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Hydrologic and Chemical Data from the Long Valley Hydrologic Advisory Committee Monitoring Program in Long Valley Caldera, Mono County, California, 1988-1997

By **Michael L. Sorey and Christopher D. Farrar**

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ABSTRACT

This report presents hydrologic and chemical data from the Long Valley Hydrologic Advisory Committee Monitoring Program in Long Valley caldera over the period 1988-1997. Data were collected by the U.S. Geological Survey at sites to the east and west of the geothermal development area at Casa Diablo and precipitation data were provided by the U.S. Forest Service. The data are based on both continuous and instantaneous measurements of ground-water levels and pressures in wells and a thermal pool, discharge of streams, discharge and temperature of springs, annual precipitation at the Mammoth Ranger Station, and chemical analyses of selected ions in water samples.

INTRODUCTION

Geothermal energy development in the Long Valley caldera in eastern California began in 1985 with startup of the MP-I binary power plant at Casa Diablo (fig. 1). Two additional binary plants, MP-II and PLES-I, were added in December 1990, bringing the total installed capacity at present to approximately 40 megawatts. The Long Valley Hydrologic Advisory Committee (LVHAC) is an advisory committee to the Mono County Board of Supervisors and to regulatory agencies that oversee the environmental aspects of both geothermal development and development of nonthermal ground water in the Long Valley caldera. The LVHAC is guided in this endeavor by existing county, state, and federal regulations and permits and by hydrologic monitoring programs carried out by the U.S. Geological Survey (USGS) and by Mammoth Pacific, Limited Partnership (MPLP), in cooperation with Mono County.

Purpose, Scope, and Format

Results of these hydrologic monitoring programs have been presented in a series of unpublished reports issued quarterly since 1988 to the LVHAC by the USGS and Mesquite Group, Inc., a consultant to MPLP. The data collected by the geothermal operator are proprietary and are not included in this report. Presentation of the publically available monitoring data in a single report is needed to enable regulatory agencies to assess existing conditions and any changes that may have taken place in the hydrologic system since monitoring began.

This report contains graphical and tabular records of hydrologic and chemical data collected by the USGS, for most sites over the period of 1988-1997 but at two sites over somewhat longer periods. Each graph uses a common time axis and records are grouped under several categories, including (1) water levels in wells and spring pools, (2) precipitation and streamflow measurements, and (3) other types of data such as discharge and temperature of springs and calculated thermal-water discharge in springs in Hot Creek Gorge and the Fish Hatchery. A table listing chemical analyses for water samples collected by the USGS at various sites is also included.

Most of the data presented here are based on field measurements, expressed in the measured units. Values of thermal-water discharge from springs in Hot Creek Gorge were calculated from combinations of field measurements of streamflow and laboratory analyses of selected chemical constituents, as described in a subsequent section of this report.

Descriptions of Study Area and Monitoring Sites

All hydrologic monitoring sites and sites of geothermal and nonthermal groundwater development described in this report are located within the Long Valley caldera (figs. 1 and 2). The caldera forms a well-defined surface-water drainage basin with a single outlet by way of the Owens River in the southeastern part. A number of perennial and intermittent streams drain from the mountains that border the southern and western sides of the caldera. Fewer streams drain the mountains to the north because there is less precipitation. These peripheral streams drain toward one of two main east-flowing streams on the caldera floor, Mammoth Creek on the south and Owens River on the north. Lake Crowley is an artificial reservoir formed by Long Valley Dam across the Owens River. The reservoir receives water from streams inside the caldera and from water imported from the Mono Basin located north of the caldera. The imported water is transported 11 miles through a tunnel and discharged into the Owens River about 15 miles upstream of Lake Crowley. The reservoir is part of the water-supply system for the City of Los Angeles.

Wells monitored by the USGS include RDO-8, M-14, SC-2, SQ, CW-3, and CH-10B. Water levels are also monitored by the USGS in Hot Bubbling Pool (site HBP), a spring-fed hot pool with no surface outlet. Springs for which discharge measurements are reported here include Colton Spring (CS) and spring groups AB, CD, and 2,3 at the Fish Hatchery (sites FHAB, FHCD, and FH2,3). The discharge of thermal springs in Hot Creek Gorge is not measured directly because there are a large number of spring vents, some of which discharge subaqueously in the bed of Hot Creek. Instead, the combined discharge from all the thermal springs is calculated from measurements of chloride and boron flux in Hot Creek, as discussed in a subsequent section. Streamflow and water chemistry data are reported for two sites on Mammoth Creek (MC395 and MCAF) and two sites on Hot Creek (HCA and HCF). Precipitation data collected by the U.S. Forest Service at the Mammoth Ranger Station are also included in this report.

Previous Reports

Hydrologic data from the USGS volcano hazards monitoring program have been published in reports by Farrar and others (1985; 1987; 1989) and Howle and Farrar (1996). The latter report covers the period 1987-93 and includes data from USGS sites in the LVHAC monitoring network. Other significant data compilations include: California Department of Water Resources (1967; 1973), Lewis (1974), Willey and others (1974), Mariner and Willey (1976), Eccles (1976), and Setmire (1984). In addition, the U.S. Forest Service issued annual reports containing hydrologic data for 1980 through 1985.

ACKNOWLEDGMENTS

Thom Heller, U.S. Forest Service, provided the precipitation data for the Mammoth Ranger Station gage. Gary Sisson was helpful in providing information and access to Mammoth Community Water District well M-14. Donald Barnett, Intermountain Water Consultants, provided water-level data for well CW-3 for 1988-1991. Chris Boone and Dennis Redfern, California Department of Fish and Game, cooperated in numerous ways that assisted data collection at the Hot Creek Fish Hatchery.

METHODS OF DATA COLLECTION

Pressures and Water Levels in Wells and Pools

Continuous pressure measurements in thermal wells CH-10B and RDO-8 (figs. 3 and 6) were made using an above-ground transducer attached to a nitrogen-filled tube (bubbler line) open several feet below the water surface in the well. Water-level measurements made with an electric sounder were used to calibrate the pressure measurements to feet-of-water above the bubbler orifice. Pressures were recorded with a data logger at intervals of 15 minutes to 1 hour. The continuous pressure records were then used to compute daily mean values that were used for the graphs in this report.

Continuous water-level measurements in well CW-3 (fig. 4) were made using a float and shaft encoder in combination with a data logger. Water levels in Hot Bubbling Pool (HBP; fig. 5) were measured by several techniques, including a siphon and manometer to measure changes in water pressure above the siphon inlet and direct measurements of the depth of the pool surface below a datum on the northeast side of the pool. The entire record for this site has been converted to reflect changes in water level relative to a common arbitrary datum. The pool receives discharge from one or more subaqueous spring vents. Changes in water level in the pool are presumed to reflect changes in pressure in the subsurface conduit(s) supplying thermal water to the pool.

Depths-to-water in cold-water wells M-14, SC-2, and SQ (figs. 7-9) were measured on a monthly basis using chalked steel tapes or calibrated electric sounders, following procedures described by Garber and Koopman (1968). The water levels were measured with reference to a convenient measuring point on the well head and then adjusted to depth below land surface.

Flow Measurements in Springs and Streams

Streamflows and spring discharge were measured using velocity meters, weirs, and flumes. Procedures used are described by Buchanan and Somers (1969) and Kilpatrick and Schneider (1983). For sites where continuous measurements were made (HCF, CS, and the Fish Hatchery spring groups), daily mean values of flow were computed from stage records and a stage-discharge relation equation (Rantz and others, 1982; Kennedy, 1983, 1984). Stage was measured using a float, tape, and counter weight suspended over a pulley and was recorded electronically using a shaft-encoder and data logger, and in some cases on a graphic chart recorder for backup. For sites HCF, CS, and FHAB, plots are included of daily mean values of total discharge of all vents (figs. 12, 16, and 18). For sites FHAB and FHCD and the combination of these

two sites, plots are also included of instantaneously measured discharge during monthly visits (figs. 19, 20, and 21). For site FH2,3, the continuous discharge record was converted to monthly mean values for plotting (fig. 22)

Water-Temperature Measurements

Continuous water temperature measurements at the Hot Creek Fish Hatchery were made in the AB, CD, and H2,3 spring groups. At FHAB, several spring vents discharge subaqueously to a pool about 400 ft long and 10-25 ft wide. From June 1988 to October 1992, water temperatures were measured with a thermistor placed at the west end of the pool, 0.1 ft above the pool floor and above a subaqueous spring vent. The flow of the vent declined during January 1992 and within a few weeks there was no measurable evidence of discharge. During the period January to March 1992, water at the west end of the pool became stagnant and was cooled by winter air temperatures. In March 1992, the temperature measurement site was moved to the east end of the pool near the weir at the outflow point. At this site, the temperature recorded is a flow-weighted average temperature from all the individual vents. This average temperature is affected mainly by variations in water temperatures at the spring vents, and to a lesser extent by variations in ambient air and soil temperatures. Temperature data from this site and for FHCD are plotted in terms of monthly mean values (figs. 19 and 20).

The FHCD site is similar to the FHAB site, in that several spring vents discharge subaqueously to a collection pool about 700 ft in length. Temperature measurements at this site are made at the west end of the pool using a thermistor placed in the subaqueous discharge stream of an individual vent that issues from between basalt boulders lining the pool side.

At the FH 2,3 site, subaqueous and subaerial springs discharge to a collection pool. A thermistor is placed in a subaerial vent along the southeast side of the pool. Temperature data for this sites are also plotted in terms of monthly mean values (fig. 22).

Chemical Analyses of Water Samples

Water samples for chemical analyses have been collected periodically at various sites, including geothermal production wells MBP-1 and MBP-3 at Casa Diablo and springs and streams located east of Casa Diablo. Laboratory analyses for samples collected by the USGS were performed at the USGS Central Laboratory in Arvada, Colorado (table 1).

Water samples from subaerial springs were collected by dipping a polyethylene container into the discharge stream as near the vent as possible. Samples from

subaqueous springs and streams were collected using a depth-integrated sampler and equal-width stationing. Fluid samples were collected by the USGS from geothermal production wells MBP-1 and MBP-3. The combined fluid-vapor samples were condensed to a liquid in a coil of stainless steel tubing immersed in an ice-water bath and cooled from ~170°C to 30°C.

Aliquots of each water sample were used to determine alkalinity, pH, and specific conductance in the field. Aliquots for laboratory analyses were prepared in the field by suitable filtering and acidification procedures. Analytical methods used in the USGS laboratory are described in a report by Fishman and Friedman (1989).

Thermal-Water Discharge Calculations

Springs in Hot Creek Gorge (HCG) discharge thermal water at temperatures near boiling (93°C) into Hot Creek along an ~0.6 km reach. A chemical-flux technique is used to measure the combined flow of all spring vents (fig. 17). Eccles (1976) and Sorey and Clark (1981) describe previous applications of this method to Hot Creek, and Sorey and others (1994) describe the application at Lassen Volcanic National Park. The method is based on the fact that as the chemically concentrated thermal water from hot springs mixes with dilute, nonthermal water in the creek, the flux of conservative elements such as chloride and boron in the creek increases in proportion to the rate of thermal-water input.

For Hot Creek Gorge, values of chloride and boron flux at site HCA above the thermal springs and site HCF below the thermal springs were calculated from the product of streamflow and average concentration of Cl and B, determined from depth-integrated, equal-width sampling across each stream section. For each element, the difference in chemical flux between sites, divided by an assumed concentration of that element in the hot-spring water yields a value of thermal-water discharge. Values of 220 mg/L and 10 mg/L for the Cl and B concentrations in hot-spring water were selected as representative of previous analyses of spring samples (see, for example, data for spring HC-3 listed in table 1).

Values of thermal-water discharge sites FHAB and FHCD at the Fish Hatchery were calculated by a similar method, using measurements of the Cl and B flux in the total discharge of each spring group (figs. 19-21). For each element, the flux contributed by the thermal-water component was first calculated by subtracting the flux contributed by the nonthermal-water component from the total flux. Values of Cl and B concentration in the thermal-water component of each spring group were assumed to be the same as the average values of thermal water produced from the wells at Casa Diablo: Cl = 220 mg/L and B = 10 mg/L. Values of Cl and B in the nonthermal component in these springs (Cl = 0.3 mg/L and B = 0.01 mg/L) were estimated from concentrations

in cold springs in the southern part of the caldera. The choice of other values for these reference Cl and B concentrations would alter the absolute values calculated for thermal-water discharge, but would not significantly alter the calculated changes over the monitoring period.

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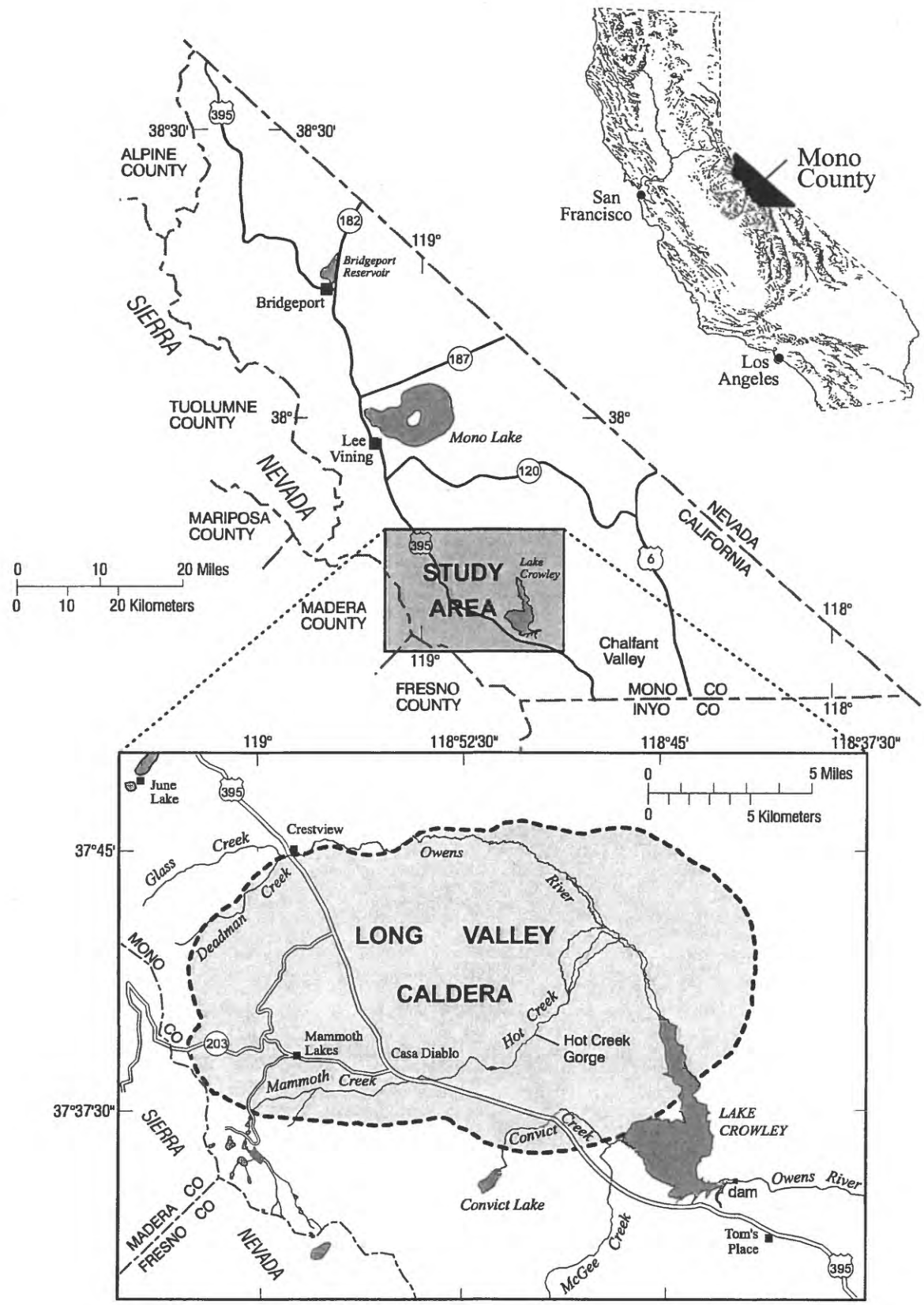


Figure 1. Location of Long Valley Caldera study area, Mono County, California.

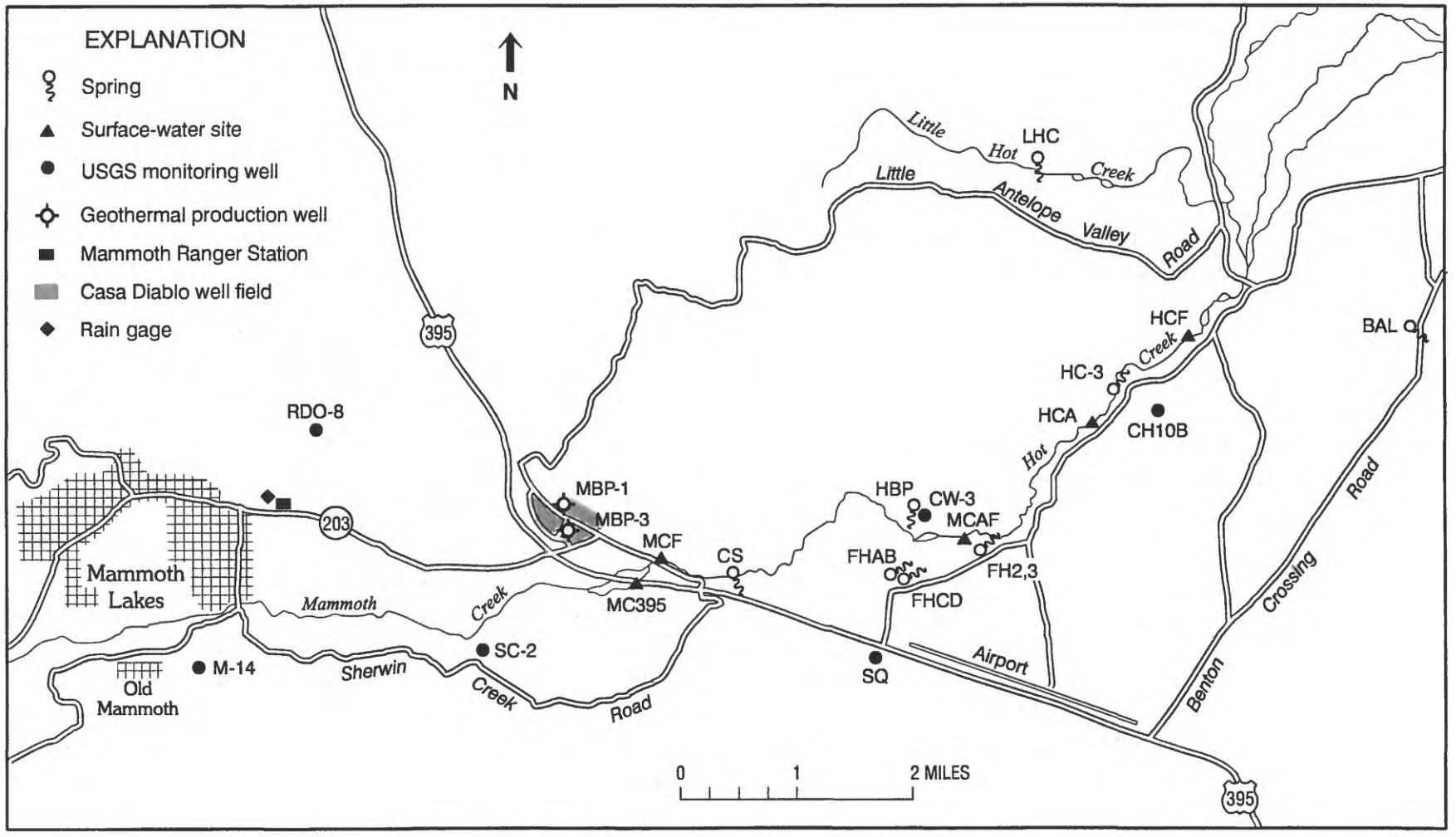


Figure 2. Map showing locations of monitoring sites in Long Valley caldera where hydrologic and chemical data are collected by the U.S. Geological Survey for the Long Valley Hydrologic Advisory committee. Geothermal production wells MBP-1 and MBP-3 noted in text and tables are shown within the shaded region at Casa Diablo.

