HYDROLOGIC CONDITIONS AT ANAKTUVUK PASS, ALASKA, 1989

By Harold R. Seitz

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CONVERSION FACTORS AND ABBREVIATIONS

Multiply inch-pound unit	By	To obtain metric unit
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
acre	0.4047	hectare
gallon per minute (gal/min)	0.06308	liter per second (L/s)
gallon per day (gal/d)	0.003785	cubic meter per day (m^3/d)
degree Fahrenheit (°F)	°C = 5/9 x (°F-32)	degree Celsius (°C)

Other abbreviations in this report are:

mg/L, milligram per liter

µg/L, microgram per liter

µS/cm, microsiemen per centimeter at 25 degrees Celsius

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ABSTRACT

Hydrologic conditions at the village of Anaktuvuk Pass in the central Brooks Range of Alaska were reviewed in September 1989. The work was done to provide data that would assist the village in the location and development of additional water supplies needed to support a piped sewage-handling system. Well logs and water-quality data from existing wells indicated that the aquifer in the area north of the central supply well and adjacent to the west bank of Contact Creek would sustain a well capable of producing the needed volume of good-quality water.

INTRODUCTION

Anaktuvuk Pass is a Nunamiut (Eskimo) village in the central Brooks Range (fig.1). Its population has grown from 66 people in 1950 to about 250 in 1990. The installation of a pumped-sewage system has been proposed for the village, and additional water supplies are needed to support such a system. In order to provide the data needed to assist in locating and developing additional water supplies, the U.S. Geological Survey, in cooperation with the North Slope Borough, visited the village to examine hydrologic conditions in September 1989. This report is a summary of the information collected during the visit and a review of work of earlier investigators at Anaktuvuk Pass.

The consulting engineer for the North Slope Borough provided background information and conveyed water needs. Personnel from the Anaktuvuk Pass Municipal Services provided local information and transportation, and acted as guides during the Survey's visit to the village.

Setting

The village of Anaktuvuk Pass is at 2,200 ft altitude in a U-shaped glaciated mountain valley that forms the divide between two major watersheds, the Anaktuvuk and John Rivers. The valley floor is a relatively flat alluvial plain between the Soakpak and Three River Mountains. The drainage of the village site is through Contact Creek to John River, which flows southward from the pass. Eleanor Lake is about 0.5 mi northeast of the village and has a surface area of about 30 acres. It drains into the headwaters of the Anaktuvuk River, which flows to the north.

Climate

Continental arctic weather dominates the climate of the area. Average minimum temperatures remain below freezing for most of the year (fig. 2). December is the coldest month with an average temperature of minus 14.3 °F; July is the warmest month with an average temperature of 50.5 °F (Arctic Environmental Information and Data Center, 1986). Precipitation averages 10.65 in/yr; half occurs as rain showers from June through September and half as snow from October through May (fig. 2).

