposits
33	Beryl-Enterprise area (Escalante Valley)	Do.
34	Central Virgin River area	Unconsolidated and consolidated-rock deposits
35	Upper Sevier River area	Unconsolidated deposits
36	Upper Fremont River Valley	Unconsolidated and consolidated-rock deposits
37	Kanab area	Consolidated-rock deposits

Table 2. Number of wells constructed and estimated withdrawal of water from wells in Utah, 2010.

Area	Number in figure 1	Number of wells[1] constructed in 2010		Estimated withdrawal from wells (acre-feet)					
				2010					2009 total[2] (rounded)
		Total	Diameter of 12 inches or more	Irrigation	Industrial[1]	Public supply[1]	Domestic and stock	Total (rounded)	
Curlew Valley	3	1	0	38,700	0	200	100	39,000	34,000
Cache Valley	5	29	0	15,800	6,000	9,600	2,000	33,000	31,000
East Shore area	9	6	1	7,200	3,600	27,200	5,000	43,000	46,000
Salt Lake Valley	10	3	2	530	[3] 34,900	82,200	22,000	140,000	137,000
Tooele Valley	12	6	1	[4,5] 11,600	1,200	10,000	1,100	24,000	25,000
Utah and Goshen Valleys	16	12	1	33,500	7,200	52,000	16,700	109,000	109,000
Northern Utah Valley[6]	16a	(6)	(1)	(9,800)	(4,100)	(39,300)	(8,100)	(61,300)	
Southern Utah Valley[6]	16b	(5)	(0)	(6,800)	(3,100)	(12,500)	(8,500)	(30,900)	
Goshen Valley[6]	16c	(1)	(0)	(16,900)	(0)	(200)	(100)	(17,200)	
Juab Valley	21	1	0	21,000	80	[7]600	400	22,000	21,000
Sevier Desert	24	5	1	38,600	4,700	1,200	1,200	46,000	48,000
Central Sevier Valley	22	19	0	21,000	0	3,900	1,300	26,000	27,000
Pahvant Valley	23	7	3	105,100	0	700	320	106,000	104,000
Cedar Valley, Iron County	32	13	1	27,900	100	7,600	2,300	38,000	38,000
Parowan Valley	31	4	0	[8] 33,200	360	530	350	34,000	37,000
Escalante Valley									
Milford area	26	3	0	41,100	[9] 20,000	700	140	62,000	56,000
Beryl-Enterprise area	33	14	6	84,600	[10] 3,700	550	650	90,000	93,000
Central Virgin River area	34	8	4	7,000	1,200	18,000	2,400	29,000	33,000
Other areas[11,12]		196	4	58,100	21,500	46,600	7,400	134,000	130,000
Total (rounded)		327	24	545,000	105,000	262,000	63,000	975,000	969,000

[1] Data provided by Utah Department of Natural Resources, Division of Water Rights.

[2] From Burden and others (2010, table 2).

[3] Includes some use for air conditioning, about 2,600 acre-feet. About 94 percent was injected back into the aquifer.

[4] Includes some domestic and stock use.

[5] Includes some flowing well discharge.

[6] Numbers for Northern Utah Valley, Southern Utah Valley, and Goshen Valley, presented within parentheses, are a subtotal of withdrawal.

[7] Previously included some springs.

[8] Includes some stock use.

[9] Includes 18,400 acre-feet for geothermal power generation (including 10,600 from a new facility in 2010). About 99 percent was injected back into the aquifer.

[10] Includes 2,740 acre-feet for heating greenhouses. About 95 percent was injected back into the aquifer.

[11] Withdrawal totals are estimated minimum. See "Other Areas" section of this report for withdrawal estimates for other areas.

[12] Includes withdrawals for upper Sevier Valley and upper Fremont River Valley that were included with central Sevier Valley in reports prior to number 31 of this series.

Table 3. Total annual withdrawal of water from wells in significant areas of groundwater development in Utah, 2000–2009.

Area	Number in figure 1	Thousands of acre-feet[1]										2000–2009 average (rounded)	2010
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009		
Curlew Valley	3	41	36	[2]38	42	38	29	31	38	44	34	37	39
Cache Valley	5	30	32	33	27	27	29	31	36	34	31	31	33
East Shore area	9	60	57	49	49	46	41	46	52	54	46	50	43
Salt Lake Valley	10	145	151	[2]140	130	125	110	131	151	135	137	136	140
Tooele Valley	12	24	21	21	22	21	[2]18	[2]21	[2]27	[2]28	25	23	24
Utah and Goshen Valleys	16	[2]120	[2]111	[2]111	[2]108	[2]105	[2]87	100	126	104	109	110	109
Northern Utah Valley[3]	16a	([2]73)	([2]67)	([2]64)	([2]68)	([2]66)	([2]46)	(58)	(72)	(71)	(63)	(65)	(61)
Southern Utah Valley[3]	16b	(33)	(32)	(36)	(33)	(30)	(31)	(29)	(38)	(34)	(30)	(33)	(31)
Goshen Valley[3]	16c	(15)	(12)	(11)	(7)	(9)	(10)	(12)	(16)	(19)	(15)	(13)	(17)
Juab Valley	21	27	29	29	27	26	14	21	26	26	21	25	22
Sevier Desert	24	15	19	36	28	41	24	20	34	44	48	31	46
Central Sevier Valley	22	13	12	11	15	15	17	16	19	24	27	17	26
Pahvant Valley	23	80	80	89	86	85	80	86	89	94	104	87	106
Cedar Valley, Iron County	32	[2]35	32	42	39	40	30	35	40	40	38	37	38
Parowan Valley	31	30	[2]33	39	31	37	27	33	34	38	37	34	34
Escalante Valley													
Milford area	26	49	42	52	50	44	40	45	49	51	56	48	62
Beryl-Enterprise area	33	84	81	99	92	98	68	79	92	93	93	88	90
Central Virgin River area	34	[2]26	27	27	28	26	29	32	33	29	33	29	29
Other areas		[2]135	114	131	128	129	111	130	155	144	130	131	134
Total (rounded)		[2]914	[2]877	[2]947	[2]902	[2]903	[2]754	[2]857	[2]1,001	[2]1,002	969	914	975

[1] From previous reports in this series.

[2] Revised.

[3] Numbers for Northern Utah Valley, Southern Utah Valley, and Goshen Valley, presented within parentheses, are a subtotal of withdrawal.

Major Areas of Groundwater Development

Curlew Valley

By David V. Allen

The Curlew Valley drainage basin extends across the Utah-Idaho State line and includes the communities of Cedar Creek and Snowville (fig. 2). The valley is bounded on the west and east by the Raft River and Hansel Mountains, which range in altitude from about 6,500 to nearly 10,000 feet. The valley is open to the south, where water draining from it enters Great Salt Lake.

The Utah part of Curlew Valley (Utah subbasin) covers about 550 square miles in Box Elder County. It is an arid to semiarid, largely uninhabited area, with a community center at Snowville. Average annual precipitation in the Utah subbasin is less than 8 inches on the valley floor, and is substantially more in the mountains.

The principal source of water in Curlew Valley is groundwater. The groundwater reservoir is primarily composed of confined aquifers in alluvial and lacustrine basin-fill deposits and volcanic rocks. These formations yield several hundred to several thousand gallons of water per minute to individual large-diameter irrigation wells west of Snowville and near Kelton.

Total estimated withdrawal of water from wells in Curlew Valley in 2010 was about 39,000 acre-feet, which is 5,000 acre-feet more than the value for 2009 and 2,000 acre-feet more than the average annual withdrawal for 2000–2009 (tables 2 and 3).

The location of wells in Curlew Valley in which the water level was measured during March 2011 is shown in figure 2. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Grouse Creek, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells is shown in figure 3.

Precipitation at Grouse Creek in 2010 was about 12.2 inches, which is about 0.2 inch more than in 2009 and about 1.0 inch more than the average annual precipitation for 1959–2010.

Water levels in Curlew Valley generally declined from March 2010 to March 2011. The largest decline, about 2 feet, was observed in a well about 11 miles west of Snowville.

Physical properties and results of chemical analyses for water from three wells in Curlew Valley are listed in tables 5 and 6, and the location of the wells is plotted in figure 41. The concentrations of dissolved solids and chloride in the water samples from wells (B-14-9)4ccc-1 and (B-14-9)5bbb-1 exceeded the secondary drinking-water standards for these constituents (500 and 250 mg/L, respectively).

The concentration of dissolved solids in water samples collected from well (B-12-11)8abb-1, 3 miles north of Kelton, and well (B-14-9)5bbb-1, 10 miles west of Snowville, from 1972–2010 and 1971–2010, respectively, is shown in figure 3. The dissolved-solids concentration in water from well (B-12-11)8abb-1 increased from 2,380 mg/L in July 2009 to 3,210 mg/L in July 2010. The dissolved-solids concentration in water samples from both wells has generally increased since the early 1970s.

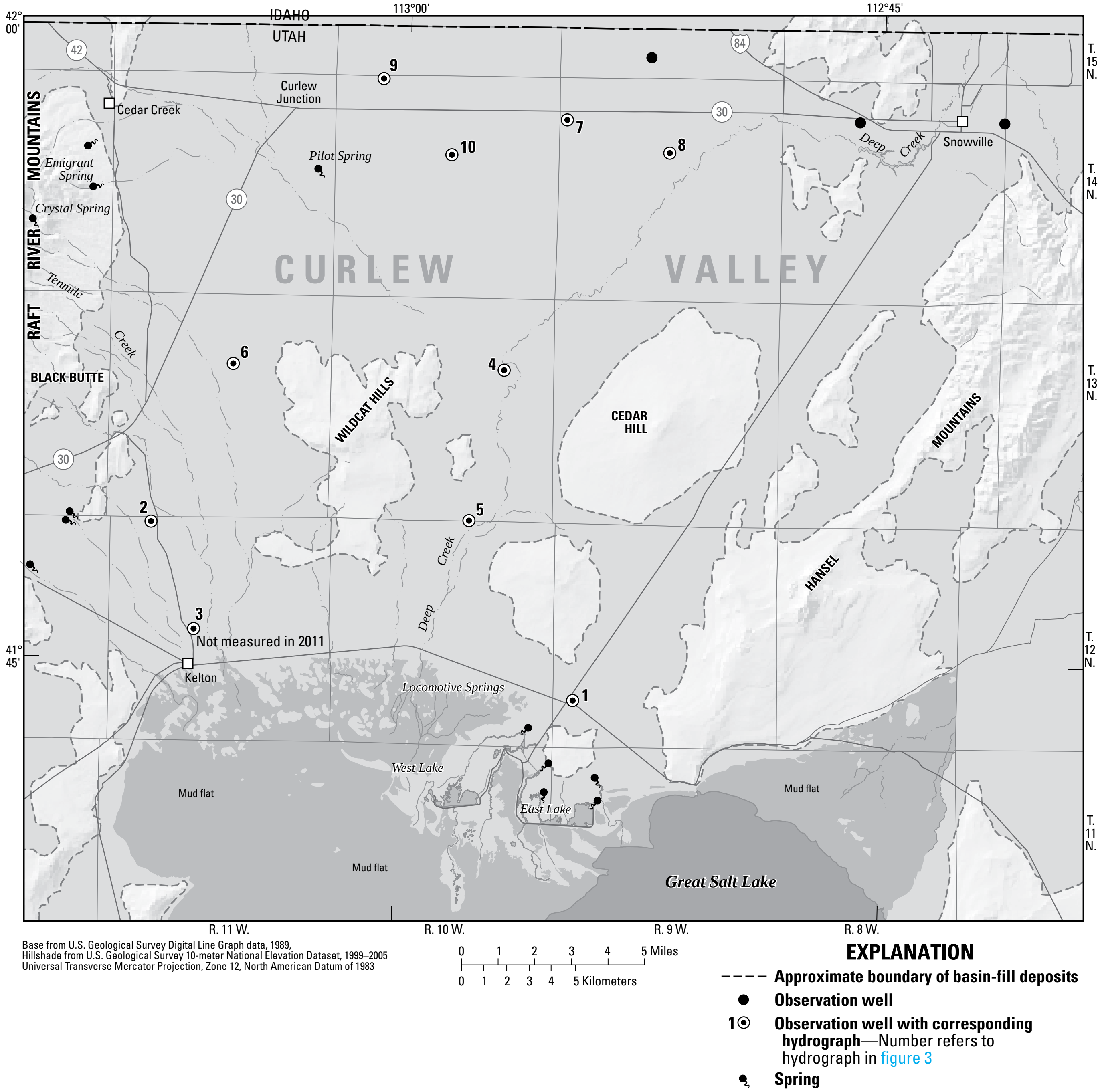


Figure 2. Location of wells in Curlew Valley in which the water level was measured during March 2011.

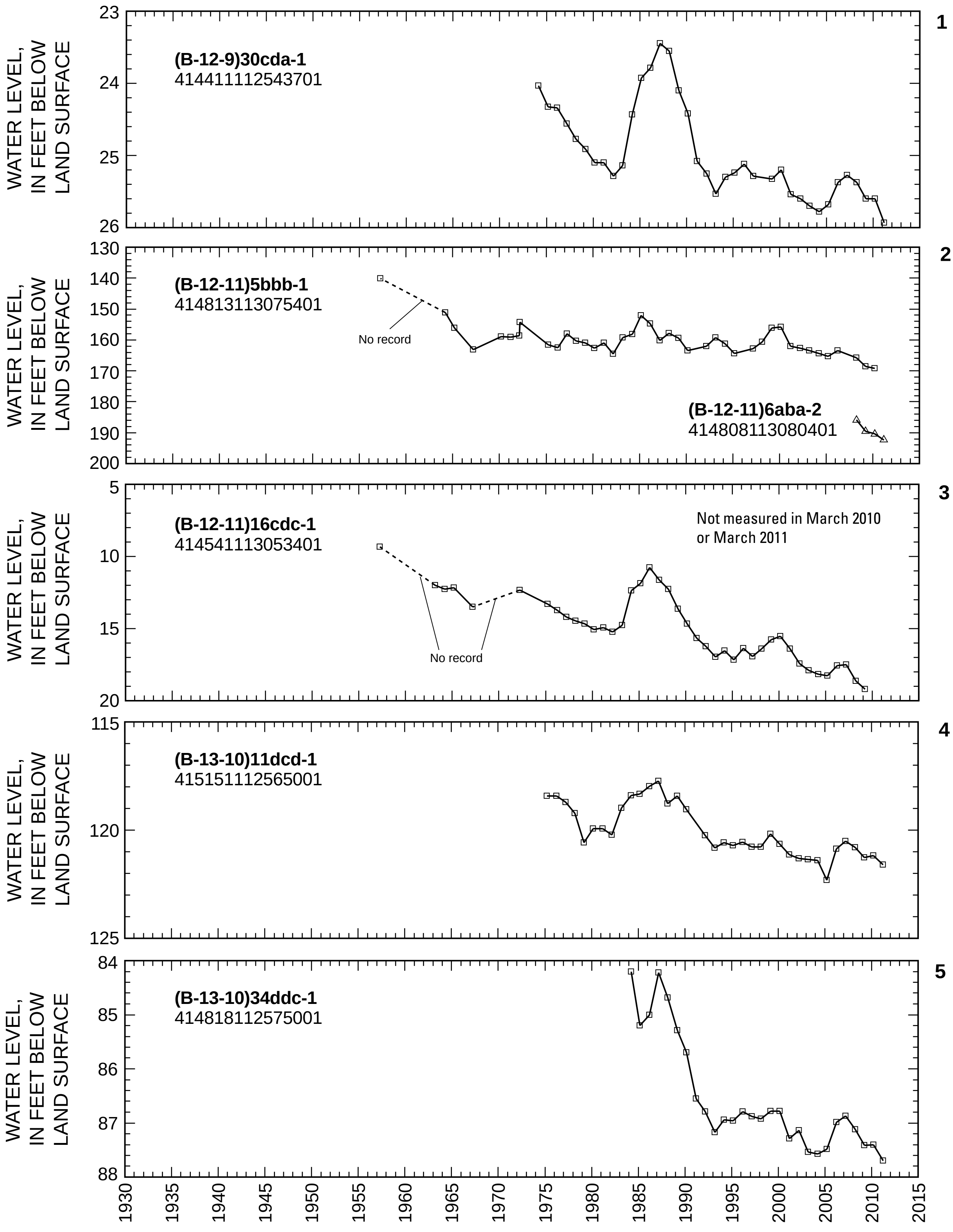


Figure 3. Relation of water level in selected wells in Curlew Valley to cumulative departure from average annual precipitation at Grouse Creek, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.

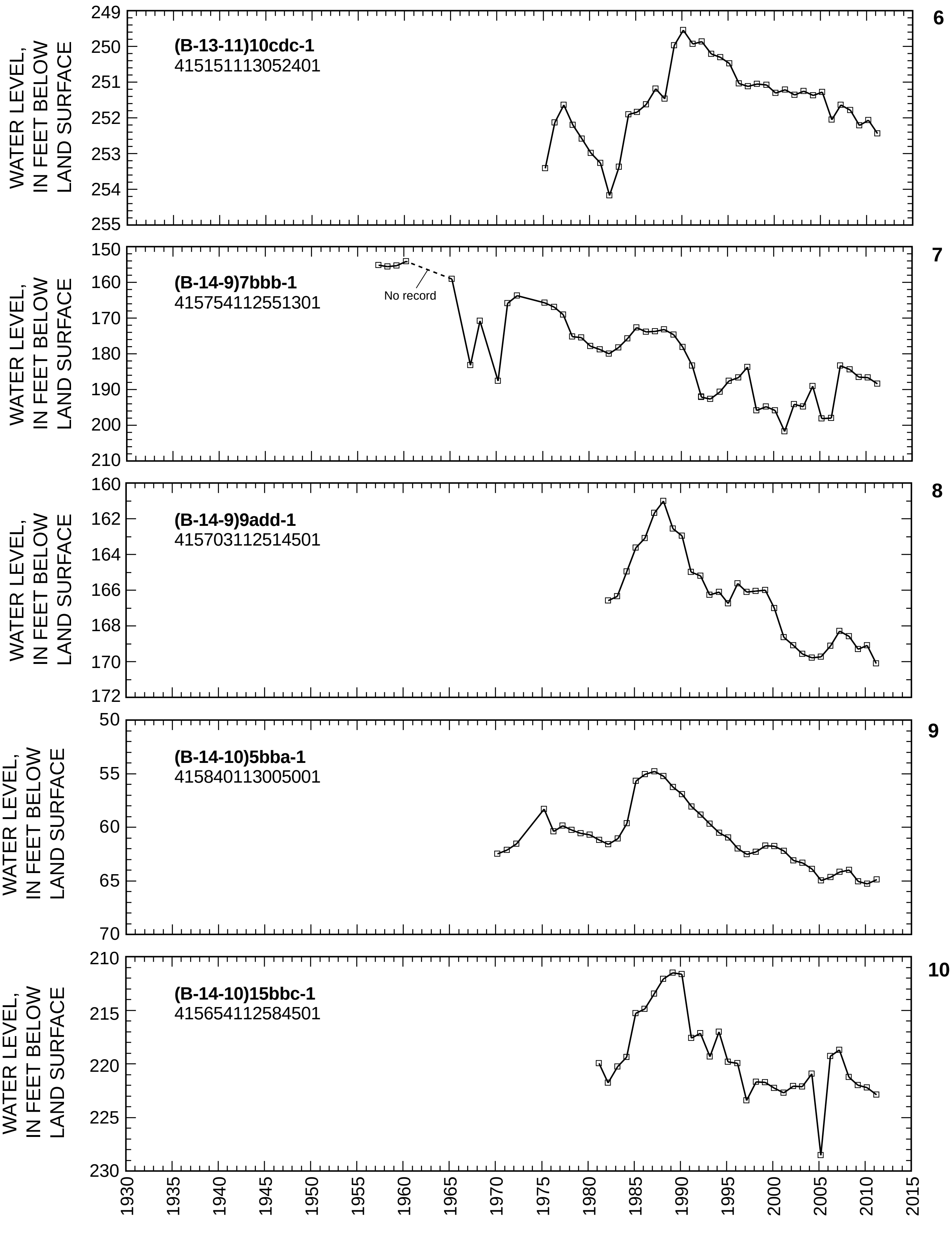


Figure 3. Relation of water level in selected wells in Curlew Valley to cumulative departure from average annual precipitation at Grouse Creek, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.—Continued

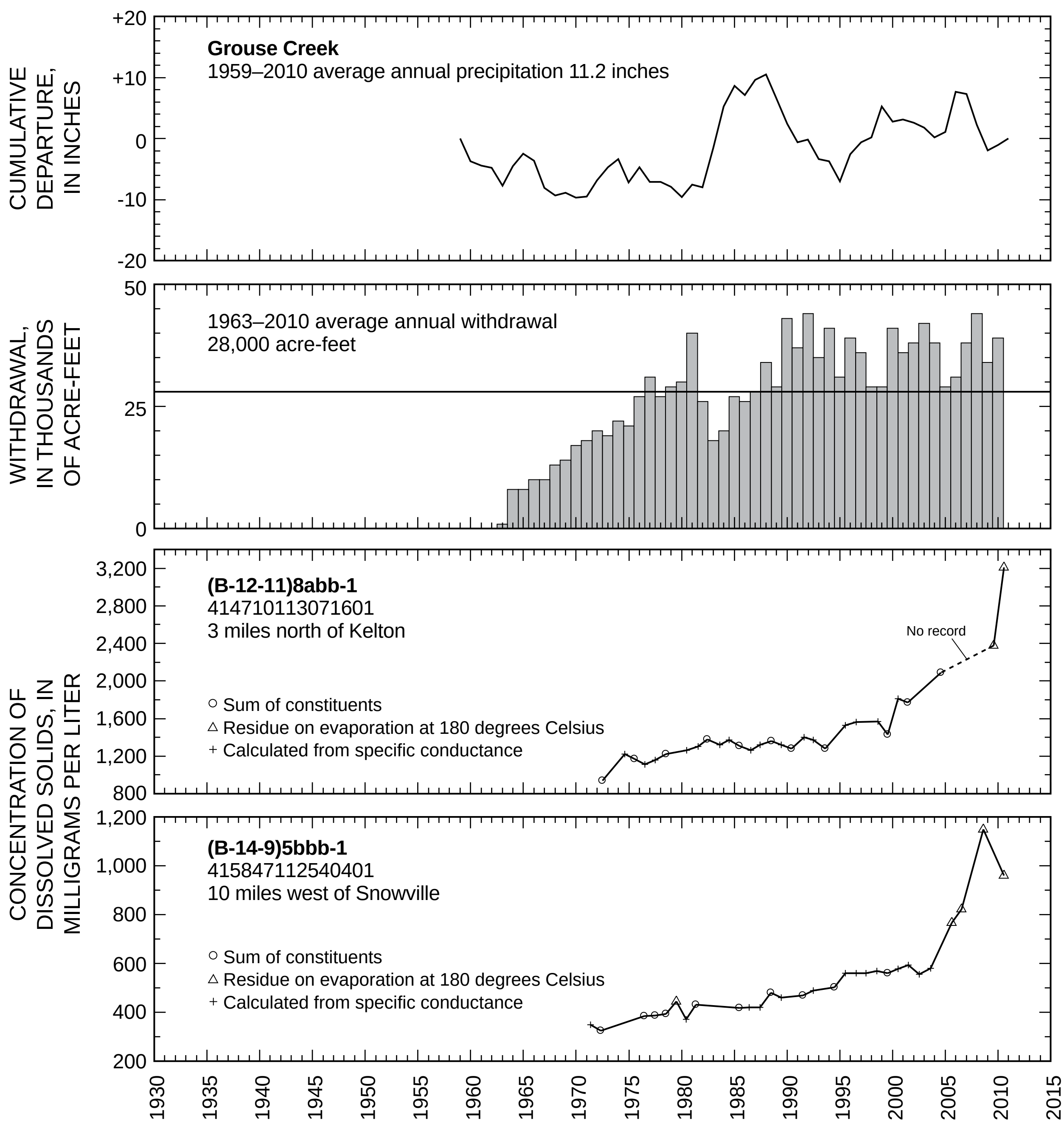


Figure 3. Relation of water level in selected wells in Curlew Valley to cumulative departure from average annual precipitation at Grouse Creek, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.—Continued

Cache Valley

By Tom M. Marston

Cache Valley covers about 450 square miles in Cache County where it is bounded on the east by the Bear River Range and on the southwest by the Wellsville Mountains (fig. 4). Groundwater occurs in unconsolidated basin-fill deposits in the valley, under both water-table and artesian conditions. Recharge to the groundwater system occurs principally along the margins of the valley, and groundwater moves toward the center of the valley and west toward Cache Junction.

Total estimated withdrawal of water from wells in Cache Valley in 2010 was about 33,000 acre-feet, which is 2,000 acre-feet more than in 2009 and 2,000 acre-feet more than the average annual withdrawal for 2000–2009 (tables 2 and 3). Withdrawal for irrigation was 15,800 acre-feet (largely from flowing wells), which is about 2,000 acre-feet more than in 2009. Withdrawal for public supply was 9,600 acre-feet, 500 acre-feet more than in 2009.

The location of wells in Cache Valley in which the water level was measured during March or April 2011 is shown in figure 4. The relation of the water level in selected observation wells to total annual discharge of the Logan River near Logan, to cumulative departure from average annual precipitation at Logan, Utah State University, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (A-13-1)29bcd-1 is shown in figure 5.

Total discharge of the Logan River (combined flow from the Logan River above State Dam, near Logan, and Logan, Hyde Park, and Smithfield Canal at Head, near Logan) during 2010 was about 142,000 acre-feet, which is 48,700 acre-feet less than the 2009 total of 190,700 acre-feet and 38,000 acre-feet less than the 1941–2010 average annual discharge. Precipitation at Logan, Utah State University, was about 20.0 inches in 2010. This is about 1.4 inches less than for 2009 and about 1.7 inches more than the average annual precipitation for 1930–2010.

Water levels throughout the valley generally declined slightly from March 2010 to March 2011. This is consistent with decreased precipitation in 2010 compared to 2009. Water levels fluctuated between 1935 and 1983; since 1985, water levels have fluctuated depending on the amount and timing of precipitation and recharge to the unconsolidated deposits from snowmelt runoff.

Physical properties and results of chemical analyses for water from five wells in Cache Valley are listed in tables 5 and 6, and the locations of the wells are plotted in figure 41. The concentration of manganese in the water sample from well (A-13-1)29bcd-1 exceeded the secondary drinking-water standard for this constituent (50 µg/L).

The concentration of dissolved solids in water samples collected from well (A-13-1)29bcd-1, located 1.5 miles west of Smithfield, from 1970 to 2010, is shown in figure 5. The concentration has ranged from 223 to 278 mg/L, with a median value of 258 mg/L. The water sample collected in August 2010 had a dissolved-solids concentration of 253 mg/L, similar to the median value. There is little variability in the data and no apparent trends. This is consistent with the relatively small range (55 mg/L) and standard deviation (11 mg/L) associated with the data.

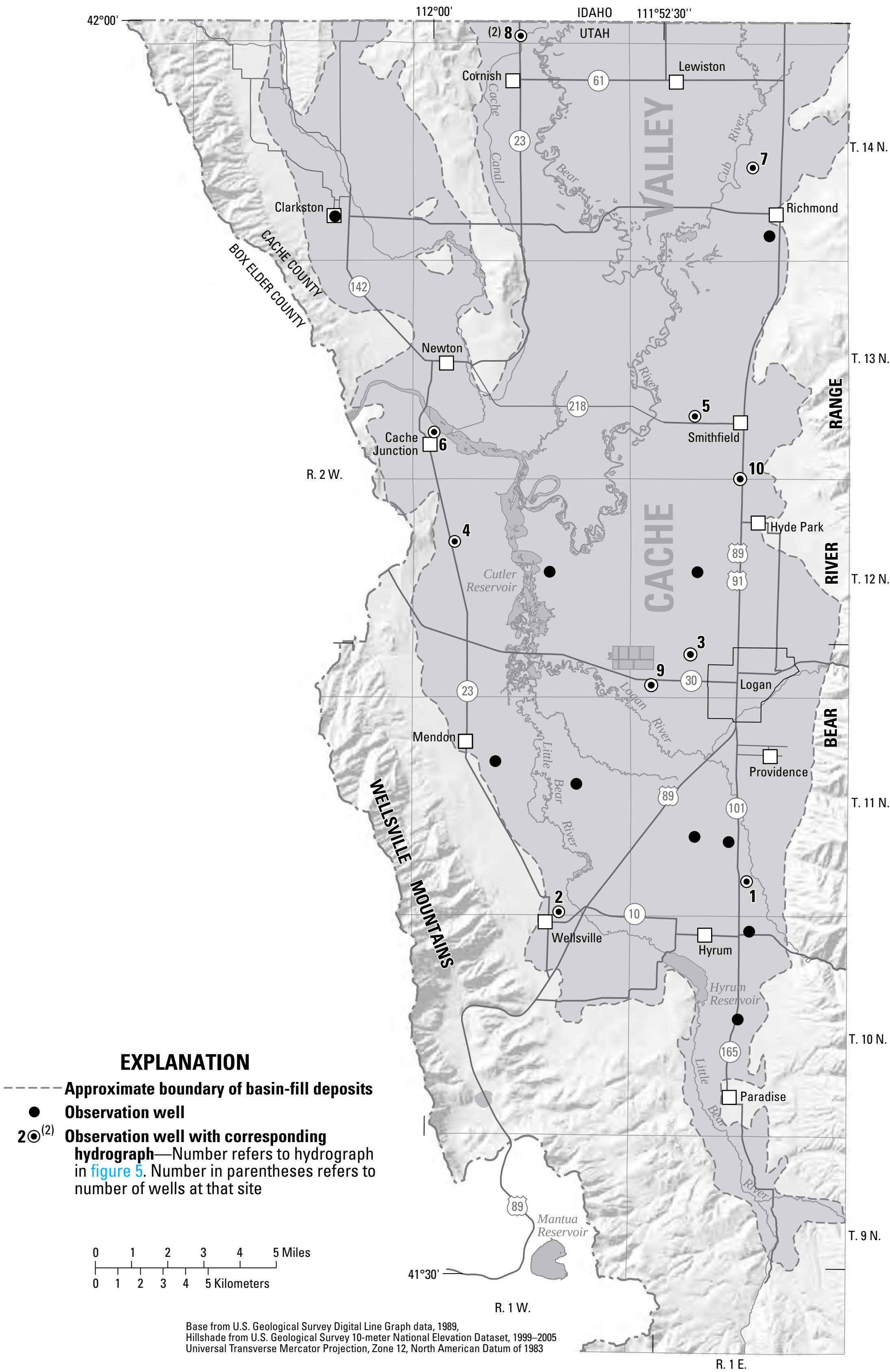


Figure 4. Location of wells in Cache Valley in which the water level was measured during March or April 2011.

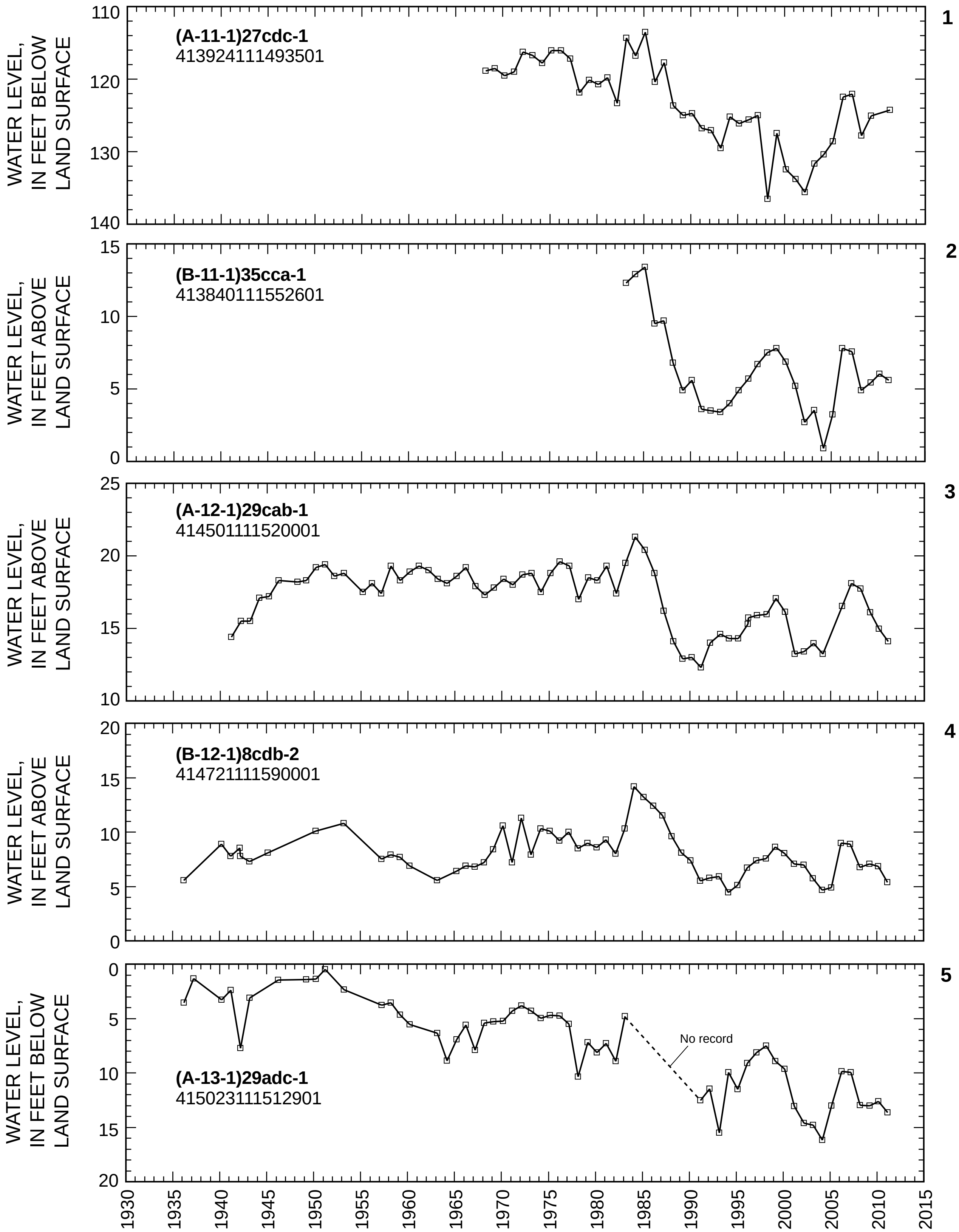


Figure 5. Relation of water level in selected wells in Cache Valley to total annual discharge of the Logan River near Logan, to cumulative departure from average annual precipitation at Logan, Utah State University, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (A-13-1)29bcd-1.

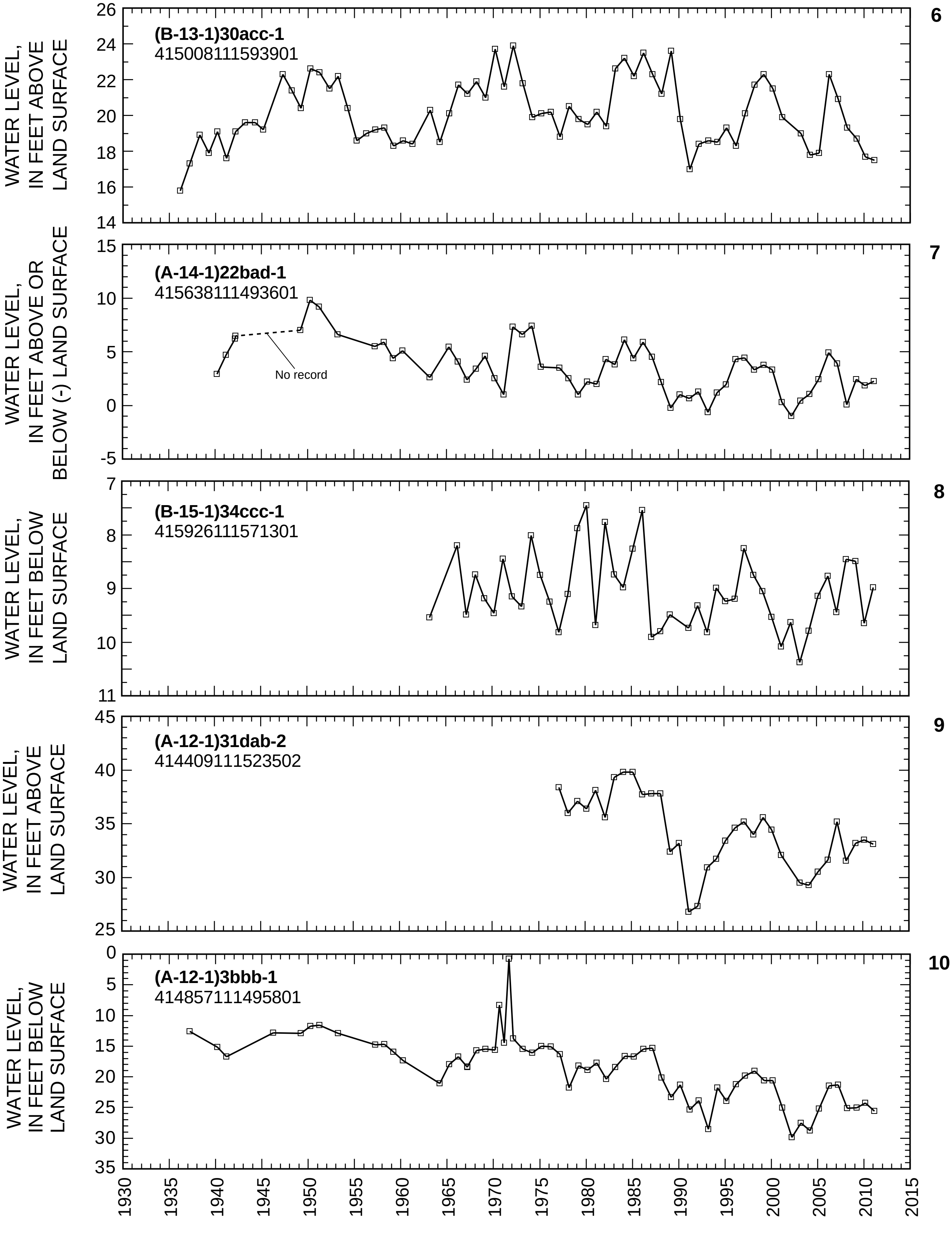


Figure 5. Relation of water level in selected wells in Cache Valley to total annual discharge of the Logan River near Logan, to cumulative departure from average annual precipitation at Logan, Utah State University, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (A-13-1)29bcd-1.—Continued

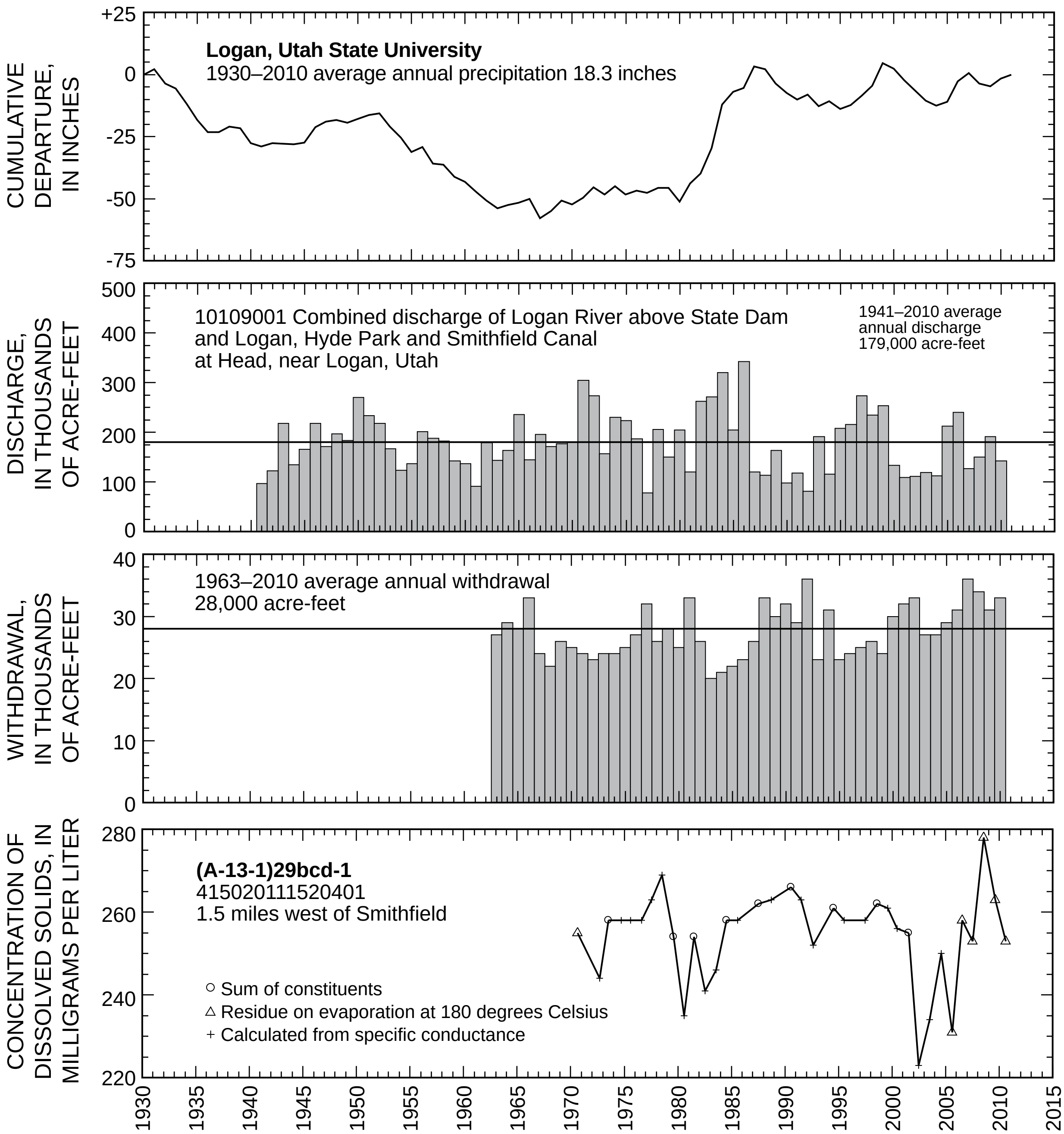


Figure 5. Relation of water level in selected wells in Cache Valley to total annual discharge of the Logan River near Logan, to cumulative departure from average annual precipitation at Logan, Utah State University, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (A-13-1)29bcd-1.—Continued

East Shore Area

By Martel J. Fisher

The East Shore area is in north-central Utah between the Wasatch Range and Great Salt Lake within Davis, Weber, and Box Elder Counties (fig. 6). Groundwater occurs in unconsolidated basin-fill deposits under both water-table and artesian conditions, but most of the water withdrawn by wells is from the artesian aquifers. Water enters the artesian aquifers along the contact between the Wasatch Range and the eastern edge of the basin-fill deposits, and generally moves westward toward Great Salt Lake.

Total estimated withdrawal of water from wells in the East Shore area in 2010 was about 43,000 acre-feet, which is 3,000 acre-feet less than was reported for 2009 and 7,000 acre-feet less than the average annual withdrawal for 2000–2009 (tables 2 and 3). Withdrawal for public supply was 27,200 acre-feet in 2010 or about 2,800 acre-feet less than in 2009. Withdrawal for irrigation was about 7,200 acre-feet, which is the same as in 2009. Withdrawal for industrial use was about 3,600 acre-feet, which is about 300 acre-feet less than in 2009.

The location of wells in the East Shore area in which the water level was measured during March 2011 is shown in figure 6. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Ogden Pioneer Power House, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1 is shown in figure 7.

Precipitation at Ogden Pioneer Power House in 2010 was about 18.7 inches, which is about 2.4 inches less than the average annual precipitation for 1930–2010 and about 0.4 inch more than in 2009.

Water levels rose or declined only slightly from March 2010 to March 2011 in most of the wells measured in the East Shore area. Water levels have generally declined since the mid-1980s in wells south of Kaysville in the East Shore area and have generally declined since the mid-1950s in wells north of Kaysville. Declines are probably due to continued large withdrawals for pubic supply (table 2).

Physical properties and results of chemical analyses for water from five wells in the East Shore area are listed in tables 5 and 6, and the locations of the wells are plotted in figure 41. The concentrations of dissolved solids and chloride in water samples from wells (B-5-1)6bdd-5 and (B-7-2)32bbb-1 exceeded the secondary drinking-water standards for these constituents (500 and 250 mg/L, respectively). The concentrations of iron and manganese in water samples from wells (B-4-2)27aba-1 and (B-7-2)32bbb-1 exceeded the secondary standards for these constituents (300 and 50 μg/L, respectively). Water from well (B-5-2)6bdd-1 exceeded the secondary standard for manganese, and water from well (B-5-2)6bdd-5 exceeded the secondary standard for iron. Water from well (B-4-2)27aba-1 also exceeded the MCL for arsenic (10 μg/L).

The concentration of dissolved solids in water samples collected from well (B-4-2)27aba-1, 2.3 miles south-southeast of Syracuse, from 1969 to 2010, is shown in figure 7. The concentration has ranged from 287 to 633 mg/L with a median value of 400 mg/L. From 1969 to 1993, dissolved-solids concentrations in water samples varied by as much as 346 mg/L; however, concentrations in water samples collected from 1995 to 2010 varied by less than 30 mg/L. The dissolved-solids concentration in the water sample collected in August 2010 (399 mg/L) compares well to the median value.

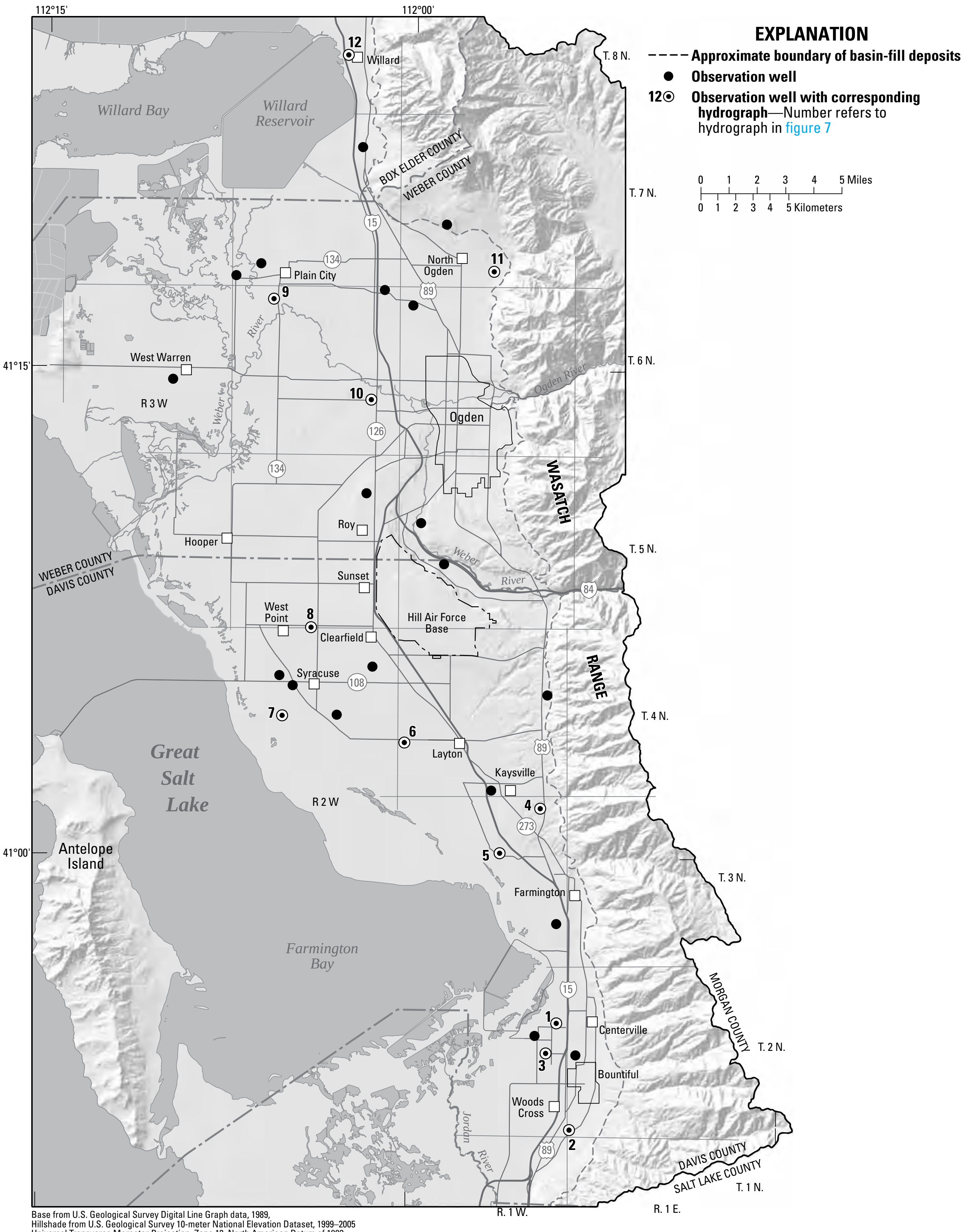


Figure 6. Location of wells in the East Shore area in which the water level was measured during March 2011.

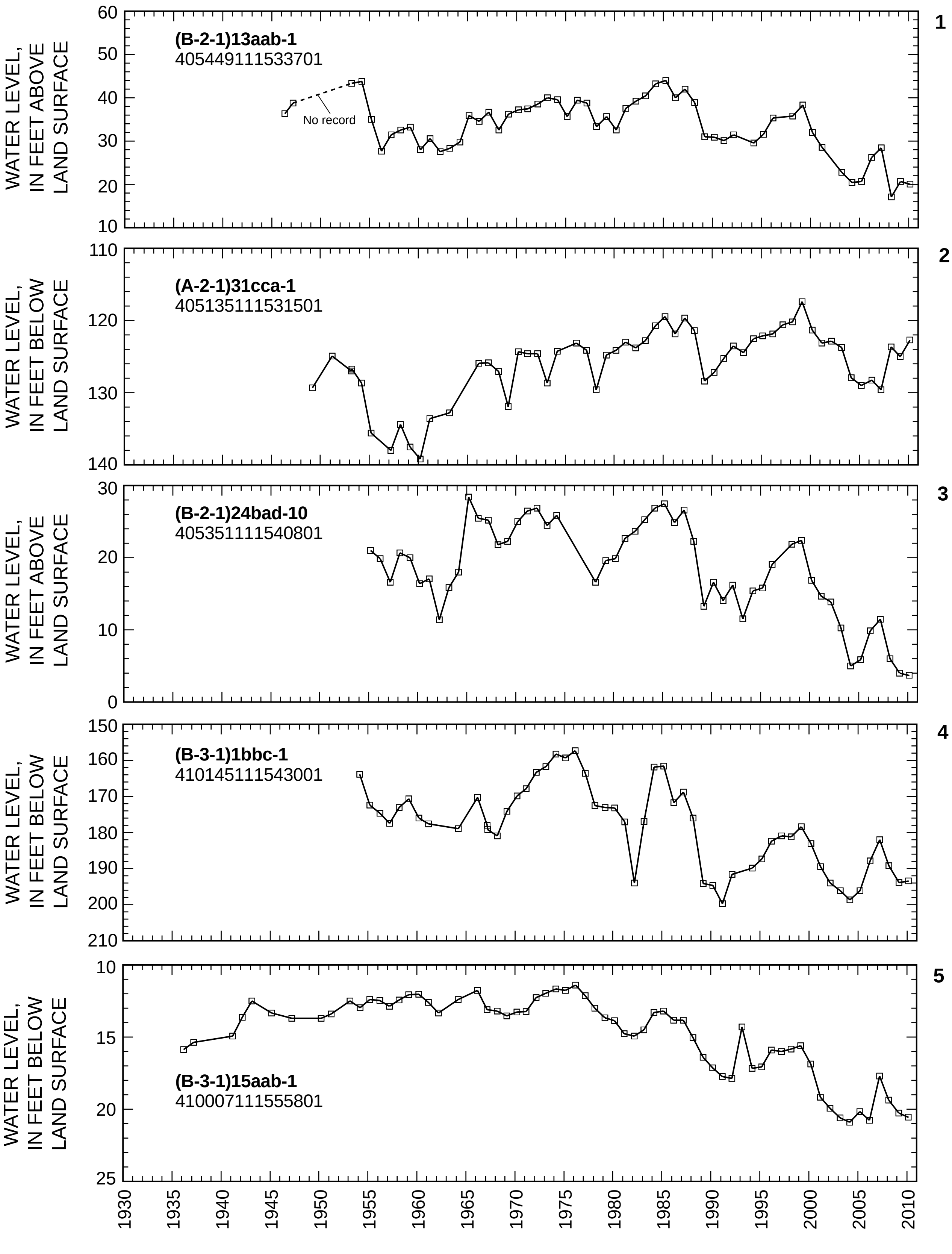


Figure 7. Relation of water level in selected wells in the East Shore area to cumulative departure from average annual precipitation at Ogden Pioneer Power House, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1.