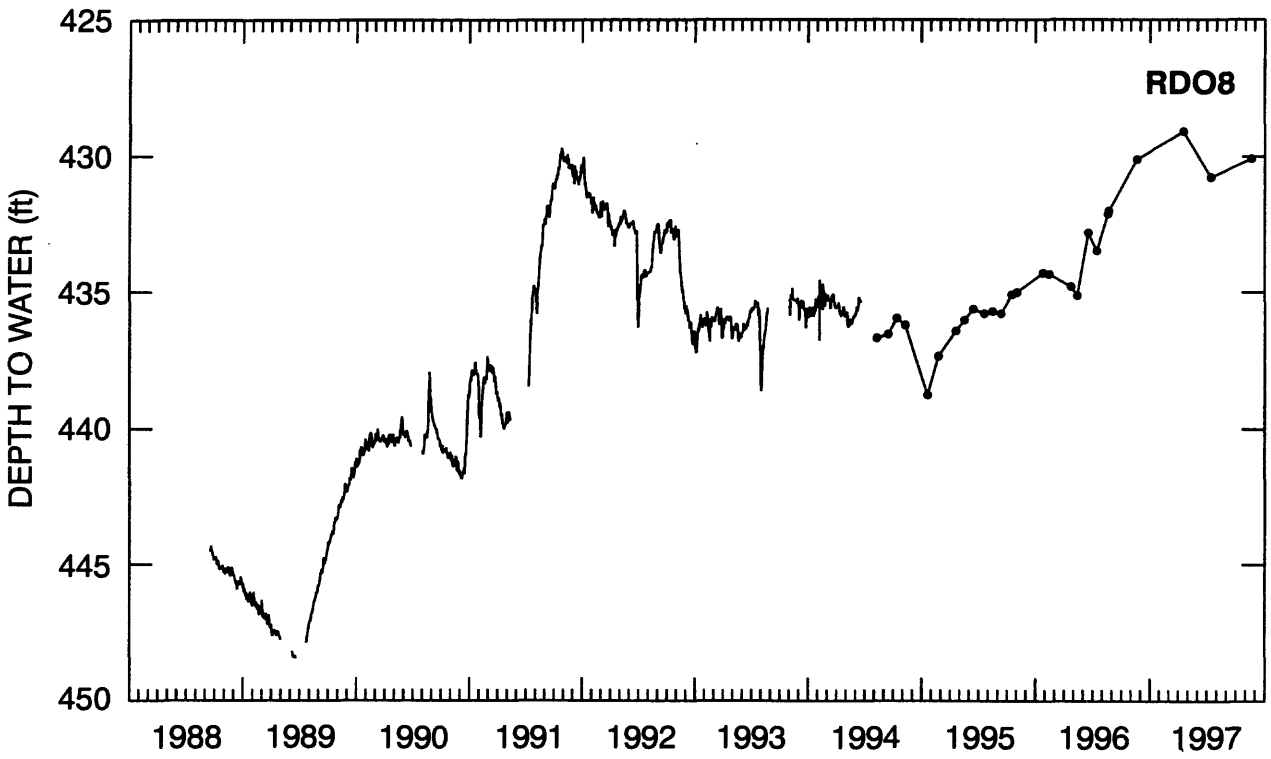


Figure 3. Graph of daily mean values of depth-to-water in observation well RDO-8, 1988-1994, and instantaneous measurements 1994-1997. Continuous monitoring was suspended in this well in 1994.

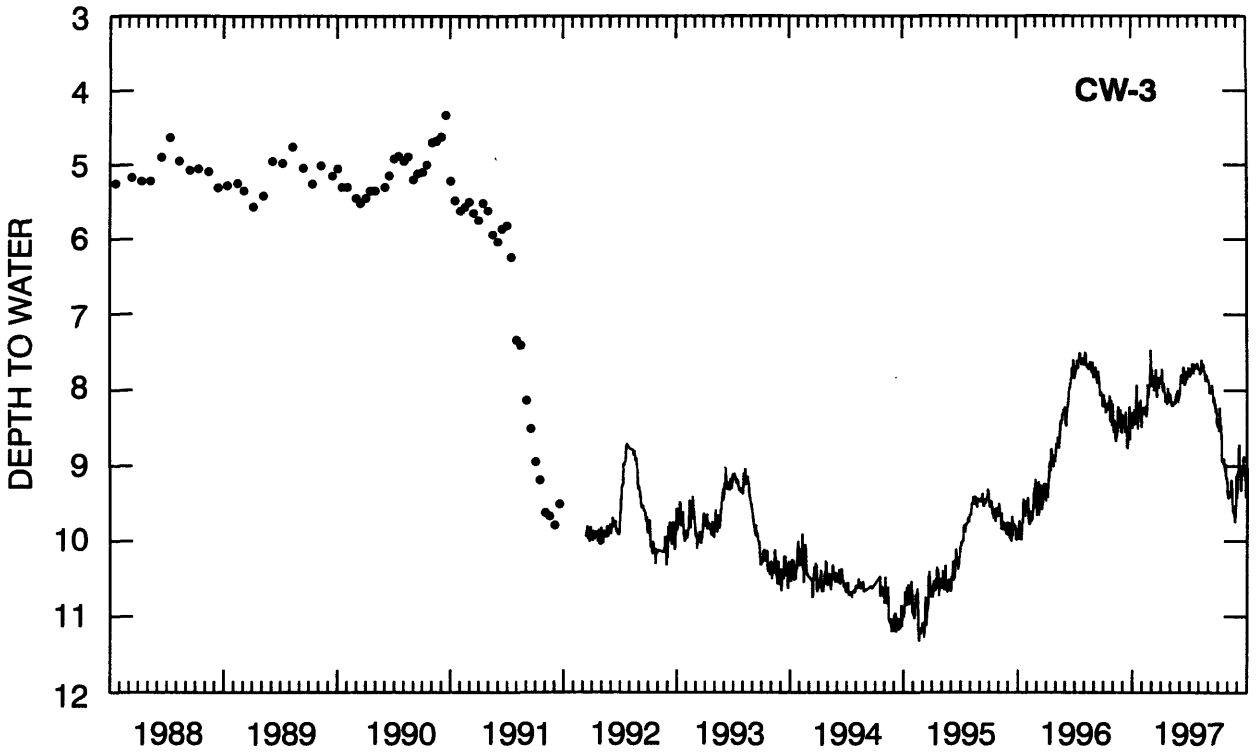


Figure 4. Graph of depth-to-water below land surface in observation well CW-3, 1988-1997. Data prior to March 11, 1992, are based on periodic instantaneous measurements (Donald Barnett, Intermountain Water Consultants, written commun. 1993). Data after that time are based on daily mean values of depth-to-water recorded continuously.

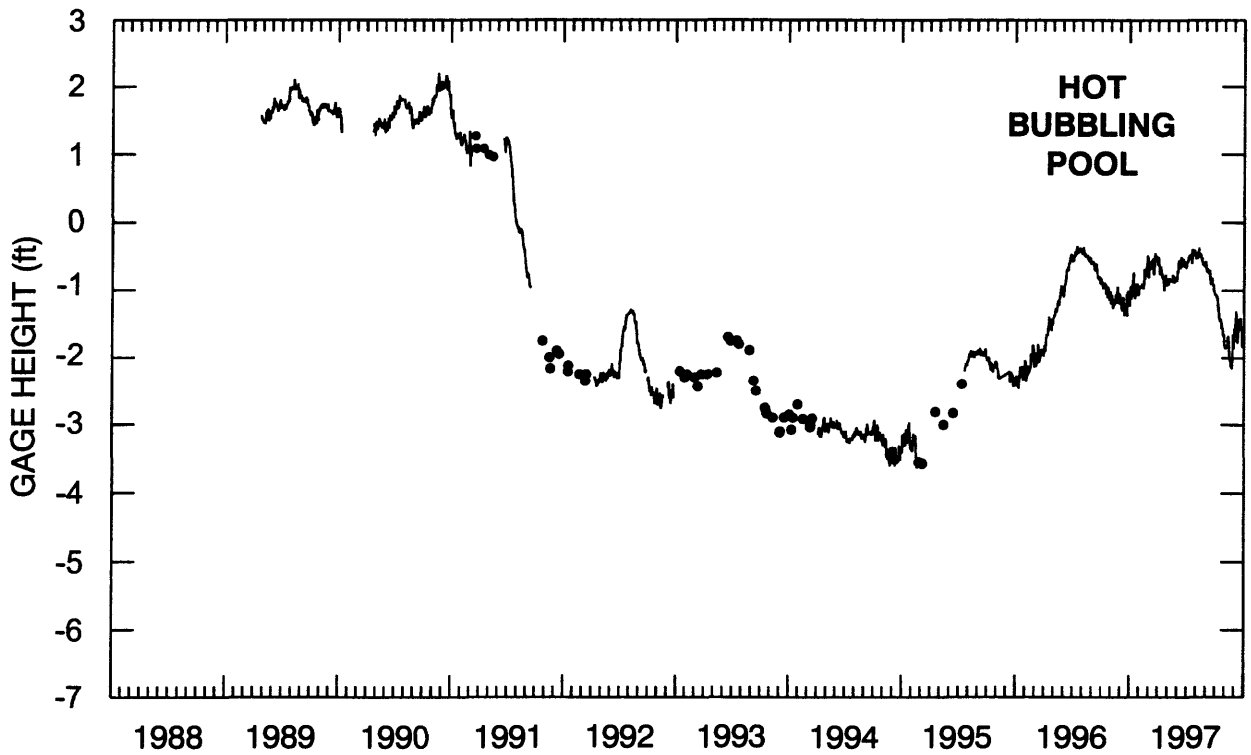


Figure 5. Graph of daily mean values of water level relative to an arbitrary datum near land surface at Hot Bubbling Pool, 1988-1997. Miscellaneous data points for periods of missing record are based on instantaneous measurements.

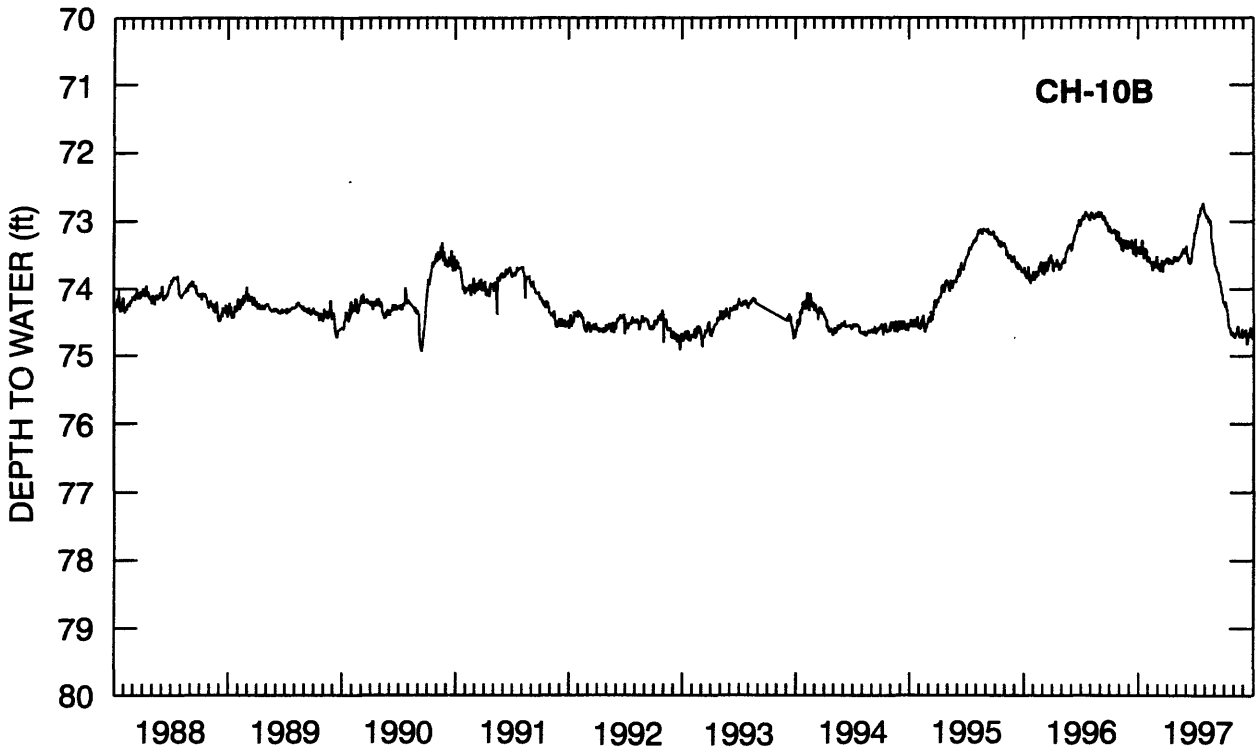


Figure 6. Graph of daily mean values of depth-to-water below land surface in observation well CH-10B, 1988-1997.

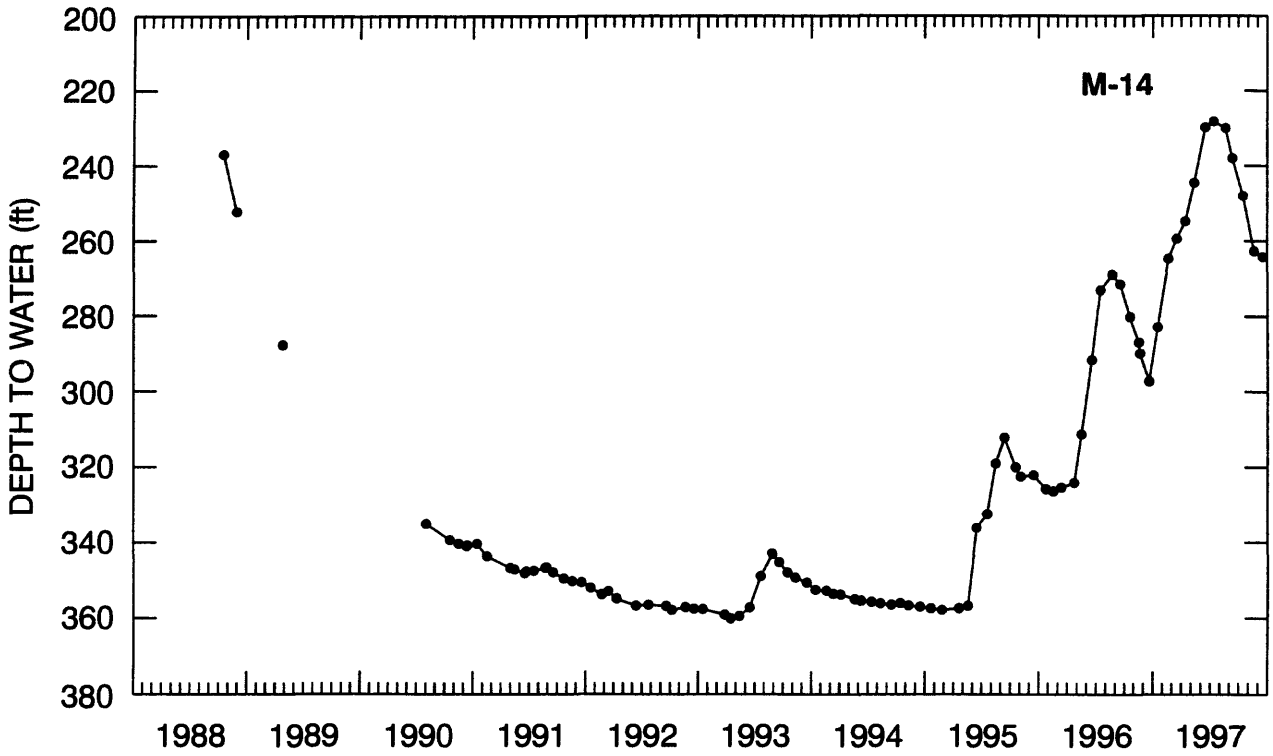


Figure 7. Graph of instantaneous measurements of water level below land surface in observation well M-14, 1988-1997.

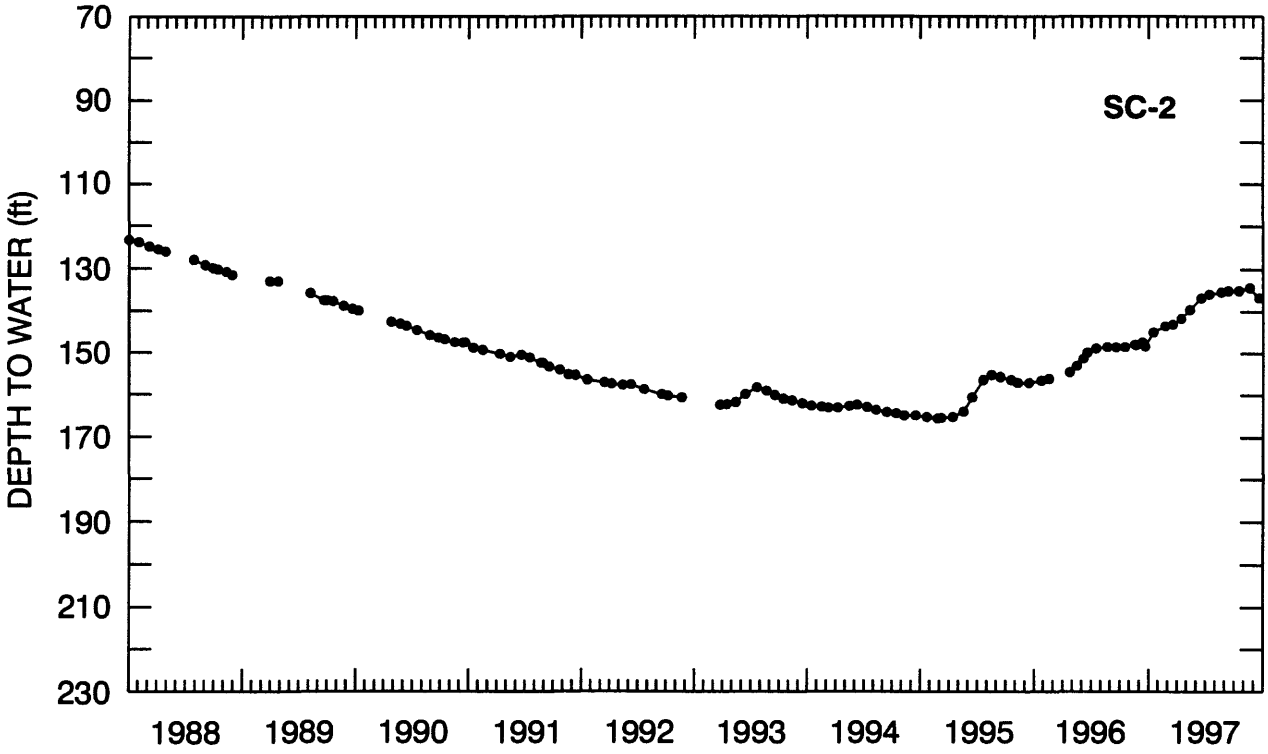


Figure 8. Graph of instantaneous measurements of water level below land surface in observation well SC-2, 1988-1997.