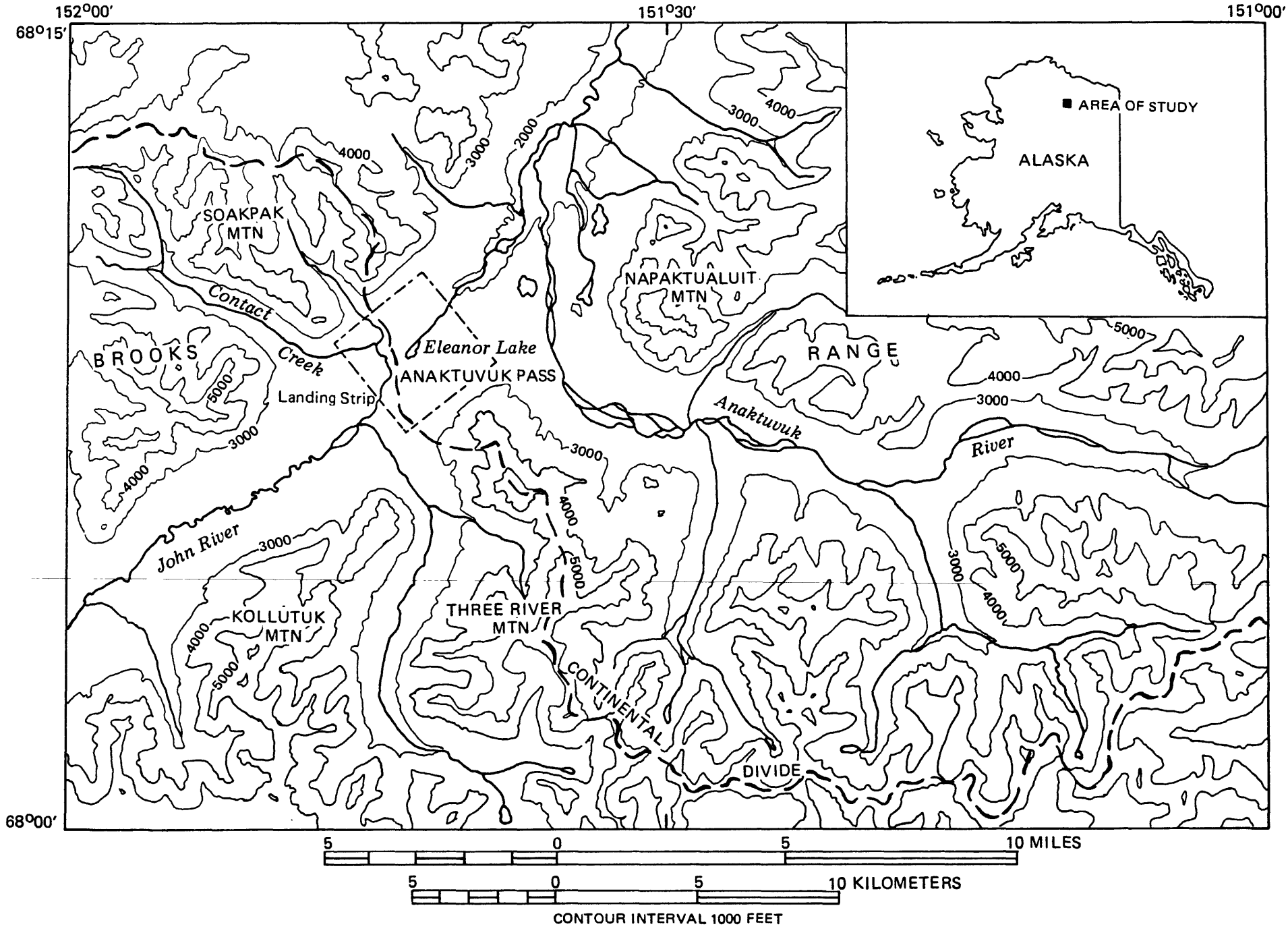


Figure 1.--Location of the Anaktuvuk Pass area.

