Overview of Environmental and Hydrogeologic Conditions at Unalakleet, Alaska

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U.S. GEOLOGICAL SURVEY

Open-File Report 95-347

Prepared in cooperation with the

FEDERAL AVIATION ADMINISTRATION

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By Joseph M. Dorava

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Anchorage, Alaska
1995

U.S. DEPARTMENT OF THE INTERIOR
BRUCE BABBITT, Secretary

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CONVERSION FACTORS

Multiply	By	To obtain
millimeter (mm)	0.03937	inch
meter (m)	3.281	foot
kilometer (km)	0.6214	mile
square kilometer (km^2)	0.3861	square mile
cubic meter per second (m^3/s)	35.3107	cubic foot per second
cubic meter per second per square kilometer [$(m^3/s)/km^2$]	91.49	cubic foot per second per square mile
liter (L)	0.2642	gallon
liters per second (L/s)	15.85	gallon per minute
liter per day (L/d)	0.2642	gallon per day

In this report, temperature is reported in degrees Celsius (°C), which can be converted to degrees Fahrenheit (°F) by the following equation:

$$°F = 1.8\ (°C) + 32$$

VERTICAL DATUM

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

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Abstract

The remote village of Unalakleet is on the alluvial plain of the Unalakleet River in northwestern Alaska. The Federal Aviation Administration has operated airway-support facilities at Unalakleet since 1942 and wishes to consider the severity of contamination, the environmental setting, and hydrogeologic conditions when evaluating options for compliance with environmental regulations. The transitional climatic conditions near Unalakleet provide a mean annual temperature of -3.2 degrees Celsius and a mean annual precipitation of about 360 millimeters. Wet tundra vegetation surrounds the abundant surface-water bodies near Unalakleet and barren beaches extend along the coast. Unalakleet obtains its drinking water from an infiltration gallery near Powers Creek about 7 kilometers north of the village. Surface spills and disposal of hazardous materials combined with storm-surge flooding in Unalakleet may affect the quality of the drinking water. Alternative drinking-water sources are not locally available. More distant surface-water sources may provide drinking-water alternatives for Unalakleet; however, their quantity and quality are unknown.

INTRODUCTION

The Federal Aviation Administration (FAA) owns and (or) operates airway-support and navigational facilities throughout Alaska. At many of these sites, fuels and potentially hazardous materials such as solvents, polychlorinated biphenyls, and pesticides may have been used and (or) disposed of. To determine if environmentally hazardous materials have been spilled or disposed of at the sites, the FAA is conducting environmental studies mandated under the Comprehensive Environmental Response, Compensation, and Liability Act and the Resource Conservation and Recovery Act. To complete these more comprehensive environmental studies, the FAA requires information on the hydrology and geology of areas surrounding the sites. This report, the product of compilation, review, and summary of existing hydrologic and geologic data by the U.S. Geological Survey, in cooperation with the FAA, provides such supplemental information for the FAA facility and nearby areas at Unalakleet, Alaska. Also presented in this report is a description of the environmental setting of the Unalakleet area.

BACKGROUND

Location

Unalakleet is in northwestern Alaska (fig. 1) at about lat 63°52' N, long 160°47' W., 240 km southeast of Nome and 650 km west of Fairbanks. Unalakleet is a small remote village on the eastern shore of Norton Sound near the mouth of the Unalakleet River, and is accessible only by air or sea. In 1990, the population of Unalakleet was 714 (U.S. Bureau of Census, 1991). The village, an

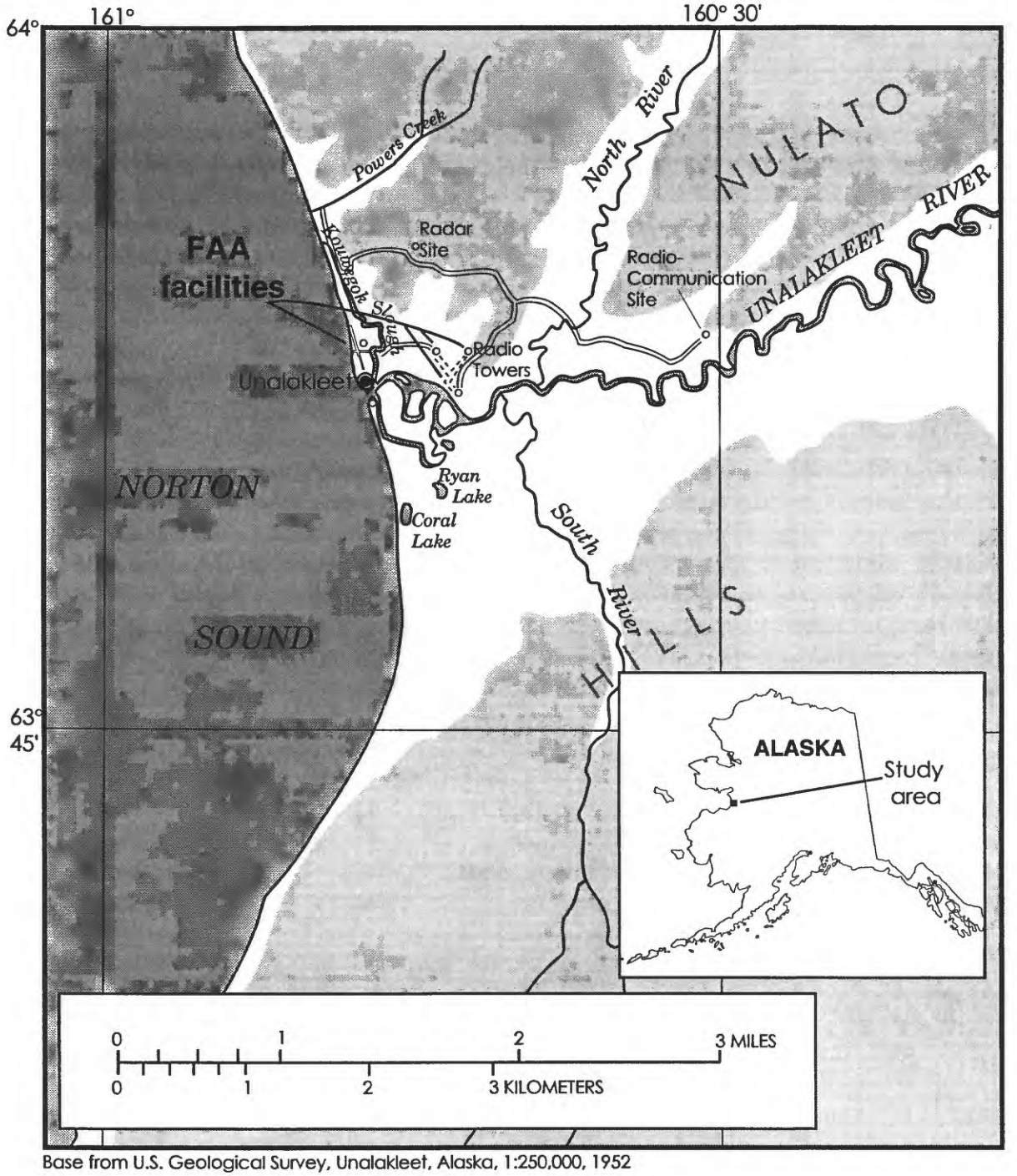

Figure 1. Location of Unalakleet, Alaska, and Federal Aviation Administration facilities. Light shaded areas represent uplands with elevations greater than 61 m.

airport runway, and many of the FAA facilities are about 8 m above sea level on a narrow spit of land between Kouwegok Slough and Norton Sound (fig. 1). Additional FAA airway-support facilities include navigation aids identified by radio towers east and north of the runway (fig. 1).

History

The FAA or its predecessors have had facilities in Unalakleet since 1942 when the military used the site to ferry aircraft to Siberia. Former Department of Defense facilities in Unalakleet include a radar site and a radio-communications site (fig. 1). A detailed account of FAA-owned, leased, or transferred properties in Unalakleet and a listing of suspected sources of contamination near these facilities can be found in an Environmental Compliance Investigation Report (ECIR) of the FAA facilities in Unalakleet (Ecology and Environment, Inc., 1992).

PHYSICAL SETTING

Climate

Unalakleet lies in the transitional climatic zone where the maritime influence of Norton Sound and the continental climate of interior Alaska combine to produce pronounced temperature variations, low precipitation, and light surface winds (Hartman and Johnson, 1984). The mean annual temperature in Unalakleet for 1941–87 was -3.2 °C; however, temperatures range from a July mean maximum of 16.2 °C to a December mean minimum of -20.6 °C (Leslie, 1989). Mean annual precipitation is about 360 mm and includes about 950 mm of snowfall. The months of greatest rainfall are July and August and the month of highest snowfall is November. Mean monthly and annual temperature, precipitation, and snowfall are summarized in table 1.

Table 1. Mean monthly and annual temperature, precipitation, and snowfall for the period 1941 to 1987, Unalakleet, Alaska

[Modified from Leslie (1989); °C, degree Celsius; mm, millimeter]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
						Temperature (°C)							
Mean maximum[1]	-12.1	-11.9	-8.4	-1.3	7.6	12.7	16.2	15.0	10.5	0.8	-7.4	-13.2	0.7
Mean minimum[2]	-19.8	-20.2	-18.1	-10.4	-0.9	5.3	8.8	7.7	2.5	-6.0	-14.1	-20.6	-7.2
Mean	-16.0	-16.1	-13.4	-5.9	3.3	9.0	12.5	11.3	6.5	-2.6	-10.8	-16.8	-3.2
						Precipitation (mm)							Total
	12.2	11.2	14.2	12.2	16.3	29.7	59.9	90.9	57.4	25.7	13.7	12.2	355.6
						Snowfall (mm)							Total
	124.5	127.0	139.7	88.9	22.9	0.0	0.0	0.0	17.8	124.5	170.2	132.1	947.4

[1]Maximum, for period of record, 30.6, July 1972.
[2]Minimum for period of record, -46.7, December 1974.

Vegetation

Vegetation in the Unalakleet area consists of a closed spruce-hardwood forest inland along the Unalakleet River, wet tundra near sloughs and along the coast, and alpine tundra on the dry upland slopes of the Nulato Hills north and west of the village (Viereck and Little, 1972). The forested riparian areas have widely spaced, mature white spruce, black spruce, tamarack, white birch, poplar, and cottonwood. Undergrowth consists of willow and young cottonwood (Sloan and others, 1986; Viereck and Little, 1972). The wet tundra areas adjacent to Kouwegok Slough, the mouth of Unalakleet River, and Norton Sound consists predominantly of sedges and grasses. The alpine tundra areas inland from Unalakleet are covered with lichens, mosses, sedges, dwarf birch, lingonberry, crowberry, Labrador tea, and other low-growing shrubs (Viereck and Little, 1972).

Geology

The geology of the Unalakleet area has been described at a reconnaissance level by Cass (1959) and in more detail by Patton and Moll (1985). Bedrock exposures are not at the FAA facilities in Unalakleet. Volcanic graywacke and mudstone are exposed along the coastline north and south of Unalakleet and in steep banks along the Unalakleet River. Sandstone and shale are exposed in the Nulato Hills across the North River. The village of Unalakleet and the FAA facilities are situated on sand-and-gravel flood-plain deposits of the Unalakleet River (Patton and Moll, 1985). Drillers' logs indicate that the depth to bedrock is about 12 m near Powers Creek, 7 km north of Unalakleet (appendix 1).

Permafrost generally lies under the coastal areas along Norton Sound and polygonal ice wedges are along the coast; however, a test boring near Unalakleet did not reach permafrost within about 10 m below land surface (Ferrians, 1965). Drillers' logs from wells near Powers Creek indicate that the top of frozen ground occurs at depths ranging from 4.6 to 15.2 m (appendix 1). Areas adjacent to and beneath streams and lakes are typically thawed by the heat from these water bodies and generally are unfrozen (Ferrians, 1965).

Organic-rich soils in the Unalakleet area are characterized by a thick peaty surface mat and a maximum active layer thickness of about 0.5 m where permafrost is present (Rieger and others, 1979). Because of the seasonal variations in temperature and precipitation, the soils are alternately wet and dry as indicated by their characteristic mottled, dark-gray appearance (Rieger and others, 1979). The predominant silt loam soils are developed on alluvium and colluvium (Rieger and others, 1979).

HYDROLOGY

Surface Water

The village of Unalakleet is nearly surrounded by water. The Unalakleet River flows from west to east along the southern edge of the village. Kouwegok Slough extends from the north along the western edge of the village, and Norton Sound is to the east (fig. 1). Many abandoned channels along Kouwegok Slough and the Unalakleet River drain to the south and west. The Unalakleet River is part of the National Wild and Scenic Rivers System (Sloan and others, 1986; U.S. Bureau of Land Management, 1983)

Snowmelt and rainfall runoff supply most of the water in the streams of the region. Discharge in local streams typically increases in late May or early June and increases again during heavy rainfall in late summer or early fall. Minimum discharge will occur following extended periods of reduced runoff in late winter or early spring.