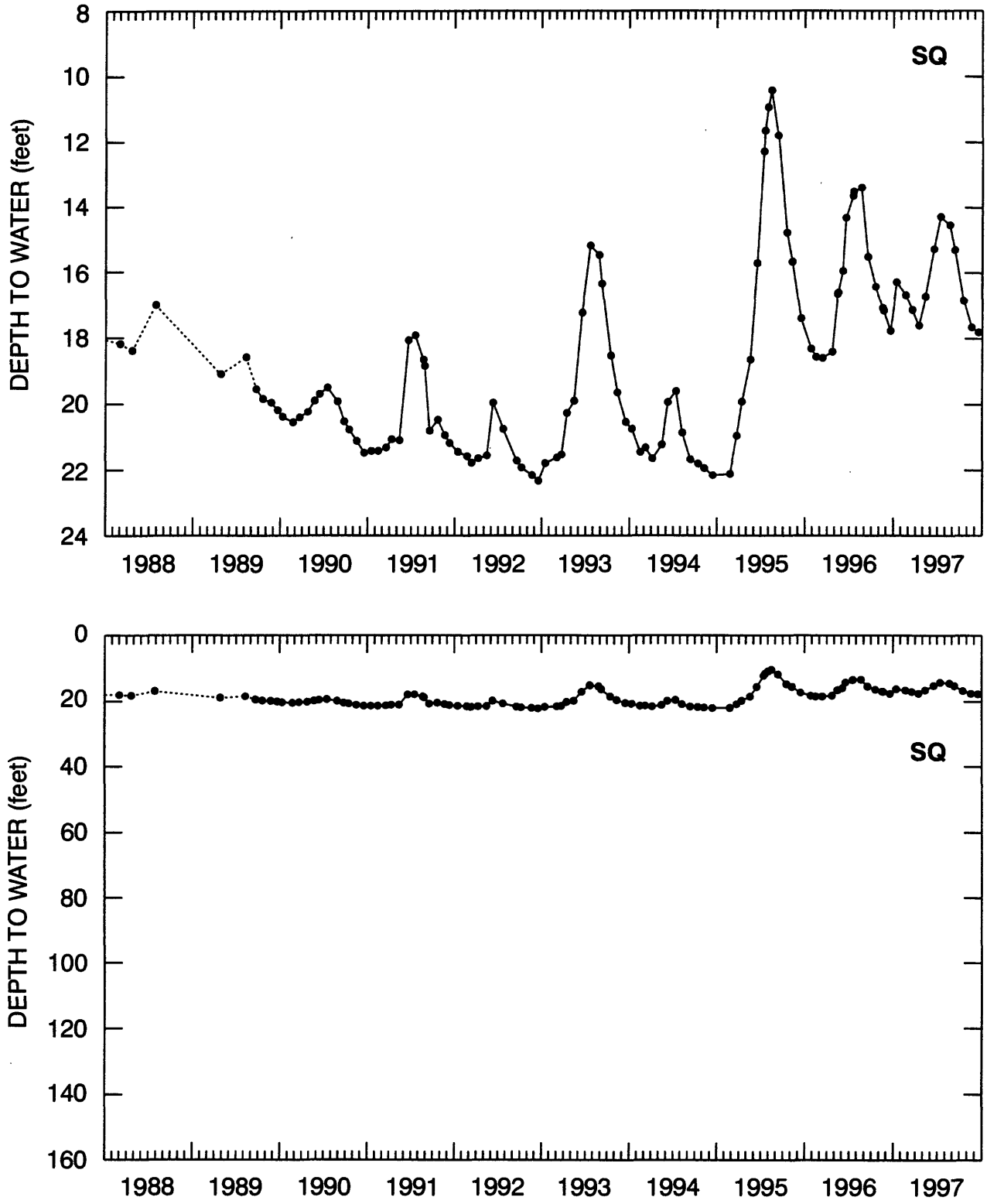


Figure 9. Graphs at two different scales of instantaneous measurements of depth to water in observation well SQ, 1988-1997.

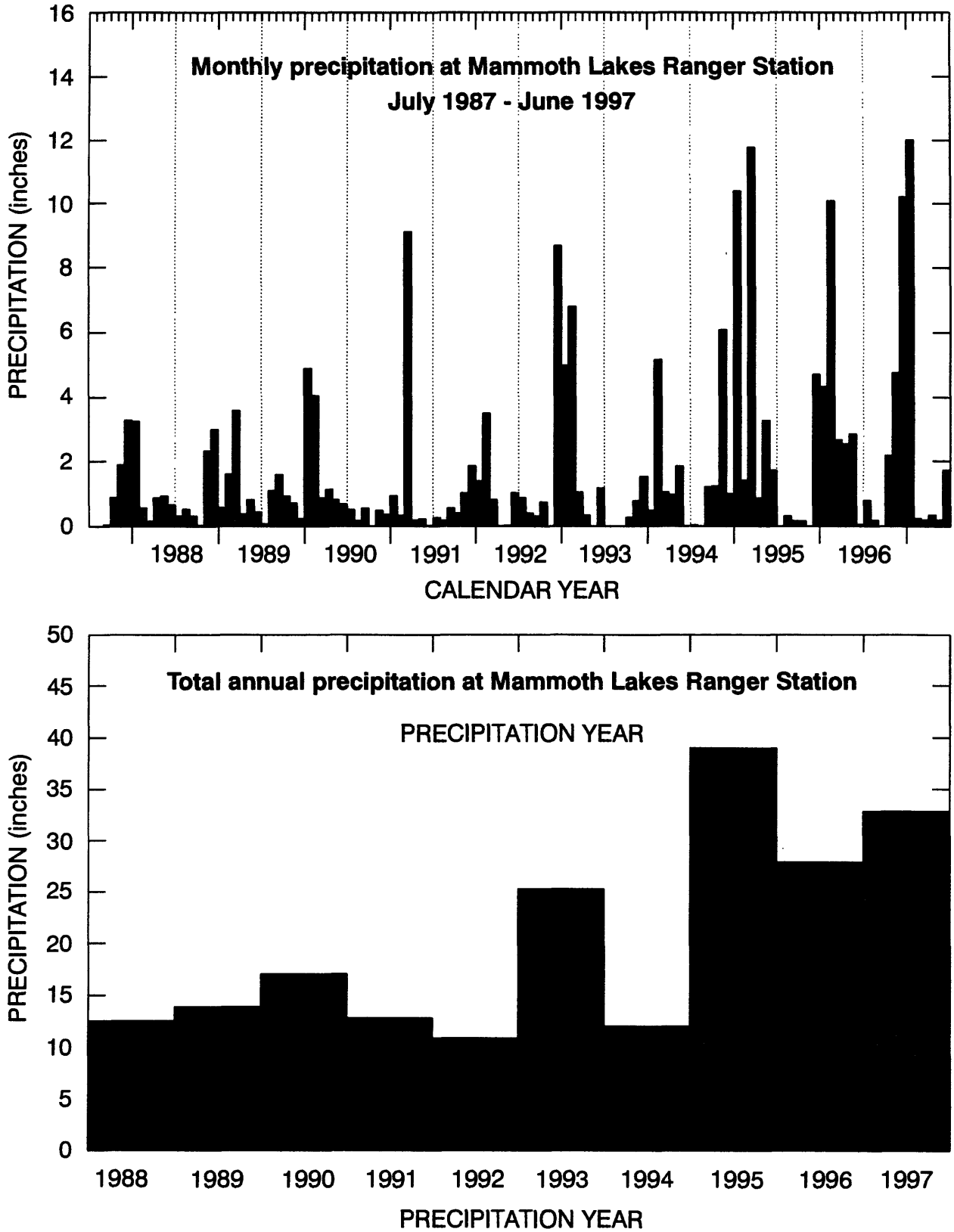


Figure 10. Graphs of monthly precipitation and total annual precipitation in precipitation years (July 1-June 30) at Mammoth Lakes Ranger Station for 1988-1997.

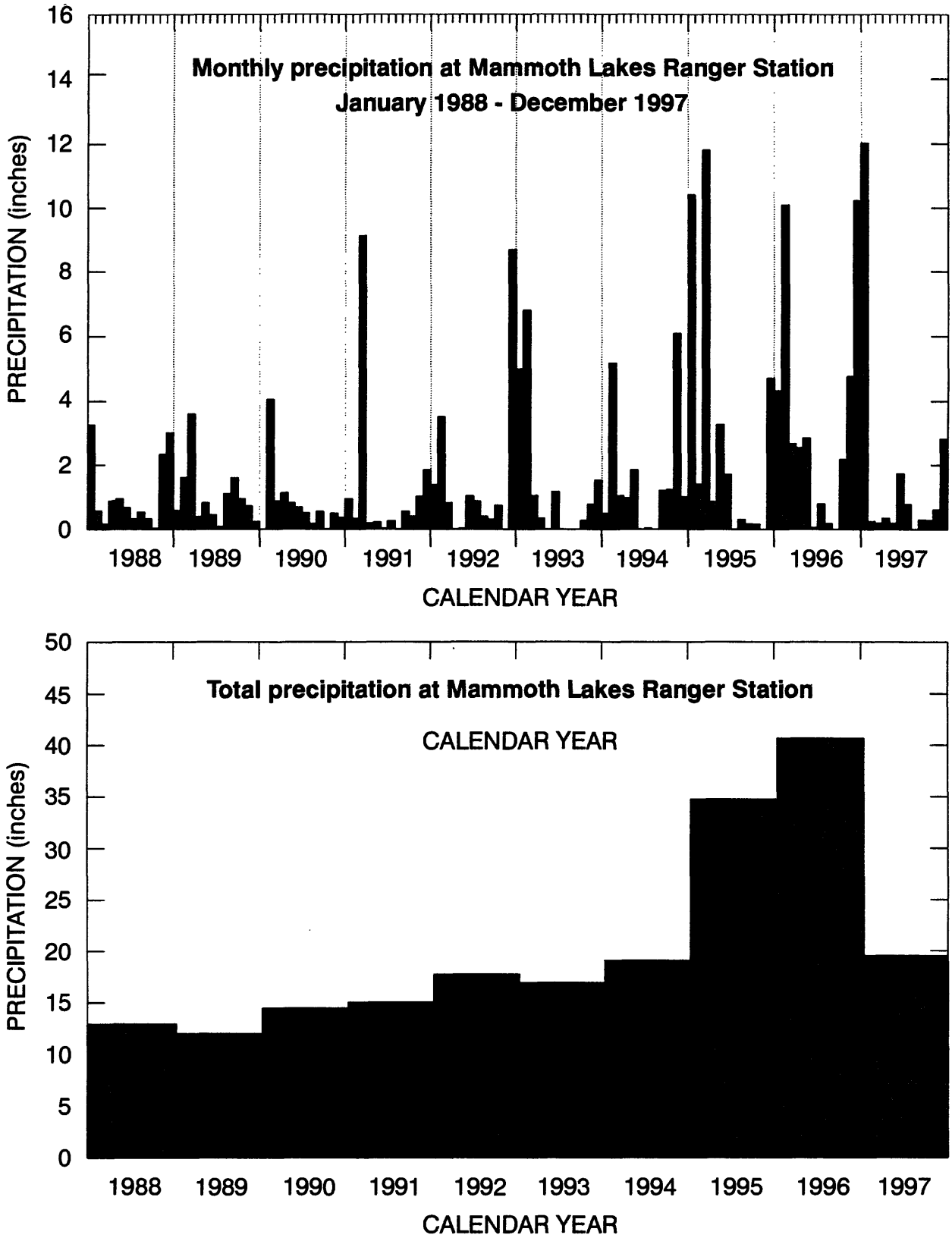
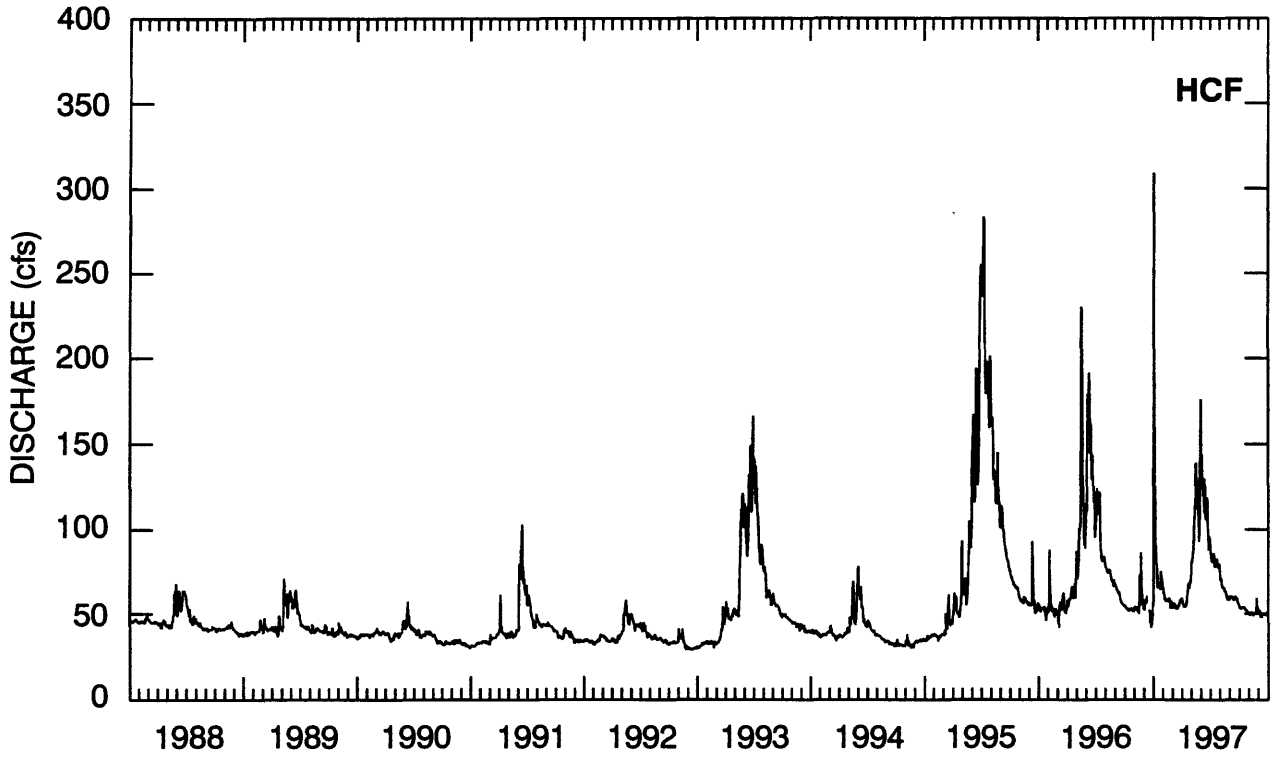


Figure 11. Graphs of monthly precipitation and total annual precipitation in calendar years (January 1-December 31) at Mammoth Lakes Ranger Station for 1988-1997.



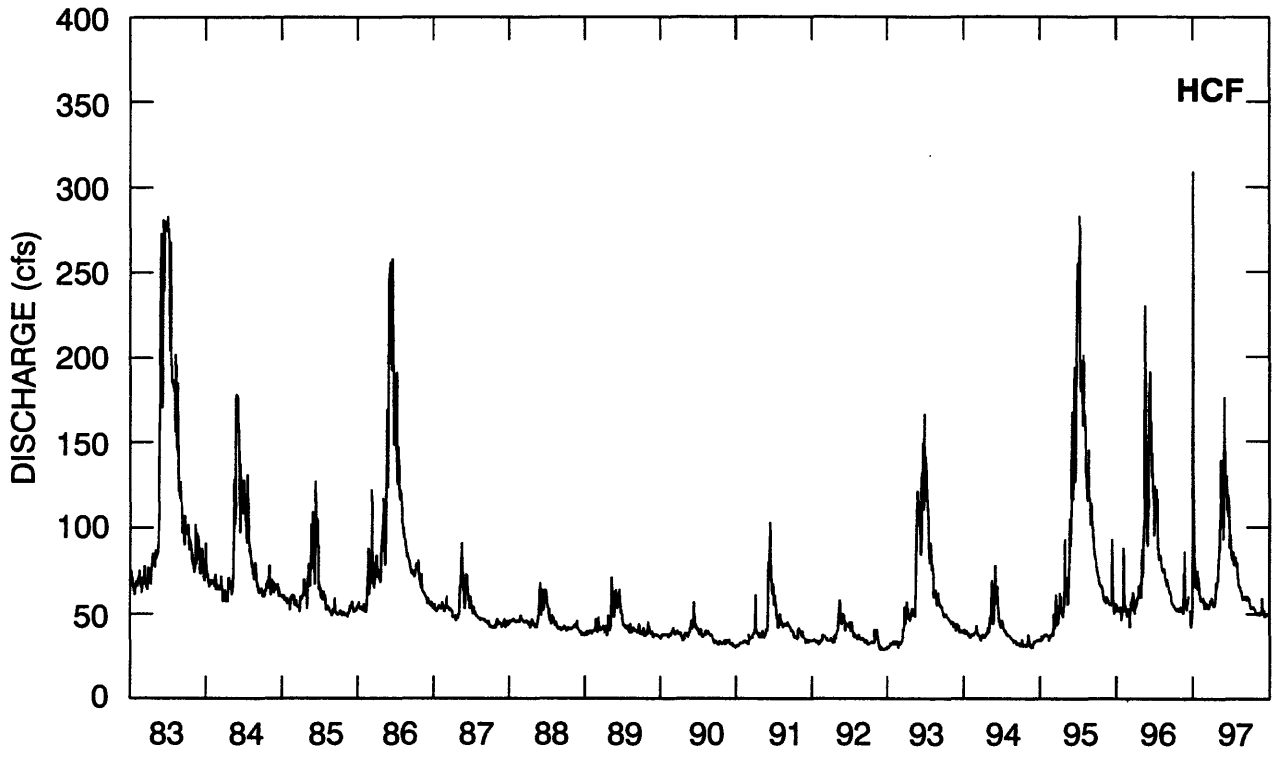


Figure 12. Graphs of daily mean discharge at Hot Creek Flume (HCF), 1988-1997 and 1983-1997.