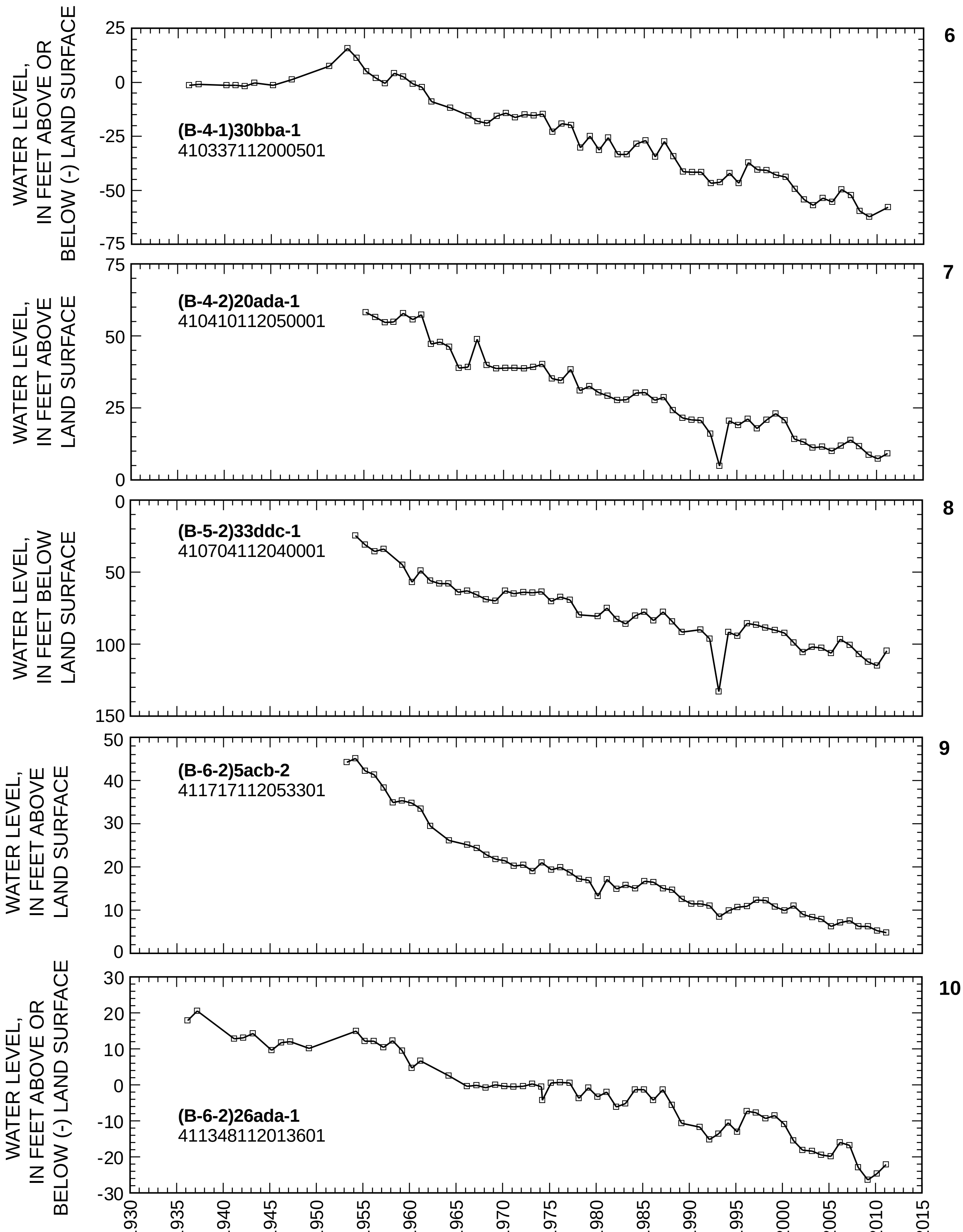


Figure 7. Relation of water level in selected wells in the East Shore area to cumulative departure from average annual precipitation at Ogden Pioneer Power House, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1.—Continued

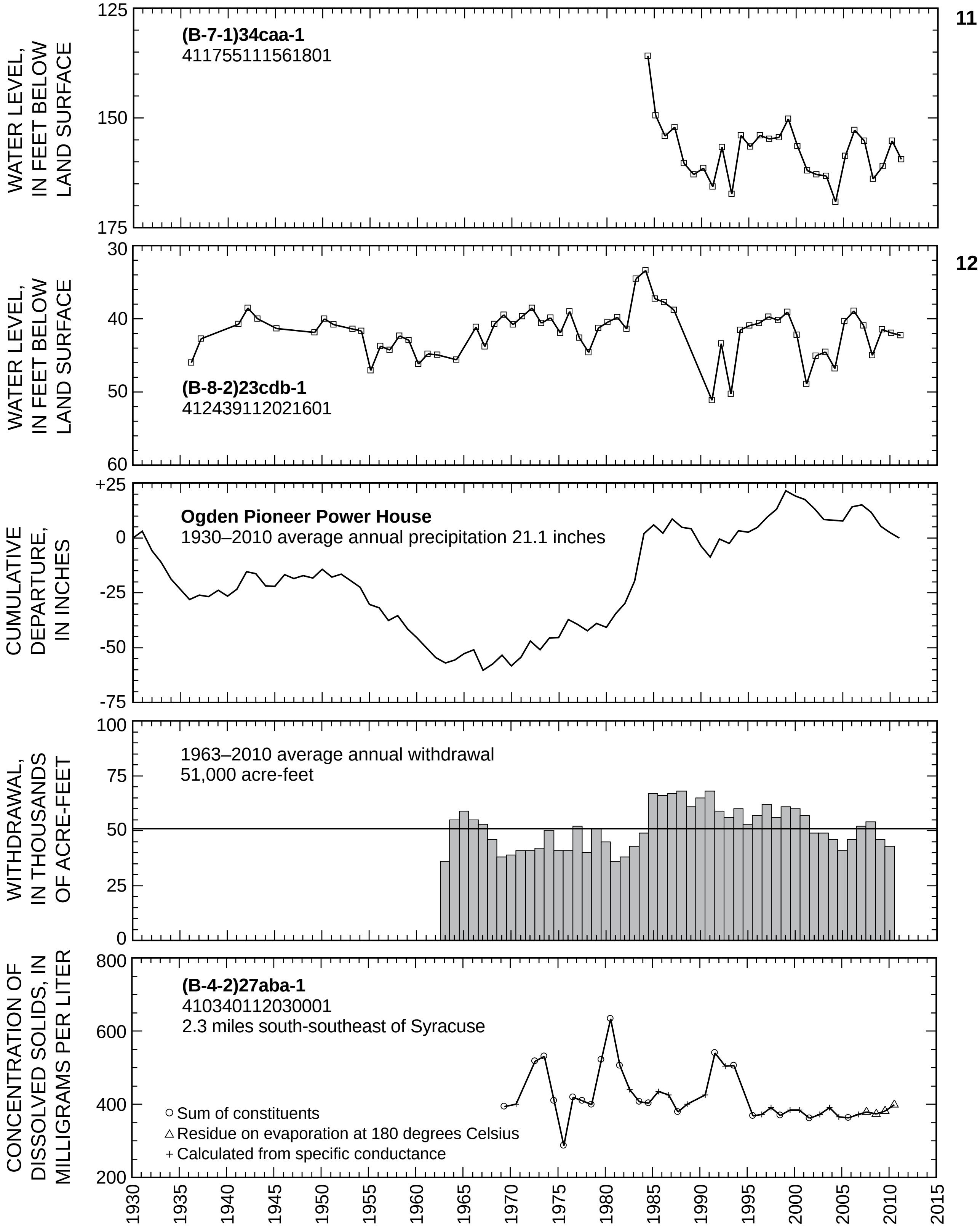


Figure 7. Relation of water level in selected wells in the East Shore area to cumulative departure from average annual precipitation at Ogden Pioneer Power House, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1.—Continued

Salt Lake Valley

By Ted J. Balling

Salt Lake Valley covers about 400 square miles between the Wasatch Range and the Oquirrh and Traverse Mountains in Salt Lake County (fig. 8). Groundwater occurs in unconsolidated deposits in the valley under water-table and artesian conditions. Recharge to the aquifers occurs mainly along the area where the mountains border the valley. In the southwestern part of the valley, groundwater moves from the base of the Oquirrh Mountains eastward toward the Jordan River. In the northwestern part of the valley, the direction of movement is mostly toward Great Salt Lake. In the eastern half of the valley, groundwater moves westward from the base of the Wasatch Range toward the Jordan River. The Jordan River drains both surface water and groundwater from the valley.

Total estimated withdrawal of water from wells in Salt Lake Valley in 2010 was about 140,000 acre-feet, which is 3,000 acre-feet more than in 2009 and 4,000 acre-feet more than the average annual withdrawal for 2000–2009 (tables 2 and 3). Withdrawal for public supply was about 82,200 acre-feet, which is 2,700 acre-feet more than the total for 2009. Withdrawal for industrial use was about 34,900 acre-feet, which is 300 acre-feet less than the total for 2009.

The location of wells in Salt Lake Valley in which the water level was measured during February 2011 is shown in figure 8. Estimated population of Salt Lake County, total annual withdrawal from wells, annual withdrawal for public supply, and average annual precipitation at the Salt Lake City Weather Service Office (WSO) (International Airport) are shown in figure 9. Precipitation at the Salt Lake City WSO during 2010 was about 18.7 inches, about 2.9 inches more than in 2009 and about 3.5 inches more than the average annual precipitation for 1931–2010.

The relation of the water level in selected observation wells completed in the principal aquifer to cumulative departure from average annual precipitation at Silver Lake Brighton, and the relation of the water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from the well are shown in figure 10. Precipitation at Silver Lake Brighton was about 55.0 inches in 2010, which is about 12.4 inches more than in 2009 and about 12.6 inches more than the average annual precipitation for 1931–2010.

Water levels rose or declined only slightly from February 2010 to February 2011 in most of the wells measured in Salt Lake Valley. The water level in most of the observation wells was highest during 1985–87, which corresponds to a period of much-greater-than-average precipitation. Levels have generally declined since 1987, except in the northeast part of the valley, where water levels have fluctuated but overall have risen.

Physical properties and results of chemical analyses for water from five wells in Salt Lake Valley are listed in tables 5 and 6, and the locations of the wells are plotted in figure 41. The dissolved-solids concentration in water samples from all wells exceeded the secondary drinking-water standards for this constituent (500 mg/L). Water from well (B-1-2)19aca-1 also exceeded the secondary standards for chloride (250 mg/L) and fluoride (2.0 mg/L). Water from well (C-3-2)36dcc-1 exceeded the secondary standard for chloride.

The concentration of dissolved solids in water samples collected from well (D-1-1)7abd-6, a flowing well at 800 South 500 East in Salt Lake City, from 1931 to 2010, is shown in figure 10. The concentration has ranged from 554 to 879 mg/L with a median value of 689 mg/L. The concentration of dissolved solids increased from 576 mg/L in December 1931 to 879 mg/L in July 2009. The dissolved-solids concentration in August 2010 (841 mg/L) decreased 38 mg/L from July 2009.

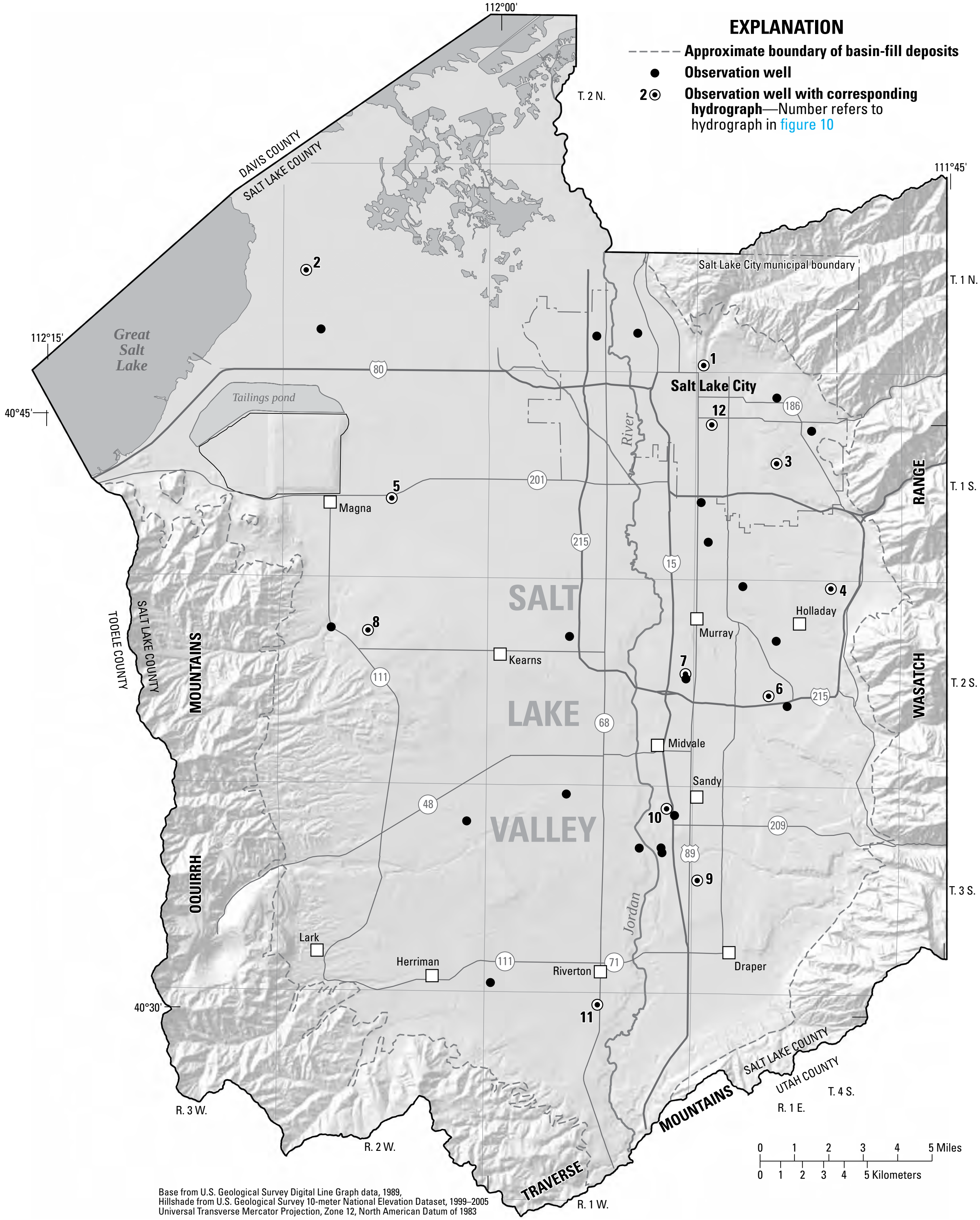


Figure 8. Location of wells in Salt Lake Valley in which the water level was measured during February 2011.

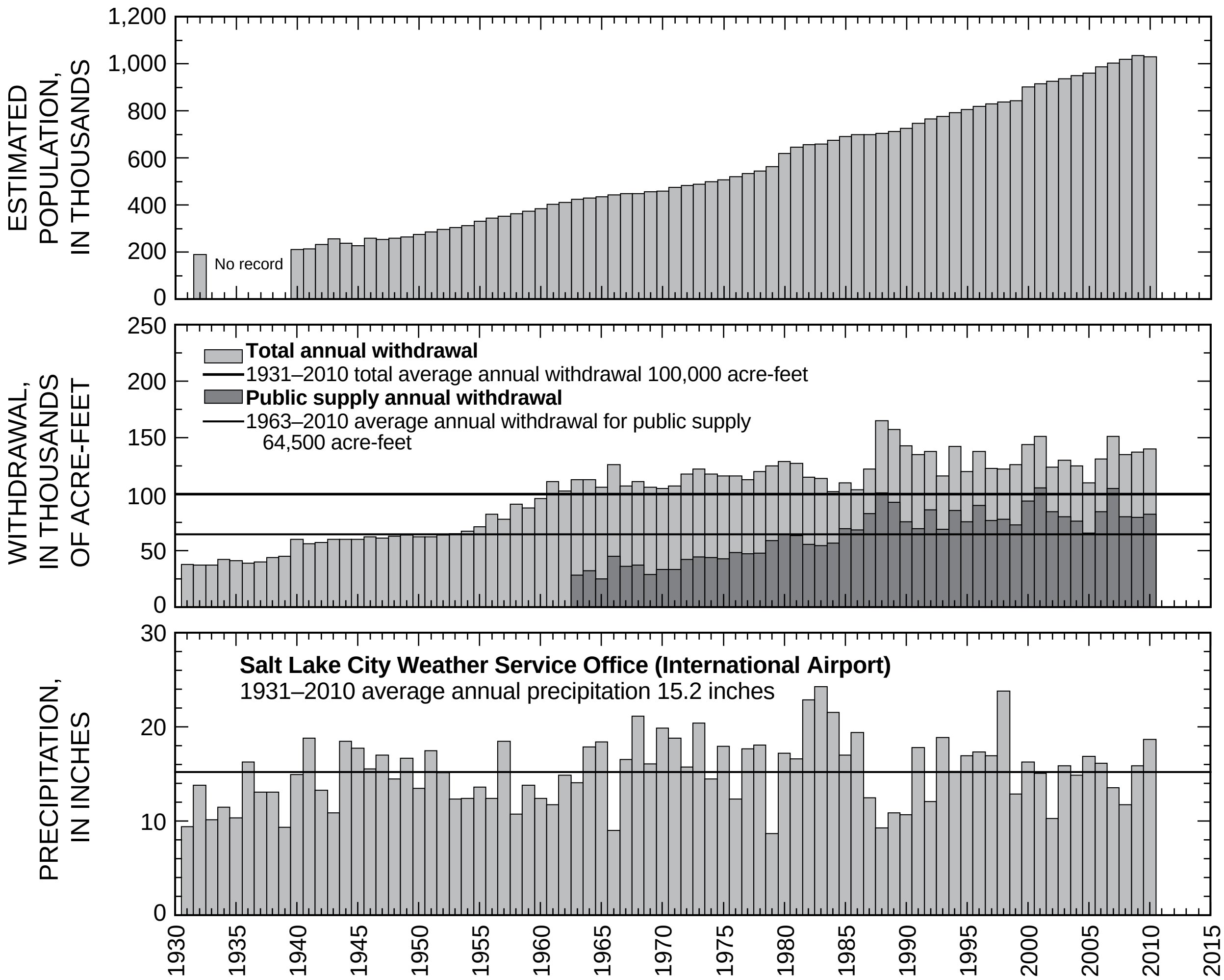


Figure 9. Estimated population of Salt Lake County, total annual withdrawal from wells, annual withdrawal for public supply, and average annual precipitation at Salt Lake City Weather Service Office (International Airport).

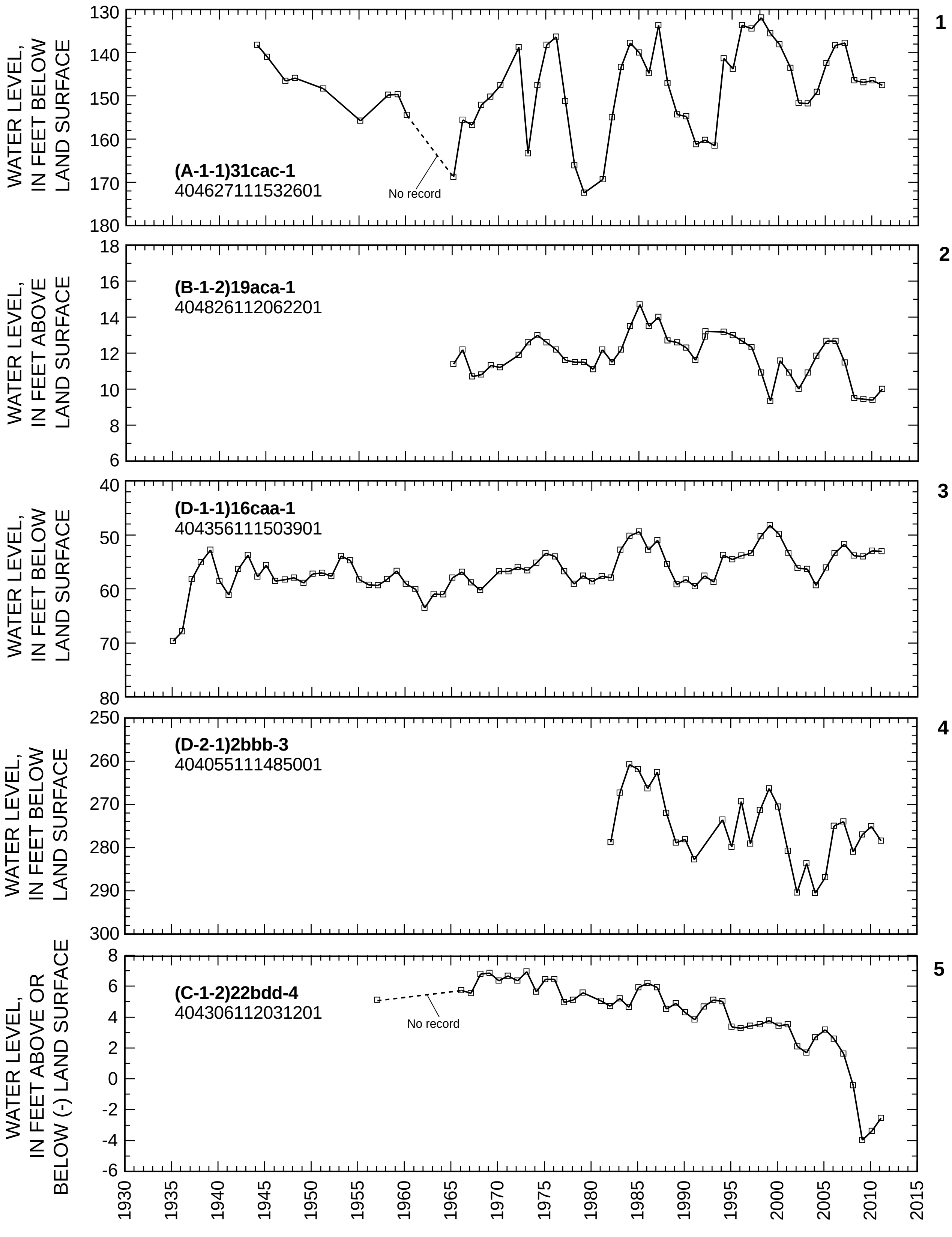


Figure 10. Relation of water level in selected wells completed in the principal aquifer in Salt Lake Valley to cumulative departure from average annual precipitation at Silver Lake Brighton, and relation of water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from the well.

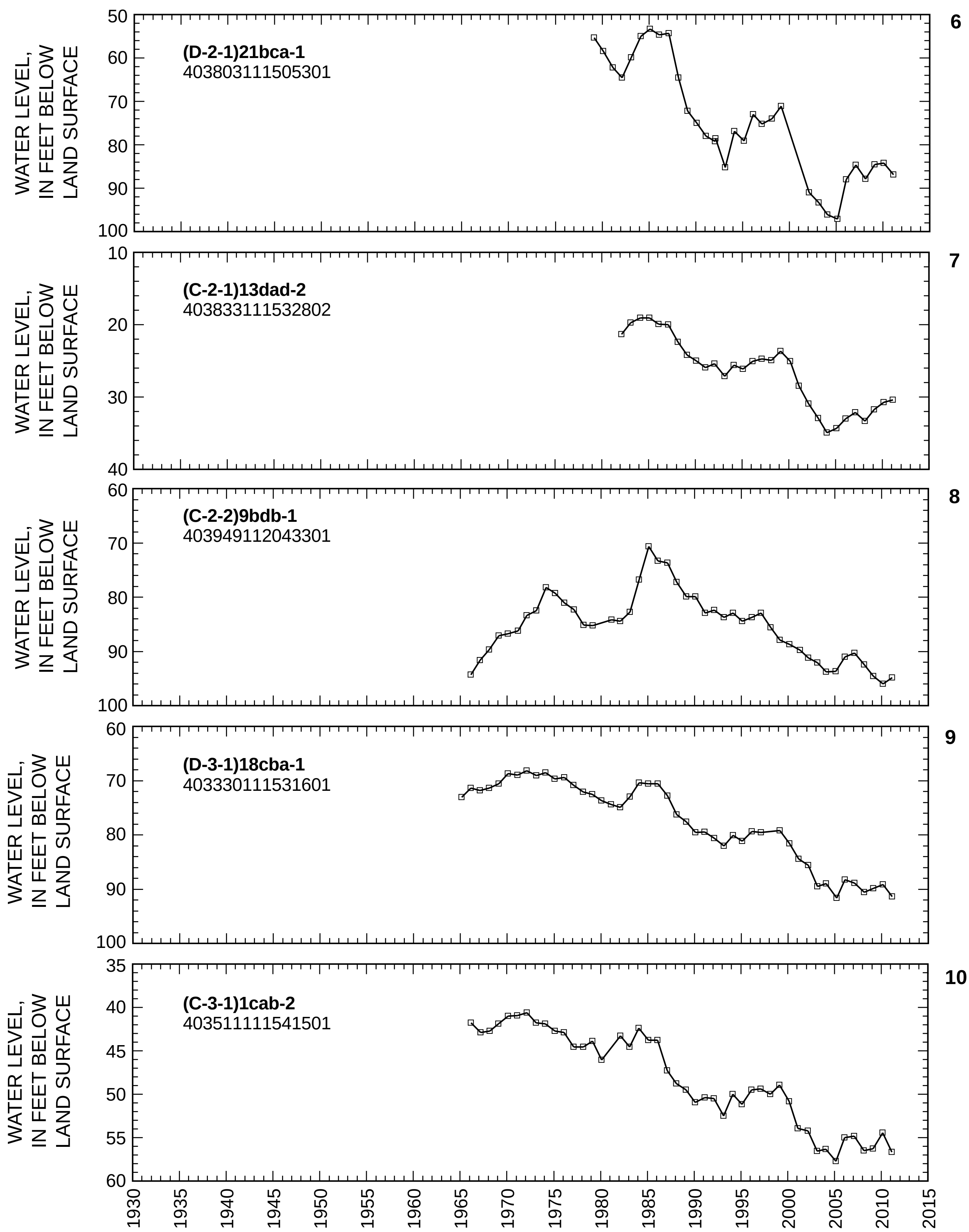


Figure 10. Relation of water level in selected wells completed in the principal aquifer in Salt Lake Valley to cumulative departure from average annual precipitation at Silver Lake Brighton, and relation of water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from the well.—Continued

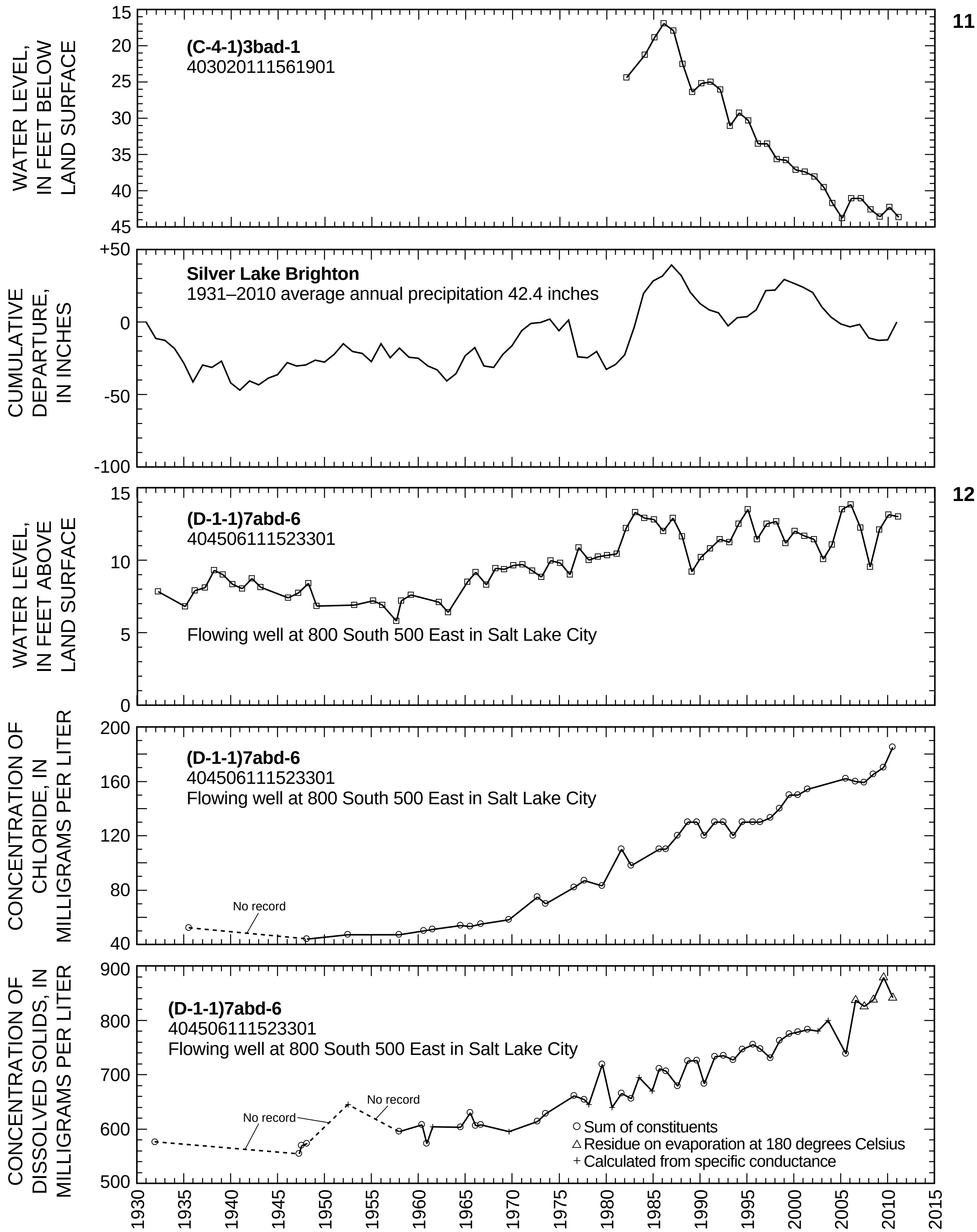


Figure 10. Relation of water level in selected wells completed in the principal aquifer in Salt Lake Valley to cumulative departure from average annual precipitation at Silver Lake Brighton, and relation of water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from the well.—Continued

Tooele Valley

By Paul Downhour

Tooele Valley lies between the Stansbury and Oquirrh Mountains and extends south from Great Salt Lake to South Mountain. The total area of the valley is about 250 square miles within Tooele County (fig. 11). Groundwater occurs in the bedrock and unconsolidated basin-fill deposits in Tooele Valley under both water-table and artesian conditions, but most of the water withdrawn by wells is from artesian aquifers in the unconsolidated deposits.

Total estimated withdrawal of water from wells in Tooele Valley in 2010 was about 24,000 acre-feet, which is about 1,000 acre-feet less than the total for 2009 and 1,000 acre-feet more than the average annual withdrawal for 2000–2009 (tables 2 and 3). Withdrawal for irrigation was about 11,600 acre-feet, which is 900 acre-feet less than the total for 2009. Withdrawal for public supply was about 10,000 acre-feet, which is 500 acre-feet less than in 2009. Withdrawal for industrial use was about 1,200 acre-feet, which is the same as in 2009.

The location of wells in Tooele Valley in which the water level was measured during March 2011 is shown in figure 11. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Tooele, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-2-6)23cbb-1 is shown in figure 12. Precipitation at Tooele during 2010 was about 22.3 inches, which is about 5.4 inches more than in 2009 and about 4.4 inches more than the average annual precipitation for 1936–2010.

Water levels declined in most of the wells measured in Tooele Valley from March 2010 to March 2011. Declines probably are the result of continued large local withdrawals for irrigation and public supply.

Physical properties and results of chemical analyses for water from six wells in Tooele Valley are listed in tables 5 and 6, and the locations of the wells are plotted in figure 41. The dissolved-solids concentration in water samples from all six wells exceeded the secondary drinking-water standard for this constituent (500 mg/L), and water from two of the wells, (C-2-5)34cbc-1 and (C-2-5)35cab-1, also exceeded the MCL (2,000 mg/L). The concentration of chloride in water samples from three wells, (C-2-4)31add-6, (C-2-5)34cbc-1, and (C-2-5)35cab-1, exceeded the secondary drinking-water standard for this constituent (250 mg/L).

The concentration of dissolved solids in water samples collected from well (C-2-6)23cbb-1, located 3 miles northwest of Grantsville, from 1961 to 2008, is shown in figure 12. The concentration has ranged from 553 to 848 mg/L with a median value of 701 mg/L. The maximum concentration was measured in the water sample collected in August 2008. The dissolved-solids concentration in water from this well has increased since 2001; the well was not sampled in 2010.

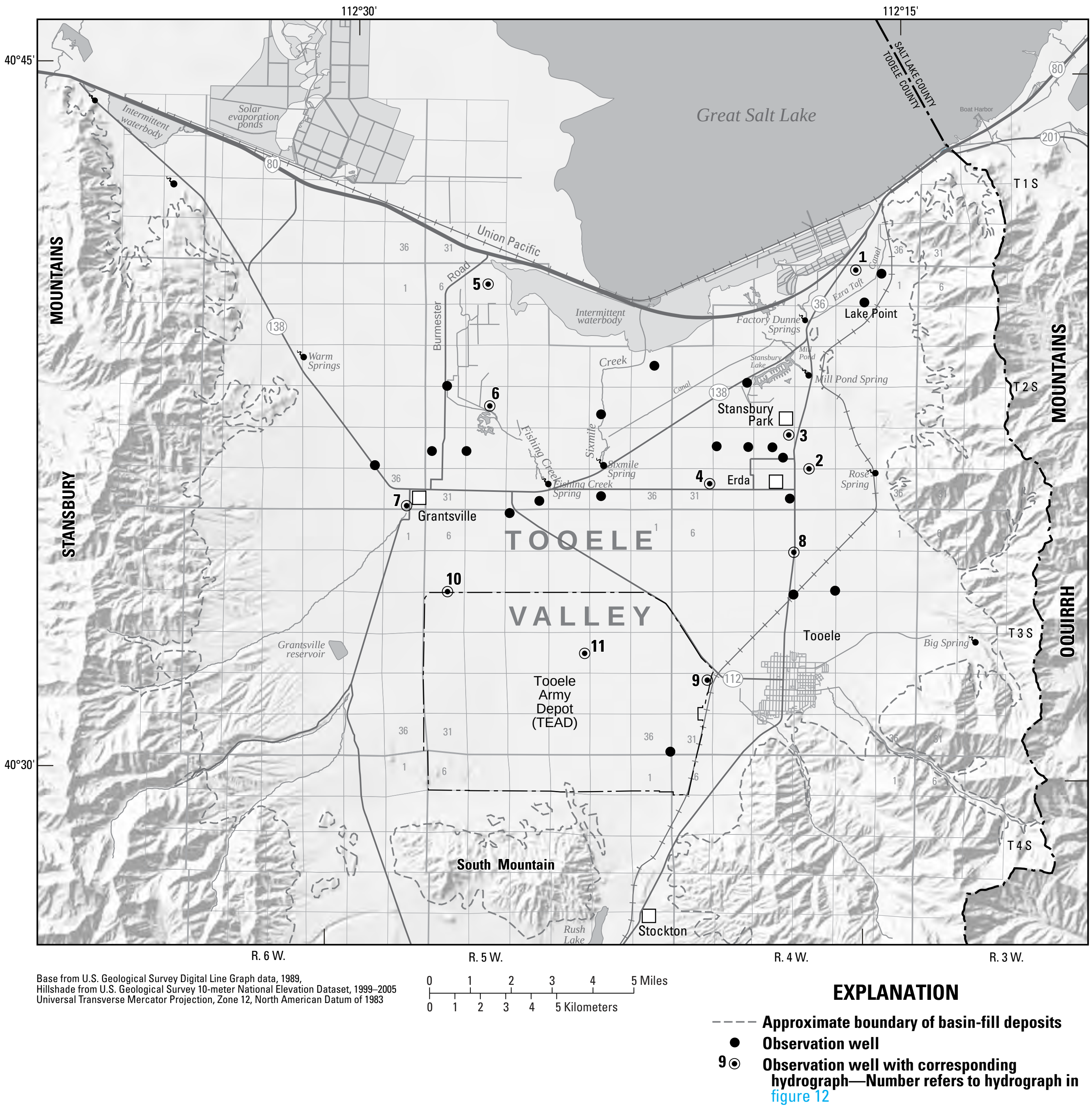


Figure 11. Location of wells in Tooele Valley in which the water level was measured during March 2011.

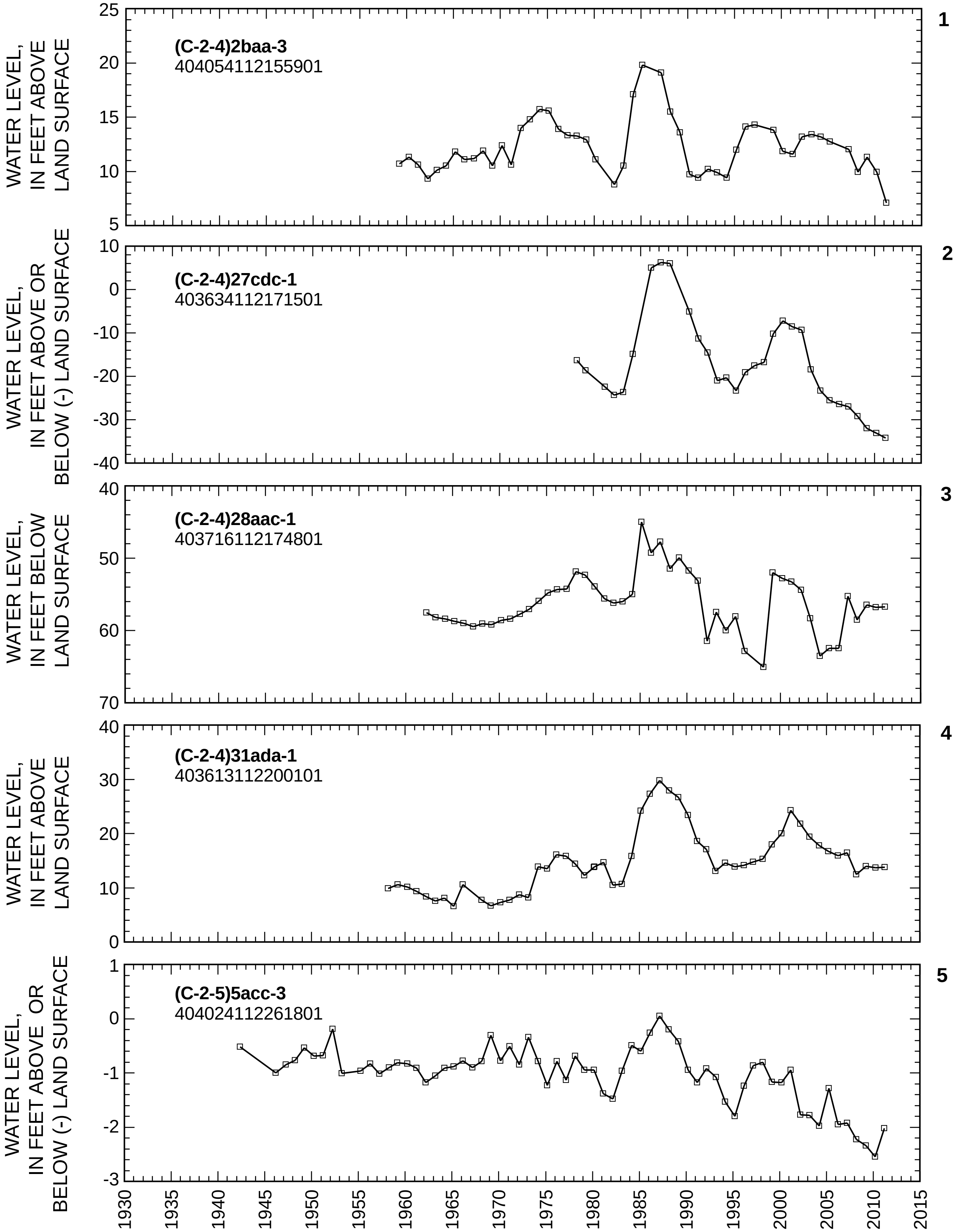


Figure 12. Relation of water level in selected wells in Tooele Valley to cumulative departure from average annual precipitation at Tooele, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-2-6)23cbb-1.

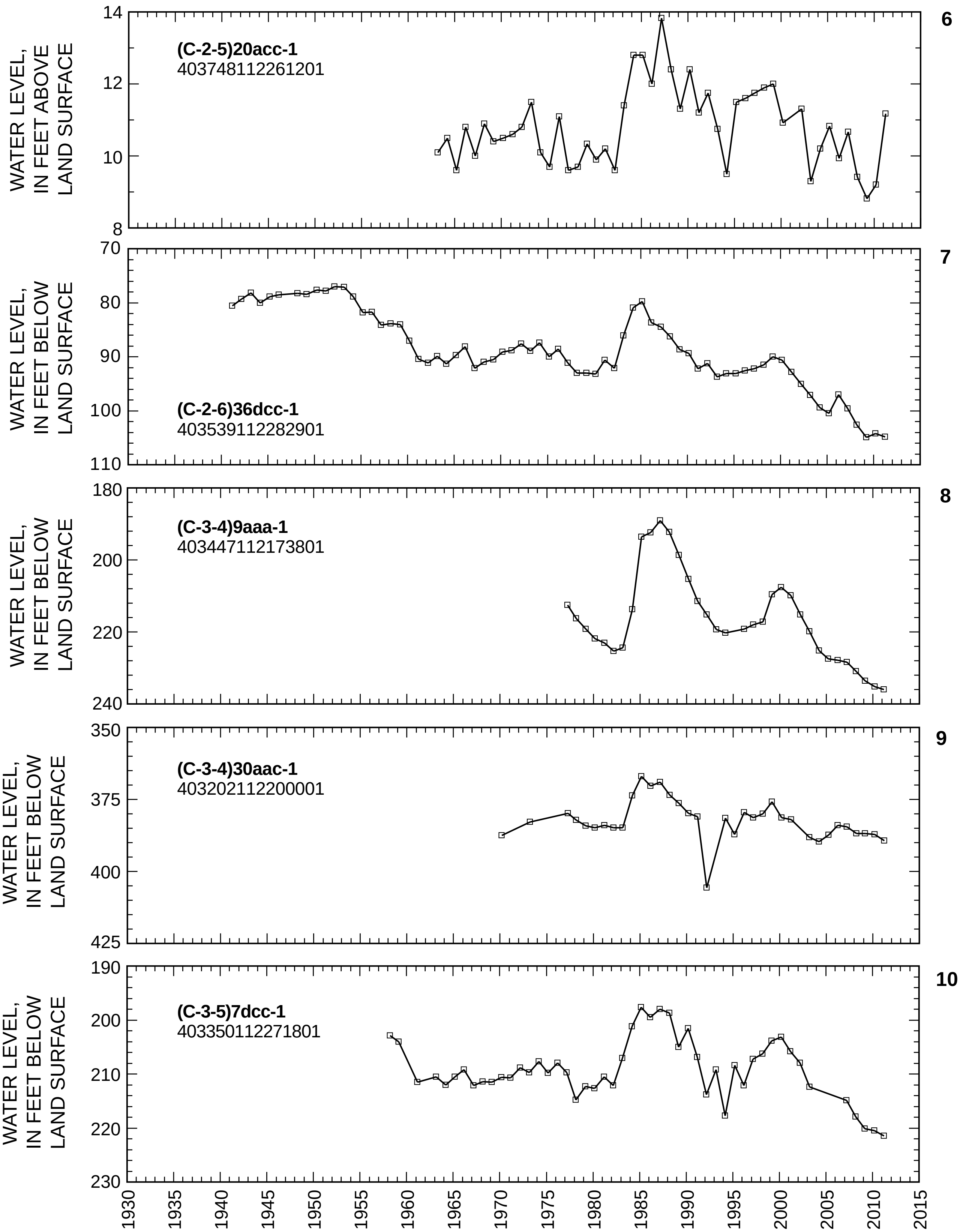


Figure 12. Relation of water level in selected wells in Tooele Valley to cumulative departure from average annual precipitation at Tooele, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-2-6)23cbb-1.—Continued

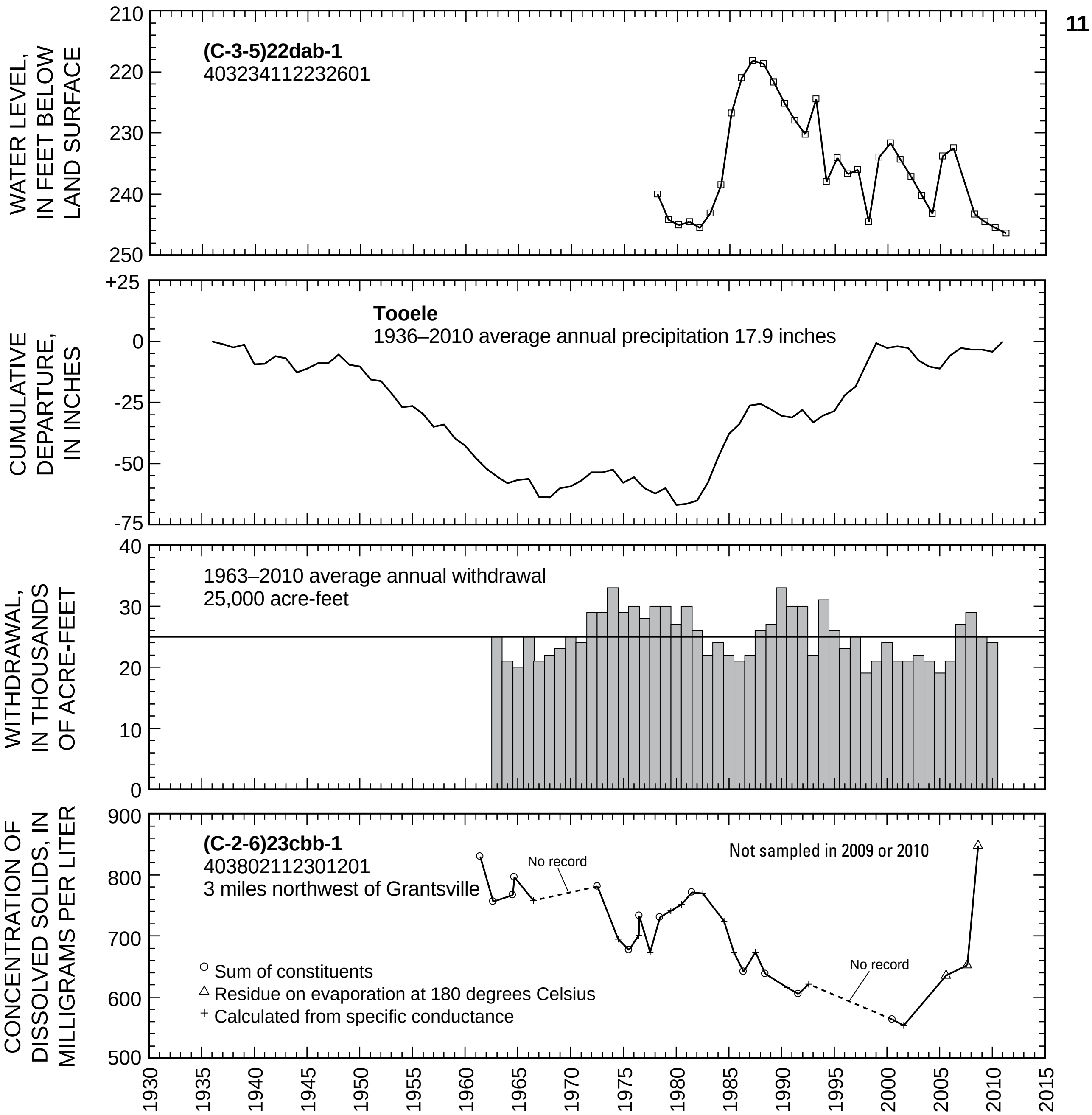


Figure 12. Relation of water level in selected wells in Tooele Valley to cumulative departure from average annual precipitation at Tooele, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-2-6)23cbb-1.—Continued

Utah and Goshen Valleys

By Manuel Guzman

Utah Valley, in Utah County, is divided into two groundwater basins, northern and southern, which are separated by Provo Bay in northern Utah Valley (fig. 13). Groundwater occurs in unconsolidated basin-fill deposits in the valley. The principal groundwater recharge area for the basin-fill deposits is in the eastern part of the valley, along the base of the Wasatch Range.

Southern Utah Valley is bounded by the Wasatch Range, West Mountain, and the northern extension of Long Ridge. Goshen Valley is bounded by West Mountain, Long Ridge, the Lake Mountains, and the East Tintic Mountains (fig. 13). Groundwater in Utah and Goshen Valleys occurs in the basin-fill deposits under both water-table and artesian conditions, but most wells discharge from artesian aquifers.

Total estimated withdrawal of water from wells in Utah and Goshen Valleys in 2010 was about 109,000 acre-feet, which is the same as in 2009, and 1,000 acre-feet less than the average annual withdrawal for 2000–2009 (tables 2 and 3). Withdrawal in northern Utah Valley was about 61,300 acre-feet, which is 2,000 acre-feet less than in 2009. Withdrawal in southern Utah Valley was about 30,900 acre-feet, which is 800 acre-feet more than in 2009. Withdrawal in Goshen Valley was about 17,200 acre-feet, which is 1,800 acre-feet more than in 2009. Overall withdrawals in 2010 were similar to withdrawals in 2009. Increased withdrawal for irrigation was offset by decreased withdrawal for public supply and industrial use.

The location of wells in Utah and Goshen Valleys in which the water level was measured during March 2011 is shown in figure 13. Water levels generally rose slightly from March 2010 to March 2011 in most of the wells measured in the northern and southern parts of Utah Valley. Water levels in most of the wells measured in Goshen Valley generally declined slightly from March 2010 to March 2011. Water levels in all three parts of Utah Valley generally rose in the early 1980s. The rise corresponds to a period of greater-than-average precipitation and recharge from surface water. Water levels generally declined from 1985 to 1993 in Utah Valley and generally rose from 1993 to 1998. This rise is the result of greater-than-average precipitation during this period. Water levels generally declined throughout Utah Valley from March 1999 to March 2005. Water levels in some wells reached their lowest level for their period of record, many dating back to 1935. From March 2005 to March 2007, most water levels in Utah and Goshen Valleys rose as a result of average to greater-than-average precipitation in 2005 and 2006 following 6 years of less-than-average precipitation.

