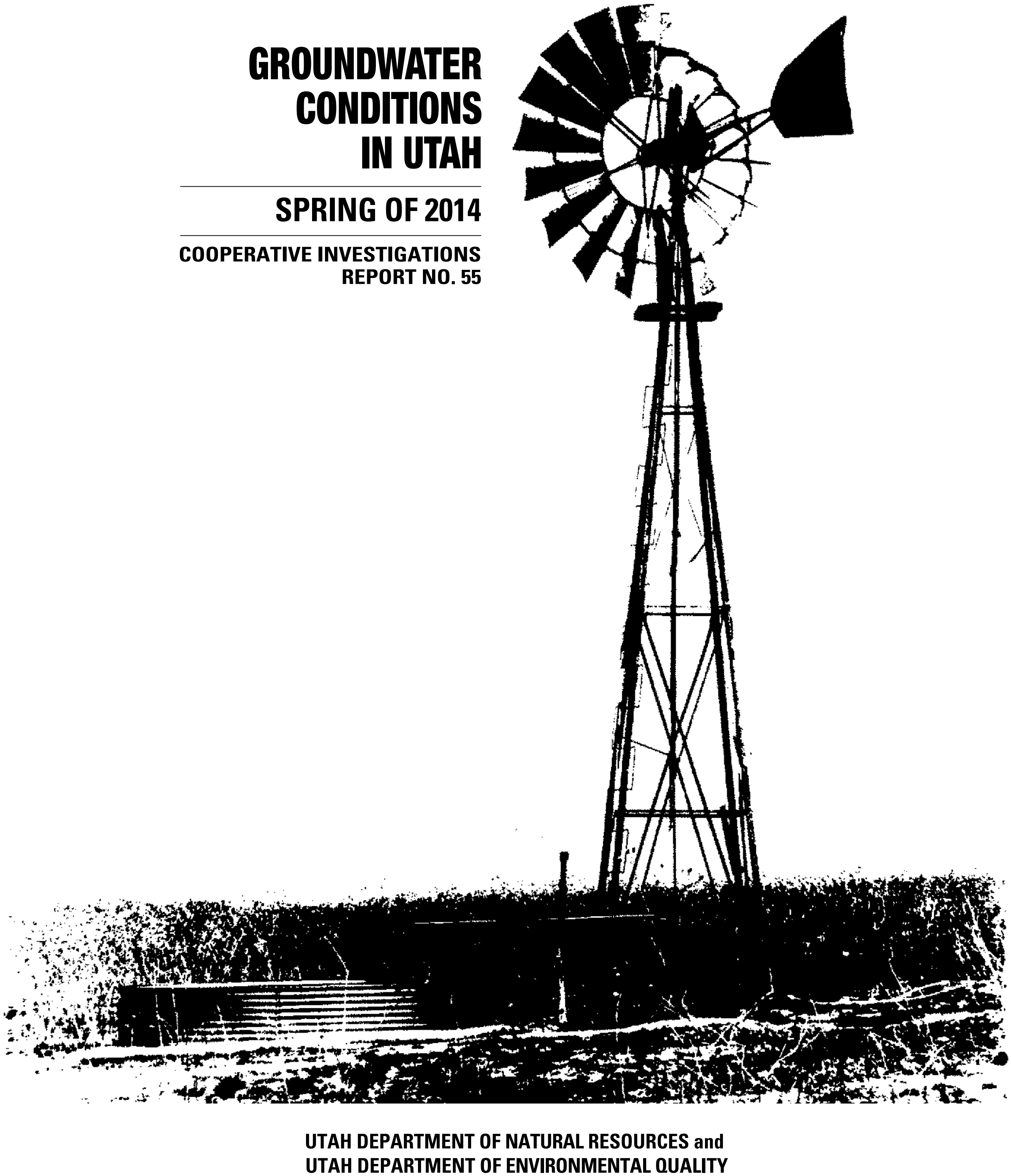
GROUNDWATER CONDITIONS IN UTAH

SPRING OF 2014

COOPERATIVE INVESTIGATIONS
REPORT NO. 55



UTAH DEPARTMENT OF NATURAL RESOURCES and
UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

U.S. GEOLOGICAL SURVEY

GROUNDWATER CONDITIONS IN UTAH, SPRING OF 2014

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

Published by the
Utah Department of Natural Resources
Cooperative Investigations Report No. 55
2014

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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	0.06301	liter per second
inch	2.54	centimeter
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.

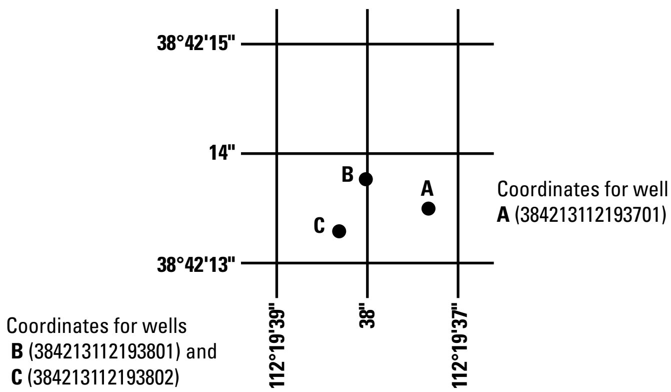
Definition of Terms

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–micron 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.
Precipitation—The total annual precipitation in inches, rounded to tenths of an inch. For selected locations, it is computed from monthly total precipitation (rain, sleet, hail, snow, etc.). Data are supplied by the National Oceanic and Atmospheric Administration (NOAA) and the Western Regional Climate Center (WRCC). 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

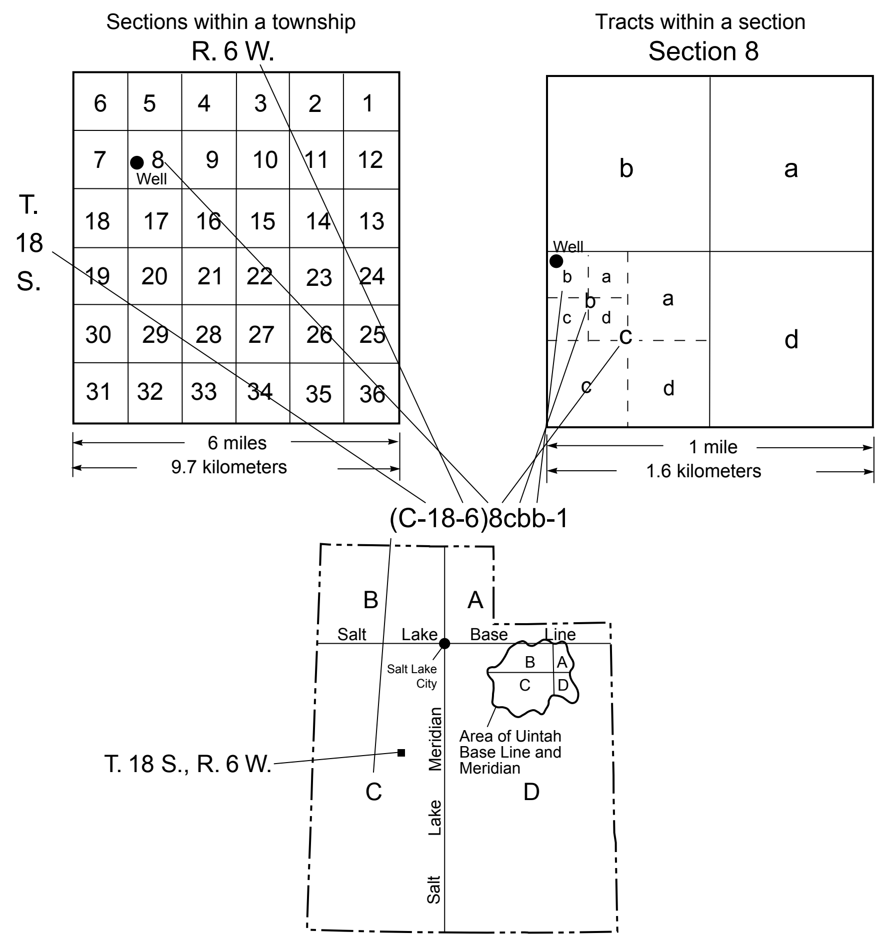
Wells by Latitude and Longitude

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 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. Well numbers for wells located in half ranges will have an additional “R” 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 2014

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

Introduction

This is the fifty-first 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 2013. 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/GW2014.pdf*. Groundwater conditions in Utah for calendar year 2012 are reported in Burden and others (2013) and are available online at *http://ut.water.usgs.gov/publications/GW2013.pdf*.

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 on figure 1 and 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 may contain open fractures. Most wells that yield water from consolidated-rock aquifers 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 2013 was about 1,027,000 acre-feet (table 2), which is about 24,000 acre-feet less than the revised total for 2012 and 101,000 acre-feet more than the 2003–2012 average annual withdrawal (table 3). The decrease in withdrawal resulted mostly from decreased irrigation and public-supply use. The total estimated withdrawal for irrigation was about 558,000 acre-feet, which is about 11,000 acre-feet less than the revised total for 2012. Withdrawal for public-supply use was about 293,000 acre-feet, which is 16,000 acre-feet less than in 2012 (Burden and others, 2013). Withdrawal for industrial use was about 117,000 acre-feet, which is 4,000 acre-feet more than the value for 2012. Withdrawal for domestic and stock use was about 60,000 acre-feet, which is 2,000 acre-feet less than the revised total for 2012.

From 2012 to 2013, groundwater withdrawal decreased or was the same in 12 of the 16 areas of groundwater development discussed in this report (table 2). Withdrawal in Salt Lake Valley decreased about 14,000 acre-feet, the largest decrease in any of the groundwater development areas shown on figure 1. Withdrawal in Sevier Desert increased about 23,000 acre-feet, the largest increase in any of the areas. The 2013 total withdrawal was more than the average annual withdrawal for 2003–2012 in 14 of the 16 areas (table 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 2013 at 18 of 27 weather stations included in this report (Western Regional Climate Center, accessed July 1, 2014, at *http://www.wrcc.dri.edu*), was less than the long-term average. The greatest decrease in precipitation from average was 11.8 inches at Pineview Dam. The greatest increase in precipitation from average was 4.8 inches at Hatch.

During February and March 2014, about 650 water-level measurements were made in wells for areas included in this report. Most water-level data included in the hydrographs for these wells 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 2013, 341 wells were constructed for new appropriations of groundwater, as determined by the Utah Division of Water Rights (table 2); this is 31 more wells than the total reported for 2012 (Burden and others, 2013). In 2013, 30 large-diameter wells (12 inches or more) were constructed for new appropriations of groundwater (table 2), which is 8 more than the total reported for 2012. These new wells are used principally for withdrawal of water for public supply, irrigation, and industrial purposes.

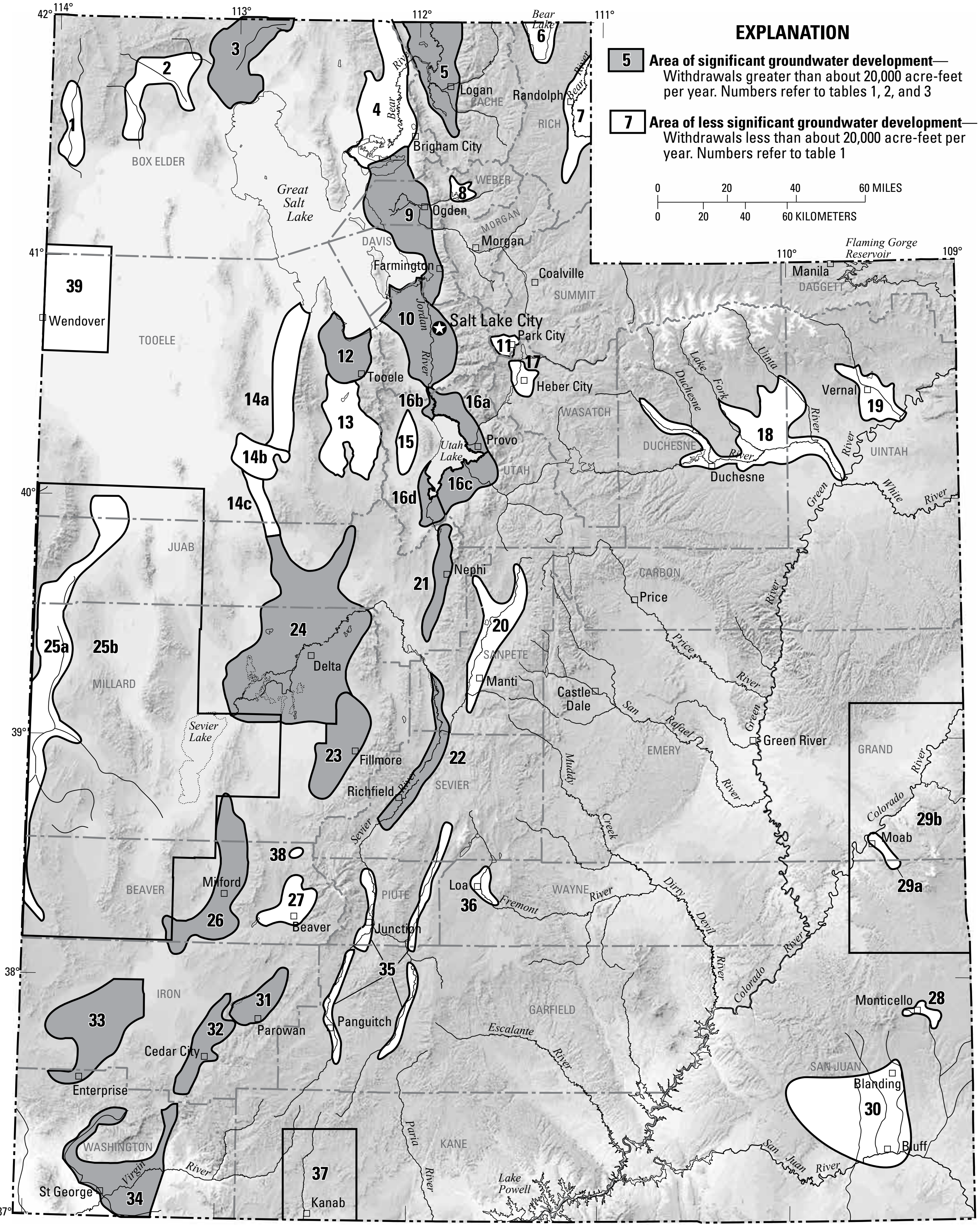


Figure 1. Areas of groundwater development in Utah specifically referred to in this report.

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

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

Table 2. Number of wells constructed and estimated withdrawal of water from wells in Utah, 2013.

Area	Number in figure 1	Number of wells[1] constructed in 2013: Total	Number of wells[1] constructed in 2013: Diameter of 12 inches or more	Estimated withdrawal from wells, in acre-feet (rounded), 2013: Irrigation	2013: Industrial[1]	2013: Public supply[1]	2013: Domestic and stock	2013: Total	2012 total[2]
Curlew Valley	3	1	0	40,000	0	200	100	40,000	42,000
Cache Valley	5	27	0	17,500	5,400	13,100	2,000	38,000	38,000
East Shore area	9	5	0	6,800	3,300	33,700	5,000	49,000	46,000
Salt Lake Valley	10	6	3	700	[3]38,900	91,600	22,000	153,000	167,000
Tooele Valley	12	10	2	[4,5]12,100	400	11,600	1,100	25,000	30,000
Utah and Goshen Valleys	16	28	1	28,300	10,700	59,400	13,000	111,000	[6]113,000
Northern Utah Valley-east[7]	16a	(3)	(1)	(3,700)	(7,300)	(41,000)	(4,200)	(56,200)	[6](58,000)
Northern Utah Valley-west[7]	16b	(1)	(0)	(0)	(0)	(1,800)	(2,100)	(3,900)	(3,900)
Southern Utah Valley[7]	16c	(22)	(0)	(8,700)	(3,400)	(16,500)	(6,600)	(35,200)	[6](35,000)
Goshen Valley[7]	16d	(2)	(0)	(15,900)	(0)	(100)	(70)	(16,100)	[6](16,000)
Juab Valley	21	7	1	26,400	90	[8]480	400	27,000	28,000
Sevier Desert	24	6	1	37,000	7,000	1,500	1,200	47,000	24,000
Central Sevier Valley	22	11	0	23,800	50	3,100	1,500	28,000	28,000
Pahvant Valley	23	7	1	101,500	0	880	320	103,000	114,000
Cedar Valley, Iron County	32	2	0	28,900	100	7,300	2,300	39,000	40,000
Parowan Valley	31	3	1	[9]30,900	200	320	350	32,000	38,000
Escalante Valley									
Milford area	26	7	5	45,900	[10]20,800	700	130	68,000	67,000
Beryl-Enterprise area	33	7	4	88,100	[11]4,100	540	650	93,000	91,000
Central Virgin River area	34	8	0	6,200	540	20,300	2,400	29,000	29,000
Other areas[12, 13]		206	11	63,700	25,500	48,700	7,500	145,000	156,000
Total (rounded)		341	30	558,000	117,000	293,000	60,000	1,027,000	[6]1,051,000

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

[2] From Burden and others (2013, table 2).

[3] Includes some use for air conditioning, about 2,800 acre-feet, of which about 92 percent was injected back into the aquifer.

[4] Includes some domestic and stock use.

[5] Includes some flowing well discharge.

[6] Revised.

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

[8] Previously included some springs.

[9] Includes some stock use.

[10] Includes 18,200 acre-feet for geothermal power generation, of which about 99 percent was injected back into the aquifer.

[11] Includes 2,810 acre-feet for heating greenhouses. About 95 percent was injected back into the aquifer.

[12] Withdrawal totals are estimated minimum. See “Other Areas” section of this report for withdrawal estimates (table 4).

[13] 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, 2003–2012.

Area	Number in figure 1	Thousands of acre-feet[1] (rounded)											
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2003–2012 average (rounded)	2013
Curlew Valley	3	42	38	29	31	38	44	34	39	32	42	37	40
Cache Valley	5	27	27	29	31	36	34	31	33	30	38	32	38
East Shore area	9	49	46	41	46	52	54	46	43	37	46	46	49
Salt Lake Valley	10	130	125	110	131	151	135	137	140	126	167	135	153
Tooele Valley	12	22	21	[2]18	[2]21	[2]27	[2]28	25	24	21	30	24	25
Utah and Goshen Valleys	16	[2]108	[2]105	[2]87	[2]99	126	[2]120	[2]105	[2]106	[2]90	[2]113	106	111
Northern Utah Valley[3]	16a,b	[2](68)	[2](66)	[2](46)	(58)	(72)	[2](67)	[2](60)	[2](58)	[2](45)	[2](62)	(60)	(60)
Southern Utah Valley[3]	16c	(33)	(30)	(31)	(29)	(38)	(34)	(30)	(31)	(28)	[2](35)	(32)	(35)
Goshen Valley[3]	16d	(7)	(9)	(10)	(12)	(16)	(19)	(15)	(17)	(17)	[2](16)	(14)	(16)
Juab Valley	21	27	26	14	21	26	26	21	22	15	28	23	27
Sevier Desert	24	28	41	24	20	34	44	48	46	20	24	33	47
Central Sevier Valley	22	15	15	17	16	19	24	27	26	31	28	22	28
Pahvant Valley	23	86	85	80	86	89	94	104	106	89	114	93	103
Cedar Valley, Iron County	32	39	40	30	35	40	40	38	38	34	40	37	39
Parowan Valley	31	31	37	27	33	34	38	37	34	32	38	34	32
Escalante Valley													
Milford area	26	50	44	40	45	49	51	56	62	53	67	52	68
Beryl-Enterprise area	33	92	98	68	79	92	93	93	90	84	91	88	93
Central Virgin River area	34	28	26	29	32	33	29	33	29	28	29	30	29
Other areas		128	129	111	130	155	144	130	134	123	156	134	145
Total (rounded)		[2]902	[2]903	[2]754	[2]856	[2]1,001	[2]998	[2]965	[2]972	[2]845	[2]1,051	926	1,027

[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 Adam S. Birkin

The Curlew Valley drainage basin extends across the Utah-Idaho state line and includes the communities of Cedar Creek, Kelton, 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 surrounding mountains.

The principal source of water in Curlew Valley is groundwater. The groundwater reservoir consists primarily 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 2013 was about 40,000 acre-feet, which is 2,000 acre-feet less than the value for 2012 and 3,000 acre-feet more than the average annual withdrawal for 2003–2012 (tables 2 and 3).

The location of wells in Curlew Valley in which the water level was measured during March 2014 is shown in figure 2. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Oakley, Idaho (62 miles northwest of Snowville), to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells is shown in figure 3.

Precipitation at Oakley, Idaho in 2013 was about 8.8 inches, which is 2.3 inches less than in 2012 and 2.1 inches less than the average annual precipitation for 1930–2013.

Water levels in Curlew Valley generally declined slightly from March 2013 to March 2014. However, several wells had declines greater than 8 feet. The largest decline, 38.8 feet, occurred in a well about 3 miles west of Snowville. These large declines are probably the result of large localized withdrawals for irrigation.

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 1972–2013 and 1971–2013, respectively, is shown in figure 3. The dissolved-solids concentration in water from well (B-14-9)5bbb-1 decreased slightly from July 2012 to July 2013. The dissolved-solids concentration in water from well (B-12-11)8abb-1 decreased substantially from September 2011 to July 2013. Dissolved-solids concentrations in water from both wells have generally increased since the early 1970s.

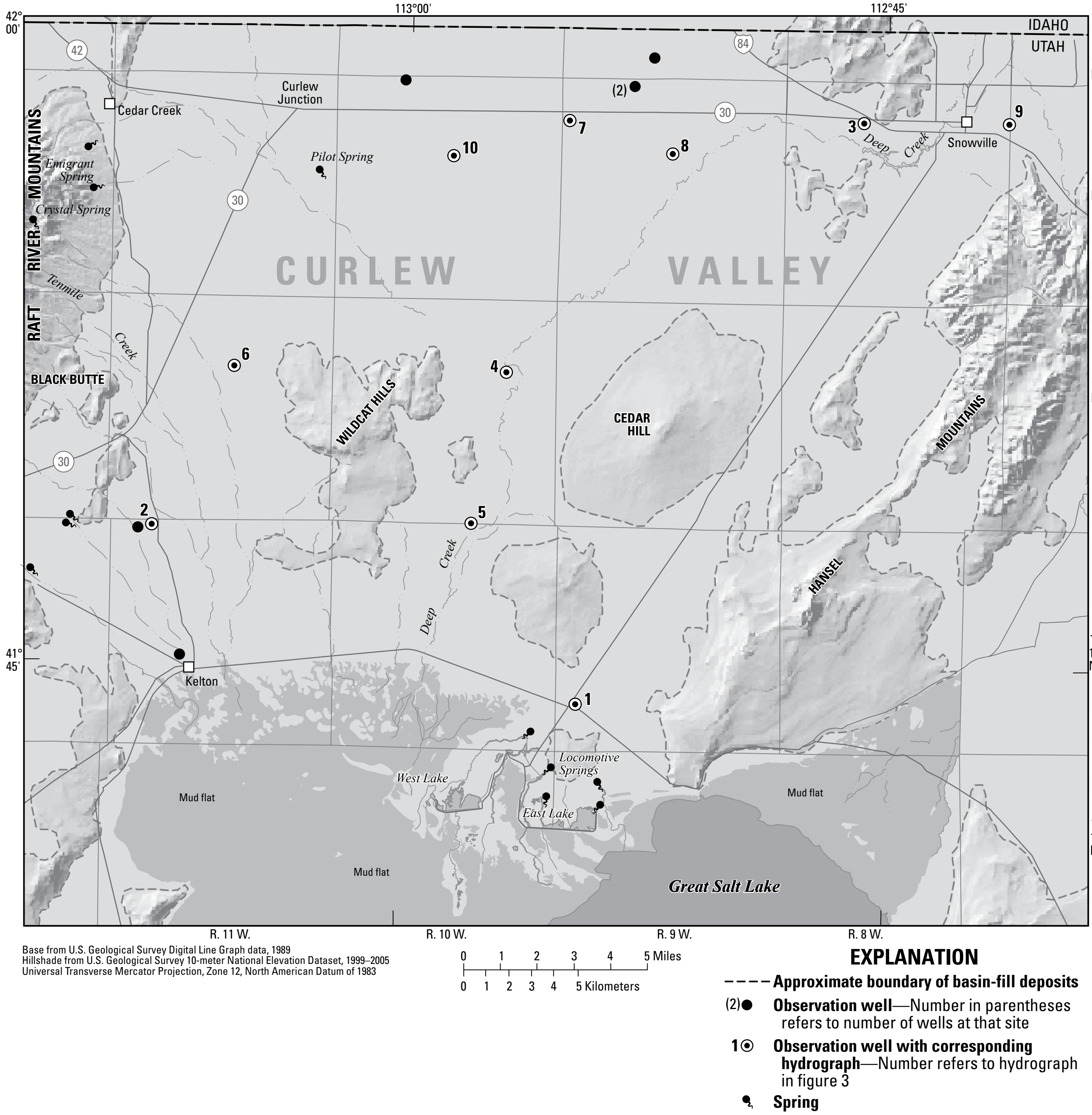


Figure 2. Location of wells in Curlew Valley in which the water level was measured during March 2014.

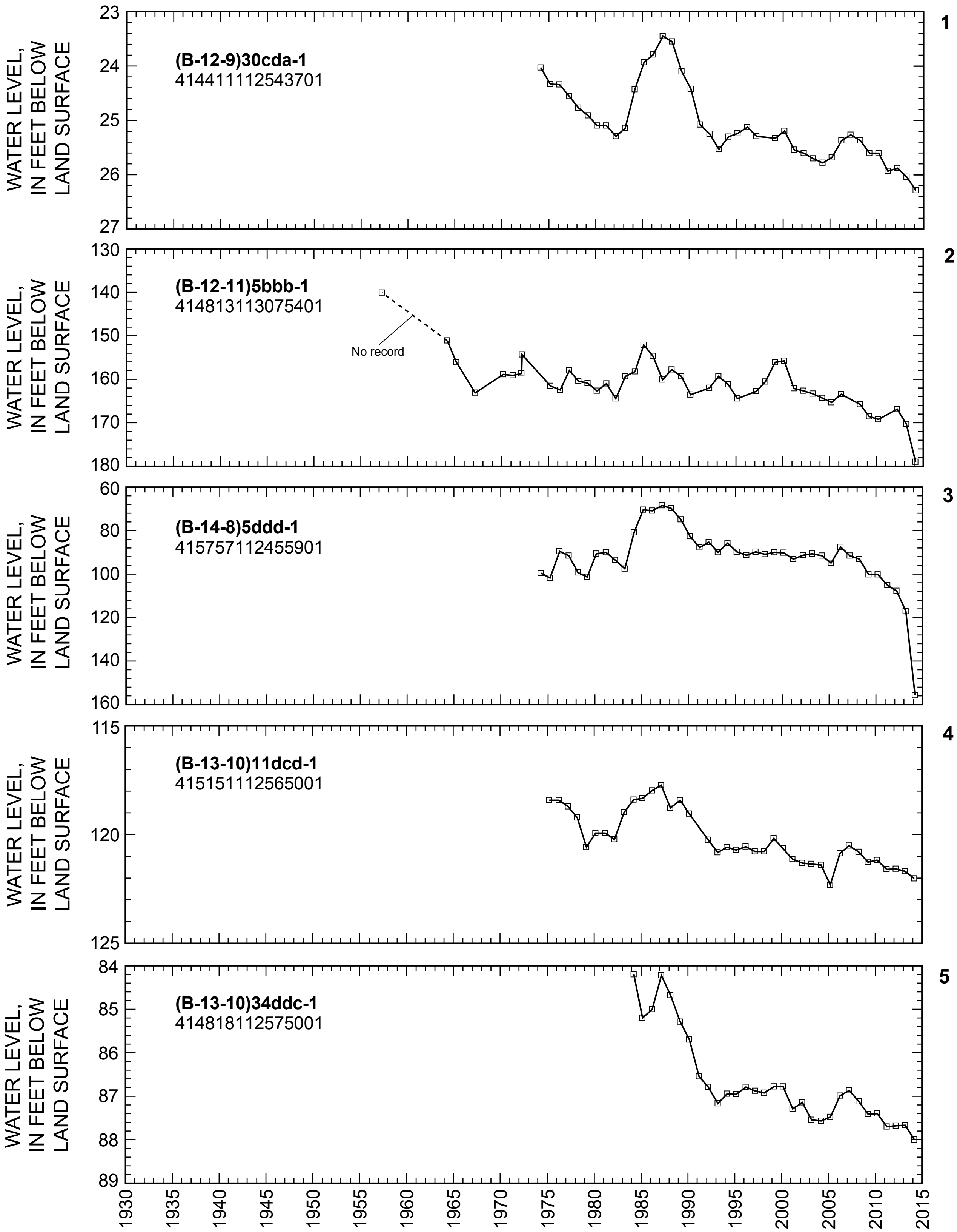


Figure 3. Relation of water level in selected wells in Curlew Valley to cumulative departure from average annual precipitation at Oakley, Idaho, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.

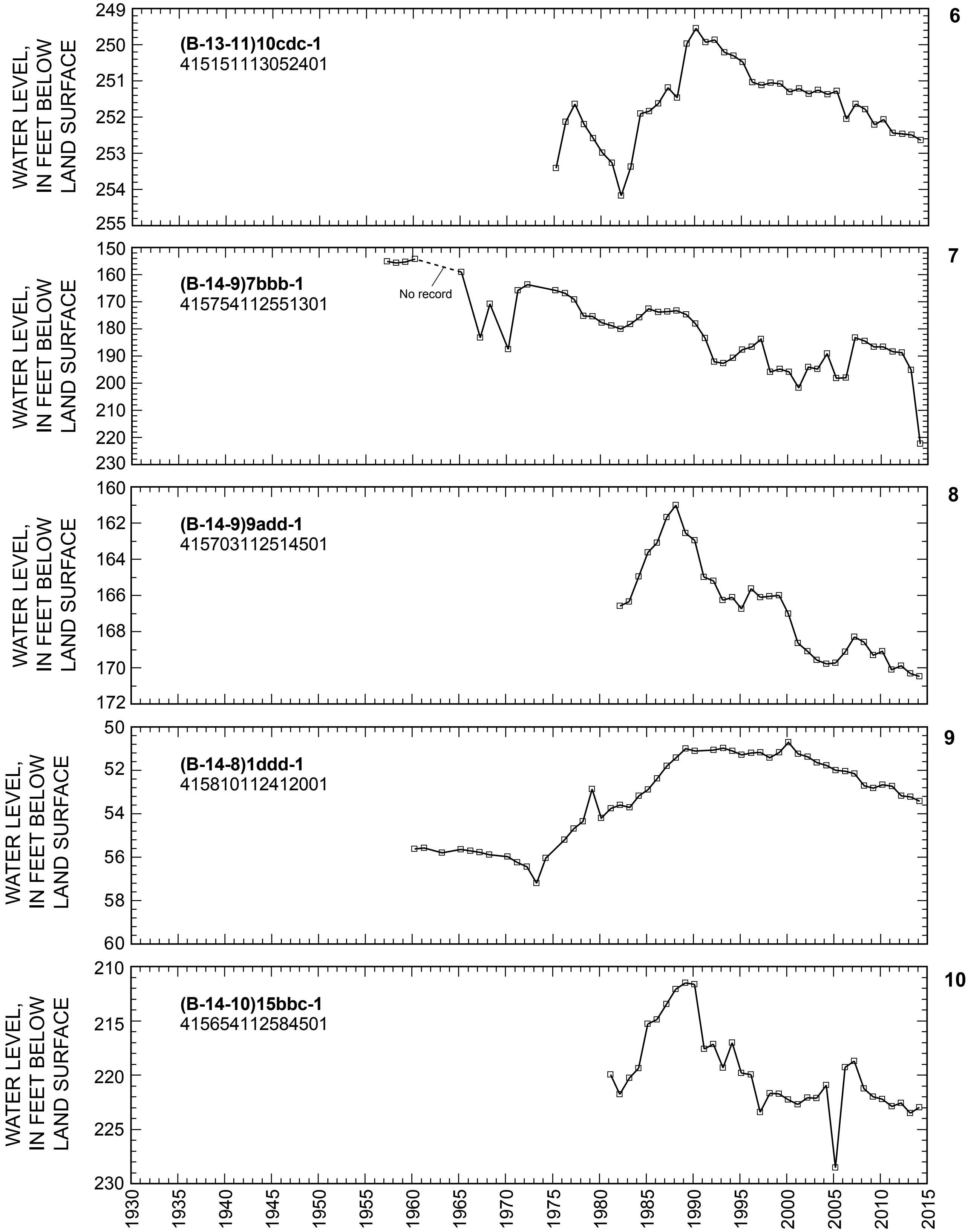


Figure 3. Relation of water level in selected wells in Curlew Valley to cumulative departure from average annual precipitation at Oakley, Idaho, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.—Continued

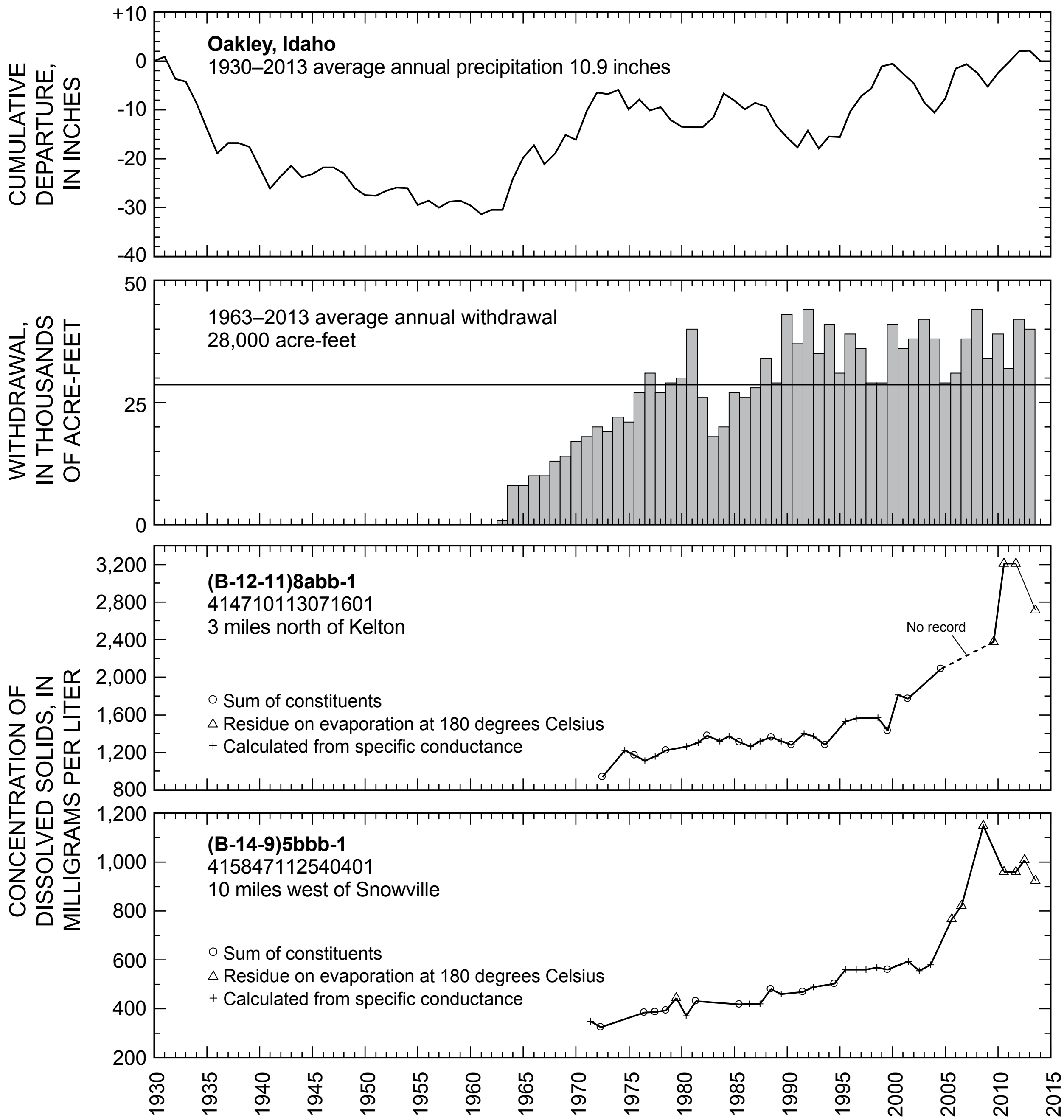


Figure 3. Relation of water level in selected wells in Curlew Valley to cumulative departure from average annual precipitation at Oakley, Idaho, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.—Continued

Cache Valley

By Steven Gerner

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 2013 was about 38,000 acre-feet, which is the same as in 2012 and 6,000 acre-feet more than the average annual withdrawal for 2003–2012 (tables 2 and 3). Withdrawal for irrigation was 17,500 acre-feet, of which an estimated 12,000 acre-feet was from flowing wells. Irrigation withdrawals were nearly the same as in 2012. Withdrawal for public supply was 13,100 acre-feet, slightly less than in 2012.

The location of wells in Cache Valley in which the water level was measured during March 2014 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 and Cache Highline Canal, near Logan) during 2013 was about 102,000 acre-feet, which is 38,000 acre-feet less than the 2012 total of 140,000 acre-feet and 78,000 acre-feet less than the 1941–2013 average annual discharge. Precipitation at Logan, Utah State University was about 11.8 inches in 2013. This is about 3.9 inches less than for 2012 and about 6.4 inches less than the average annual precipitation for 1930–2013.

Water levels throughout the valley generally declined from March 2013 to March 2014. Declines are probably the result of greater-than-average withdrawals for irrigation and public-supply use, and less-than-average precipitation. Water levels have fluctuated over the entire period of record, as far back as 1935 in many cases, depending on the amount and timing of precipitation, and recharge to the unconsolidated deposits from snowmelt runoff.

The concentration of dissolved solids in water samples collected during 1970 to 2012 from well (A-13-1)29bcd-1, located 1.5 miles west of Smithfield, is shown in figure 5. The concentration has ranged from 223 to 278 mg/L, with a median value of 258 mg/L. This well was not sampled in 2013.

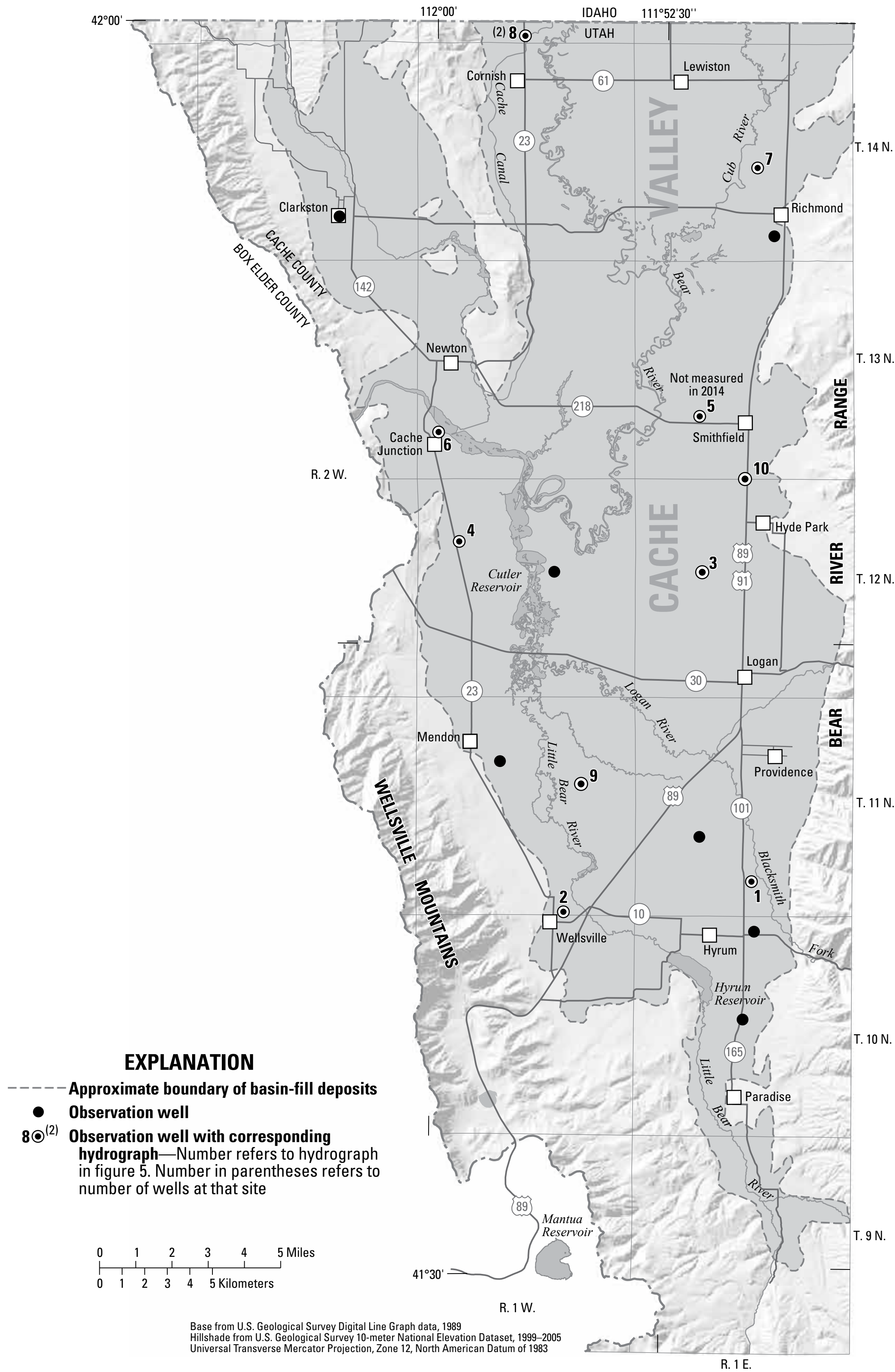


Figure 4. Location of wells in Cache Valley in which the water level was measured during March 2014.

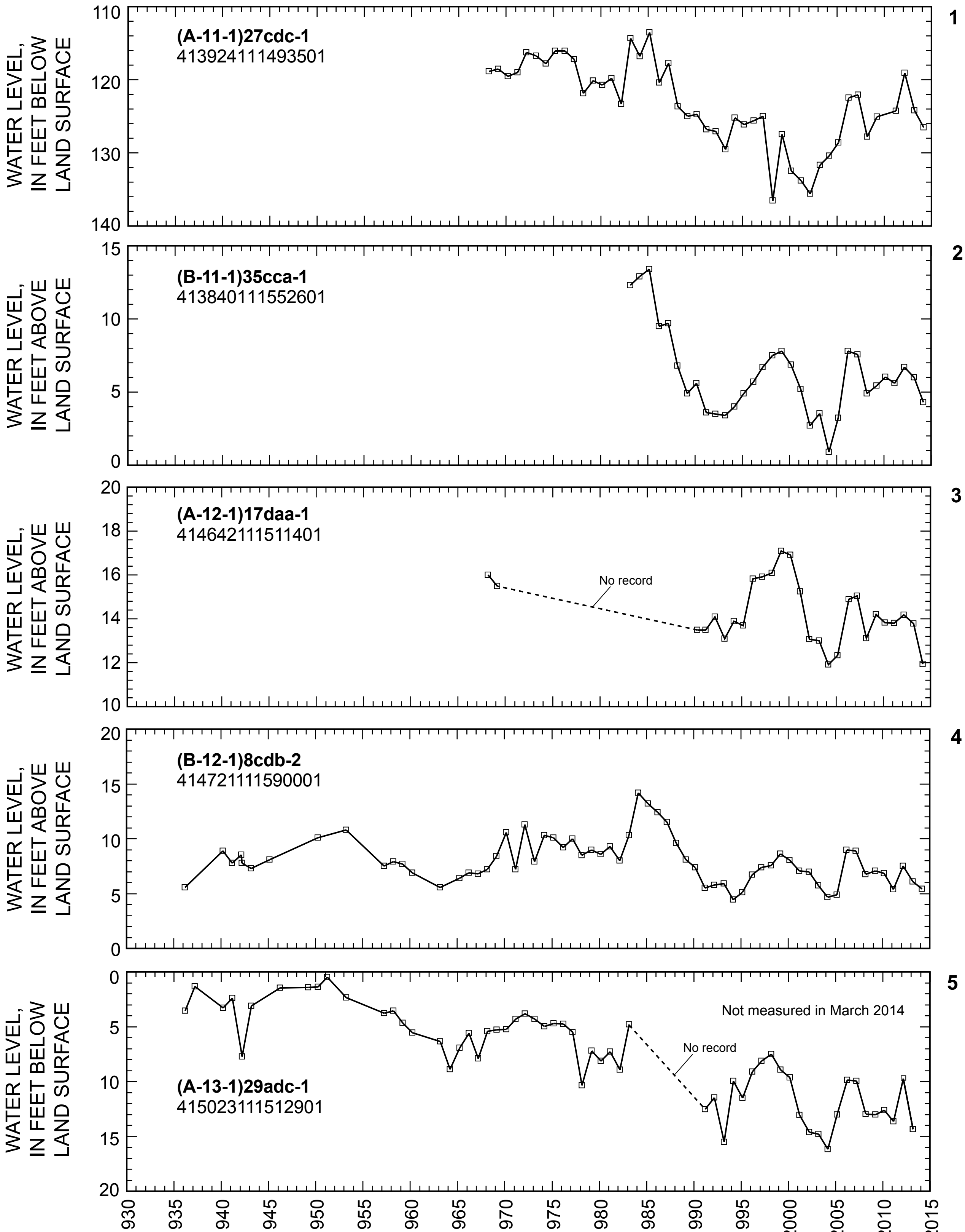


Figure 5. Relation of water level in selected wells in Cache Valley to total annual discharge of the Logan River near Logan, to cumulative departure from average annual precipitation at Logan, Utah State University, to annual withdrawal from wells, and to concentration of dissolved solids in water from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

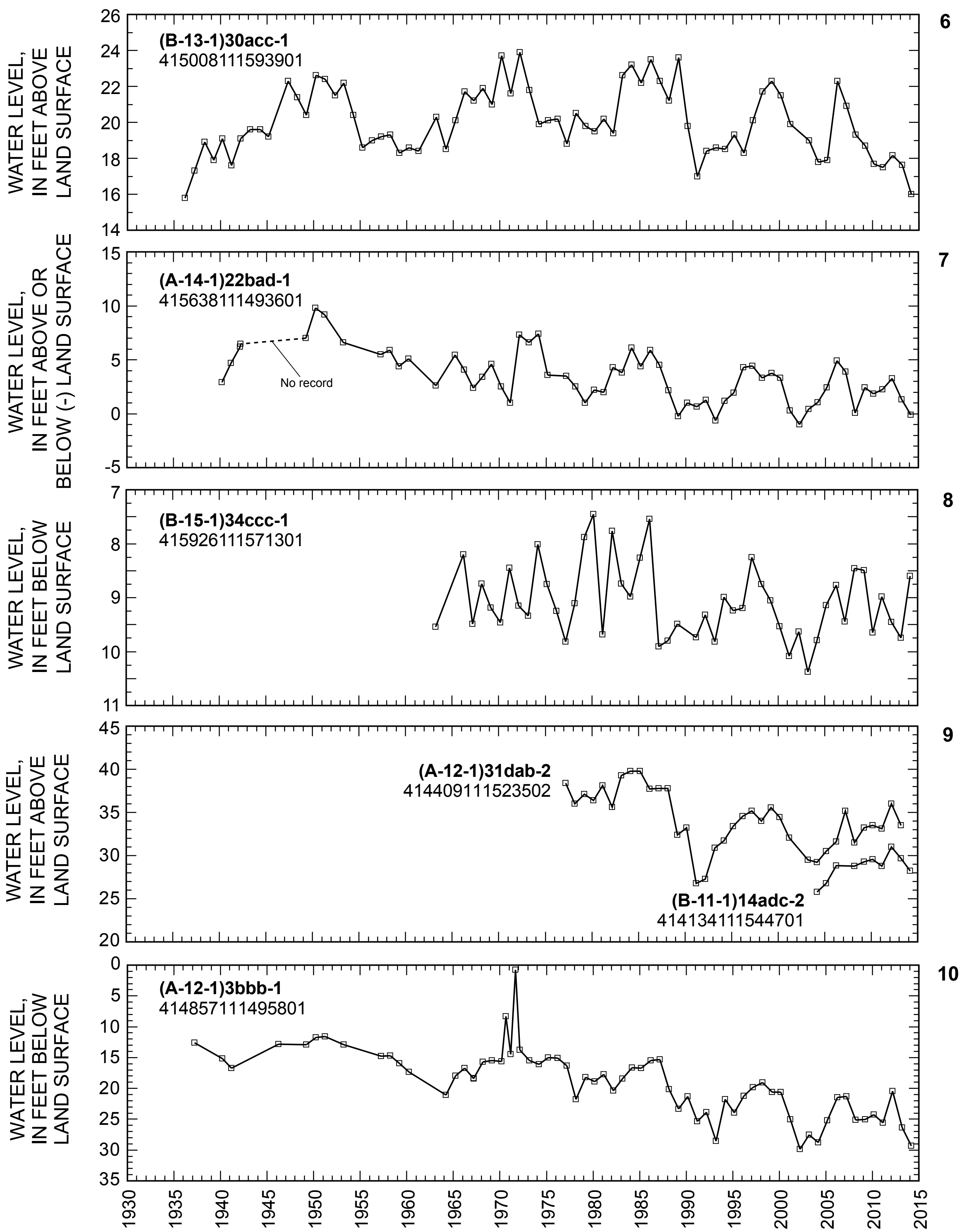


Figure 5. Relation of water level in selected wells in Cache Valley to total annual discharge of the Logan River near Logan, to cumulative departure from average annual precipitation at Logan, Utah State University, to annual withdrawal from wells, and to concentration of dissolved solids in water from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

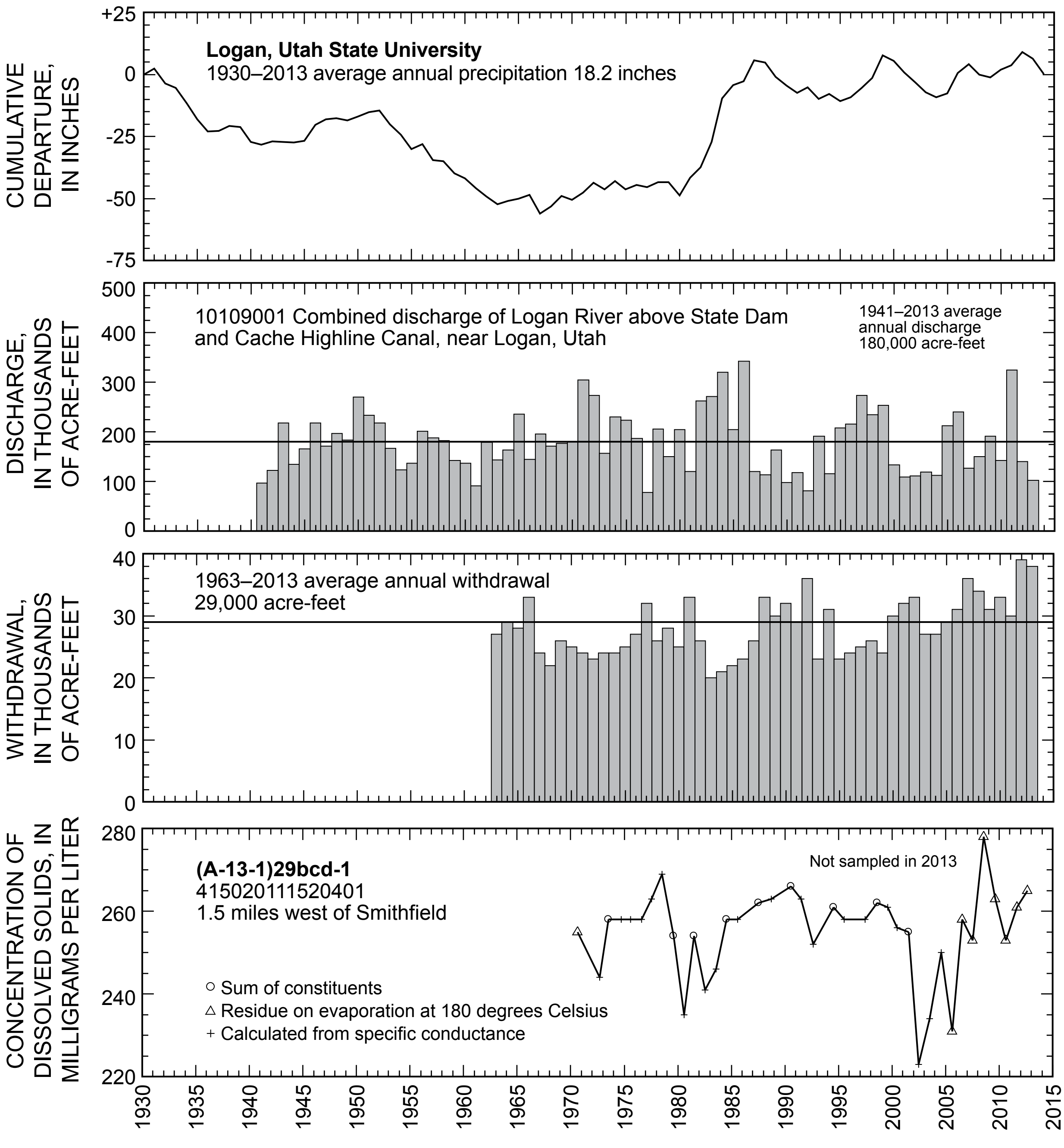


Figure 5. Relation of water level in selected wells in Cache Valley to total annual discharge of the Logan River near Logan, to cumulative departure from average annual precipitation at Logan, Utah State University, to annual withdrawal from wells, and to concentration of dissolved solids in water from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

East Shore Area

By John P. Carricaburu

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.