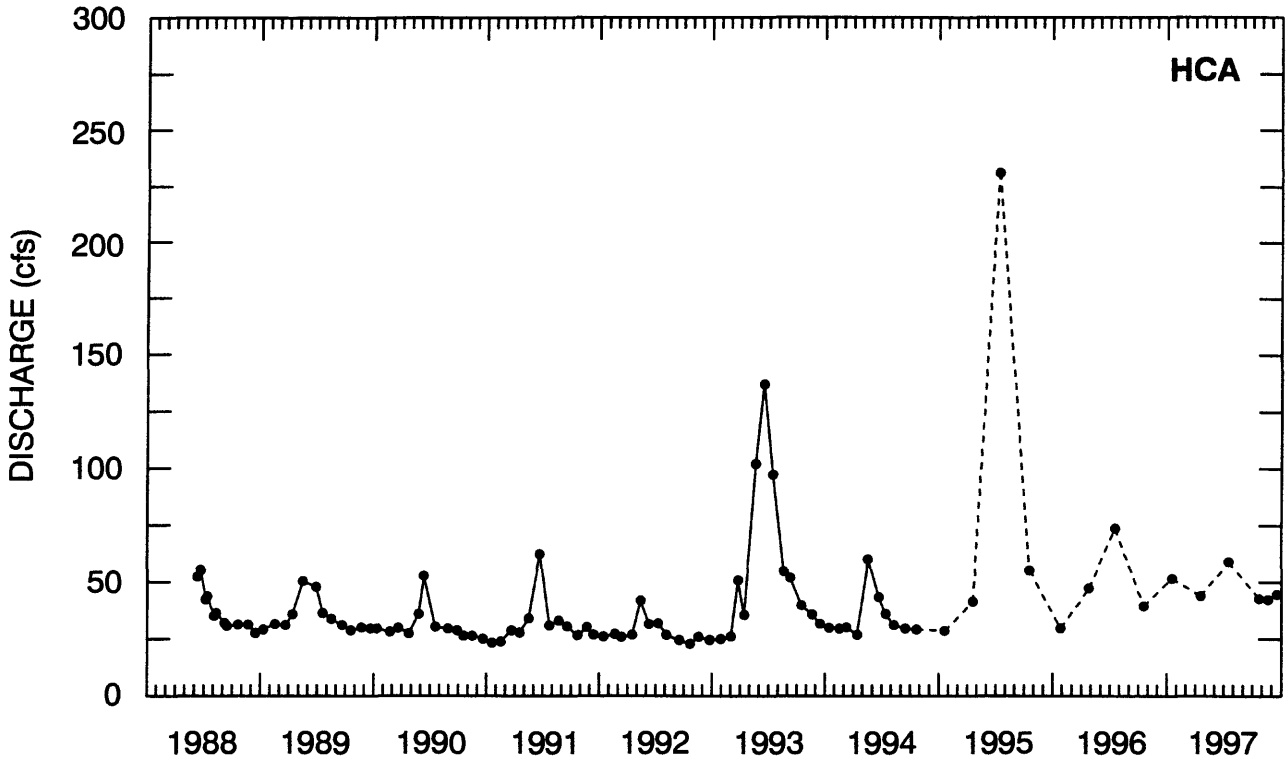


Figure 13. Graph of instantaneous measurements of discharge in Hot Creek above the thermal springs in the gorge (HCA), 1988-1997.

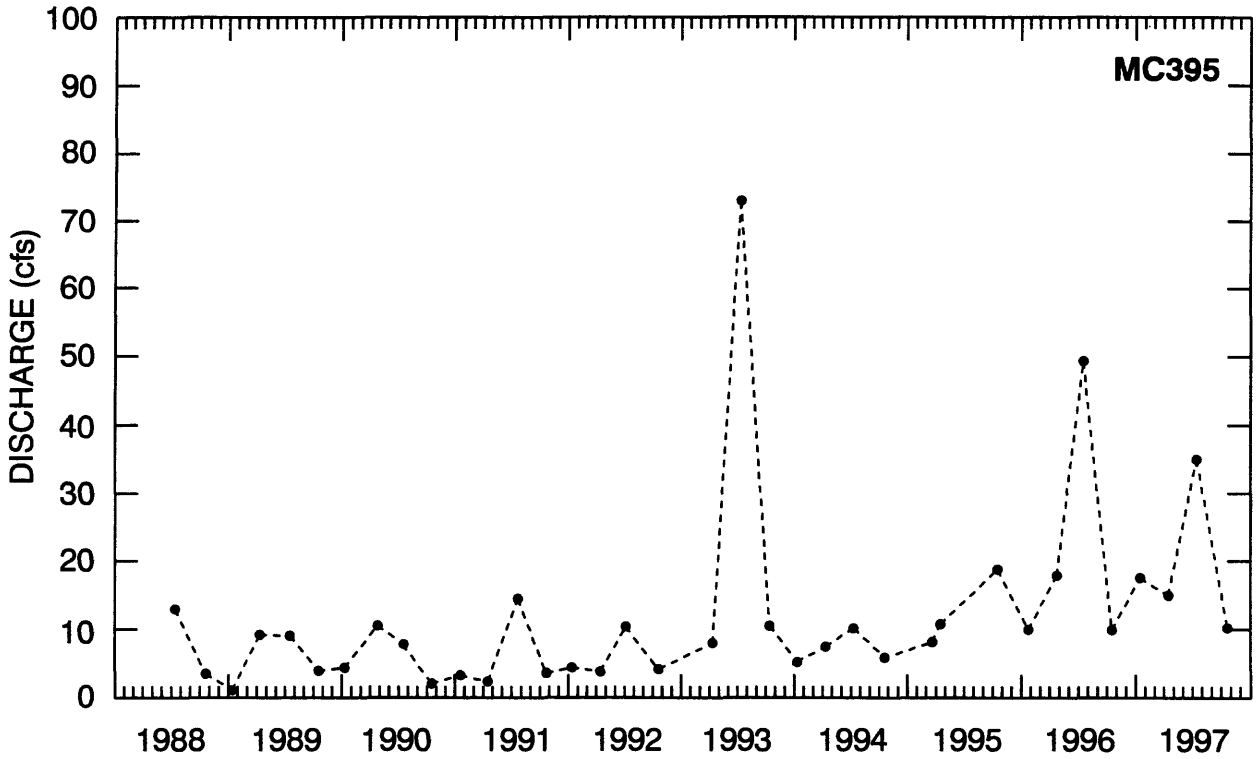


Figure 14. Graph of instantaneous measurements of discharge in Mammoth Creek at Highway 395 (MC395), 1988-1997.

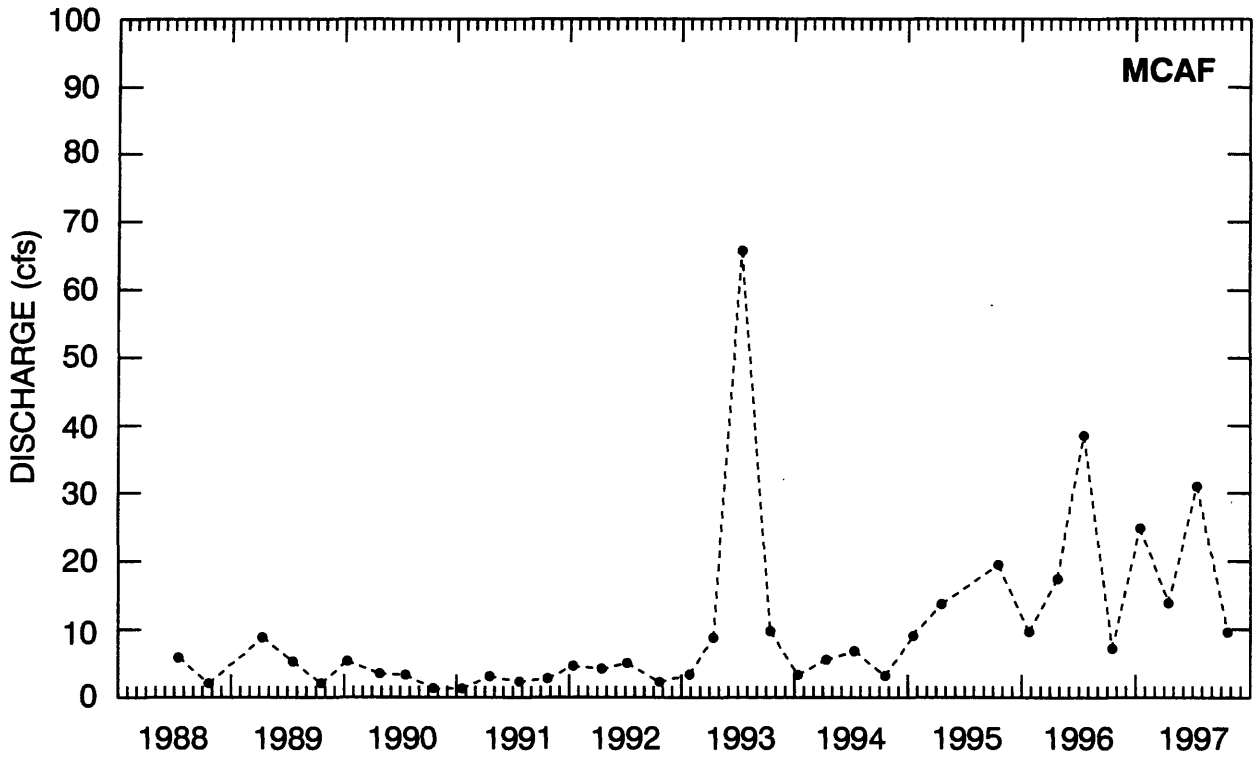


Figure 15. Graph of instantaneous measurements of discharge in Mammoth Creek above the input from the Fish Hatchery (MCAF), 1988-1997.

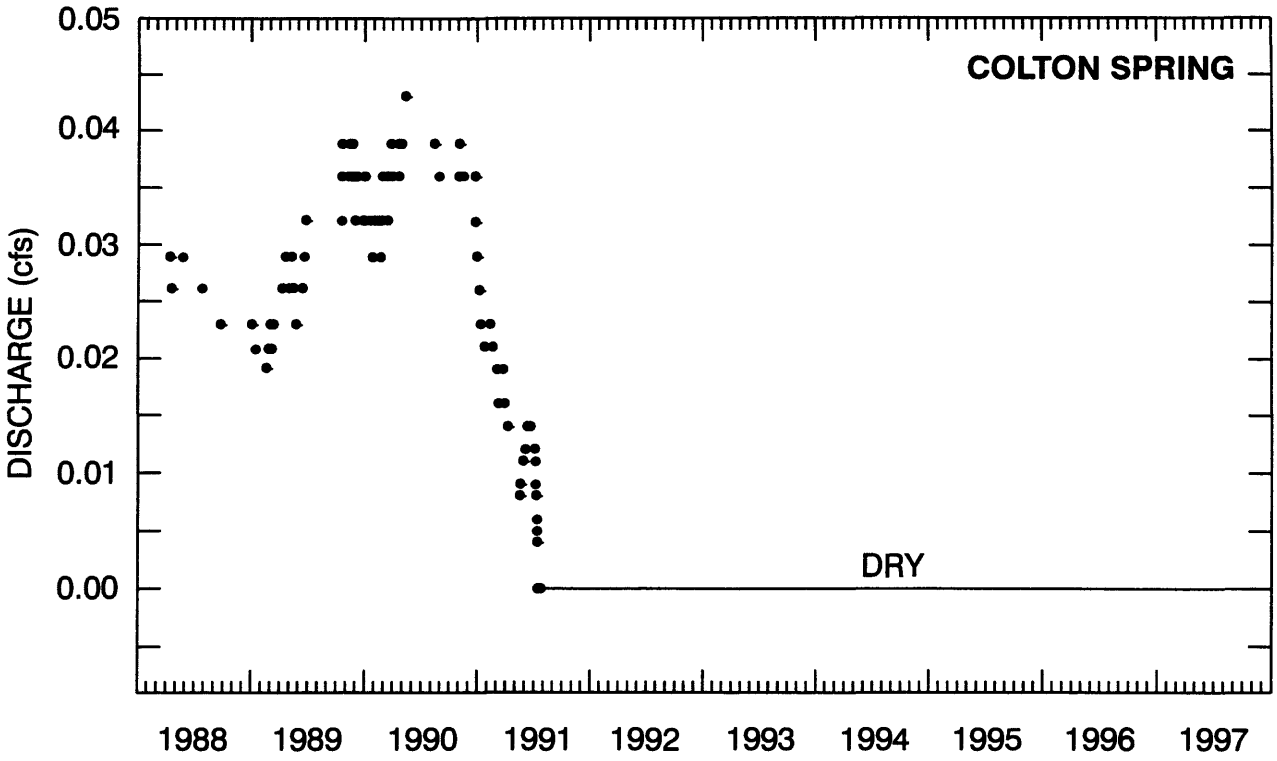


Figure 16. Graph of daily mean discharge and instantaneous discharge measurements at Colton Spring (CS), 1988-1997.

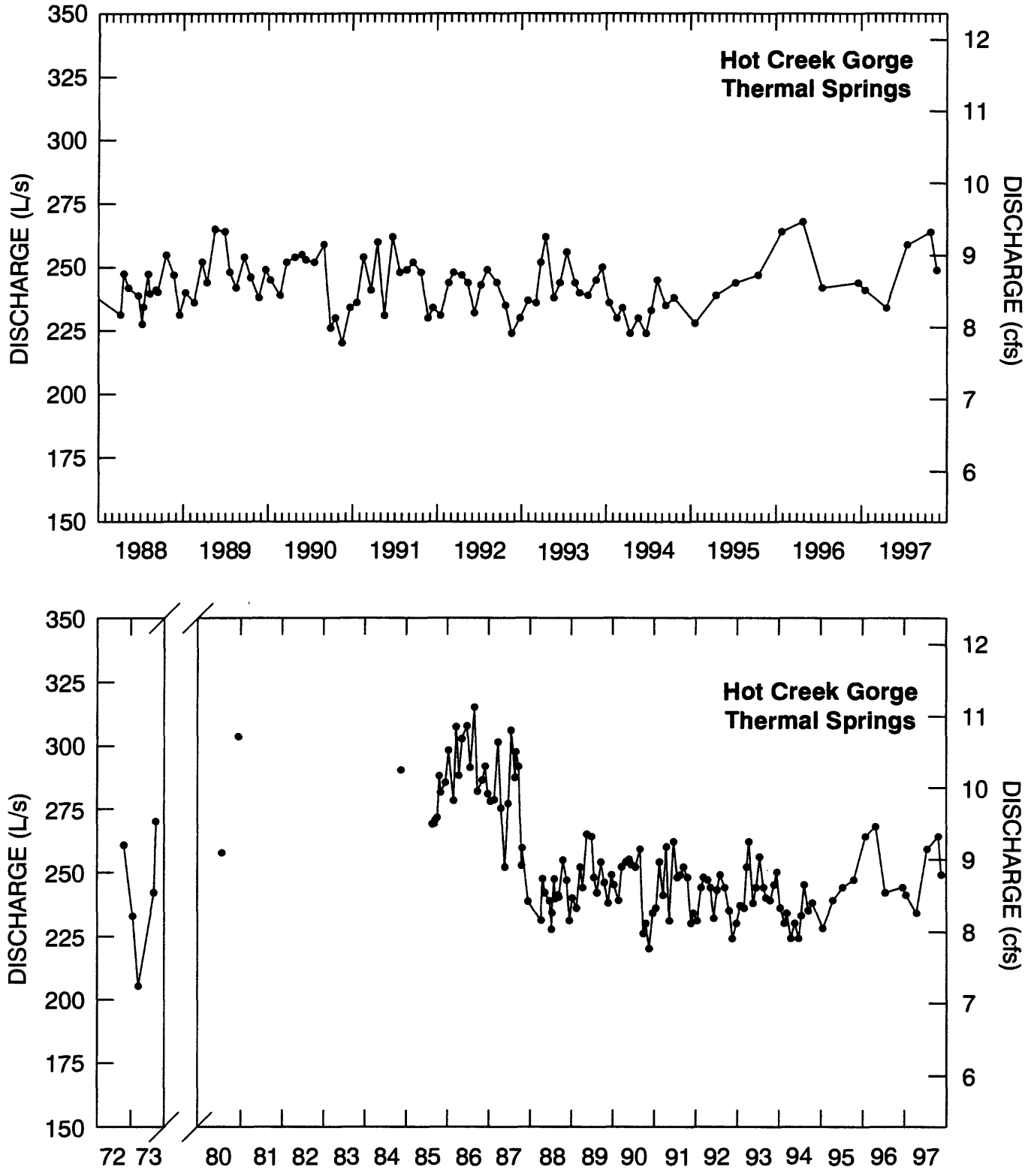


Figure 17. Graphs of calculated thermal-water discharge from hot springs in Hot Creek Gorge (HCG), 1988-1997 and 1972-1997.

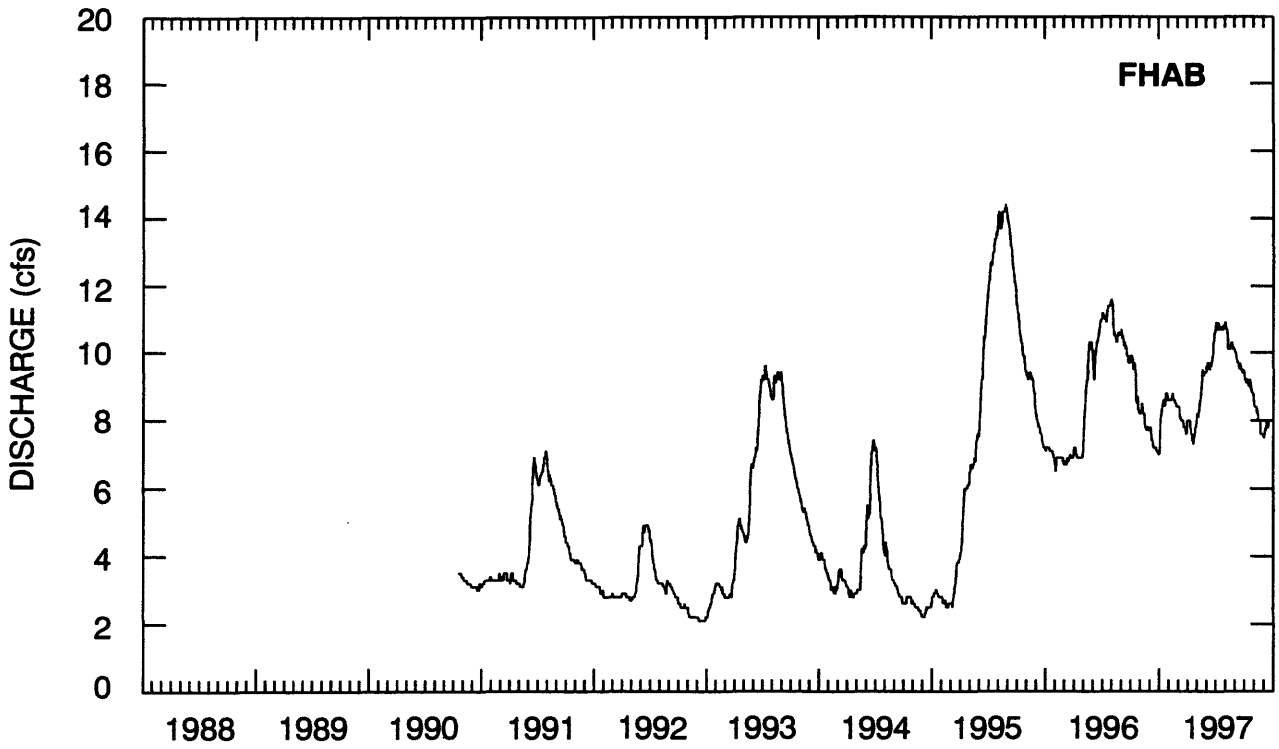


Figure 18. Graph of daily mean discharge, Fish Hatchery spring group AB (FHAB), 1988-1997. Continuous monitoring began at this site in 1990.

