

Water-Resources Data for the Devils Hole Area, Nye County, Nevada, July 1978 - September 1988

By Craig L. Westenburg

U.S. GEOLOGICAL SURVEY

Open-File Report 90-381

Prepared in cooperation with the
NATIONAL PARK SERVICE



Carson City, Nevada
1993

U.S. DEPARTMENT OF THE INTERIOR

BRUCE BABBITT, *Secretary*

U.S. GEOLOGICAL SURVEY

Dallas L. Peck, *Director*

Any use of trade, product, or firm names in this publication is for descriptive purposes only and does not constitute endorsement by the U.S. Government.

For additional information
write to:

District Chief
U.S. Geological Survey
333 West Nye Lane, Room 203
Carson City, NV 89706-0866

Copies of this report may be
purchased from:

U.S. Geological Survey
Open-File Reports Services
Federal Center, MS 517
Box 25286
Denver, CO 80225-0046

CONTENTS

	<i>Page</i>
ABSTRACT	1
INTRODUCTION	1
Purpose and scope	1
Acknowledgment	3
Location	3
Hydrogeologic setting	3
Local identification system	3
WATER-LEVEL FLUCTUATIONS	5
Devils Hole	5
Observation wells	7
SPRING DISCHARGE	7
ELECTRIC-POWER CONSUMPTION	12
REFERENCES CITED	13

ILLUSTRATIONS

Figure 1. Map showing location of Ash Meadows and Devils Hole	2
2. Map showing location of monitored wells and springs in the vicinity of Devils Hole	4
3-7. Graphs showing:	
3. Lowest daily mean water levels for each month at Devils Hole, January 1968 to September 1988	6
4. Daily mean water level in Devils Hole, July 1, 1978, to September 30, 1988	8
5. Instantaneous water-level measurements in wells 230 S17 E50 36DD1, 230 S18 E51 6AA1, and 230 S18 E51 7BBB1 from July 1, 1978, to September 30, 1988	9
6. Daily mean water level in wells 230 S18 E51 7BDB1 and 230 S18 E51 7DB2 from July 1, 1978, to September 30, 1988	10
7. Daily mean discharge of Fairbanks, Big, and Jack Rabbit Springs from July 1, 1978, to September 30, 1988	11

TABLES

Table 1. Physical data for wells referred to in this report	5
2. Electric-power consumption by pumps in irrigation wells 230 S18 E51 7DAC1, 7DAD1, and 7CA1	12

CONVERSION FACTORS

<i>Multiply</i>	<i>By</i>	<i>To Obtain</i>
acre	4,047	square meter
cubic feet per second (ft ³ /s)	0.02832	cubic meter per second
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer

SEA LEVEL

In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929, formerly called "Sea-Level Datum of 1929"), which is derived from a general adjustment of the first-order leveling networks of the United States and Canada.

WATER-RESOURCES DATA FOR THE DEVILS HOLE AREA, NYE COUNTY, NEVADA, JULY 1978 - SEPTEMBER 1988

By Craig L. Westenburg

ABSTRACT

Data on water levels, spring discharge, and consumption of electric power by irrigation pumps collected at Devils Hole and vicinity from July 1978 through September 1988 are reported herein. These data were collected to document the effects of irrigation pumping on the pool level at Devils Hole and the recovery following cessation of irrigation pumping in August 1982. The pool contains the endangered species of pupfish, *Cyprinodon diabolis*. Data on fluctuations in water level and springflow are presented in graphic form. Data on consumption of electric power by pumps in irrigation wells, useful as an index of the pumpage, are presented in tabular form.

INTRODUCTION

The U.S. Geological Survey has collected comprehensive water-resources data in the Devils Hole area since July 1953 and in cooperation with the National Park Service since July 1972. Devils Hole, a collapsed depression in the limestone hills northeast of Ash Meadows, Nye County, Nev. (fig. 1), is the sole known natural habitat of the Devils Hole pupfish (*Cyprinodon diabolis*), an endangered species. This species feeds and reproduces on a slightly submerged rock ledge in Devils Hole. Past irrigation pumping, however, nearly exposed this ledge (Dudley and Larson, 1976, p. 1). The Geological Survey data collection involves monitoring the effects of ground-water pumping from selected irrigation wells in the Ash Meadows area on the water level in Devils Hole.

Purpose and Scope

The monitoring program includes collection of three types of water-resources data: Water levels in Devils Hole and in observation wells; discharge of major springs; and electric-power consumption by pumps in irrigation wells. The scope of the current program does not include the development of specific cause-and-effect relations.

This report, which is the seventh in a series, presents water-resources data collected from July 1978 through September 1988. Data for earlier periods are presented by Larson (1974a, 1974b, 1975), Hanes (1976), and Carson (1979, 1980). Additional information on Devils Hole and vicinity is given by Dudley and Larson (1976), Carr (1988), and Hoffman (1988).

All basic data on water levels, spring discharge, and electric-power consumption for the overall period of U.S. Geological Survey investigations at Devils Hole are available in files of the Geological Survey office in Carson City, Nev. (333 W. Nye Lane).