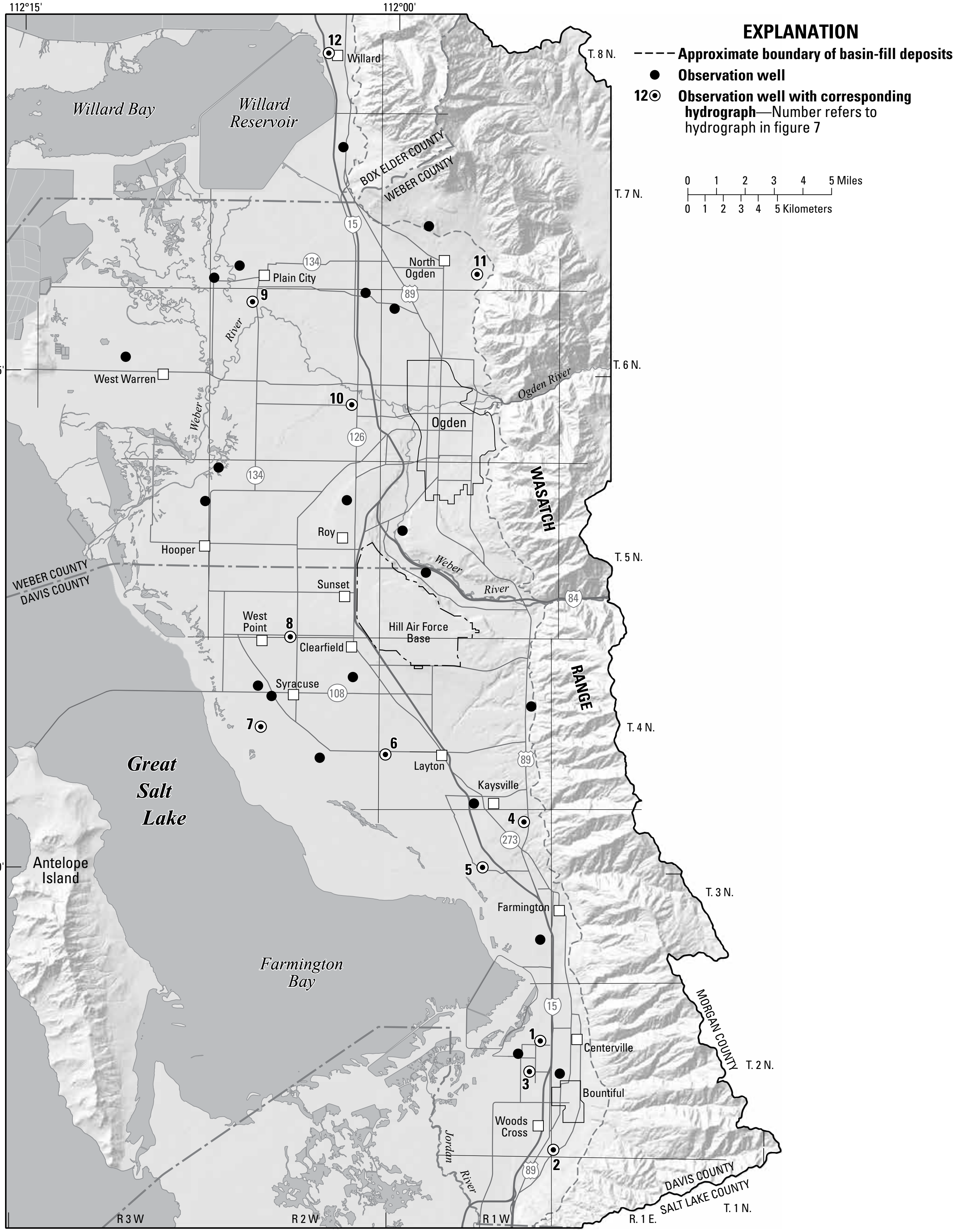
Total estimated withdrawal of water from wells in the East Shore area in 2013 was about 49,000 acre-feet, which is 3,000 acre-feet more than was reported for 2012 and 3,000 acre-feet more than the average annual withdrawal for 2003–2012 (tables 2 and 3). Withdrawal for public supply was 33,700 acre-feet in 2013, about 3,100 acre-feet more than in 2012. Withdrawal for irrigation was about 6,800 acre-feet, which is 200 acre-feet less than was reported for 2012. Withdrawal for industrial use was about 3,300 acre-feet, which is 500 acre-feet less than in 2012.

The location of wells in the East Shore area in which the water level was measured during March 2014 is shown in figure 6. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Pineview Dam, 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 Pineview Dam in 2013 was about 18.7 inches, which is about 11.8 inches less than the average annual precipitation for 1949–2013 and about 5.2 inches less than in 2012.

Water levels declined from March 2013 to March 2014 in most of the wells measured in the East Shore area. Declines are probably due to increased withdrawals for public-supply use and less-than-average precipitation. 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.

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 2013, is shown in figure 7. The median concentration during this period was 391 mg/L. From 1969 to 1993, dissolved-solids concentrations in water samples ranged from 287 to 633 mg/L. Dissolved-solid concentrations in water samples collected from 1995 to 2013 were much less variable, ranging from 362 to 399 mg/L. The dissolved-solids concentration in the water sample collected in June 2013 (372 mg/L) was similar to the median concentration.



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 6. Location of wells in the East Shore area in which the water level was measured during March 2014.

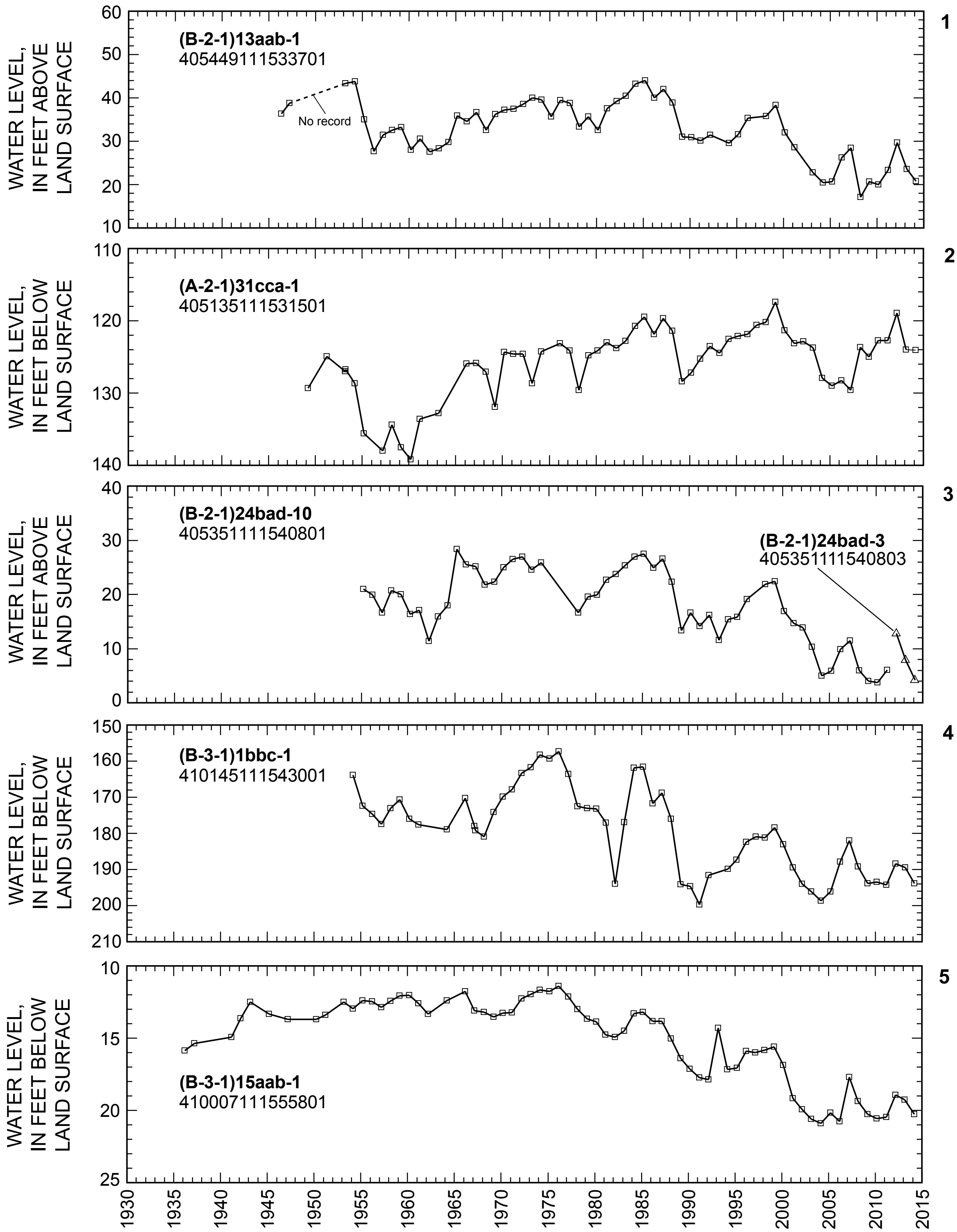


Figure 7. Relation of water level in selected wells in the East Shore area to cumulative departure from average annual precipitation at Pineview Dam, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1.

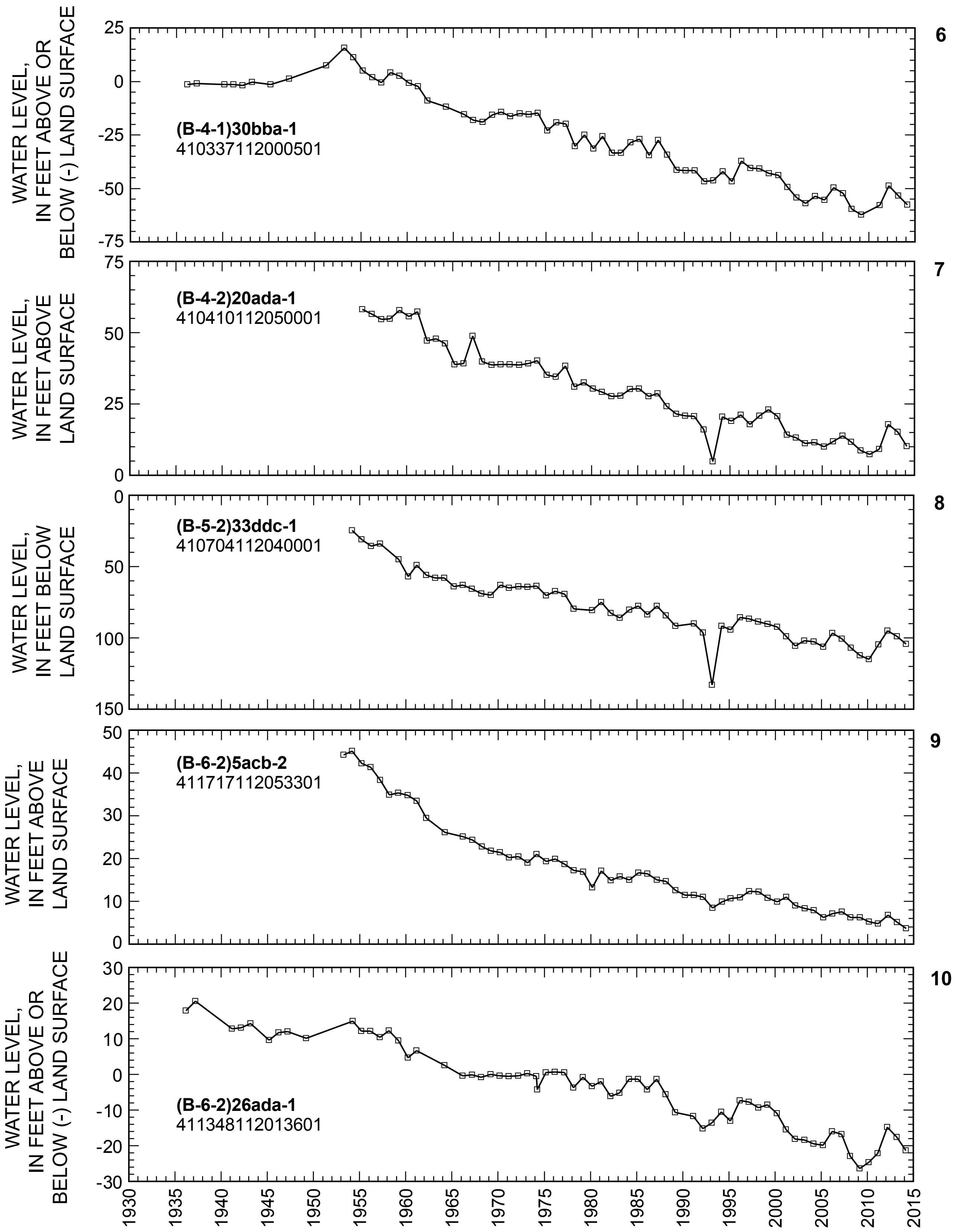


Figure 7. Relation of water level in selected wells in the East Shore area to cumulative departure from average annual precipitation at Pineview Dam, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1.—Continued

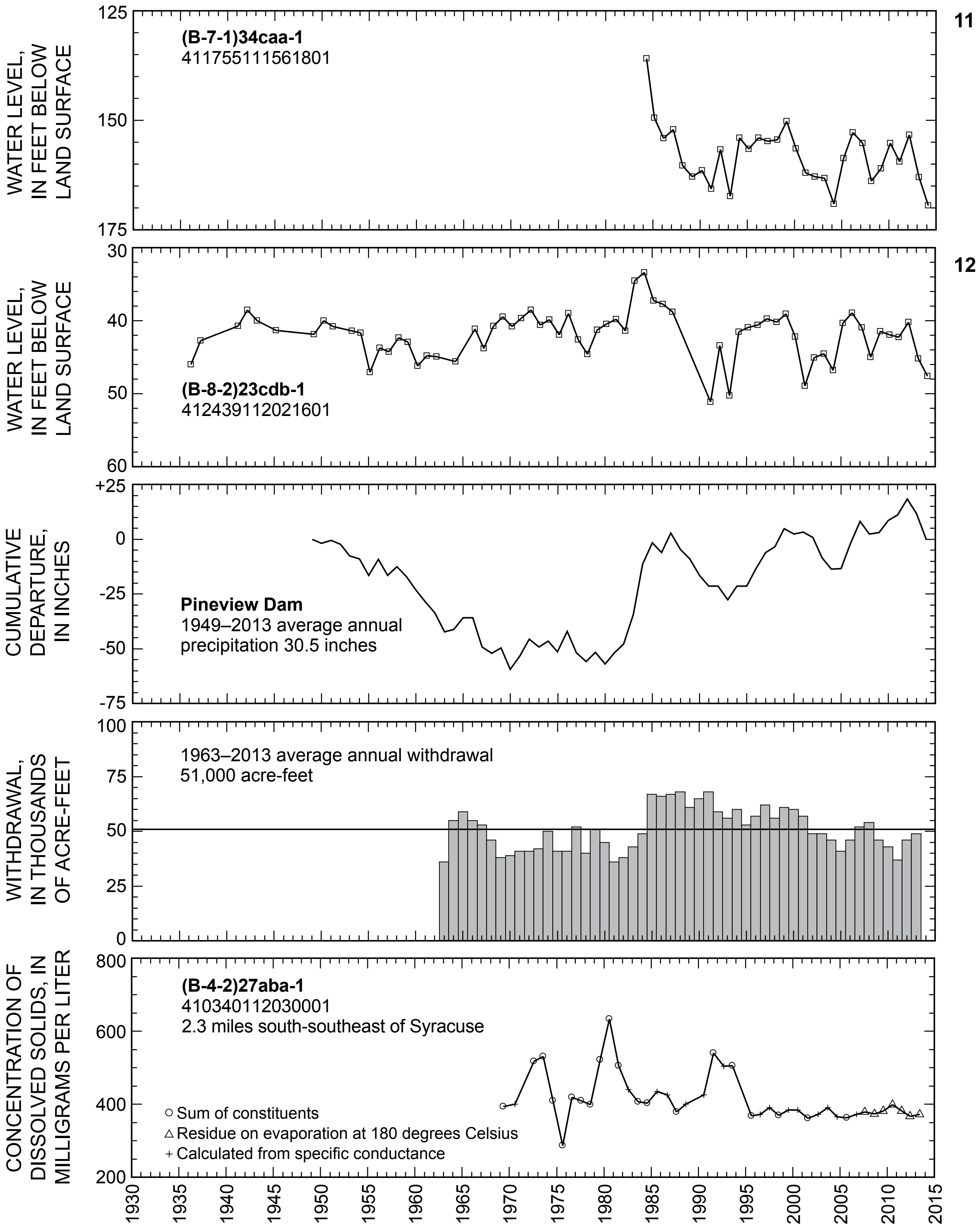


Figure 7. Relation of water level in selected wells in the East Shore area to cumulative departure from average annual precipitation at Pineview Dam, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1.—Continued

Salt Lake Valley

By V. Noah Derrick

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 2013 was about 153,000 acre-feet, which is 14,000 acre-feet less than in 2012 and 18,000 acre-feet more than the average annual withdrawal for 2003–2012 (tables 2 and 3). Withdrawal for public supply was about 91,600 acre-feet, which is 15,800 acre-feet less than the total for 2012. Withdrawal for industrial use was about 38,900 acre-feet, which is 1,900 acre-feet more than the total for 2012.

The location of wells in Salt Lake Valley in which the water level was measured during February 2014 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 (International Airport) are shown in figure 9. Precipitation at Salt Lake City during 2013 was about 11.7 inches, about 1.1 inches less than in 2012 and about 3.5 inches less than the average annual precipitation for 1931–2013.

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 31.3 inches in 2013, which is about 5.4 inches less than in 2012 and about 11.0 inches less than the average annual precipitation for 1931–2013.

Water levels declined from February 2013 to February 2014 in most of the wells measured in Salt Lake Valley. Declines are probably the result of continued large withdrawals for public supply and industrial use, and less-than-average precipitation. 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.

The concentrations of dissolved solids and dissolved chloride (from 1931–2013 and 1935–2013, respectively) in water samples collected from well (D-1-1)7abd-6, a flowing well at 800 South 500 East in Salt Lake City, are shown in figure 10. The concentration of dissolved solids has ranged from 554 to 879 mg/L with a median value of 706 mg/L. The concentration of dissolved solids generally increased from 576 mg/L in December 1931 to 879 mg/L in July 2009. The dissolved-solids concentration in June 2013 (788 mg/L) decreased 86 mg/L from July 2012. The dissolved chloride concentration generally increased from 52 mg/L in July 1935 to 194 mg/L in July 2012, with a median value of 120 mg/L. The dissolved chloride concentration decreased slightly (13 mg/L) from July 2012 to June 2013.

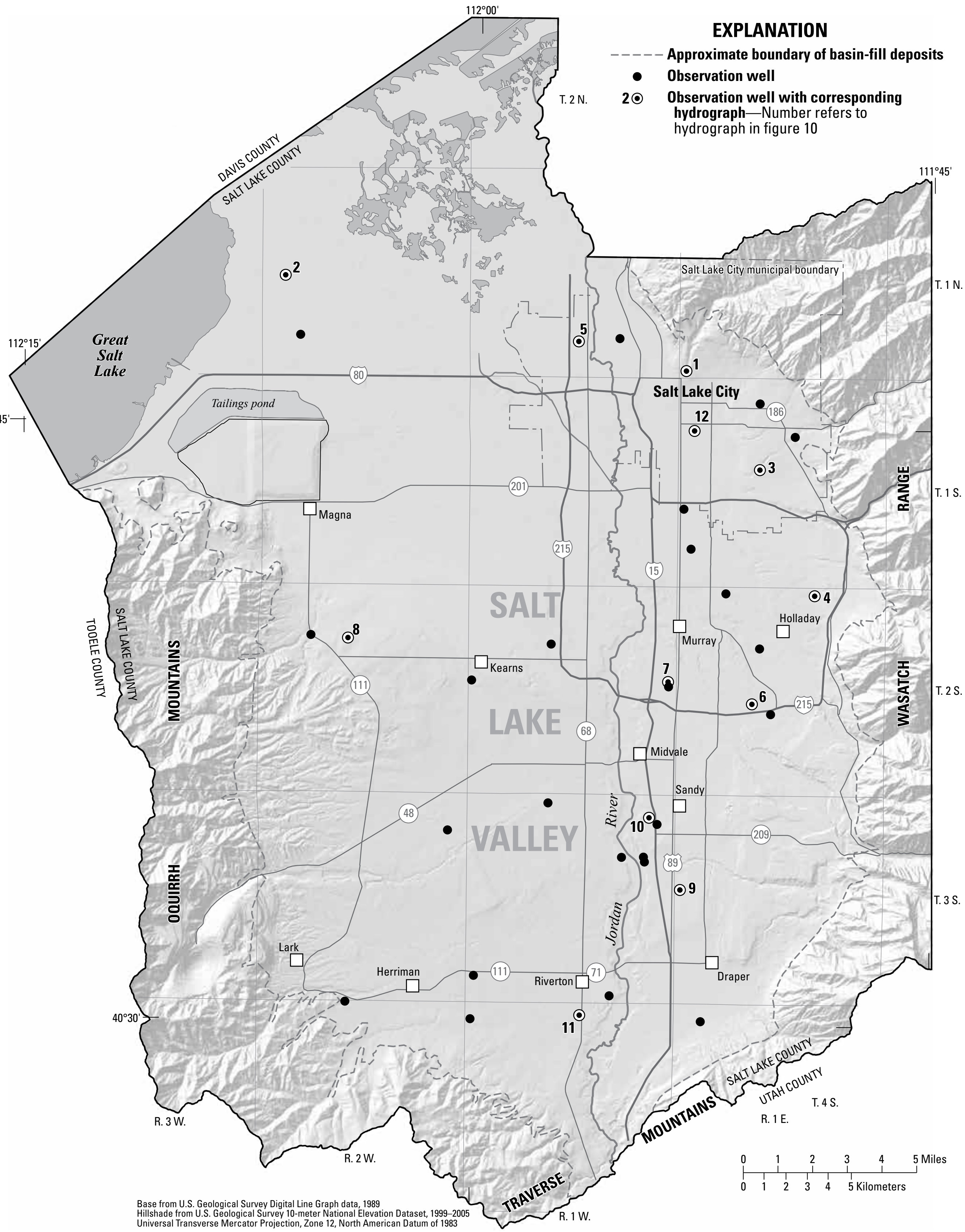


Figure 8. Location of wells in Salt Lake Valley in which the water level was measured during February 2014.

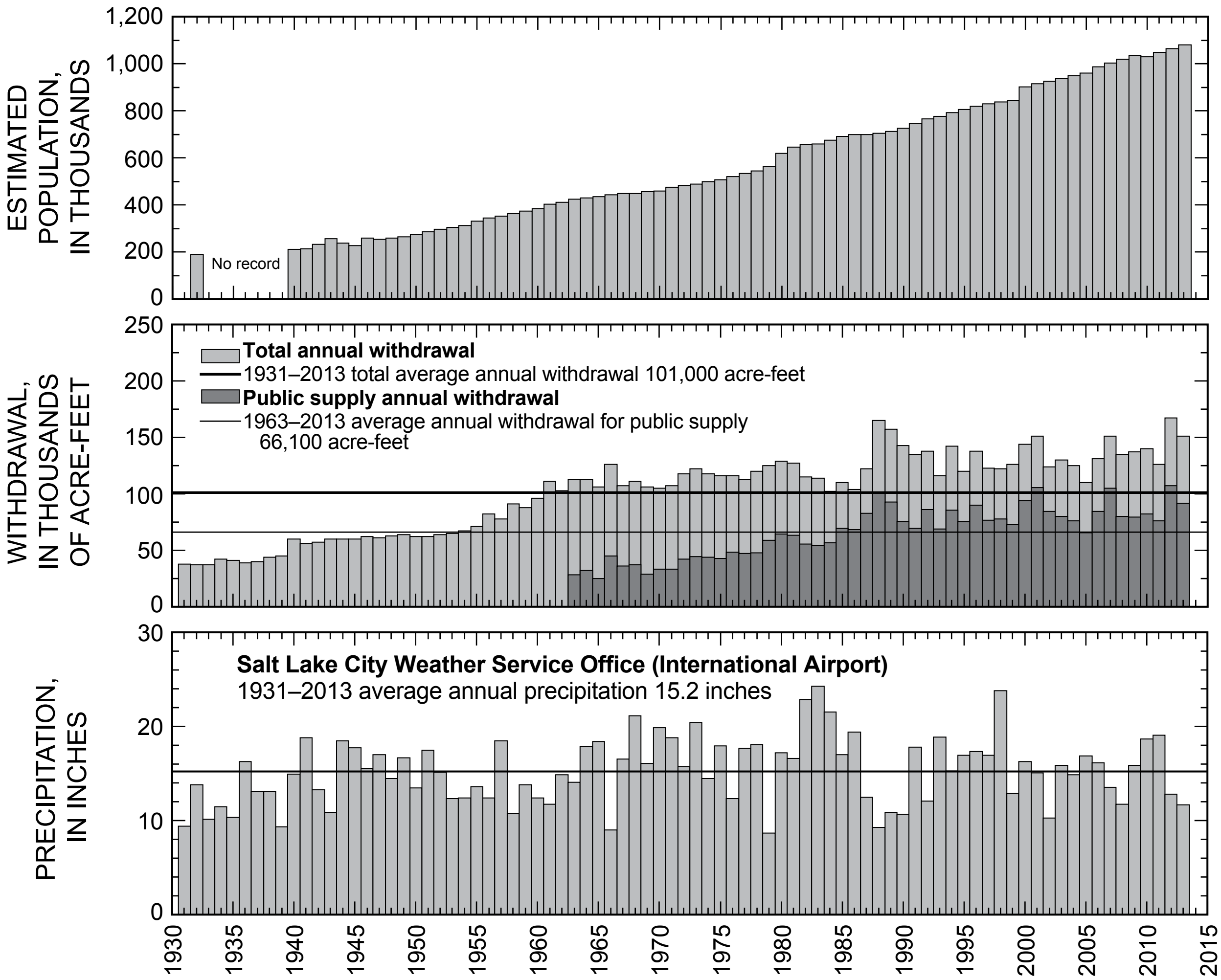


Figure 9. Estimated population of Salt Lake County, total annual withdrawal from wells, annual withdrawal for public supply, and average annual precipitation at Salt Lake City Weather Service Office (International Airport).

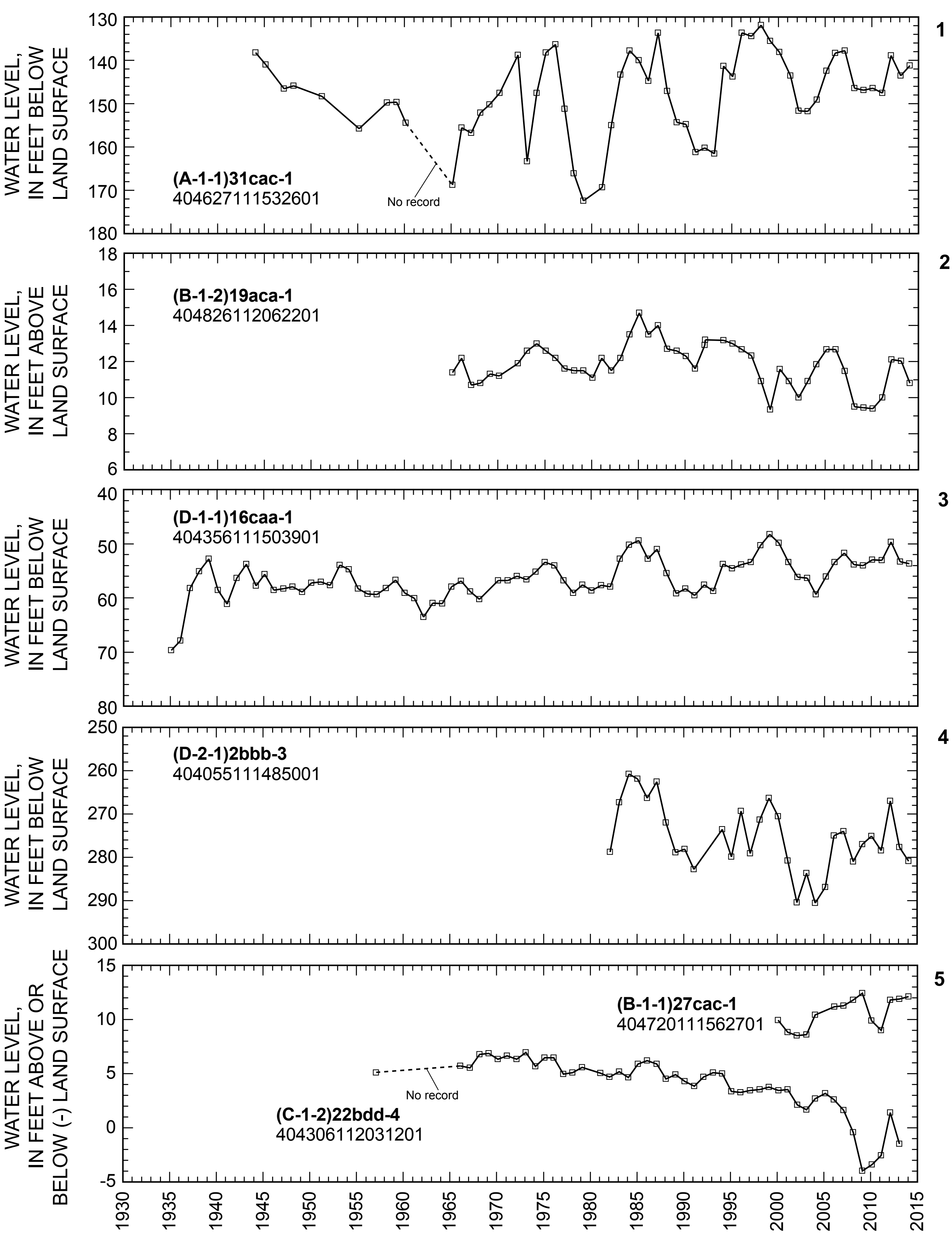


Figure 10. Relation of water level in selected wells completed in the principal aquifer in Salt Lake Valley to cumulative departure from average annual precipitation at Silver Lake Brighton, and relation of water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from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

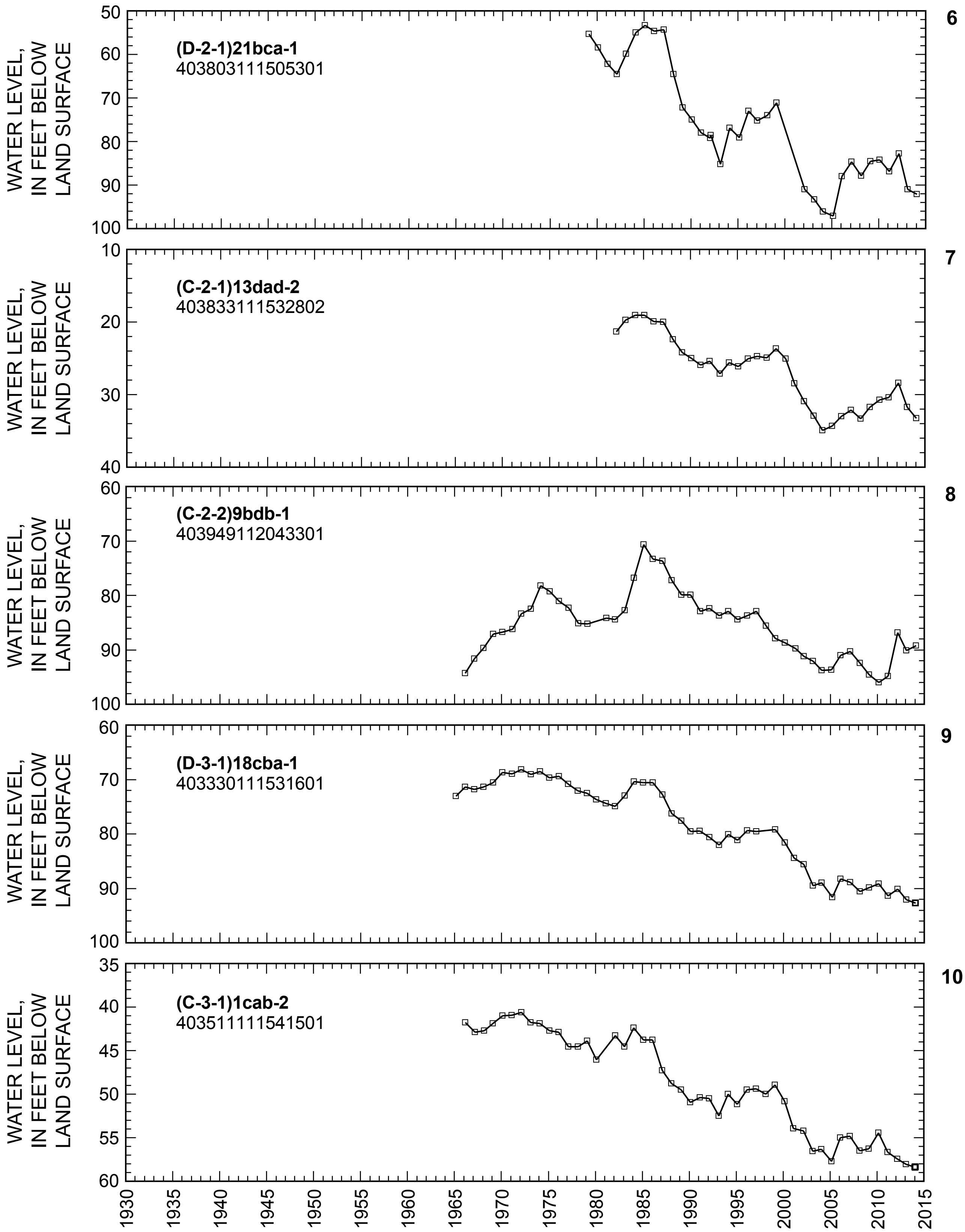


Figure 10. Relation of water level in selected wells completed in the principal aquifer in Salt Lake Valley to cumulative departure from average annual precipitation at Silver Lake Brighton, and relation of water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from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

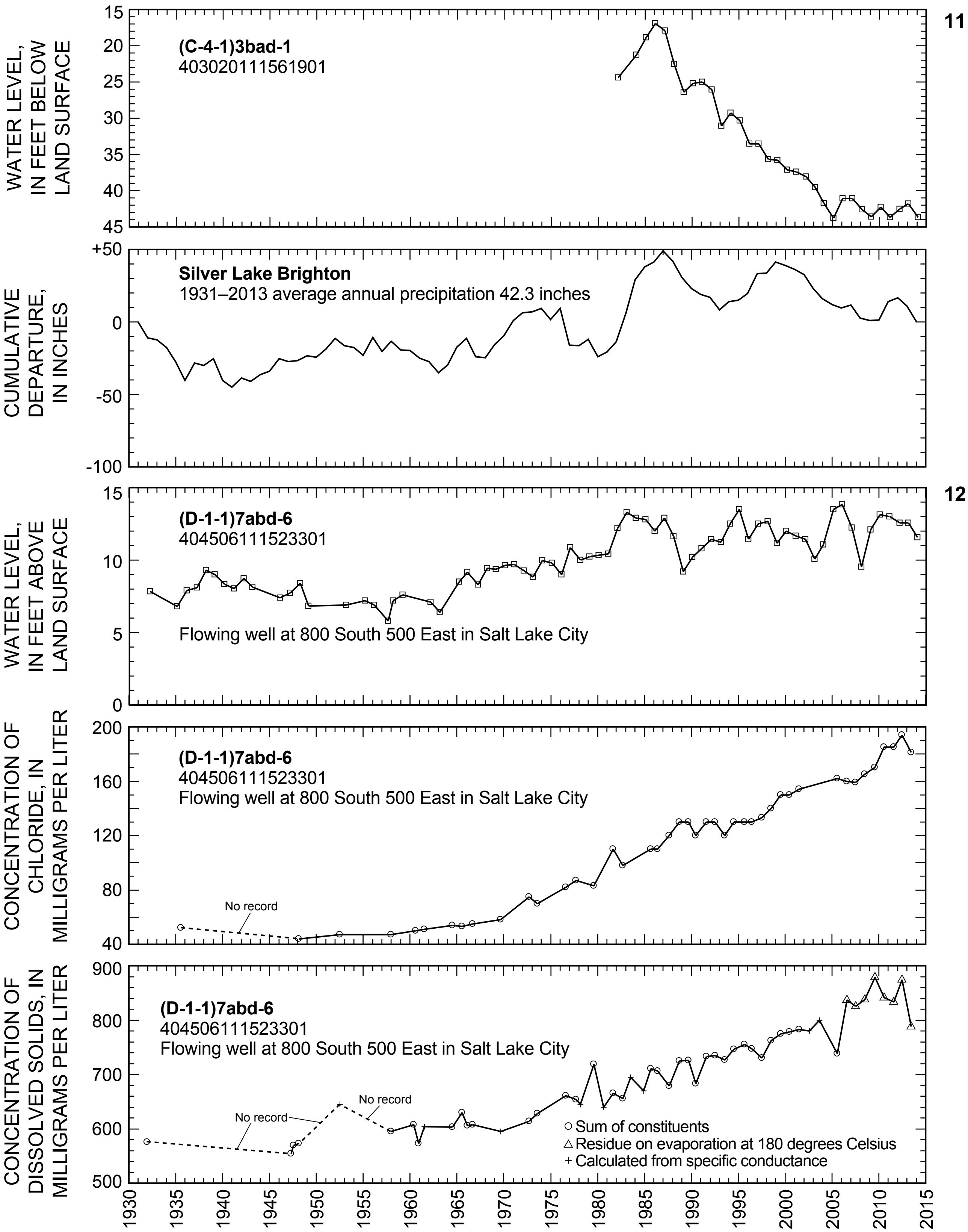


Figure 10. Relation of water level in selected wells completed in the principal aquifer in Salt Lake Valley to cumulative departure from average annual precipitation at Silver Lake Brighton, and relation of water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from 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 2013 was about 25,000 acre-feet, which is about 5,000 acre-feet less than the total for 2012 and 1,000 acre-feet more than the average annual withdrawal for 2003–2012 (tables 2 and 3). Withdrawal for irrigation was about 12,100 acre-feet, which is 2,100 acre-feet less than the total for 2012. Withdrawal for public supply was about 11,600 acre-feet, which is 1,900 acre-feet less than in 2012. Withdrawal for industrial use was about 400 acre-feet, which is 400 acre-feet less than in 2012.

The location of wells in Tooele Valley in which the water level was measured during March 2014 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-2-4)33bdd-1 is shown in figure 12. Precipitation at Tooele during 2013 was about 19.2 inches, which is about 4.2 inches more than in 2012 and about 1.3 inches more than the average annual precipitation for 1936–2013.

Water levels declined from March 2013 to March 2014 in most of the wells measured in Tooele Valley. The largest decline, about 12.9 feet, was observed in a well about 3 miles east of Tooele.

The concentration of dissolved solids in water samples collected from well (C-2-4)33bdd-1, located at Erda, from 1977 to 2013, is shown in figure 12. The concentration has ranged from 456 to 616 mg/L with a median value of 509 mg/L. The concentration of dissolved solids in the water sample collected during June 2013 was 577 mg/L. The dissolved-solids concentration has generally increased since 1977.

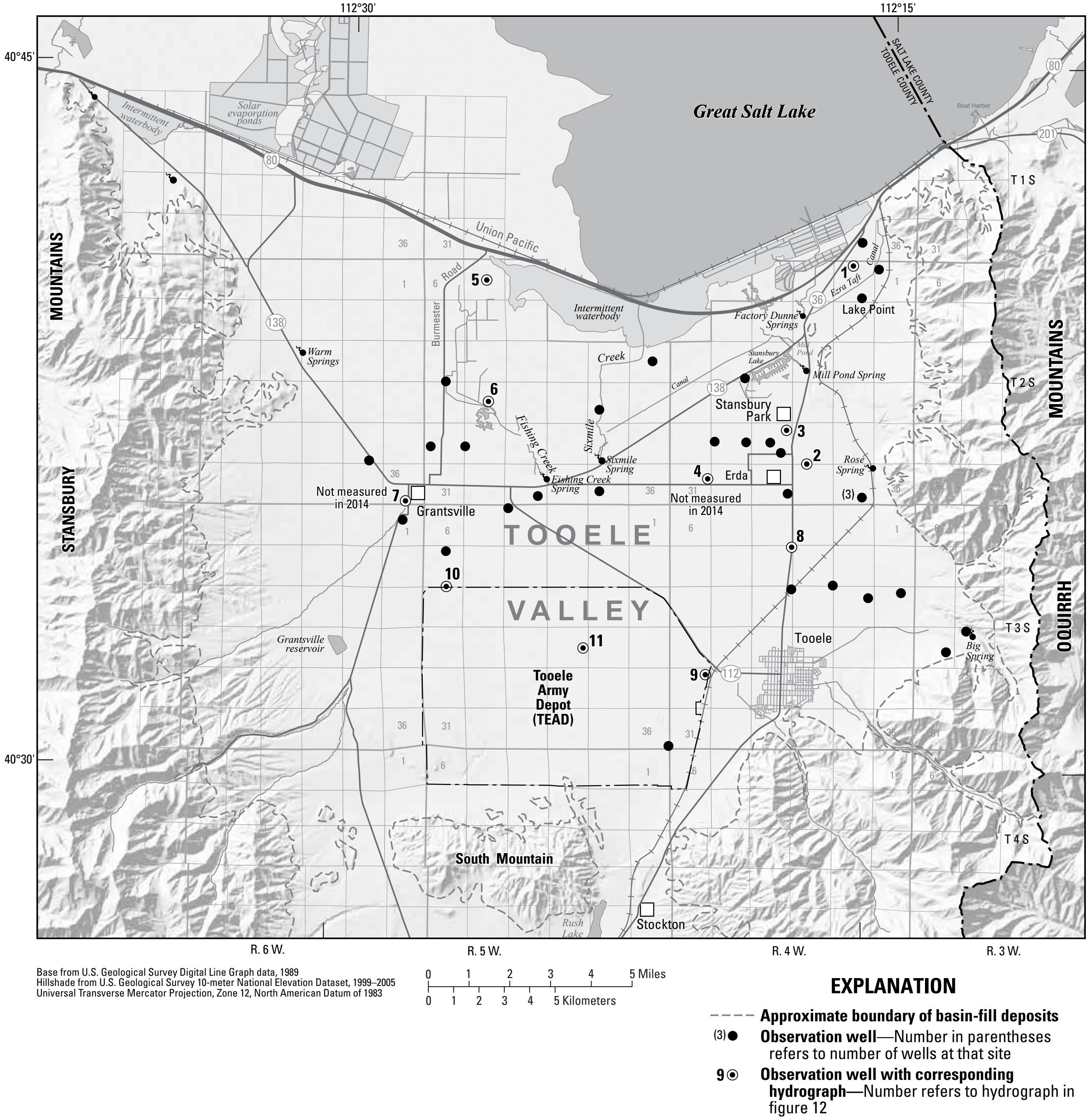


Figure 11. Location of wells in Tooele Valley in which the water level was measured during March 2014.

