PRELIMINARY REPORT OF PERMAFROST INVESTIGATIONS IN THE DUNBAR AREA, ALASKA

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INTRODUCTION

The purpose of this report is to present a preliminary description of the Permafrost conditions in the Dunbar region. The report is the result of reconnaissance work on August 6, 1948.

The Dunbar area includes a strip along the Alaska Railroad from Standard to Berg, a distance of 20 miles (fig. 1), an area that has been withdrawn by the government for possible unit agricultural settlement. The area lies in the interior of Alaska on the southern border of the Yukon-Tanana Plateau.

GENERAL GEOLOGIC SETTING

In the Dunbar area the Yukon-Tanana Plateau consists of gently rolling, well-rounded hills about 1,200 to 2,000 feet high. The lowlands are at an altitude of about 400 feet.

From Standard to Dunbar, a distance of about 7 miles, the railroad is in the relatively narrow valley of lower Goldstream River. At Dunbar the river empties out into the broad lake-covered alluvial plain termed the Minto Flats. From Dunbar to Berg, a distance of 13 miles, the Minto Flats adjoin the hills, and the railroad traverses a narrow strip at the base of the hills. The Flats are northwest of the track and the hills southeast.

The area from the Tanana River to Standard can be divided into three main terrain divisions: (1) the floodplain, (2) the depositional slope—the low-lying area between the floodplain and the hills and extending into the valleys—and (3) the hills.

FLOODPLAIN

As the floodplain of the Tanana River is outside the government withdrawal area, it will not be discussed.

DEPOSITIONAL SLOPE

The lower gentle slopes of the hills and locally the valley bottoms have been tentatively termed the depositional slope. The contact between the depositional slope and the hills is an arbitrary one. The sediment both of the lower hills and the depositional slope is silt, but the silt of the depositional slope has a higher organic content. Where the steeper slope of the hills gives way to the more gentle slope of the depositional area, the drainage becomes sluggish and the water-saturated ground is frozen. The contact between the hills and the depositional slope area is therefore tentatively placed at the contact between the frozen gentle slope and the unfrozen steeper slope. This contact is generally at a higher altitude on the north-facing slopes than on the south-facing slopes.

Sediment of the depositional slope is mostly muck. Muck is a dark, fetid, highly organic silt that generally contains abundant remains of animals of the glacial period. In the creek valleys muck overlies creek gravels which, in turn, rest on bedrock.

Permafrost

The sediment of the depositional slope is permanently frozen to a depth of at least 150 feet. This permafrost probably consists of a continuous body extending from hill to hill (fig. 2). The thickness of the frozen ground probably decreases toward the hills where it pinches out at the base of the hill. The creek gravels under the muck are frozen. It is not known if the ground is thawed under the river. Depth to permafrost is about 12 to 24 inches in the bottom land, but where permafrost thins toward the hills the depth to permafrost increases.

Perhaps the most important characteristic of the frozen ground in the depositional slope is the presence of many large clear-ice masses of irregular shapes and sizes. The presence of these ice masses is indicated by the following:

(1) Exposure of ice masses in railroad cuts through the lower end of tan-colored silt ridges.

(2) Exposure of ice masses in well at Standard. An ice mass at least 15 feet thick was encountered. 1/

(3) Thermokarst pits in the upper part of the depositional slope probably near the contact of the frozen and nonfrozen ground. Pits 20 feet long, 10 feet wide, and 8 feet deep were noticed.

1/ Oral communication, railroad section chief, August 6, 1948.