The drainage basin of the Unalakleet River has an area of about 5,300 km^2 upstream from the mouth at Unalakleet (Sloan and others, 1986). During a hydrologic reconnaissance study in 1983, Sloan and others, (1986) found that the river and its major tributaries contributed between 0.1 and 0.26 $(m^3/s)/km^2$ of water in August, and between 0.0 and 0.003 $(m^3/s)/km^2$ of water during March. These values are almost the extremes for unit discharge in the river because the August measurements were made after heavy rains when the river was about 0.3 m higher than normal, and the March measurements were made after an extended period of reduced runoff.

Floods

The flood hazard in Unalakleet is considered to be high (U.S. Army Corps of Engineers, 1993). The primary sources of flooding in this coastal village are high tides and storm-driven waves. Major flooding occurred in 1965, 1968, 1971, and 1974 (U.S. Army Corps of Engineers, 1993). Data from the files of the U.S. Army Corps of Engineers Flood Plain Management Section indicate that in 1965, the largest recorded flood in Unalakleet was caused by storm-driven waves. The flood inundated the entire village and had a peak stage of about 6.6 m above sea level (Harlan Legare, hydrologist, U.S. Army Corps of Engineers, oral commun., 1995). The Corps of Engineers plans to use the recorded occurrence of floods in Unalakleet to produce a refined approximation of the probability of storm-surge tide flooding (Harlan Legare, hydrologist, U.S. Army Corps of Engineers, oral commun., 1995). This refinement is required because the 100-year storm-surge tide is currently estimated to be about 23 m high in the marine area near Unalakleet (Brower and others, 1977). Storm surges usually occur during the fall when Norton Sound is free of ice. Strong, persistent, onshore winds blowing across vast open stretches of Norton Sound generate high waves and may cause coastal flooding especially during high tide. Normal tide range for the Norton Sound area is less than 1 m (Brower and others, 1977; Hartman and Johnson, 1984).

Although not the primary source of flooding in Unalakleet, overbank flooding on the Unalakleet River also is possible and may affect the village and the FAA facilities along the river. During August 1983, Sloan and others (1986) found evidence for a flood with a peak stage of about 1.5 m above the normal water surface. No evidence of ice-jam flooding was observed, which suggests that the springtime flood heights were not augmented by backwater from ice (Sloan and others, 1986). Because river floods have not been a significant problem in Unalakleet, no new flood-frequency calculations were made. On the basis of regional-flood characteristics (Lamke, 1979), estimates of the 2-year flood and the 50-year flood for the Unalakleet River at the mouth are 600 and 1,240 m^3/s respectively (Sloan and others, 1986). The potential for flooding at specific locations along the river, however, is difficult to evaluate without detailed investigations of flood heights and local topography.

Ground Water

Because of permafrost and the low permeability of bedrock in most of the area, ground water is recharged and discharged principally in the alluvium along stream courses (Sloan and others, 1986). Surface-water drainage from the Nulato Hills north and east of Unalakleet enters the North

River, Powers Creek, and Unalakleet River, which flow to the southwest and west respectively. An alluvial aquifer in this setting probably would be confined to the area between these hills and the coast. Environmental remediation at former Defense Department facilities, located between the Nulato Hills and the coast northeast of Unalakleet, is planned (U.S. Army Corps of Engineers, 1990a, b and 1991a, b; Woodward-Clyde Consultants, 1985).

Although few details of aquifer characteristics are available, Selkregg (1976) states that the alluvial plain of the Unalakleet River can provide as much as 0.6 L/s of ground water. Furthermore, Williams (1970) states that ground water is available in a similar environmental setting in an unfrozen alluvial aquifer under the Koyukuk River about 150 km northeast of Unalakleet. Marine gravel and sand in spits, barrier bars, raised beaches, and some deltas near Unalakleet may contain small quantities of fresh-water. These features are known to contain ground water in the Nome area; however, heavy pumping or seasonal storm surges may result in saltwater intrusion into these coastal aquifers. Ground-water investigations at the nearby villages of Koyuk, about 120 km north of Unalakleet, and Shaktolik, about 50 km north, which are in a similar climatologic, hydrologic, and geologic setting as Unalakleet, indicate that adequate sources of drinking water could be obtained by installing shallow horizontal infiltration pipes or drilling shallow vertical wells in inland areas away from the coast (Waller, 1958).

Information about several wells near the FAA facilities in Unalakleet—including depth, yield, water-surface elevation measurements, and miscellaneous water-quality properties—is given in appendix 2. A 8.5-meter-deep well that supplies water to the quarters area had a reported yield of about 1 L/s. Another 13-meter-deep well reported to be inside a garage also yielded about 1 L/s. A third well at the Control Building was 9.4 m deep and yielded about 1.3 L/s of brackish water from an aquifer that was 4.6 m below land surface. The 16.8-meter-deep fire well is reported to contain saltwater, but its potential yield and exact location are unknown. On November 24, 1958, a 5.1-meter-deep well at the Unalakleet school had a water level of 2.44 m below land surface. Water-quality constituents and properties measured in water samples from these wells include concentrations of major ions—silica, aluminum, magnesium, chlorine, fluorine, and dissolved solids—and measurements of alkalinity, specific conductance, pH, and color (appendix 2).

The U.S. Public Health Service (USPHS) provided records describing 16 wells in the Unalakleet area (appendix 1). The USPHS records include wells that range from 6 to 33 m below land surface. These wells were developed in aquifer materials ranging from sandy gravel to clay and rock. Several wells were contaminated with saltwater, and others had an inadequate quantity of water. The 10.4-meter-deep well near Powers Creek is identified as an excellent source of water and yielded 2.5 L/s (appendix 1).

DRINKING WATER

Drinking water is provided by a public water system that collects water from an infiltration gallery near Powers Creek (Environmental Services, Ltd., 1980). The village water is stored in a 3.8-million-liter tank and is treated before distribution. The quality of public water supplies is monitored regularly, and the water supply must meet current regulations (U.S. Environmental Protection Agency, 1995; Alaska Department of Environmental Conservation, 1995).

Water-use withdrawals of about 190 L/d per person were estimated for Unalakleet on the basis of the 1990 population of 714. The water use compares with an average water use per person of 1,960 L/d estimated for all uses for the entire State of Alaska in 1990 (Solley and others, 1993).

In 1977, alternative sources of drinking water for Unalakleet were investigated by the Indian Health Services (A.D. Ronimus, hydrologist, Indian Health Service, written commun., 1977; appendix 3, this report). Ground-water and surface-water alternatives were evaluated for their potential to supply Unalakleet with acceptable drinking water. All local drinking-water sources that were investigated (except for a single 10.4-meter-deep well near Powers Creek) were discounted because they produced salty water or because they had significant accessibility problems (appendix 3). These results indicate that Unalakleet's present source of drinking water may not have a reasonable alternative as defined by the U.S. Environmental Protection Agency (1987). A more distant alternative source of drinking water may be expensive to develop, but may be available from the South River or perhaps from the Ryan and Coral Lakes (fig. 1) if they are deep enough so that they do not freeze completely in the winter. However, data are not adequate to characterize the quantity and quality of waters from these more distant alternative sources.

SUMMARY

The remote location of Unalakleet makes the village dependent on the air or sea for transportation. The transitional climatic conditions of the area provide long cold winters and short cool summers. These climatic conditions also influence streamflow in the Unalakleet area, which is greatly reduced in the winter and dominated by snowmelt and rainfall runoff during other times. The potential for flooding generated by storm-driven waves is high, especially for the village and the FAA facilities, which are on the narrow spit of land between Norton Sound and Kouwegok Slough. Drinking water in Unalakleet is provided by a public system that collects water from an infiltration gallery near Powers Creek. Local alternative sources of drinking water may not be available because they are difficult to access, have an inadequate quantity, or are affected by saltwater. More distant alternatives may be available from the South River or perhaps from Coral or Ryan Lakes if they are deep enough. Data, however, are not adequate to determine if these alternative sources provide enough water to meet the needs of Unalakleet or if they meet current drinking-water regulations.

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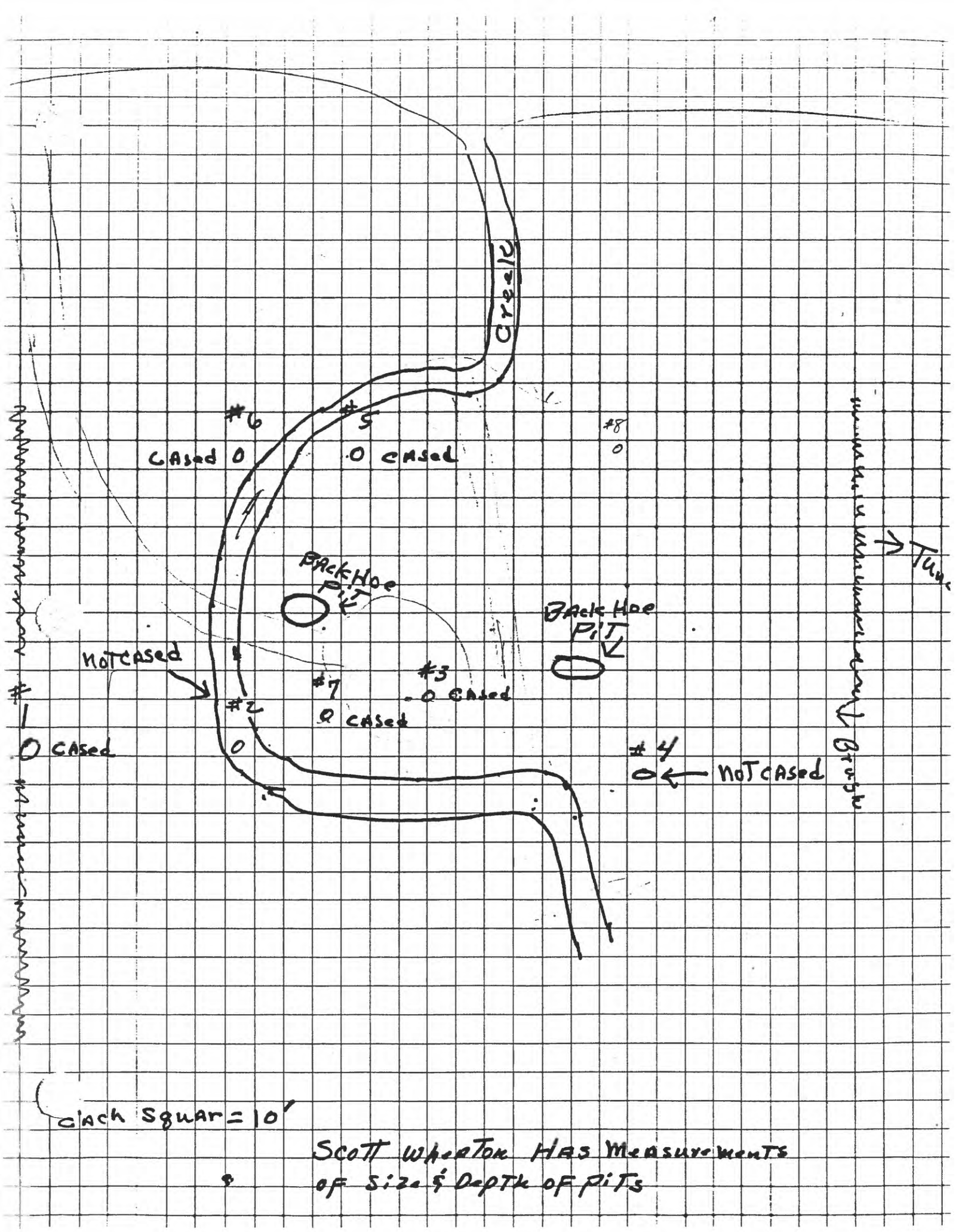
APPENDIX 1

WELL-DRILLERS' LOGS

(Data from the files of the U.S. Public Health Service)



Scott Wheaton has Measurements of Size & Depth of Pits

Lee map

WELL LOG

U.S. PUBLIC HEALTH SERVICE, DIVISION OF INDIAN HEALTH

LOCATION UIVALAKLEET - POWER HOUSE NO I DATE STARTED 1-[illegible]-77

DATE COMPLETED 1-27-77 DRILLER MARK F ANDERSON

TOTAL DEPTH OF WELL 40 FT. CASING INSTALLED 45 DIAMETER 6"

GROUT N/A SCREEN SIZE N/A MFG. N/A LENGTH N/A

STATIC WATER LEVEL 7 FT. HRS. PUMPED N/A @ N/A GPM DRAWDOWN N/A FT.