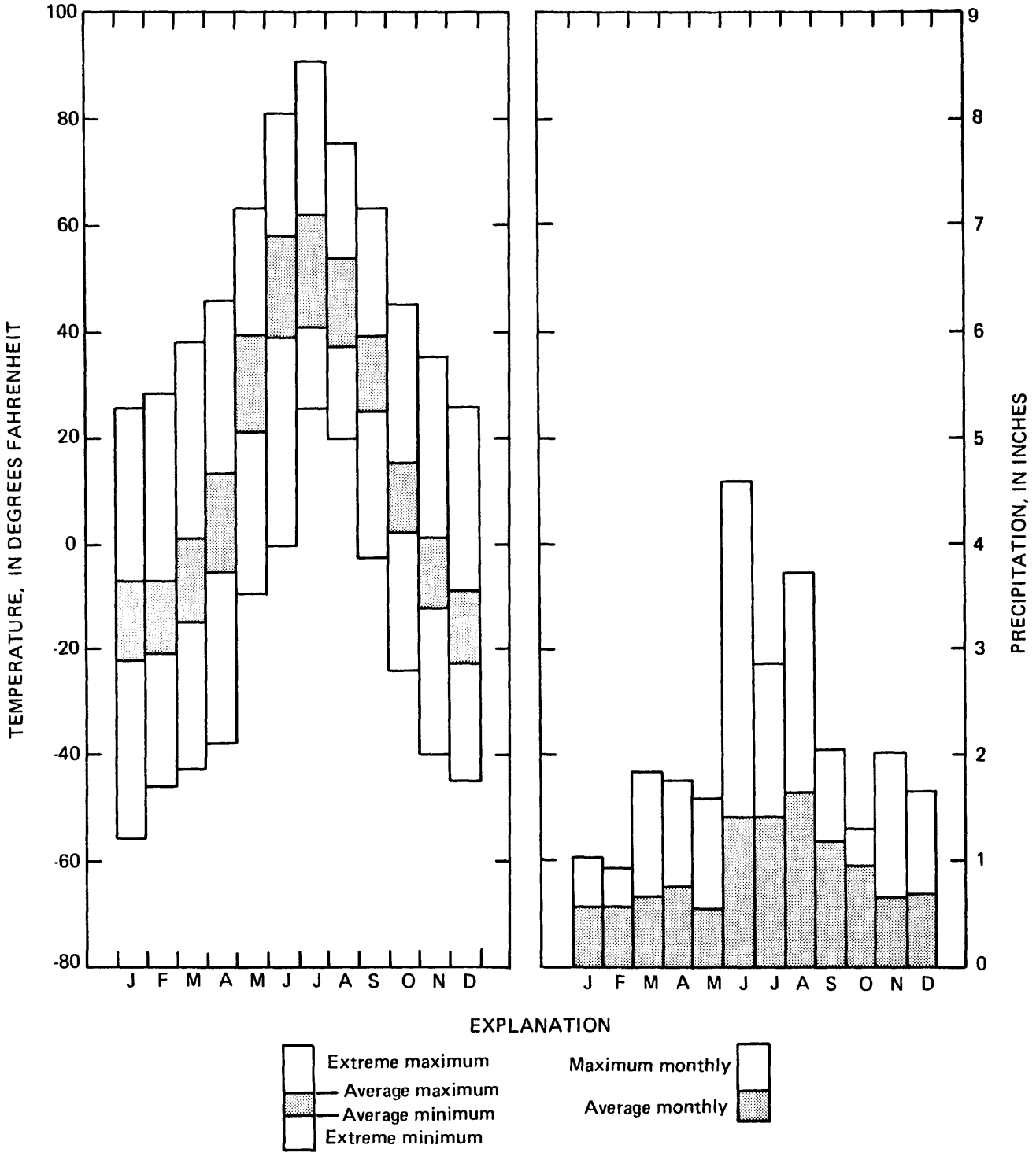


Figure 2.--Temperature and precipitation data for the Anaktuvuk Pass area. (Data from University of Alaska, 1978.)

SOURCES OF WATER

Surface-water sources at Anaktuvuk Pass are Contact Creek (which flows through the village in a southerly direction) and Eleanor Lake (fig. 3), as well as springs near the southwest end of the airstrip. During the winter months, Contact Creek ceases to flow as icings occur and Eleanor Lake freezes over. On September 21, 1989, soundings of Eleanor Lake were made along a north-south meander line using a lead line; the maximum depth of the lake was found to be 42 ft deep on that date. All surface water in the vicinity of Anaktuvuk Pass (including the springs) has been reported to be contaminated by bacteria (Sloan, 1972); thus, surface water is not readily usable as a source of drinking water without treatment.

In 1972, the Geological Survey made a water-resources reconnaissance of the area (Sloan, 1972); in 1974, two wells were drilled to develop ground water as the drinking-water source for the village. One well (No. UD01500218DAAA1) was drilled to a depth of 72 ft (fig. 4) and now serves as the central water supply for the village. The water is distributed to individual houses, businesses, and shops by tank truck. The second well (No. UD01500217BCCC1) was drilled in the bed of Contact Creek to a depth of 71 ft (fig. 5). This well was destroyed when Contact Creek was channelized to prevent spring flooding. A third well (No. UD01500218DADC1), drilled in 1978 to a depth of 92 ft (fig. 6), serves as the water supply for the village school. See figure 3 for the locations of the wells.

WATER QUALITY

In September 1989, water samples were collected from the middle of Eleanor Lake, from Contact Creek at the north end of the village, and from the well head of the central supply well. The samples were analyzed for common ions, nutrients, selected trace metals, and the presence of fecal bacteria. Water from the central supply well had previously been sampled for analysis by the Geological Survey on May 2, 1974.

Analyses of water samples from Eleanor Lake (table 1) and Contact Creek (table 2) indicated that the inorganic chemical quality of the water meets the criteria for drinking water established by the U.S. Environmental Protection Agency (1977). This water would be suitable for drinking, except for the presence of fecal bacteria. This contamination is probably from animals and waterfowl.

Analyses of water samples from the central supply well made in May 1974 and September 1989 (table 3) indicated that the water is of acceptable quality for drinking-water use. The water contains low levels of the following: dissolved solids (89 mg/L), hardness (96 mg/L as $CaCO_3$), nutrients (<0.010 mg/L of nitrogen; <0.010 mg/L of phosphorus), and trace metals. The water meets drinking water standards established by the Alaska Department of Environmental Conservation (1982) for all components except mercury.

The sample collected on September 21, 1989, contained 4.0 µg/L of mercury, which exceeds the Alaska drinking water criterion. The sample collected in 1974, however, contained no detectable mercury. Regular sampling for the State of Alaska's Village Safe Water Office, including a September 1989 sample, shows no mercury contamination (Jane Dale, Alaska Village Safe Water Office, oral commun., 1990). It appears that the Geological Survey's September sample was contaminated during collection, handling, or laboratory analysis. The most likely source of the contamination is mercuric chloride used to preserve nutrient samples.

Figure 3.--Aerial photograph of Anaktuvuk Pass. (Photo from Aeromap U.S. Inc., 1982.)

WELL LOG

WELL NO. UD01500218DAAA1 DATE STARTED 4-25-74

COMPLETED 4-29-74 DRILLER Grinder-Estabrook

TOTAL DEPTH OF WELL 72 FT. CASING INSTALLED 68' DIAMETER 6"

GROUT _____ SCREEN SIZE 30 slot LENGTH 5'

STATIC WATER LEVEL 50' HRS. PUMPED Not known GAL/MIN Not known DRAWDOWN _____ FT.

