

*Technical Report 103*

JANUARY, 1964

# Ground Temperature Observations McGrath, Alaska

U.S. ARMY MATERIEL COMMAND  
COLD REGIONS RESEARCH & ENGINEERING LABORATORY  
HANOVER, NEW HAMPSHIRE



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by G. W. Aitken

U.S. ARMY MATERIEL COMMAND  
COLD REGIONS RESEARCH & ENGINEERING LABORATORY  
HANOVER, NEW HAMPSHIRE

## PREFACE

Collection of the data presented herein was authorized in July 1946 by the Chief of Engineers in "Instructions and Outline on Meteorological Data Study". The program was initiated by the Permafrost Division, St. Paul District, and continued by the Arctic Construction and Frost Effects Laboratory (ACFEL), U. S. Army Engineer Division, New England. It was carried out for the Civil Engineering Branch, Engineering Division, Military Construction, Office, Chief of Engineers. In February 1961 ACFEL was merged with the U. S. Army Snow Ice and Permafrost Research Establishment to form the U. S. Army Cold Regions Research and Engineering Laboratory (USA CRREL).

The program included the collection of data at 20 stations in Alaska and one in Canada. The present report summarizes the data obtained at one of these stations. The data obtained at the other stations in this program will be presented in separate reports.

The investigation was a cooperative venture of the Corps of Engineers, the United States Weather Bureau, and the Federal Aviation Agency (formerly Civil Aeronautics Administration). Substantial support and assistance in the investigation were provided by personnel of the Alaska Field Station, CRREL (formerly Arctic Construction Investigation Area) at Fairbanks, Alaska, under the direction of Mr. F. F. Kitze, Chief. Personnel from the AFS installed and maintained the ground-temperature-measuring equipment and rendered technical assistance to the operating personnel of the U. S. Weather Bureau and Federal Aviation Agency.

This report was prepared by the Construction Engineering Branch (Mr. E. F. Lobacz, Chief) as a project of the Experimental Engineering Division (Mr. K. A. Linell, Chief).

Construction Engineering Branch personnel actively engaged in this project have been Messrs. George W. Aitken, C. W. Fulwider, and Pfc. R. Huck. Mr. J. F. Haley, formerly Assistant Chief, ACFEL, Mr. Harry Carlson, formerly Chief, Permafrost Division, and many others of these organizations contributed substantially in this investigation. Mr. Aitken and Mr. Fulwider analyzed the project data and prepared the basic format for the report series.

Commanding Officer of USA CRREL during the preparation and publication of this report was Colonel William L. Nungesser. Technical Director was Mr. W. K. Boyd.

This report has been reviewed and approved for publication by the Office of the Chief of Engineers, U. S. Army.

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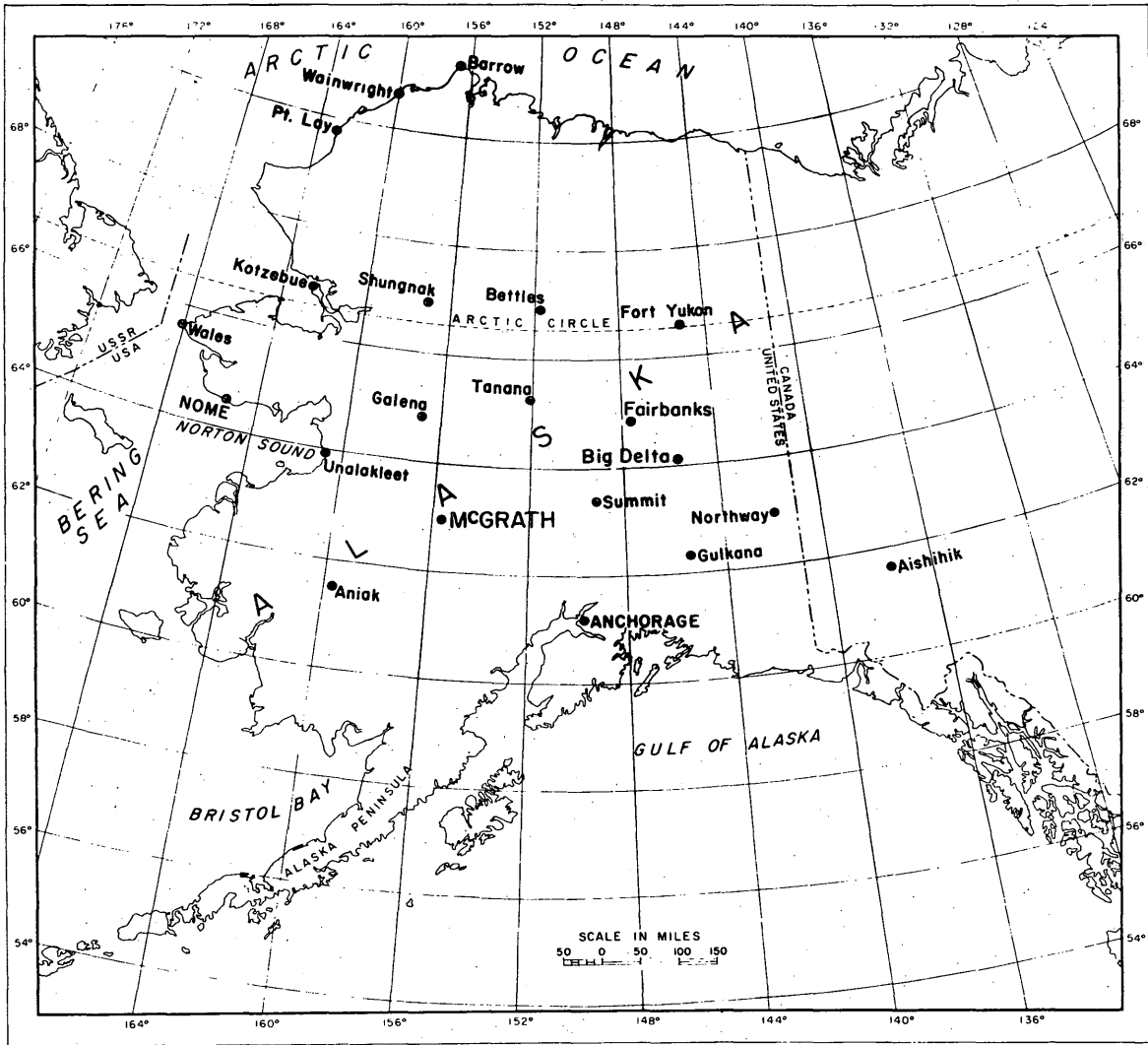
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### SUMMARY

This report summarizes climatological, ground-temperature, and soil data obtained at McGrath, Alaska. The climatological data were obtained from U. S. Weather Bureau records for the years 1944 to 1958; the ground-temperature data were obtained from daily observations during the years 1947 to 1958; and the soil data were obtained from samples taken while drilling two holes: one in August 1946 and the other in July 1958.