DRILLED DRY WITH BAILER.

DEPTH	HOLE DIAMETER / CASING DIAMETER	FORMATION
0 - 20		Blue silt frozen
20 - 32		Yellow silt + clay frozen
32 - 40		Blue clay frozen
40 & back		Little sand & rocks on BR. Some water tasted fresh

SOIL DATA TO 15 FT.
FEET THAWED 0
BOTTOM OF FROST & MATERIAL 20
SEASONAL OR PERMA FROST PERMA

WATER DATA FIELD TEST
TASTE
APPEARANCE FRESH
AFTER 24 HOURS
IRON
CHLORIDES
TDS

PUMP TEST N/A - STATIC LEVEL
PUMPING LEVEL N/A @ N/A GPM
AFTER N/A HRS.

HIGHEST RECOMMENDED PUMP RATE

WILL STATIC LEVEL CHANGE WITH TIDES N/A OR FROST N/A

DEVELOP PROCEDURE N/A

ESTIMATED MAN HOURS FOR DRILLING 20 HOURS FOR TOTAL JOB 25

CREW [illegible]

WELL LOG

U.S. PUBLIC HEALTH SERVICE, DIVISION OF INDIAN HEALTH

LOCATION UNALAKLEET NO.2 DATE STARTED 1-28-77

DATE COMPLETED 1-31-77 DRILLER ANDERSON

TOTAL DEPTH OF WELL 50 FT. CASING INSTALLED 40 DIAMETER 6"

GROUT NA SCREEN SIZE NA MFG. NA LENGTH NA

STATIC WATER LEVEL NO HRS. PUMPED NA @ ____ GPM DRAWDOWN NA FT.

HOLE DIAMETER
CASING DIAMETER

DEPTH	FORMATION
0-17	Brown Mush Partially Frozen Lots of organic matter. made some water
17-20'	Blue Clay Frozen
20'-50'	Yellow Clay Frozen

SOIL DATA TO 15 FT.
FEET THAWED To 17'
BOTTOM OF FROST & MATERIAL 50
SEASONAL OR PERMA FROST PERM

WATER DATA FIELD TEST
TASTE ____
APPEARANCE FRESH NA
AFTER 24 HOURS ____
IRON ____
CHLORIDES ____
TDS ____

PUMP TEST NA - STATIC LEVEL
PUMPING LEVEL NA @ ____ GPM
AFTER ____ HRS.

HIGHEST RECOMMENDED PUMP RATE NA
WILL STATIC LEVEL CHANGE WITH TIDES ____ OR FROST ____

DEVELOP PROCEDURE NA

ESTIMATED MAN HOURS FOR DRILLING 40 HOURS FOR TOTAL JOB 45

CREW ANDERSON - ST. ANTHONY

WELL LOG

U.S. PUBLIC HEALTH SERVICE, DIVISION OF INDIAN HEALTH

LOCATION UNALAKLEET - NO. 3 DATE STARTED 2-2-77

DATE COMPLETED 2-6-77 DRILLER ANDERSON

TOTAL DEPTH OF WELL 50 FT. CASING INSTALLED 45 DIAMETER 6"

GROUT NA SCREEN SIZE NA MFG. NA LENGTH NA

STATIC WATER LEVEL NA HRS. PUMPED NA GPM DRAWDOWN NA FT.

DEPTH	HOLE DIAMETER / CASING DIAMETER	FORMATION
0'-3'		BROWN MUSKEG
3'-7'		BLUE CLAY PERM
7-14		YELLOW CLAY PERM
14-30		ROCK-SHALE VERY HARD DRILLING & DRIVING
30-50		BLUE CLAY

SOIL DATA TO 15 FT.
FEET THAWED 0
BOTTOM OF FROST & MATERIAL 15
SEASONAL OR PERMA FROST

WATER DATA FIELD TEST
TASTE
APPEARANCE FRESH
AFTER 24 HOURS
IRON
CHLORIDES
TDS

PUMP TEST NA - STATIC LEVEL
PUMPING LEVEL NA @ GPM
AFTER HRS.

HIGHEST RECOMMENDED PUMP RATE NA
WILL STATIC LEVEL CHANGE WITH TIDES OR FROST

DEVELOP PROCEDURE NA

ESTIMATED MAN HOURS FOR DRILLING 50 HOURS FOR TOTAL JOB 50

CREW ANDERSON - ST. ANTHONY

WELL LOG

U.S. PUBLIC HEALTH SERVICE, DIVISION OF INDIAN HEALTH

JCATION UNALAKLEET WO-4 DATE STARTED 2-7-77

DATE COMPLETED 2-10-77 DRILLER MARK F. ANDERSON

TOTAL DEPTH OF WELL 49 FT. CASING INSTALLED 49 DIAMETER 6"

GROUT NA SCREEN SIZE NA MFG. NA LENGTH NA

STATIC WATER LEVEL NA HRS. PUMPED NA @ _____ GPM DRAWDOWN NA FT.

DEPTH	HOLE DIAMETER / CASING DIAMETER	FORMATION
0'-3'		MUSKEG
3'-17'		BLUE CLAY
17-49		BROWN SILT MIXED-WITH SAND & GRAVEL

SOIL DATA TO 15 FT.
FEET THAWED [illegible]
BOTTOM OF FROST & MATERIAL 18
SEASONAL OR PERMA FROST _____

WATER DATA FIELD TEST
TASTE _____
APPEARANCE FRESH _____
AFTER 24 HOURS _____
IRON _____
CHLORIDES NA
TDS _____

PUMP TEST NA - STATIC LEVEL
PUMPING LEVEL _____ @ _____ GPM
AFTER _____ HRS.

HIGHEST RECOMMENDED PUMP RATE NA
WILL STATIC LEVEL CHANGE WITH TIDES _____ OR FROST _____

DEVELOP PROCEDURE NA

ESTIMATED MAN HOURS FOR DRILLING 40 HOURS FOR TOTAL JOB 50

CREW ANDERSON - ST. ANTHONY

WELL LOG

U.S. PUBLIC HEALTH SERVICE, DIVISION OF INDIAN HEALTH

LOCATION UNALAKLEET POWERS CREEK well no II DATE STARTED 2-15-77

DATE COMPLETED 2-19-77 DRILLER MARK F ANDERSON

TOTAL DEPTH OF WELL 38' FT. CASING INSTALLED 0 DIAMETER NA

GROUT N/A SCREEN SIZE N/A MFG. N/A LENGTH N/A

STATIC WATER LEVEL N/A HRS. PUMPED N/A @ N/A GPM DRAWDOWN N/A FT.

DRILLED IN STREAM CHANNEL

DEPTH	HOLE DIAMETER / CASING DIAMETER	FORMATION
0' - 6'		ICE & WATER
5' - 8'		BROWN SAND & SILT - CREEK BOTTOM
8' - 18'		BLUE CLAY - STREAK OF SAND & ROCK AT 15'
18 - 20'		Yellow Clay
20' - 32		SILTY SAND & GRAVEL
THERE WERE INTERMITTANT LAYERS		
of CLAY THIN LENSES - MADE WATER		
32 - 38		BLUE CLAY TO BEDROCK
38		BEDROCK

SOIL DATA TO 15 FT.
- FEET THAWED
- BOTTOM OF FROST & MATERIAL
- SEASONAL OR PERMA FROST

WATER DATA FIELD TEST
- TASTE
- APPEARANCE FRESH
- AFTER 24 HOURS
- IRON
- CHLORIDES
- TDS

PUMP TEST _____ - STATIC LEVEL

PUMPING LEVEL _____ @ _____ GPM

AFTER _____ HRS.

HIGHEST RECOMMENDED PUMP RATE

WILL STATIC LEVEL CHANGE WITH TIDES _____ OR FROST _____

DEVELOP PROCEDURE _____

ESTIMATED MAN HOURS FOR DRILLING _____ HOURS FOR TOTAL JOB 40

CREW ANDERSON - 5T Fm Hdy

WELL LOG

U.S. PUBLIC HEALTH SERVICE, DIVISION OF INDIAN HEALTH

LOCATION UNALAKLEET-POWERS CREEK WELL NO. 3 DATE STARTED 2-19-77

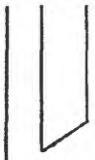
DATE COMPLETED 2/23/77 DRILLER MARK F ANDERSON

TOTAL DEPTH OF WELL _____ FT. CASING INSTALLED 41' DIAMETER 6"

GROUT N/A SCREEN SIZE _____ MFG. _____ LENGTH 26'

STATIC WATER LEVEL _____ HRS. PUMPED _____ @ _____ GPM DRAWDOWN _____ FT.

DEPTH | HOLE DIAMETER / CASING DIAMETER | FORMATION



SOIL DATA TO 15 FT.
- FEET THAWED _____
- BOTTOM OF FROST & MATERIAL _____
- SEASONAL OR PERMA FROST _____

WATER DATA FIELD TEST
- TASTE _____
- APPEARANCE FRESH _____
- AFTER 24 HOURS _____
- IRON _____
- CHLORIDES _____
- TDS _____

PUMP TEST _____ - STATIC LEVEL

PUMPING LEVEL _____ @ _____ GPM

AFTER _____ HRS.

HIGHEST RECOMMENDED PUMP RATE

WILL STATIC LEVEL CHANGE WITH TIDES _____ OR FROST _____

DEVELOP PROCEDURE _____

ESTIMATED MAN HOURS FOR DRILLING _____ HOURS FOR TOTAL JOB _____

CREW _____

WELL LOG

U.S. PUBLIC HEALTH SERVICE, DIVISION OF INDIAN HEALTH

LOCATION UNALAKLEET-POWERS CREEK - Well No. 4 DATE STARTED 3-10-77

DATE COMPLETED 3-11-77 DRILLER MARK ANDERSON

TOTAL DEPTH OF WELL 18' FT. CASING INSTALLED Pulled DIAMETER 6"

GROUT ____ SCREEN SIZE N/A MFG. N/A LENGTH N/A

STATIC WATER LEVEL N/A HRS. PUMPED ____ @ ____ GPM DRAWDOWN ____ FT.

DEPTH	HOLE DIAMETER / CASING DIAMETER	FORMATION
0' 2'		SEASONAL FROST
2'-8½'		Blue Clay
8½'-9'		SAND & GRAV. WET
18'		Blue Clay
18		Yellow clay

SOIL DATA TO 15 FT.
FEET THAWED ____
BOTTOM OF FROST & MATERIAL ____
SEASONAL OR PERMA FROST Seasonal - 2'

WATER DATA FIELD TEST
TASTE ____
APPEARANCE FRESH ____
AFTER 24 HOURS N/A
IRON ____
CHLORIDES ____
TDS ____

PUMP TEST N/A - STATIC LEVEL
PUMPING LEVEL N/A @ ____ GPM
AFTER ____ HRS.

HIGHEST RECOMMENDED PUMP RATE
WILL STATIC LEVEL CHANGE WITH N/A
TIDES ____ OR FROST ____

DEVELOP PROCEDURE N/A

ESTIMATED MAN HOURS FOR DRILLING ____ HOURS FOR TOTAL JOB 22

CREW ANDERSON - ST. ANTHONY

WELL LOG

U.S. PUBLIC HEALTH SERVICE, DIVISION OF INDIAN HEALTH

LOCATION UNALAKLEET-Powers Creek-Well No. 5 DATE STARTED 3-13-77

DATE COMPLETED 3-17-77 DRILLER MARK ANDERSON

TOTAL DEPTH OF WELL 38' FT. CASING INSTALLED 20' DIAMETER 6"

GROUT N/A SCREEN SIZE Felled MFG. N/A LENGTH N/A

STATIC WATER LEVEL ~~N/A~~ 5' HRS. PUMPED _____ @ 12 GPM DRAWDOWN _____ FT.
Below Ground

DEPTH	HOLE DIAMETER / CASING DIAMETER	FORMATION
0'-2'		Seas FROST
2'-4'		Blue clay
4'-6'		BROWN SLUSH Probably Seas.
6'-9'		SAND + GRAVEL 3 G.P.M.
9'-11'		Yellow Clay
Blue 11-12		Blue Clay
12-13		SAND + GRAVEL Bailed DRY
13'-18		Blue Clay
18' 19		SANDSTONE + Some ROCKS
19-21		Blue Clay
21-26		Yellow clay
26-30		Yellow Clay Some GRAVEL in it
30-31		SAND + GRAVEL Screened WITH 20#
31-38		Blue Clay
38		BED ROCK
		MADE WATER AS IN OTHERS

SOIL DATA TO 15 FT.
FEET THAWED _____
BOTTOM OF FROST & MATERIAL _____
SEASONAL OR PERMA FROST Seasonal 0'-2'

WATER DATA FIELD TEST
TASTE FRESH
APPEARANCE FRESH ✓
AFTER 24 HOURS _____
IRON _____
CHLORIDES _____
TDS _____

PUMP TEST 30' - STATIC LEVEL
PUMPING LEVEL _____ @ 12 GPM
AFTER 1 HRS.