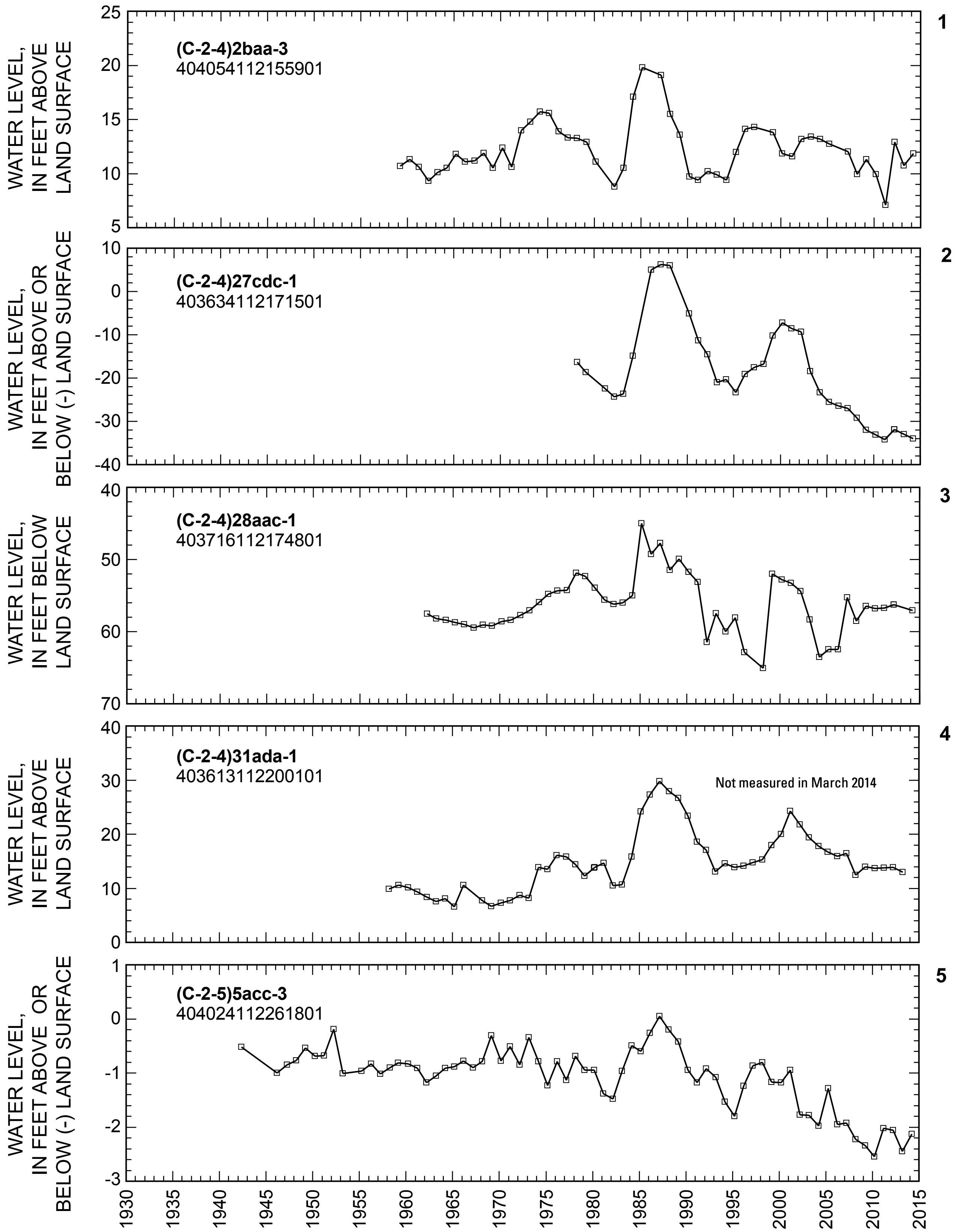


Figure 12. Relation of water level in selected wells in Tooele Valley to cumulative departure from average annual precipitation at Tooele, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-2-4)33bdd-1.

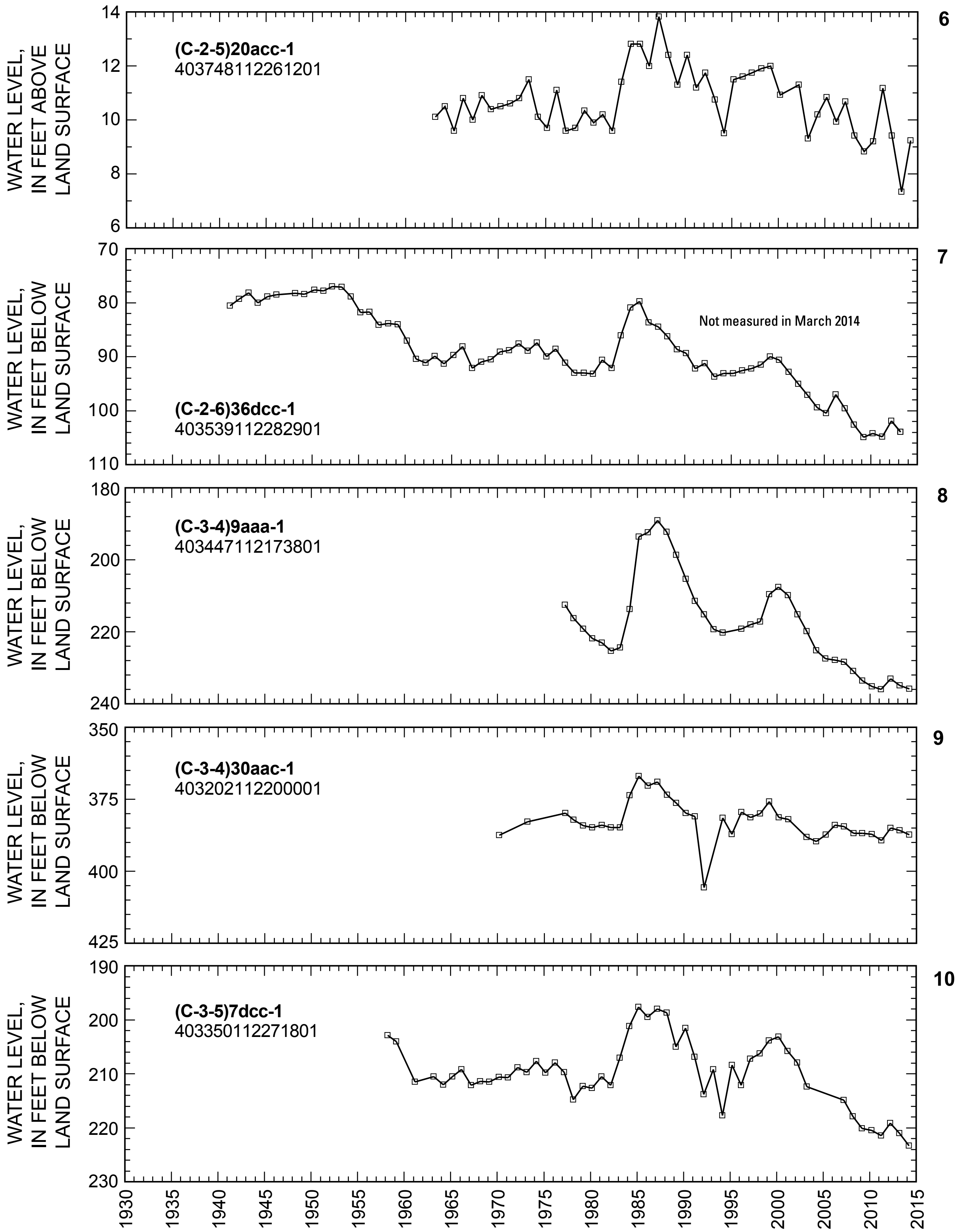


Figure 12. Relation of water level in selected wells in Tooele Valley to cumulative departure from average annual precipitation at Tooele, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-2-4)33bdd-1.—Continued

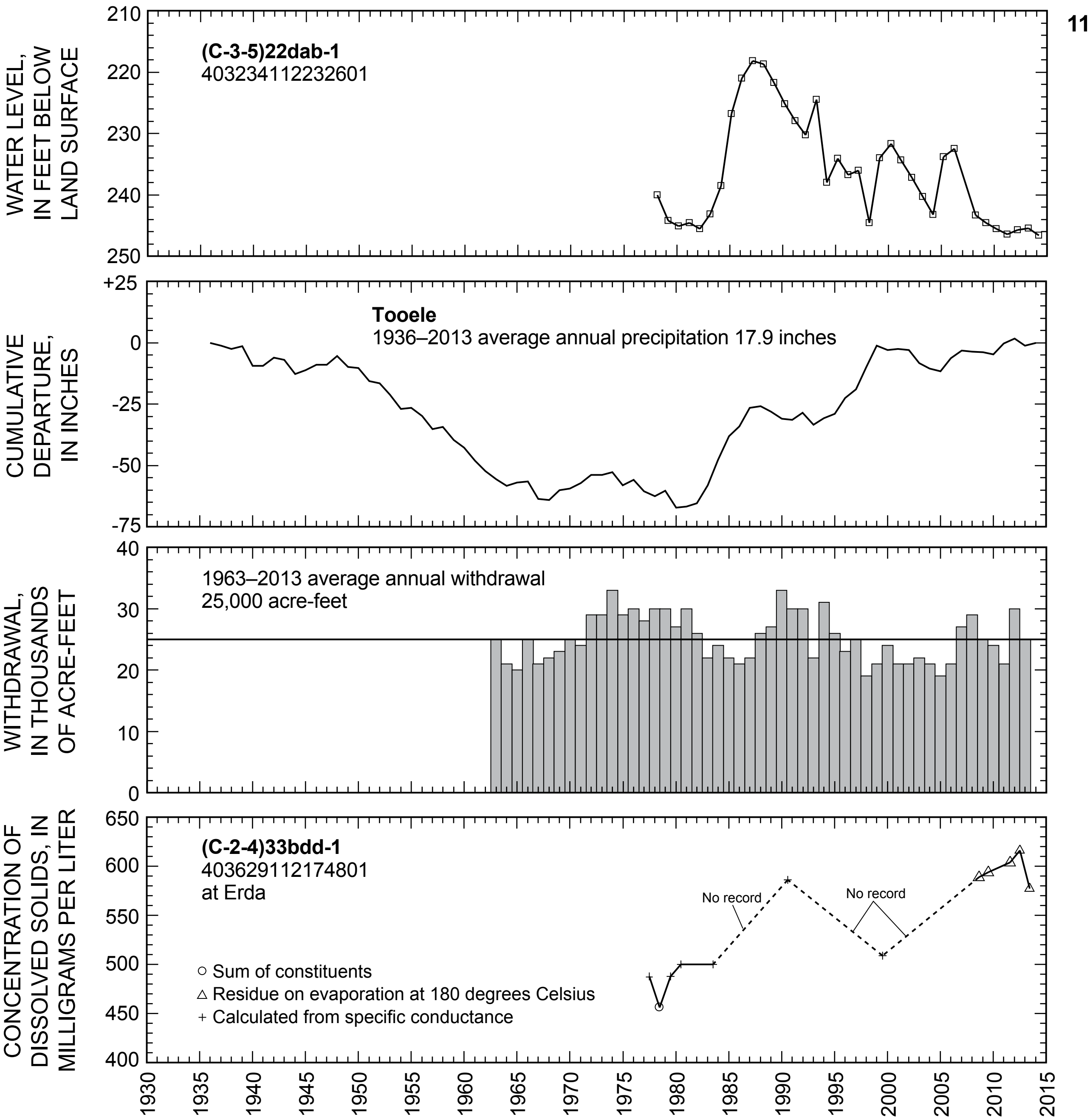


Figure 12. Relation of water level in selected wells in Tooele Valley to cumulative departure from average annual precipitation at Tooele, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-2-4)33bdd-1.—Continued

Utah and Goshen Valleys

By Lincoln Smith

Utah Valley is bounded by the Wasatch Range, West Mountain, and the northern extension of Long Ridge. The Valley is divided into two groundwater basins, northern and southern, which are separated by Provo Bay in northern Utah Valley (fig. 13). Northern Utah Valley is further divided by the Jordan River into two subbasins, northern Utah Valley-east and northern Utah Valley-west. 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 unconsolidated basin-fill deposits under both water-table and artesian conditions, but most wells discharge from artesian aquifers. 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.

Total estimated withdrawal of water from wells in Utah and Goshen Valleys in 2013 was about 111,000 acre-feet, which is 2,000 acre-feet less than the revised value for 2012, and 5,000 acre-feet more than the average annual withdrawal for 2003–2012 (tables 2 and 3). Withdrawal in northern Utah Valley (-east and -west) was about 60,100 acre-feet, which is 1,800 acre-feet less than the revised value for 2012. Total estimated withdrawal in northern Utah Valley-west was about 3,900 acre-feet, or about 6 percent of the total withdrawal in northern Utah Valley. Withdrawal in southern Utah Valley was 35,200 acre-feet, about the same as the revised value for 2012. Withdrawal in Goshen Valley was 16,100 acre-feet, which was also about the same as the revised value for 2012. The overall decrease in total pumpage from all three valleys was mainly due to decreased withdrawals for irrigation and reduced estimates of withdrawals for domestic and stock use.

The location of wells in Utah and Goshen Valleys in which the water level was measured during March 2014 is shown in figure 13. Water levels declined from March 2013 to March 2014 in most of the wells measured in Utah and Goshen Valleys. Declines are probably due to continued large withdrawals because of less-than-average precipitation and decreased availability of surface water. Water levels in Utah and Goshen Valleys 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. During this period, water levels in some wells were the lowest on record, with 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 2013 was about 158,400 acre-feet, which is 11,900 acre-feet less than the 1933–2013 annual average and 1,400 acre-feet less than in 2012. Precipitation at Silver Lake Brighton in 2013 was about 31.3 inches, which is about 11.0 inches less than the long-term average (1931–2013) and about 5.4 inches less than in 2012. Precipitation at Spanish Fork Power House in 2013 was about 15.7 inches, which is about 3.6 inches less than the long-term average (1930–2013) and about 0.5 inch less than in 2012.

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 the mouth of the 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 1,560 mg/L with a median value of 728 mg/L. The concentration of dissolved solids in the July 2013 sample was 1,410 mg/L. 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. This well was not sampled in 2013. The dissolved-solids concentration in water from well (D-9-1)36bbc-1 has ranged from 153 to 311 mg/L with a median value of 288 mg/L. The concentration of dissolved solids in the July 2013 sample was 309 mg/L.

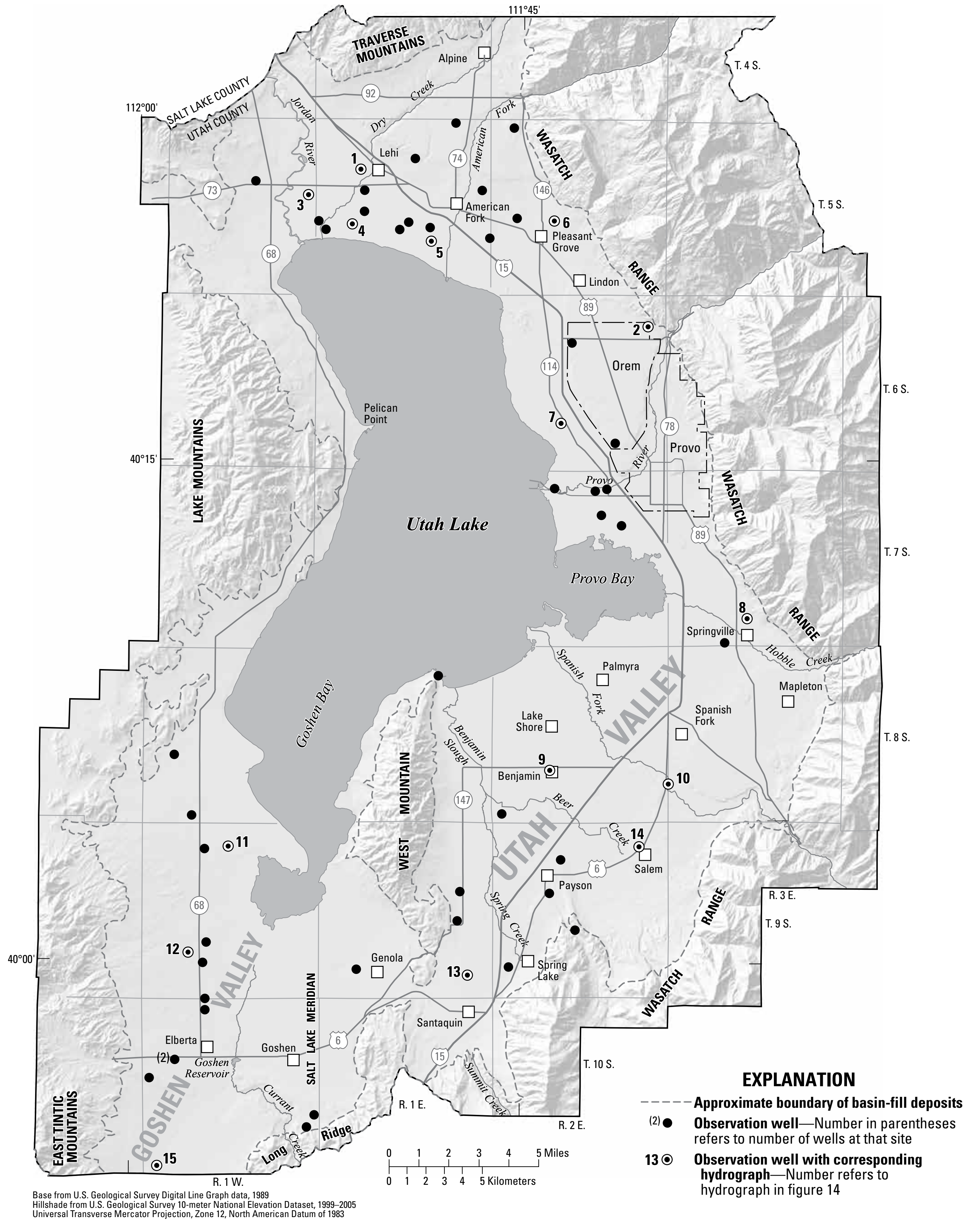


Figure 13. Location of wells in Utah and Goshen Valleys in which the water level was measured during March 2014.

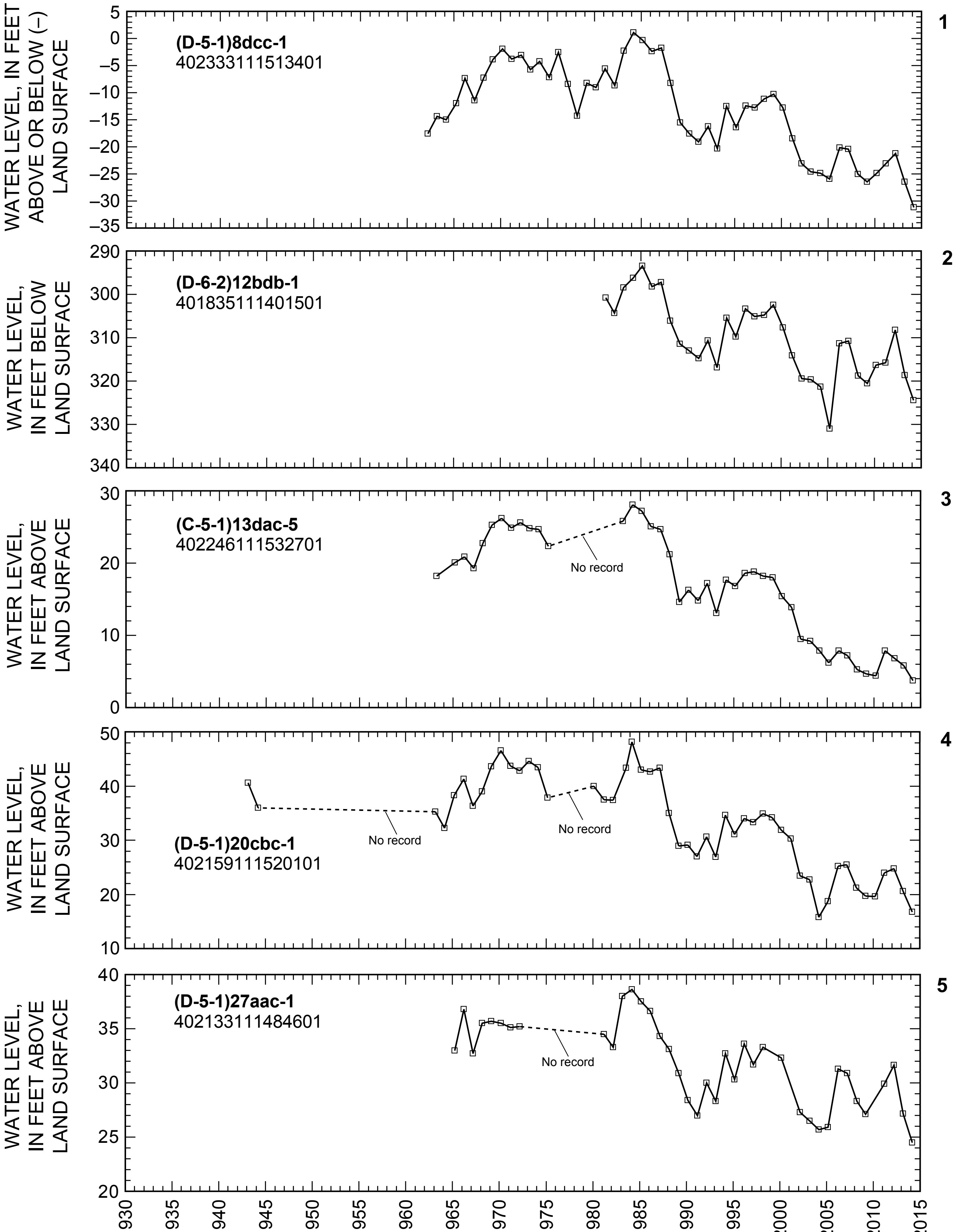


Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Power House, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish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

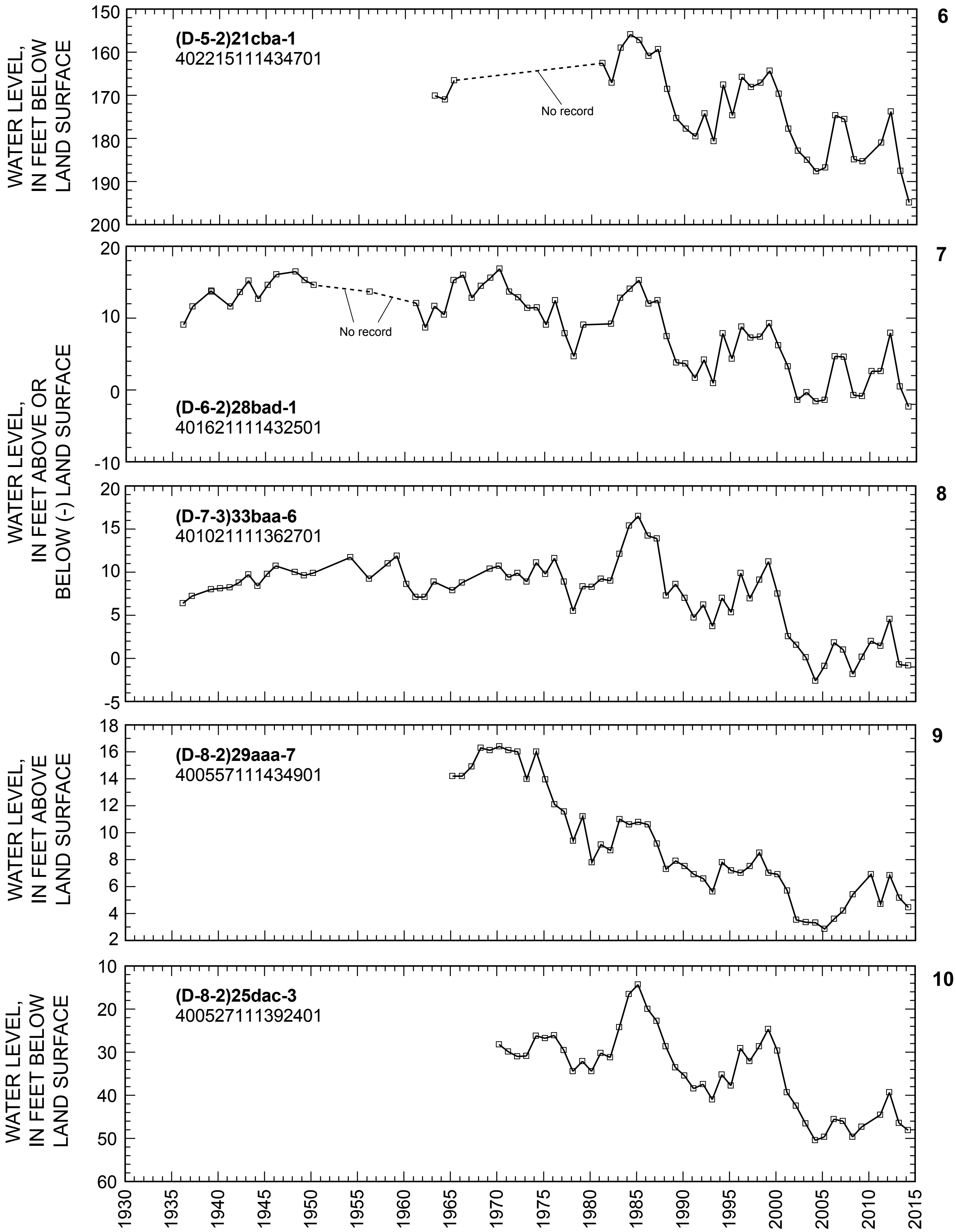


Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Power House, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish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

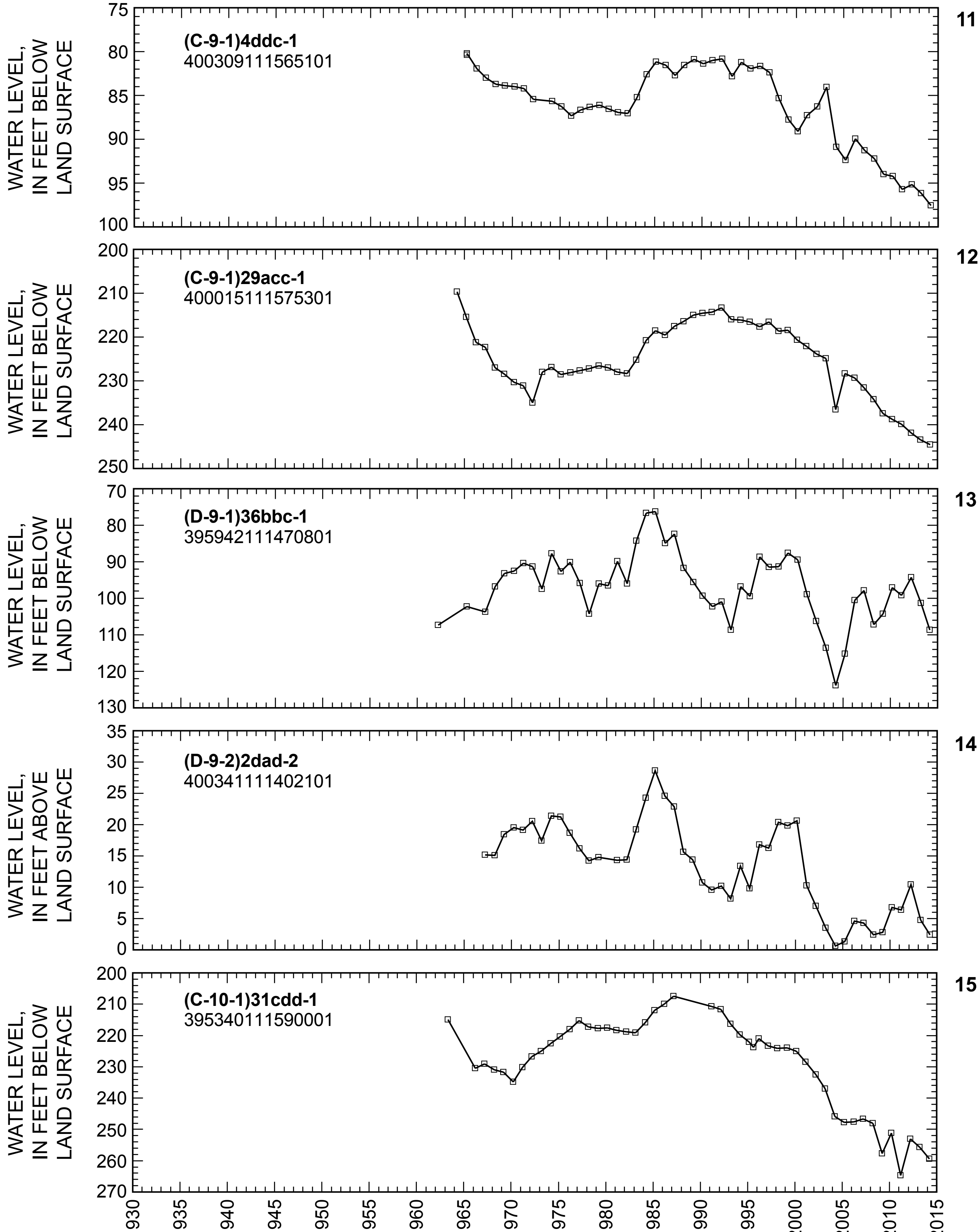


Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Power House, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish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

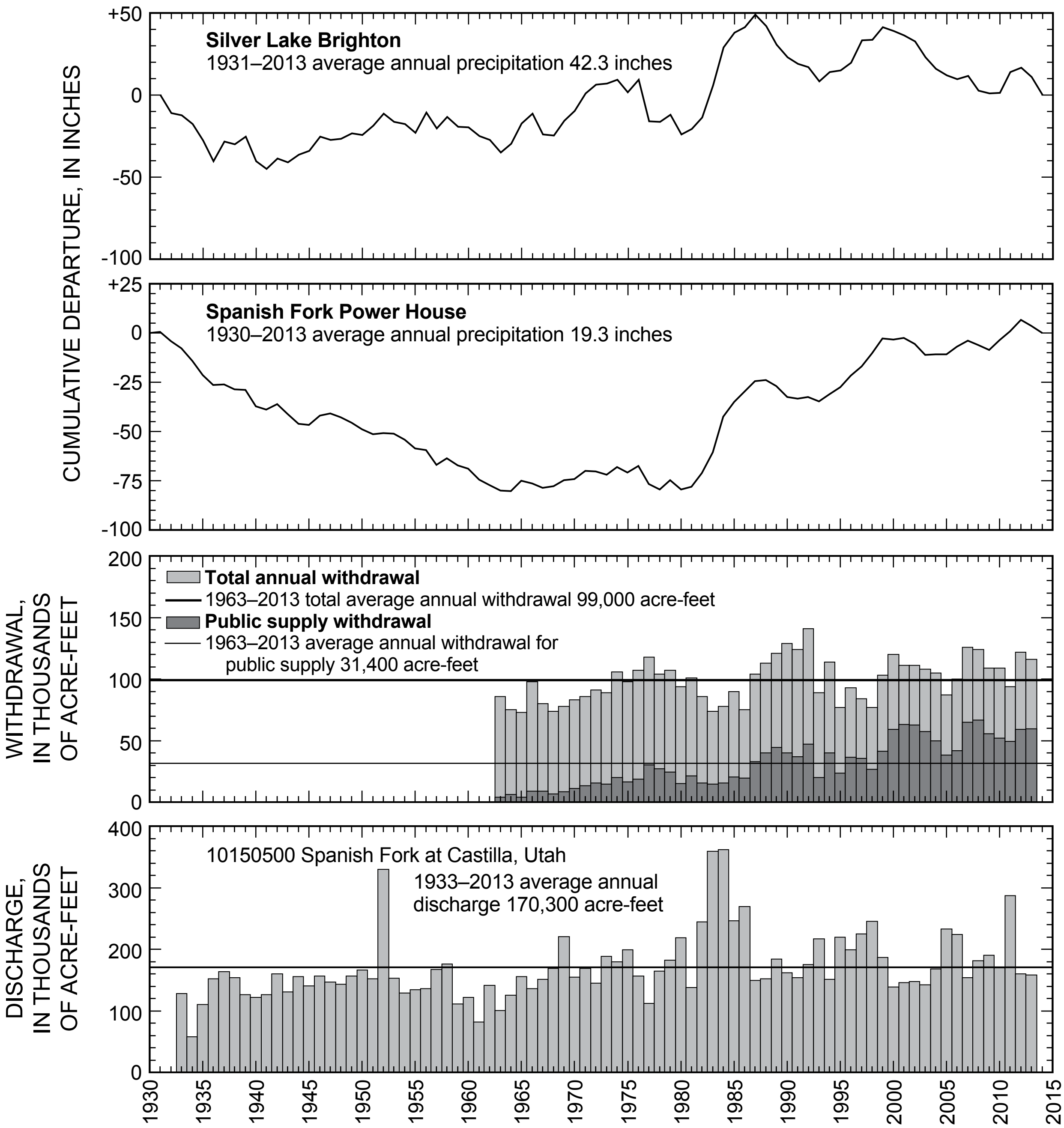


Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Power House, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish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

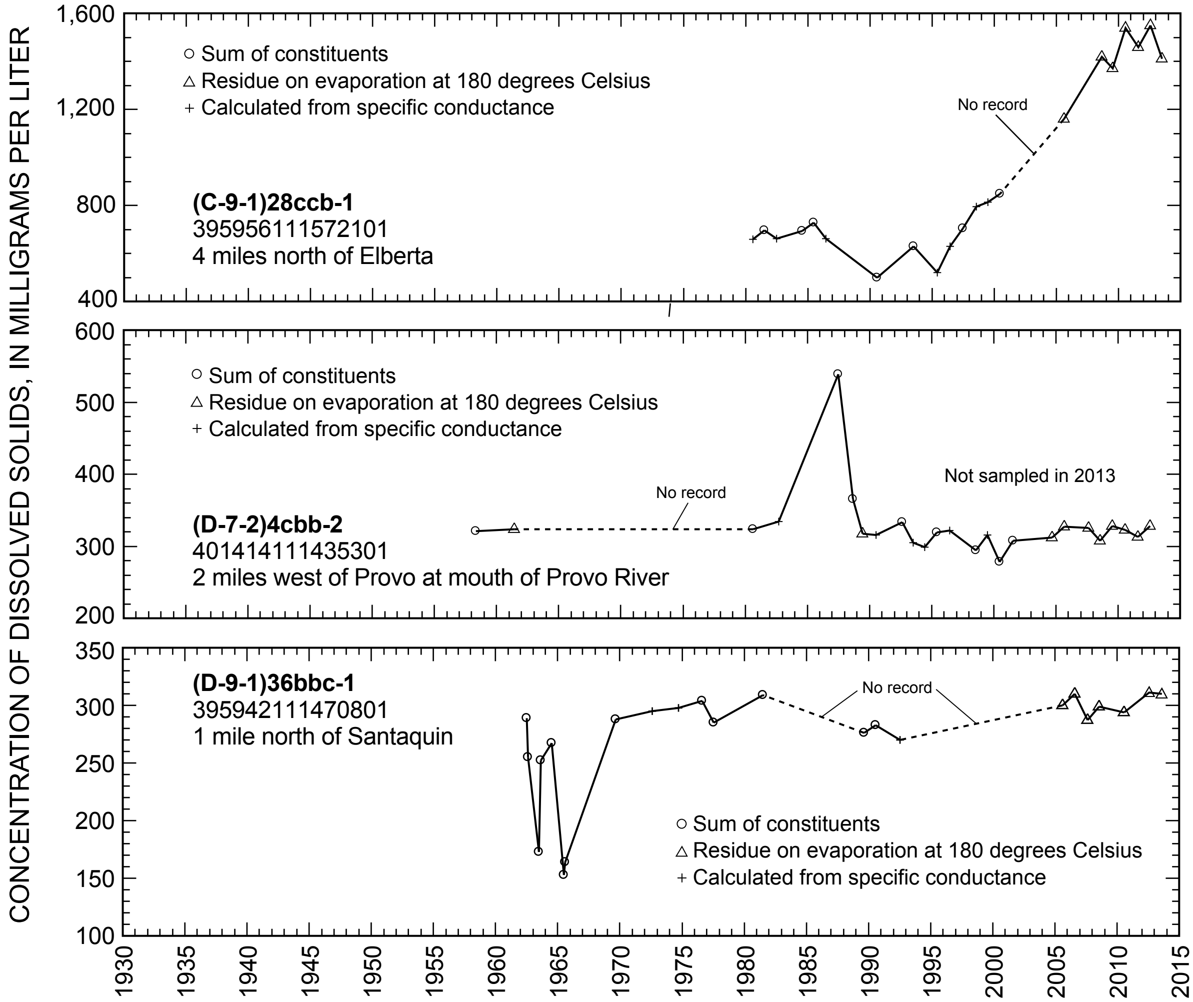


Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake Brighton and Spanish Fork Power House, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish 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, is about 30 miles long and 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 2013 was about 27,000 acre-feet, which is 1,000 acre-feet less than the amount reported for 2012 and 4,000 acre-feet more than the average annual withdrawal for 2003–2012 (tables 2 and 3).

The location of wells in Juab Valley in which the water level was measured during March 2014 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-14-1)26dbd-1, is shown in figure 16. Precipitation at Nephi during 2013 was about 8.4 inches, which is about 5.8 inches less than the average annual precipitation for 1935–2013, and about 2.2 inches less than in 2012.

Water levels declined in all of the wells measured in Juab Valley from March 2013 to March 2014 (fig. 16). Declines are probably the result of continued large withdrawals for irrigation and less-than-average precipitation. 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 2014, although there was a substantial rise from 1993 to 1999.

The concentration of dissolved solids in water from well (C-14-1)26dbd-1, located 2 miles west of Levan, is shown in figure 16. The dissolved-solids concentration in the water sample collected in July 2013 was 778 mg/L.

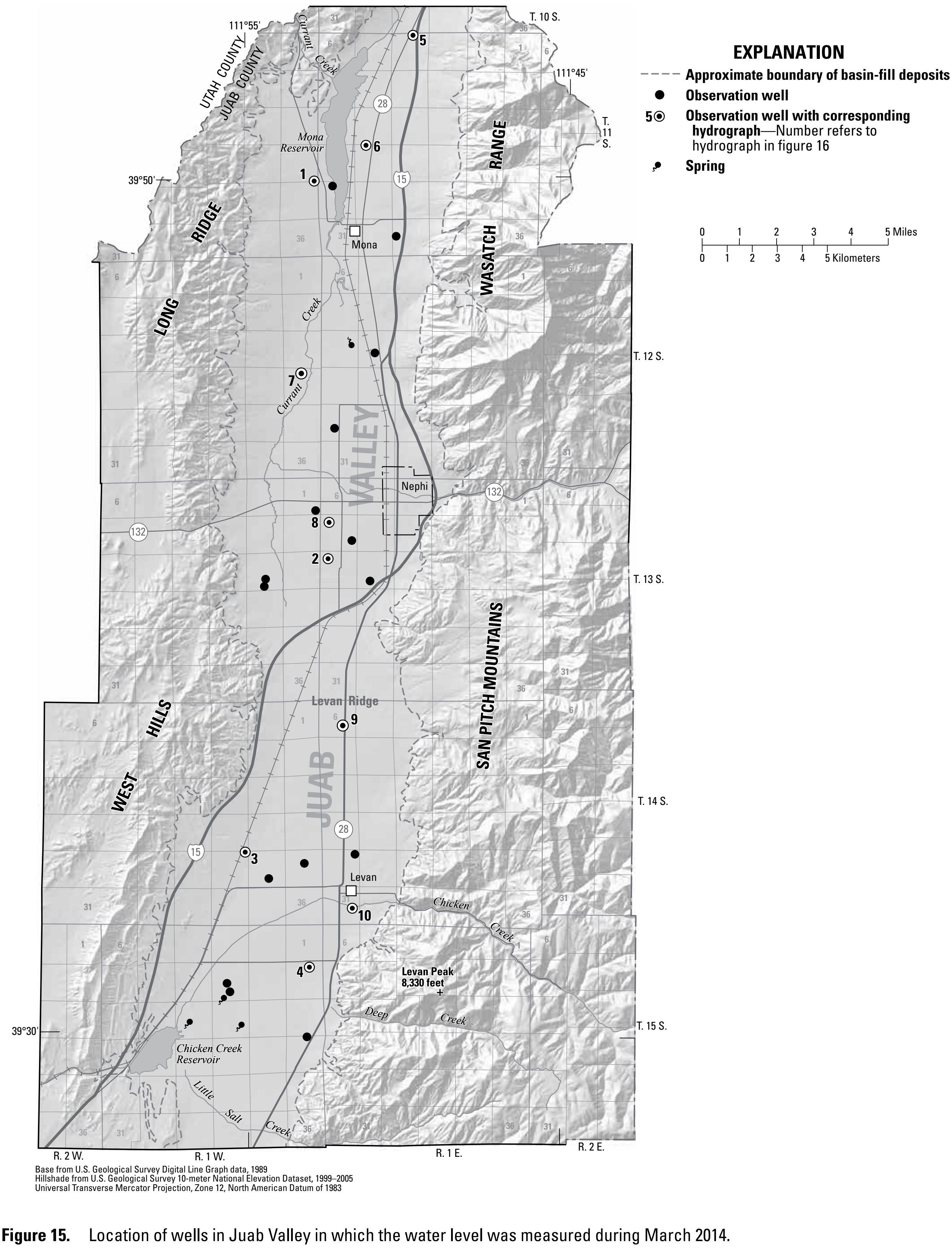


Figure 15. Location of wells in Juab Valley in which the water level was measured during March 2014.

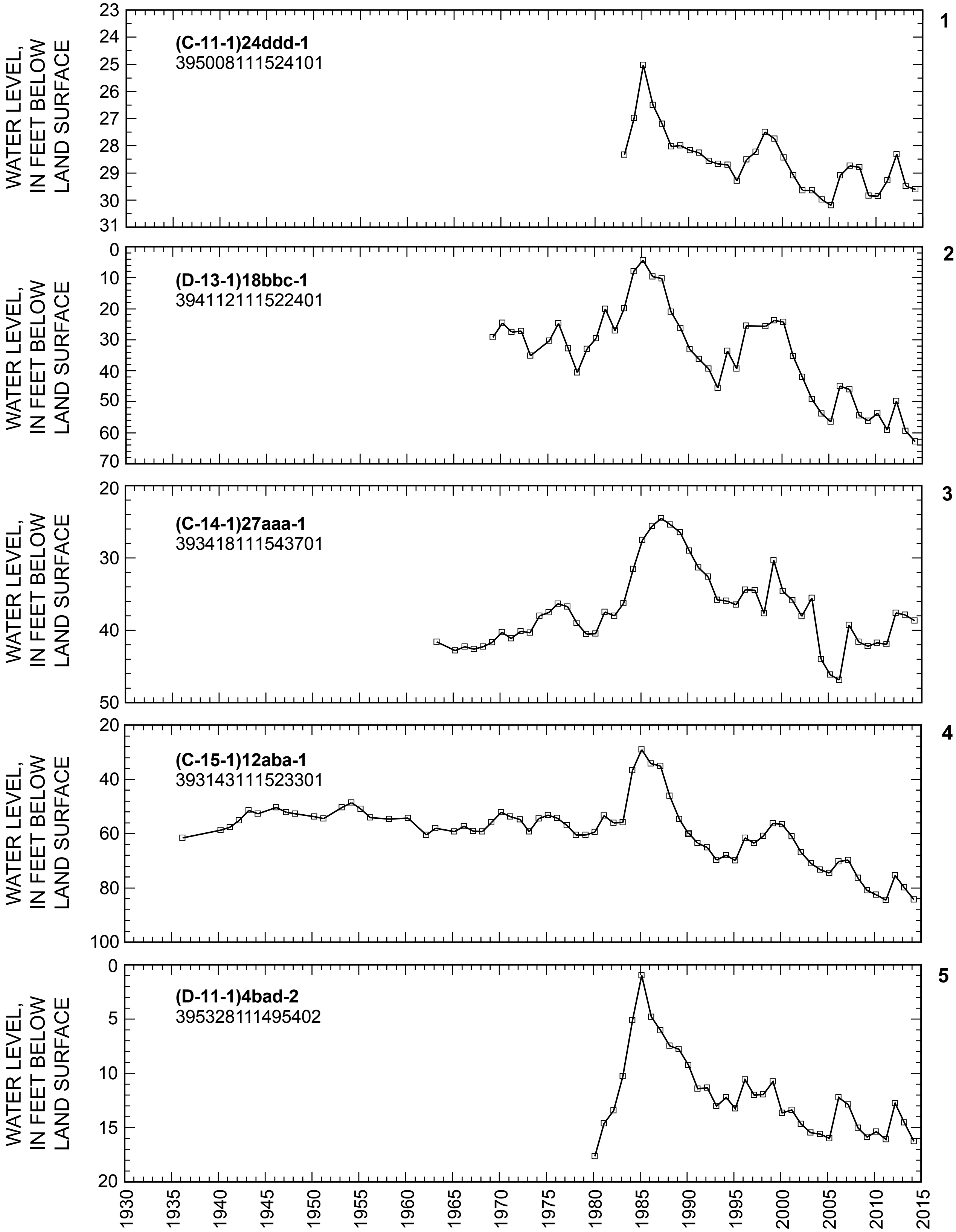


Figure 16. Relation of water level in selected wells in Juab Valley to cumulative departure from average annual precipitation at Nephi, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-14-1)26dbd-1.

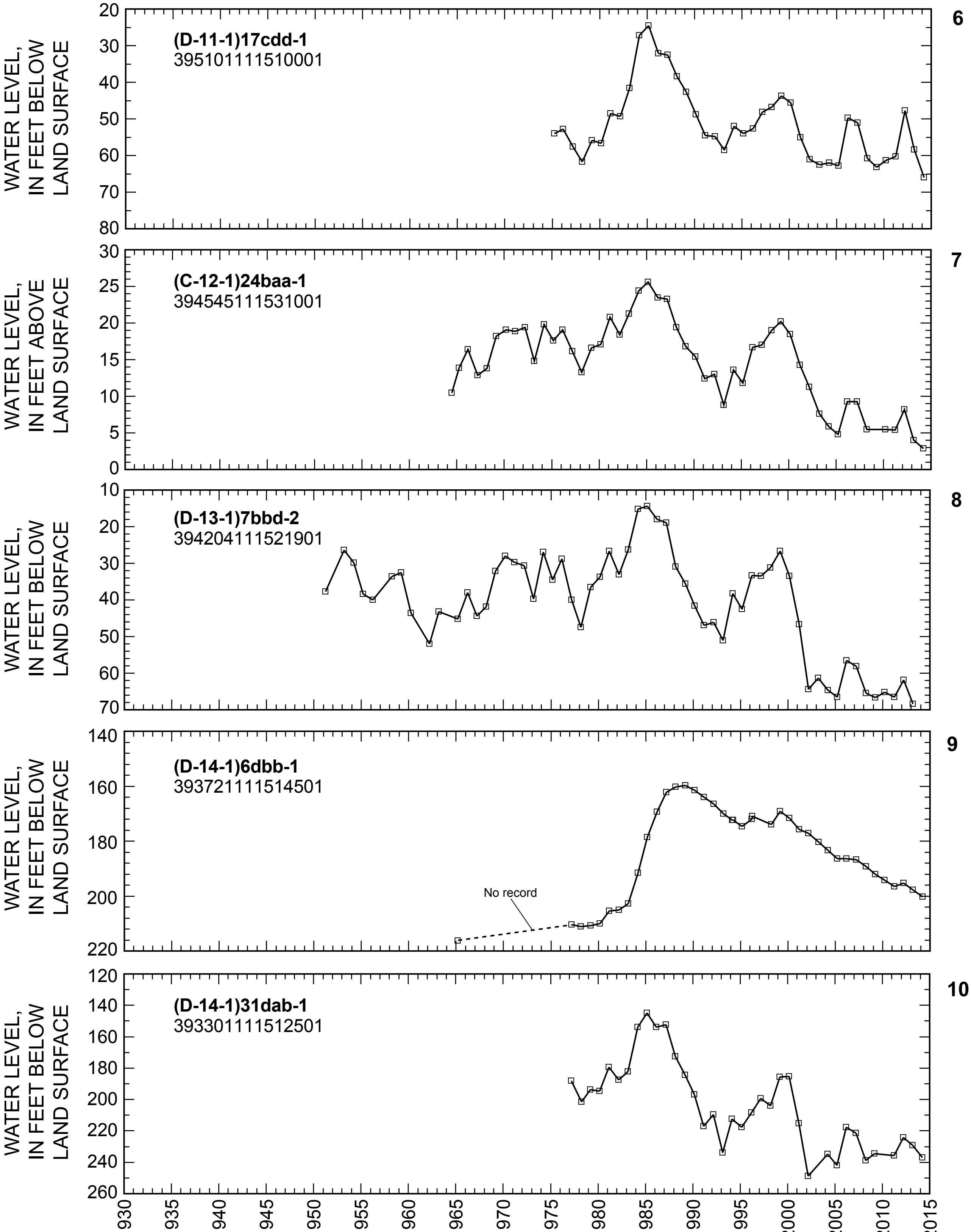


Figure 16. Relation of water level in selected wells in Juab Valley to cumulative departure from average annual precipitation at Nephi, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-14-1)26dbd-1.—Continued

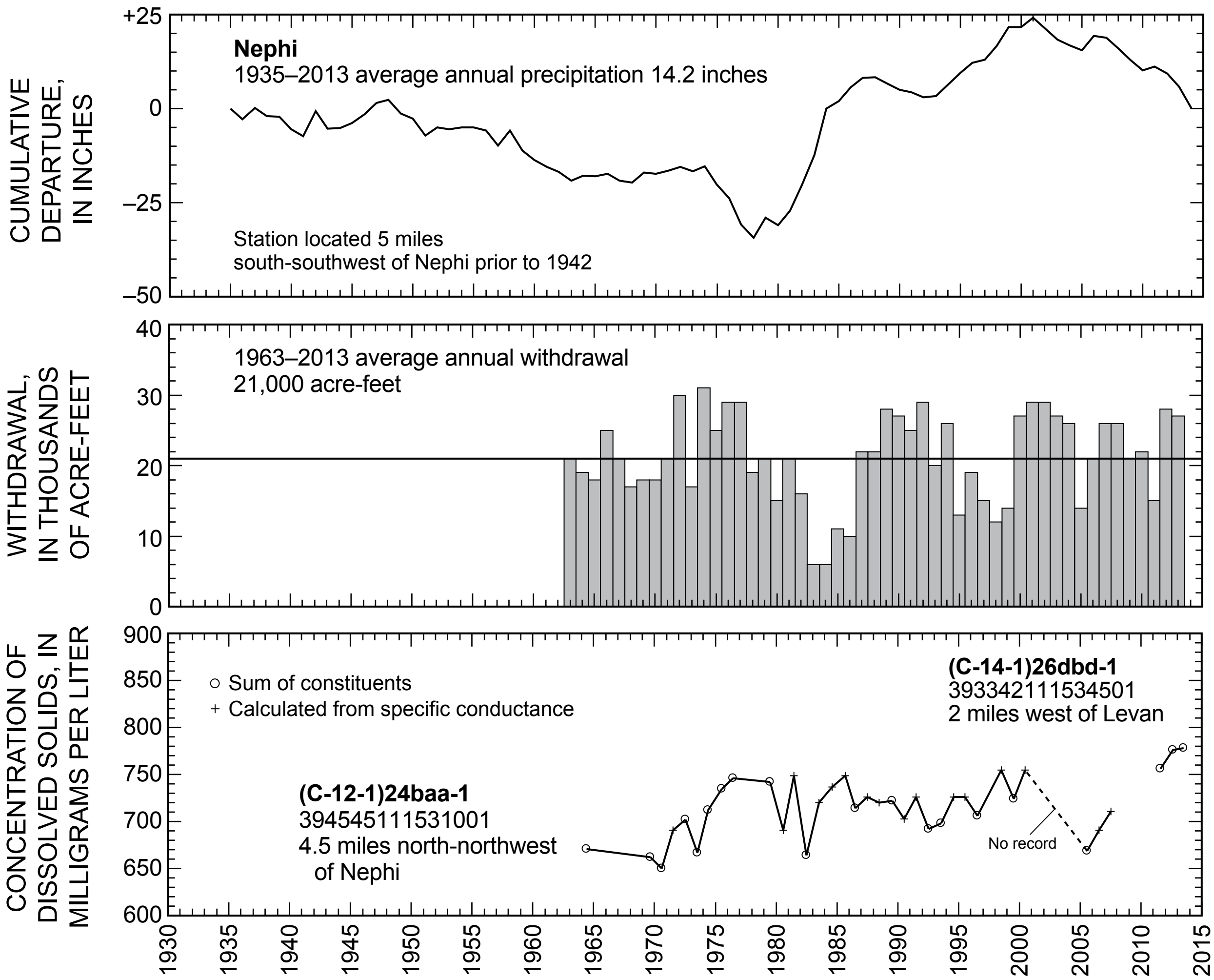


Figure 16. Relation of water level in selected wells in Juab Valley to cumulative departure from average annual precipitation at Nephi, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-14-1)26dbd-1.—Continued

Sevier Desert

By Travis L. Gibson

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 2013 was about 47,000 acre-feet, which is 23,000 acre-feet more than in 2012 and about 14,000 acre-feet more than the 2003–2012 average annual withdrawal (tables 2 and 3). The increase in withdrawals from 2012 to 2013 was mainly due to increased pumpage for irrigation, which coincides with decreased withdrawal of surface water from the Sevier River.

