Water Levels in Selected Wells and Directions of Ground-Water Movement Near Fort Hall, Fort Hall Indian Reservation, Southeastern Idaho

By D.J. Parliman and H.W. Young

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FORT HALL INDIAN RESERVATION

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ILLUSTRATIONS

TABLE

CONVERSION FACTORS AND VERTICAL DATUM

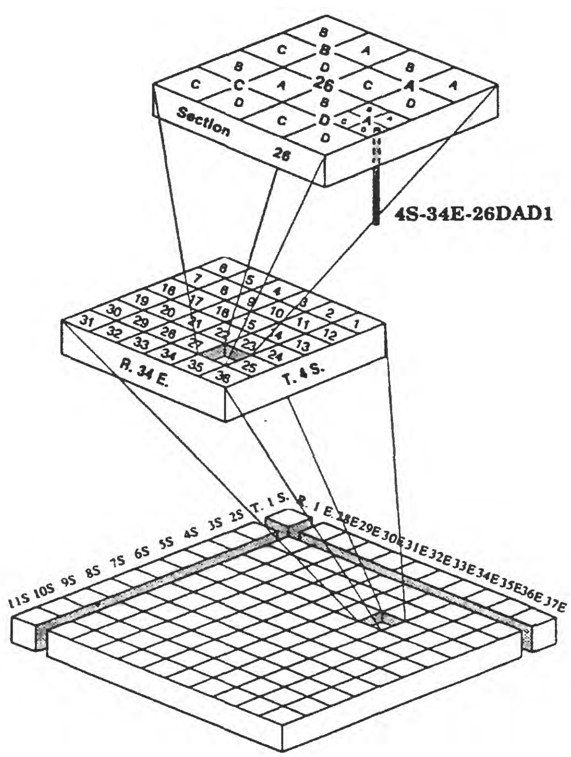
Multiply	By	To obtain
acre	4,047	square meter
foot (ft)	0.3048	meter
inch (in.)	25.4	millimeter
mile (mi)	1.609	kilometer
square mile (mi^2)	2.590	square kilometer

Sea level: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929—a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.

WELL-NUMBERING SYSTEM

The well-numbering system used by the U.S. Geological Survey in Idaho indicates the location of wells within the official rectangular subdivision of public land, with reference to the Boise base line and Meridian. The first two segments of the number designate the township (north or south) and range (east or west). The third segment gives the section number; three letters, which indicate the 1/4 section (160-acre tract), 1/4-1/4 section (40-acre tract), 1/4-1/4-1/4 section (10-acre tract); and the serial number of the well within the tract. Some well locations also include a 1/4-1/4-1/4-1/4 section (2 1/2-acre tract) letter within the section number.

Quarter sections are designated by the letters A, B, C, and D in counterclockwise order from the northeast quarter of each section. Forty-acre, 10-acre, and 2 1/2-acre tracts within each quarter section are lettered in the same manner. For example, well 4S-34E-26DAD1 is in the SE1/4NE1/4SE1/4 sec. 26, T. 4 S., R. 34 E., and was the first well inventoried in that tract.



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ABSTRACT

In April 1990, water levels were measured in 81 wells near Fort Hall to determine directions of ground-water movement in areas where dissolved nitrate-nitrogen concentrations were determined to be consistently high.

Principal rock units are unconsolidated deposits and basalt. Basalt underlies the entire study area. Recharge is primarily from underflow from adjacent areas, precipitation, and locally from applied irrigation water and canal leakage. Principal water-yielding zones are gravel and sand lenses in the unconsolidated deposits and cinder or rubble in the basalt. The regional ground-water system is in basalt.

Ground water in unconsolidated deposits can be under unconfined (water-table) or confined conditions. Water levels in wells completed in near-surface unconsolidated deposits probably represent unconfined conditions. Water levels in wells completed in deeper unconsolidated deposits (more than approximately 50 feet below land surface) and basalt probably represent a mixture of unconfined and confined conditions. Most domestic wells are completed in deeper unconsolidated deposits and most irrigation wells are completed in basalt.

Hydraulic heads in water-yielding zones in basalt are higher than hydraulic heads in unconsolidated deposits. Water levels generally are lowest in May and highest in October. Hydrographs for all wells show an overall decline in water levels from 1985 to 1990.

In unconsolidated deposits, the water-level gradient from the Fort Hall Main Canal to the western edge of the Gibson Terrace is about 2 feet per mile. The general directions of ground-water movement are westward and southwestward toward the Fort Hall Bottoms. In basalt, the water-level gradient is about 1 foot per mile, and directions of ground-water movement are southwestward toward the Fort Hall Bottoms and northwestward toward Ferry Butte.

INTRODUCTION

Historically, ground-water level data were sparse for areas near Fort Hall on the Fort Hall Indian Reservation (fig. 1). Two ground-water quality studies were completed in this area by the U.S. Geological Survey (USGS), in cooperation with the Shoshone-Bannock Tribes, during 1988 and 1989 (Parliman and Young, 1988, 1989). Dissolved nitrite plus nitrate as nitrogen concentrations (nitrate-nitrogen) were consistently high in water samples from wells located between Fort Hall and Ferry Butte, on and near the Gibson Terrace (first described in a report by Mansfield, 1920, p. 16), but water-level data were needed to help determine directions of ground-water movement. Information also was needed on principal water-yielding zones, seasonal and long-term variability of water levels in wells completed in different water-yielding zones, and water levels prior to large ground-water withdrawals during the irrigation season.

In March 1990, the USGS, in cooperation with the Shoshone-Bannock Tribes, began a study to determine directions of ground-water movement on and near the Gibson Terrace where dissolved nitrate-nitrogen concentrations were determined to be consistently high.