HIGHEST RECOMMENDED PUMP RATE
WILL STATIC LEVEL CHANGE WITH TIDES _____ OR FROST N/A

DEVELOP PROCEDURE N/A

ESTIMATED MAN HOURS FOR DRILLING _____ HOURS FOR TOTAL JOB _____

CREW [illegible] ST. ANTHONY

WELL LOG

U.S. PUBLIC HEALTH SERVICE, DIVISION OF INDIAN HEALTH

LOCATION UNALAKLEET - POWERS CREEK - WELL NO. 6 DATE STARTED 3-17-77

DATE COMPLETED 3-19-77 DRILLER MARK F ANDERSON

TOTAL DEPTH OF WELL _____ FT. CASING INSTALLED PULLED DIAMETER _____

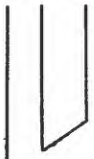
GROUT _____ SCREEN SIZE _____ MFG. _____ LENGTH _____

STATIC WATER LEVEL _____ HRS. PUMPED _____ @ _____ GPM DRAWDOWN _____ FT.

DEPTH

HOLE DIAMETER
CASING DIAMETER

FORMATION



SOIL DATA TO 15 FT.
- FEET THAWED _____
- BOTTOM OF FROST & MATERIAL _____
- SEASONAL OR PERMA FROST _____

WATER DATA FIELD TEST
- TASTE _____
- APPEARANCE FRESH _____
- AFTER 24 HOURS _____
- IRON _____
- CHLORIDES _____
- TDS _____

PUMP TEST _____ - STATIC LEVEL

PUMPING LEVEL _____ @ _____ GPM

AFTER _____ HRS.

HIGHEST RECOMMENDED PUMP RATE

WILL STATIC LEVEL CHANGE WITH TIDES _____ OR FROST _____

DEVELOP PROCEDURE _____

ESTIMATED MAN HOURS FOR DRILLING _____ HOURS FOR TOTAL JOB _____

CREW _____

WELL LOG

U.S. PUBLIC HEALTH SERVICE, DIVISION OF INDIAN HEALTH

LOCATION UNALAKLEET-POWERS CREEK-WELL NO. 7 DATE STARTED 3-20-77

DATE COMPLETED 3-22-77 DRILLER MARK F. ANDERSON

TOTAL DEPTH OF WELL 31 FT. CASING INSTALLED 21 DIAMETER 6"

GROUT N/A SCREEN SIZE 30 MFG. _____ LENGTH 10' 8"

STATIC WATER LEVEL 5 HRS. PUMPED _____ @ N/A GPM DRAWDOWN N/A FT.

DEPTH	HOLE DIAMETER / CASING DIAMETER	FORMATION
0-2'		SEASONAL FROST
2-4'		BROWN CLAY
4'-10'		SAND & GRAVEL LENSE OF CLAY AT 7'
10-12		YELLOW CLAY
12-19		BLUE CLAY-TH IN LAYER OF SAND & ROCK AT 15"
19-21		YELLOW CLAY
21-22'		CLAY SOT GRITTY H²O AT 22'
22'-25		SAND & GRAVEL SILTY-MADE H²O
25-26		YELLOW CLAY
26-27		SAND & GRAVEL
27-28		YELLOW-CLAY
28-29		SAND-MADE WATER
29-31		YELLOW CLAY
31		BLUE CLAY
SCREENED FROM		31'-21'

SOIL DATA TO 15 FT.
FEET THAWED _____
BOTTOM OF FROST & MATERIAL _____
SEASONAL OR PERMA FROST _____

WATER DATA FIELD TEST
TASTE _____
APPEARANCE FRESH _____
AFTER 24 HOURS _____
IRON _____
CHLORIDES _____
TDS _____

PUMP TEST N/A - STATIC LEVEL
PUMPING LEVEL N/A @ _____ GPM
AFTER _____ HRS.

HIGHEST RECOMMENDED PUMP RATE

WILL STATIC LEVEL CHANGE WITH
TIDES _____ OR FROST _____

DEVELOP PROCEDURE N/A

ESTIMATED MAN HOURS FOR DRILLING _____ HOURS FOR TOTAL JOB _____

CREW _____

WELL LOG

U.S. PUBLIC HEALTH SERVICE, DIVISION OF INDIAN HEALTH

LOCATION UNALAKLEET / POWERS CREEK DATE STARTED 4-7-77

DATE COMPLETED 4-9-77 DRILLER ANDERSON

TOTAL DEPTH OF WELL 32 FT. CASING INSTALLED 16' DIAMETER 8"

GROUT N/A SCREEN SIZE 8" MFG. JOHNSON LENGTH 15'

STATIC WATER LEVEL r HRS. PUMPED N/A @ GPM DRAWDOWN N/A FT.

DEPTH	HOLE DIAMETER / CASING DIAMETER	FORMATION
0-2		SEAS FROST
2-4		BROWN SLUSH
4-10		SAND & GRAVEL
10-12		YELLOW-CLAY
12-18		BLUE CLAY
18-20		SAND & CLAY
20-21		YELLOW CLAY
21-24		SAND & GRAV
24-25		CLAY YELLOW
25-26		SAND STONE GRAVEL
26-27		"
27-29		YELLOW CLAY
29-32		SAND & GRAVEL

SOIL DATA TO 15 FT.
FEET THAWED
BOTTOM OF FROST & MATERIAL
SEASONAL OR PERMA FROST SEAS

WATER DATA FIELD TEST
TASTE FRESH
APPEARANCE FRESH ✓
AFTER 24 HOURS
IRON
CHLORIDES
TDS

PUMP TEST N/A - STATIC LEVEL
PUMPING LEVEL @ GPM
AFTER HRS.

HIGHEST RECOMMENDED PUMP RATE
WILL STATIC LEVEL CHANGE WITH TIDES OR FROST N/A

Test pumped @ 10 gpm - drew down to pump in 1 minute. then pumped @ 20 gpm, drew down to 21'

DEVELOP PROCEDURE JETTING FOR 7 HOURS

ESTIMATED MAN HOURS FOR DRILLING HOURS FOR TOTAL JOB

CREW ANDERSON - ST. ANTHONY

APPENDIX 2

GROUND WATER

(Data from the files of the U.S. Geological Survey)

9-185
(October 1950)

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

WELL SCHEDULE

Date November 24, 19 58 Field No. UNA-2

Record by P R Ford Office No.

Source of data Circ. 169

1. *Location:* State Alaska County W

Map

¼ ¼ sec. T N S R E W

2. *Owner:* Mission Address Unalakleet

Tenant Address

Driller Address

3. *Topography*

4. *Elevation* ft. above below

5. *Type:* (Dug), drilled, (driven), bored, jetted 19

6. *Depth:* Rept. 30 ft. Meas. ft.

7. *Casing:* Diam. in., to in., Type

Depth ft., Finish

8. *Chief Aquifer* From ft. to ft.

Others

9. *Water level* 8 ft. rept. meas. 19 above below

which is ft. above below surface

10. *Pump:* Type Capacity G. M.

Power: Kind Horsepower

11. *Yield:* Flow G. M., Pump 16 G. M., Meas., Rept. Est.

Drawdown 26 ft. after hours pumping G. M.

12. *Use:* Dom., Stock, PS., RR., Ind., Irr., Obs.

Adequacy, permanence

13. *Quality* Temp °F.

Taste, odor, color Sample Yes No

Unfit for

14. *Remarks:* (Log, Analyses, etc.)

U. S. GOVERNMENT PRINTING OFFICE 16—62891-1

9-185
(October 1950)

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

WELL SCHEDULE

Date November 24, 1958 Field No. UNA-1

Record by P R Ford Office No.

Source of data Circ. 169

1. *Location:* State Alaska County W

Map

¼ ¼ sec. T N S R E W

2. *Owner:* School Address Unalakleet

Tenant Address

Driller Address

3. *Topography*

4. *Elevation* ft. above below

5. *Type:* (Dug), drilled, (driven), bored, jetted 19

6. *Depth:* Rept. 30 ft. Meas. ft.

7. *Casing:* Diam. in., to in., Type

Depth ft., Finish

8. *Chief Aquifer* From ft. to ft.

Others

9. *Water level* 8 ft. rept. meas. 19 above below

which is ft. above below surface

10. *Pump:* Type Capacity G. M.

Power: Kind Horsepower

11. *Yield:* Flow G. M., Pump G. M., Meas., Rept. Est.

Drawdown ft. after hours pumping G. M.

12. *Use:* Dom., Stock, PS., RR., Ind., Irr., Obs.

Adequacy, permanence

13. *Quality* Temp °F.

Taste, odor, color Sample Yes No

Unfit for

14. *Remarks:* (Log, Analyses, etc.)

U. S. GOVERNMENT PRINTING OFFICE 16—62891-1

9–185
(October 1950)

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

WELL SCHEDULE

Date 3-31-60, 19____ Field No. UNA-4

Record by R.R. Ford Office No. ____

Source of data Chem. Analyses

1: *Location:* State Alaska County W

Map ____

____ ¼ ____ ¼ sec. ____ T ____ N S R ____ E W

2. *Owner:* Federal Aviation Agency Address Unalakleet

Tenant ____ Address ____

Driller ____ Address ____

3. *Topography* ____

4. *Elevation* ____ ft. above below ____

5. *Type:* Dug, drilled, driven, bored, jetted ____ 19____

6. *Depth:* Rept. 26 ft. Meas. ____ ft.

7. *Casing:* Diam. 6 in., to ____ in., Type ____

Depth ____ ft., Finish ____

8. *Chief Aquifer* ____ From ____ ft. to ____ ft.

Others ____

9. *Water level* ____ ft. rept. meas. ____ 19____ above below ____

____ which is ____ ft. above below surface

10. *Pump:* Type ____ Capacity ____ G. M. ____

Power: Kind ____ Horsepower ____

11. *Yield:* Flow ____ G. M., Pump ____ G. M., Meas., Rept. Est. ____

Drawdown ____ ft. after ____ hours pumping ____ G. M.

12. *Use:* (Dom.), Stock, PS., RR., Ind., Irr., Obs. ____

Adequacy, permanence ____

13. *Quality* ____ Temp ____ °F.

Taste, odor, color ____ Sample (Yes) No 10-27-59

Unfit for Lab No 5582

14. *Remarks:* (Log, Analyses, etc.) ____

U. S. GOVERNMENT PRINTING OFFICE 16—62891-1

9–185
(October 1950)

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

WELL SCHEDULE

Date 3-31-60, 19____ Field No. UNA-3

Record by R.R. Ford Office No. ____

Source of data Chem. Analyses

1: *Location:* State Alaska County W

Map ____

____ ¼ ____ ¼ sec. ____ T ____ N S R ____ E W

2. *Owners:* Federal Aviation Agency Address Unalakleet

Tenant Contract Employee Address ____

Driller ____ Address ____

3. *Topography* ____

4. *Elevation* ____ ft. above below ____

5. *Type:* Dug, drilled, driven, bored, jetted ____ 19____

6. *Depth:* Rept. 21 ft. Meas. ____ ft.

7. *Casing:* Diam. 6 in., to ____ in., Type ____

Depth ____ ft., Finish ____

8. *Chief Aquifer* ____ From ____ ft. to ____ ft.

Others ____

9. *Water level* ____ ft. rept. meas. ____ 19____ above below ____

____ which is ____ ft. above below surface

10. *Pump:* Type ____ Capacity ____ G. M. ____

Power: Kind ____ Horsepower ____

11. *Yield:* Flow ____ G. M., Pump ____ G. M., Meas., Rept. Est. ____

Drawdown ____ ft. after ____ hours pumping ____ G. M.

12. *Use:* (Dom.), Stock, PS., RR., Ind., Irr., Obs. ____

Adequacy, permanence ____

13. *Quality* ____ Temp ____ °F.