The relation of the water level in selected observation wells to cumulative departure from average precipitation at Silver Lake Brighton and Spanish Fork Power House, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish Fork at Castilla, and to concentration of dissolved solids in water from three wells is shown in figure 14. Discharge of Spanish Fork at Castilla in 2010 was about 169,600 acre-feet, which is about the same as the 1933–2010 annual average. Precipitation at Silver Lake Brighton in 2010 was about 55.0 inches, which is about 12.6 inches more than the long-term average (1931–2010) and about 12.4 inches more than in 2009. Precipitation at Spanish Fork Power House in 2010 was about 23.7 inches, which is about 4.4 inches more than the long-term average (1930–2010) and about 0.6 inch less than in 2009.

Physical properties and results of chemical analyses for water from eight wells in Utah Valley (including northern and southern Utah Valleys) and Goshen Valley are listed in tables 5 and 6, and the locations of the wells are plotted in figure 41. For Goshen Valley, the dissolved-solids and chloride concentrations in water samples from all three wells exceeded the secondary drinking-water standards for these constituents (500 and 250 mg/L, respectively). The concentration of nitrite plus nitrate in water from wells (C-9-1)28ccb-1 and (C-9-1)29acc-1 exceeded the MCL for this constituent (10 mg/L), and water from well (C-9-1)4ddc-1 exceeded the MCL for arsenic (10 µg/L). For southern Utah Valley, the water sample from well (D-8-2)31cdb-1 exceeded the secondary drinking-water standards for chloride (250 mg/L), dissolved solids (250 mg/L), and iron and manganese (300 and 50 µg/L, respectively). Results of analyses of water sampled from the two wells in northern Utah Valley, (D-5-1)8aaa-3 and (D-5-1)20cbc-1, did not exceed secondary drinking-water standards or MCLs.

The concentration of dissolved solids in water samples collected from wells (C-9-1)28ccb-1, located 4 miles north of Elberta, (D-7-2)4cbb-2, located 2 miles west of Provo at mouth of Provo River, and (D-9-1)36bbc-1, located 1 mile north of Santaquin, is shown in figure 14. The concentration of dissolved solids in water from well (C-9-1)28ccb-1 has ranged from 498 to 1,540 mg/L with a median value of 701 mg/L. The new maximum value for dissolved solids is associated with the sample collected in July 2010. The dissolved-solids concentration in water from well (D-7-2)4cbb-2 has ranged from 278 to 539 mg/L with a median value of 321 mg/L. Water collected from this well in 2010 had a dissolved-solids concentration of 323 mg/L, near the median value. The dissolved-solids concentration in water from well (D-9-1)36bbc-1 has ranged from 153 to 310 mg/L with a median value of 286 mg/L. The dissolved-solids concentration in the water sample collected in July 2010 (294 mg/L) is very close to the median value.

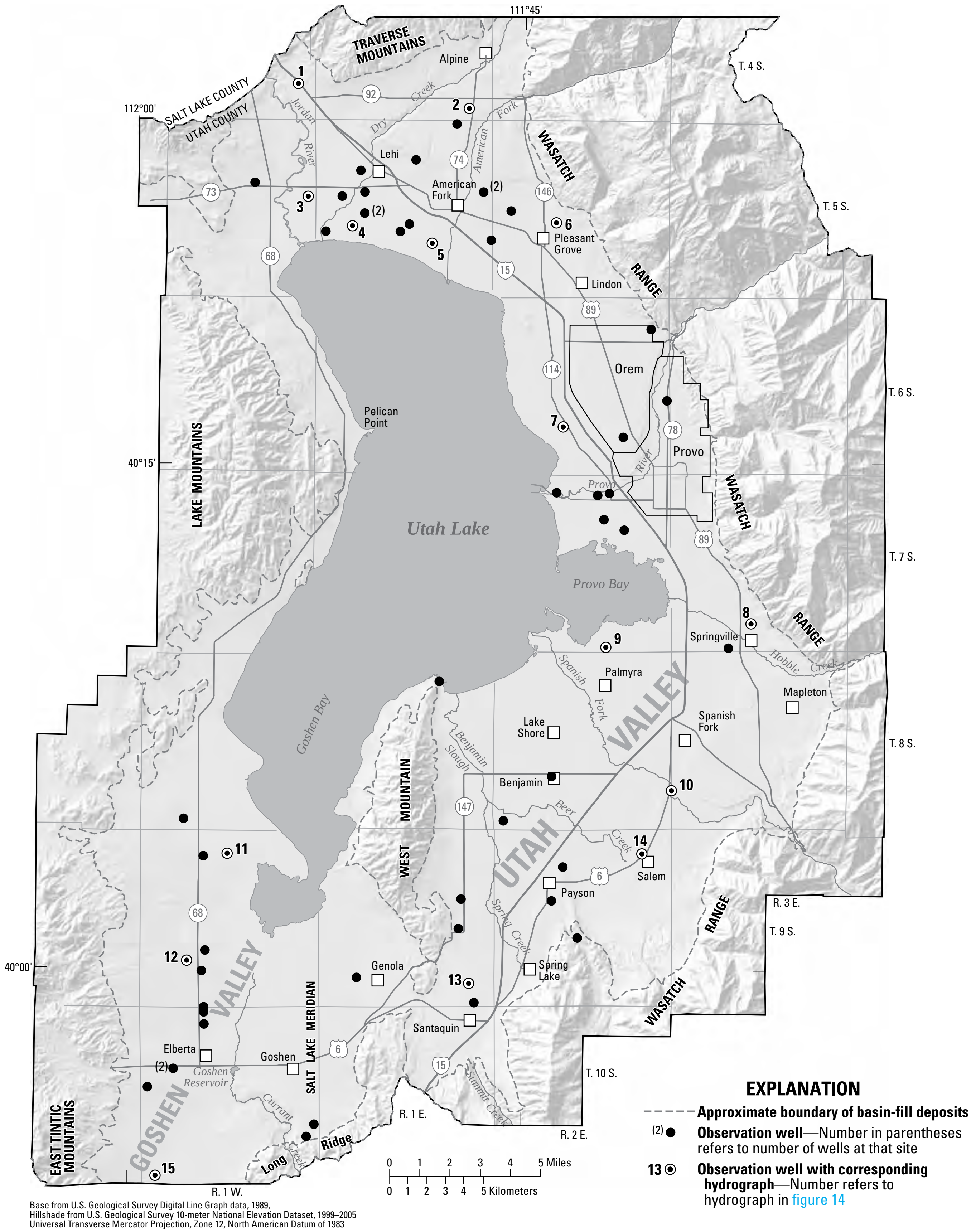


Figure 13. Location of wells in Utah and Goshen Valleys in which the water level was measured during March 2011.

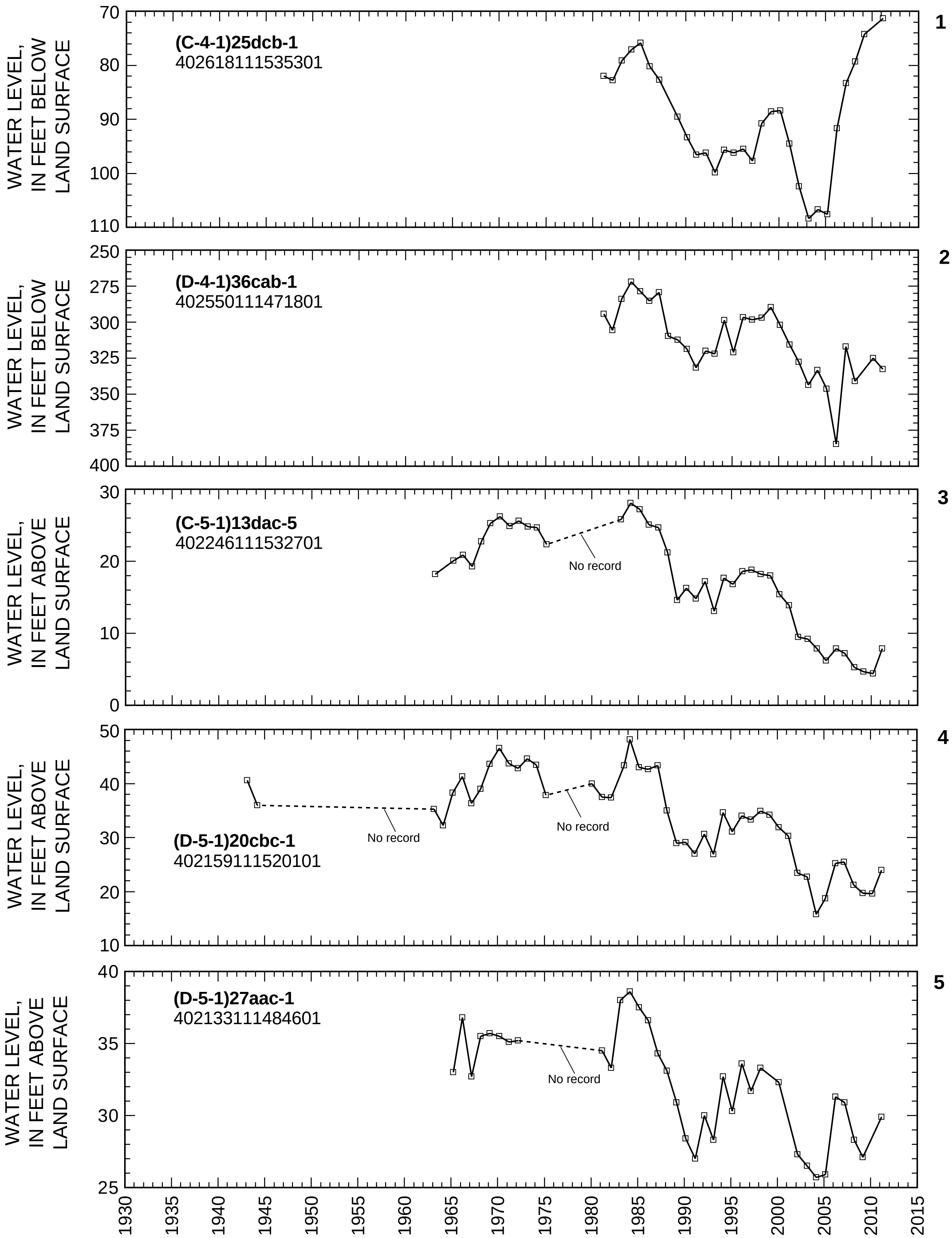


Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Power House, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish Fork at Castilla, and to concentration of dissolved solids in water from three wells.

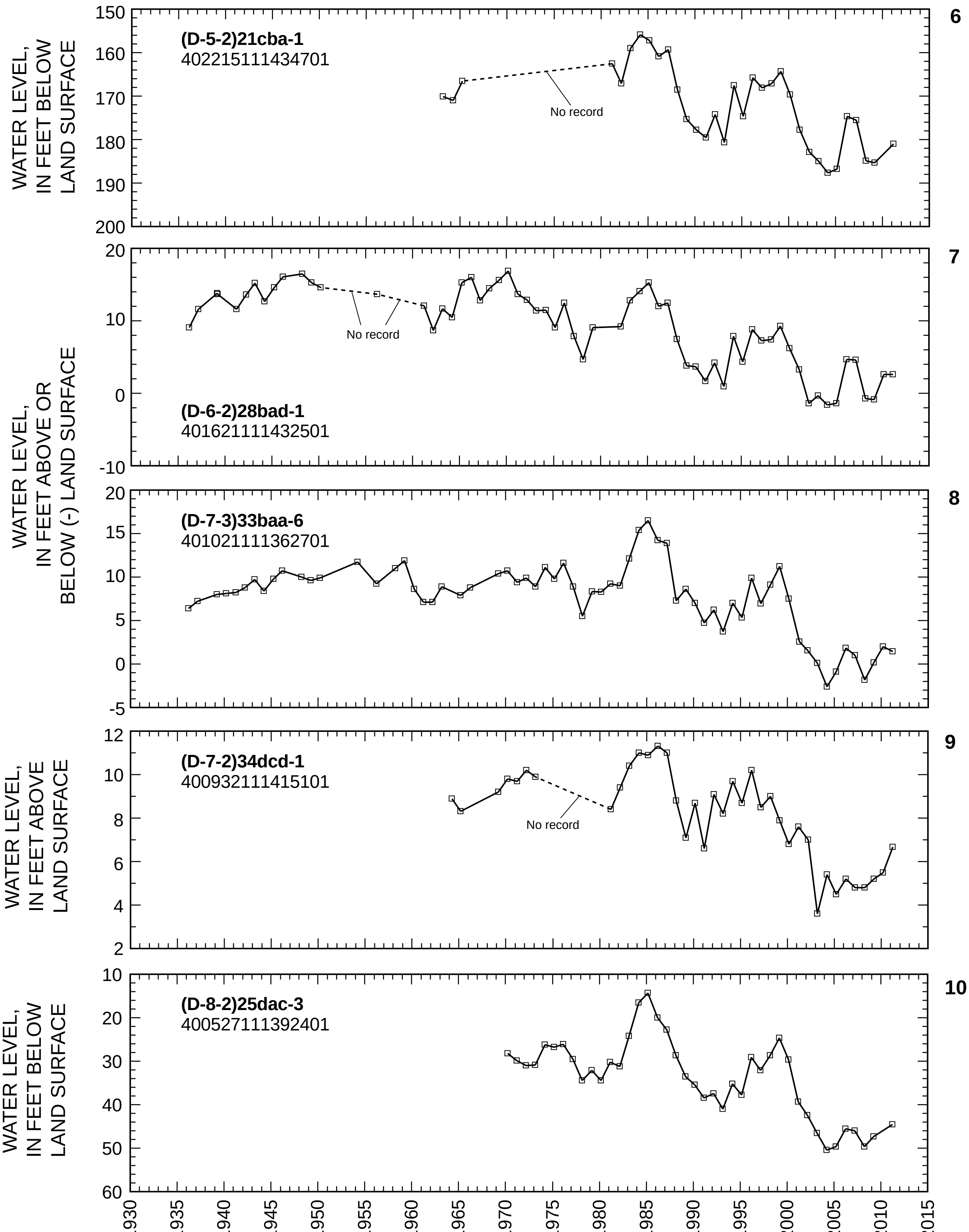


Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Power House, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish Fork at Castilla, and to concentration of dissolved solids in water from three wells.—Continued

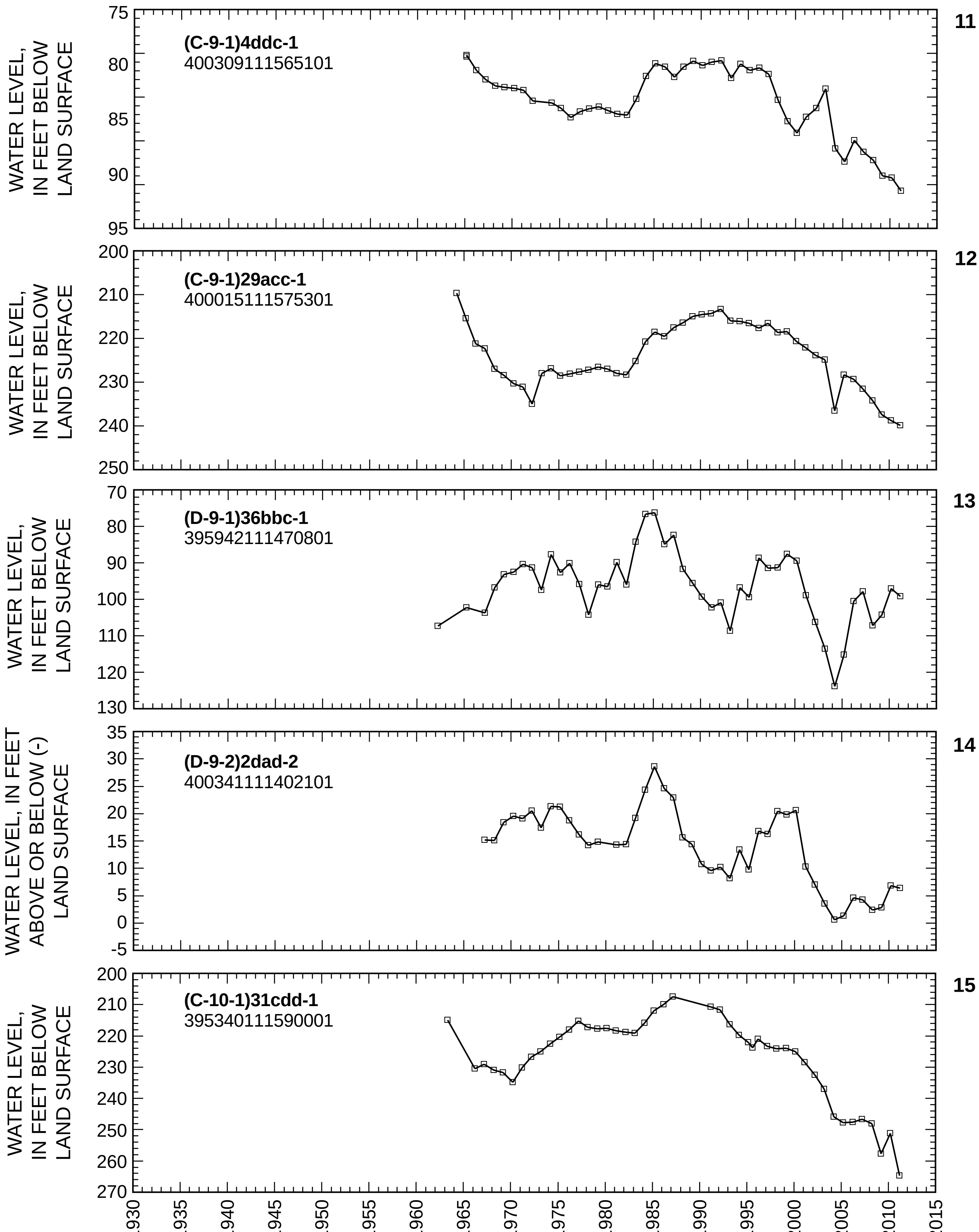


Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Power House, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish Fork at Castilla, and to concentration of dissolved solids in water from three wells.—Continued

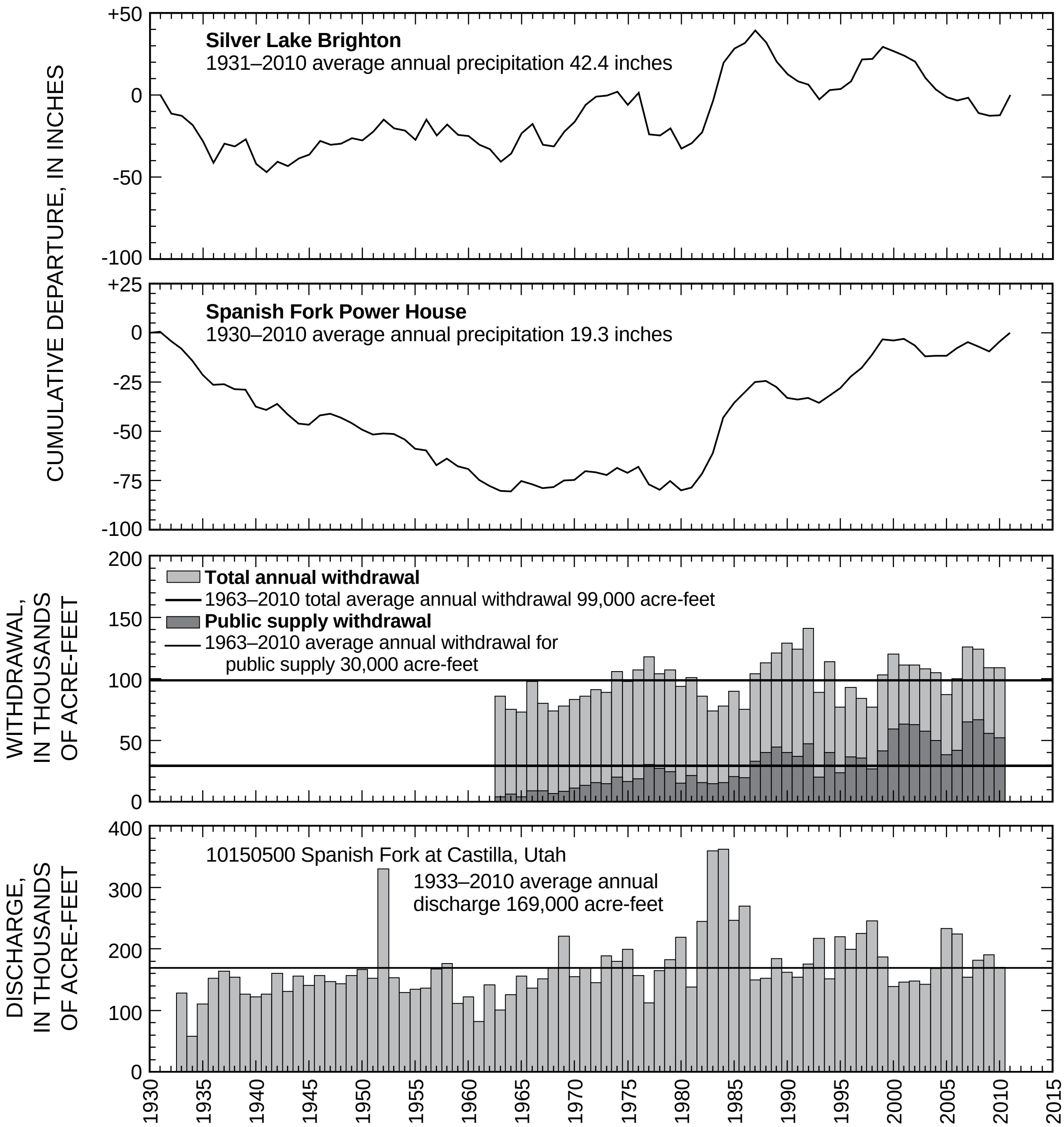


Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Power House, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish Fork at Castilla, and to concentration of dissolved solids in water from three wells.—Continued

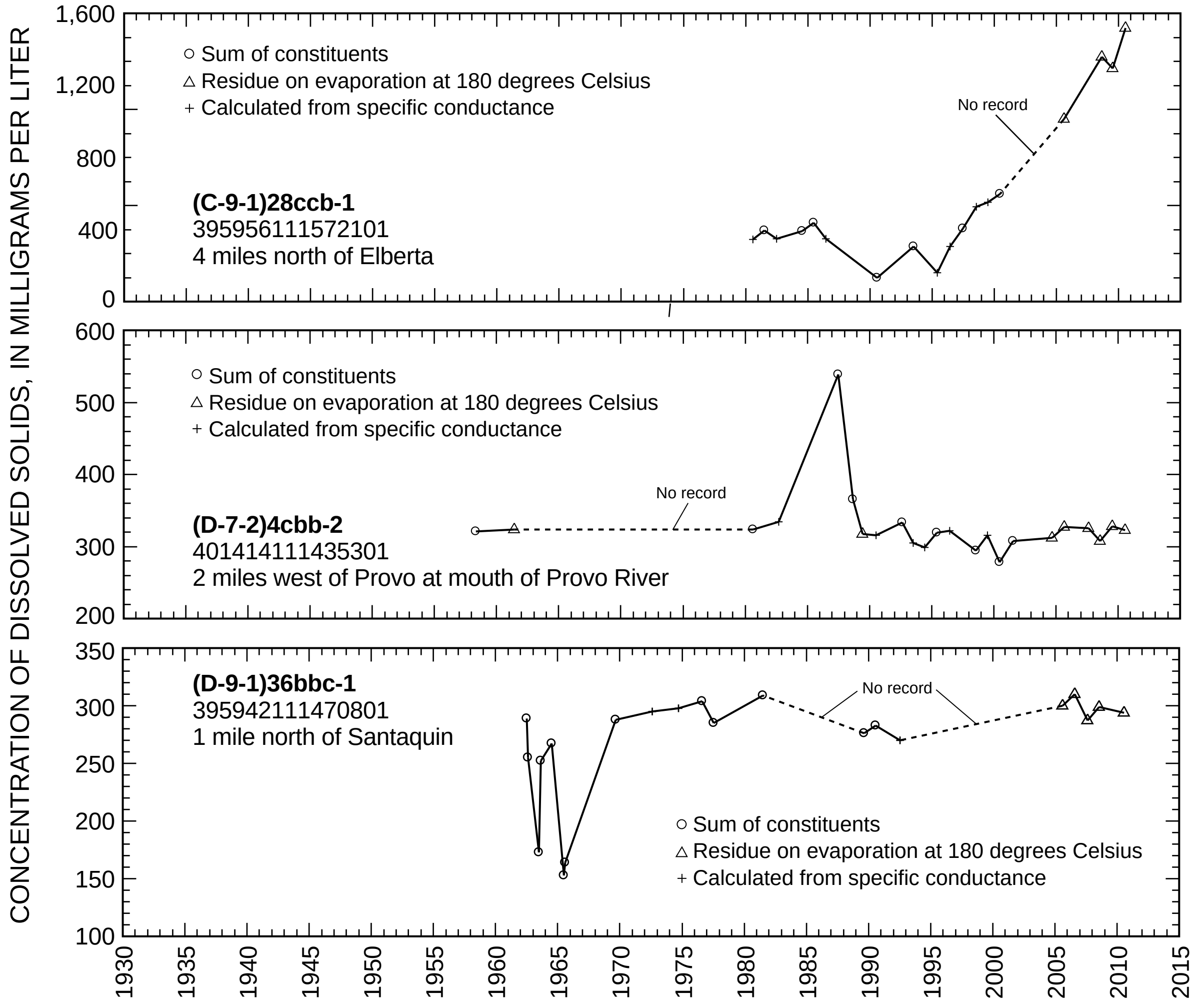


Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Power House, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish Fork at Castilla, and to concentration of dissolved solids in water from three wells.—Continued

Juab Valley

By Robert J. Eacret

Juab Valley, in central Utah in Juab County, is about 30 miles long and averages about 4 miles wide. It is bounded on the east side by the Wasatch Range and the San Pitch Mountains and on the west side by the West Hills and Long Ridge (fig. 15). Groundwater drains from the valley in two directions—in northern Juab Valley it drains north via Currant Creek into Utah Lake, and in southern Juab Valley it drains south via Chicken Creek into the Sevier River. The northern and southern parts of Juab Valley are separated topographically and hydrologically by Levan Ridge, a gentle rise near the midpoint of the valley floor.

Groundwater in Juab Valley occurs in the unconsolidated basin-fill deposits under both water-table and artesian conditions; artesian conditions are prevalent in the southern part of the valley. Most of the recharge to the groundwater reservoir occurs on the eastern side of the valley along the Wasatch Range and the San Pitch Mountains. Groundwater moves to discharge points at the northern and southern ends of the valley. The groundwater divide between the northern and southern parts of Juab Valley is near Levan Ridge.

Total estimated withdrawal of water from wells in Juab Valley in 2010 was about 22,000 acre-feet, which is 1,000 acre-feet more than the amount reported for 2009 and 3,000 acre-feet less than the average annual withdrawal for 2000–2009 (tables 2 and 3).

The location of wells in Juab Valley in which the water level was measured during March 2011 is shown in figure 15. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Nephi, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-12-1)24baa-1 is shown in figure 16. Precipitation at Nephi during 2010 was about 15.1 inches, which is about 0.8 inch more than the average annual precipitation for 1935–2010, and about 3.6 inches more than in 2009.

Water levels rose or declined only slightly in most of the wells measured in Juab Valley from March 2010 to March 2011 (fig. 16). Water levels generally rose from 1978 to their highest level in 1985–87. This rise corresponds to a period of greater-than-average precipitation during 1978–86. Water levels generally declined from the late 1980s to 2011, although there was a substantial rise from 1993 to 1999.

Physical properties and results of chemical analyses for water from three wells in Juab Valley are listed in tables 5 and 6, and the locations of the wells are plotted in figure 41. Water samples from all three wells exceeded the secondary drinking-water standard for dissolved solids (500 mg/L). The water from well (D-13-1)5ddb-3 exceeded the secondary standard for chloride (250 mg/L) and water from well (D-14-1)31ada-1 exceeded the secondary standard for sulfate (250 mg/L).

The concentration of dissolved solids in water samples collected from well (C-12-1)24baa-1, located 4.5 miles north-northwest of Nephi, from 1964 to 2007, is shown in figure 16. The concentration has ranged from 650 to 755 mg/L with a median value of 714 mg/L. Dissolved-solids concentrations have varied little during the period of record. The well was not sampled in 2008, 2009, or 2010.

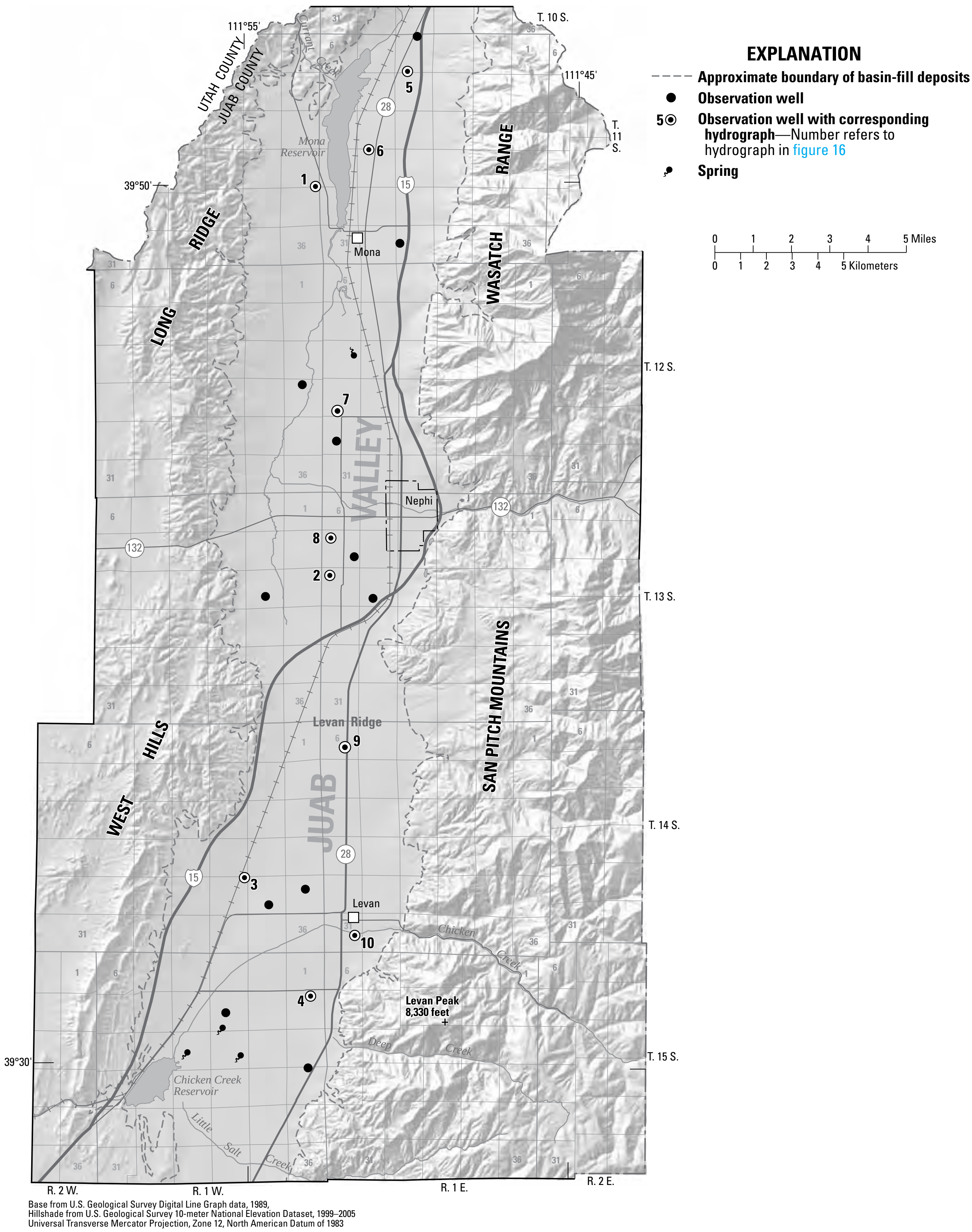


Figure 15. Location of wells in Juab Valley in which the water level was measured during March 2011.

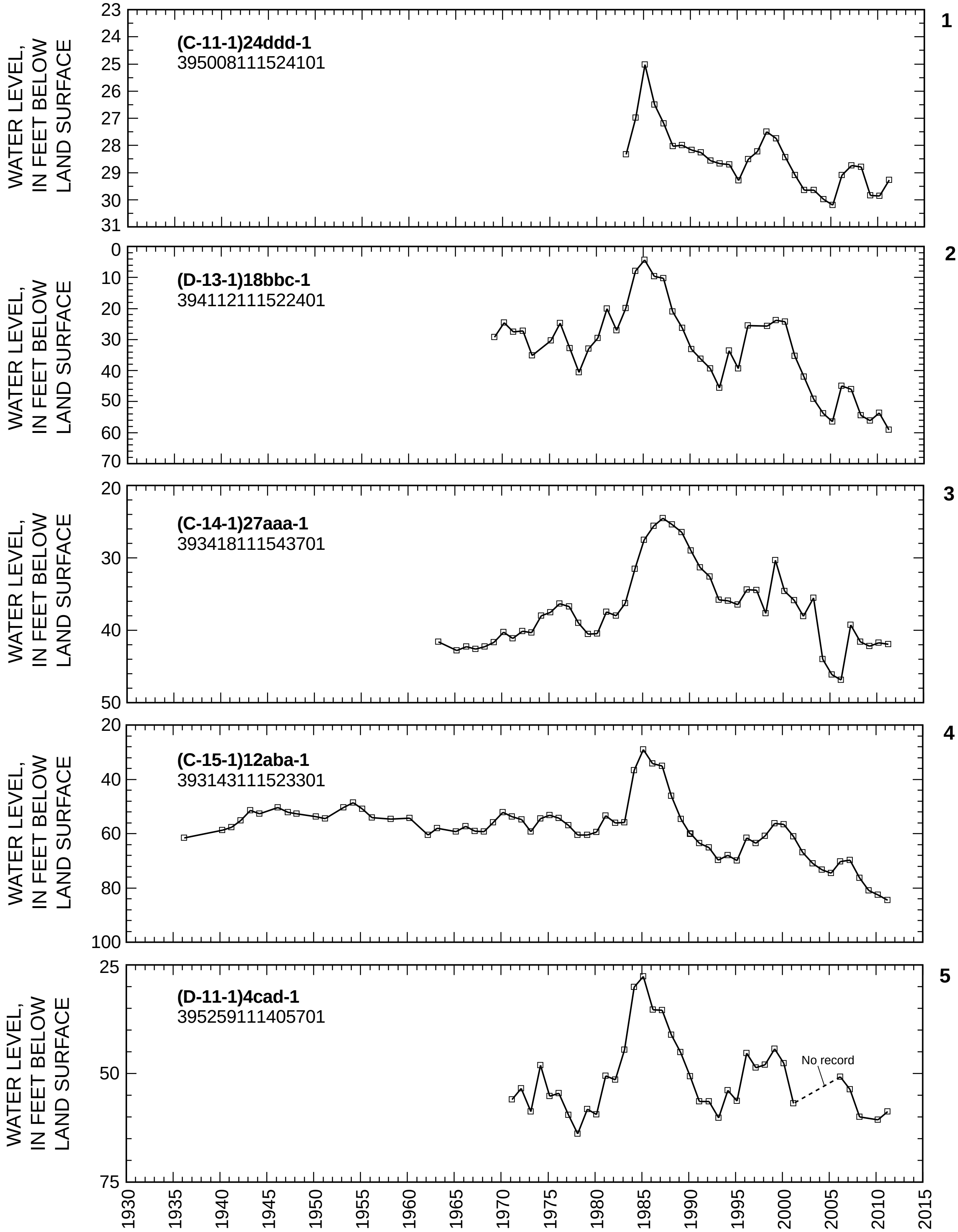


Figure 16. Relation of water level in selected wells in Juab Valley to cumulative departure from average annual precipitation at Nephi, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-12-1)24baa-1.

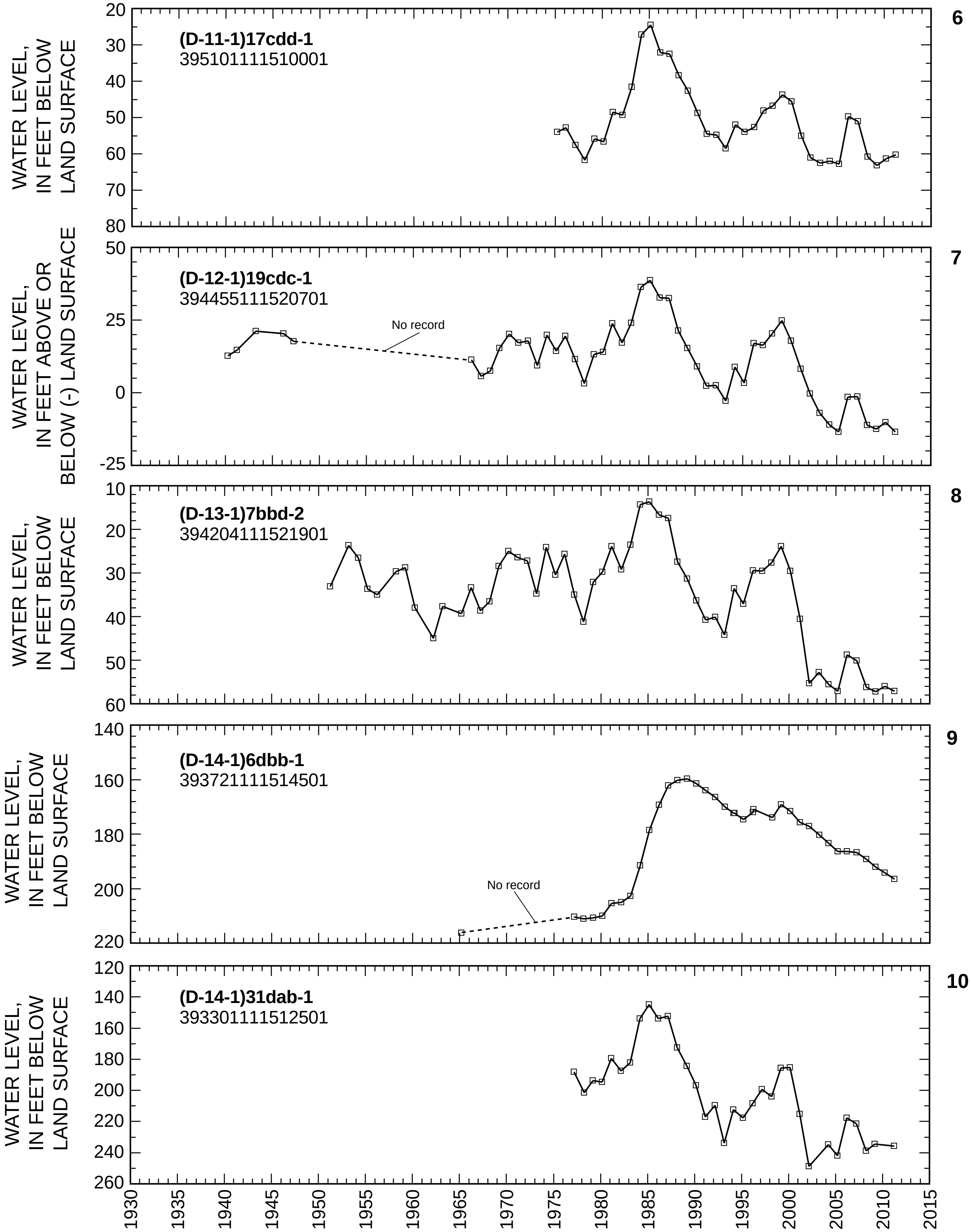


Figure 16. Relation of water level in selected wells in Juab Valley to cumulative departure from average annual precipitation at Nephi, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-12-1)24baa-1.—Continued

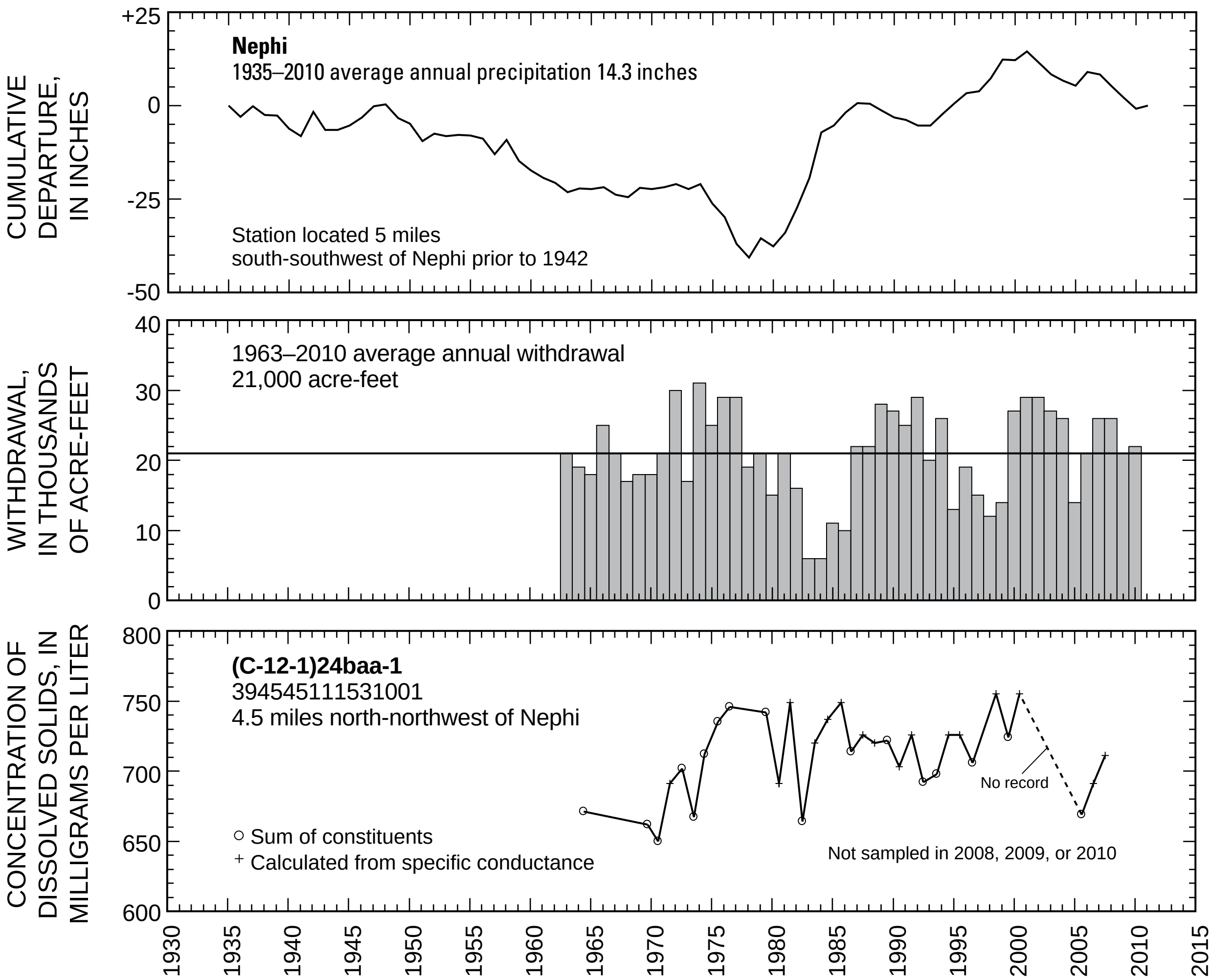


Figure 16. Relation of water level in selected wells in Juab Valley to cumulative departure from average annual precipitation at Nephi, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-12-1)24baa-1.—Continued

Sevier Desert

By Manuel Guzman

The part of the Sevier Desert described here covers about 2,000 square miles in northern Millard and southern Juab Counties (figs. 17 and 18). It principally includes the broad, gently sloping areas that radiate from the Canyon Mountains to the east, the Drum Mountains to the west, and several non-continuous mountains to the north. Groundwater occurs in the Sevier Desert in unconsolidated deposits under water-table and artesian conditions. Most of the groundwater is discharged from wells completed in either of two artesian aquifers—the shallow or deep artesian aquifer. The Sevier River enters the Sevier Desert from the east and is a source of recharge to the aquifers.

Total estimated withdrawal of water from wells in the Sevier Desert in 2010 was about 46,000 acre-feet, which is 2,000 acre-feet less than in 2009 and about 15,000 acre-feet more than the 2000–2009 average annual withdrawal (tables 2 and 3). The decrease in withdrawals was mainly due to increased withdrawals from surface water for irrigation.

The location of wells in the Sevier Desert in which the water level was measured during March 2011 is shown in figures 17 and 18. The relation of the water level in selected observation wells to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8cba-1 is shown in figure 19.

Discharge of the Sevier River near Juab in 2010 was 124,900 acre-feet, 13,400 acre-feet more than in 2009 and 52,700 acre-feet less than the long-term average (1935–2010). Precipitation at Oak City was about 18.6 inches in 2010, about 5.6 inches more than the 1930–2010 average annual precipitation and about 6.0 inches more than in 2009.

Most water levels from March 2010 to March 2011 declined in both the shallow and deep artesian aquifers in the Sevier Desert, probably due to continued large withdrawals for irrigation. Water levels in both the shallow and deep aquifers generally rose from 1980 to 1987, which corresponds to a period of greater-than-average precipitation and less-than-average withdrawal. Water levels in both aquifers began declining during 1987–90 and continued to decline until 1995. Levels generally rose or remained stable from about 1995 to 1999. Rises during this period probably resulted from decreased groundwater withdrawals because of increased precipitation and greater availability of surface water for irrigation. Water levels generally declined from March 2001 to March 2005, probably as a result of 4 years of less-than-average surface-water supplies and increased withdrawals from wells. Water levels measured in March 2006 and March 2007 generally rose in both aquifers, probably due to increased precipitation and availability of surface water. Water levels in the shallow and deep aquifers have generally declined since March 2008.

Physical properties and results of chemical analyses for water from four wells in the Sevier Desert are listed in tables 5 and 6, and the locations of the wells are plotted in figure 41. Dissolved-solids concentrations in water samples from all wells except (C-17-6)26daa-3 exceeded the secondary drinking-water standard for this constituent (500 mg/L). Water from well (C-15-5)13bbc-1 also exceeded the secondary standard for chloride (250 mg/L), sulfate (250 mg/L), iron (300 µg/L), and manganese (50 µg/L). Water from well (C-15-4)26dcc-1 exceeded the MCL for nitrate plus nitrite (10 mg/L), and water from well (C-17-6)26daa-3 exceeded the MCL for arsenic (10 µg/L).

The concentration of dissolved solids in water samples collected from well (C-15-4)8cba-1, located 2.5 miles east of Lynndyl, from 1958 to 2010, is shown in figure 19. The concentration has ranged from 1,490 to 2,340 mg/L, with a median value of 2,030 mg/L. The concentration of dissolved solids has increased from 1,490 mg/L in 1958 to 2,340 mg/L in 2009. The well was not sampled in 2010.

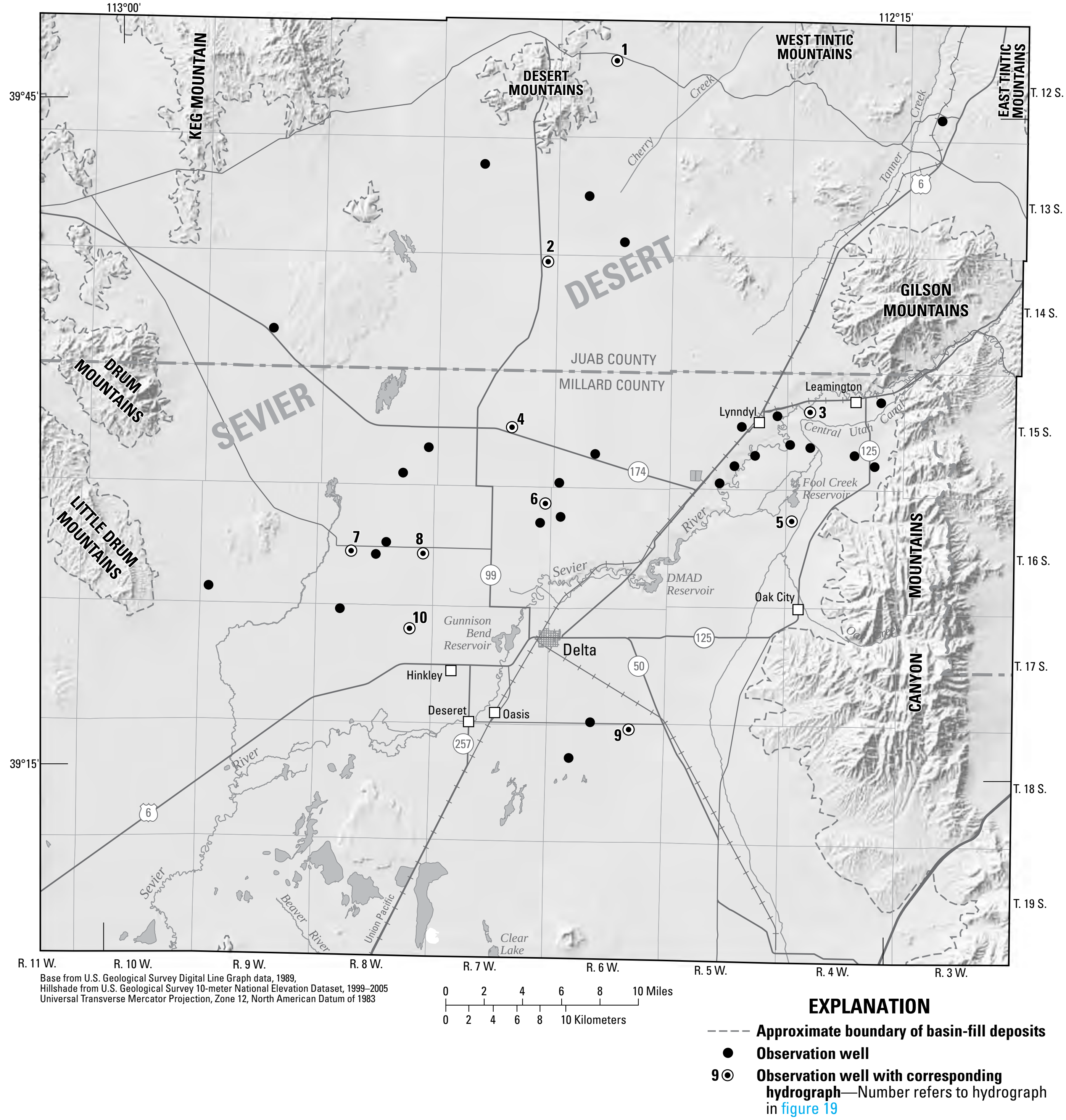
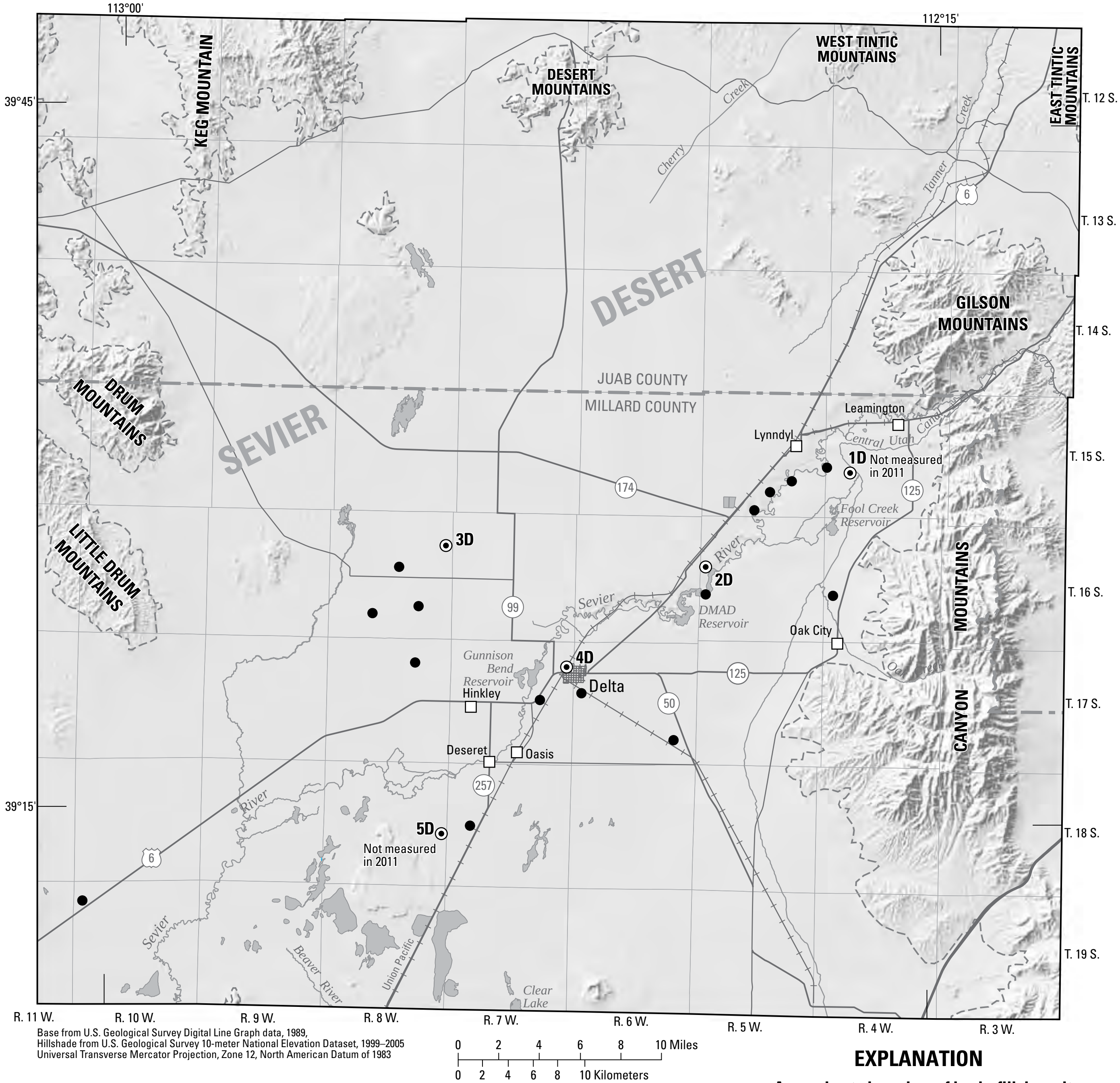


Figure 17. Location of wells in the shallow artesian aquifer in part of the Sevier Desert in which the water level was measured during March 2011.