Purpose and Scope

The primary purposes of this report are to (1) present measurements of water levels in wells on and near the Gibson Terrace, (2) define water-level contours, and (3) define directions of ground-water movement.

The scope of the study included (1) compilation of water-level and well-construction information for areas near Fort Hall, including the Gibson Terrace; (2) measurement of water levels in 81 wells between April 9 and 18, 1990; and (3) construction of water-level contour maps from which directions of ground-water movement could be determined. Water levels were measured when canals and ditches were dry and prior to the beginning of the irrigation season. Water-level data from seven additional wells, part of a Fort Hall Indian Reservation water-level monitoring network, also were compiled for use in this study. Water levels in these monitoring wells were measured in March 1990. Locations of the 88 wells are shown in figure 2. Well-construction, water-use, and selected water-level data for each well are shown in table 1 (back of report).

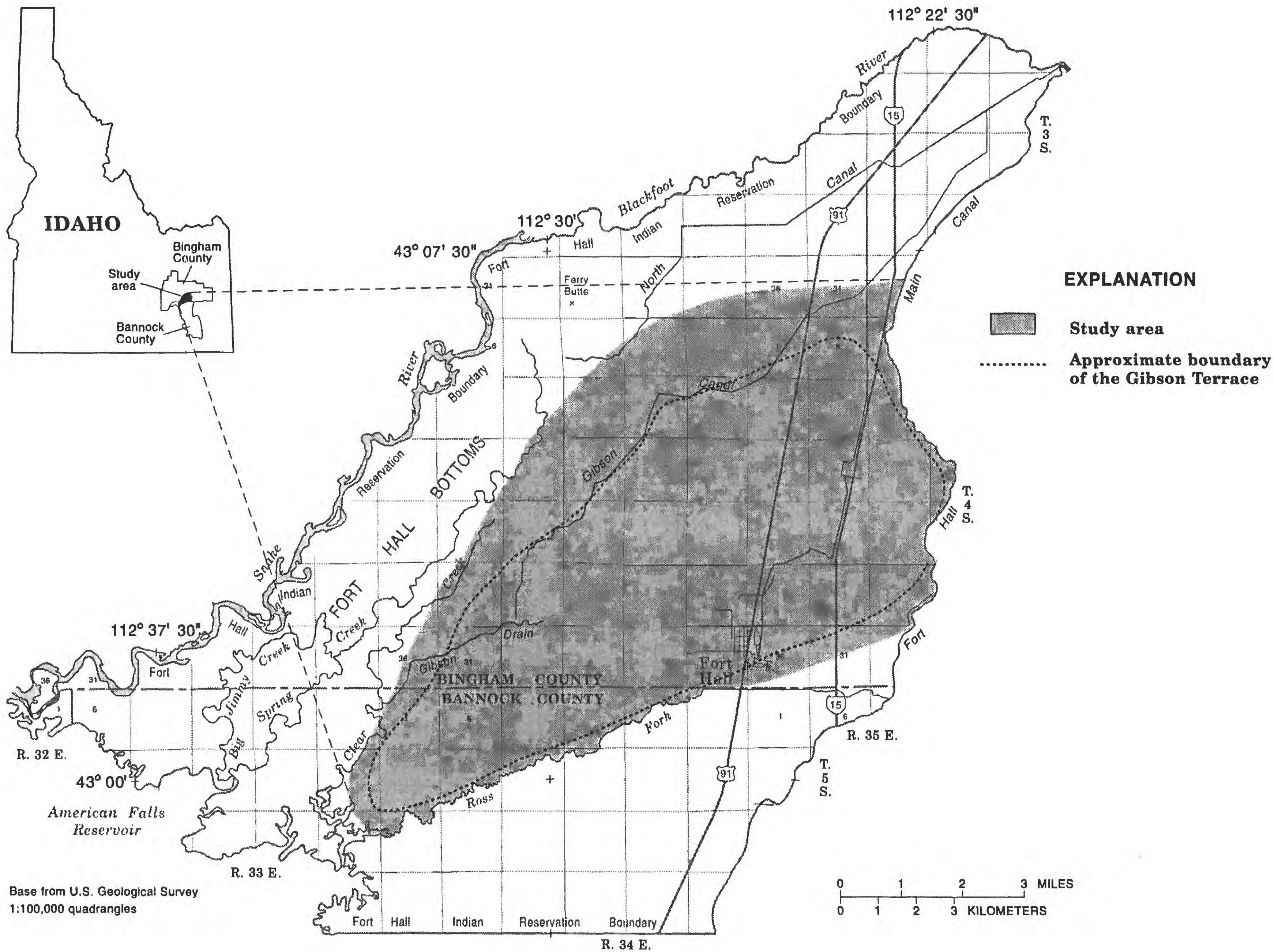

Figure 1. Location of study area, Gibson Terrace, and surrounding areas.