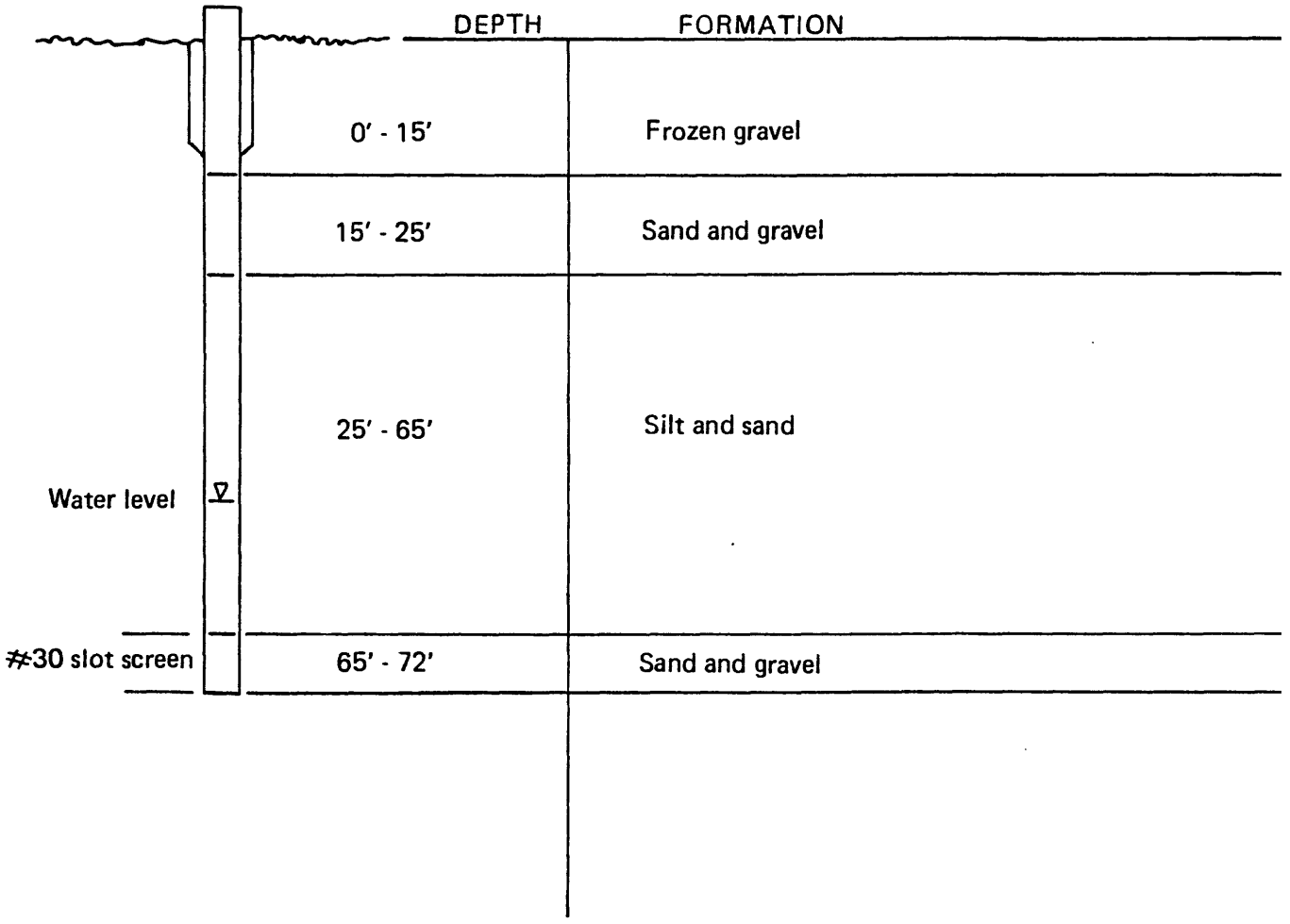


Figure 4.--Log of central supply well at Anaktuvuk Pass.(Log from U.S. Public Health Service.)