Ground-temperature observation sites.

# GROUND TEMPERATURE OBSERVATIONS, MCGRATH, ALASKA

## INTRODUCTION

### Purpose

The McGrath, Alaska data summarized in this report were obtained in connection with an investigation to evaluate the relationship between climatic conditions, soil conditions, and soil temperatures in arctic and subarctic areas. These data could be used by agencies requiring general knowledge of this area for such purposes as site selection or as a guide in more detailed investigational efforts.

### Scope

The investigational program involved the collection of climatological, ground temperature, and soil data from 20 stations in Alaska and one in Canada.

The climatological data for McGrath, Alaska, were obtained from U. S. Weather Bureau records for the years 1944 to 1958. Ground-temperature observations were obtained on a daily basis from 1947 to 1958 by the U. S. Weather Bureau for the Arctic Construction and Frost Effects Laboratory, U. S. Army Engineer Division, New England. Soil data were obtained from samples taken during the drilling of two holes: one in August, 1946 and the other in July, 1958.

## DESCRIPTION OF SITE

### Location

McGrath is a small village in southwestern Alaska on the south bank of the Kuskokwim River at  $62^{\circ} 58'$  north latitude and  $155^{\circ} 37'$  west longitude (Fig. 1). A Federal Aviation Agency airfield adjacent to the town, consisting of two asphalt-surfaced runways, provides the only year-round access to the area. The nearest large communities are Anchorage, 220 air miles southeast, and Fairbanks, 280 air miles northeast.

### Terrain

McGrath is located on the flood plain of the Kuskokwim River in the central plateaus province of interior Alaska. The Kuskokwim River and adjacent alluvial valleys are the dominant features of this area with maturely dissected groups of bedrock hills and mountains representing the plateaus.

### Climate

Climatological data for McGrath, Alaska, are given in Table I and in Figures 2 and 3.

Table I gives air temperatures, amounts of precipitation, snowfall and snow cover, and the freezing and thawing indexes.

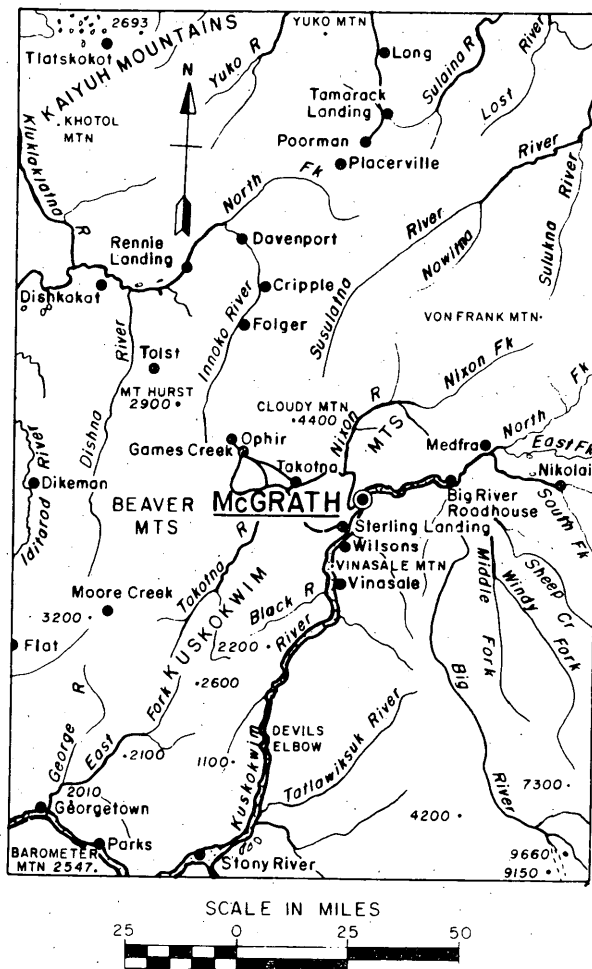


Figure 1. Vicinity map.

GROUND TEMPERATURE OBSERVATIONS

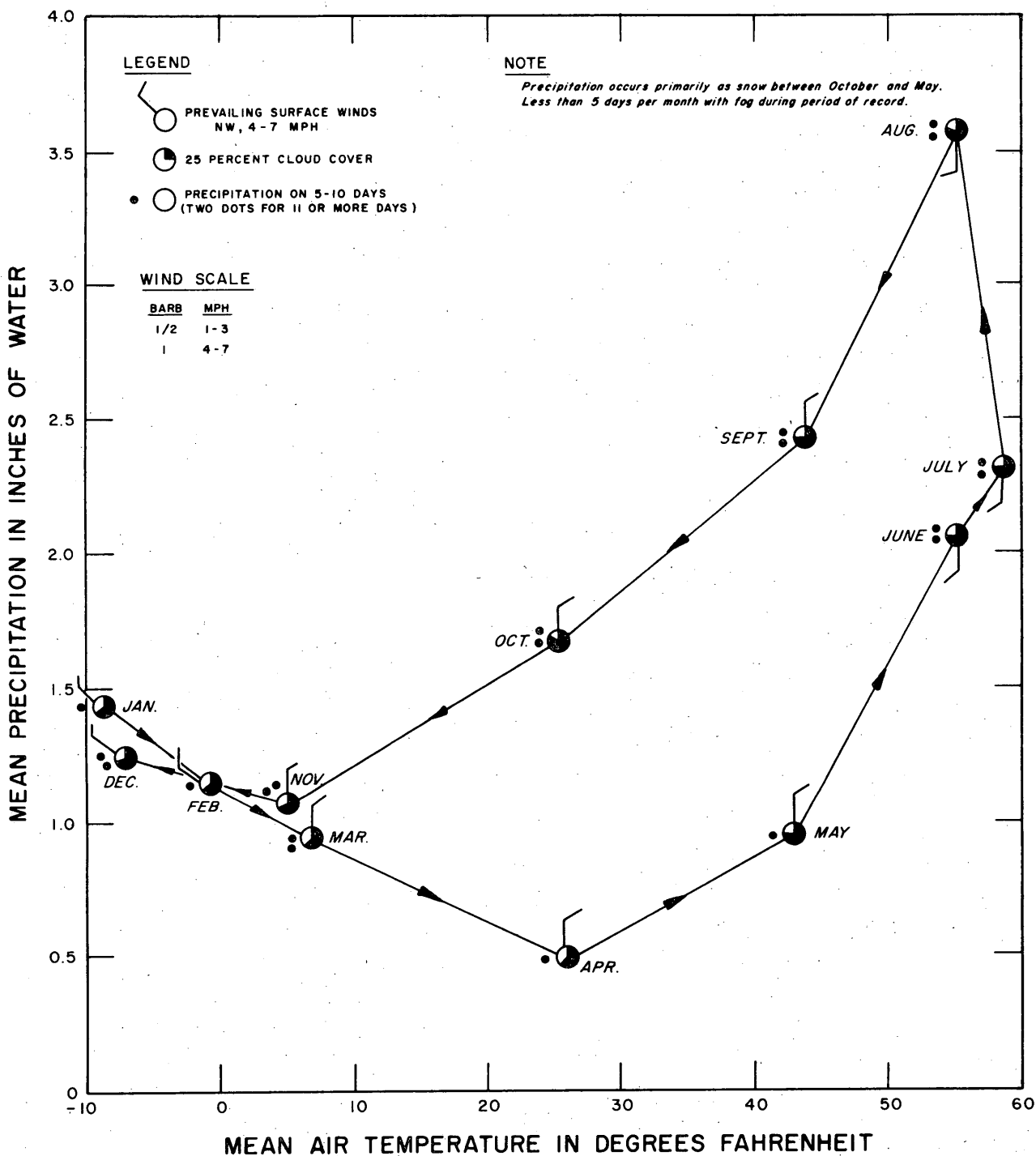


Figure 2. Climograph.