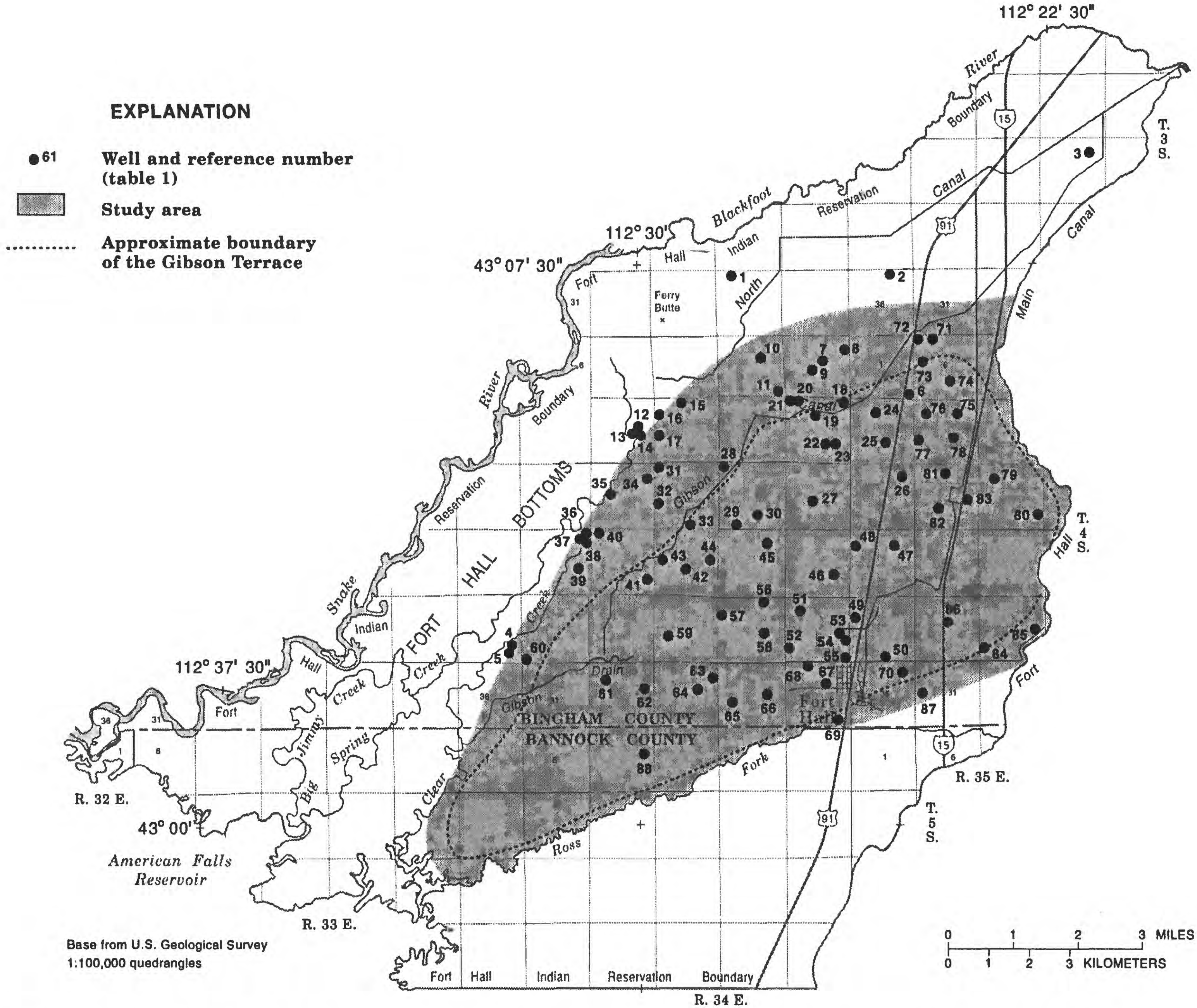

Figure 2. Location and identification of wells on or near the Gibson Terrace in which water levels were measured in March or April 1990.

Acknowledgments

Well-construction information necessary for the completion of this project was furnished by private well owners, public and private business personnel, and State and Federal agency personnel in Idaho. Personnel with the Shoshone-Bannock Tribes; U.S. Department of the Interior, Bureau of Indian Affairs at Fort Hall; and Portland Area Indian Health Service in Seattle, Wash., also provided information on historical land uses, water uses, and ground-water quality that was important for understanding the ground-water system near Fort Hall.

DESCRIPTION OF THE STUDY AREA

The study area comprises about 45 mi² near Fort Hall and includes lowlands from Ross Fork northward to Ferry Butte, westward to the Fort Hall Bottoms, and eastward to the Fort Hall Main Canal. Land-surface altitude ranges from about 4,400 to 4,500 ft above sea level, and the land slopes generally southwestward.

The climate is semiarid, characterized by cold, wet winters and hot, dry summers. Mean annual precipitation is about 11 in. Precipitation is greatest during winter and spring and least during late summer.

Economy of the study area is strongly influenced by irrigated agriculture. Major crops include potatoes, grains, and alfalfa. Crops are irrigated from about mid-April through September. Irrigation water is provided by canals, ditches, and numerous large-capacity wells. Historically, cropland in the southwestern part of the study area was developed more slowly than in other areas, owing to numerous wetlands. Complex systems of tile drains in some wetland areas divert near-surface water to drain wells; drain water then is pumped to the Gibson Drain.

GEOLOGY

Principal rock units include recent unconsolidated stream and windblown deposits; older stream, glacial, windblown, lake, and playa deposits; and basalt and associated interbeds of the Snake River Group of Quaternary age (Mansfield, 1920; Dow, 1978; Parliman, 1987, p. 14).

Unconsolidated gravel, sand, silt, and clay are the predominant deposits and overlie the basalt. Basalt and associated interbeds underlie the entire area. Basalt can be highly fractured or unfractured. Interbeds include uneven thicknesses of volcanic cinders, rubbly basalt, or unconsolidated deposits. Basalt surfaces are undulating; local relief is tens of feet. Altitude of the top of the basalt surface is given in table 1 for wells completed in basalt. Data for wells in T. 4 S., R. 35 E., sec. 7 (wells 75–78, table 1) exemplify the irregularity of the basalt surface.

HYDROLOGY

Recharge to the ground-water system is primarily from underflow from adjacent areas, precipitation, and locally from applied irrigation water and canal leakage. Precipitation is a major source of recharge from about March until May. Infiltration of applied irrigation water and canal leakage are important sources of recharge from late April until about October.