EXPLANATION

- - - - **Approximate boundary of basin-fill deposits**

● **Observation well**

5D ⊙ **Observation well with corresponding hydrograph**—Number with letter 'D' refers to deep artesian aquifer hydrograph in figure 19

Figure 18. Location of wells in the deep artesian aquifer in part of the Sevier Desert in which the water level was measured during March 2011.

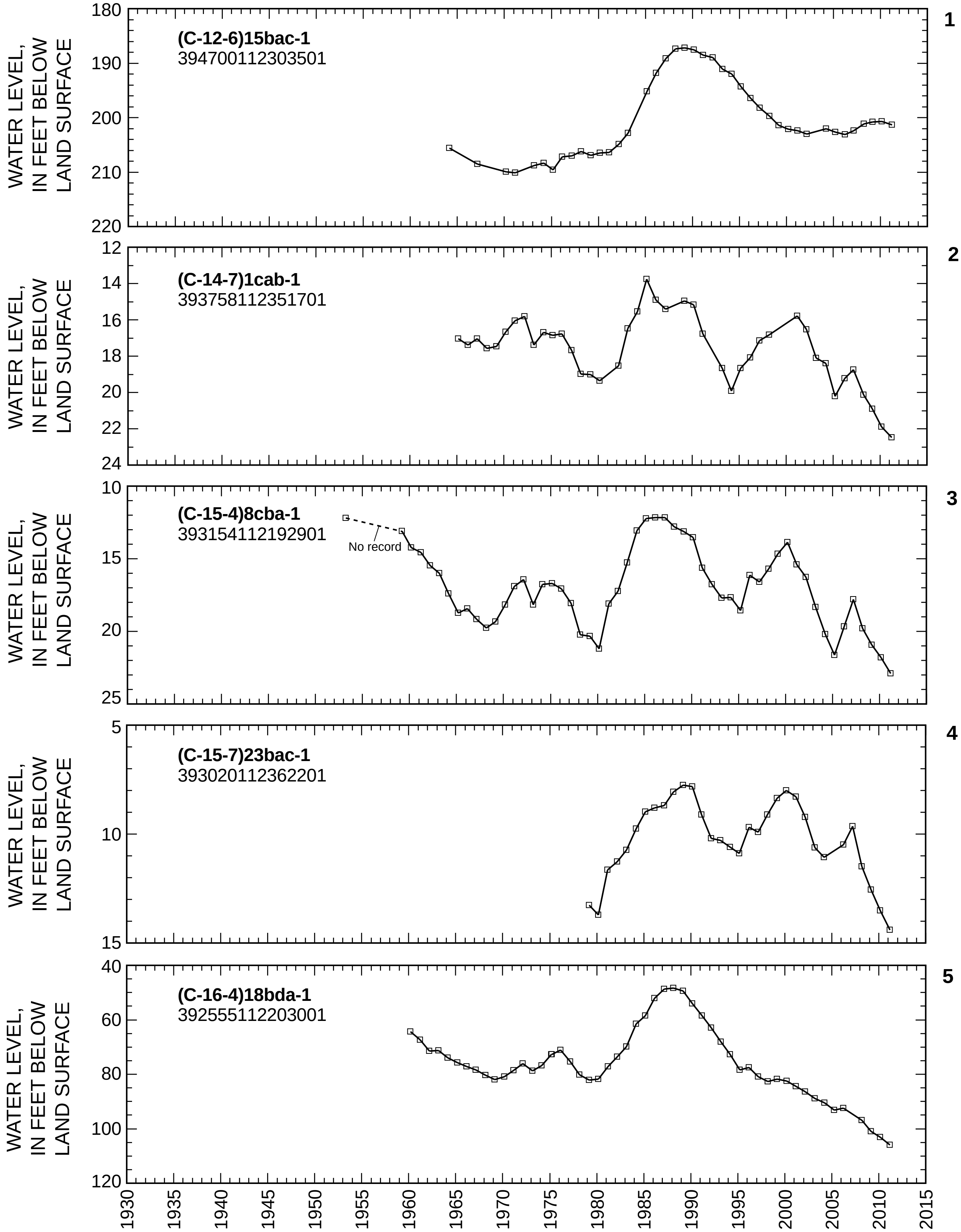


Figure 19. Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8cba-1.

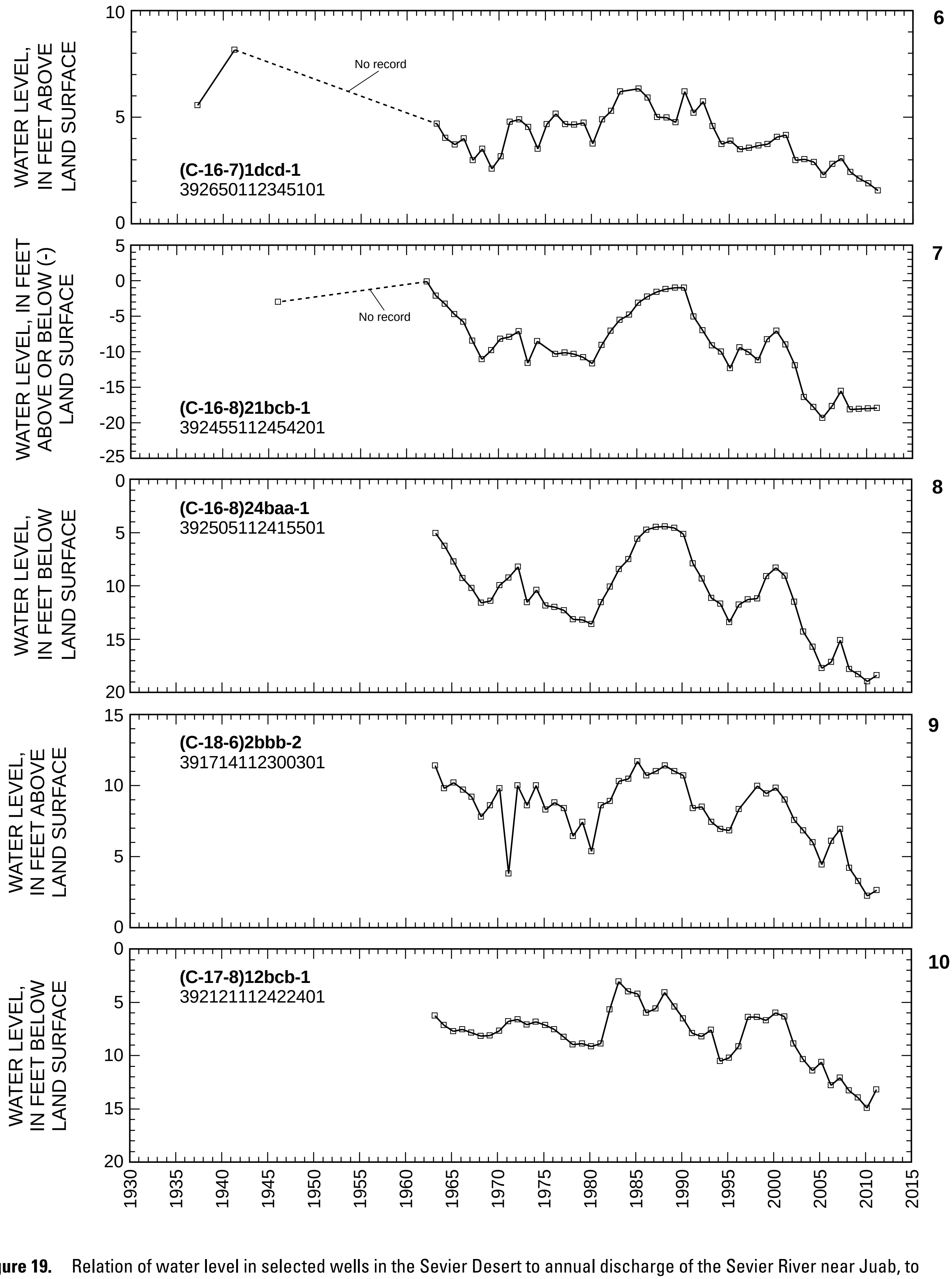


Figure 19. Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8cba-1.—Continued

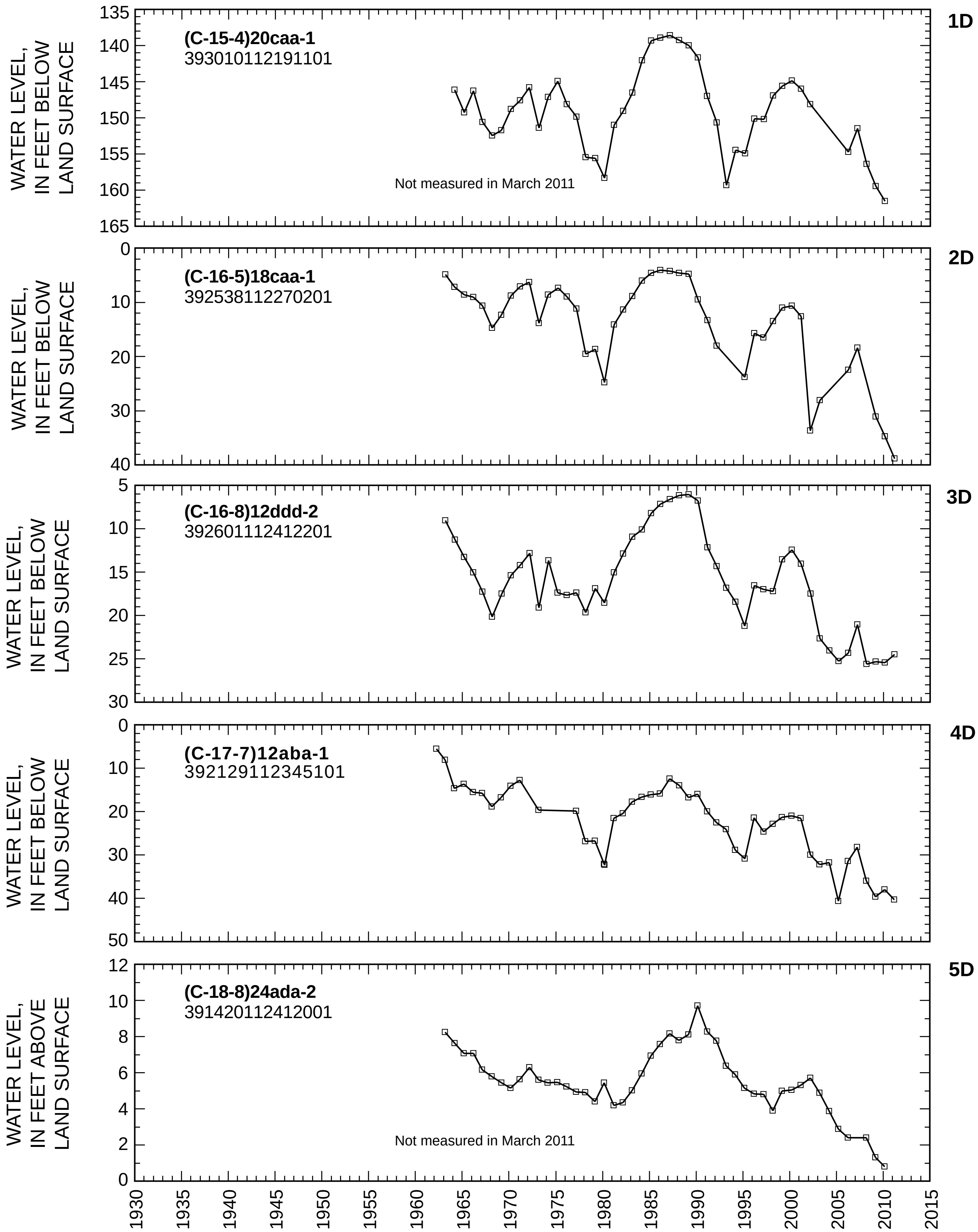


Figure 19. Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8cba-1.—Continued

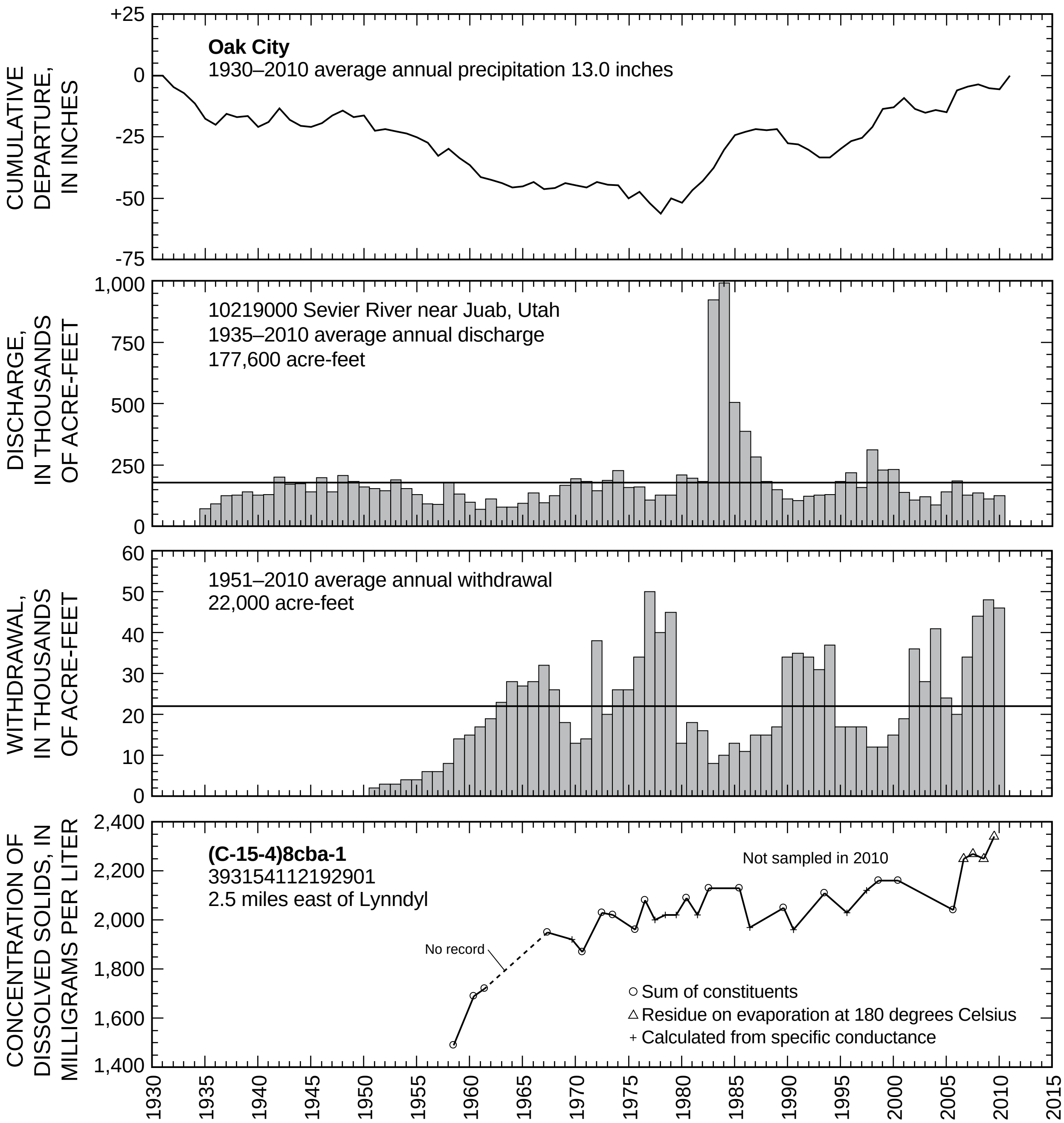


Figure 19. Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8cba-1.—Continued

Central Sevier Valley

By Bradley A. Slaugh

Central Sevier Valley, located in northern Piute, Sevier, and southern Sanpete Counties, in south-central Utah, is surrounded by the Sevier and Wasatch Plateaus to the east and the Tushar Mountains, Valley Mountains, and Pahvant Range to the west (fig. 20). Altitude ranges from 5,100 feet on the valley floor at the north end of the valley near Gunnison to more than 12,000 feet in the Tushar Mountains. Groundwater occurs in unconsolidated basin-fill deposits under both water-table and artesian conditions.

Total estimated withdrawal of water from wells in central Sevier Valley in 2010 was about 26,000 acre-feet, which is 1,000 acre-feet less than reported for 2009 and 9,000 acre-feet more than the average annual withdrawal for 2000–2009 (tables 2 and 3).

The location of 23 wells in central Sevier Valley in which the water level was measured during March 2011 is shown in figure 20. The relation of the water level in selected observation wells to annual discharge of the Sevier River at Hatch, to cumulative departure from average annual precipitation at Richfield, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4 is shown in figure 21.

Discharge of the Sevier River at Hatch in 2010 was about 88,800 acre-feet, which is about 9,500 acre-feet more than the 1940–2010 average annual discharge. Precipitation at Richfield was about 10.1 inches in 2010, which is about 2.1 inches more than the 1950–2010 average annual precipitation and about 5.9 inches more than in 2009.

Water levels in north-central Sevier Valley generally rose only slightly from March 2010 to March 2011 and generally declined only slightly in south-central Sevier Valley. Hydrographs for selected wells show that March water levels generally rose from about 1978 to 1985 and declined from 1985 to about 1993. Since 1993, water levels have fluctuated depending upon the amount and timing of precipitation and recharge to the basin-fill aquifer from snowmelt runoff.

Physical properties and results of chemical analyses for water from three wells in central Sevier Valley are listed in tables 5 and 6, and the locations of the wells are plotted in figure 41. The water sample from well (C-19-1)23cac-1 exceeded the secondary drinking-water standards for dissolved solids (500 mg/L), chloride (250 mg/L) and sulfate (250 mg/L).

The concentration of dissolved solids in water samples collected from well (C-23-2)15dcb-4, located 0.1 mile south of the Sevier River in Venice, from 1955 to 2010, is shown in figure 21. The concentration has ranged from 307 to 630 mg/L, with a median value of 414 mg/L. Relative to the median value, there were modest (less than 220 mg/L) increases in dissolved-solids concentrations during the mid- to late 1960s and 1980s. Samples collected from 1990 through 2010 show little variation and are in close agreement with the median value.

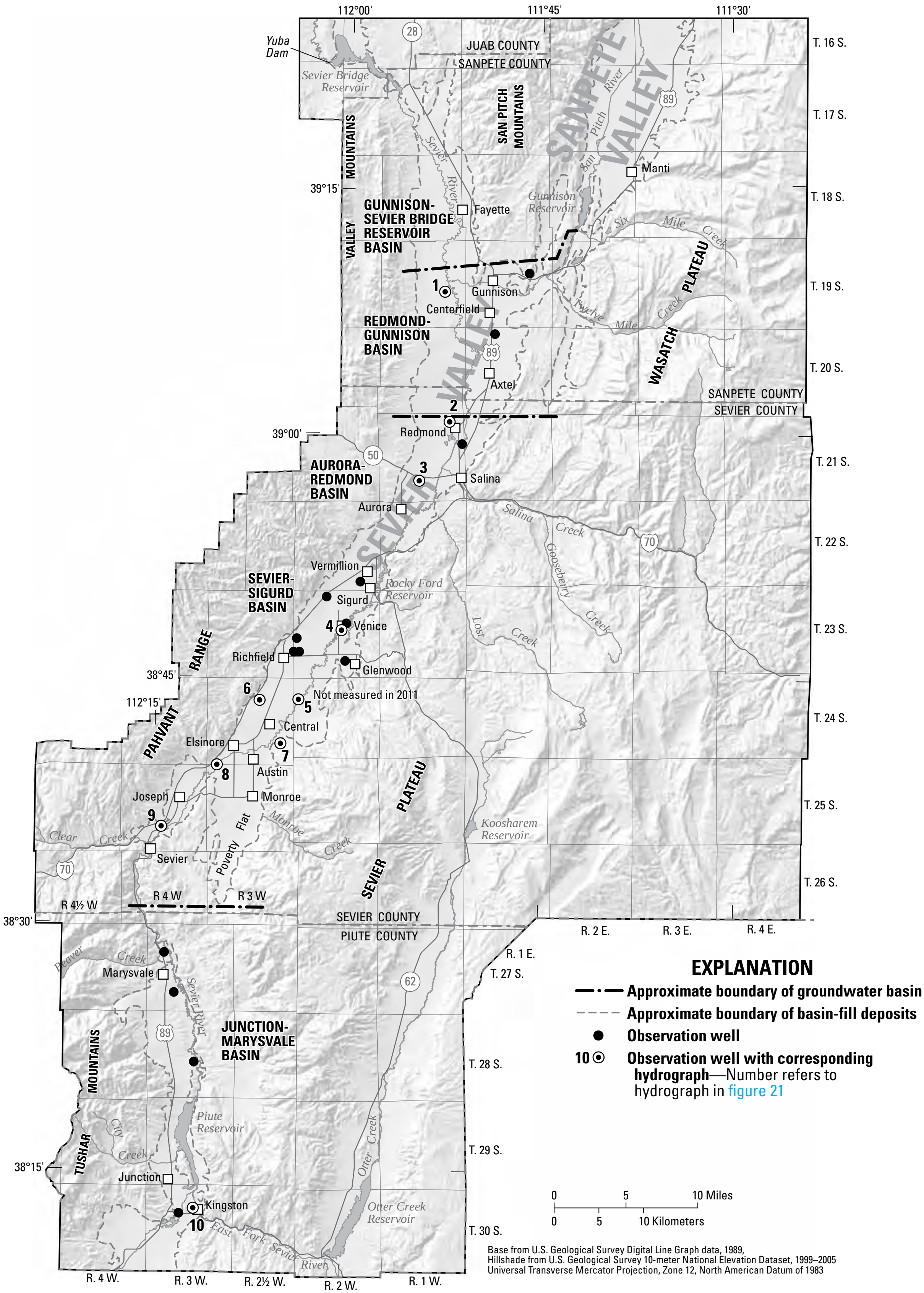


Figure 20. Location of wells in central Sevier Valley in which the water level was measured during March 2011.

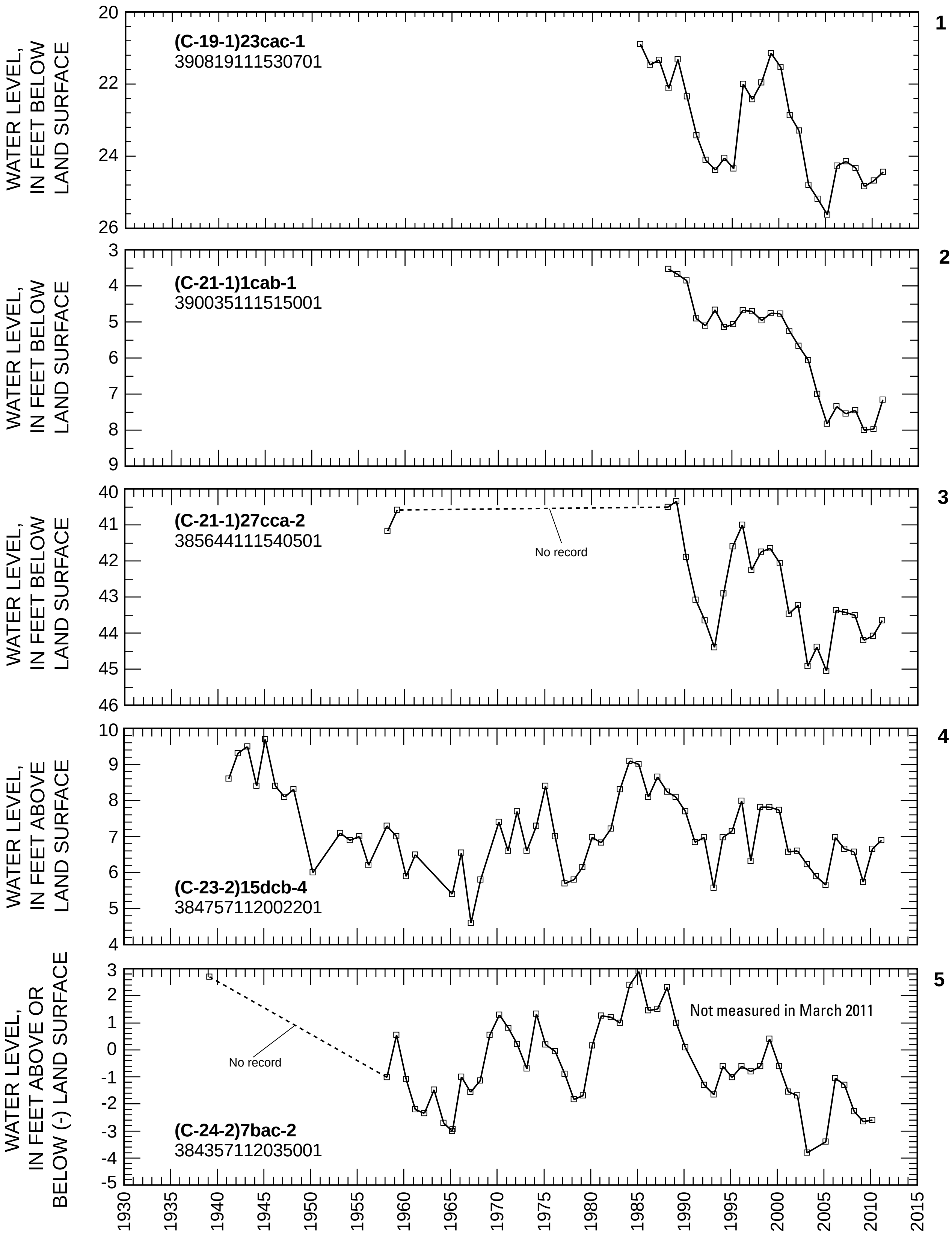


Figure 21. Relation of water level in selected wells in central Sevier Valley to annual discharge of the Sevier River at Hatch, to cumulative departure from average annual precipitation at Richfield, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4.

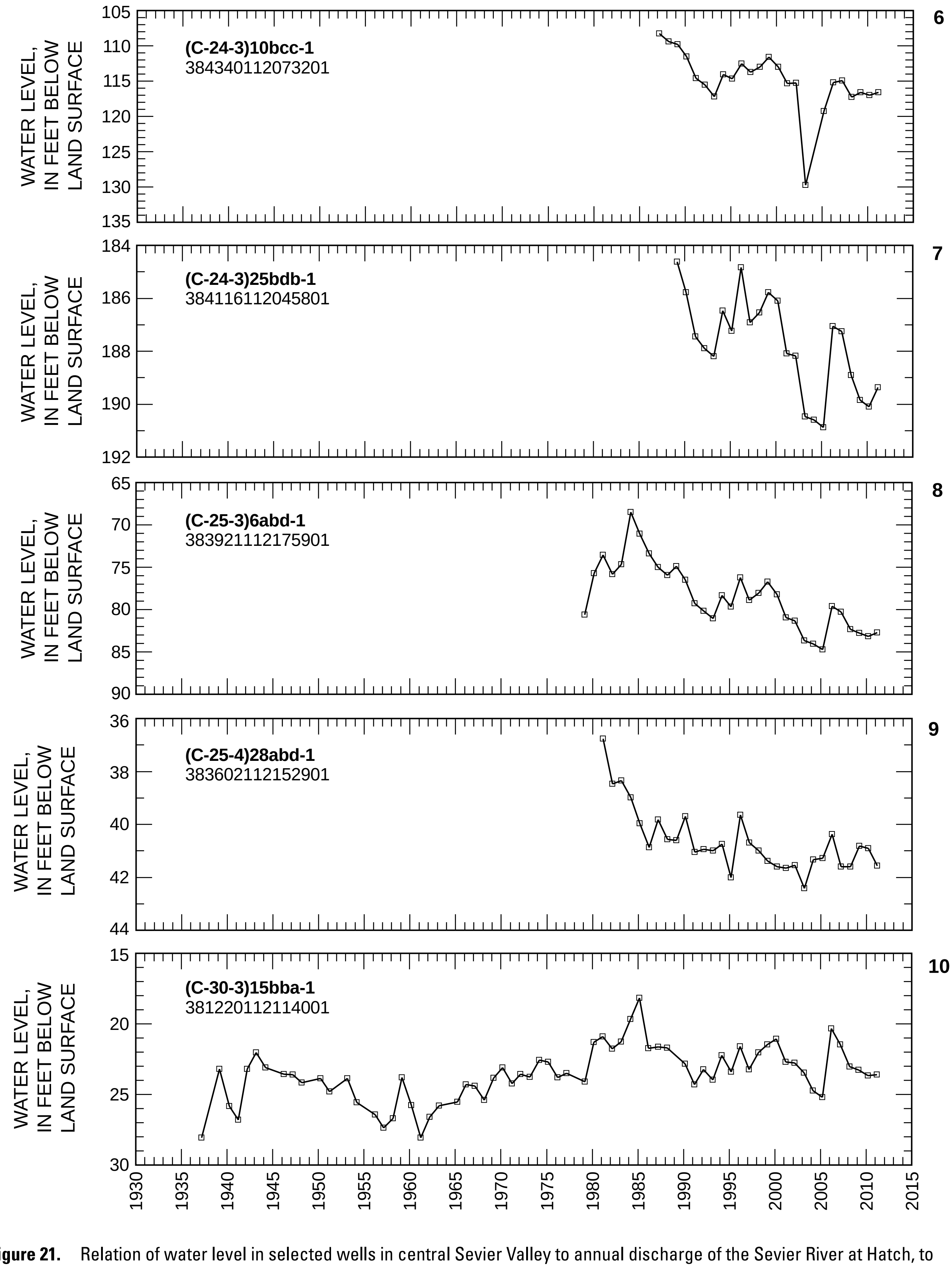


Figure 21. Relation of water level in selected wells in central Sevier Valley to annual discharge of the Sevier River at Hatch, to cumulative departure from average annual precipitation at Richfield, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4.—Continued

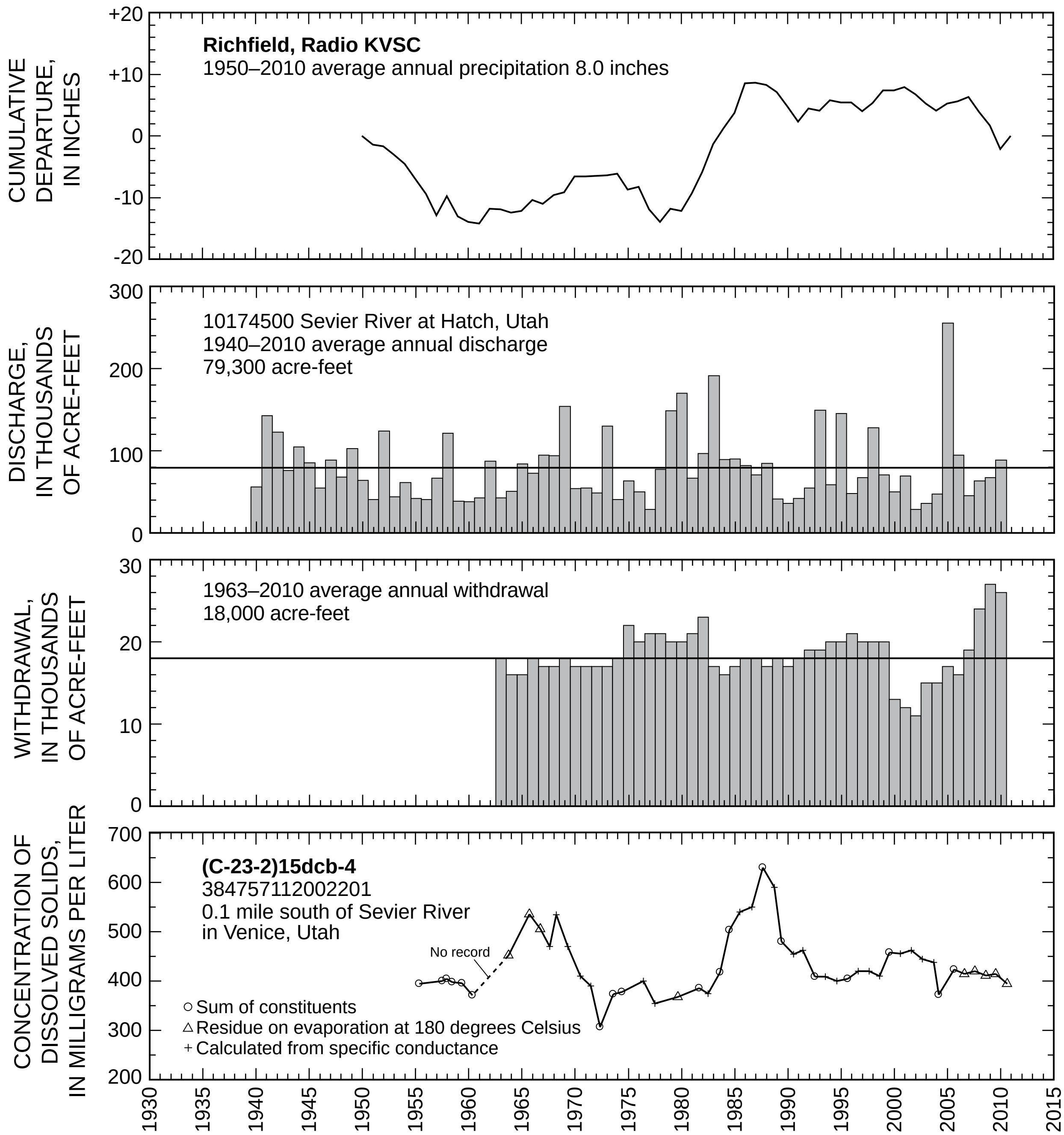


Figure 21. Relation of water level in selected wells in central Sevier Valley to annual discharge of the Sevier River at Hatch, to cumulative departure from average annual precipitation at Richfield, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4.—Continued

Pahvant Valley

By Robert L. Swenson

Pahvant Valley, in southeastern Millard County, extends from the vicinity of McCornick in the north to Kanosh in the south, and from the Pahvant Range and Canyon Mountains on the east and northeast to a low basalt ridge known as The Cinders on the west (fig. 22). The area of the valley covers about 300 square miles. Groundwater drains west to the valley from the mountainous terrain to the east. Groundwater occurs in basin-fill deposits in the valley under both water-table and artesian conditions.

Total estimated withdrawal of water from wells in Pahvant Valley in 2010 was about 106,000 acre-feet, which is about 2,000 acre-feet more than was reported in 2009 and 19,000 acre-feet more than the average annual withdrawal for 2000–2009 (tables 2 and 3). Withdrawal for irrigation in 2010 was about 105,100 acre-feet, which is 2,000 acre-feet more than was reported in 2009.

The location of wells in Pahvant Valley in which water levels were measured during March 2011 is shown in figure 22. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells is shown in figure 23.

Precipitation at Fillmore during 2010 was about 23.5 inches, which is about 8.3 inches more than the average annual precipitation for 1930–2010 and about 11.7 inches more than in 2009.

Water levels declined in wells measured in the extreme northern and southwestern parts of Pahvant Valley from March 2010 to March 2011. Declines of more than 9 feet were measured near McCornick. Declines are probably the result of continued large withdrawals for irrigation. Water level rises were noted in the central and southeastern parts of the valley. Rises of up to 10 feet were measured in wells around Flowell and Meadow. Rises are probably due to greater-than average-precipitation and decreased local withdrawals. Water levels generally declined from the early 1950s until 1982 as a result of generally less-than-average precipitation and increased withdrawals. Water levels generally rose from 1982 to 1985 and were generally higher than in the early 1950s. The 1982–85 rises were the result of greater-than-average precipitation and decreased withdrawals for irrigation. Water levels generally have declined throughout the valley since 1985.

Physical properties and results of chemical analyses for water from four wells in Pahvant Valley are listed in tables 5 and 6, and the locations of the wells are plotted in figure 41. Concentrations of dissolved solids in water from all wells exceeded the secondary drinking-water standard for this constituent (500 mg/L). Water from wells (C-23-6)8abd-1 and (C-23-6)9ccd-1 exceeded the MCL for dissolved solids (2,000 mg/L) and sulfate (1,000 mg/L), and the secondary standard for chloride (250 mg/L).

The concentration of dissolved solids in water samples collected from wells (C-21-5)7cdd-2 and (C-21-5)7cdd-3, located in the Flowell area, from 1957 to 2009, and from well (C-23-6)8abd-1, located in the Kanosh area, from 1957 to 2010, is shown in figure 23. Wells (C-21-5)7cdd-2 and (C-21-5)7cdd-3 are located near each other and are finished in the same aquifer. The dissolved-solids concentrations in water samples from these wells were combined to give an extended temporal record for this constituent. Dissolved-solids concentrations in water samples from these wells have ranged from 707 to 1,080 mg/L, with a median value of 874 mg/L. Well (C-21-5)7cdd-3 was not sampled in 2010. The concentration of dissolved solids in water samples from well (C-23-6)8abd-1 has ranged from 2,350 to 5,990 mg/L, with a median value of 4,268 mg/L. The water sample collected in August 2010 had a dissolved-solids concentration of 5,180 mg/L.

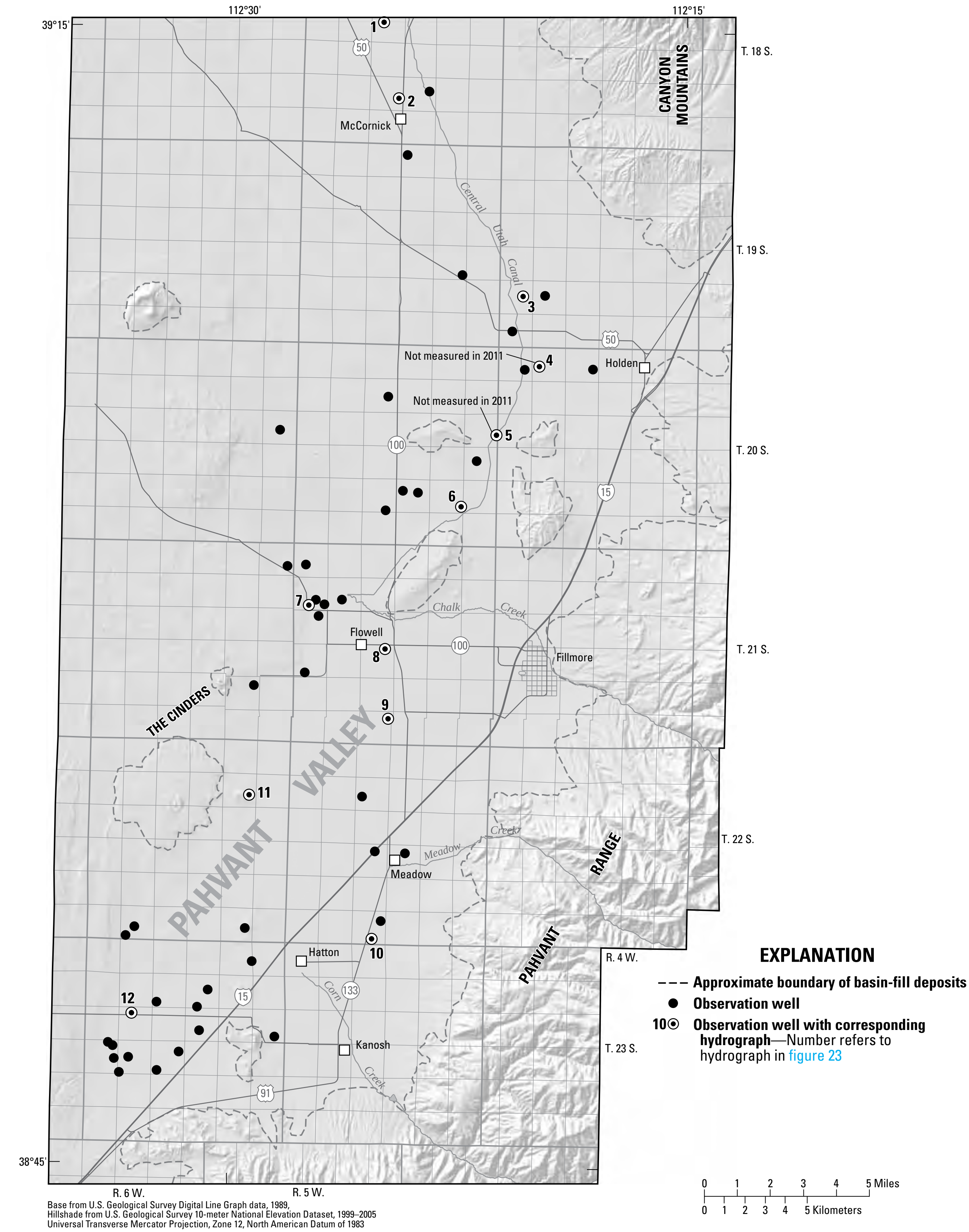


Figure 22. Location of wells in Pahvant Valley in which the water level was measured during March 2011.

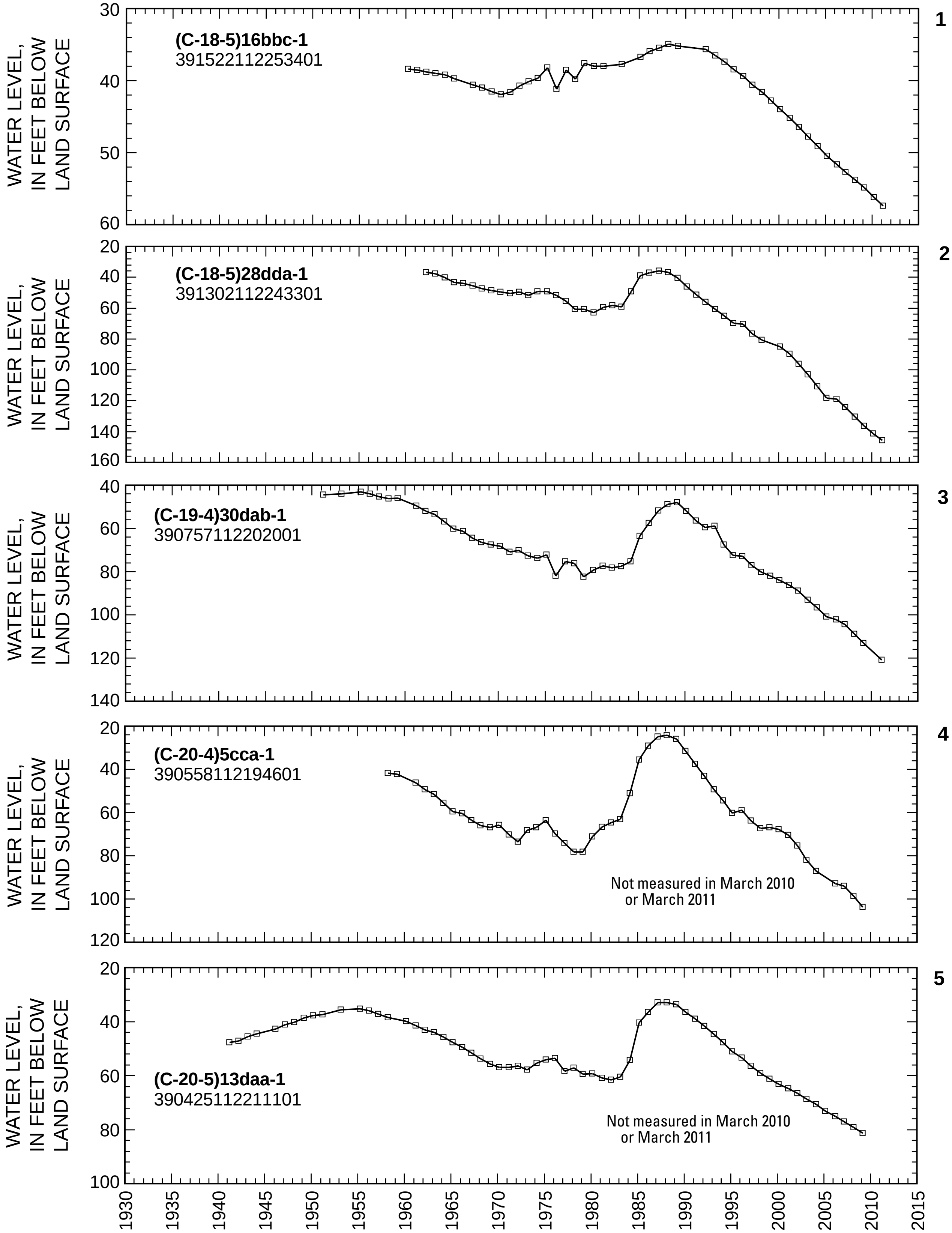


Figure 23. Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.