Taste, odor, color ____ Sample (Yes) No 10-27-59

Unfit for Lab No 5582

14. *Remarks:* (Log, Analyses, etc.) ____

U. S. GOVERNMENT PRINTING OFFICE 16—62891-1

~~(63° 52' 25"N 160° 47'W)~~

WRD Exp. (GW) From "Place Names"
April 1966

Well No. Unalakleet

NW

WELL SCHEDULE

U. S. DEPT. OF THE INTERIOR GEOLOGICAL SURVEY WATER RESOURCES DIVISION

MASTER CARD

Control Bldg. on spot of 30'9" deep FSS, BM

Record by _____ Source of data _____ Date _____ Map _____

State _____ (1-2) County (or town) _____ (3-4)

Latitude: (5) deg (7) min (9) sec (11) N S Longitude: (12) degrees (15) min sec (18) Sequential number: (19)

Lat-long accuracy: (20) T. _____ N S, R _____ E W, Sec _____, _____ ¼, _____ ¼, _____ ¼ _____ B & M

Local well number: (21-34) Other number: _____

Local use: (35-51) Owner or name: (FSS) FAA

Owner or name: (52-66) Address: _____

Ownership: (C) County, (F) Fed Gov't, (M) City, (N) Corp or Co, (P) Private, (S) State Agency, (W) Water Dist _____ (67)

Use of water: (A) Air cond, (B) Bottling, (C) Comm, (D) Dewater, (E) Power, (F) Fire, (H) Dom, (I) Irr, (M) Med, (N) Ind, (P) P S, (R) Rec, (S) Stock, (T) Instit, (U) Unused, (V) Repressure, (W) Recharge, (X) Desal-P S, (Y) Desal-other, (Z) Other _____ (68)

Use of well: (A) Anode, (D) Drain, (G) Seismic, (H) Heat Res, (Φ) Obs, (P) Oil-gas, (R) Recharge, (T) Test, (U) Unused, (W) Withdraw, (X) Waste, (Z) Destroyed (69)

DATA AVAILABLE: Well data (70) Freq. W/L meas.: _____ (71) Field aquifer char. (72)

Hyd. lab. data: _____ (73)

Qual. water data; type: _____ (74)

Freq. sampling: _____ (75) Pumpage inventory: yes no, period: _____ (76)

Aperture cards: _____ yes (77)

Log data: _____ (78-79)

WELL-DESCRIPTION CARD

SAME AS ON MASTER CARD (1-19) Depth well: _____ ft (20-23) Meas. rept accuracy (24)

Depth cased: (first perf.) _____ ft (25-28) Casing type: _____; Diam. _____ in (29-30)

Finish: (C) porous concrete, (F) gravel w. (perf.), (G) gravel w. (screen), (H) horiz. gallery, (Φ) open end, (P) perf., screen, sd. pt., (S) shored, (T) open hole, (W) other _____ (31)

Method Drilled: (A) air rot, (B) bored, (C) cable, (D) dug, (H) hyd rot., (J) jetted, (P) air percussion, (R) reverse rotary, (T) trenching, (V) driven, (W) drive wash, (Z) other _____ (32)

Date Drilled: _____ (33-35) Pump intake setting: _____ ft (36-38)

Driller: _____ name, _____ address

Lift (type): (A) air, (B) bucket, (C) cent, (J) jet, (L) multiple, (cent.), (M) multiple, (turb.), (N) none, (P) piston, (R) rot, (S) submerg, (T) turb, (Z) other (39) Deep Shallow (40)

Power (type): diesel, elec, gas, gasoline, hand, nat gas, LP gas, wind; H.P. _____ (41) Trans. or meter no. _____

Descrip. MP _____ ft above below LSD. Alt. MP _____

Alt. LSD: _____ (42-45) Accuracy: (source) _____ (47)

Water Level _____ ft above below MP; Ft above below LSD (48-51) Accuracy: _____ (52)

Date meas: _____ (53-55) Yield: _____ gpm (56-60) Method determined (61)

Drawdown: _____ ft (62-64) Accuracy: _____ (65) Pumping period _____ hrs (66-68)

QUALITY OF WATER DATA: Iron _____ ppm (69) Sulfate _____ ppm (70) Chloride _____ ppm (71) Hard. _____ ppm (72)

Sp. Conduct _____ K x 10^6 (73) Temp. _____ °F (74-76) Date sampled _____ (77-79)

Taste, color, etc. _____

Well No.

20 gpm 87 ft. c 15' Brackish

Well No. _____

Latitude-longitude _____ N S
d m s d m s

HYDROGEOLOGIC CARD

SAME AS ON MASTER CARD (1–19) Physiographic Province: _____ (20–21) Section: _____

_____ (22) Drainage Basin: _____ (23–25) Subbasin: _____ (26)

Topo of well site: (D) depression, (C) stream channel, (E) dunes, (F) flat, (H) hilltop, (K) sink, (L) swamp, (Φ) offshore, (P) pediment, (S) hillside, (T) terrace, (U) undulating, (V) valley flat _____ (27)

MAJOR AQUIFER: _____ system, _____ series (28–29) _____ aquifer, formation, group (30–31)

Lithology: _____ (32–33) Origin: _____ (34) Aquifer Thickness: _____ ft

(35–37) Length of well open to: _____ ft (38–40) Depth to top of: _____ ft (41–43)

MINOR AQUIFER: _____ system, _____ series (44–45) _____ aquifer, formation, group (46–47)

Lithology: _____ (48–49) Origin: _____ (50) Aquifer Thickness: _____ ft

(51–53) Length of well open to: _____ ft (54–56) Depth to top of: _____ ft (57–59)

Intervals Screened: _____

Depth to consolidated rock: _____ ft (60–63) Source of data: _____ (64)

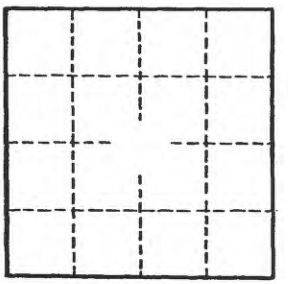
Depth to basement: _____ ft (65–68) Source of data: _____ (69)

Surficial material: _____ (70–71) Infiltration characteristics: _____ (72)

Coefficient Trans: _____ gpd/ft (73–75) Coefficient Storage: _____ (76–78)

Coefficient Perm: _____ gpd/ft^2; Spec cap: _____ gpm/ft; Number of geologic cards: _____ (79)

Second well
42'3" deep-
pump 900 gph inside - 90 mgt



Quarters area well
98' deep - across from apts.
drillable 800 gph -

Fire well - 55'3".
all water there is -
50 ft.

Well No. _____

GPO 857–700

ANALYTICAL NOTES

Location 718th A. C. & W. Sqd. County
Source Deep well Depth (ft) Diam (in.)
Cased to (ft) Date drilled Point of coll. Pump House #1
Owner 718th A. C. & W. Sqd. (USAF)
Treatment Use Domestic
WBF WL 17' Yield
Temp (° F) Appear. w.c. clear
Collected 11-19-57 By S/Sgt. Steele
Remarks

		ppm	epm
SiO_2	5 ml	11	
Abs.	~~.155~~ .165		
Al	ml		
Abs. (Al+Fe)			
Abs. (Fe)			
Fe,	25 ml	0.00	
Abs. Samp. .000			
Ml std 1 ppm .185	2 ppm .360		
Fe, Spec. Fe	25 ml	0.00	
Abs. Samp. .000			
Ml std			
Mn,	ml	0.01	
Abs.			
Ml std			
	ml		
	ml		
Ca	50 ml	22	1.10
11.80 / 4.05 / 2.75			
Mg	50 ml	6.5	.53
15.45 / 11.30 / 4.15			
	ml		
	ml		

		ppm	epm
HCO_3	50 ml	103	1.69
18.10 / 12.95 / 5.15		51	
~~CO_3~~	ml	84	
H/K on $CaCO_3$			
OH	ml		
SO_4	25 ml	2.6	.05
~~0.70 / 0.100~~	+10 ppm .090		
Cl	25 ml	2.0	.06
0.70 / 0.50 / .20 / .10 / 0.10			
F	10 ml	0.0	.00
Ml std	4.00		
	ml		
	ml		
NO_3	25 ml	0.0	.00
Abs.			
Ml std			
	ml		

Lab. No. Col- 4393 Field No. R No.

Lab. No. Col- 4393

	ppm	epm		ppm	epm
Na	3.5 ✓	0.15 ✓		ml	
Reading Avg std 100 Sample 42.5 std					
K	0.1 ✓	.00 ✓		ml	
Reading Avg std 100 Sample 8.5 std					
	ml			ml	
	ml				
Total cations		1.78 ✓	Total anions		1.80 ✓

Total ions, epm 3.58 ✓ Difference, epm 0.02 ✓ Percent difference − 0.6 ✓

		ppm		
			Specific Conductance (micromhos at 25° C) R KCl 326 R Sample 1940	168 ✓
			pH 7.6	
			Color 20	
Dissolved Solids	Sum	~~45~~ 99 ✓		
	Residue on evap. at 180° C ml			
Hardness as $CaCO_3$	ml 1.63 − 1.69 − 0.06 TH	82 ✓		
	Noncarbonate	~~X~~ 0 ✓		

	By	Date
Analyzed	EBB	12-12-57
Calc. checked	C.L.B	12-18-57
Reviewed	HBW	12-30-57
Reviewed		
Typed	DMW	1-6-58
Typing checked	HBW	1-7-58

ANALYTICAL NOTES

Location 718th A.F.C. & W. Sqd. County
Source Storage Tank Depth (ft) Diam (in.)
Cased to (ft) Date drilled Point of coll.
Owner
Treatment Use Dom.
WBF WL Yield
Temp (° F) Appear. w.c. clear
Collected 11-19-57 By
Remarks

		ppm	epm
SiO_2	5 ml	11 ✓	
Abs.	.175		
Al	ml		
Abs. (Al+Fe)			
Abs. (Fe)			
Fe,	25 ml	0.11 ✓	
Abs.	.020		
Ml std			
Fe,	ml		
Abs.			
Ml std			
Mn,	ml	0.01	
Abs.			
Ml std			
	ml		
	ml		
Ca	50 ml	23 ✓	1.15 ✓
14.70 / 11.85 / 2.85 ✓			
Mg	50 ml	6.9 ✓	.57
19.85 / 15.50 / 4.35 ✓			
	ml		
	ml		

		ppm	epm
HCO_3	50 ml	108 ✓ / 53 ✓	1.77 ✓
23.50 / 18.10 ✓ / 5.40			
~~CO_3~~	ml	88	
Alk as $CaCO_3$			
OH	ml		
SO_4	25 ml	2.0 ✓	.04 ✓
~~0.40 / 0.35~~ +10ppm .085			
Cl	25 ml	2.0 ✓	.06 ✓
0.90 / 0.70 / 0.20 ✓ / .10 / 0.10 ✓			
F	10 ml	0.0 ✓	.00 ✓
Ml std	4.00		
	ml		
	ml		
NO_3	25 ml	0.0 ✓	.00 ✓
Abs.			
Ml std			
	ml		

Lab. No. Col- 4394 Field No. R No.

Lab. No. Col- 4394

	ppm	epm		ppm	epm
Na	3.5 ✓	0.15 ✓		ml	
Reading Avg std 100 Sample 42.0 std					
K	0.1 ✓	.00 ✓		ml	
Reading Avg std 100 Sample 8.5 std					
	ml			ml	
	ml				
Total cations		1.87 ✓	Total anions		1.87 ✓

Total ions, epm 3.74 ✓ Difference, epm 100 ✓ Percent difference ±0.0 ✓

		ppm		
			Specific Conductance (micromhos at 25° C) R KCl 326 R Sample 1870	174 ✓
			pH 7.0	
			Color 25	
Dissolved Solids	Sum	102 ✓		
	Residue on evap. at 180° C ml			
Hardness as $CaCO_3$	ml TH 1.72 − 1.77 − 0.05	86 ✓		
	Noncarbonate	0 ✓		

	By	Date
Analyzed	EB	12-12-57
Calc. checked	C&B	12-18-57
Reviewed	JBN	12-30-57
Reviewed		
Typed	BJM.	1-6-58
Typing checked	JBN	1-7-57

ANALYTICAL NOTES

Location 718th A. C. & W. Sqd. County
Source Dispensary Depth (ft) Diam (in.)
Cased to (ft) Date drilled Point of coll.
Owner
Treatment Use
WBF WL Yield
Temp (° F) Appear. w.c. clear
Collected 11-19-57 By S/Sgt. Pashbig
Remarks

		ppm	epm
SiO_2	10 ml	10 ✓	
Abs. .310			
Al	ml		
Abs. (Al+Fe)			
Abs. (Fe)			
Fe,	25 ml	0.11 ✓	
Abs. .020			
Ml std			
Fe,	ml		
Abs.			
Ml std			
Mn,	ml	0.01	
Abs.			
Ml std			
	ml		
	ml		
Ca	50 ml	21 ✓	1.05 ✓
17.40 / 14.70 / 2.70 ✓			
Mg	50 ml	~~8.4~~ 8.1 ✓	~~.73~~ .67 ✓
8.55 / 4.20 / ~~4.30~~ X / 4.35 ✓			
	ml		
	ml		

		ppm	epm
HCO_3	50 ml	110 ✓	1.80 ✓
54 ✓			
29.00 / 23.50 ✓ / 5.50			
CO_3	ml	90	
Alk as $CaCO_3$			
OH	ml		
SO_4 ~~0.30~~ ~~0.40~~	25 ml	2.0 ✓	.04 ✓
+10 ppm .085			
Cl 1.10 / 0.90 ✓ / .20 / .10 / 0.10 ✓	25 ml	2.0 ✓	.06 ✓
F	10 ml	0.0 ✓	.00 ✓
Ml std	4.00		
	ml		
	ml		
NO_3	25 ml	1.2 ✓	.02 ✓
Abs. .105			
Ml std			
	ml		

Lab. No. Col- 4395 Field No. R No.