The location of wells in the Sevier Desert in which the water level was measured during March 2014 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 2013 was 120,000 acre-feet, 141,900 acre-feet less than in 2012 and 60,600 acre-feet less than the long-term average (1935–2013). Precipitation at Oak City was about 11.7 inches in 2013, about 1.3 inches less than the 1930–2013 average annual precipitation and about 0.5 inch more than in 2012.

Most water levels in the shallow artesian aquifer declined from less than 1 foot to greater than 6 feet from March 2013 to March 2014. Declines were probably due to decreased recharge as a result of less-than-average precipitation and increased withdrawal of groundwater. The variation in declines is likely due to geographic location and localized withdrawals. The water level in most wells in the deep artesian aquifer declined from March 2013 to March 2014. Declines of water levels in this aquifer varied from less than 1 foot to greater than 15 feet depending on geographic location and localized withdrawals.

Periods when the water level in the shallow and deep aquifers generally rose (including 1980–89, 1995–99, 2006–07, and 2010–12) correspond to greater-than-average precipitation, less-than-average groundwater withdrawals, and greater than average discharge of the Sevier River, with apparent persistent recharge occurring in the deep aquifer in years following greater-than-average surface water availability. Periods when the water level in the shallow and deep aquifers generally declined (including 1988–94, 2001–05, 2008–10, and 2013) correspond to less-than-average precipitation, greater-than-average groundwater withdrawals, and less-than-average discharge of the Sevier River.

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 2013, 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 dissolved-solids concentration in the water sample from July 2013 was 2,050 mg/L.

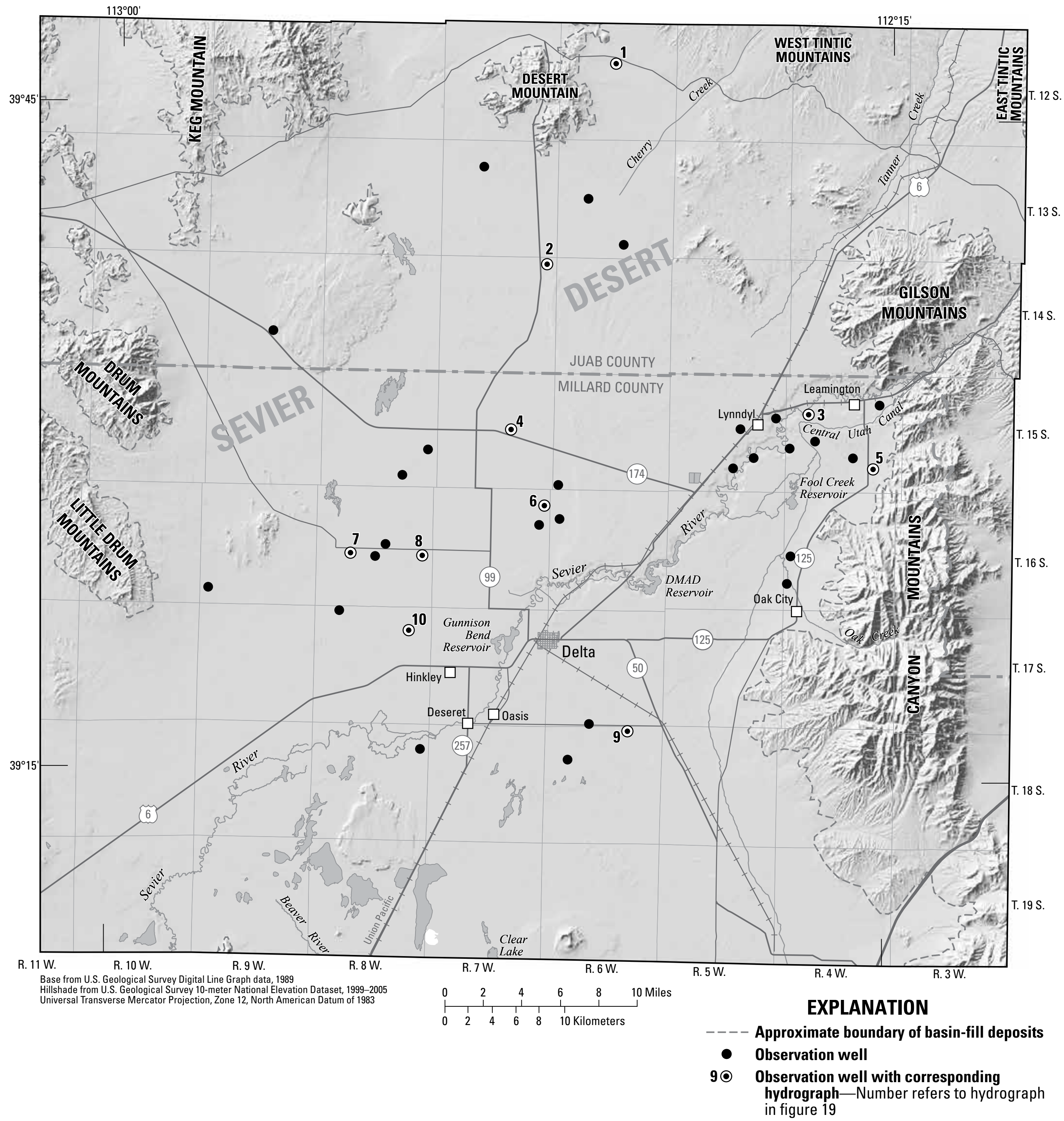


Figure 17. Location of wells in the shallow artesian aquifer in part of the Sevier Desert in which the water level was measured during March 2014.

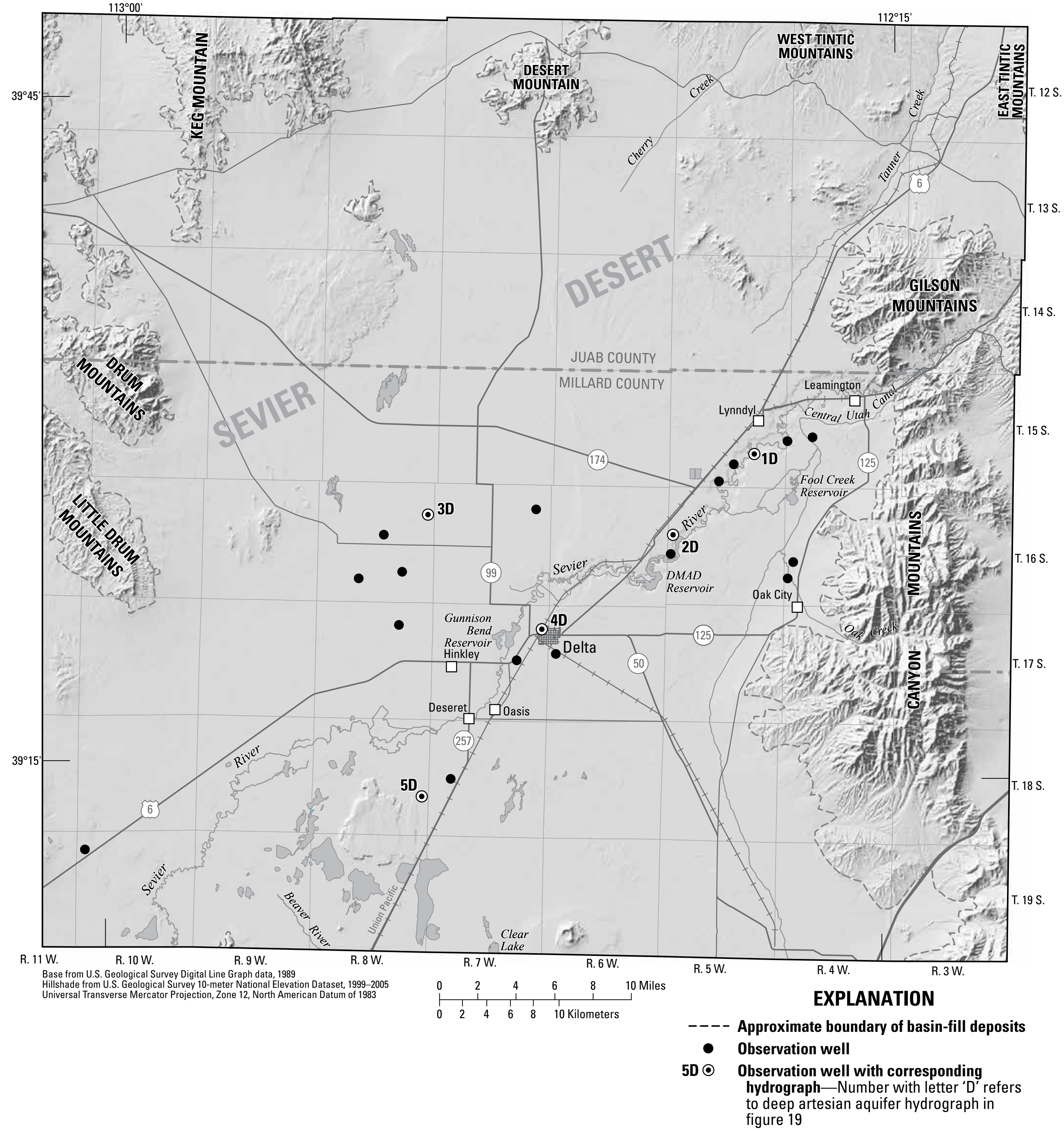


Figure 18. Location of wells in the deep artesian aquifer in part of the Sevier Desert in which the water level was measured during March 2014.

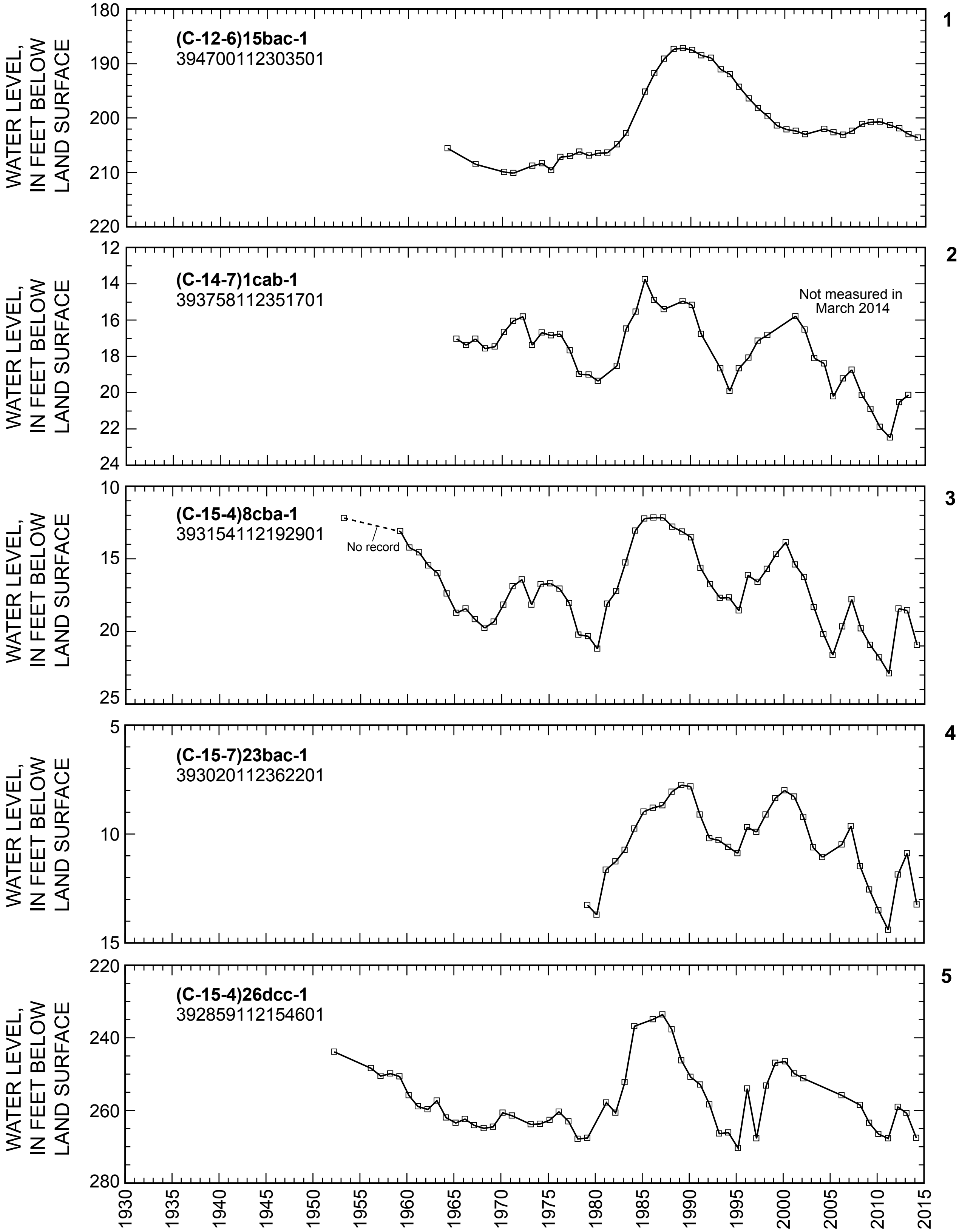


Figure 19. Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8cba-1.

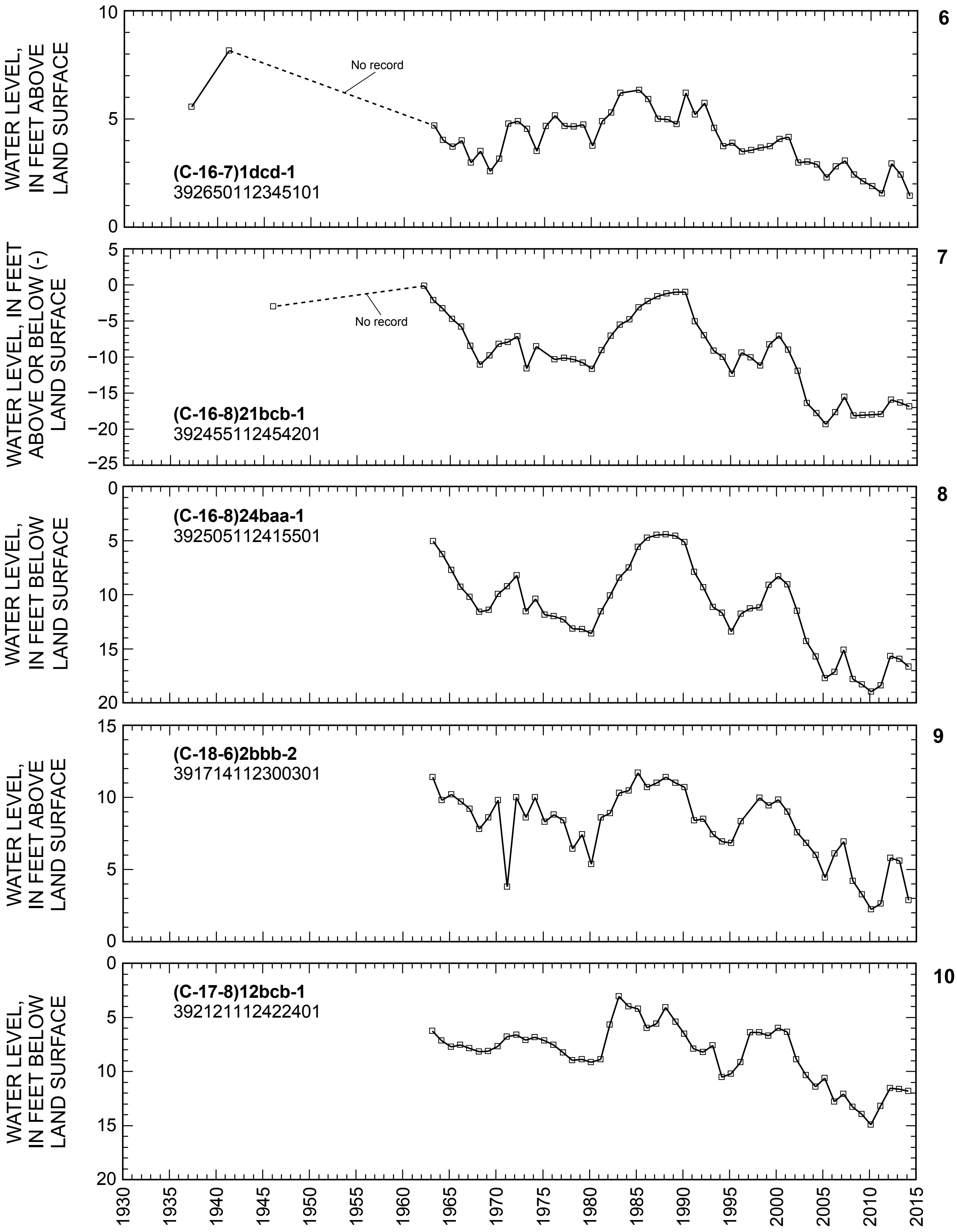


Figure 19. Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8cba-1.—Continued

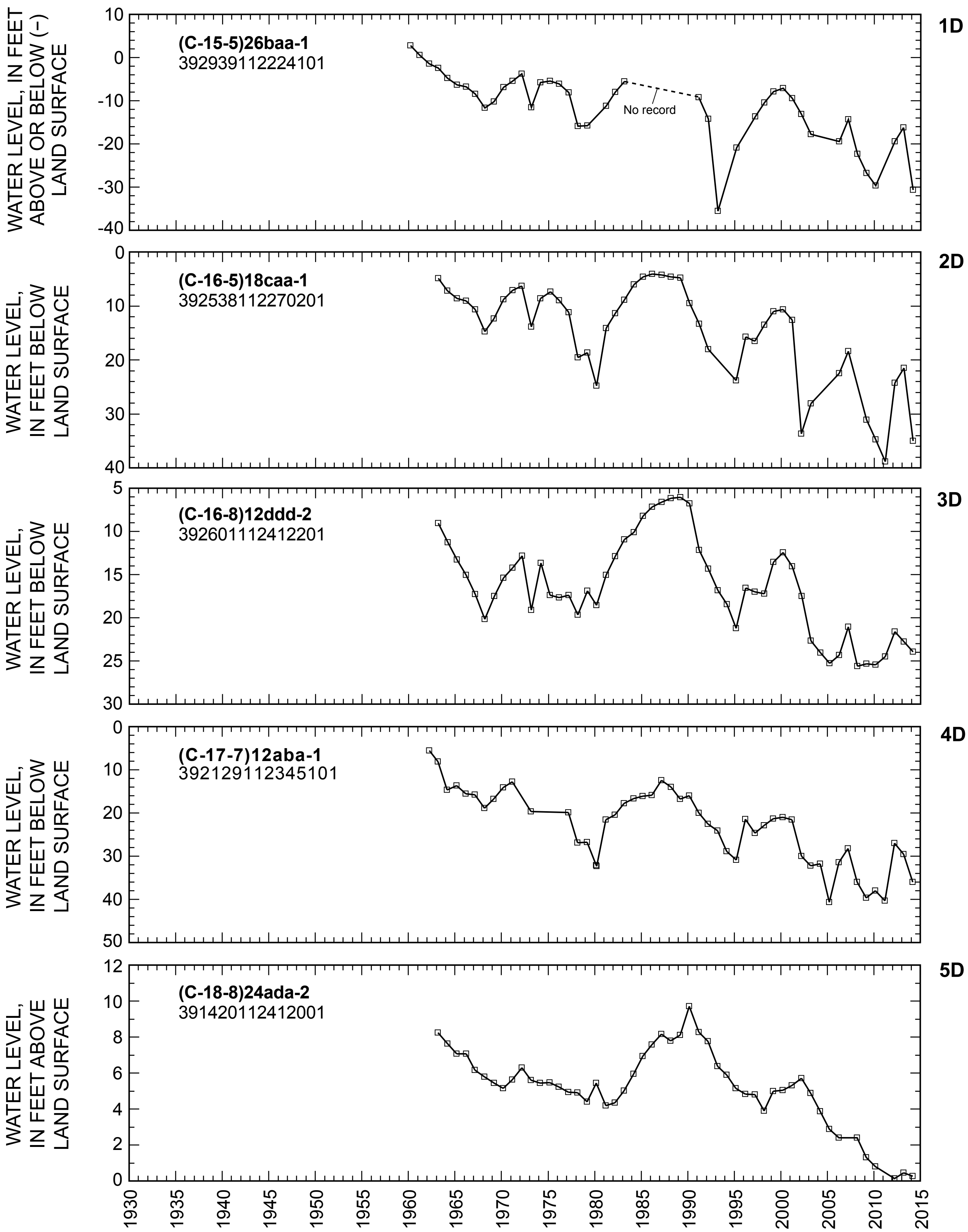


Figure 19. Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8cba-1.—Continued

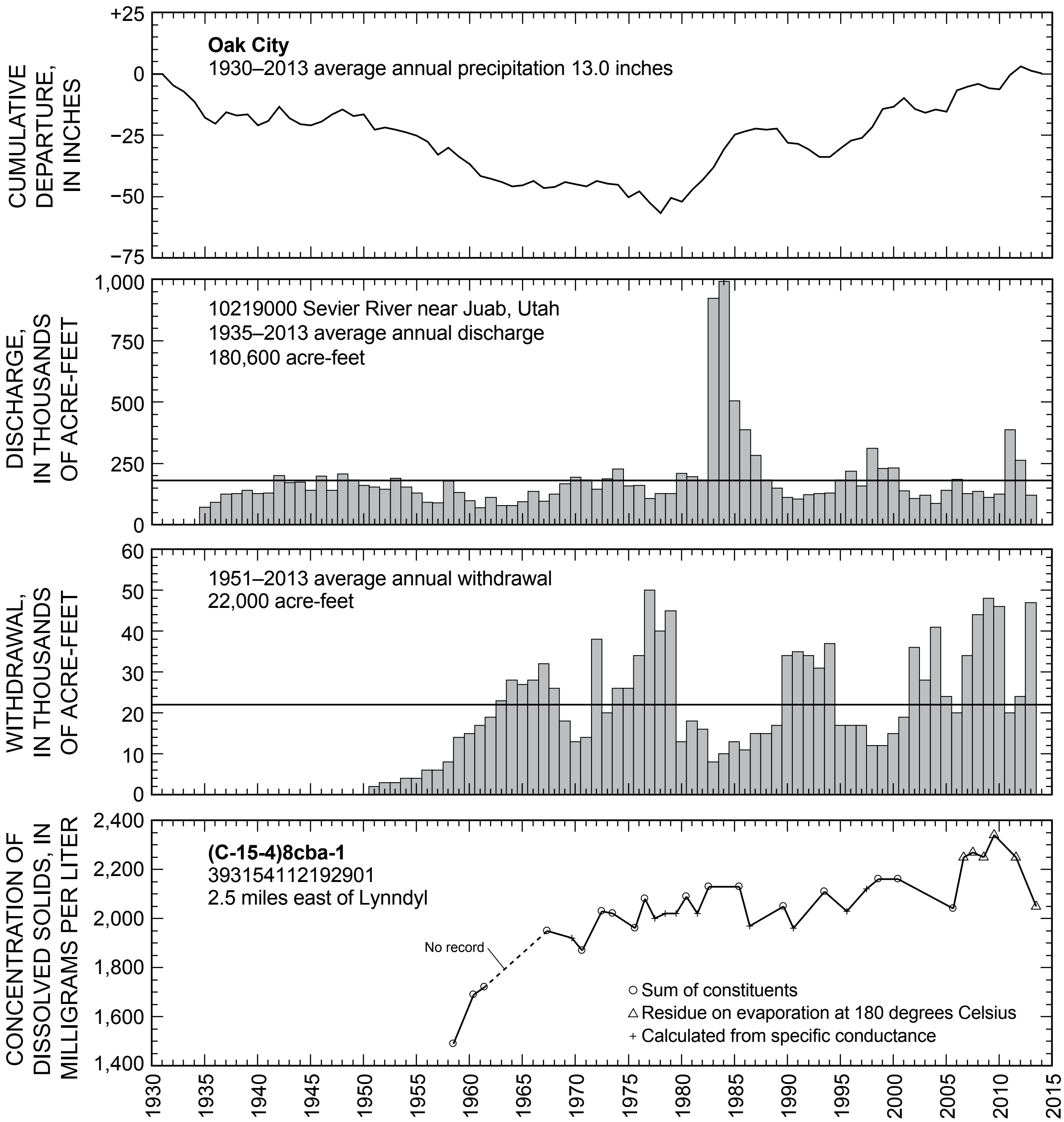


Figure 19. Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)8cba-1.—Continued

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 2013 was about 28,000 acre-feet, which is the same as reported for 2012 and 6,000 acre-feet more than the average annual withdrawal for 2003–2012 (tables 2 and 3).

The location of 23 wells in central Sevier Valley in which the water level was measured during March 2014 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 Radio KVSC, 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 2013 was about 56,600 acre-feet, which is about 23,800 acre-feet less than the 1940–2013 average annual discharge. Precipitation at Richfield Radio KVSC was about 9.0 inches in 2013, which is about 0.9 inch more than the 1950–2013 average annual precipitation and about 1.3 inches more than in 2012.

Water levels in central Sevier Valley generally declined from March 2013 to March 2014. 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.

The concentration of dissolved solids in water samples collected from well (C-23-2)15dcb-4, located 0.1 mile south of Sevier River in Venice, from 1955 to 2013, is shown in figure 21. The concentration has ranged from 307 to 630 mg/L. There were substantial increases and decreases in dissolved-solids concentration during the mid- to late 1960s and 1980s. Dissolved-solids concentrations in samples collected from 1990 through 2013 show little variability and are generally near the median value for all sample concentrations.

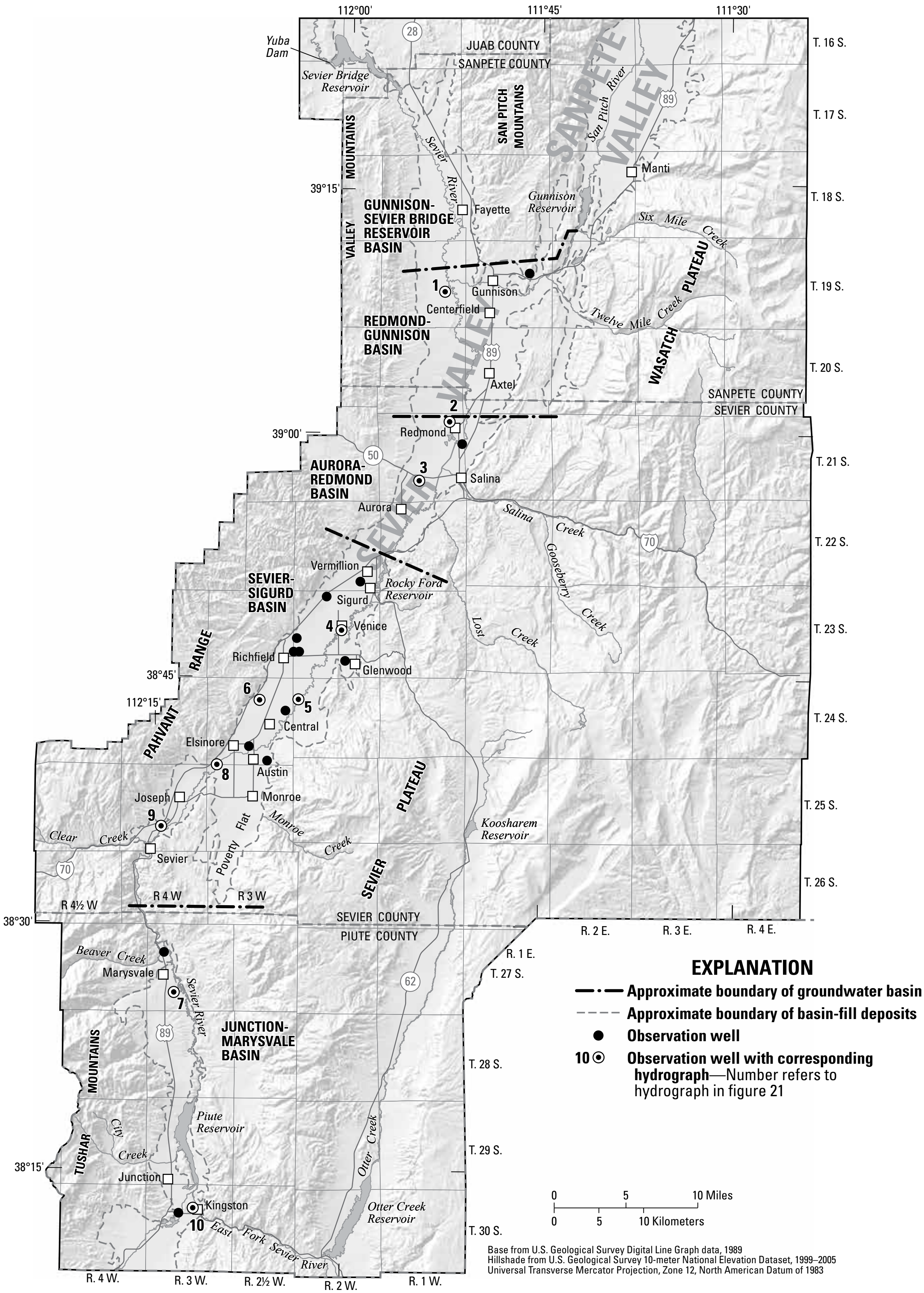


Figure 20. Location of wells in central Sevier Valley in which the water level was measured during March 2014.

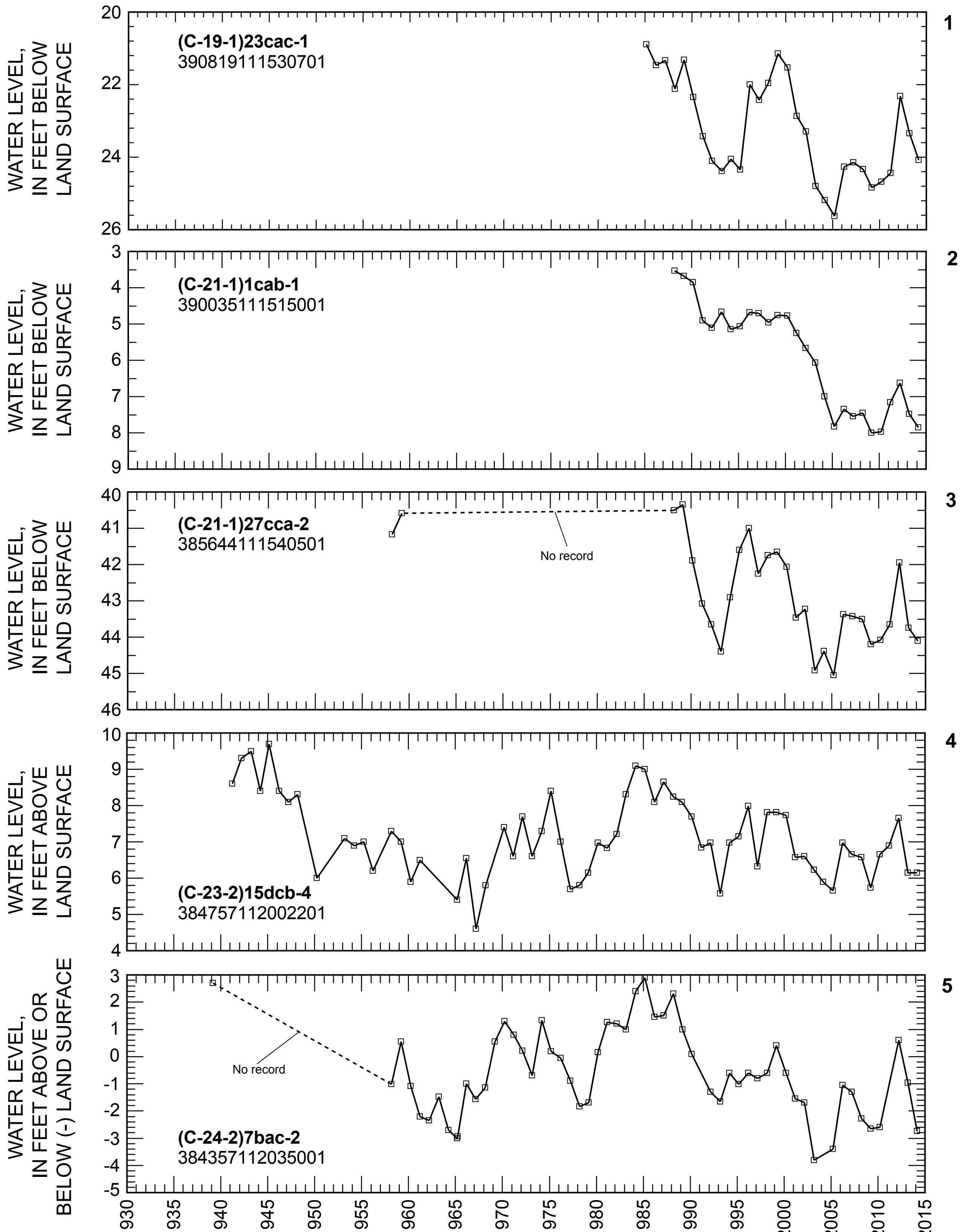


Figure 21. Relation of water level in selected wells in central Sevier Valley to annual discharge of the Sevier River at Hatch, to cumulative departure from average annual precipitation at Richfield Radio KVSC, to annual withdrawal from wells, and to concentration of dissolved solids in water from well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

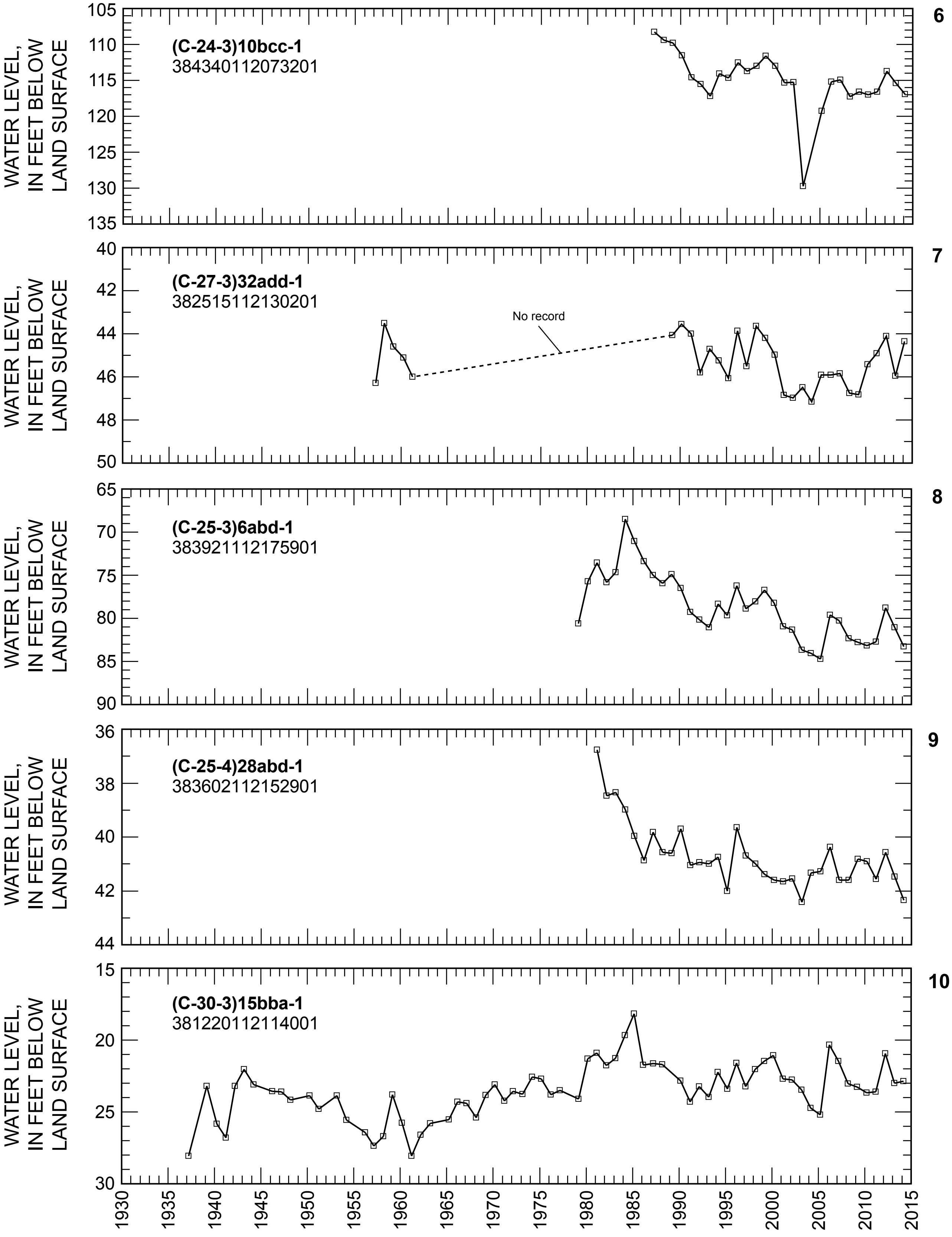


Figure 21. Relation of water level in selected wells in central Sevier Valley to annual discharge of the Sevier River at Hatch, to cumulative departure from average annual precipitation at Richfield Radio KVSC, to annual withdrawal from wells, and to concentration of dissolved solids in water from well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

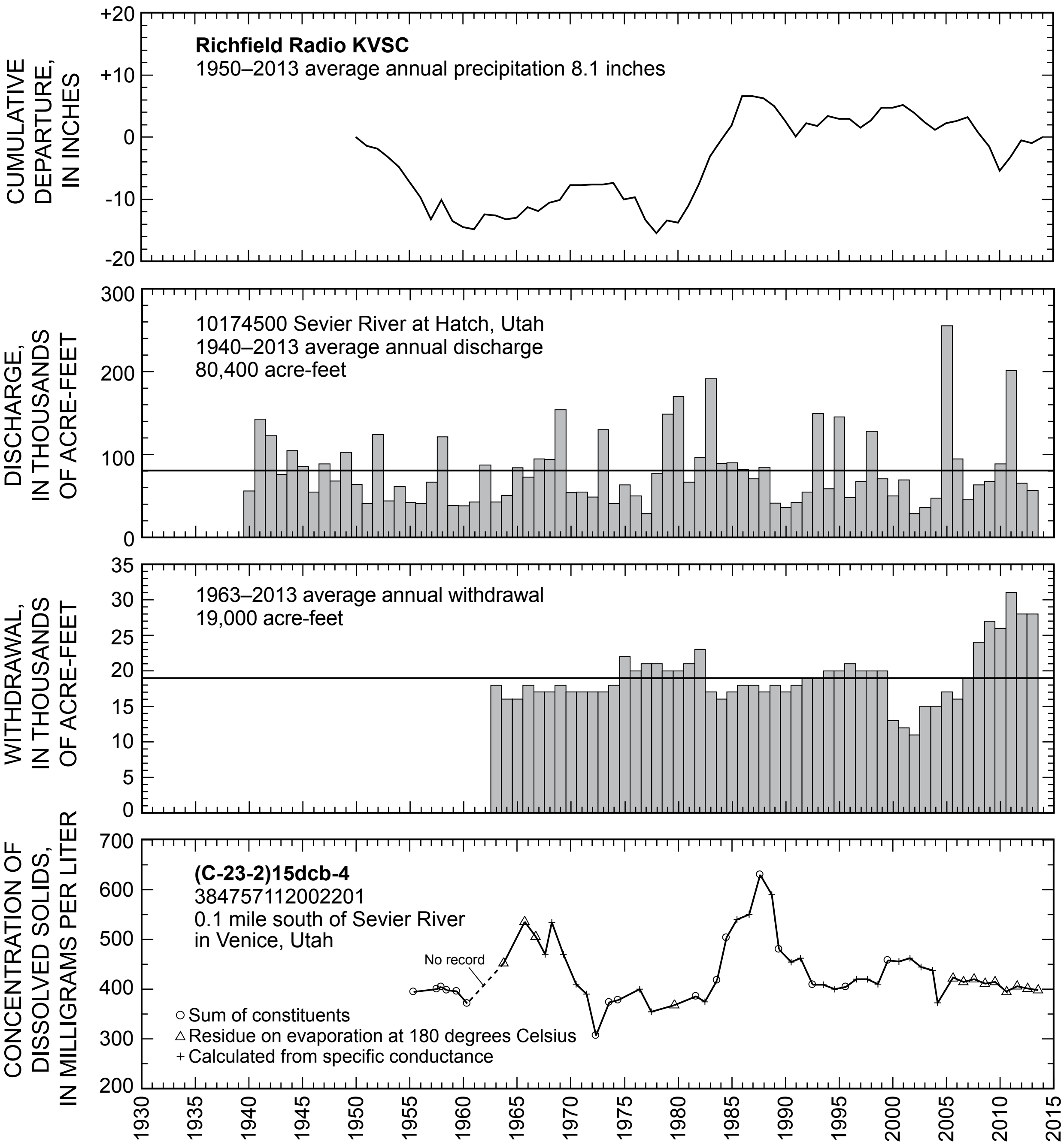


Figure 21. Relation of water level in selected wells in central Sevier Valley to annual discharge of the Sevier River at Hatch, to cumulative departure from average annual precipitation at Richfield Radio KVSC, to annual withdrawal from wells, and to concentration of dissolved solids in water from well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

Pahvant Valley

By Nickolas R. Whittier

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 is 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 2013 was about 103,000 acre-feet, which is about 11,000 acre-feet less than was reported in 2012 and 10,000 acre-feet more than the average annual withdrawal for 2003–2012 (tables 2 and 3). Withdrawal for irrigation in 2013 was about 101,500 acre-feet, which is 11,800 acre-feet less than was reported in 2012.

The location of wells in Pahvant Valley in which the water level was measured during March 2014 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 2013 was about 14.8 inches, which is about 0.4 inch less than the average annual precipitation for 1930–2013 and about 2.1 inches more than in 2012.

Water levels declined from March 2013 to March 2014 in most parts of Pahvant Valley; however, there were a few wells in the southwest part of the valley in which water levels rose slightly. Water-level declines of more than 4 feet were observed in several wells north of Flowell. These declines are probably the result of continued large localized withdrawals for irrigation. Water levels generally declined from the early 1950s until 1982 as a result of generally less-than-average precipitation and increased withdrawals. Water levels rose substantially from 1982 to 1985 as a result of greater-than-average precipitation and decreased withdrawals for irrigation. Water levels generally have declined throughout the valley since the mid- to late 1980s.

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 1954 to 1958 and 1960 to 2013, respectively, and from well (C-23-6)8abd-1, located in the Kanosh area, from 1957 to 2012, 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. The concentration of dissolved solids in the water sample collected in July 2013 was 895 mg/L. 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. This well was not sampled in 2013.

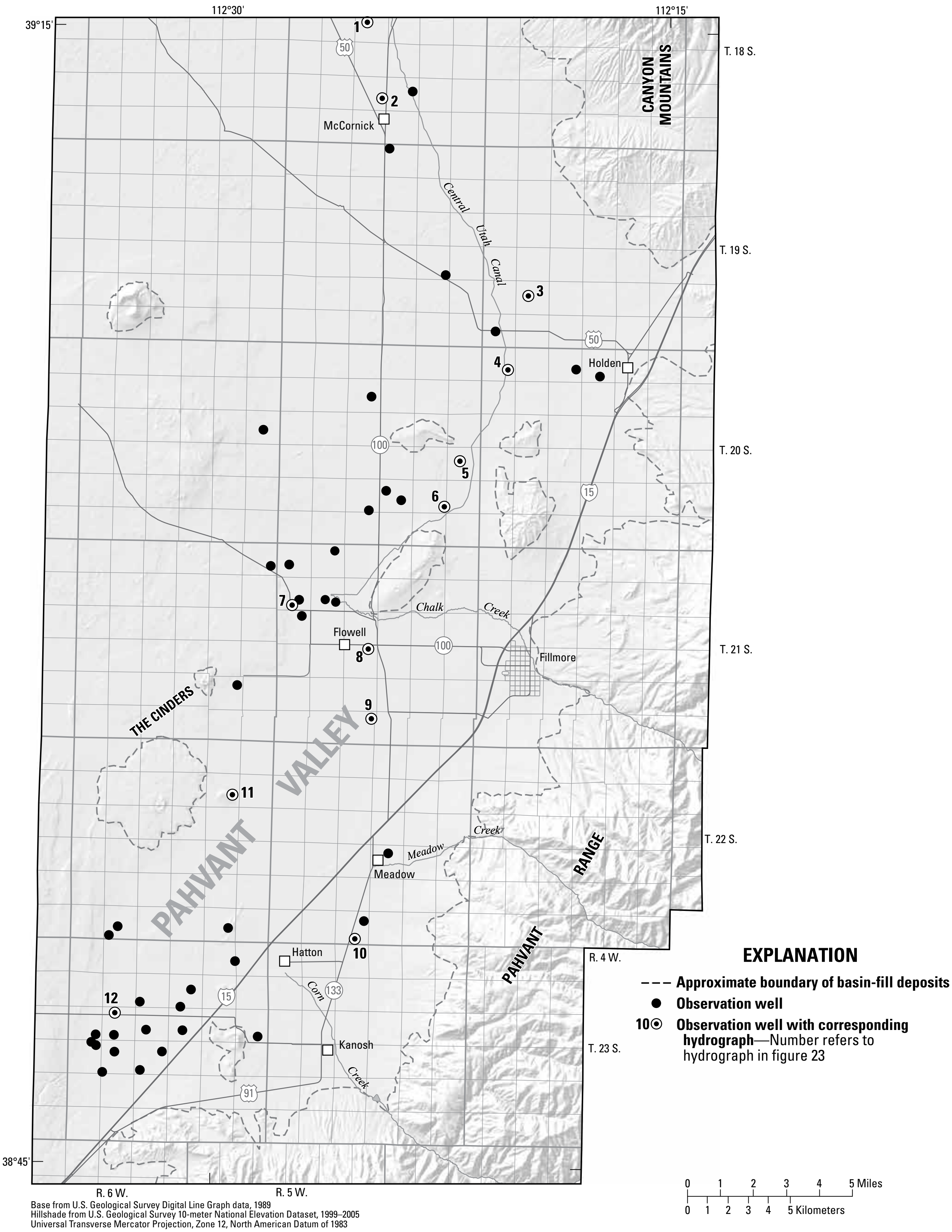


Figure 22. Location of wells in Pahvant Valley in which the water level was measured during March 2014.