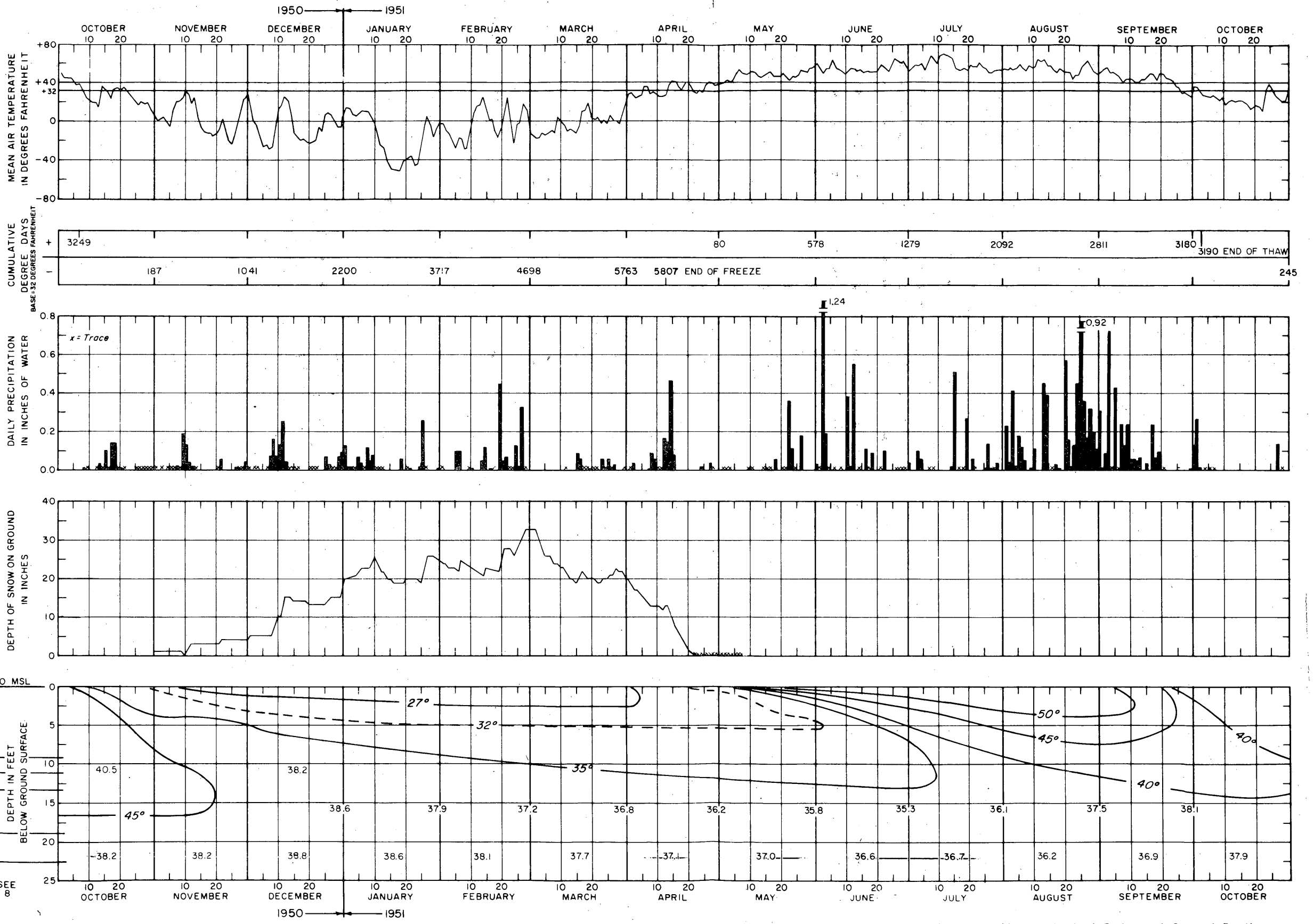


Figure 3. Meteorological Data and Ground Isotherms.

GROUND TEMPERATURE OBSERVATIONS

Table I. Climatological data  
for  
McGrath, Alaska.

Air temperature - °F	
Mean annual .....	25.5
Recorded high (6/6/57) .....	88
Recorded low (1/25/47) .....	-64
Precipitation - inches	
Mean annual .....	19.1
Max. annual (1945) .....	23.5
Max. monthly (Aug 1945).....	6.3
Snowfall - inches	
Mean annual .....	87.4
Max. annual (1946) .....	124.5
Max. monthly (Feb 1944).....	38.0
Freezing index (degree-days, F, below 32 )	
Average (1947 - 1958).....	5395
Minimum (Oct 57 - Apr 58) .....	4443
Maximum (Oct 48 - May 49) .....	6105
Thawing index (degree-days, F, above 32 )	
Average (1947 - 1958).....	3059
Minimum (May 48 - Oct 48) .....	2651
Maximum (Apr 57 - Oct 57) .....	3790
Average date start freeze season .....	8 Oct
Average date start thaw season .....	26 Apr
Average length of freeze season (days) .....	209
Average length of thaw season (days) .....	156

Snow cover - inches  
first day of month for 1948-1958

	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June
Maximum recorded	-	0	8	14	40	37	38	31	25	0
Minimum recorded	-	0	T	5	12	15	17	13	3	0
10-year average	-	0	3	10	20	24	26	24	12	0

T = Trace

The air temperatures were obtained in accordance with standard Weather Bureau procedures. The snow cover measurements were made in the vicinity of the Weather Bureau building and are believed to be representative of the ground-temperature assembly location.

Figure 2, a climograph (also called a hythergraph) gives: mean monthly values of precipitation versus temperature; direction and force of prevailing winds; amount of cloud cover; number of days of precipitation (rain and/or snow); and fog data for the area.

Figure 3 presents meteorological data and ground isotherms for a typical year (October 1950 to October 1951). The meteorological data include average daily air temperatures, degree-days of thaw and freeze (cumulative on the last day of each month), daily precipitation (rain and/or snow), and depth of snow on the ground.