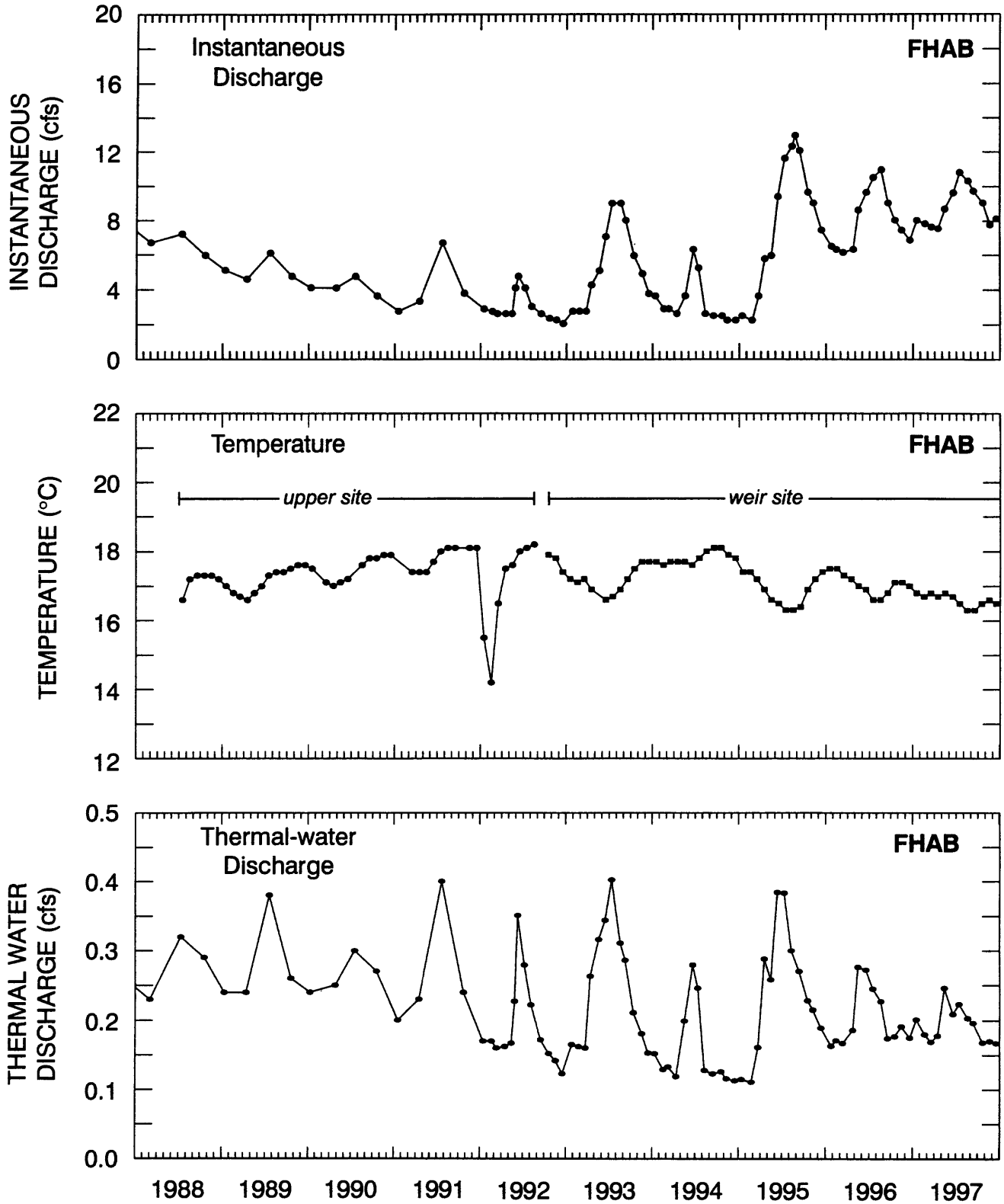


Figure 19. Graphs of instantaneous total discharge, monthly mean temperature, and calculated thermal-water discharge, Fish Hatchery spring group AB (FHAB), 1988-1997.

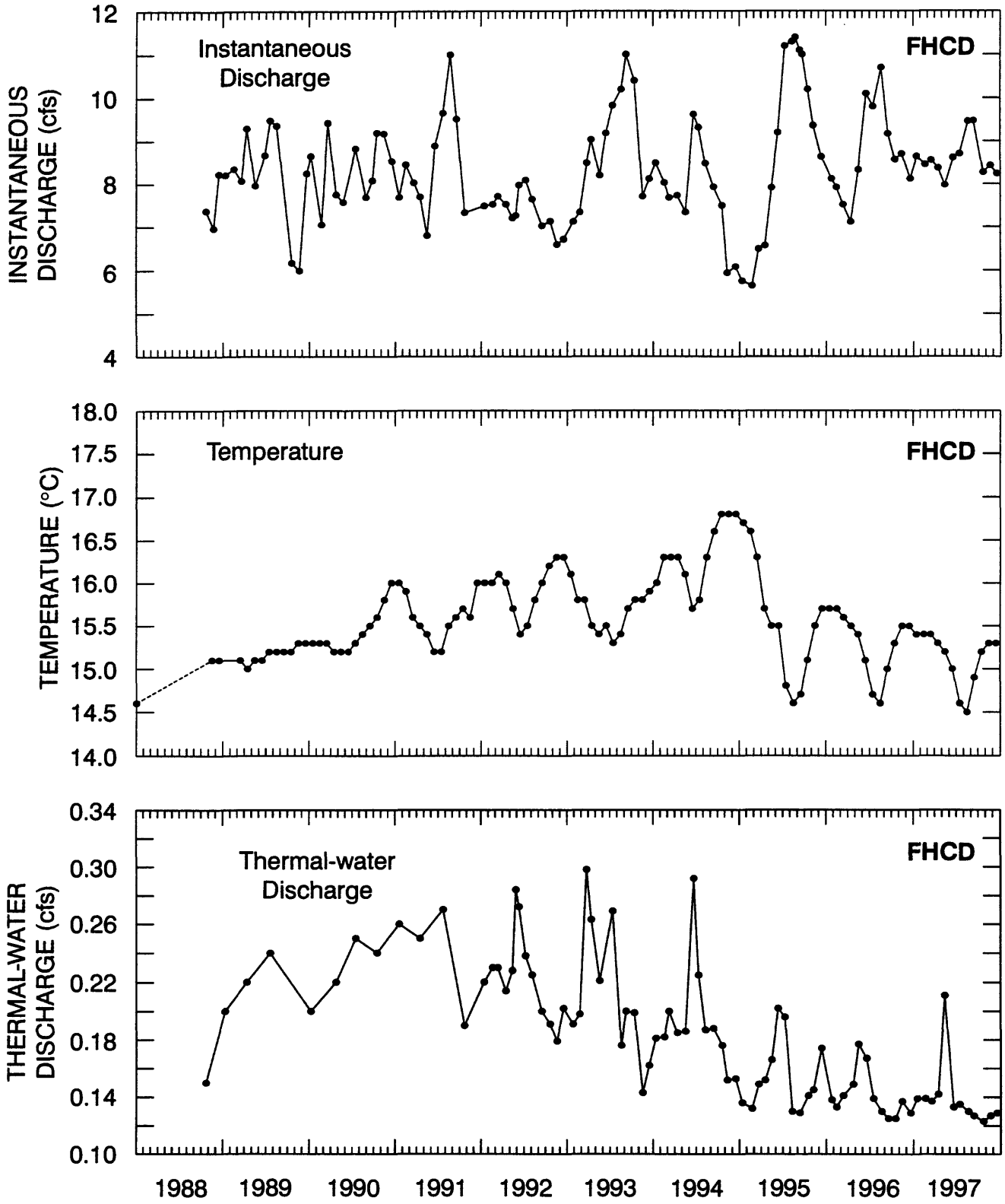


Figure 20. Graphs of instantaneous total discharge, monthly mean temperature, and calculated thermal-water discharge, Fish Hatchery spring group CD (FHCD), 1988-1997.

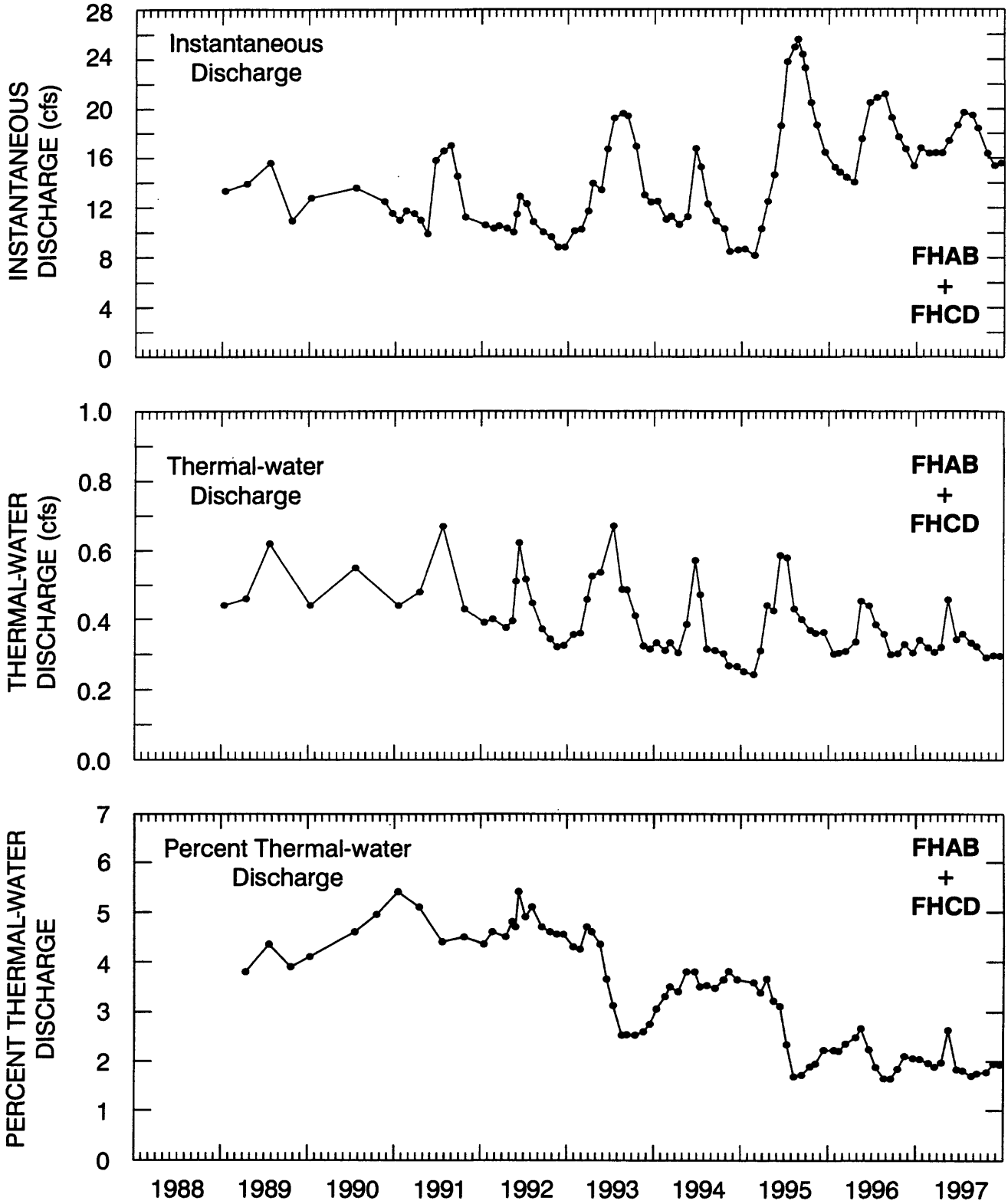


Figure 21. Combined instantaneous total discharge, calculated thermal-water discharge, and percent thermal water, Fish Hatchery spring groups AB and CD, 1988-1997.

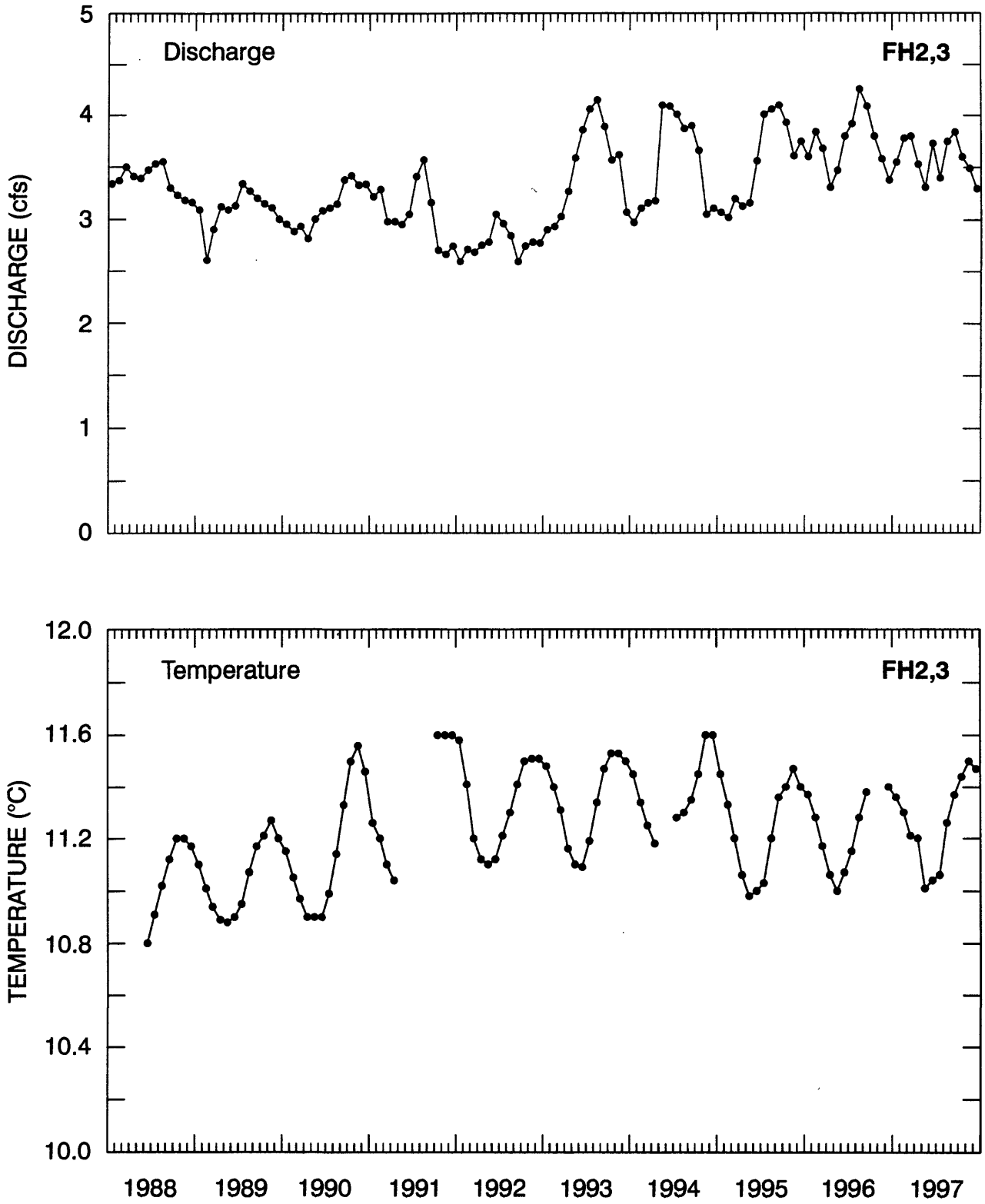


Figure 22. Graphs of average monthly discharge and temperature at Fish Hatchery spring group 2,3 (FH2,3), 1988-1997.

Table 1. Chemical analyses of water samples collected and analyzed by the U.S. Geological Survey. Concentrations reported in mg/L; --indicates no data.

SITE[1]	MBP-1	MBP-1	MBP-1	MBP-1	MBP-1	MBP-3	MBP-3	MBP-3	MBP-3	MBP-3	BAL	BAL	BAL	BAL
DATE	07-13-88	01-12-89	07-21-89	01-10-90	07-10-90	07-13-88	01-12-89	07-21-89	01-10-90	07-10-90	07-14-88	01-12-89	07-17-89	01-10-90
PARAMETERS[2]:														
Discharge (cfs)	--	--	--	--	--	--	--	--	--	--	0.06	0.05	0.06	0.10
T (°C)	163.0	163.0	163.0	--	158.0	169.0	168.0	163.5	--	161.0	57.5	57.5	57.5	57.0
SC (field)	--	--	--	1630	1630	--	--	--	1610	1710	--	--	--	--
SC (lab)	1700	1700	1680	1720	1750	1630	1670	1700	1730	1750	1750	1760	1750	1790
pH (field)	6.5	6.8	6.8	6.5	6.8	6.5	6.4	6.1	6.7	6.3	7.0	7.0	6.7	7.0
Alkalinity (field)	335	348	344	347	--	360	443	354	387	--	--	719	693	645
Alkalinity (lab)	341	340	334	337	351	365	357	367	367	377	642	645	648	638
Ca	5.3	5.7	5.1	5.3	7.9	5.8	2.1	5.9	6.1	7.4	25	25	25	24
Mg	0.10	0.26	0.15	0.08	0.11	0.19	0.20	0.25	0.22	<0.02	0.62	0.54	0.61	0.66
Na	350	330	340	340	360	340	330	330	340	330	360	350	360	370
K	23	30	--	33	30	22	30	30	35	31	31	31	35	38
Cl	250	250	250	240	260	240	240	260	240	240	150	150	160	150
SO_4	120	110	120	120	120	110	110	110	120	110	61	64	64	64
F	11	9.6	10	11	11	9.8	8.6	10	10	8.0	4.8	3.7	4.9	4.4
SiO_2	240	240	230	230	220	240	230	230	230	210	200	190	190	190
N	0.44	0.37	0.32	0.33	0.28	0.33	0.25	0.22	0.25	0.21	0.13	0.10	0.10	0.11
P	0.01	<0.01	0.02	0.02	0.01	0.03	<0.01	<0.01	0.01	<0.01	0.05	0.06	0.06	0.05
As	1.8	1.2	1.7	1.8	0.51	1.7	0.42	1.0	0.26	0.34	0.38	0.47	0.20	0.15
B	9.9	9.9	11	10	10	9.6	9.5	9.6	10	10	6.1	6.0	6.6	6.4
Fe	0.012	0.013	0.008	0.031	0.021	0.29	0.009	0.022	0.018	0.028	0.18	0.16	0.18	0.19
Li	2.4	2.7	2.6	2.4	2.4	2.4	2.6	2.7	2.5	2.6	1.5	1.6	1.7	1.5
Mn	0.006	0.018	0.013	0.018	0.025	0.006	0.009	0.02	0.025	0.027	0.16	0.15	0.15	0.16
Hg	--	0.0045	0.001	0.0068	0.0021	--	0.0024	0.0010	0.0012	0.0052	0.0003	<0.0001	<0.0001	0.0001
Sr	0.17	0.19	0.17	--	--	0.20	0.086	0.19	--	--	0.18	0.18	0.18	--
δD (‰)	-117	--	-117	-119	-117	-119	--	--	-118	-116	--	--	--	-128
$\delta^{18}O$ (‰)	-14.7	--	-14.7	-14.8	-14.7	-14.8	--	--	-15.0	-14.7	--	--	--	-16.3
Tritium (T.U.)	1.3	--	0.9	1.1	1.0	1.6	--	1.3	1.4	1.3	--	--	--	--
TDS (lab)	1250	1200	1200	1210	1250	1220	1200	1240	1230	1230	1260	1230	1270	1260
TDS (sum)	1220	1200	--	1200	1230	1200	1230	1200	1230	--	1230	1250	1260	1240

Table 1.--continued.