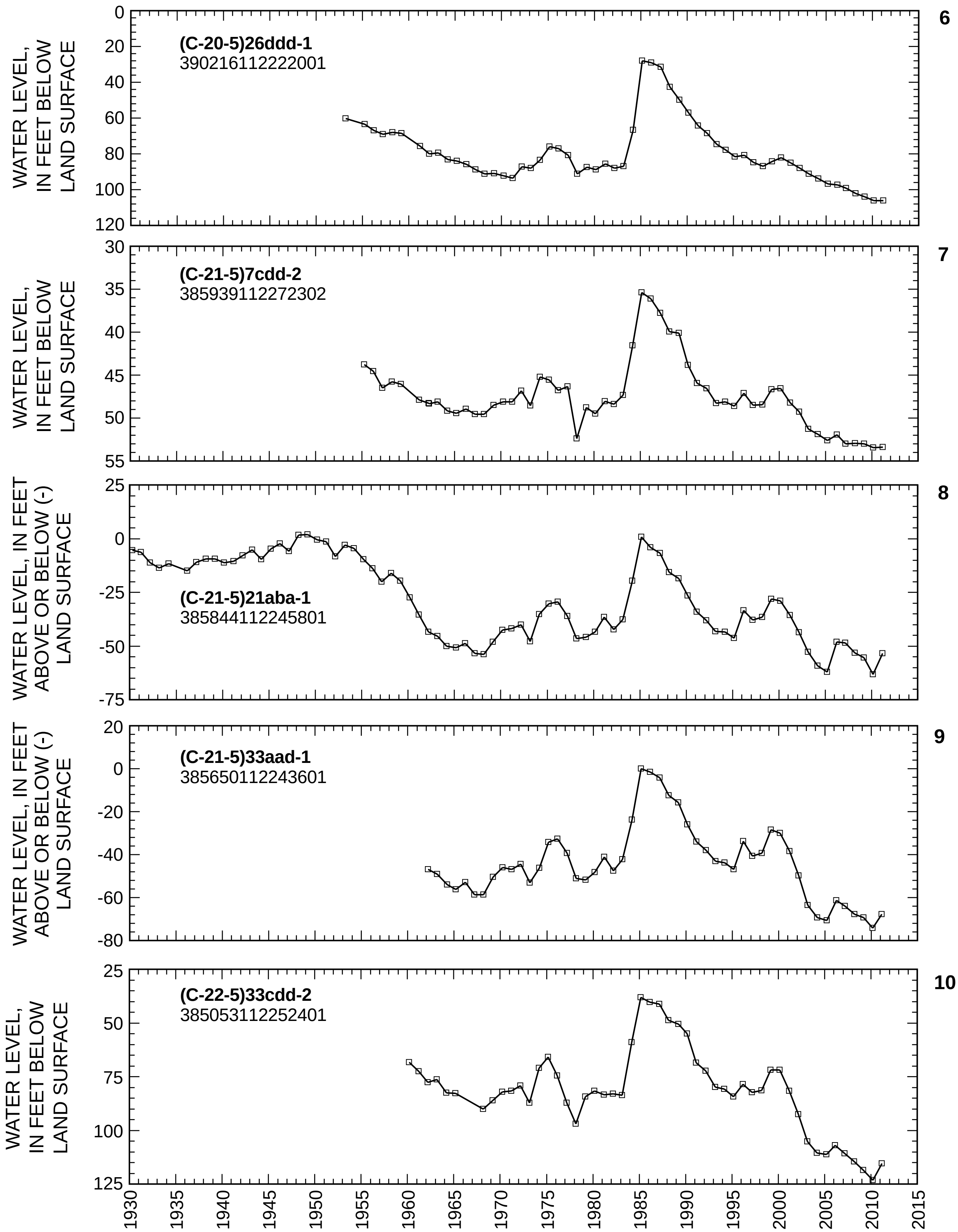


Figure 23. Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.—Continued

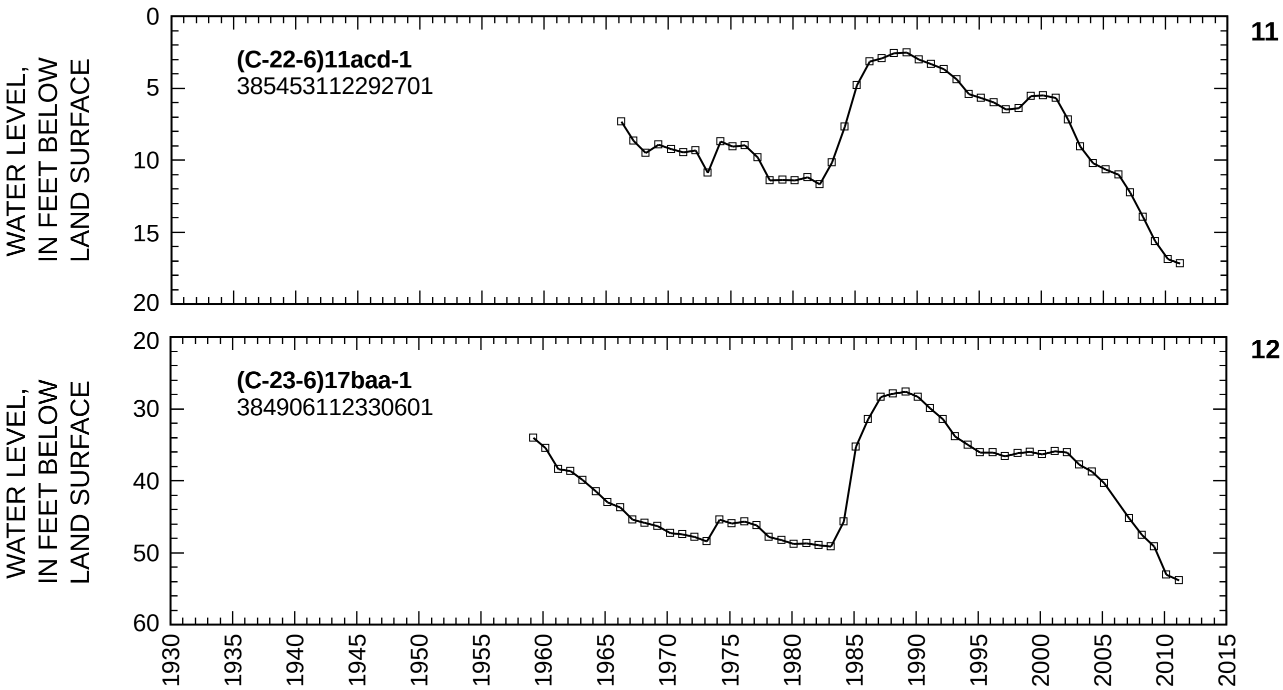


Figure 23. Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.—Continued

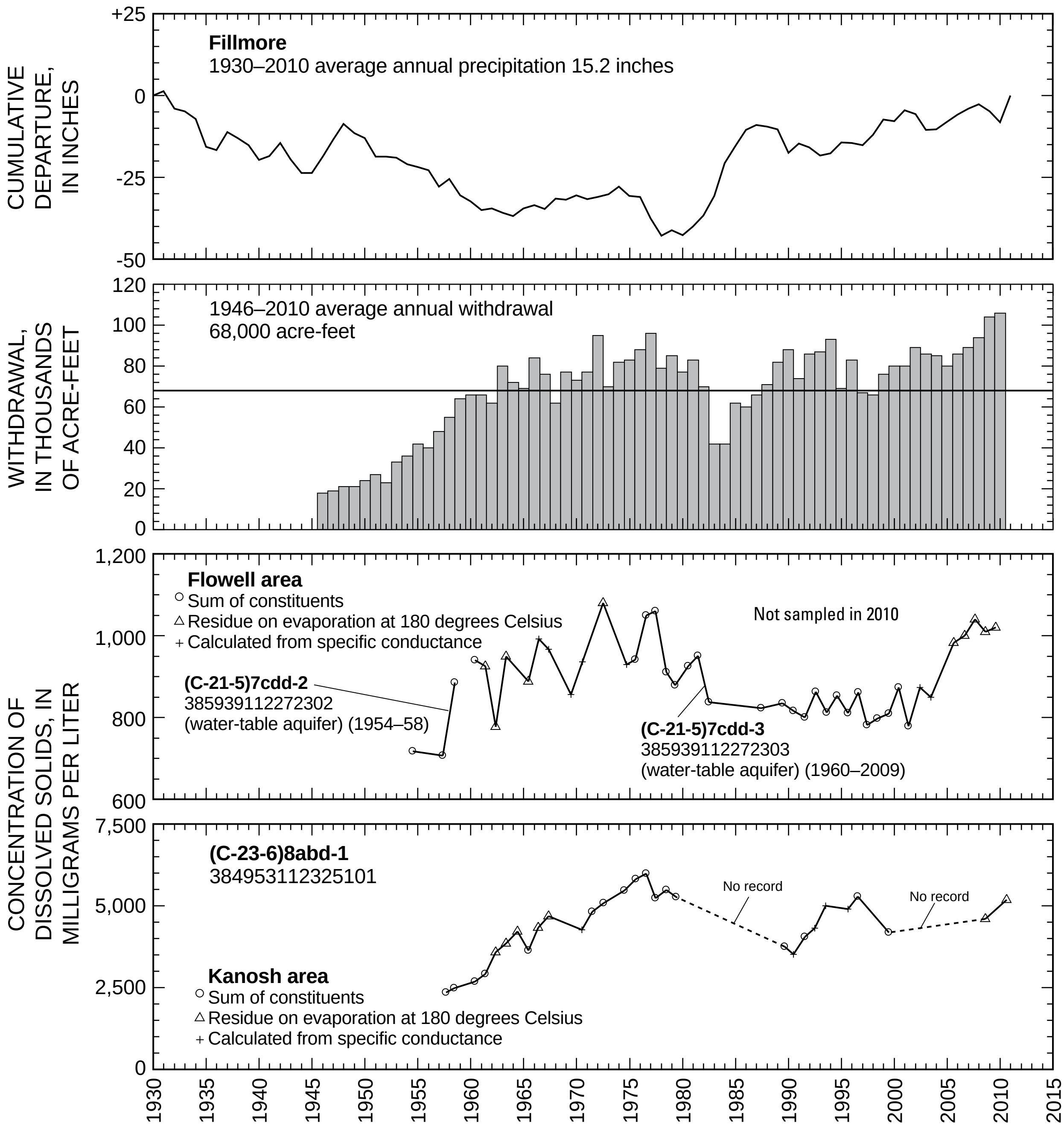


Figure 23. Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.—Continued

Cedar Valley, Iron County

By James H. Howells

Cedar Valley is in eastern Iron County, southwestern Utah. The valley covers about 220 square miles from the vicinity of Rush Lake in the north to the community of Kanarraville in the south and includes Cedar City on its eastern edge (fig. 24). Groundwater in Cedar Valley occurs in unconsolidated basin-fill deposits, mostly under water-table conditions. The principal source of recharge to the basin-fill aquifer is water from Coal Creek, some of which seeps directly from the stream channel into the groundwater system.

Total estimated withdrawal of water from wells in Cedar Valley in 2010 was about 38,000 acre-feet, which is the same as in 2009 and 1,000 acre-feet more than the average annual withdrawal for 2000–2009 (tables 2 and 3).

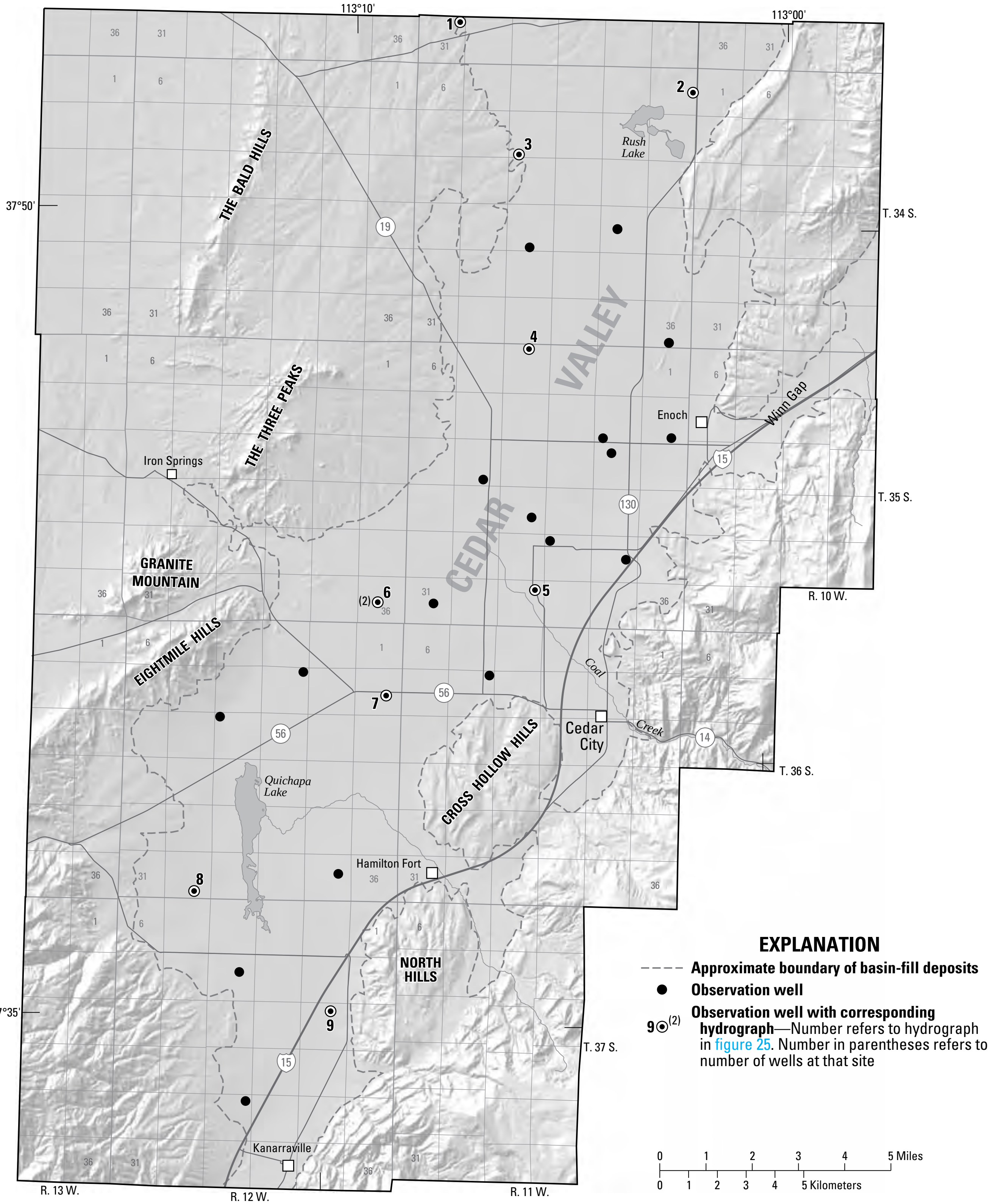
The location of wells in Cedar Valley in which the water level was measured during March 2011 is shown in figure 24. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells is shown in figure 25.

Precipitation at Cedar City Federal Aviation Administration Airport in 2010 was about 16.4 inches, which is about 7.5 inches more than in 2009 and about 5.7 inches more than the average annual precipitation for 1949–2010. Discharge of Coal Creek was about 31,700 acre-feet in 2010, which is 10,100 acre-feet more than in 2009, and 7,300 acre-feet more than the average annual discharge for 1936 and 1939–2010.

Groundwater levels generally rose from March 2010 to March 2011 in most parts of Cedar Valley. The largest rises, greater than 8 feet, were measured in three wells north and west of Cedar City. Water-level rises probably resulted from locally decreased withdrawals, greater-than-average precipitation, and increased recharge. Water-level declines were measured in several wells near Quichapa Lake. Water-level declines probably resulted from continued localized large withdrawals for irrigation and municipal use.

Physical properties and results of chemical analyses for water from four wells in Cedar Valley are listed in tables 5 and 6, and the locations of the wells are plotted in figure 41. Concentrations of dissolved solids in water from all wells exceeded the secondary drinking-water standard for this constituent (500 mg/L). Water from wells (C-35-11)11ccc-1, (C-35-11)31dbd-1, and (C-37-12)23acb-1 exceeded the secondary standard for sulfate (250 mg/L). Also, water from well (C-35-11)11ccc-1 exceeded the MCL for nitrate plus nitrite (10 mg/L).

The concentration of dissolved solids in water samples collected from well (C-37-12)23acb-1, located 2.3 miles northeast of Kanarraville, from 1966 to 2010, and well (C-35-11)31dbd-1, located about 4 miles northwest of Cedar City, from 1977 to 2010, is shown in figure 25. Dissolved-solids concentration in water from well (C-37-12)23acb-1 has ranged from 347 to 961 mg/L, with a median value of 498 mg/L; the concentration of dissolved solids has generally increased from 1966 to 2010. For well (C-35-11)31dbd-1, the concentration of dissolved solids in water samples has ranged from 364 to 1,020 mg/L, with a median value of 534 mg/L. From 1987 to 2010, the concentration has generally increased.



Base from U.S. Geological Survey Digital Line Graph data, 1989,
Hillshade from U.S. Geological Survey 10-meter National Elevation Dataset, 1999–2005
Universal Transverse Mercator Projection, Zone 12, North American Datum of 1983

Figure 24. Location of wells in Cedar Valley, Iron County, in which the water level was measured during March 2011.

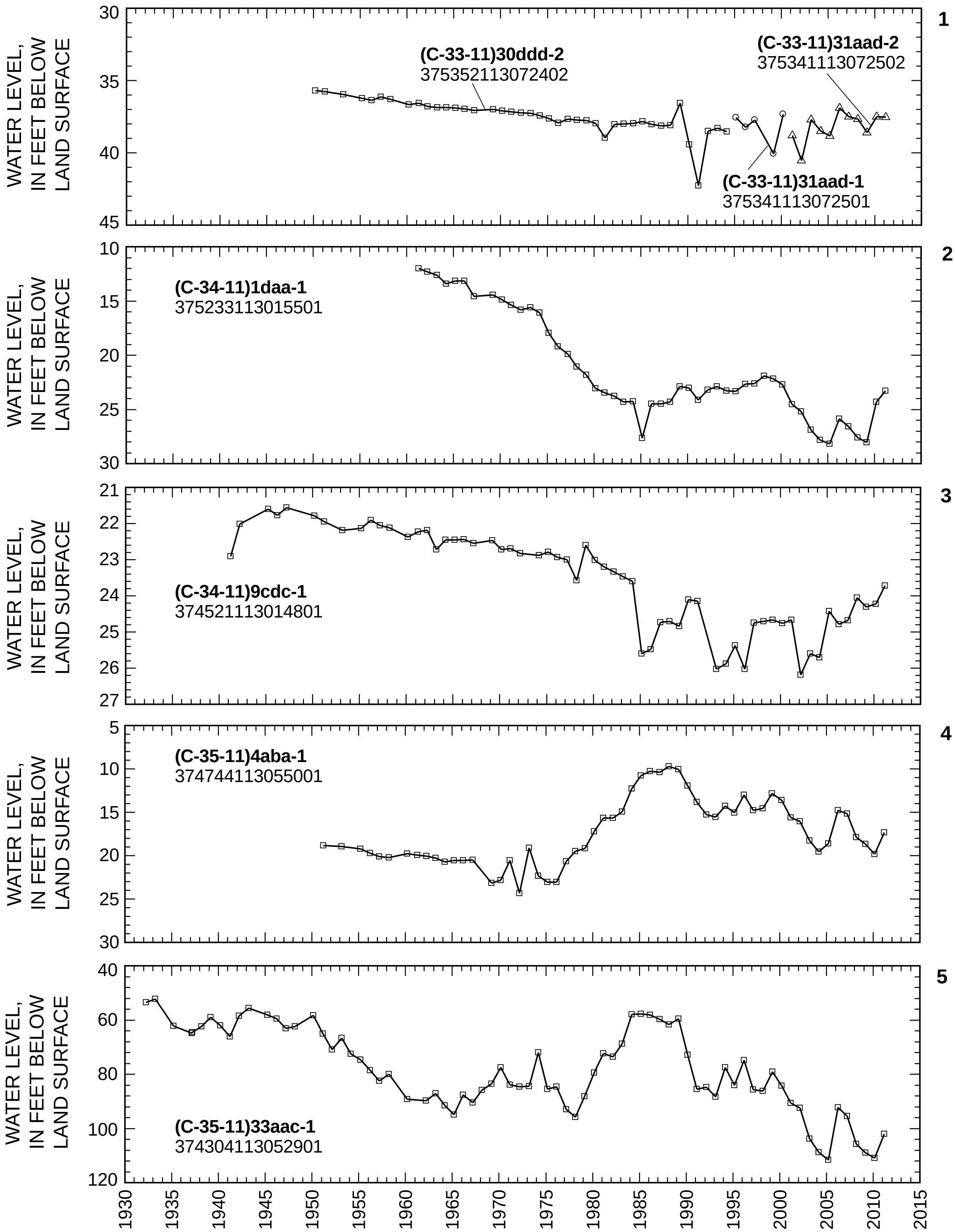


Figure 25. Relation of water level in selected wells in Cedar Valley, Iron County, to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.

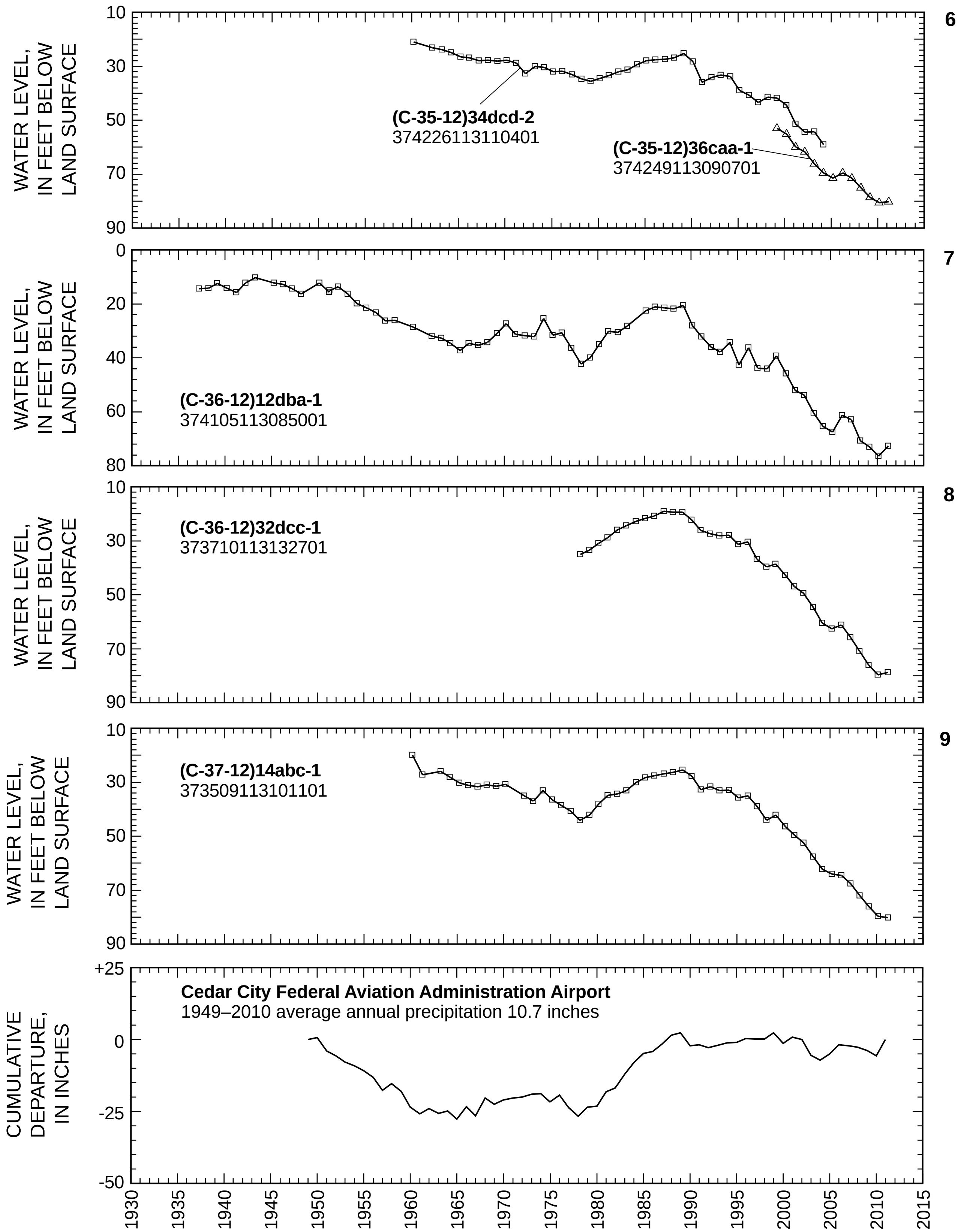


Figure 25. Relation of water level in selected wells in Cedar Valley, Iron County, to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.—Continued

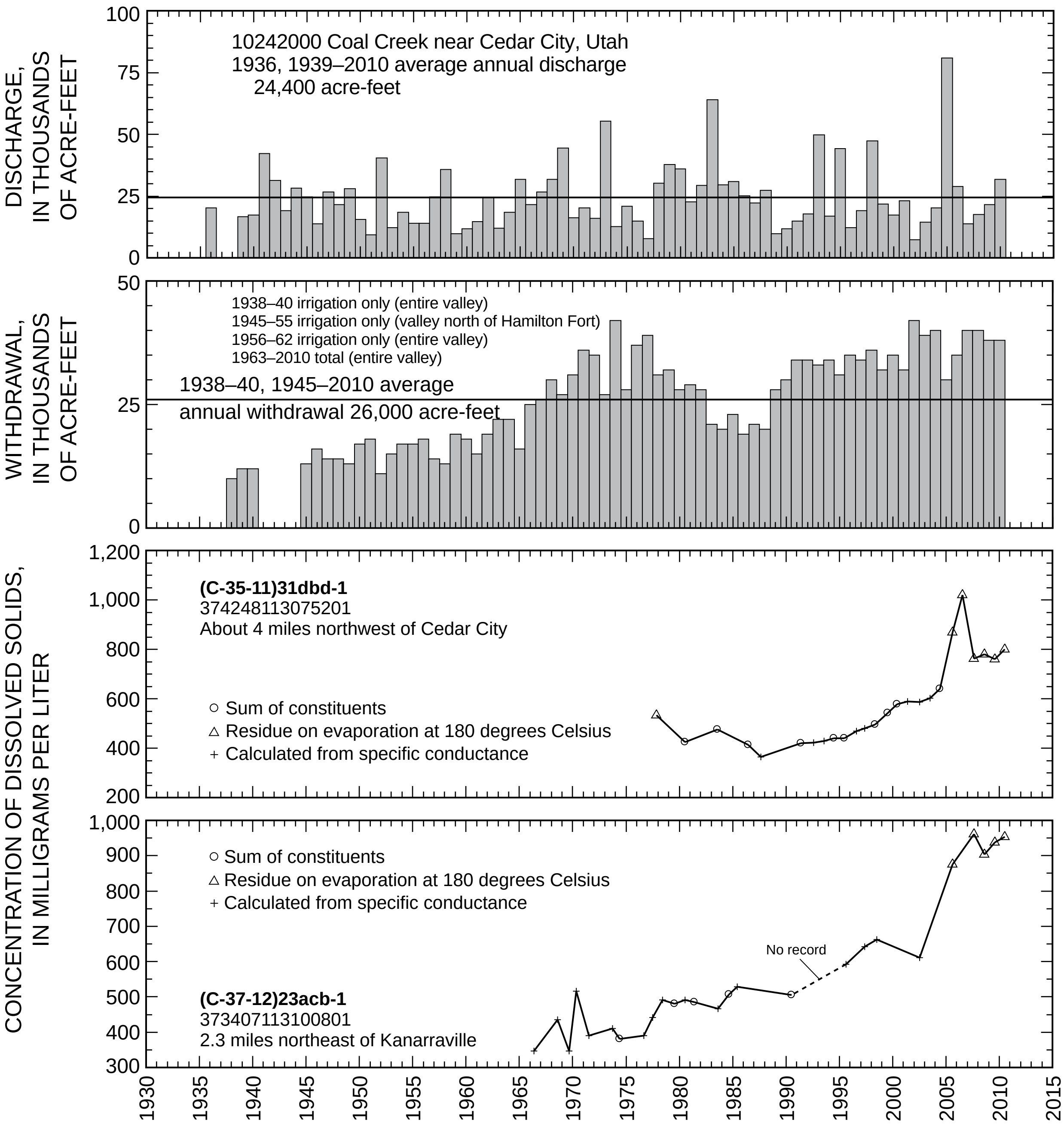


Figure 25. Relation of water level in selected wells in Cedar Valley, Iron County, to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.—Continued

Parowan Valley

By James H. Howells

Parowan Valley is in northern Iron County, southwestern Utah. The valley covers about 160 square miles west of the Hurricane Cliffs and includes the towns of Paragonah and Parowan (fig. 26). Groundwater occurs in unconsolidated basin-fill deposits under both water-table and artesian conditions.

Total estimated withdrawal of water from wells in Parowan Valley in 2010 was about 34,000 acre-feet, which is about 3,000 acre-feet less than was reported for 2009 and the same as the average annual withdrawal for 2000–2009 (tables 2 and 3). The decrease is mainly due to decreased withdrawals for irrigation.

The location of wells in Parowan Valley in which the water level was measured during March 2011 is shown in figure 26. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1 is shown in figure 27.

Precipitation at Cedar City Federal Aviation Administration Airport in 2010 was about 16.4 inches, which is about 7.5 inches more than the value for 2009 and 5.7 inches more than the average annual precipitation for 1949–2010.

Water levels declined from March 2010 to March 2011 in the northern and southern parts of Parowan Valley for which data are available. The largest decline, about 2 feet, was measured in a well north of Summit. Water levels rose in wells in the central part of Parowan Valley for which data are available. The largest rise, about 2.3 feet, was measured in a well west of Parowan. Water levels in Parowan Valley generally have declined since 1950. Some rises occurred during 1973–74, 1983–85, 1996–99, and 2006. Declines in water levels are probably the result of continued large local withdrawals for irrigation. Rises are probably the result of less withdrawal for irrigation and several years of greater-than-average precipitation.

Physical properties and results of chemical analyses for water from four wells in Parowan Valley are listed in tables 5 and 6, and the locations of the wells are plotted in figure 41. No water from the four wells sampled in Parowan Valley exceeded any secondary drinking-water standards or MCLs.

The concentration of dissolved solids in water samples collected from well (C-33-8)31ccc-1, located 2 miles west of Paragonah, from 1961 to 2010, is shown in figure 27. The concentration has ranged from 257 to 885 mg/L, with a median value of 291 mg/L. The water sampled collected in July 2010 had a dissolved-solids concentration of 280 mg/L. With the exception of relatively high dissolved-solids concentrations in water samples collected in 1970, 1973, and 1974, concentrations have varied little.

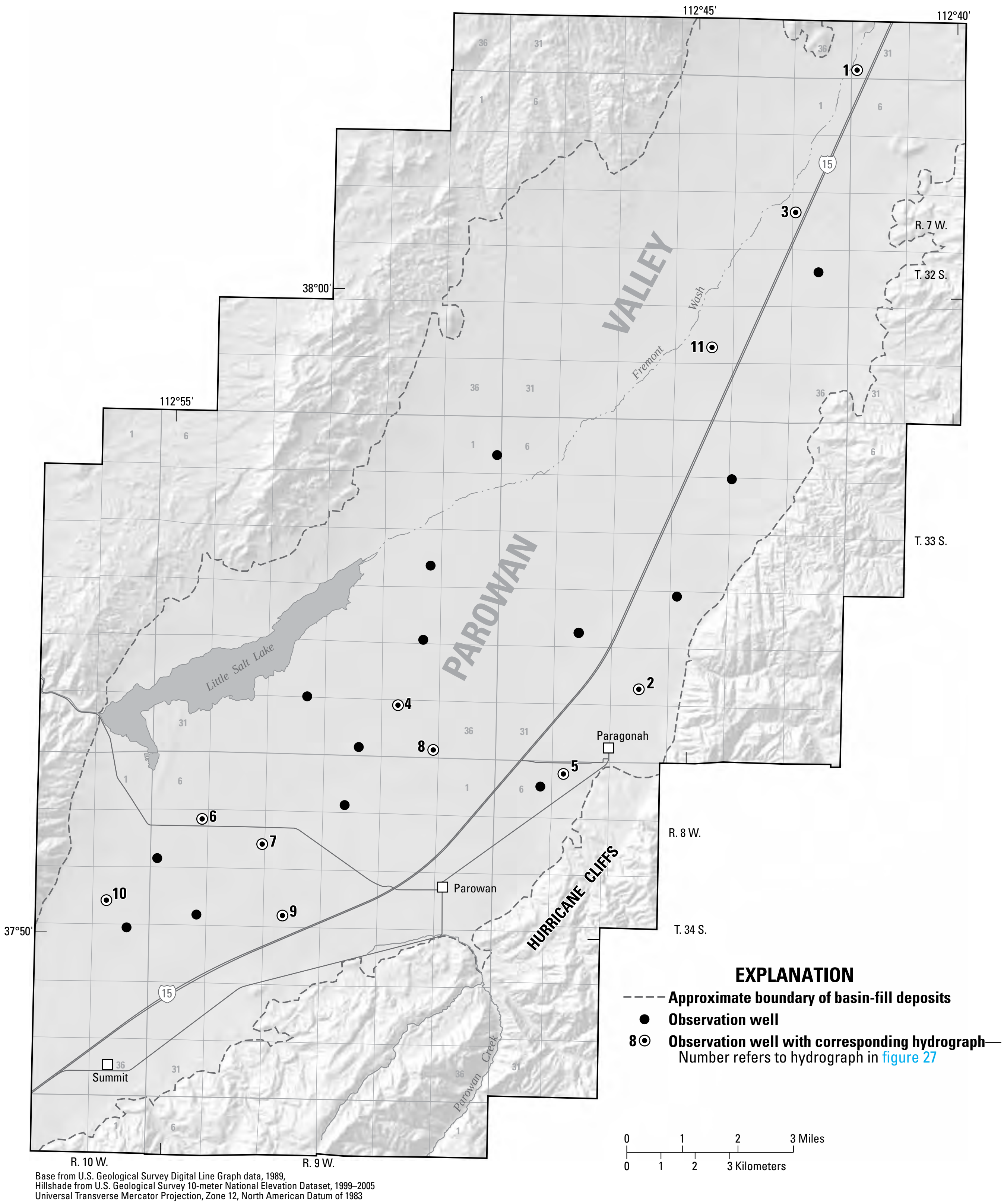


Figure 26. Location of wells in Parowan Valley in which the water level was measured during March 2011.

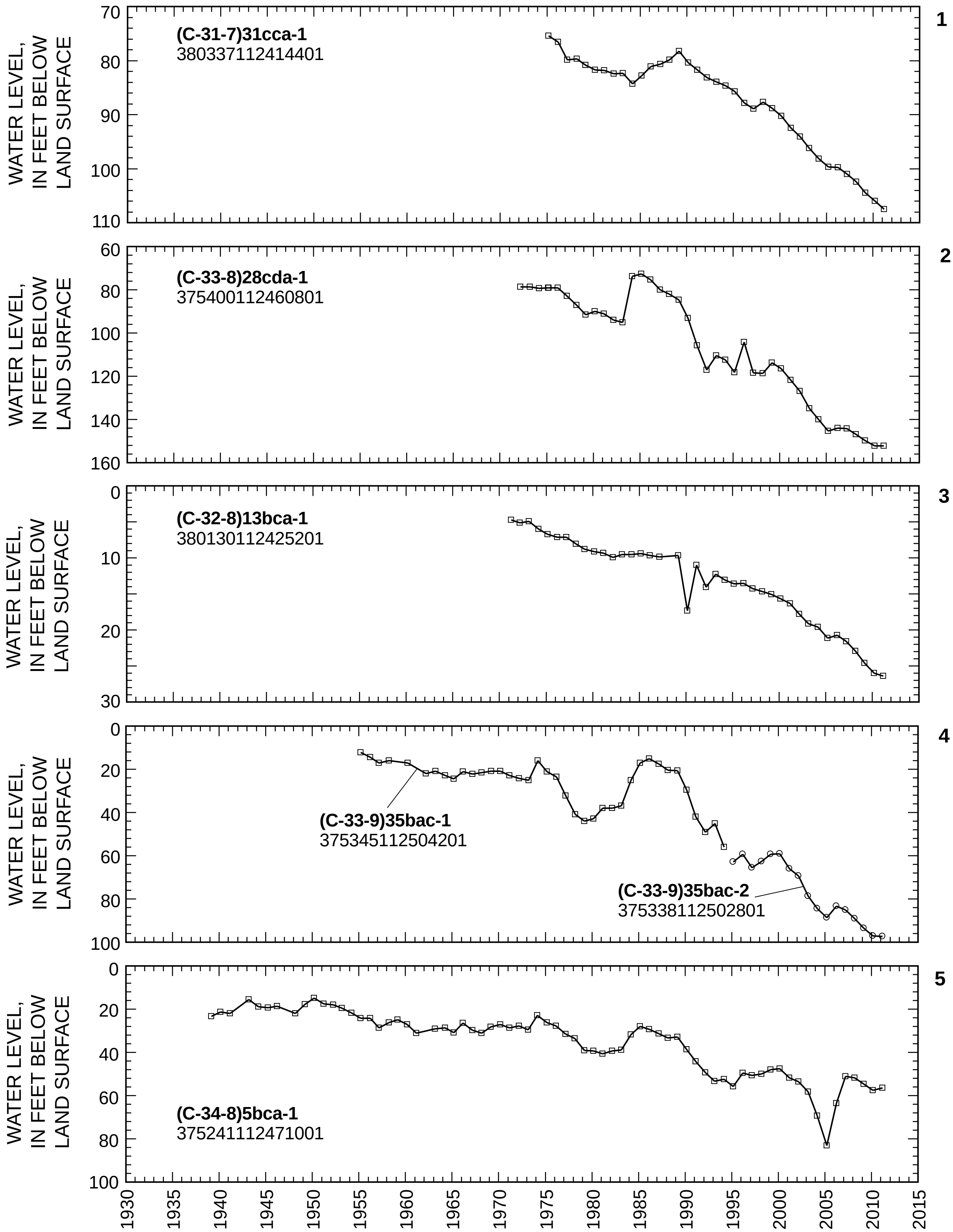


Figure 27. Relation of water level in selected wells in Parowan Valley to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1.

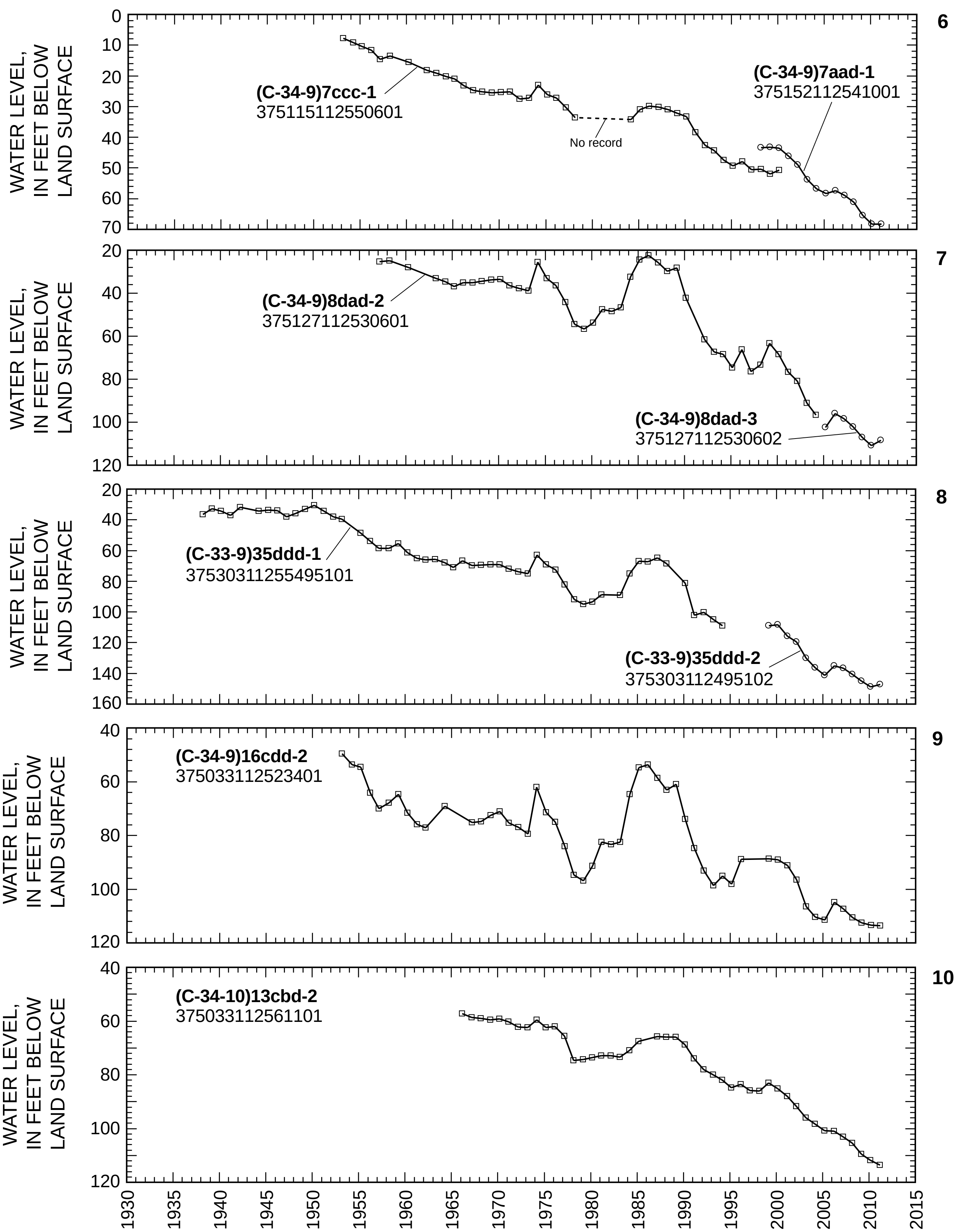


Figure 27. Relation of water level in selected wells in Parowan Valley to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1.—Continued

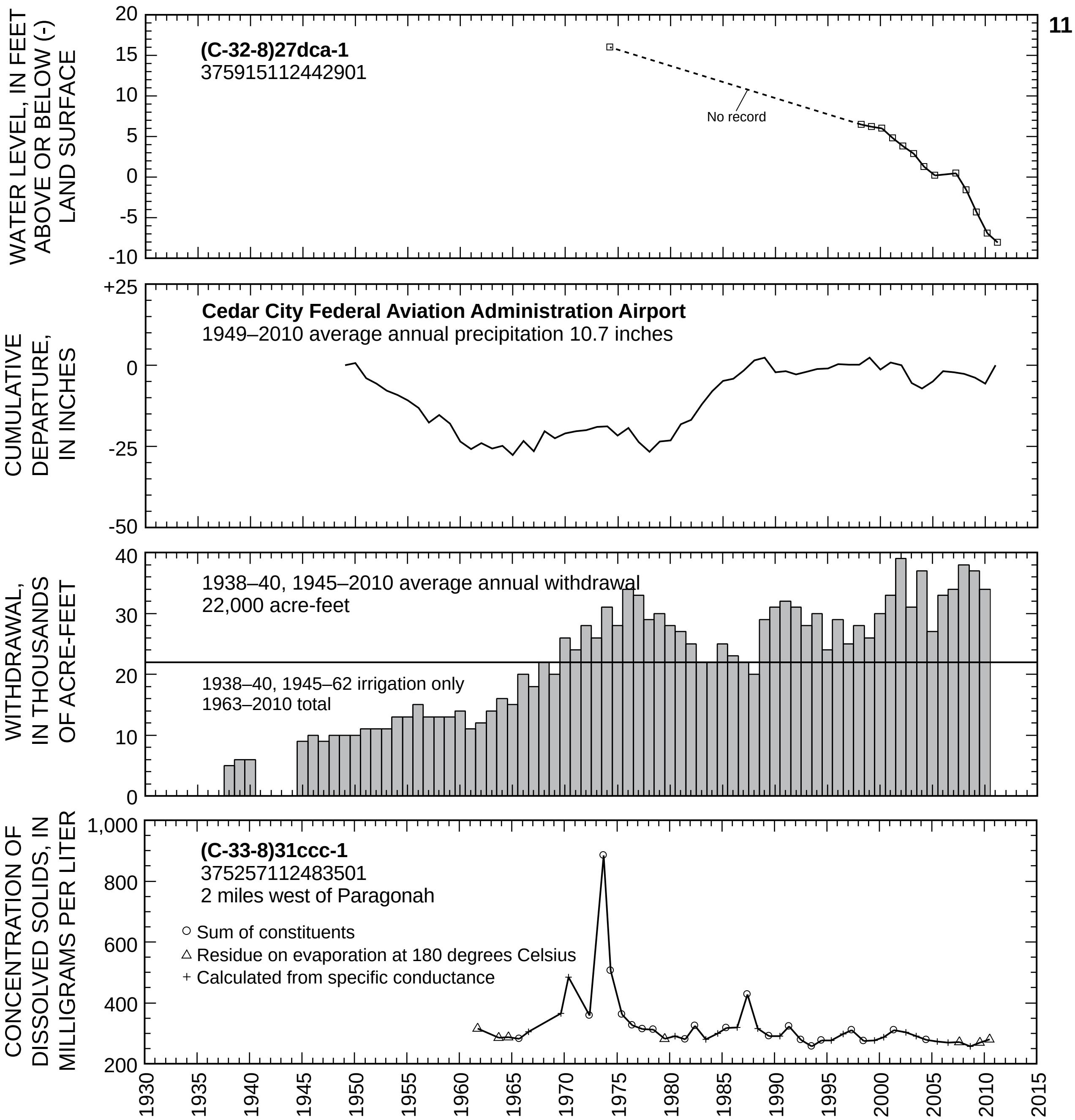


Figure 27. Relation of water level in selected wells in Parowan Valley to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1.—Continued

Escalante Valley

Milford Area

By Bradley A. Slaugh

The Milford area is in southwestern Utah and includes that part of Escalante Valley lying entirely within Beaver County west of the Mineral Mountains, the southern part of Millard County, and a small area in the northern part of Iron County (fig. 28). Groundwater occurs in unconsolidated basin-fill deposits in the valley.

Total estimated withdrawal of water from wells in the Milford area of Escalante Valley in 2010 was about 62,000 acre-feet, which is 6,000 acre-feet more than was reported for 2009 and 14,000 acre-feet more than the average annual withdrawal for 2000–2009 (tables 2 and 3). This increase was the result of increased withdrawal for industrial use, due to a new geothermal power plant.

The location of wells in the Milford area in which the water level was measured during March 2011 is shown in figure 28. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Black Rock, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-29-10)5cdd-2 is shown in figure 29.

Precipitation at Black Rock in 2010 was about 13.1 inches, about 6.9 inches more than in 2009 and about 4.2 inches more than the 1952–2010 average annual precipitation.

Water levels generally declined slightly from March 2010 to March 2011 in the Milford area. The amount of water-level rise or decline depends largely on groundwater withdrawals, the amount and timing of precipitation, and recharge to the basin-fill aquifer from the Beaver River. Since the early 1950s water levels generally have declined in the south-central Milford area in response to the long-term effects of groundwater withdrawals. Water-level rises during 1983–85 resulted from greater-than-average precipitation during 1982–85 and increased recharge to the basin-fill aquifer from record flow in the Beaver River during 1983–84.

Physical properties and results of chemical analyses for water from five wells in the Milford area are listed in tables 5 and 6, and the locations of the wells are plotted in figure 41. The concentration of dissolved solids in the water sample from well (C-29-11)1add-1 exceeded the secondary drinking-water standard (500 mg/L).

The concentration of dissolved solids in water samples collected from well (C-29-10)5cdd-2, located 5 miles south of Milford, from 1969 to 2010, is shown in figure 29. The concentration has ranged from 486 to 909 mg/L with a median value of 573 mg/L. The dissolved-solids concentration in the August 2010 sample (486 mg/L) is a new minimum value. With the exception of a relatively high dissolved-solids concentration in the water sample collected in 2001 (909 mg/L), concentrations have varied little.

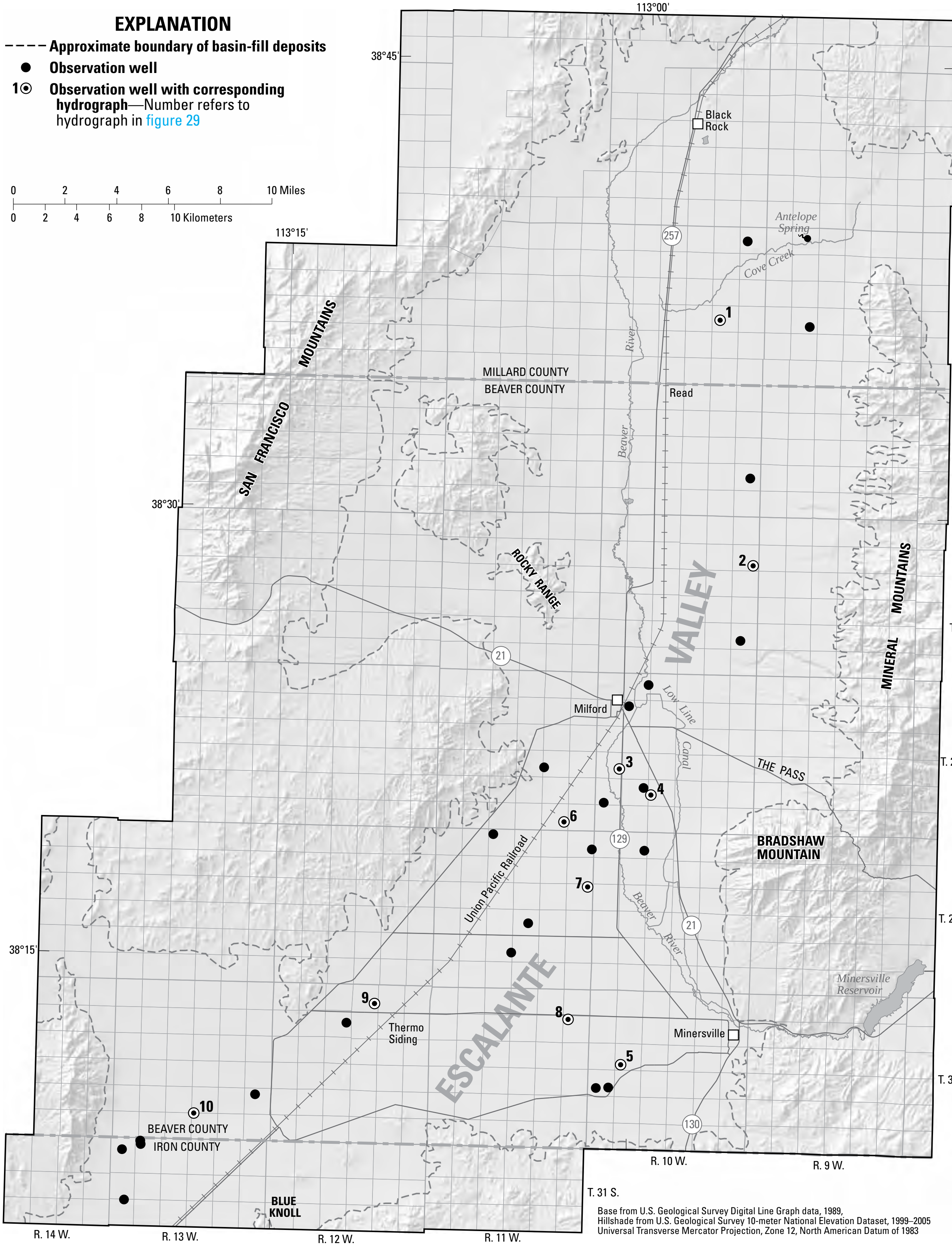


Figure 28. Location of wells in the Milford area in which the water level was measured during March 2011.

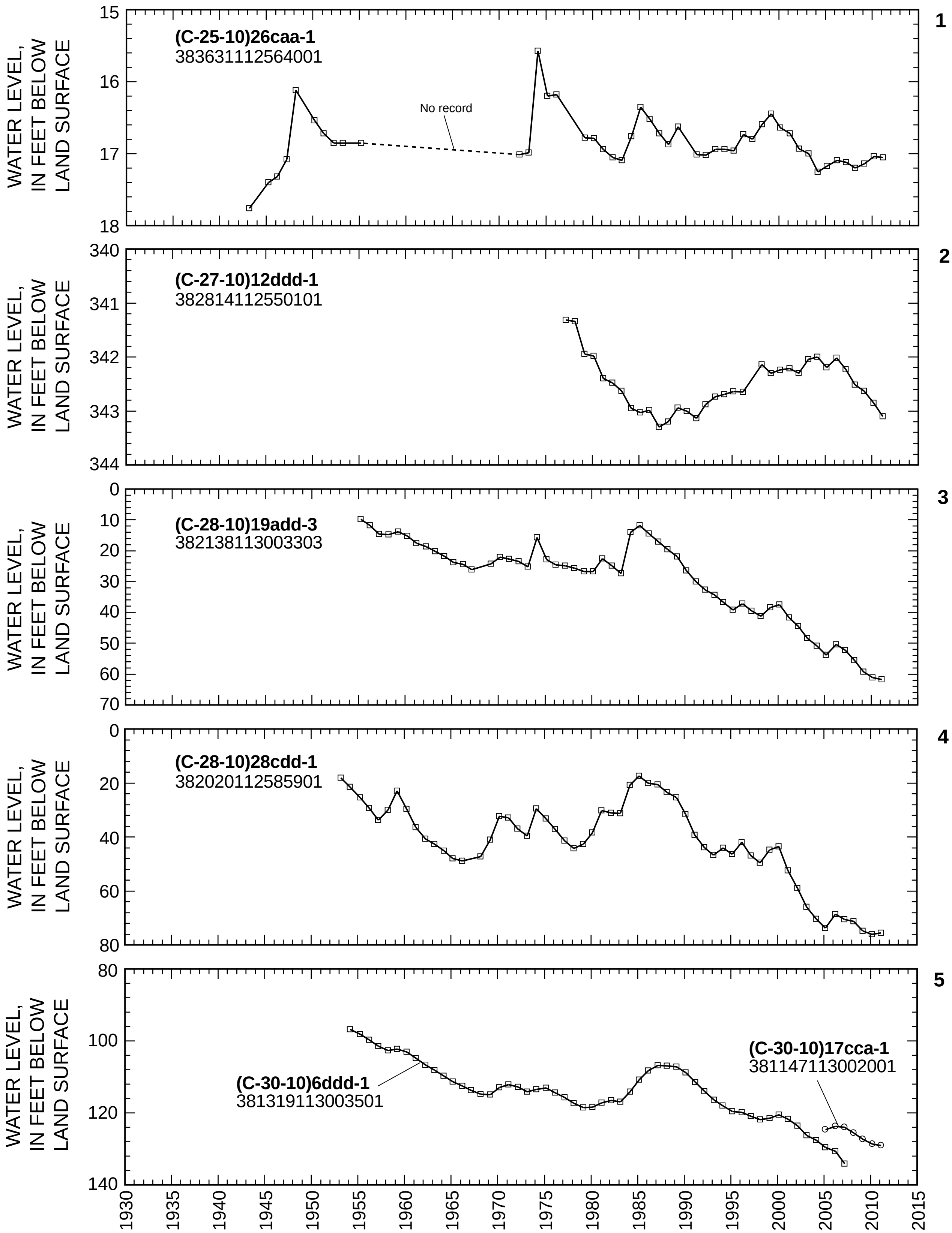


Figure 29. Relation of water level in selected wells in the Milford area to cumulative departure from average annual precipitation at Black Rock, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-29-10)5cdd-2.