## GROUND TEMPERATURE OBSERVATIONS

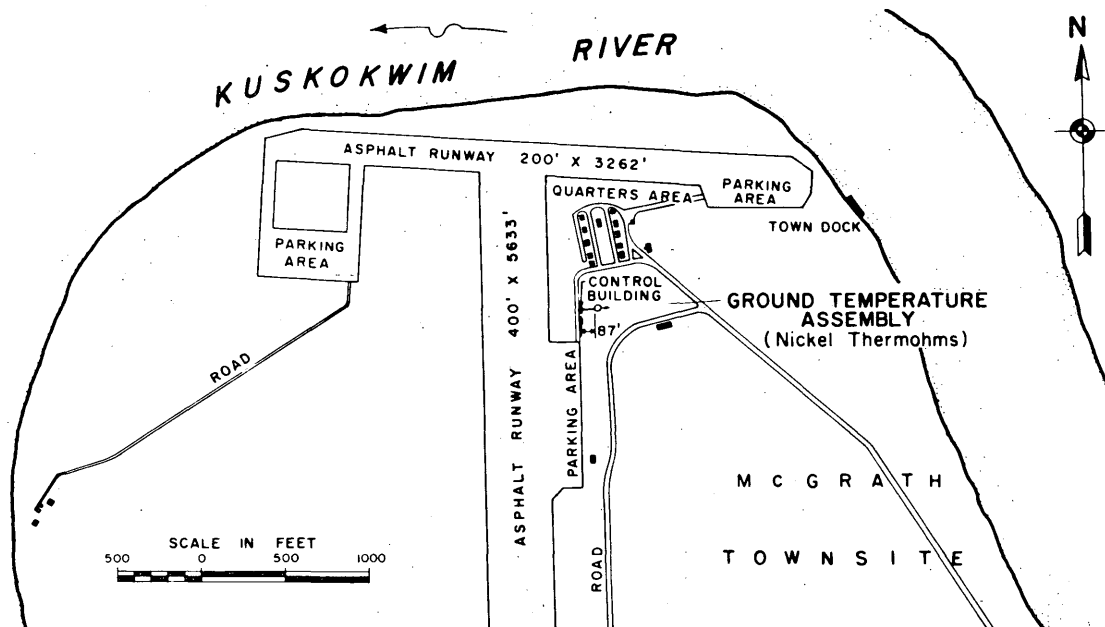


Figure 4. Site location.

## GROUND TEMPERATURE ASSEMBLY

Location

The ground-temperature assembly was installed 87 feet east of the U. S. Weather Bureau control building  $\frac{1}{4}$  mile from the Kuskokwim River (Fig. 4).

The location of the ground-temperature assembly in such close proximity to the Kuskokwim River should be considered when interpreting the ground-temperature data. It is possible that ground temperatures will vary considerably as the distance from the river changes.

Drainage and vegetation

The ground near the temperature assembly is essentially flat and there is no surface water drainage past the assembly. The ground water table is close to the surface and drainage is generally poor because of the lack of relief in the area.

At the time of installation of the temperature assembly, all vegetation and surface organic material had been removed; between 1947 and 1949 the area was seeded with grass and clover, and was covered with a moderate growth of grass, clover and fireweed throughout the remainder of the observational period (Fig. 5).

Temperature-well drilling

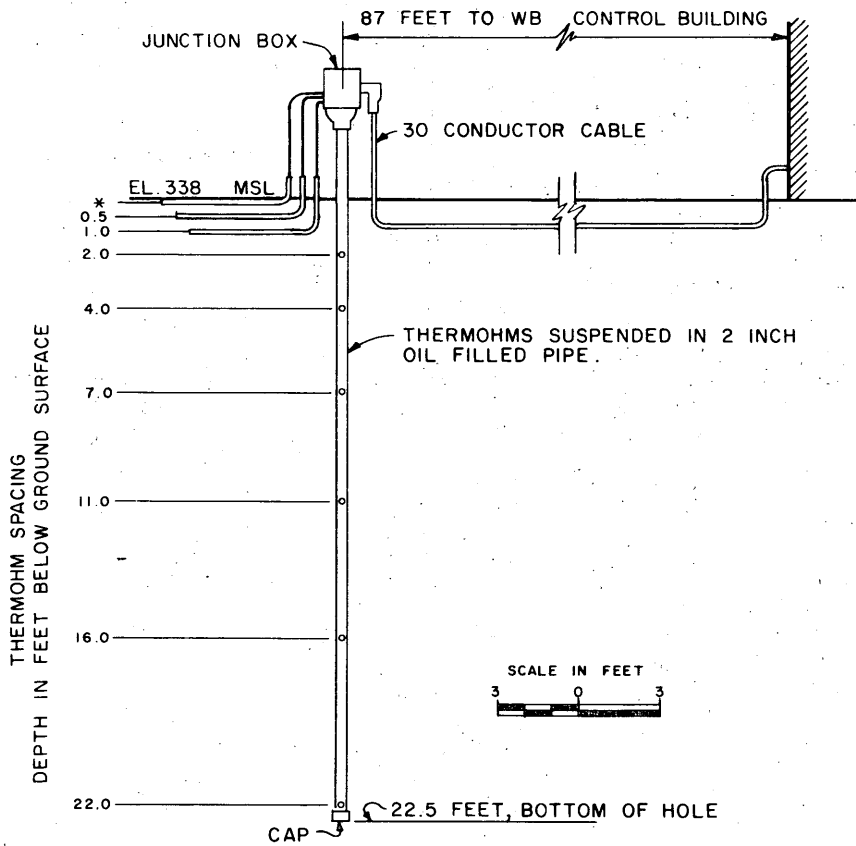
The 22.5-ft-deep temperature well was drilled on 25 August 1946. The drilling was accomplished in one day without difficulty by a combination of driving and water jetting.

Instrumentation

The ground-temperature-measuring equipment installed at McGrath consisted of nine nickel resistance thermometers (thermohms); the three top thermohms were encased in  $\frac{3}{4}$ -in. -diam tubing about 3 feet from the temperature well; the other six thermohms were suspended in a 2-in. -diam oil-filled pipe.



Figure 5. General view of ground temperature assembly looking west, showing Weather Bureau building in background.



\* Thermohm located  $\frac{1}{8}$  to  $\frac{1}{4}$  inch below ground surface

Figure 6. Resistance thermometer installation.

## GROUND TEMPERATURE OBSERVATIONS

The thermohms extended from 0.0 to a depth of 22.0 ft below the ground surface, and were spaced as shown in Figure 6. It should be noted that the 0.0-ft thermohm was actually  $\frac{1}{8}$ -in. to  $\frac{1}{4}$ -in. below the ground surface.

Temperature observations were made with a Leeds and Northrup Model 8010-S temperature indicator; it was a Wheatstone Bridge type instrument with a scale range of -50 to +120F.