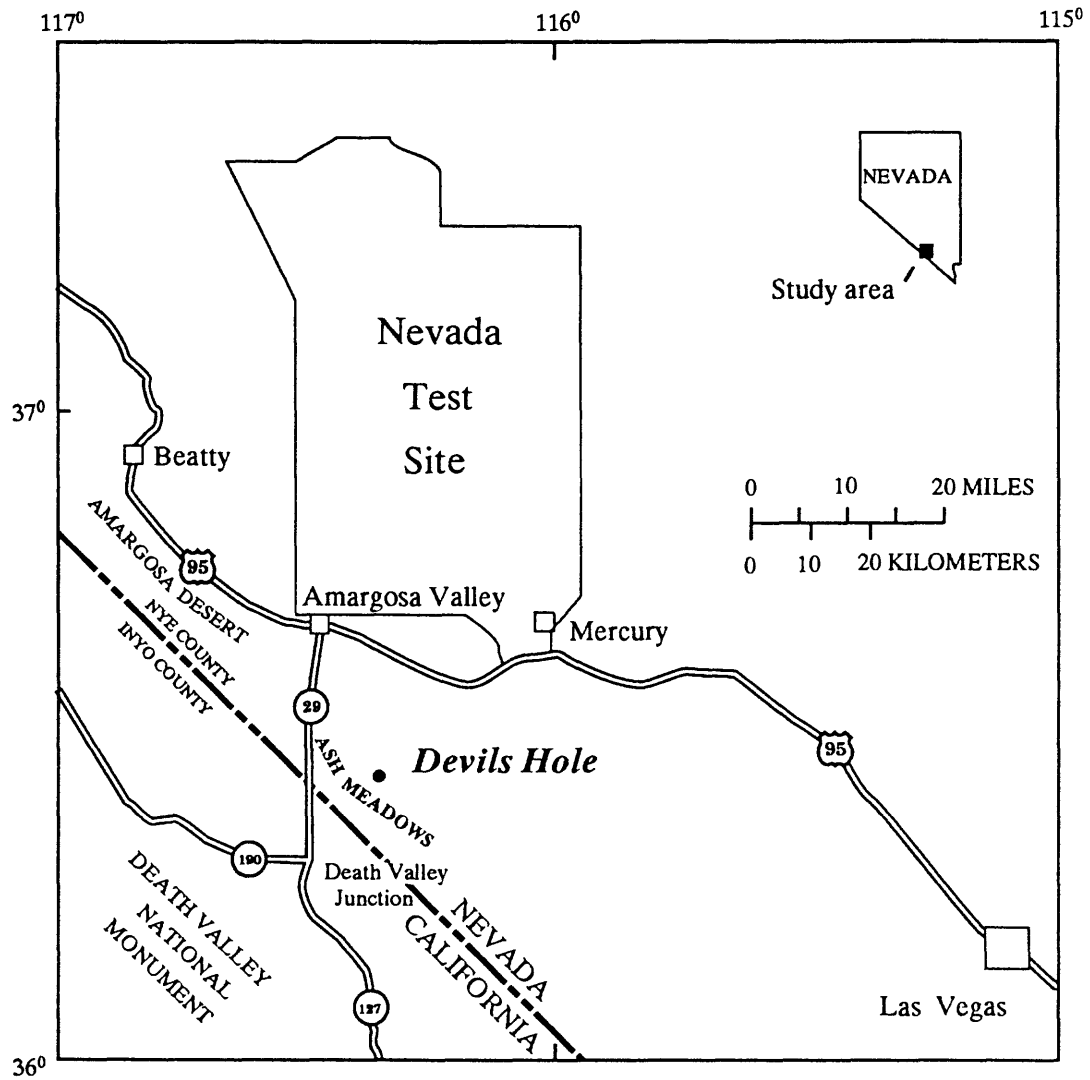


FIGURE 1. -- Location of Ash Meadows and Devils Hole.

Acknowledgment

Gratitude is expressed to Richard Pruska, U.S. Geological Survey, who calculated and verified more than 20 years of data for the Devils Hole area.

Location

Devils Hole is in a 40-acre tract of Death Valley National Monument that is geographically separate from the main part of the Monument. Devils Hole is about 65 miles north-northwest of Las Vegas, Nev., and about 12 miles northeast of Death Valley Junction, Calif. (fig. 1).

Devils Hole is on the northeast boundary of Ash Meadows, an area of many oases and meadows watered by numerous springs (fig. 2). Ash Meadows, at an altitude of approximately 2,200 feet, is bordered on the northeast by a segmented group of low hills with relief ranging from 500 to 900 feet.

Hydrogeologic Setting

The Ash Meadows area discharges ground water collected from several thousand square miles of a regional aquifer system in carbonate rocks of Paleozoic age (Dudley and Larson, 1976, p. 5-9). The rocks exposed in the hills bordering Ash Meadows to the northeast, and those in which Devils Hole is formed, are part of the carbonate aquifer system. Faults define the boundary between the carbonate rocks and clastic sediments of Ash Meadows. Ground water from the carbonate aquifer system moves westward across the fault contacts into the clastic aquifer system and is discharged by the springs in Ash Meadows (Carson, 1980, p. 6).

Local Identification System

The local site-identification system used in this report is based on an index of hydrographic areas in Nevada (Rush, 1968) and the rectangular subdivision of the public lands referenced to the Mount Diablo base line and meridian. Each site designation consists of four units separated by spaces. The first unit is the hydrographic area number. The second unit is the township, preceded by an N or S to indicate location north or south of the base line. The third unit is the range, preceded by an E to indicate location east of the meridian. The fourth unit consists of the section number and letters designating the quarter section, quarter-quarter section, and so on (A, B, C, and D indicate the northeast, northwest, southwest, and southeast quarters, respectively), followed by a number indicating the sequence in which the site was recorded. For example, site 230 S18 E51 7DAC1 is in Amargosa Desert (hydrographic area 230). It is the first site recorded in the southwest quarter of the northeast quarter of the southeast quarter of section 7, Township 18 South, Range 51 East, Mount Diablo base line and meridian.