WELL LOG

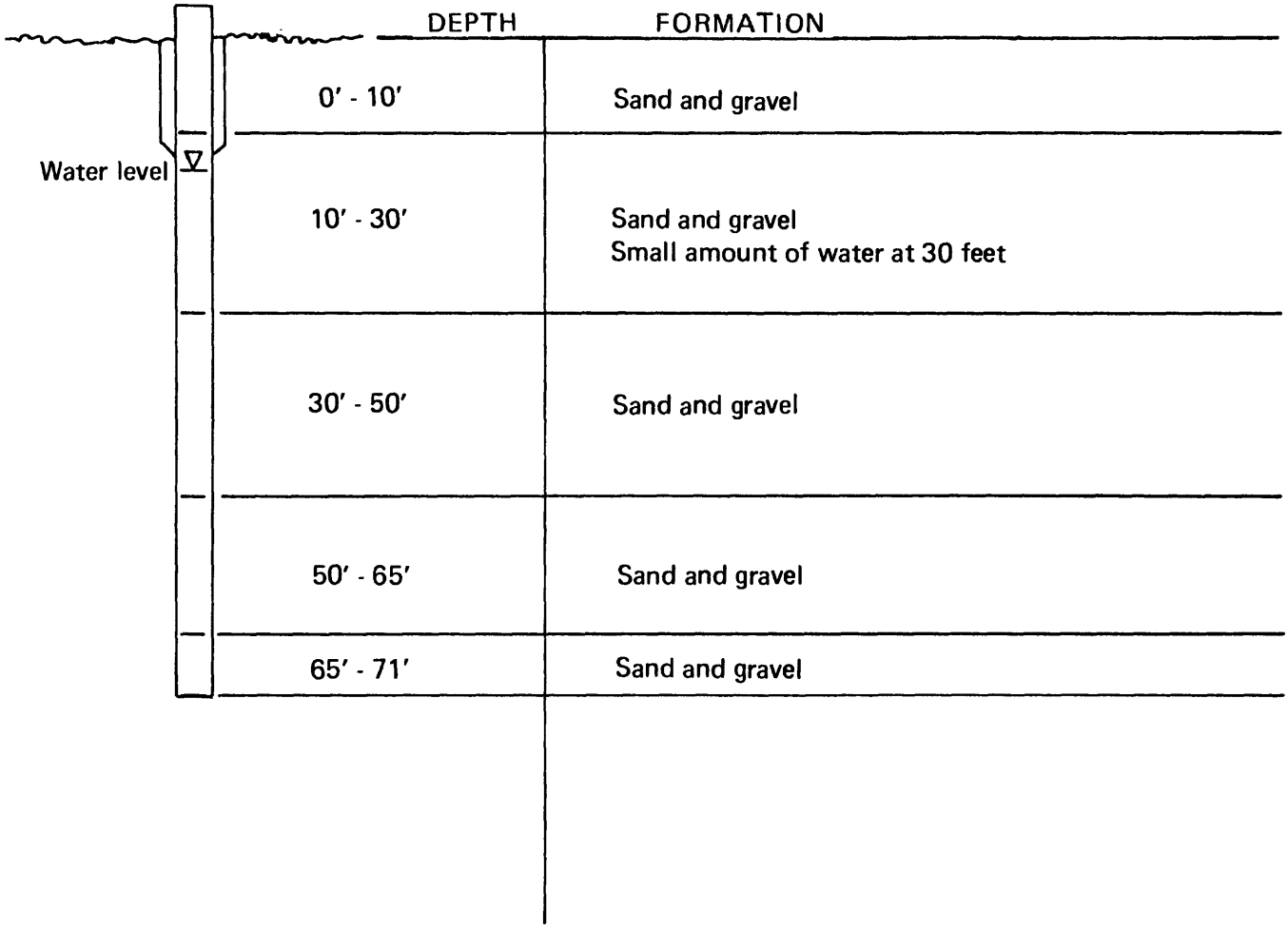
WELL NO. UD01500217BCCC1 DATE STARTED 4-9-74

COMPLETED 4-17-74 DRILLER Grinder

TOTAL DEPTH OF WELL 71 FT. CASING INSTALLED 71' DIAMETER 6"

GROUT None SCREEN SIZE None LENGTH

STATIC WATER LEVEL 14' HRS. PUMPED 32 GAL/MIN 30 DRAWDOWN 0 FT.



DEPTH	FORMATION
0' - 10'	Sand and gravel
10' - 30'	Sand and gravel Small amount of water at 30 feet
30' - 50'	Sand and gravel
50' - 65'	Sand and gravel
65' - 71'	Sand and gravel

Figure 5.--Log of destroyed well in bed of Contact Creek at Anaktuvuk Pass. (Log from U.S. Public Health Service.)

WELL LOG

WELL NO. UD01500218DADC1 DATE STARTED 4-18-78

COMPLETED 4-26-78 DRILLER Swan and Ice Drilling

TOTAL DEPTH OF WELL 92 FT. CASING INSTALLED 80' DIAMETER 6"

GROUT 30' SCREEN SIZE #20 slot/80'-85' #60 slot/85'-90' LENGTH 5'/5'

STATIC WATER LEVEL 38' HRS. PUMPED 14 GAL/MIN 42 DRAWDOWN 8 FT.