Principal water-yielding zones are gravel and sand lenses in the overlying unconsolidated deposits and cinder or rubble in the basalt. The regional ground-water system is in basalt.

Water Levels In Selected Wells, 1985–90

Ground water in unconsolidated deposits can be under unconfined (water-table) or confined (artesian) conditions. Water levels in wells completed in near-surface unconsolidated deposits (less than approximately 50 ft below land surface) probably represent unconfined conditions. Water levels in wells cased to and completed in deeper unconsolidated deposits and basalt probably represent a mixture of unconfined and confined conditions. Most domestic wells in the study area are more than 60 ft deep and are completed in the deeper unconsolidated deposits. Most irrigation wells in the area are more than 200 ft deep and are completed in the basalt.

Changes in water levels in wells completed at different depths are shown in figures 3 and 4 for two well nests (single boreholes containing several

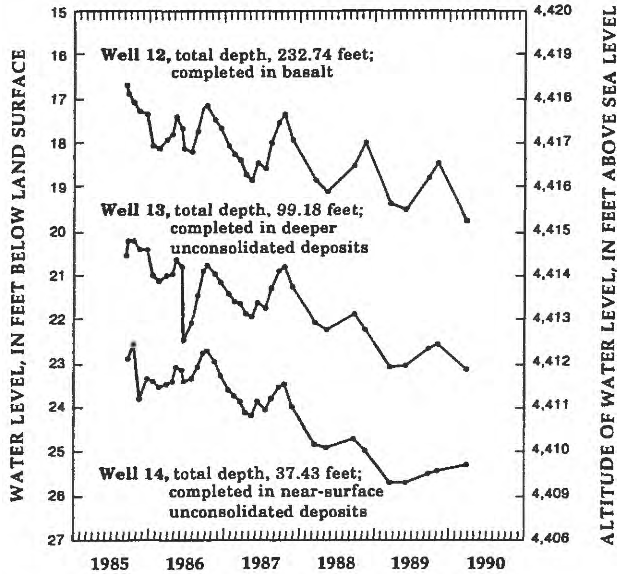

Figure 3. Water levels in wells 12, 13, and 14, September 1985 to March 1990. (See table 1)

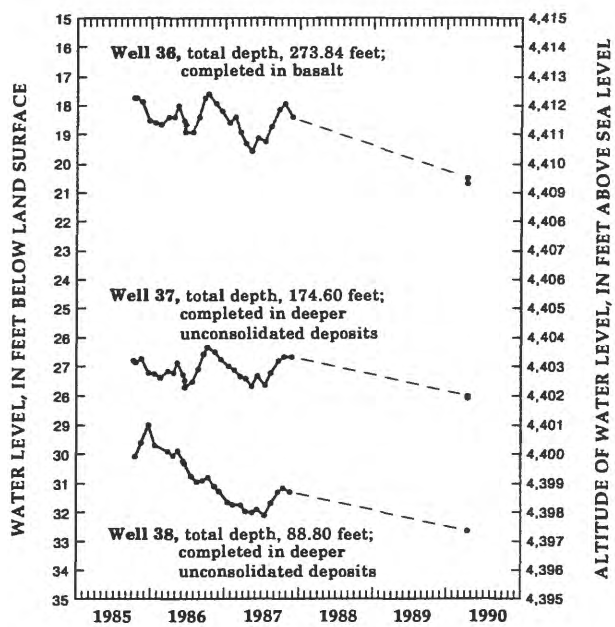

Figure 4. Water levels in wells 36, 37, and 38, October 1985 to April 1990. (Dashed lines indicate periods for which no data are available; see table 1)

wells completed in discrete water-yielding zones) near the Fort Hall Bottoms (reference numbers 12–14 and 36–38, table 1). Variability of water levels in deeper unconsolidated deposits near Fort Hall (reference num-

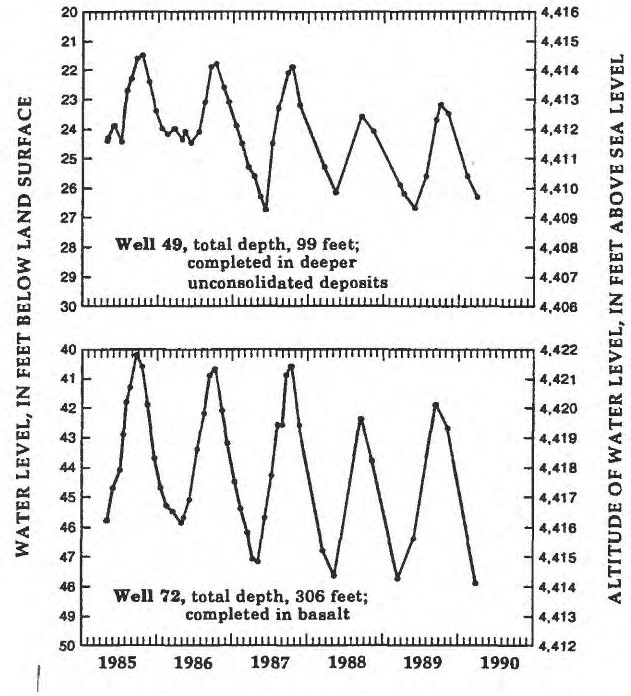

Figure 5. Water levels in wells 49 and 72, April 1985 to March 1990. (See table 1)

ber 49) and in basalt near Gibson (reference number 72) is shown in figure 5. At each well nest, hydraulic heads in water-yielding zones in the basalt are higher than hydraulic heads in unconsolidated deposits.