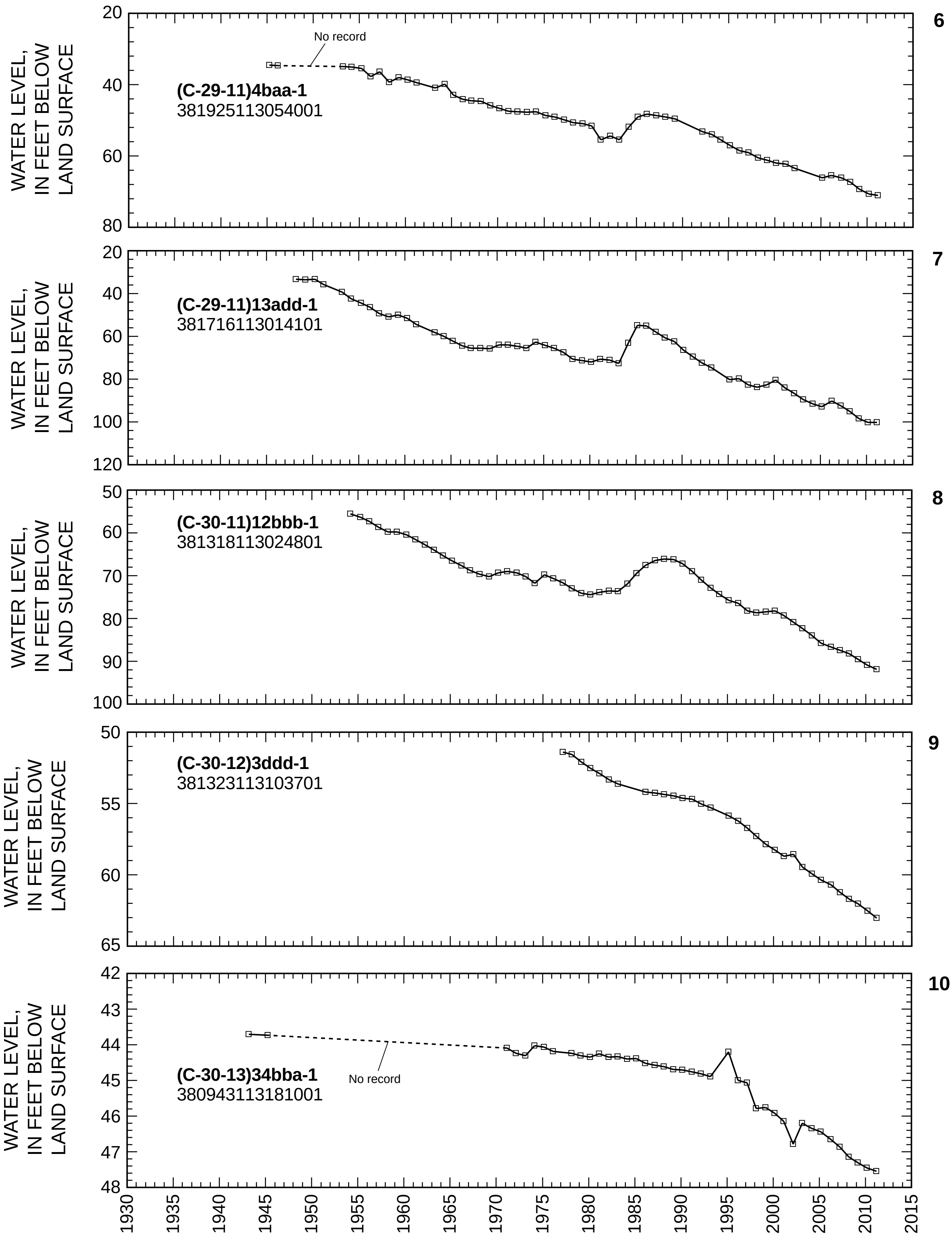


Figure 29. Relation of water level in selected wells in the Milford area to cumulative departure from average annual precipitation at Black Rock, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-29-10)5cdd-2.—Continued

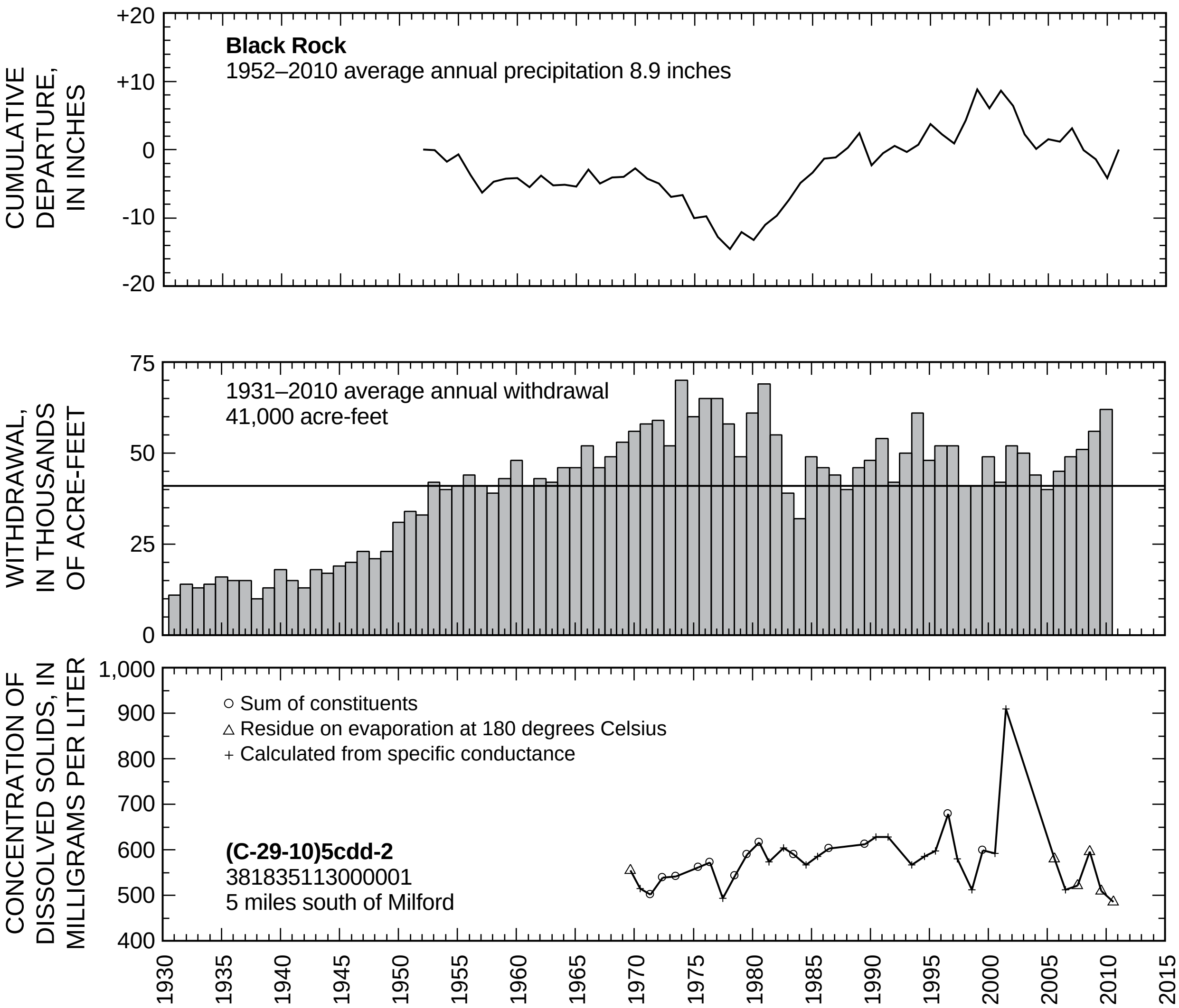


Figure 29. Relation of water level in selected wells in the Milford area to cumulative departure from average annual precipitation at Black Rock, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-29-10)5cdd-2.—Continued

Escalante Valley

Beryl-Enterprise Area

By Howard K. Christiansen

The Beryl-Enterprise area covers about 800 square miles at the southern end of Escalante Valley, southeast of the Wah Wah Mountains in Iron County, and a small area in Washington County in the vicinity of the community of Enterprise (fig. 30). Groundwater occurs in unconsolidated basin-fill deposits in the valley.

Total estimated withdrawal of water from wells in the Beryl-Enterprise area in 2010 was about 90,000 acre-feet, which is 3,000 acre-feet less than in 2009 and 2,000 acre-feet more than the average annual withdrawal for 2000–2009 (tables 2 and 3).

The location of wells in the Beryl-Enterprise area in which the water level was measured during March 2011 is shown in figure 30. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Enterprise, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-2 is shown in figure 31.

Precipitation at Enterprise in 2010 was about 25.3 inches, which is about 11.1 inches more than the average annual precipitation for 1955–2010 and about 13.4 inches more than in 2009.

Water levels declined slightly from March 2010 to March 2011 in most of the wells measured in the Beryl-Enterprise area. Water levels have declined steadily since 1950 and show little or no recovery during periods of greater-than-average precipitation. The declines are a result of continued large withdrawals for irrigation since 1950. A decline of about 130 feet from March 1948 to March 2011 was measured in well (C-36-16)29daa-1, about 5 miles northeast of Enterprise (fig. 31).

Physical properties and results of chemical analyses for water from five wells in the Beryl-Enterprise area are listed in tables 5 and 6, and the locations of the wells are plotted in figure 41. The concentration of dissolved solids in water samples from wells (C-34-16)28ddc-2, (C-34-17)32cca-1, and (C-36-15)4bad-3, exceeded the secondary drinking-water standard (500 mg/L). Also, water from well (C-36-15)4bad-3 exceeded the MCL for arsenic (10 µg/L).

The concentration of dissolved solids in water samples collected from well (C-34-16)28dcc-2, located 6 miles south-southeast of Beryl, from 1950 to 2010, is shown in figure 31. Based on the chemistry of the water from well (C-34-16)28dcc-2, the sum of the constituents has been determined to be the best method to estimate the concentration of dissolved solids. The concentration has ranged from 460 to 699 mg/L with a median value of 648 mg/L. The concentration of dissolved solids in the water sample collected in August 2010 was 667 mg/L.

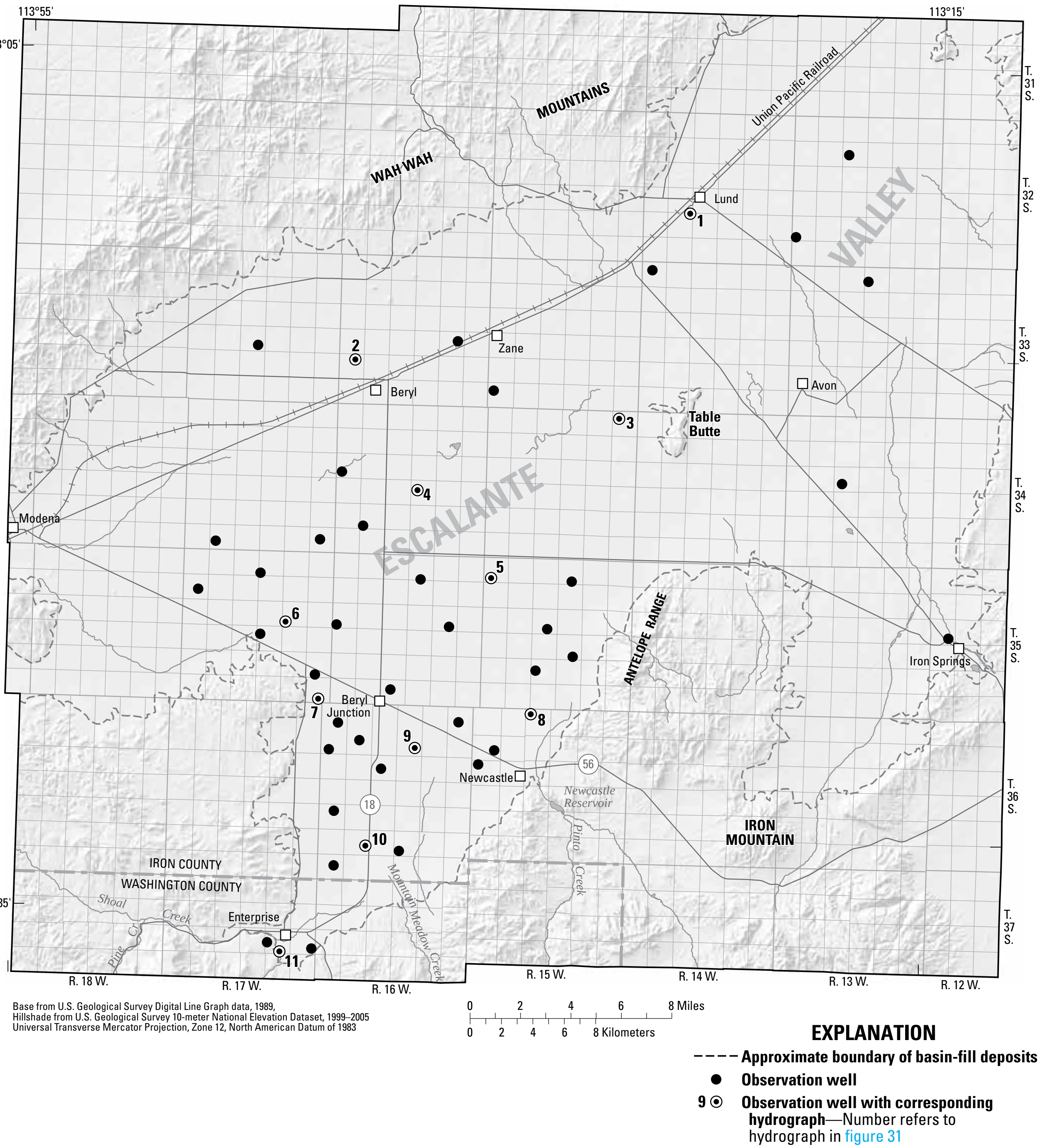


Figure 30. Location of wells in the Beryl-Enterprise area in which the water level was measured during March 2011.

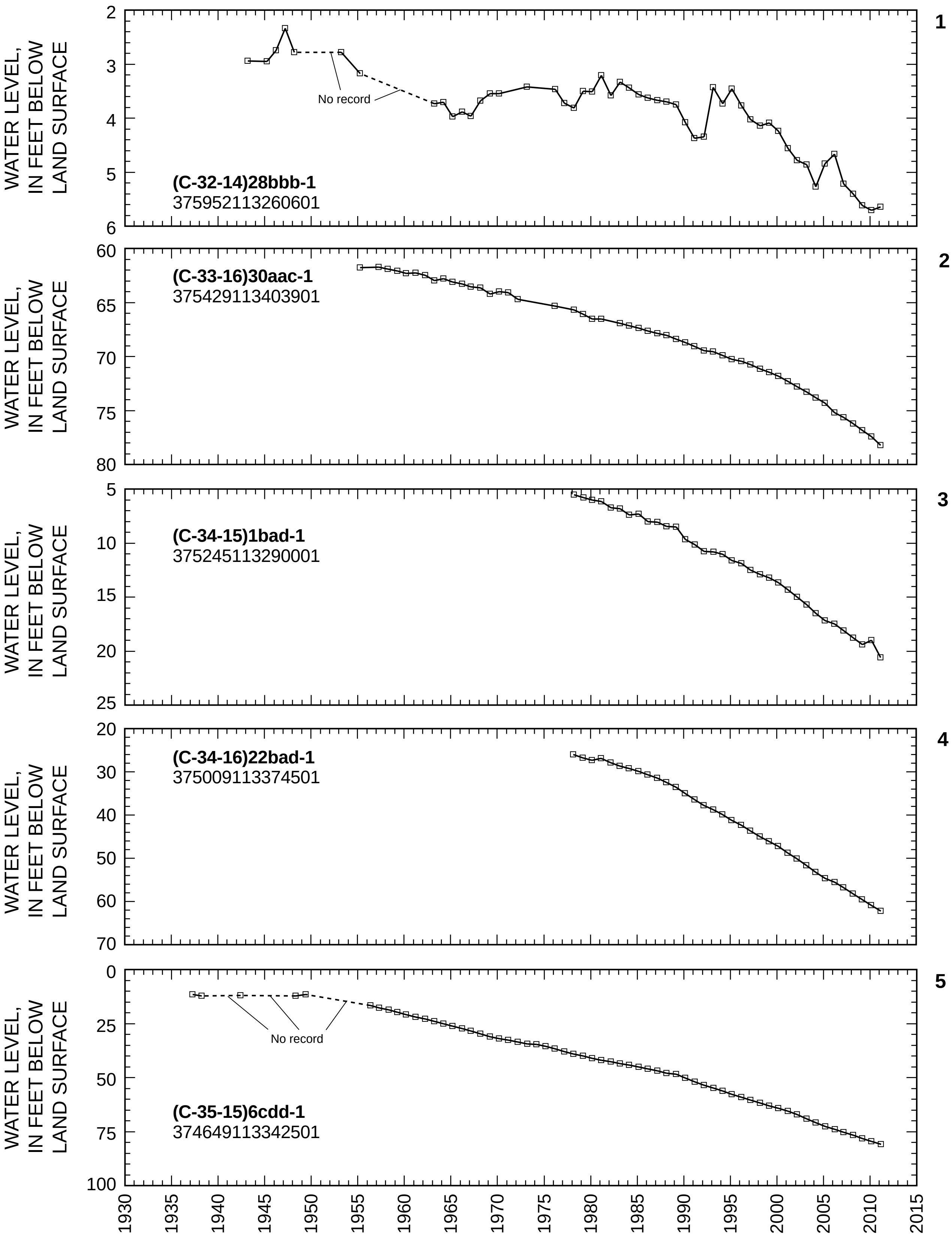


Figure 31. Relation of water level in selected wells in the Beryl-Enterprise area to cumulative departure from average annual precipitation at Enterprise, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-2.

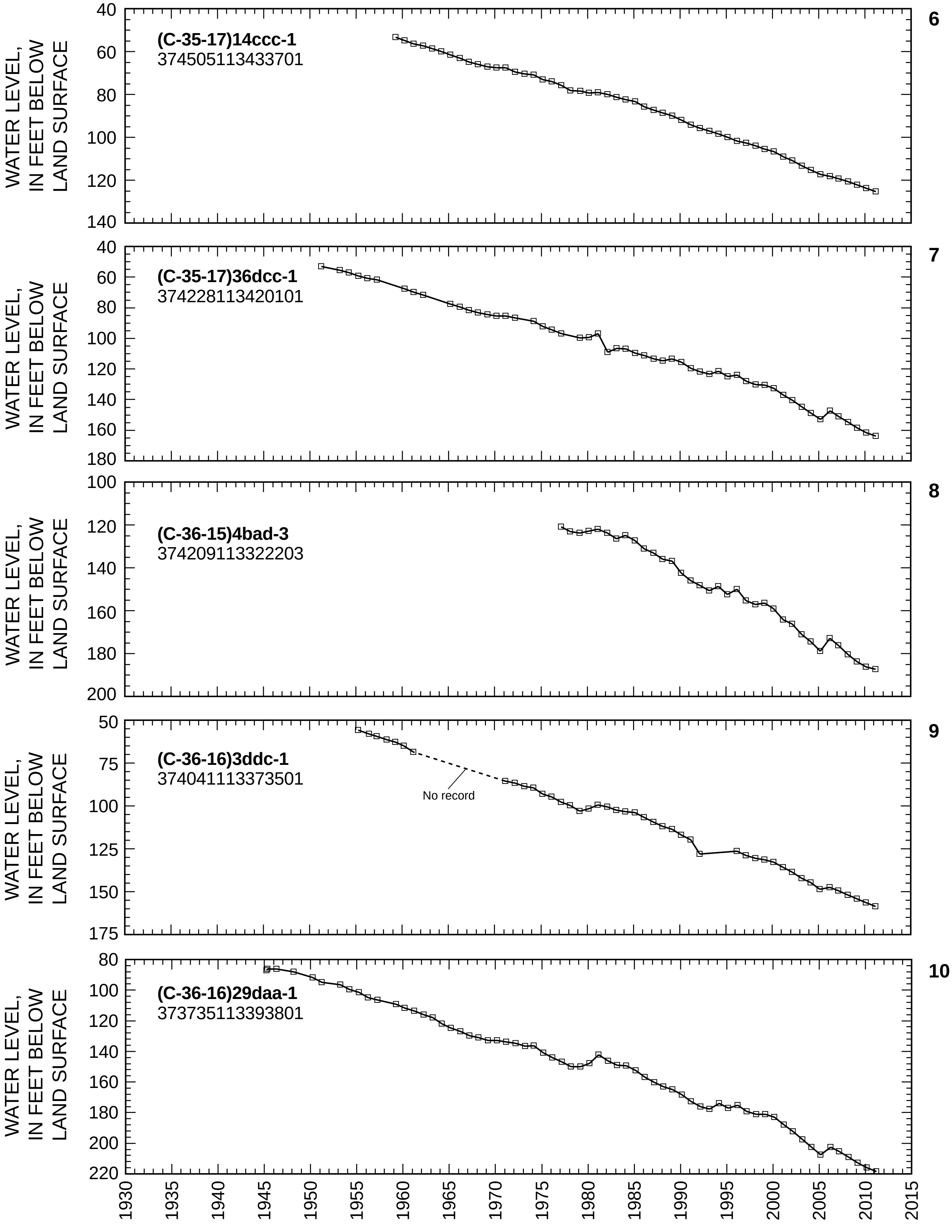


Figure 31. Relation of water level in selected wells in the Beryl-Enterprise area to cumulative departure from average annual precipitation at Enterprise, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-2.—Continued

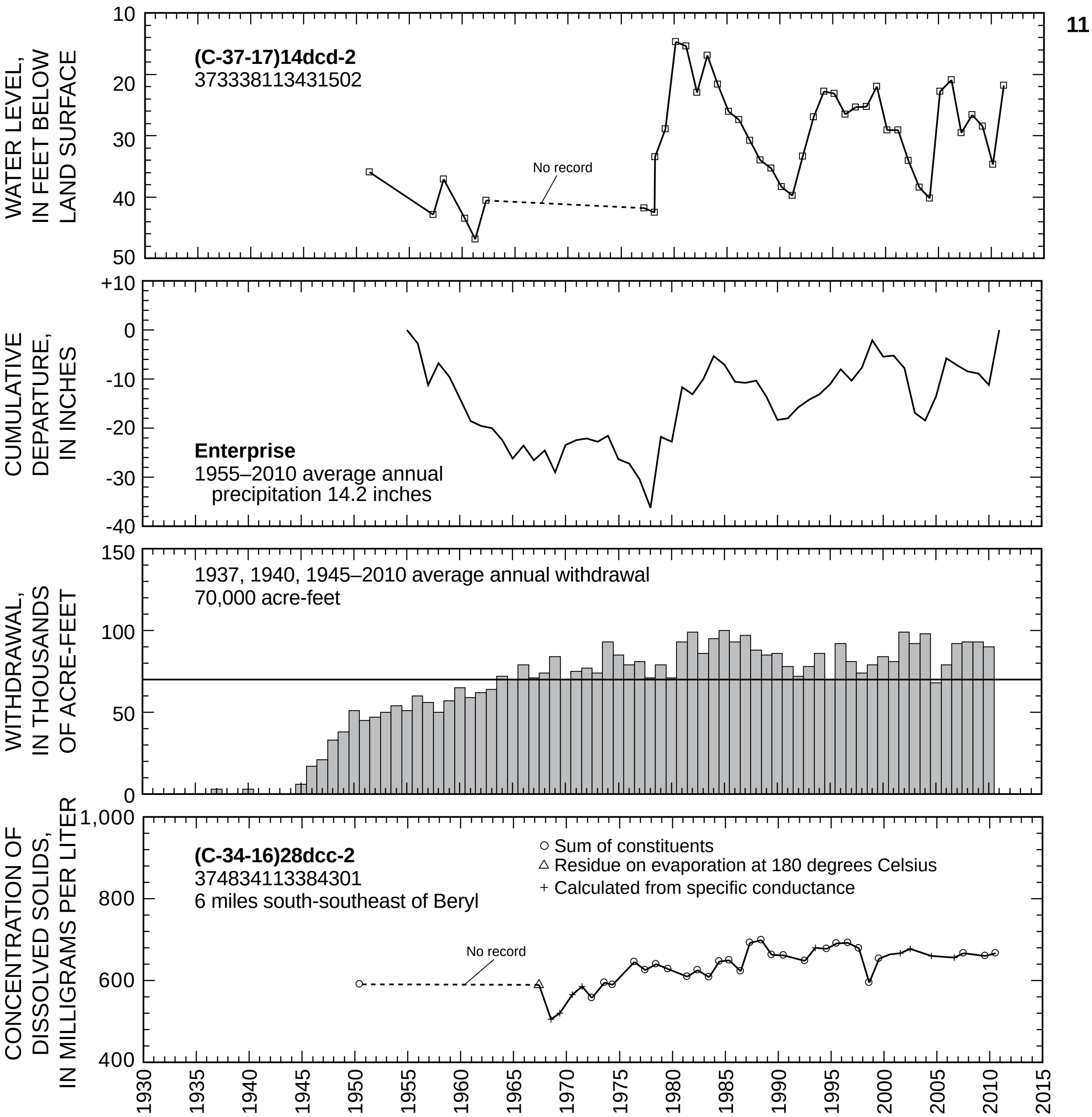


Figure 31. Relation of water level in selected wells in the Beryl-Enterprise area to cumulative departure from average annual precipitation at Enterprise, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-2.—Continued

Central Virgin River Area

By Howard K. Christiansen

The central Virgin River area is between the Pine Valley Mountains and the Hurricane Cliffs, and is bounded by the Beaver Dam Mountains to the southwest, in Washington County (fig. 32). Major groundwater development includes water from valley-fill aquifers that is used primarily for irrigation, and water from consolidated rock and valley fill that is used primarily for public supply. Most of the wells are located near the Virgin and Santa Clara Rivers.

Total estimated withdrawal of water from wells in the central Virgin River area in 2010 was about 29,000 acre-feet, which is about 4,000 acre-feet less than in 2009 and the same as the average annual withdrawal for 2000–2009 (tables 2 and 3). Withdrawal for irrigation decreased by about 100 acre-feet from 2009 to 2010. Withdrawal for public supply decreased by about 5,000 acre-feet. Withdrawals for domestic and stock use were about the same as in 2009.

The location of wells in the central Virgin River area in which the water level was measured during February 2011 is shown in figure 32. The relation of the water level in selected observation wells to annual discharge of the Virgin River at Virgin, to cumulative departure from average annual precipitation at St. George, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-41-17)8cbd-2 is shown in figure 33.

Discharge of the Virgin River at Virgin in 2010 was about 183,800 acre-feet, which is 92,000 acre-feet more than in 2009 and about 50,600 acre-feet more than the long-term average for 1931–70 and 1979–2010. Precipitation at St. George in 2010 was about 15.0 inches, which is about 6.8 inches more than the average annual precipitation for 1930–2010 and 11.7 inches more than in 2009.

Water levels from February 2010 to February 2011generally rose in the central Virgin River area. Rises are probably the result of greater-than-average precipitation and decreased withdrawals for public supply.

Physical properties and results of chemical analyses for water from three wells in the central Virgin River area are listed in tables 5 and 6, and the locations of the wells are plotted in figure 41. The water from wells (C-42-14)15cbd-1 and (C-43-15)25cdd-1 exceeded the MCLs for dissolved solids (2,000 mg/L) and sulfate (1,000 mg/L). Also, water from well (C-42-14)15cbd-1 exceeded the secondary standard for chloride (250 mg/L) and the MCLs for nitrate plus nitrite (10 mg/L) and arsenic (10 µg/L). Water from well (C-41-17)8cdb-2 also exceeded the MCL for arsenic.

The concentration of dissolved solids in water samples collected from wells (C-41-17)8cbd-1 and (C-41-17)8cbd-2, located 1.5 miles south of Gunlock Reservoir, from 1966 to 2010, is shown in figure 33. These wells are located near each other and are finished in the same aquifer. The dissolved-solids concentrations in water samples from both wells were combined to give an extended temporal record for this constituent. The concentration has ranged from 255 to 313 mg/L with a median value of 290 mg/L. The dissolved-solids concentration in the water sample collected in August 2010 (292 mg/L) is very close to the median value.

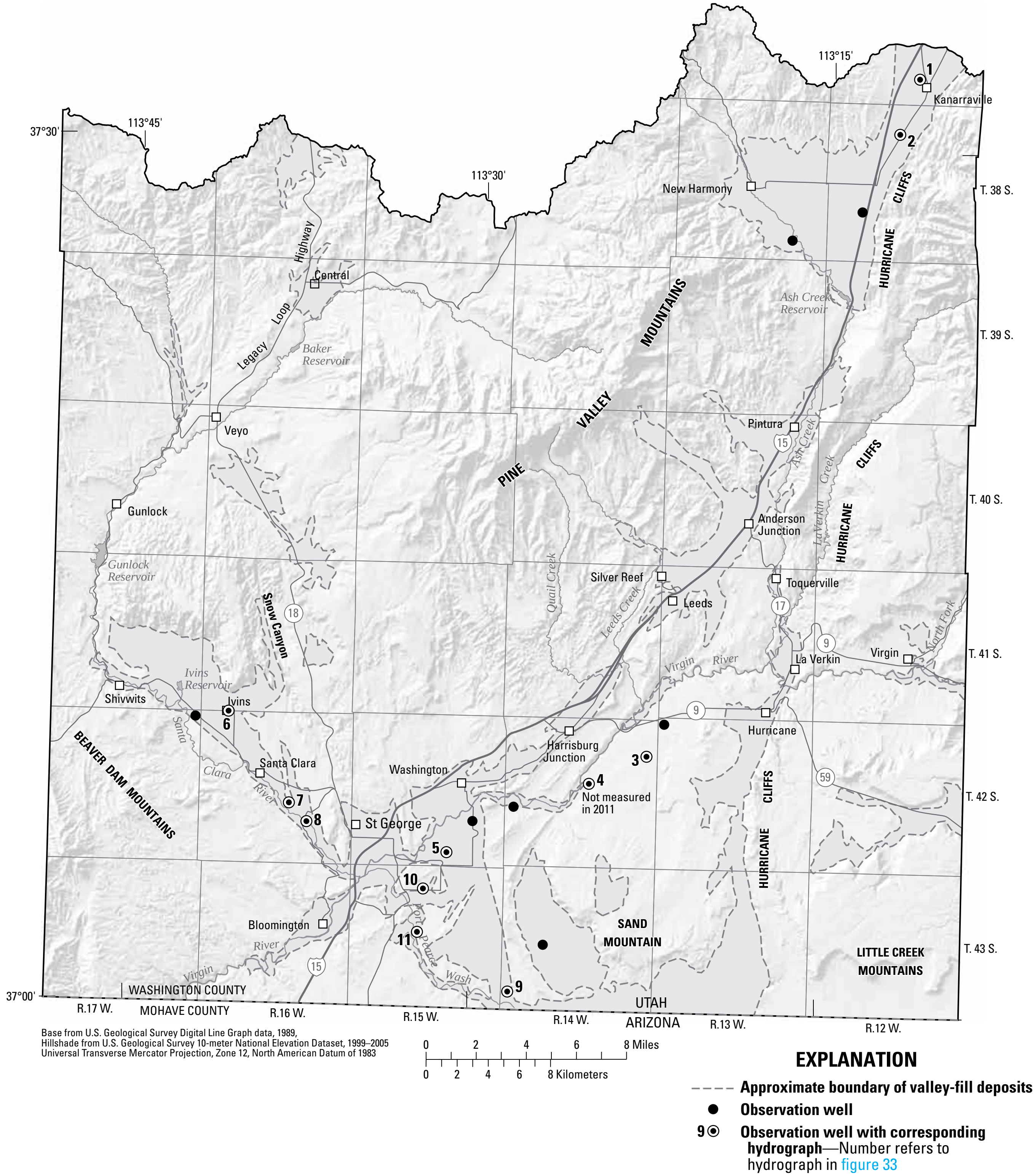


Figure 32. Location of wells in the central Virgin River area in which the water level was measured during February 2011.

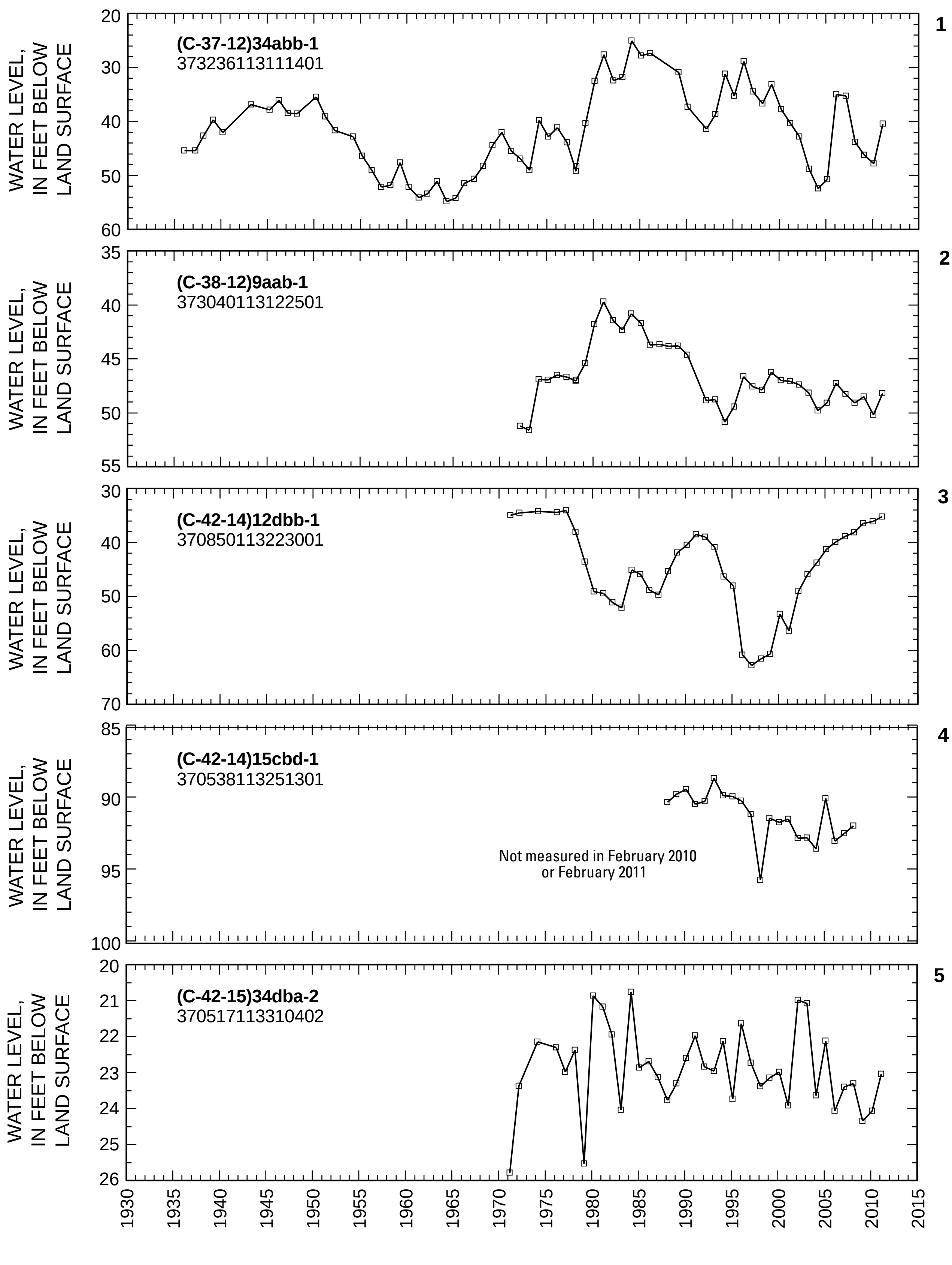


Figure 33. Relation of water level in selected wells in the central Virgin River area to annual discharge of the Virgin River at Virgin, to cumulative departure from average annual precipitation at St. George, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-41-17)8cbd-2.

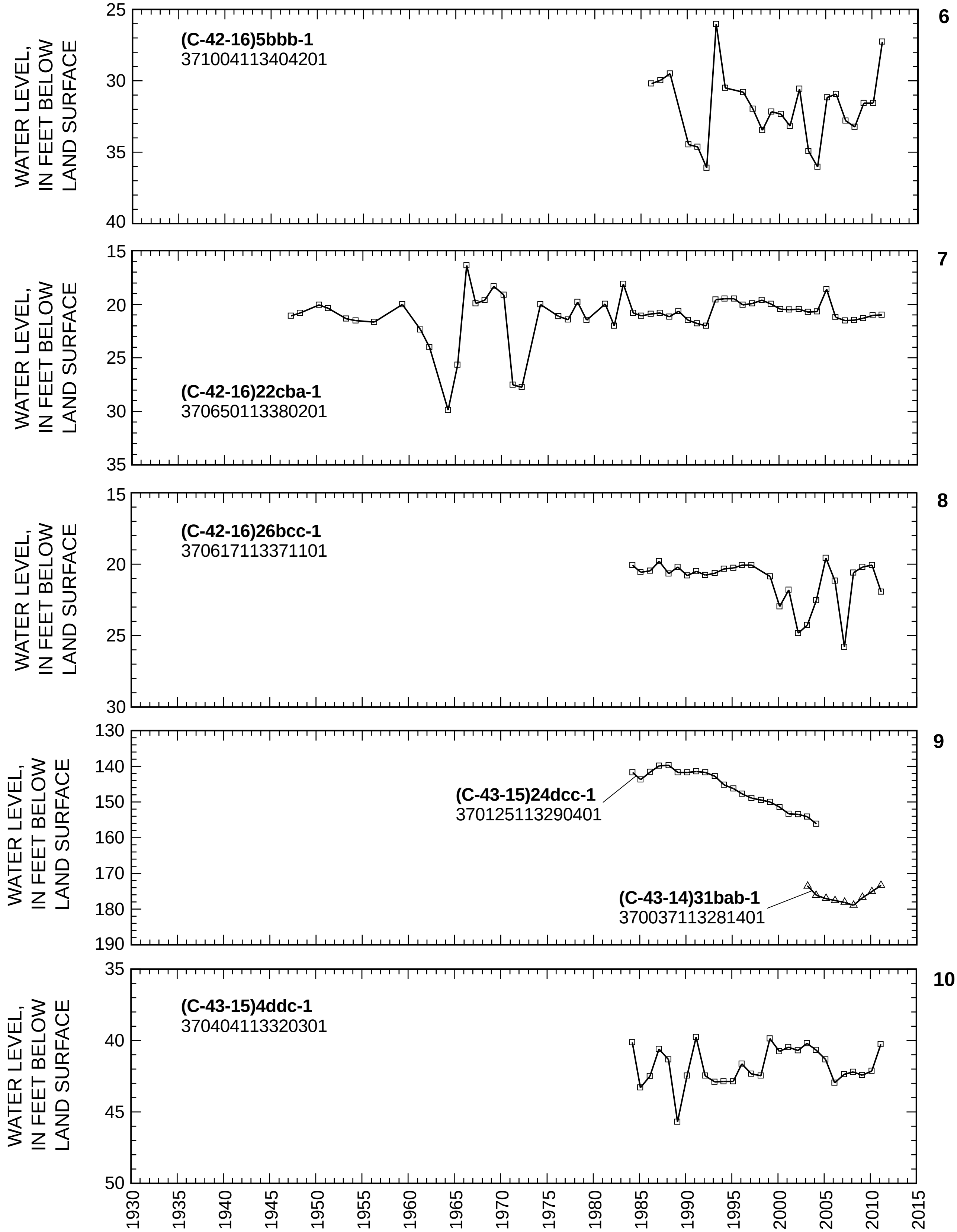


Figure 33. Relation of water level in selected wells in the central Virgin River area to annual discharge of the Virgin River at Virgin, to cumulative departure from average annual precipitation at St. George, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-41-17)8cbd-2.—Continued

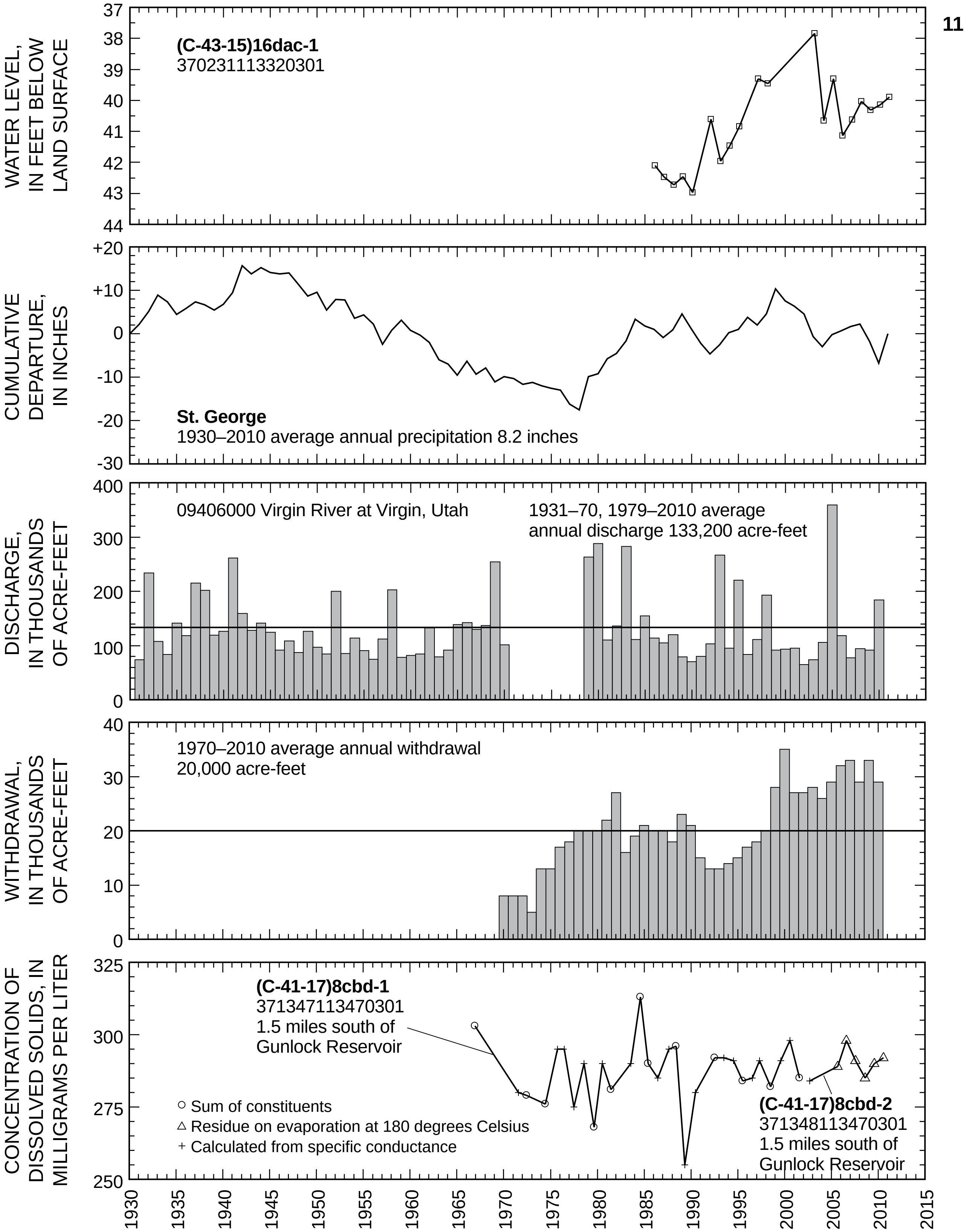


Figure 33. Relation of water level in selected wells in the central Virgin River area to annual discharge of the Virgin River at Virgin, to cumulative departure from average annual precipitation at St. George, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-41-17)8cbd-2.—Continued

Other Areas

By Martel J. Fisher

Total estimated withdrawal of water from wells in other areas of Utah listed below in 2010 was about 134,000 acre-feet, which is 4,000 acre-feet more than the estimate for 2009 and 3,000 acre-feet more than the average annual withdrawal for 2000–2009 (tables 2 and 3). The largest increases were due to increased withdrawals for public-supply use. In many of the areas listed below (table 4), withdrawals in 2010 were less than in 2009, except in Grouse Creek Valley, lower Bear River Valley, and Sanpete Valley, where irrigation withdrawals increased slightly or stayed the same, and in Ogden Valley and Cedar Valley, Utah County, where public-supply use increased slightly.

The location of wells in Cedar Valley, Utah County, in which the water level was measured during March 2011 is shown in figure 34. The relation of the water level in observation wells in Cedar Valley to cumulative departure from average annual precipitation at Provo BYU is shown in figure 35.

Water levels in selected wells in Cedar Valley generally rose during the 1970s. Water levels rose sharply from the early to mid-1980s as a result of greater-than-average precipitation, but generally have declined since the mid-1980s. Water levels declined slightly in most of the wells from March 2010 to March 2011.

The location of wells in Sanpete Valley in which the water level was measured during March 2011 is shown in figure 36. The relation of the water level in selected observation wells in Sanpete Valley to cumulative departure from average annual precipitation at Manti is shown in figure 37.

Water levels in many of the selected wells in Sanpete Valley rose from the late-1970s to the mid-1980s as a result of greater-than-average precipitation and have varied since the mid-1980s, but overall have declined. Water levels rose or decreased only slightly in most of the selected observation wells from March 2010 to March 2011.

The location of wells in Snake Valley and the West Desert in which the water level was measured during March 2011 is shown in figure 38. The relation of the water level in selected observation wells in the area to cumulative departure from average annual precipitation at Callao is shown in figure 39.

Water levels in many of the selected wells in Snake Valley and the West Desert rose, or decreased only slightly, from March 2010 to March 2011. Water levels rose sharply in the early to mid-1980s as a result of greater-than-average precipitation, but have generally declined since the mid-1980s.

The relation of the water level in wells in the remaining selected areas of Utah (table 4) to cumulative departure from average annual precipitation at sites in or near those areas is shown in figure 40. Water levels rose or decreased only slightly in most of the selected observation wells from March 2010 to March 2011.

Table 4. Estimated withdrawal of water from wells in other areas of Utah, 2010.

Number in figure 1	Area	Estimated withdrawal from wells (acre-feet)					
		2010					2009 total (rounded)
		Irrigation	Industrial	Public supply	Domestic and stock	Total (rounded)	
1	Grouse Creek Valley	1,800	0	0	20	1,800	1,700
2	Park Valley area	1,800	0	0	10	1,800	2,000
4	Lower Bear River area	3,700	340	6,900	200	11,100	7,900
8	Ogden Valley	0	0	12,100	20	12,100	11,200
13	Rush Valley	4,300	230	280	30	4,800	5,400
14	Skull Valley, Dugway area, and Old River Bed	2,200	3,600	780	10	6,600	7,400
15	Cedar Valley, Utah County	1,400	0	4,300	40	5,700	6,200
20	Sanpete Valley	4,900	850	600	4,000	10,400	10,300
25a	Snake Valley	17,400	0	90	50	17,500	18,500
27	Beaver Valley	8,600	20	1,200	460	10,300	12,800
	Remainder of State	12,000	16,500	20,300	2,600	51,400	46,400
Total (rounded)		58,100	21,500	46,600	7,400	134,000	130,000

Water Quality

Physical properties and results of chemical analyses for water from wells in the areas indicated below are listed in tables 5 and 6, and the locations of the wells are shown in figure 41.

Beaver Valley

The water sample from well (C-29-8)25aca-1, the only well sampled in Beaver Valley, exceeded the secondary standard for manganese (50 µg/L) and exceeded the MCL for arsenic (10 µg/L).

Lower Bear River area

Concentrations of dissolved solids and chloride in water from the four wells sampled in the lower Bear River area exceeded the secondary standards for these constituents (500 mg/L and 250 mg/L, respectively). Also, water from well (B-12-4)26bbb-1 exceeded the secondary standard for sulfate (250 mg/L), and the MCLs for dissolved solids (2,000 mg/L) and nitrate plus nitrite (10 mg/L).

Duchesne River area

Water from three of the five wells sampled in the Duchesne River area, including wells U(C-1-1)33bcc-1, U(C-1-4)31bbb-1, and U(C-2-4)28aba-1, exceeded the secondary standard for dissolved solids (500 mg/L). Also, water from well U(C-1-1)33bcc-1 exceeded the secondary standard for sulfate (250 mg/L) and iron (300 µg/L).

Curlew Valley (Kelton area)

Concentrations of dissolved solids in water from the three wells sampled in the Kelton area of Curlew Valley exceeded the secondary standard for this constituent (500 mg/L). Also, water from well (B-12-11)8abb-1 exceeded the MCL for dissolved solids (2,000 mg/L). Water from two wells, (B-12-11)8abb-1 and (B-12-11)8bbb-1, exceeded the secondary standard for chloride (250 mg/L).

Snake Valley

The concentration of dissolved solids in the water sample from well (C-11-17)11aaa-1, one of three wells sampled in Snake Valley, exceeded the secondary standard for this constituent (500 mg/L).

Sanpete Valley

The water sample from well (D-14-3)20aca-1, one of three wells sampled in Sanpete Valley, exceeded the MCL for nitrate plus nitrite (10 mg/L).

Upper Sevier River area

Concentrations of major ions, trace elements, and nutrients in water from the three wells sampled in this area did not exceed secondary standards or MCLs.

Rush Valley

Water samples from two of the three wells sampled in Rush Valley, including wells (C-5-5)32dbb-2 and (C-8-5)31ccd-5, exceeded the secondary standard for dissolved solids (500 mg/L). Also, water from well (C-8-5)31ccd-5 exceeded the secondary standard for chloride (250 mg/L).

Skull Valley

Concentrations of dissolved solids and chloride in water from the two wells sampled in Skull Valley exceeded the secondary drinking-water standards for these constituents (500 and 250 mg/L, respectively) and the MCL for dissolved solids (2,000 mg/L).

Cedar Valley, Utah County

Concentrations of major ions, trace elements, and nutrients in water from the one well sampled in this area did not exceed secondary standards or MCLs.

Heber Valley

Concentrations of iron and sulfate in water from one of the ten wells sampled in Heber Valley, (D-4-4)2bcd-1, exceeded the secondary standards for these constituents (300 µg/L and 250 mg/L, respectively). Analytical results for major ions, trace elements (arsenic, molybdenum, selenium, and uranium were not analyzed for), and nutrients in water from the remaining wells sampled did not exceed secondary standards or MCLs.

Upper Fremont River Valley

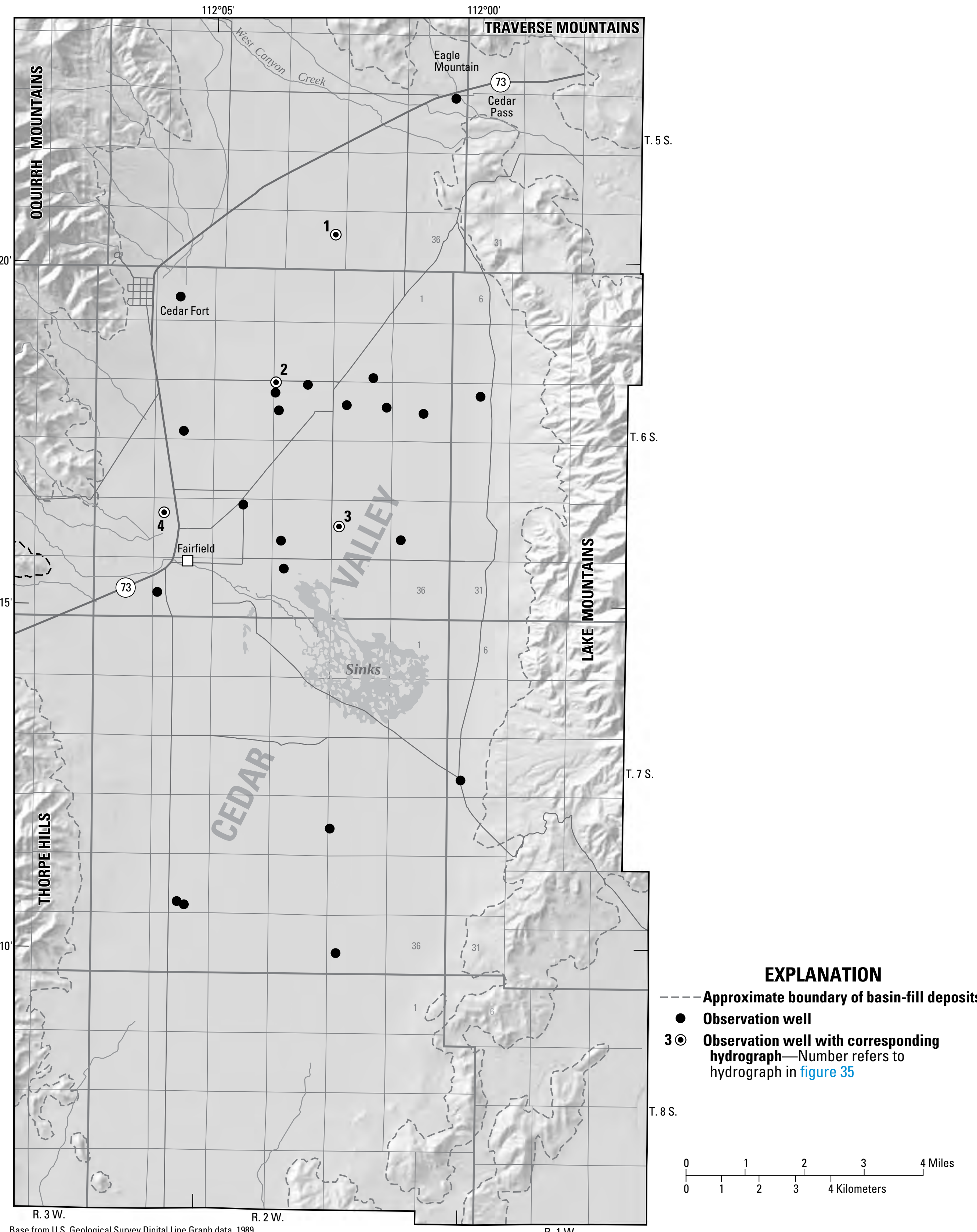
The concentration of arsenic in the water sample from well (D-27-22)26ddc-1, the only well sampled in the upper Fremont River Valley, exceeded the MCL for this constituent (10 µg/L).