Other well-numbering systems have been used in Nevada. In particular, Dudley and Larson (1976, table 3) used a sequence number to identify well sites in the Devils Hole area. Table 1 cross-references the well numbers used by Dudley and Larson (1976) with those used in this report.

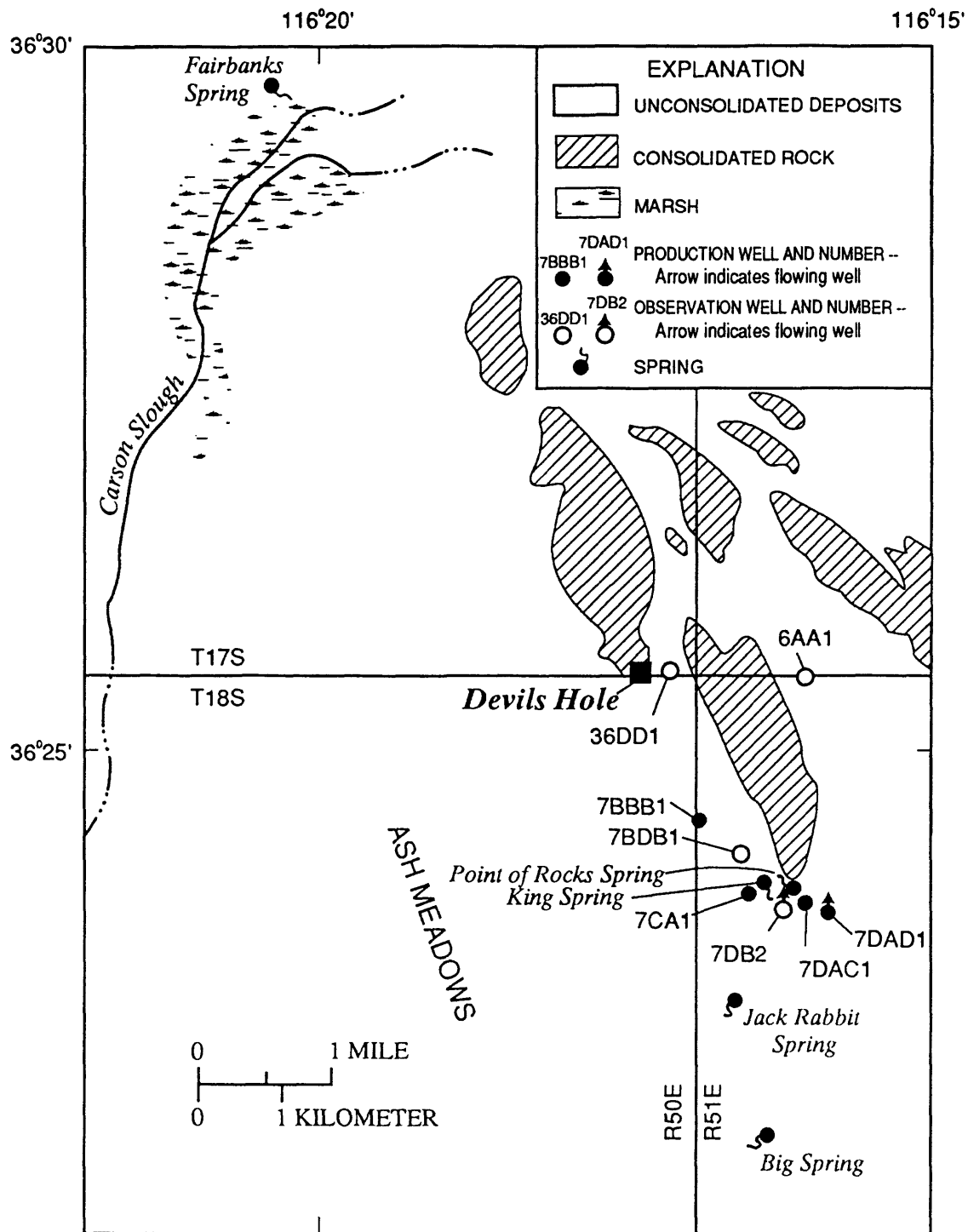


FIGURE 2.--Location of monitored wells and springs in the vicinity of Devils Hole.

TABLE 1.--Physical data for wells referred to in this report¹

[--, not referenced in Dudley and Larson, 1976; ?, unknown]

Well	Identification used by Dudley and Larson (1976)	Land-surface altitude (feet above sea level)	Feet below land surface	
			Well depth	Perforated interval
230 S17 E50 36DD1	--	2,405	248	48-248
230 S18 E51 6AA1	12	2,435	?	0-?
230 S18 E51 7BBB1	5	2,320	500	109-500
230 S18 E51 7BDB1	13	2,340	818	132-467
230 S18 E51 7CA1	4	2,295	500	100-500
230 S18 E51 7DAC1	2	2,315	300	60-300
230 S18 E51 7DAD1	3	2,315	780	10-780
230 S18 E51 7DB2	--	2,315	282	40-282

¹ Additional data are given by Dudley and Larson (1976, table 3).

WATER-LEVEL FLUCTUATIONS

Devils Hole

Devils Hole water level is monitored by a continuous recorder attached to a float in a stilling well. The water level is the distance of the water surface below an established reference point near the recorder.