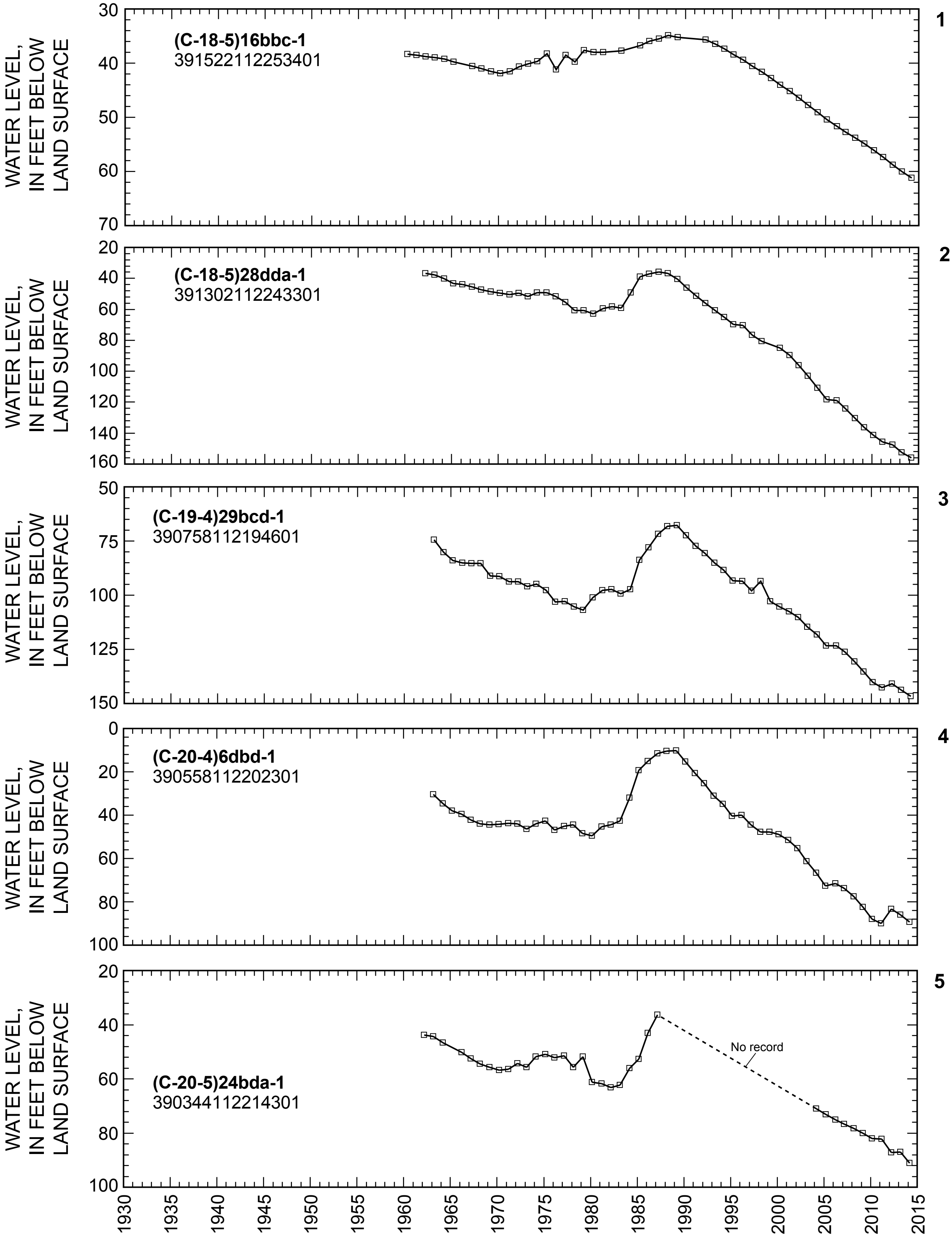


Figure 23. Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.

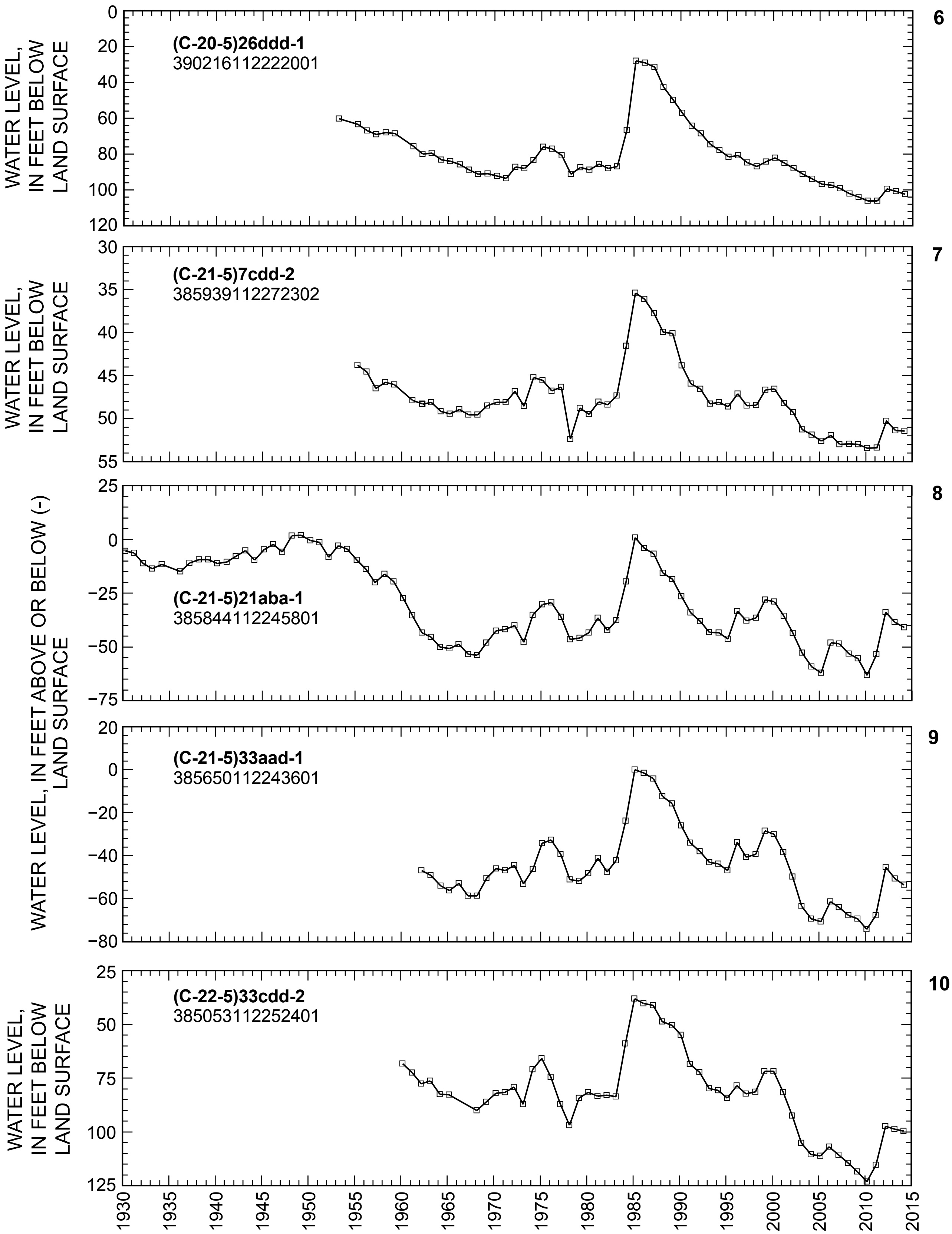


Figure 23. Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.—Continued

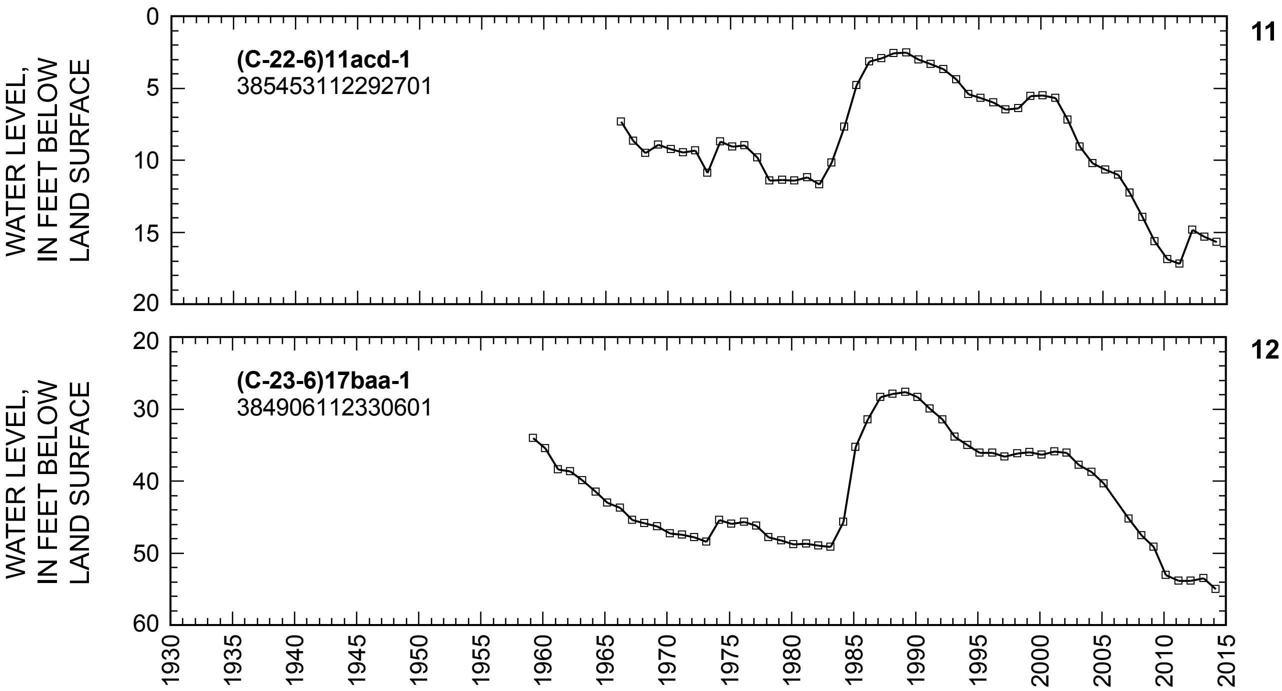


Figure 23. Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.—Continued

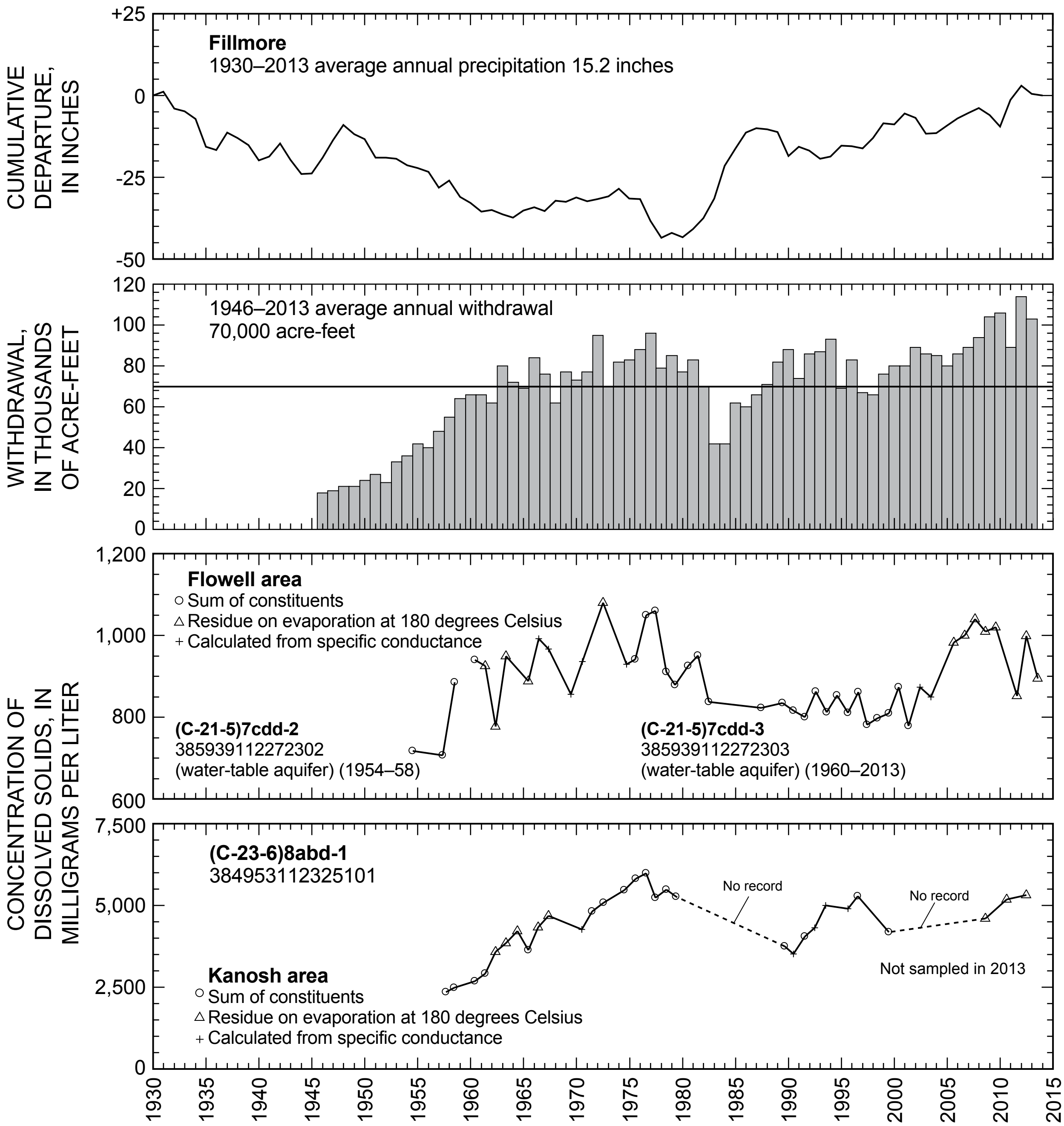


Figure 23. Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.—Continued

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.

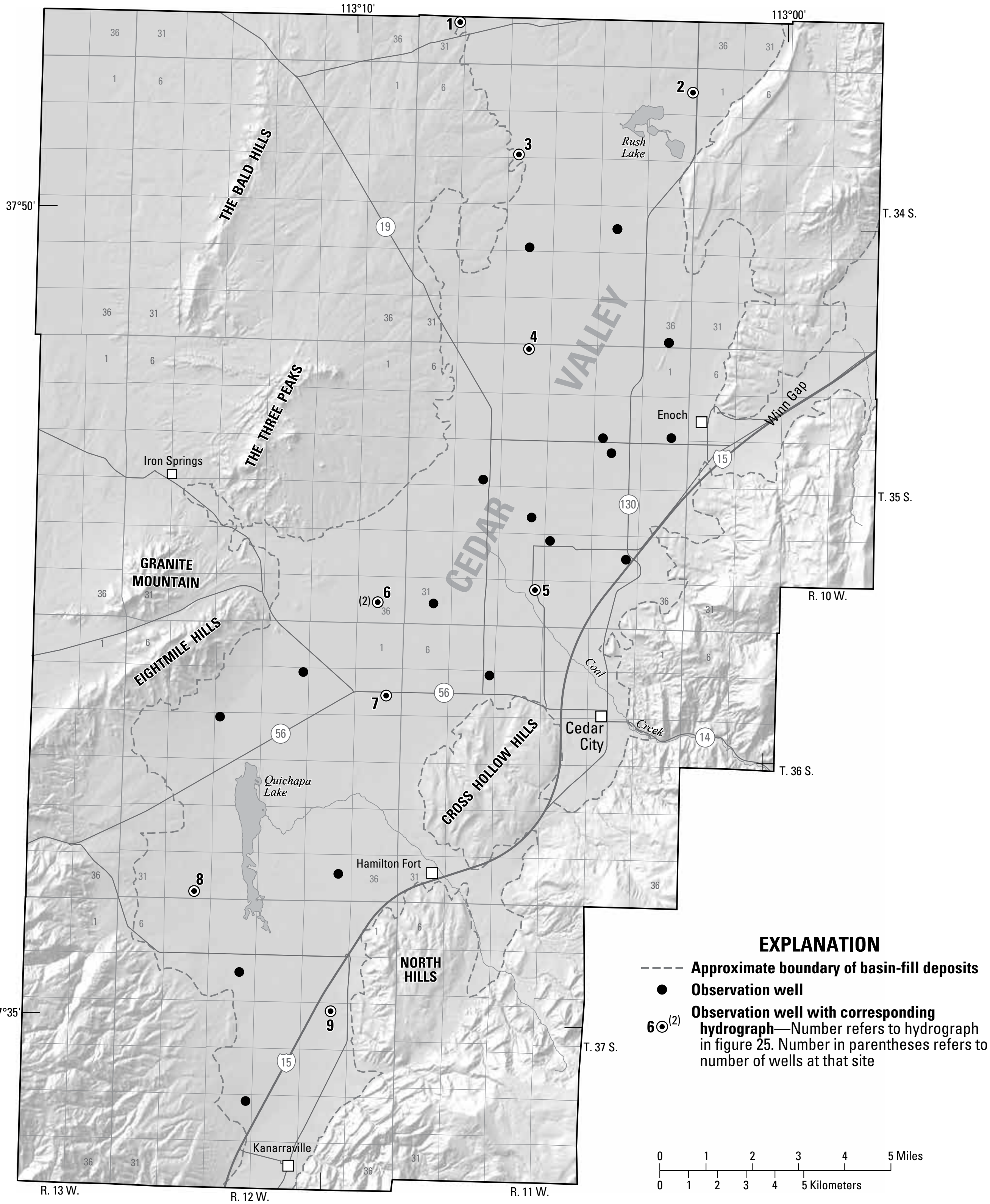
Total estimated withdrawal of water from wells in Cedar Valley in 2013 was about 39,000 acre-feet, which is 1,000 acre-feet less than in 2012 and 2,000 acre-feet more than the average annual withdrawal for 2003–2012 (tables 2 and 3).

The location of wells in Cedar Valley in which the water level was measured during March 2014 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 2013 was about 14.8 inches, which is about 2.2 inches more than in 2012 and 3.9 inches more than the average annual precipitation for 1949–2013. Discharge of Coal Creek was about 18,100 acre-feet in 2013, which is 300 acre-feet less than the revised value for 2012, and 6,500 acre-feet less than the average annual discharge for 1936 and 1939–2013.

Groundwater levels declined from March 2013 to March 2014 in most parts of Cedar Valley. The largest decline, greater than 9 feet, was measured in a well west of Cedar City. Water-level declines probably resulted from locally increased withdrawals and decreased recharge. Water-level rises were measured in two wells north of Cedar City. Water-level rises probably resulted from decreased localized withdrawals and increased recharge.

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 2012, and well (C-35-11)31dbd-1, located about 4 miles northwest of Cedar City, from 1977 to 2013, is shown in figure 25. The dissolved-solids concentration in water from both wells has generally increased. Well (C-37-12)23acb-1 was not sampled in 2013.



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 2014.

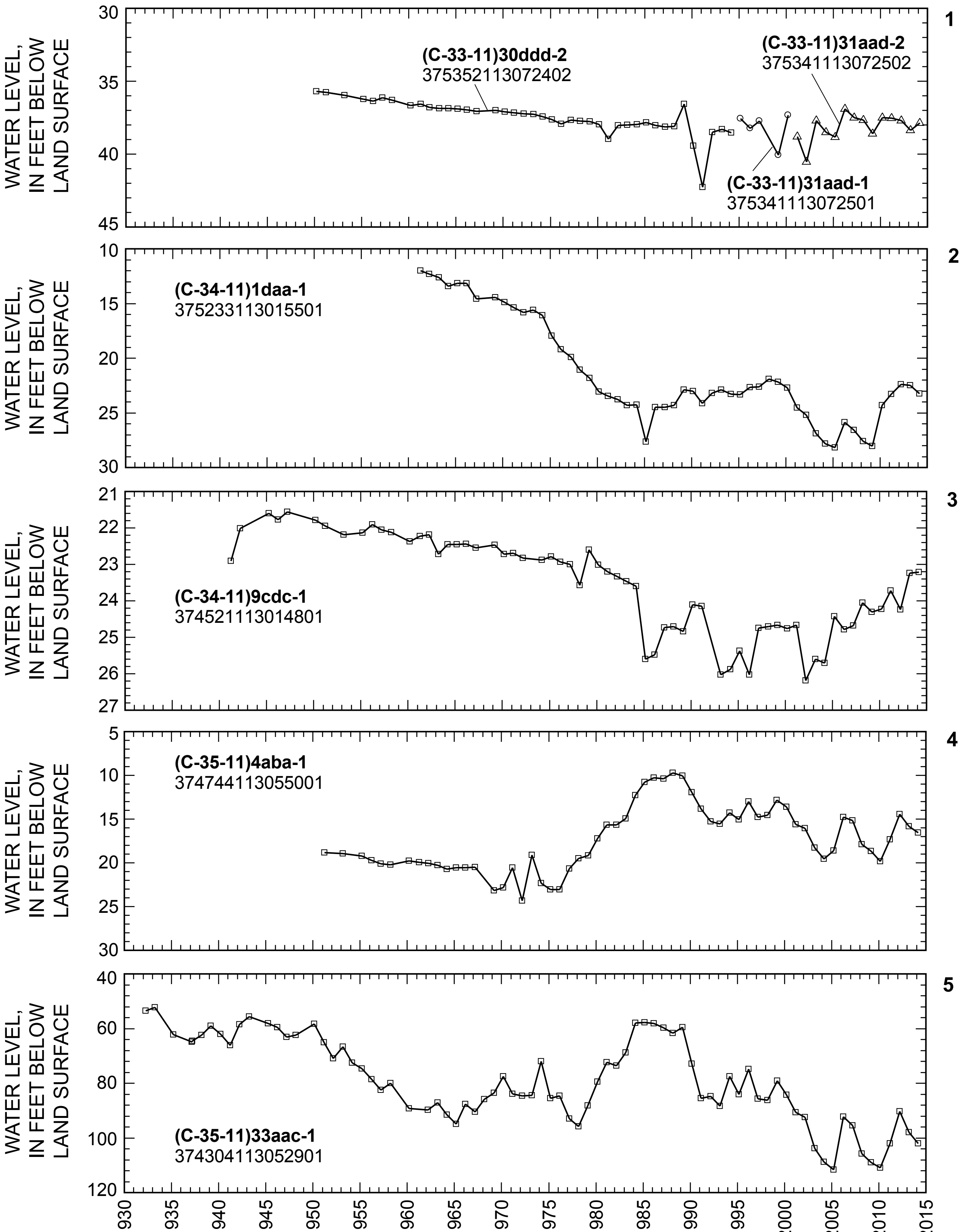


Figure 25. Relation of water level in selected wells in Cedar Valley, Iron County, to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, to annual withdrawal from wells, and to concentration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

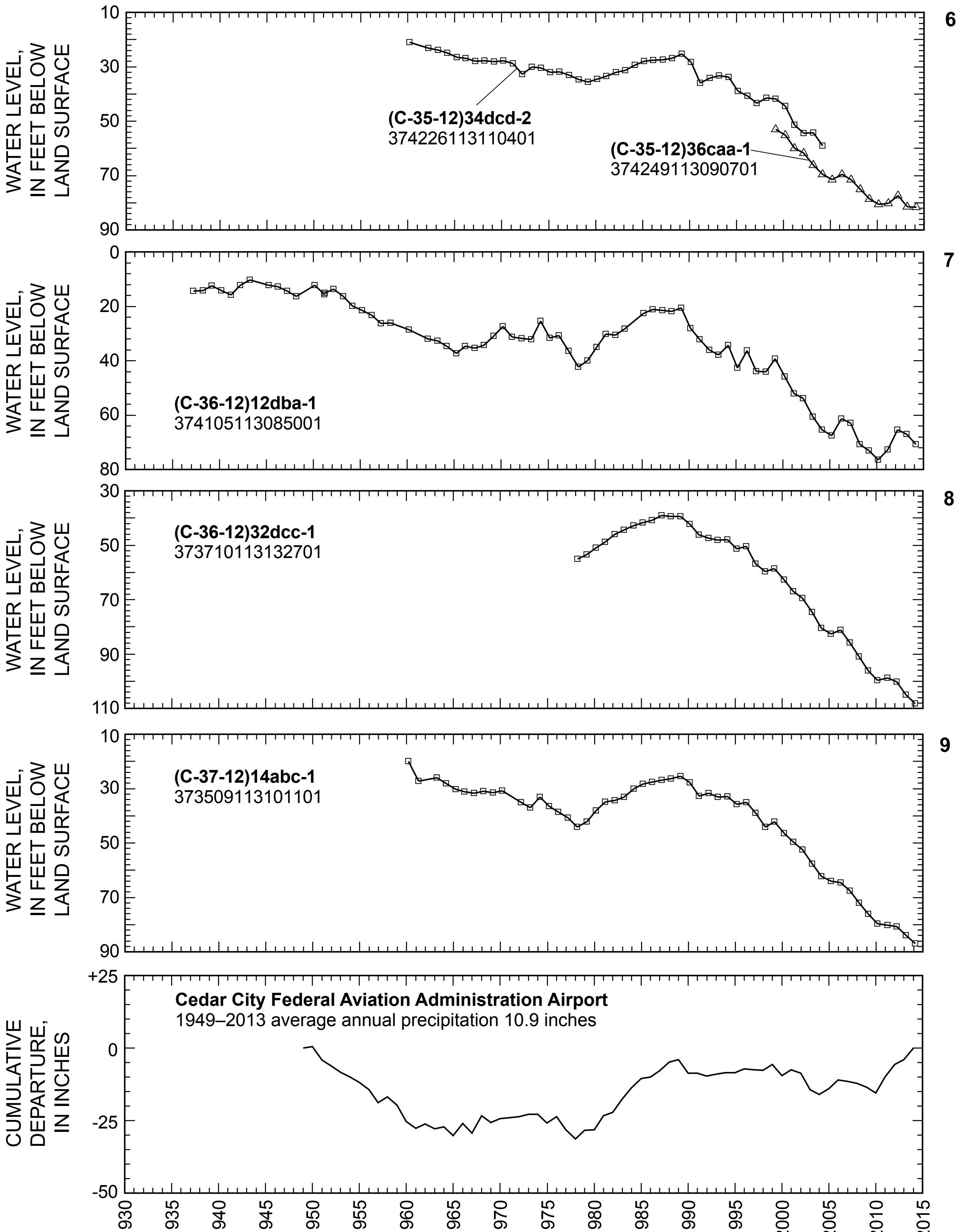


Figure 25. Relation of water level in selected wells in Cedar Valley, Iron County, to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, to annual withdrawal from wells, and to concentration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

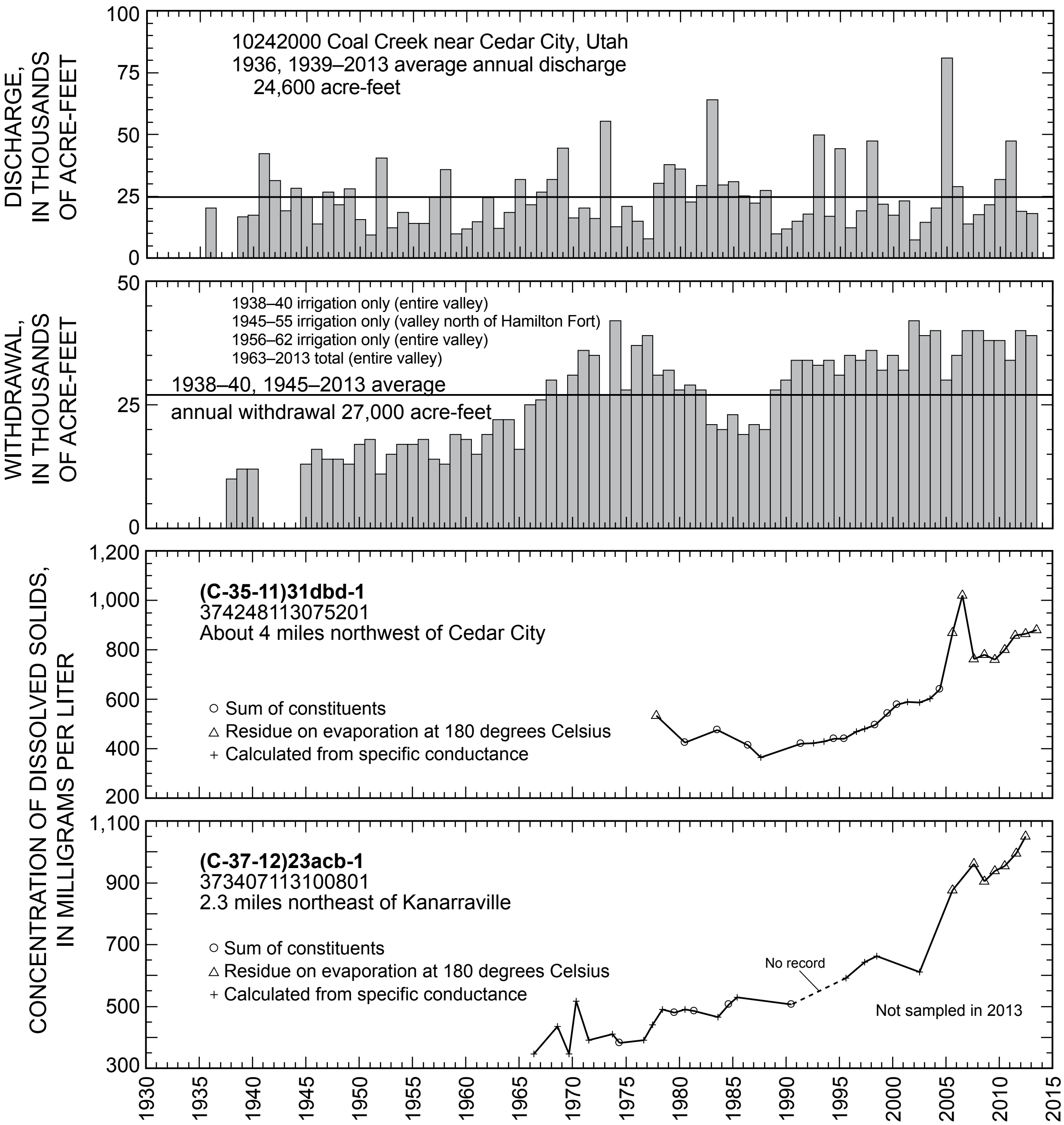


Figure 25. Relation of water level in selected wells in Cedar Valley, Iron County, to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, to annual withdrawal from wells, and to concentration 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 2013 was about 32,000 acre-feet, which is about 6,000 acre-feet less than was reported for 2012 and 2,000 acre-feet less than the average annual withdrawal for 2003–2012 (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 2014 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 2013 was about 14.8 inches, which is about 2.2 inches more than the value for 2012 and 3.9 inches more than the average annual precipitation for 1949–2013.

Water levels declined from March 2013 to March 2014 in most parts of Parowan Valley for which data are available. The largest declines, more than 2 feet, were measured in two wells northwest of Parowan and in one well north of Paragonah. Water levels rose in two wells north of Summit and in one well northwest of Paragonah. Water levels in Parowan Valley generally have declined since 1950. Some rises occurred during 1973–74, 1983–85, 1996–99, 2006, and 2012. 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.

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 2013, is shown in figure 27. The water sample collected in July 2013 had a dissolved-solids concentration of 279 mg/L. With the exception of relatively high dissolved-solids concentrations in water samples collected in 1970, 1973, and 1974, concentrations have varied little.

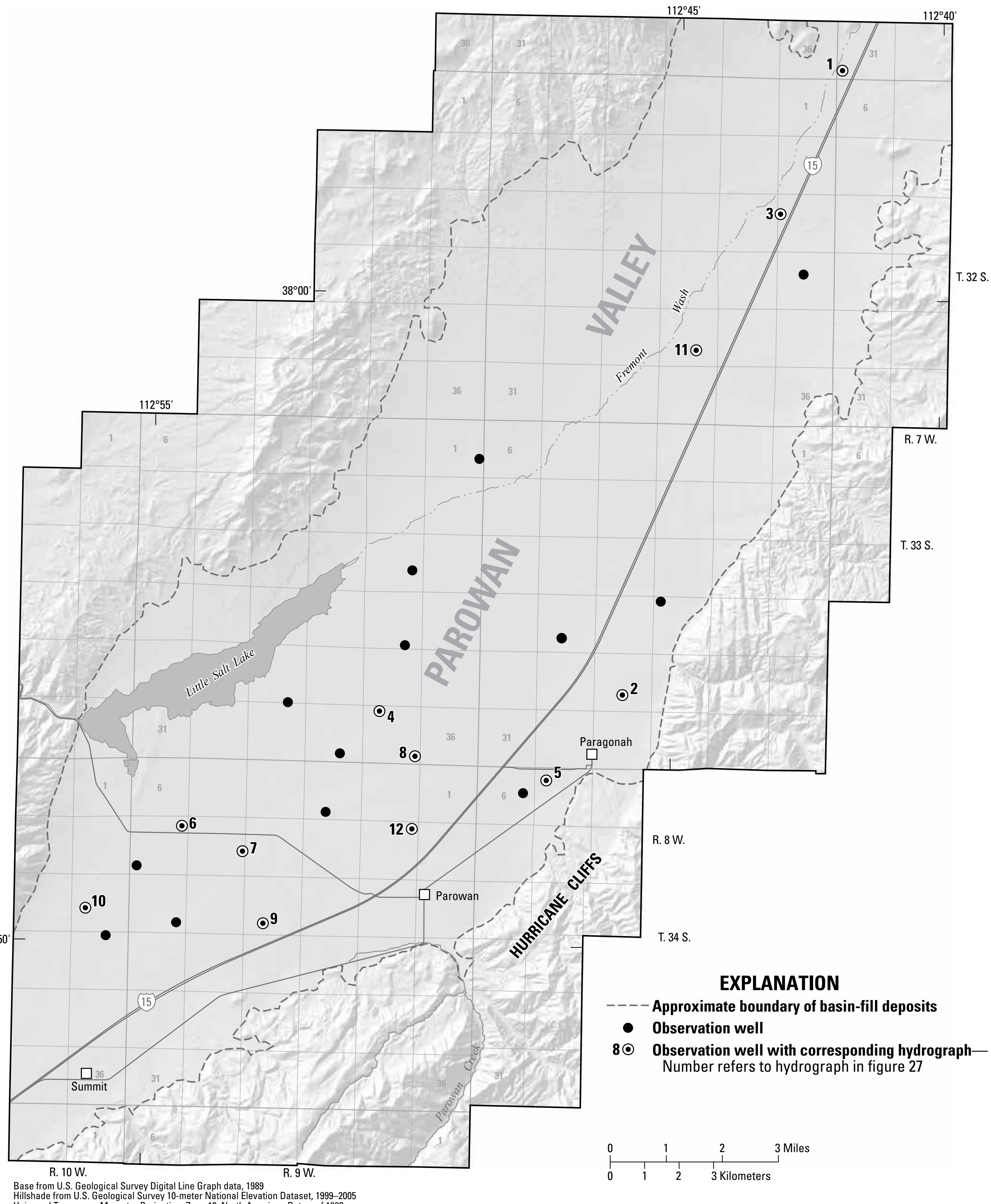


Figure 26. Location of wells in Parowan Valley in which the water level was measured during March 2014.

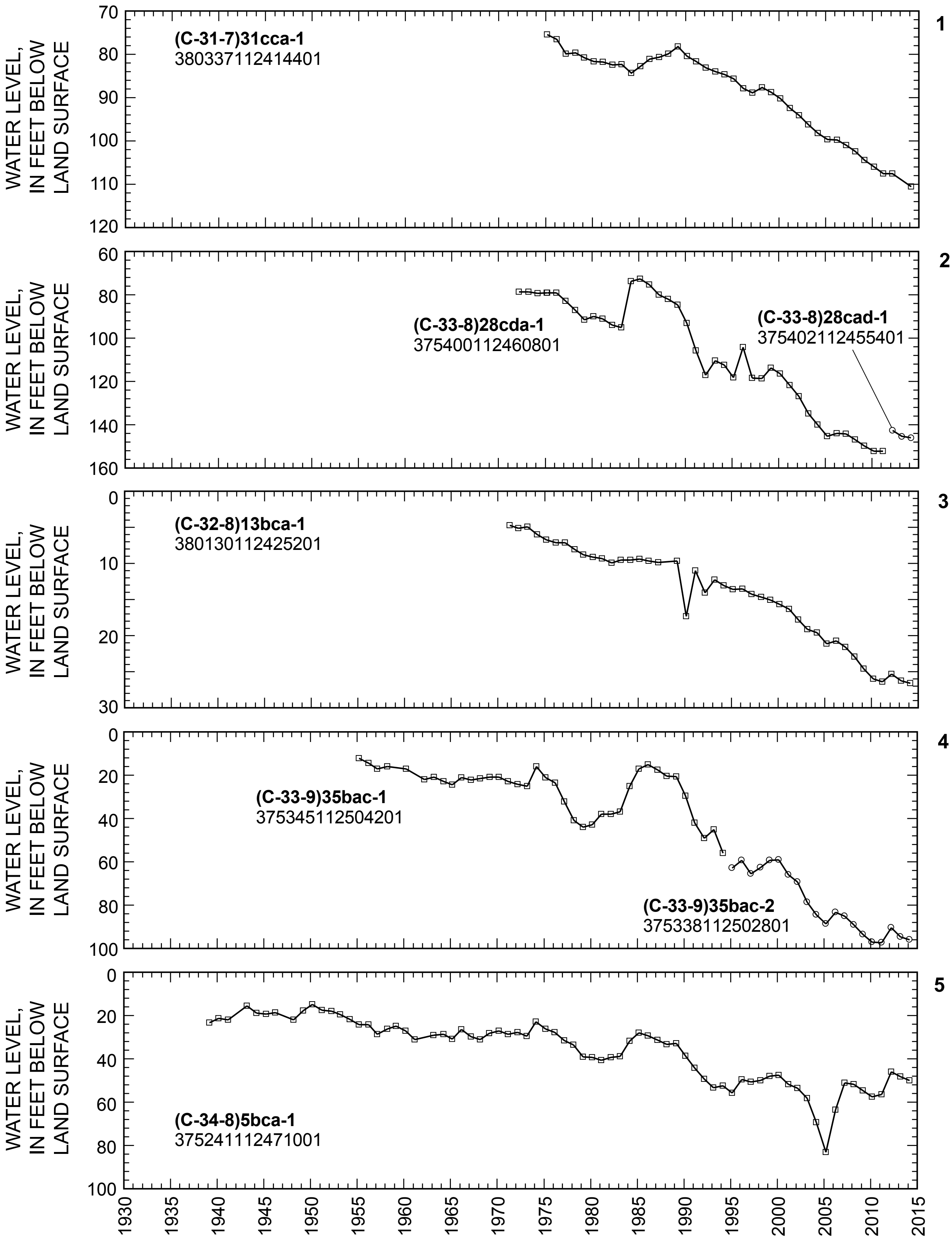


Figure 27. Relation of water level in selected wells in Parowan Valley to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1.

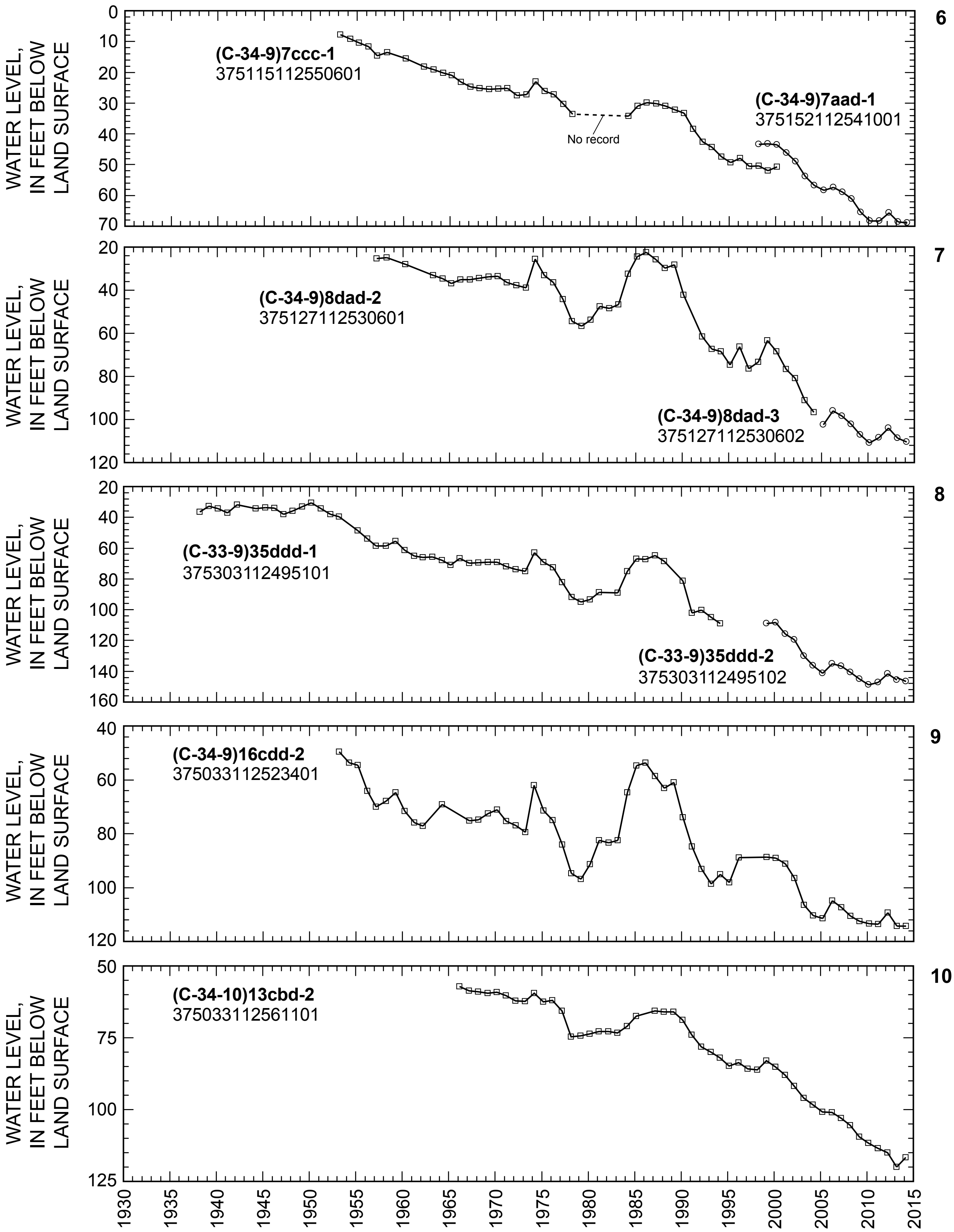


Figure 27. Relation of water level in selected wells in Parowan Valley to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1.—Continued

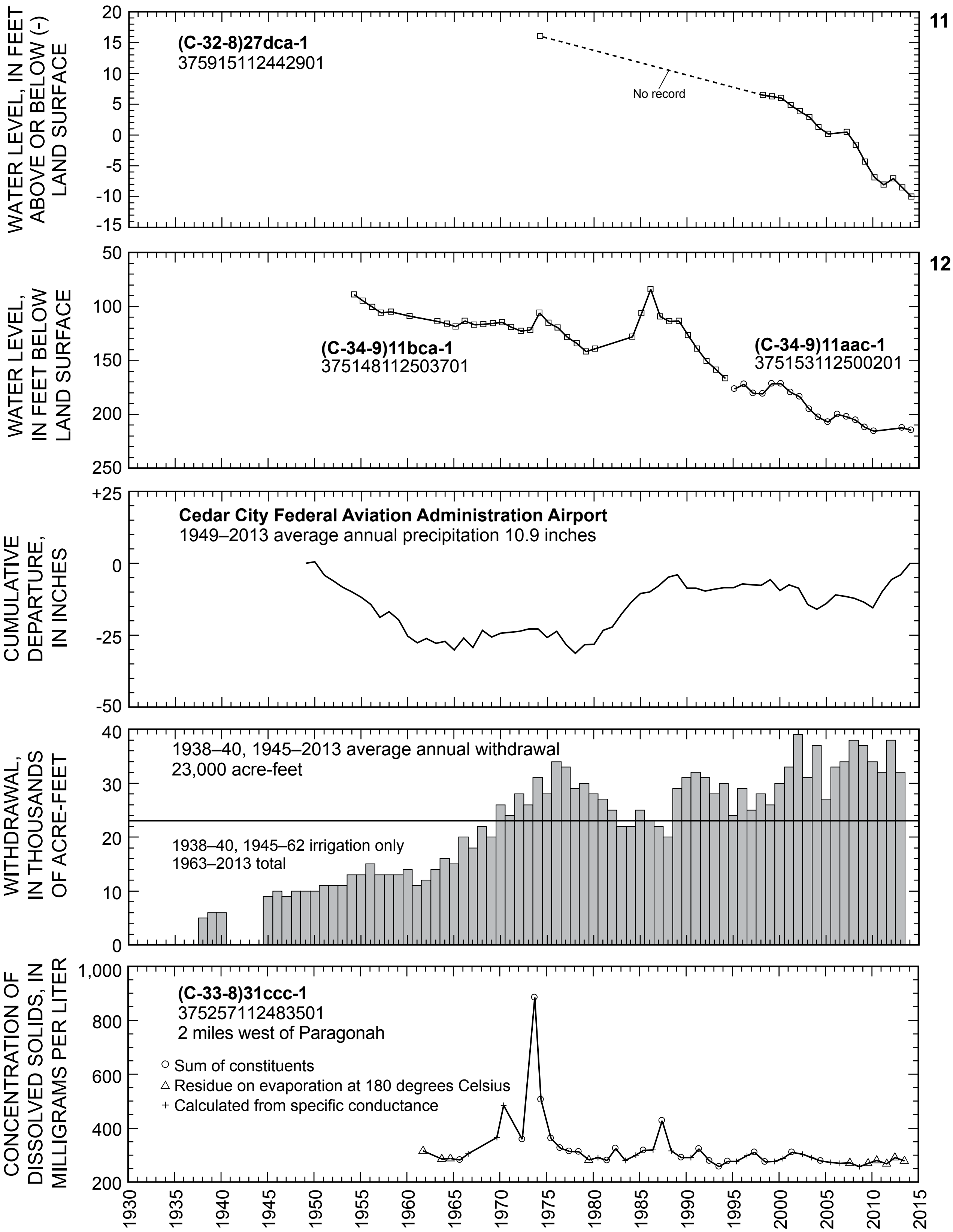


Figure 27. Relation of water level in selected wells in Parowan Valley to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1.—Continued

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 2013 was about 68,000 acre-feet, which is 1,000 acre-feet more than was reported for 2012 and 16,000 acre-feet more than the average annual withdrawal for 2003–2012 (tables 2 and 3). This increase was most likely the result of increased pumpage for irrigation due to decreased availability of surface water and less-than-average precipitation.

The location of wells in the Milford area in which the water level was measured during March 2014 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 2013 was about 8.1 inches, about 1.5 inches more than in 2012 and about 0.9 inch less than the 1952–2013 average annual precipitation.

Water levels declined from March 2013 to March 2014 in most of 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.

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 2013, is shown in figure 29. The dissolved-solids concentration in the July 2013 sample was 453 mg/L. With the exception of a relatively high dissolved-solids concentration in the water sample collected in 2001 (909 mg/L), concentrations have varied little.