Spanish Valley

Concentrations of dissolved solids and sulfate in water from two wells sampled in Spanish Valley, (D-25-21)35dab-1 and (D-26-22)17add-1, exceeded the secondary standards for these constituents (500 and 250 mg/L, respectively). Water from well (D-25-21)35dab-1 also exceeded the secondary standard for iron (300 µg/L).

Upper Colorado River area

The water sample from one of three wells in this area, (D-20-25)12bab-1, exceeded the secondary standard for iron (300 µg/L).



Base from U.S. Geological Survey Digital Line Graph data, 1989,
Hillshade from U.S. Geological Survey 10-meter National Elevation Dataset, 1999–2005
Universal Transverse Mercator Projection, Zone 12, North American Datum of 1983

Figure 34. Location of wells in Cedar Valley, Utah County, in which the water level was measured during March 2011.

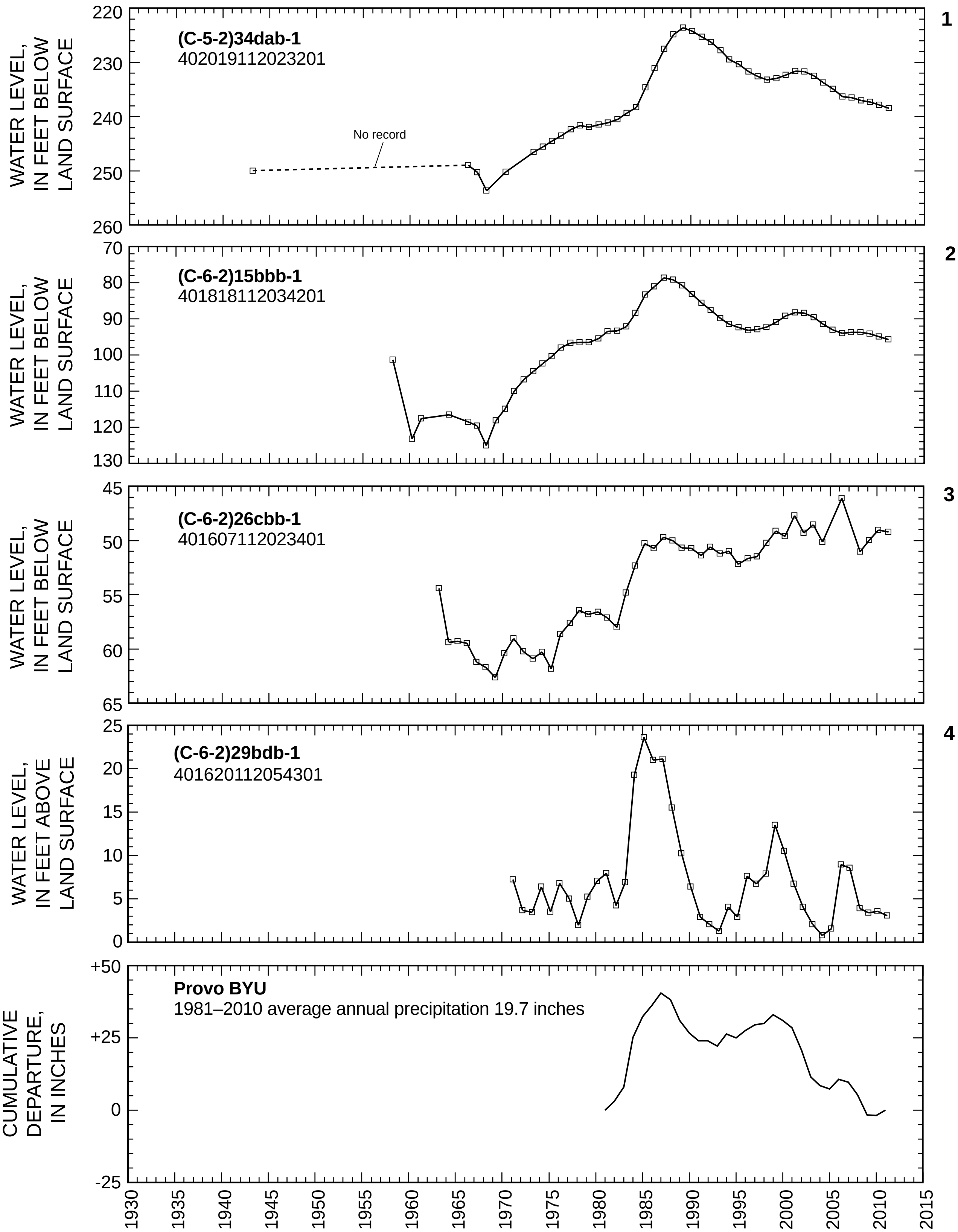
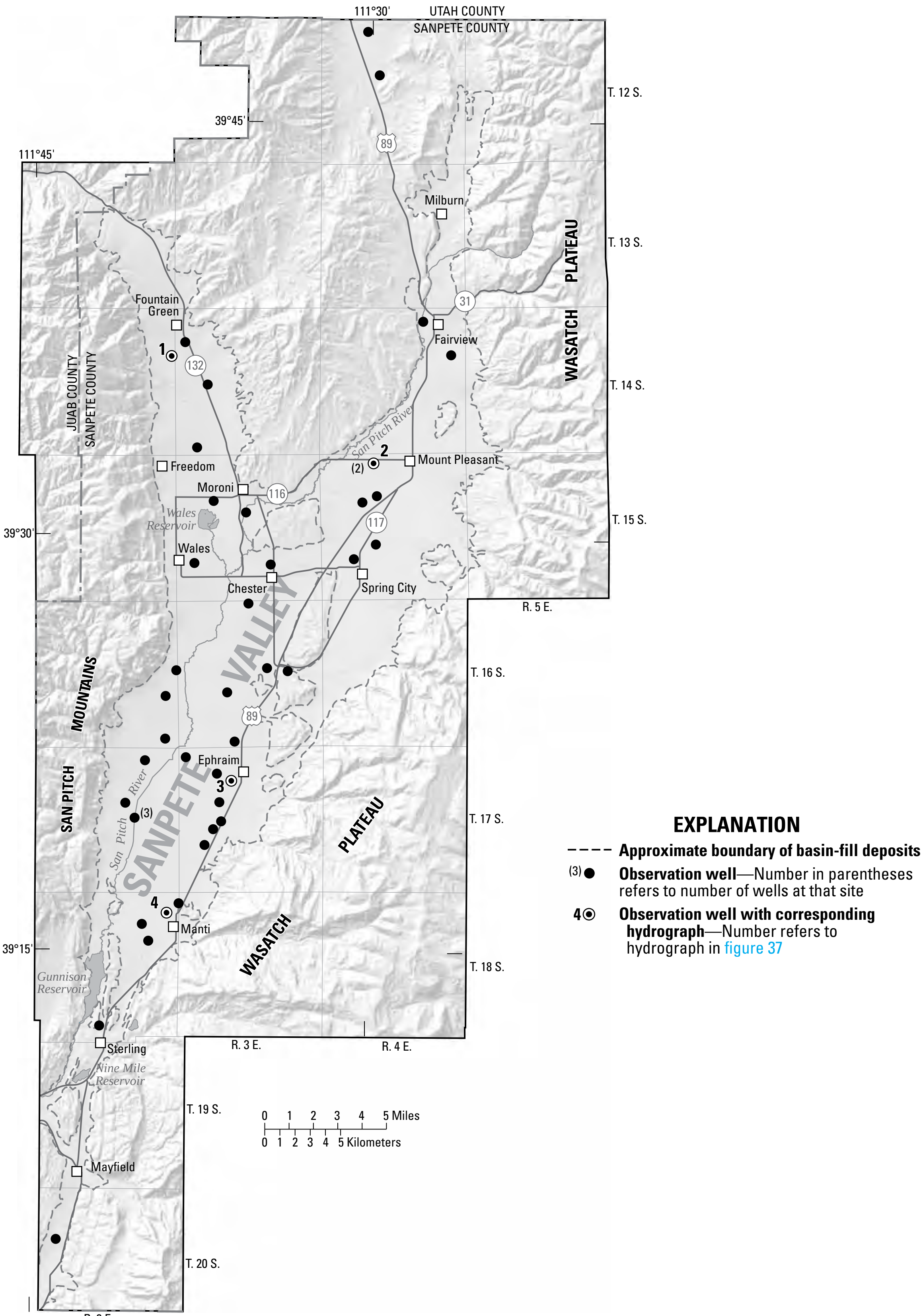


Figure 35. Relation of water level in selected wells in Cedar Valley, Utah County, to cumulative departure from average annual precipitation at Provo BYU.



Base from U.S. Geological Survey Digital Line Graph data, 1989,
Hillshade from U.S. Geological Survey 10-meter National Elevation Dataset, 1999–2005
Universal Transverse Mercator Projection, Zone 12, North American Datum of 1983

Figure 36. Locations of wells in Sanpete Valley in which the water level was measured during March 2011.

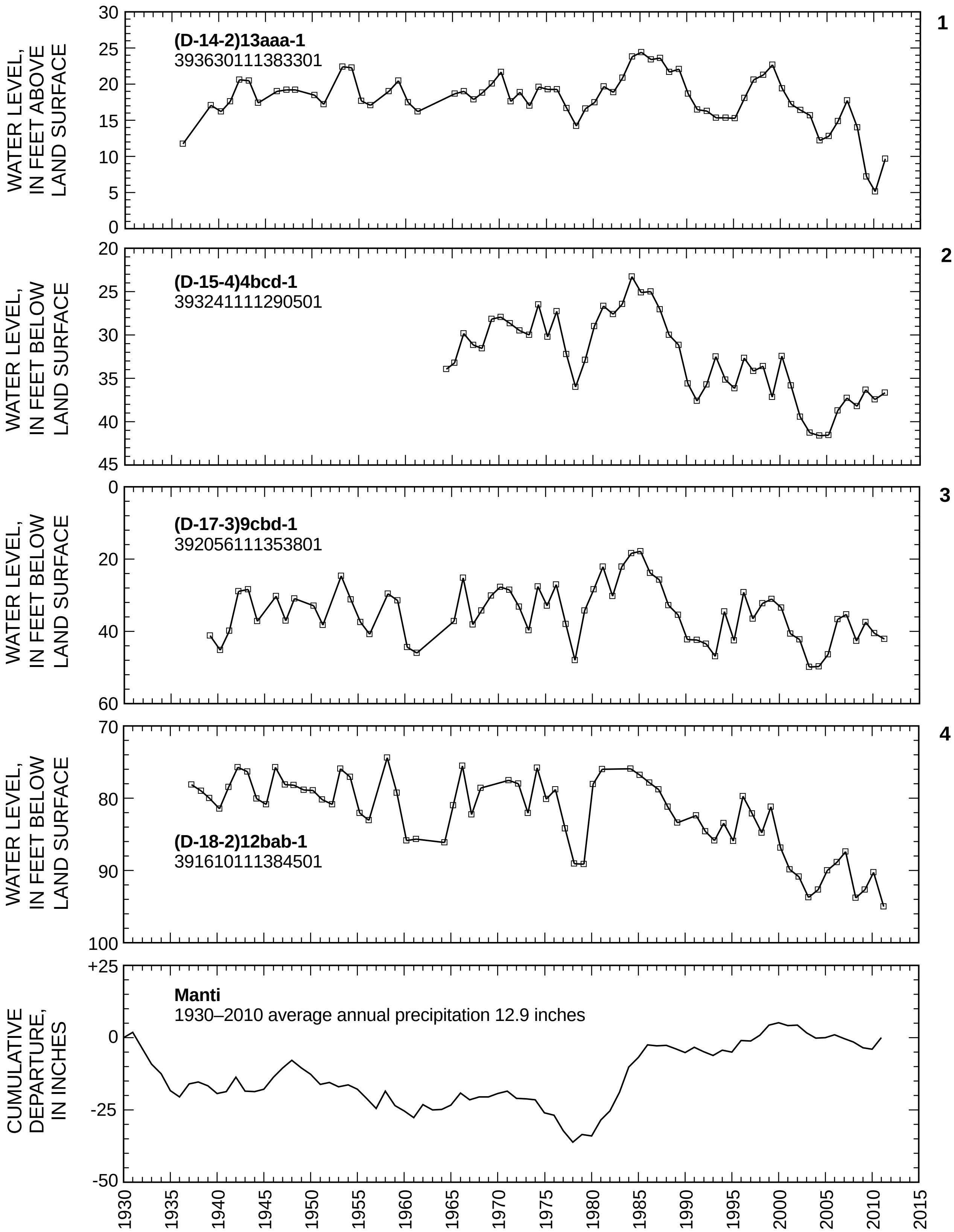


Figure 37. Relation of water level in selected wells in Sanpete Valley to cumulative departure from average annual precipitation at Manti.

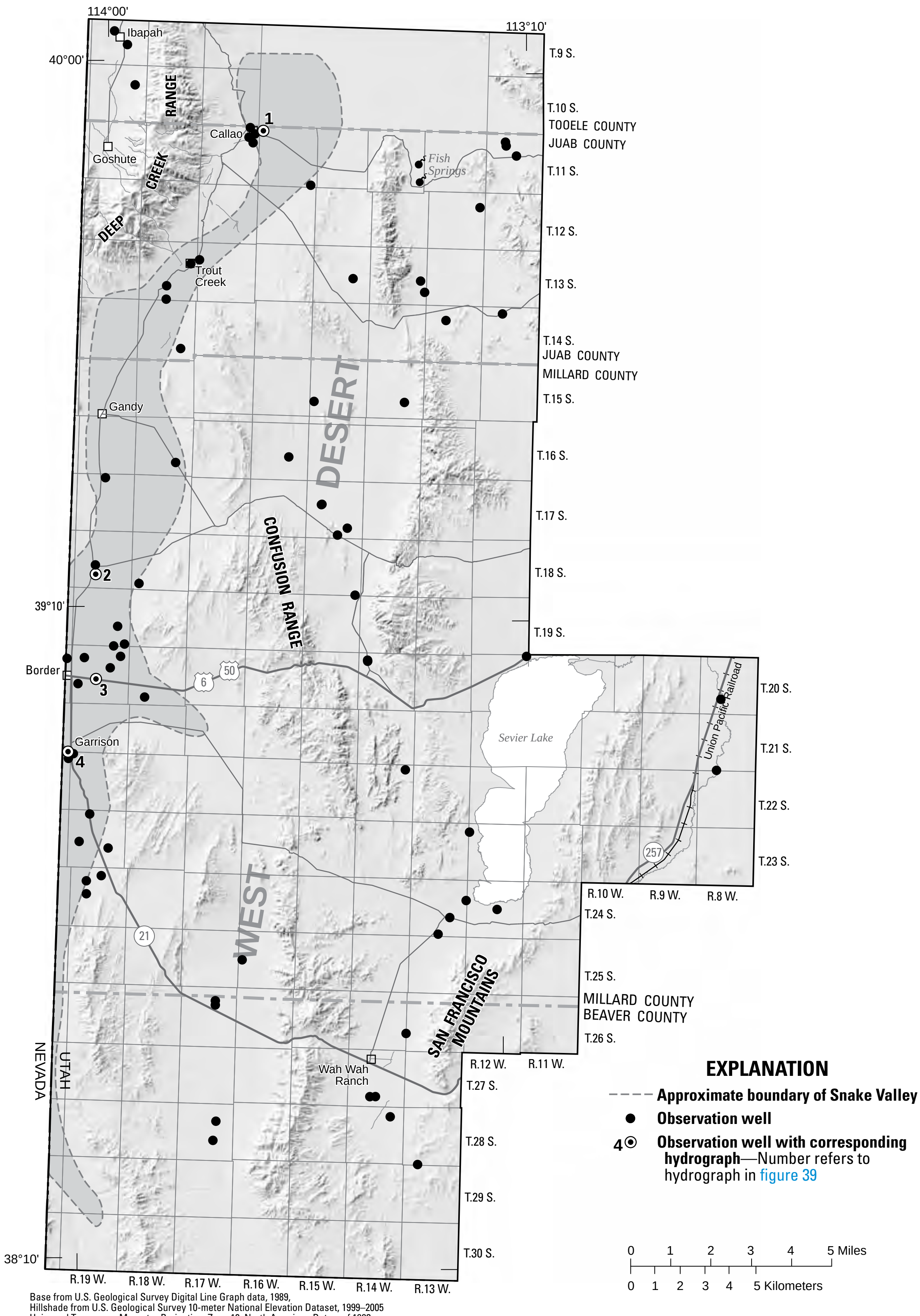


Figure 38. Location of wells in Snake Valley and the West Desert in which the water level was measured during March 2011.

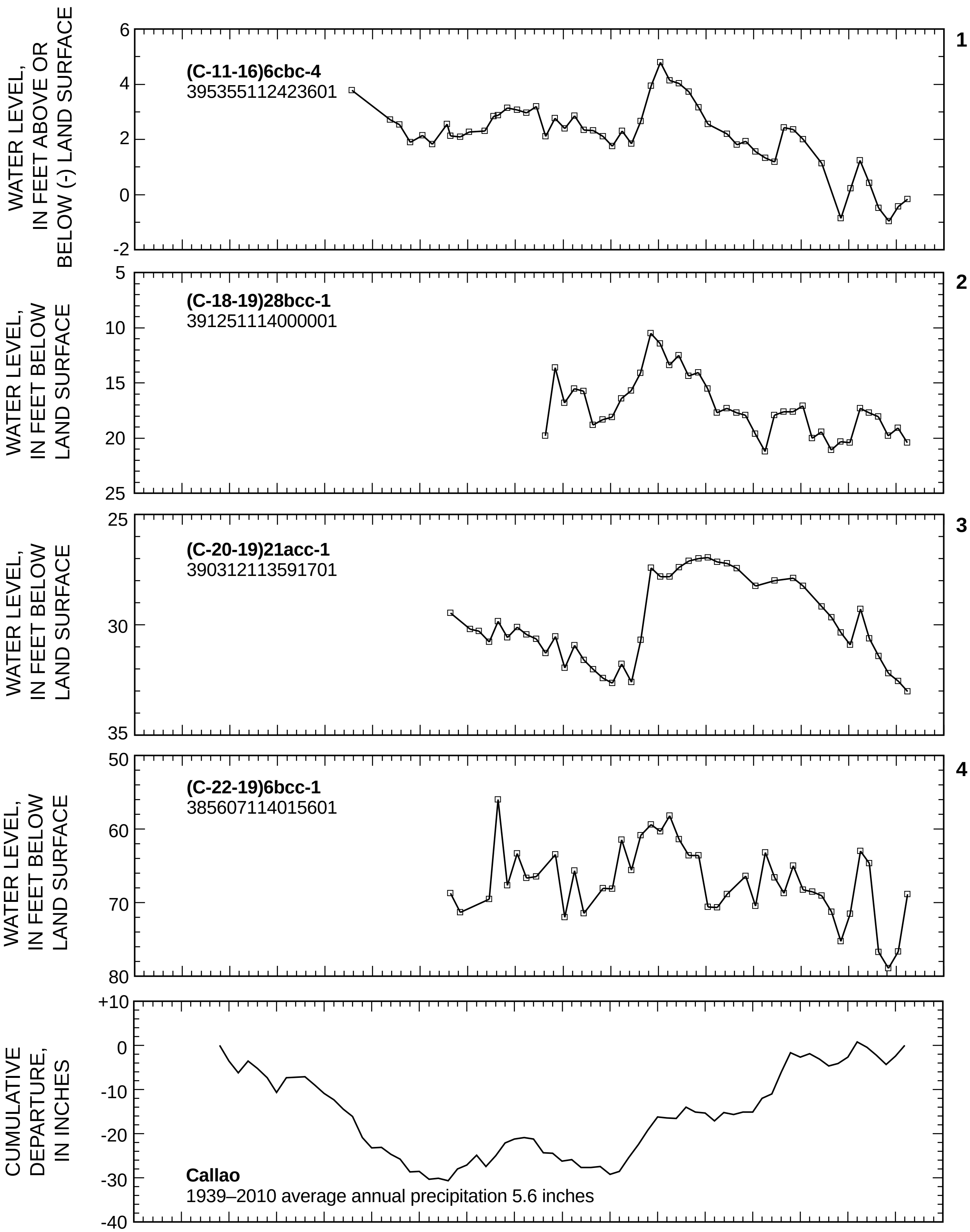


Figure 39. Relation of water level in selected wells in Snake Valley and the West Desert to cumulative departure from average annual precipitation at Callao.

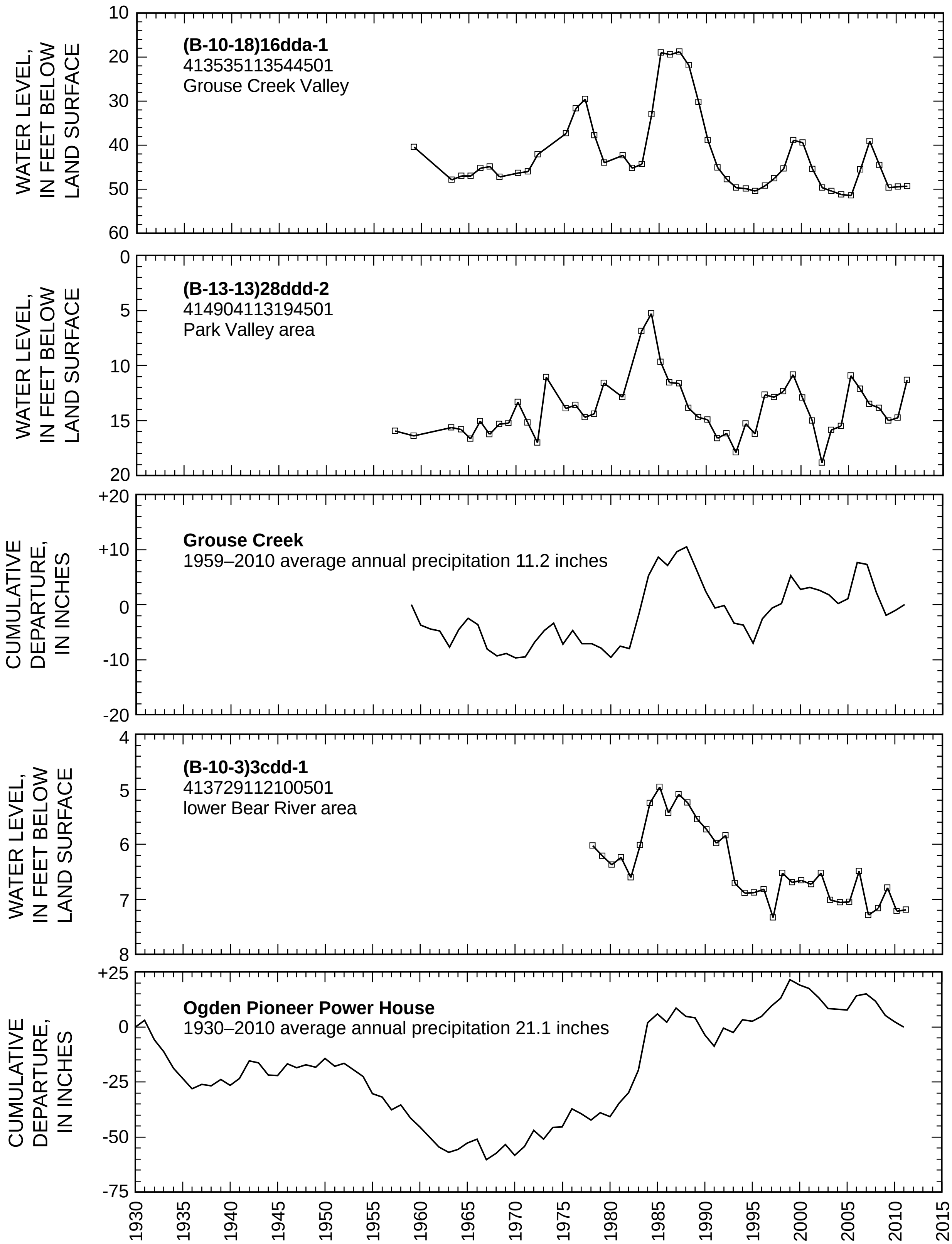


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.

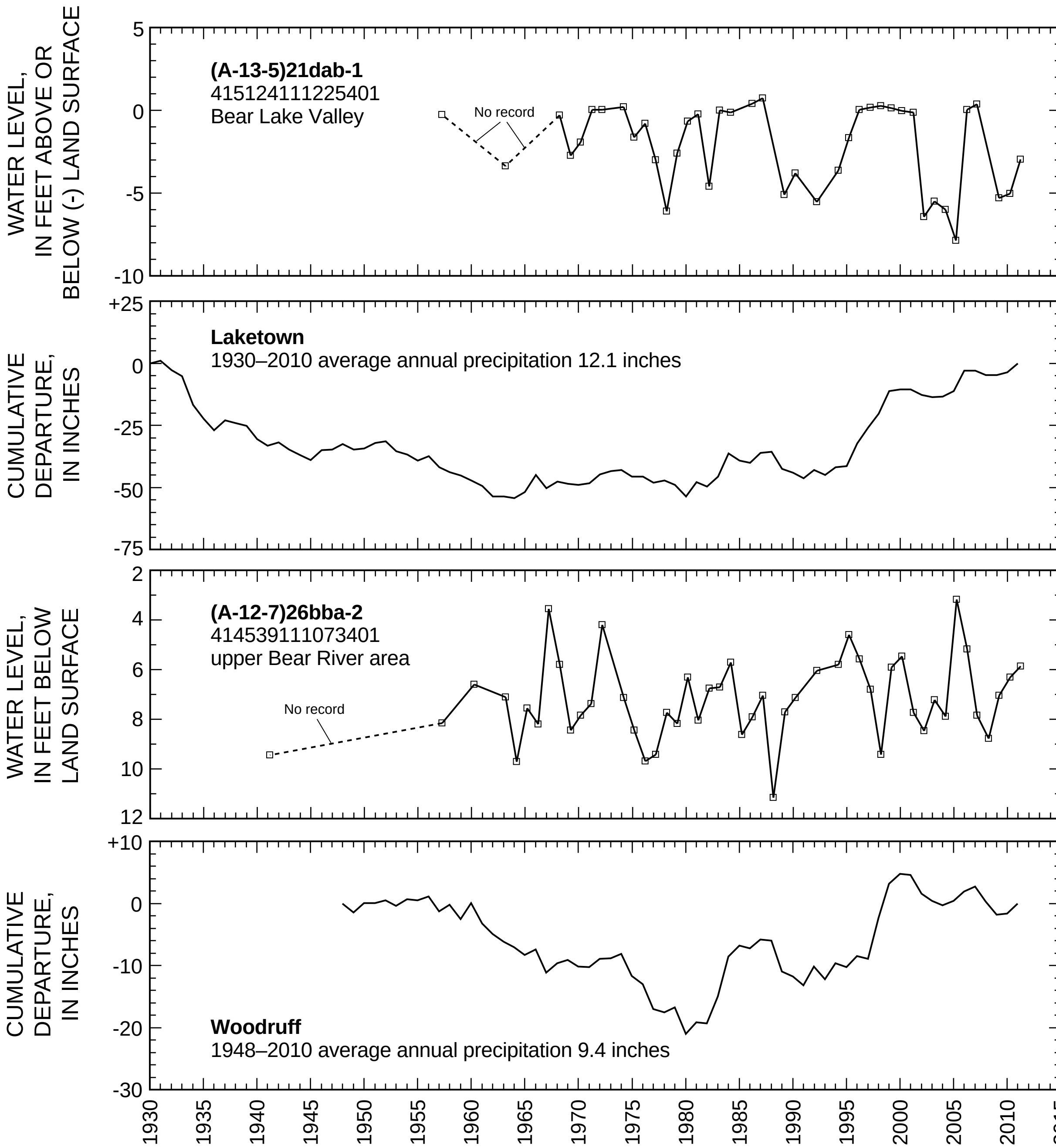


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

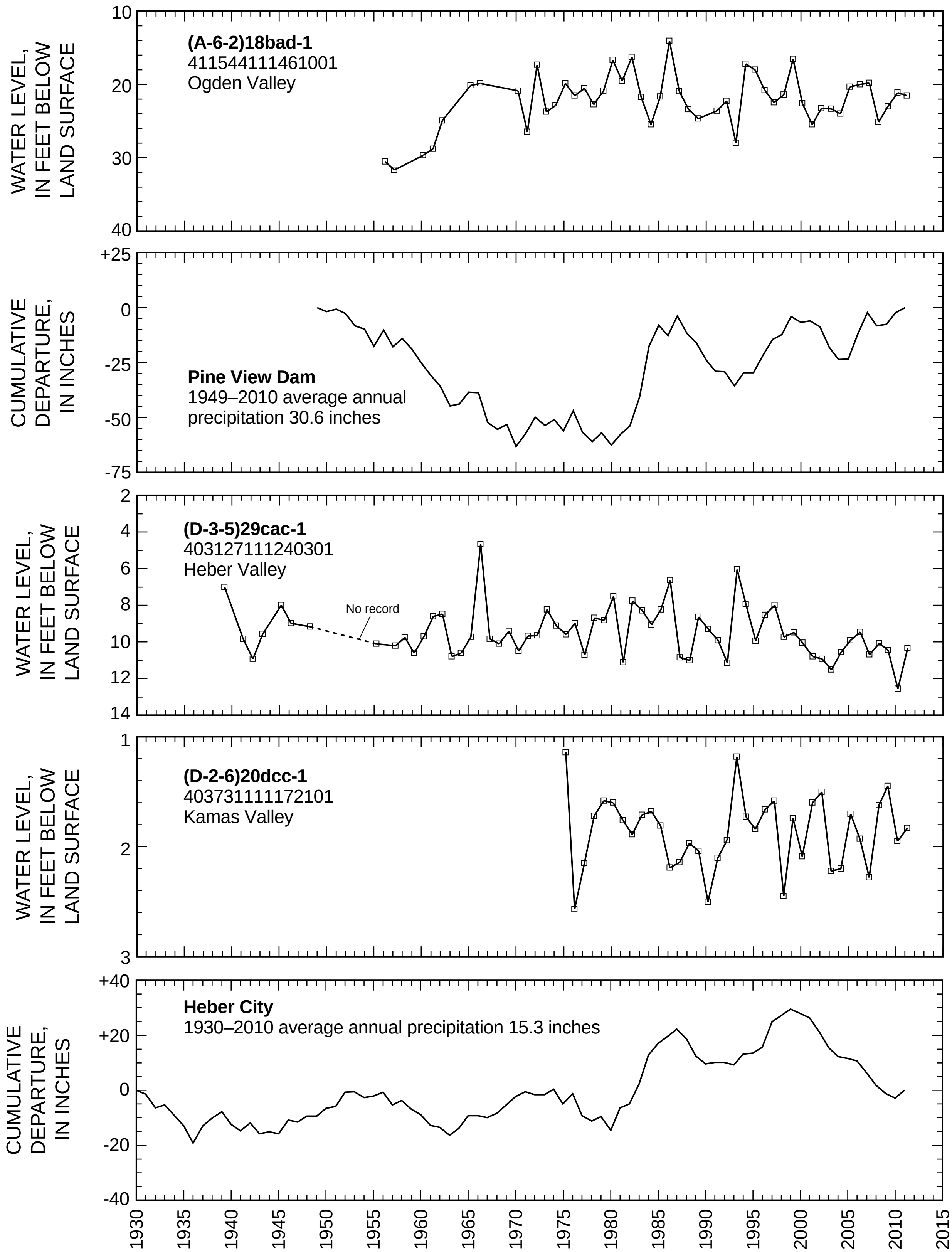


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

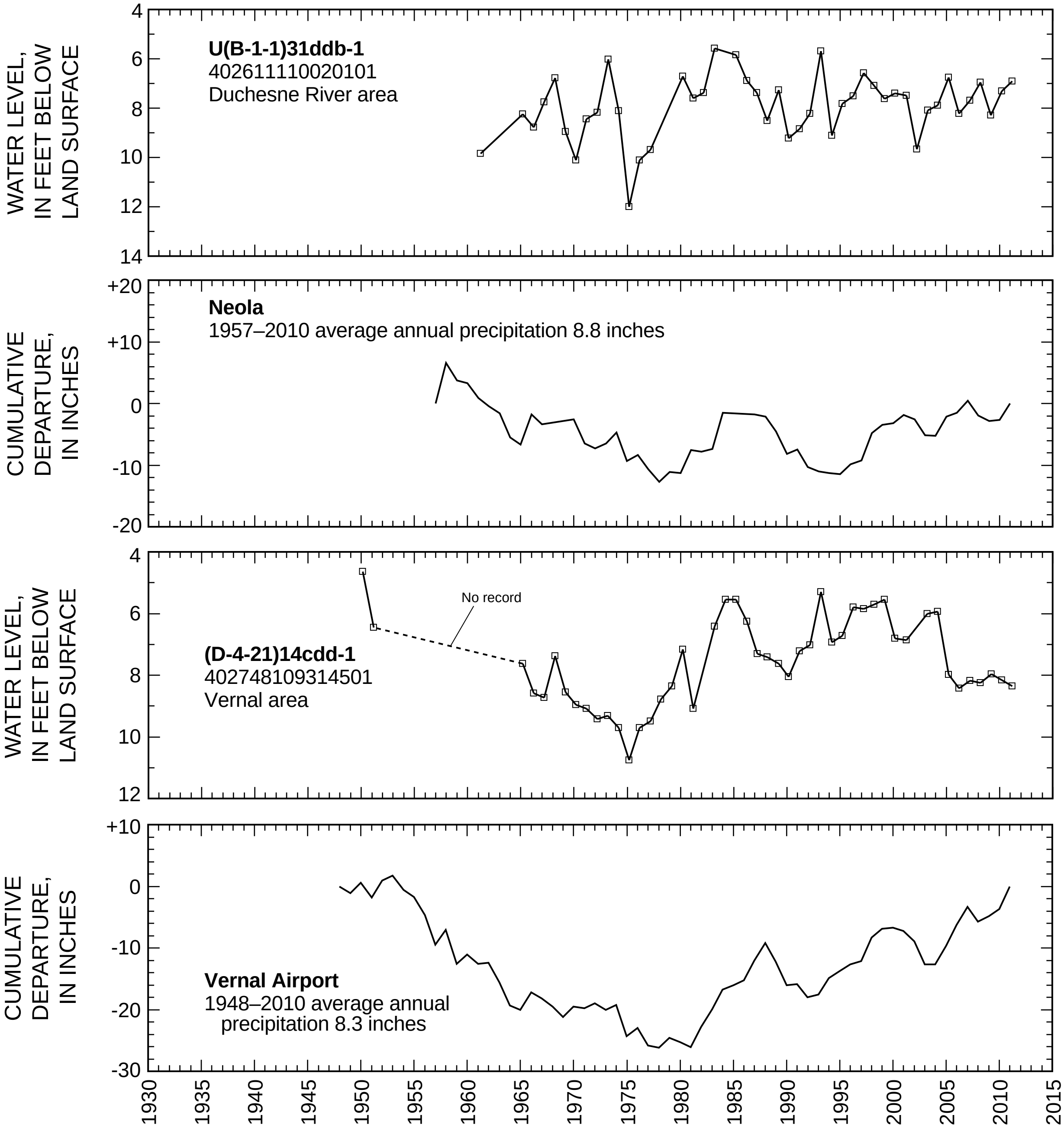


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

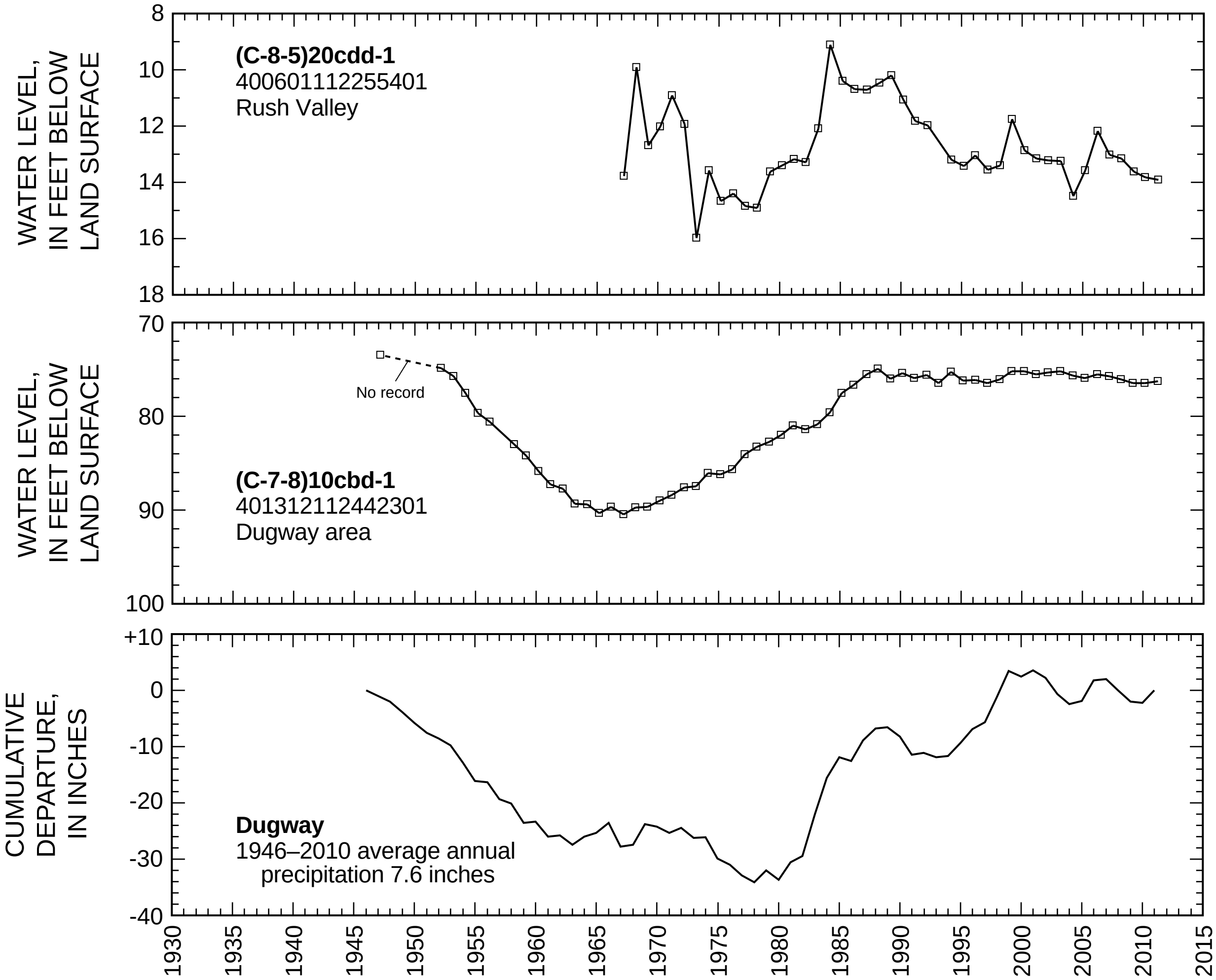


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

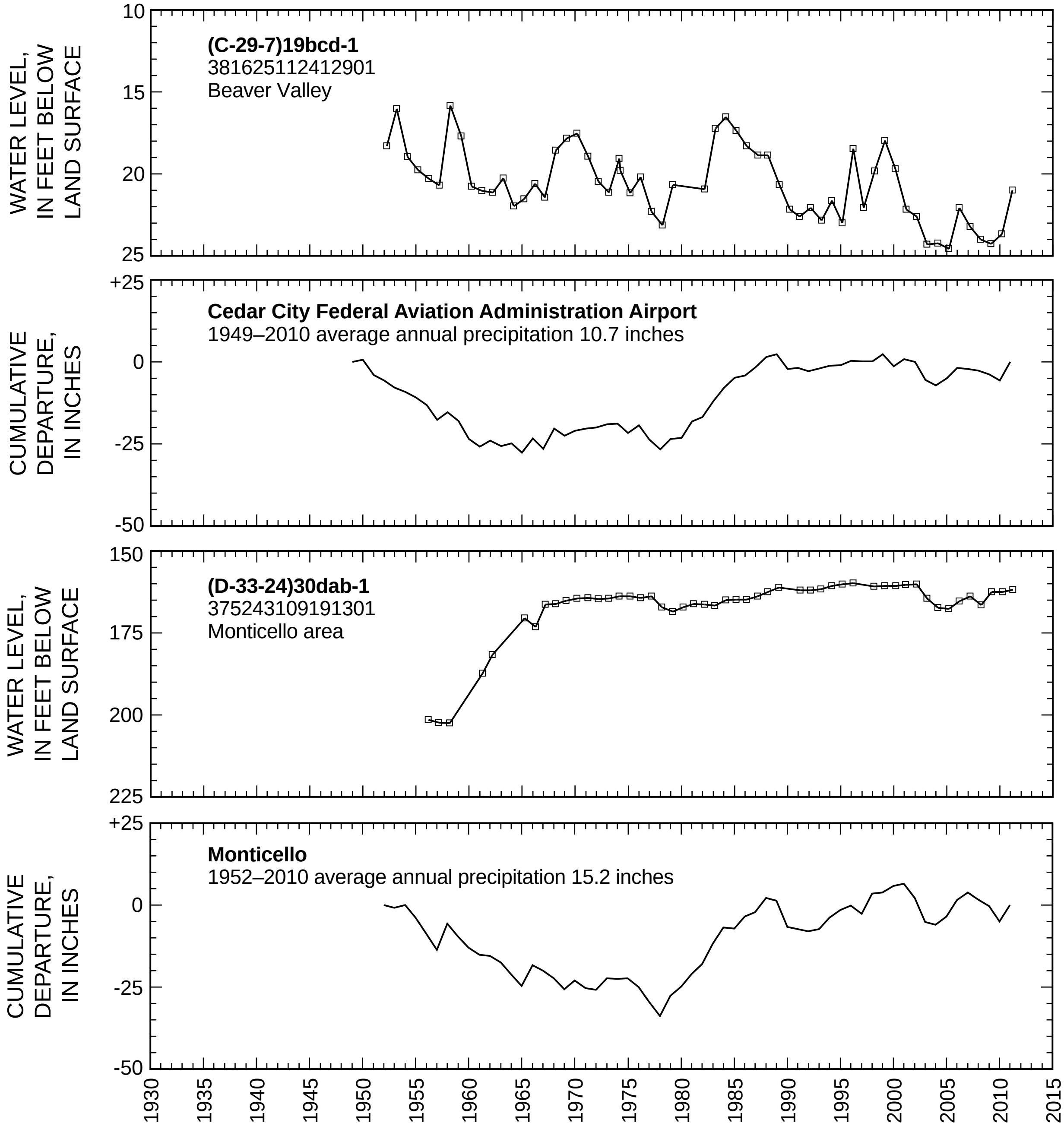


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

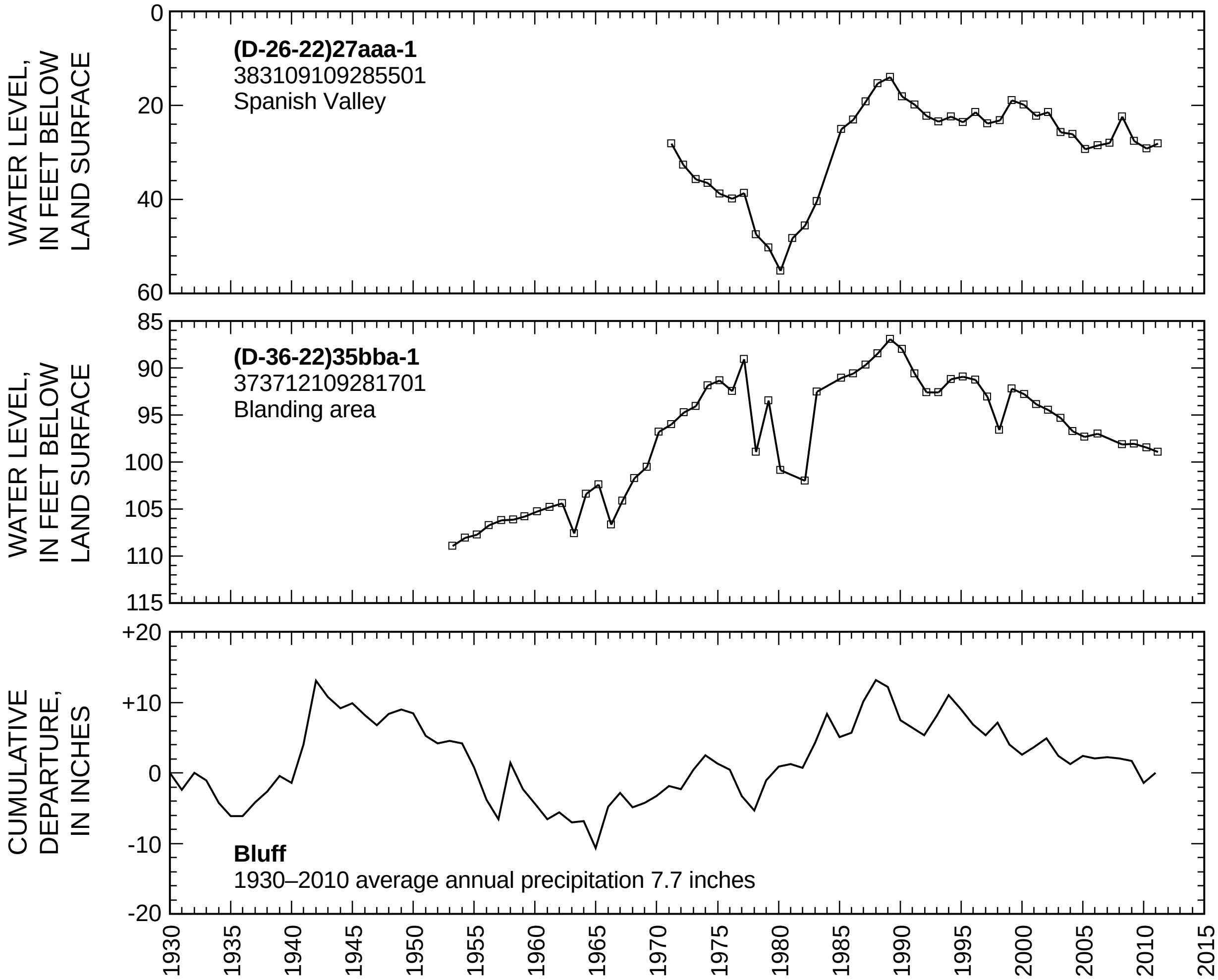


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

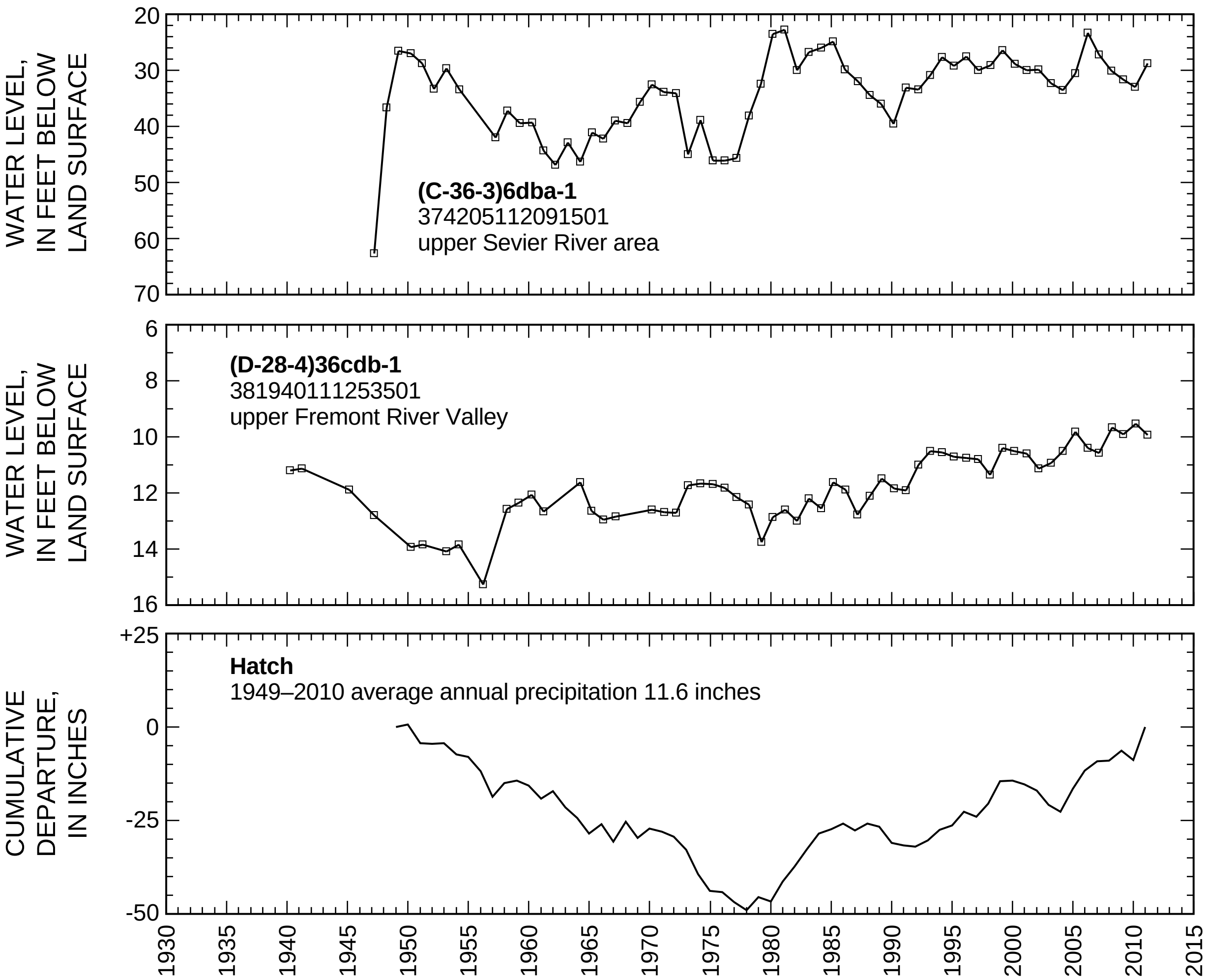


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

Quality of Water from Selected Wells in Utah, Summer of 2010

From June through September 2010, the U.S. Geological Survey (USGS), Utah Water Science Center, in cooperation with the Utah Department of Environmental Quality, Division of Water Quality, sampled water from 114 wells located in 21 counties (fig. 41). Samples were collected during this time period to limit seasonal variability in the data. The majority of water samples were collected from irrigation wells. Field parameters that were measured at the time the water samples were collected included pH, specific conductance, and water temperature. Chemical constituents that were analyzed in the water samples included major ions, dissolved solids, nutrients (nitrite plus nitrate and orthophosphate), and selected trace elements. The USGS National Water Quality Laboratory in Denver, Colorado, analyzed the water samples. Field parameter values and analytical results for major ions, dissolved solids and nutrients are listed in table 5. Analytical results for trace elements are listed in table 6.