SITE[1]	CS	CS	CS	CS	CS	CS	CS	FH-AB	FH-AB	FH-AB	FH-AB	FH-AB	FH-AB	FH-AB
DATE	07-14-88	01-12-89	07-18-89	01-10-90	07-18-90	01-18-91	04-17-91	07-11-88	10-18-88	01-10-89	04-12-89	07-20-89	10-19-89	01-08-90
PARAMETERS[2]:														
Discharge (cfs)	0.03	0.02	0.03	0.04	0.04	--	--	6.7	6.7	5.1	4.6	6.1	4.8	--
T (°C)	93.0	92.5	93.0	93.0	93.0	92.5	92.5	16.0	16.5	16.0	16.0	16.5	17.0	16.5
SC (field)	--	--	--	--	--	--	--	270	267	272	278	276	280	254
SC (lab)	1910	1870	1910	1930	1890	1860	1240	272	272	280	287	282	291	250
pH (field)	8.5	8.4	8.3	8.6	8.6	8.8	8.7	7.1	7.2	7.1	7.2	7.1	7.2	7.1
Alkalinity (field)	402	390	384	408	403	386	357	--	114	116	115	105	--	111
Alkalinity (lab)	389	383	410	400	399	382	354	109	112	112	112	109	110	110
Ca	1.5	1.5	1.6	1.5	1.4	1.3	1.2	14	14	14	14	14	14	14
Mg	<0.10	0.02	0.04	<0.10	<0.20	<0.10	0.02	10	11	10	10	9.9	9.7	10
Na	370	370	390	390	380	380	370	26	29	26	27	28	28	29
K	31	31	32	34	29	28	29	5.0	5.2	6.0	5.6	6.0	6.0	6.4
Cl	270	270	270	260	230	260	260	10	11	11	11	15	12	13
SO_4	130	130	140	140	120	120	140	14	13	14	14	13	13	14
F	9.5	11	11	12	9.1	12	11	0.2	0.3	0.3	0.2	0.3	0.3	0.3
SiO_2	260	250	260	260	250	250	260	60	61	60	61	62	60	63
N	0.06	0.05	0.06	0.08	<0.01	0.02	0.10	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	0.02
P	0.11	0.09	0.10	0.10	0.11	0.06	0.28	0.15	0.14	0.16	0.15	0.14	0.15	0.15
As	2.2	2.1	1.8	1.7	1.2	1.6	1.8	0.056	0.051	0.056	0.026	0.05	0.048	0.039
B	11	11	11	11	12	12	12	0.44	0.47	0.46	0.55	0.59	0.56	0.59
Fe	<0.003	<0.003	0.004	0.009	<0.003	0.008	0.011	0.003	0.003	<0.003	0.006	0.004	0.007	0.008
Li	2.8	3.0	3.1	2.9	3.0	4.4	2.9	0.090	0.090	0.10	0.11	0.11	0.10	0.090
Mn	0.006	0.005	0.006	0.005	0.005	0.004	0.004	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Hg	0.0003	0.0003	0.0002	0.0005	0.0003	0.0005	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0009	<0.0001
Sr	0.11	0.11	0.11	--	--	--	--	0.091	0.096	0.097	0.099	0.098	0.10	--
δD (‰)	--	--	--	-114	-113	--	-115	-114	--	--	--	--	--	-115
$\delta^{18}O$ (‰)	--	--	--	-14.2	-14.3	--	-13.9	-15.2	--	--	--	--	--	-15.5
Tritium (T.U.)	--	--	--	--	0.8	--	--	63	--	--	--	--	--	--
TDS (lab)	1360	1360	1250	1370	1240	1340	1410	201	203	192	209	214	191	210
TDS (sum)	--	1310	1350	--	--	--	1300	207	215	214	214	214	212	219

Table 1.--continued.

SITE[1]	FH-AB	FH-AB	FH-AB	FH-AB	FH-AB	FH-AB	FH-AB	FH-AB	FH-AB	FH-AB	FH-AB	FH-AB	FH-AB	FH-AB
DATE	04-24-90	07-17-90	10-17-90	01-16-91	04-16-91	07-23-91	10-23-91	01-14-92	04-15-92	07-07-92	10-20-92	01-26-93	04-13-93	07-13-93
PARAMETERS[2]:														
Discharge (cfs)	4.8	5.0	3.8	3.4	3.4	7.0	3.9	3.1	2.9	4.4	2.4	3.1	4.9	10
T (°C)	17.0	16.5	17.0	17.5	16.5	16.5	17.5	17.0	17.0	17.5	17.5	17.5	16.5	16.5
SC (field)	290	273	281	295	302	264	275	274	276	268	289	287	289	226
SC (lab)	291	301	298	305	311	274	283	282	285	270	299	295	291	236
pH (field)	7.3	7.2	7.1	7.2	7.1	7.1	7.2	7.4	7.4	7.2	7.4	7.5	7.3	7.3
Alkalinity (field)	103	111	113	109	113	102	105	106	108	101	115	116	105	--
Alkalinity (lab)	113	112	114	114	116	100	109	108	107	102	116	116	107	93
Ca	14	15	14	15	15	13	14	13	14	12	14	14	14	9.4
Mg	10	10	10	11	11	9.0	9.2	9.3	9.9	8.8	10	11	10	7.1
Na	29	31	29	30	30	29	26	28	29	28	31	31	28	21
K	6.3	6.4	6.0	6.1	6.2	5.6	6.7	6.0	5.8	5.9	6.6	6.4	6.0	4.6
Cl	14	14	18	18	16	13	15	12	14	16	14	13	14	9.1
SO_4	14	9.5	14	18	16	14	17	18	19	16	15	14	16	12
F	0.3	0.2	0.3	0.3	0.2	0.3	0.3	0.3	0.4	0.3	0.3	0.3	0.3	0.3
SiO_2	62	65	63	62	63	62	61	66	61	63	63	67	63	56
N	<0.01	0.01	0.02	0.01	<0.01	0.03	0.01	<0.01	<0.01	0.02	0.02	<0.01	0.01	0.01
P	0.15	0.16	0.14	0.13	0.13	0.15	0.13	0.15	0.16	0.15	0.15	0.15	0.16	0.16
As	0.052	0.059	0.05	0.046	0.045	0.077	0.038	0.05	0.053	0.047	0.05	0.055	0.047	0.04
B	0.59	0.68	0.66	0.69	0.68	0.64	0.62	0.62	0.62	0.70	0.67	0.62	0.62	0.50
Fe	0.003	0.005	<0.003	0.004	<0.003	0.005	0.006	<0.003	0.004	<0.003	<0.003	0.007	<0.003	0.006
Li	0.10	0.11	0.10	0.10	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.11	0.10	0.080
Mn	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Hg	<0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Sr	--	--	--	--	--	--	--	--	--	--	--	--	--	--
δD (‰)	-115	-114	-115	-115	-115	-111	-116	-115	-116	-114	-115	-115	-116	-114
$\delta^{18}O$ (‰)	-15.5	-15.4	-15.3	-15.5	-15.5	-15.2	-15.4	-15.4	-15.5	-15.3	-15.5	-15.5	-15.6	-15.5
Tritium (T.U.)	--	52	--	45	--	--	--	--	--	--	--	--	--	--
TDS (lab)	209	215	206	203	227	194	196	200	216	168	230	211	186	180
TDS (sum)	214	220	225	227	229	210	216	219	222	213	227	230	221	178

Table 1.--continued.

SITE[1]	FH-AB	FH-AB	FH-AB	FH-AB	FH-AB	FH-AB	FH-AB	FH-AB	FH-AB	FH-AB	FH-AB	FH-AB	FH-AB	FH-AB
DATE	10-13-93	01-11-94	04-12-94	07-12-94	10-19-94	10-19-94	01-17-95	04-18-95	06-20-95	07-11-95	07-11-95	01-24-96	07-16-96	10-16-96
PARAMETERS[2]:														
Discharge (cfs)	6.6	4.0	2.9	5.2	2.8	--	2.9	6.0	--	13	--	7.1	12	8.6
T (°C)	17.5	17.5	18.0	18.0	18.0		18.0	17.0	16.5	16.0	--	17.5	16.5	17.2
SC (field)	239	254	264	232	267	--	291	287	217	212	--	243	224	240
SC (lab)	241	261	272	236	278	278	292	295	226	216	216	255	230	245
pH (field)	7.2	7.3	7.3	7.3	7.2	--	7.2	7.2	7.3	7.2	--	7.1	7.2	7.3
Alkalinity (field)	97	97	107	90	101	--	114	115	--	85	--	108	94	--
Alkalinity (lab)	100	105	108	93	141	160	120	119	92	89	88	112	99	--
Ca	12	12	12	10	13	13	14	14	10	9.4	9.4	13	11	--
Mg	8.9	8.8	8.6	7.7	9.2	9.1	10	10	7.5	7.2	7.3	10	8.3	--
Na	22	26	25	23	28	28	28	27	22	21	21	24	22	--
K	5.1	5.8	5.3	5.9	6.0	6.0	6.0	5.9	4.9	4.5	4.8	5.5	5.1	--
Cl	7.5	9.4	10	9.9	11	12	10	11	8.2	7.1	7.1	5.6	4.7	4.8
SO_4	12	13	13	11	13	12	12	11	9.4	9.1	9.1	9.5	10	--
F	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.3	0.3	0.3	--
SiO_2	53	60	56	56	60	59	61	59	59	58	59	57	58	--
N	0.03	0.01	0.02	<0.01	<0.02	<0.02	<0.02	<0.02	0.02	0.02	<0.02	<0.02	0.03	--
P	0.14	0.11	0.13	0.12	0.14	0.14	0.15	0.15	0.12	0.14	0.14	0.13	0.16	--
As	0.047	0.044	0.044	0.043	0.052	0.052	0.045	0.046	0.042	0.043	0.048	0.039	0.036	--
B	0.39	0.43	0.47	0.51	0.53	0.54	0.49	0.52	0.41	0.36	0.36	0.27	0.28	0.25
Fe	0.005	0.007	0.003	0.004	<0.003	<0.003	<0.003	0.012	0.011	0.013	0.011	<0.003	<0.003	--
Li	0.070	0.10	0.090	0.090	0.10	0.10	0.11	0.10	0.090	0.080	0.080	0.10	0.076	--
Mn	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	--
Hg	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	--	<0.0001	<0.0001	<0.0001	0.0001	--
Sr	--	--	--	--	--	--	--	--	--	--	--	--	--	--
δD (‰)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
$\delta^{18}O$ (‰)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tritium (T.U.)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TDS (lab)	182	200	200	164	192	192	208	214	166	164	164	178	150	--
TDS (sum)	181	196	196	179	204	238	212	212	180	171	174	192	178	--

Table 1.--continued.

SITE[1]	FH-AB	FH-AB	FH-CD	FH-CD	FH-CD	FH-CD	FH-CD	FH-CD	FH-CD	FH-CD	FH-CD	FH-CD	FH-CD	FH-CD
DATE	01-16-97	07-15-97	10-21-88	01-10-89	04-12-89	07-20-89	10-19-89	01-08-90	04-24-90	07-17-90	10-16-90	01-17-91	04-16-91	07-23-91
PARAMETERS[2]:														
Discharge (cfs)	8.1	11	7.4	8.2	9.3	9.5	6.2	8.6	7.8	8.8	9.2	7.7	7.7	9.6
T (°C)	16.7	16.9	15.0	14.0	15.0	15.5	15.0	15.5	15.5	15.5	15.5	16.0	16.0	16.0
SC (field)	257	234	185	229	231	236	232	213	243	230	222	246	263	235
SC (lab)	261	243	233	241	243	242	244	249	245	246	249	256	257	245
pH (field)	7.2	7.2	7.3	7.3	7.3	7.2	7.5	7.3	7.4	7.2	7.2	7.4	7.3	7.3
Alkalinity (field)	--	106	108	108	108	108	--	105	99	104	108	--	108	105
Alkalinity (lab)	--	106	103	104	106	105	104	105	106	105	108	110	110	105
Ca	13	12	12	12	12	12	12	12	12	12	12	13	13	12
Mg	10	9.0	9.4	9.0	9.0	9.0	8.6	9.0	9.1	8.8	9.1	9.5	9.6	8.9
Na	23	21	24	22	23	23	23	24	25	24	24	25	25	25
K	5.3	5.3	4.4	5.1	4.7	5.1	4.6	5.5	5.2	5.1	4.9	5.1	5.1	5.0
Cl	5.2	4.3	4.5	5.6	5.6	5.7	5.4	5.2	7.2	7.0	6.3	8.2	8.0	6.9
SO_4	11	9.7	11	11	11	10	11	11	10	11	11	14	10	11
F	0.3	0.3	0.3	0.3	0.3	0.4	0.3	0.3	0.3	0.1	0.3	0.4	0.3	0.3
SiO_2	53	54	57	57	58	59	57	60	60	59	59	58	59	59
N	<0.02	--	0.02	0.02	<0.01	0.02	0.02	0.04	<0.01	0.01	0.02	0.01	<0.01	0.03
P	0.13	0.11	0.16	0.18	0.18	0.17	0.17	0.17	0.19	0.19	0.17	0.18	0.16	0.17
As	0.038	0.034	0.057	0.062	0.054	0.049	0.054	0.030	0.054	0.055	0.066	0.048	0.052	0.085
B	0.29	0.27	0.23	0.24	0.24	0.26	0.27	0.26	0.27	0.28	0.27	0.32	0.31	0.28
Fe	<0.003	<0.003	0.008	0.008	0.007	0.006	0.007	0.016	0.007	<0.003	0.009	0.006	0.004	0.005
Li	0.080	0.0	0.070	0.080	0.090	0.080	0.070	0.070	0.070	0.080	0.070	0.080	0.080	0.080
Mn	<0.0001	<0.0001	<0.001	0.003	<0.001	0.003	<0.001	0.001	<0.001	0.001	<0.001	0.002	0.001	<0.001
Hg	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Sr	--	--	0.069	0.07	0.07	0.072	0.072	--	--	--	--	--	--	--
δD (‰)	--	--	--	--	--	--	--	-117	-117	-117	-118	-115	-117	-114
$\delta^{18}O$ (‰)	--	--	--	--	--	--	--	-15.9	-15.8	-15.8	-15.8	-15.8	-15.8	-15.7
Tritium (T.U.)	--	--	--	--	--	--	--	--	--	47	--	46	--	--
TDS (lab)	--	--	181	171	181	188	154	180	182	187	181	163	176	184
TDS (sum)	--	--	190	189	191	191	186	193	190	192	193	202	197	194

Table 1.--continued.

SITE[1]	FH-CD	FH-CD	FH-CD	FH-CD	FH-CD	FH-CD	FH-CD	FH-CD	FH-CD	FH-CD	FH-CD	FH-CD	FH-CD	FH-CD
DATE	10-23-91	01-14-92	04-15-92	07-07-92	10-20-92	01-26-93	04-13-93	07-13-93	10-13-93	01-11-94	04-13-94	07-12-94	10-19-94	01-17-95
PARAMETERS[2]:														
Discharge (cfs)	7.3	7.5	7.5	8.0	7.1	7.1	9.0	13	10	8.5	7.7	9.3	7.5	--
T (°C)	15.5	16.0	16.0	16.5	15.5	16.0	15.5	17.0	15.0	15.5	16.0	16.5	15.5	--
SC (field)	239	243	240	246	244	250	255	214	237	242	247	250	251	--
SC (lab)	247	251	252	248	252	259	258	223	239	249	256	254	261	262
pH (field)	7.5	7.5	7.7	7.5	7.4	7.6	7.5	7.4	7.2	7.5	7.4	7.3	7.3	--
Alkalinity (field)	111	106	109	106	107	113	107	--	104	102	111	109	109	--
Alkalinity (lab)	108	109	106	108	110	113	111	98	108	110	112	113	116	115
Ca	12	12	12	12	12	13	14	11	11	12	12	12	13	13
Mg	9.4	9.2	9.3	9.1	9.3	10	9.5	8.1	8.0	9.3	9.4	9.5	9.6	10
Na	26	24	24	25	25	27	23	22	23	24	23	24	25	24
K	5.2	5.1	5.1	5.2	5.3	5.3	5.2	4.5	5.3	5.2	5.2	5.5	5.3	5.1
Cl	6.1	7.3	6.4	6.5	5.9	5.9	6.7	4.2	4.3	4.6	5.3	5.2	5.1	5.2
SO_4	13	15	13	12	11	11	11	11	11	11	11	11	10	11
F	0.3	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
SiO_2	59	62	55	58	58	62	58	58	58	56	56	55	57	58
N	0.03	<0.01	0.01	0.03	0.03	<0.01	0.02	0.03	0.04	0.01	0.03	<0.01	<0.02	<0.02
P	0.11	0.18	0.19	0.18	0.18	0.18	0.18	0.18	0.15	0.15	0.16	0.16	0.17	0.17
As	0.046	0.050	0.056	0.054	0.053	0.055	0.051	0.046	0.040	0.050	0.048	0.045	0.055	0.048
B	0.26	0.30	0.30	0.32	0.29	0.29	0.30	0.25	0.21	0.24	0.26	0.27	0.26	0.26
Fe	<0.003	0.007	0.003	0.003	<0.003	0.005	0.012	<0.003	<0.003	<0.003	0.005	<0.003	<0.003	0.004
Li	0.070	0.080	0.070	0.080	0.080	0.080	0.080	0.070	0.090	0.080	0.080	0.080	0.080	0.090
Mn	<0.001	0.002	<0.001	<0.001	0.002	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Hg	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Sr	--	--	--	--	--	--	--	--	--	--	--	--	--	--
δD (‰)	-116	-115	-117	-116	-116	-115	-117	-116	--	--	--	--	--	--
$\delta^{18}O$ (‰)	-15.7	-15.6	-15.8	-15.7	-15.7	-15.8	-15.8	-15.8	--	--	--	--	--	--
Tritium (T.U.)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TDS (lab)	173	170	194	182	204	190	180	168	174	184	186	168	180	184
TDS (sum)	200	201	193	194	194	204	195	180	185	185	191	190	193	198

Table 1.--continued.