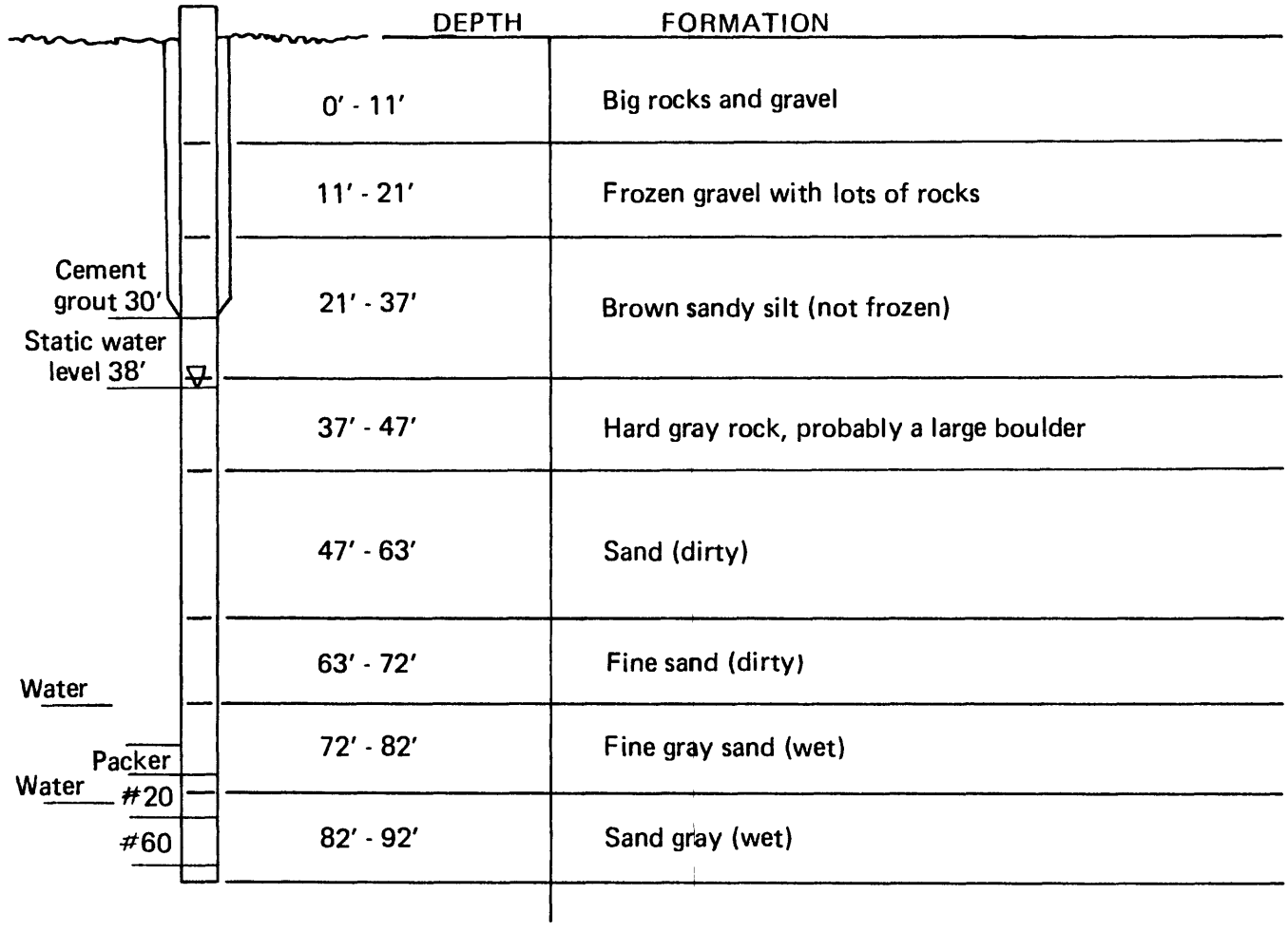


Figure 6.--Log of school well at Anaktuvuk Pass (Log from Dowl Engineers, 1978.)

Table 1.-- Analysis of water from Eleanor Lake (Site ID 680856151423700)

[µS/cm, microsiemens per centimeter at 25 °C; °C, degree Celsius; NTU, nephelometric turbidity units; cols./100 mL, colonies per 100 milliliters; mg/L, milligrams per liter; µg/L, micrograms per liter]

Date 1989	Time	Specific conductance (µS/cm)	pH (standard units)	Temperature air (°C)	Temperature water (°C)	Turbidity (NTU)	Coli-, form, fecal (cols./ 100 mL)	Hardness total (mg/L as $CaCO_3$)	Calcium dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Alkalinity field (mg/L as $CaCO_3$)
Sept. 21...	1400	95	7.60	-9.5	2.0	0.70	K1	46	14	2.7	1.9	46