Seasonal water-level trends in all hydrographs are similar—water levels typically are lowest in May and highest in October—but patterns and amplitudes of seasonal water-level change differ from zone to zone. Water levels in all water-yielding zones declined from 1985 to 1990.

Directions of Ground-Water Movement, April 1990

Water-level contours and general directions of ground-water movement in deeper unconsolidated deposits are shown in figure 6. Water-level contours and general directions of ground-water movement in basalt are shown in figure 7. Ground-water movement is in the direction of the decreasing water-level gradient, generally from areas of recharge to areas of discharge. Arrows showing the direction of movement in figures 6 and 7 are drawn perpendicular to contours on the water-level surface.

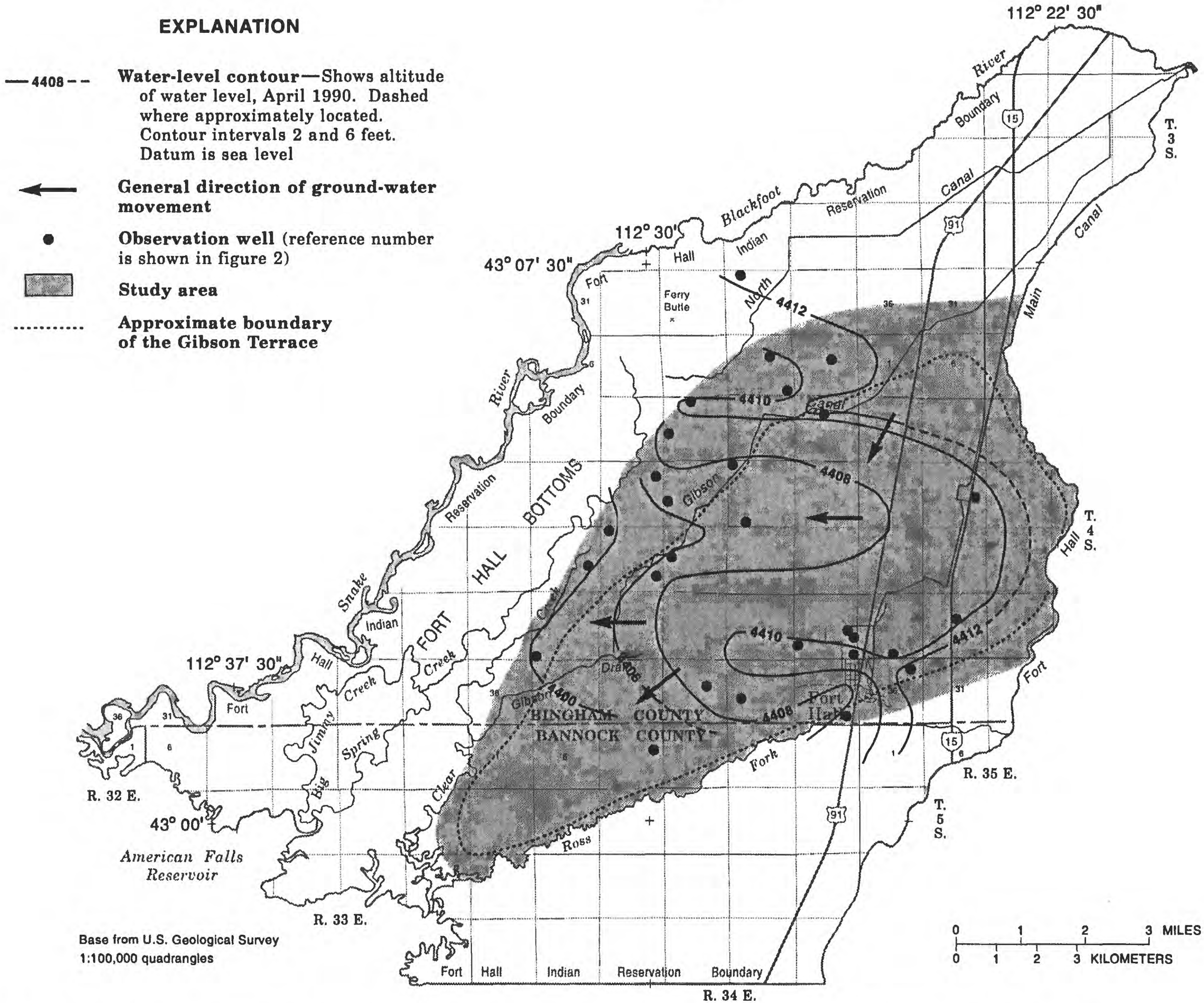

Figure 6. Water-level contours and general directions of ground-water movement in deeper unconsolidated deposits, April 1990.