SITE[1]	FH-CD	FH-CD	FH-CD	FH-CD	FH-CD	FH-CD	FH-CD	FH-CD	FH-2,3	FH-2,3	FH-2,3	FH-2,3	FH-2,3	FH-2,3
DATE	04-18-95	04-18-95	07-11-95	01-24-96	07-16-96	07-16-96	01-16-97	07-15-97	07-11-88	10-18-88	01-10-89	04-11-89	07-20-89	10-18-89
PARAMETERS[2]:														
Discharge (cfs)	6.6	6.6	10	8.0	--	9.8	8.6	8.7	3.5	3.2	3.0	3.2	3.4	3.3
T (°C)	15.0	15.0	15.5	14.5	--	15.5	14.7	15.5	11.0	11.0	11.0	11.0	11.0	11.0
SC (field)	249	250	223	234	--	232	238	236	193	187	182	186	190	190
SC (lab)	257	258	228	245	--	239	243	245	194	188	190	192	196	198
pH (field)	7.3	7.3	7.3	7.3	--	7.3	7.1	7.2	7.2	7.1	7.2	7.2	7.1	7.3
Alkalinity (field)	108	109	98	107	--	87	--	111	--	--	--	73	77	--
Alkalinity (lab)	113	114	100	111	--	107	--	111	75	75	75	76	79	77
Ca	13	13	11	13	12	12	12	13	16	16	16	16	16	16
Mg	9.4	9.3	8.5	10	9.7	9.1	9.3	9.2	5.6	5.9	5.4	5.4	5.5	5.3
Na	23	23	21	21	21	21	22	21	13	15	13	13	14	14
K	5.1	5.1	4.7	4.8	4.4	4.8	5.0	5.1	3.0	3.2	3.4	3.3	3.5	3.5
Cl	5.2	5.2	3.8	3.8	2.8	2.9	3.3	2.8	6.2	5.4	5.4	5.4	5.4	5.6
SO_4	9.5	9.4	10	8.8	9.7	10	10	9.7	12	12	12	12	11	11
F	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.3	0.2
SiO_2	56	56	55	54	54	55	51	52	39	39	38	38	39	38
N	<0.02	<0.02	0.02	<0.02	--	0.04	<0.02	<0.02	0.01	<0.01	<0.01	<0.01	0.01	<0.01
P	0.17	0.17	0.15	0.14	--	0.17	0.14	0.13	0.08	0.09	0.09	0.10	0.09	0.10
As	0.048	0.049	0.045	0.043	0.040	0.037	0.044	0.035	0.020	0.022	0.026	0.048	0.020	0.023
B	0.25	0.25	0.20	0.19	0.18	0.18	0.19	0.18	0.12	0.090	0.090	0.10	0.11	0.10
Fe	0.007	0.005	0.006	0.003	<0.003	<0.003	0.004	<0.003	0.004	0.043	0.003	0.010	0.003	0.008
LI	0.080	0.080	0.070	0.080	--	0.068	0.070	0.0	0.040	0.040	0.040	0.040	0.050	0.040
Mn	0.001	0.001	<0.001	0.001	<0.001	0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Hg	<0.0001	<0.0001	<0.0001	<0.0001	--	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Sr	--	--	--	--	--	--	--	--	--	--	--	--	--	0.058
δD (‰)	--	--	--	--	--	--	--	--	-120	--	--	--	--	--
$\delta^{18}O$ (‰)	--	--	--	--	--	--	--	--	-16.2					--
Tritium (T.U.)	--	--	--	--	--	--	--	--	34	--	--	--	--	--
TDS (lab)	186	186	168	172	180	150	--	--	141	143	137	139	156	122
TDS (sum)	190	190	176	182	--	169	--	--	142	143	140	139	143	142

Table 1.--continued.

SITE[1]	FH-2,3	FH-2,3	FH-2,3	FH-2,3	FH-2,3	FH-2,3	FH-2,3	FH-2,3	FH-2,3	FH-2,3	FH-2,3	FH-2,3	FH-2,3	FH-2,3
DATE	01-09-90	04-24-90	07-17-90	10-16-90	01-16-91	04-16-91	07-23-91	10-23-91	01-14-92	04-15-92	07-07-92	10-20-92	01-26-93	04-13-93
PARAMETERS[2]:														
Discharge (cfs)	3.3	3.0	3.9	3.4	--	3.0	3.9	2.7	2.7	3.0	2.9	3.0	3.1	3.3
T (°C)	11.0	11.0	11.5	11.5	11.5	11.0	13.0	11.5	11.5	11.0	11.0	11.5	11.5	11.5
SC (field)	179	199	192	166	177	190	198	201	200	210	213	210	213	241
SC (lab)	196	202	203	200	191	199	206	207	206	218	215	216	222	244
pH (field)	7.2	7.2	7.1	7.1	7.2	7.1	7.0	7.2	7.3	7.4	7.2	7.2	7.4	7.1
Alkalinity (field)	73	74	77	79	--	76	79	75	79	82	84	85	88	86
Alkalinity (lab)	76	76	78	78	77	76	79	81	81	80	84	84	86	90
Ca	16	16	17	16	16	16	17	17	17	18	18	18	18	20
Mg	5.3	5.6	5.5	5.4	5.2	5.4	5.7	5.8	5.6	6.2	5.9	5.9	6.3	6.8
Na	14	15	15	14	14	15	16	16	15	16	16	16	18	17
K	3.6	3.5	3.4	3.4	3.2	3.5	3.5	3.7	3.5	3.5	3.6	3.7	3.7	3.8
Cl	5.2	7.1	8.0	7.3	5.7	6.9	7.9	8.0	7.0	9.4	8.1	8.3	8.2	11
SO_4	6.0	13	11	12	11	11	13	12	12	12	12	12	12	13
F	0.2	0.2	0.1	0.4	<0.1	0.2	0.2	0.2	0.2	0.1	0.1	0.2	0.2	0.2
SiO_2	40	40	40	39	38	39	39	39	41	38	39	39	41	40
N	0.02	<0.01	0.02	<0.02	<0.01	<0.01	0.02	0.01	<0.01	<0.01	0.02	0.03	<0.01	<0.01
P	0.09	0.10	0.10	<0.09	0.10	0.08	0.09	0.08	0.10	0.10	0.10	0.10	0.10	0.10
As	0.018	0.023	0.021	0.024	0.020	0.022	0.022	0.019	0.021	0.021	0.023	0.022	0.024	0.021
B	0.10	0.11	0.10	0.10	0.10	0.11	0.12	0.11	0.11	0.12	0.12	0.11	0.12	0.12
Fe	0.008	<0.003	<0.003	<0.003	<0.003	<0.003	0.004	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Li	0.040	0.040	0.050	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.050	0.040
Mn	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Hg	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Sr	--	--	--	--	--	--	--	--	--	--	--	--	--	--
δD (‰)	-123	-119	-120	-119	-118	-121	-117	-120	-120	-121	-119	-120	-119	-119
$\delta^{18}O$ (‰)	-16.2	-16.2	-16.0	-16.0	-16.2	-16.2	-16.1	-110.0	-15.9	-16.0	-16.1	-16.0	-16.1	-16.0
Tritium (T.U.)	--	--	32	--	28	--	--	--	--	--	--	--	--	--
TDS (lab)	134	147	150	129	105	146	140	142	116	158	130	167	149	158
TDS (sum)	136	149	149	146	141	146	152	151	150	156	157	157	162	167

Table 1.--continued.

SITE[1]	FH-2,3	FH-2,3	FH-2,3	FH-2,3	FH-2,3	FH-2,3	FH-2,3	FH-2,3	FH-2,3	FH-2,3	FH-2,3	FH-2,3	HC-3	HC-3
DATE	07-13-93	10-13-93	01-11-94	04-12-94	07-12-94	01-18-95	04-18-95	07-11-95	01-24-96	07-16-96	07-16-96	07-15-97	07-11-88	07-19-89
PARAMETERS[2]:														
Discharge (cfs)	4.2	3.5	3.0	3.2	4.1	3.1	3.3	4.1	3.7	--	3.9	3.3	--	--
T (°C)	11.5	12.0	11.5	11.0	11.0	10.0	11.0	11.0	11.5	--	11.0	11	93.0	95.0
SC (field)	230	234	219	216	221	224	236	237	220	--	223	209	--	--
SC (lab)	241	237	227	226	225	226	244	244	231	--	228	85	1720	1780
pH (field)	7.1	7.1	7.3	7.3	7.3	7.3	7.1	7.1	7.2	--	7.3	7.2	8.1	7.8
Alkalinity (field)	--	92	83	87	88	85	91	94	91	--	78	85	473	--
Alkalinity (lab)	95	95	90	98	90	88	94	97	95	--	90	86	476	479
Ca	21	19	18	18	18	18	19	20	18	18	18	16	3.8	3.2
Mg	6.9	6.5	6.2	6.1	6.1	6.1	6.4	6.7	6.6	6.6	6.4	5.7	0.17	0.27
Na	17	17	16	16	16	17	17	17	16	17	18	16	390	380
K	3.8	3.9	4.1	3.7	4.1	3.6	3.9	3.9	3.8	3.7	3.9	3.9	17	26
Cl	8.6	8.3	7.5	8.3	7.4	8.3	10	8.7	6.8	7.2	7.0	6.2	220	220
SO_4	13	12	12	12	11	11	10	11	9.8	11	12	11	96	96
F	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	9.9	9.7
SiO_2	41	38	38	38	38	40	39	40	39	40	42	39	150	140
N	0.02	0.03	<0.01	0.02	<0.01	<0.02	<0.02	0.02	<0.02	--	0.06	<0.02	0.06	0.02
P	0.10	0.10	0.09	0.09	0.09	0.11	0.11	0.10	0.10	--	0.12	0.10	0.04	0.05
As	0.020	0.022	0.015	0.021	0.023	0.025	0.019	0.023	0.021	0.024	0.024	0.023	1.3	1.1
B	0.13	0.11	0.11	0.12	0.13	0.12	0.12	0.12	0.11	0.12	0.11	0.11	9.7	10
Fe	<0.003	0.004	<0.003	0.009	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.011	<0.003	0.004
Li	0.040	0.040	0.050	0.040	0.050	0.040	0.040	0.050	0.040	--	0.043	0.0	2.4	2.5
Mn	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.001	0.002
Hg	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	--	<0.0001	<0.0001	0.0001	<0.0001
Sr	--	--	--	--	--	--	--	--	--	--	--	--	0.26	0.28
δD (‰)	-118	--	--	--	--	--	--	--	--	--	--	--	-120	--
$\delta^{18}O$ (‰)	-16.0	--	--	--	--	--	--	--	--	--	--	--	-15.0	--
Tritium (T.U.)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TDS (lab)	164	166	152	148	132	152	168	158	154	158	140	--	1200	1190
TDS (sum)	171	163	154	156	156	157	163	167	157	--	157	--	1180	1180

Table 1.--continued.

SITE[1]	HC-3	HC-3	HCF	HCF	HCF	LHC-SP	LHC-SP	LHC-SP	LHC-SP	LHC-SP	LHC-SP	LHC-SP	LHC-SP	LHC-SP
DATE	07-18-90	04-16-92	07-12-88	07-19-89	11-19-97	07-14-88	01-13-89	07-17-89	01-09-90	07-18-90	01-18-91	07-24-91	01-15-92	04-16-92
PARAMETERS[2]:														
Discharge (cfs)	--	--	57	42	51	0.12	0.12	0.03	0.12	0.12	0.12	--	0.12	--
T (°C)	95.5	81.0	34.0	37.0	25.5	83.0	82.5	82.5	82.5	83.0	82.5	82.5	82.5	82.5
SC (field)	--	--	470	586	521	--	--	--	2100	--	1990	2030	1920	1980
SC (lab)	1780	1810	471	559	520	1860	1900	1920	1960	1920	1910	1910	1920	1930
pH (field)	8.1	7.6	7.8	7.7	7.8	7.0	6.8	6.7	7.1	7.0	6.9	7.6	8.0	7.6
Alkalinity (field)	503	--	140	171	171	590	630	631	574	595	566	602	601	598
Alkalinity (lab)	475	475	147	173	168	599	592	603	594	595	553	567	606	597
Ca	3.2	3.2	12	13	13	23	22	23	23	23	23	21	22	22
Mg	0.21	0.07	5.5	5.7	6.3	0.58	0.55	0.62	0.65	0.69	0.63	0.63	0.42	0.61
Na	380	370	78	98	85	370	350	390	400	390	390	370	390	380
K	24	12	7.0	8.2	7.7	24	24	22	30	28	27	25	25	28
Cl	220	230	40	52	42	200	200	200	200	200	200	200	210	200
SO_4	94	110	24	28	24	95	98	100	100	98	99	100	99	100
F	9.9	12	1.6	2.4	2.0	7.8	7.2	7.9	8.5	8.4	8.5	8.1	8.1	9.4
SiO_2	140	160	58	67	59	90	81	88	87	87	82	82	89	82
N	0.04	0.11	<0.01	<0.01	<0.02	0.15	0.14	0.11	0.15	0.11	0.13	0.15	0.05	0.13
P	0.06	0.07	0.16	0.17	0.14	0.04	0.02	0.03	0.04	0.04	0.02	0.15	0.06	0.06
As	1.0	1.1	0.23	0.27	0.24	0.59	0.85	0.30	0.70	0.61	0.70	0.71	0.71	0.71
B	9.9	10	1.7	2.3	1.9	8.5	8.5	8.8	9.0	8.8	8.7	9.2	8.9	9.1
Fe	<0.003	0.007	0.017	0.010	<0.010	0.031	0.036	0.036	0.037	0.015	0.032	0.033	0.036	0.029
Li	2.3	4.0	0.45	0.60	0.0	2.6	2.7	2.9	2.7	2.8	4.2	3.8	3.6	4.5
Mn	0.002	0.004	0.010	0.009	0.021	0.21	0.20	0.20	0.21	0.21	0.20	0.19	0.20	0.20
Hg	0.0002	0.0002	0.0001	<0.0001	<0.0001	0.0004	0.0005	<0.0001	0.0001	0.0001	0.0007	0.0002	0.0001	<0.0001
Sr	--	--	0.11	0.12	--	0.58	0.56	0.54	--	--	--	--	--	--
δD (‰)	-119	-120	--	--	--	--	--	--	-124	-122	-122	-120	-123	--
$\delta^{18}O$ (‰)	-15.1	-14.7	--	--	--	--	--	--	-15.8	-15.8	-15.7	-15.7	-15.6	--
Tritium (T.U.)	0.9	--	--	--	--	--	--	--	--	<0.3	--	--	--	--
TDS (lab)	1200	1200	323	388	--	1250	1230	1260	1240	1250	1230	1220	1150	1220
TDS (sum)	1190	1200	315	381	--	1180	1170	1220	1210	1210	1180	1190	1220	1200

Table 1.--continued.

SITE[1]	LHC-SP	LHC-SP	LHC-SP	LHC-SW	LHC-SW	MC-395	MC-395	MC-395	MC-395	MC-395	MC-395	MC-395	MC-395	MC-395
DATE	07-08-92	01-26-93	07-15-93	07-18-90	07-08-92	07-13-88	10-18-88	01-11-89	04-11-89	07-18-89	10-18-89	01-09-90	04-25-90	07-17-90
PARAMETERS[2]:														
Discharge (cfs)	--	0.13	0.13	0.44	--	13	3.5	1.0	9.1	9.0	3.9	4.3	10	7.7
T (°C)	82.5	83.0	82.5	52.5	54.0	13.0	5.5	0.0	5.5	13.5	4.0	0.0	3.0	17.5
SC (field)	1920	1900	1910	--	1940	82	140	165	143	90	137	143	124	84
SC (lab)	1890	1920	1940	1980	1960	82	144	167	152	93	142	173	--	94
pH (field)	7.7	7.1	7.8	8.1	8.4	7.9	8.2	7.6	7.7	7.2	8.2	7.9	8.0	8.0
Alkalinity (field)	600	585	--	626	611	42	73	78	69	49	--	86	64	45
Alkalinity (lab)	570	599	602	609	597	30	70	79	72	43	65	79	--	44
Ca	23	23	23	20	16	7.8	11	13	11	8.5	11	14	10	8.5
Mg	0.62	0.63	0.62	0.60	0.50	2.4	5.6	6.3	6.0	2.9	4.8	6.2	4.7	2.8
Na	400	400	390	420	440	4.8	9.3	11	11	5.8	9.3	11	8.6	6.0
K	27	22	24	28	28	1.1	2.3	2.6	2.4	1.2	2.1	3.0	2.0	1.1
Cl	200	200	190	210	210	0.30	0.40	0.40	0.40	0.30	1.0	0.40	0.50	0.10
SO_4	100	100	100	100	110	3.1	5.8	6.8	6.3	4.0	6.0	6.0	5.1	3.6
F	5.8	8.7	8.7	8.7	9.7	0.2	0.1	0.3	0.2	0.1	0.1	0.1	0.1	0.2
SiO_2	87	90	86	93	--	9.4	17	30	27	11	17	30	21	12
N	0.11	0.14	0.12	0.02	0.02	0.01	<0.01	<0.01	0.01	0.02	<0.01	0.02	<0.01	0.02
P	0.04	0.04	0.03	0.04	0.03	0.02	0.03	0.05	0.06	0.01	0.03	0.04	0.04	0.03
As	0.69	0.78	0.65	0.71	0.74	0.003	0.004	0.004	0.021	0.004	0.003	0.029	0.004	0.003
B	9.1	9.2	9.7	9.1	9.6	<0.010	<0.010	0.020	0.010	<0.010	0.010	0.010	<0.010	<0.010
Fe	0.050	0.036	0.035	0.016	0.02	0.015	0.020	0.017	0.026	0.037	0.021	0.026	0.021	0.038
LI	2.8	2.7	2.9	3.0	2.7	0.030	0.030	0.040	0.040	0.020	0.030	0.030	0.020	0.020
Mn	0.20	0.21	0.20	0.17	0.060	0.002	0.002	<0.001	0.002	0.004	0.002	0.003	0.002	0.004
Hg	<0.0001	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Sr	--	--	--	--	--	0.028	0.046	0.052	0.046	0.032	0.046	--	--	--
δD (‰)	-123	-124	--	-123	--	--	--	--	--	--	--	--	--	--
$\delta^{18}O$ (‰)	-15.7	-15.7		-15.0	--	--	--	--	--	--	--	--	--	--
Tritium (T.U.)	--	--	--	<0.3	--	--	--	--	--	--	--	--	--	--
TDS (lab)	1200	1220	1230	1280	1250	50	95	109	108	86	76	116	88	63
TDS (sum)	1220	1210	1200	1270	1190	55	95	117	106	63	90	123	93	--

Table 1.--continued.