Date	Bicarbonate dissol. field (mg/L as HCO_3)	Carbonate dissol. field (mg/L as CO_3)	Sulfate dissolved (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)	Bromide dissolved (mg/L as Br)	Silica, dissolved (mg/L as SiO_2)	Solids, residue at 180 °C dissolved (mg/L)	Nitrogen, nitrate dissolved (mg/L as N)	Nitrogen, NO_2+NO_3 dissolved (mg/L as N)	Nitrogen, ammonia dissolved (mg/L as N)
Sept. 21...	56	0	2.7	0.35	0.11	<0.010	1.4	48	0.090	14.0	0.030

Date	Nitrogen, organic dissolved (mg/L as N)	Nitrogen, ammonia + organic dissol. (mg/L as N)	Nitrogen dissolved (mg/L as N)	Phosphorus dissolved (mg/L as P)	Phosphorus ortho, dissolved (mg/L as P)	Arsenic dissolved (µg/L as As)	Barium, dissolved (µg/L as Ba)	Beryllium, dissolved (µg/L as Be)	Cadmium dissolved (µg/L as Cd)	Chromium, dissolved (µg/L as Cr)	Cobalt, dissolved (µg/L as Co)	Copper, dissolved (µg/L as Cu)
Sept. 21...	0.67	0.70	15	<0.010	<0.010	<1	68	1	1	<1	<3	<10

Date	Iron, dissolved (µg/L as Fe)	Lead, dissolved (µg/L as Pb)	Lithium dissolved (µg/L as Li)	Manganese, dissolved (µg/L as Mn)	Mercury dissolved (µg/L as Hg)	Molybdenum, dissolved (µg/L as Mo)	Nickel, dissolved (µg/L as Ni)	Selenium, dissolved (µg/L as Se)	Silver, dissolved (µg/L as Ag)	Strontium, dissolved (µg/L as Sr)	Vanadium, dissolved (µg/L as V)	Zinc, dissolved (µg/L as Zn)
Sept. 21...	68	<10	<4	8	0.1	<10	<10	<1	<1.0	22	<6	5

K Non-ideal colony count

Table 2.-- Analysis of water from Contact Creek
(Site ID 680846151435700)

[ft³/s, cubic feet per second; µS/cm, microsiemens per centimeter at 25 °C; °C, degree Celsius; NTU, nephelometric turbidity units; cols./100 mL, colonies per 100 milliliters; mg/L, milligrams per liter; µg/L, micrograms per liter]

Date 1989	Time	Discharge, inst. (ft³/s)	Specific conductance (µS/cm)	pH (standard units)	Temperature air (°C)	Temperature water (°C)	Color (platinum-cobalt units)	Turbidity (NTU)	Coliform fecal (cols./100 mL)	Hardness total (mg/L as $CaCO_3$)	Calcium dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)
Sept. 21...	1515	E3.0	202	7.80	-9.5	0.5	3	0.20	K1	110	34	5.2

Date	Sodium, dissolved (mg/L as Na)	Alkalinity field (mg/L as $CaCO_3$)	Bicarbonate dissol. field (mg/L as HCO_3)	Carbonate dissol. field (mg/L as CO_3)	Sulfate dissolved (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)	Bromide dissolved (mg/L as Br)	Silica, dissolved (mg/L as SiO_2)	Solids, residue at 180 °C dissolved (mg/L)	Nitrogen, NO_3+NO_2, dissolved (mg/L as N)
Sept. 21...	0.70	80	98	0	26	0.20	0.10	<0.010	1.6	116	<0.100

Date	Nitrogen, ammonia dissolved (mg/L as N)	Nitrogen, organic dissolved (mg/L as N)	Nitrogen, ammonia + organic dissol. (mg/L as N)	Phosphorus dissolved (mg/L as P)	Phosphorus ortho, dissolved (mg/L as P)	Arsenic dissolved (µg/L as As)	Barium, dissolved (µg/L as Ba)	Beryllium, dissolved (µg/L as Be)	Cadmium dissolved (µg/L as Cd)	Chromium, dissolved (µg/L as Cr)	Cobalt, dissolved (µg/L as Co)	Copper, dissolved (µg/L as Cu)
Sept. 21...	0.020	0.38	0.40	<0.010	<0.010	<1	49	<0.5	<1	<1	<3	<10

Date	Iron, dissolved (µg/L as Fe)	Lead, dissolved (µg/L as Pb)	Lithium dissolved (µg/L as Li)	Manganese, dissolved (µg/L as Mn)	Mercury dissolved (µg/L as Hg)	Molybdenum, dissolved (µg/L as Mo)	Nickel, dissolved (µg/L as Ni)	Selenium, dissolved (µg/L as Se)	Silver, dissolved (µg/L as Ag)	Strontium, dissolved (µg/L as Sr)	Vanadium, dissolved (µg/L as V)	Zinc, dissolved (µg/L as Zn)
Sept. 21...	8	<10	<4	<1	0.2	<10	<10	<1	<1.0	45	<6	17