Ground water in the Devils Hole area was used to irrigate crops for cattle feed starting May 1969. The withdrawal of ground water affects the water level in Devils Hole (Dudley and Larson, 1976, p. 1). Efforts to avoid or mitigate the effects of pumping on Devils Hole water level failed and pumping eventually ceased. Only one pump, at well 230 S18 E51 7DAD1, operated from July 1981 to August 1982. Since August 1982, no pumping has taken place. Figure 3 shows the lowest daily mean water level for each month in Devils Hole from January 1968, prior to the period of pumping, through September 1988. The low water level declined from about 1.3 feet below the reference point in January 1968 to 3.8 feet below in September and October 1972. Thereafter, the low-water level rose slowly as pumping decreased and eventually ceased. For the period July 1978 to September 1988, the lowest daily mean water level for the month ranged from 2.48 to 1.94 feet below the reference point.

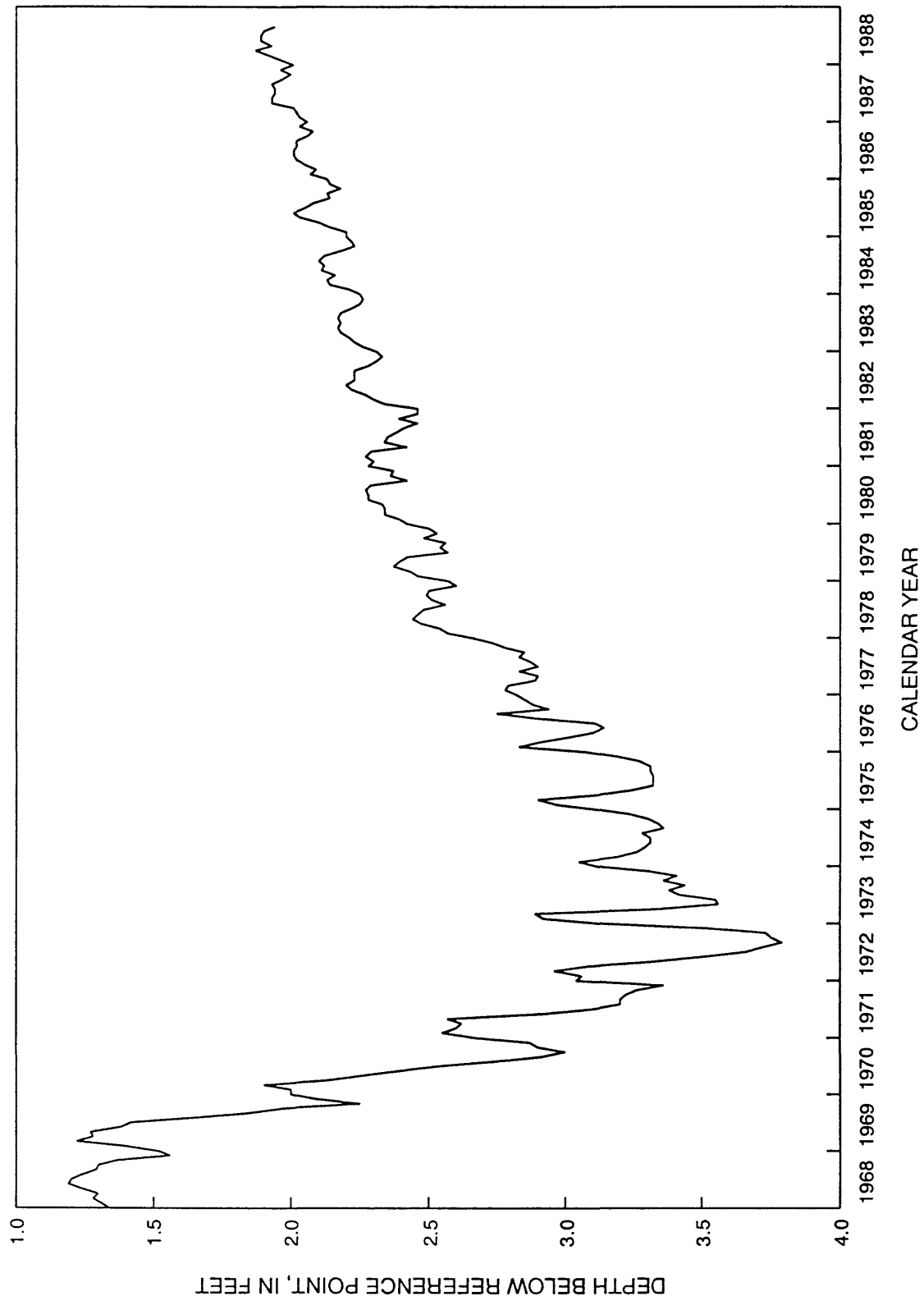


FIGURE 3.--Lowest daily mean water levels for each month at Devils Hole, January 1968 to September 1988.

Superimposed on the long-term trend of water levels in Devils Hole are short-term fluctuations resulting from several stimuli (Dudley and Larson, 1976, p. 11). These stimuli include the seasonal and daily changes in the rate and location of pumping, tidal deformation of the carbonate aquifer, changes in barometric pressure, and seismic events caused by natural earthquakes and nuclear explosions at the Nevada Test Site north of Devils Hole (fig. 1).

Figure 4 shows the daily mean water level in Devils Hole from July 1978 to September 1988. Short-term fluctuations and long-term trends are evident.

Observation Wells

In addition to monitoring the water level in Devils Hole, the Geological Survey monitors water levels in five wells in the Devils Hole area. These are wells 230 S17 E50 36DD1; 230 S18 E51 6AA1, 7BBB1, 7BDB1, and 7DB2. The locations of these wells are shown in figure 2.