Resistance thermometers were used instead of thermocouples because similar equipment had been used previously by the U. S. Weather Bureau and station personnel were familiar with the observational procedure involved.

## SOIL INVESTIGATIONS

Exploration

In conjunction with drilling operations for the temperature well, representative soil samples were obtained with a 4-in. hand auger after each drill run. On 16 July 1958, a 21.8-ft deep exploratory hole was drilled adjacent to the temperature well. The exploratory drilling was performed by drive-sampling using a 200-lb drop weight driving 3-in. -diam hardened steel drive tubes.

Soil data

Laboratory tests were performed to identify and classify the soil samples obtained, with moisture and density tests made on suitable representative samples obtained from the exploratory hole. The boring log and soil data for the temperature well are shown in Figure 7, and boring log and soil data for the exploratory hole are shown in Figure 8.

## GROUND TEMPERATURES

Observed ground temperatures

Ground-temperatures were recorded daily at McGrath for 11 years (1947-1958). The maximum, minimum, and average of the temperatures recorded the first day of each month are shown in Table II. The ground temperatures recorded the first day of each month for the 1947-1958 period of observation are shown in Table III.

Ground-temperature gradients and maximum-minimum curves

Ground-temperature gradients for a typical thaw and freeze season (1951-1952) at McGrath are shown in Figure 9. Gradients were plotted for the end-of-thaw, mid-thaw, mid-freeze and end-of-freeze. The maximum and minimum ground temperatures observed during the period of record at each depth are also presented.

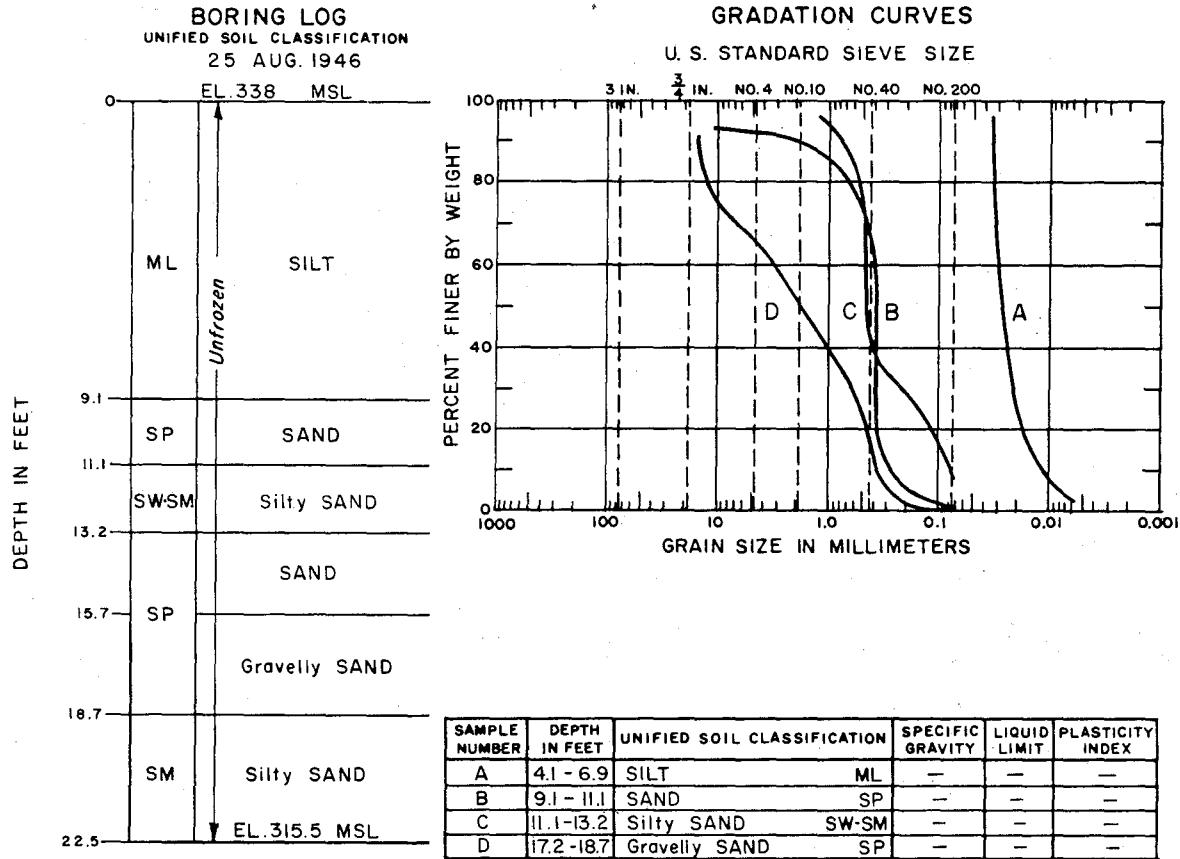
The end-of-thaw gradient indicates the maximum temperatures observed at each depth below 4 ft during the 1951 thawing season; the end-of-freeze gradient shows the minimum subsurface temperatures recorded (at depths greater than 4 feet) for the 1951-52 freezing season. It should be noted that the maximum and minimum temperatures shown for the various depths do not represent the 1951-52 season as do the gradients; rather, they are the maximum and minimum temperatures recorded at each depth during the years 1947 to 1958.

Seasonal frost

The depth of seasonal frost penetration at McGrath varied from year to year; the average seasonal depth of penetration shown by the ground-temperature data during the period of record (1947-1958) was about 6 feet below the ground surface.

The ground-temperature data obtained at McGrath show that there is no permafrost at the temperature well location to a depth of 22.5 feet. These data were corroborated by the borings made in August 1946 and July 1958.

It is probable that permafrost does exist at relatively shallow depths at other locations on the Kuskokwim flood plain, particularly at sites located slightly further from the river than the temperature assembly.



**NOTES**

Boring by driving and water jetting.  
 Samples taken with 4 inch hand auger after each drill run.  
 Moisture content and undisturbed dry density not obtained.

Figure 7. Boring log and soil data, ground-temperature well.