E Estimated
K Non-ideal colony count

Table 3.-- Analysis of water from the central supply well

[µS/cm, microsiemens per centimeter at 25 °C; °C, degree Celsius; NTU, nephelometric turbidity units; mg/L, milligrams per liter; µg/L, micrograms per liter]

Station number	Local identifier		Date	Time	Specific conductance (µS/cm)	pH (standard units)	Temperature water (°C)	Color (platinum-cobalt units)	Turbidity (NTU)
680831151435201	UD01500218DAAA1	003	05-02-74	1130	177	7.70	3.5	2	--
			09-21-89	1530	177	7.40	6.5	1	0.20

Date	Hardness total (mg/L as $CaCO_3$)	Hardness noncarb. tot.fld (mg/L as $CaCO_3$)	Calcium dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Alkalinity field (mg/L as $CaCO_3$)	Bicarbonate dissol. field (mg/L as HCO_3)	Carbonate dissol. field (mg/L as CO_3)	Sulfate dissolved (mg/L as SO_4)
05-02-74	86	6	28	3.8	0.20	0.30	--	--	--	5.8
09-21-89	96	--	32	4.0	0.50	--	85	104	0	<12

Date	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)	Bromide dissolved (mg/L as Br)	Silica, dissolved (mg/L as SiO_2)	Solids, residue at 180 °C dissolved (mg/L)	Solids, sum of constituents, dissolved (mg/L)	Nitrogen, nitrite dissolved (mg/L as N)	Nitrogen, NO_2+NO_3, dissolved (mg/L as N)	Nitrogen, ammonia dissolved (mg/L as N)	Nitrogen, organic dissolved (mg/L as N)	Nitrogen, ammonia + organic dissol. (mg/L as N)
05-02-74	0.70	<0.10	--	3.2	--	92	--	0.570	--	--	--
09-21-89	<0.20	<0.10	<0.010	2.9	89	--	<0.010	<0.100	0.010	0.19	0.20

Date	Phosphorus dissolved (mg/L as P)	Phosphorus ortho, dissolved (mg/L as P)	Arsenic dissolved (µg/L as As)	Barium, dissolved (µg/L as Ba)	Beryllium, dissolved (µg/L as Be)	Cadmium dissolved (µg/L as Cd)	Chromium, dissolved (µg/L as Cr)	Cobalt, dissolved (µg/L as Co)	Copper, dissolved (µg/L as Cu)	Iron, dissolved (µg/L as Fe)	Lead, dissolved (µg/L as Pb)
05-02-74	--	0.020	--	--	--	--	--	--	--	40	--
09-21-89	<0.010	<0.010	<1	23	1	2	<1	<3	90	9	<10

Date	Lithium dissolved (µg/L as Li)	Manganese, dissolved (µg/L as Mn)	Mercury dissolved (µg/L as Hg)	Molybdenum, dissolved (µg/L as Mo)	Nickel, dissolved (µg/L as Ni)	Selenium, dissolved (µg/L as Se)	Silver, dissolved (µg/L as Ag)	Strontium, dissolved (µg/L as Sr)	Vanadium, dissolved (µg/L as V)	Zinc, dissolved (µg/L as Zn)
05-02-74	--	<10	--	--	--	--	--	--	--	--
09-21-89	<4	4	4.0	<10	<10	<1	<1.0	38	<6	200

Table 4.- Analysis of water from the school well (No. UD01500218DADC1)

[Analysis reported by DOWL Engineers (1978); all values in milligrams per liter]

Date	Calcium	Iron, total	Magnesium	Manganese	Hardness as $CaCO_3$
6-16-78	117	1.1	54	0.77	517
7-24-78	159	0.7	62	1.1	652

Water from the school well was sampled on June 16 and July 24, 1978 (DOWL Engineers, 1978). The analyses of these samples (table 4) indicated that the water was very hard (>500 mg/L as $CaCO_3$), and contained elevated levels of calcium, iron, magnesium, and manganese. On the basis of these analyses, the water is considered potable, but would cause staining of fixtures. It would be difficult to use for wash water, as the hardness would limit the sudsing of soap. Trace metals were not reported.

ADDITIONAL WATER SUPPLY

Historically, whenever a piped-sewage system is installed in an area, water usage rises dramatically. For Anaktuvuk Pass, it is estimated that a water supply of 15,000 gal/d will be needed to support a new sewage system. A well (or wells) that produces 100 to 300 gal/min would provide an adequate supply. A review of existing well logs and water-quality data from the central supply and school wells indicated that the aquifer that underlies the area north of the central supply well and adjacent to the west bank of Contact Creek (area shown on figure 3) would sustain a well (or wells) capable of producing the needed volume of good-quality water. A drilled well (or wells) 8 in. or larger in diameter, drilled to a depth of 70 to 80 ft and completed in gravel, probably would provide such a yield.

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