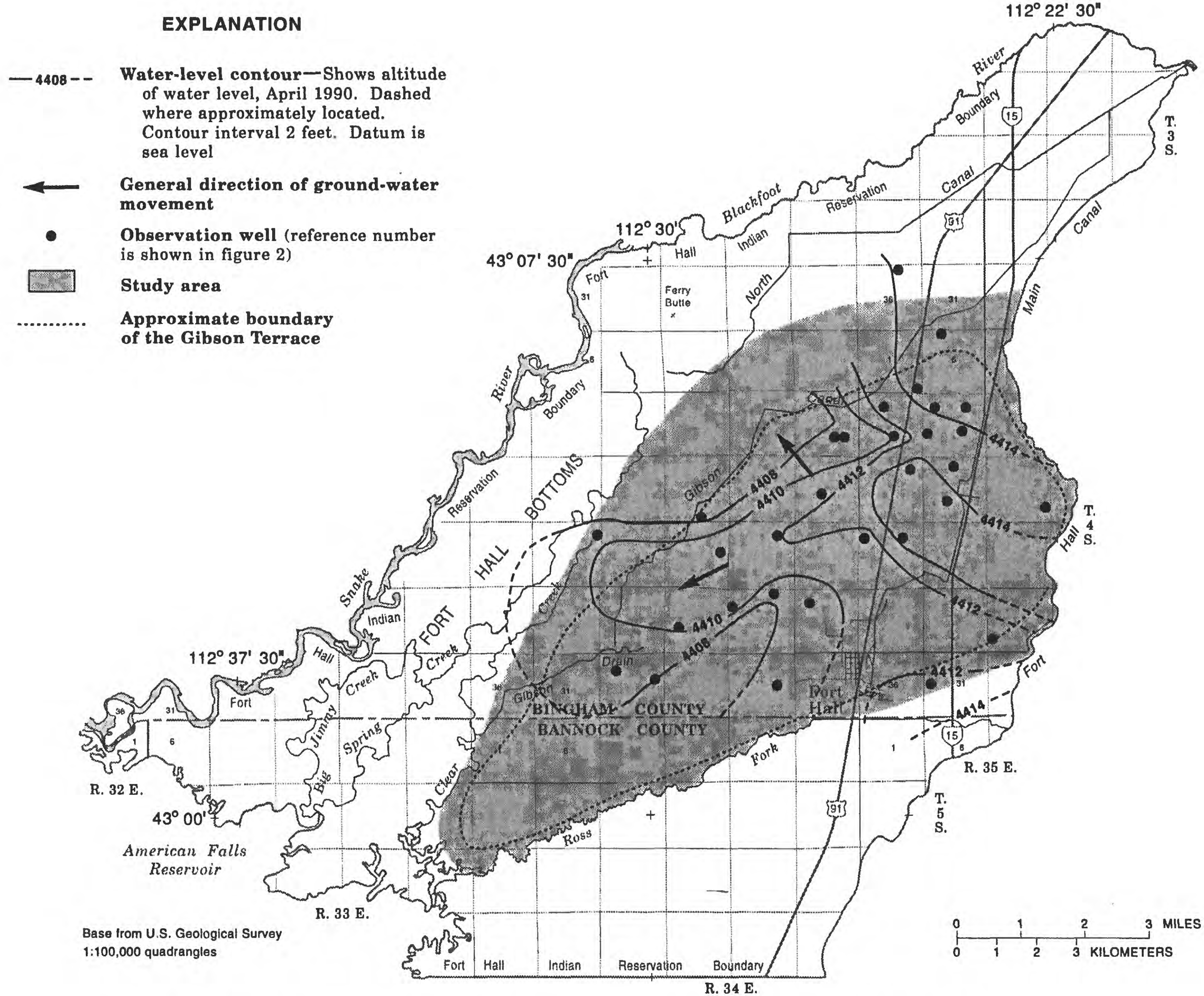

Figure 7. Water-level contours and general directions of ground-water movement in basalt, April 1990.

In the deeper unconsolidated deposits, the water-level gradient from the Fort Hall Main Canal to the western edge of the Gibson Terrace is about 2 ft/mi. Gradients are greatest (about 4 ft/mi) in areas near Ferry Butte, Fort Hall, and the western edge of the Gibson Terrace and least (less than 1 ft/mi) in the central part of the Gibson Terrace. The general directions of ground-water movement are westward and southwestward toward the Fort Hall Bottoms.

In the basalt, the water-level gradient from the Fort Hall Main Canal to the eastern edge of the Gibson Terrace is about 1 ft/mi. Gradients are greatest (more that 2 ft/mi) in T. 4 S., R. 34 E., secs. 11–15 and least (less than 0.5 ft/mi) in the central part of the Gibson Terrace. General directions of ground-water movement are southwestward toward the Fort Hall Bottoms and northwestward toward Ferry Butte.

SUMMARY

In April 1990, water levels were measured in 81 wells near Fort Hall to determine directions of ground-water movement in areas where dissolved nitrate-nitrogen concentrations were determined to be consistently high.

Principal rock units in the area are unconsolidated deposits and basalt. Basalt underlies the entire area, and basalt surfaces are undulating.

Recharge to the ground-water system is primarily from underflow, precipitation, and locally from applied irrigation water and canal leakage. Principal water-yielding zones are gravel and sand lenses in the unconsolidated deposits and cinder or rubble in the basalt. The regional ground-water system is in basalt.

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——1989, Selected ground-water quality data for the area near Fort Hall, Fort Hall Indian Reservation, southeastern Idaho, June 1989: U.S. Geological Survey Open-File Report 89–594, scale 1:100,000.

Table 1. *Well-construction, water-use, and water-level data, March and April 1990*

[Type of opening: x, open hole; p, perforated; o, open end; t, sandpoint. Primary use of water: H, domestic; I, irrigation; U, unused; D, dewatered. Source of well data: D, driller; S, USGS; O, well owner. Lithology of primary water-yielding zone: UD, unconsolidated deposits; BSLT, basalt and associated interbeds; ?, information based on driller's log for nearby well. Water level and altitude of water-level surface: –, water level above land surface; E, flowing; G, nearby flowing; R, recently pumped; V, foreign substance (oil) on water surface; P, pumping. —, no data available]