GROUND TEMPERATURE OBSERVATIONS

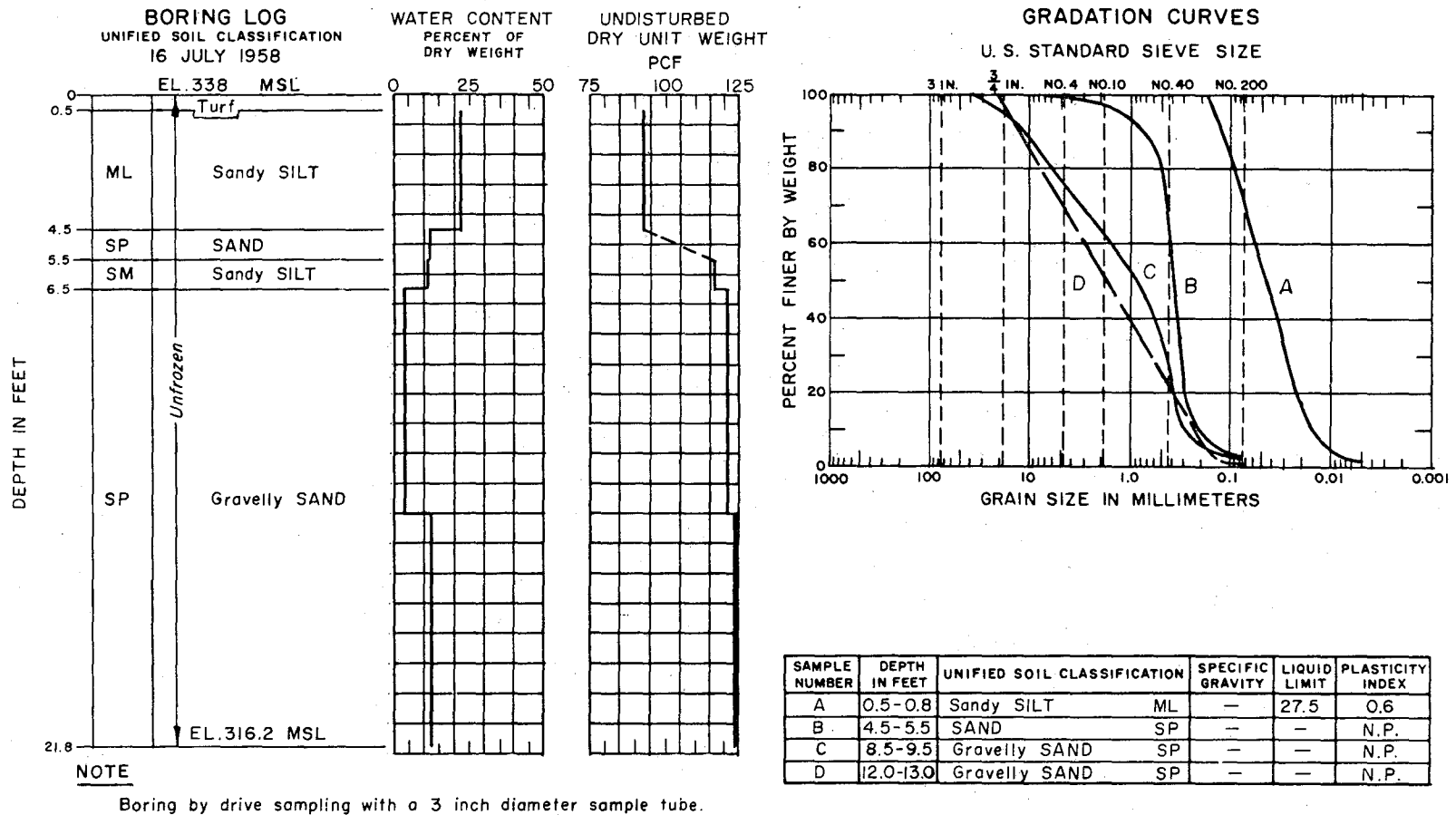


Figure 8. Boring log and soil data, exploratory drilling.

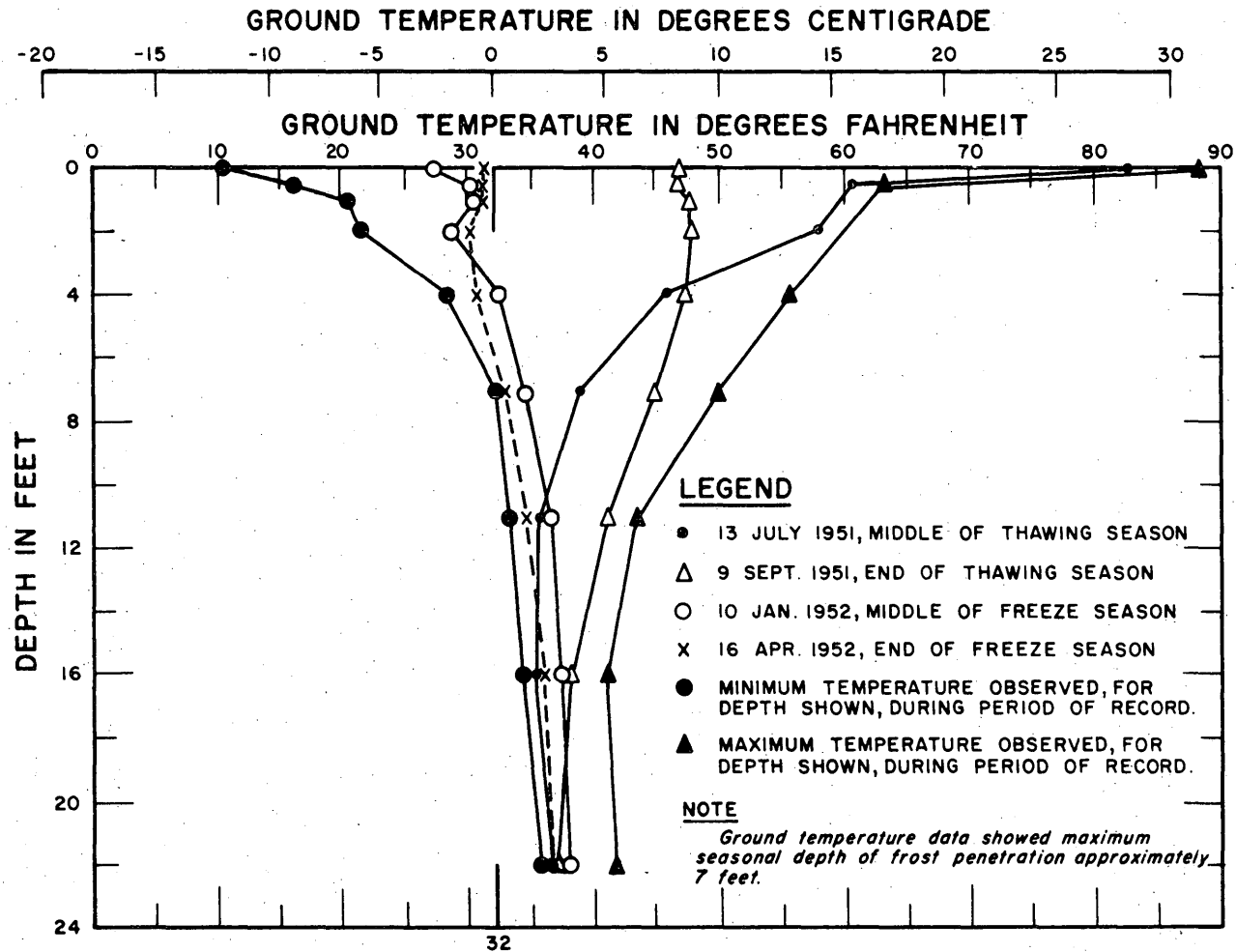


Figure 9. Ground-temperature gradients and maximum-minimum curves.