The water samples were collected using protocols in the USGS National Field Manual for the Collection of Water-Quality Data (U.S. Geological Survey, variously dated). Analytical methods used by the laboratory are described in Fishman and Friedman (1989). Water-quality data in this report are stored in the USGS National Water Information System (NWIS) database and are available online at http://waterdata.usgs.gov/ut/nwis/qw.

Water-quality field blanks were collected to determine if samples were being contaminated during equipment decontamination and/or sample collection and processing procedures. A field blank is an inorganic blank water sample that is prepared by the USGS National Water Quality Laboratory, carried in the field, and processed using the same methods and equipment as the environmental water samples. The field blank is subject to processing in the field, preservation, shipment, laboratory handling procedures, and analytical protocols. Twelve field blank water samples were processed during the 2010 sampling period. Analytical results associated with the samples were less than the detection limit for all constituents.

Replicate water samples also were collected at two wells. A replicate sample is collected concurrent with an environmental sample and is used to assess the repeatability of the laboratory analytical results. Analytical results for the replicate water samples were in good agreement with the environmental samples, confirming the repeatability of the laboratory analytical results.

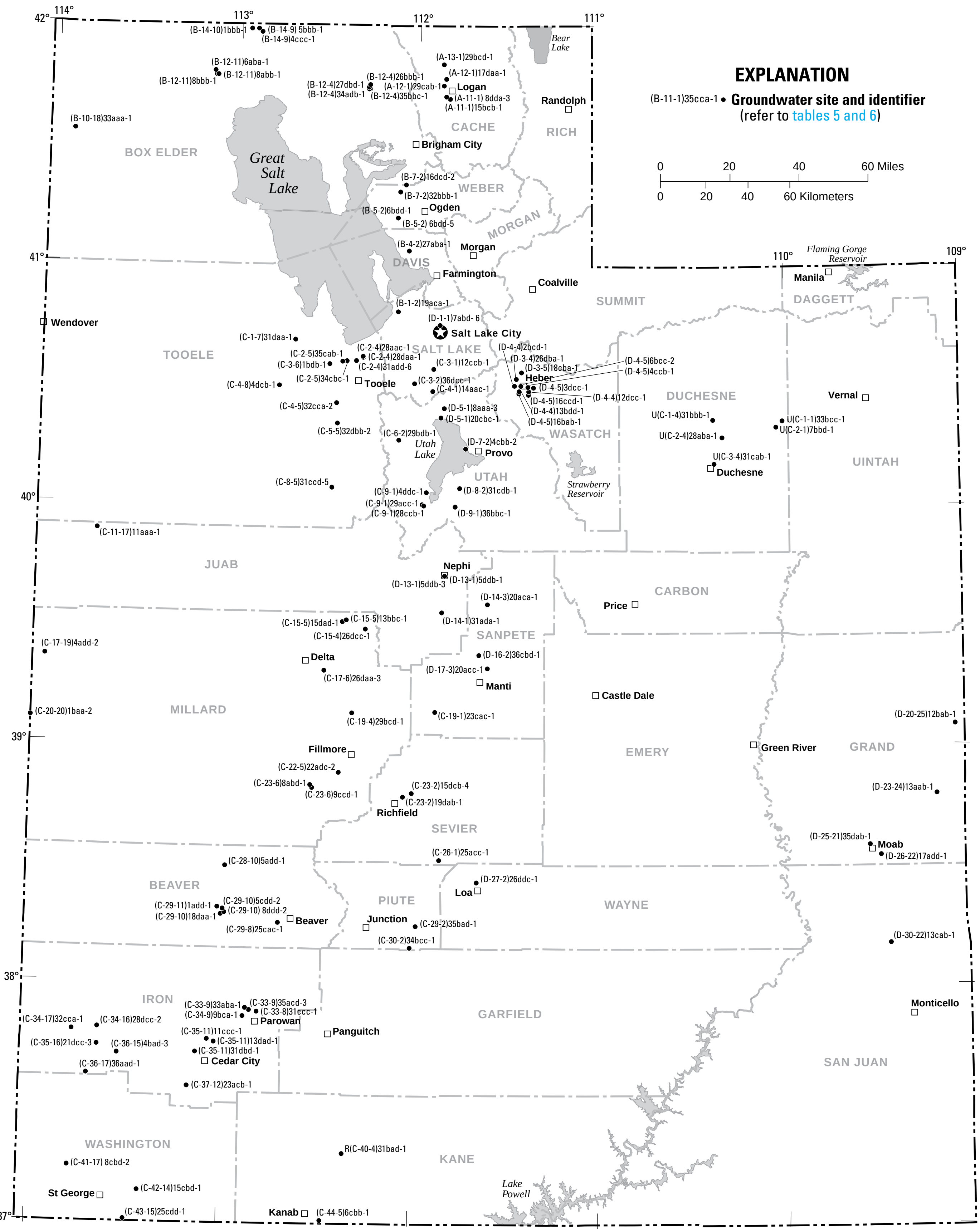


Figure 41. Location of groundwater sites sampled during the summer of 2010.

Table 5. Physical properties and concentration of major ions and nutrients in water samples collected from selected wells in Utah, summer of 2010.
[µS/cm, microsiemens per centimeter; °C, degrees Celsius; mg/L, milligrams per liter; ANC, acid neutralization capacity; —, no data; e, estimated; <, less than; L, laboratory value]

Local identifier (refer to figure 41)	Station number	Date	pH, field, in standard units	Specific conductance, field, in µS/cm at 25°C	Water Temperature, field, in °C	Hardness, water, in mg/L as $CaCO_3$	Calcium, dissolved, in mg/L	Magnesium, dissolved, in mg/L
Beaver County								
Beaver Valley								
(C-29-8)25cac-1	381516112422201	7/12/2010	7.4	304	18.8	97	30.6	5.06
Escalante Valley, Milford area								
(C-28-10)5add-1	382924112592901	8/11/2010	7.5	851	17.3	257	62.8	24.3
(C-29-10)5cdd-2	381835113000001	8/11/2010	7.3	786	14.0	360	107	22.2
(C-29-10)8ddd-2	381741112592702	8/11/2010	8.0	786	15.8	326	85.3	27.3
(C-29-10)18daa-1	381714113003401	8/11/2010	7.3	536	16.3	217	63.4	14.3
(C-29-11)1add-1	381901113014101	8/11/2010	7.6	800	16.0	337	98.8	22.1
Box Elder County								
Curlew Valley								
(B-14-9)4ccc-1	415800112525301	7/27/2010	7.3	2,870	19.5	604	164	47.4
(B-14-9)5bbb-1	415847112540401	7/26/2010	7.4	1,370	17.1	494	143	33.3
(B-14-10)1bbb-1	415845112562201	7/27/2010	7.6	580	15.8	209	58.5	15.3
Grouse Creek Valley								
(B-10-18)33aaa- 1	413300113543001	7/26/2010	7.3	1,010	11.6	387	113	25.4
(B-12-11)6aba-1	414811113081701	7/26/2010	7.8	1,080	15.7	284	79.9	20.4
(B-12-11)8abb-1	414710113071601	7/26/2010	7.3	4,250	13.4	1,590	447	114
(B-12-11)8bbb-1	414720113075201	7/26/2010	7.1	2,700	13.8	695	195	50.4
Lower Bear River area								
(B-12-4)26bbb-1	414510112163501	7/30/2010	7.3	3,020	13.4	1,190	271	124
(B-12-4)27dbd-1	414454112173101	7/27/2010	7.3	2,480	15.0	814	180	88.4
(B-12-4)34adb-1	414405112165701	7/30/2010	7.3	2,030	16.3	578	131	61.1
(B-12-4)35bbc-1	414406112163601	7/27/2010	7.4	1,540	16.6	349	79.6	36.5
Cache County								
Cache Valley								
(A-11-1)8dda-3	414216111511001	8/11/2010	7.3	502	10.4	265	65.6	24.6
(A-11-1)15bcb-1	414143111495501	8/11/2010	7.3	551	11.8	298	70.0	29.8
(A-12-1)17daa-1	414642111511401	8/11/2010	7.5	514	19.9	237	57.4	22.8
(A-12-1)29cab-1	414501111520001	8/11/2010	7.4	495	19.2	225	55.2	21.2
(A-13-1)29bcd-1	415020111520401	8/11/2010	7.7	452	13.0	193	40.3	22.5
Davis County								
East Shore area								
(B-4-2)27aba- 1	410340112030001	7/21/2010	7.9	622	16.6	46	11.7	4.05
Duchesne County								
Duchesne River area								
U(C-1-1)33bcc-1	402114110003301	8/9/2010	8.0	1,350	12.6	505	135	40.7
U(C-1-4)31bbb-1	402130110231301	8/9/2010	7.3	869	10.6	482	112	49.4
U(C-2-1)7bbd-1	401940110023601	8/9/2010	8.2	787	14.6	50	13.4	4.07
U(C-2-4)28aba-1	401706110201501	9/9/2010	7.1	815	13.9	438	95.6	48.4
U(C-3-4)31cab-1	401030110225701	8/9/2010	7.3	591	14.7	295	81.1	22.4
Grand County								
Spanish Valley								
(D-25-21)35dab-1	383510109335601	9/21/2010	7.2	1,710	14.7	998	256	87.1
(D-26-22)17add-1	383238109302501	9/24/2010	7.5	1,720	14.5	754	196	64.5
Upper Colorado River area								
(D-20-25)12bab-1	390513109060601	9/24/2010	7.6	557	16.2	253	31.2	42.4
(D-23-24)13aab-1	384750109122701	9/24/2010	8.9	660	17.4	6	1.80	0.44

Potassium, dissolved, in mg/L	Sodium, dissolved, in mg/L	ANC, fixed end point, lab, in mg/L as $CaCO_3$	Bromide, dissolved, in mg/L	Chloride, dissolved, in mg/L	Fluoride, dissolved, in mg/L	Silica, dissolved, in mg/L	Sulfate, dissolved, in mg/L	Solids, dissolved, residue at 180°C, in mg/L	Nitrate plus nitrite, dissolved, in mg/L as N	Orthophosphate, dissolved, in mg/L as P
Beaver County										
Beaver Valley										
8.48	20.6	102	0.03	6.28	0.72	72.8	39.4	245	<.04	0.042
Escalante Valley, Milford area										
2.81	62.4	112	0.20	138	0.31	25.4	97.3	485	0.74	0.016
4.90	24.7	260	0.18	53.7	0.30	35.4	69.3	486	2.49	0.049
4.08	35.6	196	0.22	67.4	0.34	28.8	98.1	491	4.05	0.021
4.07	20.2	136	0.16	45.5	0.36	34.8	53.7	334	2.27	0.034
5.50	24.6	160	0.25	108	0.34	38.6	68.1	530	3.59	0.029
Box Elder County										
Curlew Valley										
23.9	317	222	0.66	720	0.24	59.0	168	1,820	4.02	0.039
13.9	51.8	125	0.28	345	0.20	55.5	24.0	959	1.97	0.035
7.13	27.8	154	0.07	78.5	0.29	59.0	24.0	380	0.34	0.036
Grouse Creek Valley										
9.05	54.1	235	0.25	152	0.32	51.6	79.6	659	0.65	0.049
5.38	102	170	0.19	219	0.24	19.6	47.0	617	0.49	0.017
13.3	165	120	0.92	1,330	0.12	22.5	38.9	3,210	1.64	0.017
7.95	258	289	0.51	683	0.14	22.4	62.8	1,710	3.24	0.018
Lower Bear River area										
7.30	170	181	0.79	699	0.18	33.7	428	2,220	15.8	0.035
4.13	169	171	0.82	647	0.24	23.4	156	1,580	5.18	0.019
4.24	179	189	0.61	515	0.25	21.1	80.5	1,310	2.72	0.020
3.78	170	202	0.30	341	0.27	21.6	45.5	900	1.74	0.019
Cache County										
Cache Valley										
1.61	7.00	238	E.01	9.97	0.18	9.34	23.6	282	0.38	0.011
1.80	6.58	268	E.01	8.40	0.17	11.3	23.6	311	1.46	0.017
7.19	17.9	249	E.02	8.84	0.31	26.4	10.8	298	2.16	0.023
5.36	17.3	222	E.02	15.8	0.31	22.0	20.5	289	1.27	0.026
1.61	24.2	228	E.01	8.67	0.17	10.7	11.2	253	0.12	0.011
Davis County										
East Shore area										
5.34	116	269	0.06	42.9	0.40	19.1	E.10	399	<.04	0.635
Duchesne County										
Duchesne River area										
2.95	119	121	<.02	0.75	1.45	7.56	626	1,030	<.04	E.005
1.01	21.0	456	0.10	18.8	0.99	32.4	27.6	561	1.53	0.055
2.29	155	242	E.02	72.4	1.70	8.45	57.9	453	<.04	E.007
3.27	9.79	274	0.09	22.2	0.18	8.17	159	522	0.07	E.014
1.25	19.0	248	E.02	7.80	0.29	8.66	75.7	386	0.09	0.009
Grand County										
Spanish Valley										
3.80	25.9	293	0.14	42.3	0.45	18.4	723	1,430	E.03	0.016
3.59	119	168	0.30	58.5	0.34	14.8	735	1,420	4.33	0.012
Upper Colorado River area										
4.03	26.0	296	0.08	5.61	0.35	8.36	23.7	324	<.04	E.007
1.53	153	252	0.10	21.0	0.47	7.63	60.2	401	<.04	0.008

Table 5. Physical properties and concentration of major ions and nutrients in water samples collected from selected wells in Utah, summer of 2010.—Continued

[µS/cm, microsiemens per centimeter; °C, degrees Celsius; mg/L, milligrams per liter; ANC, acid neutralization capacity; —, no data; e, estimated; <, less than; L, laboratory value]

Local identifier (refer to figure 41)	Station number	Date	pH, field, in standard units	Specific conductance, field, in µS/cm at 25°C	Water Temperature, field, in °C	Hardness, water, in mg/L as $CaCO_3$	Calcium, dissolved, in mg/L	Magnesium, dissolved, in mg/L
Iron County								
Cedar Valley								
(C-35-11)11ccc-1	374550113040601	7/13/2010	7.9	979	13.9	445	84.9	56.5
(C-35-11)13dad-1	374515113015501	7/13/2010	7.7	795	13.9	331	67.3	39.6
(C-35-11)31dbd-1	374248113075201	7/13/2010	7.8	1,060	18.0	599	118	74.2
(C-37-12)23acb-1	373407113100801	7/13/2010	7.7	1,320	15.7	625	142	65.8
Escalante Valley, Beryl-Enterprise area								
(C-34-16)28dcc- 2	374834113384301	7/20/2010	7.4	1,060	12.9	441	135	25.4
(C-34-17)32cca- 1	374753113464601	8/10/2010	7.6	975	19.6	358	116	16.7
(C-35-16)21dcc- 3	374412113384503	7/20/2010	7.4	383	14.2	164	50.9	8.91
(C-36-15) 4bad- 3	374209113322203	8/10/2010	7.8	775	21.3	137	43.9	6.65
(C-36-17)36aad- 1	373656113415201	8/10/2010	7.9	444	13.0	176	54.9	9.41
Parowan Valley								
(C-33-8)31ccc-1	375257112483501	7/12/2010	7.7	490	14.8	208	42.4	24.8
(C-33-9)33aba-1	375344112521601	7/12/2010	8.4	324	15.3	133	25.7	16.8
(C-33-9)35acd-3	375320112510003	7/12/2010	7.9	466	14.7	209	42.8	24.9
(C-34-9)9bca-1	375147112530001	7/12/2010	L 7.6	561	11.6	288	59.5	33.8
Juab County								
Juab Valley								
(D-13-1)5ddb-1	394225111502201	8/2/2010	L 7.2	1,560	12.9	494	136	37.5
(D-13-1)5ddb-3	394226111502101	7/29/2010	L 7.3	1,570	12.8	497	137	37.7
(D-14-1)31ada-1	393315111511601	7/29/2010	L 7.3	1,300	13.5	697	186	56.5
Snake Valley								
(C-11-17)11aaa-1	395319113431201	8/4/2010	7.6	850	15.2	280	83.1	17.6
Kane County								
Kanab area								
(C-44-5)6cbb-1	370050112274501	7/19/2010	6.9	2,110	15.5	703	177	63.3
R(C-40-4)31bad-1	371740112210601	7/19/2010	7.2	1,850	11.9	963	133	153
Millard County								
Pahvant Valley								
(C-19- 4)29bcd- 1	390758112194601	8/9/2010	7.3	930	14.2	394	86.5	43.3
(C-22- 5)22adc- 2	385303112234801	8/10/2010	7.3	1,140	15.5	300	77.4	25.9
(C-23- 6) 8abd- 1	384953112325101	8/9/2010	7.0	7,580	16.1	2,120	515	202
(C-23- 6) 9ccd- 1	384910112321401	8/10/2010	7.2	6,530	15.0	1,720	448	148
Sevier Desert								
(C-15-4)26dcc-1	392859112154601	7/30/2010	L 7.5	L 991	15.2	420	114	32.5
(C-15-5)13bbc-1	393113112215701	7/30/2010	7.0	L 2,590	14.2	1,050	204	132
(C-15-5)15dad-1	393046112231301	7/30/2010	L 7.7	987	15.2	331	66.1	40.4
(C-17-6)26daa-3	391832112285601	7/30/2010	7.4	L 664	20.7	145	27.9	18.4
Snake Valley								
(C-17-19)4add-2	392141113585601	8/3/2010	7.4	500	16.9	182	44.1	17.4
(C-20-20)1baa-2	390604114025201	8/3/2010	7.5	440	15.8	177	43.8	16.4
Piute County								
Upper Sevier Valley								
(C-29-2)35bad-1	381440111584001	8/16/2010	7.2	475	15.7	196	55.1	14.2
(C-30-2)34bcc-1	380915112003001	8/16/2010	7.0	277	16.4	107	34.3	5.23

Potassium, dissolved, in mg/L	Sodium, dissolved, in mg/L	ANC, fixed end point, lab, in mg/L as $CaCO_3$	Bromide, dissolved, in mg/L	Chloride, dissolved, in mg/L	Fluoride, dissolved, in mg/L	Silica, dissolved, in mg/L	Sulfate, dissolved, in mg/L	Solids, dissolved, residue at 180°C, in mg/L	Nitrate plus nitrite, dissolved, in mg/L as N	Orthophosphate, dissolved, in mg/L as P
Iron County										
Cedar Valley										
4.46	29.6	169	0.16	40.6	0.26	35.5	265	690	10.3	0.033
5.60	48.6	286	0.10	22.5	0.19	43.1	110	519	4.00	0.043
2.52	11.9	137	0.06	15.1	0.24	21.8	431	799	2.30	0.015
2.00	50.0	144	0.60	119	0.09	18.7	398	954	1.96	0.029
Escalante Valley, Beryl-Enterprise area										
8.37	33.4	122	0.77	228	0.57	60.9	94.9	881	1.58	0.044
10.7	45.0	135	0.48	159	0.49	69.5	105	701	5.54	0.035
4.17	13.5	153	0.09	24.6	0.27	50.1	13.0	273	1.19	0.044
4.69	114	156	0.13	38.6	1.50	52.1	175	541	0.83	0.036
6.56	21.9	178	0.12	23.9	0.32	50.9	15.6	327	2.15	0.078
Parowan Valley										
2.78	22.6	204	0.06	20.9	0.19	29.6	20.0	280	1.49	0.036
3.22	14.3	133	0.02	10.0	0.25	32.8	20.1	205	0.35	0.037
2.65	14.9	189	0.03	19.7	0.20	27.3	22.1	271	1.91	0.028
2.99	10.8	244	0.05	15.0	0.14	28.5	39.4	344	2.29	0.025
Juab County										
Juab Valley										
3.65	140	373	0.09	228	0.21	24.5	110	927	4.95	0.030
3.64	148	320	0.07	272	0.22	23.3	120	968	3.62	0.026
2.07	43.7	242	0.05	57.0	0.29	13.2	449	982	1.46	0.010
Snake Valley										
2.35	55.7	142	0.14	177	0.28	19.4	25.7	534	2.44	0.031
Kane County										
Kanab area										
9.28	230	311	0.23	59.4	0.51	14.0	874	1,680	E.04	0.015
9.67	94.3	364	0.09	23.1	0.69	13.4	786	1,530	<.04	0.014
Millard County										
Pahvant Valley										
1.50	32.3	236	0.25	128	0.14	17.6	27.5	531	9.58	0.020
17.1	109	248	0.22	176	0.74	12.7	70.3	638	0.85	0.010
74.0	834	—	2.26	1,910	1.11	39.3	1,210	5,180	1.92	0.056
74.0	734	334	1.78	1,550	1.25	38.8	1,050	4,450	2.06	0.054
Sevier Desert										
1.77	45.8	172	0.19	81.0	0.15	13.2	187	618	11.1	0.017
6.52	114	208	0.56	569	0.30	29.3	337	1,550	0.27	0.033
4.02	70.9	178	0.16	187	0.36	27.9	59.1	554	0.12	0.023
14.7	85.7	247	0.04	41.8	1.79	68.2	36.4	452	0.37	0.041
Snake Valley										
1.83	35.5	190	0.08	33.5	0.19	14.8	15.2	275	2.31	0.013
1.26	15.8	132	0.11	40.1	0.15	16.1	20.8	231	0.58	0.012
Piute County										
Upper Sevier Valley										
6.03	13.8	180	0.17	27.0	0.18	47.0	17.2	320	1.05	0.073
2.33	15.0	128	0.05	7.10	0.23	39.9	3.49	196	0.13	0.088

Table 5. Physical properties and concentration of major ions and nutrients in water samples collected from selected wells in Utah, summer of 2010.—Continued

[µS/cm, microsiemens per centimeter; °C, degrees Celsius; mg/L, milligrams per liter; ANC, acid neutralization capacity; —, no data; e, estimated; <, less than; L, laboratory value]

Local identifier (refer to figure 41)	Station number	Date	pH, field, in standard units	Specific conductance, field, in µS/cm at 25°C	Water Temperature, field, in °C	Hardness, water, in mg/L as $CaCO_3$	Calcium, dissolved, in mg/L	Magnesium, dissolved, in mg/L
Salt Lake County								
Salt Lake Valley								
(B-1-2)19aca-1	404826112062201	8/3/2010	8.3	2,280	16.7	48	7.74	6.86
(C-3-1)12ccb-1	403408111543201	8/3/2010	7.6	940	19.5	283	63.3	30.4
(C-3-2)36dcc-1	403029112004601	8/4/2010	7.2	1,330	15.3	544	156	37.7
(C-4-1)14aac-1	402835111544701	8/4/2010	7.6	1,300	17.4	413	87.8	47.1
(D-1-1)7abd-6	404506111523301	8/3/2010	7.2	1,380	14.4	605	148	57.5
San Juan County								
Upper Colorado River area								
(D-30-22)13cab-1	381034109274501	9/21/2010	7.7	392	13.6	206	23.1	35.9
Sanpete County								
Central Sevier Valley								
(C-19-1)23cac-1	390819111530701	8/16/2010	7.2	2,670	16.9	674	103	101
Sanpete Valley								
(D-14-3)20aca-1	393521111362501	8/16/2010	L 7.4	L 836	13.8	358	96.0	28.8
(D-16-2)36cbd-1	392238111390501	8/16/2010	L 7.6	756	15.9	297	46.2	44.0
(D-17-3)20acc-1	391920111361901	8/16/2010	L 7.5	L 726	17.0	348	61.2	47.4
Sevier County								
Central Sevier Valley								
(C-23-2)15dcb-4	384757112002201	8/16/2010	7.4	674	17.3	305	64.0	35.3
(C-23-2)19dab-1	384702112031001	8/16/2010	7.4	636	18.8	299	58.1	37.4
Upper Sevier River area								
(C-26-1)25acc-1	383115111512501	8/16/2010	6.8	112	11.9	38	11.1	2.52
Tooele County								
Rush Valley								
(C-4-5)32cca-2	402525112251502	7/19/2010	7.1	886	12.5	305	84.5	22.8
(C-5-5)32dbb-2	402024112254601	7/19/2010	7.1	1,090	9.6	402	116	27.2
(C-8-5)31ccd-5	400418112271701	7/19/2010	7.1	1,380	11.6	528	162	30.2
Skull Valley								
(C-1-7)31daa-1	404113112395801	7/20/2010	7.3	8,480	17.5	559	107	71.0
(C-4-8)4dcb-1	402942112450001	8/19/2010	8.2	3,930	17.4	127	40.4	6.44
Tooele Valley								
(C-2-4)28aac-1	403716112174801	6/3/2010	7.8	1,120	13.5	420	104	38.9
(C-2-4)28daa-1	403657112173901	6/3/2010	7.4	1,000	12.6	412	103	37.5
(C-2-4)31add-6	403606112195401	6/3/2010	7.6	1,690	15.7	470	120	41.5
(C-2-5)34cbc-1	403612112241001	6/3/2010	7.6	5,450	17.8	993	242	94.2
(C-2-5)35cab-1	403602112230101	6/3/2010	7.5	4,110	20.1	458	111	43.6
(C-3-6)1bdb-1	403514112283701	8/19/2010	7.5	957	13.6	352	102	23.4
Utah County								
Cedar Valley								
(C-6-2)29bdb-1	401620112054301	8/5/2010	8.5	251	13.1	99	17.1	13.6
Goshen Valley								
(C-9-1)4ddc-1	400309111565101	7/28/2010	7.5	1,350	17.1	315	81.2	27.3
(C-9-1)28ccb-1	395956111572101	7/28/2010	7.2	L 2,190	18.1	702	185	58.4
(C-9-1)29acc-1	400015111575301	7/28/2010	7.3	1,520	16.9	444	109	41.9
Northern Utah Valley								
(D-5-1)8aaa-3	402420111505701	8/5/2010	7.5	396	13.6	168	39.3	17.0
(D-5-1)20cbc-1	402159111520101	8/5/2010	7.7	352	11.4	165	39.2	16.3

Potassium, dissolved, in mg/L	Sodium, dissolved, in mg/L	ANC, fixed end point, lab, in mg/L as $CaCO_3$	Bromide, dissolved, in mg/L	Chloride, dissolved, in mg/L	Fluoride, dissolved, in mg/L	Silica, dissolved, in mg/L	Sulfate, dissolved, in mg/L	Solids, dissolved, residue at 180°C, in mg/L	Nitrate plus nitrite, dissolved, in mg/L as N	Orthophosphate, dissolved, in mg/L as P
Salt Lake County										
Salt Lake Valley										
2.61	483	384	0.28	441	2.71	20.1	110	1,320	<.04	0.176
8.12	80.4	185	0.11	127	0.27	33.6	109	574	0.25	0.020
8.03	51.1	229	0.26	256	0.13	44.4	65.3	939	1.49	0.042
11.1	110	219	0.16	179	0.57	26.0	182	820	4.06	0.042
3.12	58.1	288	0.11	185	0.20	19.3	173	841	5.08	0.040
San Juan County										
Upper Colorado River area										
3.01	4.46	206	0.06	6.16	0.28	8.32	8.53	217	0.38	E.007
Sanpete County										
Central Sevier Valley										
3.35	318	599	0.34	343	0.53	36.6	352	1,700	5.71	0.068
Sanpete Valley										
4.20	27.4	275	0.13	44.9	0.08	37.8	30.8	500	16.3	0.047
1.20	49.3	266	0.14	70.4	0.26	18.8	47.4	466	0.69	0.015
1.46	21.4	311	0.04	15.0	0.29	15.8	68.8	444	2.41	0.021
Sevier County										
Central Sevier Valley										
3.22	18.8	268	0.08	28.2	0.37	33.9	48.1	395	0.97	0.044
2.34	16.2	305	0.04	14.1	0.20	14.5	19.5	355	3.02	0.019
Upper Sevier River area										
1.90	6.16	48	E.01	3.78	0.24	45.3	1.56	97	0.30	0.067
Tooele County										
Rush Valley										
1.31	59.4	224	0.09	135	0.14	14.2	45.3	500	1.55	0.020
1.24	75.4	315	0.13	155	0.25	17.2	51.5	634	1.73	0.021
1.75	50.9	128	0.28	326	0.09	16.1	52.2	1,010	1.63	0.017
Skull Valley										
61.8	1,410	182	1.48	2,770	0.38	29.1	218	4,780	1.66	0.036
32.2	699	78	0.74	1,180	E.06	10.2	80.2	2,140	0.69	0.067
Tooele Valley										
1.98	71.0	218	0.17	115	0.10	14.8	197	702	3.12	0.028
1.70	57.8	203	0.12	49.8	0.12	13.9	247	669	3.34	0.027
3.04	149	197	0.29	373	0.20	16.7	85.9	987	4.87	0.020
12.4	701	171	1.10	1,680	0.45	23.4	204	3,480	4.43	0.022
9.90	633	205	0.74	1,190	0.53	24.6	116	2,340	2.96	0.025
2.00	45.4	156	0.16	196	E.07	22.0	28.3	594	2.51	0.027
Utah County										
Cedar Valley										
1.04	15.2	118	0.02	12.9	0.16	3.38	1.01	145	<.04	<.008
Goshen Valley										
13.9	137	143	0.30	284	0.41	66.4	113	845	2.29	0.038
18.8	144	109	0.76	527	0.23	64.9	118	1,540	19.1	0.030
12.3	130	116	0.49	292	0.24	61.7	122	955	18.1	0.030
Northern Utah Valley										
2.06	15.4	128	0.05	39.4	0.25	20.0	18.1	229	0.75	0.018
1.04	9.19	132	E.01	8.84	0.23	11.5	34.3	207	1.88	0.018

Table 5. Physical properties and concentration of major ions and nutrients in water samples collected from selected wells in Utah, summer of 2010.—Continued

[µS/cm, microsiemens per centimeter; °C, degrees Celsius; mg/L, milligrams per liter; ANC, acid neutralization capacity; —, no data; e, estimated; <, less than; L, laboratory value]

Local identifier (refer to figure 41)	Station number	Date	pH, field, in standard units	Specific conductance, field, in µS/cm at 25°C	Water Temperature, field, in °C	Hardness, water, in mg/L as $CaCO_3$	Calcium, dissolved, in mg/L	Magnesium, dissolved, in mg/L
Utah County—Continued								
Southern Utah Valley								
(D-7-2)4cbb-2	401414111435301	8/2/2010	7.2	530	12.7	262	66.0	23.7
(D-8-2)31cdb-1	400422111454201	7/28/2010	7.2	2,630	—	327	80.0	30.9
(D-9-1)36bbc-1	395942111470801	7/28/2010	7.2	L 521	10.6	278	71.7	24.0
Wasatch County								
Heber Valley								
(D-3-4)26dba-1	403146111272701	8/18/2010	7.3	760	12.9	364	110	21.6
(D-3-5)18cba-1	403325111254601	8/18/2010	7.3	325	10.0	148	44.2	9.22
(D-4-4)2bcd-1	403004111280301	8/18/2010	7.0	1,330	14.1	628	183	41.7
(D-4-4)12dcc-1	402842111263101	8/18/2010	6.9	690	12.6	326	92.2	23.3
(D-4-4)13bdd-1	402810111263601	9/9/2010	L 7.6	L 570	12.1	256	68.6	20.6
(D-4-5)3dcc-1	402937111214901	8/17/2010	7.0	520	11.0	254	83.2	11.2
(D-4-5)4ccb-1	402946111233901	8/17/2010	6.8	410	12.0	202	64.8	9.74
(D-4-5)6bcc-2	403003111255801	8/17/2010	7.1	385	13.1	184	56.0	10.7
(D-4-5)16bab-1	402840111232201	8/18/2010	7.1	600	11.7	305	84.2	22.9
(D-4-5)16ccd-1	402750111232701	8/17/2010	7.4	510	16.1	247	61.2	22.8
Washington County								
Central Virgin River area								
(C-41-17)8cbd-2	371348113470301	7/20/2010	7.7	480	18.4	231	65.2	16.5
(C-42-14)15cbd-1	370538113251301	7/19/2010	7.2	2,790	30.1	1,490	320	166
(C-43-15)25cdd-1	370034113290801	7/19/2010	7.5	2,880	20.2	1,810	564	96.7
Wayne County								
Upper Fremont River Valley								
(D-27-2)26ddc-1	382544111392401	8/16/2010	7.7	246	16.0	90	25.3	6.61
Weber County								
East Shore area								
(B-5-2)6bdd-1	411153112064603	7/21/2010	7.7	441	16.0	142	33.5	14.3
(B-5-2)6bdd-5	411153112064605	7/21/2010	8.2	2,110	13.3	228	63.5	16.9
(B-7-2)16dcd-2	412011112041401	7/21/2010	8.0	370	25.4	62	19.2	3.38
(B-7-2)32bbb-1	411824112060601	7/21/2010	7.7	2,410	18.1	336	70.5	38.8

Potassium, dissolved, in mg/L	Sodium, dissolved, in mg/L	ANC, fixed end point, lab, in mg/L as $CaCO_3$	Bromide, dissolved, in mg/L	Chloride, dissolved, in mg/L	Fluoride, dissolved, in mg/L	Silica, dissolved, in mg/L	Sulfate, dissolved, in mg/L	Solids, dissolved, residue at 180°C, in mg/L	Nitrate plus nitrite, dissolved, in mg/L as N	Orthophosphate, dissolved, in mg/L as P
Utah County—Continue										
Southern Utah Valley										
2.87	16.6	230	0.03	13.3	0.28	19.4	44.4	323	<.04	0.039
30.7	451	396	0.35	593	1.29	54.5	140	1,590	E.03	0.047
1.49	7.56	230	0.03	19.7	0.26	16.5	19.4	294	2.19	0.013
Wasatch County										
Heber Valley										
5.62	21.9	261	—	30.1	0.53	18.3	80.1	—	3.58	—
2.46	9.45	135	—	10.1	0.14	31.1	21.8	—	0.12	—
12.9	56.9	364	—	57.4	1.08	19.6	314	—	0.85	—
1.44	19.5	247	—	50.5	0.14	23.5	33.5	—	3.35	—
1.06	15.8	209	—	42.0	E.08	13.4	14.2	—	2.67	—
3.28	7.61	192	—	34.2	E.08	37.2	6.91	—	5.57	—
2.55	5.30	160	—	12.8	0.09	39.1	15.5	—	3.92	—
2.12	7.89	168	—	10.4	0.09	28.6	19.3	—	1.58	—
1.56	13.5	272	—	20.4	0.22	28.8	20.8	—	2.97	—
1.17	14.4	200	—	23.3	0.15	13.7	25.4	—	2.93	—
Washington County										
Central Virgin River area										
2.24	12.9	193	0.05	14.1	0.36	17.1	43.9	292	0.39	0.020
9.28	122	150	0.74	264	0.39	21.6	1,220	2,350	13.4	0.020
9.42	61.6	109	0.20	43.0	0.28	17.4	1,830	2,890	2.47	0.015
Wayne County										
Upper Fremont River Valley										
2.79	12.7	103	0.03	6.77	0.26	43.4	11.9	175	0.24	0.035
Weber County										
East Shore area										
8.88	34.7	218	0.03	16.9	0.27	34.6	E.11	256	<.04	0.181
10.2	302	76	0.49	634	0.34	14.7	<.90	1,200	<.04	0.010
8.14	52.0	184	E.01	8.99	1.04	30.9	2.56	237	<.04	0.038
19.5	303	154	0.51	696	0.33	30.3	<.90	1,420	<.04	0.064

Table 6. Concentration of trace elements in water samples collected from selected wells in Utah, summer of 2010.

[µg/L, micrograms per liter; < , less than; E, estimated; —, no data]

Local identifier (refer to figure 41)	Station number	Date	Arsenic, dissolved, in µg/L	Iron, dissolved, in µg/L	Manganese, dissolved, in µg/L	Molybdenum, dissolved, in µg/L	Selenium, dissolved, in µg/L	Uranium, dissolved, in µg/L
Beaver County								
Beaver Valley								
(C-29-8)25cac-1	381516112422201	7/12/2010	13.8	14	60.2	6.8	E .02	<.01
Escalante Valley, Milford area								
(C-28-10)5add-1	382924112592901	8/11/2010	1.5	13	0.5	1.0	1.8	10.8
(C-29-10)5cdd-2	381835113000001	8/11/2010	2.3	<6	<.2	0.5	0.58	31.6
(C-29-10)8ddd-2	381741112592702	8/11/2010	4.6	<6	<.2	1.9	1.1	12.1
(C-29-10)18daa-1	381714113003401	8/11/2010	3.2	<6	0.5	1.1	0.35	8.16
(C-29-11)1add-1	381901113014101	8/11/2010	3.8	E 5	<.2	1.1	0.56	17.4
Box Elder County								
Curlew Valley								
(B-14-9)4ccc-1	415800112525301	7/27/2010	3.2	E 9	<.4	1.1	9.0	4.69
(B-14-9)5bbb-1	415847112540401	7/26/2010	1.9	<6	<.2	0.8	2.0	1.35
(B-14-10)1bbb-1	415845112562201	7/27/2010	4.3	<6	<.2	1.4	1.2	1.99
Grouse Creek Valley								
(B-10-18)33aaa-1	413300113543001	7/26/2010	6.1	14	0.4	4.5	3.5	10.0
(B-12-11)6aba-1	414811113081701	7/26/2010	1.5	<6	<.2	1.5	1.0	1.99
(B-12-11)8abb-1	414710113071601	7/26/2010	0.76	E 9	<.6	0.5	1.1	3.13
(B-12-11)8bbb-1	414720113075201	7/26/2010	1.3	E 9	<.4	0.5	2.2	4.34
Lower Bear River area								
(B-12-4)26bbb-1	414510112163501	7/30/2010	2.5	E 6	<.4	0.6	37.3	3.81
(B-12-4)27dbd-1	414454112173101	7/27/2010	0.85	<12	<.4	0.8	18.2	1.69
(B-12-4)34adb-1	414405112165701	7/30/2010	0.84	<12	<.4	0.9	14.0	1.49
(B-12-4)35bbc-1	414406112163601	7/27/2010	0.93	<6	<.2	0.9	4.0	1.36
Cache County								
Cache Valley								
(A-11-1)8dda-3	414216111511001	8/11/2010	0.09	E 5	0.8	0.5	0.97	1.19
(A-11-1)15bcb-1	414143111495501	8/11/2010	0.46	<6	0.4	0.6	0.31	1.04
(A-12-1)17daa-1	414642111511401	8/11/2010	1.4	35	5.4	0.8	0.19	0.63
(A-12-1)29cab-1	414501111520001	8/11/2010	1.2	E 4	2.3	0.7	0.17	0.56
(A-13-1)29bcd-1	415020111520401	8/11/2010	5.9	132	67.8	0.8	0.05	0.28
Davis County								
East Shore area								
(B-4-2)27aba-1	410340112030001	7/21/2010	23.2	370	50.6	0.3	E .03	E .01
Duchesne County								
Duchesne River area								
U(C-1-1)33bcc-1	402114110003301	8/9/2010	3.0	1,240	21.9	3.4	<.04	0.75
U(C-1-4)31bbb-1	402130110231301	8/9/2010	2.8	E 4	<.2	1.3	0.74	5.20
U(C-2-1)7bbd-1	401940110023601	8/9/2010	0.63	208	7.8	5.9	<.04	0.12
U(C-2-4)28aba-1	401706110201501	9/9/2010	0.05	207	7.8	0.3	0.15	0.74
U(C-3-4)31cab-1	401030110225701	8/9/2010	0.48	9	E .1	0.6	0.42	1.00

Table 6. Concentration of trace elements in water samples collected from selected wells in Utah, summer of 2010.—Continued

[µg/L, micrograms per liter; < , less than; E, estimated; —, no data]

Local identifier (refer to figure 41)	Station number	Date	Arsenic, dissolved, in µg/L	Iron, dissolved, in µg/L	Manganese, dissolved, in µg/L	Molybdenum, dissolved, in µg/L	Selenium, dissolved, in µg/L	Uranium, dissolved, in µg/L
Grand County								
Spanish Valley								
(D-25-21)35dab-1	383510109335601	9/21/2010	2.3	397	22.6	13.5	1.7	34.0
(D-26-22)17add-1	383238109302501	9/28/2010	0.26	24	2.6	0.9	9.0	4.61
Upper Colorado River area								
(D-20-25)12bab-1	390513109060601	9/24/2010	2.7	1,450	37.8	1.0	<.04	0.46
(D-23-24)13aab-1	384750109122701	9/24/2010	2.9	69	2.1	2.1	<.04	0.04
Iron County								
Cedar Valley								
(C-35-11)11ccc-1	374550113040601	7/13/2010	2.3	<6	<.2	0.6	1.8	3.44
(C-35-11)13dad-1	374515113015501	7/13/2010	3.0	<6	<.2	0.4	1.7	3.52
(C-35-11)31dbd-1	374248113075201	7/13/2010	0.95	<6	<.2	0.5	1.5	2.79
(C-37-12)23acb-1	373407113100801	7/13/2010	1.0	10	0.7	0.4	9.9	1.90
Escalante Valley, Beryl-Enterprise area								
(C-34-16)28dcc-2	374834113384301	7/20/2010	8.6	<6	<.2	0.5	3.0	3.39
(C-34-17)32cca-1	374753113464601	8/10/2010	3.3	<6	<.2	0.8	1.6	4.03
(C-35-16)21dcc-3	374412113384503	7/20/2010	3.9	<6	<.2	0.4	0.50	2.98
(C-36-15)4bad-3	374209113322203	8/10/2010	21.3	<6	<.2	9.1	0.34	1.31
(C-36-17)36aad-1	373656113415201	8/10/2010	3.8	<6	<.2	1.0	0.48	3.26
Parowan Valley								
(C-33-8)31ccc-1	375257112483501	7/12/2010	4.0	E 4	<.2	0.5	0.87	1.93
(C-33-9)33aba-1	375344112521601	7/12/2010	5.2	<6	0.4	0.5	0.30	1.67
(C-33-9)35acd-3	375320112510003	7/12/2010	2.4	<6	<.2	0.2	0.46	1.81
(C-34-9) 9bca-1	375147112530001	7/12/2010	1.7	<6	<.2	0.1	2.0	2.97
Juab County								
Juab Valley								
(D-13-1)5ddb-1	394225111502201	8/2/2010	0.78	<6	<.2	0.5	2.0	2.15
(D-13-1)5ddb-3	394226111502101	7/29/2010	0.74	E 5	<.2	0.5	1.6	1.82
(D-14-1)31ada-1	393315111511601	7/29/2010	0.28	21	0.5	0.3	0.85	0.61
Snake Valley								
(C-11-17)11aaa-1	395319113431201	8/4/2010	0.52	<6	<.2	0.5	0.43	13.8
Kane County								
Kanab area								
(C-44-5)6cbb-1	370050112274501	7/19/2010	2.9	15	160	6.1	0.11	1.11
R(C-40-4)31bad-1	371740112210601	7/19/2010	0.23	214	159	1.2	0.04	9.30
Millard County								
Pahvant Valley								
(C-19-4)29bcd-1	390758112194601	8/9/2010	1.9	<6	0.4	0.1	1.2	0.92
(C-22-5)22adc-2	385303112234801	8/10/2010	1.2	8	0.5	1.0	0.52	0.48
(C-23-6) 8abd-1	384953112325101	8/9/2010	8.5	E 23	3.6	1.5	10.7	9.24
(C-23-6) 9ccd-1	384910112321401	8/10/2010	9.3	<24	3.0	2.0	7.7	7.96
Sevier Desert								
(C-15-4)26dcc-1	392859112154601	7/30/2010	1.8	<6	<.2	0.2	4.3	0.86
(C-15-5)13bbc-1	393113112215701	7/30/2010	5.5	549	326	1.0	0.14	2.74
(C-15- 5)15dad- 1	393046112231301	7/30/2010	5.1	10	11.2	2.5	0.18	1.71
(C-17- 6)26daa- 3	391832112285601	7/30/2010	12.5	11	0.5	4.5	0.94	1.24

Table 6. Concentration of trace elements in water samples collected from selected wells in Utah, summer of 2010.—Continued

[µg/L, micrograms per liter; < , less than; E, estimated; —, no data]

Local identifier (refer to figure 41)	Station number	Date	Arsenic, dissolved, in µg/L	Iron, dissolved, in µg/L	Manganese, dissolved, in µg/L	Molybdenum, dissolved, in µg/L	Selenium, dissolved, in µg/L	Uranium, dissolved, in µg/L
Millard County—Continued								
Snake Valley								
(C-17-19)4add-2	392141113585601	8/3/2010	2.0	<6	<.2	0.6	0.53	2.12
(C-20-20)1baa-2	390604114025201	8/3/2010	1.4	<6	<.2	0.6	0.50	1.13
Piute County								
Upper Sevier Valley								
(C-29-2)35bad-1	381440111584001	8/16/2010	1.3	E 4	1.6	0.5	0.31	5.64
(C-30-2)34bcc-1	380915112003001	8/16/2010	1.9	<6	0.2	0.4	0.26	0.60
Salt Lake County								
Salt Lake Valley								
(B-1-2)19aca-1	404826112062201	8/3/2010	1.8	102	13.4	14.7	0.11	0.01
(C-3-1)12ccb-1	403408111543201	8/3/2010	3.9	<6	<.2	1.6	1.2	4.76
(C-3-2)36dcc-1	403029112004601	8/4/2010	2.3	E 5	E .1	0.9	3.5	5.42
(C-4-1)14aac-1	402835111544701	8/4/2010	7.2	8	0.4	7.1	2.8	3.89
(D-1-1)7abd-6	404506111523301	8/3/2010	1.1	8	5.1	1.2	1.7	1.83
San Juan County								
Upper Colorado River area								
(D-30-22)13cab-1	381034109274501	9/21/2010	0.05	<6	<.2	1.0	3.2	2.11
Sanpete County								
Central Sevier Valley								
(C-19-1)23cac-1	390819111530701	8/16/2010	7.5	<12	<.4	5.6	4.3	9.32
Sanpete Valley								
(D-14-3)20aca-1	393521111362501	8/16/2010	1.2	<6	<.2	0.3	2.2	1.83
(D-16-2)36cbd-1	392238111390501	8/16/2010	5.6	106	25.8	1.5	0.69	0.81
(D-17-3)20acc-1	391920111361901	8/16/2010	0.50	<6	<.2	1.2	1.9	1.85
Sevier County								
Central Sevier Valley								
(C-23-2)15dcb-4	384757112002201	8/16/2010	3.4	<6	<.2	3.3	1.3	4.95
(C-23-2)19dab-1	384702112031001	8/16/2010	1.5	E 5	E.2	0.5	0.38	1.73
Upper Sevier River area								
(C-26-1)25acc-1	383115111512501	8/16/2010	2.5	<6	<.2	0.9	0.14	0.11
Tooele County								
Rush Valley								
(C-4-5)32cca-2	402525112251502	7/19/2010	0.64	<6	<.2	0.5	2.0	1.75
(C-5-5)32dbb-2	402024112254601	7/19/2010	1.9	93	22.6	0.2	2.0	0.01
(C-8-5)31ccd-5	400418112271701	7/19/2010	1.2	<6	<.2	0.2	1.6	1.63
Skull Valley								
(C-1-7)31daa-1	404113112395801	7/20/2010	5.4	<30	<1.0	1.5	0.91	2.44
(C-4-8)4dcb-1	402942112450001	8/19/2010	2.8	E 14	1.0	0.1	0.85	0.21

Table 6. Concentration of trace elements in water samples collected from selected wells in Utah, summer of 2010.—Continued

[µg/L, micrograms per liter; < , less than; E, estimated; —, no data]

Local identifier (refer to figure 41)	Station number	Date	Arsenic, dissolved, in µg/L	Iron, dissolved, in µg/L	Manganese, dissolved, in µg/L	Molybdenum, dissolved, in µg/L	Selenium, dissolved, in µg/L	Uranium, dissolved, in µg/L
Tooele County—Continued								
Tooele Valley								
(C-2-4)28aac-1	403716112174801	6/3/2010	2.0	<6	<.2	0.4	12.7	2.09
(C-2-4)28daa-1	403657112173901	6/3/2010	1.5	<6	<.2	0.3	9.9	1.87
(C-2-4)31add-6	403606112195401	6/3/2010	1.7	E 6	<.2	0.5	4.1	2.17
(C-2-5)34cbc-1	403612112241001	6/3/2010	5.6	<18	<.6	1.9	8.0	2.36
(C-2-5)35cab-1	403602112230101	6/3/2010	5.8	E 14	E .5	3.4	5.1	2.08
(C-3-6) 1bdb-1	403514112283701	8/19/2010	0.42	<6	<.2	0.2	0.75	1.54
Utah County								
Cedar Valley								
(C-6-2)29bdb-1	401620112054301	8/5/2010	0.18	63	25.8	3.4	E .02	<.01
Goshen Valley								
(C-9-1) 4ddc-1	400309111565101	7/28/2010	11.5	E 3	<.2	2.3	2.3	5.14
(C-9-1)28ccb-1	395956111572101	7/28/2010	3.9	<12	<.4	1.7	6.6	5.64
(C-9-1)29acc-1	400015111575301	7/28/2010	6.4	<6	E .1	0.9	5.1	5.31
Northern Utah Valley								
(D-5-1)8aaa-3	402420111505701	8/5/2010	2.4	<6	<.2	1.9	2.5	1.99
(D-5-1)20cbc-1	402159111520101	8/5/2010	1.0	10	E .1	2.5	1.7	2.31
Southern Utah Valley								
(D-7-2) 4cbb-2	401414111435301	8/2/2010	1.8	697	71.8	1.0	<.04	0.02
(D-8-2)31cdb-1	400422111454201	7/28/2010	2.9	19	43.4	2.1	0.33	2.24
(D-9-1)36bbc-1	395942111470801	7/28/2010	0.40	<6	<.2	0.6	1.3	1.5
Wasatch County								
Heber Valley								
(D-3-4)26dba-1	403146111272701	8/18/2010	—	E 4	E .1	—	—	—
(D-3-5)18cba-1	403325111254601	8/18/2010	—	321	12.6	—	—	—
(D-4-4) 2bcd-1	403004111280301	8/18/2010	—	54	5.6	—	—	—
(D-4-4)12dcc-1	402842111263101	8/18/2010	—	<6	E .1	—	—	—
(D-4-4)13bdd-1	402810111263601	9/9/2010	—	25	17.3	—	—	—
(D-4-5)3dcc-1	402937111214901	8/17/2010	—	<6	<.2	—	—	—
(D-4-5) 4ccb-1	402946111233901	8/17/2010	—	15	2.0	—	—	—
(D-4-5)6bcc-2	403003111255801	8/17/2010	—	29	2.6	—	—	—
(D-4-5)16bab-1	402840111232201	8/18/2010	—	<6	<.2	—	—	—
(D-4-5)16ccd-1	402750111232701	8/17/2010	—	E 3	0.4	—	—	—
Washington County								
Central Virgin River area								
(C-41-17)8cbd-2	371348113470301	7/20/2010	23.0	10	1.4	5.6	0.23	1.48
(C-42-14)15cbd-1	370538113251301	7/19/2010	13.4	<12	4.8	3.0	37.1	12.2
(C-43-15)25cdd-1	370034113290801	7/19/2010	0.86	40	1.7	3.1	10.4	6.12

Table 6. Concentration of trace elements in water samples collected from selected wells in Utah, summer of 2010.—Continued

[µg/L, micrograms per liter; < , less than; E, estimated; —, no data]

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Wayne County								
Upper Fremont River Valley								
(D-27-2)26ddc-1	382544111392401	8/16/2010	14.2	E 5	15.4	1.4	0.14	2.88
Weber County								
East Shore area								
(B-5-2)6bdd-1	411153112064603	7/21/2010	9.9	158	123	0.4	<.04	<.01
(B-5-2)6bdd-5	411153112064605	7/21/2010	1.3	1,160	35.3	2.2	0.06	0.02
(B-7-2)16dcd-2	412011112041401	7/21/2010	2.3	47	41.8	2.1	<.04	0.01
(B-7-2)32bbb-1	411824112060601	7/21/2010	3.6	354	269	0.4	E .03	E .01

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