Periodic water-level measurements were made in wells 230 S17 E50 36DD1; 230 S18 E51 6AA1, and 7BBB1 and levels are shown in figure 5. Well 230 S17 E50 36DD1 is 900 feet east of Devils Hole. Well 230 S18 E51 6AA1 is about 1 mile east of Devils Hole and about 1.5 miles north of the major well field in Ash Meadows, near Point of Rocks Spring (fig. 2). Well 230 S18 E51 7BBB1 is 1 mile south of Devils Hole and about 1 mile northwest of the center of the well field. Ground water was pumped at various rates during 1978-82 (table 2) and was not pumped during 1983-88. The water-level measurements for well 230 S17 E50 36DD1 ranged from 49.0 feet to 48.4 feet during 1978-82 and from 48.9 feet to 48.0 feet during 1983-88. The water-level measurements for well 230 S18 E51 6AA1 ranged from 75.1 feet to 74.3 feet during 1978-82 and from 74.7 feet to 74.3 feet during 1983-88. The water-level measurements for well 230 S18 E51 7BBB1 ranged from 25.0 feet to 21.6 feet during 1978-82 and from 23.8 feet to 21.1 feet during 1983-88.

Wells 230 S18 E51 7BDB1 and 7DB2 are in the well field near Point of Rocks Spring (fig. 2) and are equipped with water-level recorders. Figure 6 shows the daily mean water levels for July 1978 to September 1988. The water level in well 230 S18 E51 7DB2 dropped to a low of 7.4 feet during July and August 1979, rose to land surface during November 1983 and since then, the well has been flowing. The water level in well 230 S18 E51 7BDB1 dropped to a low of 72.6 feet during July 1979. From September 1987, 5 years after pumping ceased, to September 1988, the water level rose 1.3 feet, from 13.2 feet to 11.9 feet.

SPRING DISCHARGE

The discharge of three springs in the Ash Meadows area is monitored by the Geological Survey. The monitored springs, which cumulatively contribute about one-third of the total spring discharge in Ash Meadows, are Fairbanks, Big, and Jack Rabbit Springs. The locations of these springs are shown in figure 2. They are aligned in a generally northwest-trending direction and are controlled structurally by faulting (Dudley and Larson, 1976, p. 9-10).

The discharge of the monitored springs for July 1978 to September 1988 is shown in figure 7. The average discharge of Fairbanks Spring was 3.6 cubic feet per second (ft³/s) in July 1988, 6 years after all pumping ceased. The average discharge of Fairbanks Spring in July 1978 was also 3.6 ft³/s. Discharge of Big Spring averaged 2.0 ft³/s in July 1988, and also 2.0 ft³/s in July 1978. Discharge of Jack Rabbit Spring averaged 1.3 ft³/s in July 1988, and 1.2 ft³/s in July 1978 when ground water was being pumped. Six years after pumping ended, the discharge of these three springs showed generally minor fluctuation.