DEPTH IN FEET	1947											
	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
0.0	29.0	26.4	30.2	31.0	31.2	42.4		52.0	52.3	32.8		
0.5	30.2	29.0	30.6	31.3	31.6	44.5		54.0	52.4	36.7	32.2	31.7
1.0	30.4	30.0	30.3	31.0	31.2	45.4		55.1	52.8	38.3	32.4	31.7
2.0	30.7	29.9	30.2	30.0	30.8	46.1		55.8	53.0	40.6	33.0	31.8
4.0	32.7	32.1	31.8	31.7	31.6	38.2		53.9	51.8	43.5	36.3	34.2
7.0	34.9	34.0	33.4	33.2	33.0	34.0		46.1	46.7	43.6	39.4	36.6
11.0	36.4	35.3	34.7	34.2	34.0	33.9		38.6	40.9	40.8	39.8	38.2
16.0	37.2	36.5	36.0	35.5	35.1	35.0		36.1	38.2	38.6	39.2	38.7
22.0	36.7	36.4	36.1	35.6	35.6	35.2		35.1	36.2	37.5	37.7	37.7

DEPTH IN FEET	1948											
	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
0.0												
0.5	30.9	30.6	30.4	31.2	31.3	50.1	59.1	53.0	43.8	38.8	32.7	31.2
1.0	31.2	30.6	30.4	30.7	31.1	49.0	58.8	53.8	45.9	39.7	32.8	31.5
2.0	31.3	30.9	30.4	30.7	30.9	47.0	56.9	54.2	48.6	40.0	33.3	30.8
4.0	33.4	32.6	32.3	32.0	31.9	39.4	50.1	52.2	48.2	42.1	36.4	34.0
7.0	35.4	34.5	34.1	33.6	33.4	35.1	42.1	46.0	45.1	43.3	39.4	36.8
11.0	36.6	35.9	35.2	34.7	34.4	35.0	36.9	39.1	40.7	41.3	40.2	38.2
16.0	37.8	37.0	36.7	36.2	35.8	35.8	36.0	37.0	38.1	40.0	39.9	39.1
22.0	37.4	37.1	36.7	36.3	36.1	36.0	36.0	36.1	36.3	37.6	38.3	38.3

DEPTH IN FEET	1949											
	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
0.0												
0.5	31.2	31.0	30.9	31.0	31.4	51.9	46.6	55.0	52.9	42.0	32.1	32.0
1.0	31.2	31.0	31.1	30.9	31.1	50.1	46.7	54.8	53.0	42.4	32.4	32.0
2.0	30.4	30.7	30.6	30.0	31.1	44.0	46.9	54.4	52.3	42.8	33.1	31.2
4.0	33.1	32.5	32.2	31.9	32.1	34.8	43.4	50.9	50.1	46.0	37.0	34.0
7.0	35.4	34.5	34.1	33.8	33.8	34.2	40.1	44.1	45.7	45.0	40.0	37.0
11.0	36.9	36.1	34.7	34.8	34.8	34.3	35.0	38.0	41.3	41.9	40.6	38.3
16.0	38.5	37.8	37.0	36.4	36.7	36.7	35.8	37.0	38.8	40.0	40.0	39.3
22.0												

DEPTH IN FEET	1950											
	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
0.0												
0.5	30.0	30.5	29.3	30.2	31.6	45.6	57.2	57.4	50.0	45.1	31.5	24.1
1.0	30.8	30.2	29.5	30.0	31.0	44.4	56.4	56.4	52.0	45.0	32.5	28.2
2.0	29.6	29.8	29.0	29.2	30.8	42.2	56.0	56.2	50.2	45.4	31.6	29.0
4.0	32.9	32.0	31.4	31.4	31.2	33.8	47.3	53.2	50.2	46.2	37.6	33.0
7.0	35.3	34.4	33.8	33.4	33.0	32.7	38.7	46.5	47.5	43.0	40.2	37.0
11.0	37.1	36.2	35.4	35.0	34.0	34.3	36.0	38.9	41.2	41.4	39.8	39.0
16.0	38.6	37.4	37.3	36.9	36.3	36.0	35.0	37.1	38.2	40.1	40.1	39.8
22.0	38.1	37.4	37.3	37.0	37.0	36.5	36.1	36.6	36.9	37.9	38.4	38.8

Table III. Ground temperatures, °F, recorded first day of month, 1947-1958.

DEPTH IN FEET	1951											
	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
0.0	26.0	26.1	20.6	26.2	54.6	61.7	59.3	63.4	53.8	32.9	30.6	28.2
0.5	27.5	27.5	25.3	27.1	32.3	48.2	51.0	53.1	53.4	36.1	31.0	31.0
1.0	27.9	28.0	26.6	27.3	31.1	44.7	51.8	54.0	53.9	38.0	32.1	31.2
2.0	27.8	28.0	26.4	27.3	31.1	43.7	51.3	53.2	52.8	38.0	32.2	29.9
4.0	31.3	31.3	31.4	30.4	30.8	31.4	41.0	50.0	50.9	43.7	34.3	33.4
7.0	34.2	34.0	33.6	33.1	32.8	32.8	35.0	43.2	46.1	44.1	39.2	36.1
11.0	36.7	36.1	35.5	34.8	34.1	34.4	34.1	37.6	39.8	41.3	40.0	38.2
16.0	38.6	37.9	37.2	36.8	36.2	35.8	35.3	36.1	37.5	38.1	39.6	39.0
22.0	38.2	38.1	37.7	37.1	37.0	36.5	36.0	36.4	36.9	37.0	38.2	38.1

DEPTH IN FEET	1952											
	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
0.0	30.0	28.5	31.1	29.4	31.2	75.7	62.1	58.1	50.7	33.1	25.2	27.9
0.5	30.9	30.0	31.0	30.3	31.2	38.1	56.3	54.0	51.4	39.3	33.0	32.0
1.0	31.1	30.2	30.8	30.3	31.0	34.3	54.8	54.1	51.4	41.1	33.8	32.2
2.0	30.7	29.4	30.5	29.7	30.5	34.3	55.0	53.6	50.6	40.0	32.8	30.0
4.0	32.8	32.0	31.9	30.8	31.3	31.1	47.1	51.7	50.0	44.4	37.4	34.2
7.0	35.1	34.2	33.9	33.3	33.0	33.0	38.3	43.6	46.0	43.8	40.2	36.1
11.0	36.9	35.9	35.2	34.9	34.5	34.8	35.1	38.3	40.7	41.0	40.9	38.9
16.0	38.1	37.2	36.9	36.5	36.1	35.8	35.5	34.9	37.5	39.2	40.0	38.7
22.0	38.1	37.8	37.2	37.0	36.8	36.7	36.2	36.3	36.7	37.2	38.5	38.4