Lab. No. Col- 4395

	ppm	epm		ppm	epm
Na	3.3 ✓	0.14 ✓	____ ml ____		
Reading Avg ____ std 100 Sample 41.0 ____ ____ ____ std ____ ____ ____					
K	0.1 ✓	.00 ✓	____ ml ____		
Reading Avg ____ std 100 Sample 8.5 ____ ____ ____ std ____ ____ ____					
____ ml ____			____ ml ____		
____ ml ____					
Total cations		~~1.92~~ 1.86 ✓	Total anions		1.92 ✓

Total ions, epm ~~3.84~~ 3.78 ✓ Difference, epm ~~.06~~ - 0.06 ✓ Percent difference ~~±3.0~~ - 1.6 ✓

		ppm
Dissolved Solids	Sum	~~103~~ 102 ✓
	Residue on evap. at 180° C ____ ml	
Hardness as $CaCO_3$	____ ml 1.72 -1.90 -0.08 TH	~~82~~ 86 ✓
	Noncarbonate	0 ✓

Specific Conductance (micromhos at 25° C) R KCl 326 R Sample 1830	178 ✓
pH 7.5	
Color 20	

	By	Date
Analyzed	EAB	12-12-57
Calc. checked	C & B	12-18-57
Reviewed	B N	12-30-57
Reviewed		
Typed	B M.	1-6-58
Typing checked	B N	1-7-57

ANALYTICAL NOTES

Location 718th A. C. & W. Sqd. County
Source Depth (ft) Diam (in.)
Cased to (ft) Date drilled Point of coll. Kitchen
Owner
Treatment Use
WBF WL Yield
Temp (° F) Appear. w.c. clear
Collected 11-19-57 By S/Sgt. Pasbrig
Remarks

		ml	ppm	epm
SiO_2	Abs. .170	5	11 ✓	
Al	Abs.(Al+Fe) / Abs.(Fe)			
Fe,	Abs. .020 / Ml std	25	0.11 ✓	
Fe,	Abs. / Ml std			
Mn,	Abs. / Ml std		0.01	
Ca	20.10 / 17.40 / 2.70 ✓	50	21 ✓	1.05 ✓
Mg	4.20 / 0.00 / 4.20 ✓	50	7.4 ✓	.61 ✓

		ml	ppm	epm
HCO_3	34.20 / 29.00 / 5.20 ✓	50	104 / 51 ✓	1.70 ✓
CO_3	alk as $CaCO_3$		83	
OH				
SO_4	.090 +10 ppm	25	2.6 ✓	.05 ✓
Cl	1.30 / 1.10 / .20 / .10 / 0.10 ✓	25	2.0 ✓	.06 ✓
F	Ml std	10	0.0 ✓	.00 ✓
NO_3	Abs. / Ml std	25	0.0 ✓	.00 ✓

Lab. No. Col- 4396 Field No. R No.

Lab. No. Col- 4396

	ppm	epm		ppm	epm
Na	3.3	0.14		ml	
Reading Avg std 100 Sample 41.0 std					
K	0.0	.00		ml	
Reading Avg std 100 Sample 8.0 std					
	ml			ml	
	ml				
Total cations		1.80	Total anions		1.81

Total ions, epm 3.62 Difference, epm 0.01 Percent difference − 0.3

		ppm		
			Specific Conductance (micromhos at 25° C) R KCl 326 R Sample 1920	170
			pH 7.4	
			Color 20	
Dissolved Solids	Sum	98		
	Residue on evap. at 180° C ml			
Hardness as $CaCO_3$	ml 1.66 − 1.70 = −0.09 TH	83		
	Noncarbonate	0		

	By	Date
Analyzed	ESB	12-12-57
Calc. checked	CLB	12-18-57
Reviewed	[illegible]	12-30-57
Reviewed		
Typed	[illegible]	1-6-58
Typing checked	[illegible]	1-7-57

55 82

1GW

ANALYTICAL NOTES

Location Q UNALAKEET, ALASKA; FAA County
Source CONTROL BUILDING WELL Depth (ft) 30'+9" Diam (in.) 6"
Cased to (ft) Date drilled Point of coll.
Owner
Treatment Use
WBF WL Yield
Temp (° F) Appear. w.c.
Collected 27 OCT 59 By
Remarks WELL SCREEN JOHNSON EVERDUR 35 THOUSAND OPENING

	ml	ppm	epm
SiO_2	2.50 ml	20 ✓	
Abs. ~~85.0~~ 17.5 ~~14.5~~	144 dil		
Al	ml		
Abs. (Al+Fe)			
Abs. (Fe)			
Fe, tot Sol	25 ml	0.59	
Abs. 17.0	filtered for color		
Ml std	avg OD. = 28.67/mg		
Fe, opt	10 ml	4.4	
Abs. 15.0	.290 .580 .870		
Ml std			
Mn, tot Sol	100 ml	0.22	
Abs. 8.0	Spot > 0.02		0.02
Mn	100 ml		Cl 3.50 − 0.00 = 3.50 − 0.10 = 3.40 ✓
0.05 mg = 19.0 abs.			
0.10 mg = 36.0 abs. avg			
	ml		
Ca	50 ml	27 ✓	
4.05 − 0.60 = 3.45 ✓			1.35 ✓
Mg 19.35 − 14.00 = 5.35 ✓	50 ml	= 8.9	
= 3.45 ✓ 1.90 ✓ (0.02)	= 1.88 mg/l		0.73 ~~0.74~~
	ml		
	ml		

	ml	ppm	epm
HCO_3 4.30 − 0.90 = 3.40 ✓	50 ml	268 ✓	4.39
as $CaCO_3$ = 220			
CO_3	ml	0	0.00
~~OH~~ Soy	10 ml		
0.60 − 0.25 = 0.35 − 0.05 = 0.30 ✓			
SO_4 0.60 − 0.30 = 0.30 − 0.05 = 0.25	10 ml	~~6.0~~	0.12 ~~0.00~~
Cl 3.35 − 0.00 = 3.35 − 0.10 = 3.25	50 ml	~~65.0~~ 34 ✓	0.96 ~~0.96~~ ~~1.83~~
as NO_3 1 ml = 0.5 mg Cl⁻			
F	5 ml	0.0	
~~Abs~~ ~~Ml std~~ ~~X std~~ 4.00			0.00
	ml		
	ml		
NO_3	25 ml	0.3	
Abs. 7.0			
Ml std	Deionized		0.00 ✓
	ml		

Lab. No. Col- 55 82 Field No. R No.

Lab. No. Col- 5582 Field No.

	ppm	epm		ppm	epm
Na	74 ✓			ml	
Reading Avg 80 std 100 Sample 96.5 10 ml 80 std 88		3.22 ✓			
K	9.0 ✓			ml	
Reading Avg 5 std 100 Sample 95 + std 51.0 0 5	20 = 100 15 = 80 10 = 56 5 = 29.5 1 = 7.0	0.23 ✓			
	ml			ml	
	ml				
Total cations		5.55 ✓	Total anions		5.47 ✓

Total ions, epm 11.02 ✓ Difference, epm +0.08 ✓ Percent difference +0.7 ✓

		ppm		
			Specific Conductance (micromhos at 25° C) R KCl 323 R Sample 645	501 ✓
			pH	7.8
			Color	~~150~~ 120
Dissolved Solids	Sum 193	312 ~~+99~~		
	Residue on evap. at 180° C ml			
Hardness as $CaCO_3$	ml 2.08 − 4.39	104 ✓		
	Noncarbonate	0 ✓		
	alkalinity $CaCO_3$ = 220 ✓			
	CO_2 = 7			

	By	Date
Analyzed	CLB	4 DEC 59
Calc. checked	WSW	12/16/59
Reviewed	WSW	12/16/59
Reviewed		
Typed		
Typing checked		

GROUND WATER LAB. NO. 68 28

County : 2ND DIVISION Loc[illegible]:
Sample No.: Region: W of 141
Inv. : AIR FORCE POTABLE
W.O.No. :
GW Basin : BERING COASTAL
Loc. : @ 718TH AC&W Sqd. UNALAKLEET, ALASKA UNALAKLEET QUADRANGLE
Samp. Pt. : @ NEW GALLERY
Pumptime : Disch. :
Temp. : °F. Coll. :
Agency : PST
Remarks : 1ST SAMPLE NEW SYSTEM

WELL DATA
Type : Drilled:
Depth : 20' Ft. Dia. : In.
Cased : Ft. Perf. :
Gravel packed:
Use :
Owner : AIR FORCE
Remarks : before 1 JAN 62

CALCIUM 50 ml
6.10 − 3.40 = 2.70 16.80 − 13.90 = 2.90 epm
F 8.01
Ca ppm 23

MAGNESIUM
epm TH 1.84
epm Ca 1.15
epm Mg 0.69
Mg ppm 8.4

SILICA 10 ml
A 43.0 mg 0.10
Factor 0.233
A sample 40.5
SiO_2 ppm 9.4

IRON(dis) 25 ml
A 11.6 mg 0.01
Factor 0.0345
A sample 0.5
Fe ppm 0.02

IRON(total) ml
A mg
Factor
A sample
Fe ppm

ALKALINITY
HCO_3 117 50 ml CO_3
15.75 − 9.90 = 5.85

SODIUM dil
Sample 44.5 %T
Curve
Na ppm 3.8

POTASSIUM dil
Sample +2.5 %T × 0.118
K ppm 0.3

TOTAL ALKALINITY as CO_3 58
as HCO_3 117 as $CaCO_3$ 96

SULFATE 10 ml
5.00 − 4.85 = 0.15 − 0.05 = 0.10 0.2 meq
SO_4 ppm 2.0

CHLORIDE 50 ml
1 ml = 0.5 mg Cl
7.70 − 7.30 = 0.40 − 0.10 = 0.30
Cl ppm 3.0

FLUORIDE 10 ml
Corr. ml −0.20
mg Std 0.01
F ppm 0.2

NITRATE 25 ml
ml Ag_2SO_4
A 9.2 mg 0.01
Factor 0.0425
A sample 52.5
NO_3 ppm 2.3

BORON ml
A mg
Factor
A sample
B ppm

SUM 110
T/A ft
DISSOLVED SOLIDS ml
D.S. ppm

HARDNESS 50 ml as $CaCO_3$
1.60 − 0.00 = 4.60
Total 92
HCO_3 (0.82) 96
Non-Carb —

% Na 8.4
SPECIFIC CONDUCTANCE
R(KCl) 322
R sample 1701
Micromhos at 25°C 189

pH 7.4
COLOR 5
TURB
% E −1.7

epm		epm	
1.15	Ca		CO_3
0.69	Mg	1.92	HCO_3
		0.04	SO_4
0.17	Na	0.08	Cl
0.01	K	0.01	F
		0.04	NO_3
2.02	Sum	2.09	Sum

Δ −0.07
Σ 4.11

Palmer 1958 GPO 976283 #1828

DATE STARTED 29 JAN 62 CHEMIST CLB
DATE COMPLETED 9 FEB 62 CHECKED

6628

ALUMINUM _____ ml

A _____ mg _____ Appar. Al _____

Asample _____ Fe X .12 – _____

Factor _____ Mn X .04 – _____

F X .05 + _____

Al ppm [ ]

MANGANESE (qual.) 1 ml

A _____ mg _____

Asample _____

Factor _____ Mn ppm [0.00]

CHROMIUM _____ ml

A _____ mg _____

Asample _____

Factor _____ Cr ppm [ ]

_____ ml

A _____ mg _____

Asample _____

Factor _____ ppm [ ]

COPPER _____ ml

A _____ mg _____

Asample _____ Factor _____

Acolor _____

Acorr. _____ Cu ppm [ ]

LEAD _____ ml

A _____ mg _____

Asample _____

Factor _____ Pb ppm [ ]

ZINC _____ ml

A _____ mg _____

Asample _____

Factor _____ Zn ppm [ ]

ARSENIC _____ ml

A _____ mg _____

Asample _____

Factor _____ As ppm [ ]

_____ ml

A _____ mg _____

Asample _____

Factor _____ ppm [ ]

GROUND WATER

LAB. NO. 7870

County :
Sample No. :
Inv. : USAF POTABLE
W.O.No. :
GW Basin : NORTON SOUND
Loc. : UNALAKLEET AFS, ALASKA
718th AC & W Sqd.
Samp. Pt. : @ WATER GALLERY
Pumptime :
Temp. : °F.
Agency : USAF
Remarks :