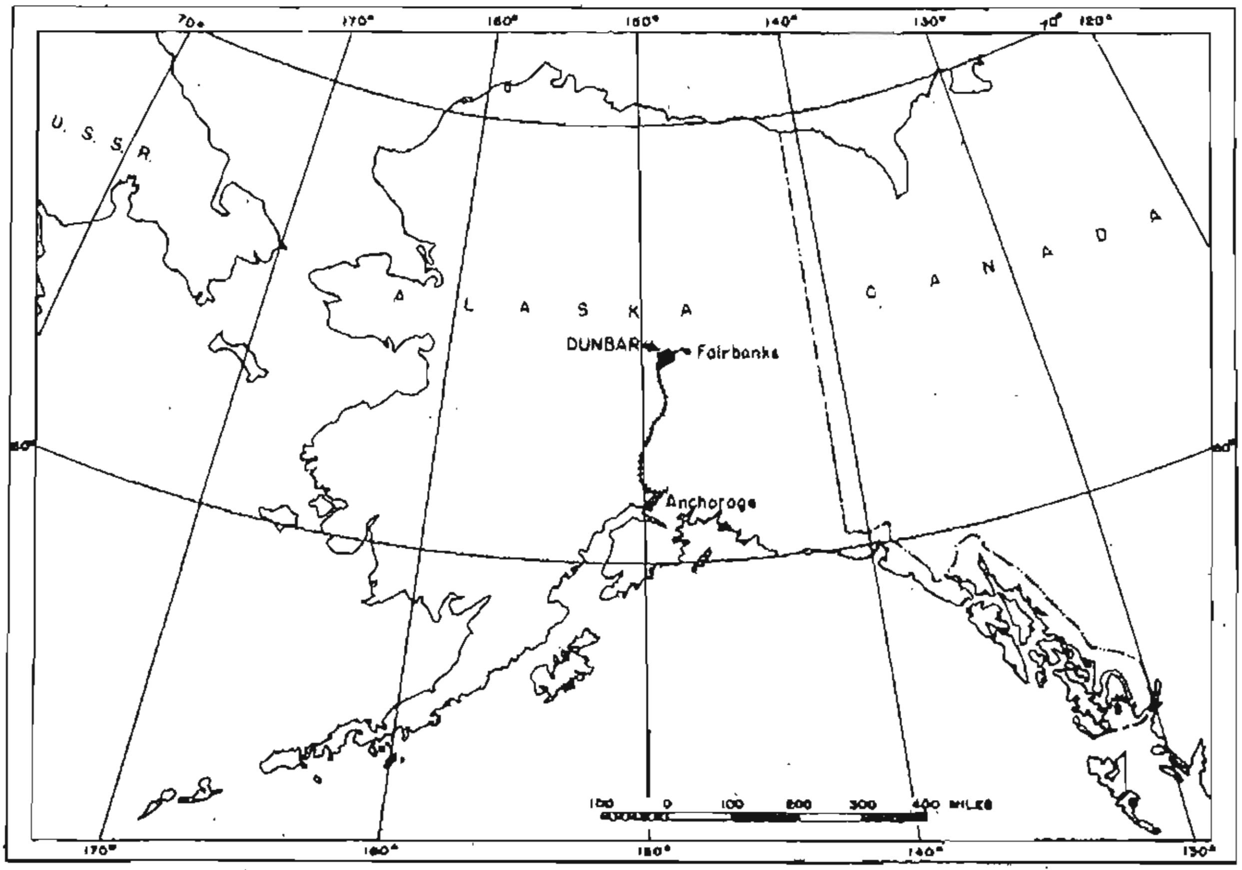

Figure 1. Index map of Alaska, showing location of Dunbar area.