Reference No.	Well location	Total depth of well (feet)	Top of open interval (feet)	Type of opening	Primary use of water	Source of well data	Altitude of top of basalt surface (feet above sea level)	Lithology of primary water-yielding zone	Date of water-level measurement	Water level (feet below land surface)	Altitude of water-level surface (feet above sea level)
1	3S-34E-34BAAA1	90	89	x	H	D	—	UD	4-12	31.72	4,413
2	3S-34E-36ABBA1	82	80	x	H	D	4,387	BSLT	4-12	44.93	4,414
3	3S-35E-21ADA1	343	82	p	I	D	4,403	BSLT	3-20	46.78	4,438
4	4S-33E-25DDB1	117	117.74	o	U	S	—	UD	3-26	–6.86 E	4,391
5	4S-33E-25DDB2	21	18	t	U	S	—	UD	3-26	5.46 G	4,379
6	4S-34E- 1DDD1	94	60	x	H	D	4,399	BSLT	4- 9	44.18	4,415
7	4S-34E- 2ACC1	79	79	o	H	D	—	UD	4-11	38.15	4,411
8	4S-34E- 2ADA1	100	99	x	H	D	—	UD	4-11	41.08 R	4,412
9	4S-34E- 2CAA1	—	—	—	H	—	—	UD?	4-11	35.23 R	4,411
10	4S-34E- 3DBBC1	—	—	—	H	—	—	UD?	4-12	30.27	4,410
11	4S-34E- 3DDD1	121	121	o	H	D	—	UD	4-11	35.70	4,409
12	4S-34E- 8DBD1	232.74	229.74	t	U	D	4,290	BSLT	3-26	19.76	4,416
13	4S-34E- 8DBD2	99.18	96.18	t	U	D	—	UD	3-26	23.14	4,412
14	4S-34E- 8DBD3	37.43	26.15	p	U	D	—	UD	3-26	25.31	4,410
15	4S-34E- 9BAB1	—	—	—	H	—	—	UD?	4-11	24.67	4,410

Table 1. *Well-construction, water-use, and water-level data, March and April 1990*—Continued

Reference No.	Well location	Total depth of well (feet)	Top of open interval (feet)	Type of opening	Primary use of water	Source of well data	Altitude of top of basalt surface (feet above sea level)	Lithology of primary water-yielding zone	Date of water-level measurement	Water level (feet below land surface)	Altitude of water-level surface (feet above sea level)
16	4S-34E- 9BBC1	—	—	—	H	—	—	UD?	4-13	23.79	4,407
17	4S-34E- 9CBC1	—	—	—	H	—	—	UD?	4-12	21.75	4,408
18	4S-34E-11AAAD1	—	—	—	H	—	—	—	4-11	42.30	4,413
19	4S-34E-11BAC1	80	77	x	H	D	—	UD	4-11	40.94	4,410
20	4S-34E-11BBA1	84	80	x	H	D	—	UD	4-11	38.94	4,412
21	4S-34E-11BBB1	83	—	—	H	O	—	UD?	4-11	34.52	4,410
22	4S-34E-11DBD1	270	220	x	I	D	4,303	BSLT	4-10	37.85 V	4,408
23	4S-34E-11DBD2	160	—	—	H	O	—	BSLT?	4-10	38.01	4,408
24	4S-34E-12BDA1	475	204	x	I	D	4,243	BSLT	4-10	40.67 V	4,412
25	4S-34E-12DCB1	270	250	x	I	D	4,306	BSLT	4-10	40.82 V	4,409
26	4S-34E-13ADA1	400	265	x	I	D	4,311	BSLT	4-10	31.24 V	4,415
27	4S-34E-14CAD1	305	211	x	I	D	4,233	BSLT	4- 9	32.98 V	4,411
28	4S-34E-15BBA1	—	—	—	H	—	—	UD?	4-10	33.15	4,407
29	4S-34E-15CDC1	94	94	o	H	D	—	UD	4-13	31.70	4,406
30	4S-34E-15DCB1	—	—	—	I	—	—	—	4-10	29.74 V	4,410
31	4S-34E-16BBB1	83	83	o	H	D	—	UD	4-12	32.05	4,408
32	4S-34E-16CBCC1	—	—	—	H	—	—	UD?	4-12	29.32	4,407
33	4S-34E-16CDD1	370	221	x	I	D	4,211	BSLT	4-10	29.35	4,408
34	4S-34E-17ADAA1	—	—	—	U	—	—	US?	4-12	32.69	4,406
35	4S-34E-17CBD1	—	—	—	H	—	—	UD?	4-13	37.28	4,383

Table 1. *Well-construction, water-use, and water-level data, March and April 1990*—Continued

Reference No.	Well location	Total depth of well (feet)	Top of open interval (feet)	Type of opening	Primary use of water	Source of well data	Altitude of top of basalt surface (feet above sea level)	Lithology of primary water-yielding zone	Date of water-level measurement	Water level (feet below land surface)	Altitude of water-level surface (feet above sea level)
36	4S-34E-19AAD1	273.84	270.84	t	U	D	4,289	BSLT	4-13	20.67	4,409
37	4S-34E-19AAD2	174.60	171.60	t	U	D	—	UD	4-13	28.06	4,402
38	4S-34E-19AAD3	88.80	47.20	p	U	D	—	UD	4-13	32.61	4,397
39	4S-34E-19DAC1	—	—	—	H	—	—	UD?	4-13	27.25	4,400
40	4S-34E-20BBB1	—	—	—	H	—	—	UD?	4-13	34.93	4,399
41	4S-34E-20DDD1	210	68	p	I	D	—	UD	4-10	28.68 V	4,407
42	4S-34E-21CAD1	380	225	x	I	D	4,210	BSLT	4-10	56.43 P	4,379
43	4S-34E-21CBB1	112	111	x	H	D	—	UD	4-12	21.92	4,408
44	4S-34E-21DAA1	370	230	x	I	D	4,209	BSLT	4-10	22.88 V	4,411
45	4S-34E-22AAC1	355	224	x	I	D	4,218	BSLT	4- 9	28.02 V	4,412
46	4S-34E-23DAC1	265	—	—	I	D	4,255	BSLT	4- 9	29.02 P	4,409
47	4S-34E-24ABD1	270	154	x	I	D	4,289	BSLT	4-10	27.90 V	4,415
48	4S-34E-24BBCC1	300	190	x	I	D	4,267	BSLT	4- 9	29.39 V	4,411
49	4S-34E-25BCC1	99	99	o	H	D	—	UD	3-26	26.27	4,410
49	4S-34E-25BCC1	99	99	o	H	D	—	UD	4- 9	26.68	4,409
50	4S-34E-25DCC1	120	120	o	H	D	—	UD	4-11	32.04	4,410
51	4S-34E-26BAC1	—	—	—	I	—	—	BSLT?	4- 9	19.28 V	4,410
52	4S-34E-26CCB1	101	90	p	I	D	—	UD	4- 9	24.51 V	4,410
53	4S-34E-26DAB1	—	—	—	H	—	—	UD?	4- 9	27.57	4,409
54	4S-34E-26DAD1	80	—	—	H	—	—	UD?	4- 9	25.15	4,410