DEPTH IN FEET	1953											
	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
0.0	25.3	23.2	28.1	28.3	46.0	54.1	73.9	65.2	54.0	33.0	17.0	27.0
0.5	29.8	27.0	29.2	29.7	34.1	46.2	55.8	61.2	52.3	39.2	32.1	29.2
1.0	30.9	28.3	29.6	29.9	32.2	43.5	54.7	61.0	52.6	41.1	33.3	30.0
2.0	29.6	26.5	29.7	29.9	33.0	46.1	55.1	57.1	51.3	38.9	29.6	28.7
4.0	32.8	32.0	31.0	31.6	32.2	37.8	49.2	47.7	49.0	43.8	36.6	32.8
7.0	35.4	34.4	33.5	33.6	34.2	34.1	41.4	46.8	46.0	45.2	40.3	36.3
11.0	37.3	36.3	35.3	35.1	35.4	35.2	36.7	39.7	40.2	42.5	41.2	38.8
16.0	38.6	37.7	37.9	36.8	36.3	35.4	35.3	35.4	37.0	39.7	40.0	39.6
22.0	38.3	38.0	38.3	37.6	37.9	37.5	36.2	36.9	36.3	37.3	39.0	39.2

DEPTH IN FEET	1954											
	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
0.0	20.8	22.0	21.0	31.4	42.1	72.9	72.3	59.4	51.9	39.3	29.4	28.1
0.5	28.2	26.3	25.2	31.4	31.6	44.7	53.0	54.7	50.4	43.2	32.3	28.0
1.0	29.0	27.3	26.3	30.9	30.9	41.2	51.4	53.1	51.0	43.3	32.6	28.9
2.0	27.4	26.0	25.0	29.9	30.3	43.7	53.5	52.5	49.7	41.9	32.1	28.8
4.0	31.7	31.0	30.6	29.9	27.3	32.0	46.8	50.0	49.9	41.5	34.1	28.2
7.0	34.2	34.2	34.0	32.0	32.4	31.8	39.2	45.1	48.0	42.8	37.9	33.3
11.0	36.9	36.2	36.4	35.1	34.2	34.6	35.2	38.6	41.3	41.9	39.3	35.1
16.0	36.8	38.0	37.7	36.8	35.2	35.3	35.0	34.7	36.8	35.9	40.0	36.0
22.0	38.7	38.7	38.8	37.2	36.7	37.0	35.7	36.0	36.7	36.2	39.8	37.2

Table III. (Cont'd) Ground temperatures, °F, recorded first day of month, 1947-1958.

DEPTH IN FEET	1955											
	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
0.0	28.0	27.3	28.3	31.0	32.0	56.1	63.1	64.8	51.7	42.1	30.9	30.3
0.5	30.1	28.3	31.0	31.6	31.5	38.7	50.5	58.5	48.8	42.0	33.6	32.1
1.0	31.7	29.1	33.1	31.0	31.0	35.6	50.1	57.1	49.1	42.8	33.9	32.7
2.0	27.9	27.6	34.7	30.1	30.9	37.9	50.2	57.6	48.0	40.9	29.1	29.5
4.0	29.1	30.1	33.7	28.2	31.0	30.6	44.4	51.4	49.7	42.5	35.7	33.9
7.0	30.9	33.2	37.8	34.0	33.3	32.9	39.2	46.0	48.0	42.9	39.8	36.9
11.0	33.9	37.2	36.4	35.6	34.8	34.8	36.0	39.2	41.7	41.8	41.0	38.8
16.0	35.2	37.8	36.4	37.1	36.8	36.1	35.8	37.4	39.2	38.8	40.2	39.8
22.0	36.9	37.8	37.2	38.2	37.7	35.0	35.7	35.3	37.9	38.1	38.3	39.4

DEPTH IN FEET	1956											
	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
0.0	29.0	29.0	30.8	30.1	30.0	77.4	71.6	67.7	58.4	34.2	27.0	30.0
0.5	31.0	30.0	31.5	31.6	30.2	44.3	57.0	57.3	54.3	37.6	33.2	31.1
1.0	31.5	31.0	31.5	30.6	30.9	42.9	56.0	57.7	54.8	38.9	33.6	30.8
2.0	28.2	29.0	29.2	29.7	31.6	45.3	56.1	56.0	52.7	37.0	28.9	24.7
4.0	32.6	32.0	31.8	30.9	32.0	37.9	49.9	55.2	48.4	42.7	34.1	30.4
7.0	35.2	34.2	34.3	33.3	33.9	35.2	42.1	48.1	49.0	44.4	39.8	35.9
11.0	37.1	36.1	36.1	35.7	34.8	35.4	36.1	41.0	42.8	43.0	41.0	38.4
16.0	38.6	37.6	37.9	36.9	35.0	34.3	35.1	37.1	38.0	40.1	40.1	39.3
22.0	38.2	38.0	38.2	36.1	37.8	37.7	36.2	37.2	38.4	37.3	39.0	39.0

DEPTH IN FEET	1957											
	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
0.0	21.1	31.7	25.7	28.0	45.4						30.0	29.4
0.5	23.2	32.1	27.0	28.5	32.2	44.0	55.1	57.2	54.3	36.2	33.0	32.2
1.0	24.3	30.0	27.7	28.6	31.5	41.0	53.1	56.3	54.3	37.8	33.1	32.2
2.0	22.8	28.6	26.0	28.5	32.0	43.6	57.0	57.7	52.9	36.5	30.0	29.1
4.0	29.9	30.5	30.0	34.8	20.1	31.5	44.2	51.1	52.0	38.4	35.1	32.9
7.0	34.0	33.6	32.9	33.0	32.7	33.0	36.2	44.6	47.5	45.8	38.2	36.9
11.0	36.4	35.7	34.9	34.4	34.4	34.6	34.6	38.6	41.3	42.9	40.2	38.4
16.0	38.3	37.2	36.8	34.0	36.2	34.7	34.0	36.4	37.8	38.9	38.3	38.4
22.0	39.6	37.9	36.8	37.0	36.8	36.8	36.3	36.2	35.3	37.3	37.4	38.1

DEPTH IN FEET	1958											
	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
0.0	23.9	27.9	26.8	29.0	41.3							
0.5	27.9	29.7	28.8	30.1	32.0	49.9	54.6					
1.0	29.5	30.1	29.3	30.1	31.3	45.2	54.4					
2.0	23.5	27.7	25.8	27.5	33.3	53.1	53.1					
4.0	28.3	29.7	29.5	30.7	30.0	32.4	48.7					
7.0	34.5	34.1	33.4	33.3	33.3	32.9	40.1					
11.0	36.8	36.0	35.6	35.0	34.6	34.8	36.1					
16.0	36.6	36.8	37.0	36.1	35.8	32.9	34.1					
22.0	38.2	37.8	36.6	36.9	37.0	30.6	33.5					

Table III. (Cont'd) Ground temperatures, °F, recorded first day of month, 1947-1958.

GROUND TEMPERATURE OBSERVATIONS