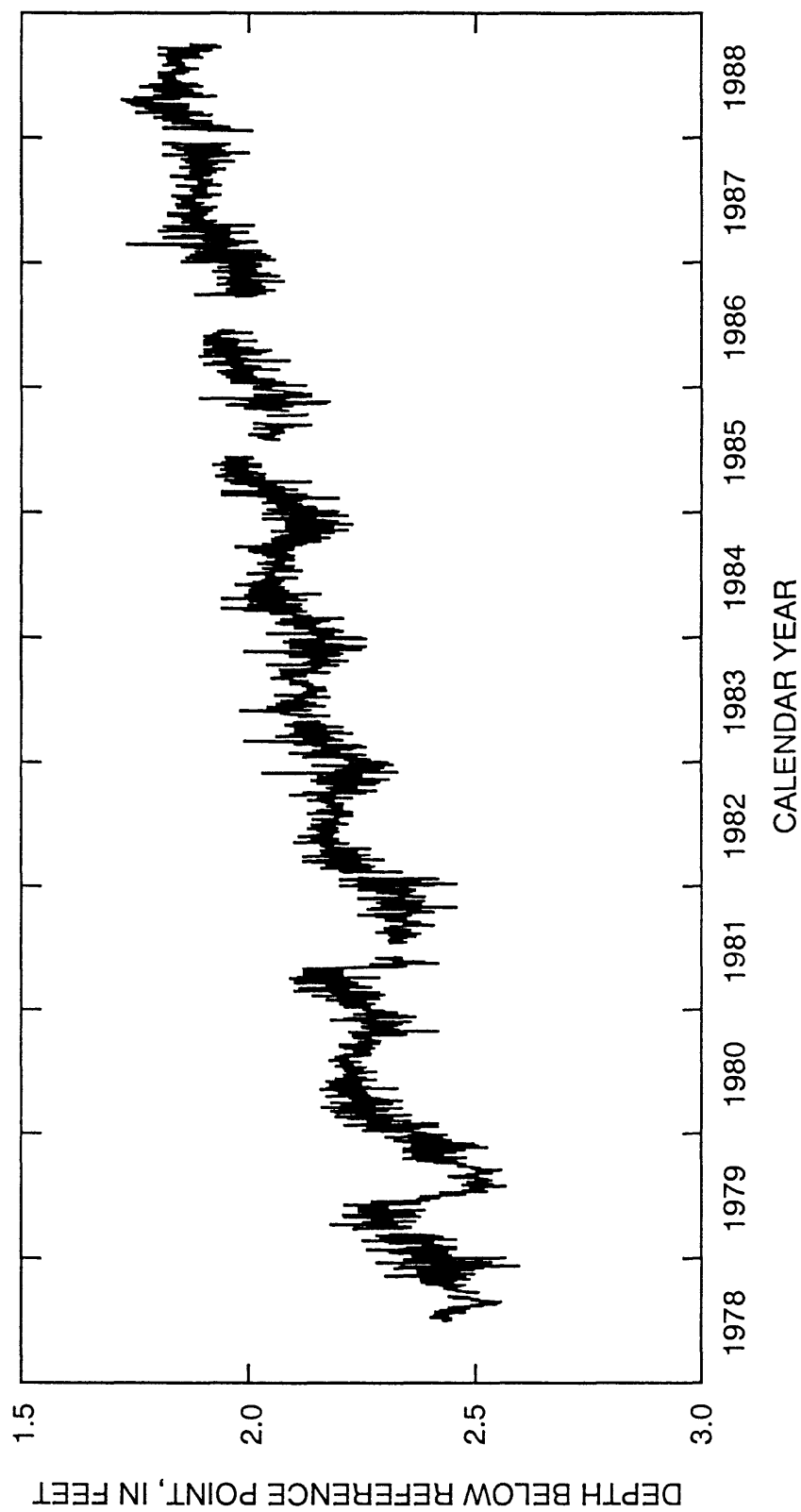


FIGURE 4.--Daily mean water level in Devils Hole, July 1, 1978, to September 30, 1988.

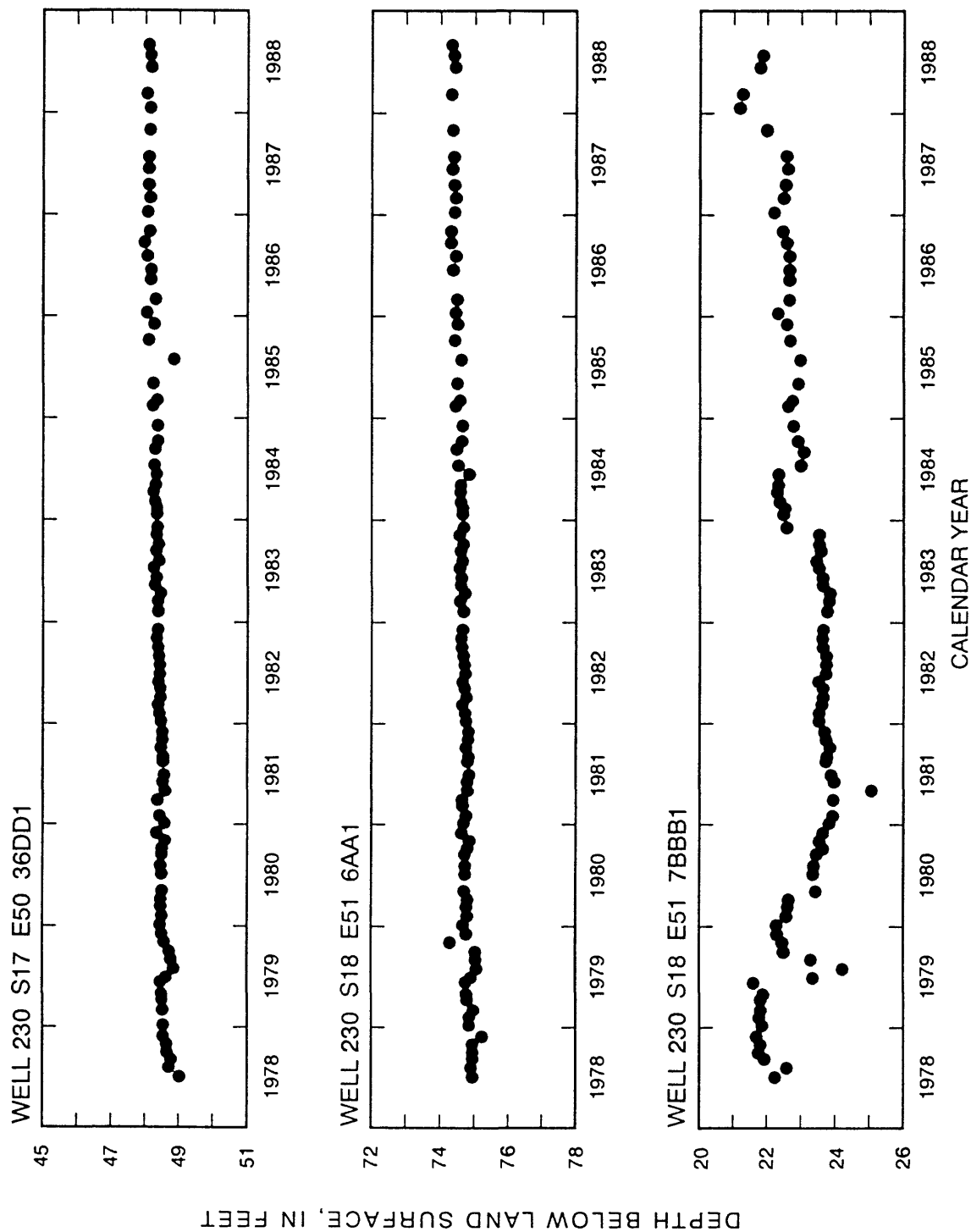


FIGURE 5.--Instantaneous water-level measurements in wells 230 S17 E50 36DD1, 230 S18 E51 6AA1, and 230 S18 E51 7BBB1 from July 1, 1978, to September 30, 1988.