Loc.No:
Region: W of 141

WELL/DATA #1
Type :
Depth : Ft.
Cased : Ft.
Gravel packed:
Use : GALLERY
Owner :
Remarks : USAF

Drilled:
Dia. : In.
Perf. :

Disch. :
Coll. : PST 9 JAN 64

SILICA 10 ml
A 40.0 mg 0.10
Factor 0.25
A sample 38.0
SiO_2 ppm 9.5

IRON (dis) 25 ml
A 11.6 mg 0.01
Factor 0.0345
A sample 0.5
Fe ppm 0.02

IRON (total) 25 ml
A 11.6 mg 0.01
Factor 0.0345
A sample 11.5
Fe ppm 0.40

CALCIUM 50 ml
3.00 ml
F 20 EPM
Ca ppm 24

MAGNESIUM
epm TH 1.88
epm Ca 1.20
epm Mg 0.68
Mg ppm 8.3

ALKALINITY
HCO_3 117
30 ml
CO_3
5.85 ml
CO_2 = 7

SODIUM dil
Sample 40.0 %T
Curve 410
Na ppm 3.2

POTASSIUM dil
Sample 3.0 %T · 0.123
K ppm 0.4

TOTAL ALKALINITY as CO_3 58
as HCO_3 117
as $CaCO_3$ 96

SULFATE 10 ml
0.15 − 3 = 0.10 ml
SO_4 ppm 2.0

CHLORIDE 50 ml
1 ml = 0.5 mg Cl
0.45 − 8 = 0.35 ml
Cl ppm 3.5

FLUORIDE 10 ml
−1.0 × −0.027
Corr. ml
mg Std
F ppm 0.0

NITRATE 25 ml
ml Ag_2SO_4
A 9.2 mg 0.01
Factor 0.0435
A sample 54.0
NO_3 ppm 2.3

BORON ml
A mg
Factor
A sample
B ppm

SUM 111
T/A ft
DISSOLVED SOLIDS ml
D.S. ppm

HARDNESS 50 ml as $CaCO_3$
4.70 ml
Total 94
HCO_3 (0.82) 96
Non-Carb —

% Na 6.9

SPECIFIC CONDUCTANCE
R(KCl) 345
R sample 1773
Micromhos at 25°C 195

pH 7.4
COLOR 5
TURB
% E −1.7

epm	epm
1.20 Ca	— CO_3
0.68 Mg	1.92 HCO_3
—	0.04 SO_4
0.14 Na	0.10 Cl
0.01 K	0.00 F
—	0.04 NO_3
2.03 Sum	2.10 Sum

Δ −0.07
Σ 4.13

Palmer 1958 GPO 976283 #7870

DATE STARTED 20 JAN 64 CHEMIST CLB
DATE COMPLETED 11 FEB. 64 CHECKED

7870

ALUMINUM ____ ml

A ____ mg ____ Appar. Al ____

Asample ____ Fe X .12 – ____

Factor ____ Mn X .04 – ____

F X .05 + ____

Al ppm [ ]

MANGANESE (qual.) 1 ml

A ____ mg ____ SPOT

Asample ____

Factor ____ Mn ppm [0.00]

CHROMIUM ____ ml

A ____ mg ____

Asample ____

Factor ____ Cr ppm [ ]

____ ml

A ____ mg ____

Asample ____

Factor ____ ppm [ ]

COPPER ____ ml

A ____ mg ____

Asample ____ Factor ____

Acolor ____

Acorr. ____ Cu ppm [ ]

LEAD ____ ml

A ____ mg ____

Asample ____

Factor ____ Pb ppm [ ]

ZINC ____ ml

A ____ mg ____

Asample ____

Factor ____ Zn ppm [ ]

ARSENIC ____ ml

A ____ mg ____

Asample ____

Factor ____ As ppm [ ]

____ ml

A ____ mg ____

Asample ____

Factor ____ ppm [ ]

GROUND WATER | LAB. NO. 8136

County : | Loc.No: | WELL DAT
Sample No.: | Region: | Type : | Drilled:
Inv. : | | Depth : Ft. | Dia. : In.
W.O.No. : UNALAKLEET | | Cased : Ft. | Perf. :
GW Basin : 718M AC+W SQ | | Gravel packed:
Loc. : | | Use :
| | Owner :
| | Remarks :

Samp. Pt. : GALLERY

Pumptime :
Temp. : °F. | Disch. :
Agency : | Coll. :
Remarks : 8/10/64/0900 AST

SILICA 10 ml
A 0.435 mg 0.1
Factor 22.99
A sample 0.465
SiO_2 ppm 11

IRON (dis) 25 ml
A 0.310 mg .025
Factor 3.226
A sample 0.015
Fe ppm 0.05

IRON (total) 25 ml
A 0.310 mg .025
Factor 3.226
A sample 0.015
Fe ppm 0.05

SODIUM 0 dil
Sample 37 %T
Curve 0-10
Na ppm 2.9

POTASSIUM 0 dil
Sample 6 %T
K ppm 0.1

SULFATE 10 ml
0.70
0.00
0.70
0.05
0.65
SO_4 ppm 6.2

CHLORIDE 50 ml
1 ml = 0.5 mg Cl
0.65
0.00
0.65
0.10
0.55
Cl ppm 3.9

FLUORIDE 10 ml
A Sample
~~Corr.~~ ml −1
A
~~mg~~ Std −38
F ppm 0.0

CALCIUM 50 ml
5.05
2.40
2.65
F 8.01
Ca ppm 21

MAGNESIUM
epm TH 1.78
epm Ca 1.05
epm Mg 0.73
Mg ppm 8.9

ALKALINITY
HCO_3 100 50 ml CO_3 0
11.10
7.00
4.10

TOTAL ALKALINITY as CO_3 49
as HCO_3 100 as $CaCO_3$ 82

NITRATE 10 ml
ml Ag_2SO_4 0.0
A 1.400 mg 0.3
Factor 21.43
A sample 0.055
NO_3 ppm 1.2

BORON ml
A mg
Factor
A sample
B ppm —

SUM 104
T/A ft 0.14
DISSOLVED SOLIDS ml
D.S. ppm —

HARDNESS 50 ml as $CaCO_3$
19.00
14.55
4.45
Total 89
HCO_3 (0.82) 82
Non-Carb 7

% Na 7

SPECIFIC CONDUCTANCE
R (KCl) 319
R sample 1868
Micromhos at 25°C 171

pH 7.2
COLOR 5
TURB —
% E +0.3

epm	epm
1.05 Ca	0.00 CO_3
0.73 Mg	1.64 HCO_3
	0.13 SO_4
0.13 Na	0.11 Cl
0.00 K	0.00 F
	0.02 NO_3
1.91 Sum	1.90 Sum

CO_2 100
.100
10 ppm

Δ 1
Σ 381

Palmer 1958 GPO 976283
DATE STARTED 8/19/64 CHEMIST
DATE COMPLETED 8/24/64 CHECKED
H 8131

8136

ALUMINUM _____ ml

A _____ mg _____ Appar. Al _____

Asample _____ Fe X .12 – _____

Factor _____ Mn X .04 – _____

F X .05 + _____

Al ppm

MANGANESE (qual.) 100 ml

A 0.310 mg 0.2

Asample 0.000

Factor _____ Mn ppm 8.0

CHROMIUM _____ ml

A _____ mg _____

Asample _____

Factor _____ Cr ppm

_____ ml

A _____ mg _____

Asample _____

Factor _____ ppm

COPPER _____ ml

A _____ mg _____

Asample _____ Factor _____

Acolor _____

Acorr. _____ Cu ppm

LEAD _____ ml

A _____ mg _____

Asample _____

Factor _____ Pb ppm

ZINC _____ ml

A _____ mg _____

Asample _____

Factor _____ Zn ppm

ARSENIC _____ ml

A _____ mg _____

Asample _____

Factor _____ As ppm

_____ ml

A _____ mg _____

Asample _____

Factor _____ ppm

GROUND WATER LAB. NO. 8585

County : Loc.No:
Sample No.: Region:
Inv. :
W.O.No. :
GW Basin :
Loc. : 718th ACWRON - Unalakleet

Samp. Pt. : water gallery

Pumptime : Disch. :
Temp. : 45 °F. Coll. : 9/1/65 by
Agency : Ormonde PST
Remarks : clear at collection

WELL DATA
Type : Drilled:
Depth : Ft. Dia. : In.
Cased : Ft. Perf. :
Gravel packed:
Use : domestic
Owner : USAF
Remarks :

CALCIUM 50 ml
1.85
0.00
1.85
F 8.01
Ca ppm 15

MAGNESIUM
epm TH 1.32
epm Ca 0.74
epm Mg 0.58
Mg ppm 7.1

ALKALINITY
HCO_3 73 ml CO_3 -0-
3.65
0.00
3.65

SILICA 10 ml
A 0.495 mg 0.10
Factor 20.20
Asample 6.490
SiO_2 ppm 10.

IRON(dis) 25 ml
A 0.255 mg 0.025
Factor 3.922
Asample 0.045
Fe ppm ~~1.8~~

IRON(total) 25 ml
A 0.255 mg 0.025
Factor 3.922
Asample 0.052
Fe ppm 2.0

SODIUM -0- dil
Sample 36 %T
Curve 0-10
Na ppm 2.8

POTASSIUM 0 dil
Sample 17-13 %T
K ppm 0.5

TOTAL ALKALINITY as CO_3 36
as HCO_3 73 as $CaCO_3$ 60

SULFATE 10 ml
~~0.20~~ 1.00
0.00 0.00
~~1.45~~ 1.00
SO_4 ppm 9.6

CHLORIDE 25 ml
1 ml = 0.5 mg Cl
0.25
0.00
0.25
0.10
0.15
Cl ppm 2.1

FLUORIDE 10 ml
A Std
~~Corr.~~ ml 0.085
mg Std 0.325
F ppm 0.2

NITRATE 10 ml
ml Ag_2SO_4 —
A 1.500 mg 0.30
Factor 20
Asample 0.045
NO_3 ppm 0.1

BORON — ml
A — mg
Factor —
Asample —
B ppm —

SUM 85
T/A ft 1.2
DISSOLVED SOLIDS ml
D.S. ppm

HARDNESS 50 ml as $CaCO_3$
3.30
0.00
3.30
Total 66
HCO_3(0.82) 60
Non-Carb 6

% Na 8
SPECIFIC CONDUCTANCE
R(KCl) 339
Rsample 2532
Micromhos at 25°C 134

pH 7.0
COLOR 10
TURB
% E -1.6

epm	epm
0.74 Ca	— CO_3
0.58 Mg	1.20 HCO_3 ~~0.05~~ 0.20
—	~~0.50~~ SO_4
0.12 Na	0.06 Cl
.01 K	0.01 F
—	0.01 NO_3
1.45 Sum	1.48 Sum

$ppm CO_2 = 73 \times 0.159 = 12$

Δ 3
Σ 1.93

Palmer 1958 GPO 976283 DATE STARTED 9-9-65 CHEMIST
DATE COMPLETED 9-14-65 CHECKED

8585

ALUMINUM _____ ml

A _____ mg _____

Asample _____

Factor _____

Appar. Al _____

Fe X .12 – _____

Mn X .04 – _____

F X .05 + _____

Al ppm [ ]

MANGANESE (qual.) _____ ml

A _____ mg _____

Asample _____

Factor _____

Mn ppm [.02]

CHROMIUM _____ ml

A _____ mg _____

Asample _____

Factor _____

Cr ppm [ ]

_____ ml

A _____ mg _____

Asample _____

Factor _____

ppm [ ]

COPPER _____ ml

A _____ mg _____

Asample _____

Factor _____

Acolor _____

Acorr. _____

Cu ppm [ ]

LEAD _____ ml

A _____ mg _____

Asample _____

Factor _____

Pb ppm [ ]

ZINC _____ ml

A _____ mg _____

Asample _____

Factor _____

Zn ppm [ ]

ARSENIC _____ ml

A _____ mg _____

Asample _____

Factor _____

As ppm [ ]

_____ ml

A _____ mg _____

Asample _____

Factor _____

ppm [ ]

SURFACE WATER ( ) WASTE LAB. NO. 9779

Source :
Loc. : Unalakleet
Dr. Basin :
Pt. Coll. : Tap In Well House

County :
Loc.No. : 63° 52' 00" Region :
Inv : 160° 47' 00" Sample No:
W.O.No. : #75002 GH :
Temp. : °F. DO :
Coll. : 11/6/66 - H. Bartol pH :
Agency : PST.
Remarks:

Type Waste:
Treatment :
Rec.Water :
Loc.Disch. :
Remarks :