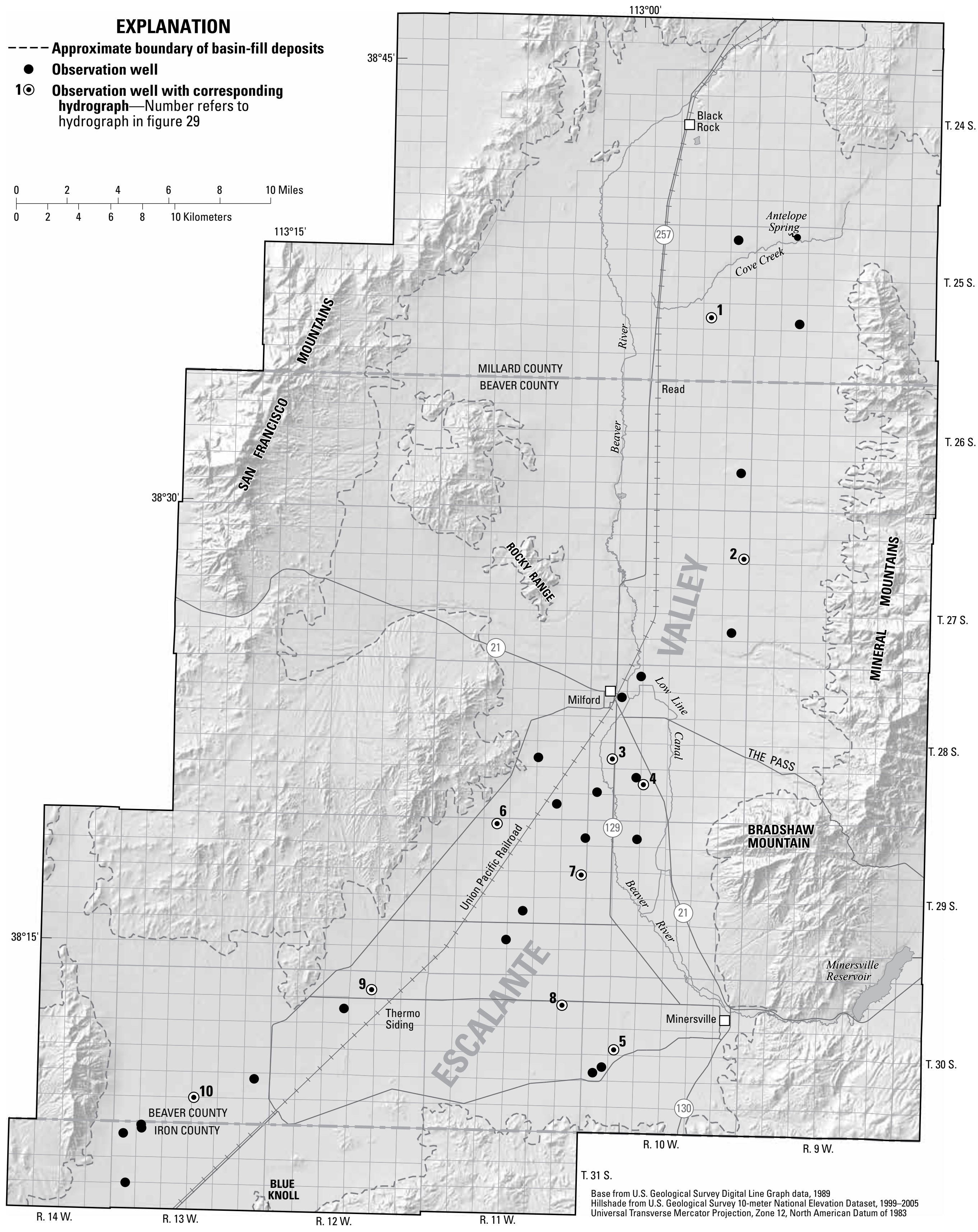


Figure 28. Location of wells in the Milford area in which the water level was measured during March 2014.

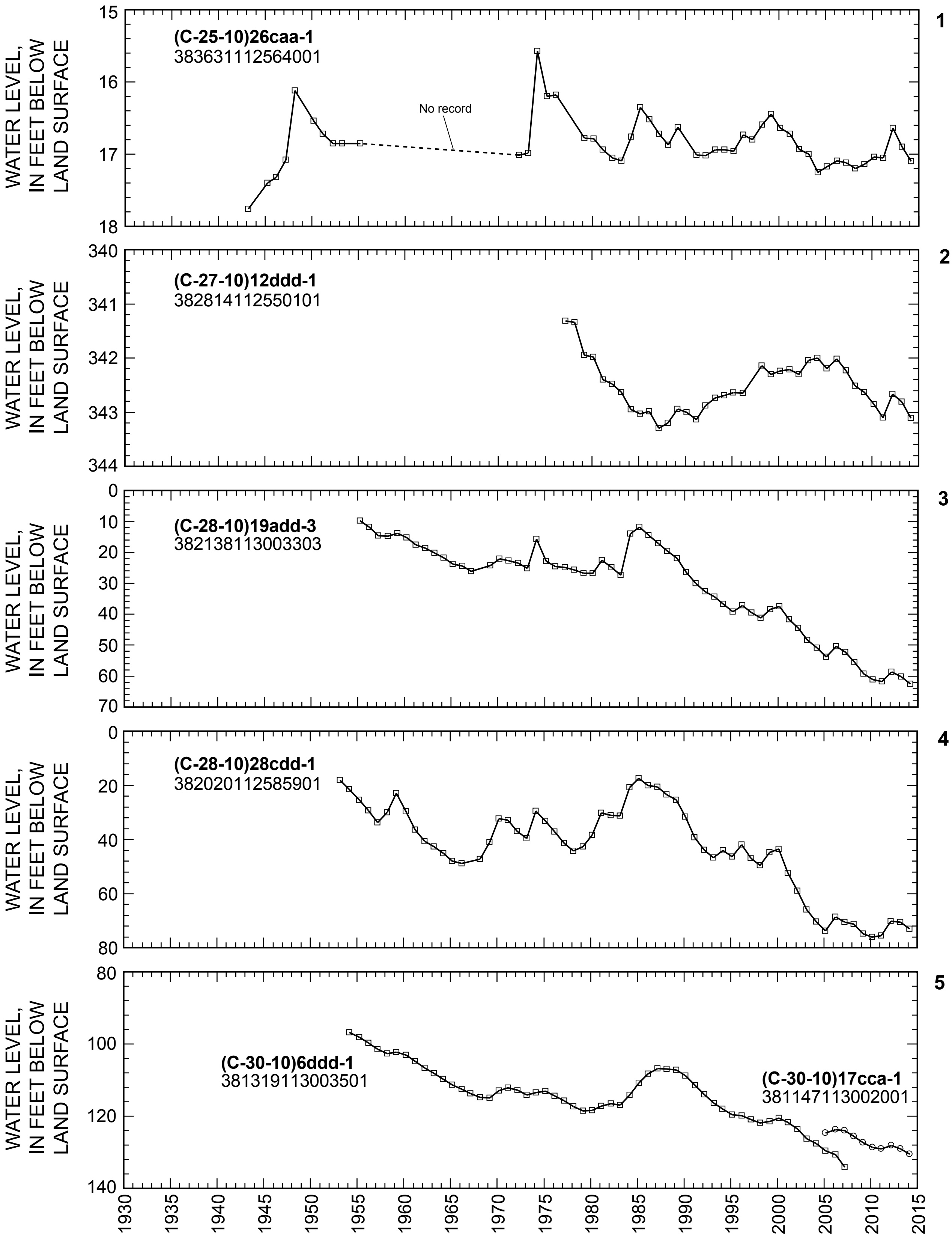


Figure 29. Relation of water level in selected wells in the Milford area to cumulative departure from average annual precipitation at Black Rock, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-29-10)5cdd-2.

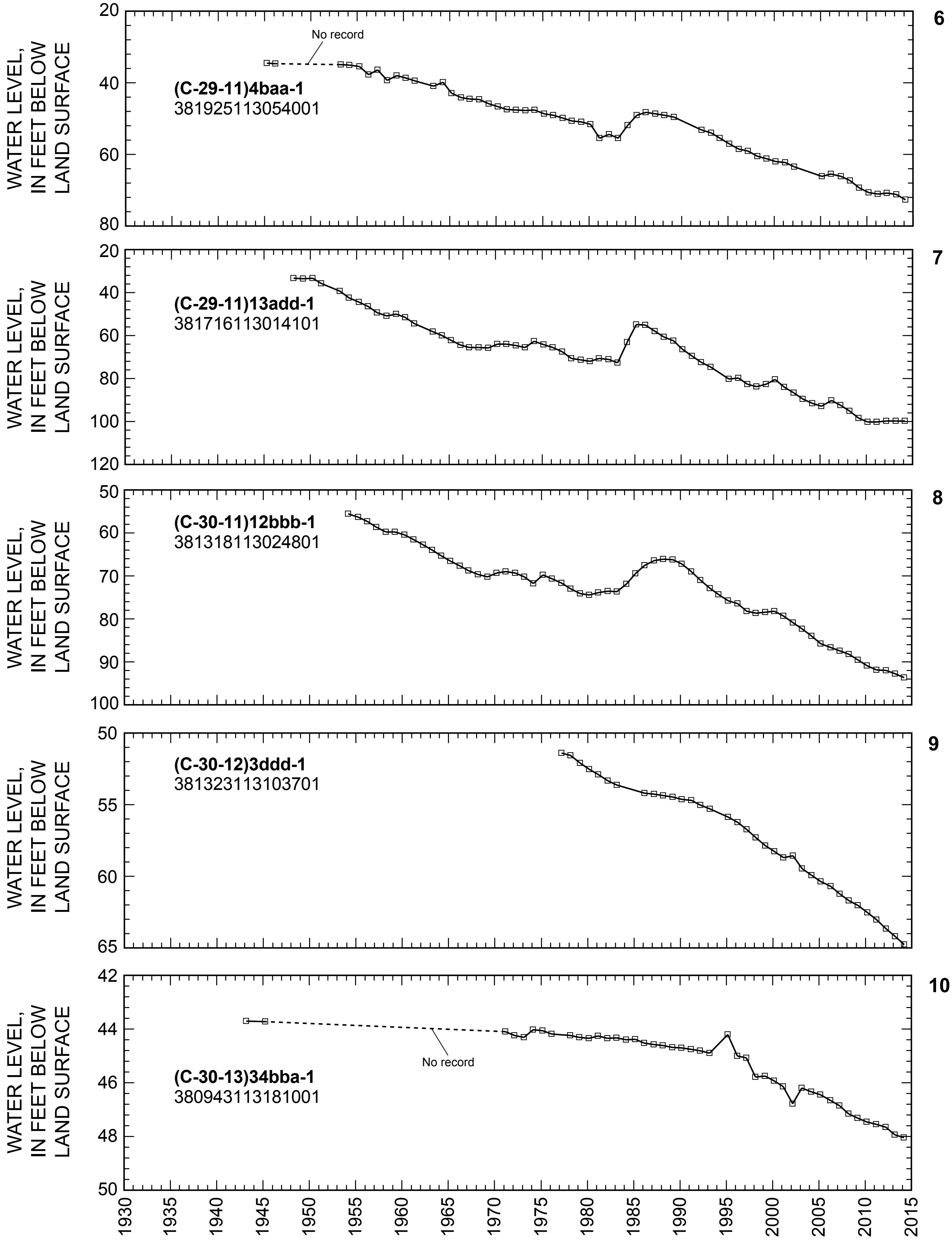


Figure 29. Relation of water level in selected wells in the Milford area to cumulative departure from average annual precipitation at Black Rock, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-29-10)5cdd-2.—Continued

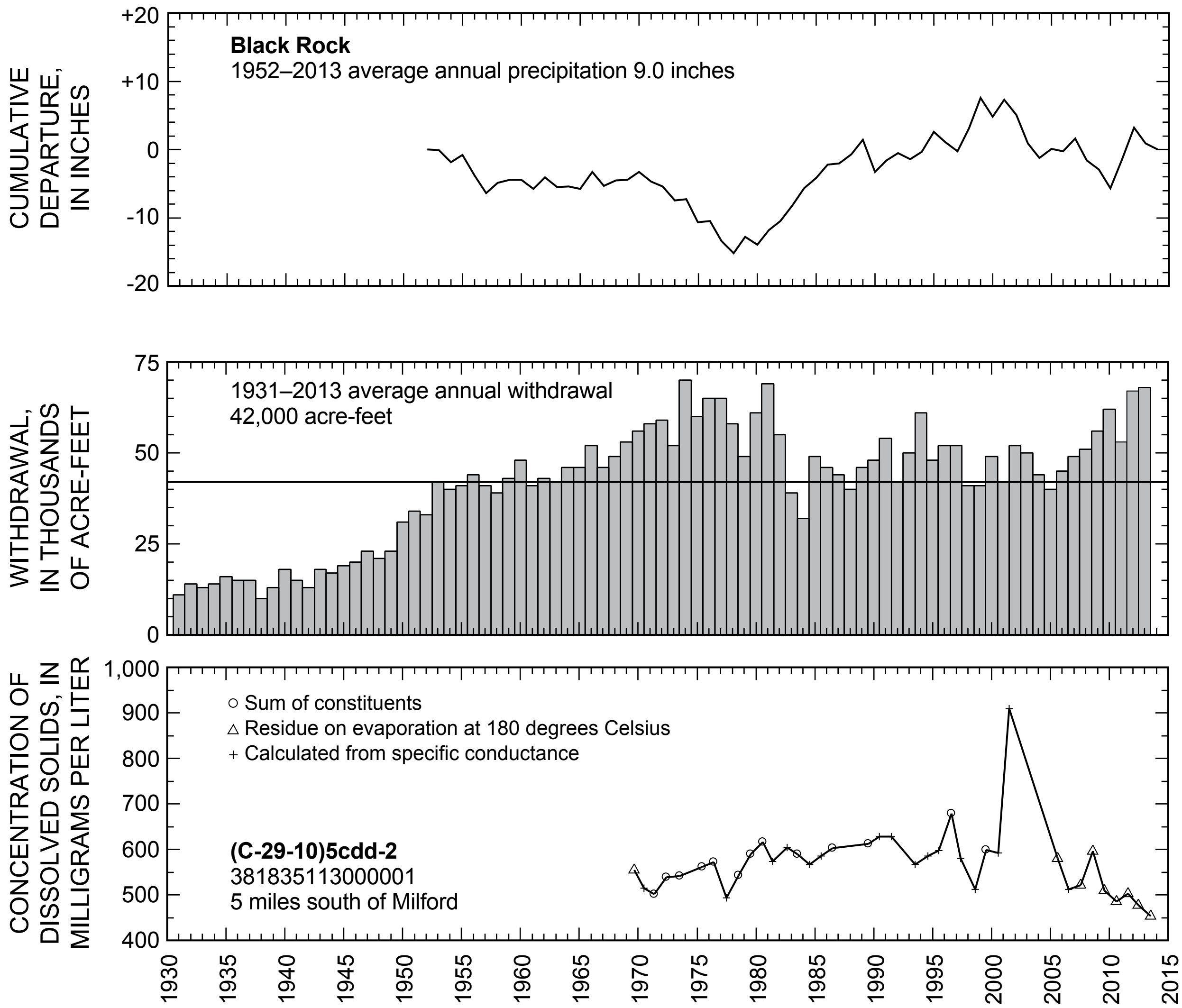


Figure 29. Relation of water level in selected wells in the Milford area to cumulative departure from average annual precipitation at Black Rock, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-29-10)5cdd-2.—Continued

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 2013 was about 93,000 acre-feet, which is 2,000 acre-feet more than in 2012 and 5,000 acre-feet more than the average annual withdrawal for 2003–2012 (tables 2 and 3).

The location of wells in the Beryl-Enterprise area in which the water level was measured during March 2014 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-3 is shown in figure 31.

Precipitation at Enterprise in 2013 was about 11.8 inches, which is about 2.2 inches less than the average annual precipitation for 1955–2013 and about 0.2 inch less than in 2012.

Water levels declined slightly from March 2013 to March 2014 in most of the wells measured in the Beryl-Enterprise area. Water levels throughout most of the area have declined steadily since 1950 and have shown little or no recovery during periods of greater-than-average precipitation. For example, water-level measurements in well (C-36-16)29daa-1, about 5 miles northeast of Enterprise, have shown a decline of nearly 135 feet from March 1948 to March 2014 (fig. 31). Declines such as this one are a result of continued large withdrawals for irrigation beginning in about 1950.

The concentration of dissolved solids in water samples collected from well (C-34-16)28dcc-3, located 6 miles south-southeast of Beryl, is shown in figure 31 (this well replaces well (C-34-16)28dcc-2). The concentration of dissolved solids in the water sample collected in August 2013 was 583 mg/L, an increase of greater than 100 mg/L from the 2012 value.

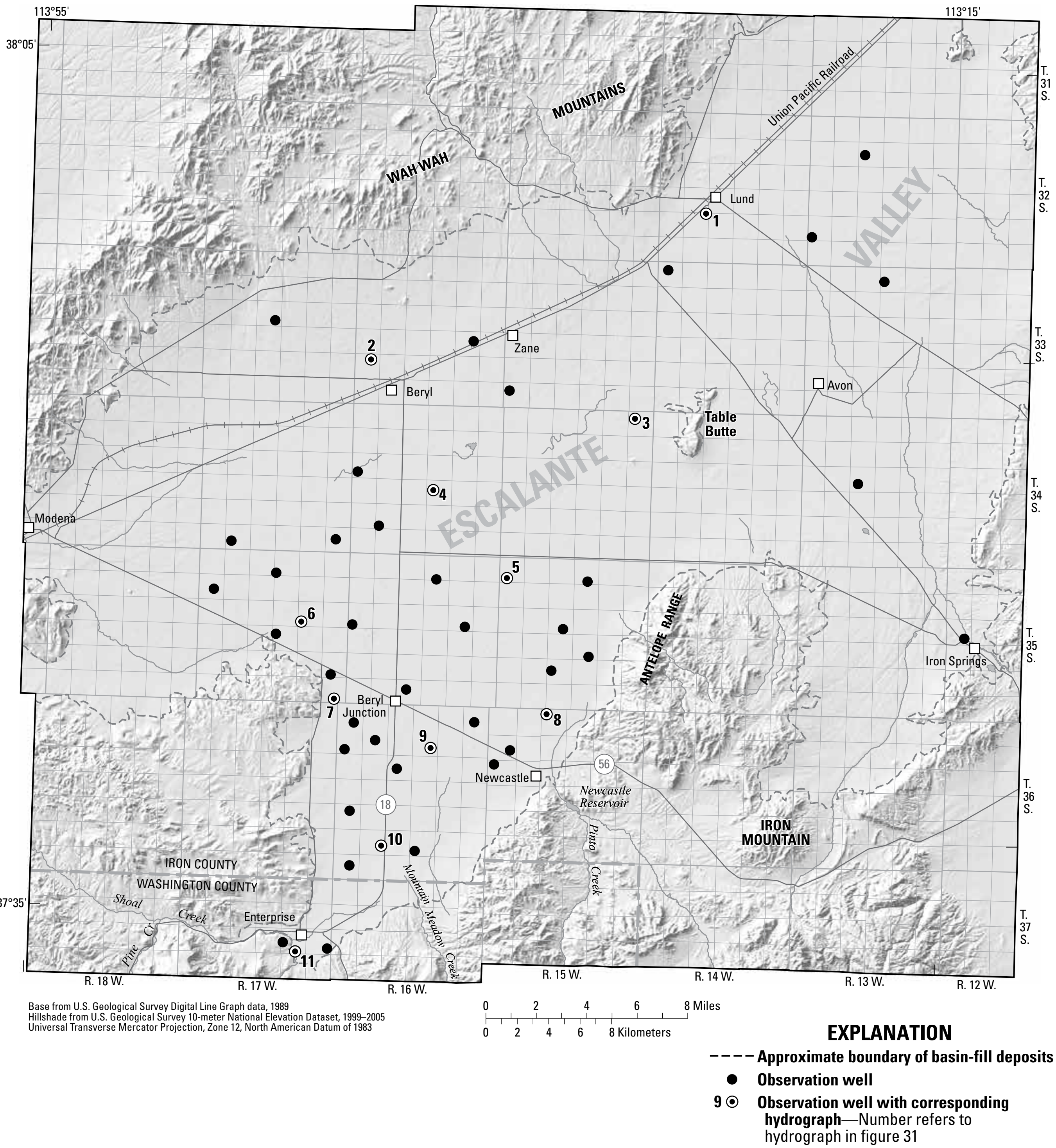


Figure 30. Location of wells in the Beryl-Enterprise area in which the water level was measured during March 2014.

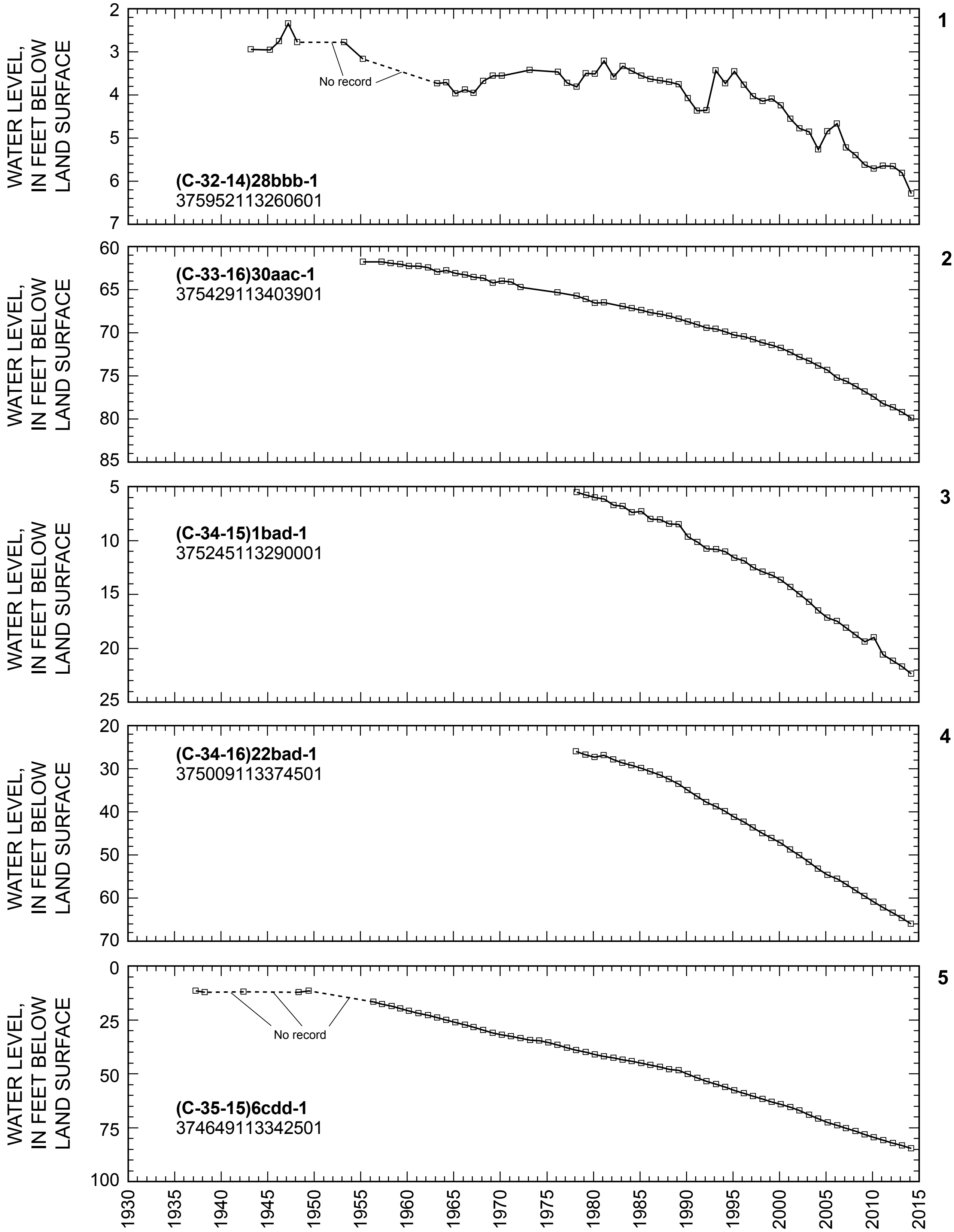


Figure 31. Relation of water level in selected wells in the Beryl-Enterprise area to cumulative departure from average annual precipitation at Enterprise, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-3.

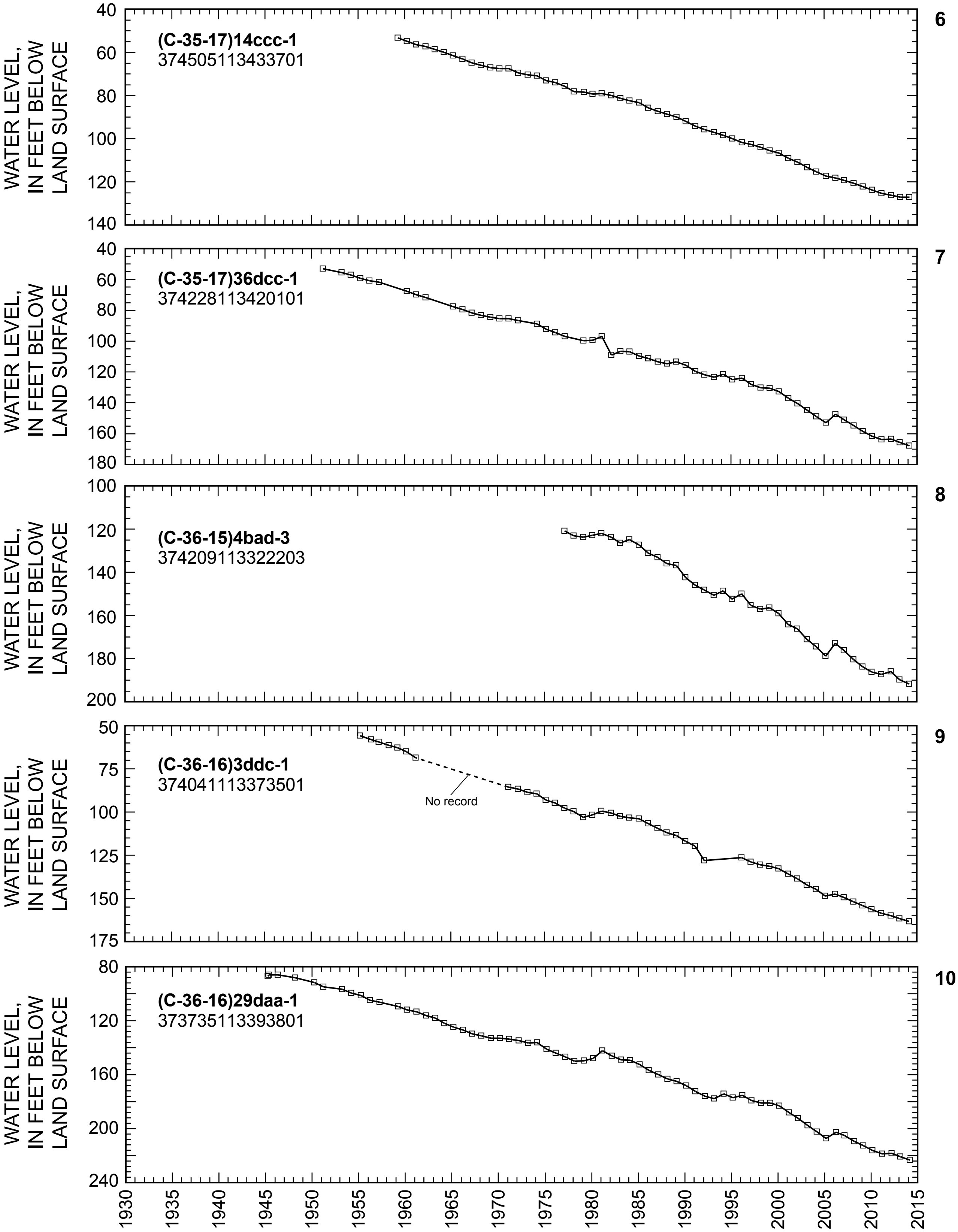


Figure 31. Relation of water level in selected wells in the Beryl-Enterprise area to cumulative departure from average annual precipitation at Enterprise, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-3.—Continued

11

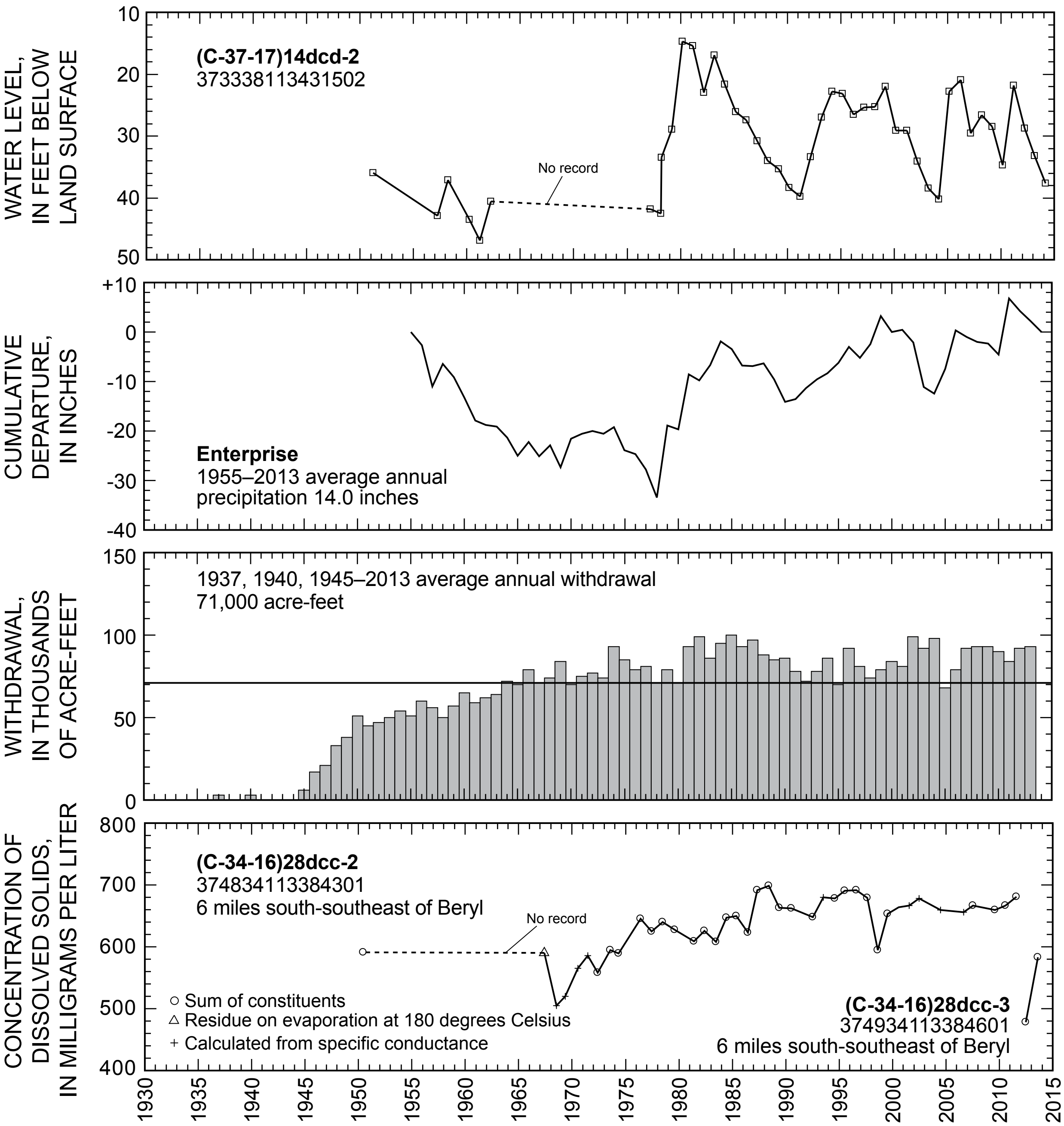


Figure 31. Relation of water level in selected wells in the Beryl-Enterprise area to cumulative departure from average annual precipitation at Enterprise, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-3.—Continued

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 aquifers 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 2013 was about 29,000 acre-feet, which is the same as in 2012 and 1,000 acre-feet less than the average annual withdrawal for 2003–2012 (tables 2 and 3). Withdrawals for irrigation and industrial use decreased slightly, and withdrawal for public supply increased. Domestic and stock use was about the same as in 2012.

The location of wells in the central Virgin River area in which the water level was measured during February 2014 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, Utah, in 2013 was about 91,000 acre-feet, which is 8,100 acre-feet more than the value for 2012 and about 42,300 acre-feet less than the long-term average for 1931–70 and 1979–2013. Precipitation at St. George in 2013 was about 5.9 inches, which is about 2.2 inches less than the average annual precipitation for 1930–2013 and 2.5 inches less than in 2012.

Water levels from February 2013 to February 2014 generally declined or rose only slightly in most of the central Virgin River area. The largest decline, about 5.3 feet, was observed in a well west of Kanarraville. Declines are probably the result of continued large withdrawals for public supply and irrigation use.

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 2013, 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 dissolved-solids concentration in the water sample collected in July 2013 was 273 mg/L.

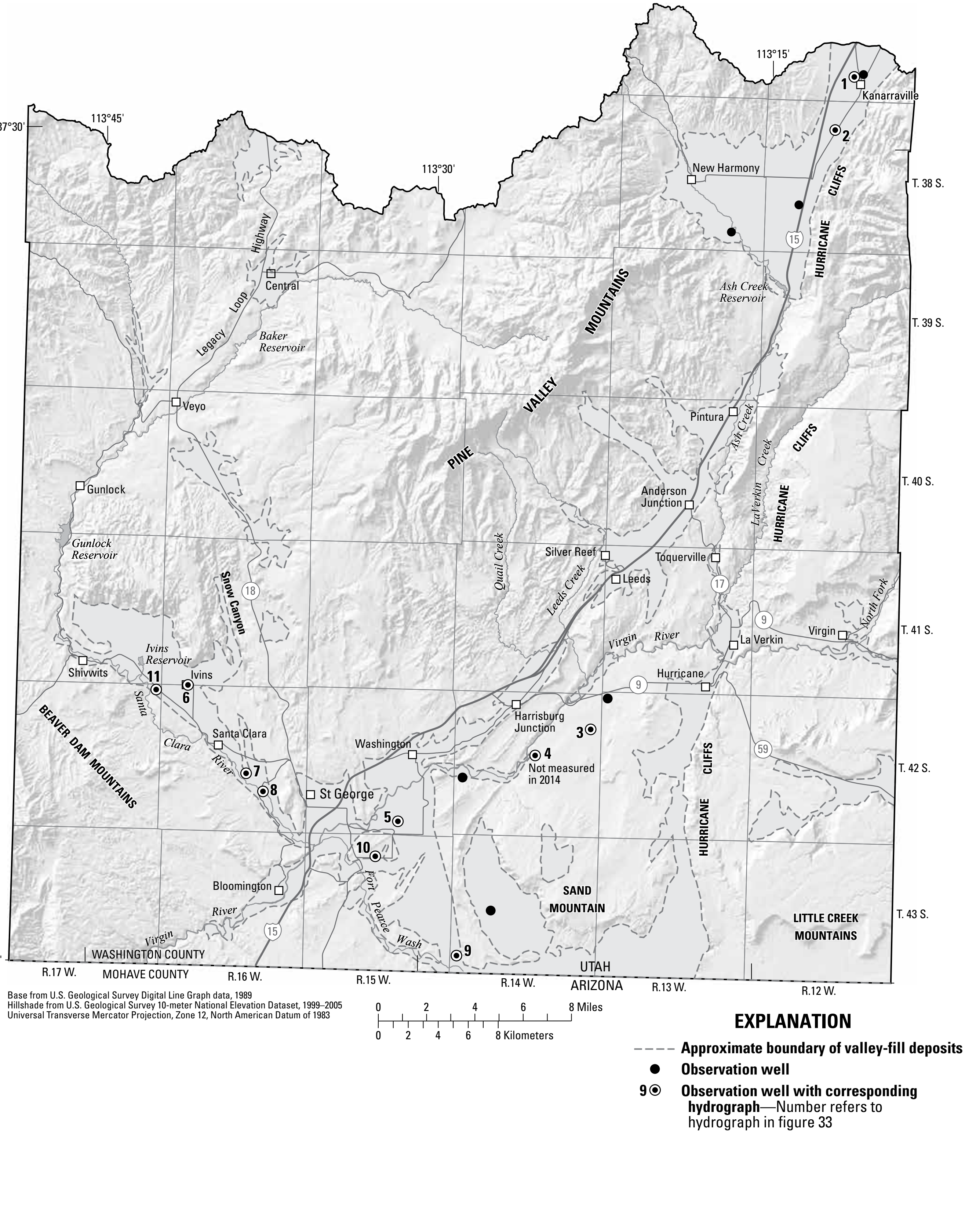


Figure 32. Location of wells in the central Virgin River area in which the water level was measured during February 2014.

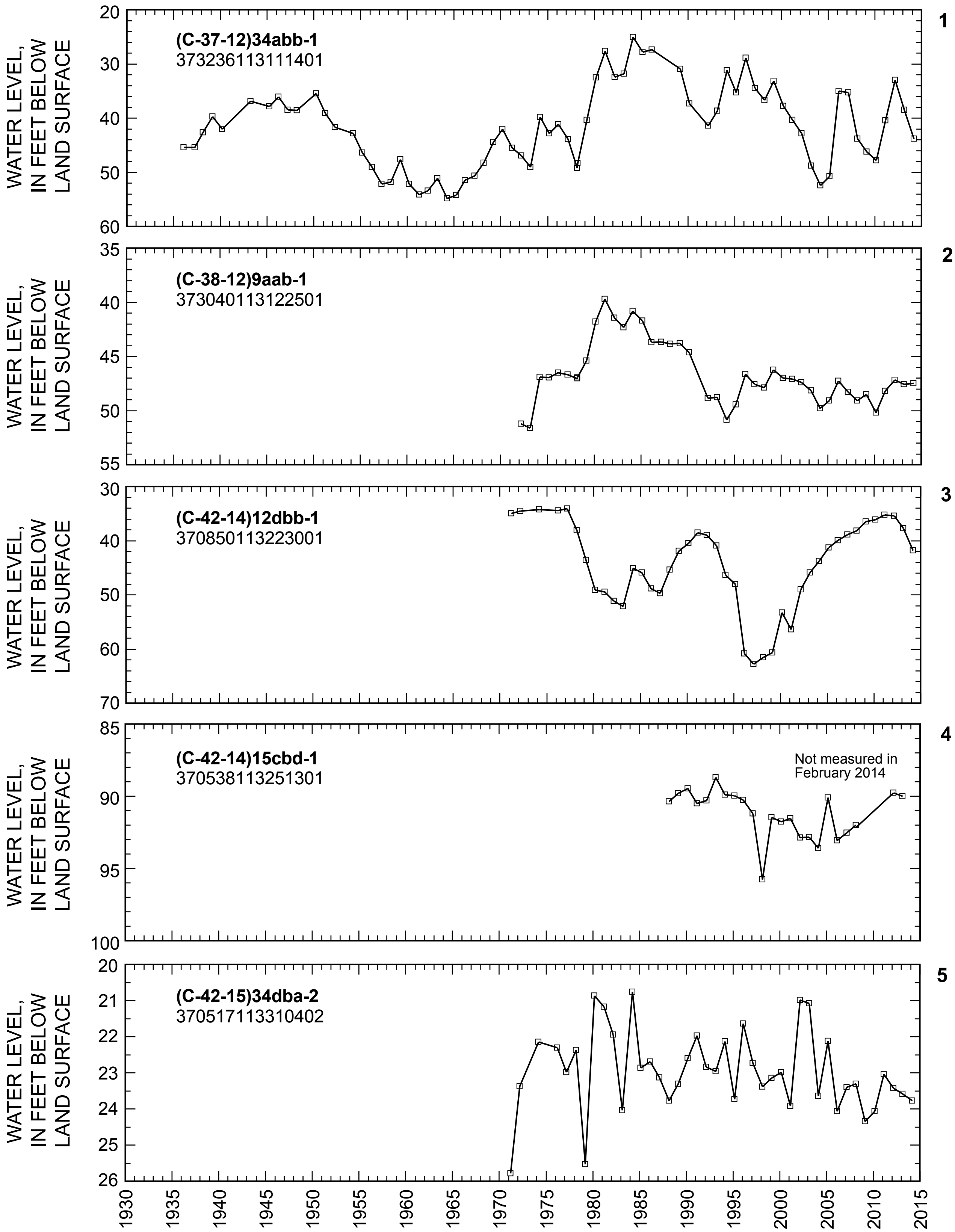


Figure 33. Relation of water level in selected wells in the central Virgin River area to annual discharge of the Virgin River at Virgin, Utah, to cumulative departure from average annual precipitation at St. George, to annual withdrawal from wells, and to concentration of dissolved solids in water from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

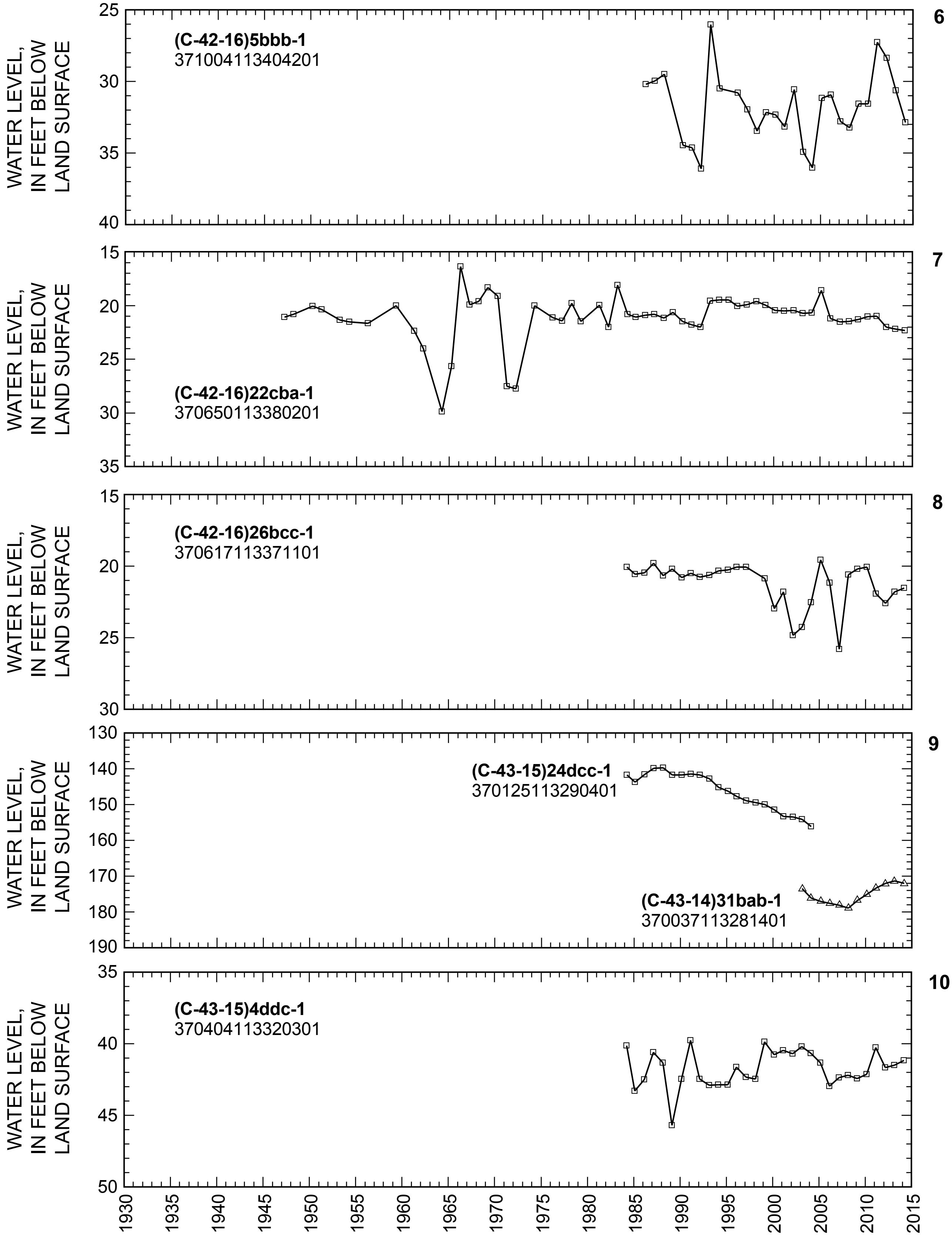


Figure 33. Relation of water level in selected wells in the central Virgin River area to annual discharge of the Virgin River at Virgin, Utah, to cumulative departure from average annual precipitation at St. George, to annual withdrawal from wells, and to concentration of dissolved solids in water from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

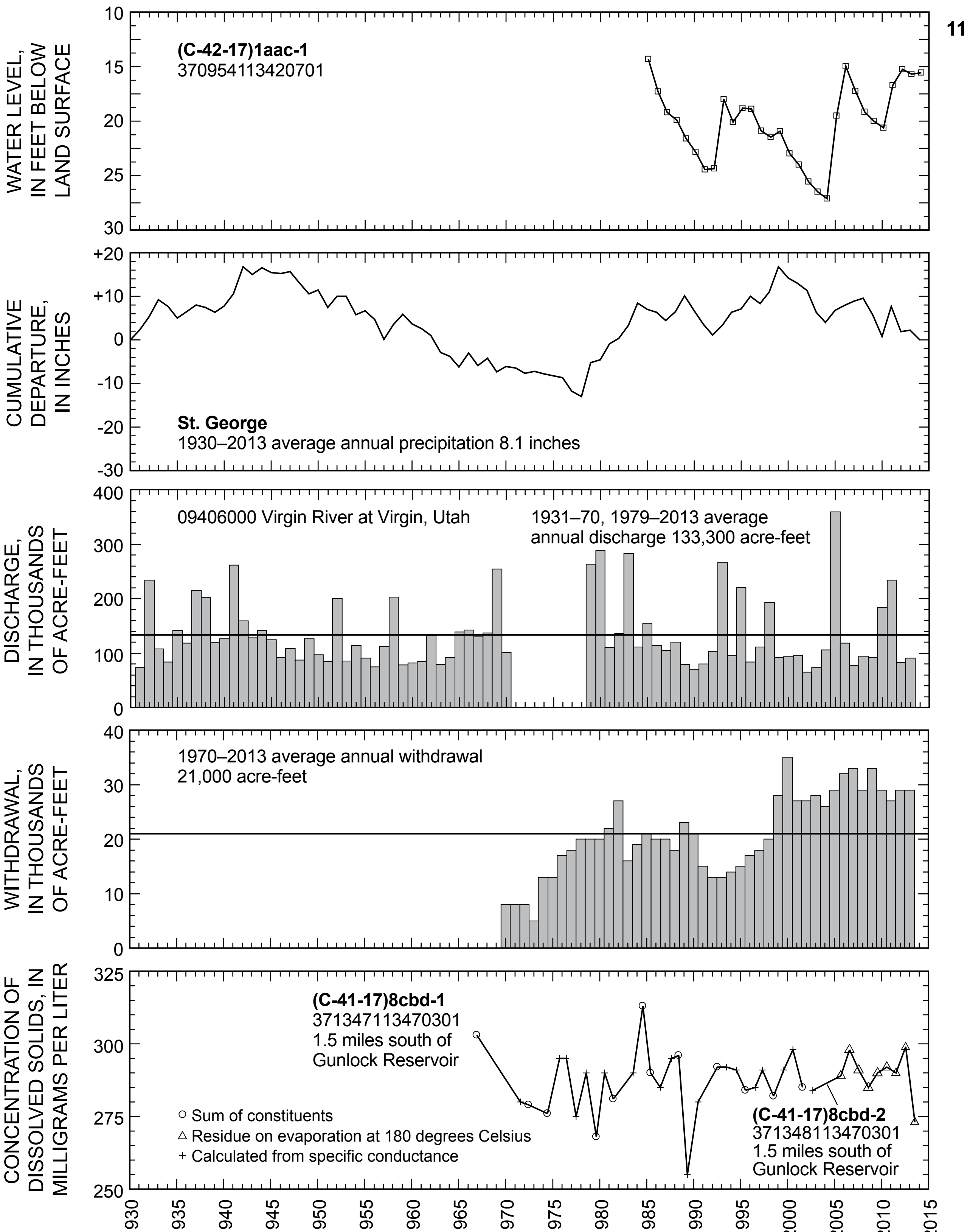


Figure 33. Relation of water level in selected wells in the central Virgin River area to annual discharge of the Virgin River at Virgin, Utah, to cumulative departure from average annual precipitation at St. George, to annual withdrawal from wells, and to concentration of dissolved solids in water from 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 (table 4) in 2013 was about 145,000 acre-feet, which is 11,000 acre-feet less than that for 2012 and 11,000 acre-feet more than the average annual withdrawal for 2003–2012 (tables 2 and 3). The largest decreases were due to decreased withdrawals for irrigation use. In most of the areas listed in table 4, withdrawals in 2013 were less than in 2012, except in Remainder of State, where public-supply use increased slightly, and in Grouse Creek Valley and Rush Valley, where irrigation withdrawals increased slightly.