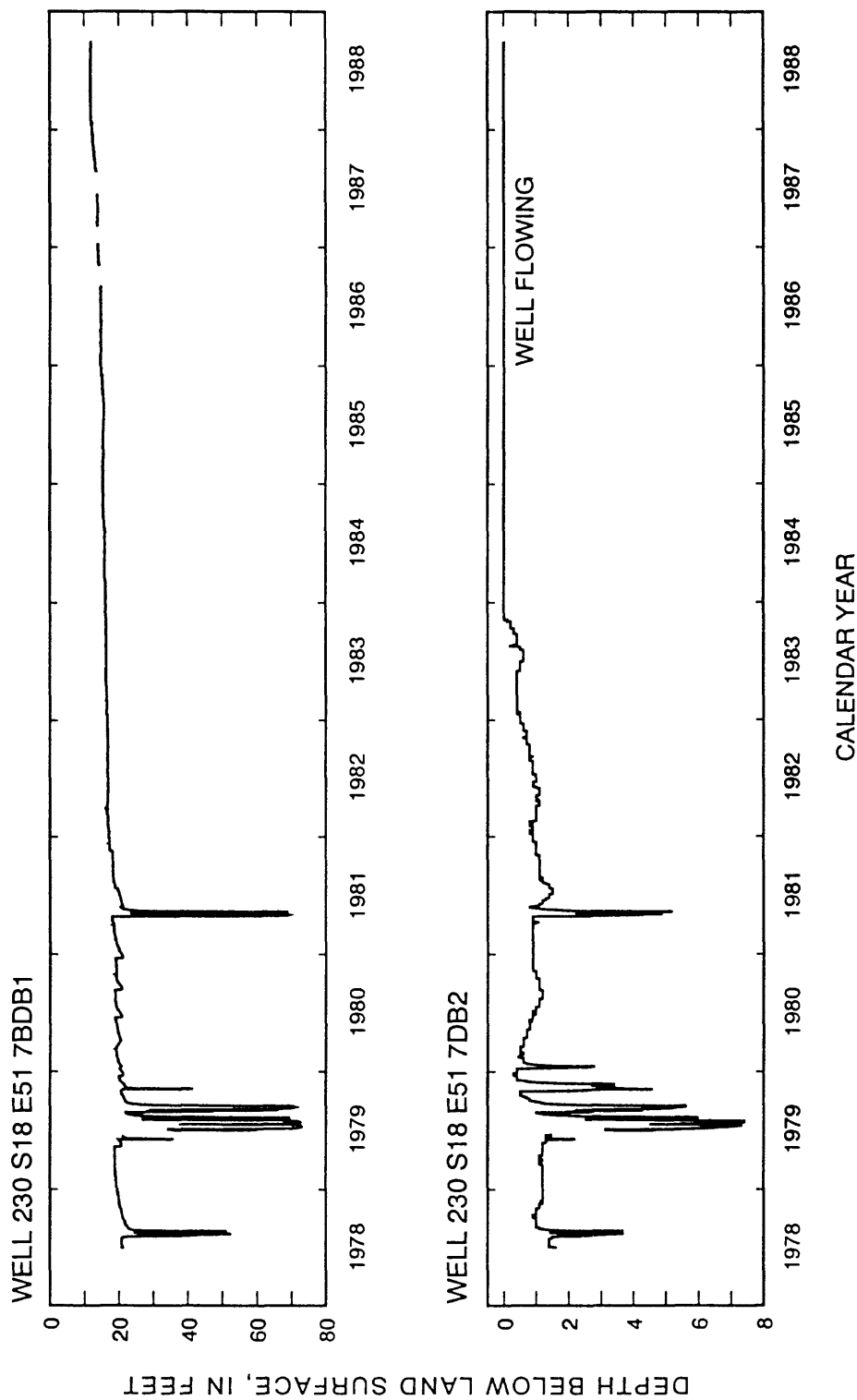


FIGURE 6.--Daily mean water level in wells 230 S18 E51 7BDB1 and 230 S18 E51 7DB2 from July 1, 1978, to September 30, 1988.