SITE[1]	MC-395	MC-395	MC-395	MC-395	MC-395	MC-395	MC-395	MC-395	MC-395	MC-395	MC-395	MC-395	MC-395	MC-395
DATE	10-16-90	01-17-91	04-16-91	07-22-91	10-22-91	01-13-92	04-14-92	07-06-92	10-19-92	01-25-93	04-12-93	07-12-93	10-13-93	01-10-94
PARAMETERS[2]:														
Discharge (cfs)	2.0	3.2	2.4	14	3.6	4.4	3.7	10	4.1	--	7.9	73	10	5.2
T (°C)	8.0	0.0	1.0	17.0	9.5	0.5	10.0	15.0	9.5	0.0	4.5	17.0	9.0	0.0
SC (field)	103	165	161	71	119	137	159	88	121	121	161	42	101	126
SC (lab)	141	174	179	73	123	147	173	88	125	129	169	44	107	137
pH (field)	8.1	8.0	8.1	7.3	8.3	8.2	8.4	8.1	8.1	7.9	8.2	7.8	8.1	8.0
Alkalinity (field)	64	81	82	35	63	70	80	42	62	--	79	--	49	60
Alkalinity (lab)	68	85	85	35	60	72	81	42	60	61	79	21	52	66
Ca	11	14	13	7.8	9.7	12	12	8.3	11	11	12	5.5	9.1	11
Mg	5.0	6.4	6.7	2.1	4.4	5.1	6.8	2.6	4.3	4.4	6.3	0.92	3.7	5.0
Na	9.6	12	13	4.9	7.5	9.4	13	5.3	7.9	8.3	12	2.1	6.1	8.9
K	2.2	2.8	2.8	1.0	1.9	2.1	2.6	1.1	2.0	1.9	2.6	0.60	1.6	2.1
Cl	1.2	0.20	0.20	0.10	0.70	0.50	0.10	0.10	0.40	0.40	0.70	0.20	0.30	0.40
SO_4	4.3	5.9	7.4	3.1	5.1	5.3	6.6	3.5	4.3	5.4	7.2	1.7	4.1	5.0
F	0.3	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.1	<0.1	0.1	<0.1
SiO_2	18	30	30	12	14	27	28	10	14	22	30	8.8	16	25
N	<0.05	0.04	<0.01	0.02	0.02	0.01	0.02	0.01	0.02	<0.01	0.02	0.02	0.03	0.01
P	0.04	0.04	0.04	0.01	0.03	0.04	0.06	0.02	0.02	0.08	0.05	0.02	0.02	0.04
As	0.003	0.004	0.004	0.004	0.004	0.002	0.005	0.002	0.003	0.003	0.005	0.002	0.003	0.003
B	<0.010	0.010	<0.010	0.020	<0.010	<0.010	0.020	<0.010	<0.010	<0.010	0.010	0.010	<0.010	<0.010
Fe	0.022	0.016	0.028	0.035	0.023	0.012	0.020	0.029	0.020	0.018	0.019	0.036	0.030	0.018
Li	0.020	0.030	0.030	0.020	0.020	0.030	0.040	0.010	0.020	0.020	0.030	0.0	0.010	0.040
Mn	0.003	0.004	0.002	0.005	0.004	<0.001	0.002	0.003	0.004	<0.001	0.002	0.007	0.005	0.0
Hg	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Sr	--	--	--	--	--	--	--	--	--	--	--	--	--	--
δD (‰)	--	--	--	--	-104	--	--	--	--	--	-112	-114	--	--
$\delta^{18}O$ (‰)	--	--	--	--	-14.0	--	--	--	--	--	-15.3	-15.6	--	--
Tritium (T.U.)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TDS (lab)	81	99	109	46	66	95	108	48	99	80	98	30	70	88
TDS (sum)	91	120	123	--	82	104	118	--	82	91	119	33	71	94

Table 1.--continued.

SITE[1]	MC-395	MC-395	MC-395	MC-395	MC-395	MC-395	MC-395	MC-395	MC-395	MC-395	MC-395	MC-395	MC-395	MC-395
DATE	04-12-94	07-11-94	10-19-94	01-17-95	04-17-95	10-16-95	01-24-96	04-23-96	07-16-96	10-16-96	01-14-97	04-15-97	07-15-97	10-20-97
PARAMETERS[2]:														
Discharge (cfs)	7.4	10	5.8	--	11	19	9.9	18	49	9.8	18	15	35	10
T (°C)	2.0	18.0	2.0	0.0	0.5	7.5	0.5	3.0	12.5	6.0	0.0	3.7	13.0	6.0
SC (field)	148	86	133	130	148	93	120	128	51	129	97	136	60	128
SC (lab)	158	90	140	135	157	96	130	134	55	135	108	145	65	137
pH (field)	8.2	8.2	8.0	7.8	8.1	7.9	8.0	7.9	7.9	8.2	0	8.3	7.9	8.1
Alkalinity (field)	75	40	64	60	71	43	59	61	24	61	0	68	29	65
Alkalinity (lab)	76	42	67	63	74	45	62	62	25	65	0	68	29	65
Ca	12	8.1	11	11	12	7.4	10	11	5.5	11	8.8	12	6.1	10.4
Mg	6.1	2.7	4.8	4.5	5.5	3.3	4.9	4.7	1.4	5.0	3.5	5.7	1.7	5.2
Na	10	5.1	9.0	8.4	10	5.0	7.8	7.8	2.9	8.3	6.2	9.3	3.4	8.2
K	2.3	1.4	2.0	2.2	0.70	1.4	1.9	1.9	0.70	2.3	1.7	2.1	0.86	2.1
Cl	0.40	0.30	0.30	0.50	0.70	0.20	0.30	0.40	0.10	0.30	0.40	0.40	0.15	0.24
SO_4	6.0	3.5	4.1	4.9	5.8	2.9	3.8	5.5	2.4	4.2	4.7	5.1	2.3	3.4
F	0.1	<0.1	0.1	<0.1	0.1	0.1	0.2	0.1	<0.1	0.1	<0.1	0.1	<0.1	<0.1
SiO_2	27	9.6	17	22	27	16	24	25	10	19	20	27	10	21
N	0.03	<0.01	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.05	0.02	0.02	0.02	0.02	0.02
P	0.04	0.02	0.03	0.03	0.04	0.03	0.03	0.03	0.03	0.04	0.03	0.04	0.02	0.03
As	0.003	0.003	0.003	0.002	0.003	0.003	0.004	0.009	0.002	0.002	0.003	0.003	0.002	0.003
B	<0.010	<0.010	0.010	0.020	0.010	<0.010	<0.010	<0.010	<0.010	0.010	0.01	0.02	<0.020	0.02
Fe	0.021	0.029	0.035	0.027	0.02	0.024	0.030	0.041	0.045	0.032	0.045	0.033	0.024	0.024
LI	0.030	0.020	0.020	0.020	0.030	0.010	0.020	0.024	0.006	0.023	0.015	0.027	0.0	0.0
Mn	0.002	0.004	0.004	0.001	0.003	0.004	0.001	0.004	0.005	0.011	0.002	0.005	<0.004	0.003
Hg	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	--	<0.0001	<0.0001	<0.0001	<0.0001	0.0002	<0.0001	<0.0001
Sr	--	--	--	--	--	--	--	--	--	--	--	--	--	--
δD (‰)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
$\delta^{18}O$ (‰)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tritium (T.U.)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TDS (lab)	108	54	88	88	104	54	82	80	20	86	--	--	--	--
TDS (sum)	109	54	87	90	107	62	88	94	37	87	--	--	--	--

Table 1.--continued.

SITE[1]	MCAF	MCAF	MCAF	MCAF	MCAF	MCAF	MCAF	MCAF	MCAF	MCAF	MCAF	MCAF	MCAF	MCAF
DATE	07-13-88	10-19-88	4-11-89	07-18-89	10-18-89	01-09-90	04-25-90	07-17-90	10-16-90	01-17-91	04-16-91	07-22-91	10-22-91	01-13-92
PARAMETERS[2]:														
Discharge (cfs)	5.8	2.1	8.7	5.3	2.1	5.3	3.5	3.3	1.3	1.2	3.1	2.4	2.8	4.6
T (°C)	25.5	10.0	14.5	23.5	12.0	2.5	17.0	24.0	12.5	5.5	13.5	24.5	13.5	0.5
SC (field)	146	221	165	135	202	192	168	142	195	251	195	155	154	165
SC (lab)	140	229	171	138	213	209	--	151	228	268	209	161	158	177
pH (field)	8.7	8.3	8.2	8.6	8.6	8.0	8.7	8.9	8.5	8.0	7.5	8.2	8.7	8.0
Alkalinity (field)	57	88	73	58	--	87	70	61	88	101	85	63	67	76
Alkalinity (lab)	54	89	75	54	82	84	--	60	88	100	87	62	65	77
Ca	9.0	12	11	8.3	12	13	10	9.1	12	13	13	9.2	9.4	12
Mg	3.5	6.7	5.9	3.6	5.8	6.5	4.8	3.7	6.2	7.0	6.7	3.8	4.4	5.4
Na	13	23	15	13	20	18	8.6	15	23	29	19	16	14	15
K	2.8	4.9	3.0	3.2	5.0	4.5	2.0	3.5	5.5	6.7	4.2	3.7	3.6	3.5
Cl	6.1	11	3.3	5.6	9.6	6.3	6.0	7.2	12	17	7.4	8.3	5.8	4.5
SO_4	8.4	12	7.7	7.0	10	9.0	8.2	6.1	14	15	10	7.6	7.1	7.5
F	0.1	0.3	0.2	0.3	0.2	0.2	0.3	0.2	<0.1	0.4	0.2	0.3	0.3	0.2
SiO_2	25	41	31	26	40	40	21	24	44	56	36	32	27	35
N	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	0.02	<0.02	0.08	<0.01	0.04	0.01	<0.01
P	0.05	0.04	0.06	0.06	0.04	0.04	0.06	0.10	0.05	0.07	0.04	0.05	0.03	0.04
As	0.046	0.004	0.020	0.052	0.038	0.021	0.003	0.052	0.046	0.054	0.029	0.043	0.027	0.020
B	0.25	0.50	0.14	0.24	0.44	0.29	<0.010	0.29	0.50	0.64	0.23	0.36	0.24	0.20
Fe	0.055	0.055	0.043	0.056	0.033	0.035	0.022	0.065	0.064	0.28	0.13	0.044	0.041	0.068
Li	0.050	0.10	0.060	0.060	0.080	0.060	0.020	0.070	0.090	0.12	0.070	0.060	0.050	0.050
Mn	0.015	0.044	0.070	0.010	0.020	0.026	0.005	0.02	0.081	1.0	0.22	0.009	0.018	0.096
Hg	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0043	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Sr	0.039	0.069	0.051	0.041	0.064	--	--	--	--	--	--	--	--	--
δD (‰)	--	--	--	--	--	--	--	--	--	--	--	--	-107	--
$\delta^{18}O$ (‰)	--	--	--	--	--	--	--	--	--	--	--	--	-14.0	--
Tritium (T.U.)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TDS (lab)	100	163	123	113	118	152	110	107	155	197	146	98	99	118
TDS (sum)	103	165	121	102	153	151	110	106	170	207	148	119	111	129

Table 1.--continued.

SITE[1]	MCAF	MCAF	MCAF	MCAF	MCAF	MCAF	MCAF	MCAF	MCAF	MCAF	MCAF	MCAF	MCAF	MCAF
DATE	04-14-92	07-06-92	10-19-92	01-25-93	04-12-93	07-13-93	10-13-93	01-10-94	04-12-94	07-11-94	10-19-94	01-17-95	04-18-95	10-16-95
PARAMETERS[2]:														
Discharge (cfs)	4.2	5.0	2.2	3.4	8.7	66	9.7	3.3	5.5	6.7	3.2	8.9	14	--
T (°C)	15.5	22.0	14.5	2.5	14.0	13.0	10.0	5.5	5.5	25.0	5.5	0.0	0.5	--
SC (field)	187	105	156	220	187	71	120	175	170	101	168	166	186	--
SC (lab)	193	103	160	235	193	74	124	186	177	104	174	170	195	128
pH (field)	8.4	8.9	8.4	7.7	8.3	7.6	7.7	8.2	8.0	8.5	8.1	7.7	7.9	--
Alkalinity (field)	83	43	69	79	79	--	54	73	77	45	73	66	81	--
Alkalinity (lab)	84	43	68	78	81	35	56	79	78	46	76	70	86	58
Ca	12	7.6	11	13	12	6.8	10	12	11	8.2	11	12	13	8.4
Mg	6.5	2.7	4.8	6.0	6.3	2.0	4.0	5.9	5.8	2.9	5.3	5.0	6.3	4.4
Na	17	8.4	14	25	15	4.4	8.6	16	13	7.3	15	14	15	9.0
K	3.3	2.1	3.5	5.3	3.6	1.2	2.3	3.6	3.0	2.2	3.3	3.3	3.2	2.3
Cl	4.8	2.2	4.6	13	5.2	1.2	2.4	4.9	3.3	1.6	4.2	5.0	4.4	2.3
SO_4	8.2	5.0	6.7	18	10	2.3	5.0	7.8	7.6	4.4	6.5	8.1	8.3	3.9
F	0.2	<0.1	0.2	0.2	0.2	<0.1	0.1	0.2	0.2	0.1	0.2	0.1	0.2	<0.1
SiO_2	33	15	26	40	32	14	20	37	32	14	29	28	32	24
N	0.01	0.01	0.02	0.04	0.02	0.03	0.03	0.01	0.03	<0.01	<0.02	0.02	<0.02	<0.02
P	0.07	0.04	0.04	0.07	0.05	0.03	0.03	0.04	0.04	0.03	0.03	0.04	0.05	0.03
As	0.029	0.019	0.026	0.060	0.024	0.011	0.011	0.015	0.017	0.016	0.023	0.018	0.018	0.017
B	0.17	0.11	0.20	0.52	0.18	0.060	0.070	0.21	0.14	0.080	0.21	0.17	0.17	0.10
Fe	0.068	0.066	0.034	0.23	0.11	0.075	0.061	0.10	0.082	0.064	0.067	0.10	0.10	0.069
Li	0.060	0.030	0.050	0.10	0.060	0.010	0.020	0.06	0.050	0.030	0.050	0.050	0.060	0.040
Mn	0.092	0.035	0.024	0.24	0.12	0.071	0.064	0.11	0.10	0.084	0.074	0.097	0.16	0.043
Hg	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Sr	--	--	--	--	--	--	--	--	--	--	--	--	--	--
δD (‰)	--	--	--	--	-112	-113	--	--	--	--	--	--	--	--
$\delta^{18}O$ (‰)	--	--	--	--	-15.2	-15.4	--	--	--	--	--	--	--	--
Tritium (T.U.)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TDS (lab)	136	68	134	162	118	54	74	142	124	72	102	110	134	86
TDS (sum)	136	69	112	170	133	53	85	132	123	68	119	116	132	89

Table 1.--continued.

SITE[1]	MCAF	MCAF	MCAF	MCAF	MCAF	MCAF	MCAF	MCAF	MCF	MCF	MCF	MCF	MCF	MCF
DATE	01-24-96	04-23-96	07-16-96	10-16-96	01-14-97	04-15-97	07-15-97	10-20-97	07-13-88	10-19-88	01-11-89	04-11-89	07-18-89	10-18-89
PARAMETERS[2]:														
Discharge (cfs)	9.6	17	39	7.1	25	14	31	9.6	12	3.1	3.6	8.3	7.8	3.0
T (°C)	0.5	13.0	18.0	11.0	1.0	8.5	16.0	8.0	17.0	5.0	0.0	7.0	17.5	5.5
SC (field)	150	141	86	154	133	157	89	145	84	140	165	144	88	131
SC (lab)	161	144	89	159	136	164	92	154	83	145	167	152	93	141
pH (field)	8.0	8.0	7.8	8.2	0	8.2	7.9	8	8.2	7.6	7.6	7.9	7.3	8.2
Alkalinity (field)	70	65	38	68	0	74	41	70	38	78	76	71	47	--
Alkalinity (lab)	72	65	40	70	0	75	41	70	38	70	80	72	43	64
Ca	11	11	7.2	10	9.7	12	7.5	11	8.0	11	13	11	8.6	10
Mg	5.7	4.9	2.6	5.1	4.2	6.0	2.6	5.4	2.5	5.6	6.3	5.9	3.0	4.8
Na	12	9.6	6.7	13	10	12	6.1	11	5.4	9.4	11	11	6.0	9.3
K	2.7	2.4	1.4	3.2	2.5	2.7	1.6	2.8	1.1	2.3	2.6	2.3	1.1	2.0
Cl	2.7	1.4	1.4	3.2	2.5	2.0	1.3	1.8	0.50	0.50	0.40	0.50	0.30	1.2
SO_4	4.7	6.0	2.9	5.9	6.1	6.0	2.8	4.5	4.1	5.6	6.9	6.4	4.0	5.0
F	0.2	0.1	0.2	0.2	0.1	0.2	0.2	<0.1	0.1	0.1	0.1	0.1	0.2	0.1
SiO_2	29	27	18	30	26	31	16	26	9.3	17	30	27	11	17
N	<0.02	<0.02	0.03	0.02	<0.02	<0.02	<0.02	<0.02	<0.01	<0.01	<0.01	0.01	0.01	<0.01
P	0.03	0.04	0.03	0.04	0.03	0.05	0.02	0.02	0.02	0.04	0.05	0.05	0.02	0.03
As	0.017	<0.001	0.013	0.020	0.013	0.014	0.009	0.012	0.005	0.004	0.004	0.004	0.004	0.003
B	0.11	0.060	0.080	0.16	0.12	0.09	0.07	0.09	0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Fe	0.071	0.054	0.080	0.061	0.059	0.046	0.046	0.049	0.015	0.018	0.017	0.030	0.039	0.021
Li	0.050	0.033	0.025	0.045	0.034	0.041	0.0	0.0	0.010	0.030	0.040	0.040	0.020	0.030
Mn	0.11	0.054	0.047	0.082	0.051	0.041	0.13	0.041	0.016	0.003	0.004	0.004	0.008	0.004
Hg	--	<0.0001	<0.0001	<0.0001	<0.0001	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	--	<0.0001	<0.0001
Sr	--	--	--	--	--	--	--	--	0.031	0.047	0.052	0.046	0.033	0.045
δD (‰)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
$\delta^{18}O$ (‰)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tritium (T.U.)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TDS (lab)	102	90	50	114	--	--	--	--	56	94	113	105	71	84
TDS (sum)	110	103	63	112	--	--	--	--	54	98	116	107	63	88

Table 1.--continued.

SITE[1]	MCF	MCF
DATE	01-09-90	04-25-90
PARAMETERS[2]:		
Discharge (cfs)	4.5	8.8
T (°C)	0.0	5.5
SC (field)	147	131
SC (lab)	170	132
pH (field)	8.0	8.3
Alkalinity (field)	83	53
Alkalinity (lab)	80	63
Ca	14	9.9
Mg	6.2	4.9
Na	11	16
K	2.8	3.4
Cl	0.50	0.50
SO_4	6.0	5.4
F	0.1	0.1
SiO_2	30	31
N	0.02	<0.01
P	0.04	0.04
As	0.001	0.030
B	<0.010	<0.010
Fe	0.021	0.059
Li	--	0.060
Mn	0.003	0.052
Hg	--	<0.0001
Sr	--	--
δD (‰)	--	--
$\delta^{18}O$ (‰)	--	--
Tritium (T.U.)	--	--
TDS (lab)	120	87
TDS (sum)	121	104

[1] MBP-3 denotes a geothermal production well at Casa Diablo; BAL denotes thermal spring downstream from Big Alkali Lake; FHAB, FHCD, and FH2,3 denote springs at the Hot Creek Fish Hatchery; HC-3 denotes a hot spring downstream from bridge in Hot Creek gorge; LHC-SP denotes hot spring near the head of Little Hot Creek; MC395 denotes surface water sampling site along Mammoth Creek upstream of State Highway 395; MCAF denotes surface water sampling site along Mammoth Creek upstream of input from Hot Creek Fish Hatchery; HCF denotes surface water sampling site at the flume below Hot Creek gorge.

[2] T denotes temperature; SC denotes specific conductance in μS/cm; Alkalinity expressed in mg/L of $CaCO_3$; stable isotope values δD and $\delta^{18}O$ expressed as parts per mil relative to SMOW; Tritium values expressed in Tritium Units (T.U.); TDS denotes total dissolved solids in mg/L, determined both by dry weight (lab) and as the sum of concentrations of individual chemical constituents (sum).