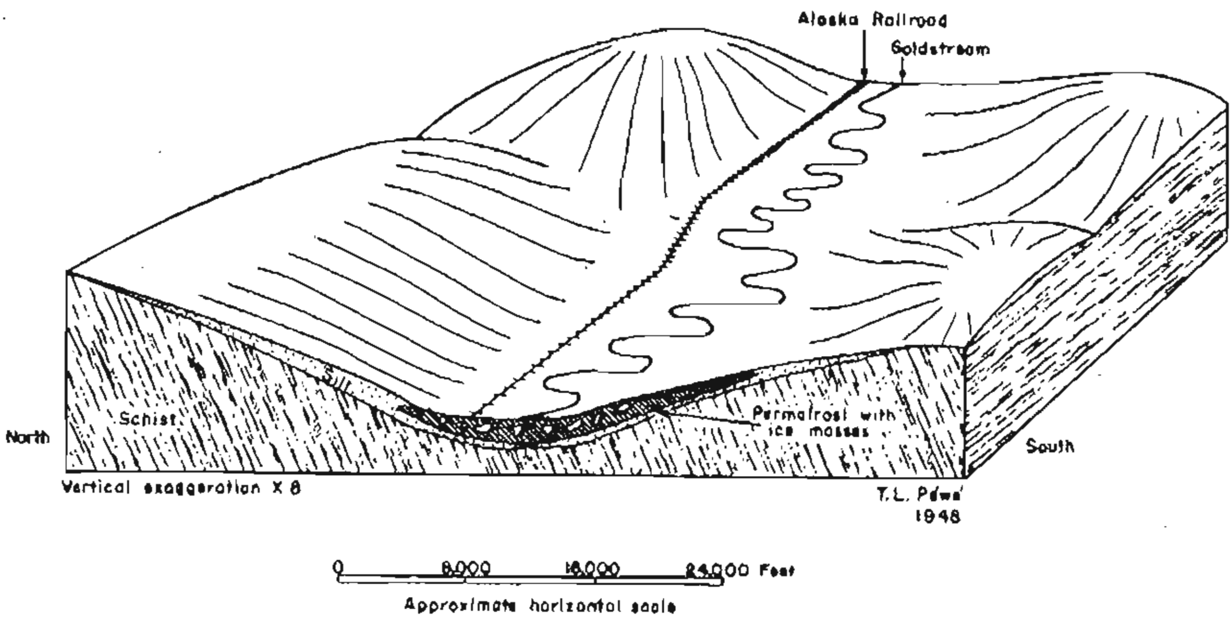

Figure 2. Sketch showing probable permafrost distribution in lower Goldstream River Valley near Dunbar, Alaska, based on prediction from known permafrost distribution in upper Goldstream Valley.

(4) Presence of cave-in-lakes. As ice thaws and pits are formed they sometimes hold water which thaws the bank causing the lake to enlarge by the caving in of the bank, with trees and other plants therefore slumping into the water.

(5) Presence of polygonal ground.

(6) Sinking of railroad tracks.

(7) Similarity to the depositional slope of the Fairbanks area about 41 miles away.

Economic application

Construction.—The depositional slope is less favorable for construction than the floodplain or hill area due to permafrost conditions. The permanently frozen, fine-grained muck is subject to much heaving and slumping. The melting of the ice masses is a major factor in the slumping of the ground.

Agriculture.—Polygonal mounds and pits may form in areas cleared for farms on the depositional slope. This is what has occurred on the depositional slope in the Fairbanks area. When the overlying vegetative cover is removed, the underlying ice masses begin to melt. If the ice masses are in a polygonal network, the area in the middle of the ice polygon net is left standing in relief as the surrounding ground sinks. In the Fairbanks area, mounds begin to form in the second or third year after the field is cleared.

In addition to mounds, many pits may form in the fields. These pits are the result of the melting of a mass of ice. They have been termed thermokarst pits and form readily when the land is cleared. A few such pits have already formed in uncleared areas in the Dunbar region under present climatic conditions. When such land is cleared, pitting will probably be intensified.

The formation of such mounds and pits is detrimental to farming. Sometimes fields must be abandoned and frequently cultivation must be stopped and the field used for pasture. The important factor to note is not that the homesteader can still use the field if he constantly combats the melting, but that it takes valuable time, money, and soil to fight these conditions resulting from permafrost. As farming in this region is near-marginal at best, such added difficulties may prove insuperable.

Ground water.—As permafrost is near the surface in the depositional slope, ground water in most places is not available to shallow wells. Beneath the confining permafrost, water is generally available but at depths sometimes exceeding 150 feet. The water in many instances would be unpalatable. This is true at Berg.

HILLS

The hills in the area are of Birch Creek schist mantled with 1 to 40 feet of tan-colored silt. Lower hills and lower slopes have the greatest thickness of silt. Like loess, silt has the property of standing in vertical cliffs. On the steep slopes the silt is cut into parallel vertical ridges, but on the lower slopes the silt is cut into rather small flat-topped remnants and small eliptical knobs. The remnants farthest away from the valley bottom are probably not frozen and those in the bottom have a depth to permafrost of over 4 feet. Some of the lower ends of the silt ridges contain ice masses as revealed in railroad cuts.

Because of the relatively steep slopes, drainage is generally good and no permafrost occurs. Some frozen ground is found on the north-facing side of the hills, but this has tentatively been placed in the depositional slope area.

Economic application

Construction.—Because of difficulties resulting from permafrost, the hills offer the best location for the construction of buildings.

Agriculture.—The combination of greater solar head and no slumping of the ground in the field makes the gentle, south-facing hill slopes the best location for farms. However, the amount of gently sloping land is small and most slopes are too steep for cultivation. The type of soil on the slopes yields very readily to gullying and soil erosion.

Ground water.—To obtain water on the hills, wells probably would have to be continued down into the underlying bedrock. This may prove too expensive for the homesteader. Some water may be obtained from springs at the base of the hills. The location of such springs and the possibility of their winter use has not been definitely determined.