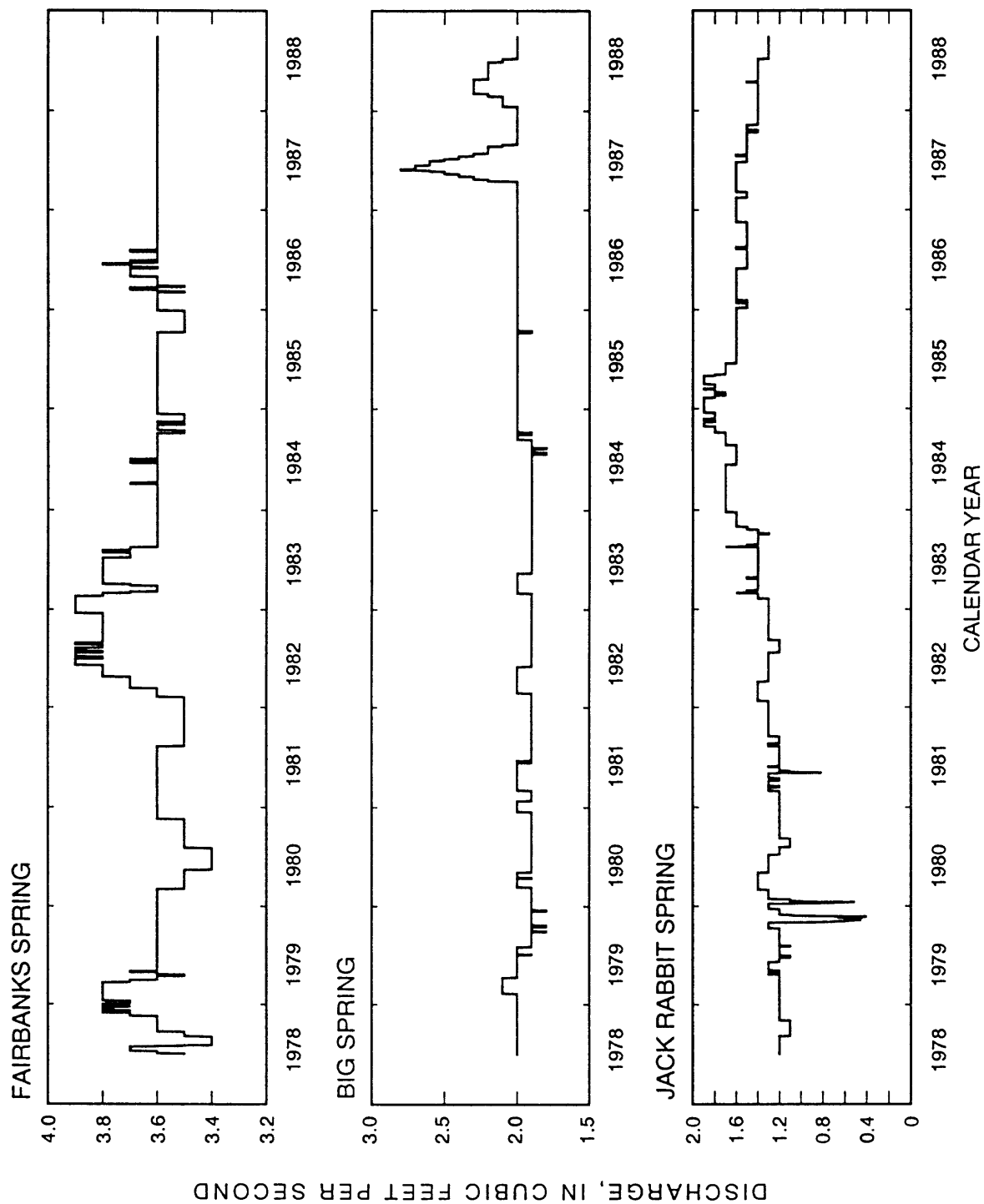


FIGURE 7.--Daily mean discharge of Fairbanks, Big, and Jack Rabbit Springs from July 1, 1978, to September 30, 1988.

ELECTRIC-POWER CONSUMPTION

Electric-power consumption is recorded by the Geological Survey for the pumps of three irrigation wells in Ash Meadows: 230 S18 E51 7DAC1, 7DAD1, and 7CA1. The locations of these wells are shown in figure 2 and the total monthly consumption is shown in table 2. The consumption of electric power is an indicator of the amount of water pumped during the month. No pumping occurred after August 1982 and all pumps were removed by November 1983.

TABLE 2.--*Electric-power consumption by pumps
in irrigation wells 230 S18 E51 7DAC1, 7DAD1,
and 7CA1*

Month	Electric-power consumption (kilowatt hours, rounded)				
	1978	1979	1980	1981	1982
January	0	0	10,600	0	0
February	0	0	0	0	80
March	0	0	0	0	40
April	0	0	0	3,900	200
May	0	0	0	22,400	0
June	0	16,400	0	0	40
July	1,200	27,500	0	560	40
August	12,100	13,400	0	0	40
September	0	26,700	0	0	0
October	0	0	0	0	0
November	0	1,200	0	0	0
December	0	0	0	0	0
Total	13,300	85,200	10,600	26,900	400

REFERENCES CITED

- Carr, W.J., 1988, Geology of the Devils Hole area, Nevada: U.S. Geological Survey Open-File Report 87-560, 32 p.
- Carson, R.L., 1979, Water-resources data collected in the Devils Hole area, Nevada, 1976-77: U.S. Geological Survey Open-File Report 79-742, 22 p.
- 1980, Water-resources data collected in the Devils Hole area, Nevada, 1977-78: U.S. Geological Survey Open-File Report 80-772, 15 p.
- Dudley, W.W., Jr., and Larson, J.D., 1976, Effect of irrigation pumping on desert pupfish habitats in Ash Meadows, Nye County, Nevada: U.S. Geological Survey Professional Paper 927, 52 p.
- Hanes, W.T., 1976, Water-resources data collected in the Devils Hole area, Nevada, 1975-76: U.S. Geological Survey Open-File Report 76-797, 15 p.
- Hoffman, R.J., 1988, Chronology of diving activities and underground surveys in Devils Hole and Devils Hole Cave, Nye County, Nevada, 1950-86: U.S. Geological Survey Open-File Report 88-93, 12 p.
- Larson, J.D., 1974a, Water-resources data collected in the Devils Hole area, Nevada, 1972-73: U.S. Geological Survey Water-Resources Investigations Report 61-73, 20 p.
- 1974b, Water-resources data collected in the Devils Hole area, Nevada, 1973-74: U.S. Geological Survey Open-File Report 74-330, 12 p.
- 1975, Water-resources data collected in the Devils Hole area, Nevada, 1974-75: U.S. Geological Survey Open-File Report, 12 p.
- Rush, F.E., 1968, Index of hydrographic areas in Nevada: Nevada Division of Water Resources Information Report 6, 38 p.