CALCIUM ____ ml
F ____
Ca ppm

MAGNESIUM
epm TH 1.76
epm Ca ____
epm Mg ____
Mg ppm

SILICA ____ ml
A ____ mg
Factor ____
A sample ____
SiO_2 ppm

IRON(dis) ____ ml
A ____ mg
Factor ____
A sample ____
Fe ppm

IRON(total) ____ ml
A ____ mg
Factor ____
A sample ____
Fe ppm

ALKALINITY
HCO_3 ____ ml CO_3
~~124~~

SODIUM ____ dil
Sample ____ %T
Curve ____
Na ppm

POTASSIUM ____ dil
Sample ____ %T
K ppm

TOTAL ALKALINITY as CO_3 ____
as HCO_3 as $CaCO_3$

SULFATE ____ ml
SO_4 ppm

CHLORIDE 30 ml
1 ml = 0.5 mg Cl
15.10
Cl ppm 107

FLUORIDE ____ ml
Corr. ml ____
mg Std ____
F ppm

NITRATE ____ ml
ml Ag_2SO_4 ____
A ____ mg
Factor ____
A sample 0.030
$NO_3 + NO_2 = 0.7$ ppm
~~NO_3 ppm~~ 0.7

BORON ____ ml
A ____ mg
Factor ____
A sample ____
B ppm

SUM
T/A ft
DISSOLVED SOLIDS ____ ml
D.S. ppm

HARDNESS ____ ml as $CaCO_3$
12.40
6.00
4.40
Total 88
HCO_3(0.82) ____
Non-Carb

% Na
SPECIFIC CONDUCTANCE
R(KCl) 334
R sample 900
Micromhos at 25°C 371

pH 7.1
COLOR 20
TURB 288 mg/l
% E

epm		epm	
____	Ca	____	CO_3
____	Mg	____	HCO_3
____		____	SO_4
____	Na	3.02	Cl
____	K	____	F
____		0.01	$NO_3 + NO_2$
____	Sum	____	Sum

TS = 288 mg/l
Organic 33 mg/l

Δ ____
Σ ____

____ X ____
F:(Ca+Mg) epm Na
SAR

Palmer 1958 GPO 976283 DATE STARTED ____ CHEMIST ____
DATE COMPLETED ____ CHECKED ____

ALUMINUM _____ ml

A _____ mg _____ Appar. Al _____

Asample _____ Fe X .12 – _____

Factor _____ Mn X .04 – _____

F X .05 + _____

Al ppm

MANGANESE (qual) _____ ml

A _____ mg _____

Asample _____

Factor _____ Mn ppm

CHROMIUM _____ ml

A _____ mg _____

Asample _____

Factor _____ Cr ppm

_____ ml

A _____ mg _____

Asample _____

Factor _____ ppm

COPPER _____ ml

A _____ mg _____

Asample _____ Factor _____

Acolor _____

Acorr. _____ Cu ppm

LEAD _____ ml

A _____ mg _____

Asample _____

Factor _____ Pb ppm

ZINC _____ ml

A _____ mg _____

Asample _____

Factor _____ Zn ppm

ARSENIC _____ ml

A _____ mg _____

Asample _____

Factor _____ As ppm

_____ ml

A _____ mg _____

Asample _____

Factor _____ ppm

ound Water Analysis
ological Survey - Anchorage 19___

Lab No. 11653-68-85 / AS-53

State ____ [1 2] County ____ [3 4] Lat. [5] 63 5 2 3 0 [10 11] (0 1 11 NS) Long. [12] 1 6 0 4 7 3 0 [18] (0 1 11)

Seq. No. [19] Date Coll. [20] 07 12 68 [25] Sampling Depth [26–29] Type[c] #75003 [30]

Well Location: Unalakleet BIA School Collected by: Terry Kotze

~500 hrs. at Taps 15°C

Owner ____ Appearance ____ WBF ____

Constituent	Value	Card columns	epm
Specific Conductance: R (KCl) 351; R Sample 1916		31–35: 183	
pH		36–38: 7.5	
Temp °F		39–41	
Silica	382	42–44: 8.5	
Calcium	24	45–49: [redacted]	TH 1.57; 1.20 [redacted]
Magnesium	4.5	50–53: [redacted]	.37 [redacted]
Sodium % Na	54	54–58: 4.9	.21
Potassium	23.5	59–61: .3	.01
			1.99 (epm cations)

Constituent	epm	Value / work	Card columns
HCO_3	1.44		62–65: 88
CO_3			66–67
SO_4 10	.08	.82 − .50 = .32	68–72: 3.8
Cl 50	.31	5.78 − 3.54 = 2.19	73–78: 11
Data Source[d] 79		Card Q	Q
F 10	.00	1.950	26–28: .1
NO_3 2	.00	1.008	29–32: .1
PO_4			33–35
	1.83 (epm anions)	% of Error ✓	

Total Alkalinity 50

11.26 − 6.87 = 4.39

as HCO_3 88
as $CaCO_3$ 72
as CO_3 43

Constituent	Value	Card columns
B		36–3
Al		39–4
Iron	[redacted] .66	Total [redacted]; 42 (dis)
Mn		46
Cu		50
Pb		53
Zn		55
Dissolved Solids		58 Residue; 64 Calc 11
Hardness Total		70: 7
HCO_3(0.82)	7	
Non-Carb		74
Color		78 79: 15
Card R		

und Water Analysis
logical Survey - Anchorage 19___

Lab No. 1845-68-11
ALS-53
Alaska Dept B Health Welfare

ate ____ [ ][ ] 1 2 County ____ [ ][ ] 3 4 Lat. [0 1 11 NS] 5 10 11 Long. [0 1 11] 12 18

q. No. [ ] 19 Date Coll. 6 8 2 2 6 8 (20–25) Sampling Depth [ ] 26 29 Type[c] ____ [ ] 30

ll Location Unalakleet SDA School Collected by Terry Kotzer
0930 hours at Tap
WBF ____

ner ____ Appearance ____
23°C

ecific Conductance R (KCl) 352 R Sample 1803 31–35: 195	1.61	HCO_3 62–65: 98	Total Alkalinity 50 4.88 as HCO_3 98 as $CaCO_3$ 80 as CO_3 48
		CO_3 66 67	B 36–38
H 36–38: 7.6 ; Temp °F 39–41		SO_4 10 1.21 .95 .26 68–72: 2.5	Al 39–41
ilica .399 42–44: 9.2	.05		Iron Total .72 .212 42 (dis) 4
alcium ; TH 1.82 45–49: 28 ; 1.40	.39	Cl 50 5.04 2.21 2.83 73–78: 14	Mn 46–49
		Data Source[d] 79 ; Card Q ; Q	Cu 50–5
Magnesium 50–53: 5.1 ; .42	.01	F 10 1.920 26–28: .2	Pb 53–5
Sodium % Na ____ 54–58: 5.2 ; .23	.00	NO_3 2 1.011 29–32: .2	Zn 55
Potassium 59–61: .2 ; .00		PO_4 33–35	Dissolved Solids 58 Residue 64 Calc 11
			Hardness Total 70: 9 HCO_3(0.82) 8 74 Non-Carb
2.05 epm cations	2.06 epm anions	% of Error ____	Color 78 79: 2 5 ; Card R

11845-68-1142

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

2SW

WATER ANALYSIS

Location Unalakleet County
Source Infiltration gallery area
Point of coll. * * *
Owner Treatment

Use Gage height (ft) Discharge (cfs) Temp (°F)
Appear. when coll.
Collected 4/28/67 By
Remarks Organic matter - 2ll. Total CO_2 - 18 ppm

	ppm	epm		ppm	epm
Silica (SiO_2)	4.8		Bicarbonate (HCO_3)	35	0.57
Aluminum (Al)	----		Carbonate (CO_3)	0	0.00
Iron (Fe)	26				
Sodium (percent)	23		Sulfate (SO_4)	6.0	0.12
			Chloride (Cl)	8.9	0.25
			Fluoride (F)	0.2	0.01
Calcium (Ca)	9.7	0.48			
Magnesium (Mg)	2.5	0.21	Nitrate (NO_3)	0.7	0.01
Sodium (Na)	5.0	0.22			
Potassium (K)	1.3	0.03			
Total	.94	.94	Total		.96

	ppm		
		Specific conductance (micromhos at 25° C)	106
Dissolved solids:			
Calculated	82	pH	6.5
Residue on evaporation at 180°C		Color greater than	25
		less than	30
Hardness as $CaCO_3$	34		
Noncarbonate	5		

Lab. No. 10100 Field No. Project Basic Data

APPENDIX 3

DRINKING-WATER SOURCES

(Data from the files of the Indian Health Service)

WATER SOURCE INVESTIGATION

UNALAKLEET, ALASKA

MAY 1977

PREPARED BY
Arthur D. Ronimus
Office of Environmental Health
Indian Health Service
3350 Commercial Drive
Anchorage, Alaska

YEAR DRILLED	LOCATION:	DEPTH DIAMETER:	SOIL:	WATER:	QUANTITY:	COMMENTS: WELLS DRILLED BY PHS UNLESS NOTED
1962, January	Downtown, Armory	4", 24'	Sandy	Good	Low, 3 GPM	Draws from perched water table, inadequate for system, BIA drilled
1962, January	Downtown, Armory	4", 24'	Sandy gravel, clay	Salt, iron	Adequate	Saline, BIA drilled
1963, June	Airport	4", 20-30'	Sandy gravel	Saline	Sufficient quality from three wells 15 GPM, Avg	Draws water from perched water table, subject to salt water intrusion,
1963, June	Airport	4", 20-30'	"	Good		
1963, June	Airport	4", 20-30'	"	Good		
1963, June	Airport	4", 20-30'	"	Observation only		
1963, June	Airport	4", 20-30	"	"		
1975, May	Infiltration gallery	6", 73'	Sandy gravel, silts	Good	15 GPM	Not sufficient in volume as source, Corp of Engineers drilled
1975, December	Pumphouse	6", 109'	Sandy gravel, frozen soils	Salt	Adequate 30 + GPM	Salt water, for use as emergency source
1975, December	Infiltration gallery	6", 34'	Sands & gravel	Saline	40 GPM	Saline, not suitable as potable water source

YEAR DRILLED	LOCATION	DEPTH DIAMETER:	SOIL:	WATER:	QUANTITY:	WELLS DRILLED BY PHS UNLESS NOTED COMMENTS:
1977, January	Powers Creek	6", 40'	Sandy, silts, frozen	Low water	NA	1-2 GPM maximum
1977, January	Spring source, A. F. Hill	6", 50'	Silt, Clay frozen	No water	NA	Dry Hole
1977, February	Bluff region FAA site	6", 50'	Clay, rock	No water	NA	Dry Hole
1977, February	Unalakleet River	6", 49'	Clays, sand, gravel	None	NA	Dry Hole
1977, February	Powers Creek	6", 34'	Silt, sand & gravel	Fresh, Clear	Good, 40 + GPM	Appears to be excellent source
1977, March	Powers Creek	6", 35'	Silt, sand, gravel	Good water	Low	Not adequate as source- 3-4 GPM

Source	Water Supply	Potential Water Quality w/Filtration	Access to Gallery Site for Maintenance During Summer	Access to Gallery Site for Maintenance During Winter	Potential Damage to Transmission Line During Onshore Floods with Block Ice	Reliability of Source	Power Availability & Relability	Potential of Damage to Intake During Onshore Flood	Potential Flood Damage During Spring Breakup intake or Pipeline	Potential Contamination Sources of Watershed
Existing Trail Creek	Not adequate in winter months. Less than 20 gpm in winter	Poor (iron and color in winter) #5	Poor: slough crossing required	Good: snow machine	High damage Potential	Poor	Good (uses FAA stand by)	Washing out of existing line is possible	Yes, Building has flooded	Yes, Musk Ox Farm
Power Creek	80 gpm can be increased with more site development	Good	Good (road access)	Good (road)	Low damage potential	Good	Good, would use stand by generator with power line from pumphouse	None	None	Minimal
Unalakleet River	Yes Unlimited Supply	Potential salt water intrusion during high-tide	Poor will require a boat or slough crossing	Good	high damage potential	Marginal (salty at times	Good, FAA stand by	Washing out of existing line is possible	bank erosion may interfere with the collection system	Minimal
North River	Yes Unlimited Supply	Good	Poor will require 4 wheel drive vehicle 8 miles	Poor: snow machine steep hills	High damage potential	Good	Would require overhead power line	Washing out of existing line is possible	Bank erosion may interfere with the collection system	Minimal
Dam on Trail Creek	Yes 40 + gpm	Poor	Poor	Good: snow machine	High damage potential	Poor: high iron and color	Good FAA stand by	Washing out of existing line is possible	None	Yes, Musk Ox Farm