The location of wells in Cedar Valley, Utah County, in which the water level was measured during March 2014, 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, then declined during the mid- to late 1980s and early 1990s. Water levels in these wells have been relatively stable since 1995. Water levels declined in most of the wells from March 2013 to March 2014.

The location of wells in Sanpete Valley in which the water level was measured during March 2014 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 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 declined in all of the selected observation wells from March 2013 to March 2014.

The location of wells in Snake Valley and the West Desert in which the water level was measured during March 2014 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 all of the selected wells in Snake Valley and the West Desert declined from March 2013 to March 2014. 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 declined or rose only slightly in most of the selected observation wells from March 2013 to March 2014.

Table 4. Estimated withdrawal of water from wells in other areas of Utah, 2013.

Number in figure 1	Area	Estimated withdrawal from wells (acre-feet)					
		2013					2012 total (rounded)
		Irrigation	Industrial	Public supply	Domestic and stock	Total (rounded)	
1	Grouse Creek Valley	2,100	0	0	20	2,100	1,300
2	Park Valley area	2,100	0	0	10	2,100	2,400
4	Lower Bear River area	3,900	440	7,600	200	12,100	12,400
8	Ogden Valley	0	0	11,400	20	11,400	11,900
13	Rush Valley	5,100	290	140	30	5,600	5,200
14	Skull Valley, Dugway area, and Old River Bed	2,900	4,600	720	10	8,200	13,500
15	Cedar Valley, Utah County	920	0	5,000	40	6,000	7,300
20	Sanpete Valley	6,400	2,600	1,400	4,000	14,400	15,500
25a	Snake Valley	20,200	0	90	50	20,300	22,900
27	Beaver Valley	7,500	20	410	480	8,400	11,200
	Remainder of State	12,600	17,500	21,900	2,600	54,600	52,700
Total (rounded)		63,700	25,500	48,700	7,500	145,000	156,000

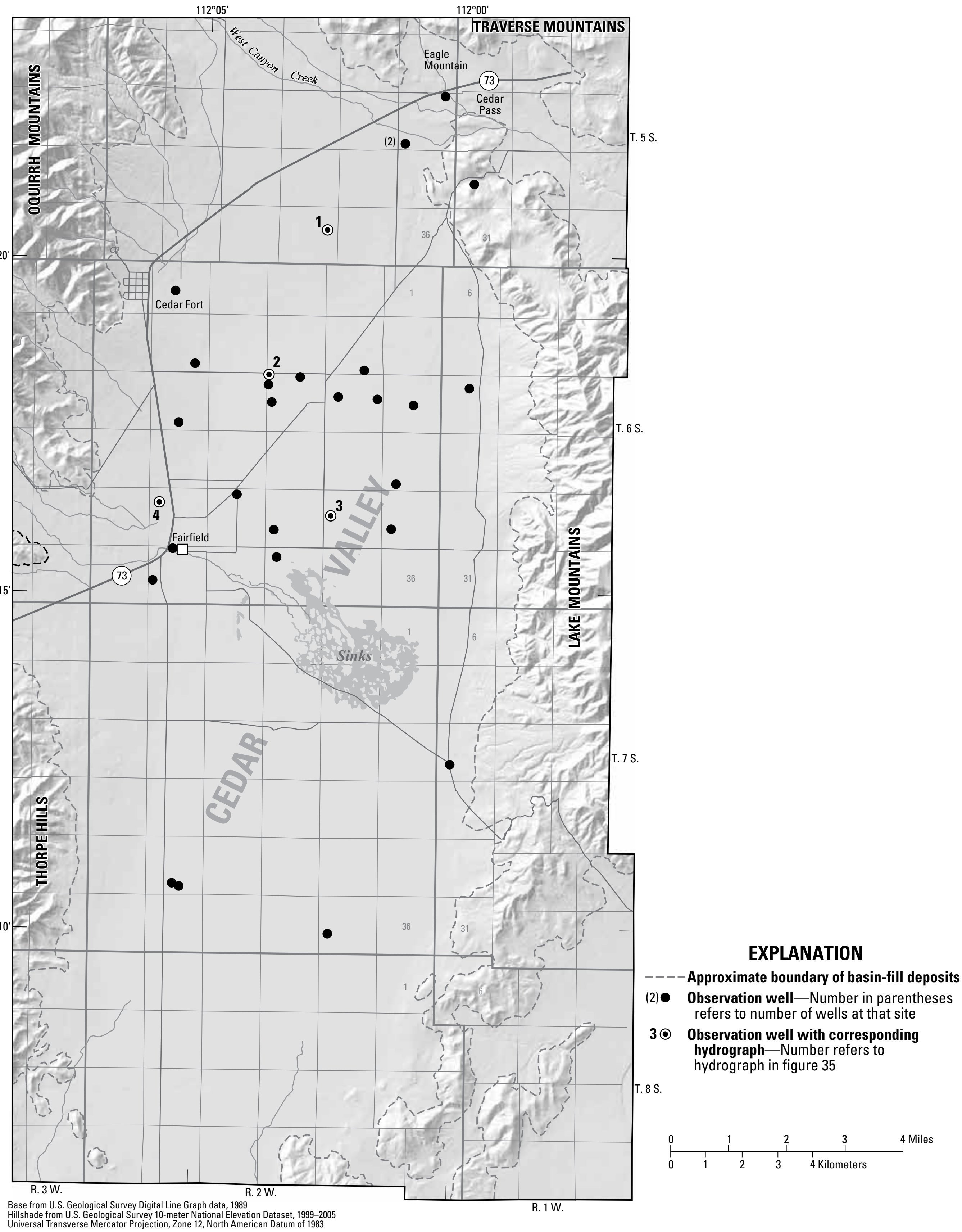


Figure 34. Location of wells in Cedar Valley, Utah County, in which the water level was measured during March 2014.

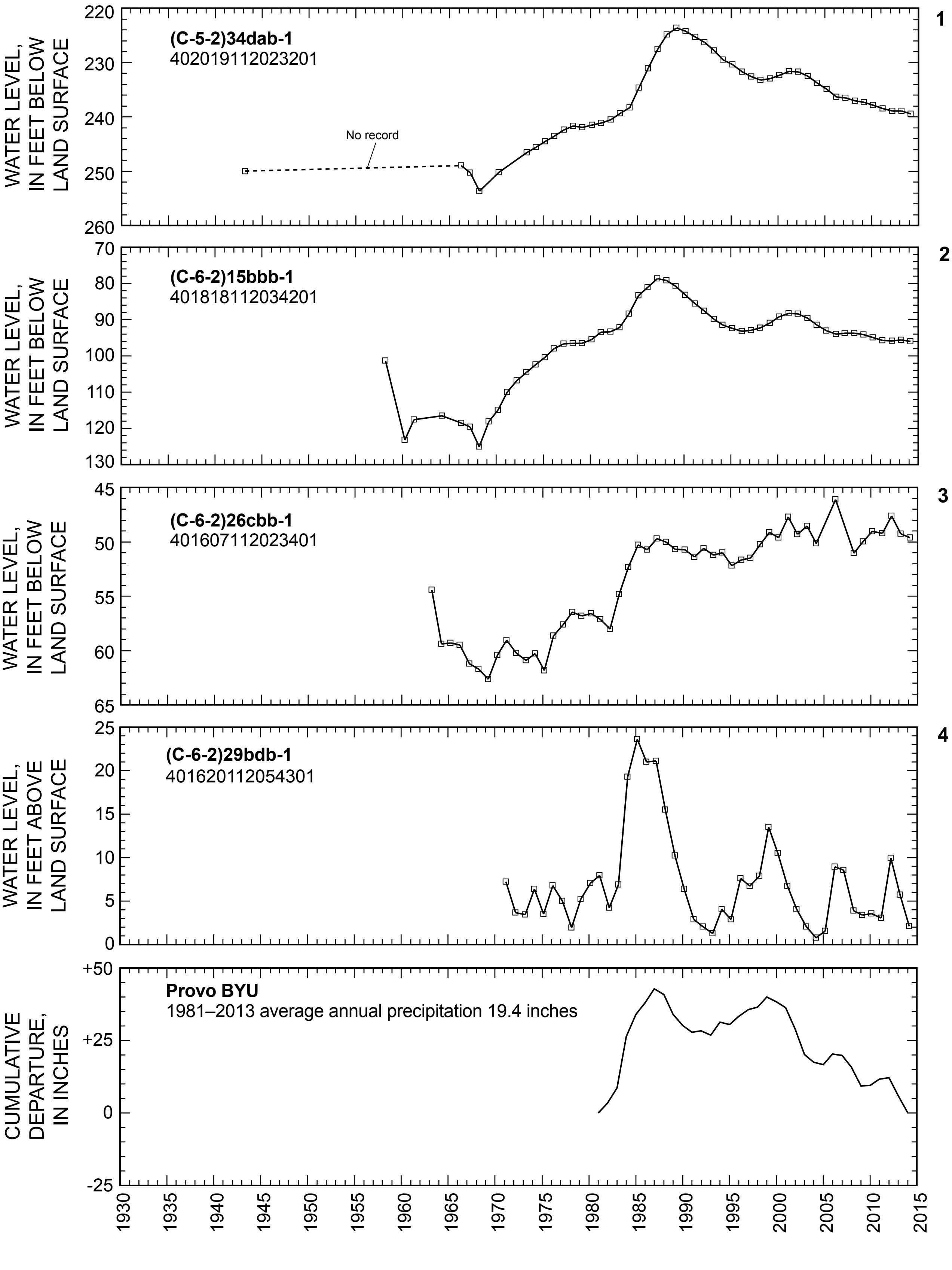


Figure 35. Relation of water level in selected wells in Cedar Valley, Utah County, to cumulative departure from average annual precipitation at Provo BYU.

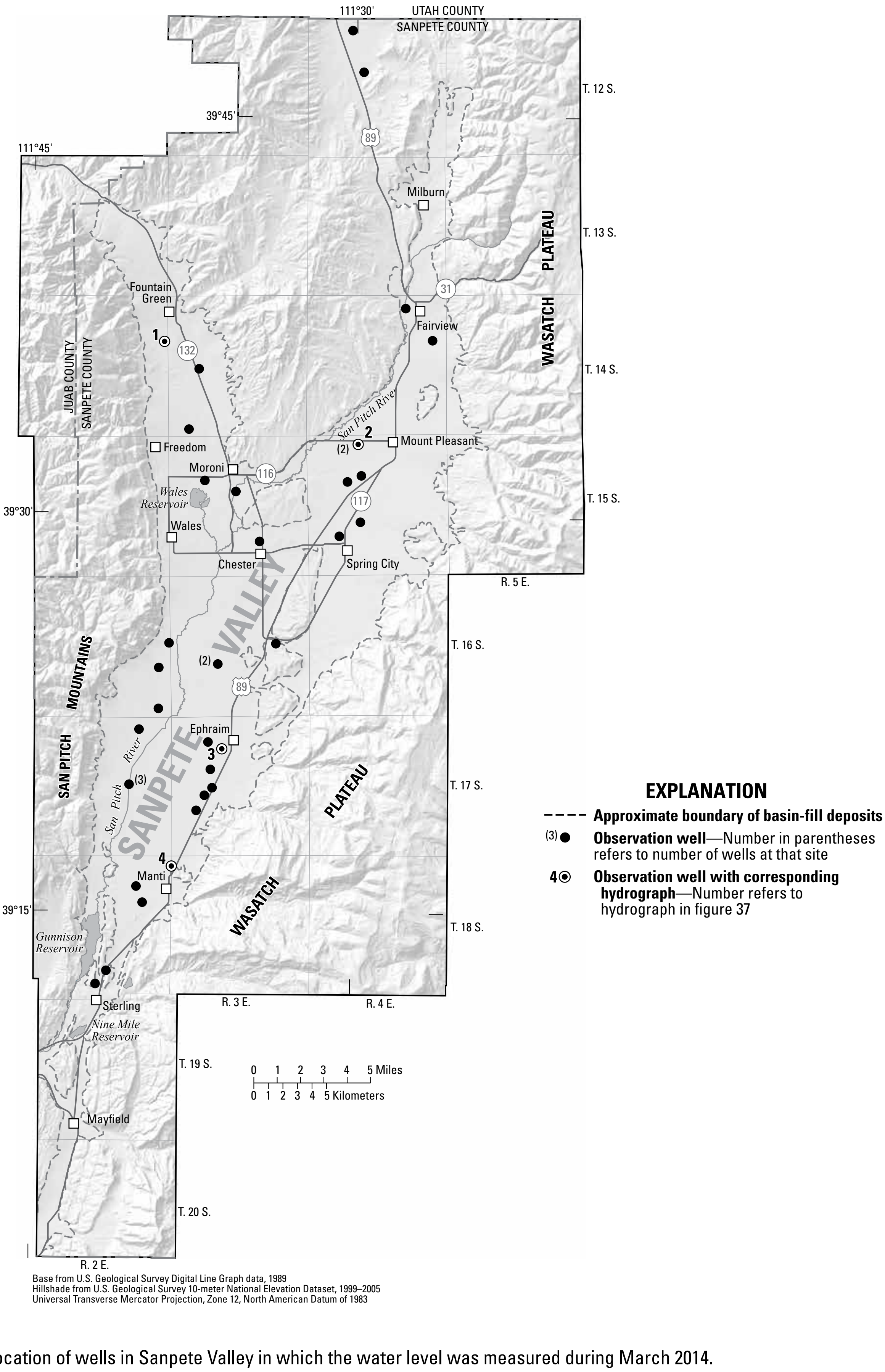


Figure 36. Location of wells in Sanpete Valley in which the water level was measured during March 2014.

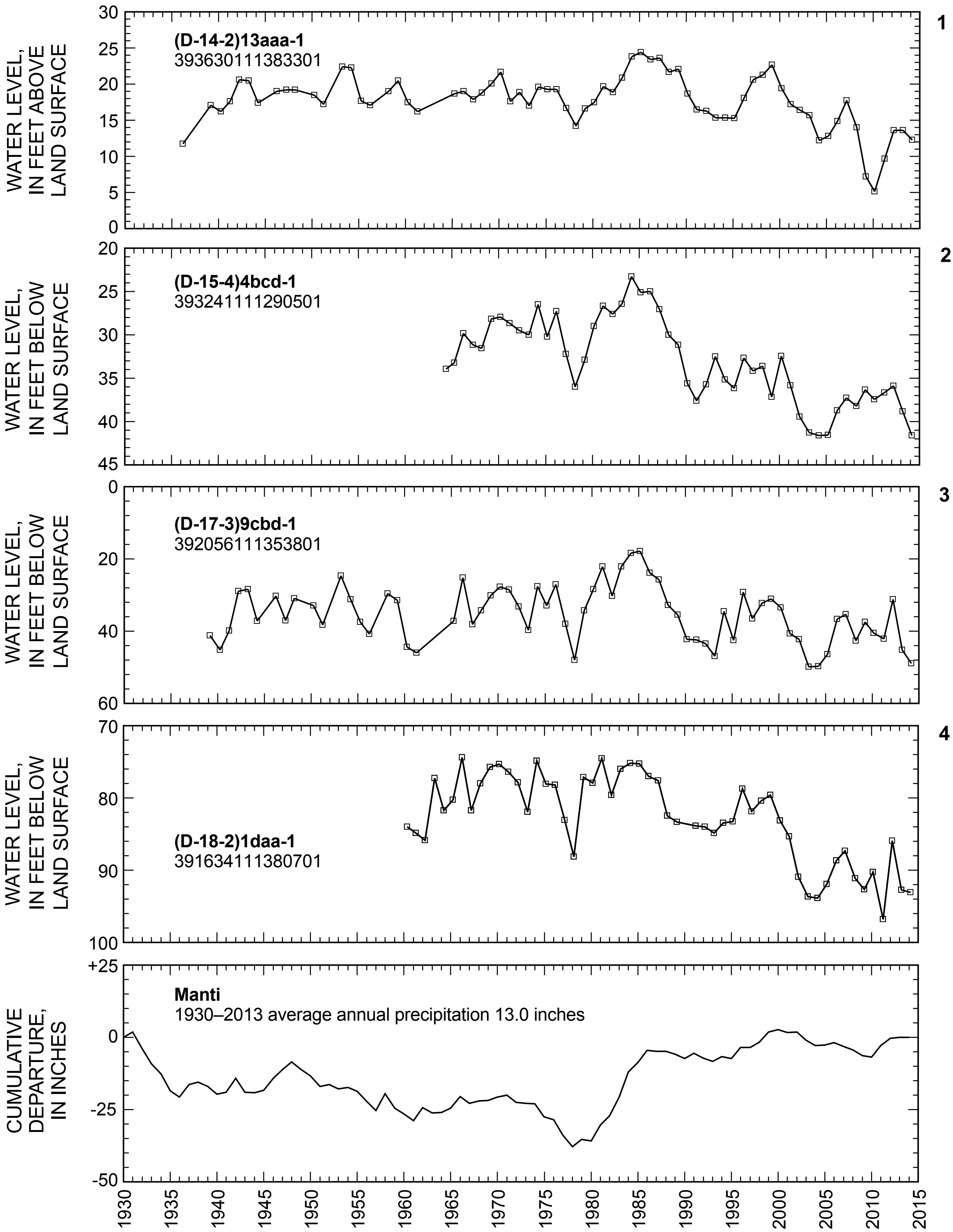


Figure 37. Relation of water level in selected wells in Sanpete Valley to cumulative departure from average annual precipitation at Manti.

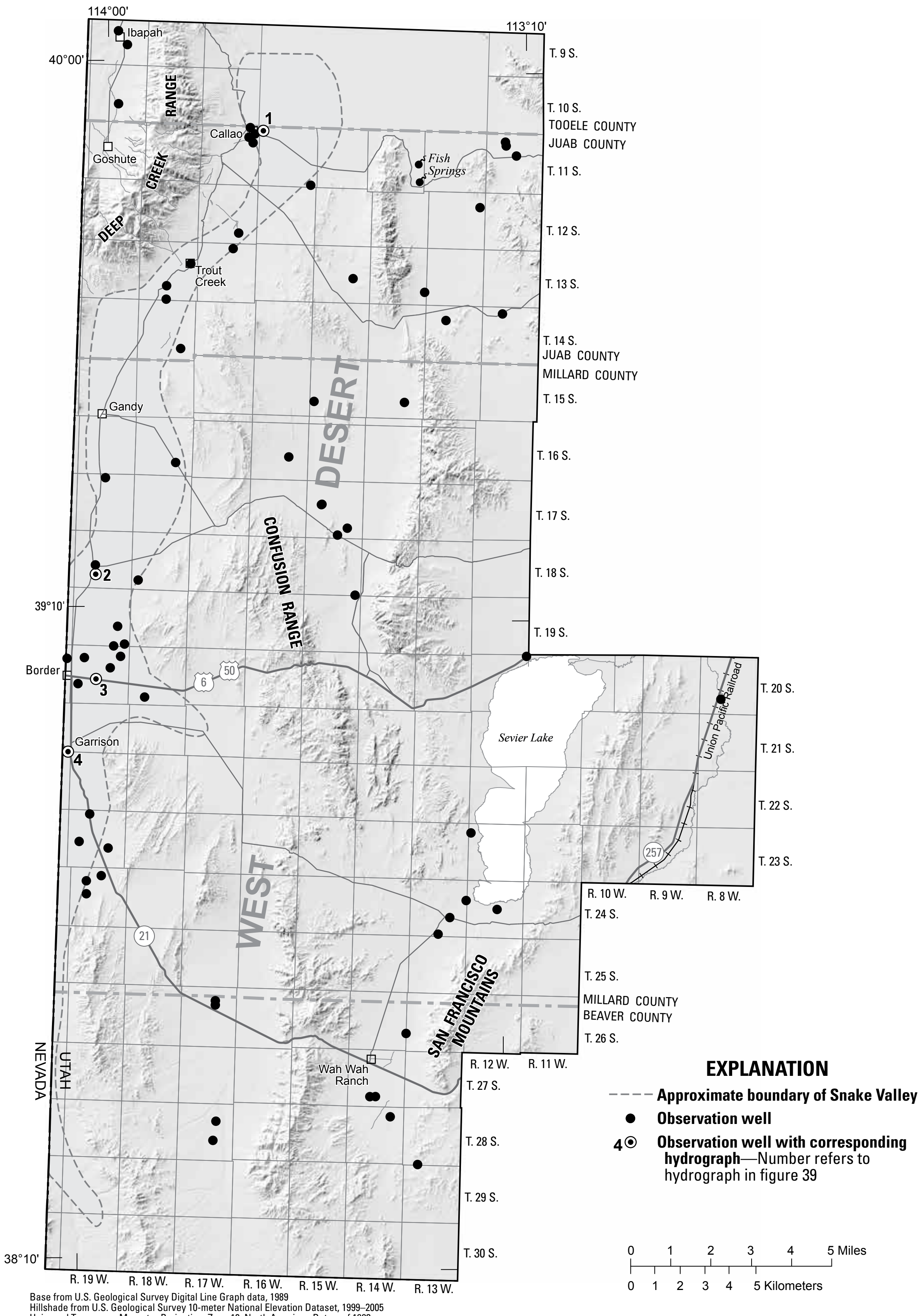


Figure 38. Location of wells in Snake Valley and the West Desert in which the water level was measured during March 2014.

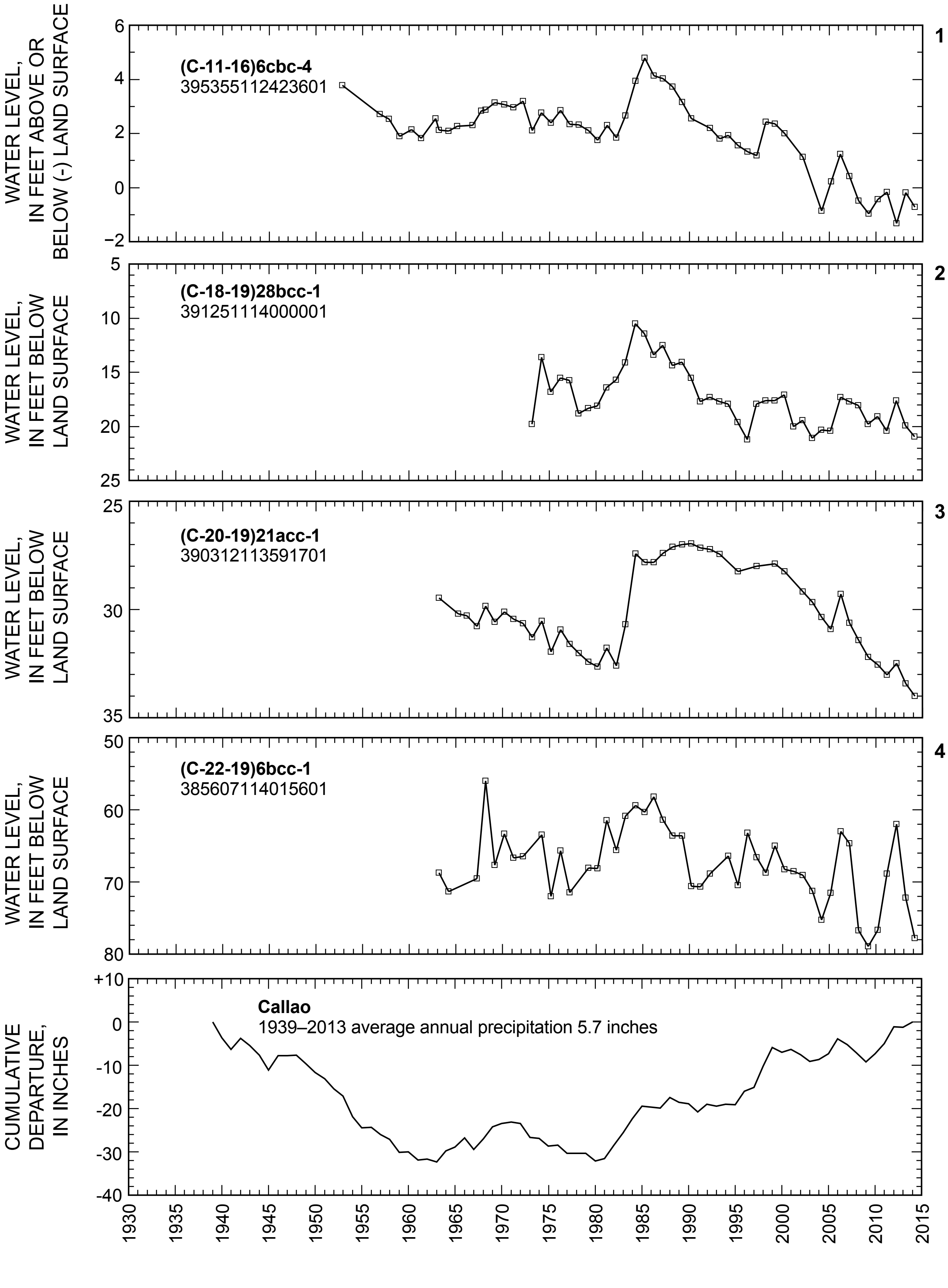


Figure 39. Relation of water level in selected wells in Snake Valley and the West Desert to cumulative departure from average annual precipitation at Callao.

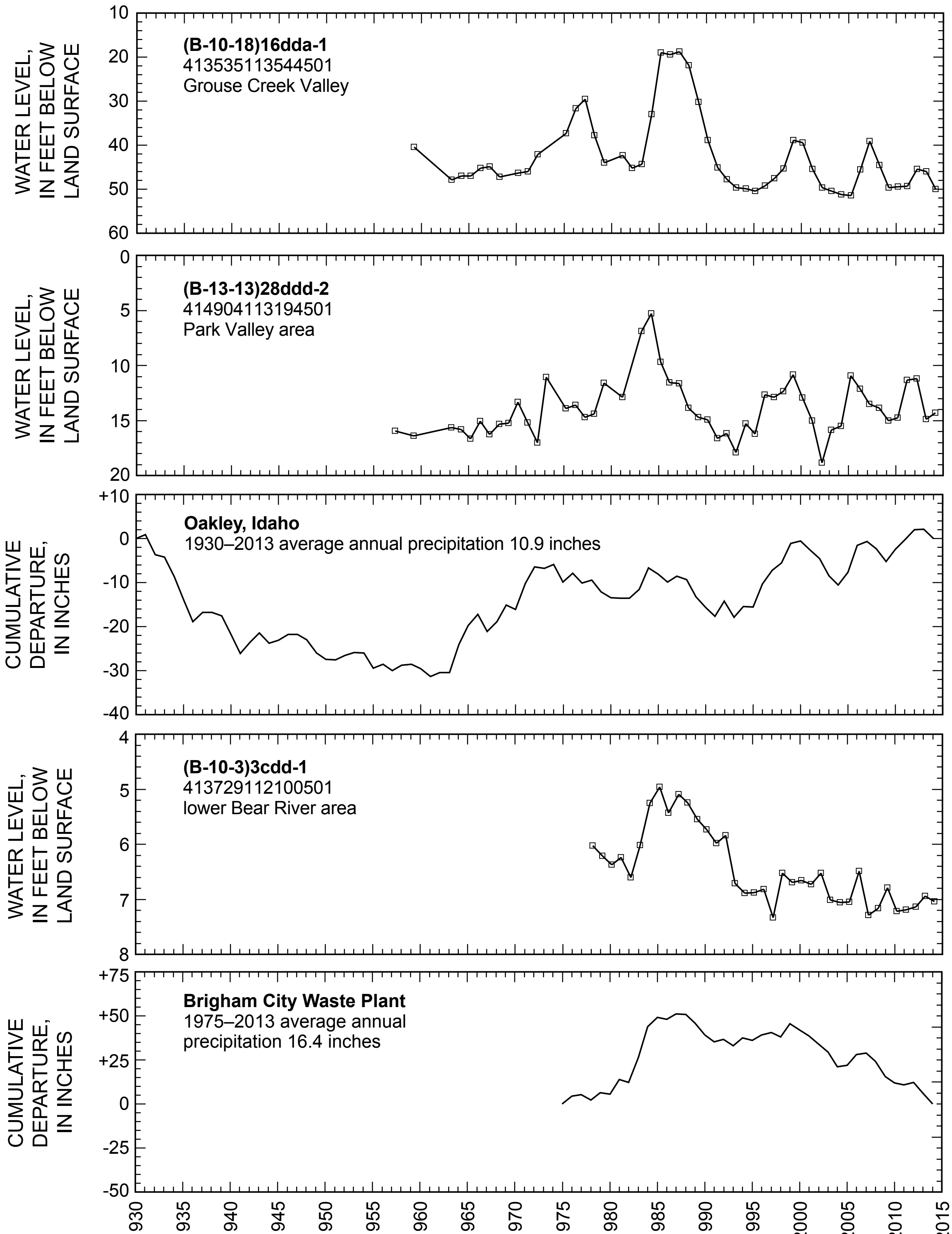


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.

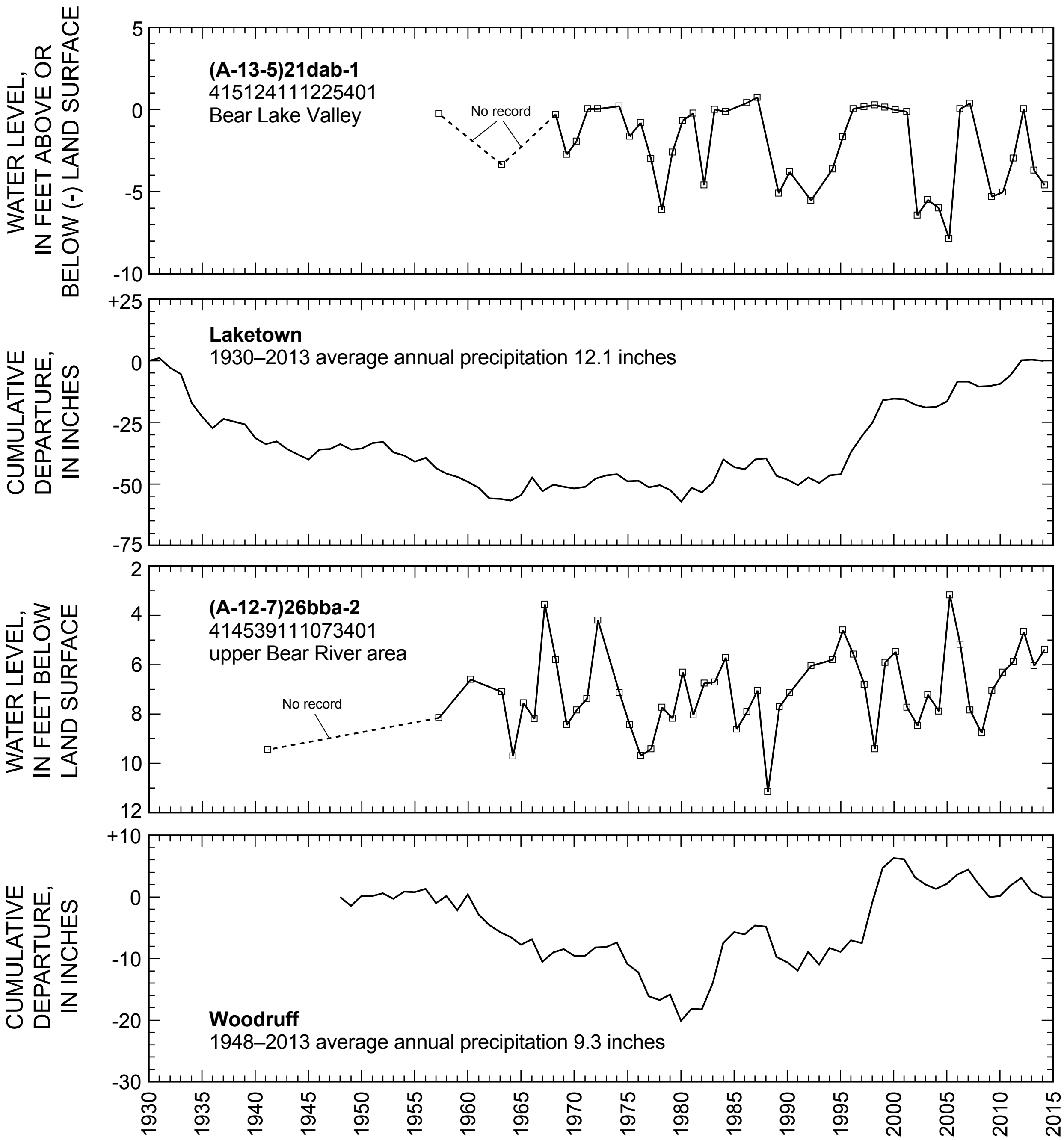


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

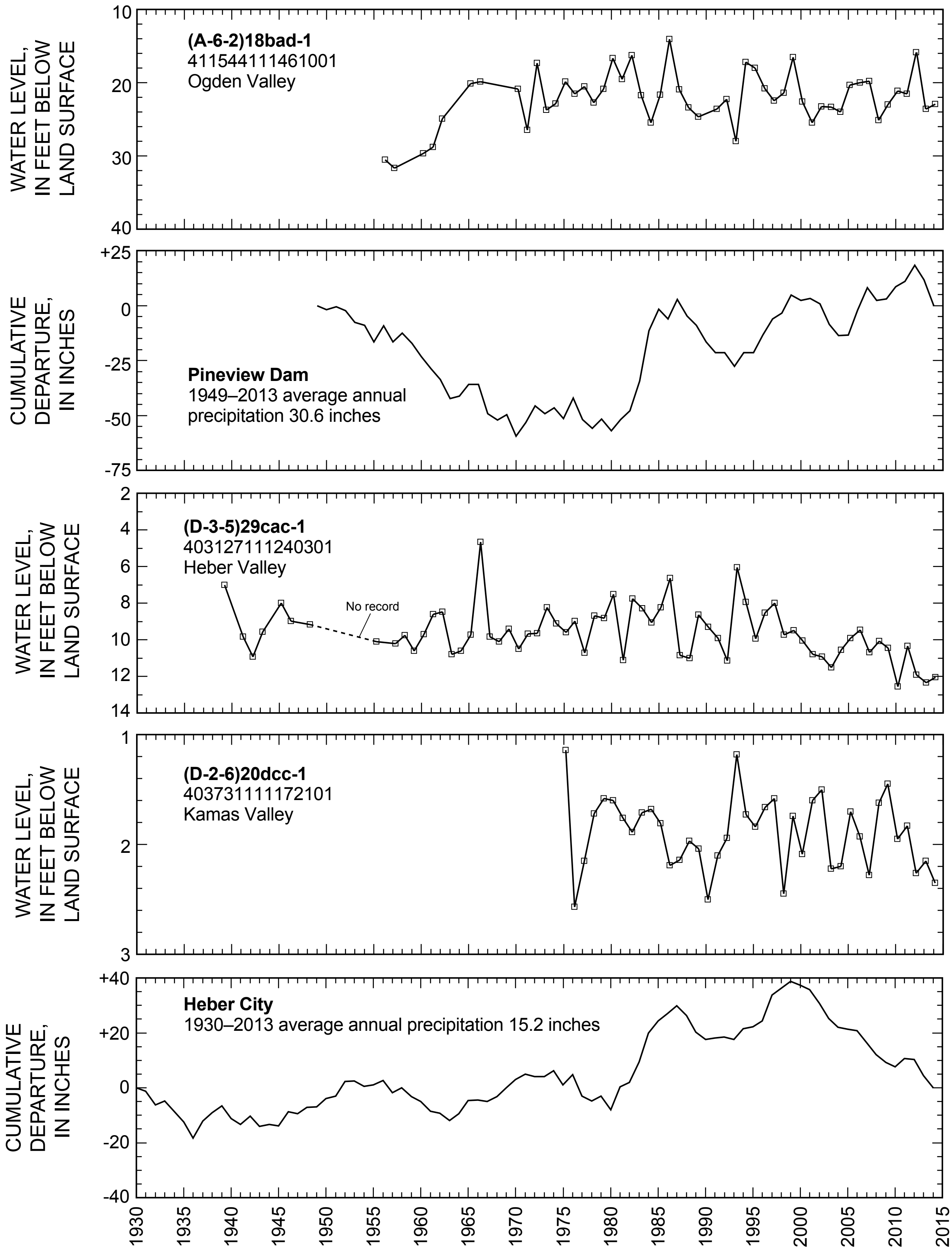


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

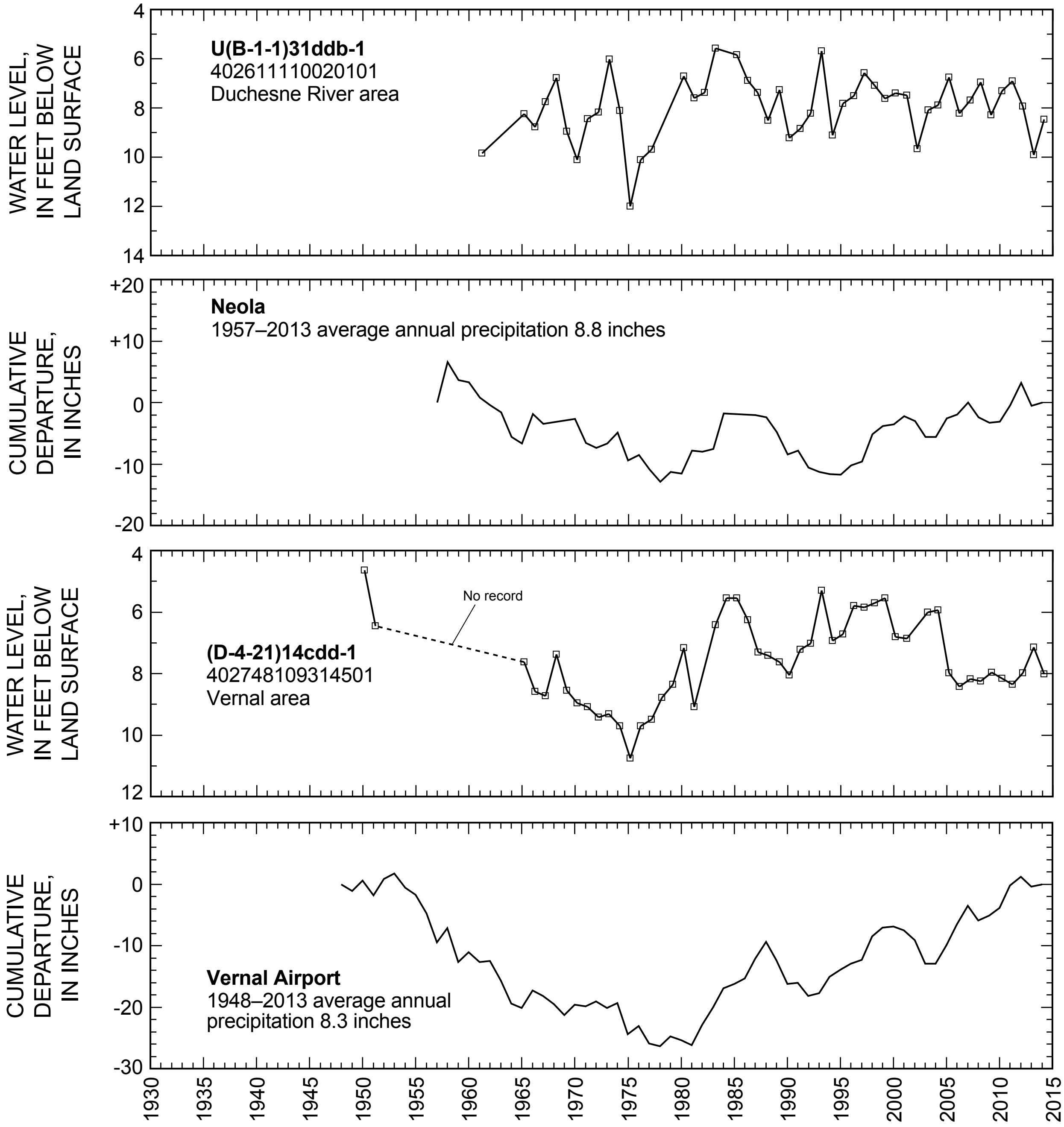


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

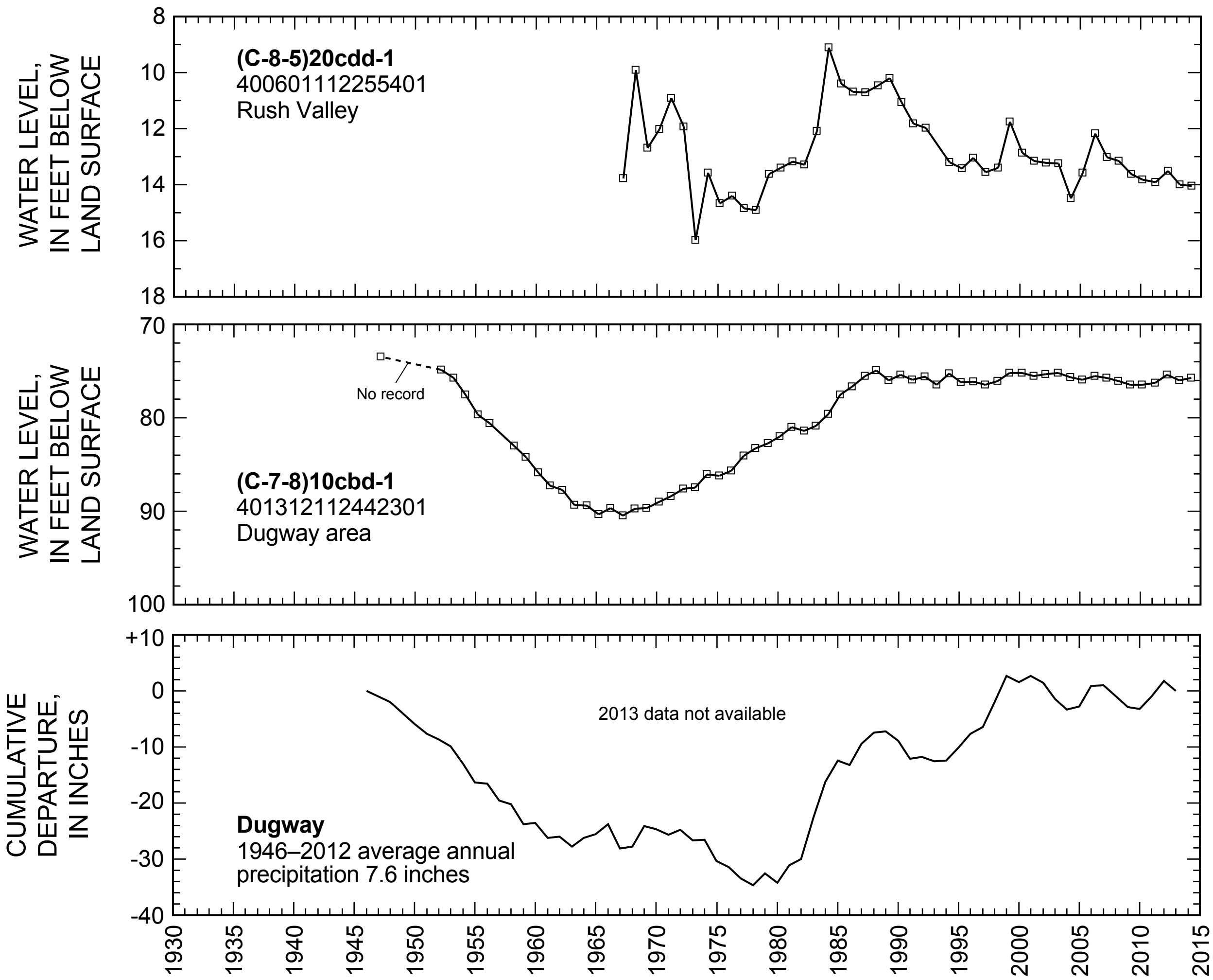


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

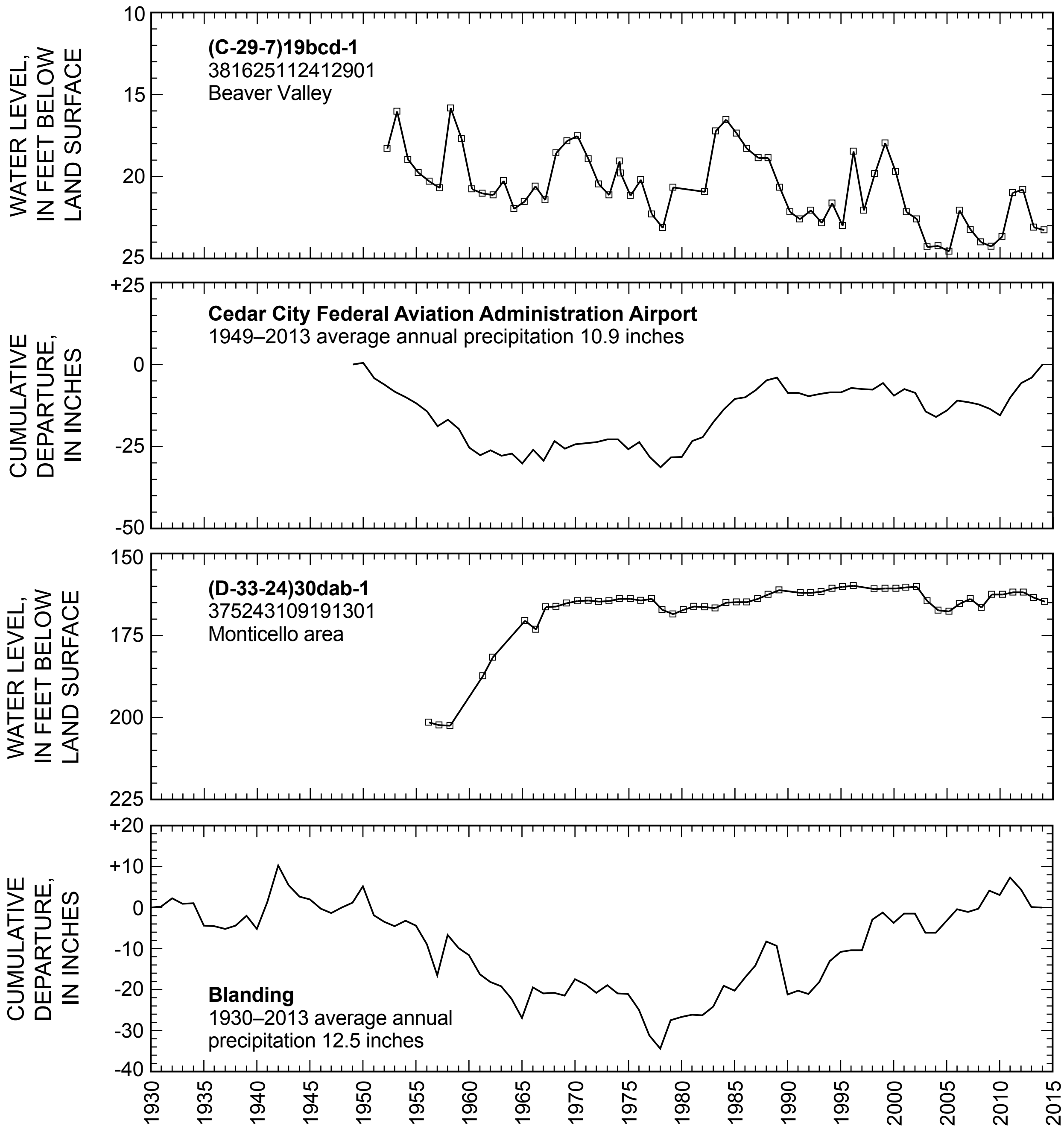


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

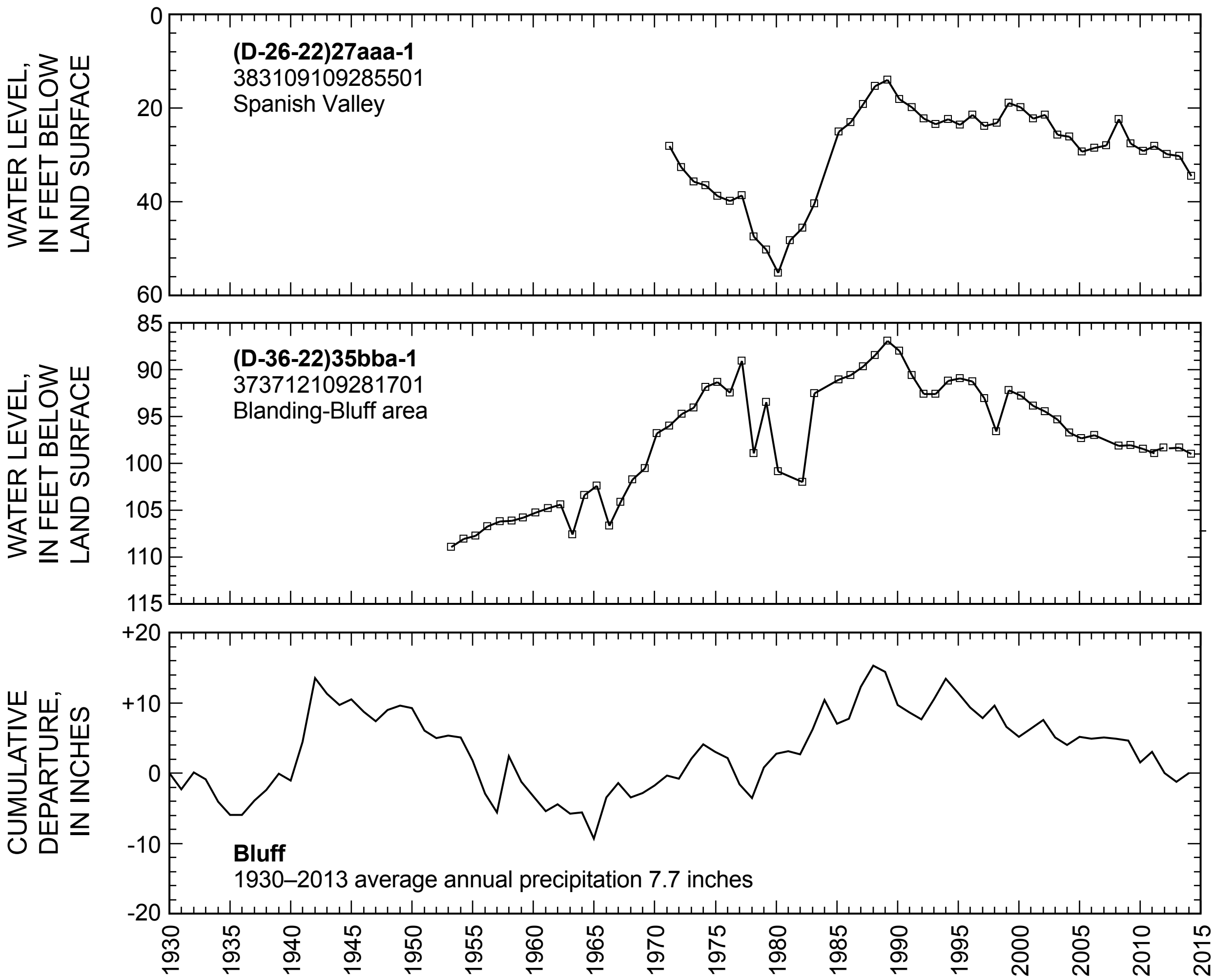


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

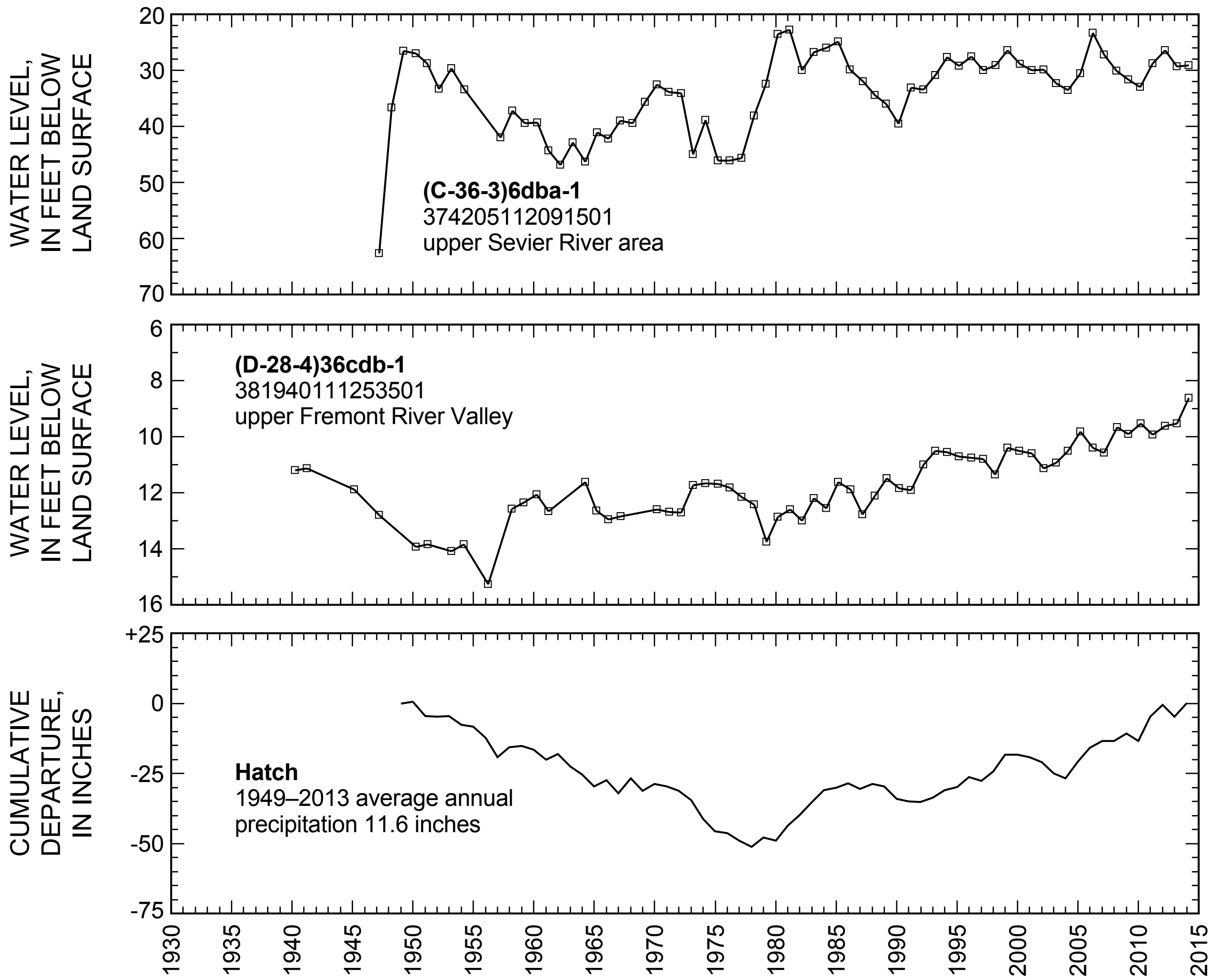


Figure 40. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.—Continued

Quality of Water from Selected Wells in Utah, Summer of 2013

From June through September 2013, 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 112 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 (nitrate plus nitrite 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 shown in table 5. Analytical results for trace elements are shown 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. Eleven field blank water samples were processed during the 2013 sampling period. Analytical results for all constituents in the field blanks were less than the laboratory reporting limits.