Table 1. *Well-construction, water-use, and water-level data, March and April 1990*—Continued

Reference No.	Well location	Total depth of well (feet)	Top of open interval (feet)	Type of opening	Primary use of water	Source of well data	Altitude of top of basalt surface (feet above sea level)	Lithology of primary water-yielding zone	Date of water-level measurement	Water level (feet below land surface)	Altitude of water-level surface (feet above sea level)
55	4S-34E-26DDDC1	69	—	—	I	O	—	UD	4-13	28.84	4,411
56	4S-34E-27AAB1	330	190	x	I	D	4,209	BSLT	4- 9	26.83	4,408
57	4S-34E-27BCB1	—	—	—	I	—	—	BSLT?	4-12	19.69V	4,410
58	4S-34E-27DAC1	308	240	x	I	D	4,261	BSLT	4-10	25.05 P	4,406
59	4S-34E-28CACC1	296	235	x	D	D	4,250	BSLT	4-10	10.05V	4,410
60	4S-34E-30CCC1	120	119	x	H	D	—	UD	4-13	11.00	4,401
61	4S-34E-32ADA1	250	187	x	I	D	4,237	BSLT	4-10	14.18 V	4,409
62	4S-34E-32BBD1	250	187	x	I	D	4,240	BSLT	4-10	12.00	4,408
63	4S-34E-33AADD3	—	—	—	H	—	—	UD?	4-10	22.90 R	4,402
64	4S-34E-33ADC1	115	57	p	I	D	—	UD	4-10	14.73	4,409
65	4S-34E-34CAB1	141	85	p	I	D	—	UD	4-10	15.76 V	4,409
66	4S-34E-34DABB1	287	155	x	I	D	4,280	BSLT	4-10	26.34 V	4,409
67	4S-34E-35ACDC1	—	—	—	H	—	—	UD?	4-13	32.02	4,408
68	4S-34E-35BAA1	—	—	—	H	—	—	UD?	4-11	28.71 R	4,410
69	4S-34E-35DDC1	100	—	—	H	—	—	UD?	4-13	29.07	4,409
70	4S-34E-36AAAB1	—	—	—	H	—	—	UD?	4-11	50.33	4,413
71	4S-35E- 6BAC1	84	61	x	I	D	4,403	BSLT	4-11	47.34	4,415
72	4S-35E- 6BBB1	306	141	p	U	D	4,334	BSLT	3-26	47.95	4,414
73	4S-35E- 6BCDC1	168	—	—	H	O	—	—	4-18	52.60 R	4,414
74	4S-35E- 6DCB1	—	—	—	I	—	—	BSLT?	4-10	49.09	4,413

Table 1. *Well-construction, water-use, and water-level data, March and April 1990*—Continued

Reference No.	Well location	Total depth of well (feet)	Top of open interval (feet)	Type of opening	Primary use of water	Source of well data	Altitude of top of basalt surface (feet above sea level)	Lithology of primary water-yielding zone	Date of water-level measurement	Water level (feet below land surface)	Altitude of water-level surface (feet above sea level)
75	4S-35E- 7ACA1	105	18	x	I	D	4,465	BSLT	4-10	68.73 V	4,414
76	4S-35E- 7BCA1	228	203	x	I	D	4,326	BSLT	4-10	43.06 V	4,414
77	4S-35E- 7CCBB1	525	227	x	I	D	4,228	BSLT	4-10	36.52 V	4,412
78	4S-35E- 7DCB1	228	203	x	I	D	4,315	BSLT	4-10	32.64 V	4,413
79	4S-35E-17BAC1	—	—	—	I	—	—	BSLT?	4-10	50.53	4,414
80	4S-35E-17DDA1	87	49	x	I	D	4,426	BSLT	4-10	62.16 V	4,413
81	4S-35E-18ACB1	466	177	x	I	D	4,271	BSLT	4-10	34.29 V	4,413
82	4S-35E-18CDA1	265	124	x	I	D	4,317	BSLT	4-10	25.66 V	4,414
83	4S-35E-18DABC1	—	—	—	H	—	—	UD?	4-11	30.34	4,410
84	4S-35E-29CBC1	180	75	x	I	D	4,388	BSLT	4-10	48.98 V	4,411
85	4S-35E-29DACA1	—	—	—	H	—	—	BSLT?	4-11	92.98	4,407
86	4S-35E-30ACC1	—	—	—	H	—	—	UD?	4- 9	35.05	4,410
87	4S-35E-31CBBB1	125	117	x	H	D	4,454	BSLT	4- 9	54.68	4,413
88	5S-34E-5DADD1	63	63	o	H	D	—	UD	4-17	38.47	4,390