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 results of the environmental samples and within 2 percent for all constituents.

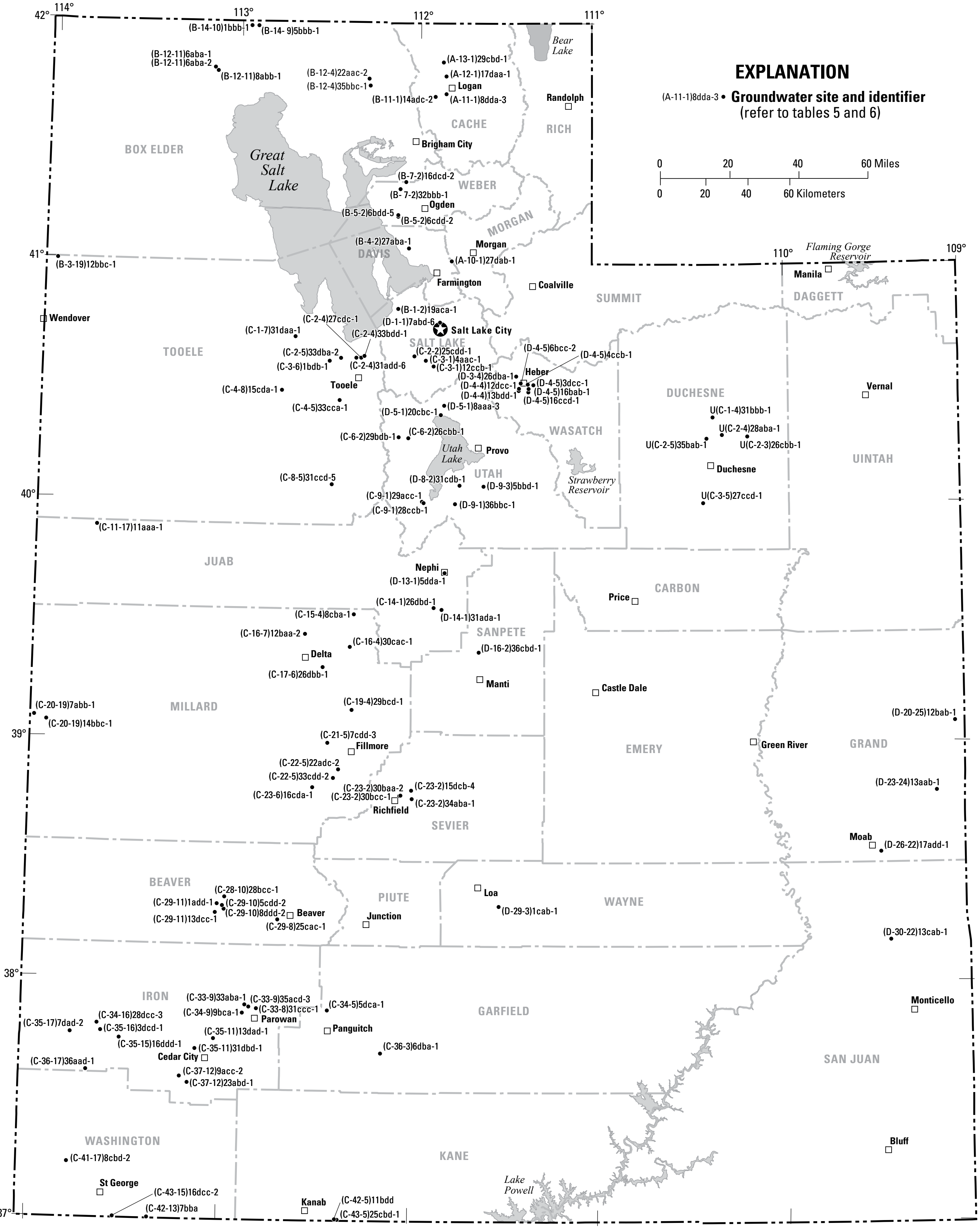


Figure 41. Location of groundwater sites sampled during the summer of 2013.

Table 5. Physical properties and concentration of major ions and nutrients in water samples collected from selected wells in Utah, summer of 2013.

[Date of sample: YYYYMMDD, year, month, day; µS/cm, microsiemens per centimeter; °C, degrees Celsius; mg/L, milligrams per liter; ANC, acid neutralization capacity; <, less than; E, estimated; L, laboratory value; —, no data]

Local identifier (refer to figure 41)	Station number	Date (YYYYMMDD)	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	20130708	8.0	299	17.9	98	30.8	5.2
Escalante Valley, Milford area								
(C-28-10)28bcc-1	382046112592001	20130715	7.7	1,100	16.4	441	90.8	52
(C-29-10)5cdd-2	381835113000001	20130715	7.2	750	14.5	323	94.9	21
(C-29-10)8ddd-2	381741112592702	20130715	7.2	993	15.1	403	106	33.5
(C-29-11)1add-1	381901113014101	20130715	7.3	783	16.1	313	90.4	21.3
(C-29-11)13dcc-1	381649113021301	20130715	7.3	1,220	16.5	519	158	30.6
Box Elder County								
Curlew Valley								
(B-12-11)6aba-1	414811113081701	20130717	7.5	1,120	16.1	291	80.8	21.7
(B-12-11)6aba-2	414808113080401	20130717	7.0	3,960	14.2	1,290	352	101
(B-12-11)8abb-1	414710113071601	20130717	6.8	4,250	13.1	1,480	422	104
(B-14-9)5bbb-1	415847112540401	20130717	7.3	1,380	17.3	512	149	34.1
(B-14-10)1bbb-1	415845112562201	20130717	7.5	564	15.9	212	58.8	15.9
Lower Bear River area								
(B-12-4)22aac-2	414551112170501	20130910	7.2	1,510	17.3	418	94.9	44
(B-12-4)35bbc-1	414406112163601	20130910	7.2	1,620	16.7	399	91.8	41.2
Cache County								
Cache Valley								
(A-10-1)27dab-1	413428111485701	20130823	7.2	514	12.1	257	65.1	23
(A-11-1)8dda-3	414216111511001	20130822	7.3	507	11.6	266	66.6	24.1
(A-12-1)17daa-1	414642111511401	20130822	7.1	517	20.0	230	56.4	21.7
(A-13-1)29cbd-1	415011111521401	20130822	7.6	438	13.2	182	39.4	20.3
(B-11-1)14adc-2	414134111544701	20130823	7.2	552	12.9	286	70.5	26.7
Davis County								
East Shore area								
(B-4-2)27aba-1	410340112030001	20130611	8.0	607	13.3	45	11.5	4.0
Duchesne County								
Duchesne River area								
U(C-1-4)31bbb-1	402130110231301	20130805	L 7.9	854	11.5	454	91.7	54.6
U(C-2-3)26cbb-1	401641110115801	20130806	L 9.0	869	12.4	6.5	1.6	0.64
U(C-2-4)28aba-1	401706110201501	20130807	L 7.7	828	12.4	469	106	50
U(C-2-5)35bab-1	401611110251502	20130807	L 9.5	586	13.2	5.0	0.89	0.68
U(C-3-5)27ccd-1	401104110263001	20130806	L 8.4	789	11.2	220	43.1	27.4
Garfield County								
Central Sevier Valley								
(C-34-5)5dca-1	375241112261201	20130722	7.0	352	15.0	151	42.3	10.9
(C-36-3)6dba-1	374205112091501	20130722	7.2	536	19.3	290	53.6	38
Grand County								
Upper Colorado River area								
(D-20-25)12bab-1	390513109060601	20130822	8.4	550	—	205	24.4	35.1
(D-23-24)13aab-1	384750109122701	20130819	9.0	677	21.2	6.5	1.9	0.45
Spanish Valley								
(D-26-22)17add-1	383238109302501	20130815	7.3	1,680	15.0	745	194	63.5

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										
8.1	19.6	102	0.03	6.2	0.79	68.7	41	238	<0.04	0.023
Escalante Valley, Milford area										
4.4	48.7	119	0.45	146	0.50	38	225	699	3.61	0.017
4.5	25	241	0.16	52.4	0.25	30.4	67.9	453	2.44	0.084
4.3	44.5	227	0.31	99.9	0.28	26.4	125	561	5.16	0.018
4.8	25.8	152	0.24	108	0.38	33.3	70.9	492	3.75	0.025
6.2	33.6	137	0.60	207	0.34	32.1	113	797	12.5	0.031
Box Elder County										
Curlew Valley										
2.8	39.8	128	0.13	121	0.15	16.3	28.3	470	0.49	0.01
7.3	251	173	0.48	658	0.09	22.1	291	1,770	3.77	0.013
10.3	218	110	0.81	1,180	0.06	21.2	64.8	2,980	2.57	0.01
13.5	51.2	114	0.28	357	0.17	54	24.3	1,010	1.98	0.026
8.2	17.4	142	0.05	55.2	0.19	58.2	18.4	339	0.80	0.026
Lower Bear River area										
4.5	131	192	0.29	332	0.20	20.6	69.7	847	2.62	0.014
3.8	162	202	0.38	372	0.23	20.3	55.6	884	2.45	0.015
Cache County										
Cache Valley										
5.4	110	170	0.21	235	0.20	18.8	51	615	0.53	0.014
11.1	246	217	0.92	1,140	0.20	23.4	53.4	2,480	3.22	0.014
11.1	239	178	0.28	1,260	0.15	20.6	54.5	2,710	2.42	0.019
13.3	54.2	125	0.29	357	0.16	52.7	23.4	924	1.92	0.029
7.0	28.5	154	0.08	76.5	0.26	58.2	24.5	405	0.34	0.029
Davis County										
East Shore area										
4.7	117	264	E 0.05	43.3	0.36	26.6	0.2	372	<0.04	0.635
Duchesne County										
Duchesne River area										
0.83	26.7	418	0.14	25.7	1.05	34.4	29.2	362	3.28	0.045
0.8	210	375	0.01	5.0	2.45	6.8	89.7	542	<0.04	0.034
3.3	10.1	274	0.09	22.7	0.14	7.8	168	419	0.05	<0.004
0.38	139	296	0.01	1.1	0.26	8.5	17.3	341	<0.04	0.061
1.1	122	356	0.05	14.8	0.70	12.4	90.7	447	<0.04	0.023
Garfield County										
Central Sevier Valley										
1.2	18.1	174	0.05	4.06	0.19	32	3.6	209	1.46	0.08
0.8	3.6	281	0.04	4.91	0.13	7.6	9.2	275	0.22	<0.004
Grand County										
Upper Colorado River area										
4.3	35.3	258	0.08	5	0.31	6.3	29.1	277	0.13	<0.004
1.6	141	254	0.10	21.0	0.46	7.8	62.2	398	<0.04	<0.004
Spanish Valley										
3.5	111	130	0.32	52.3	0.26	14.7	700	1,220	4.39	<0.004

Table 5. Physical properties and concentration of major ions and nutrients in water samples collected from selected wells in Utah, summer of 2013.—Continued

[Date of sample: YYYYMMDD, year, month, day; µS/cm, microsiemens per centimeter; °C, degrees Celsius; mg/L, milligrams per liter; ANC, acid neutralization capacity; <, less than; E, estimated; L, laboratory value; —, no data]

Local identifier (refer to figure 41)	Station number	Date (YYYYMMDD)	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)13dad-1	374515113015501	20130709	7.4	782	13.5	328	67.7	38.5
(C-35-11)31dbd-1	374248113075201	20130709	7.5	1,110	—	642	127	78.7
(C-37-12)9acc-2	373542113122402	20130709	7.8	364	17.4	127	40.6	6.2
(C-37-12)23abd-1	373409113095501	20130815	7.6	676	—	271	62.3	28.1
Escalante Valley, Beryl-Enterprise area								
(C-34-16)28dcc-3	374934113384601	20130805	7.6	1,360	13.1	412	124	25.1
(C-35-15)16ddd-1	374503113313701	20130722	7.6	679	15.6	228	61.6	18
(C-35-16)3dcd-1	374648113373101	20130722	7.2	430	12.6	188	57.4	10.8
(C-35-17)7dad-2	374617113470601	20130722	7.8	479	15.9	172	54.6	8.8
(C-36-17)36aad-1	373656113415201	20130722	7.5	449	13.8	184	56.7	10.2
Parowan Valley								
(C-33-8)31ccc-1	375257112483501	20130708	7.6	495	14.9	208	42.5	24.7
(C-33-9)33aba-1	375344112521601	20130709	7.9	316	15.5	134	25.4	17.1
(C-33-9)35acd-3	375320112510003	20130708	7.4	454	14.5	221	46.4	25.6
(C-34-9)9bca-1	375147112530001	20130708	7.5	533	11.8	277	57.1	32.5
Juab County								
Juab Valley								
(C-14-1)26dbd-1	393342111534501	20130711	7.3	1,110	13.5	520	112	58.3
(D-13-1)5dda-1	394226111501601	20130711	7.2	1,600	11.9	560	155	42.1
(D-14-1)31ada-1	393315111511601	20130711	7.2	1,270	12.7	651	174	52.7
Snake Valley								
(C-11-17)11aaa-1	395319113431201	20130709	7.3	1,080	15.1	372	110	23.5
Kane County								
Kanab area								
(C-42-5)11bdd	371027112230201	20130716	7.6	471	17.5	238	70	15.3
(C-43-5)25cbd-1	370220112221201	20130716	7.3	1,620	15.8	724	116	105
Millard County								
Pahvant Valley								
(C-19-4)29bcd-1	390758112194601	20130715	7.1	898	14.0	427	94.7	46.3
(C-21-5)7cdd-3	385939112272303	20130731	7.0	1,490	11.7	535	117	58.8
(C-22-5)22adc-2	385303112234801	20130715	7.3	1,200	15.4	345	90.6	28.9
(C-22-5)33cdd-2	385053112252401	20130731	7.2	911	13.9	325	89.5	24.7
(C-23-6)16cda-1	384829112315901	20130731	7.2	5,480	16.2	1,310	363	97.3
Sevier Desert								
(C-15-4)8cba-1	393154112192901	20130710	7.1	3,380	13.4	952	213	102
(C-16-4)30cac-1	392344112203801	20130710	7.4	837	13.1	315	79.7	28.3
(C-16-7)12baa-2	392649112350802	20130710	8.1	493	15.1	123	21.4	16.8
(C-17-6)26dbb-1	391834112292001	20130710	8.0	556	20.7	139	26.1	18
Snake Valley								
(C-20-19)7abb-1	390430114013001	20130709	7.9	334	15.8	153	35.6	15.6
(C-20-19)14bbc-1	390416113573801	20130709	7.9	379	13.8	164	37.8	16.9

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										
5.3	48.8	292	0.08	19.3	0.16	40.6	109	452	3.04	0.03
2.5	11.2	134	0.09	13.7	0.24	20.3	474	879	2.55	0.01
6.1	16.7	130	0.12	26.8	0.28	63.7	9.3	260	0.98	0.027
1.4	30.7	178	0.20	36.3	0.10	19	119	433	2.78	0.017
Escalante Valley, Beryl-Enterprise area										
9.2	39.6	83.4	0.71	178	0.86	63.3	85.7	687	1.5	0.026
3.6	57	152	0.17	51.2	0.49	48.7	122	471	0.42	0.03
4.2	13.7	141	0.15	43	0.21	48.6	12.3	289	1.41	0.038
7.6	30.6	146	0.09	21.6	0.62	63.8	69.6	344	0.99	0.024
6.4	23.1	181	0.12	25	0.27	52.5	15.2	298	2.01	0.069
Parowan Valley										
2.7	20.9	202	0.09	24.1	0.18	28.1	21.8	279	1.71	0.028
3.1	14	132	0.03	10.2	0.26	30.4	20.6	203	0.40	0.027
2.5	13.9	188	0.04	19.9	0.16	26	22.2	280	2.01	0.02
2.8	10.2	233	0.05	13	0.12	27	37.6	315	2.24	0.021
Juab County										
Juab Valley										
3.1	54.1	253	0.06	58	0.20	18.5	313	679	2.05	0.018
3.7	156	264	0.12	271	0.12	22.9	139	964	6.28	0.027
1.9	37.6	242	0.11	55.1	0.19	13.5	446	878	1.86	0.007
Snake Valley										
2.5	57.8	143	0.24	242	0.22	19.1	29.3	741	2.78	0.026
Kane County										
Kanab area										
2.5	14.7	154	0.09	7.3	0.22	13.5	76.2	290	2.97	0.017
8.5	114	378	0.76	76.7	0.41	15	396	1,110	10.3	0.014
Millard County										
Pahvant Valley										
1.6	36	237	0.26	125	0.08	18.2	28.6	500	10.7	0.013
4.8	119	310	0.24	169	0.13	23.7	240	895	5.54	0.021
18	114	252	0.26	196	0.42	12.8	75	678	1.04	0.01
5.0	64.4	230	0.21	117	0.25	16.8	64.5	519	3.48	0.037
77.1	589	354	1.63	1,140	1.32	40.1	643	3,600	2.3	0.043
Sevier Desert										
7.8	353	442	0.65	594	0.15	27.3	543	2,050	0.3	0.026
1.2	47.6	247	0.16	84.8	0.07	12.8	51.4	358	4.91	0.014
3.2	49.4	115	0.07	56.1	0.36	23.7	48.7	286	0.09	0.016
15.8	67.9	228	0.05	34.3	1.85	57.8	39.4	371	0.27	0.024
Snake Valley										
1.2	14.2	132	0.05	23.1	0.09	15.5	12.3	217	0.45	0.01
1.3	17.2	157	0.08	26.6	0.33	19.5	11.5	241	0.08	0.011

Table 5. Physical properties and concentration of major ions and nutrients in water samples collected from selected wells in Utah, summer of 2013.—Continued

[Date of sample: YYYYMMDD, year, month, day; µS/cm, microsiemens per centimeter; °C, degrees Celsius; mg/L, milligrams per liter; ANC, acid neutralization capacity; <, less than; E, estimated; L, laboratory value; —, no data]

Local identifier (refer to figure 41)	Station number	Date (YYYYMMDD)	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	20130619	8.5	2,320	16.9	44.5	7.5	6.3
(C-2-2)25cdd-1	403637112005201	20130621	7.1	4,150	13.8	1,420	323	149
(C-3-1)4aac-1	403533111570701	20130621	7.2	1,450	15.2	542	135	49.5
(C-3-1)12ccb-1	403408111543201	20130619	7.5	934	19.3	266	57.5	29.8
(D-1-1)7abd-6	404506111523301	20130619	7.1	1,380	14.5	627	154	59.1
San Juan County								
Upper Colorado River area								
(D-30-22)13cab-1	381034109274501	20130816	8.0	399	13.8	207	23.6	36.1
Sanpete County								
Sanpete Valley								
(D-16-2)36cbd-1	392238111390501	20130821	7.5	814	—	304	47.1	45.2
Sevier County								
Central Sevier Valley								
(C-23-2)15dcb-4	384757112002201	20130723	7.2	671	12.3	318	65.1	37.7
(C-23-2)30baa-2	384641112034601	20130723	6.9	898	14.3	450	90.5	54.4
(C-23-2)30bcc-1	384635112040801	20130723	7.0	735	19.0	364	74.4	43.2
(C-23-2)34aba-1	384550112000901	20130723	6.9	1,510	13.1	655	184	47.5
Tooele County								
Rush Valley								
(C-4-5)33cca-1	402526112252001	20130801	7.4	953	12.7	336	93.6	24.7
(C-8-5)31ccd-5	400418112271701	20130801	7.4	1,220	12.1	432	130	26.4
Skull Valley								
(C-1-7)31daa-1	404113112395801	20130625	7.2	8,150	17.5	506	96.1	64.7
(C-4-8)15cda-1	402757112440401	20130625	7.5	1,250	16.1	380	114	22.8
Tooele Valley								
(C-2-4)27cdc-1	403634112171501	20130624	7.1	1,260	13.1	468	112	45.6
(C-2-4)31add-6	403606112195401	20130624	6.9	1,880	16.2	553	141	48.6
(C-2-4)33bdd-1	403629112174801	20130624	7.2	1,020	14.2	290	73.4	26
(C-2-5)33dba-2	403600112245501	20130625	6.9	3,000	16.9	787	182	81
(C-3-6)1bdb-1	403514112283701	20130625	7.3	1,130	14.7	436	127	28.7
Wendover area								
(B-3-19)12bbc-1	405941113584801	20130718	8.4	253	16.0	78	18	8
Utah County								
Cedar Valley								
(C-6-2)26cbb-1	401607112023401	20130725	7.6	744	11.6	337	56.2	47.7
(C-6-2)29bdb-1	401620112054301	20130725	7.8	336	11.2	156	35.1	16.6
Goshen Valley								
(C-9-1)28ccb-1	395956111572101	20130702	7.3	2,430	17.8	789	207	66.2
(C-9-1)29acc-1	400015111575301	20130702	7.4	1,750	16.3	512	126	48.1
Northern Utah Valley								
(D-5-1)8aaa-3	402420111505701	20130701	7.8	395	13.9	166	38.7	16.7
(D-5-1)20cbc-1	402159111520101	20130701	7.9	358	11.4	173	40.9	17.2
Southern Utah Valley								
(D-8-2)31cdb-1	400422111454201	20130702	7.1	1,730	18.6	303	71.9	29.9
(D-9-1)36bbc-1	395942111470801	20130702	7.4	520	10.8	270	68.7	24
(D-9-3)5bbd-1	400407111375101	20130701	8.4	344	15.6	157	42	12.6

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										
2.6	417	386	0.07	350	2.45	17.4	86.6	1,290	<0.04	0.183
4.9	218	154	0.11	914	0.16	30.6	238	2,650	9.07	0.015
3.7	101	233	0.04	174	0.08	26.2	261	869	3.52	0.026
8.1	76.7	185	0.06	124	0.24	29.3	109	547	0.26	0.019
3	60.9	289	0.06	181	0.13	18	153	788	5.03	0.04
San Juan County										
Upper Colorado River area										
3.1	4.4	206	0.06	5.9	0.25	8.1	7.8	230	0.34	<0.004
Sanpete County										
Sanpete Valley										
1.2	48.9	272	0.14	70.8	0.28	18	50.6	463	0.67	0.013
Sevier County										
Central Sevier Valley										
3.1	19.6	270	0.08	27.4	0.39	33	46.3	397	1.1	0.043
1.9	31.8	454	0.09	15.3	0.14	14.9	31.5	495	3.56	0.024
1.5	23.1	365	0.06	14.5	0.17	13.4	23.2	359	2.09	0.017
3.6	82.7	434	0.17	154	0.15	43.5	168	842	5.1	0.081
Tooele County										
Rush Valley										
1.4	69.3	158	0.14	154	0.11	13.9	51.4	530	1.73	0.013
2	75.6	71.5	0.20	276	0.06	16.2	53.6	727	1.04	0.011
Skull Valley										
55.6	1,300	183	1.81	2,440	0.33	27	186	4,640	1.58	0.025
2.3	89.1	114	0.27	274	0.10	13.6	67.7	868	4.77	0.016
Tooele Valley										
2.1	91.8	232	0.20	137	0.06	16.5	221	758	3.67	0.028
3.2	160	185	0.40	404	0.12	16	122	1,100	5	0.016
2.1	102	169	0.16	130	0.12	12.3	104	577	1.84	0.024
9.5	268	204	0.67	700	0.25	25.2	159	1,800	2.71	0.017
2.1	46.9	155	0.22	238	0.06	20.7	27.9	762	3.19	0.024
Wendover area										
3.4	20.7	90.2	0.07	21.5	0.08	11.8	11.4	170	0.23	0.01
Utah County										
Cedar Valley										
3.4	23.4	212	0.12	110	0.31	55.3	28.8	433	0.18	0.033
1.0	15.6	164	0.03	12.4	0.17	9	7.9	191	<0.04	<0.004
Goshen Valley										
19.7	148	105	0.84	610	0.20	61.4	130	1,680	23.5	0.027
12.4	132	111	0.63	368	0.20	55.2	127	1,140	23.7	0.028
Northern Utah Valley										
2.0	14.8	127	0.05	40.2	0.23	19.2	17	251	0.77	0.016
1.1	9.4	137	0.01	8.9	0.21	11.9	38.1	220	1.94	0.01
Southern Utah Valley										
14.2	220	333	0.21	298	0.62	56.5	86.7	953	<0.04	0.057
1.5	7.5	226	0.03	24.4	0.21	16.2	19.8	298	2.37	0.012
1.6	13.4	144	0.02	13.2	0.14	1.7	25.8	205	<0.04	0.015

Table 5. Physical properties and concentration of major ions and nutrients in water samples collected from selected wells in Utah, summer of 2013.—Continued

[Date of sample: YYYYMMDD, year, month, day; µS/cm, microsiemens per centimeter; °C, degrees Celsius; mg/L, milligrams per liter; ANC, acid neutralization capacity; <, less than; E, estimated; L, laboratory value; —, no data]

Local identifier (refer to figure 41)	Station number	Date (YYYYMMDD)	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
Wasatch County								
Heber Valley								
(D-3-4)26dba-1	403146111272701	20130827	6.8	834	13.4	409	125	23.5
(D-4-4)12dcc-1	402842111263101	20130827	6.7	756	11.4	343	97.3	24.4
(D-4-4)13bdd-1	402810111263601	20130827	7.5	479	19.4	233	55.1	23.1
(D-4-5)3dcc-1	402937111214901	20130828	6.8	542	11.1	273	90.3	11.6
(D-4-5)4ccb-1	402946111233901	20130828	6.6	428	12.0	215	68.9	10.4
(D-4-5)6bcc-2	403003111255801	20130827	7.1	418	15.7	206	63.8	11.3
(D-4-5)16bab-1	402840111232201	20130827	7.0	665	12.3	333	91.9	25.2
(D-4-5)16ccd-1	402750111232701	20130828	7.4	438	12.0	226	55	21.5
Washington County								
Central Virgin River area								
(C-41-17)8cbd-2	371348113470301	20130718	7.2	483	17.9	233	69.8	14.2
(C-42-13)7bba	370915113213801	20130718	7.4	1,680	26.6	856	212	79.3
(C-43-15)16dcc-2	370218113322101	20130718	7.2	3,030	20.3	2,030	587	136
Wayne County								
Upper Fremont River Valley								
(D-29-3)1cab-1	381902111321101	20130723	8.1	213	13.5	79.7	21.2	6.5
Weber County								
East Shore area								
(B-5-2)6bdd-5	411153112064605	20130611	8.4	2,120	13.7	223	61.4	16.9
(B-5-2)6cdd-2	411130112064502	20130611	7.9	436	15.2	143	32.9	14.7
(B-7-2)16dcd-2	412011112041401	20130612	8.0	376	25.4	60	18.5	3.4
(B-7-2)32bbb-1	411824112060601	20130612	7.8	2,440	18.7	325	67.5	38

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
Wasatch County										
Heber Valley										
6.5	26.2	149	—	31.7	0.51	21	118	[1]442	—	0.028
1.5	26.8	241	—	63.2	0.07	23.6	40.1	[1]422	—	0.044
1.8	9.8	180	—	21.9	0.32	13.2	17.8	[1]251	—	0.012
3.4	8.2	197	—	40.6	0.09	39.5	7.7	[1]320	—	0.092
2.5	5.1	173	—	19.5	0.09	43.4	14.6	[1]269	—	0.092
1.6	6.0	169	—	12.9	0.07	25.3	26.2	[1]249	—	0.048
1.6	14.3	292	—	26.2	0.16	31.9	21.1	[1]388	—	0.039
1.2	7.3	206	—	10.8	0.15	13.4	28.3	[1]261	—	0.01
Washington County										
Central Virgin River area										
1.8	16.6	198	0.09	18.8	0.22	23.8	33.7	273	0.31	0.016
9.6	71	157	0.12	94.6	0.17	13.5	691	1,310	0.32	0.006
9.7	77.8	134	0.39	62.4	0.28	17.7	1,710	3,050	2.19	0.01
Wayne County										
Upper Fremont River Valley										
3.3	9.4	68	0.02	5.52	0.23	47.7	27.8	170	0.29	0.018
Weber County										
East Shore area										
9.0	293	76.9	0.39	598	0.29	14.5	<1.2	1,210	<0.04	<0.004
8.7	39.5	202	E 0.05	16.8	0.26	31.5	0.3	272	<0.04	0.177
8.4	64.4	188	0.02	9	1.25	29.2	2.2	246	<0.04	0.035
18.6	300	153	0.46	697	0.30	25.8	<1.3	1,350	<0.04	0.063

[1] Dissolved solids determined by sum of constituents.

Table 6. Concentration of trace elements in water samples collected from selected wells in Utah, summer of 2013.

[Date of sample: YYYYMMDD, year, month, day; µg/L, micrograms per liter; < , less than]

Local identifier (refer to figure 41)	Station number	Date (YYYYMMDD)	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	20130708	13.5	17.6	61.7	7.51	<0.03	<0.004
Escalante Valley, Milford area								
(C-28-10)28bcc-1	382046112592001	20130715	4	10.4	<0.16	1.74	3.5	6.87
(C-29-10)5cdd-2	381835113000001	20130715	2.3	19.5	0.52	0.53	0.54	26.1
(C-29-10)8ddd-2	381741112592702	20130715	3.9	5.5	<0.16	1.51	1.2	17.8
(C-29-11)1add-1	381901113014101	20130715	4.3	<4	1.23	1.09	0.49	14.5
(C-29-11)13dcc-1	381649113021301	20130715	2.4	<4	<0.16	1.12	1.4	24.4
Box Elder County								
Curlew Valley								
(B-12-11)6aba-1	414811113081701	20130717	1.5	<4	<0.16	1.57	1.1	2.29
(B-12-11)6aba-2	414808113080401	20130717	1.5	<12	<0.48	0.75	2	5.68
(B-12-11)8abb-1	414710113071601	20130717	0.72	<12	<0.48	0.42	1.8	4.79
(B-14-9)5bbb-1	415847112540401	20130717	1.9	8.6	<0.16	0.81	1.9	1.59
(B-14-10)1bbb-1	415845112562201	20130717	4.4	<4	<0.16	1.39	1.2	2.33
Lower Bear River area								
(B-12-4)22aac-2	414551112170501	20130910	0.86	8.1	<0.16	0.60	3.4	1.05
(B-12-4)35bbc-1	414406112163601	20130910	0.89	<4	<0.16	0.83	7.5	1.38
Cache County								
Cache Valley								
(A-10-1)27dab-1	413428111485701	20130823	1.5	<4	<0.16	0.58	0.13	0.663
(A-11-1)8dda-3	414216111511001	20130822	0.11	6.6	1.22	0.47	1	1.26
(A-12-1)17daa-1	414642111511401	20130822	1.3	<4	<0.16	0.77	0.21	0.663
(A-13-1)29cbd-1	415011111521401	20130822	10.2	783	52.3	0.80	<0.03	0.047
(B-11-1)14adc-2	414134111544701	20130823	0.7	<4	0.38	1.2	1.5	0.713
Davis County								
East Shore area								
(B-4-2)27aba-1	410340112030001	20130611	21.9	266	43.2	0.35	0.05	0.007
Duchesne County								
Duchesne River area								
U(C-1-4)31bbb-1	402130110231301	20130805	3.8	<4	<0.16	2.06	1.1	6.79
U(C-2-3)26cbb-1	401641110115801	20130806	<0.04	29.2	0.83	2.72	<0.03	0.059
U(C-2-4)28aba-1	401706110201501	20130807	<0.04	159	7.45	0.27	0.09	0.715
U(C-2-5)35bab-1	401611110251502	20130807	0.59	6.7	0.42	0.35	<0.03	0.302
U(C-3-5)27ccd-1	401104110263001	20130806	4.9	56.9	34	4.52	0.03	0.663
Garfield County								
Central Sevier Valley								
(C-34-5)5dca-1	375241112261201	20130722	1.1	<4	<0.16	0.32	0.15	2.57
(C-36-3)6dba-1	374205112091501	20130722	0.31	5	<0.16	0.38	0.34	1.59
Grand County								
Upper Colorado River area								
(D-20-25)12bab-1	390513109060601	20130822	1.3	<4	0.45	2.69	<0.03	0.581
(D-23-24)13aab-1	384750109122701	20130819	3.6	27.4	1.46	2.15	<0.03	0.048
Spanish Valley								
(D-26-22)17add-1	383238109302501	20130815	0.33	10.0	0.22	0.91	8.6	4.35

Table 6. Concentration of trace elements in water samples collected from selected wells in Utah, summer of 2013.—Continued

[Date of sample: YYYYMMDD, year, month, day; µg/L, micrograms per liter; < , less than]

Local identifier (refer to figure 41)	Station number	Date (YYYYMMDD)	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
Iron County								
Cedar Valley								
(C-35-11)13dad-1	374515113015501	20130709	2.8	<4	<0.16	0.44	1.4	3.73
(C-35-11)31dbd-1	374248113075201	20130709	0.88	8	<0.16	0.52	1.3	2.93
(C-37-12)9acc-2	373542113122402	20130709	5.4	<4	<0.16	1.62	0.72	0.922
(C-37-12)23abd-1	373409113095501	20130815	0.88	<4	<0.16	0.56	3.1	1.41
Escalante Valley, Beryl-Enterprise area								
(C-34-16)28dcc-3	374934113384601	20130805	<0.04	6.1	<0.16	0.22	<0.03	<0.004
(C-35-15)16ddd-1	374503113313701	20130722	14.7	5.8	0.43	3.72	0.39	2.37
(C-35-16)3dcd-1	374648113373101	20130722	2.8	<4	<0.16	0.42	0.75	2.03
(C-35-17)7dad-2	374617113470601	20130722	5.8	<4	<0.16	0.82	0.59	5.24
(C-36-17)36aad-1	373656113415201	20130722	3.9	<4	<0.16	0.99	0.5	3.35
Parowan Valley								
(C-33-8)31ccc-1	375257112483501	20130708	3.8	<4	<0.16	0.45	0.88	2
(C-33-9)33aba-1	375344112521601	20130709	5.2	<4	0.2	0.54	0.33	1.79
(C-33-9)35acd-3	375320112510003	20130708	2.3	<4	<0.16	0.25	0.39	1.88
(C-34-9)9bca-1	375147112530001	20130708	1.7	<4	<0.16	0.15	1.9	3.02
Juab County								
Juab Valley								
(C-14-1)26dbd-1	393342111534501	20130711	0.91	6.4	<0.16	1.2	0.74	2
(D-13-1)5dda-1	394226111501601	20130711	0.68	<4	<0.16	0.48	2	2.03
(D-14-1)31ada-1	393315111511601	20130711	0.25	6.7	0.23	0.26	0.79	0.586
Snake Valley								
(C-11-17)11aaa-1	395319113431201	20130709	0.47	<4	<0.16	0.38	0.45	17.8
Kane County								
Kanab area								
(C-42-5)11bdd	371027112230201	20130716	1	<4	<0.16	0.10	1.1	1.1
(C-43-5)25cbd-1	370220112221201	20130716	1.3	<4	48.5	3.45	19.7	12.2
Millard County								
Pahvant Valley								
(C-19-4)29bcd-1	390758112194601	20130715	1.8	6.7	<0.16	0.15	1.1	0.93
(C-21-5)7cdd-3	385939112272303	20130731	2.4	<4	<0.16	1.51	2.7	3.61
(C-22-5)22adc-2	385303112234801	20130715	1.2	9.2	<0.16	0.80	0.55	0.526
(C-22-5)33cdd-2	385053112252401	20130731	2	8.3	<0.16	0.65	1.6	1.28
(C-23-6)16cda-1	384829112315901	20130731	10.4	<12	<0.48	0.87	2.8	1.93
Sevier Desert								
(C-15-4)8cba-1	393154112192901	20130710	<0.08	253	415	0.46	1.9	0.807
(C-16-4)30cac-1	392344112203801	20130710	1.1	<4	<0.16	0.13	0.92	0.821
(C-16-7)12baa-2	392649112350802	20130710	13.8	<4	5.04	1.2	0.12	2.44
(C-17-6)26dbb-1	391834112292001	20130710	12.2	14.4	1.46	2.92	0.6	1.1
Snake Valley								
(C-20-19)7abb-1	390430114013001	20130709	1.6	<4	<0.16	0.43	0.32	1.31
(C-20-19)14bbc-1	390416113573801	20130709	3.9	<4	<0.16	2.35	0.25	2.1

Table 6. Concentration of trace elements in water samples collected from selected wells in Utah, summer of 2013.—Continued

[Date of sample: YYYYMMDD, year, month, day; µg/L, micrograms per liter; < , less than]

Local identifier (refer to figure 41)	Station number	Date (YYYYMMDD)	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
Salt Lake County								
Salt Lake Valley								
(B-1-2)19aca-1	404826112062201	20130619	1.5	89.8	11.8	13.6	0.07	0.011
(C-2-2)25cdd-1	403637112005201	20130621	12	41.7	3.22	2.1	55.5	9.34
(C-3-1)4aac-1	403533111570701	20130621	4.1	12.1	<0.16	0.72	2.9	3.67
(C-3-1)12ccb-1	403408111543201	20130619	3.7	<4	<0.16	1.49	1.1	4.65
(D-1-1)7abd-6	404506111523301	20130619	1.1	6.6	3.22	1.15	1.6	1.82
San Juan County								
Upper Colorado River area								
(D-30-22)13cab-1	381034109274501	20130816	0.04	<4	<0.16	1.07	2.9	2.01
Sanpete County								
Sanpete Valley								
(D-16-2)36cbd-1	392238111390501	20130821	6	140	23.6	1.46	0.78	0.933
Sevier County								
Central Sevier Valley								
(C-23-2)15dcb-4	384757112002201	20130723	3.7	<4	<0.16	3.51	0.97	5.28
(C-23-2)30baa-2	384641112034601	20130723	1.9	<4	<0.16	0.34	0.36	2.77
(C-23-2)30bcc-1	384635112040801	20130723	1.8	<4	<0.16	0.43	0.21	2.25
(C-23-2)34aba-1	384550112000901	20130723	3.4	<4	<0.16	0.53	0.56	28.6
Tooele County								
Rush Valley								
(C-4-5)33cca-1	402526112252001	20130801	0.63	<4	<0.16	0.54	2	1.88
(C-8-5)31ccd-5	400418112271701	20130801	1.4	<4	<0.16	0.16	1.1	1.94
Skull Valley								
(C-1-7)31daa-1	404113112395801	20130625	4.9	31.3	<0.8	1.51	1.1	1.9
(C-4-8)15cda-1	402757112440401	20130625	0.46	6.7	<0.16	0.24	1.9	0.576
Tooele Valley								
(C-2-4)27cdc-1	403634112171501	20130624	1.8	<4	<0.16	0.22	14.8	1.93
(C-2-4)31add-6	403606112195401	20130624	1.2	5.9	<0.16	0.48	4.8	2.43
(C-2-4)33bdd-1	403629112174801	20130624	1.3	<4	<0.16	0.53	1.9	2.06
(C-2-5)33dba-2	403600112245501	20130625	3.4	15.9	<0.32	1.27	6	4.24
(C-3-6)1bdb-1	403514112283701	20130625	0.46	4.7	<0.16	0.21	0.82	1.76
Wendover area								
(B-3-19)12bbc-1	405941113584801	20130718	0.46	11.3	0.44	0.66	0.32	0.38

Table 6. Concentration of trace elements in water samples collected from selected wells in Utah, summer of 2013.—Continued

[Date of sample: YYYYMMDD, year, month, day; µg/L, micrograms per liter; < , less than]

Local identifier (refer to figure 41)	Station number	Date (YYYYMMDD)	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
Utah County								
Cedar Valley								
(C-6-2)26cbb-1	401607112023401	20130725	5.9	5.4	21.6	3.02	0.4	3.84
(C-6-2)29bdb-1	401620112054301	20130725	0.35	217	57.2	1.09	0.05	0.835
Goshen Valley								
(C-9-1)28ccb-1	395956111572101	20130702	7.6	8.8	<0.32	3.51	14.4	11.2
(C-9-1)29acc-1	400015111575301	20130702	6.7	<8	<0.16	0.93	5.7	5.05
Northern Utah Valley								
(D-5-1)8aaa-3	402420111505701	20130701	2.4	<4	<0.16	1.72	2.4	1.95
(D-5-1)20cbc-1	402159111520101	20130701	1.1	<4	<0.16	2.08	1.7	2.42
Southern Utah Valley								
(D-8-2)31cdb-1	400422111454201	20130702	4.3	61.2	107	1.74	0.9	1.76
(D-9-1)36bbc-1	395942111470801	20130702	0.44	<4	<0.16	0.54	1.3	1.48
(D-9-3)5bbd-1	400407111375101	20130701	1.1	4.6	12.4	0.88	0.29	0.483
Wasatch County								
Heber Valley								
(D-3-4)26dba-1	403146111272701	20130827	12.4	<4	<0.16	0.62	0.36	0.797
(D-4-4)12dcc-1	402842111263101	20130827	1.1	<4	<0.16	0.12	0.2	1.38
(D-4-4)13bdd-1	402810111263601	20130827	1.1	<4	6.75	1.02	0.68	1.52
(D-4-5)3dcc-1	402937111214901	20130828	1.2	4.2	0.53	0.08	0.09	1.31
(D-4-5)4ccb-1	402946111233901	20130828	1.3	9.4	0.9	0.08	0.07	1.13
(D-4-5)6bcc-2	403003111255801	20130827	0.89	14	3.04	0.19	0.2	1.97
(D-4-5)16bab-1	402840111232201	20130827	1.8	7.4	<0.16	0.41	0.36	1.91
(D-4-5)16ccd-1	402750111232701	20130828	1	6.4	0.67	1.42	1.1	1.82
Washington County								
Central Virgin River area								
(C-41-17)8cbd-2	371348113470301	20130718	25.7	71.2	11.5	3.17	1.3	1.45
(C-42-13)7bba	370915113213801	20130718	0.85	25.2	0.3	0.48	2.6	6.41
(C-43-15)16dcc-2	370218113322101	20130718	0.95	10.4	<0.32	3.88	6.5	4.66
Wayne County								
Upper Fremont River Valley								
(D-29-3)1cab-1	381902111321101	20130723	7.2	21.2	1.17	1.17	0.37	1.12
Weber County								
East Shore area								
(B-5-2)6bdd-5	411153112064605	20130611	1.2	605	30.9	2.39	0.06	<0.008
(B-5-2)6cdd-2	411130112064502	20130611	9.8	215	111	0.39	<0.03	<0.004
(B-7-2)16dcd-2	412011112041401	20130612	2.9	55.9	38	2.31	<0.03	0.01
(B-7-2)32bbb-1	411824112060601	20130612	3.7	166	236	0.50	<0.06	<0.008

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UTAH DEPARTMENT OF NATURAL RESOURCES

Utah Department of Environmental Quality